Aerosol Spectrometer
AQ Guard Smart

Operating Manual
– for people with specialist knowledge –

V 1.7

Table of contents

1 About this manual

1.1 Function of the manual

This manual provides information on fine dust measurement devices in the series *AQ Guard Smart*.

Some of the topics addressed are:

- Safety
- Functionality
- Use
- Operation
- Maintenance

1.2 Target group for the manual

This manual is intended to be used by **persons with professional knowledge** who, due to their technical education or experience, are familiar with activities in the field of particle measurement technology.

1.3 Presentation rules

The following presentations are used in this manual:

Text	Product names and product descriptions Example: *Fidas*
	Cross-references to other documents Example: *Information about … is found in the manual for the …*
`Text`	Menu items Example: `Shut Down System`
	Selection and settings Example: Start measuring with `Record`
`Text > Text`	Menu paths. The sequence of the menus is indicated by the ">" character. Example: `Menu > Check for Updates`
"Text"	Word compositions and figurative language Example: "Measuring Unit"
[□32]	Reference to page number Example: For further information, see the section "Technical data [□12]"

2 For your safety

2.1 Hazards and safety instructions

Qualified person

1. Only a properly qualified person may perform installation, commissioning and any other work on the device.

2. Follow the generally accepted codes of practice when installing the device.

Operate only undamaged equipment

1. After unpacking the device, check that all components are in pristine shape and are not damaged in any way.

2. To ensure safety, never operate damaged components. Consult the manufacturer.

Safe operation of the device

1. If the device is operated connected to an electrical outlet: Connect the power cable to an outlet with a residual current circuit breaker.

2. Only operate the device with the insulation and/or casing fully installed.

3. Make sure that the housing and/or the casing on the device is undamaged, complete, and correctly installed.

Safe use of the device

1. Do **not** use the device in a flammable or explosive environment, e.g. rich in hydrogen or oxygen.

2. Do **not** use the device with flammable or explosive carrier gases, e.g. rich in hydrogen or oxygen.

Compliance with work regulations

▸ Comply with the accident prevention regulations issued by the employers' liability insurance association as well as with local and national work regulations.

Radio radiation - protection of other devices

The device contains a WiFi module that generates, uses and radiates radio frequency. This radiation can disrupt other equipment.

1. Use the device only where permitted!

2. Do not use the device if it could impact electronic equipment or potentially cause other hazards.

2.2 Safety notes on using the built-in LTE dongle

If the built-in LTE dongle (HUAWEI 3372h-320) is equipped with a SIM card, additional safety measures are required.

Note For the usage in the USA, LTE sticks or modems from other manufacturers are available.

Comply with the following safety notes if the dongle has been activated and is transmitting signals via a mobile network. The safety notes are an extract from the manufacturer's safety information, version: November 2020.

Additional detailed information can be found on the manufacturer's website https://consumer.huawei.com/de/support/smart-home/e3372/.

Frequency bands and output

Frequency bands in which the radio device operates: Some bands may not be available in every country or region. Consult your local network provider for details.

Maximum high frequency current transmitted in the frequency bands for operation of the radio device: The maximum current for all bands is below the limit indicated in the respective harmonized standard.

The following nominal limits apply to the frequency band and (radiated and/or cable) transmission: GSM 900: 37 dBm, GSM 1800: 34 dBm, WCDMA 900/2100: 25.7 dBm, LTE band 1/3/7/8/20/28: 25.7 dBm.

Using mobile communication

Use the device only where permitted! Do use the device if it could impact electronic equipment or potentially cause other hazards.

Interference with medical equipment

- Comply with all rules and regulations of the hospitals and health care facilities! Do not use the device in areas where it is prohibited.
- Some wireless devices can disrupt proper functioning of hearing aids or pacemakers. Consult the manufacturer of the medical device for further information.
- Pacemaker manufacturers recommend maintaining a minimum distance of at least 20 cm between the device and a pacemaker to prevent potential interference with the pacemaker.

Areas with flammable and explosive materials

- Do not use the device in places where flammable or explosive materials are stored, such as at a gas station, oil depot or chemical plant. Using the device in these environments increases the risk of explosion or fire. Always follow instructions in text form or as symbols.

- Do not store or transport the device in the same container as flammable liquids, gases or explosive substances.

2.3 Warnings

The warnings in this manual are highlighted with pictographs and signal words. The severity of a hazard is indicated by the pictograph and signal word.

Layout of the warnings

The warnings that precede each action are shown as follows:

	⚠ **DANGER**
⚠	**Type and source of the hazard**
	Explanation of type and source of the hazard / description of consequences of failure to comply with the warning.
	▸ Measures to avert the hazard

Meaning of the signal words

DANGER	Immediate danger to life or risk of severe physical injury if this hazard is not avoided.
WARNING	Possible risk of severe physical injury if this hazard is not avoided.
CAUTION	Possible risk of minor physical injury if this hazard is not avoided.
NOTICE	Damage to property if this hazard is not avoided.

Meaning of the pictographs

⚠	DANGER Warnings with information about the severity of the hazard
⚡	DANGER Danger to life due to electric shock
❗	NOTICE Damage to property

2.4 Regulations

Observe the following regulations and directives:

Statutory regulations
- Legal regulations for accident prevention
- Legal regulations for environmental protection
- Employer's Liability Insurance Association provisions

Standards and directives
- The applicable safety requirements according to DIN, EN, and VDE

2.5 Obligations of the user

To ensure proper functioning of the device, observe the following:

1. Carefully read through the manual before using the device.

2. Keep the manuals in the vicinity of the device to ensure that information can be checked at all times.

3. Only carry out activities described in the manual intended for your use.

4. Make sure that the required inspections and maintenance tasks are carried out.

5. Have the device serviced by the manufacturer or an authorized distributor.

6. Have damage to the device repaired promptly by the manufacturer.

3 Product description

3.1 Use

3.1.1 Intended use

The device is manufactured and tested according to good engineering practices and the recognized safety rules. In order to avoid hazards to yourself or third parties and damage to the device and other assets, only use the device properly and as intended.

The device is intended to be used only for measuring fine dust and gases (depending on the model).

Measurable fine dust fractions: PM_1, $PM_{2,5}$, PM_4, PM_{10} and PM_{tot}.

Countable particle sizes: 0.175 - 20 µm.

The device is suitable for outdoor use.

The device is intended to be used only by the following persons:

- Persons who are familiar with activities in the field of particle measuring technology based on their education or experience.

Any use other than the intended use is prohibited. The manufacturer assumes no liability for damages resulting from this. All warranty claims are voided if changes are made to the device, including in the course of assembly and installation.

All corresponding documentation must be observed for any work on the device.

3.1.2 Improper use

The device is not intended for use by the following persons:

- Persons with limited physical, sensory or mental abilities
- Persons lacking the required qualification, experience or knowledge
- Persons under 18 years of age

The device is not intended to be operated or stored under the following ambient conditions:

- Corrosive environments
- Explosive environments
- Environments with flammable materials
- Areas with strong electrical or electromagnetic fields
- Areas with ionizing radiation
- Areas subjected to shock and vibrations

The device is not intended for use as alarming gas detectors for limit/alarm value monitoring in workplaces and indoor spaces.

Neither the manufacturer nor the supplier of the device will be liable for damage that can be attributed to unintended use.

3.2 Models

The *AQ Guard Smart System* includes several model variants.

The variants are described below:

Model	Special features
AQ Guard 1000	Without gas sensor module
AQ Guard Smart 1100	With gas sensor module
AQ Guard Smart 1200	With gas sensor module TVOC, CO2, GPS module

3.3   Main components
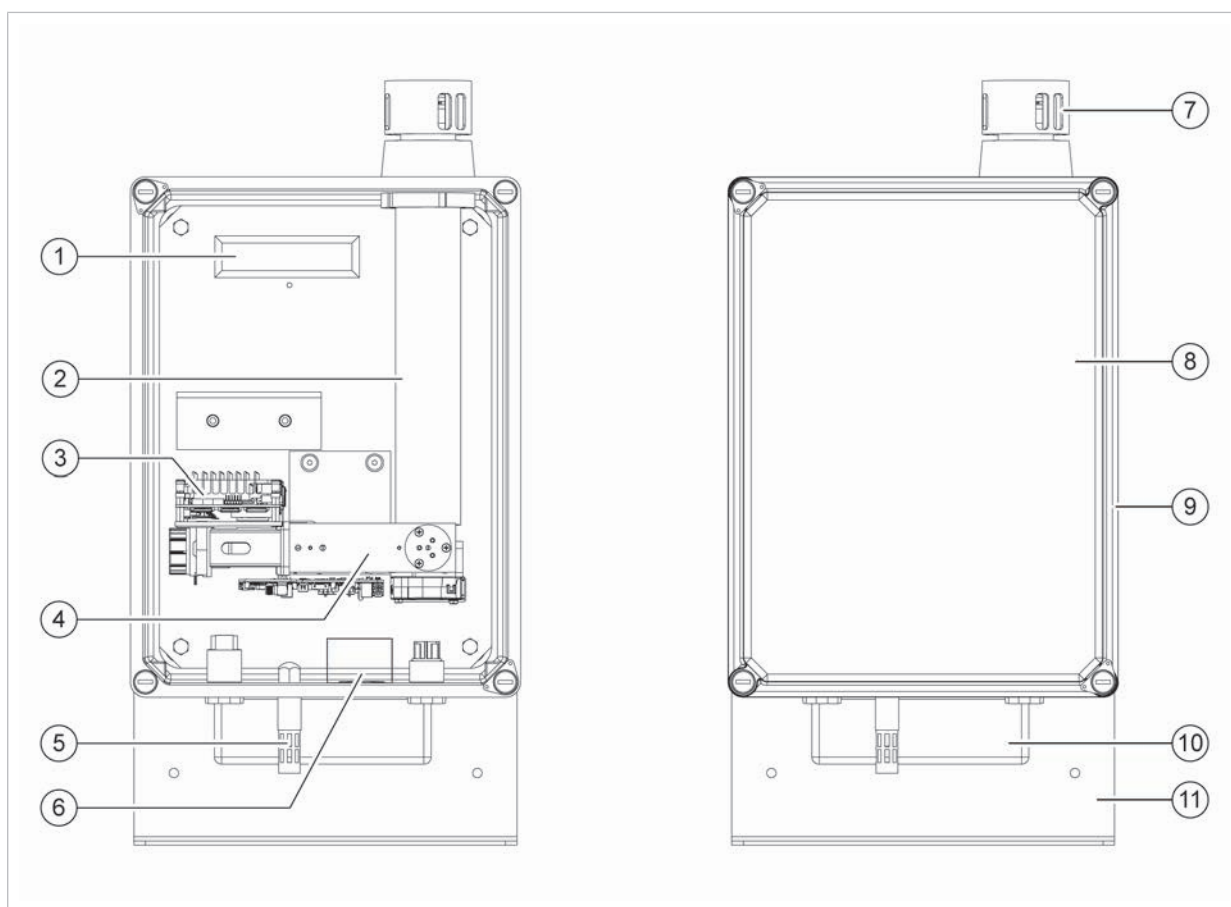
Main components of device (left: without cover, open / right: with cover, closed)

1	LTE stick	2	Protective tube for the interior aerosol inlet tube
3	Single board computer	4	Aerosol sensor
5	Temperature and moisture sensor	6	Gas sensor module
7	Sampling head; can be detached	8	Housing cover
9	Housing	10	Power supply unit
11	Mounting console		
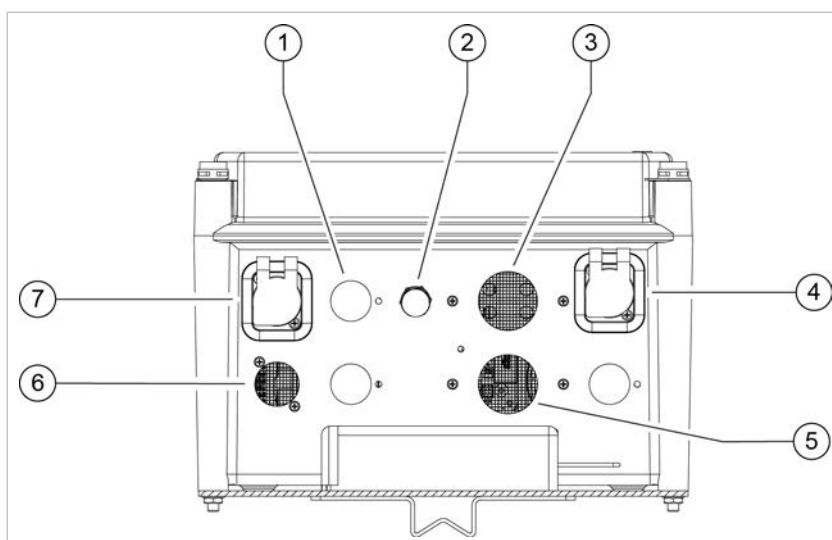
Ports on the bottom of the housing

1	Connection socket weather station (optional)	2	Temperature/humidity sensor
3	Gas sensor module (CO, O3,NO2, SO2) (AQ Guard Smart1100, 1200)	4	Power Connection socket for the power supply 12 V
5	CO2 sensor (AQ Guard Smart1200)	6	VOC sensor (AQ Guard Smart1200) Ethernet socket (AQ Guard Smart 1000 M)
7	USB socket		

3.4 Functional description

The following descriptions refer to the fully equipped version of the devices. The fully equipped version has to include all of the available packages.

Analysis of particles in ambient air

Measuring devices in the series *AQ Guard Smart* continuously analyze fine dust particles from the ambient air and simultaneously calculate the immission values $PM_{2.5}$ and PM_{10}, which require monitoring. The values PM_1, PM_4, PM_{tot}, the particle number concentration C_n and the particle size distribution are calculated and recorded. The number of particles is determined by means of optical light scattering.

Analysis of gases in ambient air

The AQ Guard Smart System, Model AQ Guard Smart 1100, is equipped with gas sensors for CO, SO_2, O_3 and NO_2. Concentration of the gases is measured electrochemically.

Determination of basic data of ambient air

Other sensors determine the basic data of the ambient air:

- Air temperature
- Air pressure
- Relative humidity
- Wind speed, wind direction (optional)

Scattered light analysis

The device works with the optical aerosol spectrometer that uses scattered light analysis to determine the size of an individual particle. The single particles move through an optically differentiated measurement volume that is homogeneously illuminated with a polychromatic LED light source. Each particle generates a scattered light pulse that is detected at an angle of 90° degrees. The particle count is determined based on the number of scattered light pulses. The level of the measured scattered light pulse is a measure of the particle diameter.

Interfaces

The device has several data interfaces, enabling realtime access via Ethernet, WiFi or mobile data (optionally LoRa). All of the measured values are calculated and logged in the device. Evaluation with an external device is not required and is not intended. This means that the user has complete control of the data and can decide himself which information should be accessible.

The measured values can be shown via a web interface. A built-in server transmits the data to external devices.

There is also the option of linking to the data platform *MyAtmosphere*, via which the data can be transmitted, saved and viewed.

Unsupervised continuous operation

The device is intended to be used continuously and without supervision. The sampling head and the optical sensor system should be protected from pollution to the greatest extent possible. The elements can be cleaned by the user when necessary.

3.5   Environmental conditions

Environmental conditions affect the functionality of the device.

The following environmental conditions apply for the operation and storage of the device:

- Temperature range:
  -20°C to +50°C

- Air pressure: atmospheric pressure

Operation and storage under other environmental conditions, for instance in corrosive or explosive environments, powerful electrical or electromagnetic fields, areas with ionizing radiation or areas subject to shocks and vibrations are prohibited.
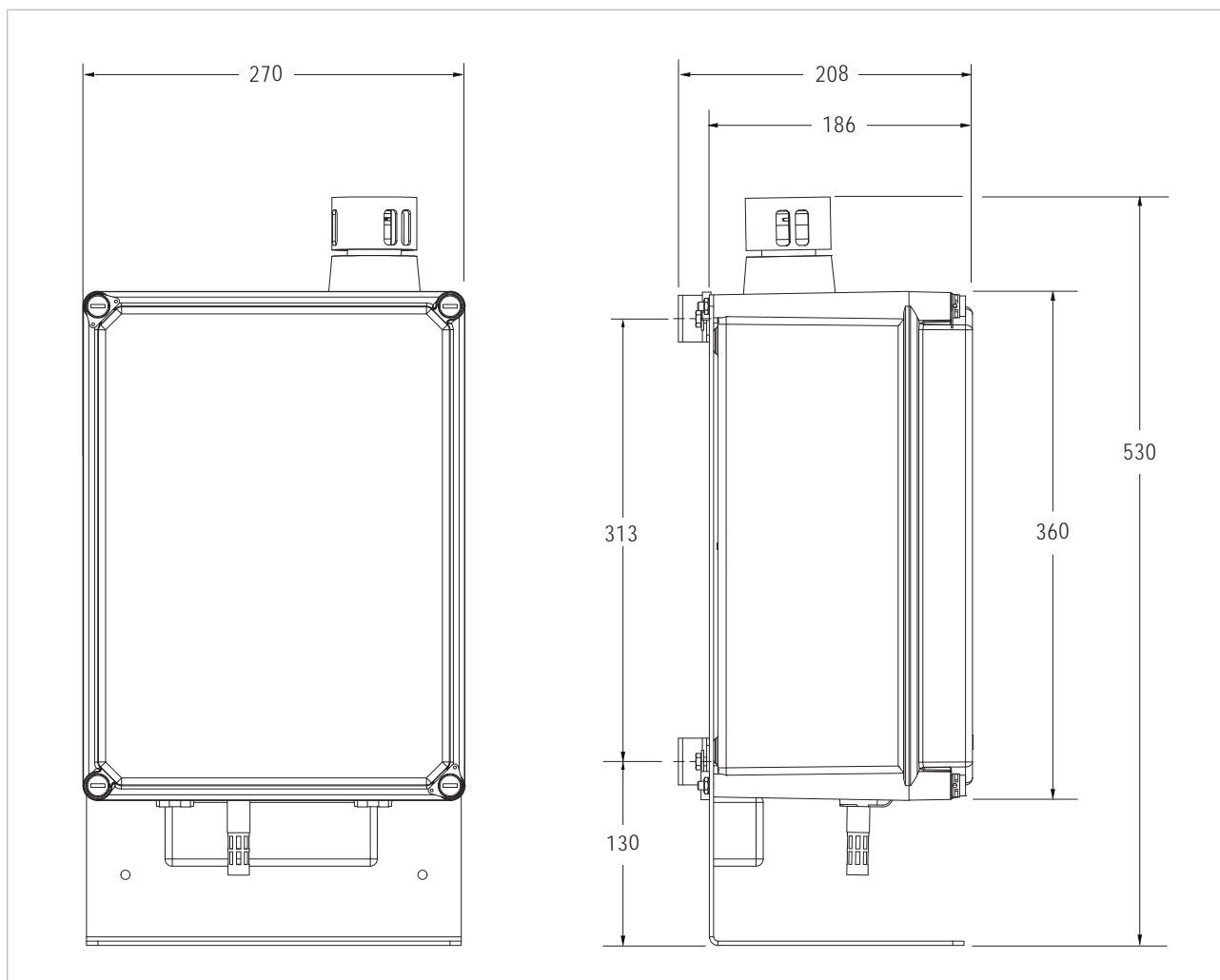
3.6   Type plate

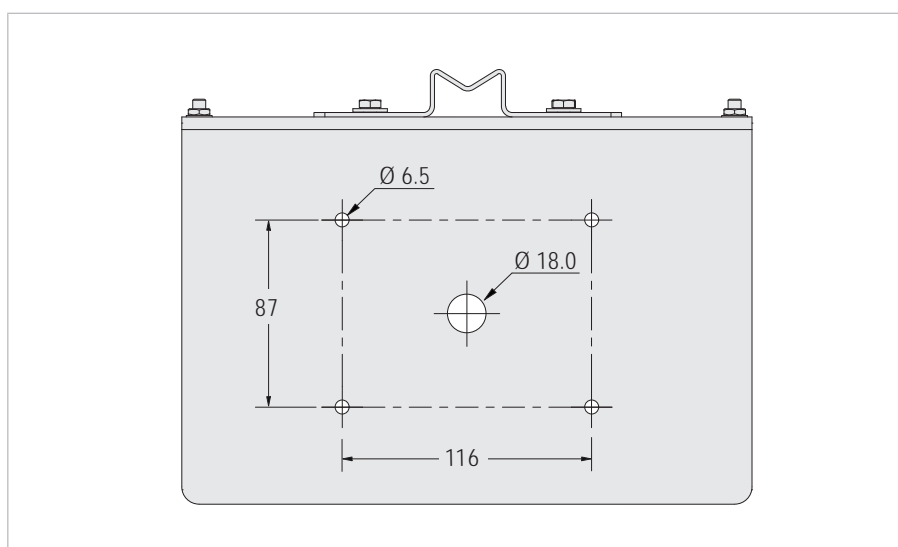The type plate is on the underside of the housing.

The type plate shows the following information:

- Type = product name

- SN = serial number

- U = operating voltage

- Year = year of construction

- Name and address of manufacturer

3.7 Dimensions

Main dimensions – in millimeters

Dimensions of the holes in the mounting console base plate – in millimeters

3.8 Scope of delivery

Inspect the delivered equipment for damage and completeness.

The delivery includes the following:

- Measuring device with mounting console
- Power supply, 12V DC / 5A, 60W, outdoor, OWA-60E
- 2 brackets for mounting the device on a pole or post
- Cleaning kit 6966
- Calibration dust *MonoDust 1500*
- Calibration certificate
- Adapter for calibration
- Adapter for pedestal
- Operating instructions

3.9 Optional accessories

The following optional accessories are available for purchase:

- Touch screen 7", USB, article no. 8104
- Signal light, article no. 8088
- Sun protection, article no. 8036
- Weather station WS200, article no. 8047

3.10 Conformity

As the manufacturer, we hereby declare that this product meets the fundamental directives for bringing it to market in the EU.

4 Initial commissioning

4.1 Overview

Initial commissioning of the device includes the following tasks:

- Unpacking the device
- For information on how to mount the device on a supporting structure, refer to section "Mounting device on a supporting structure [▷ 20]"
- For information on how to check the device status, refer to the section "Menu Device Info / Device Status [▷ 51]"
- For information on how to check for leakage, refer to the section "Checking for Leakage [▷ 74]"

Setup time: The tasks listed above take about 30 minutes to complete.

4.2   Mounting device on a supporting structure

Safety

The device can be mounted in places that are not accessible from the ground. Use suitable aids that ensure safe access during work. These include a sturdy ladder or a platform with railing.

	⚠ **WARNING**
	Risk of injury due to unsuitable climbing assistance
	Unsuitable climbing aids can cause loss of stability and lead to falls. This can result in serious injury or death.
	▸ Use only climbing assistance suitable for the specific purpose.
	▸ Comply with all applicable regulations and laws pertaining to occupational safety.

|	⚠ **WARNING**
	Risk of injury due to unsuitable supporting structure or inadequate mounting
	An unsuitable supporting structure or inadequate mounting can pose a hazard. A falling or overturning device can harm persons, animals or objects. This can result in serious injury or death. Impact can damage objects.
	▸ Always use a supporting structure that is anchored to the ground or protected in some other way from overturning over or being flung away. The supporting structure has to be able to sustainably withstand the anticipated conditions of use.
	▸ Fasten the device to the supporting structure only at the intended fastening points.
	▸ Sufficiently tighten screws and nuts securing the device, and check the condition of the supporting structure and connectors at reasonable intervals.

Suitable supporting structure

Fastening elements on device

The device has to be mounted to a suitable supporting structure to be able to operate it at the point of use (not included in delivery). Use the fastening elements to properly secure the device. The essential components of a supporting structure are:

- Vertical pole or post

- Stand or tripod – secured by the operator to prevent it from overturning

The following fastening elements are available on the device:
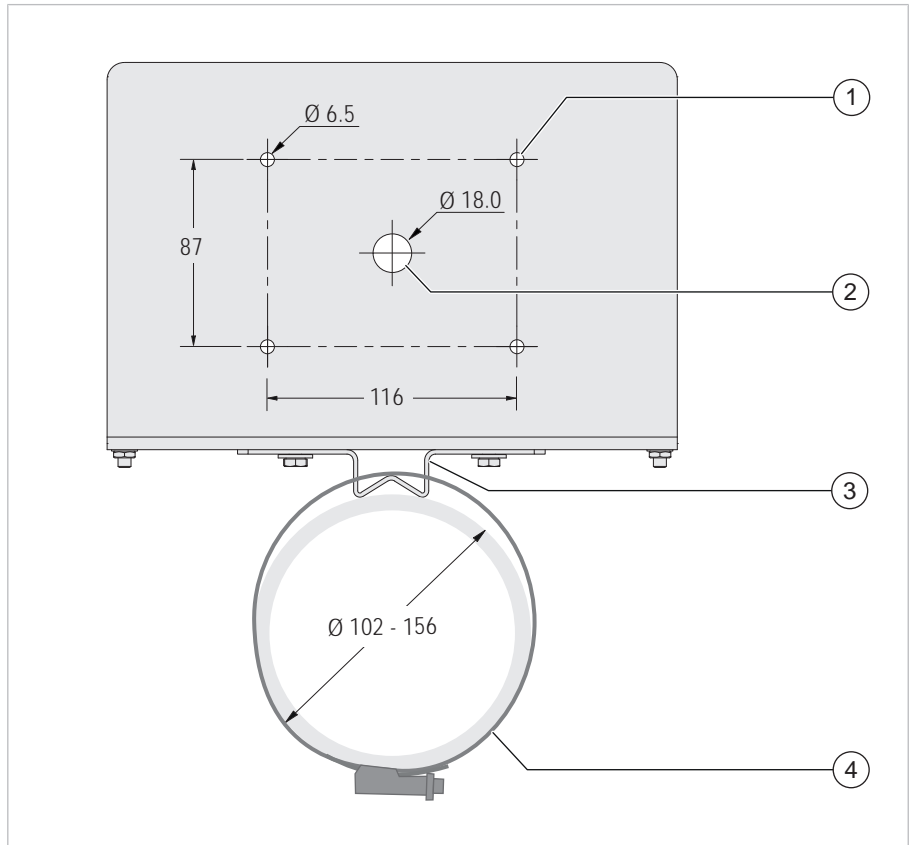
Fastening elements on device – all dimensions in millimeters

1	4 holes in the base plate, diameter Ø 6.5 mm, for a stand or tripod	2	1 hole in the base plate, diameter Ø 18.0 mm, for a stand or tripod
3	2 Clamps to secure (pass through) the brackets	4	2 clamps for mounting the device on a vertical pole or post Suitable for diameters Ø 102 mm to 156 mm.

Aligning horizontally

We recommend positioning the device such that the temperature and moisture sensor is not exposed to direct sunlight. The device should be placed such that the cover faces north.
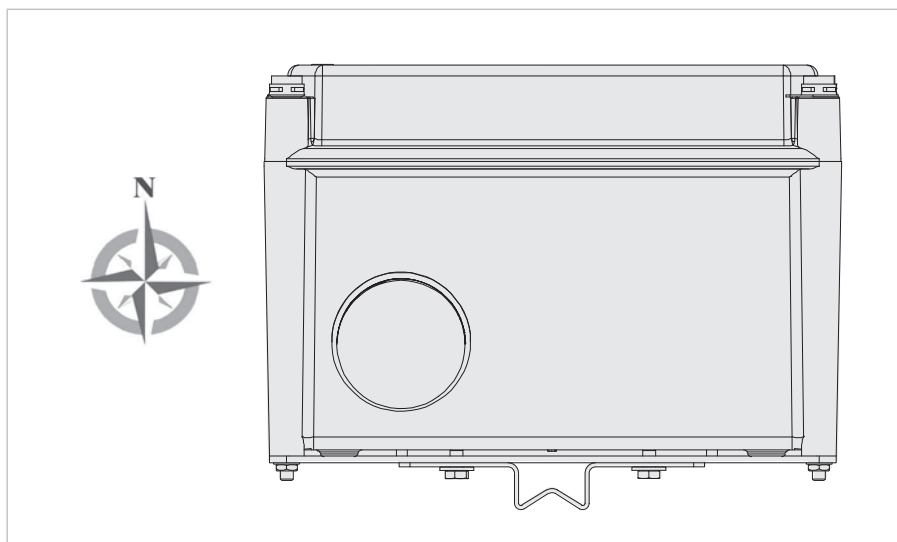
Recommended horizontal alignment of the device

4.3   Connecting a network cable (optional)

The computer has a port for a network cable. This gives the operator the option of connecting the device to a network via LAN.

The network cable is not included in the scope of delivery.

There are two ways to connect a network cable:

1. The network cable can be connected with an adapter to the USB port on the underside of the device. The adapter is not included in the scope of delivery.

2. The network cable can be connected directly to the device. The housing cover has to be removed to be able to connect the cable. When closing the cover, comply with the instructions in the section "Opening and closing housing [▶ 65]".
    The additional cable can be passed through the rubber plug on the underside of the housing. To do this, cut a small hole in the rubber plug. Make the hole as small as possible and seal the opening with silicone after passing through the cable.
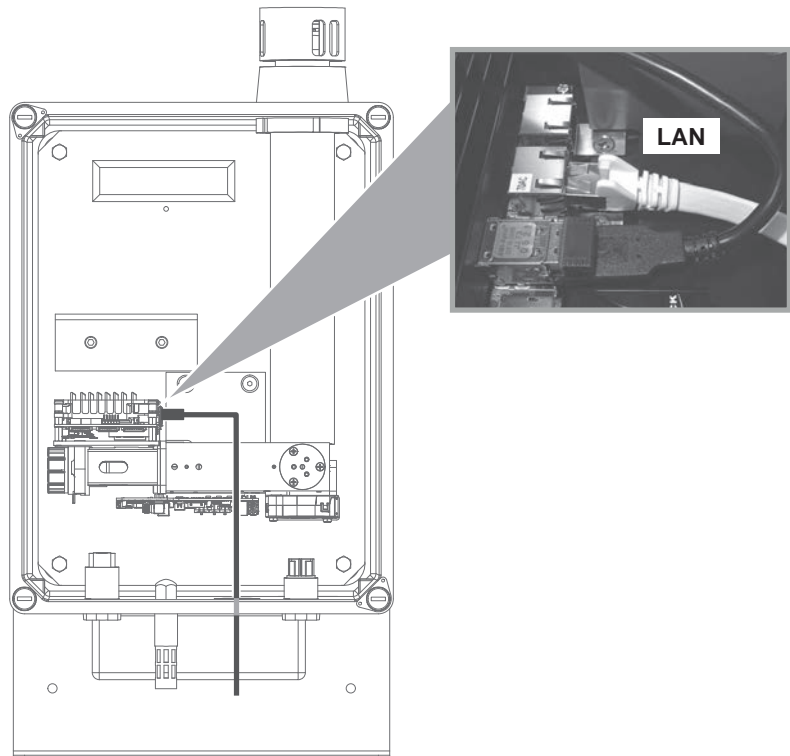
Connecting a network cable to the computer

4.4 Operational readiness

The included power supply converts the primary voltage 115/230 Volt AC to 12 Volt DC. As soon as the power supply is connected, the firmware opens and the device begins to measure.

4.5 Function test

Function test via Web interface or user interface of the firmware

When a device is switched on for the first time, proper functioning of the device can be checked in these ways:

- Open the Web interface on the device;
  refer to the section "Access to measured data via Web interface [▶ 62]".

- Establish a Remote Desktop connection to the device;
  refer to the section "Access to firmware via Remote Desktop [▶ 60]".

- Connect a touch screen to the device via USB. A touch screen is available as an accessory,
  refer to the section "Optional accessories [▶ 18]".

Noting IP address

The default setting of the hotspot feature is activated. Do not switch off this feature until you have written down the unique address assigned to the device when it was linked to a network. This address can be found in the menu `Communication`.

Notice If neither the unique IP address is available nor the hotspot feature switched on, it is not possible to access the device's user interface with a mobile device or PC.

When a data connection has been established, the data can be accessed via the data platform *MyAtmosphere*. Otherwise the user interface of the device can be accessed via a touch screen available as an accessory.

4.6 Using a SIM card for mobile data

The LTE stick built into the device can be equipped with a SIM card. It allows measured data to be transmitted (as a transfer protocol) via a mobile network.

The device operator has to select and purchase the SIM card.

Size of SIM card: Mini-SIM (2FF), 25 x 15 mm.

4.6.1 Check firewall settings

If a SIM card is used, the firewall settings must be checked.
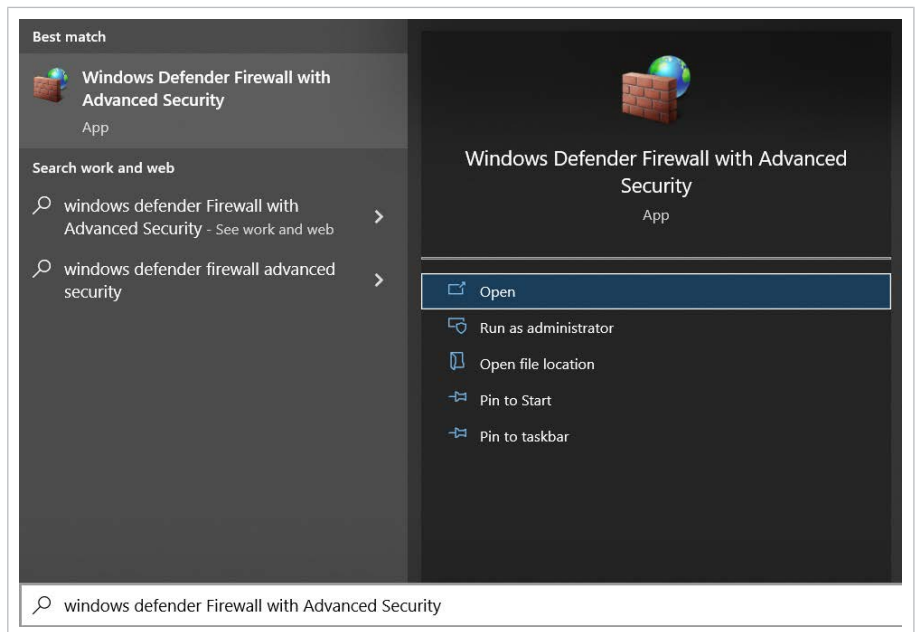
To check the firewall settings, proceed as follows:

1. Enter "Windows Defender Firewall with Advanced Security" via the Windows search function.

2. Click the "Open" button.

    ⇨ The "Windows Defender Firewall with Advanced Security" window opens.

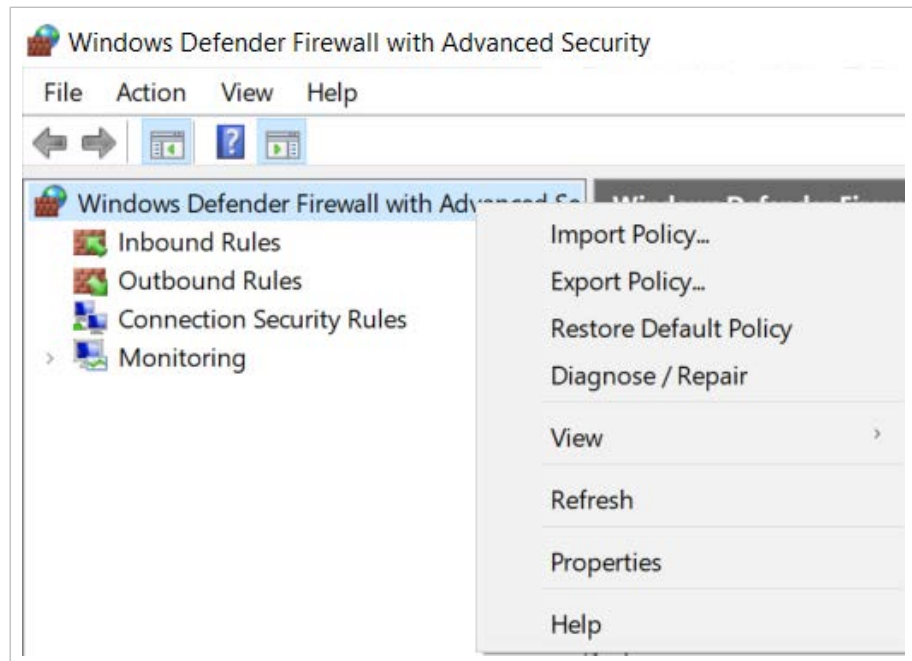3. Right click on "Windows Defender Firewall with Advanced Security".

4. Select "Properties".

   ⇨ The "Windows Defender Firewall with Advanced Security on Local Computer" window opens.
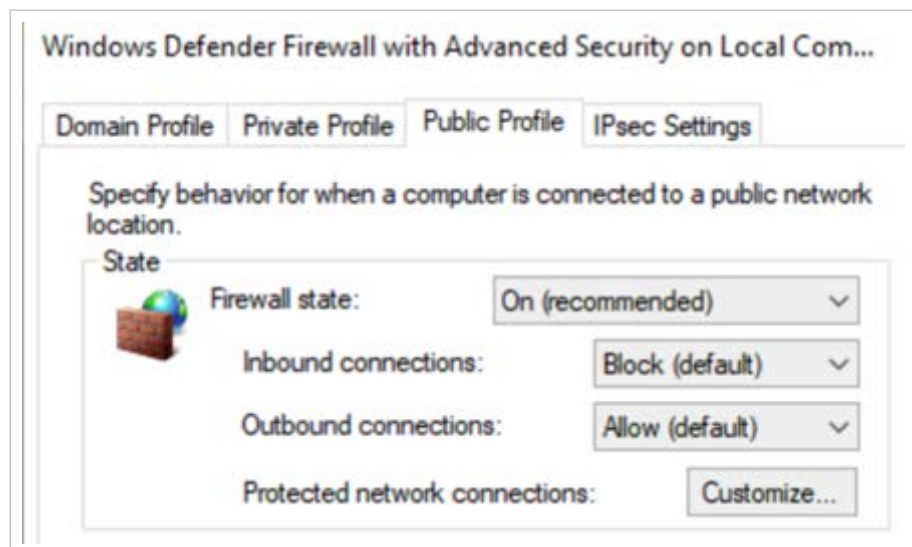
5. In the "Public Profile" tab, set the "Firewall state" to "On" and select the (default) values for both connections.

Note   If additional ports are required in addition to web access, the ports must be defined as a new rule in this program in the section "Inbound rules".

4.6.2 Enable LTE stick

To enable the LTE stick, proceed as follows:

‣ Go to Windows > Settings.
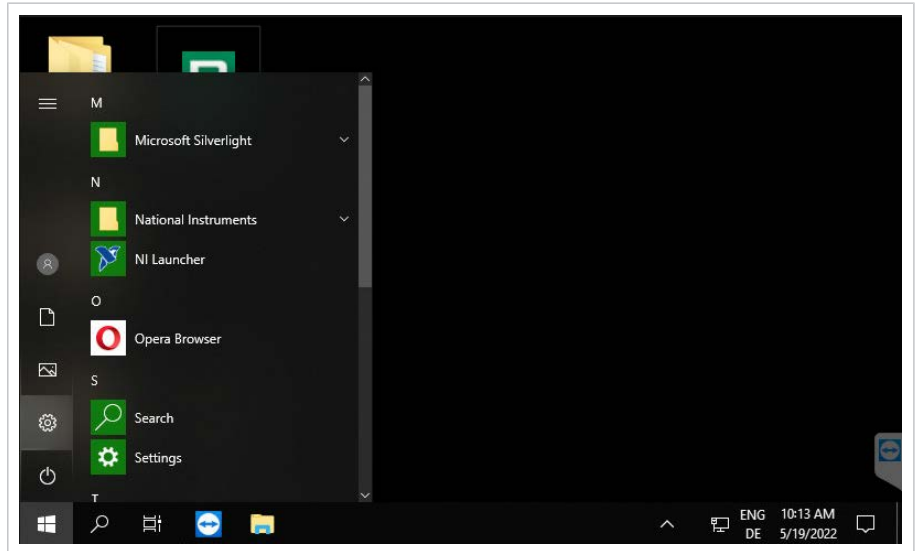
‣ Go to „Network & Internet".
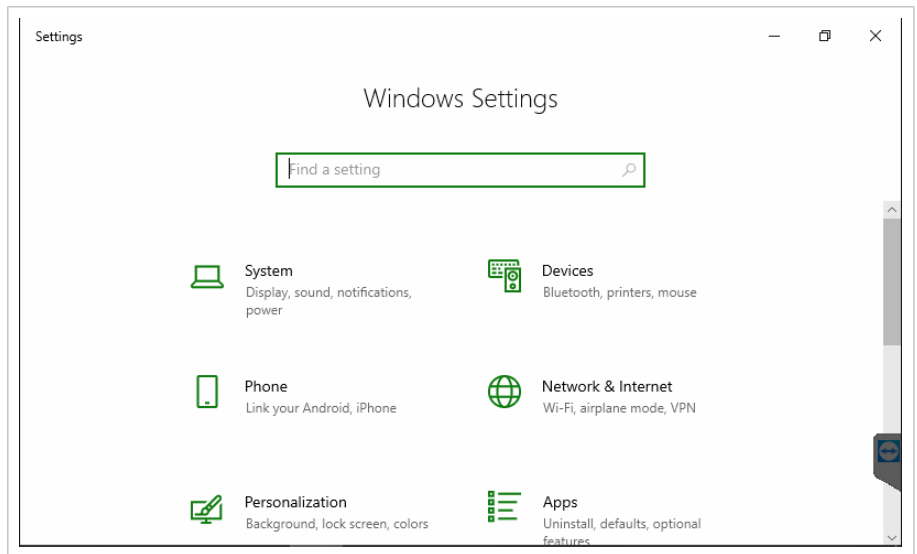
▸ Choose „Change adapter options".
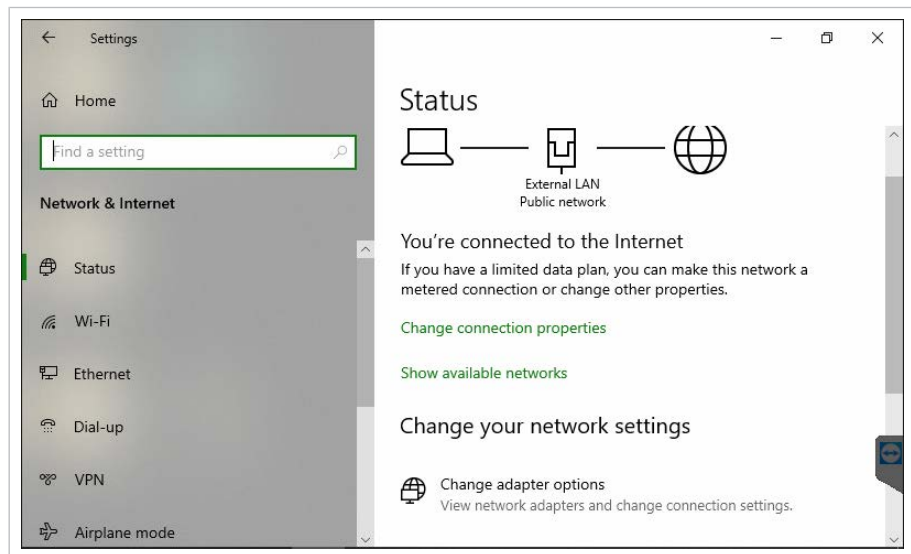
▸ Choose „Remote NDIS based Internet Sharing Device".
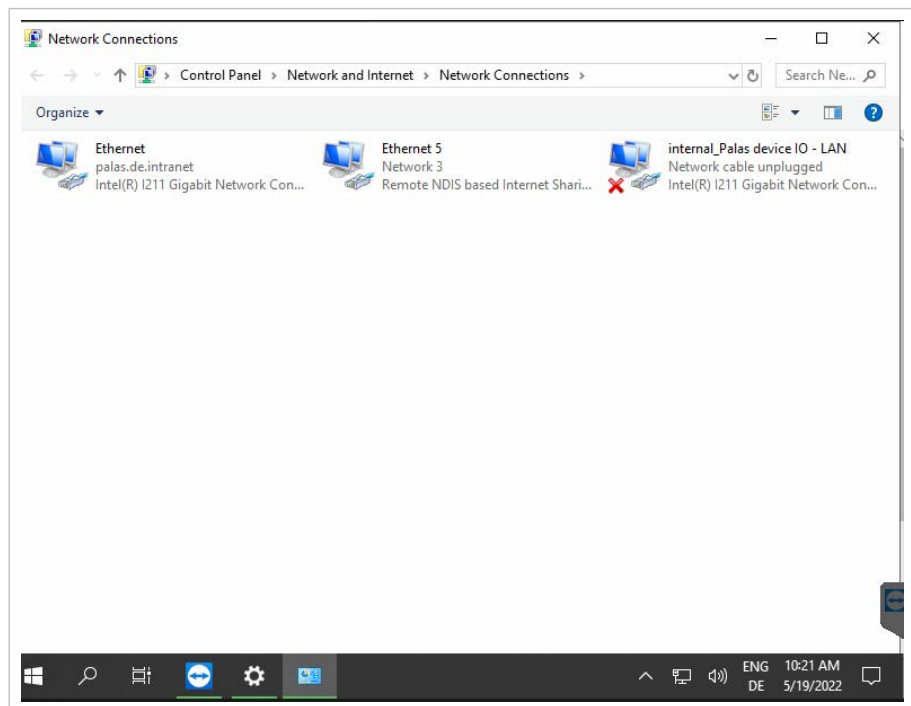
▸ Right click on the network.

▸ Choose "Enable".
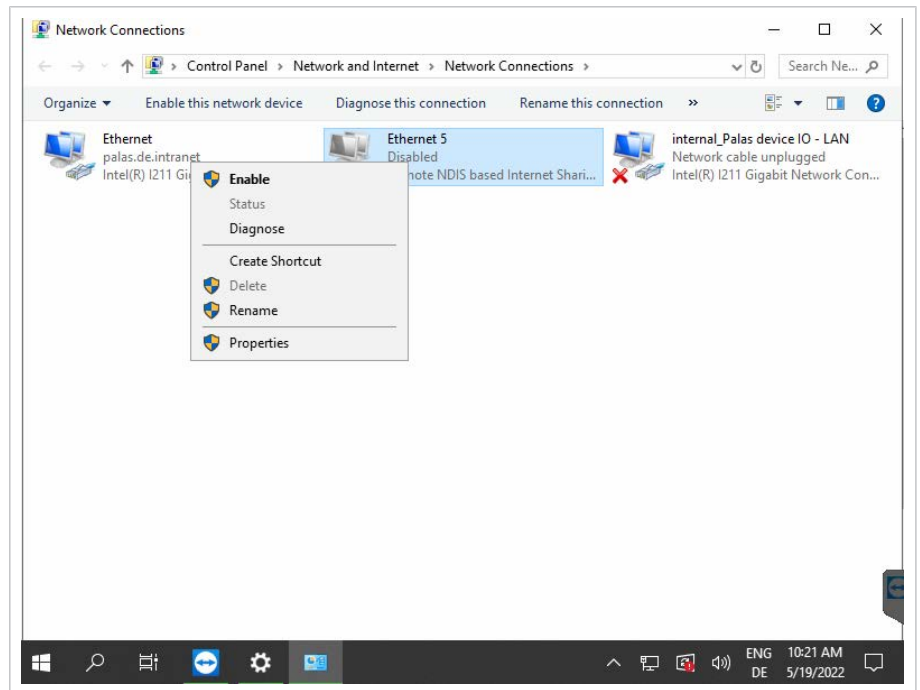
After activating the LTE Stick, the current system configuration must be saved permanently by the System Protection Tool.

You can find a shortcut of the tool on the desktop of Windows. Exit the firmware of the device with **Exit to OS** to get to the desktop. A double click on the icon starts the tool.

Once you have started the tool, this window opens:
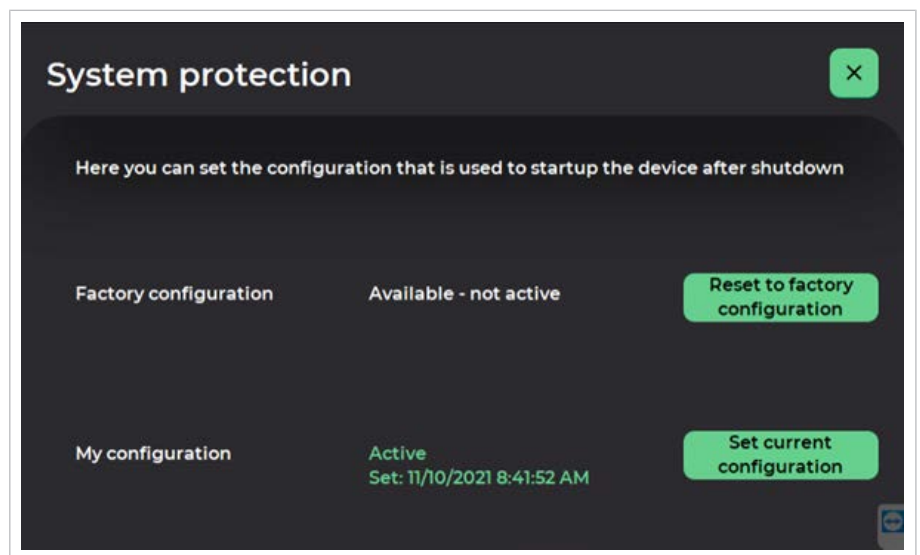
By pressing the button Set current configuration, you save the current configuration and define that this configuration will be used the next time the device is restarted.

4.6.3 Configuring SIM card

Once a SIM card has been inserted into the LTE stick, the communications settings can be configured via the "Microsoft Edge" app. If this app is not available, the "Internet Explorer" app can be used.

A keyboard (connected via USB or virtually via Remote Desktop) is needed to use this app.

There are 2 ways to view the Windows interface:

- Press the Windows key on a keyboard
- Close the firmware with `Exit to OS` (`Settings > Expert User`)

IP address of LTE stick: http://192.168.8.1

When opened in the browser, only part of the page can be seen. Use Ctrl +/- to adjust the size such that the page can be viewed properly.

The communication settings are a factor of the SIM card used, the mobile data provider and your specific needs. We recommend having an IT administrator make the communication settings or having a technician from the mobile data provider help with configuration. Most of the settings are self-explanatory.

Configuring PIN request

If the SIM card is protected by a PIN, a prompt to enter the PIN will appear first.
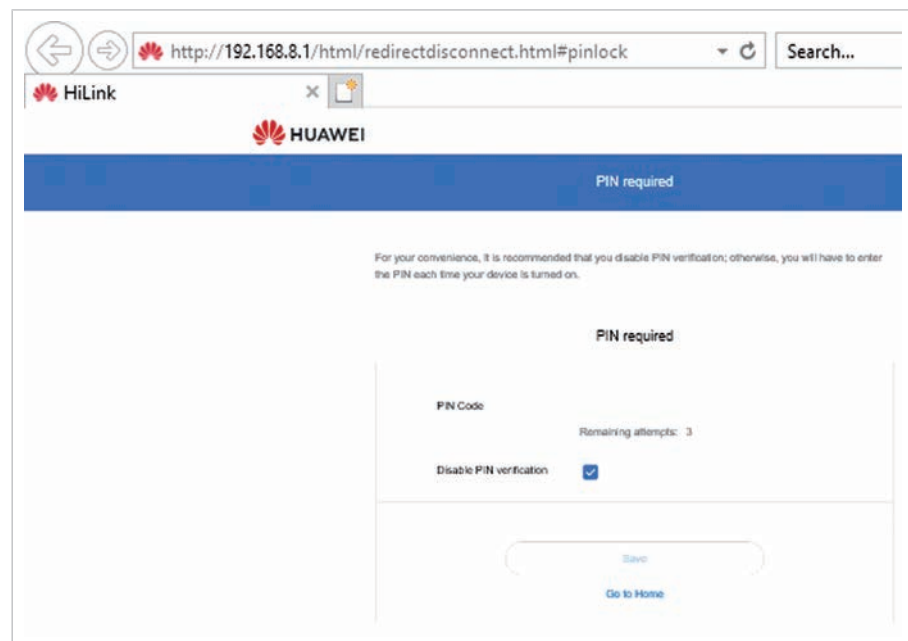
PIN request for a protected SIM card

If you want the PIN to be required every time the device is switched on, deactivate the checkbox "Disable PIN verification".

If you do not want this, select the checkbox.

Initial login

The following 3 screens appear when logging in for the first time:
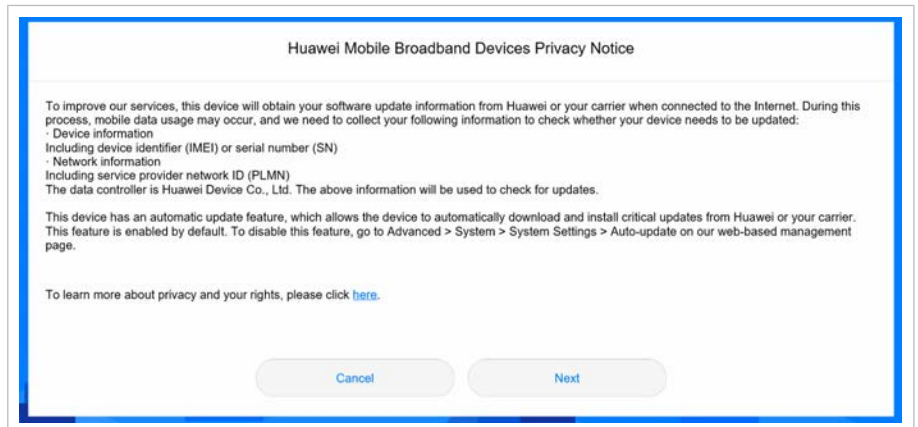
LTE stick information screen

▸   Select "Next".

LTE stick welcome screen

▸   Select "Start".
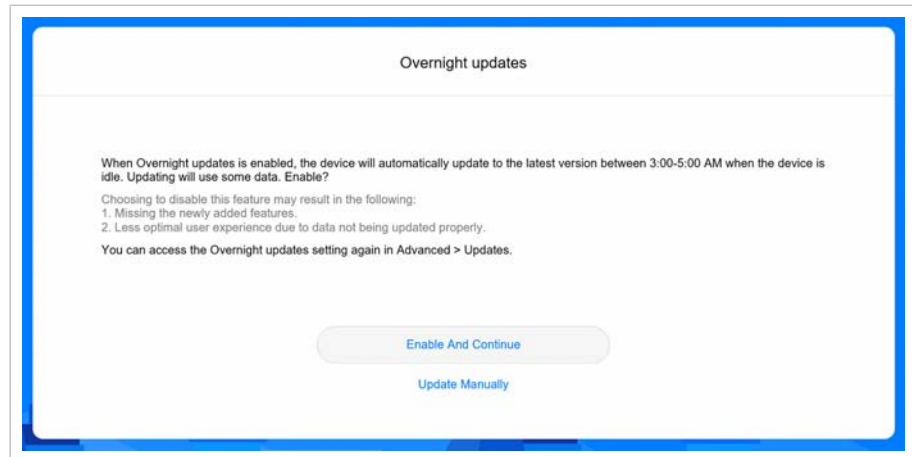
LTE stick menu: Overnight updates

▸ Select "Update Manually".

Configuring connection profile

To create a connection profile that meets the requirements of your mobile data provider, navigate through the menu like this:
Mobile Network > Internet Connection.
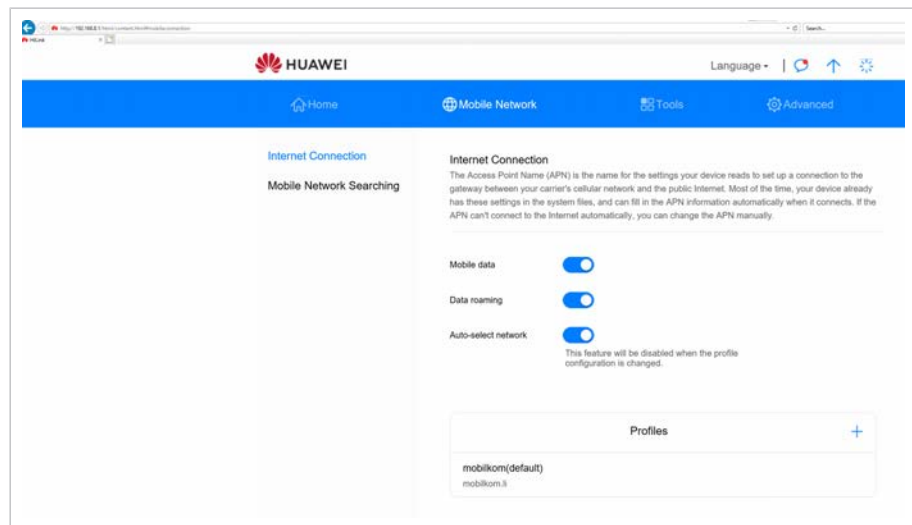
LTE stick menu: Mobile Network > Internet Connection

Create your own profile here or use the default profile "mobilkom".

To create your own profile:

1. Select the blue plus symbol (+) next to "Profiles".

    ⇨ The menu "Profile Management" appears.

2. Enter the profile information as required by the mobile data provider.

*LTE stick menu: Mobile Network > Internet Connection > Profiles
(Profile Management)*

If the checkbox by "Set as Default Profile" is activated, the respective profile is used.

4.6.4 SIM card with its own public and static IP address

For most use cases a SIM card with its own public and static IP address is not necessary. The use of the Transfer protocol TCP ASCII [▶ 83] outside a local network, for example, requires that the device can be reached via the Internet (bidirectional communication). In this case this protocol only works when using a SIM card with its own public and static IP address.

If a SIM card with its own public and static IP address will be used, further settings are necessary.

▸ Activate the DMZ status via the slider.

4.7 Setting up MyAtmosphere (optional)

4.7.1 Preparing the device

Note At least firmware 1.012 is needed for streaming to MyAtmosphere.

1. Connect the device to the internet.
   Use an Ethernet cable, WiFi or an integrated LTE modem. A SIM card is not provided.

2. Select `Settings` in the main menu.

   ⇨ A keypad for entering the PIN opens.

3. Enter the PIN.

   ⇨ The menu `Settings` appears.
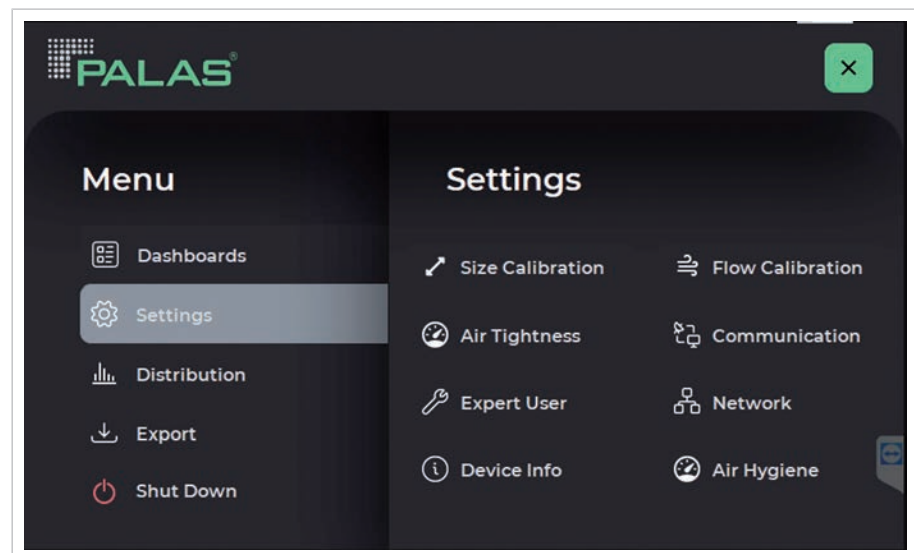
Menu `Settings`

4. Select `Communication`.

5. Select `MyAtmosphere`.
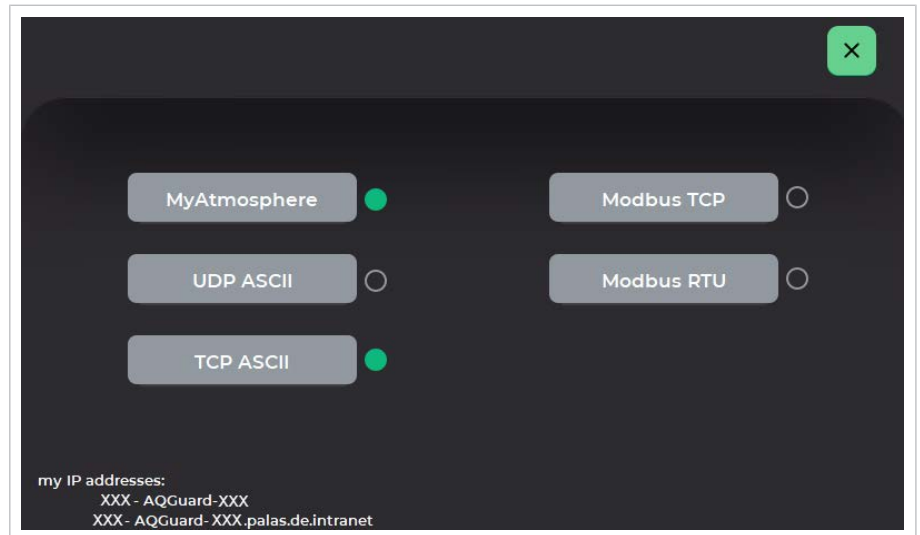
Menu `Communication`

6. Activate MyAtmosphere.

   ⇨ The device will start transmitting the measurements using an MQTT protocol. It could take a few minutes before the device will appear on MyAtmosphere.
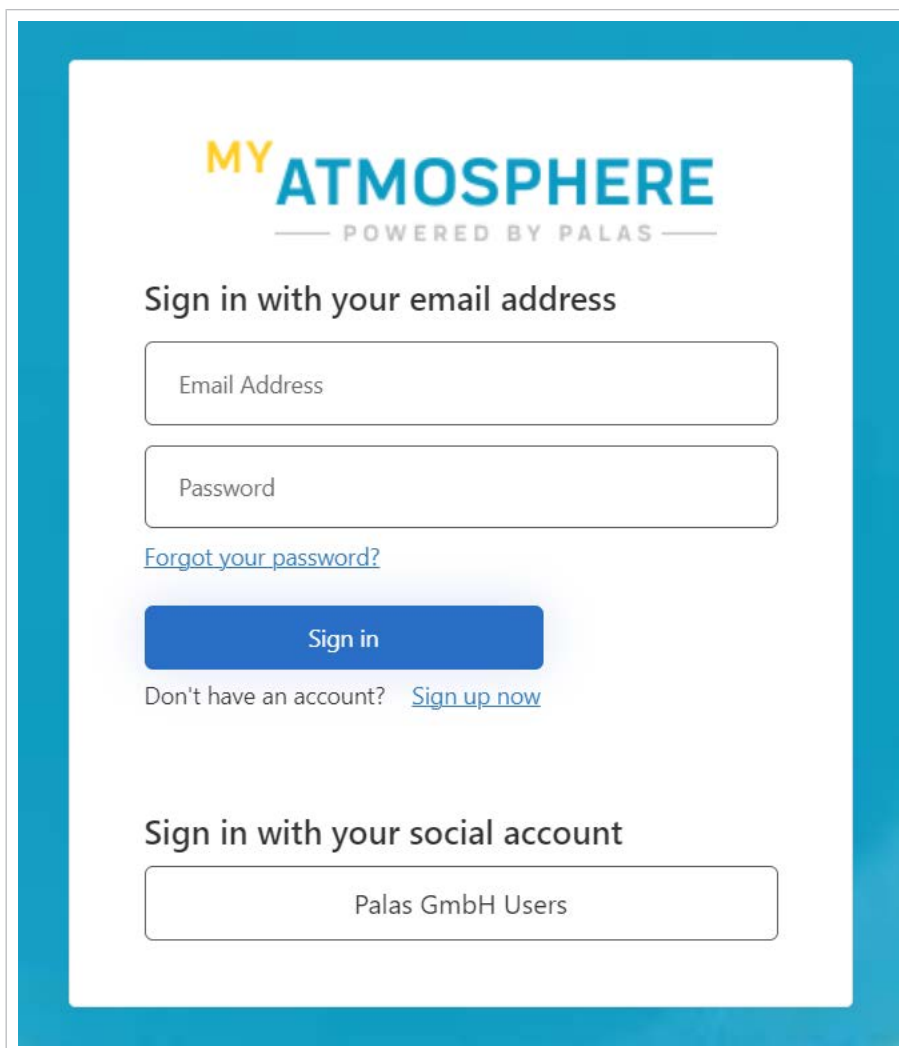
7. Note down the serial number and the activation code.
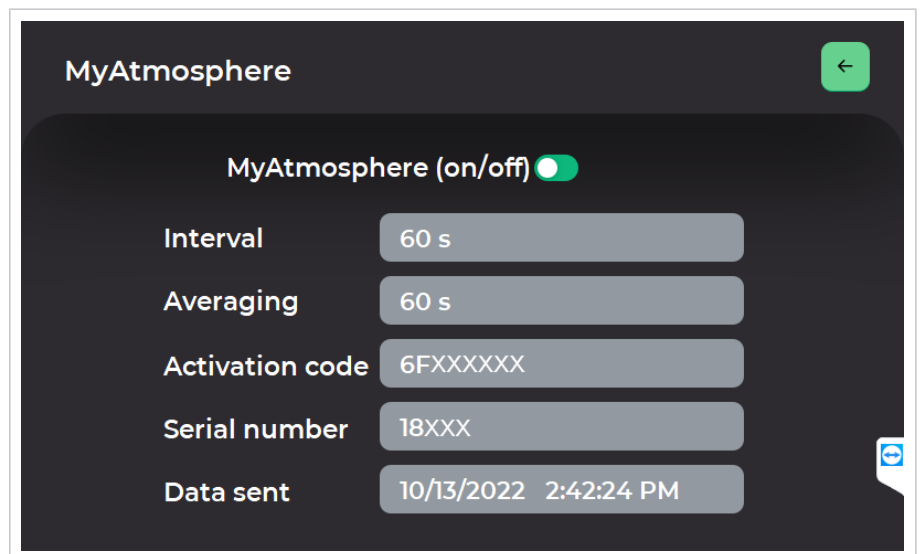
Menu `MyAtmosphere`

4.7.2 Sign in to MyAtmosphere

▸ Open the page https://my-atmosphere.cloud.

If you do not have a user account yet, proceed as follows:

▸ Click on the "Sign up now" link.

⇨ The registration window opens.

To register, proceed as follows:

1. Fill in your e-mail address.

2. Click on the `Send verification code` button.

   ⇨ A verification code is sent to the e-mail address entered.

3. Enter the verification code.

4. Click on the `Verify code` button.

5. Fill out all the fields provided.

6. Click on the `Create` button.
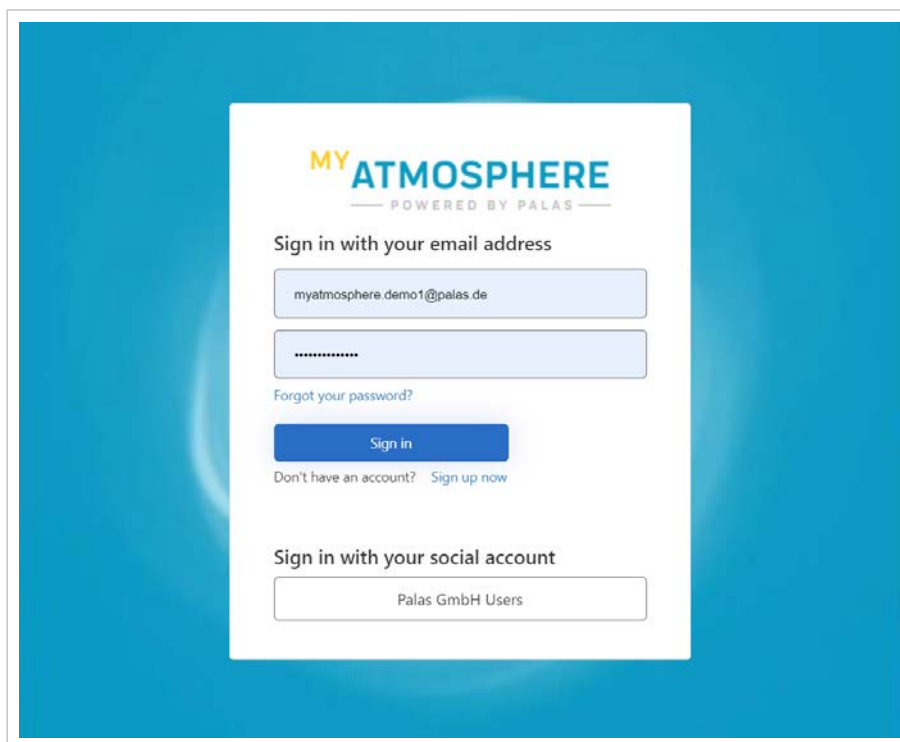
Registration

Note   If you are already assigned to an AQ network with a Viewer or Editor role, you have to register a new user account to create your own network. When you create an AQ network, you are assigned an administrator role. This assignment is only done for users who are not yet registered or users who already have an administrator role.

To sign in to MyAtmosphere, proceed as follows:

1. Enter your e-mail address.

2. Enter your password.

3. Click on the `Sign in` button.

   ⇨ You are now logged in to MyAtmosphere.

Login

4.7.3   Register the device
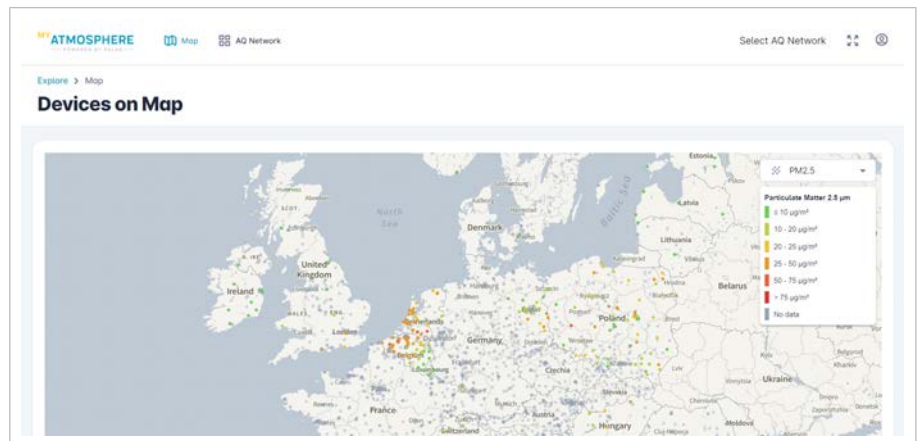
Homepage MyAtmosphere
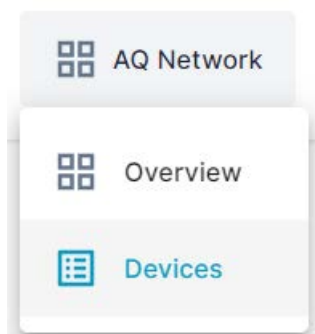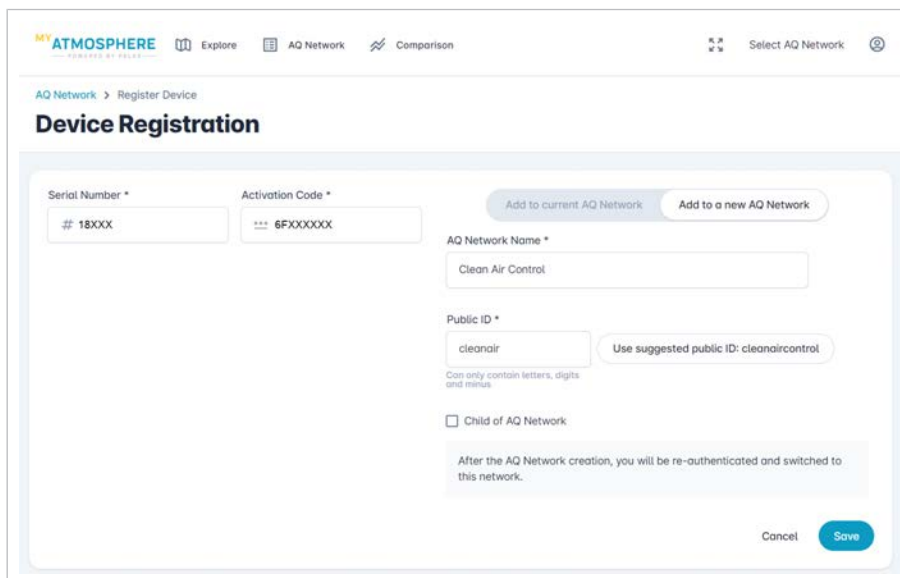
1. Select `AQ Network` in the upper menu.

2. Select `Devices` in the drop-down menu.

   ⇨ An overview of the devices in the AQ network appears.
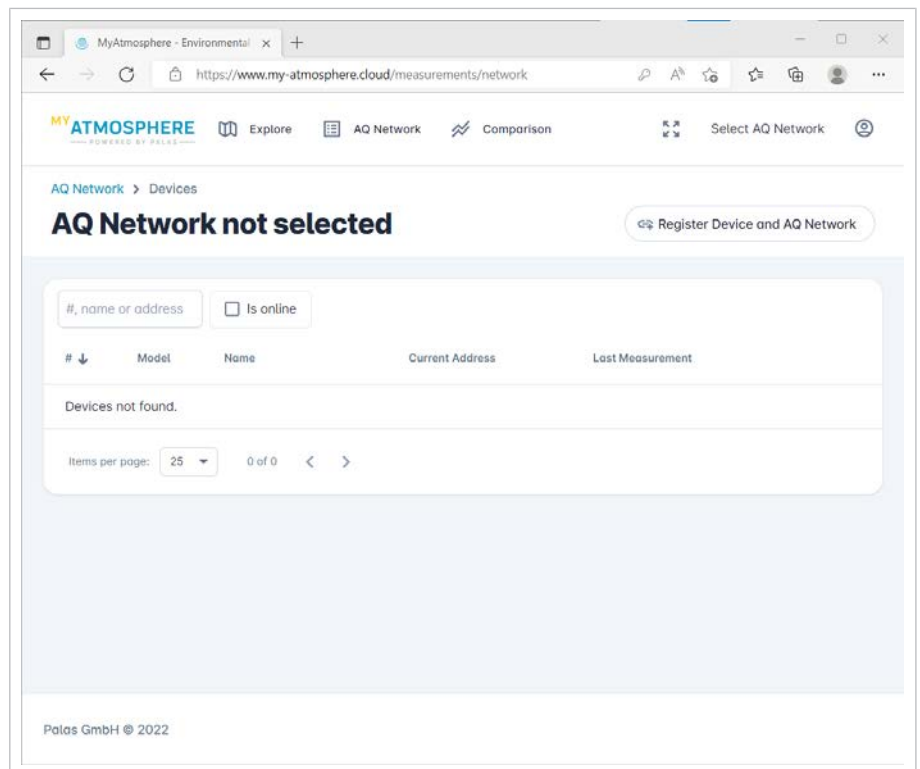
View AQ Network

3. Click on the `Register Device and AQ Network` button.

   ⇨ The `Device Registration` menu appears.

4. Insert the previously noted serial number and activation code.

5. Fill in the preferred network name and Public ID, which will be used to create a new AQ network.
The Public ID is an individual and unique name which appears both on the interface and in the URL.

6. Click on the `Save` button.

Device Registration

4.8   Setting up optional accessories

4.8.1   Setting up the signal light

The signal light is not included in the scope of delivery.

The signal light has an integrated WLAN module and is therefore connected to the hotspot of the device.

The device can be configured to make the signal light react to PM_1, $PM_{2.5}$, PM_4, PM_{10}, PM_{tot} or C_n.

The minimum requirement for using the signal light is firmware 1.013.

4.8.1.1   Configuring the signal light at initial startup

Before initial startup, the signal light provides a WiFi hotspot. The SSID is "shellyswitch25". This designation can also differ, in any case the term "shelly" is included. A password is not assigned.

For the configuration of the signal lamp, it is recommended to use a laptop.

1.   Connect laptop to the hotspot.

2.   Enter the IP address 192.168.33.1 in the URL bar of the browser.

3.   The interface of the signal light appears.
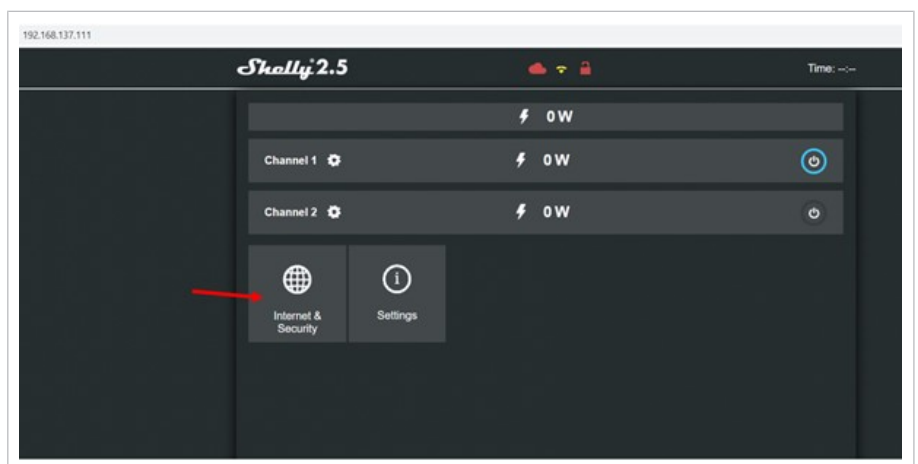
4.   Select "Internet & Security".
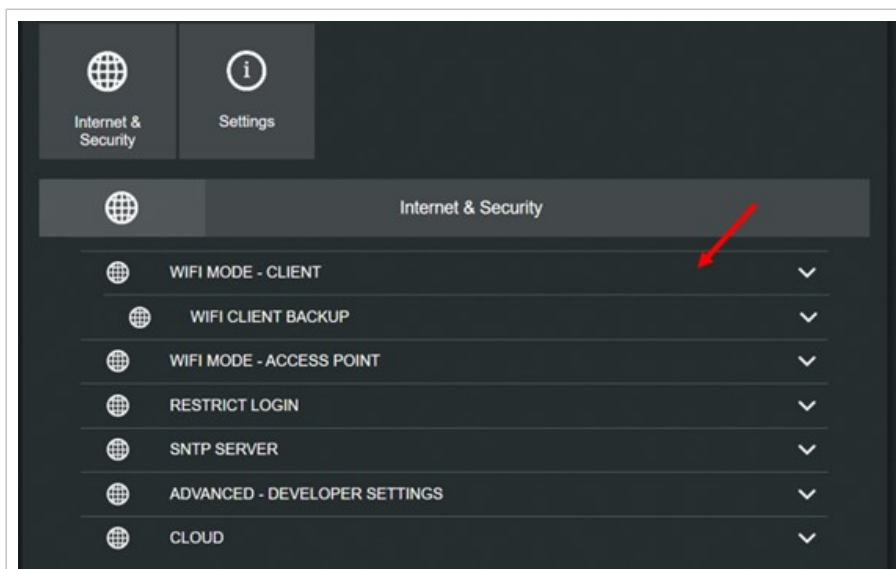
Note The signal light's WLAN module must be operating in client mode for it to connect to the device's hotspot.
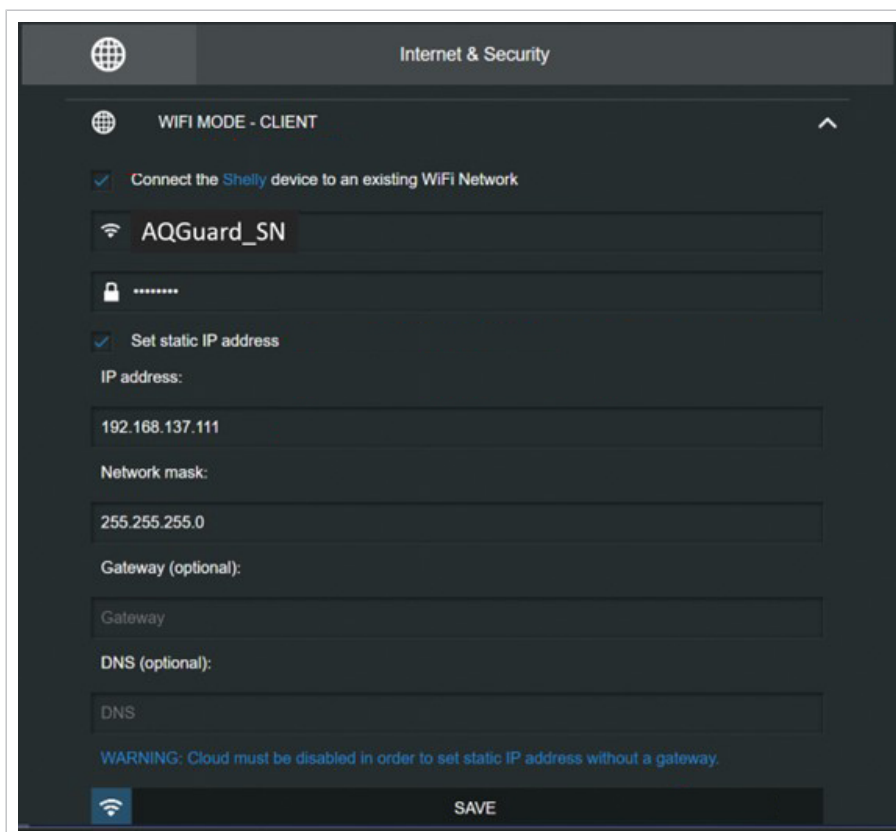
1. Set the checkmark at "Connect the Shelly device to an existing WiFi Network".

2. Enter the SSID of the hotspot at the WLAN icon.

3. Enter the password of the hotspot at the password icon.

4. Set the checkmark at "Set static IP address".

5. Enter the IP address under "IP address".

6. Click on "SAVE".

After saving, the connection to the device is established immediately. The hotspot of the signal light which was used up to this point is now no longer available.

To open the interface of the signal light again from this point on, proceed as follows:

1. Connect the terminal device used to the hotspot of the device.

2. Enter the IP address "192.168.137.111" in the address bar of the browser.

4.8.1.2 Adjusting the channel settings

Channel 1 and 2 must be adjusted in such a way that they deactivate themselves every 30 seconds. The corresponding menu can be accessed via the gearwheel icon next to the channel name.
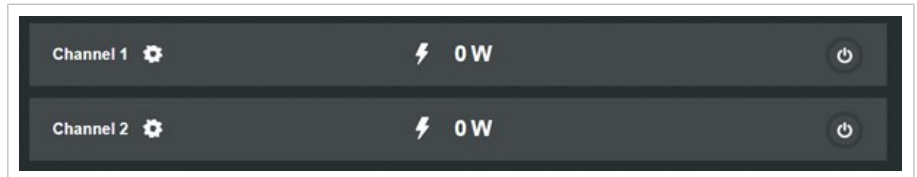
Afterwards, the required settings can be set in the "Timer" menu.
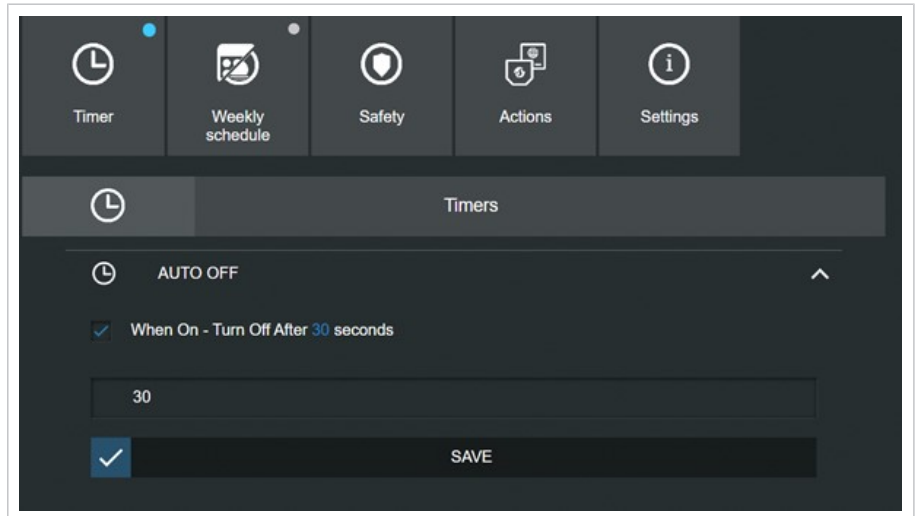
This setting means that the signal light no longer lights up as soon as the connection between the measuring device and the signal light is interrupted.

4.8.1.3 Resetting the WLAN module

The WLAN module has a reset button on the back. To reset the module, proceed as follows:

▶ Press and hold the reset button for 10 seconds.

4.8.1.4 Configuring the measuring device

To configure the measuring device, proceed as follows:

1. Open the DeviceController.val file in the directory P:\Desktop\Startup\ AQ-Guard\DeviceController.

2. Set four different parameters in the section "external hardware":

- #status_light = TRUE/FALSE
- #status_light_value = 0/1/2/3/4/5
    - 0: PM_1
    - 1: $PM_{2.5}$
    - 2: PM_4
    - 3: PM_{10}
    - 4: PM_{tot}
    - 5: C_n
- #status_light_limit-1 = X
- #status_light_limit-2 = Y

	Color of the signal light
V<X	green
V≥X und V< Y	orange
V≥Y	red

X: Threshold value limit 1

Y: Threshold value limit 2

V: Measured value

4.8.2 Installing the sun protection

The sun protection is not part of the scope of delivery.

If the sun protection is purchased as an optional accessory, the following parts are included in the delivery:

- 1x sun protection
- 1x back plate
- 4x screw
- 4x spring washer
- 8x ring washer
- 4x spacer sleeve

To install the sun protection, screw the sun protection as shown in the following figure.
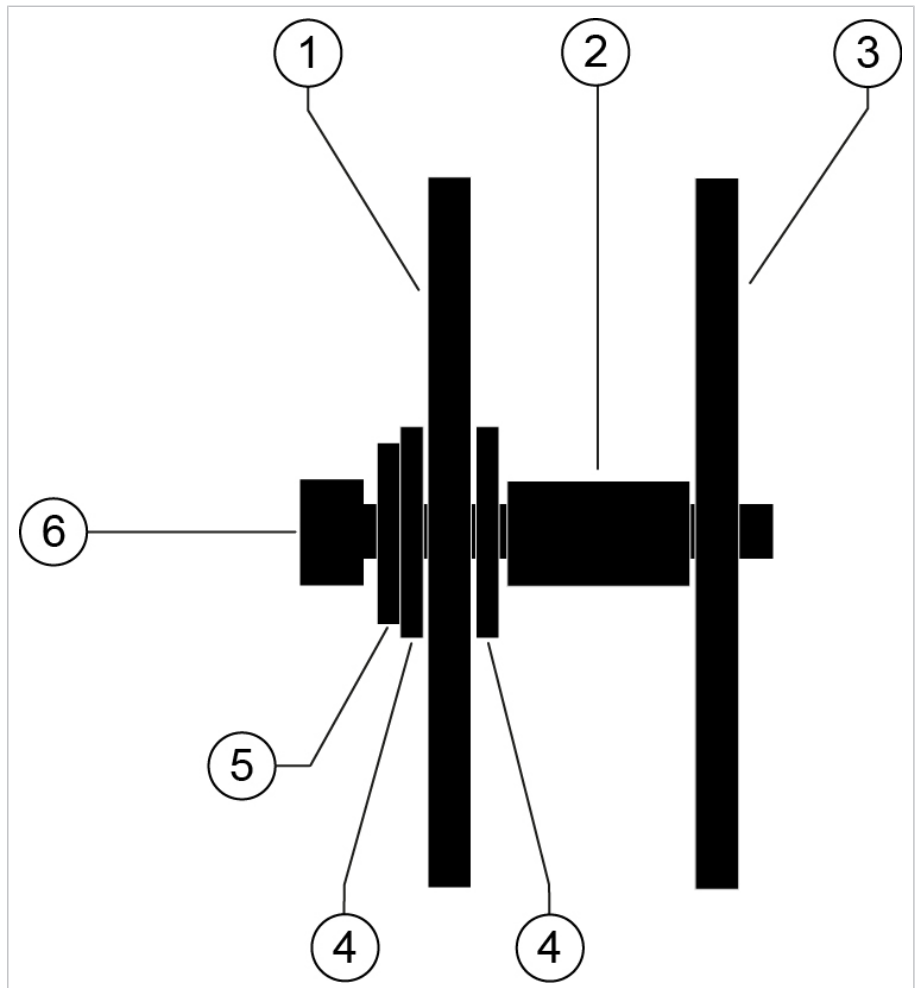
AQ Guard Smart - Installing sun protection

1	Sun protection	2	Spacer sleeve
3	Back plate	4	Ring washer
5	Spring washer	6	Screw

5 Operation and settings

5.1 Turning the device on

If the device is connected to the power supply, the firmware starts.

If the firmware was closed with `Shut Down`, the device has to first be disconnected from the power supply and then connected again before the firmware can start.

Once the firmware has started, the following things occur automatically:

- The measuring process starts. The data is automatically stored in the internal memory. It takes about two minutes before the first PM values are displayed.
- The firmware dashboard used last appears.

The warm-up time, from switching on the device until valid measured data is available, is about 10 to 15 minutes.

If there is a device including a gas sensor module, the following must be observed:

- The sensors need time to stabilize after the device is switched on. This can influence the data quality up to 2 days after switching on the device.
- Sensors are sensitive to rapid changes in temperature and humidity. Changes from one environment (e.g. air-conditioned office) to another environment (outside) should be done as smoothly as possible.

5.2 Firmware

The firmware has to be accessed to check device functioning, make settings or calibrate the device.

There are different ways to access the firmware:

- Access via Remote Desktop;
  refer to the section "Access to firmware via Remote Desktop [▶ 60]"
- Access via touch screen via USB
  A touch screen is available as an accessory,
  refer to the section "Optional accessories [▶ 18]".

5.2.1 Dashboards

Screens showing measured data are called dashboards.

There are several types of dashboards. Each dashboard is displayed differently.

When the device is switched on, the dashboard used last appears.

Select which dashboard to display in the main menu. Touch the menu symbol on a dashboard to access the main menu.

5.2.1.1 Dashboards with measured values as diagrams

Dashboards as diagrams show the course of fine dust concentrations. The time span can be selected as needed. If the time span `10 Minutes` is active, the current value (`LIVE`) is shown in addition to the average concentration (`avg.`).

The average concentration (`avg.`) is the mean over the time span shown.

The current value (`LIVE`) is updated every second.

Use the green arrows to move to a different fine dust fraction.

Dashboards with measured values as diagrams – in this case: PM2.5, 10 minutes

5.2.1.2   Dashboards with measured values as lists
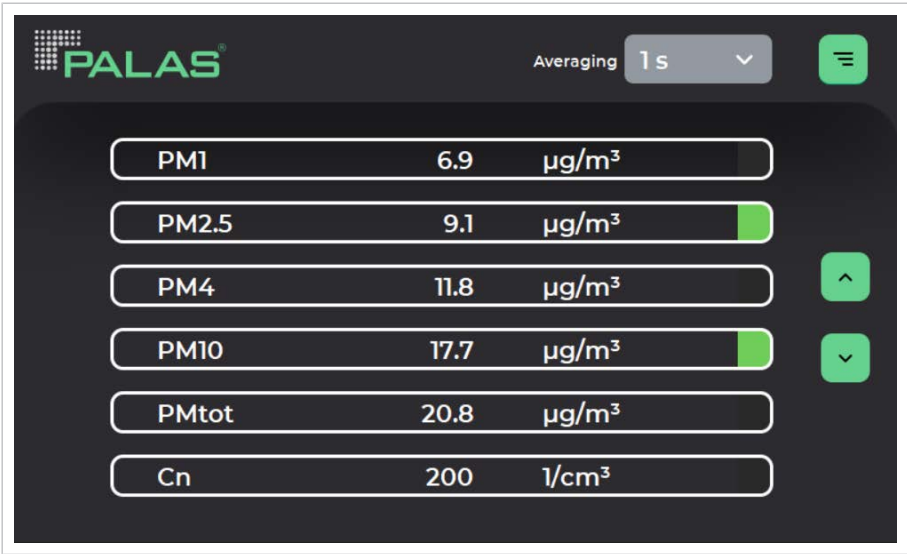
Dashboards with measured values as lists

5.2.2 Main menu

All menus where settings can be made as well as the dashboards can be accessed from the main menu.

Touch the menu symbol on a dashboard to access the main menu.
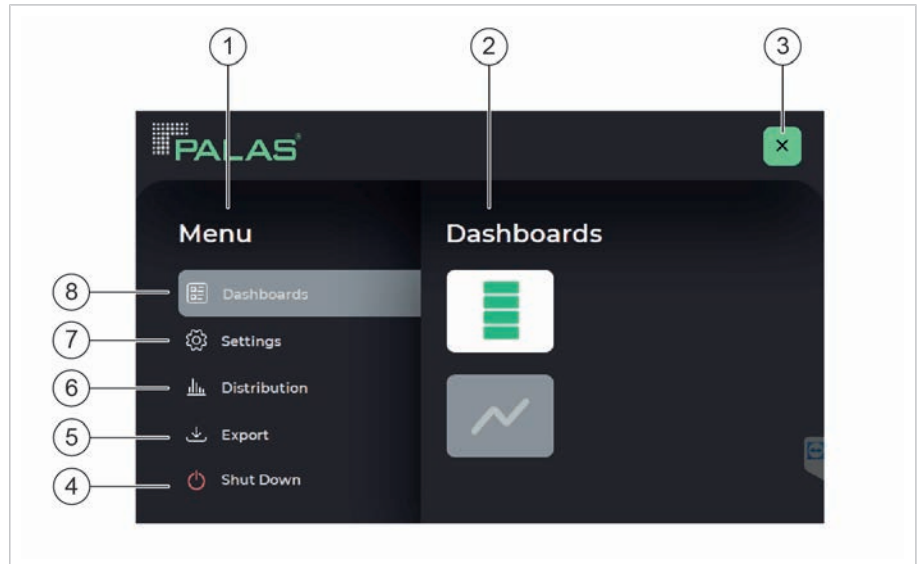
Main menu

1	Display and selection of menu items.	2	Editing area (in this case: dashboards)
3	Close symbol (x): Closes the main menu and shows the selected dashboard.	4	`Shut Down`: Shuts down the firmware and the operating system.
5	`Export`: Copies measured data to an inserted flash drive.	6	`Distribution`: Opens the menu `Distribution`.
7	`Settings`: Calibrate the device and access network settings in this menu. This area is password-protected.	8	`Dashboards`: Area where a dashboard is selected.

5.2.3   Menu PSD

The menu `PSD` shows the Particle Size Distribution. Either the number concentration or the mass concentration can be displayed. The display can be adapted to the specific needs with the following elements:

- LOG / LIN: Choose whether the vertical axis should be in logarithmic or linear elements

- Sum: Second curve with cumulated values

- dCn / dCm: Choose whether number concentration or mass concentration should be shown

Menu path   `Main menu > Distribution`
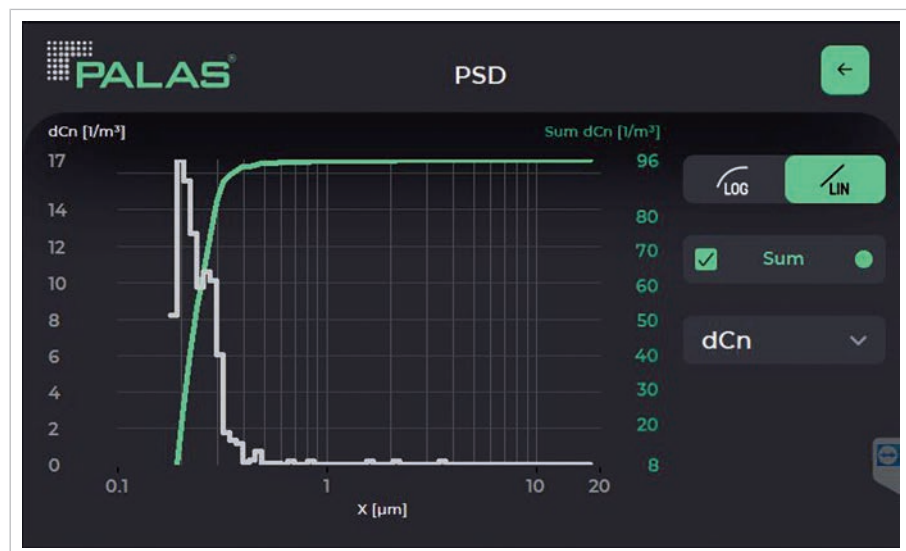
Menu `PSD` – shown here with number concentration dCn

5.2.4 Menu Device Info / Device Status

The menu `Device Status` in the section `Device Info`shows the following information:

- Serial number of device (in the header)
- Information on the device status

Menu path   `Main menu > Settings > Device Info > Device Status`

PIN for the menu `Settings`: 8320.
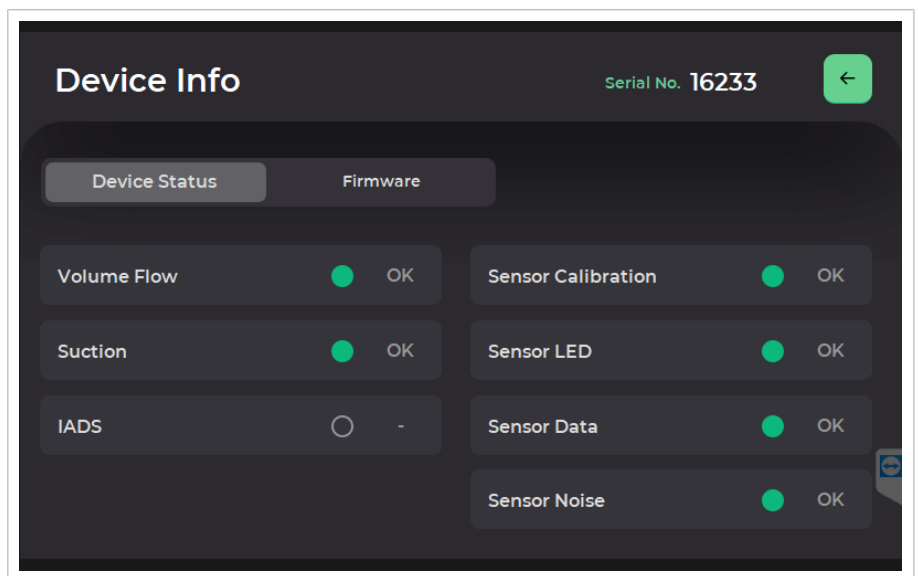
Menu `Device Info / Device Status`

Information on the device status

When the device is ready for operation, the status items show a green dot and the text `OK`.
If a problem occurs, a red dot appears along with the word `Alert`.

The operator can solve some of the problems by calibrating the device. Please contact Palas or your sales partner when you encounter problems that cannot be solved with calibration.

Meaning of status information:

Element	Status = `OK`	Status = `Alert`
`Volume Flow`	The volume flow rate is within the tolerance range.	The volume flow rate is outside of the tolerance range. Calibrate the volume flow rate.
`Suction`	The exhaust fan output is within the tolerance range.	The exhaust fan output is outside of the tolerance range. Calibrate the volume flow rate.
`IADS`	---	No drying system installed.

Element	Status = `OK`	Status = `Alert`
`Sensor Calibration`	The sensor calibration data is within the tolerance range.	The sensor calibration data is outside of the tolerance range. Calibrate the particle size with *MonoDust 1500*.
`Sensor LED`	The LED unit signals are within the tolerance range.	The LED unit signals are outside of the tolerance range.
`Sensor Data`	The sensor supplies plausible measured values.	The measured values are not plausible.
`Sensor Noise`	Little or no electronic interference.	The electronic interference is outside of the tolerance range.

5.2.5   Menu Device Info / Firmware

The menu `Firmware` in the section `Device Info` shows the following information:

- Serial number of device (in the header)
- Firmware version ("Device")
- Current version of installed hardware components MIO and SLA
- Algorithm used

Menu path   `Main menu > Settings > Device Info > Firmware`

PIN for the menu `Settings`: 8320.
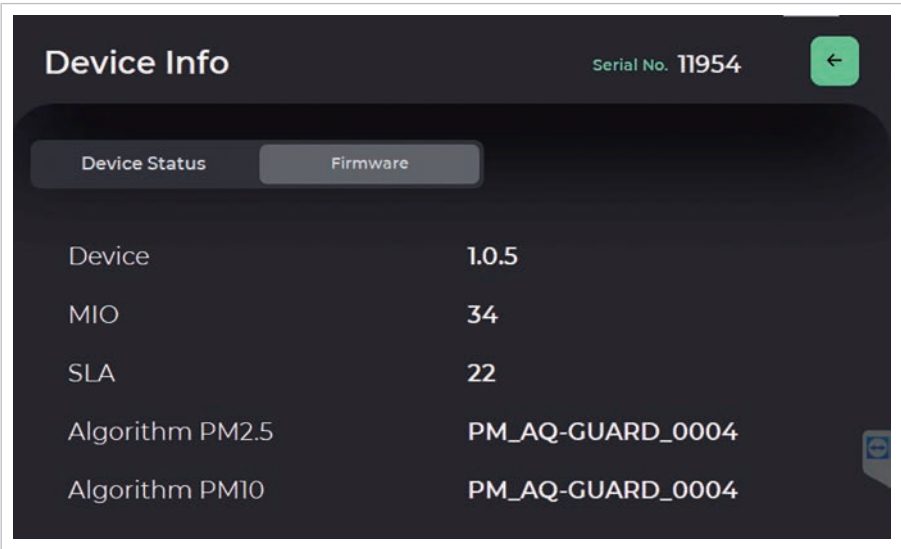
Menu `Device Info / Firmware`

5.2.6 Menu Communication

The settings for transfer protocols can be accessed via the menu `Communication`. Transfer protocols enable measured data to be sent to an IP address connected to the device.

Menu path

`Main menu > Settings > Communication`

PIN for the menu `Settings`: 8320.

My IP addresses:

IP addresses are shown in the bottom left corner of the screen. If the device is connected to a network, the individual IP address assigned to the device is also shown. Make a note of this address to be able to establish the respective connections, if necessary.

5.2.7 Copying measured data and reports to flash drive

The device saves measured data in a "promo" text file every day. 1 file is created per day.
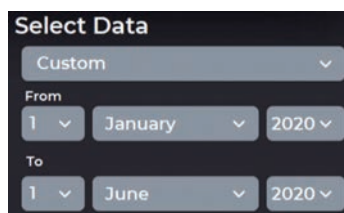
The created files can be copied onto an external storage device, e.g. onto a flash drive.
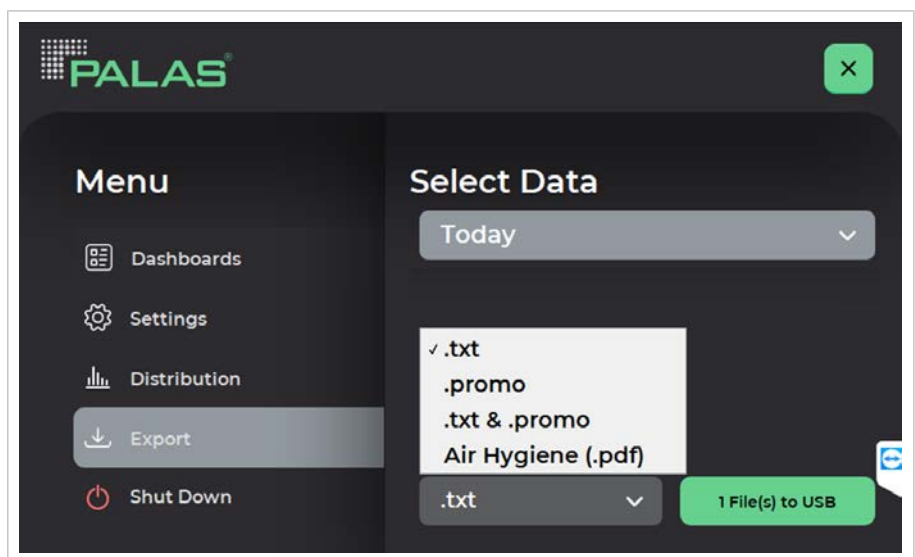
Menu `Export` with drop-down lists to select the time period and the file format.
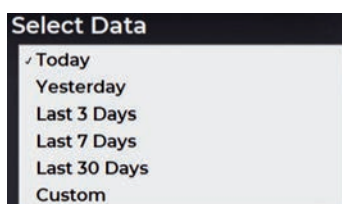
1. Insert a flash drive into the USB port.

2. Open the main menu.

3. Select `Export`.

   ⇨ The window `Select Data` opens.

4. Apply the default (Today) in the upper window or open the drop-down list using the arrow.

Select Data

Custom

From

1 | January | 2020

To

1 | June | 2020

5. Apply the pre-defined time period or select `Custom` to define your own time period.

6. Apply the default in the lower window or select a different file format.

7. Touch `X Files(s) to USB`.

⇨ The files are then copied onto the flash drive.

8. Pull out the flash drive.

5.2.8   WiFi and hotspot

The device can be linked to a network via WiFi or it can act as a hotspot. These functions enable the Web interface showing measured data to be accessed or the device to be operated via Remote Desktop. Also refer to section "Access to measured data via Web interface [▷ 62]" and "Access to firmware via Remote Desktop [▷ 60]".

Linking device to a network via WiFi

1. Select `Settings` in the main menu.

   ⇨ A keypad for entering the PIN opens.

2. Enter the PIN 8320.

   ⇨ The menu `Settings` appears.
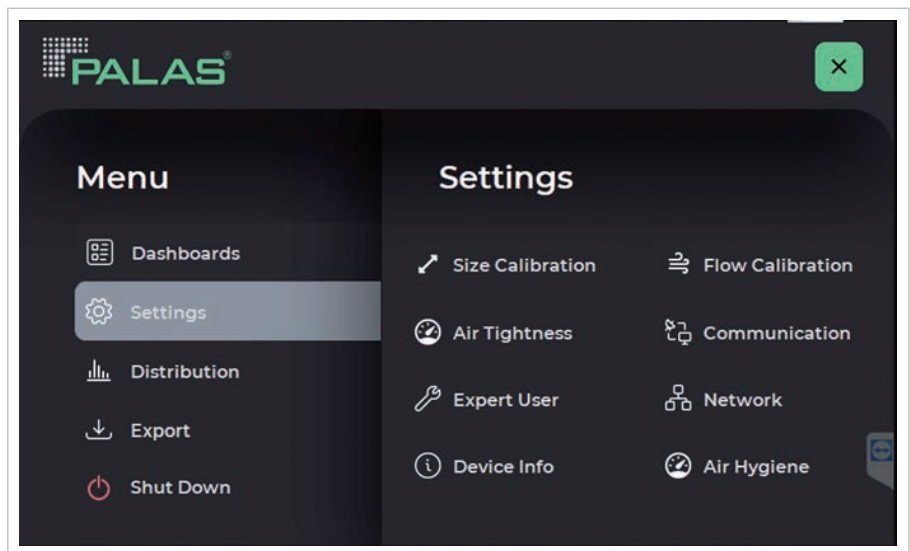
Menu `Settings`

1. Select `Network`.

2. Select `WIFI`.

3. Move the slider to the right to activate the WiFi feature.

   ⇨ The available networks appear.

4. Select a network. When setting up for the first time, enter the network PIN.

   ⇨ The network to which the device has connected is indicated by a checkmark.
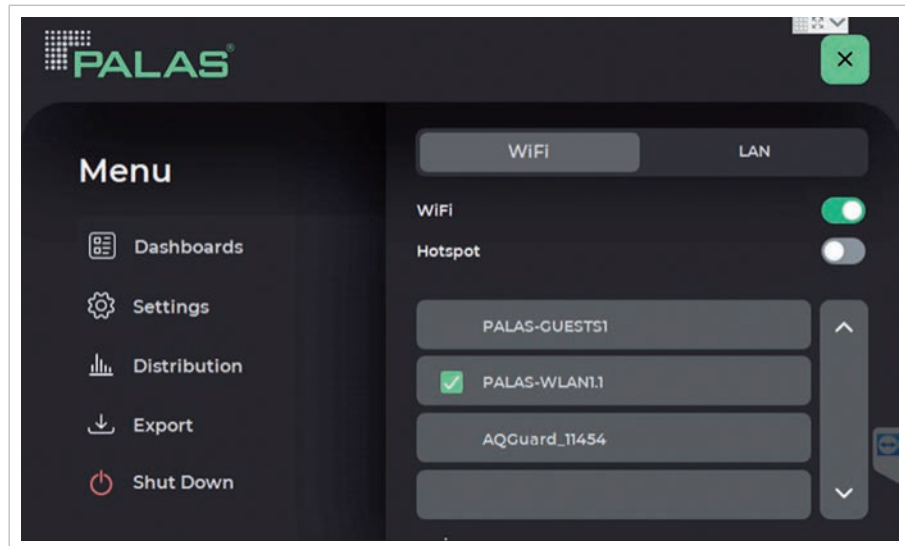
Menu `Settings > Network > WIFI`

Activating hotspot feature

The hotspot feature can be activated even when WiFi is activated. Do this by moving the respective slider to the right.

The default setting of the hotspot feature is activated.
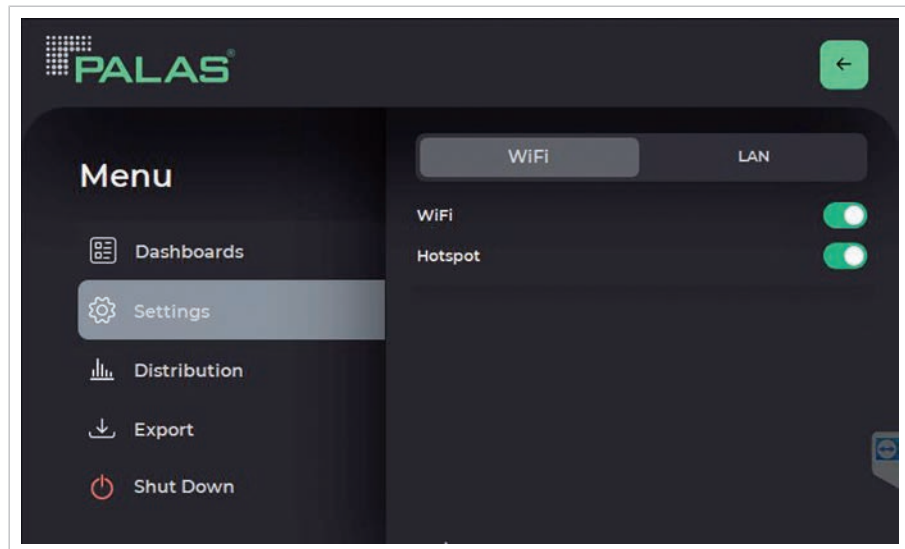
Menu `Settings > Network > WIFI` *with activated hotspot feature*

5.2.9 LAN connection

The device can be linked to a network via a LAN connection.

Linking device to a network via LAN

1. Select `Settings` in the main menu.

    ⇨ A keypad for entering the PIN opens.

2. Enter the PIN 8320.

    ⇨ The menu `Settings` appears.
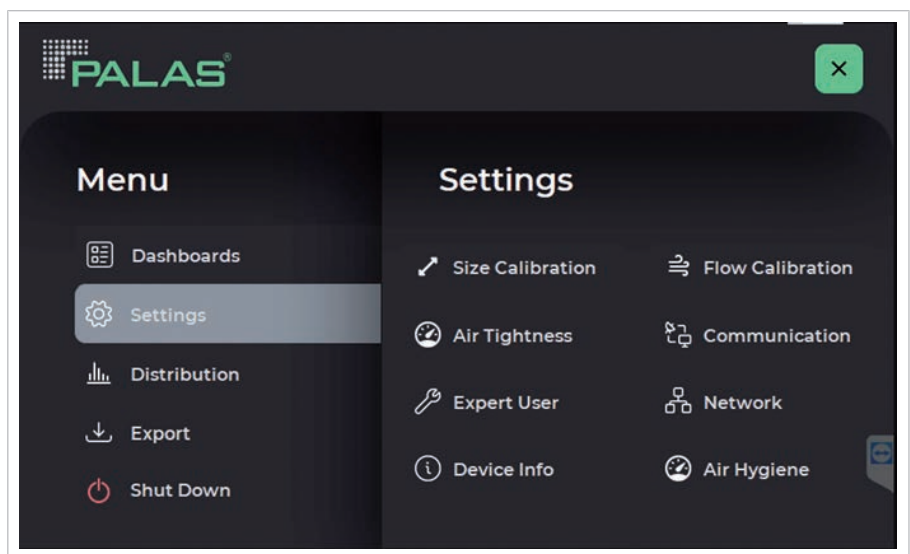
Menu `Settings`

1. Select `Network`.

2. Select `LAN`.

3. Move the slider to the right to create an automatic LAN connection (DHCP).
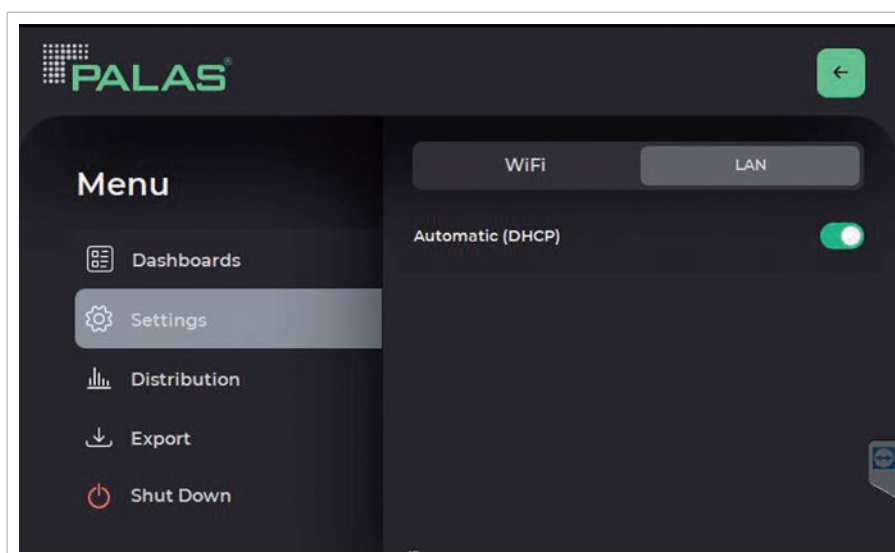
Menu `Settings > Network > LAN` *with automatic LAN connection (DHCP)*

1. Move the slider to the left to manually create a LAN connection with a fixed IP address.

   ⇨ Input fields with parameters for the manual LAN connection appear.

2. Fill out all the fields and then confirm with `Save`.
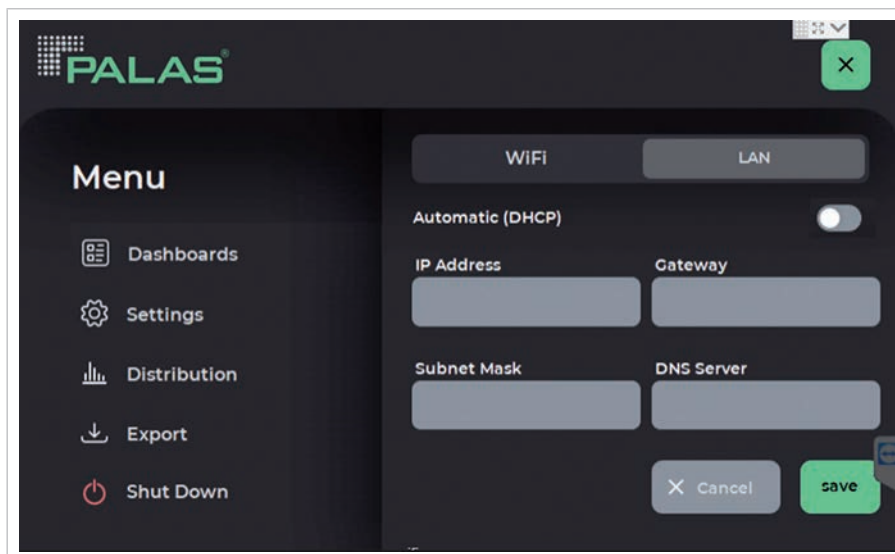
Menu `Settings > Network > LAN` *with fields for a manual LAN connection*

5.2.10 Menu Expert User
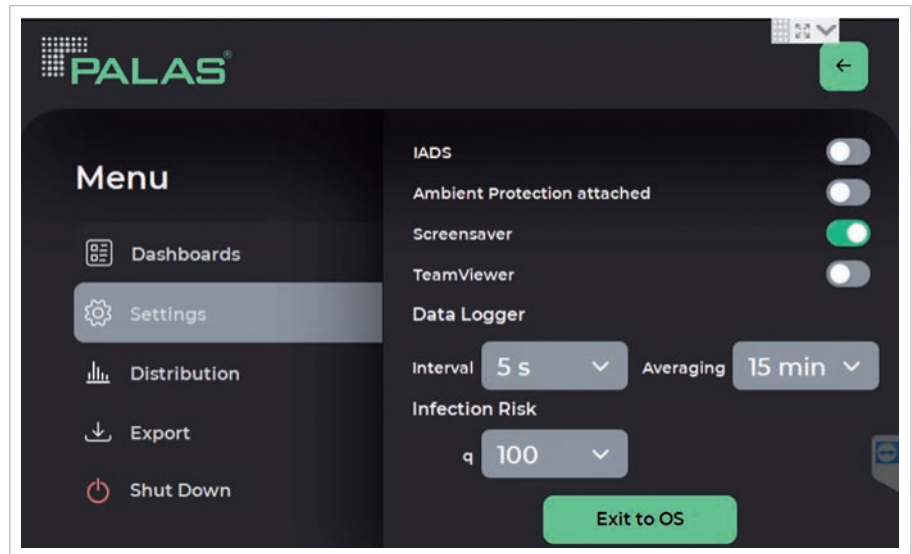
Menu `Settings > Expert User`

The menu `Expert User` contains the following features:

Feature	Description
IADS	Function not available.
Ambient Protection attached	Function not available.
Screensaver	Activates or deactivates the screen saver. The screen saver switches on if the screen is not touched for 30 minutes.
Teamviewer	Activates or deactivates the application "Teamviewer". Prerequisite: The device is linked to the Internet via a network connection. The connection is intended to be used for service purposes only. The default setting of the Teamviewer feature is off. It takes about 20 seconds before the Teamviewer appears.
Datalogger	Allows the way in which data is stored to be determined. The frequency of saving and the time period for averaging can be set.
Infection Risk	Function not available.
Exit to OS	Closes the firmware without shutting down the operating system.

5.3   Access to firmware via Remote Desktop

The device can be operated via a Remote Desktop connection when needed. The firmware user interface can be accessed via the Remote Desktop app on a PC or mobile device (smartphone or tablet).

iOS and Android offer suitable apps (e.g. RdClient) for mobile devices.

When you attempt to connect to a network with your PC, your company's safety guidelines may not allow a connection to be established. Please discuss this with your IT administrator.

A connection can be established via WiFi or the device's hotspot. A LAN cable can also be used to connect to a PC.

Type of connection	Prerequisites	IP address
Hotspot	WiFi: ON (default)	192.168.137.1
	Hotspot: ON (default)	
WiFi:	WiFi: ON	Unique IP address (IPv4)
	Hotspot: OFF	
	The device is connected to a network via WiFi	
LAN	LAN: ON	Unique IP address (IPv4)
	The device is connected to a network via LAN	

Connecting when hotspot is on

1.   Open the Remote Desktop app on the PC or mobile device.

2.   Enter the IP address: 192.168.137.1.

3.   Enter the user name "Palas".

⇨ The user name changes to "PALAS/Palas".

4.   Leave the "Password" field blank and confirm (There is no password).

⇨ The connection is established.

Connecting via WiFi or LAN

You will need the unique IP address (IPv4) of the device to connect in this way. This address is displayed in the menu `Communication`. Note the IPv4 address promptly.

1. Open the Remote Desktop app on the PC or mobile device.

2. Enter the IPv4 address of the device.

3. Enter the user name "Palas".

4. Leave the "Password" field blank and confirm (There is no password).

⇨ The connection is established.

5.4 Access to measured data

There are several ways to access measured data:

Type of data	Type of access
Visual depiction	Via the firmware user interface – on an external touch screen (via USB). A touch screen is available as an accessory.
Visual depiction	Via the user interface of the firmware – by Remote Desktop.
Visual depiction	Via the Web interface.
As a file	Via a transfer protocol.
As a file	By copying text files onto a storage device via USB.

5.4.1 Access to measured data via Web interface

In addition to the actual user interface, there is a Web interface that can be used to display data. The Web interface can be viewed with a standard browser on a mobile device or PC.

A connection can be established via WiFi or the device's hotspot. A LAN cable can also be used to connect to a PC.

Type of connection	Prerequisites	IP address
Hotspot	WiFi: ON (default)	192.168.137.1
	Hotspot: ON (default)	
WiFi:	WiFi: ON	Unique IP address (IPv4)
	Hotspot: OFF	
	The device is connected to a network via WiFi	
LAN	LAN: ON	Unique IP address (IPv4)
	The device is connected to a network via LAN	

Connecting via hotspot

1. Search for networks on a mobile device or PC.

   ⇨ `AQGuard_#####` appears.
   (##### = serial number)

2. Enter the password `aq-guard` and touch "Connect".

3. Open the browser.

4. Enter the IP address URL in the address bar of the browser: http://192.168.137.1

⇨ The starting screen of the Web interface appears.

Connecting via WiFi or LAN

You will need the unique IP address (IPv4) of the device to connect in this way. This address is displayed in the menu `Communication`. Note the IPv4 address promptly.

1. Open the browser on the PC or mobile device.

2. Enter the IPv4 address of the device in the address bar of the browser.

⇨ The starting screen of the Web interface appears.

5.5 Turning the device off

Always shut down the firmware before stopping the power supply. If the firmware is not shut down properly, data can be lost.

Switch off the device like this:

1. Open the main menu.

2. Select `Shut Down`.

   ⇨ The firmware is shut down. The screen turns black.

⇨ The device switches off.

6   Maintenance

Regular maintenance of the device extends the service life and improves operational reliability.

The maintenance tasks described here can be performed by the customer or by the operator of the device. More extensive work, which is not described in this manual, may be performed only by Palas specialists or by persons or organizations authorized by Palas. Unauthorized changes or modifications will lead to loss of warranty. Palas will not be liable for damage caused by unauthorized changes or modifications.

Please contact Palas or a service partner for maintenance and repairs not described in this manual.

Palas GmbH

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D-76229 Karlsruhe

Germany

www.palas.de

6.1   Maintenance intervals

Maintenance to be performed by operator

Qualified personnel can perform the following maintenance tasks:

Maintenance task	Interval	Additional information
Calibrate particle size with calibration dust	Every 12 months / in the event of an error in the status indication Sensor Calibration	Calibrating particle size [▶ 66]
Calibrate volume flow rate	Every 12 months / in the event of an error in the status indication Volume Flow or Suction	Calibrating volume flow rate [▶ 69]
Clean aerosol sensor optical glasses	As needed: When device calibration fails.	Cleaning aerosol sensor optical glasses [▶ 73]

6.2 Opening and closing housing

Removable cover

The cover has to be removed from the housing to perform maintenance. The cover is attached to the housing with 4 black plastic screws. Once the 4 screws have been released and extracted, the cover can be detached.
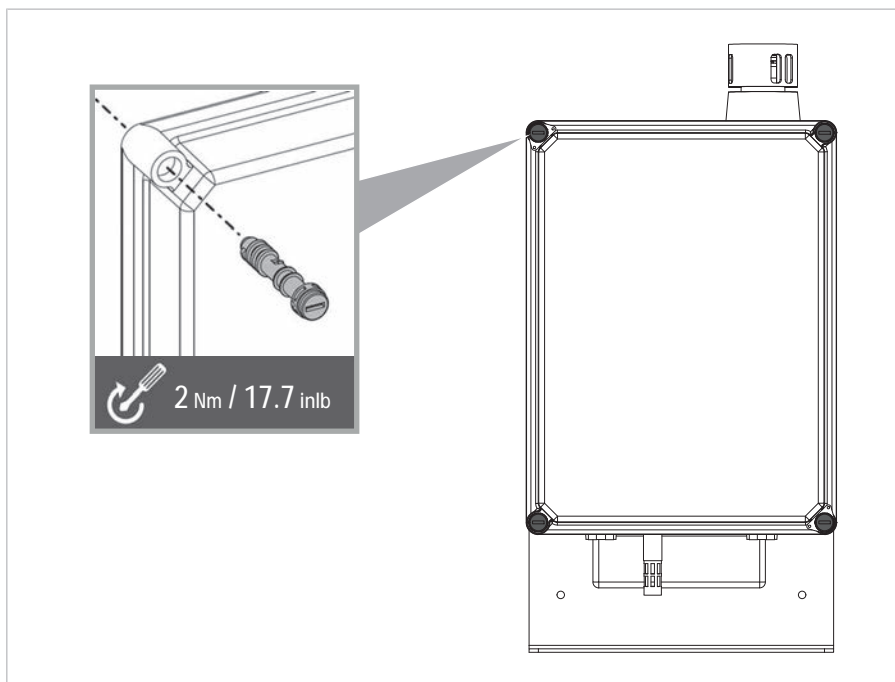
Plastic screws for opening and closing housing

Properly closing housing

Check the seal around the cover before putting the cover back into place. The device is only protected from moisture when the seal is intact.

Torque for plastic screws: **2 Nm**.

	NOTICE
!	**Components can be damaged by applying incorrect torque to plastic screws** The screws can break if they are too tight. If they are not tightened enough, the housing will not be properly sealed. Water can penetrate and damage or destroy parts. ▸ Tighten the 4 screws evenly applying the specified torque: 2 Nm.

6.3 Calibrating particle size

The device was calibrated before it left the factory. Continuous automatic calibration of the measuring system ensures that the data is measured consistently for several months.

The device has to be recalibrated when in the menu `Device Status` an error is indicated by `Sensor Calibration`.

Requirement for calibration

To be able to calibrate the device correctly, it has to have been operating for at least 1 hour. The device does not reach a thermally stable state until then.

Calibration dust *MonoDust 1500*
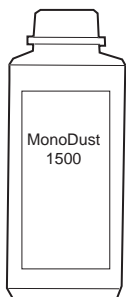
A special dust with a very small monodisperse distribution and known particle size is used to calibrate the device. Delivery of the device includes one container of the calibration dust *MonoDust 1500*. Use only *MonoDust 1500* to calibrate the device.

When used properly, a single container is sufficient to calibrate the device multiple times. Only a small amount of the dust is needed for the calibration process. *MonoDust 1500* can be ordered from Palas or a sales partner.

The label on the container as well as the certificate for the calibration dust indicate reference values (`setpoint raw channel`) needed to calibrate the particle size.

This is how to use the calibration dust properly:

1. Shake the closed container gently or knock it gently with your open hand.

   ⇨ Some of the particles swirl in the air inside the container and remain in the air for a few minutes.

2. Unscrew the lid and place the opening of the container near the device´s aerosol inlet tube.

Activating calibration mode

1. Select `Settings` in the main menu.

   ⇨ A keypad for entering the PIN opens.

2. Enter the PIN 8320.

   ⇨ The menu `Settings` appears.
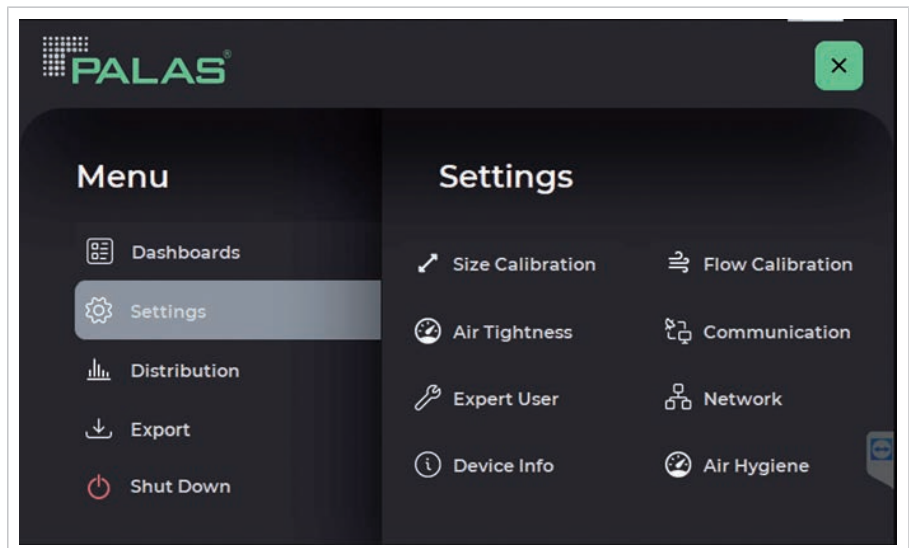
Menu `Settings`

▸ Select `Size Calibration`.

⇨ The menu `Size Calibration` showing the particle count and the raw data channels appears.
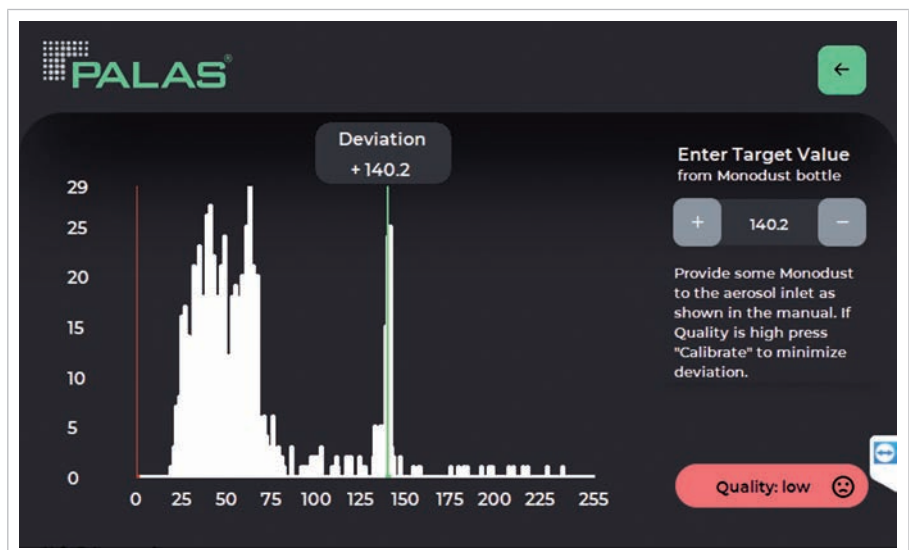
Menu `Settings > Size Calibration` – Waiting for good signal quality

Performing calibration

1. Guide the hose from the device's aerosol inlet tube into the container.

2. Use the + and – keys to enter the value `Setpoint raw channel` of the calibration dust as the "Target Value".

3. Gently squeeze the container several times to exchange some air between the container and the environment.

    ⇨ The display changes after a few seconds: `Quality: high` is indicated and the button `Calibrate` appears.

4. Touch `Calibrate`.

    ⇨ The value `Deviation` indicates the deviation from the "Target Value".

The device is properly calibrated when the `Deviation` is not greater than **0.5**.

Repeat the calibration process to check calibration.
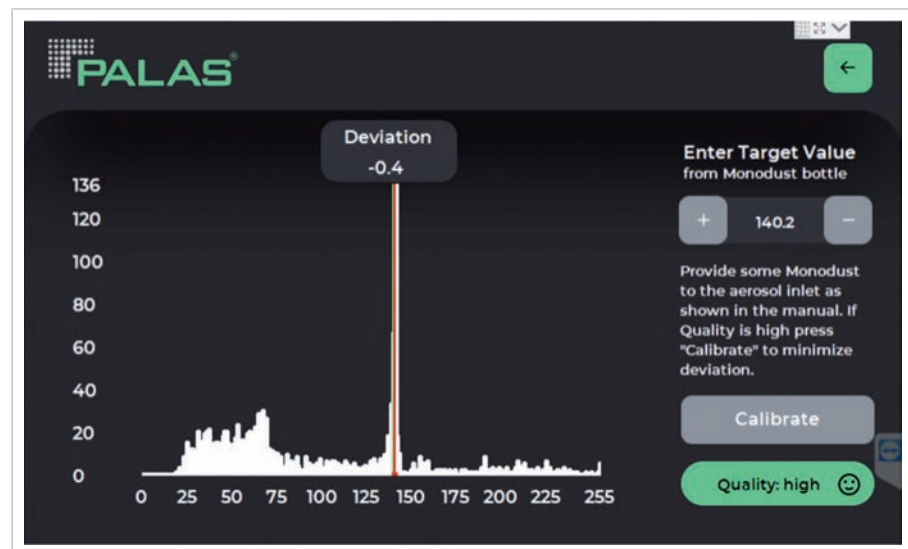
Menu `Settings > Size Calibration` – Device calibrated successfully

6.4   Calibrating volume flow rate

Aids and peripheral conditions

To calibrate the volume flow rate, the aerosol inlet has to be connected to an external volume flow meter. Recommended meter: Gilibrator-2, Sensidyne.

The volume flow rate of the device is regulated to 1.0 l/min. A correction value can be adjusted with the keys + and - for calibration purposes. Change the correction value such that the volume flow rate `Flow` shown on the device is the same as the value measured by the external volume flow meter.

Important   For correct calibration, the volume flow rate has to be as steady as possible before and during measurement. Always avoid an erratic volume flow rate course.

Requirement for calibration

To be able to calibrate the device correctly, it has to have been operating for at least 1 hour. The device does not reach a thermally stable state until then.

Connecting aerosol inlet tube to measuring device

An adapter must be used to connect the device. For this purpose, the sampling head must be unscrewed and the adapter must be attached.

1. Detach the sampling head from the device.

2. Attach the adapter for calibration.

3. Use a tube to connect the adapter to the external volume flow rate measuring device.

Activating calibration mode

1. Select `Settings` in the main menu.

   ⇨ A keypad for entering the PIN opens.

2. Enter the PIN 8320.

   ⇨ The menu `Settings` appears.
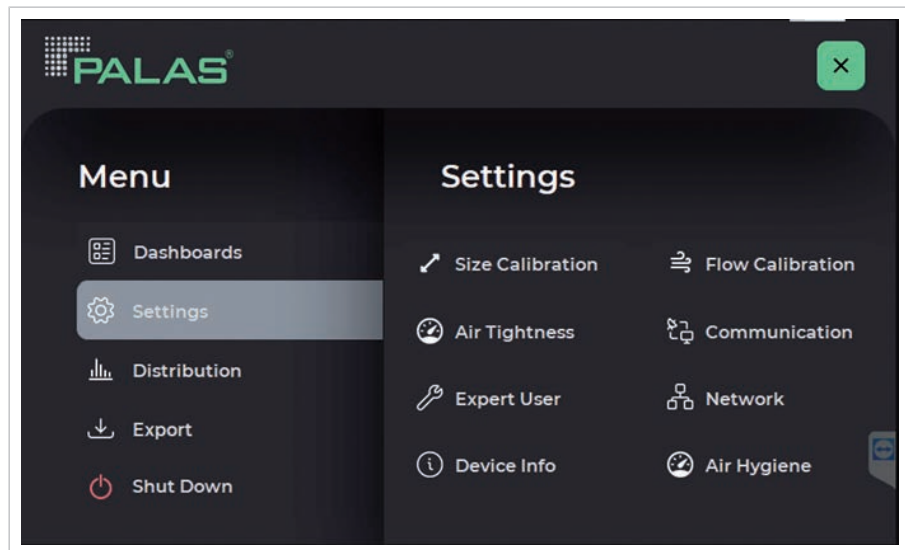
Menu `Settings`

▸ Select `Flow Calibration`.

⇨ The menu `Flow Calibration` opens.
The white line shows the course of the volume flow rate over the last 15 minutes.
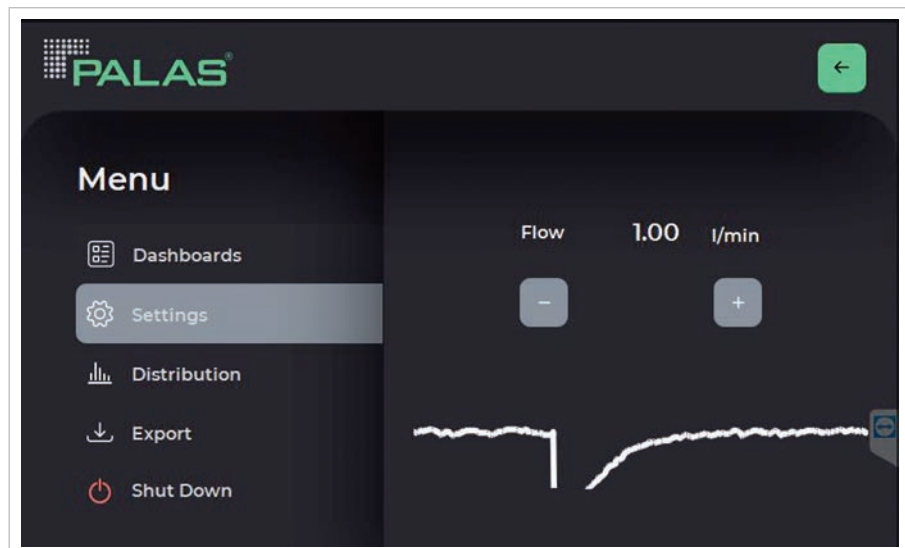
Menu `Settings > Flow Calibration`

Performing calibration

1. Wait until the volume flow rate stabilizes at 1.00 l/min.

2. Compare the volume flow rate `Flow` shown on the device to the value determined with the external volume flow meter.

3. Adjust the volume flow rate with the + and - keys such that flow rate `Flow` shown on the device is the same as the value measured by the external volume flow meter.

   ⇨ The device changes the volume flow rate and regulates itself to 1.00 l/min again.

4. Repeat the procedure until the volume flow rate `Flow` is the same as the value measured by the external volume flow meter.

6.5 Individual calibration of the gas sensor system

It is possible to adjust the calibration of the gas sensors individually. For this, entries in the "DeviceController.val" file must be changed. This file can be found under the path `P:\Desktop\startup\AQ_Guard\DeviceController`.

The file is divided into several sections. In the section "Calib-Settings" you can find "slope" and "offset" for each gas. A dot must be used as decimal separator.

```
[Calib-Settings]
#$T_ap = -2.8
#$rh_ap = 2.7
#$slope_CO2 = 1
#$offset_CO2 = 0
#$slope_VOC = 1
#$offset_VOC = 0
#$slope_NO2 = 1
#$offset_NO2 = 0
#$slope_SO2 = 1
#$offset_SO2 = 0
#$slope_O3 = 1
#$offset_O3 = 0
#$slope_CO = 1
#$offset_CO = 0
```

Calib-Settings

After changing the entries, the firmware must be restarted.

Calibration via co-location with a reference device

The instrument must be mounted in the immediate vicinity of the reference instrument for a period of at least several days (depending on the measured value variation, in addition to the stabilization period).

The measurement conditions must be representative. This means that there must be no barriers between the measuring devices and the devices should be positioned at a similar distance from possible sources.

The averaging of the measured values has to last at least 30 minutes. A linear regression line between *AQ Guard Smart* and reference values can be used to determine "offset" and "scale".

Calibration with pre-mixed gases in the laboratory

It is possible to calibrate the sensors with a suitable measurement setup in the laboratory. The calibration must be performed under laboratory conditions (20°C-25°C).

The gas must be supplied passively to the sensors, there must be no direct inflow. In addition, the humidity of the sample gas must not be lower than 30%.

Comparison of several devices with each other under operating conditions

If several devices should be used in a measuring campaign, it is useful to adjust "offset" and "scale" of the devices in the field prior to the campaign.

For this purpose, one of the devices can be defined as a "golden sample". The other devices are then calibrated against this device. The calibration against the "golden sample" works in the same way as the calibration against a reference.

6.5.1 Replacement of the gas sensor module

Sensors have a lifetime of two years depending on the conditions of usage. The sensor module of the *AQ Guard Smart* can only be replaced as a complete unit. The old sensor module must be returned to Palas. If a new sensor module is used, an update of the configuration settings is necessary. In this case, please contact Palas.

6.6 Cleaning aerosol sensor optical glasses

Clean the aerosol sensor, if the device cannot be calibrated.

Tool and cleaning utensils

Use the included tool and cleaning utensils to perform maintenance.

Cleaning kit 6966

Disconnecting power supply

1. Close the firmware by selecting `Shut Down`.

2. Unplug the power supply.

Gaining access to optical glasses

The aerosol inlet tube has to be removed to be able to clean the optical glasses. The aerosol inlet tube is under a protective tube.

Proceed as follows to access the optical glasses:

1. Release the 4 plastic screws from the housing.

2. Remove the housing cover.

3. Unscrew the nut fron the inside of the housing.

4. Detach the cable from the heater.

5. Pull the protective tube up and out of the housing.

   ⇨ The aerosol inlet tube is now accessible.

6. Release the screw on the aerosol inlet tube.

7. Pull the aerosol inlet tube up and out.

Cleaning

	NOTICE
⚠	**Damage to device caused by improper cleaning**
	Unsuitable cleaning agents or unsuitable tools can damage the optical glasses and make them unusable.
	▸ Use only special cloths for optics or the included cleaning tools to clean optical glasses.
	▸ Do not touch optical glass with fingers.
	▸ Do not use cleaning agents to clean.

Use the included cleaning swabs.

Assembling the removed components

Reassemble the components in the opposite order in which they were detached.

6.7 Checking for Leakage

The device should be checked for leakage upon initial startup and every time it is moved to a new location.

Proceed as follows to check the device for leakage:

Preparations – Gaining access to aerosol inlet tube

To be able to perform the following steps, a hose has to be connected to the aerosol inlet.

For this purpose, the sampling head must be unscrewed and the adapter must be attached.

1. Detach the sampling head from the device.

2. Attach the adapter for calibration.
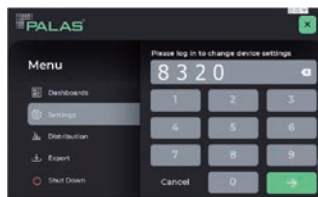
Opening the menu `Air Tightness`

1. Select `Settings` in the main menu.

   ⇨ A keypad for entering the PIN opens.

2. Enter the PIN 8320.

   ⇨ The menu `Settings` appears.
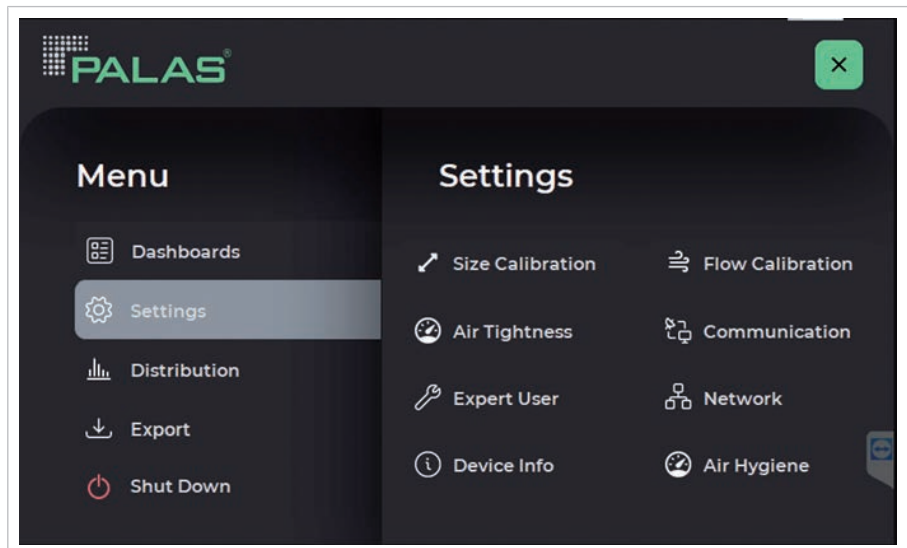
Menu `Settings`

▶ Select `Air Tightness`.

⇨ The menu `Air Tightness`, containing a red curve and the particle concentration, appears.
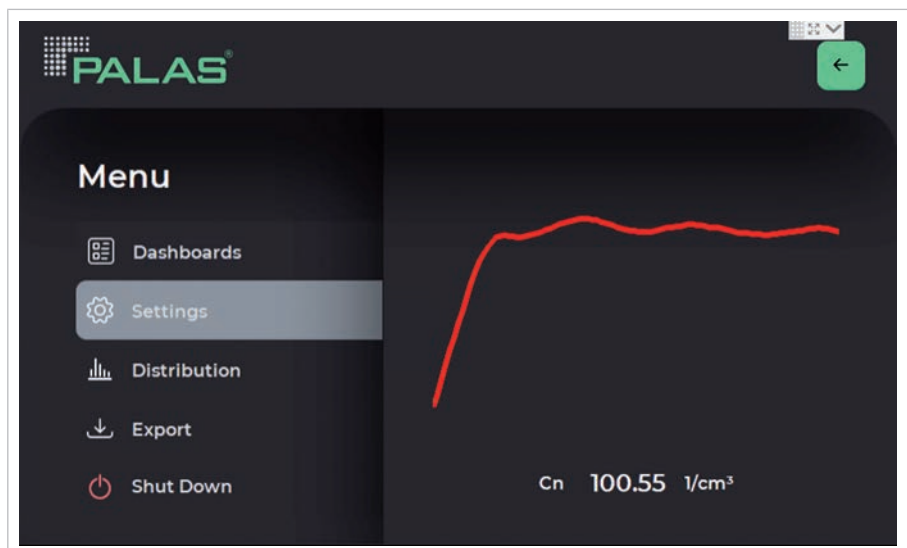
Menu `Air Tightness`

▸ Use a hose (NW 8) to connect a HEPA filter to the aerosol inlet tube.

⇨ The particle concentration will drop. When the particle concentration falls below 1.00 $1/cm^3$, the curve turns green.

⇨ If the particle concentration remains at 0.00 $1/cm^3$, mass flow control is deactivated and the fan is fixed at 100% output.

⇨ Then the leak check begins. "Leak check" appears.
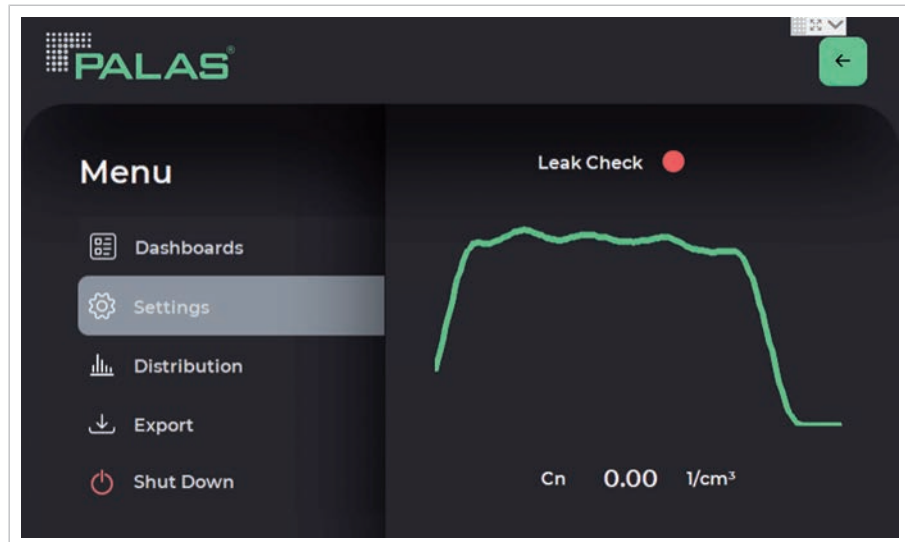
Menu `Air Tightness` *– Leak check starts*
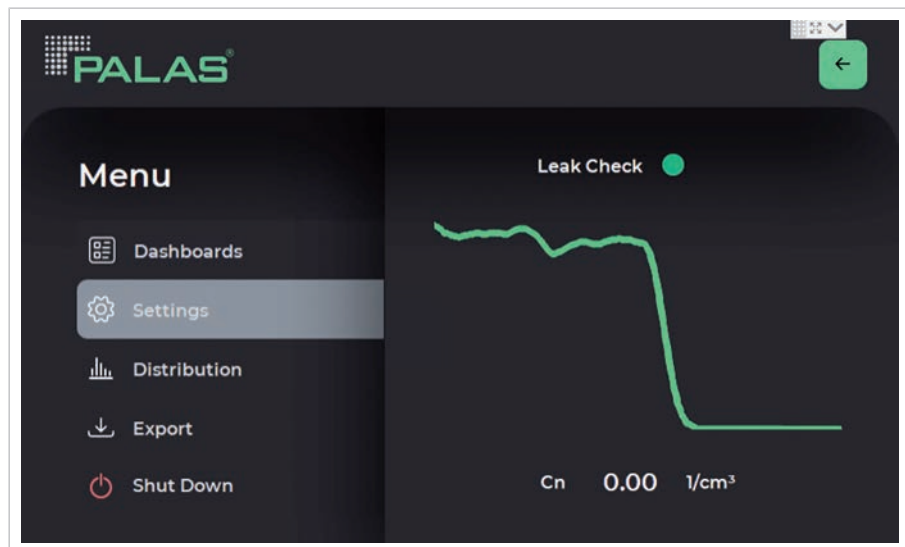
Menu `Air Tightness` *– Passed leak check*

If the leak check is successful, the dot next to "Leak Check" turns green. Mass flow control is activated again and the fan returns to a normal output.

The HEPA filter can be removed and the device reassembled.

7 Errors

Self-diagnostics

The device has a self-diagnostics system. The device monitors the state of individual components and indicates any faults. A red dot then appears in the status bar (1).
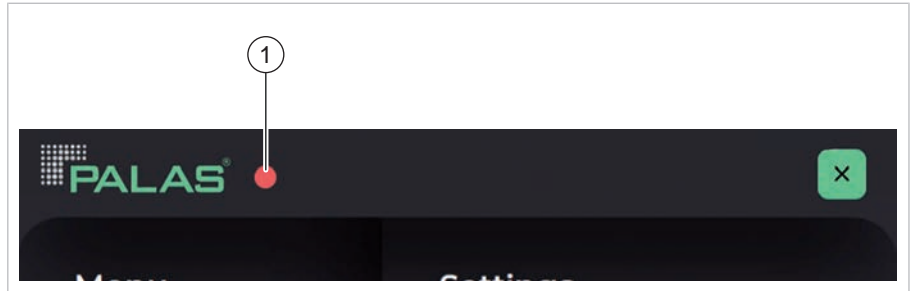
Error – red dot in the status bar

There are different ways to call up the status of individual components:

- Display on the screen: Menu `Settings > Device Info / Device Status`.
  Refer to the section "Menu Device Info / Device Status".

Problems that you cannot solve yourself

Please contact Palas or a service partner when you encounter problems that you cannot solve yourself.

State the serial number of the device when submitting a written request.

Keep the serial number handy for any queries by phone.

To receive help from our headquarters, go to:

https://www.palas.de/service

See also

8 Packaging and transportation

Package the device securely to exclude damage during transportation.

Original packaging
For the purpose of shipping, use the original packaging including the protective inner packaging or the original transport case (if applicable).

If you no longer have the original packaging, use packaging that securely protects the device against detrimental influences during transportation. Detrimental influences during transportation may include temperature, impacts, falling, or vibrations.

9 Declaration of conformity

EU- Declaration of Conformity

PALAS®

The Manufacturer

Palas GmbH
Greschbachstraße 3 b
76229 Karlsruhe
Germany

hereby declares that the products

Aerosol Spectrometers:
AQ Guard, AQ Guard Smart 1000 / 1100 / 1200 / 2000

Fine dust measuring devices:
Fidas Smart 100 / 100 E

are in conformity with the following Directive:

2014/53/EU	Radio Equipment Directive (RED)
2011/65/EU	RoHS
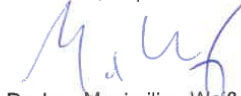
The protection goals of the following Directives are observed:

2014/35/EU	Low Voltage Directive
2014/30/EU	Electromagnetic Compatibility (EMC)

The following harmonized standards have been applied:

DIN EN 61010-1:2020-03	Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements (IEC 61010-1:2010 + COR:2011 + A1:2016, modified + A1:2016/COR1:2019)
DIN EN 61326-1:2013-07	Electrical Equipment for Measurement, Control and Laboratory Use. EMC Requirements. General Requirements (IEC 61326-1:2012)
DIN EN IEC 63000:2019-05	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances (IEC 63000:2016)

Karlsruhe, September 5, 2022

Dr.-Ing. Maximilian Weiß
General Manager

www.palas.de

PALASCOUNTS

10 Declaration of Conformity for LTE Dongle HUAWEI 3372h-320

A Huawei LTE dongle is built into the device: HUAWEI 3372h-320.

The product meets the essential requirements and other relevant provisions of the guideline 2014/53/EU.

The currently valid version of the declaration of conformity for this product can be found at: https://consumer.huawei.com/en/legal/certification.

The product may be used in all member states of the EU.

Comply with national and local regulations when using the device.

Use of the product may be restricted as a factor of your local mobile network.

Note   For the usage in the USA, LTE sticks or modems from other manufacturers are available.

11   Technical specifications

Measured data

Measuring principle	Optical light scattering by single particles
Measurable particle sizes	0.175 to 20 µm
Measured values	PM_1, $PM_{2.5}$, PM_4, PM_{10}, PM_{tot}, C_N, particle size distribution, pressure, temperature, moisture; depending on the model: CO, SO_2, O_3, NO_2
Measuring range based on particle count C_n	0 - 20,000 particles/cm^3
Measuring range based on mass	0 to 20,000 µg/m^3
Measuring range gases	O_3, SO_2, NO_2: 0-5 ppm CO: 0-10 ppm
Measuring range for air temperature	-20 - +50 °C
Measuring range for air pressure	700 - 1100 hPa
Measuring range for humidity	0 - 100 %
Zero point of PM data	< 0.1 µg/m^3
Flow rate of sampling stream	1.0 l/min
Reaction time	1 second

Device specifications

Interfaces	USB, LAN (internal), WiFi (local hotspot), 4G modem, *MyAtmosphere*
Internal memory	10 GB
Operating temperature	-20 - +50 °C
Power supply (primary voltage)	115 – 230 V AC, 50 – 60 Hz
Power supply (secondary voltage)	12 V DC (via power supply)
Average power consumption	25 W (incl. heater)
Maximum power consumption	60 W
Weight	6.0 kg

12   Transfer protocols

12.1   Transfer protocol UDP ASCII

UDP (User Datagram Protocol) is a transfer protocol used in IP-computer networks. The transmission consists of data packet that a sender (the measuring device) transmits to a specified IP address at certain intervals. The transmission interval can be changed.

There is no check to confirm that the data packets arrive at the target computer. The sender cannot accept and control commands.

Structure of a data packet

Each data packet consists of the following elements:

- Serial number of device
- Beginning character "<"
- Command "sendVal"
- Number and measured value for each data channel, separated by a semicolon
- Ending character ">"
- "Checksum"
  (calculated applying XOR sum, byte by byte over the entire string)

$$SN<sendVal\ 0=X_0;1=X_1;\ .\ .\ .\ 204=X_{204}>Checksum$$

①   ②   ③   ④
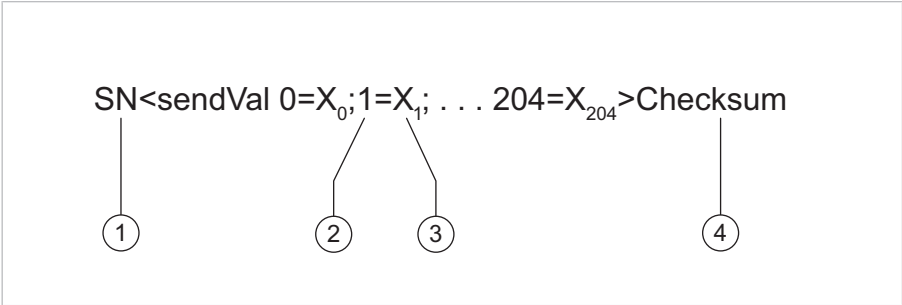
UDP ASCII – arrangement of data elements in a data packet

1	Serial number	2	Number of data channel 1
3	Measured value of data channel 1	4	Checksum

12.2   Transfer protocol TCP ASCII

TCP ASCII is a simple transfer protocol that transmits data via TCP-IP.

Special features of the syntax: The commands `getVal` and `sendVal` as well as `getHis` and `sendHis` can be used to enable communication via *TCP ASCII*. Multiple channels can be used within a single command.

`getVal` and `sendVal`

The command `getVal` is used to query various measured values. In addition, `getVal` can be used to query any number of channels.

Command:

`<getValK1;K2;…;Kn>\r\n`

K: Number of the data channel

Answer:

`<sendVal\sK1=v1;K2=v2;…;Kn=vn>CRC\r\n`

v: Value of the data channel

CRC: Checksum

`getHis` and `sendHis`

The command `getHis` is used to query the temporal course of a measured variable.

The data channels that can be queried are listed below:

History data channels	Name	Unit
100	PM1	µg/m³
101	PM2.5	µg/m³
102	PM4	µg/m³
103	PM10	µg/m³
104	PMtot	µg/m³
200	CO2	ppm
201	VOC	mg/m³
202	SO2	µg/m³
203	NO2	µg/m³
204	O3	µg/m³
205	CO	mg/m³
206	NH3	ppm
300	Cn	1/cm³
400	T	°C

History data channels	Name	Unit
401	P	hPa
402	rH	%
403	wind speed	Km/h
404	wind direction	°
408	wind signal quality	%
500	AQI	
501	Infection risk index	
619	error (0: no error)	
620	warning (0: no warning)	

Command:

`<getHisL;XXX>\r\n (L = history length index; XXX = history data channel)`

Answer:

`<sendHis\sTimestamp;L;XXX=v0;v1;v2;v3;…;vn-1>CRC\r\n (v = history data; XCRC = Checksum)`

s	History length	Averaging	Interval	Max. number of values (n)
0	10 minutes	1 s	1s	600
1	1 hour	1 s	1s	3600
2	24 hours	60 s	60 s	1440
3	1 week	15 min	15 min	672

The timestamp is assigned to v0 and represents the end of the averaging interval.

12.3 List of Data Channels

The data channels listed here apply to both types of data transfer protocols (UDP ASCII and TCP ASCII).

Measured data from data channels not yet assigned data are shown as 0.

Channel number	Content of data channel
0	Status information on the element "Volume Flow". 0 = OK, 1 = error
1	Status information on the element "Suction". 0 = OK, 1 = error
2	Status information on the element "IADS". 0 = OK, 1 = error
3	Status information on the element "Sensor Calibration". 0 = OK, 1 = error
4	Status information on the element "Sensor LED". 0 = OK, 1 = error
5	Status information on the element "Sensor Data". 0 = OK, 1 = error
6	Status information on the element "Sensor Noise". 0 = OK, 1 = error
23	Aerosol pump output [%]
24	Temperature of IADS [C°]
26	Temperature of LED [C°]
27	Volume flow [l/min]
35	Air Quality Index AQI [%]
36	Infection Risk Index [%]
40	Air temperature [C°]
41	Relative humidity [%]
42	Wind speed [km/h]
43	Wind direction [°]
44	Precipitation intensity [l/m²/h]
45	Precipitation type
46	Temperature dew point [°C]
47	Air pressure [hPa]
48	Wind signal quality
50	CO_2 concentration [ppm]

Channel number	Content of data channel
51	Mass concentration of volatile hydrocarbons VOC [mg/m3]
52	SO2 [µg/m³]
53	NO2 [µg/m³]
54	O3 [µg/m³]
55	CO [mg/m³]
56	NH3 [ppm]
60	Number concentration Cn [P/cm^3]
61	Mass concentration of fine dust fraction PM$_1$ [µg/m^3]
62	Mass concentration of fine dust fraction PM$_{2.5}$ [µg/m^3]
63	Mass concentration of fine dust fraction PM$_4$ [µg/m^3]
64	Mass concentration of fine dust fraction PM$_{10}$ [µg/m^3]
65	Total mass concentration PM$_{total}$ [µg/m^3]
77	PM2.5_CE [µg/m³]
78	PM10_CE [µg/m³]
110	Number concentration

Data channels 110 and higher indicate the number concentration in particles/cm^3 for the indicated interval. The following list shows the lower and upper limits of the intervals.

Xuk [µm] =Lower interval limit

Xok [µm] = Upper interval limit

Channel number	Xuk [µm]	Xok [µm]
110	0.1778	0.1911
111	0.1911	0.2054
112	0.2054	0.2207
113	0.2207	0.2371
114	0.2371	0.2548
115	0.2548	0.2738
116	0.2738	0.2943
117	0.2943	0.3162
118	0.3162	0.3398
119	0.3398	0.3652
120	0.3652	0.3924
121	0.3924	0.4217
122	0.4217	0.4532
123	0.4532	0.4870
124	0.4870	0.5233
125	0.5233	0.5623
126	0.5623	0.6043
127	0.6043	0.6494
128	0.6494	0.6978
129	0.6978	0.7499
130	0.7499	0.8058
131	0.8058	0.8660
132	0.8660	0.9306
133	0.9306	1.0000
134	1.0000	1.0746
135	1.0746	1.1548
136	1.1548	1.2409
137	1.2409	1.3335
138	1.3335	1.4330
139	1.4330	1.5399
140	1.5399	1.6548
141	1.6548	1.7783

Channel number	Xuk [µm]	Xok [µm]
142	1.7783	1.9110
143	1.9110	2.0535
144	2.0535	2.2067
145	2.2067	2.3714
146	2.3714	2.5483
147	2.5483	2.7384
148	2.7384	2.9427
149	2.9427	3.1623
150	3.1623	3.3982
151	3.3982	3.6517
152	3.6517	3.9242
153	3.9242	4.2170
154	4.2170	4.5316
155	4.5316	4.8697
156	4.8697	5.2330
157	5.2330	5.6234
158	5.6234	6.0430
159	6.0430	6.4938
160	6.4938	6.9783
161	6.9783	7.4989
162	7.4989	8.0584
163	8.0584	8.6596
164	8.6596	9.3057
165	9.3057	10.0000
166	10.0000	10.7461
167	10.7461	11.5478
168	11.5478	12.4094
169	12.4094	13.3352
170	13.3352	14.3301
171	14.3301	15.3993
172	15.3993	16.5482
173	16.5482	17.7828

12.4 Transfer Protocol Modbus TCP

The device can communicate with other programs via Modbus TCP. Port 502 is used for communication.

Input Registers

Adress (unsigned word)	Quantity (unsigned word)	Data
0	1	millisecond timer
21	2	PM1 [µg/m³]
23	2	PM2.5 [µg/m³]
25	2	PM4 [µg/m³]
27	2	PM10 [µg/m³]
29	2	PMtot [µg/m³]
31	2	PM0.2 [µg/m³]
33	2	PM0.3 [µg/m³]
35	2	PM0.4 [µg/m³]
37	2	PM0.5 [µg/m³]
39	2	PM7 [µg/m³]
41	2	PM15 [µg/m³]
43	2	PM20 [µg/m³]
45	2	reserve 1
47	2	reserve 2
49	2	reserve 3
51	2	reserve 4
53	2	PM2.5_CE [µg/m³]
55	2	PM10_CE [µg/m³]
121	2	Cn [1/cm³]
123	2	M1,0 [µm]
125	2	M2,0 [µm²]
127	2	M3,0 [µm³]
129	2	x10(dCn) [µm]
131	2	x16(dCn) [µm]
133	2	x50(dCn) [µm]
135	2	x84(dCn) [µm]
137	2	x90(dCn) [µm]
221	2	CO2 [ppm]
223	2	VOC [mg/m³]
225	2	SO2 [µg/m³]
227	2	NO2 [µg/m³]

Adress (unsigned word)	Quantity (unsigned word)	Data
229	2	O3 [µg/m³]
231	2	CO [mg/m³]
233	2	NH3 [ppm]
321	2	T [°C]
323	2	p [hPa]
325	2	rH [%]
327	2	wind speed [km/h]
329	2	wind direction [°]
331	2	precipitation intensity [l/m²/h]
333	2	precipitation type
335	2	temperature dew point [°C]
337	2	wind signal quality [%]
339	2	radiation
341	2	lightning detection

Adress (unsigned word)	Quantity (unsigned word)	Data