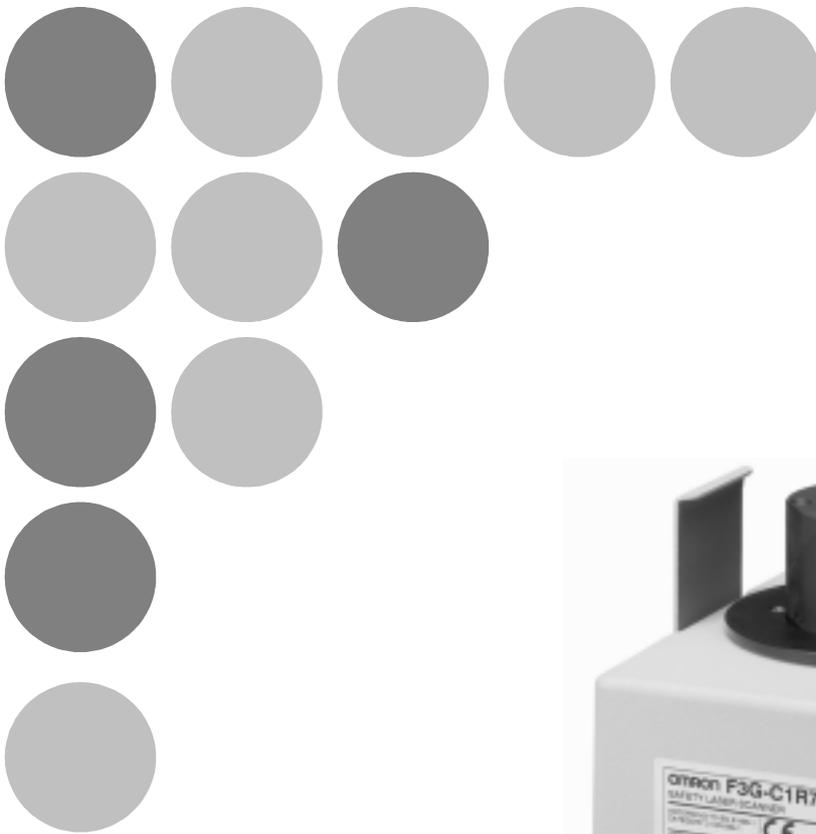


F3G-C1R70

Safety Laser Scanner

Instruction Manual



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1 About this document

Please read this chapter carefully before working with this documentation and the safety laser scanner F3G-C1R70.

1.1 The function of this document

This document provides information on the technical properties of the Safety Laser Scanner F3G-C1R70 (Rotating Laser Scanner). You will find information on:

- Safety
- Structure and operation
- Planning
- Maintenance and care

1.2 The target group of this document

This document is intended for those persons who constructively integrate the safety laser scanner F3G-C1R70, and commission and operate it as a protective device.

1.3 Depth of information of this document

This document contains all the information necessary for planning, acquisition and maintenance of the safety laser scanner F3G-C1R70. Information is provided on its operating principle, possible uses and mounting.

More information is available from OMRON directly.

1.4 Abbreviations and terms

1.4.1 Abbreviations

ESPE Electro-sensitive protective equipment (e.g. safety laser scanner F3G-C1R70)

CSL Configuration Software for Laserscanner. With a **PC** and the **CSL**, as a user, you can define the monitored areas, and define or check the correct configuration of the safety laser scanner F3G-C1R70.

The safety laser scanner F3G-C1R70 uses a reference target fixed to the F3G-C1R70 for self-checking. Any change to this target is interpreted as a system error.

OSSD Output signal switching device

1.4.2 Important terms

Please distinguish between the following terms:

Machine In this instruction manual, **machine** is used as a term for the system to be monitored. A dangerous state or a dangerous movement that rules out the presence of persons or objects in the protective field is involved in the operation of the machine.

Scanning range The **maximum scanning range** describes an arc of 300° around the sensor with a radius of max. 7.5 m.

Protective field	The safety area that, when infringed, results in the immediate shut down of the dangerous movement is termed the protective field . If a person or object enters the protective field , the safety laser scanner F3G-C1R70 provides a stop signal to the machine via the OSSD switching outputs.
Protective field size	The maximum protective field size is defined by the distance of the safety laser scanner scanning head to the most distant point of the protective field including the safety supplement.
Monitored areas	Monitored areas are a general term used for protective fields (up to 6 m) and/or warning fields (up to 7.5 m). Monitored areas can have irregular shapes or shapes adapted to the surroundings. The safety laser scanner F3G-C1R70 monitors them continuously by means of individual radial laser beams.
Warning field	The warning field is described as that safety area whose infringement causes an optical or acoustic warning signal. If a person or object enters the warning field , the safety laser scanner F3G-C1R70 provides a signal to the monitored machine via the warning output.
Response time	The response time is maximum time between intrusion of objects in monitored areas and making OSSDs into OFF-state (Open).
Reactivation time	The reactivation time is time between removal of objects from monitored areas and making OSSDs into ON-state (Close).

1.5 Symbols used

Particular emphasis is given to some information in this document to make it easier to find quickly.

Recommendation	Recommendations are designed to give you assistance in your decision-making process with respect to a function or a technical measure.
Note	Such notes provide information on special device features.
<ul style="list-style-type: none"> ● Red, ● Yellow, ○ Green 	LED symbols describe the state of a diagnostics LED. Examples: <ul style="list-style-type: none"> ● Red The red LED is illuminated constantly. ● Yellow The yellow LED is flashing. ○ Green The green LED is off.
➤ Action	An arrow indicates that some action is required. Carefully read and follow the instructions for the action to be taken.



Warning!

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

Always read warnings attentively and follow instructions carefully!



Software notes show the location in the CSL (Configuration Software for Laserscanner) where you can make the appropriate settings and adjustments.

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 hazards

2 On safety

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



WARNING

Safety notes

Please observe the following items in order to ensure the correct and safe use of the safety laser scanner F3G-C1R70.

Prior to commissioning the safety laser scanner F3G-C1R70 for the first time, please read this instruction manual and the users manual for the CSL (Configuration Software for Laserscanner) carefully. Get to know the system and the CSL. Please contact your nearest OMRON representative if you have any questions. We will be pleased to provide assistance.

All appropriate legal regulations, the requirements of the trade associations and the instructions of the manufacturer of the machine to be monitored must be observed without fail.

The protective function of the safety laser scanner F3G-C1R70 depends on the correct definition and programming of the **warning field** and **protective field**.

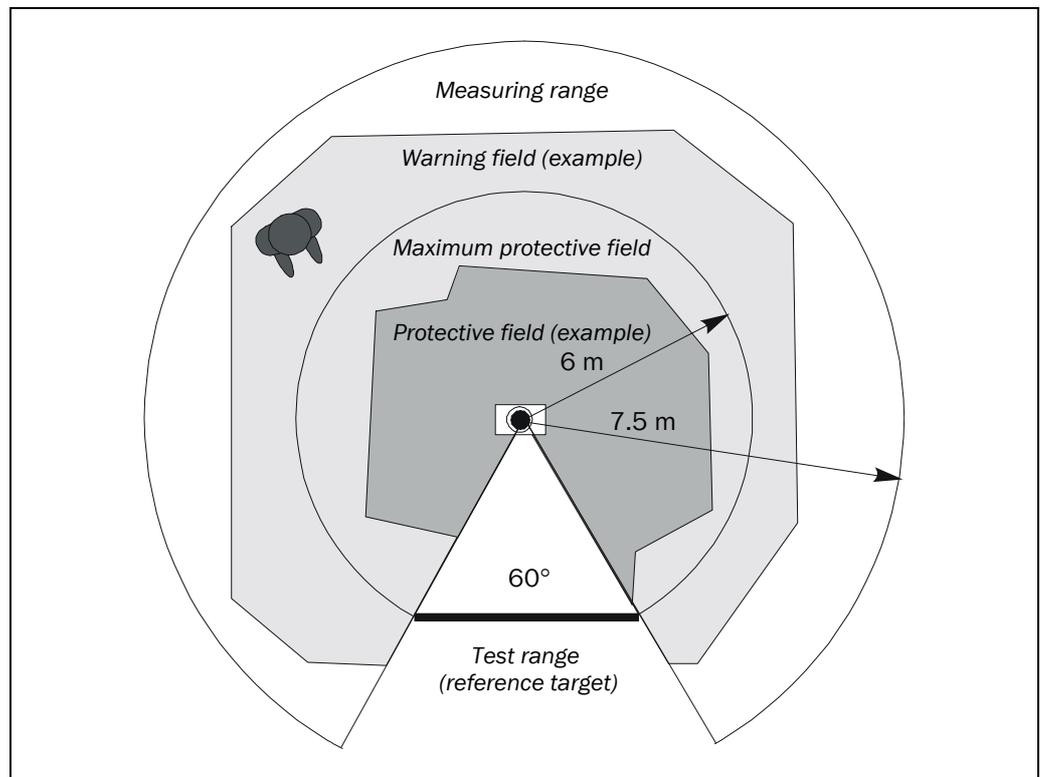
Installation of the safety laser scanner F3G-C1R70, definition and programming of the areas to be monitored and integration in the machine control system, must be carried out only by authorised personnel who are appropriately trained.

After completing the programming, the arrangement of the protective and warning fields are to be tested on the machine while it is switched on, but **not running**. On this topic see Section 7.2 "Testing the Monitor functions" on page 29.

2.1 Use of the device

The safety laser scanner F3G-C1R70 has been developed and approved as a Type 3 electro-sensitive protective equipment according to the IEC/EN 61496-1 standard.

Fig. 1: Schematic diagram of the monitored areas



The safety laser scanner F3G-C1R70 has been designed for industrial use. Its task is to detect access of persons to hazardous areas and stop the dangerous movement of a machine in this area. A signal is triggered as soon as a person or object enters the monitored area:

- If a person or object is present within the **warning field**, the safety laser scanner F3G-C1R70 switches a relay contact at the corresponding signal output. This signal can be used for acoustic and optical warnings. Warning is to indicate that the hazardous area is to be left before the protective field is activated and the safety laser scanner F3G-C1R70's OSSDs issue a stop signal that triggers a machine stop.
- If a person or object is present within the **protective field**, the safety laser scanner F3G-C1R70 switches two independent relay contacts, OSSDs. These signals must lead to an immediate switching off of the dangerous machine movement.

The CSL (Configuration Software for Laserscanner) is included with the safety laser scanner F3G-C1R70 for the definition and testing of the protective field and warning field.

2.2 Correct use of the device

The safety laser scanner F3G-C1R70 can only be used as protective equipment for detecting persons or objects (horizontal protective field). Operation of the device is only permissible according to the technical specifications. All warranty claims against OMRON are forfeited in the case of any other use, or if alterations are made to devices, even as part of their mounting or installation.

2.3 General safety information and protective measures



WARNING

The safety laser scanner F3G-C1R70 must only be employed for monitoring tasks fulfilling all the following conditions:

- The safety laser scanner F3G-C1R70 must be able to terminate the dangerous state within a defined time period by triggering the stop signal.
- The safety distance monitored by the safety laser scanner F3G-C1R70 must be smaller than the maximum protective field.
- The maximum value of the machine's stopping time plus the safety laser scanner F3G-C1R70's response time must be calculated so that nobody can gain access to the hazardous point before the dangerous movement has come to a complete stop.

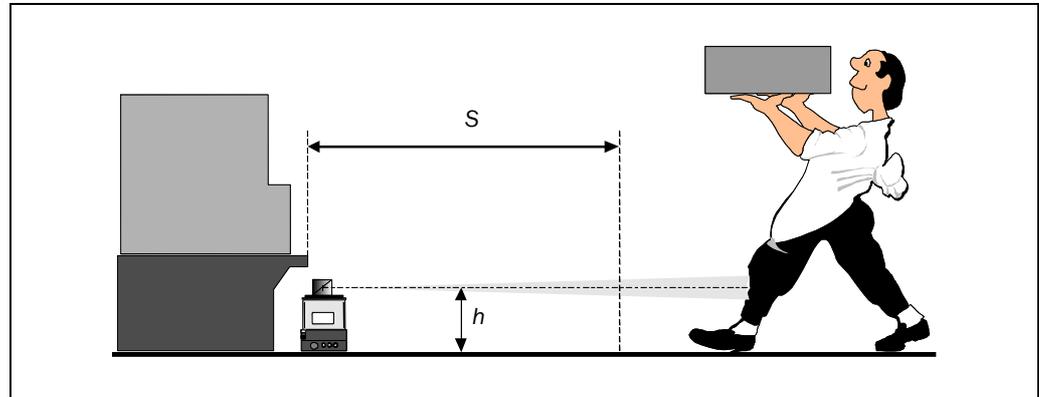


The safety laser scanner F3G-C1R70 is of laser safety class 1. Additional measures for screening the laser radiation are not necessary (eye safe).

2.3.1 Stationary application

According to Chapter 6.2 of the EN 999 standard, the safety distance between the limit of the protective field and the hazardous area of a stationary machine is calculated as follows:

Fig. 2: Calculation of the safety distance for a stationary application



$$S = 1.6 \times (t_1 + t_2) + (1200 - 0.4 h) + ZM$$

Please note: $1200 - 0.4 h \geq 850$

Here...

S = The safety distance (in mm)

t_1 = The response time of the F3G-C1R70 (in ms) (see Chapter 11 "Technical data" on page 35)

t_2 = The machine stopping/run-down time (in ms)

h = Height of protective field above the floor (in mm) $300 \leq h \leq 1000$

1.6 = The assumed approach speed (in m/s)

ZM = Maximum measuring error of the F3G-C1R70 (see Chapter 11 "Technical data" on page 35)



WARNING

Ensure that the correct mounting height is used!

When selecting the mounting height ensure that it is not possible to enter the hazardous area from below the protective field.



WARNING

The safety laser scanner F3G-C1R70 must be supplemented by further safety devices if one of the following situations applies:

- A hazardous point can be reached without passing through the monitored areas.
- The area monitored by the safety laser scanner F3G-C1R70 can be reached from above, below or from the side.
- According to EN 999, possible access by crawling below the protective field must be taken into account above the regulation minimum protective field height of 300 mm.

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Example for a stationary application

Machine width $M = 2.2 \text{ m} = 2200 \text{ mm}$

Response time of the F3G-C1R70 = 280 ms

The machine stopping/run-down time = 300 ms

Height of protective field above the floor = 0.5 m = 500 mm

Maximum measuring error of the F3G-C1R70 = 350 mm

Protective field width = $M + \text{safety supplement left and right}$

$S = 1.6 \text{ m/s} \times (280 \text{ ms} + 300 \text{ ms}) + (1200 \text{ mm} - 0.4 \times 500 \text{ mm}) + 350 \text{ mm} = 2278 \text{ mm}$

Protective field width = 2200 mm + 350 mm + 350 mm = 2900 mm

Maximum protective field size = $(S^2 + \frac{1}{2} \text{ protective field width}^2)^{\frac{1}{2}} = 2700 \text{ mm}$

Please note: The example only applies if no access from the side is possible. Access from the side must be prevented either by a wider protective field and/or other measures.

Fig. 3: Example: minimum distance for stationary application

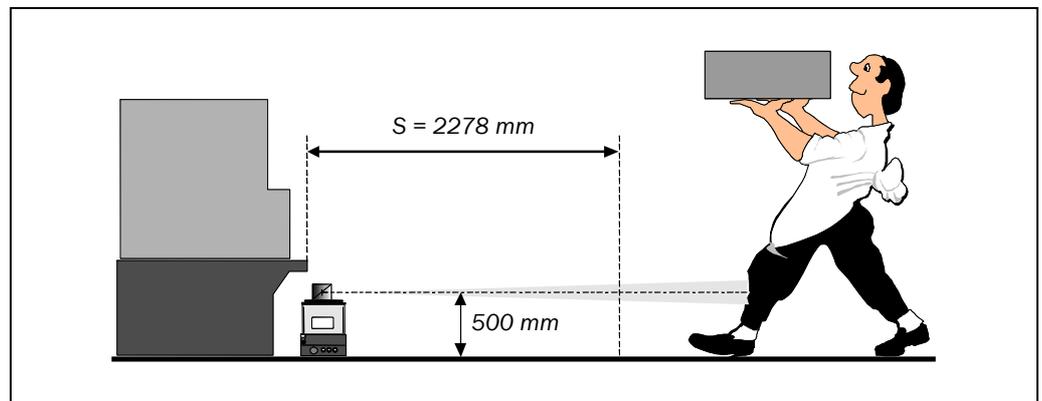
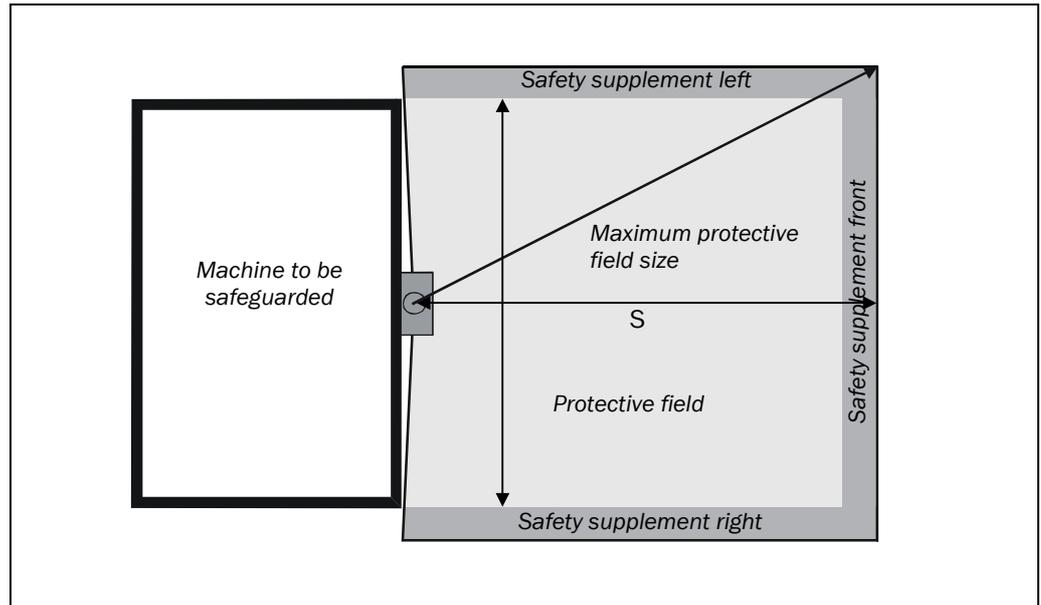


Fig. 4: Example: maximum protective field size and safety supplements for stationary applications



Safety supplements are to be determined for maximum protective field sizes.



WARNING

The following applies if the access of persons from behind cannot be hindered by appropriate sizing of the protective field:

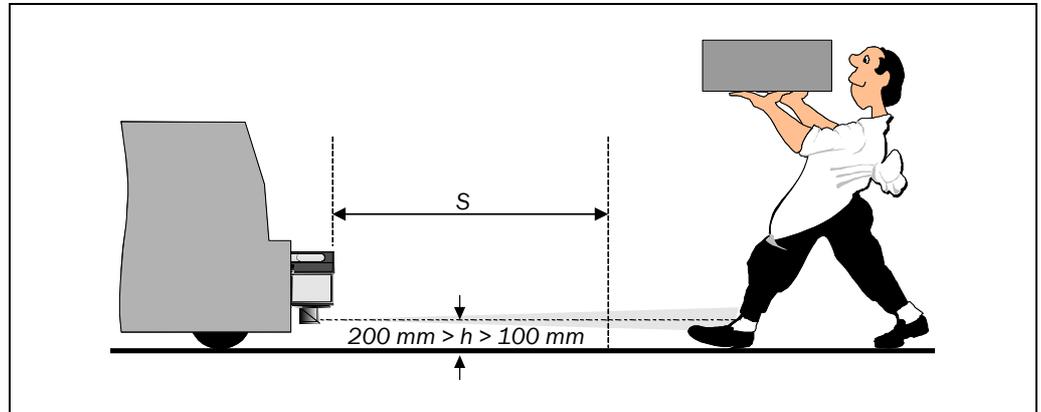
- A manual restart interlock must be present in the machine control system (generally necessary). The switch to reset the interlock condition must be installed so that the entire hazardous area is visible and free of personnel, also the switch must not be able to be operated from within the hazardous area.
- The width of the accessible, unmonitored area directly in front of the machine must be smaller than 35 mm for a maximum protective field size of up to 3 m. For larger maximum protective field sizes, the distance must be reduced to zero.

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2.3.2 Application on automated guided vehicles (AGVs)

Taking the regulations for automated guided vehicles (e.g. EN 1525: Safety of industrial trucks - Driverless trucks and their systems) into account, the minimum distance between the edge of the protective field and the hazardous area of the AGV is calculated as follows:

Fig. 5: Calculating the minimum distance for automated guided vehicles



$$S = 1.1 \times ((V_{max} \times (t_1 + t_2)) + B) + ZM + F^1$$

Here...

S = Minimum distance (in mm) = max. stopping distance of the AGV

t₁ = Response time of the F3G-C1R70 (in ms) (see Chapter 11 “Technical data” on page 35)

t₂ = AGV control system reaction time (in ms)

V_{max} = Maximum speed of the AGV (m/s)

B = Maximum braking path for the AGV (in mm)

ZM = Maximum measuring error of the F3G-C1R70 (see Chapter 11 “Technical data” on page 35)

F = Foot clearance: 150 mm (for the AGV with a floor clearance of less than 120mm)

h = Height of protective field above the floor (in mm)

1.1 = Safety supplement for possible brake wear



WARNING

The safety laser scanner F3G-C1R70 must be supplemented by further safety devices if one of the following situations applies:

- A hazardous point can be reached without passing through the monitored areas.
- The area monitored by the safety laser scanner F3G-C1R70 can be reached from above, below or from the side.



WARNING

Define protective field cover correctly!

The protective field must cover the entire width of the AGV. The protective field must be increased at the sides by the safety supplements (see Chapter 11 “Technical data” on page 35).

¹⁾ F only applies when there is no foot clearance according to EN 1493.



Define the protective field correctly where routes bisect each other!

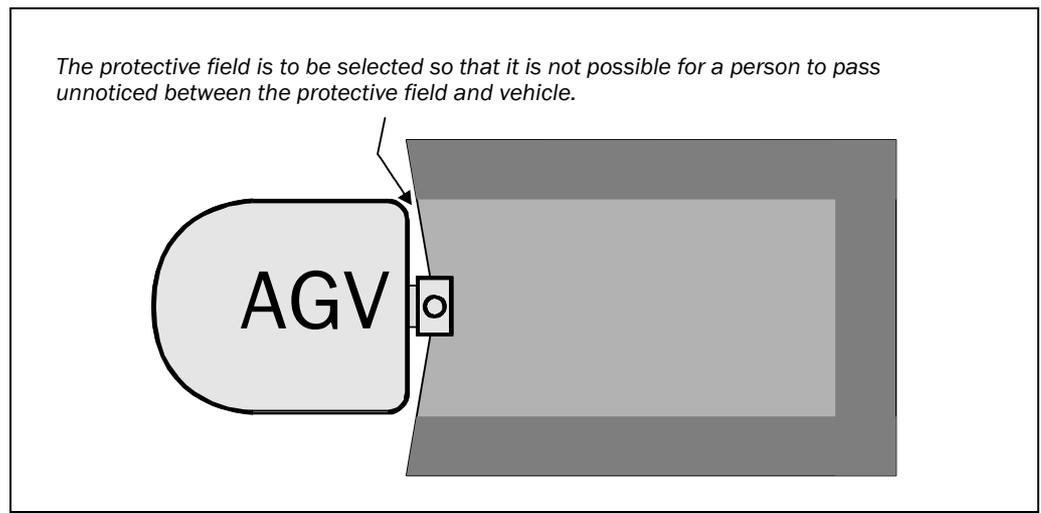
At “crossroads” where there are “blind spots”, the protective field must have the same configuration as in the direction of motion.



Avoid undercutting of the protective field!

The protective field must be configured in such a way that stepping between the protective field and the AGV from behind in the direction of motion (undercutting) is not possible. The safety laser scanner F3G-C1R70 has a maximum scanning angle of 300°.

Fig. 6: Prevent undercutting of the AGV protective field



The following must be considered!

- In cases where it is not possible to prevent undetected personnel from standing in front of the AGV by appropriate sizing of the protective field, then a manual restart interlock must be included in the AGV. The switch to reset the interlock condition must be installed so that the entire hazardous area is visible and free of personnel, also the switch must not be able to be operated from within the hazardous area.
- The width of the accessible area that is not monitored directly in front of the AGV must be less than 35 mm for a maximum protective field size of up to 3 m. For larger maximum protective field sizes, the distance must be reduced to zero.



Program reactivation delay!

In case of AGV applications, you must program a reactivation delay for the safety laser scanner F3G-C1R70. The reactivation delay defines the length of time [ms] before the relay is reactivated after the monitored field is clear (automatic restart after time).

With automatic restart, the restart period must be set to a minimum of 2000 ms.



You can stipulate the reactivation delay independently for the warning field and the protective field (Right-click on the device symbol in the navigation area > Configuration draft > Edit parameters). The values permitted are between 200 and 5000 ms.

F3G-C1R70

Example for application on AGVs

AGV_{width} = 1.6 m = 1600 mm

Response time of the F3G-C1R70 = 280 ms

AGV control system reaction time = 300 ms

Maximum speed of the AGV = 1 m/s

Maximum braking distance for the AGV = 0.3 m = 300 mm

Maximum measuring error of the F3G-C1R70 = 250 mm

F unnecessary: the AGV has foot clearance

Safety supplement for possible brake wear = 1.1

Protective field width = AGV_{width} + safety supplement left and right

$$S = 1.1 \times ((1 \text{ m/s} \times (280 \text{ ms} + 300 \text{ ms})) + 300 \text{ mm}) + 250 \text{ mm} = 1218 \text{ mm}$$

$$\text{Protective field width} = 1600 \text{ mm} + 250 \text{ mm} + 250 \text{ mm} = 2100 \text{ mm}$$

$$\text{Maximum protective field size} = (S^2 + \frac{1}{2} \text{ protective field width}^2)^{\frac{1}{2}} = 1608 \text{ mm}$$

Fig. 7: Example: minimum distance for automated guided vehicles

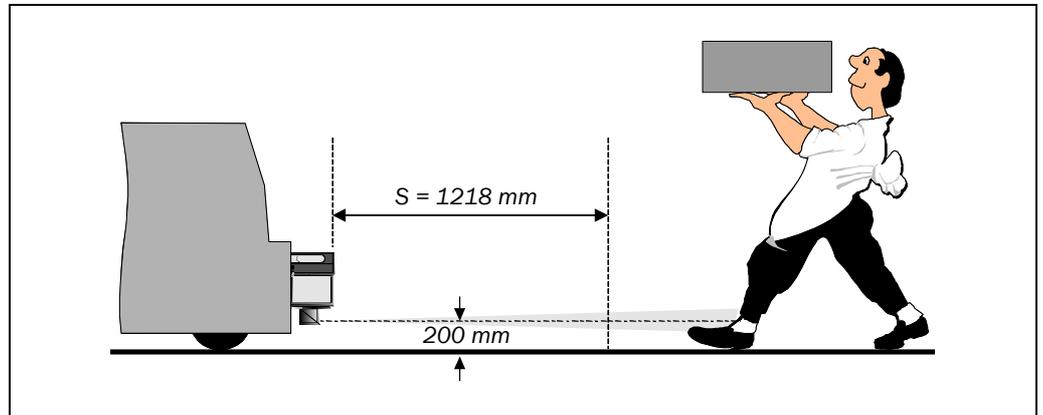
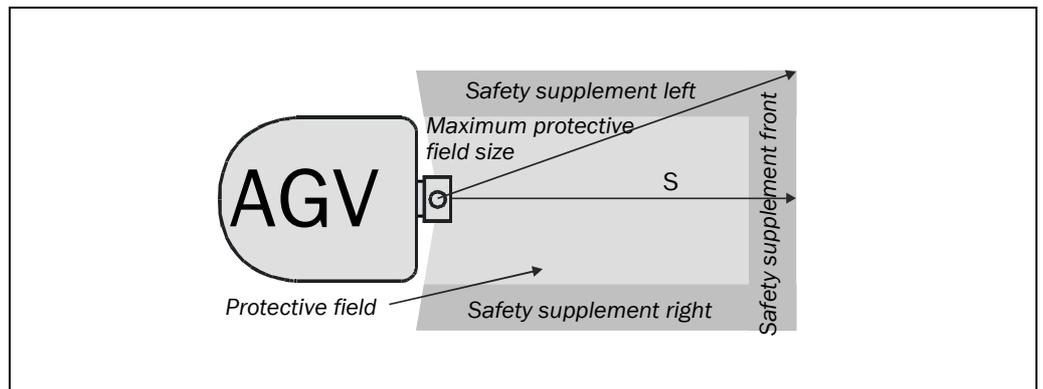


Fig. 8: Example: maximum protective field size and safety supplements for AGVs



2.4 Protection of the environment

The safety laser scanner F3G-C1R70 is constructed in such a way that it adversely affects the environment as little as possible. It emits and contains no environmentally damaging substances and requires only a minimum of energy and resources.

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

Disposal

- Note** ➤ Always dispose of unusable or irreparable devices according to the particular waste disposal regulations applicable in the country of use.

3 Product description

3.1 Construction of the device

The sensor of the safety laser scanner F3G-C1R70 is housed in a sturdy aluminum housing. The housing is protected against water spray according to IP 65 (only applicable if the connection sockets are equipped with plugs or covers).



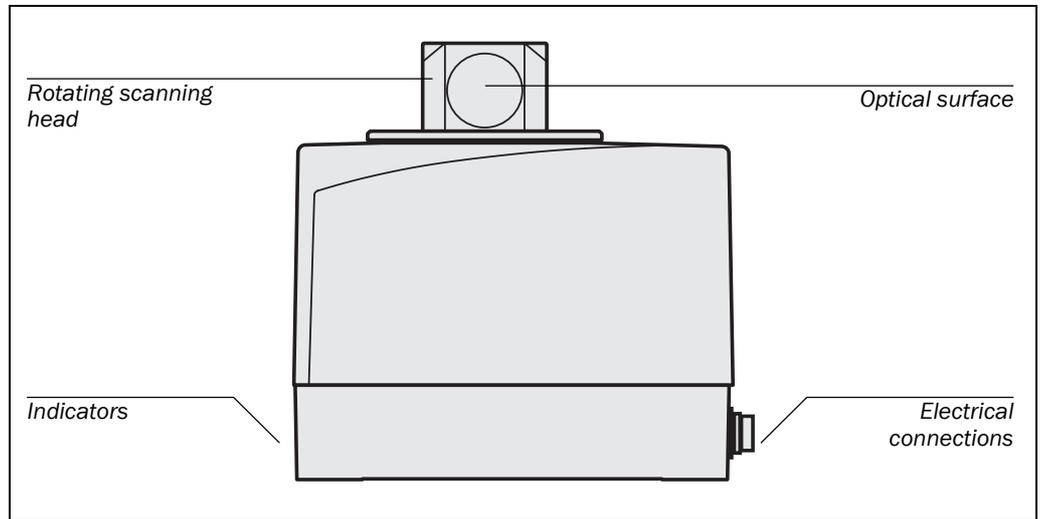
WARNING

Do not damage seals!

The housing screws are sealed. Any damage to seals leads to forfeiture of the manufacturer's warranty.

The mirror and laser optics are located on the top of the housing in a rotating housing component. The laser transmitter and receiver use the same lens. This complex co-axial construction prevents angular error resulting from separate transmitter and receiver optics.

Fig. 9: Construction of the safety laser scanner F3G-C1R70



The invisible laser beams emitted conform to laser safety class 1. The measurement area begins immediately in front of the optical surface.



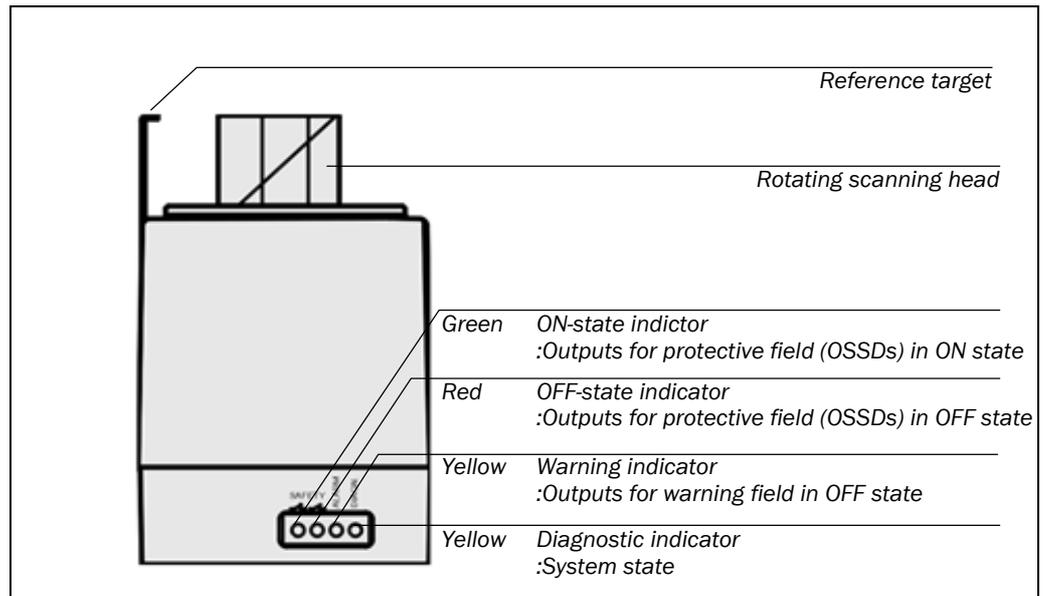
WARNING

Do not mount the device at eye level!

Fix the safety laser scanner F3G-C1R70 so that the measuring beam is not at eye level during use.

There are four indicators on the side of the housing showing the state of the system.

Fig. 10: LEDs on the safety laser scanner F3G-C1R70



Tab. 1: Status of the LEDs for the safety laser scanner F3G-C1R70

Indicator Status				Meaning
ON Green	OFF Red	Warning Yellow	Diag. Yellow	
○	○	○	○	Device switched off
●	●	●	●	Test LEDs for 1 sec. after Power On ²⁾
●	○	○	○	The system is ready for operation, the outputs for protective field (OSSDs) and for warning field are in an ON state
○	●		○	Outputs for protective field (OSSDs) are in OFF-state.
		●	○	Output for warning field is in OFF-state.
○	●	●	● ³⁾	System error

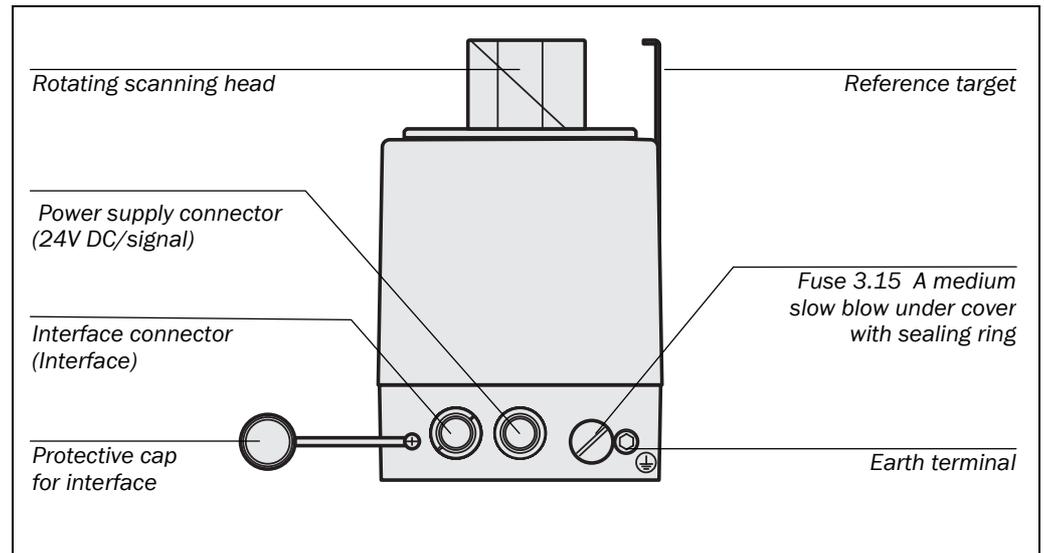
²⁾ The diagnostic indicator lights up during the start-up test after Power On. During the last 5 seconds before operational readiness is achieved and the release of the release of outputs for protective field (OSSDs), this indicator blinks at 2 Hz.

³⁾ For more on this topic see Section 10.2 "System error indications" on page 34.

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There are two connection sockets on the opposite side of the housing, indicated as **Interface** and **24 V DC/signal**.

Fig. 11: Housing connection side



- **Interface connector**

This connector is used for communication with the computer. At this connection, an RS 232 interface is available.

- **Power supply connector**

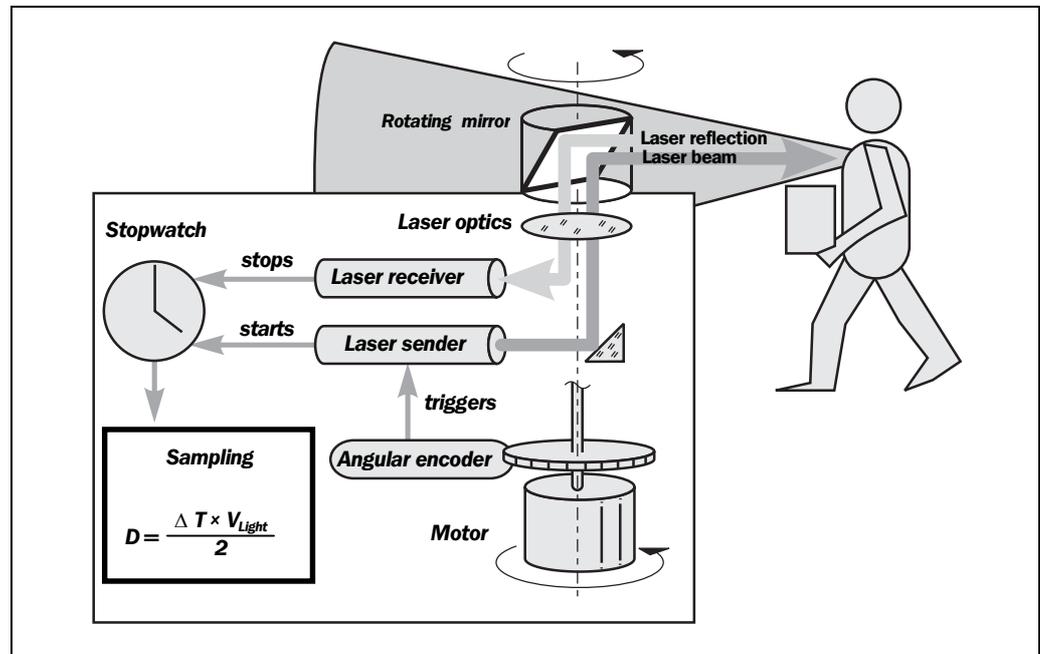
This connector is used for connecting the power supply, the two outputs for protective field, OSSD1 and OSSD2, and the output for warning field.

3.2 Operating principles of the device

Measurement principle

The safety laser scanner F3G-C1R70 emits pulsed laser beams throughout a complete 360° with the help of a rotating mirror. The light pulses are reflected diffusely from objects in the vicinity and received by a photodiode in the sensor. The safety laser scanner F3G-C1R70 determines the distance to the object from the propagation time that the light requires from emission to reception of the reflection at the sensor.

Fig. 12: Schematic diagram of operating principle



The direction of each individual measurement beam is determined with the help of an angular encoder.

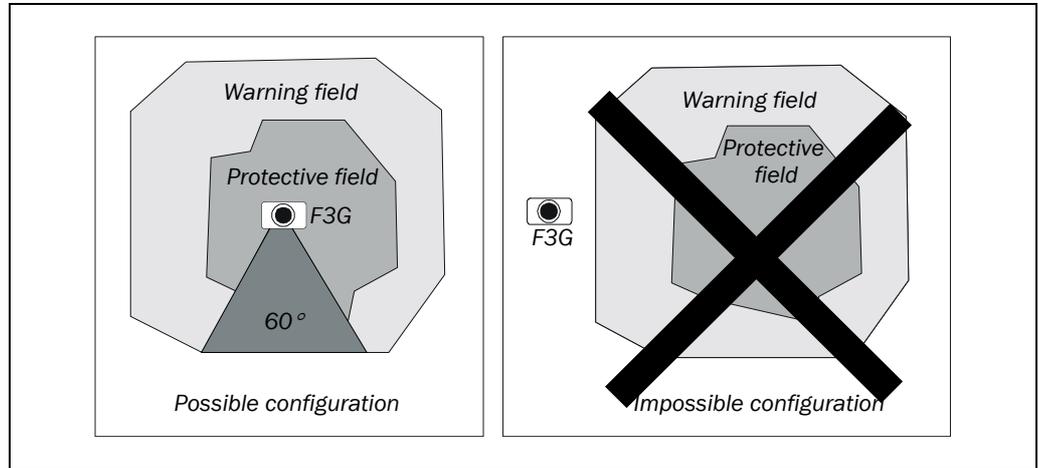
The measurement data for distance and direction can be called up by a computer via the interface.

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Monitoring of protective field and warning field

Two distance limit values, representing the warning field and protective field, can be defined for each measurement beam with the help of the CSL. While monitoring, the safety laser scanner F3G-C1R70 compares the measured object distance with defined limit values.

Fig. 13: Configuration of monitored areas



The tables of distance limit values are determined with a computer and laid down in the safety laser scanner F3G-C1R70. The warning and protective field limits can be of any shape and ideally adapted to the surroundings. The safety laser scanner F3G-C1R70 must therefore be within the limits of both the warning field and the protective field.

Self-testing

Comprehensive internal tests run continuously within the safety laser scanner F3G-C1R70. This ensures the system's high level of operational reliability. All basic components are either present in duplicate, or are monitored by testing logics that operate independently.

The so-called reference or test target is an important constituent of the self-testing systems. This involves a stationary target firmly mounted on the safety laser scanner F3G-C1R70, detected on each rotation. Any alteration in the measurement value indicates a system error and leads to an error state.

During monitoring the safety laser scanner F3G-C1R70 checks that it is functioning correctly.

The system sensitivity of the device is monitored through the measurement of the light reflected from the reference target. Contamination of the optical surface or the reference target can thus lead to the system error: **Device insensitive/reference target error** (LED indicators). If this happens, clean the optical surface as well as the reference target as per the instructions given in Section 9 "Maintenance and care" on page 33.

4 Installation and mounting

4.1 Operating conditions

Please note the following points before using the device:

- The device is only for use in predominantly enclosed areas.
- The safety laser scanner F3G-C1R70 is protected against water spray according to IP 65 and operates within a temperature range of 0 to 50 °C. Protect the system from moisture and temperatures that are outside the temperature range.
- Protect the safety laser scanner F3G-C1R70 from continuous direct sunlight.
- To prevent condensation, do not expose the safety laser scanner F3G-C1R70 to rapidly changing temperatures.
- Do not expose the safety laser scanner F3G-C1R70 to aggressive chemicals (detergents).
- Glass panes or reflective surfaces are not reliably detected by the safety laser scanner F3G-C1R70 as objects.
- The safety laser scanner F3G-C1R70 only detects objects that are visible from its location and not covered up.
- Rain, snow, dust and smoke are detected as “objects” and may trigger **warning field** or **protective field** states.

4.2 Mounting the device



WARNING

Observe the machine manufacturer's safety regulations!

It is essential that the safety instructions for working on the machine, defined by the machine manufacturer, are observed when mounting the safety laser scanner F3G-C1R70.

Mounting of the safety laser scanner F3G-C1R70 may only be carried out by qualified personnel.

The safety laser scanner F3G-C1R70 can be mounted in any orientation (standing, hanging, lying).

F3G-C1R70

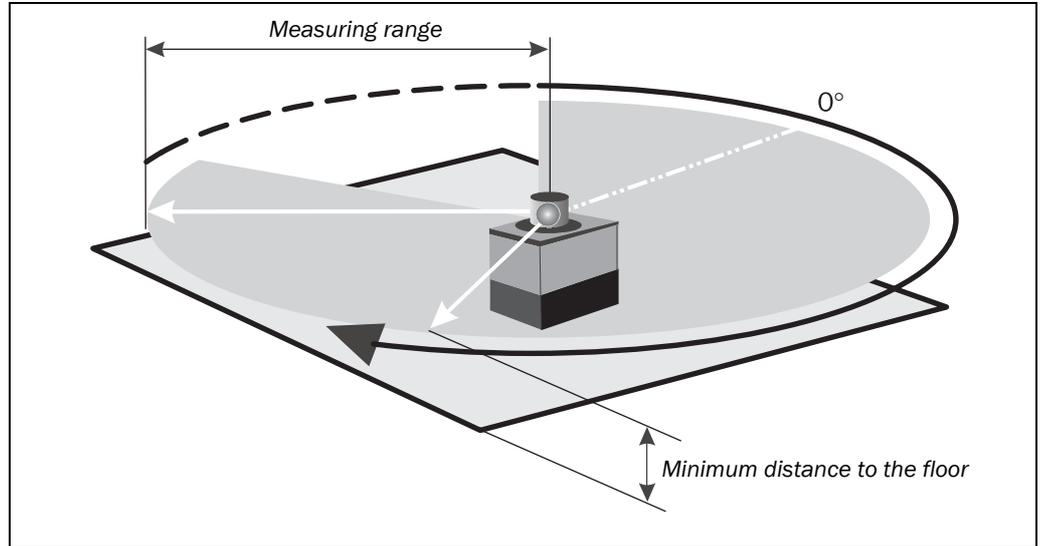
The emitted laser beam has a divergence of $\leq 1^\circ$.



WARNING

It is essential that during mounting a minimum distance of 100 mm to the floor must be maintained.

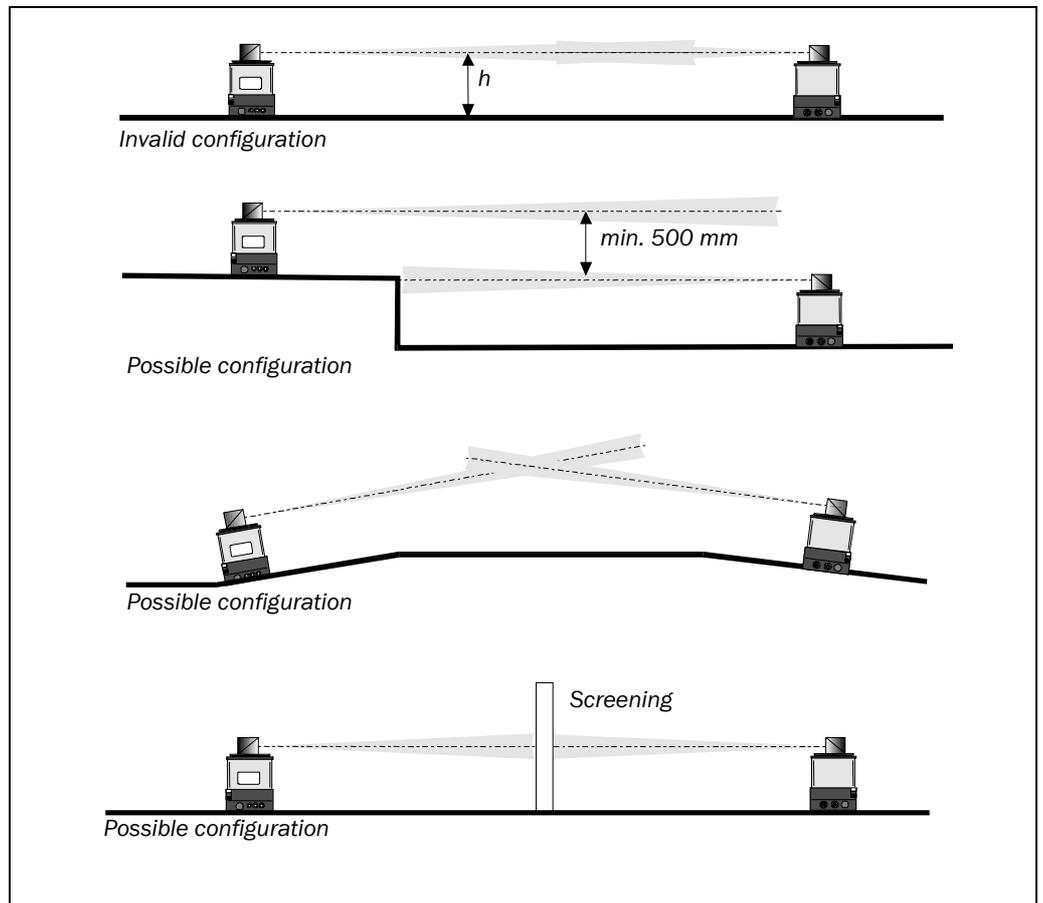
Fig. 14: Minimum distance to the floor



WARNING

When installing several safety laser scanners, mounting must be carried out in a way that does not allow any mutual interference.

Fig. 15: Mounting several safety laser scanners



The followings are required for mounting the device:

- 4 M4 bolts
- 4 washers and locking washers
- If necessary, a spirit level for ensuring level mounting

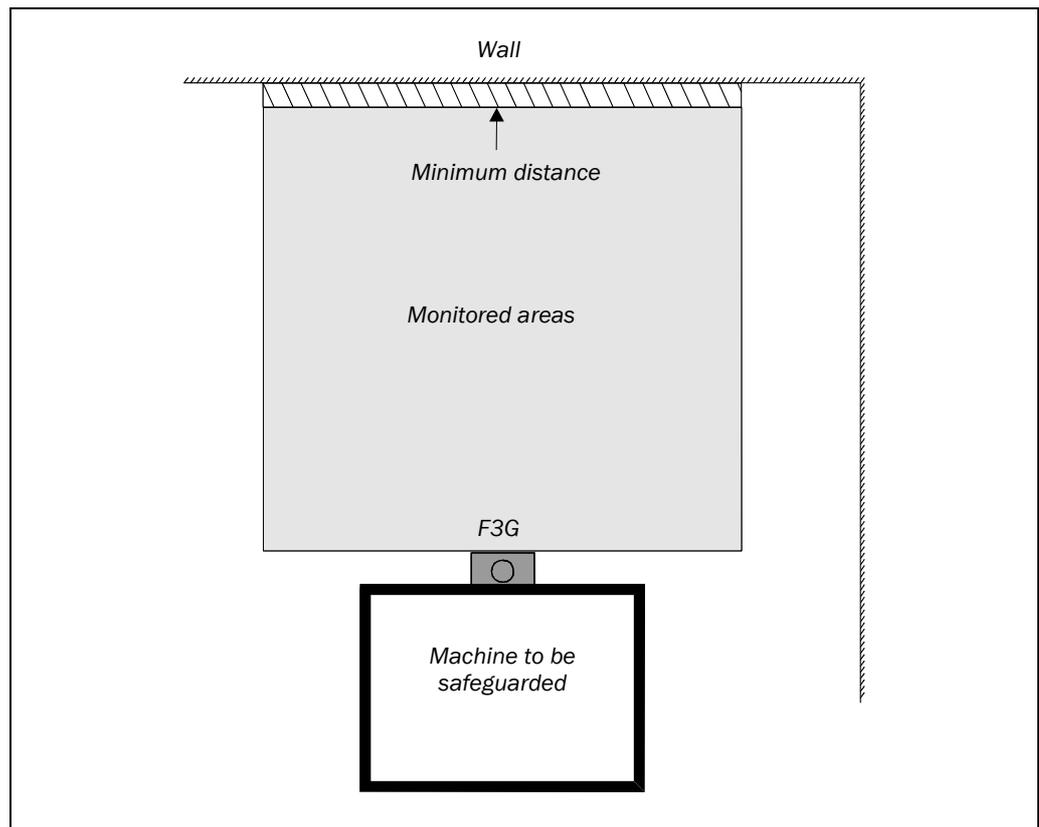
Fit safety laser scanner F3G-C1R70 to machine:

1. Turn off the machine and check that you are not taking any risks!
2. Turn the mounting screws (with the washers and locking washers in place) and tighten them finger tight.
3. When attaching to non-mobile machines, it is recommended that the spirit level is used in two axes to ensure level mounting.
4. Tighten the screws.
 - Tightening torque: 2.6 N·m
 - Minimum meshing length: 8mm

4.3 Minimum distance from objects

When mounting in front of a wall, for reasons of availability, the programmed monitored areas may not be closer than 25 cm to the wall.

Fig. 16: Minimum distance of the area monitored by the safety laser scanner F3G-C1R70 from surrounding objects



5 Electrical installation

5.1 Integrating the safety laser scanner F3G-C1R70's outputs into the machine control system



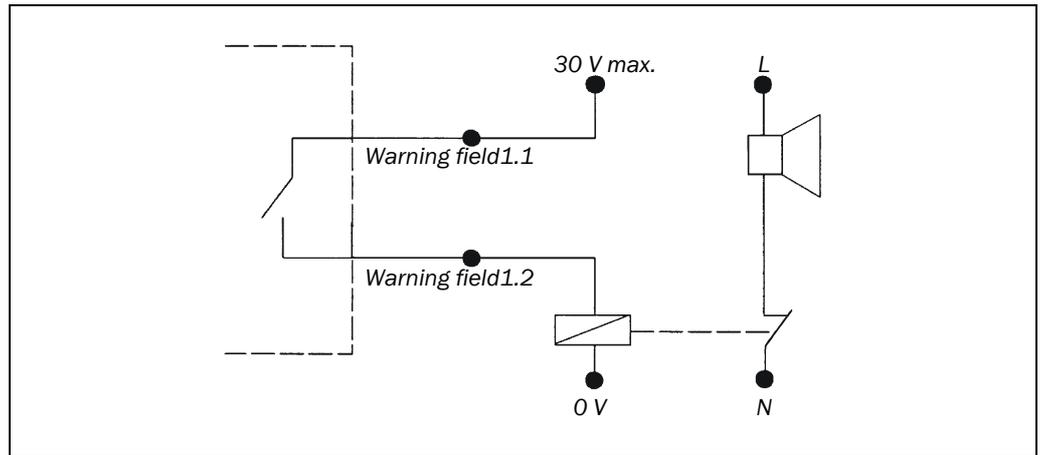
WARNING

Connection only by qualified personnel!

Connection of the safety laser scanner F3G-C1R70 to the machine may only be carried out by appropriately qualified personnel.

These persons must have all the information provided by the suppliers of the machine.

Fig. 17: Example of integration of the warning field signal



Three potential-free switching outputs are available for connection to the machine for **warning field** and **protective field** states. The outputs are designed as N. O. contacts.

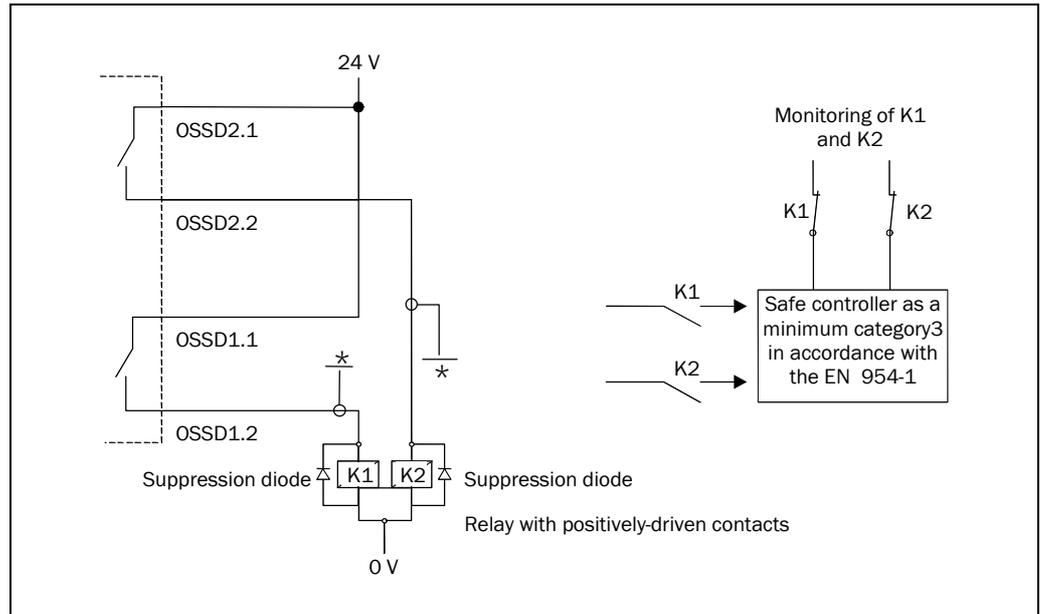
Switching output for warning field (Non-safety output)

The switching output for **warning field** can be used for the output of a warning signal. The switching output for **warning field** is opened when the warning field is activated, or when there is a safety laser scanner F3G-C1R70 fault.

If an object is again removed from the warning field, its switching output closes after an adjustable time between 200 and 5000 ms (reactivation delay).

The switching output for **warning field** can be switched with a maximum of 30 Volts and is internally fuse-protected with 2 Amps.

Fig. 18: Example of integration of OSSDs. The wiring is to be laid down in such a way that it is protected against mechanical effects.
 * = Screen to rule out cross-circuits



OSSD switching outputs (Safety outputs)

The OSSD switching outputs can be used as emergency stop trips in the system controller. The OSSD switching outputs are open if

- the protective field has been activated

or

- the safety laser scanner F3G-C1R70 has a fault.

The switching output closes after a programmable time of between 200 and 5000 ms (reactivation delay), assuming that there is no system fault.



You can stipulate the reactivation delay independently for the warning field and the protective field (Right-click on the device symbol in the navigation area > Configuration draft > Edit parameters).

The **OSSD1** and **OSSD2** outputs can be wired with a maximum of 30 Volts and are internally fuse-protected with 2 Amps.

5.2 Connecting the power supply and signal cables

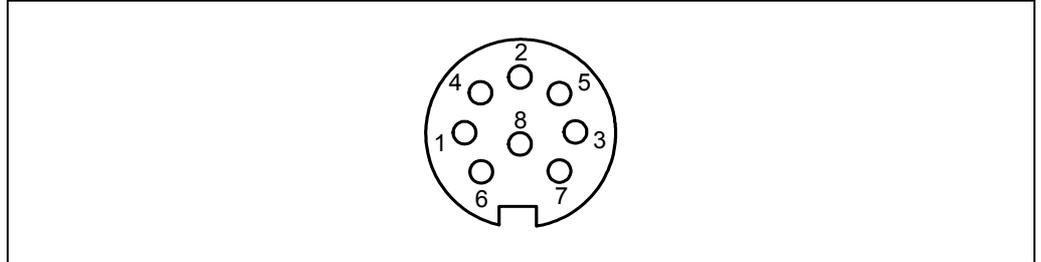


WARNING

Electrical work is to be carried out only by appropriately trained electrical specialists!

Electrical connection of the power supply and connection of the signal cables for the warning field, OSSD1 and OSSD2 take place together via the middle socket on the right-hand side of the housing. The power supply cable F39-JG5A (optional) is available for those electrical connections.

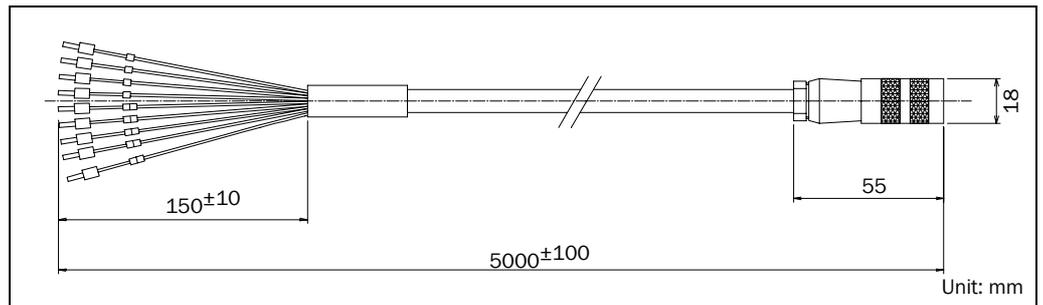
Fig. 19: Plug allocation for connection of the power supply and the signal cables



Tab. 2: Plug allocation for connection of the power supply and the signal cables

Pin	Signal	Explanation	Colour	Marking
1	+24 V DC	24 V DC supply	Brown	+
2	0 V	Ground	Blue	-
3	OSSD2.1	Relay contact of the OSSD 2	White	S2
4	OSSD2.2		Grey	S2
5	OSSD1.1	Relay contact of the OSSD 1	Black	S1
6	OSSD1.2		Green	S1
7	Warning output1.1	Relay contact of the warning output	Red	A
8	Warning output1.2		Pink	A
	FE	Functional earth (shield)	Black	FE

Fig. 20: Dimension of the power supply cable



Connecting the power supply to the safety laser scanner F3G-C1R70:

1. Wiring is to be protected.
2. Turn off the machine and make sure that you are not exposed to any danger.
3. Avoid short-circuits.
4. Earth the safety laser scanner F3G-C1R70 from the earth terminal
 - cross-section for functional earth/ground 1 ... 2 mm²
5. Prepare the power supply:
 - operating voltage for the safety laser scanner F3G-C1R70: 24 V DC \pm 25 %
 - power consumption in operation: typically 750 mA at 24 V DC (switch on current: 2 A for 100 ms)
6. Connect the plug of the power supply cable to the power supply connector of the safety laser scanner F3G-C1R70 and tighten the screw.
7. Connect safety laser scanner F3G-C1R70 and computer.
8. Switch on safety laser scanner F3G-C1R70.
9. The rotating scanning head starts to rotate. After a few seconds the diagnostic indicator goes out and the safety laser scanner F3G-C1R70 is ready for configuration of the areas to be monitored.

- Notes**
- On connecting the safety laser scanner F3G-C1R70, it is imperative to ensure that the earth is connected correctly. The safety laser scanner F3G-C1R70 must be provided with a safety insulating transformer according to IEC 742 or equivalent means of isolation. This also applies for the charging devices for vehicle batteries, if charging is to take place on the vehicle.
 - For stationary applications, the safety laser scanner F3G-C1R70 must be **earthed** (for more on earth connection, see Section 3.1 “Construction of the device” on page 15).
 - The **functional earth** is to be connected with ground potential for installation on transport vehicles. For applications with battery-powered vehicles, a DC voltage transformer must be connected in series before the safety laser scanner F3G-C1R70. On request, please consider a relevant protection against “low dump” (voltage drop).

Fig. 21: Example of the power supply and grounding of stationary applications

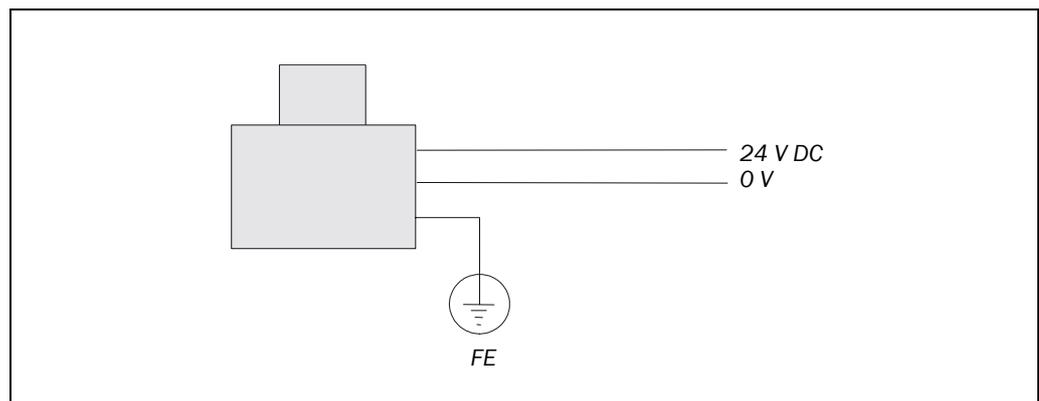
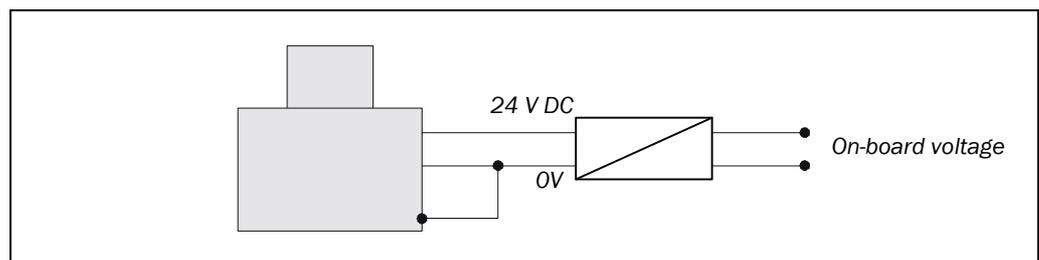


Fig. 22: Example of the power supply and grounding on a transport vehicle

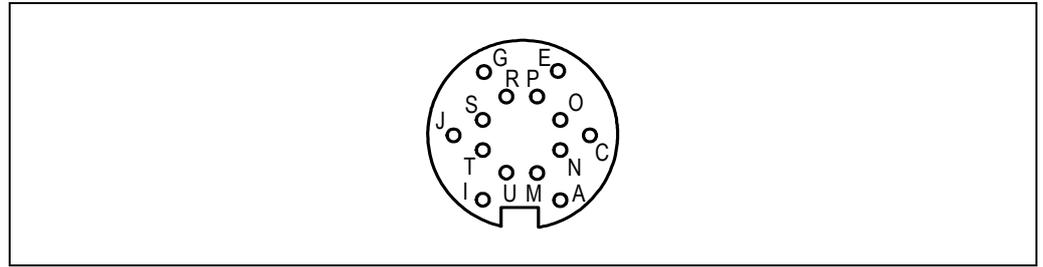


F3G-C1R70

5.3 Connecting the data cables

The interface cable F39-JG5R (optional) is available to connect the safety laser scanner F3G-C1R70 to the PC.

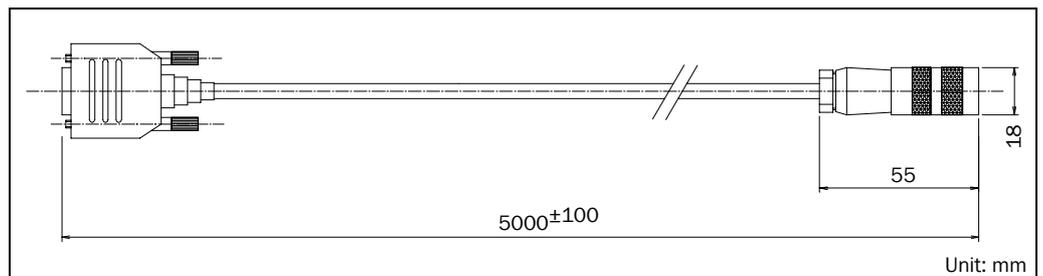
Fig. 23: Pin allocation of the interface cable



Tab. 3: Pin allocation of the interface cable

Pin	Signal	Explanation	Direction	Level
A	GND	Ground, RS 232	—	—
C	RTS	RS 232: Ready to send	Output	24 V
E	CTS	RS 232: Clear to send	Input	24 V
G	TxD	RS 232: Transmit data	Output	24 V
J	RxD	RS 232: Receive data	Input	24 V
L	—	Do not connect!	—	—
M	RES	Reset (active LOW)	Input	24 V
N	—	Do not connect!	—	—
O	—	Do not connect!	—	—
P	—	Do not connect!	—	—
R	—	Do not connect!	—	—
S	—	Do not connect!	—	—
T	—	Do not connect!	—	—
U	—	Do not connect!	—	—

Fig. 24: Dimension of the interface cable



Connecting the interface cable between the PC and the safety laser scanner F3G-C1R70:

1. Prevent short-circuits and switch off the safety laser scanner F3G-C1R70 and the PC.
2. Connect the interface cable to the interface connector of the safety laser scanner F3G-C1R70 and the serial interface port of the PC.
3. Make sure to screw connectors tight.
The device only conforms to enclosure rating IP65 if the interface connector is connected with the interface cable, or covered with a cap.

6 Configuration

6.1 Delivery status

Protective field and warning field are set for maximum size in the safety laser scanner F3G-C1R70 as a default when supplied. The relay reactivation delay is set to the standard value of 200 ms. Prior to commissioning, the safety laser scanner F3G-C1R70 must be configured for the planned application with the aid of the CSL (Configuration Software for Laserscanner) supplied.

6.2 Preparing the configuration

How to prepare the configuration:

- Make sure that the safety laser scanner F3G-C1R70 has been properly mounted, and that the electrical connections are correct and in place.
- Plan all necessary settings (warning field, protective field, reactivation delay, etc.).
- To configure the safety laser scanner F3G-C1R70, you need:
 - CSL (Configuration Software for Laserscanner) on CD-ROM
 - Users manual for CSL on CD-ROM
 - PC/Notebook with Windows 9x/NT 4/2000 Professional/XP with a serial interface (RS 232) (PC/Notebook is not included.)
 - Interface cable F39-JG5R for communication between PC and safety laser scanner F3G-C1R70 (Interface cable is not included.)
- To configure the device, please read the users manual for the CSL (Configuration Software for Laserscanner) and use the online help in the program.

7 Commissioning

7.1 Access authorization

Access to the safety laser scanner F3G-C1R70 is password protected.

- The password is **F3GC** on delivery.
- The user (Safety Officer) must ensure that the password is known only by authorized persons.

Recommendation

It is recommended that the **F3GC** password is replaced by a new password that you select.



Right-click on the device symbol in the navigation area > **Access rights** > **Change password**

- Without a password, it is possible to select the Monitor function on the PC and edit protective fields, but it is not possible to **change** the protective field or parameters.
- **Using** a password, it is possible to change the protective field and parameters.

7.2 Testing the Monitor functions

After you have defined the monitored areas with the CSL, you must check and accept the installation. For this purpose, proceed in two steps:

- First, check the definition of the protective field with a computer connected, and document the test.
- Then, connect to the machine and repeat the test.

Check definition of the protective field and document:

- Insert a dark test object with a diameter of about 70 mm from all sides into the protective field. Check every section of the protective field limit.

The ON-state indicator (green LED) must go out, and the OFF-state indicator (red LED) on the front of the safety laser scanner F3G-C1R70 must light up.

- Add test-results to your documentation.

Check installation of the safety system to the machine:

- When you are sure that the definition of the protective field is correct, connect the safety laser scanner F3G-C1R70 signal cables to the machine control system. Repeat the test with the machine switched on, **but not running**. Check as far as possible the behaviour of the protective device.
- Also, check the behavior when the safety laser scanner F3G-C1R70 is switched off.
- Switch on the machine. Carefully insert an object, e.g. a box, into the monitored areas. Observe the machine's reaction.
- Prepare a report.

Before accepting the system, consider the following points:

- Test to ensure that no dangerous state can be set in motion as long as an object is present in the hazardous area.
- Ensure that the dangerous state or the dangerous movement comes to a stop before any part of a person's body can reach the hazardous point. When defining the protective field, take the machine stopping/run-down time and the safety laser scanner F3G-C1R70's response time into account.
- Ensure that the safety laser scanner F3G-C1R70 and other protective devices monitor all access points to the hazardous areas.
- Check that the safety laser scanner F3G-C1R70 is firmly mounted. Check that the system doesn't move under normal operating conditions and that its position cannot be changed.
- Train the machine operating personnel to operate the safety laser scanner F3G-C1R70. Explain its design and how to use the system (Indicators, faults).

7.3 Regular examinations



WARNING

Carry out regular tests!

Daily tests can be carried out by the machine's operating personnel.

The six-monthly maintenance (see below) and testing of the monitored areas must only be carried out by authorised Safety Officers.

Daily tests

- Check the state and installation of the safety laser scanner F3G-C1R70 for any changes. If in doubt, switch off the safety laser scanner F3G-C1R70 and immediately inform the Safety Officer.
- Keep the optics clean. Only use a soft brush or optical cloth for cleaning the optics.
- Check the surroundings for changes (e.g. structural alterations) that may have taken place since configuration.

Six-monthly tests

- Check the definition of the protective field at least every six months.
- Follow the regulation procedure described in Section 7.2 "Testing the Monitor functions" on page 29.

8 Transport and storage

8.1 Transporting the safety laser scanner F3G-C1R70

Adhere to the following instructions when transporting the safety laser scanner F3G-C1R70:

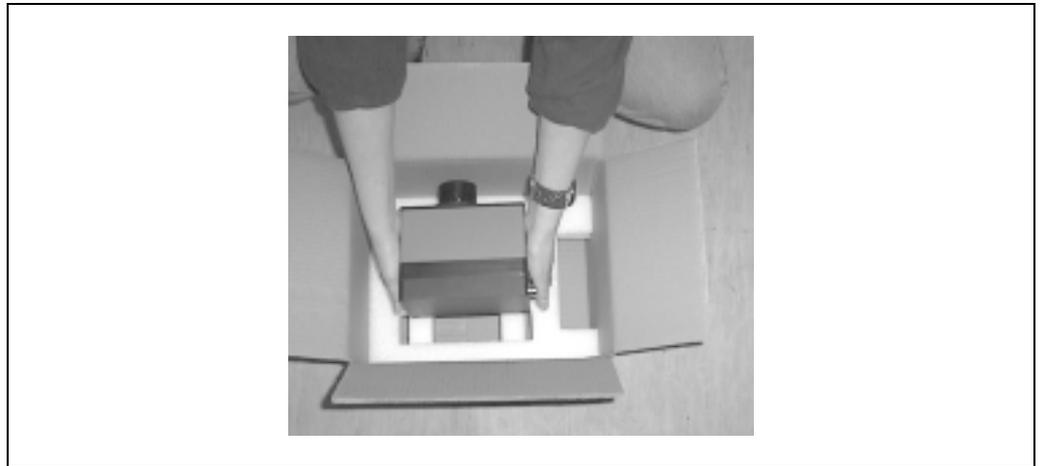
Notes

1. Remove all plugs to prevent buckling of the cable.
2. Fix rotating parts with adhesive tape to prevent scratching of the optics.
3. Do not allow any mechanical loads to affect the rotating parts.
4. Use the original packaging.

This is how you pack the safety laser scanner in its original packaging:

1. Place the lower membrane cushion upright in the box and lay the safety laser scanner F3G-C1R70 on it on its side.

Fig. 25: Place F3G-C1R70 on its side in the original packaging



2. Place the upper membrane cushion on top of the safety laser scanner F3G-C1R70.

Fig. 26: Place the upper membrane cushion on top of the F3G-C1R70

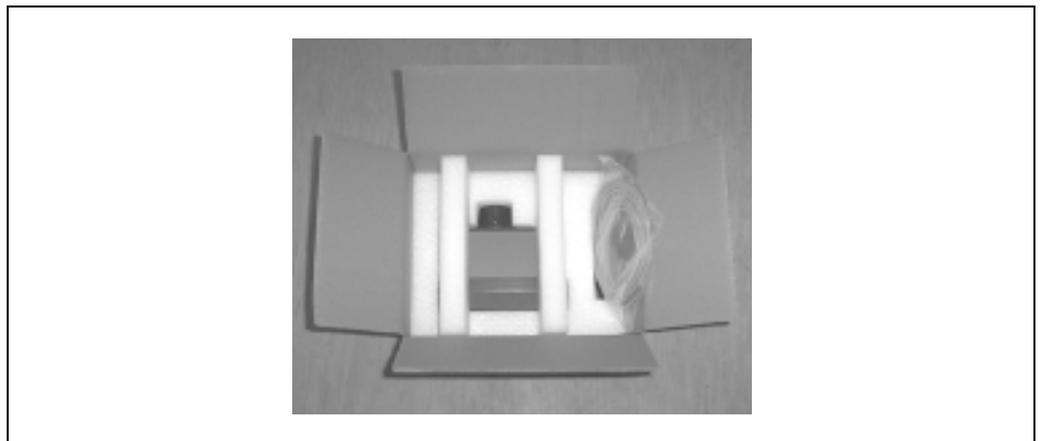


Fig. 27: Put the accessories in the original packaging

3. Finally, place the accessories in the box.



4. Before sending the package label it clearly: "Sensitive measurement device – fragile!"

8.2 Storage

Adhere to the following instructions when storing the safety laser scanner F3G-C1R70:

- Notes**
- Carefully dry the system before storage. Condensation can damage optical parts.
 - Do not store the system in closed airtight containers, so that any remaining dampness can evaporate. If possible, use the original packaging.
 - Store with an air humidity of 5 to 95%RH (without condensation)
 - Storage temperature -20 to +70 °C

9 Maintenance and care

The safety laser scanner F3G-C1R70 requires no maintenance apart from the regular examinations already mentioned. No adjustments or calibration is necessary.

Please observe the following general instructions for handling the safety laser scanner F3G-C1R70:

- Notes**
- To ensure the error-free operation of the sensor, clean the optical surface of the scanning head as soon as there is evidence of visible contamination. Do not touch the optical surface directly when cleaning. Use a plastic cleaner with a soft optical cloth to clean the optical surface. Never use rough cloths or aggressive detergents such as acetone.
 - Clean the safety laser scanner F3G-C1R70's housing with a soft, damp cloth. Do not use aggressive detergents.
 - Protect the safety laser scanner F3G-C1R70 from continuous direct sunlight.
 - Do not expose the safety laser scanner F3G-C1R70 to rapid temperature changes to prevent the formation of condensation.
 - Never open the safety laser scanner F3G-C1R70! The system does not contain any components that can be repaired or maintained by the operator.
 - If errors occur or you have difficulty using the safety laser scanner F3G-C1R70, contact your nearest OMRON representative.



WARNING

Never open the safety laser scanner F3G-C1R70. The system does not contain any components that can be repaired or maintained by the operator.

10 Troubleshooting

10.1 Correcting faults

All the indicators are off and the rotating scanning head is not rotating:

- Power supply 18 ... 30 V (24 V \pm 25%) present?
- Fuse intact?
- Plug correctly mounted on the safety laser scanner F3G-C1R70 and tightly connected?
- Connect the power supply with correct polarity?

The ON-state indicator (green LED) does not light up, Output contacts are open:

- Clean the optical surface (see Section 7.3 "Regular examinations" on page 30).
- Check power supply for high current.
- Connect the computer and display the CSL diagnosis.



Right-click on the device symbol in the navigation area > **Diagnosis** > **Show**.

- If you cannot solve the problem, please contact to your nearest OMRON representative.

Objects within the monitored areas are not detected:

- Is the diagnostic indicator (yellow LED) lit or blinking?
 - **Yes:** the safety laser scanner F3G-C1R70 has found an error: Check the optical surface and the reference target.
 - **No:** With the aid of the computer and the CSL, check the definitions for the protective and warning field.



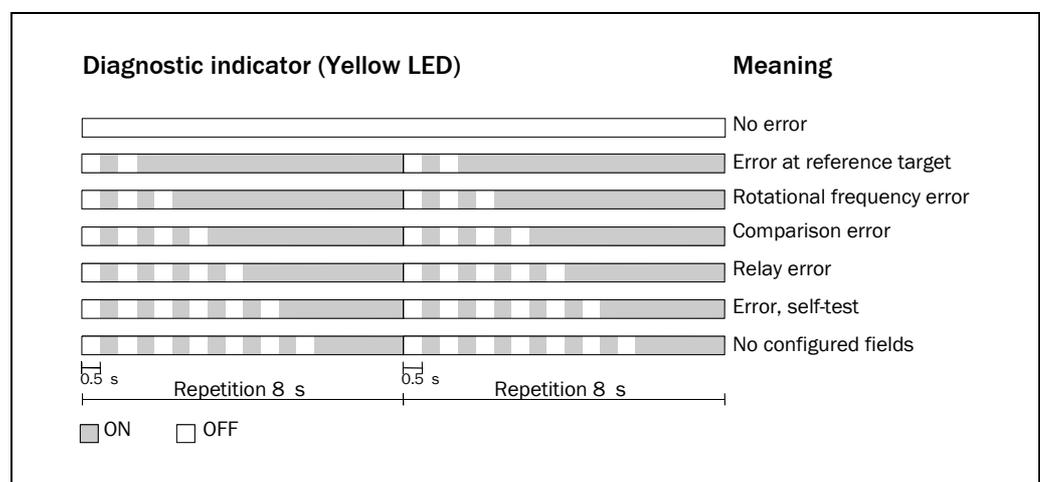
Right-click on the device symbol in the navigation area > **Configuration draft** > **Edit field setting...**

Objects are reported within the monitored areas without actually existing:

- Check the surroundings for changes (e.g. structural alterations) that may have taken place since configuration.
- Rain, snow, smoke and dust could be the cause of the spurious object detection!

10.2 System error indications

Fig. 28: System error indications



F3G-C1R70

11 Technical data

11.1 Data sheet

Tab. 4: Technical data for the safety laser scanner F3G-C1R70

Safety classes

Safety category	Type 3 ESPE acc. to EN/IEC 61496-1 error-proof acc. to EN/IEC 61496-1
Laser protection class	Laser Class 1 acc. to EN60825-1, IEC825-1, Laser Class I of FDA (21 CFR1040.10)

Characteristic data for the safety laser scanner F3G-C1R70

Measurement and tolerance range	0 to 7.5 m
Range for a safe detection of the "nominal leg" ⁴⁾	0 to 6 m (incl. safety supplement)
Detection capability	Non-transparent: 70 mm min. in diameter (with 1.8% min. reflectivity)
Response time	280 ms
Reactivation time	200 to 5000 ms (adjustable)
Maximum scanning angle	300°

Laser and angular measurement

Laser diode	Infrared laser diode (Avalanche Photo Diode)
Wavelength	905 nm
Pulse frequency	5.76 KHz + 5%
Scanning frequency	8 Hz + 5%
Scanning angle	300°
Angle encoder resolution	360×4 increments
Point resolution	0.5°

Optics (co-axial transmitter and receiver optics)

Laser beam divergence	15 mrad
Focal length	30 mm
Optical surface diameter	30 mm

Power supply

Supply voltage	24 V DC ± 25% (ripple 5Vp-p max.) without voltage drop due to cable, (via a safety insulating transformer acc. to IEC 742, see section 5.2 "Connecting the power supply and signal cable" on page 25).
Current uptake	Approx. 1 A at 24 V DC
Switch on current	2 A for 100 ms
Power consumption	24 W total
Circuit protection	Fuse 3.15 A medium slow blow

⁴⁾ Definition of the "nominal leg": black cylinder with 70 mm diameter and 1.8% reflectivity. This corresponds approximately to a leg in child's clothing made of black corduroy.

Tab. 4: Technical data for the safety laser scanner F3G-C1R70 (continued)

Housing and environmental resistance

Material	Housing: Aluminum Optical surface, Indicator: Glass
Degree of protection	IP 65 (IEC 60529)
Length	168 mm
Width	108 mm
Height	176 mm
Weight	3.5 kg
Ambient temperature	During operation: 0 to 50 °C During storage: -20 to 70 °C
Ambient humidity	During operation: 5 to 95 %RH (without condensation) During storage: 5 to 95 %RH (without condensation)
Vibration resistance	Normal operation: 10 to 55 Hz, double amplitude 0.7 mm, X, Y and Z directions 20 sweeps
Shock resistance	Normal operation: 100 m/s ² , X,Y and Z directions 1000 times

Interfaces

Data interfaces to computer	RS 232: 9600 baud, 8 data bits, 1 stop bit, no parity
Signal outputs for warning field, OSSD1, OSSD2	Potential-free relay outputs, max. 2 A, max. 30 V, purely Ohmic load, number of operations 2 million, Self-resetting fuse (2 A)

Cable Connection

Interface connection	14-pin circular connector (Binder: Series 423)	
24 V DC/signal connection	8-pin circular connector (Binder: Series 423)	
Cable (optional)	for power supply and output	0.5 mm ² x 8 cores, with braided wire shield, 20 m max., allowable bending radius: 90 mm
	for PC interface	5 m max., allowable bending radius: 112 mm

Accessories

Accessories	Instruction manual, CSL on CD-ROM, Mounting screws
-------------	--

F3G-C1R70

11.2 Device accuracy and safety supplements

The accuracy of the device depends on distance. Accuracy is as follows:

Tab. 5: Accuracy of the F3G-C1R70 in relation to distance

Distance up to	Safety supplement
2 metres ⁵⁾	25 cm
3 metres ⁵⁾	35 cm
4 metres ⁵⁾	45 cm
5 metres ⁵⁾	55 cm
6 metres ⁵⁾	70 cm

All possible influences, and particularly the reflective properties of the materials that could come into question and all background effects, have been taken into consideration in these tolerances.

Please note that when programming the device the safety supplement must be calculated in.

⁵⁾ All distance figures include safety supplement.

12 Order data

12.1 Delivery

The following components are included in the safety laser scanner F3G-C1R70 package:

- Safety laser scanner F3G-C1R70 qty. 1
- Instruction manual (this manual) qty. 1
- Notes to user qty. 1
- CD-ROM including CSL (Configuration Software for Laserscanner) and the users manual for the CSL qty. 1
- Mounting screw set
 - 4 bolts (M4 × 10)
 - 4 washers
 - 4 locking washers

12.2 Optional accessories

- Power supply cable F39-JG5A (5m)
- Interface cable F39-JG5R (5m)

13 Appendix

13.1 Dimensional drawings, safety laser scanner F3G-C1R70

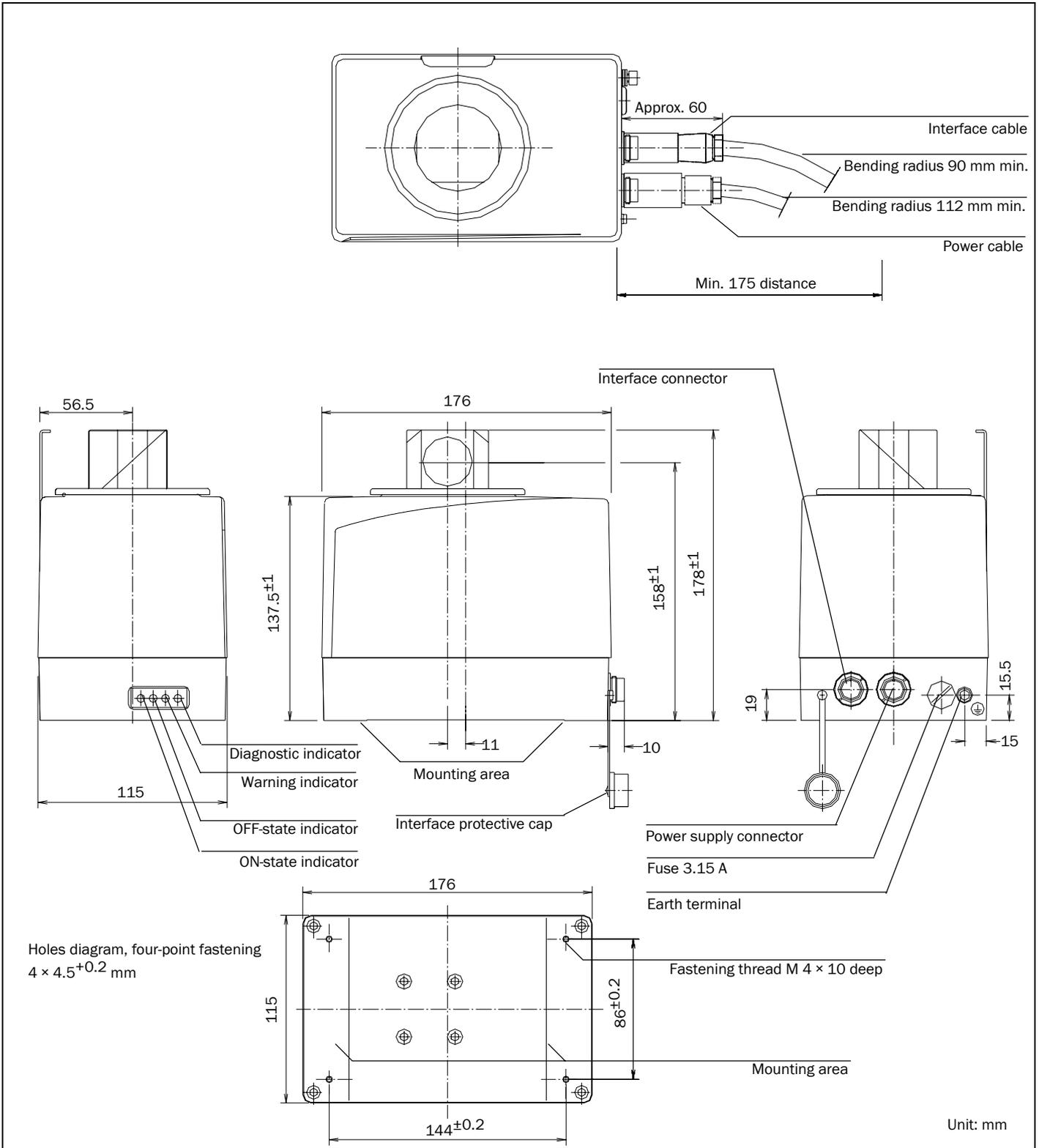


Fig. 29: Dimensional drawings, safety laser scanner F3G-C1R70

13.2 Standards and directives

The most important standards and directives, 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 type of use. Further information on device-specific standards can be obtained from the authorities responsible, or from your trade association.

If the machine or vehicle is to be operated in a country that does not belong to the European Union, we recommend that you contact the plant operator or local authorities.

On the application and installation of protective equipment

- The Machinery Directive 98/37/EC
- Safety of machinery – Basic concepts, general principles for design (EN 292-1, -2)
- The safety of integrated production systems (DIN EN 1921)
- Safety of machinery – Electrical machine equipment – Part 1: General requirements (EN 60204)
- Safety of machinery – Safety distances to prevent danger zones being reached by the upper limbs (EN 294)
- Safety requirements for robots (EN 775)
- Safety rules for electro-sensitive protective equipment on power-driven equipment (ZH 1/597)
- Safety of machinery – The positioning of protective equipment in respect of approach speeds of parts of the human body (EN 999)
- Safety of machinery – Principles for risk assessment (EN 1050)

On the construction and equipping of protective equipment

- Safety of machinery – Electro-sensitive protective equipment – Part 1: General requirements (IEC/EN 61496-1 as well as based on IEC/EN 61496-3)
- Basic safety considerations for MCR safety systems (DIN V 19250)
- Safety of machinery – Electrical equipment of machines – Part 1: General requirements (EN 60204)
- Safety of machinery – Safety-related parts of control systems – General principles for design (EN 954)

13.3 Checklist for the manufacturer



Check list for the manufacturer/OEM for the installation of electro-sensitive protective equipment (ESPE).

The details on the items listed below must be available at the latest when the system is commissioned for the first time, depending, however, on the various applications the requirements of which must be reviewed by the manufacturer/OEM.

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 <input type="checkbox"/> | No <input type="checkbox"/> |
| 2. Are the applied directives and standards listed in the declaration of conformity? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 3. Does the protective device comply with the required safety category? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 4. Is the access to the hazardous area/ hazardous point only possible through the protective field of the ESPE? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 5. Have appropriate measures been taken to prevent (mechanical point-of-operation guarding) or monitor unprotected presence in the hazardous area when protecting a hazardous area/hazardous point and have these been secured against removal? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 6. Are additional mechanical protective measures fitted and secured against manipulation, which prevent reaching below, above or around the ESPE? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 7. Has the maximum shutdown and/or stopping/run-down time of the machine been measured, specified and documented (at the machine and/or in the machine documentation)? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 8. Has the ESPE been mounted such that the required safety distance from the nearest hazardous point has been achieved? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 9. Are the ESPE devices properly mounted and secured against manipulation after adjustment? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 10. Are the required protective measures against electric shock in effect (protection class)? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 11. Is the command unit for resetting the protective equipment (ESPE) or restarting the machine present and correctly installed? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 12. Are the outputs of the ESPE (OSSDs) integrated in compliance with the required safety category and does the integration comply with the circuit diagrams? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 13. Has the protective function been checked in compliance with the test notes of this documentation? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 14. Are the given protective functions effective at every setting of the operating mode selector switch? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 15. Are the switching elements activated by the ESPE, e.g. contactors, valves, monitored? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 16. Is the ESPE effective over the entire period of the dangerous state? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 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 <input type="checkbox"/> | No <input type="checkbox"/> |

This checklist does not replace the initial commissioning, or the regular inspection by specialist personnel.

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