



EN Operating instructions. pages 1 to 6
Translation of the original operating instructions

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ES Encontrará el manual de instrucciones actual en su idioma oficial de la UE en nuestra página de Internet www.schmersal.net.

NL U vindt de huidige versie van de gebruikshandleiding in uw officiële landstaal op het Internet, www.schmersal.net.

IT Il manuale d'istruzioni aggiornato nella vostra lingua (lingua ufficiale UE) è scaricabile in Internet all'indirizzo www.schmersal.net.

JP EU公用語で書かれた最新の取扱説明書は、インターネット (www.schmersal.net) からダウンロードできます。

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1. About this document

1.1 Function

This operating instructions manual provides all the information you need for the mounting, set-up and commissioning to ensure the safe operation and disassembly of the safety switchgear. The operating instructions must be available in a legible condition and a complete version in the vicinity of the device.

1.2 Target group: authorised qualified personnel

All operations described in this operating instructions manual must be carried out by trained specialist personnel, authorised by the plant operator only.

Please make sure that you have read and understood these operating instructions and that you know all applicable legislations regarding occupational safety and accident prevention prior to installation and putting the component into operation.

The machine builder must carefully select the harmonised standards to be complied with as well as other technical specifications for the selection, mounting and integration of the components.

1.3 Explanation of the symbols used



Information, hint, note:

This symbol is used for identifying useful additional information.



Caution: Failure to comply with this warning notice could lead to failures or malfunctions.

Warning: Failure to comply with this warning notice could lead to physical injury and/or damage to the machine.

1.4 Appropriate use

The products described in these operating instructions are developed to execute safety-related functions as part of an entire plant or machine. It is the responsibility of the manufacturer of a machine or plant to ensure the correct functionality of the entire machinery or plant.

The safety switchgear must be exclusively used in accordance with the versions listed below or for the applications authorised by the manufacturer. Detailed information regarding the range of applications can be found in the chapter "Product description".

1.5 General safety instructions

The user must observe the safety instructions in this operating instructions manual, the country-specific installation standards as well as all prevailing safety regulations and accident prevention rules.



Further technical information can be found in the Schmersal catalogues or in the online catalogue on the Internet: www.schmersal.net.

The information contained in this operating instructions manual is provided without liability and is subject to technical modifications.



The entire concept of the control system, in which the safety component is integrated, must be validated to EN ISO 13849-2.

There are no residual risks, provided that the safety instructions as well as the instructions regarding mounting, commissioning, operation and maintenance are observed.

1.6 Warning about misuse



In case of inadequate or improper use or manipulations of the safety switchgear, personal hazards or damage to machinery or plant components cannot be excluded. The relevant requirements of the standards 13855 and DIN EN ISO 13857 must be observed.

1.7 Exclusion of liability

We shall accept no liability for damages and malfunctions resulting from defective mounting or failure to comply with this operating instructions manual. The manufacturer shall accept no liability for damages resulting from the use of unauthorised spare parts or accessories.

For safety reasons, invasive work on the device as well as arbitrary repairs, conversions and modifications to the device are strictly forbidden; the manufacturer shall accept no liability for damages resulting from such invasive work, arbitrary repairs, conversions and/or modifications to the device.

2. Product description

2.1 Ordering code

This operating instructions manual applies to the following types:

SLB 400-C10-1R



Only if the information described in this operating instructions manual are realised correctly, the safety function and therefore the compliance with the Machinery Directive is maintained.

2.2 Special versions

For special versions, which are not listed in the order code below 2.1, these specifications apply accordingly, provided that they correspond to the standard version.

2.3 Destination and use

In combination with one to four testable safety light barriers, SLB 400-E50-21P (transmitter) and SLB 400-R50-21P (receiver), the SLB 400-C10-1R safety-monitoring module is a non-contact safety guard to IEC 61496, type 4, for the protection of hazardous areas on power-driven work equipment.



The user must evaluate and design the safety chain in accordance with the relevant standards and the required safety level.

2.4 Technical data

Standards:	EN 61496-1, DIN CLC/TS 61496-2, EN ISO 13849-1
Start-up test:	yes
Start conditions:	Start-reset button, on/off coding
Feedback circuit:	yes
Enclosure:	glass-fibre reinforced thermoplastic
Mounting:	Snaps onto standard DIN rail to EN 50022
Termination:	Screw terminals
Cable section:	max. 4 mm ² (incl. conductor ferrules)
Protection class:	terminals IP20, enclosure IP40
U _e :	24 VDC ± 15%
Max. fuse rating of the operating voltage:	1 A
I _e :	0.3 A without additional transistor outputs and safety light barriers
Inputs:	
Monitored inputs	max. 4 pairs of light barriers
Input resistance:	approx. 2 kΩ to GND
Input signal „1“:	10 ... 30 VDC

Input signal „0“:	0 ... 2 VDC
Max. cable length:	100 m of 0.75 mm ² conductor
Outputs:	2 enabling paths
Utilisation category:	AC-15, DC-13
I _e /U _e :	2 A / 250 VAC, 2 A / 24 VDC
Contact load capacity:	max. 250 VAC, max. 2 A (cos Ω = 1)
Switching voltage:	max. 250 VAC
Load current:	max. 2 A
Switching capacity:	max. 500 VA
Max. fuse rating:	2 A gG D-fuse
Signalling output:	2 transistor outputs, Y1 + Y2 = max. 100 mA, p-type, short-circuit proof
Response time:	≤ 25 ms
EMC rating:	conforming to EMC Directive
Max. switching frequency:	10 Hz
Overvoltage category:	II to DIN VDE 0110
Degree of pollution:	3 to DIN VDE 0110
:	10 ... 55 Hz / amplitude 0.35 mm, ± 15 %
Resistance to shock:	30 g / 11 ms
Ambient temperature:	-20 °C ... +55 °C
Storage and transport temperature:	-25 °C ... +70 °C
Dimensions:	99.7 x 75 x 110 mm

2.5 Safety classification

(in combination with the SLB 400-E/R50-21P safety light barriers)

Standards:	EN ISO 13849-1, IEC 61508
PL:	up to e
Control category:	up to 4
PFH-value:	
- up to max. 100,000 switching cycles/year:	3,08 × 10 ⁻⁸ /h at DC 2 A;
- up to max 50.000 switching cycles/year:	7,11 × 10 ⁻⁸ /h at AC 2 A
SIL:	up to 3
Service life:	20 years

2.6 Basic principles for safe utilisation

Electrical influence of the machine or plant control system to be protected must be enabled.

A switching command from the safety-monitoring module must cause the shutdown of the hazardous movement.

Settings and changes to the safety guard must only be carried out by authorised expert staff.

It must be ensured that a person cannot reach the danger point of the hazardous area before the hazardous movement has come to a standstill. As long as a person or a body part is within the danger point or the hazardous area, the machine must not restart.

Actuation of command devices destined to the release of the machine or plant from outside the hazardous area must be impossible. The operator must have a complete overview of the hazardous area.

2.7 Functions

The safety-monitoring module has a dual-channel structure. It includes two safety relays with monitored positive action contacts. The series-wired NO contacts of the relays build the enabling paths. The safety-monitoring module has inputs to monitor testable safety light barriers, a start button, a feedback contact to monitor external contactors and an input for the soiling outputs of the safety light barriers. The status of these inputs is signalled by the yellow LED located next to the terminal. The safety function of the entire system is automatically checked, after each switch-on of the ESD and each manual test request (external test signal by actuation of the corresponding command device). In addition to that, a cyclic test is performed during operation.

The operation is possible:

- with one up to four light barriers
- with or without start/restart interlock and
- with or without contactor control

The operating modes with start/restart interlock, contactor control and operation with two light barriers are factory set.

Operating principle after switch-on

After the operating voltage has been switched on, the safety-monitoring module performs an internal self-test. After that, the connected light barriers are activated and tested.

If no fault is detected, the further operation depends on the chosen operating mode. If the enabling paths of the safety-monitoring module are closed, the green "Relay" LED will be on.

If the light beam of a safety light barrier is interrupted, the enabling paths of the safety-monitoring module will be opened and the "Relay" LED will become red.

2.8 Operating modes

The desired operating modes are set by means of DIP switches, which are located below the enclosure cover. The default factory setting is the operation with one pair of light barriers (bridge between the terminals of the other connections), with start/restart interlock and with contactor control (switch settings: J1 = ON, J2 = ON, J3 = ON, J5=J6=J7=J8=OFF).

To change the basic settings, the operating voltage must be switched off and the enclosure cover of the safety-monitoring module must be opened. After the settings have been changed, the enclosure cover must be closed and the operating voltage must be switched back on.

Operating mode	switch-position	Function
Protective mode	J1=OFF, J2=OFF	As soon as the protective field is free (light beam free), the enabling paths are closed. The "relay" LED is green.
With start-/restart interlock	J1=ON, J2=ON	This operating mode avoids that the enabling paths are automatically switched to the ON condition after the operating voltage has been switched off and back on or after an intervention in the protection field (interruption of the light beam) or after a change of the device settings. The release request of the restart interlock is shown by the LED (RESTART) and the output Y1. Only after the command device/start button (NO contact) has been actuated and released (actuation time at least 250 ms and 5 s at the most), the indication will disappear and the enabling paths will be enabled.
With contactor control	J3=ON	The series-wired NC contacts of the external contactors must be connected to the feedback loop. Prior to each start-up of the safety-monitoring module, the switched-off status of the external contactors is checked (NC contact closed).
Without contactor control	J3=OFF	If the contactor control is not required, the feedback loop must not be connected.

2.9 Setting of the system codes

The up to four safety light barriers of the SLB 400-C must be tested by means of different bit patterns. In this way, a mutual interference of the light barriers is excluded. In order to avoid the mutual interference of multiple systems (multiple SLB 400-C), a specific bit pattern set can be set through the DIP switches J5 to J8.

Bit pattern set	switch-position				Operational behaviour/ Notes
	J5	J6	J7	J8	
1	OFF	OFF	OFF	OFF	System 1 (Factory setting)
2	OFF	ON	OFF	ON	System 2
3	ON	OFF	ON	OFF	System 3
4	ON	ON	ON	ON	System 4



Operation with less than four pairs of safety light barriers
If less than four pairs of safety light barriers are connected, the connections of the test inputs and the switching outputs of the non-connected light barriers must be bridged.

3. Mounting

3.1 General mounting instructions

Mount the SLB 400-C10-1R safety-monitoring module on the DIN rail in the control cabinet and wire it in accordance with the wiring diagram (refer to the paragraph "Electrical wiring") and the requirements.

3.2 Mounting of the safety light barriers

The mounting possibilities are shown on the dimensional drawing and in the technical data of the corresponding safety light barrier. When fitting the safety light barriers, the provisions of this operating instructions manual and the applicable standards and prescriptions must be observed.



Additional measures could be required to ensure that the electro-sensitive device does not present a dangerous breakdown, when other forms of light beams are available in a special application (e.g. use of wireless control devices on cranes, radiation of welding sparks or effects of stroboscopic lights).

Safety distance

The light barriers must be mounted so that a person cannot reach the danger point or the hazardous area before the hazardous movement has come to standstill and furthermore that tampering is prevented. The safety distance "S" must be calculated to the formula of EN ISO 13855.

$$S = K \times T + C$$

(K = 1,600 mm/s, T = total response time, C = constant)

Number of safety light barriers and height of the light beams:

The number of light beams and the height of the light beams above the reference floor are defined by the requirements of the power-driven work equipment, the EN ISO 13855 or a risk analysis. The following table shows the applicable values to EN ISO 13855 at the time of printing for the height of the light beams above the reference floor and the calculation of the safety distance "S":

Number of light barriers	Height of the light beams above reference floor in mm	Calculation of the safety distance "S"
4	300 / 600 / 900 / 1200	$S = (1600 \text{ mm/s} \times T) + 850 \text{ mm}$
3	300 / 700 / 1100	$S = (1600 \text{ mm/s} \times T) + 850 \text{ mm}$
2	400 / 900	$S = (1600 \text{ mm/s} \times T) + 850 \text{ mm}$
1	750	$S = (1600 \text{ mm/s} \times T) + 1200 \text{ mm}$

$T = (\text{response time of the machine} + \text{response time SLB 400-C10-1R})$
in seconds

Deflection

Surfaces, which are arranged parallel to the light beam, can cause a deflection. In that case, a obstacle in the light beam will no longer be detected. Therefore, a lateral minimum distance for the optical axis must be respected and observed with regard to reflecting surfaces or obstacles. (Fig. 1a and Fig. 1b). This distance depends on the angle of radiation of the light barrier and the distance of transmitter and receiver.

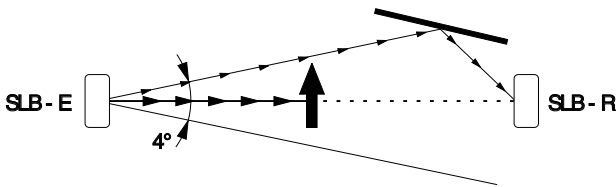


Fig. 1a: safety function inoperative

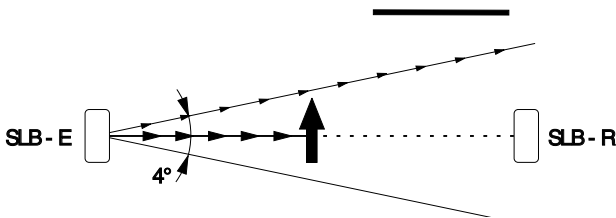


Fig. 1b: safety function operational

4. Electrical connection

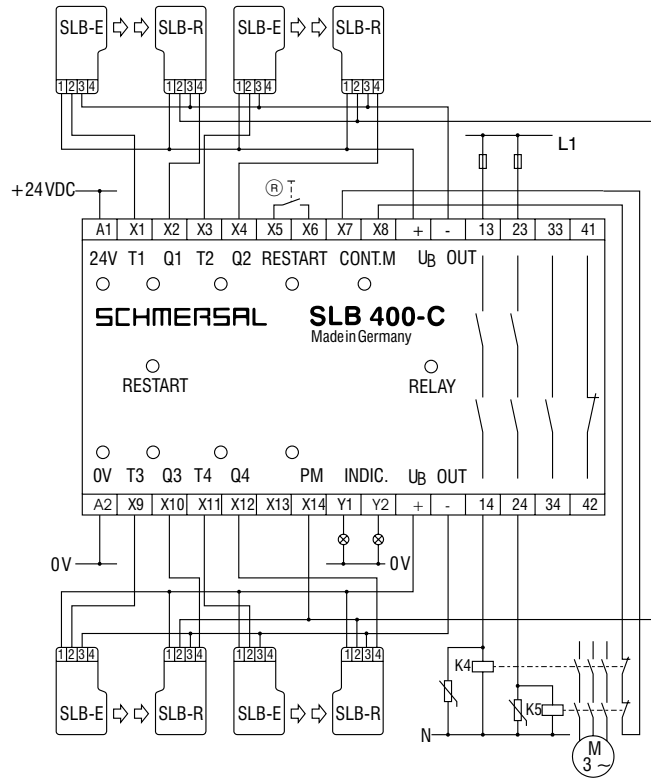


The electrical connection may only be carried out by authorised personnel in a de-energised condition. The reset button must be positioned outside of the hazardous area so that the operator has an overview of the hazardous area when actuating the reset button.

Notes on the wiring diagram

- For the protection of hazardous areas up to control category 4 / PL e to EN ISO 13849-1.
- Monitoring of one up to four pairs of safety light barriers and the power contactor using the SLB 400-C10-1R safety-monitoring module.
- Use a micro-fuse (2 A quick blow) to protect the relay output contacts.
- Terminal configuration: max. 2 wired.

4.1 Wiring example



Transmitter SLB-E

- 1 (BN): +UB
- 2 (WH): Test
- 3 (BU): 0V
- 4 (BK): not connected

Receiver SLB-R

- 1 (BN): +UB
- 2 (WH): Qp (pollution)
- 3 (BU): 0V
- 4 (BK): Q



Inductive loads must be suppressed by means of a suitable circuit (use contact protection parallel to the load). The outputs Y1 and Y2 nor the signalling contacts must be integrated in the safety circuit.



To avoid any mutual interference, every transmitter / receiver must be connected by means of a separate cable. If multiple light barriers are connected to a cable, a cable with individual conductor shielding must be used.

Operation with less than four pairs of safety light barriers

If less than four pairs of safety light barriers are connected, the terminals of the non-connected light barriers (X1/X2, X3/X4, X9/X10, X11/X12) must be bridged. Upon delivery, a bridge is installed between the terminals X3/X4, X9/X10, X11/X12.

Operation with start/restart interlock (manual start)

The operating mode with start/restart interlock (start/restart) is set through DIP switches (refer to the chapter Device settings). The command device (NO contact) is connected to the terminals X5 and X6. After the interruption of a safety light barrier, the command device must be actuated for at least 250 ms and 5 s at the most and then be released. The indication disappears and the enabling paths are enabled. If the command device is not actuated after the operating voltage has been switched on, the enabling paths remain open.

If it is possible to leave the hazardous area in the direction of the danger point, it is imperative to choose an operation with restart interlock.

4.2 Wiring

Pin	Function/connection
A1	+U _B operating voltage SLB 400-C
A2	-U _B operating voltage SLB 400-C
+	+U _B operating voltage SLB 400 E/R
-	-U _B operating voltage SLB 400 E/R
13-14	Enabling path
23-24	Enabling path

Light barriers	
X1	Connection test input light barrier 1
X2	Connection switching output light barrier 1
X3	Connection test input light barrier 2
X4	Connection switching output light barrier 2
X9	Connection test input light barrier 3
X10	Connection switching output light barrier 3
X11	Connection test input light barrier 4
X12	Connection switching output light barrier 4

Signalling outputs	
33-34	Signalling contact enabling path closed (NO contact)
41-42	Signalling contact enabling path opened (NC contact)
X5	Start/restart button (NO contact) connection, voltage tap +24 V DC
X6	Start/restart button (NO contact) connection, input
X7	Feedback circuit connection, voltage tap +24 V DC
X8	Feedback circuit connection, input
X14	Signal input, safety light barrier(s) soiled
Y1	Signal output, enabling request of the start/restart interlock
Y2	Signal output, safety light barrier(s) soiled

5. Set-up and maintenance

5.1 Functional testing

The safety function of the safety components must be tested. The following conditions must be previously checked and met:

1. Correct assembly of the safety light barriers
2. Check the integrity of the cable entry and connections.
3. Check the safety light barrier's and the safety-monitoring module's enclosure for damage.
4. If one or more light barriers are interrupted, the hazardous movement is brought to standstill
5. The safety distance of the application exceed the mathematically calculated one.

5.2 Diagnostic

LED display

The LED indication of the safety-monitoring module shows the different switching conditions and errors. The switching conditions are explained in the table.

LED	Colour	Function
Power	green	LED is on, when the operating voltage is correctly connected.
Restart	yellow	LED is on, when the actuation of the command device (start/restart button) by the operator is requested. The LED stays on, until the button has been correctly (incl. times) actuated.
Input LED's	yellow	LED's are on, when a positive voltage is present at the corresponding input terminal.
RELAY	green	Enabling paths closed (system ready for operation and clear)
	red (permanently)	Enabled paths opened (system ready for operation, however not clear)
	red (flashing)	System error (flash code, refer to paragraph "Diagnostic")

Integral system diagnosis (ISD)

In case of error messages, the "RELAY" LED of the safety-monitoring module lights intermittently red. During these intermissions, the LED flashes one up to six times with short pulses. The possible errors and their causes are listed in the following table.

Display	Error	Cause
one impulse	Short-circuit	Short-circuit in the cable, the test inputs of the light barriers, the contacts of the contactor control, the button of the restart interlock.
two impulses	Contactor control	The contactor control is disabled through the DIP switches and there is a positive signal at the input.
three impulses	DIP-switch	The restart interlock or the bit pattern set is not set with a dual-channel structure at the DIP switch.
four impulses	Relay	Error of the internal relays or their control, supply voltage too low.
five impulses	Interference signals	Too high inductive or capacitive interferences on the connecting cables
six impulses	internal error	Error at an input circuit or processor error

Deleting the error message

The error message is deleted, when the error cause is eliminated and the protection field of at least one light barrier has been interrupted.

5.3 Maintenance

A regular visual inspection and functional test, including the following steps, is recommended:

1. Check the correct fixation of the safety light barriers
2. Clean the optics of the transmitter and the receiver with a soft, clean cloth. The use of aggressive, abrasive or scratching cleaning agents, which could attack the surface, is prohibited.
3. The total response time of the machine does not exceed the response time calculated during the first putting into operation.

6. Disassembly and disposal



6.1 Disassembly

The safety switchgear must be disassembled in a de-energised condition only.

6.2 Disposal

The safety switchgear must be disposed of in an appropriate manner in accordance with the national prescriptions and legislations.

7.1 EC Declaration of conformity

	
EC Declaration of conformity	
Translation of the original declaration of conformity K.A. Schmersal GmbH Industrielle Sicherheitsschaltssysteme Möddinghofe 30, 42279 Wuppertal Germany Internet: www.schmersal.com	
We hereby certify that the hereafter described safety components both in its basic design and construction conform to the applicable European Directives.	
Name of the safety component:	SLB 400-C10-1R (in combination with SLB 400-E/R50-21P)
Description of the safety component:	Electro-sensitive safety device with non-contact operating principle BWS
Harmonised EC-Directives:	2006/42/EC EC-Machinery Directive 2004/108/EC EMC-Directive
Person authorized for the compilation of the technical documentation:	Ulrich Loss Möddinghofe 30 42279 Wuppertal
Notified body, which approved the full quality assurance system, referred to in Appendix X, 2006/42/EC:	TÜV Rheinland Industrie Service GmbH Alboinstraße 56 12103 Berlin ID n°: 0035
Place and date of issue:	Wuppertal, June 22, 2011
SLB 400-C-B-BE	
	Authorised signature Heinz Schmersal Managing Director



The currently valid declaration of conformity can be downloaded from the internet at www.schmersal.net.



K. A. Schmersal GmbH
Industrielle Sicherheitsschaltssysteme
Möddinghofe 30, D - 42279 Wuppertal
Postfach 24 02 63, D - 42232 Wuppertal

Telefon +49 - (0)2 02 - 64 74 - 0
Telefax +49 - (0)2 02 - 64 74 - 1 00
E-Mail: info@schmersal.com
Internet: <http://www.schmersal.com>