# RAS Prime

## Collision awareness systems

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Sensor Intelligence.

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**Version of the operating instructions**

The latest version of these operating instructions can be obtained in PDF format at **www.sick.com.**

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# 1    General safety notes and protective means

These operating instructions are designed for the technical personnel in regards to safe installation and operation of the Reachstacker Assistance System (RAS).

This document contains all information required for mounting, electrical installation, commissioning and operation of the RAS. All tasks are described step by step. Further information about laser measurement technology is available from SICK AG, Division Auto Detection and Ranging, and on the Internet at www.sick.com.

The RAS has been designed and manufactured based on a risk analysis and careful selection of the pertinent harmonized standards as well as other technical specifications. Hence, the RAS matches state-of-the-art technology.

In design and production, established technological rules have been applied and observed. Development and production at SICK AG ensure this quality standard by a certified quality management system according to EN ISO 9001:2000.

## 1.1    Symbology used

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

**Important**    Sections marked "Important" provide information about special features of the device.

| *NOTICE* |
|---|

**Note!**

Note    A note indicates potential hazards that could involve damage or degradation of the functionality of the Reachstacker Assistance System or other devices.



WARNING

| *WARNING* |
|---|

**Warning**!

A warning indicates an actual or potential hazard. They are designed to help you prevent accidents.
The safety symbol besides the warning indicates the nature of the risk of accident, e. g., due to electricity. The warning category (CAUTION, WARNING, DANGER) indicates the severity of the hazard.

➢ Read carefully and follow the warning notices!

# 2      Safety notes

⚠
WARNING

Improper installation and commissioning, damaged components or bad environmental conditions like low/high temperatures, heavy dust, heavy fog and heavy spray may reduce the system performance, could cause malfunctions andfalse warnings, and may lead to a complete dysfunction of the system.

**Observe the following points in order to ensure safe use of the RAS as intended:**

1. The operating company must ensure that every person working on or with the RAS has read and understood these operating instructions.
2. Official and legal requirements must be adhered to when operating the RAS.
3. For installation and usage of the RAS as well as for commissioning and regular technical inspection, national/international legal requirements apply, in particular:
   - The accident prevention regulations/safety rules
   - Other pertinent safety rules
4. Adhere to the following safety notes in order to prevent dangers to persons and/or property:
   - By following suitable instructions and adhering to inspections, the operator must ensure that the window of all laser scanners is always clean, free of damage and has a free field of view (e.g., the sensor head is not covered with any kind of material). SICK AG recommends a check-up before the machine starts operation.
   - Additionally, the local safety and accident prevention regulations apply for operating the RAS.
   - A defect of the system can cause danger to human life or damage to the RAS.

## 2.1      Range of application

⚠
WARNING

Not permitted for personal protection!

The Reachstacker Assistance System is not a system for personal protection within the sense of valid safety standards for machines!

- The Reachstacker Assistance System is a driver assistance system. It provides optical and/or acoustical warning information about objects outside the vehicle to the operator. The operator has the full responsibility for safe operation at all times, in particular with regard to persons that are in the danger zone of the vehicle.

## 2.2      Laser protection

⚠
CAUTION

The RAS uses a laser scanner with an infrared laser light. The devices are specified as Class 1 laser (eye-safe).

The laser beam is invisible for the human eye!

Caution — improper use can cause dangerous exposure to radiation.

➢ Do not open the housing of the laser scanner, such as the LMS1xx (opening the housing does not interrupt laser operation).
➢ Observe the latest valid laser protection regulations.

## 2.3    Laser power

The laser corresponds to Class 1 laser (eye safe) as per EN 60825-1 (for publication date see laser warning label on the device). Complies with 21 CFR 1040.10 with the exception of the deviations as per Laser Notice No. 50, July 26, 2001. The laser beam cannot be seen with the human eye.

The radiation emitted in normal operation is not harmful to the eyes and human skin.

- Incorrect usage can result in hazardous exposure to laser radiation.
  - ➢ Do not open the housing (opening the housing will not switch off the laser).
  - ➢ Pay attention to the laser safety regulations as per IEC 60825H1 (latest version).

**Important**    In order to ensure Class 1 laser, no maintenance is necessary.

# 3      Introduction

The <u>R</u>eachstacker <u>A</u>ssistance <u>S</u>ystem (RAS) is a high-performance proximity detection and collision warning system based on proven SICK AG laser scanning technology and knowledge about advanced driver assistant systems. The system is designed for simple installation and easy operation.

Improper installation and commissioning could cause malfunctions and false warnings that lead to a system failure.

This manual is designed to ensure correct installation, availability of all system functions and proper operation of the RAS in scenarios the system is designed for.

The individual functionality of components and the overall system behavior are checked based on a test protocol for the installation (checklist) using different test scenarios.

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# 4 RAS Function

The RAS is a proximity detection and collision warning system for port site Reachstacker vehicles. It consists of two sensors, an interactive operator display, an Ethernet switch, cables and an alarm siren. The system warns the operator of a possible collision with other objects.

During the operation of the vehicle, the RAS will constantly monitor the vehicle's surroundings for obstacles. If an obstacle is detected in one or more of the configured warning zones, the zone violation is reported to the operator visually and audibly.

## 4.1 Components

*Table 1: RAS components*

| Component | Function |
|---|---|
| Operator display | Interactive operator display with setup support |
| Sensor LMS1xx "Rear Left" | Rear left corner obstacle detection with detection range: 0.5...18 m |
| Sensor LMS1xx "Rear Right" | Rear right corner obstacle detection with detection range: 0.5...18 m |
| Alarm siren | Audible alarm |
| Ethernet switch | Ethernet connection of the sensors and the display |
| Cable | Ethernet cable, Power cable for laser scanner, operator display and Ethernet switch |

## 4.2 Rear monitoring sensors

The rear-end collision warning supports the operator while driving in reverse.

Dependent on the mounting position of the sensors, a configured area at the rear of the vehicle is monitored (see Figure 1: Operator view with pre-alarm warning (yellow zone violated)).

The system provides a visual and audible alarm when an obstacle is violating one of the three warning zones (green, yellow, red).

The dimensions of the warning zones are adjustable to meet individual safety requirements.

Rear surveillance is activated at all times (see Figure 1: Operator view with pre-alarm warning (yellow zone violated)).

*Figure 1: Operator view with pre-alarm warning (yellow zone violated)*

## 4.3    Operator display

The operator display is the user interface of the system. It controls and displays all functions. It has a touch-screen monitor that is used for user input during system setup and operation.

## 4.4    Requirements

This section lists requirements of the Reachstacker Assistance System. Note that violating any requirement may lead to system malfunction and/or permanent physical destruction of components.

## 4.5    Vehicle

The RAS is intended for installation on port-site vehicles like Reachstackers.

## 4.6    Electrical

*Table 2: Electrical requirements*

| Requirement | Value |
|---|---|
| Supply voltage | 24 VDC (min:19.2V .. 28.8V) |
| Typical power consumption (fully equipped system) | 30 W |
| Peak power consumption (during startup or with sensor-internal heating) | 130 W |

SICK recommends the use of DC/DC converters to supply the system with a smooth voltage. A capable DC/DC converter can be ordered as accessory, part number: 6044524

## 4.7    Environmental

*Table 3: Environmental*

| Requirement | Value |
|---|---|
| Operating temperature range for components inside cabin (ambient) | -25°C ... +50°C |
| Operating temperature range for components outside cabin (ambient) | -25°C ... +50°C |
| Storage temperature | -25°C ... +60°C |

# 5    System Installation

## 5.1    Components

The following section describes the system components and their configuration within the system.

Note    All components are pre-configured for optimal system performance.  No component-level setup is required. The following tables are for informational purposes only! Please do not change! This may cause system malfunction and limited performance.

### 5.1.1    Sensor LMS1xx "Rear Left"

*Table 4: Sensor LMS1xx "Rear Left"*

| Parameter | Value |
|---|---|
| IP address | 192.168.1.6 |
| Net mask | 255.255.255.0 |
| Scan frequency | 25 Hz |
| Scan resolution | 0.5 deg |

Note    If a sensor has not yet been configured for the system, its factory default IP address is 192.168.0.1, Net mask 255.255.255.0.

### 5.1.2    Sensor LMS1xx "Rear Right"

*Table 5: Sensor LMS1xx „Rear Right"*

| Parameter | Value |
|---|---|
| IP address | 192.168.1.7 |
| Net mask | 255.255.255.0 |
| Scan frequency | 25 Hz |
| Scan resolution | 0.5 deg |

### 5.1.3    Operator Display

*Table 6: Operator displayparameters*

| Parameter | Value |
|---|---|
| IP address | 192.168.1.10 |
| Net mask | 255.255.252.0 |

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*Figure 2: Display cable layout*



| Pin | Cable | 0,5 mm² wire no. | Function |
|-----|-------|------------------|----------|
| 1 | 1 | 1 | V+ |
| 2 | | 2 | V+ |
| 3 | | 3 | GND |
| 4 | | 4 | GND |
| 20 | 2 | 1 | In1 (optional: FlexiSoft) |
| 21 | | 2 | In2 (unused) |
| 19 | | 3 | In3 (unused) |
| 22 | | 4 | In4 (unused) |
| 25 | 3 | 1 | Out1 (optional FlexiSoft) |
| 26 | | 2 | Out2 (optional FlexiSoft) |
| 24 | | 3 | Out3 (Siren GND) |
| --- | | 4 | --- |
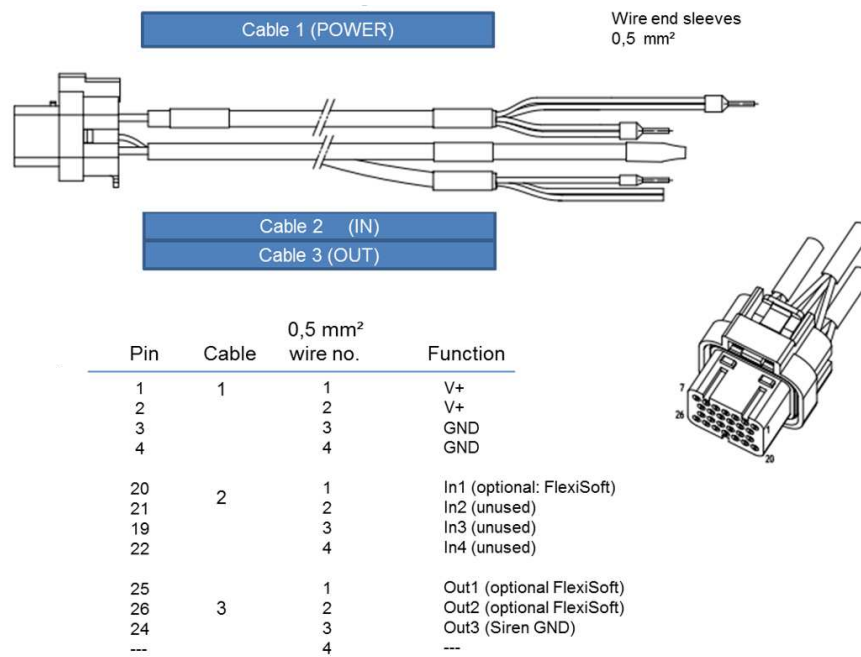
### 5.1.4    Alarm siren

Rotary switch: volume selector, use to adjust the preferred volume level.

Dip switches: sound type: 1,4=OFF, 2,3,5=ON

Wire connections: blue: 0 V, red: V+, black: leave unconnected

Using the black wire instead of the blue will result in a different tone.

### 5.1.5    Ethernet switch

No configuration available.

### 5.1.6    Hardware Installation

General information:

To protect the system components (sensors, Ethernet switch, operator display) from shocks and vibration damping measures must be installed. SICK AG recommends using the mounting brackets with part number: 1053343 that have built-in damper elements. However, equivalent shock dampening measures may also be used as long as the relevant spectrum of mechanical stress is significantly reduced.

**Note**   Failure to install a suitable shock and vibration damper may result in a reduced system life cycle!
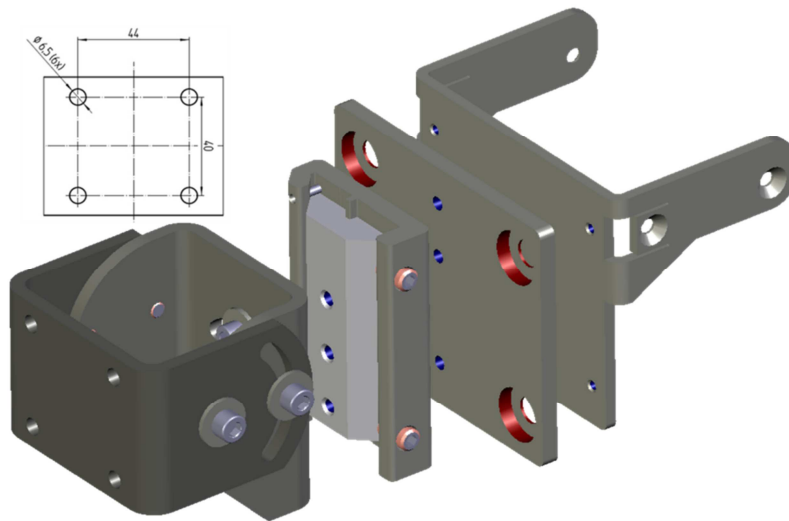
**Note**   It is recommended to use cable conduits for a bundled and safe installation of all cables.

### 5.1.7 Sensor mounting (optional)

For the laser scanners, mounting brackets with built-in shock absorbers are available.

Part number: 1053343

*Figure 3: Sensor mounting bracket for the sensor LMS1xx*



SICK AG recommends furthering protecting the scanners from mechanical exposure with a rugged housing.

### 5.1.8 Mounting positions for sensors "Rear Left" and "Rear Right"

Both sensors must be mounted at the rear-end corners of the vehicle and inside vehicle footprint. The mounting height must be chosen so that relevant objects, such as other vehicles, containers or infrastructure, are within the area of view. The sensors should be mounted upright to ensure a scanning plane parallel to the surface. In case of the sensor position is quite hight, the sensor can be tilt down a little bit. But the laserbeam shouldn't touch the ground within the range of the warning zones to avoid false alarmes. It's recommendet to keep a distance of app. 3-5m between the end of the green warning zone and the position where the laser beam hits the ground.

Note  Please avoid obstructions due to a guard rail,ladder, etc. Recommended mounting height is approx. 1.5 m.

Additional protective measures for the scanner may be required (e.g., housing / step protection for the sensors, etc. cp. "General Safety Notes").

Both sensors are connected to the Ethernet switch and the power supply with two cables each, one for Ethernet and one for the power supply.

Note  It is recommended to use cable conduits for a bundled and safe installation of all cables.

### 5.1.9      Ethernet switch mounting

The Ethernet switch should be mounted in a position in the inside of the vehicle, not exposed to direct sunlight, e.g., inside the cabin behind the operator seat. The switch is rated IP67, however it is not recommended for outside mounting.

Before mounting the switch, check that all components can be reached with the supplied cables.

The Ethernet switch must be supplied with power (24 V).

**Note**      It is recommended to use cable conduits for a bundled and safe installation of all cables.

### 5.1.10      Operator display mounting

The display is mounted inside the driver's cabin within a clear view of the driver. The display is mounted using the supplied RAM-mount adjustable mounting system. This will also minimize mechanical shocks to the display.

The operator display is connected to the Ethernet switch with the M12 Ethernet cable, to the power supply (black cable marked with "POWER") and to the alarm siren (black cable marked with "OUT," wire 3).

**Note**      It is recommended to use cable conduits for a bundled and safe installation of all cables.

# 6 Setup

Before the system can be used on the vehicle, the software setup must be completed. In order to do this, the following requirements must be met:

1.  The function test (Chapter **Fehler! Verweisquelle konnte nicht gefunden werden.**) has been successfully completed
2.  The system is powered up and running. (**Note**: warnings of zone violations may occur at this point since the setup has yet to be completed).
3.  A large, flat area with a sufficient field of view for the scanners has to be available. Park the vehicle on this flat area in order to conduct the rear sensor setup.
4.  A laptop with Ethernet configured to access network address 192.168.1.10 and an Ethernet cable are available.

    The operator display shows the  operator view (preconfigured systems) or a warning message for a new and not configured system.

*Figure 4: New and not configured RAS Prime*



## 6.1 Entering setup mode

The setup mode is only accessible after unlocking via web interface. Connect an external laptop configured with static IP address e.g. 192.168.1.88 and subnet mask 255.255.255.0 via Ethernet to the RAS's Ethernet switch. Open address http://192.168.1.10 with an internet browser. First click on tab "Unlock" (1), after that click on the button "Unlock" (2). If the unlock procedure was successful the message "Success! The pane is now unlocked" is shown.

*Figure 5: Entering setup*
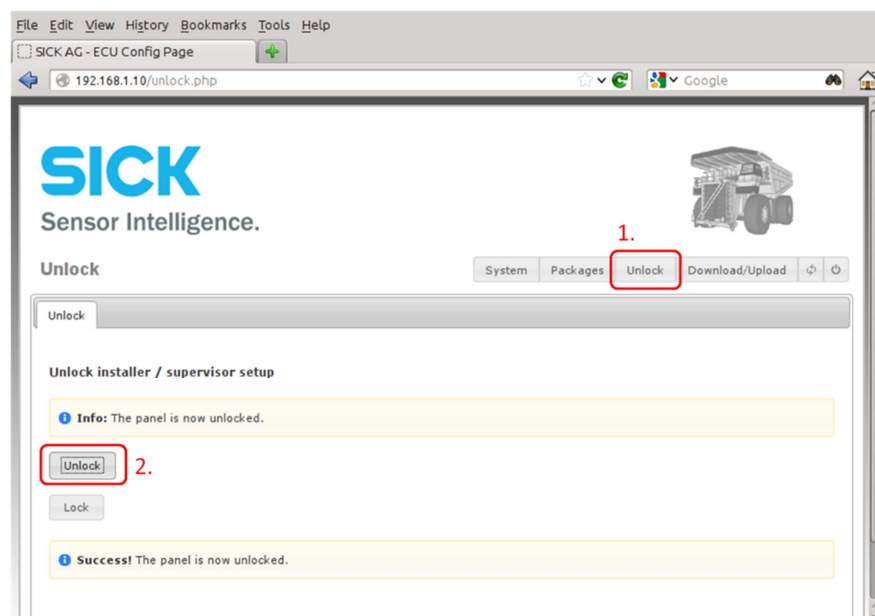
After a few seconds, two icons will appear in the upper corners of the screen:

**Setup icon** (upper left corner): Tab in icon to enter system setup.

**Speaker icon**: Tab to enable/disable sound.

Steps that are not completed are marked with a red cross – finished steps are marked with a green "checked" icon.

Gently press the **Setup icon** to enter the setup wizard; the setup page will appear with six choices.

*Figure 6: Setup screen*



1.     **Vehicle Setup**: enter the vehicle parameters (e.g., width)
2.     **Sensor setup**: setup all sensor positions and adjust all mounting angles.
3.     **Supervisor setup**: adjust the size of the warning zones.
4.     **Reset**: offers to reset all parameters to factory defaults.
5.     **info**: offers a status and test page.
6.     **Done**: ends setup, stores changed parameters and returns to operator view.

Left of the three setup buttons, icons of either a green tic mark (OK) or a red cross (Not OK) are shown:

**Green tick mark**    means that the underlying setup was completed successfully at least once.

**Red cross**    means that the setup step is either not yet done or was not successfully completed.

**Note**    Note that upon completion of the setup, all three indicators must be green. Although that does not guarantee correct values, it indicates that no topics have been accidentally missed.

## 6.2     Supervisor setup – warning zones

The configuration of the warning zone sizes determines the warning zone strategy. The evaluation of warning zones allows the supervisor to adjust the warning levels according to specific vehicles and to the port safety operation requirements. Improper adjustment could hinder the system's performance.

## 6.3 Warning configuration

The collision warning uses three warning zones, which are green, yellow and red. The overall logic follows the traffic light: the green zone is the "obstacle monitoring zone." This area is meant to deliver information to the operator about the obstacles surrounding the vehicle.

The yellow zone constitutes the "pre-alarm" – the operator must be alert and prepared to stop. A red zone violation causes the "urgent alarm" – the operator must stop the vehicle to avoid the collision!

However, the length of each warning zone can be configured separately. To alter the distance from the vehicle's rear-end to the end of the warning zone (warning zone length), press the plus and minus button (see Figure 7: Rear warning zones).

In case the green warning zone is not required, the length must be set identical to the length of the yellow warning zone. When only the red warning zone is required, yellow and green warning zones must be set identical to the length of the red warning zone. After all parameters are set correctly, press the "next" icon.

*Figure 7: Rear warning zones*



Depending on the configured field of view and the mounting position of the sensors, the warning zones also cover the rearmost side of the vehicle and can be adjusted (see Figure 8: Side and front warning zones ).

Depending on the work the vehicle is used for, smaller warning zones to the side may be required. Smaller warning zones to the side may be required if the vehicle is frequently used in narrow passage areas and is pemitted in the site's safety operation requirements.

To change green, yellow and red zone dimensions, press the plus and minus button as often as the required value appears. To disable the green zone, the length must be set identical to the yellow zone. To disable the green and yellow zones, the length of both zones must be set identical to the red warning zone.

After all parameters are set correctly, press the "next" icon in the lower right corner.

*Figure 8: Side and front warning zones*

# 7   Function Test

After installation and change of the system configuration, a function test should be carried out. Before starting this test, verify that all components are securely mounted and connected. Then, connect the power supply cable of the switch panel to the vehicle power supply and switch on the power.

The display needs approx. 45 seconds to start up, followed by the RAS application display appearing in the middle of the screen.

**Note**   Warnings (optical and audible) may occur as the system setup (Chapter 6.2) has yet to be completed. This is not a malfunction and can be ignored.

### 7.1.1   Checking object detection

Check the monitoring zones along their outer edges for proper detection. To do so, walk the edges yourself, or check the functionality using suitable tools.

The system should show the zone on the operator display and trigger an alarm accordingly for every zone breach.

### 7.1.2   Response to errors

In case of an error an error pop-up message will appear. In this case, please refer to Chapter 10 for troubleshooting.

# 8    Operation

When the vehicle comes close to objects, zone violations will result in a visual and audible alarm. A zone violation is highlighted in the color of the warning zone (green, yellow or red). This enables the operator to understand the hazadous situation very quick.

*Figure 9: Operator screen with pre-alarm warning*



The usual configuration of the collision warning uses three warning zones:

- The green zone is the "obstacle monitoring zone." This area is meant to deliver information to the operator about the obstacles surrounding the vehicle. There is no audible alarm.
- The yellow zone constitutes the "pre-alarm" – the operator must be alert and prepared to stop. There is an intermittent audible alarm.
- A red zone violation causes the "urgent alarm" – the operator must stop to avoid the collision! There is a constant warning tone.

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# 9      Maintenance

The system has a built-in dirt detection mechanism as well as sensor availability monitoring. The operator display informs the driver if the system is no longer functional due to contamination or damaged sensor cable. The following actions are required in order to return the system back to full functionality.

To ensure proper operation of the system, please follow the preventive steps in the list below within the given time intervals:

*Table 7: Maintenance work*

| Maintenance work | Interval |
|---|---|
| Clean sensor screens. Remove dust / specks with a clean, soft cloth. Be sure not to damage the screen by using force or abrasive materials. | weekly |
| Check for cable wear. Check all cabling visually for wear, defective isolation or loose connections. | Every 6-months |

In addition, regular maintenance may be required for the components, e.g., the sensors. Please refer to the sensor manuals for details.

# 10 Troubleshooting

## 10.1 System shows no activity - display remains dark

*Table 8: Troubleshooting*

| Reason | How to check, and what to do about it |
|---|---|
| Operator display is not connected to power. | Check power connection to the operator display.<br>What to do: establish power connection (plug in cable?). |
| System has no - or not enough - power. | Check the power supply to the system. Voltage must be 24 V.<br>What to do: switch on power supply (Ignition?). |
| Operator display is broken. | If power reaches the display, and at least the power LED is on, the display may be defective.<br>What to do: cross-check with another display. If the display is broken, send to SICK AG for repair or replacement. |

## 10.2 Operator display shows error pop-up message

When the system is starting or while it is running, an error pop-up message may occur (see Figure 10: Operator display - error).

There are two types of messages. One which can be acknowledged by tapping on the OK button (see Figure 10: Operator display - error to the right) and the other which cannot.

*Figure 10: Operator display - error*



**Note** The error message will only list the first component that failed. For example, if the Ethernet connection of the display is missing, it will report both sensors missing.

### 10.2.1    Error codes

The error codes are shown in a pop-up message on the operator display (see Figure 10: Operator display - error)

Error code number syntax: 'CCE'

'CC' = component (one or two digits)

'E' = error (one digit)

*Table 9: Error message*

| Error message | How to check, and what to do about it |
|---|---|
| CC1 = component dirty | The dirt detection has detected that the sensors are dirty. |
| 91 = sensor left dirty<br>101 = sensor right dirty | TO DO: clean the sensor with a sponge and water. When the sensor is clean, the message disappears. |
| CC2 : component offline | The component (sensor, display, etc.) is offline. |
| 92 = sensor left<br>102 = sensor right | TO DO: check the power and Ethernet connection (cable, connectors, power supply, etc.) Restart the system after the cause of this error has been removed. |
| CC4 : configuration invalid | The system was not configured. This is the factory default. |
| 04 = system not configured | TO DO: configure the system, first unlock with web interface |

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# 11  Appendix

## 11.1  Component wiring

*Figure 11: Component wiring*
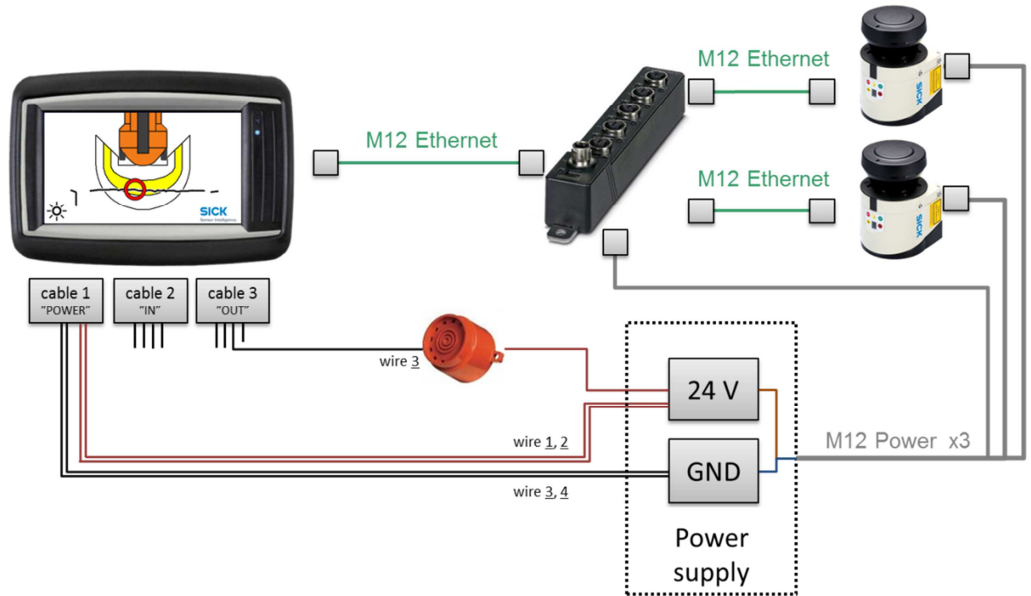


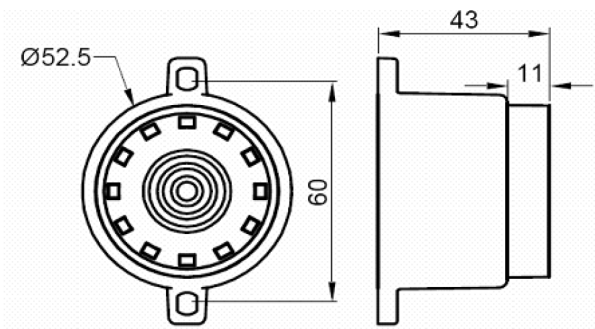## 11.2  Mechanical dimensions

All dimensions are given in mm.

### 11.2.1  Sensors

Mounting: see Chapter 5.1.7 for details about the mounting bracket. For sensor dimensions, please refer to the sensor user manual.
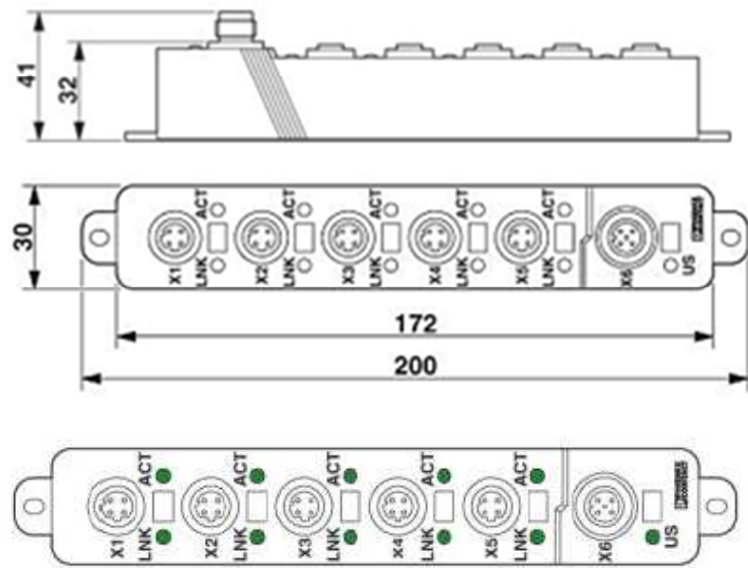
### 11.2.2  Alarm siren

*Figure 12: Alarm siren*

# Appendix

### 11.2.3    Ethernet switch
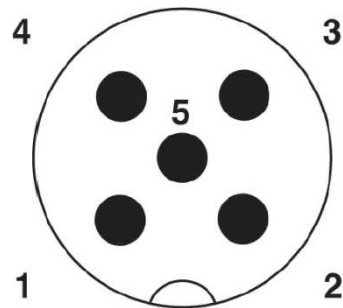
Part No. 2070530

*Figure 13: Ethernet switch*



X1 - X5: Ethernet connection
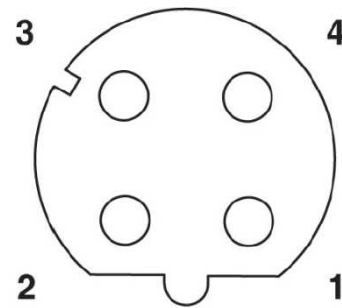X6: Supply voltage
ACT: ACT LEDs
LNK: Link LED
US: $U_{S1}$ LED

**Connecting the supply voltage**
PIN 1 Us
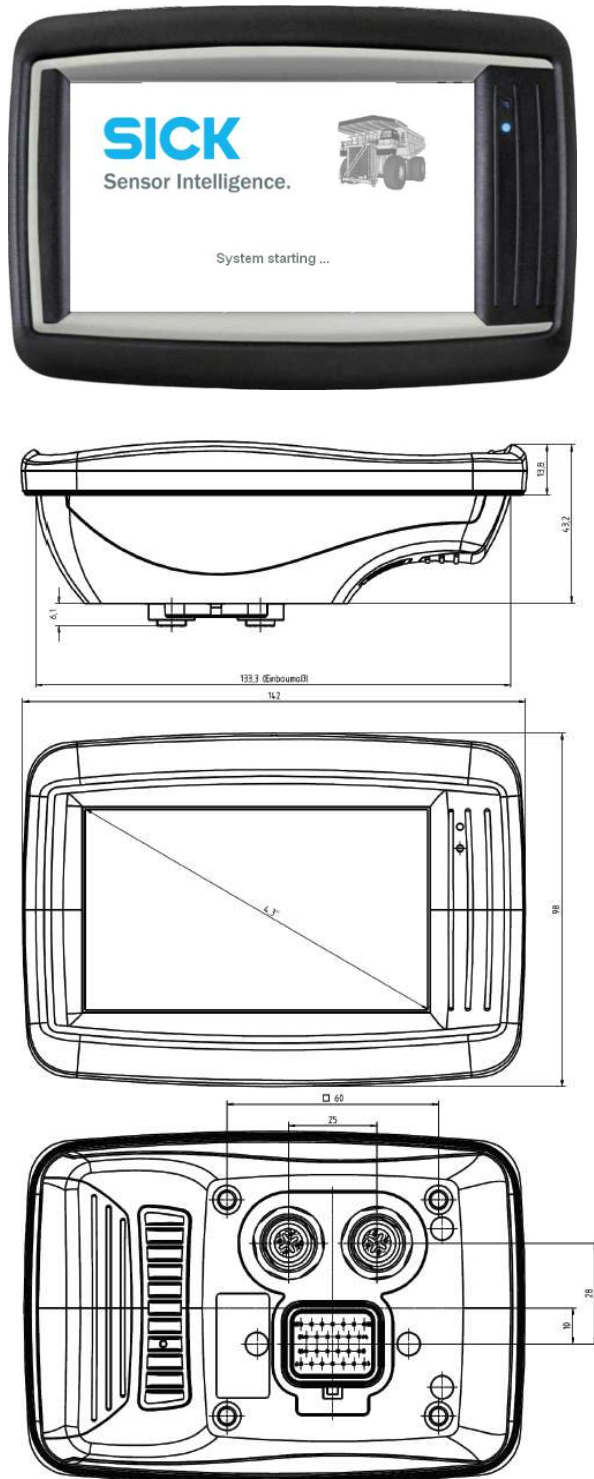PIN 2 n.c.
Pin 3 GND
Pin 4 n.c.
Pin 5 Functional earth ground

**Assignment of the LAN socket**
Pin 1 Transmit +
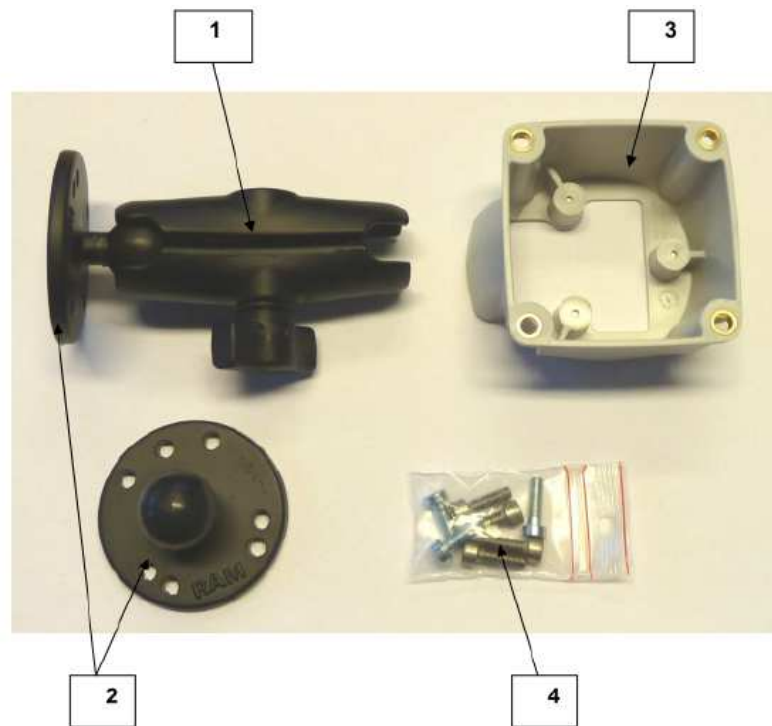Pin 2 Receive +
Pin 3 Transmit -
Pin 4 Receive -

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### 11.2.4    Operator display

Part No. 2067671 Operator Display RAS-1200

*Figure 14: Operator display*

*Figure 15: parts of the display mounting set*

Part No. 2070562



1 RAM Mount arm

2 RAM Mount 1" Ball mount

3 RAM Mount display adapter

4 set of screws

**Note**     Note that some space is required on the left-hand side of the display for the Ethernet and power cable.

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