Laser Scanner Interface
LSI 101

TECHNICAL DESCRIPTION

SICK

QUALITY SYSTEM

certified by DQS according to
DIN EN ISO 9001 Reg. No. 462-03

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This *Technical Description* contains the information you will need for planning, project design and set-up of the LSI.
It describes the mechanical and electrical installation and programming of the LSI.

The description covers the following LSI types:
– LSI 101-11X (certified for personal protection to IEC/EN 61496-1)
The last digit in the type designation (X: 1 to 4) represents the maximum number of connectable sensors.

Refer also to the *Technical Description* for the PLS laser scanner. It contains additional information necessary for planning and installation of the LSI system.

As well as the *Technical Description* you should also have received a set of *Operating Instructions*, providing you with the key information you will need for day-to-day use of the LSI.

Keep the *Technical Description* and the *Operating Instructions* in a safe place where they can be accessed at any time.

The information contained in this document is subject to change without prior notice.

Essential reading:

General safety advice: ..... Section 0
Important information: ..... Section 2
Supply package, Installing and connecting the LSI: ..... Sections 6 to 8
Getting started with the user software: ..... Sections 9.1 to 9.3
Tests: ..... Section 10
Technical data: ..... Section 12.3

0 General safety advice and protective measures

Safety regulations and advice

1. The use and installation of the electro-sensitive protective equipment (ESPE), as well as the commissioning process and routine checks, are subject to national and international legal regulations, in particular

   - Machinery Safety Regulations derived from the Machinery Directive 98/37 EC ,
   - Work Equipment Regulations derived from the Provision and Use of Work Equipment Directive 89/655 EEC,
   - Any applicable safety regulations and
   - accident prevention regulations and safety guidelines.

   The manufacturers and operators of the machinery on which our safety devices are used are solely responsible for ensuring all applicable safety guidelines and regulations from the relevant authorities are observed and complied with.

2. **In addition**, our recommendations, **in particular instructions for testing** (see *Tests*) set out in this *Technical Description* and in the *Operating Instructions* (including instructions relating to use, mounting, installation and integration into the machine control system) – must be followed.

3. The tests must be performed by **qualified experts** or by **specially authorised and instructed personnel** and must be documented in such a way as to be able to be viewed and understood at any time.

4. Our *Operating Instructions* must be made available to the **employee** (operator) of the machine on which our safety device is used. The employee must be instructed **by qualified experts**.

5. The appendix to this brochure includes a checklist for testing by the manufacturer and equipment supplier and user.

1 Approvals and certificates

SICK

EC Declaration of Conformity

Under the terms of EC Machine Directive 98/37/EC, Appendix II C, and EMC 89/336/EEC

We hereby declare that the devices

of the product family PLS101-312 / 316 & LSI

are safety components for a machine constructed as per the EC directive 98/37/EC art. 1 para. 2. This declaration will lose its validity if any modification to a device used in the plant is made without prior consultation.

We employ a quality system certified by the DQS (German Quality Assurance Society), No. 462, as per ISO 9001 and have therefore observed the regulations in accordance with module H as well as the following EC directives and EN standards during development and production:

1. ***EC directives***	EC machine directive 98/37/EC EC EMC directive 89/336/EEC as per 92/31/EEC, 93/68/EEC, 93/465/EEC			
2. ***Harmonized standards used***	EN 954-1	Safety-related components of controllers		Edition 96-12
	EN 50081-2	Emitted interference, indust.		Edition 93-08
	EN 61496-1	Safety of mach., active opto-electronic protective devices (AOPD)		Edition 97-12
3. ***Test result***	IEC 61496-1	BWS type 3 (BWS-E)		

Conformance of a type sample belonging to the above-mentioned product family with the regulations from the EC machine directive has been certified by:

Address of notified authority (Germany)	Berufsgenossenschaftliches Institut für Arbeitssicherheit (BIA) Alte Heerstr. 111 D-53757 Sankt Augustin
EC type sample test No.	981092 dated 1998-07-02

The CE mark was affixed to the appliance in conformance with directive 89/336/EEC and 93/68/EEC.

Waldkirch/Br., 2002-05-06

ppa. Dr. Plasberg
(Head of Research & Development
Division Industrial Safety Systems)

ppa. Zinober
(Head of Production
Division Industrial Safety Systems)

The declaration certifies conformance with the listed directives, but does not guarantee product characteristics. The safety instructions contained in the product documentation must be observed.

Mat. No.: 9 051 802

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Vorstand: Anne-Kathrin Deutrich (Sprecherin) • Dr. Robert Bauer • Dieter Fischer • Jens Höhne (Stellvertr.) • Walter Schmitz
Sitz: Waldkirch i. Br. • Handelsregister: Emmendingen HRB 355 W

2 Information for correct use

The LSI protects personnel and property. It is designed for monitoring of danger zones in enclosed areas in conjunction with one or more PLS laser scanners.
Refer also to the instructions regarding intended use. SICK accepts no liability for loss or damage resulting from failure to use the LSI in accordance with its intended purpose.

- Pay attention to the information given in the *Technical Description* to the *PLS* laser scanner. It contains important information on safe operation of the LSI system.
- Install the LSI in a dry location and protect the unit against dirt and damage (IP 54 cabinet).
- The wires for all connectors must be carried outside the control cabinet in separate sheathed cables.
- Lay all cables and wires such that they are protected against damage.
- Avoid strong electrical fields such as from welding cables and induction cables in the immediate vicinity, or from mobile phones being operated close by.
- Make sure the connected control system and all other equipment conforms to the required safety level. Make sure the control guarantees prompt switching between monitoring cases. Remember that there may already be someone in the protective field when the switch is made. Safe protection can only be guaranteed by prompt switching (that is, before the danger to the person arises at the location concerned).
- Make sure the input circuit configuration is adequate to the expected ambient conditions, in order to prevent the system from being influenced and resultant errors in monitoring case switching.
- Make sure the response time of the LSI system is adequate in all monitoring cases to protect the danger zone. (The response time of the LSI depends on the scan rate, and is set in the PLS/LSI user software.)
- Make sure any obstacles in the monitoring area do not impede or shadow the fields of view of the connected PLS units.
  If areas of shadowing are unavoidable, check whether they present a risk. Take additional precautions as necessary.
- Keep the monitoring areas free of smoke, mist, steam and other air pollution. The functioning of the LSI system may otherwise be impaired, and error shutdowns may occur.
- In installation and use of the LSI comply with the applicable local standards and regulations. A summary listing of the key regulations is presented in the *appendix*.
- To programme the monitoring areas and cases, refer to the description of the PLS/LSI user software in section 9. It describes how to connect the LSI to a PC and operate it with the user software.
- Note that special parameters are transmitted to a sensor programmed by the LSI. Before it can be disconnected from the LSI and re-used as a stand-alone unit, you will need to deconfigure it using the SICK diagnosis function.
- If you are using the LSI for vehicle protection, note that it can only be used on vehicles with electric motors.
  When operating the LSI on materials handling equipment in narrow aisles, be sure to refer to the *Technical Description* of the corresponding *PLS*.
  If you are using the LSI with PLS type 101-316, note that the response time of the LSI is fixed at 270 ms.
- At the end of its service life, dispose of the LSI in an appropriate, environmentally compatible manner.

3 How the LSI functions

Operating principle

The SICK LSI (Laser Scanner Interface) is an electronic component with which you can interconnect one or more PLS laser scanners and create a system which can be flexibly controlled according to application. This means the LSI system is capable of monitoring complex danger zones on a machine or vehicle.

Sensors, monitoring areas and monitoring cases

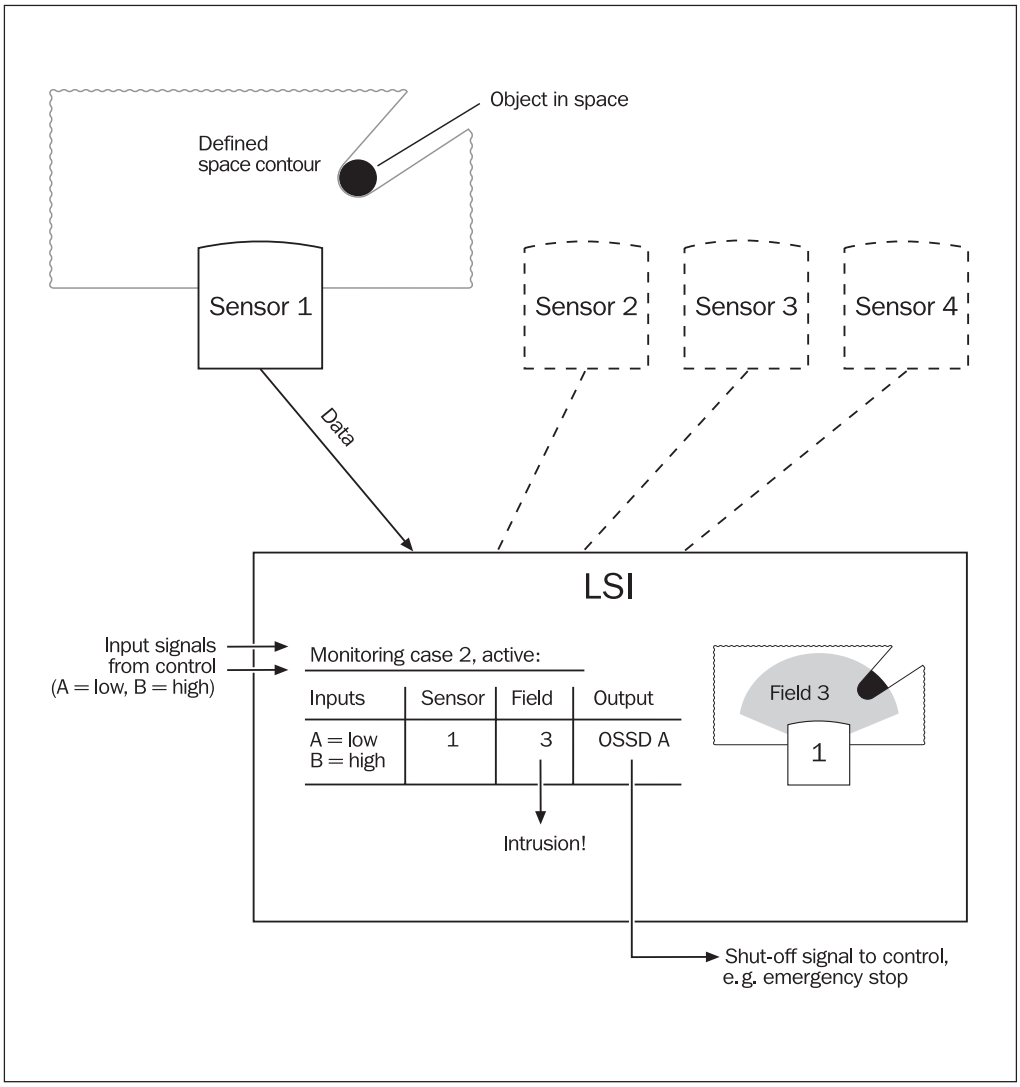
The LSI receives specific input signals from the control, such as input A = low, input B = high. In the LSI the signals activate one of the monitoring cases configured by you using the PLS/LSI user software.

The definition of each individual monitoring case determines which monitoring area (consisting of a protective field and a warning field) is to be monitored by the specified connected sensor.

The active sensor, e.g. sensor 1, transmits the space contour it "sees" to the LSI. The LSI compares the data received from the sensor with the contour of the defined monitoring area.

As soon as the LSI detects an object in the monitoring area, it shuts off the output configured for the case at hand. In the example there is an object in protective field 3, and the LSI shuts off the defined output OSSD A. This output signal is sent to the control, where it triggers a response, such as an emergency stop.

With the aid of the monitoring cases the LSI system can respond flexibly to different input signals and monitor different areas on the sensors depending on the requirements of the situation. Up to two sensors may be active at any one time under the same input conditions (simultaneous monitoring cases).



Evaluation of a monitoring case in the LSI (simplified scheme)

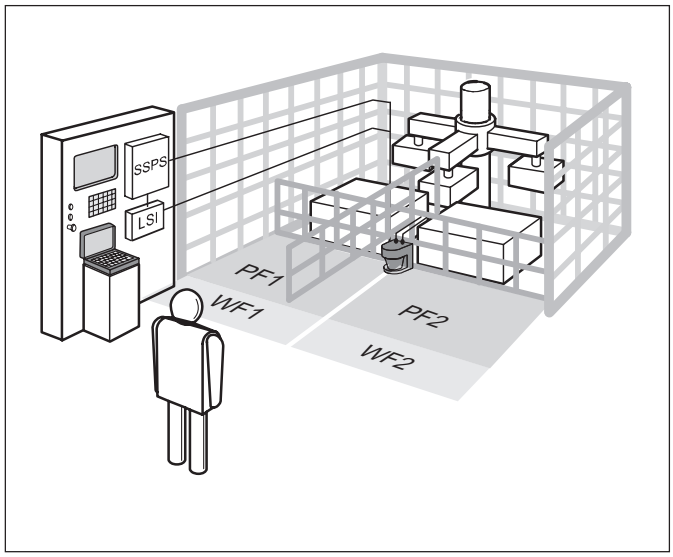
4 Applications of the LSI

This section provides an overview of the key areas of application of the LSI.

Area protection

On machines involving hazardous movement, the LSI in conjunction with one or more PLS units ensures that the machine (or just its hazardous movement) is stopped as soon as anyone enters the danger zone. This is achieved by means of flexibly definable monitoring areas, each comprising a protective field (PF) and a warning field (WF), which are assigned to the connected sensors for monitoring. The LSI is able to guard the interiors of large machines in the same way.

You can define different monitoring cases to adapt the active protective fields to the situation on the machine and to monitor changing danger zones – such as in different production phases of the machine – specific to situation.



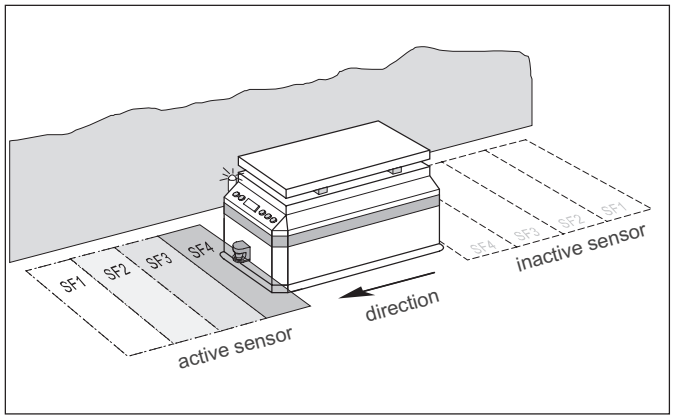
Machining centre with varying loading positions.
Switch signal is initiated by “safe PLC”.

Vehicle protection

You can use the LSI on vehicles (such as on automated guided vehicles – AGVs, forklifts or shunting trucks), in order to guard a vehicle’s route through a factory hall for example. With its connected sensors, the LSI then ensures the vehicle reduces its speed and ultimately stops if a person or other obstacle is in its way. You can guard manually controlled vehicles and automated guided vehicles (AGVs).

Several monitoring cases which you define yourself can be used to monitor different danger zones in different ways, such as when the vehicle is moving forwards or reversing.

You can also record the speed of the vehicle by means of incremental encoders, and thereby adapt monitoring areas of different sizes dynamically related to the vehicle speed.



Automated guided vehicle with direction detector and speed-sensitive protective field switching

5 Planning the LSI system

5.1 General planning information

Sensors:

You can connect up to four sensors to the LSI.
All connected sensors must be of the same type (e.g. four x PLS 101-312).
If you use the system for safety applications, be sure to use safety sensors.
Safety sensors are currently types PLS 1XX-3XX, or any types expressly approved as such in the *Technical Description*.

Monitoring areas:

You can define up to eight monitoring areas. Each monitoring area consists of a protective field and a warning field.

With regard to defining the size of the monitoring areas, refer to the *Technical Description* of the *PLS*. It provides examples of dimensioning for static and dynamic applications.
For the PLS system with LSI the minimum response time is 190 ms. (Exception: If you are using the LSI together with PLS type 101-316 for vehicle protection, note that the response time of the LSI is then fixed at 270 ms.)

Monitoring cases:

To view the monitoring areas on the connected sensors, you can set up to 15 monitoring cases.
A maximum of two monitoring cases may be active at any one time (simultaneous monitoring cases).

Safety and signalling outputs:

The LSI has two independent safety output pairs OSSD (output load per OSSD channel max. 250 mA ≤ 100 nF; reset/restart effective from 0.2 to 5 seconds).
If necessary, you can run external device monitoring (EDM) at each of the safety outputs (permitted tolerance max. 200 ms).

For the output associated with the warning field and device status, the load is max. 100 mA.

Inputs:

The LSI has the following inputs:
– Four binary inputs (A to D) (2-channel, antivalent)
– Two incremental encoder inputs (alternatively to inputs C and D)
– Two reset/restart inputs
– Two EDM inputs (external device monitoring)

5.2 Mobile: For on-board vehicle use

With the aid of incremental encoders you can adapt the size of the monitored area to the speed of the vehicle.

Note:
The two incremental encoders must be installed such that one continues working safely and without error if the other one fails. To this end, mechanical and electrical design measures must be implemented to counter a failure of the incremental encoders. Also ensure that no factors influencing the system (e.g. temperature, shaft breakage, slip) are able to influence the speed recording capability of both incremental encoders simultaneously.

The incremental encoders must meet the following requirements:
– Type: Two-channel rotary encoder with 90° phase offset
– Power supply: 24 V DC
– Outputs: Push/pull outputs
– Protection IP 54 or higher
– Shielded cable
– Max. pulse frequency: 100 kHz
– Min. number of pulses: 50 pulses per cm

Calculate for both incremental encoders the number of pulses the encoders deliver per centimetre of travel with your vehicle travelling straight ahead. You will need these values to configure the PLS/LSI user software (see *section 9.7* and the calculation example in the appendix, *section 12.1*).

Calculating the depth of the protective field on the vehicle:

When calculating the required depth of protective field on a vehicle, you must take into account the fact that the increase in braking distance is quadratic and not linear as the speed rises (see *diagram*).

Note:
For detailed information on calculation of the protective field depth and the necessary safety allowances refer to the *Technical Description* of the *PLS*.

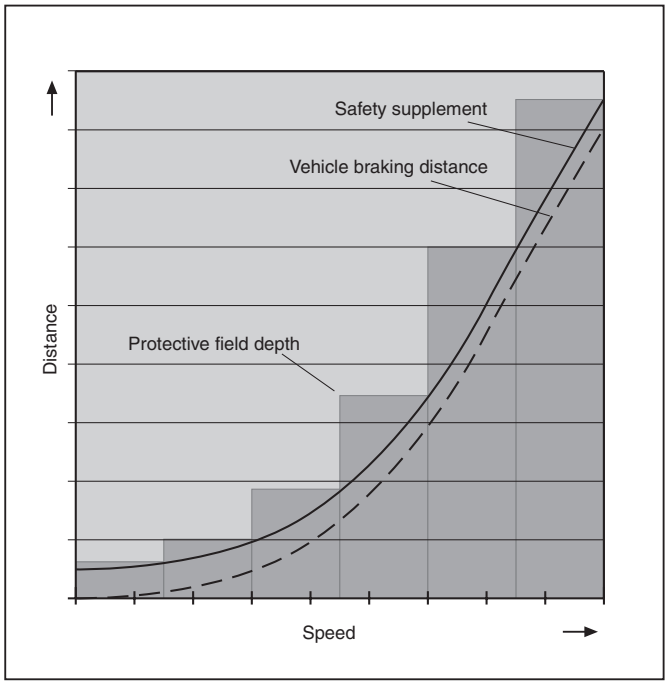
- Define the required speed ranges for your application.
- Calculate the longest braking distance for each of the speed ranges (i.e. the braking distance for the upper speed limit).
- Add the necessary safety allowances to the distance calculated (see *Technical Description* of *PLS*).

This produces the required depth of protective field for each speed range.

- Configure the protective fields with the aid of the PLS/LSI user software, as described in *section 9.7.*

For mobile installations you are recommended to affix an adhesive label or a printout of the configuration on the vehicle as an aid to routine checking of the installation.

For stationary installations you are recommended to mark the outline of the protective field on the floor as an aid to routine checking of the installation.



The braking distance of the vehicle plus the safety allowance produces the necessary protective field depth.

6 Supply package

You should receive:
- the LSI
- a connection set as per your order (see below) (e.g. connection set A: one PLS power plug, one PLS interface connector, one screw-in interface connector to connect the PLS to the LSI)
- one DIN rail bracket (mounted)
- two wall mounting brackets
- the Operating Instructions
- this Technical Description
- 10 plug-in connectors

Note:
No user software is supplied with the LSI.
The PLS/LSI user software as from version 03.21(16-bit)/03.61 (32-bit) is used to programme a single PLS or an LSI system. It is supplied with the PLS (on a 3.5" floppy disk).
Version 03.21 is only shipped on request.

Available connection sets:

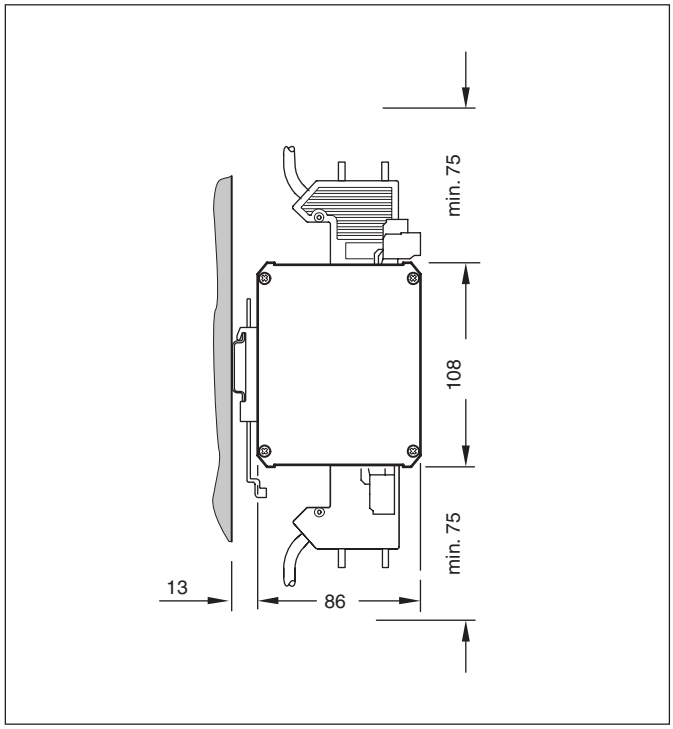
	Order no.
Connection set A 1 PLS power plug, 1 PLS interface connector, 1 screw-in interface connector for sensor connection to LSI, without cable	2 019 065
Various cable lengths are available.	
Connection set B As connection set A, with 3 metre cable	2 019 066
Connection set C As connection set A, with 5 metre cable	2 019 067
Connection set D As connection set A, with 10 metre cable	2 019 068
Connection set E As connection set A, with 15 metre cable	2 019 069
Connection set F As connection set A, with 20 metre cable	2 019 070
Connection set G As connection set A, with 30 metre cable	2 025 902

7 Installing the LSI

The LSI is shipped with a DIN rail bracket. A wall bracket is also supplied.
By mounting the LSI on the wall bracket you can eliminate unwanted vibration effects.

Mounting the LSI on a DIN rail:

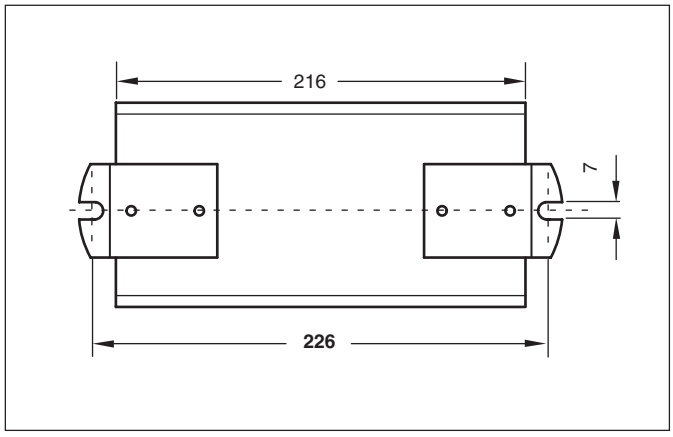
- Mount the LSI as shown in the diagram with a TS 35 standard DIN rail.



LSI with a DIN rail (all dimensions in mm)

Mounting the LSI on a wall:

- Unscrew the DIN rail bracket.
- Attach the supplied wall bracket to the LSI as shown in the diagram.
- Mount the LSI on the wall. Use M 6 size screws.



Mounting the LSI on a wall (all dimensions in mm)

8 Connecting the LSI

8.1 Wiring up the LSI and PLS

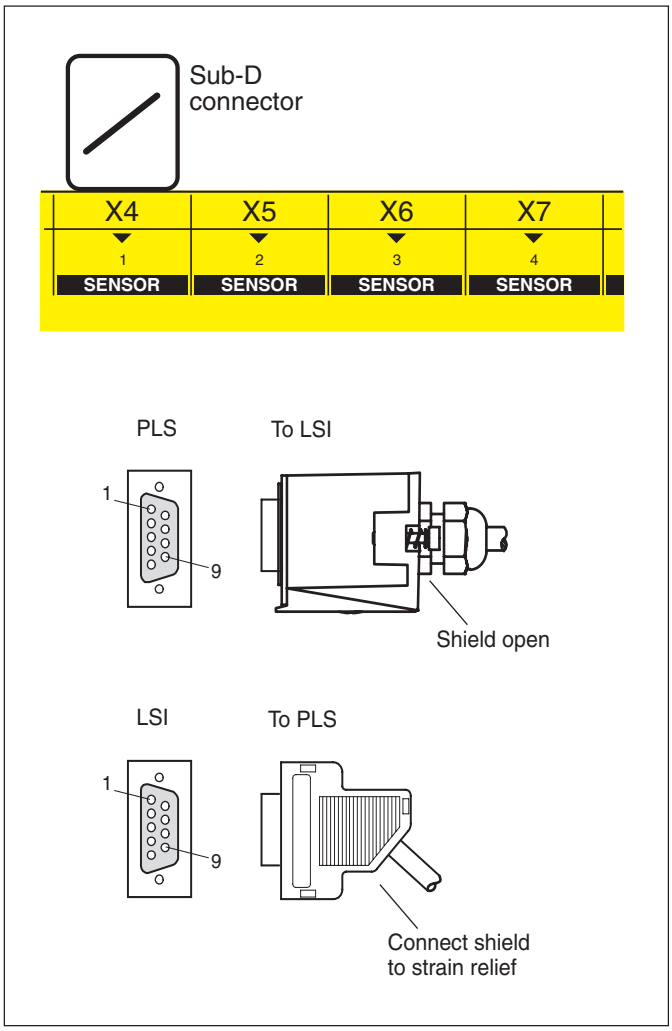
Note:
Also refer to the complete *connection diagram* in the appendix.

Cabling requirements
Communication cable from LSI to PLS:
The communication cable to the PLS must be a shielded twisted pair data cable (“Twisted pair”). On the LSI end be sure to use the accessory 9-pin metallised Sub D connectors, because they are provided with a special shield. Connect the data cable braid to the strain relief on the LSI end only. The braid is not connected at the PLS end. Pay attention to the pin assignment. Use a low-capacitance twisted pair data cable of type Li2YCY (TP) with a cross-section of at least 2 x 2 x 0.25 mm^2.
Max. cable length: 30 m

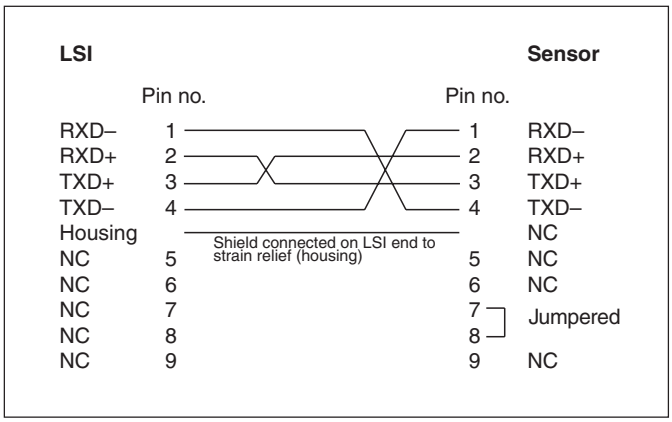
Power supply cable to PLS:
Use a copper cable with a maximum cross-section of 0.5 mm^2.
Max. cable length: 30 m

- Connect the LSI “Power Out +” and “Power Out –” terminals to the power supply terminals on the PLS sensors using 4-pin spring terminal strips.
- Connect the LSI communication terminals (e.g. “Sensor 1”) to the PLS interface.
- Connect the braid to the strain relief on the LSI end. The braid on the PLS end is not connected. Pay attention to the pin assignment.

Note:
The safety outputs (OSSD) of the connected PLS unit(s) must not be used in conjunction with the LSI. Also refer to the complete connection diagram in the appendix.



Connecting PLS to LSI



Pin assignment of the RS 422 interface connector

8.2 Connecting the LSI to the control and the power supply

Note:
Also refer to the complete *connection diagram* in the appendix.

Cabling requirements

Power supply cable to LSI:
Use a copper cable with a maximum cross-section of 2.5 mm^2.
Max. cable length: 50 m

Signal cables from and to the LSI:
Use a copper cable with a maximum cross-section of 2.5 mm^2.
Max. cable length: 50 m

Connecting LSI inputs:

- Connect the inputs (A, B, C, D) of the LSI to the control as shown in the *connection diagram*.
  Use 4-pin spring terminal strips (the supplied WAGO crimp tool will help with wiring).
  Notes:
  Each input requires two signals which must always be mutually inverted (maximum permitted tolerance: 80 ms with 2-scan evaluation).
  If you are using incremental encoders, the binary inputs C and D are occupied and so are not available to you.

Connecting LSI outputs:

- Connect the outputs to the control as shown in the connection diagram.
  Use 4-pin spring terminal strips.
  Note:
  Each safety output (OSSD) may be connected to only one switching element. If several switching elements are required, suitable contact expansion must be provided. Note that in safety-related controls for K1 to K4 you must use relays or contactor relays with positively guided contacts, incorporating the appropriate precautions (protective circuit).

Lay all cables and wires such that they are protected against damage.
The wires for all connectors must be carried outside the control cabinet in separate sheathed cables.

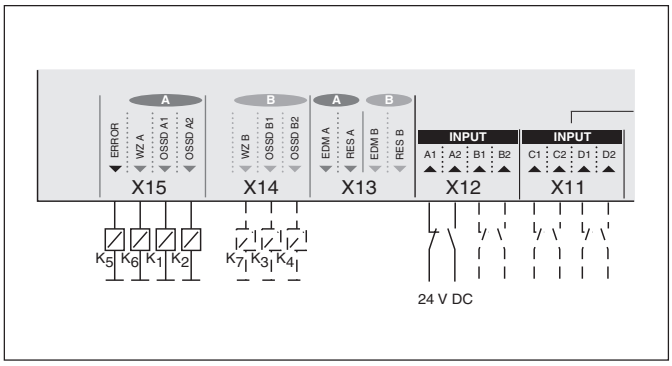
If you are using the LSI to guard danger zones: Make sure the connected control system and all other equipment conforms to the required safety level!

If you have not switched monitoring cases for a long time, carry out a function check of the connected input controller. You can carry out the check in a number of ways:
– Intentional intrusion in the active protective field after switching monitoring cases
  (paying attention to simultaneous monitoring cases!)
– Check by means of the I/O monitor (see *section 9.10*)

Also refer to the complete *connection diagram* in the appendix.

Mark the connectors to prevent inadvertent swapping.

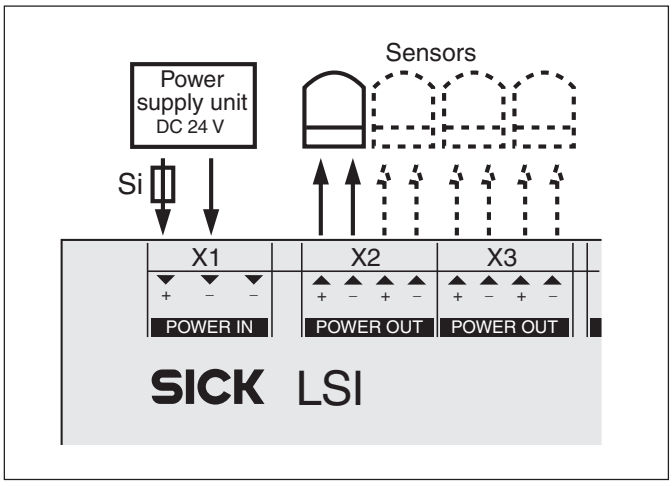
Switching of monitoring cases is initiated by a signal change at inputs A, B, C, D.
When this occurs it must be ensured that the protective effect is maintained and the machine/vehicle is always set to a safe condition.



Connecting LSI inputs and outputs

Connecting the LSI to the power supply:

- Connect the power supply connection of the LSI by way of an appropriately rated fuse to the power supply source, e.g. a 24 V DC power supply unit (transformer with safe isolation to EN 60742; see *technical data* in appendix)
  Use 3-pin spring terminal strips.



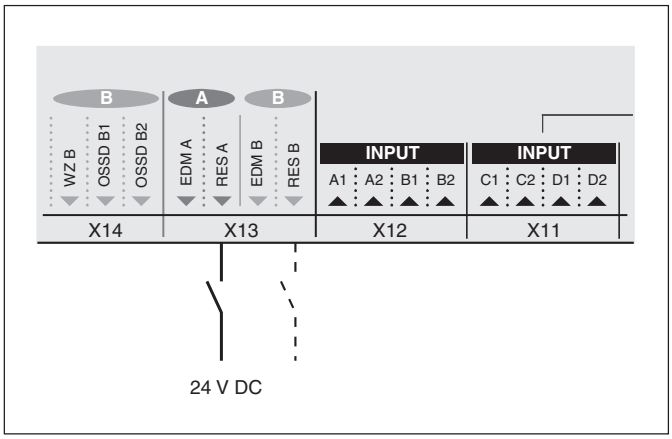
Connecting the LSI to the power supply

Connecting restart buttons as necessary:

- Connect the restart buttons (NO contacts) to inputs “RES A” and “RES B”.
  Use 4-pin spring terminal strips.

Notes:
Outside the switch cabinet “RES A” and “RES B” must be routed in separate sheathed cables.

When mounting the restart buttons,
make sure the button is mounted such that the danger zone is in full view when the button is pressed.



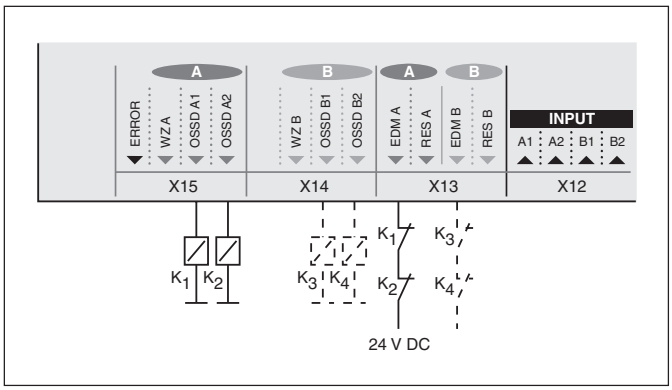
Connecting restart buttons

Connecting an external device monitor as necessary:

- Connect the NC contacts of the contactors to inputs “EDM A” and “EDM B” as shown in the diagram. (K1 to K4 are contacts of the elements which directly control the hazardous movement.)
  Use 4-pin spring terminal strips.

Notes:
Outside the switch cabinet “EDM A” and “EDM B” must be carried in separate sheathed cables.

External device monitoring is activated 200 ms after a switching operation. In the static state the outputs are tested cyclically every 5 seconds.



Connecting an external device monitor

Connecting incremental encoders as necessary:

- Connect two incremental encoders to “Speed Input C” and “Speed Input D”. Use 9-pin metallised Sub-D connectors.

Notes:
If you are using incremental encoders, the binary inputs C and D are occupied and so are not available to you.

The incremental encoders must meet the following requirements:
– Type: Two-channel rotary encoder with 90° phase offset
– Power supply: 24 V DC
– Outputs: Push/pull outputs
– Protection IP 54
– Shielded cables
– Max. pulse frequency: 100 kHz
– min. 50 pulses per cm

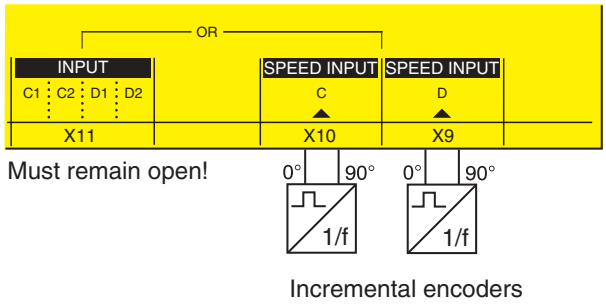
Outside the switch cabinet the connecting wires of the incremental encoders must be routed in separate sheathed cables.

On the LSI end be sure to use the accessory 9-pin metallised Sub D connectors, because they are provided with a special shield.

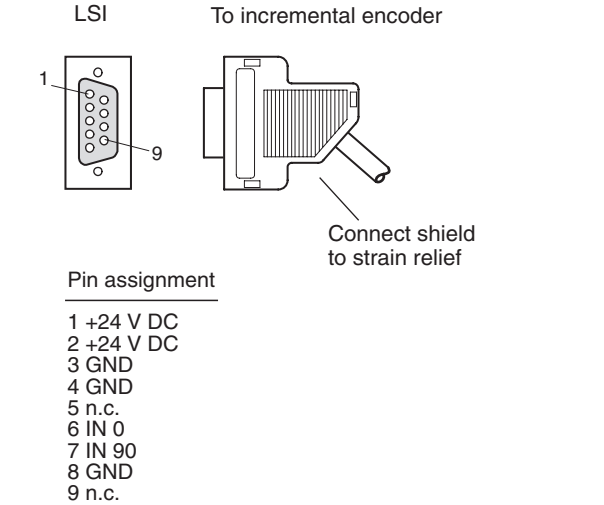
- Connect the shield braid to the strain relief as shown in the diagram. Pay attention to the pin assignment.

Note:
You will find a number of examples of connection and configuration options for the LSI in *section 12.1*.

Make sure your incremental encoders deliver at least 50 pulses per centimetre travelled by your vehicle
(for configuration of incremental encoders see *section 9.7* and the calculation example in the appendix).



Connecting incremental encoders



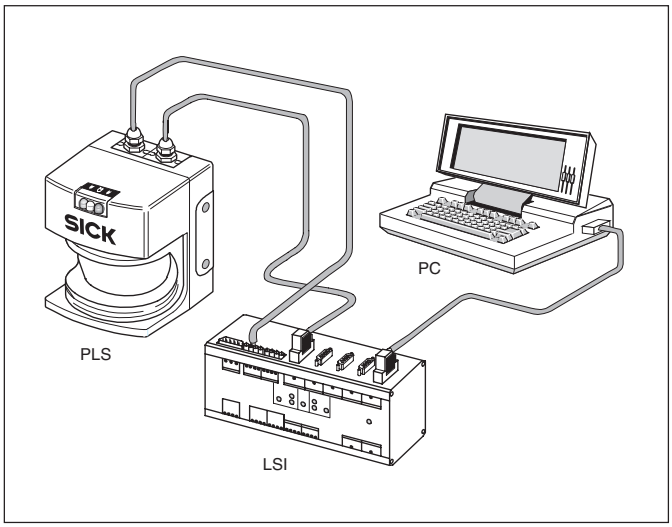
Shielding and pin assignment

8.3 Connecting the LSI to a PC

To configure your LSI system or change settings, you must temporarily connect the PC to the LSI. For this purpose the LSI is fitted with a RS 232/RS 422 interface which enables you to connect quickly and easily between the PC and the LSI.

- Connect the LSI interface RS 232 (COM port) to a free serial port on the PC.
  Use a RS 232/RS 422 interface cable (see “Accessories” in the appendix).

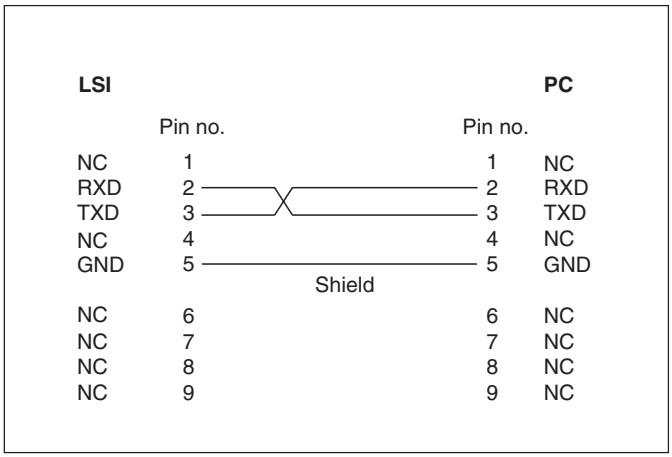
You can then configure the LSI system.



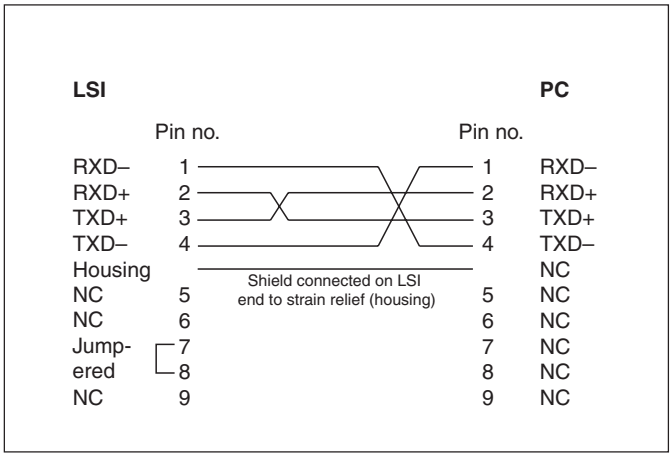
Connecting the LSI to a PC

Notes:
The LSI’s RS 232 interface is set up for connection to the PC. If required, you can reprogramme it to a RS 422 interface by jumpering pins 7 and 8. The “RS 422” LED on the LSI then lights up as an indicator.

The pin assignment of a RS 422 interface is not standardised. Compare the configuration on the connecting cable with the pin configuration on the PC (see diagram) and adapt it as necessary.



Pin assignment of the interface connector in RS 232 mode



Pin assignment of the interface connector in RS 422 mode

9 Programming the LSI – User software

9.1 Installing the PLS/LSI user software

Note:
The PLS/LSI user software as from version 03.21/03.61 is used to programme a single PLS or an LSI system. If you have already installed this user software on your PC for a PLS application you do not need to install any new software for the LSI. You can start programming immediately.
If you have an older PLS/LSI user software version installed on your PC and want to continue using it, enter a different program folder for the new PLS/LSI user software version when installing it.

System requirements

Take note of the relevant hardware requirements of the operating systems listed.

- min. 4 MB available memory on the hard disk
- Windows 95™, Windows 98™ or Windows NT™ 4/SP4 (version 03.21 available for Windows™ 3.11 on request)
- min. 80486 processor
- min. 4 MB RAM
- Colour monitor recommended
- Installed graphics printer driver
- Correctly set date and time (utilised in configuration protocol)

The Install programme guides you through the installation process for your PLS/LSI user software. Simply run the Install programme. To run Install:

- Boot your PC.
- Insert the PLS/LSI programme disk in your PC's floppy disk drive.
- **Under Windows™ 3.11:**
  Choose **File – Run** from the FileManager.
  Windows 95™, Windows 98™ and Windows NT™ 4/SP4:
  Choose **Run** from the Start menu.
- Select and run "Install.exe".
- As necessary, enter the program directory/folder where you want the new PLS/LSI user software to be installed.
- Follow the on-screen instructions.

When the installation is finished a message box appears telling you that the setup has been completed successfully.

The PLS/LSI user software programme has been installed. You can run it any time by clicking on its icon.

9.2 Procedure

Notes:
When the program 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 LSI, you must log on as an “Authorised Client”. How to log on is described in *section 9.3*.

Make sure the LSI and all PLS units are correctly connected, as described in *section 8*.

The status bar at the bottom of the screen contains a colour key for on-screen display of the protective field and warning field.

Essential steps

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

- **Configure hardware:**
  You log the sensors on and select whether you are using the LSI for area protection or for protection on a vehicle. You also define the inputs and outputs and the restart behavior of the outputs.
- **Define monitoring areas:**
  You define the areas to be monitored by the LSI. If you wish, you can also determine the shape and size of the protective fields and warning fields here.
  You can define up to eight monitoring areas.
- **Define monitoring cases**
  For each monitoring case (max. 15) you link a sensor to a monitoring area and define the input conditions under which the monitoring case is to be activated. Here you also define which output is switched when there is an intrusion into the protective field.
  You can also define a specific order of switching between the monitoring cases.
- **Send a configuration to the LSI:**
  You now transmit all the configuration settings you have made to the LSI. You must be logged on as an “Authorised Client” to be able to do this.
- **Edit monitoring areas:**
  Here, if you wish, you have the chance to alter the shape and size of the protective fields and warning fields.
- **Send monitoring areas to LSI:**
  Finally you transmit the protective fields and warning fields to the LSI. For this, too, you must be logged on as an “Authorised Client”.

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

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

Other options

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

- **Edit fields:**
  To edit the protective and warnings fields the PLS/LSI user software provides you with a number of useful editing functions.
- **Teach-in and check protective field:**
  In the teach-in process the active sensor scans the defined space contour, and the LSI generates a protective field from the scan. You can influence the physical extent of the protective field by marking out its contour with a target board, for example. You have to check learned protective fields.
  You can also edit a learned protective field subsequently, just like any other segmented field. (This function is not available for the LSI used with PLS 101-316 .)
- **Adapt protective fields to speed:**
  If you are using the LSI on a vehicle, you can switch between protective fields of different size and shape depending on the speed of the vehicle. In this way you can adapt the monitoring area flexibly to the surroundings and speed of the vehicle. For this, you must connect incremental encoders to the LSI.
- **Simulate monitoring cases:**
  You can check the monitoring case settings by simulating the input conditions on PC . In this way you can check whether the sensors and fields are correctly assigned in every monitoring case.
- **Monitor protective fields:**
  You can monitor the protective fields and warning fields in operation using a connected PC. You can also store the defined space contours of the sensors as a check.
- **Monitor inputs and outputs:**
  You can monitor and log the switching states of the inputs and outputs of the LSI with the I/O monitor. You can save the retrieved data to an ASCII file for further evaluation.
- **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 LSI. You can save any configuration to the hard disk or to a floppy.
- **Change password:**
  To protect your LSI against manipulation, you should change the logon password.
- **Change screen view:**
  You can zoom, unzoom or move the screen view, for example.
- **Interrogate fault memory (system diagnosis):**
  For troubleshooting purposes you can interrogate the fault memory of the LSI and the connected sensors.

9.3 Getting started: Initial configuration

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

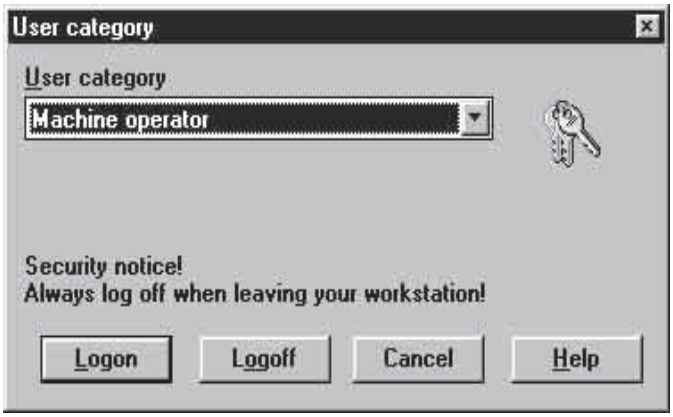
- Switch on your LSI system
  (it takes a few seconds to start up).
- Start the PLS/LSI user software.

The following dialogue box appears:

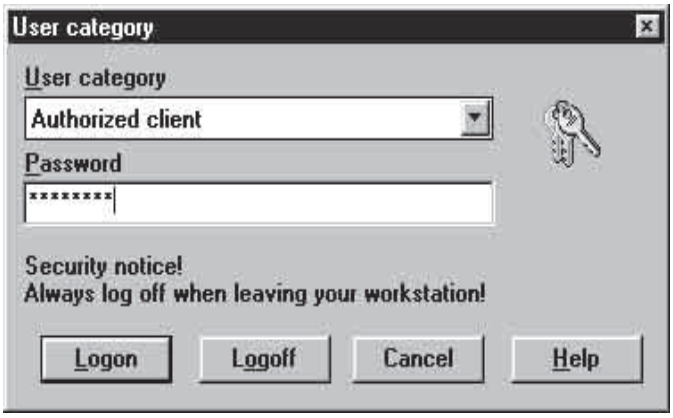
- Click on “Yes”.

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

Note:
To start up the system the desired configuration must always be transmitted from the PC to the LSI.



The following dialogue box appears:
To be able to transmit configuration data and monitoring areas to the LSI subsequently, you must be logged on as an “Authorised Client”.



- Choose “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).

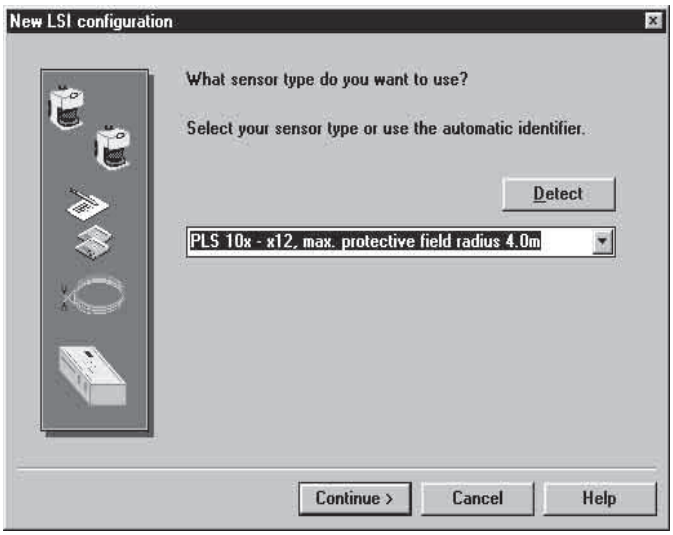
Note:
Always log off when leaving your workstation! This will prevent unauthorised persons from manipulating your LSI system.

Configuring the hardware

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

To create a new configuration:

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



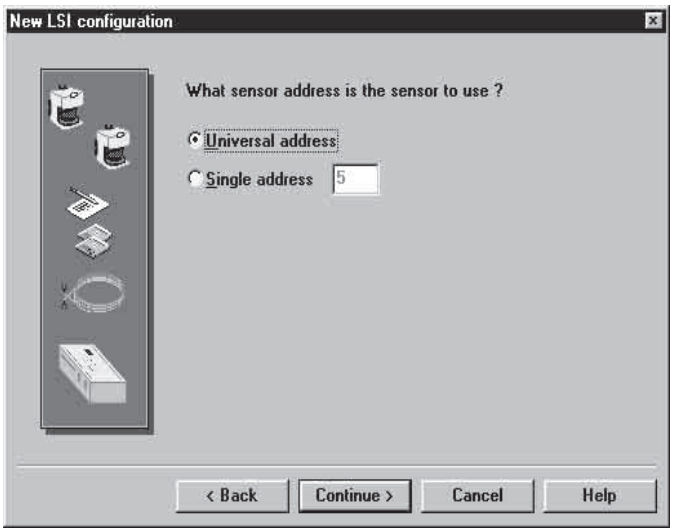
The following dialogue box appears: This is where you set the sensor type you want to work with.

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

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

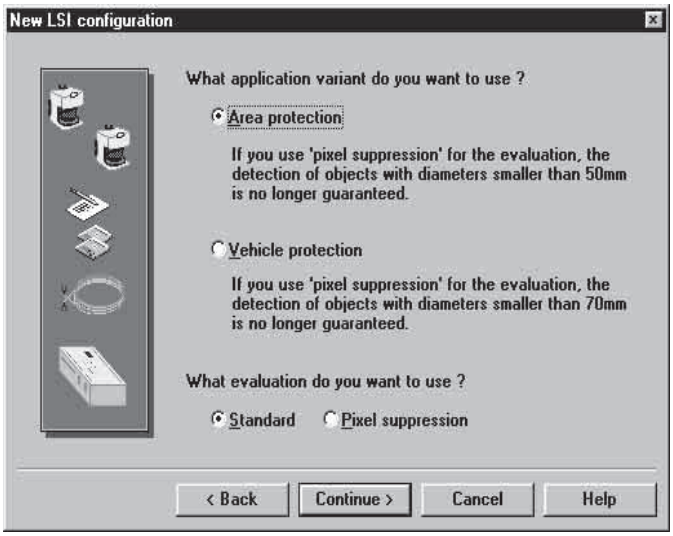
To edit the received configuration:

- From the menu choose **LSI – Configuration – Edit** .
- Or choose the “Edit Configuration” button from the toolbar.



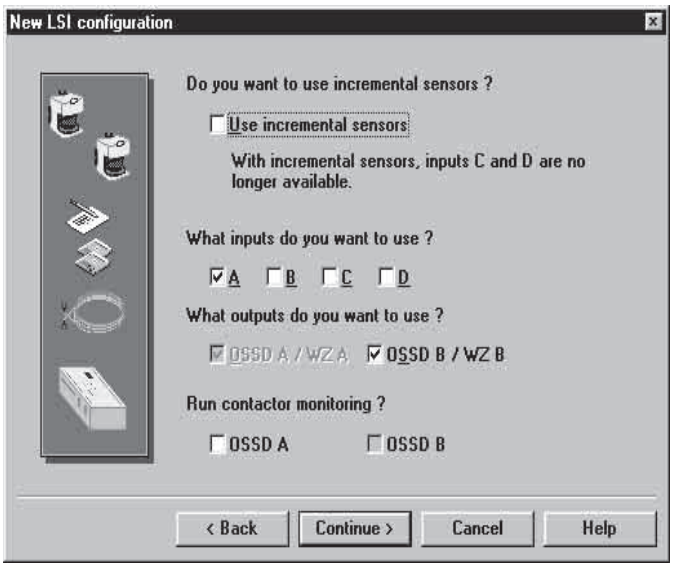
The following dialogue box appears: This is where you set the address under which the LSI and the sensors are to be addressed.

- 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 any other LSI.
  Single address (between 5 and 126):
  If you set “Single address” you assign the LSI 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 LSI match. This makes sense when you want to ensure that a configuration saved as a file can only be transmitted to a specific LSI unit.
- Click on “Continue”.



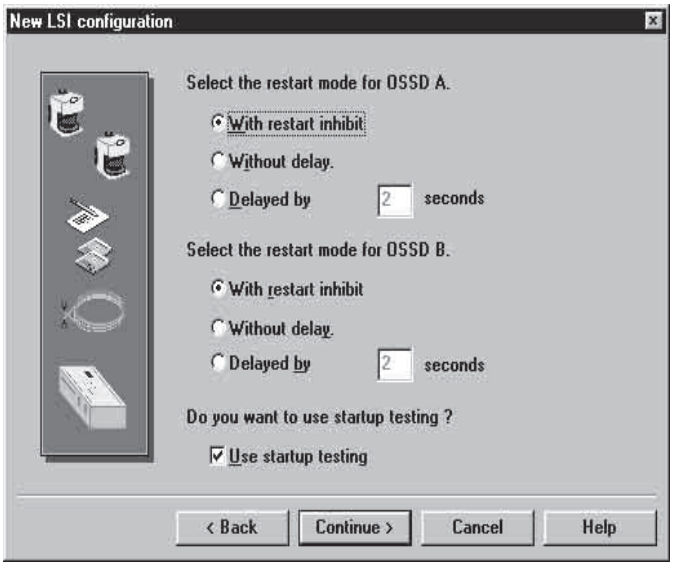
The following dialogue box appears: This is where you define the area of application of your LSI system.

- Select whether you want to use the LSI for area protection or for protection on a vehicle (e.g. an automated guided vehicle – AGV).
- Select which evaluation you want to use.
  Standard:
  This is the standard evaluation.
  Pixel suppression:
  In this setting, objects detected only by a single pixel per scan are ignored. This can be useful in preventing unintended shutdowns.
- Click on “Continue”.



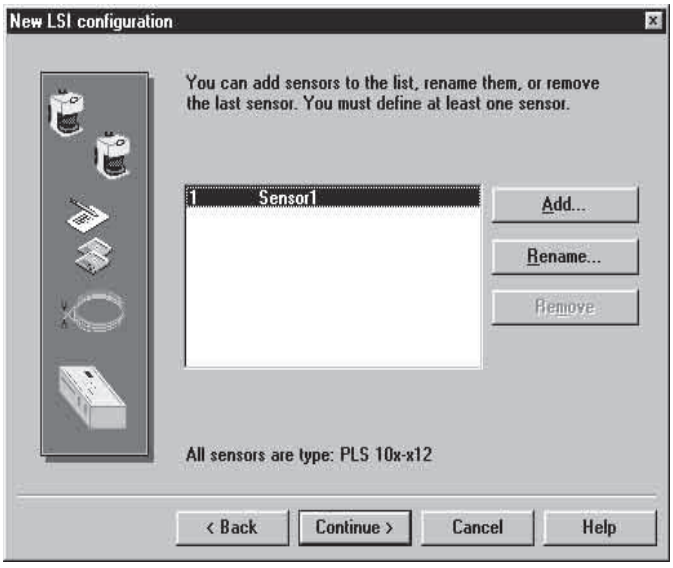
The following dialogue box appears: This is where you set which inputs and outputs you are using.

- Check the checkbox to indicate if you have connected incremental encoders. You can use incremental encoders if you are operating the LSI on a vehicle (see section 9.7).
- Select which inputs and outputs you are using by placing a check against them.
- Check the checkbox to indicate if external device monitoring (EDM) is to be active for the outputs you are using. How to connect the external device monitor is described in section 8.2.
- Click on “Continue”.



The following dialogue box appears: This is where you set the restart response of the outputs and the start-up testing.

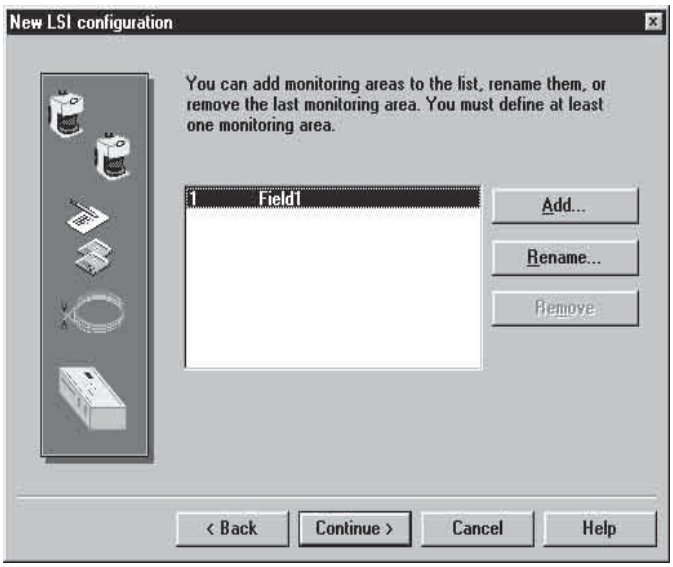
- For the configured outputs, select how the LSI is to restart after a protective field infringement.
  With restart inhibit:
  The system only restarts after a protective field infringement or a reset when the protective field is free and the restart button is pressed.
  Without delay (without restart inhibit):
  The system restarts as soon as the protective field is free after the preset response time (multiple scans).
  Restart delayed by n seconds:
  The system only restarts when the time set here has elapsed after the protective field has become free again.
- You can also select whether you want to work with start-up testing. If you select this option, you must intentionally interrupt the protective field once after switching on the system.
  In this way you can stipulate that, after switching on the system, the machine operator must first verify the detection of the PLS by intruding into the protective field fefore beginning work.
- Click on “Continue”.



The following dialogue box appears: This is where you log on the sensors you are using. When the system is shipped one sensor is already logged on.

To log on other sensors:

- Click on “Add”.
- Enter a name for the sensor and click on “OK”. The sensor is logged on.
- Click on “Continue”.

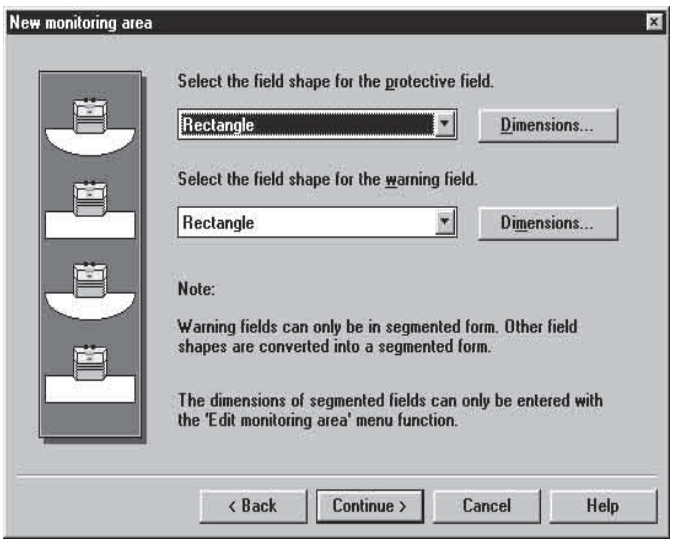


Defining monitoring areas

The following dialogue box appears: This is where you define the monitoring areas to be used.
One monitoring area is already defined when the system is shipped (see also *section 9.4*, “Expanding the configuration”).

To define other monitoring areas:

- Click on “Add”.
- Enter a name for the monitoring area and click on “Continue”.



The following dialogue box appears:

- Select the shape of the protective field and warning field. 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.

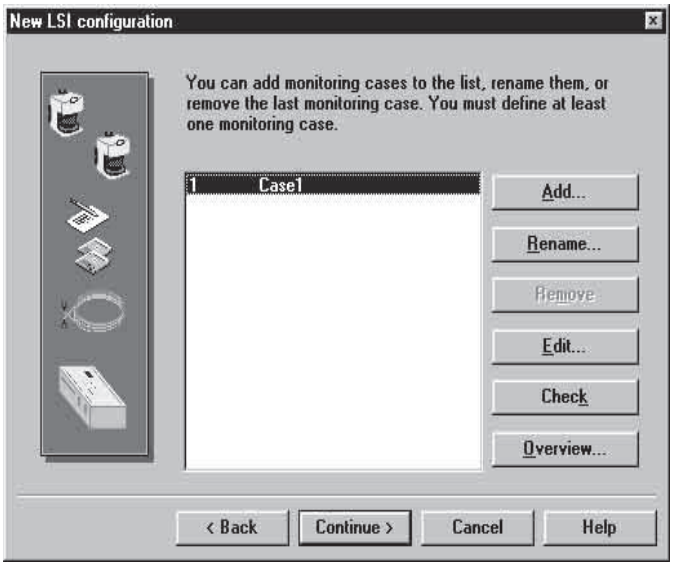
Note:
You will find more details on editing the protective fields and warning fields in *section 9.5*.

- Click on “Continue”.
- Confirm your settings with “OK”.

The monitoring area is set.

- Click on “Continue”.

Defining monitoring cases



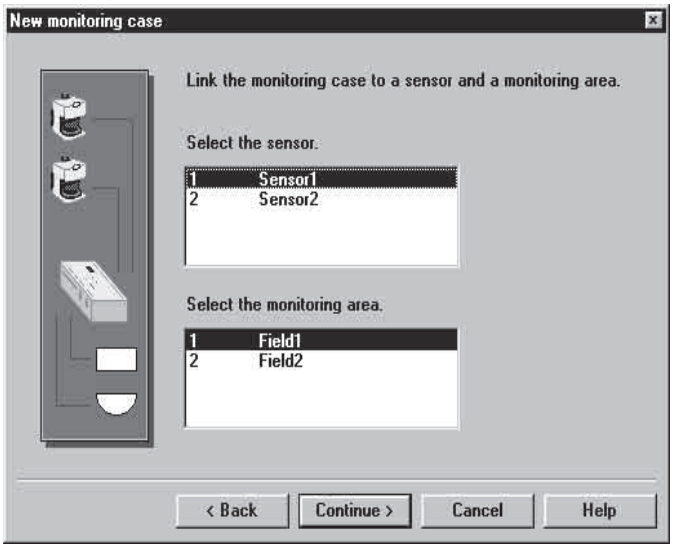
The following dialogue box appears: This is where you define the monitoring cases to be used.
One monitoring case is already defined when the system is shipped. You can change its settings as you wish.

To change a monitoring case:

- Click on “Edit” and change the settings as you need.

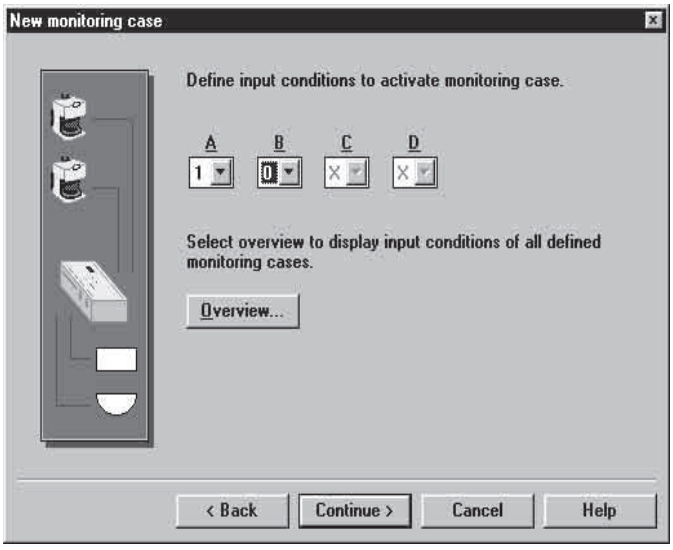
To define other monitoring cases:

- Click on “Add”.
- Enter a name for the monitoring case and click on “Continue”.



The following dialogue box appears:

- Select the sensor you want to be active in this monitoring case.
- Select the monitoring area you want to monitor on the selected sensor.
- Click on “Continue”.



The following dialogue box appears:

- For the existing inputs, define the input information on which you want activation of the monitoring case to be based:
  X = low or high
  0 = low
  1 = high

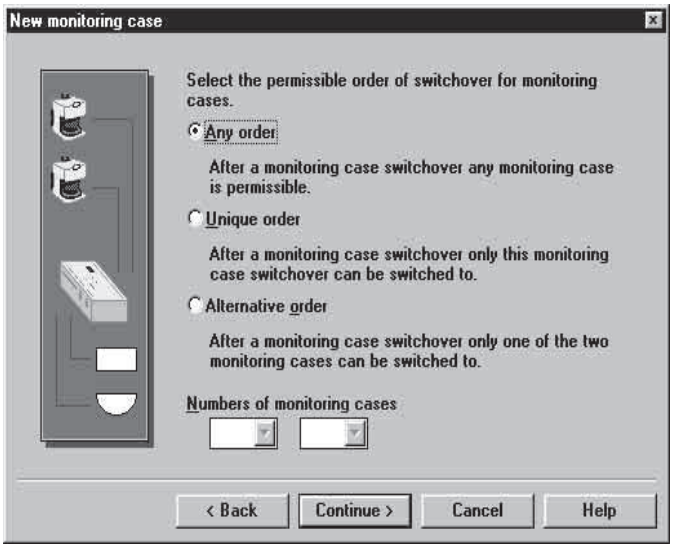
Note:
Each input consists of two signals of which the states must always be inverted, e.g. for input A signals A_1 and A_2:
– Input A low: $A_1 = 1$ and $A_2 = 0$
– Input A high: $A_1 = 0$ and $A_2 = 1$

The value set in the dialogue box always corresponds to the signal level of the assigned input A_2, or B_2, C_2, D_2. (For the wiring of the inputs see *section 8.2*.)

- Click on “Continue”.

The following dialogue box appears:

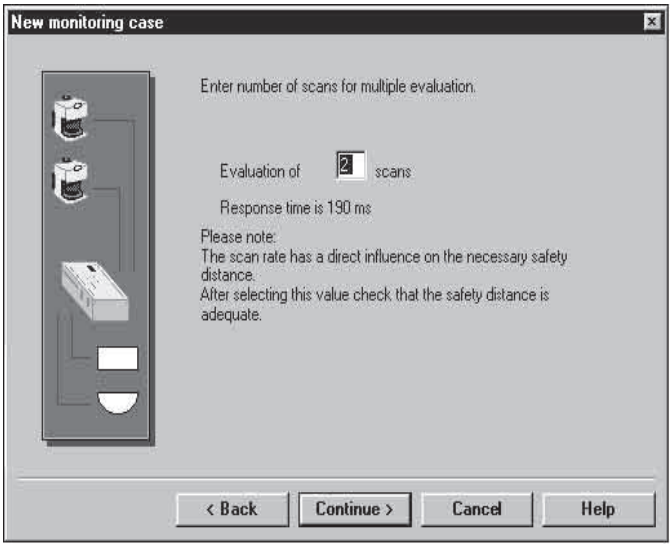
- Select the output to be switched in this monitoring case if there is an object in the protective field.
- Click on “Continue”.



The following dialogue box appears:
This is where you set the order in which the monitoring cases are to be activated.

Note:
You can alter this setting later. For more details on this and on switching between several monitoring cases refer to “Additional monitoring cases” in *section 9.4*.

- Select “Any” as the order, for example.
- Click on “Continue”.



The following dialogue box appears: This is where you set how often (that is, in how many consecutive scans) the sensor must detect an object in the protective field before the configured outputs are shut off (between 2 and 16 scans are possible). (If you are using the LSI together with PLS type 101-316 for vehicle protection, the response time of the LSI is fixed at 270 ms.)

- 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. The current response time is shown in the box.
- Click on “Continue” and confirm your settings with “OK”.

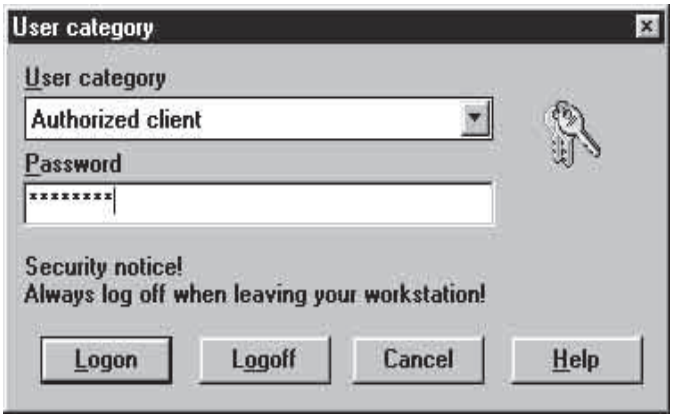
The monitoring case is defined.

- Click on “Continue”.
- Click on “OK” to accept the configuration.

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

Sending a configuration to the LSI

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



The following dialogue box appears:

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

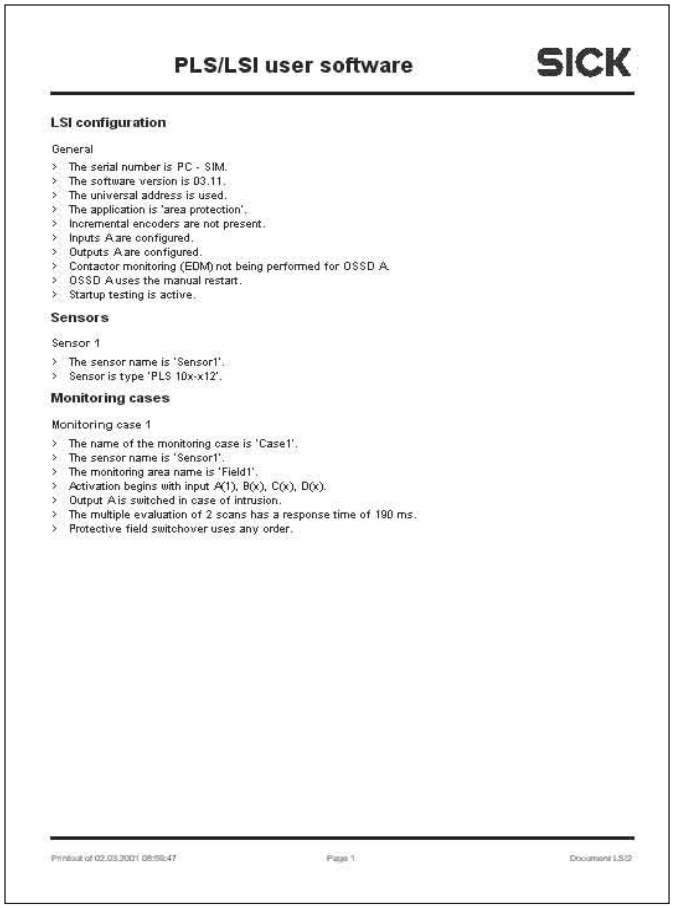
You are now logged on and can send data to the LSI.

- From the menu choose **LSI – Configuration – Send to LSI**, or click on the “Send Configuration” button on the toolbar.

The screen displays a multi-page overview of the configuration settings for you to check through once again.

To correct settings:

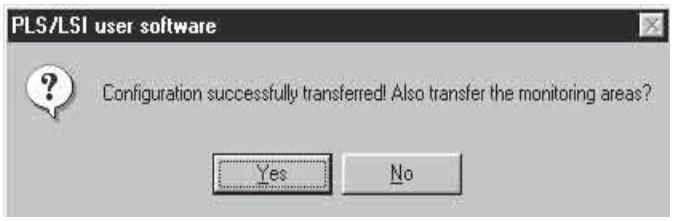
- Click on “Cancel” to close the overview and change the settings.



To confirm settings:

- Click on “Confirm”.

The configuration data are sent to the LSI and stored there.



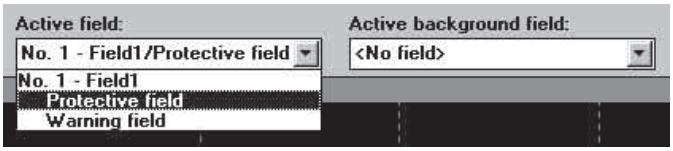
The following dialogue box appears:

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

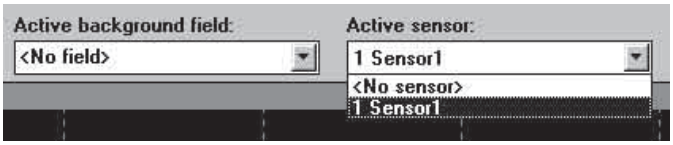
Editing a monitoring area

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

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



- From the “Active Sensor” list select the sensor of which you want to see the current defined space contour in the background for comparison purposes.



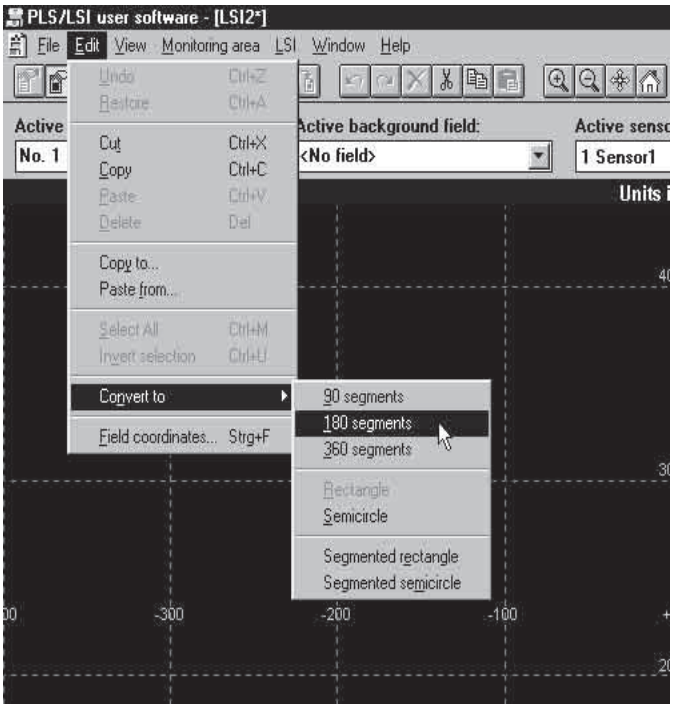
The selected fields and the space contour of the selected sensor are shown on-screen.

The status bar at the bottom of the screen contains a colour key for on-screen display of the protective field and warning field.

Note:
The space contour of the active sensor serves only as an aid to defining the protective and warning fields. The sensor you select here has no influence on the linking of monitoring areas and sensors in the monitoring cases.

Convert field shape:

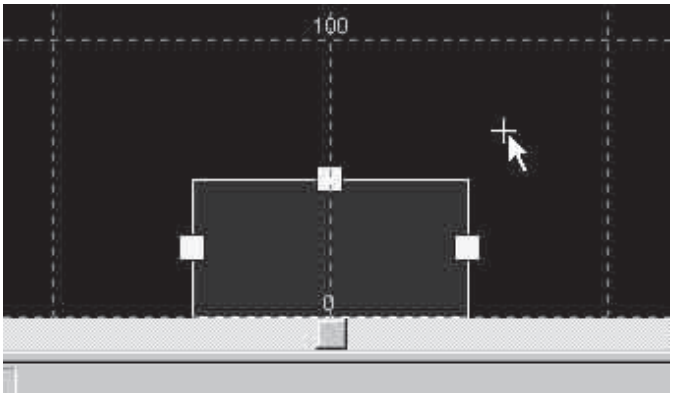
- To convert a field into a different shape, choose **Edit – Convert Into** from the menu.



Various field shapes are available to choose from:
– 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.
– 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.
– Semi-circle: Here you define the radius.
– Segmented rectangle / Segmented semi-circle: You define a rectangle or a semi-circle and select the desired resolution (number of segments). The field is automatically converted into a segmented field with the appropriate dimensions.

Notes:
Warning fields are always segmented fields. If you have defined a warning field as a rectangle or semi-circle, it is automatically converted into a segmented field 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.

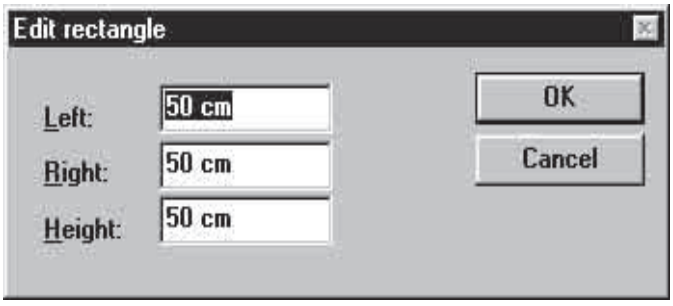
The following sections set out only the basic means of defining the sizes of the various field shapes. For more information on editing fields, refer to *section 9.5.*



Define rectangular field:

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

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



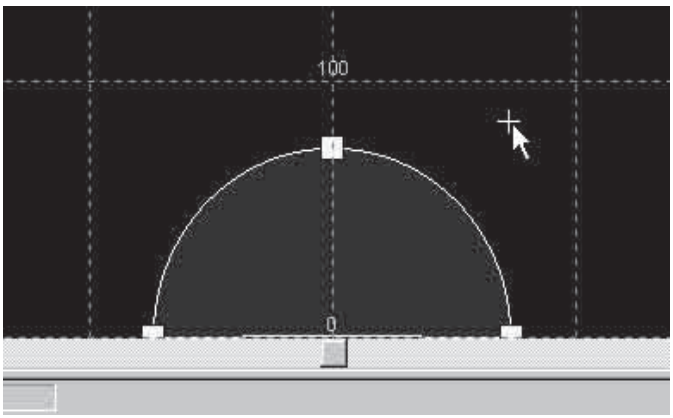
… **or:**

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

This dialogue box appears, showing the dimensions of the rectangle.

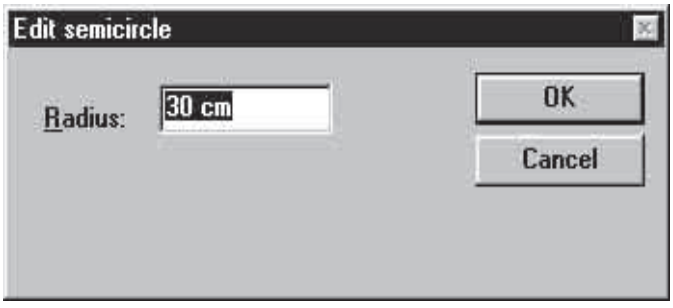
- Enter the dimensions you want.
- Confirm with “OK”.

The dimensions of the rectangle are changed accordingly.



Define semi-circle:

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



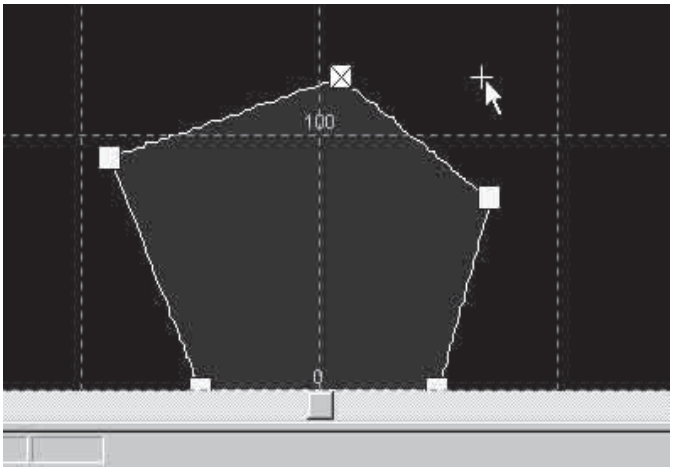
… **or:**

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

This dialogue box appears, showing the radius of the semi-circle.

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

The radius of the semi-circle is changed accordingly.

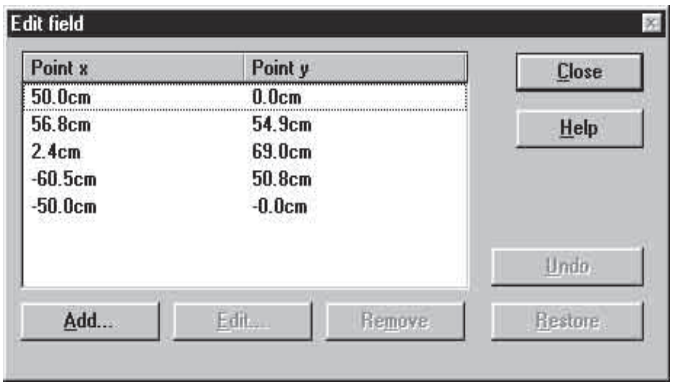


Define segmented field:

- 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:
  Select the point and click on the “Delete” button on the toolbar.

… **or:**

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



This dialogue box 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 it or remove it.

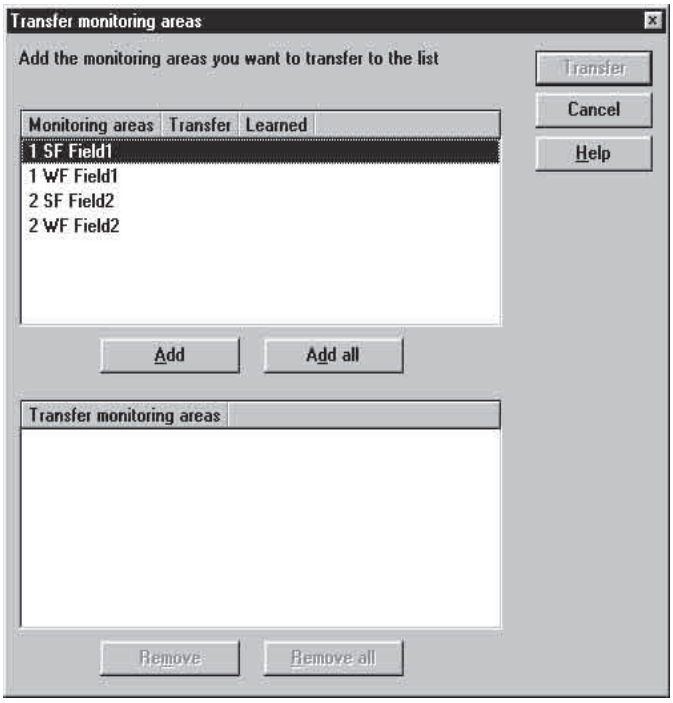
- To set a point:
  Click on the “Add” button and enter your desired co-ordinates in the dialogue box.
- To move a point:
  Select the point in the list and click on the “Edit” button. Enter your desired co-ordinates in the dialogue box.
- To delete a point:
  Select the point in the list and click on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

Note:
You can also select a point with the mouse before choosing **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 area – Edit** menu function, or deactivate the “Edit Monitoring area” button on the toolbar.

Note:
Intrusion into needle-shaped protective fields or parts of protective fields (segments comprising just one pixel) are ignored by the system for the sake of greater availability.

If protective field shapes of such kinds are unavoidable, always programme at least one additional adjacent pixel.



Sending a monitoring area to the LSI

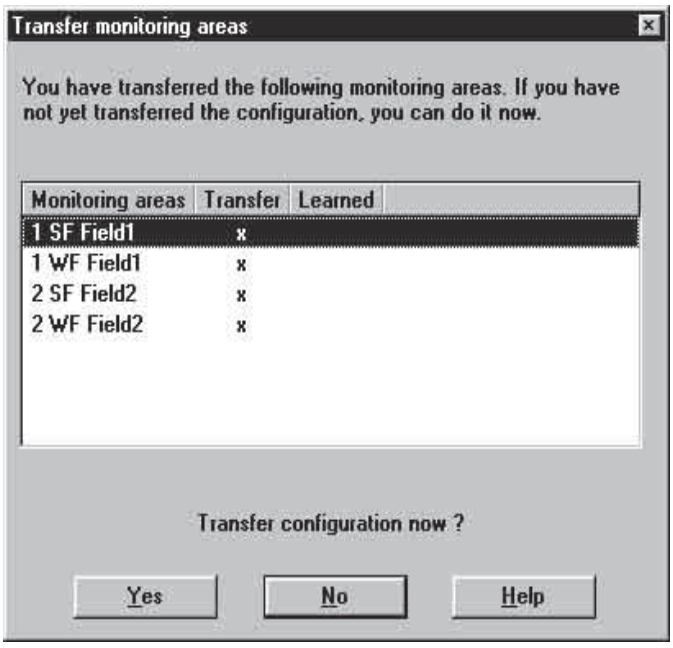
- From the menu choose **Monitoring area – Send to LSI**, or click on the "Send Monitoring area" button on the toolbar.

The following dialogue box 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 "Add".

The fields are entered in the list at the bottom.

- Click on "Send" and confirm for each individual field.



The following dialogue box appears: The transmitted fields are now marked with asterisks in the list.

- Check that all protective fields 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 yet sent the configuration, click on "Yes" and transmit it as previously described under "Send configuration to LSI".

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

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

When leaving your workstation log off by way of the "LSI – 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 LSI system. (How to change the password is described in *section 9.13*).

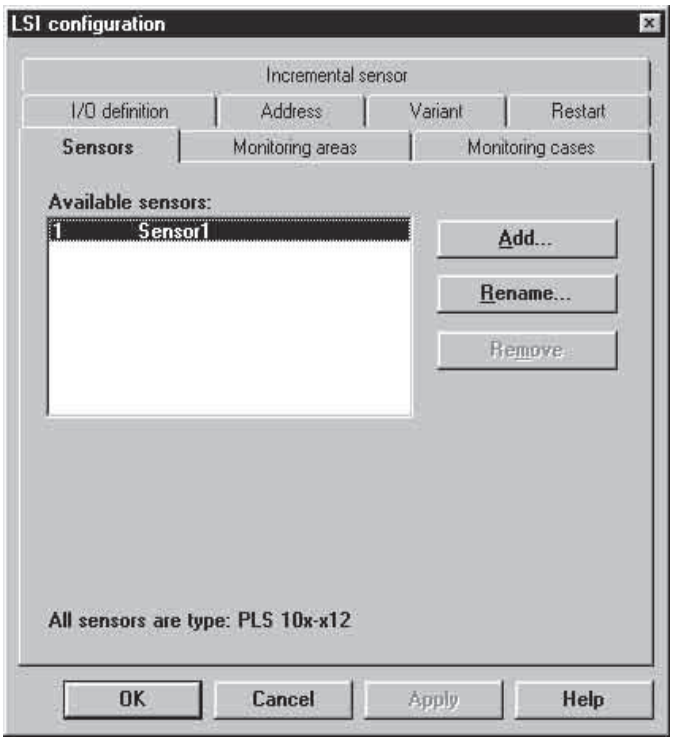
9.4 Expanding the configuration

This section shows you how you can expand your configuration to adapt it to your specific requirements.
You can add sensors and monitoring areas and work with additional monitoring cases.
You can also change the inputs and outputs and edit the settings for the address, the application variant and the restart behaviour.

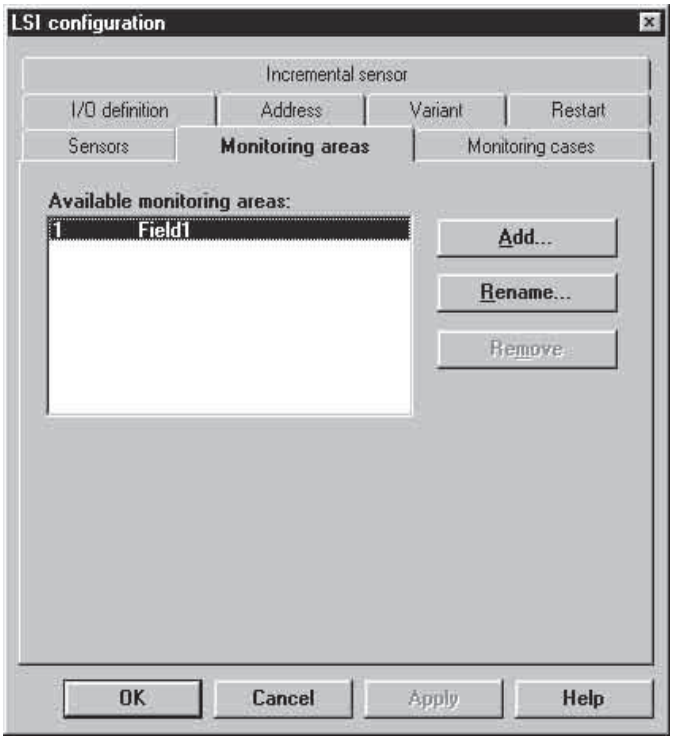
Note on the following subsections:
There are two basic means of expanding the standard application, depending on the user category under which you are logged on:

– If you are logged on as an “Authorised Client” you are automatically guided through all the steps, as when creating a new configuration (see *section 9.3*).
– If you are logged on as “SICK Service”, you can only call up and alter specific individual settings.
The following subsections describe these options. This means you do not need to read the entire section, but can go straight to the passages which are relevant to your application.

Logging on additional sensors

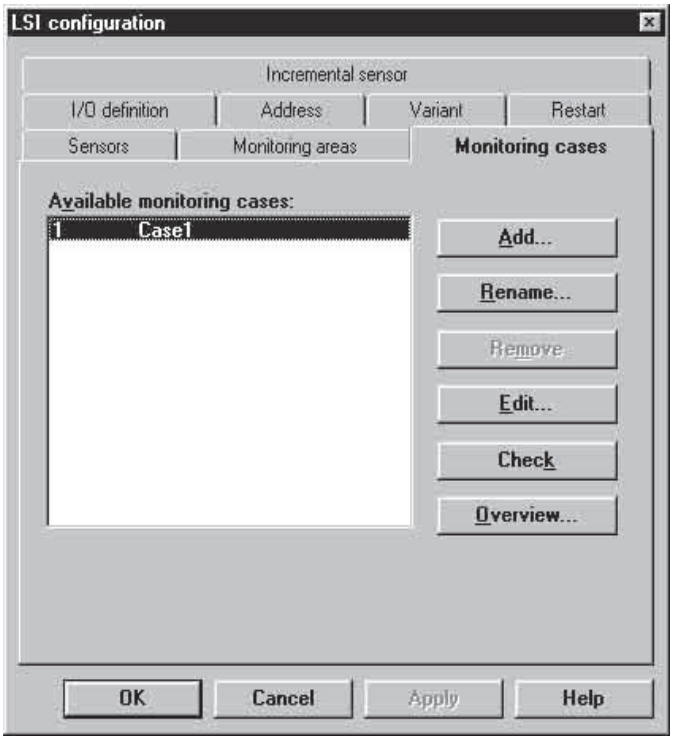


- From the menu choose **LSI – Configuration – Edit** .
- Or choose the “Edit Configuration” button from the toolbar.
- From the “LSI Configuration” dialogue box select the “Sensors” tab.
- Click on “Add”.
- Log on all the sensors connected to your LSI one after the other and name them as you wish. You can log on up to four sensors.



Defining additional monitoring areas

- From the menu choose **LSI – Configuration – Edit** .
- Or choose the “Edit Configuration” button from the toolbar.
- From the “LSI Configuration” dialogue box select the “Monitoring areas” tab.
- Click on “Add”.
- Log on all the monitoring areas you need one after the other and name them as you wish.
- Define the size and shape of the protective and warning fields for your application as described in the example in *section 9.3*.



Defining additional monitoring cases

- From the menu choose **LSI – Monitoring Cases – Edit** .

The following dialogue box appears:

View list of all monitoring cases:

- Click on “Overview”. You get a list of all defined monitoring cases, their input and output definitions and the active sensors and monitoring areas. Here you can keep a running check on your settings.

Check plausibility:

- Click on “Check”. During configuration you check here that the monitoring cases with their current settings are plausible. This can help you to detect any conflicts or errors.

To generate a new monitoring case:

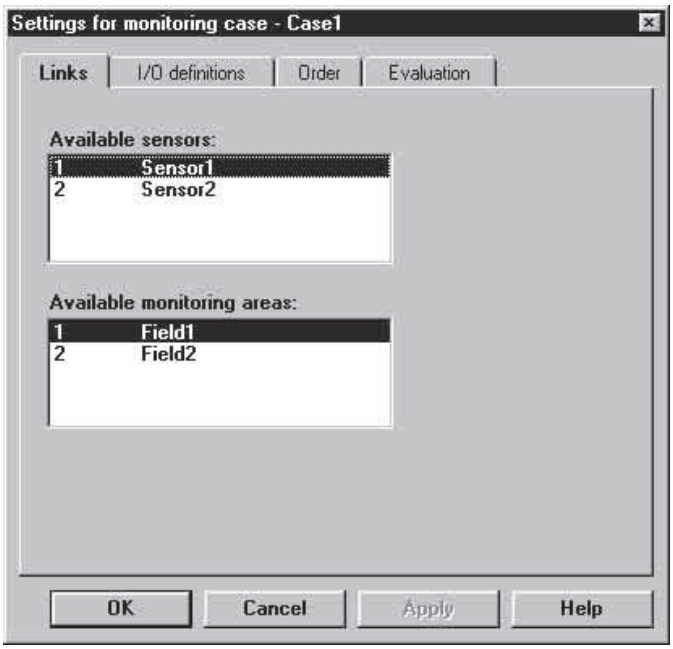
- Click on “Add”. A series of dialogue boxes appears in which you can enter your settings as described in section 9.3. (You can alter any of the settings later).

To delete a monitoring case:

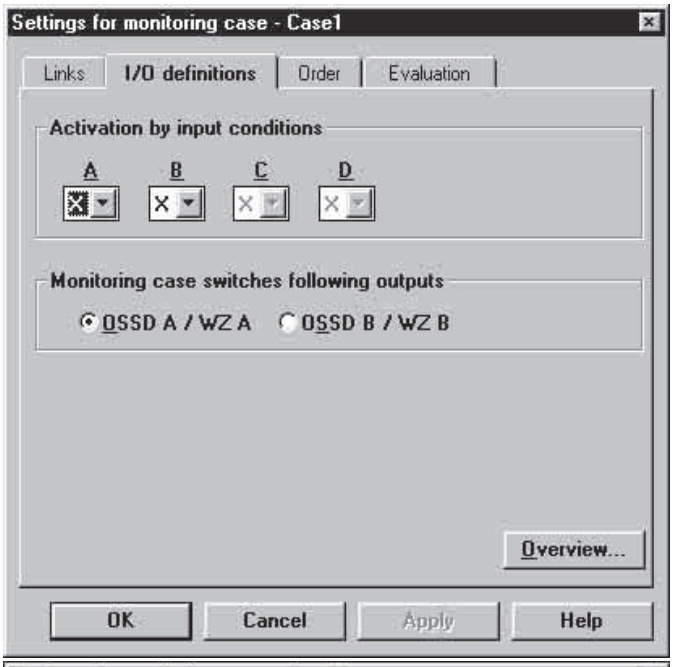
- Select the monitoring case you want to delete from the list and click on “Remove”.

To change a monitoring case:

- Select the monitoring case you want to change from the list and click on “Edit”. You can then make the change you want on the various tabs as described below:



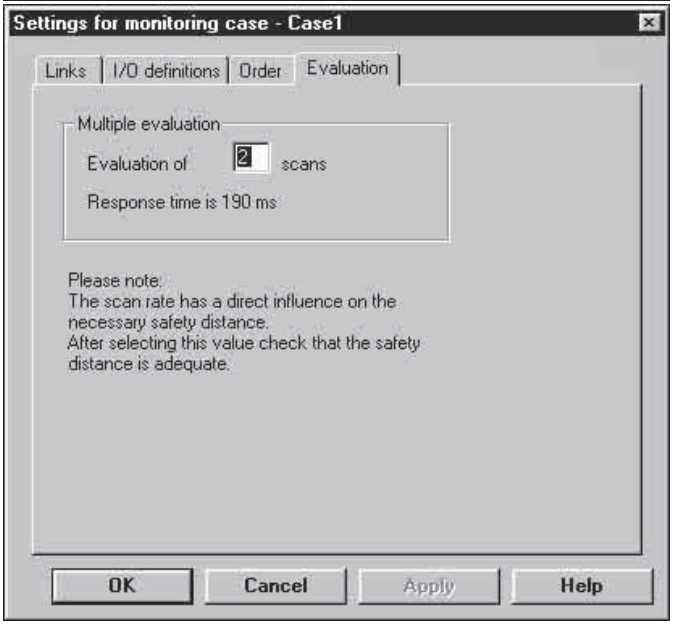
"Links" tab:
This is where you define which monitoring area (comprising a protective field and a warning field) is to be monitored on which sensor.



"I/O Definitions" tab:
This is where you set the input information on which you want activation of the monitoring case to be based:
X = low or high,
0 = low,
1 = high.
Also select the output to be switched in the event of an intrusion into the protective field.

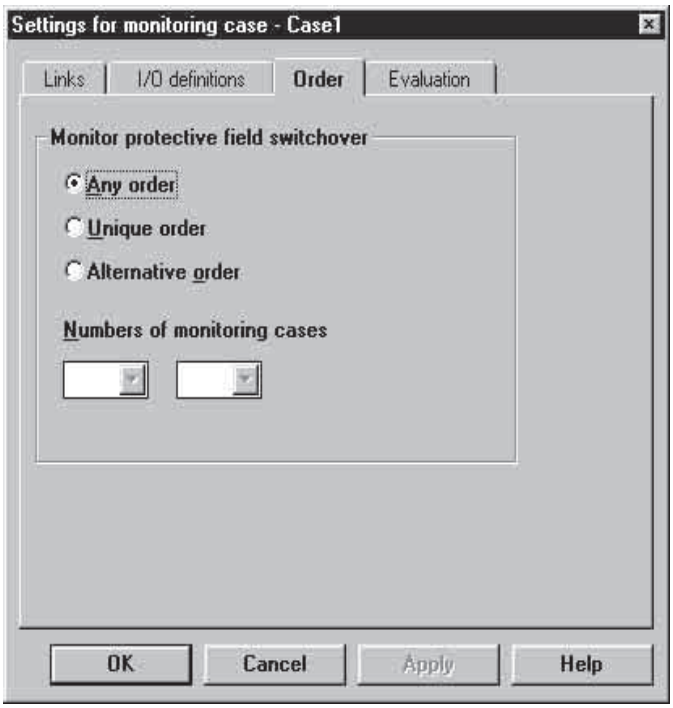
Note:
Each input consists of two signals of which the states must always be inverted, e.g. for input A signals A_1 and A_2:
– Input A low: $A_1 = 1$ and $A_2 = 0$
– Input A high: $A_1 = 0$ and $A_2 = 1$

The value set in the dialogue box always corresponds to the signal level of the assigned input A_2, or B_2, C_2, D_2. (For the wiring of the inputs see *section 8.2*.)



"Evaluation" tab:
This is where you set how often (that is, in how many consecutive scans) the sensor must detect an object in the protective field before the configured outputs are shut off (between 2 and 16 scans are possible).
This sets the response time of the LSI.

Note:
If you are using the LSI together with PLS type 101-316 for vehicle protection, the response time of the LSI is fixed at 270 ms.

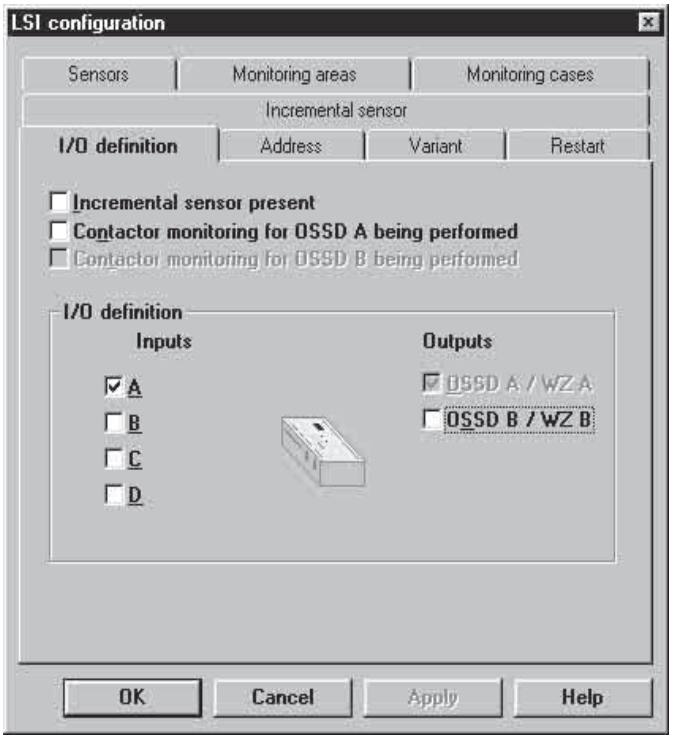


"Order" tab:
Here you can set the order in which the monitoring cases are to be activated.

– Any: After the current monitoring case, any other case may be activated.
– Specific: After the current monitoring case, only the case you selected from the list below can be activated.
– Alternative: After the current monitoring case, only one of the two cases you selected from the lists below can be activated.

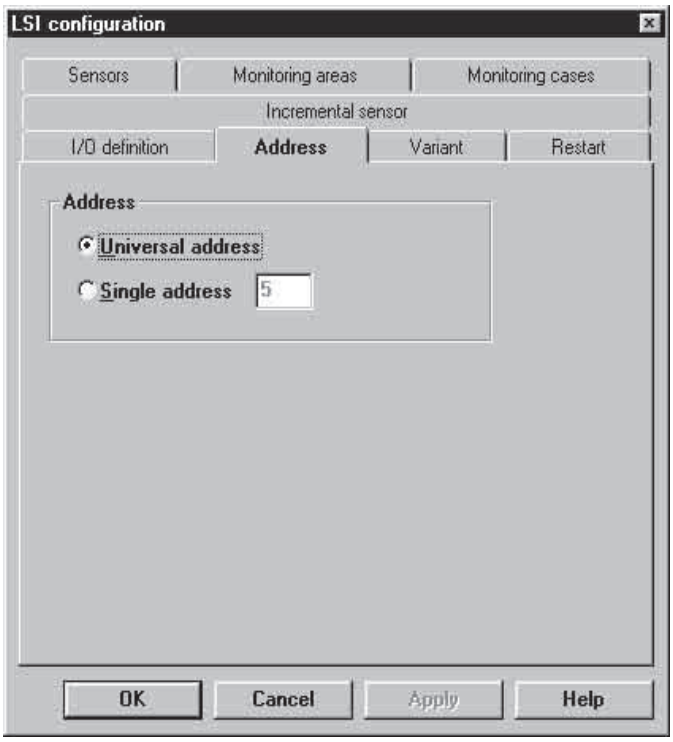
Note on specific and alternative order of activation:
When programming the order, make sure only one input at a time changes state when switching monitoring cases.
Order example:

	A	B
1.	0	0
2.	1	0
3.	1	1
4.	0	1



Changing inputs and outputs

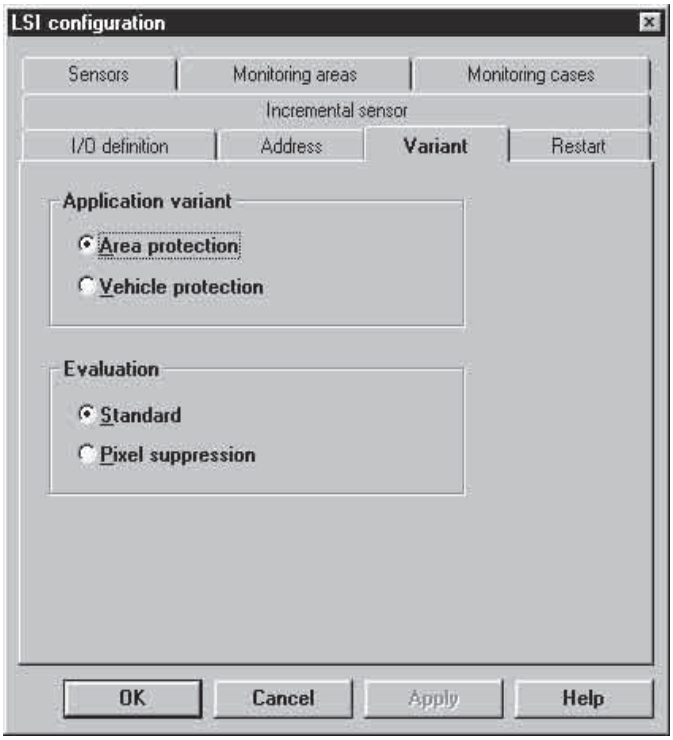
- From the menu choose **LSI – Configuration – Edit** .
- Or choose the "Edit Configuration" button from the toolbar.
- From the "LSI Configuration" dialogue box select the "I/O Definition" tab.
- Check the checkbox to indicate if you have connected incremental encoders. You can use incremental encoders if you are operating the LSI on a vehicle (see *section 9.7*).
- Select which inputs and outputs you are using by placing a check against them.
- Check the checkbox to indicate if external device monitoring (EDM) is to be actice for the outputs you are using.



Changing address

You can define whether the LSI is addressed by way of a universal address or single address.

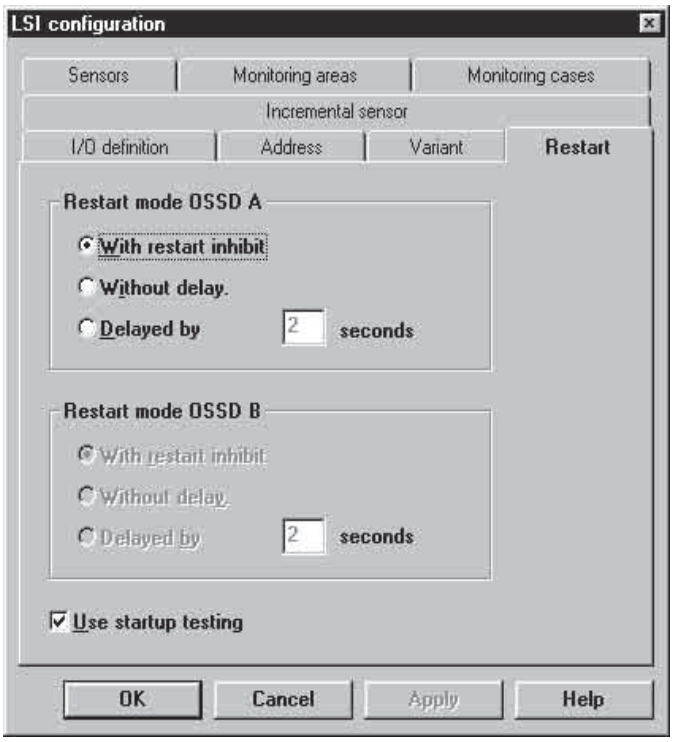
- From the menu choose **LSI – Configuration – Edit** .
- Or choose the “Edit Configuration” button from the toolbar.
- From the “LSI Configuration” dialogue box select the “Address” tab.
- Select whether you want to use a universal or single address.
  Universal address (zero, recommended setting):
  If you set “Universal address”, the stored configuration can be transferred at a later time to any other LSI.
  Single address (between 5 and 126):
  If you set “Single address” you assign the LSI 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 LSI match. This makes sense when you want to ensure that a configuration saved as a file can only be transmitted to a specific LSI unit.



Changing application variant

You can also change the area of application of the LSI system at a later time.

- From the menu choose **LSI – Configuration – Edit** .
- Or choose the “Edit Configuration” button from the toolbar.
- From the “LSI Configuration” dialogue box select the “Variant” tab.
- Select whether you want to use the LSI for area protection or for protection on a vehicle (e.g. an automated guided vehicle – AGV).
- Select which evaluation you want to use.
  Standard:
  This is the standard evaluation.
  Pixel suppression:
  In this setting, objects detected only by a single pixel per scan are ignored. This can be useful in preventing unintended shutdowns.

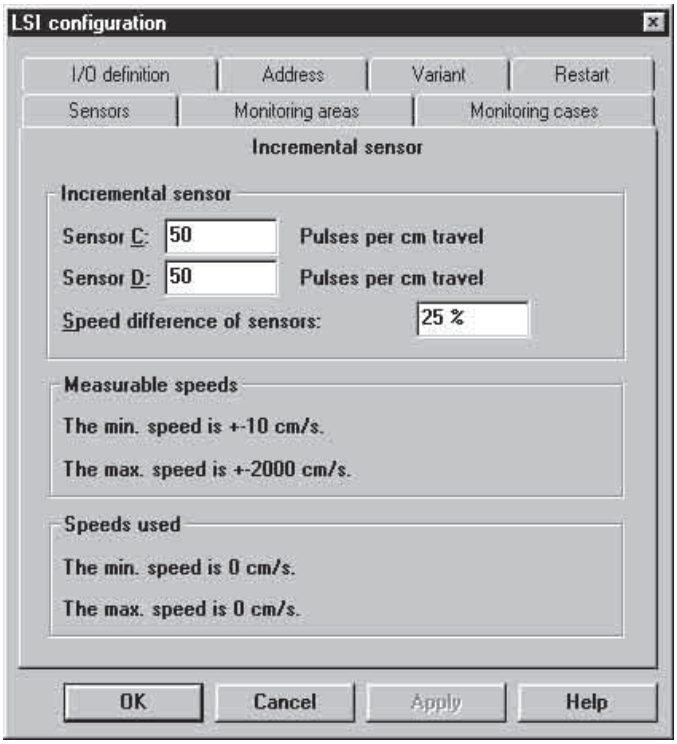


Changing the restart behaviour

You can change the settings for the restart behaviour and the start-up testing.

- From the menu choose **LSI – Configuration – Edit**.
- Or choose the “Edit Configuration” button from the toolbar.
- From the “LSI Configuration” dialogue box select the “Restart” tab.
- For the configured outputs OSSD A and B, select how the LSI 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 (without restart inhibit):
  The system restarts as soon as the protective field is free after the preset response time (multiple scans).
  Restart delayed by n seconds:
  The system only restarts when the time set here has elapsed after the protective field has become free again.

  Use 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.
  (How to perform start-up testing is described in *section 12.2*).



Configuring incremental encoders

If you want to evaluate the speed of a vehicle in vehicle protection mode, enter the data from the incremental encoders here. The “Incremental encoders available” checkbox on the “I/O Definition” tab must be checked for this. (For detailed information on evaluation of the speed data of a vehicle refer to *section 9.7.*)

- From the menu choose **LSI – Configuration – Edit** .
- Or choose the “Edit Configuration” button from the toolbar.
- From the “LSI Configuration” dialogue box select the “Incremental Encoders” tab.
- Enter the number of pulses per cm of travel for the incremental encoders C and D being used.
- Enter the maximum speed difference between incremental encoders C and D as a percentage.

Note:
The maximum possible speed of the vehicle is displayed in the box.
The minimum recordable speed is ±10 cm/s.
For technical reasons, and for the sake of greater availability, lower speeds are ignored and interpreted as 0 cm/s.

9.5 Editing/dimensioning fields

Section 9.3 describes the basic way to edit a protective field or warning field. You can use rectangular, semi-circular or multiple segmented fields. You can draw the fields using the mouse or type in their co-ordinates.

This section describes 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.

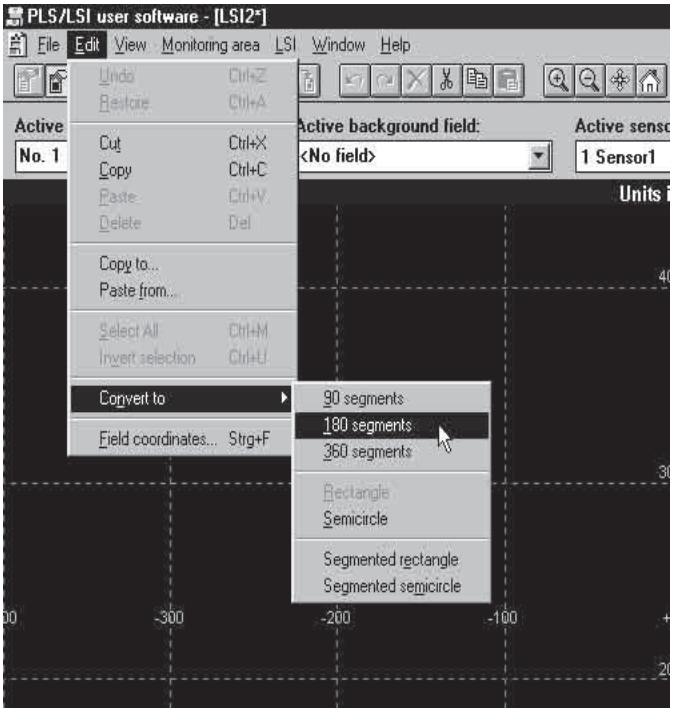
The status bar at the bottom of the screen contains a colour key for on-screen display of the protective field and warning field.

Notes:
Protective fields require additional allowances, to cover the measurement error of the PLS for example. There are also specific dimensioning rules to follow, such as for use of the system on materials handling equipment in narrow aisles. Refer to the *Technical Description* of the PLS.
After programming, check on the plant or vehicle that all monitoring areas are the correct size and shape! You can do this by intruding intentionally into the monitoring areas.

Only start up the plant or vehicle when you are sure all monitoring areas are operating effectively!

Converting fields

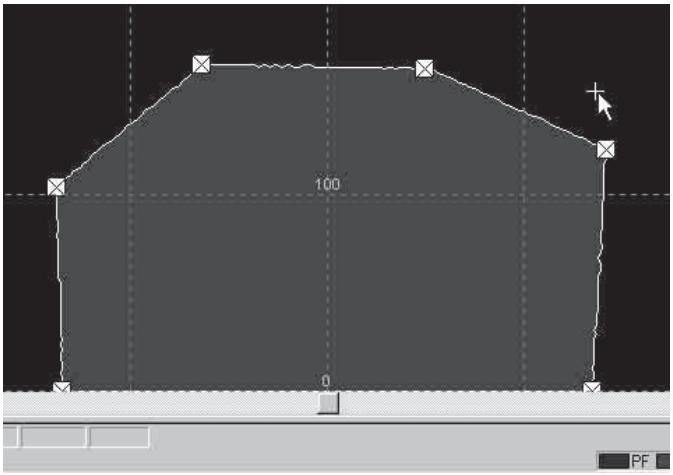
You can convert a field into a different shape – for example, a rectangular field into a segmented field.



- From the menu choose **Edit – Convert to** .

These field shapes are available to choose from:
– 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.
– 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.
– Semi-circle: Here you define the radius.
– Segmented rectangle / Segmented semi-circle: You define a rectangle or a semi-circle and select the desired resolution (number of segments). The field is automatically converted into a segmented field with the appropriate dimensions.

Note:
Warning fields are always segmented fields. If you have defined a warning field as a rectangle or semi-circle, it is automatically converted into a segmented field with the appropriate dimensions.



Changing the scale of a segmented field

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

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

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

Copying and pasting fields

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

- From the menu choose **Edit – Copy** to copy the current field to the clipboard.
- From the “Active Field” list select another field of the same type (protective field or warning field).
- From the menu choose **Edit – Paste** to paste the field from the clipboard.

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

Saving individual fields

You can save individual fields as files so they are available to be used in other configurations.

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

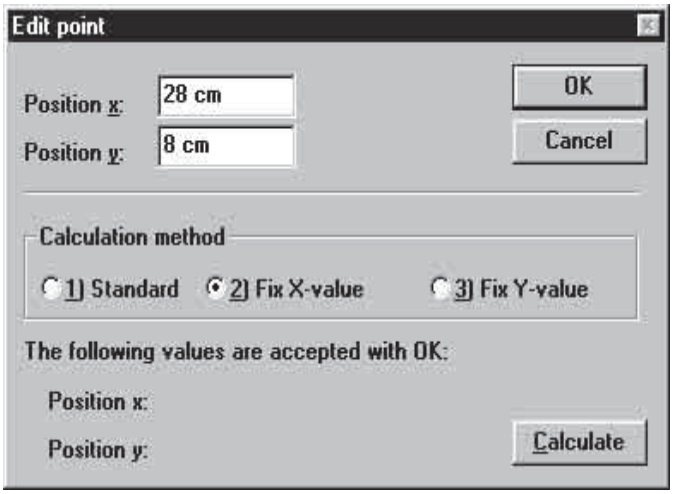
The field is inserted. You can then edit the field as normal.

Fixing co-ordinates

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

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

This dialogue box appears.



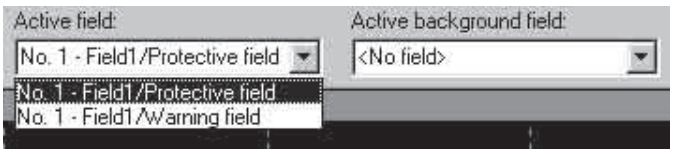
- Enter the co-ordinates you want for x and y.
- Select which co-ordinate must not deviate from the entered value, for example “Fix X-value”, and click on “Calculate”.

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

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

9.6 Teaching-in a protective field

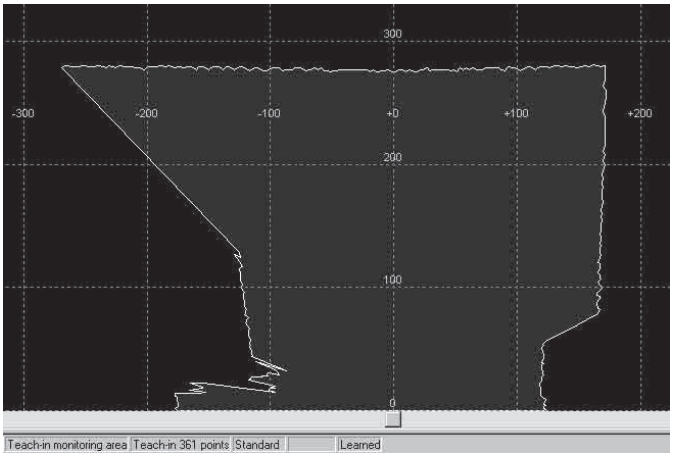
You can teach-in protective fields. In the teach-in process the active sensor scans the defined space contour, and the LSI generates a protective field from the scan. You can influence the physical extent of the protective field by marking out its contour with a target board, for example. You have to check learned protective fields.
You can also edit a learned protective field subsequently, just like any other segmented field. (This function is not available for the LSI used with PLS 101-316 .)



- From the “Active Field” list select the protective field you want to edit.

- From the “Active Sensor” list select the sensor from which you want to receive the data.

- From the menu choose **Monitoring area – Teach-in**.
- Or click on the “Teach-in Monitoring area” button on the toolbar.



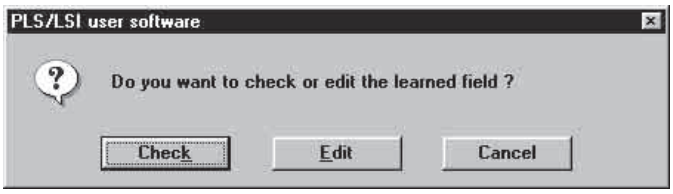
The active sensor scans its surroundings and shows you the result. The contour you see on-screen is the largest possible extent of the protective field.
(The precise contour of the protective field is based on the ambient dimensions).

- 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 adopts to the taught-in contour.

Note:
To prevent fixed obstacles in the scanning plane subsequently producing false signals, 13 cm (= max. measuring error of LSI) is automatically deducted from the learned contour. Take this into account as appropriate when reviewing over the protective field.

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

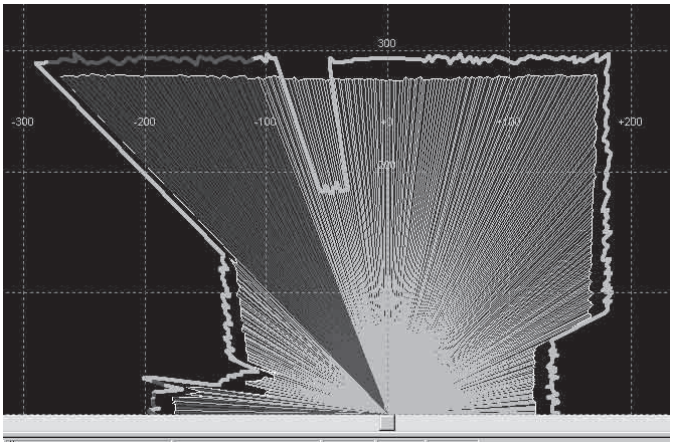


This dialogue box appears. You now have three options:
– You can reject the taught-in protective field.
– You can edit it as a segmented field.
– Or you can check it and then activate it in the LSI.

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 then edit the taught-in protective field like a segmented field and then transfer it to the LSI.

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 reached all 361 points and measuring rays. It is important to do this in a corridor no more than approximately 70 cm from the inner edge of the protective field.

The status bar indicates the number of checked points.

As soon as you have checked all points, this dialogue box automatically appears.

To abort the check before all points have been checked:

- From the menu choose **Monitoring area – Teach-in**, or deactivate the “Teach-in Monitoring area” button on the toolbar.
  The same dialogue box appears.

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

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

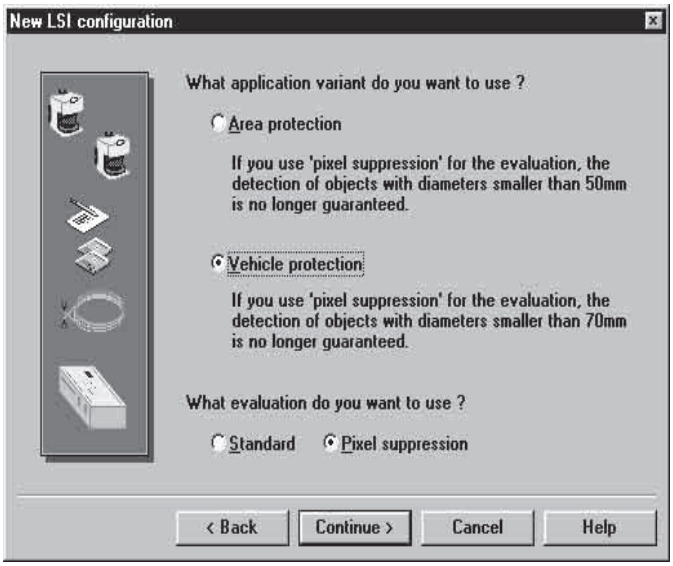
Note:
You can also edit the taught-in protective field subsequently and then transfer it as a segmented protective field to the LSI.

9.7 Adapting protective fields to speed

If you are using the LSI on a vehicle, you can switch between protective fields of different size and shape depending on the speed of the vehicle. In this way you can adapt the monitoring area flexibly to the surroundings and speed of the vehicle.

For this, you must have connected incremental encoders to the LSI. The LSI receives the speed data from the incremental encoders and switches to a different monitoring case as necessary.

- Calculate the number of pulses your encoders deliver per centimetre travel of your vehicle (min. 50 pulses per cm). (A calculation example for a typical application is given in *section 12.1.* in the appendix).
- To be able to transfer the configuration to the LSI subsequently, log on as an “Authorised Client” by way of the **LSI – User Category** menu function.
- Choose **File – New** from the menu and create an LSI configuration with the following settings in the dialogue boxes:

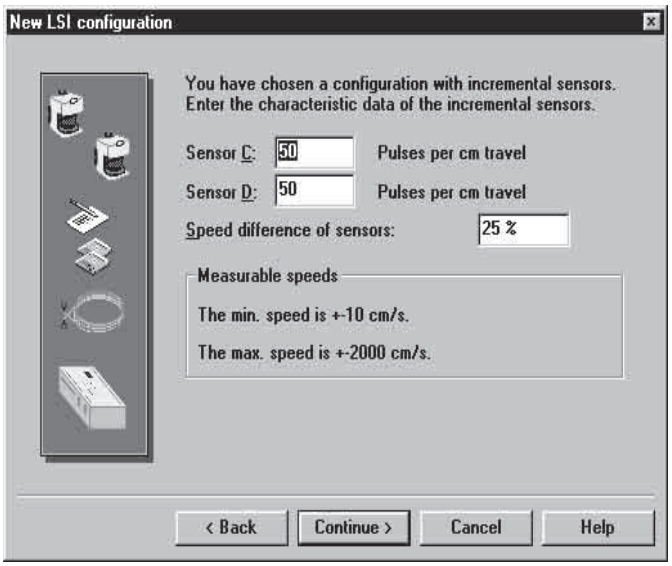


– Application variant: Vehicle protection

– Pixel suppression activated: This is the recommended setting to prevent unintended shutdowns and enhance the availability of the system.

– Use incremental encoders: As a result inputs C and D are occupied and so are no longer available to you.

– Activate inputs and outputs and external device monitoring (EDM) according to your requirements.
(In the example, no other input is configured apart from the incremental encoders. In this case OSSD A is connected to the vehicle’s braking system.)

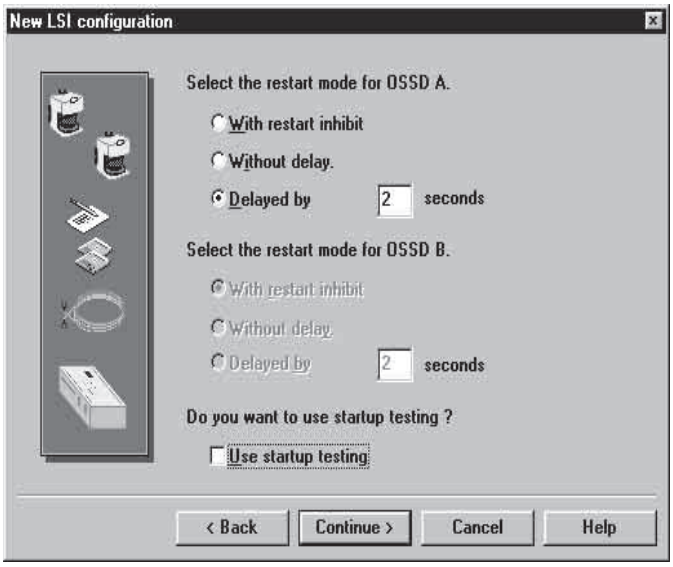


– Number of pulses of the encoders per centimetre travel of your vehicle: Enter the values calculated for your application here.
(A calculation example for a typical application is given in *section 12.1.* in the appendix).

Note:
The maximum possible speed of the vehicle is displayed in the box.
The minimum recordable speed is ±10 cm/s.
For technical reasons, and for the sake of greater availability, lower speeds are ignored and interpreted as 0 cm/s.

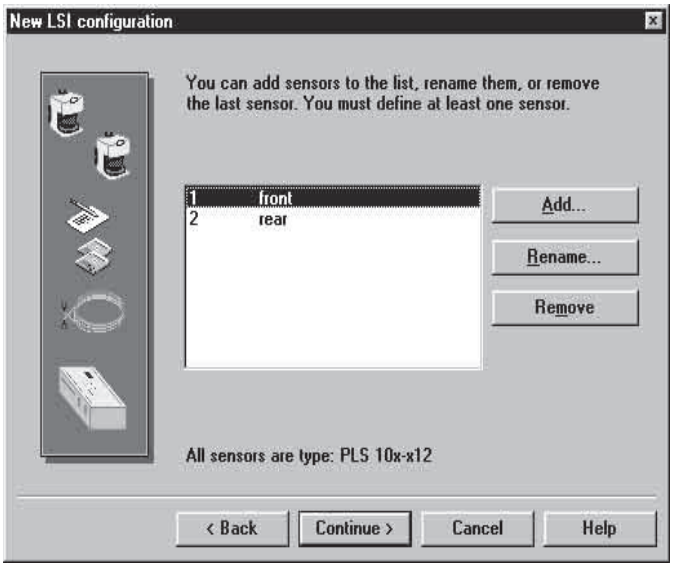
– Speed difference between the two incremental encoders: The recommended setting is 25 %. The values of the two incremental encoders may only differ by up to this amount.

Note:
The speed difference entered here may be exceeded for max. 20 seconds, e.g. for cornering. Activation of the protective field in such cases is always based on the higher of the two speed values. This ensures maximum safety.

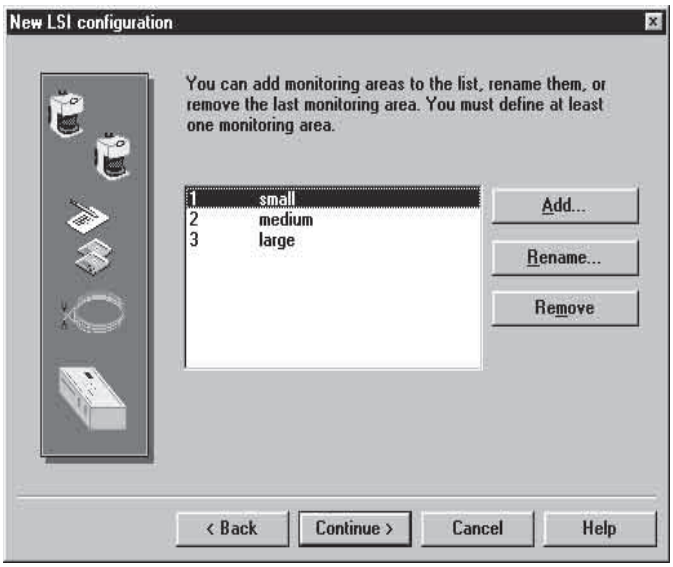


– Set the restart behaviour for the outputs according to your requirements.
(In this example, delayed restart after two seconds is selected for the configured output OSSD A.)

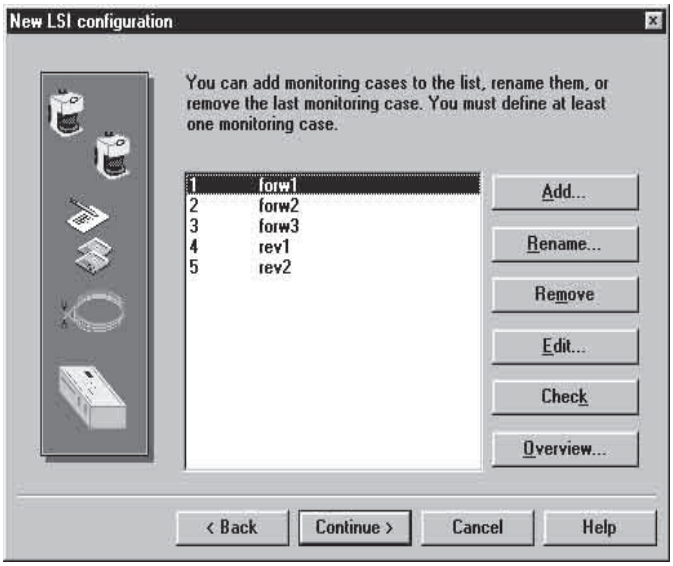
– Start-up testing off: This is the recommended setting.



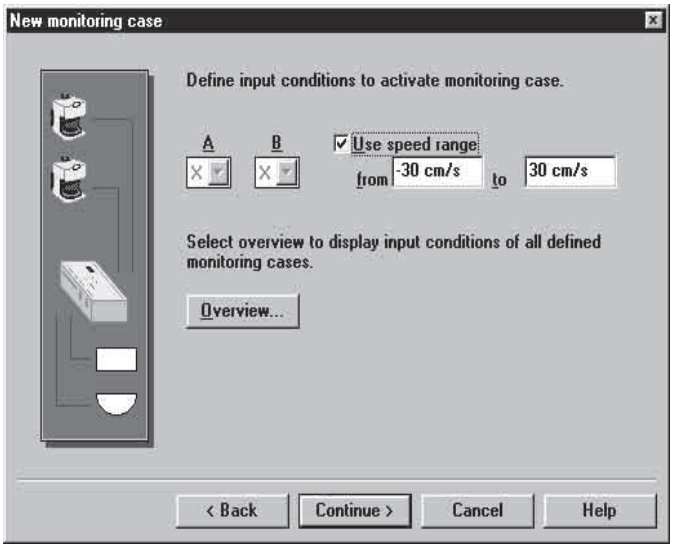
– Log on and name sensors.
(In the example, the two sensors in use are named according to their position on the vehicle: one sensor is mounted at the front and one at the rear, to monitor the forward and reverse movement of the vehicle.)



– Enter and name monitoring areas.
(In the example, three monitoring areas are used, named according to their size.)



– Define monitoring cases: Click on “Add” and make the settings you need for your application.
Name each monitoring case and assign sensors and monitoring areas as described in *section 9.3* for the getting started example.
(In the example, five monitoring cases are defined: three for forward and two for reverse.)

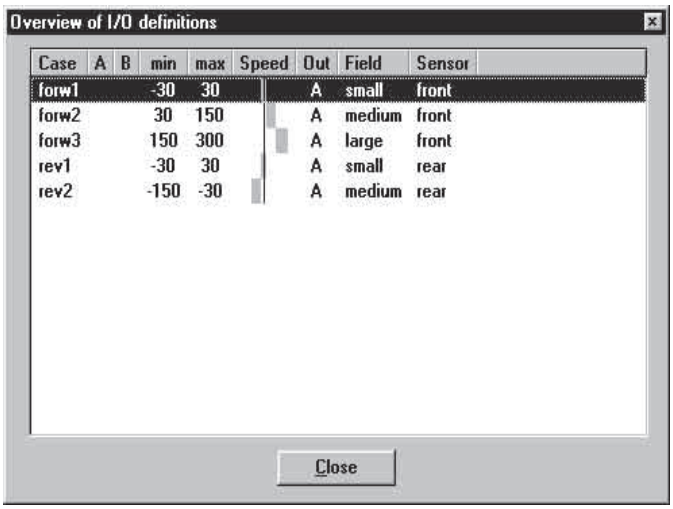


– Use speed range: Activate this option and enter the speed range in which you want the monitoring case to be active.

Notes:
In order to avoid errors, make sure a monitoring case is defined for every speed at which the vehicle may run.

For technical reasons, speeds between –10 cm/s and +10 cm/s are interpreted as 0 cm/s. Consequently, you can only enter values less than –10 cm/s or greater than +10 cm/s. To cover the range ±10 cm/s, enter speed ranges as follows, for example:
– For forward running: from –10 cm/s to +150 cm/s
– For reverse: from –300cm/s to +10 cm/s
The more negative value is always at the left.

When defining the speed ranges, note that a maximum of two monitoring cases can be active at any one time (simultaneous monitoring cases).



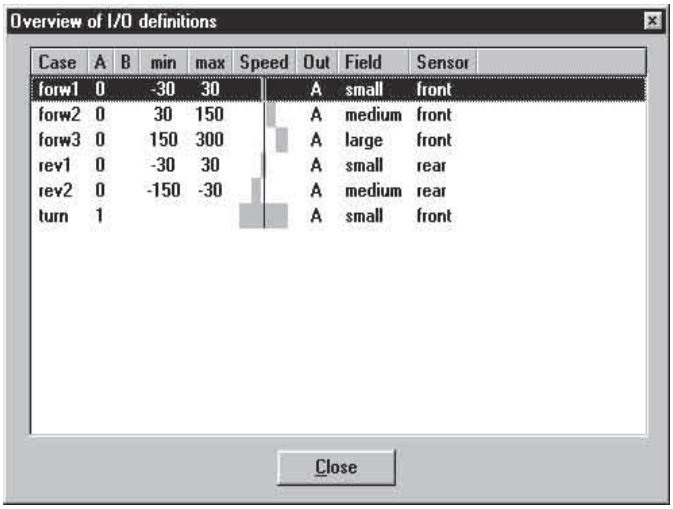
– Click on “Overview” to check your settings. The monitoring cases are listed with the associated sensors, fields and speed ranges.
(In the example, five monitoring cases are defined: three for forward running at different speeds and two for reverse. The “forward1” and “reverse1” monitoring cases are active together (simultaneous monitoring cases) and protect the vehicle in both directions at low speeds.

– Edit monitoring areas: Define the size and shape of the various protective and warning fields for your application as described in *sections 9.3* and *9.5.*

Additional hints and tips:
Section 12.1 presents a number of examples offering additional possibilities for implementing your application on a vehicle in a configuration with incremental encoders.

Section 9.8 describes how you can simulate monitoring cases on PC in order to check the linking of sensors and fields at different speeds.

Section 9.10 presents information on the “I/O Monitor” menu function, with which you can receive and log the switching states of the inputs and outputs and the incremental encoders from the LSI in operation.



Note on turning on the spot:
When a vehicle is turning on the spot, the directional information from the two incremental encoders differs. Under normal circumstances this would cause the LSI system to shut down. You can enable turning on the spot by defining a “turnaround” monitoring case as follows:
– The “Use speed range” option is deactivated for this monitoring case. The data from the incremental encoder are then not evaluated during turning. Then the full speed range of the vehicle is highlighted in the overview (see diagram).
– Apart from the incremental encoders, a further input must be configured exclusively to activate the “turnaround” monitoring case, e.g. input A. In all other monitoring cases this input must be set to “0 = low”.

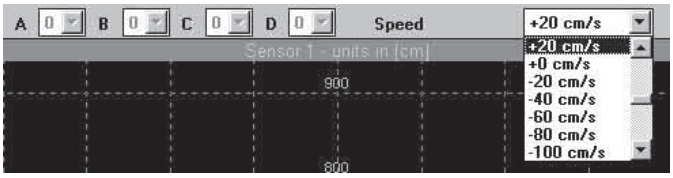
9.8 Simulating monitoring cases

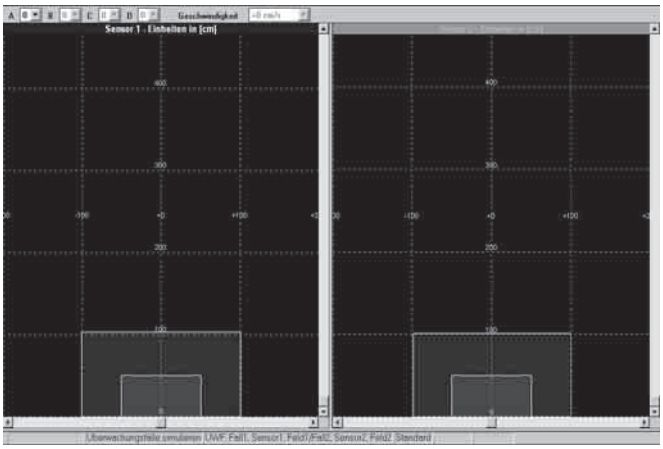
You can check the monitoring case settings by simulating the input conditions of each individual case on your PC. In this way you can also check whether the sensors and fields are correctly assigned in every monitoring case.

- From the menu choose **LSI – Monitoring Cases – simulate**.
- Or choose the “Simulate monitoring cases” button from the toolbar.

A dialogue box appears displaying the logged-on sensors.

- Set the desired state for each input (A, B, C, D):
  0 – low
  1 – high
- If you have connected incremental encoders, activate the “Speed” checkbox and set your desired speed in the list.





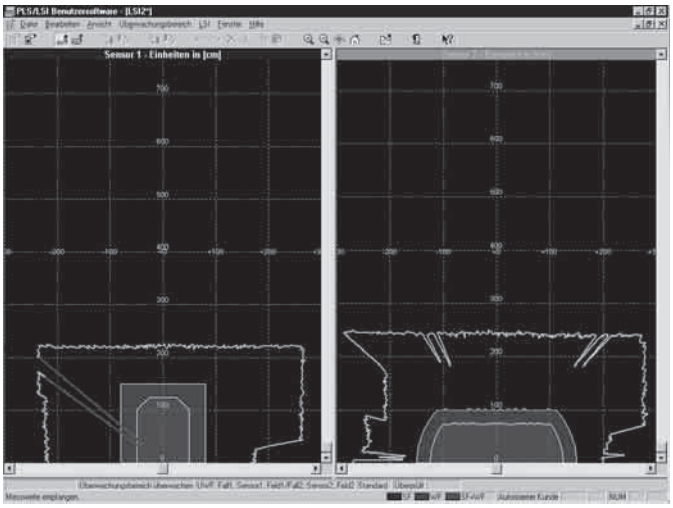
The dialogue box displays the monitoring cases active under the given input conditions: The active monitoring area appears in the box of the sensor to which it is assigned for the monitoring case in question.
In the example there are two sensors. Under the set input conditions, two monitoring cases are active at one time (simultaneous monitoring cases).

The names of the active monitoring cases are displayed on the status bar at the bottom of the dialogue box.

9.9 Monitoring protective fields

You have the option of monitoring the space contour and the defined protective fields in operation, by means of a connected PC.

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



The active sensor with the active monitoring case is displayed on-screen.
(In the example, two sensors are logged on and two monitoring cases active simultaneously.)
The status bar at the bottom of the screen contains a colour key for on-screen display of the protective field and warning field.

Saving a defined 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 choose **LSI – Tools – Measurements – Record Measurements**.
- Specify the file name under which you want to save the measured values and click on “OK”.

This dialogue box appears.

- Click on “OK”.
- From the menu choose **Monitoring area – Monitor**.
- Or click on the “Monitor Monitoring area” button on the toolbar.

The measurements are recorded.

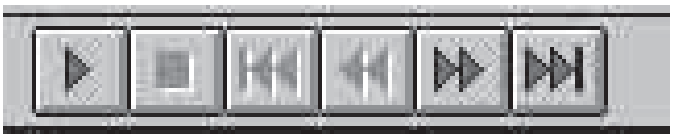
Stop recording:

- Deactivate the **Monitoring area – Monitor** menu option.
- From the menu choose **LSI – Tools – Measurements – Stop recording**.

Play back recorded measurements:

- From the menu choose **LSI – Tools – Measurements – Play Back Measurements**.
- Select the file you want and click on “OK”.

The measurements are played back. Where the space contour protrudes into the protective field it is represented in red.



The toolbar contains six additional buttons with which you can control the recording process as on a CD player.

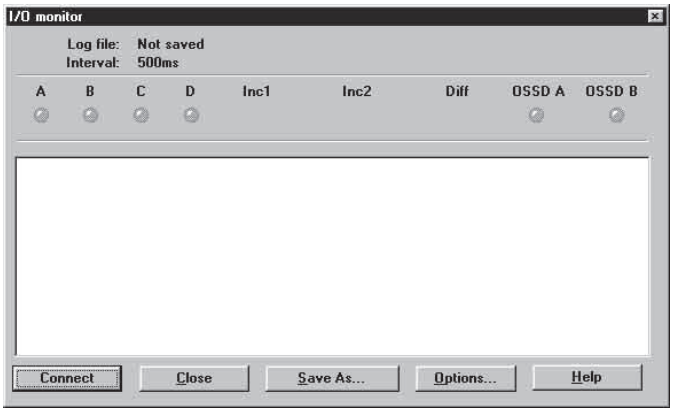
Stop playback:

- Deactivate the **LSI – Tools – Measurements – Play Back Measurements** menu option.

9.10 Monitoring inputs and outputs

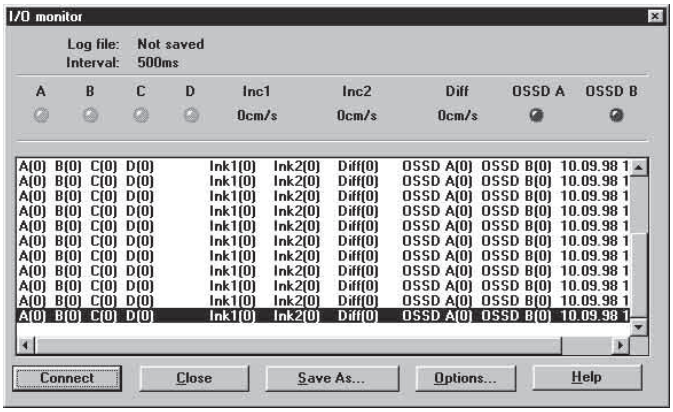
You can monitor and log the switching states of the inputs and outputs of the LSI. You can save the retrieved data to an ASCII file for further evaluation.

- From the menu choose **LSI – Tools – I/O Monitor**.



This dialogue box appears.

- Click on “Connect”.



The states of the inputs and outputs and the active monitoring cases are displayed at the top of the box and also logged as ASCII text.

If you are using the LSI on a vehicle and have connected incremental encoders, you can read off the speed data and the difference in speed between the encoders and record the data during operation for example.

Stop recording:

- Click on “Stop”. The connection to the LSI is cut and recording is stopped.

Change recording interval:

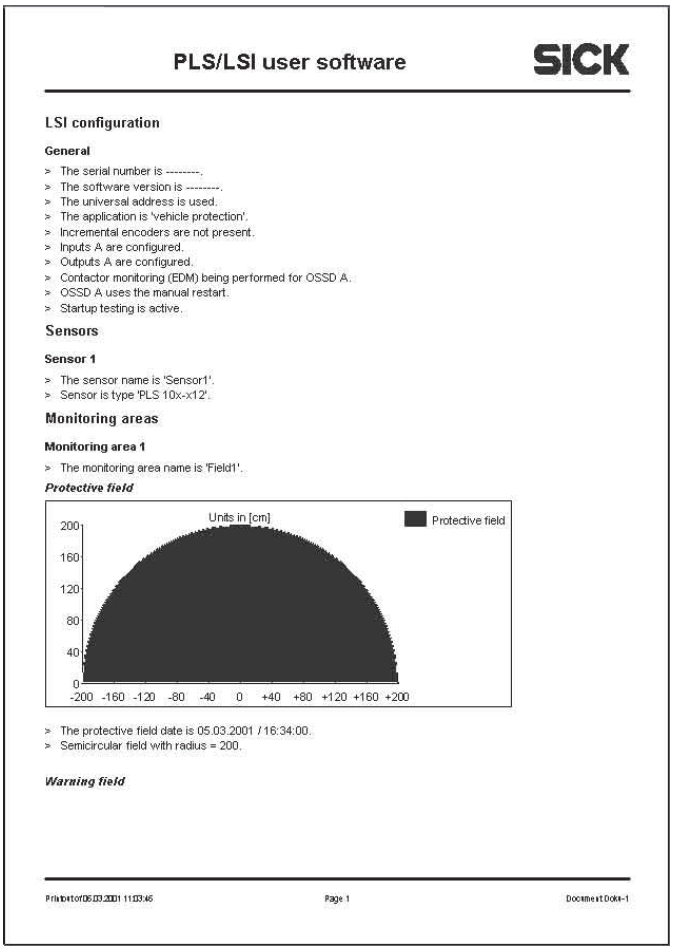
- Click on “Options” and set the interval as you wish.

Save data:

- Click on “Save As” and save the retrieved data as an ASCII file for further evaluation.

Stop monitoring inputs and outputs:

- Click on “Close”.



PLS/LSI user software

SICK

LSI configuration

General

> The serial number is --------.
> The software version is --------.
> The universal address is used.
> The application is 'vehicle protection'.
> Incremental encoders are not present.
> Inputs A are configured.
> Outputs A are configured.
> Contactor monitoring (EDM) being performed for OSSD A.
> OSSD A uses the manual restart.
> Startup testing is active.

Sensors

Sensor 1

> The sensor name is 'Sensor1'.
> Sensor is type 'PLS 10x-x12'.

Monitoring areas

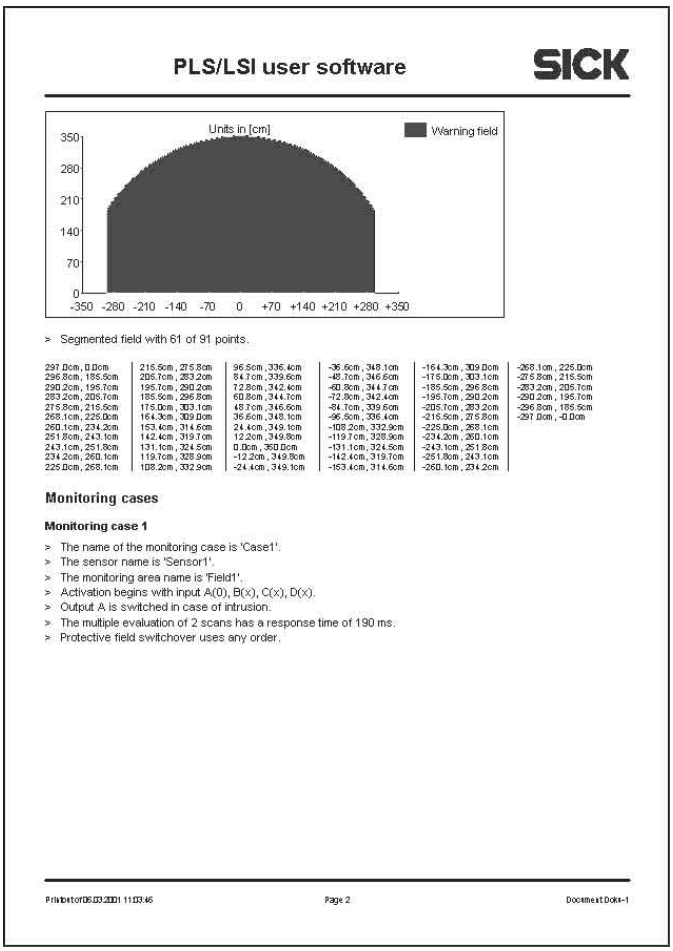
Monitoring area 1

> The monitoring area name is 'Field1'.

Protective field

> The protective field date is 05.03.2001 / 16:34:00.
> Semicircular field with radius = 200.

Warning field



PLS/LSI user software

SICK

> Segmented field with 61 of 91 points.

297.0cm, 0.0cm	215.6cm, 275.8cm	96.5cm, 336.4cm	-36.6cm, 348.1cm	-164.3cm, 309.0cm	-268.1cm, 225.0cm
296.8cm, 185.5cm	205.7cm, 283.2cm	84.7cm, 339.6cm	-48.1cm, 346.6cm	-175.0cm, 303.1cm	-275.8cm, 215.5cm
290.2cm, 195.7cm	195.7cm, 290.2cm	72.8cm, 342.4cm	-60.8cm, 344.7cm	-185.5cm, 296.8cm	-283.2cm, 205.7cm
283.2cm, 205.7cm	185.5cm, 296.8cm	60.8cm, 344.7cm	-72.8cm, 342.4cm	-195.7cm, 290.2cm	-290.2cm, 195.7cm
275.8cm, 215.5cm	175.0cm, 303.1cm	48.7cm, 346.6cm	-84.7cm, 339.6cm	-205.7cm, 283.2cm	-296.8cm, 185.5cm
268.1cm, 225.0cm	164.3cm, 309.0cm	36.6cm, 348.1cm	-96.5cm, 336.4cm	-215.5cm, 275.8cm	-297.0cm, -0.0cm
260.1cm, 234.2cm	153.4cm, 314.6cm	24.4cm, 349.1cm	-108.2cm, 332.9cm	-225.0cm, 268.1cm	
251.8cm, 243.1cm	142.4cm, 319.7cm	12.2cm, 349.8cm	-119.7cm, 328.9cm	-234.2cm, 260.1cm	
243.1cm, 251.8cm	131.1cm, 324.5cm	0.0cm, 350.0cm	-131.1cm, 324.5cm	-243.1cm, 251.8cm	
234.2cm, 260.1cm	119.7cm, 328.9cm	-12.2cm, 349.8cm	-142.4cm, 319.7cm	-251.8cm, 243.1cm	
225.0cm, 268.1cm	108.2cm, 332.9cm	-24.4cm, 349.1cm	-153.4cm, 314.6cm	-260.1cm, 234.2cm	

Monitoring cases

Monitoring case 1

> The name of the monitoring case is 'Case1'.
> The sensor name is 'Sensor1'.
> The monitoring area name is 'Field1'.
> Activation begins with input A(0), B(x), C(x), D(x).
> Output A is switched in case of intrusion.
> The multiple evaluation of 2 scans has a response time of 190 ms.
> Protective field switchover uses any order.

9.11 Checking settings

You can call up an overview at any time showing all the configuration and monitoring area settings. You can also print out the overview.

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

- From the menu choose **File – Page View**.

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

Scroll pages:

- Click on the “Next” or “Previous” button as appropriate.

Switch view:

- Click on the “One Page” / “Two Pages” button.

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 or unzoomed one stage.
- Or click on the place you want to zoom into. The view is zoomed one stage at the selected point.

Print page:

- Click on the “Print” button.

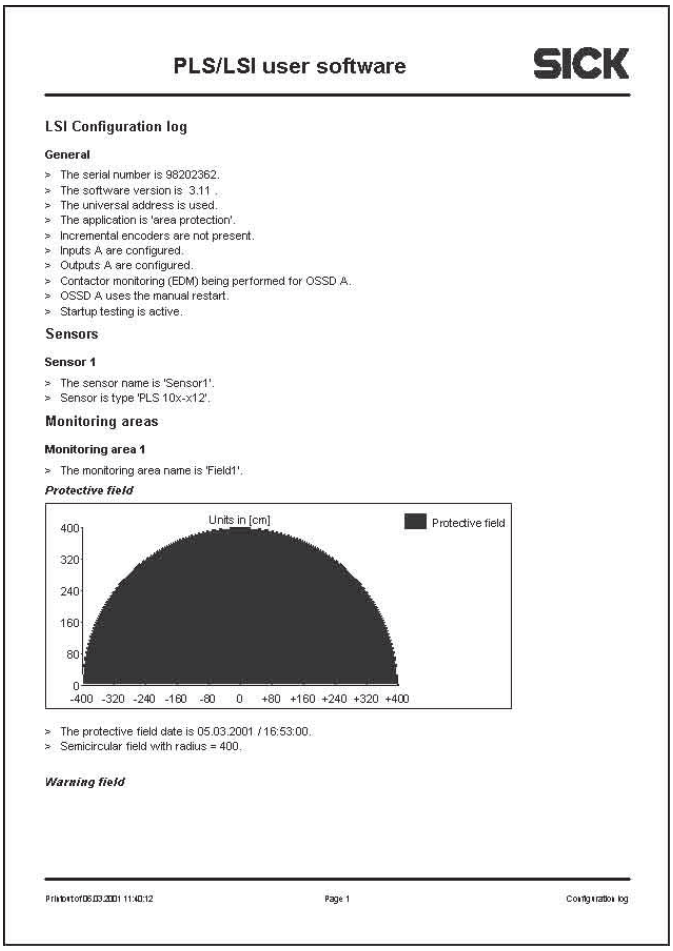
9.12 Receiving and saving a configuration

Receive configuration from LSI

You can receive the configuration data stored in the LSI to print or save it.

- From the menu choose **LSI - Configuration - Configuration Log**.

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


PLS/LSI user software

SICK

LSI Configuration log

General

> The serial number is 98202362.
> The software version is 3.11 .
> The universal address is used.
> The application is 'area protection'.
> Incremental encoders are not present.
> Inputs A are configured.
> Outputs A are configured.
> Contactor monitoring (EDM) being performed for OSSD A.
> OSSD A uses the manual restart.
> Startup testing is active.

Sensors

Sensor 1

> The sensor name is 'Sensor1'.
> Sensor is type 'PLS 10x-x12'.

Monitoring areas

Monitoring area 1

> The monitoring area name is 'Field1'.

Protective field

> The protective field date is 05.03.2001 / 16:53:00.
> Semicircular field with radius = 400.

Warning field

Printed on 05.03.2001 11:40:12 Page 1 Configuration log

Scroll pages:

- Click on the “Next” or “Previous” button as appropriate.

Switch view:

- Click on the “One Page” / “Two Pages” button.

Change size of screen view:

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

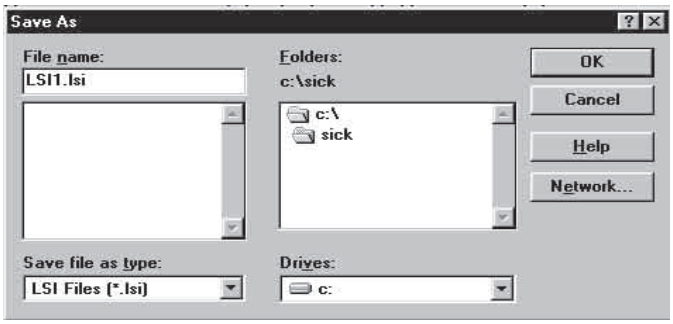
- Click on the “Zoom In” or “Zoom Out” button. The view is zoomed or unzoomed one stage.
- Or click on the place you want to zoom into. The view is zoomed one stage at the selected point.

Print log:

- Click on the “Print” button.

Save configuration log:

- Click on the “Save” button.



The following dialogue box appears:

- Specify the file name under which you want to save the configuration log and click on “OK”.

You can call up the saved file subsequently to edit the settings or transfer them to the LSI.

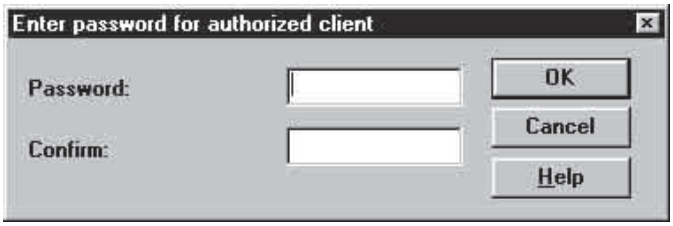
9.13 Changing password

To be able to transmit configuration data and monitoring areas to the LSI you must be logged on as an “Authorised Client” or as “SICK Service”. This requires a password (default: “SICK_PLS”).

To protect your LSI 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:

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



This dialogue box 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 LSI.

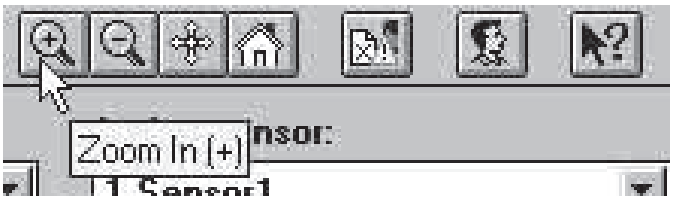
- Log off.
- Make a note of the new password at a location accessible only to authorised persons.

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

9.14 Changing screen view

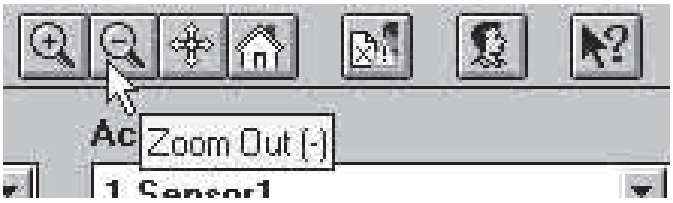
You can enlarge, reduce or move the fields on-screen to make them look as you want. You can also choose between a circular and a rectangular grid pattern in the background.

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 unzoomed one stage further with every click of the mouse.

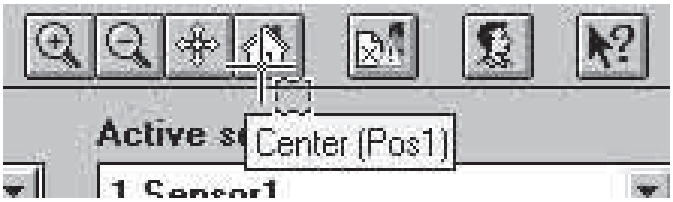
Move view

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

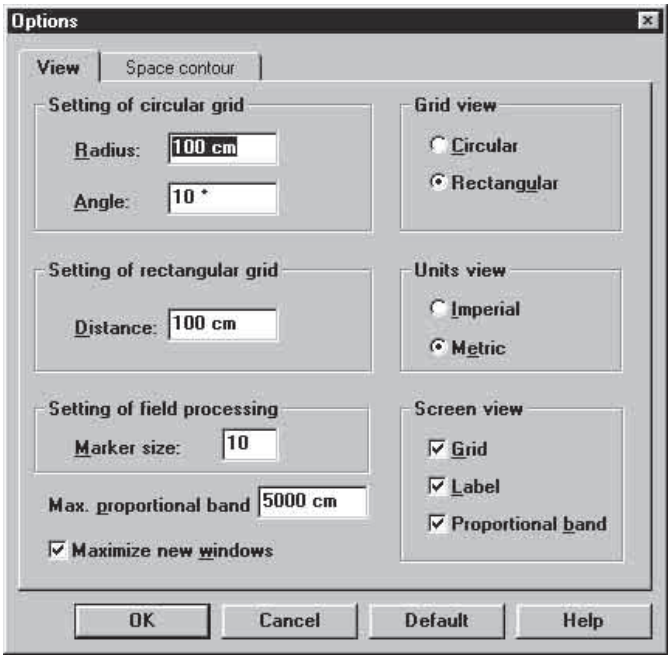
… **or:**

- 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.

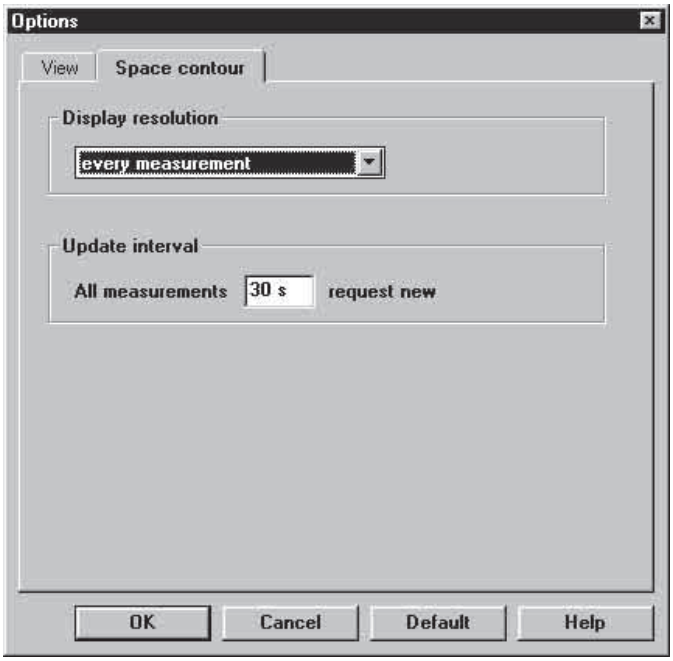
- From the menu choose **View – Options** .
- In the dialogue box select the “View” tab.
- Check the checkbox for a rectangular or circular grid pattern.
- Set your desired grid width.
- Select the marker size for editing the fields.
- Set your desired maximum visible area.
- Check the checkbox for metric 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 defaults.

To confirm settings:

- Click on “OK”.



Set display resolution

You can set how many measured values of the space contour are to be displayed in monitoring and editing of the fields.

Note:
The more measured values you display, the more accurate the display will be, but the slower it will be, too.

- From the menu choose **View – Options** .
- Select the “Space Contour” tab.
- Under “Display Resolution”, select how many measured values of the space contour you want to evaluate.
- Enter the time intervals at which new values are to be requested during editing.

9.15 Interrogating the fault memory (system diagnosis)

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

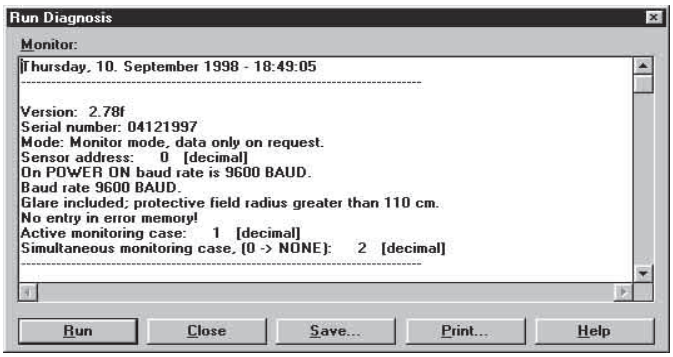
The fault table in *section 11.2* will tell you what to do to rectify the fault.

Initial fault diagnosis

You can carry out a simple diagnosis to localise faults.

- From the menu choose **File – Page View**.

This dialogue box appears.



- Click on “Execute”.

The diagnosis is carried out and the window displays information on the current status of your LSI system.
Move the scroll bar at the right of the screen to scroll through all the entries in the fault memory.

The fault codes are given at the bottom of the list. To find out what the fault codes mean, and whether you can rectify the fault yourself, refer to the fault table in *section 11.2*.

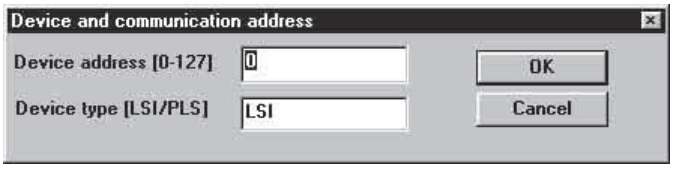
If necessary you can also carry out a second diagnosis to get more detailed information. The more detailed diagnosis is described below.

To interrogate the fault memory and the sensor status of the configured PLS units, check the “Request PLS states via LSI” box.

Interrogating the LSI fault memory

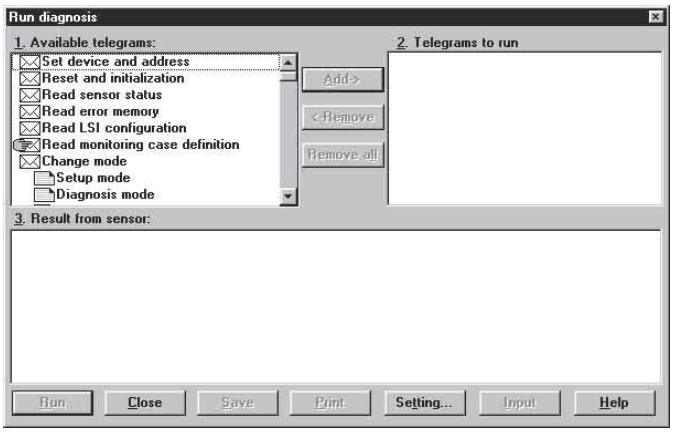
- From the menu choose **LSI – SICK Diagnosis**.

This dialogue box appears.



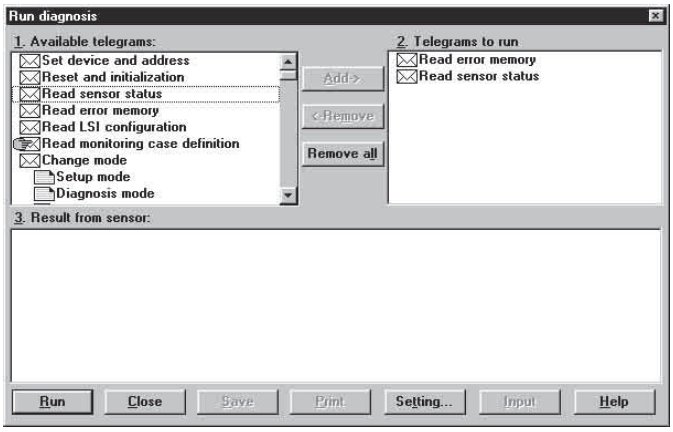
- Make sure zero is entered as the device address and “LSI” as the device type, and confirm with “OK”.
  (This assumes the device address has not yet been changed. If you have assigned the LSI a different address, you must enter the new address here accordingly.)

The “Execute Diagnosis” dialogue box 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 LSI 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 codes mean from the fault table in *section 11.2*.

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”.

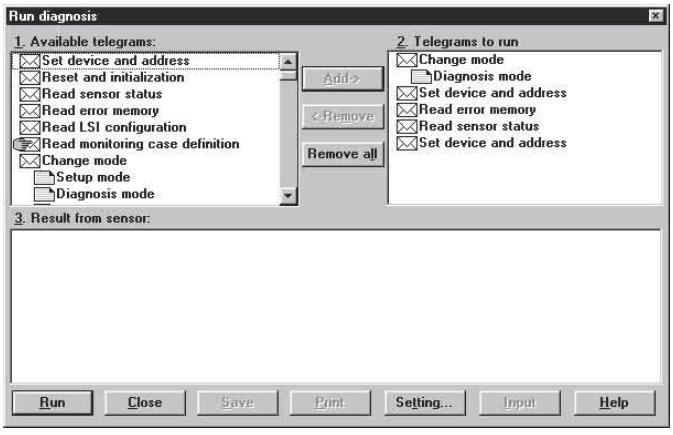
Save result log as file:
- Click on “Save” and enter a file name and destination directory/folder.

Note:
When you have rectified the fault reset the LSI: Choose **LSI – Initialise**.
Or execute the “Reset and initialisation” telegram in the SICK diagnosis.
The LSI system is then reset.

Interrogating the fault memory of a sensor

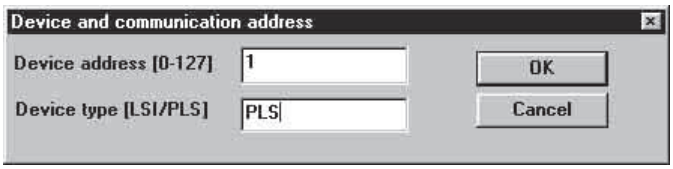
If a fault is signalled by rapid flashing of the yellow LED (≈4Hz) of a sensor, the sensor fault memory can be interrogated as follows:

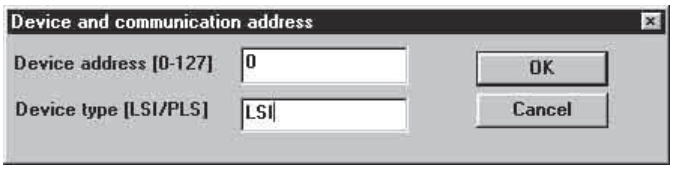
- From the menu choose **LSI – SICK Diagnosis** and enter zero as the device address and “LSI” as the device type, as described above. Click on “OK”.



The “Run Diagnosis” dialogue box appears.

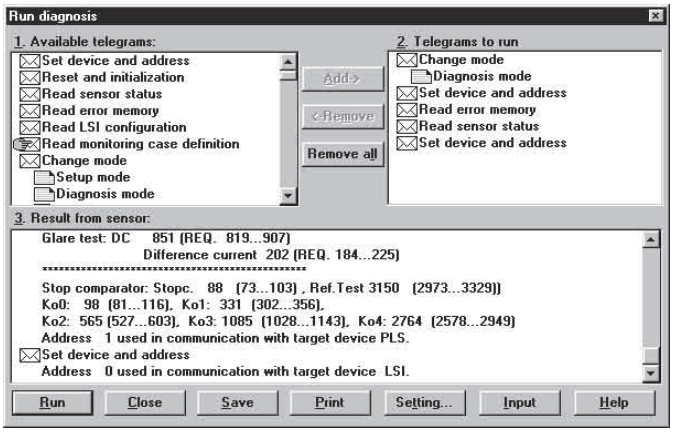
- Insert the following telegrams in the execution list one after the other:
  - “Switch operating mode: Diagnosis mode”
  - “Set device and address”
  - “Read fault memory”
  - “Read sensor status”
  - “Set device and address”
- Click on “Run“.





While the telegrams are being executed, a dialogue box appears in which you need to enter the device address of the sensor:

- Enter the device address of the desired sensor (1 to 4) and enter “PLS” as the device type.
- Click on “OK”.



A second dialogue box appears in which you need to enter the device address of the LSI:

- Enter zero as the device address and “LSI” as the device type.
- Click on “OK”.

The fault memory and the sensor status of the PLS are read, and the result is displayed in the box at the bottom of the screen. For the sensor fault codes refer to the Technical Description of the PLS.

- Eliminate the fault and reset the LSI system as described below:

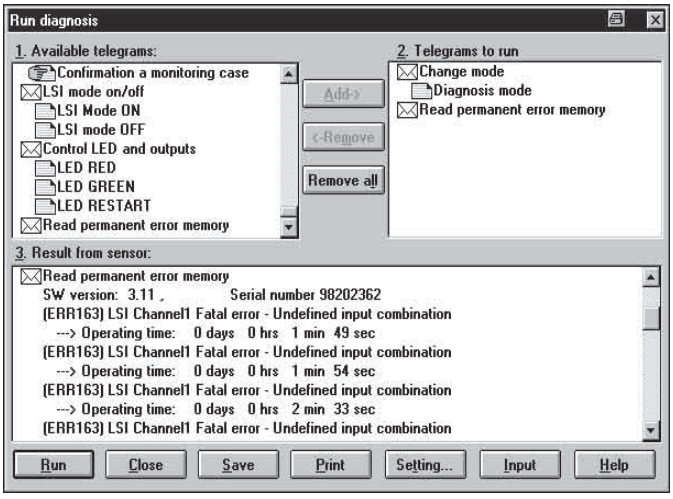
In case of PLS faults:

- Switch the power supply to the PLS off and back on again. Then choose **LSI – Initialise** from the menu to reset the LSI system.

In case of LSI faults:

- From the menu choose LSI – Initialise to reset the LSI system, or execute the “Reset and initialisation” telegram in the SICK diagnosis. The LSI system is then reset.

Reading the permanent fault memory



Up to 20 initial faults from the fault memory are summarised in short form and stored in the non-volatile permanent fault memory. As a result, fault codes can be displayed even after the system has been reset a number of times. If more than 20 entries are registered, the oldest is deleted.

- From the menu choose **LSI – Sick Diagnosis**, as described above.
- Insert the following telegrams in the execution list one after the other:
  – “Change mode: Diagnosis mode”
  – “Read permanent error memory”
- Click on “Run”.

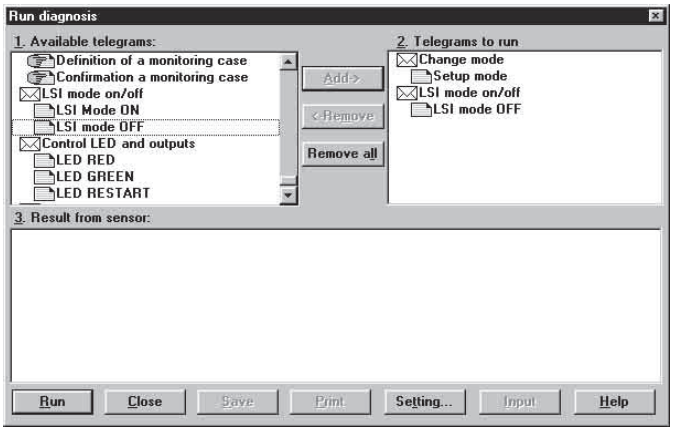
Note:
The time in “days, hrs, min & sec” indicates the elapsed operating time in monitoring mode.

9.16 Deconfiguring a sensor

A sensor previously connected to an LSI system is programmed for operation on an LSI. Before it can be disconnected from the LSI and re-used as a stand-alone unit, you will need to deconfigure it using the SICK diagnosis function.

- From the menu choose **LSI – SICK Diagnosis** and enter zero as the device address and “LSI” as the device type, as described above. Click on “OK”.

The “Run Diagnosis” dialogue box appears.



- Insert the following telegrams in the execution list one after the other:
  – “Change mode: Setup mode”
  – “LSI mode on/off: LSI mode OFF”
- Click on “Run”.

All connected sensors are deconfigured.
You can then disconnect them from the LSI and use them as stand-alone units.

Note:
If you want to use sensors without the LSI, refer to the *Technical Description* of the PLS.

10 Tests

10.1 Checking the LSI

These tests are required in order to check that the safety devices are functioning correctly and are properly integrated into the machine/plant control, as well as to reveal any alterations or manipulations in the system.

The following instructions must be observed to ensure compliance with the intended use:

The units must be installed and their electrical connections made only by qualified personnel. Qualified in this context means that personnel have undergone specialist training and have gained experience of power-driven machinery/equipment. They are also required to be sufficiently familiar with the relevant national health and safety regulations, accident prevention regulations, directives and codes of practice to be able to assess the safe condition of any power-driven machinery/equipment. Such persons are normally qualified personnel of the manufacturers of the electro-sensitive protective equipment (ESPE) or personnel who have been trained accordingly by the device manufacturers and are engaged primarily for the testing of electro-sensitive protective equipment and have been commissioned by the device operators.

1. Testing of the protective device by an expert, before initial start-up of the machine:
   - Test before initial start-up to confirm that the safety requirements demanded by national/international regulations, in particular, Machinery Directive and Provision and Use of Work Equipment Directive are fulfilled (EC Declaration of Conformity).
   - Test the effectiveness of the protective device on the machine in all operating modes programmable on the machine, based on the supplied checklist.
   - The personnel operating the machine protected by the safety device must be instructed by qualified personnel prior to starting work. The instruction is the responsibility of the machine operating company.

   Test your LSI system using the checklist reproduced in the Technical Description.
2. Regular testing of the protective device by experts:
   - Testing must be carried out in accordance with the valid national and international regulations and standards at the intervals specified therein. The purpose of these tests is to reveal any modifications or manipulations of the protective device since the initial commissioning.
   - The tests must be carried out in the event of any major modifications to the machine or protective device, as well as after re-fitting or repair in the event of damage to the housing, front screen, connecting cable, etc.

   Test your LSI system using the checklist reproduced in the *Technical Description*.
3. Daily testing of the protective device by authorised and instructed personnel:

   To test your LSI system correctly:

   1. The test must be carried out for the relevant preset monitoring case.
   2. Check the mechanical installation to ensure that all mounting screws are secure and that the PLS is properly aligned.
   3. Check each PLS unit for visible changes, such as damage, manipulation etc.
   4. Switch on the machine/plant.
   5. Watch the LEDs on each PLS (red, green, yellow).
   6. If at least one LED is not permanently lit when the machine/plant is switched on, it is to be assumed that there is a fault in the machine or plant. In this case the machine must be shut down immediately and checked by a specialist.
   7. Deliberately obstruct the protective field while the machine is running in order to test the effectiveness of the entire system. The LEDs of each tested PLS unit must change from green to red and the hazardous movement must stop immediately. Repeat this test at different points in the danger area and on all PLS units. If you discover any non-conformance of this function, the machine/plant must be shut down immediately and checked by a specialist.
   8. For stationary applications, check that the danger area marked out on the floor matches the shape of the protective field stored in the PLS and that any gaps are protected by additional safety measures. In the case of mobile applications, check that the moving vehicle actually stops at the field limits which are set in the LSI and listed on the data plate in the vehicle or in the configuration log. If you discover any non-conformance of this function, the machine/plant/vehicle must be stopped immediately and checked by a specialist.
   9. This test replaces the test specified in the PLS *Technical Description/Operating Instructions.*

10.2 Checklist

Checklist for machine manufacturer/installer for the installation of Electro Sensitive Protective Equipment (ESPE)

Dependent upon the application, the below listed checks are a minimum when placing an ESPE in operation for the first time.

For reference purposes the checklist should be retained or stored with the machine documents.

1. **Are the relevant safety standards incorporated into the machine build? Will they satisfy the Regulations?**
   Yes ☐ No ☐
2. **Are the standards listed in the Declaration of Conformity?**
   Yes ☐ No ☐
3. **Is the ESPE the correct Type and interfaced to the correct Category?**
   Yes ☐ No ☐
4. **Is access to the danger zone/point of danger only possible through the ESPE?**
   Yes ☐ No ☐
5. **Are measures in place to prevent standing between the ESPE and the danger zone (mechanical point-of-operation guarding)? If so, are these measures secured against removal?**
   Yes ☐ No ☐
6. **Are all monitoring areas selectable by way of the LSI configured such that the measures in place as per item 5 remain operational?**
   Yes ☐ No ☐
7. **Are additional mechanical means positioned to avoid reaching over, under or around, and are they secure against manipulation?**
   Yes ☐ No ☐
8. **Has the overall machine stopping time been checked and documented (on the machine and/or in the machine documents?**
   Yes ☐ No ☐
9. **Is the resultant safety distance observed between the danger point and the ESPE in all operating modes (monitoring cases)?**
   Yes ☐ No ☐
10. **Is the ESPE correctly fixed and secured against movement after setting in its fixed position?**
    Yes ☐ No ☐
11. **Are the required protection measures against electric shock in place (protection class)?**
    Yes ☐ No ☐
12. **Are the monitoring case switching signals for the LSI inputs A, B, C, D of two-channel design (For more details see LSI *Technical Description, section 8.2*)?**
    Yes ☐ No ☐
13. **Is the re-set / re-start switch for the ESPE installed and fitted to the correct standard?**
    Yes ☐ No ☐
14. **Are the OSSDs of the ESPE connected in accordance with the machine circuit diagram?**
    Yes ☐ No ☐
15. **Have the protective functions been inspected in accordance with the inspection instructions of this document?**
    Yes ☐ No ☐
16. **Are the switching elements controlled by the ESPE, e. g. contactors, valves, monitored?**
    Yes ☐ No ☐
17. **Is the ESPE effective during the entire hazardous state?**
    Yes ☐ No ☐
18. **Is the Daily Check Requirement sign positioned in a place visible to the operator?**
    Yes ☐ No ☐

This checklist does not replace the initial commissioning or regular inspections by qualified personnel.

11 Care and maintenance

Every time the front screen of a PLS is replaced (see *PLS Technical Description, section 11*, “Care and maintenance”), the contamination measurement must be calibrated.

- From the menu choose **LSI – Tools – Calibrate Contamination Measurement**.
- Select the PLS on which you want to calibrate the contamination measurement via the LSI.

Note:
The contamination measurement may only be calibrated directly after replacement of the front screen.

11.1 LEDs on the LSI

On the LSI and the sensors there are light-emitting diodes (LEDs) which deliver important information indicating whether your system is working correctly. You can check here to see what the functions of the LEDs are.

LSI LEDs:

Status	**OSSD** (green)	WEAK/ ERROR (yellow)	RES (yellow)	OSSD (red)
Protective field free	◎			
Object in protective field				◎
Contamination warning *		○ 1 Hz		
Contamination *		◎		◎
Fatal error **		○ ≈4 Hz		◎
Start-up testing				◎
Waiting for reset/restart			○ 1 Hz	◎

PLS LEDs:

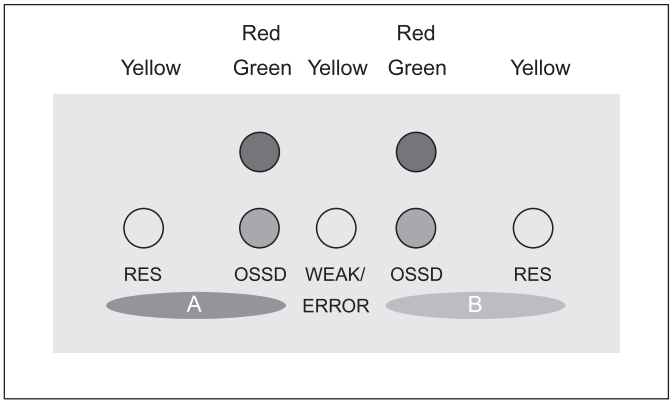
Status	Green	Yellow	Red
Protective field free	◎		
Object in protective field			◎
Contamination warning *		○ 1 Hz	
Contamination *		◎	◎
Fatal error **		○ ≈4 Hz	◎
Start-up testing	◎		
Waiting for reset/restart		○ 1 Hz	◎

Output level on LSI:

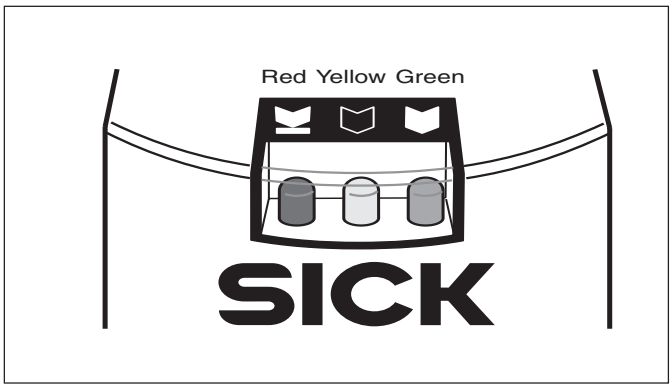
Status	Output OSSD	Output Warning field	Output ERROR
Protective field free	⎍		
Warning field free		⎍	
Object in protective field	⎍		
Object in warning field ***		⎍	
Contamination warning *			⎍
Contamination *	⎍	⎍	⎍
Fatal error **	⎍	⎍	⎍ ≈4 Hz
Start-up testing	⎯		
Waiting for reset/restart	⎯		

◎ = LED lit
○ 1 Hz = LED flashing slowly
○ ≈4 Hz = LED flashing rapidly
⎍ = Output switches to high
⎍ = Output switches to low
⎯ = Output is constantly low
⎍ ≈4 Hz = Output alternates between high and low

* Clean front screen with plastic cleaner and a soft cloth.
** System error: Carry out system diagnosis (see section 9.15).
*** Object in warning zone: not indicated by the yellow LEDs of the PLS and LSI.



LEDs on the LSI



LEDs on the PLS sensor

11.2 LSI fault table

This table enables you to find out what the SICK diagnosis fault codes mean, and whether you can rectify the fault yourself. How to execute the SICK diagnosis is described in *section 9.15*.

Fault codes not listed in this table are internal faults. Please contact SICK Service.

11.3 SICK Service/Hotline

If you have any further questions please refer to your local office or contact the SICK Service Hotline.

Fault code:	Cause / corrective action:
11 – 21	**Communication failure between PLS and LSI:** Check the communication cable. Switch the power off and back on again.
41	**Sensor fault:** Switch the power off and back on again. Replace the PLS, or contact SICK Service.
43	**Sensor has no default password:** Contact SICK Service to have the default password configured.
44	**Wrong sensor address:** Check the wiring between the LSI and the sensors. Reconfigure the LSI.
56	**Configuration error:** Check the wiring between the LSI and the sensors.
57	**Maximum input voltage at the inputs exceeded:** Check the voltage level of the LSI inputs
59	**Initialisation error in channel 1:** Contact SICK Service.
60	**Initialisation error in channel 2:** Contact SICK Service.
61, 63	**OSSD fault:** Check the output load. Switch the power off and back on again. Replace the LSI, or contact SICK Service.
110	**Measurement telegram error, sensor 1:** Check the wiring between the LSI and sensor 1. Interrogate the sensor fault memory (see *section 9.15*), or contact SICK Service.
111	**Measurement telegram error, sensor 2:** Check the wiring between the LSI and sensor 2. Interrogate the sensor fault memory (see *section 9.15*), or contact SICK Service.
112	**Measurement telegram error, sensor 3:** Check the wiring between the LSI and sensor 3. Interrogate the sensor fault memory (see *section 9.15*), or contact SICK Service.

Fault code:	Cause / corrective action:
113	**Measurement telegram error, sensor 4:** Check the wiring between the LSI and sensor 4. Interrogate the sensor fault memory (see *section 9.15*), or contact SICK Service.
114	**Initialisation error, sensor 1:** Check the wiring between the LSI and sensor 1. Check that the connected sensor type matches the configured type. Reconfigure the LSI, or contact SICK Service.
115	**Initialisation error, sensor 2:** Check the wiring between the LSI and sensor 2. Check that the connected sensor type matches the configured type. Reconfigure the LSI, or contact SICK Service.
116	**Initialisation error, sensor 3:** Check the wiring between the LSI and sensor 3. Check that the connected sensor type matches the configured type. Reconfigure the LSI, or contact SICK Service.
117	**Initialisation error, sensor 4:** Check the wiring between the LSI and sensor 4. Check that the connected sensor type matches the configured type. Reconfigure the LSI, or contact SICK Service.
118	**Protective field configured too large:** Adapt the size of the protective field to the sensor variant.
120	**Contamination on sensor 1:** Check and clean the front screen of the sensor.
121	**Contamination on sensor 2:** Check and clean the front screen of the sensor.
122	**Contamination on sensor 3:** Check and clean the front screen of the sensor.
123	**Contamination on sensor 4:** Check and clean the front screen of the sensor.
144	**Initialisation error in channel 1:** Contact SICK Service.
145	**Initialisation error in channel 2:** Contact SICK Service.
161	**Configured measurement tolerance of incremental encoders exceeded:** Check the connections of the incremental encoders.
162	**Directional values of incremental encoders different:** Check the connections of the incremental encoders.
163	**Undefined input combination:** Check the configuration of the input conditions.
165	**Incorrect monitoring case switching sequence:** Check the sequence setting in the configuration (see *section 9.4*).

Fault code:	Cause / corrective action:
180	**Fault in sensor 1:** Switch the power off and back on again. Interrogate the sensor fault memory (see *section 9.15*). Replace the sensor, or contact SICK Service.
181	**Fault in sensor 2:** Switch the power off and back on again. Interrogate the sensor fault memory (see *section 9.15*). Replace the sensor, or contact SICK Service.
182	**Fault in sensor 3:** Switch the power off and back on again. Interrogate the sensor fault memory (see *section 9.15*). Replace the sensor, or contact SICK Service.
183	**Fault in sensor 4:** Switch the power off and back on again. Interrogate the sensor fault memory (see *section 9.15*). Replace the sensor, or contact SICK Service.
200	**Same level at input A:** Check input levels at A1 and A2. The levels must be mutually inverted.
201	**Same level at input B:** Check input levels at B1 and B2. The levels must be mutually inverted.
202	**Same level at input C:** Check input levels at C1 and C2. The levels must be mutually inverted.
203	**Same level at input D:** Check input levels at D1 and D2. The levels must be mutually inverted.
204	**Faulty actuation of inputs:** Check the actuation.
206	**Incorrect actuation of RES A:** Check the levels and the time response at RES A.
208	**Incorrect actuation of RES B:** Check the levels and the time response at RES B.
209	**Maximum input frequency of incremental encoder inputs exceeded:** Check the configuration of the incremental encoders.
240	**External device monitor EDM A still open:** Check EDM A.
242	**EDM A closed when output active:** Check EDM A. Switch the power off and back on again. Replace the LSI, or contact SICK Service.
243	**EDM A open when output inactive:** Check EDM A. Switch the power off and back on again. Replace the LSI, or contact SICK Service.
244	**External device monitor EDM B still open:** Check EDM B.

Fault code:	Cause / corrective action:
246	**EDM B closed when output active:** Check EDM B. Switch the power off and back on again. Replace the LSI, or contact SICK Service.
247	**EDM B open when output inactive:** Check EDM B. Switch the power off and back on again. Replace the LSI, or contact SICK Service.
248	**Object in protective field:** Check the ambient conditions. Adapt the configuration of the LSI to the ambient conditions.
249	**Object in warning field:** Check the ambient conditions. Adapt the configuration of the LSI to the ambient conditions.

12 Appendix

12.1 Application examples

Refer also to the instructions for the PLS given in the *PLS Technical Description*.

The application examples presented on the following pages are intended only as guides. You may need to incorporate additional protection measures.

Remember that there may already be someone in the protective field when the switch is made to a different monitoring case. Safe protection can only be guaranteed by prompt switching (that is, before the danger to the person arises at the location concerned).

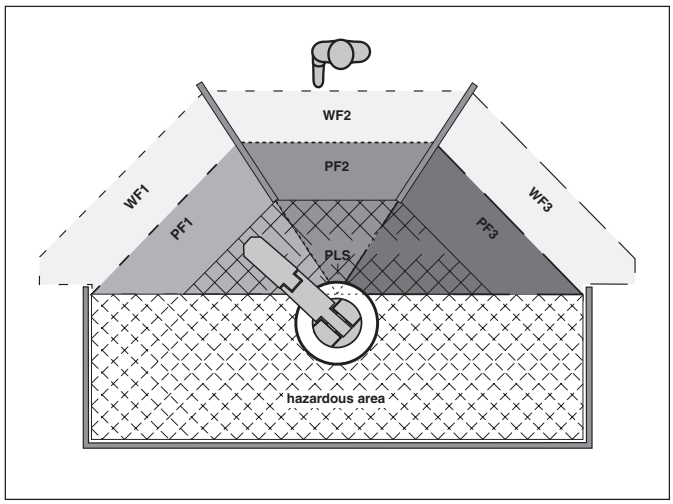
General note on the wiring diagrams:
Use only relays with positively guided contacts.
The switching elements connected in parallel with the contactors provide arc suppression (varistors for maximum alternating operating voltage $V_{RMS} = 25$ V).

1) Output circuits. These contacts must be integrated into the control system such that the hazardous state is eliminated when the output circuit is open.
   For categories 3 and 4 to EN 954-1 they must be integrated in a two-channel configuration (x, y paths).

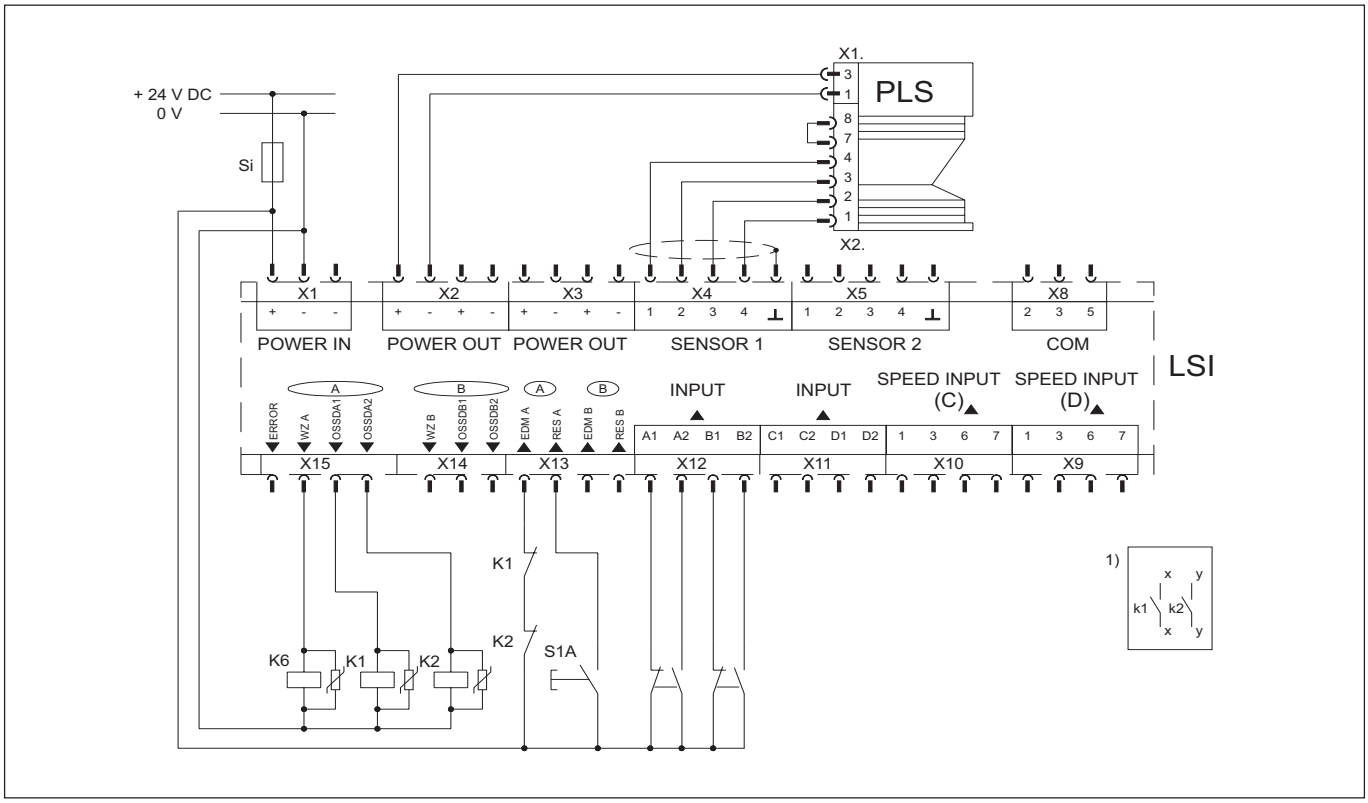
For area protection

1. Example: Machining centre with three loading stations

The LSI system is configured as follows:
– One PLS sensor connected
– Three monitoring areas defined (the protective and warning fields are shown in the diagram)
– One OSSD output and one warning field output configured
– Three monitoring cases configured, activated via the binary inputs
– Alternative order of monitoring cases

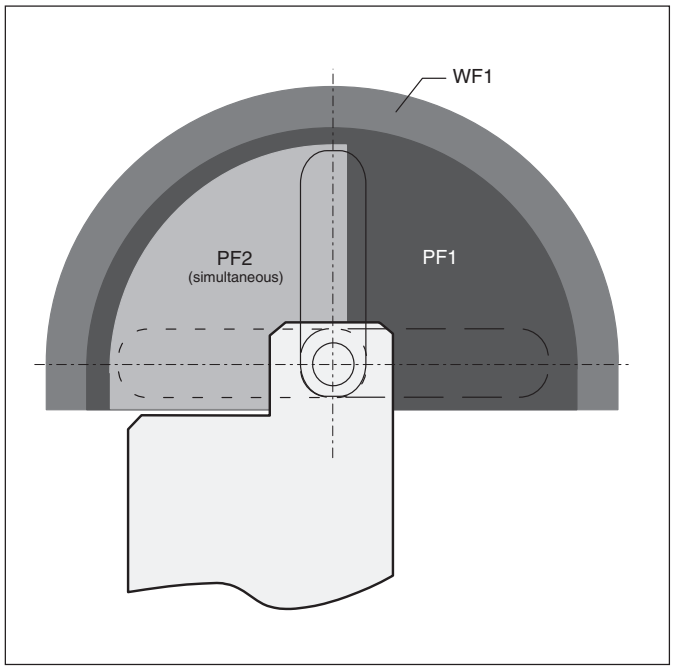


1. Application example: Machining centre with three loading stations

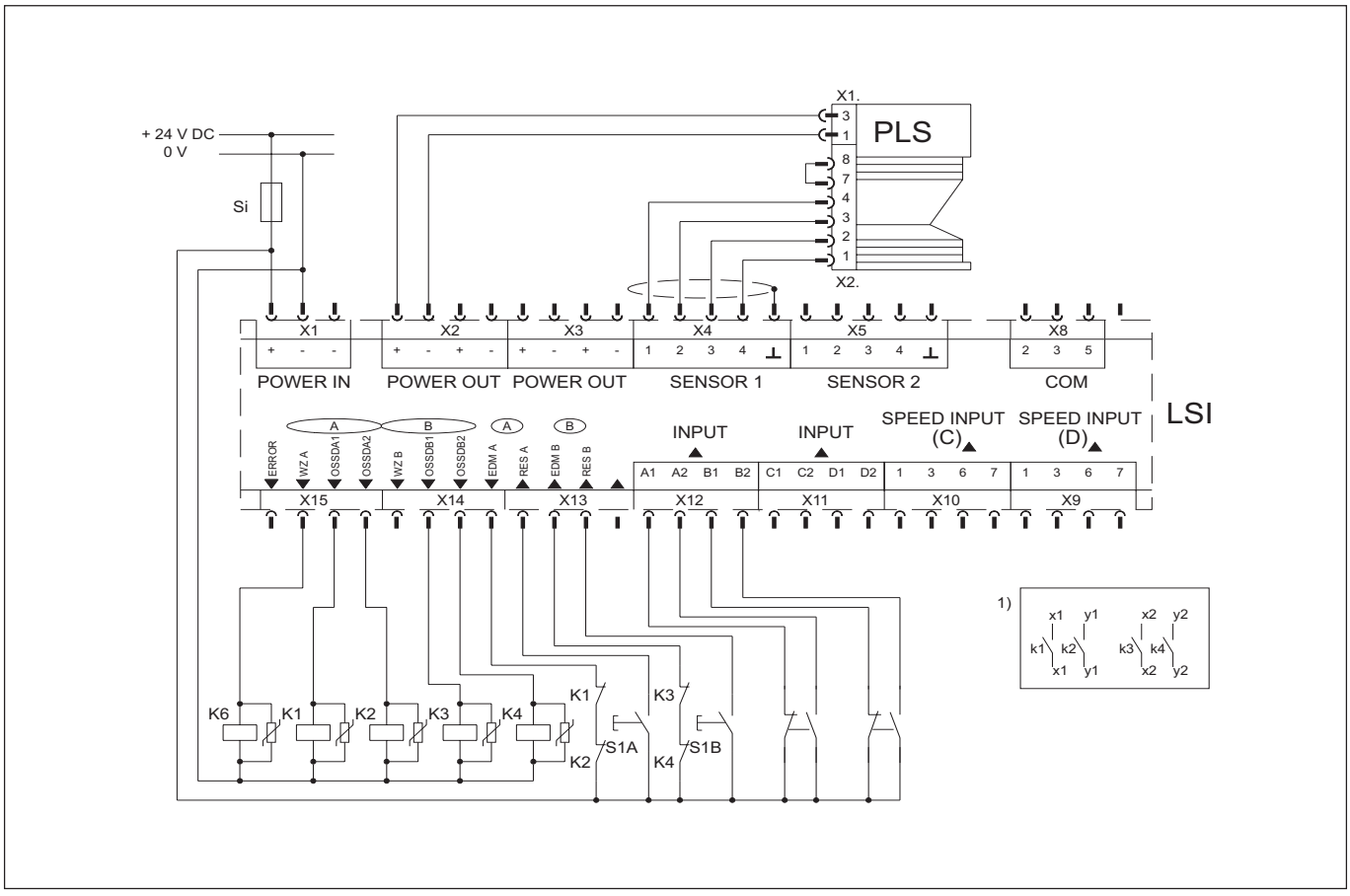


2. Example: Pipe bending machine

The LSI system is configured as follows:
- One PLS sensor connected
- Two protective fields (simultaneously) and one warning field defined
- Two OSSD outputs and one warning field output configured
- Three monitoring cases configured, activated via the binary inputs
- Any order of monitoring cases



2. Application example: Pipe bending machine



For on-board vehicle use

3. Example: Automated guided vehicle (AGV), forward and reverse, with incremental encoders

Calculate the number of pulses your encoders deliver per centimetre travel of your vehicle.

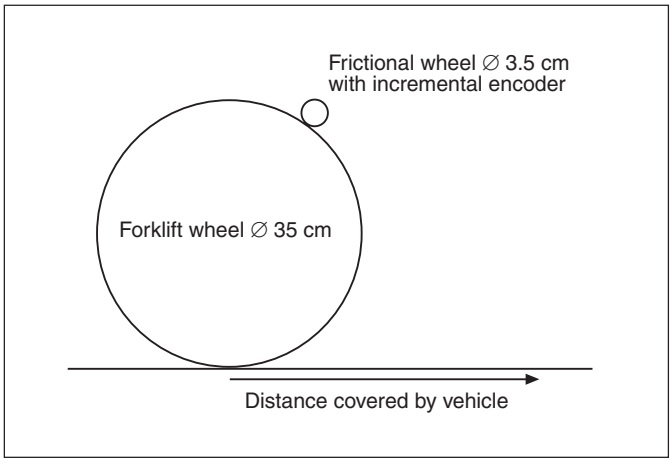
The result depends on the number of pulses the incremental encoder delivers per revolution, and on the transmission ratio between the vehicle's running wheel and the friction wheel to which the incremental encoder is fitted.

How to calculate the number of pulses per centimetre:

The running wheel of a forklift truck has a diameter of 35 cm.

The friction wheel to which the incremental encoder is fitted has a diameter of 3.5 cm.

The incremental encoder in use delivers 1000 pulses per revolution.



Calculation of pulses per centimetre

Circumference of forklift wheel = $d \cdot \pi = 35\ cm \cdot \pi = 109.96\ cm$

One revolution of the forklift wheel corresponds to 10 revolutions of the friction wheel, and thus to 10,000 pulses of the incremental encoder.

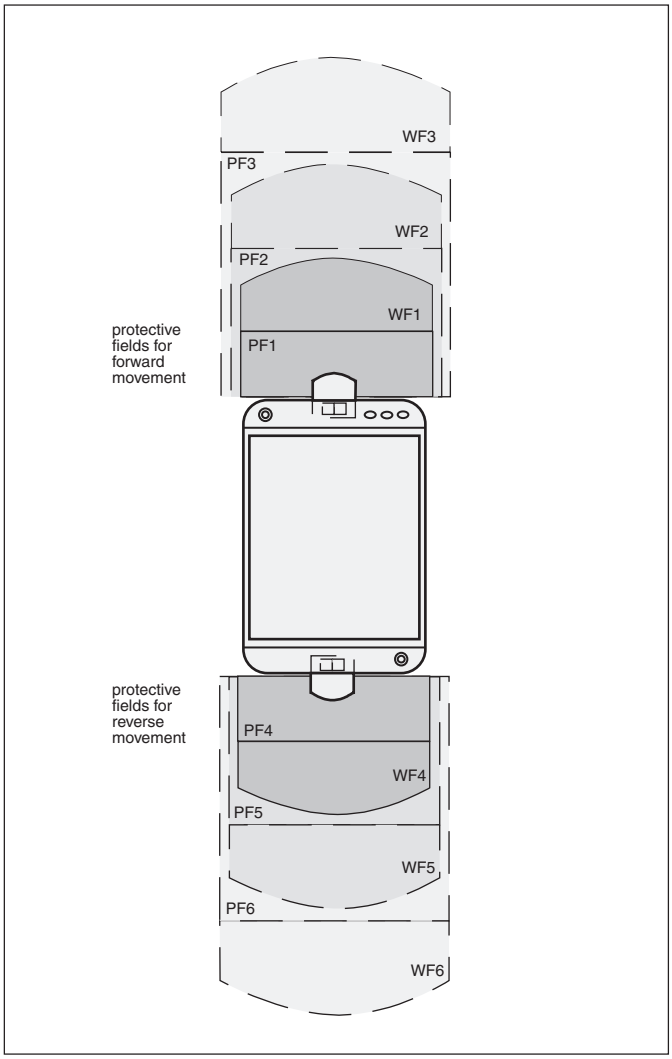
The number of pulses of the incremental encoder per centimetre travel of the vehicle is calculated as:

Pulses per cm = 10,000 : 109.96 = 90.94

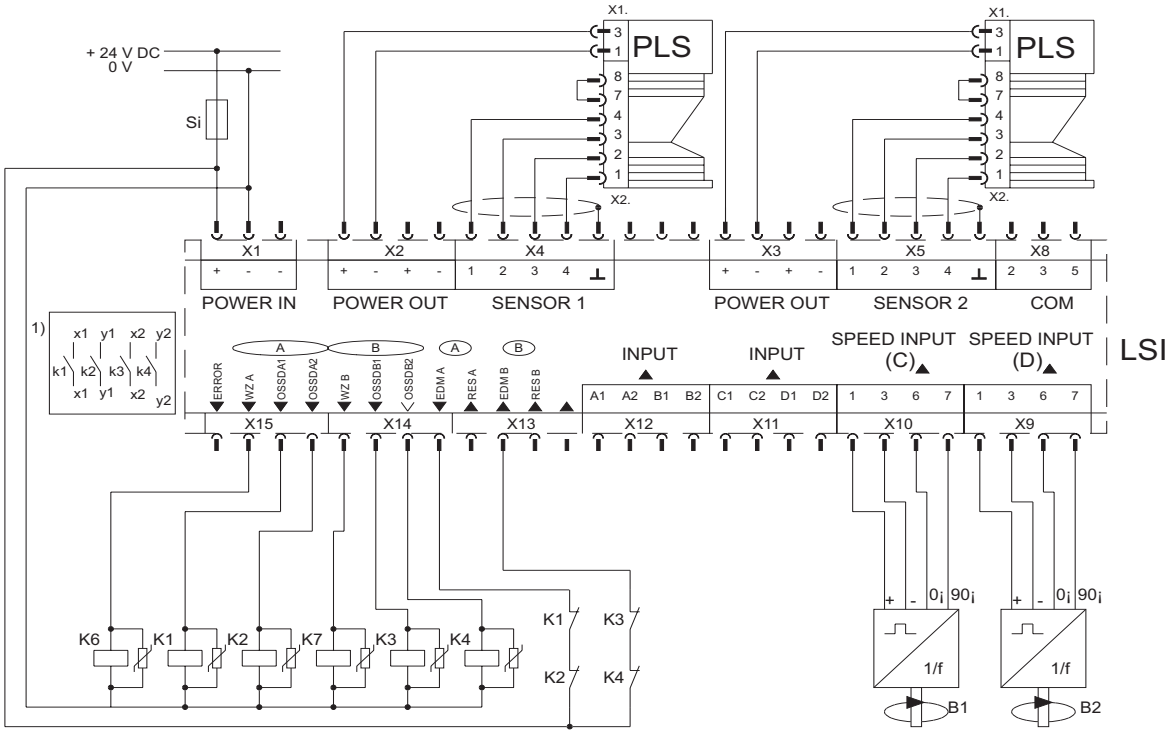
Consequently, when configuring the incremental encoders in the PLS/LSI user software you need to enter the rounded value "91" under "Pulses per centimetre". From that figure, the user software calculates the maximum permissible speed of the vehicle.
(How to configure the incremental encoders in the PLS/LSI user software is described in *section 9.7.*)

The LSI system is configured as follows:
- Two PLS sensors connected
- Six monitoring areas defined (the protective and warning fields are configured in stages, as shown in the diagram)
- Two incremental encoders connected and configured
- Two OSSD outputs and two warning field outputs configured
- Six monitoring cases (three for forward running, three for reverse)
- Any order of monitoring cases

(The circuit diagram for this example is on the next page.)



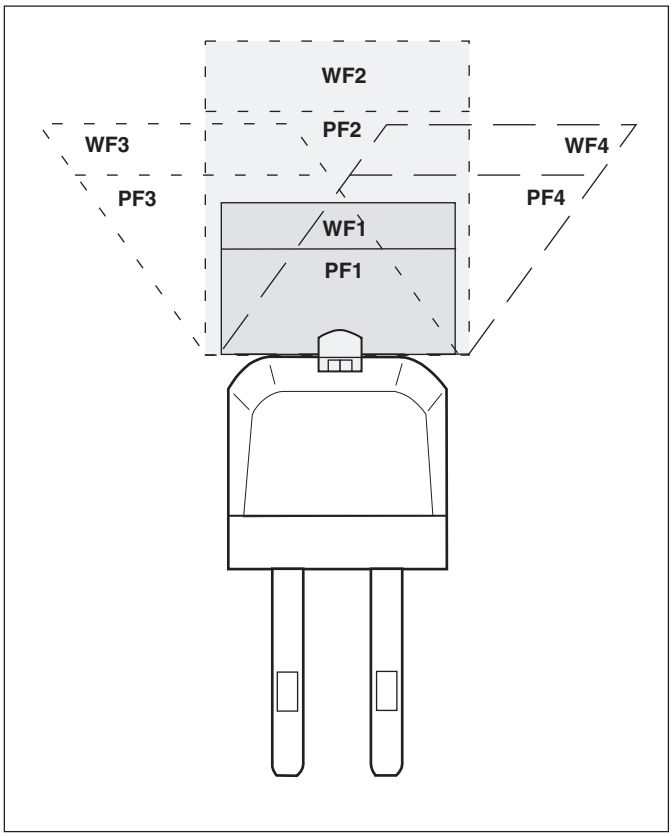
3. Application example: Automated guided vehicle (AGV), forward and reverse



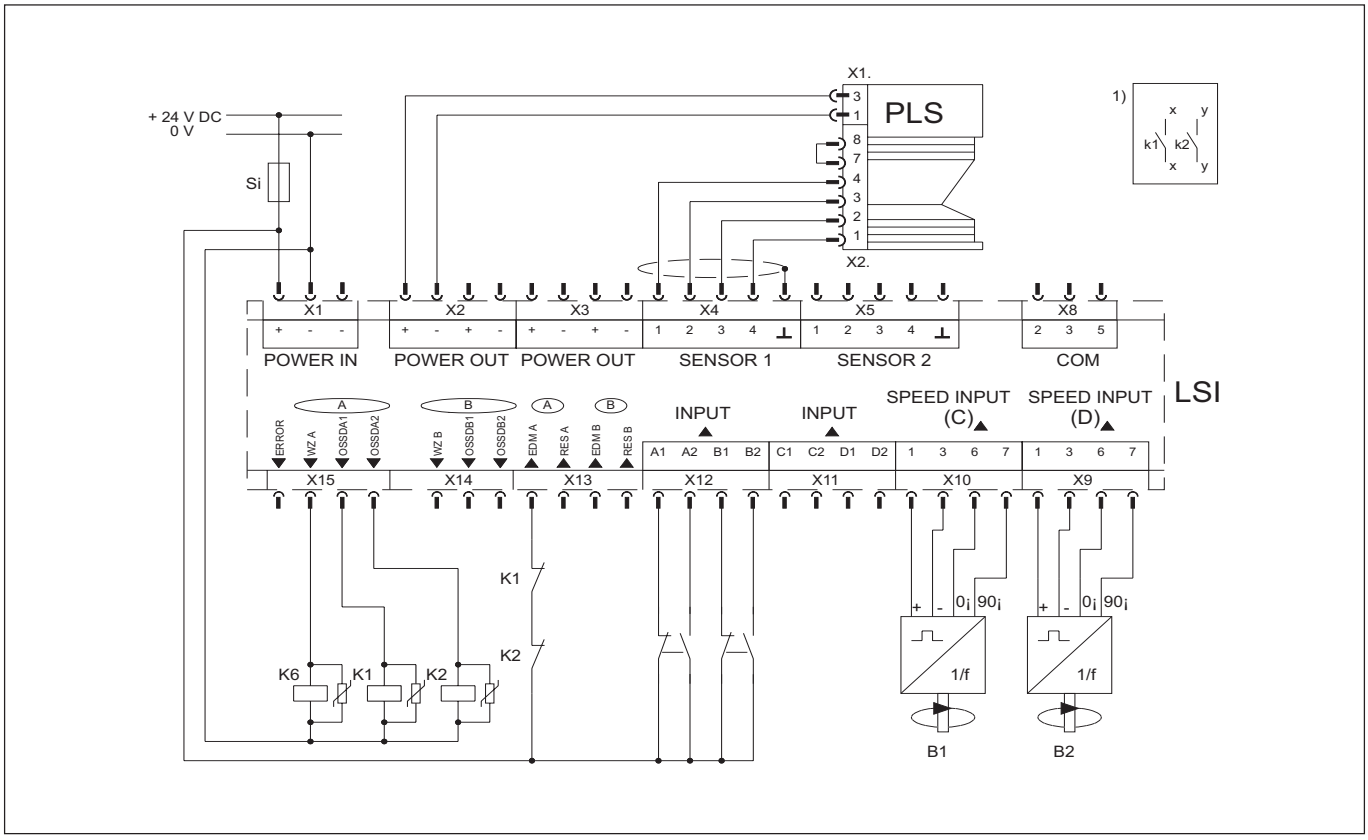
4. Example: Automated guided vehicle (AGV), forward only, with incremental encoders

Calculate the number of pulses your encoders deliver per centimetre travel of your vehicle, as described in the third example, and enter the resultant values in the user software under “Pulses per centimetre”.
(How to configure the incremental encoders in the PLS/LSI user software is described in *section 9.7*.)

The LSI system is configured as follows:
– One PLS sensor connected
– Four monitoring areas defined (the protective and warning fields are shown in the diagram)
– One OSSD output and one warning field output configured
– Four monitoring cases configured (e.g. slow, fast, left, right)
– Two incremental encoders connected and configured
– The “slow” and “fast” monitoring cases are activated by way of the incremental encoders;
the “left” and “right” cases via the binary inputs.
– Any order of monitoring cases



4. Application example: Automated guided vehicle (AGV), forward only



12.2 Start-up testing and restarting

Performing start-up testing

You can set in the PLS/LSI user software whether you want to carry out a start-up test when your LSI system has powered up. You can use the start-up test to check whether the protective field evaluation you stored in the LSI is working correctly.

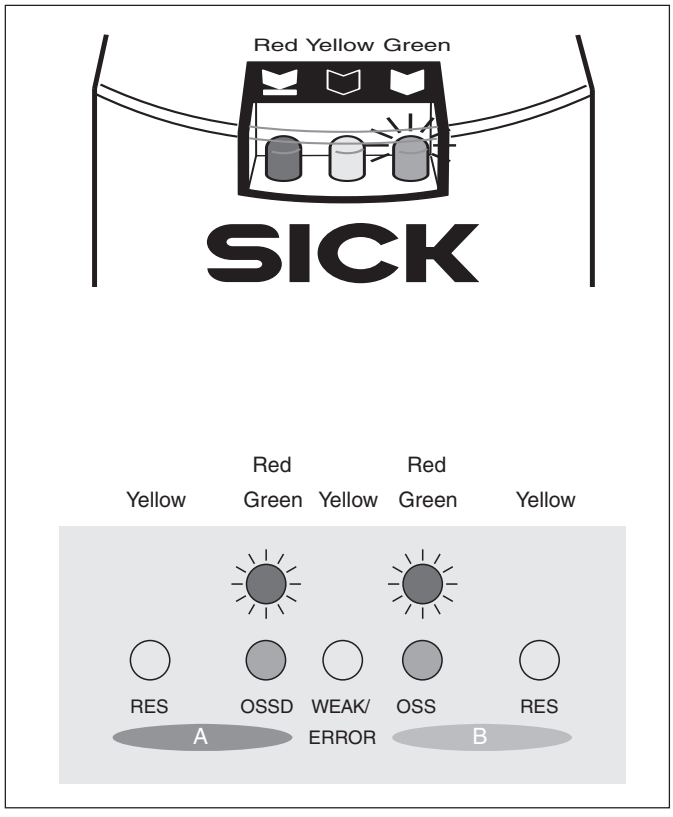
In doing so, you test only the sensor which is active during power-up and the monitoring area assigned to it. Consequently, the question of which sensor and which monitoring area is tested depends on which monitoring case is activated first on power-up. Since two monitoring cases may be activated simultaneously, in start-up testing you must test either one or two sensors.

Only after start-up testing are the configured outputs enabled, and the system is ready for operation.
How to programme start-up testing in the PLS/LSI user software is described in *section 9.3.*

How to perform start-up testing:

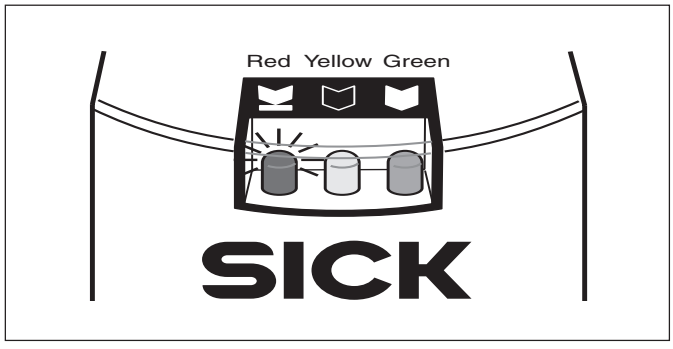
- Switch on the LSI.
  (It takes a few seconds to warm up.)

The green LED on the active sensor (possibly two sensors) lights up: The protective field which is active on power-up on the sensor is free.
The red LEDs at both outputs (OSSD A and OSSD B) light up on the LSI: The outputs are deactivated.



- Intrude into the protective field of the active sensor to make the red LED on the sensor light up.
- Move out of the protective field again.
- Also intrude into the protective field of the second active sensor where appropriate and then move out of it again.

Depending on the restart response you programmed in the PLS/LSI user software, the configured output (or, where appropriate, both outputs) is/are enabled. More detailed information on the restart response is given in the following subsection.

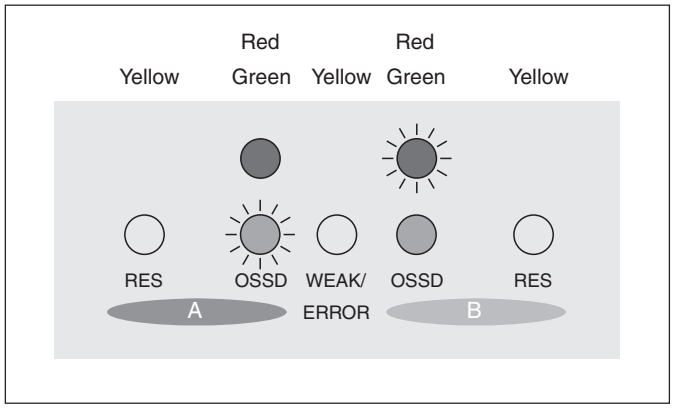


Restart after intrusion into the protective field

You have the following options, programmable in the PLS/LSI user software (see *section 9.3*):
– Without delay
– Delayed by n seconds
– With restart button

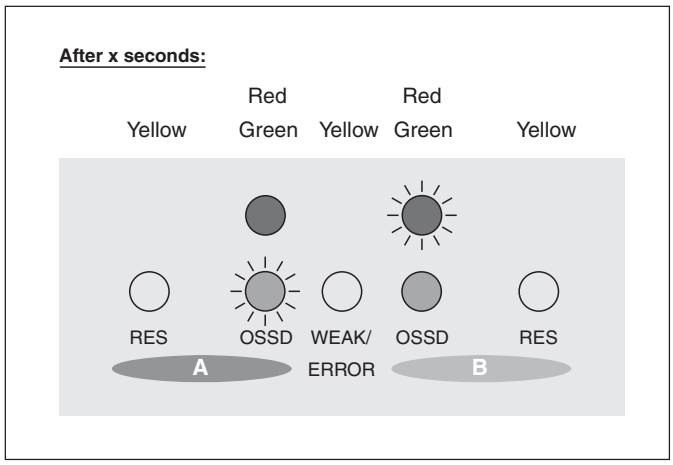
Restart “without delay”:

As soon as the active protective field is free, the LSI enables the output after the pre-set response time (multiple scans). The red LED at the configured output (OSSD A or B) goes out and the green LED lights up.



Restart “delayed by x seconds”:

The LSI starts up when the preset time has expired after the protective field has become free. At the end of this time, the red LED at the configured output goes out and the green LED lights up. The output is then free.

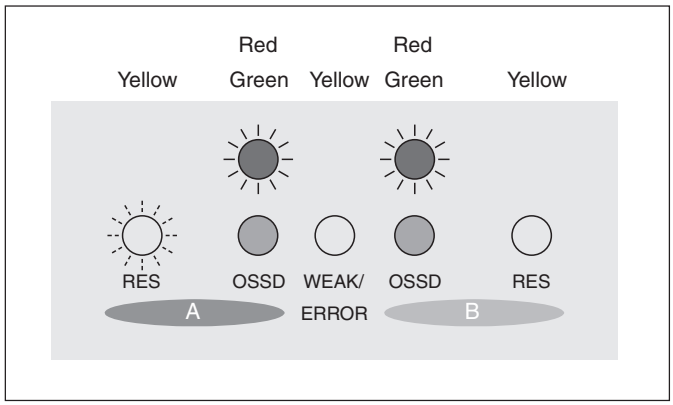


Restart “with restart button”:

The yellow “RES” LED at the configured output flashes.
You must then press the restart button. Only then is the output enabled.

Note:
When mounting the restart buttons,
make sure the button is mounted such that the danger zone is in full view when the button is pressed.

The system is then ready for operation.



12.3 Technical data

Here you will find the key technical data of the LSI.

Notes:
Also refer to the technical data of the PLS contained in the *PLS Technical Description*.
The requirements for the cables to be used are set out in *section 8* of this *Technical Description* and in the *LSI Operating Instructions, section 4.3*, "Cable requirements".

Properties	**Specifications**			**Comments**
	min.	**typ.**	**max.**	
Power supply connection (Uv)	16.8 V	24 V	28.8 V	**Protected against polarity reversal by a safety isolating transformer to EN 60742**
Permissible residual ripple			500 mV	The upper and lower voltage limits must not be infringed.
Cable length			50 m	
Cable cross-section			2.5 mm^2	
Permissible cable resistance			2.5 Ohm	
Response time (adjustable)				
at 2 scan rate			190 ms	
Formula for multiple scans (n = 2 to 16)	110 ms + (n x 40 ms)			Exception: PLS 101-316 with LSI in vehicle protection applications, where the response time is **270** ms, non-adjustable
Power-up time				
On power-on		9 sec.		
Power consumption				
without PLS and no load			15 W	
with 1 PLS and max. load			63 W	
with 2 PLS and max. load			80 W	
with 3 PLS and max. load			97 W	
with 4 PLS and max. load			114 W	
PLS connection	See PLS technical data Connect only PLS units of the same types			
RES A, RES B (Reset/Restart input)				
Quantity	One input per OSSD pair			
Input resistance at HIGH		3.8 kOhm		
Voltage for HIGH	15 V		28.8 V	
Voltage for LOW	0 V		1 V	
Current consumption				
Start pulse current (where $\tau = 100\ \mu s$)	15 mA		32 mA	
Static input current	3.5 mA		9 mA	

Properties	Specifications min.	typ.	max.	Comments
Time response of reset/restart button				
LOW level before actuation	160 ms			
HIGH level during actuation	240 ms		5 s	
LOW level after actuation	160 ms			
Cable length			50 m	
Cable cross-section			2.5 mm^2	
Permissible cable resistance			2.5 Ohm	
EDM input (external device monitoring)				
Quantity	One input per OSSD pair			
Input resistance at HIGH		3.8 kOhm		
Voltage for HIGH	15 V		28.8 V	
Voltage for LOW	0 V		1 V	
Current consumption				
Start pulse current (where $\tau = 100$ µs)	15 mA		32 mA	
Static input current	3.5 mA		9 mA	
Time response of EDM input				
High level after OSSD activation			200 ms	
Low level on OSSD deactivation			200 ms	
Cyclic monitoring of the rest and operating positions		5 s		
Cable length			50 m	
Cable cross-section			2.5 mm^2	
Permissible cable resistance			2.5 Ohm	
Inputs A, B (2-channel: A1, A2/B1, B2 antivalent), static binary				
Input resistance at HIGH		3.8 kOhm		
Voltage for HIGH	15 V		28.8 V	
Voltage for LOW	0 V		1 V	
Current consumption				
Start pulse current (where $\tau = 100$ µs)	15 mA		32 mA	
Static input current	3.5 mA		9 mA	
Port inconsistency				
Time window for valid switchover ... (at 2 scan rate)			80 ms	
Cable length			50 m	
Cable cross-section			2.5 mm^2	
Permissible cable resistance			2.5 Ohm	

Properties	Specifications min.	typ.	max.	Comments
Inputs C, D (2-channel: C1, C2/D1, D2 antivalent), static binary				
Input resistance at HIGH		2.6 kOhm		
Voltage for HIGH	15 V		28.8 V	
Voltage for LOW	0 V		1 V	
Current consumption				
Start pulse current (where $\tau = 0.5$ µs)	15 mA		32 mA	
Static input current	5 mA		13 mA	
Port inconsistency				
Time window for valid switchover (at 2 scan rate)			80 ms	
Cable length			50 m	
Cable cross-section			2.5 mm²	
Permissible cable resistance			2.5 Ohm	
Inputs C, D (only for incremental encoder 0°/90°), dynamic				
Input resistance at HIGH		2.6 kOhm		
Voltage for HIGH	15 V		28.8 V	
Voltage for LOW	0 V		1 V	
Current consumption				
Start pulse current (where $\tau = 0.5$ µs)	15 mA		32 mA	
Static input current	5 mA		13 mA	
Duty factor g (Ti/T)		0.5		
Input frequency			100 kHz	
Min. number of pulses per cm	50			
Evaluable speed range	±10 cm/s		±2000 cm/s	
Tolerance time for differing directional information or signal failure of an incremental encoder			0.4 s	≥ 10 cm/s
Exceeding of speed tolerance where incremental encoders in same direction			20 s 60 s	≥ 30 cm/s < 30 cm/s
Cable length			50 m	
Cable cross-section			2.5 mm²	
Permissible line impedance			2.5 Ohm	
Warning field output A/B (PNP), HIGH-active				
Quantity	One output per OSSD pair			
Switching voltage HIGH-active at 50 mA	Uv -1 V		Uv	
Switching voltage HIGH-active at 100 mA	Uv -0.5 V		Uv	
Switching current (referred to EXT_GND)			100 mA	

Properties	Specifications min.	typ.	max.	Comments
Current limitation (t = 5 ms, 25 degrees Celsius)	600 mA		920 mA	
Pure load inductance			2 H	
Switching sequence			6 1/s	
Response time (n = 2 to 16 ; n = scan rate)	150 ms + (n x 40 ms)			
Cable length			50 m	
Cable cross-section			2.5 mm^2	
Permissible cable resistance			2.5 Ohm	
Error output (PNP), HIGH-active				
Quantity	One output			
Switching voltage HIGH-active at 50 mA	Uv -1 V		Uv	
Switching voltage HIGH-active at 100 mA	Uv -0,5 V		Uv	
Switching current (referred to EXT_GND)			100 mA	
Current limitation (t = 5 ms, 25 degrees Celsius)	600 mA		920 mA	
Pure load inductance			2 H	
Switching sequence		≈ 4 1/s		
Cable length			50 m	
Cable cross-section			2.5 mm^2	
Permissible cable resistance			2.5 Ohm	
Safety outputs (OSSD A, OSSD B), dynamic, High-active				
Quantity	Two 2-channel outputs			
Switching voltage High-active (Ueff)	Uv -3,4 V		Uv	
Voltage for LOW	0 V		2.5 V	
Switching current (reference to EXT_GND)	2 mA		250 mA	
Short-circuit protected	by monitoring of outputs			
In case of fault: Leakage current			1.1 mA	Break in GND cable. The downstream switching element must detect this state as Low.
Pure load capacity			100 nF	
Pure load inductance			2 H	
Switching sequence (without switchover and without simultaneous monitoring)			6 1/s	
Response time at double speed			190 ms	
Cable length			50 m	

Properties	Specifications min.	typ.	max.	Comments
Cable cross-section			2.5 mm²	
Permissible cable resistance			2.5 Ohm	
Test pulse data (OSSD_Test)				
Test pulse width		100 µs		
Test frequency	Once per scan			
Test pulse data (Test_Ub)				
Test pulse width		100 µs		
Test frequency	Twice per scan			
Safety category	Single error fail-safe			
DIN V 19250	Requirement class 4			
EN 954-1	Category 3			
IEC/EN 61496-1	Type 3			
General data				
Enclosure rating			IP 20	Installation in switch cabinet with min. IP 54 specified.
Protection class		3 Safety-low voltage		
Humidity class		F to DIN 40040		
Vibration resistance		**IEC 60068, part 2-6**		
Frequency range		10 ... 55 Hz		
Amplitude		0.35 mm		
Shock resistance		IEC 60068, part 2-29		
Continuous shock 1000		10 g / 16 ms		
Interference immunity (EMC)		IEC / EN 61496-1 EN 50081-2 DIN 40839-1 and -3		
Mass (net)		1.25 kg		
Dimensions (W x H x D)	216 mm x 108 mm x 86 mm			Dimensions excluding terminals and connectors
Operating temperature in degrees Celsius	0		+50	
Storage temperature in degrees Celsius	-25		+70	

Properties	Specifications min.	typ.	max.	Comments
Protective fields	1		8	
Warning fields	1		8	
Protective field output	2 independent, monitored semiconductor outputs, 2-channel, PNP HIGH-active, 24 V/250 mA			
Warning field output	2 independent semiconductor outputs, PNP HIGH-active, 24 V/100 mA			
Fault output	1 semiconductor output, PNP HIGH-active, 24 V / 100 mA			
Reset/restart input	1 input per OSSD pair (to 24 V DC)			
EDM input (external device monitoring)	1 input per OSSD pair (to 24 V DC)			
Inputs A1, A2, B1, B2, C1, C2, D1, D2	Static binary inputs to 24 V DC			
Inputs C, D	Dynamic inputs to 24 V DC			
Switchover of monitoring cases (use of inputs A - D)	4 static binary input pairs (x1 and x2 antivalent) A1, A2, B1, B2, C1, C2, D1, D2 or 2 dynamic incremental encoder inputs (C, D) and 2 static binary input pairs (x1 and x2 antivalent) A1, A2, B1, B2			
Interface (PC)				Only for temporary configuration and diagnostic purposes
Transmission rate				
RS 232	9600, 19200, 38400 Baud			
RS 422	9600, 19200, 38400 Baud			
Cable length				
RS 232			15 m	
RS 422			100 m	
Interface (LSI - PLS)				Use of a low-capacitance twisted-pair data cable of type Li2YCY (TP) with a cable cross-section of min. 2 x 2 x 0.25 mm^2
Transmission rate				
RS 422		500 kB		
Cable length				
RS 422			30 m	
Cable cross-section				
RS 422	0.25 mm^2			

12.4 Accessories

For installation

	Part no.
Mounting kit (DIN rail and mounting bracket)	2 019 300

LSI variants

	Part no.
LSI 101-112 (for connection of max. 2 PLS 101-3xx)	1 016 063
LSI 101-114 (for connection of max. 4 PLS 101-3xx)	1 016 065

For connection to the control and the PLS

	Part no.
Connection set A 1 PLS power plug, 1 PLS interface connector, 1 screw-in interface connector for sensor connection to LSI, without cable	2 019 065
Connection set B, as connection set A, with 3 metre cable	2 019 066
Connection set C, as connection set A, with 5 metre cable	2 019 067
Connection set D, as connection set A, with 10 metre cable	2 019 068
Connection set E, as connection set A, with 15 metre cable	2 019 069
Connection set F, as connection set A, with 20 metre cable	2 019 070
Connection set G, as connection set A, with 30 metre cable	2 025 902
Terminal strip set, WAGO connector set, 8-part	2 018 946
SUB–D connector (RS 232/RS 422) with screw-in terminals, EMC protected	6 011 808
SUB–D connector (RS 232/RS 422) with soldered terminals, EMC protected	2 019 097

Power supply units

	Part no.
24 V DC, 2.5 A	6 010 361
24 V DC, 4,0 A	6 010 362
24 V DC, 10 A	6 011 156

Interface cables

RS 232	Part no.
Interface cable, 3 m	2 016 401
Interface cable, 5 m	2 016 402
Interface cable, 10 m	2 016 403
RS 422	
Interface cable, 3 m	2 019 130
Interface cable, 5 m	2 019 131
Interface cable, 10 m	2 019 132

User documentation

	Part no.
Technical Description LSI, German, without software discs	8 008 309
Technical Description, LSI, English, without software discs	8 008 310
Technical Description, LSI, French, without software discs	8 008 311
Technical Description LSI, Spanish, without software discs	8 009 033

12.5 Standards and regulations

The following lists the key standards and regulations applicable to the use optoelectronic safety devices. Depending on 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.

Regarding the use and installation of safety devices:

Machinery Directive 98/37 EC

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

Safety requirements for automated manufacturing systems (VDI 2854)

Safety of machines – Electrical equipment of machines – Part 1: General requirements (EN 60 204)

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

Safety requirements for robots (EN 775)

Safety rules for electro-sensitive protective equipment 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 protective devices:

Safety of machines – Electro-sensitive protective equipment – Part 1: General requirements (IEC/EN 61496-1)

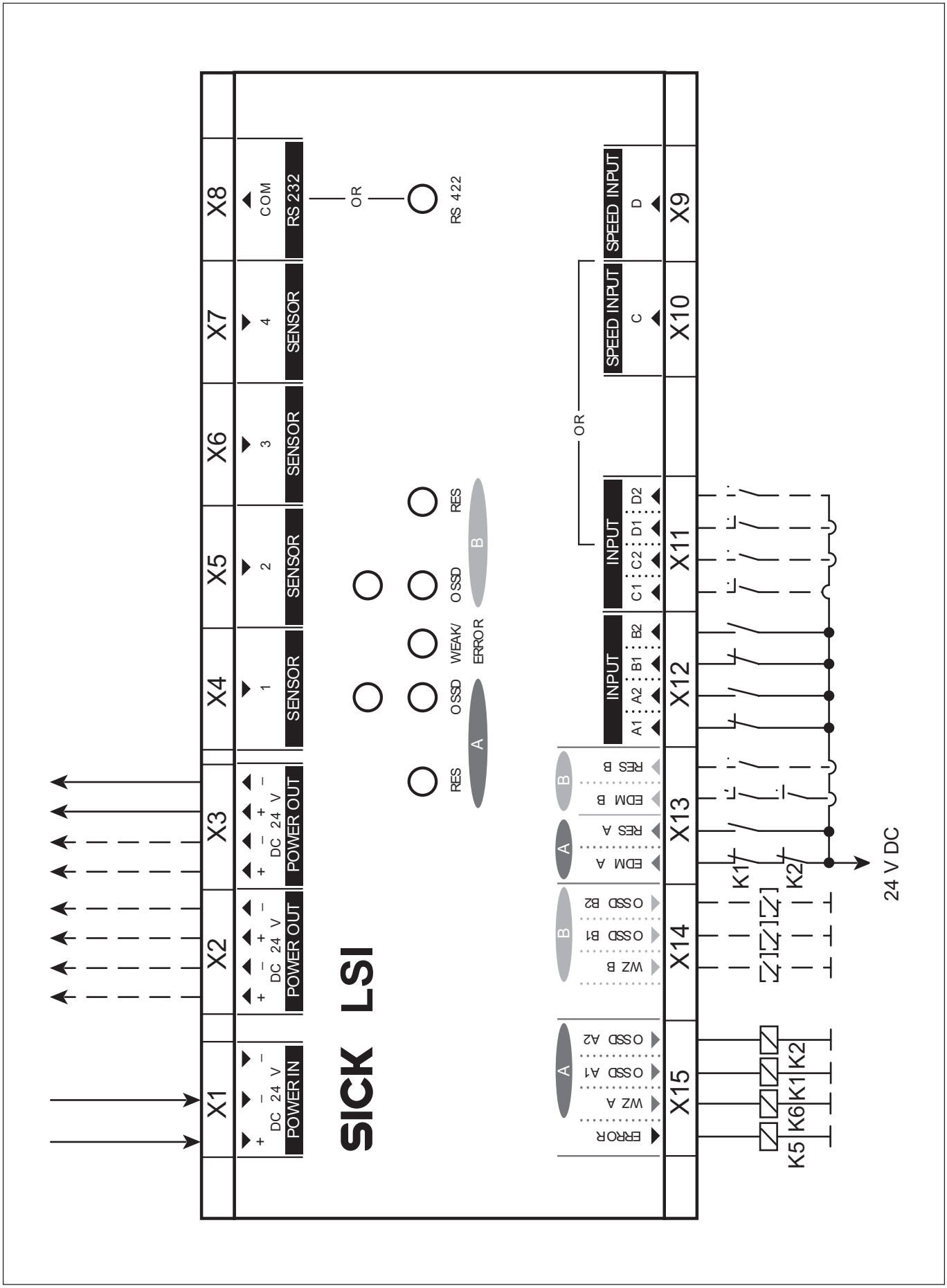
Basic safety observations for instrumentation and control protective devices (DIN V 19 250)

Safety of machines – Electrical equipment of machines – Part 1: General requirements (EN 60 204)

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

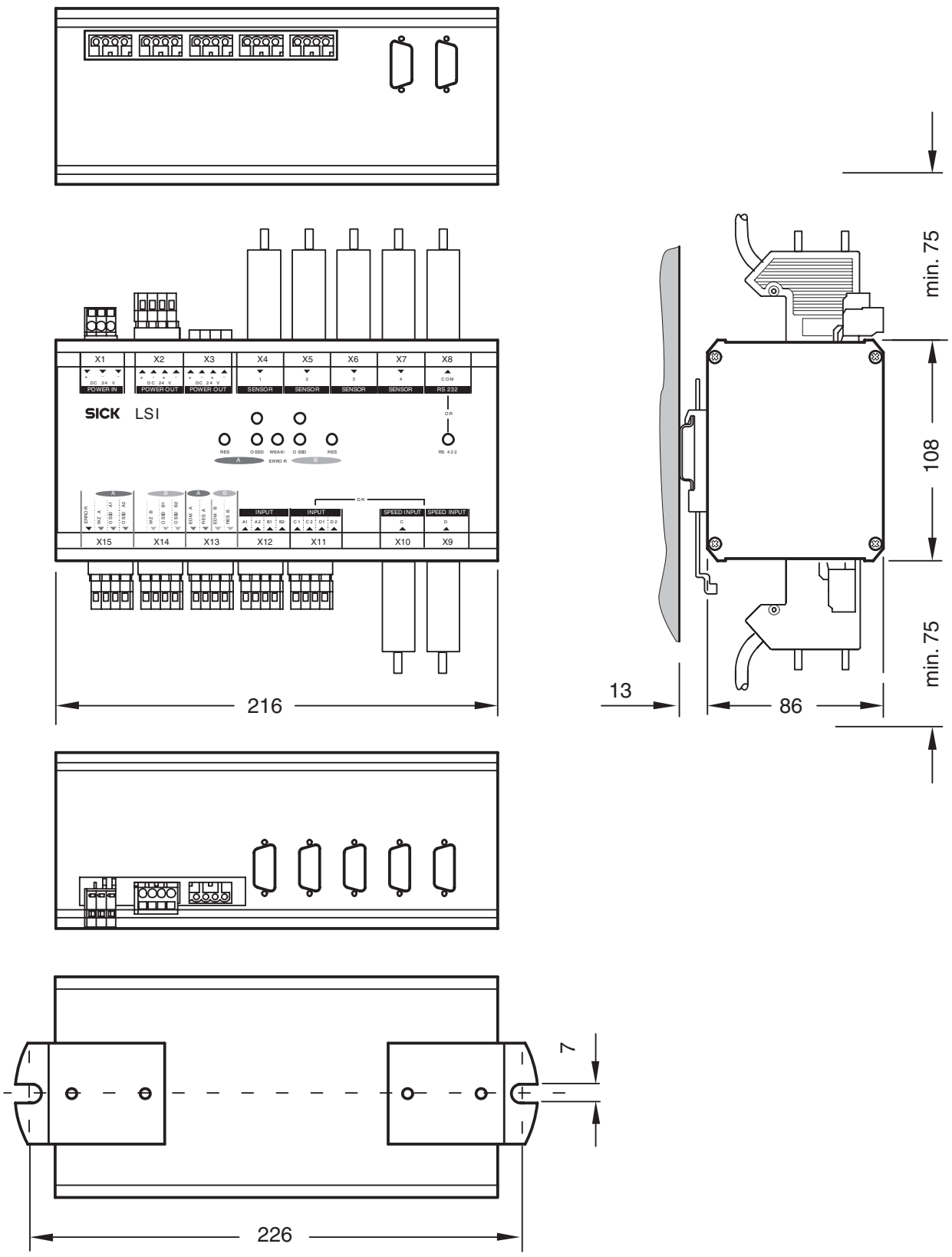
On these subjects please also order our brochure “Safe machines with optoelectronic protection devices”.

12.6 Connection diagram



12.7 Dimensional drawing

(all dimensions in mm)



13 Glossary

AGV

Automated Guided Vehicle (materials handling equipment)

EDM

External device monitoring. Text from EN 61946-1. A device which monitors the relays or contactors actuated by the ESPE.

Incremental encoder

A component which generates electrical pulses proportional to a movement. Various physical variables can be derived from these pulses (e.g. speed, distance, etc.).

I/O monitor

Function of the PLS/LSI user software with which the switching states of the LSI inputs and outputs can be monitored and logged. You can save the retrieved data to an ASCII file for further evaluation.

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 50 metres is also achievable.

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

Monitoring area

A monitoring area consists of a protective field and a warning field. In the PLS/LSI user software, a maximum of eight monitoring areas can be defined in a configuration and assignedto the connected sensors depending on monitoring case.

Monitoring case, simultaneous

A maximum of two monitoring cases may be active at any one time – that is, under the same input conditions – on an LSI.

Pixel suppression

When you select the “Pixel suppression” option, objects detected only by a single pixel per scan are ignored. This can be useful in preventing unintended shutdowns.

Plausibility check

A function of the PLS/LSI user software with which you can check the definition of the monitoring cases for errors.

Protective field

In the range up to a radius of 4 metres, the PLS/LSI offers up to eight sensor fields with fail-safe accident prevention functions in accordance with category 3 of EN 954 – for area protection but also as a (non-tactile) bumper replacement.

Space contour

You can receive the ambient defined space contour from the sensor and save the measurements. In this way, when error shutdowns occur you can check at which point the space contour protrudes into the protective field.

Speed difference

In vehicle protection applications, the speed of two axes, or running wheels, is registered with incremental encoders. When the vehicle is cornering, the two items of speed information may differ. In the PLS/LSI user software you can programme how large the speed difference between the two incremental encoders may be before the system is shut down (default value for speed difference: 25 %).

Warning field

The warning field is a sensor field with a radius up to 15 metres. It can be used to monitor larger areas and to trip simple switching functions (e.g. warning functions) or to switch an automated guided vehicle to slow running.

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