in.hub

USER MANUAL

Software SIINEOS

Version 2.7.7 / 04.08.2023

Table of contents

1 Legal notice

Warning concept

This manual contains information that you must observe for your personal safety and to prevent damage to property. Warnings are presented in decreasing order of hazard level as follows:

DANGER

Indicates a direct hazard for humans. Irreversible injuries or death will result if not observed.

WARNING

Indicates a recognizable hazard for humans. Irreversible injuries or death may result if not observed.

CAUTION

Indicates a recognizable hazard for humans or possible damage to property. May lead to reversible injuries or damage to property if not observed.

ATTENTION

Information on potential damage to property. May cause damage to property if not observed.

NOTE: Under “Note”, you will find tips, recommendations, and useful information on specific actions and facts.

If several hazard levels occur, the warning for the highest level is always used. If the triangle warning against personal injury is used in a warning, then a warning against property damage can also be added to the same warning notice.

Qualified personnel

The product associated with this documentation may only be handled by personnel qualified for the respective task. Furthermore, the product may only be handled in compliance with the associated documentation and the safety and warning instructions contained therein. Due to their training and experience, qualified personnel are equipped to recognize and avoid potential hazards when handling these products.

Basic knowledge required

Knowledge of personal computers, operating systems, and programming is a prerequisite. General knowledge in the field of automation technology is recommended.

Safety instructions

Before commissioning the product, be sure to read the safety regulations carefully and observe the corresponding information in the manual. Always keep the User Manual within reach.

Intended use

in.hub products may only be used for the applications specified in the corresponding technical documentation.

If third-party products and components are used, they must be recommended or approved by in.hub.

Proper storage, setting up, assembly, installation, commissioning, operation, and maintenance are essential for the correct and safe operation of the product.

The permissible environmental conditions must be complied with. Information in the associated documentation must be observed.

Trademarks

All names marked with the symbol “®” are registered trademarks. Other names in this document may be trademarks whose use by third parties for their own purposes may infringe on the rights of the owners.

Disclaimer

The content of this publication has been checked for conformity with the hardware described. Nevertheless, discrepancies cannot be ruled out, so we do not assume any liability for its completeness and correctness. The information in this publication is reviewed on a regular basis. Any corrections needed will be included in the subsequent editions.

2 General information

This User Manual contains all the information you need to configure and set up your gateway with SIINEOS.

This manual is intended for system administrators who are commissioning a gateway or an add-on module and connecting it to other units (automation systems, mobile terminals, personal computers, etc.), as well as for service and maintenance technicians who are installing extensions or performing error analyses.

2.1 Scope of delivery

SIINEOS operating system / system software

1 × User Manual (PDF)

2.2 Network security

Please keep in mind that the product does not encrypt communication within the internal network. Therefore, protect your network against unauthorized access from outside! The integration into a network with Internet access must be carried out with special care. For this, it is essential to talk with your system administrator in advance.

2.3 Service and support

If you have any questions about specific use cases or about technical parameters, please contact us.

Email: service@inhub.de

Phone: +49 371 335 655 00 (Technical Sales Staff)

These details will connect you with the appropriate contact.

3 Product information

SIINEOS is a Linux-based operating system and IoT platform specifically designed to meet the requirements of data security and continuity for operating procedures in the industrial sector.

It supports all common interfaces and fieldbus protocols for the direct connection of sensors, controllers, and other peripheral devices.

Furthermore, SIINEOS supports easy data acquisition, data preprocessing, and data connection to third-party systems, thus reducing the complexity of IoT and digitalization projects and making it easier to start working with them.

Extensive documentation on SIINEOS and a user-friendly software development kit make it possible to use all the potential of our industrial gateways quickly and efficiently. Regular software updates keep you up to date.

3.1 Software architecture

SIINEOS comprises four levels:

- Boot level
- System level
- In.Core framework

  Collection of software building blocks that can be used to quickly create both simple and complex IoT and IIoT applications.

- Application level with the In.Core apps.

  These consist of generic and parent objects and can be easily configured and combined using the QML language. Each In.Core module can be imported individually and contains the actual function objects.

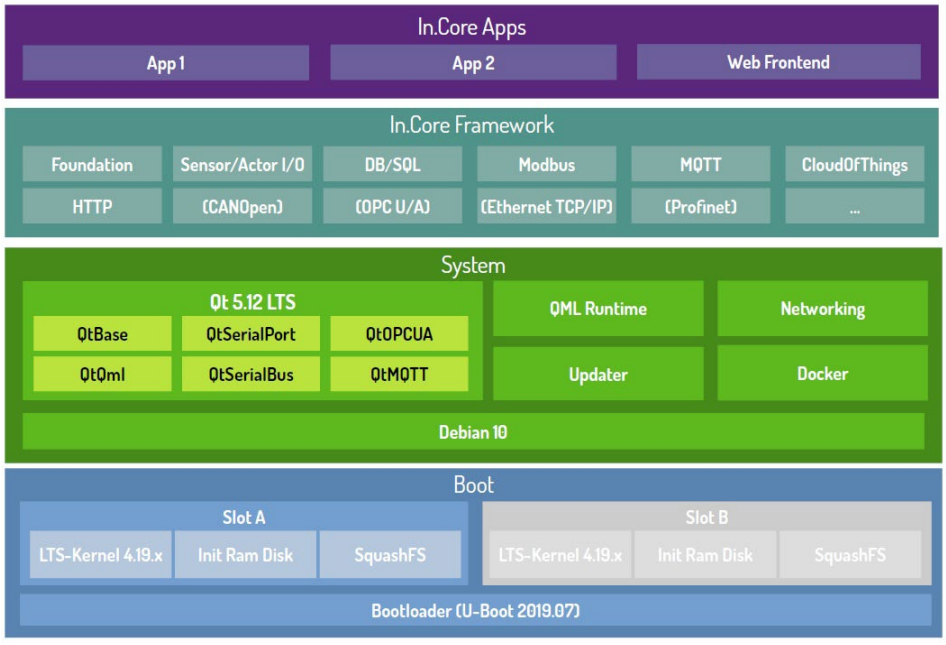


Fig. 1: SIINEOS software architecture

4 Setting up the working environment with SIINEOS

In this section, you will find detailed step-by-step instructions for configuring SIINEOS and setting up your working environment.

In short, you can also get help via tooltips in the SIINEOS UI when you move the mouse over a button or an input field.

You can also download all current technical documents, as well as software packages, tutorials, and installation instructions from the in.hub download portal:

https://download.inhub.de/

4.1 Logging in to SIINEOS

NOTE: The latest versions of **Firefox, Edge** or **Chrome** browsers are recommended for SIINEOS. Using other or older browsers may cause compatibility issues.

NOTE: Make sure that the gateway is connected to the PC.

When you log in to SIINEOS for the first time

1. Enter the following address in your browser:

   http://192.168.123.1/smac

2. Log in with the initial user data (**hubadmin/hubadmin**).

   The SIINEOS management console opens.

Fig. 2: Home page of SIINEOS (example)

On the start page, you will now see information about your system, e.g., the current SIINEOS version, name of the device, location, type, system resources, etc.

3. Select the **Users** page and change the password of the **hubadmin** user. See the section *Managing user accounts, page 32*.

If you have already set up SIINEOS

1. In your browser, enter the individual IP address you configured. See the section *Setting up Ethernet 1 and Ethernet 2, page 16*.
2. Log in with your user data and click **Log in**.

   The SIINEOS management console opens.

4.1.1 Setting the color mode and language

1. Open the SIINEOS home page by selecting the **Overview** page on the left.

Fig. 3: “Overview” page with color mode and language settings (example)

2. By default, the dark mode is selected for the screen display. To switch to the light screen mode, set the **Dark mode** slider to **Off**.
3. To change the language, open the drop-down list.

   German and **English** are available.

4.2 Configuring the system

On the **System** page, you can enter or configure the following system settings and information:

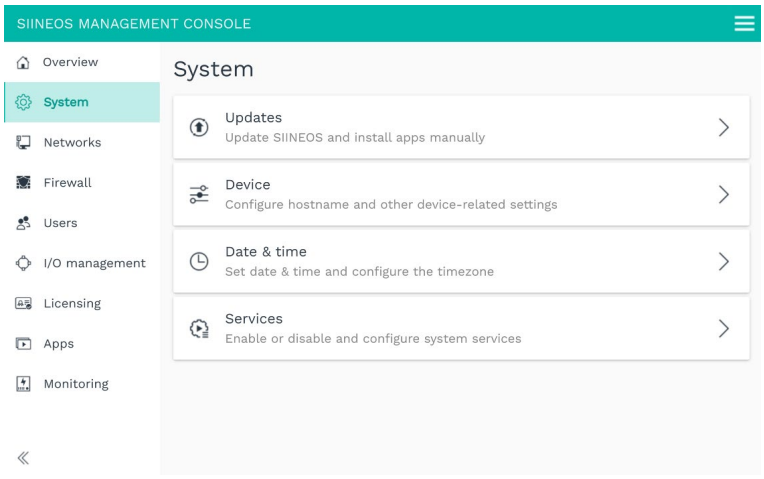


Fig. 4: “System” page

4.2.1 Uploading SIINEOS updates and application software packages (apps)

On the **System** page, you can upload updates of the SIINEOS operating system and apps.

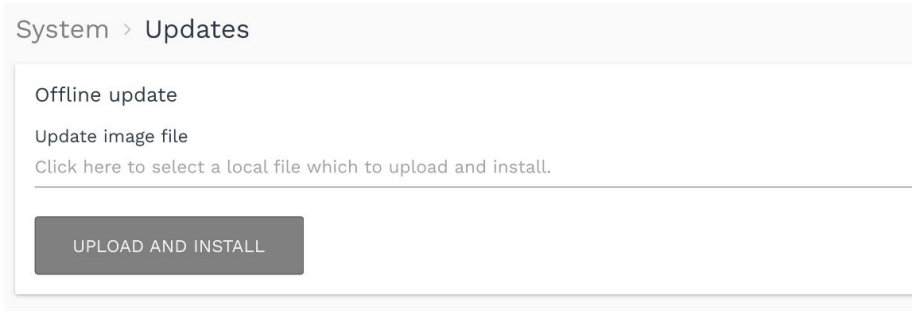


Fig. 5: System > Updates

Update SIINEOS

NOTE: As soon as a SIINEOS update is available, in.hub provides the software package. Therefore, check the in.hub download portal regularly to see if new updates are available: https://download.inhub.de/

1. Go to the https://download.inhub.de/siineos/ page and select the current SIINEOS version and package.

   Two variants are available: the complete software package and a light variant with no Docker container and with a smaller file size.

2. When the download is complete, go to the **System** page in SIINEOS and select **Updates.**
3. Click in the **Update image file** input field and select the software bundle from your local file store.

4. Click **Upload and install**.

   The installation runs automatically.

   After successful installation, you will be asked if you want to restart the gateway.

5. Click **Yes**.
6. After restarting, check on the **Overview** page that the new version of SIINEOS is displayed.
7. If the version has not been updated, proceed as follows:
   - First, clear your browser cache and refresh the page in your browser.
   - If that doesn't work:

     Disconnect the gateway from the power supply and reconnect it after a few seconds.

   - Start SIINEOS and check the version number.

Install app updates

1. On the **System** page, click **Updates.**
2. Click in the **Update image file** input field and select the software bundle provided by in.hub in `*.raucb` format from your local file store.
3. Click **Upload and install**.

   The installation runs automatically.

   You will then be prompted to restart the gateway.

4. Click **No**.

   You do not need to restart the gateway when uploading apps.

4.2.2 Making device settings

1. On the **System** page, click **Device.**

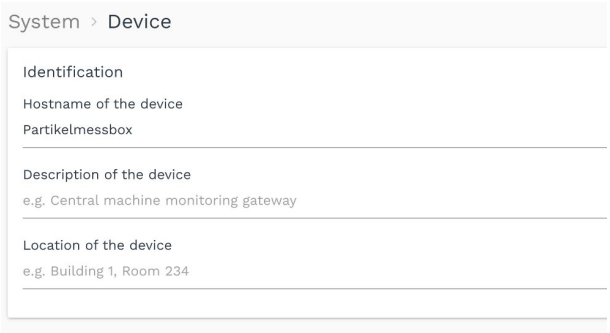


Fig. 6: System > Device (example)

2. Make the following entries in the input fields:
   - **Host name of the device:** Enter a name to uniquely identify the device in your network.
   - **Description of the device**: Enter what the device is used for.
   - **Location of the device**: Enter the physical location of the device to quickly locate the control cabinet and device when needed.
3. When you have completed the input, click **Save & close**.

4.2.3 Locating the gateway in the control cabinet

In order to keep track of which device you are currently making settings on when using several gateways, there is the function **Identify via LEDs** in SIINEOS.

1. On the **System** page, click **Device**.
2. Click the **Actions** button and select **Identify via LEDs**.

   On the gateway you are currently on, the device identification LED on the front panel will start flashing red and green alternately for 10 seconds.

4.2.4 Setting the date and time

1. On the **System** page, click **Date & time**.

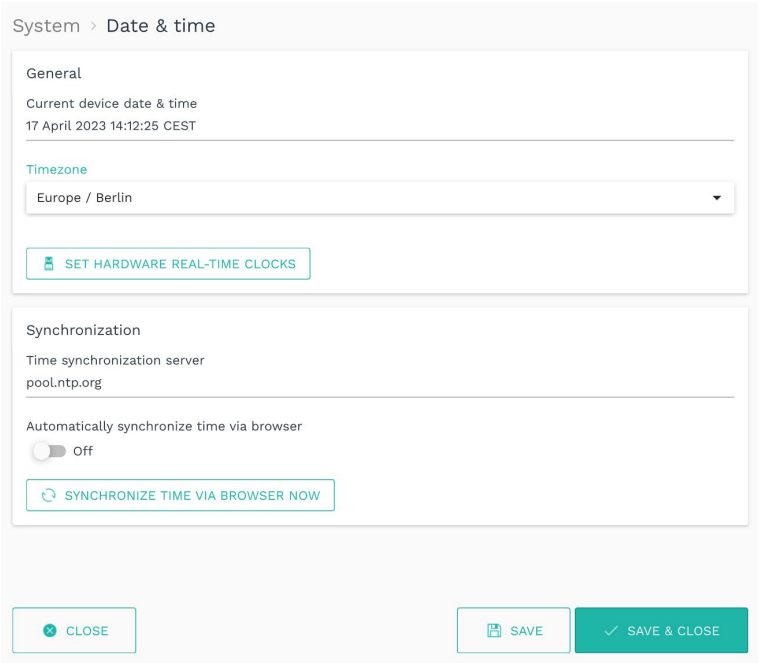


Fig. 7: System > Date & time (example)

   The current system time of the gateway is displayed under **General**. When logging in for the first time, the UTC time is displayed.

2. Select the **time zone** where your gateway is located.
3. Optional: If you are using a HUB-MRT100 or a HUB-RT100, you can write the gateway's system time to the real-time clock on the USB stick by clicking **Set hardware real-time clocks**.

   See also *Optional: Calibrating the HUB-MRT100 / HUB-RT100, page 13*.
4. If you want to obtain the system time of your gateway from a central NTP server, enter the server address under **Time synchronization server**.
5. If you want to synchronize the system time of your gateway with the system time of your browser, set the **Automatically synchronize time via browser** slider to **On**.
6. Click **Synchronize time via browser now** to synchronize the date settings for the gateway with your computer.

   If the gateway has been switched off and you are not using an external real-time clock for the time, this setting will be lost. You must then synchronize again with the browser. The time zone is kept.
7. When you have completed the input, click **Save & close**.

NOTE: If you enter an NTP server for the synchronization of the time on this page, it will automatically be adopted in the configuration of the **Wi-Fi** and **Ethernet** networks. However, if an address is already entered there, it will not be overwritten. You should therefore check your entries for the NTP server.

4.2.5 Optional: Calibrating the HUB-MRT100 / HUB-RT100

HUB-MRT100 is a USB stick that stores the system time on the one hand and process data on the other, so that this information is not lost in the event of a power failure.
HUB-RT100 only stores the system time.

If you use one of the two real-time clocks, a calibration function is available in SIINEOS. This allows you to transfer and save the system time of the gateway to the stick.

1. Plug the HUB-MRT100 or HUB-RT100 into a USB port on your gateway.

   If there is not enough space in the control cabinet, you can also use a USB extension cable or a USB HUB.

   As soon as the stick is plugged in, the LED in the stick lights up, indicating that the external real-time clock is working.

2. In SIINEOS navigate to **System > Date & Time**.
3. First click **Synchronize time via browser now** to ensure that the gateway time is in sync with the computer.
4. Now click **Set hardware real-time clocks** to transfer the system time to the external real-time clock.
5. Leave the stick permanently plugged into the device so that the gateway can always get the time from the HUB-MRT100 or the HUB-RT100 if the power supply is interrupted.

4.2.6 Configuring system services

1. On the **System** page, click **Services**.

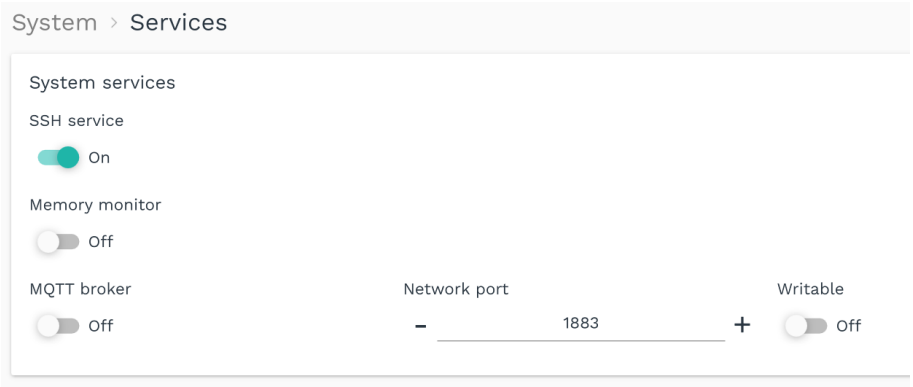


Fig. 8: System > Services (example)

2. Make the following entries in the input fields and with the sliders:
   - **SSH service**: If you want to access the gateway with an SSH client, set the slider to **On**.

     The SSH service allows direct access to the system and data, as well as troubleshooting. In conjunction with the OpenVPN client, a gateway can also be accessed from outside the local network.
   - **Memory monitor**: Set the slider to **On** to automatically restart the gateway when memory is insufficient.
   - **MQTT broker**: Set the slider to **On** to publish the local system bus via an MQTT broker.
   - Change the default **Network port** if necessary.
   - If external clients are to publish messages on the bus, set the **Writable** slider to **Off**.
3. When you have completed the input, click **Save & close**.

4.3 Restarting, shutting down, or logging off

1. In the SIINEOS management console, click the button in the upper right corner .

   A menu opens.

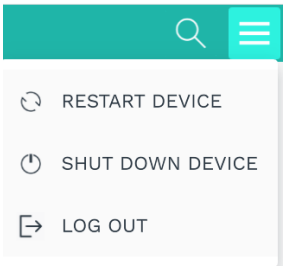


Fig. 9: Menu with actions for the current session

2. Select the action you want to perform:

Restart device	A system message is displayed asking if you really want to restart the gateway. 1. Confirm with **Yes**. After the restart, the login window is displayed again.	Possible reasons for a restart: • When the system stops responding • If you have postponed the restart after an update, for example, and want to do it later • If the new version is not displayed after an SIINEOS software update
Shut down device	A system message is displayed asking if you really want to shut down the gateway. 1. Confirm with **Yes**. All apps and SIINEOS will shut down safely and still-opened/buffered data will be stored. **NOTE**: After shutdown, you can only connect to the gateway using the micro-USB cable and the IP address http://192.168.123.1/smac.	Possible reasons for a shutdown: • If you want to prepare maintenance work on the power supply • If you want to shut down cleanly at the end of a demonstration and avoid data loss due to abrupt shutdown during a write operation.
Log out	You log out of the system and allow another user to log in.	Possible reasons for logging off: • Shift change

4.4 Configuring networks

On the **Networks** page, you can configure the following connections:

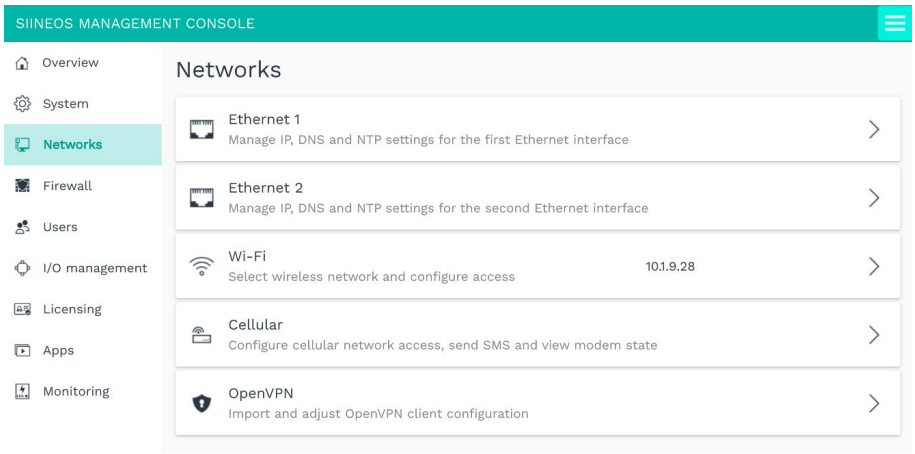


Fig. 10: “Networks” page (example)

4.4.1 Setting up Ethernet 1 and Ethernet 2

On the **Ethernet 1** and **Ethernet 2** pages, you can activate/deactivate the first and second Ethernet interface of your gateway and enter the respective network parameters.

RECOMMENDATION: We recommend **Ethernet 1** for gateway communication in a company network and **Ethernet 2** for gateway communication in an isolated machine network.

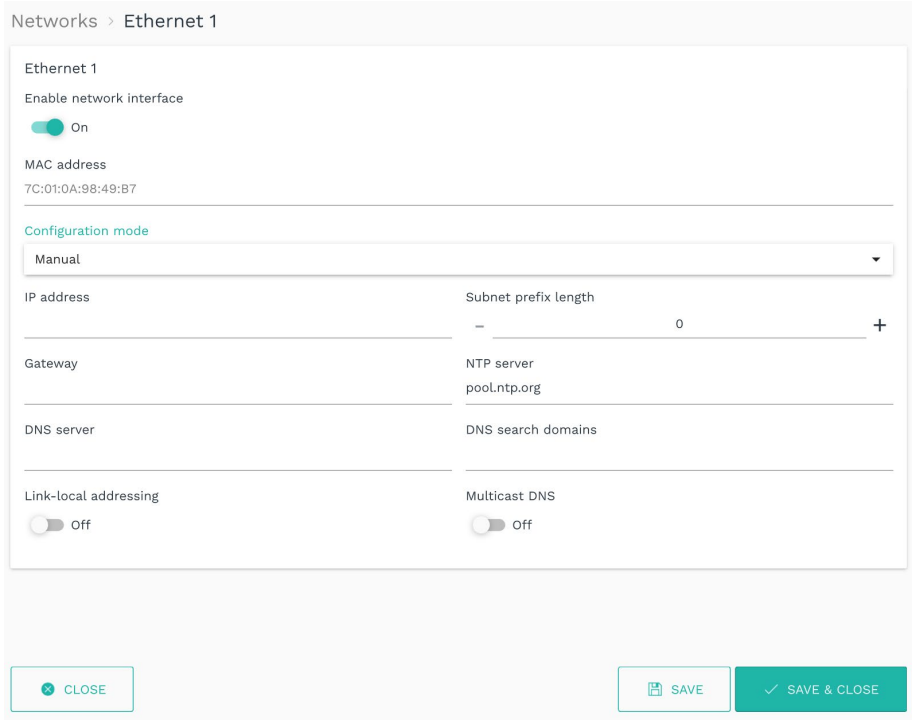


Fig. 11: Networks > Ethernet 1 > Configuration mode “Manual” (example)

1. On the **Networks** page, select **Ethernet 1** or **Ethernet 2.**
2. To enable the interface, set the **Enable network interface** slider to **On.**

   The MAC address printed on the gateway housing is displayed.
3. In the **Configuration mode** drop-down list, select either **Manual** or **Automatic (DHCP)**, depending on whether you want to enter the network settings manually or obtain them automatically from a DHCP server.
4. Fill in the input fields according to the selected configuration mode:

   HINT: For several parameters where you can make multiple entries, e.g. for the DNS server, separate them with a space, not a comma.

IP address	Enter the required IPv4 or IPv6 address of the gateway to be assigned to the Ethernet 1 or Ethernet 2 interface.
Subnet prefix length	Enter the subnet prefix length of the IPv4 or IPv6 address. For IPv4 addresses, the value **24** is typically entered here for networks with subnet mask **255.255.255.0** or the value **16** for networks with subnet mask **255.255.0.0.**
Gateway	Enter the IP address of the gateway.
NTP server (optional)	Enter the IP address or computer name of the time server from which the gateway should obtain its system time.
DNS server	Enter the IP address of the DNS server through which names of computers in the network / on the Internet are to be resolved.
DNS search domains (optional)	Enter the internal DNS domain of your company network, e.g., **lan.mycompany.com**.
Link-local addressing (optional)	Set the slider to **On** if you need a link-local address for local communication within the network segment. The gateway generates the link-local address automatically, so that communication in the same network segment is possible without DHCP or static IP address.
Multicast DNS (optional)	Set the slider to **On** if all nodes in the network are to be addressed directly instead of a query to a DNS server. Gateways are then accessible in the network at **<hostname>.local**. The host name can be found in SIINEOS on the **System > Device** page.

Run DHCP server on interface (available only with Ethernet 2)	**NOTE**: We recommend using this function only for a direct one-to-one connection between the gateway and a sensor, a PLC, an add-on module, or a TBEN module. A larger network with multiple machines requires a central IT infrastructure. Set the **Run DHCP server on interface** slider to **On** if you want the gateway to assume the role of DHCP server and assign IP addresses to the connected devices in the isolated machine network. **DHCP address pool offset** Specify which IP addresses are to be assigned for the connected peripheral device. Example: You enter a “12”. Starting from the parameter entered under **IP address,** the number after the last dot is replaced by “12”, e.g., 10.1.9.**12** If this IP address is already assigned, the device may not be accessible on the network. Change your entries if necessary. **DHCP address pool size** Specify the maximum number of peripherals that can be included in the network. The recommended value is 1. **RECOMMENDATION**: Restart the connected peripheral device so that it can send its requests to the gateway. Only then will the IP address be assigned.

5. If you have selected **Automatic (DHCP)**, you can select or deselect the following parameters:

IPv6 auto configuration	By default, the slider is set to **On**, which means that in addition to the IPv4 address, an IPv6 address is also automatically configured using IPv6 router advertisements from the network and the DHCPv6 client is started.
Use routes from DHCP server	By default, the slider is set to **On** if the routes/gateways, it receives from the DHCP server, are to be registered in the system. Set the slider to **Off** if you only want to access the local network via this interface and access the Internet via another interface if necessary.

6. Click **Save & close** to save your entries.

   This takes you back to the **Networks** page.

4.4.2 Setting up Wi-Fi

On the **Wi-Fi** page, you can connect to a wireless network (WLAN/Wi-Fi).

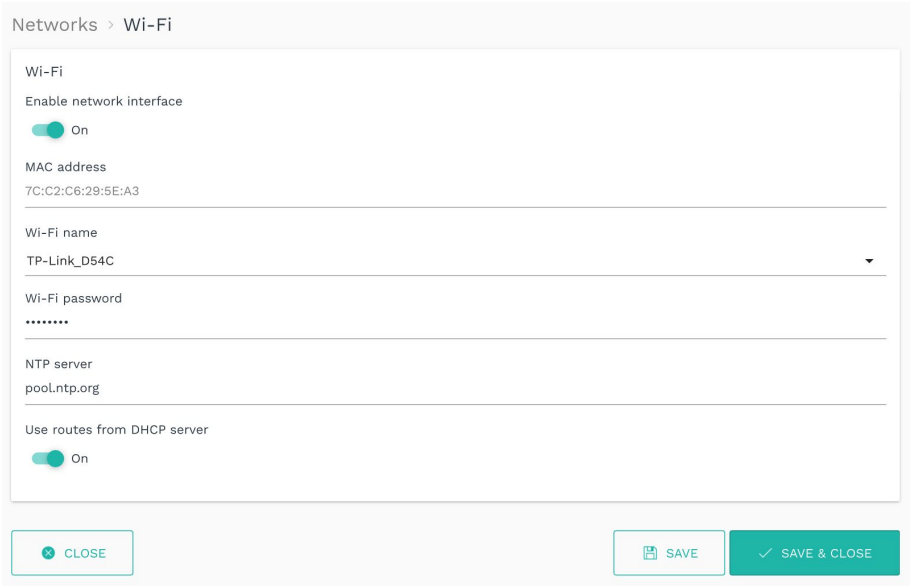


Fig. 12: Networks > Wi-Fi

1. If you want to connect to a wireless network, set the **Enable network interface** slider to **On**.

   The MAC address, which is also printed on the gateway housing, is displayed.

2. Enter the name and password of the wireless network you want to connect to.
3. Optional: Enter the IP address of an NTP server from which the gateway should obtain its system time.
4. Optional: Set the **Use routes from DHCP server** slider to **Off** to access only the local network through this interface and access the Internet through another interface if necessary.
5. Click **Save & close** to save your entries.

   This takes you back to the **Networks** page.

4.4.3 Setting up the mobile connection

The in.hub LTE stick can be connected via an USB interface to establish Internet access in environments without a network. This access can be used, for example, to connect the gateway to a cloud or to access the gateway remotely via the VPN tunnel.

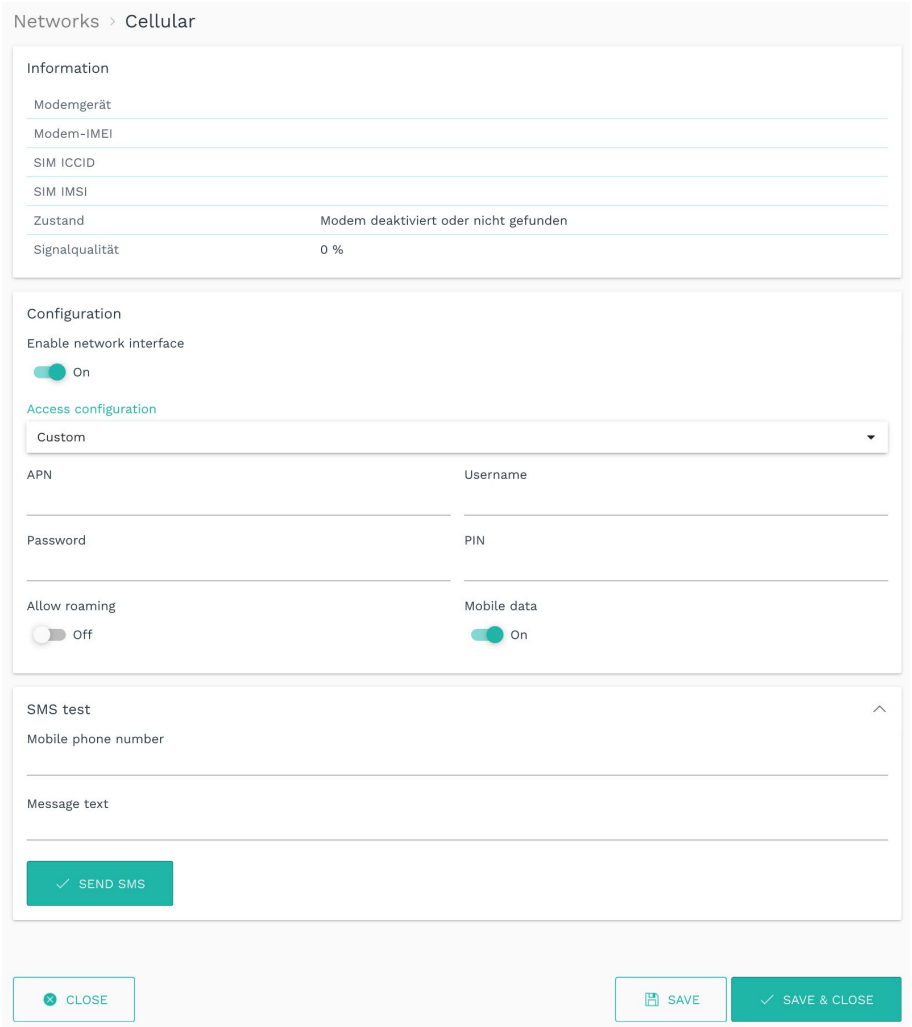


Fig. 13: Networks > Cellular > Access configuration “Custom” (example)

1. If you want to use the in.hub LTE stick as a network interface, set the **Enable network interface** slider to **On**.
2. In the **Access configuration** drop-down list, select a predefined SIM card / cellphone provider(s) or **Custom**.
3. If you have selected **Custom**, make the following entries:

APN	Access point (access point name) Enter the address of the access point you received from your cellphone operator to establish communication between the terminal device and the cellular network.
Username	If the network provider has specified a username in addition to the APN, enter it here.

Password	If the network provider has specified a password in addition to the APN, enter it here.
PIN	Enter the PIN of the SIM card. **NOTE**: Make sure you enter the correct PIN for the SIM card inserted, otherwise the card will be blocked after three unsuccessful attempts.
Allow roaming	If you want to allow roaming, set the slider to **On**. **NOTE:** If you have a SIM card with roaming service, you can enable this feature to dial into non-provider networks when needed.
Mobile data	By default, this function is turned on. If you only want to use the in.hub LTE stick to send SMS messages, set the slider to **Off**.

4. To check whether your entries are correct, enter a message text and the cellphone number of the terminal under **SMS test** and click **Send SMS.**
5. If no SMS arrives, check if the signal quality is sufficient.
6. Click **Save & close** to save your entries.

   This takes you back to the **Networks** page.

4.4.4 Setting up OpenVPN

If the gateway is to use a VPN tunnel to your company network, you can import the OpenVPN client configuration here and adjust the name. This requires that an OpenVPN server to be running in the company headquarters.

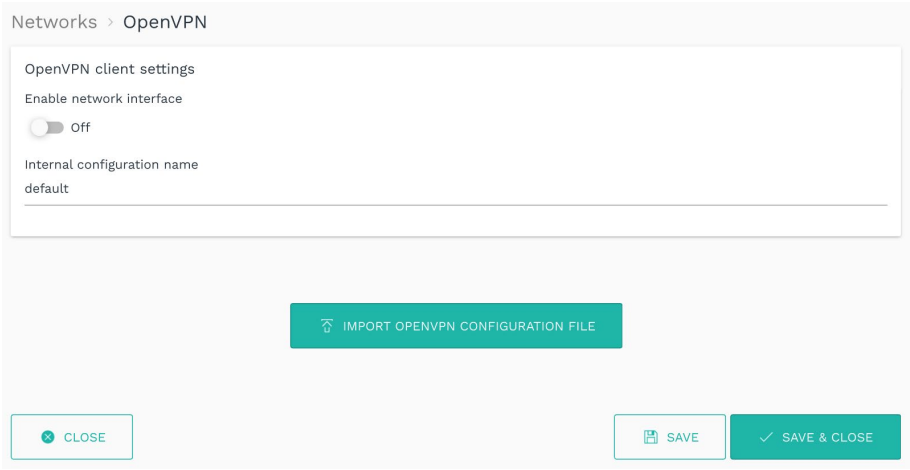


Fig. 14: Networks > OpenVPN

1. If you want to use OpenVPN, set the **Enable network interface** slider to **On**.
2. Click **Import OpenVPN configuration file** to select the configuration file from your local file directory.
3. Enter the file name (without file extension) in the **Internal configuration name** field.
4. Click **Save & close to** save your entries.

   This takes you back to the **Networks** page.

4.5 Configuring the firewall

RECOMMENDATION: When adjusting or configuring the device-internal firewall, always connect your computer via the micro-USB port on the front of the gateway if possible and open the SIINEOS management console via the USB network address http://192.168.123.1.

This will prevent you from losing access to the gateway over the network due to an incompletely or incorrectly configured firewall rule.

On the **Firewall** page, you can configure the gateway's built-in network firewall, defining rules that determine how the gateway communicates on the network and how it handles network traffic received. The following functions are available:

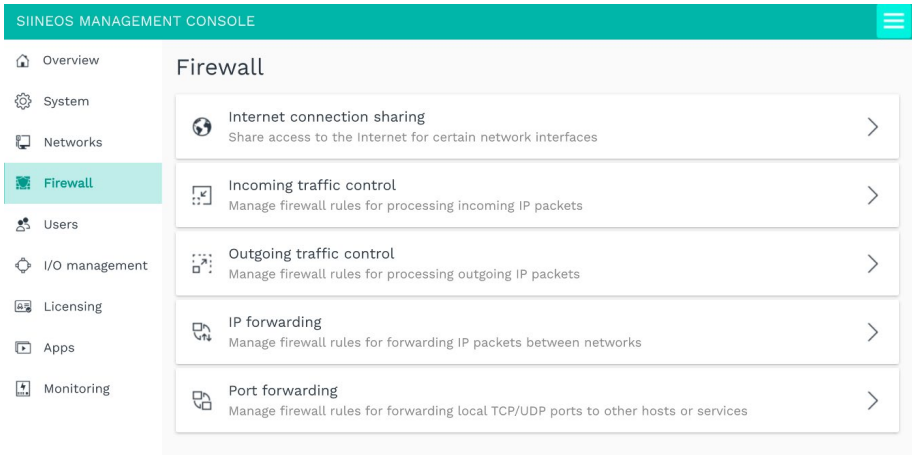


Fig. 15: "Firewall" page

In principle, you can use the device-internal firewall as part of your company's own security concept, but you do not have to. The configuration of the firewall is optional. A firewall is particularly useful when devices or the network in which one of the communicating devices is located are accessed from outside.

So, first you specify whether the traffic passing through the gateway should be processed or not.

- If you don't need this feature, just skip the **Firewall** page.
- If you do, then you can follow the blacklisting approach that SIINEOS uses by default, i.e., any traffic that is not explicitly forbidden is allowed.

  Or you can take the whitelisting approach, which means that any traffic that is not explicitly allowed is forbidden.

Notes on incoming and outgoing network traffic

All rules you create are processed for each incoming data package in sequence—from top to bottom in the list. At the point where all the criteria of a rule apply to a data packet, rule processing is concluded with the selected action. No further rules are processed.

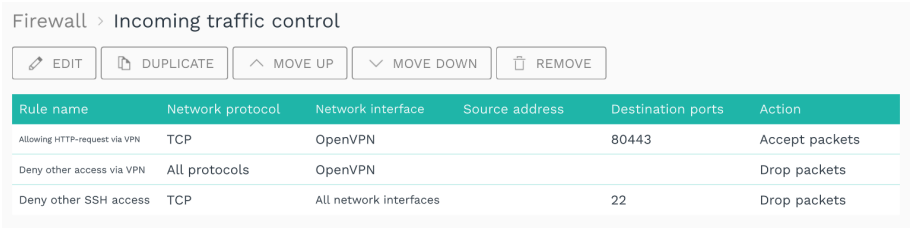


Fig. 16: Example of a rules list for incoming network traffic

You can change the order of the rules using the **Move up** or **Move down** buttons.

RECOMMENDATION: Create all positive rules first. It must be defined very specifically which access should be allowed by whom. It is useful to have a rule at the end of the list where no conditions are set. You can then only select in the **Actions** drop-down whether the gateway ignores the request from the network (**Drop packet**) or whether the gateway actively rejects the request (**Reject packet**).

4.5.1 Sharing Internet connections

In this window, you define the networks that the devices (e.g. machines) connected in this network are allowed to use to access the Internet via the gateway.

1. On the **Firewall** page, select **Share Internet connection**.

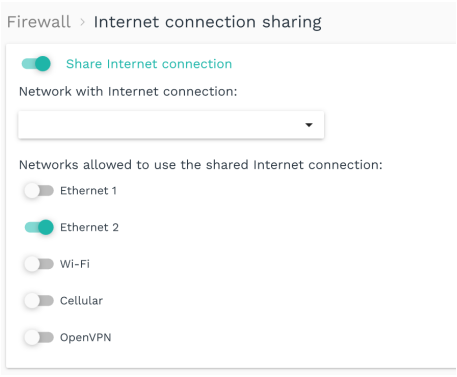


Fig. 17: Firewall > Internet connection sharing (example)

2. Activate the **Share Internet connection** slider.
3. In the **Network with Internet connection** drop-down list, select the network that the gateway uses to access the Internet.
4. Activate the slider of the network that is allowed to use the shared Internet connection.
5. Click **Save & close**.

   This takes you back to the **Firewall** page.

4.5.2 Controlling incoming network traffic

In this window, you define firewall rules that determine how incoming IP packets are handled by SIINEOS.

By default, all incoming packets are allowed, so the respective network services of the gateway (e.g., SSH, MQTT, SMAC) are accessible from all networks.

So, if you want to restrict access from certain source addresses, you can define rules here.

1. On the **Firewall** page, select **Incoming traffic control**.

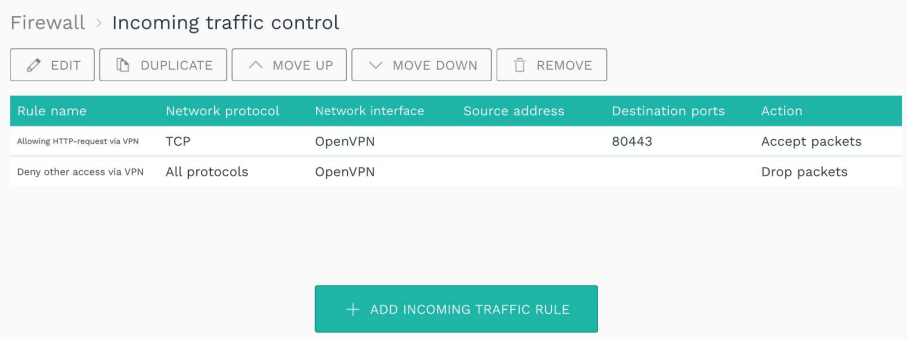


Fig. 18: Firewall > Incoming traffic control (example)

2. To add a new rule, click **Add incoming traffic rule**.

   The setup wizard opens to guide you through creating the rule. In the following, confirm each entry either with **Next** or by pressing **Enter**.

3. Under **Rule name,** enter a name.

4. Select the **Network protocol** for network packets for which this rule applies.

   Select **All protocols** if you want the rule to apply to all network protocols.

5. Select the **Input interface** through which the data packet must arrive for the rule to apply.

   Select **All network interfaces** if the packet can arrive via any interface for the rule to apply.

6. Enter a **Source address** if you want the rule to apply only to packets sent from specific hosts or networks.

   Enter the network address of an entire network (e.g. 192.168.5.0/24) or of a specific machine (e.g. 192.168.5.140).

   If you leave the field empty, the rule will be applied to any source address.

7. Under **Destination ports**, you can restrict access to specific TCP/UDP ports of the gateway.

   Enter the port numbers, separated by spaces, to which access is to be controlled by this rule.

   If you leave the field empty, access to all TCP/UDP ports will be allowed or denied (depending on the action selected in the next step).

8. Under **Action,** select from the drop-down list what to do with the network packets that match all the criteria of the rule.
    - **No action**: The rule is switched to inactive, i.e., the process advances to the next rule.
    - **Accept packets**: The request is allowed, and the packets are allowed to arrive.
    - **Drop packets**: The request is not allowed, and the packet is discarded, i.e., effectively ignored. No response is returned.
    - **Reject packets**: The request is actively rejected and answered. A reject packet is returned to the sender so that the connection setup fails.
9. When you have made all the entries, click **Finish**.

    This takes you back to the list of all rules.
10. If you want to edit a rule, select the rule and click **Edit** or double-click.

    A page opens, where you can see and edit all the settings for the rule in one view.

    To save your changes, click **Save & close**.
11. If you want to duplicate a rule, select the rule, and click **Duplicate**.

    This takes you back to the setup wizard, where you can customize the rule.
12. If you want to remove a rule, select the rule, and click **Remove**.
13. If you want to change the order in which the rules are run, select a rule and click **Move up** or **Move down.**

4.5.3 Controlling outgoing network traffic

In this window, you can define firewall rules that determine how outgoing IP packets are handled by SIINEOS.

By default, all outgoing packets are allowed, so the gateway has unrestricted access to all reachable networks, as well as the Internet, if applicable.

If you want to prevent access to certain destination addresses, you can define rules here.

1. On the **Firewall** page, select **Outgoing traffic control**.

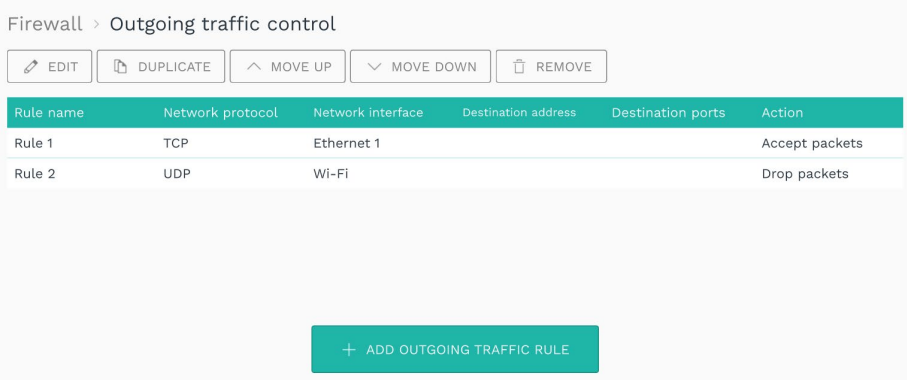


Fig. 19: Firewall > Outgoing traffic control (example)

2. To add a new rule, click **Add outgoing traffic rule**.

   The setup wizard opens to guide you through creating the rule. In the following, confirm each entry either with **Next** or by pressing **Enter**.

3. Under **Rule name,** enter a name.
4. Select the **Network protocol** for the network packets to which this rule should apply.

   Select **All protocols** if you want the rule to apply to all network protocols.

5. Select the **Output interface** through which the packet will be sent (based on the network configuration/routing table).

   Select **All network interfaces** if the packet can originate from any interface for the rule to apply.

6. Enter a **Destination address** if you want the rule to apply only to packets sent to specific recipients (hosts/networks).

   Enter the network address of an entire network (e.g. 192.168.5.0/24) or of a specific machine (e.g. 192.168.5.140).

   If you leave the field empty, the rule will be applied to all recipients (hosts/networks).

7. Under **Destination ports**, you restrict access from the gateway to specific TCP/UDP ports of the destination computer/network.

   Now enter the port numbers, separated by spaces, to which access is to be controlled by this rule.

   If you leave the field empty, access to all TCP/UDP ports will be allowed or denied (depending on the action selected).

8. Under **Action,** select from the drop-down list what to do with the network packets to which this rule applies:
    - **No action**: The rule is switched to inactive, i.e. the process advances to the next rule.
    - **Accept packets**: The packet may be sent over the corresponding network interface.
    - **Drop packages**: The packet is not sent but discarded. The sending application does not receive any information that the packet was not sent.
    - **Reject packets**: The packet will not be sent, and the sending application will be informed that the network packet could not be / has not been sent.
9. When you have made all the entries, click **Finish**.

    This takes you back to the list with all the rules.
10. If you want to edit a rule, select the rule, and click **Edit** or double-click.

    A page opens, where you can see and edit all the settings for the rule in one view.

    To save your changes, click **Save & close**.
11. If you want to duplicate a rule, select the rule and click **Duplicate**.

    This takes you back to the setup wizard, where you can customize the rule.
12. If you want to remove a rule, select the rule and click **Remove**.
13. If you want to change the order in which the rules are run, select the rule and click **Move up** or **Move down.**

4.5.4 Setting and editing rules for IP forwarding

In this window, you can define rules for direct forwarding of data packets, for example, if you want to access a machine connected to the gateway via VPN.

1. On the **Firewall** page, select **IP forwarding.**

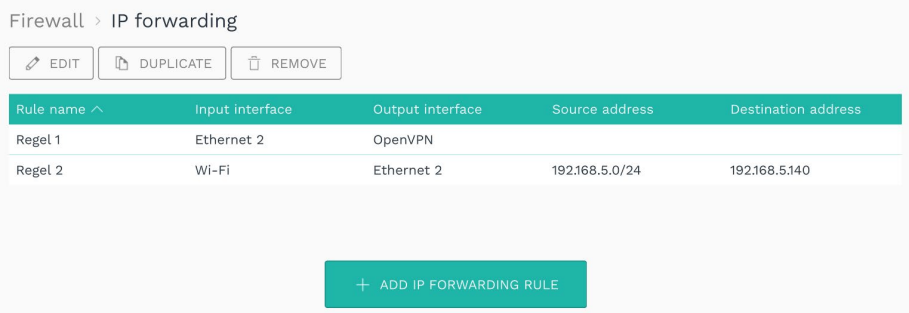


Fig. 20: Firewall > IP forwarding (example)

2. To add a new rule, click **Add IP forwarding rule**.

   The setup wizard opens to guide you through creating the rule. In the following, confirm each entry either with **Next** or by pressing **Enter**.

3. Under **Rule name,** enter a name.
4. From the drop-down list, select the **Input interface** from which to forward traffic.
5. From the drop-down list, select the **Output interface** (destination) to which the traffic is to be forwarded.
6. If traffic should only take place with a certain host or in a limited network, you can now enter the **Source address** and then the **Destination address.**

   Enter the network address of an entire network (e.g. 192.168.5.0/24) or of a specific machine (e.g. 192.168.5.140).

   If you do not enter anything, the traffic will not be restricted.

7. When you have made all the entries, click **Finish**.

   This takes you back to the list with all forwarding rules.

8. If you want to edit a rule, select the rule and click **Edit** or double-click.

   A page opens, where you can see all the settings for the rule and edit them in one view.

   To save your changes, click **Save & close**.

9. If you want to duplicate a rule, select the rule and click **Duplicate**.

   This takes you back to the setup wizard where you can customize the rule.

10. If you want to remove a rule, select the rule and click **Remove**.

4.5.5 Configuring port forwarding

1. On the **Firewall** page, select **Port forwarding.**

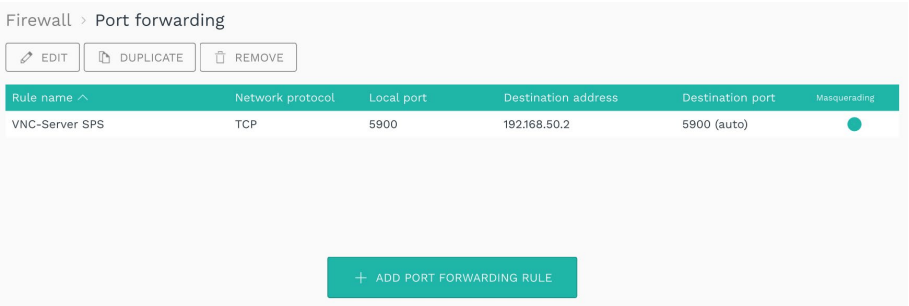


Fig. 21: Firewall > Port forwarding (example)

2. To add a new rule, click **Add port forwarding rule**.

   The setup wizard opens to guide you through creating the rule. In the following, confirm each entry either with **Next** or by pressing **Enter**.

3. Under **Rule name,** enter a name.
4. Select the **Network protocol** for network packets for which the port forwarding rule should apply.
5. Under **Local port,** enter the number of the local port to be forwarded.
6. Under **Destination address,** enter the IP address of the host to which the traffic should be forwarded.
7. If you want to forward the traffic to another port instead of a local port, specify the required port number under **Destination port.**

   If you do not enter anything, the local port is used.

8. Under **Masquerading**, the slider is automatically set to **On**. This means, that for all forwarded packets the source address is replaced by the IP address of the gateway.

   This is always necessary if no direct IP routing between sender and destination host is possible. This address translation ensures that replies from the destination host are correctly returned to the original sender. In most cases where port forwarding is desired, masquerading is also necessary for communication to work as desired.

   If you do not want this, set the slider to **Off**.

9. When you have made all the entries, click **Finish**.

   This takes you back to the list with all port forwarding rules.

10. If you want to edit a rule, select the rule and click **Edit** or double-click.

    A page opens, where you can see all the settings for the rule and edit them in one view.

    To save your changes, click **Save & close**.

11. If you want to duplicate a rule, select the rule and click **Duplicate**.

    This takes you back to the setup wizard, where you can customize the rule.

12. If you want to remove a rule, select the rule and click **Remove**.

4.6 User management

The following three user roles are provided in the SIINEOS user administration:

- **System administrator**

  Can log into SIINEOS and configure the system, activate apps, and open them in SIINEOS so that app users can access them.

  For the first login to SIINEOS, a user account (**hubadmin/hubadmin**) with the role **System administrator** is created. You should change the preset password after logging in.

- **App administrator**

  Can log into the administration interface of an app (e.g. MADOW) and configure it.

  For the initial login to the **InGraf** app, a user account (**ingrafadmin**/**ingrafadmin**) with the **App administrator** role is created.

  For the initial login to the **MADOW** app, a user account (**madowadmin**/**madowadmin**) with the **App administrator** role is also created.

  You should change the preset passwords after logging in.

- **App user**

  Can log into protected areas of an app where sensitive information is displayed, for example.

All other user accounts are created and managed by you as the system administrator. For apps, the two user roles **App administrator** and **App user** are available.

Some areas in the apps require no authentication. For example, a machine operator can connect directly to MADOW via the corresponding web address and view downtimes without having to log in.

4.6.1 Managing user accounts

On the **Users** page you can add user profiles, assign one of the predefined roles to users and edit, deactivate, or remove profiles.

> **NOTE:** You cannot deactivate or remove the preconfigured **System administrator** role.

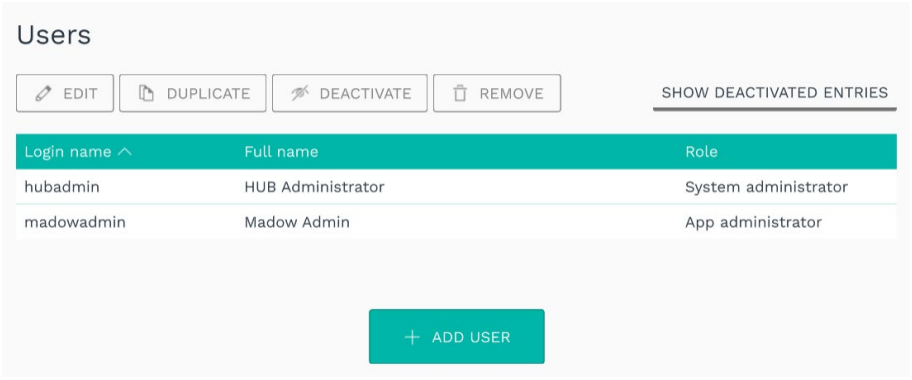


Fig. 22: "Users" page (example)

1. On the **Users** page, click **Add User** to create a new user.

   -or-

   Select an existing user and click **Duplicate**.

   The **Add user** dialog box opens.

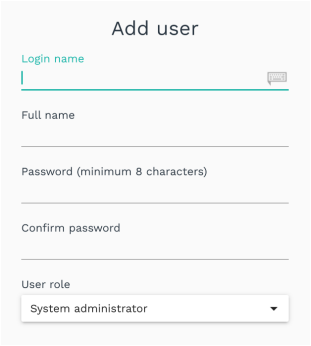


Fig. 23: Users > Add user (example)

2. Enter the **Login name**, **Full name,** and a **Password**.

   The password must have of at least 8 characters.

3. In the drop-down list, assign a **User role** to the user.
4. When you have completed the input, click **Save & close**.

   The user is created and appears in the list.

5. To edit a user, select the corresponding line in the list and click **Edit**.

   The same window opens as when creating a user. Here, you can change all the details and/or assign a different user role.

6. If you want to remove a user, select the user and click **Remove**.
7. To deactivate a user, e.g., because the user is absent for a prolonged period, select the corresponding line in the list and click **Deactivate**.

8. To restore a deactivated user, click the **Show deactivated entries** filter, select a user and click **Activate**.

TIP: If there are a large number of entries, you can search within the list. To do this, click on the icon with the magnifying glass at the top right and enter the username you are looking for.

4.7 Monitoring system

On the **Monitoring** page, you can monitor live the usage of the processor and the network interfaces, as well as the data traffic of your gateway.

The page is mainly used for diagnostic purposes. For example, you can check whether data is being sent or received via the correct network interface. The complete startup of the system and all apps can also be quickly seen from the CPU usage.

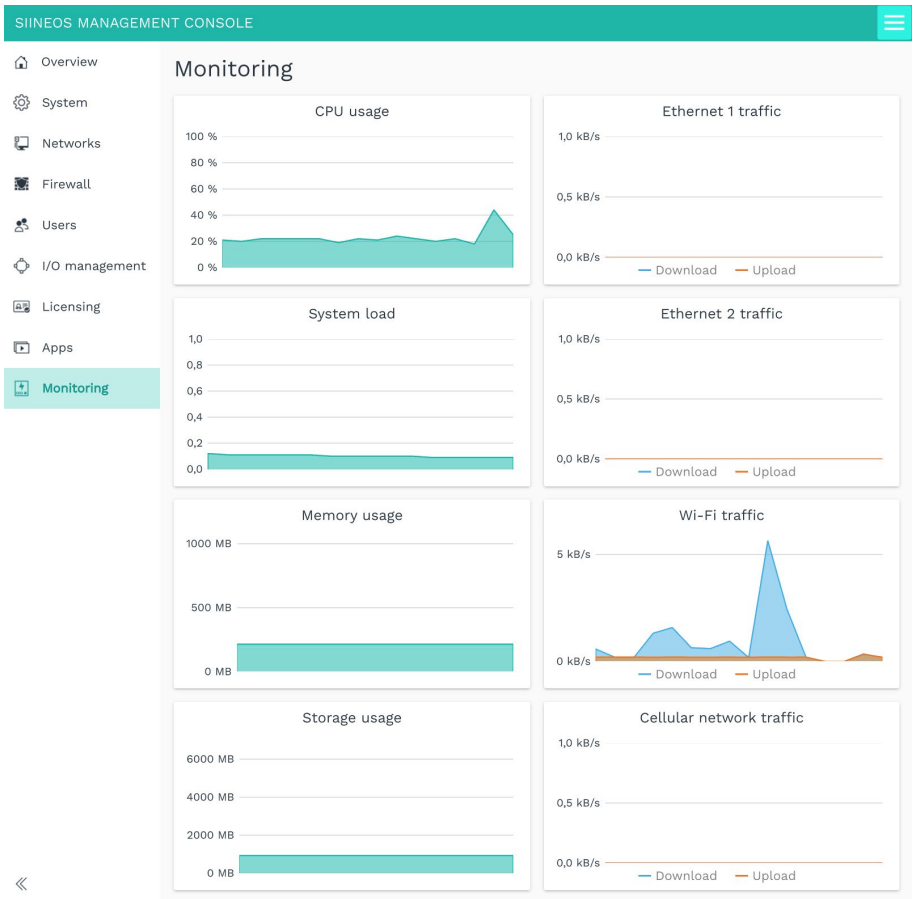


Fig. 24: “Monitoring” page (example)

4.8 Opening and managing apps

On the **Apps** page you will find various software tools that you can access directly. The apps shown in the following image are pre-installed.

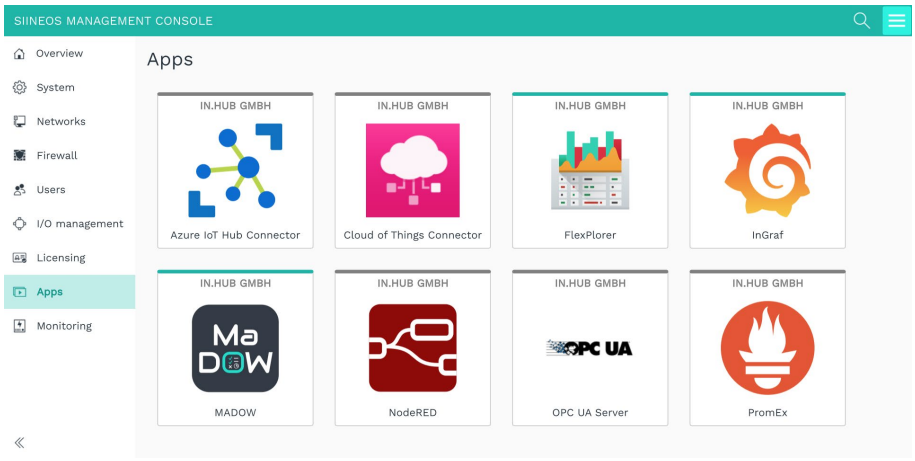


Fig. 25: “Apps” page

1. Open the required app by clicking on the tile.

   An overview opens, where you can find information about the application, as well as a description of the app and how it works.

2. To start the app, click **Enable app**.
3. To view or change the settings for the app, click on **Manage app**.
4. Once the app is activated, click **Open app**.

   The app will now open in a new window or tab, depending on your browser settings.

   If it is an external app, e.g., Grafana, you will now be forwarded to the login page. Make sure that you have a user account.

TIP: If there are many entries, you can also search specifically for an app. To do this, click on the icon with the magnifying glass at the top right and enter the name of the app or the manufacturer.

4.9 Adding and managing licenses

On the **Licensing** page, you will find all in.hub software licenses that you have purchased. You can also add new licenses here.

Prerequisite: You have ordered the license from us and have already received the license file.

> **HINT:** Contact our technical sales department if you would like to purchase a license for a software product.

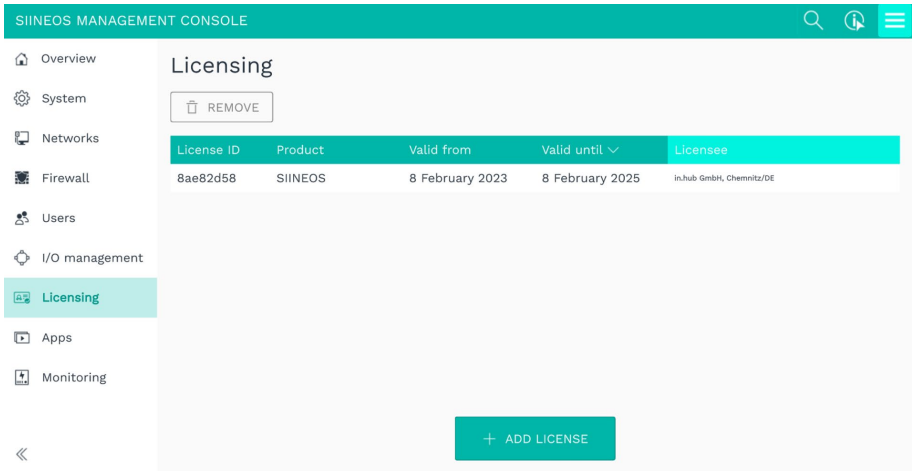


Fig. 26: “Licensing” page (example)

1. Click **Add license**.
2. Select the license file you received from in.hub from your file directory and click **OK**.

   The license is added to the list.
3. To remove a license again, e.g. because it has become invalid, select the license ID and click **Remove**.

   The license file itself is not deleted, but only removed from the list.

> **TIP:** If there are many entries, you can also search specifically for a license. To do this, click on the icon with the magnifying glass at the top right and enter the name of the license.
>
> 

5 I/O management

You can connect a variety of external peripheral devices to an in.hub gateway, such as sensors, Modbus Clients, or even other in.hub gateways and add-on modules.

The interfaces and signals of the peripheral devices are configured and set up by you, so that measured values are output according to your requirements.

On the **I/O management** page, you can perform the following tasks:

- Create I/O units, manage them, and configure their interfaces.

  Creating I/O units, page 43

- Link input and output signals to trigger actions when signal values or measured values fall outside a defined range.

  Configuring signal connections, page 73

- Connect signals from different I/O units to create new, synthetic signals.

  Creating synthetic signals, page 74

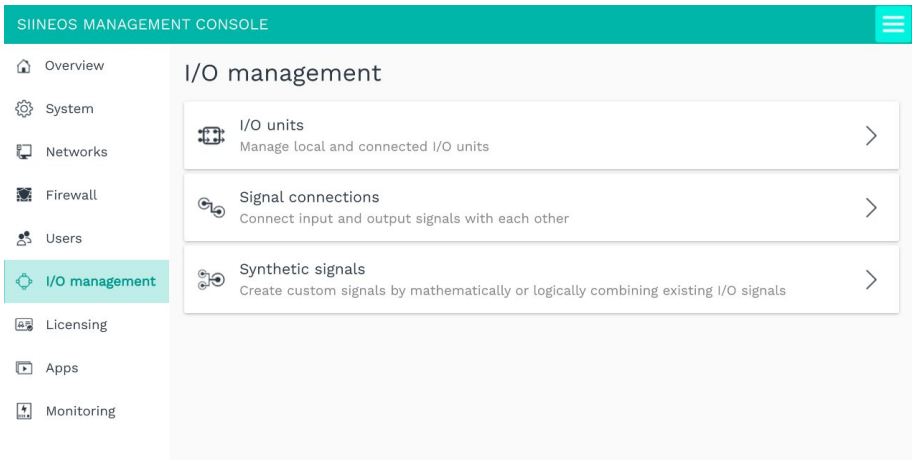


Fig. 27: “I/O management” page

For sample workflows that guide you through the software and the settings required for the task in an application-oriented manner, please go to *SIINEOS - workflow descriptions, page 78*.

5.1 Working with I/O management

When you use I/O management to create devices or clients or to configure signals and/or signal connections, there are several functions that can support you in your daily work. These include, for example, sorting and filtering of long lists or saving and reusing settings that you have made for a specific I/O unit. The following section will introduce you to these tools.

5.1.1 Filtering I/O units

If there are a large number of devices on the **I/O units** page, it may be helpful to filter them. You have the following filters available:

Fig. 28: Filter criteria (the “Connected” filter is currently applied)

The following rules apply to the filtering of entries:

- An I/O device can either be connected **or** disconnected, i.e., the device is physically connected, or the underlying network connection is established (e.g., to the MQTT broker or to the OPC UA server).
- An I/O unit can either be enabled **or** disabled. This is done in the general settings of each unit.
- For example, an I/O unit may be disconnected but still enabled, or connected but still disabled, etc.

  Exception: For I/O units based on network connections, “connected” and “disabled” are mutually exclusive. Here, the “connected” state is the only way to determine whether the connection parameters are correct, and a connection is possible.

Reading information

- Move the mouse over a tile. Further information about the created I/O unit is displayed.
- In case of error messages, a character is displayed in the upper right corner. In the tooltip you will find more information about this error message.

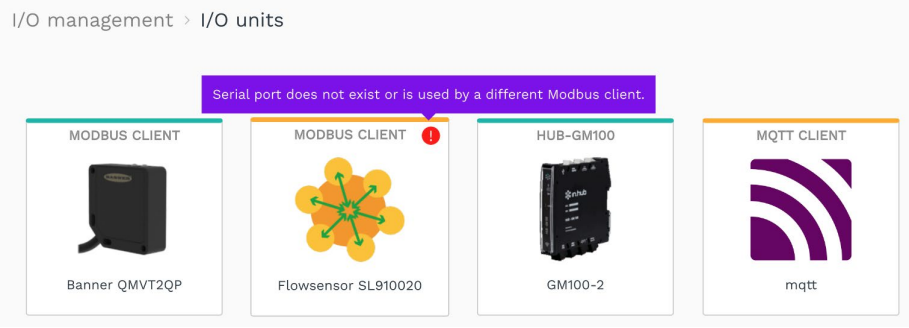


Abb. 29: Error message at I/O unit "Modbus Client" (example)

Setting filters

1. On the **I/O management** page, click a filter in the upper right corner to apply it.

   The filter changes its color to turquoise.

2. Click the filter again to deselect it.

   The filter changes its color to gray.

5.1.2 Using the menu „Actions“

If you edit entries in the I/O management, you can use the **Actions** menu in the **Add I/O unit** and **Synthetic signals** windows. This allows you to save the entries with the settings you have made in order to use them again elsewhere, or you can load entries that have already been saved onto the current device.

1. Open a I/O unit and click the **Actions** button.

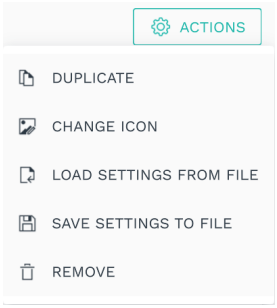


Fig. 30: “Actions” menu

-or-

Open the list with the synthetic signals and click the **More actions** button.

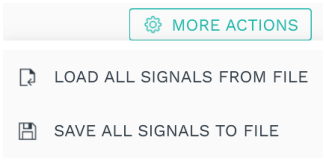


Abb. 31: Synthetic signales > Menu „More actions“

2. Now select the required action for the I/O unit or the synthetic signal:

Duplicate	A tile is created on the **I/O unit** page and identified by the suffix **(copy).** You can now edit this I/O unit as you wish.

Change icon (Picture of an I/O unit)	A dialog is displayed where you can upload the new image. 1. Click in the **Image file** input field and select from your local data directory the new image in PNG format and with max. 128 KB file size. 2. Click **Upload and update**. 3. If you want to restore the original image, click **Reset to default**. 4. Confirm with **OK**. The image is now replaced.
Load settings from file	This allows you to apply settings that have already saved to the open I/O unit. Your local data directory opens. 1. Select the file with the settings to upload.
Save settings to file	Depending on your system, a file save dialog will open or the file will be automatically downloaded to your download folder.
Remove	1. Confirm with **Yes**. The unit is then removed.
Load all signals from file	This allows you to load all signals into the list that you have already saved. Your local data directory opens. 1. Select the JSON file with the settings to upload it.
Save all signals to file	All synthetic signals including their settings are saved in a JSON file and downloaded immediately.

5.1.3 Sorting lists and reading information

You can quickly and easily sort lists and read various information about signals, signal connections, or synthetic signals directly in the list view.

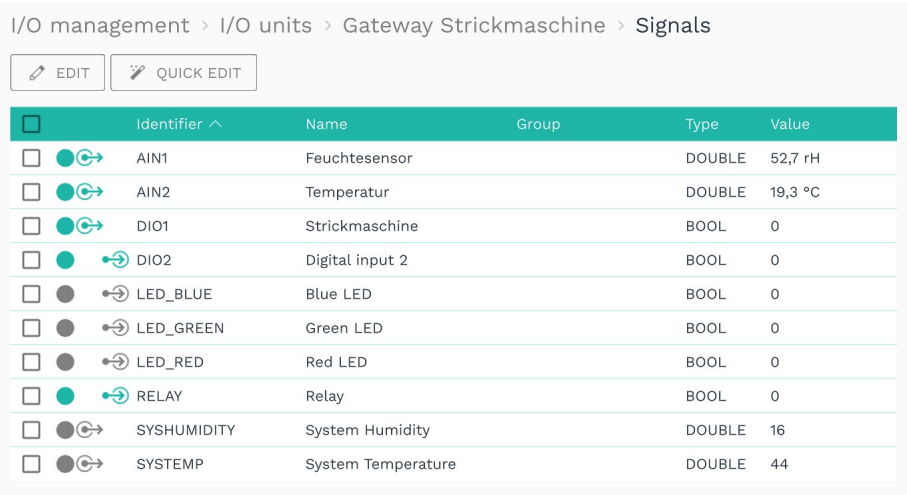


Fig. 32: List view of the signals from the HUB-GM100 (example)

1. Open an I/O unit and go to the overview of signals.

   -or-

   On the **I/O management** page, click **Signal connections.**

   -or-

   On the **I/O management** page, click **Synthetic signals.**

   A list view is displayed showing all signals or connections.

2. To sort, click in the header of a column.

   You can sort alphabetically forward (A-Z) or alphabetically backward (Z-A).

3. To get information on the states of a signal or a signal connection, pay attention to the following icons:

   Only for signals: Entry is selected for the **Remove** and **Quick edit** function

   Signal or signal connection is activated

   Signal or signal connection is deactivated

   Only for signals: Signal is being written to the I/O unit (e.g., to a relay)

   Only for signals: Signal is being read from the I/O unit (e.g., from a sensor at an analog input)

   NOTE: The icons may vary depending on the task you have selected on the **I/O management** page.

5.1.4 Editing, duplicating, or removing list entries

For editing signals, signal connections, or synthetic signals, various buttons are available in each list view.

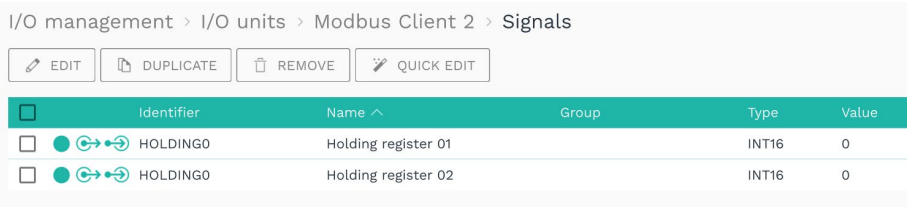


Fig. 33: List view with buttons for editing (example)

NOTE: The buttons for the signals may vary depending on the I/O unit selected. If a button is not displayed in a list view, this function is not available for the selected I/O unit.

1. Open an I/O unit and go to the overview of signals.

   -or-

   On the **I/O management** page, click **Signal connections.**

   -or-

   On the **I/O management** page, click **Synthetic signals.**

   A list view is displayed showing all signals or connections.

2. Select one of the following buttons:

Edit	1. Select an entry and click **Edit**. -or- Double-click the entry you want to edit. You will return either to the setup wizard or to the Signal settings.
Duplicate	1. Select a list entry and click **Duplicate**. A copy of the signal or signal connection will be created, which you can edit as usual. **NOTE**: This button is not displayed for I/O units that have fixed preconfigured signals or channels.
Remove	1. Select the signal via the checkbox. -or- Select the signal connection. 2. Click **Remove**. A message will be displayed asking if you really want to delete the entry. 3. Confirm with **Yes**.

Edit signal properties (Only in Synthetic signals)	1. Select a synthetic signal from the list and click **Edit signal properties**. A window will open where you will find three tabs. 2. In the **Signal settings** tab, activate and configure the synthetic signal. 3. In the **Signal processing** tab, you can define how the signal value should be processed. For more details, see *Configuring signal-processing steps, page 67*. 4. Click **Save**. 5. In the **Measurement modelling** tab, you define how the measured values are to be displayed. For more details, see *Configuring measurement modelling, page 71*. 6. Finally, click **Save & close**.
Reset (Only in Synthetic signals)	Resets an applied counter (**Infinite counter** or **Resettable counter**). 1. Select a synthetic signal and click **Reset**. The counter is reset.
Quick edit (Only under I/O unit > Signals)	1. If you want to edit several signals at the same time, select the signals via the checkbox and then click **Quick edit**. 2. Select one of the five actions to be applied to all selected signals: ○ **Enable/Disable**: Enable or disable multiple signals at once ○ **Group**: Assign a common group name ○ **Data series set**: All synthetic signals including their Assign a common name for the data series set. This will display all signals with the same data series set in FlexPlorer under Live diagrams in a common diagram, so that the signal values of different devices/sensors can be compared directly in live operation. ○ **Sampling interval**: Set the sampling interval ○ **Decimals**: Set the number of decimal places ○ **Unit**: Set a unit A dialog window opens. 3. Enter the parameter required by the selected quick tool (e.g., the group name or number of decimal places). 4. Click **Save & close**.

5.1.5 Searching for entries

The search function is available for all list views of the SIINEOS management console. In the **I/O management,** you can use it to search through I/O units, signals, signal connections, and synthetic signals.

1. Just start typing.

   Your input is directly transferred to the search field in the upper right corner and the hits are dynamically displayed in the list.

   You can enter upper- or lower-case letters and numbers.

   The search runs through all the entries you have made in the settings, for example, also device addresses.

5.2 Creating I/O units

If you have selected **I/O units** on the **I/O management** page, you can now set up your peripheral devices. Each device has individual settings and parameters, so the following sections describe how to set up each I/O unit separately.

On the in.hub download portal you will also find the operating manuals of in.hub's own devices for further information: https://download.inhub.de/

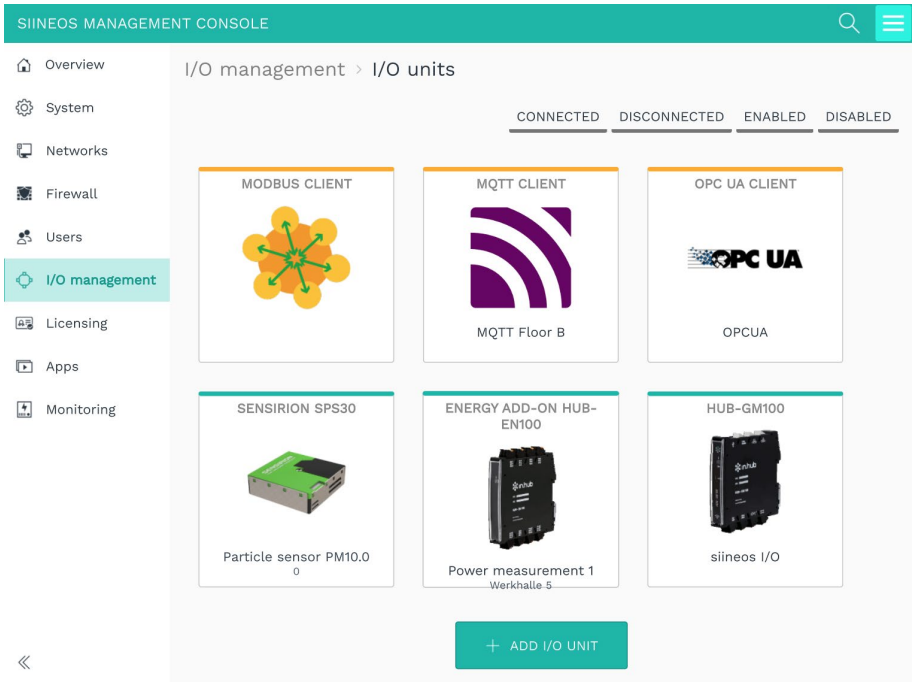


Fig. 34: I/O management > I/O units (example)

5.2.1 Adding a HUB-GM100

NOTE: This I/O unit refers to the local gateway you are currently using and allows you to access signals at the local interfaces.

1. On the home page of **I/O management,** select **I/O units.**
2. Click **Add I/O unit**.
3. Select **HUB-GM100** or **HUB-GM200** as the type.

   The setup wizard opens to guide you through the creation process. In the following, confirm each entry either with **Next** or by pressing **Enter**.
4. Enter the **Name** for the I/O unit.
5. Click **Finish** to add the I/O unit.

   A page opens, where you can now make the settings for the unit.

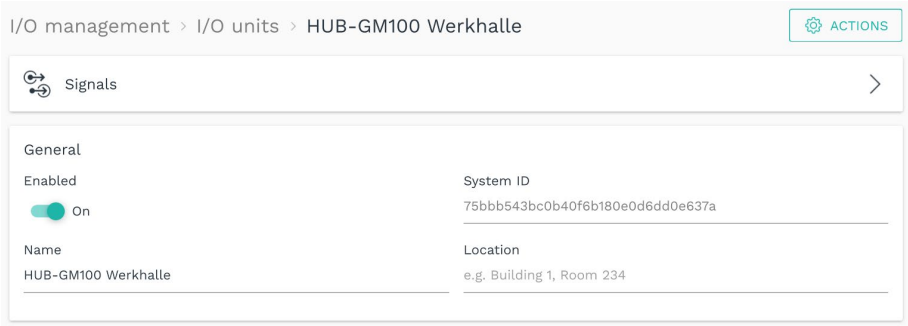


Fig. 35: Device settings for the HUB-GM100 (example)

The new I/O unit is automatically enabled. If you only want to use it later, you have to set the slider to **Off**.

6. Optional: Enter the **Location**.
7. Click **Signals**.

   The signals for all interfaces and internal sensors are already created.

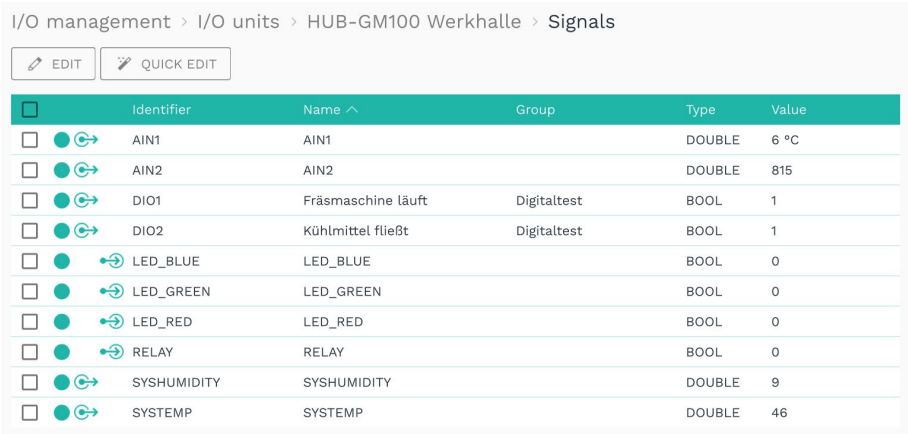


Fig. 36: Signals for the HUB-GM100 (example)

8. Select the signal you want to configure.

   A window opens, where you will find three tabs.

9. In the **Signal settings** tab, activate and configure the interface.
   - Optional: Change the name of the interface.
   - Set the slider to **On**.
   - In the **Sampling interval** field, specify the intervals at which the signal is to be sampled (in milliseconds).
10. Depending on the selected signal type, further inputs are necessary:

AIN (analog input)	**Mode** Select the analog interface type for the connected sensor. The options are 0...5 V / 0...10 V / 0...20 V / 4...20 mA
DIO (digital input/output)	**Mode** Specify whether this interface is to act as an input or output. - You have selected **Input**: To count how many times the signal value has changed from 0 to 1, set the slider **Count rising edges** to **On**. To count how many times the signal value has changed from 1 to 0, set the slider **Count falling edges** to **On**. - You have selected **Output**: Under **Default state** set the slider to **On**, if a positive voltage is to be output at the digital input.
LED	**Default state** Set whether the LED should be off or on in the default state.
Relay	**Default state** Set whether the relay should be off or on in the default state.

11. In the **Signal processing** tab, you can define how the signal value should be processed.

    For more information, see *Configuring signal-processing steps, page 67*.
12. Click **Save**.
13. In the **Measurement modelling** tab, you can define how the measured values are to be displayed.

    For more information, see *Configuring measurement modelling, page 71*.
14. Finally, click **Save & close**.

5.2.2 Adding a HUB-GM200

NOTE: This I/O unit refers to the local gateway you are currently using and allows you to access signals at the local interfaces.

15. On the home page of **I/O management,** select **I/O units.**
16. Click **Add I/O unit**.
17. Select **HUB-GM200** as the type.

    The setup wizard opens to guide you through the creation process. In the following, confirm each entry either with **Next** or by pressing **Enter**.
18. Enter the **Name** for the I/O unit.
19. Click **Finish** to add the I/O unit.

    A page opens, where you can now make the settings for the unit.

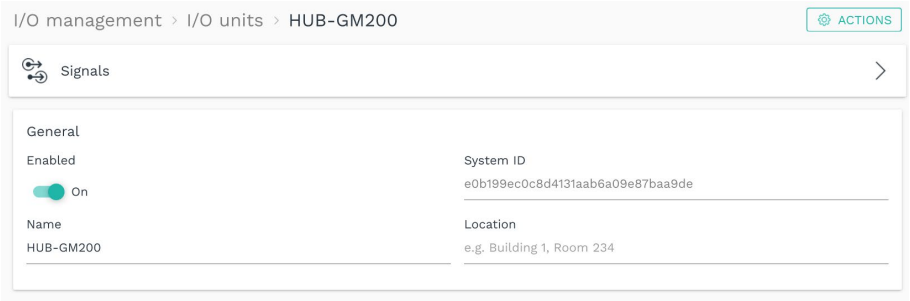


Fig. 37: Device settings for the HUB-GM200 (example)

The new I/O unit is automatically enabled. If you only want to use it later, you have to set the slider to **Off**.

20. Optional: Enter the **Location**.
21. Click **Signals**.

    The signals for all interfaces are already created.

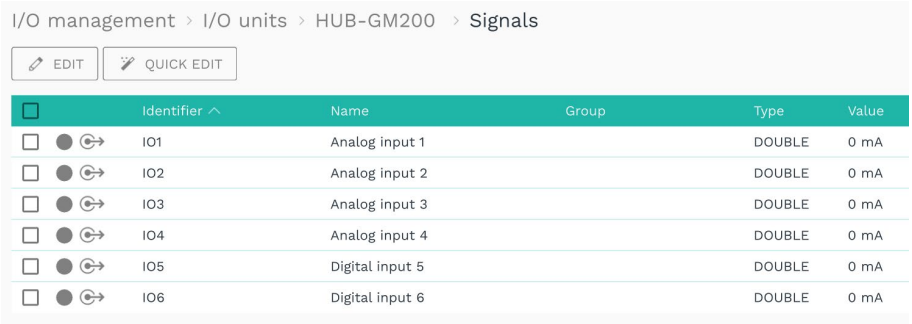


Fig. 38: Signals for the HUB-GM200 (example)

22. Select the signal you want to configure.

    A window opens, where you will find three tabs.
23. In the **Signal settings** tab, activate and configure the interface.
    - Optional: Change the name of the interface.
    - Set the slider to **On**.

- In the **Sampling interval** field, specify the intervals at which the signal is to be sampled (in milliseconds).

24. Depending on the selected signal type, further inputs are necessary:

IO1 to **IO4**	**Mode** Select the interface type for the connected sensor. • **Analog input 4...20 mA** • **Analog input 0...10 V** • **Digital input** To count how many times the signal value has changed from 0 to 1, set the slider **Count rising edges** to **On**. To count how many times the signal value has changed from 1 to 0, set the slider **Count falling edges** to **On**. • **Digital output** Set whether to be off or on as the **Default state**.
IO5 and **IO6**	**Mode** Specify whether this interface is to act as a digital input or digital output.

25. For all input signals you can define how the signal value should be processed in the **Signal processing** tab.

    For more information, see *Configuring signal-processing steps, page 67*.

26. Click **Save**.
27. In the **Measurement modelling** tab, you can define how the measured values are to be displayed.

    For more information, see *Configuring measurement modelling, page 71*.

28. Finally, click **Save & close**.

5.2.3 Adding a HUB-EN100 energy add-on module

1. On the home page of **I/O management,** select **I/O units.**
2. Click **Add I/O unit**.
3. Select **Energy Add-On HUB-EN100** as the type.

   The setup wizard opens to guide you through the creation process. In the following, confirm each entry either with **Next** or by pressing **Enter**.

4. Enter the **Name** for the I/O unit.

5. Click **Finish** to add the I/O unit.

   A page opens, where you can now make the settings for the unit.

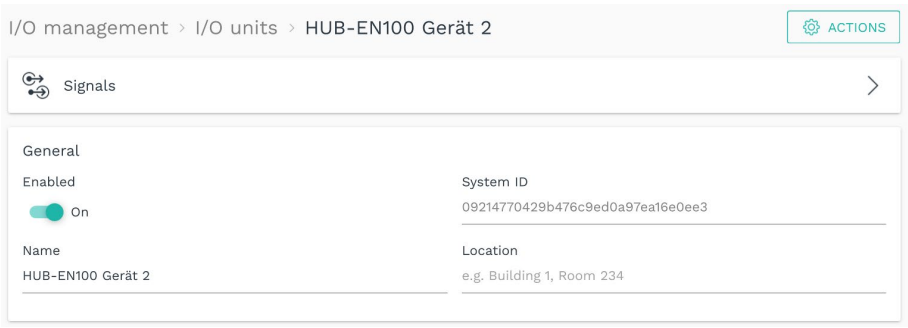


Fig. 39: Device settings for the HUB-EN100 (example)

   The new I/O unit is automatically enabled. If you only want to use it later, you have to set the slider to **Off**.

6. Optional: Enter the **Location.**

7. Click **Signals**.

   The signals for all channels of the HUB-EN100 are already created.

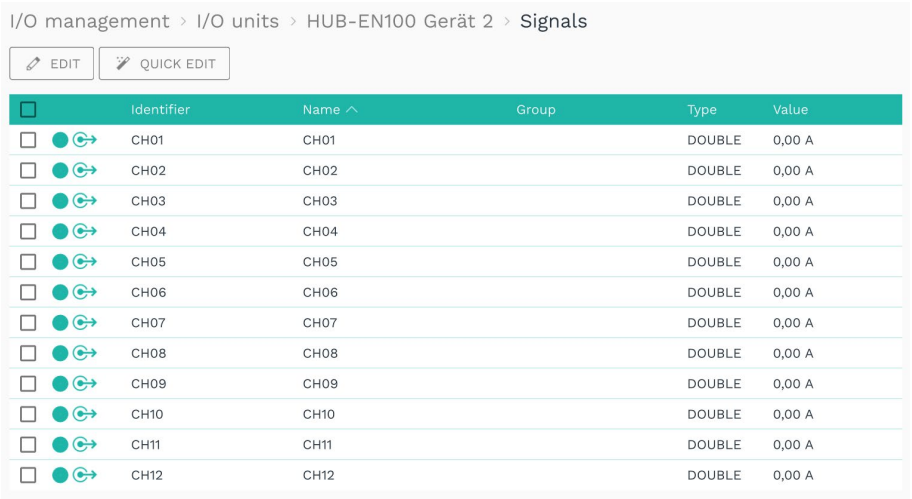


Fig. 40: Signals for the HUB-EN100 (example)

8. Select the signal you want to configure.

   A window opens, where you will find three tabs.

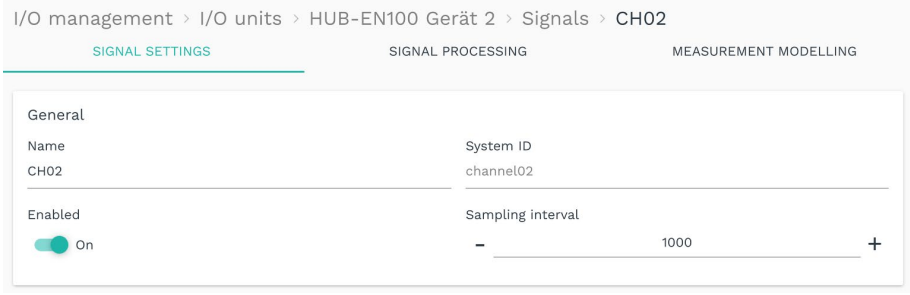


Fig. 41: “Signal settings” tab for the HUB-EN100

9. In the **Signal settings** tab, activate and configure the interface.
   - Optional: Change the name of the interface.
   - Set the slider to **On**.
   - In the **Sampling interval** field, specify the intervals at which the signal is to be sampled (in milliseconds).
10. In the **Signal processing** tab, you can define how the signal value should be processed.

    For more information, see *Configuring signal-processing steps, page 67*.
11. Click **Save**.
12. In the **Measurement modelling** tab, you define how the measured values are to be displayed.

    For more information, see *Configuring measurement modelling, page 71*.
13. Finally, click **Save & close**.

5.2.4 Adding the HUB-VM102 vibration module

1. On the home page of **I/O management,** select **I/O units.**
2. Click **Add I/O unit**.
3. Select **HUB-VM102** as the type.

   The setup wizard opens to guide you through the creation process. In the following, confirm each entry either with **Next** or by pressing **Enter**.
4. Enter the **Name** for the I/O unit.
5. Click **Finish** to add the I/O unit.

   A page opens, where you can now make the settings for the unit.

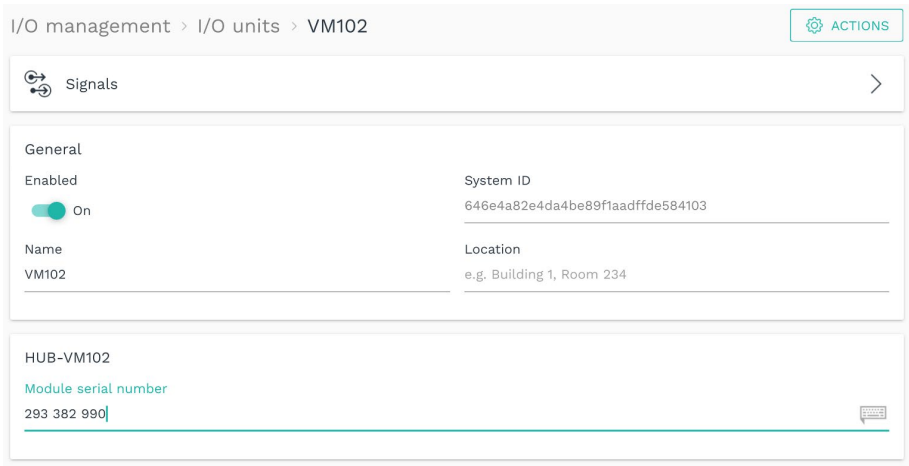


Fig. 42: Device settings for the HUB-VM102 (example)

   The new I/O unit is automatically enabled. If you only want to use it later, set the slider to **Off**.
6. Optional: Enter the **Location.**
7. Under **Module serial number**, enter the S/N number that can be found on the housing of the HUB-VM102.

8. Click **Signals**.

   The signals for all channels of the HUB-VM102 are already created.

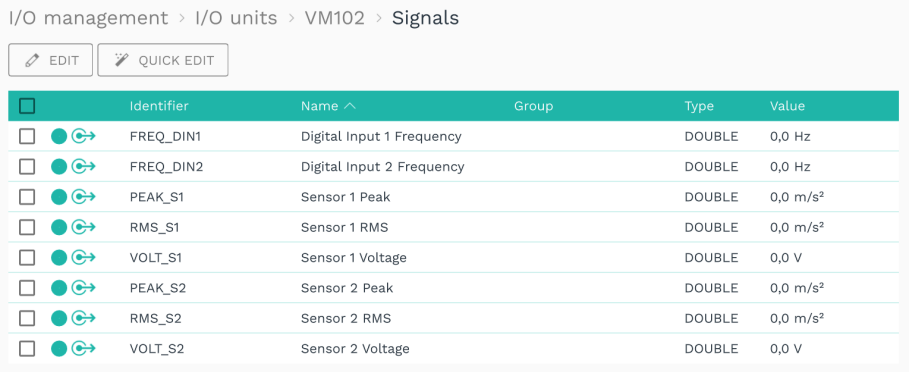


Fig. 43: Signals for the HUB-VM102 (example)

9. Select the signal you want to configure.

   A window opens, where you will find three tabs.

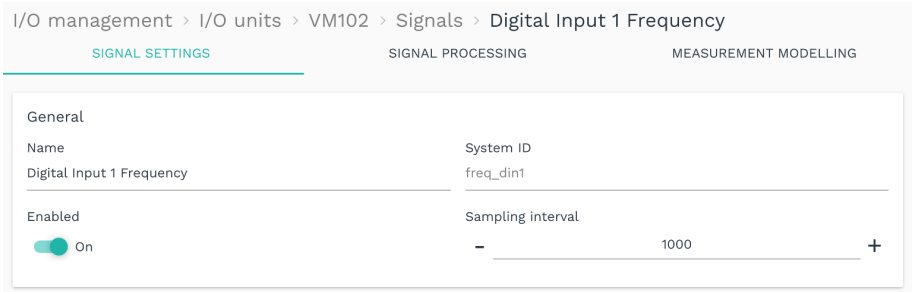


Fig. 44: “Signal settings” tab for the HUB-VM102

10. In the **Signal settings** tab, activate and configure the interface.
    - Optional: Change the name of the interface.
    - Set the slider to **On**.
    - In the **Sampling interval** field, specify the intervals at which the signal is to be sampled (in milliseconds).
11. In the **Signal processing** tab, you can define how the signal value should be processed.

    For more information, see *Configuring signal-processing steps, page 67*.
12. Click **Save**.
13. In the **Measurement modelling** tab, you define how the measured values are to be displayed.

    For more information, see *Configuring measurement modelling, page 71*.
14. Finally, click **Save & close**.

5.2.5 Adding a Sensirion SPS30 particle sensor

1. On the **I/O management** page, select **I/O units.**
2. Click **Add I/O unit**.
3. Select **Sensirion SPS30** as the type.

   The setup wizard opens to guide you through the creation process. In the following, confirm each entry either with **Next** or by pressing **Enter**.
4. Enter the **Name** for the I/O unit.
5. Click **Finish** to add the I/O unit.

   A page opens, where you can now make the settings for the unit.

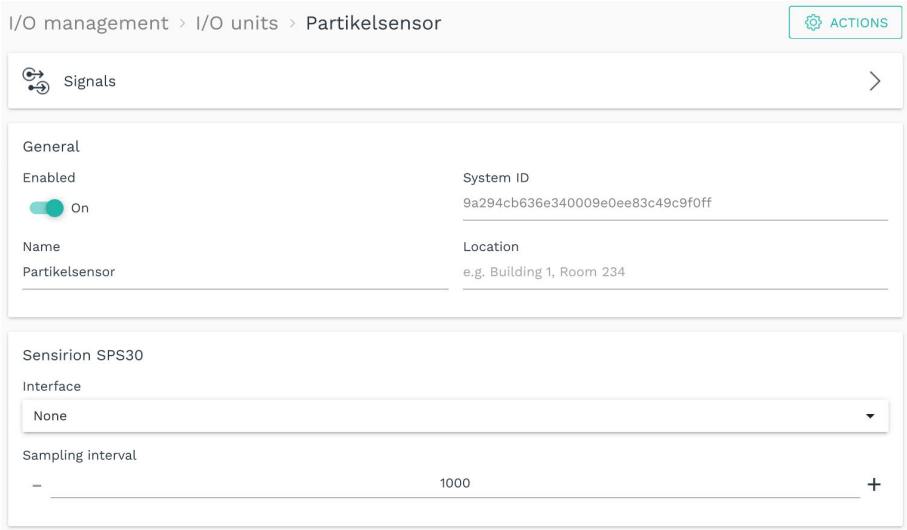


Fig. 45: Device settings for the Sensirion SPS30 particle sensor (example)

   The new I/O unit is automatically enabled. If you only want to use it later, set the slider to **Off**.
6. Optional: Enter the **Location**.
7. In the **Interface** drop-down list, select the sensor you want to add.

   NOTE: This list is only filled in if you also have sensors connected. If multiple sensors are connected, e.g., via a USB hub, then the sensors are numbered in sequence as they are plugged in to the USB hub.
8. In the **Sampling interval** field, specify the intervals at which the signal is to be sampled (in milliseconds).
9. Click **Signals**.

   The signals for all measured values of the particle sensor are already created.

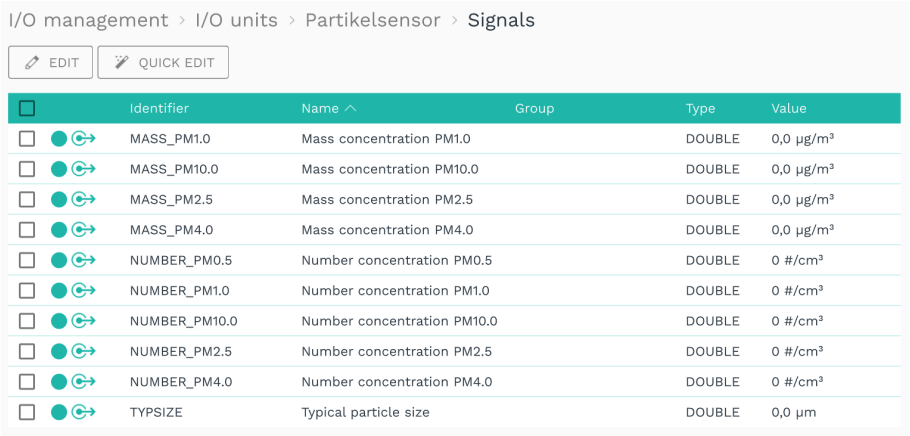


Fig. 46: Signals for the Sensirion SPS30 particle sensor (example)

10. Select the signal you want to configure.

    A window opens, where you will find three tabs.

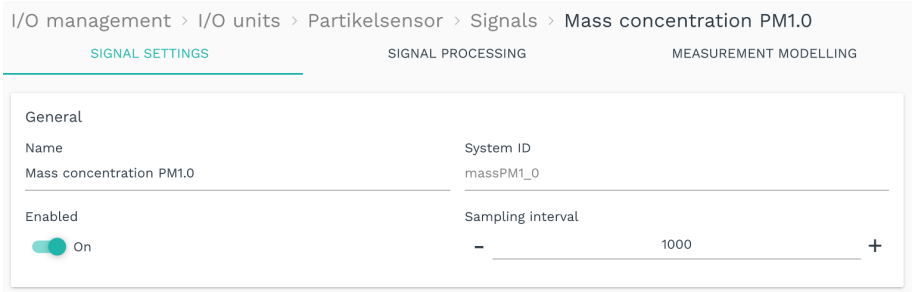


Fig. 47: “Signal settings” tab for the Sensirion SPS30

11. In the **Signal settings** tab, activate and configure the interface.
    - Optional: Change the name of the interface.
    - Set the slider to **On**.
    - In the **Sampling interval** field, specify the intervals at which the signal is to be sampled (in milliseconds).
12. In the **Signal processing** tab, you can define how the signal value should be processed.

    For more information, see *Configuring signal-processing steps, page 67*.
13. Click **Save**.
14. In the **Measurement modelling** tab, you define how the measured values are to be displayed.

    For more information, see *Configuring measurement modelling, page 71*.
15. Finally, click **Save & close**.

5.2.6 Adding a Modbus RTU Modbus client

1. On the **I/O management** page, select **I/O units.**

   Before you create a new Modbus client of the type **Modbus RTU**, please check if there is already a Modbus RTU client.

   If you want to connect a second device via Modbus RTU, the already created Modbus RTU client must be used, because there is only one physical Modbus RTU interface.

   However, in case a virtual RS485 or RS232 interface is connected via an external USB interface, a 2nd Modbus RTU client must be created.

2. Click **Add I/O unit**.
3. Select **Modbus client** as the type.

   The setup wizard opens to guide you through the creation process. In the following, confirm each entry either with **Next** or by pressing **Enter**.

4. Enter the **Name** for the I/O unit.
5. Click **Finish** to add the I/O unit.

   A page opens, where you can now make the settings for the unit.

   The new I/O unit is automatically enabled. If you only want to use it later, set the slider to **Off**.

6. Optional: Enter the **Location**.
7. Under **Modbus type** select **Modbus RTU.**

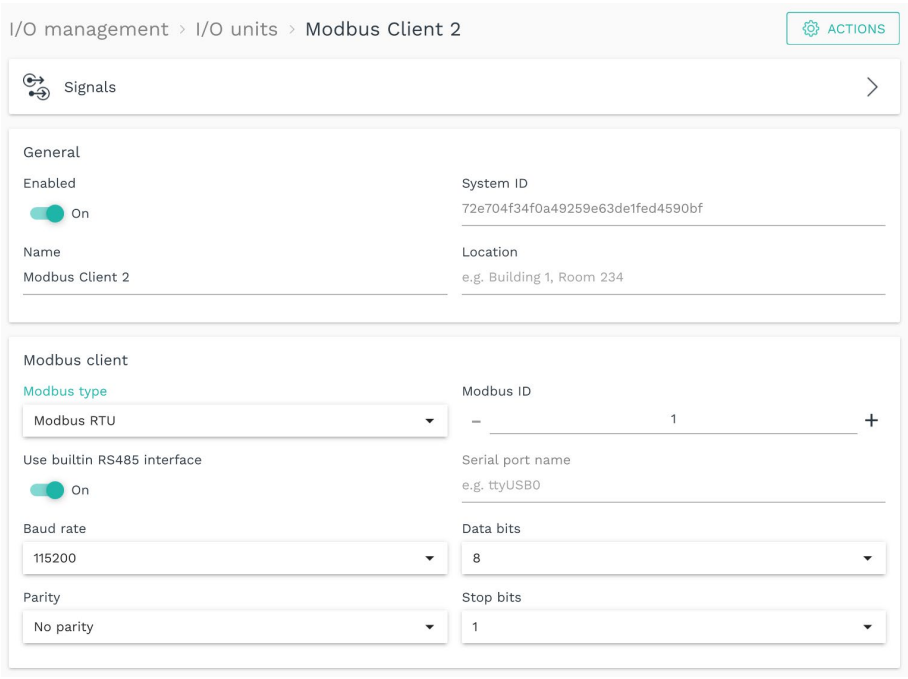


Fig. 48: Device settings for the Modbus client type RTU (example)

8. In the **Modbus client** area you now make the following settings.
   - Under **Modbus ID** enter the ID of the device you want to communicate with.
   - Fill in all other input fields, like **Baud rate** or **Parity** according to the documentation of the connected device.

- Optional: If you connect a sensor via the external USB interface, which provides a virtual RS485 or RS232 interface (virtual COM port) to communicate via Modbus, then set the **Use builtin RS485 interface** slider to **Off**.
- **NOTE**: If you use this option, you must also specify a name for the serial port. This is sensor-dependent and may need to be determined via SSH. Usually either "ttyUSB0" or in some cases "ttyACM0" is used.

  By default, the slider is set to **On**.

9. Click **Signals**.

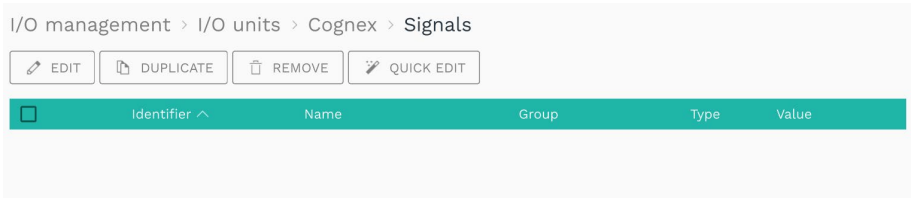


Fig. 49: Initially, no signals are predefined for the Modbus client

10. Click **Add I/O signal**.

    A window opens, where you will find three tabs.

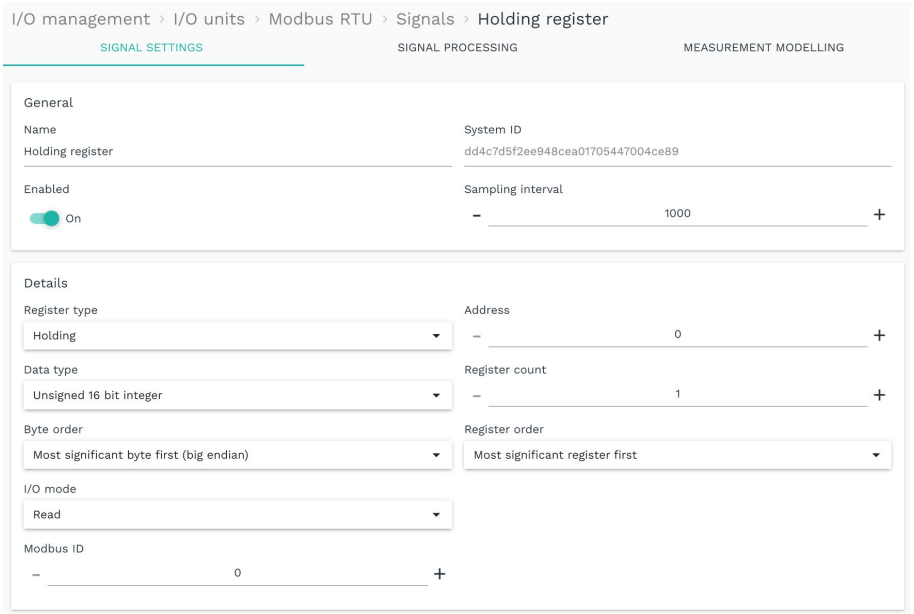


Fig. 50: “Signal settings” tab for the Modbus client

11. In the **Signal settings** tab, activate and configure the signal.
    - Optional: Change the name of the signal.
    - Set the slider to **On**.
    - In the **Sampling interval** field, specify the intervals at which the signal is to be sampled (in milliseconds).

      NOTE: If you have selected the **I/O mode** "Write", no sampling takes place, and the sampling interval is ignored. Instead, the default value is written at startup and at each change. If the register is connected to a source signal via signal connection, the register is written with each change of the source signal.

12. Further entries are necessary in the **Details** area.
    - Depending on the selected register type, different entries can be made as to whether to read from the register or whether and what is to be written to the register. Please also refer to the tooltips.
    - If only one device is connected via the Modbus RTU client, then leave the **Modbus ID** at the default value **0**.
    - If another device shall communicate via Modbus RTU, then you have to add another signal to the already created I/O unit **Modbus Client** (**I/O Unit > Modbus RTU > Signals > Add I/O Signal**) and give this signal a different Modbus ID. This ignores the global setting of the already created I/O unit **Modbus Client** (see point 8) and uses the Modbus ID entered here instead.
    - Fill in all other input fields according to the documentation of the connected device.
13. In the **Signal processing** tab, you can define how the signal value should be processed.

    For more information, see *Configuring signal-processing steps, page 67*.
14. Click **Save**.
15. In the **Measurement modelling** tab, you define how the measured values are to be displayed.

    For more information, see *Configuring measurement modelling, page 71*.
16. Finally, click **Save & close**.

5.2.7 Adding a Modbus TCP Modbus client

1. On the **I/O management** page, select **I/O units.**
2. Click **Add I/O unit**.
3. Select **Modbus client** as the type.

   The setup wizard opens to guide you through the creation process. In the following, confirm each entry either with **Next** or by pressing **Enter**.
4. Enter the **Name** for the I/O unit.
5. Click **Finish** to add the I/O unit.

   A page opens, where you can now make the settings for the unit.

   The new I/O unit is automatically enabled. If you only want to use it later, set the slider to **Off**.
6. Optional: Enter the **Location**.
7. Under **Modbus type** select **Modbus TCP.**

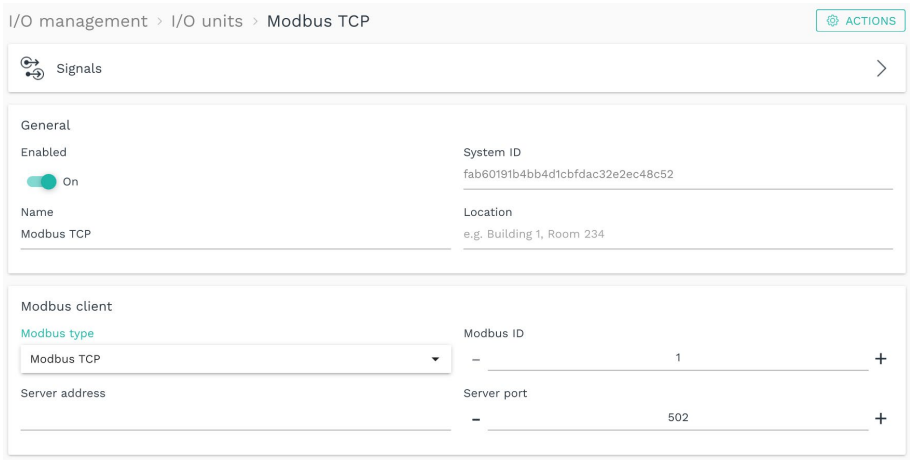


Fig. 51: Device settings for the Modbus client type TCP (example)

8. Enter the Modbus ID of the device you want to communicate with.
9. Enter the **Server address** and the **Server port** of the Modbus TCP server.
10. Click **Signals**.

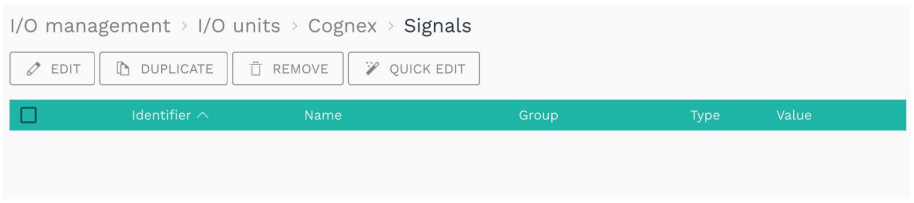


Fig. 52: Initially, no signals are predefined for the Modbus client

11. Click **Add I/O signal**.

    A window opens, where you will find three tabs.

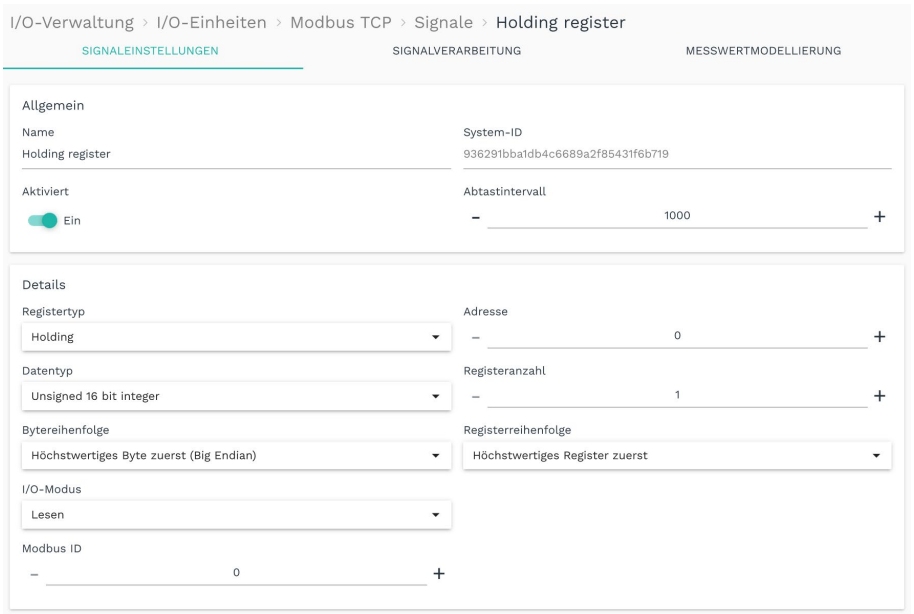


Fig. 53: “Signal settings” tab for the Modbus client

12. In the **Signal settings** tab, activate and configure the signal.
    - Optional: Change the name of the signal.
    - Set the slider to **On**.
    - In the **Sampling interval** field, specify the intervals at which the signal is to be sampled (in milliseconds).

      NOTE: If you have selected the **I/O mode** "Write", no sampling takes place, and the sampling interval is ignored. Instead, the default value is written at startup and at each change. If the register is connected to a source signal via signal connection, the register is written with each change of the source signal.
13. Further entries are necessary in the **Details** area.
    - Depending on the selected register type, different entries can be made as to whether to read from the register or whether and what is to be written to the register. Please also refer to the tooltips.
    - Fill in all other input fields according to the documentation of the connected device.
14. In the **Signal processing** tab, you can define how the signal value should be processed.

    For more information, see *Configuring signal-processing steps, page 67*.
15. Click **Save**.
16. In the **Measurement modelling** tab, you define how the measured values are to be displayed.

    For more information, see *Configuring measurement modelling, page 71*.
17. Finally, click **Save & close.**

5.2.8 Adding an MQTT client

1. On the **I/O management** page, select **I/O units.**
2. Click **Add I/O unit**.
3. Select **MQTT client** as the type.

   The setup wizard opens to guide you through the creation process. In the following, confirm each entry either with **Next** or by pressing **Enter**.
4. Enter the **Name** for the I/O unit.
5. Click **Finish** to add the I/O unit.

   A page opens, where you can now make the settings for the unit.

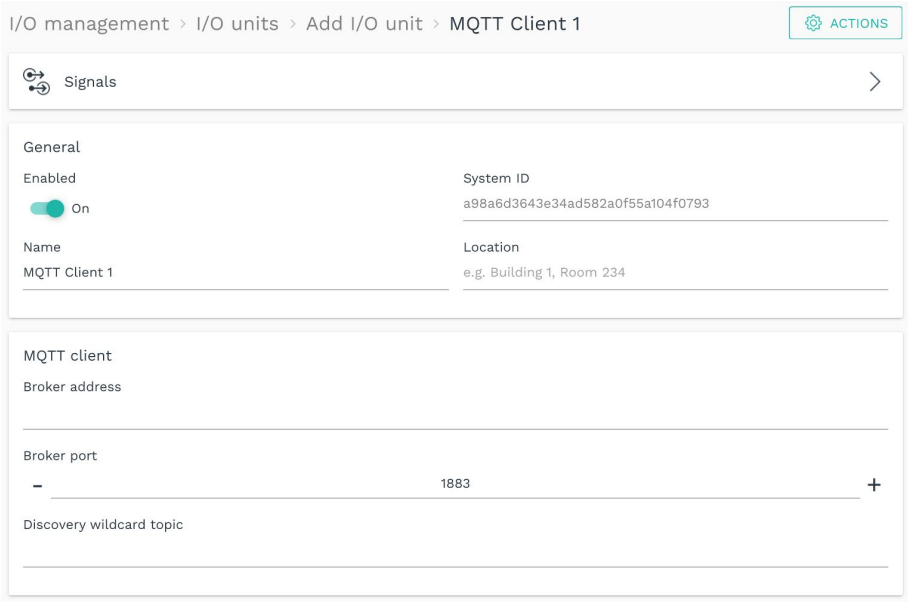


Fig. 54: Device settings for the MQTT client (example)

The new I/O unit is automatically enabled. If you only want to use it later, set the slider to **Off**.

6. Optional: Enter the **Location**.
7. Under **MQTT Client**, enter the **Broker address**, **Broker port**, and optionally the **Discovery wildcard topic.**

   NOTE: These parameters must be known to you from your MQTT network.
8. Click **Save**.
9. Click **Signals**.

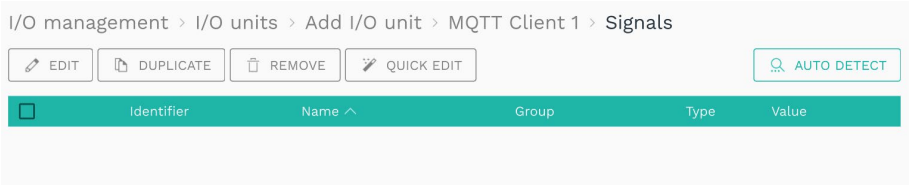


Fig. 55: Initially, no signals are predefined for the MQTT client

10. Click **Add I/O signal**.

    -or-

    Click **Auto detect** to add as signals all topics published on the MQTT broker that match the discovery wildcard topic as signals.

    When you add a new signal, a window opens, where you will find three tabs.

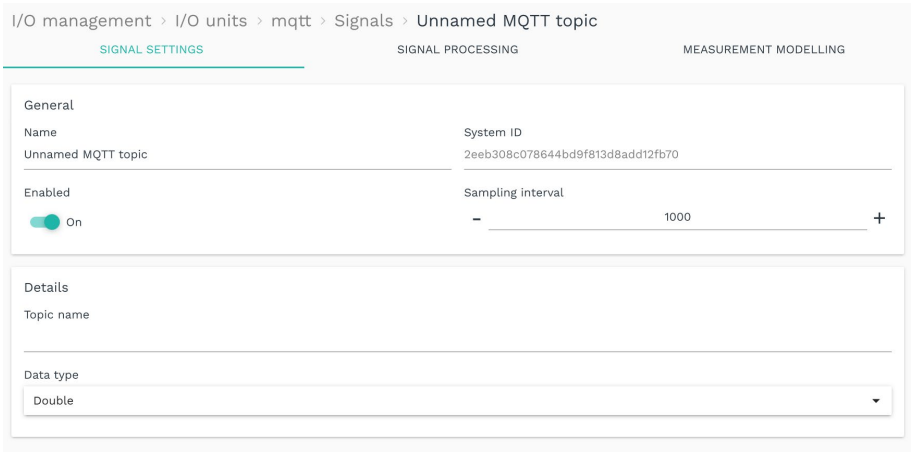


Fig. 56: “Signal settings” tab for the MQTT Client with “Double” data type

11. In the **Signal settings** tab, activate and configure the signal.
    - Enter the name of the signal.
    - Set the slider to **On**.
    - In the **Sampling interval** field, specify the intervals at which the signal is to be sampled (in milliseconds).
    - In the **Details** area, enter the **Topic name**.
    - In the **Data type** drop-down list, select how the data in the MQTT topic should be interpreted.

      Double is selected by default, i.e. the MQTT data is interpreted as double precision floating point numbers.

      If the data in the MQTT topic is a JSON string, select the **JSON data** entry. Only then you can enter the key name containing the actual numeric value in the **JSON data key** field.

    NOTE: These parameters must be known to you from your MQTT network.

12. In the **Signal processing** tab, you can define how the signal value should be processed.

    For more information, see *Configuring signal-processing steps, page 67*.

13. Click **Save**.

14. In the **Measurement modelling** tab, you define how the measured values are to be displayed.

    For more information, see *Configuring measurement modelling, page 71*.

15. Finally, click **Save & close**.

5.2.9 Adding an OPC UA client

1. On the **I/O management** page, select **I/O units.**
2. Click **Add I/O unit**.
3. Select **OPC UA client** as the type.

   The setup wizard opens to guide you through the creation process. In the following, confirm each entry either with **Next** or by pressing **Enter**.
4. Enter the **Name** for the I/O unit.
5. Click **Finish** to add the I/O unit.

   A page opens, where you can now make the settings for the unit.

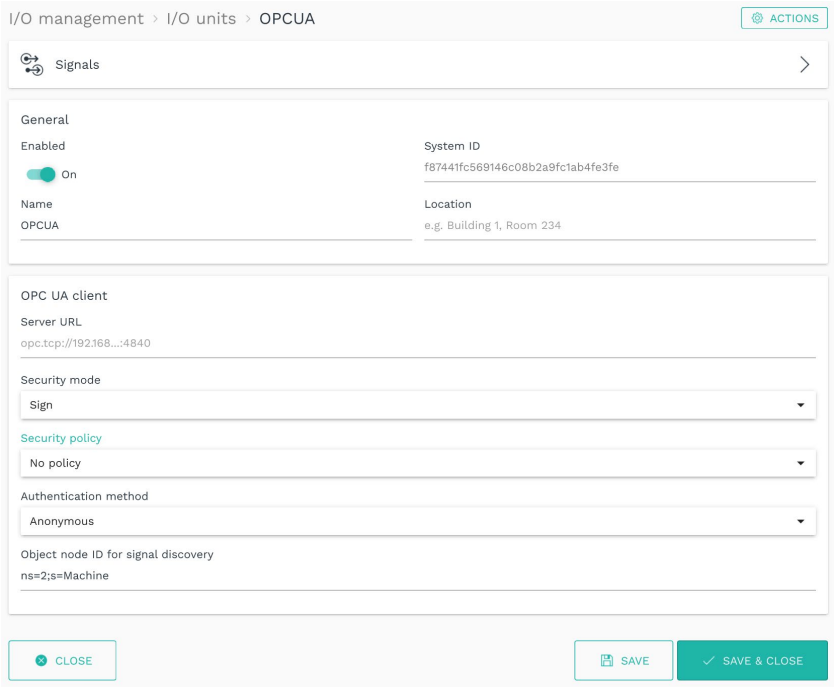


Fig. 57: Device settings for the OPC UA client (example)

   The new I/O unit is automatically enabled. If you only want to use it later, set the slider to **Off**.
6. Optional: Enter the **Location**.
7. Under **OPC UA client** make the following settings:
   - **Server URL**
   - Under **Security mode** you define whether messages between gateway and OPC-UA-Server should only be signed or encrypted and signed or if no security mode is necessary.
   - Under **Security policy** select which encryption algorithm should be used for the security modes.

     If no encryption algorithm is to be applied, select **No policy**. If it does, you can upload the respective server and client certificate as a file and enter the private key.

- If it has been defined on the OPC UA server that authentication is required, select the **Authentication method** "User name and password" and determine the user data. If no authentication is required select "Anonymous".
- If the value node is to be detected automatically, enter the complete **Object node ID for signal discovery** (optional input, in this example "ns=2;s=Machine").

NOTE: These parameters must be known from your OPC UA server (e.g., the PLC configuration).

8. Click **Save**.
9. Select **Signals**.

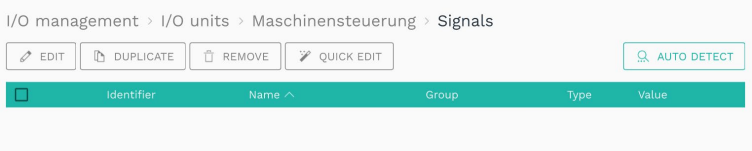


Fig. 58: Initially, no signals are predefined for the OPC UA client

10. Click **Add I/O signal**.

    -or-

    Click **Auto detect** if you have configured a valid object node ID for signal detection. Then, nodes representing a signal value are automatically detected and added as signals.

    When you add a new signal, a window opens, where you will find three tabs.

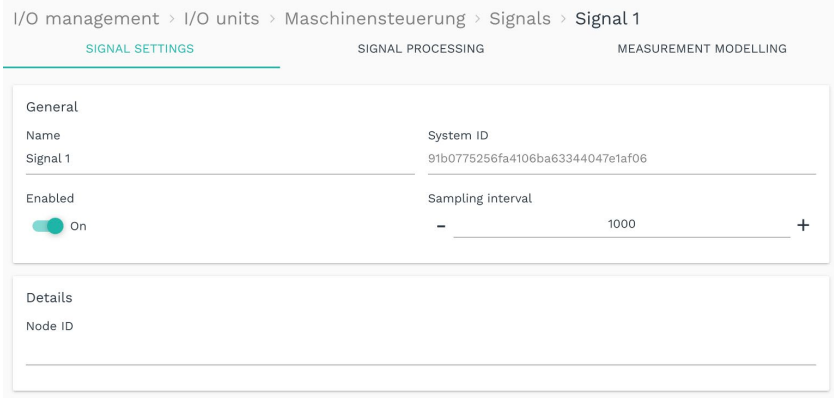


Fig. 59: “Signal settings” tab of the OPC UA client

11. In the **Signal settings** tab, activate and configure the signal.
    - Enter the name of the signal.
    - Set the slider to **On**.
    - In the **Sampling interval** field, specify the intervals at which the signal is to be sampled (in milliseconds).
    - In the **Details** area, enter the **Node ID.**

      NOTE: This parameter must be known to you from your OPC UA server (e.g., the PLC configuration).

      If the signal was automatically detected, the field **Node ID** is filled in. If not, specify the full node ID, e.g. “ns=2;s=Machine”.

12. In the **Signal processing** tab, you can define how the signal value should be processed.

    For more information, see *Configuring signal-processing steps, page 67*.

13. Click **Save**.
14. In the **Measurement modelling** tab, you define how the measured values are to be displayed.

    For more information, see *Configuring measurement modelling, page 71*.

15. Finally, click **Save & close**.

5.2.10 Adding a TBEN-S1-8DIP module

1. On the **I/O management** page, select **I/O units.**
2. Click **Add I/O unit**.
3. Select **TBEN-S1-8DIP** as the type.

   The setup wizard opens to guide you through the creation process. In the following, confirm each entry either with **Next** or by pressing **Enter**.

4. Enter the **Name** for the I/O unit.
5. Click **Finish** to add the I/O unit.

   A page opens, where you can now make the settings for the unit.

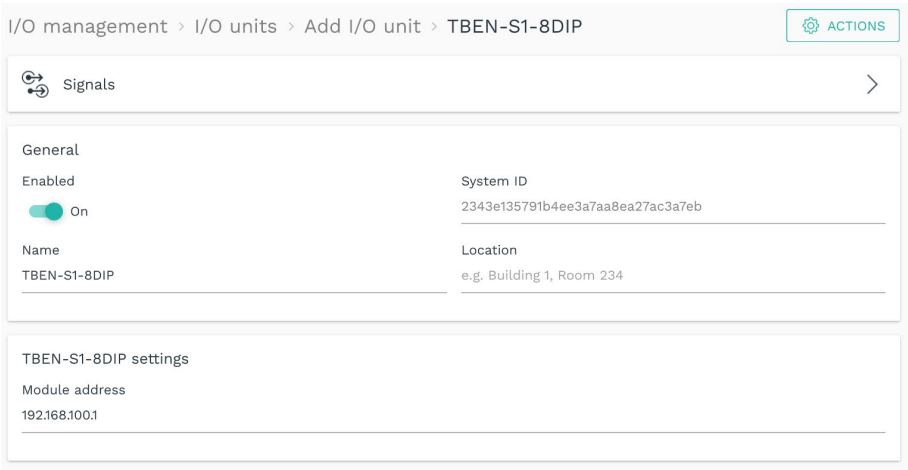


Fig. 60: Device settings for the TBEN-S1-8DIP module (example)

   The new I/O unit is automatically enabled. If you only want to use it later, set the slider to **Off**.

6. Optional: Enter the **Location**.
7. In the **Module address input** field, enter the host name or the IP address of the TBEN module to which a connection is to be established.
8. Click **Save**.
9. Select **Signals**.

   The signals for all digital inputs of the TBEN module are already created.

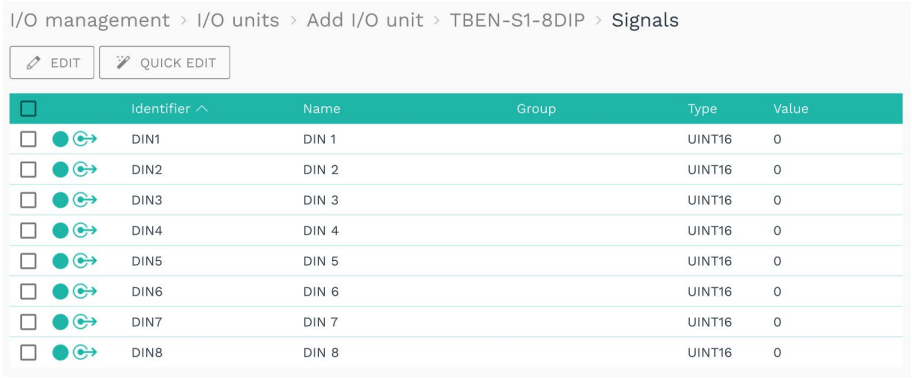


Fig. 61: Signals for the TBEN-S1-8DIP module

10. Select the signal you want to configure.

    A window opens, where you will find three tabs.

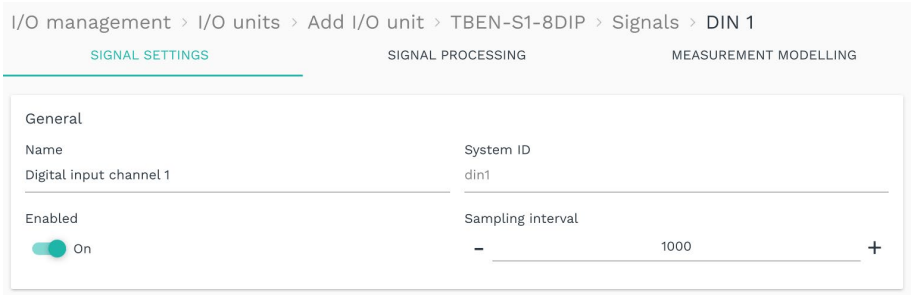


Fig. 62: “Signal settings” tab for the TBEN-S1-8DIP module

11. In the **Signal settings** tab, activate and configure the signal.
    - Enter the name of the signal.
    - Set the slider to **On**.
    - In the **Sampling interval** field, specify the intervals at which the signal is to be sampled (in milliseconds).
12. In the **Signal processing** tab, you can define how the signal value should be processed.

    For more information, see *Configuring signal-processing steps, page 67*.
13. Click **Save**.
14. In the **Measurement modelling** tab, you define how the measured values are to be displayed.

    For more information, see *Configuring measurement modelling, page 71*.
15. Finally, click **Save & close**.

5.2.11 Adding a TBEN-S2-4AI module

1. On the home page of **I/O management,** select **I/O units.**
2. Click **Add I/O unit**.
3. Select **TBEN-S2-4AI** as the type.

   The setup wizard opens to guide you through the creation process. In the following, confirm each entry either with **Next** or by pressing **Enter**.
4. Enter the **Name** for the I/O unit.
5. Click **Finish** to add the I/O unit.

   A page opens, where you can now make the settings for the unit.

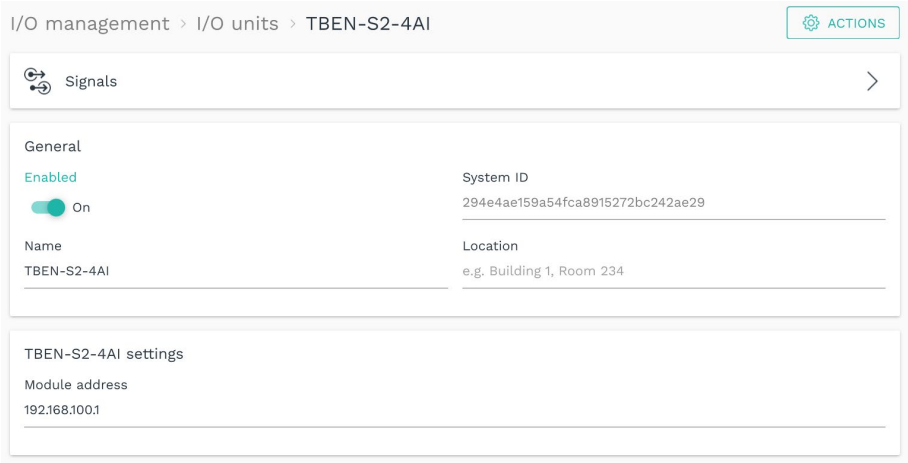


Fig. 63: Device settings for the TBEN-S2-4AI module (example)

   The new I/O unit is automatically enabled. If you only want to use it later, set the slider to **Off**.
6. Optional: Enter the **Location**.
7. Enter in the input field **Module address** the host name or the IP address of the TBEN module to which a connection is to be established.
8. Click **Save**.
9. Select **Signals**.

   The signals for all analog input channels are already applied.

Fig. 64: Signals for the TBEN-S2-4AI module

10. Select the signal you want to configure.

    A window opens, where you will find three tabs.

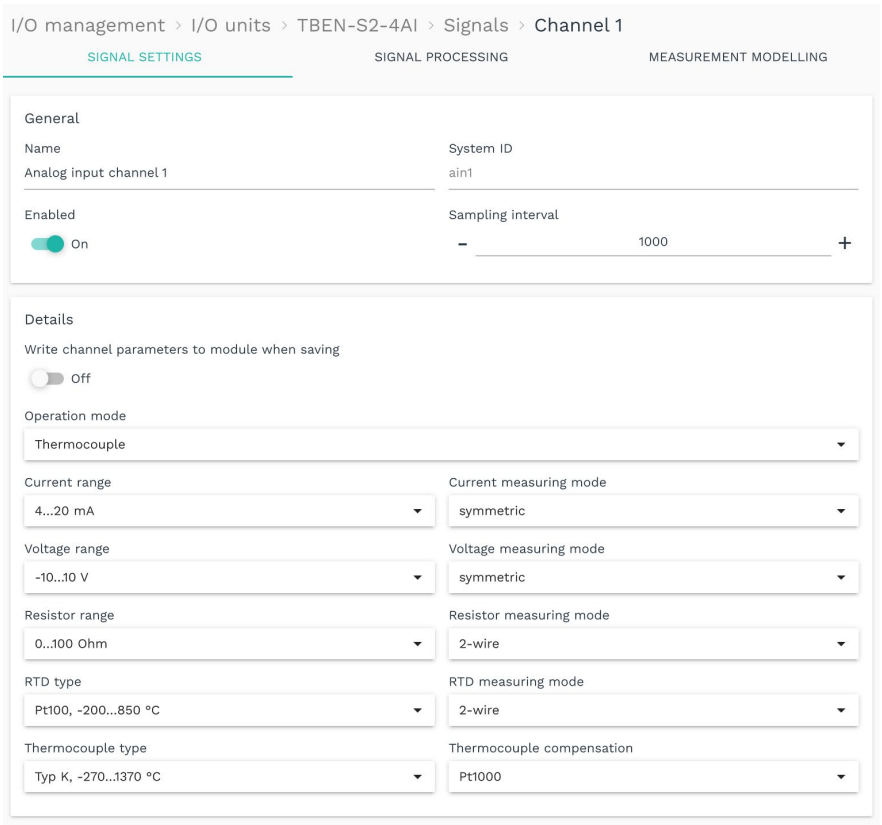


Fig. 65: “Signal settings” tab for the TBEN-S2-4AI module

11. In the **Signal settings** tab, activate and configure the signal.
    - Enter the name of the signal.
    - Set the slider to **On**.
    - In the **Sampling interval** field, specify the intervals at which the signal is to be sampled (in milliseconds).
    - The **Details** area displays the parameters that are read in by the connected TBEN-S2-4AI module.

      NOTE: Only make changes if you are sure that they will not damage the module.

      By activating the **Write channel parameters to module when saving** slider, you confirm that the settings read in and possibly changed are correct and should really be written back to the module. The changes only become effective if you click **Save** afterwards.
12. In the **Signal processing** tab, you can define how the signal value should be processed.

    For more information, see *Configuring signal-processing steps, page 67*.
13. Click **Save**.
14. In the **Measurement modelling** tab, you define how the measured values are to be displayed.

    For more information, see *Configuring measurement modelling, page 71*.
15. Finally, click **Save & close**.

5.2.12 Configuring signal-processing steps

HINWEIS: SIINEOS uses the expr-eval library as of version 2.7.4. This provides the following mathematical functions:

https://github.com/in-hub/expr-eval#expression-syntax

This can lead to incorrect results or signal processing steps that do not function properly for signals that have already been configured. Therefore, check the mathematical functions of your existing signal processing steps.

For all I/O units and interfaces, the steps with which signal values can be processed can be selected on the **Signal processing** tab.

The processing functions are processed by SIINEOS in the order in which they appear on the tab, so if you have activated **Preprocessing** and **Threshold comparison**, preprocessing is calculated first, and the threshold comparison is then carried out with this value.

The signal-processing steps are optional. You do not have to process your signal values: you can have them output unprocessed if this is sufficient.

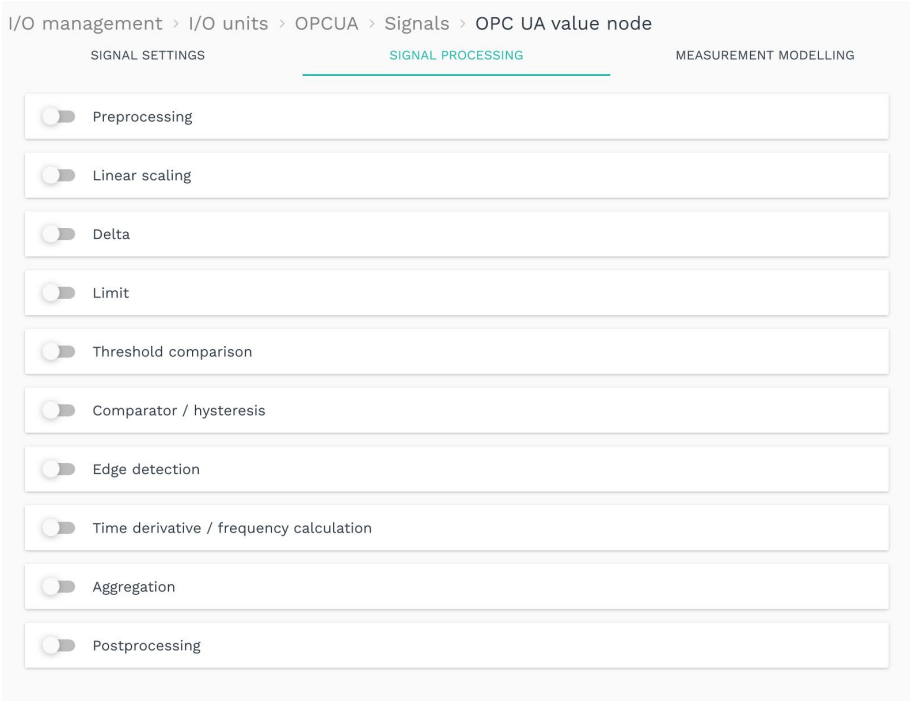


Fig. 66: “Signal processing” tab

1. Use the slider to activate the required step of the signal processing.

   The input area opens.

   The following processing functions are available:

Preprocessing	With this function, the signal value can be preprocessed via a mathematical expression. The signal value is available in the variable “x” and can be combined with any arithmetic operators (+ – * / % **) and constants. For example, a fixed value (offset) can be subtracted or added. SIINEOS uses the expr-eval library for the calculation. With this, the following mathematical functions can now be applied: https://github.com/in-hub/expr-eval#expression-syntax *Examples of mathematical expressions:* x - 2 (x - 4) * 0.7 sin(x * PI / 180) max(x, 10) abs(x)
Linear scaling	This function applies a simple linear function to the input value. While it is basically also possible to create a linear function using the parameters (slope/coefficient and constant) given in the previous function as a mathematical expression (e.g. x * 5 + 7), this function allows the simple input of 2 input and output values. These values are often known from the data sheets especially for analog sensors. *Example*: A temperature sensor can have a value range of -20 °C to +80 °C at a 4 ... 20 mA interface. In this case, the value **4** would be entered at **X1** and the value **20** at **X2,** as well as the value **-20** at **Y1** and the value **80** at **Y2.**
Delta	The function compares the current signal value with the previously measured signal value. You have several options via the drop-down list how the delta should be calculated: • Absolute difference to the previous value • Relative changes to the previous value • Relative changes to the previous value in %. • If the value changes from a numeric value that is considered positive to a numeric value that is considered negative (or vice versa), -1 (or +1) is output. This can be used to detect anomalies, for example.

Limit	The function sets lower and upper limits for the signal value downwards and/or upwards, i.e., if the signal is falling below the minimum value, the gateway supplies this minimum value as the signal value. If the signal value is above the maximum value, this value is used as the signal value.
Threshold comparison	The function converts the signal value into a logical 0 or 1 value, depending on how the signal value relates to the threshold value. *Example*: If the **Signal is above** mode is selected and a threshold value of **10** is set, the output of the device is 1 as long as the signal value is greater than 10. If it falls below, the output is 0.
Comparator/ hysteresis	The function compares the input value with a lower and upper threshold value and delivers the associated output value depending on the result. With this behavior, a two-point control or hysteresis is achieved. In addition, the course over time can be included by setting the minimum undercut and minimum overshoot duration to a value greater than 0 ms. For the output signal to assume the upper output value, the input signal must be continuously above the upper threshold for a certain number of milliseconds. Similarly, the output signal is only reset to the lower output value if the value has fallen below the lower threshold value for longer than x milliseconds.
Edge detection	If (especially digital) signals are to be used for counting, the rising and/or falling edges can be counted. A counter is then used as the output value, which increases each time the input signal changes from 0 to 1 (rising edge) or from 1 to 0 (falling edge). Analog signals can also be converted into digital signals using upstream functions such as threshold value comparison, e.g., by using the value 1 (rising edge) as input for edge detection when a threshold value is exceeded and thus automatically using the value 0 as input when the value falls below the threshold value.
Time derivative / frequency calculation	This function determines the number of changes from 0 to non-0 (e.g. to 1 or any other level). As the result, it delivers not the original signal value, but the number per unit time or the frequency. This can, for example, be used to create a piece counter, so that the signal processing no longer delivers the digital input, but the number of parts produced per second/minute/hour. Ideally, this function is combined with an averaging directly afterwards, because otherwise the value can fluctuate wildly, especially at the beginning.

Aggregation	If several signal values are to be combined in time, the **Aggregation** function can be activated. Here, either a specific value (e.g. the largest or smallest), the sum of all values, or the average value is determined and output based on the values received over a specific duration (aggregation interval). You can also specify whether the aggregated value should be calculated every time it is sampled (continuously) or only periodically at the end of the aggregation interval (periodically).
Postprocessing	After the input signal has been processed by one or more functions, it can be post-processed analogously to the preprocessing function, so the accuracy can be adjusted by rounding or similar, for example. The format and syntax of the mathematical expression correspond to those of the preprocessing function.

2. Fill in the input fields of the signal-processing steps you want to apply.
3. Click **Save** and continue to the **Measurement modelling** tab.

5.2.13 Configuring measurement modelling

For all I/O units and interfaces, the same parameters can be configured on the **Measurement modelling** tab to display measured values.

> **NOTE:** This configuration is optional, but you can only display your data in the **FlexPlorer** app if this tab is filled in. For example, you should enter the number of decimal places, because otherwise measured values always appear without decimal places by default, and therefore also in the apps that transfer the values to the cloud or write them to Grafana.

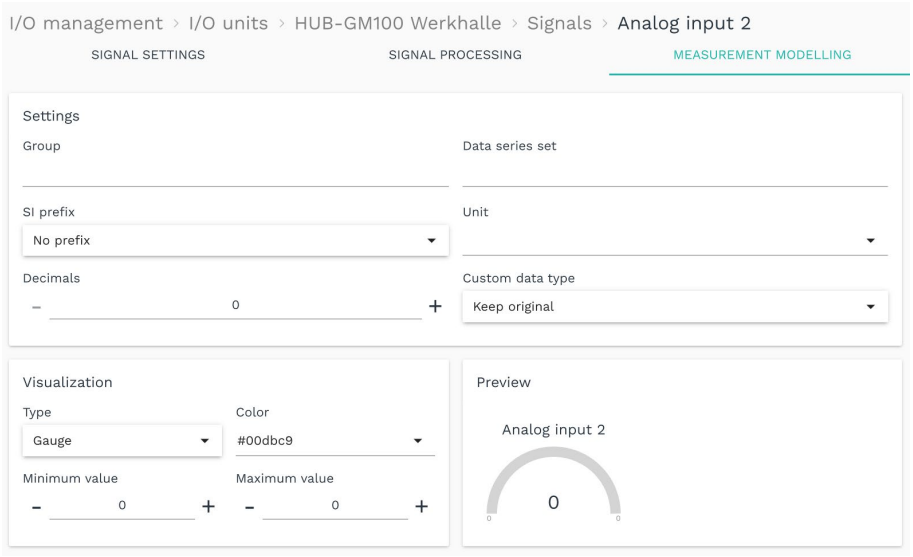


Fig. 67: “Measurement modelling” tab

1. Select the following parameters as required or enter the appropriate values:

Group	If a name is entered, this only affects the view in the FlexPlorer app. For all interfaces with the same group name, the preview views (sensibly of the same type, e.g., gauge) are lined up side by side in FlexPlorer, so that measured values from various devices/sensors can be compared.
Data series set	All signals with the same data series set are displayed in FlexPlorer in a common diagram under Live Diagrams, so that the signal values from various devices/sensors can be compared directly in live operation.
SI prefix	Depending on the value range of the signal, it may be useful to select a suitable SI prefix for the unit, e.g., giga, mega, kilo, etc.
Unit	Select the physical unit that the value should be given.
Decimals	Enter the number of decimal places to be displayed.

Custom data type	Select a data type and thus overwrite the original data type of a signal. For signals like Modbus registers that originally only provide integers, the data type can be explicitly changed to **Double** if signal processing results in a floating point number. This is especially relevant for apps that consider the data type of signals, e.g. the OPC UA Server app.
Minimum value	Enter the value to be used as minimum in the visualization element (e.g. a gauge). This can be the smallest measurable value of the connected device, but it does not have to be.
Maximum value	Enter the value to be used as the maximum in the visualization element (e.g. a gauge). This can be the largest measurable value of the connected device, but it does not have to be.
Type	Select the type of visualization that best fits the output values. **Gauge**, **counter**, **LED** or **no visualization** are available.
Color	Select a color for the display of the measured values.

2. Click **Save & close** to finish the input.

5.3 Configuring signal connections

If you want to control and write output signals depending on input signals, you can configure and use signal connections.

With signal connections, you can trigger actions that control the switching of an alarm by a relay, for example, or you can forward sensor values to a Modbus-connected controller.

NOTE: In the signal connections setup wizard, readable input signals to the I/O units are displayed only if they have been activated with the slider in **Signal settings**.

1. On the **I/O management** page, select the **Signal connections** function.

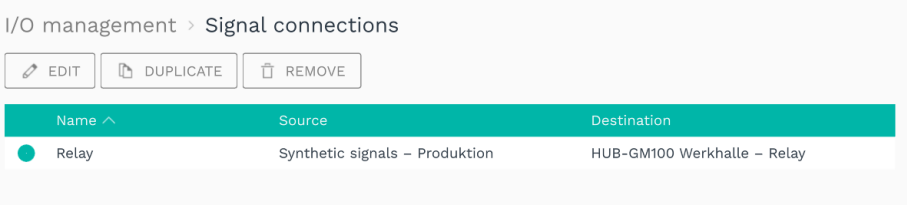


Fig. 68: Examples for signal connections (initially, no synthetic signals are predefined)

2. To create a new signal connection, click **Add signal connection**.

   The setup wizard opens to guide you through the creation process. In the following, confirm each entry either with **Next** or by pressing **Enter**.

3. Enter the **Connection name.**

   The connection is automatically enabled. If you want to disable it temporarily or permanently, you can deactivate the connection.

4. Under **Source signal**, select the I/O unit and the associated signal to be read from, e.g., a particle sensor.

5. Under **Signal processing**, you can optionally process or modify the just-selected source signal before it is written to the destination signal, e.g., 0 and 1 in case of a threshold exceedance.

   NOTE: The source signal itself is not changed: this step refers exclusively to the calculation of the target signal. The signal processing of the source signal, as you know it from the I/O units, still takes place independently.

6. Under **Destination signal**, you select the I/O unit and the associated signal to which the value is forwarded. This can be e.g., the HUB-GM100 with a relay that signals a stop to the machine when a threshold value is exceeded.

The signal connection could now look like this, for example:

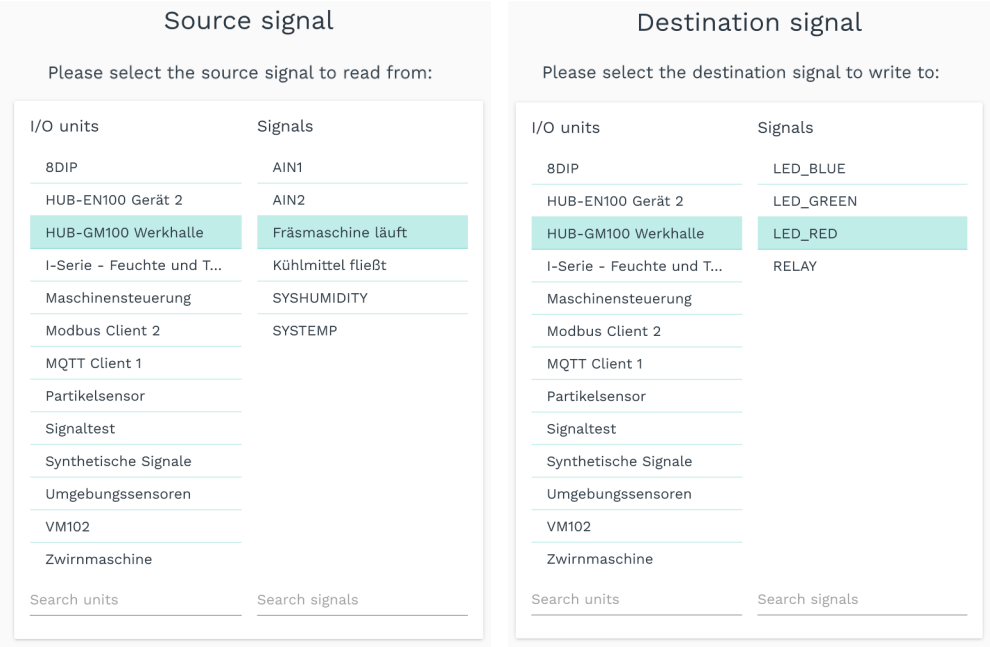


Fig. 69: I/O management > Signal connections > Edit signal connection (example)
Example: The milling machine is connected to the digital input (DIO1) of the HUB-GM100. The red LED of the HUB-GM100 is to light up when a threshold value is exceeded. Enter this threshold value directly after the source signal (see step 5).

7. Where there are extensive entries, you can search for units or signals by entering at least one digit or letter in the search field below the selection lists.
8. When you have finished typing, click **Save & close**.

5.4 Creating synthetic signals

With this function you can logically link signals from sensors or from bus protocols, for example, and thus create new signals. This is particularly useful in combination with software applications that can evaluate machine statuses, such as MADOW.

Case study 1: You can, for example, link two signals—“milling machine running” (signal 1) and “coolant flowing” (signal 2)—with each other using “AND”, and define that a machine is only recognized as running if signal 1 AND signal 2 are true/active/set or have the logical value 1. A standstill is thus detected as soon as one of the two signals no longer has the logical value 1.

Case study 2: With logical/binary signals, an alarm can be triggered as soon as at least one of 2 measured values from a particle sensor for different particle sizes is above a limit value.

NOTE: In the signal connections setup wizard, readable input signals to the I/O units are only displayed if they have been activated with the slider in the signal settings.

1. On the **I/O management** page, select the **Synthetic signals** function.

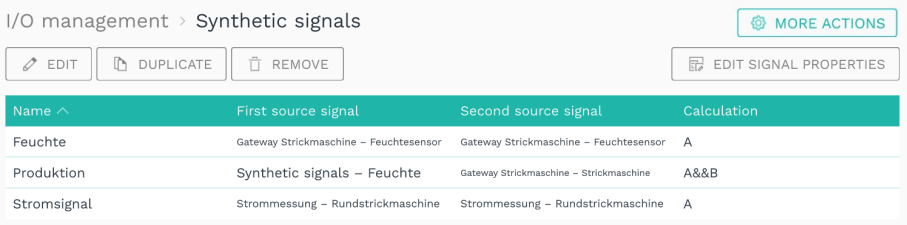


Fig. 70: Synthetic signals (initially, no synthetic signals are predefined)

2. To create a new signal, click **Add synthetic signal**.

   The setup wizard opens to guide you through the creation process. In the following, confirm each entry either with **Next** or by pressing **Enter**.

3. Enter the **Signal name.**

4. Under **First source signal,** select the I/O unit and the first signal to be read from, e.g., the digital input DIO1 (“Milling machine running”).

5. Under **Second source signal**, select the I/O unit and the second signal to be read from, e.g., digital input DIO2 (“Coolant flowing”).

   The synthetic signal could now look like the following, for example:

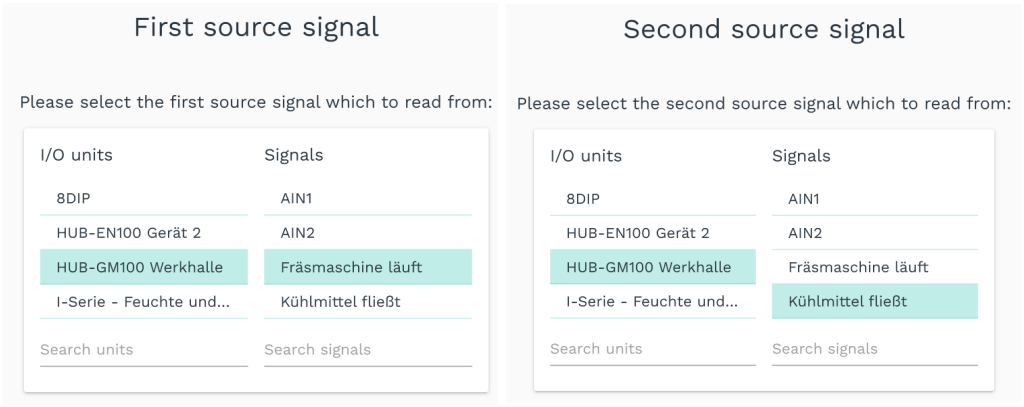


Fig. 71: I/O management > Synthetic signals > Edit synthetic signal (example)
Example: If the signal value of digital input 1 (DIO1) detects that the “milling machine is running” and the signal value of digital input 2 (DIO2) detects that the “coolant is flowing”, then the synthetic signal added here is generated, which outputs a machine state (however is is defined).

6. Where there are extensive entries, you can search for units or signals by entering at least one digit or letter in the search field below the selection lists.

7. Now select one of the mathematical operations or logics to be used to calculate the synthetic signal from the two source signals.

   - **Sum up values**: The values of both source signals are added together.
   - **Subtract values**: The values of both source signals are subtracted.
   - **Multiplicate values**: The values of both source signals are multiplied.
   - **Divide values**: The values of both source signals are divided.
   - **Logical AND operation**: Combines both source signals with an “AND”, i.e., both signal values must be non-0 for the synthetic signal also to have the logical value 1.

- **Logical OR operation**: Links both source signals with an “OR”, i.e., at least one signal value must be non-0 for the synthetic signal also to have the logical value 1.
- **RS flip-flop**: With this function you can model a RS flip-flop where the output is controlled by the signals S (set) and R (reset). The signal S sets the output to 1 until the signal R resets the output to 0.

  The two inputs S (set) and R (reset) correspond to the first and the second source signal. If a source signal has a value greater than 0, it is interpreted as a logical 1, i.e. the flip-flop is set or reset.
- **Infinite counter**: Increases by the difference of the previous and current value of the source signal.

  HINT: Since the second source signal is ignored, it makes sense to select the same signal as for the first source signal.
- **Resettable counter**: Works like the infinite counter with the difference that the second signal resets the counter if this value is not 0.

  HINT: The counter values are saved in the background every 10 seconds. The counter reading is retained even when the device is restarted.
- **Custom mathematical or logical expression**: Enter a mathematical formula according to the syntax of the expr-eval library (https://github.com/oat-sa/expr-eval#expression-syntax) to calculate the value of the synthetic signal from the source signals 1 and 2.

  Examples of inputs:

A >= 1 or B >= 2	Result = 1, if A ≥ 1 OR B ≥ 2; otherwise, result = 0
A > 0.5 and B < 10	Result = 1, if A > 0.5 AND B < 10; otherwise, result = 0
max(A, B)	The larger of the two signals is the result
A^B	Result = A to the B-th power

8. When you have finished typing, click **Finish**.
9. To save all signals in one file (e.g. to reuse them on another device) or if you want to transfer synthetic signals from another device to the present one, click **Actions** and select the corresponding menu item.
10. You can deactivate, make settings, process, and model the synthetic signal just like all other signals. To do this, select the signal and click **Edit signal properties** or double-click the signal.

    A window opens, where you will find three tabs.

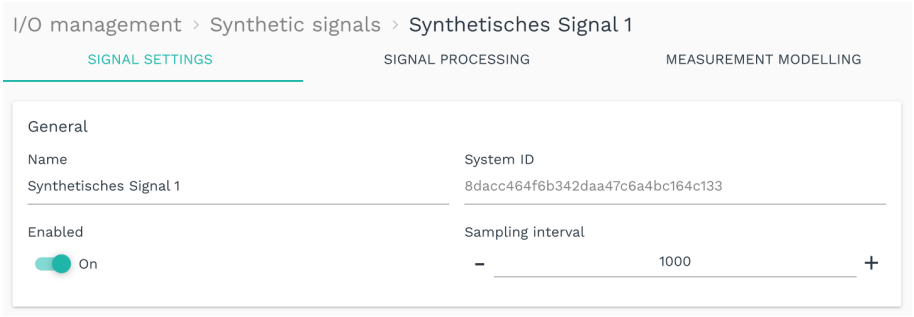


Fig. 72: “Signal settings” tab for the selected synthetic signal

11. In the **Signal settings** tab, activate and configure the signal.
    - Optional: Change the name of the signal if necessary.
    - Optional: Set the slider to **Off** if you do not want to use the signal at this time.
    - In the **Sampling Interval** field, specify the intervals at which calculations are to be made from the source signals (in milliseconds).

      RECOMMENDATION: The synthetic signal is not automatically recalculated as soon as one of the source signals changes, but only as often as specified by the sampling interval. We recommend choosing a very short sampling interval (e.g., set it to the minimum of 50 ms), so that the synthetic signal is updated with only very little delay.
12. In the **Signal processing** tab, you can define how the signal value should be processed.

    For more information, see *Configuring signal-processing steps, page 67*.
13. Click **Save**.
14. In the **Measurement modelling** tab, you define how the measured values are to be displayed.

    For more information, see *Configuring measurement modelling, page 71*.
15. Finally, click **Save & close**.

6 SIINEOS - workflow descriptions

6.1 Connecting a temperature sensor and setting it up in I/O management

Objective: A temperature sensor is to be connected to the HUB-GM100. An analog input is to be used as the interface. The signal is to be converted into measured values with unit and linearization and the temperature curve is to be displayed.

1. On the **I/O management** page, click **Add I/O unit.**

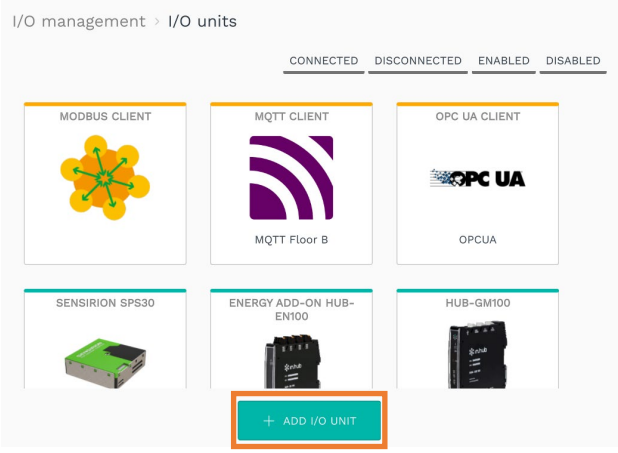


Fig. 73: If you are connecting the gateway for the first time, this page is empty. If you have been working with the gateway for some time, all I/O units that have already been added are displayed.

The setup wizard opens to guide you through the creation process. In the following, confirm each entry either with **Next** or by pressing **Enter**.

2. Select **HUB-GM100** as the type.

Fig. 74: Setup wizard for creating an I/O unit, in this example a HUB-GM100

3. Enter the **Name**.
4. Click **Save** and then click **Finish**.

   The device settings open. The new I/O unit is automatically activated.
5. Optional: Enter the **Location**.
6. Click **Signals.**

7. Now select the interface you want to use and configure for the temperature sensor.

   In this case, it is the analog interface **AIN1,** because the temperature sensor sends its signal to the HUB-GM100 in analog form.

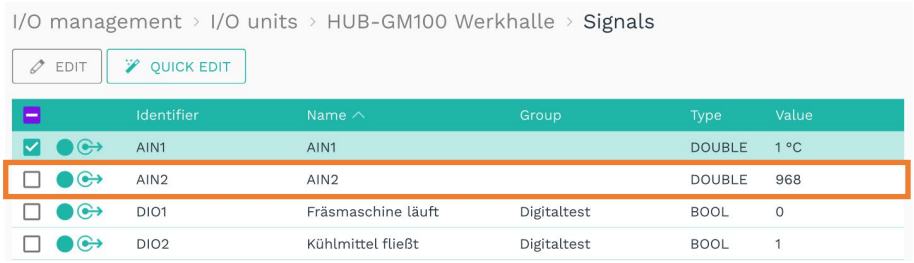


Fig. 75: Signals for the HUB-GM100

8. Click **Edit** or double-click the signal.

   A window opens, where you will find three tabs.

9. In the **Signal settings** tab, configure the **AIN1** interface.

   For the temperature sensor, specify the following:

   - **Name**: You can leave **AIN1** as the name or you can add “Temperature sensor” so that it is quickly apparent what is connected to the interface.
   - **Enabled**: On
   - **Sampling interval**: Specify the intervals at which the temperature signal is to be sampled (in milliseconds), in this case every **1000** ms.
   - **Mode**: Select the type of analog interface for the sensor, e.g., **0...10 V**.

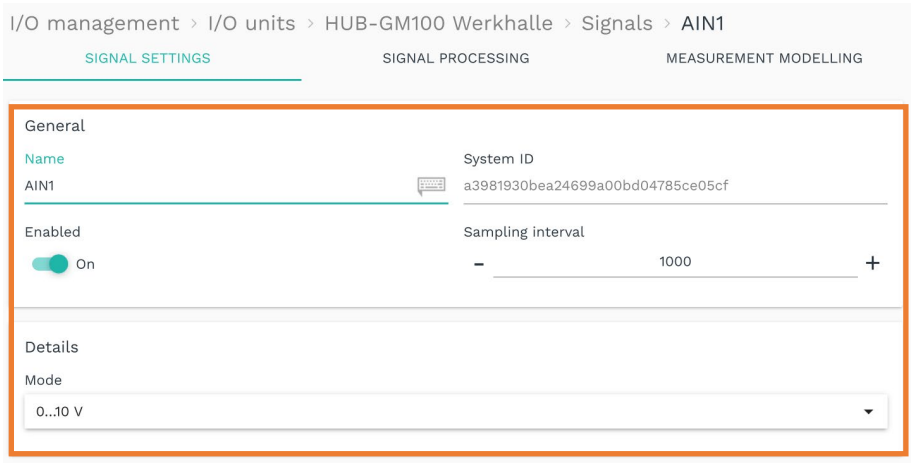


Fig. 76: Signal settings for the interface AIN1

10. Click **Save** and switch to the **Signal processing** tab.

11. In the **Signal processing** tab, you can define how the signal value should be processed.

    For more information, see *Configuring signal-processing steps, page 67.*

    The signal values of the temperature sensor are to be processed so that the measured values are displayed in normalized form. To do this, activate **Linear scaling** and enter the following:

    - **Minimum input value**: Enter the minimum value of the voltage you selected under **Settings > Mode**, in this example **0**.
    - **Maximum input value**: Enter the maximum value of the voltage you selected under **Settings > Mode**, in this example **10**.
    - **Minimum output value**: From the data sheet of the temperature sensor, take the smallest value of the measuring range that the sensor can measure, in this example **-50.**
    - **Maximum output value**: From the data sheet of the temperature sensor, take the highest value of the measuring range that the sensor can measure, in this example **120.**

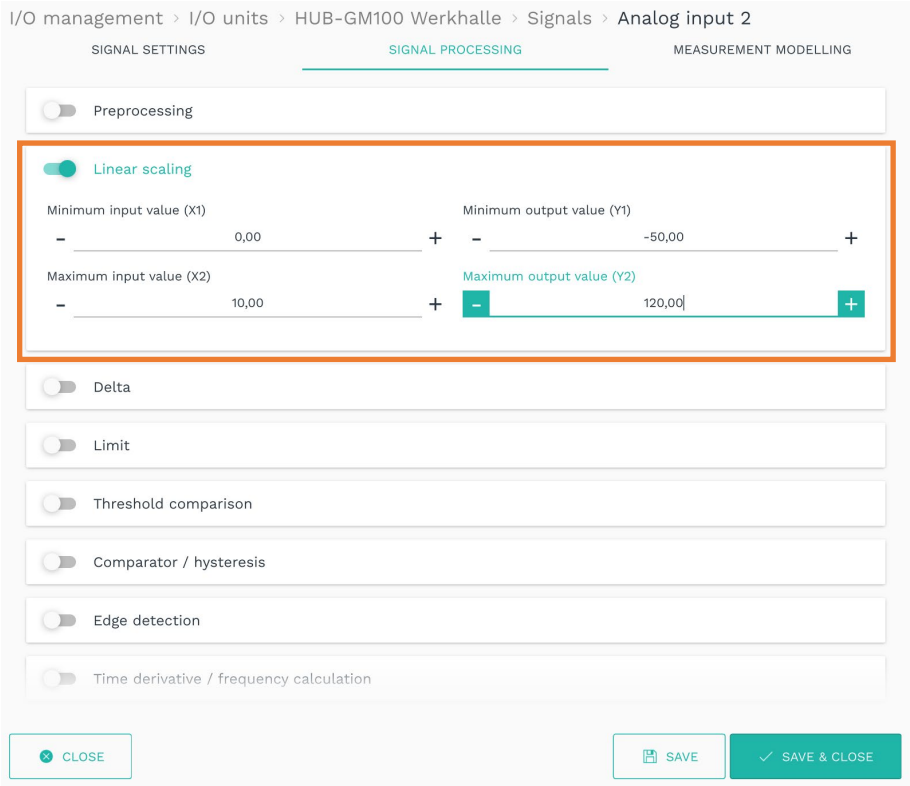


Fig. 77: Signal processing “Linear scaling”

12. Click **Save** and switch to the **Measurement modelling** tab.
13. In the **Measurement modelling** tab, you define how the measured values are to be displayed.

    For more information, see *Configuring measurement modelling, page 71.*

    For the temperature sensor, enter the following:

    - **Group**: Can be left empty in this example.
    - **Data series record**: Can be left empty in this example.
    - **SI prefix**: **No prefix** is required.

- **Unit**: Since this is a temperature sensor, select **°C.**
- **Decimal places**: The measured values are to be output with one decimal place, so enter **1.**
- **Custom data type**: Select **Keep original**.
- **Minimum value**: Enter the smallest sensible value for your task to which the measurement series should be displayed. This can be the smallest measurable value of the temperature sensor, i.e., **-50** (°C), but does not have to be.
- **Maximum value**: Enter the largest sensible value for your task to which the measurement series should be displayed. This can be the largest measurable value of the temperature sensor, i.e., **120** (°C), but does not have to be.
- **Type**: For the temperature sensor, the **Gauge** representation is useful.
- **Color**: Select the color you want.

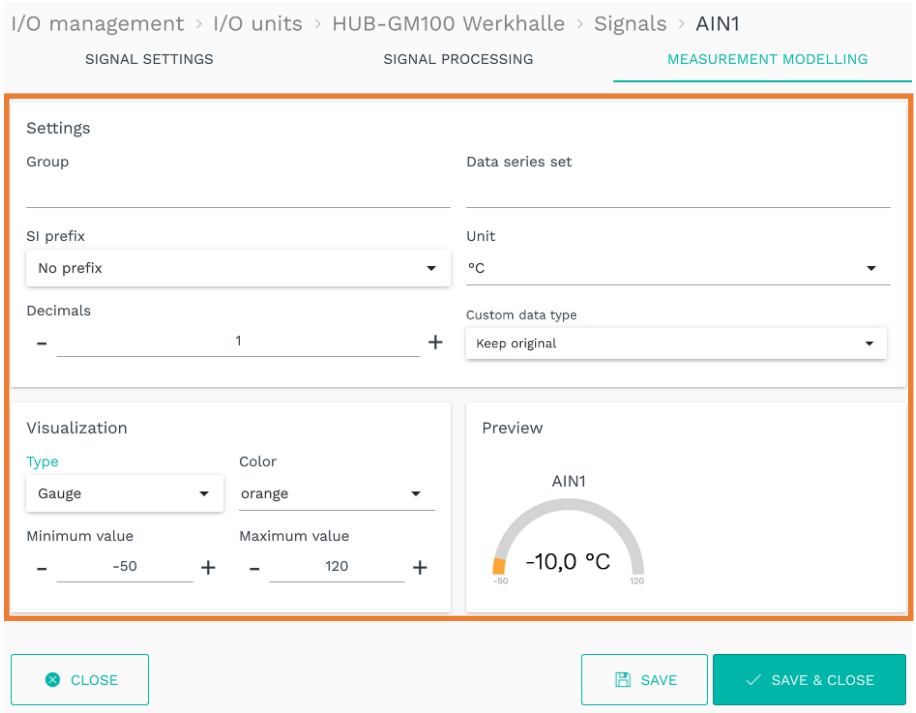


Fig. 78: Measurement modelling for the signal AIN1

In the preview you will now see the values displayed in the form of a measuring instrument.

14. Click **Save & close**.

6.2 Displaying measured values in FlexPlorer

FlexPlorer is an in.hub proprietary visualization tool that allows you to view your data live at any time.

1. To display all measured values from the interfaces, go to the **Apps** page and select the **FlexPlorer** tile.

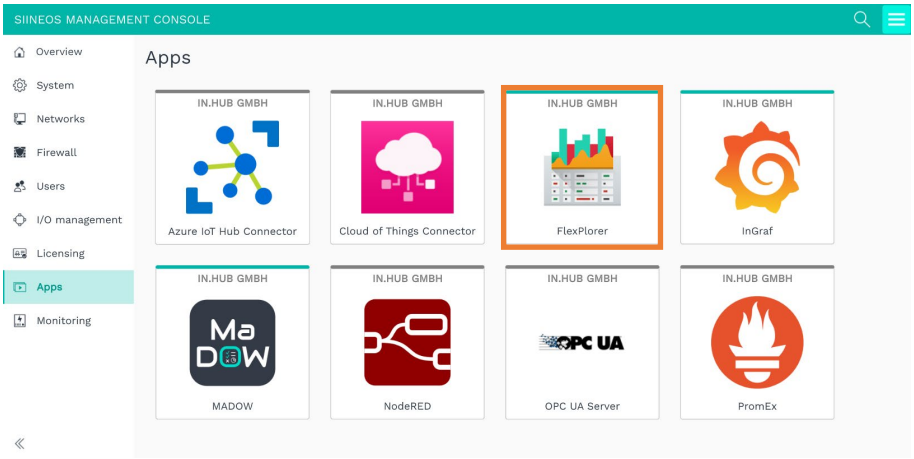


Fig. 79: “Apps” page

2. For first time use, click **Enable app**.

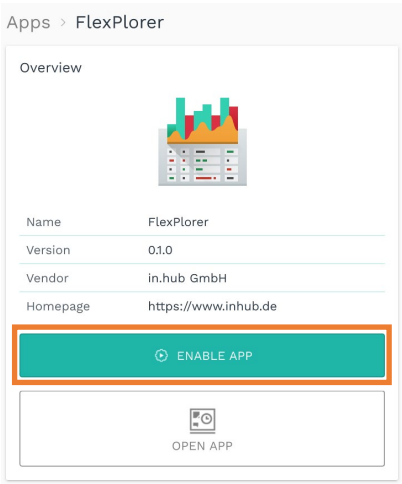


Fig. 80: Apps > FlexPlorer > Enable app

3. Click **Open app**.

   The **Overview** page opens in a new browser tab.

   Here, you can see the information from the measurement modelling for each activated I/O unit with the configured signals in a graphical representation:

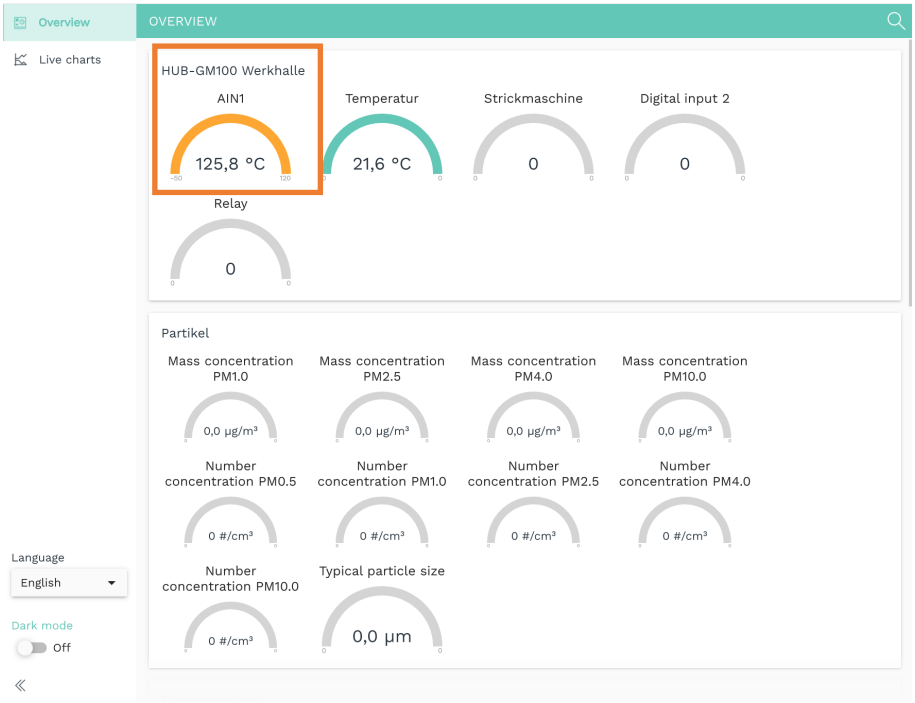


Fig. 81: FlexPlorer with the display of the temperature sensor connected to the interface AIN1

4. Switch to **Live charts** to monitor changes in measured values live.

Fig. 82: Live chart in the FlexPlorer

You can customize the view of the live diagrams using various buttons:

- Specify whether the live diagrams should be displayed in a 1-, 2-, 3- or 4-column layout.
- Choose whether only readable, only writable or all signals should be displayed.

6.3 Setting up the HUB-EN100 add-on module and reading values measured by a current sensor

Objective: An add-on module, the HUB-EN100, has been connected to the HUB-GM100. This is to be used to record current values of a machine via a current sensor. The associated I/O unit is now activated and set up in SIINEOS.

1. On the **I/O management** page, select **I/O units.**
2. Click **Add I/O unit**.
3. Select **Energy Add-On HUB-EN100** as the type.

   The setup wizard opens to guide you through the creation process. In the following, confirm each entry either with **Next** or by pressing **Enter**.
4. Enter the **Name**.
5. Click **Save** and then click **Finish**.

   The device settings open. The new I/O unit is automatically activated.
6. Optional: Enter the **Location**.
7. Click **Signals**.

   The signals for all channels of the HUB-EN100 are already created.

Fig. 83: Signals for the HUB-EN100

8. Now select the channel to which the current sensor is connected, in this case **CH01.**

   A window opens, where you will find three tabs.
9. In the **Signal settings** tab, you now configure the **CH01** interface.

   For the current sensor, specify the following:

   - **Name**: You can leave **CH01** as name or assign another name to make it quickly obvious what is connected to the interface, e.g., **Phase 1** or **Machine 1**.
   - **Enabled**: On
   - **Sampling interval**: Specify the intervals at which the current value is to be sampled (in milliseconds). By default, **1000** ms is set; this can also be left as it is for the current sensor.

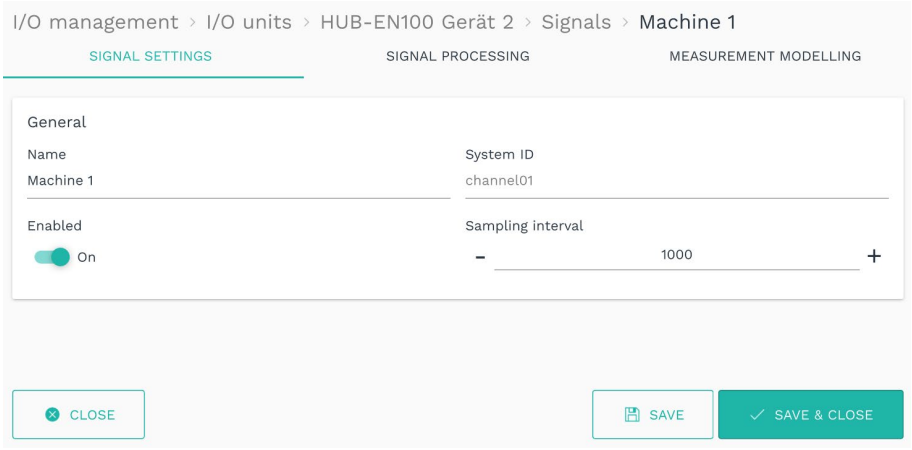


Fig. 84: Signal settings for signal “CH01” and renaming to “Machine 1”

10. Click **Save** and switch to the **Signal processing** tab.
11. In the **Signal processing** tab, you can define how the signal value is to be processed.

    For more information, see *Configuring signal-processing steps, page 67.*

    The signal values from the current sensor do not need to be processed. You can skip this step.
12. In the **Measurement modelling** tab, you define how the measured values are to be displayed.

    For more information, see *Configuring measurement modelling, page 71*.

    For the current sensor, enter the following:

    - **Group**: Can be left empty in this example.
    - **Data series set**: Can be left empty in this example.
    - **SI prefix**: **No prefix** is required.
    - **Unit**: Since this is a current sensor, leave **A** selected.
    - **Decimals**: The measured values are to be output with two decimal places. Leave the default value of **2** entered.
    - **Custom data type**: Select **Keep original**.
    - **Minimum value**: Enter the smallest value that makes sense for your task, up to which the measurement series should be displayed. This can be the smallest measurable value of the current sensor but does not have to be. In this example, the scale should start at **0.**
    - **Maximum value**: Enter the largest sensible value for your task to which the measurement series should be displayed. This can be the largest measurable value of the current sensor, i.e., **80 A,** but does not have to be.
    - **Type**: For the current sensor, the **Gauge** representation is useful.
    - **Color**: Select the color you want.

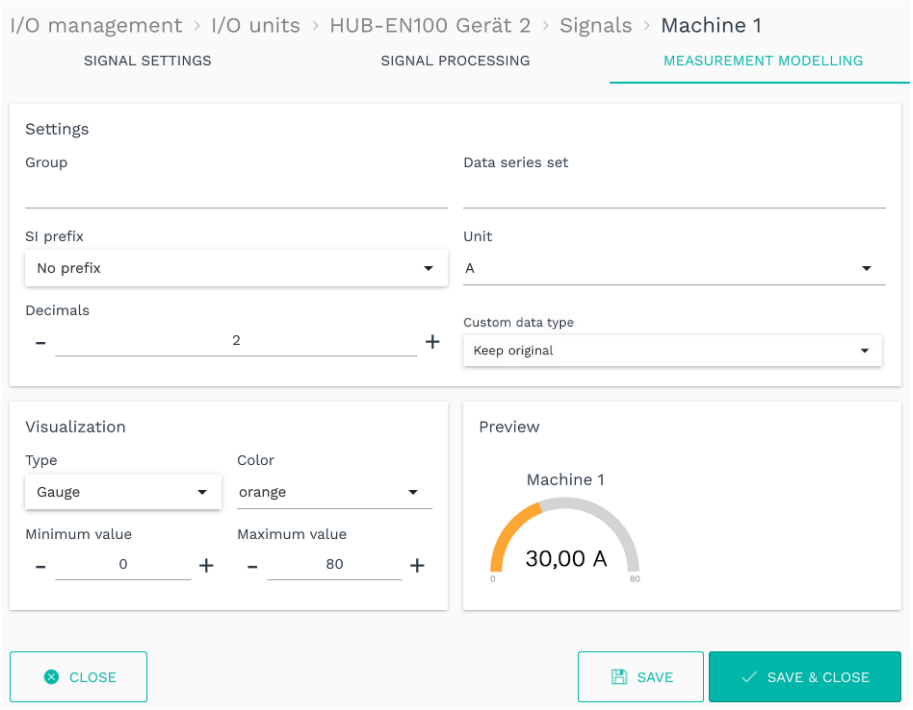


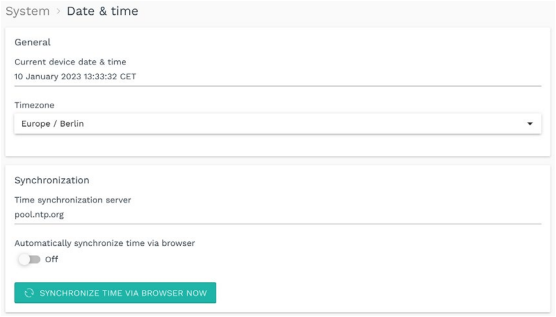
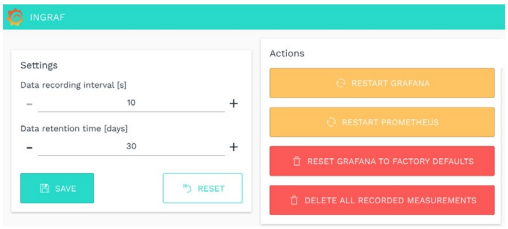
Fig. 85: Measurement modelling of the “Machine 1” signal

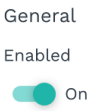
In the preview, you will now see the values displayed in the form of a measuring instrument.

13. Click **Save & close**.
14. If you open the **FlexPlorer** or **Grafana** application in SIINEOS on the **Apps** page, you can view the measured values from the current sensor in real time and adjust the display of the data according to your needs.

    See the section *Visualizing measured values in FlexPlorer, page 82*.

7 Troubleshooting

Problem	Possible cause	Remedy
Grafana Data is not arriving in the app. Visualization is not possible.	In SIINEOS, the time has not been synchronized with the browser. -or- The gateway was briefly without power, and the time setting was lost.	1. In SIINEOS, select the **System** page and go to the **Date & time** section.  2. Click **Synchronize time via browser now** to synchronize the date settings for the gateway with your computer. If the gateway power supply is cut off, this setting is lost. You will then have to resynchronize with the browser. For more information: *Setting date and time, page 11*.
	The database has broken down due to the loss of voltage during writing.	1. In SIINEOS, select the **Apps** page and open the **InGraf** app. 2. Click **Manage app**.  3. Click the **Delete all recorded measurements** action to completely reset the database.

Problem	Possible cause	Remedy
Signal connections Required I/O unit or signal is not displayed	The I/O unit or signal has not been activated.	1. In SIINEOS, select the **I/O management** page and open the I/O unit or signal you are looking for. 2. In the device settings for the I/O unit or in the signal settings for the signal, set the slider to **On**.  For more information: *Working with I/O management, page 37*.
Update You have uploaded a SIINEOS update, and the new software version is not displayed.	Browser cache still contains an old version of the web interface. -or- Gateway is no longer responding.	1. First, clear your browser cache and refresh the page in your browser. 2. If this does not work: Switch off the power to the gateway and switch it on again after a few seconds. Then restart SIINEOS and check the version number on the **Overview** page.
Connection problems An error message occurs when trying to open the address http://192.168.123.1/smac	A proxy server is specified for this IP address in the SIINEOS network settings. -or- The firewall of the local PC (Windows firewall) or the firewall of the company network prevents access to the gateway or parts of the interface.	1. First check if the gateway is plugged in via USB cable and flashing. 2. In the proxy server settings for the system or the browser, you or your administrator must make sure that no proxy server is used for the IP address 192.168.123.1, so that the browser accesses the connected gateway directly. Either temporarily disable the use of the proxy server or add an appropriate exception rule for the above IP address.

Problem	Possible cause	Remedy
Connection problems You can no longer reach the gateway on the network, or a system service is not responding.	A firewall rule in SIINEOS is preventing traffic to and from the gateway.	1. Go to the **Firewall** page and check which action is selected in the rules for both incoming and outgoing network traffic. 2. Select the **Accept packet** action to allow the data exchange. For more information: *Configuring the firewall, page 23*.
Connection problems The gateway is located in an isolated machine network and you cannot reach it in this network.	If the network is secured by its own firewall, the ports for communication with the gateway may not be enabled.	1. Make sure that the following ports are enabled in your local system firewall settings to access the gateway: ○ HTTP port: 80 ○ HTTPS port: 443 ○ SIINEOS system bus (MQTT): 1988
Connection problems An add-on module is connected to the network via Ethernet and you cannot reach it on the network.	You have assigned the device an IP address that lies in the range between 192.168.123.**1** and 192.168.123.**254**. This network address range is already used for the direct USB connection.	1. Assign a new IP address that is outside the range already assigned.
App does not have access to the Internet You can no longer open or restart an app.	Docker-based apps are temporarily unable to connect to the Internet after changes in firewall rules.	1. Restart the gateway. The firewall is reconfigured in interaction with the Docker service. For more information: *Restarting, shutting down, or logging off, page 15*.

Signals from the Modbus RTU device do not arrive. The Modbus RTU device is connected, but signals do not arrive at the gateway.	The pins of the RS485 socket of the gateway and the corresponding pins at the Modbus RTU device are not connected correctly.	1. Check on the in.hub gateway at the RS485 socket that: ○ + is connected to the bus line A ○ - is connected to the bus line B **NOTE**: In some cases, manufacturers name A and B differently. Therefore, compare the signs of the bus line in the manufacturer's data sheet with our connections and swap the pairing if necessary.
The results of the signal processing are 0 or incorrect. You have entered mathematical expressions in the **Signal Processing** tab that cannot be evaluated by the expr-eval library without errors.	Since SIINEOS version 2.7.4, mathematical expressions are calculated with an improved method for signal processing as well as for user-defined calculations of synthetic signals. Instead of internal functions with ECMAScript syntax, the more powerful expr-eval library is used. Existing formulas may have to be adapted with it.	1. Navigate to the **Signal Processing** tab and rearrange your mathematical formulas according to the specifications of the expr-eval library: https://github.com/in-hub/expr-eval#expression-syntax
The gateway no longer responds, e.g. during the update process. The gateway cannot be put into operation even by switching it off and on (disconnect power supply and reconnect).	–	1. Disconnect and connect the gateway from/with the power supply three times in a row. The LEDs on the front panel must have lit up for at least 5 seconds between the three processes. After 3 unsuccessful boot attempts, the device switches to another boot slot and boots with the usually older version installed in this boot slot. All settings are retained.

8 Further information

8.1 OPTIONAL: Programming your own software applications (apps)

NOTE: in.hub provides the building blocks for programming your own app, the programming itself is carried out by the customer's own software developer.

1. On your PC, go to the in.hub download section at https://download.inhub.de/ and select **InCore downloads > InCore SDK installer** to download the software development kit (In.Core Framework).
2. To install and set up the software development kit and some necessary applications, please follow the instructions at https://download.inhub.de/incore/ **> InCore install guide.**
3. Once installation and setup are complete, you can program the user software according to your in-house requirements.

   Please refer to the developer documentation. It provides user-ready software blocks to quickly build the IoT/IIoT application: https://incore.readthedocs.io/en/latest/
4. Store the finished software bundle locally on your PC in `*.raucb` format.
5. Upload the software application to SIINEOS, see the section *Uploading SIINEOS updates and application software packages (apps), page 9*.

in.hub GmbH
Technologie-Campus 1
DE-09126 Chemnitz

+49 371 335 655 00
info@inhub.de