

# SYMEO LOCAL POSITIONING RADAR

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Product: LPR<sup>®</sup>-1D24 (Symeo BSV101757)

Product Documentation



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The documentation for the LPR®-1D24 Local Positioning Radar System is published by:

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## HISTORY

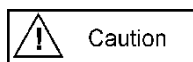
Version	Date	Description
1.00	29.01.2016	Initial Release

## SYMBOLS USED

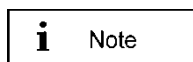
The following symbols are used throughout the documentation:



This symbol appears before instructions that must be followed at all times. Failure to comply with these instructions will result in personal injury.



This symbol appears before instructions that must be followed at all times. Failure to comply with these instructions will result in damage to equipment.



This symbol appears before information of particular importance.

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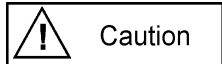
Published by SYMEO GmbH

# 1 General Information

## 1.1 Safety Instructions

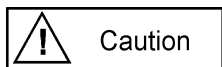


LPR®-1D24 Systems are purely tracking and assistance systems. They therefore do not satisfy special requirements for personal safety.



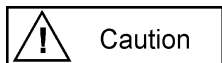
Follow the safety instructions in this documentation!

## 1.2 Mounting



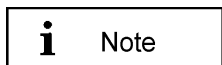
All mounting, installation and maintenance work must be carried out by an electrically qualified or trained person!

## 1.3 Repairs



Repairs on the devices should only be performed by Symeo GmbH.

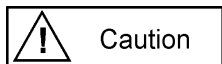
## 1.4 Transport and Storage



Use the original packaging or other suitable packaging for returns and whenever the system is to be transported. This ensures protection from crushing, impact, moisture and electrostatic discharge.

During setup and before operation, refer to the instructions for environmental conditions in this document and in the data sheet. Place the cables in such a way so that they do not build the possible cause of risk and are not damaged.

## 1.5 Power Supply



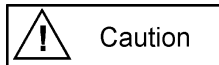
While installing or using it in open-air, the transient overvoltage cannot be excluded. Here, overvoltage protection is to be used for low voltage in accordance to DIN EN 61643-21 and IEC 61643-21.

While connecting the plug and sockets, please observe the correspondent chapter in this document "Specification of Connectors".

Do not use damaged cables (damaged insulation, bare wires). A defective cable may cause a fire hazard.

Be careful that the device can be damaged with reverse polarity despite of strict implementation of polarity reversal protection. In that case the unit must be sent to the SYMEO service for further testing.

## 1.6 Setup and Operation

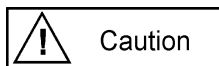


During mounting, make sure that no objects or liquids reach inside the device (risk of short-circuit).

In case of emergency (e.g. damaged housing, control elements or power cables, penetration of liquids or foreign bodies) switch off the device immediately, disconnect from the power line the device and inform your SYMEO service.

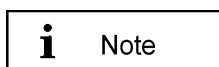
Protect the contacts of all sockets and plugs of the device from static electricity. Avoid touching the contacts. If touching the contacts is unavoidable, then one should take the following precautions: Touch a grounded object or wear a ground strap before touching the contacts. This will dissipate static charges.

The device must be secured against falling.



The LPR®-1D24 unit must not be opened.

## 1.7 System Extensions and Accessories

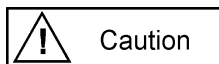


Data cables to peripheral devices must be shielded properly.

For LAN cabling, the requirements apply in accordance with EN 50173 and EN 50174-1/2. Use of either a Category 5 shielded cable for 10/100 Ethernet or Category 5e shielded cable for Gigabit Ethernet is a minimum requirement. The specifications of standard ISO/IEC 11801 must be complied with.

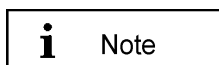
The warranty becomes void in case of any damages caused by replacement of components on the device during installation.

## 1.8 Additional Instructions



Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

## 1.9 General Requirements for Compliance of Radio Apparatus



This device complies with Part 15 of the FCC Rules and with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

## 2 Overview of LPR®-1D24 Unit

LPR®-1D24 is a highly precise radio sensor for distance measurement. Two paired units allow for long range applications and enable additional data transfer at the same time. The exact position of a moving machine component, e.g. a crane or crane trolley, can thus be dynamically determined in real-time, while data collected at one end (e.g. a load cell input) is available at the paired unit simultaneously.



*Figure 1: LPR®-1D24 measurement path*

In addition to the distance reading, the relative approach speed of the LPR® sensors is available. Distance and speed can be used for internal collision avoidance decisions at predetermined distance thresholds. Optional on-board relays will be activated. All data is made available at standard interfaces.

The devices are easy to install and operate. Rough alignment between the facing units is sufficient, even for very long distances. The multi-channel radio antenna is integrated into the robust housing. A built-in terminal server allows straightforward configuration of the unit ID, the paired unit ID and other parameters in any browser.

Symeo LPR® radio works highly reliable under adverse conditions. Interference with any WiFi equipment operating in parallel can be excluded at all times. A unique ID per each unit allows operating multiple pairs in immediate vicinity.

LPR®-1D24 sensors are maintenance-free and paired sensors can be interconnected with other pairs, providing several distances at a single interface, e.g. for crane xy position acquired by two sensor pairs.



## **2.1 Technical Data LPR®-1D24 Unit**

The technical specifications for LPR®-1D24 can be found in our data-sheet under the following link:

[http://www.symeo.com/cms/upload/pdf/en/DataSheets/Symeo\\_Datasheet\\_LPR-1D24.pdf](http://www.symeo.com/cms/upload/pdf/en/DataSheets/Symeo_Datasheet_LPR-1D24.pdf)

### 3 Mounting and Alignment of LPR®-1D24 Units



Warning

- The device must be secured against falling.
- All mounting, installation and maintenance work must be carried out by electrician or a person with similar training and skills!

The LPR®-1D24 units are delivered with a separate mounting bracket (see *Figure 2*). *Figure 2* shows a complete system including the mounting bracket. The bracket must be mounted with a pipe clamp on a pipe. The pipe diameter is best chosen between 40 mm and 75 mm. For mounting, a flat wrench of SW 13 is required.

For mounting the system, please proceed as follows:

- ⇒ At a suitable place, mount the LPR®-1D24 unit to a suitable pipe with the bracket. To adjust the system, do not tighten the mounting bracket finally. Specified alignments have to be adhered to if indicated by Symeo.
- ⇒ A minimum distance of 3 meters between the measuring system units must be maintained to guarantee the specified accuracy. Mounting closer than the minimum distance decreases the accuracy at close proximity.
- ⇒ The units must have the same orientation for mounting, for example both units with connectors downwards. For outdoor use the units have to be mounted with the connectors downwards.
- ⇒ Now adjust the system on the opposite side.
- ⇒ The two system units should be mounted opposite to each other and possibly should not be an offset horizontal and vertical from each other or twisted.
- ⇒ Now fix the system by tightening the screws in the mounting bracket and the mounting bracket on pipe in such a way that no modification is possible anymore. Flat wrench SW 13 is required.

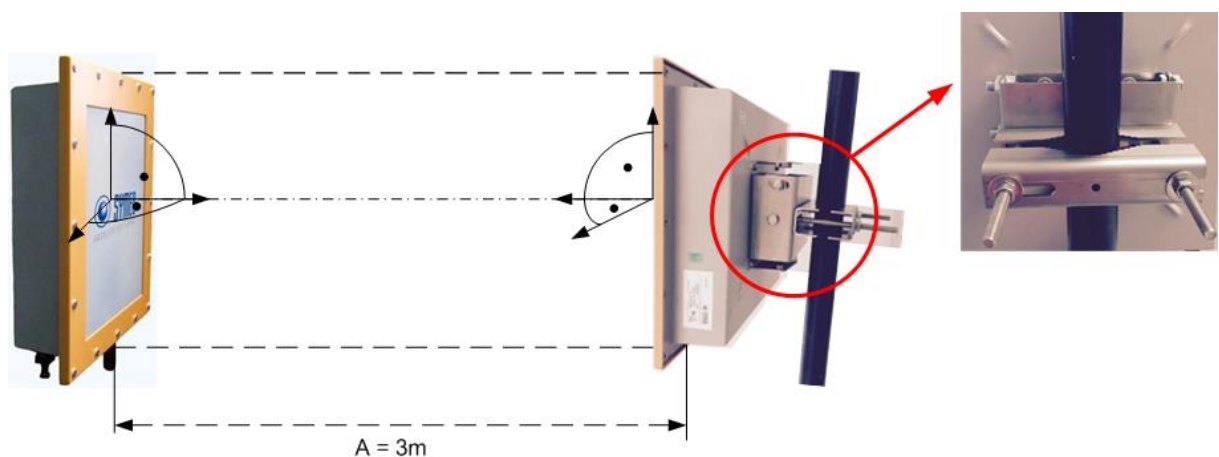


Figure 2: LPR®-1D24 unit inclusive mounting bracket

### 3.1 Mounting of the Fall Protection

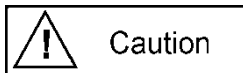
The LPR®-1D24 units must be protected against fall. For every unit Symeo provides a protection set consisting of the following components:

A: 2 x ring nuts M5,

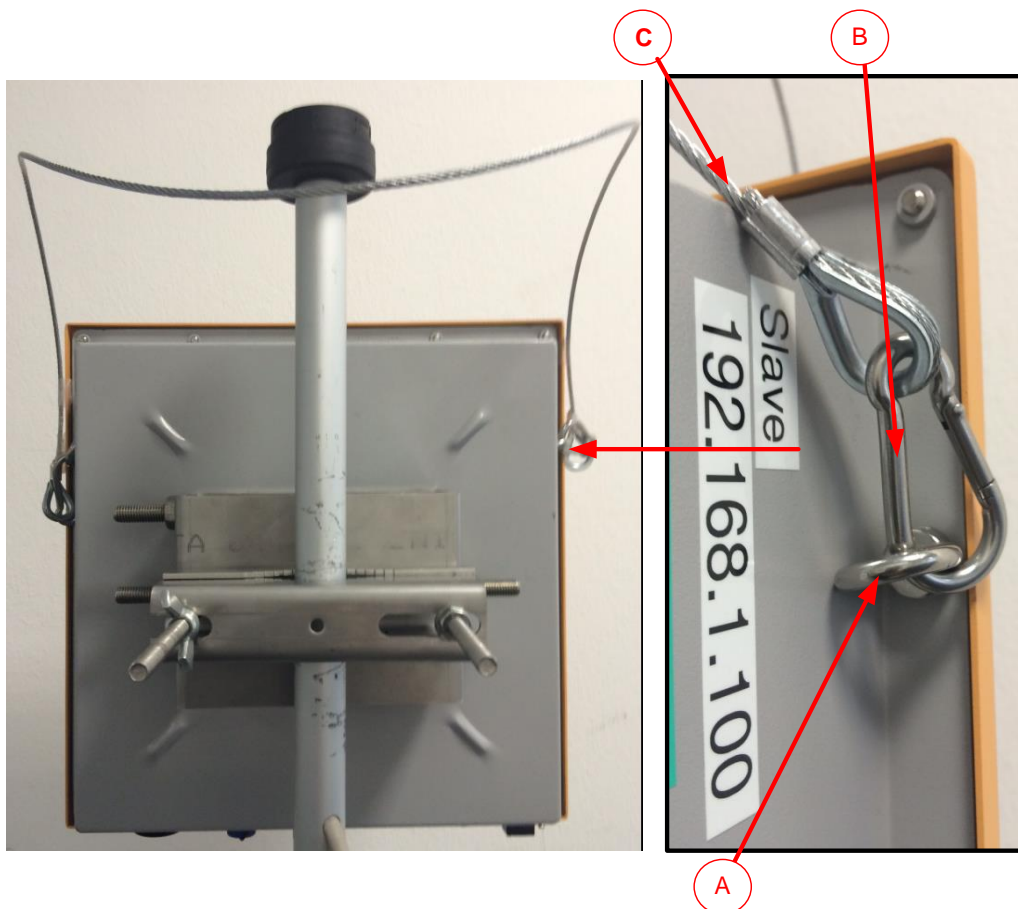
B: 2 x snap hooks 5 x 50 mm

C: 1 x steel cable 3 mm x 1 m

The two ring nuts must be mounted on the back of the LPR®-1D24 unit laterally on the respective second screw from above, which are 4 mm longer than the other screws. Then the snap hook must be attached to the ring nuts. Please put the steel cable around a pipe or a bracket and hang it also in the snap hook (see picture below).



The backup set should be installed before the assembly of the unit to secure it against falling.



*Figure 3: Mounting of the fall protection*

## **4 Requirements for Power Supply**

The power supply should have the following characteristics:

- Potential free
- Output power at least 25 W
- Output voltage 10 V DC to 36 V DC
- Short-term maximum current flow (when switched on):
  - At 24 V DC: 2000 mA for 50 ms
  - At 12 V DC: 2500 mA for 50 ms

## 5 Specification of the Connectors

### 5.1 Overview of Connections

All connectors are fixed externally to the housing. Figure 4 shows the connections in detail.

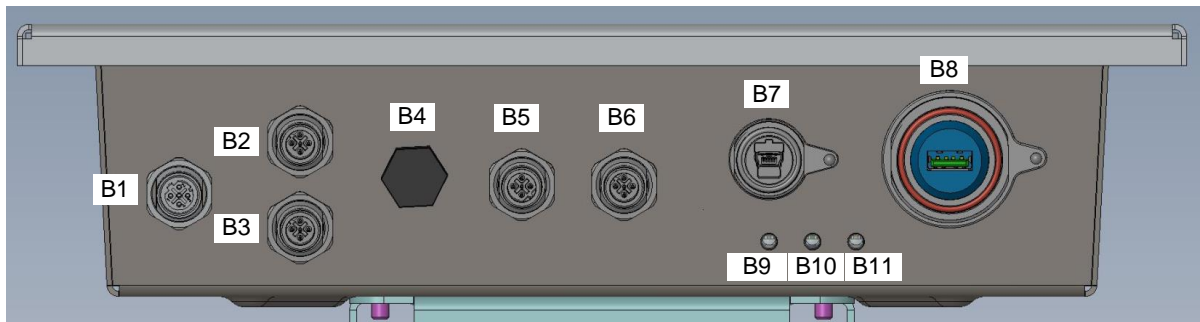


Figure 4: LPR®-1D24 Connectors

- B1: Ethernet
- B2: Can-Bus IN/ Profibus IN
- B3: Can-Bus OUT/ Profibus OUT/ Termination (optional)
- B4: Pressure equalization membrane
- B5: Serial interface RS422/RS485 / Relays (optional)
- B6: Power supply
- B7: Mini-USB
- B8: USB – A (Logging)
- B9 – B11: Status LEDs

**i** Note

On the following pages you will find the connector type, the pin assignment, the product code and the Symeo order number. For more information, please see the data sheets on the attached data carrier.

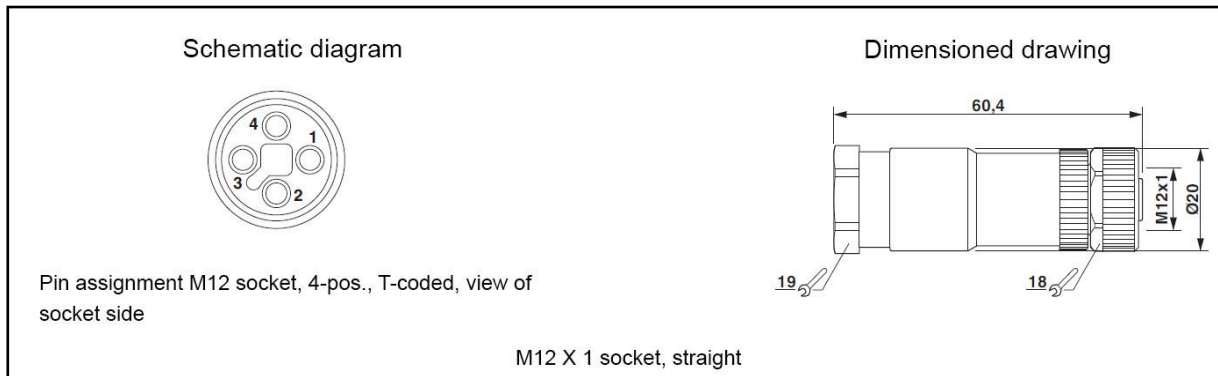
## 5.2 Power Supply

The LPR®-1D24 unit is powered by a 4-pin M12-Connector to the operating voltage (*Figure 4 – Connection B6*).

### 5.2.1 Plugs

Recommended connector:

- **SACC-M12FST-4PECON-PG 9-M – 1418052**  
 Cable diameter: 6 - 8 mm  
**Symeo order number: MTE101761**



*Figure 5: M12 Connector for the power requirement*

### 5.2.2 Pin Assignment

Power Supply 10 V DC – 36 V DC	M12 Connector
$V_{DC+}$	Pin 1
$V_{DC+}$	Pin 2
$V_{DC-}$	Pin 3
$V_{DC-}$	Pin 4

Table 1: Pin assignment power supply

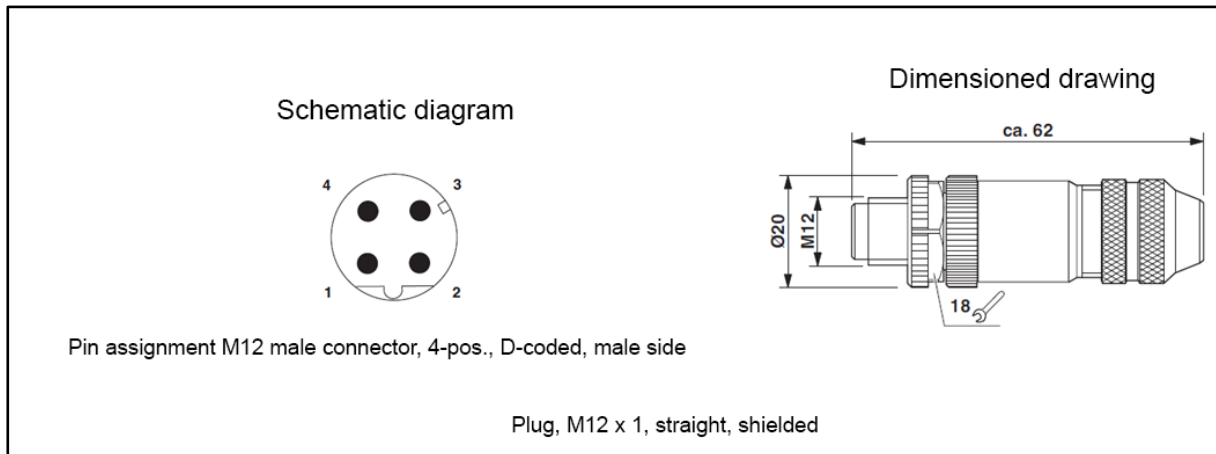
## 5.3 Ethernet M12

The LPR®-1D24 unit can be connected to the Ethernet via M12-Connector (*Figure 4 – Connection B1*).

### 5.3.1 Plugs

Recommended connector:

- Connector Ethernet M12
  - **SACC-M12MSD-4CON-PG 7-SH – 1521258**  
 Cable diameter: 4 – 6 mm (PG7)  
**Symeo order number: MTE101768**



*Figure 6: M12 Ethernet M12*

### 5.3.2 Pin Assignment

Signal	Color of Conductor PROFinet®	Color of Conductor EIA/TIA 568B	Pin Assignment
TD+	Yellow	White/Orange	1
TD-	Orange	Orange	3
RD+	White	White/Green	2
RD-	Blue	Green	4

Table 6: Pin assignment for Ethernet M12

### 5.3.3 Connector Cable M12 – RJ45

The connector cable M12 – RJ45 is required for the Ethernet-connection for configuration of the LPR®-1D24 units with M12 plug and RJ 45 connector.

- **Symeo order number: MTE102007**

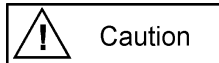
## 5.4 USB – mini

The LPR®-1D24 units are equipped with a USB mini connector externally (*Figure 4 – Connector B7*). This port is only for service use.

### 5.4.1 Plugs

Recommended connector:

- Connector: **SCPU-10-G-02.00-MBS-AM** from Samtec
- USB mini-B-plug
- Pin assignment according to USB-Standard



If the USB-port at the device is not used, it must be closed with the end cap to prevent leakage.

## 5.5 USB – A Devices

The LPR®-1D24 unit has a USB-Flash Drive Connector, on which the data can be logged for service purposes (*Figure 4 – Connection B8*).



## 6 LPR®-1D24 Housing Dimensions

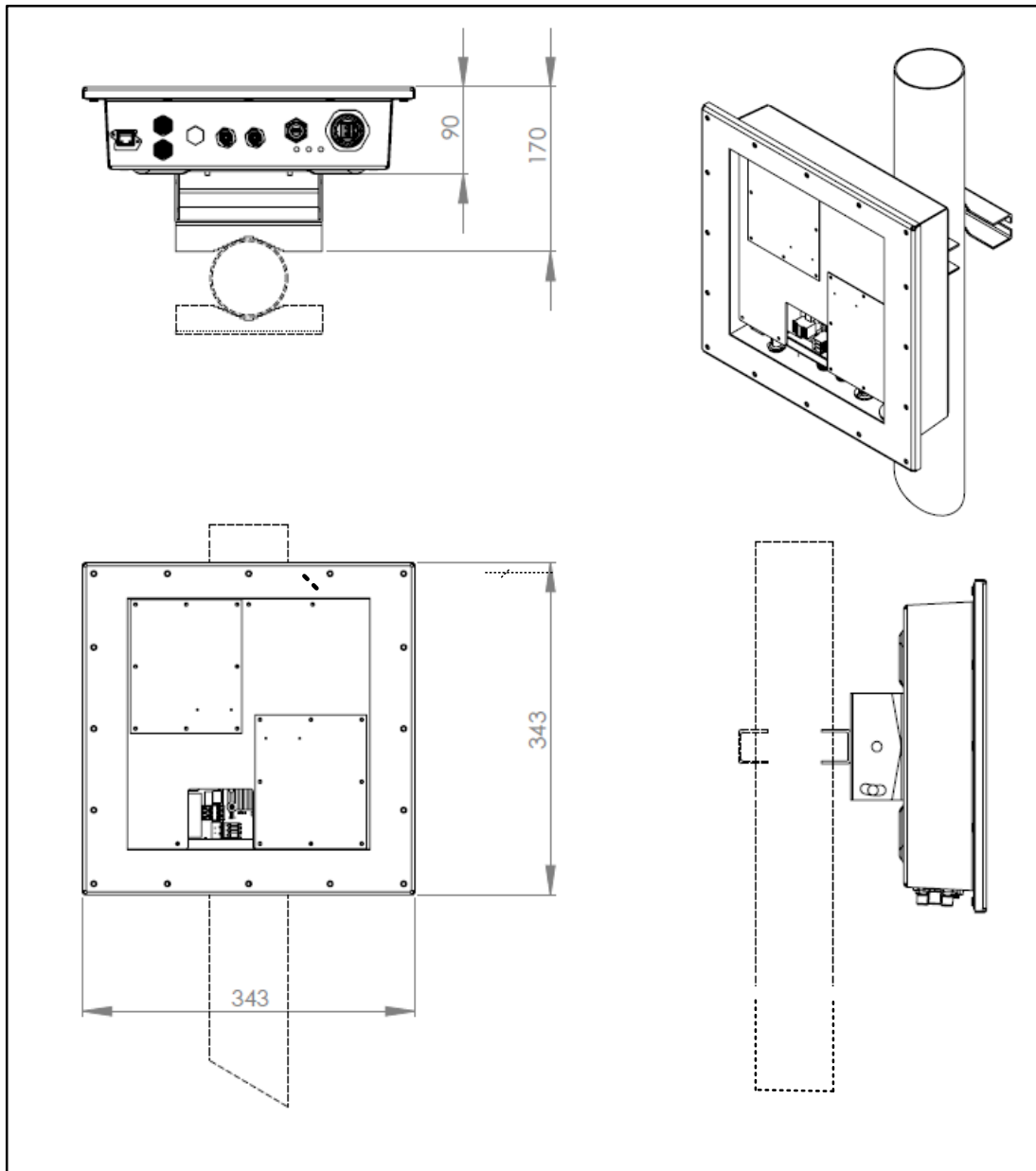
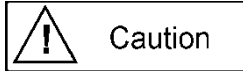


Figure 7: LPR®-1D24 Housing Dimensions

The minimum pipe diameter is 40 mm, the maximum pipe diameter is 75 mm.

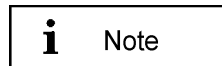
## 7 Web User Interface for LPR®-1D24

This chapter describes the LPR®-1D24 Web User Interface.



Caution

Connection via the Ethernet is required!



Note

For the Ethernet-connection the connector cable M12 – RJ45 is required for configuration of the LPR®-1D24 units with M12 plug and RJ 45 connector. This connector cable can be ordered by Symeo (see 5.3.3).

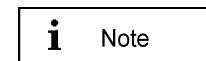
### 7.1 Requirements

In order for a unit to be successfully commissioned, the LPR®-1D24 components must have been installed correctly:

- ⇒ The unit has been connected to the power supply.
- ⇒ Data link has been established over TCP/IP.

Once these prerequisites have been fulfilled, you can connect the unit to the network and commission the LPR®-1D24 system. How to do this is explained in the following chapters.

#### 7.1.1 Connection to LPR®-1D24 Unit

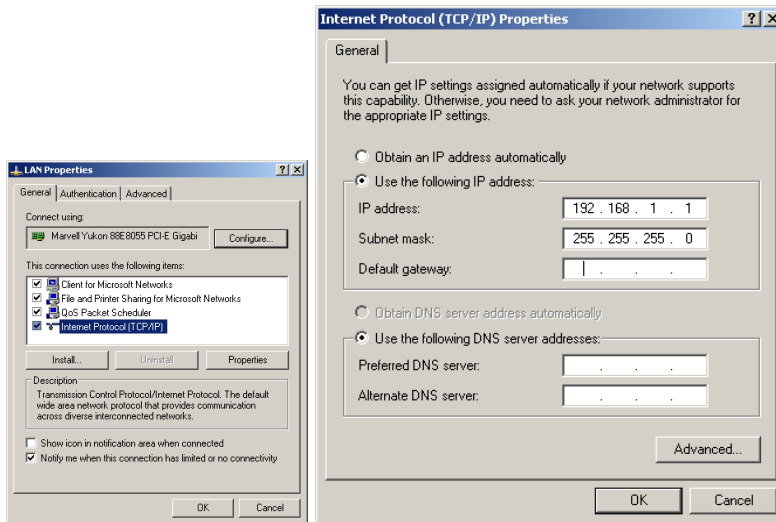


Note

At delivery the IP-address of the LPR®-1D24 unit is set to **192.168.1.99**, if no other IP-Address is labeled outside the LPR®-1D24 unit. You can change the IP-Address of the LPR®-1D24 unit via the web interface of the LPR®-Unit.

To get a connection between your PC and the LPR®-1D24 unit it is maybe necessary to change the network parameters of your computer. The PC and the LPR®-1D24 unit must be located in the same network. That means in this example that the first three numeric pads of both IP-addresses must be the same.

- ⇒ Disconnect your PC from the network.
- ⇒ Connect the LPR®-1D24 unit and the computer with a network cable.
- ⇒ Open the network settings of your computer (see picture below).



- ⇒ Enter the following fixed IP-address i.e. **192.168.1.1**. The subnet mask should be set to **255.255.255.0**.
- ⇒ Click in both windows **OK**.

Figure 8: Network Settings

**i** Note

If the firewall settings are too restrictive, you may not get access to the LPR®-1D24 unit. In this case deactivate the firewall temporarily.

The LPR® unit should be available via your PC now. You can check the connection with a *ping* to the LPR®-1D24 unit:

Open the Command-Window:

1. Push the Windows **Start** Button
2. Choose **Run**
3. Enter **cmd** and click **OK**
4. Enter in the cmd.exe window: **ping 192.168.1.99** or the IP-address of the LPR®-1D24 unit.

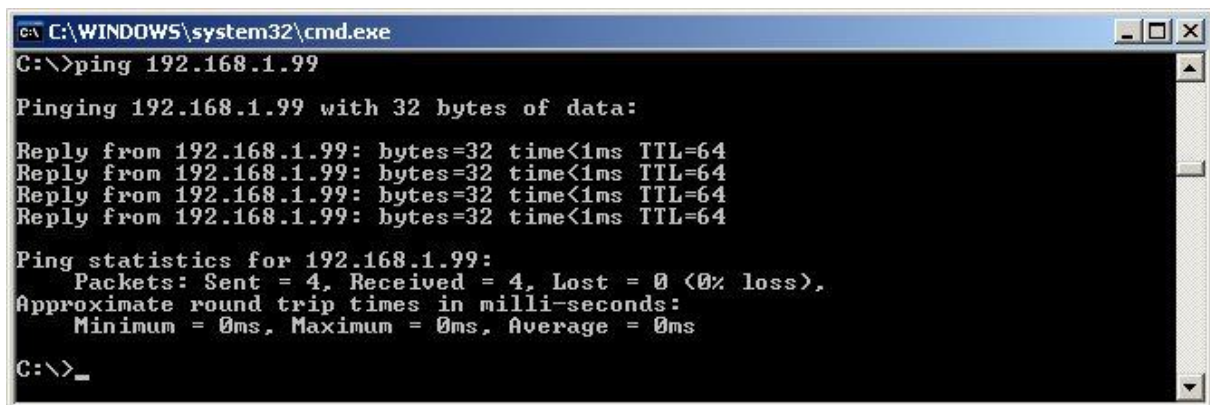


Figure 9: Ping LPR®-1D24 unit

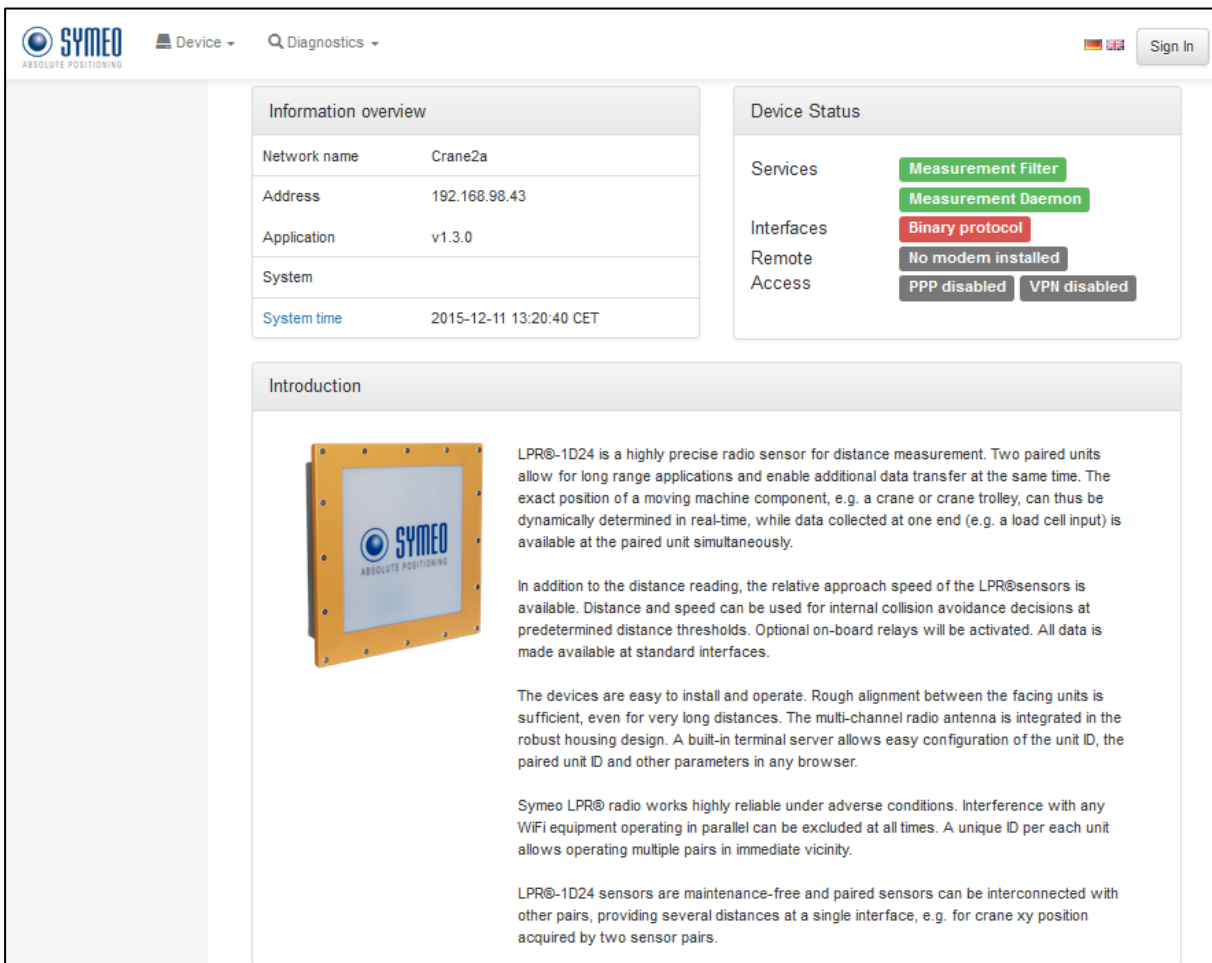
The LPR®-1D24 unit should answer with a *Reply*.

## 7.2 Open User Interface

**i** Note

At delivery, the IP-address of the LPR®-1D24 unit is **192.168.1.99**, unless another IP-address is labeled outside the box.

- ⇒ Open your web browser. In the address bar of the web browser enter the IP-address of the LPR®-1D24 unit: `http://192.168.1.99`. Press **Enter**.
- ⇒ A connection is established with your LPR®-1D24 unit.



The screenshot shows the SYMEO web interface for the LPR®-1D24 unit. At the top, there is a navigation bar with 'Device' and 'Diagnostics' dropdown menus, a 'Sign In' button, and a language selector. The main content area is divided into three sections:

- Information overview:** A table with the following data:
 

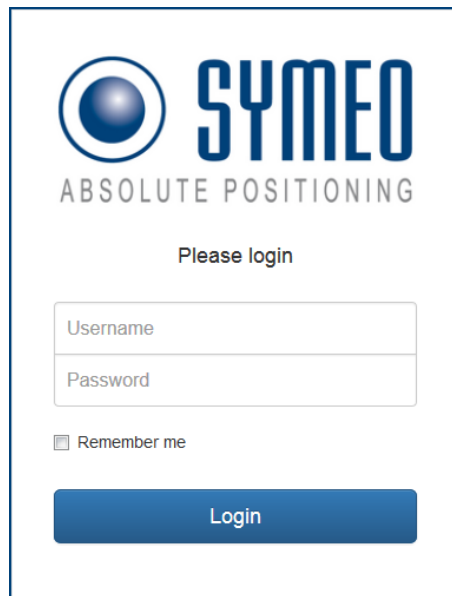
Network name	Crane2a
Address	192.168.98.43
Application	v1.3.0
System	
System time	2015-12-11 13:20:40 CET
- Device Status:** A list of services and interfaces with status indicators:
  - Services: Measurement Filter (green), Measurement Daemon (green)
  - Interfaces: Binary protocol (red)
  - Remote: No modem installed (grey)
  - Access: PPP disabled (grey), VPN disabled (grey)
- Introduction:** A text block with an image of the LPR®-1D24 unit. The text describes the unit as a highly precise radio sensor for distance measurement, capable of long-range applications and real-time data transfer. It also mentions that the unit is easy to install and operate, and that it works reliably under adverse conditions.

*Figure 10: Homepage of the LPR®-1D24 unit*

The homepage of the LPR®-1D24 unit's Web User Interface will appear.

A website language selection can be made using the flags in the top right corner of the homepage.

- ⇒ Click the "Sign in" button in the top right corner of the homepage. The dialog box with the username and password field will appear (see picture below).



The login form features the SYMEO logo and the text 'ABSOLUTE POSITIONING' at the top. Below this, it says 'Please login'. There are two input fields: 'Username' and 'Password'. A checkbox labeled 'Remember me' is located below the password field. A blue 'Login' button is positioned at the bottom of the form.

⇒ Enter the user name "**symeo**" and the password "**54all2u**" and press "*Login*". Now your status is displayed as "Logged in".



*Figure 11: Sign in on the home page of the LPR®-1D24 unit*

You can always come back to this page if you press on the Symeo symbol or the Symeo character in the top left hand corner of this page.

## 7.3 Device

With this function (see picture below) you switch either to:

- Device configuration
- Application settings
- VPN remote access settings
- Firmware update
- Reboot device

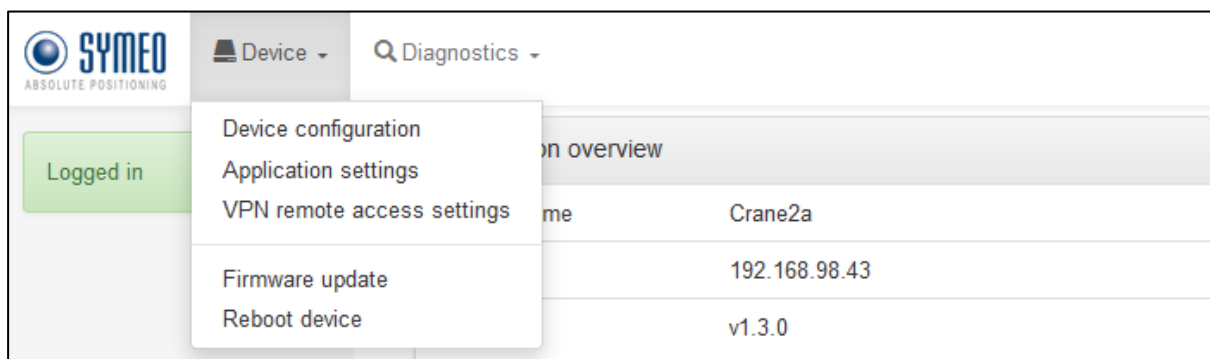


Figure 12: Device Menu

Furthermore you will find on top of every page the device status (see picture below):

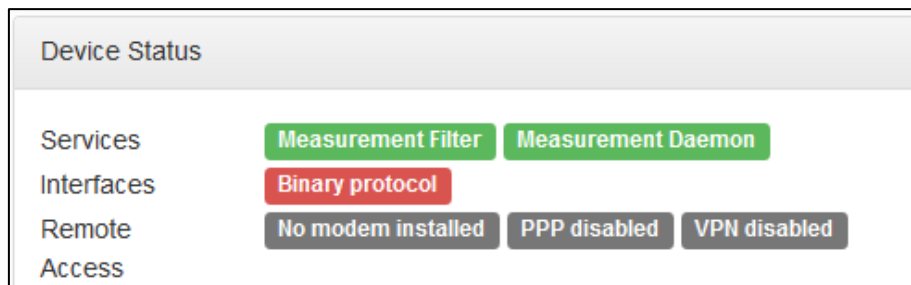
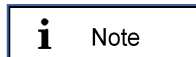


Figure 13: Information overview and device status

- The information overview shows you the Hostname of the LPR®-1D24 unit and its IP-address.
- The device status shows you the status of the services and interfaces.
  - The service status “*Measurement Filter*” and “*Measurement Daemon*” and also the interface status “*Binary protocol*” must be green, otherwise please contact Symeo customer support.



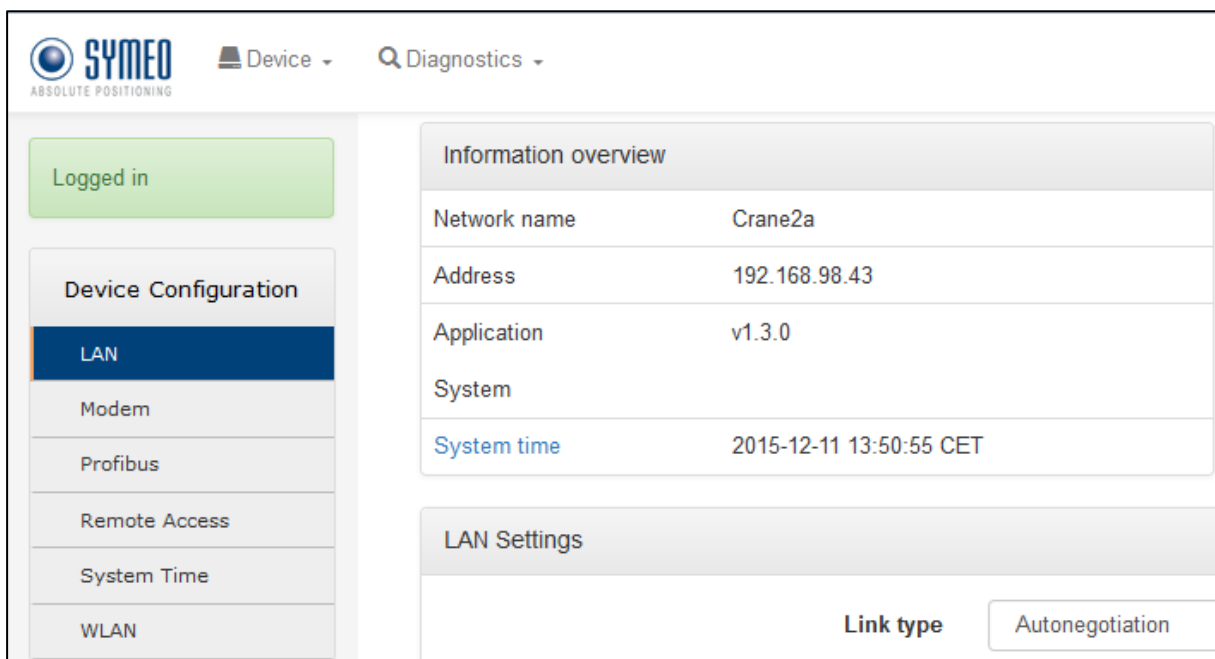
It takes some seconds after switching on or after a reboot before the color changes to green. A yellow color could indicate as well an error in the configuration settings.

- The interface status “*Binary protocol*” is only green if the customer is connected to the binary port.

## 7.4 Device - Device Configuration

With this function (see picture below) you can chose either to:

- define the LAN settings
- define Modem settings
- define the Profibus settings
- define the Remote Access settings
- set the System Time
- set WLAN settings



*Figure 14 – Device: Device Configuration Menu*

### 7.4.1 Device - Device Configuration – LAN

With this function (see picture below) you can:

- chose the Link type
- define the Address Mode
- change the IP-Address
- change the IP-Netmask
- change the Gateway
- change the local Hostname
- change the DNS IP-Address
- change the IP-Address of a Syslog Server
- change the Network routes

**LAN Settings**

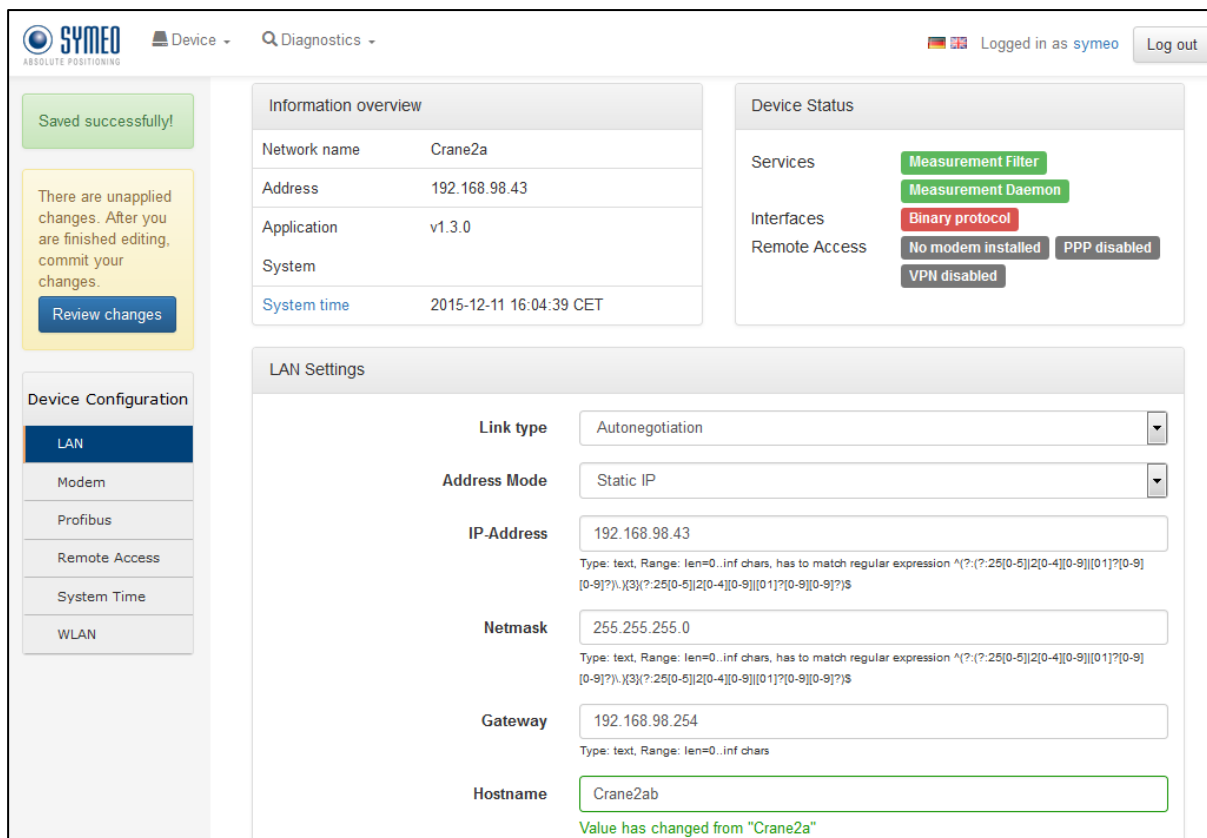
<b>Link type</b>	<input type="text" value="Autonegotiation"/>
<b>Address Mode</b>	<input type="text" value="Static IP"/>
<b>IP-Address</b>	<input type="text" value="192.168.98.43"/> <small>Type: text, Range: len=0..inf chars, has to match regular expression <code>^(?:25[0-5] 2[0-4][0-9] [01]?[0-9][0-9]?)\.(?:25[0-5] 2[0-4][0-9] [01]?[0-9][0-9]?)\$</code></small>
<b>Netmask</b>	<input type="text" value="255.255.255.0"/> <small>Type: text, Range: len=0..inf chars, has to match regular expression <code>^(?:25[0-5] 2[0-4][0-9] [01]?[0-9][0-9]?)\.(?:25[0-5] 2[0-4][0-9] [01]?[0-9][0-9]?)\$</code></small>
<b>Gateway</b>	<input type="text" value="192.168.98.254"/> <small>Type: text, Range: len=0..inf chars</small>
<b>Hostname</b>	<input type="text" value="Crane2a"/> <small>Type: text, Range: len=0..inf chars, has to match regular expression <code>^[a-zA-Z0-9]*\$</code> Local hostname, this name will also be offered to the DHCP server in DHCP mode</small>
<b>DNS</b>	<input type="text" value="0.0.0.0"/> <small>Type: text, Range: len=0..inf chars, has to match regular expression <code>^(?:25[0-5] 2[0-4][0-9] [01]?[0-9][0-9]?)\.(?:25[0-5] 2[0-4][0-9] [01]?[0-9][0-9]?)\$</code> IP of name server (domain name system)</small>
<b>Syslog</b>	<input type="text" value="0.0.0.0"/> <small>Type: text, Range: len=0..inf chars IP of server for syslog messages</small>
<b>Network routes</b>	<input type="text"/> <small>Type: text, Range: len=0..inf chars</small>

*Figure 15 – Device: Device Configuration - LAN Settings*

Please press “**Enter**” or “Save Settings” after you did changes.

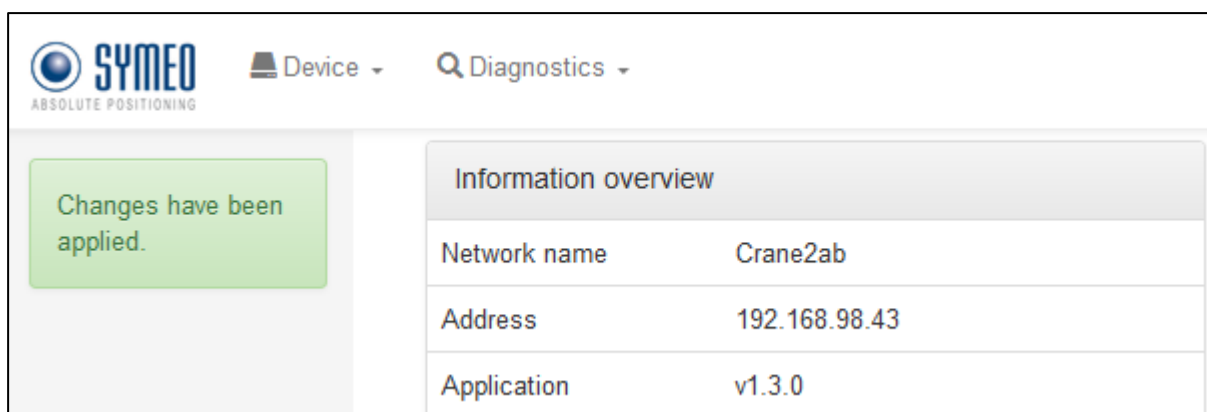


Following message appears in the upper left corner “Saved successfully” (see picture below). Furthermore it will be shown in green, what has been saved (in the picture below the hostname). Now you need to press “Commit” if you want to apply the change. The unit will perform a reboot to apply it. If you want to discard the change, press “Reset”.



*Figure 16 – Device: Device Configuration LAN Settings - Commit the change*

If the changes are applied successfully, it will be indicated in the upper left corner of the web page.



*Figure 17 – Device: Device Configuration LAN Settings - Changes have been applied*

**i** Note

All changes always have to be saved and confirmed. Only then the changes are applied on the unit.

## 7.4.2 Device - Device Configuration – System Time

With this function (see picture below) you chose to

- set the time zone
  - must be set to custom timezone if needed timezone is not in the dropdown menu
- set the IP-address of the NTP-server
- set the Custom timezone
  - needs to be filled if custom timezone is used

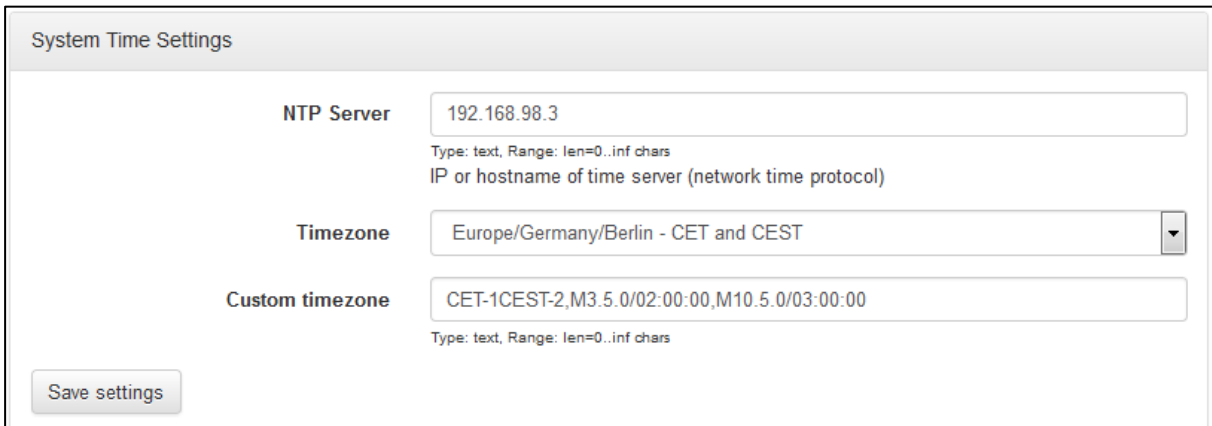
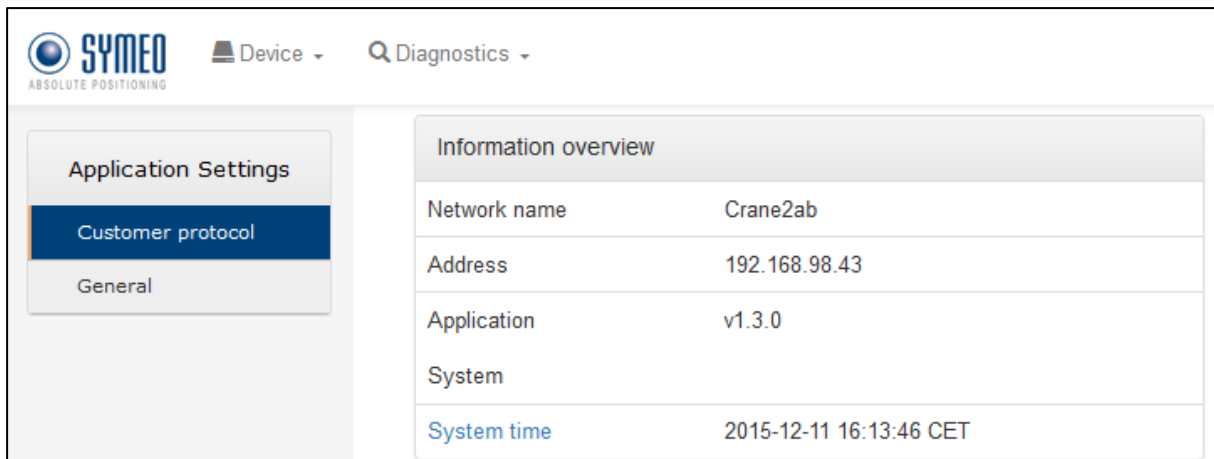


Figure 18 – Device: Device Configuration - SystemTime Settings

## 7.5 Device - Application Settings

With this function (see picture below) you switch either to:

- Customer protocol
- General (configuration parameter)

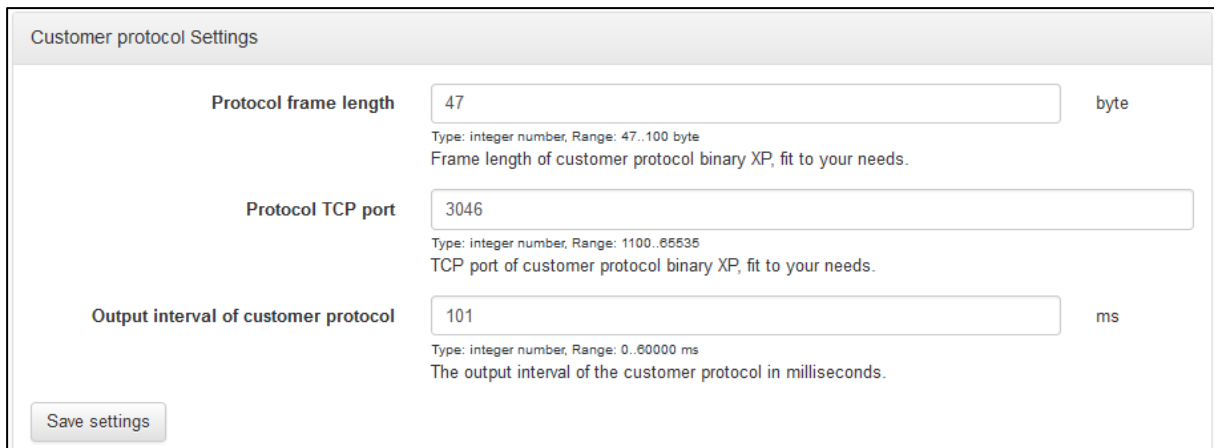


*Figure 19 – Device: Application Settings*

### 7.5.1 Device - Application Settings – Customer Protocol

With this function (see picture below) you chose to:

- set the Protocol frame length
- set the Protocol TCP port
- define the Output interval of customer protocol



*Figure 20 – Device: Application Settings - Customer Protocol Settings*

### 7.5.2 Device - Application Settings – General

With this function (see picture below) you can set the LPR®-1D24 settings:

- LPR group ID
  - Group identifier of one pair of LPR® units, associated together. Has to be the same on units measuring with each other. Diverse measurement paths must also be adjusted to different group IDs.

- Measurement mode
  - Measuring mode for the LPR®-1D24 unit. Any measuring pair of LPR®-1D24 units has to consist of one Master and one Slave Unit.
- FSK communication channel
  - Data communication channel number. Has to be the same on all units needing to communicate with each other.
  - The lowest usable communication channel is channel 16, the highest usable channel is channel 95, depending on the configuration of the device. A set of 20, 40 or 80 usable channels can be configured.
- Measurement channel
  - Changes ramp slope of measurements. Has to be configured identically on Master and Slave Unit of one pair. Can be changed to separate interfering pairs when other pairs are close by.

General Settings

<b>LPR group ID</b>	<input style="width: 95%;" type="text" value="1000"/> <small>Type: integer number, Range: 1..1022</small> <small>Group identifier of one pair of LPR units associated together. Has to be the same on units measuring with each other.</small>
<b>Measurement mode</b>	<input style="width: 95%;" type="text" value="Master unit"/> <small>Measuring mode for the LPR-1D24 unit. Any measuring pair of LPR-1D24 stations has to consist of one master and one slave unit.</small>
<b>FSK communication channel</b>	<input style="width: 95%;" type="text" value="1"/> <small>Type: integer number, Range: 1..19</small> <small>Data communication channel number. Has to be the same on all units needing to communicate with each other.</small>
<b>Measurement channel</b>	<input style="width: 95%;" type="text" value="0"/> <small>Changes ramp slope of measurements. Has to be configured identically on master and slave unit of one pair. Can be changed to separate interfering pairs when other pairs are close by.</small>

*Figure 21 – Device: Application Settings – General Settings*

Example Configuration of one pair of LPR® units:

General Settings

**LPR group ID**   
Type: integer number, Range: 1..1022  
 Group identifier of one pair of LPR units associated together. Has to be the same on units measuring with each other.

**Measurement mode**   
Measuring mode for the LPR-1D24 unit. Any measuring pair of LPR-1D24 stations has to consist of one master and one slave unit.

**FSK communication channel**   
Type: integer number, Range: 1..19  
 Data communication channel number. Has to be the same on all units needing to communicate with each other.

**Measurement channel**   
Changes ramp slope of measurements. Has to be configured identically on master and slave unit of one pair. Can be changed to separate interfering pairs when other pairs are close by.

General Settings

**LPR group ID**   
Type: integer number, Range: 1..1022  
 Group identifier of one pair of LPR units associated together. Has to be the same on units measuring with each other.

**Measurement mode**   
Measuring mode for the LPR-1D24 unit. Any measuring pair of LPR-1D24 stations has to consist of one master and one slave unit.

**FSK communication channel**   
Type: integer number, Range: 1..19  
 Data communication channel number. Has to be the same on all units needing to communicate with each other.

**Measurement channel**   
Changes ramp slope of measurements. Has to be configured identically on master and slave unit of one pair. Can be changed to separate interfering pairs when other pairs are close by.

*Figure 22: Example configuration of one measurement pair Master and Slave Unit*

**i** Note

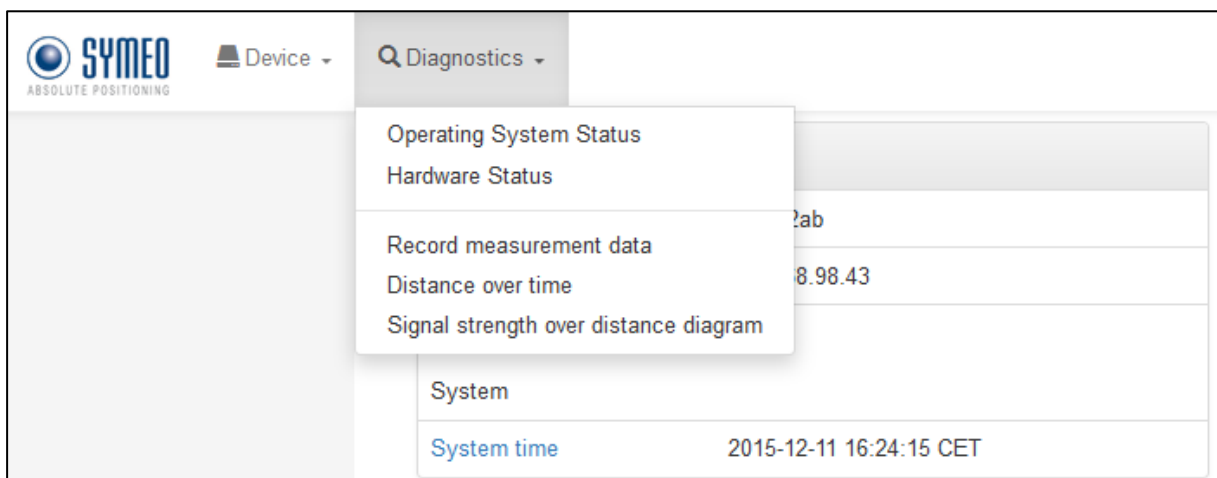
**Configuration rules:**

- Don't use a group ID more than once per site.
- If pairs of LPR®-units are mounted close to each other, the FSK channels should be at least two channels apart from each other.
- The bandwidth variation number should stay on the default value 0.

## 7.6 Diagnostics

With this function (see picture below) you chose to:

- Operating System Status
- Hardware Status
- Record measurement data
- Distance over time diagram
- Signal strength over distance diagram

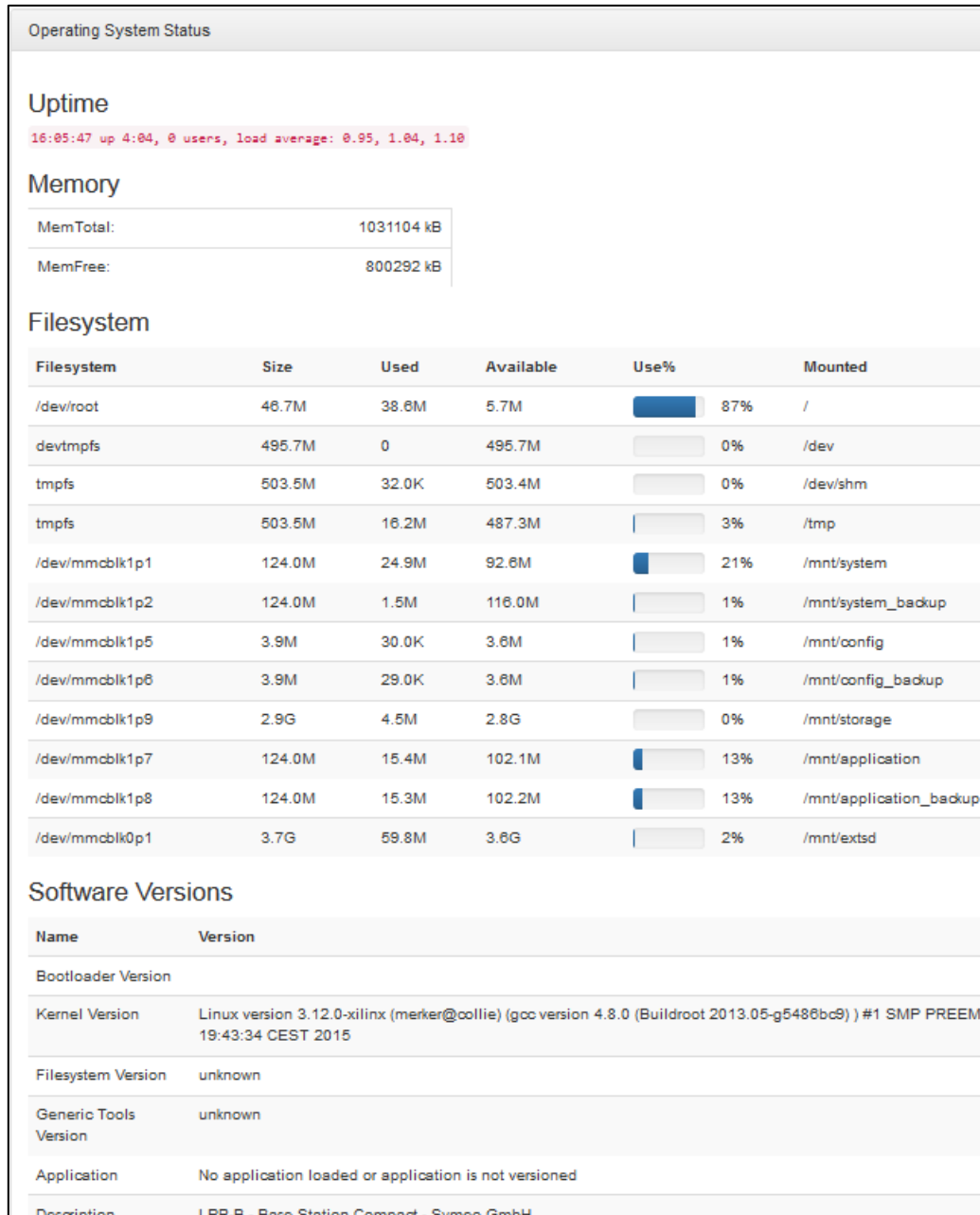


*Figure 23 – Diagnostics Menu*

### 7.6.1 Diagnostics - Operating System Status

With this function (see picture below) the operating system status can be seen.

In case of problems, these information may be asked by Symeo support.



*Figure 24 – Diagnostics: Operating System Status*

### 7.6.2 Diagnostics - Hardware Status

With this function (see picture below) system values and system voltages are displayed. In case of problems, these information may be asked by Symeo support.

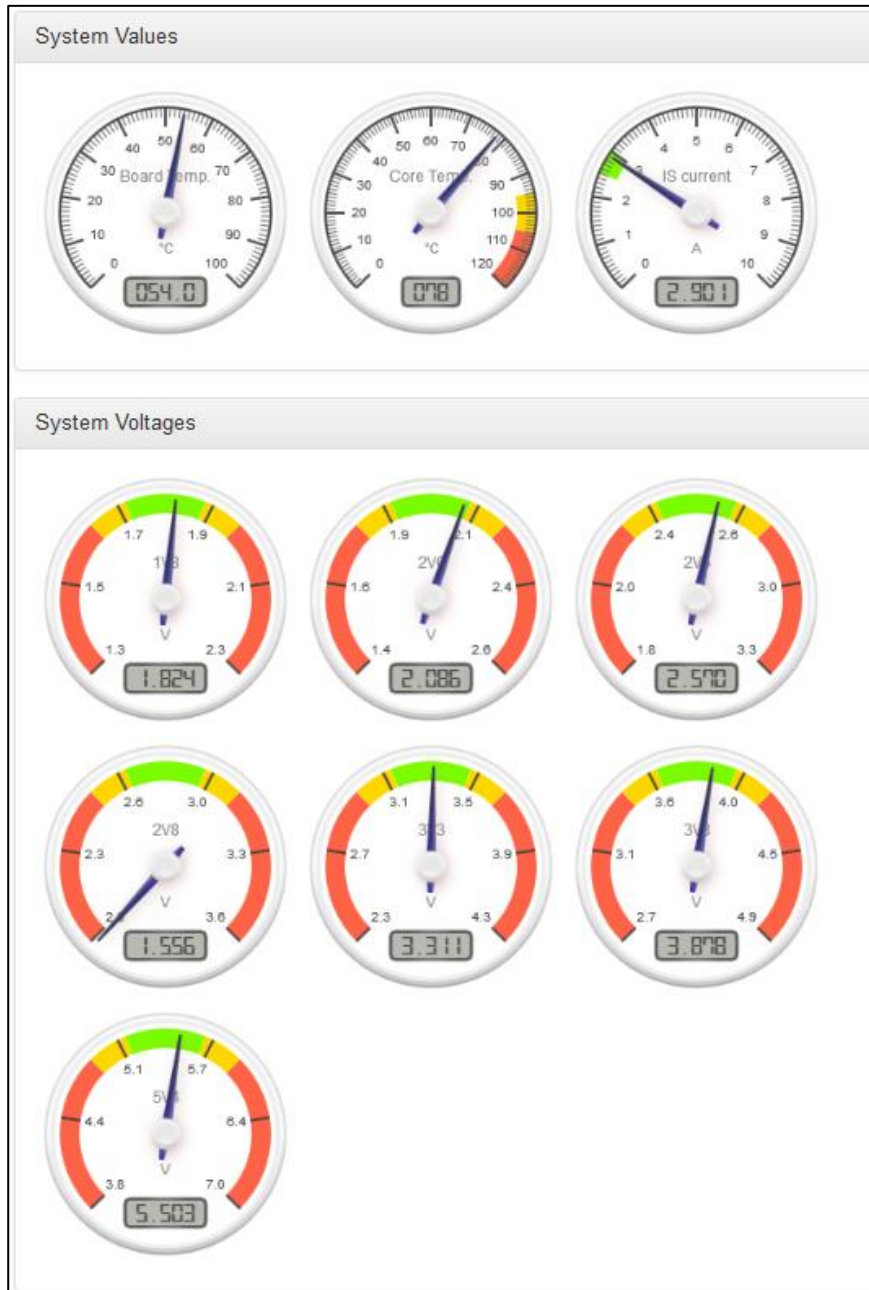


Figure 25 – Diagnostics: Hardware Status

This display is automatically refreshed every 5 seconds.



### 7.6.3 Diagnostics - Distance over Time

With this function (see picture below) the current distance and the current RSSI value (Signal strength) will be displayed. Furthermore the distance over time graph.

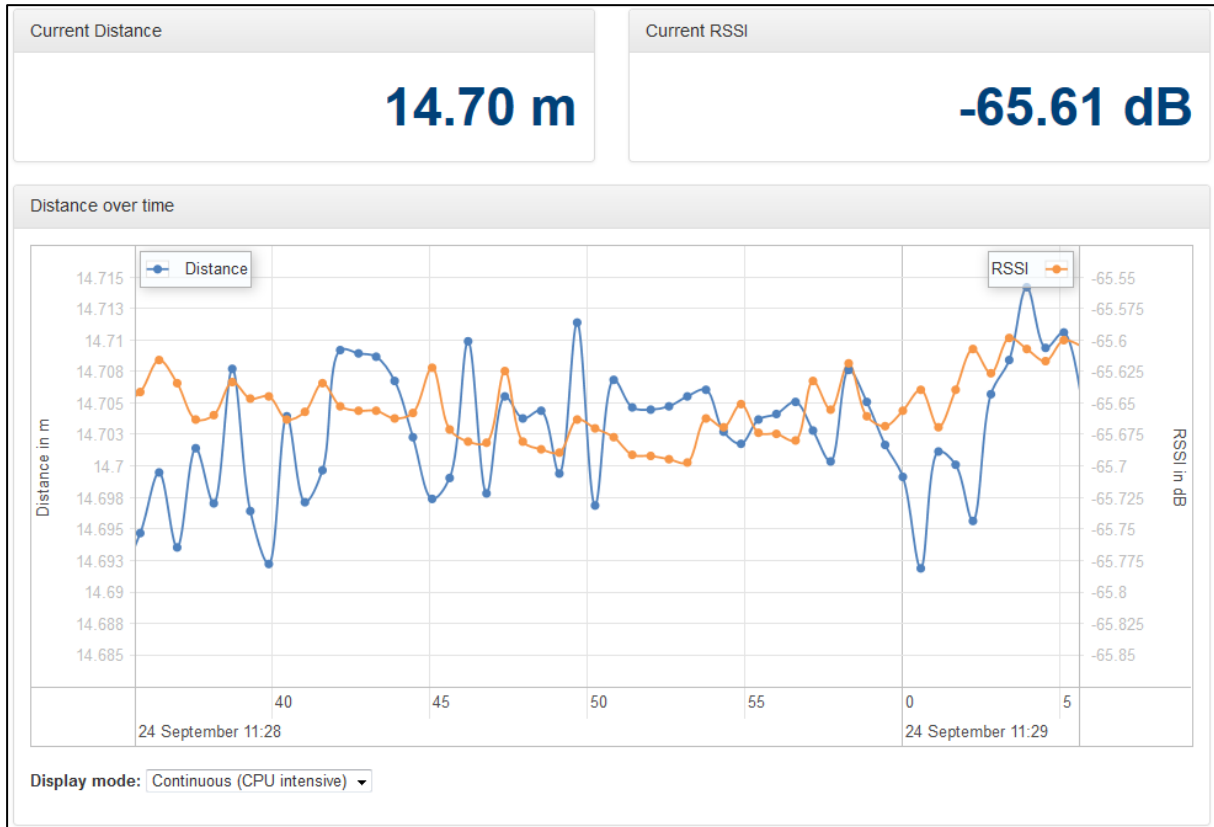


Figure 26 – Diagnostics: Distance over time

By pointing the mouse in the graph and using the scroll wheel you can downsize or enlarge the timeline.

### 7.6.4 Diagnostics - Signal Strength over Distance Diagram

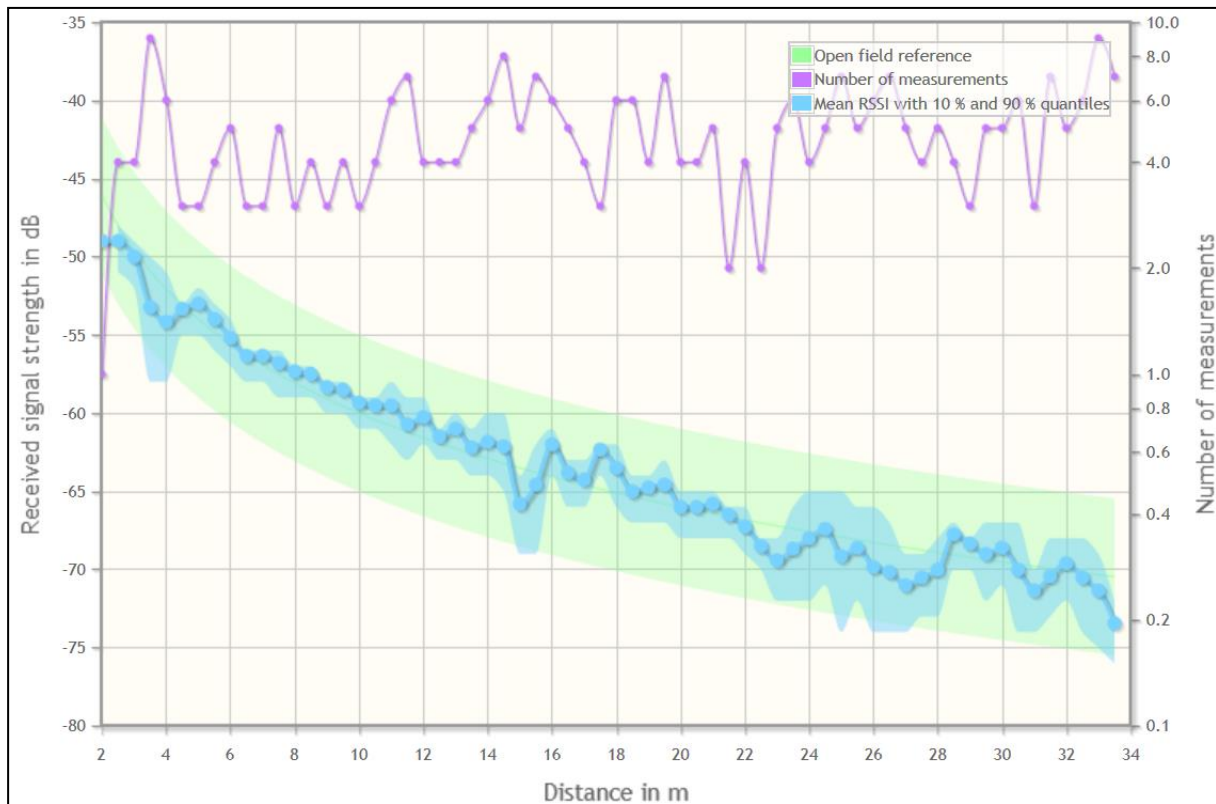


Figure 27 – Diagnostics: Signal strength over distance diagram

This diagram shows the recorded distance-signal strength pairs since the last power-on. You can use it to detect abnormal signal propagation routes at certain constellations of the two LPR®-1D24 stations, as the signal strength should decrease with increasing distance.

The diagram is automatically refreshed every 10 seconds.

The distance axis displays the distance between the two LPR®-1D24 stations, and the RSSI axis the received signal strength in dB. As the signal strength at specific distances may vary, the statistical distribution of the signal strength is also recorded. Displayed are the mean received signal strength, the 10 % quantile and the 90 % quantile. The Quantiles give you information about how many recorded signal strength values were lower than the corresponding line. 10 % of the recorded signal strengths were lower than the 10 % quantile line and 90 % were lower than the 90 % quantile line, leaving 80 % in between those two lines. This way you get an idea of the signal strength distribution per distance without including extreme outliers. This helps identifying distances with increased signal distortions (e.g. due to multipath signal propagation), as the variance of the signal strength there usually increases.