LiDAR Localization Hardware Integration

LiDAR localization
Described product
LiDAR Localization Hardware Integration

Manufacturer
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Original document
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1 About this document

1.1 Purpose of this document

This additional technical note describes the hardware integration and how to enable the measurement data of the 2D LiDAR sensor.

The full operating instructions of the used 2D LiDAR sensor must be made available to all people who work with the device.

1.2 Scope

This document is included with the following SICK part numbers (this document in all available language versions):

- 8025193

1.3 Target groups

This document is written for system specialists working in the field of hardware development intending to integrate the LiDAR localization system in their application.

1.4 Symbols and document conventions

The following symbols and conventions are used in this document:

Safety notes and other notes

DANGER
Indicates a situation presenting imminent danger, which will lead to death or serious injuries if not prevented.

WARNING
Indicates a situation presenting possible danger, which may lead to death or serious injuries if not prevented.

CAUTION
Indicates a situation presenting possible danger, which may lead to moderate or minor injuries if not prevented.

NOTICE
Indicates a situation presenting possible danger, which may lead to property damage if not prevented.

NOTE
Indicates useful tips and recommendations.

Instructions to action

- The arrow denotes instructions to action.
- The sequence of instructions for action is numbered.
- Follow the order in which the numbered instructions are given.
- The check mark denotes the result of an instruction.
2 Safety information

2.1 General safety notes

DANGER
Danger of using data output for safety function
Data output may only be used for general monitoring and control tasks.
- Do not use data output for safety-related applications.

DANGER
Danger of using CoLa2 for safety function
CoLa2 may only be used for general monitoring and control tasks.
- Do not use CoLa2 for safety-related applications.

2.2 Safety notes electrical installation

Information on the requirements that must be met for safe integration of the localization controller and 2D LiDAR sensors into the control and electronics of the machine, see the corresponding operating instructions.

DANGER
Hazard due to electrical voltage
Hazard due to unexpected starting of the machine
- Make sure that the machine is (and remains) disconnected from the power supply during the electrical installation.
- Make sure that the dangerous state of the machine is (and remains) switched off.

- Carry out the electrical installation work in conformity with EN 60204-1.
- Use suitable power supply.
- Check that all earthing points are connected with the same ground potential.
- Connect the shielding of all data lines (Ethernet, CAN, serial) directly to the functional earth (FE) at the control cabinet entry point.
3 Supported hardware

3.1 Localization controllers

LiDAR-LOC is available for the localization controllers listed below. For quick integration, some information is provided in this document. For additional information, consult the operation instructions of the corresponding device.

**NOTICE**

By default, the localization controller is a programmable device. When using the localization controller with the application software LiDAR-LOC, the controller is converted into an application device. This means that the device cannot be programmed any longer; it is locked for any additional application and cannot be unlocked.

Table 1: Supported localization controllers

<table>
<thead>
<tr>
<th>Localization controller</th>
<th>Operating instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIM1000 FXA</td>
<td>8023299</td>
</tr>
<tr>
<td>SIM1012</td>
<td>8023514</td>
</tr>
</tbody>
</table>

3.2 2D LiDAR sensors

LiDAR-LOC can be operated for the SICK sensors listed below. The functional scope and technical specifications of the sensors significantly determine the specified properties of LiDAR-LOC. For quick integration, some information is provided in this document.

For additional information, consult the operation instructions of the corresponding sensor.

**NOTICE**

SICK does not guarantee that the system functions with other sensors.

Table 2: Supported sensor types

<table>
<thead>
<tr>
<th>2D LiDAR sensor</th>
<th>Field sets 1) / Safety</th>
<th>Aperture angle</th>
<th>Scanning range with ... remission</th>
<th>Frequency</th>
<th>Angular resolution</th>
<th>Reflector support in LiDAR-LOC</th>
<th>Documentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>outdoorScan3</td>
<td>yes / PL d</td>
<td>275°</td>
<td>1.8 %: 4 m 100 %: 40 m</td>
<td>≤ 33 Hz</td>
<td>0.51° / 0.39°</td>
<td>yes</td>
<td>EtherNet/IP™: 8023153 Core I/O: 8023150</td>
</tr>
<tr>
<td>microScan3 4.0 m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>EtherNet/IP™: 8020198 PROFINET: 8021217 EFI-pro: 8021911</td>
</tr>
<tr>
<td>microScan3 5.5 m</td>
<td></td>
<td></td>
<td>1.8 %: 5.5 m 100 %: 40 m</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>microScan3 9.0 m</td>
<td></td>
<td></td>
<td>1.8 %: 9 m 100 %: 64 m</td>
<td>≤ 25 Hz</td>
<td>0.125° / 0.1°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>nanoScan3 3 m</td>
<td></td>
<td></td>
<td>1.8 %: 3 m Measurement range: ≤ 40 m</td>
<td>≤ 33 Hz</td>
<td>0.17°</td>
<td></td>
<td>I/O: 8024594</td>
</tr>
</tbody>
</table>
## Recommendations

For high quality of the localization, we recommend to consider the following information about the sensors.

### microScan3

- **Protective field range 9 m (64 m warning field range):**
  The sensors with 64 m measurement range are preferred over the ones with 40 m measurement range. They can be used in both configurations, 50 ms and 40 ms scan cycle time. Smaller scan cycle times allow potentially higher velocities, however, are primarily dependent on your risk assessment.

- **Protective field range 4 m and 5.5 m (40 m warning field range):**
  When using the sensors with 40 m measurement range, they can be used in both configurations, 40 ms and 30 ms scan cycle time, with corresponding 0.39° and 0.51° resolution. A smaller scan cycle time allows potentially higher velocities. A higher resolution allows the detection of smaller objects. However, the configuration is primarily dependent on your risk assessment.

---

### 2D LiDAR sensor

<table>
<thead>
<tr>
<th>2D LiDAR sensor</th>
<th>Field sets 1) / Safety</th>
<th>Aperture angle</th>
<th>Scanning range with ... remission</th>
<th>Frequency</th>
<th>Angular resolution</th>
<th>Reflector support in LiDAR-LOC</th>
<th>Documentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>TiM7xxS</td>
<td>yes / PL b</td>
<td>270°</td>
<td>5 %: 5 m 10 %: 8 m &gt; 50 %: 25 m</td>
<td>15 Hz</td>
<td>0.33°</td>
<td>no</td>
<td>Operating instructions: 8023886 Product information: 8014314</td>
</tr>
<tr>
<td>TiM7xx</td>
<td>yes / –</td>
<td>10 %: 8 m Working range: 0 ... 25 m</td>
<td></td>
<td></td>
<td></td>
<td>Operating instructions: 8024231 Product information: 8014314</td>
<td></td>
</tr>
<tr>
<td>TiM5xx</td>
<td>no / –</td>
<td>10 %: 2 / 8 m Working range: 0 ... 4 / 10 / 25 m</td>
<td></td>
<td></td>
<td>0.33° / 1°</td>
<td>Operating instructions: 8015886 Product information: 8014314</td>
<td></td>
</tr>
<tr>
<td>NAV2xx</td>
<td></td>
<td>10 %: 18 m 90 %: 50 m</td>
<td>25 Hz</td>
<td>0.25°</td>
<td></td>
<td>Operating instructions NAV245: 8018478 NAV210: 8024592</td>
<td></td>
</tr>
<tr>
<td>LMS15x</td>
<td></td>
<td>25 Hz / 50 Hz</td>
<td></td>
<td>0.25° / 0.5°</td>
<td></td>
<td>Operating instructions: 8012471</td>
<td></td>
</tr>
<tr>
<td>NAV310</td>
<td>360°</td>
<td>10 %: 35 m 90 %: 100 m Max: 0.5 m ... 250 m</td>
<td>5 Hz ... 20 Hz</td>
<td>0.125° ... 0.75°</td>
<td></td>
<td>Operating instructions: 8016535</td>
<td></td>
</tr>
<tr>
<td>NAV340</td>
<td></td>
<td>8 Hz</td>
<td>0.1°</td>
<td></td>
<td></td>
<td>Operating instructions: 8016197</td>
<td></td>
</tr>
<tr>
<td>NAV350</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Operating instructions: 8013889</td>
<td></td>
</tr>
</tbody>
</table>

1) Field sets are used for non-safe collision avoidance of obstacles.
4 Example setup

A LiDAR-LOC example setup consists at least of a localization controller running the LiDAR-LOC software, a service computer for configuration, a 2D LiDAR sensor and a switch to connect these peripheral devices to the vehicle network.

A second 2D LiDAR sensor can be added to obtain a field of view up to 360°.

For safety applications a SICK safety controller can be connected to the device network to handle the safety relevant tasks.

In **figure 1** an example setup to integrate LiDAR-LOC with a localization controller, a service computer (PC), a switch, one or two 2D LiDAR sensors, a vehicle controller and a SICK safety controller is shown.

![Figure 1: LiDAR-LOC example setup with a switch](image)

The **figure 2** illustrates an example setup to integrate LiDAR-LOC without a switch using the localization controller’s gateway function.
Figure 2: LiDAR-LOC example setup without a switch
5 Localization controllers

5.1 SIM1000 FXA

5.1.1 Device overview

Figure 3: SIM1000 FXA – overview

1. Connections for synchronization and voltage supply
2. Serial connections (not used)
3. Ethernet connections

5.1.2 Electrical installation

The electrical installation is described in detail in the operating instructions:
- 8023298
5.1.2.1 Connections overview

![Connections diagram](image)

Figure 4: Connections overview

1. Terminal block 1 and 2
2. Terminal block 3 and 4
3. Ethernet connections

5.1.2.2 Power supply

**Important information**

**NOTE**

The SIM1000 FXA device is supplied with power from an external power supply unit via the pins A1 and A2.

**Power supply**

For the power supply of the SIM1000 FXA, connect the open ends of the power supply cable to the pins of the terminal block 1.

![Terminal block 1 and 2](image)

Figure 5: Terminal block 1 and 2

**Table 3: Pin allocations of the power connections**

<table>
<thead>
<tr>
<th>Designation</th>
<th>Signal</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>+24 V</td>
<td>Supply voltage IN</td>
</tr>
<tr>
<td>A2</td>
<td>GND</td>
<td>Ground</td>
</tr>
</tbody>
</table>
5.1.2.3 Ethernet connections

**Important information**

**NOTICE**
Shielded Ethernet cables must be used. The shielding of the Ethernet cables must be connected to functional earth.

---

**Table 4: Ethernet connections**

<table>
<thead>
<tr>
<th>Designation</th>
<th>Transmission rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port 1</td>
<td>100 MBit/s</td>
</tr>
<tr>
<td>Port 2</td>
<td>1 GBit/s</td>
</tr>
<tr>
<td>Port 3</td>
<td>100 MBit/s</td>
</tr>
<tr>
<td>Port 4</td>
<td>1 GBit/s</td>
</tr>
</tbody>
</table>

---

5.1.2.4 Synchronization

When using the CoLa-A synchronization methods, connect the I/O port of the vehicle controller with IY2 of the terminal block 2 of the SIM1000 FXA.

---

**Figure 6: Ethernet connections**

**Figure 7: Terminal block 1 and 2**
Table 5: Pin allocations of the synchronization connection

<table>
<thead>
<tr>
<th>Designation</th>
<th>Signal</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>IY2</td>
<td>Output 1</td>
<td>Synchronization I/O when using command LocRequestTime-stamp</td>
</tr>
</tbody>
</table>

Switching output
- Max. output current: 100 mA
- Min. high output logic level: VCC – 3 V
- Max. low output logic level: 3 V
- Push/Pull, NPN, PNP configurable

5.1.3 Ethernet configuration

**Ethernet configuration**

**NOTE**

Preset IP addresses of the Ethernet interfaces:
- Port 1: 192.168.0.1
- Port 2: 192.168.1.1 (preferred for connection to a switch or service computer, due to the GBit/s functionality)
- Port 3: 192.168.2.1
- Port 4: 192.168.3.1 (preferred for connection to a switch or service computer, due to the GBit/s functionality)

When expanding the GigE interfaces with one or more Ethernet switches, it is essential to use only jumbo-frame compatible GigE switches. Switches limited to just 100 MB do not support the data packet mode and can cause transmission errors.

**Changing the IP addresses**

**NOTE**

Do not configure the Ethernet interfaces such that they are in the same subnet, e.g. 192.168.0.1, 192.168.0.2, 192.168.0.3, 192.168.0.4.

The individual IP addresses can be changed using the SICK SOPAS ET PC tool. This is described in detail in the “SIM Getting Started Guide”, which is available for download from the SICK AppSpace area of the SICK Support Portal. This guide also includes further notes on how to connect SICK sensors.

5.1.4 Status LEDs

**Status LEDs**

When the device is operating, the operational status of the connections is indicated visually by status LEDs.

Using these status indicators, the operator can find out quickly and easily whether the device and the peripherals are working properly or whether any faults or errors have occurred.

Monitoring the visual indicators is part of the routine inspection carried out on the device and the machine/plant area into which the device is incorporated.

Table 6: Meaning of symbols

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LED off</td>
</tr>
</tbody>
</table>
### Situation and function of the LEDs

**Table 7: Situation and function of the LEDs**

<table>
<thead>
<tr>
<th>Designation</th>
<th>LED behavior</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS ¹</td>
<td>![LED on]</td>
<td>Voltage connected.</td>
</tr>
<tr>
<td>Dev RDY</td>
<td>![LED on]</td>
<td>Runlevel READY, no errors detected. ²¹</td>
</tr>
<tr>
<td></td>
<td>![LED off]</td>
<td>Runlevel READY, boot process error.</td>
</tr>
<tr>
<td>Sys RDY</td>
<td>![LED off]</td>
<td>Application software LiDAR-LOC is booting</td>
</tr>
<tr>
<td></td>
<td>![LED on]</td>
<td>Application software LiDAR-LOC is ready</td>
</tr>
<tr>
<td>Result</td>
<td>![LED off]</td>
<td>Localization is disabled/not running</td>
</tr>
<tr>
<td></td>
<td>![LED on]</td>
<td>Localization is running and application results are available</td>
</tr>
<tr>
<td>Funct 1</td>
<td>![LED off]</td>
<td>Sensor is not configured or cannot be connected to</td>
</tr>
<tr>
<td></td>
<td>![LED on]</td>
<td>All active sensors are OK and are providing data</td>
</tr>
<tr>
<td></td>
<td>![LED off]</td>
<td>One of the active sensors is not supported, or there is an error in the configuration, or the sensor was unplugged during operation</td>
</tr>
<tr>
<td>Funct 2</td>
<td>Reserved</td>
<td></td>
</tr>
<tr>
<td>IY1 / IY2</td>
<td>![LED off]</td>
<td>Voltage not applied to the connection.</td>
</tr>
<tr>
<td></td>
<td>![LED on]</td>
<td>Voltage applied. No signal activity.</td>
</tr>
<tr>
<td></td>
<td>![LED flashing]</td>
<td>Voltage applied. Signal activity.</td>
</tr>
<tr>
<td></td>
<td>![LED off]</td>
<td>Voltage not applied to the connection. Signal activity.</td>
</tr>
<tr>
<td>Designation</td>
<td>LED behavior</td>
<td>Description</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Link</td>
<td><img src="image" alt="Green LED" /></td>
<td>Connection established with Ethernet.</td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Red LED" /></td>
<td>Connection not established with Ethernet.</td>
</tr>
<tr>
<td>Act</td>
<td><img src="image" alt="Yellow LED" /></td>
<td>Data transmission via Ethernet.</td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Orange LED" /></td>
<td>No activity.</td>
</tr>
</tbody>
</table>

1) Module status
2) Time delay before availability due to boot process (approx. 20 s)

5.2 SIM1012

5.2.1 Device overview

Figure 8: SIM1000 FXA – overview

1. Elongated drill holes for mounting
2. Connections for power
5.2.2 Accessories

Memory card

The device is delivered without memory card. The memory card is required to activate the product. The memory card must be purchased separately.

SICK recommend the following products:
- MicroSD memory card with 1 GB for industrial use – Part number: 4051366
- MicroSD memory card with 2 GB for industrial use – Part number: 4077575

Further topics
- "Memory card", page 17

5.2.3 Electrical installation

The electrical installation is described in detail in the operating instructions:
- 8023514
5.2.3.1 Connections overview

![Connections overview diagram]

**Figure 9: Connections overview**

1. **POWER**: Voltage supply input
2. **CAN**: Connection for SICK CAN sensor network (not used)
3. **ETHERNET**: 2 x 1 Gigabit Ethernet
4. **SENSOR S1 - S6**: Connections with digital inputs/outputs and voltage supply. Can be alternatively used as IO-Link master connections (not used).
5. **INC**: 1 x incremental encoder In/Out or 1 x RS-422 (not used)
6. **SERIAL**: 1 x RS-232 / RS-422 / RS-485 or 1 x incremental encoder In/Out (not used)
7. For functional ground connection, see electrical installation/notes chapter.
8. **USB connection** (Micro-B, for configuration/diagnostics/firmware update)
9. **microSD card slot**

5.2.3.2 Memory card

**Overview**

The memory card is required to activate the product.

**Approach**

- Insert the microSD card in the microSD card slot.
Further topics

- "Accessories", page 16

5.2.3.3 Power supply

Important information

**NOTE**
The SIM1012 device is supplied with power from an external power supply unit via the pins 1 and 3.

Power supply

For the power supply of the SIM1012, connect the power supply cable to the power connection.

![Power connection diagram](image)

Figure 10: POWER pin assignment, M12 – 4-pin T-coded, male

Table 8: Pin allocations of the power connection

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
<th>Function</th>
<th>Wire color</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>24 V IN1</td>
<td>Supply voltage IN1</td>
<td>brown</td>
</tr>
<tr>
<td>3</td>
<td>GND IN1</td>
<td>Ground</td>
<td>blue</td>
</tr>
</tbody>
</table>

1) Applies to the connecting cables recommended as accessories.

5.2.3.4 Ethernet connections

Important information

**NOTICE**
Shielded Ethernet cables must be used. The shielding of the Ethernet cables must be connected to functional earth.

Ethernet connections

For Ethernet connections use the Ethernet Ports 1 and 2.

Table 9: Ethernet connections

<table>
<thead>
<tr>
<th>Designation</th>
<th>Transmission rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port 1</td>
<td>1 GBit/s</td>
</tr>
<tr>
<td>Port 2</td>
<td></td>
</tr>
</tbody>
</table>

![Ethernet connection diagram](image)

Figure 11: ETH1 – ETH2 pin assignment, M12 – 8-pin X-coded, female

Table 10: Pin allocations of the ethernet connections

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>D1+</td>
</tr>
</tbody>
</table>
5.2.3.5 Synchronization

When using the CoLa-A synchronization methods, connect the I/O port of the vehicle controller with the pin 4 of the SENSOR S1 connection of the SIM1012.

![SENSOR S1 pin assignment](image)

_Figure 12: SENSOR S1 pin assignment, M12 – 5-pin A-coded, female_

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>D1-</td>
</tr>
<tr>
<td>3</td>
<td>D2+</td>
</tr>
<tr>
<td>4</td>
<td>D2-</td>
</tr>
<tr>
<td>5</td>
<td>D4+</td>
</tr>
<tr>
<td>6</td>
<td>D4-</td>
</tr>
<tr>
<td>7</td>
<td>D3-</td>
</tr>
<tr>
<td>8</td>
<td>D3+</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Output 1</td>
<td>Synchronization I/O when using command LocRequestTimestamp</td>
</tr>
</tbody>
</table>

_Complementary information_

Switching output
- Max. output current: 100 mA
- Min. high output logic level: VCC – 3 V
- Max. low output logic level: 3 V
- Push/pull, NPN, PNP configurable

5.2.4 Ethernet configuration

_Ethernet configuration_

**NOTE**

Preset IP addresses of the Ethernet interfaces:
- Port 1: 192.168.0.1 (e.g. connection to the service computer or switch)
- Port 2: 192.168.1.1 (e.g. connection to the 2D LiDAR sensor or switch)

When expanding the GigE interfaces with one or more Ethernet switches, it is essential to use only jumbo-frame compatible GigE switches. Switches limited to just 100 MB do not support the data packet mode and can cause transmission errors.

_Changing the IP addresses_

The individual IP addresses can be changed using the SICK SOPAS ET PC tool. This is described in detail in the “SIM Getting Started Guide”, which is available for download from the SICK AppSpace area of the SICK Support Portal. This guide also includes further notes on how to connect SICK sensors.
5.2.5 Status LEDs

Status LEDs

When the device is operating, the operational status of the connections is indicated visually by status LEDs.

Using these status indicators, the operator can find out quickly and easily whether the device and the peripherals are working properly or whether any faults or errors have occurred.

Monitoring the visual indicators is part of the routine inspection carried out on the device and the machine/plant area into which the device is incorporated.

Table 12: Meaning of symbols

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LED off</td>
</tr>
<tr>
<td></td>
<td>LED on</td>
</tr>
<tr>
<td></td>
<td>LED flashes</td>
</tr>
<tr>
<td></td>
<td>LED goes out briefly</td>
</tr>
<tr>
<td></td>
<td>LED lights up briefly</td>
</tr>
</tbody>
</table>

Situation and function of the LEDs

Table 13: Device status

<table>
<thead>
<tr>
<th>Designation</th>
<th>LED behavior</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dev RDY</td>
<td>Yellow</td>
<td>Device booting</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td>Runlevel READY, no errors detected.</td>
</tr>
<tr>
<td></td>
<td>Red</td>
<td>Runlevel READY, boot process error.</td>
</tr>
<tr>
<td>Sys RDY</td>
<td>White</td>
<td>Application software LiDAR-LOC is booting</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td>Application software LiDAR-LOC is ready</td>
</tr>
<tr>
<td>Result</td>
<td>White</td>
<td>Localization is disabled/not running</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td>Localization is running and application results are available</td>
</tr>
<tr>
<td>Funct 1</td>
<td>White</td>
<td>Sensor is not configured or cannot be connected to</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td>All active sensors are OK and are providing data</td>
</tr>
<tr>
<td></td>
<td>Red</td>
<td>One of the active sensors is not supported, or there is an error in the configuration, or the sensor was unplugged during operation</td>
</tr>
<tr>
<td>Funct 2</td>
<td></td>
<td>Reserved</td>
</tr>
</tbody>
</table>
### Table 14: POWER IN

<table>
<thead>
<tr>
<th>Designation</th>
<th>LED behavior</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power IN1</td>
<td></td>
<td>Voltage not applied to the connection.</td>
</tr>
<tr>
<td>Power IN2</td>
<td></td>
<td>Voltage applied.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Under/overvoltage detected.</td>
</tr>
</tbody>
</table>

### Table 15: SENSOR S1

<table>
<thead>
<tr>
<th>Designation</th>
<th>LED behavior</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pwr/Act</td>
<td></td>
<td>Voltage not applied to the connection.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Voltage applied. No signal activity.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Voltage applied. Signal activity.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Voltage not applied to the connection. Signal activity.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Overvoltage or short-circuit detected. No signal activity.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Overvoltage or short-circuit detected. Signal activity.</td>
</tr>
</tbody>
</table>

### Table 16: ETHERNET 1 - 2

<table>
<thead>
<tr>
<th>Designation</th>
<th>LED behavior</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Link/Act</td>
<td></td>
<td>Connection not established with Ethernet.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Connection established with Ethernet.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No activity.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Data transmission via Ethernet.</td>
</tr>
</tbody>
</table>

1) Time delay before availability due to boot process (approx. 20 s)
6 2D LiDAR sensors

6.1 Important notes

This chapter describes the electrical and data interface integration. For additional information about sensor mounting, refer to the LiDAR-LOC Operating Instructions in chapter "System requirements" in the following document:

- 8025192

6.2 microScan3

6.2.1 Device overview

Figure 13: microScan3 – overview

1. Optics cover
2. Display
3. Keypad
4. USB port
5. Status LEDs
6. Additional LEDs for ON state and OFF state
7. Network LEDs
8. Safety laser scanner without system plug
9. System plug
10. Cover plate

6.2.2 Electrical installation

Overview

The electrical installation is described in detail in the operating instructions:

- 8021911

The examples are given for microScan3 EFI-pro variant but are also applicable for EtherNet/IP™ and PROFINET.
Supply voltage and power consumption

Supply voltage:
• 24 V DC (16.8 ... 30 V DC) (SELV/PELV) according to IEC 60204-1
• Must be able to bridge a brief power outage of 20 ms with a starting voltage of ≤ 3 A

The laser scanner consumes the following:
• Power consumption ≤ 11 W (typ. 7.2 W)
• Power consumption Standby typical 7 W

System plug and connections

Table 17: Position of the electrical connections

<table>
<thead>
<tr>
<th>Safety laser scanners</th>
<th>Suitable system plug</th>
<th>Plug connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>microScan3 – EtherNet/IP™</td>
<td>XD1, XF1, XF2</td>
<td>• XD1: voltage supply, XF1, XF2: 2 × Ethernet for EtherNet/IP – CIP Safety, data output, configuration, and diagnostics.</td>
</tr>
<tr>
<td>MICSX-BANNZZZZ1 (part number: 2086102)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Voltage supply (XD1)

Voltage supply is supplied via a 4-pin, A-coding M12 male connector on the device side.

![Figure 14: Pin assignment of the voltage supply (male connector, M12, 4-pin, A-coded)](image)

Table 18: Pin assignment of the voltage supply

<table>
<thead>
<tr>
<th>Pin</th>
<th>Designation</th>
<th>Function</th>
<th>Wire color 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+24 V DC</td>
<td>24 V DC supply voltage</td>
<td>Brown</td>
</tr>
<tr>
<td>2</td>
<td>NC</td>
<td>Not connected</td>
<td>White</td>
</tr>
<tr>
<td>3</td>
<td>0 V DC</td>
<td>0 V DC supply voltage</td>
<td>Blue</td>
</tr>
<tr>
<td>4</td>
<td>FE</td>
<td>Functional earth/shield</td>
<td>Black</td>
</tr>
</tbody>
</table>

1) Applies to the connecting cables recommended as accessories.

Network connection (XF1, XF2)

On the device side, Ethernet and EFI-pro are connected via 4-pin, D-coding M12 female connectors. There is a network switch in the safety laser scanner which connects the two Ethernet female connectors. The two Ethernet female connectors therefore have the same function. The pin assignment corresponds to EN 61918, Appendix H.

![Figure 15: Ethernet pin assignment (female connector, M12, 4-pin, D-coding)](image)
### 6.2.3 Ethernet configuration

**Overview**

To connect the localization controller to the LiDAR sensor, the LiDAR sensor must be in the same network as the localization controller. To change the network settings of the LiDAR sensor, use the Safety Designer software from SICK.

**Approach**

1. In the Safety Designer, open Configuration → Addressing.
2. In the section **IP address**, configure the Ethernet interface IP of the microScan3 to an unused IP address in the subnet, e.g. 192.168.1.2.

![Setting the IP address with the SICK Safety Designer](image)

### 6.2.4 Configuration of the data output

#### 6.2.4.1 Important notes

Using the safe 2D LiDAR sensor does require the safety-related functions of the sensor to be fully configured. The configuration needs to be valid and verified and the sensor must not be in error mode.

When using PROFINET scanners, the inputs have to be configured in the same way as the scanner is integrated. E.g. if there is an input signal configured, the input source has to be electrically applied.

#### 6.2.4.2 Overview

For more information on the microScan3’s data output via UDP and TCP/IP, refer to the document with the following SICK part numbers:
DANGER

Danger of using data output for safety function.
Data output may only be used for general monitoring and control tasks.

Do not use data output for safety-related applications.

Data output allows for the output of measurement data and other data via the Ethernet interface. Other network participants, the receivers, can call up and use the data.

6.2.4.3 Activating and configuring data output

You can activate and configure the data output in two ways:

- With the Safety Designer
- Via the CoLa2 protocol

In following, the configuration with the Safety Designer is shown.

6.2.4.4 Single receiver of measurement data

When using LiDAR-LOC, the measurement data output of the 2D LiDAR sensor is automatically configured. The user cannot make changes, except when using UDP broadcast (described in “Multiple receivers of measurement data via broadcast”, page 25).

6.2.4.5 Multiple receivers of measurement data via broadcast

Overview

If you want to transmit measurement data from the safety laser scanner to multiple clients, you must use broadcasting.

The only case using this feature is, when the measurement data is needed in multiple applications, for example, for localization and classification. When having only a single receiver of the measurement data, that is, LiDAR-LOC, the user does not have to make any changes.

For the default Ethernet configuration of the SIM, port 2 is:

- IP: 192.168.1.1
- Subnet mask: 255.255.255.0

The broadcast IP address for this subnet (derived from IP of the SIM) is:

- 192.168.1.255

Important information

NOTE

When using multiple LiDARs, a different receiver port for each sensor must be configured (UDP port). For example:

- UDP port Safety Scanner 1: 6060
- UDP port Safety Scanner 2: 6061

If multiple sensors use the same receiver port, the scans may interfere with each other. This may cause a fault in LiDAR-LOC or any customer application. Setting a receiver port number in the range between 51000 and 51100 may cause interference with other sensor configurations and should be avoided.
NOTE
When localizing, please close the SICK Safety Designer. The CoLa-A communication of the SICK Safety Designer interferes with the CoLa-A communication of LiDAR-LOC.

Approach
1. In the Safety Designer, open Configuration → Data output.
2. Choose On request and additionally continuously.
3. In section Send Mode, enter the IP address of the target computer to the broadcast UDP address, e.g. 192.168.1.255.
4. Enter the UDP port, for example, 6060.
5. In Send, select Every Measuring.
6. In section Selection data content, select the information blocks Measurement Data and Configuration of Data Output.

![Figure 17: Configuring the data output with the SICK Safety Designer](image1)

6.3 nanoScan3

6.3.1 Device overview

![Figure 18: nanoScan3 - overview](image2)
6.3.2 Electrical installation

Overview
The electrical installation is described in detail in the operating instructions:

- 8024594

Supply voltage and power consumption
Supply voltage:
- 24 V DC (16.8 ... 30 V DC) (SELV/PELV) according to IEC 60204-1
- Must be able to bridge a brief power outage of 20 ms with a starting voltage of ≤ 1.3 A

The laser scanner consumes the following:
- Power consumption ≤ 3.9 W to max. 15.9 W

System plug and connections
The laser scanner requires a system plug with Ethernet connection.

Voltage supply

![Figure 19: Connecting cable (male connector, M12, 8-pin, A-coded)](image)

Table 20: Pin assignment of the connecting cable with 8-pin M12 plug connector

<table>
<thead>
<tr>
<th>Pin</th>
<th>Designation</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+24 V DC</td>
<td>24 V DC supply voltage</td>
</tr>
<tr>
<td>3</td>
<td>0 V DC</td>
<td>0 V DC supply voltage</td>
</tr>
</tbody>
</table>

1) Applies to the connecting cables recommended as accessories.

![Figure 20: Connecting cable (male connector, M12, 17-pin, A-coded)](image)
Table 21: Pin assignment of the connecting cable with 17-pin M12 plug connector

<table>
<thead>
<tr>
<th>Pin</th>
<th>Designation</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+24 V DC</td>
<td>24 V DC supply voltage</td>
</tr>
<tr>
<td>2</td>
<td>0 V DC</td>
<td>0 V DC supply voltage</td>
</tr>
</tbody>
</table>

1) Applies to the connecting cables recommended as accessories.

Figure 21: Connecting cable (male connector, M12, 17-pin, A-coded)

Table 22: Pin assignment of the connecting cable with flying leads, 17-wire

<table>
<thead>
<tr>
<th>Wire color</th>
<th>Designation</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown</td>
<td>+24 V DC</td>
<td>24 V DC supply voltage</td>
</tr>
<tr>
<td>Blue</td>
<td>0 V DC</td>
<td>0 V DC supply voltage</td>
</tr>
</tbody>
</table>

Network connection

Figure 22: Ethernet pin assignment (female connector, M12, 4-pin, D-coding)

Table 23: Ethernet pin assignment

<table>
<thead>
<tr>
<th>Pin</th>
<th>Designation</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TX+</td>
<td>Send data +</td>
</tr>
<tr>
<td>2</td>
<td>RX+</td>
<td>Receive data +</td>
</tr>
<tr>
<td>3</td>
<td>TX–</td>
<td>Send data -</td>
</tr>
<tr>
<td>4</td>
<td>RX–</td>
<td>Receive data -</td>
</tr>
<tr>
<td></td>
<td>Housing</td>
<td>Shielding</td>
</tr>
</tbody>
</table>

6.3.3 Ethernet configuration

see "Ethernet configuration", page 24

6.3.4 Configuration of the data output

see "Configuration of the data output", page 24
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