TRAFFIC INFORMATION COLLECTOR

Profiling systems

SICK
Sensor Intelligence.

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Manufacturer	SICK AG Erwin-Sick-Str. 1 · 79183 Waldkirch · Germany	
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1 About these operating instructions

Please read this chapter carefully before you begin working with this documentation and the **T**elematic **I**nformation **C**ollector (TIC for short).

1.1 Described software versions

Software	Function	Status
TEMS Info interface	Profiling software for recording and processing measurement data	≥ V 2.0
TEMS platform	Profiling software	≥ V 2.8.0

Tab. 1:   Software versions

1.2 Purpose of this document

These operating instructions are designed to give **technical personnel** instructions on the safe mounting, configuration, electrical installation, commissioning, operation, and maintenance of the TIC profiling system.

These operating instructions do **not** provide information on operating the customer system into which the TIC profiling system has been or is going to be integrated. More information on this can be found in the customer documentation.

1.3 Target group

These operating instructions are intended for persons integrating the Traffic Information Collector into a system and performing initial commissioning and operation.

They are also intended for the planners and integrators of the customer system, as well as the operating entity with responsibility for it.

Target group	Activities
Entity operating the customer system	
System user	Operating the system: site view and display of the measurement results in TEMS Manager → The system user reports faults to the system manager.
System manager	Mounting, electrical installation, maintenance, and replacement of system components. → The system manager submits support requests to SICK.
SICK	
SICK service technician	Commissioning, configuration, and support.

Tab. 2:   Target group

1.4 Information depth

Note These operating instructions contain information about the following topics related to the profiling system:

- System description
- Mounting
- Electrical installation
- Commissioning
- Operation
- Maintenance and care
- Fault diagnosis and troubleshooting
- Technical data and dimensional drawings

When planning and using RFID profiling systems such as the TIC, technical skills are required that are not covered by this document.

The official and legal regulations for operating the system must always be complied with.

Further information about the device components used in the TIC can be found in the accompanying operating instructions.

1.5 Abbreviations used

3D point cloud	The 2D cross-sections recorded by the 2D LiDAR sensors during the measurement process are merged together to form a 3D point cloud. The point cloud is used as the basis for calculating the vehicle dimensions and for vehicle classification.
FTP	File transfer protocol = a network protocol for transferring data between different systems
LiDAR	Light detection and ranging = method for optical length and speed measurement
LMS	Laser measurement scanner = 2D LiDAR sensor from SICK AG
TEMS	Traffic enhanced measurement system
TEMS Info client	Customer side of the TEMS Info interface
TEMS Info interface	TCP/IP interface for communication with the TEMS Recorder
TEMS Manager	Web-based configuration software for the profiling system
TEMS Recorder	Profiling software on the Traffic Controller; it processes the data from the 2D LiDAR sensors and outputs the results
UNC	Entering a UNC path (**U**niversal **N**aming **C**onvention) allows a path in a network to be accessed without the need for a drive letter. The UNC path does not need to be visible in Windows Explorer. Windows shared folders can also be used as UNC destinations.
UPS	Uninterruptible voltage supply
TIC	Traffic Information Collector
WCF	Windows Communication Foundation

1.6 Symbols used

Recommendation Recommendations are intended to help you make a decision regarding the use of a particular function or technical feature.

Note Notes provide information about the features of a device, application tips, or other useful information.

1. / 2. ... Instructions that must be carried out in the described order are referred to as step-by-step **Step by step** instructions and are indicated by numbered lists. Carefully read and follow the instructions for action.

➤ Instructions requiring specific action are indicated by an arrow. Carefully read and follow **Action** the instructions for action.

● ☀ ○ LED icons describe the status of a diagnostics LED.
   ● The LED is illuminated continuously.
   ☀ The LED is flashing.
   ○ The LED is off.

⸭8⸭, L⟳2 Display symbols show the status of the 7-segment display:
   UU Constant display of characters, e.g., U
   ⸭8⸭ Flashing display of characters, e.g., 8
   L⟳2 Alternating display of characters, e.g., L and 2

2 On safety

This chapter provides information that concerns your own safety as well as the safety of the plant operator.

▶ Please read this chapter carefully before you begin working with the Traffic Information Collector.

2.1 Qualified safety personnel

The Traffic Information Collector must only be mounted, commissioned, and maintained by adequately qualified personnel.

A person is considered qualified safety personnel if he/she

- Has sufficient skills in the field of the respective equipment based on his/her technical training and experience **and**
- Has been instructed by the manufacturer on system operation and all applicable safety guidelines **and**
- Is familiar with all relevant country-specific occupational safety regulations, work safety regulations, guidelines, and generally accepted technical rules and standards (e.g., DIN standards, VDE regulations, country-specific rules) to such an extent that he/she is able to evaluate the safe condition of the power-driven machinery **and** he/she
- Has access to and has read the operating instructions.

2.2 Applications of the system

The Traffic Information Collector is a system for vehicle classification on multi-lane roads with eye-safe 2D LiDAR sensors. The system takes the measurements automatically in free-flowing traffic without any need for manual operation.

The TIC is designed for use in multi-lane, free-flowing traffic and stop-and-go traffic as part of electronic toll systems. It can also be used for traffic management and analysis.

The Traffic Information Collector is available in the TIC102, TIC502 and TIC501 variants. All three variants classify vehicles in up to 30 vehicle classes in accordance with the specified category system and outputs vehicle data such as length, width and height as well as speed.

The TIC102 and TIC502 profiling systems can be supplemented with a system function for automated axle counting. **In addition** to the vehicle class and vehicle data, the number of axles, the position of the axles and, if necessary, the height above the first axle are determined.

Data output

All the data recorded by the individual system functions are made available via a TCP/IP interface (TEMS Info interface).

2.3   Intended use

The TIC profiling system may only be used as described in section **2.2 Applications of the system**. It may only be used by qualified personnel in the environment in which it was mounted and initially commissioned by qualified safety personnel in accordance with these operating instructions.

Notes   The TIC is not a safety device for human protection and therefore does not comply with any safety standards.

It is purely a measurement system without any safety functions and must only be used in this capacity.

Consequently, any responsibility on the part of SICK is restricted to these defined and limited properties of the measurement system.

Note   If used in any other way or if alterations are made to the profiling system – including in the context of mounting and installation – this will render void any warranty claims directed to SICK AG.

2.4   General safety notes and protective measures

2.4.1   Safety notes and icons

The following safety and hazard notes concern your own safety, the safety of third parties, and the safety of the devices. You should therefore observe them at all times.

⚠	**DANGER**

Denotes an immediate hazard that may result in severe to fatal injuries.

The symbol shown on the left-hand side of the note refers to the type of hazard in question (the example here shows a risk of injury resulting from electrical current).

⚠	**WARNING**

Denotes a potentially dangerous situation that may result in severe to fatal injuries.

The symbol shown on the left-hand side of the note refers to the type of hazard in question (the example here shows a risk of damage to the eye by laser beams).

⚠	**WARNING**

Denotes a potentially dangerous situation that may result in minor personal injury or possible material damage.

	NOTE

Denotes a potential risk of damage or functional impairment of the device or the devices connected to it.

This symbol refers to supplementary technical documentation.

2.4.2   **General safety notes**

The profiling system has been designed in a way that allows for safe operation. Protective devices reduce potential risks to the maximum possible extent. However, a certain level of risk will always remain.

Awareness of potential hazardous points in the system will help you to work in a safer manner and thus prevent accidents.

To avoid risks, please also observe the special warnings in each of the individual chapters.

⚠ **WARNING**

Safety notes

Observe the following to ensure the safe use of the profiling system as intended.

- The notes in these operating instructions (e.g., regarding use, mounting, installation, or integration into the machine controller) must be observed.
- All official and statutory regulations governing the operation of the profiling system must be complied with.
- National and international legal specifications apply to the installation and use of the profiling system, to its commissioning, and to recurring technical inspections, in particular:
    – Work safety regulations and safety rules
    – Any other relevant safety provisions
- The checks must be carried out by qualified safety personnel or specially qualified and authorized personnel, and must be recorded and documented to ensure that the tests can be reconstructed and retraced at any time.
- These operating instructions must be made available to the operator of the system in which the profiling system is used.
- The operator of the profiling system must be instructed by qualified safety personnel and must read the operating instructions.

⚠ **WARNING**

Risk resulting from improper operation

Improper installation and commissioning, damaged components, and unsuitable ambient conditions such as excessively cold or warm temperatures and high levels of dust, fog or spray, may cause faults and faulty alarms and may result in a complete system crash.

⚠ **WARNING**

System does not comply with safety standards

The profiling system is not suitable for the protection of humans within the meaning of the applicable safety standards for machines. The system therefore does not comply with safety standards.

⚠ **WARNING**

Location of use

The profiling system is intended exclusively for use in traffic-related applications.

2.4.3 Potential hazardous points

Laser protection

⚠ **WARNING**

Damage to the eye by laser beams

The 2D LiDAR sensors used in the profiling system conform to Class 1 laser (eye-safe) criteria according to IEC 60825-1 (latest version); see laser warning plate on the device for publication date. This ensures compliance with 21 CFR 1040.10 except for the tolerances according to Laser Notice No. 50 of July 26, 2001.

The laser beam operates at a wavelength of γ = 905 nm (invisible infrared light). The laser beam is not visible to the human eye.

The radiation emitted in normal operation is harmless to human skin and eyes.

WARNING   Improper use (e.g., opening the housing and stopping the motor) can result in dangerous exposure to radiation.

▶ Never open the 2D LiDAR sensor housing. Opening the housing does not interrupt the operation of the laser beam.

▶ Pay attention to the laser safety regulations as per IEC 60 825-1 (latest version).

Important   • No maintenance is required to ensure compliance with laser class 1.

• The laser output aperture is the inspection window on the 2D LiDAR sensor.

• The laser warning is located on the right-hand side of the 2D LiDAR sensor.

Electrical current

⚠ **DANGER**

Risk of injury and damage caused by electrical current

Improper handling of live devices may lead to severe personal injury or death by electric shock!

▶ Electrical installation and maintenance work must always be carried out by personnel authorized to do so.

▶ Be sure to disconnect the voltage supply before attaching or detaching any electrical connections.

▶ Select and implement wire cross-sections and their correct fuse protection in accordance with the applicable standards.

▶ Do not touch any live parts.

▶ In the event of danger, immediately disconnect the profiling system from the voltage supply.

▶ Always use original fuses with the specified current rating.

▶ Report any damaged cables to the maintenance team without delay.

▶ Observe the current safety regulations when working on electrical systems.

<table>
<tr><td></td><td>⚠ DANGER</td></tr>
</table>

Damaging potential equalization currents due to different ground potentials

The profiling system has been designed and tested for electrical safety in accordance with EN 60 950-1 (2006-04) and EN 60 950-1 / A11 (2009-03).

The profiling system is connected to the peripheral devices (voltage supply, PLC/host, any other sensors, etc.) via shielded cables. The shield of each cable is connected to the metal housing of the corresponding system components via the system plug.

If the peripheral devices have metal housings and if the cable shields are also connected to these housings, it is assumed that all devices involved in the system have the same ground potential.

This is achieved by fulfilling the following conditions, for example:

- Mounting the devices on conductive metal surfaces.
- Correctly earthing the devices and metal surfaces in the system.
- Low-impedance and current-carrying equipotential bonding between areas with different ground potentials, if necessary.

If these conditions are not met, e.g., on devices in a widely distributed system spanning several buildings, different ground potentials may cause potential equalization currents to flow along the cable shields between the devices, thereby creating hazards.

<table>
<tr><td></td><td>⚠ DANGER</td></tr>
</table>

Risk of injury and damage caused by potential equalization currents

Potential equalization currents between the profiling system and the peripheral devices can have the following effects:

- Dangerous voltages on the metal housing, e.g., of the 2D LiDAR sensors
- Incorrect functioning of or irreparable damage to the devices
- Damage/irreparable damage to the cable shields due to heating and cable fires.

Commissioning/operation/maintenance

<table>
<tr><td></td><td>⚠ WARNING</td></tr>
</table>

Risk resulting from incorrect commissioning and configuration!

Do not commission without testing by qualified personnel!

Before carrying out initial commissioning of the profiling system, you must have it checked and approved by qualified safety personnel.

<table>
<tr><td></td><td>⚠ WARNING</td></tr>
</table>

Avoid strong vibrations and jolts at the measurement site

Do not allow the system components of the profiling system to be exposed to excessive vibrations or jolts as a result of construction work **at the** measurement site or within its immediate vicinity (work involving compressors, road rollers/compactors, etc.).

▶ Switch off all components of the profiling system if strong vibrations are anticipated.

NOTE

Claims under the warranty rendered void

The housings of the devices must not be opened. The devices are sealed.

If the device is opened, any warranty claims against SICK AG will be void.

⚠ **WARNING**

Risk resulting from faults

Cease operation if the cause of the malfunction has not been clearly identified!

▶ Immediately stop system operation if you cannot clearly identify the fault and if you cannot safely remedy the problem.

2.5   Protecting the environment

The profiling system has been designed to minimize its impact on the environment. It consumes very little energy.

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

Disposal after final decommissioning

▶ Always dispose of unusable or irreparable devices in accordance with the applicable waste disposal regulations specific to your country.

▶ Remove the plastic parts and recycle the aluminum housing of the 2D LiDAR sensor.

▶ Dispose of all electronic assemblies as hazardous waste. The electronic assemblies can be easily removed.

Note   SICK AG does not take back devices that are unusable or irreparable.

3   System description

This chapter describes the layout and operating principle of the TIC profiling system, in particular the interaction of the different components.

Note   Always read this chapter before mounting, installing, or commissioning the TIC.

3.1   System functions of the TIC product family

The TIC profiling system is available with the TIC102, TIC502 and TIC501 system functions.

The initial TIC102, TIC502 and TIC501 system functions are used for **vehicle detection**. They provides a 3D point cloud for the vehicle, which serves as the basis for calculating the measurements. To do so, the system functions, depending on the variant, use 2D LiDAR sensors of type LMS111-S05 or LMS511 SE (system extension) (referred to LMS111 and LMS511 for short in the following). For the TIC102 system function, the 2D LiDAR sensors are permanently installed in a housing. In the TIC502, the 2D LiDAR sensors are pre-assembled on a plate.

The two system functions for vehicle detection, TIC102 and TIC502, can be supplemented by a system function for automated **counting of vehicle axles**. This system function uses a LMS511 SE 2D LiDAR sensor.

All system functions are controlled via an **Traffic Controller** via TCP/IP.

Fig. 1:   TIC system functions

A Traffic Controller can process the information of a maximum of four system functions: Either four TIC102, four TIC502 or four TIC501 units. The system functions cannot be combined in one Traffic Controller.

The supplemented system function for axle counting is thereby classified as a TIC102 or TIC502. That means: If a TIC102 is supplemented by two system functions for axle counting, only two TIC102 system functions can be connected to the Traffic Controller.

Note   The system functions for **classifying** vehicles and for detection of the **vehicle dimensions** require their own sensors. They use the vehicle detection data.

Since the dimensions are not measured, but only calculated, no accuracy can be specified. The TIC profiling system therefore only provides an indication of vehicle dimensions.

2D LiDAR sensors

The 2D LiDAR sensor records the contour of the passing vehicle. To do this, it establishes a measuring range and scans the vehicle using a non-contact time-of-flight process.

The laser beam is emitted through the inspection window. The scan plane position of the LMS511 is indicated by a housing marking next to the inspection window (see the circle in the figure below).

In the TIC102, the 2D LiDAR sensors are installed as a fixed component in the housing. The laser is beamed through special output apertures in the housing.
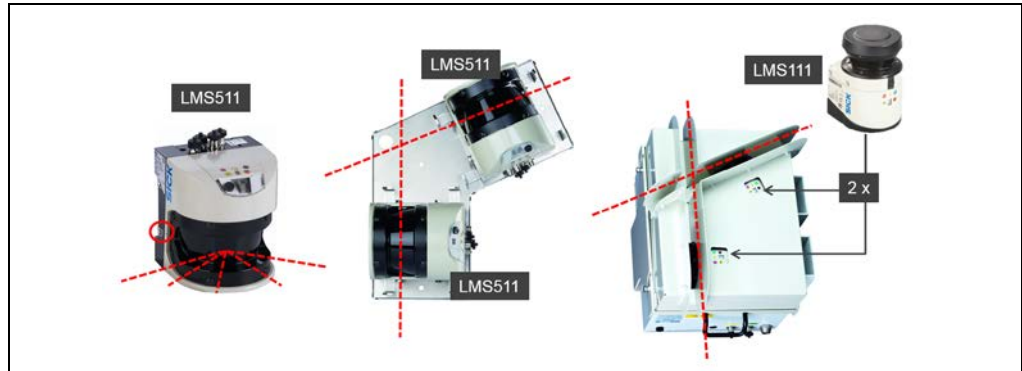
Fig. 2:   *Laser output aperture on the LMS111 and LMS511 2D LiDAR sensors*

Note   The 2D LiDAR sensors automatically measure contamination on the inspection window. The level of contamination is displayed directly on the device or displayed via the Traffic Controller and/or transmitted to the downstream customer system.

For detailed information about the operating principle of the 2D LiDAR sensors, please refer to the operating instructions for the LMS111 and LMS511 product families.

Traffic Controller

The Traffic Controller uses the installed profiling software to calculate the vehicle dimensions using the vehicle contour, the vehicle class and other data.

At the same time, the Traffic Controller acts as the central control unit for the profiling system. Using its TCP/IP Ethernet interface, it constantly provides the downstream systems with all system data, the measuring points, measurement results, and system messages.

The TCP/IP interface is also used for set-up, calibration, and fault analysis with the aid of tools.

Fig. 3:   *Traffic Controller as the central control unit of the profiling system*

3.2   System components and scope of delivery

3.2.1   Components of the TIC102 system function

The TIC102 system function is designed for use in multi-lane, free-flowing traffic and stop-and-go traffic for toll systems and for performing traffic management. It classifies vehicles from different category systems and also detects vehicles when they switch lanes.

The TIC102 monitors exactly one lane. Up to four TIC102 units can run on the Traffic Controller. Up to four lanes can be detected in this way.

System components

The TIC102 system function consists of the **LMS Width** and **LMS Length** system components. These system components use LMS111 type 2D LiDAR sensors. They are permanently installed in a housing and aligned to each other at a 25° angle.

Fig. 4:   System components – TIC102
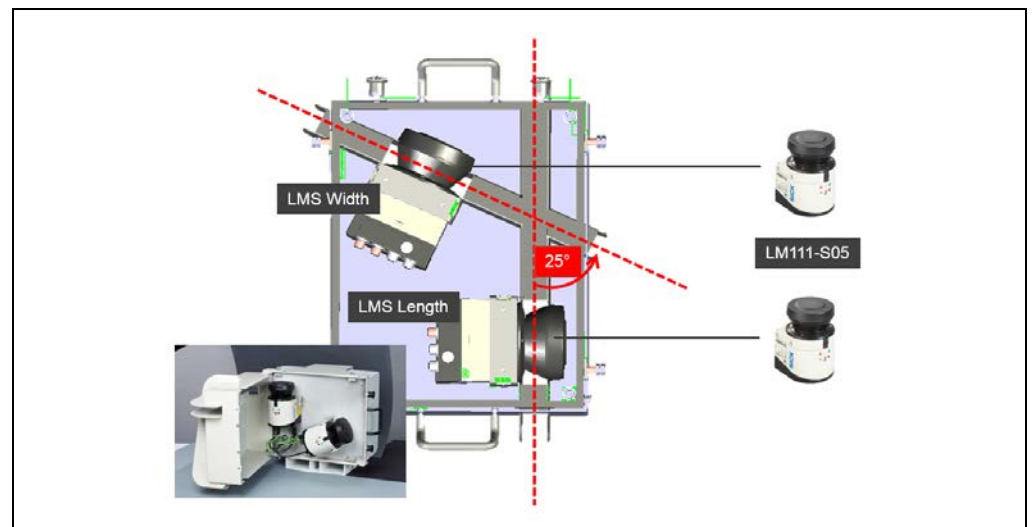
The **LMS Width** aligned with the side of the lane records the vehicle's profile in individual 2D profile sections. The LMS Width also detects vehicles when they change lanes.

The **LMS Length** (which is aligned along the lane) is responsible for vehicle tracking, measures changes in vehicle speed, and provides the time axis to which the individual 2D cross-sections are assigned.

Master and slave

The TIC102 system function is available in the **master** and **slave** versions.

The housing of a **TIC102 Master** also contains the two LMS111 2D LiDAR sensors in addition to the Traffic Controller. Only the two 2D LiDAR sensors are installed in a **TIC102 Slave**. A TIC102 slave can only be operated together with a TIC102 Master or via an external Traffic Controller as an OEM variant (see chapter *3.2.5 Traffic Controller FPS as OEM variant*). For more information on OEM variants, please contact your local SICK agency.

Both housing variants contain an overcurrent protective device as well as a network switch.
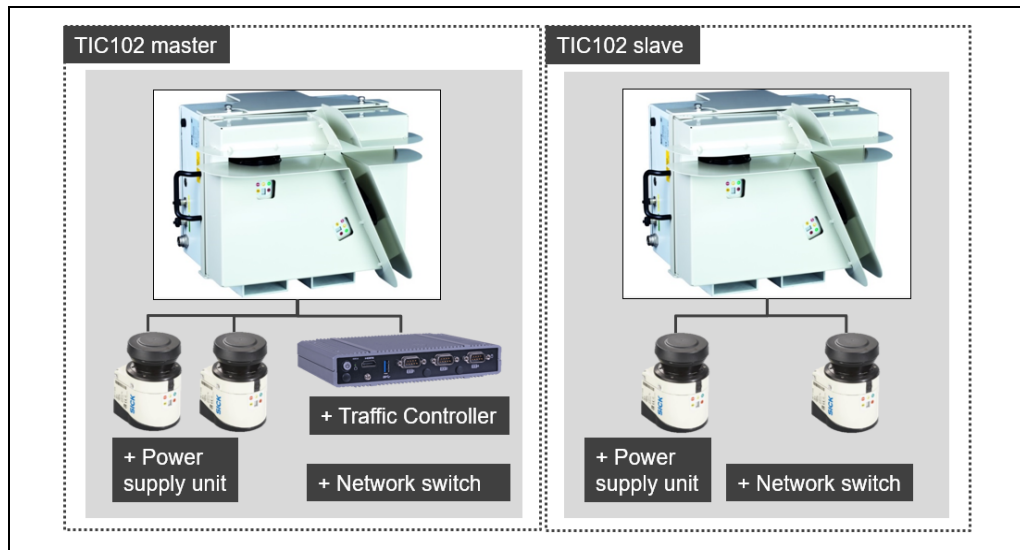
Fig. 5:   System components – TIC102 Master/TIC102 Slave

Scope of delivery, TIC102

Quantity	Part No.	Description
1	1055102	**TIC102 master**
		The TIC102 with 2 integrated LMS111-S05 2D LiDAR sensors, integrated Traffic Controller TIC with TIC software and network switch. USB stick with TEMS analyzer, TEMS info sample client, source code for TEMS info sample client, and operating instructions

Supplementary components

Quantity	Part No.	Description
1-3	1055104	**TIC102 slave**
		TIC102 with two integrated LMS111-S05 2D LiDAR sensors and network switch

Accessories

Quantity	Part No.	Description
1-4	6045327	Connecting cable (30 m) for voltage supply
1	6045311	Ethernet cable (30 m) for connecting the TIC102 Master to the company network
1-3	6045328	Ethernet cable (15 m) for connecting the two TIC102 units to each other

3.2.2 Components of the TIC502 system function

The TIC502 system function is designed analog to the TIC102 for use in multi-lane, free-flowing and stop-and-go traffic for toll stations and for performing traffic management. It classifies vehicles from different category systems and also detects vehicles when they switch lanes.

The TIC502 monitors exactly one lane. Up to four TIC502 units can run on the Traffic Controller. Up to four lanes can be detected in this way.

System components

The TIC502 system functions consist of the **LMS Width** and **LMS Length** system components. These system components use LMS511 type 2D LiDAR sensors. The 2D LiDAR sensors are pre-assembled on a metal plate and also aligned at a 25° angle to one another.
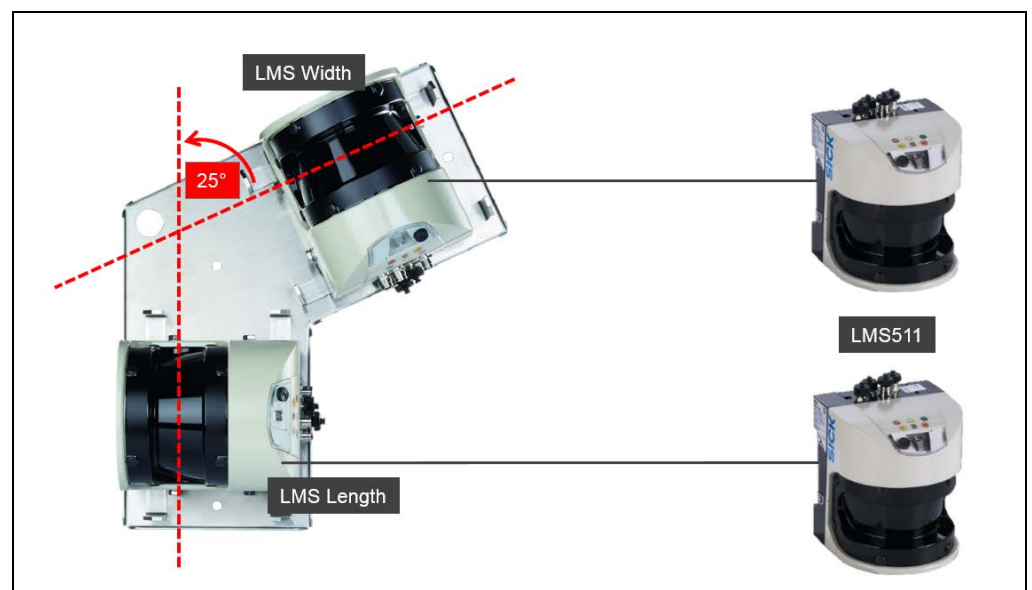
Fig. 6: System components – TIC502

The **LMS Width** aligned with the side of the lane records the vehicle's profile in individual 2D profile sections. The LMS Width also detects vehicles when they change lanes.

The **LMS Length** (which is aligned along the lane) is responsible for vehicle tracking, measures changes in vehicle speed, and provides the time axis to which the individual 2D cross-sections are assigned.

Note Compared to the TIC102, the TIC502 provides **higher detection accuracy** due to the LMS511 type 2D LiDAR sensors used. A TIC502 is also more reliable for use in harsh operating environments.

Master and slave

The TIC502 system function is available in the **master** and **slave** versions.

A **TIC502 Master** consists of the LMS511 type 2D LiDAR sensors mounted on the mounting plate and a separate Traffic Controller. The Traffic Controller is installed in a control cabinet at the customer site. A **TIC502 Slave** contains only the two 2D LiDAR sensors fastened on a metal plate.

A TIC502 Slave can only be operated with a TIC502 Master or via an external Traffic Controller as an OEM variant (see chapter *3.2.5 Traffic Controller FPS as OEM variant*). For more information on OEM variants, please contact your local SICK agency.
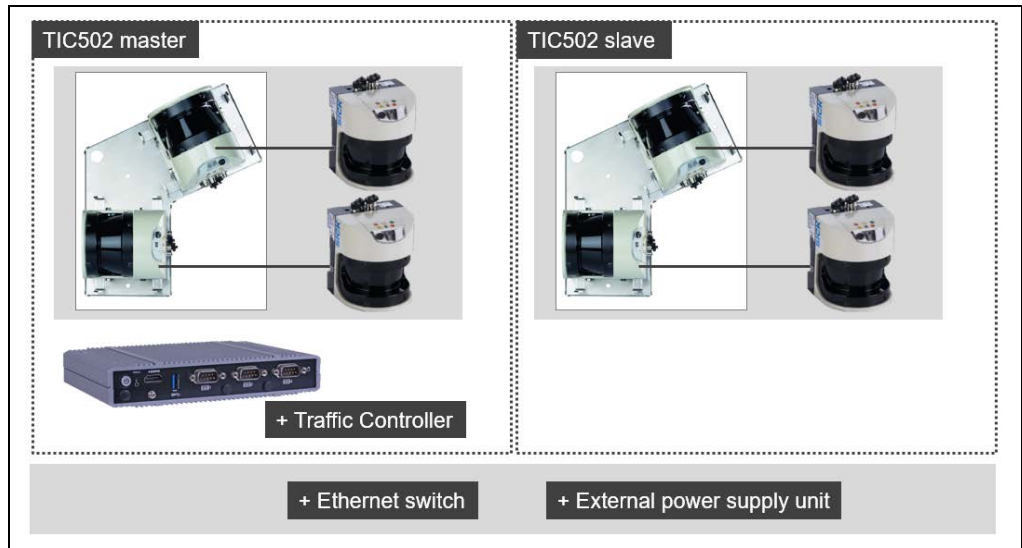
Fig. 7:   System components – TIC502 Master/TIC502 Slave

Note   The customer will also require an **Ethernet switch** and a **power supply unit** for the voltage supply.

Scope of delivery, TIC502

Quantity	Part No.	Description
1	1085137	**TIC502 master**
		The TIC502 with 2 integrated LMS511 SE 2D LiDAR sensors and a separate Traffic Controller with TIC software. USB stick with TEMS analyzer, TEMS info sample client, source code for TEMS info sample client, and operating instructions

Supplementary components

Quantity	Part No.	Description
1-3	1085138	**TIC502 slave**
		TIC502 with 2 integrated LMS511 2D LiDAR sensors.

Accessories

Quantity	Part No.	Description
1-4	6050687	Voltage supply (20 m) connecting cable for the LMS511 SE
1-4	6050685	Ethernet cable (20 m) for connecting the 2D LiDAR sensors to the Ethernet switch
1	6026083	Ethernet cable (3 m) for connecting the Ethernet switch and the Traffic Controller

3.2.3   Components of the TIC501 system function

The TIC501 system function is designed for use in multi-lane, free-flowing traffic and for traffic management applications and simple toll systems.

The TIC501 delivers higher number and classification accuracy in flowing traffic. In stop-and-go traffic, the classification accuracy and the detection of speed and vehicle length is reduced.

A TIC501 can detect several lanes (1 to 3) at the same time. Up to four TIC501 units can run on a Traffic Controller TIC. The TIC501 system function therefore supports the monitoring of several roads.

System components

A TIC501 consists only of one LMS511 type 2D LiDAR sensor and a Traffic Controller.

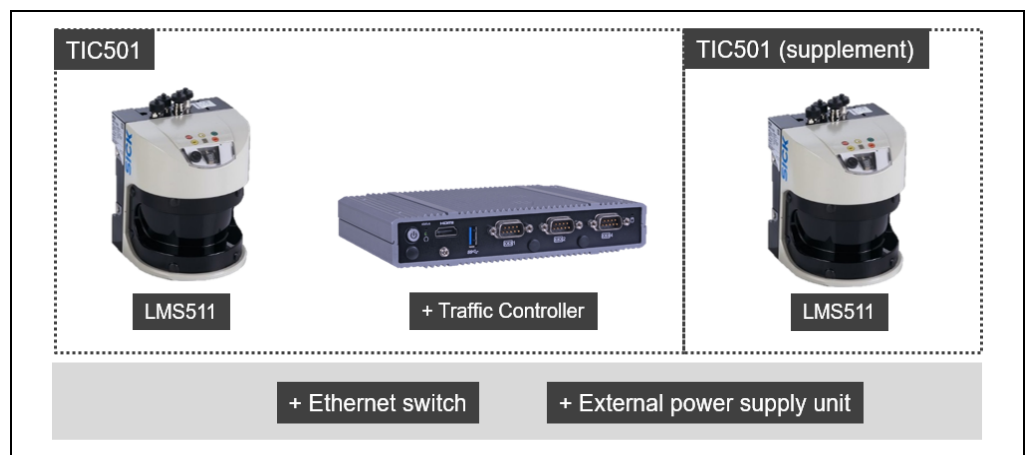*Fig. 8:*   *System components – TIC501*

Note   The customer will also require a **power supply unit** for the voltage supply. If several TIC501 units are used, an **Ethernet switch** is required.

Scope of delivery, TIC501

Quantity	Part No.	Description
	1069322	**TIC501**
1	(1091458) *	LMS511 SE 2D LiDAR sensor
1	(2090117) *	Traffic Controller TIC with TIC software USB stick with TEMS analyzer, TEMS info sample client, source code for TEMS info sample client, and operating instructions
* For spare parts order		

Supplementary components

Quantity	Part No.	Description
1-3	1091458	LMS511 SE 2D LiDAR sensor

Accessories

Quantity	Part No.	Description
1-4	6050687	Voltage supply (20 m) connecting cable for the LMS511 SE
1-4	6050685	Ethernet cable (20 m) for connecting the 2D LiDAR sensors to the Ethernet switch
1	6026083	Ethernet cable (3 m) for connecting the Ethernet switch and the Traffic Controller

Note   If alternative LMS511 Traffic units are already used, they can continue to be used. Arrange the corresponding accessories with your local SICK representative.

3.2.4 Components of the axle counting system function

The system function for axle counting (**Axle Detector)** extends the system functions for vehicle detection and classification to include the option of automatically counting the vehicle axes.

The system function consists of the **LMS Axle** system component. This system component uses one LMS511 2D LiDAR sensor.

The **Axle Detector** system function can be operated together with one of the TIC102 or TIC502 system functions.
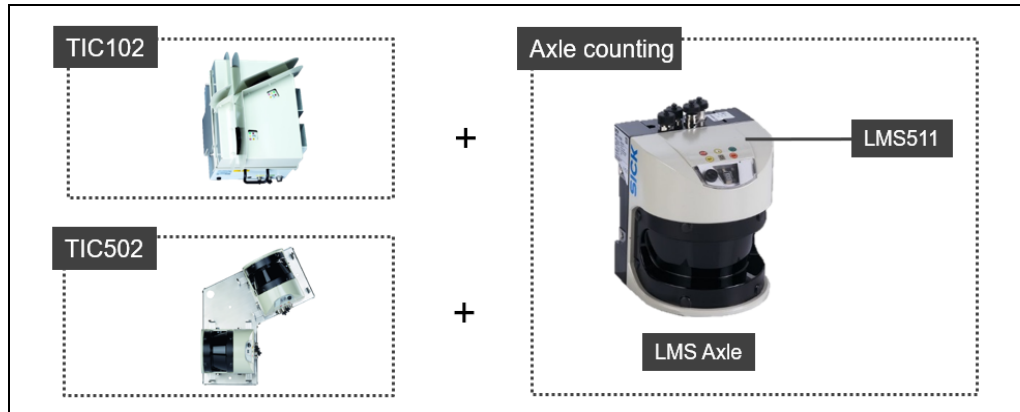

Fig. 9: *System components – Axle counting*

Scope of delivery

Quantity	Part No.	Description
1-2	1091458	LMS511 SE 2D LiDAR sensor

Accessories

Quantity	Part No.	Description
1-2	2056850	Protection hood, recommended for protection from direct sunlight (heat) and environmental influences
1-2	2063050	Weather hood, recommended for protection from direct sunlight (heat) and environmental influences
1-2	2015623	Mounting kit 1 (mounting kit 1 to assist with mounting)
1-2	2015624	Mounting kit 2 (mounting kit 2 to assist with mounting, required mounting kit 1)
1-2	2015625	Mounting kit 3 (mounting kit 3 to assist with mounting, requires mounting kit 1+2)
1-2	2059271	Mounting bracket (for retrofitting to existing LMS2x1 mounting)
1-2	2018303	Mounting kit (mounting kit for wall mounting (adjustment bracket))
1-2	6050687	Voltage supply (20 m) connecting cable for the LMS511 SE
1-2	6045328	Ethernet cable (15 m) for connecting the 2D LiDAR sensors to the TIC102
1-2	6050685	Ethernet cable (20 m) for connecting the 2D LiDAR sensors to an Ethernet switch (for connection to the TIC502).

3.2.5   Traffic Controller FPS as OEM variant

The TIC102 Slave and TIC502 Slave system functions can also be operated as an OEM variant with an external Traffic Controller.

As an OEM variant, the Traffic Controller is installed together with the TEMS Recorder as a virtual machine on the host server. Implementation is carried out using **VirtualBox** virtualization software by Oracle.
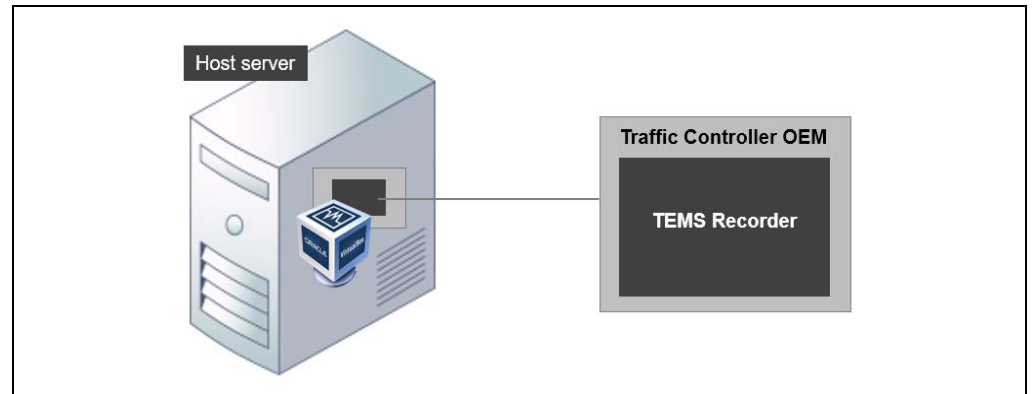
Fig. 10:   Traffic Controller and TEMS Recorder

If several profiling systems are operated in parallel for monitoring several lanes, one Traffic Controller must be installed for each system. In principle, you are able to install several Traffic Controller virtual machines on one host server.

In order to install **one** virtual machine on the host server, the following system requirements must be met:

Fig. 11:   Traffic Controller OEM system requirements

Note

Additional details can be found at your SICK agency.

Components

The OEM version of the virtual Traffic Controller is made up of the following components:

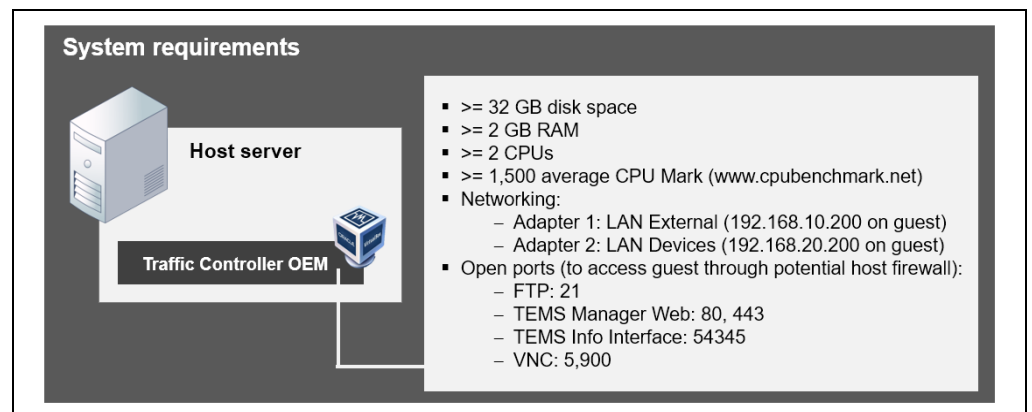- The **TrafficControllerOEM.vdi** file. The **vdi** file (**v**irtual **d**isk **i**mage) contains an image of the virtual machine with the operating system and the profiling software TEMS Recorder.
- The **TrafficControllerOEM.vbox** file. The **vbox** file contains the complete virtual machine. The configuration file in XML format can be opened and edited in Editor.
- The **license** for the Windows 7 Embedded operating system used by the virtual machine.

Supported operating systems

The virtual machine can be installed on the following operating systems on the customer's host server:

- Windows 7 Professional
- Linux Ubuntu 12.04
- CentOS 6.4

System requirements

In addition to the resources for the host server's operating system, the following requirements must be met in order to use the virtual Traffic Controller on the host server:

General
Standard PC or comparable computer, 64 bit
≥ 32 GB free storage space on the hard drive (recommended: 100 GB)
At least 2 GB RAM (recommended: 4 GB RAM)
WEB browser with the current version. This browser must support HTML5 and WebGL.
Data interface: Ethernet 10/100 Mbit or 1000 Mbit Adapter1: LAN External (192.168.10.200) Adpater2: LAN Devices (192.168.20.200)
Standard screen (VGA or DVI)
Open ports in the firewall FTP: 21 TEMS Manager Web: 80, 443 TEMS Info Interface: 54345 VNC: 5,900

Tab. 3:   Traffic Controller OEM system requirements

3.3 The measurement site

3.3.1 Typical layout of the measurement site

The system components for vehicle detection are mounted either above the road on a gantry or to the side of the road on a mast or post. This position enables the profile of the vehicle to be captured perfectly and the length to be calculated. Depending on the system configuration, one or more 2D LiDAR sensors are responsible for monitoring up to four lanes of a road. One direction of travel is assigned to each lane.

The system components for axle counting are mounted on the side on the right and/or left edge of the lane.

A side strip can be visualized in the layout of the measurement site. The side strip is not included in any system function.

Within all layouts, the system components are precisely positioned in a 3-dimensional coordinate system.
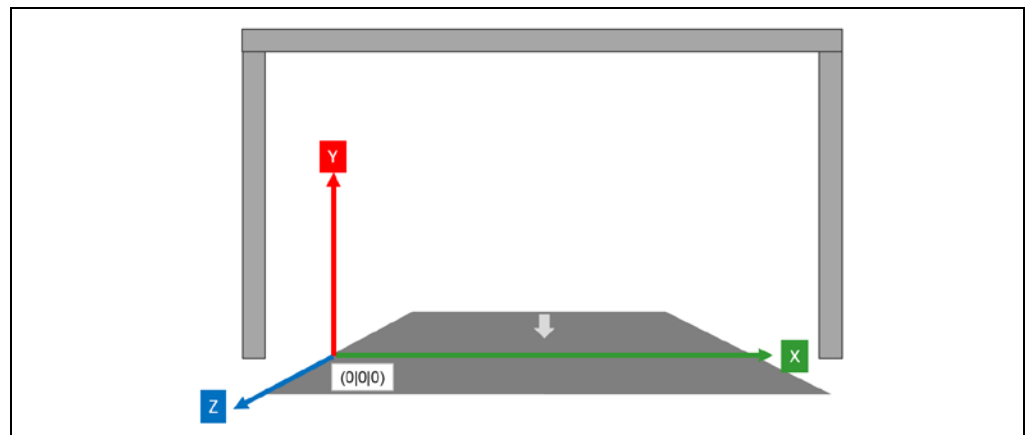

Fig. 12:   Coordinate system

The following axes are used in this coordinate system:

- The horizontal axis (X-axis) points orthogonally across the lane. The zero-point of this axis is the right-hand edge of the lane (or the right edge of the side stripe).
- The vertical axis (Y-axis) points upward perpendicular to the road surface.
- The movement axis (Z-axis) points in the direction of travel. The third distance value is measured in relation to the measuring plane.

3.3.2   Measurement site for TIC102

A TIC102 is assembled on a gantry in the center of the respective lane. Its central position enables it to record as many vehicles as possible within the range of the 2D LiDAR sensors.

The beam of the LMS Width is emitted diagonally to the road surface. The beam of the LMS Length is emitted along the direction of travel.
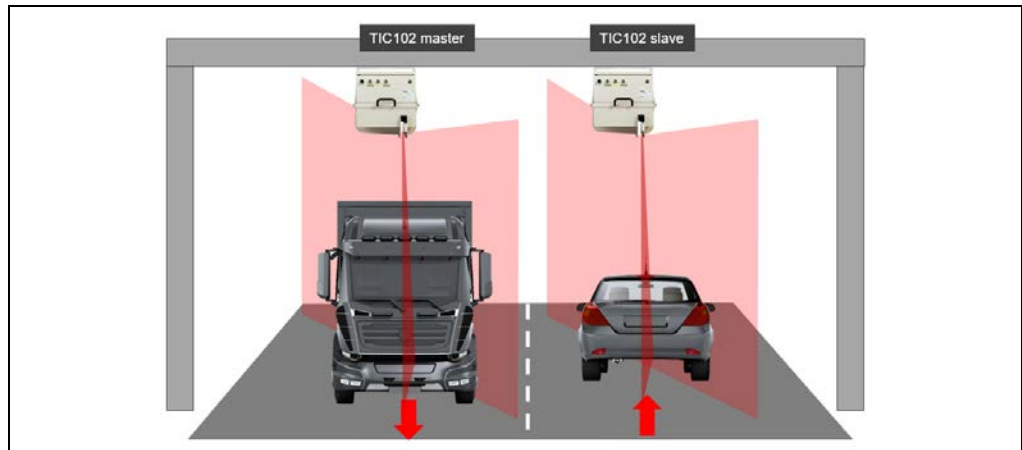

Fig. 13:   Measurement site – TIC102 (monitoring of 2 lanes)

One TIC102 each is used for monitoring a lane. The Traffic Controller installed in the TIC102 Master can integrate up to four TIC102 units depending on the number of lanes to be monitored.
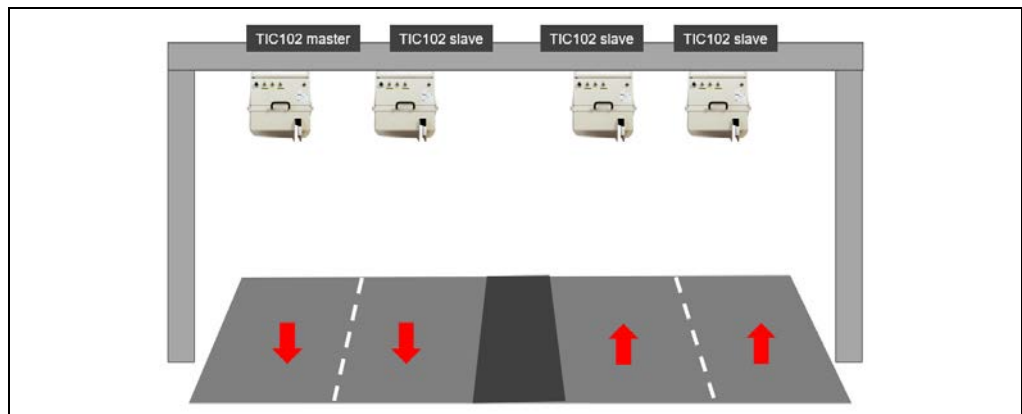

Fig. 14:   Measurement site – TIC102 (monitoring of 4 lanes)

3.3.3 Measurement site for TIC502

A TIC502 is assembled analog to the TIC102 on a gantry in the center of the respective lane.

The beam of the LMS Width is emitted diagonally to the road surface. The beam of the LMS Length is emitted along the direction of travel.
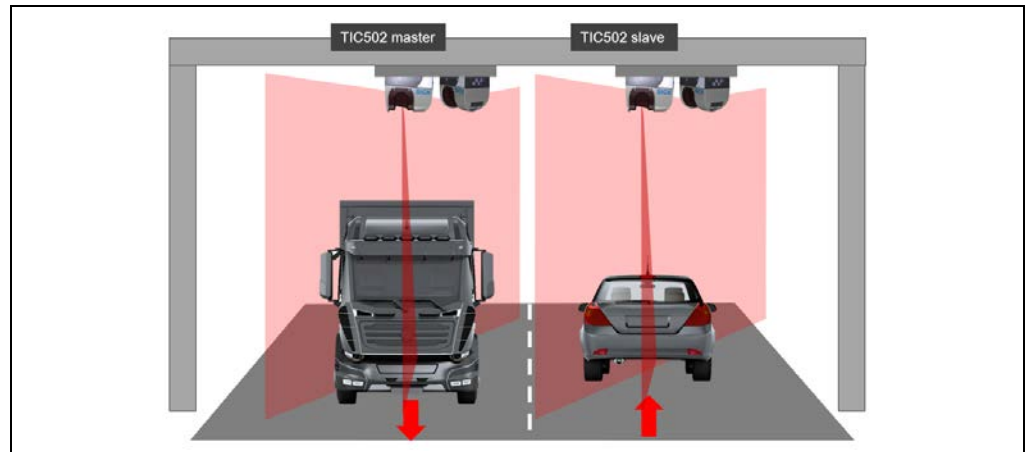

Fig. 15:   Measurement site – TIC502 (monitoring of 2 lanes)

One TIC502 each is used for monitoring a lane. Depending on the number of lanes to be monitored, data from up to four TIC502 units can be processed on the Controller.
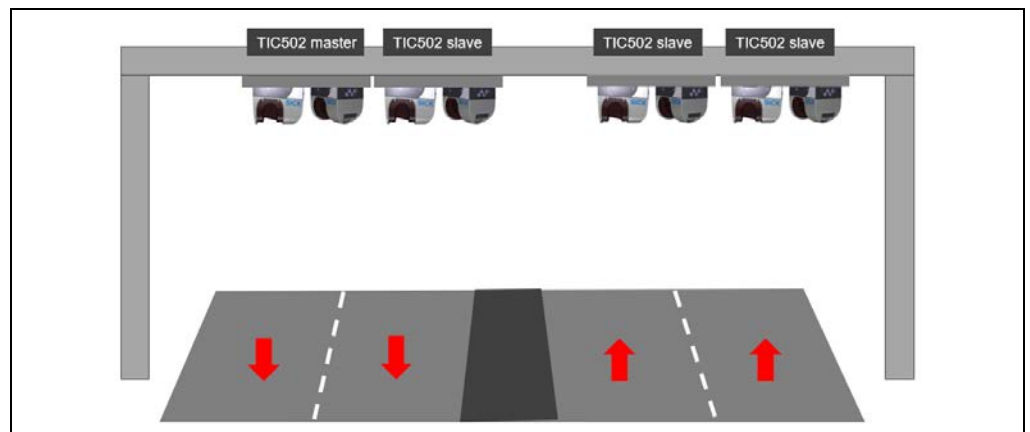

Fig. 16:   Measurement site–- TIC502 (monitoring of 4 lanes)

3.3.4   Measurement site for TIC501

The mounting position of the TIC501 can be adapted flexibly to the local conditions. It is supported analog to the TIC102 / TIC502 via overhead mounting on a gantry.

The beam of the TIC501 is emitted perpendicular to the road surface.

Several lanes can be monitored with one TIC501. A maximum of four lanes can be monitored with a TIC501 if mounted in the center.
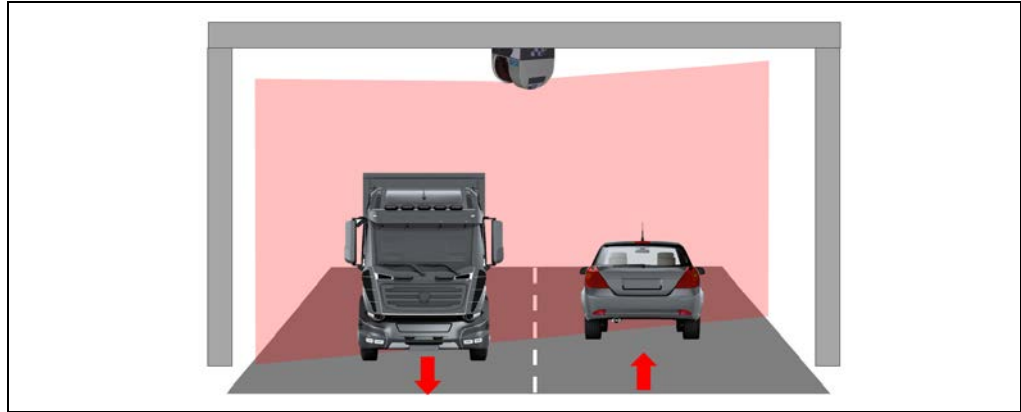
Fig. 17:   Measurement site – TIC501 overhead mounting (monitoring of 2 lanes)

A TIC501 can be expanded with up to three additional LMS511 units. Several roads can be monitored at the same time in this way.

Fig. 18:   Measurement site – TIC501 (monitoring of 3 + 3 lanes)

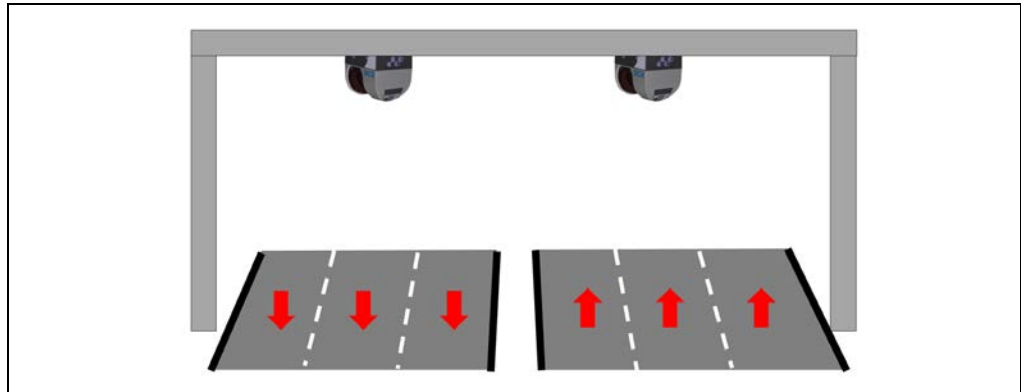Side mounting above the lane on a post or mast is also possible. A maximum of two lanes can be monitored with a TIC501 if mounted on the side.
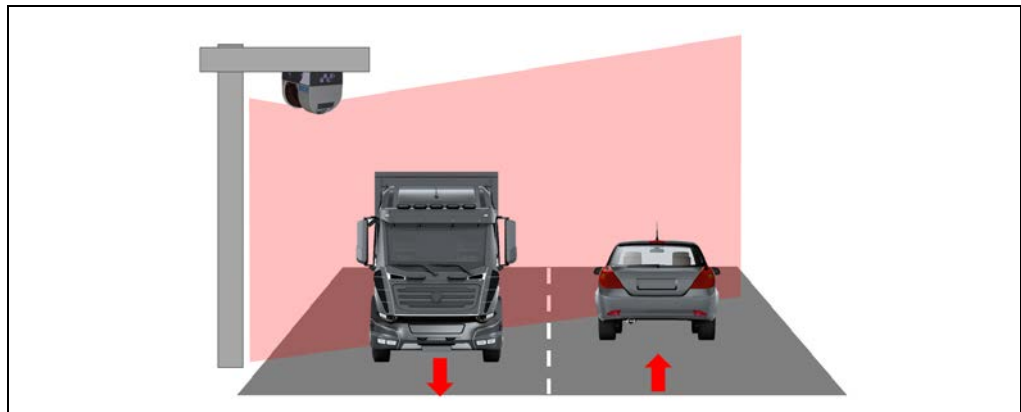
Fig. 19:   Measurement site – TIC501 side mounting (monitoring of 2 lanes)

3.3.5   Measurement site for additional axle counting

The **LMS Axle** system component for counting axles is mounted at the side of the lane. This mounting position ensures that the side of the vehicle is captured.

An LMS Axle typically monitors the next-closest lane. When monitoring several lanes with an LMS Axle, shading by vehicles driving next to each other is possible.

That is why two TIC102 / TIC502 units are typically extended by two LMS Axle units in the configuration for two lanes with additional axle counting. The LMS Axle is connected to the TIC102 / TIC502 in the lane in which axles are to be counted.

Fig. 20:   Measurement site – axle counting

3.4 System operating principle

3.4.1 Operating principle of vehicle detection

As soon as a vehicle passes through the measurement site, the 2D LiDAR sensors record its contour.
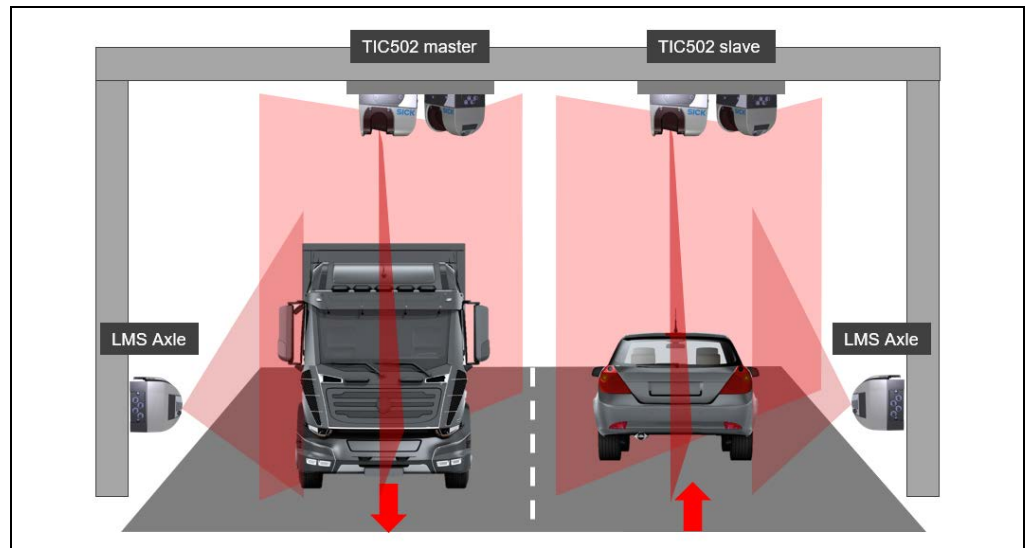
The 2D LiDAR sensors do this by establishing the measuring range and using a non-contact process to scan the vehicle. The profiling system does not require any reflectors or position marks to do this. It is an active system featuring eye-safe infrared lasers.

Fig. 21:   Vehicle detectionoperating principle – detection of vehicle contour

The system uses the measurement data obtained to generate a 3D point cloud. Based on this point cloud, the vehicle class can be determined and the number of axles output.
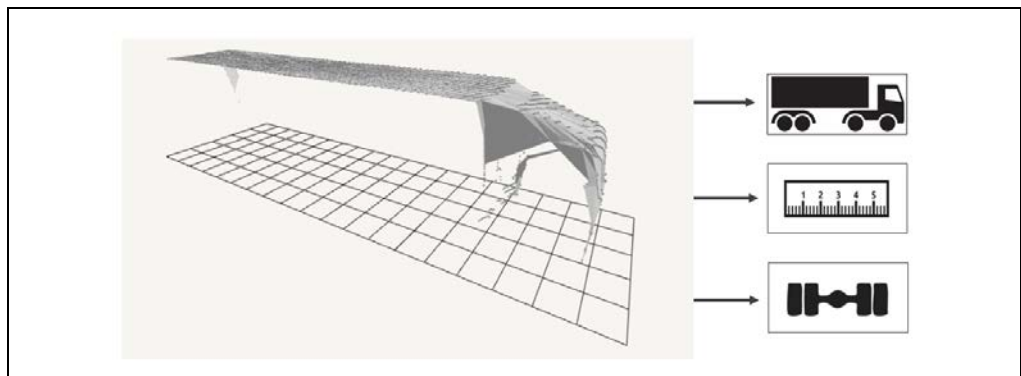

Fig. 22:   Vehicle detection operating principle – 3D point cloud

Notes   Any measuring points resulting from environmental influences (such as fog, rain or snow) that cannot be attributed to the object are suppressed using special filters. This means that the measurement process can be optimized and refined to a considerable extent, even in harsh ambient conditions.

Minimum distance

A minimum distance is required in order to separate the vehicles reliably. The length of this minimum distance depends on the speed at which the vehicles travel through the measurement station.

This rule of thumb applies: The faster the speed, the longer the distance between the vehicles has to be.

Additional information can be found in chapter *3.6 Project planning*.

3.4.1.1   Operating principle of the TIC102 / TIC502

The operating principle of the TIC102 and TIC502 system functions are identical.

LMS Width   The laser beam emitted vertically the lane surface from the LMS Width detects the upper side of the vehicle.

The recording process starts as soon as a vehicle is detected by the LMS Width. The recording process stops when the LMS Width detects the final point on the vehicle. After the vehicle has passed through, 2D cross-sections are generated and sent to the Traffic Controller.

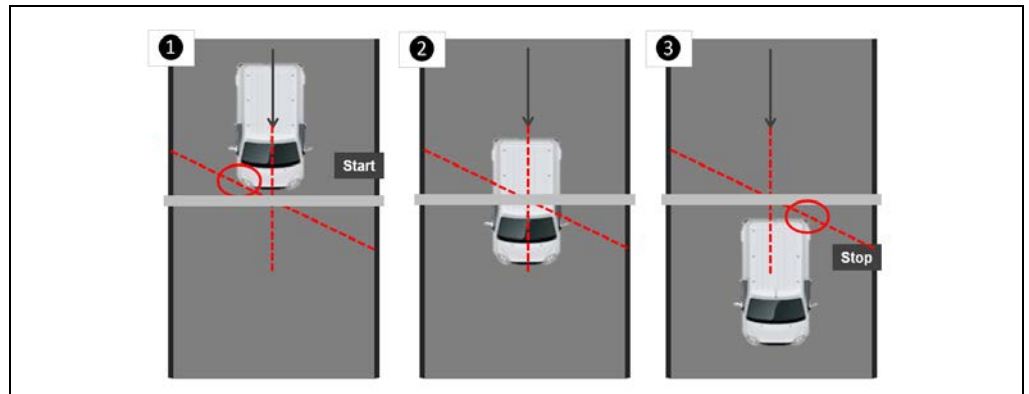*Fig. 23:   Operating principle of TIC102 / TIC502 vehicle detection – LMS Width*

LMS Length   The beam of the **LMS Length** is emitted along the direction of travel. It detects the top, front, and tail of the vehicle. The data captured by the LMS Length are used to calculate the length and speed of the vehicle.
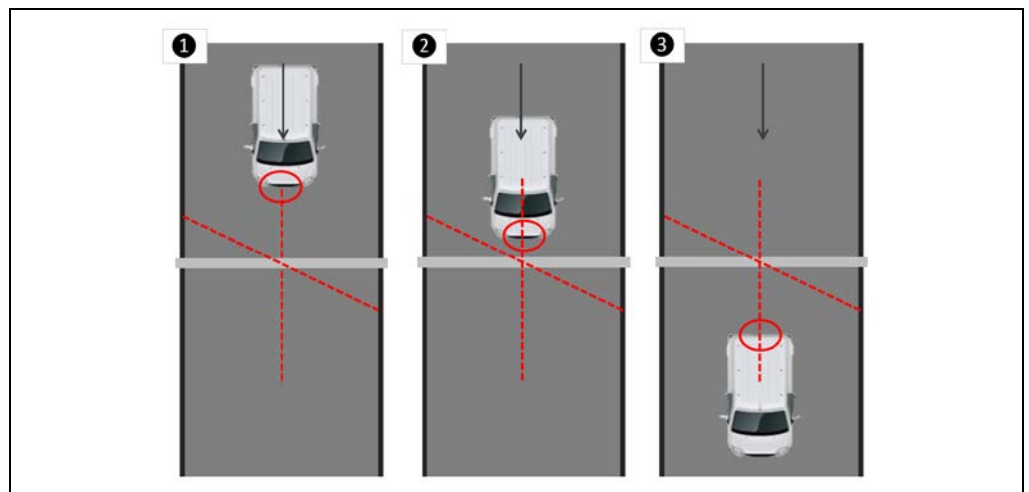

Fig. 24:   Operating principle of TIC102 / TIC502 vehicle detection – LMS Length

Note If tracking with the LMS Length is not possible – for example because the vehicle changes lanes or does not drive under the 2D LiDAR sensor – length and speed can only be calculated from the 3D point cloud with low accuracy.

3.4.1.2   Operating principle of the TIC501

The 2D LiDAR sensor aligned to the lane at an angle of 20 to 40° is used to record the vehicle profile. The speed and the length are also calculated from the profile recording.

The recording process starts as soon as a vehicle is detected by the 2D LiDAR sensor. The recording process stops when the 2D LiDAR sensor detects the final point on the vehicle.
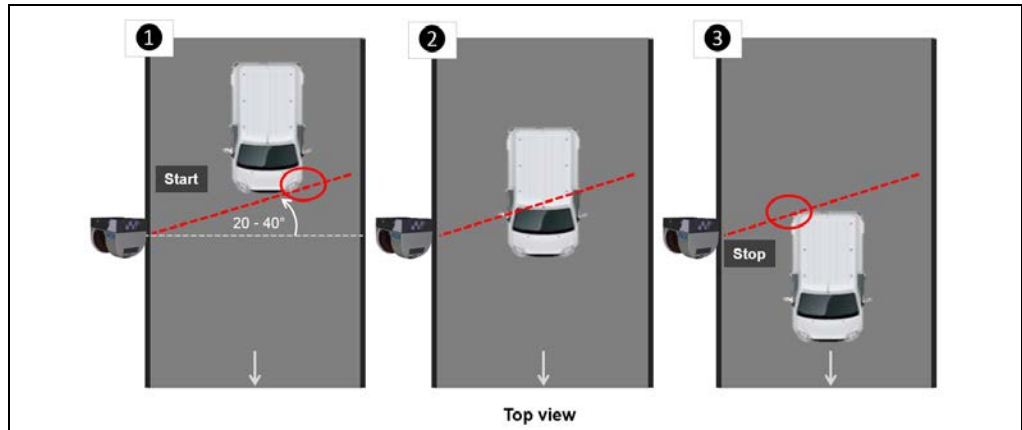
Fig. 25:   Operating principle of TIC501 vehicle detection – LMS Width

3.4.2   Operating principle of the vehicle classification

The Traffic Controller combines the individual 2D sections of the vehicle. A 3D point cloud is generated taking into account the speed and respective position of the vehicle on the measured section.

The vehicle is classified on the basis of the 3D point cloud.

Fig. 26:   Operating principle of vehicle classification

Classification criteria

The classification criteria are defined by the choice of category system. The category system depends on the local conditions that apply in the country where the profiling system is being used.

Europe uses a detailed category system with 28 vehicle classes. Vehicles are identified by comparing them against the vehicle shape. The class representing the closest match of the vehicle shape is allocated to the vehicle.

Fig. 27: Vehicle classes in the European category system
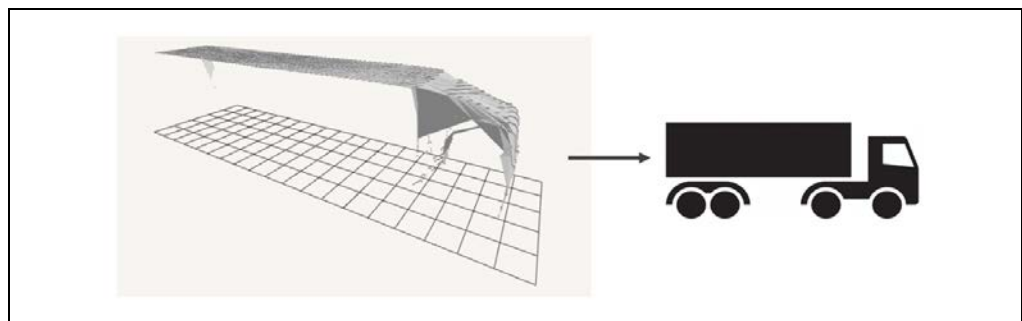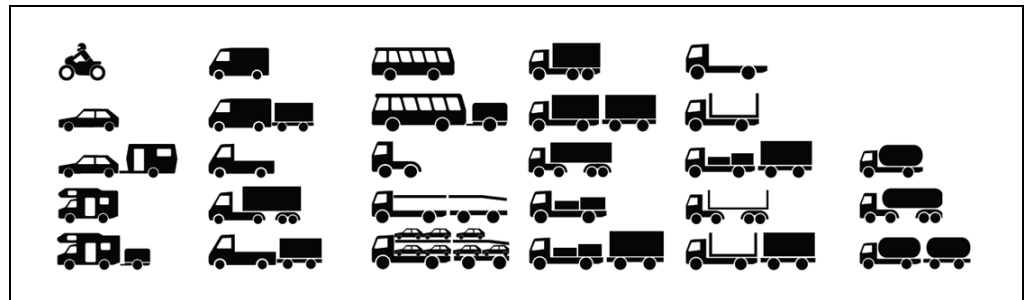
The categories can be grouped together into various **output category systems**, such as **Swiss10** with 10 categories, **TLS 8+1** with 8 categories, **TLS 5+1** with 5 categories, and **TLS 2+0** with 2 categories. Other groupings are also possible.

With the **output category system**, vehicles are no longer identified on the basis of the individual vehicle classes within the category system. Instead, they are identified on the basis of classification groups. For example, the **TLS 2+0** output category system includes two classification groups: **Car or similar** and **Truck or similar**.

Notes Vehicles are classified on the basis of the 3D point cloud without considering the total permissible weight.

Extreme weather situations such as heavy rain or snowstorms may affect the accuracy of output data.

Counting and classification precision of the TIC102 / TIC502 system functions

The system is not affected by weather conditions such as fog, rain, and snow. It works in accordance with the technical specifications listed in the annex.

- The typical counting accuracy is > 99.8% (for the TIC102) and
  > 99.85% (for the TIC502)
- The typical classification accuracy is 98% for classification pursuant to the TLS 8+1 standard for normal traffic.

Note Extreme weather situations such as heavy rain or snowstorms may affect the accuracy of output data.

Counting and classification precision of the TIC501 system function

The TIC501 is not affected by weather conditions such as fog, rain, and snow. It works in accordance with the technical specifications listed in the annex.

- The typical counting accuracy is > 99.8%.
- The typical classification accuracy is 96.0% for classification pursuant to the TLS 8+1 standard for normal traffic (for overhead mounting and mounting of two lanes).

The terms for counting accuracy and classification precision are explained in the appendix (see chapter *9.4 Terminology relating to statistical measurement accuracy*).

3.4.3   Operating principle of the function for calculating the vehicle dimensions

In addition to the vehicle class, the vehicle width, the vehicle height and the vehicle length as well as the speed of the vehicle are determined from the 3D point cloud.

Since the dimensions are not measured, but only calculated, no accuracy can be specified. The TIC profiling system therefore only provides an <u>indication</u> of vehicle dimensions.

Note   For a TIC501, the calculations of the speed and length information are less accurate than for the TIC102 and TIC502 system functions due to the lack of an LMS Length.

3.4.4   Operating principle of the vehicle axle counting function

The respective 2D LiDAR sensor for counting the number of axles is mounted at the edge of the lane and captures the side of the passing vehicle. In order to count the number of axles and determine the axle position and, if applicable, the height of the first axle, the system also needs to access the measuring points of the 3D point cloud.

Determining the number of axles

- In order to determine the number of axles, the first step is to analyze point patterns of the wheels and shadow patterns on the roadway. Combining the two analysis methods helps to achieve a high level of measurement accuracy.

  The areas containing wheels (and, by implication, axles) can be expected to generate very few measurement points, if any at all.

  In contrast, a large number of measurement points will be detected in areas of the vehicle where there are no wheels (and, in turn, no axles) and the 2D LiDAR sensor is able to look "underneath" the vehicle to a certain extent.
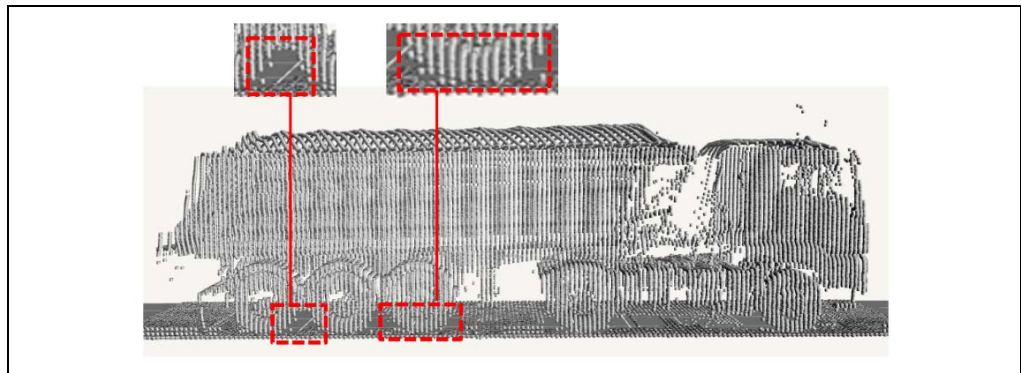

Fig. 28:   Operating principle of axle counting – Wheel detection using shadow patterns

- In a second step, the shadow patterns undergo a plausibility check. This means that each shadowed area is checked to see whether there is a corresponding point pattern for a wheel.

Every wheel detected is counted as one axle. Twin wheels count as one axle. Wheels on a raised axle (at least 10 cm above the ground) will not be counted.
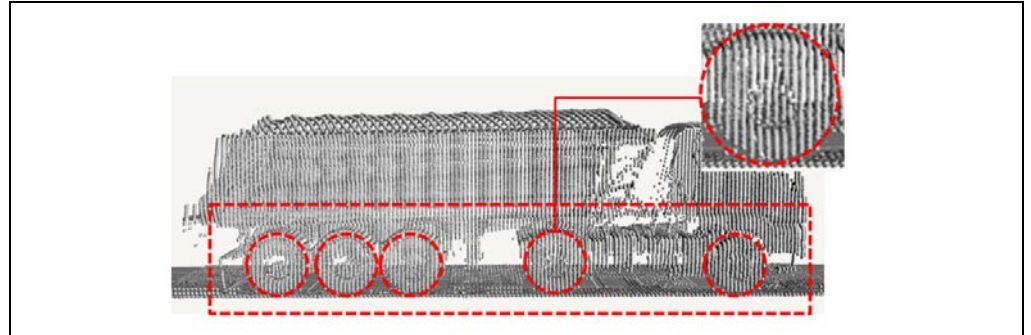

Fig. 29: Operating principle of axle counting – Wheel detection using a point pattern

Calculating axle positions

The axle positions are determined on the basis of the point cloud starting from the front of the vehicle.
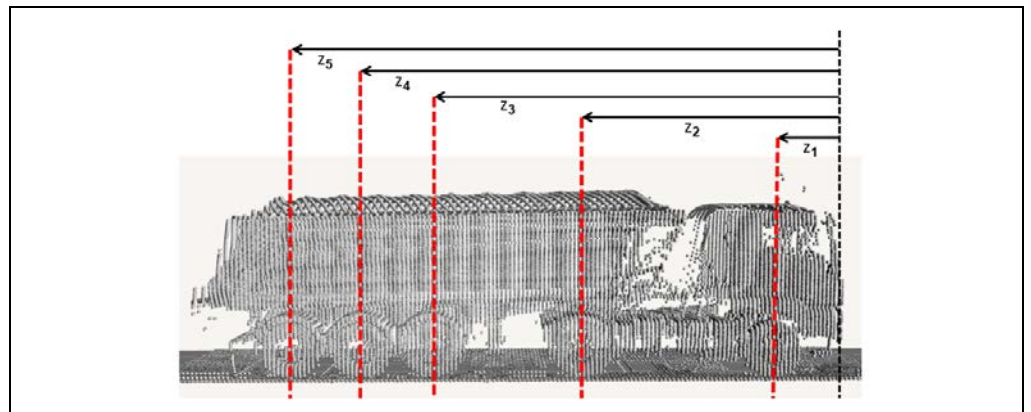
Fig. 30: Operating principle of axle counting – Determining the position of the axles

Calculating vehicle height above the first axle

For the calculation of the vehicle height above the first axle, the profile cross-sections and the 3D point cloud recorded by the LMS Axle are used to search for the existence of an axle within the first 2 meters of the vehicle. The position of the first axle is used to calculate the height of the vehicle in this area.

Fig. 31: Axle counting op – Vehicle height above the first axle

If an axle is not detected within the first 2 meters of the vehicle, the vehicle height one meter from the vehicle front is output with a reduced confidence level.

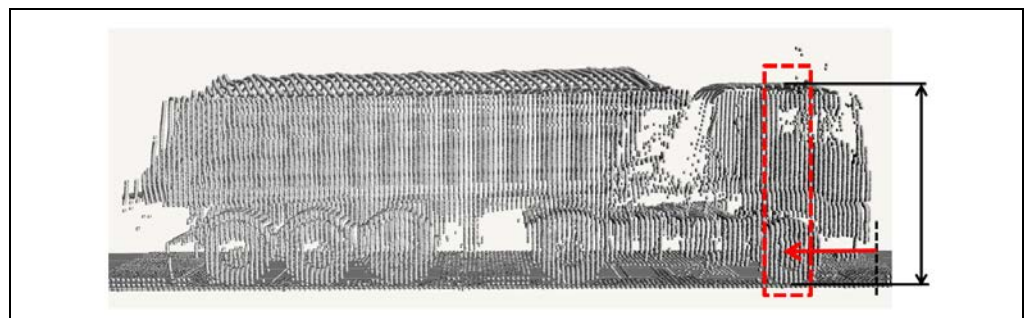**Accuracy**

The axle counting accuracy is 97% for normal traffic on dry roads.

- The axle counting accuracy decreases if the vehicle's axles are difficult to detect. This affects vehicles with a lower chassis, vehicles that are close to the edge of the lane, and vehicles that have lots of small wheels located very close to one another.
- When the road is very wet and there is a high level of spray, the axle counting accuracy will reduce significantly.
- Raised axles (about 10 cm above the ground) are generally not detected.

3.4.5 Emission of object location messages

In addition to vehicle-related information, all three system functions also deliver so-called object location messages. These messages provide information on the time at which the vehicle <u>was</u> located at a defined position in the lane. In order to integrate third-party systems such as license plate cameras, these messages must be assigned with a time stamp.

It is possible to define trigger lines before and after the measuring plane. If a vehicle passes over this line during the measurement process, a message is emitted.

Note Stable time synchronization (NTP) is essential for this type of integration.

For the TIC102 and TIC502 system functions, the LMS Length supplies the information about the vehicle's location within the lane for localization. To do this, it scans the front and rear end of the vehicle.

The time stamp for the vehicle location is sent to the Traffic Controller 20 ms after the position line is passed for the TIC102 and 10 ms after for the TIC502.
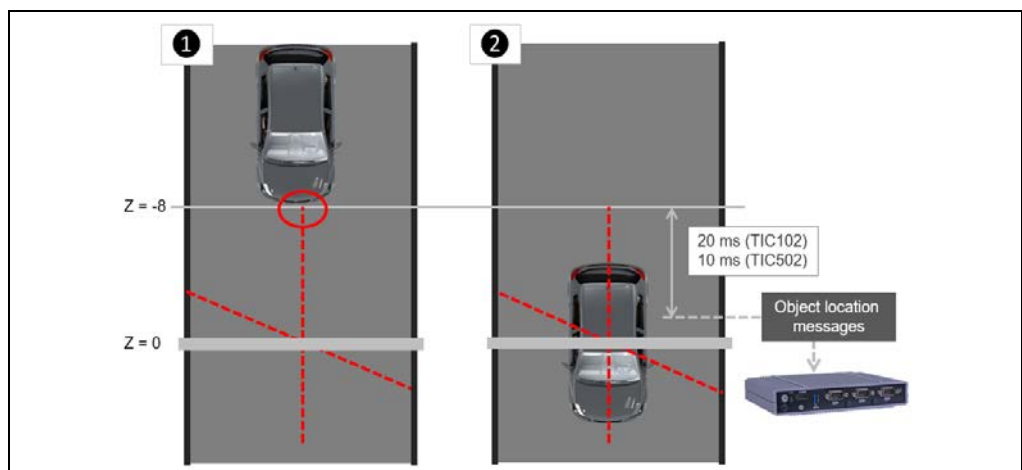

Fig. 32: Determination of object location messages – TIC102 / TIC502

If – as with the TIC501, for example – this information cannot be detected by the LMS Length, the vehicle's position, time, and speed are calculated using the 3D point cloud for the vehicle in question. The object location messages are then emitted <u>after</u> the calculation process for the 3D point cloud.

Recommended distance of the trigger lines from the zero point of the Z-axis

System	Maximum distance in both directions
TIC102	Max. 15 m (recommended max. 10 m)
TIC502	Max. 20 m (recommended max. 20 m)
TIC501	Max. 15 m (no recommended)

Note   The recommendation is based on distances for which triggering works with high reliability. Calculated data from large distances are treated with uncertainty regarding speed changes and detection accuracy.

3.4.6   Data processing in the Traffic Controller

All the measured values converge in the Traffic Controller. The TEMS Recorder processes the raw data supplied in a continuous data stream. The data in this stream are supplemented and consolidated.

All of the profiling system functions are structured **hierarchically** for data processing. This structure is defined in the system configuration.

- At the start of the process, the **initial system function** records the basic data. This supplies the vehicle data.
- The **subsequent system functions** add to the basic data.

The figure below illustrates how, for a profiling system with axle counting, the initial vehicle data is continuously supplemented by the measurement results of the individual system functions.

At the end of the data processing flow, data are output to the higher-level system via the TCP/IP interface.
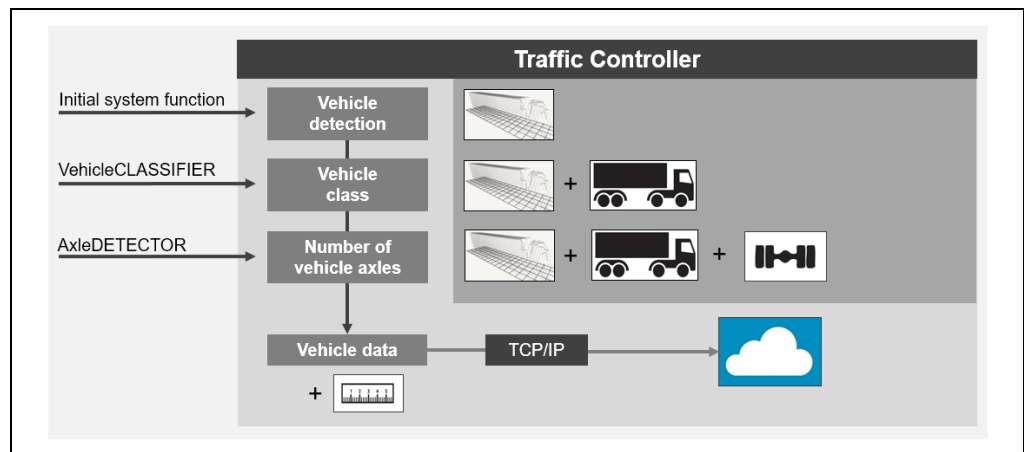

Fig. 33:   How data are processed in the Traffic Controller

When using two LMS Axle units, the values with the respectively higher confidence level is used for data processing.

You can also adjust the configuration so that only values from one of the two LMS Axles are used as a preference (e.g., because it is mounted in a better position).

3.4.7   **Output data**

In addition to the vehicle class and vehicle data, the profiling system also outputs the measurement site data and the system status.

The data shown in parentheses is only output if the system function is used to count vehicle axes.
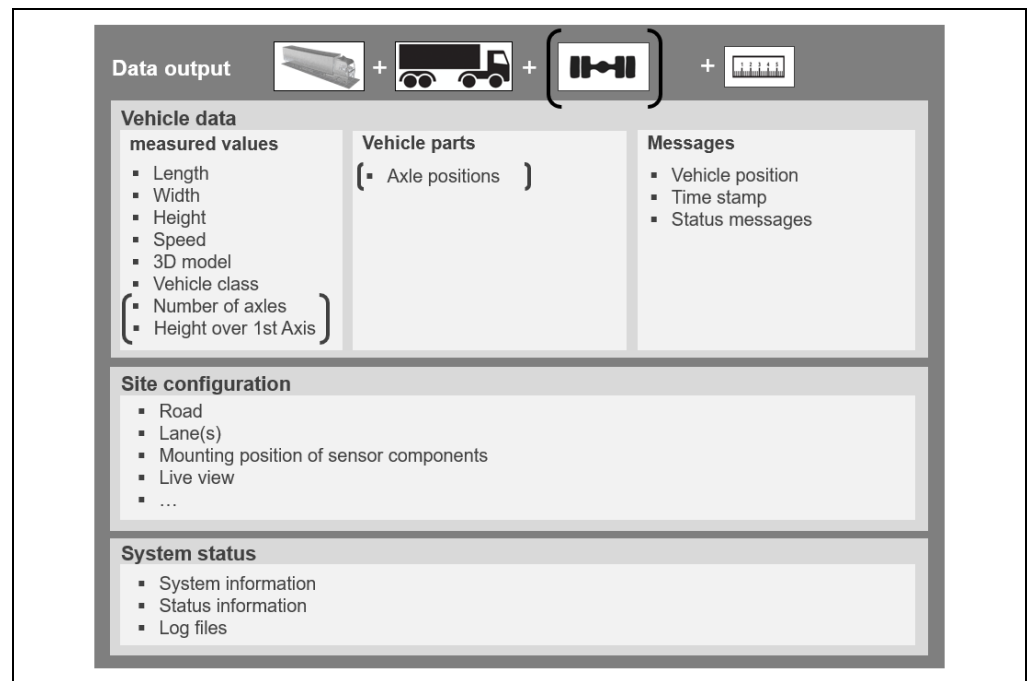

Fig. 34:   Output data

The earliest time for output of the complete vehicle information to the downstream system when monitoring **one lane** or with **one** 2D LiDAR sensor (TIC501) is typically 250 ms after recording is stopped.

Note   For systems with several TIC102 or TIC502 system functions on the same road, data output is delayed by max. 3 seconds to prevent double detection when vehicles change lanes.

This also applies for solutions with several laser scanners of the TIC501 system function on the same road.

3.5 System interfaces

Communication between the system components and the downstream components takes place via TCP/IP interfaces. The interfaces can, for example, be utilized by a traffic checkpoint or system operator.
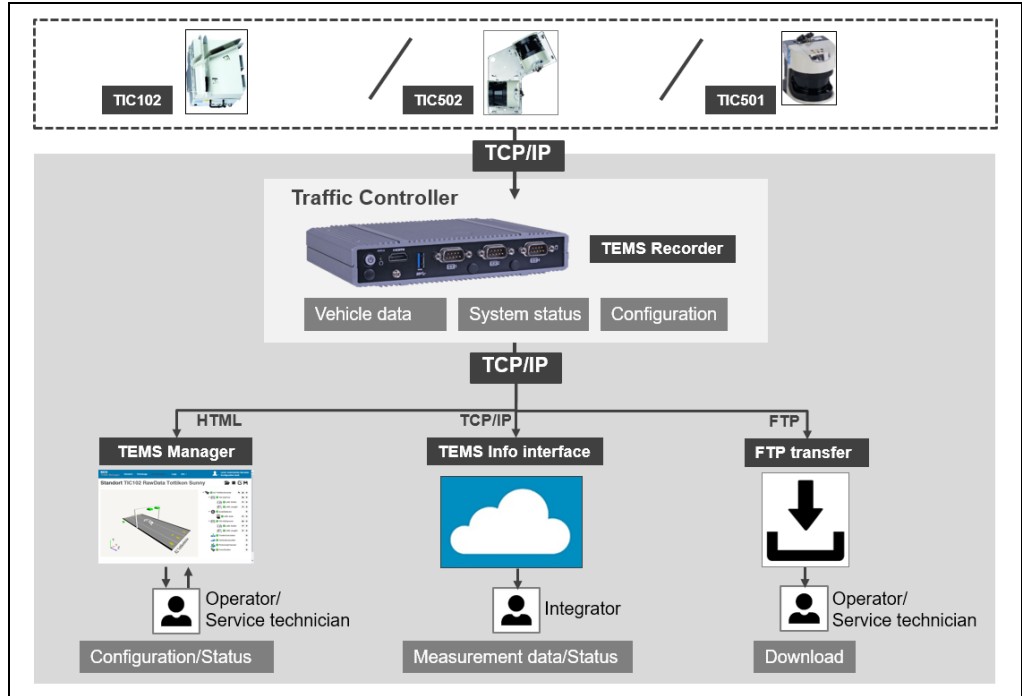

Fig. 35: Interfaces of the profiling system

All the sensors are connected to the Traffic Controller via an Ethernet interface. The TEMS Recorder with profiling functionality comes pre-installed on the Traffic Controller. The recipients of the data output via the TCP/IP interface are:

- The web-based **TEMS Manager** allows you to check that the profiling system is operating correctly from any computer that is connected to the Traffic Controller. It also provides a detailed view of the measurement results. TEMS Manager is used by operators and service technicians.

  Provided that you have the relevant access authorization, you can also use **TEMS Manager** to configure and monitor the system. As an alternative to TEMS Manager, you can also use **TEMS Manager Command Line** if you wish to configure the system using command lines.

- **TEMS Info interface**. This receives measurement results as messages. The interface distinguishes between messages containing vehicle information and messages containing data on the positioning of the vehicle in the lane. The TEMS Info interface also delivers all system status messages.
  Integrators can use the TEMS Info interface to integrate the system into third-party systems (traffic routing system, alert systems, etc.).

- **FTP interface**. This can be used to download vehicle data stored in the Traffic Controller and the TEMS Recorder log files. Alternatively, vehicle data can also be uploaded automatically to a customer FTP server (see chapter *3.5.3 Plug-ins for saving and downloading the vehicle data* and *3.5.3 Downloading log files*).

3.5.1   Integration into existing IT infrastructure

The Traffic Controller network is divided into internal and external network structures. For this reason, the Traffic Controller has two ports.
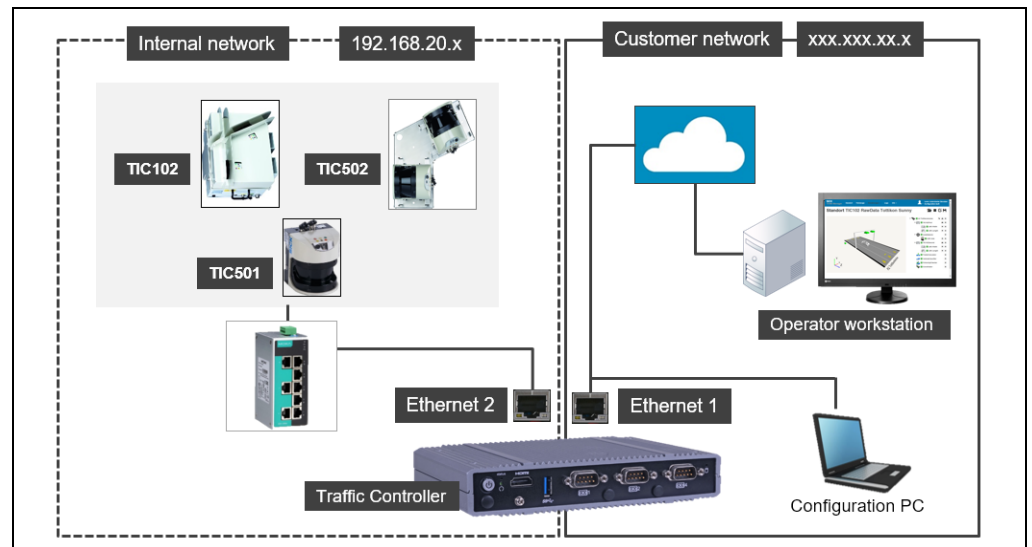

Fig. 36:   Integration of the profiling system into existing IT infrastructure

The IP address of the **external** network interface card (**Ethernet 1**) is freely configurable so that the profiling system can be integrated into the existing customer network.

Meanwhile, all the system components are connected to **one another** via the **internal** network (**Ethernet 2** with network address **192.168.20.x**).

3.5.2   Site view in TEMS Manager

TEMS Manager can be used to check that the profiling system is operating correctly from any computer that is connected to the Traffic Controller.
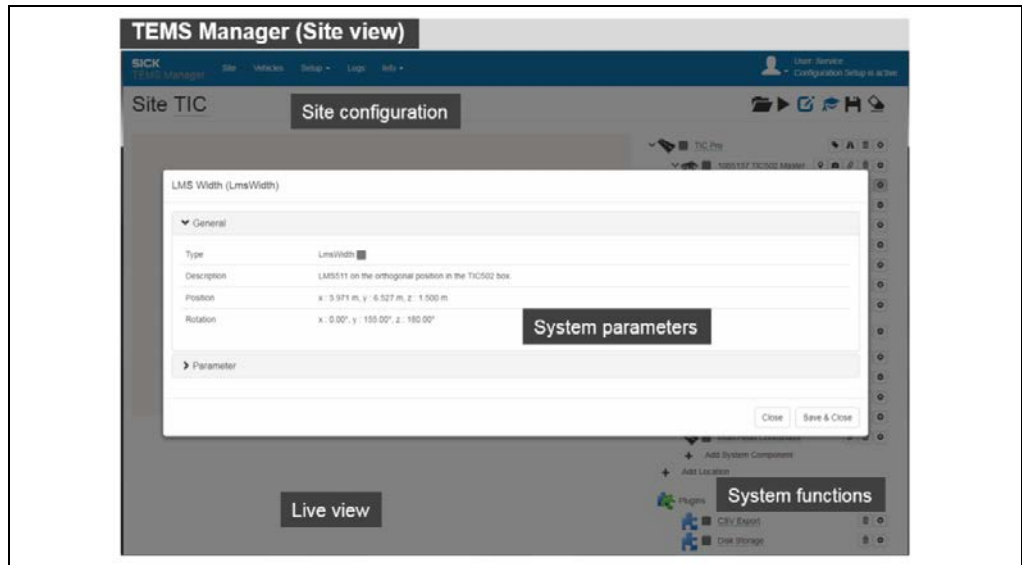

Fig. 37:   Interfaces – TEMS Manager (site view)

In addition, TEMS Manager serves as a visualization platform for the measurement results.
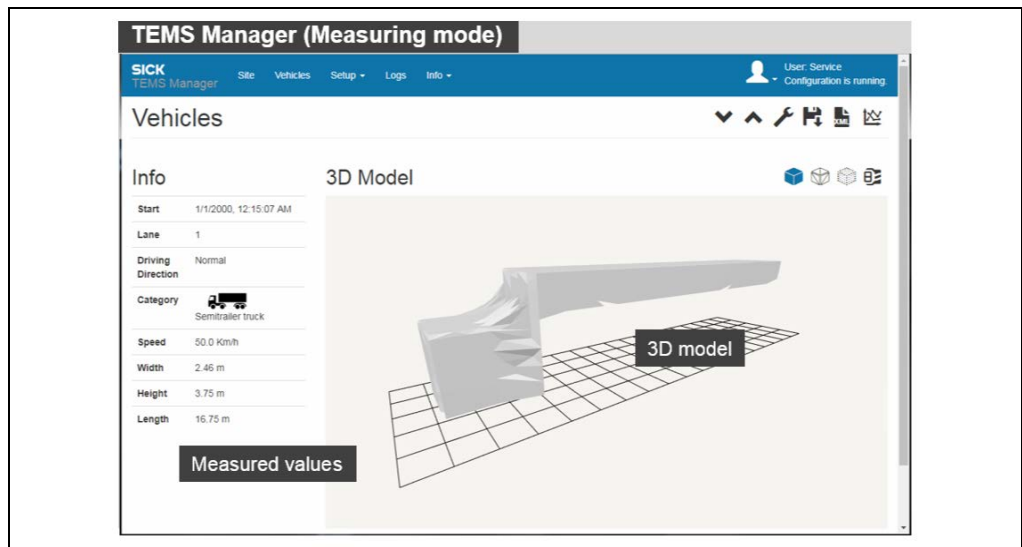

Fig. 38:   Interfaces – TEMS Manager (measuring mode)

Note   Provided that they have the relevant access authorization, service technicians can also use TEMS Manager to configure the system.

3.5.3 Plug-ins for saving and downloading the vehicle data

By activating certain plug-ins, you can take the vehicle data that are temporarily stored in TEMS Manager and save them permanently on the Traffic Controller and/or can transfer them to an external storage medium.

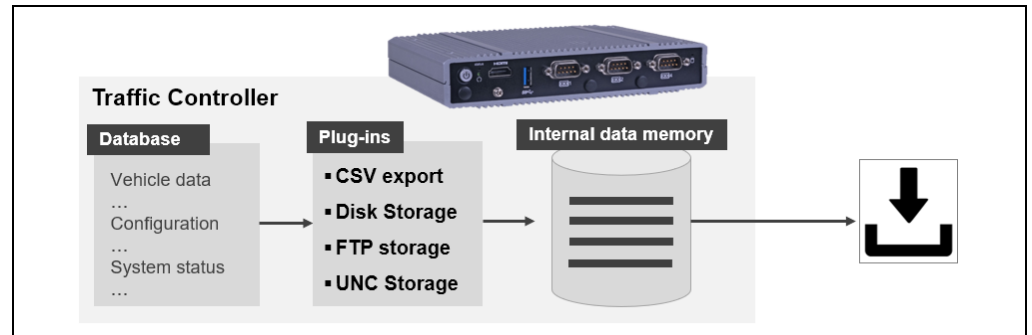The plug-ins support various storage formats and transfer methods.

Fig. 39:   Plug-ins for saving and downloading the vehicle data

Saving vehicle data on the Traffic Controller

The **CSV Export** and **Disk Storage** plug-ins are both used for saving vehicle data on the Traffic Controller.

- The **CSV Export** plug-in saves the vehicle data obtained to a tabular csv file, which is located inside the **/lists** directory. A separate table row is created in the csv file for each vehicle. As part of this process, you can also specify the period to be covered by a file. Usually, a csv file contains the vehicle data for a particular day. This makes the csv file very suitable for statistical purposes.

- The **Disk Storage** plug-in stores each detected vehicle in a separate file using the **vehicle** file format. The vehicle file is placed in the **/data** directory.

  The vehicle file contains all the information recorded for a vehicle. In addition to the vehicle data, it includes (among other things), the 3D point cloud data or information about when and where the vehicle was located within the measuring range when the data was collected.

Notes
- Please note that the storage space is limited. The storage space is overwritten cyclically for as long as the plug-ins remain active.

- For both plug-ins, you can specify in the parameter definition how often the vehicle data should be deleted from the Traffic Controller data memory (see also chapter *6.6.5 Displaying the system parameters and system status*). The delete operation is only performed if the plug-ins are active.

- If the plug-ins have been deactivated, the data inside the **/data** and **/lists** directories must be deleted **manually**.

- Any directories that you have created in or under the FTP directory must also be deleted manually. This process is not automated either.

- When there is no space left on the internal memory card, the data from the Traffic Controller must be overwritten. This shortens the service life of the Traffic Controller.

Downloading vehicle data from the Traffic Controller via FTP

Both csv files and vehicle files can be downloaded from the Traffic Controller via FTP by using an FTP client on the customer network.

For this reason, the Traffic Controller has an integrated FTP server. This FTP server is accessed via the **client** user account with the corresponding password (see also chapter *9.5.5 User data for accessing the FTP server of the Traffic Controller*).
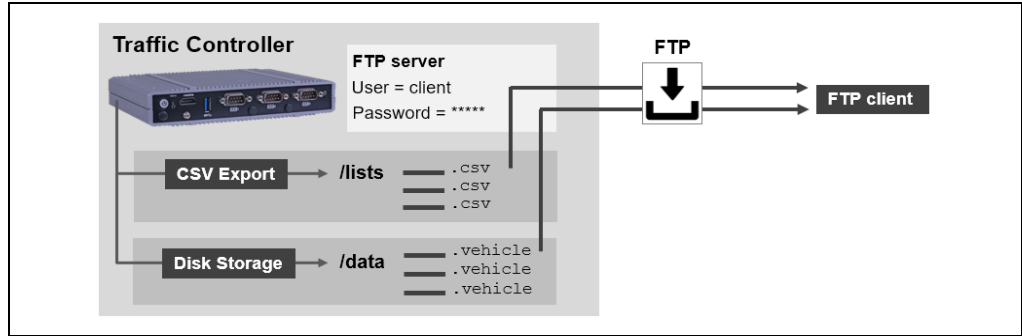

Fig. 40: Downloading vehicle data via FTP

Transferring vehicle data directly to an external storage medium

The **FTP Export** and **UNC Export** plug-ins do not allow you to save the vehicle data permanently on the Traffic Controller. Instead, they are used to transfer the data directly to an external storage medium.

- The **FTP Storage** plug-in works in a similar way to the **Disk Storage** plug-in by generating vehicle files in the **vehicle** format. It then uploads these automatically to a customer FTP server. For this reason, the Traffic Controller has an integrated FTP client. The connection settings for the FTP server are stored in the plug-in itself.
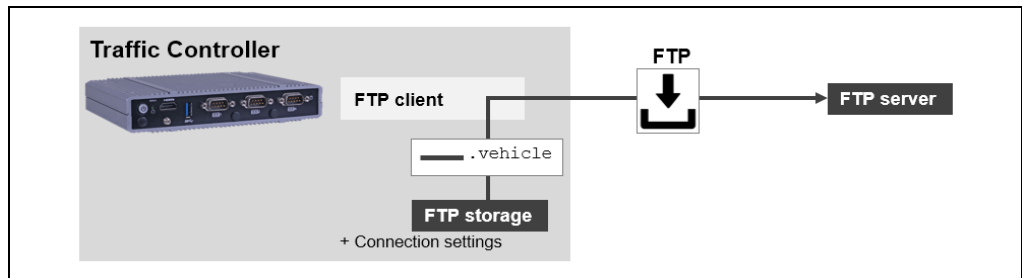

Fig. 41: Automatically uploading vehicle data to a customer FTP server

- The **UNC Storage** plug-in also creates vehicle files in the vehicle format, but it saves these in a UNC path. Entering a UNC path (**U**niversal **N**aming **C**onvention) allows a directory in a network to be accessed without the need for a drive letter. The UNC path does not need to be visible in Windows Explorer. Windows shared folders can also be used as UNC destinations. The storage location is specified in the plug-in itself.
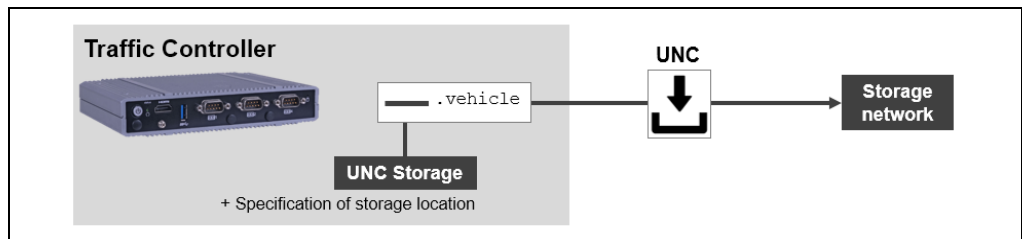

Fig. 42: Automatically saving vehicle data in a UNC directory

3.5.4   Downloading log files

All TEMS Recorder operations are saved to log files in the Traffic Controller, which are kept in the **/logs** directory.

A new file is created for each day. The system automatically deletes any log files older than three months.
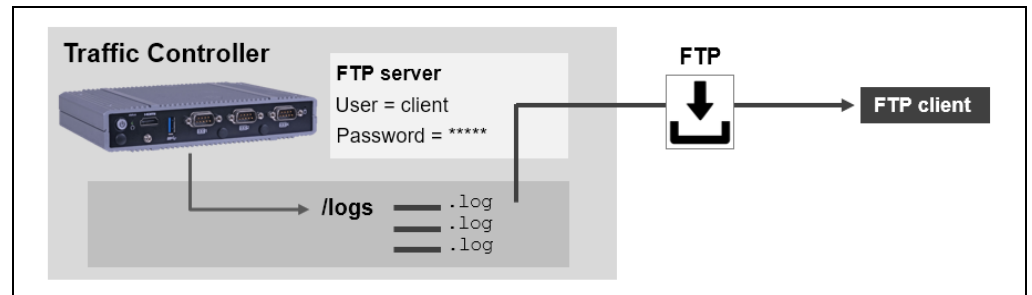

Fig. 43:   Downloading log files via FTP

Just like the csv and vehicle files that are stored on the Traffic Controller, log files can also be downloaded via FTP. These can then be sent to SICK Support for fault diagnosis. Alternatively, the files can be downloaded via TEMS Manager.

This download process relies on the FTP server that is installed on the Traffic Controller. This FTP server is accessed via the **client** user account with the corresponding password (see also chapter *9.5.5 User data for accessing the FTP server of the Traffic Controller*).

Note   The log files can also be transferred onto a local data card from TEMS Manager. Additional information can be found in chapter *6.9 Downloading log files*.

3.6 Project planning

Reliable and problem-free use of the profiling system depends on a number of different factors.

3.6.1 General system requirements

To operate the profiling system, the following are required:

- A supply voltage of 24 V DC (12 V DC … 36 V DC) for the Traffic Controller.
- Supply voltage 24 V DC (22.8 V DC … 25.2 V DC) for TIC102.
- A supply voltage of 19.2 V to 28.8 V for the LMS511 2D LiDAR sensor.
- Customer computer with a TCP/IP data interface for setting up the system, processing the measurement results further, and monitoring the system.
- If no Ethernet cables are purchased from SICK for the connection between the 2D LiDAR sensor and Ethernet switch or between the Ethernet switch and Traffic Controller, or if no male connectors have to be assembled, we recommend using an Ethernet cable quality in accordance with CAT 5e (10/100 Mbit/s) requirements.

Requirements for the client computer

An up-to-date version of a web browser must be installed on the client computer.
This browser must support **HTML5** and **WebGL**.

Requirements for the customer network

Port 80 must be open in the customer network for the TEMS Manager:

Depending on the functionality, the following ports are required:

- Port 21 for FTP access (log files, vehicle files)
- Port 40,000 to 45,000 for FTP data transfer
- Port 123 for NTP time synchronization
- Port 5900 for remote access via VNC

3.6.2 Requirements for vehicles

The profiling system can be used to detect all types of vehicle.

By default, the profiling system for vehicles is designed with the following dimensions:

Dimension	Min.	Max.
Length	2.2 m	21.5 m (for European classification) 30.0 m (for American classification)
Width	0.6 m	3.75 m
Height	1.0 m	4.3 m
The listed dimensions are default values, not fixed values. They can be adjusted via the standard configuration in TEMS Manager.		

Tab. 4:   Project planning – vehicle properties

In order to separate the vehicles, a minimum distance of 0.6 m to the side of each vehicle is required.

The vehicles can drive through the measuring range in a straight line at a speed of 0 to 250 km/h.

3.6.3   General requirements at the measurement site

A **flat** road with a route as **straight** as possible is needed for use of the profiling system. The length of the straight section before and after the measuring point is defined by the maximum vehicle length to be checked.
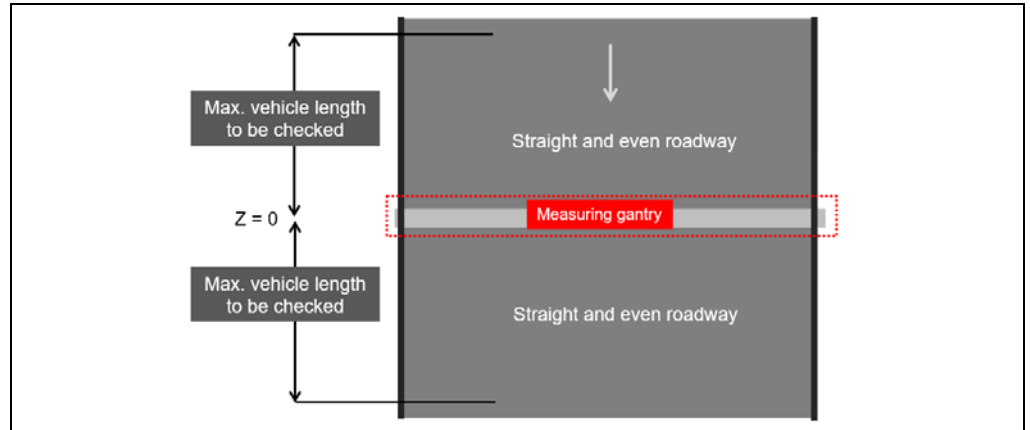

Fig. 44:   Project planning – measurement site (straight section)

Minimum distance

TIC102 / TIC502   To ensure optimum measurement results, there must be a minimum distance between vehicles passing through the measurement site. The faster the speed, the longer the distance between the vehicles has to be.
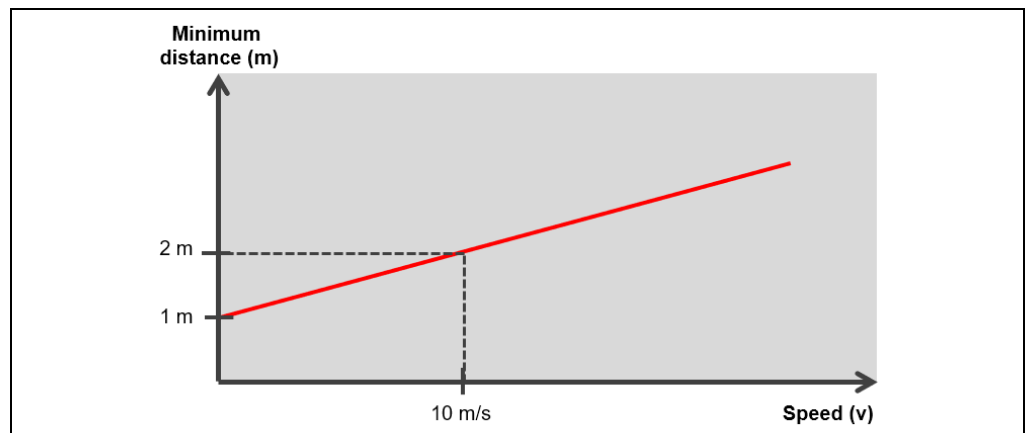

Fig. 45:   Project planning – Calculating the TIC102 / TIC502 minimum vehicle distance

TIC501   For a TIC501, the minimum distance depends on the installation angle of the 2D LiDAR sensor to the lane.

If the speed of the passing vehicles is high, a larger installation angle is needed for data collection. If the expected speed of the vehicles is too high, a smaller installation angle is sufficient.
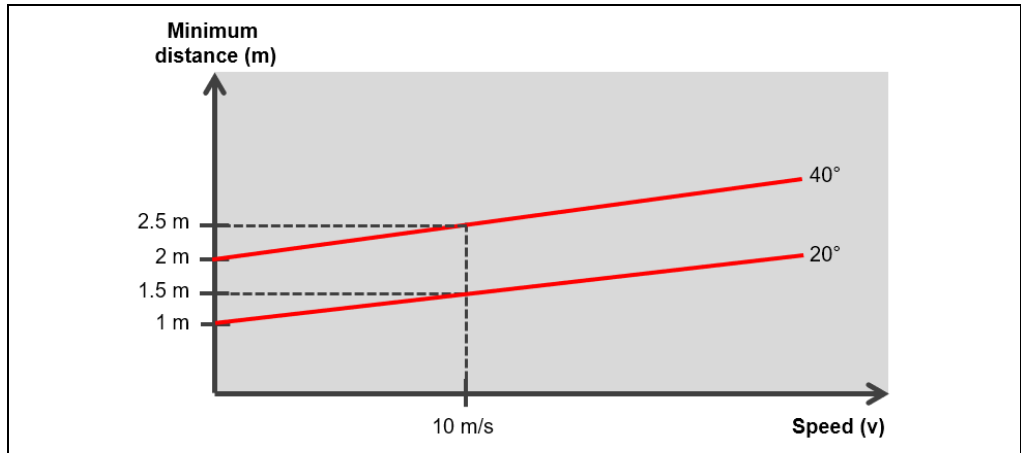

Fig. 46:   Project planning – Calculating the TIC501 minimum vehicle distance

Note   Please note: The larger the installation angle, the larger the minimum distance between two vehicles.

If it is expected that the speeds will be slow and the vehicles will drive close to one another, then select an installation angle of 20° to 25°.

Background: With a large installation angle and low speeds, vehicles driving close to one another would not be correctly separated and detected as a vehicle.
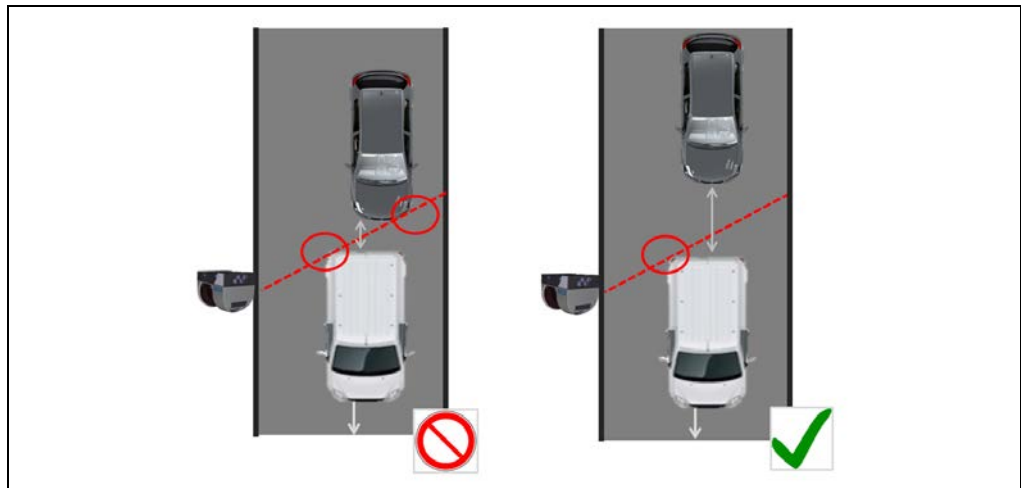

Fig. 47:   Project planning – Calculating the TIC501 minimum vehicle distance (installation angle)

3.6.4   Requirements for mounting the vehicle detection components

3.6.4.1   TIC102; TIC502 project planning

The TIC102 or TIC502 system components are assembled on a gantry in the center of the respective lane. Its central position enables it to record as many vehicles as possible within the range of the 2D LiDAR sensors.

We recommend attaching the system components to a gantry that is **accessible by foot**. This means that the lanes do not have to be closed for the commissioning process or for any later maintenance work.

The system components **must** be mounted to a gantry that is 5 to 8 meters above the ground. The ideal height is 6 meters, measured from the lower edge of the TIC housing or the lower edge of the 2D LiDAR sensors.

Make sure in any case that the system components are attached at least 1 m higher than the highest vehicle to be detected.
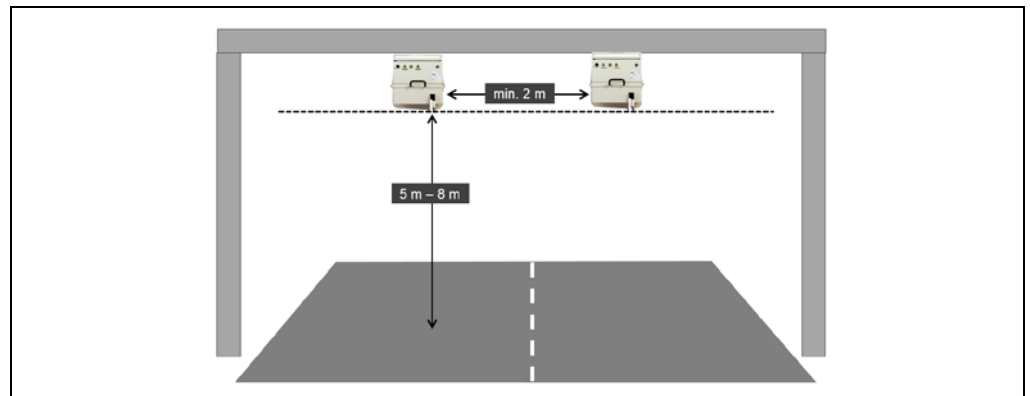
TIC102

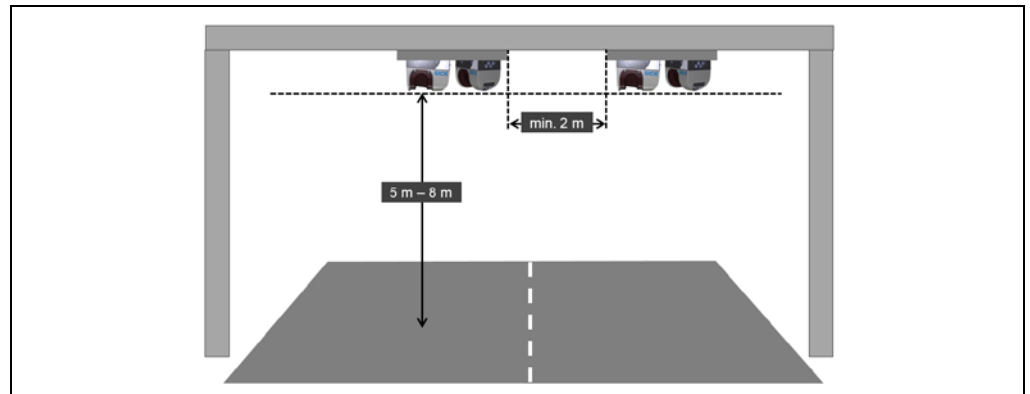*Fig. 48:   Project planning – mounting the TIC102*

TIC502

Fig. 49:   Project planning – mounting the TIC502

When monitoring several lanes, the individual system components must be mounted at a distance of at least 2 meters from one another. A maximum of four TIC102 / TIC502 units can be connected to the Traffic Controller in one system.

The individual TIC102 / TIC502 units must be on the same measuring plane. They must be mounted at the same position on the Z-axis vertical to the road.

Notes   ▶ It is important to ensure that all the 2D LiDAR sensors have an unobstructed view of the measuring range at all times.

▶ The 2D LiDAR sensors must always be mounted free of vibrations and oscillations.

3.6.4.2 TIC501 project planning

The LMS Width must be mounted overhead on the gantry. The signal must be emitted vertically to the lane surface.

The TIC501 system function delivers optional results if a mounting position is selected in the center of the lane(s) to be monitored. The 2D LiDAR sensor can also be mounted on a gantry.

We recommend attaching the system components to a gantry that is **accessible by foot**. This means that the lanes do not have to be closed for the commissioning process or for any later maintenance work.

The LMS Width **must** be mounted to a gantry that is 5 to 8 meters above the ground. The ideal height is 6 meters, measured from the lower edge of the 2D LiDAR sensor.

Make sure in any case that the system components are attached at least 1 m higher than the highest vehicle to be detected.
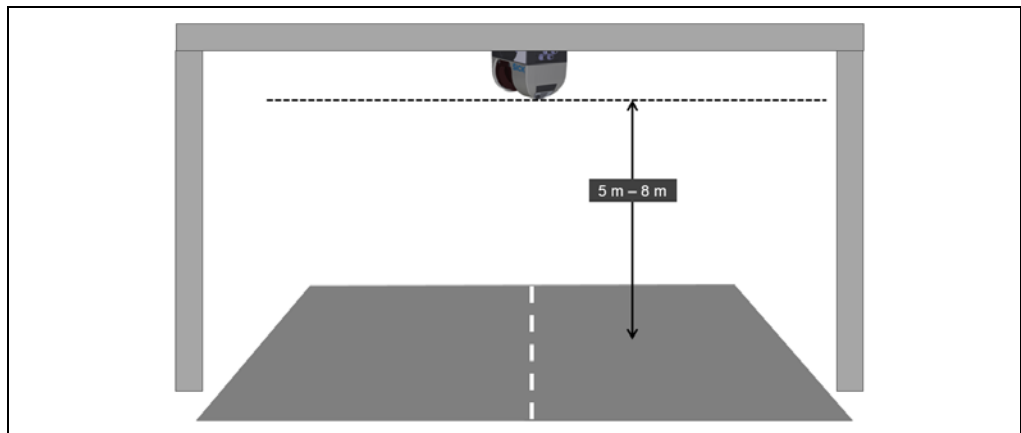

Fig. 50:   Project planning – mounting the TIC501

Rotation with overhead mounting

The LMS Width must be aligned on the gantry so that the signal is emitted at an angle of 20 to 40° to the **Y-axis** (direction of travel).
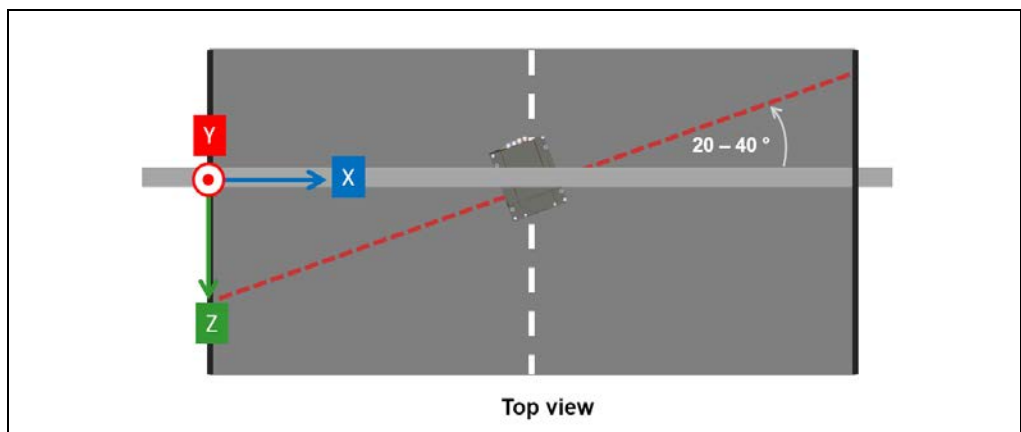

Fig. 51:   Project planning – mounting the TIC501 (rotation with overhead mounting)

Installation of several LMS511 units on a gantry

When monitoring several lanes, the individual 2D LiDAR sensors must be mounted at the same position on the Z-axis. A maximum of four LMS Width units can be connected to the Traffic Controller in one system.

Note

If there are several 2D LiDAR sensors, double detection is in principle possible in the area in which the measurement levels of the 2D LiDAR sensors overlap.

That is why the LMS Width must be not mounted in parallel, but rather turned to one another as shown in the following figure.
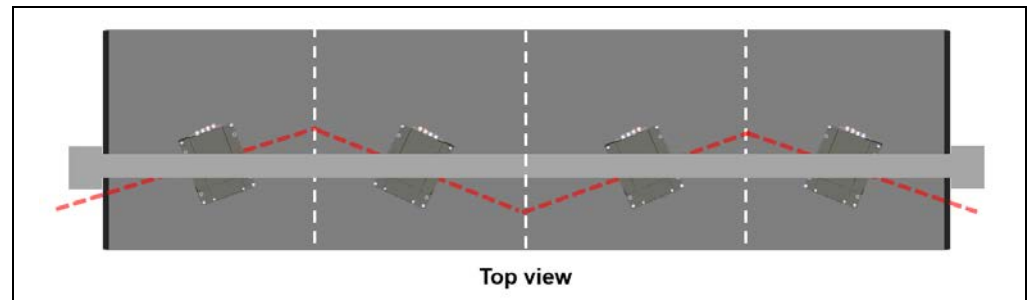

Fig. 52:   Project planning – mounting the TIC501 (installation of several LMS Width units on the gantry)

Mounting position on the side high on a post/mast

The side mounting of the LMS Width on a post or mast is done at a 90° angle to the **lane surface**.

When mounted at the side, the TIC501 system function achieves the highest counting and classification accuracy if a mounting position is selected about 5 to 8 m above the lane.

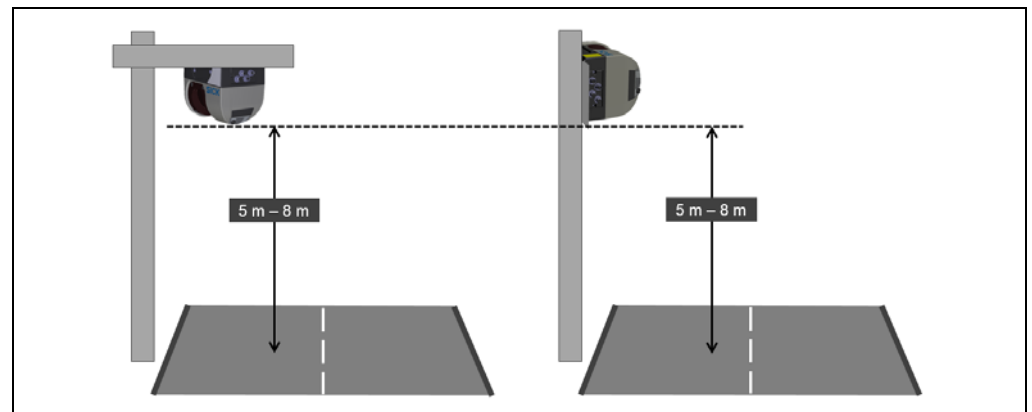Posts or masts must enable low-vibration mounting of the 2D LiDAR sensors.

Fig. 53:   Project planning – mounting the TIC501 (mounting position on post/mast)

Notes

- At a **low** mounting height, vehicles which are shaded by a vehicle moving in parallel are not detected.
- A low mounting position also does not provide sufficient protection from vandalism and manipulation.

Rotation for side mounting

The LMS Width must be aligned on the post or mast so that the signal is emitted at an angle of 20 to 40° to the direction of travel.
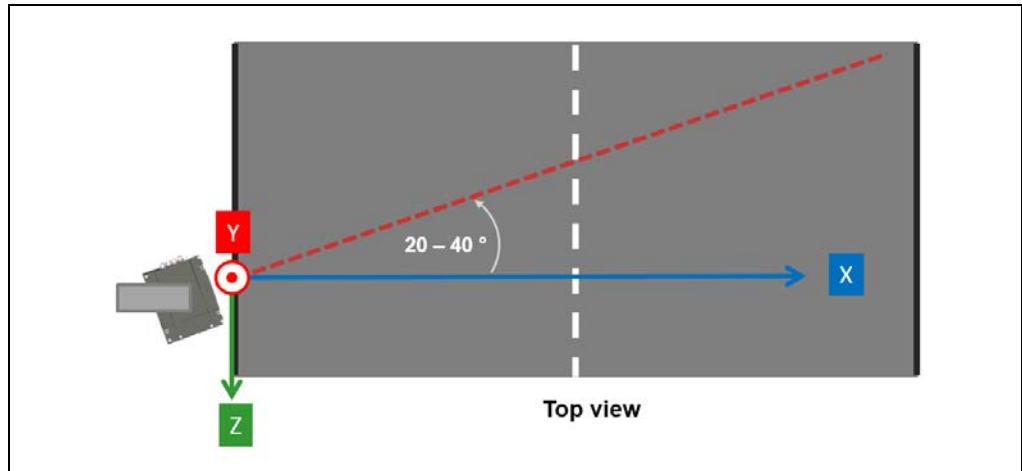

Fig. 54:   Project planning – Mounting the TIC501 (rotation with mounting on post/mast)

Turning the LMS Width around the X- and Z-axis must be prevented by the mounting.

Ideal mounting position

The following figure shows the combination of the vertical and horizontal distance for the TIC501 that generates the best measurement results.
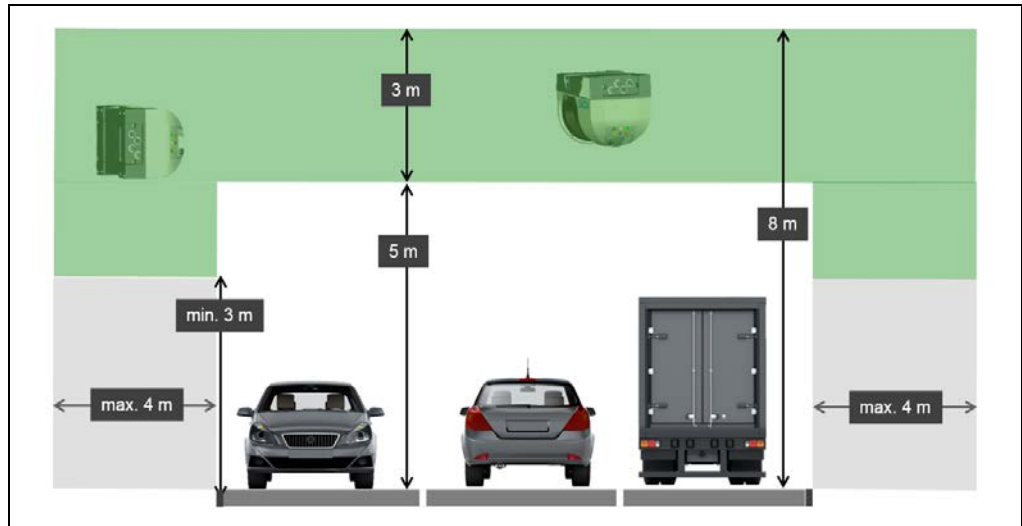

Fig. 55:   Project planning – Mounting the TIC501 (ideal mounting position)

The chart can be interpreted as follows:

- The TIC501 has the best performance within the green range.
- A maximum distance of 4 m to the lane edge is recommended for side mounting of the TIC501. The side mounting height should be at least 3 m.
- If the TIC501 is mounted on the side within the gray area, the system's ability to count perform may be reduced.

3.6.5   Requirements for mounting the axle counting components

The LMS Axle 2D LiDAR sensor must be positioned so that it is able to record the entire flank of the vehicle and, in particular, the entire axle area. Consequently, it must be mounted at the side of the lane.

Notes
- The area between the LMS Axle and the vehicle must be free from any optical obstacles. Please note that items such as guardrails or bushes should not restrict the scanner's view.
- The LMS Axle must have a good view of the road surface. A good view means that it must be able to detect as many measurement points on the ground as possible.

Requirements for optimum measurement results

The LMS Axle achieves optimum measurement results when as many measurement points can be generated in the analysis area (shadow pattern, point patterns for wheels) as possible. In order to obtain the minimum number of measurement points required, a mounting position for the LMS Axle must be selected so that the distance between the 2D LiDAR sensor and the wheels is not too large and so that the laser beam's angle of incidence is not too steep.

The flatter the angle of incidence and the closer the 2D LiDAR sensor is to the lane, the more measurement points will be generated.
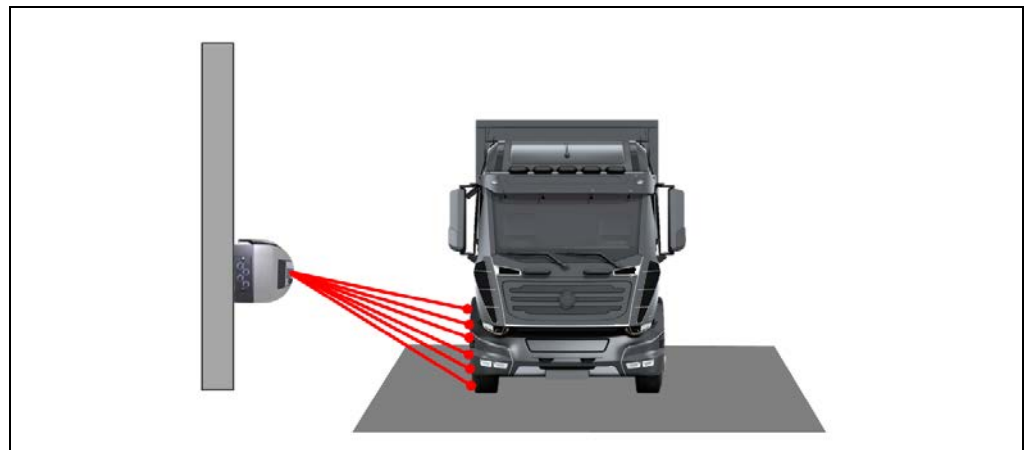

Fig. 56:   Axle counting project planning – Angle of incidence for the LMS Axle (optimum)

In the following figure, the mounting position is too high and, because the laser scanner is too close to the edge of the lane, the angle of incidence is too steep. This means that fewer measurement points are generated in the analysis area (shadow pattern, point pattern for the wheels).
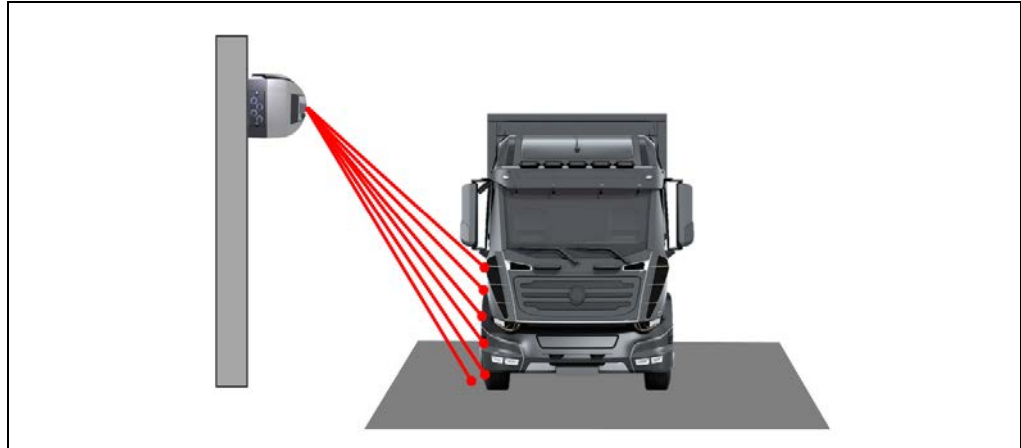

Fig. 57:   Axle counting project planning – Angle of incidence for the LMS Axle (too steep)

The following figure shows the combination of the vertical and horizontal distance for the LMS Axle that generates the best measurement results.
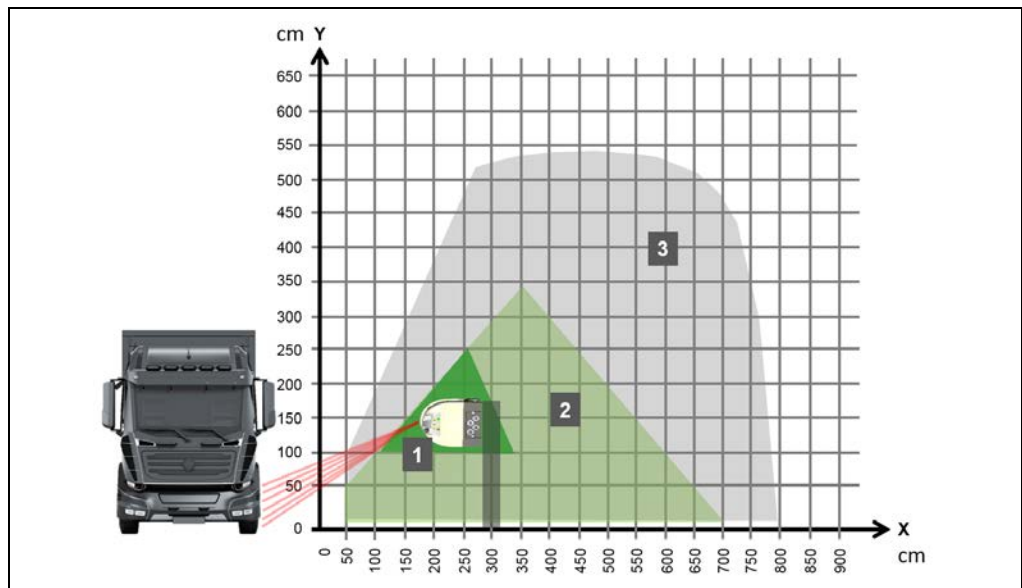

Fig. 58:   Axle counting project planning – Ideal mounting position for the LMS Axle

The chart can be interpreted as follows:

- The dark green triangle (1) marks the area where the LMS Axle will achieve the best possible performance.
- A mounting position within the light green triangle (2) will provide good to very good results.
- If the LMS Axle is mounted within the gray area (3), the system's ability to count axles accurately will be reduced.

Requirements for the mounting position and rotation

Position   If possible, the 2D LiDAR sensor mounted on the side of the vehicle edge should be on the **same level** as the associated system function (TIC102 / TIC502). A tolerance of ± 0.5 m in the Z-direction if permitted.
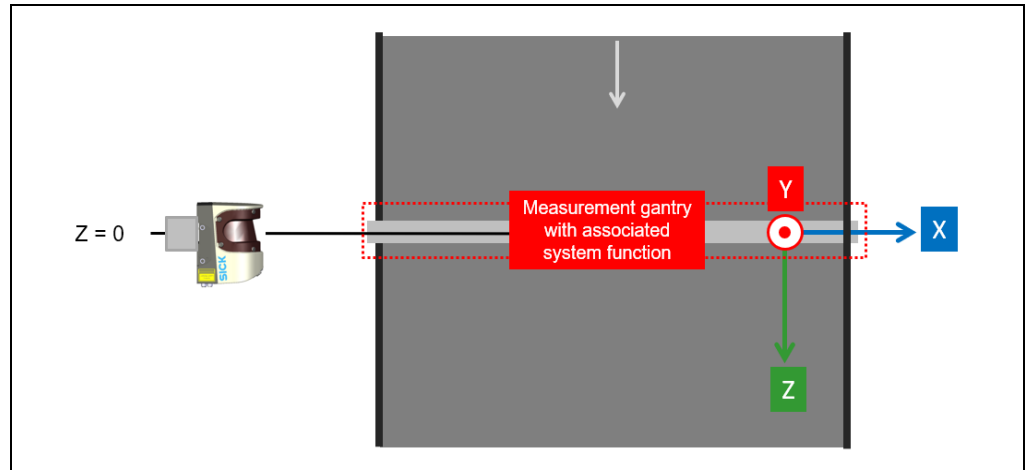

Fig. 59:   Axle counting project planning – Distance of the LMS Axle to the measurement gantry (on the Z-axis)

Rotation   When mounting the device, make sure that the LMS Axle is aligned correctly on all three axes.

You can tell whether the rotation of the 2D LiDAR sensor is correct by considering the top, side, and front views.

- **Rotation about the Y-axis**: The signal must be output at an angle of 90° in relation to the **direction of travel**. The system tolerates a rotational error of ± 2° about the Y-axis.
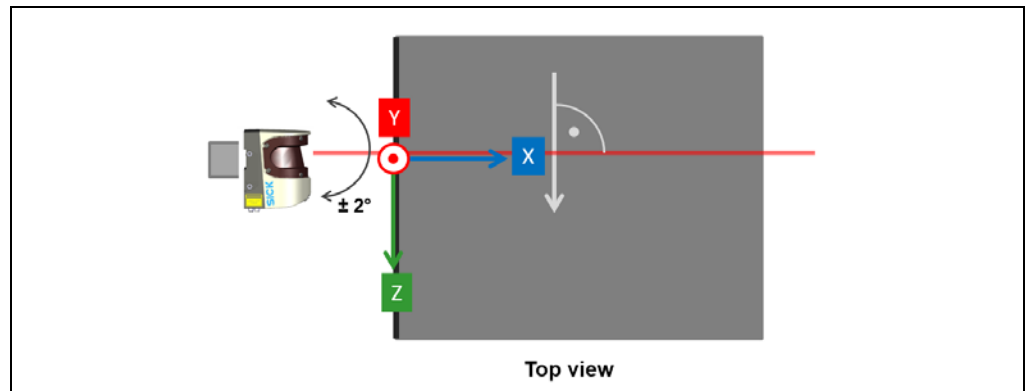

Fig. 60:   Axle counting project planning – Rotation of the LMS Axle about the Y-axis

- **Rotation about the X-axis**: The signal must be output at an angle of 90° in relation to the **road surface**. The system tolerates a rotational error of ± 2° about the X-axis.
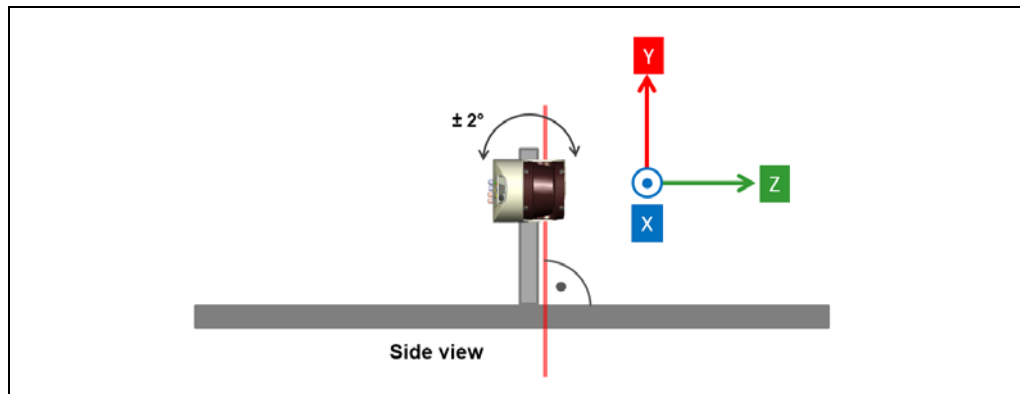

Fig. 61:   Axle counting project planning – Rotation of the LMS Axle about the X-axis

- **Rotation about the Z-axis**: The device's rear panel must be perpendicular to the road surface. The system tolerates a rotational error of ± 2° about the Z-axis.
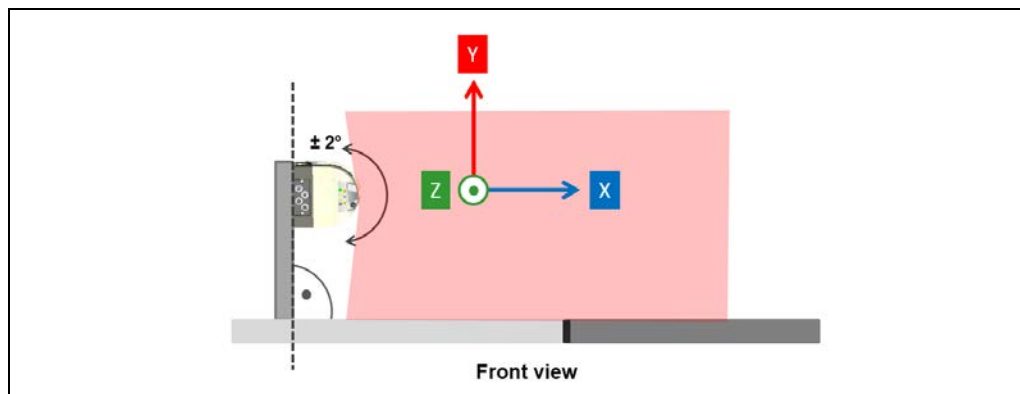

Fig. 62:   Axle counting project planning – Rotation of the LMS Axle about the Z-axis

3.7   Status indicators

3.7.1   TIC102 status indicators

The status indicators for the LMS111 installed in the TIC102 housing are located in the recesses of the housing. The 2D LiDAR sensor is fully automated in normal operation and requires no operator intervention. The LEDs (1) signal the operational status of the 2D LiDAR sensor.
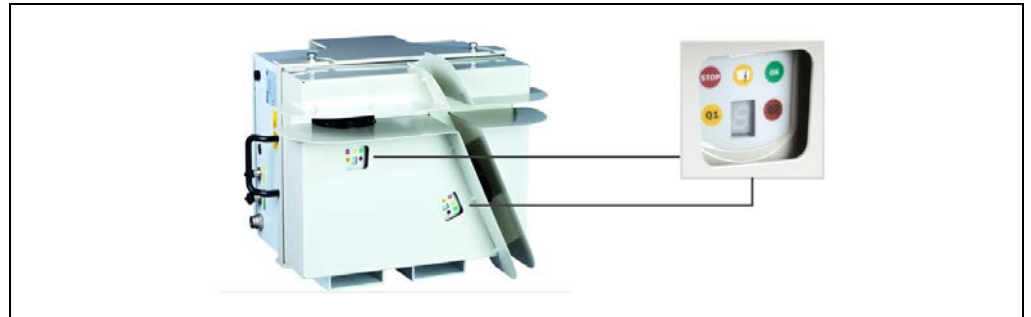
Fig. 63:   Status indicators – TIC102 (LMS111)

Display	Meaning
OK	2D LiDAR sensor in operation, no evaluation cases are reporting an event
STOP	2D LiDAR sensor in operation, at least one evaluation case reports an event
🖎	Optics cover is dirty
Q1	Switching output switched
Q2	2D LiDAR sensor in teach-in mode

Tab. 5:   Status indicators – TIC102

Note   The status indicators of the Traffic Controller installed in the housing are not visible.

3.7.2   TIC502 / TIC501 status indicators

The 2D LiDAR sensors used by the TIC502 or TIC501 system functions also use a 7-segment display in addition to the LEDs.

The LEDs (1) signal the operational status of the 2D LiDAR sensor, the 7-segment display (2) is also available for diagnostics when errors or faults occur (see chapter *8.2.1 Fault indicator for the 2D LiDAR sensors*).

Above the inspection window you will find a key that explains the meaning of the status indicators (3).
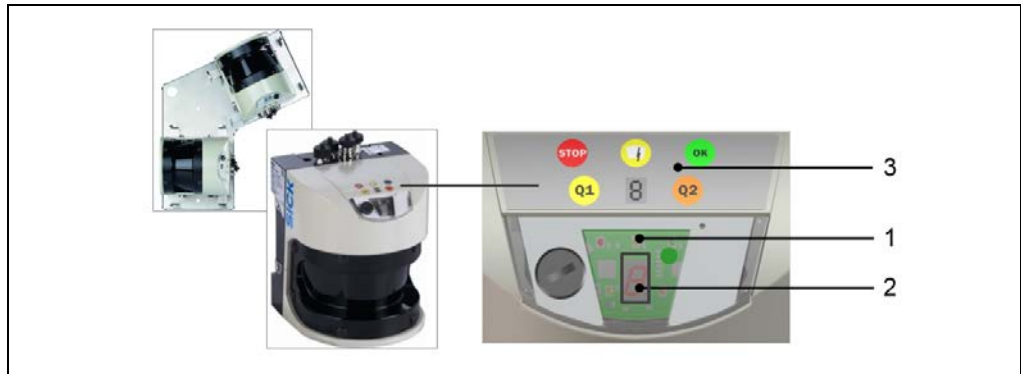
Fig. 64:   Status indicators – LMS511 2D LiDAR sensors

Display	Meaning
OK	2D LiDAR sensor in operation, no evaluation cases are reporting an event
STOP	2D LiDAR sensor in operation, at least one evaluation case reports an event
(dirty)	Optics cover is dirty
Q1	Switching output switched
Q2	2D LiDAR sensor in teach-in mode

Tab. 6:   Status indicators –2D LiDAR sensors

3.7.3   Status indicators and controls on the Traffic Controller

On the front of the Traffic Controller, you will find the following status indicators and controls:

Fig. 65:   Status indicators – Traffic Controller

No.	Meaning
1	Status LED: Lights up green when device is ready for operation
2	Power ON/OFF
3	Reset
4	HDD LED: Lights up green when the hard drive is being accessed

Tab. 7:   Status indicators – Traffic Controller

4 Mounting

4.1 General advice

Mount the 2D LiDAR sensor at the position designated in the project planning.

Observe the detailed diagrams and information contained in the appendix to these operating instructions.

⚠ *WARNING*

Risk of damage to devices during mounting

▶ Mount the 2D LiDAR sensors so that they are protected from dirt and damage.

▶ Ensure that the field of view of each 2D LiDAR sensor is not restricted.

▶ Make sure that the connectors can be plugged in and unplugged without any difficulty.

▶ Avoid exposing the 2D LiDAR sensors to excessive shock and vibration.

⚠ *WARNING*

Legal provisions

▶ When mounting the system components, please observe any national and local legal stipulations and official instructions.

⚠ *WARNING*

Prevent the 2D LiDAR sensors from falling

▶ We recommend that you secure the components that have been mounted above the lane so that they cannot fall down, e.g., by using a chain or rope.

NOTE

Refer to the project planning notes

▶ Always observe the notes provided in chapter *3.6 Project planning*.

4.2   Mounting 2D LiDAR sensors

4.2.1   Mounting the TIC102

⚠️ **WARNING**

Risk of injury due to falling components

One TIC102 weighs approximately 16 kg.

Measures

➤ Do **not** perform any mounting work alone.

➤ Ask a second person to hold the components during mounting.

➤ Wear safety shoes.

4.2.1.1   Noting the serial numbers of the 2D LiDAR sensors for several TIC102 Slaves

If the measurement site is intended to have **more** than one **TIC102 Slave**, you must note the serial numbers of the LMS111 installed in the housing <u>before mounting</u>. This information is required during commissioning when manually assigning the devices to the system functions in TEMS Manager.

➤ Completely open the housing cover of the TIC102. Pull both cover screws outwards and turn them in the connection. The housing cover pops open.

The serial number of the LMS111 is located on the left-hand side of the device.

Fig. 66:   Mounting the TIC102 – Noting serial numbers of the 2D LiDAR sensors

Recommendation   Note which components of the TIC102 have which serial numbers and mark the TIC102 accordingly so that it can be mounted at the right place.

4.2.1.2   Mounting the TIC102

A TIC102 is mounted on the gantry in the middle of the lane orthogonally to the road.

The apertures on the housing for the signal output (see red arrows in the illustration) must point towards the road. The LMS Length (dashed line) must be aligned in parallel with the direction of travel.

Use the brackets available as accessories for the mounting process (1).
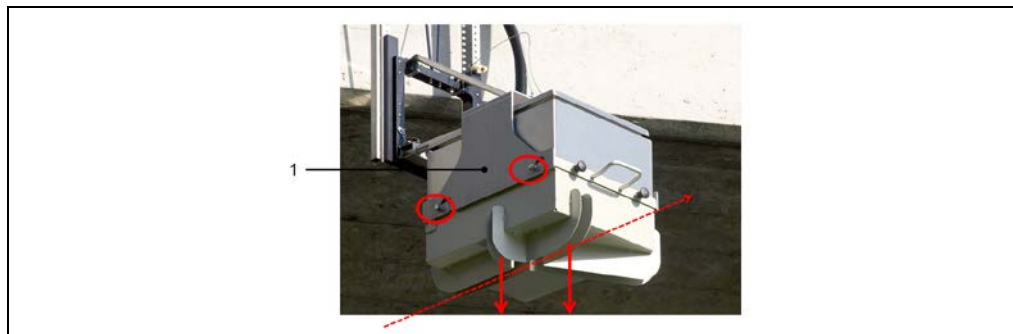

Fig. 67:   Mounting – TIC102

1.   Mount the TIC102 to the bracket.
2.   Mount the bracket with the TIC102 to the gateway or bridge.

Note   Do not secure the mounting bracket to the housing by turning screw but instead by turning the nut (see arrow in the following illustration).
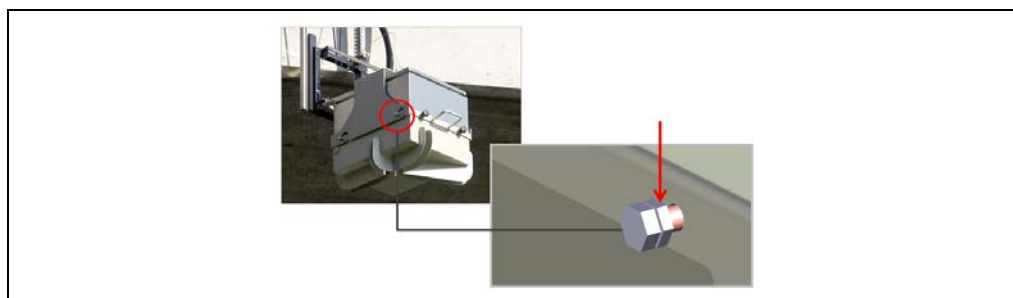
Fig. 68:   Mounting information – TIC102

Mounting accessories: TIC102

	Accessories	Description	Part number
	Mounting bracket	Mounting bracket for mounting the TIC102	4068061
	Weather hood	Recommended for protecting the TIC102 housing against environmental influences Color: RAL 7032 gray	4068062
	LS80b scan finder	Infrared receiver for locating the laser beam	6020756

4.2.2   **Mounting the TIC502**

> ⚠ **WARNING**
>
> **Risk of injury due to falling components**
>
> One TIC502 weighs approximately 12 kg.
>
> **Measures**
>
> ➤ Do **not** perform any mounting work alone.
>
> ➤ Ask a second person to hold the components during mounting.
>
> ➤ Wear safety shoes.

4.2.2.1   **Noting the serial numbers of the 2D LiDAR sensors if there are several TIC502 Slaves**

If the measurement site is intended to have **more** than one **TIC502 Slave**, you must note the serial numbers of the LMS511 SE <u>before mounting</u>. This information is required during commissioning when manually assigning the devices to the system functions in TEMS Manager.
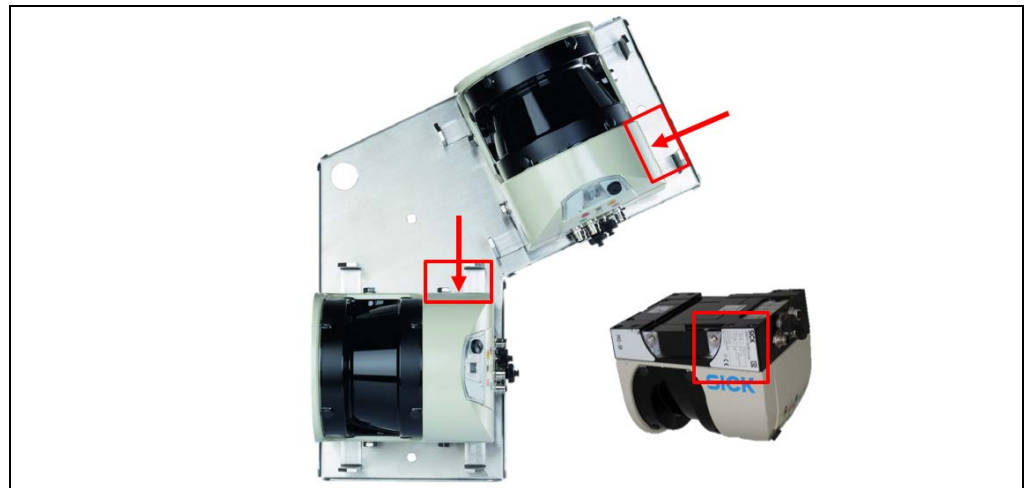

Fig. 69:   Mounting TIC502 – noting serial numbers of the 2D LiDAR sensors

Recommendation   Note which component of the TIC502 has which serial number and mark the TIC502 accordingly so that it can be mounted at the right place.

4.2.2.2   Mounting the TIC502

A TIC502 is mounted on the gantry in the middle of the lane orthogonally to the road.

The inspection window of the 2D LiDAR sensors must point to the lane. The LMS Length must be aligned in parallel with the direction of travel.

To enable correct alignment and orientation of the mounting plate, the 2D LiDAR sensors have labels which mark them as **LMS Width** and **LMS Length**.

A label on the mounting side of the plate visualizes the direction of travel of the vehicle. This specifies the correct alignment of the TIC502.
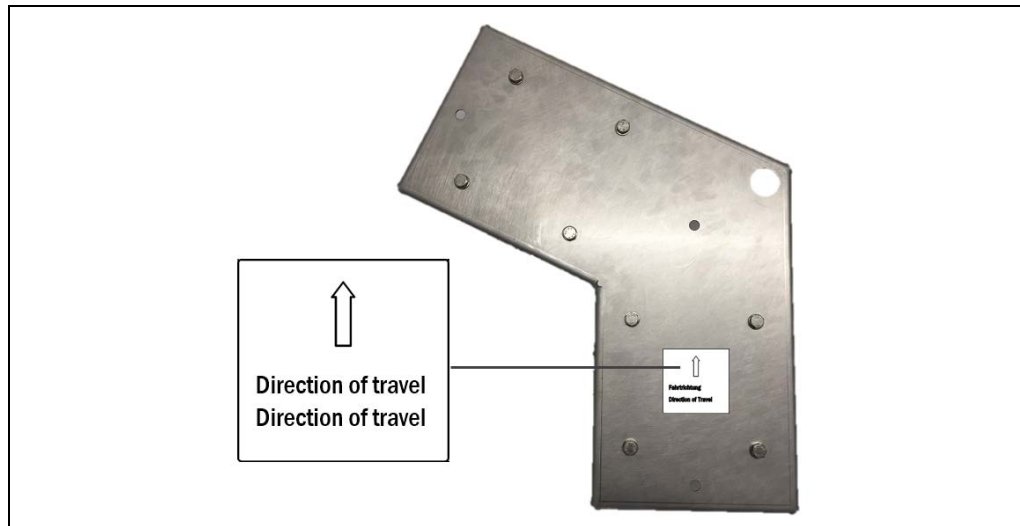

Fig. 70:   Mounting – TIC502

Use a bracket which fits the hole pattern of the plate to mount the TIC502.

1. Mount the TIC502 to the bracket.

2. Mount the bracket with the TIC502 to the gantry or bridge.

4.2.3 Mounting the TIC501

4.2.3.1 Noting the serial numbers of the 2D LiDAR sensors of the TIC501

For the TIC501, you must generally note the serial number of the LMS511 SE, regardless of how many TIC501 system functions are used.

This information is required during commissioning when manually assigning the devices to the system functions in TEMS Manager.

Fig. 71:   Mounting TIC501 – noting serial numbers of the 2D LiDAR sensors

Recommendation   Note which component of the TIC501 has which serial number and mark the TIC501 accordingly so that it can be mounted at the right place.

4.2.3.2 Mounting the TIC501

The TIC501 is mounted to a gantry or to the side of a post or a mast. The laser beam must be emitted at a right angle to the lane.

They are normally mounted using the connections in the direction of travel.

Make sure that the rotation is correct in accordance with the project planning.

Fig. 72:   Mounting – TIC501

Mounting accessories

The associated mounting kits for mounting of the 2D LiDAR sensors can be purchased at SICK AG (see chapter *4.2.4.3 SICK mounting accessories for the LMS511 2D LiDAR sensor* for more).

4.2.4   Mounting the LMS Axle

4.2.4.1   Noting serial numbers of the 2D LiDAR sensors of the LMS Axle

When using the Axle Detector system function, you must generally note the serial numbers of the LMS Axle, regardless of whether the measurement site has one or two LMS Axle units.

This information is required during commissioning when manually assigning the devices to the system functions in TEMS Manager.

Fig. 73:   Mounting the LMS Axle – noting serial numbers of the 2D LiDAR sensors

Recommendation Note which component has which serial number and mark the LMS Axle accordingly so that it can be mounted at the right place.

4.2.4.2   Mounting the LMS Axle

The LMS Axle is mounted on the side on the edge of the lane. The laser beam must be emitted at a right angle to the lane. The connections should usually point in the direction of travel.
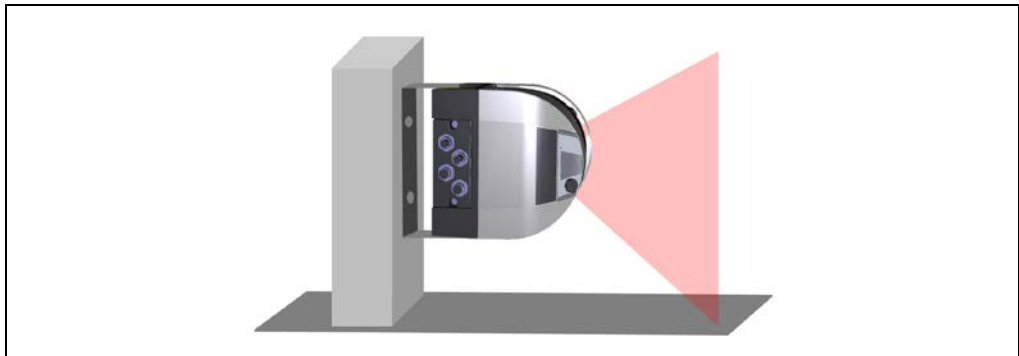

Fig. 74:   Mounting – LMS Axle

Note   The 2D LiDAR sensor mounted on the side of the vehicle edge must be on the **same level** as the associated system function (TIC102 / TIC502). The line through the intersection point between the LMS Width and LMS Length is taken as the level.
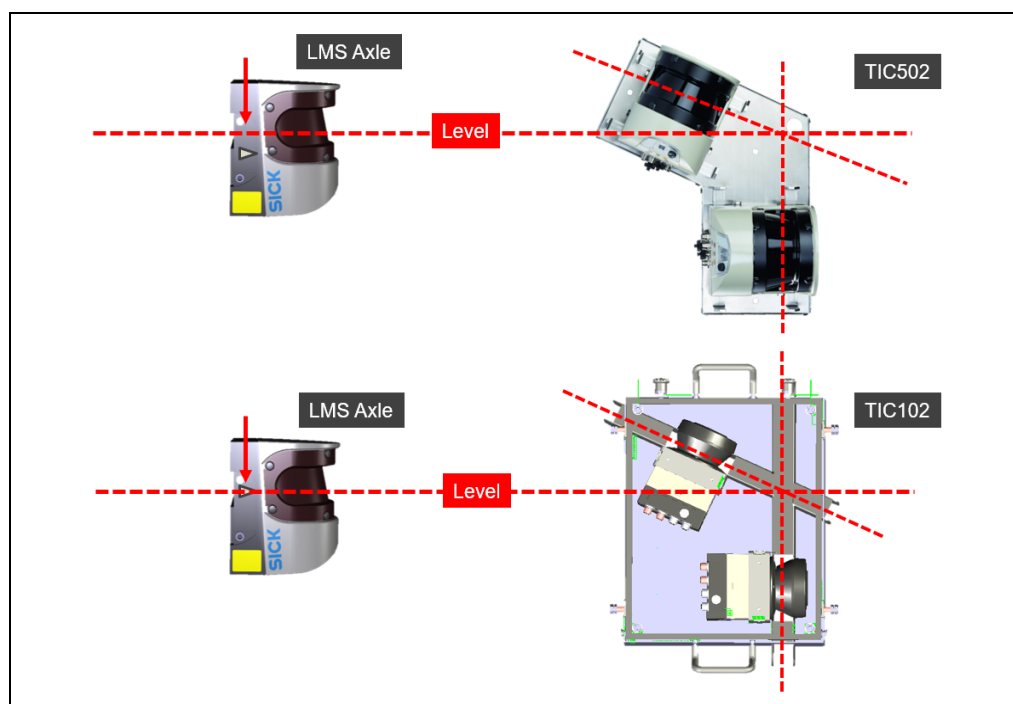
Fig. 75:   Mounting of LMS Axle – LMS Axle level – TIC102 / TIC502

Note   Please refer to the diagram below to see how the vertical and horizontal distances of the LMS Axle should be combined for the best possible measurement results.

Fig. 76:   Mounting of the LMS Axle – Ideal mounting position

- The dark green triangle (1) marks the area where the LMS Axle will achieve the best possible performance.
- A mounting position within the light green triangle (2) will provide good to very good results.

- If the LMS Axle is mounted within the gray area (3), the system's ability to count axles accurately will be reduced.

Mounting accessories

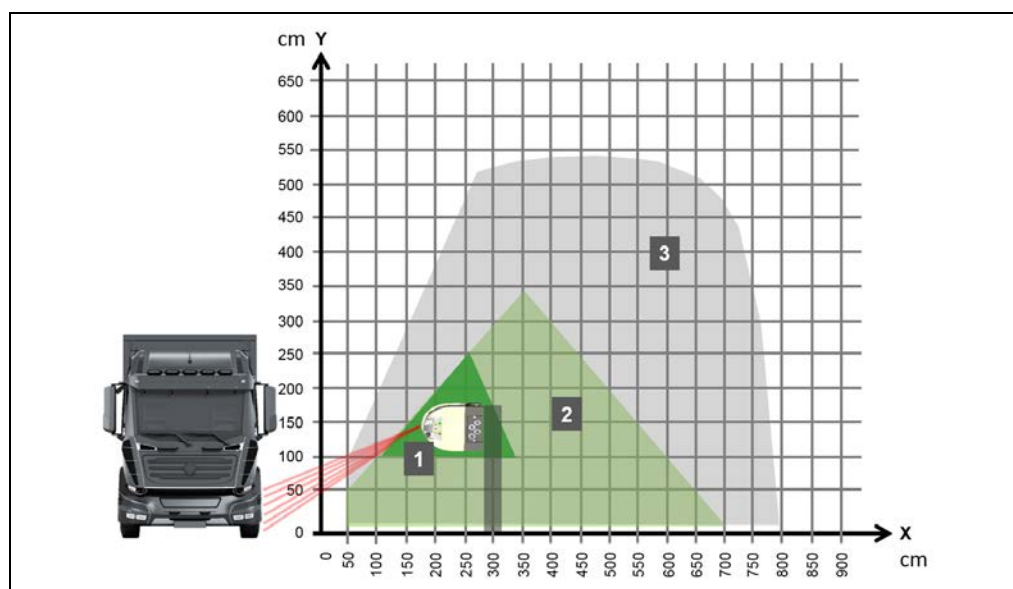The associated mounting kits for mounting of the 2D LiDAR sensors can be purchased at SICK AG (see chapter *4.2.4.3 SICK mounting accessories for the LMS511 2D LiDAR sensor* for more).

4.2.4.3 SICK mounting accessories for the LMS511 2D LiDAR sensor

Recommendation In order to protect the LMS511 2D LiDAR sensor housing against the weather, we recommend fitting a **weather hood**.

The weather hood also protects the 2D LiDAR sensor from direct sunlight on the 2D LiDAR sensor housing (overheating) and, to a great extent, from dazzle resulting from sunlight or other light sources.

Mounting brackets

Suitable mounting kits for mounting the LMS511 (with or without the weather hood) can be purchased from SICK AG.

If the bracket is provided by the user, the following points must be observed:

- Stable mounting bracket that allows adjustable alignment of the 2D LiDAR sensor in the X- and Y-axes
- 4 x M6 screws for the LMS511
- The screw length must be selected in accordance with the wall thickness/bracket used

For detailed information about mounting the 2D LiDAR sensors, please refer to the operating instructions for the device concerned.

Recommendation

To ensure that the back of the LMS511 is also protected against the weather when a weather hood (1) is fitted, we recommend mounting a plate (2) to cover the device housing.
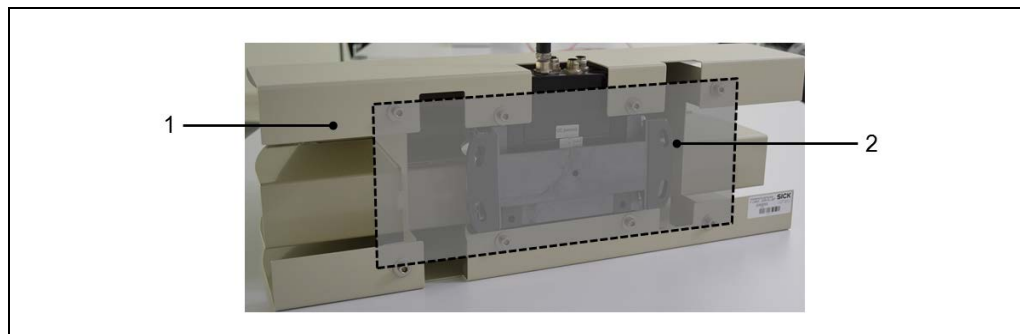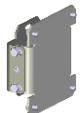
Fig. 77: Mounting the LMS511 weather hood

Weather protection covers for LMS511

	Accessories	Description	Part number
	Protection hood	Recommended for protection from direct sunlight (heat) and environmental influences Color: RAL 7032 gray	2056850
	Weather hood	Recommended for protection from direct sunlight (heat) and environmental influences Color: RAL 7032 gray	2063050

Mounting kits for LMS511

	Accessories	Description	Part number
	Mounting kit 1	Mounting kit 1 to assist with mounting	2015623
	Mounting kit 2	Mounting kit 2 to assist with mounting Mounting kit 1 required	2015624
	Mounting kit 3	Mounting kit 3 to assist with mounting Mounting kits 1 and 2 required	2015625
	Mounting bracket	For retrofitting, if mounting bracket 2018303 is already in use	2059271
	Mounting kit	Mounting kit for wall mounting (adjustment bracket)	2018303

Mast mounts for LMS511

	Accessories	Description	Part number
	Post/wall bracket	Post/wall bracket with adapter plate	1081412
	Mast mount	Mast mount requires adapter plate (2059271) or wall bracket (2018303)	2018304

	Adjustable strap for mast mount	Adjustable strap for mast mount (2018304)	5306222
	Adjustable strap lock	Adjustable strap lock for tightening, 2 pieces required	5306221

Scan finder

The scan finder helps locate the laser beam.

Devices	Accessories	Description	Part number
	LS80b scan finder	Infrared receiver for locating the laser beam	6020756

Note   For additional accessories, please visit *www.sick.com*.

4.3   Mounting the Traffic Controller

Separate mounting of the Traffic Controller if only required for the TIC502 and TIC501 system functions. For the TIC102, the Traffic Controller is installed in the housing of the TIC102.

⚠ **WARNING**

Consider the protection class

▶ The Traffic Controller has an IP 20 protection class rating and must always be mounted in an electric or control cabinet.

NOTE

The Traffic Controller must not be opened. The hard drive is already integrated into the device.

The Traffic Controller should be mounted in a suitable location inside the control cabinet at the measurement site.

Ideally, it should be mounted near the higher-level control but never in the vicinity of transformers or other power units.

In order to accommodate the leads and wiring, there must be enough terminals available.

Mounting

▶ Install the Traffic Controller in a suitable location inside the control cabinet.

To do this, use the M4 thread in the Traffic Controller.

Note   The Traffic Controller does not have active cooling. For optimum heat dissipation inside the control cabinet, we recommend mounting it on a metal plate.

4.4   Mounting the Ethernet switch

The TIC502 system function requires an Ethernet switch with at least **4 ports**. An Ethernet switch with least **4 ports** are required to use several TIC501.

For the TIC102, the Ethernet switch is installed in the housing of the TIC102.

▶ Mount the Ethernet switch in a suitable location inside the control cabinet.

5   Electrical installation

5.1   General advice

> ### ⚠ DANGER
>
> **Disconnect the power to the system**
>
> ▶ Make sure that all the components of the profiling system are disconnected from the voltage supply during the electrical installation work.

> ### ⚠ DANGER
>
> **Risk of injury due to electrical current**
>
> ▶ Comply with standard safety requirements when working on electrical plants.
>
> ▶ Be sure to disconnect the voltage supply before attaching or detaching any electrical connections.

> ### ⚠ WARNING
>
> **Protect cables against slack**
>
> ▶ Make sure that the cables are routed correctly. The cables must not loop down or fall slack in any way. They must never pose a hazard to the vehicles driving under the gantry.

5.2   Connections

All system functions have in common that the system components are connected individually to the voltage supply and connected to the Traffic Controller via Ethernet.

5.2.1   TIC102 connections

TIC102 master   The TIC102 Master has the following connections:
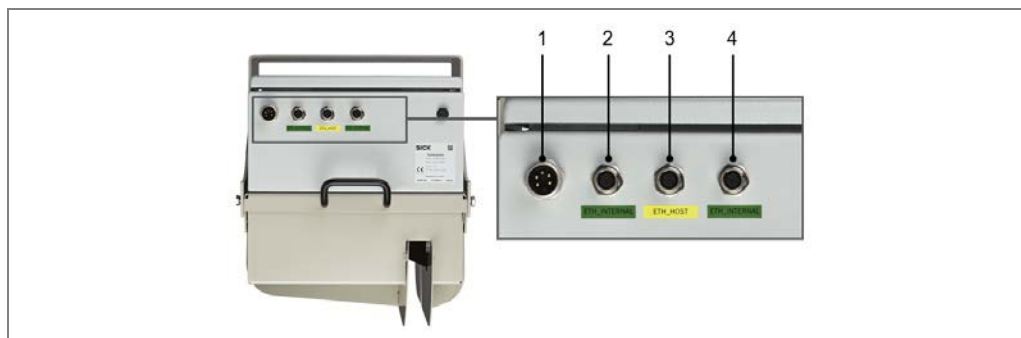
Fig. 78:   Connections – TIC102 Master

No.	Connection	Designation (in diagram)	Description
1	PWR	-X1	Connection to the voltage supply
2	ETH_INTERNAL	-X2	Ethernet connection to a TIC102 Slave
3	ETH_HOST	-X3	Ethernet connection to the network connection (TEMS Info Interface)
4	ETH_INTERNAL	-X4	Ethernet connection to a TIC102 Slave or the 2D LiDAR sensor for axle counting

Tab. 8:   Connections – TIC102 Master

TIC102 slave The TIC102 Slave has the following connections:
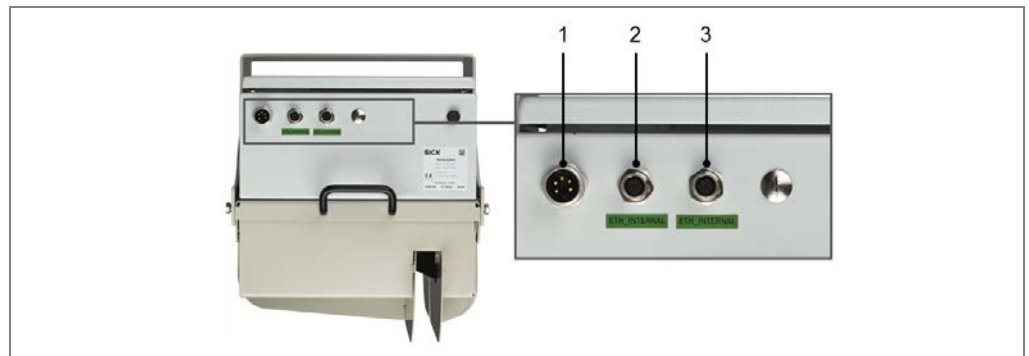
Fig. 79: Connections – TIC102 Slave

No.	Connection	Designation (in diagram)	Description
1	PWR	-X1	Connection to the voltage supply
2	ETH_INTERNAL	-X2	Ethernet connection to the TIC102 Master or another TIC102 Slave
3	ETH_INTERNAL	-X3	Ethernet connection to the TIC102 Master or another TIC102 Slave

Tab. 9: Connections – TIC102 Slave

5.2.2 Connections to LMS511 2D LiDAR sensor

The LMS511 2D LiDAR sensor has the following connections:
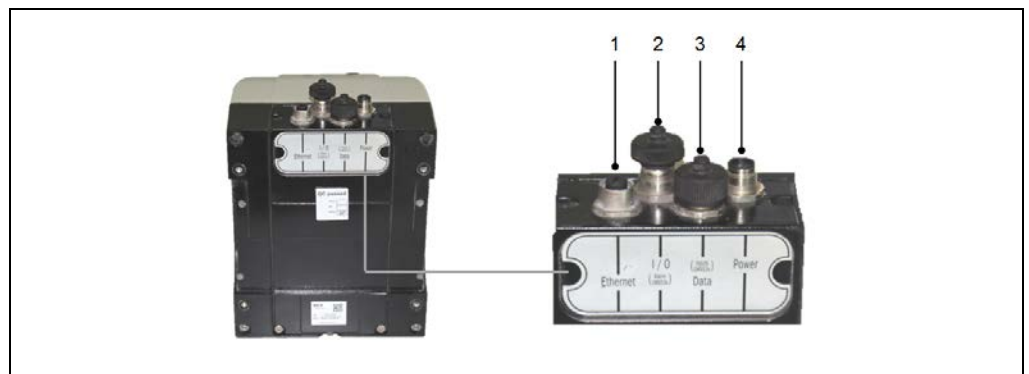
Fig. 80: Connections – LMS511

No.	Connection	Description
1	Ethernet	Ethernet connection to a switch
2	I/O	Not assigned
3	Data	Not assigned
4	Power	Connection to the voltage supply

Tab. 10: Connections – LMS511

5.2.3 Connections on the Traffic Controller

The Traffic Controller has the following connections:

Front
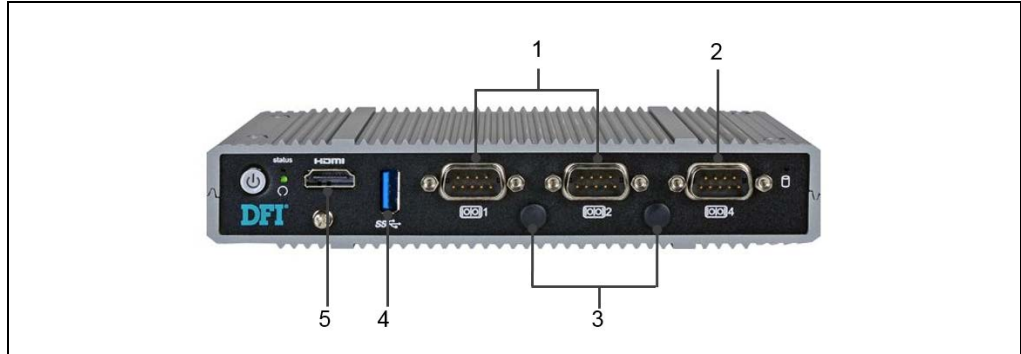
Fig. 81: Connections – Traffic Controller (front side)

No.	Meaning
1	COM 1/2
2	COM 4 (8-bit DIO)
3	Antenna connection
4	USB 3.0
5	HDMI

Tab. 11: Connections – Traffic Controller (front side)

Back
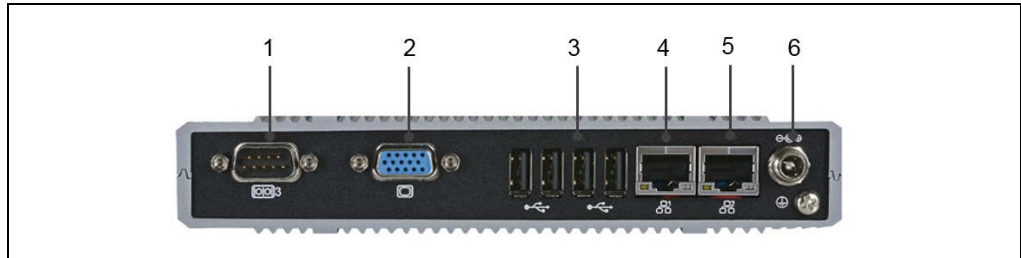
Fig. 82: Connections – Traffic Controller (rear side)

No.	Meaning
1	COM 3
2	FGS
3	USB 2.0
4	Ethernet 1: Customer network
5	Ethernet 2: Sensor network
6	DC-in

Tab. 12: Connections – Traffic Controller (rear side)

5.3   Electrical installation of the TIC102

All TIC102 units are connected in series via Ethernet cables. Connection to the external customer network is done using the TIC102 Master. The system components are each supplied separately with voltage.
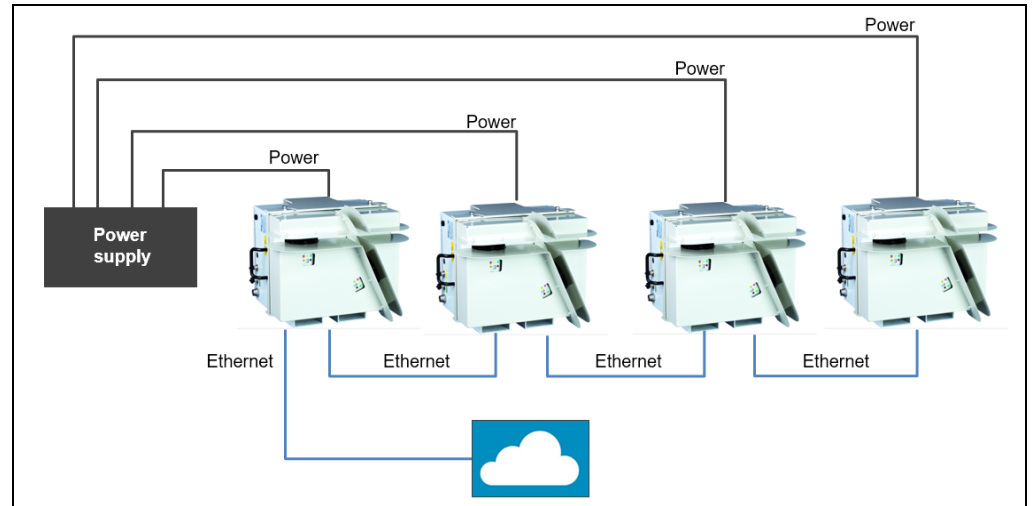
Fig. 83:   Electrical installation – TIC102 wiring overview

5.3.1   Connecting the TIC102 to the voltage supply

Connect the voltage to each TIC102. Use the cables available as accessories for connecting to the power supply. One end of the cables has a M12 plug connector, the other is open for connection to the voltage supply.

1. Screw the M12 round connector of the cable into the **Power Supply** female connector on the respective TIC102.

Fig. 84:   Electrical installation of the TIC102 – Connecting the voltage supply

2. Run the cable to the power supply.

3. Connect the wires to the terminals of the voltage supply.
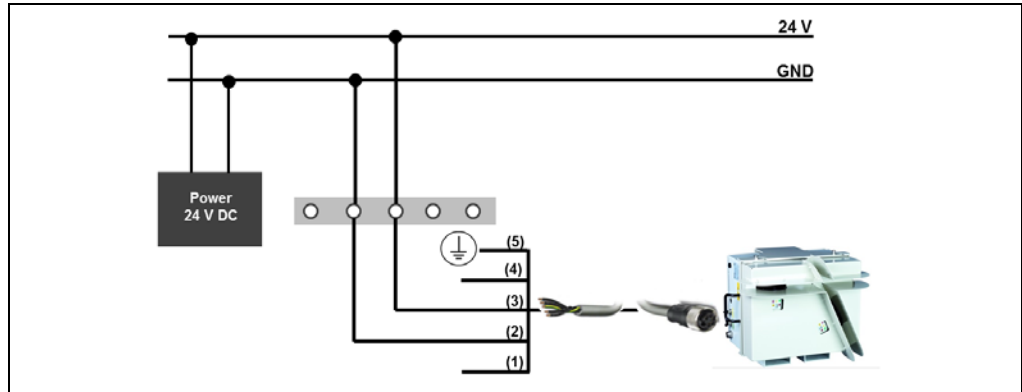
Fig. 85:   Electrical installation of the TIC102 – Connection to the voltage supply (control cabinet)

▶ Connect the wires to the power supply in the control cabinet as follows:

Marking and color of the wires (free end)			7/8" x 5 male connector	
Marking (wires)	Wire color	Description	Diagram	Pin
(1)	Black	Not assigned		1
(2)	Black	Earthing (–GND)		2
(3)	Black	Voltage (+24 V)		4
(4)	Black	Not assigned		5
(5)	Green-yellow	Protection earth		3

Tab. 13:   Electrical installation of the TIC102 – Power cable pin assignment

Note For the voltage supply, use a cable with a suitable cross-section so that the voltage loss between the connection point and the TIC102 is within the tolerance zone.

5.3.2 Connecting TIC102 units to one another via Ethernet

If you are working with several TIC102 units, you must create a TCP/IP connection between the individual components in a series connection.

Use the Ethernet cables available as an accessory. They feature the required M12 plug connector on both sides.

No separate network switch is required for this. It is integrated into the TIC102 housing.

1. Connect the Ethernet cable on one of the two **ETH_INTERNAL** female connectors on the TIC102 Master and fasten the plug connector.

2. Lead the cable to the next TIC102 Slave and screw the cable to the **ETH_INTERNAL** female connector.
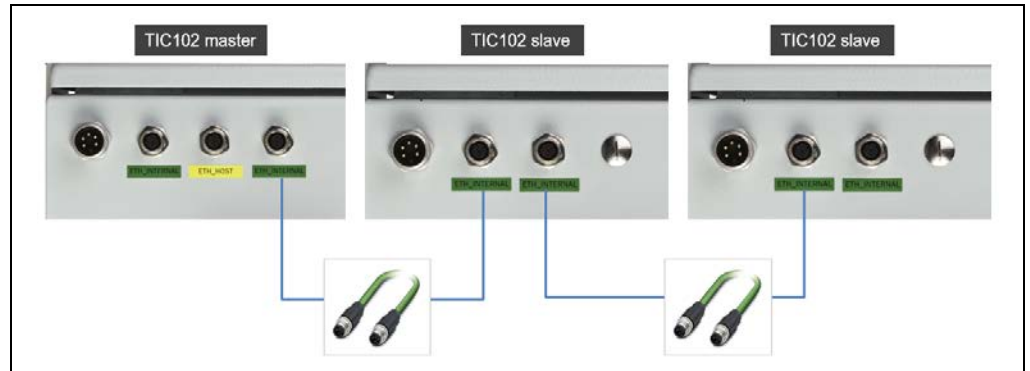
Fig. 86:   TIC102 electrical installation – Connecting the TIC102 sensors

3. Also connect the other TIC102 Slaves to the **ETH_INTERNAL** female connectors.

Ethernet cable

Pin	Wire color	Connection
1	Ethernet_TX+	Ethernet interface
2	Ethernet_RX+	Ethernet interface
3	Ethernet_TX–	Ethernet interface
4	Ethernet_RX–	Ethernet interface

Tab. 14:   Electrical installation of the TIC102 – Ethernet cable pin assignment

5.3.3   Connect TIC102 Master to the customer interface

Connect the TIC102 Master to the company network. Use the Ethernet cable available as an accessory. This has an M12 plug connector for connection to the TIC102 Master on one end. The other end has an RJ45 male connector for connection to the company network.

The TIC102 Master can be connected directly to the company network via a network switch provided at the customer site.

▶ Connect the **ETH_HOST** connection of the TIC102 Master to the Ethernet connection of the relevant client.
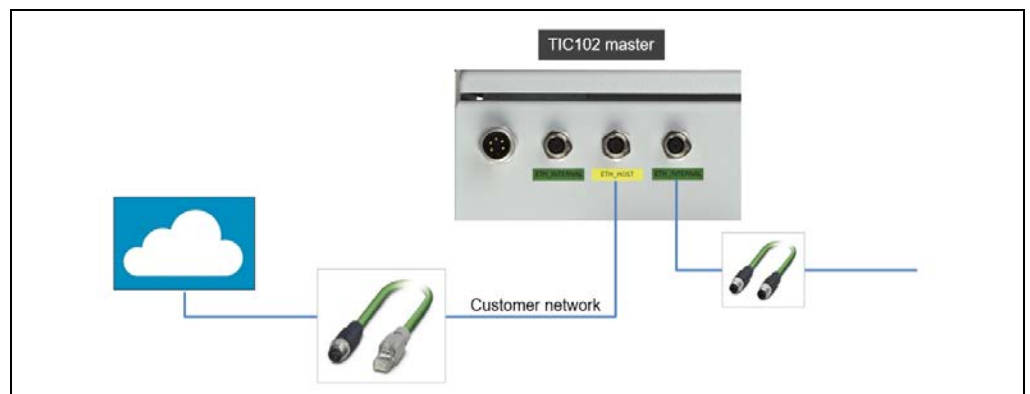
Fig. 87:   Electrical installation of the TIC102 – Connection to the customer interface

5.3.4   SICK connecting cables for TIC102

	Accessories	Description	Part number
	Power connecting cable	Voltage supply with 5-pin M12 coupling and open cable end (electronics and heating), 30 m	6045327
	Ethernet connecting cable	Connecting cable for connection of the TIC102 units to one another, 15 m	6045328
	Ethernet connecting cable	Connecting cable for connecting the TIC102 Master to the company network, 30 m	6045311

5.4 TIC502 / TIC501 electrical installation

Connect the 2D LiDAR sensors used by the TIC502 or TIC501 system functions to the voltage supply and to the Traffic Controller using the Ethernet switch provided at the customer site.

The Traffic Controller is used for the connection to the customer network.

Wiring overview of the TIC502

Fig. 88:   Electrical installation – TIC502 wiring overview

Wiring overview of the TIC501
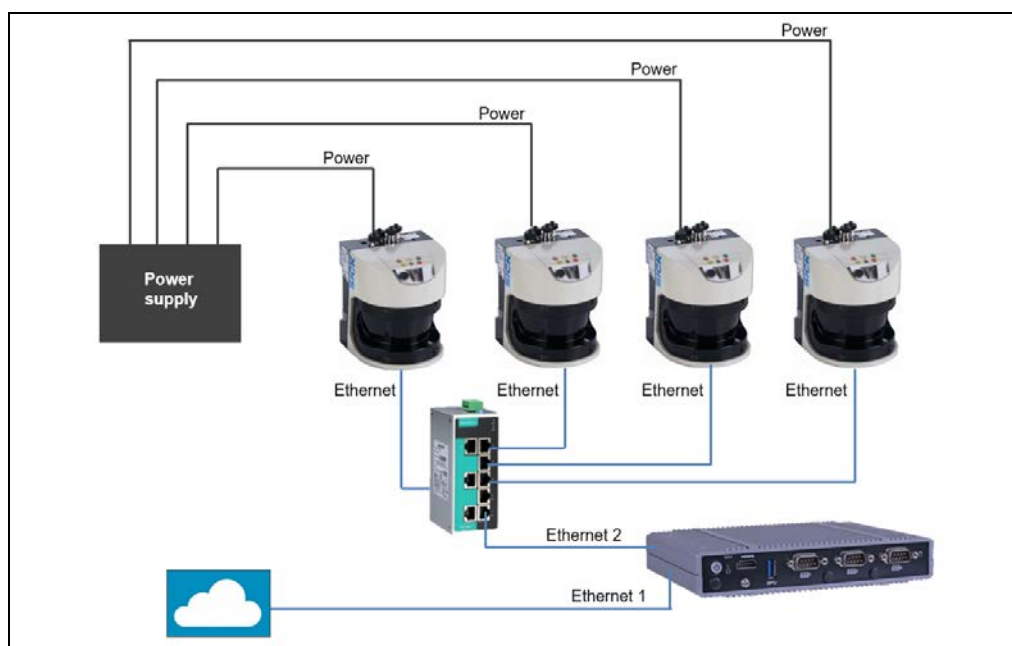
Fig. 89:   Electrical installation – TIC501 wiring overview

5.4.1   Traffic Controller connection

5.4.1.1   Connecting the Traffic Controller to the voltage supply

The Traffic Controller should be connected to the voltage supply using the power cable included with delivery. One end of the cable has a plug connector and the other is open. The white and black wires must be connected to the voltage supply in the control cabinet.

Note   The Traffic Controller and the 2D LiDAR sensors can be connected to the same voltage supply.

▶ Plug the male connector of the power cable into the female connector on the Traffic Controller and screw the connection tight.

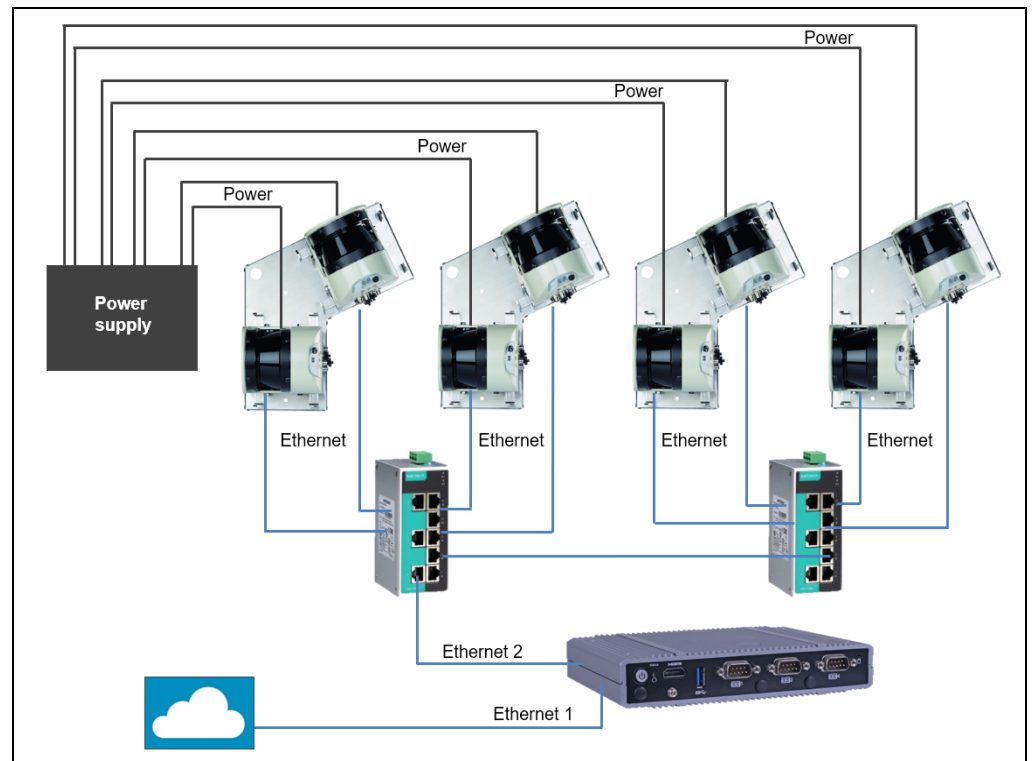▶ Connect the Traffic Controller to the voltage supply.
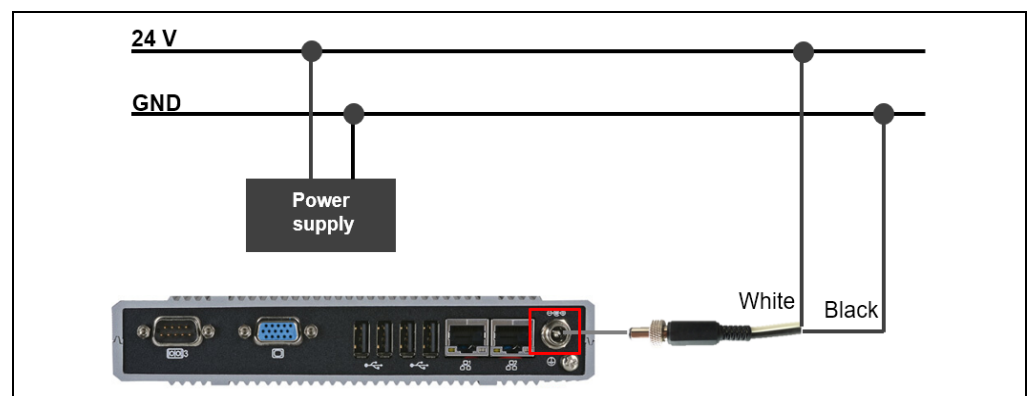
Fig. 90:   Electrical installation of the TIC502 / TIC501 – Connecting the Traffic Controller to the voltage supply

▶ Connect the wires of the black and white cable in the control cabinet as follows:

Wire color	Voltage supply
White	12 V … 36 V DC
Black	0 V

Tab. 15:   Electrical installation of the TIC502 / TIC501 – Connecting the Traffic Controller to the voltage supply

5.4.1.2   Connecting the Traffic Controller to the Ethernet switch

The Traffic Controller that has been mounted inside the control cabinet must be connected to the Ethernet switch. The Ethernet switch connects the 2D LiDAR sensors to the Traffic Controller.

▶ Connect the **Ethernet 2** connection of the Traffic Controller to the Ethernet switch.

Fig. 91:   Electrical installation of the TIC502 / TIC501 – Connecting the Traffic Controller to the Ethernet switch

5.4.2 **2D LiDAR sensor connection**

5.4.2.1 **Connecting the 2D LiDAR sensors to the voltage supply**

Each 2D LiDAR sensor is connected to the voltage supply separately.

Please use the cables for connecting to the voltage supply that are available as accessories. This cable has an M12 plug connector for connection to the 2D LiDAR sensor on one end. The other end is open with shielding for connection to the voltage supply.
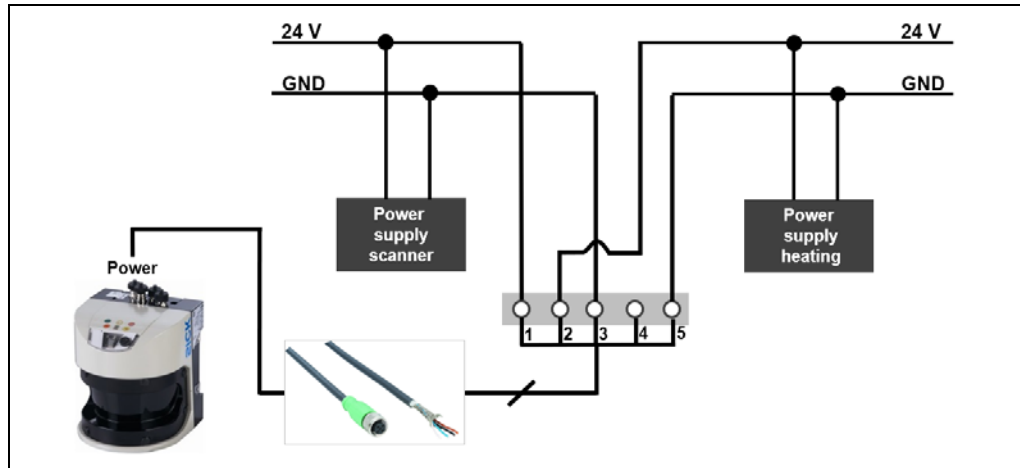
Fig. 92:   Electrical installation of the LMS511 2D LiDAR sensor – Connecting to the voltage supply

Connection notes

A voltage of 19.2 V to 28.8 V is required. The power consumption per 2D LiDAR sensor is 22 W plus another 55 W for the heating, where applicable. We recommend using separate power supply units for the 2D LiDAR sensor and its heater.

▶ Wire all connections using copper cables.

▶ Use the following wire cross-sections:

Connection of	Cable cross-section
Supply voltage	At least 0.25 mm² if local voltage supply (power supply unit) is in the immediate proximity.
	At least 1.0 mm² with a maximum length of 20 m when connected to available 24 V DC mains voltage

For additional information on the electrical installation work, please see the operating instructions for the 2D LiDAR sensor.

Connecting the 2D LiDAR sensors

1. Screw the M12 round connector of the cable into the **Power** female connector on the 2D LiDAR sensor.

2. Run the cable to the control cabinet or to the distribution box.

3. Connect the wire ends of the connecting cable to the terminals of the control cabinet.

▶ Connect the wires to the power supply in the control cabinet as follows:

Pin	Wire color	Connection
1	Brown	Voltage (+24 V)
2	White	Heating (+24 V)
3	Blue	Ground
4	–	–
5	Black	Heating ground

Tab. 16:   Electrical installation of the LMS511 2D LiDAR sensor – Connecting to the voltage supply

5.4.2.2   Connecting the 2D LiDAR sensors to the Ethernet switch

Each 2D LiDAR sensor of the TIC502 is connected to the Ethernet switch separately via the Ethernet interface. The Ethernet cable has an M12 plug connector so that it can be connected to the 2D LiDAR sensor and an RJ45 male connector so that it can be connected to the female connector of the Ethernet switch. The connection of TIC501 to an Ethernet switch is only required if several TIC501 units are used.
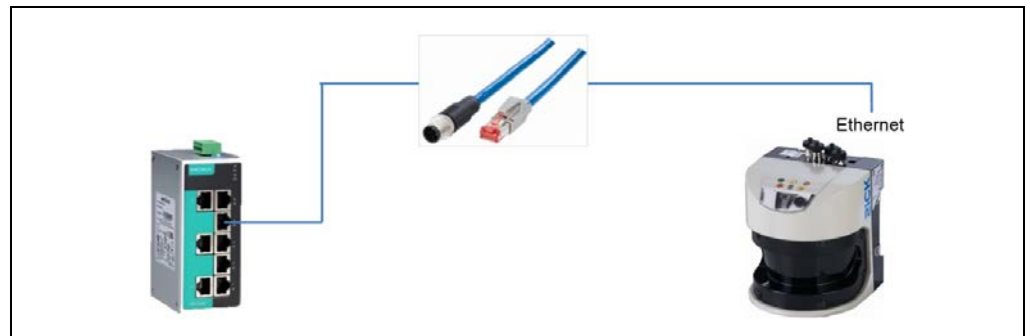
Fig. 93:   Electrical installation of the LMS511 2D LiDAR sensors – Connecting to the Ethernet switch

1. Screw the M12 male connector into the female **Ethernet** connector on the respective 2D LiDAR sensor.
2. Run the Ethernet cable from the 2D LiDAR sensor to the switch.
3. There, insert the RJ45 male connector into a free female connector.

Ethernet cable

Pin	Wire color	Description of the Ethernet interface
1	Ethernet_TX+	Transmit+
2	Ethernet_RX+	Receive+
3	Ethernet_TX−	Transmit−
4	Ethernet_RX−	Receive−

Tab. 17:   Electrical installation of the LMS511 2D LiDAR sensor – Ethernet cable pin assignment

5.4.3   Connecting to the customer interface

Set up the client interface for TEMS Manager to enable the transfer of measurement results and status messages.

▶ Connect the **Ethernet 1** connection of the Traffic Controller to the Ethernet connection of the relevant client.
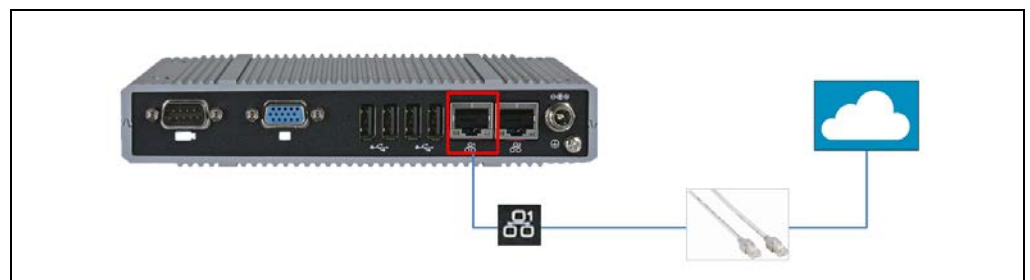
Fig. 94:   Electrical installation of the LMS511 2D LiDAR sensor – Connecting the customer interface to the client

5.5 Ethernet switch connection to the power supply

The cable for connecting the Ethernet switch to the voltage supply must be supplied by the customer.

▶ Connect the Ethernet switch (which can be ordered as an accessory under part number **6043482**) to the voltage supply as shown below.
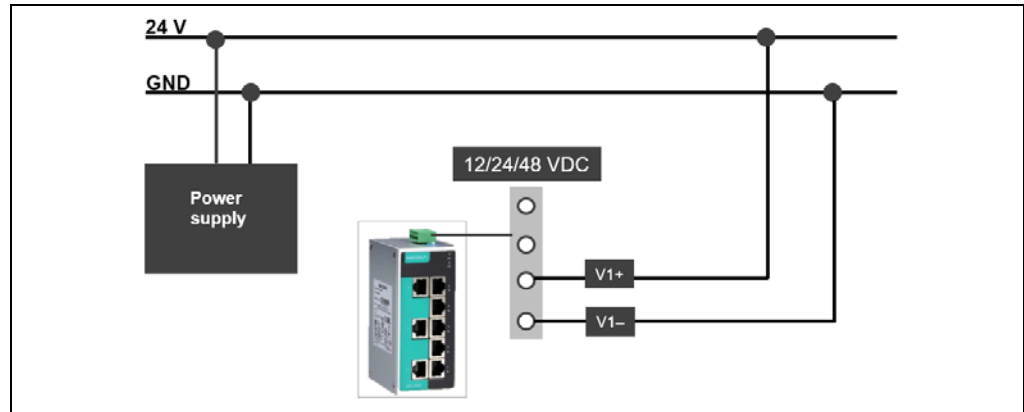
Fig. 95: Electrical installation of Ethernet switch

5.6 Electrical installation of the LMS Axle

5.6.1 Connecting the LMS Axle to the TIC102

The LMS Axle is connected to the TIC102 in the lane in which axles are to be counted. The connection is established via Ethernet cable.

Configuration for a lane with axle counting

The LMS Axle is connected to the TIC102 Master in series for configuration of a lane with additional axle counting.

The two devices must be supplied separately with voltage.
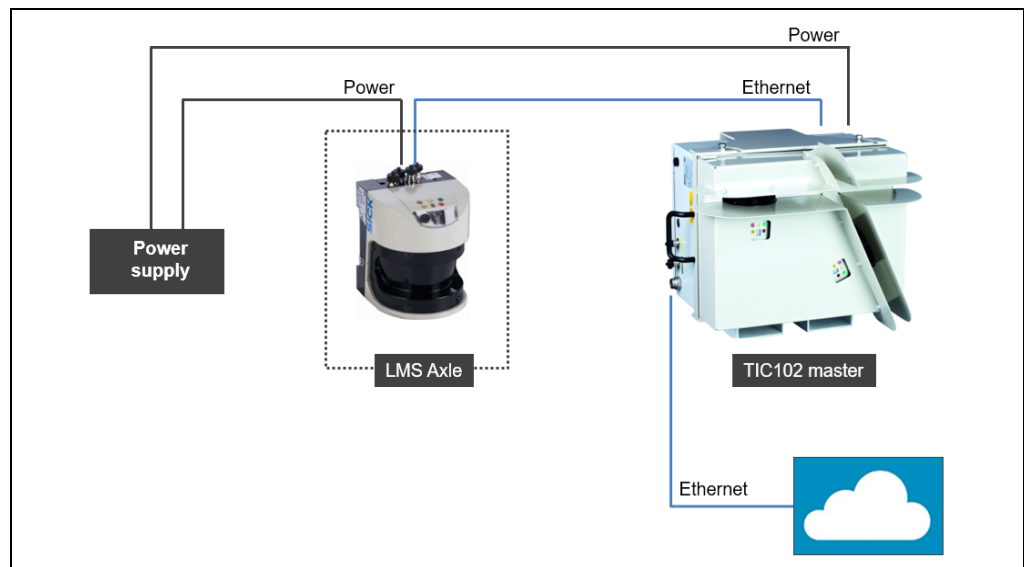
Fig. 96: LMS Axle electrical installation – TIC102 (1 lane with axle counting)

Configuration for two lanes with axle counting

Two TIC102 units are extended by one LMS Axle each for the configuration for two lanes with additional axle counting. An Ethernet cable in series connection is used for the connection.
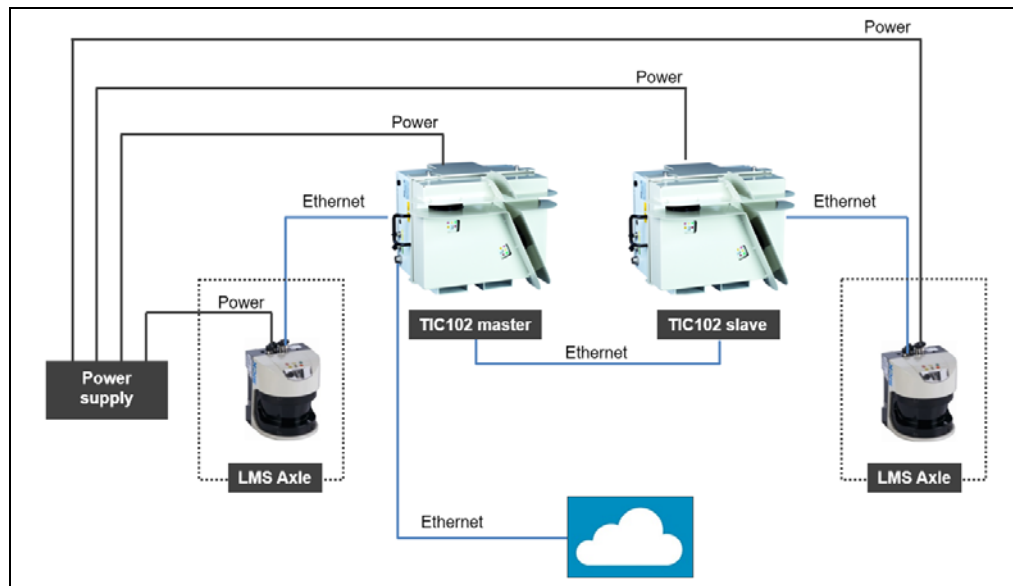
Fig. 97:   LMS Axle electrical installation – TIC102 (2 lanes with axle counting)

5.6.2   Connecting the LMS Axle to the TIC502

The LMS Axle is connected to the Ethernet switch and supplied separately with voltage. The LMS Axle is assigned via TEMS Manager.

Configuration for two lanes with axle counting

The following figure shows the monitoring of two lanes using two TIC502 units. Each TIC502 is assigned to an LMS Axle.
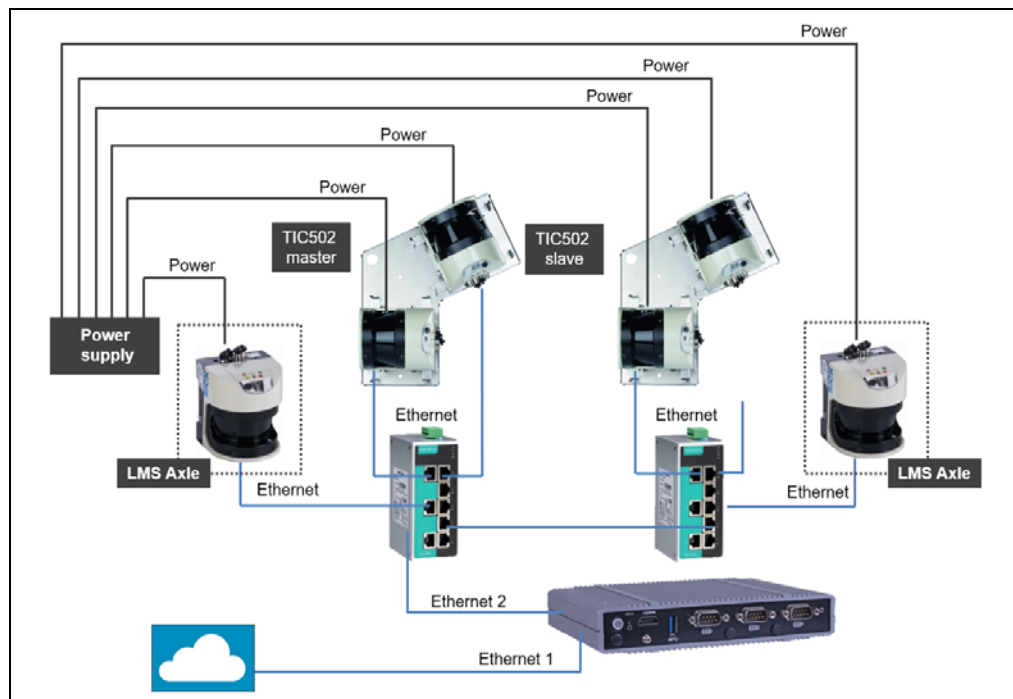
Fig. 98:   LMS Axle electrical installation – TIC502 (2 lanes with axle counting)

5.7   SICK connecting cables for 2D LiDAR sensors

LMS511 2D-LiDAR sensor

	Accessories	Description	Part number
	Power connecting cable	Voltage supply with 5-pin M12 coupling and open cable end (electronics and heating), 20 m	6050687
	Connecting cable Ethernet from 2D LiDAR sensor to Ethernet switch	Connecting cable with M12 male connector 4-pin / RJ45, 20 m	6050685
	Ethernet data cable from network switch to Traffic Controller TIC	Head A connection type: male connector, RJ45 Head B connection type: male connector, RJ45 – 3 m	6026083

Ethernet switch

	Accessories	Description	Part number
	Ethernet switch	8 ports, permissible operating temperature –40 °C … +75 °C	6043482

Note   For additional accessories, please visit *www.sick.com*.

6   Commissioning

> ⚠️ **WARNING**
>
> **Avoid strong vibrations and jolts at the measurement site**
>
> ▶ Do not allow the system components of the profiling system to be exposed to excessive vibrations or jolts as a result of construction work at the measurement site or within its immediate vicinity (work involving compressors, road rollers/compactors, etc.).
>
> ▶ Switch off all components of the profiling system if strong vibrations are anticipated.

6.1   Starting the profiling system

Switch on the voltage supply.

The system starts up automatically when the power supply is connected.

Checking operating state

All components of the profiling system are checked for operational readiness.

The LED display for the connected devices indicates the device status during the power-up cycle.

Operating state after 60 s

The system is ready for operation after approximately 60 seconds.

▶ Check the operational status of the components by looking at the status indicators.

6.2   Connecting to TEMS Manager

In principle, TEMS Manager can be started from any client computer that is connected to the Traffic Controller via the external customer network.
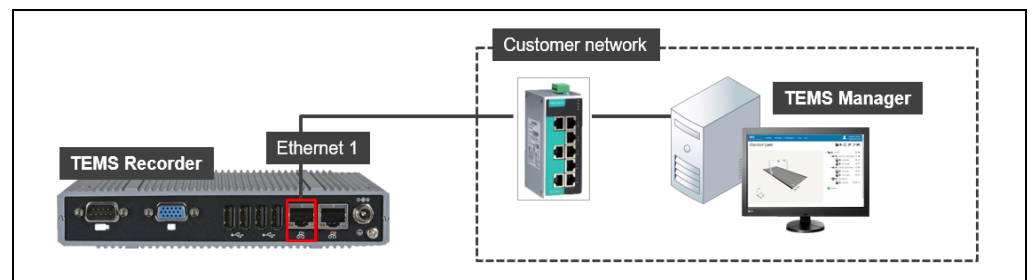
Fig. 99:   Connection between TEMS Manager and client computer

Prerequisites

- An up-to-date version of a web browser must be installed on the client computer.
- This browser must support **HTML5** and **WebGL**.

6.3 Configuring the IP address of the Traffic Controller (= customer interface)

Upon delivery, the default IP address of the Traffic Controller is 192.168.10.200.

The IP address of the Traffic Controller is configured in TEMS Manager. If you want to connect to TEMS Manager from a client computer, the IP addresses of the Traffic Controller and the client computer must be in the same address range.

The default IP address of the Traffic Controller usually differs from the address range of the customer network. Therefore, the first step is to change the IP address of a configuration PC that is not connected to the customer network to make it compatible with the address range of the Traffic Controller.

Only then will you be able to access TEMS Manager and change the IP address of the Traffic Controller to the address range of the customer network.

Changing the IP address of the configuration PC

1. Change the IP address of the configuration PC. Assign an IP address within the address range of the Traffic Controller.

2. Connect the configuration PC directly to the Traffic Controller via the **Ethernet 1** interface.

   For a TIC102, lead a corresponding Ethernet cable from the TIC102 Master to the control cabinet and connect it there with the configuration PC.
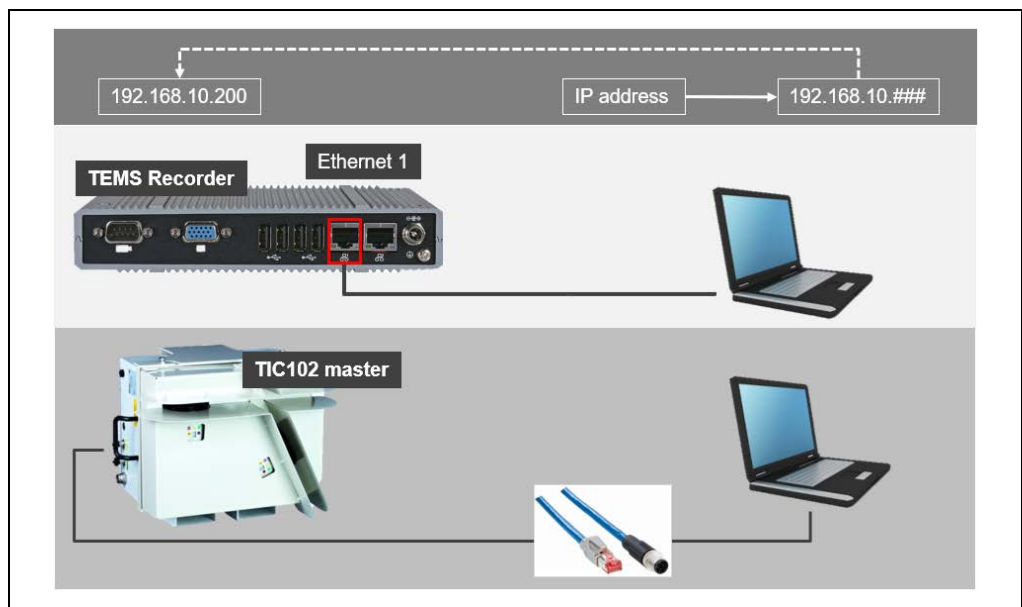
Fig. 100: Changing the IP address of the configuration PC

Starting TEMS Manager

Now connect to TEMS Manager via the configuration PC.

An up-to-date version of a web browser must be installed on the configuration computer. This browser must support **HTML5** and **WebGL**.

1. Start the web browser on the configuration PC.

2. Enter the default IP address of the Traffic Controller in the address line.

As soon as the connection to the Traffic Controller has been established, the TEMS Manager web interface opens.
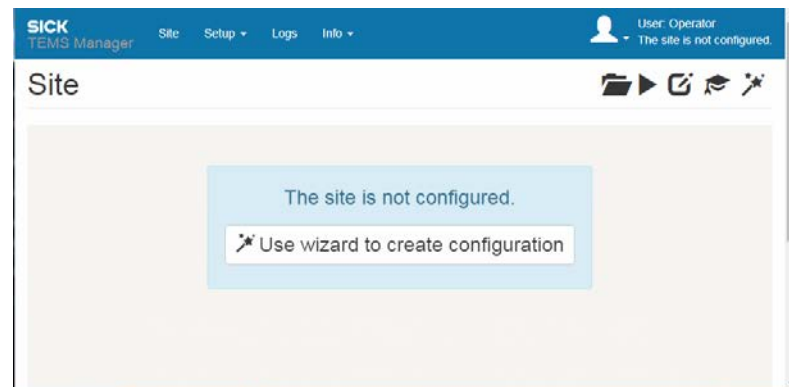
Adjusting the IP address of the Traffic Controller

1. Click the **Setup** menu and select the **IP Configuration** function.

   The authorization must be **Service**.
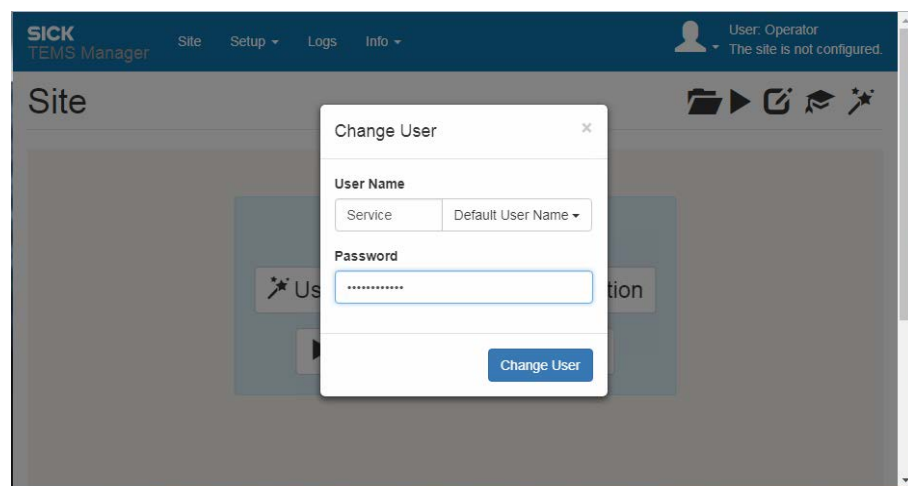
2. Click in the **User name** field. Enter **Service** in the user name field and log in with the default password set up for this purpose (for more information, see appendix at *9.5 Users and authorizations*).

The IP address configuration interface opens. The Traffic Controller is displayed with its default IP address.
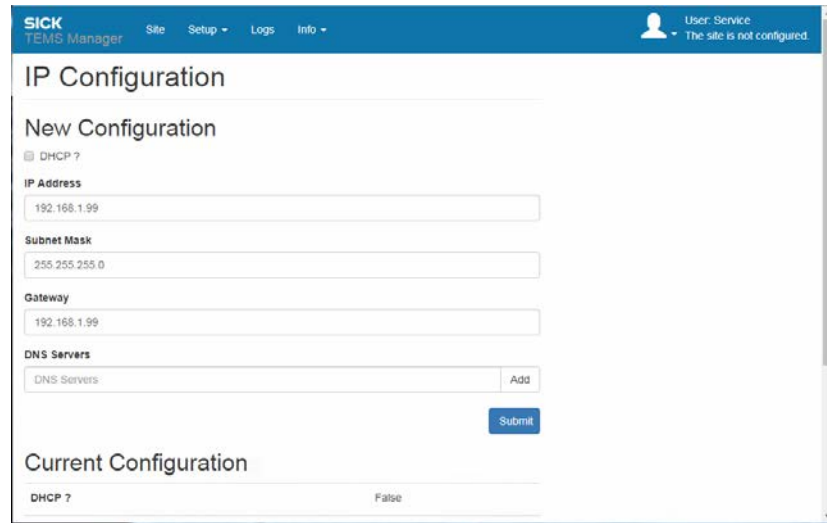
3. Define the IP address that is to be used for accessing the Traffic Controller on the customer network.

4. Enter the customer network **Gateway**. If no IP gateway has been defined or if none is required, use the same address as for step 3 above.

Note   Take care to enter the IP address correctly so that the Traffic Controller can be subsequently found on the customer network.

5. Press **Submit** to confirm.

Resetting the IP address of the configuration PC

As soon as the IP address has been changed, TEMS Manager is automatically accessed via the new IP address. Consequently, communication between the configuration PC and the Traffic Controller is no longer possible.

Now the configuration PC must be configured to an IP address within the address range of the customer network.

1. Change the IP address of the configuration PC. Assign a free IP address from the address range of the customer network.

2. Start the web browser on the configuration PC.

3. Establish a connection with TEMS Manager via the new IP address of the Traffic Controller.
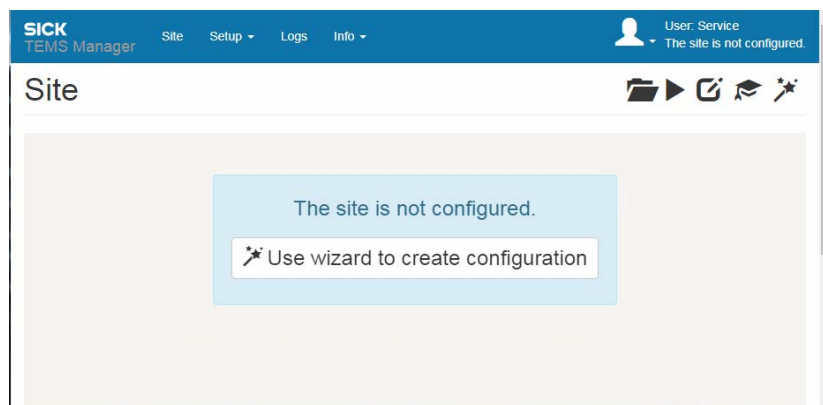
6.4 Setting up the site configuration with the wizard

A wizard is used to help you select system functions. The selected system functions can then be adjusted to the measuring site in the next step.

Launching the wizard

Start the wizard for selecting the site configuration on the start page.

▶ Click on **Set up site configuration with the wizard**. The site configuration wizard opens.
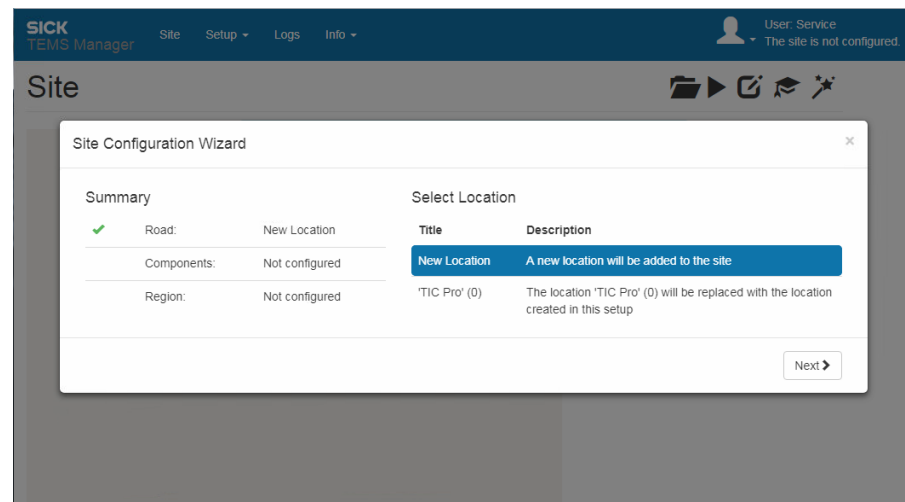
The **summary** on the left-hand side shows the pages of the wizard that must be completed depending on the components selected. When you have completed configuration on one of these pages, it will be marked with a tick.

On the right-hand side, settings are adjusted for the page selected. As no site configuration has been created yet, the **New site** option is highlighted.

Click **Next** to switch to the next page of the wizard.

Note

On a smaller screen, the **summary** area appears above the input area.

6.4.1   Selecting system functions

On the second page, select the initial system functions for vehicle measurement.
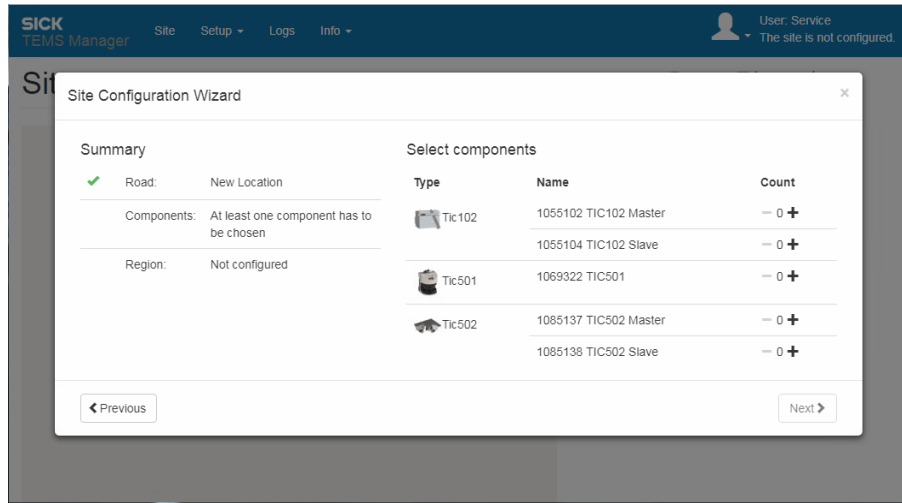
Depending on the number of lanes to be monitored, select the number of required system functions with the plus icon. You can select up to a maximum of three slaves for the TIC102 and TIC502. The maximum number of four system functions is the limit for the TIC501.

Side strip   Also clarify whether the site provides a side strip. This information only affects the visualization of the measurement site in TEMS Manager.

The system components for counting axles are shown at a distance from the lane. The master is assigned to the lane which is directly adjacent to the side strips for the TIC102 and TIC502.

The side strip is not included in any system function.

In the following example, we will configure a site with a TIC502 Master and TIC502 Slave.

▶ Click on the plus icon in the master bar. The counter increases by one. The selected system function appears at the top under **Components**.

▶ The plus icon is then deactivated as only one master can be selected per system.

▶ Click on the plus icon in the line below and extend the site to include the required number of slaves.
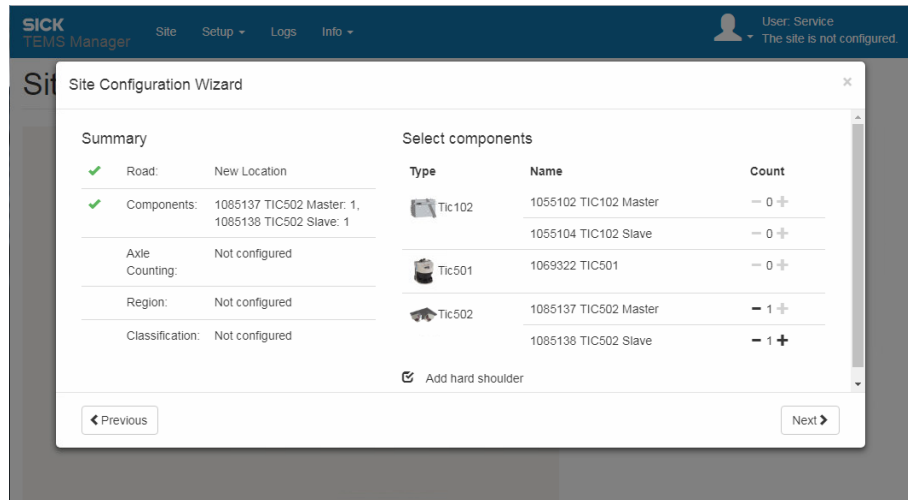
━ You can use the minus icon to delete selected system functions from the site configuration.

6.4.2   Selecting axle counting

On the **Select axle counting** side, you can extend the site configuration to include the **Axle Detector** system function.
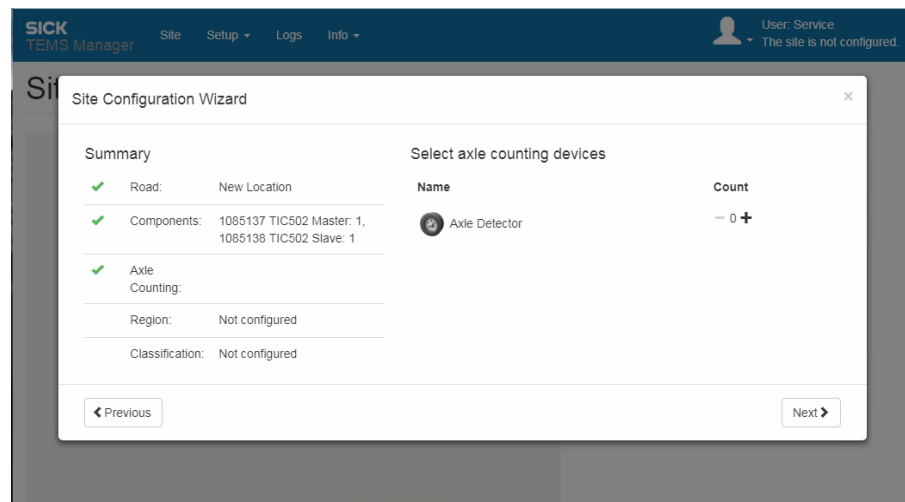
▶ Click on the plus icon and define the number of system functions used.

A site configuration can be assigned a maximum of two **Axle Detector** system functions.

Note   If your site configuration does not provide for axle counting, change directly back to the next wizard page using **Next**.

6.4.3 Selecting a region

On the third page, define the region in which the category system will be used.

This limits the number of category systems available on the fourth page of the wizard.
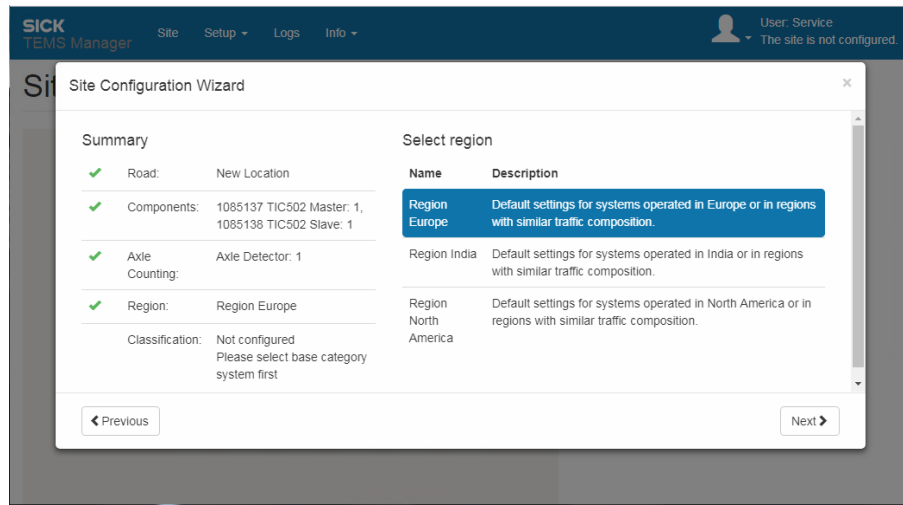
▶ Select **Region Europe** for all European countries. Vehicles are identified by comparing criteria for 28 vehicle classes. The class representing the closest match is allocated to the vehicle.

▶ Select **Region North America** for the USA and Canada. Vehicles are identified by comparing them against 30 vehicle classes. The class representing the closest match is allocated to the vehicle.

Note The most appropriate classification system can be evaluated with your SICK representative.

6.4.4 Defining the classification system

On the **Classification** page, specify the basis for which the vehicles are to be classified.
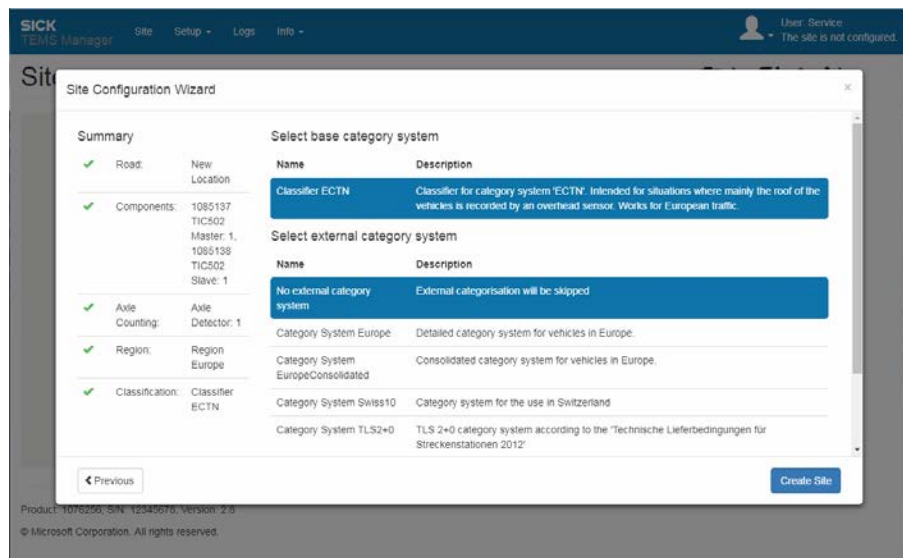
Selecting the basic category system

- If you have selected the **Europe** region, the **ECTN classifier** basic category system is automatically assigned to the region.

- If you have selected the **North America** region, the **NorthAmericaDetailed** basic category system is automatically assigned to the region.

Note   For the TIC501, you must indicate whether the system components are mounted on the side or overhead. This specification can optimize the calculation logic for the determination of the vehicle class regarding the mounting position.

Selecting an external category system

▶ Specify which external **output category system** you want to use depending on the selected region.

With the **output category system**, vehicles are no longer identified on the basis of the individual vehicle classes within the category system. Instead, they are identified using classification groups (traffic checking regulations).

If you have selected the **ECTN classifier** for the **Europe** region, the external categories available to choose from are **Europe**, **Swiss10**, **TLS 2+0**, **TLS 5+1**, and **TLS 8+1**. For example, the **TLS 2+0** external category system includes two classification groups: **Car or similar** and **Truck or similar**.

6.4.5   Completing site configuration

Once you have completed all the entries and all the pages are marked with a tick, you can quit the wizard.

▶ Click the **Set up site** button. The wizard closes.

The site opens in editing mode in TEMS Manager.

6.5   Working in TEMS Manager

This chapter provides an overview of how to visualize the measurement site in TEMS Manager once the site configuration wizard is complete and it tells you what editing methods are available.

6.5.1   The user interface

The **menu bar** containing the main workspaces is visible in every working context.

The layout and structure of each workspace depends on which working context has been selected.
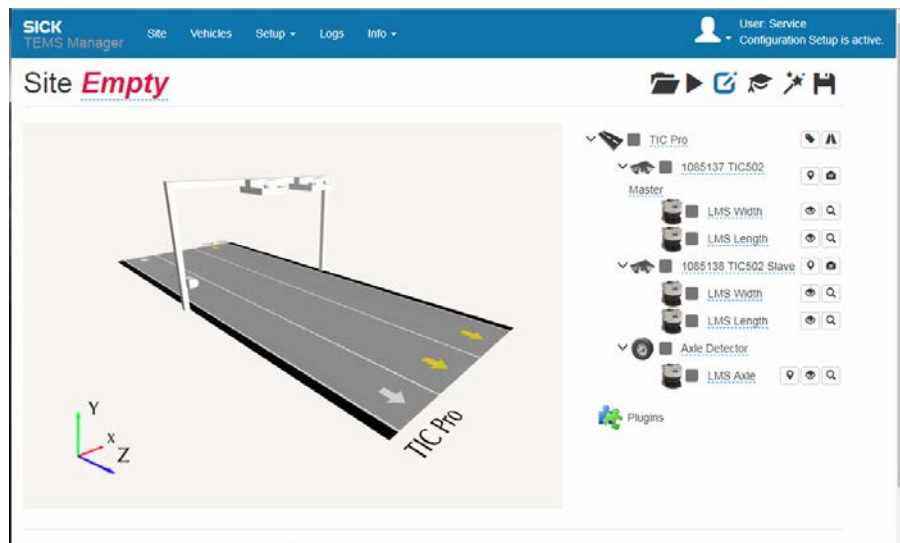
For users with the **Operator** and **Authorized user** authorizations, the **Location**, **Vehicles**, **Logs**, and **Info** registers are available.

The **Settings** register is restricted to users with the **Service** authorization.

Working range	Meaning
Location	Shows the measurement site in a live view. It also allows you to display the system parameters and current system status.
Vehicles	Displays the measurement results during operation.
Settings	Contains administrative functions. This allows you to change passwords or update the system, for example.
Logs	Contains the system log files.
Info	This provides information to the TEMS Recorder and facilitates file uploads and downloads.

Note   The menu bar also contains notes on system faults.

Login information

The right-hand side of the menu bar shows the logged-in users and the operating status. The **Configuration is running** entry tells you that the profiling system is operating properly.
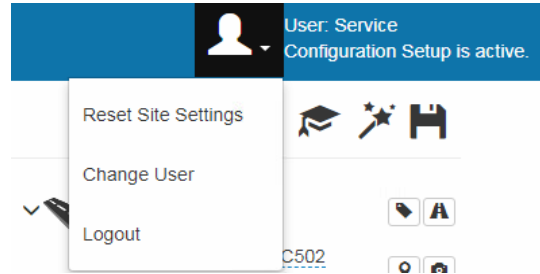
The user icon opens a menu with the following functions:

Function	Meaning
Resetting page settings	Sets all display settings (zoom, rotation in 3D displays, table displays, etc.) back to standard values. This function is particularly useful if the gantry is no longer visible in the live view because of the adjustments you have made to the 3D scenery.
Change users	Log out current user and log in another user.
Logout	Log out current user.

Reopening the start page

Clicking the program name reloads TEMS Manager. This makes the start page reappear with the **Site** workspace open.

Notes concerning system faults

The navigation bar also alerts you to any system faults.

In this case, a red exclamation point appears in the **Site** workspace.

On the right-hand side, a corresponding note is displayed in red.

Please see *8.3.1 Fault diagnosis in TEMS Manager* for details of how to proceed.

Display format on small screens

The TEMS Manager display format automatically adjusts to the size of the screen. On a smartphone or tablet, the content is arranged from top to bottom.
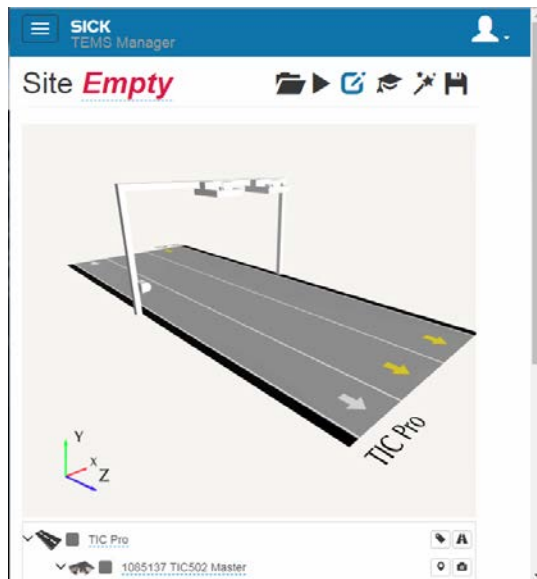
▶ Click the menu icon to access the individual workspaces in TEMS Manager.
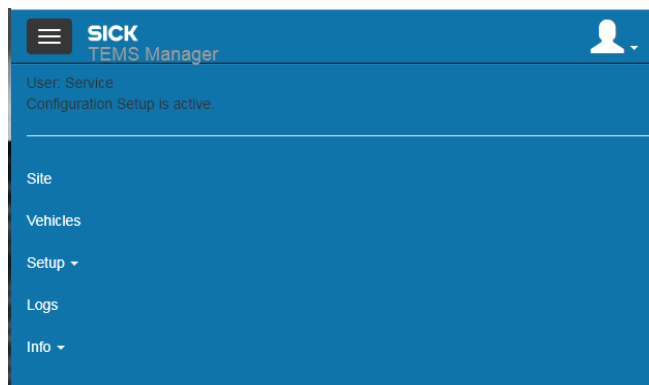
6.5.2   Displaying the measurement site

The **Site** register is divided into two.
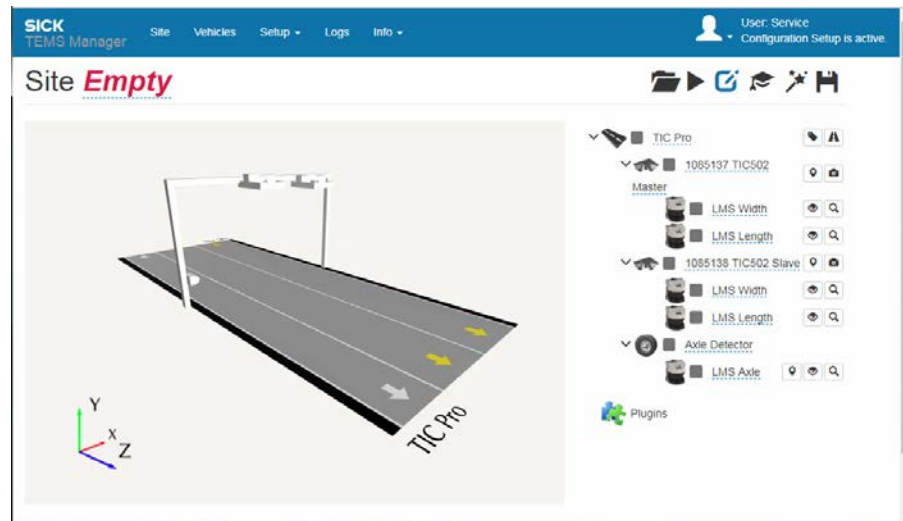
- The **navigation area** on the right-hand side contains all the system functions that have to be adapted to the measurement site. These are all functions that are connected to a system component.

  The system functions are displayed in a hierarchical structure:
  Lane → System function → System components.

  The lower section lists plug-ins for selecting and configuring the recorded measured values, vehicle data, and status information.

- The view on the left-hand side shows the **measurement site** with the road, lane(s), and direction of travel, along with the **system components**, the installation site, and the status display.

  During operation, this is where the vehicles detected by the profiling system are displayed as a live 3D model in TEMS Manager.

  The raw measurement data supplied by the 2D LiDAR sensors can also be displayed here.

The toolbar above the navigation tree offers the following functions in editing mode:

Icon	Meaning
	Load site configuration and start/edit it Allows you to load a configuration file. You can either start the configuration or open it in editing mode instead.
	Start current site configuration Starts the configuration that is currently open in editing mode. A red number in the icon indicates that the configuration is erroneous. Erroneous configurations cannot be started. Faulty configuration can occur after running through the site configuration wizard if devices with the same IP address have not yet been assigned to the system components (for more information, see chapter *6.6.2.3 Assigning devices to vehicle detection components*).
	Edit site configuration To quit editing mode, click the blue icon. The configuration remains loaded. To reopen the configuration file in editing mode, click the icon again. Click the ▶ icon to restart the loaded configuration file.
	Activate/deactivate expert mode Switches the export mode on and off. Expert mode displays all system functions in the navigation area and functions for editing the parameter values, etc., (see chapter *6.6.4 Working in expert mode*).
	Start the configuration wizard Opens the configuration wizard with the current site configuration. The site configuration can be edited and stored in the wizard.
	Save current site configuration on hard drive Saves the current site configuration onto a data card.
	Reset site configuration Resets all the changes that have been made to the system parameters in editing mode, but only after you confirm the prompt. The navigation tree will then be completely blank. The icon only appears in expert mode.

Adapting the graphic display

You can use the tools in your browser to adjust the view of the measurement site. In the TEMS Manager graphical user interface (GUI), you can zoom in and out of the site, move the view, and rotate it about the vertical and horizontal axes. To do this, you have to click on the graphic interface.

Function	Meaning
Rotate ↺	Rotates the site clockwise or counterclockwise on the GUI when you press and hold the **left** mouse button.
Move ✛	Moves the site up, down, right, and left when you press and hold the **right** mouse button.
Zoom in/ out ⊕	Enlarges or reduces the display of the site via the mouse wheel when the mouse pointer is on the graphical display. If you want to increase or decrease the zoom increments, press and hold the Shift key at the same time.

Tab. 18: Functions for displaying the measurement site in TEMS Manager

Controlling the graphical display with touch gestures

If you are using a computer with a touchscreen, you can control the graphical display with certain touch gestures. This involves swiping or dragging your fingers across the screen.

Function	Meaning
Enlarge	To zoom in, touch the graphical display with your thumb and index finger, and spread them apart. This is called the "zoom gesture".
Reduce	To zoom out, touch the graphical display with your index finger and thumb, and slide them together. This is called the "pinch gesture".
Rotate	Place your index fingers on the graphical display and drag them in the desired direction to make the measurement site rotate accordingly.

6.6   Adapting system functions to the measurement site

Once you have completed the site configuration wizard, all the system functions should be available, and correctly interconnected.

All system functions that then have to be adapted to the measurement site are displayed in the navigation area.

You have to enter information about the measurement site, store the correct position and rotation of the system components, assign devices to the system components, and configure the IP addresses.

Recommendation   ▶ Work through the hierarchical structure in the navigation tree from top to bottom when editing the system parameters.

Note   You can still configure the measurement site and system functions even if you have not yet connected or linked any devices. You must know the mounting position of the system components.

If it is necessary to assign the devices to the system components and configure the IP addresses, this takes place in a subsequent step.

6.6.1   Configuring the measurement site

6.6.1.1   Adapting information about the measurement site

The first step is to adjust the details of the measurement site.

All the designations underlined in blue can be changed by clicking the relevant designation. An input field then appears so that you can enter the desired text.

Specifying the measurement site designation

1. Click the current designation underneath the header and enter the new name.

2. Click the Enter key to confirm.

Specifying the name of the road

1. Go to the road level in the navigation tree and click the **Edit road configuration** icon.

   An input line appears underneath the road per lane. The side strip is also listed as a lane.
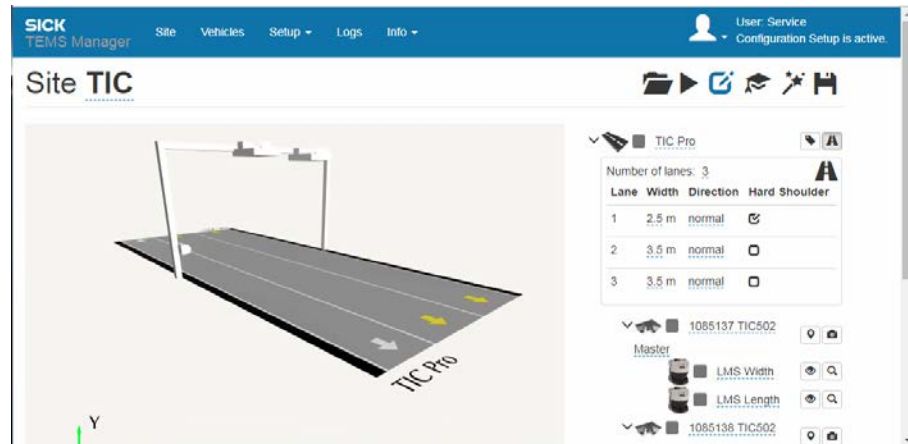
The values that you are allowed to change are underlined in blue.

2. Click the road name underlined in blue in the navigation tree.

3. Change the designation and click Enter to confirm.

Configuring the lanes, lane width, and direction of travel

1. For the TIC102 and TIC502, the number of the lanes to be monitored is specified by the number of the system functions specified in the configuration wizard. The following rule applies: A TIC102 or TIC502 system function monitors exactly one lane. You will not make any adjustments in this case.

   For the TIC501, the number of lanes must be checked and adjusted since a TIC501 system function can in principle monitor several lanes. Click the current value and then enter the desired number in the field that appears.

2. To complete the input process, press Enter.

3. Enter the width of the respective lane.

4. Define how you want the direction of travel to be displayed in the live view. With the **normal** setting, the arrow points from the top left to the bottom right.

6.6.1.2   Signing the configuration

By applying a signature, you can – for example – document that a particular configuration has been checked and approved. The signature is encrypted. It is generated when the configuration is saved and written to the XML configuration file. Among other things, the signature contains a reference to the configuration PC, the details of the logged-in user, and the date of saving.

Once a configuration has been signed it cannot be changed without removing the signature. This offers a reliable way of checking whether the configuration has been changed (e.g., following the latest standardization procedure).

1. Go to the road level in the navigation tree and click the **Sign road configuration** icon.

   Two input fields appear underneath the road.

2. Enter the name of the person who approved the configuration and add any other comments about the approval process.

3. The signature information is supplemented by a date field. Once the signature has been applied, the **Name**, **Notes**, and **Date** fields are deactivated and can no longer be changed.

   The **Sign road configuration** icon turns green.

4. To hide the signature area, click the **Sign road configuration** icon again.

Quitting editing mode

▶ To hide the input line in the navigation tree, click the **Edit road configuration** icon again.

6.6.2 Configuring system functions for vehicle detection

6.6.2.1 Defining the position and rotation of the LMS Width and LMS Length

Define the exact positions of the sensor components used for vehicle detection.
The values entered must be based on the zero-point of the coordinate system.

Roughly aligning components

Provisionally align the sensor components in the graphical display of the live view.

1. Click on a component in the live display.
2. Click on the component again and keep the mouse button pressed. A grid appears to serve as a guide.
3. Now move the component to the relevant plane.

Note   The orientation of the grid will automatically adapt to the current perspective of the live view. Rotate the measurement site in the live view to switch between displaying the grid along the X-axis and the Z-axis, respectively.

Precisely adjusting components
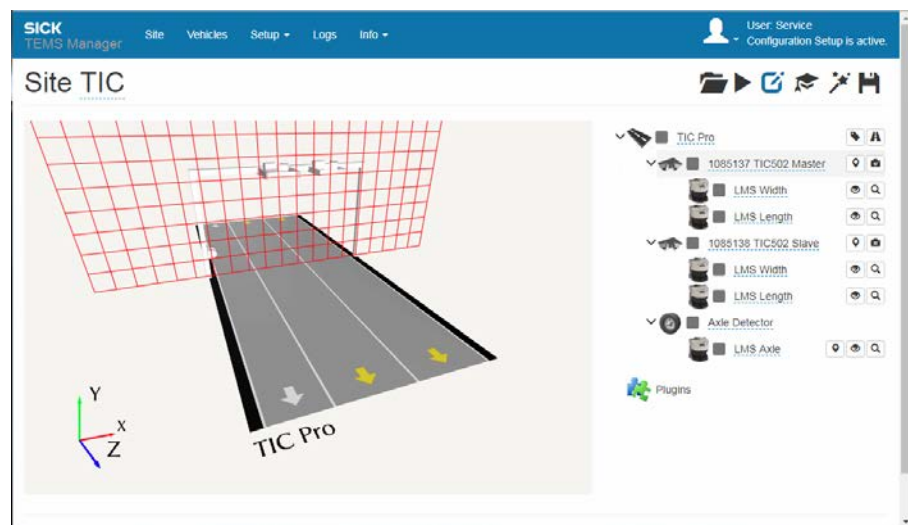
Now define the exact positions of the sensor components.

Note   Above all, pay attention to the positioning and alignment of the components in the X-direction. The devices are finely positioned in the Y-direction when starting the configuration via Floor Finding (for more information, see chapter *6.7 Running the configuration*).

The exact angle positions must be specified for a TIC501.

1. Go to the system function level in the navigation tree and click the **Edit system component position** icon.

   The input lines appear. These already contain the position values defined during rough alignment.

2. The position and angle can be defined using either the slide controls or by entering the values manually.

Tip   Place the mouse pointer on a slide control and turn the mouse wheel. The values increase/decrease in "standard" increments. To increase/decrease the zoom increments, simultaneously press and hold the *Shift* key or the *Ctrl* key, respectively.

3. Where necessary, adapt the view so that the effects of your changes are clearly visible in the GUI.

Position   When entering the position, please observe the alignment of the coordinate system:

- The X-axis lies straight across the width of the road. The first distance parameter X is measured from the origin of the right-hand edge of the lane (when viewed in the direction of travel).
- The Y-axis defines the height at which the component is mounted. The second distance parameter Y is measured from the surface of the road.
- The Z-axis points in the direction of travel. The third distance value is measured in relation to the measuring plane.

Note   In most cases, you do not need to adjust the Z-value if you have selected the components in the wizard. The value only needs to be adjusted if the components have accidentally been displaced or were not added using the wizard.

Rotation   The components can be rotated about the X-, Y-, and Z-axes.

- The components that are mounted overhead on the gantry must be attached so that they point down vertically. The Z value is preset at 180°.

Note   Accurate entries for the position and alignment of the system components will help to improve measurement accuracy later in the process.

6.6.2.2   Defining lines for determining the position of the vehicle

You can add lines to the configuration per TIC102, TIC502 or TIC501 system function to determine the position of the vehicle in the lane. If a vehicle passes over this line during the measurement process, a corresponding object location message will be sent via the TEMS Info interface.

The message contains the exact time at which the vehicle crossed over the line. This means that third-party systems (such as license plate cameras or DSRC antennas) can assign events from other components or select the correct image from a video stream.

Note   This mechanism is not suited for triggering time-critical tasks!

1. Go to the system function level in the navigation tree and click the **Edit system component trigger positions** camera icon.

   The input line opens for determining the positions of trigger lines.
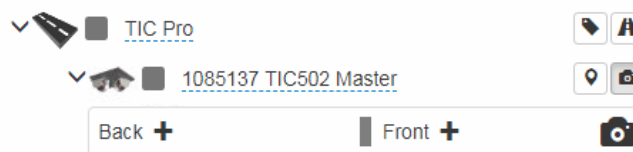
   Using the plus icon in the **Back** and **Front** areas defined trigger lines based on the zero point of the Z-axis.

2. Use the slide control to position the position line or enter a value manually using the input field. The line will be displayed in the visualization.
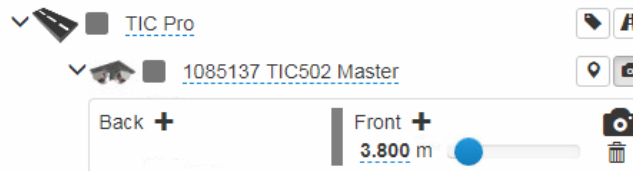
Note   A maximum of three trigger lines can be defined per system function.

6.6.2.3   Assigning devices to vehicle detection components

Manual assignment of the 2D LiDAR sensors to the components of a system function is required if the measurement site contains **more** than one **TIC102 Slave** or **TIC502 Slave** system function. When using only **one** TIC102 Slave or TIC502 Slave, all devices can be **automatically** assigned to the components of the system functions with their factory setting IP addresses.

When using the **TIC501** and **Axle Detector** system functions, **assignment** of the 2D LiDAR sensors can **generally** be made to the system components.

The following cases can be differentiated for assignment of the devices to the system components:

- **Device assignment for several TIC102 Slaves:** To correctly assign the 2D LiDAR sensors to the TIC102 Slaves used, you need the serial numbers that you recorded before mounting (see chapter *4.2.1.1 Noting the serial numbers of the 2D LiDAR sensors for several TIC102 Slaves*). The identical IP addresses of the TIC102 Slave are adjusted during device assignment.
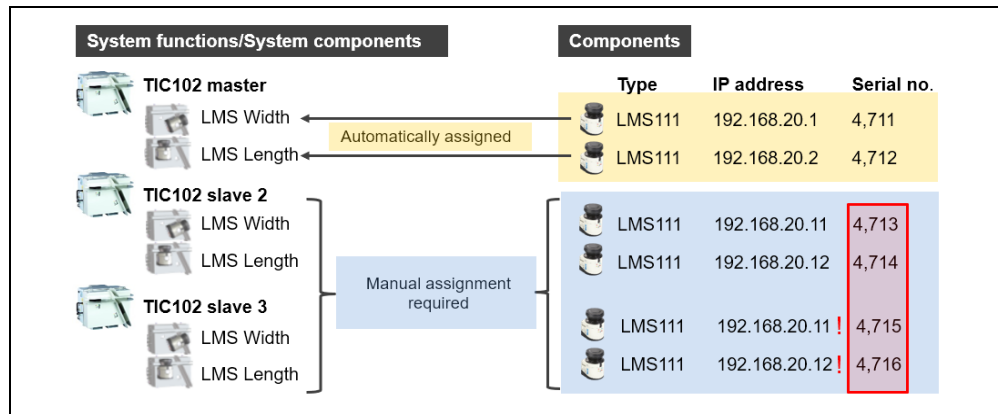
- **Device assignment for several TIC502 Slaves:** To correctly assign the 2D LiDAR sensors to the TIC102 Slaves used, you need the serial numbers that you recorded before mounting (see chapter *4.2.1.1 Noting the serial numbers of the 2D LiDAR sensors for several TIC102 Slaves*). The identical IP addresses of the TIC502 Slave are adjusted during device assignment.
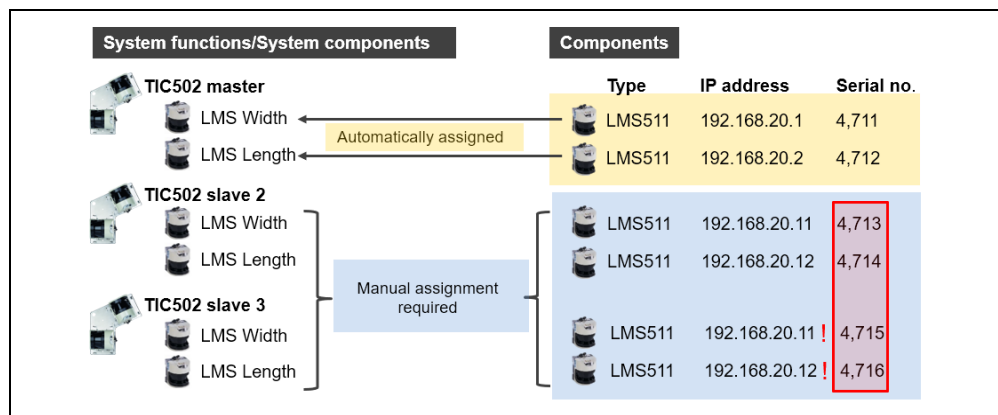
- **Device assignment for the TIC501:** For the TIC501, the 2D LiDAR sensors are generally assigned manually to the system component, regardless of how many TIC501 system functions are used. For assignment, you need the serial numbers that you recorded before mounting the scanners (see chapter *4.2.3.1 Noting the serial numbers of the 2D LiDAR sensors of the TIC501*).

  The IP address of the sensors must be changed to the address range of the internal sensor network 192.168.**20**.x.
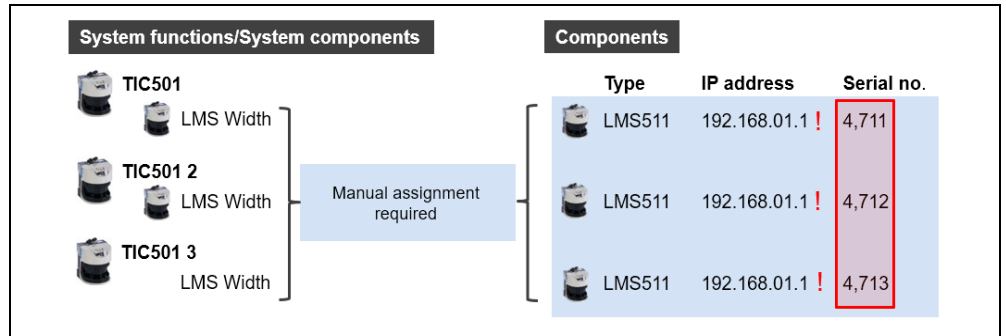
The assignment of the 2D LiDAR sensors to the system components takes place via the device search. This is started on the level of the respective system component via the **Start device search** magnifier icon.

Example **Running device search for several TIC102 Slaves**

The following example shows the process for a site with one TIC102 Master and two TIC102 Slaves.

In the navigation area, the system components are listed with a red number which cannot be automatically assigned to a system function.

As part of the device assignment process, the conflict between the identical IP addresses is also resolved by changing the IP addresses.
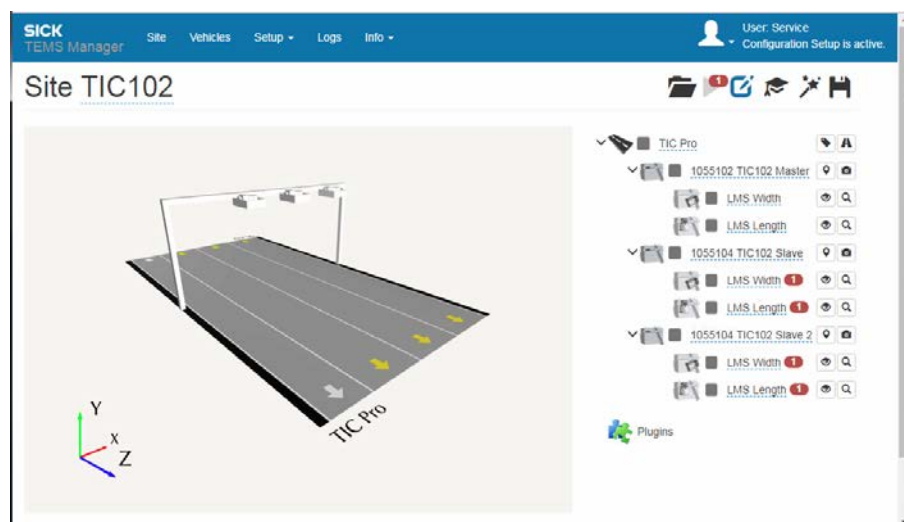
Note ▶ Move your cursor over the number to open a window with the corresponding details.

In the example, we start the device search for the **LMS Width** component of the **TIC102 Slave 2.**
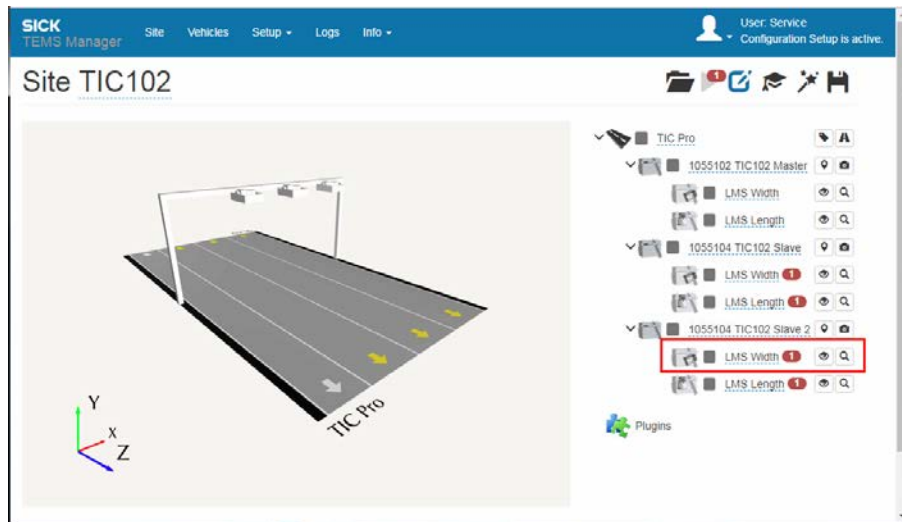
1. Click the **Start device search** magnifier icon. The list of assignable devices is currently empty.
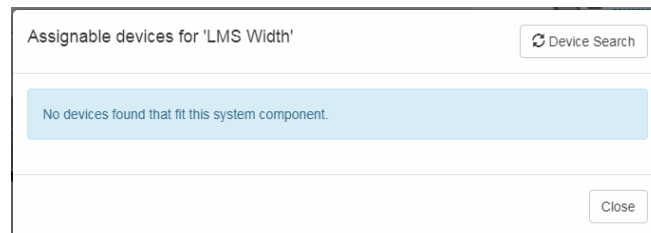
2. Click the **Device Search** button. The devices connected to the Traffic Controller appear in the list of devices along with their IP address, firmware, and serial number.

   2D LiDAR sensors with a yellow background color are already assigned to other system functions. In our example, the 2D LiDAR sensors are for the **TIC102 Master** system functions.
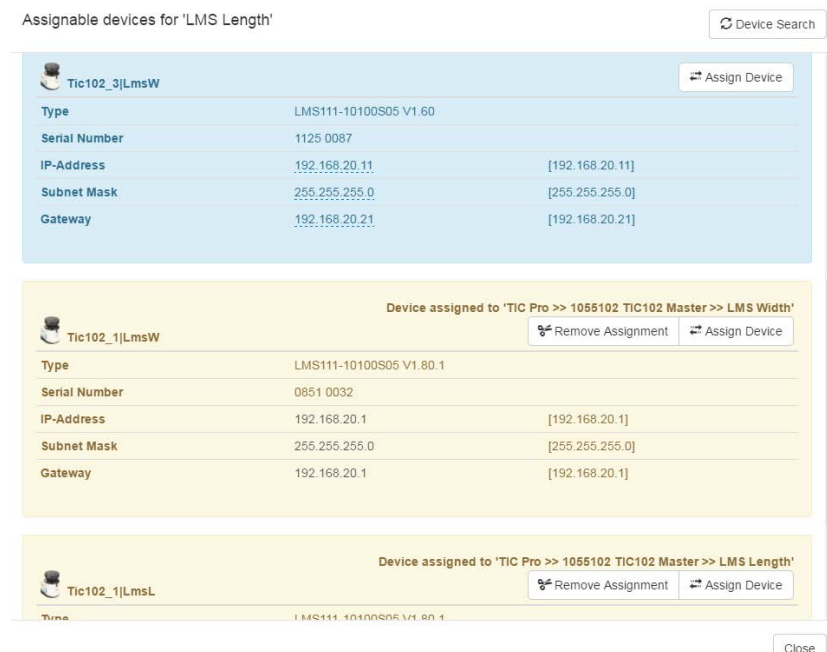
2D LiDAR sensors with a blue background are yet to be assigned. In the example, these are the four sensors of the **TIC102 Slave** and **TIC102 Slave 2** system component.
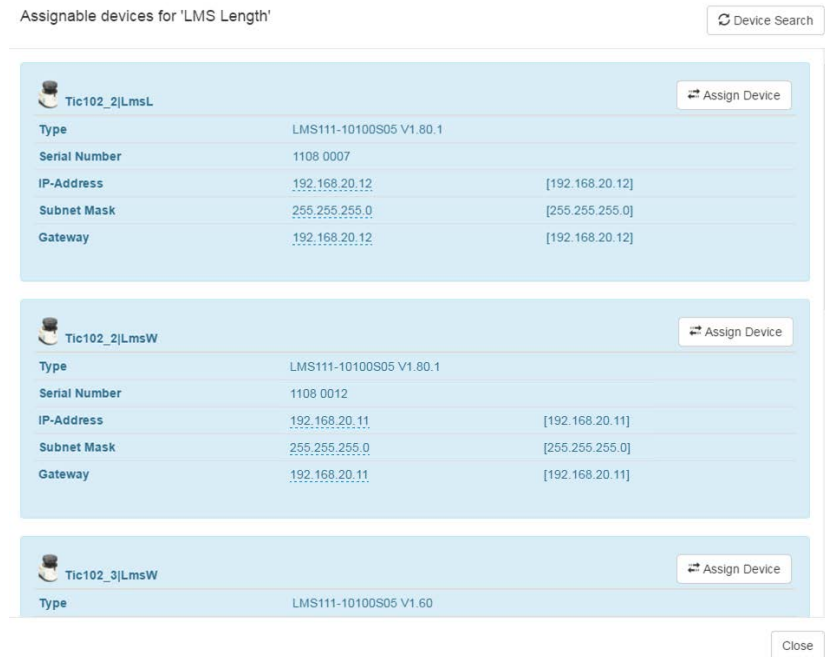
3. **Search** for the component with the **matching serial number** and change its IP address. To do this, click on the IP address. Make sure that the new IP address is unique. It must not be the same as the default IP address (192.168.20.11 or 192.168.20.12).

   The label for the **Assign device** button changes as a result of changing the IP address in **Prepare device**.
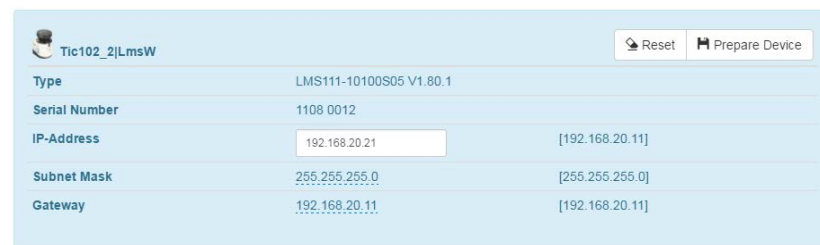
Note   The system suggests a new IP address for one or two LMS Width units and shows it in bold print. If the serial number fits, you can take the suggestion or define an individual IP address as described. Otherwise click on the device with the matching serial number and change the IP address there.

4. Now click on **Prepare device** with the correct serial number and the changed IP address. The button then reverts to **Assign device.**

5. Click **Assign Device**. The sensor is assigned to the **LMS Width** system component. In the list of devices, the 2D LiDAR sensor now appears with a green background.
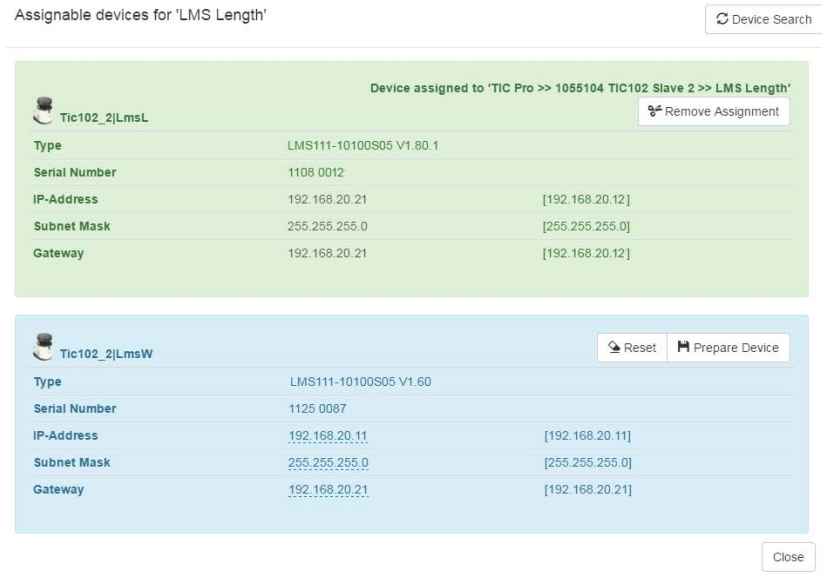
The green background color indicates that the assigned device belongs to the current component. The devices yet to be assigned are still blue.

Note   Accidentally assigning the LMS Width to an LMS Length is prevented by the system.

6. Once the change has been made, click **Close**.

The device search closes. The red circle containing the error number has now disappeared from both **LMS Width** listings.
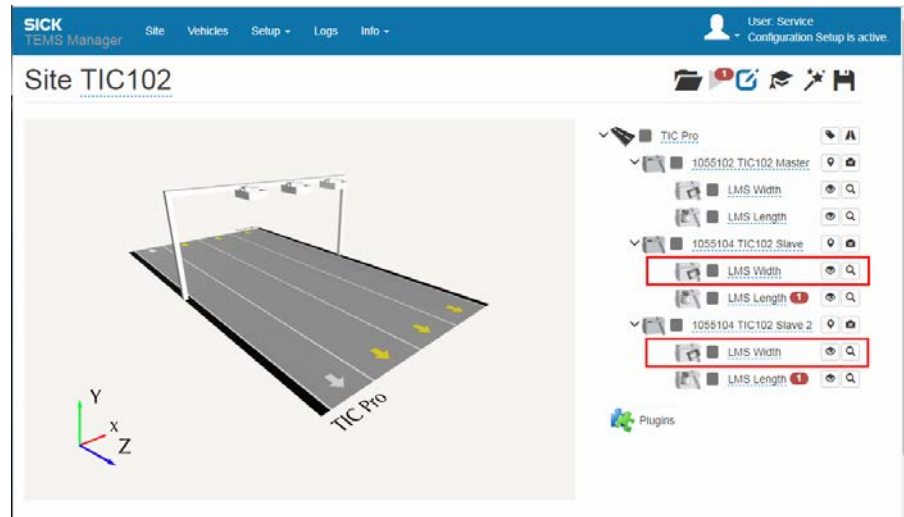
7. Apply the same process when assigning devices for the two 2D LiDAR sensors to the **LMS Length** system components. Start again with the system component of the **TIC102 Slave 2** system function.

All red error numbers must have disappeared by the end.

6.6.3 Configuring system functions for axle counting

6.6.3.1 Defining the position and rotation of the LMS Axle

Define the exact position and rotation of the LMS Axle. We recommend displaying the measurement points for the 2D LiDAR sensor in question for this process.

Notes   Please note: TEMS Manager always shows the LMS Axle on a gantry. You can move and rotate the 2D LiDAR sensor freely in any direction and thus define a mounting position independently of its position on the gantry.

The **LMS Axle** must be in the same Z-plane as the respective system function for vehicle classification.

Roughly aligning components

First align the 2D LiDAR sensor in the graphical display of the live view.

1. Click on a component in the live display.
2. Click on the component again and keep the mouse button pressed. A grid appears to serve as a guide.
3. Now move the component to the relevant plane.

Note   The orientation of the grid will automatically adapt to the current perspective of the live view. Rotate the measurement site in the live view to switch between displaying the grid along the X-axis and the Z-axis, respectively.

Precisely adjusting components
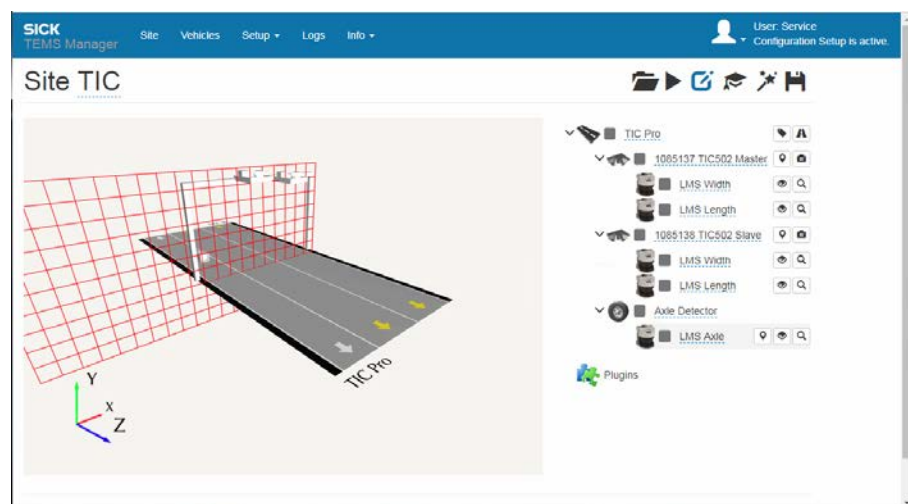
Now define the exact positions of the 2D LiDAR sensor.

1. Go to the component level in the navigation tree and click the **Edit system component position** icon.

   The input lines appear. These already contain the position values defined during rough alignment.

2. The position and angle can be defined using either the slide controls or by entering the values manually.

Tip   Place the mouse pointer on a slide control and turn the mouse wheel. The values increase/decrease in "standard" increments. To increase/decrease the zoom increments, simultaneously press and hold the *Shift* key or the *Ctrl* key, respectively.

3. Where necessary, adapt the view so that the effects of your changes are clearly visible in the GUI.

Position   When entering the position, please observe the alignment of the coordinate system:

- The X-axis lies straight across the width of the road. The first distance parameter X is measured from the origin of the right-hand edge of the lane (when viewed in the direction of travel).

- The Y-axis defines the height at which the laser 2D LiDAR sensors is mounted. The second distance parameter Y is measured from the surface of the road.

- The Z-axis points in the direction of travel. The third distance value is measured in relation to the measuring plane of the sensor components (when viewed in the direction of travel).

   Make sure that the LMS Axle is located exactly in the measuring plane of the other sensor components.

Rotation   Align the LMS Axle correctly on all three axes.

- Rotation about the **X-axis** (first field): The signal must be output at an angle of 90° in relation to the **road surface**.

- Rotation about the **Y-axis** (second field): The signal must be output at an angle of 90° in relation to the **direction of travel**.

- Rotation about the **Z-axis** (third field): The device's rear panel must be perpendicular to the road surface.

   A rotational error of ± 2° is tolerated for all axes.

Note   Accurate entries for the position of the system components will help to improve measurement accuracy later in the process.

Checking that the mounting position is correct

In the live view, check that the mounting position is correct by referring to the unfiltered raw data of the 2D LiDAR sensor.

1. Go to the component level and click the **Visualize live data for device** icon and then on **Measurement points** in the input line below. The measurement points appear.
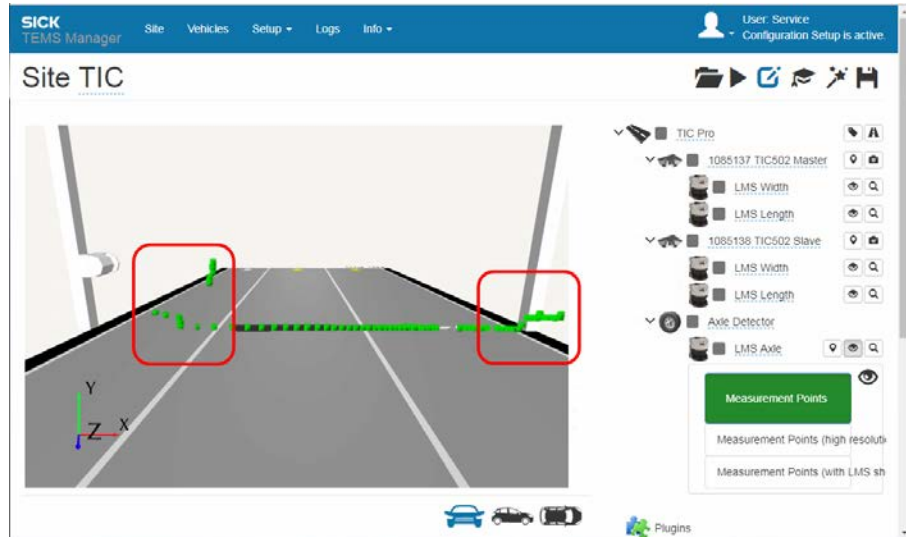
Note   The area at the bottom provides a detailed display of the measurement points within the coordinate system.

2. Adjust the Y-axis position so that all measurement points are visible on the road surface.

3. Adjust the angle of rotation and use the measurement points to check that the signal is being output as required.

4. Adjust the X position so that no permanent measurement points (e.g., lane dividers or borders) are visible within the lane. This is because the profiling system automatically limits the processing of measurement points to the width of the lane.

5. Filter the permanent measurement points by moving the 2D LiDAR sensor out of the measuring range on the X-axis.

Note   If you click on the expanded function again, the measurement points disappear from view.

6.6.3.2 Assigning devices to axle counting components

When using the **Axle Detector** system function, you must generally assign the 2D LiDAR sensors manually to the system components, regardless of whether the measurement site has one or two LMS Axle units. For assignment, you need the serial numbers that you recorded before mounting the scanners (see chapter *4.2.4.1 Noting serial numbers of the 2D LiDAR sensors of the LMS Axle*).

The IP address of the sensors must be changed to the address range of the internal sensor network 192.168.**20**.x.
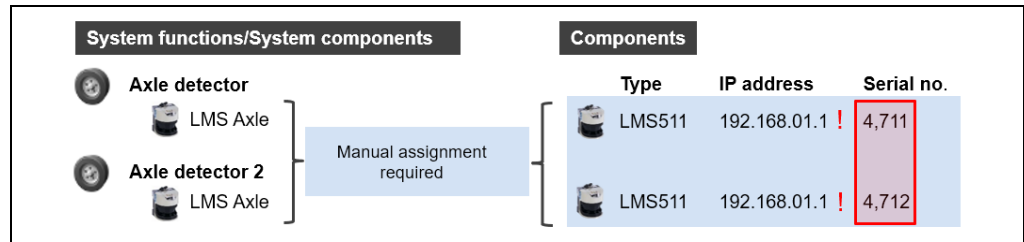
Fig. 101: Assigning devices to axle counting components

Note   The system assumes the assignment of the **Axle Detector** system function for vehicle detection. The first **Axle Detector** system function is assigned to the first TIC, the second **Axle Detector** system function to the second TIC or the outermost TIC. In a lane with two **Axle Detector** system functions, the two system functions are connected to the same TIC.

Example   In our example with an **Axle Detector** system function, the IP address of the sensor must be changed and the sensor assigned to the LMS Axle system component. IP address change and assignment is done using the device search (see chapter *6.6.2.3 Assigning devices to vehicle detection components* for the detailed process).
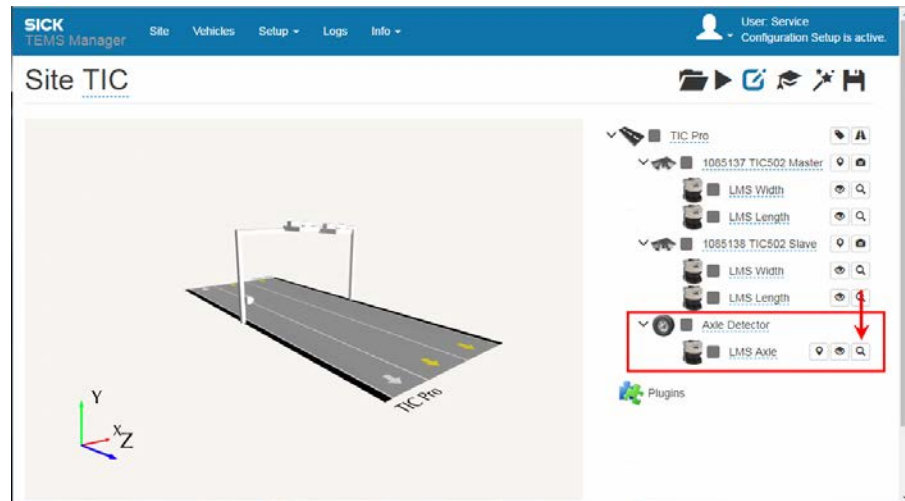
Running device search

1. Go to the level of the **LMS Axle** system component and click the **Start device search** magnifier icon.
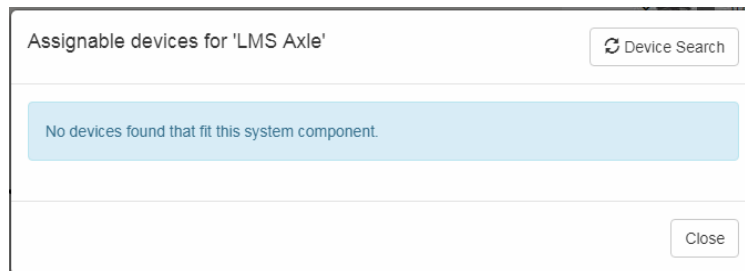
Assignable devices for 'LMS Axle'	⟳ Device Search
No devices found that fit this system component.	
	Close

2. Click the **Device Search** button. The devices connected to the Traffic Controller appear in the list.

3. Change the IP address of the sensor and confirm with **Prepare device**.

Assignable devices for 'LMS Axle'	⟳ Device Search
LMS	⇄ Assign Device
Type	LMS5xx_HeavyDuty V1.80.1-12.04.2018 V1.80.1
Serial Number	1602 1283
IP-Address	192.168.20.4 [192.168.20.4]
Subnet Mask	255.255.255.0 [255.255.255.0]
Gateway	192.168.20.1 [192.168.20.1]
	Close
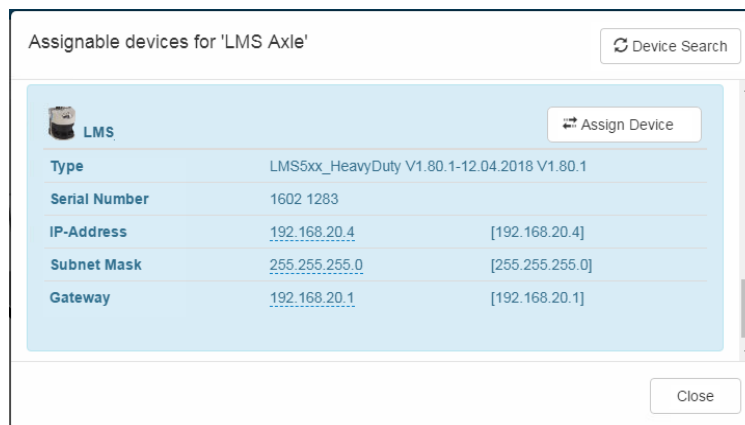
4. Click **Assign device** in the LMS Axle with the correct IP address. The sensor is assigned to the **LMS Axle** system component. In the list of devices, the 2D LiDAR sensor now appears with a green background.

Assignable devices for 'LMS Length'	⟳ Device Search
	Device assigned to 'TIC Pro >> Axle Detector >> LMS Axle'
LMS	✂ Remove Assignment
Type	LMS5xx_HeavyDuty V1.80.1-12.04.2018 V1.80.1
Serial Number	1602 1283
IP-Address	192.168.20.4 [192.168.20.4]
Subnet Mask	255.255.255.0 [255.255.255.0]
Gateway	192.168.20.1 [192.168.20.1]
	Close
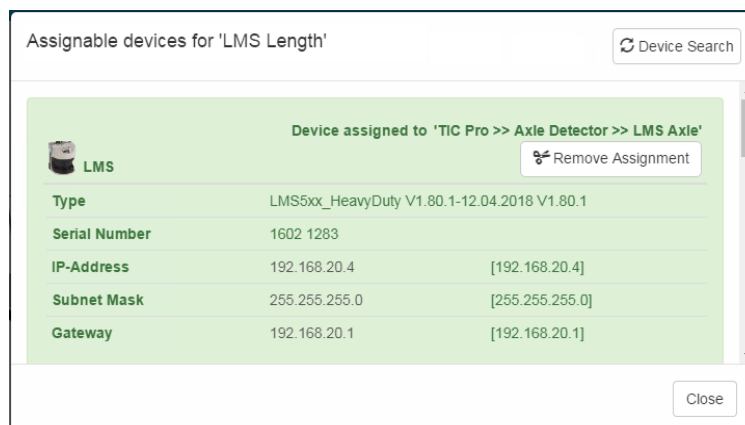
5. Click **Close**. The device search closes.

6.6.4   Working in expert mode

In expert mode the navigation area also displays system functions that do not have any device components. These include the system function for vehicle classification.

In expert mode, functions also appear which allow system and device parameters to be edited and plug-ins to be added.

Activating expert mode

▶ Go to the toolbar above the navigation area and click the **Activate/deactivate expert mode** icon.

The navigation area is expanded to include system functions and editing functions.
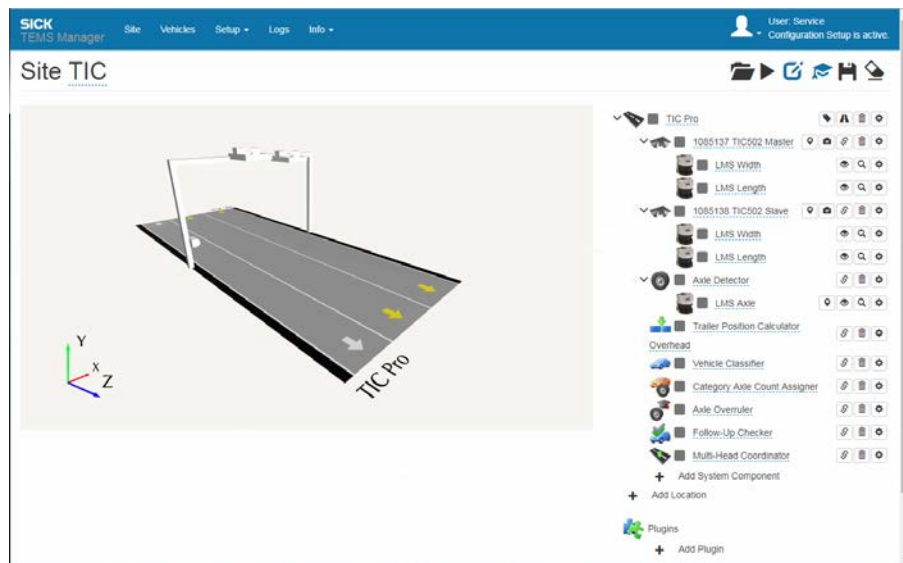
Notes on links

> **NOTE**
>
> Do **not** change the **links** to other system functions that have been set up using the chain-link icon ⚭.

6.6.5 Displaying the system parameters and system status

The system parameters for the relevant system function/system component can be visualized by opening the detail window. Users with **Operator** authorization are only allowed to display the parameters. Users with **Authorized User** authorization or higher are permitted to edit them as well.

Opening the detail window

1. Expand the tree that contains the system functions.

2. Mark a system function or system component in the navigation area and click the **Show Details** icon.

In the example, we open the parameters for the **LMS Width** system component. The number of displayed parameters depends on the authorization.
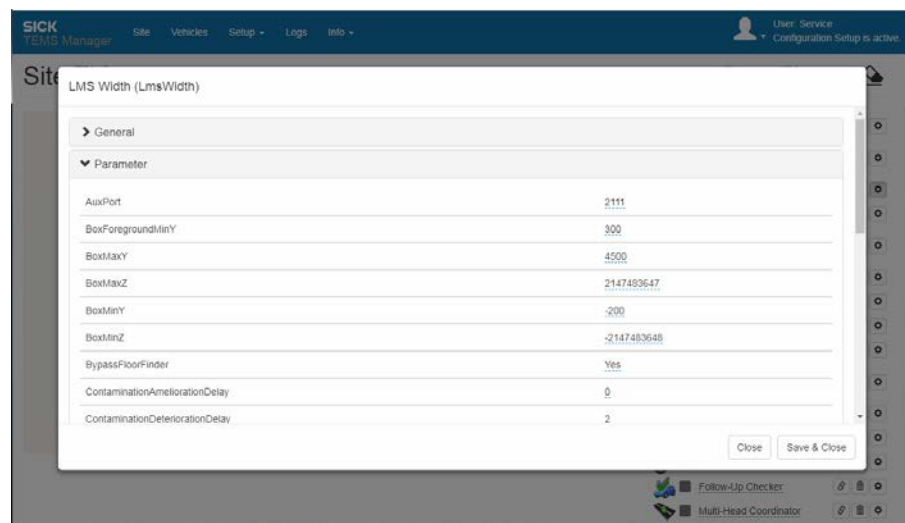
Adapting the IP address

▶ To move the contents of the window up and down, use the scroll bar or turn the mouse wheel. At the bottom, you can adapt the IP address manually, for example.

Checking the position and alignment of the 2D LiDAR sensors

▶ Take the position and alignment of the 2D LiDAR sensors from the **General** area. These must tally with the specified values and the installation situation.
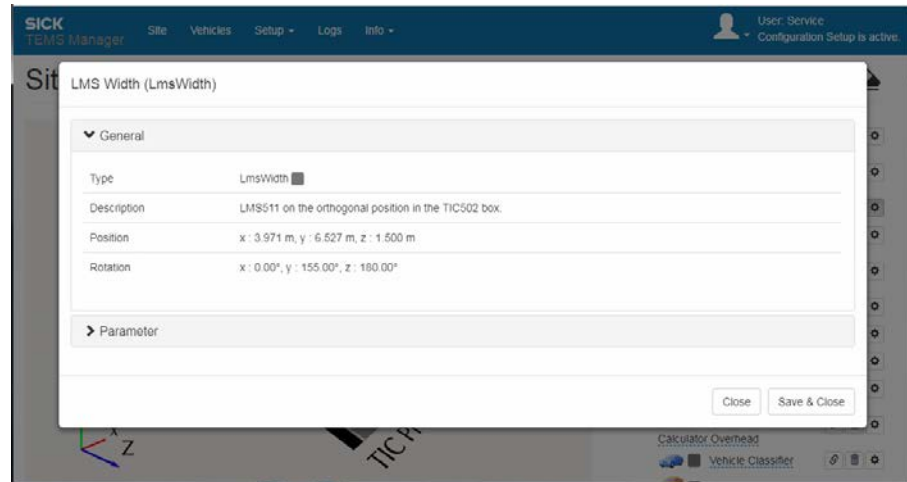
6.6.6   Displaying system functions for vehicle classification

When the profiling system is used for vehicle classification, it is the category system that defines the criteria used to classify the recorded vehicles. The category system is selected via the wizard.

The same applies for the additional classification via an external output category system. With the **output category system**, vehicles are no longer identified on the basis of the individual vehicle classes within the category system. Instead, they are identified using classification groups (traffic checking regulations).

You can check the selected category system via the system parameters and make changes if necessary. An external category system can also be selected if you did not do this in the configuration wizard during initial commissioning.

1. Go to the level of the **Vehicle Classifier** system component and click the **Show Details** icon.

The category system is preset within the **ClassifierVehicle** parameter.
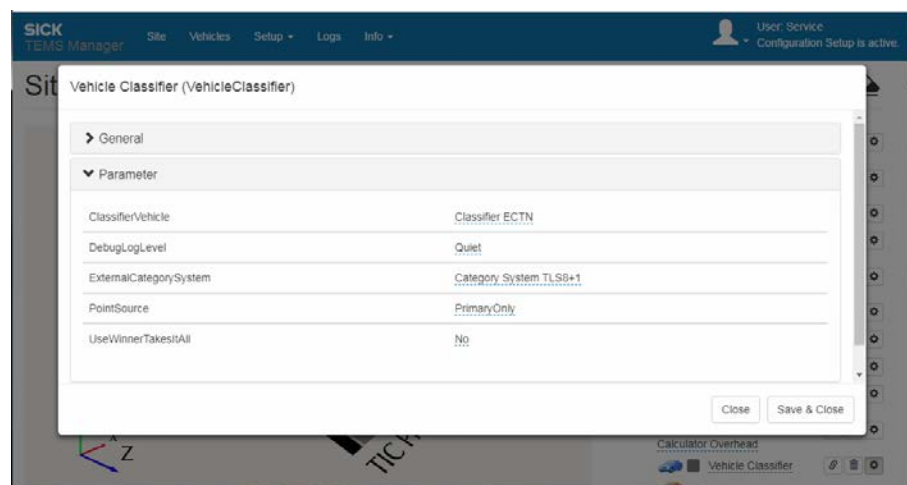
2. You can define your preferred external category system via the
ExternalCategorySystem parameter.
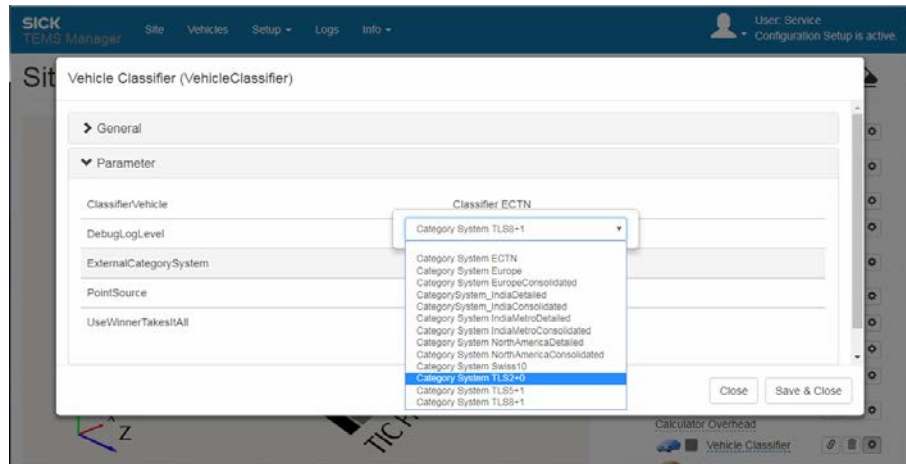
6.6.7 Working with the Axle Overruler

The **Axle Overruler** system function enables you to set up rules for checking how many axles the system has counted for a vehicle. If one of the rules is applicable, the figure can be **corrected** and thus **overwritten**.

Depending on which vehicle classes are checked under the rule and the probability of the vehicle belonging to one of these classes, the number of axles can be changed to an exact value or narrowed down to a minimum or maximum number of axles.

Examples   For example, the axle number 4 can be entered for all vehicles belonging to the **car carrier transporter** class because their low-lying trailers make it difficult for the LMS axle to identify the axles clearly. For vehicles placed in the **Car** and **Bike** classes, the number of axles can be restricted to exactly 2.

Note   The rules have to be defined in conjunction with your local SICK contact.

6.6.8 Configuring plug-ins

TEMS Manager includes a range of plug-ins for processing the recorded vehicle data. The following plug-ins can be selected and configured as standard: **CSV Export**, **Disk Storage**, **FTP Storage**, and **UNC Storage** (see also chapter *3.5.3 Plug-ins for saving and downloading the vehicle data*). Only a few settings are required for the configuration process.

Adding plug-ins

1. Click on the **Add plug-in** link in the navigation area.
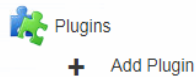
2. A list of all available plug-ins opens.
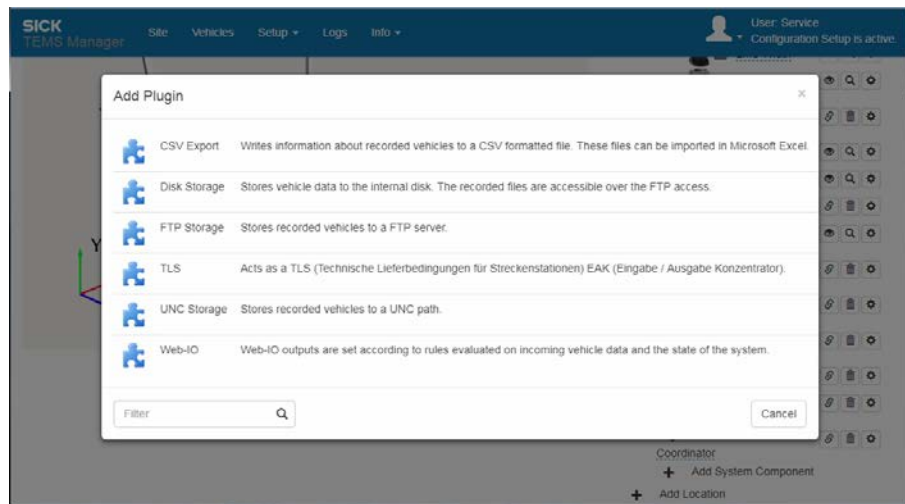
3. Click on the required plug-in in the list; it is then applied to the navigation area.
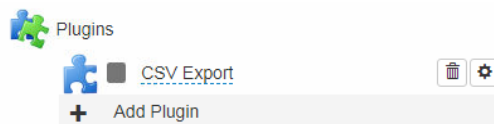
A plug-in can be configured using the gear icon **Show Details**.

CSV Export

The **CSV Export** plug-in saves the vehicle data obtained to a csv file, which is located inside the **/lists** directory. A separate data set is created in the csv file for each vehicle. As part of this process, you can also specify the period to be covered by a file. Usually, a csv file contains the vehicle data for a particular day.

▶ Open the detail window for the **CSV Export** plug-in.
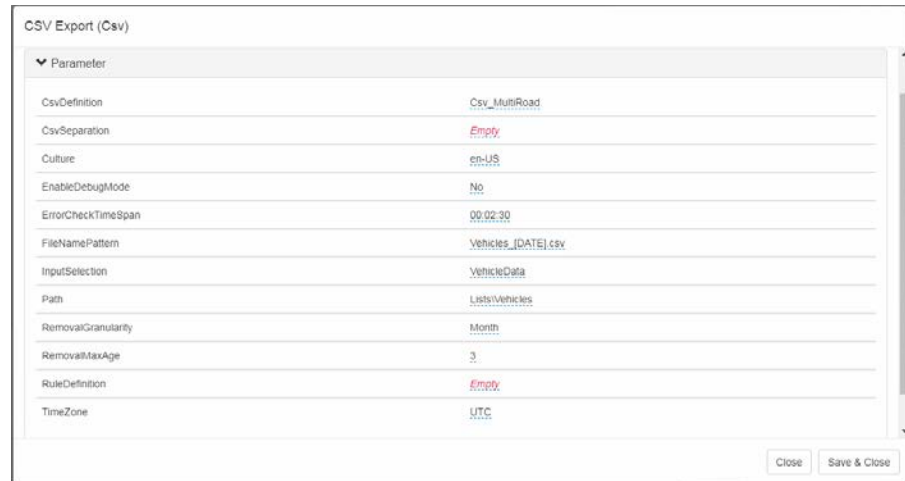
The following parameters usually play a key role in determining the output structure of the csv file:

Parameters	Description
CsvDefinition	Determines whether measured values are identified for one lane, more than one lane, or for several lanes in conjunction with the axle counting function.
Culture	Defines the number format to be used.
TimeZone	Defines the time stamp for the measurement results when exported to the csv file.

Disk Storage

The **Disk Storage** plug-in stores each detected vehicle in a separate file using the **vehicle** file format. The vehicle file is placed in the **/data** directory. The vehicle file contains all the information recorded for a vehicle.

▶ Open the detail window for the **Disk Storage** plug-in.
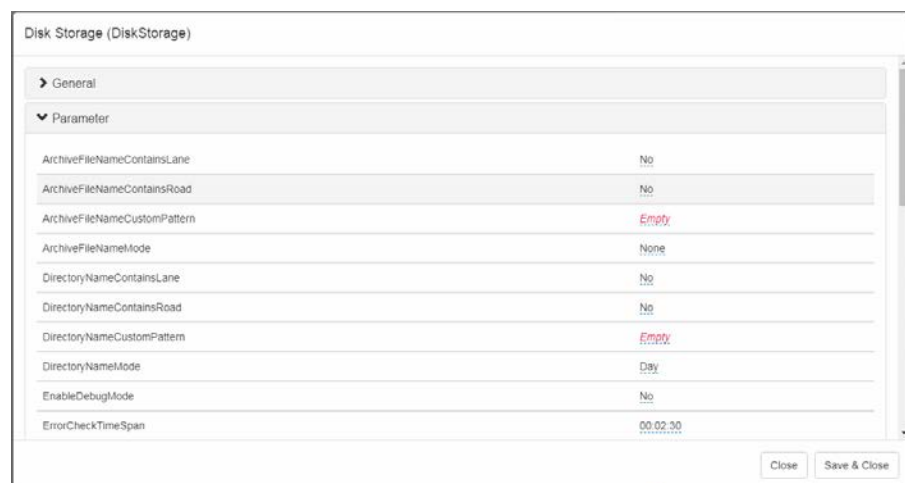
Where necessary, specify the directory and file names. You do not have to configure any of the other parameters.

FTP Storage

The **FTP Storage** plug-in enables vehicle data to be uploaded to an FTP server automatically. The data are not stored on the Traffic Controller.

▶ Open the detail window for the **FTP Storage** plug-in.

Set the following parameters to configure the FTP transfer:

Parameters	Description
FtpBasePath	FTP root directory
FtpPassword	FTP password for accessing the customer's FTP server.
FtpServerAddress	IP address of the customer FTP server to which the measurement results are to be uploaded. If the IP address is not in the same number range as the Traffic Controller, the (correct) IP gateway must be set within the IP configuration.
FtpServerPort	The port via which the connection to the FTP server is to be established.
FtpUserName	FTP user name granting access to the FTP server.

UNC Storage

The **UNC Storage** plug-in enables vehicle data to be saved in a UNC path automatically. UNC paths allow a directory on the network to be accessed without the need for a drive letter. The data are not stored on the Traffic Controller.

▶ Open the detail window for the **UNC Storage** plug-in.

Configure the UNC path as follows:

Parameters	Description
BasePath	Defines the network directory. The network directory has to be shared so that it can be accessed.
UNCDomainName UNCPassword UNCUsername	A Windows user must have been granted write access to the shared network directory. If this user is not a domain user, the computer name must be entered under the **UNCDomainName** parameter. Example **\\SRV1\Vehicles\Road1** UncDomainName: **SRV1** UncUserName: **tems_user** UncPassword: **sAfE_PassWord**

6.7   Running the configuration

You can now complete the configuration of the measurement site and run it in the TEMS Recorder straight away. The system components are automatically calibrated when starting the configuration.

Start configuration

▶ Click the **Start site configuration** icon.

A progress bar is displayed to visualize the start of configuration.
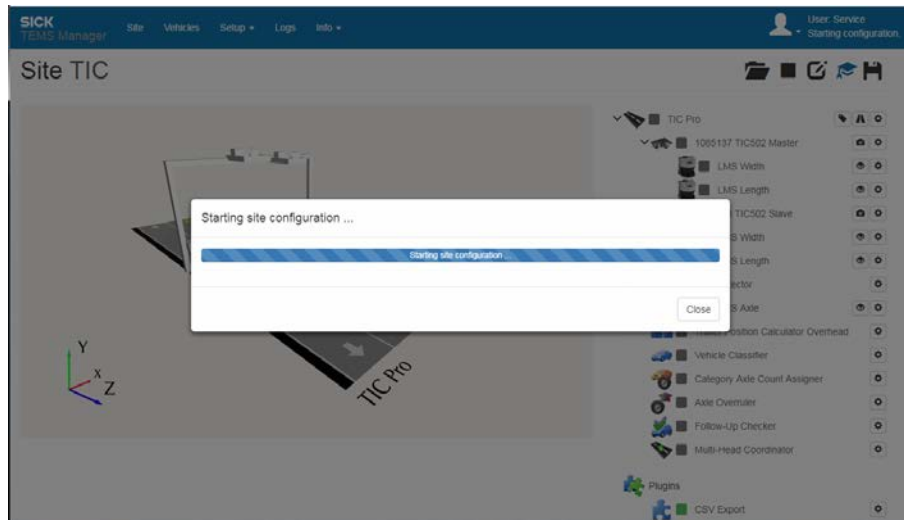
Calibration

Following this, the mounting height of the system components will be detected automatically by measuring the distance from the ground (Floor Finding). During the Floor Finding process, each 2D LiDAR sensor collects a certain amount of measurement data from the road in the measuring range. This process may take a few seconds. It will be tracked in the visualization.

Notes   ▶ If the configuration cannot be started, we recommend that you first check the voltage supply for the system components (to make sure it is correct), the network connectivity, and the IP addresses.

▶ Also make sure that the system components have been mounted according to the specifications (see chapter *3.6 Project planning*).

▶ Check the position and alignment of the system components in TEMS Manager. The position and alignment must match the actual conditions.

6.7.1 Checking operational readiness

If all the system components in the live view are **green** once the configuration has been successfully started, they are ready for operation. In the navigation tree, the operational readiness of the system functions and system components is indicated by a **green square**. A gray icon signals that a device status is currently unknown.
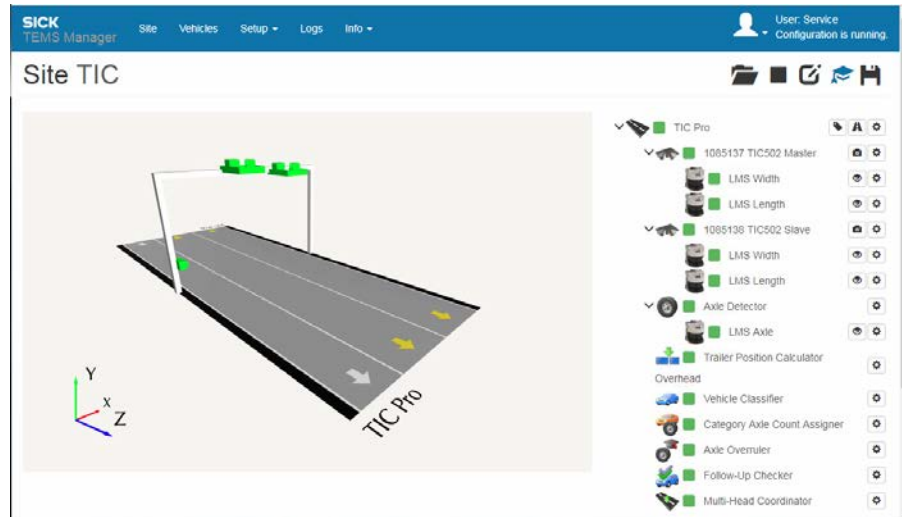
Note   When the configuration starts, the sensor components remain red until a connection has been established. Depending on the network connectivity, this may take up to two minutes.

If a sensor component remains underline permanently **red**, it could be that an incorrect IP address has been assigned to it. The problem could also be caused by a missing or inadequate voltage supply or poor network connectivity.
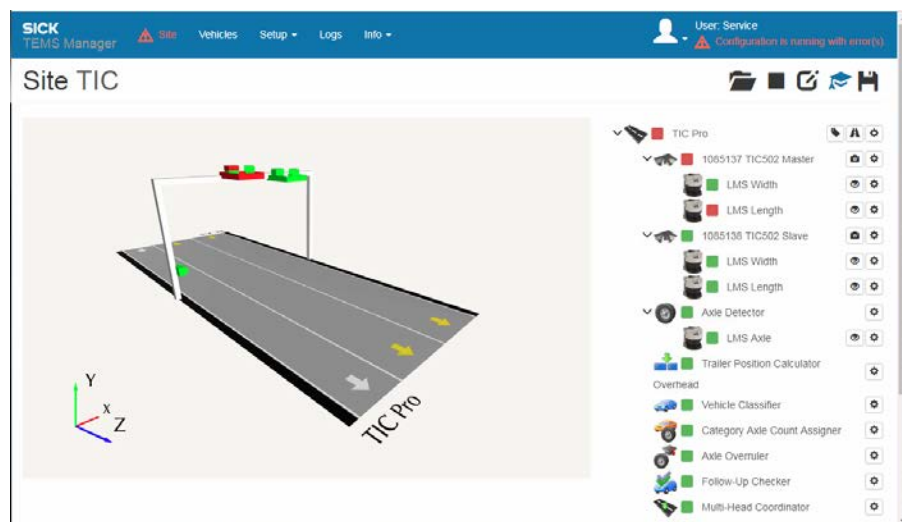
Additional information on fault detection can be found in chapter *8.3.1 Fault diagnosis in TEMS Manager*.

The toolbar above the navigation tree offers the following functions in operating mode:

Symbol	Meaning
	Load and start site configuration Loads the configuration file containing the key system parameters into TEMS Manager and starts the configuration. If a configuration is loaded while another configuration is running, the system will automatically stop the current configuration. The new configuration is loaded and started. System operation is paused during this process. The function requires login as a user with **Authorized User** authorization or higher.
	Stop current site configuration Stops the configuration that is currently running in measuring mode. The function requires login as a user with **Authorized User** authorization or higher.
	Edit site configuration Stops the configuration that is currently running and switches the system to editing mode. Once in editing mode, you can change the system parameters. The function requires login as a user with **Authorized User** authorization or higher.
	Activate/deactivate expert mode Switches the export mode on and off. Expert mode displays all system functions in the navigation area and functions for editing the parameter values, etc.
	Save current site configuration on hard drive Saves the current site configuration onto a data card. The configuration that is saved in the file can help SICK Support to resolve fault situations quickly. The function is available for all authorizations.

6.7.2   Displaying measurement points

In the live view, you can show the measurement points to visualize what a 2D LiDAR sensor can see on the basis of the system parameters. This helps to localize any errors when launching a configuration.

1. Go to the device level in the navigation tree and click the **Visualize live data for device** icon. The functions for visualizing the measurement points in the live view appear.

2. Click **Raw measuring points**. The measurement points detected by the 2D LiDAR sensor are displayed in the live view of TEMS Manager. The display is based on the unfiltered raw data for the 2D LiDAR sensor's entire visual range.
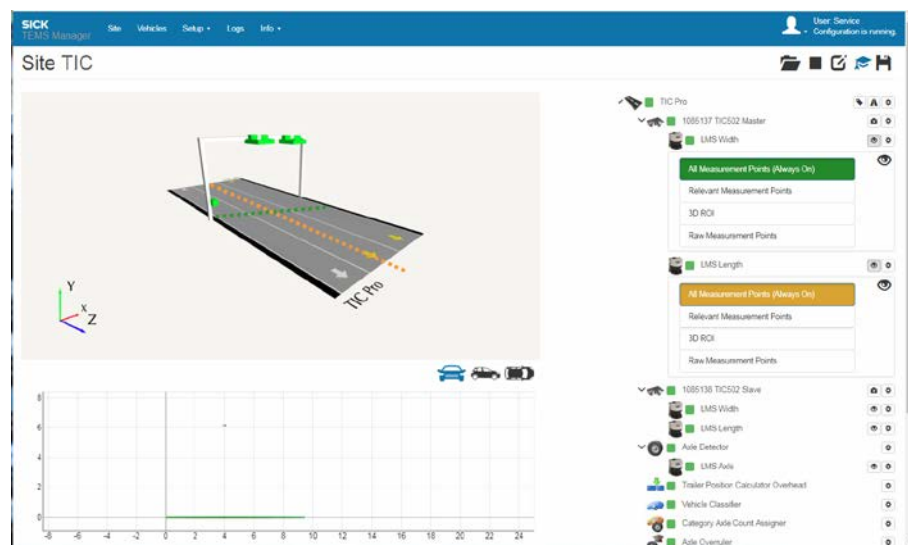
3. Click **Relevant Measurement Points**. The live view of TEMS Manager now shows the **filtered measurement data** from the 2D LiDAR sensors. The filtered measurement data are used as the basis for the 3D point cloud and the resulting calculations.

Note   If you click on the expanded function again, the measurement points disappear from view.

6.7.3 Displaying the device status

In expert mode, you can access status information on the individual system components during operating mode.

1. Go to the toolbar above the navigation area and click the **Activate/deactivate expert mode** icon.

2. Click the **Show Details** icon for one of the system components.

3. Open the **States** area to display the status information for the system component concerned.

4. In the event of a fault, you can (for example) refer to this information to see if the 2D LiDAR sensor is affected by contamination (see also *8.3.1 Fault diagnosis in TEMS Manager*).

6.7.4 Switching back to editing mode

When in operating mode, you can return to editing mode, change settings, and restart configuration directly at any time.

▶ Go to the toolbar above the navigation area and click the **Edit site configuration** icon.
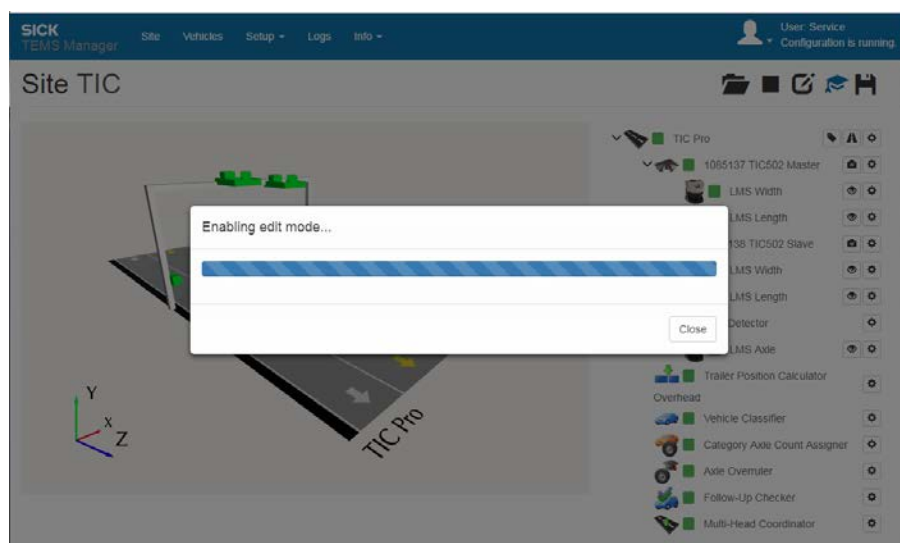
Note You can only switch to this mode if you are logged in as a user with **Authorized User** authorization or higher.

6.7.5   Saving the configuration on the hard drive

To be able to resolve fault situations quickly, SICK Support often needs to have the current configuration file for the measurement site. This file can be saved onto the hard drive of a computer so that it can be sent to SICK Support. The computer must be connected to the Traffic Controller.
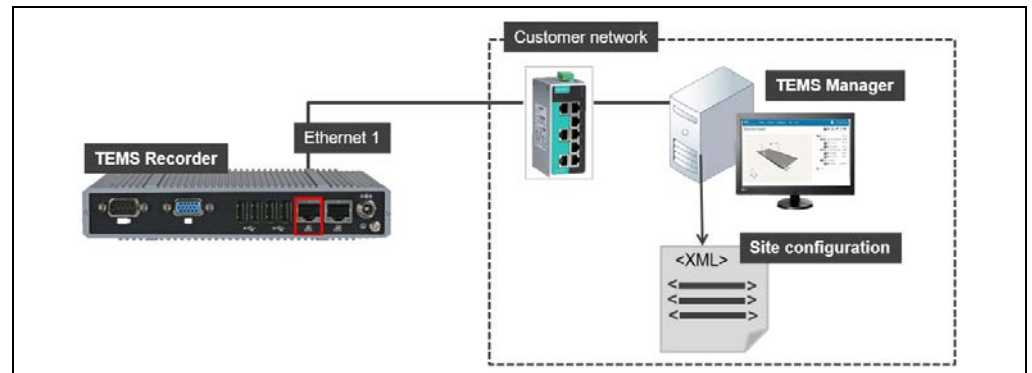
Fig. 102: Saving the configuration on the hard drive

Note   The site configuration can be stored while a configuration is running. The process for saving a site configuration does not affect the current system status.

1. Click the **Save current site configuration on hard drive** icon in the toolbar.

2. The download dialog box of the browser opens right away.

3. Specify the location for saving the configuration file. The site configuration is saved in **XML file format**.

   The XML file contains a range of information on the site configuration, including:

   - IP address for the 2D LiDAR sensors
   - Mounting positions and names of the 2D LiDAR sensors
   - Definitions and names of the roads and lanes

Editing the XML file manually

Experienced users can also edit the XML file containing the site configuration directly, and can adjust the names of the roads and lanes or the position of the system components accordingly.

The XML file is loaded in TEMS Manager by clicking the **Load and start site configuration icon** as described previously (see chapter *6.13.2 Using a configuration file to load system parameters*).

6.8   Checking that measuring mode is working properly

Finish commissioning the system by performing a test run. The test run must make sure that the system components are working correctly and that they are delivering plausible measured values.

The test run can only be performed if the site configuration process has been successfully completed and all of the system functions and system components in the navigation tree have a green square next to them.

6.8.1   Displaying vehicles with measured values

Whenever TEMS Manager is connected to the TEMS Recorder, the **Vehicles** workspace contains a table of the last 50 vehicles recorded (or vehicles with a maximum memory of 50 MB). The order in which the vehicles are displayed depends on the column selected and the sorting setting.

The display shows the time of the recording, the detected vehicle category together with a pictogram, the lane, the speed, and the vehicle dimensions.

Changing the number of vehicles displayed

By default, ten vehicles are displayed per page.

▶ To change this, go to the **Entries per Page** field underneath the table and enter the desired number (in increments of five). The maximum number of vehicles that can be displayed in the table is 25.

▶ You can use the search field to filter the list of vehicles on the page. Enter a character string. The list is automatically narrowed down so that only those vehicles with a matching character string in one of the columns remain.

Navigating within the vehicle view

To switch between the individual pages of the vehicle overview, use the page numbers on the right-hand side below the table.

The icons have the following meanings:

Icon	Meaning
«	Opens the first page.
»	Opens the last page.
3	The icon for the currently open page is highlighted in blue.
...	Click this icon to switch to the previous or next page from the current one.
... 5 ...	Allows you to open a specific page directly.

Editing the list view settings

You can show and hide the various columns that make up the vehicle table.

1. Go to the toolbar in the **Vehicles** workspace and click the tool icon.

2. To control which columns are visible, select/deselect the relevant checkboxes.
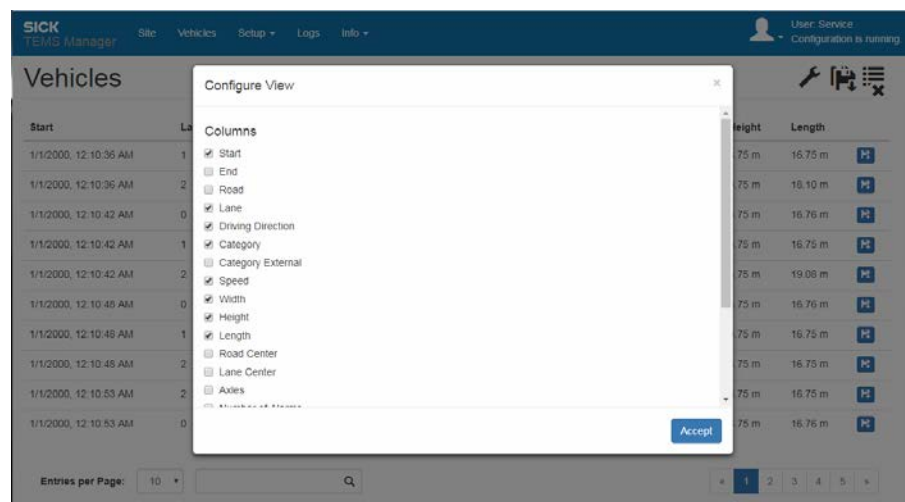
Checking the measurement results

Use the table to verify that the measurement site is in proper condition.

▶ Check that the vehicles are being continuously detected by the profiling system.

▶ Make sure that the profiling system is delivering plausible measured values.

6.8.2   Saving vehicle data

The "Vehicles" list view also allows you to save the measured values for the vehicles onto a local hard drive.

- To save the data for a specific vehicle, click the associated "Save" icon on the right-hand side of the list.

- If you want all the vehicles currently listed in TEMS Manager to be written to a local hard drive, go to the toolbar and click the **Save all vehicles** icon. Please note that only the last 50 measured vehicles can be displayed and saved in TEMS Manager.

Note   If the **Disk Storage** plug-in has been activated, **all** of the vehicle data stored on the Traffic Controller under the **/data** directory can be downloaded using an **FTP download** (see chapter *3.5.3 Plug-ins for saving and downloading the vehicle data*).

1. Connect to the FTP server of the Traffic Controller using an FTP client (e.g., FileZilla).

2. Log in by entering **client** for the user name and **client** as the password.

6.8.3   Accessing detailed information about a vehicle

6.8.3.1   3D model and measurement results

For each vehicle, you can open a details page that contains additional information.

▶ To do this, click inside the relevant vehicle line. The details page appears in the same browser window.

The measured values for the vehicle are displayed in the **Info** area. The **3D-Model** area contains the three-dimensional model of the vehicle.
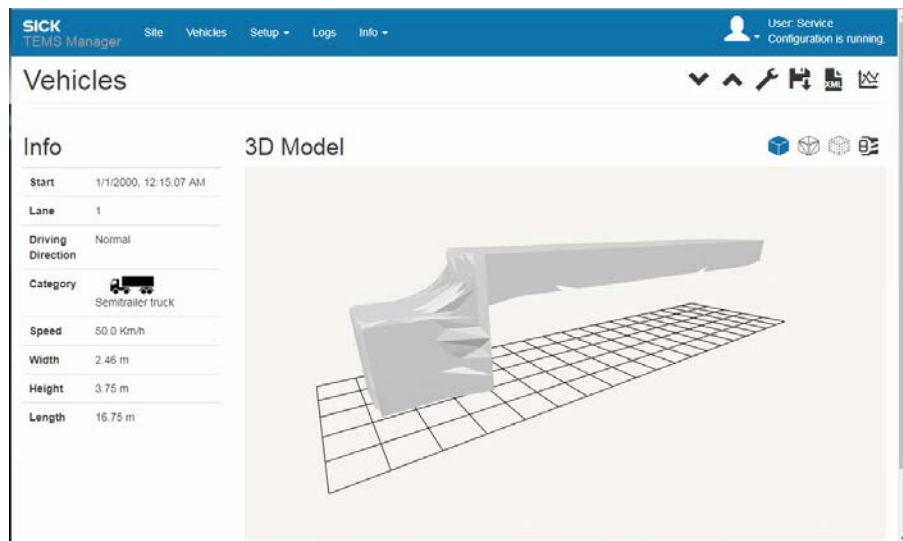
Changing the view of the 3D model

You can rotate and move the 3D model of the vehicle – and zoom in and out – in exactly the same way as with the graphical display of the site.

- To display the surface of the vehicle, select the **Show continuous surfaces in the 3D view** icon.
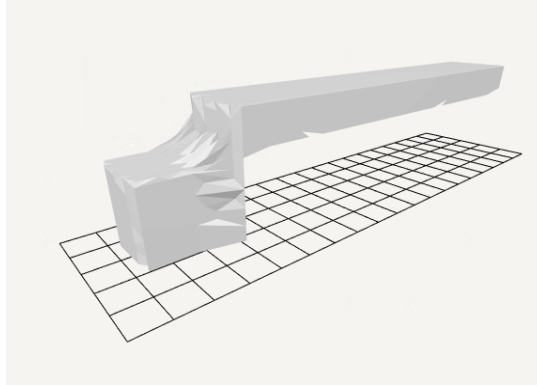
- Alternatively, you can select the **Show grid structure in the 3D view** icon if you want to see a framework view of the vehicle.
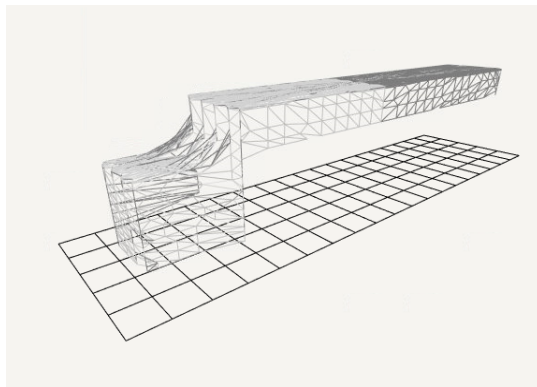
- The **Show point data in the 3D view** icon provides a point view.
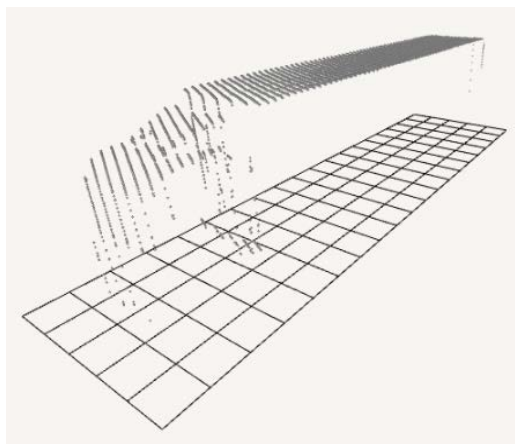
Adjusting how much data is displayed

You can define the scope of the data to be displayed on the details page in a similar way as for the "Vehicles" table view.

1. Click the tool icon on the top right-hand side of the details page.

2. To control which data items are visible, select/deselect the relevant checkboxes and click **Accept** to confirm your choices.
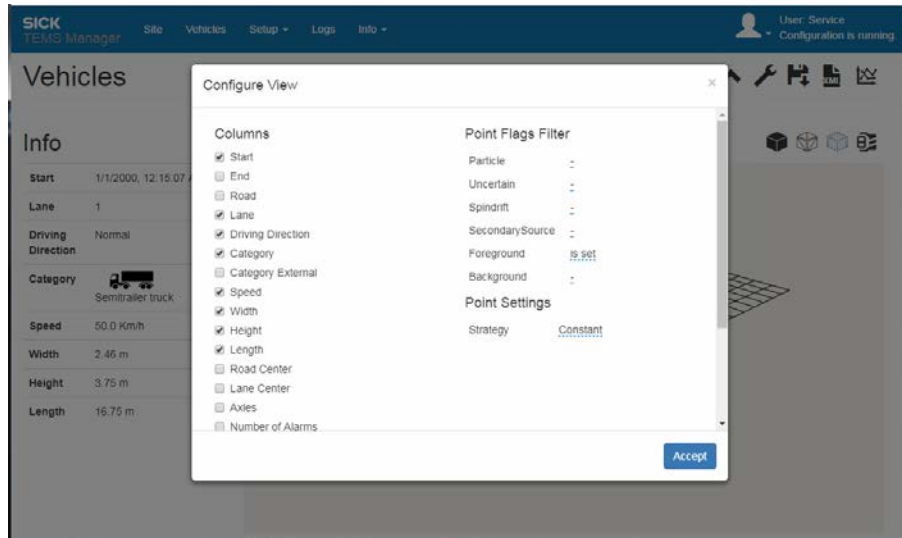
Displaying values together with the confidence level

Alternative values with a calculated confidence level are available for most measured values. These can be displayed in a separate window.

▶ Move the mouse over a measured value and click to open the **Additional Values** window, which contains alternative information on the measured value (e.g., speed plus confidence level according to different calculation methods).
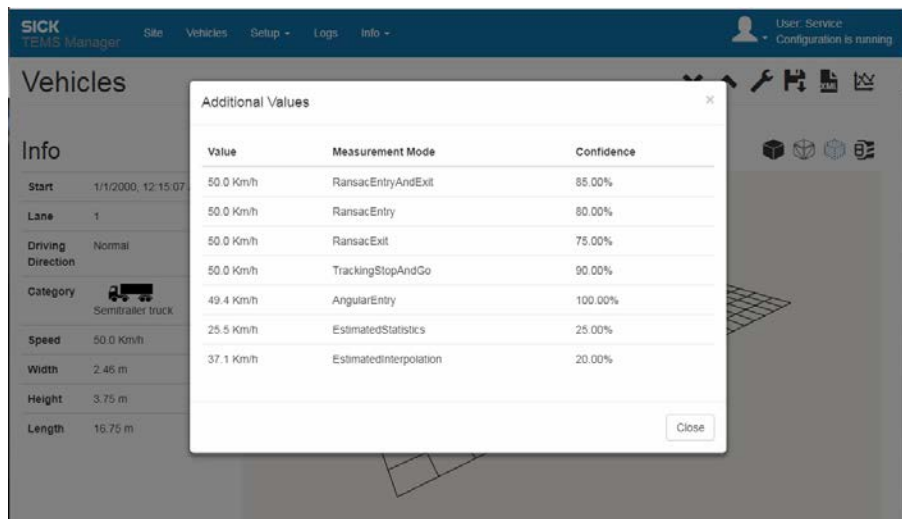
Displaying a time-position-speed diagram

From the time-position-speed diagram, you can see how the alternative values have been calculated. This diagram plots the measurement points that have been obtained for each calculation method in time and space (Z-axis).
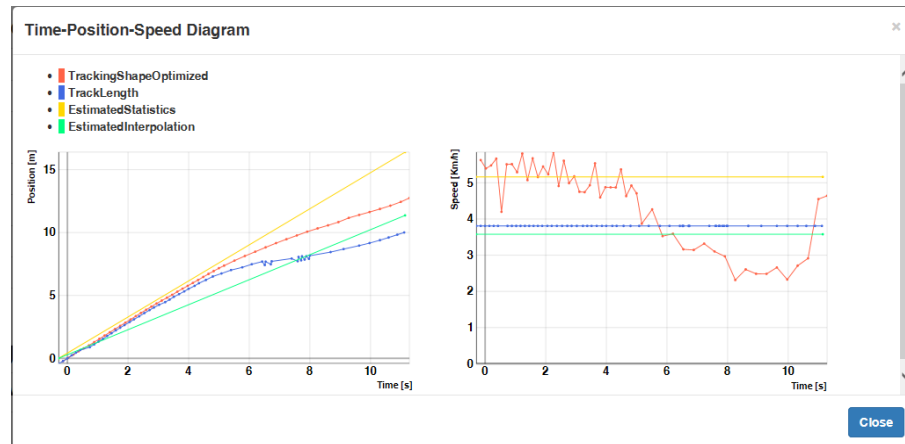
Note

The time-position-speed diagram is an expert function that can be used to analyze errors.

For instance, the diagram can shed light on distorted 3D models of vehicles that appear "elongated" or "compressed". In such cases, it may be that the system was unable to obtain any measurement points within a particular area.

Switching to the details page for the previous/next vehicle

You can switch to the details page for the next or previous vehicle directly from the current one without having to return to the list of vehicles first.

▶ To do this, use the two arrows in the toolbar.

Saving vehicle data

▶ Click the **Save vehicle locally** icon on the details page to save the measured values for the vehicle that is currently on display to a local hard drive.

Displaying the vehicle data in XML format

▶ Click the **Display vehicle data as XML** icon to display the vehicle data in the **Info** area in XML format. This is the format that is used for transferring the measurement results to the customer system.
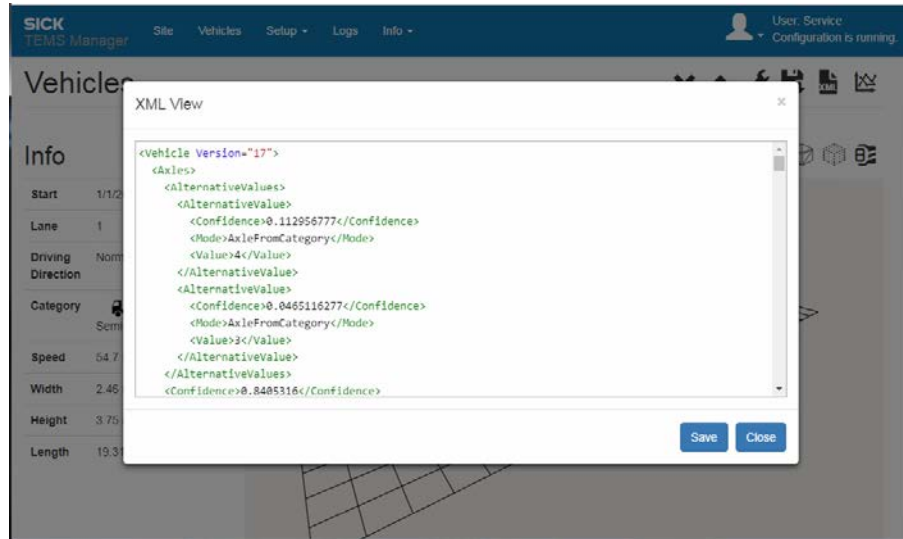
Returning to the vehicle list

▶ Go to the menu bar and click the **Vehicles** workspace option.

This opens the list of the last 200 vehicles measured.

6.8.3.2   Vehicle classes

The **Vehicle Classifier** system function is used to report the vehicle class under Information. The class is chosen from all classes in the set category system.

▶ Click inside the "Category" field to open the **Additional Values** window, which displays a list of all the vehicle classes within the category system.

This enables you to see the confidence level with which the vehicle has been assigned to the class in question.
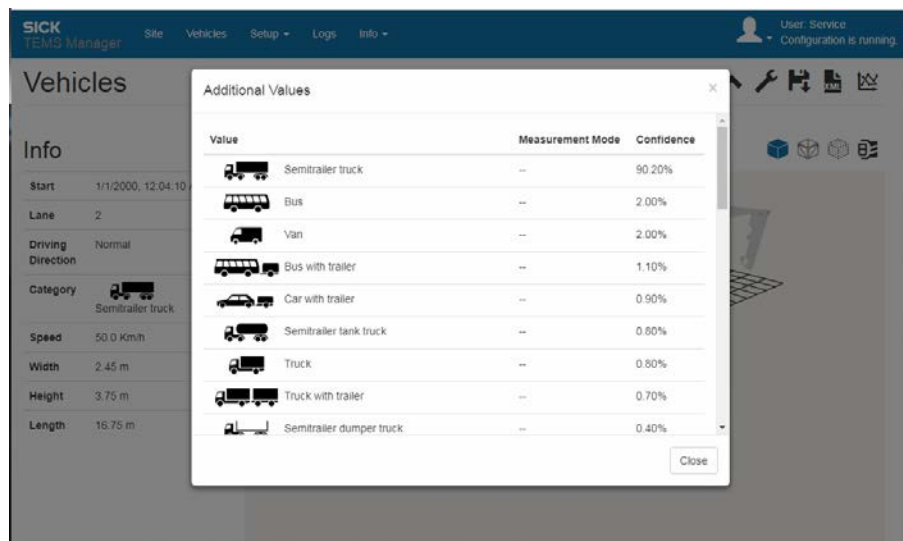
Displaying the vehicle class on the basis of the output category system

1. Show the **Category External** column using the tool icon.

   In the **Category External** area, the vehicle class is determined and reported on the basis of the selected output category system. In this case, reference is no longer made to all the vehicle classes within the selected category system because the configured classification groups are used instead (see also chapter *3.4.2 Operating principle of the vehicle classification*).

2. Click inside the "Category External" field to open the **Additional Values** window. This enables you to see the confidence level with which the vehicle has been assigned to the output category in question.
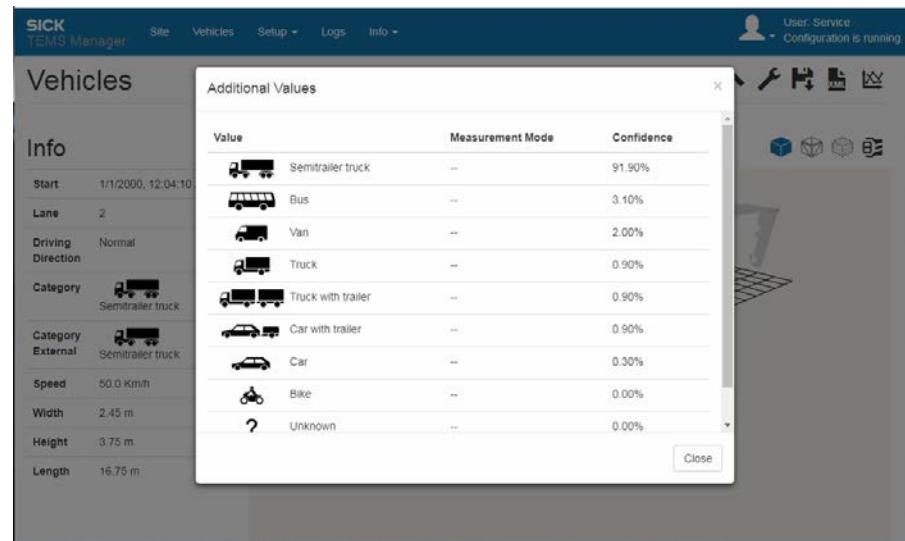
	Note	By grouping the vehicle classes together in this way, a higher confidence level can be achieved than when the vehicle is assigned on the basis of all the classes within the set category system.

6.8.3.3 Measuring the vehicle area in the 3D model

The 3D model on the details page has a function you can use to measure individual areas of the vehicle shown. This allows you to identify and check the dimensions of the towing vehicle or the distance between the towing vehicle and the trailer, for example.

▶ Go to the toolbar in the **3D model** area and click the **Measure** icon.

Regardless of which graphical display you have selected, a box containing the maximum vehicle dimensions appears above the vehicle. The dimensions of this box are displayed in the upper right area of the 3D view. The values correspond to the maximum vehicle dimensions after invoking the function.

Depending on the selected perspective, the 3D model creates a visualization of the measurements by means of a length, width, and height line.
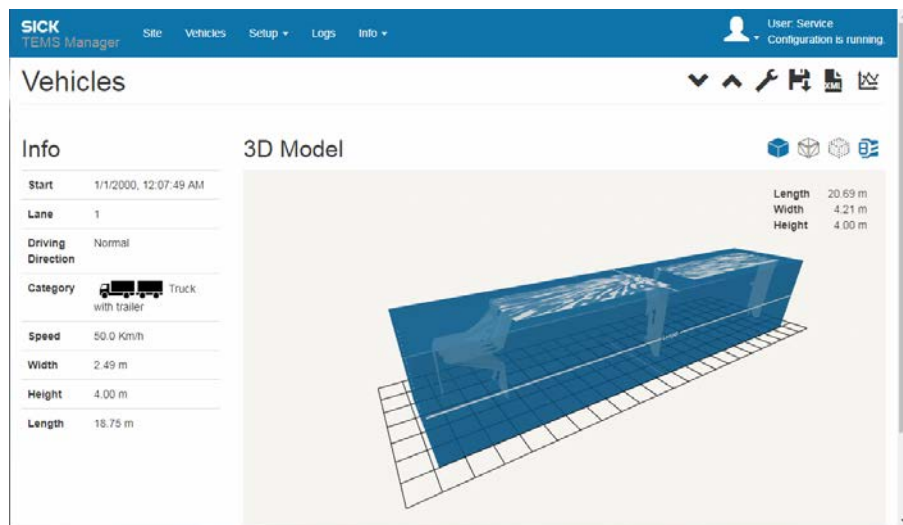
Selecting the view

Rotate the model so you can clearly see the relevant dimension line.

- The **side view** visualizes the length line of the box. This view makes it possible to measure the length (and height) with ease.
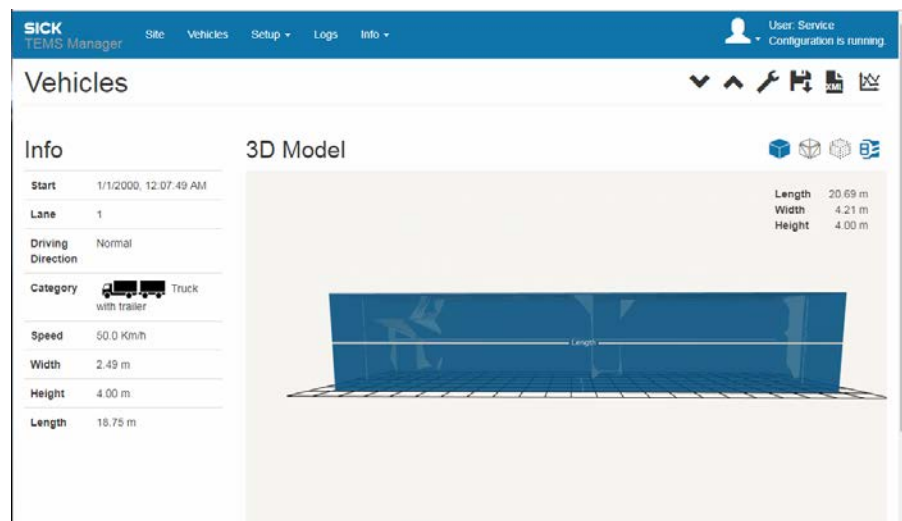
- The **top view** visualizes the width line of the box. This view makes it possible to measure the width (and length) with ease.
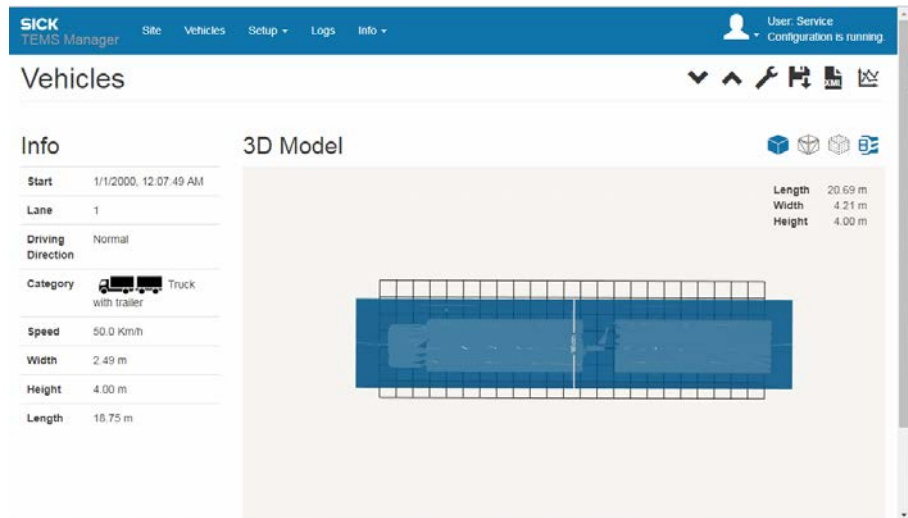
- The **front/rear view** visualizes the height line of the box. This view makes it possible to measure the height (and width) with ease.
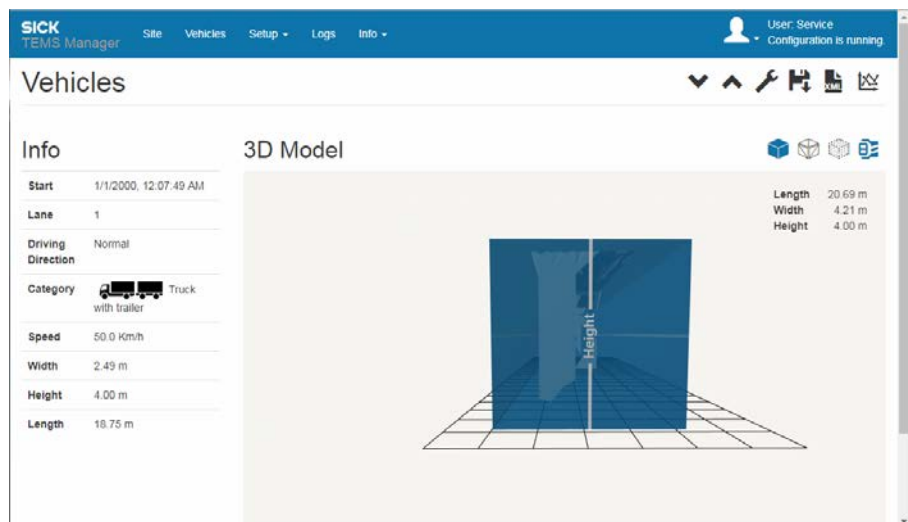
Taking measurements

The example below identifies the length of the tractor. This principle is the same for all measurements.

1. Select the appropriate perspective. In this example, it is the side view.

2. Double-click on the box. The box edges are activated.
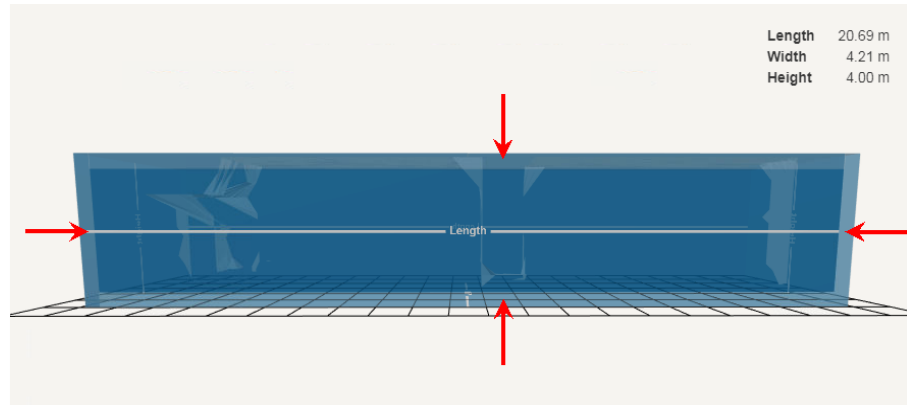
3. Click on the edge you would like to move.

4. Move the edge along the corresponding axis for the shape to be measured. The box dimensions (here the box length) is updated.
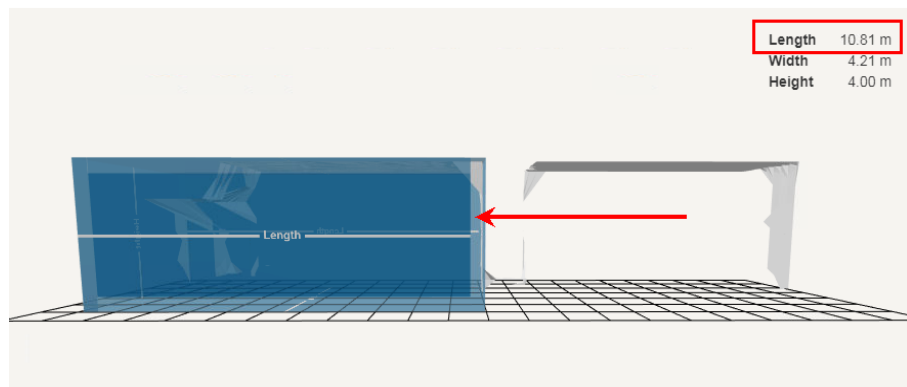
Note   The dimensions of the box are always crucial. There is no specific zero point

5. Check the plausibility of the dimensions shown. In this example, the length dimensions of the tractor.

Note   Double-clicking on the box edge shows the box with the original (maximum) vehicle measurements.

Deactivating measurements

▶ Click the **Measure** icon again. The box disappears again.

6.9   Downloading log files

To help SICK Support with fault analysis, it is often necessary to forward the latest system logs. You can download these logs via the **Logs** workspace and send them as an e-mail attachment.

All system actions are written to a log file of the **Recorder** type. A separate log file is created for each day.

In addition, the availability status of the Traffic Controller is checked and logged continuously. The results of the internal self-check are recorded using the **RecorderStatus** log type. Once again, a separate log file is created for each day.

The **RecorderAudit** log type delivers a list of all login processes and changes to user rights.

Displaying the list of log files

1. Open the **Logs** workspace via the menu bar.

   Both log types are listed in a tree structure.
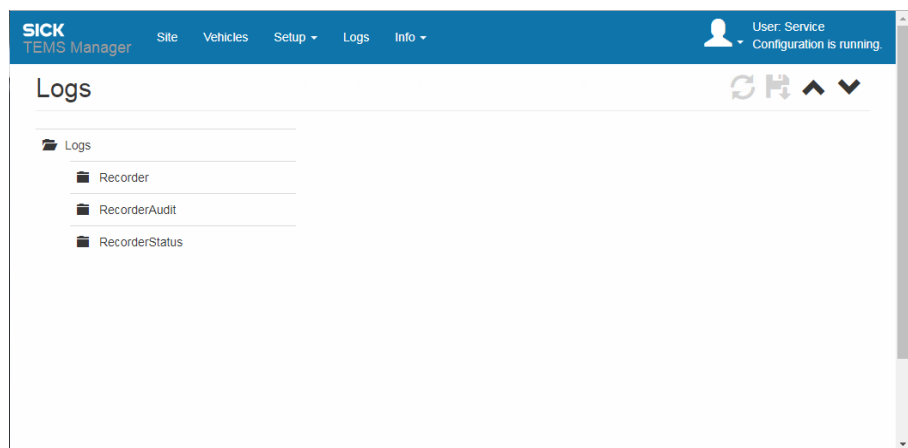
2. Expand the folders for each log type to display the individual logs. The logs are sorted by month and date. The right-hand side of the window shows an excerpt of each logged entry.
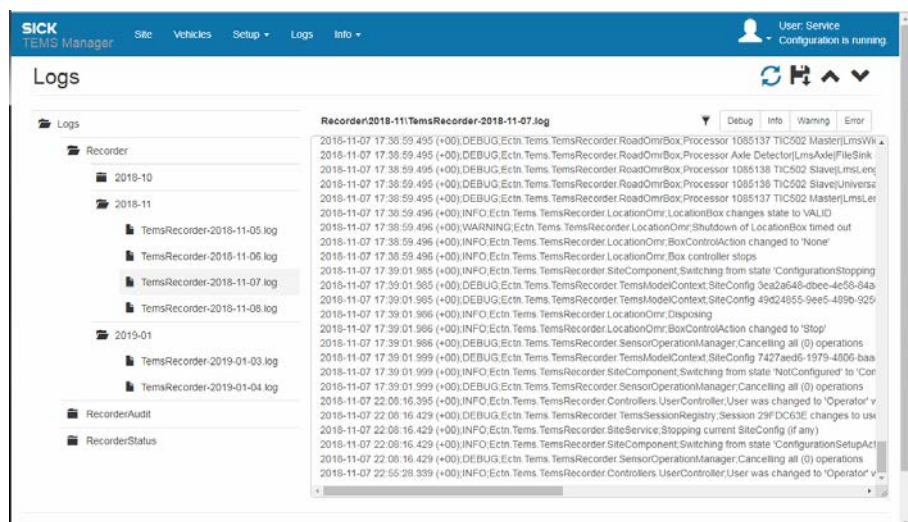
Updating the list

In the toolbar, there are two different options for updating the list of log entries.

▶ If you click on this icon, the list will be updated automatically. New log entries are continuously added.

▶ Alternatively, you can update the log entries manually with this icon.

Filtering the list according to log entry type

▶ You can filter the list based on the following types: **Debug**, **Info**, **Warning**, and **Error**. Click one of the four buttons to activate and deactivate the relevant filter.

Note   You can combine several filters.

Defining the level of detail for "Recorder" log type entries

You can define a different level of detail for the log entries in the **Recorder** log type. Support will let you know which level of detail is required to provide further assistance.

1. Switch to editing mode using the **Edit default configuration** icon.

2. Expand the tree that contains the system functions.

3. Mark a system function or system component in the navigation area (here a 2D LiDAR sensor) and click the **Show Details** icon.

4. Select the level of detail advised by Support in the **DebugLogLevel** parameter. A distinction is made between **Quiet**, **Normal**, **Detailed**, and **Diagnostics** detail levels.
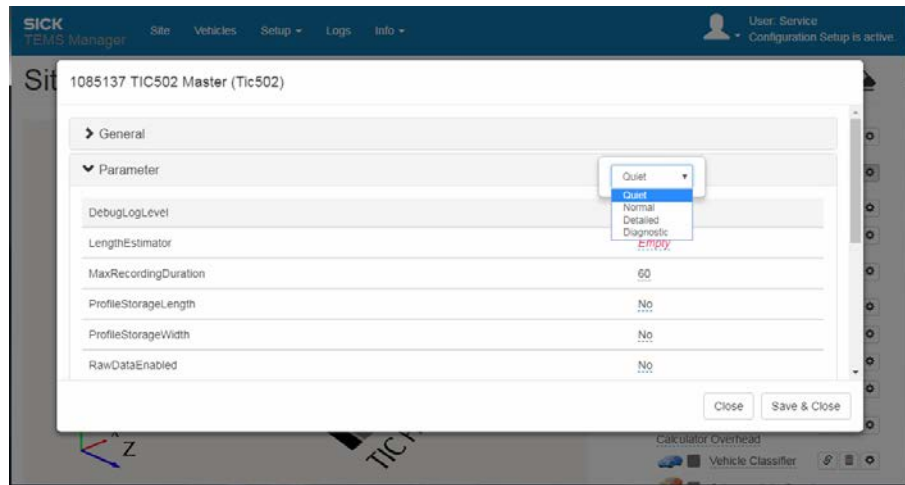
5. Click the **Start site configuration** icon. All system actions are now written to the log file of the **Recorder** type with the set level of detail.

Sending log files

Support will usually ask for the latest version of each log file or a log file containing the reported fault.

1. Select the log file of the relevant type in the list.

2. Go to the toolbar and click the **Download log file** icon.

3. Save the log files in a directory of your choice.

Downloading log files via FTP

Alternatively, all the logs can be downloaded from the Traffic Controller via FTP. The status logs are stored inside the **/logs** directory (see also chapter *3.5.4 Downloading log files*).

1. Connect to the FTP server of the Traffic Controller using an FTP client (e.g., FileZilla).

2. Log in by entering **client** for the user name and **client** as the password.

If the raw 2D LiDAR sensor data are also required for fault analysis, please refer to chapter *8.3.4 Providing raw data to help Support*.

6.10   Updating the TEMS Recorder and packages

6.10.1   Displaying information on the TEMS Recorder

During operation, information on the TEMS Recorder can be displayed and analyzed in TEMS Manager. In addition to general data and information on the IP configuration, you can also check other data here, including the UTC (**U**niversal **T**ime **C**oordinated) time setting.

Note   Upon delivery, the Traffic Controller always uses UTC time as the reference time. The local web browser and the TEMS Analyzer then convert the UTC times into local time for the displays.

▶ Go to the TEMS Manager menu bar and switch to the **Info → Info** workspace.
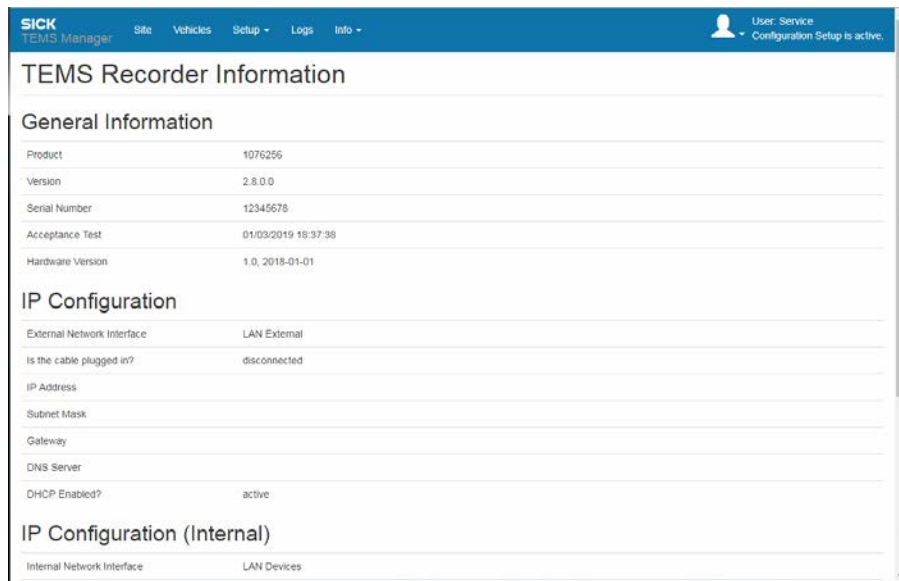
6.10.2   Updating the TEMS Recorder

Patches and service packs for the TEMS Recorder are supplied in the **temsUpdate** file format and installed via TEMS Manager.

Note   The configuration that is currently running has to be stopped for this.

Getting started

1. Save the update file in a directory of your choice on the customer network.
2. Start TEMS Manager from a client computer.

Note   The client computer must be able to access the directory containing the update file.

3. Go to the **Setup** workspace and click **Firmware Update**.

Note   When logging in, the user must have **Service** authorization. If you are not yet logged in at this level, please do so now (for more information, see appendix at *9.5 Users and authorizations*).
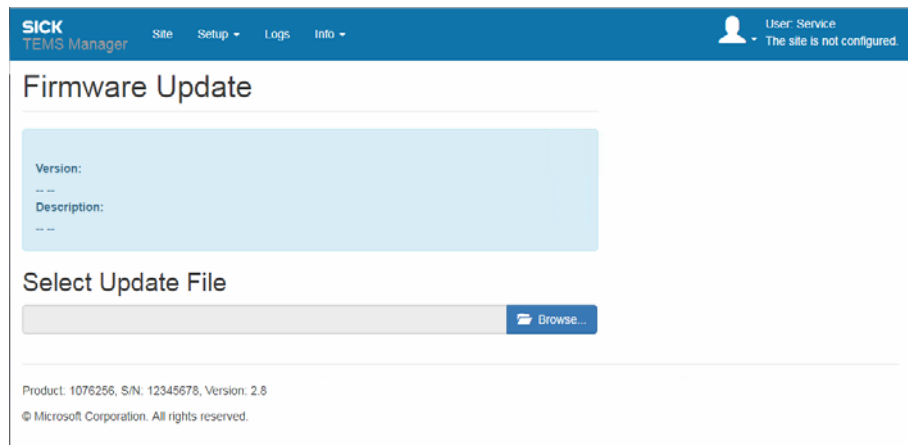
Performing an update

1. Click the **Browse** button and select the update file.

    First of all, the file is copied to the Traffic Controller.

2. Once it has been copied across, the update version number and description are displayed.
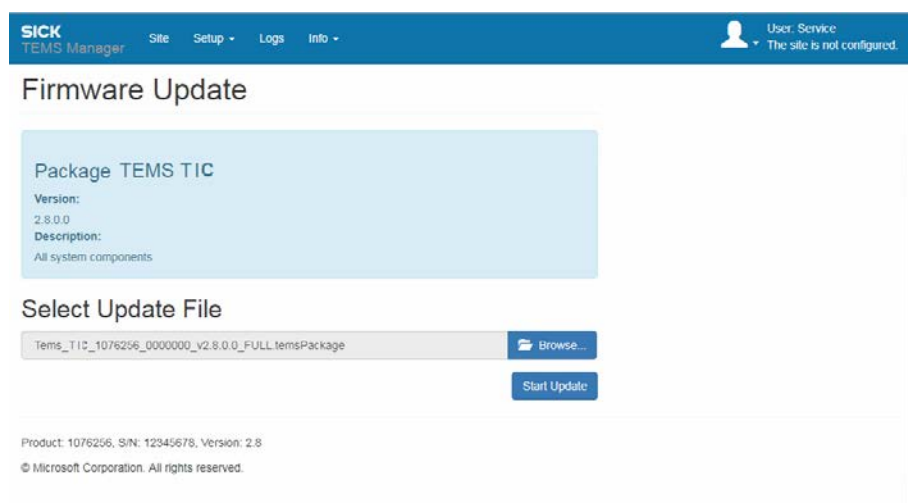
3. Click the **Start Update** button. You will see a message indicating that a maintenance process is about to be started on the TEMS Recorder.

4. Click **Continue**. The TEMS Recorder update is installed on the Traffic Controller. This process may take a little while.

5. You will receive a notification once the process has finished.

6. To complete the operation, confirm the message by clicking **OK**.

6.10.3   Updating packages

Additional system components, plug-ins, and configuration files (e.g., Vehicle Classifier) are supplied as separate files in the **temsPackage** file format. Once again, they are installed via TEMS Manager.

The procedure is very similar to the one for TEMS Recorder updates.

Note   The configuration that is currently running has to be stopped for this.

1. Save the temsPackage file in a directory of your choice on the customer network.

2. Go to the **Setup** workspace and click **Update Packages**.

3. Select the temsPackage file. First of all, the file is uploaded to the Traffic Controller. After that, installation commences.

4. Install any additional temsPackage files (where applicable) using the same process as described above.

6.11 Using the TEMS Info interface

The TEMS Info interface is available while the Traffic Controller is running. The TEMS Info interface selects measured values, measurement results, and status messages at the customer end from a permanent TCP/IP data stream.

The data to be transferred are freely definable. You can see which data protocol the interface uses by referring to the source code (C#) for the **TEMS Info sample client**.

Notes
- Further details on the message categories, types, and layout can be found in the **separate interface description for the TEMS Info interface** (8017178).
- Please note: A maximum of 10 TEMS Info clients can be connected via the TEMS Info interface. TEMS Manager does not count as a TEMS Info client.

Establishing a connection

The TCP/IP connection is established via the Info client. Several connections to the TEMS Info server can be established, but each one has to be configured separately.

The connection is set up using the following sequence of messages:

TEMS Recorder	Direction	TEMS Info client
	←	Establishing a socket connection
	←	"Initialize" message
"Information" message	→	
	←	"Configuration" message

Tab. 19: TEMS Info interface (messages: establishing a connection)

If the server does not accept the client connection, the following messages are exchanged:

TEMS Recorder	Direction	TEMS Info client
	←	Establishing a socket connection
	←	"Initialize" message
"Error" message	→	

Tab. 20: TEMS Info interface (messages: connection not accepted)

Heartbeat

If "Heartbeat" messages are activated, they are sent regularly by the TEMS Recorder. Based on the heartbeats received, the TEMS Info client can detect that the TEMS Info server is ready for operation and can still complete its tasks.

TEMS Recorder	Direction	TEMS Info client
"Heartbeat" message	→	

Tab. 21: TEMS Info interface (message: heartbeat)

Vehicle data

A series of messages are sent whenever a vehicle is detected by the profiling system.

TEMS Recorder	Direction	TEMS Info client
Message "Object Start"	→	
Message "Object Stop"	→	
Message "Vehicle Result" or Message "Vehicle Result Extended"	→	
Message "Object Location" This message is sent once while the vehicle is passing through the measurement site.	→	

Tab. 22: TEMS Info interface (messages: vehicle data)

Status messages

When "Status Messages" are activated, they are sent regularly by the Traffic Controller if the status changes (provided that this has been configured).

TEMS Recorder	Direction	TEMS Info client
"Status" message	→	

Tab. 23: TEMS Info interface (status messages)

Disconnecting

The connection is terminated when the TCP/IP connection is closed by either the TEMS Info client or by the TEMS Recorder.

6.12   Installing the security certificate for the HTTPS connection

6.12.1   Uploading the supplied HTTPS certificate

Access from the client computer to TEMS Manager is via an HTTP connection by default. To establish a secure HTTPS connection, a corresponding security certificate can be downloaded from TEMS Manager and installed on the client computer.
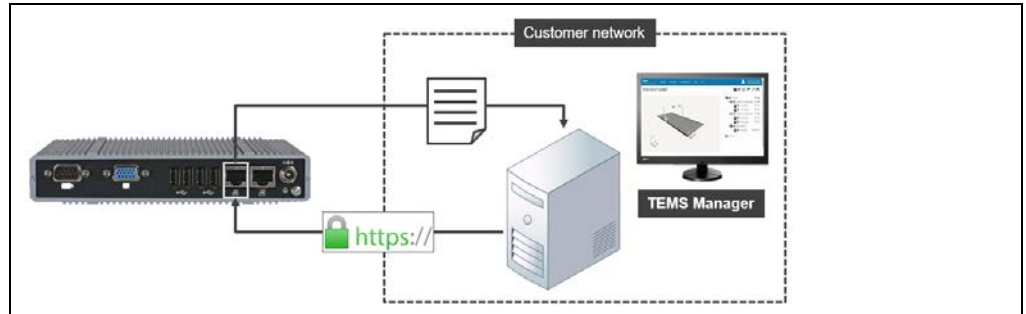
Fig. 103: Uploading the supplied HTTPS certificate

Stopping the current configuration

1. Click the **Stop current site configuration / Exit editing mode** icon.
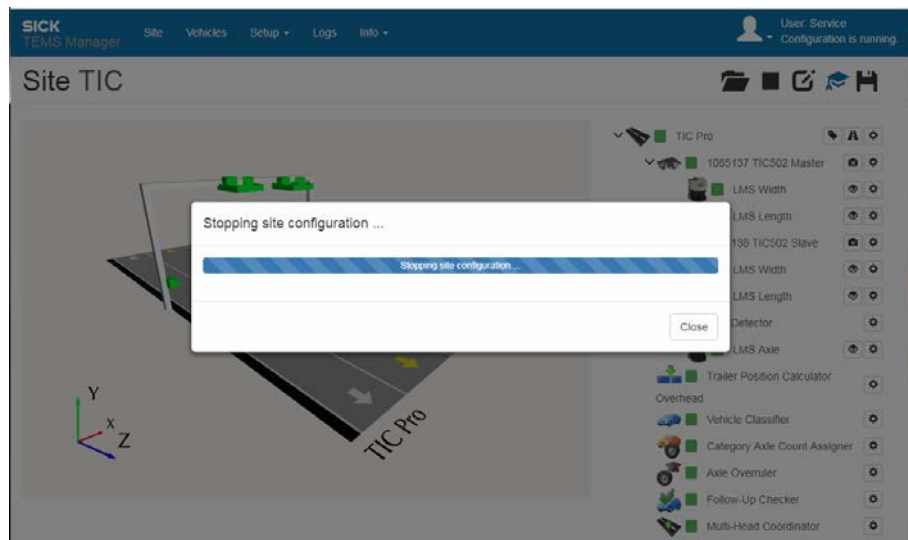
Downloading the certificate

1. Select **Downloads** in the **Info** working range.
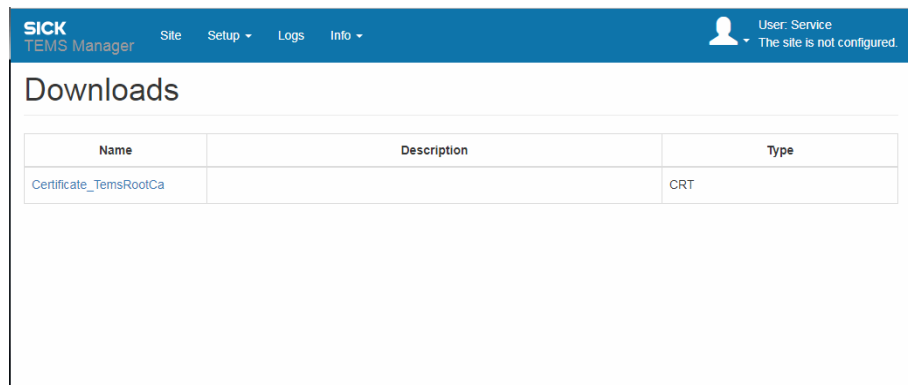
2. Download the CRT file onto the local client computer.

Installing the certificate

1. Double-click the CRT file to open it. The **Certificate** window opens containing the certificate details.
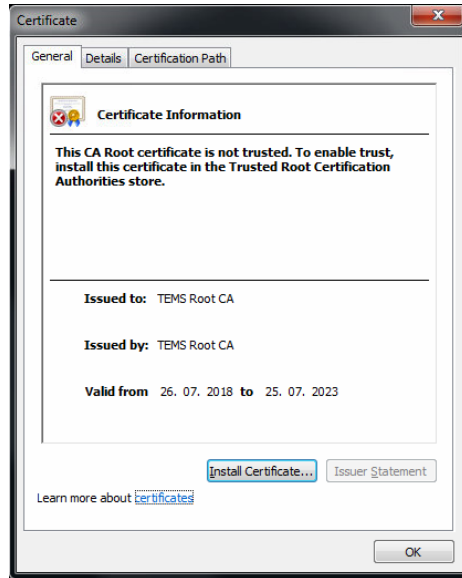
2. Click on the **Install certificate** button. The certificate import wizard opens.

3. Go through the wizard and save the certificate in the certificate memory on the client computer.

Starting TEMS Manager ▶ Then connect to TEMS Manager via a secure HTTPS connection.

6.12.2 Uploading your own HTTPS certificate

Alternatively, you can also use your own HTTPS certificate. This certificate must be uploaded to the Traffic Controller.

1. Navigate to the **Settings** working range and select **SSL certificate → Set certificate**.
2. Click **Browse** and select the local **CRT** file.
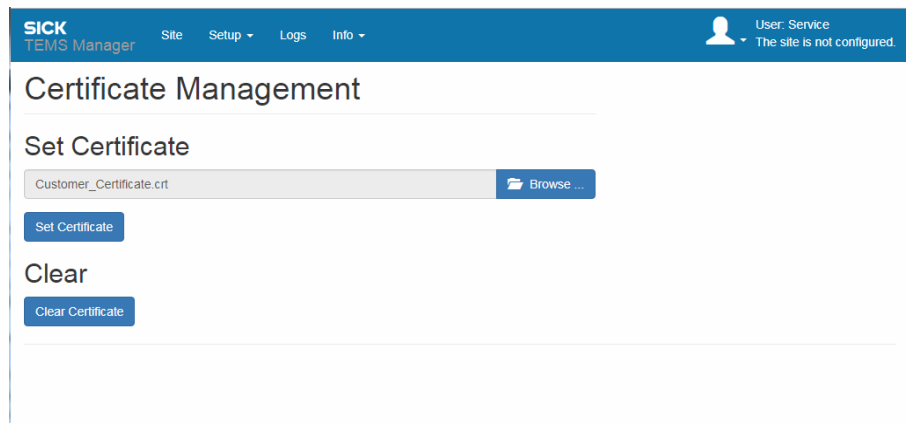
3. Click **Set certificate**. The following safety note appears.
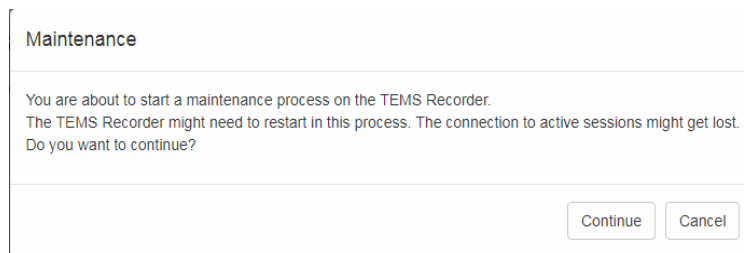
4. Press **Continue** to confirm.

The certificate for setting up the secure HTTPS connection is uploaded to the Traffic Controller.

6.13 Extending site

6.13.1 Adding system component

You can change or extend the site configuration using the wizard. For example, you can add a system function to the site and define an external category system.

In the following example, a site existing of two TIC502 units and one LMS Axle will be extended to include an additional LMS Axle.
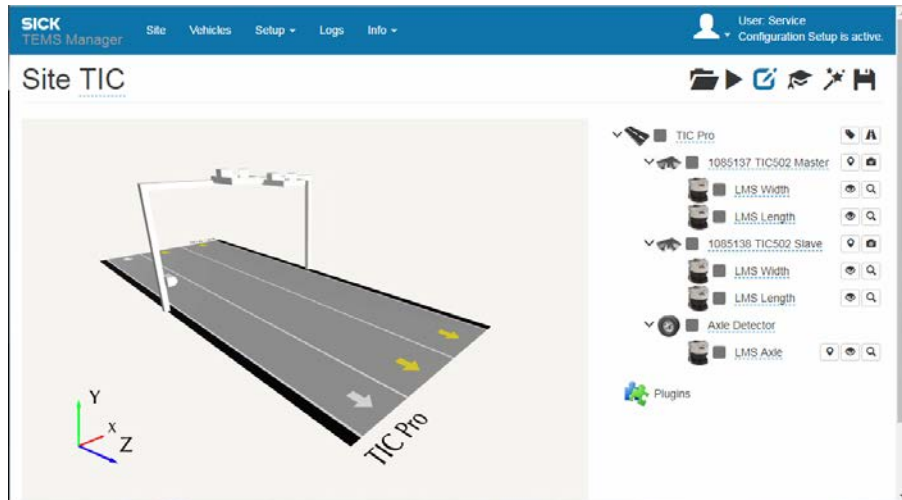
1. Click on the **Start the site configuration wizard** icon in Editing mode in the site configuration. The site configuration wizard opens.

   The current configuration is shown on the left-hand side. The right-hand side is where you can create a new site or edit the current one.
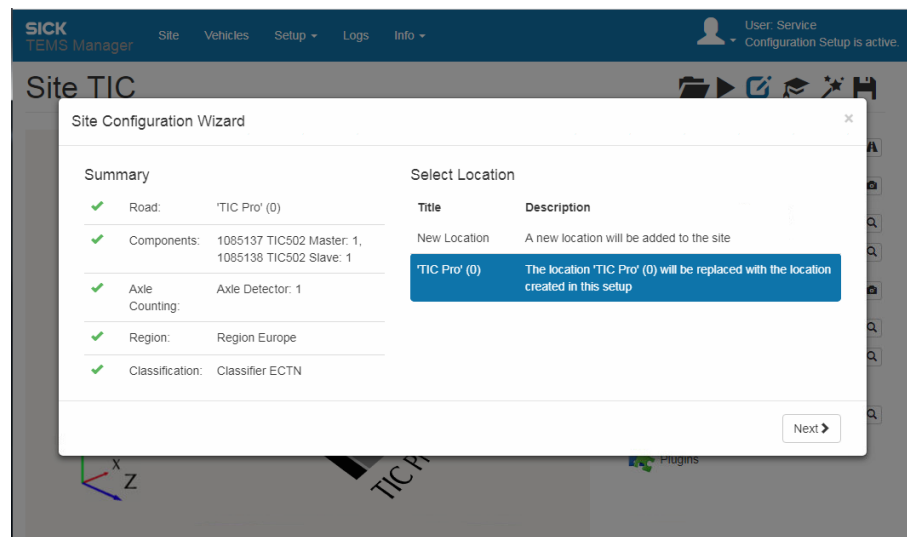
2. Select the second option for which the current configuration is to be replaced by the configuration generated in the wizard.

3. Click **Next** to confirm your selection. On the second page, select the components for vehicle detection. In the example, the configuration with two TIC502 is retained.
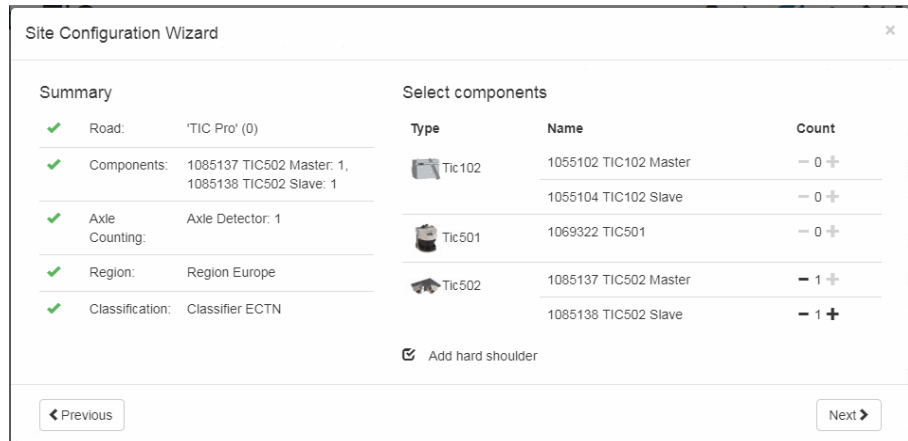
4. An **LMS Detector** system function is currently suggested on the third page.
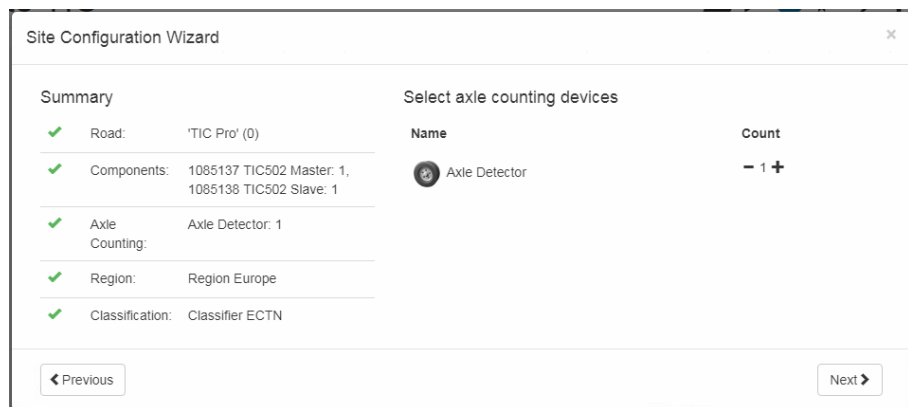
5. Add another **Axle Detector** system function in the site configuration using the plus icon, then click on **Next**.

6. In this example, you keep the category system settings.

7. End the wizard by clicking **Create site**. The site is extended to include an LMS Axle.
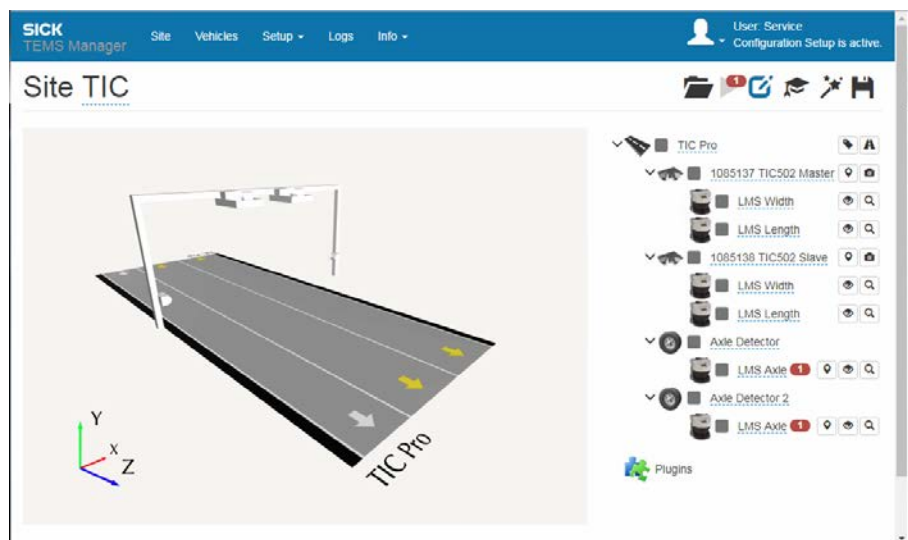
8. In , you can read how to put an additional axle counting system function into operation.

6.13.2   Using a configuration file to load system parameters

In the following example, the site configuration includes an XML file with the key system parameters. The system parameters are loaded in TEMS Manager, where they are subsequently adjusted to the conditions at the measurement site.

When logging in, the user must have **Service** authorization.

1. In TEMS Manager, click the icon for **Load site configuration and start/edit it**.
2. Select the configuration file and click **Start Configuration**.
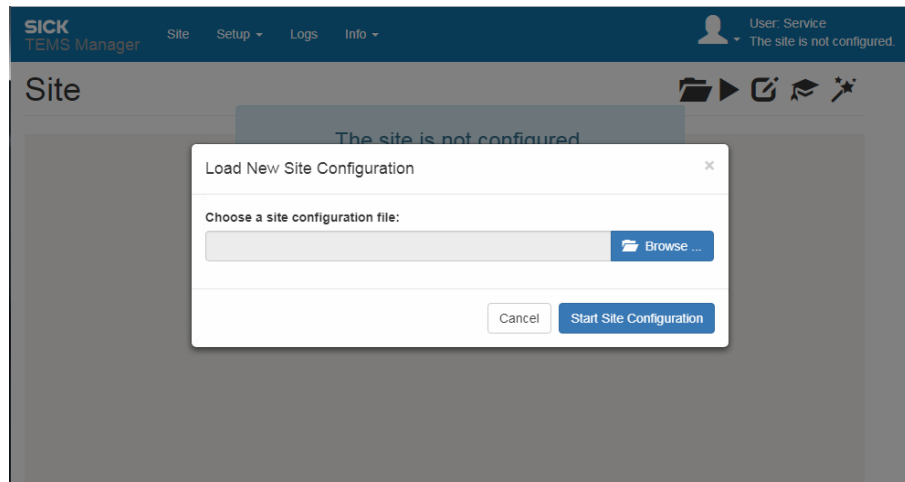
3. The configuration is loaded in TEMS Manager.

Note   If a configuration is loaded while another configuration is running, the system will automatically stop the current configuration. The new configuration is loaded and started. System operation is paused during this process.

7 Maintenance

7.1 Overview of maintenance tasks

In general, the system components are maintenance-free.

All 2D LiDAR sensors installed in the devices feature an integrated contamination monitoring function. The optical surfaces of the 2D LiDAR sensors are subject to certain maintenance intervals.

The following maintenance work must be carried out at the specified time intervals:

Component	Maintenance task	Interval *	Design
2D LiDAR sensor	Cleaning the inspection window	▪ In the event of a contamination message: as soon as possible ▪ Aside from this: As and when required	System manager
General	Visually inspect the electrical cabling and wiring for damage	1x/year	System manager
* The intervals depend on the ambient conditions and degree of contamination. In addition, the intervals must be defined according to how important they are for the customer process.			

Tab. 24: Maintenance intervals

7.2 Maintenance during operation

7.2.1 Visual inspection

Perform the following thorough checks at regular intervals:

Check PG connectors

Check the PG connectors on the devices and inside the control cabinet and, if necessary, tighten them.

Checking plug connectors

Unscrew the plug connectors and check the male contacts for moisture and traces of corrosion.

⚠	*WARNING*

Plug connectors damaged by corrosion

Plug connectors that have been damaged by corrosion must be replaced straight away. Corroded plug connectors can have a major impact on 2D LiDAR sensors' performance.

Cables

Regularly check the electrical installation. Make sure that all cable connections are secure.

⚠	*WARNING*

Loose connections or scorched cables

▶ Defects such as loose connections or scorched cables must be rectified immediately.

⚠	*WARNING*

Damaged cable insulation

There is a risk of electrocution if the insulation of the cables is damaged.

⚠	*WARNING*

Protect cables against slack

▶ Make sure that the cables are routed correctly. The cables must not loop down or fall slack in any way. They must never pose a hazard to the vehicles driving under the gantry.

Brackets

▶ Check the sturdiness of the brackets by looking for cracks and other signs of damage.

▶ Check the screw connections once a year.

7.2.2   Cleaning the 2D LiDAR sensors

The 2D LiDAR sensors are largely maintenance-free.

To achieve the full optical output of the 2D LiDAR sensors, the inspection window must be checked for contamination and cleaned accordingly. This is especially true in harsh operating environments (dust, humidity, etc.).

Displaying the degree of contamination in TEMS Manager

The 2D LiDAR sensors feature a contamination indicator that will issue an error message in TEMS Manager in the event of excessive contamination. In addition, the degree of 2D LiDAR sensor contamination is indicated in the TEMS Manager live view by a corresponding color icon (see also chapter *8.3.1 Fault diagnosis in TEMS Manager*).

Requesting the degree of contamination via the TEMS Info interface

The customer can also call up the contamination message via the **TEMS Info interface**.

Cleaning the inspection window

▶ Use a clean, soft brush to remove dust from the inspection window.

▶ Then wipe the inspection window with a clean, damp cloth.

⚠ **WARNING**

Damage to the inspection window

The optical output is weakened by scratches and streaks on the inspection window.

▶ Do not use aggressive cleaning agents.

▶ Do not use abrasive cleaning agents.

▶ Avoid scratching and chafing movements on the inspection window.

Note   Static charging may cause dust particles to stick to the inspection window. You can mitigate this effect by using anti-static plastic cleaner (part no. 5600006) and a SICK lens cloth (part no. 4003353).

Cleaning the housing and weather hood

▶ Where necessary, remove the worst of the contamination from the 2D LiDAR sensor housings and weather hoods. To do this, use a damp cloth.

7.3 Replacing components

Faulty or damaged system components must be dismantled and replaced with new or repaired components.

After a component has been replaced, the measurement site must be updated (see also chapter *7.3.6 Updating the measurement site*).

⚠ DANGER

Disconnect the power to the plant

▶ Make sure the power supply for the entire plant is disconnected throughout the entire time that you are carrying out maintenance and repair work.

⚠ DANGER

Risk of injury due to electrical current

Only a qualified electrician or trained persons working under the guidance and supervision of a qualified electrician are permitted to work on electrical plants or equipment and must comply with electrical regulations when doing so.

❗ NOTE

Claims under the warranty rendered void

Some of the housing screws on the devices are sealed.

Any claims against SICK AG under the warranty will be rendered void if the seals are damaged or if the device is opened.

The housing must only be opened by authorized SICK service personnel.

7.3.1 Which system components can be exchanged?

TIC102

If a 2D LiDAR sensor or the Traffic Controller in a TIC102 is defective, the entire system component must be exchanged. Replacing an individual 2D LiDAR sensor or the Traffic Controller is not possible.

TIC501 / TIC502 / LMS Axle

The LMS511 2D LiDAR sensors mounted on the mounting plate can be replaced separately. The entire component can also be replaced.

The TIC501 and LMS Axle 2D LiDAR sensors are replaced individually.

Replacement of the Traffic Controller mounted separately is possible.

7.3.2 Replace the TIC102

A defective TIC102 can only be replaced in its entirety.

Part number	Description
1055102	TIC102 master
1055104	TIC102 slave

Replacing the device

1. Loosen the M12 round connectors from the TIC102 connections and remove the connecting cables.

2. Dismantle the defective TIC102 from the mounting.

3. Mount the replacement device.

4. Connect the cables to the connections of the new TIC102 and screw the plug connectors together.

Note ▶ Update the measurement site. Additional information can be found in chapter *7.3.6 Updating the measurement site*.

7.3.3 Completely replacing the TIC502

A defective TIC502 can be replaced in its entirety.

Part number	Description
1085137	TIC502 master
1085138	TIC502 slave

Replacing the device

1. Loosen the M12 round connectors from the 2D LiDAR sensors and remove the connecting cables.

2. Dismantle the defective TIC502 from the mounting.

3. Mount the replacement device.

4. Connect the cables to the new 2D LiDAR sensor and screw together the plug connectors.

Note ▶ Update the measurement site. Additional information can be found in chapter *7.3.6 Updating the measurement site*.

7.3.4 Replacing LMS511 2D LiDAR sensor

Defective LMS511 2D LiDAR sensors can be replaced individually. Order the device by quoting the following part number:

Part number	Description
1091458	LMS511 SE 2D LiDAR sensor

Replacing the device

1. Loosen the M12 round connectors on the 2D LiDAR sensor and remove the connecting cables from the 2D LiDAR sensor.

2. Dismantle the defective 2D LiDAR sensor from the mounting (mounting bracket or mounting plate).

3. Mount the replacement device.

4. Connect the cables to the new 2D LiDAR sensor and screw together the plug connectors.

Note ▶ Update the measurement site. Additional information can be found in chapter *7.3.6 Updating the measurement site*.

7.3.5 Replacing the Traffic Controller

To order the replacement device, please contact your responsible SICK sales unit.

Replacing the controller

1. Undo the screw connection on the male connector for the voltage supply and pull the voltage cable out of the female connector of the Traffic Controller.

2. Pull the connected Ethernet cables out of the respective female connectors.

3. Undo the wall bracket fixing screws and remove the Traffic Controller TIC together with the assembled wall brackets.

4. Undo the four M4 screws and remove the two wall brackets from the back of the Traffic Controller.

5. Mount the replacement device inside the control cabinet using the wall brackets.

6. Plug the two Ethernet cables into the designated female connectors.

7. Connect the voltage supply to the new Traffic Controller and screw together the plug connectors.

8. Switch the supply voltage on again.

Note ▶ Update the measurement site. Additional information can be found in chapter *7.3.6 Updating the measurement site*.

7.3.6 Updating the measurement site

After replacing a system component, you will have to update the measurement site using TEMS Manager in order to guarantee continued measurement accuracy.

How you proceed depends on

- Whether you have replaced a system component with an integrated Traffic Controller (TIC102 Master).
- Whether you have replaced a system component without the Traffic Controller (TIC102 Slave, TIC502, TIC501, LMS Axle).
- Or whether you have only replaced the separately mounted Traffic Controller (TIC502 / TIC501).

Requirements

- Using the installed TEMS Manager program, you have connected to the Traffic Controller via the **Ethernet 1** TCP/IP interface (see chapter *6.2 Connecting to TEMS Manager*).
- The **site configuration** has been **stored** on a backup data card.

7.3.6.1 Updating after replacing a TIC102 Master

Since the Traffic Controller is also affected by the replacement of the TIC102 Master system component, you must either put the entire system in operation (see chapter *6.4 Setting up the site configuration with the wizard*) or update the measurement site based on the saved configuration file (see chapter *7.3.6.3 Updating the configuration after replacing the Traffic Controller*).

7.3.6.2 Update after sensor replacement (TIC102 Slave/TIC502 / TIC501 / LMS Axle)

In this case, the Traffic Controller is not affected by the component replacement and so you can update the configuration that is currently running on the TEMS Recorder.

Establishing a connection with the TEMS Recorder

1. Connect to TEMS Manager.
2. In TEMS Manager, log in as a user with the **Authorized User** authorization or higher.

Stopping the current configuration

1. Click the **Stop current site configuration / Exit editing mode** icon.
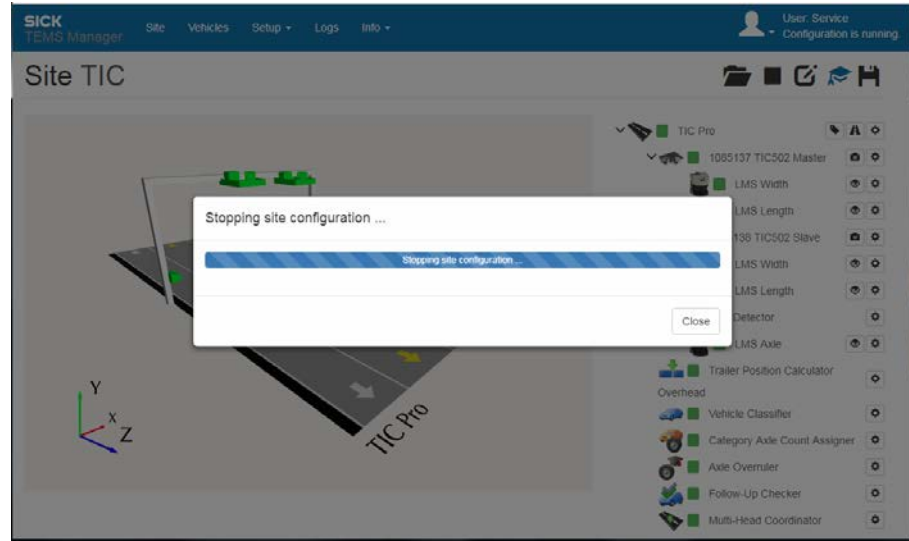
2. Switch to edit mode. To do this, click the **Edit site configuration** icon.

Reassigning the IP address for the replacement device / Assigining the device

The replacement device is still set to its default IP address. The IP address must be changed using the device search when assigning the device. The replacement device must have the same IP address as the device it replaced.

If the device has already been addressed using its default IP address at the measurement site, you do not need to change the IP address. The device can be assigned directly.

1. Go to the navigation area and click the magnifier icon for the sensor component that has been replaced (in this case: **LMS Width** of the **TIC502 Slave** system function).
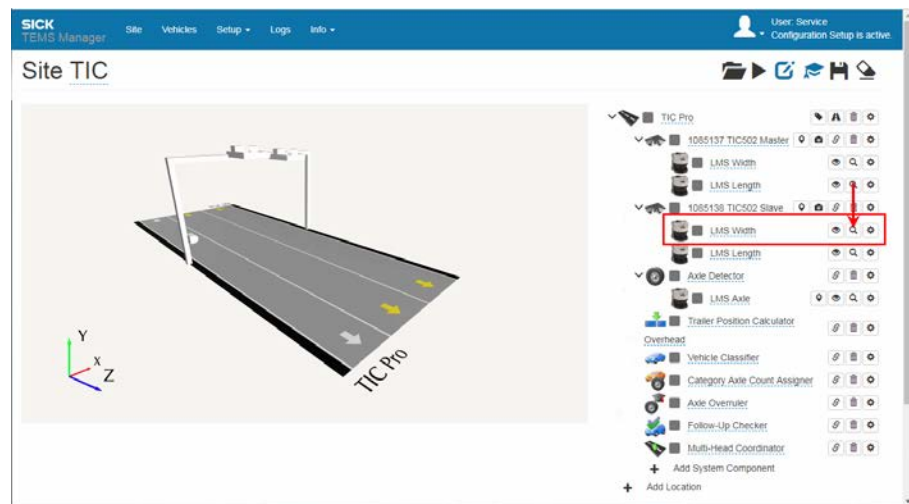
2. The list of assignable devices is currently empty.
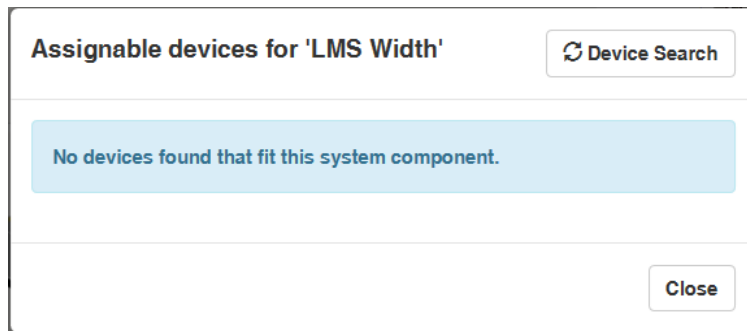
3. Click the **Device Search** button. The devices connected to the Traffic Controller appear in the list of devices.
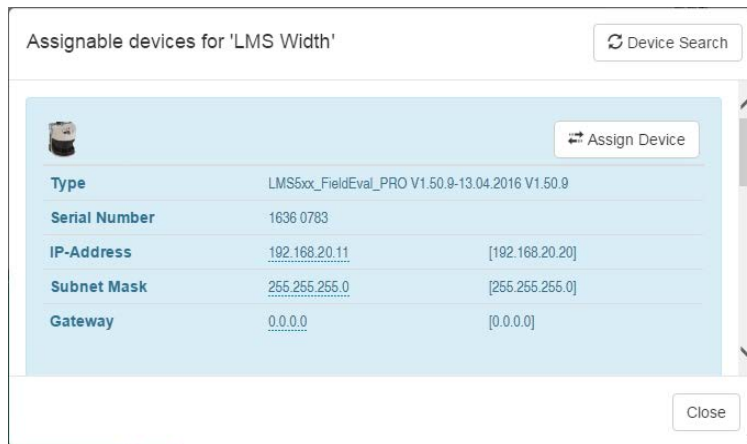
4. Click the in the field with the factory setting IP address and adjust it as appropriate.

5. Click **Assign Device**. The replacement device is assigned to the **LMS Width** system component of the **TIC502 2** system function. In the list of devices, the 2D LiDAR sensor now appears with a green background.

6. Once the change has been made, close the "Device Search" dialog box.

Loading the site configuration

▶ Click the **Load site configuration** icon.

Once the loading process is complete, all of the system functions and system components should be shown with a green icon.

This means that the profiling system is ready for operation again.

7.3.6.3 Updating the configuration after replacing the Traffic Controller

If only the Traffic Controller has been replaced, the first thing you have to do is establish a connection with the new TEMS Recorder.

You can then upload a site configuration to the new TEMS Recorder from a site configuration file using TEMS Manager.

Changing the IP address of the Traffic Controller

Upon delivery, the default IP address for the replacement device is 192.168.10.200.

Before you can establish a connection with the Traffic Controller, you have to change this IP address.

This procedure is described in detail in chapter *6.3 Configuring the IP address of the Traffic Controller*.

Establishing a connection with the TEMS Recorder

1. Connect to TEMS Manager.

2. In TEMS Manager, log in as a user with the **Authorized User** authorization or higher.

Loading the site configuration

1. Click the icon for **Load site configuration and start/edit it**.

Load New Site Configuration   ×

Choose a site configuration file:

                                                              📂 Browse ...

                        Cancel   Start Site Configuration   Edit Site Configuration

2. Select the XML file containing the site configuration. The site configuration is transferred from the file to the TEMS Recorder and started.

Note   If a configuration is loaded while another configuration is running, the system will automatically stop the current configuration. The new configuration is loaded and started. System operation is paused during this process.

8 Fault diagnosis

This chapter describes how to identify and remedy faults in the profiling system.

⚠️ **WARNING**

Danger in the event of malfunction!

Cease operation if the cause of the malfunction has not been clearly identified!

▶ Immediately stop system operation if you cannot clearly identify the fault and if you cannot safely remedy the problem.

8.1 SICK Support

If you cannot remedy the error with the help of the information provided in this chapter, please contact your SICK subsidiary.

To deal with your inquiry quickly, we will require the following information:

- Exact name of system component.
- Firmware version (see chapter *6.10.1 Displaying information on the TEMS Recorder*).
- Log files (see chapter *8.3.3 Detecting system errors using log files*).
- Configuration file (see chapter *6.7.5 Saving the configuration on the hard drive*).
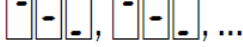
8.2   Fault indicators at component level

This section explains what the fault indicators for the individual devices mean and how to respond to them.

8.2.1   Fault indicator for the 2D LiDAR sensors
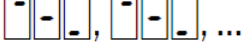
The 7-segment display on the 2D LiDAR sensors provides the following information:

7-segment display for the LMS111

Display	Possible cause	Remedy
⁻∣-∣◻∣.∣, ⁻∣-∣◻∣.∣, …	No error has occurred.	Device is in measuring mode
⟩◻.⟨	Idle mode, outputs are in the OFF state, laser is switched off.	No error has occurred.
⟩-⟨	Motor starting	No error has occurred.
E.	Fault in the 2D LiDAR sensor	Send the 2D LiDAR sensor to the manufacturer for repair.

Tab. 25:   7-segment display for the 2D LiDAR sensor LMS111

7-segment display for the LMS511

Display	Possible cause	Remedy
⁻∣-∣◻∣.∣, ⁻∣∣-∣◻∣.∣, …	No error has occurred.	Device is in measuring mode
⟩◻.⟨	Idle mode, outputs are in the OFF state, laser is switched off.	No error has occurred. If the criteria for IDLE mode are withdrawn, operational readiness is restored.
⟩-⟨	Motor starting	No error has occurred.
E.	Fault in the 2D LiDAR sensor	▶ Send the 2D LiDAR sensor to the manufacturer for repair.
0.	Connection to slave broken	▶ Re-establish the connection to the slave.
3.	Heater not connected or temperature too low.	▶ Wait until the device has warmed up. ▶ Check the connection of the heater. ▶ Send the 2D LiDAR sensor to the manufacturer for repair.

Tab. 26:   7-segment display for the 2D LiDAR sensor LMS511

Note   These error messages refer to the displays while the device is running. They are displayed for as long as the error occurs.

Displays that appear during start-up can be ignored. They disappear as soon as the device is running stably.

8.2.2   Traffic Controller fault indicators

The LEDs on the Traffic Controller provide the following information in the event of a fault:

Display	Possible cause	Remedy
Status LED on power button does not light up	▪ Supply voltage missing or too low ▪ Traffic Controller is defective	▶ Check the voltage supply. ▶ Replace the Traffic Controller.
LED on female Ethernet connector does not light up	▪ Ethernet cable disconnected ▪ Network component (e.g., Ethernet switch) is defective	▶ Check the Ethernet connection. ▶ Replace the defective network component.

Tab. 27: Traffic Controller fault indicators

8.3   Fault indicators at system level

Faults that occur on the profiling system are divided into two basic categories: **warnings** and **errors**:

- In the event of a warning, the system remains operational. However, the cause of the fault must be eliminated as quickly as possible.

  Warnings indicate things like minor contamination on a 2D LiDAR sensor.

- In the event of an error, the system is still operational in principle. However, the system can no longer be relied on to function correctly.

General system fault

Display	Possible cause	Possible measures
No connection to the Traffic Controller TIC	▪ Traffic Controller supply voltage missing or too low	▶ Check the voltage supply.
	▪ Ethernet connection to the Traffic Controller interrupted	▶ Check the Ethernet connection.
	▪ Fault in network configuration	▶ Check the network configuration.
	▪ Traffic Controller TIC defective.	▶ Replace the Traffic Controller.

Tab. 28: General system fault

8.3.1   Fault diagnosis in TEMS Manager

In TEMS Manager, warnings and errors are displayed at every level of the hierarchy – i.e., at device level, system function level, road level, and site level.
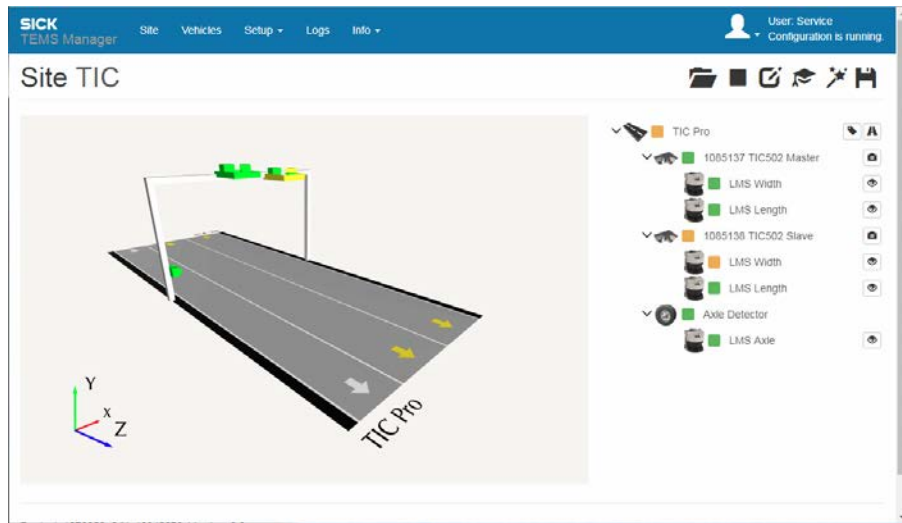
Warnings and errors at a lower level affect all the superordinate levels.
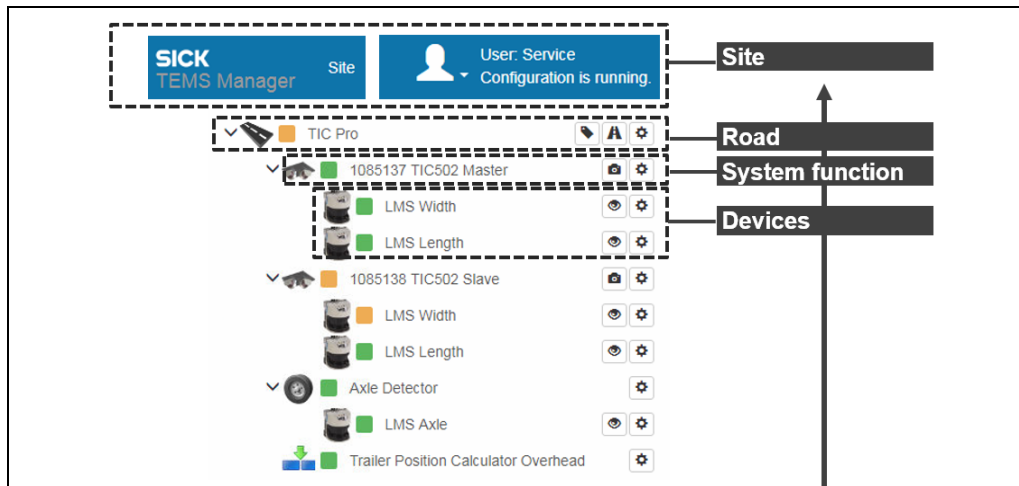
8.3.1.1   Standardized visualization icons

In the **live view**, attention is drawn to errors and warnings by highlighting the system components in different colors. The following color coding system applies:

- If a system component is shown in **green** in the live view, it is ready for operation.
- **Yellow** highlighting indicates a fault of the **warning** type.
- **Red** highlighting signals the presence of a device error.

You can narrow the problem down by right-clicking the system component's red or yellow icon. This opens a window containing further detailed information.

Green, yellow, or red icons are also used in the **navigation tree** to indicate whether the system components and system functions are ready for operation.

A **gray** icon signals that the current status is unknown. This is the case during initialization of the profiling system, for example.

8.3.1.2   Fault indicators at site level

Errors at site level are only shown in the menu bar.

- If the profiling system is only ready for operation to a limited extent, the **Site** workspace is highlighted in red font.
- In addition, a red exclamation point appears.
- On the right-hand side, the following information message is displayed in red: **Configuration is running with error(s)**.

Notes
- A site error is displayed if there is an error (red icon) on at least one of the subordinate levels.

Example
A 2D LiDAR sensor outputs a contamination message. However, this does not affect the operational readiness of the overall system in general. Consequently, the profiling system remains ready for operation. Although the configuration is affected by the error, it is still able to run.

- Warnings do not affect the site level.

Example
Minor contamination of a 2D LiDAR sensors does not impair the operational readiness of the profiling system.

8.3.1.3   Fault indicators at all subordinate levels

Road		
Display	Possible cause	Possible measures
Road red (navigation tree)	▪ An error has occurred at a subordinate level	▶ Check the live view or navigation tree to see which component is causing the error.
Road yellow (navigation tree)	▪ A warning has occurred at a subordinate level	▶ Check the live view or navigation tree to see which component is causing the warning.

2D LiDAR sensors		
Display	Possible cause	Possible measures
Inspection window yellow	▪ Minor contamination on the inspection window of the 2D LiDAR sensor	▶ Clean the inspection window of the 2D LiDAR sensor when possible.
Inspection window red	▪ Heavy contamination on the inspection window of the 2D LiDAR sensor.	▶ Clean the inspection window of the 2D LiDAR sensor immediately.
Housing yellow	▪ Minor contamination on the inspection window of the 2D LiDAR sensor Inspection window of the 2D LiDAR sensor is yellow	▶ Clean the inspection window of the 2D LiDAR sensor.
Housing red	▪ Heavy contamination on the inspection window of the 2D LiDAR sensor	▶ Clean the inspection window of the 2D LiDAR sensor.
	▪ No supply voltage to the 2D LiDAR sensor or voltage is too low.	▶ Check the voltage supply.
	▪ Ethernet connection to the 2D LiDAR sensor interrupted.	▶ Check the Ethernet connection.
	▪ 2D LiDAR sensor heater not connected or temperature too low.	▶ Check the connection of the heater.
	▪ 2D LiDAR sensor defective.	▶ Note the fault indicator on the 2D LiDAR sensor's 7-segment display.

System functions without devices
* The icon is green when the system function is running properly.
A red icon indicates that system functions have not been linked correctly, for example.

Plug-ins (Disk Storage)		
Display	Possible cause	Possible measures
Plug-in red	▪ Insufficient memory available on the hard drive.	▶ Check the hard drive's storage capacity.
	▪ Directory not present on hard drive	▶ Check the directory.
	▪ Hard drive not available	▶ Check the connection.

8.3.1.4   Analyzing the error situation

Narrow down the system fault by visualizing the measurement points.

Visualizing the live data for the device component

1. Go to the device in the navigation tree and click the **Visualize live data for device** icon.

2. Click **Raw measuring points**. The live view in TEMS Manager shows the **unfiltered raw data** for the 2D LiDAR sensor. You are able to see what the 2D LiDAR sensor can see in its visual range.

3. Click **Relevant Measurement Points**. The live view now shows the **filtered measurement data** from the 2D LiDAR sensors. The filtered measurement data are used as the basis for the 3D point cloud and the resulting calculations. Visualization of the filtered measurement data helps to detect faults.

Showing the details

The detail window helps you narrow down the system fault even further. Other status messages can also be accessed here.

1. Switch on expert mode.

2. Go to the relevant device component level in the navigation tree and click the **Show Details** icon. The detail window opens. The **Status** section in following example shows what the window looks like when the *LMS Width* 2D LiDAR sensor is contaminated.
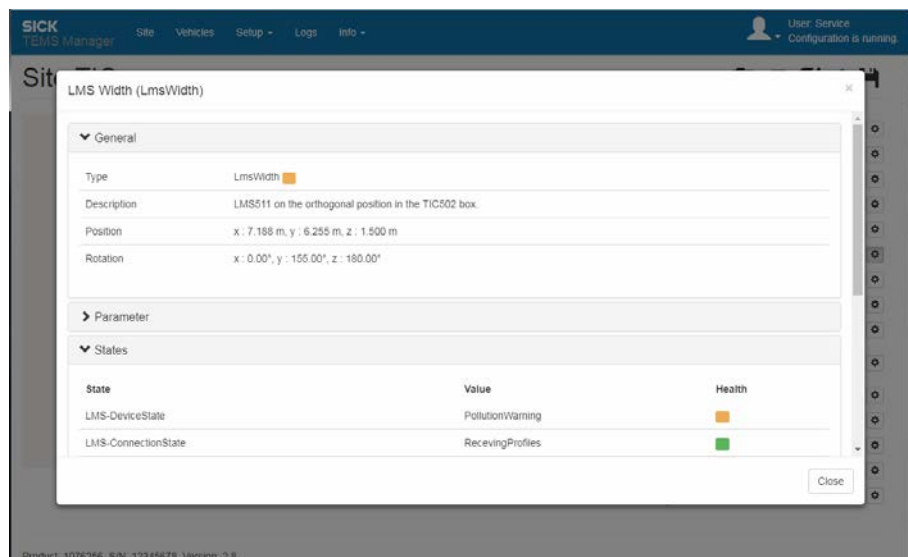
8.3.1.5   Fault indicators in editing mode

In editing mode, fault numbers appear in the navigation tree to indicate when configurations are affected by faults.
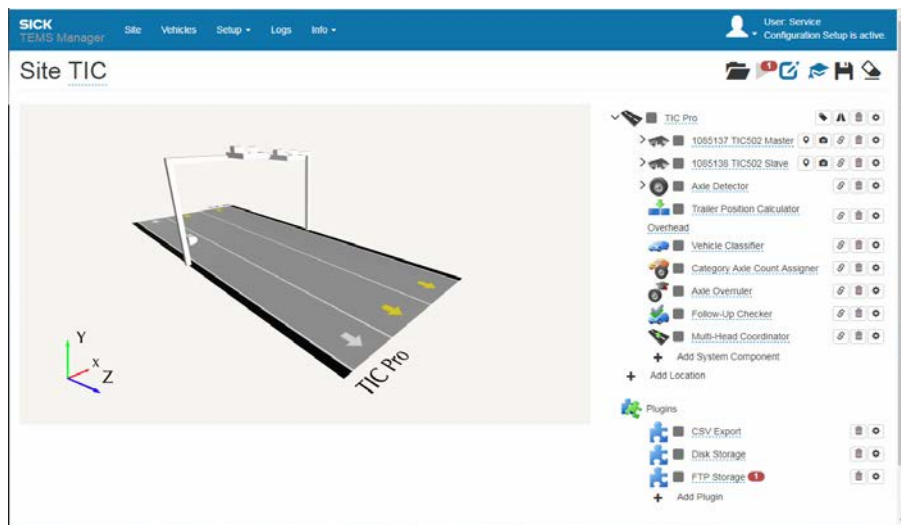
Red numbers signal the presence of an error. Erroneous configurations cannot be started. Yellow numbers signal a warning. Warnings do not prevent the configuration from starting.

The number shows how many errors or warnings there are in each case.

You can narrow the problem down by right-clicking the fault number. This opens a window containing further detailed information.
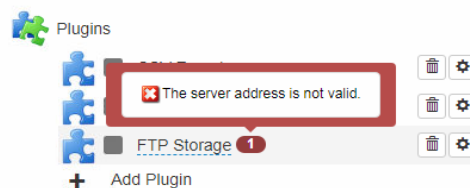
In the example, no IP address has been entered for the **FTP Storage** plug-in.

8.3.2   **Fault diagnosis via the TEMS Info interface**

The customer can also conduct a detailed fault diagnosis by requesting status messages from the TEMS Info client.

The data protocols used for accessing data in the TCP/IP data stream are listed in the separate description for the TEMS Info interface (available on the USB stick).

8.3.3   **Detecting system errors using log files**

All TEMS Recorder operations are logged on the Traffic Controller.

To help SICK Support with fault analysis, it is often necessary to forward the latest system logs. You can download these logs via the **Logs** workspace and send them as an e-mail attachment.

All system actions are written to a log file of the **Recorder** type. A separate log file is created for each day (see also chapter *6.9 Downloading log files*).

Alternatively, all the logs can be downloaded from the Traffic Controller via FTP. The status logs are stored inside the **/logs** directory (see also chapter *3.5.4 Downloading log files*).

1. Connect to the FTP server of the Traffic Controller using an FTP client.

2. Log in by entering **client** for the user name and **client** as the password.

8.3.4   **Providing raw data to help Support**

Sometimes, the measurement points recorded by the 2D LiDAR sensors also have to be forwarded to Support to assist it with its tasks. Under the default configuration for the profiling system, these raw data are not saved. You have to initiate the saving process yourself.

NOTE

Due to the large volume of data involved, we recommend only recording raw data for a maximum of one hour at a time. To enable a detailed fault analysis, it is usually sufficient to record raw data for a period of 20 minutes.

▶ Therefore, you should deactivate the function for recording raw data after 20 minutes.

Recording raw data

You can only activate the function for recording raw data if you are a user with **Service** authorization.

1. In the editing mode for the site configuration, log in as a user with **Service** authorization.

2. Switch on expert mode.

3. In the navigation tree, go to the level of the relevant system function (not the system component) and click the **Show Details** icon.
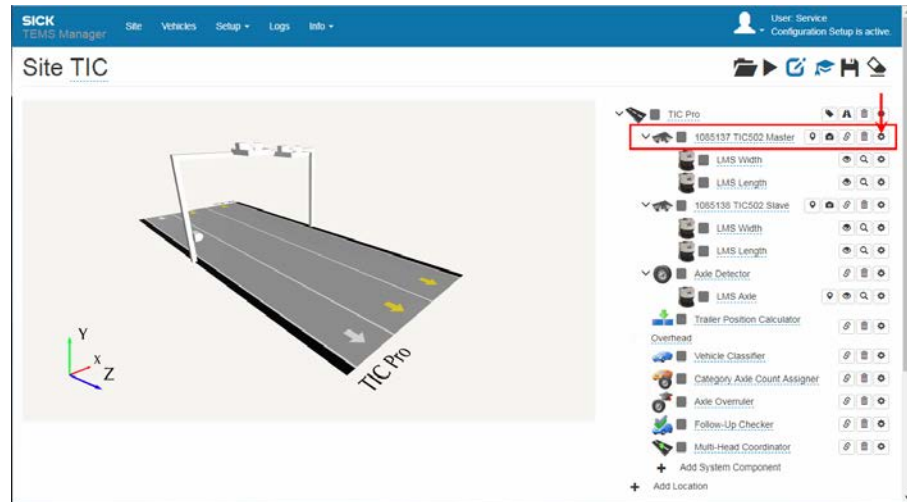
4. In the detail window for the system function, set the **RawDataEnabled** parameter to **Yes**.
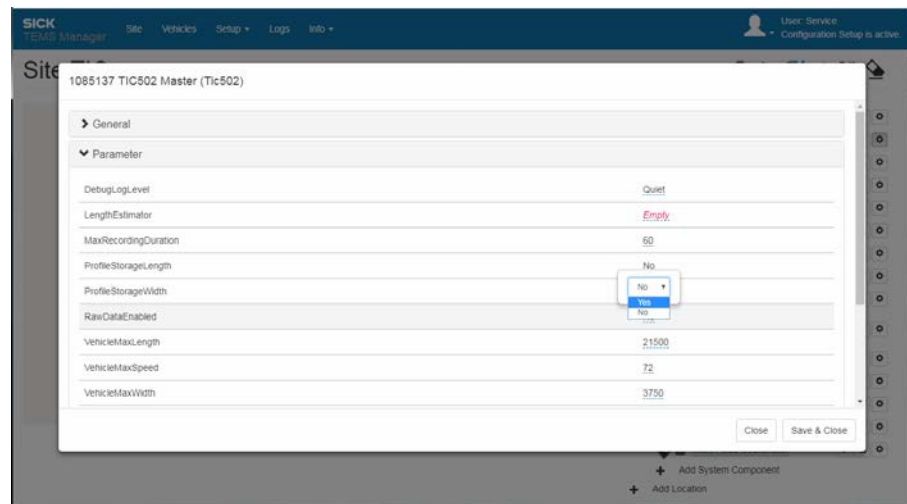
5. Close the detail window and start the configuration.

   The raw 2D LiDAR sensor data are then saved inside the **/RawData** directory on the Traffic Controller.

Stopping raw data recording

1. After approximately 20 minutes, switch back to editing mode and open the detail window for the system function.

2. Set the **RawDataEnabled** parameter to **No**.

Downloading raw data via FTP

Perform an FTP download to transfer the raw data from the */**RawData** directory on the Traffic Controller.

1. Connect to the FTP server of the Traffic Controller using an FTP client (e.g., FileZilla).

2. Log in by entering **client** for the user name and **client** as the password.

Important	**Deleting raw data**

Once the raw data has been downloaded from the */**RawData** directory on the Traffic Controller, you must **manually delete** the data. Otherwise, the data will clog up the SSD by taking up unnecessary storage capacity.

The raw data are **not** deleted automatically when you deactivate the function for recording raw data.

8.3.5   Sensor component failures

In the event of a sensor component failure, the configuration continues running. However, the profiling system is only operable to a limited extent (see also chapter *8.3.1.2 Fault indicators at site level*).

Note	Once a configuration affected by errors has been stopped, the profiling system can no longer be started.

The configuration can only be restarted once the fault has been resolved.

8.4 Typical fault situations

The Floor Finder will not switch off

Possible cause	Remedy
The 2D LiDAR sensors do not have a clear view of the measuring range. The LMS Width is hanging down too low (lower than 5 m) or is not perpendicular to the road (Z-axis rotation greater than 5°). The positions and alignment of the 2D LiDAR sensors do not match the actual conditions.	▶ Use the filtered raw data to check whether the 2D LiDAR sensor's visual range is clear (see chapter *8.3.1 Fault diagnosis in TEMS Manager*). ▶ Check the position and alignment of the 2D LiDAR sensors in TEMS Manager. The position and alignment must match the actual conditions. ▶ Carry out mounting in accordance with the specifications. ▶ Use the **FloorFinderState** and **FloorFinderResult** parameters to analyze the status messages of the Floor Finder. **FloorFinderState** ▪ **Unknown**: No status available (yet) ▪ **Recording**: Collecting data ▪ **Calculating**: Performing calculation ▪ **Finished**: Result is available **FloorFinderResult** ▪ **None**: No result available (yet) ▪ **NotEnoughPoints**: The number of visible measurement points is insufficient → Wrong configuration ▪ **NoiseTooHigh**: Too much "interference" in measurement data → Snow, trash, dust, spray ▪ **TooClose**: Result too near to scanner → Is there an object in the way? ▪ **AngleDeviationTooLarge**: Result skewed → Is the scanner hanging crooked? ▪ **DistanceSigmaTooLarge**: Too much difference between measurements → Too much traffic? ▪ **AngleSigmaTooLarge**: Too much difference between measurements → Mounting too unstable? ▪ **Calculated**: Final result is available
There is heavy contamination on the inspection window of the 2D LiDAR sensor.	▶ Clean the inspection window of the 2D LiDAR sensor.
The surface of the road is not level.	
There is snow or there are leaves on the road.	▶ Clear away anything located in the measuring range of the 2D LiDAR sensor. ▶ Make sure that the 2D LiDAR sensor's visual range is clear.
Road surface is extremely dark (e.g., due to new paving)	
Road is extremely wet	

Several outputs for the same vehicle

Possible cause	Remedy
This suggests that the distance between the system components in the configuration does not match the distances in real life.	▶ Check the configuration.

There is no vehicle, no fault

Possible cause	Remedy
The 2D LiDAR sensors' visual range has been blocked by outside ambient conditions, e.g., snow or dirt.	▶ Clear away anything that is blocking the 2D LiDAR sensor's measuring range. ▶ Check that the 2D LiDAR sensor's visual range is clear.
The IP addresses of the 2D LiDAR sensors (e.g., those of the LMS Width and the LMS Length) have been interchanged.	▶ Check the configuration.

Problems with length measurement/speed measurement

Possible cause	Remedy
Static objects are located in the LMS Length's field of view, e.g., concrete lane barriers, guardrails, sections of the gantry or a bridge, bumps in the surface of the road, etc.	▶ Use the filtered raw data to check whether the LMS Length's visual range is clear (see chapter *8.3.1 Fault diagnosis in TEMS Manager*). ▶ Check the inspection window of the LMS Length for contamination. ▶ Clean the inspection window of the 2D LiDAR sensor.

Speed measurement with opposite sign

Possible cause	Remedy
The direction of travel was configured incorrectly in TEMS Manager.	▶ Check the direction of travel for the lanes in TEMS Manager. The configuration does not have to be stopped for this.

Classification keeps delivering poor results (unclear 3D point clouds)

Possible cause	*Remedy*
The orientation of the 2D LiDAR sensors was incorrectly rotated by 180° when configuring it in TEMS Manager.	▶ Check the configuration.
The TIC501 mounting angle does not correspond with correct alignment.	▶ Adjust the mounting angle in the configuration until the point cloud of the vehicle is output in a clean square shape.
The wrong classification system was selected for the TIC501.	▶ Check the configuration. If the TIC501 is mounted on the side of the lane, the **ECTN Side classifier** basic category system must be selected.
The IP addresses of the LMS Width and the LMS Length have been interchanged.	▶ Check the configuration.
There is heavy contamination on the inspection window of the 2D LiDAR sensor.	▶ Clean the inspection window of the 2D LiDAR sensor.
There are problems with length measurement. Static objects are located in the field of view of the LMS Length, e.g., concrete lane barriers, guardrails, sections of the gantry or a bridge, or bumps in the surface of the road.	▶ Use the **filtered** raw data to check whether the visual range of the LMS Length is clear (see chapter *8.3.1 Fault diagnosis in TEMS Manager*). ▶ Check the inspection window of the LMS Length for contamination. ▶ Clean the inspection window of the 2D LiDAR sensor.

Incorrect number of axles

Possible cause	Remedy
The LMS Axle was not mounted in accordance with the specifications (mounted too high, angle of incidence too steep, etc.)	▶ Make sure that the device is mounted in accordance with the specifications (see chapter *3.6.5 Requirements for mounting the axle counting components*).
The LMS Axle's visual range has been blocked by outside ambient conditions, e.g., snow, temporary lane barriers.	▶ Check that the visual range of the 2D LiDAR sensor is clear. ▶ Clear away anything that is blocking the 2D LiDAR sensor's measuring range.

9   Annex

9.1   Technical data

9.1.1   TIC102 data sheet

	TIC102 master	TIC102 slave
Features		
System part	TIC102 (integrated evaluation unit)	TIC102 Slave (without evaluation unit; must be connected to a TIC102 Master)
Integrated application	Vehicle classification, traffic counting, axle counting * * Another LMS511 SE is required for axle counting.	
Scanner version	Two-scanner solution	
Vehicle data	■ Vehicle class (various categorization systems with up to 30 classes) ■ Direction of travel ■ Lane assignment ■ Confidence level for all vehicle data ■ Point clouds	
Number of lanes covered	1	
Recommended distance between maximum vehicle height and sensor	Typ. 1.5 m	
Calibration	Automatic	
Laser class	1 eye-safe (IEC 60825-1 (2007-3))	
Heating	Yes	
Integrated computer unit	Traffic Controller TIC	–
Performance		
Counting accuracy	> 99.8%	
Classification accuracy	Typ. 98% (for TLS8+1 classes)	
Interfaces		
Data log	■ TEMS Info interface (TCP/IP interface) ■ TEMS Manager (HTTP configuration software)	–
NTP synchronization	Yes	–
Mechanics/electronics		
Supply voltage	24 V DC (22.8 V DC … 25.2 V DC)	
Power consumption	130 W, with heating 51 W, without heating	120 W, with heating 41 W, without heating
Dimensions	355 mm x 482 mm x 373 mm	
Weight	16.1 kg	15 kg
Mounting position	Above the lane	
Installation height	6 m, 5 m … 8 m	
Enclosure rating	IP 66 (EN 60529)	
Ambient data		
Ambient operating temperature	–20 °C … +50 °C * * Protect the TIC102 from direct sunlight with a weather guard to keep it from overheating.	

Tab. 29: TIC102 data sheet

9.1.2 TIC502 data sheet

	TIC502 master	TIC502 slave
Features		
System part	TIC502 Master (with separate evaluation unit)	TIC502 Slave (without evaluation unit; must be connected to a TIC502 Master or Traffic Controller TIC via an Ethernet switch)
Integrated application	Vehicle classification, traffic counting, speed detection, axle counting * * Another LMS511 SE is required for axle counting.	
Scanner version	Two-scanner solution	
Vehicle data	▪ Vehicle class (various categorization systems with up to 30 classes) ▪ Direction of travel ▪ Speed ▪ Lane assignment ▪ Confidence level for all vehicle data ▪ Point clouds	
Number of lanes covered	1	
Recommended distance between maximum vehicle height and sensor	Typ. 1.5 m	
Calibration	Automatic	
Laser class	1 eye-safe (IEC 60825-1 (2007-3))	
Heating	Yes	
Separate computer unit	Traffic Controller TIC	–
Performance		
Counting accuracy	> 99.85%	
Classification accuracy	Typ. 98% (for TLS8+1 classes)	
Accuracy of speed measurement	± 3 km/h at < 100 km/h* ± 3% at > 100 km/h* Only for vehicles with directional stability which pass under the LMS Length	
Interfaces		
Data log	▪ TEMS Info interface (TCP/IP interface) ▪ TEMS Manager (HTTP configuration software)	–
NTP synchronization	Yes	–
Mechanics/electronics		
Supply voltage	24 V DC (22.8 V DC … 25.2 V DC) for the LMS511 2D LiDAR sensor 24 V DC (12 V DC … 36 V DC) for the Traffic Controller	
Power consumption	120 W, with heating 54 W, without heating	110 W, with heating 44 W, without heating
Dimensions (L x W x H)	498 mm x 411 mm x 191 mm (only mounting plate with pre-assembled LMS511)	
Weight	12.8 kg	12 kg
Mounting position	Above the lane	
Installation height	6 m, 5 m … 8 m	
Ambient data		
Ambient operating temperature	−40 °C … +60 °C * * Protect the TIC502 from direct sunlight with a weather guard to keep it from overheating.	

Tab. 30: TIC502 data sheet

9.1.3   TIC501 data sheet

TIC501	
General advice	
System part	TIC502 with separate evaluation unit
Features	
Integrated application	Vehicle classification, traffic counting
Scanner version	1 scanner solution
Vehicle data	▪ Vehicle class (various categorization systems with up to 30 classes) ▪ Lane assignment ▪ Confidence level for all vehicle data ▪ Point clouds
Number of lanes covered	Up to 4 lanes per LMS511 SE
Performance	
Counting accuracy	> 99.8% (detection of 2 lanes overhead with an LMS511 SE)
Classification accuracy	Typ. 96% (for TLS 8+1 classes, detection of 2 lanes overhead)
Interfaces	
Data log	▪ TEMS Info interface (TCP/IP interface) ▪ TEMS Manager (HTTP configuration software)
Mechanics/electronics	
Mounting position	Over the lane or on the side
Weight	4.4 kg
Ambient operating temperature	–40 °C ... +60 °C * * Protect the TIC502 from direct sunlight with a weather guard to keep it from overheating.

Tab. 31: TIC501 data sheet

9.1.4   Excerpt from the LMS511 SE data sheet

LMS511 SE	
Application	Outdoor
Light source	Infrared (λ = 905 nm)
Laser class	Laser class 1 (IEC 60825-1 (2007-3)), eye-safe
Aperture angle	190°
Scanning frequency	25 Hz ... 100 Hz
Sensing range	80 m maximum 40 m maximum for objects with remission under 10%
Statistical error	+/– 6 mm
Systematic error	+/– 25 mm
Ambient light immunity	70,000 lx
Optical indicators	5 x LED; 1 x 7 segment display
Voltage supply	24 V DC (19.2 V DC ... 28.8 V DC)
Power consumption	22 W + 55 W heating (typical)
Enclosure rating	IP 67, acc. to EN 60529
Weight	3.7 kg
Ambient temperature (operation)	–40 °C ... +60 °C
Storage temperature range	–40 °C... +70 °C
Dimensions	160 mm x 155 mm x 185 mm

Tab. 32: LMS511 SE data sheet

9.1.5 Excerpt from the Traffic Controller TIC data sheet

Traffic Controller TIC	
Functions	Receipt and filtering of sensor data Processing for vehicle data Issue of vehicle and diagnostic data via the user interface
Application	Indoor
Optical indicators on the device	LED status and function indicators
Supply voltage	24 V DC (12 V DC ... 36 V DC)
Operator interface	Female Ethernet connector LAN 1 on Traffic Controller
Sensor interface	Female Ethernet connector LAN 2 on Traffic Controller
Housing dimensions	180 mm x 33 mm x 121.2 mm (W x H x D)
Weight	800 g
Mounting	Screwable
Enclosure rating	IP 20
Internal memory	32 GB
Data log	▪ TEMS Info interface (TCP/IP interface) ▪ TEMS Manager (HTTP configuration software)
NTP synchronization	Yes
Ambient temperature, operation	–20 °C ... +60 °C (SSD) –40 °C ... +80 °C (storage)
Ambient temperature, storage	–20 °C ... +85 °C

Tab. 33: Excerpt from the Traffic Controller data sheet

9.2 Dimensional drawings

9.2.1 Dimensional drawings for the TIC102
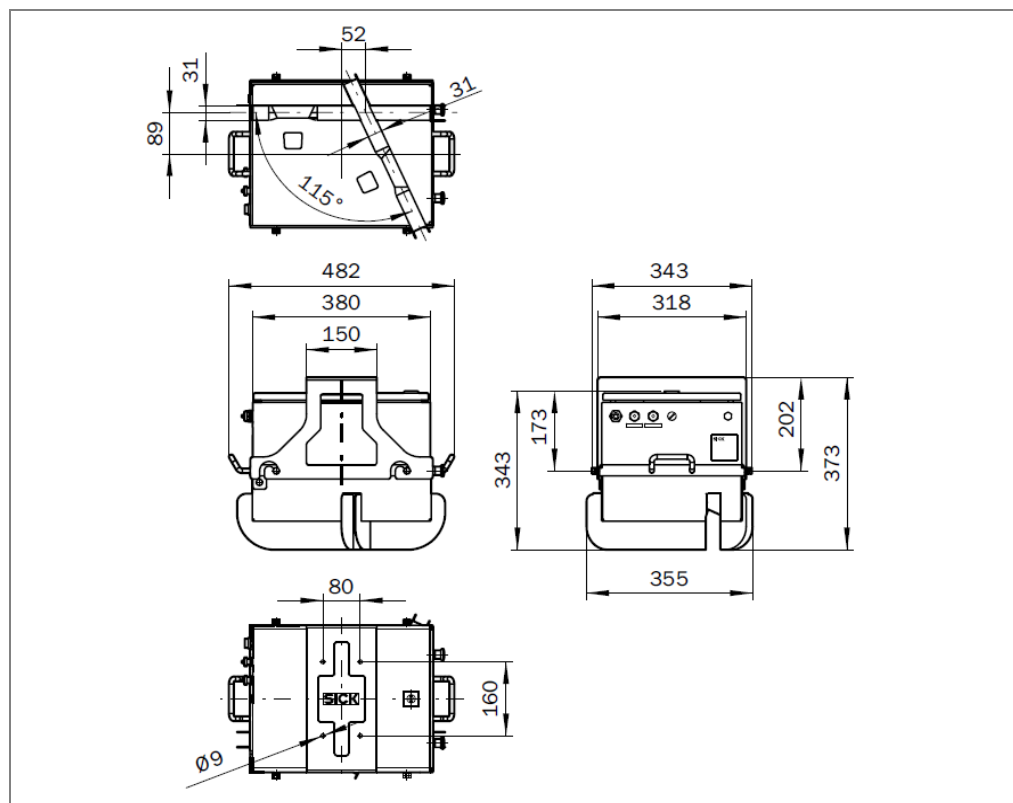
Fig. 104: Dimensional drawings of the TIC102 with mounting bracket

9.2.2 Dimensional drawings for the TIC502
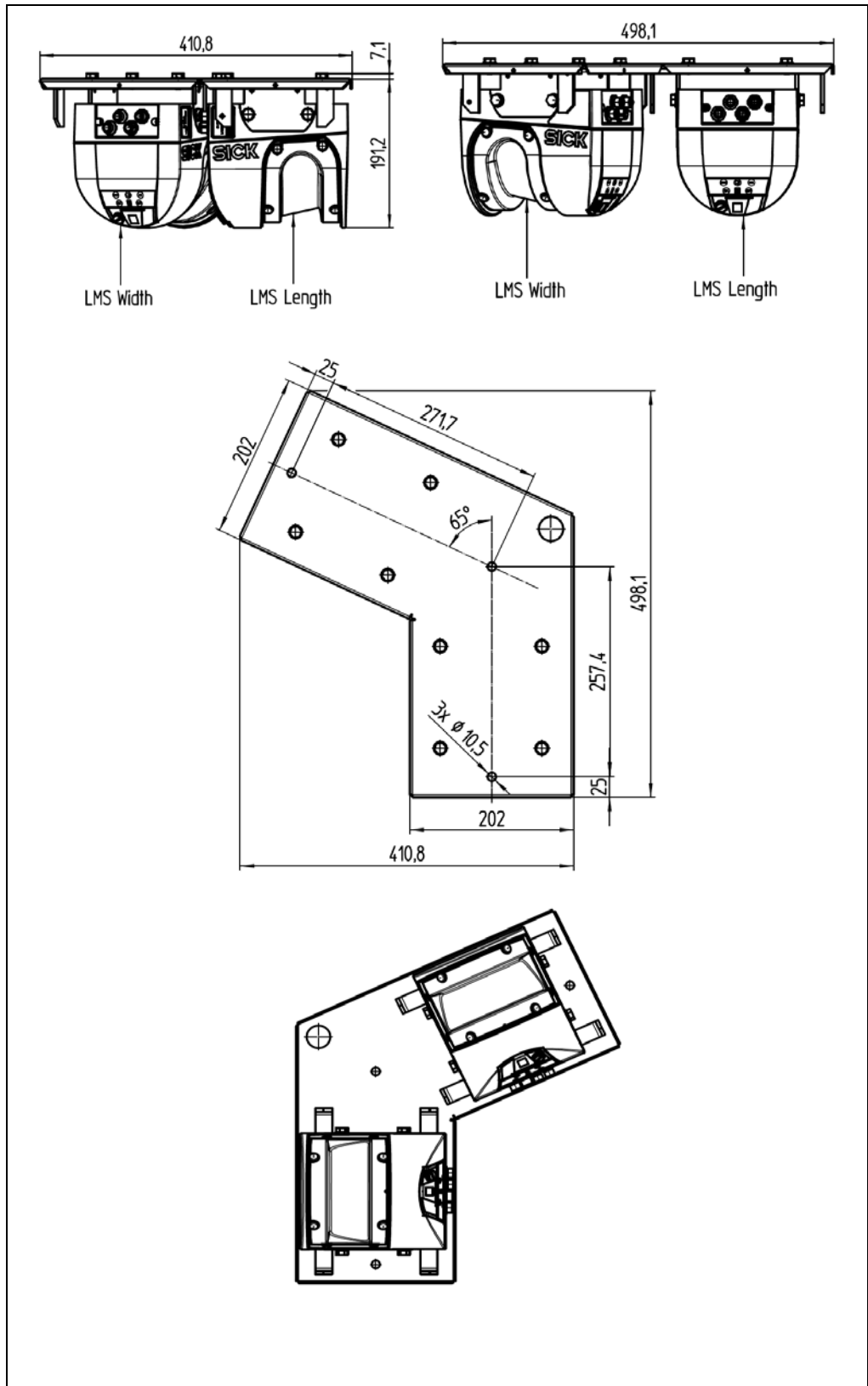
Fig. 105: TIC502 dimensional drawings

9.2.3   Dimensional drawings for LMS511 SE 2D LiDAR sensor

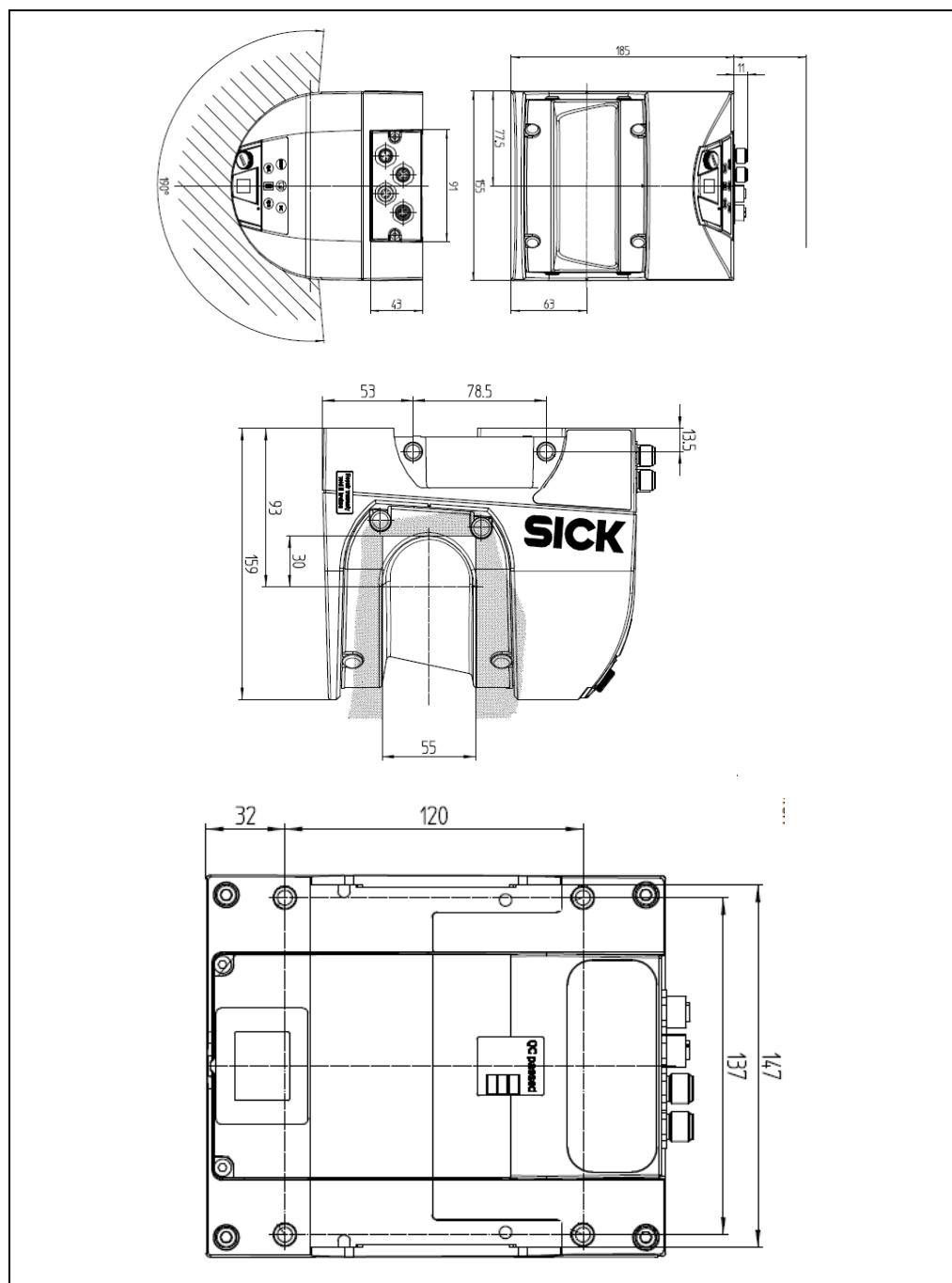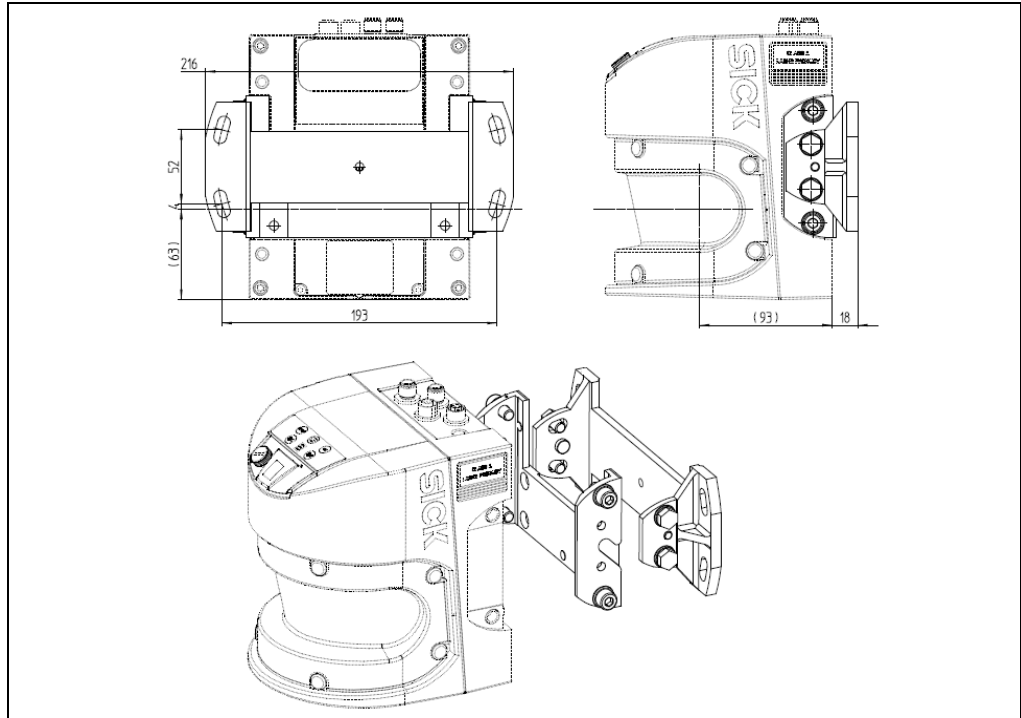*Fig. 106: Dimensional drawings for the LMS511 SE 2D LiDAR sensor*

Fig. 107: Dimensional drawings of the LMS511 SE with mounting kits 1 and 2
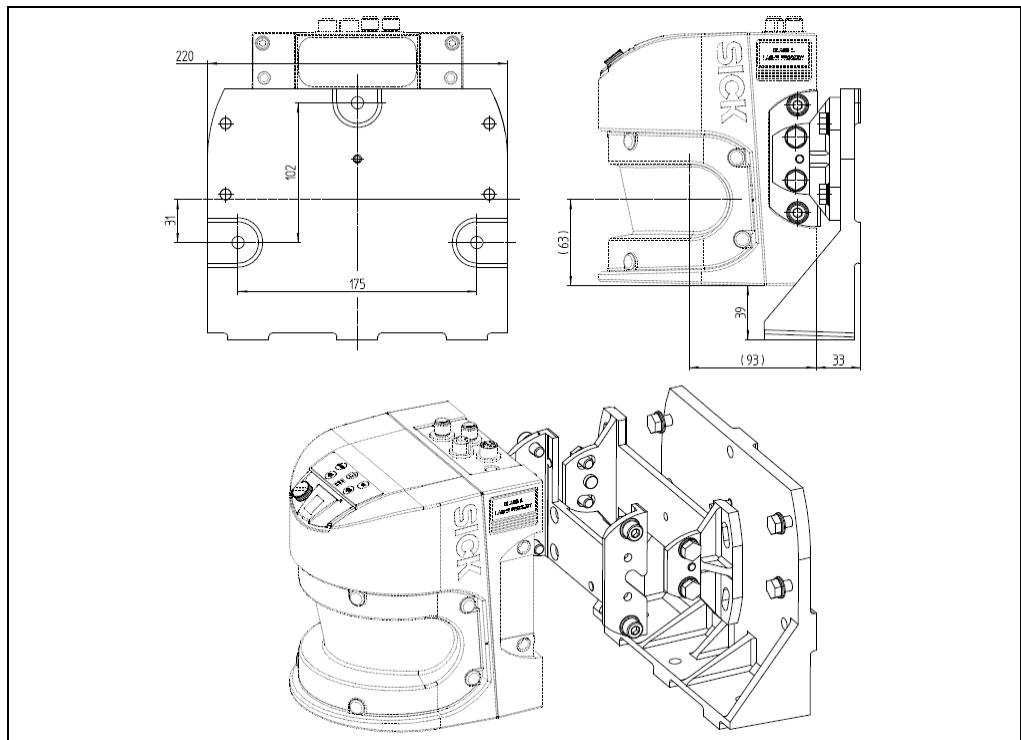

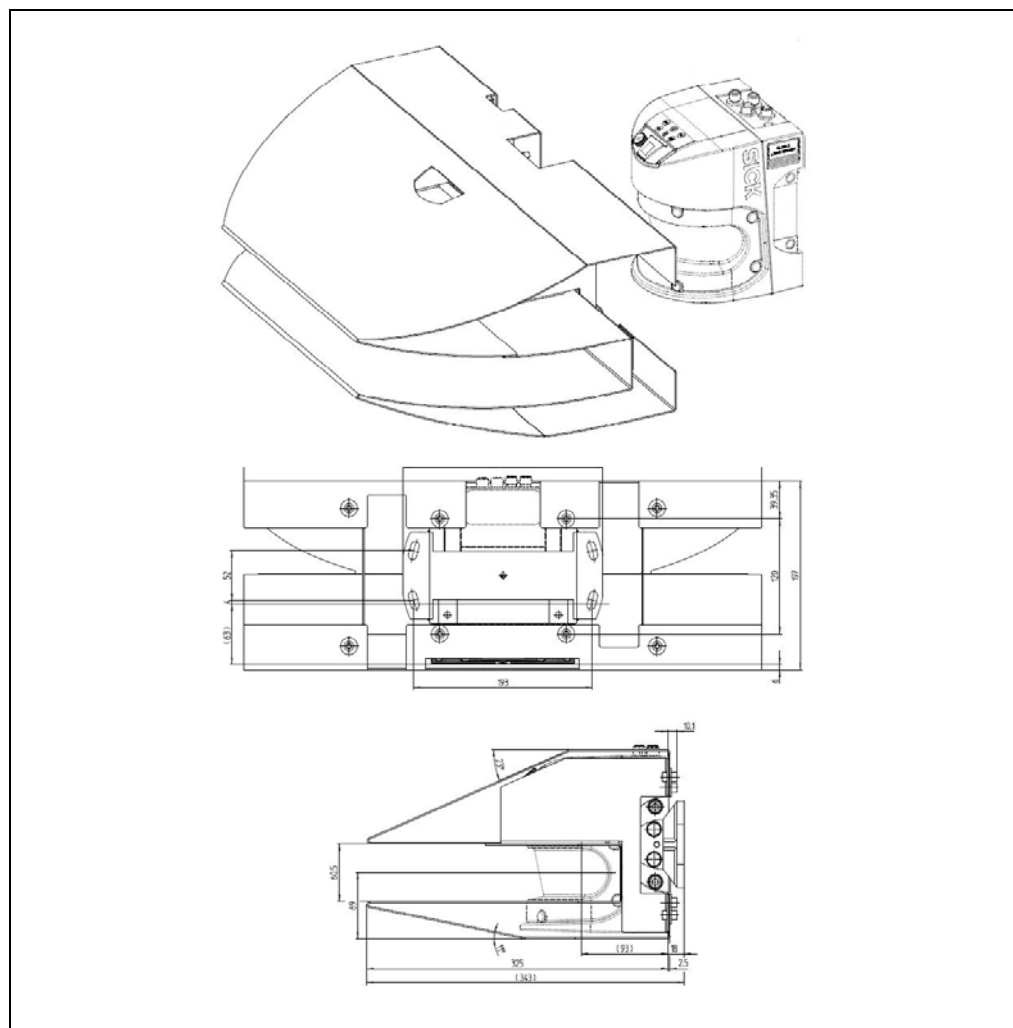*Fig. 108: Dimensional drawings for the LMS511 SE with mounting kits 1, 2, and 3*

Fig. 109: Dimensional drawings for the LMS511 SE with weather hood (large)

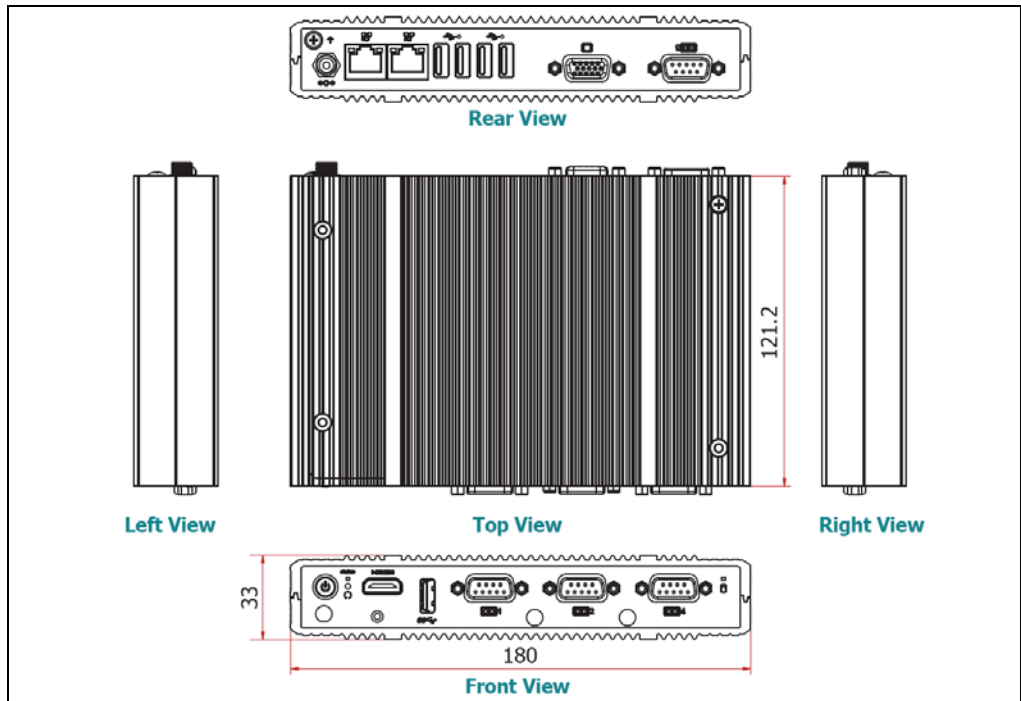### 9.2.4 Traffic Controller dimensional drawings

Fig. 110: Dimensional drawing of the Traffic Controller

9.3 Category systems

9.3.1 European region

Europe uses a detailed category system with 28 different categories. These categories are broken down into 4 further category systems: **Swiss10** with 10 categories, **TLS 8+1** with 8 categories, **TLS 5+1** with 5 categories, and **TLS 2+0** with 2 categories.

In vehicle information, these categories are described as follows:

```
...
<Category>
        <Value>ECTN.Car</Value>
</Category>
<CategoryExternal>
        <Value>TLS 8+1.Car</Value>
</CategoryExternal>
...
```

Note The weight data is used purely for the purpose of describing the relevant vehicle class. The external vehicle geometry is the definitive factor when determining the classes, not the effective and total permissible weight.

Category systems							
ECTN	Swiss 10	TLS 8+1	TLS 5+1	TLS 2+0	ECTN (output via interface)	Description	Symbol
000	0	6	6	32	Unknown	Vehicle has been detected but cannot be classified	
110	2	10	1	32	Bike	Motorbike or scooter (but not bicycles or mopeds)	
210	3	7	1	32	Car	Car (up to 9 seats, total weight ≤ 3.5 t)	
211	4	2	2	33	CarWithTrailer	Car with trailer (up to 9 seats, total weight ≤ 3.5 t)	
310	5	11	1	32	Van	Van with tapered front, body at least the same height as the driver's cab (including small vans and removal trucks, weight 2.8 t up to 3.5 t)	
311	6	2	2	33	VanWithTrailer	Van with trailer (weight 2.8 t to 3.5 t)	

320	5	11	1	32	VanPickup	Pick-up with or without a small load (front driver's cab, no body, weight ≤ 3.5 t)	
321	6	2	2	33	VanPickupWith Trailer	Pick-up without or with a small load, with trailer (front driver's cab, no body, weight ≤ 3.5 t)	
330	5	11	1	32	CamperVan	Motor home (cube design, roof without extension (e.g., bunk extension) weight ≤ 3.5 t)	
331	6	2	2	33	CamperVanWith Trailer	Motor home with trailer (cube design, roof without extension (e.g., bunk extension) weight ≤ 3.5 t)	
340	7	9	4	33	ArticVan	Van with semitrailer (weight ≤ 3.5 t)	
410	8	3	3	33	Truck	Truck with body (up to 12 m long, weight > 3.5 t)	
411	9	8	4	33	TruckWithTrailer	Truck with body and trailer (up to 18.75 m long, weight > 3.5 t)	
420	8	3	3	33	TruckDumpster	Dumper truck with empty or almost empty loading surface (up to 12 m long, weight > 3.5 t)	
421	9	8	4	33	TruckDumpster-WithTrailer	Dumper truck with empty or almost empty loading surface, with trailer (up to 18.75 m long, weight > 3.5 t)	
430	8	3	3	33	TruckTanker	Tanker for transporting liquids (oval cross-section, up to 12 m long, weight > 3.5 t)	
431	9	8	4	33	TruckTankerWith Trailer	Tanker for transporting liquids, with trailer (oval cross-section, up to 18.75 m long, weight > 3.5t)	
440	8	3	3	33	TruckLowLoaded	Low-loader without body or with low freight (freight lower than driver's cab, up to 12 m long, weight > 3.5 t)	
441	9	8	4	33	TruckLowLoaded WithTrailer	Truck without body or with low freight, with trailer (freight lower than driver's cab, up to 18.75 m long, weight > 3.5 t)	
450	9	8	4	33	TruckCarTransp orterLoaded	Car carrier transporter, loaded, with trailer (2 loading surfaces, length up to 21.5 m, weight > 3.5 t)	
451	9	8	4	33	TruckCarTransp orterEmpty	Car carrier transporter, not loaded, with trailer (2 loading surfaces, length up to 21.5 m, weight > 3.5 t)	
510	10	9	4	33	ArticTruck	Truck with semitrailer (loaded, up to 16.5 m long, weight > 3.5 t)	

520	10	9	4	33	ArticTruck Dumpster	Dumper truck with semitrailer, with empty or almost empty loading surface (up to 16.5 m long, weight > 3.5 t)	
530	10	9	4	33	ArticTruckTanker	Tanker with semitrailer (oval cross-section, up to 16.5 m long, weight > 3.5 t)	
540	10	9	4	33	ArticTruckLow Loaded	Low loader with semitrailer (up to 16.5 m long, weight > 3.5 t)	
590	8	3	3	33	TractorTruck	Articulated truck without semitrailer	
610	1	5	5	33	Bus	Bus for transporting large numbers of people (overland bus, regional bus, > 9 seats)	
611	1	5	5	33	BusWithTrailer	Bus for transporting large numbers of people, with trailer (overland bus, regional bus, > 9 seats)	

Tab. 34: Category systems – European region

9.3.2 North American region
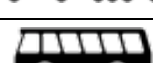
North America uses a detailed categorization system, the **North America Detailed**, with 30 categories. These categories are grouped into 11 broader categories under the **North America Consolidated** category system.

In vehicle information, these categories are described as follows:

```
…
<Category>
        <Value>NorthAmericaDetailed.AutomobileWithTrailer</Value>
</Category>
<CategoryExternal>
        <Value>NorthAmericaConsolidated.AutomobileWithTrailer</Value>
</Category>
…
```

Category Systems

North America Detailed (Class No. and Name)		North America Consolidated (Class No. and Name)		Description	Symbol
0	Unknown	0	Unknown	Detectable, but not classifiable vehicle	?
110	Motorcycle	1	Motorcycle	Motorbike or scooter (without bicycle or moped)	
111	MotorcycleWithTrailer	2	MotorcycleWithTrailer	Motorbike or scooter with trailer of all types	
210	Automobile	3	Automobile	Automobiles of all types, with load on the roof, with bicycle attached at the back	
211	AutomobileWithTrailer	4	AutomobileWithTrailer	Automobiles with trailer of all types, empty / nearly empty / loaded	
320	Pick-up	5	VanPickup	Pick-ups of all types, with / without load at the back, on the top	
310	Van			Van with tapered front, including school van and pickup with hard top	
350	VanCommercial			Vans with tapered front and high cubical back	
1302	PickupSnowPlow			Pick-ups with a snow-plow mounted in the front	
321	PickupWithTrailer	6	VanPickupWithTrailer	Pick-ups with trailer of all types, empty / nearly empty / loaded	
311	VanWithTrailer			Vans with trailer of all types, empty / nearly empty / loaded	
351	VanCommercialWithTrailer			Vans with tapered front and high cubical back, with trailer of all types, empty / nearly empty / loaded	
340	PickupKingpin			Pick-ups with kingpin, regardless of loading	

410	Truck			Trucks with cubical loading in the back	
360	PickupFlatbed			Pick-up flatbeds with wide load area, often also double tires on the second axle, including pick-up tow trucks	
440	TruckFlatBed	9	Truck	Trucks with flat loading area at the back, empty / nearly empty / loaded	
1402	TruckSnowPlow			Trucks, normally with flatbed, with a snow-plow mounted in the front	
1404	TruckConcrete			Trucks used for concrete transportation (special form in US)	
411	TruckWithTrailer			Trucks with trailer of all types, empty / nearly empty / loaded, includes moving truck pulling an automobile	
361	PickupFlatbedWith Trailer	10	TruckWith Trailer	Pick-up flatbeds with trailer of all types, empty / nearly empty / loaded	
441	TruckFlatBedWith Trailer			Trucks with flat loading area with trailer of all types, empty / nearly empty / loaded, includes also tractor unit with trailer	
510	TractorTrailerCombo			Semitrailer trucks with cubical loading in the back, regardless of the shape of the cab	
530	TractorTrailerCombo Tanker			Semitrailer trucks transporting cylindrical loading	
540	TractorTrailerCombo LowLoaded			Semitrailer trucks with low loading area in the back, empty / nearly empty / loaded, also tractor trailer pulling a recreation vehicle	
550	Autotransporter	11	TractorTrailer Combo	Semitrailer trucks transporting cars, loaded or empty	
1502	TractorTrailerCombo-HouseTransportation			Semitrailer trucks transporting house, very wide (above 3.5 m) and high load (above 4 m)	
590	TractorUnit			Semitrailer tractor truck	
511	TandemTrailerCombo	12	TandemTrailer Combo	Semitrailer trucks with 1 trailer	
610	BusRV			Bus for transportation of people, coach, overland bus, includes recreation vehicles	
620	SchoolBus	7	Bus	Bus for transportation of school pupils	
611	BusRVWithTrailer	8	BusRVWith Trailer	Bus with trailer of all types, empty / nearly empty / loaded	

Tab. 35: Category systems – North American region

9.3.3   Brief overview of grouped category systems

Category system	Class No.	Description	Output via interface
TLS 8+1	6	Unknown	Unknown
	10	Motorbike	Bike
	7	Car	Car
	11	Delivery van	Van
	2	Car with trailer	CarWithTrailer
	3	Truck	Truck
	8	Truck with trailer	TruckWithTrailer
	9	Articulated truck	TruckArtic
	5	Bus	Bus

Category system	Class No.	Description	Output via interface
TLS 5+1	6	Unknown	Unknown
	1	Car group	Car
	2	Car with trailer	CarWithTrailer
	3	Truck	Truck
	4	Truck combinations	TruckWithTrailer
	5	Bus	Bus

Category system	Class No.	Description	Output via interface
TLS 2+0	32	Car or similar	Car
	33	Truck or similar	Truck

Category system	Class No.	Description	Output via interface
Swiss 10	0	Unknown	Unknown
	1	Bus, car	Bus
	2	Motorbike	Bike
	3	Car	Car
	4	Car with trailer	CarWithTrailer
	5	Delivery van	Van
	6	Delivery van with trailer	VanWithTrailer
	7	Delivery van with semitrailer	VanArtic
	8	Truck	Truck
	9	Truck with trailer, freight truck	TruckWithTrailer
	10	Truck with semitrailer, articulated truck	TruckArtic

Category system	Class No.	Output (interface)
NorthAmerica Consolidated	0	Unknown
	1	Motorcycle
	2	MotorcycleWithTrailer
	3	Automobile
	4	AutomobileWithTrailer
	5	VanPickup
	6	VanPickupWithTrailer
	9	Truck
	10	TruckWithTrailer
	11	TractorTrailerCombo
	12	TandemTrailerCombo
	7	Bus
	8	BusRVWithTrailer

9.4 Terminology relating to statistical measurement accuracy

The counting accuracy shows how many of the vehicles have been correctly detected and – consequently – counted. Counting accuracy is independent of the type of vehicles in the traffic.

In the example below, measurement accuracy is determined on the basis of 10,000 vehicles. For ease of understanding, the vehicles consist of cars (5,000) and trucks (5,000) only.

In our example, 20 of the 10,000 vehicles were not detected. This gives a counting accuracy of 99.8%.
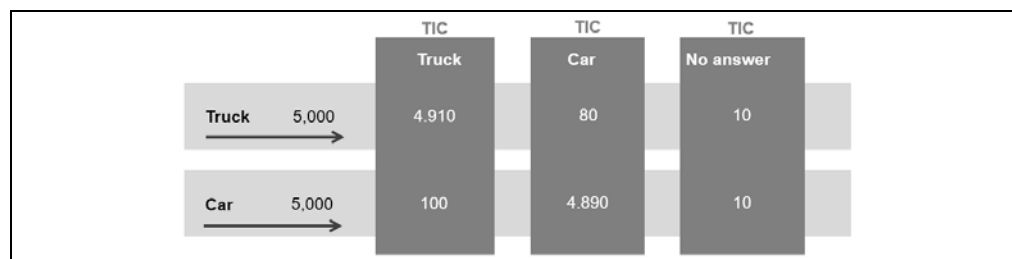
Fig. 111: Counting accuracy and classification accuracy

Counting accuracy

The counting accuracy shows how many of the vehicles have been correctly detected and – consequently – counted. Counting accuracy is independent of the type of vehicles in the traffic.

In our example, 20 of the 10,000 vehicles were not detected. This gives a counting accuracy of 99.8%.

Classification accuracy

The classification accuracy shows how many of the vehicles have been correctly classified. In our example, 9,800 of the 10,000 vehicles have been correctly classified. The system's classification accuracy amounts to 98%.

The classification rate for trucks is higher than for cars.

- Trucks: 4,910 of 5,000 vehicles were correctly classified = 98.2%
- Cars: 4,890 of 5,000 vehicles were correctly classified = 97.8%

The classification accuracy of the entire system therefore depends on the type of vehicles in the traffic and the category system used. Depending on the type of vehicles in the traffic and the category system used, the measurement accuracy of the entire system may increase or decrease.

Confidence

For most of the data recorded for a vehicle, there is a confidence level (between 0 and 100%). The confidence level expresses the level of certainty with which the value was correctly identified by the system component.
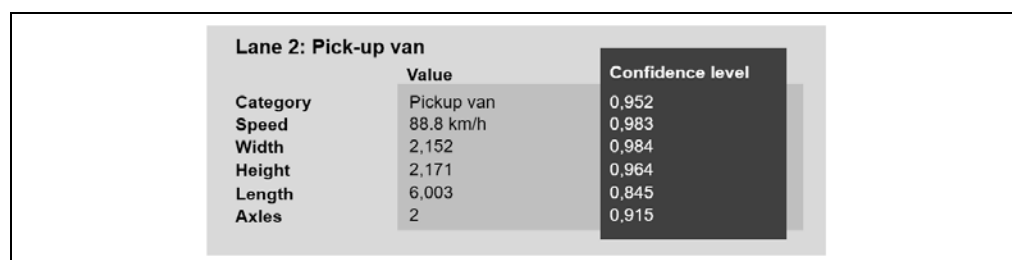
Fig. 112: Output data with confidence level

The confidence level can be processed internally as well as during analysis in downstream systems.

9.5   Users and authorizations

9.5.1   Overview

Three standard users are differentiated for working in TEMS Manager: **Operator**, **Authorized User**, and **Service**.

The users are assigned the following authorizations:

User	Authorization	Password	Rights
Operator	Operator	–	▪ Change own password ▪ View basic parameters
AuthorizedClient	Authorized Client	Client	▪ Change own password ▪ View basic parameters ▪ View advanced parameters ▪ Edit configuration ▪ Load and start configuration
Servicing	Servicing	Service level	▪ Change passwords of all users ▪ View basic parameters ▪ View advanced parameters ▪ View expert parameters ▪ Manage users ▪ Edit configuration ▪ Load and start configuration
Production	Production		▪ Program-internal user. ▪ Can neither be edited nor deleted.
Developer	Developer		▪ Program-internal user. ▪ Can neither be edited nor deleted.

Tab. 36:   User and authorizations – TEMS Manager

Note   Change **AuthorizedClient** and **Service** default passwords straight after initial login to protect TEMS Manager against unauthorized access.

Access regulation on user management

Users with the **Service** authorization have access to all users. They can create new users and delete existing users (except the logged-in user) and change user passwords.

Users with the **Authorized user** or **Operator** authorization can only change their password in user management. Other functions are not available.

Note   User management can only be called up if configuration is stopped.

9.5.2   Changing default passwords

1. Stop the current configuration.

2. Register as a user with the **Service** authorization.

3. In the **Settings** register, select the **User management** function.

4. Click on the Edit icon in the user line.

5. Define the new password in the **Change password** area. The new password must not be identical to the previous one.

6. Enter the new password again. This ensures that you wish to use the spelling entered in the previous field.

7. Confirm with **Change password**. Successful adaptation of the password is confirmed.

8. Return to the list of users using the arrow icon.

Note   A password can be assigned for the **Operator** user, which is delivered without a password by default, with this function.

9.5.3 Creating users

1. Register as a user with the **Service** authorization.
2. Open user management.
3. Click on **Create user**.
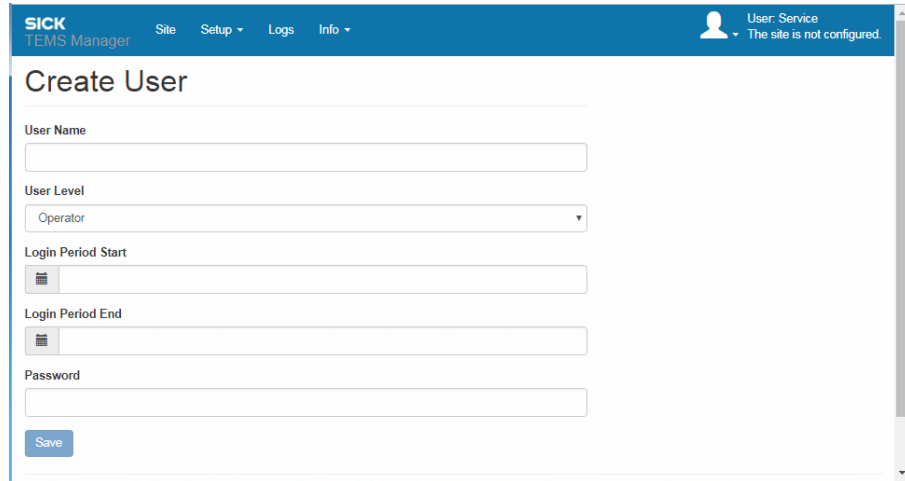
4. Enter user name.

Note   The user name is case-sensitive. Note upper-/lowercase letters.

5. Assign the user one of the three authorizations.
6. As an option, you can limit the log-in time of the user.
7. Assign password.
8. Complete with **Save**. The list of standard users is extended to include the newly created user.
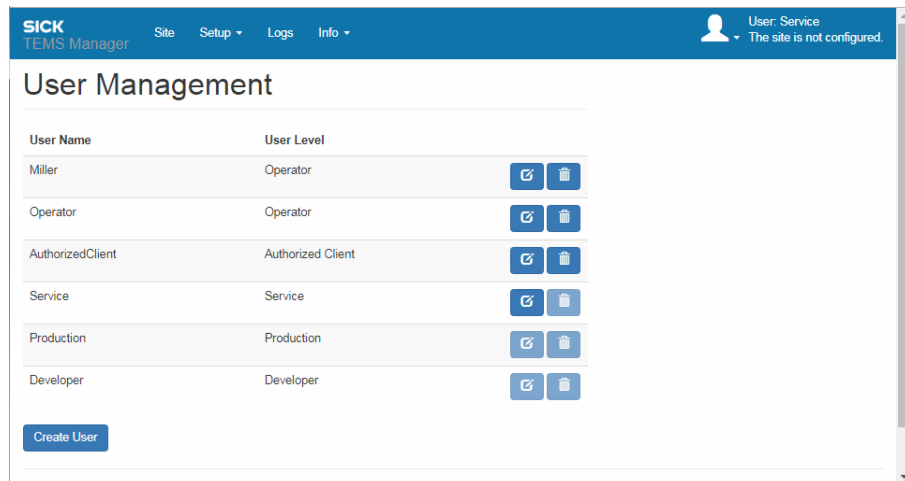
Logging in

Logging in is done later with user name and password.

9.5.4 Change password

Users with the **Authorized user** or **Operator** authorizations can only change their password in user management.

1. In the **Settings** register, select the **User management** function.

2. Enter new password and confirm by entering it again.

3. Click on **Change password**.

9.5.5 User data for accessing the FTP server of the Traffic Controller

The application processing unit features an integrated FTP server for downloading vehicle data and log files via FTP. This FTP server is accessed by entering set user data.

User name	Client
Password	Client

Tab. 37: Accessing the FTP server of the APU

Note   The user name and password of the FTP server cannot be changed.

9.6   TEMS Manager Command Line Tool

9.6.1   Introduction

Starting from TEMS Recorder version 2.0.7, a command line version of the TEMS Manager is available for handling TEMS recorder devices from a Windows computer with a .NET 4.0 installed.
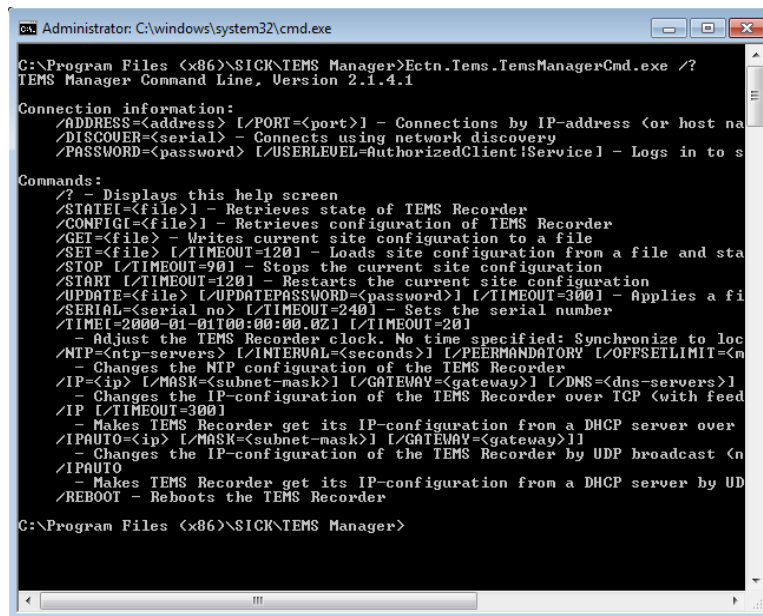
TEMS Manager Command Line (with executable Ectn.Tems.TemsManagerCmd.exe at the default installation path C:\Program Files\SICK\TEMS Manager) has a text-based user interface intended to be used with the Windows command line (cmd.exe) or in Powershell.

Using TEMS Manager Command Line, the following functionality is available:

1. Connection to a TEMS Recorder instance
   ▶ Using IP Address / Host Name and optionally port number
   ▶ Using the serial number of the TEMS Recorder
2. Uploading a site configuration (in temsXml format)
3. Downloading current site configuration (in temsXml format)
4. Downloading TEMS Recorder configuration (in temsXml format)
5. Querying TEMS Recorder state (in temsXml format)
6. Stopping / restarting the current site configuration
7. Executing administrative tasks
   ▶ Changing IP configurations (DHCP/STATIC)
   ▶ Changing NTP configurations
   ▶ Setting the time
   ▶ Updating firmware
   ▶ Changing or setting a serial number (only possible for customers with an OEM Image)
   ▶ Rebooting the TEMS Recorder computer

9.6.2 Usage from Windows Command Line

1. Start the Windows Command Line and go to the installation directory of the TEMS Manager software (default installation path: C:\Program Files\SICK\TEMS Manager). In 64 bit systems, the path will look as follows: C:\Program Files (x86)\SICK\TEMS-Manager.

2. In order to see the available commands in the help screen, type `Ectn.Tems.TemsManagerCmd.exe /?.`

3. For example, in order to connect to a TEMS Recorder with serial number 91234567 you can use `Ectn.Tems.TemsManagerCmd.exe /discover=91234567.`

9.6.3 Usage from Powershell

TEMS Manager Command Line can be used from Powershell for more advanced scripting.
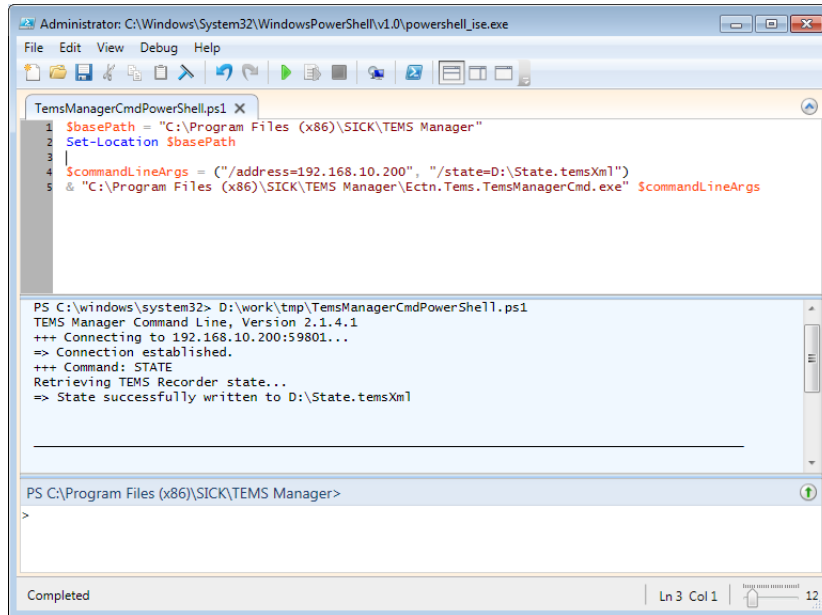
Scripting with Powershell is the preferred way to manage multiple TEMS Recorder systems.

For example, it is possible to collect the state of all reachable TEMS Recorders, change IP addresses, change NTP servers, or update the TEMS Recorders to a specific version.

9.6.4   Command Specification

Introduction

This section describes the functional specifications for TemsManagerCmd.

Each time TemsManagerCmd is invoked, it executes one operation and then terminates.

The command line arguments determine which operation will be executed.

The command line arguments must always (except in case of "/?") contain connection information.

The return value is either 0 (success) or greater than 0 (error code). Detailed progress information is printed to the standard console and error messages to the error console.

Name	Description	ERRORLEVEL
success	The command was successfully executed.	0
Error	An unspecified error occurred. Details are printed to the console output.	1
AbortedByUser	Most long-running operations may be canceled by the user using the ESC-key.	2

Description	Parameters	Optional
*Connect through IP	/address=127.0.0.1	/port=1234
*Connect through serial no.	/discover=12345678	
Provide password	/password=servicelevel	/userlevel=Service
Get status	/state	=D:\State.temsXml
Get configuration	/config	=D:\Recorder.temsXml
Get site configuration	/get	=D:\Site.temsXml
Set site configuration	/set=D:\Site.temsXml	
Start last configuration	/start	/timeout=300
Stop active configuration	/stop	/timeout=300
Update firmware	/update=D:\File.temsUpdate	/updatepassword=XXX
Set serial number	/serial=12344567	
Set actual time	/time=2013-04-28T10:10:10Z	
Set NTP server	/ntp=ch.pool.ntp.org	
Set IP address (TCP)	/ip=127.0.0.1	/mask= /gateway= /dns=
Get IP address from DHCP (TCP)	/ip	
Set IP address (UDP)	/ipauto=127.0.0.1	/mask= /gateway=
Get IP address from DHCP (UCP)	/ipauto	
Reboot	/reboot	
Help	/?	

Connect to TEMS Recorder via IP Address
`Ectn.Tems.TemsManagerCmd.exe /address=127.0.0.1 [ /port=1234 ]`
Connects to a TEMS Recorder that is specified by an IP address or a host name (DNS) and optionally a TCP Port number.

Parameters	Arguments	Default
Address	IP Address or Host Name	Required
Port	TCP Port	59801

Name	Description	ERRORLEVEL
Argument Error	Address is invalid or port number is out of range [1... 65535] Neither /address nor /discover are present.	5
No Connection	No connection could be established. Exception details are written to the error console.	6

Connect to TEMS Recorder via Discovery
`Ectn.Tems.TemsManagerCmd.exe /discover=12345678`
Connects to a TEMS Recorder on the local LAN using AutoIP discovery.

Parameters	Arguments	Default
Discover	8-digit serial number of the TEMS Recorder with which a connection should be established.	Required

Name	Description	ERRORLEVEL
Discovery Failed	Auto IP couldn't be started because the port was already in use.	7
Not Found	The discovery couldn't find a TEMS Recorder with the indicated serial number	8
Multiple Results	The discovery found more than one TEMS Recorder with the same serial number.	9

Provide Password

`Ectn.Tems.TemsManagerCmd.exe <connection info> [/password=<password> ]`
`[ /userlevel=<userlevel> ]`
Example
`Ectn.Tems.TemsManagerCmd.exe <connection info> /password=client`
`/userlevel=AuthorizedClient`

All commands that change the site configuration or the settings of TEMS Recorder require a higher access level. By default, "Service" user level is assumed. Thus only a password parameter needs to be provided – i.e., "/password". To explicitly alter access rights the following switch: /userlevel=xxx with its corresponding password is required.

Parameters	Arguments	Default
UserLevel	The name of a user level that the user wishes to log on to. Available user levels are: ▪ Operator ▪ AuthorizedClient ▪ Servicing	Servicing
Password	Secret password, provided in plain text without quotation marks. The default passwords are: ▪ User level "Operator" = <none> ▪ User level "AuthorizedClient" = client ▪ User level "Service" = servicelevel	Service level

Name	Description	ERRORLEVEL
Bad Credentials	The given password for specific user level was incorrect.	3
Connection Failure	The given user level has insufficient access rights to perform the operation.	70

Query Status

`Ectn.Tems.TemsManagerCmd.exe <connection info> /state[=D:\State.temsXml]`

Retrieves the current site state and serializes it to the indicated file. The XML file is structured as follows:

```xml
<ConfigurationXml Version="2" RecorderVersion="2.1.4.5">
  <State>
    <SiteState>ConfigurationRunning</SiteState>
    <SiteStateMessage />
    <RoadState>
      <Caption>Road1</Caption>
      <IsOnline>true</IsOnline>
      <DeviceState>
        <Caption>Head1</Caption>
        <Health>Good</Health>
        <DeviceState>
          <Caption />
          <Health>Good</Health>
          <StateGroup Name="LMS" Value="OK" Health="Good" />
        </DeviceState>
      </DeviceState>
    </RoadState>
    <PluginState>
      <Name>Ectn.Tems.TemsRecorderPluginCsv.PluginTypeLogicCsv</Name>
      <IsOnline>true</IsOnline>
    </PluginState>
    <PluginState>
      <Name> Ectn.Tems.TemsRecorderPluginDiskStorage.PluginTypeLogicDiskStorage</Name>
      <IsOnline>true</IsOnline>
    </PluginState>
    <TemsInfoClientCount>0</TemsInfoClientCount>
    <RecorderTime>2013-05-27T22:30:34.7176626Z</RecorderTime>
    <NtpClientState>Unknown</NtpClientState>
    <UserLevel>Service</UserLevel>
  </State>
</Tems>
```

Parameters	Arguments	Default
State	Output file where the serialized site state is stored. If no file name is specified, the resulting XML document is printed to the console.	Required

Name	Description	ERRORLEVEL
Connection Failure	Timeout, network interruption, …	10
Output Write Failure	Invalid output path or access denied	11

Get Configuration
`Ectn.Tems.TemsManagerCmd.exe <connection info> /config=D:\out.temsXml`
Retrieves serial number, version number, IP configuration, and NTP configuration and writes the information to an XML file.
The XML file contains the following elements:

```xml
<ConfigurationXml Version="2" RecorderVersion="2.1.4.5">
  <RecorderConfig>
    <Product>1055102</Product>
    <Version>2.1.4.5</Version>
    <SerialNumber>12345678</SerialNumber>
    <Name>TEMS-1234-5678</Name>
    <HardwareId>0123456789AB</HardwareId>
    <AcceptanceTest>2002-05-30T09:30:10Z</AcceptanceTest>
    <ExternalDhcpEnabled>false</ExternalDhcpEnabled>
    <ExternalIpAddress>192.168.10.200</ExternalIpAddress>
    <ExternalSubnetMask>255.255.255.0</ExternalSubnetMask>
    <ExternalGateway />
    <ExternalDnsServers />
    <DevicesIpAddress>192.168.20.200</DevicesIpAddress>
    <DevicesSubnetMask>255.255.255.0</DevicesSubnetMask>
    <DevicesGateway />
    <NtpServers>ch.pool.ntp.org</NtpServers>
    <ProcessingPoints>8</ProcessingPoints>
    <NtpStatusUpdateFrequency>30</NtpStatusUpdateFrequency>
    <NtpStatusUpdatePeerMandatory>true</NtpStatusUpdatePeerMandatory>
    <NtpStatusUpdateOffsetLimit>0</NtpStatusUpdateOffsetLimit>
    <TemsInfoPort>54345</TemsInfoPort>
    <TemsInfoMaximalClientCount>10</TemsInfoMaximalClientCount>
  </RecorderConfig>
</ConfigurationXml>
```

Parameters	Arguments	Default
Config	Output file where the serialized configuration information is stored.	Required
	If no output file is specified, the resulting XML document is printed to the console.	

Name	Description	ERRORLEVEL
success	The configuration information was successfully written to the output file.	0
Connection Failure	Timeout, network interruption, …	20
Output Write Failure	Invalid output path or access denied	21

Get Current Site Configuration
`Ectn.Tems.TemsManagerCmd.exe <connection info> /get=D:\Site.temsXml`
Retrieves the current site configuration and serializes it to the indicated file.

Parameters	Arguments	Default
Get	Output file where the serialized site configuration is stored.	Required

Name	Description	ERRORLEVEL
Connection Failure	Timeout, network interruption, …	30
No Configuration	No configuration is currently set on the TEMS Recorder	31
Output Write Failure	Invalid output path or access denied	32

Set Site Configuration
`Ectn.Tems.TemsManagerCmd.exe <connection info> /set=D:\Site.temsXml`
Sets a serialized site configuration on the TEMS Recorder as the current configuration. Once this has been successfully completed, the configuration is started as if the command line argument /start was used.

Parameters	Arguments	Default
set	File with a serialized site configuration	Required
Timeout	Number of seconds to wait for the completion of this operation	120

Name	Description	ERRORLEVEL
success	The site configuration is loaded and has state "ConfigurationRunning"	0
Input Read Failure	The site configuration file did not exist or couldn't be accessed	40
Load Failure	TEMS Recorder rejected the site configuration for some reason. More details in the error console.	41

Start Last Site Configuration
`Ectn.Tems.TemsManagerCmd.exe <connection info> /start [ /timeout=300 ]`
Restarts a site configuration that was previously stopped.

Parameters	Arguments	Default
Start	–	Required
Timeout	Number of seconds to wait for the completion of this operation	120

Name	Description	ERRORLEVEL
success	The site configuration is in state "Configuration Running"	0
Connection Failure	Timeout, network interruption, …	50
Initialization Failure	TEMS Recorder failed to initialize the configuration. More details in the error console	51
Timeout	TEMS Recorder didn't reach state "Not Configured" in time	52

Stop Current Site Configuration
`Ectn.Tems.TemsManagerCmd.exe <connection info> /stop [ /timeout=111 ]`
Stops the site configuration that is currently loaded. For example, this is required before a maintenance operation can be started.

Parameters	Arguments	Default
Stop	–	Required
Timeout	Number of seconds to wait for the completion of this operation	60

Name	Description	ERRORLEVEL
success	The TEMS Recorder has reached (or already was) in state "No Configuration"	0
Connection Failure	Timeout, network interruption, …	60
Timeout	TEMS Recorder didn't reach state "Not Configured" in time	61

Firmware update

`Ectn.Tems.TemsManagerCmd.exe <connection info> /update=D:\Firmware.temsUpdate`

Uploads and applies a firmware update to the TEMS Recorder.

Parameters	Arguments	Default
Update	File with the update	Required
Timeout	Number of seconds to wait for the completion of this operation	300
Updatepassword	Special password that should be used during updates from older versions of Tems Recorder (<2.1.1)	-

Name	Description	ERRORLEVEL
success	The firmware update was successfully applied.	0
Connection Failure	Timeout, network interruption, …	70
Input Read Failure	The update file did not exist or couldn't be accessed	71
Not Ready	TEMS Recorder isn't in state "Not Configured"	72
Failure	One of the steps of the update process failed. More details in the error console.	73

Serial Number Change

`Ectn.Tems.TemsManagerCmd.exe <connection info> /serial=12344567`

Changes the serial number of the TEMS Recorder. This is only available in combination with an OEM Image.

Parameters	Arguments	Default
Serial	8-digit serial number of the TEMS Recorder (usually the serial number of the IPC)	Required
Timeout	Number of seconds to wait for the completion of this operation	300

Name	Description	ERRORLEVEL
success	The serial number change was successfully applied.	0
Connection Failure	Timeout, network interruption, …	80
Argument Failure	The serial number wasn't in the required format.	81
Not Ready	TEMS Recorder isn't in state "Not Configured"	82
Failure	One of the steps of the process failed. More details in the error console.	83
Already Set	Serial number was already set and cannot be changed again.	84

Set Clock

`Ectn.Tems.TemsManagerCmd.exe <connection info> /time=2013-04-28T10:10:10Z`

Sets the clock on the TEMS Recorder to the specified time.

Parameters	Arguments	Default
Time	Date and time in XML format.	Required
Timeout	Number of seconds to wait for the completion of this operation	20

Name	Description	ERRORLEVEL
success	The time was successfully set.	0
Connection Failure	Timeout, network interruption, …	90
Argument Failure	The argument was not a valid date/time value.	91
Not Ready	TEMS Recorder isn't in state "Not Configured"	92
Failure	One of the steps of the process failed. More details in the error console.	93

Change NTP Configuration

`Ectn.Tems.TemsManagerCmd.exe <connection info> /ntp=127.0.0.1,ch.pool.ntp.org`

Changes the list of NTP servers.

Parameters	Arguments	Default
Ntp	Comma separated list (no spaces!) of NTP servers. If no NTP server is specified, the NTP client is deactivated.	Required
Timeout	Number of seconds to wait for the completion of this operation	20

Name	Description	ERRORLEVEL
success	The NTP configuration was successfully changed.	0
Connection Failure	Timeout, network interruption, …	100
Argument Failure	The argument was not a valid list of NTP servers.	101
Not Ready	TEMS Recorder isn't in state "Not Configured"	102
Failure	One of the steps of the process failed. More details in the error console.	103

Change IP Configuration through TCP

```
Ectn.Tems.TemsManagerCmd.exe <connection info> /ip=127.0.0.1
    [ /mask=255.255.255.0 ]
    [ /gateway=127.0.0.1 ]
    [ /dns=127.0.0.1,128.0.0.1 ]
```

Changes the IP configuration on the TEMS Recorder.

Parameters	Arguments	Default
IP	New IP (v4) address of the TEMS Recorder	Required
Mask	Subnet mask of the TEMS Recorder	Default Subnet Mask for IP address
Gateway	IP address of the default gateway.	No gateway
Dns	Comma separated list of IP addresses of DNS servers.	No DNS servers
Timeout	Number of seconds to wait for the completion of this operation	300

Name	Description	ERRORLEVEL
success	The IP configuration was successfully changed.	0
Connection Failure	Timeout, network interruption, …	110
Argument Failure	One of the arguments was not valid IP address (v4)	111
Not Ready	TEMS Recorder isn't in state "Not Configured"	112
Failure	One of the steps of the process failed. More details in the error console.	113

Change IP Configuration to DHCP through TCP

`Ectn.Tems.TemsManagerCmd.exe <connection info> /ip`

Makes the TEMS Recorder get its configuration from

Parameters	Arguments	Default
IP	No arguments	

Name	Description	ERRORLEVEL
success	The IP configuration was successfully changed.	0
Connection Failure	Timeout, network interruption, …	110
Argument Failure	One of the arguments was not valid IP address (v4)	111
Not Ready	TEMS Recorder isn't in state "Not Configured"	112
Failure	One of the steps of the process failed. More details in the error console.	113

Change IP Configuration through UDP

```
Ectn.Tems.TemsManagerCmd.exe <connection info> /ipauto=127.0.0.1
    [ /mask=255.255.255.0 ]
    [ /gateway=127.0.0.1 ]
```

Changes the IP configuration on the TEMS Recorder.

Parameters	Arguments	Default
IpAuto	New IP (v4) address of the TEMS Recorder	Required
Mask	Subnet mask of the TEMS Recorder	Default Subnet Mask for IP address
Gateway	IP address of the default gateway.	No gateway
Timeout	Number of seconds to wait for the completion of this operation	300

Name	Description	ERRORLEVEL
success	The IP configuration was successfully changed.	0
Connection Failure	Timeout, network interruption, …	110
Argument Failure	One of the arguments was not valid IP address (v4)	111
Not Ready	TEMS Recorder isn't in state "Not Configured"	112
Failure	One of the steps of the process failed. More details in the error console.	113

Set DHCP IP Configuration

```
Ectn.Tems.TemsManagerCmd.exe <connection info> /ipauto
Ectn.Tems.TemsManagerCmd.exe <connection info> /ip
```

Changes the IP configuration to DHCP on the TEMS Recorder.

Parameters	Arguments	Description	Default
IP	-	Through TCP	Required
IPAUTO	-	Through UDP	Required

Name	Description	ERRORLEVEL
success	The IP configuration was successfully changed.	0
Connection Failure	Timeout, network interruption, …	110
Argument Failure	One of the arguments was not valid IP address (v4)	111
Not Ready	TEMS Recorder isn't in state "Not Configured"	112
Failure	One of the steps of the process failed. More details in the error console.	113

Reboot

```
Ectn.Tems.TemsManagerCmd.exe <connection info> /reboot
```

Reboots the TEMS Recorder.

Parameters	Arguments	Default
Reboot	-	Required

Name	Description	ERRORLEVEL
success	The Reboot command was accepted by the TEMS Recorder.	0
Connection Failure	Timeout, network interruption, …	120

Help Screen

```
Ectn.Tems.TemsManagerCmd.exe /?
```

Prints a help screen that shows all possible combinations of command line switches.

10   Disposal

NOTE

The applicable local and statutory environmental regulations and guidelines for the disposal of industrial and electrical waste must be observed.

NOTE

Disposal of batteries, electrical and electronic devices.

▶ In accordance with international directives and regulations, batteries, accumulators, and electrical or electronic devices must not be disposed of with household waste.

▶ The owner is obligated to dispose of the devices at the end of their service life via the appropriate public disposal points.

▶ This symbol on the product, packaging, or in this document indicates that a product is covered by these provisions.

The following component groups may contain substances that need to be disposed of separately:

- **Electronics:**

  Capacitors, accumulators, batteries.

- **Displays:**

  Liquid in the LC displays.

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