TECHNICAL DESCRIPTION

Proximity Laser Scanner
PLS

SICK

Table of Contents

This technical description contains all the information necessary for project planning and setting up the PLS. You will find in it the information you need for mechanical mounting, electrical installation and programming of the PLS.

The description covers the following PLS types:
– PLS 101-312 (certified for personal protection to IEC/EN 61496-1)
– PLS 201-313 (non certified)

To avoid confusion between the certified and non-certified types, the main part of this technical description relates only to the certified types. You can find the relevant information on the non-certified types in condensed form in the Appendix in Chapter 12.5.

Along with the technical description, you are also provided with an instruction manual containing important information for day-to-day use of the PLS.

Keep the technical description and instruction manual readily to hand at all times.

The information given in this description can be altered and amended without prior notice.

Essential chapters you should read:

General safety notes	Chapter 0
Important notes	Chapter 2
Location planning	Chapter 5
Supply / package	
Mounting and connecting up the PLS	Chapters 6 to 8
Getting to know the user software	Sections 9.1 to 9.3
Checks	Chapter 10
Technical data	Section 12.3

0 General Safety Notes and Protective Measures

Safety regulations and notes

1. The use/installation of proximity scanners used as non-contact protective devices, as well as the recurrent technical checks, are covered by national/international legal regulations, in particular

   - Machine Directive 98/37 EU,
   - Use of Work Materials Directive 89/655 EEC,
   - the safety regulations and
   - the accident prevention and safety regulations.

   Manufacturers and operators of machinery equipped with our protective systems are responsible for consulting with the relevant authorities about, and complying with, all the applicable safety regulations.

2. **Furthermore**, our instructions, **particularly with regards to the check regulations** (see Chapter 10 “Checks”) detailed in this technical description or instruction manual (e.g. concerning the use, extension, installation or integration in the machine controller), must be heeded and complied with without fail.

3. The checks must be carried out by **skilled** or **authorised and instructed personnel**, and are to be documented in a clear and comprehensible manner.

4. Our operating instructions are to be made available to the **employee** (operator) using the machinery equipped with our protective systems. The employee is to be instructed in their use **by skilled personnel**.

5. A check list for manufacturer and outfitter checks is supplied as an enclosure to this brochure.

1 Declaration of Conformity

Note:
Additional certification by Underwriters Laboratories Inc.
(UL) as per UL 1998 and CSA C22.2 Number 0.8-M 1996.

SICK

EC Declaration of conformity

en

Ident-No. : 9051785 / O542

The undersigned, representing the following manufacturer

SICK AG
Industrial Safety Systems
Sebastian-Kneipp-Straße 1
79183 Waldkirch
Deutschland

herewith declares that the product

PLS101-312

is in conformity with the provisions of the following EC directive(s) (including all applicable amendments), and that the standards and/or technical specifications referenced overleaf have been applied.

Waldkirch, 9.6.2004

ppa. Dr. Plasberg
(Manager Research and Development)

i.V. Knobloch
(Manager Production)

2 Notices / Regulation Use

The PLS proximity laser scanner is a device designed to protect people and property. It is intended to monitor hazardous areas in enclosed spaces. PLS is not designed for outdoor use.
Observe the instructions relating to regulation use. SICK cannot be held liable for damage arising from use of the PLS other than stipulated.

- Install the PLS in a dry location and protect the unit against dirt and damage.
- Lay all wires and connecting cables such that they are protected against damage.
- Avoid the creation of strong electrical fields which could, for example, arise in the immediate vicinity of welding or induction cables, or which could also be caused by mobile telephones being used nearby.
- Make sure that no obstacles in the monitoring range can obstruct the field of vision of the PLS or cause shadows. Such shadow areas cannot be monitored by the PLS. Where there are unavoidable areas of shadow, check whether they present any risk. Take additional precautionary measures as necessary.
- Keep the monitoring range free of smoke, fog, steam and other air pollution. The functioning of the PLS may otherwise be impaired and error shutdowns may occur.
- Avoid placing strongly reflective objects such as retroreflectors in the scanning plane of the PLS, as they may influence its measurement results.
- Mount the PLS so that it cannot be dazzled by sunlight. Also avoid stroboscopic and fluorescent lamps, as they may influence the PLS under certain circumstances.
- In mounting, installation and use of the PLS, observe the standards and regulations applicable in your country. The Appendix presents a summary of the most important regulations.
- For programming of the monitoring range, take note of the description of the user software as from Chapter 9. This describes how to connect the PLS to a PC and how to work with the user software.
- Before releasing the machine for use, test whether access to the hazard area is fully covered by the safety devices. After release, also check at regular intervals (such as every morning before beginning work) that the PLS is activated properly when an infringement of the protective field occurs. This test should be carried out along all protective field limits, in accordance with application-specific regulations.
- If you want to deploy one or more PLS together with an LSI (Laser Scanner Interface) in your application, to work with several different switchable or variable protective fields for example, please also take note of the technical description of the LSI.
- If you employ the PLS for vehicle protection: please note that the PLS can only be used on electrically driven vehicles.
- The PLS must be disposed of in a proper and environmentally friendly manner at the end of its useful service life.

3 How the PLS Works

Principle of function

The PLS is an optical sensor which scans its surroundings with infrared laser beams. It is used to monitor a hazardous area on a machine or vehicle. The PLS can be used on manually controlled- vehicles, such as narrow-aisle forklifts and other lift trucks, as well as in driverless transport systems (DTS) such as shunting cars and free-navigating vehicles.

As a result of its scanning principle, the PLS requires neither separate receivers nor reflectors.

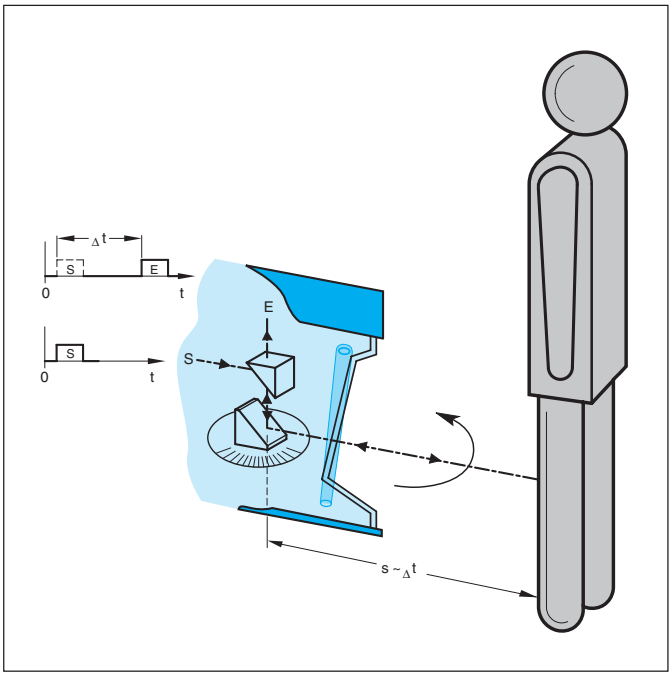
This has the following advantages:

– You can adapt the monitoring range precisely to the hazardous area of a machine.
– Since you do not need not need any receivers or additional reflectors, you keep the entire-area freely accessible and driveable.
– If the hazardous area changes, you can alter the sensor simply by- reprogramming the software, with no additional mounting.
– Different reflective materials do not influence the functioning of the sensor. This makes the PLS highly versatile in its uses.

The sensor operates on the principle of reflex light time measurement. It emits very short light pulses. At the same time an "electronic stopwatch" runs. If the light encounters an object, it is reflected and thrown back to the sensor. From the time between sending and receiving, the sensor calculates its **distance** from the object.

In the sensor there is also a uniformly rotating mirror, which deflects the light pulses so that they sweep a semicircular area. By determining the mirror angle, the PLS detects in which **direction** the object is located.

The sensor determines its precise **position** from the measured distance and the direction of the object.



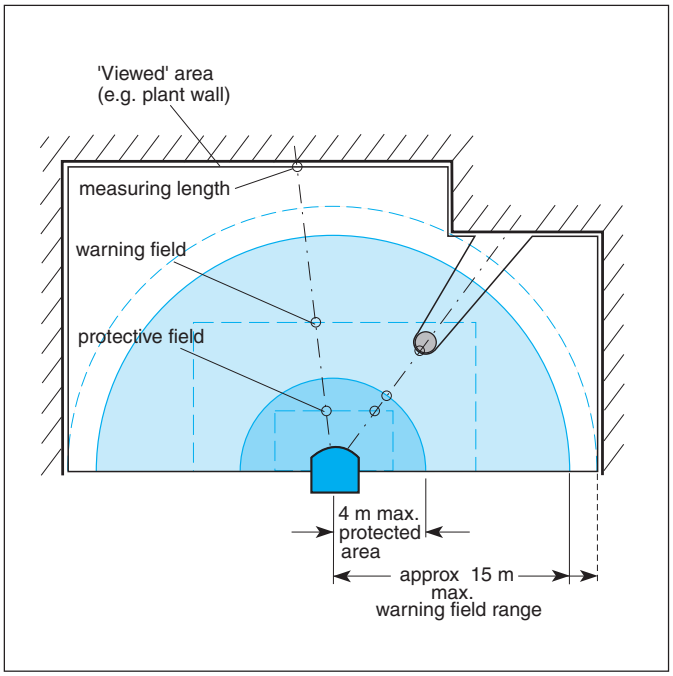
Fields and measuring range of the PLS

The monitoring range of the sensor consists of a protective field and a warning field. You can use the applied software to define the two fields and store them in the memory.

The **protective field** protects the hazardous area of a machine or vehicle. As soon as the sensor detects an object in the protective field, it deactivates the safety outputs, thereby switching off the machinery or stopping the vehicle.
This is a safety function. Its safety integrity corresponds to Cat. 3 as per EN 954-1:
The test basis is Type 3 as per EN 61496-1

You can define the **warning field** such that the sensor detects on object before it enters the actual hazardous area, and triggers an alarm signal, for example.

Independent of its evaluation of the protective and warning fields, the sensor continually scans its **surroundings** for additional measuring tasks, such as to navigate a DTS or measure contours.

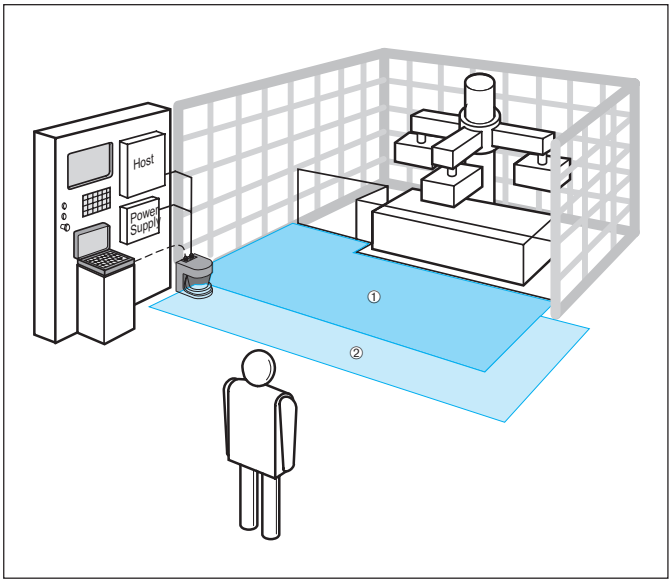


4 Fields of Application – What the PLS Can Do

These pages provide an overview of the key fields of applica-tion of the PLS.

Area protection

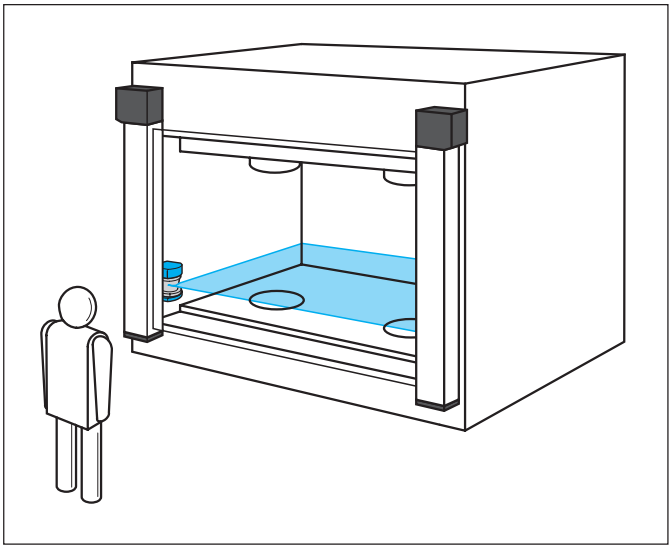
On hazardous stationary machinery the PLS ensures that the machine (or only its hazardous environment) is shut down as soon as someone enters the hazardous area. This is done by means of a protective field ❶ which you can define according to your needs and store in the PLS.
You can also define a warning field ❷ in front of the actual hazardous area which triggers an alarm signal as soon as someone approaches the hazardous area. The person can then move out of the warning area without the machine or its hazard-ous movement having to be stopped. This helps you to safe-guard continuous production.



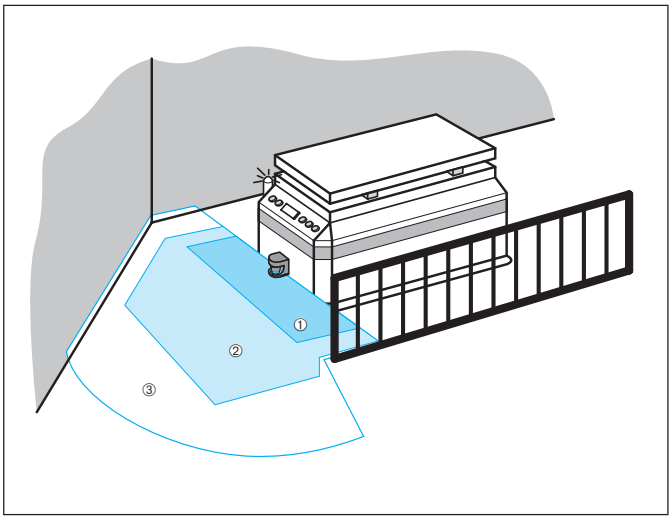
Internal space protection

Where internal spaces exist in large machines, the PLS ensures that the machine can only start up when the internal space is clear. This is important especially with regard to internal spaces which are not clearly visible, or not visible at all, from the outside.

In this application the PLS performs only a secondary protective function. The actual personal protection is provided by a light grid, whilst the PLS monitors restarting of the machine.



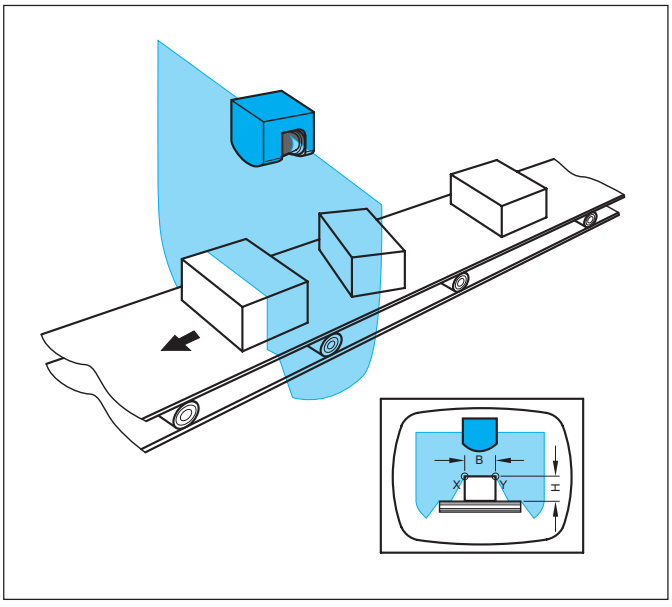
Vehicle protection and navigation



You can employ the PLS on vehicles, such as driverless transport systems (DTS), forklifts and shunting cars, to safeguard a vehicle's path – on its way through a factory hall for example. The protective field ❶ of the PLS ensures that the protective semiconductor outputs (OSSDs) are deactivated, thereby stopping the vehicle if a person or obstacle is standing in the way. You can also define a warning field ❷ which, for example, triggers an alarm signal some distance before the person or obstacle is reached and cuts the speed of the vehicle. You can protect both manually controlled vehicles and driverless transport systems (DTS).

Independent of the protective and warning field settings, the PLS continually monitors the positions of objects in its surroundings ❸. Vehicles with an internal navigation system can use this ambient data to update their system.
For this, the PLS is permanently linked to the on-board computer of the PLS. The data transmitted by the PLS is encoded in -telegrams. The telegram description can be ordered from SICK.

Measurement of contours



You can use the measurement principle of the PLS for a wide variety of measuring tasks, such as:
- Size measurement of goods
- Position detection of goods (e.g. pallets)
- Cross-section measurement in aisles and tunnels
- Profile measurement of goods or vehicles
- Position measuring of goods on shelves
- Filling level measurement
- Length measurement

If you want solutions for measurement problems of this kind, please order documentation from our LMS laser scanner series, which is suitable for such tasks.

5 Location Planning

The PLS monitors hazardous areas and protects operating personnel and plants. To enable it to fulfil these tasks, you need to observe a number of rules and safety criteria when choosing its location. The key information with regard to this is presented on the following pages.

Note:
It may be that other standards and regulations not cited here are also of importance to your application.
If you are uncertain about your application, please contact your local SICK office.
Always choose a location

- which provides the maximum safety in the hazardous area,
- in which no obstacles can obstruct the field of vision of the PLS or cause umber shadows,
- in which the PLS is protected against damp, dirt and damage,
- in which the PLS is not influenced by sunlight or artificial light sources,
- which is as accessible as possible for electrical installation work.

Please note that intrusion into needle-formed protective fields/ protective field sections (protective field segments only consist of a single pixel) is ignored by the device for reasons of availability.
If such forms of protective fields cannot be avoided, always programme at least one more adjacent pixel.
Approval of the PLS for use as a personal protection appliance is based on area protection. Other mounting locations are, following an assessment of potential risks and with the approval of the relevant authorities, also possible. The possibility of people being endangered must always be excluded.

Range of the PLS

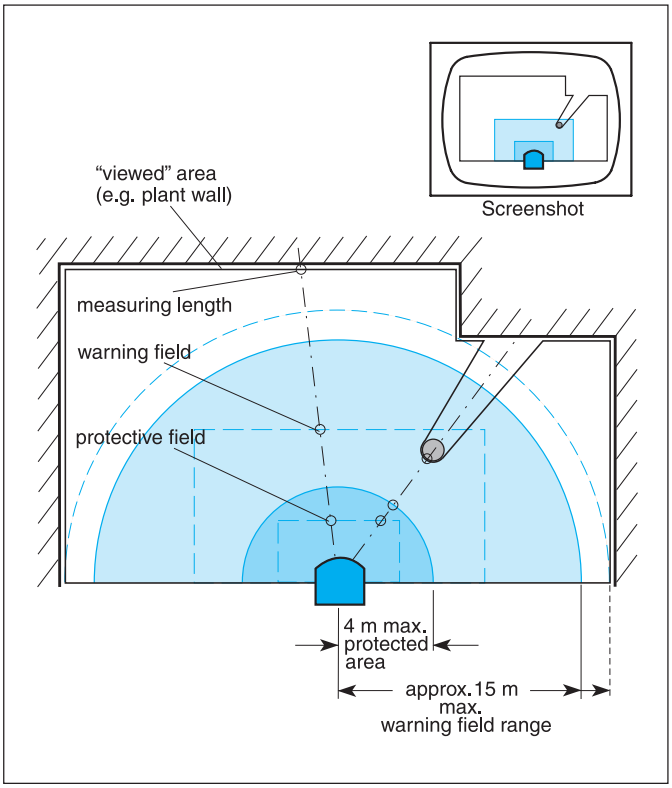
The PLS measures its surroundings in a semicircular plane – (scanning angle 180°). Employment of an optoelectronic safety device as area protection requires a minimum resolution of 70 mm at a specific mounting height of 300 mm. The PLS guarantees this resolution to a distance of 4 metres. Therefore the system software of PLS type 101-312 limits the maximum radius of the protected field automatically to 4 metres.

The PLS type 201-313 does not have this limitation, and so is not certified for personal protection.

The **protective field** safeguarding the hazardous area of a machine- or vehicle may have a maximum radius of 4 metres. The PLS shuts the machine down or stops the vehicle in the event of an intrusion into the protective field.

The **warning field** may have any radius up to 50 metres. You should note, however, that the sensor is only able to detect objects with a reflectance of approx. 20 – 30 % to a distance of 15 metres.

The **measuring range** of the PLS extends to a radius of 50 metres. Up to that distance the PLS is able to detect the contour of its surroundings (e.g. the space contour). It can then additionally evaluate this data for the protective field and the warning field, provided the reflectance of the object is sufficient to be detected.



5.1 Stationary protection with PLS

Important notes on configuration

In “with restart inhibit” mode the actuating element for the restart inhibit must- be positioned so that there is full visibility of the hazardous area. The actuating element for the restart inhibit must not be accessible from the point directly in front of the sensor.

In “with restart inhibit” mode the close-up zone[1)] of the sensor (4 cm wide area measured from the front screen outer area) is either to be rendered inaccessible (e.g. by a bar or undercut), or a proximity scanner with a 4 cm detection range is to be mounted over the sensor.

For area protection, side access to the machine base is also to be taken into account when configuring the protective field. This assumes that a person approaches the machine base from the side. If side access is possible (no solid restrictions such as a wall), the protective field should be configured wider than the machine base.

In area protection applications it must be ensured that, with protective field widths over 2 metres, there are no retroreflectors in the immediate proximity of the protective field on the scanning plane. Otherwise corruption of the measured values is to be expected under extreme conditions. If it is impossible to avoid having retroreflectors in the scanning plane, an extra 20 cm should be added to the maximum measuring error[2)].
The maximum measuring error is

- 94 mm for protective fields ≤ 2 m
- 131 mm for protective fields > 2 m

Where there are fixed restrictions (walls) there must be no retroreflectors in the scanning plane, as otherwise someone could move along the wall to bypass the protective field.

For both graphic and numerical programming, it must be ensured for reasons of functionality (solid barriers should not lead to unintentional shutdown) that where fixed contours exist a distance of 94 mm for protective fields below 2 metres and 131 mm for protective fields over 2 metres is observed.

Where the teach-in function is used, a 45 mm supplement on top of the maximum measuring error is required for the accuracy of the learned contour.

Recommendation:
When installing stationary plants, it is recommended that you mark out the shape of the protective field on the floor to make it easier to perform the regular machinery checks.

1) An optical radar cannot distinguish between a dirty front screen and an obstacle directly in front of the sensor. For the sake of functionality, the PLS was designed to reliably detect solid black bodies such as black cord or shoe leather only at a distance of 4 cm measured from the outer contour of the front screen.

2) Accuracy of the sensor in safety applications: the sensor determines the distance of an obstacle from the flight time of a very short light pulse. To attain optimum accuracy against obstacles of solid black material (1.8% reflectance) up to precision triple reflectors (10,000% reflectance), the PLS compensates the received signal. If there is a dark object in front of a retroreflector, under certain circumstances (see above) the error distance of 20 cm may be too large. This would mean that a person could intrude 20 cm into the monitored area without being detected by the PLS.
This measuring error occurs only when the following conditions simultaneously apply:
   – the distance to the target is greater than 2 metres,
   – the target is smaller than 140 mm,
   – the retroreflector is on the scanning plane,
   – the reflector is aligned perpendicular to the sensor within an angle of ± 30°,
   – the target reflectance is in the area of 1.8%,
   – the retroreflector is not more than 2 metres behind the target, and
   – the reflector has high reflectance.

Location planning

There are two basic alternative procedures for defining mounting locations:

First option: using the so-called teach-in mode. In this mode the PLS measures the ambient contour and stores it (after automatic correction) as the outer protective field. The following formulae must be applied to check compliance with the relevant specifications, such as the safety distance and mounting height-, retrospectively.

Second option: using graphical or numerical protective field input. In this the specifications to be complied with are ascertained at the outset and are then set in programming of the scanner.

The basis for planning the mounting location of the PLS is as per EN 999. It describes the necessary safety distance from the hazardous area by:

S = (K x T) + C

Where:

S is the minimum distance in millimetres, measured from the hazardous area to the detection point, detection line, detection plane or protective field;

K is a parameter in millimetres per second, derived from data relating to approach speeds of the body or body parts;

T is the stopping time of the overall system in seconds

C is an additional distance in millimetres which takes account of the possibility of intrusion into the hazardous area before tripping of the safety device.

In access protection applications, an approach speed of 1600 mm/s is applied as K.

T results from addition of the response time of the sensor and the stopping time of the hazardous movement.

C describes the possibility of reaching over the protective field without tripping the sensor, and varies with the height of the protective field limit according to the following correlation:

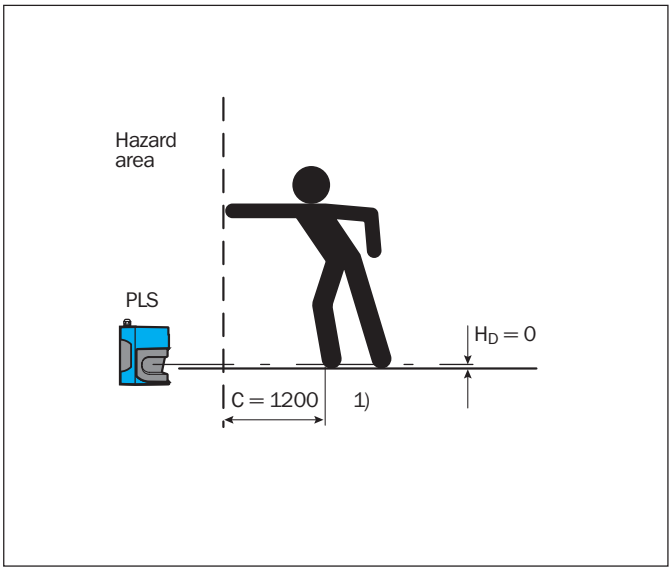
$C = 1200\ mm - 0.4\ H_D$ (H_D = height of detection)
where $C \geq 850$ mm

Consequently:
where $H_D = 0 : C_{HD=0} = 1200$ mm
where $H_D = 875 : C_{HD=875} = 850$ mm

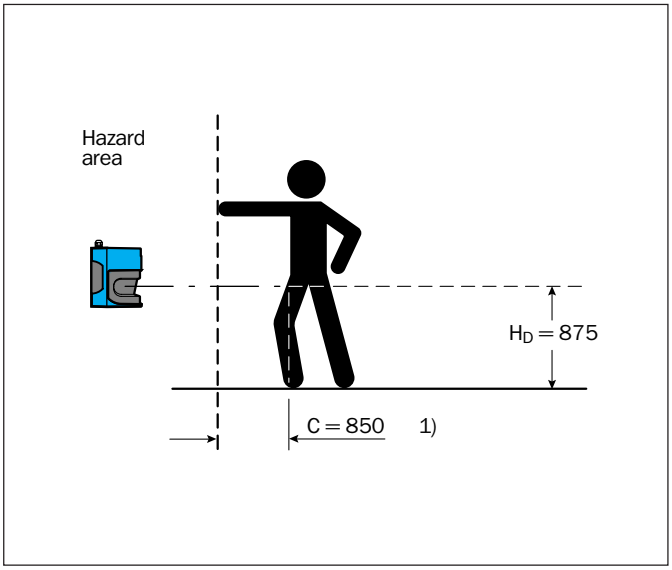
This correlation is shown graphically in the adjacent diagrams (cases 1 and 2).

Note:
The protective field supplement C is to be chosen depend-ing on the height of detection H_D.
In case 2b, protection of marginal areas, note that the scanning plane is not raised.
Also note that if the sensor is not mounted parallel to the floor the effective protective field length is reduced.

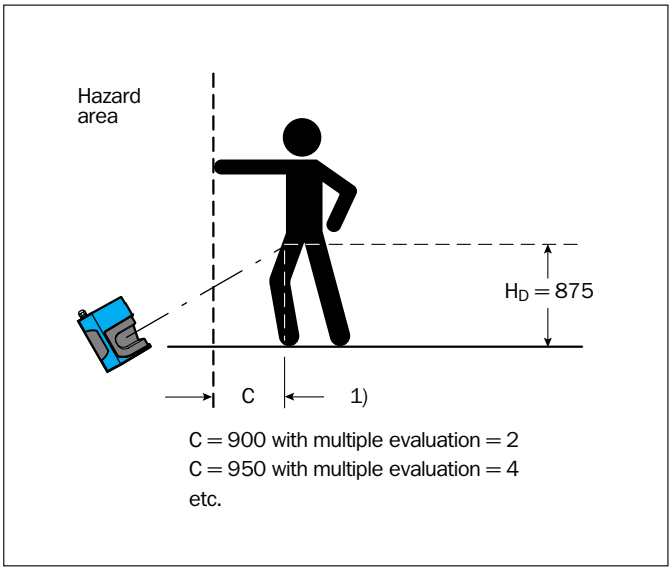
1) Supplement to safety distance



Case 1: Scanning plane parallel to ground ($H_D = 0$)



Case 2a: Scanning plane at maximum height and parallel to ground ($H_D = 875$)



Case 2b: Scanning plane at maximum height, not parallel to ground ($H_D = 875$)

As a secondary condition, EN 999 stipulates the following minimum height:

$H_D = 15 \times (d - 50)$ mm

Application of this formula is necessary as the leg diameter changes with the distance from the floor. Here, d is the resolution of the PLS (d is dependent on the distance from the scanner).

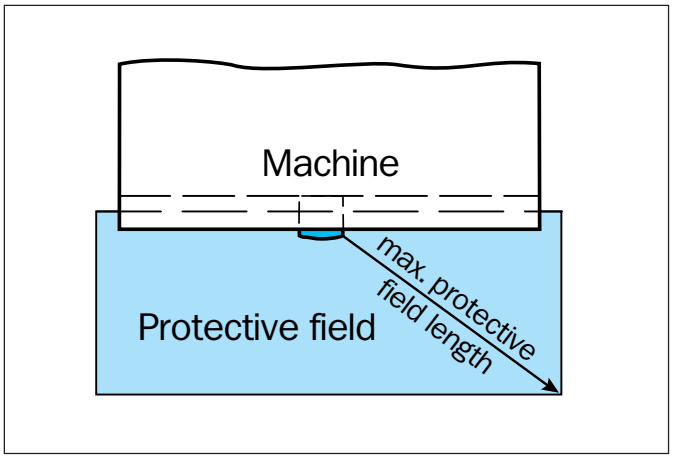
The resolution of the scanner must always be determined at the point of the greatest measuring distance, i.e. at the greatest occurring protective field length SL_{max}.

Based on the working principle of the PLS by means of radial scanning of the surroundings, a resolution is produced which decreases as the distance from the sensor increases.

Thus a protective field length SL greater than 2.70 metres (only up to this distance is a scanner resolution of 50 m guaranteed) makes a certain detection height necessary. In this way it is possible to compensate for the lower resolution with greater leg diameter.

These correlations between SL, H_D, H_S and C are shown graphically- in the adjacent diagrams. In this, H_D is the height of the scanner plane, measured directly on the sensor.

With horizontal mounting there is no risk of unwanted accessing at mounting heights below 100 mm (for example crawling under the scanning plane). To prevent children from crawling underneath, the maximum mounting height is 200 mm. Mounting heights of less than 100 mm are generally not to be recommended, as in such cases it is possible that the scanner may accidentally shut down as a result of the increased dust concentration directly on the floor. For these reasons this mounting range is often preferred, and consequently is identified as such in the diagram.

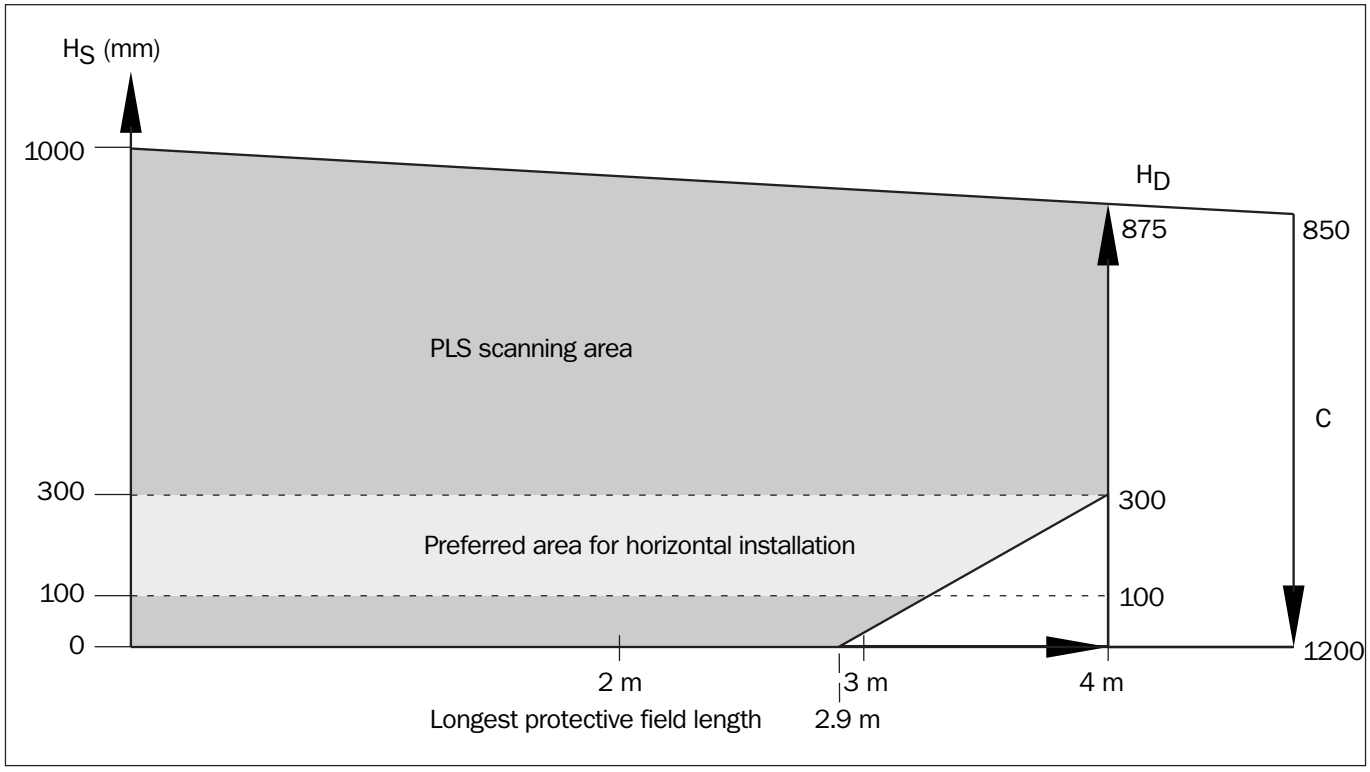


Resolution of the scanner at the point of longest protective field length SL.

Using the diagram:

Define the maximum protective field length SL_{max} in your layout. Shift the right Y-axis (H_D) in parallel onto the located value SL_{max}. Then place the desired scanning plane in the remaining area shaded grey. The plotted scanning line must not leave the grey area at any point.

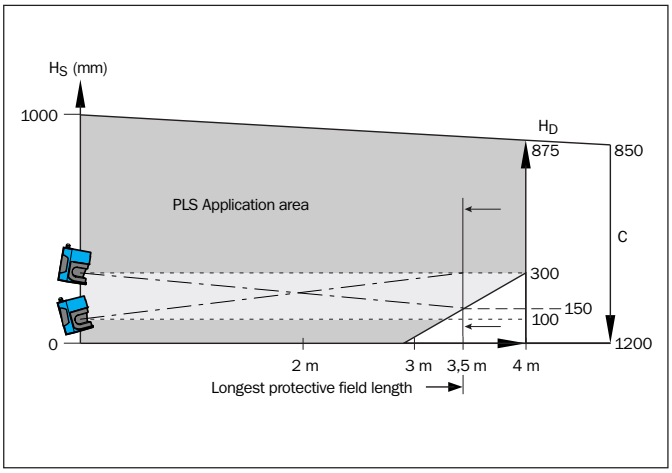
Within the area shaded grey in the diagram any mounting orientation is possible, provided it does not impair the safety distance.



Correlation between protective field length, resolution of sensor and height of scanning plane

Read-off example:

You determine a maximum protective field length of 3.50 metres. To determine the minimum field length at the edge of the protective field, shift the right Y-axis in parallel onto the value 3.50 metres. You will then see that the detection height must not be lower than 150 mm. The mounting height of the sensor is freely selectable up to a height of 1000 mm. Thus the scanning plane does not go beyond the grey area.



Note:
Please note that the height of the beam H_S is 63 mm above the bottom edge of the housing.

There are three common mounting orientations for the PLS. The optimum mounting orientation depends on the situation. The table provides some assistance in making the right choice.

	Scanner setting	Advantages	Disadvantages
Case 1:	Scanner low (H_S < 300 mm) low scanning plane inclination (H_D approx. H_S)	No external dazzling crawling under beam not possible	Large protective field supplement C
Case 2:	Scanner high (H_S > 300 mm) low scanning plane inclination (H_D approx. H_S)	Small protective field supplement C	Risk of crawling under beam (from front and sides)
Case 3:	Scanner low (H_S < 300 mm) high scanning plane inclination (H_D > H_S)	Small protective field supplement C	Risk of crawling under beam (from front) external dazzling possible

* HD = detection height, HS = height of scanner mounting

Any other mounting orientation and intermediate height which prevents a hazardous situation arising is possible, provided the safety distance is observed. Always take account of the marginal area protection.

The protective field supplement C is determined on the basis of the choice of mounting orientation. We recommend for an initial calculation:

In case 1: C = 1200 mm
In case 2: C = 1000 mm
In case 3: C = 1000 mm

The formula to be applied is:
$S = (1600\ mm/s \times T) + C + Z_M + Z_R + Z_E$

whereby: Z_M is a supplement for the general measuring error of the PLS
Z_R is a supplement for any reflection-related measuring error of the PLS
Z_E is a supplement for the measuring error of the PLS resulting from teach-in (see important notes on configuration for stationary protection).

Note:
Every time the parameters are changed, check that the protective field is still adequately dimensioned and that no unwanted access (from the side or by crawling underneath the scanning plane) is possible!
Make sure that all necessary supplements are taken into account in the calculation.

Restart definition

The machine should preferably be operated with restart inhibit. If the machine control has no restart inhibit, the internal restart inhibit of the PLS can be used.
A restart inhibit is always essential when the protective field can be exited towards the hazardous area. Where necessary, check whether this can be prevented by plant design (see following subsection: Mounting recommendations for PLS).

If a machine can only be operated without restart inhibit, it is essential that the following points should be observed.
– A person must be reliably detected at every point in the hazardous area.
– A person must not be allowed to exit the protective field in the direction of the hazardous area (such as by crawling underneath it, stepping behind it or climbing over it).

Make sure this is prevented by plant design (see following subsection: Mounting recommendations for PLS)!

Mounting recommendations for PLS

The following considerations must be taken into account when designing the plant:

The mirror pivot point of the PLS determines the position of the front edge of the protective field. Since the mounting area and the mirror pivot point are at a set distance from one another, a zone is produced in front of the mounting area which is not detected by the scanner.

This zone becomes larger if the PLS is mounted on the mounting bracket, for example. The size of this dead zone – measured from the back edge of the PLS or the mounting kit – is:

PLS direct-mounted	109 mm
PLS with mounting kit 1	112 mm
PLS with mounting kit 1 and 2	127 mm
PLS with mounting kit 1, 2 and 3	142 mm

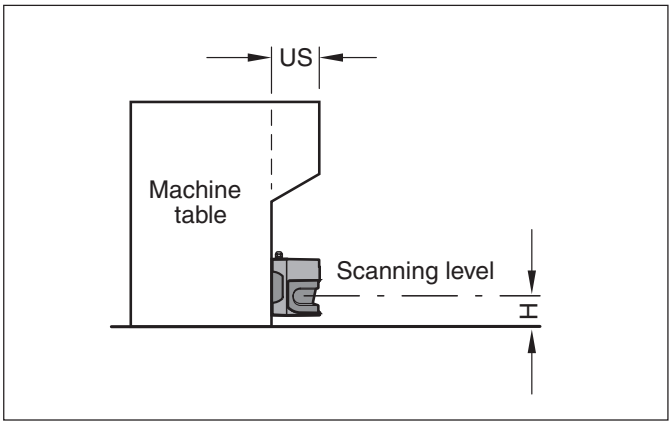
There are cases in which design measures must be applied to prevent persons from being in the hazardous area but outside the protective field (such as by crawling un-derneath it, stepping behind it or climbing over it).

To exclude this possibility where a laser scanner is mounted on the machine, one of the following measures (or a combination of them) is essential:
– undercutting,
– retraction of the laser scanner,
– mounting of the laser scanner opposite or to the side of the machine base.

Undercutting:

The undercut must always be at least as low as the dead zone. With regard to the mounting height the observations presented under “Location Planning” apply.

To prevent entry into the undercut, it is necessary to limit its height.



Undercutting

Retraction of the laser scanner:

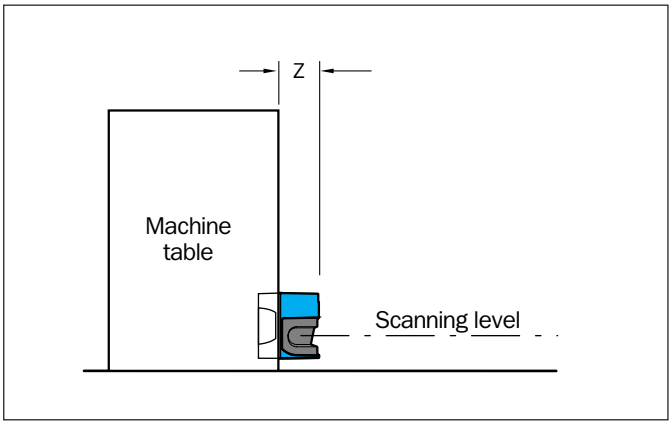
Retraction of the laser scanner into the machine contour presents an alternative to the undercut.

However, retracting the PLS too far will mean that the scanner is unable to monitor the full 180°. In such cases you need to design the shadow sides to he inaccessible (point-of-operation guard).

If you need to monitor the full 180°, for geometric reasons the retraction depth of the scanner must be limited to a maximum of 69.5 mm (corresponding to a protrusion of the PLS beyond the front of the machine of at least 86.5 mm).

The observations regarding the detection reliability of the PLS and the stipulations of EN 999 result in the following correlation between the minimum height of the scanning plane on the scanner HS_{min} and the protrusion Z from the front of the machine.

$H_{Smin} = 15 \times (Z - 90)$
where: $H_S \leq 1000mm$, $86.5\ mm \leq Z \leq 156\ mm$



Scanner retraction

Note:
Before the scanner is mounted it is essential that the height of the scanning plane H_S should be translated into the attachment height H_A !
The necessary dimensions of the scanning plane in relation to the fixed holes for the scanner are shown in the dimensional drawings in the section headed “Mounting the PLS”.

The minimum mounting height is based on the retraction depth. The deeper you can retract the PLS, the lower you can mount it. Take into consideration the possible shadowing of the marginal areas when retracting the scanner. With regard to the resolution of the PLS and the danger of crawling underneath the scanning plane, the points made under “Location planning” apply.

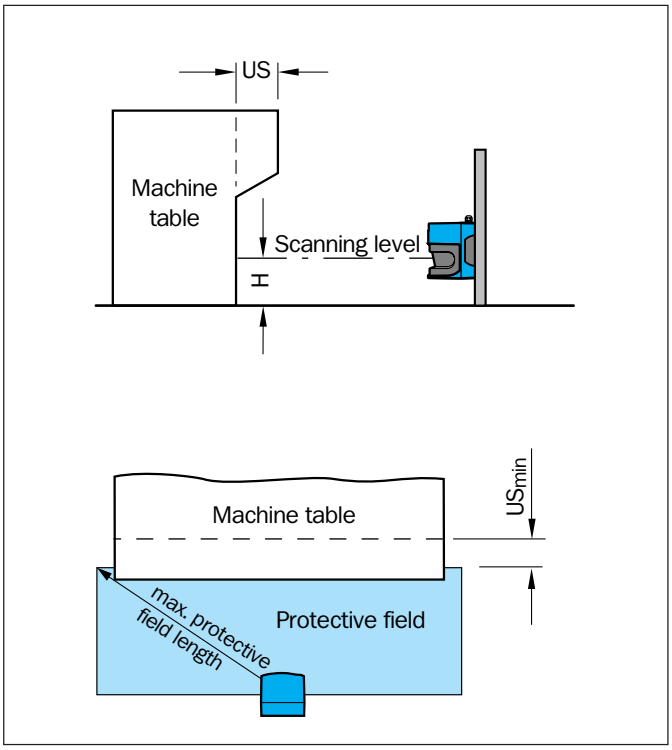
Mounting of the laser scanner opposite or to the side of the machine base:

If the PLS is in the way when installed on the machine base, it can alternatively be mounted opposite. For this, because of the measuring tolerances of the PLS, it is essential that an undercut be made in the machine base.

The necessary minimum undercut US_{min} on the machine is calculated on the basis of

$US_{min} = (2 \times SF_{distance}) - d = (2 \times \text{max. measuring error}) - d$

The maximum measuring error is dependent on the size of the maximum protective field length, and at up to 2 metres the maximum measuring distance is 94 cm; at over 2 metres the maximum measuring distance is 131 mm. The resolution at this measuring distance is given in the diagram. For application of this formula, the distance between the protective field limit and the machine must not be greater than the maximum measuring error. If the protective field limit is further away from the machine, US_{min} is increased accordingly.



Mounting of a scanner opposite or to the side of the machine base

Read-off example:

In your protective field you determine the maximum protec-tive field length as 3500 mm. From the diagram you read off a resolution d_{max} of 60 mm.

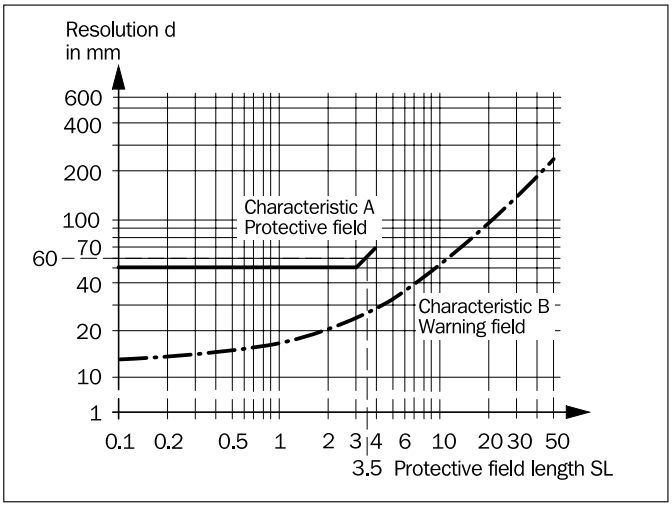


Diagram: Protective field length and calculation

5.2 Mobile protection with PLS

In mobile protection the sensor can be operated both with and without restart inhibit, depending on the application. The regulations applicable to the vehicle must be observed.

In “with restart inhibit” mode the actuating element for the restart inhibit must be positioned so that there is full visibility of the hazardous area. The actuating element for the restart inhibit must not be accessible from the point directly in front of the sensor.

In “with restart inhibit” mode the close-up zone[1)] of the sensor (4 cm wide area measured from the front screen outer area) is either to be rendered inaccessible (e.g. by a bar or undercut) or a proximity scanner with a 4 cm detection range is to be mounted over the sensor.

For mobile protection, side access to the vehicle is also to be taken into account when configuring the protective field. This assumes that a person approaches the vehicle from the side, for instance in concealed areas (e.g. crossways). If side access is possible (no solid restrictions such as a wall), the protective field should be configured wider than the vehicle.

In mobile protection applications it must be ensured that, with protective field widths over 2 metres, there are no retroreflectors in the immediate proximity of the protective field on the scanning plane. Otherwise corruption of the measured values is to be expected under extreme conditions. If it is impossible to avoid having retroreflectors in the scanning plane, an extra 10 cm should be added to the maximum measuring error[2)]. The maximum measuring area is

- 94 mm for protective fields ≤ 2 m
- 131 mm for protective fields > 2 m

Where there are fixed restrictions (walls) there must be no retroreflectors in the scanning plane, as otherwise someone could move along the edge of the protective field to bypass it.

For both graphic and numerical programming, it must be ensured for reasons of functionality (solid barriers should not lead to unintentional shutdown) that where fixed contours exist a distance of 94 mm for protective fields below 2 metres and 131 mm for protective fields over 2 metres is observed.

Where the teach-in function is used, a 45 mm supplement on top of the maximum measuring error is required for the accuracy of the learned contour.

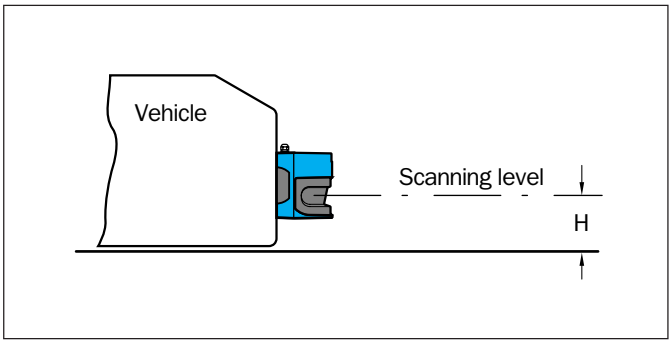
Recommendation:
When installing mobile plants, you are advised to attach a notice or a configuration diagram to the vehicle to simplify the regular checks.

1) An optical radar cannot distinguish between a dirty front screen and an obstacle directly in front of the sensor. For the sake of functionality, the PLS was designed to reliably detect solid black objects such as black cord or black shoe leather only at a distance of 4 cm measured from the outer contour of the front screen.

2) Accuracy of the sensor in safety applications: the sensor determines the distance of an obstacle from the flight time of a very short light pulse. To attain optimum accuracy against obstacles of solid black material (1.8% reflectance) up to precision triple reflectors (10,000% reflectance), the PLS compensates the received signal. If there is a dark object in front of a retroreflector, under certain circumstances (see above) the error distance of 20 cm may be too large. This would mean that a person could intrude 20 cm into the monitored area without being detected by the PLS.
This measuring error occurs only when the following conditions simultaneously apply:
   – the distance to the target is greater than 2 metres,
   – the target is smaller than 140 mm,
   – the retroreflector is on the scanning plane,
   – the reflector is aligned perpendicular to the sensor within an angle of ± 30°,
   – the target reflectance is in the area of 1.8%,
   – the retroreflector is not more than 2 metres behind the target, and
   – the reflector has high reflectance.

Location planning

The following observations take into account only the vehicle speed, not the speed of a running person. The reason is that it is assumed that a person approaching the vehicle recognises the danger and at least stands still.



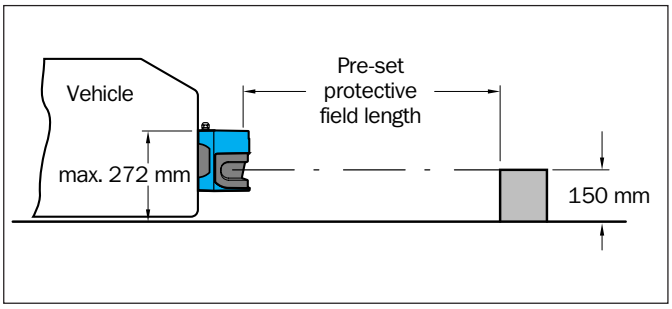
Mounting of a PLS on a vehicle

Mounting height:

Due to the intrinsic movement of the scanner in the mobile application, a resolution of 70 mm is adequate for detection of persons in mobile applications (stationary application: 50 mm). For this reason, the mobile application requires no increase protective field ranges over 2.90 m.

The sensor is to be calibrated in accordance with EN 1525 such that a body of maximum 200 mm height under all circumstances is detected in the protective field range necessary to bring the vehicle to a safe stop. (Recommendation: setting to 150 mm height).

The scanning plane should not be below 100 mm, as the increased dust concentration on the floor could cause the scanner to shut off unintentionally.



Mounting height

Mounting mode:

A basic distinction is made between two modes of mounting the PLS:

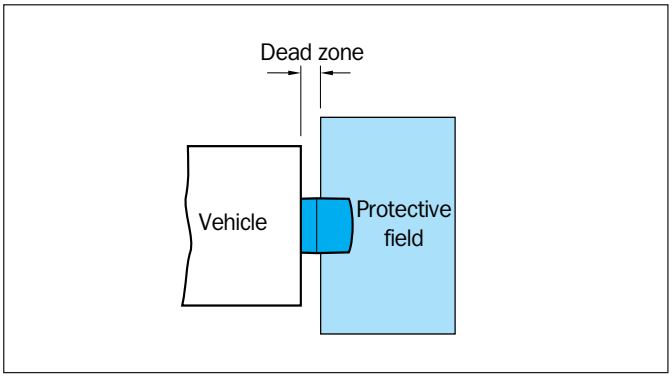
Protruding front mounting

The dead zones created at the sides of the sensor in protruding front mounting must be eliminated by mechanical trim covers or switch strips, or the vehicle must not be accelerated to speeds above 0.3 m/s in less than three seconds.

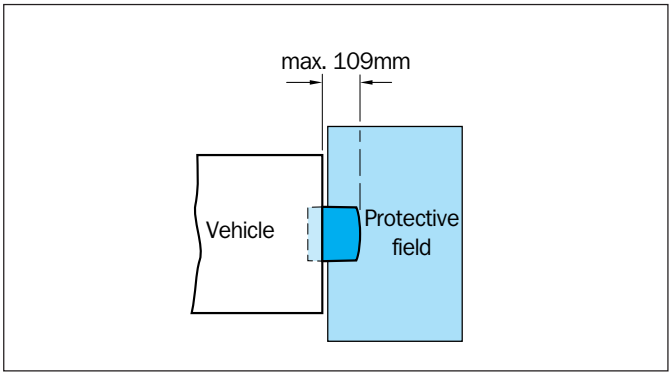
Integral in-vehicle trim panel:

The sensor is installed such that no dead zones, or no dead zones > 70 mm, are created to the side of it. The vehicle may then be accelerated to a speed of 0.3 m/s within one second. In order to meet this condition, the PLS must not protrude more than 109 mm over the front edge of the vehicle.

If the close-up zone of the sensor (4 cm wide area measured from the front screen outer contour) is either rendered inaccessible (e.g. by a bar or undercut) or is monitored by a proximity scanner or a switch strip with a 4 cm detection range, the vehicle may be accelerated at will.



Mounting mode: protruding front mounting



Mounting mode: integral in vehicle trim panel

Calculation of the necessary protective field

When configuring the protective field for vehicle applications, in addition to the actual stopping distance of the vehicle the following supplements must also be taken into account:

For the protective field length SL:

$SL = S_A + Z_M + Z_R + Z_E + Z_F + Z_B$

where: S_A is the stopping distance of the vehicle

Z_M is the supplement for the general measuring error of the vehicle;

Z_R is the supplement for any reflection-related measuring error of the PLS;

Z_E is the supplement for the measuring error of the PLS resulting from teach-in (see Important notes on configuration for mobile protection);

Z_F is the supplement for a lack of ground clearance of the vehicle;

Z_B is the supplement for the decreasing brake force of the vehicle.

The stopping distance S_A is composed of the actual braking distance of the vehicle from maximum speed and the maximum load S_{Br}, as well as its distance covered during the response time of the sensor S_{Ans}.

$S_A = S_{Br} + S_{Ans}$

where S_A is given in the specification of the vehicle manufacturer,

and $S_{Ans} = T_{Ans} \times V_{max}$.

The response time of the sensor T_{Ans} set when the PLS is shipped is 80 ms.

The supplement Z_M results from the maximum measuring distance of the PLS. For measuring distances up to 2 metres the maximum measuring error is 9.4 cm; for measuring distances above 2 metres the error is 13.1 cm. The maximum protective field length SL_{max} results from the maximum distance of the edge of the protective field from the centre of the PLS (see Important notes on configuration for mobile protection).

The supplement Z_R is necessary when there are objects with retroreflective properties on the scanning plane. If the presence of retroreflectors cannot be excluded, for protective field lengths above 250 cm a supplement of 10 cm is required (see important notes on configuration for mobile protection).

The supplement Z_E is necessary when you define the protective field using the teach-in method. This supplement takes account of the accuracy in registering the ambient contour. This supplement is independent of background conditions, and needs to be set at a constant 45 mm.

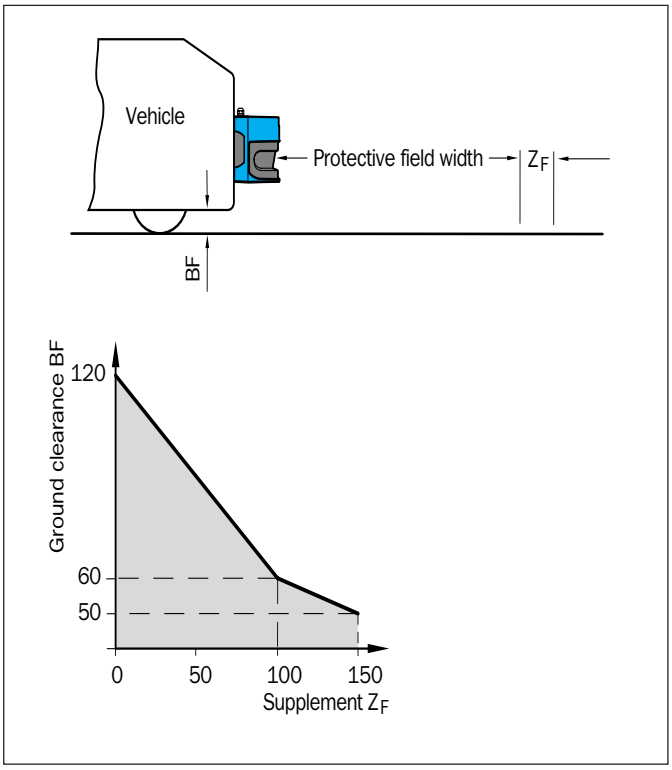
The supplement Z_F is necessary because people are generally detected above foot level, and so the braking action is unable to take account of the length of the foot in front of the point of detection. A person could therefore suffer injuries to the foot as a result of a lack of ground clearance.

The adjacent diagram shows the necessary extension of the protective field based an the supplement necessary for the lack of ground clearance of a vehicle.

The supplement for the declining braking force of the vehicle must be set at 10% of the stopping distance, unless already taken into account in the stopping distance.

The protective field width S_B also requires a supplement. Here the supplement Z_M for the general measuring error of the PLS is applied (as necessary Z_R and Z_E)

As Z_M for the protective field width – like Z_M for the protective field length - results from the maximum protective field length SL_{max}, those supplements are always identical.



Supplement on protective field A resulting from lack of ground clearance

Configuration examples

Notes:
In the user software always enter whole values in centimetres. For this, the results of all calculations must be rounded up to the next centimetre.

The stopping distance s is the stopping distance required by the vehicle (including the sensor response time) from maximum speed.

Calculation example 1 (scan rate set as default):

Stopping distance: 180 cm (brake wear taken into account)
Vehicle width: 140 cm (PLS centrally positioned)
Foot clearance: > 12 cm

max. measuring distance = $\sqrt{180^2 + 70^2} = 193.1$ cm

Z_L =	9.4 cm	PLS measuring error (max. measuring distance > 2 m)
+	0 cm	for foot clearance (foot clearance < 12 cm)
+	0 cm	for brake wear (already taken into account in stopping distance)
	= 9.4 cm	

The protective field length to be calculated is 190 cm.

Z_B =	9.4 cm	Measuring error
	= 9.4 cm	

The protective field length to be configured is 124 cm (on both sides of the PLS).

Calculation example 2 (scan rate set as default):

Stopping distance: 300 cm (without brake wear)
Vehicle width: 200 cm (PLS centrally positioned)
Foot clearance: < 5 cm
In some circumstances retroreflectors may be present on the scanning plane

max. measuring distance = $\sqrt{.300^2 + 100^2} = 316.2$ cm

Z_L =	13.1 cm	PLS measuring error (max. measuring distance > 2 m)
+	15.0 cm	for foot clearance (foot clearance < 5 cm)
+	30.0 cm	for brake wear
+	10.0 cm	for possible retroreflectors on the scanning level
	= 68.1 cm	

The protective field length to be calculated is 369 cm.

Z_B =	13.1 cm	PLS measuring error
+	10.0 cm	reflection measuring error
	= 23.1 cm	

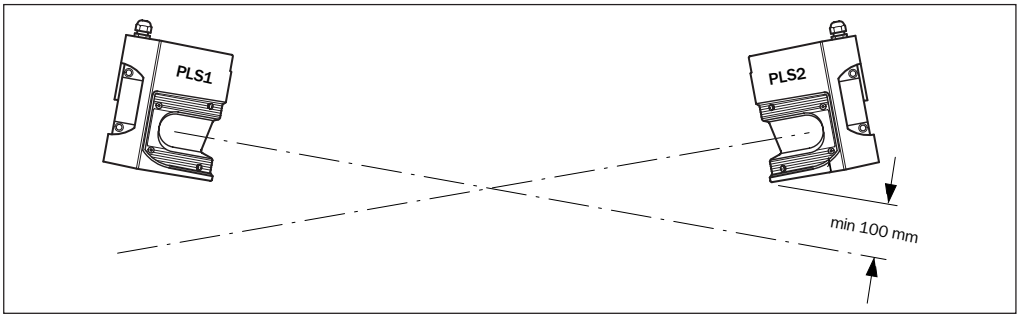
The protective field length to be configured is 124 cm (on both sides of the PLS).

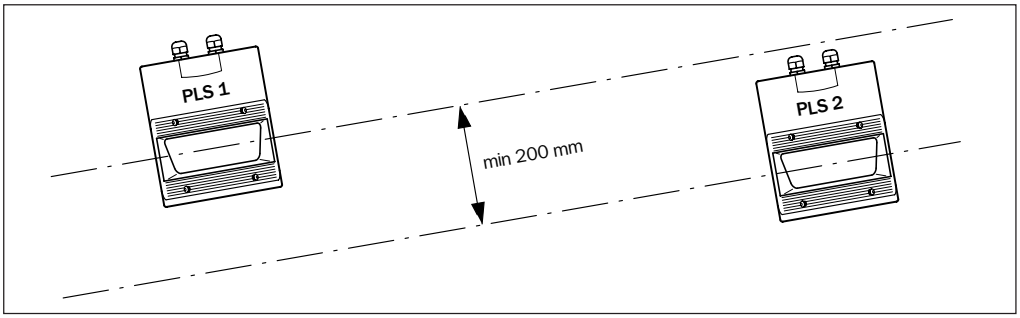
5.3 If you use several PLS units

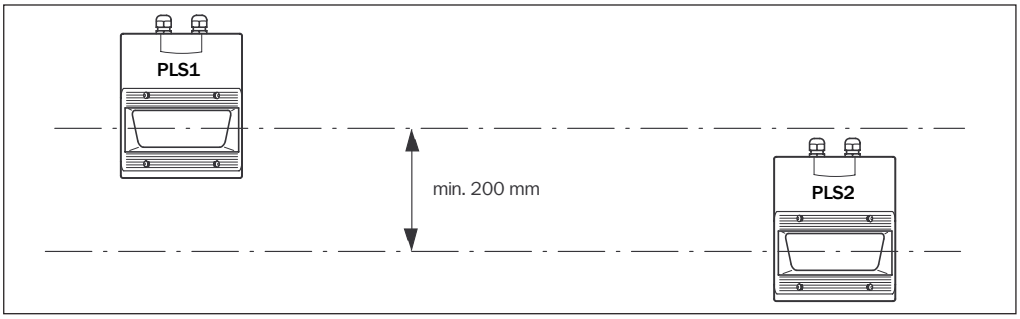
The PLS is designed so that mutual interference by sensors where more than one is deployed is highly unlikely.
To be absolutely sure to of avoiding error shutdowns, you should mount the sensors offset to one another.

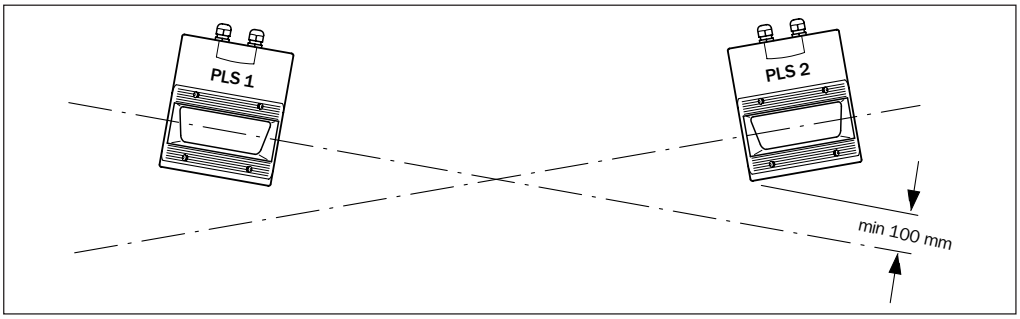
In any event, be sure to observe the stipulations of EN 999.

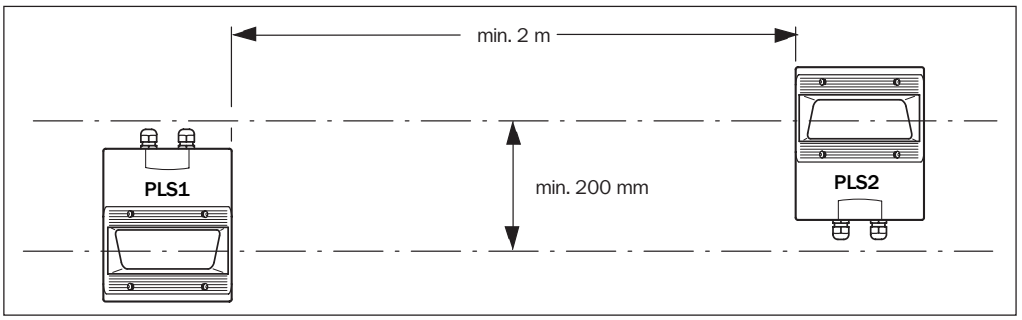
There are three different mounting kits which enable you to align the sensors at various angles.
You can find diagrams illustrating all the mounting kits together with more detailed information in the chapter headed “Mounting the PLS”.











6 Supply Package

You receive:
– one PLS sensor
– one connection set (one connection box each for power supply and interface)
– the PLS user software (on three 3.5" floppy discs)
– the operating instructions manual
– this technical description manual

Recommended accessories

At this point we can only give you a few pointers to the major accessories. You can find a complete list in the Appendix.

Connection set

You will normally receive connection set 1. It contains one connection box each for the power supply and the interface, without cables.

If you wish, instead of connection set 1 you can order one of the connection sets 2 to 7, which include a cable fitted to the power connector. The cable is routed upward out of the connection box.
Various cable lengths are available:

	Order no.
Connection set 1, without cable	2 016 184
Connection set 2, with 3 m cable	2 016 185
Connection set 3, with 5 m cable	2 016 186
Connection set 4, with 10 m cable	2 016 187
Connection set 5, with 15 m cable	2 016 188
Connection set 6, with 20 m cable	2 016 189
Connection set 7, with 30 m cable	2 016 190

Interface cable

To connect the sensor to a PC you can use the interface cable. It is available in three lengths.

For RS 232:

	Order no.
3 m interface cable	2 016 401
5 m interface cable	2 016 402
10 m interface cable	2 016 403

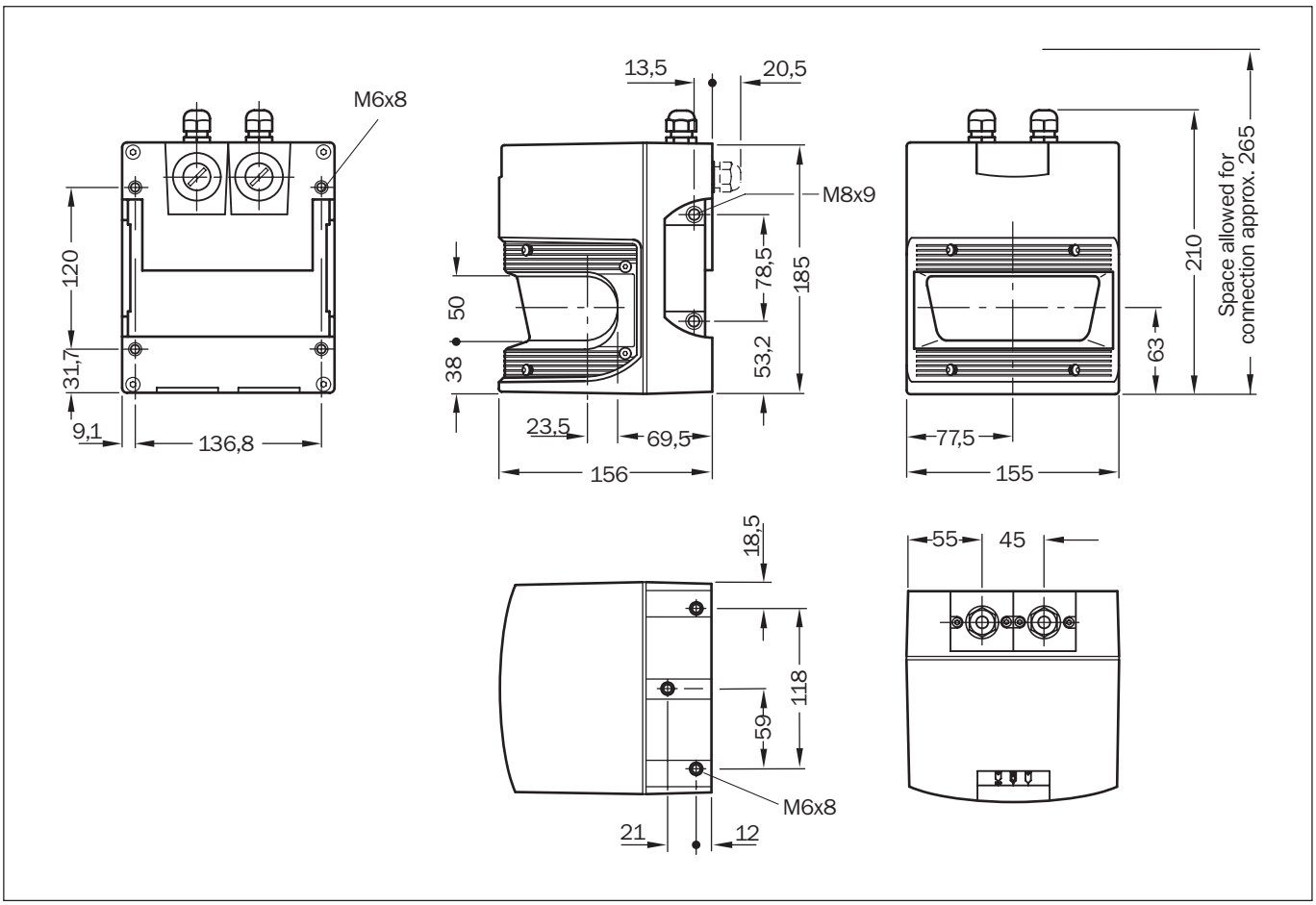
For RS 422:

	Order no.
3 m interface cable	2 019 130
5 m interface cable	2 019 131
10 m interface cable	2 019 132

7 Mounting the PLS

You can mount the PLS without auxiliary fittings directly on a wall or on the floor. Threaded holes are provided for this on the bottom and on the back of the PLS.

Note:
Mount the PLS so it is protected against damp, dirt and damage. Ensure that the area visible to the entire front screen is not restricted by refitting measures.
Also avoid excessive shock and vibration impact on the scanner. Please observe the relevant specifications set out in the Appendix under “Technical Data”.



(All dimensions in mm)

There are three mounting kits which allow the PLS to be fine-adjusted and then securely fixed in position.

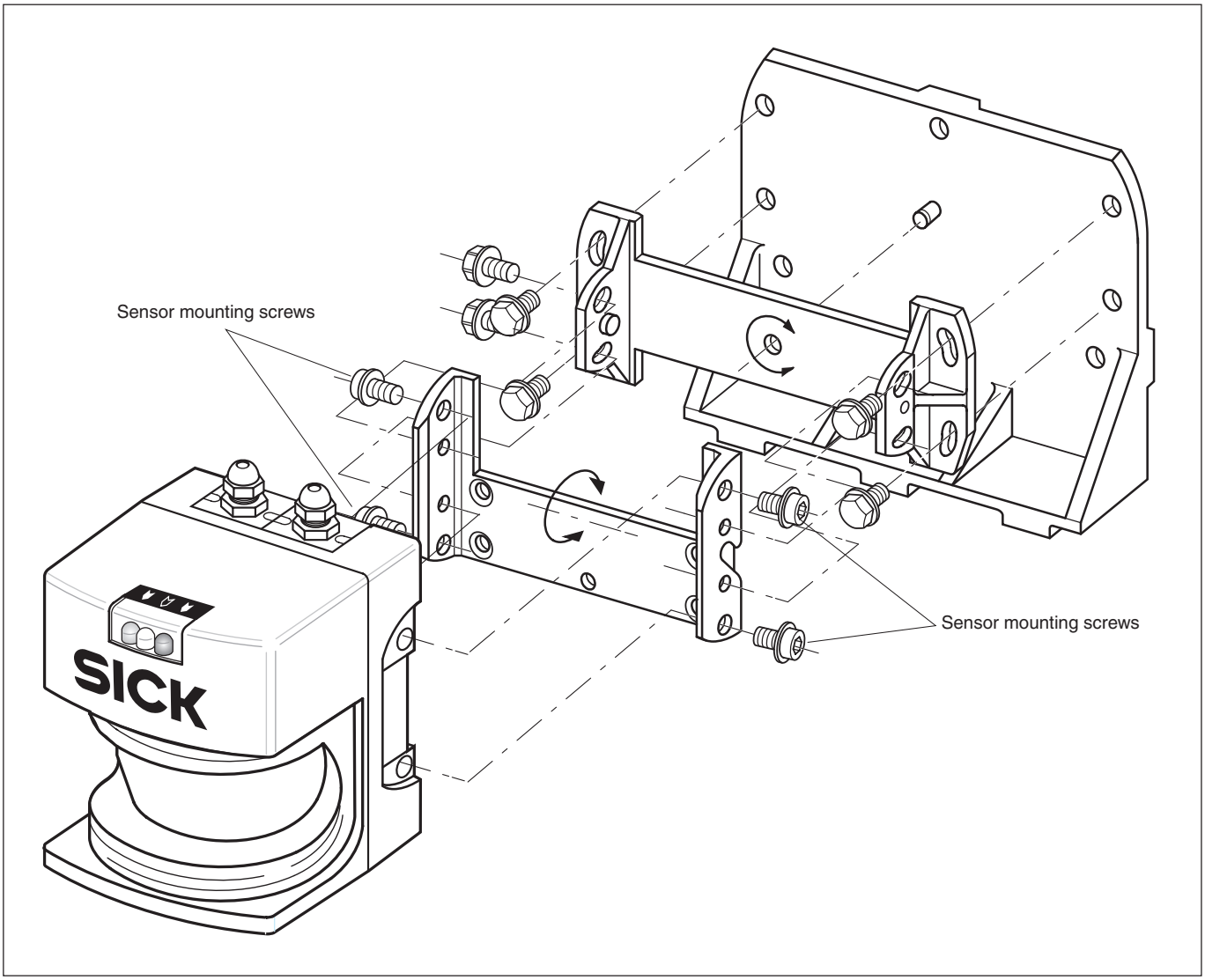
Mounting kit 1 is attached directly to the back of the PLS, and is for wall mounting. The contact areas on the PLS and an mounting kit 1 are so precise that you can replace the PLS at any time without realigning if this becomes necessary.

Mounting kit 2 is attached as an add-on to mounting kit 1, and permits fine adjustment of the PLS in two planes (see arrows in the illustration). The medium adjustment angle is ± 11°.

Mounting kit 3 (only in conjunction with mounting kits 1 and 2) can be used either for stable floor mounting of the PLS or, on uneven wall surfaces, ensures that the transverse axis on mounting kit 2 remains precisely adjustable. The maximum adjustment angle is ± 3.3°.

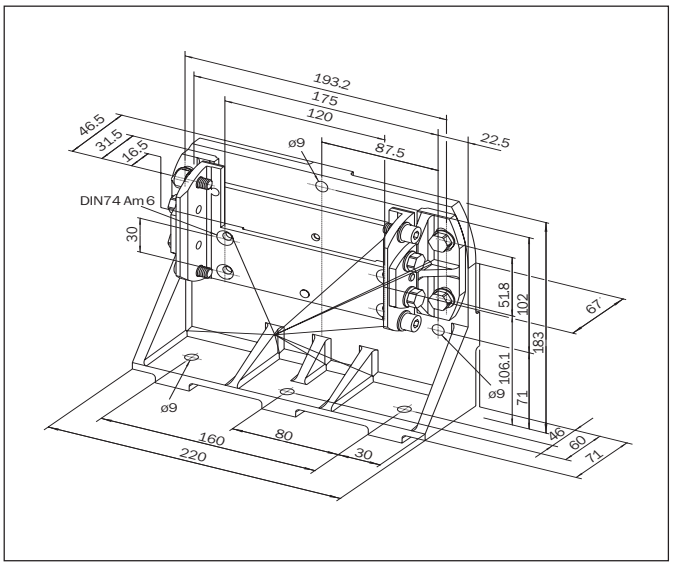
Dimensional drawings for all mounting kits are set out on the next page.

Note:
Where systems are subject to heavy vibration, you should prevent the adjusting and fixing screws from working loose by using suitable locking mechanisms, and regularly check that the screws are tight.

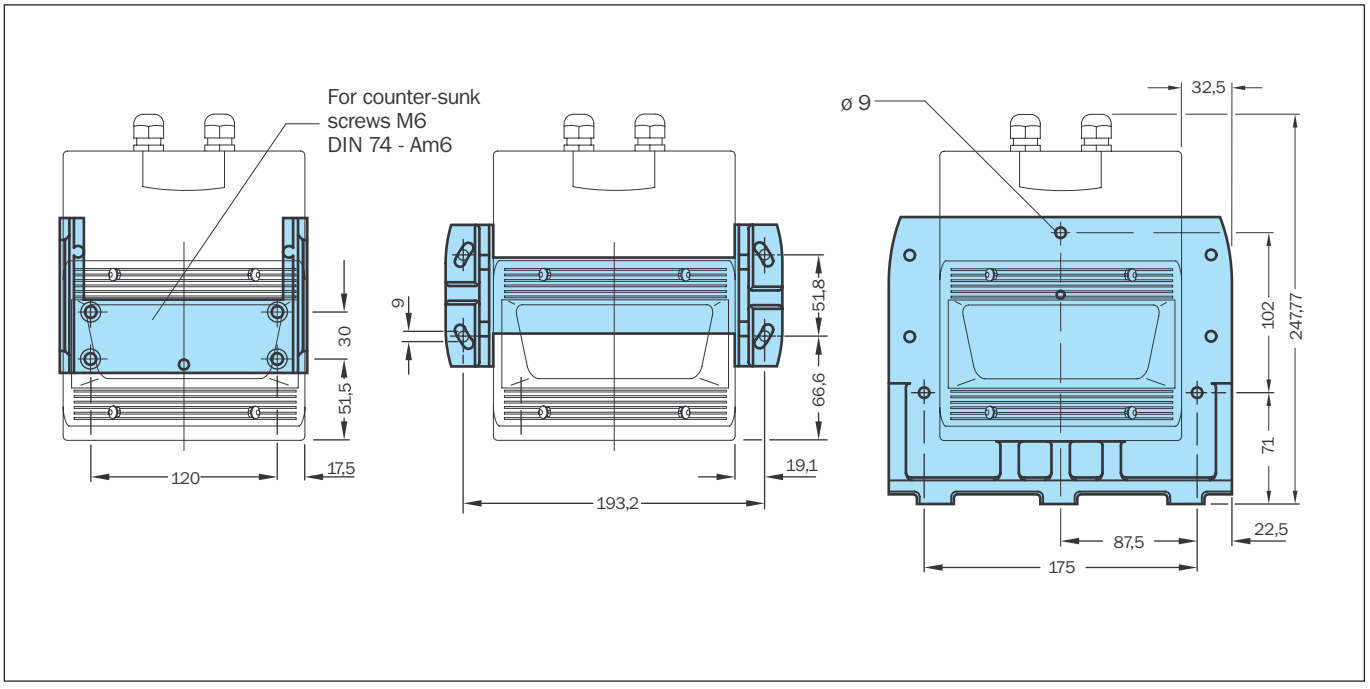


Notes:
The scanning plane is 63 mm above the bottom edge.

When a PLS is mounted using mounting kits 1, 2 and 3, the scanning plane (with horizontal alignment) is 102.5 mm above the bottom edge of mounting kit 3.



(All dimensions in mm)



(All dimensions in mm)

8 Connecting up the PLS

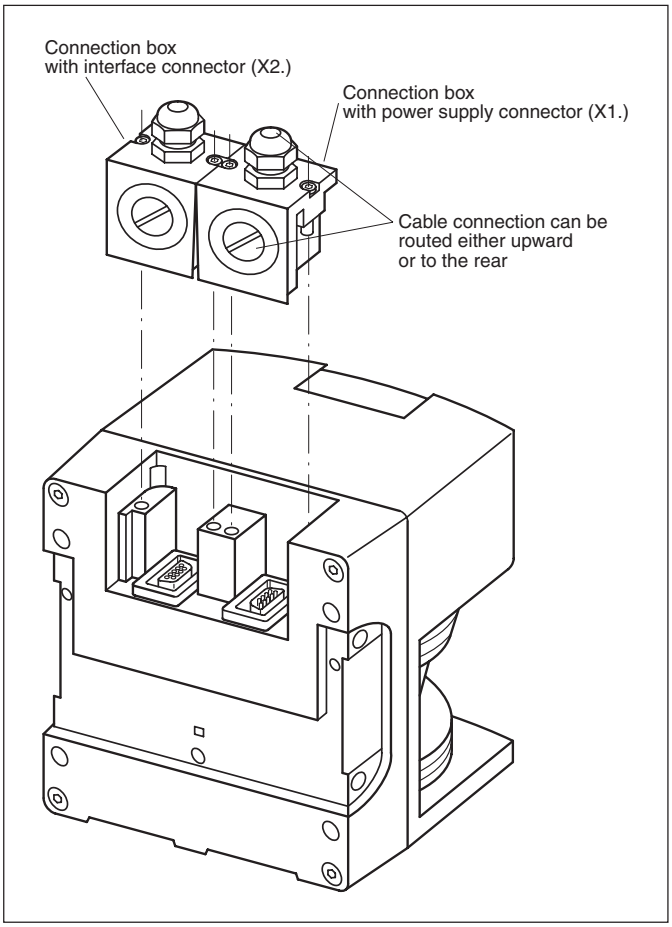
The PLS is supplied with two plug-in connection boxes for the power supply and interface. The electrical contact in each case is made by a 9-pin sub-D connector screwed into the connection box.

Only when both connection boxes, with their seals under them, are inserted flush with the housing and fixed with the side fixing screws does the PLS conform to protection class IP65. If the interface is not used, the connection box fitted with dummy plugs must be used.

You can order pre-assembled connection sets in which the power connector is fitted with an upward-routed cable. You can find more details about the available connection sets in the Appendix under “Accessories”.
If you assemble the connection yourself, you can choose whether the connecting cable is routed out of the connector housing upward or to the rear. The unused threaded hole in either case must be plugged with a dummy plug.

Notes:
Lay all wires and connecting cables so that they are protected against damage.
If you are using the PLS to protect hazardous areas: make sure that the connected controller and all other devices also have the necessary safety level.
Make sure the connection boxes for the power supply and the interface are not mixed up when assembling the cable sets.
Do not drop the connection boxes with the connectors. The sub-D connector could be pushed into the housing as a result.

- Check that the seals sit firmly on the connection boxes.
- Insert the connectors right-side up into the receptacles in the PLS housing. Push the connectors lightly into the PLS housing. You will know that a proper connection has been made if the connectors terminate flush on the housing.
- Only then should you secure the connection boxes with the hexagon socket screws on the sides.



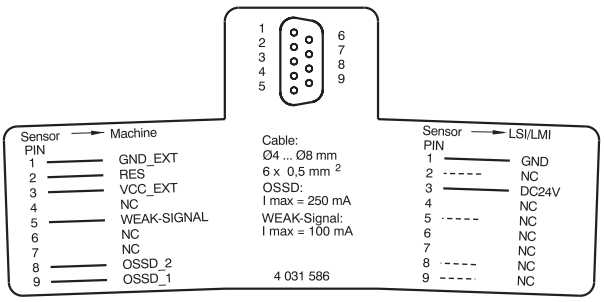
Connecting up the PLS

Connecting the power connector

The PLS requires a DC voltage of 24 V for its power supply. You can find more information about this in the Appendix under “Technical Data”.

The power connector must have the following terminals:
- VCC_EXT and GND_EXT: a 24 V DC power pack to deliver the power
- RESTART: The restart button to release the PLS after a protective field infringement
- OSSD1 and OSSD2: the two protective semiconductor outputs which safely activate when the protective field is infringed
- WEAK SIGNAL: An additional output which activates optionally in case of dirt contamination of the front screen or infringement of the warning field, or both. If the PLS detects an error in its routine self-test, the output activates 4 times per second (see Chapter 10: “LEDs on the PLS”)

Note:
Each safety output (OSSD) may only be connected to one switching element. If more than one switching element is required, a suitable contact multiplier must be provided.
If you connect loads such as lamps directly to the semiconductor outputs, you must pay attention to the following points:
- As a result of the initial resistance of a load (such as a lamp) the maximum possible current rating of the outputs must not be exceeded otherwise the outputs' current limiter will be activated.
- The loads must exhibit low-pass behaviour (fg < 500 Hz) so that the test pulses monitoring the output do not cause a shutdown.
- The maximum capacitive load is 100 nF. This must be observed particularly when using downstream safety modules.



Power connector for PLS type 101-312

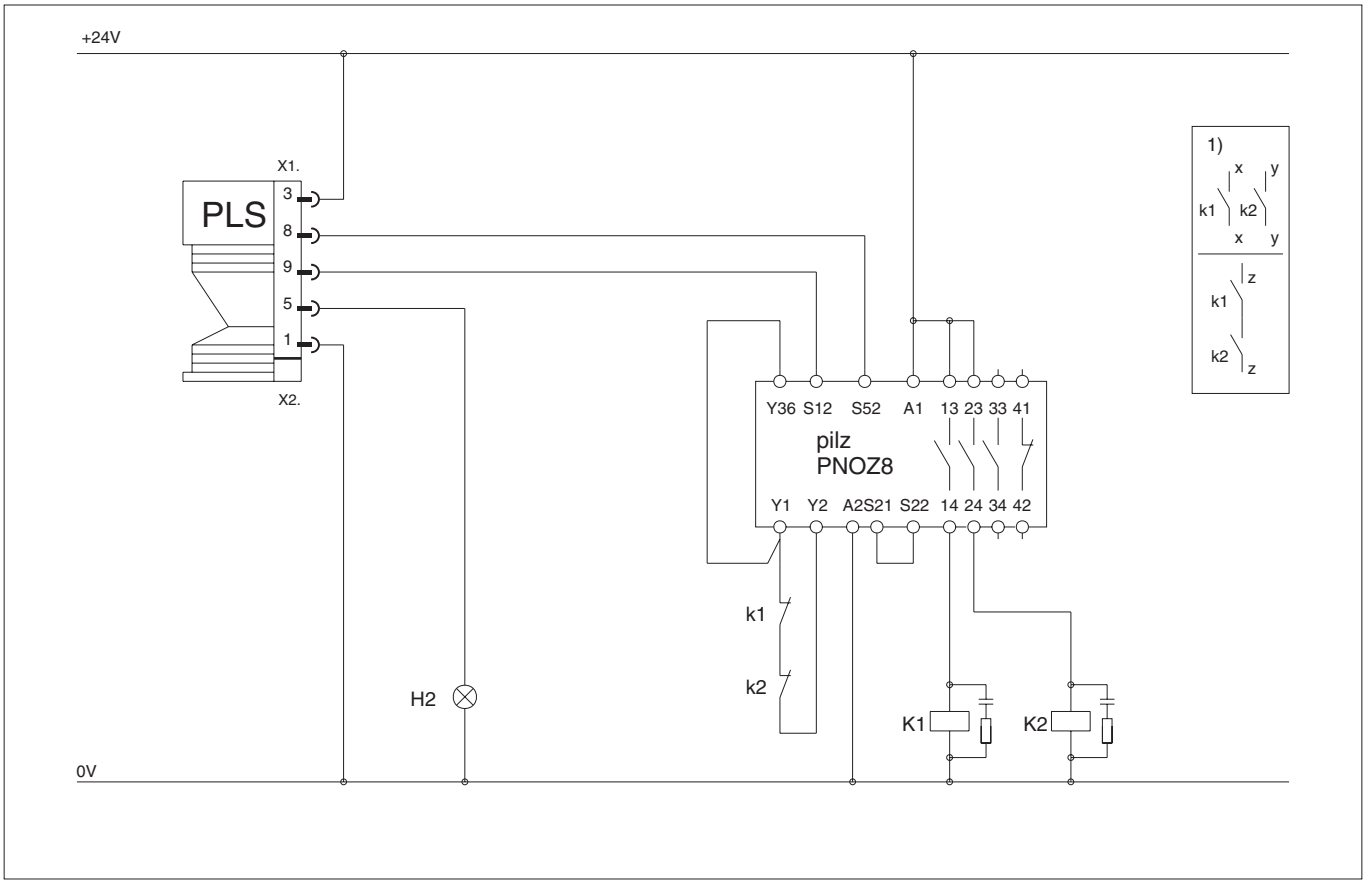
Pin no.	Signal designation	Wire colours
1	GND_EXT (ground)	brown
2	RESET/RESTART	blue
3	VOC_EXT (DC 24 V)	red
4	NC	–
5	WEAK-SIGNAL (contamination signal or warning field infringed)	grey
6	NC	–
7	NC	–
8	OSSD_2 (protective output 2)	turquoise
9	OSSD_1 (protective output 1)	orange

Power connector: wire colours

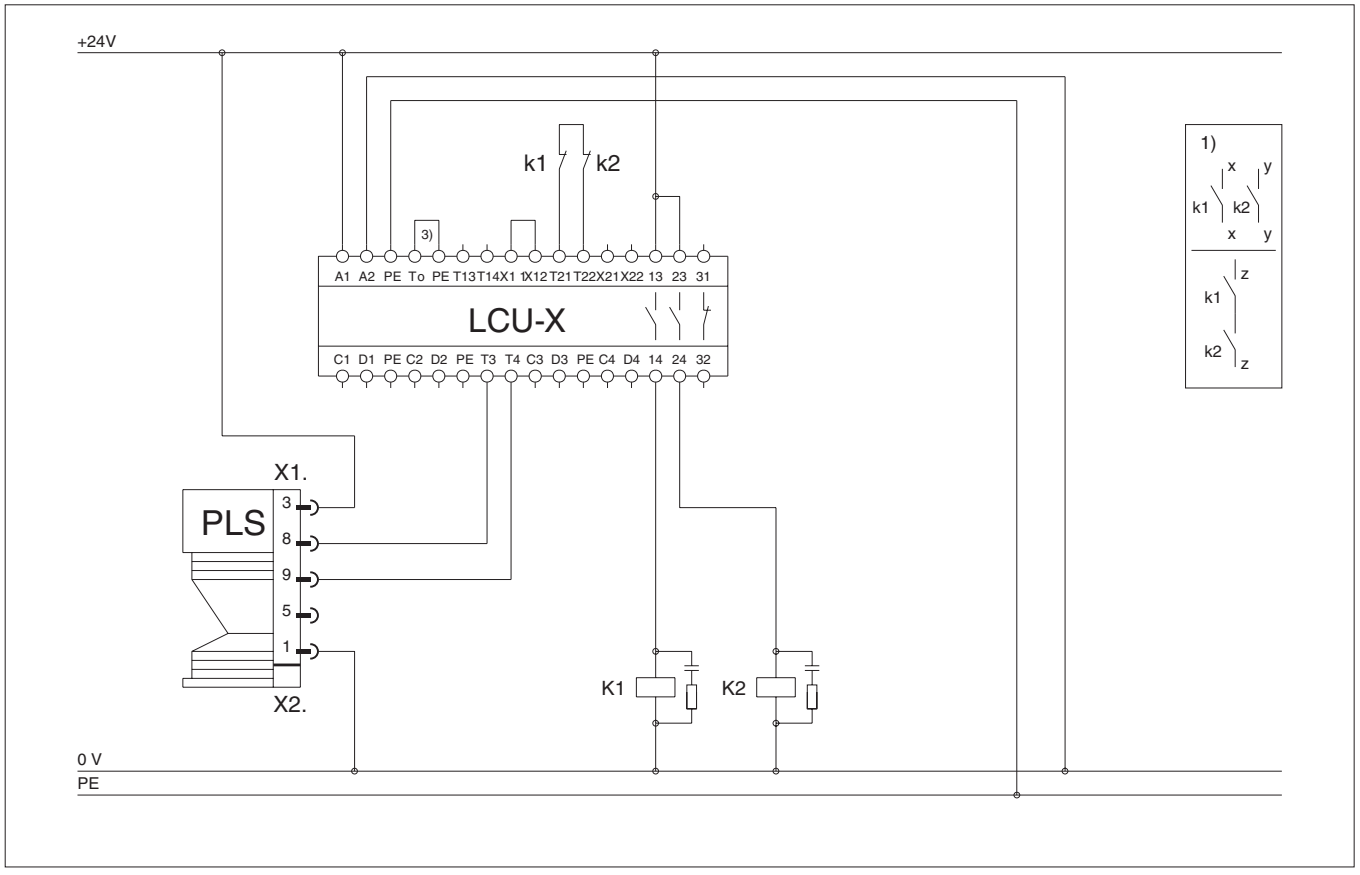
Connection examples

You need to connect the power connector pins differently depending on the application.

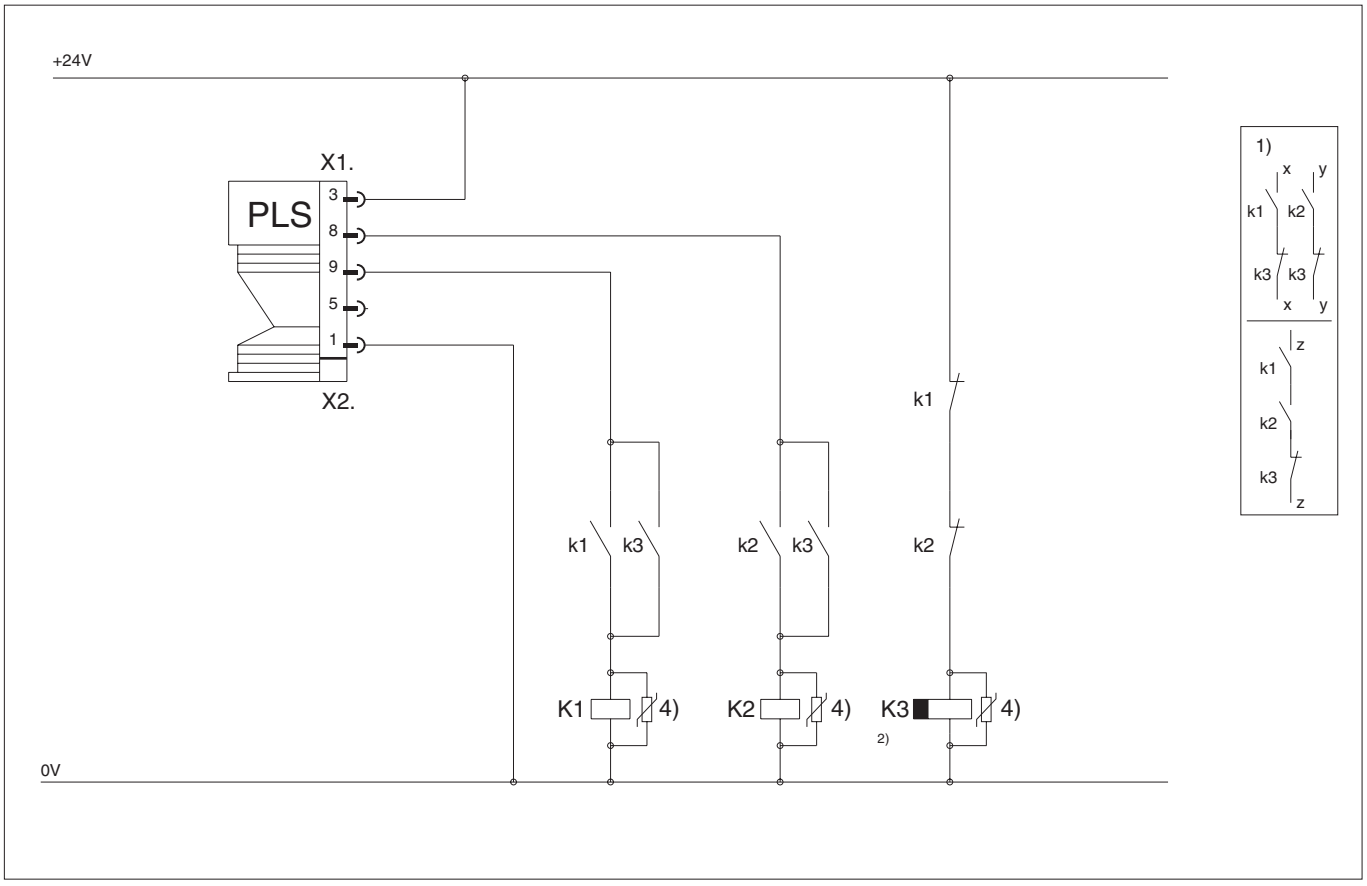
The following pages give examples of various applications.
If you want to use one or more PLS together with an LSI (Laser Scanner Interface), then the safety outputs (OSSD) of the PLS may not be used.



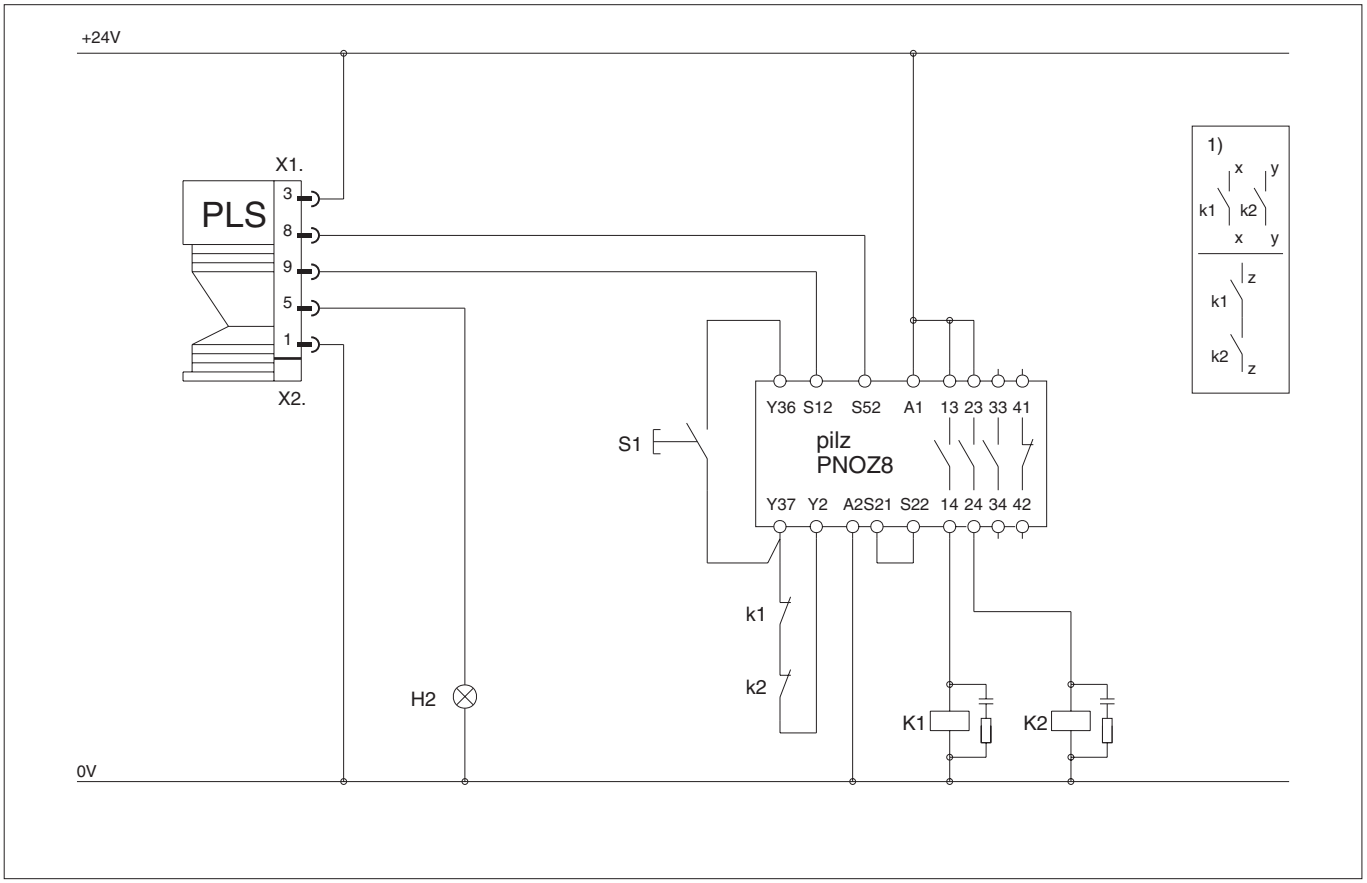
PNOZ 8 / Without restart inhibit, with contact monitoring



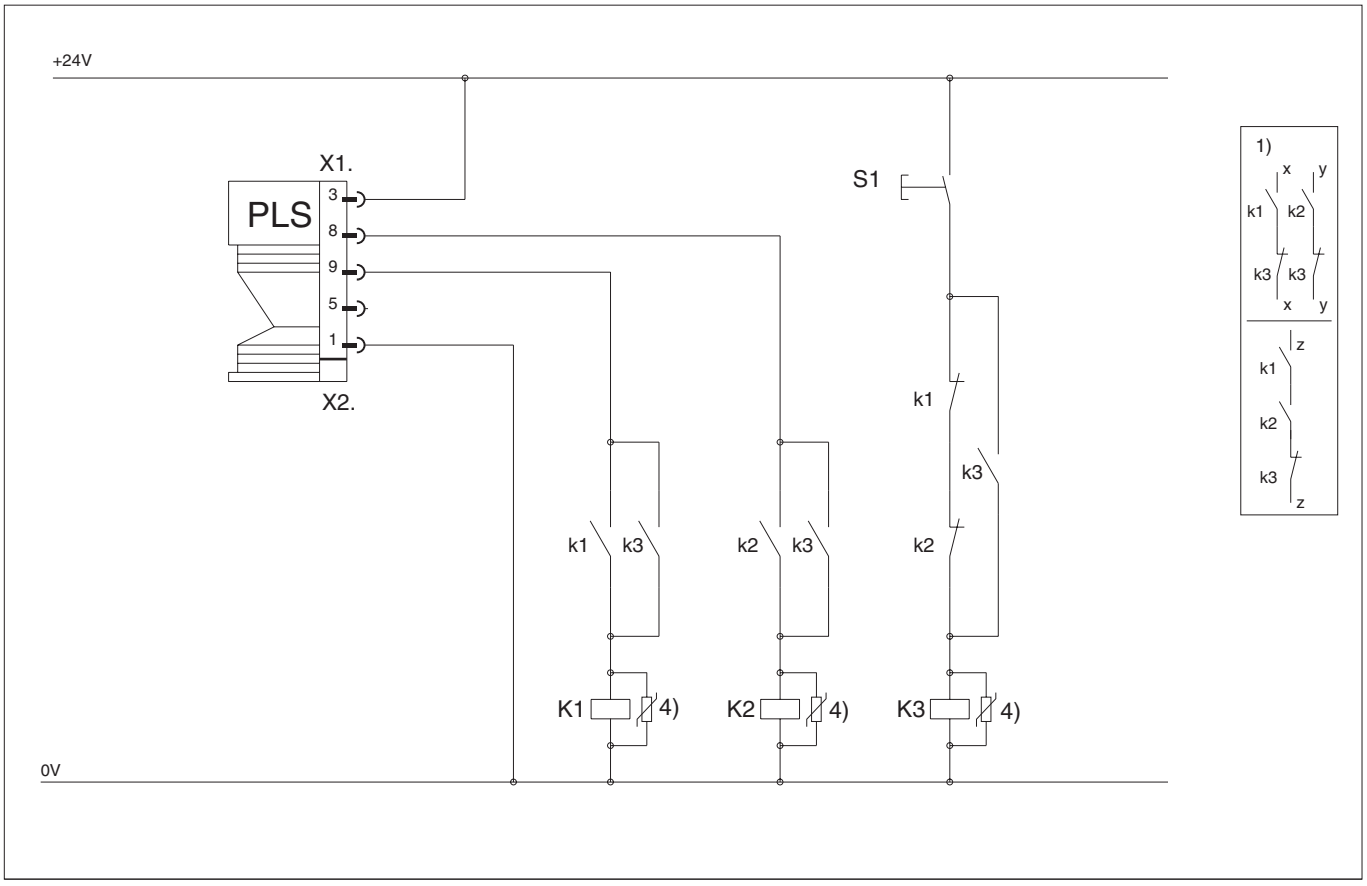
LCU-X / Protective operation without restart inhibit, with contact monitoring



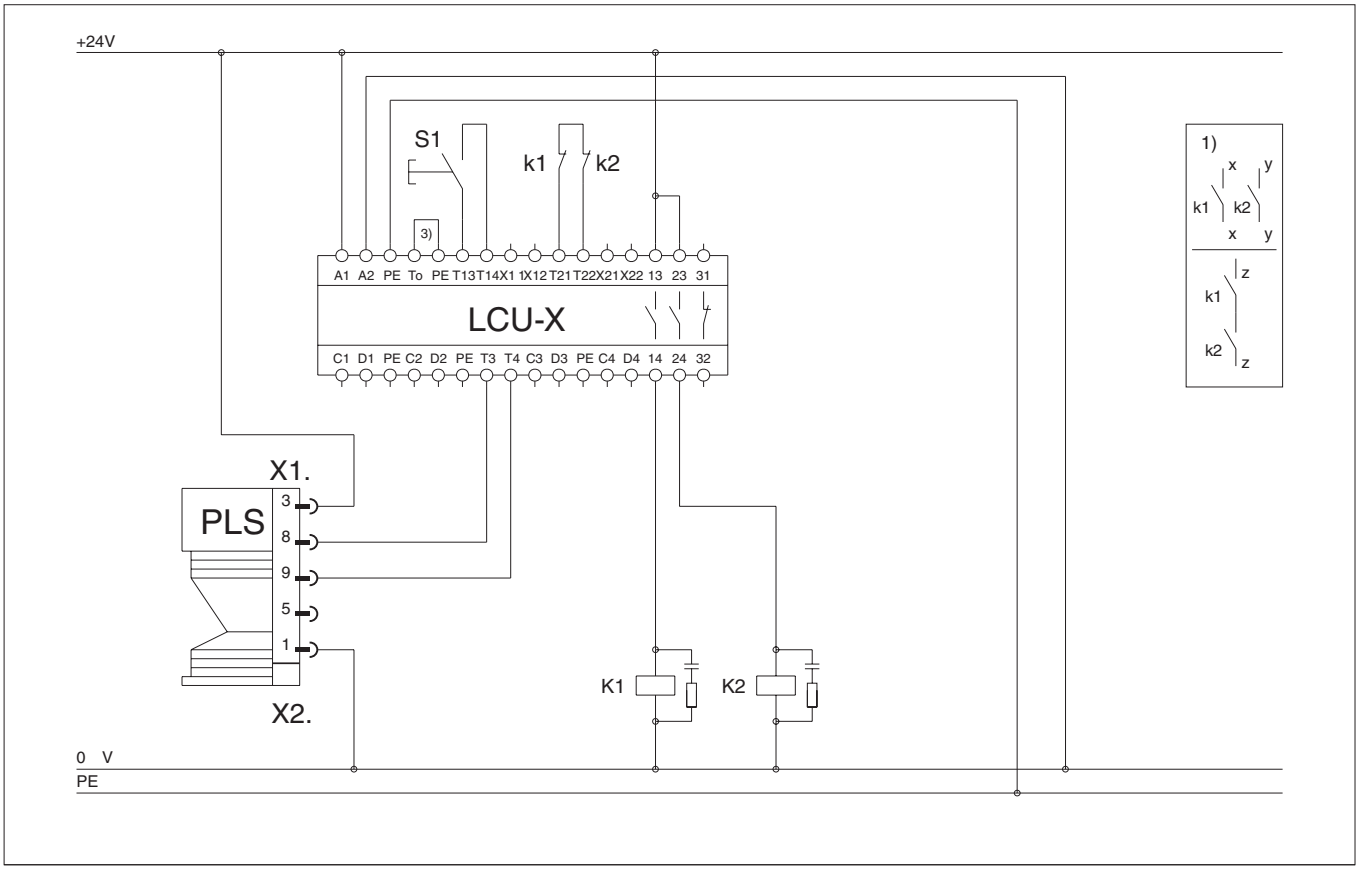
Evaluation of PLS protective outputs (OSSDs) by relay with positively-driven contacts, mode: without restart inhibit



PNOZ 8 / With restart inhibit and contact monitoring



Evaluation of PLS protective outputs (OSSDs) by relay with positively-driven contacts, mode: with restart inhibit



LCU-X/ Protective operation with restart inhibit and contact monitoring

Information about the connection examples

Note:
Use only relays with positively-driven relays. The FC elements switched in parallel with the contactors are for arc suppression.

1) Output circuits. These contacts are to be inserted into the control unit so that the hazardous state is eliminated when the output circuit is opened. In categories 3 and 4 in accordance with EN 954-1 this insertion must be in two channels (x, y paths). Single-channel insertion into the control path (z path) is only possible with single-channel control and taking account of the risk analysis.

2) To safeguard activation of K1 and K2 during the switchover phase, K3 should be executed with a release delay in accordance with the contactors used and the operating voltage.

   The control circuits must be provided with a selective over-current protection device (fuse).

3) The potential equalisation must be provided if the OV potential of the power supply unit is not connected with the protective conductor (PE) (VDE 0160).

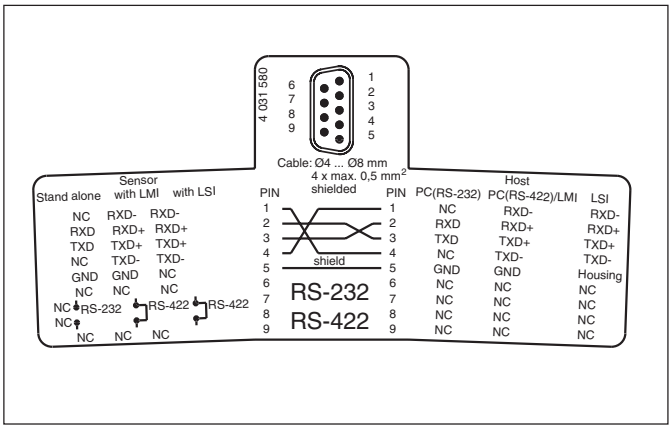
4) Voltage-dependent resistors for maximum operating AC voltage $V_{RMS} = 25$ V

Connecting the interface connector

PLS type PLS 101-312 has a universal interface. Unmodified, it operates as a RS 232 interface and so can be connected to standard computers without any problems.

Where long cable lengths (over 15 metres) or high data transfer rates are required, you can modify the interface into a RS 422 interface. There are two ways of doing this: either connect pins 7 and 8 with a jumper, or use the RS 422 interface cables, which already include the jumper (see Chapter “Accessories” in the Appendix).

When assembling the cables yourself, make sure that the cable shielding is attached.
Contacting the shielding at both ends is recommended if a RS 232 connection is being used.
When deploying an RS 232 connection, the shielding should only be connected to one end. The shielding should be applied to the computer (or LSI).



Interface connector for PLS type 101-312

Short-term connection to a PC

You normally only connect the PC to the sensor for programming purposes, for example when using the sensor to protect a hazardous area. All settings and fields remain stored in the sensor after the PLS is disconnected from the PC, until changed again by you. The sensor will not lose its data even in the event of a power failure.

To connect to the PC, use an interface cable (refer to the Appendix under “Accessories”).

Note:
If you want to connect a sensor to a computer by a RS 422 interface, you must use a suitable cable. Refer to the notes on switching interfaces on the previous page.

- Remove the connection box over the interface socket on the PLS.

Note:
When the connection box has been loosened, the PLS conforms only to protection class IP 40.

- Connect the sensor interface to the PC.
- Programme the PLS. For detailed information refer to the PSI/LSI user software description as from Chapter 9.
- Detach the interface cable from the PLS.
- Reconnect the connection box over the interface socket and screw it in tight.

Note:
The pin assignment of an RS 422 interface is not standardised. Compare the pin assignment of the connecting cable with the one an the PC and adapt it accordingly.

Permanent connection to an evaluation computer

If you want to continuously evaluate the measurement data of the PLS using the RS 422 interface (for example, because of the higher data transfer rate) you must connect the PLS permanently to an evaluation computer.

- Wire the 9-pin sub-D connector in the connection box with a suitable cable (RS 422 twisted pair).
  You can choose whether to route the cable out of the box upward or to the rear.

Note:
The cable outlet is PG 9 size, and is suitable for all cable diameters from 4 to 8 mm.

- Plug the connection box into the PLS and screw it in tight.
- Lay the cable permanently to the evaluation computer or to the vehicle’s on-board computer.

Note:
Lay all cables so that they are protected against damage.

9 Programming the PLS with the User Software

9.1 Installing the user software

Note:
This chapter describes how to programme a PLS proximity laser scanner.
If you want to deploy one or more PLS together with a SICK LSI (Laser Scanner Interface), refer instead to the technical description of the LSI, Chapter 9: “Programming the LSI with the User Software”.

The PLS/LSI user software as from version 3.61 can be used to programme PLS or PLS/LSI systems.

If you have older PLS/LSI user software installed on your PC which you want to continue using, specify a different programme directory/folder when installing the new PLS/LSI software.

System requirements

Please observe the respective hardware requirements of the operating systems listed here.

- min. 4 MB available hard disk capacity
- Windows 95™, Windows 98™ or Windows NT™ 4/SP4
- Windows™ 3.11 available upon request
  - min. 80486 processor
  - min. 4 MB main memory
- Colour monitor recommended
- Installed graphic printer driver

When installing your PLS/LSI user software you are guided by the installation pro-gramme. All you have to do is start the programme as follows:

- Boot your PC.
- Insert the PLS/LSI programme disk in the disk drive of your PC.
- **Under Windows™ 3.11:**
  Select the menu option **File – Run** in the File Manager
  Windows 95™, Windows 98™ or Windows NT™ 4/SP4:
  select Run in the Start menu.
- Select and run the programme “Install.exe”.
- If necessary, enter the programme directory/folder where you want the new PLS/LSI software to be installed.
- Follow the on-screen instructions.

After the installation is finished a message box appears to tell you that the setup has been completed successfully.

The PLS/LSI user software is now installed. You can run it at any time by clicking on its icon.

9.2 What to do

Note:
When the programme starts you are automatically logged on as the machine operator. As such, you can poll data but cannot transmit any.
To be able to transmit configuration data and monitoring areas to the PLS, you must log an as an “Authorised Client”. How to log on is described in Section 9.3.

In the status bar at the bottom of the screen you will see a colour code for the on-screen display of the protective and warning fields.

Essential steps

In creating a new configuration you are guided by the PLS/LSI user software. It guides you through the following steps:

- **Configure hardware:**
  You log the PLS on and define the restart inhibit mode of the protective outputs (OSSDs). You select the number of multiple evaluations and define whether you are using the sensor for area protection or for protection on a vehicle. You also define the switching behaviour of the “Weak Signal” output.
- **Define monitoring range:**
  You define the range to be monitored by the PLS. If you wish, you can also determine the shape and size of the protective and warning fields here.
- **Send configuration to PLS:**
  You now transmit all the configuration settings you have made to the PLS. You must be logged on as an “Authorised Client” to be able to do this.
- **Edit monitoring range:**
  Here, if you wish, you have the chance to alter the shape and size of the protective and warning fields.
- **Send monitoring range to PLS:**
  Finally you transmit the protective and warning fields to the PLS. For this too, you must be logged on as an “Authorised Client”.

When you have completed these steps the PLS system is ready for operation.

Note:
Change the logon password to protect your PLS system against manipulation (see Chapter 9.13).
Log your configuration data stored in the PLS, and back up the configuration on the hard disk or on a floppy disk (see Section 9.12).

Other options

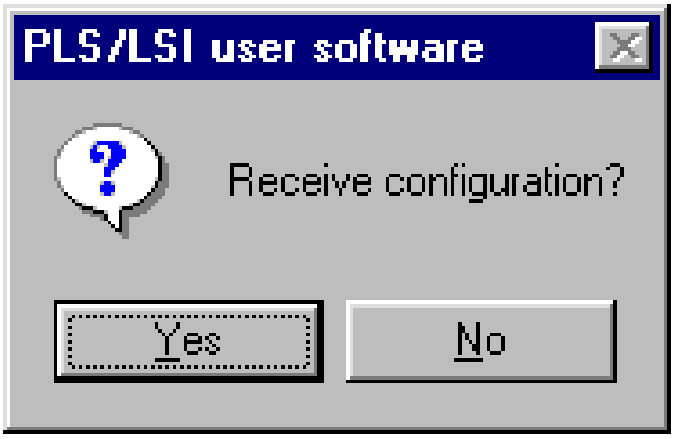
In addition to the essential steps, you can use a number of other options when configuring your PLS system.

- **Edit fields:**
  To edit the protective and warning fields the PLS/LSI user software provides you with a number of useful edit functions.
- **Teach-in and check protective field:**
  In the teach-in process you run over the contours of the desired protective field with the sensor active, and the PLS stores the learned contour. You have to check learned protective fields.
  You can also edit a learned protective field subsequently, just like any other segmented field.
- **Monitor protective field:**
  You can monitor the protective and warning fields during operation using a connected PC. You can also store the defined space contours of the sensor as a check.
- **Check settings:**
  You can view, check and print all configuration settings in a page view.
- **Receive and store configuration:**
  You can receive and print the configuration data stored in the PLS. You can save any configuration to the hard disk or to a floppy disk.
- **Change password:**
  To protect your PLS against manipulation, you should change the logon password.
- **Change screen view:**
  You can zoom in, zoom out or move the screen view, for example.
- **Interrogate fault memory (system diagnosis):**
  For troubleshooting purposes you can interrogate the fault memory of the PLS.

9.3 Starting: the initial configuration

The PLS is shipped with certain pre-configured settings. This section describes how you can adapt those settings to your application.

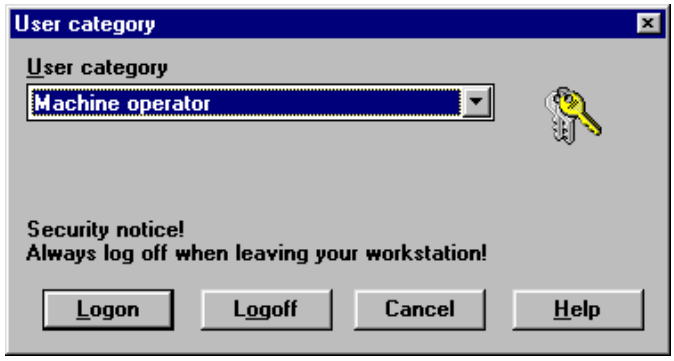
- Switch on your PLS system
  (it takes a few seconds to start up).
- Start the PLS/LSI user software.



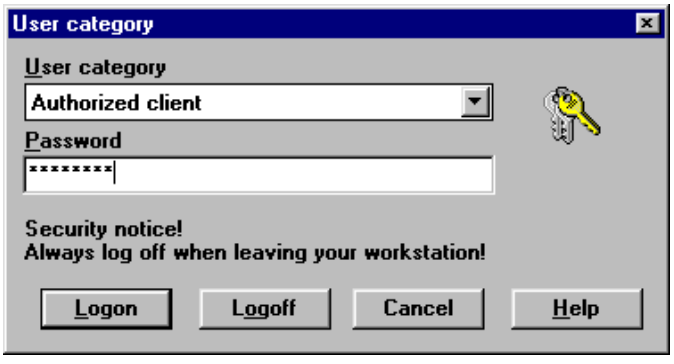
The following dialog window appears:

- Click on “Yes”.

The PC receives the pre-configured settings and displays them on-screen.



This dialog window appears.
To be able to send the configuration and monitoring area to the PLS, you must log on as an “Authorised Client”.



- Select “Authorised Client” from the category list.
- Enter the password “SICK_PLS” and click on “Logon”.

You are now logged on as an “Authorised Client” (see status bar at bottom of screen).

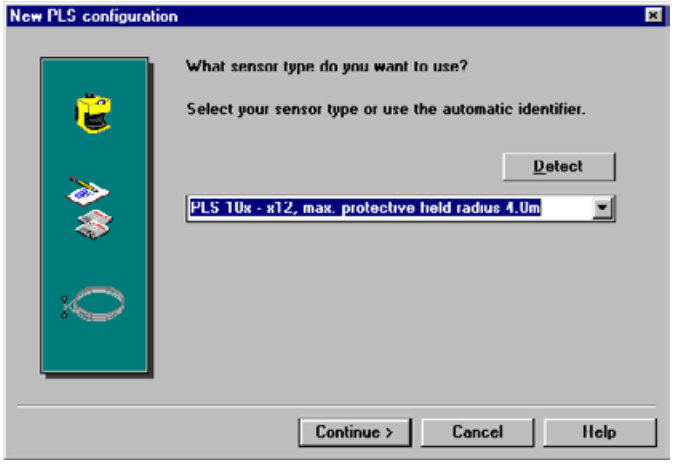
Note:
Always log off when leaving your workstation! This will prevent unauthorised persons from manipulating your PLS system.

Configure hardware

You can edit the received configuration or create a new one.

To create a new configuration:

- From the menu select **File – New** and click on “PLS Configuration”.
- Click on “OK”.



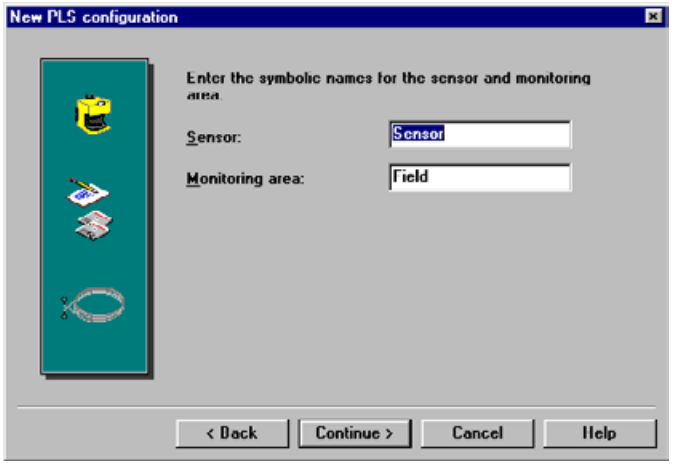
This dialog window appears. This is where you set the sensor type you want to work with.

- Select your sensor type or have the sensor automatically detected by clicking on “Detect”.
- Click on “Continue”.

The remaining steps to follow and dialog windows which appear are the same as the following steps under “Edit configuration”.

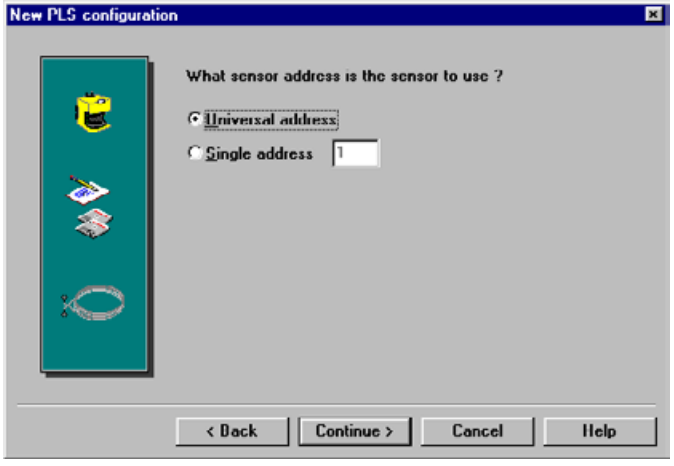
To edit the received configuration:

- From the menu select **PLS – Configuration – Edit**.
- Or select the “Edit Configuration” button from the toolbar.



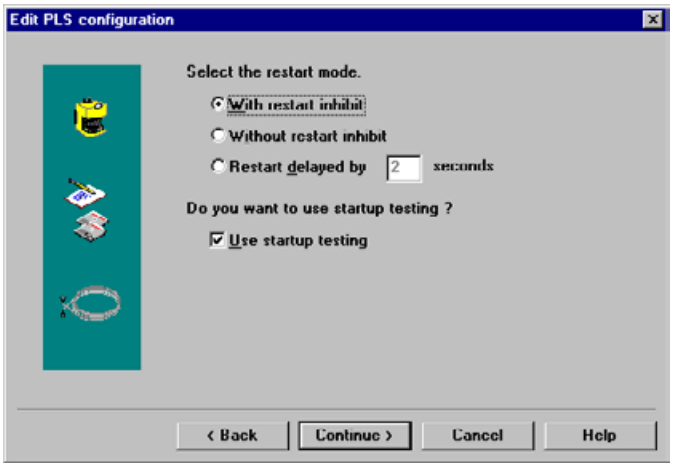
This dialog window appears. Here you can enter a symbolic name for the sensor and the monitoring range.

- Enter a name for the sensor and the monitoring range. These names have no functional significance, they are only intended as an aid to better allocation.
- Click on “Continue”.



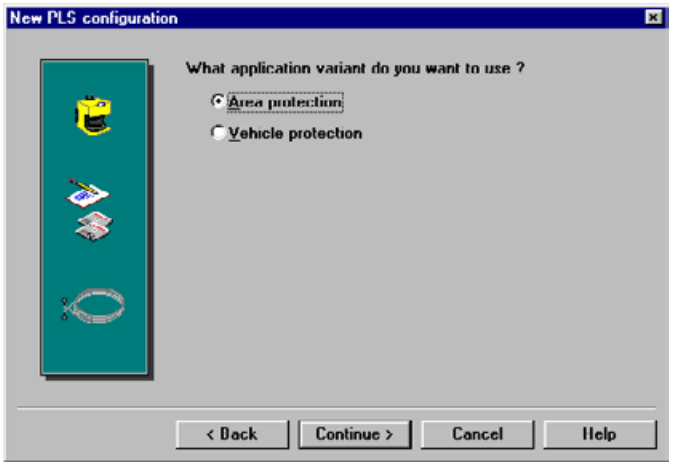
This dialog window appears. This is where you set the address under which the PLS is to be addressed.

- Select whether you want to use a universal or single address.
  Universal address (zero):
  This is the recommended setting. If you set “Universal address”, the stored configuration can be transferred at a later time to another PLS.
  Single address (between 1 and 99):
  If you set “Single address” you assign the PLS the address specified here for transferring the configuration. It is then only possible to reload a configuration at a later time if the address specified here and the one stored in the PLS match. This makes sense when you want to ensure that a configuration saved as a file can only be transmitted to specific PLS units.
- Click on “Continue”.



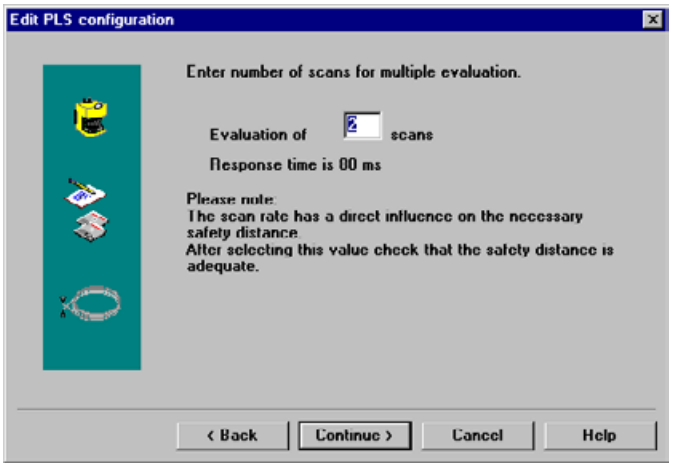
This dialog window appears. This is where you set the restart behaviour of the output and the start-up testing.

- Select how the PLS is to restart after a protective field infringement.
  With restart inhibit:
  The system only restarts after a protective field infringement or a reset when the protective field is free and the restart button is pressed.
  Without delay:
  The system restarts immediately as soon as the protective field is free.
  Delayed by n seconds:
  The system only restarts when the time set here has elapsed after the protective field has become free again.
- Here you can select whether you want to work with start-up testing.
  If you select this option you must intentionally interrupt the protective field one time after switching on the system. Only then is the system ready for operation.
- This allows you to ensure that after switching on the machinery, the machine operator must check that the PLS is detecting properly by infringing the protective field before he starts work.
- Click on “Continue”.



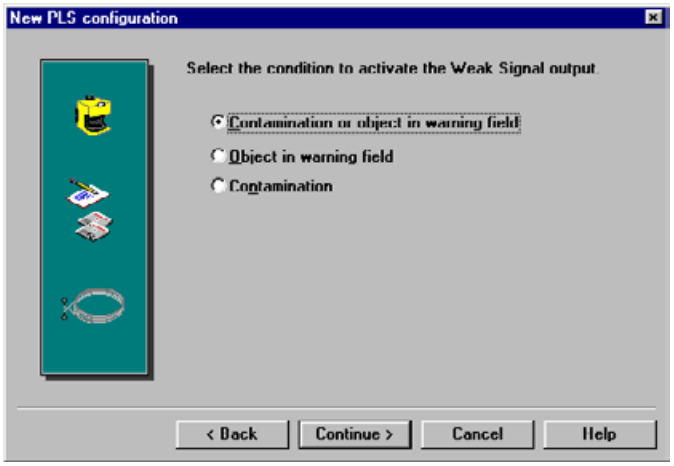
This dialog window appears. This is where you define the field of application of your PLS system.

- Select whether you want to use the PLS for area protection or for protection on a vehicle.
- Click on “Continue”.



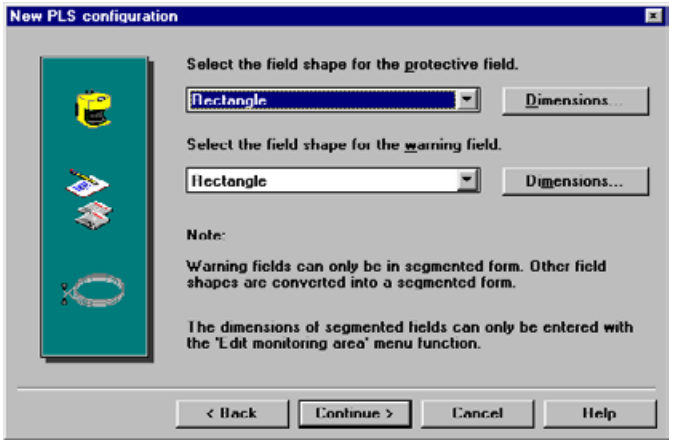
This dialog window appears. This is where you set how often (that is, in how many consecutive scans) the sensor must detect a foreign body in the protective field before it signals an infringement (between 2 and 16 scans are possible).

- Enter the desired number of scans.
  Note:
  For safety reasons, always select the lowest possible setting! If you increase the setting the system will become more stable, but will also respond more slowly. In this way you can achieve a good level of availability, for example in an environment with a high dust concentration. The current response time is shown on the box.
- Click on “Continue”.



This dialog window appears. This is where you set when the "Weak Signal" output is to activate.

- Select the desired condition:
  – Contamination of front screen or object in warning field
  – Object in warning field
  – Contamination of front screen
- Click on "Continue".

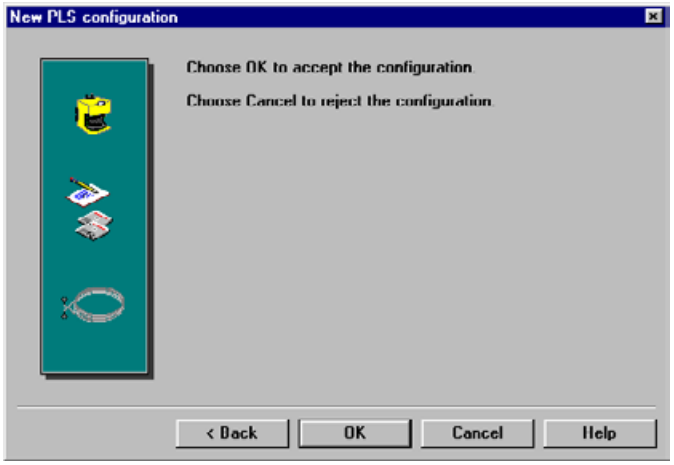


If you create a **new configuration** this dialog window appears. This is where you define the monitoring area.

- Select the shape of the protective and warning fields.
  You can define the sizes of the fields now or later. If you want to define them now, click on "Dimensions" and enter the dimensions you want.

Note:
You can find more details on editing the protective and warning fields in Section 9.4.

- Click on "Continue".

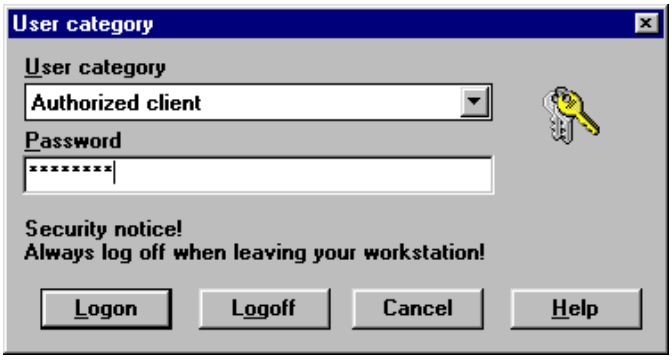


- Click on "OK" to accept the configuration.

The configuration is defined. You can now transmit the settings to the PLS, as described in the following section.

Send configuration to PLS

- Make sure you are logged an as an “Authorised Client” (see status bar at bottom of screen).
- If you are not logged an as an “Authorised Client” select **PLS – User Category** from the menu, or click on the “Logon/-Logoff User Category” button on the toolbar.



This dialog window appears.

- Select “Authorised Client” from the list of user categories.
- Enter the pasword “SICK_PLS” and click cn “Logon”.

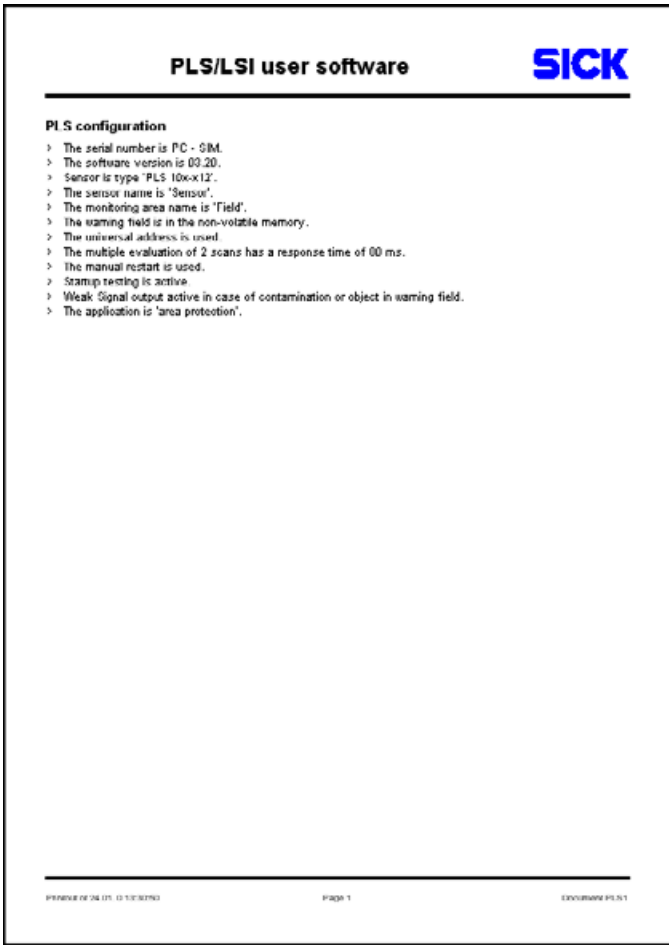
You are now logged on and can send data to the PLS.

- From the menu select PLS – Configuration – Send to PLS, or click on the “Send Configuration” button on the toolbar.

The screen displays an overview of the configuration settings for you to check through once again.

Reject settings:

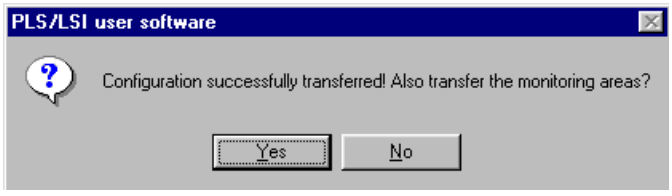
- Click on “Cancel” to close the overview.
- From the option **PLS – Configuration – Edit** in the menu you can now enter the correct settings.



Confirm settings:

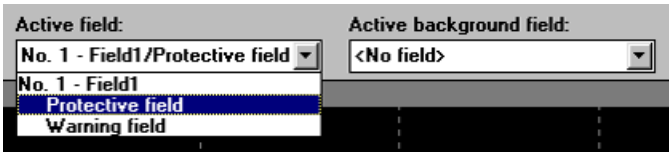
- Click on “Confirm”.

The configuration data is sent to the PLS and stored there.



This dialog window appears.

- If you want to transmit the monitoring ranges unchanged, click on “Yes”. You can then skip the next section, “Edit monitoring range”.
- If you also want to alter the shape and size of the monitoring ranges, click on “No”. You can then edit the protective and warning fields, as described in the following sections.



Edit monitoring range

The screen displays the protective field you have defined. You can edit the size of the protective and warning fields after defining them.

- From the menu select **Monitoring Range – Edit**, or click on the "Edit Monitoring Range" button on the toolbar.
- From the "Active field" list select the protective or warning field you want to edit.
- From the "Active Background Field" list select the protective or warning field that you want to see in the background for comparison purposes.

The selected fields and the contour of the sensor are shown on-screen.

A colour code for displaying the protective and warning fields is shown in the status bar at the bottom of the screen.

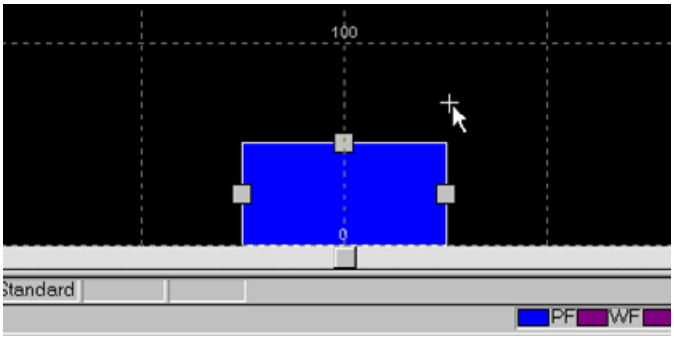
Convert field shape:

- To convert a field into a different shape, select **Edit – Convert Into** from the menu.

Three different field shapes are available to choose from:
– Rectangle: This is the default. Newly defined fields are always this shape, unless you select a different setting. You can adjust the height of the rectangle and the width at the right and left.
– Semicircle: Here you can define the radius.
– Segmented field: You can select various resolutions. The more segments a field has, the higher is its resolution. You can define the co-ordinates for each segment individually.

Notes:
Warning fields are always segmented fields. If you have defined a warning field as a rectangle or semicircle, it is automatically converted into a segment with the appropriate dimensions. When you convert a field or change the resolution of a segmented field, the shape of the field may change minimally, but this is displayed on-screen.

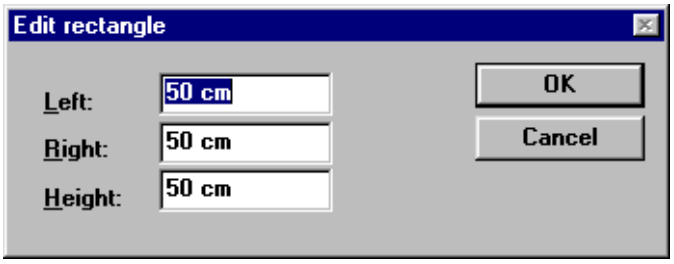
The following sections set out only the basic means of defining the sizes of the various field shapes. For more information on editing fields, refer to Section 9.4.



Define rectangular field:

- To set or move a comer point:
  Double-click on the desired position with the mouse.

Note:
In the example a rectangular grid pattern was selected for the screen view. You can switch between circular and rectangular grid patterns. For more details refer to Section 9.14.



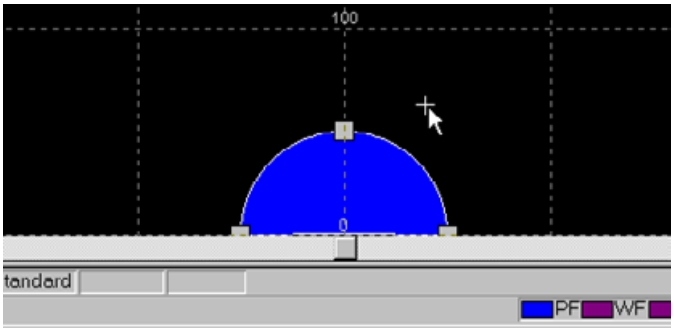
… **or:**

- From the menu select **Edit – Field Co-ordinates**.

This dialog window appears, showing the dimensions of the rectangle.

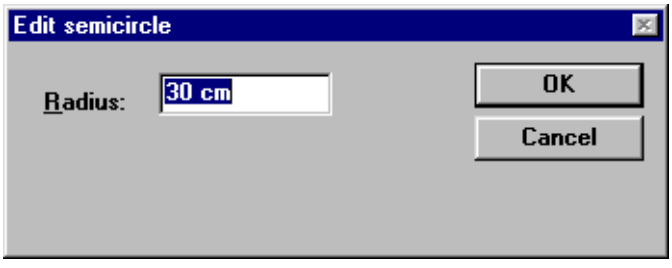
- Enter the dimensions you want.
- Confirm with “OK”.

The dimensions of the rectangle are changed accordingly.



Define semicircle:

- Double-click with the mouse on the desired position to define the radius of the field.



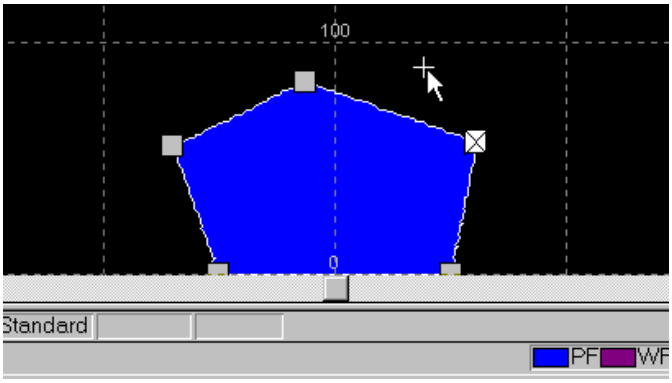
… **or:**

- From the menu select **Edit – Field Co-ordinates**.

This dialog window appears, showing the radius of the semi-circle.

- Enter the dimensions you want.
- Confirm with “OK”.

The radius of the semicircle is changed accordingly.

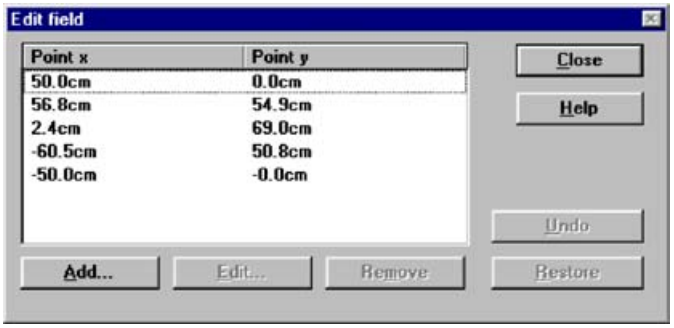


Define segmented field:

- To set a point with the mouse:
  Double-click on the desired position.
- To move a point with the mouse:
  Select the point and drag it to the desired position.
- To delete a point:
  Mark the point and click on the “Delete” button on the toolbar.

… **or:**

- From the menu select **Edit – Field Co-ordinates**.



This dialog window appears, showing the co-ordinates of all defined points. You can add any points to the list, or you can select a point and edit or remove it.

- To set a point:
  Click on the “Add” button and enter your desired co-ordinates in the dialog window.
- To move a point:
  Select the point in the list and click on the “Edit” button. Enter your desired co-ordinates in the dialog window.
- To delete a point:
  Select the point in the list and click on the “Delete” button.

Note:
You can also select a point with the mouse before selecting **Edit – Field Co-ordinates**. The co-ordinates of the point in question are then already highlighted in the list.

- When you have defined the protective and warning fields as you want, deactivate the **Monitoring Range – Edit** function or deactivate the “Edit Monitoring Range” button on the toolbar.

Note:

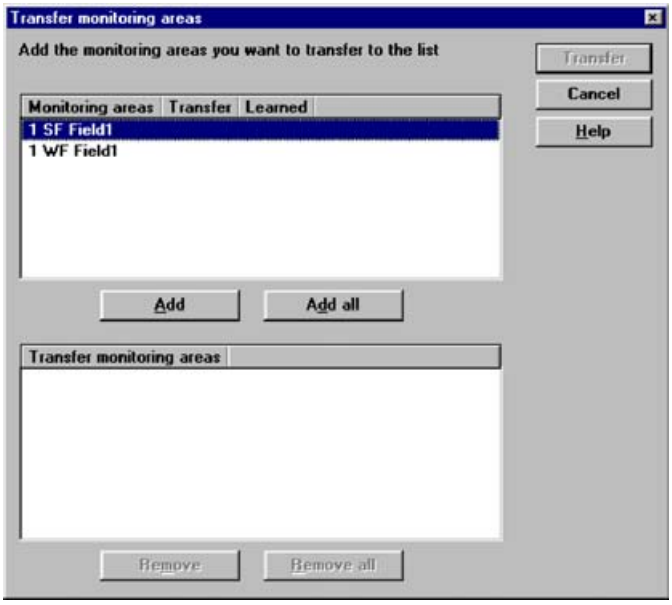
After programming, check on the plant or vehicle that the monitoring range is the correct size and shape! You can do this by intruding intentionally into the monitoring range.

This also applies when you upload a field from a floppy disk into the PLS.

Only start up the plant or vehicle when you are sure the monitoring range is operating effectively!

Send monitoring range to PLS

- From the menu select **Monitoring Range – Send to PLS**, or click on the “Send Monitoring Range” button on the toolbar.

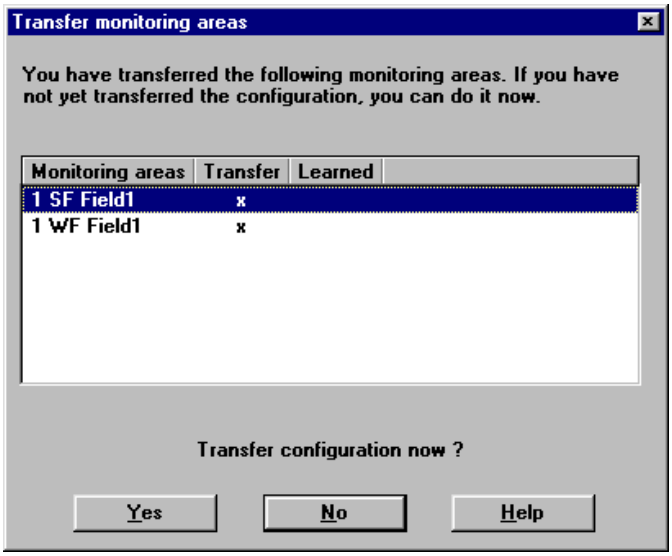


This dialog window appears.

- Click on “Add All”.
  Or – if you only want to transmit individual fields – select the fields you want from the list at the top and click on “All”.

The fields are entered in the list at the bottom.

- Click on “Send” and confirm for each individual field with “Yes” or “OK” as appropriate.



This dialog window appears. The transmitted fields are now marked with asterisks in the list.

- Check that protective and warning fields are marked with an asterisk, and so have been transmitted correctly.
- If you already sent the configuration before, you can click on “No”.
  If you have not already sent the configuration, click on “Yes” and transmit as previously described under “Send configuration to PLS”.

When you have transmitted the configuration and the monitoring range, the system is ready for operation.

Note:
When leaving your workstation log off by way of the **PLS – User category** menu function!

Also change the “Authorised Client” logon password. Make a note of the new password at a location accessible only to authorised persons. This will prevent unauthorised persons from manipulating the PLS system (how to change the password is described in Section 9.9).

9.4 Edit/dimension fields

Section 9.3 describes the basic way to edit a protective or warning field. You can use rectangular, semicircular or multiply-segmented fields. You can draw the fields either by using the mouse or by typing in their co-ordinates.

This chapter describes the additional options of defining the size and shape of the protective and warning fields for your application. Various edit functions will assist you in drawing up the fields.

A colour code for displaying the protective and warning fields is shown in the status bar at the bottom of the screen.

Note:
After programming, check on the plant or vehicle that the monitoring range is the correct size and shape! You can do this by intruding intentionally into the monitoring range.
Only start up the plant or vehicle when you are sure the monitoring range is operating effectively!

Convert field shape:

You can convert a field into a different shape – for example, a rectangular field into a segmented field.

- Select **Edit – Convert Into** from the menu.

Three different field shapes are available to choose from
– Rectangle: This is the default. Newly defined fields are always this shape, unless you select a different setting. You can adjust the height of the rectangle and the width at the right and left.
– Semicircle: Here you can define the radius.
– Segmented field: You can select various resolutions. The more segments a field has, the higher is its resolution. You can define the co-ordinates for each segment individually.

Note:
Please observe that during conversion slight deviations in the protective field co-ordinates may occur, which are nonetheless visible on-screen.
Warning fields are always segmented fields. If you have defined a warning field as a rectangle or semicircle, it is automatically converted into a segment with the appropriate dimensions.

Change scale of a segmented field

When you have defined a segmented field you can enlarge or reduce it in scale.

- Select **Edit – Select All** to select all the points in the field.
- Pick up one of the marked points with the mouse and drag the field to the size you want.

Each point is dragged on the measuring beam of its sensor away from or towards the zero point as appropriate.

Copy and paste fields

You can copy fields to the clipboard and paste them at a different location. But you cannot mix field types: you can only paste a protective field back in as a protective field, and a warning field to a warning field.

- From the menu select **Edit – Copy** to copy the selected field to the clipboard.
- Select **Edit – Paste** to paste the field from the clipboard.

You can then edit the field you have just pasted as usual.

Save individual fields

You can save individual fields as files so that they are available for use in other configurations.

- From the menu select **Edit – Copy To...** and save the current field under the desired file name on the hard disk or on a floppy disk.
- To insert the stored field at the desired location, such as in another configuration, select **Edit – Paste From...** and enter the file name and storage location.

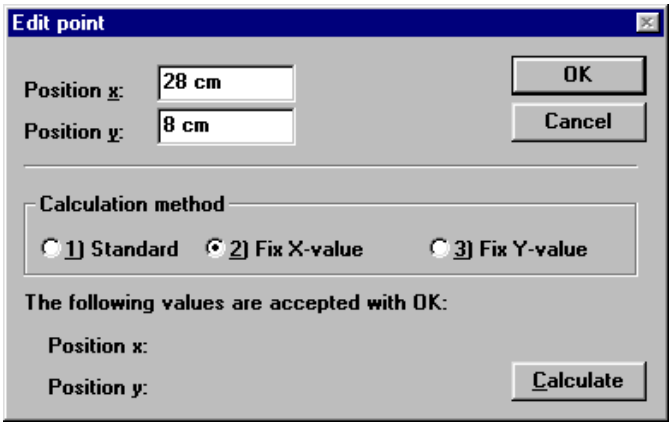
The field is inserted. You can edit the field as normal.

Fix co-ordinates

When editing a segmented field you can fix one of the co-ordinates of a point. This may be necessary when the coordinate in question must not be changed, such as when configuring a protective filed for a narrow alley.

- From the menu select **Edit – Field Co-ordinates**.
- In the list select the point whose position you want to change and click on “Edit”.

This dialog window appears.



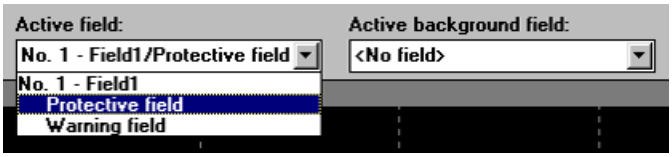
- Enter the co-ordinates you want for x and y.
- Select which co-ordinates must not deviate from the entered value, for example “Fix X-value”, and click on “Calculate”.

The next closest point on a measuring beam with the desired co-ordinates is calculated.

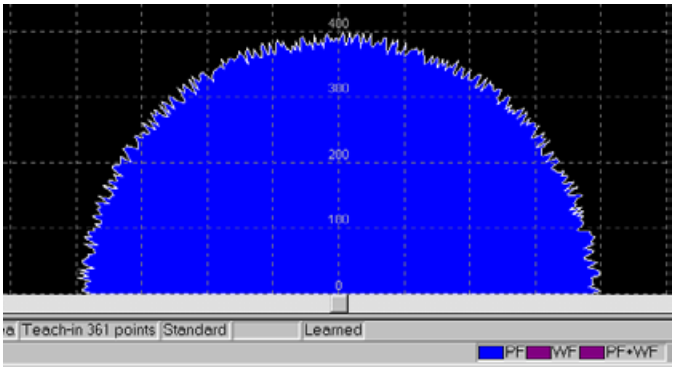
- The calculated co-ordinates are displayed. To accept them, click on “OK”.

9.5 Teach-in protective field

You can teach-in protective fields. To do so, you run over the contours of the desired protective field with the active sensor, and die PLS stores the learned contour. You have to check learned protective fields.
You can also edit a learned protective field subsequently, just like any other segmented field.



- From the “Active Field” list select the protective field.
- From the menu select **Monitoring Range – Teach-in**.
- Or click on the “Teach-in Monitoring Range” button on the toolbar.



This dialog window appears. The protective field is represented on-screen as a coloured area.

The active sensor scans its surroundings and shows you the results. The contour you see on-screen is the largest possible extent of the protective field (the precise contour of the protective field is based on the ambient contours).

- If you want to reduce the size of the learned contour, run a target (e.g. a piece of cardboard, at least 10 x 10 cm in size) slowly along the edge of your desired protective field.

The contour of the protective field is reduced at the relevant point. On the screen you can track how the protective field takes on the taught-in contour.

Note:
To prevent fixed obstacles in the scanning plane subsequently producing false signals, 13 cm (= max. measuring error of PLS) is automatically deducted from the learned contour. Take this into account as appropriate when running over the protective field. Also note that the teach-in process may result in an additional error of 4.5 cm.

- To terminate teach-in, deactivate the “Teach-in Monitoring Range” button.

This dialog window appears. You now have three options:
– You can reject the taught-in protective field,
– you can edit it as a segmented field,
– or you can check it and then activate it in the PLS.

Reject protective field:

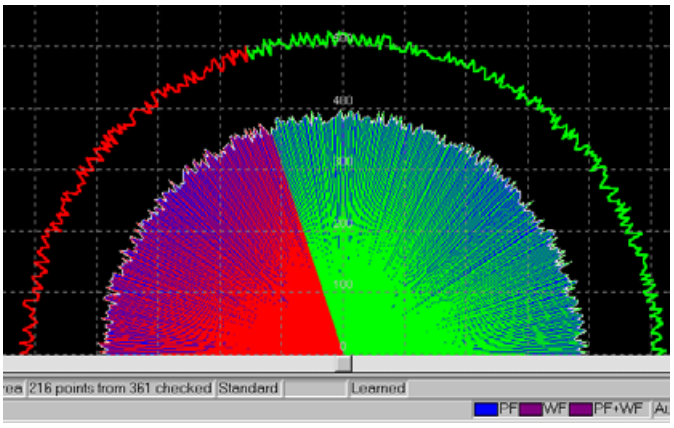
- Click on “Cancel”. The taught-in protective field is rejected and the old field retained.

Edit protective field:

- Click on “Edit”. You can now edit the taught-in protective field like a segmented field and then transmit it to the PLS.

Check protective field:

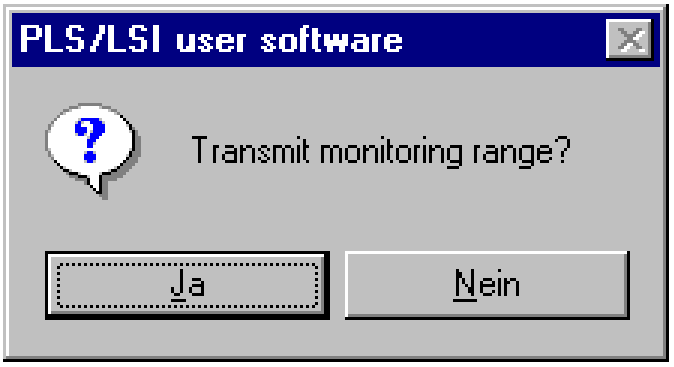
- Click on “Check”.



The taught-in protective field is shown on-screen. The space contour of the sensor is displayed for comparison purposes.

- Infringe the contour of the protective field intentionally until you have covered all 361 points and measuring beams. Here it is important that this is carried out in a corridor reaching 70 cm into the protective field.

The number of checked points is displayed in the status bar at the bottom of the screen.



This dialog window appears automatically as soon as you have checked all the points.

If you want to prematurely cancel the check:

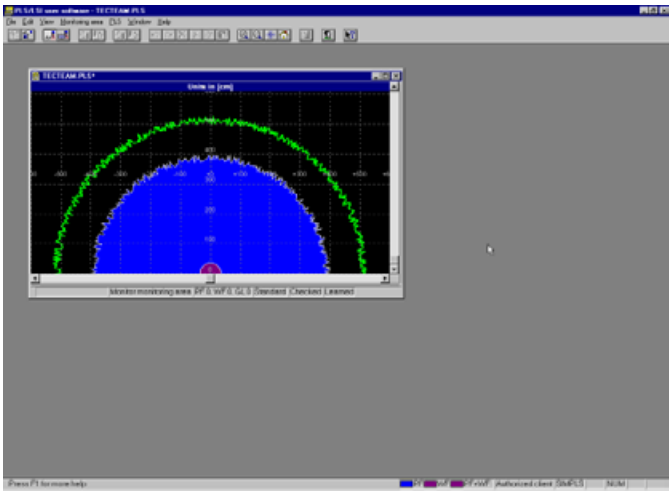
- Deactivate the **Monitoring Range – Teach-in** menu function, or deactivate the “Teach-in Monitoring Range” button on the toolbar.
  The same dialog window appears.

- Click on “Yes” to transfer the monitoring range into the PLS and confirm with “OK”.

The taught-in protective field is now active in the PLS.

Note:
You can also edit the taught-in protective field subsequently and then transmit it as a segmented protective field to the PLS.

9.6 Monitor protective field



You have the option of monitoring the contour lines and the defined protective field in operation by means of a connected PC.

- From the menu select **Monitoring Range – Monitor**.
- Or click on the “Monitor Monitoring Range” button on the toolbar.

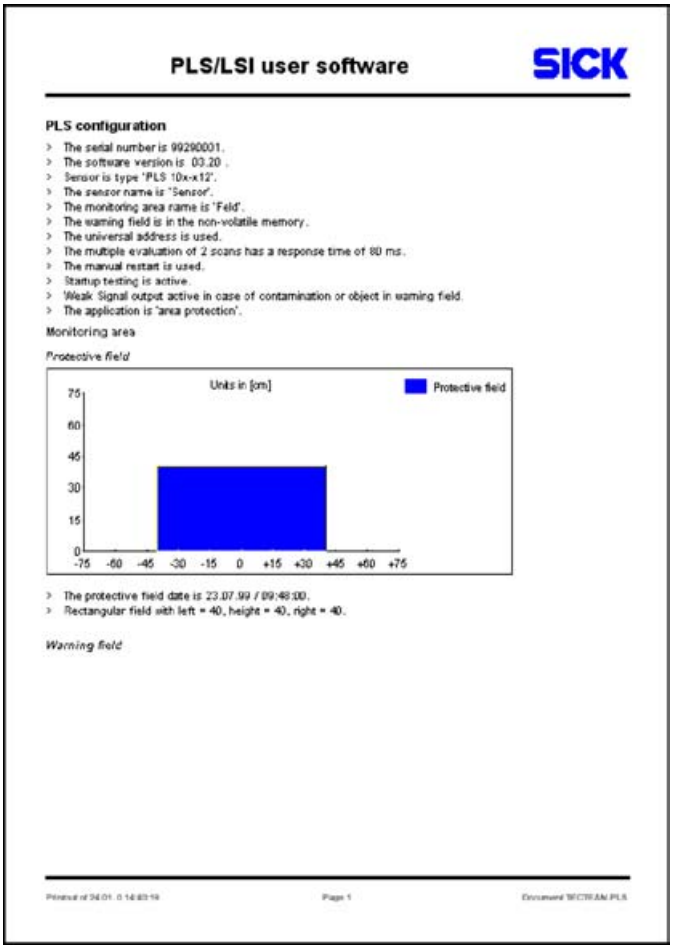
You see the protective field and the space contour on-screen.

A colour code for displaying the protective and warning fields is shown in the status bar at the bottom of the screen.

Save space contour

You can receive and save the defined space contour of a sensor. In this way, when error shutdowns occur, you can check at which point the protective field was infringed.

- From the menu select **PLS – Extras – Readings – Save Readings**.


PLS/LSI user software

SICK

PLS configuration

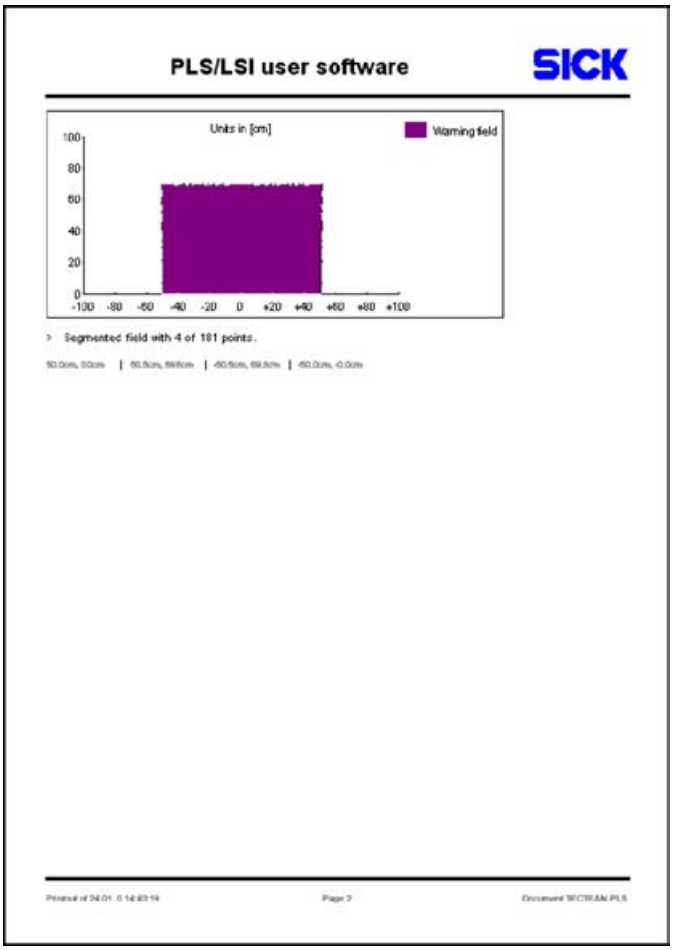
- The serial number is 99290001.
- The software version is 03.20 .
- Sensor is type 'PLS 10x-x12'.
- The sensor name is 'Sensor'.
- The monitoring area name is 'Feld'.
- The warning field is in the non-volatile memory.
- The universal address is used.
- The multiple evaluation of 2 scans has a response time of 80 ms.
- The manual restart is used.
- Startup testing is active.
- Weak Signal output active in case of contamination or object in warning field.
- The application is 'area protection'.

Monitoring area

Protective field

- The protective field date is 23.07.99 / 09:48:00.
- Rectangular field with left = 40, height = 40, right = 40.

Warning field


PLS/LSI user software

SICK

- Segmented field with 4 of 181 points.

9.7 Check settings

You can call up an overview at any time showing all the configu-ration and monitoring range settings. You can also print out the overview.

Note:
This preview does not show you the actual configu-ration active in the PLS, but only the settings you are currently editing on the PC. How to receive the active configuration from the PLS and print it is described in the next section.

- From the menu select **File – Preview**.

Several pages now appear listing all the configuration settings in texts and diagrams. You can check over your settings any time here.

Change size of screen view:

You can zoom the screen view in or out in two stages.

- Click on the “Zoom In” or “Zoom Out” button. The view is zoomed in or out by one stage a at time.
- Or click on the place you want to zoom into. The view is zoomed in or out one stage at a time at the selected point.

Print preview:

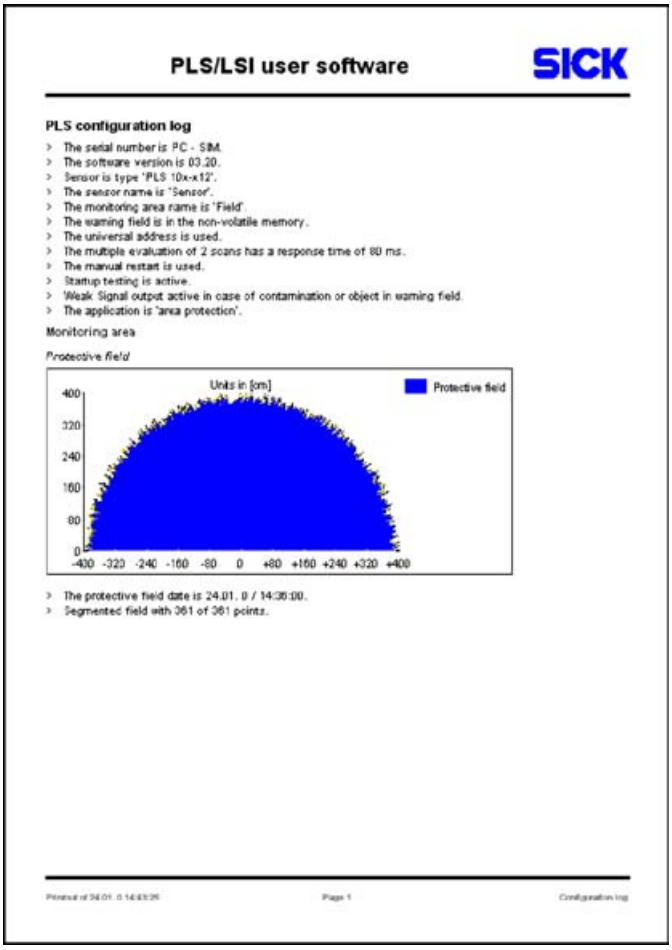
- Click on the “Print” button.

9.8 Receive and store configuration

Receive configuration from PLS

You can receive and print the configuration data stored in the PLS.

- From the menu select **PLS – Configuration – Configuration Log**.



The PC receives the current configuration from the PLS.
The screen displays an overview of all the configuration settings stored in the PLS.

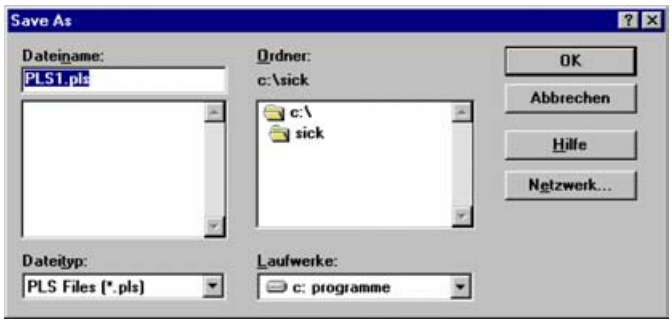
Change size of screen view:

You can zoom the screen view in or out in two stages.

- Click on the “Zoom In” or “Zoom Out” button. The view is zoomed in or out at one stage at a time.
- Or click on the place you want to zoom into. The view is zoomed in or out one stage at a time at the selected point.

Print log:

- Click on the “Print” button.



Store configuration

You can save all configuration and monitoring range settings to the hard disk or to a floppy disk.

- From the menu select **File – Save As** to save the settings.

You can call up the stored file again later to change the settings or transmit them to the PLS.

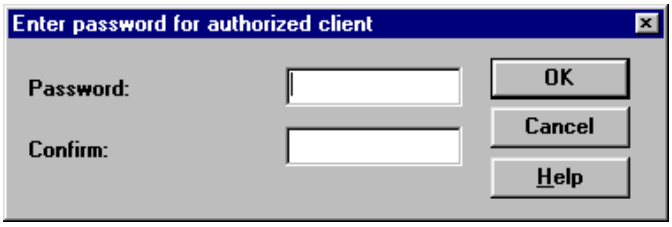
9.9 Change password

To be able to send configuration and monitoring areas to the PLS, you must log on as an “Authorised Client”. This requires a password (default: “SICK_PLS”).

To protect your PLS system against manipulation, you should change the default password and keep it in a safe location accessible only to authorised persons.

To change the password, proceed as follows:

- From the menu select **PLS – User Category**, or click an the “Logon/Logoff User Category” button on the toolbar.
- Log on as an “Authorised Client”, using the old password (e.g. “SICK_PLS”).
- Select **PLS – Password – Change for Authorised Client**.



This dialog window appears.

- Type in the new password twice - once in each box. On-screen it is shown only as a series of asterisks.
- Confirm with “OK”.

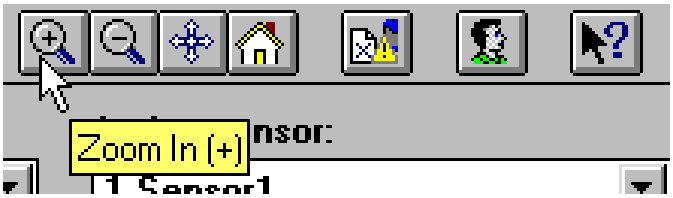
The new password is stored in the PLS.

- Logoff.
- Make a note of the new password and keep it in a safe location accessible only to authorised persons.

Note:
The new password takes immediate effect.
But please be sure to always log off before leaving your workstation! Only if you do so can the password protect your PLS system against manipulation.

9.10 Change screen view

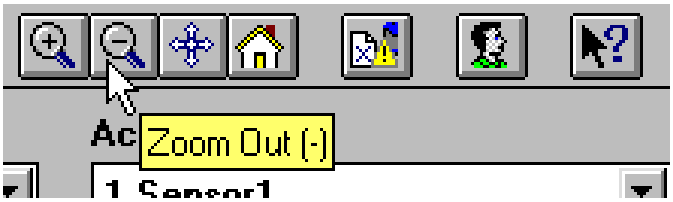
You can enlarge, reduce or move the fields on-screen to make them look as you want.
You can also choose between a circular and a rectangular background.



Enlarge or reduce view

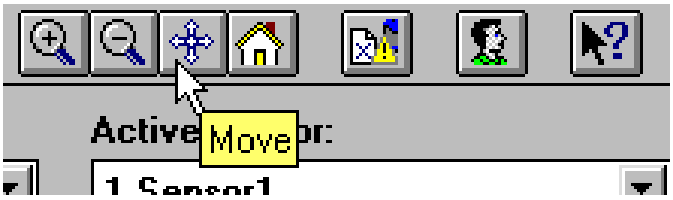
- Click on the “Zoom In” button on the toolbar.

The zoomed segment is zoomed one stage further with every click of the mouse.



- Or click on the “Zoom Out” button on the toolbar.

The zoomed segment is zoomed out one stage further with every click of the mouse.

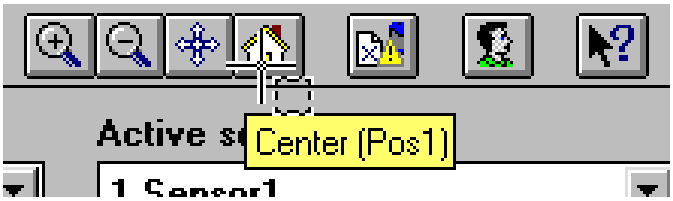


Move view

- Click on the “Move” button on the toolbar. The cursor changes shape into a four-pointed arrow.
- Hold the mouse button pressed down and move the screen segment to where you want it.

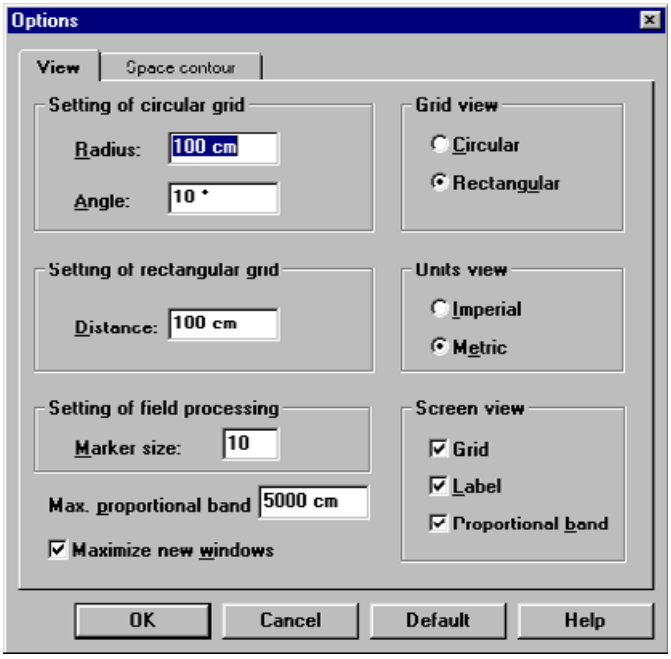
… **or:**

- Move the view using the scroll bars at the right and bottom of the screen.



Centre view

- Click on the “Centre” button on the toolbar. The zero point is now back in the centre of the screen.



Change grid pattern

You can switch between rectangular and circular grid patterns.

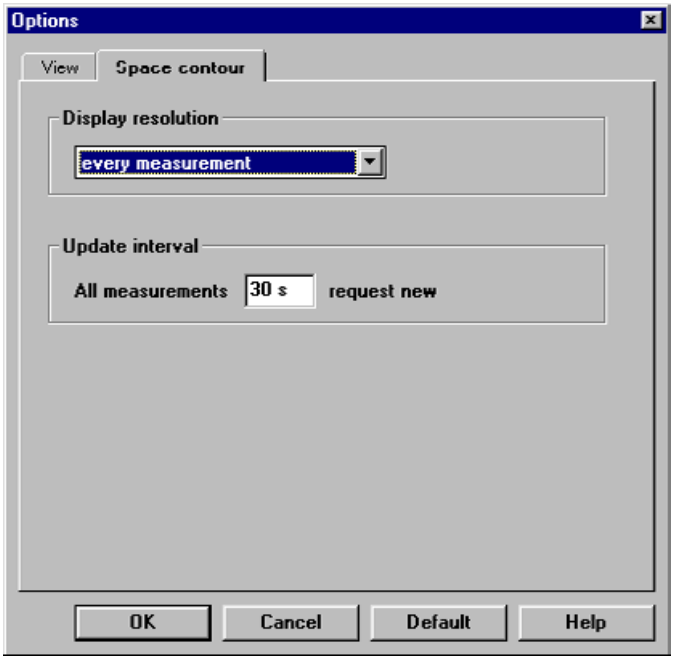
- From the menu select **View – Options**.
- In the dialog window select the “View” tab.
- Check the checkbox for a rectangular or circular grid pattern.
- Set the desired grid width.
- Set your desired maximum visible area.
- Check the checkbox for metric or imperial units.
- Check the checkboxes to display the grid pattern, labels and visible area on-screen.

Restore defaults:

- Click on the “Default” button. All values are reset to their default settings.

Confirm setting:

- Click on “OK”.



Set displayed readings

You can set how many space contour readings are to be displayed when monitoring and editing the fields.

Note:
The more readings you display, the more accurate the display will be, but it will also be slower.

- From the menu select **View – Options**.
- Select the “Readings” tab.
- Select how many space contour readings you want to evaluate.
- Enter the time intervals at which new readings are to be requested during editing.

9.11 Interrogate fault memory (system diagnosis)

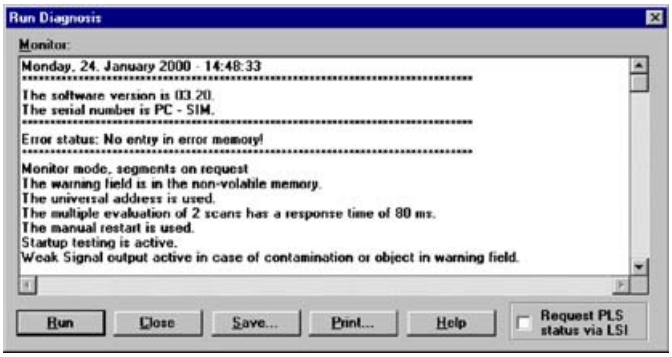
If your PLS is not functioning as you would like it, you can interrogate the fault memory of the PLS in a number of different steps to localise possible faults.

The fault table in Chapter 11.3 will tell you what to do then to rectify the fault.

General note:

The PLS fault memory is only temporary. This means that it is erased when the power is disconnected. If the fault has been rectified before restarting the PLS, the fault memory no longer contains the corresponding entry. Such a fault entry is only made if the self-start fails again after the restart. In order to ensure that faults which have just occurred are identified correctly, the fault memory must be interrogated before the power supply is disconnected.

Initial fault diagnosis



As the first step you can carry out a simple diagnosis to localise faults.

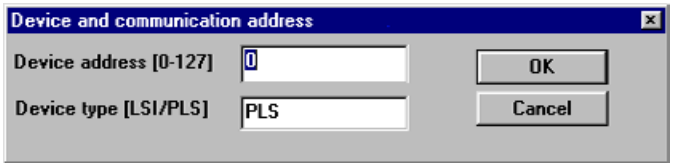
- From the menu select **PLS – Diagnosis**.

This dialog window appears.

- Click on “Run”.

The diagnosis is carried out and the window displays information on the current status of your PLS system.
The fault codes are given in the bottom section of the list display. To find out what the fault codes mean, and whether you can rectify the fault yourself, refer to the fault table in Section 11.3.

If necessary, you can also carry out a second diagnosis to get more detailed information. This is described below.

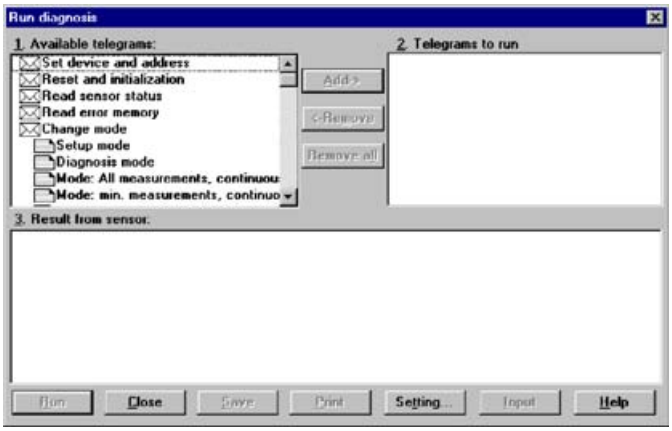


Interrogate PLS fault memory

- From the menu select **PLS – SICK-Diagnosis**.

This dialog window appears.

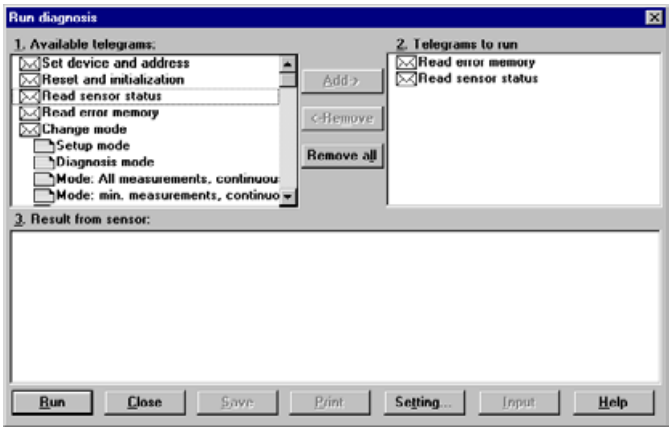
- Make sure zero is entered as the device address and “PLS” as the device type, and confirm with “OK”.



The “Run Diagnosis” dialog window appears. In it you will find various telegrams with which you can execute additional commands and functions.

Read error memory

Read sensor status



- In the list of available telegrams select the “Read fault memory” telegram and click on “Add”.
- Select the “Read sensor status” telegram and click on “Add”.

The two telegrams are now entered one under the other in the list of telegrams for diagnosis.

- Click on “Run”.

The fault memory of the PLS and the sensor status are read, and the result log is displayed in the box at the bottom of the screen. You can find out what the listed fault code means from the fault table in Section 11.3.

You can add supplementary information to the result log, print it, or save it as a file.

Enter supplementary information:

- Click on “Input” and enter the text you want. Your text is then appended to the result log.

Print result log:

- Click on “Print”.

Save result log as file:

- Click on “Save” and enter a file name and destination directory/folder.

Note:
When you have rectified the fault, reset the PLS: select **PLS – Initialise**.
Or execute the “Reset and initialisation” telegram in the SICK Diagnosis.
The PLS system is then restarted.

10 Checks

10.1 Check PLS

These checks are necessary to control that the protective devices are functioning correctly and that they are integrated in the machine / plant control systems, as well as to detect any possible alterations or malfunctions.

The following points must be observed to ensure that the devices are deployed correctly.

The devices must be mounted and electrically connected by skilled personnel. Skilled personnel are to be understood as persons who possess sufficient knowledge about the fields of the power-driven machinery (based on their specialist training and professional experience). Furthermore, they must be familiar with the applicable national industrial safety regulations, accident prevention regulations, guidelines and generally recognised technical rulings and requirements (e.g. DIN standards, stipulations laid down by the German electricians' association, technical regulations of other EU countries) to such an extent, that they can adjudge the power-driven machinery to be in a condition where it can be safely operated. Such persons are generally employees of the manufacturers of non-contact protective devices, or persons who have been trained by manufacturers of non-contact protective devices, or who are primarily occupied with checking non-contact protective devices and who act on the instructions of non-contact protective device operators.

1. Checking of the protective devices installed on the machine before commissioning by skilled personnel:
   - Checks carried out before commissioning serve the purpose of confirming that the machinery complies with national/international regulations, as well as with safety requirements stipulated by machine or machine operator guidelines (EU Declaration of Conformity).
   - Checking of the effectiveness of the protective devices installed on the machinery in all the possible operating modes in accordance with the accompanying check list.
   - The operating personnel of the machinery fitted with the protective devices must be instructed in their use by skilled personnel employed by the machine operator before they start to work with the machinery. Instruction is the responsibility of the machine operator.

   You check your PLS system by proceeding in accordance with the check list printed in the Technical Description.
2. Regular checks of the protective devices by skilled personnel:
   - Checks in accordance with the nationally applicable regulations at the stipulated intervals. These checks serve the purpose of revealing alterations made to, or manipulation of, the protective devices with regards to commissioning.
   - The checks must always be performed when significant alterations are made to the machinery or protective devices, as well as after refitting or maintenance work necessary following damage to the housing, front screen, connection cable, etc.

   You check your PLS system by proceeding in accordance with the check list printed in the Technical Description.
3. Daily checks of the protective devices by authorised and instructed persons.

   This is how you check your PLS system correctly:

   1. Checks must be performed every time the operating mode is changed.
   2. Check the mechanical installation and ensure that lock screws are tight, and that the PLS is correctly aligned.
   3. Check the PLS for visible changes such as damage, manipulation, etc.
   4. Switch on the machine / plant.
   5. Observe the PLS LEDs (red, green, yellow).
   6. In the event that at least one of the LEDs is not permanently on when the machine / plant is activated, it must be assumed that there is a fault in the machine / plant. In this case, the machine must be shut down immediately and checked by a skilled operator.
   7. Intentionally infringe in the protective field while the machine is operating in order to check the function of the entire plant. The LEDs must now change colour from green to red and the hazardous movement must stop immediately. Repeat this check at various positions in the danger zone. If a functional deviation is detected, the machine / plant must be shut down immediately and checked by a skilled operator.
   8. On stationary applications, check whether the danger zone marked out on the floor corresponds to the shape of the protective field stored in the PLS, and whether possible gaps are safeguarded by other protective measures. In the case of mobile applications, check whether the vehicle does actually stop moving within the protective field limits set in the PLS, and displayed on the notice plates or detailed in the configuration log. If a functional deviation is detected, the machine / plant must be shut down immediately and checked by a skilled operator.

10.2 Checklist

Check list for the manufacturer / outfitter for installing non-contact protective devices.

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 / outfitter.

This check list should be stored in a safe place or kept together with the machine documentation so that it can be used for reference during repeated checks.

1. **Did the safety regulations in accordance with the regulations / standards applicable to the machine serve as a basis for its design?** Yes ❑ No ❑
2. **Are the guidelines and standards listed in the Declaration of Conformity?** Yes ❑ No ❑
3. **Does the protective system comply with the required safety specifications?** Yes ❑ No ❑
4. **Is access to the hazardous area / hazard position only possible through the protective field of the non-contact protective devices ?** Yes ❑ No ❑
5. **Have measures been taken to prevent and monitor unauthorised presence in the hazardous area when safeguarding hazardous areas / hazard positions (mechanical point-of-operation guarding), and have these been secured against removal?** Yes ❑ No ❑
6. **Have additional protective measures, which are intended to prevent reaching into, underneath and around the protective field, been installed and secured against manipulation?** Yes ❑ No ❑
7. **Has the maximum machine shutdown or stopping time been measured, and entered and documented (on the machine and / or in the machine documentation)?** Yes ❑ No ❑
8. **Are the non-contact protective devices situated at the stipulated safety distance from the next nearest hazard position?** Yes ❑ No ❑
9. **Are the non-contact protective devices correctly mounted and, following adjustment, secured against displacement?** Yes ❑ No ❑
10. **Are the required safety measures against electrical shock effective (protection class)?** Yes ❑ No ❑
11. **Is the command unit for resetting the non-contact protective devices or restarting the machine present and correctly installed?** Yes ❑ No ❑
12. **Are the non-contact protective device outputs (OSSDs) integrated in accordance with the stipulated control category, and do they comply with the circuit diagrams?** Yes ❑ No ❑
13. **Has the protective function been checked in accordance with the check instructions in this documentation?** Yes ❑ No ❑
14. **Are the given protective functions effective at every setting of the operating mode selector switch?** Yes ❑ No ❑
15. **Are the switching elements activated by the non-contact protective devices (e.g. contactors, valves) monitored?** Yes ❑ No ❑
16. **Are the non-contact protective devices effective throughout the entire dangerous status?** Yes ❑ No ❑
17. **Is the corresponding status halted when the non-contact protective devices are switched on or off, the operating modes are changed over, or when switching over to another protective system?** Yes ❑ No ❑
18. **Is the notice plate for daily checks clearly visible to the operator?** Yes ❑ No ❑

This check list does not replace the initial commissioning or regular checks by skilled personnel.

11 Care and Maintenance

The PLS is extensively maintenance-free.

Note:
Do not open the sensor. It does not contain any parts you can repair. In the event of damage occurring to the PLS, contact SICK Service.

Cleaning the front screen

To enable the sensor to function fault-free, you should clean the front screen as soon as slow rhythmic flashing (once per second) of the yellow LED accompanied by a steadily lit green LED signals light contamination.
The PLS will still keep working in this state. Only as the degree of dirt contamination increases will the yellow LED come on steadily, the PLS switches off and the red LED lights up (see "LEDs on the PLS").

Clean the front screen only with a soft cloth and plastic cleaner. Never use rough rags or aggressive cleaning agents such as acetone etc.! Otherwise the front screen may be damaged.

If the front screen is scratched or damaged and needs to be replaced, you can order a replacement from SICK (see Appendix under "Accessories") and replace it yourself.

Replacing the front screen

Notes:
The front screen must only be replaced by trained personnel in a clean environment.

The front screen of the PLS is an optical component which must not be contaminated with dirt or scratched during replacement. Do not use silicon to seal the front screen, as the ensuing fumes could endanger the optical function. Mount the front screen correctly to ensure that the housing sealing complies with protection rating IP 65.

Before removing the front screen disconnect the power connector to cut power to the unit!

Please carefully follow the assembly instructions for the PLS "Changing the front screen".

The contamination calibration must be carried out every time the front screen is replaced!

From the menu select **PLS – Extras – Calibration of contamination measurement**.

Note:
The contamination calibration may only be carried out immediately after replacing the front screen.

The new front screen must not be contaminated with dirt when the calibration is performed.

11.1 SICK-Service / Hotline

If a fault occurs (e.g. the yellow LED is flashing rapidly, at around 4 times per second), be sure that your first step is always to carry out the fault diagnosis in the PLS user software. You can find more details on this in Chapter 9 under "Interrogate fault memory – System diagnosis". This SICK diagnosis function will provide you with detailed information about the fault which has occurred. You can find out about what the fault code means from the fault table in Section 11.3, and ascertain whether you can rectify the fault yourself.

If you are unable to rectify the fault yourself, please contact your nearest supplier.

Print out the fault report produced by the SICK Diagnosis function and have it to hand when you contact SICK Service.

If you need to send in the PLS, please also enclose the fault report together with the completed Service questionnaire. You will find a master copy of the Service questionnaire in Section 11.4.

If you are having difficulties or are unsure about how to use your PLS, please contact our hotline. You can reach it under Tel. (++49) 7681 / 202-3134 or Fax (++49) 7681 / 202-3130..

SICK also offers an Installation and Commissioning service package. Our Service department will be able to help you if you need further assistance.

11.2 LEDs on the PLS

The PLS has three light-emitting diodes (LEDs), which deliver important information.

In this regard also refer to the description of the PLS/LSI user software as from Chapter 9, which gives detailed information about programming the fields and outputs.

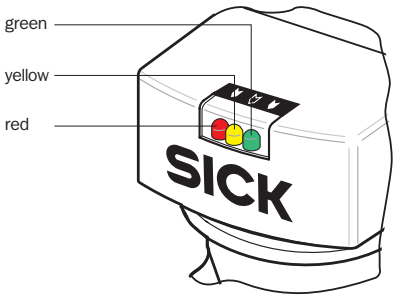
Red and green LEDs:

The red and green LEDs indicate the status of the protective field and the protective outputs (OSSDs).

Yellow LED:

The yellow LED indicates whether the warning field has been infringed or the front screen of the sensor is contaminated with dirt. You can set which option you want in the PLS/LSI user software. The description of the user software, Section 9.3, gives detailed information on setting the “Weak Signal” output.

Also, in conjunction with the red LED, this yellow LED indicates whether the sensor is awaiting release (restart).



PLS LEDs:

Status	green	yellow	red
Protective field clear	⩾◎⩽		
Object in protective field			⩾◎⩽
Object in warning field		⩾◎⩽	
Wait for restart		⩾◯⩽ 1 Hz	⩾◎⩽
Contamination warning *		⩾◯⩽ 1 Hz	
Contamination *		⩾◎⩽	⩾◎⩽
Self-test negative **		⩾◯⩽ 4 Hz	⩾◎⩽

⩾◎⩽ = LED on
⩾◯⩽ 1 Hz = LED flashes slowly
⩾◯⩽ 4 Hz = LED flashes quickly

Output level:

Status	OSSD Output	Warning field output (Weak) Error
Protective field clear	⎍	
Warning field clear		⎍ 1)
Object in protective field	⎍	
Object in warning field		⎍ 1)
Wait for restart	⎯	⎯ 2)
Contamination warning *		⎍ 1)
Contamination *	⎍	⎍
Self-test negative **	⎍	⎍⎍⎍ 4 Hz
Start test	⎯	

1) dependent on programming
2) priority over warning field / Weak message

* Clean front screen with plastic cleaner and a soft cloth.
** Perform system diagnosis. (see Section 9.11)

11.3 PLS Fault table

For safety reasons your PLS continuously performs self-test routines to guarantee fault-free functioning of the unit in case of danger. If one of these tests fails when the system is starting up or during operation, the PLS automatically shuts down the dangerous machine or plant as a safety precaution.

This table enables you to find out whether the SICK diagnosis fault codes mean, and whether you can rectify the fault yourself. How to execute the SICK diagnosis is described in Section 9.11.

Note:
If you get a fault code which you cannot find in the table, please contact SICK Service.

Error code:	Cause / What you can do about it:
2–16	**Internal error:** Cut the power to the PLS for at least 3 seconds. If the problem persists, contact the SICK Hotline.
17–20	**Dirt contamination of the front screen:** Clean the front screen or replace it. The contamination calibration must be performed every time the front screen is replaced!
24	**Mutual interference between several PLS units:** Eliminate the interference by changing the PLS mounting configuration. Follow the mounting instructions in Chapter 7. **Motor speed incorrect:** Operating at low temperatures. Observe the specifications of the unit (see Technical data).
27	**External circuitry of OSSD 1 faulty:** Check the wiring of the external circuitry. Test for short-circuit in the shutdown path to 0 volts, to 24 volts and to the second shutdown path. Make sure the resistive and capacitive load on the shutdown path complies with the unit specifications. Also test the connectors and the crimping of the cabling. **Undervoltage in power supply to unit:** Make sure the power supply to the unit complies with the specification (see Technical data). Measure the voltage directly on the PLS to take account of any voltage drop resulting from long supply lines.
28	**External circuitry of OSSD 2 faulty:** See error code 27 **Undervoltage in power supply to unit:** See error code 27
29	**Motor speed incorrect:** Operating at low temperatures. Observe the specifications of the unit (see Technical data).
31	**Sensor dazzled while measuring:** Check whether the PLS is being dazzled by an external light source, e.g. headlights, infrared light sources, sun etc. Slightly altering the location of the PLS may be sufficient to solve the problem (to do this observe the mounting instructions described in Chapter 5). If you are using the PLS on a driverless transport system, check whether the application variant “Vehicle protection” has been selected.

Error code:	Cause / What you can do about it:
32	**Object detected in the protective field:** Check the ambient conditions. Adjust the PLS configuration to the ambient conditions.
33	**Object detected in the protective field:** Check the ambient conditions. Adjust the PLS configuration to the ambient conditions.
41	**Shutdown paths are not interacting correctly:** See error codes 27 and 28, for undervoltage in the unit power supply see error code 27.
42	**Sensor receiving no data over 90° of its measuring range:** To ensure fault-free functioning of the sensor, make sure it is always receiving readings within a range of 90°, and is freely adjustable within the scanning area. In area protection this is normally always the case, so the PLS signals the fault after three seconds. In vehicle protection a condition of this kind may occur briefly while the vehicle is moving across the hall, so the unit only signals this fault after two hours.

11.4 Service questionnaire

On the following page you will find our Service questionnaire. This is designed to record all relevant data relating to any PLS laser scanner sent in to us.

Based on the information you give, we are able to take all necessary measures straight away to ensure your scanner is returned to you as soon as possible.

Please return the completed questionnaire with the scanner.

Sick AG, Seb.-Kneipp-Straße 1, D-79183 Waldkirch, Tel.: (++49) 7681 / 202 - 3134, Fax: - 3130

PLS - Service Questionnaire

By completing the questionnaire below you will help us by carrying out fault diagnosis. As soon as we have the following details, we will get back to you as quickly as possible. This makes efficient handling of queries possible.

Company _____

Contact _____ Sick contact _____

Adress _____

Phone _____ Fax: _____

Hardware as per rating plate: PLS model: PLS _ _ _ - _ _ _
Order number: 1 0 _ _ _ _ _
Device number: _ _ _ _ _ _ _ _

Software: PLS user software version: 0_ . _ _
– Select “About User Software” from the “Help” menu.

Sensor status: Please enclose printout:
– Log on to the user software as an “Authorised Client”.
– Select “SICK diagnosis” from the “Sensor” menu.
– Select, add, run and save the telegrams “Read sensor status” and “Read fault memory”.

Application: Area protection ❑ Mobile application ❑

Problem: _____

_____

_____

If the yellow LED is flashing rapidly (4 times per second):

– Is the voltage to the PLS power connector in the permissible range?

no ❑ yes ❑ Please enter the mean voltage: _____V

If the red LED is flashing rapidly (approx. 2 times per second):

– Does the 24 V power pack of the PLS have a load capacity of at least 1.5 A? no ❑ yes ❑

If the red LED is active:

– Where is the protective field being infringed? Interior ❑ Edges ❑

– Please describe the application and any critical ambient conditions:

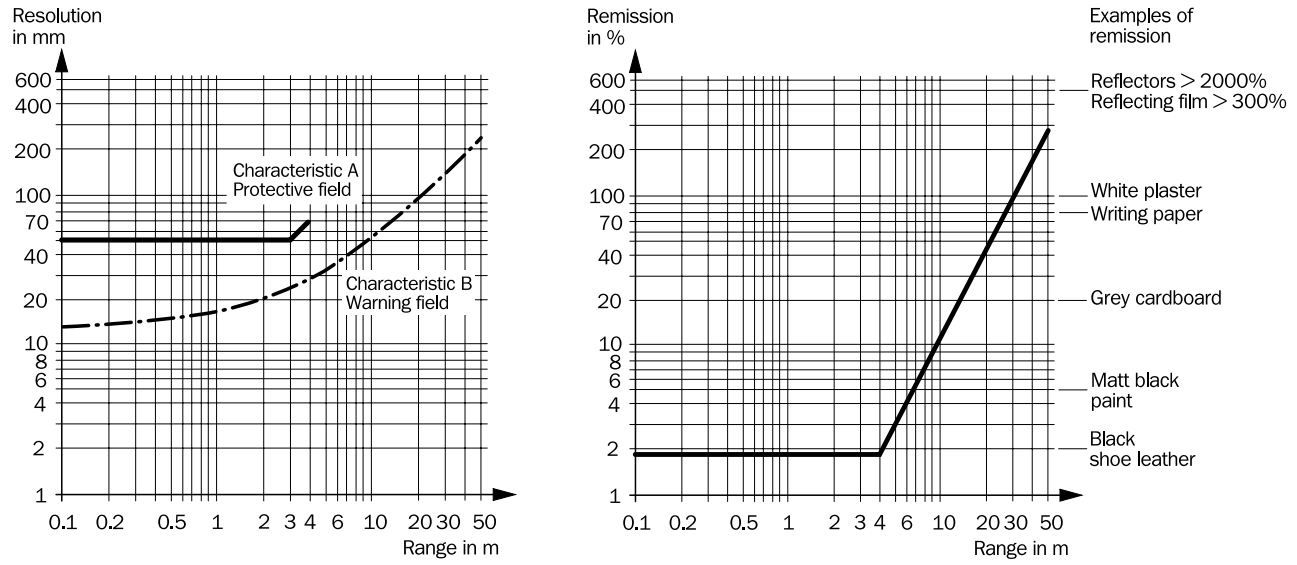
_____

_____

_____ Sketch of application on back: yes ❑ no ❑

12 Appendix

12.1 Characteristics



Characteristics:
Correlation between reflectance of object, range and resolvable object diameter.
The given remission relates to a worst-case contaminated front screen.

12.2 Accessories

Note:
If you want to deploy one or more PLS together with an LSI (Laser Scanner Interface), you will find the necessary accessories listed in the appendix to the technical description of the LSI.

	Order No.
Certified to IEC/EN 61496:	
PLS 101-312	1 016 066

Mounting kits

	Order No.
Mounting kit 1, inc. screws for PLS	2 015 623
Mounting kit 2, inc. screws for mounting kit 1	2 015 624
Mounting kit 3, inc. screws for mounting kits 1 and 2	2 015 625

Connection set

Instead of connection set 1, which is supplied as standard, you can order one of the connection sets 2 to 7, which include a cable fitted to the power connector (cable outlet upward). Various cable lengths are available:

	Order No.
Connection set 1, power and interface connectors without cable	2 016 184
Connection set 2, with 3 m cable	2 016 185
Connection set 3, with 5 m cable	2 016 186
Connection set 4, with 10 m cable	2 016 187
Connection set 5, with 15 m cable	2 016 188
Connection set 6, with 20 m cable	2 016 189
Connection set 7, with 30 m cable	2 016 190

Interface cables

For RS 232

	Order No.
Interface cable 3 m	2 016 401
Interface cable 5 m	2 016 402
Interface cable 10 m	2 016 403

For RS 422

	Order No.
Interface cable 3 m	2 019 130
Interface cable 5 m	2 019 131
Interface cable 10 m	2 019 132

Documentation and PLS/LSI user software

WIN 3.11™ on request

for WIN95™ /WIN98™ /WIN NT™

Technical description, German, with user software	2 021 899
Technical description, English, with user software	2 021 900
Technical description, French, with user software	2 021 901
Technical description, Spanish, with user software	2 021 902

Other SICK accessories

	Order No.
Power pack 24 V, 2.5 A	6 010 361
Power pack 24 V, 4 A	6 010 362
Interface module LCU-X	1 013 410
Switch device PNOZ 8 24V	6 010 810
Replacement front screen (with seal and screws)	2 022 271
Anti-static plastic cleaning agent, 1 litre	5 600 006

And also ...

You can obtain the following accessories as required from computer equipment suppliers:

– Interface adapter 9-pin (plug) to 25-pin (socket):
  If you want to connect a PC which only has a 25-pin serial port connector.

– Crimping tool:
  If you want to self-assemble your power and interface connectors.
  Available, for example, from:
  Harting KG
  32325 Espelkamp
  Phone +49 (0)5772/47-0; Fax +49 (0)5772/47-461
  “Hand-held crimping tool for single contacts”
  Order no. 0999 000 0175

12.3 Technical data

Here you can find the key technical data of the PLS.

Note:
If you want to deploy one or more PLS together with an LSI (Laser Scanner Interface), please also refer to the technical data of the LSI (see the technical description of the LSI).

Electrical details

Viewpoint for the nominal values is the plug corner (unless stated otherwise).

Properties	min.	Type details	max.	Comments
Supply voltage (Uv)	16.8 V	24.0 V	28.8 V	Non-transposable, via safety isolating transformer as per EN 60742 (also charger on transport vehicles)
Permitted residual ripple (V_{RMS})			500 mV	The limit values of the supply voltage may not be exceeded or fallen below.
Response time (adjustable via multiple evaluation)				
two-fold			2 x 40 ms	
sixteen-fold			16 x 40 ms	
Start times				
With power ON		6 s		
Consumption (without load)			17 W	
RESET / RESTART input				Necessary: command unit for operating mode with restart inhibit: make contact against VCC_EXT (Uv), dynamically monitored
Input resistance at HIGH		5.9 kOhm		
Voltage for HIGH	15 V		Uvmax	
Voltage for LOW	0 V		4.2 V	
Power consumption (HIGH)				
Initial impulse current (with $\tau = 100$ µs)	3.0 mA		6.6 mA	
Static input current	2.2 mA		5.2 mA	
Power consumption (LOW)				
Initial impulse current (with $\tau = 100$ µs)			0.9 mA	
Static input current			0.5 mA	
Temporal key behaviour (safe restart detection)				
LOW level before restart	120 ms			
HIGH level during restart	120 ms		5 s	
LOW level after restart	> 1 ms			

Properties	min.	Type details	max.	Comments
Warning field output (PNP)				
Voltage: warning field clear		Uv - 2.5 V		
Voltage: warning field clear	13.4 V			when Uv = 16.8 V
Switching current (apply relation to EXT_GND)			100 mA	
Temporal output behaviour **without restart inhibit**	Deactivation is dependent on the multiple evaluation, but activation is not			
Deactivation after WF infringement (2-fold evaluation)			127 ms	
Activation when warning field (WF) clear			40 ms	
Temporal output behaviour **with restart inhibit**	Dependent on the multiple evaluation			
Deactivation after WF infringement (2-fold evaluation)			127 ms	
Activation when warning field (WF) clear	Restart necessary			
Temporal output behaviour **after n seconds**	Dependent on the multiple evaluation			
Deactivation after WF infringement (2-fold evaluation)			127 ms	
Activation when warning field (WF) clear			40 ms	
Short-circuit-protected		yes		
Operating sequence			3 Hz	
Load inductance			2 H	
Protective outputs (OSSDs) - dynamic (HIGH active)				
Switching voltage HIGH active (Ueff)		Uv - 2.5 V		
Switching voltage HIGH active (Ueff)	13.4 V			when Uv = 16.8 V
Voltage LOW	0 V		2.5 V	
Switching current (applied to EXT_GND)	4 mA		250 mA	
Temporal output behaviour **without restart inhibit**	Dependent on the multiple evaluation			
Activation when protective field clear		190 ms		
Temporal output behaviour **with restart inhibit**	Dependent on the multiple evaluation			
Activation when protective field clear		580 ms		
Temporal output behaviour **after n seconds**	Dependent on the multiple evaluation			
Activation when protective field clear		3 s		

Properties	min.	Type details	max.	Comments
Short-circuit-protected	By monitoring outputs			
In event of error: leakage current			2.1 mA	Event of error: interruption of GND line. The post-switched control element must recognise this condition as Low.
Pure load capacity			100 nF	
Operating sequence			3 Hz	
Pure load inductance			2 H	At low operating sequence, the max. permitted load inductance is higher
Arc-suppression element (RC combination)		without		
Load low-pass behaviour (limit frequency)			500 Hz	see test pulse data
Test pulse data				The outputs are cyclically tested in activated status (in short: LOW switching). When selecting the post-switched control elements, ensure that the test pulse cannot cause a shutdown when using the parameters given above.
OSSD 1				
Test pulse width		55 µs		
Test pulse frequency		every 40 ms		
OSSD 2				
Test pulse width		55 µs or 460 µs		
Test pulse frequency	Alternating every 40 ms			
OSSD 1 und OSSD 2				
Test pulse width		55 µs		
Test pulse frequency		3 s		
Cable specification				
Cable length			30 m	
Cable cross-section			0.5 mm^2	
Permitted cable impedance			2.5 Ohm	

Properties	min.	Type details	max.	Comments
Optical details				
Scan angle		180°		
Angular resolution		0.5°		
Protective field				
Range (radius)			4 m	
Object remission	1.8 % (diffuse)		Reflector	
Resolution	70 mm			
Safety categories				
DIN V 19250	Requirement category 4			
EN 954-1	Category 3	Category 3	Category 3	
IEC/EN 61496-1	Type 3	Type 3	Type 3	The EU type test was carried in line with BiA test recommendations which, in the essential parts, comply with the current standards proposal for IEC 61496-3: 1999.
Warning field				
Range (radius)			50 m	
Remission at 15 m and 80 mm object diameter		20 %		
Safety category		none		
Measuring area				
Range (radius)			50 m	
Remission		Diagram (see p. 67)		
Resolution of distance measurement		± 50 mm		
Measuring error ≤ 2 m distance			94 mm	
Measuring error ≤ 4 m distance			131 mm	
General data				
Electrical connection	Plug-in connection box, for 0.5 mm^2 screws; crimp connection, PG 9			
Interface	universal (RS 232 / RS 422)			When assembling the cables yourself, make sure that the cable shielding is attached. Contacting the shielding at both ends is recommended if a RS 232 connection is being used. When deploying an RS 422 connection, the shielding should only be connected to one end. The shielding should be applied to the computer (or LSI).

Properties	min.	Type details	max.	Comments
Transfer rate				
RS 232	9600 Baud		56 kBaud	
RS 422	9600 Baud		500 kBaud	Permanent computer link-up only permitted with RS 422.
Cable length				
RS 232			15 m	
RS 422			100 m	
No. of multiple evaluations	2		16	
Restart after n seconds	2		60	
Laser protection class		1		
Enclosure rating	IP 65, to EN 60529			
Protection class	totally insulated, protection class 2			
Temperature range				
Ambient operating temperature	0° C		50 ° C	
Storage temperature	-25° C		70 ° C	
Humidity	DIN 40040, Table 10, code letter E, moderately dry			
Sender	Infrared laserdiode			
Wavelength	885 nm	905 nm	935 nm	
Receiver				
Acceptance angle	± 0,5°		± 1°	
Housing				
Material	Die-cast aluminium			
Front screen				
Material	Polycarbonate			
Surface	Scratch-proof coating on front			
Vibration	IEC 68, Parts 2 - 6, Table c2			
Frequency range	10 ... 150 Hz			
Amplitude	0.35 mm or 5 g			
Single shock	IEC 68, Parts 2 - 27, Table 2, 15 g / 11 ms			
Continuous shock (1000)	IEC 68, Parts 2 - 29, 10 g / 16 ms			
Interference immunity (EMC)	IEC 61496-1, EN 61000-6-4:2001-10 DIN 40839-1 and -3			
Weight (net)		approx. 4.5 kg		
Dimensions (W x H x D)	155 mm x 185 mm x 156 mm			
Colour		RAL 1021		

12.4 Standards and regulations

The following lists the key standards and regulations applicable to the use of optoelectronic safety devices in Europe and in the Federal Republic of Germany. Depending on the field of application, additional regulations may be of importance for you. You can get information on other device-specific standards from local regulatory authorities, or from professional bodies. If the machine or vehicle is operated in a country not belonging to the European Union, we recommend contacting the plant operators and the local authorities.

Regarding the use and installation of safety devices:

Machine Directive 89 / 392 EEC

Safety of machines – Basic terms, general design guidelines (EN 292)

Safety of integrated manufacturing systems (DIN EN 1921)

Safety of machines – Electrical equipment on machines – Part 1: General requirements (EN 60204)

Safety of machines – Safety distances to prevent reaching hazardous areas with upper limbs (EN 294)

Safety requirements for robots (EN 775)

Safety rules for non-contact safety devices on power-driven machinery (ZH 1 / 597)

Safety of machines – Arrangement of safety devices with regard to approach speed of body parts (EN 999)

Safety of machines – Risk assessment (EN 1050)

Regarding construction and equipping of safety devices:

Safety of machines – Non-contact safety devices – Part 1: General requirements (EN 50100-1 and -2 / DIN VDE 0113, Part 201)

Basic safety observations for instrumentation and control safety devices (DIN V 19250)

Safety of machines – Electrical equipment on machines – Part L: General requirements (EN 60204)

Safety of machines – Safety-related components of controls – Part 1: General design guidelines (EN 954)

On these subjects please also order our brochure “Safe machines with optoelectronic safety devices”.

12.5 Notes on non-certified PLS types

The PLS type 201-313 is not certified as a safety device. Therefore, subject to risk assessment, it may not be suitable for personal protection.

The main part of this description deals only with the certified PLS type PLS 101-312.
In the following you can find all the relevant information relating to the non-certified PLS type PLS 201-313. The information given here replaces the corresponding sections in the main part of the description.

1 Approvals and Certificates:

SICK

EC Declaration of conformity

en

Ident-No. : 9051806/O544

The undersigned, representing the following manufacturer

SICK AG
Industrial Safety Systems
Sebastian-Kneipp-Straße 1
79183 Waldkirch
Deutschland

herewith declares that the product

PLS201-313

is in conformity with the provisions of the following EC directive(s) (including all applicable amendments), and that the standards and/or technical specifications referenced overleaf have been applied.

Waldkirch, 9.6.2004

ppa. Dr. Plasberg
(Manager Research and Development)

i.V. Knobloch
(Manager Production)

2 Notices / Regulation Use:

The PLS type 201-313 is not certified as a safety device. Therefore, subject to risk assessment, it may not be suitable for personal protection.

The recommendations regarding mounting apply.

3 How the PLS works:
This chapter applies.

4 Fields of Application - What the PLS Can Do:
Not relevant.

5 Location Planning:
5.1 Not relevant.
5.2 Only relevant for collision protection if danger to persons resulting from a collision can be excluded.

6 Supply Package:
This chapter applies

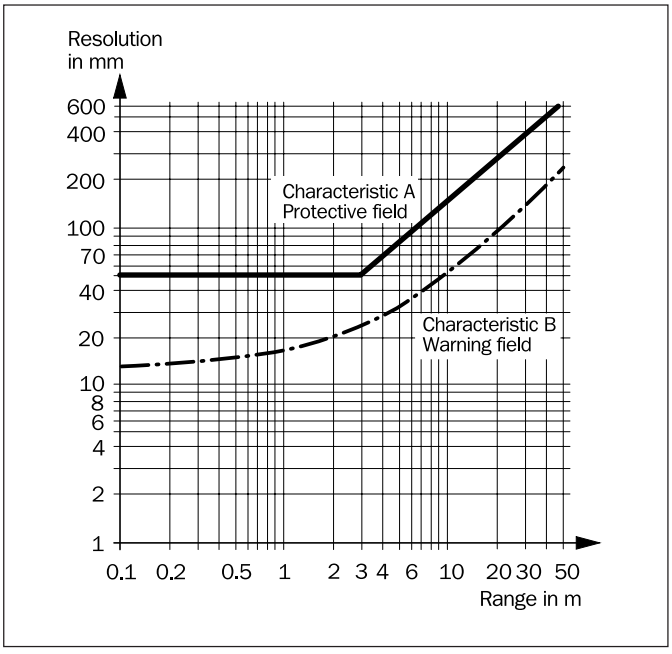
7 Mounting the PLS:
This chapter applies

8 Connecting Up the PLS
Not relevant.

9 Programming the PLS with the PLS / LSI User Software
This chapter applies

10 Care and Maintenance
This chapter applies

11 Appendix
Technical data: the protective field radius is programmable up to 50 metres. Since the resolution dependent on the distance from the scanner is more than 70 mm, the PLS type 201-313 may not be used for personal protection subject to risk assessment. Therefore a test in accordance with IEC 61496 is also irrelevant.
The resolution of this scanner is shown in the adjacent diagram.



13 Glossary

Start-up testing

When the power has been connected the sensor releases the plant only after the protective field has been infringed intentionally once.

Fault memory

A code describing the occurring fault is written to the fault memory. This error code can be read-out by the SICK diagnosis system to provide initial fault analysis.

DTS

Driverless Transport System (industrial conveyors).

Measurement zone

The field of vision of the PLS is its measurement zone. It is heavily dependent on the remission of the object struck, but without special measures also extends to around 15 metres. When using heavily reflective materials the maximum range of the 50 metres is also achievable.

With the PLS the distance to objects can also be measured in order to display them on the PC (via the computer interface) or to carry out any other evaluations on the computer.

OSSD

The OSSD outut is the switching output of the PLS. This is semiconductor based, and its fault-free functioning is tested periodically. The PLS has two parallel-working OSSD outputs, which for safety reasons must be evaluated on two channels.

Remission

The remission describes the diffuse reflectance of surfaces.

Protective field

In the “close-up zone” (radius 4 metres) the PLS offers a sensor field with fail-safe accident prevention functions in accordance with category 4 of DIN 19250 – for area protection but also as a (non-tactile) bumper replacement.

Segmented field

Protective fields are handled in segmented form; that is to say, a protective field consists of triangular areas touching each other at the edges of the field. You can freely select the number of segments on which a field is based between 90, 180 and 360. You should note, however, that the earlier PLS/LSI user software version 3.0X was only capable of processing 180 segments. If you programme a field with 360 segments using the new user software version 3.2X and view it subsequently using the old software, the display may be distorted.

Sensor status

The sensor status characterises the overall state of the system in detail. The data it contains is required to analyse the system.

Verification of the protective field

To ensure the registered contour really matches the area being protected, especially when teaching-in a protective field, it is necessary to “show” the sensor the desired field a second time as confirmation. This is done in the so-called verification process by slowly running a target board over the contour along the inside of the protective field (toward the sensor), but no more than 70 cm from the edge of the protective field. The process can be tracked on-screen by following the change in beam colour from red to green.

Warning field

The warning field is a sensor field with a radius of up to 50 metres. It can be used to monitor larger areas and to trip simple switching functions (e.g. warning functions) or to switch a driverless transport system to slow running.

Restart inhibit

A device for preventing a plant from being automatically restarted after activation of the sensor function during a hazardous part of the machine cycle, after altering the operating or activation mode, or after changing the start control device on the machinery.

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