OPERATING INSTRUCTIONS

HS80

Safety scanner system for woodworking machines

en

SICK
Sensor Intelligence.

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1 About this document

Please read this chapter carefully before working with this documentation and the HS80 safety scanner system.

1.1 Function of this document

These operating instructions are designed to address *the technical personnel of the machine manufacturer* or *the machine operator* in regards to correct mounting, configuration, electrical installation, commissioning, operation and maintenance of the HS80 safety scanner system.

These operating instructions do *not* provide instructions for operating machines on which the safety scanner system is, or will be, integrated. Information on this is to be found in the appropriate operating instructions for the machine or the system.

1.2 Target group

These operating instructions are addressed to *planning engineers*, *machine designers* and *operators* of plants and systems which are to be protected by one or several HS80 safety scanner systems. They also address people who integrate the HS80 into a machine, initialize its use, or who are in charge of servicing and maintaining the device.

1.3 Depth of information

These operating instructions contain information on the HS80 safety scanner system on the following subjects:

- mounting
- electrical installation
- putting into operation and configuration
- care and maintenance
- fault diagnosis and troubleshooting
- part numbers
- conformity and approval

Planning and using protective devices such as the HS80 also require specific technical skills which are not detailed in this documentation.

When operating the HS80, the national, local and statutory rules and regulations must be observed.

General information on accident prevention using opto-electronic protective devices can be found in the brochure “Guidelines Safe Machinery”.

Note Please refer also to the information on the Internet at www.sick.com.

1.4 Scope

These operating instructions are original operating instructions.

Note This document is part of SICK part number 8013516 (operating instructions “HS80 safety scanner system” in all available languages).

For the configuration and diagnostics on these devices, you will need an SOPAS ET (configuration and diagnostics software for laser scanner), version 2.22 or later, specially configured for the HS80 safety scanner system as well as the Flexi Soft Designer (configuration and diagnostic software for the Flexi Soft safety controller), version 1.2 or later.

1.5 Abbreviations used

ANSI American National Standards Institute

AWG American Wire Gauge = standardization and classification of wires and cables by type, diameter etc.

EDM External device monitoring

EFI Enhanced function interface = safe SICK device communication

ESD Electrostatic discharge

ESPE Electro-sensitive protective equipment

FPLC fail-safe programmable logic controller

OSSD Output signal switching device = signal output of the protective device that is used to stop the dangerous movement

SOPAS ET SICK OPEN PORTAL for APPLICATION and SYSTEMS ENGINEERING TOOL = software for the configuration and diagnostics of the laser scanner LMS80-S01

1.6 Symbols used

Recommendation Recommendations are designed to give you some assistance in your decision-making process with respect to a certain function or a technical measure.

Note Refer to notes for special features of the device.

Display indicators show the status of the 7-segment display on the LMS80-S01 laser scanner:

Constant indication of characters, e.g. 8

● Red, **☼ Yellow**, **○ Green** LED symbols describe the state of a diagnostics LED. Examples:

● Red The red LED is illuminated constantly.

☼ Yellow The yellow LED is flashing.

○ Green The green LED is off.

➢ Take action ... Instructions for taking action are shown by an arrow. Read carefully and follow the instructions for action.

WARNING

Warning!

A warning notice indicates an actual or potential risk or health hazard. They are designed to help you to prevent accidents.

Read carefully and follow the warning notices!

Software notes show you where the related setting can be made in the SOPAS ET or in the Flexi Soft Designer software.

The term “dangerous state”

The dangerous state (standard term) of the machine is always shown in the drawings and diagrams of this document as a movement of a machine part. In practical operation, there may be a number of different dangerous states:

- machine movements
- electrical conductors
- visible or invisible radiation
- a combination of several risks and hazards

2 On safety

This chapter deals with your own safety and the safety of the equipment operators.

➢ Please read this chapter carefully before working with the HS80 or with the machine protected by the HS80.

2.1 Qualified safety personnel

The HS80 safety scanner system must only be installed, commissioned and serviced by qualified safety personnel. Qualified safety personnel are defined as persons who

- due to their specialist training and experience have adequate knowledge of the power-driven equipment to be checked

and

- have been instructed by the responsible machine owner in the operation of the machine and the current valid safety guidelines

and

- are sufficiently familiar with the applicable official health and work safety regulations, directives and generally recognized engineering practice (e.g. DIN standards, VDE stipulations, engineering regulations from other EU member states) that they can assess the work safety aspects of the power-driven equipment

and

- have access to these operating instructions and have read them.

As a rule these are qualified safety personnel from the ESPE manufacturer or also persons who have been appropriately trained at the ESPE manufacturer, are primarily involved in checking ESPE and are allocated the task by the organization operating the ESPE.

2.2 Applications of the device

The HS80 safety scanner system is used to protect persons and plant. The system is only approved for **hazardous area protection on woodworking machines**, mounted on the cutter head cover. The maximum relative velocity of 8.9 m/s must not be exceeded.

The system is intended to be used in particle and dust-laden environments indoors. The HS80 is not suitable for applications outdoors.

The HS80 does not provide protection against parts thrown out or radiation emitted.

The HS80 complies with the requirements in the standard on the radiated emissions as defined for class A (industrial application). When used in residential areas it can cause radio interferences.

The HS80 is not designed and tested in accordance with IEC 61496 and cannot be used in applications that require sensors in accordance with this standard.

The HS80 corresponds to category 2 PL d in accordance with EN ISO 13849-1.

Note Depending on the application, other protective devices and measures may be required in addition to the HS80 safety scanner system.

2.3 Correct use

The HS80 safety scanner system is only allowed to be used in the context of section 2.2 “Applications of the device” on page 8 and only in connection with a suitably mounted test target. It must be used only by qualified personnel and only on the machine where it has been installed and initialized by qualified safety personnel in accordance with these operating instructions. It is only permitted to be used on machines on which the dangerous state can be stopped immediately by the HS80 and/or it is possible to prevent the machine being placed in operation.

Note If the device is used for any other purposes or modified in any way — also during mounting and installation — any warranty claim against SICK AG shall become void.

2.4 General safety notes and protective measures

WARNING

Pay attention to the safety notes!

Please observe the following items in order to ensure the correct use of the HS80 safety scanner system.

CAUTION!

Laser radiation!

The LMS80-S01 operates with an infrared-light laser diode. The laser beam cannot be seen with the human eye.

The LMS80-S01 corresponds to laser class 1 (eye safe) as per IEC 60 825-1:2014. Identical laser class for issue IEC 60 825-1:2007.
Complies with 21 CFR 1040.10 with the exception of the deviations as per Laser Notice No. 50, June, 2007.

- Incorrect usage can result in hazardous exposure to laser radiation.

➢ Do not open the housing (opening the housing will not switch off the laser).

➢ Pay attention to the laser safety regulations as per IEC 60 825-1 (latest version).

Important No maintenance is necessary to ensure compliance with laser class 1.

Laser power

The laser operates at a wavelength λ = 905 nm (invisible infrared light). The radiation emitted in normal, appropriate operation is not harmful to the eyes and human skin.

Laser output aperture

The laser output aperture is the window of the optics cover on the LMS80-S01.

Fig. 1: LMS80-S01 laser output aperture

- During the mounting, installation and usage of the HS80, observe the standards and directives applicable in your country. You will find an overview of the most important regulations in section 2.6 “Applicable directives and standards” on page 12.
- National/international rules and regulations apply to the installation, commissioning, use and periodic technical inspections of the HS80. In particular the following rules and regulations are to be followed:
  - Machinery Directive
  - Work Equipment Directive
  - the work safety regulations/safety rules
  - other relevant safety regulations
- Pay attention in particular to the test notes (see section 8.3 on page 58) the notes on mounting the test target (see section 4.3 on page 35) as well as the description of the dimensioning of the test field (see section 7.2 on page 56).
- Manufacturers and operators of the machine on which the HS80 is used are responsible for obtaining and observing all applicable safety regulations and rules.
- The notes in these operating instructions on use, mounting, installation or integration into the existing machine controller must be observed. Pay attention in particular to the test notes (see section 8.3 on page 58).
- Changes to the configuration of the devices can degrade the protective function. After every change to the configuration you must therefore check the effectiveness of the protective device. The person who makes the change is also responsible for the correct protective function of the device. When making configuration changes, please always use the password hierarchy provided by SICK to ensure that only authorized persons make changes to the configuration. The SICK service team is available to provide assistance if required.
- The tests must be carried out by qualified safety personnel or specially qualified and authorized personnel and must be recorded and documented to ensure that the tests can be reconstructed and retraced at any time.
- The operating instructions must be made available to the operator of the machine where the HS80 is used. The machine operator is to be instructed in the use of the device by qualified safety personnel and must be instructed to read the operating instructions.
- The external voltage supply for the system components must be capable of buffering brief mains voltage failures of 20 ms as specified in EN 60 204-1. Suitable power supplies are available as accessories from SICK.

➢ Enclosed with these operating instructions is a checklist for checking by the manufacturer and OEM (see section 13.2 on page 87). Use this checklist when checking the system that is protected with the HS80.

2.5 Environmental protection

The HS80 safety scanner system has been designed to minimize environmental impact. It uses only a minimum of power and natural resources.

At work, always act in an environmentally responsible manner. For this reason please note the following information on disposal.

Disposal

- Always dispose of unserviceable or irreparable devices in compliance with local/national rules and regulations with respect to waste disposal.
- Remove the plastic parts and send the aluminium housing of the laser scanner for recycling.
- Dispose of all electronic assemblies as hazardous waste. The electronic assemblies are straightforward to dismantle.

Note We would be pleased to be of assistance on the disposal of these devices. Contact your local SICK representative.

2.6 Applicable directives and standards

The most important directives and standards, valid for the use of opto-electronic protective devices in Europe, are listed below. Further regulations may be of importance to you, depending on the application. You can obtain further information of machine-specific standards from national institutions (e.g. DIN, BSI, AFNOR etc.), the authorities or your trade association.

If you operate the machine or system in a country outside the European Union, please contact the manufacturer of the plant and the local authorities and obtain information on the regulations and standards applicable there.

Application and installation of protective devices

Machinery Directive, e.g.:

- Safety of machinery — Basic concepts, general principles for design (EN ISO 12100)
- Industrial automation systems — Safety of integrated manufacturing systems — Basic requirements (ISO 11161)
- Safety of machinery — Electrical equipment of machines — Part 1: General requirements (EN 60204-1)
- Safety of machinery — safety distances to prevent hazard zones being reached by the upper and lower limbs (EN ISO 13857)
- Safety of machinery — The positioning of protective equipment in respect of approach speeds of parts of the human body (prEN ISO 13855)
- Safety of machinery — Principles of risk assessment (EN ISO 14121-1)
- Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design, Part 2: Validation (EN ISO 13849-1/EN ISO 13849-2)

Foreign standards, for example:

- Performance Criteria for Safeguarding (ANSI B11.19)

Recommendation Please request our brochure on this subject “Guidelines Safe Machinery”.

3 Product description

This chapter provides information on the special features and properties of the HS80 safety scanner system. It describes the construction and the operating principle of the system, in particular the different operating modes.

➢ Please read this chapter before mounting, installing and commissioning the device.

3.1 Special features

- protective field range of the laser scanners up to 2.5 m
- two separate protective fields
- 270° scan angle
- ambient operating temperatures of 0 °C ... +50 °C
- particle filter
- high immunity to ambient light
- integrated external device monitoring (EDM)
- integrated restart interlock/restart interlock delay for which can be configurated
- status indication by LEDs and 7-segment display on the laser scanners and the safety controller
- automatic testing of the system at pre-defined test rate
- configuration using PC or notebook with SICK user software
- configuration memory in the laser scanners and in the safety controller
- bus interface possible on the controller
- safety controller modularly expandable (for the operation of several laser scanners and/or other functions e.g. emergency stop)

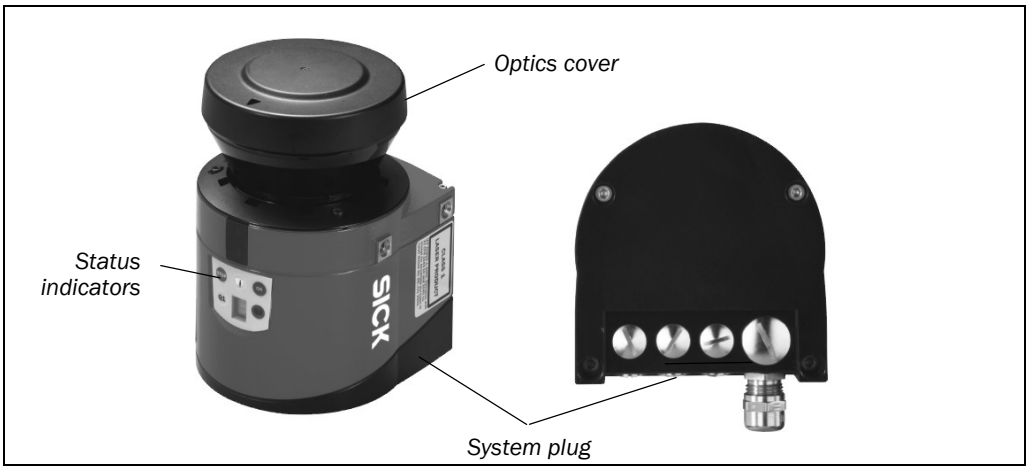
3.2 System components

The HS80 safety scanner system comprises a modular Flexi Soft safety controller and one or more laser scanners LMS80-S01.

3.2.1 Laser scanner LMS80-S01

The laser scanner LMS80-S01 with 270° scan angle and IP 65 is equipped with a contamination measurement for the front screen as well as a hardware and software filter for interference suppression.

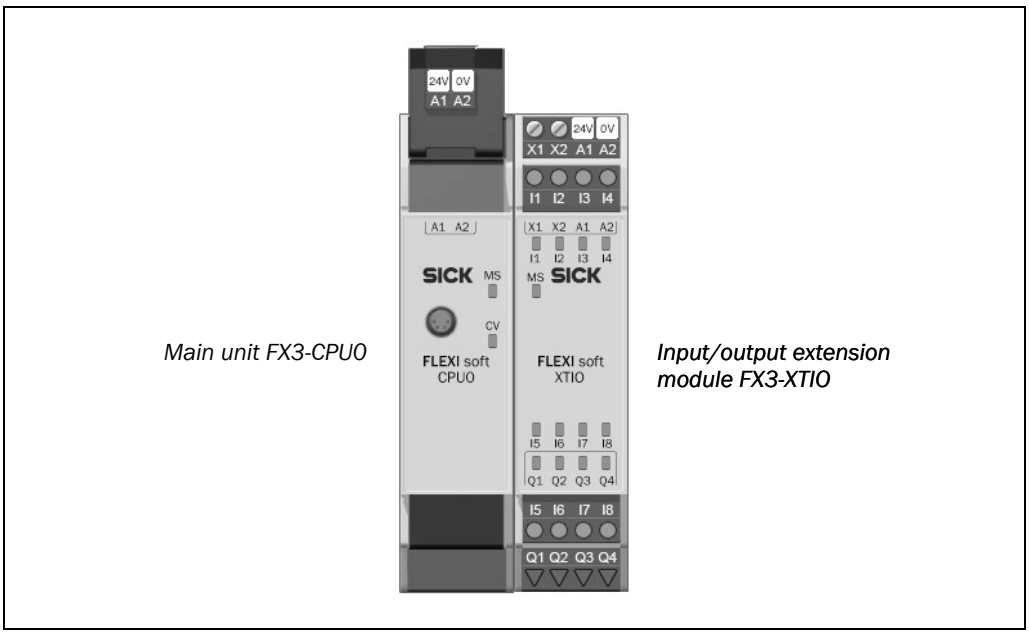
Fig. 2: Laser scanner LMS80-S01



3.2.2 Flexi Soft safety controller

The Flexi Soft safety controller comprises a main unit FX3-CPU0 and one or two input/output extension modules FX3-XTIO each with 8 safe inputs and 4 safe outputs, protection class IP 20 (installation in control cabinets).

Fig. 3: Flexi Soft safety controller



3.3 Function

The HS80 safety scanner system operates correctly as a protective device only if the following conditions are met:

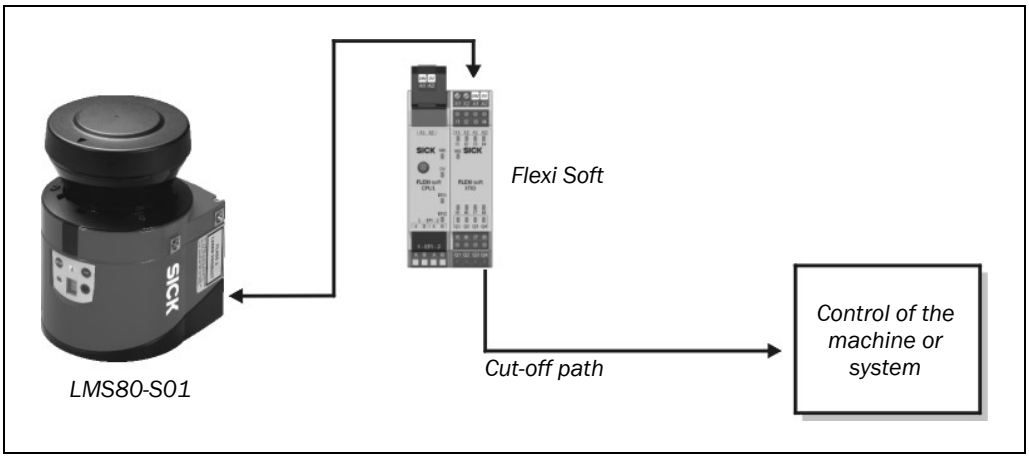
- The laser scanner must be controlled and monitored by the Flexi Soft safety controller.
- The control of the machine or system must be electrical.
- It must be possible to transfer the dangerous state of the machine or the system to a safe state at any time using the OSSD/s on the Flexi Soft after integration in the controller.
- The laser scanner must be mounted and configured such that it detects objects as they enter the hazardous area (see chapter 7 “Dimensioning” on page 51).
- An external test target must be mounted as in section 4.3 “Mounting of the test target” on page 35.

The HS80 is a self-testing safety scanner system and all its functions are monitored by the Flexi Soft safety controller.

Along with optical testing of the detection performance of the laser scanners, their output signals are also integrated in the test method and are monitored for correct switching cycles and correct function during operation.

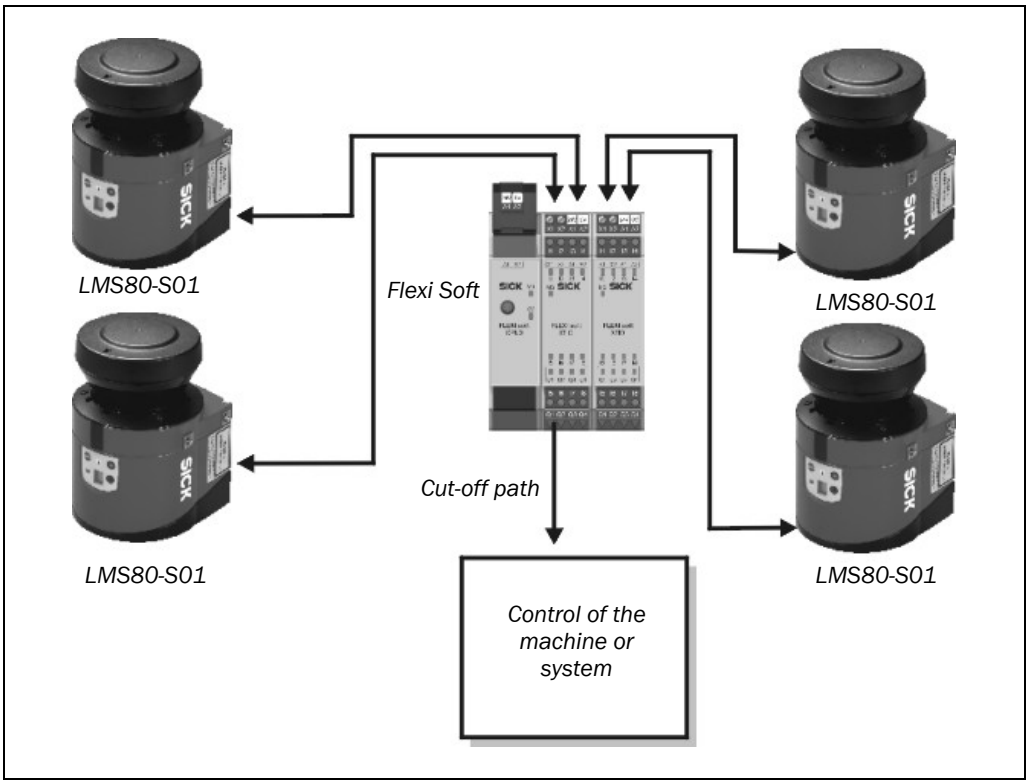
The system is integrated into the machine using the controller, including the necessary cut-off paths.

Fig. 4: Function of the HS80 safety scanner system



If more than two laser scanners are integrated into a HS80 system, the Flexi Soft safety controller must be equipped with two input/output extension modules FX3-XTIO.

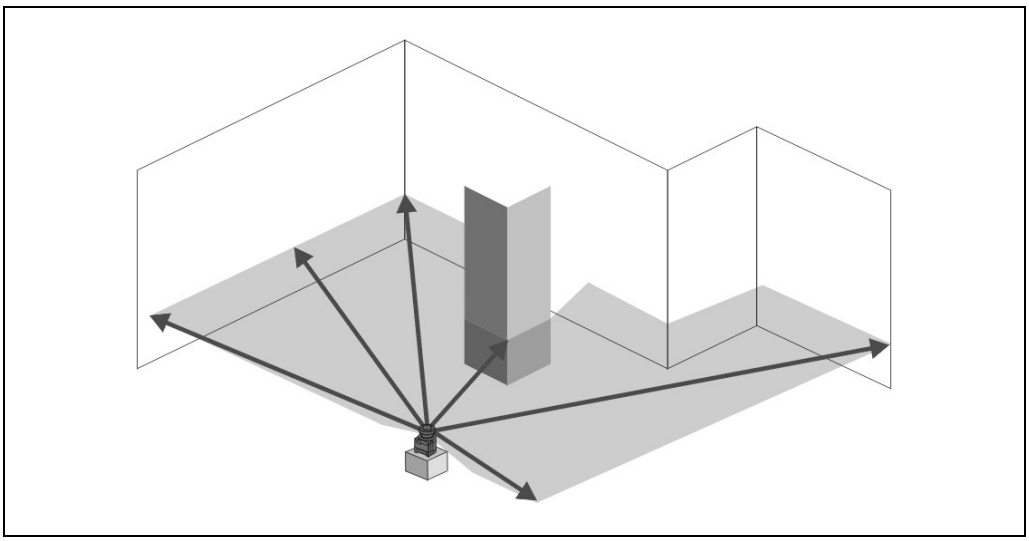
Fig. 5: Function of the safety scanner system with four LMS80-S01



3.4 Principle of operation of the laser scanner

The LMS80-S01 is an opto-electronic laser scanner that electro-sensitively scans the perimeter of its surroundings in a single plane. The LMS80-S01 measures its surroundings using two-dimensional polar co-ordinates. If a laser beam strikes an object, the position of the object is determined in the form of distance and direction.

Fig. 6: Scanning by the LMS80-S01

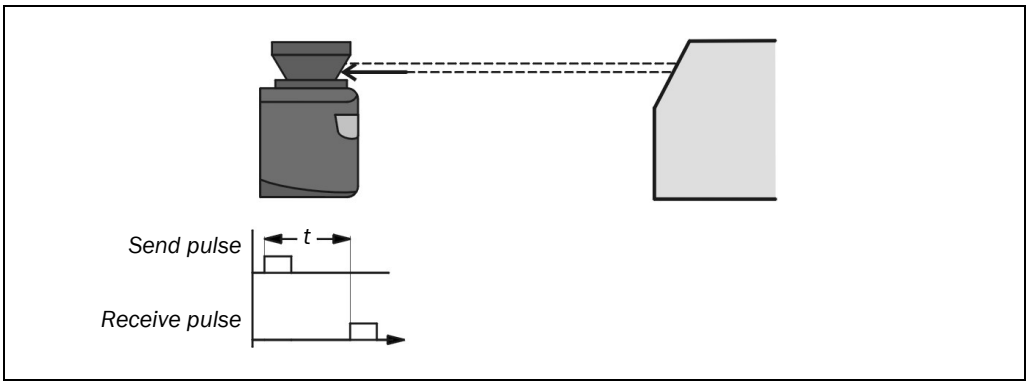


Scanning takes place over a scan angle of 270°.

Distance measurement by means of pulse propagation time measurement

The scanning range for the distance measurement is a maximum of 2.5 m. The laser scanner emits pulsed laser beams using a laser diode. If such a laser pulse strikes an object or a person, it is reflected at the related surface. The reflection is detected in the laser scanner's receiver using a photodiode.

Fig. 7: Principle of operation for pulse propagation time measurement



The safety laser scanner calculates the distance to the object from the propagation time (t) that the light requires from emission to reception of the reflection at the laser scanner. This principle of "pulse propagation time measurement" is used by radar systems in a similar manner.

Due to its active scanning principle, the laser scanner does not require external receivers nor reflectors. This has the following advantages:

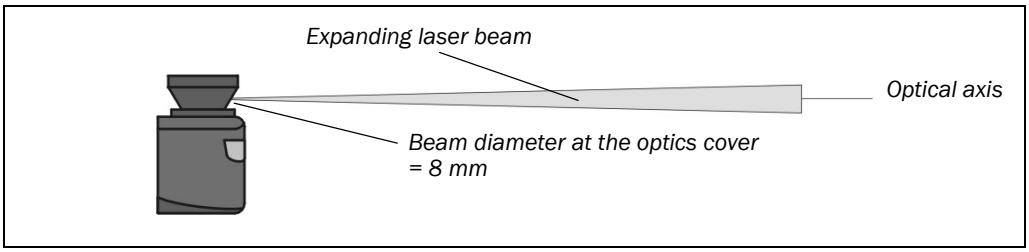
- Your installation effort is lower.
- You can easily adapt the monitored area to the hazardous area on a machine.
- In comparison with contact sensors, there is less wear when electro-sensitive scanning is used.

Beam diameter

With increasing distance from the laser scanner, the laser beam expands. As a result the diameter of the measured point on the surface of the object increases.

The distance-dependent diameter of the measured point is the distance (mm) × 0.015 rad + 8 mm.

Fig. 8: Expansion of the laser beam



3.4.1 Detection range

The scanning range of the laser scanner is dependent on the remission, the objects to be detected, the object size and the contamination on the optics cover.

The system is dimensioned for the detection of objects with a diameter of 70 mm and 10 % remission in a range segment from 0.1 m-2.5 m.

Examples for remissions:

- paper, white 80 %
- cardboard 70 %
- cork 35 %
- pallet wood 20 %
- photographic card, matt black 10 %

3.4.2 Protective fields and test fields

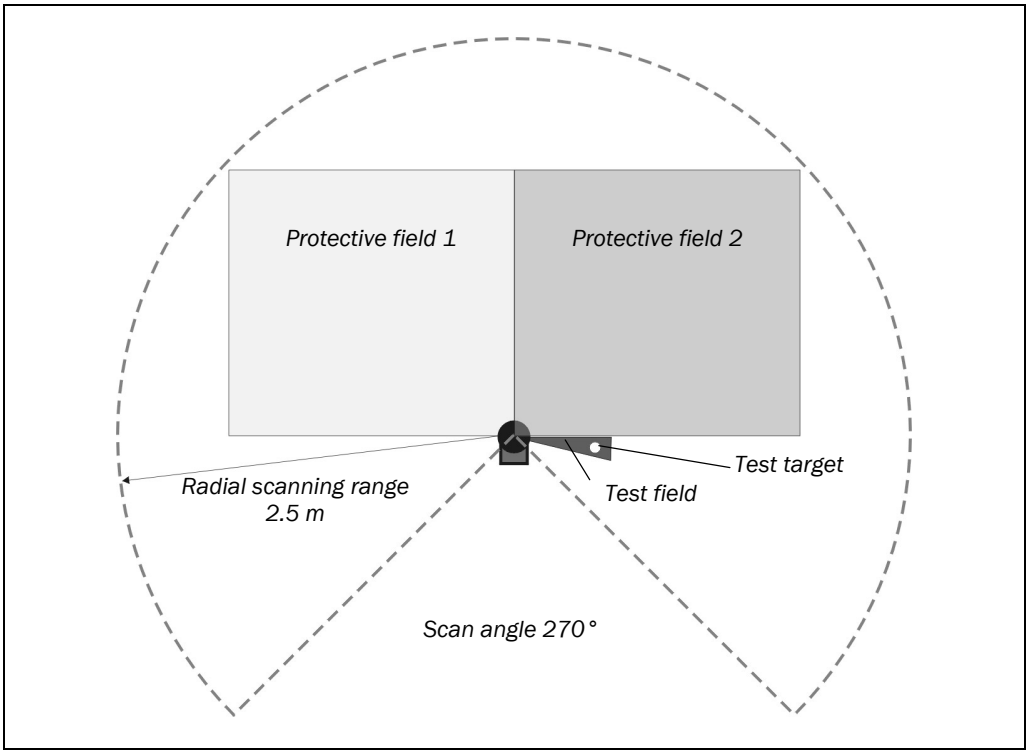
The LMS80-S01 is prepared for 3 fields:

- protective field 1
- protective field 2
- test field

Note You can also operate it with only one protective field. You then configure the second, unused protective field with a minimum size (50 mm).

The parameters for the geometry of the protective fields on the LMS80-S01 can be set as required within the maximum scanning range (2.5 m).

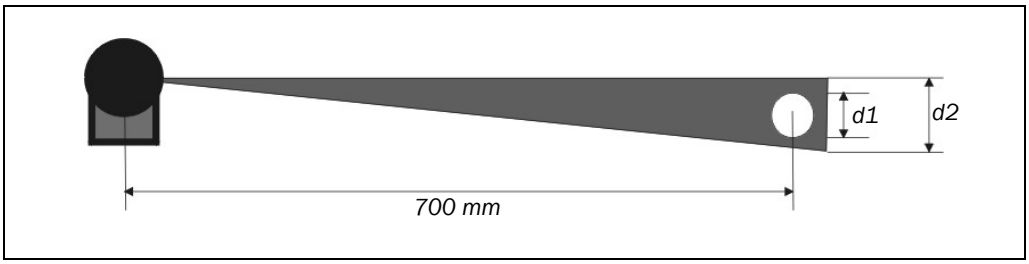
Fig. 9: Protective fields 1 and 2 as well as test field within the scan angle 270°



Test target and test field

The test field is to be configured such that the external test target can be reliably detected. The test field is continuously infringed in normal operation (object detected in the field). The **Test** switching signal is therefore LOW in correct operation (alternately on OUT1, OUT2 or OUT3 on the LMS80-S01, see Tab. 7 on page 27).

Fig. 10: Relationship between size of test target and test field

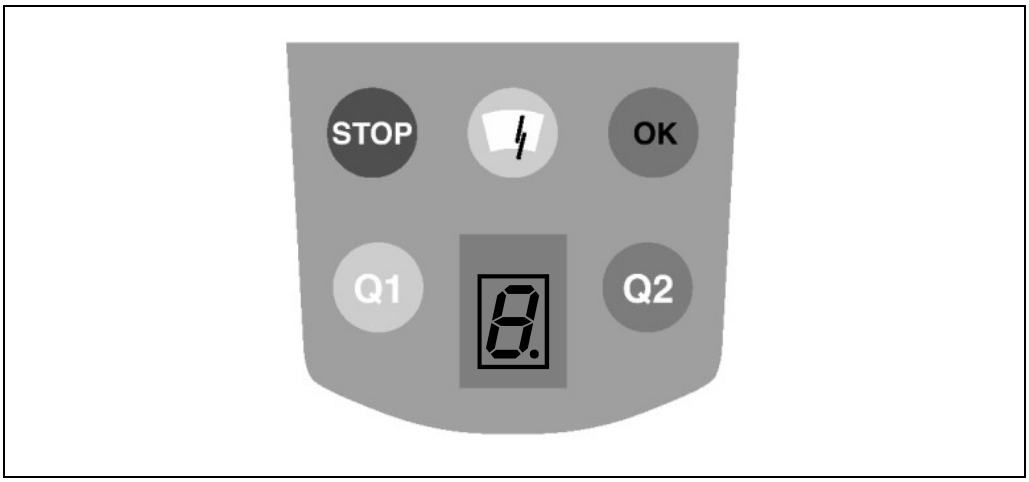


- The diameter of the test target (round bar) d1 is always 20 mm.
- The radial distance from the test target to the LMS80-S01 is defined as 700 mm (±50 mm)
- To detect only the test target in the field corridor, the maximum width of the field must not be exceeded.
- d2 (maximum width test field) = 1.5 × d1 (diameter test target) = 30 mm

3.4.3 Status indicators of the LMS80-S01

The LEDs and the 7-segment display indicate the operational status of the LMS80-S01.

Fig. 11: Status indicators of the LMS80-S01



Tab. 1: Meaning of the status indicators of the LMS80-S01

Display	Meaning
OK	Illuminates if there is no error present
STOP	Illuminates on an error in the device or a contamination error
	Illuminates on a contamination warning or in connection with STOP on a contamination error
Q1	Inactive
Q2	Inactive
8	7-segment display The 7-segment display is used for diagnostics on errors or faults that occur (see section 10.3.1 “Error displays of the LEDs and the 7-segment display” on page 63).

3.5 Principle of operation of the Flexi Soft safety controller

The SICK Flexi Soft safety controller is used as a system controller. The operation of the Flexi Soft is safety-related and the controller is certified for SIL3 as per IEC 61508 and Performance Level PL e as per EN ISO 13849-1 and SILCL3 as per EN 62061.

Note All basic functions for the HS80 safety scanner system are already pre-configured for the Flexi Soft and are available as project files. The necessary configuration is saved in non-volatile memory in the Flexi Soft by downloading the file from the Flexi Soft Designer (configuration memory in the supply connection).

Further configuration of the Flexi Soft for the HS80 safety scanner system is not necessary.

Additional control tasks (emergency stop, door contacts etc.) are possible with the Flexi Soft, however they are not part of the HS80 safety scanner system. If you want to realize further controller tasks, read the detailed software and hardware operating instructions for the Flexi Soft (SICK part no. 8012479 software and 8012477 hardware).

Flexi Soft function blocks

The principle of operation of the Flexi Soft is based on application-specific or logical function blocks. The operation of all function blocks is safety-related.

The function blocks and signals are linked in the Flexi Soft Designer. The individual links are generated in the graphic user interface using “Drag and Drop”.

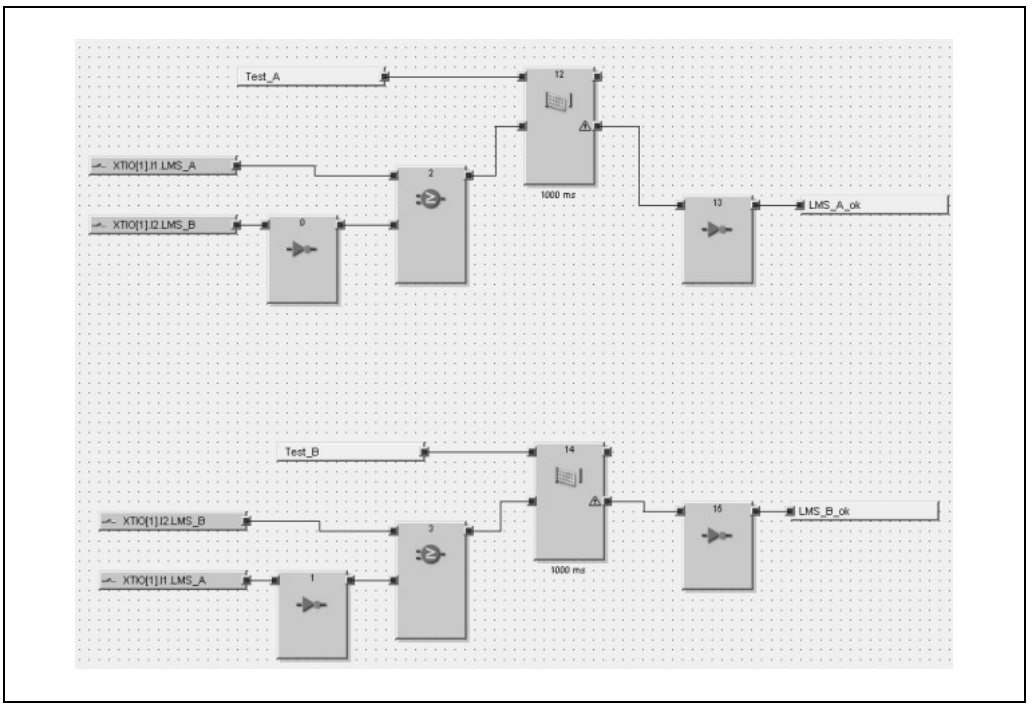
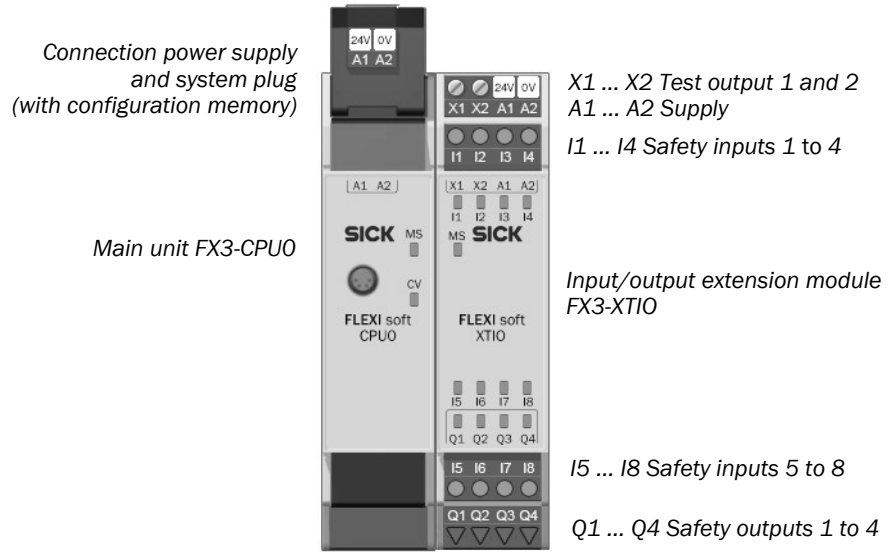


Fig. 12: Example of linked function blocks in the Flexi Soft Designer

The graphical user interface is also used as an online monitor. The related actual signal states are colour-coded and indicate the current signal state ON or OFF.

3.6 Device construction Flexi Soft

Fig. 13: Device construction Flexi Soft



Tab. 2: Connections of the Flexi Soft

Connection	Function
Safety inputs	Connection point for single or dual-channel safety inputs, labelled I1 to I8
Safety outputs	Connection point for single or dual-channel safety outputs, labelled Q1 to Q4
Power supply	Connection point for supply voltage 24 V DC/0 V, labelled A1 or A2

You will find the terminal assignment in section 5.2.1 “Connections of the Flexi Soft” on page 43.

3.6.1 Flexi Soft system plug

The system configuration for the entire Flexi Soft system (with the exception of the EFI-compatible devices) is only saved in the system plug. On the replacement of connection modules this situation has the advantage that it is not necessary to re-configure the system.

The data saved in the system plug are also retained on an interruption in the supply of power.

The main unit and the system’s inputs are supplied electrically only via the system plug; the outputs on the other hand are supplied separately electrically.

Notes

- The current from the power supply that supplies the main unit must be limited externally to max. 4 A — either by the power supply itself or by a fuse.
- If modules are replaced, ensure that the system plug is plugged into the suitable main unit. Mark all connecting cables and plug connectors unambiguously on the Flexi Soft system to avoid confusion.

3.6.2 Main unit FX3-CPU0

The main unit FX3-CPU0 is the central processing unit in the complete system in which all signals are monitored and processed logically as per the configuration saved in the system plug. The system's outputs are switched as a function of the result of the processing. During this process the internal FLEXBUS+ bus is used as the data interface.

The main unit further more has an RS-232 interface with the following functions:

- transferring the configuration from the Flexi Soft Designer to the system plug
- downloading the configuration from the system plug to the Flexi Soft Designer
- diagnostics on the Flexi Soft system using the Flexi Soft Designer
- continuous diagnosis of the Flexi Soft system via the connected PLC
  As a result the RS-232 interface is an alternative to a gateway.

Notes

- The maximum cable length allowed is 3 m. The cable must be screened and connected to the FE at suitable points.
- Avoid ground loops between the GND for the RS-232 interface and the A2 connection on the main unit, e.g. by using optocouplers.
- If the system plug is not fitted, ensure no objects can enter the opening provided for the plug.

3.6.3 Input/output extension module FX3-XTIO

The module FX3-XTIO is the extension unit with 8 safe inputs and 4 safe outputs. It has two test pulse generators: one for test output X1 and one for test output X2.

The module FX3-XTIO performs the following tasks:

- monitoring of the sensors connected
- forwarding of input information to the main unit
- reception of the control signals from the main unit and corresponding switching of the outputs
- fast shut-off: direct shut down of the actuators connected to the module possible from firmware version 1.10.0 and Flexi Soft Designer version 1.1.0

  As a result there is a significant reduction in the response time of the overall system. It is only necessary to add 8 ms to the response times of the devices on the inputs and outputs for shutting down the outputs. Propagation times on the internal FLEXBUS+ bus, as well as the logic execution time do not play a role in this case.

The module FX3-XTIO cannot be operated on its own, a main unit FX3-CPU0 is always required. It is possible to use several modules FX3-XTIO simultaneously.

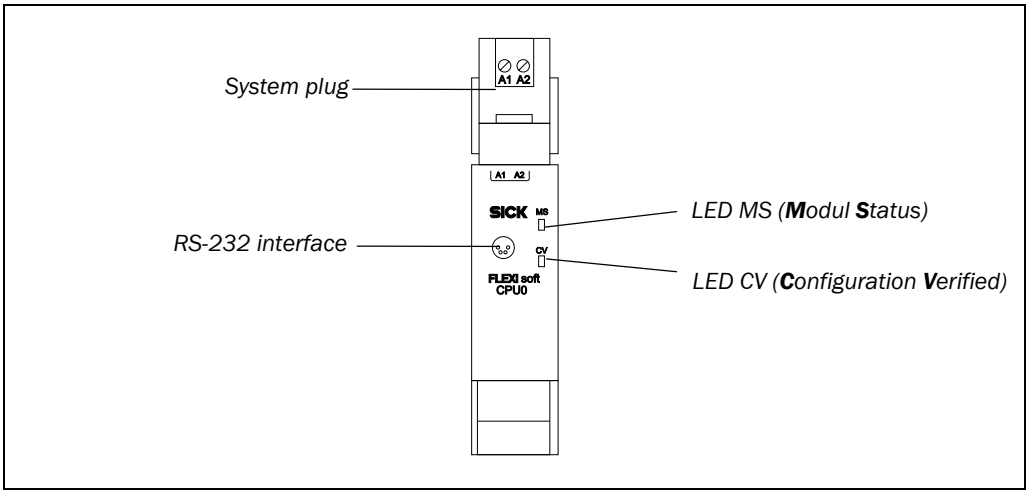
The voltage supply for the module is provided via the internal FLEXBUS+ bus.

The voltage supply for the outputs Q1 ... Q4 is provided directly at the module FX3-XTIO.

3.6.4 Status indicators

Status indicators of the FX3-CPU0

Fig. 14:Status indicators of the FX3-CPU0



Tab. 3: Indications of the LED MS

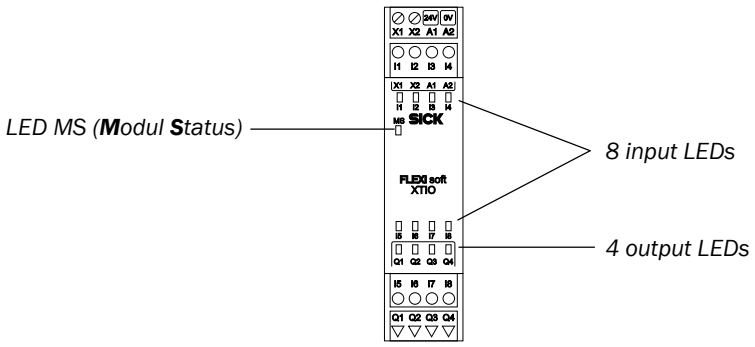
LED MS	Meaning	Note
○	Supply voltage outside the operating range	Switch on supply voltage and check at terminals A1 and A2
☼ **Red/green** (1 Hz)	A self-test is performed and the system initialized	Please wait ...
☼ **Green** (1 Hz)	System is ready for operation	To start the application, press the Start button in the Flexi Soft Designer
● **Green**	Application is running	
● **Red** ☼ **Red** (1 Hz)	Error	See error description in section 10.4.1 on page 66

Tab. 4: Indications of the LED CV

LED CV	Meaning	Note
○	Configuration required	Configuring Flexi Soft in Flexi Soft Designer
☼ **Yellow** (2 Hz)	Saving configuration data in non-volatile memory	Voltage supply must not be interrupted until the save process is complete.
☼ **Yellow** (1 Hz)	Valid, but not verified configuration	Verifying the configuration with Flexi Soft Designer software
● **Yellow**	Valid and verified configuration	

Status indicators of the FX3-XTIO

Fig. 15: Status indicators of the FX3-XTIO



Tab. 5: Indications of the LED MS

LED MS	Meaning	Note
○	Supply voltage outside the operating range	Check supply voltage at terminals A1 and A2
☼ **Green** (1 Hz)	The module is ready	Start the application in the Flexi Soft Designer
● **Green**	Application is running	
☼ **Red/green** (1 Hz) ☼ **Red** ● **Red**	Error	See error description in section 10.4.1 on page 66

Tab. 6: Indications of the input/output LEDs

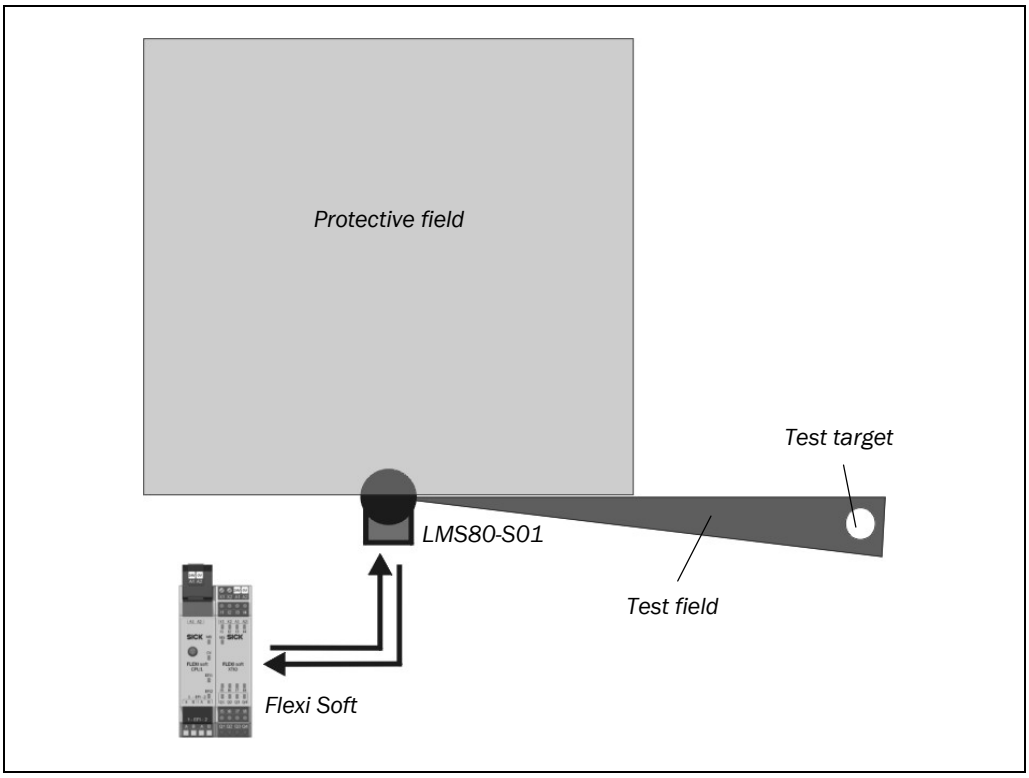
Input LEDs (I1 ... I8) output LEDs (Q1 ... Q4)	Meaning
○	Input/output is active.
● **Green**	Input/output is active.
☼ **Green**	See error description in section 10.4.1 on page 66

3.7 Principle of operation of the HS80 safety scanner system

The safety-related function of the HS80 is provided by two factors:

- The LMS80-S01 monitors a hazardous area using one or both protective fields. If a person or an object is detected in the hazardous area, the Flexi Soft safety controller switches its OSSD to the OFF state.
- Using a test field the LMS80-S01 monitors an exactly defined test target positioned outside the protective field. If the test target is not detected, the Flexi Soft switches its OSSD to the OFF state.

Fig. 16: Device construction of the HS80 safety scanner system



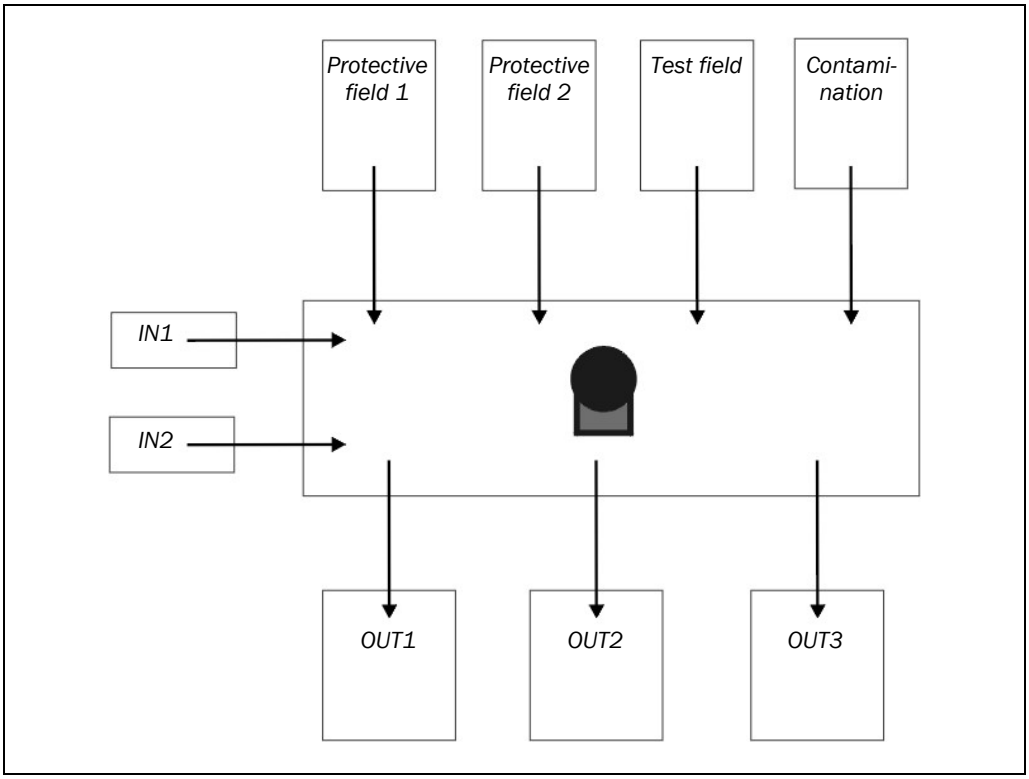
The Flexi Soft performs a safety-related plausibility check on the LMS80-S01 switching signals expected (status of the protective field and the test field).

3.7.1 Test cycle

For testing, the safety controller Flexi Soft cyclically sends switching commands to the LMS80-S01. The test rate is pre-set to 500 ms in the Flexi Soft. I.e. the controller sends a command to the two control inputs on the LMS80-S01 every 500 ms.

The monitoring fields protective field 1, protective field 2 and the test field as well as the signal VM_Warn for contamination warning are switched through to the outputs OUT1 to OUT3 as a function of the input states on the inputs IN1 and IN2 (see Tab. 7 on page 27).

Fig. 17: Principle of signal distribution to the outputs as a function of the input states on IN1 and IN2



After sending the test command, the Flexi Soft waits in the related test step for the expected signal change on the output signal switching devices on the LMS80-S01.

Notes

- The test reply from the LMS80-S01 (ON/OFF switching cycle on the outputs) is provided after the end of the response time set in the LMS, e.g. after 200 ms.
- The time the Flexi Soft waits for the LMS80-S01 test reply must always be greater than the actual response time of the LMS80-S01 (e.g. configured response time LMS80-S01 = 200 ms, time to wait = 500 ms).
- The test rate is dependent on the risk assessment for an application.
- The minimum test rate must be greater than the response time of the LMS80-S01.
- You can configure LMS80-S01 response times to max. 400 ms (exceptional case).

The LMS80-S01 input information changes cyclically in 4 steps. During each step the allocation of the protective field (PF) or the test field (Test) to the outputs changes. Optionally the VM_Warn signal is polled during the first step (contamination warning).

Tab. 7: Output signals as a function of the LMS80-S01 input signals

	Step 1		Step 2		Step 3		Step 4	
	IN2	IN1	IN2	IN1	IN2	IN1	IN2	IN1
	0	0	0	1	1	0	1	1
OUT1	PF1		PF1		Test		PF2	
OUT2	PF2		PF2		PF1		Test	
OUT3	VM_Warn		Test		PF2		PF1	

Notes

- If several laser scanners are operated (max. 4), they are evaluated in parallel in the controller. For this purpose all LMS80-S01 connected must work synchronously.
- Ensure both the control inputs IN1 and IN2 as well as the output signal switching devices OUT1 to OUT3 on the LMS80-S01 are connected similarly. If this condition is not met, the Flexi Soft switches its OSSDs to the OFF state.

Fig. 18: Signals on the LMS80-S01 outputs in case of error-free operation

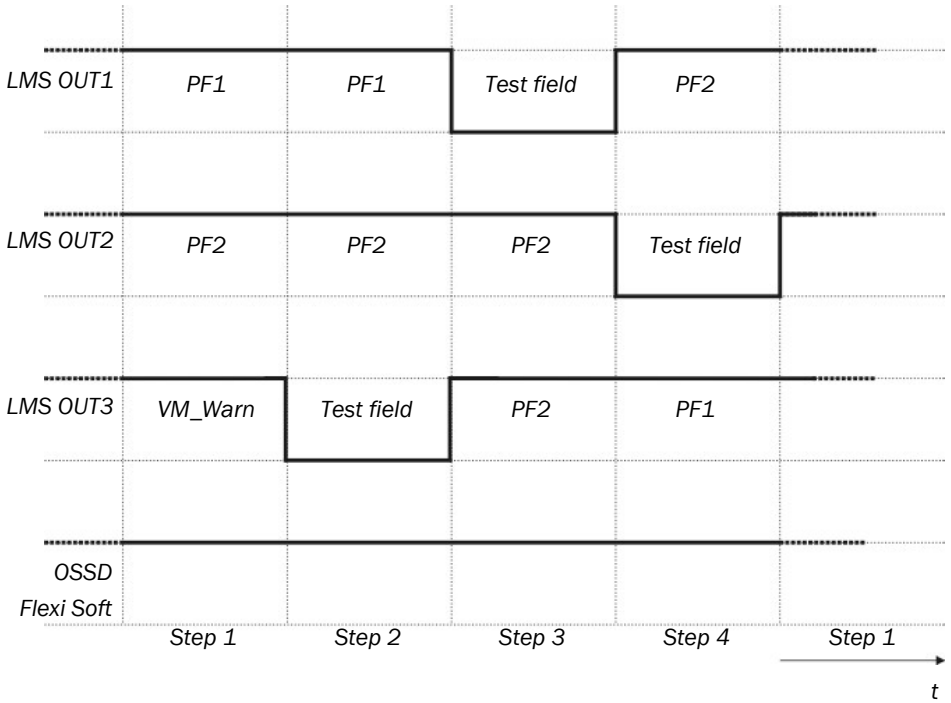
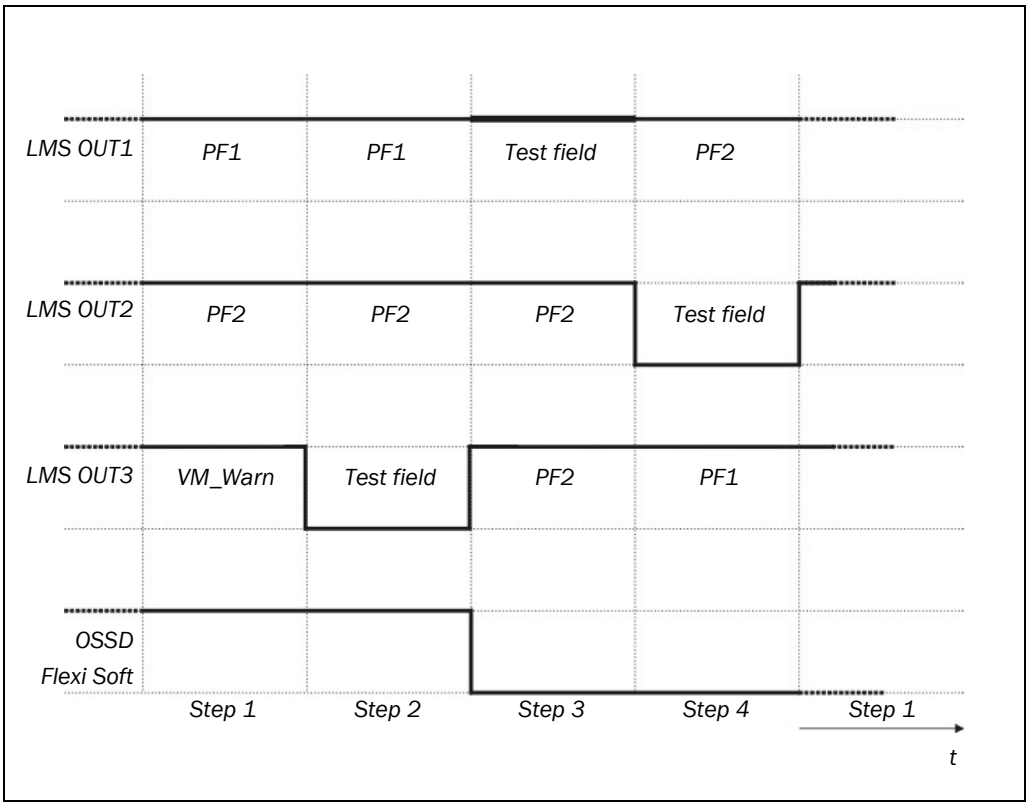


Fig. 19: Signals on the LMS80-S01 outputs in case of operation with errors



Independent of the test function, the active protective fields for monitoring the hazardous area are monitored separately and, if the protective field is infringed, a stop signal is output to the machine (OSSD ON = both protective fields are clear AND test result OK or OSSD OFF = protective field 1 or 2 occupied OR test result not OK).

The causes of a shut down can be:

- test target not detected (error case)
- protective field infringed (shutdown case)
- output signal switching device on the LMS80-S01 physically faulty or cross-circuit/earth fault (error case)

3.8 Application example

The system is intended to be used mounted on wood processing machines for monitoring hazardous areas in particle and dust-laden environments indoors.

Pay attention to the category required for the system/machine to be protected. If there is no C-type standard for the system/machine, then determine the category to be applied in accordance with the risk graph as per EN ISO 13 849-1.

Fig. 20: Machine with moving machining device, plan view

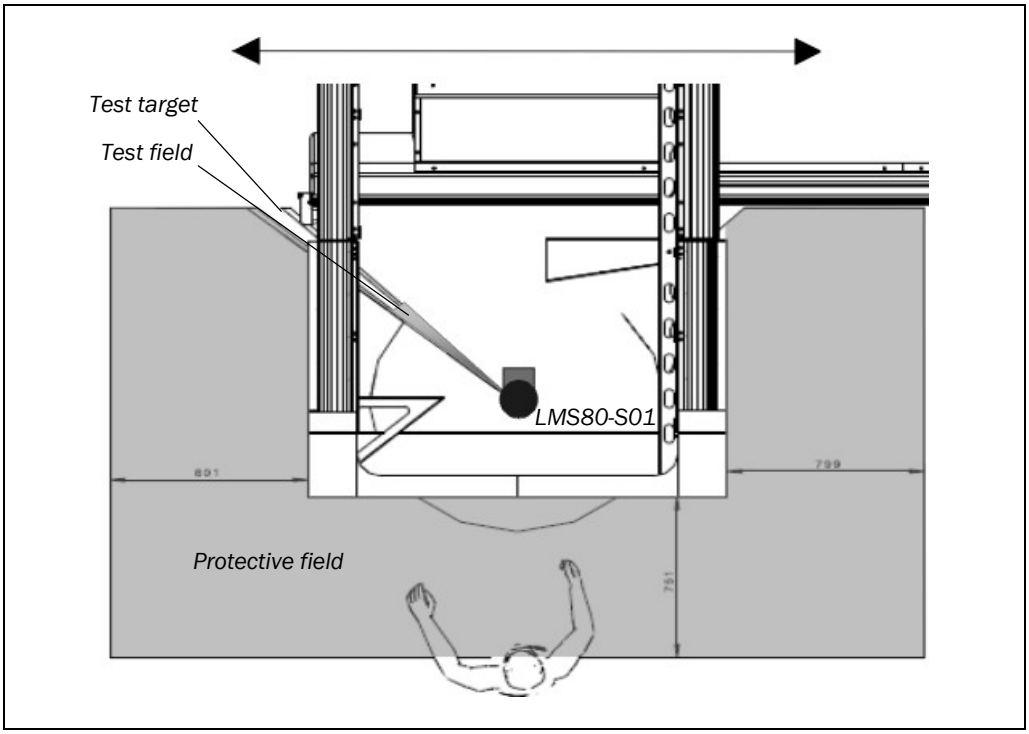
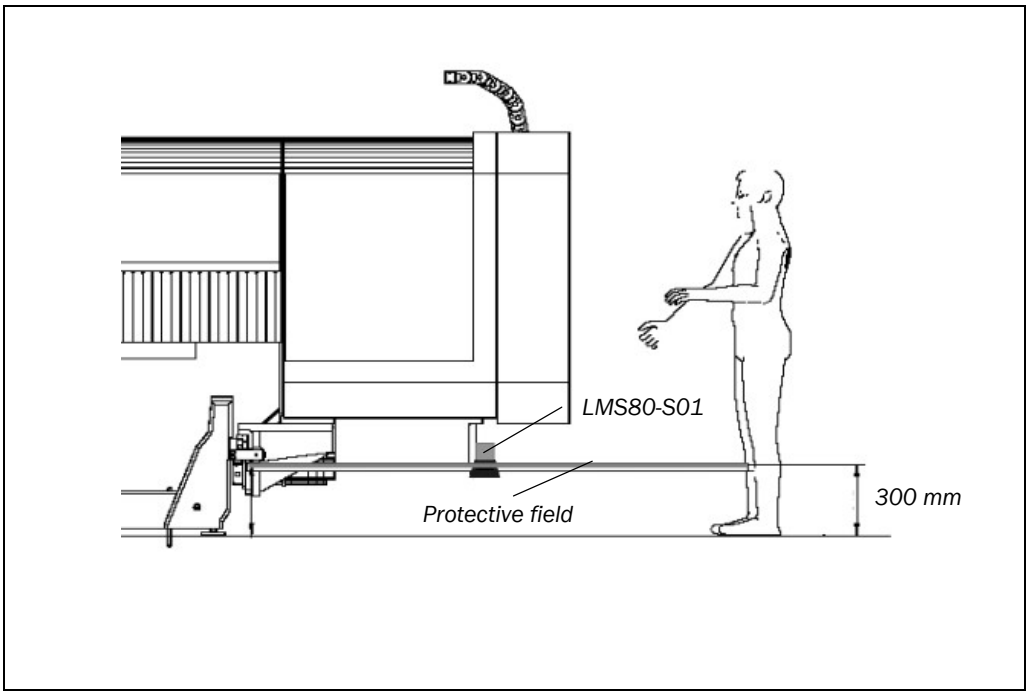


Fig. 21: Machine with moving machining device, side view



4 Mounting

This chapter describes the preparation and completion of the installation of the HS80 safety scanner system.

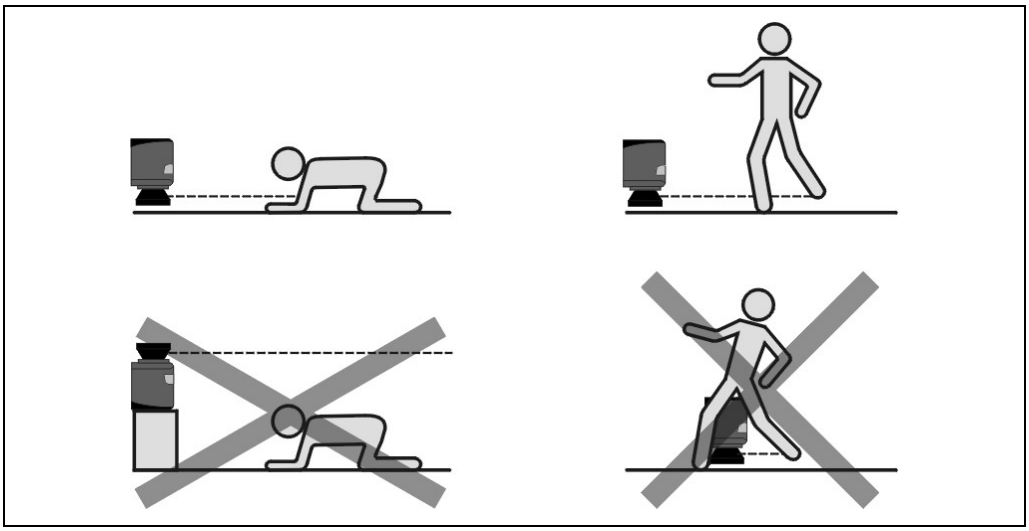
4.1 Mounting of the laser scanner

WARNING

Special features to note during mounting of the laser scanner:

- Mount the LMS80-S01 such that it is protected from dirt and damage.
- Ensure that the front screen field of view is not restricted.
- Always mount the LMS80-S01 such that you have access to the cable entries and can connect and remove the Ethernet connection plug for configuration.
- Mount the LMS80-S01 such that the indicators are easy to see.
- Avoid excessive shock and vibration loading on the laser scanner.
- On applications that suffer from heavy vibration, prevent the fixing screws from coming loose using screw locking devices.
- Regularly check the tightness of the fixing screws.
- Mount the laser scanner such that there are no unprotected areas possible and it is not possible to stand behind the hazardous area protected.
- Prevent personnel from being able to crawl beneath, stand behind or climb over the protective field by means of appropriate mounting of the laser scanner.

Fig. 22: Prevent crawling beneath, standing behind, climbing over



Note During the selection of the installation environment, ensure the location is suitable for the necessary protective field dimensions (see chapter 7 “Dimensioning” on page 51).

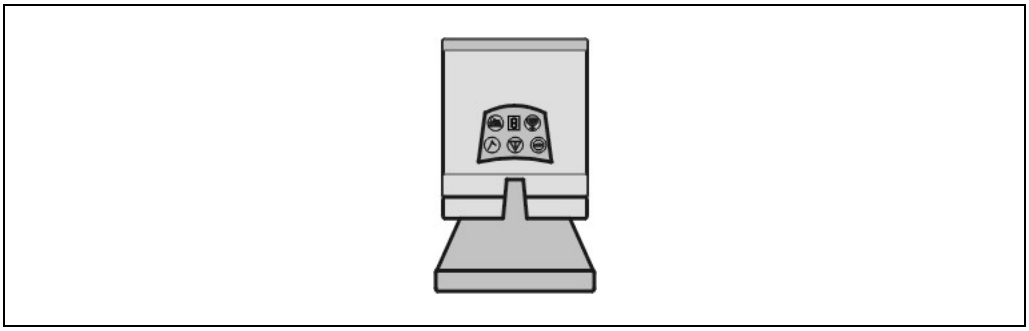
4.1.1 Recommended mounting orientation of the LMS80-S01

The recommended mounting orientation for the laser scanner is:

- electrical connections on top
- optics cover on bottom

This orientation prevents the accumulation of dust at the transition from the optics cover to the housing.

Fig. 23: Recommended mounting orientation of the LMS80-S01



4.2 Steps for mounting the LMS80-S01

The laser scanner can be fastened in the following ways:

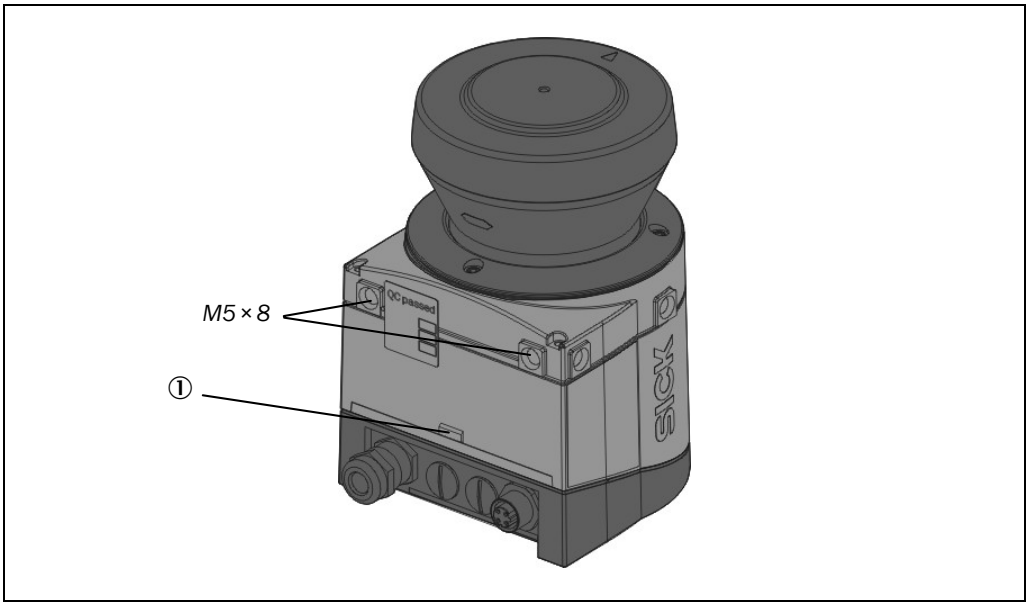
- direct mounting without mounting kit
- mounting with mounting kit 1a or 1b
- mounting with mounting kit 2 and 3 (only in conjunction with mounting kit 1a or 1b)

➢ Pay attention to the maximum torque of the M5 fixing screws on the LMS80-S01 of 5.9 Nm.

4.2.1 Direct mounting without mounting kit

The laser scanner has two threaded holes M5 × 8 on the rear. Using these you can mount the laser scanner directly on the intended mounting surface. To avoid a possible tendency to vibrate, if necessary the reference surface on the rear can be used as the third mounting point (①).

Fig. 24: Direct mounting without mounting kit



Note During mounting, please observe the dimensional drawings (see section 11.3.1 “Dimensional drawing LMS80-S01” on page 80).

4.2.2 Mounting with mounting kit 1a or 1b

With the aid of mounting kit 1 you can mount the laser scanner on a mounting surface (wall, machine). The mounting kit is available as mounting kit 1a without protection device for the optics cover and as mounting kit 1b with protection device for the optics cover.

Fig. 25: Mounting with mounting kit 1a

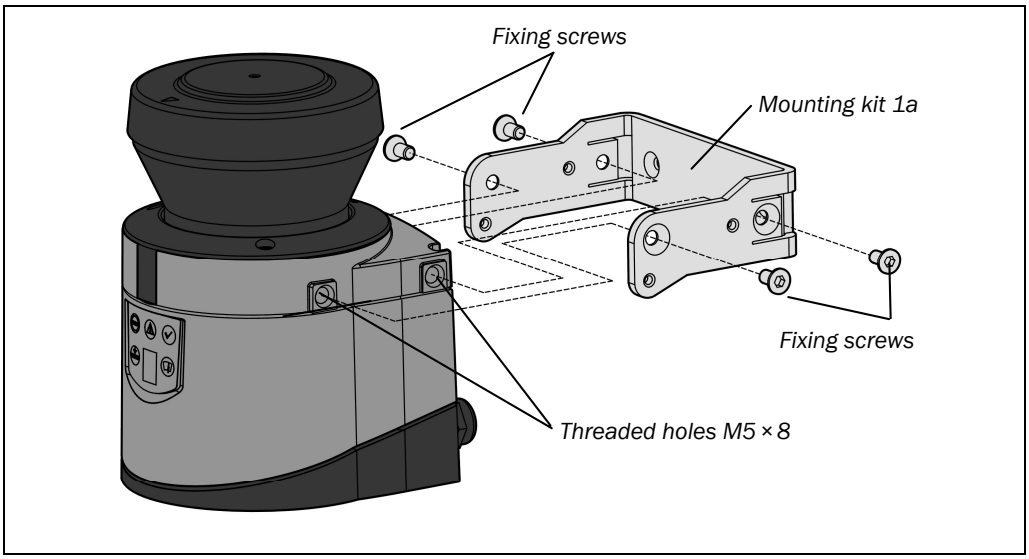
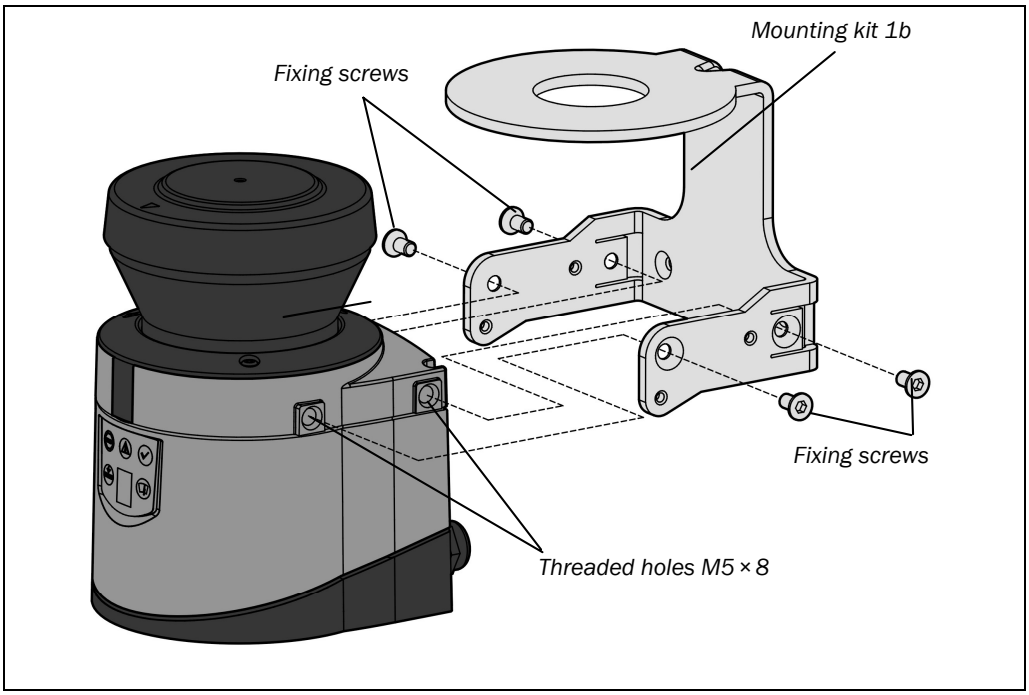


Fig. 26: Mounting with mounting kit 1b



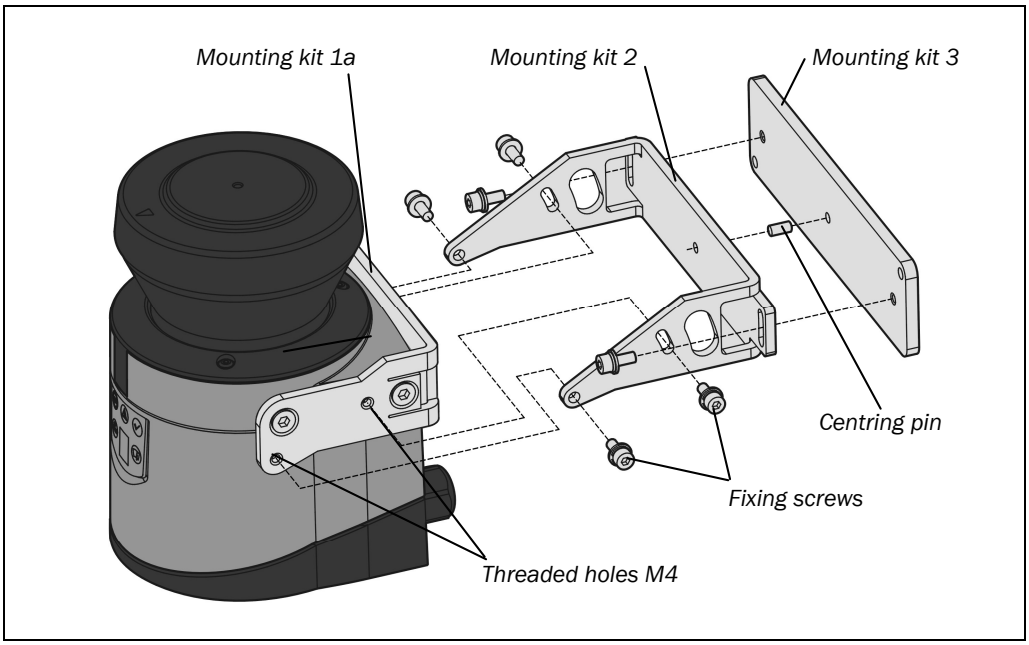
- Mount mounting kit 1a or 1b on the mounting surface.
- Then mount the laser scanner on the mounting kit 1a or 1b.

Note During mounting, please observe the dimensional drawings (see section 11.3.2 “Dimensional drawings, mounting kits” on page 81).

4.2.3 Mounting with mounting kit 2 and 3

With the aid of mounting kits 2 and 3 (only in conjunction with mounting kit 1a or 1b) you can align the laser scanner in two planes. The maximum adjustment angle is ±11° in both planes.

Fig. 27: Mounting with mounting kit 2 and 3



- Mount mounting kit 1a or 1b to the LMS80-S01.
- Mount mounting kit 3 on the mounting surface.
- Fit the centring pin (4 mm) in the central hole on mounting bracket 3.
- Fit mounting kit 2 to mounting kit 3 and mount it using two fixing screws M4 × 10.
- Then mount the laser scanner on mounting kit 2 with the aid of the threaded holes in mounting kit 1a or 1b.
- Adjust the laser scanner longitudinally and transversely and then tighten the six fixing screws on the mounting kits.

Note During mounting, please observe the dimensional drawings (see section 11.3.2 “Dimensional drawings, mounting kits” on page 81).

4.2.4 Measures in the laser scanner's near range

The reduced sensitivity in the laser scanner's near range is used for error correction and prevent the device dazzling itself inside the housing.

WARNING

Ensure it is not possible to stand behind the protective field!

In applications in which it is possible to stand behind the protective field on restarting or it is possible to approach the hazardous area outside the protective field (e.g. approach from the rear), additional measures are to be provided.

Additional measures could be:

- Locked mechanical barriers as guards in the scan direction
- Locked mechanical barriers to prevent entry into the space at the rear
- Usage of a protective cover for the LMS80-S01 (see section 12.3 "Accessories/spare parts" on page 84). The protective cover mechanically shields the near range of the LMS80-S01, a fixed, mechanical barrier is then no longer necessary.

Fig. 28: Example mechanical barrier in the near range (plan view)

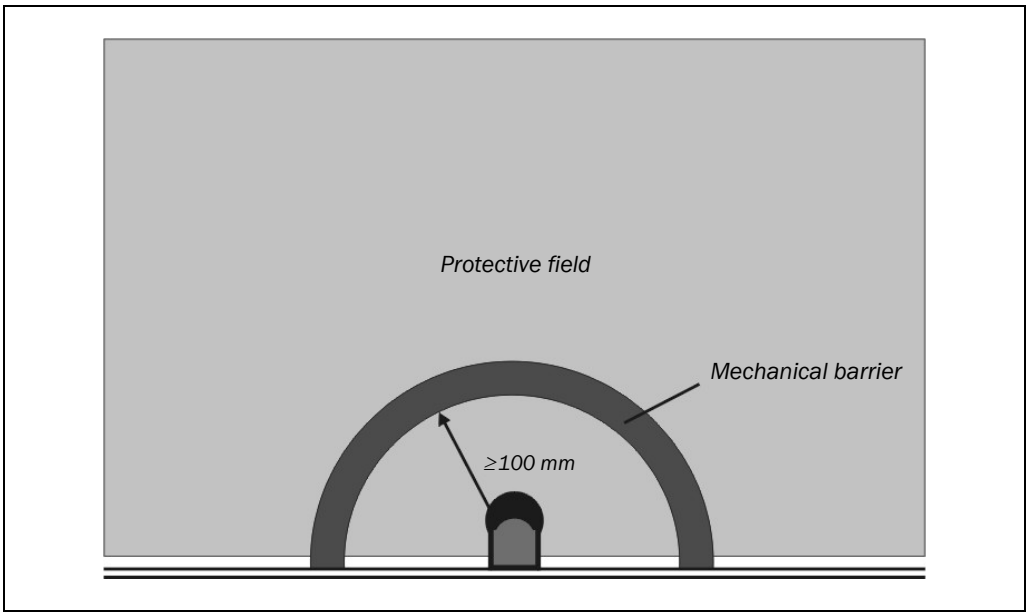
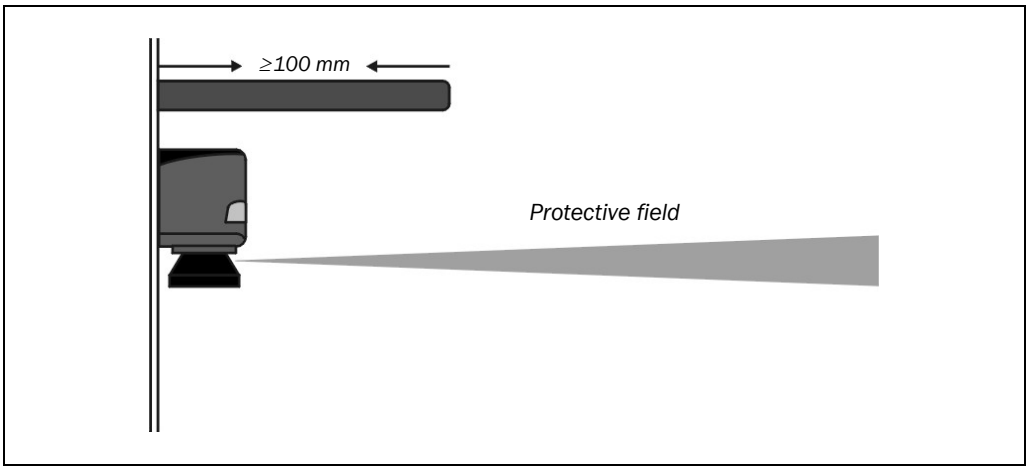


Fig. 29: Example mechanical barrier in the near range (side view)



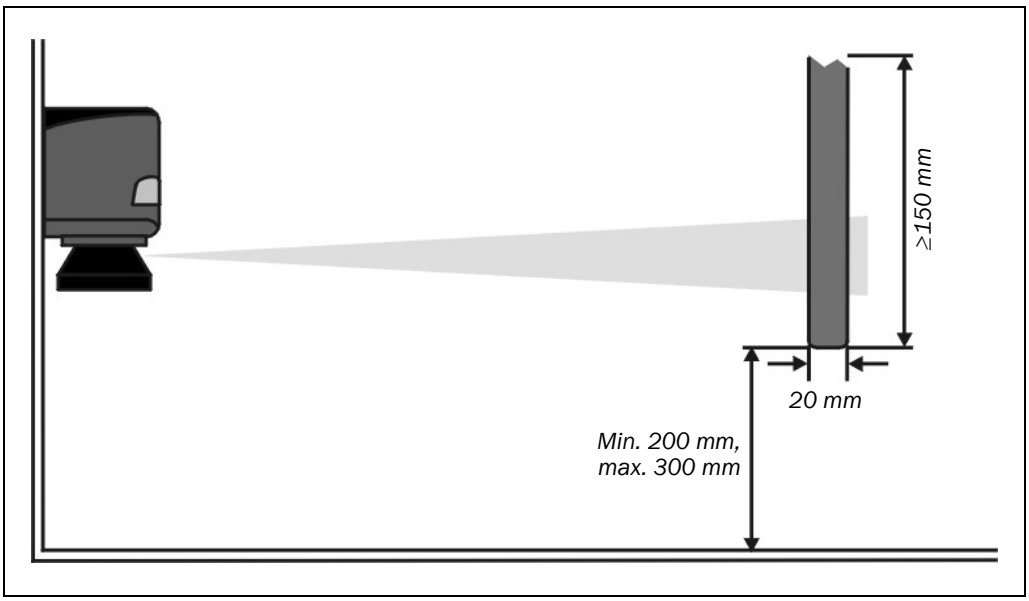
Note There must not be any object in the near range ≤100 mm

4.3 Mounting of the test target

The test target is an elementary part of the system. The correct, safety-related operation of the system can only be ensured by the correct position of the test target and correct detection by the laser scanner. The test target must meet the following requirements:

- The test target must have an object diameter of 20 mm.
- The test target must be positioned at a radial distance of 700 mm ±50 mm in relation to LMS80-S01.
- The test target must be covered with the blackout film provided. This film is used to verify the detection of black.
- Between test target and LMS80-S01 there must not be any object (clear view of the test target for the laser scanner). Ensure no moving parts hide the test target, even if only for a short time.
- To ensure the laser scanner can positively detect the test target, the target must be physically separated from the body of the machine or other objects (recommended distance >50 mm).
- Protective field(s) and test field are not allowed to overlap.
- The test target is allowed to be positioned at any angle within the 270° scan angle of the LMS80-S01.

Fig. 30: Position and size of the test target



4.4 Mounting of the Flexi Soft modular safety controller

WARNING

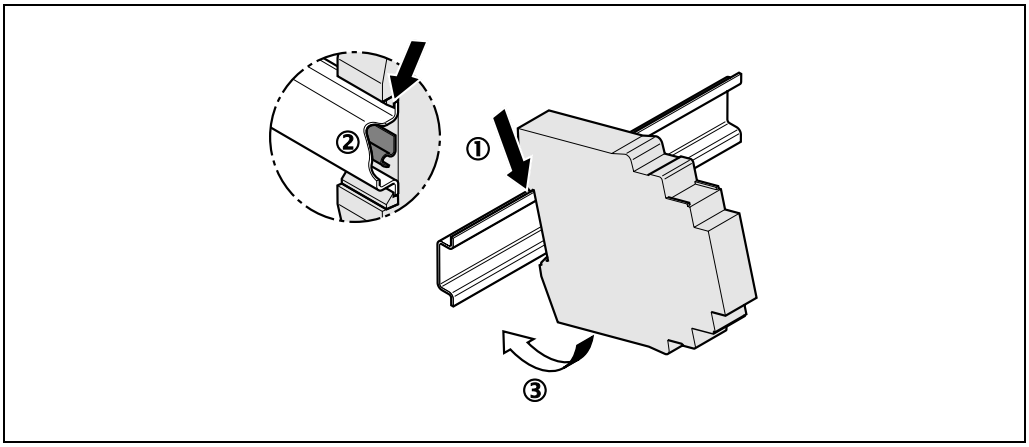
The Flexi Soft system is only suitable for mounting in a control cabinet with at least IP 54 enclosure rating!

In a Flexi Soft system the main module FX3-CPU is positioned at the extreme left.

- ➢ Mount the Flexi Soft extension module FX3-XTIO to the right of the main unit.
- ➢ Ensure that suitable ESD protective measures are taken also during mounting. Otherwise the FLEXBUS+ bus may be damaged.
- ➢ The connection between the modules is effected by means of the plug connection integrated in the housing. Take into account that, when replacing a module, the Flexi Soft modules have to be pushed approx. 10 mm apart before the appropriate module can be removed from the DIN rail.
- ➢ Take suitable measures so that foreign bodies cannot enter plug openings, in particular those for the system plug.
- Mounting in accordance with EN 50274
- The modules are located in a 22.5 mm wide modular system for 35 mm DIN rails as per EN 60715.

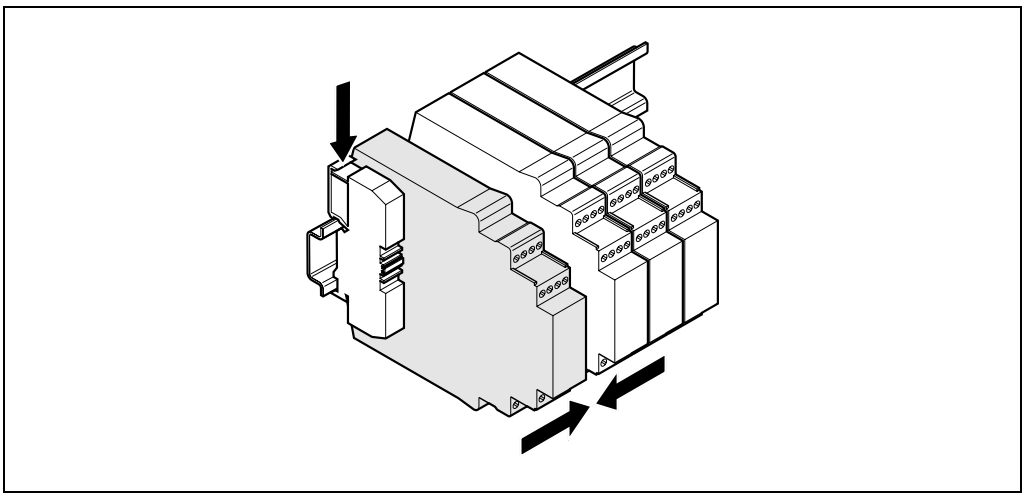
4.4.1 Mounting steps

Fig. 31: Hanging the module onto the DIN rail



- Hang the device onto the DIN rail (①).
- Ensure that the earthing spring contact is positioned correctly (②). The earthing spring contact on the module must contact the DIN rail securely and electrically conductively.
- Latch the module onto the DIN rail by pressing it lightly in the direction of the arrow (③).

Fig. 32: Installing end clips



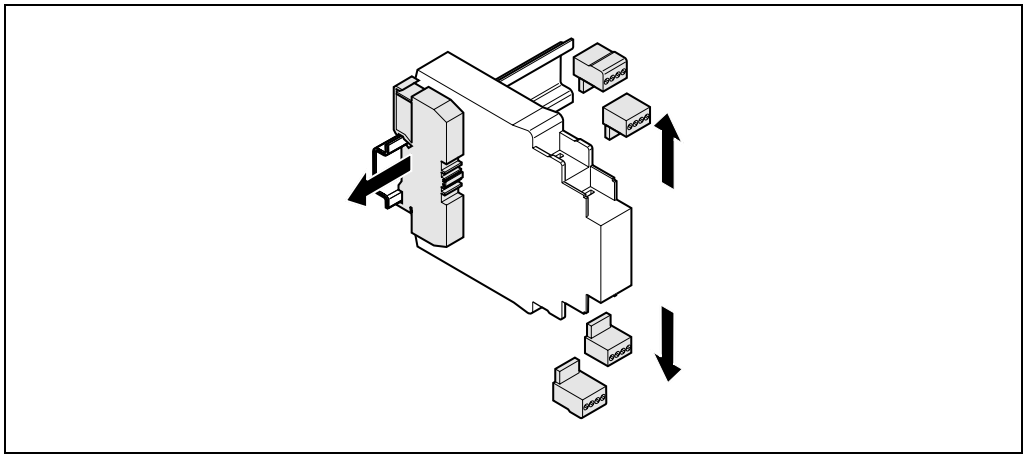
- If there are several modules, slide the modules together individually in the direction of the arrow until the side plug connection latches in.
- Install end clips on the left and right.

The following steps are necessary after mounting:

- completing the electrical connections (chapter 5)
- configuration (chapter 6)
- testing the installation (section 8.3)

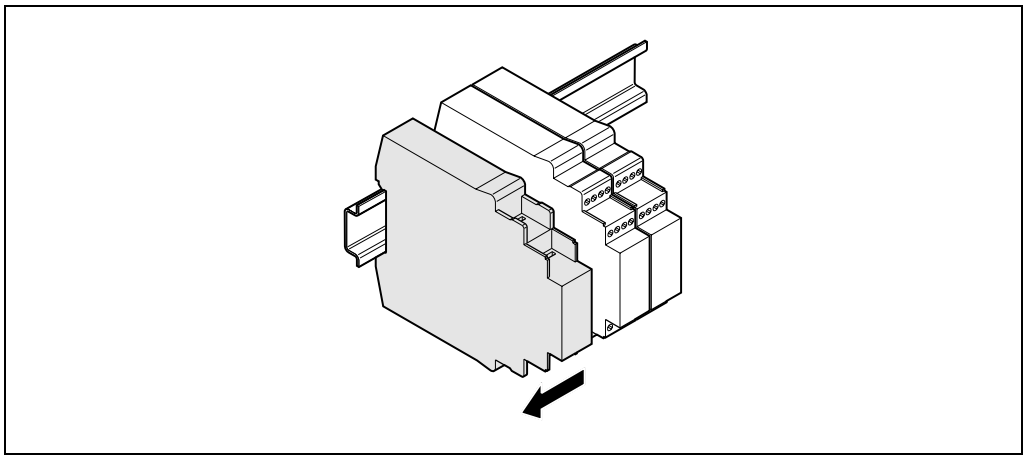
4.4.2 Steps for dismantling

Fig. 33: Remove double-layer spring terminals or removable terminals



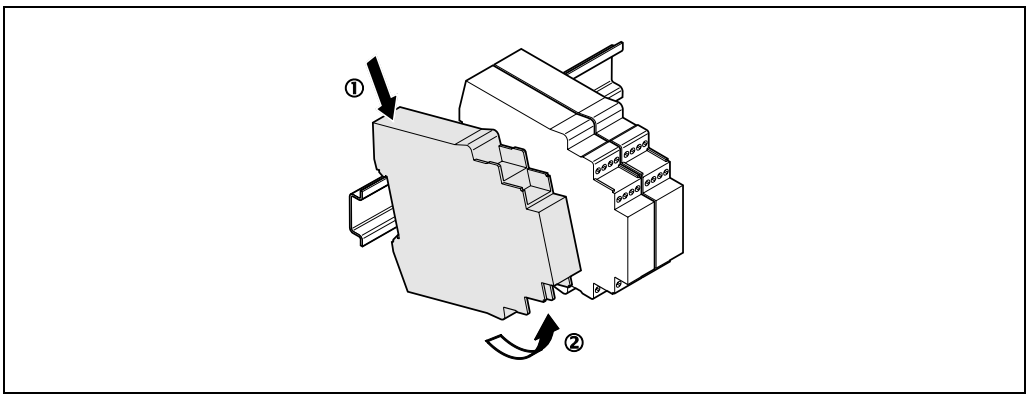
➢ Remove the double-layer spring terminals or the removable terminals with wiring and the end clips.

Fig. 34: Disconnecting plug connection



➢ If there are several modules, slide the modules away from each other individually in the direction of the arrow until the side plug connection is separated.

Fig. 35: Removing the module from the DIN rail



➢ Press the module downwards at the rear (①) and remove it from the DIN rail in the direction of the arrow while keeping it pressed down (②).

5 Electrical installation

WARNING

Switch the power supply off!

The machine/system could unintentionally start up while you are connecting the devices.

- Ensure that the entire machine/system is disconnected during the electrical installation.
- Only authorized personnel are allowed to perform the electrical installation work.
- Observe the current safety regulations when working on electrical systems.

Note The safety controller and the electronics unit for the laser scanner must be supplied from the same power supply.

5.1 Laser scanner LMS80-S01

WARNING

Do not open housing!

Opening will not interrupt laser power up.

Cable laying

- For the signal cable use at least a 5-core cable, e.g. 5 × 0.5 mm^2.
- Long lengths of cable may result in an inadmissible voltage drop on the cables. For this reason, choose a correspondingly larger wire cross-section for long lengths of cable.
- Always lay the supply cables directly to the related power supply.
- The voltage supply for the Flexi Soft and the laser scanner LMS80-S01 must be provided from the same power supply.

5.1.1 Connections of the LMS80-S01

The LMS80-S01 has a removable system plug. This has a PG7 cable entry on the rear. The connections are made to the 34-pin screw type terminal in the system plug. In addition the laser scanner has a round M12 plug connector for the connection to Ethernet.

You can move the PG7 cable entry and the round plug connector from the rear to the underside of the system plug (see section 11.3.1 “Dimensional drawing LMS80-S01” on page 80).

RS-232 interface

The LMS80-S01 also has a round M8 plug connector on the front of the unit for the connection to the RS-232 interface on a PC.

Note This interface is only used for configuration and is not allowed to be permanently connected.

Fig. 36: 34-pin screw type terminal for the LMS80-S01

Tab. 8: Terminal assignment of the LMS80-S01

Terminal	Signal	Function
1	Reserved	Do not use
2	Reserved	Do not use
3	RxD RS-232	Serial RS-232 host interface (receiver)
4	Reserved	Do not use
5	Reserved	Do not use
6	IN1	Digital input 1
7	IN1 GND	Ground digital input 1
8	IN2	Digital input 2
9	IN2 GND	Ground digital input 2
10	Reserved	Do not use
11	Reserved	Do not use
12	Reserved	Do not use
13	OUT1_A	Digital output 1
14	OUT1_B (or _GND)	Digital output 1
15	Reserved	Do not use
16	OUT2_A	Digital output 2
17	OUT2_B (or _GND)	Digital output 2
18	GND	Ground LMS80-S01
19	VS 10.8 V ... 30 V	LMS80-S01 supply voltage
20	TxD RS-232	Serial RS-232 host interface (sender)
21	Reserved	Do not use
22	GND RS-232/ GND CAN	Ground serial host interface or CAN
23	Reserved	Do not use
24	Reserved	Do not use
25	Reserved	Do not use
26	GND RS-232/ GND CAN	Ground serial host interface or CAN
27	Reserved	Do not use
28	Reserved	Do not use
29	Reserved	Do not use
30	Reserved	Do not use
31	OUT3_B (or _GND)	Digital output 3
32	OUT3_A	Digital output 3
33	Reserved	Do not use
34	Case	Housing

Fig. 37: Ethernet connection M12 × 4, socket

Tab. 9: Pin assignment Ethernet connection

Pin	Signal	Function
1	Ethernet_TX+	Ethernet interface
2	Ethernet_RX+	Ethernet interface
3	Ethernet_TX–	Ethernet interface
4	Ethernet_RX–	Ethernet interface

Fig. 38: Connection of the auxiliary interface M8 × 4, socket

Tab. 10: Pin assignment for the connection of the auxiliary interface

Pin	Signal	Function
1	–	Not assigned
2	RxD	Serial RS-232 auxiliary interface
3	0 V DC	Ground
4	TxD	Serial RS-232 auxiliary interface

Supply voltage

To commission and operate the LMS80-S01 a power supply with an output voltage of 10.8 ... 30 V as per IEC 60364-4-41 is required.

The power consumption of the LMS80-S01 with maximum output load is 20 W.

The output circuit of the power supply must be safely electrically isolated from the input circuit, this feature is normally provided by a safety transformer in accordance with IEC 742 (VDE 0551).

Wire cross-sections

Wire all connections with copper cables!

Use the following wire cross-sections:

- supply voltage at least 0.25 mm^2, if local power supply in the immediate vicinity
- supply voltage at least 1.0 mm^2 at maximum length of 20 m, if the connection is made to an existing 24 V DC supply
- output signal switching devices at least 0.25 mm^2, maximum cable length 50 m at 0.5 mm^2
- data interface at least 0.25 mm^2

For the LMS80-S01 the outside diameter of the common cable must be a maximum of 9 mm due to the cable entry.

Note If you use flexible connecting cables with stranded wire to connect to the terminals on the LMS80-S01, you must not use any ferrules.

5.2 Flexi Soft modular safety controller

Note The Flexi Soft safety controller must be supplied from the same power supply as the electronics unit for the LMS80-S01.

WARNING

Switch the entire machine/system off line!

The machine/system could unintentionally start up while you are connecting the devices.

Notes

- The Flexi Soft safety controller fulfils the EMC requirements in accordance with the basic specification EN 61000-6-2 for industrial use.
- To ensure full electromagnetic compatibility (EMC), the mounting rail must be connected to FE.
- The control cabinet or assembly casing of the Flexi Soft safety controller must comply at least with enclosure rating IP 54.
- Mounting in accordance with EN 50274
- Electrical installation in accordance with EN 60204-1
- The voltage supply of the devices must be capable of buffering brief mains voltage failures of 20 ms as specified in EN 60204-1.
- The voltage supply has to fulfil the regulations for extra-low voltages with safe separation (SELV, PELV) in accordance with EN 60664 and EN 50178 (equipment of electrical power installation with electronic devices).
- All control switches, downstream controllers and actuators connected as well as wiring and routing must comply with the required level of safety, e.g. the category and the Performance Level as per EN ISO 13849-1, the SIL claim limit as per EN 62061 or the safety integrity level as per IEC 61508.
- You must connect all modules for the Flexi Soft safety controller, the protective devices connected as well as the voltage supply(ies) to the same ground (GND). The GND for the RS-232 interface is connected internally to the GND for the supply of the main unit (A2).
- If the RS-232 interface on the main unit is used as an alternative to a gateway, please note the limitation on the cable length (max. 3 m). Also the cable must be earthed as a minimum in the control cabinet containing the main unit and connected to the main unit.
- Lay the cables outside of the control cabinet such that a cross-circuit between these cables can be excluded, e.g. in separate plastic-sheathed cables or in protected areas.
- In order to protect the safety outputs and to increase the service time of the module, all external loads must be equipped with e.g. varistors or RC circuits. Please also note that the selection of the arc suppression can increase the total response time of the safety function.
- The output signal switching devices and the external device monitoring (EDM) must be wired in the control cabinet.
- In case of a module replacement, the terminal allocation must be maintained, e.g. by labelling or appropriate cable routing.
- Mount the reset button outside the hazardous area such that it cannot be operated by a person inside the hazardous area. When operating the control switch of the reset button, the operator must have full visual command of the hazardous area.

WARNING

Restricted short-circuit detection!

One FX3-XTDI has two test pulse generators. Here one test pulse generator is responsible for the odd test outputs X1, X3, X5 and X7, the other for the even test outputs X2, X4, X6 and X8.

Note

This means that short-circuits between odd and even test outputs are detected if the test spacing is < 4 ms. If the test spacing is ≥ 4 ms, short-circuits will not be detected in every case. Short-circuits between even or odd test outputs will also not be detected. Please note this aspect on laying the wiring (e.g. lay separately, plastic-sheathed cables)!

5.2.1 Connections of the Flexi Soft

The terminal assignment on the Flexi Soft is generally based on the allocation of the signals made in the configuration. Prepared configurations for the HS80 safety scanner system are supplied.

The tables below show the terminal assignment for the Flexi Soft if the configuration for one, two, thee or four LMS80-S01 has been loaded in the Flexi Soft.

Tab. 11: Terminal assignment for the Flexi Soft system plug with one LMS80-S01

Terminal	Signal	Function
Inputs		
I1	OUT1	LMS output signal switching device 1
I2	OUT2	LMS output signal switching device 2
I3	OUT3	LMS output signal switching device 3
I4	–	Free
I5	RES	Restart input
I6	EDM	External device monitoring feedback
I7	–	Free
I8	–	Free
Test/signal outputs		
X1	Test1	Test output 1
X2	Test2	Test output 2
Outputs		
Q1	OSSD[1)]	Output for machine shut down (single-channel cat. 4)
Q2	VM_Warn	Contamination warning LMS
Q3	LMS IN1	Control input 1 at LMS
Q4	LMS IN2	Control input 2 at LMS
Voltage supply		
A1	24 V	DC power supply
A2	GND	DC power supply

1) Actuators on the outputs can be single-channel wired. To maintain the related Performance Level the cables must be laid such that cross-circuits to other electrical signals can be excluded, e.g. by laying in protected areas such as in a control cabinet or in separate plastic-sheathed cables.

Tab. 12: Terminal assignment for the Flexi Soft system plug with two LMS80-S01

Terminal	Signal	Function
Inputs		
I1	OUT1	LMS1 output signal switching device 1
I2	OUT2	LMS1 output signal switching device 2
I3	OUT3	LMS1 output signal switching device 3
I4	RES	Restart input
I5	OUT1	LMS2 output signal switching device 1
I6	OUT2	LMS2 output signal switching device 2
I7	OUT3	LMS2 output signal switching device 3
I8	EDM	External device monitoring feedback
Test/signal outputs		
X1	Test1	Test output 1 LMS1 and 2
X2	Test2	Test output 2 LMS1 and 2
Outputs		
Q1	OSSD[2)]	Output for machine shut down (single-channel cat. 4)
Q2	VM_Warn	Contamination warning LMS1 and 2
Q3	LMS IN1	Control input 1 at LMS1 and 2
Q4	LMS IN2	Control input 2 at LMS1 and 2
Voltage supply		
A1	24 V	DC power supply
A2	GND	DC power supply

[2)] Actuators on the outputs can be single-channel wired. To maintain the related Performance Level the cables must be laid such that cross-circuits to other electrical signals can be excluded, e.g. by laying in protected areas such as in a control cabinet or in separate plastic-sheathed cables.

Tab. 13: Terminal assignment for the Flexi Soft system plug with three LMS80-S01

Terminal	Signal	Function
Inputs input/output extension module FX3-XTIO 1		
I1	OUT1	LMS1 output signal switching device 1
I2	OUT2	LMS1 output signal switching device 2
I3	OUT3	LMS1 output signal switching device 3
I4	RES	Restart input
I5	OUT1	LMS2 output signal switching device 1
I6	OUT2	LMS2 output signal switching device 2
I7	OUT3	LMS2 output signal switching device 3
I8	EDM	External device monitoring feedback
Inputs input/output extension module FX3-XTIO 2		
I1	OUT1	LMS3 output signal switching device 1
I2	OUT2	LMS3 output signal switching device 2
I3	OUT3	LMS3 output signal switching device 3
I4 bis I8	–	Free
Test/signal outputs input/output extension module FX3-XTIO 1		
X1	Test1	Test output 1 LMS1 and 2
X2	Test2	Test output 2 LMS1 and 2
Test/signal outputs input/output extension module FX3-XTIO 2		
X1	Test1	Test output 1 LMS3
X2	Test2	Test output 2 LMS3
Outputs input/output extension module FX3-XTIO 1		
Q1	OSSD[3)]	Output for machine shut down (single-channel cat. 4)
Q2	VM_Warn	Contamination warning LMS1, 2 and 3
Q3	LMS IN1	Control input 1 at LMS1, 2, and 3 (PSDI step chain)
Q4	LMS IN2	Control input 2 at LMS1, 2, and 3 (PSDI step chain)
Outputs input/output extension module FX3-XTIO 2		
Q1 to Q4	–	Free
Voltage supply		
A1	24 V	DC power supply
A2	GND	DC power supply

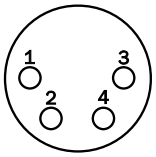
[3)] Actuators on the outputs can be single-channel wired. To maintain the related Performance Level the cables must be laid such that cross-circuits to other electrical signals can be excluded, e.g. by laying in protected areas such as in a control cabinet or in separate plastic-sheathed cables.

Tab. 14: Terminal assignment for the Flexi Soft system plug with four LMS80-S01

Terminal	Signal	Function
Inputs input/output extension module FX3-XTIO 1		
I1	OUT1	LMS1 output signal switching device 1
I2	OUT2	LMS1 output signal switching device 2
I3	OUT3	LMS1 output signal switching device 3
I4	RES	Restart input
I5	OUT1	LMS2 output signal switching device 1
I6	OUT2	LMS2 output signal switching device 2
I7	OUT3	LMS2 output signal switching device 3
I8	EDM	External device monitoring feedback
Inputs input/output extension module FX3-XTIO 2		
I1	OUT1	LMS3 output signal switching device 1
I2	OUT2	LMS3 output signal switching device 2
I3	OUT3	LMS3 output signal switching device 3
I4	–	Free
I5	OUT1	LMS4 output signal switching device 1
I6	OUT2	LMS4 output signal switching device 2
I7	OUT3	LMS4 output signal switching device 3
I8	–	Free
Test/signal outputs input/output extension module FX3-XTIO 1		
X1	Test1	Test output 1 LMS1 and 2
X2	Test2	Test output 2 LMS1 and 2
Test/signal outputs input/output extension module FX3-XTIO 2		
X1	Test1	Test output 1 LMS3 and 4
X2	Test2	Test output 2 LMS3 and 4
Outputs input/output extension module FX3-XTIO 1		
Q1	OSSD[4)]	Output for machine shut down (single-channel cat. 4)
Q2	VM_Warn	Contamination warning LMS1, 2, 3 and 4
Q3	LMS IN1	Control input 1 at LMS1, 2, 3 and 4 (PSDI step chain)
Q4	LMS IN2	Control input 2 at LMS1, 2, 3 and 4 (PSDI step chain)
Outputs input/output extension module FX3-XTIO 2		
Q1 to Q4	–	Free
Voltage supply		
A1	24 V	DC power supply
A2	GND	DC power supply

[4)] Actuators on the outputs can be single-channel wired. To maintain the related Performance Level the cables must be laid such that cross-circuits to other electrical signals can be excluded, e.g. by laying in protected areas such as in a control cabinet or in separate plastic-sheathed cables.

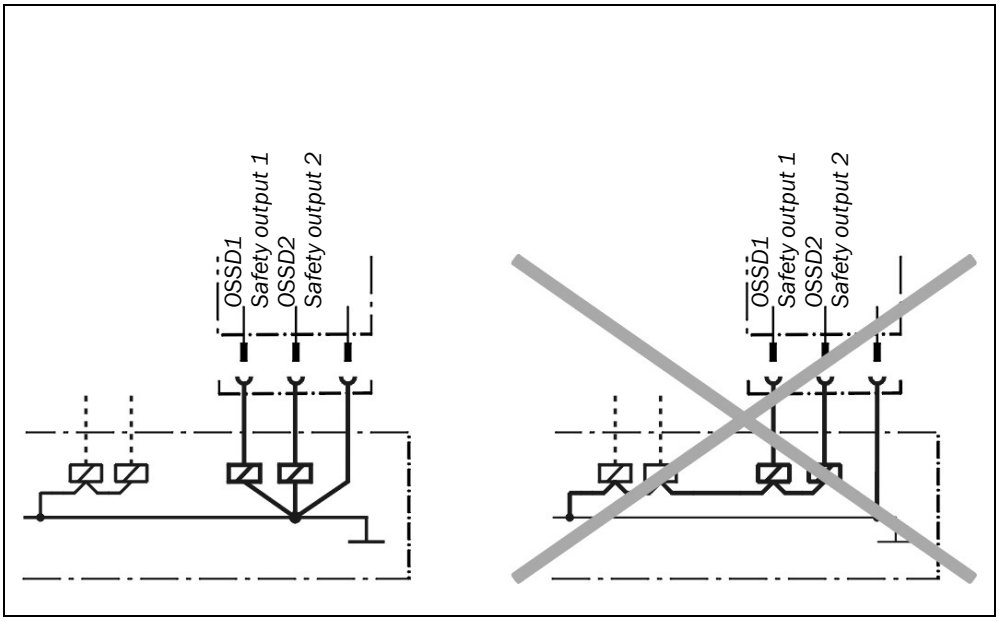
Tab. 15: Pin assignment RS-232 interface

Plug/ socket	Pin	Signal	Colour	Assignment PC-side RS-232-D-Sub (9-pin)
	1	Reserved	Brown	–
	2	RxD	White	Pin 3
	3	GND (electrically connected internally to connection A2 on the main unit)	Blue	Pin 5
	4	TxD	Black	Pin 2

WARNING

Prevent the formation of a potential difference between the load and the protective device!

- If you connect loads to the OSSDs that are not reverse polarity protected, then you must connect the 0 V connections for these loads and the related protective device separately, one after the other, to the same 0 V terminal strip. Only then is it ensured that in the case of a fault, it is not possible for a potential difference to form between the 0 V connections for the loads and the related protective device.

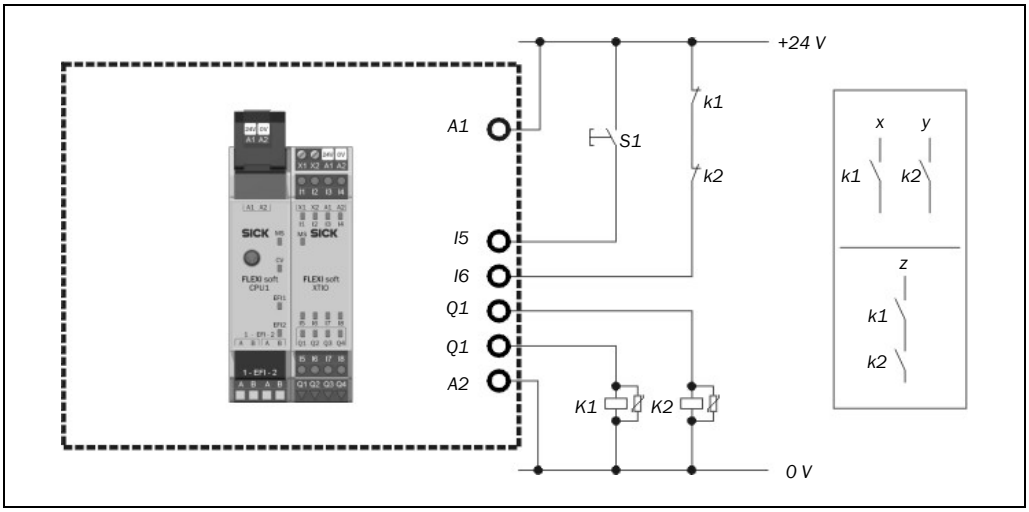


5.3 Connection diagrams

Note Only use relays with positively guided contacts. The protection elements connected in parallel with the contactors are used for arc-suppression.

Ensure that there is adequate arc-suppression at the relay contacts. Take into account that arc-suppressors may lengthen the response time.

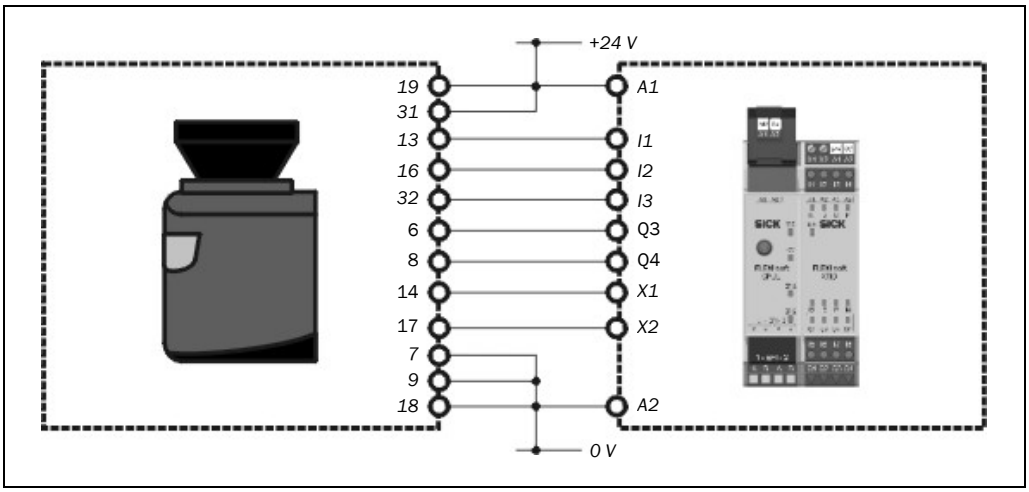
Fig. 39: Flexi Soft connection on machine side in connection with relays/contactors; operating mode: with restart interlock and external device monitoring



Integrate the cut-off paths into the machine control such that when the output circuit is open, there is no dangerous state. For categories 3 and 4 according to EN ISO 13849-1, the integration must be dual-channel (x/y paths). Observe the maximum switching current for the loading of the outputs (see Tab. 27 on page 77).

Note The safety controller and the electronics unit for the laser scanner must be supplied from the same power supply. The power supply for the LMS80-S01 electronics can be laid in the same cable as the control wires.

Fig. 40: Connecting the LMS80-S01 to the Flexi Soft



6 Configuration

6.1 Configuration of the laser scanner

Configure the laser scanner with the aid of the configuration software SOPAS ET directly on the LMS80-S01. It is only possible to access the configuration by using a password.

The following parameters must be configured:

- geometry of the protective fields 1 and 2 (see chapter 7 “Dimensioning” on page 51)
- geometry of the test field (see chapter 7 “Dimensioning” on page 51)
- response time (recommendation approx. 180 ms or higher for particle and dust-laden environments)

6.1.1 Preparing the configuration

To configure the laser scanner you need:

- the user software SOPAS ET 2.22 or later on the CD-ROM supplied
- PC/notebook with Windows 2000/XP/Vista, Ethernet interface or serial RS-232 interface (PC/notebook not included).
- Ethernet or RS-232 connection cable for connecting PC and LMS80-S01 (available as an accessory, see section 12.3 on page 84)

6.1.2 Configure

The operation of the user software requires general skills in the usage of Windows applications as well as a general understanding of the principle of operation of laser scanners.

➢ Start the PC and run the file **SopasET.exe** on the CD-ROM (the program can be run from the CD). As an alternative, the configuration software can be copied to the PC’s hard disc and started from there.

Note The necessary steps to configure the laser scanner are summarized in the separate tutorial “Configuration of the LMS80-S01”.

For information on advanced functions, e.g. settings and establishment of communication for measured data processing, see the accompanying document telegram listing (part no. 8007953).

In principle, there are 2 ways of undertaking the configuration:

Configuration with LMS80-S01 connected

It is possible to receive the configuration saved in the LMS80-S01 or to add a new configuration.

Configuration without LMS80-S01

The user software enables you to prepare and save configurations even without the device (simulated device) and to transfer them later to the LMS80-S01.

6.2 Configuration of the Flexi Soft safety controller

Configure the Flexi Soft using the configuration and diagnostics software Flexi Soft Designer directly on the Flexi Soft.

All basic functions for the HS80 safety scanner system are already pre-configured for the Flexi Soft and are available as project files. Prepared configurations are available as files for operation with 1, 2 or 3 laser scanners.

The configuration is undertaken in the following sequence:

1. Opening of the desired project file (CD-ROM)
2. Downloading the configuration file required to the Flexi Soft
3. Verifying the configuration
4. Locking the configuration

Once you have performed the steps described, the configuration is saved in the Flexi Soft system plug in non-volatile memory.

If you want to realize additional control tasks, you will find information on this topic in the operating instructions for the Flexi Soft.

6.2.1 Preparing the configuration

For the configuration of the flexible safety controller you will need:

- Flexi Soft Designer configuration and diagnostic software on the CD-ROM in the delivery
- PC/notebook with Windows 2000/XP/Vista, serial RS-232 interface (PC/notebook not included)
- RS-232 service cable for connecting the PC and the Flexi Soft (not included)

6.2.2 Configure

The operation of the user software requires general skills in the usage of Windows applications.

➢ Insert the CD-ROM for the Flexi Soft Designer in the drive on your computer to start the installation. Start the installation manually by running the file **setup.exe** in the folder **Flexi Soft Designer** on the CD-ROM.

Note The steps necessary for configuration are summarized in the separate tutorial “File download Flexi Soft”.

Default parameters Flexi Soft

- test rate for the laser scanner: 500 ms
- time window for the test reply from the laser scanner: 500 ms
- restart interlock: active
- EDM external device monitoring: active

The related file is loaded on the Flexi Soft using the serial connection (download) and is ready for operation without further configuration.

7 Dimensioning

For a horizontally mounted stationary application determine:

- the protective field size to observe the necessary safety distance,
- the height of the scan plane,
- the dimension of the test field.

Once you have defined the protective field size, mark the boundaries of the protective field on the floor. In this way you can avoid inadvertent entrance into the protective field and make it possible to subsequently check the shape of the protective field.

7.1 Dimensioning of the protective fields (safety distance)

The protective fields must be so configured that a safety distance (S) to the hazardous area is maintained. This safety distance ensures that the hazardous point can only be reached after the dangerous state of the machine has been completely stopped.

WARNING

Ensure that a human leg (70 mm) can be detected!

Mount the laser scanner such that the scan plane is at a maximum height of 300 mm.

The safety distance S as defined in prEN ISO 13855 and EN ISO 13857 depends on:

- approach speed of the body or parts of the body
- stopping/run-down time of the machine or system
  (The stopping/run-down time is shown in the machine documentation or must be determined by taking a measurement.)
- response time of the HS80 safety scanner system
- supplements for general measurement errors and any measurement errors related to reflection
- supplement for prevention of reaching over
- height of the scan plane

How to calculate the safety distance S:

➢ Calculate S using the following formula:

$$S = (K \times (T_M + T_S)) + Z_G + Z_R + C$$

Where ...

K = Approach speed (1600 mm/s, defined in prEN ISO 13855)
T_M = Stopping/run-down time of the machine or system
T_S = Response time of the HS80 and the downstream controller
Z_G = General safety supplement = 100 mm
Z_R = Supplement for measurement error related to reflection
C = Supplement for prevention of reaching over

The response time T_S of the HS80 depends on:

- the selected response time of the laser scanner
- the response time of the Flexi Soft

On this subject please read section 11.1 “Response time of the HS80 safety scanner system” on page 70.

WARNING

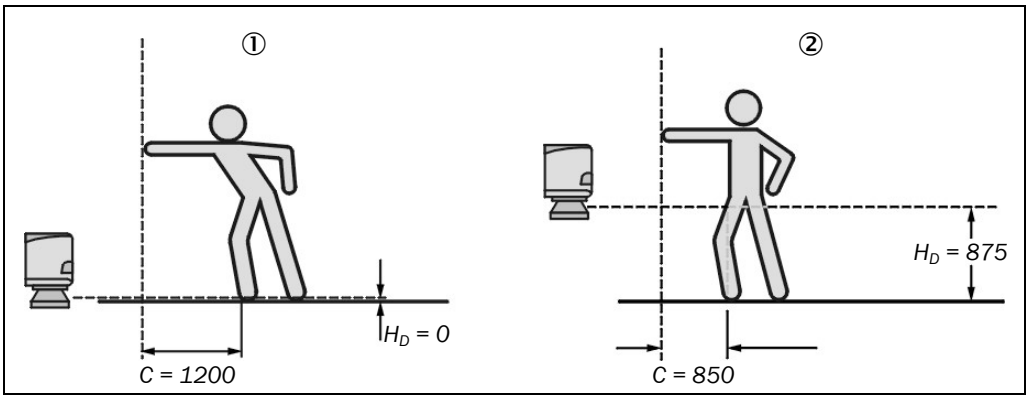
Avoid mounting retroreflectors at a distance of less than one meter from the boundary of the protective field!

With retroreflectors positioned at a distance of less than 1 m from the boundary of the protective field a supplement, Z_R, of 200 mm must be added to the protective field.

Supplement C for protection against reaching over

With a protective field installed horizontally, there is a risk that people may reach over the protective field and in this way reach the hazardous area before the HS80 shuts down the dangerous state. For this reason the calculation of the safety distance must take into account a supplement to prevent persons from finding themselves in a hazardous situation by reaching over before the system triggers (see EN ISO 13857, Table 1).

Fig. 41: Danger of reaching over (mm)



The necessary supplement for the safety distance is dependent on the height of the scan plane for the protective field. At low heights ① the supplement is larger than at greater heights ②.

WARNING

Prevent the possibility of crawling beneath the protective device if you mount it higher than 300 mm!

Prevent personnel from being able to crawl beneath the protective field by means of appropriate mounting of the LMS80-S01. If you mount the protective device higher than 300 mm, you must prevent crawling beneath by means of additional measures.

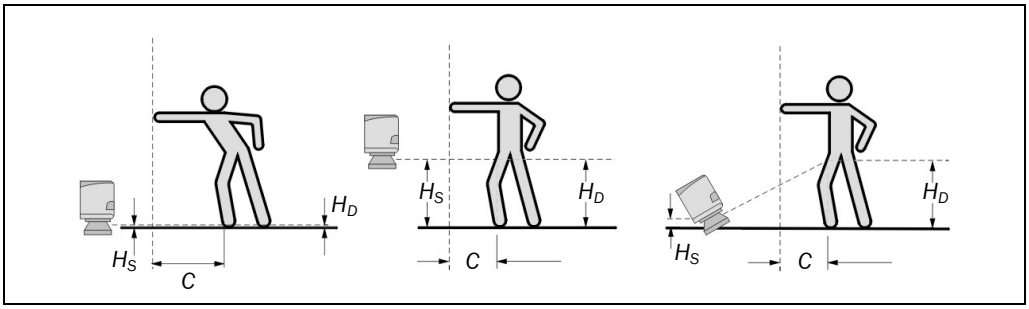
How to calculate the supplement C:

- If there is enough empty space in front of your machine or system, use 1200 mm for the supplement C.
- If the safety distance is to be kept as small as possible, calculate C using the following formula:
  $C = 1200\ mm - (0.4 \times H_D)$
  Here H_D is the height at which the protective field is mounted.

Note The minimum supplement to prevent reaching over is 850 mm (arm length).

In summary there are three usual methods of mounting the scan plane for the LMS80-S01. The optimal method depends on the related application.

Fig. 42: Mounting methods for the scan plane



Tab. 16 provides assistance making the selection.

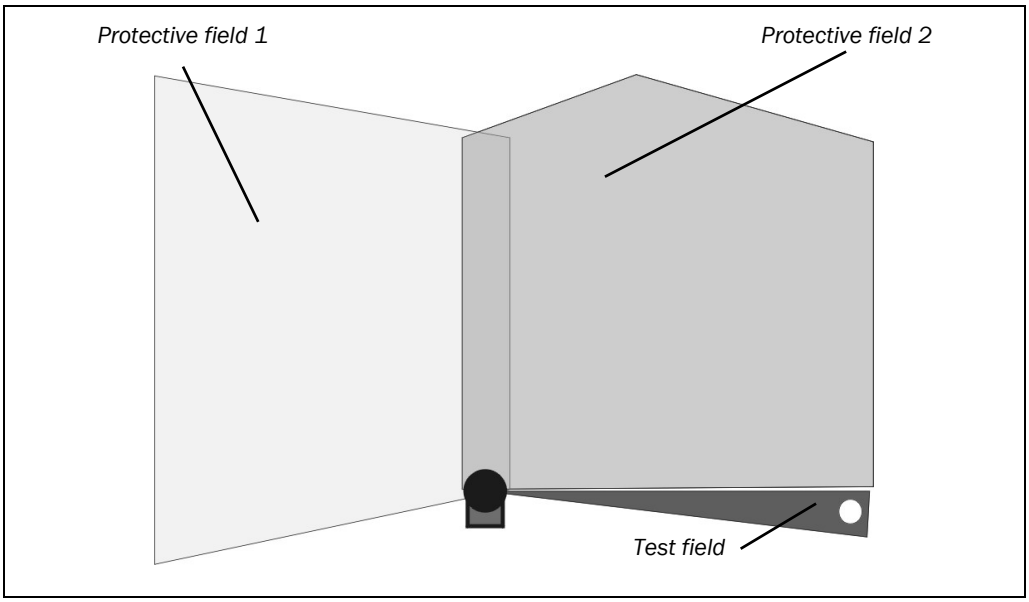
Tab. 16: Advantages and disadvantages of mounting methods
H_D = Detection height
H_S = Scanner mounting height

Mounting orientation	Benefit	Disadvantage
Laser scanner low (H_S < 300 mm) Low inclination of the scan plane ($H_D \approx H_S$)	No external effects due to dazzle, crawling beneath not possible	Larger supplement C
Laser scanner high (H_S > 300 mm) Low inclination of the scan plane ($H_D \approx H_S$)	Lower protective field supplement C	Danger of crawling beneath (at the front and side)
Laser scanner low (H_S < 300 mm) High inclination of the scan plane ($H_D > H_S$)	Lower protective field supplement C	Danger of crawling beneath (at the front), external effect due to dazzle possible

7.1.1 Protective field geometries

The protective field can have any geometry required within the 270° scan angle and the maximum scanning range of the LMS80-S01. Both protective fields operated independent of each other and are evaluated separately.

Fig. 43: Different protective field geometries



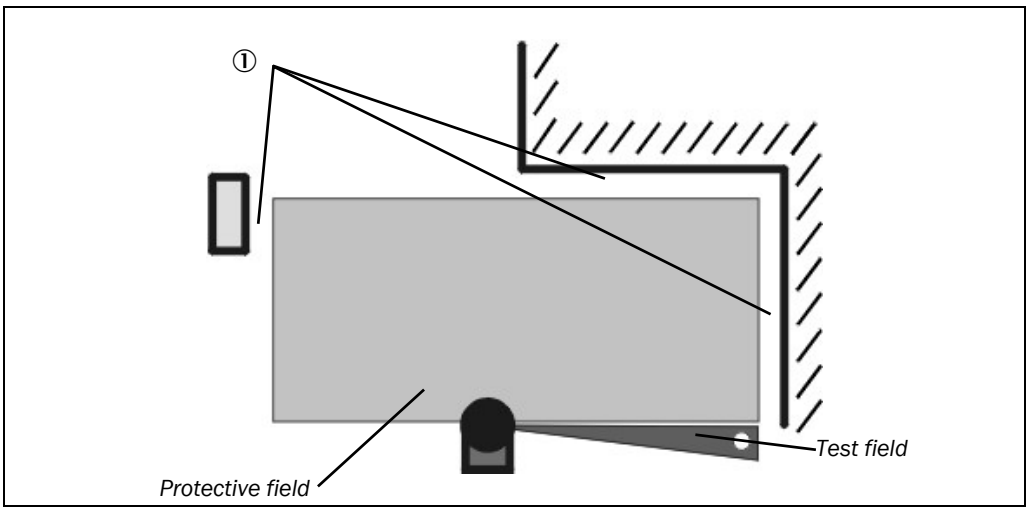
The parameters for the laser scanner LMS80-S01 are pre-set in the factory to two minimum protective fields.

Note If you only use one protective field, then the second, unused protective field must not be deleted (system interlocking). If an unused protective field has been, e.g., accidentally deleted, you must add a protective field with a radius of 50 mm.

Distance to fixed bodies or objects

If the protective fields stretch as far as a wall or another object (pillar, neighbouring machine, shelf), there must be a distance of at least 100 mm between the protective field and the object (①).

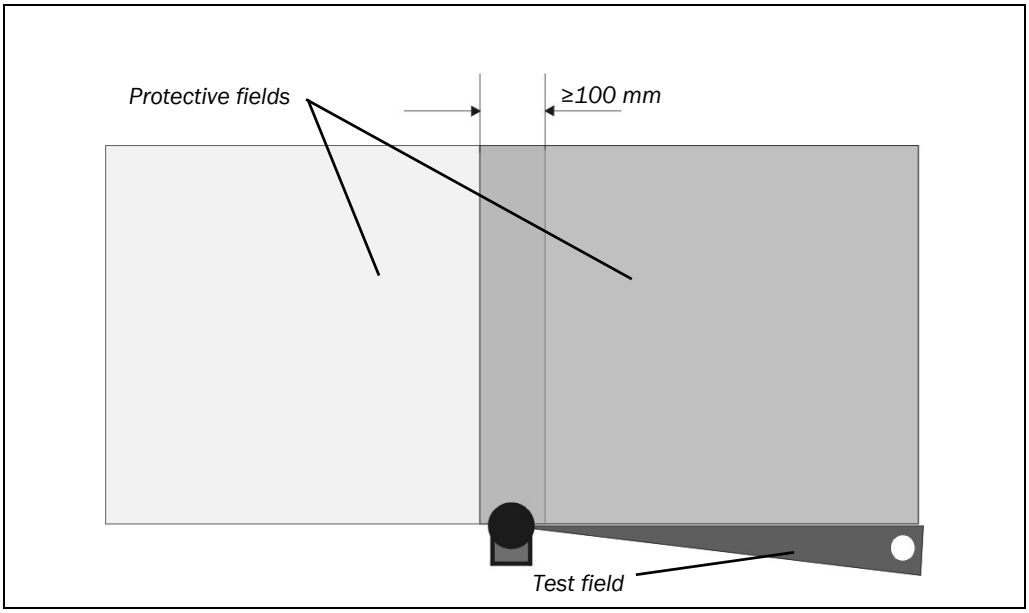
Fig. 44: Distance of the test target from objects



Overlapping protective fields

If both protective fields are used and they overlap due to the local situation, the width of the overlapping zone must be ≥100 mm.

Fig. 45: Example of overlapping protective fields



7.2 Dimensioning of the test field

The test field must be configured such that the test target can be safely detected.

Configure the test field to ensure system availability and to ensure adequate margins for the adjustment of the laser scanner. An excessively large test field can cause malfunctions due to the unintentional detection of external objects.

Configure the test field in the same way as the protective fields in the LMS80-S01 with the aid of the SOPAS ET configuration and diagnostic software.

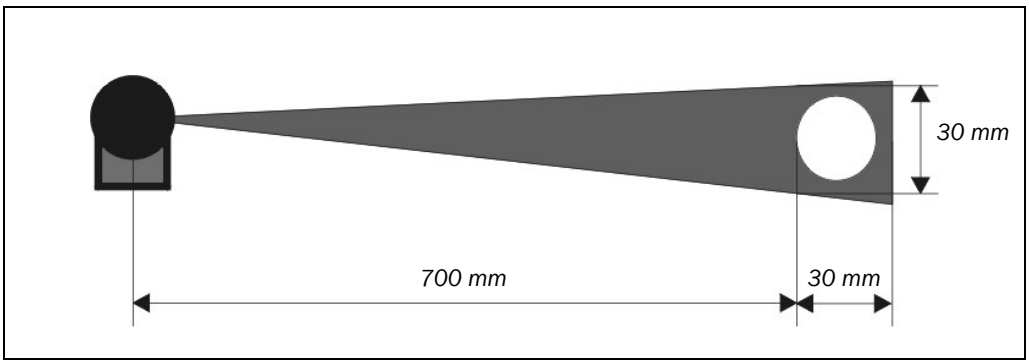
7.2.1 Dimensioning of the test target and test field

For test targets the following general figures apply:

- The test target must always be mounted outside the protective fields.
- The diameter of the test target (round bar) is always 20 mm.
- The radial distance from the test target to the LMS80-S01 is 700 mm (±50 mm).
- Width of the test field at the test target = 1.5 times the diameter of the target = 30 mm
- Depth of the test field at the test target = distance of the target from the LMS80-S01 plus 30 mm
- The distance from the test target to backgrounds must be ≥ 50 mm.

To only detect the test target in the field corridor, the field must not exceed a max. width.

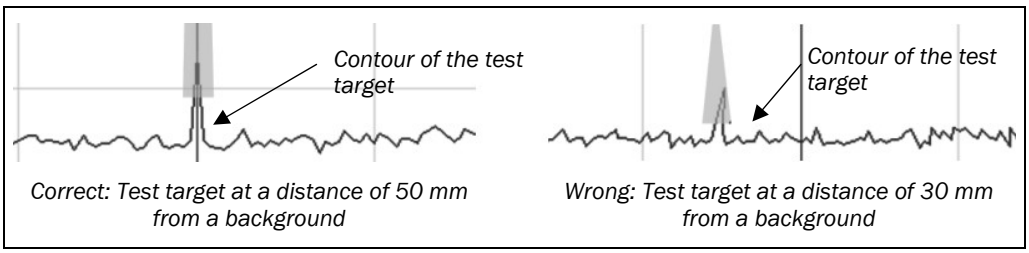
Fig. 46: Dimensioning of the test field at the test target



Distance of the test target from backgrounds

To positively detect the test target, it must be positioned a minimum distance of ≥ 50 mm from backgrounds. If the test target is too close to a background, its contour can no longer be positively differentiated and the necessary test field may, in certain circumstances, detect more than just the test target.

Fig. 47: Distance of the test target from backgrounds



Correct: Test target at a distance of 50 mm from a background

Wrong: Test target at a distance of 30 mm from a background

8 Commissioning

WARNING

Commissioning requires a thorough check by qualified safety personnel!

Before you operate a system protected by the HS80 safety scanner system for the first time, make sure that the system is first checked and released by qualified safety personnel. Please read the notes in chapter 2 “On safety” on page 8.

8.1 Commissioning of the laser scanners

The laser scanners start automatically after switching on the common power supply with the Flexi Soft. The duration of power up depends on the volume of the configuration data and can take up to 20 seconds.

8.1.1 Status displays of the LMS80-S01 during operation

Tab. 17: Status displays of the LMS80-S01 during operation

Display	Meaning
OK	Illuminates if there is no error present
1.	Protective field 1 infringed
1.	Protective field 2 infringed
-.	Test target not detected (goes out as soon as a correct test target is detected)

8.2 Commissioning of the Flexi Soft

Power up sequence of the flexible safety controller

After power up the system runs through a power up cycle. During the power-up cycle all outputs on the Flexi Soft are shut down (LOW).

Tab. 18: Indications of the MS LED on the FX3-CPU0 module

LED MS	Meaning	Note
○	Supply voltage outside the operating range	Switch on supply voltage and check at terminals A1 and A2
☀● **Red/green** (1 Hz)	A self-test is performed and the system initialized	Please wait …
☀● **Green** (1 Hz)	System is ready for operation	To start the application, press the Start button in the Flexi Soft Designer
● **Green**	Application is running	
Other displays	Errors: see section 10.4.1 on page 66	

Note After the power-up cycle the restart interlock can be removed by actuating the reset button.

On the usage of one or more laser scanners, the switching signals are displayed in the same way on inputs Ix to Iy. The output signal for scanner switching is also displayed on outputs Qx and Qy.

8.3 Test notes

Check the protective device as described below and in accordance with the applicable standards and regulations.

These tests are also used to identify if the protection is affected by external light sources or other unusual ambient effects.

These tests must therefore always be performed.

8.3.1 Tests before the initial commissioning

- Check the effectiveness of the protective device mounted to the machine, using all selectable operating modes as specified in the checklist in the annex (see section 13.2 on page 87).
- Ensure that the operating personnel of the machine protected by the safety scanner system are correctly instructed by qualified safety personnel before being allowed to operate the machine. Instructing the operating personnel is the responsibility of the machine owner.
- Annex (see section 13.2 on page 87) to this document includes a checklist for review by the manufacturer and OEM. Use this checklist as a reference before commissioning the system for the first time.

8.3.2 Testing the function of the laser scanner

- Test the function of the protective field along the outer boundaries using a test object with a diameter of 70 mm.

  The OSSDs on the Flexi Soft must switch to the OFF state on any infringement of the protective field and the restart interlock must be active.
- Check the test function by removing an external test target.
- With a test target missing, the system must shut down its OSSDs after 1 s at the latest.
- Repeat the test function in succession with all LMS80-S01 or test targets used.

Recommendation You can monitor the behaviour of the laser scanner as well as the infringements of the protective field on a PC that is connected.

Note The correct system behaviour (safe shut down of the OSSDs, restart interlock) must be checked on the flexible safety controller.

8.3.3 Regular inspection of the protective device by qualified safety personnel

- Check the system following the inspection intervals specified in the national rules and regulations. This procedure ensures that any changes on the machine or manipulations of the protective device after the initial commissioning are detected.
- If major changes have been made to the machine or the protective device, or if the safety scanner system has been modified or repaired, check the plant again as per the checklist in the annex. (see section 13.2 on page 87).

WARNING

No further operation if errors occur during the test!

If any one of the following points is not met, it is not permitted to continue to work on the machine or operate the system. In this case the installation of the HS80 must be checked by qualified safety personnel.

- Check the mechanical installation to ensure that all fixing screws are secured and that the laser scanners are properly aligned.
- Check each laser scanner for visible changes such as damage, manipulation etc.
- Switch on the machine/system.
- Monitor the LEDs on the flexible safety controller.
- If not at least one LED of the flexible safety controller is permanently lit when the machine/system is switched on, it is to be assumed that there is a fault in the machine or system. In this case the machine must be shut down immediately and checked by qualified safety personnel.
- Deliberately obstruct the protective field without risk to any personnel while the machine is running in order to test the protective function for the entire system.

  The Q4 LED[5)] for the Flexi Soft (OSSD) must go out during this process and the dangerous movement must come to a standstill immediately.

  Repeat this test at different points in the hazardous area and on all laser scanners. If you discover any non-conformance of the function, the machine/system must be shut down immediately and checked by qualified safety personnel.
- For a moving application it is to be checked whether a moving part of the machine actually stops with the protective field boundaries set in the laser scanner and indicated on the information label or in the configuration protocol. If you discover any non-conformance of this function, the machine/system must be stopped immediately and checked by qualified safety personnel.

[5)] If the safety controller integration in the machine controller is dual-channel, the LEDs for the outputs configured as OSSDs must go out.

8.3.4 Daily check on the external test targets

The test targets are an elementary part of the safety laser scanner system and must be checked daily, as they may be subject to harsh ambient conditions.

The following criteria must be checked:

- Check the correct position and firm seating of the test target body.
- Check the surface finish of the blackout film is correct.
  If the blackout film is no longer bonded over its entire surface area or is partially damaged, renew the blackout film on the test target.
- Clean a contaminated test target using a soft cloth.

Note Only use the blackout film for the test target surface. The blackout film is available as a spare part (see section 12.3 on page 84).

9 Care and maintenance

Note The housing screws of the LMS80-S01 are sealed. Claims under the warranty against SICK AG will be rendered void if the seals are damaged or the device opened. The housing is only allowed to be opened by authorized service personnel.

WARNING

Do not make any repairs to the devices!

The HS80 does not contain any repairable components.

Do not open the laser scanner!

The laser scanner is not allowed to be opened! The manufacturer's warranty will be rendered void if the device is opened.

9.1 Cleaning optics cover

WARNING

Switch the entire machine/system off line!

The system could inadvertently start up while you are cleaning the optics cover. As a matter of principle, always isolate the machine from the power supply during all work on the machine and laser scanner.

The HS80 is largely maintenance-free. The optics cover on the laser scanner should however be cleaned regularly and if it is contaminated.

- ➢ Do not use aggressive cleaning agents.
- ➢ Do not use abrasive cleaning agents.

Note Static charges cause dust particles to be attracted to the optics cover. You can reduce this effect by using the antistatic plastic cleaner (SICK part no. 5600006) and the SICK lens cloth (part no. 4003353) (see section 12.3 on page 84).

How to clean the optics cover:

- ➢ Use a clean and soft brush to remove dust from the optics cover.
- ➢ Now wipe the optics cover with a clean and damp cloth.

Note If the optics cover is scratched or damaged, the device must be replaced. In this case please contact your local SICK representative.

10 Fault diagnosis

This chapter describes how to identify and rectify errors and malfunctions of the laser scanner and the flexible safety controller.

10.1 In the event of faults or errors

WARNING

Cease operation if the cause of the malfunction has not been clearly identified!

Stop the machine if you cannot clearly identify or allocate the error and if you cannot safely rectify the malfunction.

10.2 SICK support

If you cannot remedy an error with the help of the information provided in this chapter, please contact your local SICK representative.

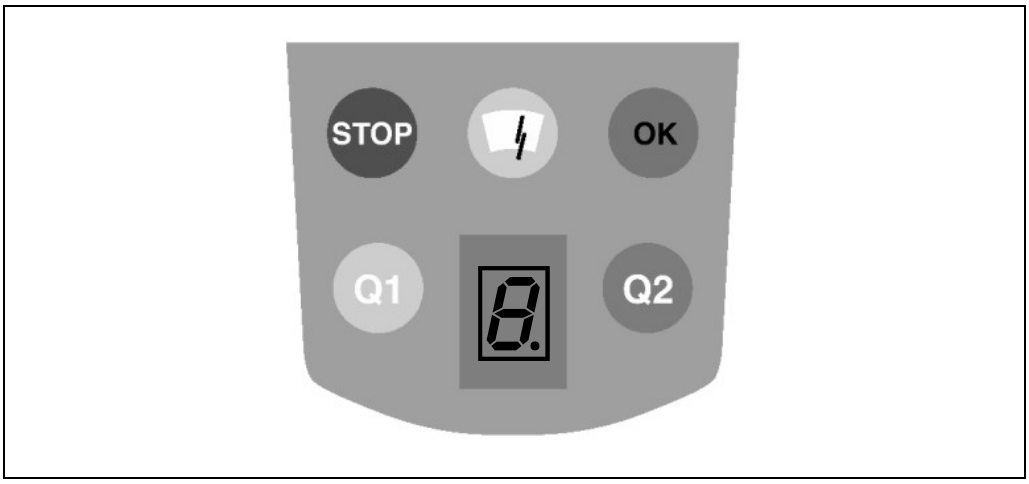
10.3 Diagnostics on the LMS80-S01

10.3.1 Error displays of the LEDs and the 7-segment display

This section explains the meaning of the error displays on the LEDs and the 7-segment display and how to respond to the messages.

The LEDs and the 7-segment display indicate the operational status of the laser scanner.

Fig. 48: Status indicators of the LMS80-S01



Tab. 19: Indications of the LMS80-S01

Display	Meaning
OK	Illuminates if there is no error present
STOP	Illuminates on an error in the device or a contamination error
	Illuminates on contamination warning or in connection with STOP on a contamination error
Q1	Inactive
Q2	Inactive
1.	Protective field 1 infringed
2.	Protective field 2 infringed
-.	Test target not detected

10.3.2 Extended diagnostics

In the SOPAS ET configuration software the protocol can be exported to PDF. It provides information on the actual device settings as well as the status of the device.

- The protocol can be read in user level **Authorized client** (the user level **Service** is only available to specially trained personnel).

➢ To save the protocol, start SOPAS ET and establish the connection to the device (see tutorial “Configuration of the LMS80-S01”). The device parameters are loaded automatically.

➢ Save the protocol in PDF format.

Fig. 49: Saving configuration protocol for the LMS80-S01

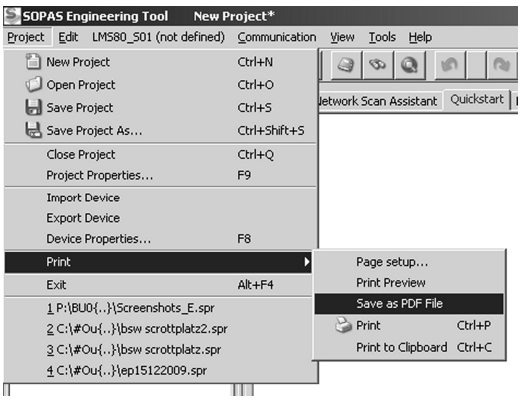


Fig. 50: Extract from the configuration protocol for the LMS80-S01

Group "Device status":

Device state	= Measure activ
Target state	= Measure active
Temperature main board top	= 65 °C
Device state	= Ready

Group "Contamination":

Contamination state	= No contamination

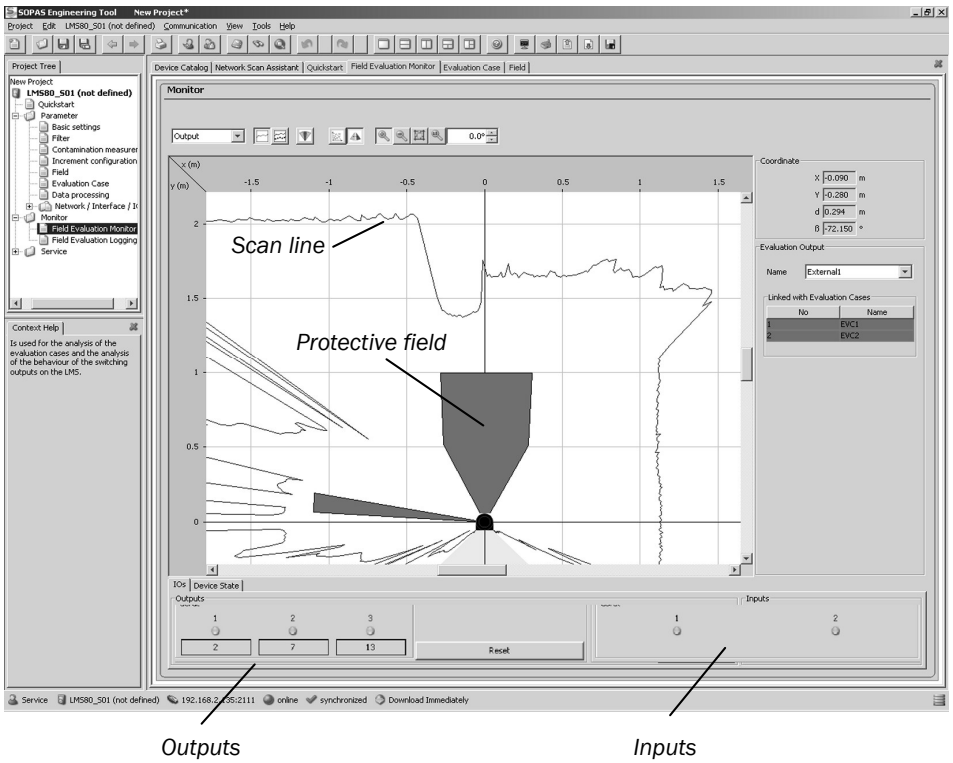
Group "Encoder status":

Current Speed	= 1000 mm/s
Current Direction	= Up

Monitor for the field evaluation in the SOPAS ET configuration software

A monitor is available in SOPAS ET for diagnostics. The monitor displays the protective fields set as well as their related status and the active scan line on the LMS80-S01.

Fig. 51: Monitor for field evaluation



Clear protective fields are shown in green, protective fields infringed by objects are shown in red. The scan line also shows the surrounding contour detected by the laser scanner within the 270° scan angle. It provides information on the position of objects and shows the contour of objects that are infringing the protective field.

The input and output states on the LMS80-S01 are also displayed in the monitor.

10.4 Diagnostics on the Flexi Soft safety controller

Error details may be obtained from:

- the LEDs on the Flexi Soft
- diagnostics with the aid of the Flexi Soft Designer

Note In the case of errors, always check whether one or more connected devices display an error.

If necessary, consult the documentation of the device that is displaying an error in order to resolve it.

10.4.1 Diagnostics using LED indications

The LED indications on the CPU as well as for the inputs and outputs on the Flexi Soft provide information on the signals from the external components (laser scanner, reset button) as well as on the output signals from the Flexi Soft.

Tab. 20: Indications of the MS LED on the FX3-CPU0 module

LED MS	Meaning	Note
○	Supply voltage outside the operating range	Switch on supply voltage and check at terminals A1 and A2.
☼ **Red/green** (1 Hz)	A self-test is performed and the system initialized.	Please wait ...
☼ **Green** (1 Hz)	System is ready for operation.	To start the application, press the Start button in the Flexi Soft Designer.
● **Green**	Application is running.	
☼ **Red** (2 Hz)	CPU has caused an internal error in the system.	Switch the supply voltage off and back on again. If necessary, modify configuration using the Flexi Soft Designer. For more detailed diagnostics see Flexi Soft Designer diagnostics.
☼ **Red** (1 Hz)	Recoverable error, either in the main module or in one of the extension modules	Check module type and version of main unit and extension modules on which the MS LED is flashing red/green. If necessary, modify configuration using the Flexi Soft Designer. For more detailed diagnostics information, please use the Flexi Soft Designer.
● **Red**	Critical error in the system	Switch the supply voltage off and back on again. If after several attempts the error has not be rectified, replace module. To locate the module affected, use the diagnostic display in the Flexi Soft Designer.

Tab. 21: Indications of the CV LED on the FX3-CPU0 module

LED CV	Meaning	Note
○	Configuration required	
☼ **Yellow** (2 Hz)	Saving configuration data in non-volatile memory	Supply must not be interrupted until the save process is complete
☼ **Yellow** (1 Hz)	Valid, but not verified configuration	Verifying the configuration with Flexi Soft Designer software
● **Yellow**	Valid and verified configuration	

Tab. 22: Indications of the MS LED on the FX3-XTIO module

LED MS	Meaning	Note
○	Supply voltage outside operating range	Check supply voltage at terminals A1 and A2.
☼ **Red/green** (1 Hz)	Recoverable external error	Check cabling for the flashing inputs and outputs. If all output LEDs are flashing, check the supply voltage on terminals A1 and A2 of this module.
☼ **Green** (1 Hz)	The module is ready.	Start the application in the Flexi Soft Designer.
● **Green**	Application is running.	
☼ **Red** (2 Hz)	Module has caused internal error in the system.	Rectification of an error state due to cross/short circuits on the outputs Q1–Q4: Rectify short-circuit, then in the logic set the signals for all outputs to 0 at the same time (e.g. by actuating emergency stop, which results in the shut down of the logic) or switch off and back on the supply for the main unit.
☼ **Red** (1 Hz)	Configuration required	
● **Red**	Critical error in the system	Switch off and back on the supply for the main unit. If after several attempts the error has not be rectified, replace module. To locate the module affected, use the diagnostic display in the Flexi Soft Designer.

Tab. 23: Indications of the input/output LEDs on the FX3-XTIO module

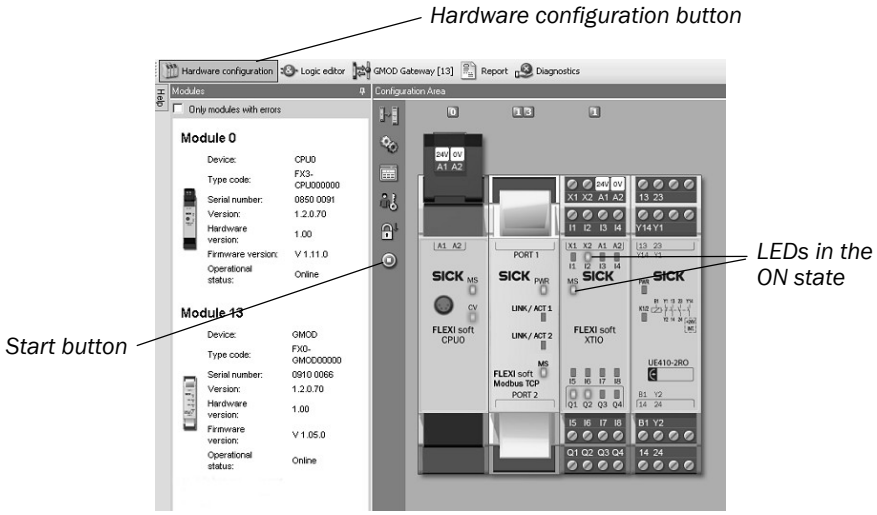
Input LEDs (I1 … I8) output LEDs (Q1 … Q4)	Meaning
○	Input/output is active.
● **Green**	Input/output is active.
☼ **Green** (1 Hz) synchronously with ☼ **Red MS**	Input/output is inactive and there is an error that can be rectified.
☼ **Green** (1 Hz) alternately with ☼ **Red MS**	Input/output is active and there is an error that can be rectified.

Monitoring in the Flexi Soft Designer

After commissioning the system, the individual signal paths and their logical states and therefore the entire application can be monitored on the PC monitor.

The application is started for this purpose using the green start icon in the **Hardware configuration** standard view in the Flexi Soft Designer; the related logic pages then show the signal states.

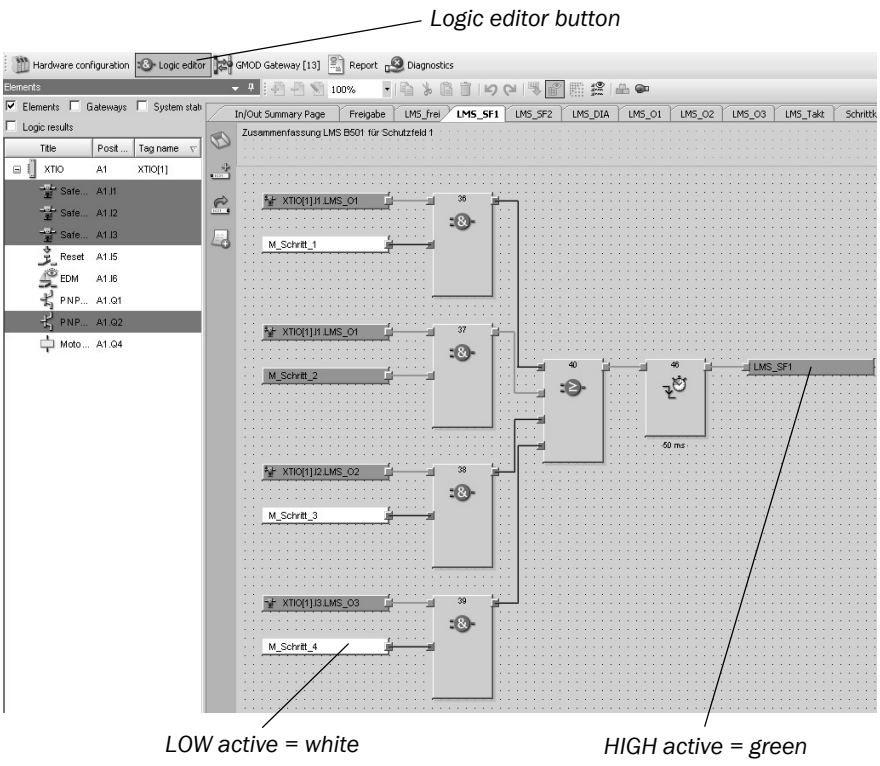
Fig. 52: Hardware configuration standard view in the Flexi Soft Designer



The LEDs on the Flexi Soft for inputs and outputs are also simulated and indicate the related states (HIGH = green, LOW = off)

In the **Logic editor** standard view in Flexi Soft Designer, the logical function blocks used as well as the status of the individual signal paths are displayed.

Fig. 53: Logic editor standard view in Flexi Soft Designer



In the **Logic editor** the expected signals in the logic and the signals connected externally (inputs, outputs) can be monitored. You can change logic area during monitoring using the tabs.

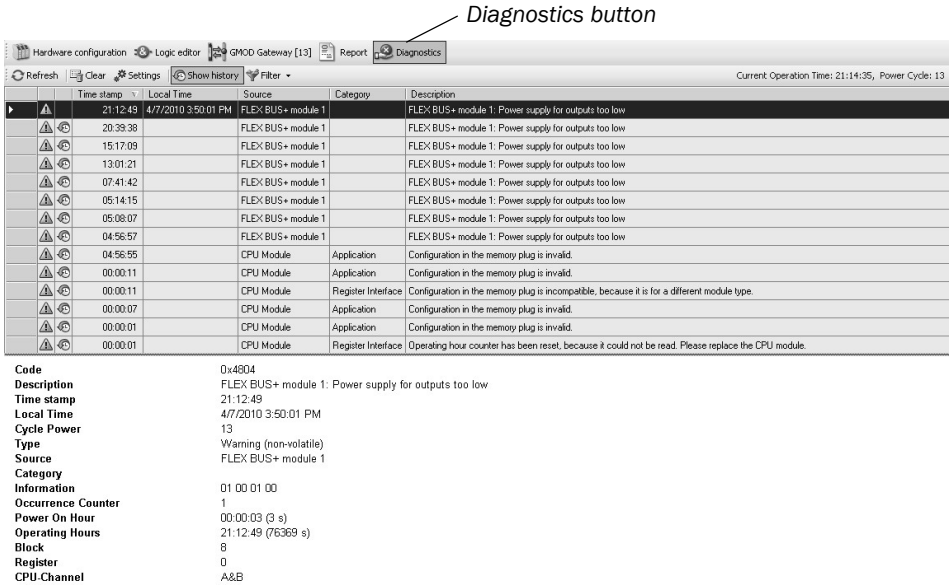
10.4.2 Extended diagnostics

The Flexi Soft Designer contains extensive diagnostic facilities. This allows you to narrow down the problem if the error is non-specific or if you experience usage downtime problems.

Diagnostics standard view in Flexi Soft Designer

The diagnostics window shows current and past events (history) as well as description of the events, e.g. cross-circuit on input I1.

Fig. 54: Diagnostics standard view in Flexi Soft Designer



For details please see the Flexi Soft Designer operating instructions.

11 Technical specifications

11.1 Response time of the HS80 safety scanner system

The response time of the HS80 is the sum of the response time of the Flexi Soft safety controller + the response time of the laser scanner (independent of the number of laser scanners connected and the test cycle).

$T_{A\ HS80} = T_{A\ Flexi\ Soft} + T_{A\ LMS80\text{-}S01}$

The response time of the laser scanner is determined from the angular resolution and the scan rate of the LMS80-S01. These parameters are configured directly on the LMS80-S01. In addition to the response time there are a further 10 ms switching time for the LMS80-S01.

In the case of applications for particle and dust-laden environments, response times of 180 ms or – if necessary – higher response times are recommended (among other reasons for particle filtering). The maximum response time for the LSM80-S01 is 400 ms.

The response time for the Flexi Soft is given by the length of the signal paths and is displayed in the configuration software Flexi Soft Designer. It is between min. 8 ms and max. 24 ms.

In addition to the response time of the Flexi Soft there are a further 11 ms propagation time for the input and output signals on the Flexi Soft.

$T_{A\ Flexi\ Soft} = 3 \times T_{A\ logic} + T_{A\ inputs} + T_{A\ outputs}$

$T_{A\ Flexi\ Soft} = 3 \times T_{A\ Logic} + 11\ ms$

Example

HS80 with one LMS80-S01 (180 ms response time) without additional logic in the Flexi Soft:

$T_{A\ HS80} = (3 \times 8\ ms + 11\ ms) + (180\ ms + 10\ ms)$

$T_{A\ HS80} = 35\ ms + 190\ ms$

$T_{A\ HS80} = 225\ ms$

11.2 Data sheets

11.2.1 HS80 safety scanner system

Tab. 24: Data sheet HS80 safety scanner system

	Minimum	Typical	Maximum
Category	Category 2 (EN ISO 13849-1)		
Test rate[6]	2 $^1/_s$ (0.5 s per test; EN ISO 13849)		
Maximum demand rate[7]	1.2 $^1/_{min}$ (EN ISO 13849)		
Performance Level[8]	PL d (EN ISO 13849-1)		
PFHd (T_{amb} = 25 °C) (mean probability of a dangerous failure per hour)			58×10^{-6}
T_M (mission time)	20 years (EN ISO 13849)		
Safety-related scanning range	2.5 m		
Relative velocity of a moving system			8.9 m/s

Note The test rate is 500 ms, i.e. test errors are detected after 500 ms. The related demand rate (safety-related reaction of the system) is: 100 × test rate = 100 × 0.5 s = 50 s (1.2 requirements per minute).

[6] Internal test. The test rate may not be exceeded if an external test is performed.
[7] At least 100 internal or external tests must be performed between two demands for a safety-relevant response of the device.
[8] For detailed information on the exact design of your machine/system, please contact your local SICK representative.

11.2.2 Laser scanner LMS80-S01

Tab. 25: Data sheet laser scanner LMS80-S01

	Minimum	Typical	Maximum
Functional data			
Scan angle			270°
Remission	10%		Several 1,000% (reflectors)
Angular resolution		0.5°	
Measurement error 1st reflected pulse			
Systematic error		±30 mm	±40 mm
Temperature drift	0 mm/°C		0.32 mm/°C
Statistical error (1 s)		12 mm	20 mm
Immunity to ambient light		40 klx	
Evenness of the scan field (25 Hz)			
Cone		±0.5°	±1°
Inclination		±1°	±2°
Distance from mirror axis of rotation (zero point on the X and Y axis) to the rear of the device		55 mm	
Distance between centre of the scan plane and the bottom edge of the housing		116 mm	
Distance measuring range	0.5 m		20 m
Power-up delay			60 s
Of a configured device		15 s	
Configurable restart after	2 s		60 s

	Minimum	Typical	Maximum
General data			
Laser protection class	Laser class 1 (IEC 60825-1:2014 and IEC 60825-1:2007)		
Enclosure rating	IP 65 (EN 60529 (1991-10); A1 (2002-02))		
Protection class	III (EN 50178)		
EMC test	EN 61000-6-2 (2005-08), EN 61000-6-3 (2007-03)		
Electrical safety	EN 50178		
Ambient operating temperature	0 °C		+50 °C
Storage temperature range	–30 °C		+70 °C (≤24 h)
Humidity (taking into account the operating temperature range)	EN 60068-2-61, method 1		
Vibration resistance	EN 60068-2-6		
Frequency range	10 Hz		150 Hz
Amplitude	5 g RMS		
Shock resistance	EN 60068-2-27		
Single shock	15 g, 11 ms		
Continuous shock	10 g, 16 ms		
Sender	Pulsed laser diode		
Wavelength	895 nm	905 nm	915 nm
Divergence of the collimated beam (solid angle)		15 mrad	
Light spot size at optics cover		8 mm	
Housing			
Material	GD-ALSI12 3.2582.05		
Colour	RAL 5012 (blue)		
Optics cover			
Material	Polycarbonate		
Surface finish	Outside with scratch-resistant coating		
System plug			
Material	GD-ALSI12 3.2582.05		
Colour	RAL 9005 (black)		
Dimensions			
Height			152 mm
Width			102 mm
Depth			106 mm
Total weight (without connecting cables)		1.1 kg	

	Minimum	Typical	Maximum
Electrical data			
Supply voltage SELV or PELV (IEC 60 364-4-41)	10.8 V	24 V	30 V
Permissible residual ripple			±5 %
Switch on current			2 A
Operating current			
At 24 V without output load		0.35 A	0.5 A
With max. output load		0.65 A	0.8 A
Power consumption			
Without output load		8.4 W	12 W
With maximum output load		16 W	20 W
Electrical connection	System plug with screw terminal block		
Technical specifications, screw terminals			
Cross-section of rigid cores	0.14 mm^2		1.5 mm^2
(American Wire Gauge – AWG)	(Approx. 26 AWG)		(Approx. 16 AWG)
Cross-section of flexible cores	0.14 mm^2		1.0 mm^2
(American Wire Gauge – AWG)	(Approx. 26 AWG)		(Approx. 18 AWG)
Insulation stripping length for the cores		5 mm	
Screw tightening torque	0.22 Nm		0.3 Nm
Cable length for device power supply at 24 V			
With wire cross-section 1 mm^2			220 m
With wire cross-section 0.5 mm^2			110 m
With wire cross-section 0.25 mm^2			50 m
Switching inputs			
Number	2		
Input resistance when HIGH		2 kW	
Voltage for HIGH	11 V	24 V	30 V
Voltage for LOW		0 V	5 V
Input capacitance		15 nF	
Static input current	6 mA		15 mA

	Minimum	Typical	Maximum
Output signal switching devices			
Number	3		
Voltage drop load		2 V	
Maximum switching current			140 mA
Current limiting (after 5 ms at 25 °C)	100 mA		200 mA
Power-up delay	Negligible		
Switch off time		0.8 ms	2 ms

Serial auxiliary interface

Communication protocol	RS-232 (proprietary)		
Transmission speed	9,600 Baud	57.6 kBd	115.2 kBd

Serial host interface

Communication protocol	RS-232 (proprietary)		
Transmission speed (selectable)	9,600 Baud	57.6 kBd	115.2 kBd
Cable length at 38,400 kBd and wire cross-section 0.25 mm^2 (approx. 24 AWG)			15 m
Galvanic isolation	Yes		
Wire cross-section of the connecting cable			0.25 mm^2
Ethernet	10/100 MBit/s		

11.2.3 Main units FX3-CPU0 and FX3-CPU1

Tab. 26: Data sheet main units FX3-CPU0 and FX3-CPU1

Safety integrity level[9)]	SIL3 (IEC 61508)
SIL claim limit[9)]	SILCL3 (EN 62061)
Category	Category 4 (EN ISO 13849-1)
Performance Level[9)]	PL e (EN ISO 13849-1)
PFHd (T_{amb} = 25 °C) (mean probability of a dangerous failure per hour)	1.07×10^{-9}
T_M (mission time)	20 years (EN ISO 13849)
Ambient temperature in operation	–25 ... +55 °C
Storage temperature	–25 ... +70 °C
Air humidity	10 ... 95%, non-condensing
Climatic conditions	55 °C, 95% r.h. (EN 61131-2)
Vibration resistance	5 ... 500 Hz (EN 61131-2)
Enclosure rating Terminals Housing	 IP 20 (EN 60529) IP 40 (EN 60529)
Electromagnetic compatibility	Class A (EN 61000-6-2, EN 55011)
Protection class	III (EN 50178)
Data interface	Internal bus (FLEXBUS+)
Configuration interface	RS-232
Cross-section connecting cable	Single or fine-stranded wire: 1 × 0.14 ... 2.5 mm² or 2 × 0.14 ... 0.75 mm² Fine stranded wire with ferrules (EN 46228): 1 × 0.25 ... 2.5 mm² or 2 × 0.25 ... 0.5 mm²
Dimensions (W × H × D)	22.5 × 93.7 × 120.8 mm
Weight	100 g

Power supply (A1, A2) via FX3-MPL0 system plug

Supply voltage	24 V DC (16.8 ... 24 ... 30 V DC)
Type of supply voltage	PELV or SELV The current from the power supply that supplies the main unit must be limited externally to max. 4 A — either by the power supply itself or by a fuse.
Power consumption	Max. 2.5 W
Power-up delay	Max. 18 s
Short-circuit protection	4 A gG (with tripping characteristic B or C)

9) For detailed information on the exact design of your machine/system, please contact your local SICK representative.

11.2.4 Input/output extension module FX3-XTIO

Tab. 27: Data sheet input/output extension module FX3-XTIO

Safety integrity level[10)]	SIL3 (IEC 61508)
Category	Category 4 (EN ISO 13849-1)
Performance Level[10)]	PL e (EN ISO 13849-1)
PFHd (T_{amb} = 25 °C) (mean probability of a dangerous failure per hour)	0.9×10^{-9} (dual-channel) 4.8×10^{-9} (single-channel)
T_M (mission time)	20 years (EN ISO 13849-1)
Ambient temperature in operation	–25 ... +55 °C
Storage temperature	–25 ... +70 °C
Air humidity	10 ... 95%, non-condensing
Climatic conditions	55 °C, 95% r.h. (EN 61131-2)
Vibration resistance	5 ... 500 Hz (EN 61131-2)
Enclosure rating Terminals Housing	 IP 20 (EN 60529) IP 40 (EN 60529)
Electromagnetic compatibility	Class A (EN 61000-6-2, EN 55011)
Protection class	III (EN 50178)
System connection	Double-layer spring terminals
Power consumption via FLEXBUS+ without currents on X1, X2	max. 1.1 W
Cross-section connecting cable	Single or fine-stranded wire: 1 × 0.14 ... 2.5 mm² or 2 × 0.14 ... 0.75 mm² Fine stranded wire with ferrules (EN 46228): 1 × 0.25 ... 2.5 mm² or 2 × 0.25 ... 0.5 mm²
Data interface	Internal bus (FLEXBUS+)
Dimensions (W × H × D)	22.5 × 93.7 × 120.8 mm
Weight	180 g

Power supply (A1, A2)

Supply voltage	24 V DC (16.8 ... 24 ... 30 V DC)
Type of supply voltage	PELV or SELV The current from the power supply that supplies the main unit must be limited externally to max. 4 A — either by the power supply itself or by a fuse.
Power consumption	Max. 96 W, determined by the load on the outputs Q1 to Q4
Power-up delay	Max. 18 s
Short-circuit protection	4A gG (with tripping characteristic B or C)

[10)] For detailed information on the exact design of your machine/system, please contact your local SICK representative.

Input circuit (I1 ... I8)

Input voltage HIGH	13 ... 30 V DC
Input voltage LOW	–5 ... +5 V DC
Input current HIGH	2.4 ... 3.8 mA
Input current LOW	–2.5 ... +2.1 mA
Switching current (on connection of mechanical contacts)	14,4 mA at 5 V 3 mA at 24 V
Discrepancy time	4 ... 30 s, configurable
Number of inputs	8

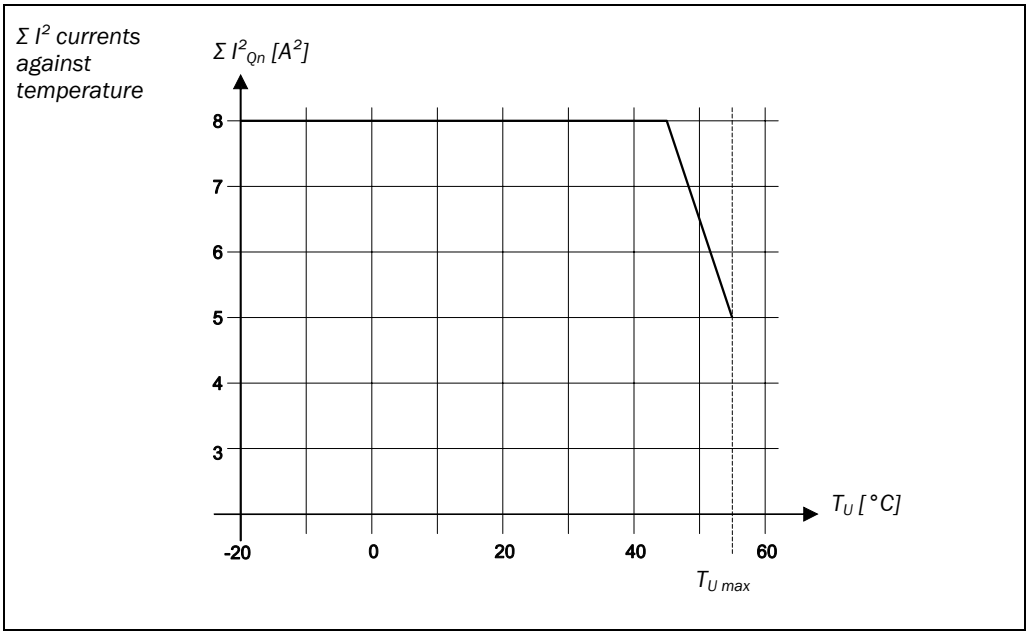
Test outputs (X1, X2)

Number of outputs	2 (with 2 test pulse generators)
Type of output	PNP semiconductors, short-circuit protected, cross-circuit monitored
Output voltage	16 ... 30 V DC
Output current	Max. 120 mA on a test output (X1 or X2) As a result max. 8 sensor cascades can be tested per module each with max. 30 mA. The total current for the Flexi Soft system is limited to max. 1.28 A. This limit corresponds to, e.g., 32 inputs from sensors that can be tested, at 30 mA each, and 64 inputs from FX3-XTIO or FX3-XTDI modules.
Test pulse rate	1 ... 25 Hz, configurable
Test pulse duration	1 ... 100 ms, configurable
Load capacity	1 µF for test pulse duration ≥4 ms 0.5 µF for test pulse duration 1 ms
Cable resistance	<100 Ω

Safety outputs (Q1 ... Q4)

Number of outputs	4
Type of output	PNP semiconductors, short-circuit protected, cross-circuit monitored
Output voltage	24 V DC (15.6 ... 30 V DC)
Output current I_{Qn}, $T_U \leq 45$ °C I_{Qn}, $T_U \leq 55$ °C	 Max. 2.0 A Max. 1.6 A
Total current I_{sum} ΣI^2_{Qn}, $T_U \leq 45$ °C ΣI^2_{Qn}, $T_U \leq 55$ °C	 Max. 8 A^2 Max. 5 A^2
Test pulse width	<650 µs
Test pulse rate	Max. 5 Hz
Load capacity	≤0.5 µF
Cable length	100 m, 1.5 mm^2
Response time	Dependent on logic configuration
Data interface	Internal bus (FLEXBUS+)

Fig. 55: Load diagram for the outputs Q1 to Q4 on the FX3-XTIO modules

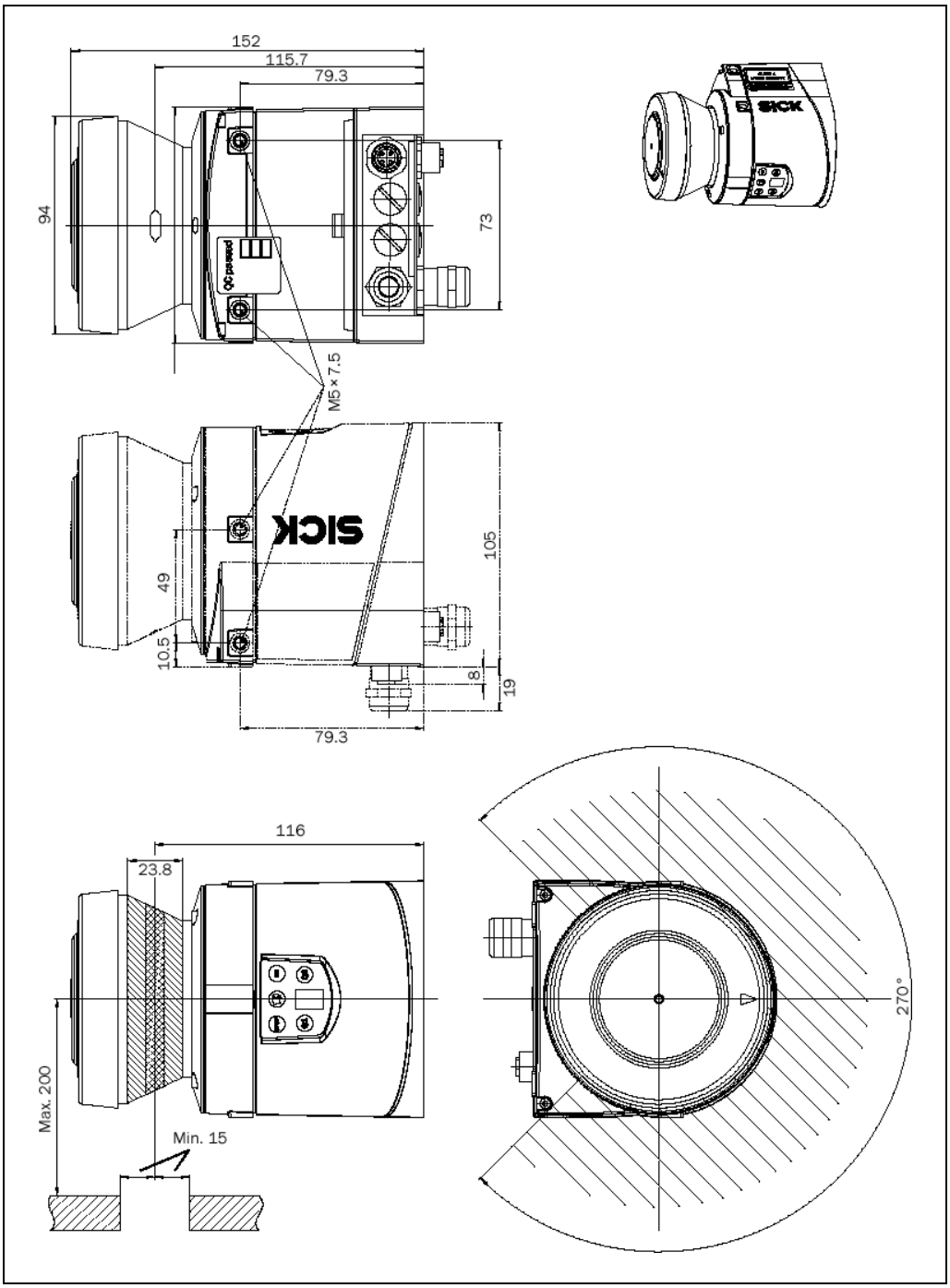


Σ I^2 currents against temperature

11.3 Dimensional drawings

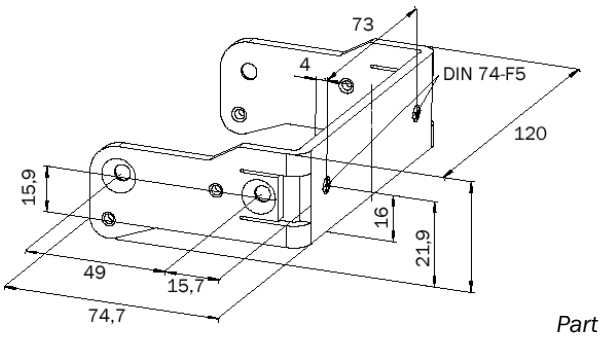
11.3.1 Dimensional drawing LMS80-S01

Fig. 56: Dimensional drawing LMS80-S01 (mm)



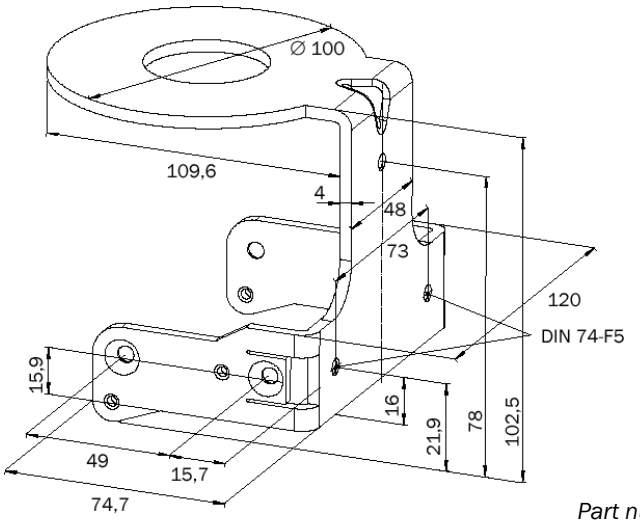
11.3.2 Dimensional drawings, mounting kits

Fig. 57: Dimensional drawing, mounting kit 1a (mm)



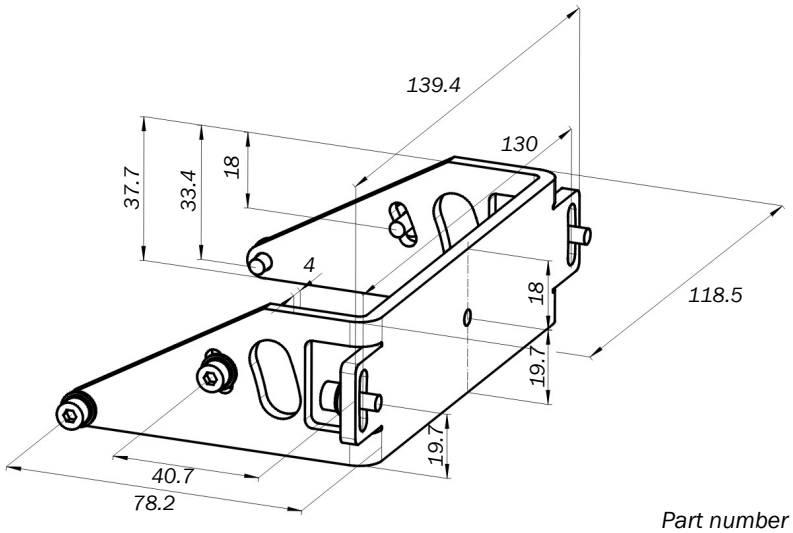
Part number 2034324

Fig. 58: Dimensional drawing, mounting kit 1b (mm)



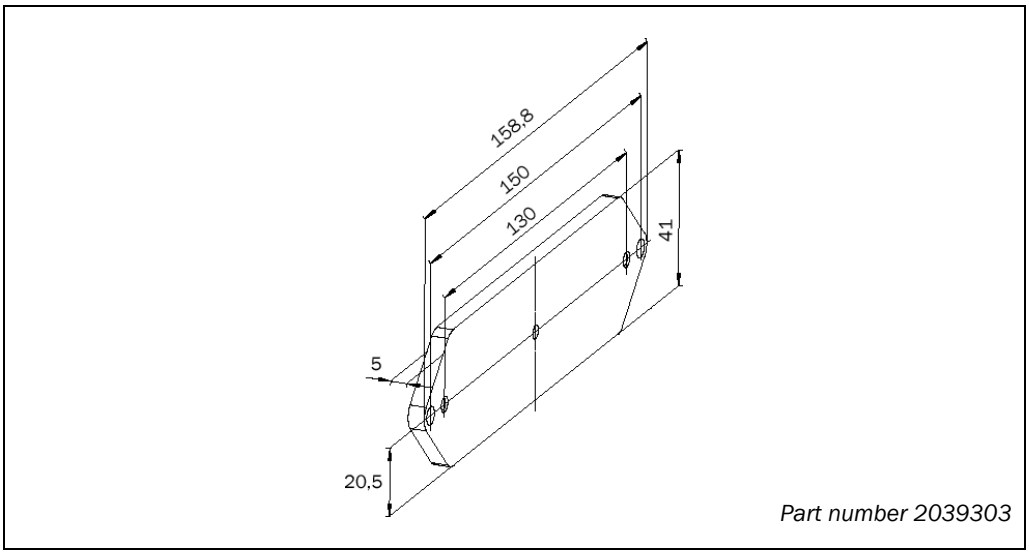
Part number 2034325

Fig. 59: Dimensional drawing, mounting kit 2 (mm)



Part number 2039302

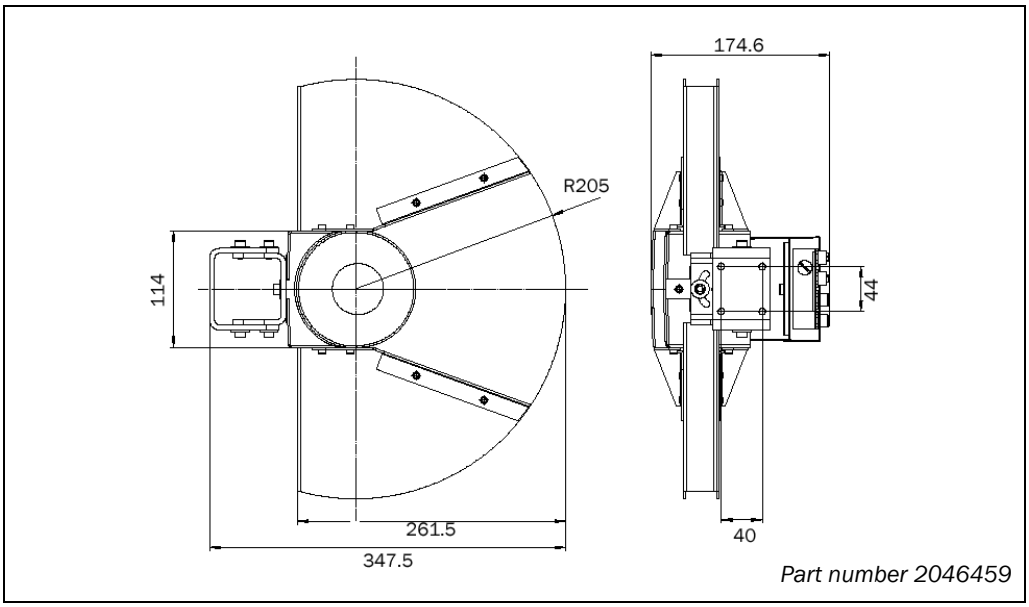
Fig. 60: Dimensional drawing, mounting kit 3 (mm)



Part number 2039303

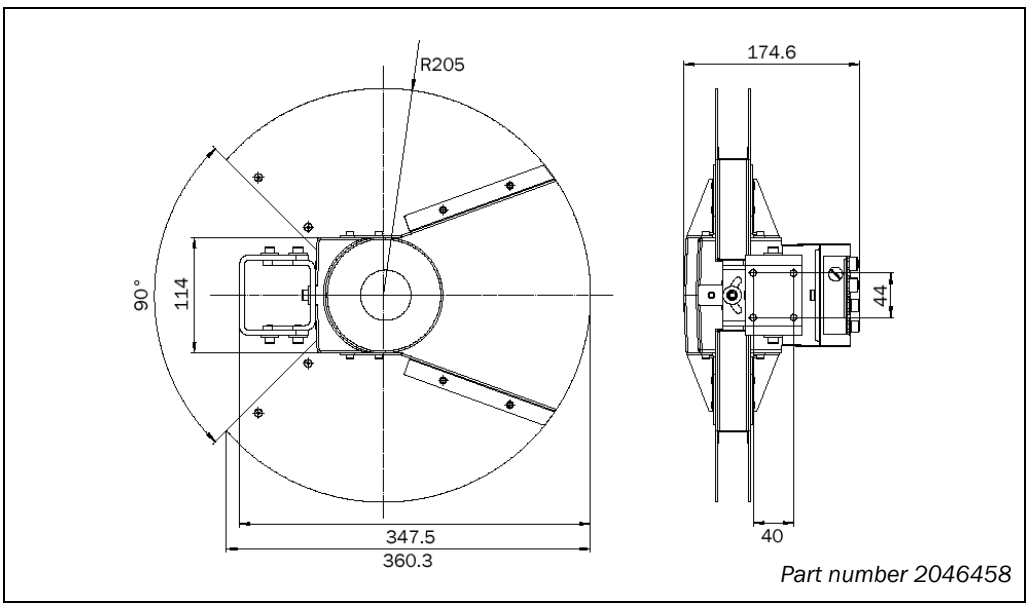
11.3.3 Dimensional drawings, protective covers

Fig. 61: Dimensional drawing protective cover 190° (mm)



Part number 2046459

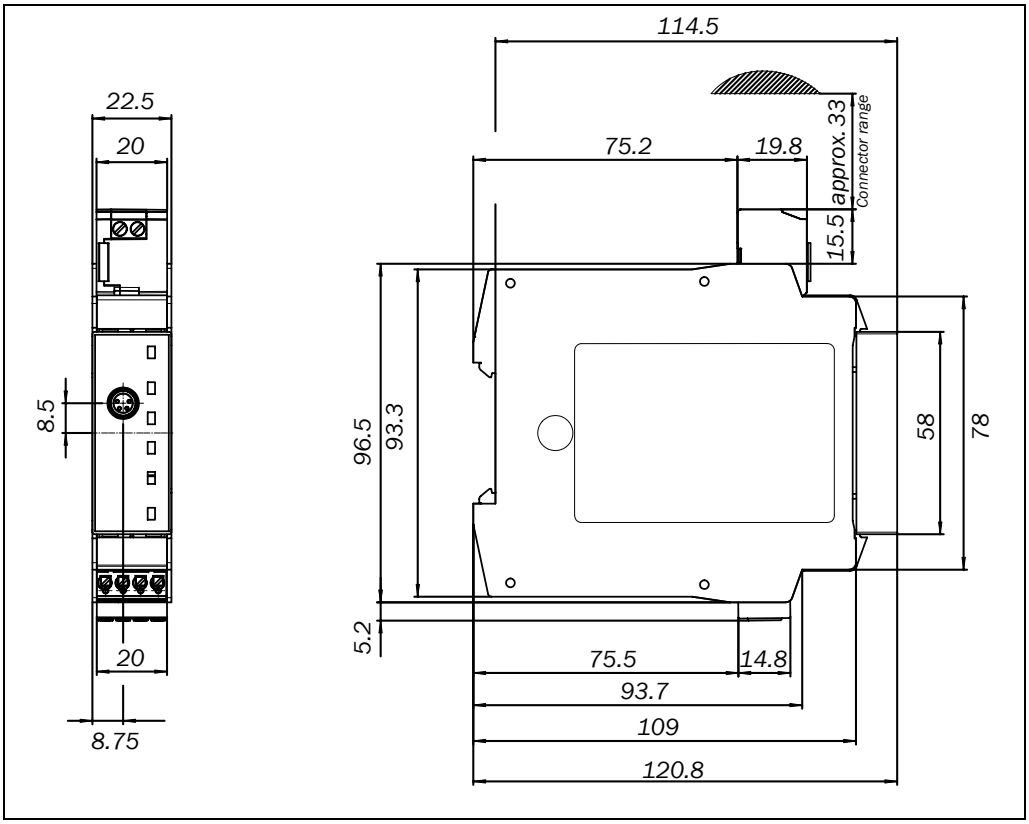
Fig. 62: Dimensional drawing protective cover 270° (mm)



Part number 2046458

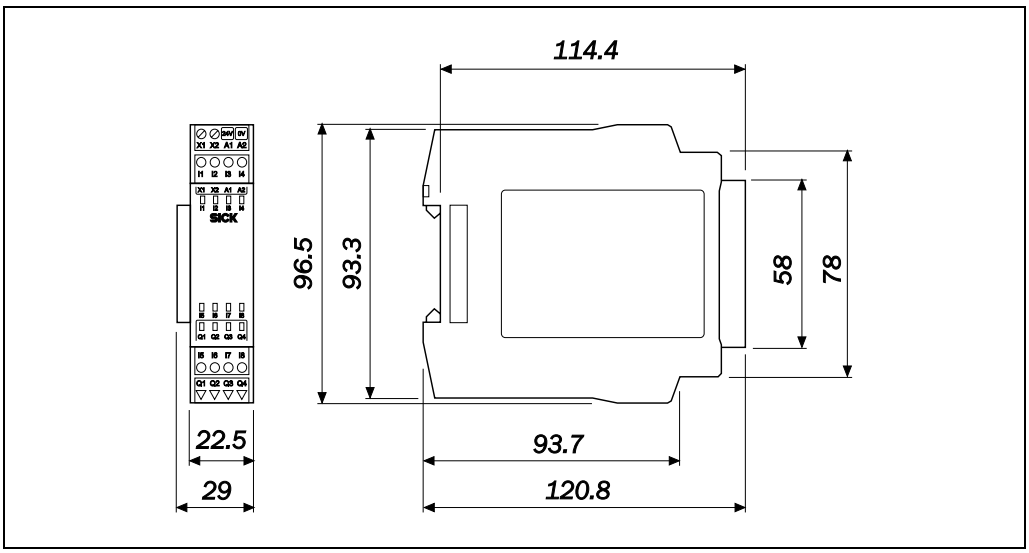
11.3.4 FX3-CPU0 main units with system plug

Fig. 63: Dimensional drawing FX3-CPU0 (mm)



11.3.5 Input/output extension module FX3-XTIO

Fig. 64: Dimensional drawing FX3-XTIO (mm)



12 Ordering information

12.1 Items supplied

- laser scanner LMS80-S01 incl. connection plug
- blackout film for covering the test target; 150 mm × approx. 150 mm
- Flexi Soft flexible safety controller
- safety note
- operating instructions for download: www.sick.com

12.2 Available system components

Tab. 28: Part numbers system components

Part	Description	Part number
LMS80-S01	Laser scanner, 270° scan angle, incl. system plug with integrated configuration memory	1047632
FX3-CPU000000	Flexi Soft main unit CPU0 double-layer spring terminals	1043783
FX3-MPL000001	Flexi Soft system plug for CPU0 with integrated configuration memory	1043700
FX3-XTIO84002	Flexi Soft extension module XTIO, input/output extension module 8 inputs/4 outputs double-layer spring terminals	1044125

12.3 Accessories/spare parts

Tab. 29: Part numbers mounting kits/protective covers

Part	Part number
Mounting kit 1a: mounting bracket for direct mounting at the rear on wall or machine	2034324
Mounting kit 1b: mounting bracket for direct mounting at the rear on wall or machine, with protection for the optics cover	2034325
Mounting kit 2: mounting bracket only in conjunction with mounting bracket 1a or 1b. Cross-wise adjustment possible.	2039302
Mounting kit 3: mounting plate only in conjunction with mounting bracket 2. Length-wise adjustment possible.	2039303
Protective cover 190°	2046459
Protective cover 270°	2046458
Mounting kit for protective covers 190°/270°	2046025
Quick-action mounting kit for protective covers 190°/270°	2046989
Blackout film for covering the test target; approx. 1 m × approx. 0.4 m	4054456

Tab. 30: Part numbers accessories

Part	Part number
LS-70B scan finder (alignment aid) for manual operation/continuous operation, with LED indication and acoustic signal, power supply using 9 V battery (included with the scan finder)	6020756
Plastic cleaner for front screen, anti-static	5600006
Lens cloth for cleaning the optics cover	4003353

Tab. 31: Connection cables

Part	Part number
Connection cable Ethernet M12 × 4/RJ450, for connecting the Ethernet interface on the LMS80-S01 with the Ethernet interface on the PC, 5 m long	6034415
Connection cable Ethernet M12 × 4/RJ45, for connecting the Ethernet interface on the LMS80-S01 with the Ethernet interface on the PC, 10 m long	6030928
Connection cable Ethernet M12 × 4/RJ45, for connecting the Ethernet interface on the LMS80-S01 with the Ethernet interface on the PC, 20 m long	6036158
Connection cable M8 × 4/D-Sub 9-pin, for connecting the serial auxiliary interface on the LMS80-S01 with the serial interface on the PC, 2 m long	6021195
Connection cable M8 × 4/D-Sub 9-pin, for connecting the serial auxiliary interface on the LMS80-S01 with the serial interface on the PC, 10 m long	2027649

12.4 Documentation

Tab. 32: Part numbers documentation

Part	Part number
Operating instructions HS80	8013518
Flexi Soft hardware operating instructions	8012477
Flexi Soft software operating instructions	8012479
LMS80-S01 telegram listing for measured data processing	8007953

13 Annex

13.1 Compliance with EU directives

EU declaration of conformity (excerpt)

The undersigned, representing the following manufacturer herewith declares that the product is in conformity with the provisions of the following EU directive(s) (including all applicable amendments), and that the respective standards and/or technical specifications are taken as the basis.

Complete EU declaration of conformity for download: www.sick.com

13.2 Checklist for the manufacturer

Checklist for the manufacturer/installer for the installation of electro-sensitive protective equipment (ESPE)

Details about the points listed below must be present at least during initial commissioning – they are, however, dependent on the respective application, the specifications of which are to be controlled by the manufacturer/installer.

This checklist should be retained and kept with the machine documentation to serve as reference during recurring tests.

1.	Have the safety rules and regulations been observed in compliance with the directives/standards applicable to the machine?	Yes ☐	No ☐
2.	Are the applied directives and standards listed in the declaration of conformity?	Yes ☐	No ☐
3.	Does the protective device comply with the required PL/SIL claim limit and PFHd in accordance with EN ISO 13849-1/EN 62061 and the required type in accordance with IEC 61496-1?	Yes ☐	No ☐
4.	Is the access to the hazardous area/hazardous point only possible through the protective field of the ESPE?	Yes ☐	No ☐
5.	Have appropriate measures been taken to protect (mechanical protection) or monitor (protective devices) any persons or objects in the hazardous area when protecting a hazardous area or hazardous point, and have these devices been secured or locked to prevent their removal?	Yes ☐	No ☐
6.	Are additional mechanical protective measures fitted and secured against manipulation which prevent reaching under, over or around the ESPE?	Yes ☐	No ☐
7.	Has the maximum stopping and/or stopping/run-down time of the machine been measured, specified and documented (at the machine and/or in the machine documentation)?	Yes ☐	No ☐
8.	Has the ESPE been mounted such that the required minimum distance from the nearest hazardous point has been achieved?	Yes ☐	No ☐
9.	Are the ESPE devices correctly mounted and secured against manipulation after adjustment?	Yes ☐	No ☐
10.	Are the required protective measures against electric shock in effect (protection class)?	Yes ☐	No ☐
11.	Is the control switch for resetting the protective device (ESPE) or restarting the machine present and correctly installed?	Yes ☐	No ☐
12.	Are the outputs of the ESPE (OSSD) integrated according to required PL/SILCL compliant with EN ISO 13849-1/EN 62061 and does the integration correspond to the comply with the circuit diagrams?	Yes ☐	No ☐
13.	Has the protective function been checked in compliance with the test notes of this documentation?	Yes ☐	No ☐
14.	Are the specified protective functions effective at every operating mode that can be set?	Yes ☐	No ☐
15.	Are the switching elements activated by the ESPE, e.g. contactors, valves, monitored?	Yes ☐	No ☐
16.	Is the ESPE effective over the entire period of the dangerous state?	Yes ☐	No ☐
17.	Once initiated, will a dangerous state be stopped when switching the ESPE on or off and when changing the operating mode, or when switching to another protective device?	Yes ☐	No ☐
18.	Has the information label for the daily check been attached so that it is easily visible for the operator?	Yes ☐	No ☐

This checklist does not replace the initial commissioning, nor the regular inspection by qualified safety personnel.

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