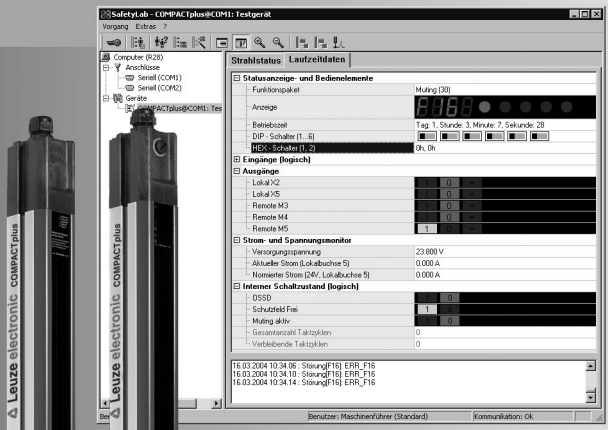
Leuze electronic

the sensor people

SafetyLab

Diagnostic- and Parameterizing Software for COMPACTplus



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CONNECTING AND OPERATING INSTRUCTIONS

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Notes on Connecting and Operating Instructions

This operating manual contains information about proper usage and effective use of the software SafetyLab. It is included with delivery.

SafetyLab is not intended for use with devices of other manufacturers.

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

Care must be taken to keep this operating manual available. It must be available for the entire time while safety devices that have been configured with SafetyLab are in use.

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 damage caused by improper usage. Proper usage of SafetyLab also includes knowledge of the connecting and operating instructions for the connected safety devices.

Version of Operating Manual: 1.1

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1 Introduction

1.1 General Information

SafetyLab is a diagnostics and parameterization program for Safety Light Curtains, Multiple Light Beam Safety Devices and Muting Transceivers of the COMPACT*plus* series of Leuze electronic. Whereas Safety Light Curtains and Multiple Light Beam Safety Devices each consist of a transmitter and a receiver, a transceiver combines both of these functions in a single unit. Since the adjustable functions of the muting transceiver largely correspond to those of a receiver, the term "receiver" as it is used below is synonymous with "transceiver".

This Operating Manual describes how to install and work with SafetyLab. It forms the basis of proper operation of the program. SafetyLab contains a Help feature for many of its function elements. Simply position the mouse pointer over one of these elements, and a descriptive pop-up window will appear automatically in the status bar.

Please keep this Operating Manual in a safe place and make SafetyLabsure it is accessible during the entire time during which you are using SafetyLab.

1.2 Symbols and Abbreviations Used in this Manual

Symbol	Meaning
	Safety note This symbol refers to possible dangers. Please be especially careful in observing these instructions.
	Reference to important information.
➢	Instructions for working with the program.
FS	Factory setting.

1.3 Function Packages

SafetyLab can be used for all available function packages of the COMPACT*plus*.

- COMPACT*plus*-b (blanking)
- COMPACT*plus*-m (muting)
- COMPACT*plus*-i (initiation, cycle control)

The firmware version of the receiver is indicated during the start-up process on the 7-segment display (see the Connection and Operating Instructions for the device in Chapter 5).

The functions in SafetyLab vary depending on the function package with which the connected receiver is equipped. The Operating Manual is divided into chapters according to the function packages. Familiarity with the chapter on "Standard Functions" is assumed for the three function packages since the functionality of these standard functions is also part of "blanking", "muting" and "cycle control".

1.4 Hardware Requirements

The following components are required for the initial startup of SafetyLab:

- The COMPACT*plus* safety device, installed as described in the Connection and Operating Instructions
- PC or laptop with:
  Microsoft Windows 95 or later
  Pentium 2 processor or later
  32 MB of RAM
  Hard drive with at least 70 MB of free memory
  CD-ROM drive
  Color monitor
  RS232 interface or
  USB interface and interface converter
  USB-RS232 with driver software

1.5 Delivery Package

The SafetyLab delivery package includes:

- CD-ROM with SafetyLab software, Connection and Operating Instructions as well as this Operating Manual in electronically readable format
- PC cable, RS232-IR adapter (9-pin to optoadapter)

1.6 Installation

Insert the CD included with delivery in your CD-ROM drive. A CD menu appears where you are asked about your preferred language and the components to be installed. If the Autostart function is not activated on your PC, start the installation program "SafetyLab.exe". After you have selected the language and the components to be installed, you will be asked for the installation path. We recommend you select the folder "Leuze electronic". After your entries are confirmed, the program and any selected manuals are installed.

2 General Safety Instructions for Working with SafetyLab

Please observe the safety instructions in Chapter 2 of the Connection and Operating Instructions. They are included with delivery. Note also the following list of safety instructions when setting parameters with SafetyLab:

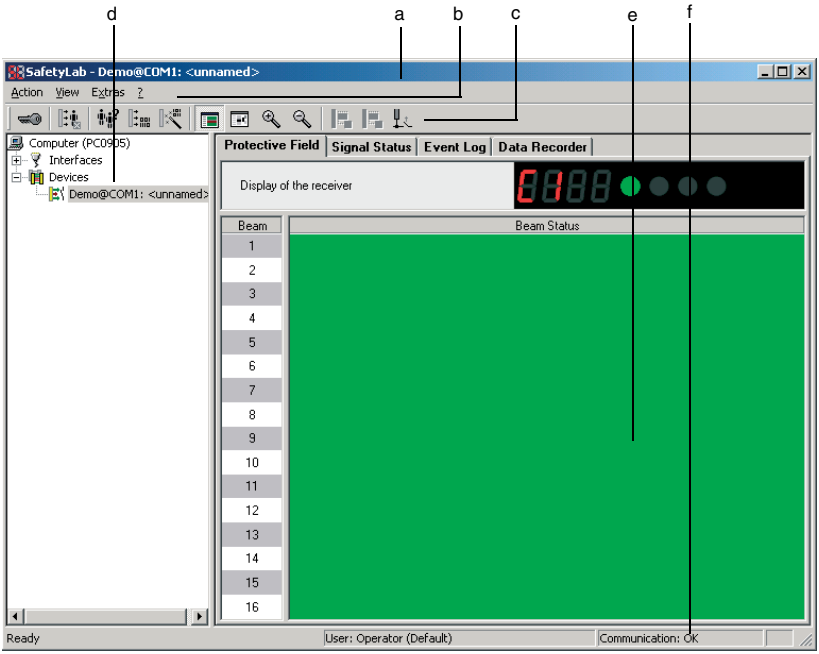
- The combination of user name/password for the authorized customer assigned by the factory: "CUST"/"cust" must be changed the first time any changes are made to parameters. Define one or more new users with passwords and then delete the user "CUST". User passwords that you create must be kept under lock and key. See Chapter 6.3.
- Since the PC is not a safety device and consequently improper functionality cannot be ruled out, the echo data that appears at the end of the process of assigning parameters must be carefully reviewed in the parameter overview and then confirmed. See Chapter 6.4.
- After all parameters meet the requirements of the application, print out the parameter overview and file it with documents related to the machine or system.

- Note that when the Basic I/O Configuration is changed, many parameters that may already have been set are reset to their original values as they were when the product left the factory. It is thus essential to check the following dialog windows. See Chapter 6.8.
- Please note that when changes are made to the optics configuration, all protective field parameters are deleted, i.e. they are set to "Normal Beam". See Chapter 7.3.

3 User Interface

3.1 Screen Areas

The SafetyLab user interface is divided into a number of screen areas as in a typical Windows application. Fig. 3.1-1 illustrates the layout of a screen page.



a = Title bar
b = Menu bar
c = Toolbar
d = Tree structure of hardware components
e = Work and display area
f = Status bar

Bild 3.1-1: Screen layout (example)

Title bar

The title bar contains the name of the software program (SafetyLab) and the hardware component selected in the tree structure.

Menu bar

In the menu bar you will find menus that are available for the configuration in question along with their submenus. These may vary depending on what hardware component selected in the tree structure. Some menu items are also accessible via popup menus that can be opened by right clicking on the hardware components.

Toolbar

The toolbar provides quick access to tools for the most frequently used functions. Click on the appropriate icon to bring up the desired function. The number and type of icons depends on the hardware component selected in the tree structure.

Tree structure of hardware components

The various hardware components are shown in this area of the screen in a tree structure. Select the desired hardware component. The menus and icons available for that component will change accordingly. Right clicking causes a popup menu to appear. This menu combines the most important submenus.

Work and display area

This area of the screen provides you with information about the hardware component. Graphic and text elements of any type may appear in this area. The appearance of the work and display area depends on the hardware component selected in the tree structure.

The work and display area is divided into tab cards

- Protective Field, where the status and any relevant parameter information of beams are displayed.
- Signal Status, where the status of control signal inputs, indication signal outputs and selected internal signals are displayed.
- Event Log, where fault and error messages that are stored in the device are listed in table format.
- Data Recorder, which can be used to record, display and evaluate selectable signals over time.
- PROFIBUS, only available for devices with PROFIsafe interface, provides specific information to the PROFIBUS communication.

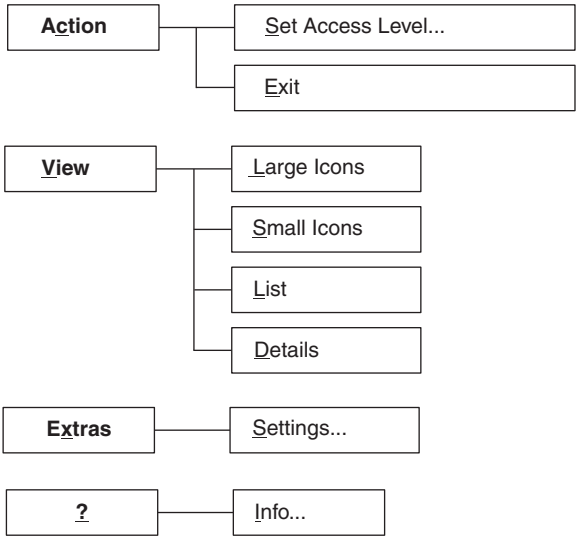
Status bar

The status bar provides you with information about software status (the access level of the current user, communication, etc.) as well as quick help on the icon the mouse pointer is resting on.

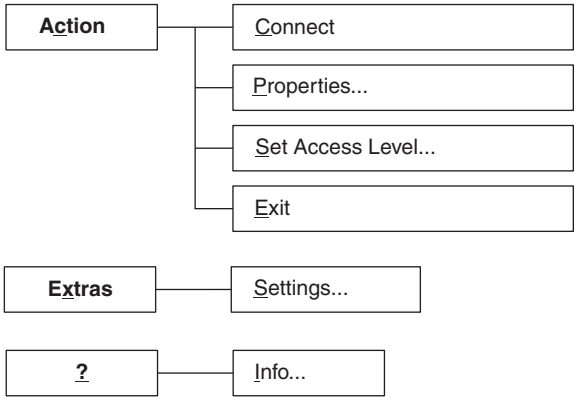
3.2 Menu Structure

The menus and their submenus as well as their enable status change depending on what hardware component is selected in the tree structure. The following illustrations show the menu structure depending on what hardware component is selected.

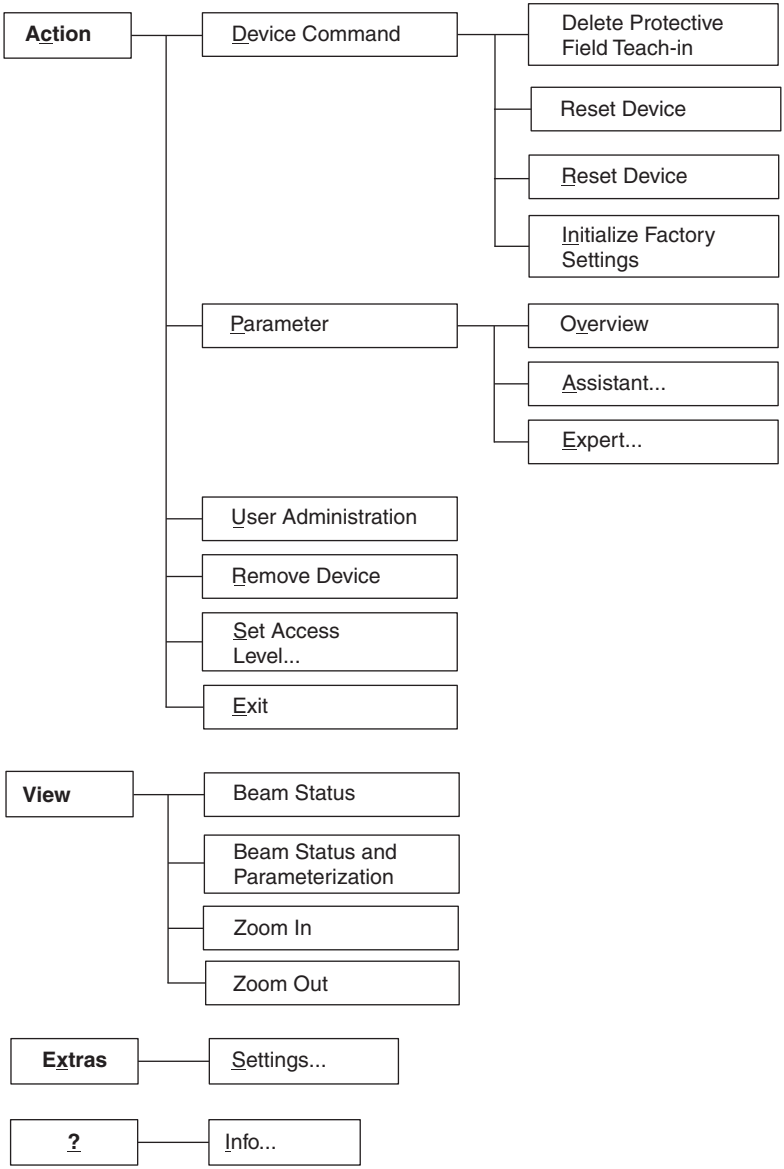
Selected hardware component: computers, connections or devices



Selected hardware component: serial interface (for example COM1)



Selected hardware component: connected device COMPACT*plus*



3.3 Menus and Toolbars

SafetyLab offers different menus and toolbars depending on which hardware component are selected in the tree structure. The following is a complete list of available menus:

Icon	Menu	Function
	*Action > Set Access Level ...*	Opens the "Set Access Level" window; see Chapter 6.2.
	*Action > Connect*	Searches for a COMPACT*plus* connected to this interface. If one is found, it will appear in the tree structure under "Devices".
	*Action > Properties...*	Opens the window to make parameter settings for the serial connection from the safety device to the PC, see Chapter 4.3 "Parameterizing the Connections".
	*Action > Remove Device*	Removes the safety device selected in the tree structure.
	*Action > User Administration*	Opens the "User Administration" window; see Chapter 6.3.
	*Action > Device Command > Protective Field Teach-in*	Only enabled for receivers with the function package "Blanking". For teach-in of a protective field with fixed and in some cases floating blanking; see Chapter 8.3 "Fixed Blanking" and Chapter 8.4 "Floating Blanking".
	*Action > Device Command > Delete Taught-in Protective Field*	Only enabled for receivers with the function package "Blanking". Deletes all blanking areas set with teach-in. See Chapter 8.3.2 and Chapter 8.4.2 "Deleting Taught-in Blanking Zones".
	*Action > Device Command > Reset Device*	Resets the connected safety device and restores the connection. The action is the same as turning the power supply of the device off and back on again.
	Action > Device Command > Initialize Factory Settings	Restores the parameter settings of COMPACT*plus* to the state as supplied from the factory. This must always be done if you will be setting device functionality with the S1…S6 switches in the receiver instead of parameterization with SafetyLab. If one (or more) switches are moved to the R position in a device parameterized with SafetyLab, the receiver goes into a fault state and generates the message "E17" in the 7-segment display. User administration is not reset to the values in effect when shipped from the factory. For more information, please see Chapter 6.3.4.
	Action > Parameter > Overview	Opens a window with the parameter overview; see Chapter 6.4 "Parameter Overview".
	*Action > Parameter > Assistant ...*	Opens the assistant (wizard), which is helpful for setting parameters of the safety device; see Chapter 6.5 "Assistant".

Icon	Menu	Function
	*Action > Parameter > Expert ...*	Opens the expert; see Chapter 6.6 "Expert".
	Action > Exit	Exits the program SafetyLab.
	*View > Large Icons*	Switches to the "Large Icons" view in the display area.
	*View > Small Icons*	Switches to the "Small Icons" view in the display area.
	*View > List*	Switches to the "List" view in the display area.
	*View > Details*	Switches to the "Details" view in the display area.
	*View > Beam Status*	Switches the diagnostic view of the protective field to "Beam Status".
	*View > Beam Status and Parameterization*	Switches the diagnostic view of the protective field to "Beam Status and Parameterization".
	*View > Zoom In*	Increases magnification of the display area (only for the "Protective Field" tab card).
	*View > Zoom Out*	Decreases magnification of the display area (only for the "Protective Field" tab card).
	Extras > Settings...	You can make country-specific adjustments to SafetyLab here; see Chapter 4.4.
	? > Info...	Shows the startup window with Copyright and version number

Depending on which hardware component is selected the following symbols are available:

Selected hardware component: computers, connections or devices

Selected hardware component: serial interface (for example COM1)

Selected hardware component: connected device (COMPACT*plus*)

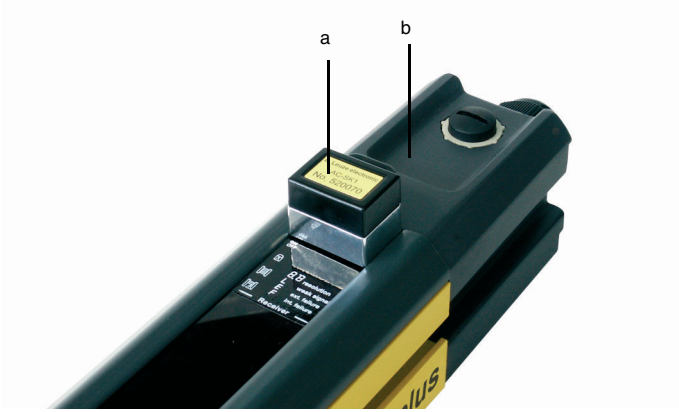
4 Getting Started

4.1 Connecting the Safety Device

Make certain the safety device is connected to the power supply. Then use the interface cable included with delivery to connect the safety device to your PC.

➢ Connect the 9-pin connector to a serial connection (for example COM1) of the PC.

➢ Place the optical adapter on the receiver's parameter interface. The parameter interface is located behind the front pane of the receiver between the connection cap and the 7-segment display. The optical adapter must be positioned so that its connection cable goes out in the direction of the connection cap. It is held in place on the device by a strong magnet and a lip that should be slid under the connection cap.



a = Optical adapter
b = Connection cap receiver

Bild 4.1-1: Place the optical adapter on the receiver

4.2 Establishing a Connection to the Safety Device

➢ Start SafetyLab.

In factory setting the option for establishing a connection automatically is deselected (Chapter 4.3), the following starting window appears:

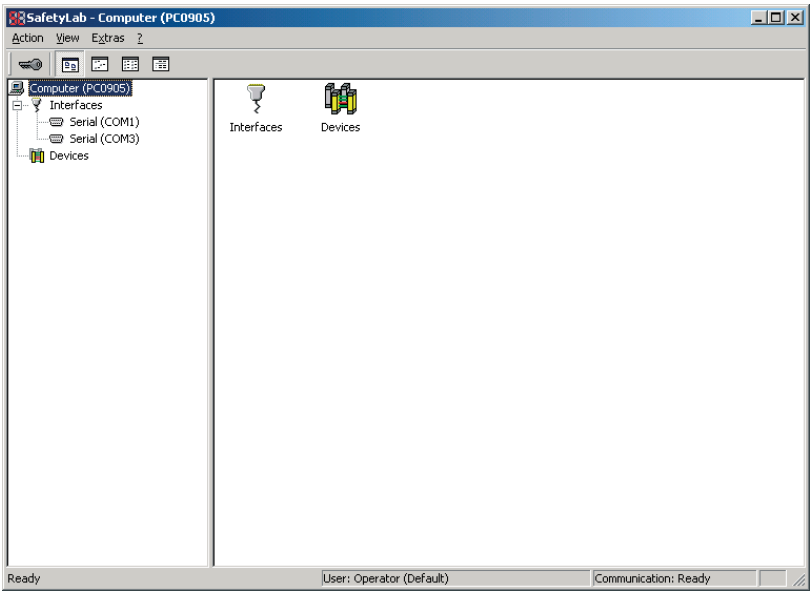


Bild 4.2-1: SafetyLab-Start window without automatic connection setup

➢ Select the serial connection (for example COM1) in the tree structure to which the receiver is connected.

➢ Select the menu item *Action > Connect*, or the appropriate icon or popup menu.

The connection to the attached safety device is set up provided the optical adapter is correctly positioned and the serial interface is not assigned to some other software.

Note!

If the software version of SafetyLab is not compatible with the firmware version of the device, for example because the device has a newer firmware as known to SafetyLab, the establishment of a connection will be refused by SafetyLab and an appropriate message appears. Please update SafetyLab by download and install an update file from the internet page of the manufacturer or contact your provider.

➢ Select the device that was detected with the keyboard or by clicking with the mouse. A window appears similar to Fig. 3.1-1.

After appropriate parameterization, SafetyLab automatically scans the serial interface COM1 of the PC for a receiver that is connected. If a device is found, SafetyLab creates a permanent diagnostic connection by creating and selecting a device icon and type

designation under "Devices" in the tree structure. After the connection with a device has been established, a window appears similar to Fig. 3.1-1.

4.3 Parameterizing the Connections

➢ Select the appropriate serial connection (for example COM1) in the tree structure to which the receiver is connected.

➢ Select the menu item *Action > Properties...* or the appropriate icon or popup menu.

The window to adjust start behavior and parameters for the serial connection from the safety device to the PC appears

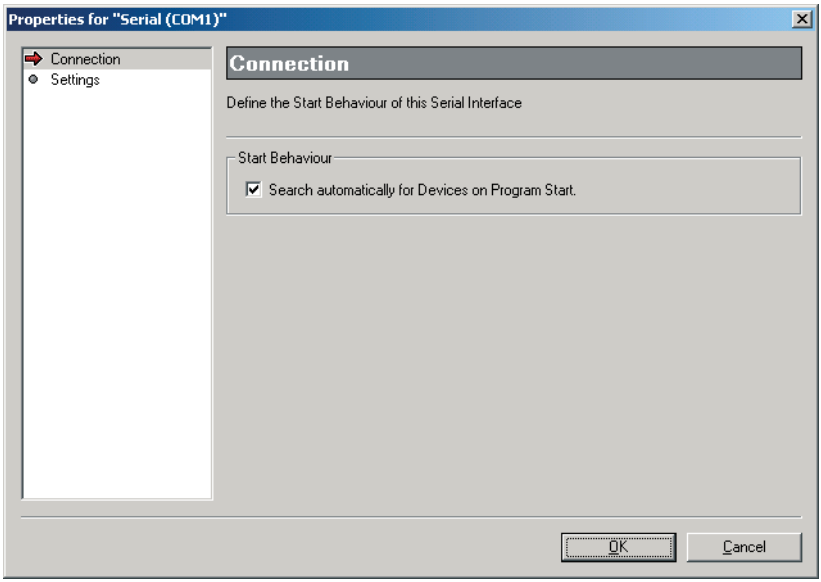


Bild 4.3-1: "Properties" window, "Connection" processing step

Element	Description
List box	List of processing steps in the left part of the window. Click on the desired processing step.
Start behavior	When the checkbox is activated, the program automatically searches for a safety device connected to the selected interface the next time the program starts. It is automatically added to the device list and selected.
[OK]	The settings are saved on the PC and are automatically adjusted the next time the program starts.
[Cancel]	Closes the window without accepting the current entry.

➢ Click on "Settings" in the list box.
The following window appears:

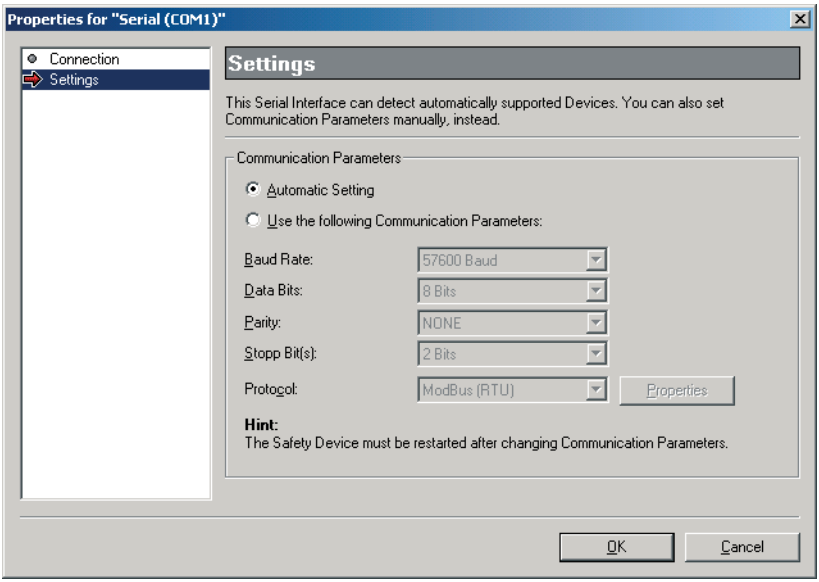


Bild 4.3-2: "Properties" window, "Settings" processing step

Element	Description
List box	List of processing steps in the left part of the window. Click on the desired processing step.
Automatic setting	Click on the selection field. The connection parameters are set automatically. Baud rate: 57600 Baud Data bits: 8 bits Parity: None Stop bit(s): 2 bits Protocol: ModBus (RTU)
Use the following Communication Parameters	Click on the selection field and select the connection parameters (baud rate, data bits, parity, stop bit, protocol) from the corresponding drop-down lists. You may need to do this if the connection is set up over a long cable with ambient interference or with a modem that will only accept certain parameters. The receiver adjusts itself automatically to the modified connection parameters and saves them permanent. Then they are available immediately the next time a connection is set up. In a direct connection between the PC COM port and the receiver via the PC cable with optical adapter, only baud rates between 9600 baud and 57600 baud can be set.

Element	Description
[OK]	The settings are saved on the PC and are automatically adjusted the next time the program starts.
[Cancel]	Closes the window without accepting the current entry.

4.4 Setting the User Interface

➢ Select the menu item *Extras > Settings...* .

The window for selecting the language and unit of measure to be used in SafetyLab appears:

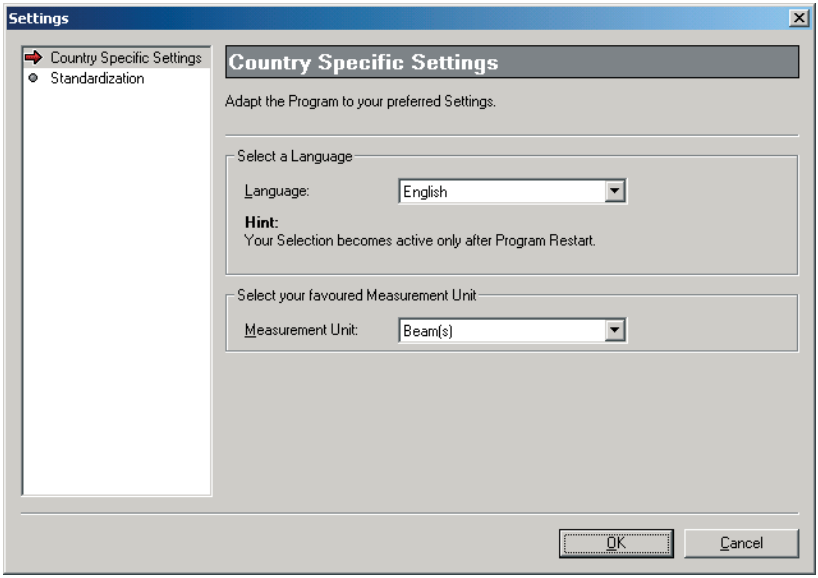


Bild 4.4-1: "Settings" window, "Country Specific Settings" processing step

Element	Description
List box	List of processing steps in the left part of the window. Select the desired processing step.
Language	The program language used. The language setting does not take effect until the next time the program is restarted.
Unit of measure	The unit of measure for the graphical representation of the protective field (inches, millimeters, beams).

Element	Description
[OK]	The settings are saved on the PC and are automatically adjusted the next time the program starts.
[Cancel]	Closes the window without accepting the current entry.

➢ Click in list box on "Standardization"
The following window appears:

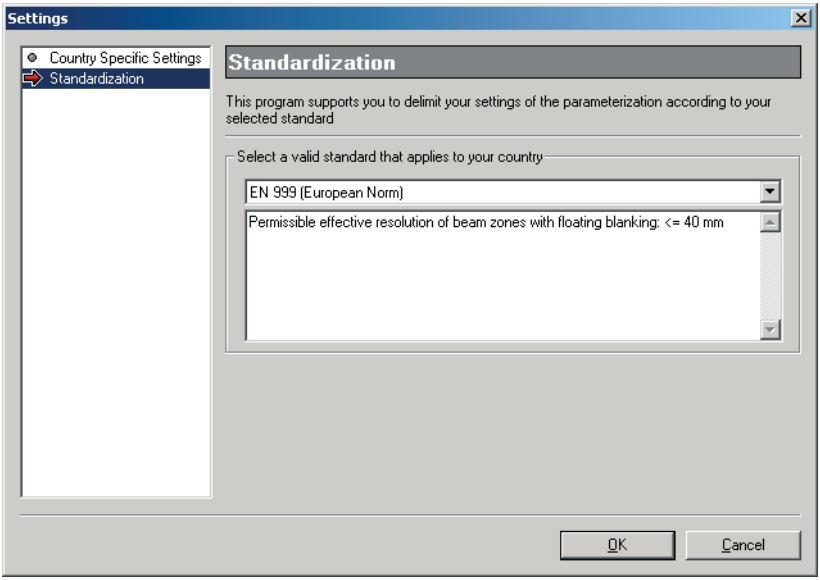


Bild 4.4-2: "Settings" window, "Standardization" processing step

You can adjust SafetyLab to the standards applicable in your country in this window. One specific use of this window is to determine the limitation of the effective resolution for beam zones with floating blanking for the function packages "Blanking" and "Cycle Control" (see Chap. 8.6). The maximum permissible resolution of 40 mm must not be exceeded when securing hazardous points in areas where European standards apply. On the other hand, ANSI specifies a different permissible limit value of 64 mm.

5 Diagnostics

5.1 General Information

After the connection is established with the safety device, SafetyLab shows the status of the protective field, the signals (internal and external) and the event log. It is also possible to record and evaluate the course of selected signals over longer periods of time with a data recorder. There is no need to set an access level (see Chapter 6.1) to do this.

➢ Select the connected safety device in the tree structure of SafetyLab.

Note!

If the "Start Behavior" checkbox (see Chapter 4.3 "Parameterizing the Connections") has been activated, SafetyLab displays the status of the protective field after a connected safety device has been automatically found and selected.

The following tab cards are available in the display area of the window.

- Protective field see Chapter 5.2 "Protective Field"
- Signal Status see Chapter 5.3 "Signal Status"
- Event Log see Chapter 5.4 "Event Log"
- Data Recorder see Chapter 5.5 "Data Recorder"
- PROFIBUS see Chapter 5.6 "PROFIBUS"

5.2 Protective Field

➢ Select the "Protective Field" tab card to display the status of the protective field.

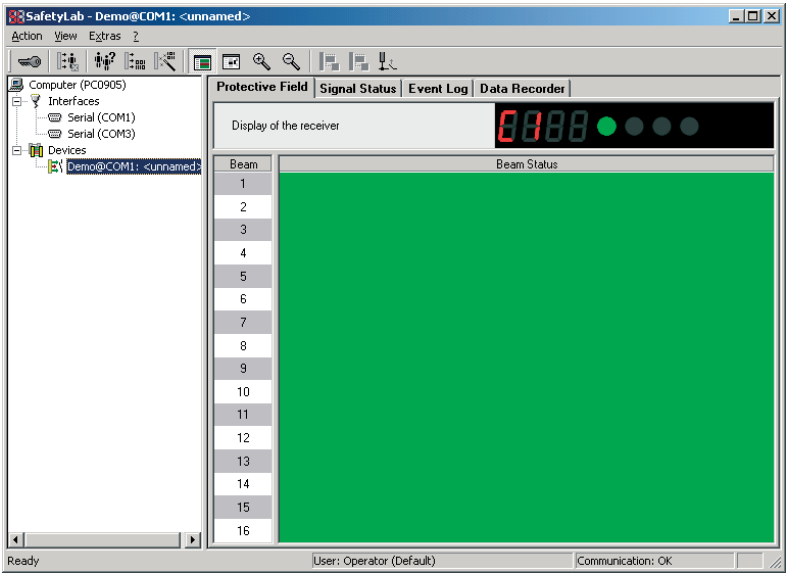
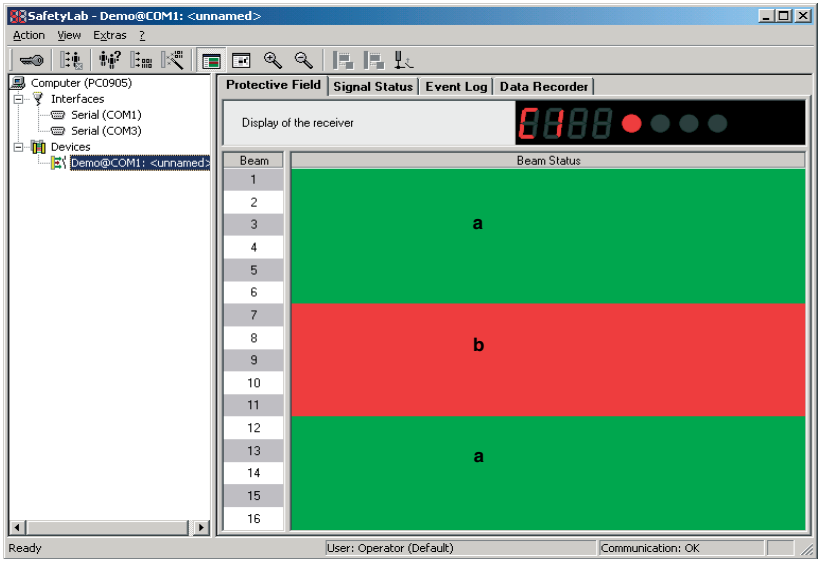


Bild 5.2-1: "Protective Field" tab card selected

The display area provides a graphical display of the protective field. Depending on which unit of measure was selected (see Chapter 4.4 "Setting the User Interface") the positions of the beams will be displayed on the left side of the display area in inches, millimeters or beams. Information in mm or inches refers to the center point of the beam in question. The current status of the display of the device appears in the "Display" area. On the meanings of the LEDs and codes in the 7-segment display, see the Connection and Operating Instructions for the device. Free beams that are not blanked out appear in light green. If there is an impermissible object in the protective field, the area in which the beams that would be expected to be free are interrupted is shown in red.
If the protective field parameters are set to include blanking areas, a permissible object will be shown in the protective field in dark green. If the actual object is smaller or larger than anticipated, the beams that deviate from the expected object are marked. This applies both to beams that are impermissibly interrupted (red) and to beams that are free but which were expected to be interrupted (yellow).

Generally the colors indicate as shown below whether the current beam status is permissible, which would enable the OSSD safety output, or impermissible, which would cause the OSSD to be turned off:

- Light green: beam free, permissible
- Dark green: beam interrupted, permissible
- Red: beam interrupted, impermissible
- Yellow: beam free, impermissible



a = light green
b = red

Bild 5.2-2: Impermissible object in the protective field

If the connected safety device is cascaded (host/guest), the limit between the basic device (host) and the extension device (guest) is marked by a thick black line. The indexing (or measuring) of the beams starts again at Beam 1 of the guest (or at the starting dimension of the first beam center point).

In addition to the beam status, beam parameterization can also be displayed by clicking on the "Beam status and parameterization" icon (see Chapter 3.3). Depending on the function package, the following additional fields are then displayed:

- Blanking
- Resolution
- Beam signal 1
- Beam signal 2

On the meaning of these fields see Chapter 7.9 "Protective Field Editor".

5.3 Signal Status

➢ Select the "Signal Status" tab card to display the status of the control signal inputs and indication signal outputs as well as internal signals.

This tab card is divided into a number of areas.

The "General" area shows the current displays for the receiver and the setting of the DIP switches in the receiver. The operating time of the device is also displayed.

Note!

To allow the changes made with SafetyLab during parameterization to take effect, all DIP switches must be in the same position L (left) as when delivered from the factory. Otherwise the receiver goes into a fault state and displays fault message "E17".

The "Inputs" and "Outputs" areas show the switch states of the control signal inputs and indication signal outputs on the local machine interface.

The logical signals L_IN and LF_IN, which are used by device-internal processing logic, are displayed. The assignment between physical signal potential and logical signal depends on:

- the hardware of the signal inputs/outputs
- firmware function for signal conditioning that can be parameterized (see Chapter 5.3.7).

Internally measured current and voltage values as well as a few internal signal states are shown in the lower area, depending on the receiver's function.

A window under the signal display is used to generate fault and error messages with information in plain text. They are only stored in SafetyLab and are lost when the program is exited or when a new connection is set up with the device. Every time an event occurs, even if it is the same one again, a new entry is generated in the 7-segment display. The purpose of this display is to be able to trace back events during the connection with the device.

The current content of this window can be deleted using the right mouse button and "Delete".

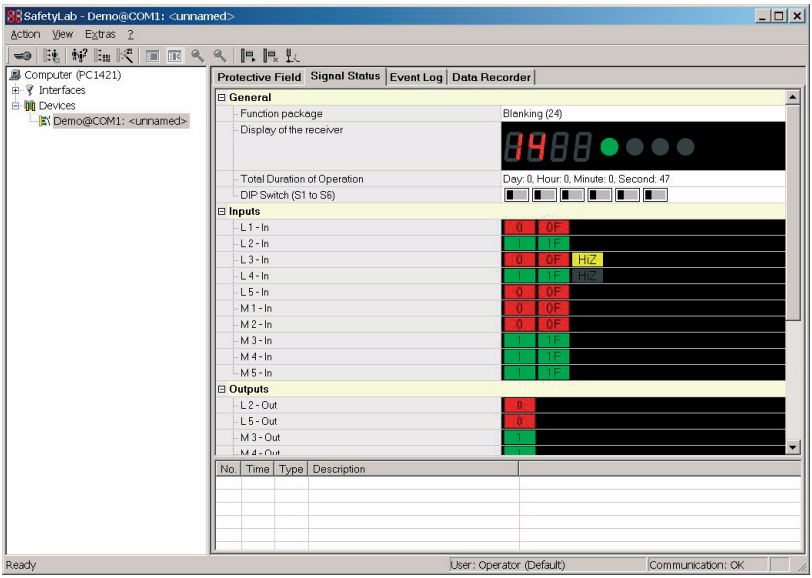


Bild 5.3-1: "Signal status" tab card selected

The individual elements of the "Signal Status" card are listed in the following table:

Element	Description
Status display and operating elements	
Display of the receiver	Status of the 7-segment display and LED display. Corresponds to the display on the safety device.
Operating time	The operating time of the safety device. This time value is generated by incrementing a device-internal counter at the rate of once a second. It is not a real-time display.
DIP switches (1...6)	The positions of the switches on the receiver's parameter module.
Inputs	
L1..L5, M1..M5	For devices with transistor or relay output: State of the corresponding control signal input.
L1..L5, M1, M2, M5	For devices with AS-i Safety at Work connection: M1, M2 = AS-i parameter bits
L1..L5, M1..M16	For devices with PROFIsafe connection: M1..M16 safe cyclic output bits
Outputs	
L2, L5, M3..M5	For devices with transistor or relay output: State of the corresponding indication signal output.
L2, L5, M3, M4	For devices with AS-i Safety at Work connection: M3, M4 = AS-i parameter bits
L2, L5, M1..M16	For devices with PROFIsafe connection: M1..M16 safe cyclic input bits
Internal switch state (list depends on the function package)	
OSSD	State of the safety switching output
OSSD circuit changeover counter	Shows the number of OSSD circuit changeovers that have occurred since the last time the counter was reset; see Chapter 7.4.
Protective Field free	Indicates whether the protective field is free.
Safety circuit closed	Shows by log. 1, whether an optional additional safety circuit on L3 and L4 is closed. If this function is not activated, log. 1 appears here.
Beam Signal 1 Beam Signal 2	= 1 if at least one protective field zone has been parametered with the corresponding beam signal and at least one object has been detected in at least one of these beam zones.
Teach-in Override	Indicates whether the override function for teach-in of beam zones with floating blanking is active (see Chapter 8.6). Only for devices with the function package "Blanking".
Muting Active	Indicates whether the "Muting" function is active. Only for device with the function package "Muting".
Bypass Active	Indicates whether the "Bypass" function is active. Only for device with the function package "Initiation".

Element	Description
Cycle Mode	Indicates the total number of expected protective field intrusions before the OSSD is turned on. Only for device with the function package "Initiation".
Remaining Cycles	Indicates the number of protective field intrusions still expected. Only for device with the function package "Initiation".
Current and voltage monitor	
Supply Voltage	Current value of the supply voltage.
Measured Current at L5	Current measured on the indication output L5 (pin 5 of the local socket).
Current at L5 (normalized to 24 V)	Current on L5 standardized to 24V based on a typical characteristic line of a lamp.
Window for error messages	Displays error messages with sequential number, time when the message was generated, type and plain text information.

The signal inputs and outputs differ in their structures, which are described in greater detail in the following chapters. First the treatment of the P_IN physical signal is described. Then Chapter 5.3.7 shows the derivation of the logical signals L_IN and LF_IN, which are used by the functions described further below.

Signal line	Type of signal line	Description
L1	Standard input	See Chapter 5.3.1
L2	Standard input/output	See Chapter 5.3.3
L3	Tristate input	See Chapter 5.3.2
L4	Tristate input	See Chapter 5.3.2
L5	Standard input/output	See Chapter 5.3.3

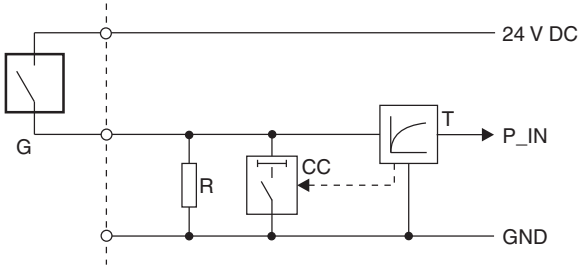
For devices with relay or transistor output:

M1	Standard input	See Chapter 5.3.1
M2	Standard input	See Chapter 5.3.1
M3	Standard input/output	See Chapter 5.3.3
M4	Standard input/output	See Chapter 5.3.3
M5	Inverse input/output	See Chapter 5.3.4

For devices with AS-i Safety at Work Interface see Chapter 5.3.5. For devices with PROFIsafe Interface see Chapter 5.3.6.

5.3.1 Standard Input

The standard inputs L1, M1 and M2 expect control signals from 24V DC against the GND reference potential. The principle of their layout is shown below.



R = Input resistance
CC= Contact cleaning circuit
T = Signal filter
G = Signal encoder

Bild 5.3-2: Layout of standard inputs – working principle

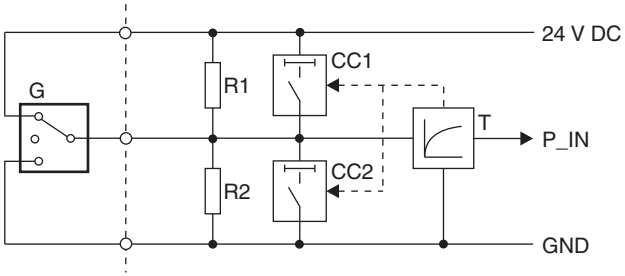
The input resistance ensures that an open input will be identical with a GND signal. In both cases P_IN is read in as zero. The CC contact cleaning circuit increases the input current for approximately 100 ms after being turned on from 4 mA to 20 mA, thus ensuring that oxidation is prevented from accumulating on the switch contacts. This significantly increases service life and thus availability. Sensors with an electronic switch output must be able to supply this current briefly. Signal filtering T (hardware and firmware) suppresses pertubations on the signal lines.

5.3.2 Tristate input

In contrast to standard inputs, tristate inputs L3 and L4 reliably distinguish between the three signal potentials

- 24V DC above reference potential
- GND, reference potential
- Open signal input, potential floating high resistant HiZ

Because of this, their preferred use is for reading in contact-based sensor signals for which reliable detection of an open contact is required (for example contacts of a safety door switch).



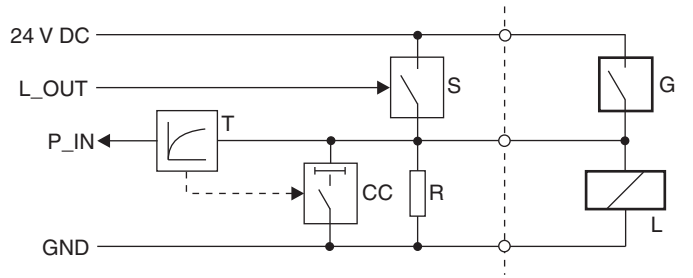
R1, R2= Input resistors
CC1, CC2= Contact cleaning circuits
T = Signal filter
G = Signal encoder

Bild 5.3-3: Layout of tristate inputs – working principle

Contact cleaning circuits CC and the hardware/firmware signal filter T have the same purpose as in standard inputs. The testing of tristate inputs required for safety reasons can be turned off. This must always be done if electronic signal sources are connected to L3 and L4 that do not switch off at a high enough Ohms level, for example light barriers as muting sensors that are connected via cable with integrated LED displays to the COMPACT*plus* receiver.

5.3.3 Standard Input/Output

Standard inputs/outputs L2, L5, M3 and M4 consist of a standard input (see Chapter 5.3.1) and a 24-V switching output (high-side switching). They can be configured as an input, as a tested output or simultaneously as input and output (see Chapter 7.5 "Control and Indication Signals").



R = Input output resistance
CC= Contact cleaning circuit
G = Signal encoder
T = Signal filter
S = Output switching element
L = Output load

Bild 5.3-4: Layout of standard inputs/outputs – working principle

The pull-down resistance R ensures that the output will be at GND potential if switching element S is not controlled, just like an open sensor input.

Control of the output switching element S takes place directly without any inversion. If necessary, inversion is implemented by the controlling functions. A standard input/output configured as an input behaves as described in Chapter 5.3.1.

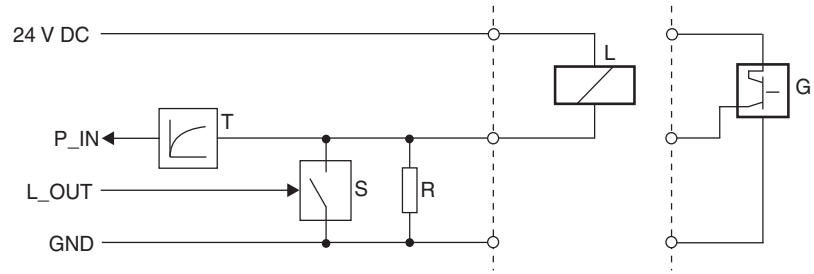
If the value read back from an output deviates from the generated value, both OSSDs are turned off. In this manner, an additional safety signal other than the OSSD status can be transferred to a downstream safety PLC by two antivalent tested outputs.

A standard input/output reads in the sensor signal when the output is controlled by briefly turning off the load control. If 24V is still present on the terminal after load control is turned off, sensor G returns a signal; if not, the sensor output has not closed. Because of this mechanism, the load L must be sufficient for certain requirements in terms of capacitive loads. The time constant of load L (for example a pilot light with a capacitor, a PLC input, etc.) must not exceed the value

$T = R * C \leq 10$ ms.

5.3.4 Input/Inverse Output

Because of its special layout, the input/inverse output M5 switches to GND potential when it is controlled by log. 1. As an input, it has no contact cleaning circuitry. Because of this, it is preferable for connecting sensors with an electronic output. M5 cannot be operated as an input and as an output simultaneously.



R = Input output resistance
T = Signal filter
G = Signal encoder
S = Output switching element
L = Output load

Bild 5.3-5: Layout of inverse inputs/outputs – working principle

The resistance R ensures that the physical signal GND is read in when output switching element S is turned off. The load must be switched against 24V DC for operation as an output.

5.3.5 AS-i Interface

Devices with AS-i offer beside safe data transmission to the safety monitor via the AS-i input data port DI0...DI3 and in addition non-safe control output data DO0...DO2 and diagnostic data via parameter port (P0, P1) with the AS-I master. Assuming the necessary potential separation is present via optocoupler, the two standard inputs/outputs M3 and M4 can be used exclusively here as indication outputs. M1, M2 and M5 are switched as inputs with the following assignment:

DO 0 = M1-Input

DO 1 = M2-Input

DO 2 = M5-Input.

The option for reading feedback from the outputs and the link with the OSSD for safe signal transmission is not available, since there is no direct signal line, only coded bits. The

receiver (AS-i master) is not available as a safe module. It should be noted that the signal output information of the indication outputs M3 and M4 is inverted and the following assignment is in effect:

P0 = 0 : M3 = 24V , P0 = 1 : M3 = GND

P1 = 0 : M4 = 24V , P1 = 1 : M4 = GND

Warning!

For reasons of safety some of control information that always originates from the non-safe AS-i master must not be transferred via control inputs M1, M2 and M5. These include:

- The start signal for start/restart interlock, see Chapter 7.17
- The feedback loop for contactor monitoring; see Chapter 7.18
- Signals for the protective field control; see Chapter 7.14
- Signals for the teach-in control; see Chapter 8.5
- Signals for muting restart; see Chapter 9.9
- Signal for selecting cycle operating mode 1-of-3; see Chapter 10.7.2

5.3.6 PROFIBUS indication signal

Devices with PROFIBUS interface support 16 input and 16 output signals, M1-In to M16-In and M1-Out to M16-Out. They are safely transferred via the PROFIsafe protocol to a master safety PLC or received from there, respectively.

Cyclic input signals, that are sent from the receiver to the safety PLC, can be used there safety relevant as long as they have been generated safely (i.e. no input signals from the local interface can be used) and the OSSD bit 0.1 is = 1. The safety relevant usage of the cyclic output signals, that are transferred from the safety PLC to the receiver, for example for the safe control of protective field parameters or as safe enable signal, requires that those signals are exclusively generated and processed safety relevant; PROFIsafe only safeguards the data transfer, but not the generation of the signals to be transferred. Neither signal filtering nor inverting can be performed in the receiver, but can be easily programmed in the PLC.

M1 to M16 are available in PROFIsafe devices wherever M1 to M5 can be selected with devices with conventional connection.

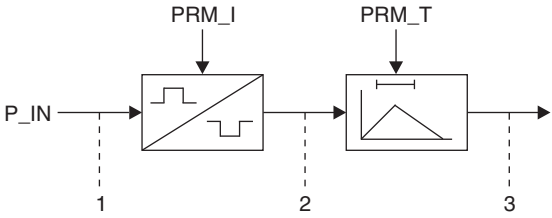
5.3.7 Signal Inversion and Filtering

Parameterizing device firmware allows the user to invert each input signal (except M1-In to M16-In of the PROFIsafe Receiver) individually as well as to delay the rising and falling signal edge of selected signals by means of time filtering. This makes it possible to filter out undesirable transitory signal pulses and gaps and thus increase the availability of the application. The filter times only affect muting or bypass sensors. When inversion is selected, on the other hand, it is always in effect.

Warning!

Signal inversion and filtering are relevant to safety and must therefore be checked after every change. Since times may vary greatly, special care and attention is required when making settings for them.

The layout of the internal signal processing chain is illustrated below:



1 = Physical signal P_IN
2 = Logical signal L_IN
3 = Logical/filtered signal LF_IN

PRM_I= Parameter for signal inversion
PRM_T= Parameter for signal filtering

Bild 5.3-6: Layout of control signal processing chain – working principle

It is also possible to turn off the test of tristate inputs L3 and L4 (factory setting in the function package "Muting"). This must be done if the input cannot be switched to high resistance, for example because a cable is being used with integrated LEDs to display the signal level.

The tristate test is the only way to distinguish reliably between a line break and a 0V level. In all Basic I/O Configurations in which a contact-based safety circuit (see Chapter 7.19) or an operating mode selector switch (see Chapter 10.3) is expected on L3 and L4, the tristate test must be forced by SafetyLab for reasons of safety.

5.4 Event Log

The real time event display is a list that appears on the "Signal Status" tab card of all errors and faults that have occurred during the time a device is connected with SafetyLab. These results are also stored in the device and can be read out and displayed by using the "Event Log" tab card. If the same event occurs multiple times one after the other, for example after an automatic reset caused by an ongoing fault, only one event line is generated, followed by a repetition line containing a reference to the number of times the same event occurred in a row. The number in the "Time" column indicates the operating time counter at the last event time point. The columns "Event ID" and "Event Value" are only for evaluation by the safety device manufacturer and have no significance beyond that.

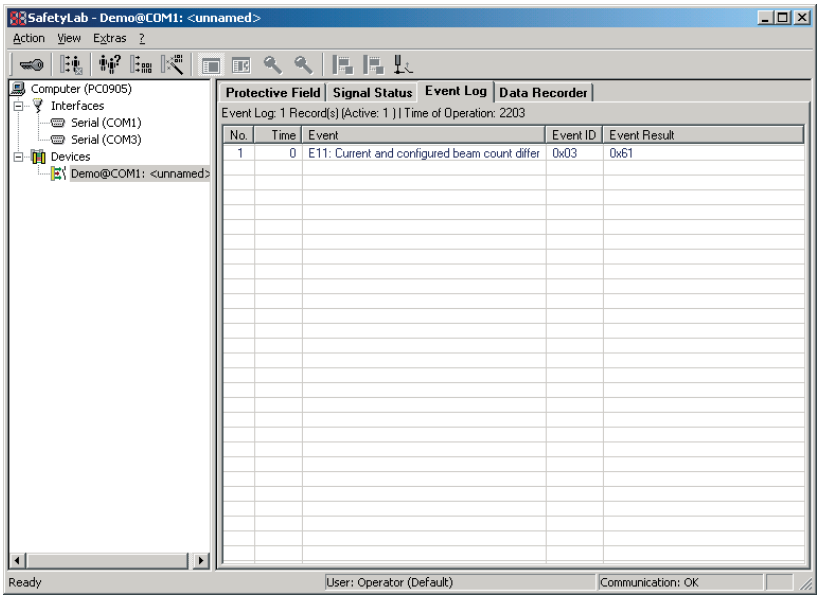


Bild 5.4-1: Event log with fault messages

Error message "E11" at time 0 is a manufacturing artifact and is entirely normal. After the first manufacturing step, the receiver has still not determined its resolution and the height of the protective field and thus not the expected number of beams as a result. This error message is generated as a result when it is turned on.

5.5 Data Recorder

The data recorder is used for event-controlled recording of selectable external and internal signals. It can also be used for graphical display of signals that have been recorded over time. When the "Data Recorder" tab card is selected for the first time after starting SafetyLab, a window appears with an empty black screen area. You may need to increase the size of the SafetyLab window to make all control elements visible so that the tab card will have the same appearance as in Fig. 5.5-1:

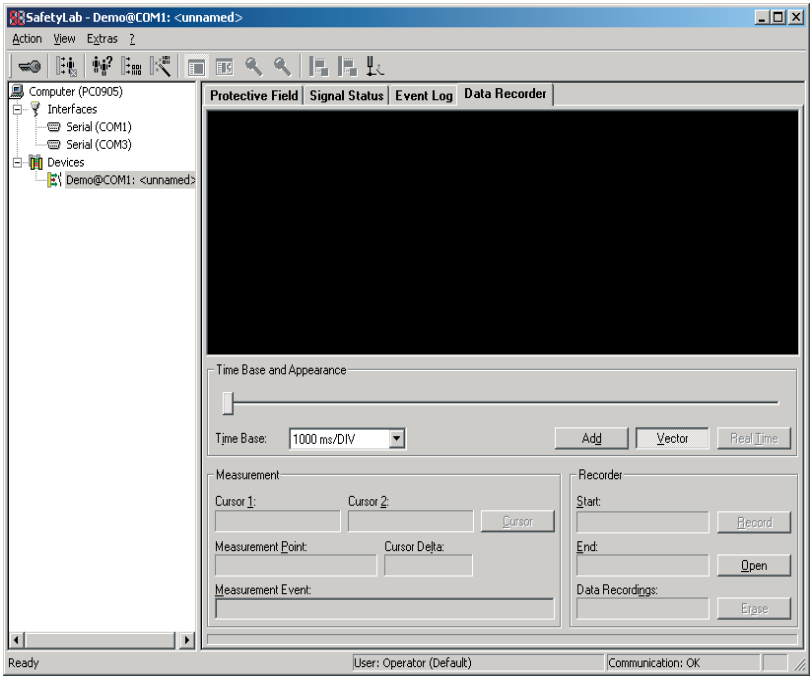


Bild 5.5-1: Initial Activation of the "Data Recorder" tab Card

➢ Click on the [Add] button or right-click on the black field. A popup menu appears with the following entries

Button	Description
Add	Inserts a new line in the data recorder window. Select the signal to be recorded in the list box as shown in Fig. 5.5-2.
Change	Allows the user to change the assignment of a pen to the signal. Applies to the pen selected by clicking with the mouse.
Remove	Deletes the pen selected by clicking on it with the mouse.
Remove All	Removes all selected signals from the display

Tabelle 5.5-1: Popup menu for editing the content of the data recorder

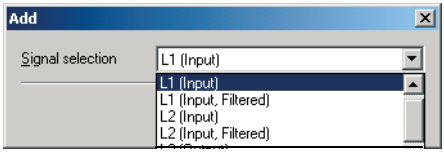


Bild 5.5-2: Selecting signals for a pen of the data recorder

➢ Assign a pen to each of the signals to be recorded.
➢ Start the data recorder by clicking on the "Record" button. Choose a file name for a new file or select an existing file. The signals are displayed and recorded until you click on the "Stop Recording" button. You cannot switch to another window during recording.
➢ Stop the recording by clicking on the "Stop Recording" button, which is displayed in a separate modal window.

The following logical signals are available:

- the input signal (L1..L5, M1..M5, ..M16 (PROFIsafe))
- the filtered input signal (L1..L5)
- the high Ohms input signal (L3, L4)
- the output signal (L2, L5, M3, M4, M5, ..M16 (PROFIsafe))

Selected internal binary and analog signals are also available.

Note!

Recording analog values for the operating voltage and the output current on L5 quickly generates large volumes of data and thus large files, since these values are generally subject to some fluctuation and each change is recorded and saved as an event.

The following control elements are available for recording and evaluating data:

Element	Description
Time basis and appearance	
Slider	You can use the slider to move the selected point in time of the signal in the "Time Base and Appearance" frame.
Time Base	Indicates the time per horizontal division. This makes it possible to change the time resolution of the display (zoom function).
[Add]	Opens the dialog for selecting a pen as shown in Fig. 5.5-2.
[Vector]	Changes the display of the signal over time between point display and closed curve. Each point represents a point in time at which a data set was saved as a record. It follows that at least one of the recorded signals changed at this point in time.

Element	Description
Measurement	
[Cursor]	Activates/deactivates the display of 2 cursors that can be used conveniently to measure the times of events and time differences.
Cursor 1, Cursor 2	Displays the point in time at which Cursor 1 or Cursor 2 is currently positioned.
Cursor Delta	Indicates the difference in time between Cursor 1 and Cursor 2.
Measurement Point	Indicates the point in time for the selected pen (the pen on which the mouse pointed is located). The event point appears in red.
Measurement Event	Describes the event at which the mouse pointer is pointing.
Recorder	
Start	The time at which the recording starts.
End	The time at which the recording ends.
Data Recordings	The number of records in the tile.
[Record]	Starts a new recording in a new or existing file. Changes of signals are represented in real time.
[Open]	Opens an existing file for evaluation in the PC's memory. Changes of signals are represented statically.
[Erase]	Deletes the signal display from the file that was opened.

After a file has been opened in the data recorder, the display would be similar to what is shown in Fig. 5.5-3.

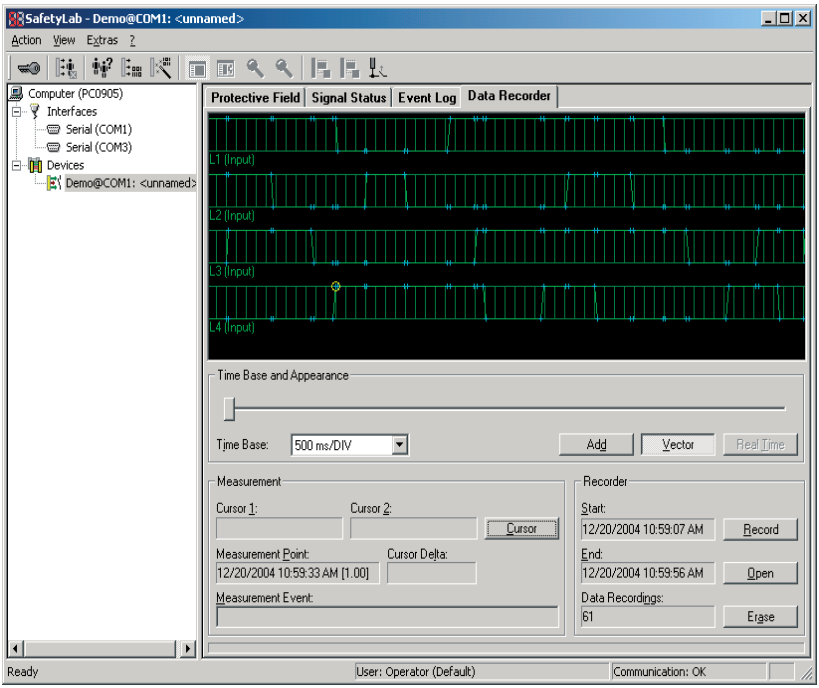


Bild 5.5-3: The "Data Recorder" tab card with recorder data read in

If a large file is generated by recording over a long period of time, it may be difficult to select an exact point with the slider while evaluating the events, because the length covered by the slider represents the entire time period of the recording.

To remedy this, proceed as follows:

➢ Set the Time Base to the lowest resolution and activate the cursor display.
➢ Position a cursor at approximately the desired point in time.
➢ Increase the resolution in the "Time Base" selection box
➢ Use the cursor control keys on your keyboard for fine positioning of the slider. Depending on the resolution, the handle of the slider might not actually move.

Note!

If you switch to another window and then come back to the data recorder, the display remains intact.

5.6 PROFIBUS

If SafetyLab is used on a device with PROFIsafe Interface, then in addition to the previously described diagnostics screens, another diagnostics screen is available for detailed PROFIBUS diagnostics, on which important PROFIBUS data is displayed from the perspective of the connected device. Knowledge of the PROFIsafe connecting and operating instructions is required to understand all details. The following is displayed:

- General PROFIBUS data
- The safe cyclic input data (in bytes and bits).
- The safe cyclic output data (in bytes and bits).
- The first errorneous acyclic telegram (non-safe data).
- Optional recorded acyclic data traffic.

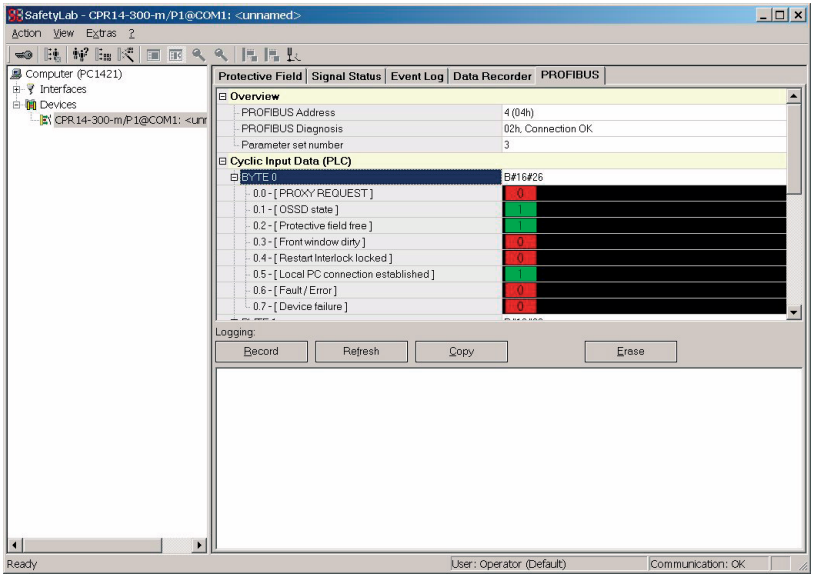


Bild 5.6-1: PROFIBUS diagnostics, top part

Element	Description
Overview	
PROFIBUS Address	Bus address that is set with the two hex switches in the connection cap of the receiver.
PROFIBUS Diagnostic	Diagnostic byte delivered by PROFIBUS with brief description of parameter set number.
Parameter set number	Number of the parameter set (1 … 255) currently loaded by the PROXY-FB in the safety PLC in the device.
Cyclic input data (PLC)	
Byte 0 ... 3	Hexadecimal display of the 4 safe cyclic input bytes that are read of from the receiver into the F-PLC in each PROFIBUS cycle (indication signals).
0.0 ... 3.7	After opening individual bytes: Display in bits of the 4 safe cyclic input bytes including brief description.
Cyclic output data (PLC)	
Byte 0 ... 3	Hexadecimal display of the 4 safe cyclic output bytes that are written from the F-PLC into the receiver in each PROFIBUS cycle (control signals).
0.0 ... 3.7	Hexadecimal display of the 4 safe cyclic output bytes that are written from the F-PLC into the receiver in each PROFIBUS cycle (control signals).
Diagnostics for PROFIBUS (MSAC1/2)	
Specification of details for the first defectively received acyclic telegram including brief description.	
Diagnostics for PROXY-FB	
Information for details of the communication between receiver and the PROXYFB.	
Button	**Description**
Record	Starts and stops the recording of acyclic telegrams for diagnostic purposes.
Update	Updates the top part of the PROFIBUS window.
Copy	Copies the content of the recording window into the Windows clipboard. The recorded data traffic can be accepted from here into other programs.
Delete	Deletes the content of the recording window.

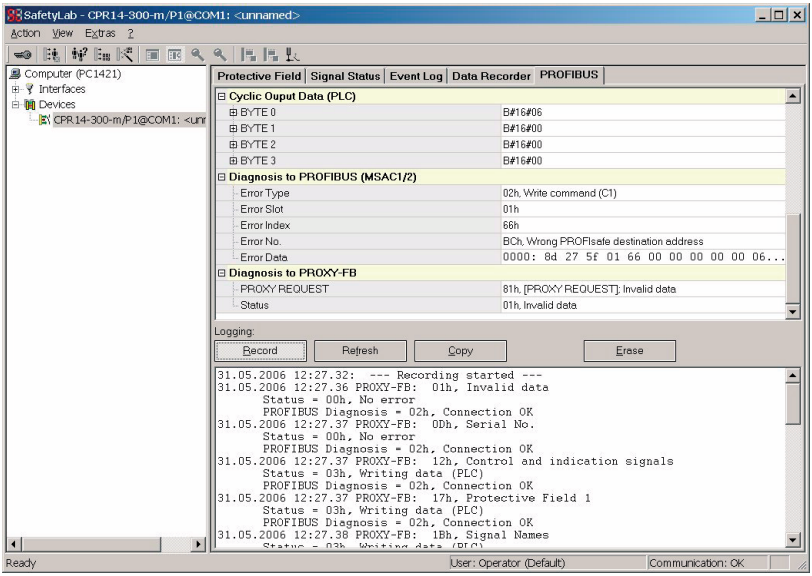


Bild 5.6-2: PROFIBUS diagnostics window, bottom part

6 Parameterization

In addition to detailed diagnostics, one of the main purposes of SafetyLab is to make it possible to set numerous receiver parameters. Since the main parameters can also be adjusted by changing DIP switches, conflicts between the setting of the DIP switch and the corresponding SafetyLab parameters must be safely prevented. Because of this, all DIP switches must be in Position L (factory setting) when parameters are set by SafetyLab. If they are not, the receiver goes into error E17.

6.1 Access Levels

Before you are able to parameterize a safety device with SafetyLab, you must log in as a person authorized to do so.

SafetyLab recognizes different access levels according to the firmware of the safety devices. These access levels have different access rights to the parameters in the safety device. A minimum access level is assigned to each of the following actions:

- Reading some parameters
- Downloading a complete set of parameters
- Editing individual parameters

The following access levels are available to SafetyLab users:

Operator

The Operator only has read access to selected parameters. There is no need to enter a user name or password. The "Operator" access level is automatically in effect when SafetyLab starts. The user has unrestricted access to status and diagnostics data.

Maintenance Staff

The Maintenance Staff has all the rights of the Operator. In addition, Maintenance Staff is also able to transfer a complete parameter set from a file to a matching safety device file (assuming it has been signed by an Authorized Customer; see Chapter 6.7). Maintenance Staff can also change their own passwords if they are approved by an Authorized Customer to do so in the definition.

Authorized Customer

The Authorized Customer represents the highest access level and has all the rights of Operator and Maintenance Staff. In addition, Authorized Customers can:

- change individual parameters
- transfer a complete parameter set without signature from the PC's RAM into the safety device
- sign parameter sets for Maintenance Staff
- administer access levels (adding or deleting users, changing user data)

SafetyLab offers a number of options for "Authorized Customers" to parameterize a connected safety device. The "Assistant" and "Expert" are available for this purpose. They are able to open the parameter set to be modified from the device or from an appropriate file and display it in an overview.

The Assistant and Expert are only accessible to "Authorized Customers" and to a limited extent "Maintenance Staff".

Warning!

If the "Operator" access level is set, the window for entering an access level (described below) appears if an attempt is made to read in parameters with the Assistant or Expert.

6.2 Setting the access level

➢ Select menu item *Action > Set Access Level...* or click on the corresponding icon.

The following window appears:

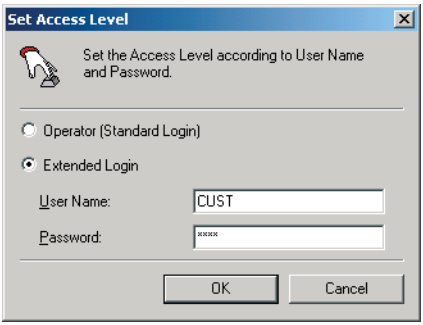


Bild 6.2-1: "Set Access Level" window

Element	Description
Operator (Standard login)	Click on the selection box to log in as an Operator.
Extended Login	Click on the selection box and enter your user name and password.
[OK]	Closes the window and accepts the current entry.
[Cancel]	Closes the window without accepting the current entry.

In factory setting, the access level "Authorized Customer" is defined with user name "CUST" as password "cust" (upper and lower case are significant in the password!).

Warning!

This data must be changed immediately by the responsible person to prevent it from being misused; see Chapter 6.3 "User Administration".

Note!

User name and password are saved in SafetyLab and remain as they are until they are changed or the program is closed. If you are working with a number of safety devices, the last combination of user name and password to be entered will be used if necessary.

6.3 User Administration

COMPACT*plus* administers up to 10 users who have access to the device either as "Maintenance Staff" or "Authorized Customer". User administration makes it possible to create new users, modify existing users or delete users.

➢ Select the connected safety device in the tree structure.

➢ Select the menu item *Action >User Administration* or the appropriate icon to open the "User Administration" window.

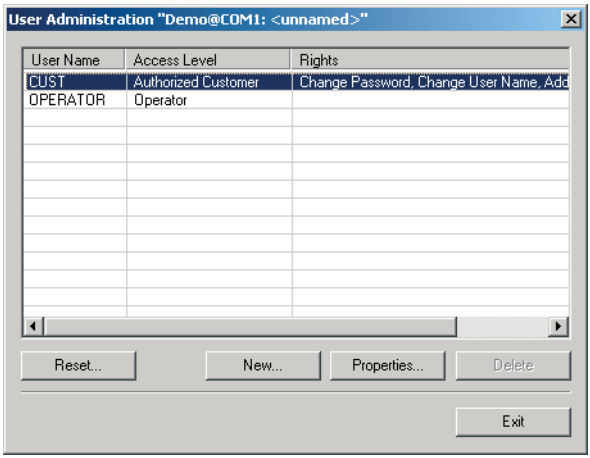


Bild 6.3-1: "User Administration" window

Element	Description
Table	Represents the existing users (user name, access level, rights) in table format.
[Reset...]	Opens the window for resetting the User Administration, see Chapter 6.3.4 "Resetting User Administration".
[New...]	Opens a window for adding a new user, see Chapter 6.3.1 "Adding Users". Only active if you are logged in as an Authorized Customer and have the right to "Add User".

Element	Description
[Properties...]	Opens a window for changing the user data of the user selected in the table; see Chapter 6.3.2 "Changing User Date". You cannot make any changes unless you are logged in as an Authorized Customer and have the corresponding rights. Otherwise, properties are simply displayed.
[Delete]	Deletes the selected user; see Chapter 6.3.3 "Deleting Users". Only active if you are logged in as an Authorized Customer and have the right "Delete User".
[Exit]	Closes the "User Administration" window.

6.3.1 Adding Users

➢ Click [New...] in the "User Administration" window to add a new user.
The following window appears:

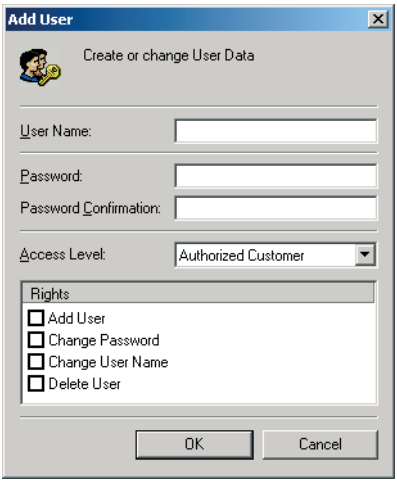


Bild 6.3-2: "Add User" window

Element	Description
User Name	Enter the new user name.
Password	Enter the desired password.
Password Confirmation	Confirm the password by entering it again.
Access Level	Select the access level for the new user from the dropdown list.

Element	Description
Rights	Click to set the appropriate checkboxes for the rights of the new user.
[OK]	Closes the "Add User" window and adds the new user. The new user now appears in the table in the "User Administration" table and is saved in the safety device.
[Cancel]	Closes the "Add User" window without accepting the data.

It is possible to assign the same password to different users.

Note!

COMPACTplus allows up to 10 freely definable users to which the access level "Authorized Customer" or "Maintenance Staff" may be assigned.

6.3.2 Changing User Date

➢ Select the desired user in the "User Administration" table and click on [Properties...].
The following window appears:

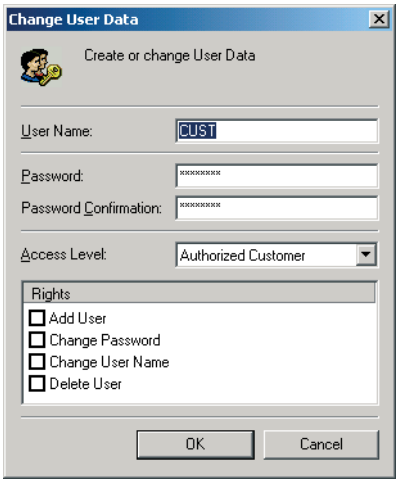


Bild 6.3-3: "Change User Data" window

➢ Enter the new data (see. Chapter 6.3.1) and click [OK].

6.3.3 Deleting Users

➢ Select the user to be deleted in the table in the "User Administration" window and click [Delete]; see Fig. 6.3-1.

6.3.4 Resetting User Administration

You have the option of resetting User Administration to the state of factory setting. You would need to do this, for example, if you are the only "Authorized Customer" and you have forgotten your password.

➢ If this happens, click on [Reset...] in the "User Administration" window.

The "Reset User Administration" window appears.

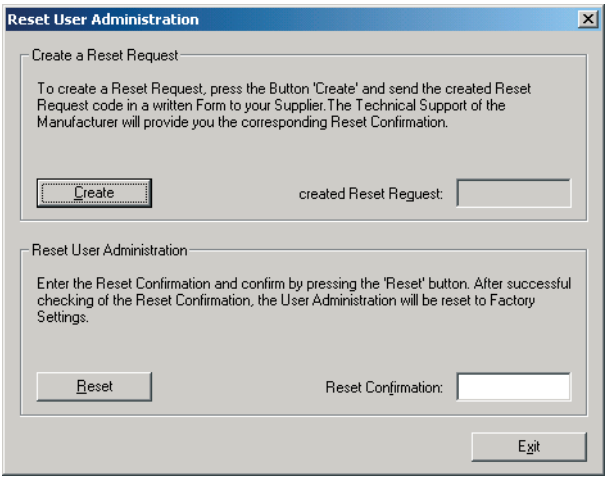


Bild 6.3-4: The "Reset User Administration" window

➢ Click [Create] to generate a reset request (appears in the corresponding field).

➢ Please contact the manufacturer in a written form, by fax or email:

email: service.schuetzen@leuze.de
Fax: +49 - 81 41 - 53 50 - 1 93
Tel.: +49 - 81 41 - 53 50 - 1 21

➢ Please let us know what the code was for theReset Request that was generated and receive the ResetConfirmation transmitted to you by the manufacturer.

Note!

The Reset action only works with a correct Reset Confirmation. The Reset Request that is generated is saved in the device. It will not be lost even after the power supply has been turned on and off. So you should not generate the Reset Request again after you have already sent it to the manufacturer for Reset Confirmation.

➢ Enter the Reset Confirmation in the "Reset Confirmation" box and click [Reset].

The existing User Administration is reset to its original state.

In addition to the Operator without a password, there is now an "Authorized Customer" defined with user name "CUST" and password "cust".

Warning!

This data must be changed immediately by the responsible person to prevent it from being misused.

6.4 Parameter Overview

➢ Select the connected safety device in the tree structure.
➢ Select the menu item *Action > Parameter > Overview* or the corresponding popup menu to open the window to display parameters.
➢ Select the menu item "Parameter>Open from Device" or click on the corresponding icon to load the parameters of the connected device and display them.

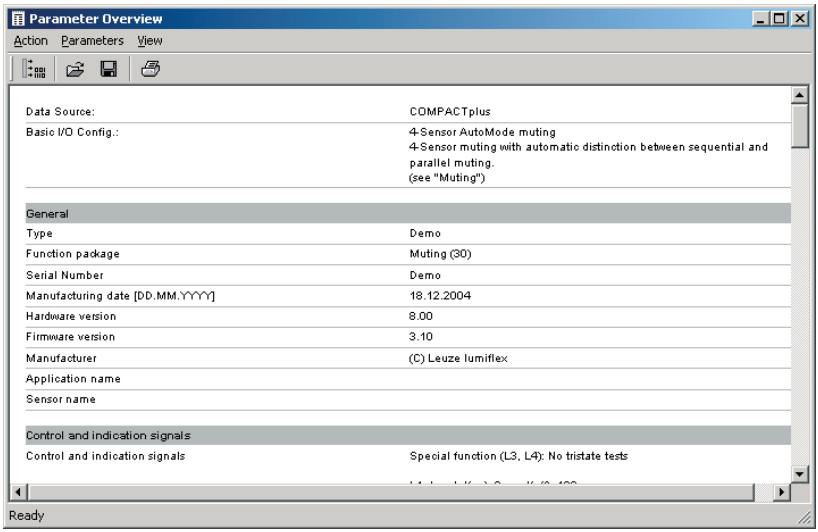


Bild 6.4-1: "Parameter Overview" window

All parameters that can be changed by the Authorized Customer are listed here. You can save the parameters that are displayed in a file and/or print them out.

Icon	Menu	Function
	Action > Close	Closes the parameter overview
	*Parameter > Load from Device*	Loads the parameter set from the connected safety device.
	*Parameter > Load from File...*	Loads the parameter set from a file. The parameters in the file must match the device (function package, resolution, protective field height, etc.)
	*Parameter > Save As...*	Gives the user the option of saving the parameter set that is displayed under another file name.
	*Parameter > Print...*	Opens the "Print" window to print out the entire parameter set.
	Parameter > Print Setup...	Opens the window to printer setup.
	View > Toolbar	Displays the toolbar.
	View > Status bar	Displays the status bar.

6.5 Assistant

The assistant performs the parameterization of the connected safety device step by step. A separate window is available for each function (see Chapter 7 to 10).

Parameterization is based on an already existing set of parameters that can be modified by an "Authorized Customer". This parameter set is loaded directly from the connected safety device or from disk at the beginning of parameterization. After parameterization it is written to the connected safety device and/or to a file by SafetyLab.

6.5.1 Loading a Parameter Set from the Safety Device or from File

➢ Select the connected safety device in the tree structure.

➢ Select the menu item *Action > Parameter > Assistant*, the popup menu of the same name or the appropriate icon to start the Assistant.

The Start window appears:

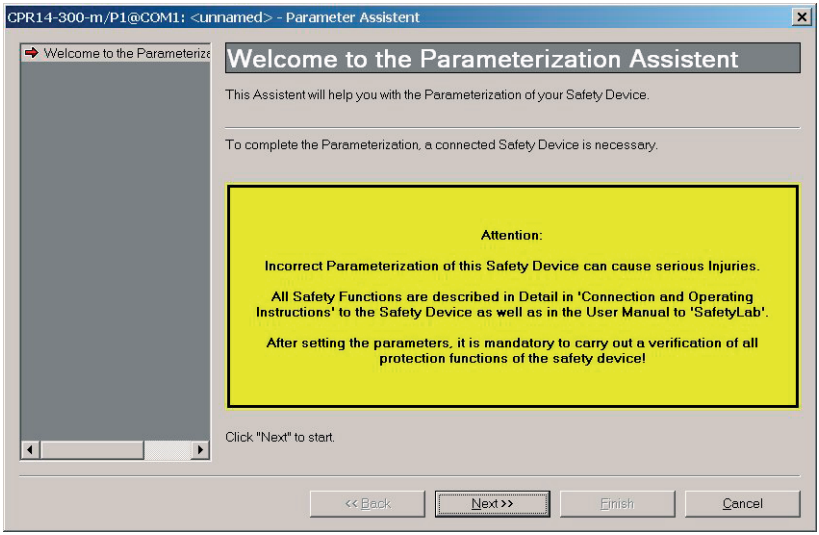


Bild 6.5-1: The "Welcome to the Parameterization Assistant"

The following buttons are available for the additional steps (windows):

Button	Function
[Back]	Switches to the previous window in the Assistant.
[Next]	Switches to the next window in the Assistant.
[Finish]	Becomes active as soon as the last step (window) in the Assistant is complete. It ends the parameterization process.
[Cancel]	After confirmation, cancels the assistant dialog without accepting the change that was entered in the dialog.

➢ Click [Next].

The "Parameter Source" window appears. Here you can select the desired data source from which the parameter set will be opened in SafetyLab.

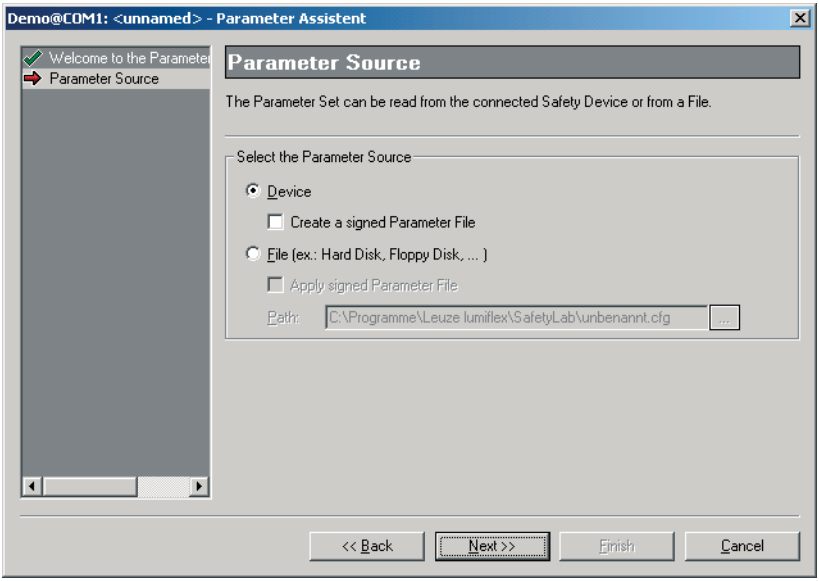


Bild 6.5-2: "Parameter Source" window

Element	Description
Device	Click the radio button if you want to open the parameter set from the connected safety device.
Creating a signed Parameter File	Click the checkbox to create a signed file Only active if the "Device" radio button is activated. Signing a file; see Chapter 6.7.2.
File	Click on the radio button if you want to open a parameter file from a data carrier (hard drive, diskette, etc.).
Apply Signed Parameter File	Click the checkbox if you want to use a signed file that was created by an "Authorized Customer and saved as a file. Only active if the "File" radio button is activated. Use Signed File; see Chapter 6.7.4.
Path	Specifies the path for the file to be opened. Only active if the "File" radio button is activated.
[...]	Opens the "Open" window to select the parameter file to be opened; see Fig. 6.5-3. Only active if the "File" radio button is activated.

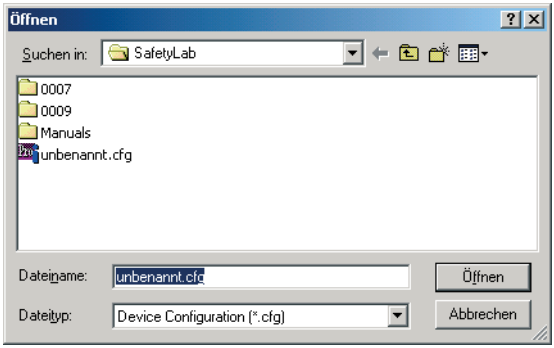


Bild 6.5-3: "Open" window

Select a parameter file.

Button	Description
[Open]	Closes the window and accepts the selected file. The corresponding path is entered in the "Path" box.
[Cancel]	Closes the window without accepting the selected file.

➢ Click [Next].

The parameter set is loaded in SafetyLab from the safety device or from file. The "General" window appears.

Depending on the function package, the program then runs through the windows of individual functions one after the other. For more information on these functions, please see Chapters 7 through 10.

6.5.2 Transferring a Parameter Set to the Safety Device and to a File

After the Assistant has gone through all the functions (windows), you reach the "Parameter Destination" window.

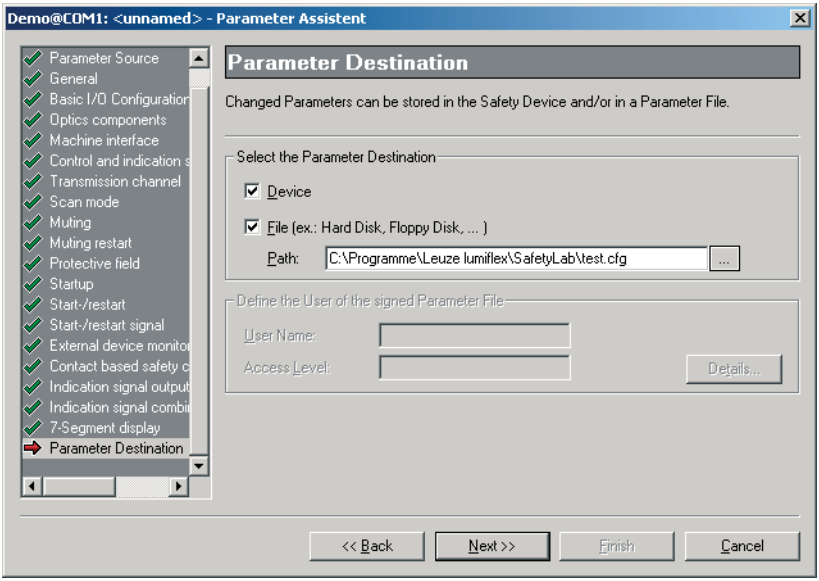


Bild 6.5-4: "Parameter Destination" window

Element	Description
Device	Click the checkbox if you want to transfer the parameter set to the safety device. Only active if data has been changed in the Assistant.
File	Click the checkbox if you want to transfer the parameter set to a data carrier (hard drive, diskette, etc).
Path	You can enter the path and a name for the parameter file to be saved. Only active if the "File" checkbox is activated.
[...]	Opens the "Save File As" window to select the path and give a name to the file to be saved; see Fig. 6.5-5. Only active if the "File" checkbox is activated.
User Name	Displays the user name of the "Maintenance Staff" level. Only relevant for signing a parameter set; see Chapter 6.7.2 "Creating a Signed Parameter Set in the Assistant".
Access Level	Displays the user level "Maintenance Staff". Only relevant for signing a parameter set; see Chapter 6.7.2 "Creating a Signed Parameter Set in the Assistant".
[Details...]	Opens the "Add User" window. Only active for signing a parameter set; see Chapter 6.7.2 "Creating a Signed Parameter Set in the Assistant".

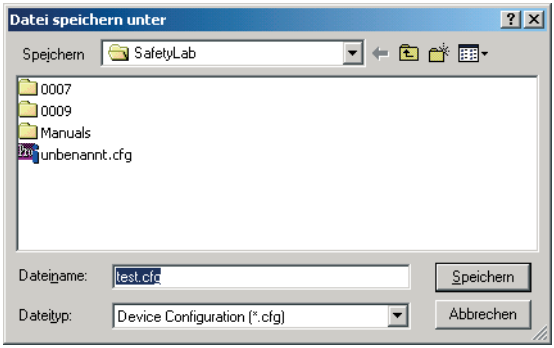


Bild 6.5-5: "Save File As" window

➢ Select an existing file to be overwritten or choose a new file name.

Button	Description
[Save]	Closes the window and accepts the path and filename in the "Path" box.
[Cancel]	Closes the window without accepting the path and filename.

➢ Click [Next].

The modified parameters are loaded into temporary memory in the safety device if you clicked on "Device" as the data destination. If the parameter destination is "File", the parameter set is saved in the specified file.

The "Parameter Check" window appears with a safety note on checking values that have been modified when "Device" is selected as the parameter destination.

For safety reasons, you must check parameters that have been modified before definitively writing them to the device's non-volatile memory: SafetyLab therefore reads the values from temporary memory and offers them for your review in table format.

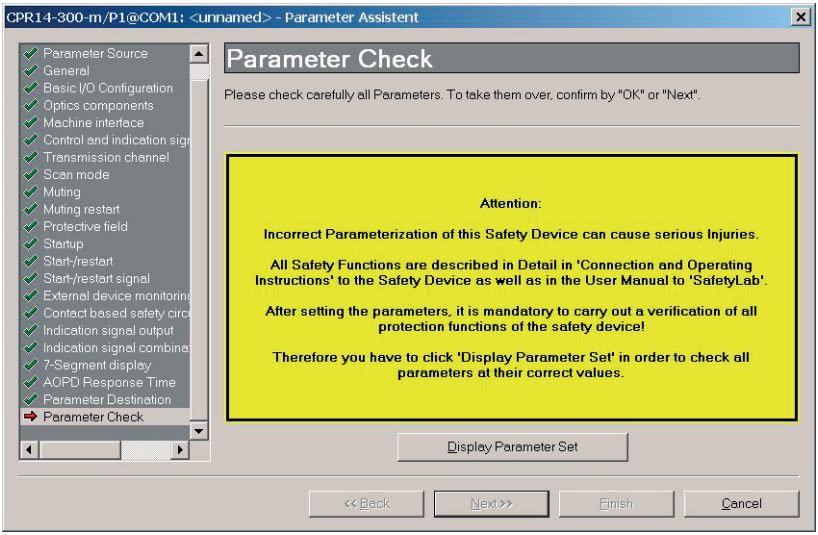


Bild 6.5-6: "Parameter Check" window

➢ Click [Display Parameter Set] to display an overview of parameters.

The "Parameter Overview" window appears. In it values that have been modified (marked in red) are juxtaposed against the current values in a table.

Warning!

Improper parameterization of the safety device can result in serious personal injury. Check the values that have been modified carefully and correct any entries that are wrong. Since the parameters have already been loaded into temporary storage of the device, the [<< Back] button is now no longer available. If there are mistakes in the parameterization, you must therefore exit using the [Cancel] button. After parameterization is complete, a function test must be performed. This is designed to prevent faulty parameters from being accepted and causing improper functionality of protective equipment. After all parameters have been adjusted and checked according to the desired application, they must be printed out and enclosed in the system documentation. For more information, see Chapter 6.4.

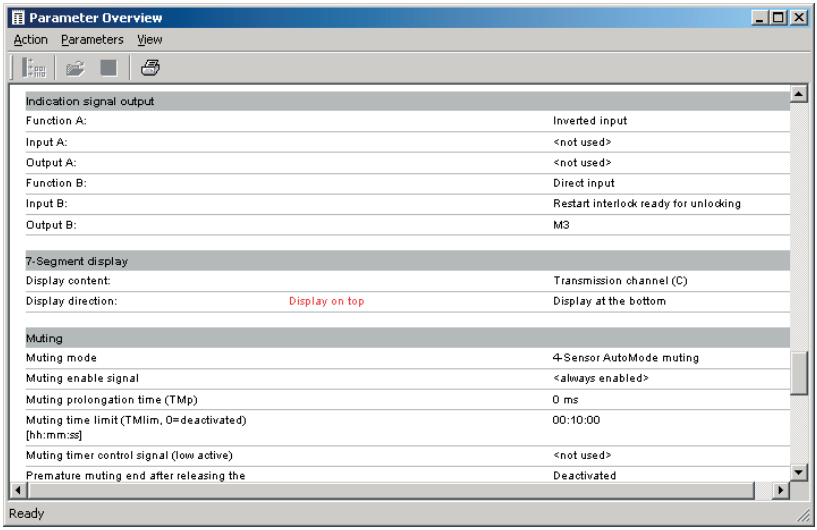


Bild 6.5-7: "Parameter Overview" window

To ensure that all parameter have been checked move the scroll bar all the way down to the bottom. If you don't, the following message will appear:

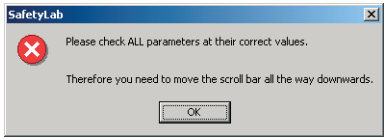


Bild 6.5-8: Message on checking the parameter overview

Note!

The [Next] button in the "Parameter Check" window does not become active until after the parameter overview has been displayed and checked.

➢ Click [Next] if all the entries are correct.

The "Parameterization finished" window appears:

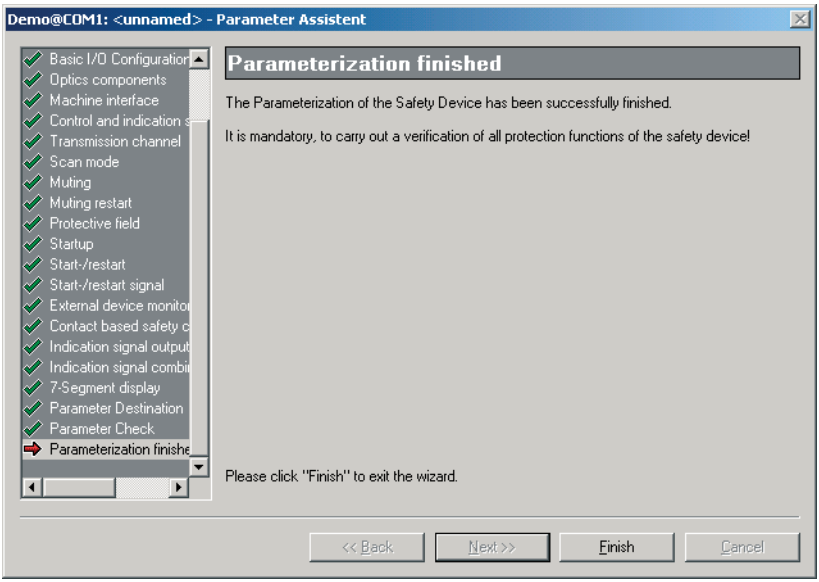


Bild 6.5-9: "Parameterization finished" window

➢ Click [Finish].

The parameter set in the safety device is transferred from the temporary memory area to the permanent one.

6.6 Expert

The Expert is available for the needs of experienced users. It offers the same functionality as the Assistant. Unlike the Assistant, however, you don't have to go through each individual window with the [Next] button. Instead you have direct access to the individual windows and are thus able to make changes more quickly.

➢ Select the connected safety device in the tree structure.

➢ Select the menu item *Action* > *Parameter* > *Expert*, the popup menu of the same name or the appropriate icon to open the Expert window.

The "Parameter Source" window appears. In it you can select the desired parameter source from which the parameter set will be opened in SafetyLab. On the meaning of the control elements, see Chapter 6.5.1.

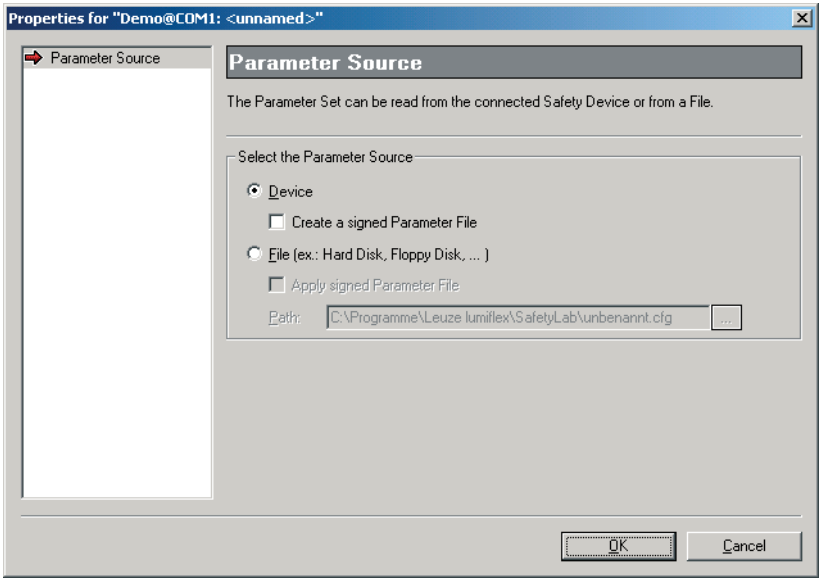


Bild 6.6-1: "Parameter Source" start window

➢ Loading a parameter set from the device or from a file in SafetyLab, see Chapter 6.5.1 "Loading a Parameter Set from the Safety Device or from File".

The "General" window appears. For more information on this and other windows, please see Chapters 7 through 10.

In contrast to the Assistant, the Expert gives you the option of selecting the window to work with directly in the list box on the left side of the window in question.

Warning!

Faulty parameterization.
Since the individual processing steps affect each other mutually, changes in some windows (for example "Basic I/O Configuration" or "Optics Components") may cause changes that have already been made in other windows to be reset. You should therefore be especially careful when checking the parameter overview before finally and definitively accepting the data. Only experienced users should work with the Expert.

The following buttons are available in all windows of the Expert:

Button	Description
[OK]	Confirms the data entry and takes you to the "Parameter Destination" window.
[Cancel]	Exits the Expert without accepting the changes.

Other buttons also appear depending on the content of the selected window.

➢ Click [OK] in the last window you were working in.

The "Parameter Destination" window appears.

Loading the parameter set to the device and/or data carrier works the same way as with the Assistant; see Chapter 6.5.2 "Transferring a Parameter Set to the Safety Device and to a File". The same safety instructions apply.

6.7 Signing

6.7.1 General Information

As a general rule, only an "Authorized Customer" (Chapter 6.1) is able to make changes individually to parameters for a safety device. Authorized Customers are also able to sign parameter sets they have personally verified and thereby give "Maintenance Staff" the right to transfer the complete signed parameter set to a safety device.

Signing means that the "Authorized Customer" saves a parameter set he or she has already created and checked in a file and then links the user name of the intended "Maintenance Staff" person with this file.

The "Maintenance Staff" in question is only able to load the safety device by logging in with a user name and password that match those in the signed file.

You will need to specify a "Maintenance Staff" person who will have the right to transfer the complete parameter set to a safety device. This is necessary because no "Maintenance Staff" person is defined in a device in factory setting. The user data is read while loading the parameter set from the signed file.

6.7.2 Creating a Signed Parameter Set in the Assistant

Proceed as follows:

➢ Log in as an "Authorized Customer".

➢ Open the Assistant with the menu item *Action > Parameter > Assistant,* with the popup menu or with the appropriate icon.

➢ Activate the "Device" radio button and the "Create Signed File" checkbox in the "Parameter Source" window.

➢ Click [Next].

➢ Check all the parameters in the individual windows.

Note!

The parameters cannot be altered during this procedure. You can only sign a parameter set if it matches the parameterization of the connected safety device. It is absolutely essential to check parameters a second time before signing.

➢ As soon as you have reached the "Parameter Destination", enter the path and filename of the file to be signed in the "Path" field (also possible with the [...] button).

➢ Click [Details].

The "Add User" window appears.

➢ Enter the user data (user name, password) for desired "Maintenance Staff" person and confirm with [OK].

The user name and the access level, "Maintenance Staff", are displayed in the "Parameter Destination" window.

➢ Click [Next].

➢ Click [Finish] in the "Parameterization finished" window.

The signed parameter set is saved as a file.

6.7.3 Creating a Signed Parameter Set in the Expert

Proceed as follows:

➢ Log in as an "Authorized Customer".

➢ Open the Expert with the menu item *Action > Parameter > Expert,* with the popup menu or with the appropriate icon.

➢ Activate the "Device" radio button and the "Create Signed File" checkbox in the "Parameter Source" window and click [OK].

➢ Check all the parameters in the individual windows.

➢ Click [OK] in the last window you checked.

The "Parameter Destination" window appears.

➢ Enter the path and filename of the file to be signed in the "Path" box (also possible with the [...] button).

➢ Click [Details].

The "Add User" window appears.

➢ Enter the user data (user name, password) for desired "Maintenance Staff" person and confirm with [OK].

➢ Click [OK] in the "Parameter Destination" window.

The signed parameter set is saved as a file.

6.7.4 Loading a Signed Parameter Set in the Assistant

Proceed as follows:

➢ Log in as "Maintenance Staff" with the user name and password that are saved in the signed file.

Note!

Only the "Maintenance Staff" person for whom the parameter set is signed is able to transfer it to the safety device.

➢ Open the Assistant with the menu item *Action > Parameter > Assistant,* with the popup menu or with the appropriate icon.

➢ Activate the "File" radio button and the "Apply signed Parameter File" checkbox in the "Parameter Source" window.

➢ Enter the path and filename of the file with the signed parameter set in the "Path" box (also possible: with the [...] button).

➢ Click [Next] until you reach the "Parameter Check" window.

➢ Click [Display Parameter Set] to check the parameters in the overview.

➢ Click [Finish] in the "Parameter Check" window.

The signed parameter set is transferred to the safety device.

6.7.5 Loading a Signed Parameter Set in the Expert

Proceed as follows:

➢ Log in as "Maintenance Staff".

Note!

Only the "Maintenance Staff" person for whom the parameter set signed is able to transfer it to the safety device.

➢ Open the Expert with the menu item *Action > Parameter > Expert,* with the popup menu or with the appropriate icon.

➢ Activate the "File" radio button and the "Apply signed Parameter File" checkbox in the "Parameter Source" window.

➢ Enter the path and filename of the file with the signed parameter set in the "Path" box (also possible: with the [...] button).

➢ Click [OK].

The "Parameter Destination" window appears.

➢ Click [OK].

The "Parameter Check" window appears.

➢ Click [Display Parameter Set] to check the parameters in the overview.

➢ Click [OK] in the "Parameter Check" window.

The signed parameter set is transferred to the safety device.

6.8 Basic I/O Configuration

The underlying principle on which COMPACT*plus* works is free (i.e. user-defined) assignment of signal lines to available functions. In addition to defining which available functions can be used, SafetyLab users can also specify the inputs and outputs to which the required signal sources and signal destinations will be connected.

For functional and safety reasons, however, this free assignment is not permitted for some functions. Contact-based safety circuits, for example, must always be connected to L3 and L4, muting sensors to L1...L4.

These definitions are made by selecting the Basic I/O Configuration (in the "Basic I/O Configuration" window) at the beginning of parameterization. You can find more information on individual Basic I/O Configurations depending on the function package of the receiver in Chapters 8.2, 9.3 and 10.3.

7 Standard Functions

The standard functions described in this chapter are included in all function packages that are described later on. Familiarity with this chapter is thus indispensable for a complete understanding of the function packages.

The individual functions (windows) of the Assistant for standard functions are described below.

The corresponding windows in the Expert differ from these only in that you do not use the "<<Back" and "Next>>" buttons to switch from one window to the next. In the Expert, you can select each window from the area on the left.

7.1 General

In the "General" window you can change the application name and sensor name in the table that is displayed. Fields that appear with green background cannot be edited.

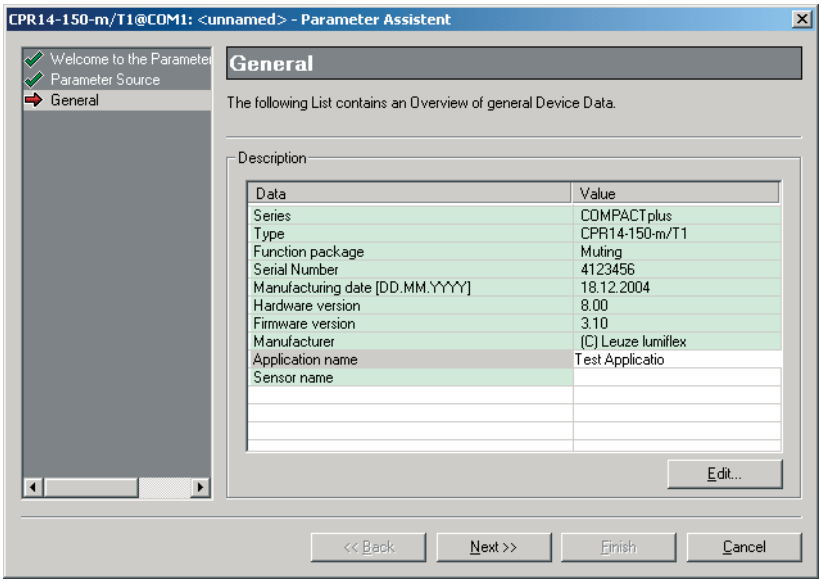


Bild 7.1-1: "General" window

➢ To enter an application name or sensor name, click on the appropriate line with the mouse (or navigate with the cursor keys and select [Edit]). The maximum length for either name is 128 characters.

The "Application Name" field can also be used to hold the name of the machine manufacturer or system builder.

Note!

The sensor name appears in the tree structure as an addition to the name of the safety device, for example "CPR14-150-b/T1@COM1: Sensor Name". If no sensor name has been defined, "unnamed" appears here.

➢ Click [Next].

You can reach the "Basic I/O Configuration" window where important signal assignments that are relevant to safety can be done. The selection options depend on the function package. They are described in the corresponding chapters 8.2, 9.3 and 10.3.

7.2 Signal Overview

The "Signals>>" button is available in windows with signal inputs or outputs assigned to a function. If you click on the "Signals>>" button, a window appears with an overview of all signal inputs and outputs in use and how they are used in the functions that are displayed. This will give you a quick overview of signals that are already assigned. If necessary, you can enable the signals in the appropriate window (name of the window in the "Function" column). It is possible to assign the same input signal to multiple functions. How useful this option is depends on the application. It must be specified by the "Authorized Customer" during parameterization. A 1:1 assignment of inputs to a corresponding function is frequently required for safety-relevant input signals.

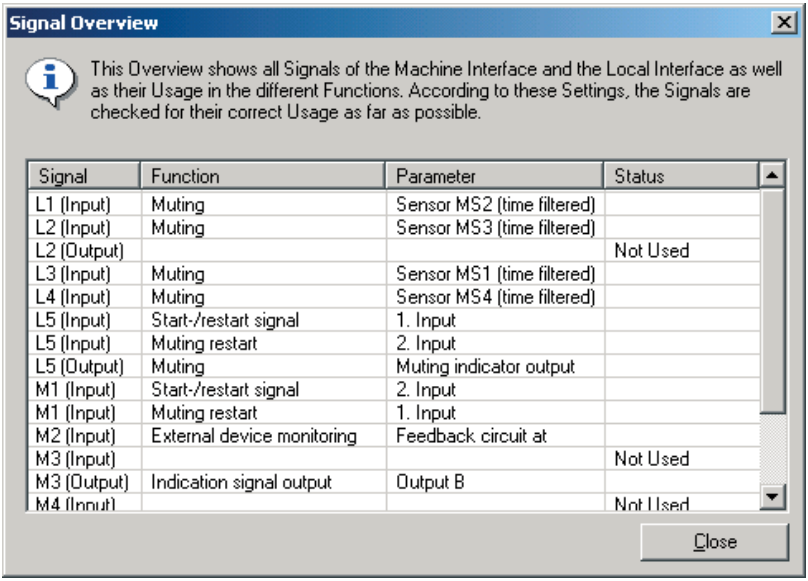


Bild 7.2-1: "Signal Overview" window

To return to the window you started from, click on the "Close" button.

7.3 Optics Components

In the "Optics Components" window you can define the layout of the optics part of the protective equipment.

Warning!

It is the responsibility of the Authorized Customer to make certain that the entries are consistent with the actual data on the type plate of the connected safety device. If the number of beams that is set here differs from the number of beams that is determined, SafetyLab will generate a warning message. You have the option of correcting the entry or ignoring the warning. This warning message cannot be generated if the number of beams that is determined here matches the number of beams that is configured. The layout of transmitter and receiver must be identical.

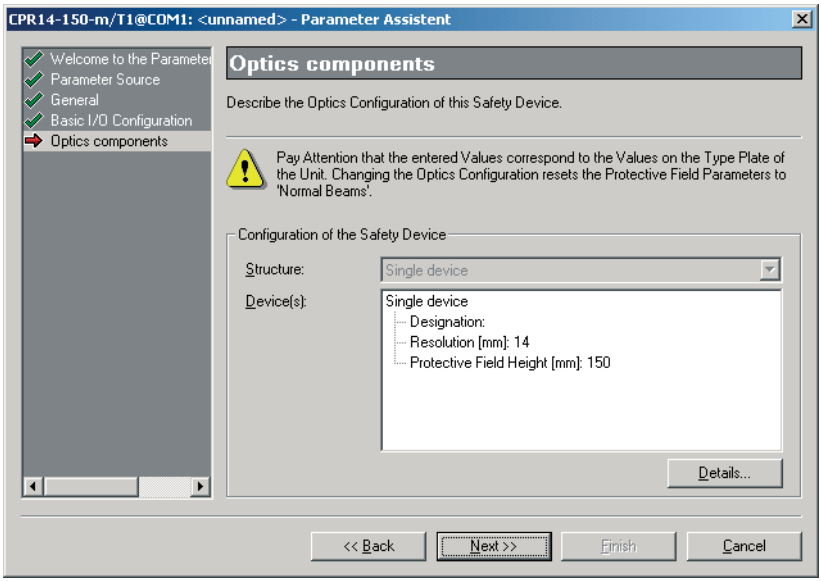


Bild 7.3-1: "Optics Components" window

Element	Description
Structure	
Single device	Only one single device is connected.
Host guest	A basic device (host) is connected with an extension device (guest). The number of beams determined in the device must be the same or greater than the number for the host. Otherwise error E11 is generated.

Element	Description
Host center guest	A basic device (host) is connected with two extension devices (center, guest). The center device is installed between the host and the guest device. The number of beams determined in the device must be the same or greater than the number for the host. Otherwise error E11 is generated.
Device(s)	Information field for displaying the device configuration.
[Details...]	Opens a window for changing the device description. Data from the device selected in the "Device" information field can be displayed and changed in the corresponding window; see Fig. 7.3-2.

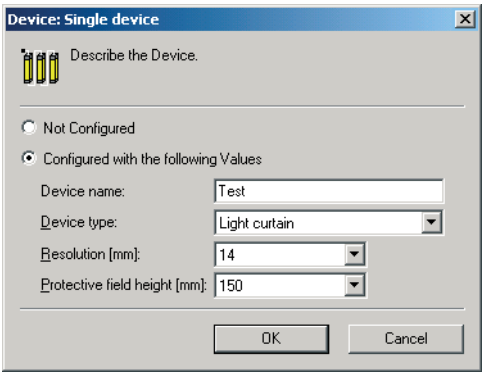


Bild 7.3-2: "Details" window (example)

Element	Description
Not configured	The connected device cannot be defined or is not present. This is the factory setting defined in the host for guests, since it is unknown at the time of delivery which guests will be connected.
Device name	You can also enter an optional description of the device. This description appears on the protective field diagnostic screen in "Beam Status and Parameterization" display mode next to the beam parameters.
Device type	Select the device type from the dropdown list. The types of devices that are available depending on the function package are available for selection: • Blanking: Safety Light Curtain • Muting: Safety Light Curtain, Multiple Light Beam Safety Device, Transceiver • Cycle control: Safety Light Curtain
Resolution/Beam clearance	Select the resolution of Safety Light Curtains or the beam spacing of Multiple Light Beam Safety Devices and Transceivers from the dropdown list.

Element	Description
Protective field height/Beam number	Select the protective field height of Safety Light Curtains and check the number of beams of Multiple Light Beam Safety Devices and Transceivers from the dropdown list.
[OK]	Closes the window and accepts the current entry.
[Cancel]	Closes the window without accepting the current entry.

➢ Click [Next].

If you enter a protective field height that is different than that of the connected safety device, the following warning message appears when you continue on to the next processing step in the Assistant.

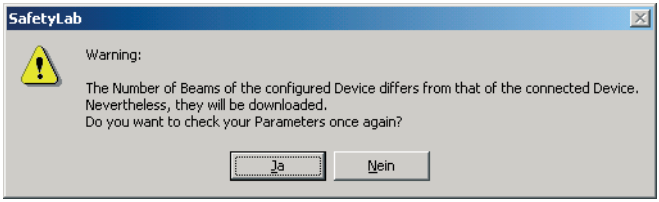


Bild 7.3-3: "Warning Message, Number of Beams" window

Button	Description
[Yes]	Assistant remains in the "Optics Components" window. Option to correct the incorrectly entered value!
[No]	The next window in the Assistant appears. The incorrect entry is accepted.

Note!

In the Expert this warning does not appear until the parameter set is about to be transferred to the safety device.

7.4 Machine Interface

The "Machine Interface" window displays data of the safety output (OSSD) of the receiver.

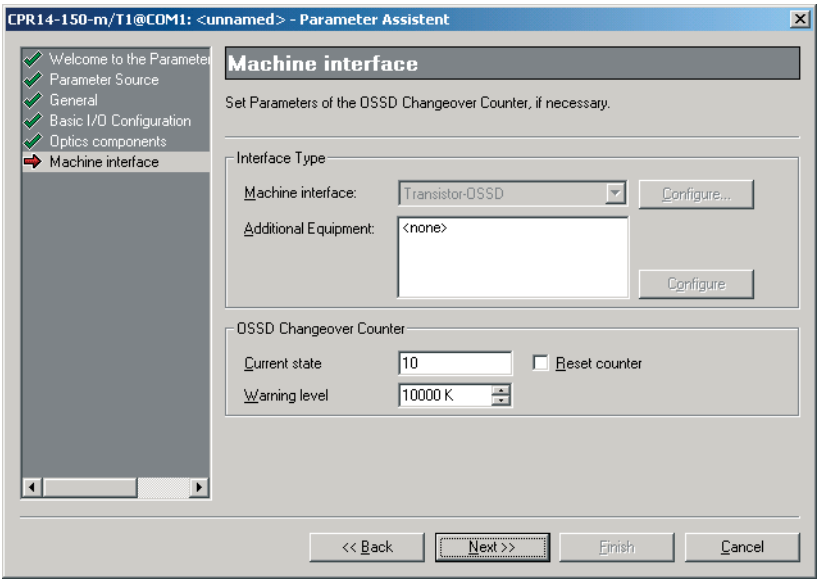


Bild 7.4-1: "Machine Interface" window

Element	Description
Interface Type	
Machine Interface	Shows the type of connection that is automatically detected by the receiver. The following types are available: • Transistor OSSD • Relay OSSD • AS-Interface Safety at Work • PROFIBUS/PROFIsafe
Additional Equipment	Shows any additional equipment.
OSSD Changeover Counter	
Current state	Shows the total number of times the OSSD safety output has switched off since delivery or since the last reset (K = 1000).
Reset counter	Click the checkbox if you want to reset the counter to zero. This could be useful, for example, if the relay cap or the downstream contactors have been replaced and the warning signal "Overflow, circuit changeover counter" is being used (see Table 7.20-1).

Element	Description
Warning level	The threshold for the number of changeovers at which a warning is generated. If the current counter status exceeds the warning level, the internal variable "Overrun OSSD switch counter" is set to 1. This could be used as a trigger via an indication signal output (see Chapter 7.20, Chapter 7.21), for example to send an information message to a PLC to replace downstream circuit contactors as a preventive measure.

If the connected device has a PROFIBUS-DP connection, then the "Configure" button is enabled The following window appears after clicking this button:

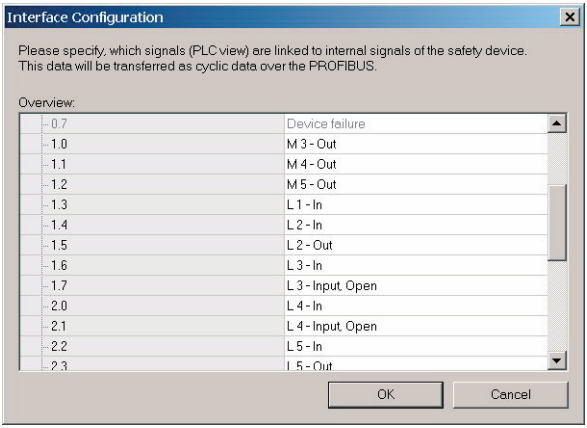


Bild 7.4-2: "Configure Connection" window for the Cyclic PROFIsafe data

You can set the assignment of the cyclic input bytes 1 to 3 to internal signals here. Input bytes in terms of ROFIBUS are sent by the sensor to the safety PLC, therefore they are output signals of the receiver. The structure of the 0 byte and that of the 4 output bytes (control inputs for the receiver) cannot be changed. 16 machine interface signals are available as input indication signals, M1-Out … M16-Out to the F-PLC, and 16 output control signals are available, M1-In … M16-In from the F-PLC.

The meaning of the parameterable input bytes in the bytes 1 to 3 can be found in Chapter 7.13 "Indication Signal Output".

7.5 Control and Indication Signals

In the "Control and Indication Signals" window you can set the signal type and if necessary the switching on and off filter time individually for each signal line.

Note!

For pin assignments with external signal lines (an additional safety circuit, for example) connected to the various versions of the local interfaces, see Chapter 11.2 "Connection Diagrams".

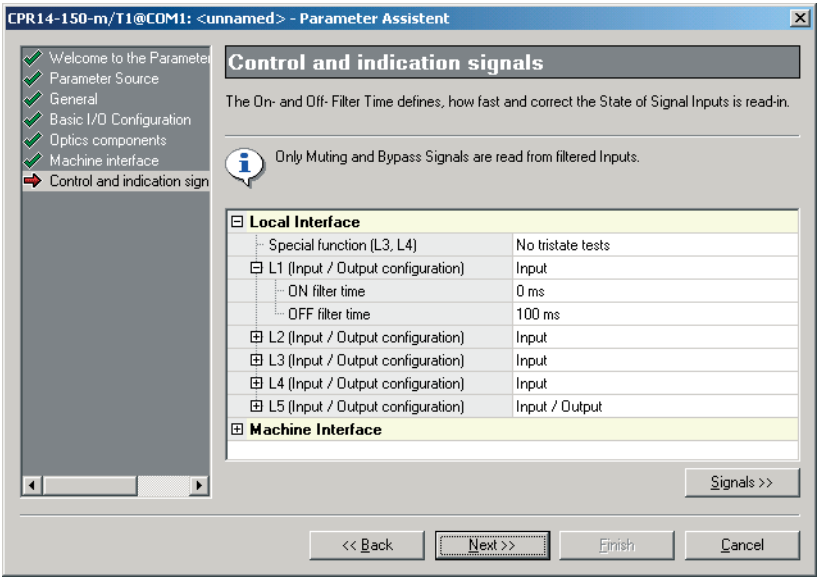


Bild 7.5-1: "Control and Indication Signals" window

The available signal lines of the local and machine interface are listed in the display area of the window.

- L1..L5: Signals of the local interface
- M1.. 5 or M1..M16 (PROFIsafe): Signals of the machine interface

For a schematic layout of signal inputs and outputs, see see Chapter 5.3 "Signal Status".

You can define for both tristate inputs L3 and L4 together whether the tristate test should be performed. They are absolutely mandatory if safety-related contact circuits such as guard door switches or operating mode selection switches will be connected to L3/L4. In this case, it is not possible to deselect them.

➢ Click the "+" symbol next to the desired signal line to display the assigned parameters.
➢ Click in the line of the parameter to be changed.

Arrow symbols appear on the right edge of the line to open a dropdown list with the available parameter values or to set time values.

Parameters	Description
Signal type (for a hardware description see Chapter 5.3)	
Input	Signal line is used as an input.
Output	Signal line is used as an output. The signal is also monitored by feedback. If the required signal status deviates from the feedback signal (for example because of a line short circuit to 24V), the OSSD is turned off. This makes it possible to transfer a signal status to a safety PLC via a safeguarded single line. To achieve a safeguarded signal transfer, the line must always evaluate both OSSDs in the evaluation of the signal. If two inverse indication outputs are linked with the same safe internal signal in this way (see Chapter 7.20), signal transmission in conformity with Category 4 can be achieved if a downstream safety control unit evaluates both signals including both OSSD signals. The actuator that is switched by the output signal must be switched against GND if output L2, L5, M3 or M4 is parameterized. The actuator must be switched against 24V for M5, since this output works GND switching.
Input/Output	Signal line is used simultaneously as an input and an output. The sensor for the input signal must be switched against 24V. The actuator that is switched by the output signal must be switched against GND if output L2, L5, M3 or M4 is parameterized. The load connected to the output must be able to tolerate the signal being turned off briefly <10 ms and must not evaluate them as log. 0.
Input (inverted)	The signal line is used as an input and is logically inverted, i.e. GND on input sets the signal to logical 1 while 24V sets it to logical 0.
Input (inverted)/ Output	Signal line is used simultaneously as an input and an output. The input signal is logically inverted, i.e. GND on input sets the signal to logical 1 while 24V sets it to logical 0. The sensor for the input signal must be switched against 24V. The actuator that is switched by the output signal must be switched against GND if output L2, L5, M3 or M4 is parameterized. The load connected to the output must be able to tolerate the signal being turned off briefly <10 ms and must not evaluate them as log. 0.
On filter time	The filter time for the signal switching on. Works only for muting or bypass sensor signals. If the input works inverted, then "switch on" stands for the falling signal edge and "switch off" for the rising signal edge. Maximum adjustable time is 3000 ms. FS: 0 ms
Off filter time	The filter time for the signal switching off. Works only for muting or bypass sensor signals. If the input works inverted, then "switch on" stands for the falling signal edge and "switch off" for the rising signal edge. Maximum adjustable time is 3000 ms. FS: 100 ms

Warning!

Should the internal restart interlock be activated and in the machine interface cable between receiver / transceiver one of the signal lines M1 to M5 is used to connect the reset

button or should M5 be used as muting sensor input, then another signal line in this cable must not be used for a further dynamic signal, that could create signals between 0.1 s and 4 s. Should the application require anyway two or more such dynamic signals in this cable, then the machine interface cable must be installed necessarily protected in such a way that cross circuits between signal lines in this cable can be excluded. If this can not be guaranteed, in case of a cross circuit an unexpected restart of the receiver / transceiver or an unexpected activation of muting with just one sensor can happen.

7.6 Transmission Channel

The window "Transmission Channel" is used to set the transmission channel of beam modulation.

After changing the transmission channel, the receiver expects a transmitter with modified beam modulation. This makes it possible to work with different safety devices positioned close together without them affecting each other's optical operation.

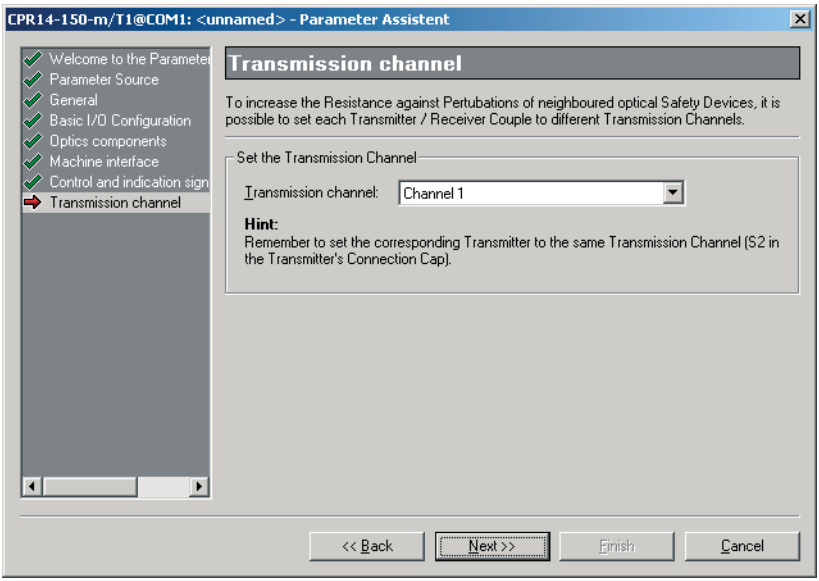


Bild 7.6-1: "Transmission Channel" window

➢ Select the transmission channel from the dropdown list.

Note!

Please note that the selected channel must fit with the setting of DIP switch S2 in the transmitter of the connected safety device (with the exception of the transceiver).
Left position = channel 1
Right position = channel 2

S2 is set to channel 1 by default when the safety device is delivered.

7.7 Scan Mode

You can set the parameters for multiple scanning in the "Scan Mode" window.

Multiple scanning makes it possible to tolerate brief interruptions in individual beams, for example in harsh ambient conditions, to achieve better availability.

Warning!

Multiple scanning affects the response time until the OSSD shuts off after beam interruptions and thus the safety distance. The safety distance and response time must be adjusted to each other. The response time must be indelibly written on the information label that is delivered with the receiver. The label must be placed close to the safety equipment.

You can find additional safety information and examples of calculations in the Connecting and Operating Instructions for the device in question.

The receiver distinguishes two types of multiple scanning:

- Scan-related
- Beam-related

Scan-related multiple scanning

The OSSDs switch to the OFF state as soon as **any one beam** is interrupted at least in the defined number of sequential scans.
This type of multiple scanning is used in Safety Light Curtains with 8 to 240 beams.
The following illustrations shows an example of scan-related multiple scanning with a scan number of 3. The receiver switches into the OFF state with scan 3, since at least one beam has been interrupted in each of the last three scans in a row.

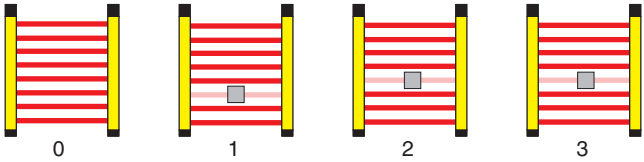


Bild 7.7-1: Scan-related multiple scanning, scan number 3 (example)

Beam-related multiple scanning

The OSSDs switch to the OFF state as soon as **the same beam** is interrupted at least in the defined number of sequential scans.
This type of multiple scanning is used in Multiple Light Beam Safety Devices.
The following illustrations shows an example of beam-related multiple scanning with a scan number of 3. The receiver does not switch into the OFF state until scan 4, since that is the first time the same beam has been interrupted in each of the last three scans in a row.

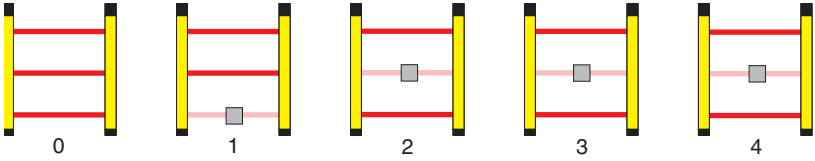


Bild 7.7-2: Beam-related multiple scanning, scan number 3 (example)

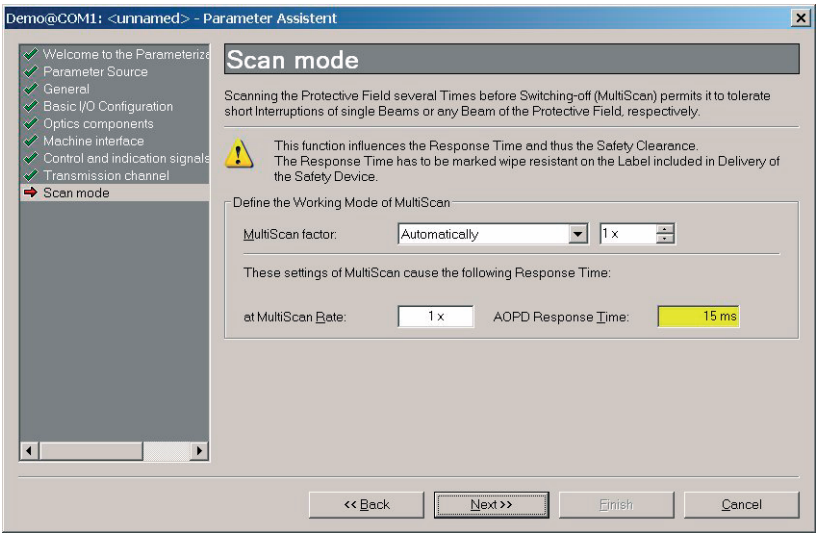


Bild 7.7-3: "Scan Mode" window

Element	Description
MultiScan factor	
Automatically	The number H of scans is determined automatically by the safety device (AutoScan). For many applications this is a good compromise between robustness and response time. Note the following assignment, which is beam-dependant: Safety Light Curtains (number of beams ≥ 8): H = 1, scan-related Multiple Light Beam Safety Devices: H = 7, beam-related Transceiver: H = 8 The AutoScan can optionally be doubled with "1x" or "2x".
Manually	The number of scans can be set manually in the selection box to the right.

Element	Description
	Increasing the number of scans increases the response time. The number of scans that can be set depends on the number of beams of the safety device. It can only be increased up to a response time of 80 ms for the protective field. This ensures that persons violating the protective field can be safely detected.
AOPD-Response time	Shows the response time resulting from the parameters above including the output module (transistor, relay, safety bus).
MultiScan factor	Shows the MultiScan factor that is set, i.e. the number of scans required to turn off the output module. This value is displayed with "Hxx" when the device starts up.

If the "floating blanking" function is set further down in the window, the AOPD response time can no longer be calculated by SafetyLab, but rather must be determined by the user. You will find information on this in Chapter 8.6.6. SafetyLab shows the following information in this case:

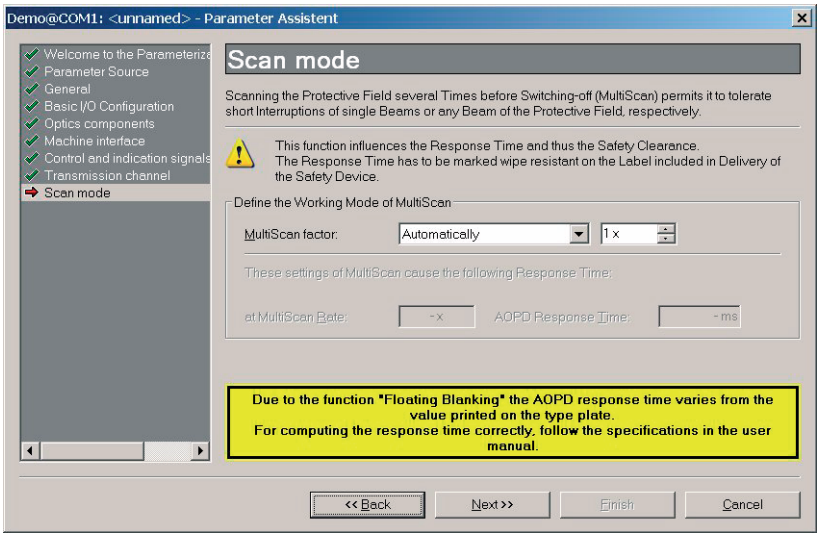


Bild 7.7-4: "MultiScan" window with floating blanking in the protective field

Depending on the function package of the connected receiver, the following windows now appear:

Function Package "Blanking":

- "Protective Field" window (see Chapter 7.8)
- "Teach-in Control" window (see Chapter 8.5)
- "Teach-in Override" window (see Chapter 8.6

Function Package "Muting":

- "Muting" window (see Chapter 9.8)
- "Muting Restart" window (see Chapter 9.9)
- "Protective Field" window

Function Package "Initiation Control":

- "Initiation Control" window (see Chapter 10.9)
- "Protective Field" window

After that the "Startup" window appears.

7.8 "Protective Field" window

The "Protective field" window shows the current beam parametering. With the [Change ...] button you can open the protective field editor for parametering the protective field (see Chapter 7.9).

The [Control...] button leads to a window where signals can be defined for activating/ deactivating individual beam parameter types (see Chapter 7.14).

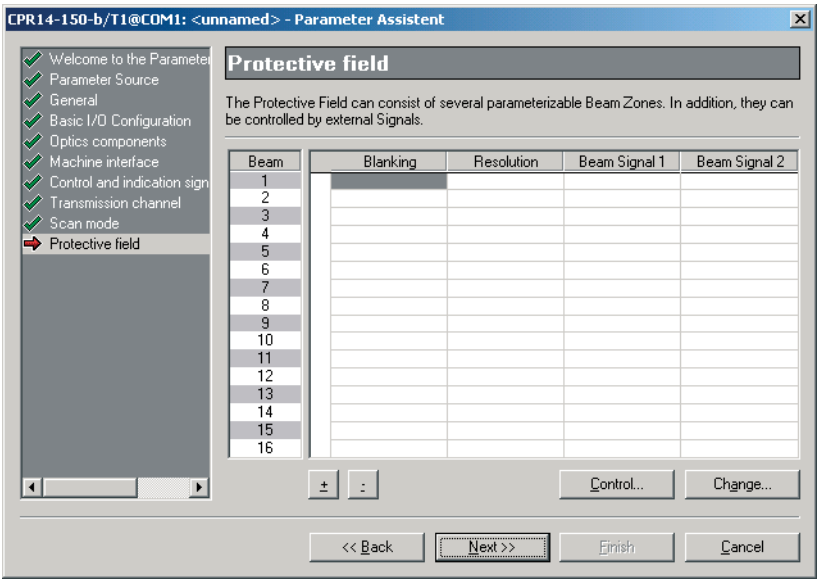


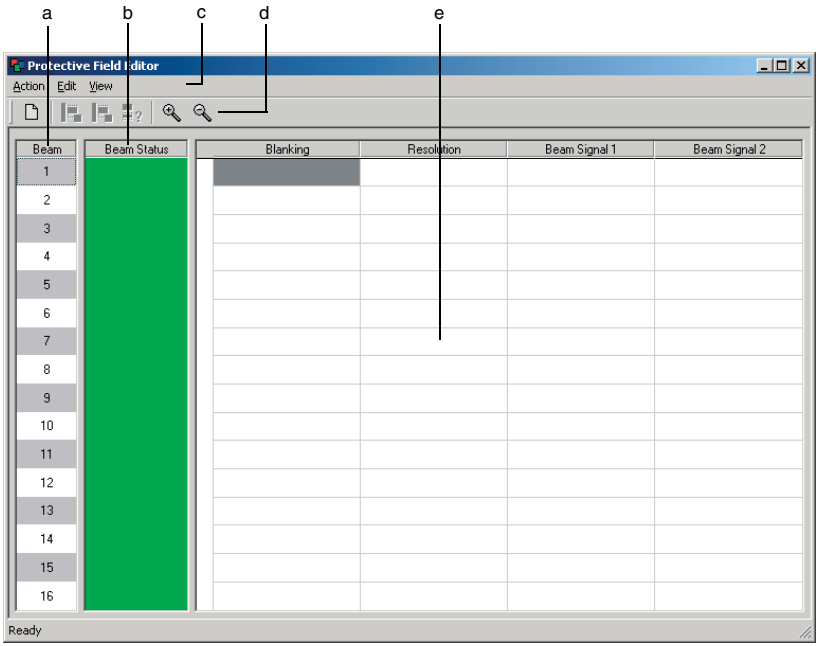
Bild 7.8-1: "Protective Field" window

Element	Description
Display area	Displays the defined protective field.
[+]	Shows more details of the display area.
[-]	Shows less details of the display area.
[Change ...]	Opens the Protective Field Editor; see Chapter 7.9.
[Control ...]	Opens a window for defining protective field control signals; see Chapter 7.14.

7.9 Protective Field Editor

7.9.1 General Information

The Protective Field Editor offers the capability of parameterizing the protective field by beam zone. Click [Change...] in the "protective field" window of the Assistant or Expert to open the Protective Field Editor.



a = beams in the protective field
b = beam status
c = menu bar
d = toolbar
e = work and display area

Bild 7.9-1: "Protective Field Editor" window

7.9.2 Toolbar and menus

The following toolbar and menus are available in the Protective Field Editor.

Icon	Menu	Function
	*Action > New Protective Field*	Deletes all previously created beam zones.
	Action > Close	Closes the Protective Field Editor. A dialog appears displaying the effective resolution for each device and asking whether you want to accept the modified protective field. If you confirm, the beam parameterization that was previously saved in the Assistant or Expert will be overwritten. The modified data is not definitively saved in the connected device until parameterization is complete; see Chapter 6.5.2 or 6.6.
	*Edit > Add Beam Zone*	Creates a marked beam zone in the display area.
	*Edit > Delete Beam Zone*	Deletes the previously created beam zone on which you clicked with the left mouse button.
	*Edit > Properties ...*	Opens a window for setting the properties of the beam zone you have clicked on as shown in Fig. 7.9-2.
	*View > Zoom in*	Shows more details of the display area.
	*View > Zoom out*	Shows less details of the display area.

The submenus of the "Edit" menu are also available as a popup menu if you hold down the right mouse button in the marked beam zone.

7.9.3 Work and display area

You can create beam zones in this part of the Protective Field Editor. It contains the following columns:

- Blanking
  Column for creating any number of beam zones of any size with fixed or floating beam blanking.
- Resolution
  Column for creating one beam zone per device with reduced resolution.
- Beam Signal 1/Beam Signal 2
  Column for creating any number of beam zones of any size that are linked with the internal signal "Beam Signal 1"/"Beam Signal 2"
  see Table 7.20-1.

7.9.4 Adding Beam Zones

Proceed as follows:

➢ Click in the desired field with the left mouse button to define the beginning of the beam zone.

➢ With the Shift key held down, click in a second field of the same column to define the end of the beam zone.

The area is marked in black.

There are three different ways to create the zone:

➢ Select the menu item *Edit > Add Beam Zone*.

➢ Select the appropriate icon.

➢ Click with the right mouse button in the zone marked in black and select *Add Beam Zone* in the popup menu that appears.

A window appears for selecting the properties of the beam zone:

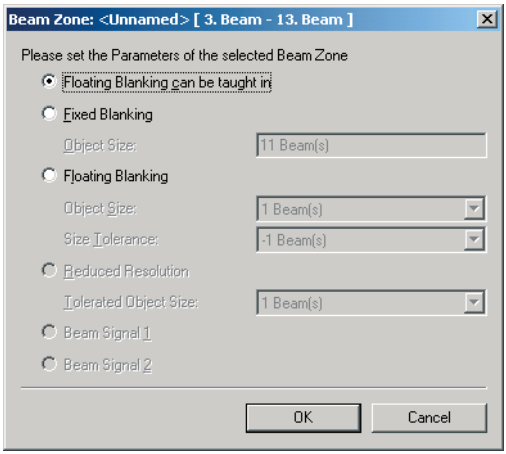


Bild 7.9-2: Window for selecting the properties of the beam zone

Only the elements that are relevant to the column in question are active.

Selection field	Description
Floating Blanking can be taught-in	Teach-in can be performed for an object with floating blanking in the selected beam zone at run time; see Chapter 8.4. The size tolerance for beam zones with Teach-in-based floating blanking is -1 beam.
Fixed blanking	The selected beam zone is parameterized with fixed blanking; see Chapter 8.3.
Object Size	Displays the size of the blanked object. It corresponds to the size of the selected beam zone and cannot be changed here.

Selection field	Description
Floating Blanking	The selected beam zone is parameterized with floating blanking; see Chapter 8.4.
Object Size	Select the object size from the dropdown list.
Size Tolerance	Select the size tolerance from the dropdown list (influences the effective resolution).
Reduced Resolution	The effective resolution is reduced in the selected beam zone; see Chapter 7.12.
Tolerated Object Size	Select the maximum tolerable object size from the dropdown list (defines the effective resolution). This ensures that objects in the protective field up to the specified size will not result in shut-off of the OSSD.
Beam signal 1	Links a beam zone created in the "Beam Signal 1" column with the internal "Beam Signal 1", see Chapter 7.13.
Beam signal 2	Links a beam zone created in the "Beam Signal 2" column with the internal "Beam Signal 2", see Chapter 7.13.

Buttons	Function
[OK]	Closes the window and accepts the current entries. The marked beam zone is created.
[Cancel]	Closes the window without accepting the current entries. The marked beam zone is not created.

7.9.5 Changing Properties of a Beam Zone

The properties of a beam zone that has already been created can be modified in the Protective Field Editor.

Proceed as follows:

➢ Click with the left mouse button in the beam zone to be modified and select menu item *Edit > Properties...* or click on the corresponding icon or

➢ Click with the right mouse button in the beam zone to be modified and select menu item *Properties...* in the popup menu that appears.

The window for selecting the properties of the beam zone appears.

➢ Change the appropriate selection field and confirm with [OK]; see Fig. 7.9-2.

7.9.6 Deleting Beam Zones

You can delete a beam zone that has been created in the Protective Field Editor.

Proceed as follows:

➢ Click with the left mouse button in the beam zone to be deleted and select the menu item *Edit > Delete Beam Zone* or click on the appropriate icon or

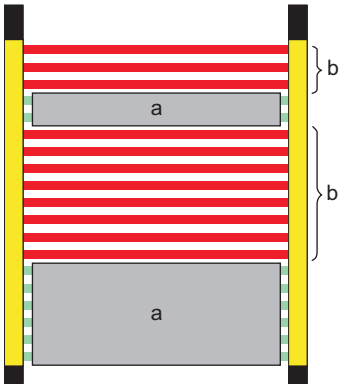
➢ Right-click on the zone to be deleted and select *Delete Beam Zone* in the popup menu that appears.

7.10 Fixed Blanking

7.10.1 General Information

If there is a beam zone with fixed blanking, an object whose position and size correspond to those of the beam zone must be immovably positioned in the protective field to meet the "Protective field free" condition (monitored blanking). The number of interrupted beams defines the beam zone to be blanked. Beam interruption on edges of objects must not be ambiguous, i.e every beam must be permanently evaluated as either interrupted or free. Changes in the beam status are not permitted at run time and will cause the OSSDs to switch off.

Fixed blanking has no effect on the detection capability of the optical protective equipment.



a = fixed object
b = active protective field zone

Bild 7.10-1: Fixed blanking (example)

Note!

The first beam of the protective field after the display area of the device can not be blanked out, since it is used as a synchronization beam.

There are two methods for fixed blanking of a beam zone:

- Parameterization in the Protective Field Editor (see Chapter 7.10.2).

- Teach-in (see Chapter 8.3.1)

Safety information on fixed blanking:

Warning!

Objects to be blanked must extend over the entire width of the protective field or must be accordingly completed by mechanical blocking with a dull surface so that there is no possibility of intrusion from the side. The object and mechanical locks must be sturdy and connected to each other. It must only be possible to remove them from the protective field together. Formation of shadows by parts that are higher than those around them will result in unmonitored zones in the protective field and must therefore be strictly avoided.

Warning!

*The functions Fixed and Floating Blanking are **only permitted in combination with Start/ Restart Interlock** (internally or in downstream machine control). This prevents the machine from possibly starting up unexpectedly if an object is missing and there is an intrusion in the protective field just at the place where the missing object should be! Exceptions to this rule are only permitted if the objects and possibly the blocks are electrically connected with inputs L3 and L4 of the local interface (provided for this purpose), thus ensuring that their position is continuously monitored.*

Warning!

Only knowledgeable and authorized personnel are permitted to set up blanking in the protective field or make changes to the resolution of the protective field. It is the machine operator's responsibility to provide access to such tools as the SafetyKey, the key for the 2-pin key switch or PC with SafetyLab and the password for the "Authorized Customer" access level only to knowledgeable and authorized personnel.

7.10.2 Parameterizing Fixed Blanking in the Protective Field Editor

Proceed as follows:

➢ Select [Change...] in the "Protective Field" window of the Assistant or Expert (see Fig. 7.8-1) to open the Protective Field Editor.

➢ Create the beam zone to be blanked out in the "Blanking" column; see Chapter 7.9.4 "Adding Beam Zones".

➢ In the window for selecting the properties of the beam zone, select the "Fixed Blanking" radio button and confirm with [OK]; see Fig. 7.9-2.

The beam zone that has been created appears in hatched lines in the "Blanking" column.

Note!

A beam zone that is parameterized in the Protective Field Editor must match the position and size of the object to be blanked out. Otherwise the receiver's OSSDs will switch into the OFF state and remain in the OFF state.

Note!

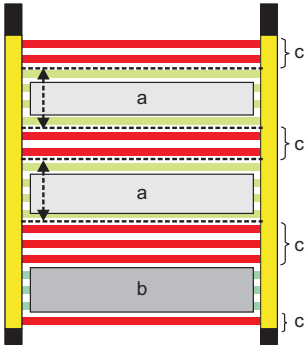
You can create any number of beam zones of any size with fixed blanking, with the exception of beam 1. A zone that has been parameterized with the Protective Field Editor can be extended with Teach-in, but it cannot be deleted with Teach-in.

7.11 Floating Blanking

7.11.1 General Information

If you want an object of fixed or slightly varying size to be able to move within a protective field zone, without the safety output being turned off, you must perform Teach-in with floating blanking for the beam zone or parameterize it with floating blanking. It must be assumed due to the beam geometry that the number of interrupted beams will deviate by at least 1 when the object moves. Because of this, a size tolerance must be taken into consideration. Size tolerance means allowing for fluctuations in the number of interrupted beams caused by minor shifts in the beam zone that is covered. This is caused in turn by permissible movements of objects that causes covered beams to be only intermittently covered or not covered at all. The setting of the size tolerance affects the effective resolution of the protective equipment. It must therefore be taken into account when calculating the safety distance. The protective field may simultaneously contain multiple beam zones with both floating and fixed blanking, provided

- they do not overlap with each other and
- there is only one object in each of them.



a = movable object
b = fixed object
c = active protective field zone

Bild 7.11-1: Floating and fixed blanking (example)

Note!

It is also advantageous to use floating blanking if you want to blank out an object that is not moving but for which the interruption of beams on the edges of the objects vacillates.

In contrast to fixed blanking, where the size of the object and the size of the beam zone are the same, the beam zone must be greater than the size of the object for floating blanking. The permissible virtual fluctuation of object size caused by the movement of an object (size tolerance) can also be changed with SafetyLab (factory setting (FS) = 1 beam).

There are two ways to define beam zones with floating blanking, the same as for fixed blanking:

- Parameterization in the Protective Field Editor (see Chapter 7.11.2).
- Teach-in (see Chapter 8.4.1)

Note!

The first beam of the protective field after the display area of the device can not be blanked out, since it is used as a synchronization beam.

Warning!

Safety information for floating blanking:
As a rule, all safety information is applicable to fixed blanking (see Chapter 7.10.1). In addition, please note:

Warning!

In the area of the edges above and below the movable object that is introduced or for blocking of the same size, the resolution is reduced according to the following tables 7.11-1 and 7.11-2. Floating blanking must only be used in applications to safeguard danger points. Because of this, floating blanking for resolutions and sizes tolerances other than those specified here is not permitted. No table is displayed for use in securing danger areas because for Safety Light Curtains with an approach parallel to the protective field, objects to be blanked out would represent barriers or, if they are positioned lower, bridges for which there would be no adequate safety distance from the hazardous point. Floating blanking is not permitted at an effective resolution of the protective field of > 40 mm in Europe (EN 999) or > 64 mm in the US (ANSI) and will neither be accepted by the device firmware nor by SafetyLab.

SafetyLab provides the option of adjusting the size of the object and the size tolerance to the same value (for example setting both to "1 beam"). In this case the object to be blanked out is not permanently located in the protective field → no object monitoring. Consequently, the effective resolution has other values than with object monitoring. These values appears in Table 7.11-2.

Floating blanking Safeguarding danger points with object monitoring with normal approach to the protective field			
Physical resolution	**Size Tolerance**	**Effective resolution d**	**Addition C to the safety distance C = 8 (d –14)**
14 mm	1 beam	19 mm	40 mm
14 mm	2 beams	29 mm	120 mm
30 mm	1 beam	38 mm	192 mm
30 mm	2 beams*	57 mm	344 mm

* not permitted in Europe

Tabelle 7.11-1: Effective resolution in the area around edges for floating blanking with object monitoring

Floating blanking Safeguarding danger points without object monitoring with normal approach to the protective field			
Physical resolution	**Size Tolerance**	**Effective resolution d**	**Addition C to the safety distance C = 8 (d –14)**
14 mm	1 beam	24 mm	80 mm
14 mm	2 beams	33 mm	152 mm
30 mm	1 beam	49 mm	280 mm

Tabelle 7.11-2: Effective resolution in the area around edges for floating blanking without object monitoring

After performing teach-in or parameterization of beam zones with floating blanking, you must recalculate the **safety distance** with the **effective** resolution according to Table 7.11-1 or 11.1-2 and correct the mounting distance to the danger point accordingly. The effective resolution must be written indelibly on the label that comes with the receiver.

7.11.2 Parameterizing Floating Blanking in the Protective Field Editor

Proceed as follows:

➢ Select [Change...] in the "Protective Field" window of the Assistant or Expert (see Fig. 7.8-1) to open the Protective Field Editor.
➢ Create the zone to be blanked out in the "Blanking" column; see Chapter 7.9.4 "Adding Beam Zones".
➢ In the window for selecting the properties of the beam zone, select the "Floating Blanking" radio button.
➢ Select the object size and size tolerance from the two dropdown lists and confirm with [OK]; see Fig. 7.9-2.
➢ Transfer the parameter set to the connected safety device.

The zone that has been created appears in hatched lines in the "Blanking" column. In contrast to teach-in of zones with movable blanking parameterization in the Protective Field Editor also makes it possible to:

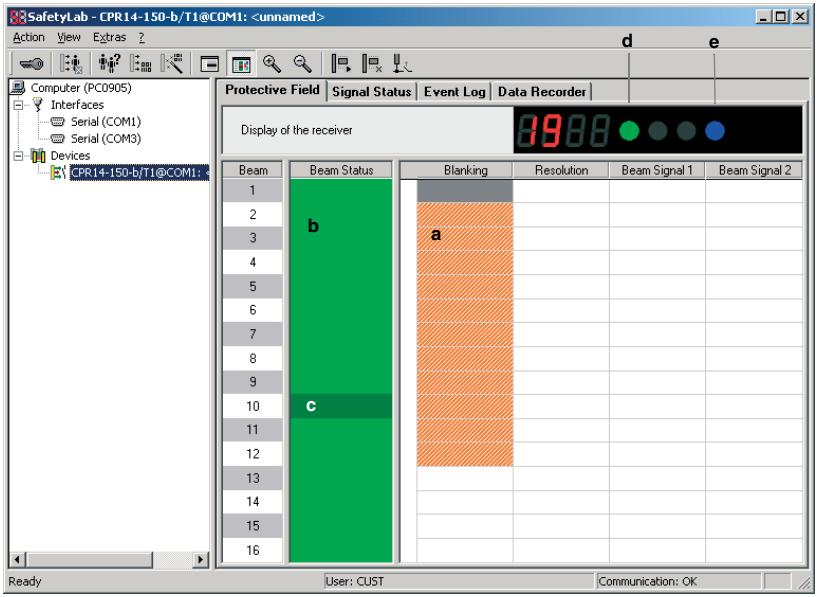
- define blanking zones that border directly on each other without any free normal beam as an intermediate space.
- define beam zones in which the object size and size tolerance are identical. Then the object can be removed from the protective field or it can be so small that it does not permanently interrupt the required minimum number of beams so the OSSDs are not shut off.

Warning!

You can create any number of beam zones of any size. A beam zone parameterized with the Protective Field Editor cannot be deleted with teach-in.
On deleting beam zones, see Chapter 7.9.6 "Deleting Beam Zones".

7.11.3 Representation of Floating Blanking

The following example shows the representation of a protective field with a physical resolution of 14 mm, a movable object and a zone with floating blanking. The beam zone was parameterized from beam 2 to 12 with floating blanking using the Protective Field Editor (a: orange hatched), in which the object must be detected with a size of 1 or 2 beams (object size = 2 beams, size tolerance = -1 beam). Because of the size tolerance, the effective resolution of the device is now 19 mm. The blue LED indicates that the special function "Blanking" has been activated. Fig. 7.11-2 shows an object in the blanking area that is shown in dark green.



a = orange: beam zone with floating blanking, object size=2 beams, size tolerance = -1 beam

b = light green: free beams

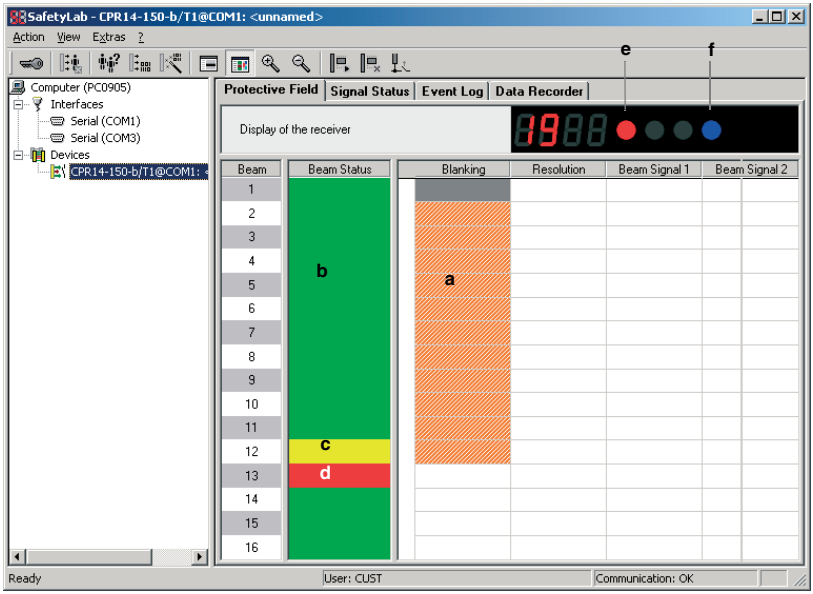
c = dark green: Permissible object in a permissible position

d = green LED

e = blue LED

Bild 7.11-2: Valid object in a protective field with floating blanking

If the same object leaves the blanking zone through the bottom, the display changes as shown in Fig. 7.11-2. The OSSDs are turned off, which is represented by the red LED in the display area. At the lower end of the blanking zone, the receiver detects that there is no object with the minimum expected object size (2 beams - 1 beam = 1 beam) in the blanking zone --> the status of the last beam 12 changes to yellow. The object interrupts beam 13, but no blanking has been defined for it, so that the interruption is not permitted in this position --> the beam status of this beam therefore switches to red.



a = orange: beam zone with floating blanking, object size = 2 beams, size tolerance = -1 beam

b = light green: free beams

c = yellow: Missing object is detected at the end of the beam zone

d = red: object in impermissible position

e = red LED

f = blue LED

Bild 7.11-3: Impermissible object position in a protective field with floating blanking

7.11.4 Extension of the response time with Floating Blanking

In principle parametering beam zones with floating blanking results in an additional extension of the response time of the receiver, as in the worst case scenario the beam zone must first be completely scanned with floating blanking in order to generate a switch-off command. The scan time required for the largest beam zone with floating blanking must be added to the scan time depending on the number of beams and the multiscan factor in order to calculate the response time.

The additional amount for the response time conditional on the floating blanking depends on the number of beams in the corresponding beam zone, which is calculated according to the resolution and the length "L" of the biggest beam zone with floating blanking as follows:

- for devices with 14 mm resolution
  t_{FB} = (L / 10 mm * 0,2 ms) + 3 ms

- for devices with 30 mm resolution
  t_{FB} = (L / 20 mm * 0,2 ms) + 3 ms

Warning!

Devices with a physical resolution greater than 30 mm are not permitted for applications with floating blanking.

If at least one beam zone has been parametered with floating blanking, the response time of the device is no longer displayed in the "AOPD Response Time" window (see Fig. 7.23), but rather replaced by a safety note. The additional amount t_{FB}, which is calculated from the formulas listed above, must be added to the response time without floating blanking. The display of the response time on the receiver is made with "t-". The user must calculate the response time of the device as follows:

➢ Select or calculate the response time (incl. cascading) from the tables in Chapter 12.2, column /T of the Connecting and Operating Instructions for the device.

➢ Multiply this value with the multiscan factor that has been set in the window „Scan mode“.

➢ Measure the length of the biggest beam zone with floating blanking in mm. Calculate the additional amount t_{FB} according to the formulas listed above and add this value to the response time already selected or calculated.

➢ Add the additional response time of the output module (transistor output = 1.6 ms, relay output = 16.6 ms, AS-i Safety at Work = 6.6 ms, PROFIsafe = 20 ms.

The resulting response time must be used as t_{AOPD} in the formulas for calculating the safety distance in Chapter 6.1 of the Connecting and Operating Instructions for the device.

Note!

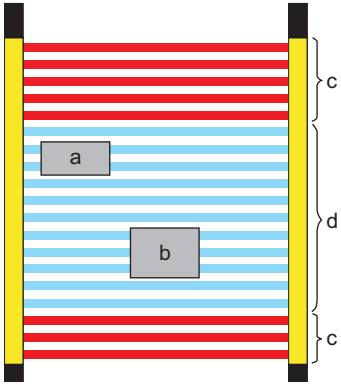
SafetyLab can help when checking the calculation made by the user by the response time without floating blanking being determined first and the additional amount from the above formulas then being added.

7.12 Reduced Resolution

7.12.1 General Information

If reduced resolution has been set with the Protective Field Editor, the receiver will not switch off as long as no more than a number of adjacent beams that can be parameterized is interrupted in the beam zone (1-3) that is parameterized in this way. This ensures that objects with a defined maximum size will not cause the OSSDs to switch off. The effective resolution to be used to calculate the safety distance decreases depending on the reduction factor. The safety distance must be adjusted accordingly.

Fig. 7.12-1 shows a protective field with a beam zone with 2-beam reduced resolution. Only objects that interrupt at least 3 adjacent beams are detected as impermissible in this beam zone of the protective field.



a = Permissible object
b = Impermissible object
c = Zone without reduced resolution
d = Zone with 2-beam reduced resolution

Bild 7.12-1: Beam zone with 2 beams resolution reduced (example)

Note!

Only one contiguous beam zone with reduced resolution can be defined within a Safety Light Curtain. In cascaded devices this applies to each individual device.

The following Table 7.12-1 shows how the resulting effective resolution depends on the physical resolution and reduction and what object sizes are tolerated in beam zones with reduced resolution.

The tolerated object size depends on what minimum optical surface must be free to interpret a beam as uninterrupted. In the worst case (transmitter and receiver are at the maximum permissible distance from each other) the entire optical surface must be free. In the best case (transmitter and receiver are right next to each other) an optical width of 1 mm is enough for a free beam.

Physical resolution	Reduction of resolution	Effective resolution	Tolerated object sizes		Preferably used for
			Worst case	Best case	
14 mm	None	14 mm	0 mm	4 mm	A
	1 beam	24 mm	4 mm	13 mm	A
	2 beams	33 mm	14 mm	22 mm	A
	3 beams	43 mm	23 mm	32 mm	B
30 mm	None	30 mm	0 mm	10 mm	A
	1 beam	49 mm	7 mm	28 mm	B
	2 beams	68 mm	26 mm	46 mm	B
	3 beams	87 mm	47 mm	65 mm	B
50 mm	None	50 mm	0 mm	10 mm	B
	1 beam	87 mm	26 mm	46 mm	B
	2 beams	124 mm	64 mm	84 mm	C
	3 beams	162 mm	101 mm	121 mm	C
90 mm	None	90 mm	0 mm	10 mm	B
	1 beam	162 mm	64 mm	84 mm	C
	2 beams	237 mm	139 mm	159 mm	C
	3 beams	312 mm	214 mm	234 mm	C

Worst case: With maximum distance between transmitter and receiver
CP14: 6 m
CP30, 50, 90: 18 m
Best case: With minimum distance between transmitter and receiver
CP14: 0.3 m
CP30, 50, 90: 0.8 m
A: Danger points protection
B: Danger areas protection
C: Access and Perimeter guarding

Tabelle 7.12-1: Beam zones with reduced resolution

Safety Light Curtains with 90 mm resolution are only available with the function package "Muting".

Warning!
The "Reduced Resolution" function must only be used if the objects that have been moved in have no shining or reflective top or bottom. Only dull surfaces are permitted!

After you have parameterized "Reduced Resolution", recalculate the safety distance or perhaps the minimum height of the protective field with the effective resolution as shown in Table 7.12-1 and correct the mounting distance from the danger point or the height of the protective equipment above the reference surface accordingly. The effective resolution must be written indelibly on the label that comes with the receiver.

7.12.2 Parameterizing Reduced Resolution

Proceed as follows:

➢ Select [Change...] in the "Protective Field" window of the Assistant or Expert (see Fig. 7.8-1) to open the Protective Field Editor.

➢ Create the desired zone in the "Resolution" column; see Chapter 7.9.4 "Adding Beam Zones".

The window for selecting the properties of the beam zone appears.

The radio button "Reduced Resolution" is automatically selected.

➢ Select the permissible object size from the corresponding dropdown list and confirm with [OK].

Objects that are smaller than (or the same size as) the tolerated object size will not be detected within the defined beam zone.

7.13 Beam Signals

Receivers of light curtains are capable of generating 2 internal signals "Beam Signal 1" and "Beam Signal 2" if certain beams or beam zones are interrupted. These signals can be transferred via indication signal outputs (see Chapter 7.20 and Chapter 7.21) to a higher-level control system, for example to show whether specific objects are present or absent.

In the Protective Field Editor, in the columns "Beam Signal 1" and "Beam Signal 2", you can define beam zones that are linked respectively to the internal "Beam Signal 1" and/or "Beam Signal 2".

For information on defining beam zones, see Chapter 7.9.4 "Adding Beam Zones".

If you have created a beam zone in the "Beam Signal 1" column, the internal signal "Beam Signal 1" will respond to an interruption of beams in this beam zone. In this manner you can determine the beam zone in which the protective field was violated.

Generating beam signals does not depend on the OSSD status and the "protective field free" signal. An overlap between beam zones for "Beam Signal 1" and "Beam Signal 2", for example makes it possible to display 4 positions of a valid or invalid object in a zone with floating blanking.

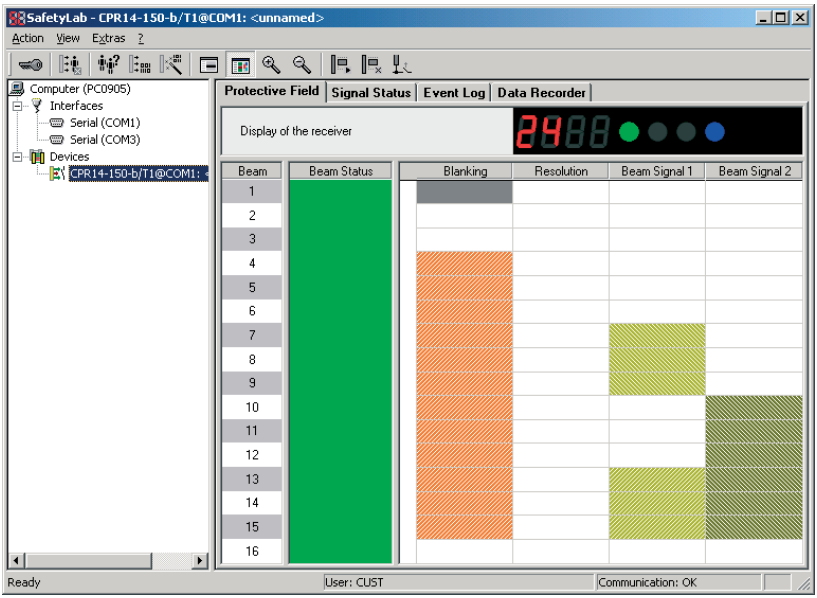


Bild 7.13-1: Using Beam Signals

In the example shown in Fig. 7.13-1, if the object to be blanked is between beams 13 and 15, then both "Beam Signal 1" and "Beam Signal 2" are log. 1, while in other beam zones in which the OSSDs are turned on, only one of the two (in beams 7 through 12) or neither (beams 1 through 6) are activated.

7.14 Protective Field Control

If the [Control...] button is actuated in the "Protective Field" window of the Assistant or Expert, the "Protective Field Control" window appears.

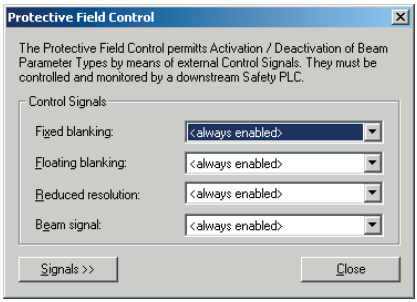


Bild 7.14-1: "Protective Field Control" window

You can define a control signal here for each type of beam parameter that activates or deactivates all beam zones with the corresponding beam parameter type in the entire protective field. The factory setting "always enabled" can be replaced by any control signal input. If this happens, the beam parameter type is activated by a log. 1 signal and is deactivated by a log. 0 signal. If internal Start/Restart Interlock is active, there is a lock for each activation/deactivation of beam parameter types.

Warning!

Since the control signals for receivers with transistor output, relay output or AS-i Safety at Work Interface are single-channels, they must only be generated by a downstream safety PLC (except for beam signals). The PLC must expect an inverse signal change as a response to a change in signal from the control input by reading the inverse control signal on an indication signal output as feedback within a time window of approximately 40 ms (Chapter 7.20). In this case the safety release circuit must not be switched directly by the receiver's OSSDs. Instead, it must depend on a reliable evaluation of the feedback signal in a downstream PLC. This restriction does not apply for receivers with PROFIsafe Interface, as its cyclic output bits are safely transferred. If internal Start/Restart Interlock is not activated, protective field control must be performed by a downstream safety device that has a Start/Restart Interlock and is able to lock it based on switching.

7.15 Startup

In the "Startup" window you can define the conditions for releasing the safety device after the power supply is turned on.

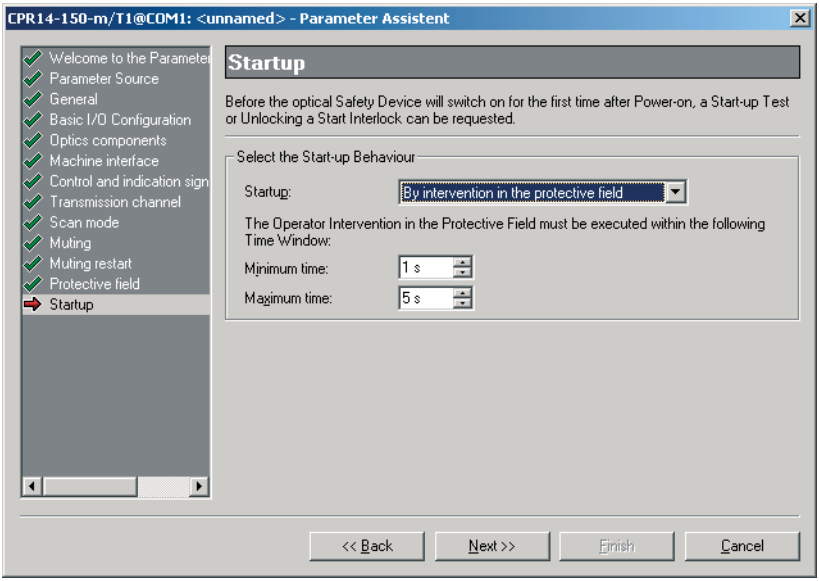


Bild 7.15-1: "Startup" window

Element	Description
Startup	
No startup test	There is no startup test. In operation without start/restart interlock (see Chapter 7.16) the OSSDs immediately switch to the ON state if the protective field is free and, when parameterized, if an optional safety circuit is closed (see Chapter 7.19).
By intervention in the protective field	The safety device is enabled by a one-time intervention in the protective field within the time window indicated below.
By single actuation of the start button	The safety device is not enabled until the start button has been pressed and released once. For the parameterization of the start button(s), see Chapter 7.17. For the connection diagram of the start button, see Chapter 11.2.3.
Minimum time (0 – 4.98 s)	Minimum duration of the interruption in the protective field. The field is only active if "By intervention in the protective field" is selected in the Startup field.
Maximum time (0.02 - 5 s)	Maximum duration of the interruption in the protective field. The field is only active if "By intervention in the protective field" is selected in the Startup field.

7.16 Start/Restart

In the "Start/Restart" window you can define the conditions for restarting the OSSD after it has been switched off.

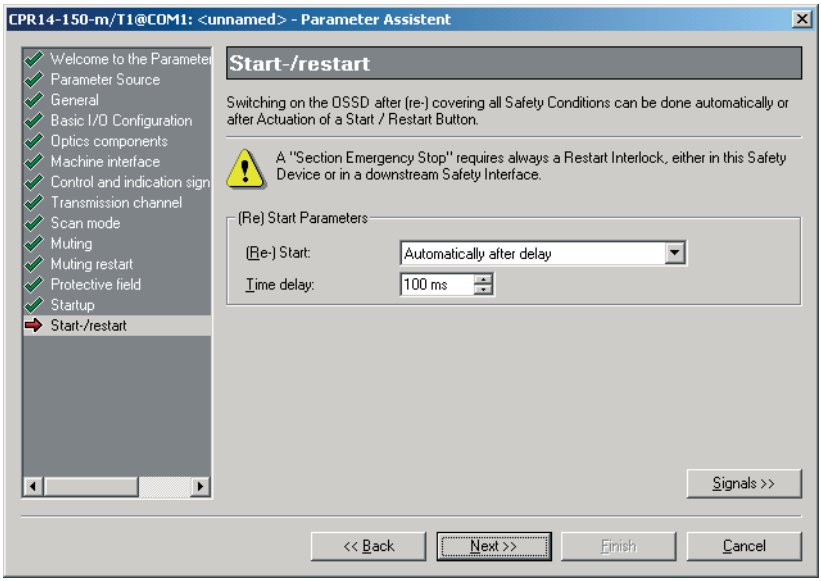


Bild 7.16-1: "Start/Restart" window

Element	Description
(Re-)Start	
Automatically after delay	Restart takes place automatically after the set delay time if all safety conditions are fulfilled (i.e. effective protective field free and optional safety circuits closed).
Manually via start button	The receiver does not switch on until after correct activation of the start button (see Chapter 7.17) if all safety conditions are met. For the parameterization of the start button(s), see Chapter 7.17. For the connection diagram of the start button, see Chapter 11.2.3.
Time Delay	The delay time after which an automatic restart will take place (20...5000 ms). Field is only active if restart is set to "Automatically after delay". FS: 100 ms

For receivers with bus interface (AS-i Safety at Work, PROFIsafe) it applies that with bus errors the internal start/restart interlock does not switch off. An immediate start after the

bus connection has returned is therefore possible if automatic restart is used for working in the higher-level unit (AS-i Monitor, Safety PLC). The same also applies for devices with conventional interface (transistor, relay) if the downstream safety device works with automatic restart.

The start/restart interlock is usually implemented in a higher-level control.

Warning!

Note the safety instructions in the Connecting and Operating Instructions for the safety device.

7.17 Start/Restart Signal

In the "Start/Restart Signal" window you can define where the start button(s) for unlocking start and restart interlocking are connected and how they work.

If start and/or restart is controlled by a start button (see Chapter 7.15 or Chapter 7.16), the corresponding start button must be connected to the receiver. The OSSD safety switching output is not turned on until this start button has been pressed and released within a defined time window.

You can connect up to two start buttons (for example if the hazardous area is not all visible from any one place). Their signals are linked in the "Start/Restart Signal" window.

For the connection diagram with a start button, see Chapter 11.2.3.

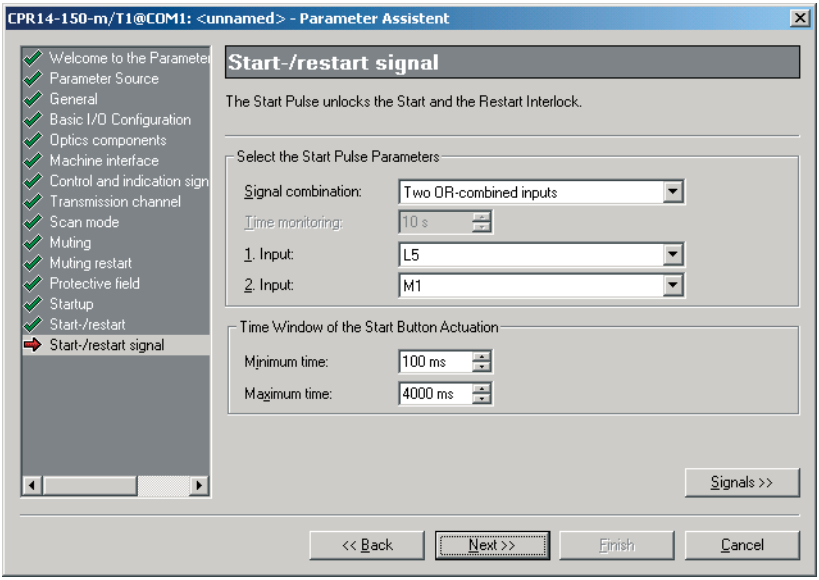


Bild 7.17-1: "Start/Restart Signal" window

Element	Description
Signal Combination	The logic used to link the two inputs for the start buttons.
No link, only one input	Only one input (one start button) is used.
Two OR-combined inputs	Two inputs (two start buttons) are used. With the OR combination, one valid start pulse on one of the inputs is sufficient to unlock the Start/Restart interlock.  A good view of the hazardous area must be available from each start button.
Two AND-combined inputs	Two inputs (two start buttons) are used. The AND combination requires that a valid start pulse be detected on both inputs within the specified time monitoring. The AND function is available from firmware version 4.x (with devices with older firmware status a warning message appears, which leads back to this window). The minimum difference time between the two start pulses is 1 second; the maximum difference time can be set between 2 and 10 seconds.
Time monitoring	The time within which the two start buttons must be pressed and released again. Only active with an AND combination of the two signals.
1. Input	
L1..L5, M1..M5, ..M16	The input to which the (first) start button is connected. (Not for AS-i Safety at Work)
2. Input	
L1..L5, M1..M5, ..M16	The input to which the second start button is connected. (Not for AS-i Safety at Work)
Minimum time	The minimum time the operator must press a start button (**100...4980 ms)**. If the button is held down for less than this time, no valid start pulse is generated. FS: 100 ms
Maximum time	The maximum time the operator can hold down a start button (**200...5000 ms)**. If the button is held down for longer than this time, no valid start pulse is generated. FS: 4000 ms

7.18 External Device Monitoring

You can define the parameters for external device monitoring in the "External Device Monitoring" window.

The receiver can check whether the switching behavior of downstream elements (for example contactors, relays, valves, etc.) is correct if they have positively guided feedback contacts. SafetyLab gives you the option of activating external device monitoring and selecting the type of external device monitoring.

Dynamic external device monitoring

In dynamic external device monitoring, the system checks before turning on the OSSD safety output whether the feedback circuit of the downstream switching elements is closed, and then opened after switching on the OSSD within the set maximum delay time. If not, the OSSDs switch back to the OFF state. The receiver goes into the error interlock state from which it can only be reset by turning the power supply off and back on again, and displays an error message on the 7-segment display.

Static external device monitoring

Static external device monitoring checks each time before the safety output OSSD is turned on whether the downstream circuit elements are in an open state and the feedback circuit is thus closed. If this is not the case, the OSSD remains in the OFF state and an error message appears on the 7-segment display of the receiver.

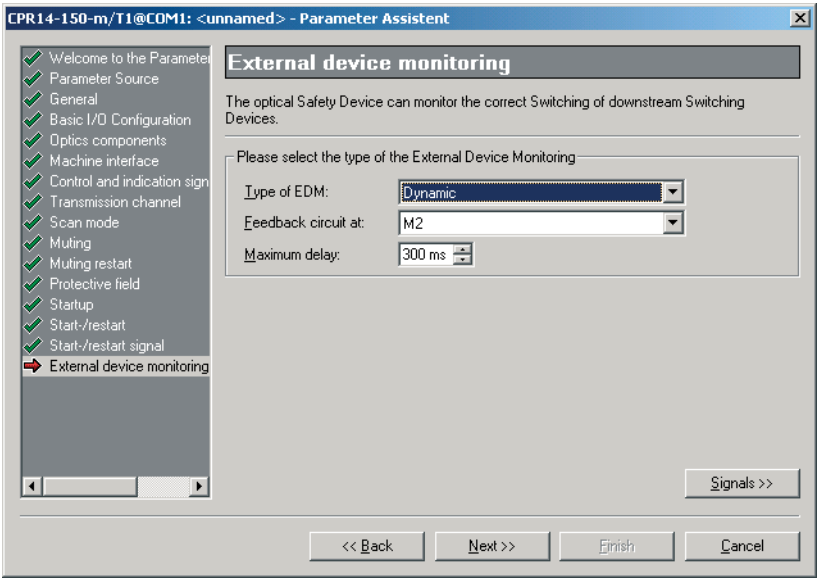


Bild 7.18-1: "External Device Monitoring" window

Element	Description
Type of EDM	
None	External device monitoring is deactivated.
Static	Static external device monitoring is performed.
Dynamic	Dynamic external device monitoring is performed.
Feedback circuit at	
L1..L5, M1..M5. ..M16	The signal line to which the feedback circuit is connected. (Not for AS-i Safety at Work)

Element	Description
Maximum delay	The time after which the feedback circuit must open and close for the receiver not to go into the error interlock state (100 - 1000 ms). FS: 300 ms Field is only active for dynamic external device monitoring.

This function is mostly deactivated in devices with bus interface, as the contractor control is performed in the higher-level control.

7.19 Contact-Based Safety Circuit

How to connect the optional safety circuit has already been defined in the "Basic I/O Configuration" window (see the corresponding chapters on the function packages). It is only displayed in the "Contact-Based Safety Circuit" window. In this window you can define whether a startup test will be performed after the power supply is turned on by opening the safety circuit and then closing it again, with expectation of simultaneousness if a 2-channel safety circuit is selected.

Warning!

You are only permitted to select one or two 1-channel safety circuits for applications that require safety category 2.

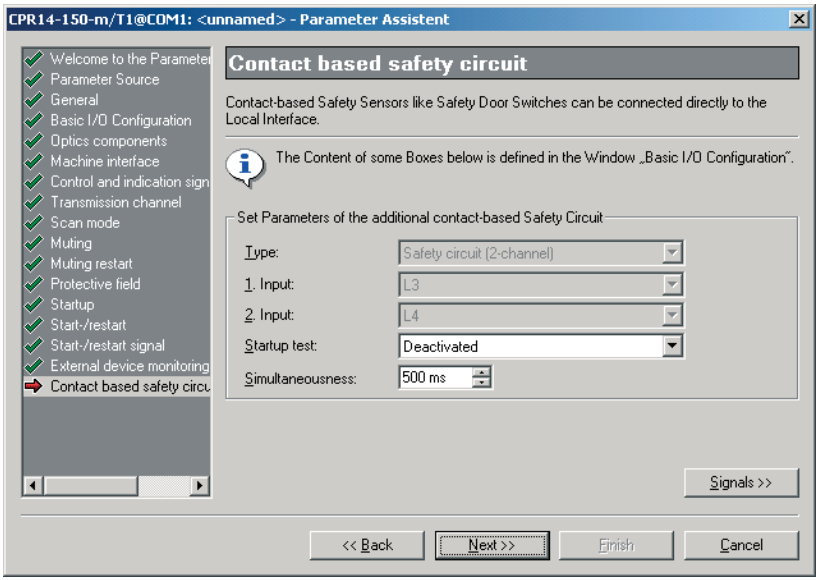


Bild 7.19-1: "Contact-Based Safety Circuit" window

Element	Description
Type	Defined in the "Basic I/O Configuration" window.
1. input	Defined in the "Basic I/O Configuration" window.
2. input	Defined in the "Basic I/O Configuration" window.
Startup test	Activates/deactivates a startup test by opening and closing the circuit after the device is turned on.
Simultaneous-ness	If a 2-channel safety circuit has been selected, this parameter defines the permissible delay time between the closing of the 1. and 2. input.

Warning!

*EMERGENCY STOP buttons connected to the receiver only affect the safety circuit that is assigned to the OSSDs of the safety device. In other words, this is an **Area EMERGENCY STOP**. The restricted effective range of the button must be clearly identified for the operating staff.*

Regulations governing EMERGENCY STOP equipment apply to the area EMERGENCY STOP. These include EN 60204-1 and EN 418. EMERGENCY STOP buttons must be interlocking. After interlock is unlocked the dangerous movement must not be started up again immediately. Instead, use a separate procedure for switching on with the start button. Operation with Start/Restart in the receiver or in a downstream evaluation unit is therefore mandatory.

The response time of this additional safety circuit is 40 ms plus the response time of the output module as shown below

- Transistor output: +1.6 ms
- Relay output: +16.6 ms
- AS-i Safety at Work-Interface:+6.6 ms
- PROFIsafe-Interface: +20 ms

Connecting to the receiver is based on the connection diagrams in Chapter 11.

7.20 Indication Signal Output

In the "Indication Signal Output" window you can define how 2 selectable internal signals are transferred to one indication signal output each.

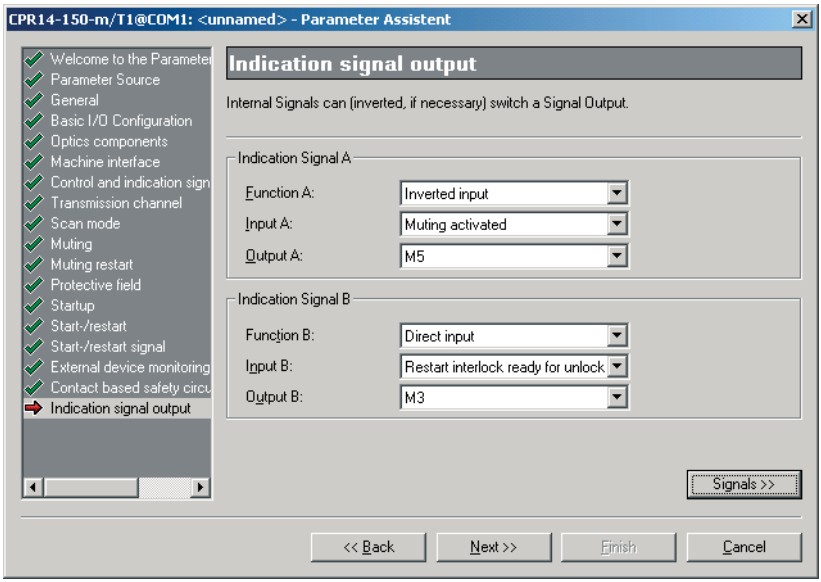


Bild 7.20-1: "Indication Signal Output" window

Element	Description
Indication signal A	
Function A	
Deactivated	Indication output is not used
Direct input	Indication output is used; the internal indication signal is generated logically directly on the output.
Inverted input	Indication output is used The signal is generated inverted on the output.
Input A	The signal that is generated on the output (may be inverted). For available signals, see Table 7.20-1.
Output A	Indication output on which the input signal is generated
Indication signal B	Same as indication signal A, but for a second indication output Information to parameterization and possibly safety relevant usage of indication signal outputs can be found in Chapter 7.5.

Warning!

If the same internal signal is generated once directly and on a second output inverted, the two signal outputs that are used for this can be used for safe data transmission of this internal binary signal to a downstream safety PLC.

Warning!

If the two antivalent signal lines are evaluated by a safety PLC, safety category 4 can be achieved with this signal transmission, as long as in addition both OSSD outputs are evaluated as = 1 (ON) to make safety relevant decisions by this indication signal. Another requirement is that the signal is internally generated safely.

The following internal signals are available for output:

Signal	Description
<always enabled>	This signal is always log. 1; used mostly for unused control signals
<not used>	This signal is always log. 0.
Start interlock locked	Startup interlock has not be unlocked yet after switching on. For this to happen, the startup interlock must have been activated in the "Startup" window (see Chapter 7.15)
Teach-in via PC	Teach-in of a protective field has been triggered via PC (see Chapter 8.3.1 and 8.4.1).
Teach-in override active	The "Teach-in Override" function for teaching-in protective fields with floating blanking has been activated (see Chapter 8.6)
Fault/Error	An error (display "Ex xx") or a fault (display "Fx xx") has occurred on the receiver (see Connecting and Operating Instructions Chapter 11)
Front window dirty	A weak beam signal has been detected for at least 10 minutes --> the front pane is probably dirty and must be cleaned.
L1 ... L5, M1 ... M5/... M16	State of logical inputs L1..L5, M1 ... M5 and M1 ... M16 without time filtering
LED (yellow)	State of the yellow LED: off = log. 0, on = log. 1. Depending on the operating mode, indicates locking of restart interlock or the number of expected cycle interventions. Can be used to display this signal via an indication light, for example.
Muting activated	The internal muting function has been activated correctly (see Chapter 9).
OSSD error	Fault on the OSSD safety output
OSSD state	State of the OSSD safety output
SafetyKey (m)	A magnet has been placed on the parameter interface. It may come from MagnetKey, SafetyKey or from the optical PC adapter.
SafetyKey (o)	The optical bridge on the parameter interface has been closed. If "SafetyKey (m)" is log. 1 as well, the SafetyKey has been set in place.
Protective field free	The active protective field is free. Blanked objects have the correct size and position. Objects in areas with reduced resolution are small enough not to trigger the safety function.
Weak beam signal	At least one beam has been detected as weak. Either the front pane is dirty or an object is partially covering one beam. Beams on the edge of a blanked object that are only partially interrupted do not trigger this signal.

Signal	Description
Safety circuit closed	The optional safety circuit on L3 and/or L4 is closed (see Chapter 7.19).
Beam signal 1, Beam signal 2	Beam signal 1 or 2 has been triggered because there is at least one object in the corresponding parameterized beam zone (see Chapter 7.13).
Blinking of remaining cycles	Indicates the remaining number of cyclic interventions by flashing briefly n times (n = 1...8). Can be directly connected with a signal lamp (see Chapter 10.4).
Overrun OSSD switch counter	The warning level for the number of times the OSSD has been switched off has been exceeded. The relay cap or downstream contactors should be replaced as a preventive measure and then the OSSD changeover counter should be reset to zero (see Chapter 7.4).
Undercurrent through muting indicator	The muting indicator has been activated and a current is flowing that is below the warning level. A redundant indicator has failed and should be replaced immediately (see Chapter 9.7 and 9.8).
Restart interlock locked	The internal Start/Restart interlock has been activated (see Chapter 7.16).
Restart interlock ready for unlocking	The internal start/restart interlock is ready to be unlocked, i.e. the active protective field is free and the optional safety circuit is closed.
Restart interlock locked	The internal Start/Restart interlock is locked. If it is ready to be unlocked, it can be unlocked with a start button (see Chapter 7.17).

Tabelle 7.20-1: Internal signals

7.21 Indication Signal Combination

In the "Indication Signal Combination" window you can link signals together and output them at a free indication output.

From the list of available internal signals you can select up to 8 with the ">" button. They can be AND or OR linked to each other according to linking logic and put out at the selected output. Signals can be inverted on both, the input and output side. In addition, appropriately parameterized signal inputs can cause the output to flash and turn off or on with a delay based on adjustable time behavior.

Note!

Flashing takes priority over statically switched inputs, i.e. if at least one flashing input is activated, the output flashes. Flashing should therefore be used sparingly and should be restricted to applications of especially important signals. The same signals are available on the input side as are shown in Table 7.20-1.

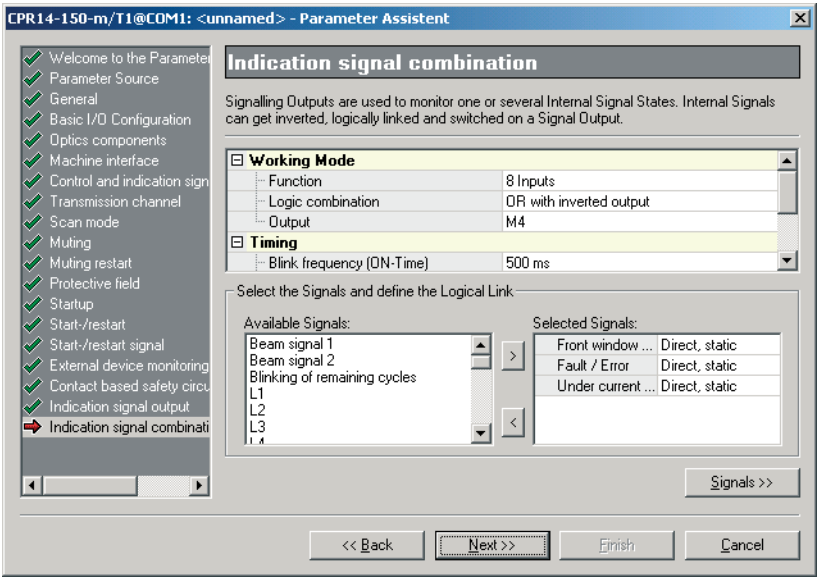


Bild 7.21-1: "Indication Signal Combination" window

Element	Description
Working Mode	
Function	
Deactivated	The function is not processed.
8 inputs	Up to 8 internal input signals can be linked.
Logic combination	
OR	The inputs are OR-linked.
OR with inverted output	The inputs are OR-linked. The result is inverted and generated on the output.
AND	The inputs are AND-linked.
AND with inverted output	The inputs are AND-linked. The result is inverted and generated on the output.
Output	The output on which the result of the combination is generated.
Timing	
Blink frequency (ON-Time)	Switch-on time with flashing output if an input signal has been activated with the attribute "blinking".
Blink frequency (OFF-Time)	Switch-off time with flashing output if an input signal has been activated with the attribute "blinking".

Element	Description
ON delay	The delay time with which the output is switched on (at log. 0 with inverted output).
OFF delay	The delay time with which the output is switched off (at log. 1 with inverted output).
Available Signals	
List according to Table 7.20-1	List of all available internal signals that can be logically linked.
Selected signals	
Direct, static	The input signal enters into link directly. The output is statically switched by this signal.
Inverted, static	The input signal enters into link logic inverted. The output is statically switched by this signal.
Direct, blinking	The input signal enters into link directly. The output is switched flashing by this signal.
Inverted, blinking	The input signal enters into link logic inverted. The output is switched flashing by this signal.

7.22 7-Segment Display

In the "7-Segment Display" window you can define the display content in permanent operation (after startup) and the direction of the receiver's 7-segment display.

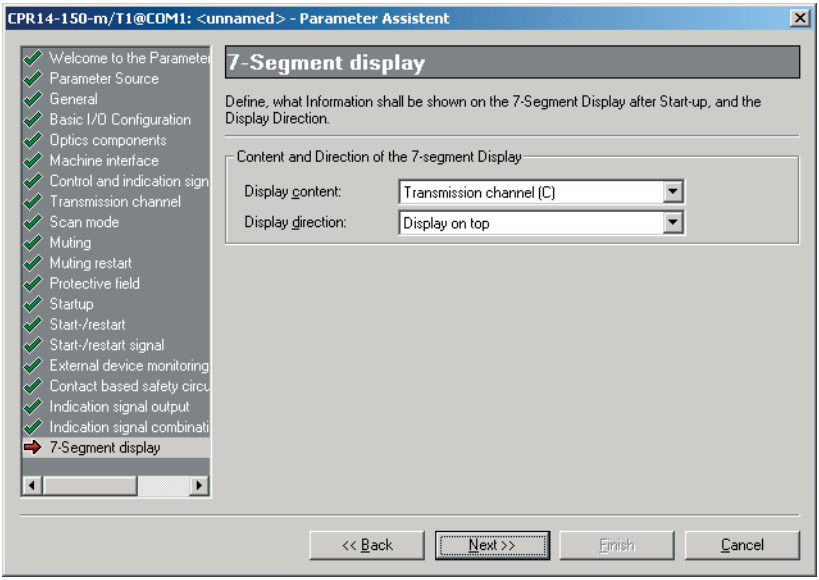


Bild 7.22-1: "7-Segment Display" window

Element	Description
Display content	
Transmission channel (C)	The transmission channel is displayed (C1 or C2).
MulitScan factor (H)	The number of scans in multiple scanning is displayed.
Effective resolution (rr)	The effective resolution of the protective field is displayed in mm. For cascaded devices, the effective resolution of the host is displayed. It depends on the physical resolution (14, 30, 50, 90 mm) and how that is reduced by the functions "Floating Blanking" and "Reduced Resolution" (see Chapter 8). If the effective resolution is > 99 mm, "rr" is displayed.

Element	Description
Operating mode (P)	The currently set operating mode is displayed (only available for receivers with the function package "Initiation". The meanings of the abbreviations are as follow • P0: Guard operation • P1: Single-break operation • P2: Double-break operation . . . • P8: 8-break operation
Bus address (A)	Only for devices with PROFIsafe interface: The PROFIBUS address (1 ... 126), that can be set by switches in the connection cap, is displayed.
Parameter set (c)	Only for devices with PROFIsafe interface: The number of the parameter set, that is selected by the safety PLC, is displayed. The parameter set can be changed during operation. It will be loaded by the Proxy-FB LG_PROXY in the device. Changes of the parameters by SafetyLab or SafetyKey are taken over by the safety PLC.
Display direction	
Display on top	Aligns the 7-segment display so that the display is positioned on top.
Display on the bottom	Aligns the 7-segment display so that the display is positioned on the bottom.

The "Parameter Destination" window appears.

➢ Download the parameter set in the safety device and/or save it on a data carrier; see Chapter 6.5.2 "Transferring a Parameter Set to the Safety Device and to a File".

7.23 "AOPD Response Time" Window

The "AOPD Response Time" window shows the response time of the receiver as well as its composition made up of the part of the protective field and the internal evaluation. The time for the internal evaluation is required with devices with PROFIsafe interface when calculating the safety distance. You will find details on the calculation in the COMPACT-plus/PROFIsafe Connecting and Operating Instructions.

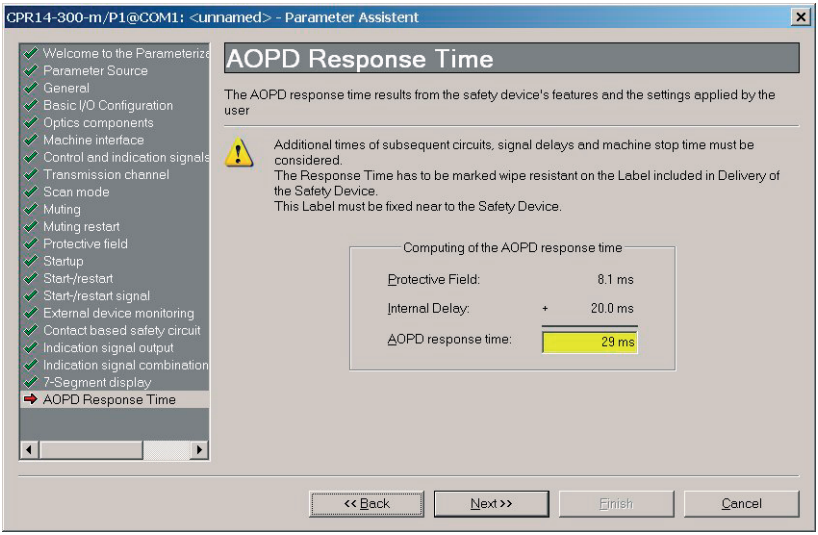


Bild 7.23-1: „AOPD Response Time“ Window“

If the "floating blanking" function is used in the protective field, the response time cannot be calculated only from the device's parametering. Please then use the information for calculating the response time in Chapter 7.11.4. SafetyLab displays a corresponding message.

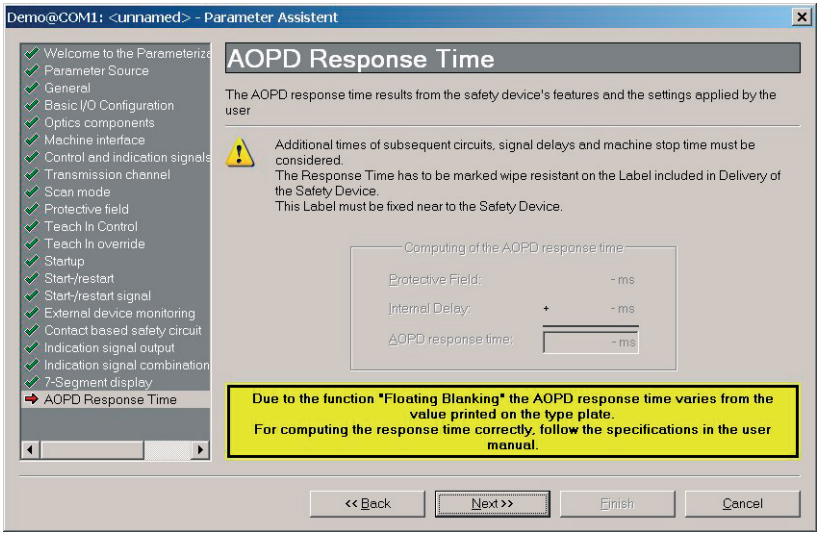


Bild 7.23-2: „AOPD Response Time“ window with the use of floating blanking

In this case the receiver shows "t-" as unknown response time with the start-up.

8 Function Package "Blanking"

8.1 General Information

The "Blanking" function package includes the standard functions as described in Chapter 7 as well as the additional option of teaching in the objects to be blanked. The following types of beam parametering are possible:

- Fixed blanking, see Chapter 7.10 "Fixed Blanking"
- Floating blanking, see Chapter 7.11 "Floating Blanking"
- Reduced resolution, see Chapter 7.12 "Reduced Resolution"
- Beam signal, see Chapter 7.13 "Beam Signals"

The protective field display area for the function package "Blanking" has the following appearance:

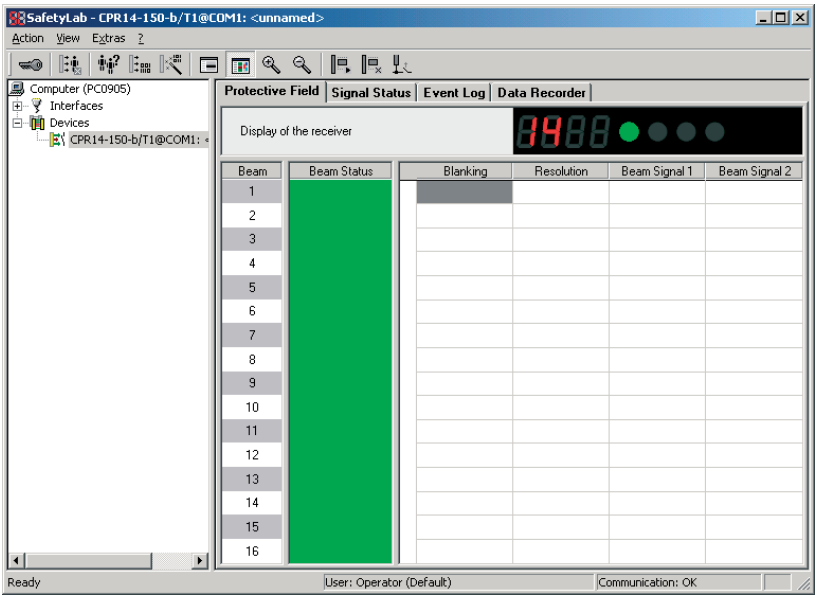


Bild 8.1-1: User interface for the function package "Blanking"

After the display area is switched to the display mode "Beam Status and Parameterization", in addition to the beam status, four columns are available to display protective field parameters (Blanking, Resolution, Beam Signal 1 and Beam Signal 2). Move the mouse pointer to a desired beam zone to display its properties. For a more detailed description, see Chapter 7.9 "Protective Field Editor".

The following icons and menu items are available in the function package "Blanking" as described in Chapter 3.3.

Icon	Function
	Performs teach-in for a protective field. Corresponds to the menu item *Action > Device Command > Teach-in Protective Field* ; see Chapter 8.3.1 and Chapter 8.4.1.
	Deletes a protective field programmed with teach-in. Corresponds to the menu item *Action > Device Command > Delete Taught-in Protective Field* ; see Chapter 8.3.2 and Chapter 8.4.2.

8.2 Basic I/O Configuration

In the "Basic I/O Configuration" window, which appears after the "General" window, you can select one or two optional safety circuits.

The receiver has two local inputs L3 and L4, which are designed for connecting contact-based safety circuits (for example guard door interlocks).

Note!

As soon as the Basic I/O Configuration is changed, some parameters of functions that depend on the Basic I/O Configuration are reset to their default values. You should therefore be especially careful in checking the parameterization if you will make subsequent changes to the Basic I/O Configuration.

Parameterization of receivers with the function package "Blanking" is performed as described in Chapters 6 and 7. Windows that appear after the "Scan Mode" window (Chapter 7.7) in the Assistant are described below.

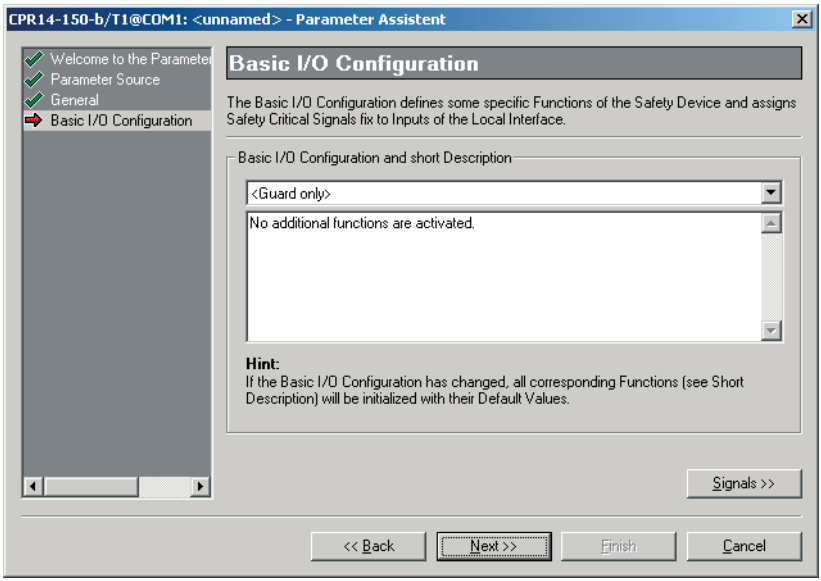


Bild 8.2-1: "Basic I/O Configuration" window

Element	Description
Basic I/O Configuration	
<Guard only>	No signal assignment is defined for functions.
Safety circuit (1-channel)	One additional 1-channel safety circuit is connected to L4. For explanations on functionality, see Chapter 7.19. For information on the connection diagram for safety circuit, see Chapter 11.2.3.
Safety circuit (2-channel)	One additional 2-channel safety circuit is connected to L3 and L4. Explanations on functionality see Chapter 7.19. For information on the connection diagram for safety circuit, see Chapter 11.2.1.
Two safety circuits (1-channel)	Two additional 1-channel safety circuits are connected to L3 and L4 respectively. Explanations on functionality see Chapter 7.18. For information on the connection diagram for safety circuits see Chapter 11.2.2.
Short description	A brief description of the corresponding Basic I/O Configuration.

8.3 Fixed Blanking

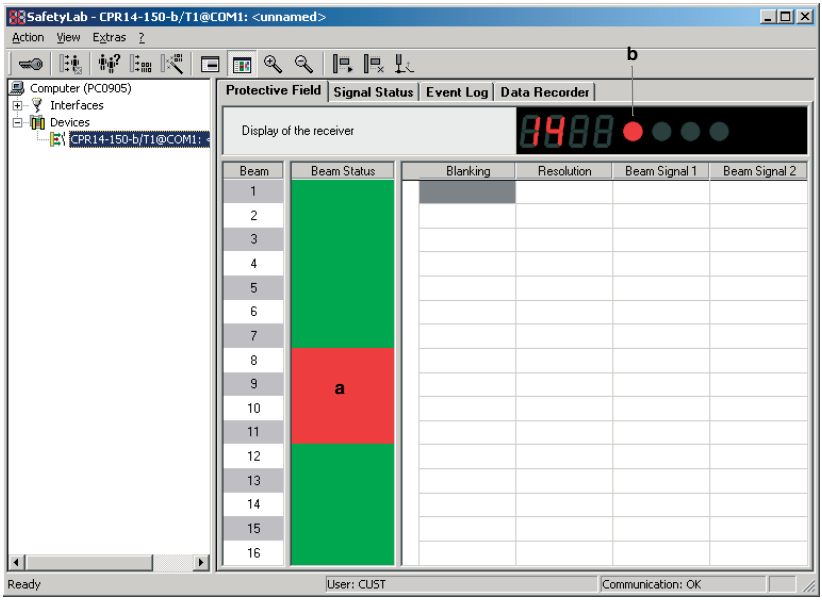
8.3.1 Fixed Blanking Teach-in

Teaching in blanking areas is only supported in the "Blanking" function package and is not performed via the protective field editor, but rather directly via the diagnostics window of the selected device. The "Authorized customer" login is required for this.

Proceed as follows:

➢ Select the connected safety device in the tree structure.
➢ Select the "Protective Field" tab card to display the protective field in the display area; see Fig. 5.2-1.
➢ Move the desired object into the protective field.

The beam zone is first marked red.



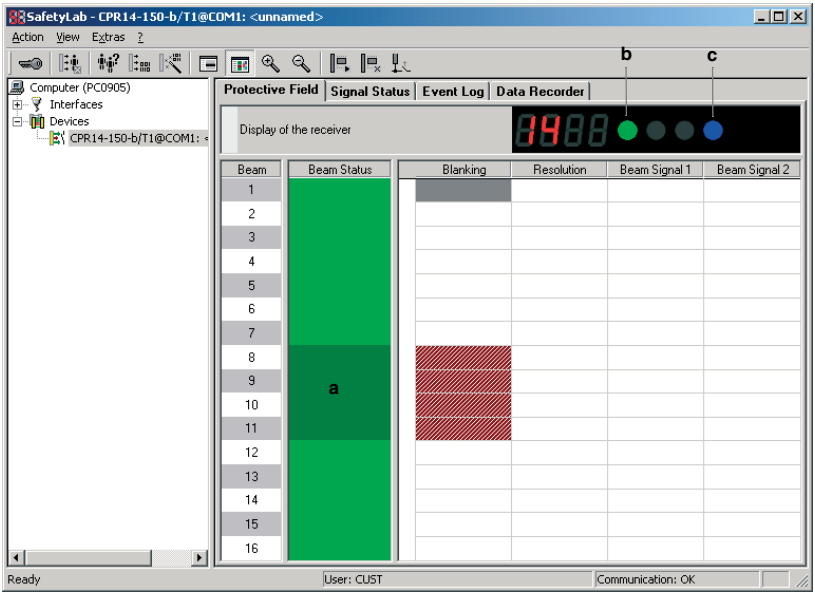
a = red: Object in the protective field before Teach-in
b = red LED

Bild 8.3-1: Object in the protective field

➢ Select the menu item *Action > Device Command > Protective Field Teach-in* or click on the corresponding icon.

The blue LED in the receiver display flashes and a message box with a button appears on the screen. Press the ENTER key or click on the button to end the Teach-in process.

Teach-in is performed for the blanked zone and the zone is shown with shaded criss-cross lines in the "Blanking" column. Since the interrupted beams in the blanking zone now correspond to the beam parameterization, this area is shown in dark green. The blue LED is continuously lit if at least one beam has been blanked out.



a = dark green: Permissible object in a permissible position
b = green LED
c = blue LED

Bild 8.3-2: Blanked zone taught in

Note!

You can teach in any number of zones of any size with the exception of beam 1. Teach-in zones that were already created are lost during this process and must be recreated again each time.

8.3.2 Deleting Taught-in Blanking Zones

➢ Select the menu item *Action > Device Command > Delete Taught-in Protective Field* or click on the corresponding icon.

All taught-in blanking zones are deleted. Parameterized protective field zones (see Chapter 7.10.2), on the other hand, cannot be deleted in the diagnostics window. They must be changed or deleted in the Protective Field Editor.

8.4 Floating Blanking

8.4.1 Floating Blanking Teach-in

Proceed as follows:

Create a beam zone

➢ Select [Change...] in the "Protective Field" window of the Assistant or Expert (see Fig. 7.8-1) to open the Protective Field Editor.

➢ In the "Blanking" column, create the beam zone where you will perform Teach-in for floating blanking; see Chapter 7.9.4 "Adding Beam Zones".

➢ In the window for selecting the properties of the beam zone, select the "Floating blanking can be taught in" radio button and confirm with [OK]; see Fig. 7.9-2.

➢ Transfer the parameter set to the connected safety device.

Blanking teach-in

➢ Select the connected safety device in the tree structure.

➢ Select the "Protective Field" tab card to display the protective field in the display area; see Fig. 5.2-1.

The defined teach-in zone is displayed with hatched lines.

➢ Place the movable object in this zone. The object appears in red in the "Beam Status" field.

➢ Select the menu item *Action > Device Command > Protective Field Teach-in,* or click on the popup menu of the same name or the appropriate icon.

➢ Place the object inside the hatched beam zone. The receiver records both the size of the object and the actual beam zone of motion within which the object resides. The permissible size tolerance is "-1 beam" or the dimension derived from that.

➢ Confirm the dialog to exit the teach-in process. Teach-in is complete for the object and it appears in dark green in the "Beam Status" field.

➢ The display of the effective resolution changes as shown in Table 7.11-1, for example from "14" to "19". The beam zone available for teach-in appears in the "Blanking" column in light gray with hatched lines. The beam zone that is actually being used appears in dark red with hatching.

8.4.2 Deleting Taught-in Blanking Zones

➢ Select the menu item *Action > Device Command > Delete Taught-in Protective Field,* or click on the popup menu of the same name or the appropriate icon.

All taught-in blanking zones are deleted.

8.5 "Teach-in Control" window

In addition to teach-in a protective field with SafetyLab it is also possible to teach in the protective field during operation with the SafetyKey or key button on the receiver.

You can define the parameters for the hardware-controlled teach-in process in the "Teach-in Control" window.

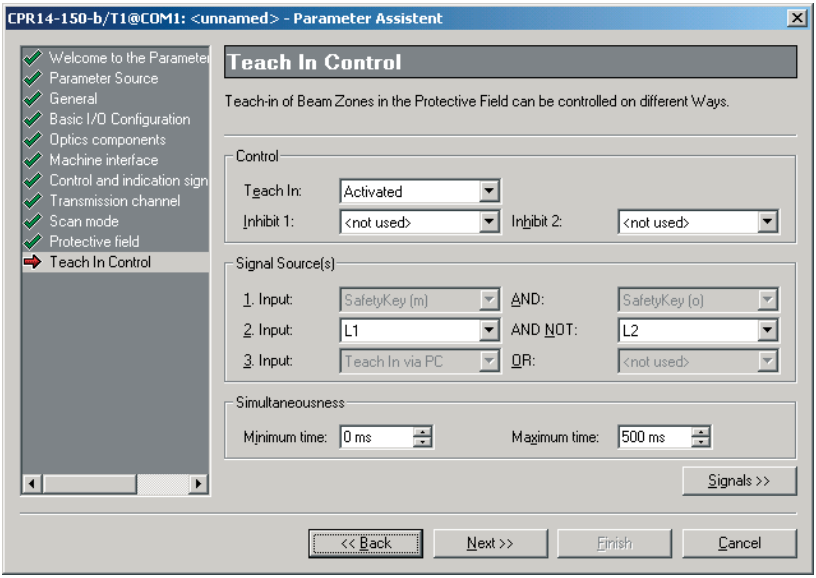


Bild 8.5-1: "Teach-in Control" window

➢ Select the appropriate parameter from the dropdown lists.

Element	Description
Control	
Teach-in	Activates/deactivates teach-in. In the deactivated state, parameterization of blanking zones can only be performed with SafetyLab.
Inhibit 1 Inhibit 2	Prevents teach-in via the signal source(s) if log. 1 is present here.
Signal source(s)	
2. input	Signal inputs for an antivalent switching key button. Both signals must be switched antivalently within the time defined below as simultaneousness to trigger teach-in. Within this same time window, you must have switched back to the original position to correctly terminate the teach-in process, thus ensuring the values from teach-in will be accepted.
Simultaneousness	
Minimum time	The minimum time that must elapse between activation of the AND-linked signals.
Maximum time	The maximum time that may elapse between activation of the AND-linked signals.

The OSSDs switch off during teach-in of fixed and floating blanking, since the protective field parameters to be taught in are not known before the teach-in process is complete.

Note!

The "Inhibit" signals can be returned from a standard PLC or a key switch in the cabinet, for example, since they are used in addition to the safety-related control inputs.

8.6 "Teach-in Override" window

The Teach-in Override function switches the OSSD safety output on during teach-in. It is required for teach-in of large movable objects if it is not possible to move the objects manually and the machine must perform the motion. Teach-in Override can only be turned on during teach-in.

In the "Teach-in Override" window you can define the signal inputs through which the safety function will be bypassed for a short time. To do this, an additional key button with two antivalent switching levels must be connected. This button triggers the bypass. The changeover of both switching levels must take place within 0.5 s.

Warning!

While the safety function is bypassed, the safety of personnel must be ensured by appropriate other means.

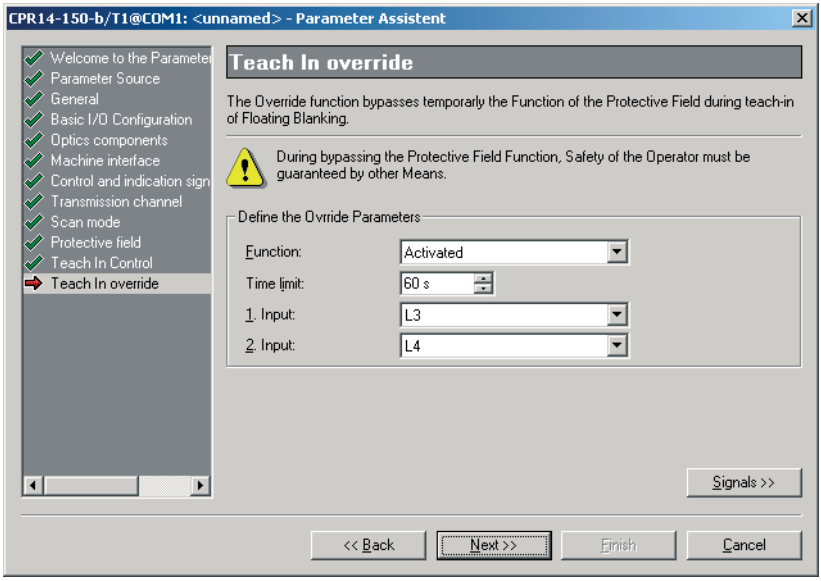


Bild 8.6-1: "Teach-in Override" window

Element	Description
Function	Activates or deactivates the bypass function. FS: Activated
Time limit	The time during which the safety function can be bypassed while it is controlled by signals on the two inputs (FS: 60 s).
1. input	The input to which a switching level of the key button is connected for activating the bypass function. 0V is expected here in the idle setting, 24V after switching on.
2. input	The input to which the second switching level of the key button is connected for activating the bypass function. 24V is expected here in the idle setting, 0V after switching on.

For teach-in of large movable objects in the protective field, proceed as follows:

➢ Move the teach-in object into the protective field.

➢ Start teach-in.

➢ Activate the Teach-in Override function → the OSSDs are turned on.

➢ If the start/restart interlock is located in a downstream safety interface, it must be unlocked here by pressing and releasing the start button.

The machine now performs one work stroke. This enables the receiver to learn the object's size and range of motion.

➢ Terminate the teach-in process first by deactivating teach-in override and then teach-in.

Teach-in has been successfully completed for the new protective field parameters if the blue LED of the receiver is lit.

Teach-in Override does turn the OSSD safety switch output on temporarily, but it does not unlock the internal start/restart interlock if it is activated. The start button must therefore be pressed after teach-in to start the machine.

9 Function Package "Muting"

9.1 General Information

The function package "Muting", contains the standard functions as described in Chapter 7 and also offers the option of "muting" the protective field. "Muting" designates the proper suppression of the protective field safety function for a limited time (for example to move materials through the protective field). The muting version of the receiver or transceiver makes it possible to connect up to four muting sensors and optionally a number of monitored muting indication lamps. The muting indicator shows to staff members by being continuously lit that muting operation has been correctly initiated and the protective field safety function is bypassed.

Note!

A muting indicator must be connected in all muting modes as long as the monitoring function has not been deselected with SafetyLab.

Muting operation is initiated by at least two independent muting sensors.

Criteria for initiating muting operation might include:

- Order of sensor activation
- Time expectation of sensor activation

Warning!

During muting operation the protective field safety function is inactive.
Take preventive measures to ensure the safety of employees during this time.

The function package "Muting" offers the following options:

- Bypassing a safety device for a limited time (several types of muting)
- Deselectable muting indicator monitoring
- Additional control signals for muting
- Filtering of muting sensor signals
- Releasing the muting station with muting restart
- Optionally controllable muting time limit
- For information on defining a beam zone with reduced resolution, see Chapter 7.12 (for Safety Light Curtains only)
- For information on defining Beam Signals, see Chapter 7.13 (for Safety Light Curtains only)

The protective field display area for Safety Light Curtains with the function package "Muting" is shown below:

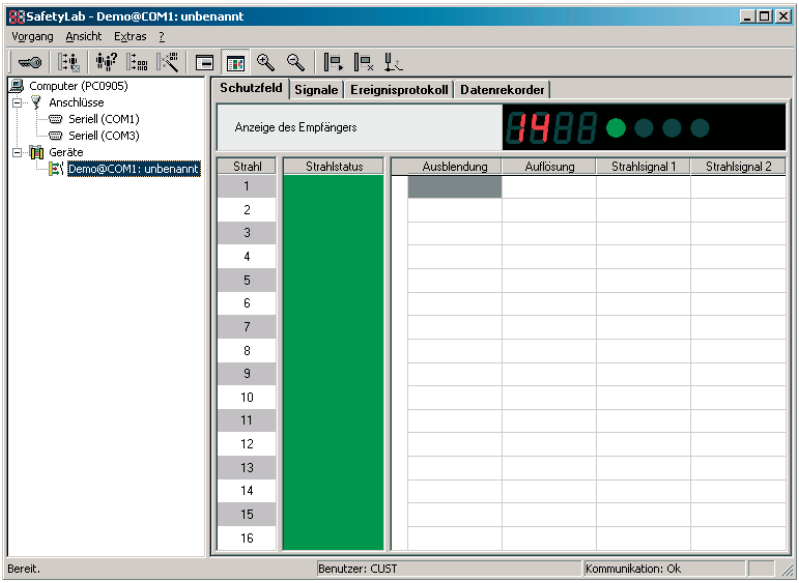


Bild 9.1-1: User interface for the function package "Muting"

In the "Beam Status and Parameterization" display mode, in addition to the beam status the columns "Resolution", for displaying protective field areas with reduced resolution, and "Beam signal 1" and "Beam signal 2" are available in the display area. These columns do not exist for multiple light beam safety devices and muting transceivers.

9.2 Hardware Requirements

Muting operation requires:

- The muting version of the receiver with connection option for external signal lines
- At least 2 muting sensors
- One muting indication lamp
- A push button for unlocking the restart interlock and for release after a fault

Depending on the design of the device, the following different types of connections are possible for muting sensors and the start button/muting lamp:

- Direct connection to local socket
- Local connection field integrated into the safety device
- Local connection box (to connected local socket)

Note!

Connection diagrams; see Chapter 11.2.

Muting sensors

You can connect a maximum of 4 binary switching muting sensors (MS1...MS4) to the receiver. Muting sensors can be, for example:

- Light barriers with beams crossing behind the protective field of the safety device in the hazardous zone
- Light barrier(s) and a feedback signal from the conveyor drive or a PLC signal, as long they are activated simultaneously or in the expected sequence
- Signals of induction loops that are activated by a fork lift, for example
- Light scanners that scan the packages or pallets as they are fed in
- Inductive proximity sensors

9.3 Basic I/O Configuration

The following selection is available in the "Basic I/O Configuration" window of the Assistant or Expert.

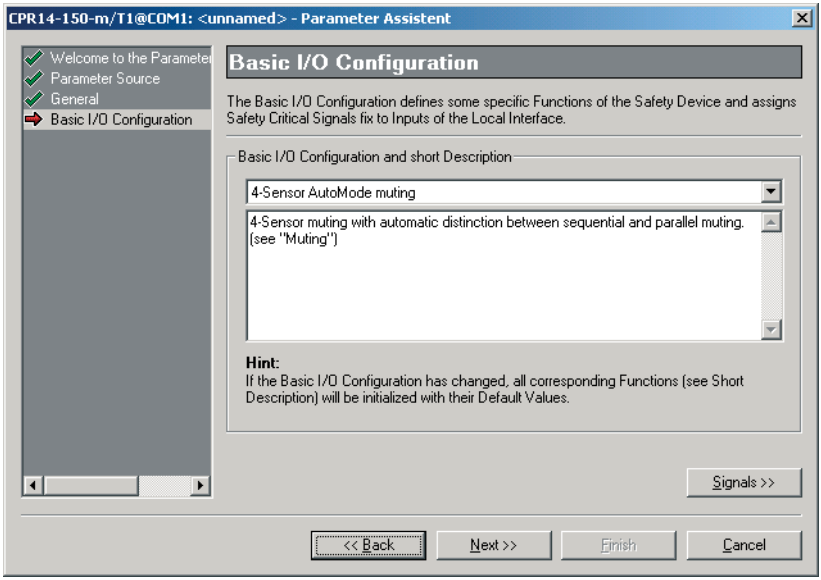


Bild 9.3-1: "Basic I/O Configuration" window

Basic I/O Configuration	Description
<Guard only>	No signal assignment for functions is defined for functions.
2-sensor parallel muting (L1, L2)	2-sensor parallel muting is activated; see Chapter 9.5.6. For information on the connection diagram for muting sensors, see Chapter 11.2.7.

Basic I/O Configuration	Description
2-sensor parallel muting (L1, L2) Safety circuit (1-channel)	2-sensor parallel muting is activated; see Chapter 9.5.6. One additional single-channel safety circuit is connected; see Chapter 7.19. For information on the connection diagram for muting sensors and safety circuit, see Chapter 11.2.10.
2-sensor parallel muting (L1, L2) Safety circuit (2-channel)	2-sensor parallel muting is activated; see Chapter 9.5.6. One additional 2-channel safety circuit is connected; see Chapter 7.19. For information on the connection diagram for muting sensors and safety circuit, see Chapter 11.2.8.
2-sensor parallel muting (L1, L2) Two safety circuits (1-channel)	2-sensor parallel muting is activated; see Chapter 9.5.6. Two additional 1-channel safety circuits are connected; see Chapter 7.19. For information on the connection diagram for muting sensors and safety circuits, see Chapter 11.2.9.
2-sensor parallel muting (L1, M5)	2-sensor parallel muting is activated; see Chapter 9.5.6. For information on the connection diagram for muting sensors, see Chapter 11.2.11.
2-sensor parallel muting (L1, M5) Safety circuit (1-channel)	2-sensor parallel muting is activated; see Chapter 9.5.6. One additional 1-channel safety circuit is connected; see Chapter 7.19. For information on the connection diagram for muting sensors and safety circuit, see Chapter 11.2.14.
2-sensor parallel muting (L1, M5) Safety circuit (2-channel)	2-sensor parallel muting is activated; see Chapter 9.5.6. One additional 2-channel safety circuit is connected; see Chapter 7.19. For information on the connection diagram for muting sensors and safety circuit, see Chapter 11.2.12.
2-sensor parallel muting (L1, M5) Two safety circuits (1-channel)	2-sensor parallel muting is activated; see Chapter 9.5.6. Two additional 1-channel safety circuits are connected; see Chapter 7.19. For information on the connection diagram for muting sensors and safety circuits, see Chapter 11.2.13.
2-sensor parallel muting (L3, L4)	2-sensor parallel muting is activated; see Chapter 9.5.7. For information on the connection diagram for muting sensors, see Chapter 11.2.15.
3-sensor sequential/parallel muting	3-sensor direction muting is activated; see Chapter 9.5.5. For information on the connection diagram for muting sensors, see Chapter 11.2.5.
3-sensor sequential/parallel muting; Safety circuit (1-channel)	3-sensor direction muting is activated; see Chapter 9.5.5. One additional 1-channel safety circuit is connected; see Chapter 7.19. For information on the connection diagram for muting sensors and safety circuit, see Chapter 11.2.6.

Basic I/O Configuration	Description
4-sensor AutoMode muting	4-sensor AutoMode muting is activated; see Chapter 9.5.1. For information on the connection diagram for muting sensors, see Chapter 11.2.4.
4-sensor parallel muting	4-sensor parallel muting is activated; see Chapter 9.5.2. For information on the connection diagram for muting sensors, see Chapter 11.2.4.
4-sensor (unidirectional) parallel muting	4-sensor directional parallel muting is activated; see Chapter 9.5.3. For information on the connection diagram for muting sensors, see Chapter 11.2.4.
4-sensor sequential muting	4-sensor sequential muting is activated; see Chapter 9.5.4. For information on the connection diagram for muting sensors, see Chapter 11.2.4.
Safety circuit (1-channel)	One additional 1-channel safety circuit is connected. For explanations on functionality, see Chapter 7.19. For information on the connection diagram for safety circuit, see Chapter 11.2.3.
Safety circuit (2-channel)	One additional 2-channel safety circuit is connected. For explanations on functionality, see Chapter 7.19. For information on the connection diagram for safety circuit, see Chapter 11.2.1.
Two safety circuits (1-channel)	Two additional 1-channel safety circuits are connected. For explanations on functionality, see Chapter 7.19. For information on the connection diagram for safety circuits see Chapter 11.2.2.

9.4 Time Definitions for Muting

The following time definitions are used in the types of muting described below.

Designation	Definition
TMSsi	The required minimum delay time between two successive muting sensor signals in sequential mode. Can be set in the "Muting" window under the "Muting Sensors" parameter; see Chapter 9.8. FS: 0 ms
TMSpi	The minimum time that must elapse between the two simultaneously expected muting sensor signals in parallel mode. Can be set in the "Muting" window under the "Muting Sensors" parameter; see Chapter 9.8. FS: 0 ms

Designation	Definition
TMSpx	Has the following meanings: 1. The maximum time that may elapse between the two simultaneously expected muting sensor signals in parallel mode. 2. The maximum time that a muting sensor may drop out of operation in parallel mode without muting operation being terminated. TMSpx is included in the definition of t3; see below. Can be set in the "Muting" window under the "Muting Sensors" parameter; see Chapter 9.8. FS: 2500 ms
TMlim	The time after which muting is ended independently of the muting operating mode that is selected (muting time limit). Can be set in the "Muting" window; see Chapter 9.8. FS: 10 min
t1	The delay after which muting operation starts after the sensor conditions for the start of muting are met. Delay t1 is the total of hardware and firmware-related delays (< 40 ms) and the on time of all sensors involved. Can be set in the "Control and Indication Signals" window; see Chapter 7.5; FS: 0 ms
t2	The delay after which muting operation ends after the sensor conditions for the end of muting are met. Delay t2 is the total of hardware and firmware-related delays (< 40 ms) and the off time of all relevant signal. Can be set in the "Control and Indication Signals" window; see Chapter 7.5; FS: 100 ms
t3	The time between two successive muting sensor signals as defined by TMSpi and TMSpx: TMSpi ≤ t3 ≤ TMSpx

Muting time limit

If muting operation is activated for longer than the changeable time TMlim (FS: 10 min), it will be terminated with fault message E50 regardless of the muting operating mode that was selected. The OSSDs switch into the OFF state. If the parameter interface is not occupied by MagnetKey or SafetyKey, the receiver automatically resets itself after about 10 seconds. If a PC is connected with SafetyLab via the optical PC adapter, the reset must be performed with SafetyLab (see Chapter 3.3). Muting is not started again until after restarting and introducing a valid muting sequence.

The muting time limit is mandatory. Muting time limit must only be turned off in legitimate cases (for example if the flow of material is uninterrupted). The value to set with the "Muting" window is 00:00:00. Every effort must be made to prevent injury to persons. If it is possible that conveyor material could remain in the muting zone for a long time, the muting time limit should not be lowered. Instead, the control input for the muting time limit (see Chapter 9.6.2) should be linked with a belt drive signal.

Warning!

When the muting time limit is turned off, the user has the responsibility for using other suitable measures to prevent access to hazardous places.

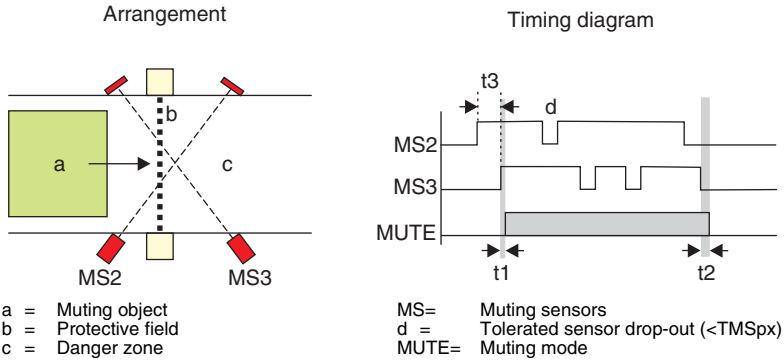
9.5 Muting Operating Modes

The Muting operating mode is selected in the "Basic I/O Configuration" window, in some cases together with a connected safety circuit. This assigns the individual muting sensor inputs MS1 ... MS4 to inputs L1 ... L4, M5 or to a subset thereof. The factory setting is 4-sensor AutoMode muting. With the correct initiation of muting, the muting indicator is switched on (if it is parameterized) and permanently monitored (if it is parameterized for that).

9.5.1 4-Sensor AutoMode Muting

With 4-sensor AutoMode muting, the system determines automatically whether parallel muting or sequential muting will be introduced. The 4 muting sensors are connected according to Chapter 11.2.4.

If one of the sensors MS2 or MS3 is activated first, parallel muting is introduced.



a = Muting object
b = Protective field
c = Danger zone

MS= Muting sensors
d = Tolerated sensor drop-out (<TMSpx)
MUTE= Muting mode

Bild 9.5-1: AutoMode muting, parallel muting introduced (example)

For information on time definitions, see Chapter 9.4.

Parallel muting is activated if both muting sensors MS2 and MS3 are activated simultaneously within time t3.

The time t3 between the activation of MS2 and MS3 must fall between a minimum time (TMSpi) and a maximum time (TMSpx).

Muting is terminated if:

- MS2 and MS3 are simultaneously inactive and time t2 has elapsed.
- MS2 or MS3 are inactive longer than TMSpx.

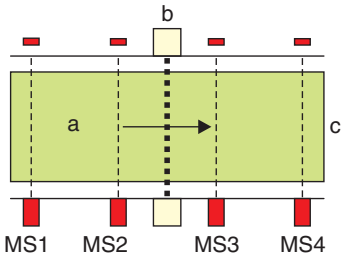
Brief dropout (d) of signals from MS2 or MS3 (not simultaneously), falling within TMSpx is tolerated.

Warning!

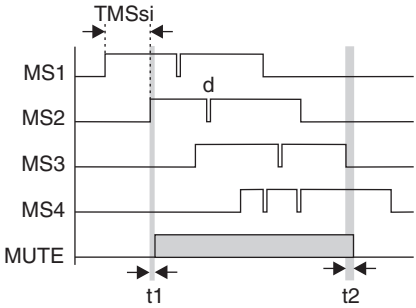
To prevent easy manipulation, the crossing point of the muting sensor light barriers must be located sufficiently far inside the danger zones. If possible, the beams should run diagonally at different heights from higher to lower.

If MS1 or MS4 is activated as the first sensor, sequential muting is initiated.

Arrangement



Timing diagram



a = Muting object
b = Protective field
c = Danger zone

MS= Muting sensors
d = Tolerated sensor drop-out (<t2)
MUTE= Muting mode

Bild 9.5-2: AutoMode muting, sequential muting introduced (example)

For information on time definitions, see Chapter 9.4.

The following sequences of signals are possible (both travel directions of the muting object):

- MS1 - MS2 - MS3 - MS4
- MS4 - MS3 - MS2 - MS1

All muting sensors must be activated in the specified order with a minimum delay time > TMSsi between the signals.

All 4 sensors must be active simultaneously for a short time for muting to be taken over to the second side. Otherwise muting operation will be terminated prematurely. The distance between MS1 and MS4 must therefore be less than the length of the muting object.

Muting is correctly terminated when the third muting sensor to be activated according to the expected order (MS3 or MS2) is inactive and t2 has elapsed. Before a new muting sequence can be introduced, all muting sensors must be inactive.

Brief drop-out of the signals from MS1, MS2, MS2 or MS4 that fall within t2 are tolerated.

9.5.2 4-Sensor Parallel Muting

4-Sensor parallel muting requires 4 muting sensors to be connected (see Chapter 11.2.4). It is especially useful in cramped conditions with light scanners or inductive proximity sensors. Muting operation is introduced if either MS2 and MS3 or MS1 and MS4 are activated simultaneously in parallel mode. Time t3 between the activation of MS2 and MS3 or MS1 and MS4 must fall between a minimum time (TMSpi) and a maximum time (TMSpx).

For information on time definitions, see Chapter 9.4.

Muting is terminated when both sensor pairs MS2 and MS3 plus MS1 and MS4 are inactive and time t2 has elapsed.

Brief dropout of signals from MS2 or MS3 (not simultaneously), falling within TMSpx is tolerated. The same applies to the sensor pair MS1/MS4.

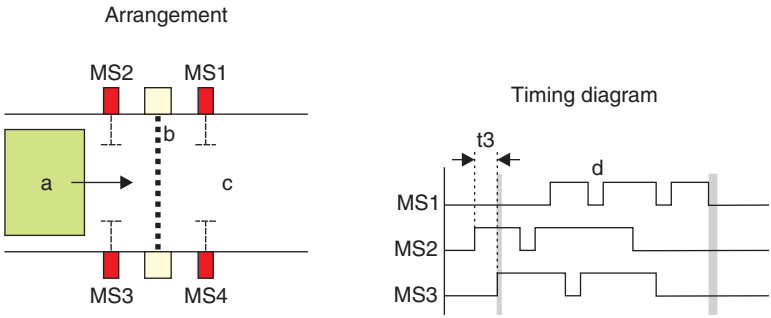


Bild 9.5-3: 4-sensor parallel muting (example)

From firmware version 5.02 it is easy to dynamically restrict the Muting area in the protective field of Safety Light Curtains (not Multiple Light Beam Safety Devices with 2 to 4 beams) with parallel Muting (see chapter 9.6.1). Depending on the traveling direction, various freely definable beam zones are excluded here from the Muting function; the protective function also remains active here during the Muting. The following assignment applies here:

- If Muting is started with the MS2||MS3 sensor pair, the beams that are seized with beam signal 1 remain active.
- If Muting is activated with the MS1||MS4 sensor pair, the beams that are seized with beam signal 2 remain active.

Once the beam signal is selected, it remains active for this Muting cycle. The traveling direction and with it the beam signal to be monitored are only determined again with the next object moving in. It is possible to seize beams with both beam signal 1 and with beam signal 2 and consequently exclude them permanently from the Muting. Synchronization beam 1 must be free with the use of partial Muting.

Warning

Partial Muting extends the response time by 40 ms.

9.5.3 4-Sensor Direction Parallel Muting

4-sensor direction parallel muting works like 4-sensor parallel muting. In this case, however, only one direction of motion of the muting object is permitted. Sensor pair MS2/MS3 start muting operation and sensor pair MS1/MS4 ends it.

9.5.4 4-Sensor Sequential Muting

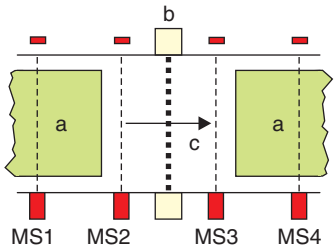
4-sensor sequential muting requires 4 muting sensors to be connected (see Chapter 11.2.4). They must also be activated in a specified order. Muting is initiated after the second sensor is activated. The following two sequences of signals are possible (both travel directions of the muting object):

- MS1 - MS2 - MS3 - MS4
- MS4 - MS3 - MS2 - MS1

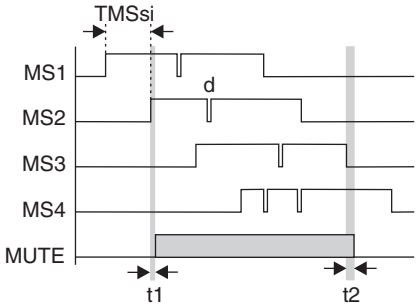
Muting is terminated when the third muting sensor to be detected according to the expected order (MS2 or MS3) is inactive and t2 has elapsed. Brief drop-out of the signals from MS1, MS2, MS2 or MS4 that fall within t2 are tolerated.

The difference compared to sequential muting AutoMode (Chapter 9.5.1) is that a second object can start a new muting cycle and activate MS1 (or MS4) as long as the first object is still in the muting zone and MS3 and MS4 (or MS1 and MS2) are still activated. It is therefore especially suitable for muting objects that follow closely one after the other and between which there is always at least one muting sensor free at any time. For information on time definitions, see Chapter 9.4.

Arrangement



Timing diagram



a = Muting object
b = Protective field
c = Danger zone

MS= Muting sensors
d = Tolerated sensor drop-out (<t2)
MUTE= Muting mode

Bild 9.5-4: 4-sensor sequential muting (example)

From firmware version 5.02 it is easy to dynamically restrict the muting area in the protective field of Safety Light Curtains (not Multiple Light Beam Safety Devices with 2 to 4 beams) with parallel Muting (see chapter 9.6.1). Depending on the traveling direction, various freely definable beam zones are excluded here from the Muting function; the protective function also remains active here during the muting. The following assignment applies here:

- If Muting is started with the MS1 sensor, the beams that are seized with beam signal 1 remain active.
- If Muting is activated with the MS4 sensor, the beams that are seized with beam signal 2 remain active.

Once the beam signal is selected, it remains active for this Muting cycle. The traveling direction and with it the beam signal to be monitored are only determined again with the next object moving in.

It is possible to seize beams with both beam signal 1 and with beam signal 2 and consequently exclude them permanently from the Muting.

Synchronization beam 1 must be free with the use of partial Muting. .

Warning!

Partial Muting extends the response time by 40 ms.

9.5.5 3-Sensor Sequential/Parallel Muting

3-sensor sequential/parallel muting has features of both sequential and parallel muting. It requires 3 muting sensors to be connected (see Chapter 11.2.5). Muting operation is initiated if the following signal sequence is maintained:

- MS1 is activated (defines the direction of motion).
- MS2 or MS3 is activated no earlier than after TMSsi.
- The time t3 between the activation of MS2 and MS3 must fall between a minimum time (TMSpi) and a maximum time (TMSpx).
- Then MS1 can be deactivated again.

For information on time definitions, see Chapter 9.4.

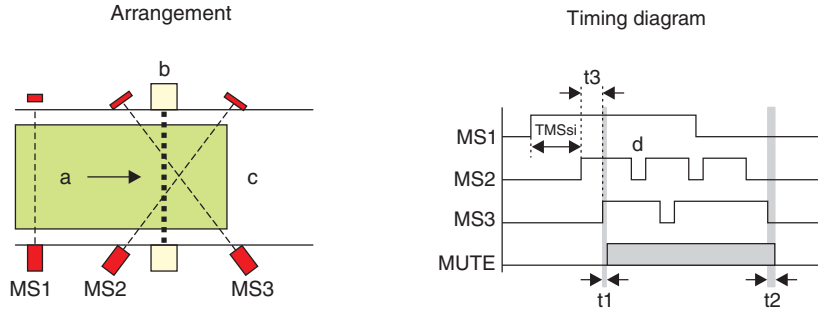
Muting is terminated when MS1, MS2 and MS3 are inactive and time t2 has elapsed.

Brief dropout of signals from MS1 that fall within t2 and MS2 or MS3 (not simultaneously), falling within TMSpx are tolerated.

Warning!

To prevent easy manipulation, the crossing point of the muting sensor light barriers must be located sufficiently far inside the hazardous zones. If possible, the beams should run diagonally at different heights from higher to lower.

Before a new muting sequence is introduced, all muting sensors MS1...MS3 must have been inactive.



a = Muting object
b = Protective field
c = Danger zone

MS= Muting sensors
d = Tolerated sensor drop-out (<TMSpx)
MUTE= Muting mode

Bild 9.5-5: 3-sensor direction muting (example)

9.5.6 2-Sensor Parallel Muting

2-sensor parallel muting requires 2 muting sensors to be connected (see Chapter 11.2.11). Muting operation is initiated when MS2 and MS3 are activated. The time t3 between the activation of MS2 and MS3 must fall between a minimum time (TMSpi) and a maximum time (TMSpx).

For information on time definitions, see Chapter 9.4.

Muting is terminated if:

- MS2 and MS3 are inactive.
- MS2 or MS3 are inactive longer than TMSpx.

Brief dropout of signals from MS2 or MS3 (not simultaneously), falling within TMSpx is tolerated.

Warning!

To prevent easy manipulation, the crossing point of the muting sensor light barriers must be located sufficiently far inside the hazardous zones. If possible, the beams should run diagonally at different heights from higher to lower.

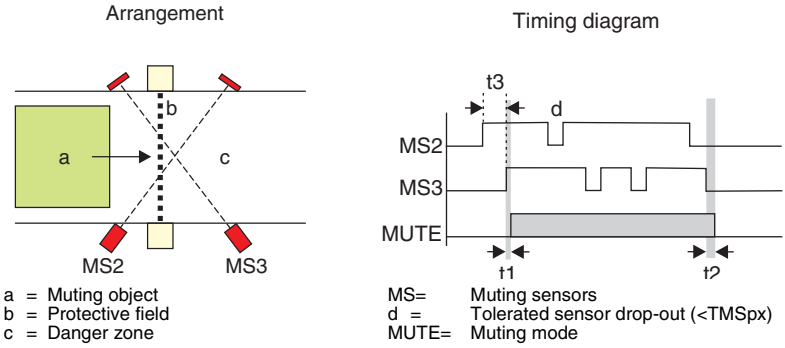


Bild 9.5-6: 2-sensor parallel muting (example)

Depending on the basic configuration that is selected, signal inputs L1 and L2 or L1 and M5 are used as muting sensor inputs MS2 and MS3.

9.5.7 2-Sensor Parallel Muting (L3, L4)

The 2-sensor parallel muting described in Chapter 9.5.6 assigns inputs L1 and L2, or L1 and M5. Since in both muting operating modes L3 and L4 are not used, they can be combined with contact-based safety circuits, which must always be connected L3 and L4. Signal L2 is parameterized as an input in this muting operating mode, but it is also able to work as an output or as an input and output simultaneously (see Chapter 7.5 "Control and Indication Signals"). In some applications, an additional output signal is required on the local interface in addition to L5 (for control of the muting indicator), for example to control lighting of a start button. The "2-sensor parallel muting" mode (L3, L4) can be used for this purpose. The difference compared to 2-sensor parallel muting as described in Chapter 9.5.6 is that muting sensors MS2 and MS3 are connected to signal lines L3 (MS2) and L4 (MS3) instead of to L1 and L2. L1 and L2 are thus available for other functions. Another advantage is that in some cases the tristate test can be added to the circuit, thus covering short circuits between the signal lines. The restriction of cable length to 0.5 m specified in the Connecting and Operating Instructions for the device when connected to the local socket is no longer in effect. Otherwise, 2-sensor parallel muting (L3,L4) works adequately for 2-sensor parallel-muting as described in Chapter 9.5.6.. Thus the signals and times specified there apply in this case as well.

9.6 Additional Muting Control

Regardless of the muting operating mode selected, additional optional control features are available for muting operation.

9.6.1 Muting Control Input and Partial Muting

An additional control input can be used to enable or inhibit muting in general. If this input is defined, a log. 1 signal must be present here to permit muting. This additional signal may come from a PLC for example, or may be a feedback signal from a conveyor drive. This generally increases the safety of the application, since muting is only possible in specific operating states of a system.

In a further application this control input can be used for the limitation of the protective field area of light curtains in which muting is permitted → partial muting. Only a part of the protective field is muted here, while other protective field areas must not be interrupted, even during the muting. For this, parameterize the permanently active part of the protective field with "Beam Signal 1" and define the signal "Beam Signal 1 - Muting disable" as muting control input by the Protective Field Editor (Chapter 7.9). An interruption of at least one beam of this protective field area removes the muting and the object in the protective field causes the OSSD to be switched off.

Synchronization beam 1 should be situated outside the muting area and not interrupted under operating conditions, as first beam interruption desynchronizes the receiver after 10 seconds and the OSSDs must switch off.

In addition to the explicit parallel Muting described here, an assignment of beam signals for the traveling direction is implicitly made in the 4-sensor parallel Muting (9.5.2) and in the 4-sensor sequential Muting, and dynamically between 2 partial Muting areas. The Muting control input is therefore available here for an additional control signal from a PLC.

To release the transportation good after an error stop (see "Muting Restart", Chapter 9.9), the permanently active non-muted part of the protective field defined by Beam Signal must be free. This protective field part can be seen as a separate light curtain with pure protective function.

An option to switchover the permanently active beam zones during runtime (= switchover of the muting area) is made possible by,

- issuing the beam signals via signal outputs or bits,
- analyzing in a higher-level control unit (PLC) and
- controlling the "muting control input" with a signal of this control unit according to the beam signals.

The switchover can be safely performed if a receiver with PROFIsafe interface is used and the controlling safety PLC evaluates in addition the OSSD bit 0.1 of the cyclic input data (must be = 1) for safety relevant decisions based on the read beam signals.

Warning!

The response time of the protective device is increased by 40 ms in addition to that caused by beam number, scan mode and machine interface type. The safety distance to the danger point has to be adapted accordingly.

9.6.2 Control Input for Muting Time Limit

If this low-active control input is activated, the operation of the timer for the muting time limit is stopped if there is a log. 1 signal on the input. The timer continues to run if the input switches to log. 0. The input can be used if operation typically involves long stop times in the flow of material. Instead of setting the time limit (FS: 10 min) to very large values, the timer should be controlled with this control input. Operation of the timer should be stopped if the flow of material stops (signal is log. 1). It should continue running without reset if the control input switches back to log. 0. Since a break in the cable is identical to the state log. 0 is (see Chapter 5.3.1), the timer runs down if an error like this occurs.

9.6.3 Muting Prolongation

In some applications muting must be extended by a fixed amount of time after the muting sensors have already terminated muting. In pure outlet applications, for example, it is possible to position 2 light scanners exclusively within the hazardous zone as muting sensors to make any simple tampering impossible. Extending muting by a fixed amount of time TMp (depending on the conveyor speed) can ensure that muting is not terminated before the conveyor material has left the protective field. Including the control input for muting enable (see Chapter 9.6.1) can further enhance safety.

Warning!

The Authorized Customer is responsible for ensuring that this option is only used if any risk to employees stemming from a potential gap in safety (for example in inlet applications) can be reliably excluded.

9.6.4 Premature End of Muting

If this function is activated, a muting cycle is terminated if:

- the muting sensor signals terminate muting (see Chapter 9.5) or
- the protective field becomes free after muting has been initiated.

This option is useful for enhancing safety if objects of different lengths must be conveyed through the muting zone on a transport carriage of constant length, especially with sequential muting. In this case, muting sensors are adjusted to the longest object. With a shorter object, muting is terminated prematurely when the protective field becomes free. To increase availability, especially for devices with a small number of beams, the delay time TMpfp can be set to values > 0. Then the end of muting is delayed after the protective field first becomes free by this set amount of time as long as the protective filed stays free for TMpfp.

Warning!

If both a delay time TMpfp and a muting prolongation time TMp (see Chapter 9.6.3) are set here, the two times must be added together to calculate the time from when the protective field becomes free until the end of muting. If muting is only terminated by the muting sensors, on the other hand, only TMp has any effect.

9.7 Muting Indicator

The muting indicator displays to staff members by being continuously lit that muting operation has been correctly initiated and is active. If the muting indicator flashes, the device is expecting a muting restart (see Chapter 9.9). In justifiable cases it may be permissible for current monitoring of the muting indicator to be deselected. If the muting indicator current monitoring is deactivated, another output other than L5 (factory setting) can be used for control. If L5 is set as muting indicator output, in addition to the number of indicators, the maximum permissible and minimum expected current in the indicator circuit on L5 as well as a current warning limit can be set. If the current value falls below this level, the internal indication signal "Undercurrent through muting indicator" is generated (see Table 7.20-1). Error messages E51 and/or E52 are generated followed by an automatic reset after 10 seconds if the current value is below or above the minimum or maximum current value in on-state.

9.8 "Muting" window

You can set the parameters for muting operation in the "Muting" window of the Assistant or Expert.

Warning!

Knowledge of the muting operation modes, control signal modes described above as well as the corresponding time definitions (TMSsi, TMSpi, TMSpx, TMSLim, t1, t2, t3) is required to make settings in the "Muting" window.

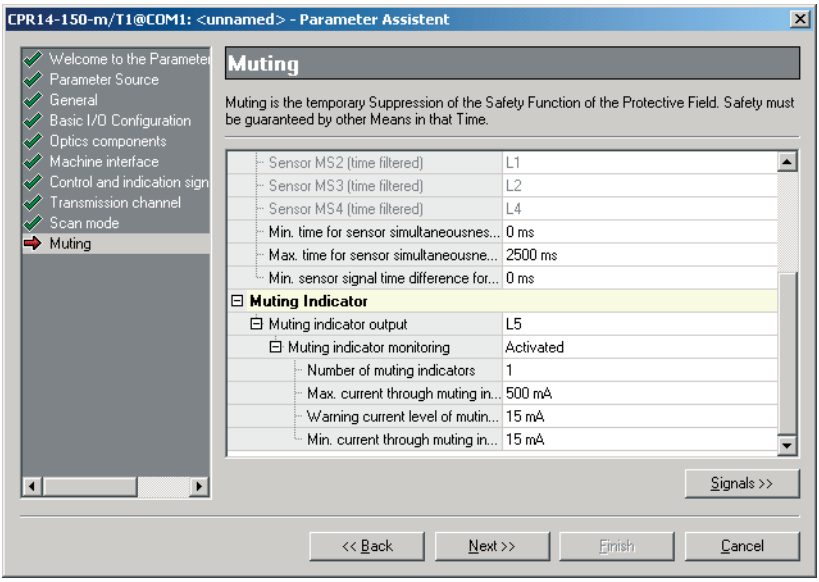


Bild 9.8-1: "Muting" window

Click the "+" symbol next to the desired element to display the assigned parameters.
Click in the line of the parameter to be changed. Arrow symbols appear on the right edge of the line to open a dropdown list with the available parameter values or to set time values.

Element	Description
Basic Settings	
Muting mode	Displays the muting operating mode that was set in the "Basic I/O Configuration" window; see Chapter 9.3.
Muting time limit TMlim	Muting time limit; see Chapter 9.4. The value 00:00:00 sets the muting time limit to "Unlimited". FS: 10 min
Muting timer control signal (low-active)	Control input for muting time limit. If this input is activated (log. 0), muting operation is terminated after TMlim regardless of which muting operating mode was selected. If log. 1 is present on this control input, the muting timer maintains its current value. It continues to run without being reset to the starting value if this input again switches to log. 0 (see Chapter 9.6.2).
Muting enable signal	Additional muting enable signal (for example internally from the beam signal or externally from PLC or conveyor drive) that generally allows or locks muting operation (see Chapter 9.6.1).
Muting prolongation time (TMp)	The lag time of muting operation after the sensor or protective field conditions for the end of muting have been met (see Chapter 9.6.3). FS: 0 ms
Premature end of muting after the protective field becomes free and time (TMpfp)	Muting is terminated either by the muting sensors or by the protective field becoming free, with a possible time delay TMpfp (see Chapter 9.6.4).
Time delay (TMpfp)	The delay time of muting operation after the protective field becomes free (see Chapter 9.6.4). If the protective field is interrupted before this time elapsed, the muting state is maintained.
Muting Sensors	
Sensors MS1 ... MS4 (time-filtered)	Displays the required muting sensors as well as the inputs used (determined by selecting the Basic I/O Configuration).
Min. time for sensor simultaneousness in parallel muting (TMSpi)	The minimum required time difference TMSpi between activation of two muting sensors in parallel mode; see Chapter 9.4 "Time Definitions for Muting". FS: 0 ms
Max. time for sensor simultaneousness in parallel muting (TMSpx)	The maximum permissible time difference TMSpx between activation of two muting sensors in parallel mode; see Chapter 9.4 "Time Definitions for Muting". FS: 2500 ms

Element	Description
Min. sensor signal time difference for sequential muting (TMSsi)	Minimum delay time TMSsi between activation of two successive muting sensors in sequential mode; see Chapter 9.4 "Time Definitions for Muting". FS: 0 ms
Muting Indicator	
Muting indicator output	The output to which the muting indicator is connected. Select L5, if you want the muting indicator to be monitored. If you want the muting indicator to be controlled without current monitoring, any free output can be used. For information on the connection diagram for muting indicators, see Chapter 11.2.
Muting indicator monitoring	Activates/deactivates current monitoring of the muting indicator(s). Only available if L5 was selected as the indicator output.
Number of muting indicators	The number of muting indicators connected to L5
Max. current trough muting indicator	Upper current limit values for muting indicator monitoring. If this value is exceeded in the indicator circuit on L5, the receiver switches into the OFF state. The system assumes an overload or short circuit is present. Error code E 52 is displayed on the 7-segment display of the receiver. The internal signal "Fault/Error" is set to log. 1. It can be transferred to a PLC, for example via an indication output (see Chapter 7.20 and Chapter 7.21). FS: 500 mA
Warning level of muting indicator	Current limit value for muting indicator monitoring. If the value in the indicator circuit on L5 falls under this limit, the internal indicator warning signal "Undercurrent trough muting indicator" is set to log. 1. It can be transferred to a PLC via an indication output, for example (see Chapter 7.20 and Chapter 7.21).
Min. trough muting indicator	Lower current limit value for muting indicator monitoring. If the indicator current falls under this value in a controlled state, the receiver switches into the OFF state. The system assumes there is a broken cable or a faulty muting indicator. Error code E 51 is displayed on the 7-segment display of the receiver. The internal signal "Fault/Error" is set to log. 1. It can be transferred to a PLC, for example via an indication output (see Chapter 7.20 and Chapter 7.21). FS: 15 mA

9.9 "Muting Restart" window

You can set the parameters for muting restart in the "Muting Restart" window of the Assistant or Expert.

Muting restart makes it possible for the protective equipment to be freed from an irregular state (for example the power supply failing and returning during muting or a muting sensor sequence that becomes invalid because of this) by pressing, releasing and pressing again the Muting Restart button within a defined time window. For this to happen:

- At least one muting sensor must be activated
- The protective field must be interrupted
- At least one Muting Restart button must be connected

The device indicates with the flashing muting indicator(s) that a muting restart is expected.

If a valid Muting signal combination is found during the Muting restart, the flashing goes to a constant light; the Muting restart button can then be released.

Note!

The Muting Restart button is used in factory setting (FS) as start button for startup or restart; see Chapter 7.17.

You can connect up to two Muting Restart buttons (for example with a large protective zone that can be seen from one place). Their signals are OR linked with each other in the "Muting Restart" window.

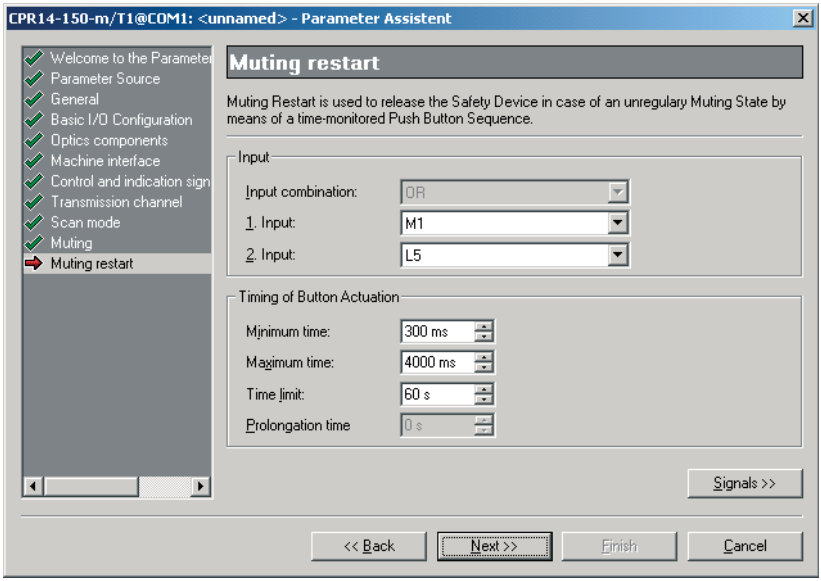


Bild 9.9-1: "Muting Restart" window

Element	Description
Input	
Input combination	The logic used to link the two inputs for the Muting Restart buttons.
1. input	The input to which a Muting Restart button is connected
2. input	The input to which the second Muting Restart button is connected
Timing of Button Actuation	
Minimum time	The minimum activation time of the Muting Restart buttons and also the minimum time that must elapse between the first and the second time the Muting Restart button is pressed.
Maximum time	The maximum activation time of the Muting Restart buttons and also the maximum time that can elapse between the first and the second time the Muting Restart button is pressed.
Time limit	Time limit for Muting Restart. After this time has elapsed, the Muting Restart is canceled. It can only be activated by pressing a Muting Restart button again if the conditions described above are present.

10 Function Package "Initiation"

10.1 General Information

The function package "Initiation" is only available for Safety Light Curtains with 14 mm and 30 mm resolution. It offers the following options in addition to the standard functions described in Chapter 7:

- Controlling safely a machine (cycle control); see Chapter 10.4
- Defining beam zones with Fixed and Floating Blanking; see Chapter 8.3 and Chapter 8.4
- Defining beam zones with Reduced Resolution; see Chapter 7.12
- Define beam zones with Beam Signals
- Bypassing the safety output for a limited time; see Chapter 10.5.

The display area for the function package "Initiation" is shown below:

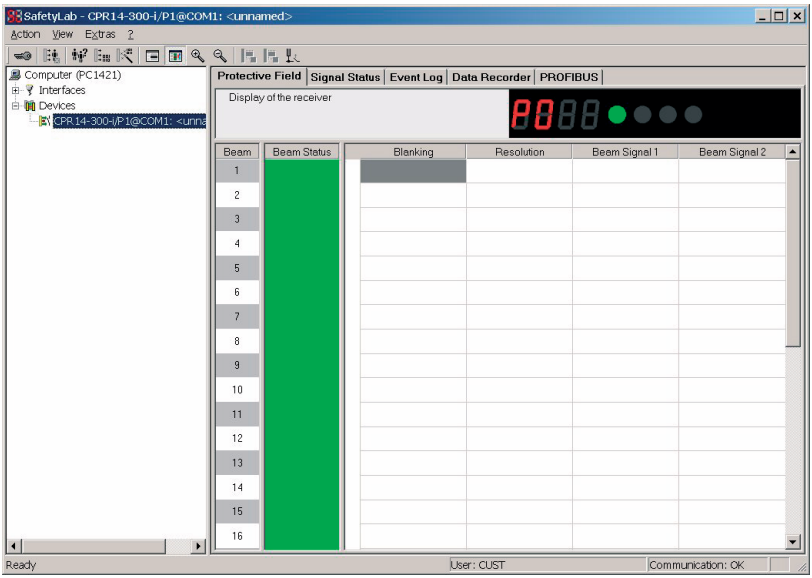


Bild 10.1-1: User interface for the function package "Initiation"

In the "Beam Status and Parameterization" display mode the "Blanking", "Resolution" and „Beam signal 1“ and Beam signal 2“ columns are available in the display area in addition to the beam status.

10.2 Hardware Requirements

Cycle control operation requires:

- The initiation version of the receiver with connection option for external signal lines
- A start button to unlock the Start/Restart Interlock
- A Clear sensor to reset a cycle (upper reverse point)
- Optionally, an operating mode selection switch
- Optionally, two bypass sensors for bypassing the non-dangerous part of a movement (for example starting from the lower reverse point of a press)
- Optionally, sensors with contacts for an additional safety circuit
- Optionally, a sensor for enabling the last cycle (presence or position sensor for the workpiece)

Connection variants

- Direct connection to local socket
- Local connection box (with local socket connected)

Note!

Connection diagrams; see Chapter 11.2.

10.3 Basic I/O Configuration

The following selection is available in the "Basic I/O Configuration" window of the Assistant or Expert.

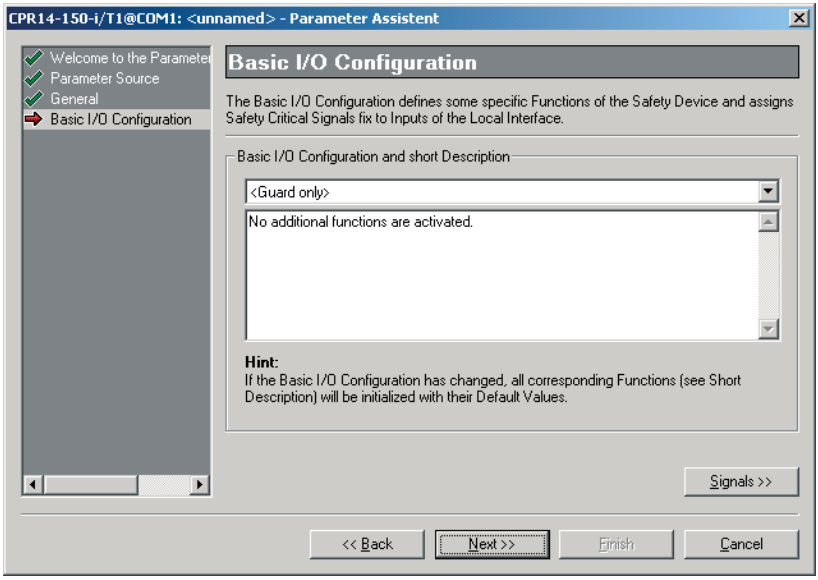


Bild 10.3-1: "Basic I/O Configuration" window

Operating mode	Description
<Guard only>	The device works in Guard mode.
Fixed break operation (1- to 8-break)	Guard and cycle operation with selectable cycle number is activated (cannot be changed during operation)
Fixed break operation (1- to 8-break); Bypass	Guard and cycle operation with selectable cycle number is activated (cannot be changed during operation). Bypass is activated; see Chapter 10.5. For information on the connection diagram for bypass sensors, see Chapter 11.2.7.
Fixed break operation (1- to 8-break); Bypass; Safety circuit (2-channel)	Guard and cycle operation with selectable cycle number is activated (cannot be changed during operation). Bypass is activated; see Chapter 10.5. One additional 2-channel safety circuit is connected; see Chapter 7.19. For information on the connection diagram for bypass sensors and safety circuit, see Chapter 11.2.8.
Fixed break operation (1- to 8-break); Safety circuit (2-channel)	Guard and cycle operation with selectable cycle number is activated (cannot be changed during operation). One additional 2-channel safety circuit is connected; see Chapter 7.19. For information on the connection diagram for safety circuit, see Chapter 11.2.1.

Operating mode	Description
2 operating modes (external, freely selectable)	External selection of operating mode via tristate input L4; see Chapter 10.7.3. For information on the connection diagram for external operating mode switch, see Chapter 11.2.18.
2 operating modes (external, freely selectable) Bypass	External selection of operating mode via tristate input L4; see Chapter 10.7.3. Bypass is activated; see Chapter 10.5. For information on the connection diagram for bypass sensors and external operating mode switch, see Chapter 11.2.19.
3 operating modes (external, 1oo3)	External selection of operating mode with a 1-out-of-3 switch on 3 free inputs; see Chapter 10.7.2.
3 operating modes (external, 1oo3); Bypass	External selection of operating mode with a 1-out-of-3 switch on 3 free inputs; see Chapter 10.7.2. Bypass is activated; see Chapter 10.5. For information on the connection diagram for bypass sensors, see Chapter 11.2.7.
3 operating modes (external, 1oo3); Bypass; Safety circuit (2-channel)	External selection of operating mode with a 1-out-of-3 switch on 3 free inputs; see Chapter 10.7.2. Bypass is activated; see Chapter 10.5. One additional 2-channel safety circuit is connected; see Chapter 7.19. For information on the connection diagram for bypass sensors and safety circuit, see Chapter 11.2.8.
3 operating modes (external, 1oo3); Safety circuit (2-channel)	External selection of operating mode with a 1-out-of-3 switch on 3 free inputs; see Chapter 10.7.2. One additional 2-channel safety circuit is connected. For information on the connection diagram for safety circuit, see Chapter 11.2.1.
3 operating modes (external, binary-coded)	External selection of operating mode with a binary coded 2-level switch on tristate inputs L3 and L4; see Chapter 10.7.1. For information on the connection diagram for external operating switches, see Chapter 11.2.16.
3 operating modes (external, binary-coded) Bypass	External selection of operating mode with a binary coded 2-level switch on tristate inputs L3 and L4; see Chapter 10.7.1. Bypass is activated; see Chapter 10.5. For information on the connection diagram for bypass sensors and external operating mode switches, see Chapter 11.2.17.
Bypass	The device works in Guard mode. Bypass is activated; see Chapter 10.5. For information on the connection diagram for bypass sensors, see Chapter 11.2.7.

Operating mode	Description
Bypass; Safety circuit (2-channel)	The device works in Guard mode. Bypass is activated; see Chapter 10.5. One additional 2-channel safety circuit is connected; see Chapter 7.19. For information on the connection diagram for bypass sensors and safety circuit, see Chapter 11.2.8.
Safety circuit (2-channel)	The device works in Guard mode. One additional 2-channel safety circuit is connected; see Chapter 7.19. For information on the connection diagram for safety circuit, see Chapter 11.2.1.

10.4 Cycle Control Operating Modes

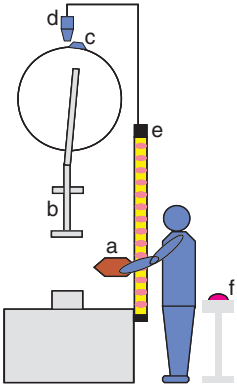
Regardless of whether internal Start/Restart Interlock is selected in the "Start/Restart" window, this function is forced if a cycle operating mode for which it is required is activated. In cycle mode the Start/Restart Interlock is locked after the power supply is turned on. It indicates this by turning on the yellow LED in the receiver's display. Before cycle control begins its regular operation, the start button must therefore be pressed once after switching on and must be released again within the defined time window. The OSSDs first remain in the OFF state. Since the various cycle operating modes differ essentially in the number of expected interventions in the protective field, only the single-break and double-break controls that are used most frequently are explained below. 3- to 8-cycle controls work in the same manner with 3 to 8 cycle interventions.

10.4.1 Single-Break Control

Working principle

In the stop phase or after switching on and resetting, there is **one** intervention in the protective field (for example to insert the workpiece to be processed). If the protective field is free again after this **one-time** intervention, the work cycle starts and the OSSDs are turned on. Activating the Clear sensor with the machine stops the work cycle. If the protective field intervention occurs during a work cycle, the receiver turns the machine off. In this case the start button must be pressed to resume operation again. This is also the case when the time limit of 30 seconds (FS) has elapsed. The intervention into the protective field must occur during this time. An intervention into a protective field must last longer than 100 ms (FS).

The following example explains the working principle of single-break control using the case of a press machine:



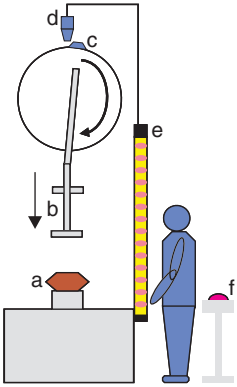
Stop phase

Initiator (c) has activated the Clear sensor (d) and deactivated it again or the start button was pressed once after switching on and then released again.

Safety Light Curtain (e) stops the machine or remains in the OFF state.

In the stop phase, for example, the workpiece (a) can be removed and a new one inserted.

For normal ongoing operation, only one intervention in the protective field is permitted. Otherwise the start button must be pressed.

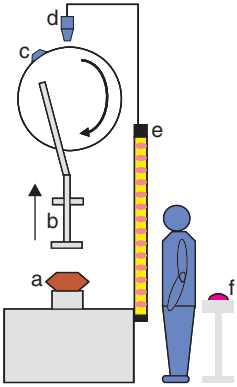


Work cycle – downward motion

As soon as the protective field is free again after the one-time intervention, the Safety Light Curtain (e) starts the machine.

The press (b) moves downward (the dangerous part of the movement).

If an intervention in the protective field occurs in this phase, the Safety Light Curtain (e) stops the machine. The only way to continue operation in this case is after actuation the start button (f).



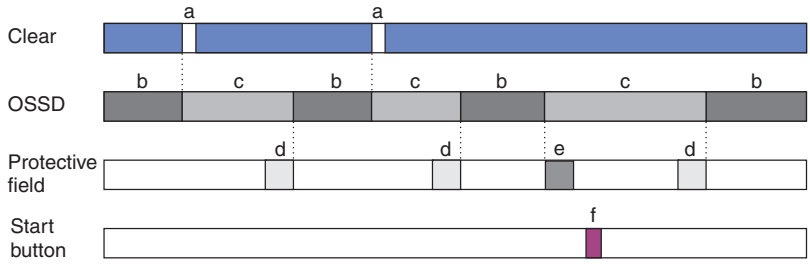
Work cycle – upward motion

Press tool (b) moves upward.

If an intervention in the protective field occurs in this (non-dangerous) phase, the Safety Light Curtain (e) stops the machine. The only way to continue operation in this case as well is by actuating the start button (f). For an intervention into the Safety Light Curtain to occur during the upward movement without stopping the machine, the bypass function must be used (see Chapter 10.5).

Time diagram

The following diagram shows a possible segment of a graph of single-break control over time.



a = Clear signal stops work cycle
b = Work cycle, OSSD on
c = Stop phase, OSSD off
d = Protective field intervention in the stop phase
e = Protective field intervention in the work cycle
f = Press the start button

Bild 10.4-1: Time diagram with single-break control (example)

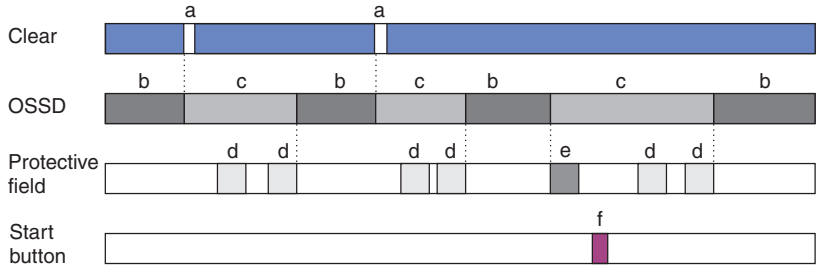
10.4.2 Double-Break control

Working principle

The working principle of double-break control is similar to single-break control, with the difference that the stop phase is not terminated until the **second** intervention into the protective field. This operating mode is useful if a work piece needs to be removed through the protective field after processing (1st intervention into the protective field) and then the next work piece for further processing must be put in place (2nd intervention into the protective field).

Time diagram

The following diagram shows a possible segment of a graph of double-break control over time.



a = Clear signal stops work cycle
b = Work cycle, OSSD on
c = Stop phase, OSSD off
d = Protective field intervention in the stop phase
e = Protective field intervention in the work cycle
f = Press the start button

Bild 10.4-2: Time diagram with double-break control (example)

10.5 Bypass

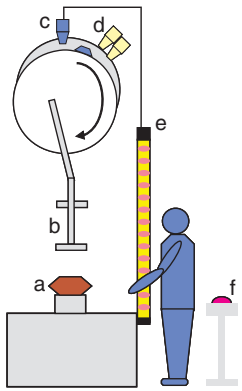
Bypass control bypasses the protective field-function temporarily for a specific purpose. The action is safety-relevant. It is initiated by two signals acting together simultaneously but must be provided independently of each other by the machine control system. Bypass control can be used in combination with cycle control or in simple protective mode as well. The Bypass function can only be activated when the OSSDs are in the ON state. The simultaneousness window expected by the bypass sensors (the minimum expected time difference TBSpi and the maximum permissible time difference TBSpx of sensor activation) can be set in the "Initiation Control" window (see Chapter 10.9). Activation of the bypass function is monitored for time. After 10 minutes of uninterrupted activation of the bypass function (fixed setting, cannot be changed) the receiver goes to a fault E50 and resets itself automatically after another 10 seconds.

10.5.1 Single-Break Operation with Bypass

Working principle

This operating mode allows for single-break control combined with muting of the non-hazardous part of the movement by the machine control system (bypass). Two bypass sensors are required in this case in addition to the Clear sensor.

If the Bypass function is activated shortly before reaching the lower reverse point, the operator can intervene into the protective field during the non-hazardous part of the upward movement and thereby initiate the next cycle. If this happens quickly enough, the press will no longer be stopped at the upper reverse point, it will start immediately with the next cycle. A prerequisite for this is that the Clear sensor must generate a cycle deletion signal just after leaving the lower reverse point.



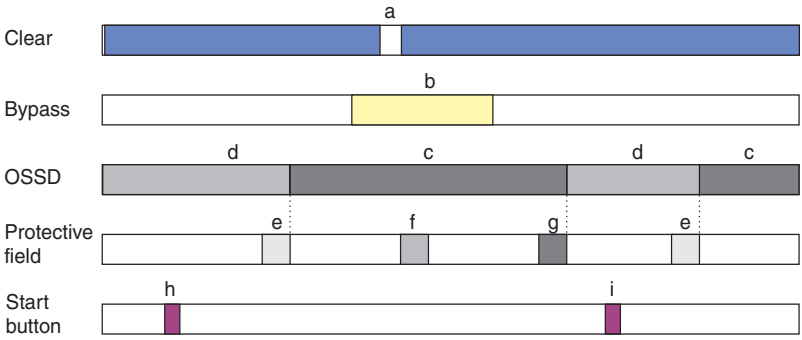
a = Workpiece
b = Press
c = Clear sensor
d = Two bypass sensors
e = Safety Light Curtain
f = Restart button

Bild 10.5-1: Arrangement of cycle control with bypass operation (example)

During Bypass operation, the work cycle is not stopped by an intervention into the protective field; see Fig. 10.5-2. The optional bypass lamp is neither monitored nor controlled in factory settings.

Time diagram

The following diagram shows a possible segment of a graph of single-break control over time with Bypass operation.



a = Clear signal deletes cycle counter
b = Bypass operation
c = Work cycle, OSSD on
d = Stop phase, OSSD off
e = Protective field intervention in the stop phase
f = Protective field intervention in Bypass mode
g = Protective field intervention in the work cycle
h = Start button pressed (reset after changing operating mode)
i = Start button pressed (reset after intervention into protective field in work cycle)

Bild 10.5-2: Time diagram for single-break control with Bypass operation (example)

10.5.2 Double-Break Operation with Bypass

Working principle

The working principle of double-break control is similar to single-break control, with the difference that the stop phase is not terminated until the **second** intervention into the protective field.

10.6 Cycle Reset/Enable

To terminate a work cycle, the receiver expects a signal on the Clear input for resetting the cycle. After the cycle has been reset, the next cycle can be initiated by one or more interventions into the protective field. If the cycle reset signal fails, the machine continues in operation if it is not stopped by other control elements (for example by a standard machine controller). The Safety Light Curtain remains in Guard operation so that an intervention into the protective field will cause the machine to stop.
The cycle reset signal can also be used to enable the cycle control. Protective field interruptions are not evaluated as cycle signals if the cycle control is not enabled.
The following settings are possible for cycle reset and enable signal clear:

10.6.1 Cycle Reset, status controlled

A static signal on the cycle reset input (FS: log. 0) resets the counter for cycle interventions. As long as there is a cycle reset signal present, no cycle feed-ins will be accepted from the protective field. Cycle control is disabled in this case, i.e. this signal is both a cycle reset signal and a cycle enable signal. The status-controlled triggering of the clear signal is suitable for cyclically operating machines (for example presses) where the cycle reset sensor on the clear input will be passed due to the inertia of the machine. In other words, the machine does not come to a stop until the cycle reset sensor is enabled again.

10.6.2 Cycle Reset, signal edge controlled

This method is suitable for machines in which a tool or the arm of a processing machine is moved in a certain idle position, where it remains until the necessary number of cycles has been fed in through the protective field. Then it returns back to the work position by the same way. If the clear sensor were passed as it was in the status-controlled method, i.e. activated and then enabled again, a cycle reset would be trigger while it was still on the way back to the work position and the machine would be stopped as a result.
Because of the signal-edge controlled reset of the cycle and activation of the clear sensor in the idle position, it is enabled again with the next cycle. Immediately after the cycle is reset, no new cycles can be fed into the protective field again.

10.6.3 Cycle Reset, signal edge controlled with cycle enable

If the cycle reset signal comes from a safety PLC rather than directly from a sensor, it may be useful to be able to control cycle enable in addition to cycle reset. Because of this, signal edge controlled cycle reset can be combined with cycle enable.

10.7 Selecting the Cycle Operating Mode

The cycle operating mode can be permanently set internally (in which case no selection switch needs to be connected) or it can be switched over during operation. In the second case, the desired cycle operating mode must be determined by an external selection switch.
The following options are available:

- Binary coded selection of 3 fix assigned operating modes via 2 tristate inputs
- 1-out-of-3 coded selection of three 3 fix assigned operating modes via any 3 inputs
- Selection of 2 selectable operating modes via 1 tristate input

The switch between operating modes must take place within 0.5 s. Otherwise an error message appears on the 7-segment display of the receiver.

Note!

Internal Start/Restart Interlock is required for cycle operation. If it is deactivated (see Chapter 7.16), it will automatically be activated when a cycle operating mode is selected. Activation or deactivation in the "Start/Restart" window is only in effect in Guard mode (7-segment display "P0").

10.7.1 3 Operating Modes – Binary Coded

In this operating mode, the setting of the operating mode is binary coded by an external operating mode selector switch with two switching levels. The switch must be connected to control inputs L3 and L4.

Three cycle operating modes (guard mode, single-break operation, double-break operation) are possible. For a connection diagram, see Chapter 11.2.16; with bypass see Chapter 11.2.17.

10.7.2 3 Operating Modes – 1-out-of-3

The cycle operating mode 1oo3 is set by 3 freely selectable control inputs to which either a selection switch with one switching level or three individual switches are connected against 24V DC. For the connection diagram; see:

Chapter 11.2.1 (with safety circuit),

Chapter 11.2.7 (with bypass sensors),

Chapter 11.2.8 (with bypass sensors and safety circuit).

10.7.3 2 operating modes

You can switch back and forth between two parameterizable cycle operating modes with an external switch, which must be connected to tristate input L4. You can select both cycle operating modes you want here in the "Initiation Control" window. For a connection diagram; see Chapter 11.2.18 or Chapter 11.2.19 (with bypass).

10.8 Cycle Control

The minimum time for a protective field interruption after which a valid cycle will be detected can be set (FS = 0.1 s). Once the maximum wait time for a cycle intervention (FS = 30 s) has elapsed, the restart interlock is locked. Cycles cannot be fed through interruptions in the protective field until the start button has been pressed. It is also possible to define an enable signal (CSC) for last cycle, which could come from a sensor, for example, which monitors for presence or the correct position of the workpiece. The OSSDs are not turned on after the last expected cycle intervention has been fed in.

10.9 "Initiation Control" window

You can set the parameters for cycle operation in the "Initiation Control" window of the Assistant or Expert.

Note!

The knowledge of the cycle operating modes and options described above is required to be able to make settings in the "Initiation Control" window.

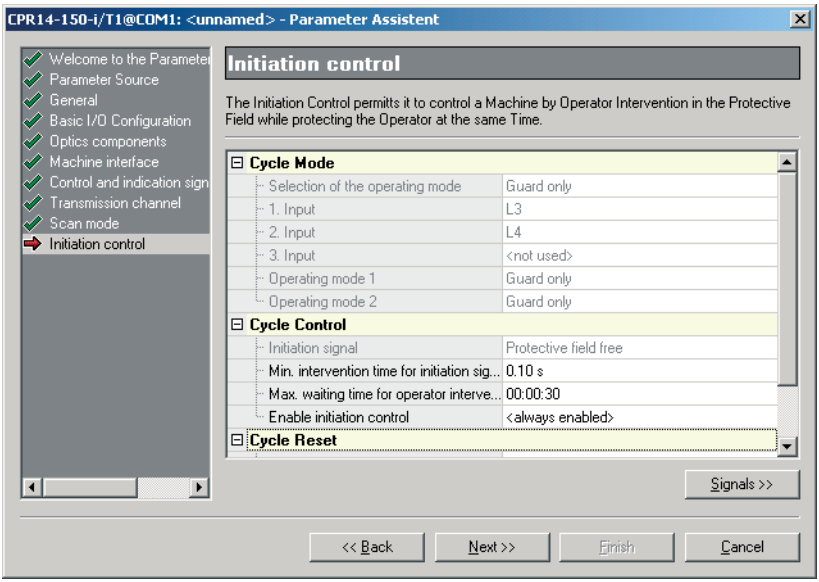


Bild 10.9-1: "Initiation Control" window

Element	Description
Cycle Mode	
Selection of the operating mode	If 1- to 8-cycle control was selected in the Basic I/O Configuration, the desired fixed operating mode will be set here. If an operating mode changeover has been selected there, it will only be displayed here. See Chapter 10.3..
1. input	1. control input for external selection of the cycle operating mode. Only freely selectable with cycle operating mode selection 1-out-of-3.
2. input	2. control input for external selection of the cycle operating mode. Only freely selectable with cycle operating mode selection 1-out-of-3.

Element	Description
3. input	3. control input for external selection of the cycle operating mode. Only freely selectable with cycle operating mode selection 1-out-of-3.
Operating mode 1	1. cycle mode type for 2 operating modes (external, freely selectable).
Operating mode 2	2. cycle mode type for 2 operating modes (external, freely selectable).
Cycle Control	
Cycle signal (display only)	Shows the signal source for cycle control, the internal signal "protective field free".
Min. intervention time for initiation signal (TCint)	Minimum time TCint, that the protective field must remain interrupted to be evaluated as a initiation signal.
Max. wait time for operator intervention [hh:mm:ss] (TCLim)	The maximum time TClim, in which a protective field interruption is evaluated as initiation signal. After this time is exceeded, the receiver switches into the interlock state of restart interlock. The start button must be pressed.
Enable for initiation control	Optional signal for enabling the last cycle. Here you can connect a sensor to detect the presence or correct position of the workpiece, etc. The cycle is in that case only initiated if the workpiece is present or if it is in the correct position.
Cycle Reset	
Input for cycle reset	Input for the clear signal.
Cycle reset executed on	Determines the form of the signal for resetting the cycle on the clear input – whether it is controlled by signal edge or status (see Chapter 10.6).
Bypass Sensors	
Sensors BS1/BS2 (time-filtered)	Displays the bypass sensor inputs determined by the selection of the Basic I/O Configuration.
Min. time for simultaneousness of bypass signals (TCSpi)	Minimum time TCSpi for the simultaneousness of bypass sensor signals, see Chapter 9.4 "Time Definitions for Muting". FS: 0 ms
Max. time for simultaneousness of bypass signals (TCSpx)	Maximum time TCSpx for the simultaneousness of bypass sensor signals. FS: 500 ms

Element	Description
Bypass Display	
Muting indicator output	Select whether you want to use one or more bypass indication light. The connection is defined on L5 if current monitoring will be activated. For information on the connection diagram for bypass indication lights, see Chapter 11.2.
Muting indicator monitoring	Activates/deactivates the current monitoring of the bypass indication light(s). It is only available if L5 is being used as a indication light output.
Number of muting indicators	Enter the number of indication lights that will be connected.
Max. current trough muting indicator	Upper current limit value for bypass indicator monitoring. If this value is exceeded in the bypass indicator circuit, the receiver switches into the OFF state. The system assumes an overload or short circuit is present. Error code E52 is displayed on the 7-segment display of the receiver. The internal signal "Fault/Error" is set to log. 1. It can be transferred to a PLC, for example via an indication output (see Chapter 7.20 and Chapter 7.21). FS: 500 mA
Warning current level of muting indicator	Current limit values for bypass indicator monitoring. If the current in the bypass indicator circuit is below this limit, the undercurrent trough bypass indicator warning signal is set to 1. It can be transferred to a PLC via an indication output, for example (see Chapter 7.20 and Chapter 7.21).
Min. current trough muting indicator	Lower current limit value for bypass indicator monitoring. If this value is exceeded in a controlled state, the receiver switches into the OFF state. The system assumes there is a broken cable or a faulty bypass indicator. Error code E51 is displayed on the 7-segment display of the receiver. The internal signal "Fault/Error" is set to log. 1. It can be transferred to a PLC, for example via an indication output (see Chapter 7.20 and Chapter 7.21). FS: 15 mA

11 External Signals and Connection Diagrams

This chapter provides you with an overview of connecting selected signals. For safety reasons, these signals are defined by the Basic I/O Configuration and are expected on input lines with fixed definitions. Because of this, they are not freely strappable, unlike the rest of the signals. After that you will find the connection diagrams of signal lines for the various function packages and Basic I/O Configurations. Since COMPACT*plus* can be equipped with various machine interfaces, but always with the same local interface (in the two design formats of local socket and local connection field), the signals defined here are present only on the local interface. The connection of the start button and optionally the muting indicator to L5 is also illustrated (FS), but it is not mandatory and can therefore be strapped to other signal lines.

11.1 Signals

11.1.1 Function Package "Blanking"

The function package "Blanking" expects 2 signal lines on the local interface for additional safety circuit(s), if that function has been selected.

The following Table 11.1-1 shows the signal lines on which the additional signals are expected for the corresponding Basic I/O Configuration.

Basic I/O Configuration	Chapter	L1	L2	L3	L4
No additional functions	-	-	-	-	-
Safety circuit (2-channel)	11.2.1	-	-	SK1	SK2
Two safety circuits (1-channel)	11.2.2	-	-	SK1	SK2
Safety circuit (1-channel)	11.2.3	-	-	-	SK1

SK1, SK2= Signal lines for safety circuit(s)

Tabelle 11.1-1: Expected signals in the function package "Blanking"

11.1.2 Function Package "Muting"

The function package "Muting" makes a fixed assignment of up to 4 signal lines of the local interface (L1...L4) by selecting the Basic I/O Configuration.

The following Table 11.1-2 shows the signal lines on which these signals are expected in the corresponding Basic I/O Configuration.

Basic I/O Configuration	Chapter	L1	L2	L3	L4	M5
No additional functions	-	-	-	-	-	-
Safety circuit (2-channel)	11.2.1	-	-	SK1	SK2	-
Two safety circuits (1-channel)	11.2.2	-	-	SK1	SK2	-
Safety circuit (1-channel)	11.2.3	-	-	-	SK1	-
4-sensor AutoMode muting	11.2.4	MS2	MS3	MS1	MS4	-
4-sensor parallel muting	11.2.4	MS2	MS3	MS1	MS4	-

Basic I/O Configuration	Chapter	L1	L2	L3	L4	M5
4-sensor unidicrectional parallel muting	11.2.4	MS2	MS3	MS1	MS4	-
4-sensor sequential muting	11.2.4	MS2	MS3	MS1	MS4	-
3-sensor sequential/parallel muting	11.2.5	MS2	MS3	MS1	-	-
3-sensor sequential/parallel muting; Safety circuit (1-channel)	11.2.6	MS2	MS3	MS1	SK1	-
2-sensor parallel muting (L1, L2)	11.2.7	MS2	MS3	-	-	-
2-sensor parallel muting (L1, L2); Safety circuit (2-channel)	11.2.8	MS2	MS3	SK1	SK2	-
2-sensor parallel muting (L1, L2); Two safety circuits (1-channel)	11.2.9	MS2	MS3	SK1	SK2	-
2-sensor parallel muting (L1, L2); Safety circuit (1-channel)	11.2.10	MS2	MS3	-	SK1	-
2-sensor parallel muting (L1, M5)	11.2.11	MS2	-	-	-	MS3
2-sensor parallel muting (L1, M5); Safety circuit (2-channel)	11.2.12	MS2	-	SK1	SK2	MS3
2-sensor parallel muting (L1, M5); Two safety circuits (1-channel)	11.2.13	MS2	-	SK1	SK2	MS3
2-sensor parallel muting (L1, M5); Safety circuit (1-channel)	11.2.14	MS2	-	-	SK1	MS3
2-sensor parallel muting (L3, L4)	11.2.15	-	-	MS2	MS3	-

SK1, SK2= Signal lines for safety circuit(s)
MS1 - MS4= Signal lines for muting sensors

Tabelle 11.1-2: Expected signals in the function package "Muting"

11.1.3 Function Package "Initiation"

The function package "Initiation" makes a fixed assignment of up to 4 signal lines of the local interface (L1...L4) by selecting the Basic I/O Configuration.

The following Table 11.1-3 shows the signal lines on which these signals are expected for the corresponding Basic I/O Configuration.

Basic I/O Configuration	Chapter	L1	L2	L3	L4
<Guard only>	-	-	-	-	-
Safety circuit (2-channel)	11.2.1	-	-	SK1	SK2
Bypass	11.2.7	BS1	BS2	-	-
Bypass; Safety circuit (2-channel)	11.2.8	BS1	BS2	SK1	SK2
Fixed break operation (1- to 8-break)	-	-	-	-	-
Fixed break operation (1- to 8-break); Safety circuit (2-channel)	11.2.1	-	-	SK1	SK2
Fixed break operation (1- to 8-break); Bypass	11.2.7	BS1	BS2	-	-
Fixed break operation (1- to 8-break); Bypass; Safety circuit (2-channel)	11.2.8	BS1	BS2	SK1	SK2
3 operating modes (external, binary-coded)	11.2.16	-	-	XM1	XM2
3 operating modes (external, binary-coded) Bypass	11.2.17	BS1	BS2	XM1	XM2
3 operating modes (external, 1oo3)	-	-	-	-	-
3 operating modes (external, 1oo3); Safety circuit (2-channel)	11.2.1	-	-	SK1	SK2
3 operating modes (external, 1oo3); Bypass	11.2.7	BS1	BS2	-	-
3 operating modes (external, 1oo3); Bypass; Safety circuit (2-channel)	11.2.8	BS1	BS2	SK1	SK2
2 operating modes (external, freely selectable)	11.2.18	-	-	-	XM1
2 operating modes (external, freely selectable); Bypass	11.2.19	BS1	BS2	-	XM1

SK1, SK2= Signal lines for safety circuit
BS1, BS2= Signal lines for bypass sensors
XM1, XM2= Signal lines for external operating mode switch

Tabelle 11.1-3: Expected external signals in the function package "Initiation"

11.2 Connection Diagrams

The following chapters illustrate the connection diagrams belonging to different Basic I/O Configurations, each in up to three different types of connections (local socket, local connection box and local connection field). In some cases one connection diagram covers a number of Basic I/O Configurations.

First, to help in understanding the connection diagrams below, is the signal assignment and internal wiring of the modules.

Local socket

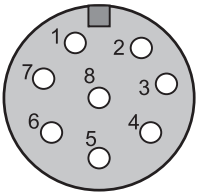


Bild 11.2-1: Receiver/transceiver – local socket M12, 8-pin

Pin	Cable color*	Assignment	
1	White	⇐	L1 input
2	Brown	⇔	L2 input/output
3	Green	⇐	L3 input
4	Yellow	⇐	L4 input
5	Gray	⇔	L5 input/output
6	Pink	⇒	Output, +24V DC
7	Blue	⇒	Output, 0V
8	Red	⇒	Output, FE, functional ground

Warning!

It is absolutely necessary to lay the cable to the local socket so there is no possibility of short circuit!

Local connection box

The local connection box is available as an accessory for connection to the local socket. The connection cable, which is about 0.5 m long with an 8-pin M12 angled connector, must be laid so there is no possibility of short circuit. The assignment of socket 6 is identical to socket 5. It serves to connect a start button in parallel to a muting indicator.

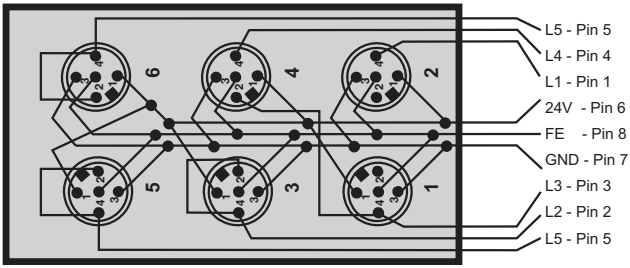


Bild 11.2-2: Internal wiring of the local connection box

Local connection field

Multiple Light Beam Safety Devices and Transceivers with the function package "Muting" are available with integrated local connection field. Only 5 M12 sockets are available to the local connection field. To be able to connect 2-channel contact-based safety circuits, the tristate input L3 is switched via a relay to pin 2 of socket X4 if the tristate test is turned on (see Chapter 6.5 "Control and Indication Signals".

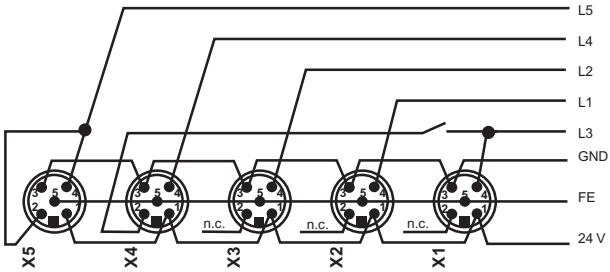


Bild 11.2-3: Internal wiring of the local connection field

Cable splitter

The cable splitter AC-SCC2 connects two sensors to the signal inputs L1 and L2 of the local socket via 1.5 m long cables each. The sensors must provide the signal on pin 2 of their 4-pin M12 connector. Thus the cable splitter is especially suitable for reflex light barriers of type PRK, that provide the dark switching signal at pin 2.

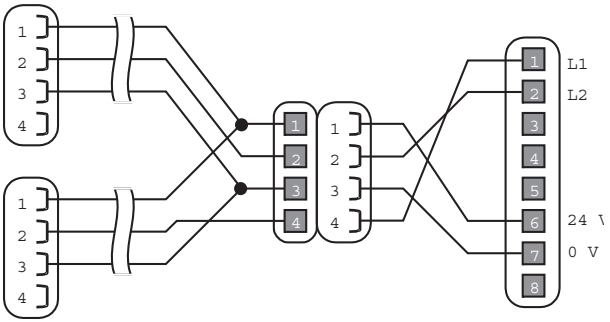


Bild 11.2-4: Layout of cable splitter AC-SCC2

11.2.1 Safety circuit (2-channel), Cycle control

The connection diagrams in this chapter apply to the following Basic I/O Configurations:

- Safety circuit (2-channel)
- Fixed break operation (1- to 8-break); Safety circuit (2-channel)
- 3 operating modes (external, 1oo3); Safety circuit (2-channel)

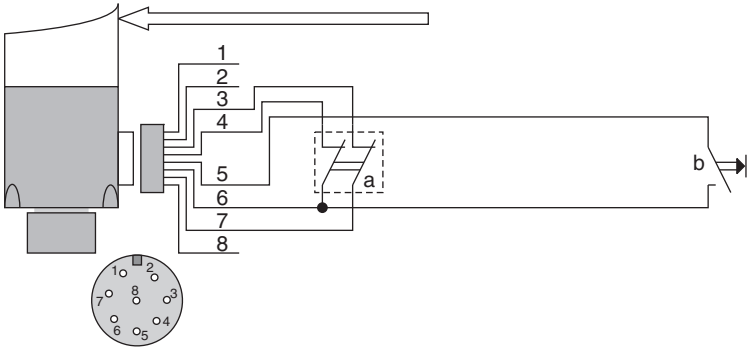
The signal line for the clear sensor for cycle control is freely selectable (FS: L1).

When selecting cycle operating mode 1oo3, an external operating mode switch with 3 signal lines must be connected. You can select any 3 free control inputs for the connection. The following table shows the control logic of the 3 inputs:

1. Input	2. Input	3. Input	Cycle operating mode
+24V DC	0V	0V	Guard mode
0V	+24V DC	0V	Single-break control
0V	0V	+24V DC	Double-break control

Other combinations are not permitted and will result in an error message.

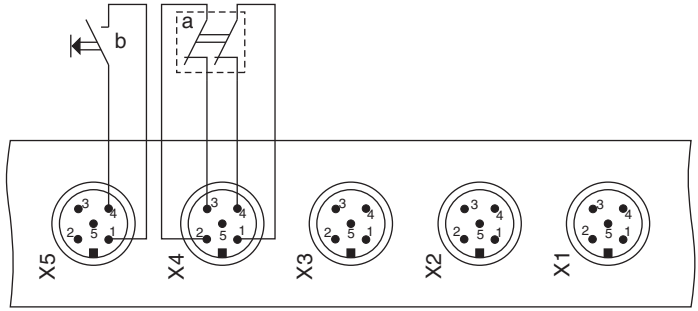
Local socket



1-8= Pin number of local socket
a = 2-channel safety circuit
b = Start button

Bild 11.2-5: Connection to local socket

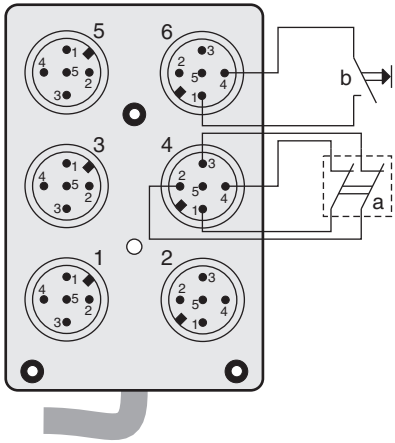
Local connection field



a = 2-channel safety circuit
b = Start button

Bild 11.2-6: Connection to local connection field

Local connection box



a = 2-channel safety circuit b = Start button

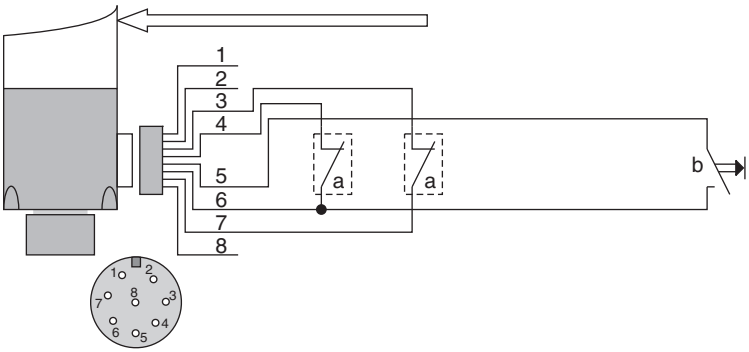
Bild 11.2-7: Connection to local connection box

11.2.2 Two safety circuits (1-channel)

Warning!

Single-channel safety circuits are only permitted for usage in applications of Safety Category 2.

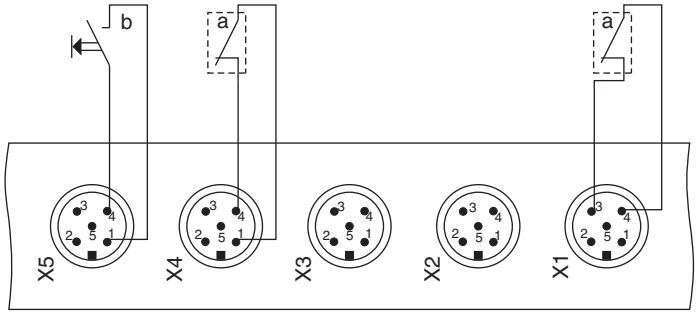
Local socket



1-8= Pin number of local socket b = Start button
a = 1-channel safety circuit

Bild 11.2-8: Connection to local socket

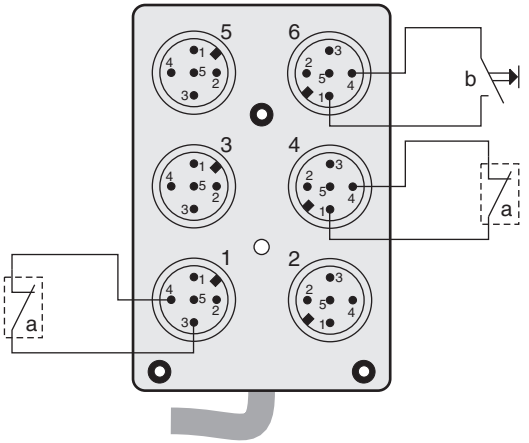
Local connection field



a = 1-channel safety circuit b = Start button

Bild 11.2-9: Connection to local connection field

Local connection box



a = 1-channel safety circuit b = Start button

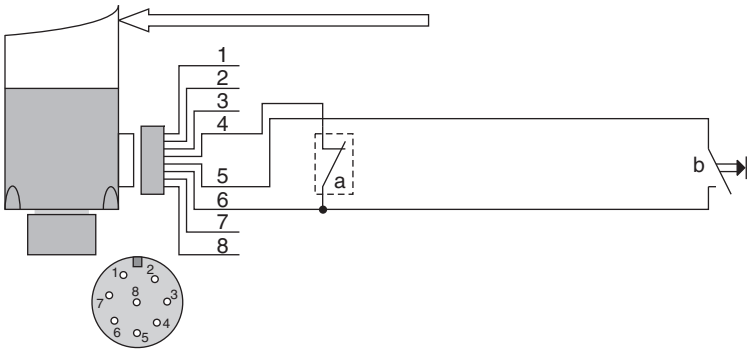
Bild 11.2-10: Connection to local connection box

11.2.3 Safety circuit (1-channel)

Warning!

Single-channel safety circuits are only permitted for usage in applications of Safety Category 2.

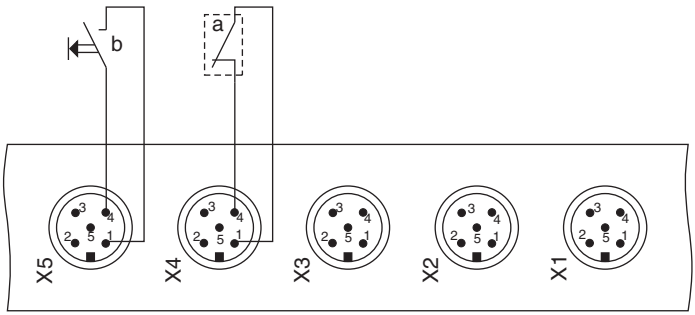
Local socket



1-8= Pin number of local socket
a = 1-channel safety circuit
b = Start button

Bild 11.2-11: Connection to local socket

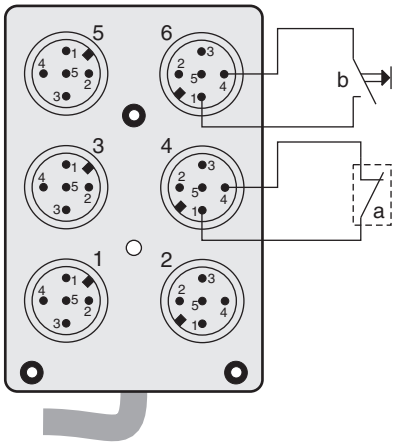
Local connection field



a = 1-channel safety circuit
b = Start button

Bild 11.2-12: Connection to local connection field

Local connection box



a = 1-channel safety circuit
b = Start button

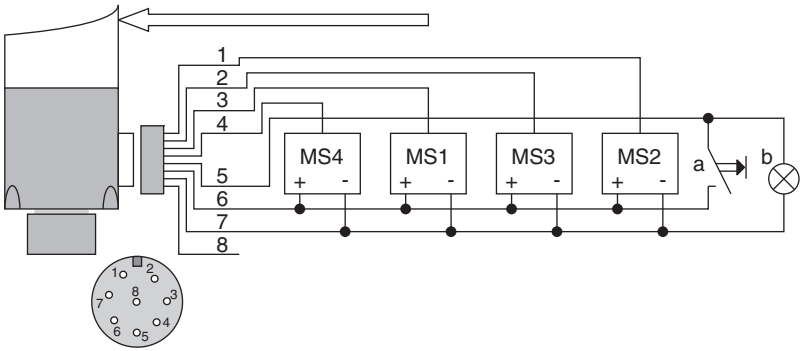
Bild 11.2-13: Connection to local connection box

11.2.4 4-sensor muting

The connection diagrams in this chapter apply to the following Basic I/O Configurations:

- 4-sensor AutoMode muting
- 4-sensor parallel muting
- 4-sensor unidirectional parallel muting
- 4-sensor sequential muting

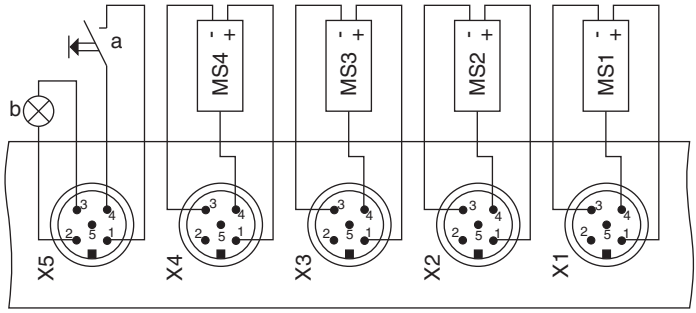
Local socket



1-8= Pin number of local socket
a = Start/muting restart button
b = External muting indicator
MS= Muting sensor

Bild 11.2-14: Connection to local socket

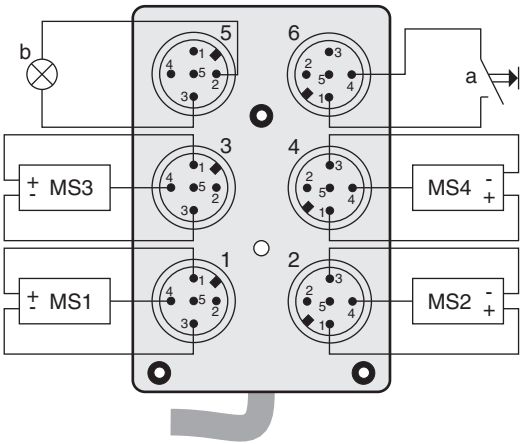
Local connection field



a = Start/muting restart button MS= Muting sensor
b = External muting indicator

Bild 11.2-15: Connection to local connection field

Local connection box

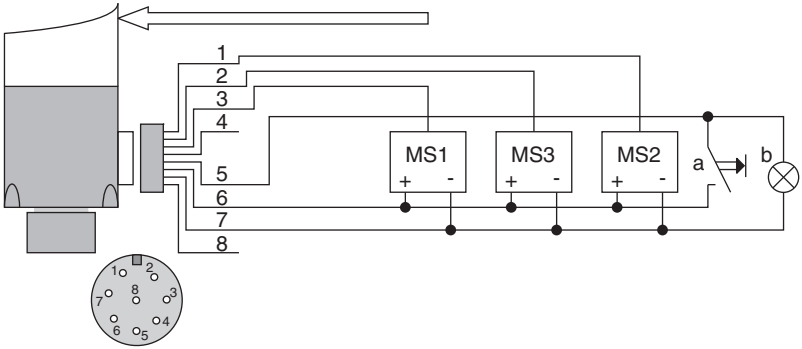


a = Start/muting restart button MS= Muting sensor
b = External muting indicator

Bild 11.2-16: Connection to local connection box

11.2.5 3-sensor sequential/parallel muting

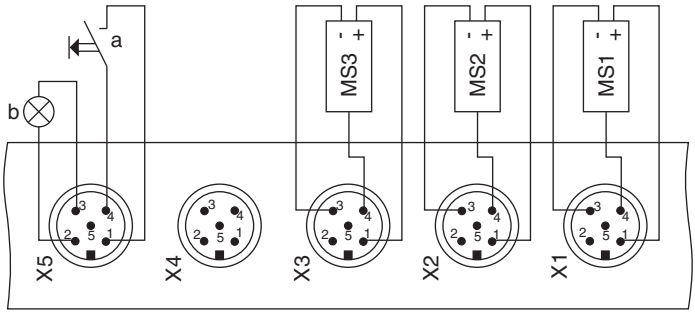
Local socket



1-8= Pin number of local socket
a = Start/muting restart button
b = External muting indicator
MS= Muting sensor

Bild 11.2-17: Connection to local socket

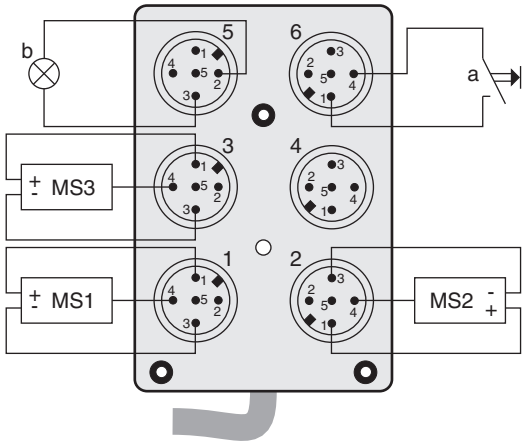
Local connection field



a = Start/muting restart button
b = External muting indicator
MS= Muting sensor

Bild 11.2-18: Connection to local connection field

Local connection box



a = Start/muting restart button
b = External muting indicator
MS= Muting sensor

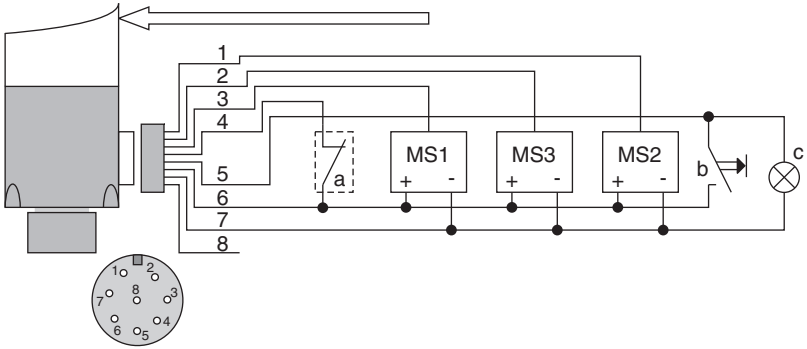
Bild 11.2-19: Connection to local connection box

11.2.6 3-sensor sequential/parallel muting; Safety circuit (1-channel)

Warning!

Single-channel safety circuits are only permitted for usage in applications of Safety Category 2.

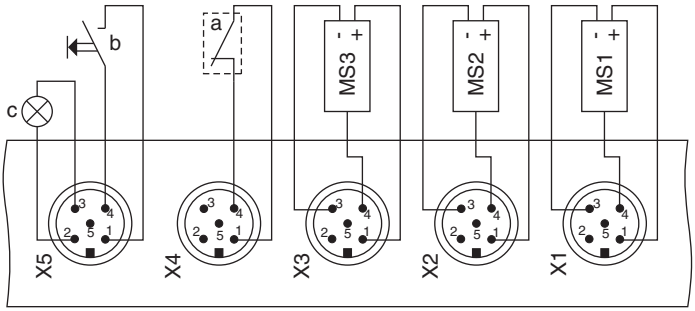
Local socket



1-8= Pin number of local socket
a = 1-channel safety circuit
b = Start/muting restart button
c = External muting indicator
MS= Muting sensor

Bild 11.2-20: Connection to local socket

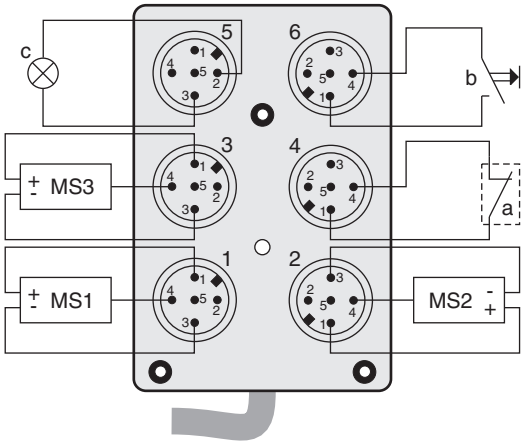
Local connection field



a = 1-channel safety circuit
b = Start/muting restart button
c = External muting indicator
MS= Muting sensor

Bild 11.2-21: Connection to local connection field

Local connection box



a = 1-channel safety circuit
b = Start/muting restart button
c = External muting indicator
MS= Muting sensor

Bild 11.2-22: Connection to local connection box

11.2.7 2-sensor parallel muting (L1, L2), Cycle control with Bypass

The connection diagrams in this chapter apply to the following basic configurations:

- 2-sensor parallel muting (L1, L2)
- Bypass control
- Fixed break operation (1- to 8-break); Bypass
- 3 operating modes (external, 1oo3); Bypass

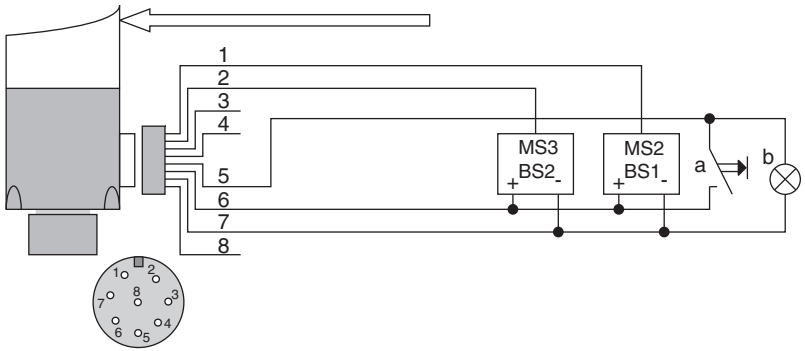
The signal line for the clear sensor for cycle control is freely selectable (FS: L1).

When selecting cycle operating mode 1oo3, an external operating mode switch with 3 signal lines must be connected. You can select any 3 free control inputs for the connection. The following table shows the control logic of the 3 inputs:

1st input	2nd input	3rd input	Cycle operating mode
+24V DC	0V	0V	Guard mode
0V	+24V DC	0V	Single-break control
0V	0V	+24V DC	Double-break control

Other combinations are not permitted and will result in a fault message.

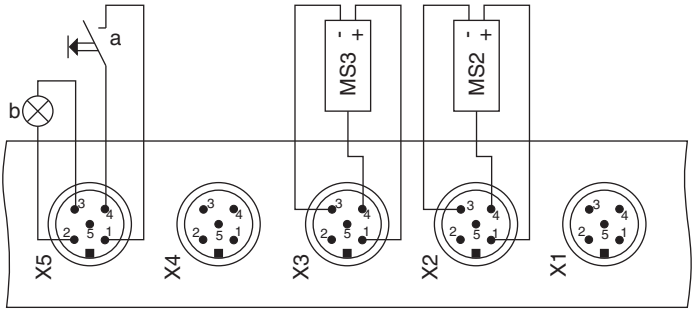
Local socket



1-8= Pin number of local socket
a = Start/muting restart button
b = External muting indicator
MS= Muting sensor
BS= Bypass sensor

Bild 11.2-23: Connection to local socket

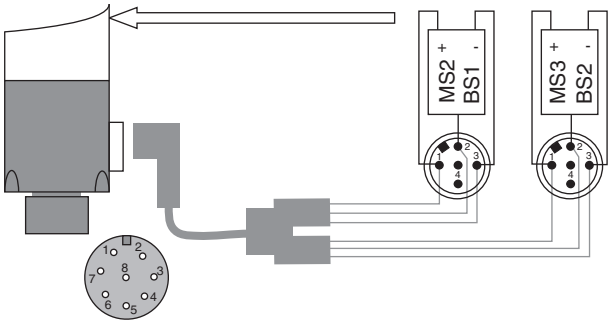
Local connection field



a = Start/muting restart button
b = External muting indicator
MS= Muting sensor

Bild 11.2-24: Connection to local connection field

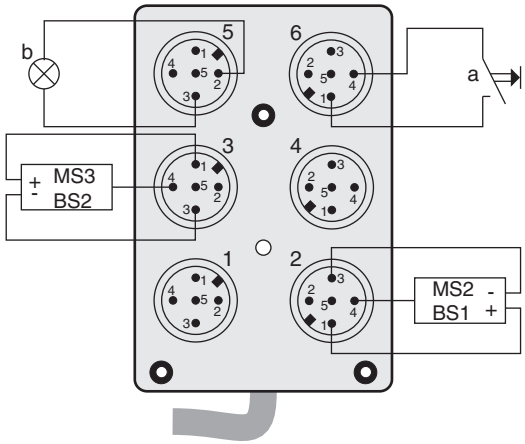
Cable splitter



MS= Muting sensor BS= Bypass sensor

Bild 11.2-25: Connection via cable splitter

Local connection box



a = Start/muting restart button MS= Muting sensor
b = External muting indicator BS= Bypass sensor

Bild 11.2-26: Connection to local connection box

11.2.8 2-sensor parallel muting (L1,L2), Cycle control with Bypass, Safety circuit (2-channel)

The connection diagrams in this chapter apply to the following Basic I/O Configurations:

- 2-sensor parallel muting (L1,L2); Safety circuit (2-channel)
- Bypass control; Safety circuit (2-channel)
- Fixed break operation (1- to 8-break); Bypass; Safety circuit (2-channel)
- 3 operating modes (external, 1oo3); Bypass; Safety circuit (2-channel)

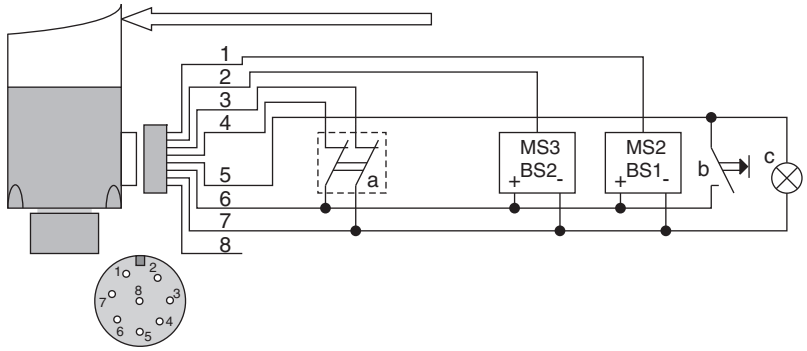
The signal line for the clear sensor for cycle control is freely selectable (FS: L1).

When selecting cycle operating mode 1oo3, an external operating mode switch with 3 signal lines must be connected. You can select any 3 free control inputs for the connection The following table shows the control logic of the 3 inputs:

1st input	2nd input	3rd input	Cycle operating mode
+24V DC	0V	0V	Guard mode
0V	+24V DC	0V	Single-break control
0V	0V	+24V DC	Double-break control

Other combinations are not permitted and will result in a fault message.

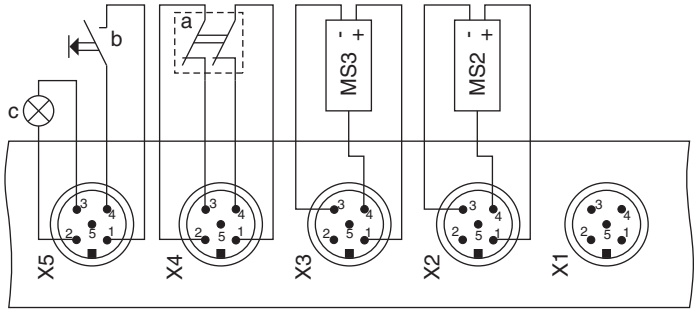
Local socket



1-8= Pin number of local socket
a = 2-channel safety circuit
b = Start/muting restart button
c = External muting indicator
MS= Muting sensor
BS= Bypass sensor

Bild 11.2-27: Connection to local socket

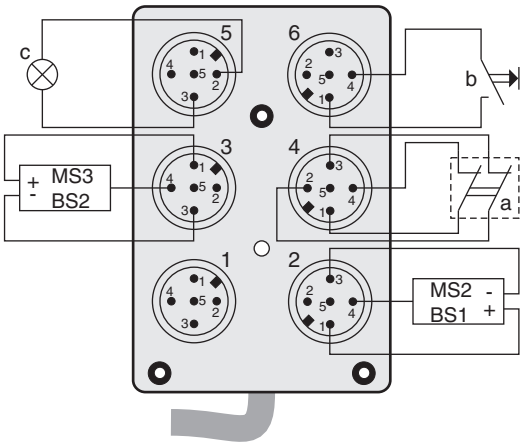
Local connection field



a = 2-channel safety circuit
b = Start/muting restart button
c = External muting indicator
MS= Muting sensor

Bild 11.2-28: Connection to local connection field

Local connection box



a = 2-channel safety circuit
b = Start/muting restart button
c = External muting indicator
MS= Muting sensor
BS= Bypass sensor

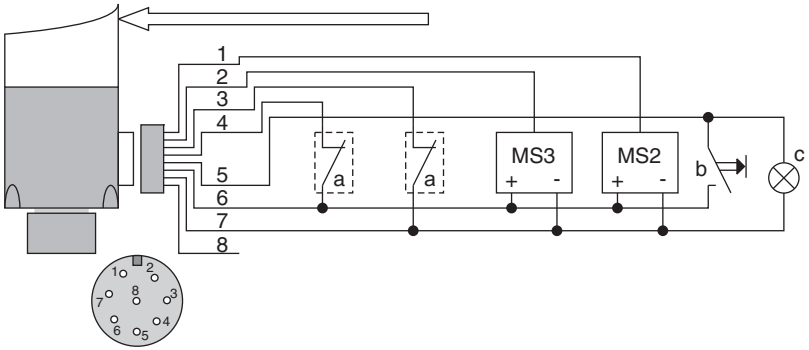
Bild 11.2-29: Connection to local connection box

11.2.9 2-sensor parallel muting (L1, L2); Two safety circuits (1-channel)

Warning!

Single-channel safety circuits are only permitted for usage in applications of Safety Category 2.

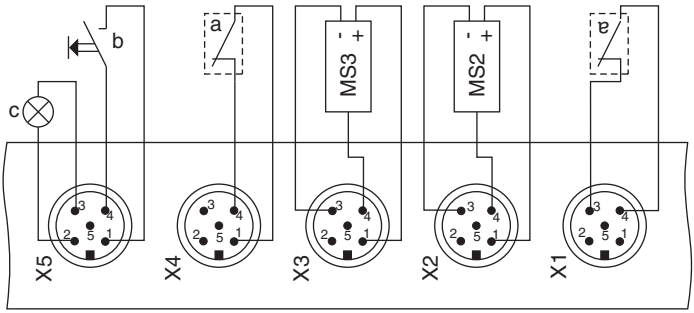
Local socket



1-8= Pin number of local socket
a = 1-channel safety circuit
b = Start/muting restart button
c = External muting indicator
MS= Muting sensor

Bild 11.2-30: Connection to local socket

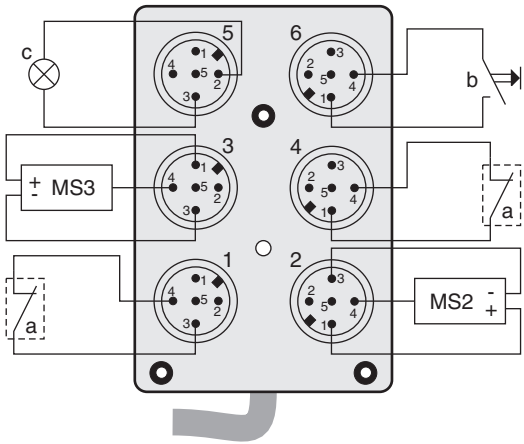
Local connection field



a = 1-channel safety circuit
b = Start/muting restart button
c = External muting indicator
MS= Muting sensor

Bild 11.2-31: Connection to local connection field

Local connection box



a = 1-channel safety circuit
b = Start/muting restart button
c = External muting indicator
MS= Muting sensor

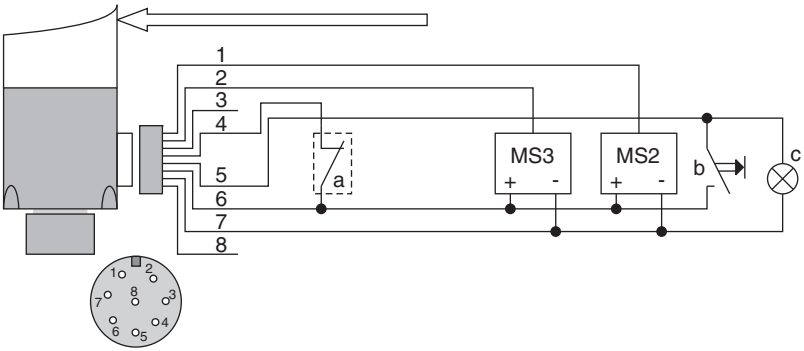
Bild 11.2-32: Connection to local connection box

11.2.10 2-sensor parallel muting (L1, L2); Safety circuit (1-channel)

Warning!

Single-channel safety circuits are only permitted for usage in applications of Safety Category 2.

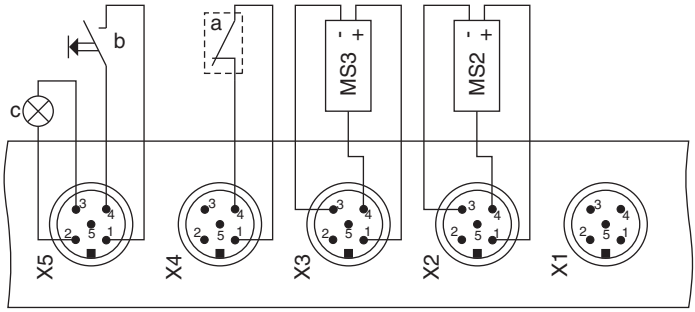
Local socket



1-8= Pin number of local socket
a = 1-channel safety circuit
b = Start/muting restart button
c = External muting indicator
MS= Muting sensor

Bild 11.2-33: Connection to local socket

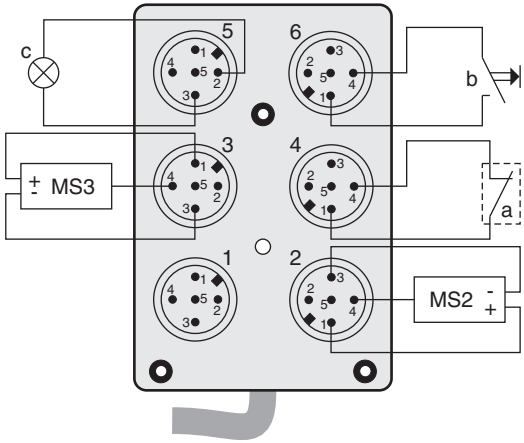
Local connection field



a = 1-channel safety circuit
b = Start/muting restart button
c = External muting indicator
MS= Muting sensor

Bild 11.2-34: Connection to local connection field

Local connection box

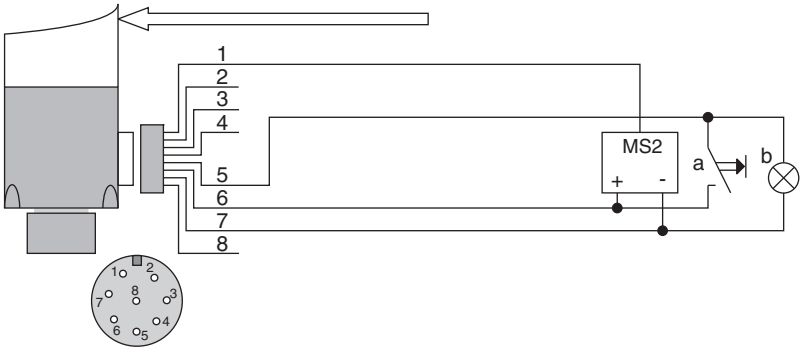


a = 1-channel safety circuit
b = Start/muting restart button
c = External muting indicator
MS= Muting sensor

Bild 11.2-35: Connection to local connection box

11.2.11 2-sensor parallel muting (L1, M5)

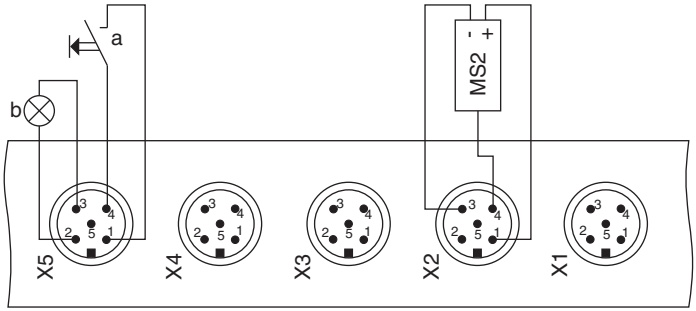
Local socket



1-8= Pin number of local socket
a = Start/muting restart button
MS3= to M5 of the machine interface
b = External muting indicator
MS= Muting sensor

Bild 11.2-36: Connection to local socket

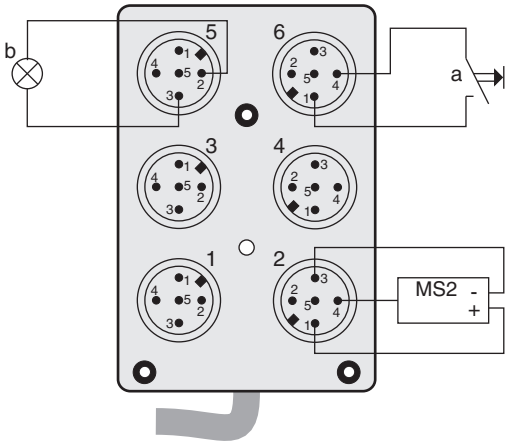
Local connection field



a = Start/muting restart button
b = External muting indicator
MS= Muting sensor
MS3= to M5 of the machine interface

Bild 11.2-37: Connection to local connection field

Local connection box

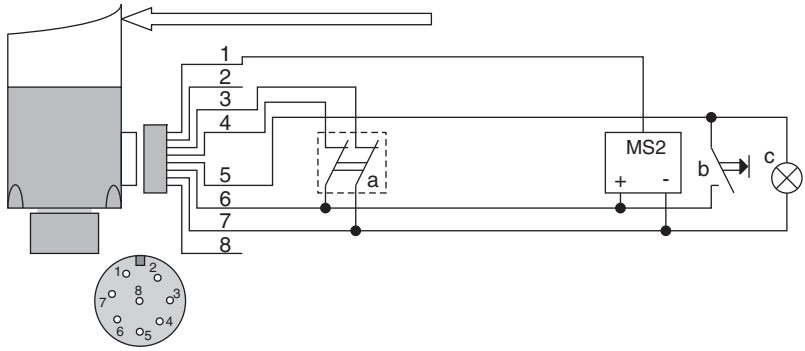


a = Start/muting restart button
b = External muting indicator
MS= Muting sensor
MS3= to M5 of the machine interface

Bild 11.2-38: Connection to local connection box

11.2.12 2-sensor parallel muting (L1, M5); Safety circuit (2-channel)

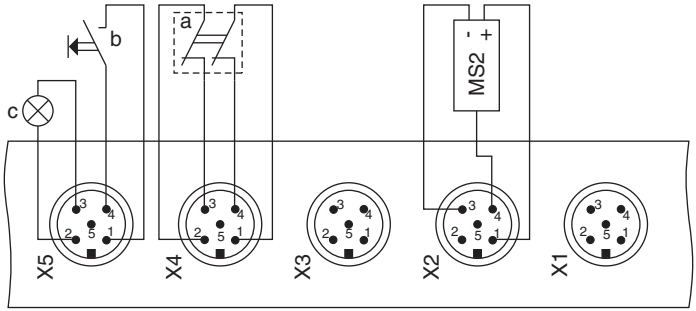
Local socket



1-8= Pin number of local socket
a = 2-channel safety circuit
b = Start/muting restart button
c = External muting indicator
MS= Muting sensor
MS3= to M5 of the machine interface

Bild 11.2-39: Connection to local socket

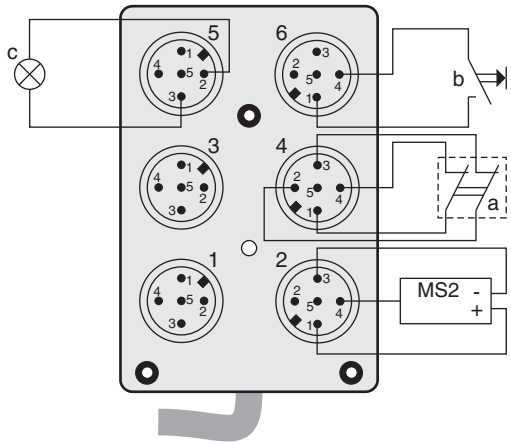
Local connection field



a = 2-channel safety circuit
b = Start/muting restart button
c = External muting indicator
MS= Muting sensor
MS3= to M5 of the machine interface

Bild 11.2-40: Connection to local connection field

Local connection box



a = 2-channel safety circuit
b = Start/muting restart button
c = External muting indicator
MS= Muting sensor
MS3= to M5 of the machine interface

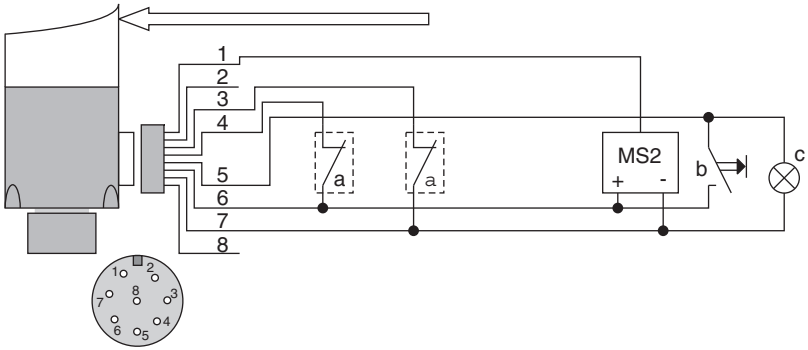
Bild 11.2-41: Connection to local connection box

11.2.13 2-sensor parallel muting (L1, M5); Two safety circuits (1-channel)

Warning!

Single-channel safety circuits are only permitted for usage in applications of Safety Category 2.

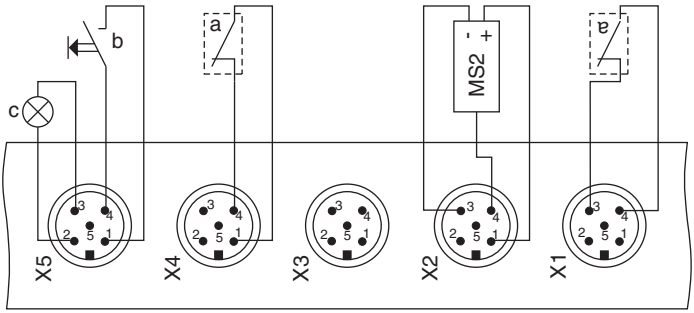
Local socket



1-8= Pin number of local socket
a = 1-channel safety circuit
b = Start/muting restart button
c = External muting indicator
MS= Muting sensor
MS3= to M5 of the machine interface

Bild 11.2-42: Connection to local socket

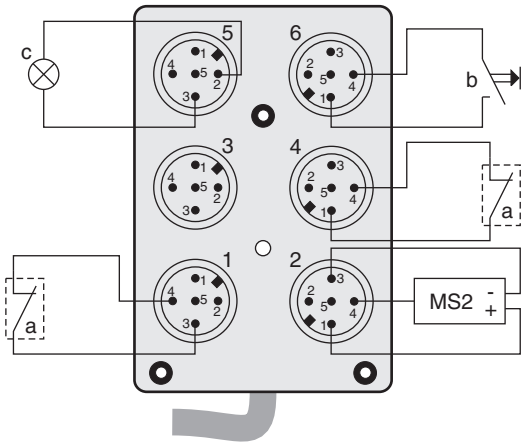
Local connection field



a = 1-channel safety circuit
b = Start/muting restart button
c = External muting indicator
MS= Muting sensor
MS3= to M5 of the machine interface

Bild 11.2-43: Connection to local connection field

Local connection box



a = 1-channel safety circuit
b = Start/muting restart button
c = External muting indicator
MS= Muting sensor
MS3= to M5 of the machine interface

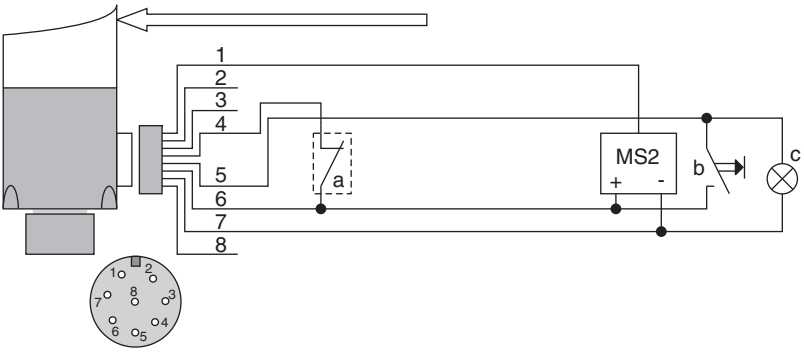
Bild 11.2-44: Connection to local connection box

11.2.14 2-sensor parallel muting (L1, M5); Safety circuit (1-channel)

Warning!

Single-channel safety circuits are only permitted for usage in applications of Safety Category 2.

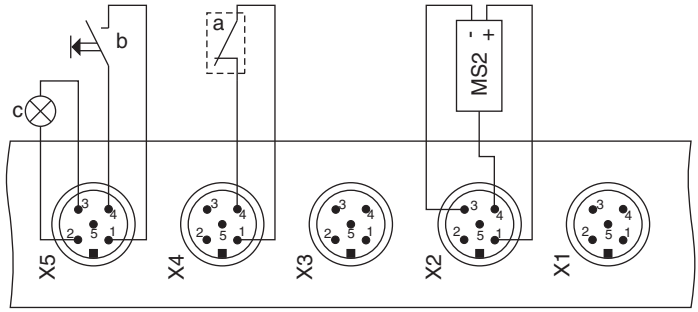
Local socket



1-8= Pin number of local socket
a = 1-channel safety circuit
b = Start/muting restart button
c = External muting indicator
MS= Muting sensor
MS3= to M5 of the machine interface

Bild 11.2-45: Connection to local socket

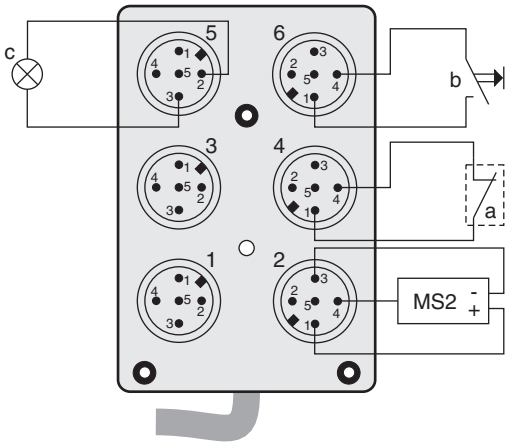
Local connection field



a = 1-channel safety circuit
b = Start/muting restart button
c = External muting indicator
MS= Muting sensor
MS3= to M5 of the machine interface

Bild 11.2-46: Connection to local connection field

Local connection box



a = 1-channel safety circuit
b = Start/muting restart button
c = External muting indicator
MS= Muting sensor
MS3= to M5 of the machine interface

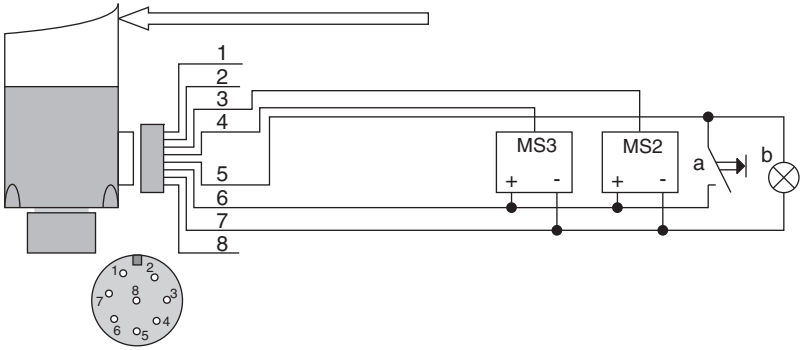
Bild 11.2-47: Connection to local connection box

11.2.15 2-sensor parallel muting (L3, L4)

Warning!

Single-channel safety circuits are only permited for usage in applications of Safety Category 2.

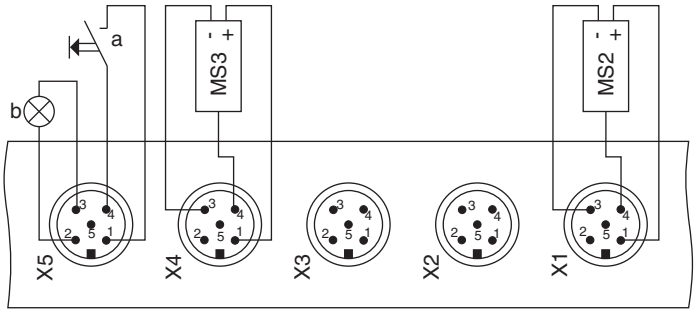
Local socket



1-8= Pin number of local socket
a = Start/muting restart button
b = External muting indicator
MS= Muting sensor

Bild 11.2-48: Connection to local socket

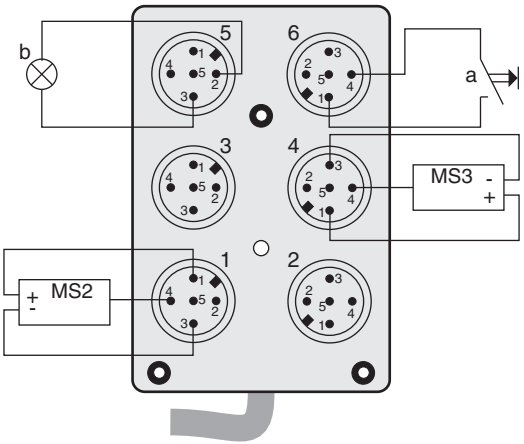
Local connection field



a = Start/muting restart button
b = External muting indicator
MS= Muting sensor

Bild 11.2-49: Connection to local connection field

Local connection box



a = Start/muting restart button
b = External muting indicator
MS= Muting sensor

Bild 11.2-50: Connection to local connection box

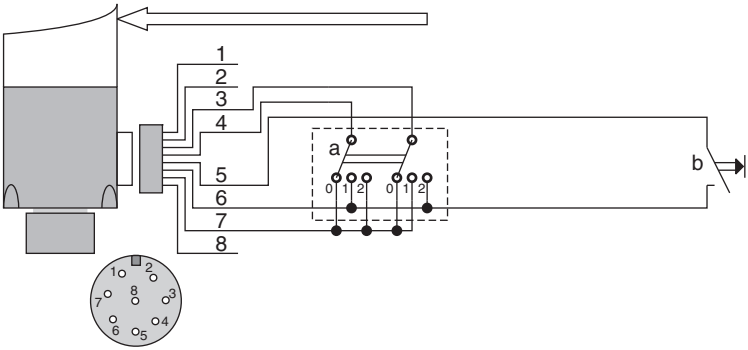
11.2.16 3 operating modes (external, binary-coded)

The following table shows the control logic for inputs L3 and L4 for the external two-level operating mode switch with binary coding:

L3	L4	Cycle operating mode
0V	0V	Guard mode
0V	+24V DC	Single-break control
+24V DC	0V	Double-break control
+24V DC	+24V DC	Reserved

An open input L3 and/or L4 is evaluated as a lead break and results in error message "E56".
The signal line for the clear sensor for cycle control is freely selectable (FS: L1).

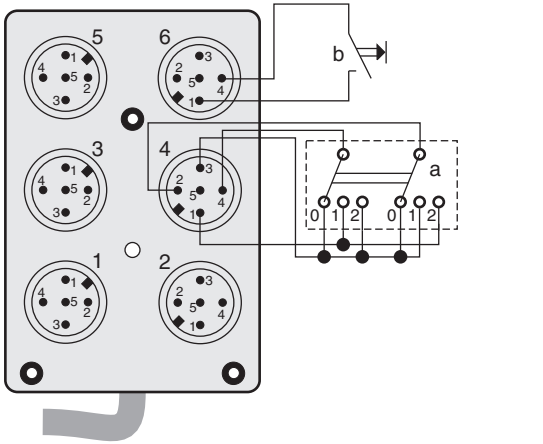
Local socket



1-8= Pin number of local socket
a = External operating mode switch for cycle control
b = Start button

Bild 11.2-51: Connection to local socket

Local connection box



a = External operating mode switch for cycle control
b = Start button

Bild 11.2-52: Connection to local connection box

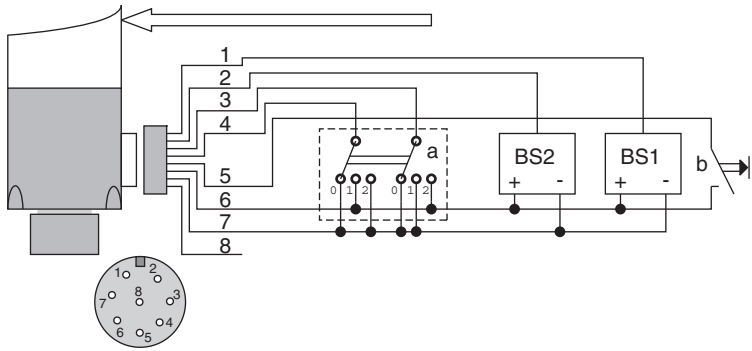
11.2.17 3 operating modes (external, binary-coded); Bypass

The following table shows the control logic for inputs L3 and L4 for the external operating mode switch:

L3	L4	Cycle operating mode
0V	0V	Guard operation
0V	+24V DC	Single-break control
+24V DC	0V	Double-break control
+24V DC	+24V DC	Reserved

An open input L3 and/or L4 is evaluated as a lead break and results in error message "E56".
The signal line for the clear sensor for cycle control is freely selectable (FS: L1).

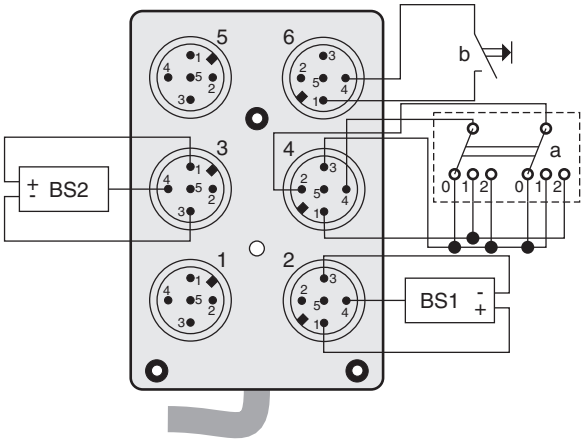
Local socket



1-8= Pin number of local socket
a = External operating mode switch for cycle control
b = Start button
BS= Bypass sensor

Bild 11.2-53: Connection to local socket

Local connection box



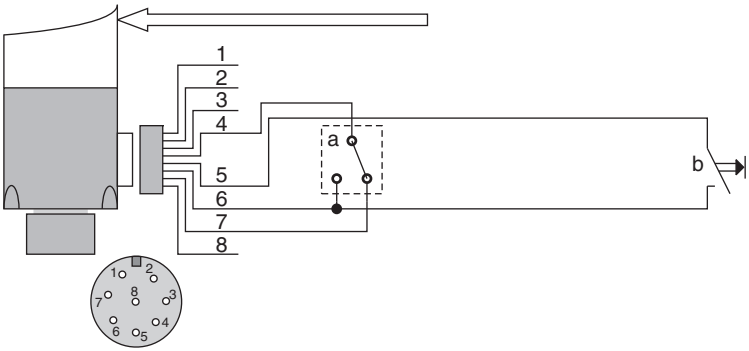
a = External operating mode switch for cycle control
b = Start button
BS= Bypass sensor

Bild 11.2-54: Connection to local connection box

11.2.18 2 operating modes (external, freely selectable)

The signal line for the clear sensor for cycle control is freely selectable (FS: L1).

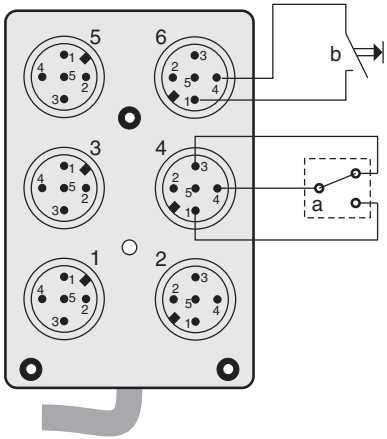
Local socket



1-8= Pin number of local socket
a = External operating mode switch for cycle control
b = Start button

Bild 11.2-55: Connection to local socket

Local connection box



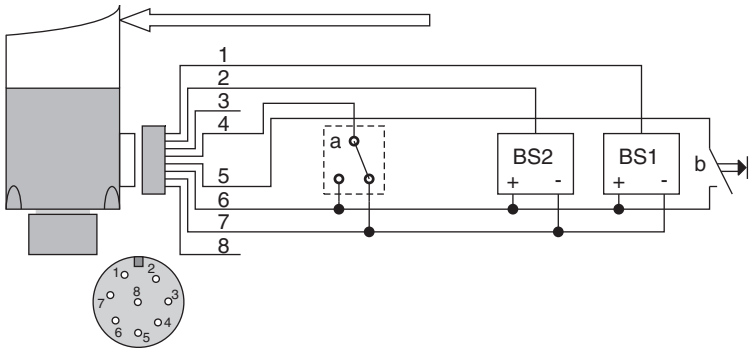
a = External operating mode switch for cycle control
b = Start button

Bild 11.2-56: Connection to local connection box

11.2.19 2 operating modes (external, freely selectable); Bypass

The signal line for the clear sensor for cycle control is freely selectable (FS: L1).

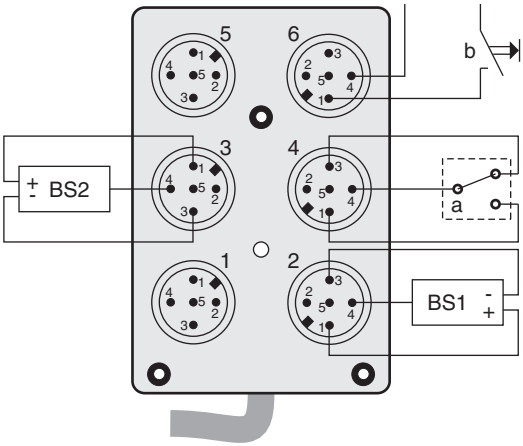
Local socket



1-8= Pin number of local socket
a = External operating mode switch for cycle control
b = Start button
BS= Bypass sensor

Bild 11.2-57: Connection to local socket

Local connection box



a = External operating mode switch for cycle control
b = Start button
BS= Bypass sensor

Bild 11.2-58: Connection to local connection box

12 Examples

To demonstrate the general process, an example of parameterization is given below for each function package.

12.1 Function Package "Blanking"

Problem:
The feeder of a punch machine into which a strip of sheet metalis being introduced, must be secured with a Safety Light Curtain. Parts are punched out of the strip of sheet metal and collected in containers arranged on the side. The rear area of the punch is secured by a protective fence. There is a door in the fence with a 2-channel safety switch that is connected to the e-stop circuit of the punch machine. After the machine is turned on, a check shall be forced to test for correct functionality of the safety components. To save cost and maintenance work, as few safety devices as possible shall be used. Since the strip is quite thin, it cannot be guaranteed that at least one beam will always be interrupted in the blanking zone.

Solution:
The COMPACT*plus* receiver with the appropriate protective field height and a resolution of 14 mm with the function package "Blanking" has a relay cap, so that the punch machine's safety circuit runs directly via the receiver. The feedback circuit of the safety circuit contactor is connected to M2. The start button is connected with L1. A lamp for start button lighting can be connected to output L2. The guard door safety circuit goes to inputs L3 and L4. Thus there is no need for a safety relay in the cabinet. A signal lamp on L5 indicates when an object outside the blanking zones interrupts the protective field.

Make the following settings with SafetyLab:

- ➢ "Basic I/O Configuration" window: Select "Safety circuit (2-channel)"; see Chapter 8.2
- ➢ "Control and Indication Signals" window: Parameterize L2 as "Output"; see Chapter 7.5
- ➢ "Protective Field" window > "[Change]": Set floating blanking with object size = 1 and size tolerance = -1 in the part of the protective field in which the strip of sheet metal is permitted to move. Set "Beam signal 1" for all beams outside the blanking zone; see Chapter 8.4 and Fig. 12.1-1. This reduces the effective resolution to 24 mm. The safety distance to the danger point must be adjusted accordingly.
- ➢ "Teach-in" window: Teach-in deactivated
- ➢ "Startup" window: Select "By intervention in the protective field" and if necessary change the time window; see Chapter 7.12
- ➢ "Start/Restart" window: Select "Manually via start button"; see Chapter 7.16
- ➢ "Start/Restart Signal" window: Select "<No combination, only one input>" and 1. input: "L1"; see Chapter 7.17
- ➢ "External Device Monitoring" window: Type of external device monitoring "Dynamic"; leave "M2", change "300 ms" if necessary; see Chapter 7.18
- ➢ "Contact-Based Safety Circuit" window: Set the startup test to "Activated"
- ➢ "Indication Signal Output" window:
  Function A = "Direct input",
  Input A = "Restart interlock ready for unlocking",
  Output A = "L2",
  Function B = "Direct input",
  Input B = "Beam signal 1",
  Output B = "L5"

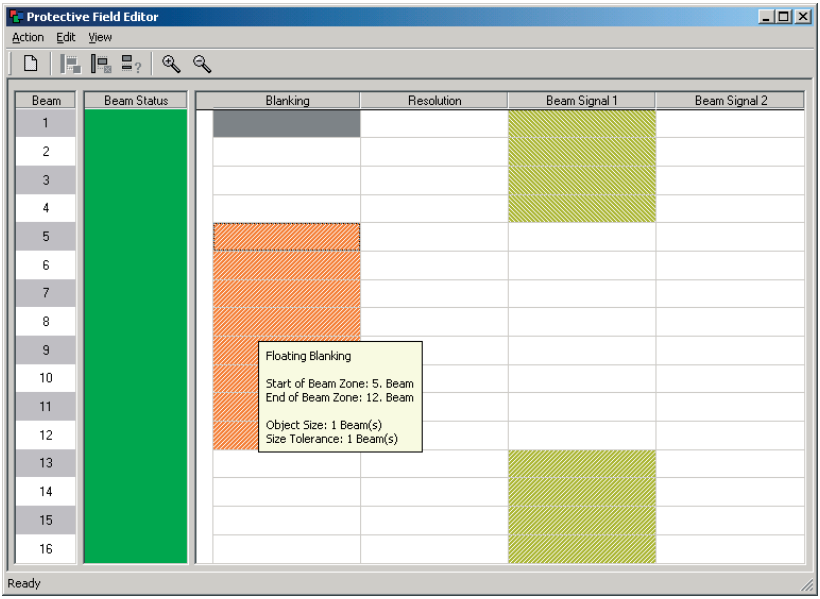


Bild 12.1-1: Parameterization of protective field for sample application punch machine

12.2 Function Package "Muting"

Problem:

A pallet transfer station is secured with a muting transceiver with integrated LED muting indicator. Since only limited space is available, muting will be activated with a reflex light barrier that is aligned diagonally over the conveyor belt and the conveyor belt control signal from a PLC. After the pallet has been placed on the conveyor belt, the PLC starts the drive. The pallet reaches the reflex light barrier and starts muting within a time window of 1 s < t < 2 s. The pallet moves through the safety equipment in normal mode within a few seconds. The muting time limit should therefore be reduced to a value of 20 seconds. If the conveyor belt comes to a stop, the muting timer stops so as not to generate an error message (which would require an operator to release it for continue production). Since the good on the pallet is covered with plastic, the light barrier may be disturbed by brief reflections during the muting. Most of these error signals will be filtered out. A number of pallet transfer stations of this type are arranged next to each other. Because of this, the OSSD status will be displayed locally to let the operator know what protective equipment might need to be restarted so that the station can be released again with the local start button. A pilot light turns on as soon as the OSSDs are turned off. The safety distance between the protective equipment and the danger point is sufficiently large so that the protective field can be set to be as insensitive as possible to interference.

Solution:
2-sensor parallel muting (L1, M5) is selected. This makes it possible to connect the muting light barrier conveniently to L1 locally while the PLC control signal to M5 is connected through the machine interface cable. Thus there is no need for a separate cable from the cabinet to the local interface. The control signals for the muting timer is also sent to M1 through the machine interface. The non-safe PLC must ensure that this signal is log. 0 when muting is activated and that it only switches to log. 1 when the conveyor belt stops during muting. If this procedure is not followed, error E53 is generated. To switch this signal only during muting, COMPACTplus reports "Muting activated" to the PLC via M3. The OSSD state is generated inversely and displayed on L2. For safety reasons, signal filtering for L1 is increased to a 100 ms on delay and 500 ms off delay. The simultaneousness expectation of parallel muting is increased to 0.5 s < t < 1.5 s. A muting prolongation of 1 second ensures that the pallet will have left the safety equipment before the end of muting.

Make the following settings with SafetyLab:

- ➢ "Basic I/O Configuration" window: Select "2-sensor parallel muting (L1, M5)"; see Chapter 9.3
- ➢ "Control and Indication Signals" window: Set the on filter time for L1 to "100 ms" and the off filter time to "500 ms". Parameterize L2 as "Input/output"; seeChapter 7.5
- ➢ "Scan Mode" window: Set the MultiScan factor to the maximum value; see Chapter 7.7
- ➢ "Muting" window; see Chapter 9.8:
  Muting time limit = "00:00:20",
  Muting timer control signal (low-active) = "M1",
  Muting prolongation time (TMp) = "1000 ms",
  Min. time for sensor simultaneousness in parallel muting (TMSpi) = "500 ms",
  Max. time for sensor simultaneousness in parallel muting (TMSpx) = "1500 ms",
- ➢ "Muting Restart" window: 1. Input = "L2", 2. input = "<not used>"; see Chapter 9.9
- ➢ "Start/Restart" window: Select "Manually via start button"; see Chapter 7.16
- ➢ "Start/Restart Signal" window: Select "<No combination, only one input>" and 1. input: "L2"; see Chapter 7.17
- ➢ "External Device Monitoring" window: Type of external device monitoring "Dynamic"; leave "M2", change "300 ms" if necessary; see Chapter 7.18
- ➢ "Indication Signal Output" window:
  Function A = "Inverted input",
  Input A = "OSSD state",
  Output A = "L2",
  Function B = "Direct input",
  Input B = "Muting activated",
  Output B = "M3"

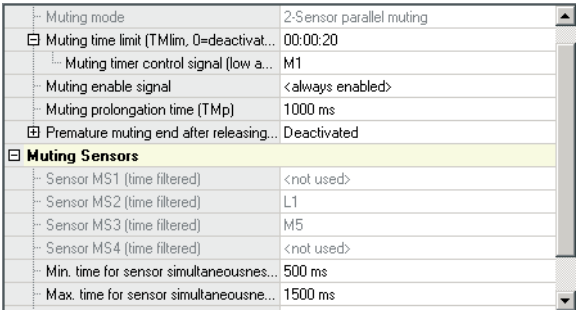


Bild 12.2-1: Settings for sample application "Muting"

12.3 Function Package "Initiation"

Problem:
Various workpieces are fed into a small hydraulic press. Depending on the workpiece, an operator changes the operating mode of the press.

- Operating mode 1: Thin sheets that protrude out beyond the protective field of the machine are processed. The Safety Light Curtain works in Guard operation with restart interlock and 1-beam reduced resolution. The safety distance is permanently set to the effective resolution that can be achieved in this arrangement.
- Operating mode 2: Heavy compact workpieces are processed. They are removed from the machine by the operator after they have been processed. Then the next workpiece is inserted for processing. The Safety Light Curtain works in double-break operation to save the start button from being pressed frequently by the operator. This increases productivity. Since the workpiece is unusable if it is inserted in the wrong position during the pressing operation, the pressing operation must not be started until the workpiece is in the correct position. To further increase productivity, the bypass function is activated in cycle operation during the upward motion of the press. A sensor in the upper reverse point generates the clear signal to delete the cycle counter. A flashing pilot light indicates locally the number of cycle interventions remaining.

Monitoring of the control valves will be implemented by the Safety Light Curtain with a feedback circuit. The status of the OSSDs will be reported to a PLC.

Solution:
The Basic I/O Configuration of the Safety Light Curtain with the function package "Initiation" is set to "2 operating modes (external, freely selectable), Bypass". Because of this, a changeover switch is expected on L4 for the operating mode, while the two bypass sensors, that are simultaneously activated within 200 ms < t < 500 ms, are connected to L1 and L2. The sensors are activated just before they run through the lower reverse point and are deactivated before they reach the upper reverse point. To save money, the clear signal is derived from the negative signal edge of a bypass sensor instead of being generated by another sensor. A 1-beam reduced resolution is set in the protective field. Reduced resolution is only in effect in Guard operation while the system switches back to full physical resolution during the changeover to double-break operation in the receiver. An enable signal is expected on L3 that enables the last cycle and thus ensures that the press is only turned on if the workpiece is in the correct position. Internal Start/Restart Interlock

and External Device Monitoring are activated. The start button and pilot light must be connected to L5, the valve feedback circuit to M2. M3 returns the OSSD state to a PLC.

Make the following settings with SafetyLab:

➢ "Basic I/O Configuration" window: Select "2 operating modes (external, freely selectable), Bypass". This defines the input for the changeover switch for selecting the operating mode to L4, bypass sensors on L1 and L2; see Chapter 10.3

➢ "Initiation Control" window; see Chapter 10.9:
Setting of Operating mode 1 = "<Guard Operation>" and Operating mode 2 = "2-break operation",
Cycle > Control > enable initiation control = "L3",
Cycle Reset > Input for cycle reset = "L2",
Cycle Reset > Input for cycle reset > cycle reset executed on = "Falling Edge"

➢ "Start/Restart" window: Select "Manually via start button"; see Chapter 7.16

➢ "Start/Restart Signal" window: Select "<No combination, only one input>" and 1. input: "L5"; see Chapter 7.17

➢ "External Device Monitoring" window: Type of external device monitoring "Dynamic"; leave "M2", change "300 ms" if necessary; see Chapter 7.18

➢ "Indication Signal Output" window:
Function A = "Direct input",
Input A = "LED (yellow)",
Output A = "L5",
Function B = "Direct input",
Input B = "OSSD state",
Output B = "M3"

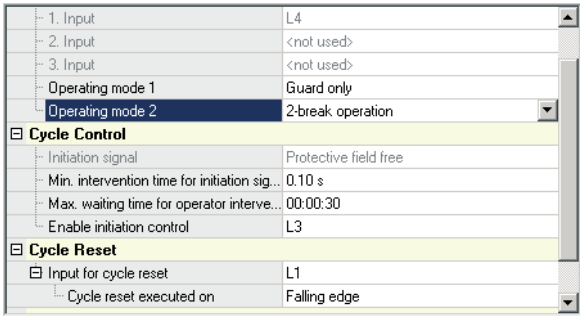


Bild 12.3-1: Settings for sample application "Cycle Control"

13 Error messages

Following is a list of all error message that can be generated by the COMPACTplus receiver, depending on the function package.

Code	Cause/significance	Measure to eliminate error
	LEDs and 7-segment displays are not lit	Check the + 24V power supply (check for reverse polarity as well). Check the connection and replace the receiver if necessary
8:8	Lit continuously → hardware error	Replace receiver
F x(x)	Internal hardware error	Replace receiver
E 1	Short circuit between OSSD1 and OSSD 2	Eliminate short
E 2	Overload on OSSD1	Connect correct load
E 3	Overload on OSSD2	Connect correct load
E 4	Overvoltage on OSSD1	Correct power supply
E 5	Overvoltage on OSSD2	Correct power supply
E 6	Short to GND on OSSD1	Eliminate short
E 7	Short to 24V on OSSD1	Eliminate short
E 8	Short to GND on OSSD2	Eliminate short
E 9	Short to 24V on OSSD2	Eliminate short
E 10	DIP switch(es) not positioned correctly	Correct switch(es) position
E 11	Current and configured number of beams are different	Configure by PC and SafetyLab the current beam parameters
E 12	Guest inserted during operation, device too long	Connect correct guest(s)
E 13	Guest removed during operation, device too short	Connect correct guest(s)
E 14	Under-voltage in the power supply	Check/replace the power unit
E 15	Reflection interference on PC-interface	Protect interface optically
E 16	Fault on an input/output	Connect signal line correctly
E 17	Error in parameterization or incorrect switch setting S1 to S6	Move switch to position L or correct parameterization with SafetyLab
E 18	Transmitter test signal received for longer than 3 seconds	Close jumpers between terminal 3 and 4 in the transmitter connection cap
E 20	EMC fault of the beams (SA)	Interference suppression for power supply and/or signal lines

Code	Cause/significance	Measure to eliminate error
E 21	EMC fault of the beams (SR)	Interference suppression for power supply and/or signal lines
E 30	Feedback contact of external device monitoring is not opening	Replace contactor and check line
E 31	Feedback contact of external device monitoring is not closing	Replace contactor and check line
E 32	Feedback contact of external device monitor not closed	Replace contactor and check line
E 39	Start button pressed too long or short-circuited	Block or remove short against 24 V
E 40	Safety circuit on L3 / L4 has short to GND	Eliminate short
E 41	Safety circuit on L3 / L4 has short to 24 V	Eliminate short
E 42	Safety circuit on L3 / L4: Simultaneity error	Replace switch
E 43	Override circuit on L3 / L4 has short to GND	Eliminate short
E 44	Override circuit on L3 / L4 has short to 24V	Eliminate short
E 45	Override circuit on L3 / L4 not connected	Connect override key button.
E 46	Override circuit on L3 / L4: Simultaneity error	Replace button
E 50	Muting time limit	Initiate muting restart
E 51	Undercurrent on muting indicator (L5)	Replace lamp
E 52	Overcurrent on muting indicator (L5)	Connect correct indicator or replace
E 53	Short circuit or wrong sequence on the control input for the muting timer control signal	Eliminate short or control correctly
E 54	Override time limit exceeded	After AutoReset: Device switches back to normal operation.
E 56	External operating mode selection switch or wire bridge not correctly connected	Check connections
E 70	Display module incompatible with the receiver's hardware	Set original display and load correct parameter set
E 71	Display module incompatible with the receiver's firmware	Set original display and load correct parameter set

Code	Cause/significance	Measure to eliminate error
E 72	Set original display and load correct parameter set	Use current version of SafetyLab
E 73	Parameter of the PROXY FB incompatible with the receiver's firmware version	Set the parameter set again and load in PROXY FB
E 95	Invalid beam parameterization	Teach-in again or parameter with SafetyLab
E 177 .. E187	PROFIBUS error	Contact the manufacturer

The following messages can also be displayed if the receiver has a PROFIsafe Interface:

b 1	Wrong sequential number or wrong CRC2 in the cyclic data
b 2	PROFIsafe Watchdog Timeout expired
b 3	The PLC has set fail-safe values
b 4	PROXY-REQUEST is set and the PROXY FB is not yet started or not yet ended (there may still be invalid parameters in the receiver)
b 5	At least one of the DIP switches is not in the left position "L"; the download of the PROXY FB generates "E17“
b 6	The functions package of the parameter set to be loaded by the PROXY FB is not compatible with the connected receiver
b 7	The number of beams of the connected receiver does not correspond with that in the parameter set of the PROXY FB
b 8	There is no valid parameter set in the PROXY FB; the receiver must be parametered again.
b 9	The last acyclic command was faulty and was not processed