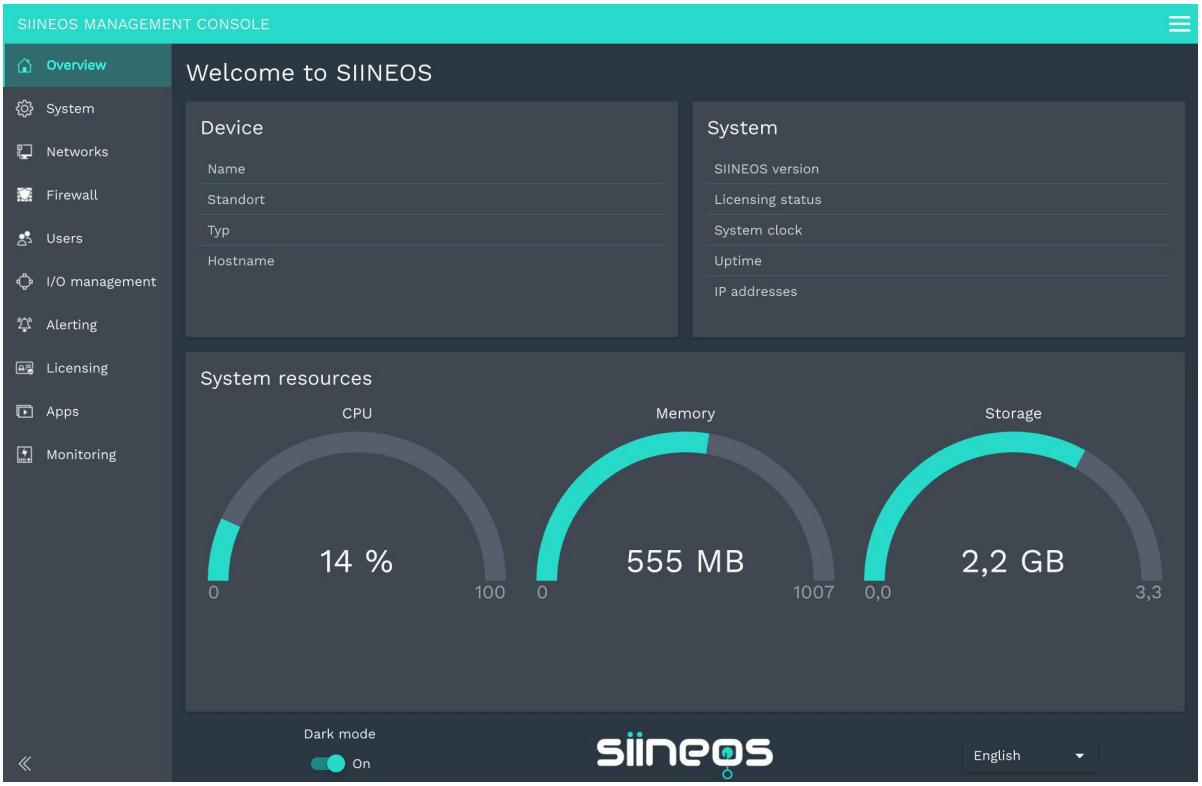

SIINEOS 2.9.2

User Manual

Document version 1.0

Table of Contents

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Legal information

Safety information

This documentation contains information that you must observe for your personal safety and to prevent material damage. Read the safety information carefully and always keep this documentation within easy reach.

The safety information is presented in descending order of hazard level as follows:

DANGER

Indicates an immediate hazard to humans. Failure to comply will lead to irreversible injuries or death.

WARNING

Indicates an identifiable hazard to humans. Failure to comply may lead to irreversible injuries or death.

CAUTION

Indicates an identifiable hazard to humans or potential material damage. Failure to comply may lead to reversible injuries or material damage.

ATTENTION

This gives you information that may lead to material damage if not complied with.

NOTE

A note gives you useful information on specific actions and issues.

TIP

A tip gives you tips, tricks or recommendations from ipf electronic that have proven to be helpful in handling the products.

Qualified personnel

The product associated with this documentation may only be handled by personnel qualified for the respective task. The device may only be installed, commissioned and operated in compliance with the associated documentation and the safety information contained therein.

Based on their training and experience, qualified personnel are able to recognize risks and avoid potential hazards when handling these products.

Knowledge of PCs, operating systems and web applications is a prerequisite. General knowledge in the field of automation technology is recommended.

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Intended use

IPF 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 ipf electronic.

Proper storage, set-up, assembly, installation, commissioning, operation and maintenance are essential for the correct and safe operation of the products.

The permissible ambient conditions must be complied with. Instructions in the associated documentation must be followed.

Brands

All designations marked with the "®" symbol are registered trademarks. The other designations in this document may be trademarks whose use by third parties for their own purposes may infringe the rights of the owner.

Disclaimer

Ipf-electronic accepts no liability for product malfunctions resulting from improper handling, mechanical damage, incorrect application and improper use.

The contents of this document have been checked for conformity with the product described. However, deviations cannot be ruled out, so that we cannot guarantee complete conformity. The information in this publication is regularly reviewed. Necessary corrections are included in subsequent editions.

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1. General information

This document contains all the information you need to commission and use the device/software.
The document is intended for service technicians, system administrators and installers who connect the product with other units, configure it and commission it.

1.1. Scope of delivery

1× SIINEOS

1× User Manual as a PDF

1.2. Other applicable documents

In addition to this document, please observe the following documents. You can find these in the IPF download portal at https://www.ipf-electronic.de/en/online-shop/product-details/by000002:

- Operating Instructions for the gateway or module on which SIINEOS is installed

1.3. Network security

Please bear in mind that the product does not communicate in encrypted form within the internal network. Therefore, protect your network from unauthorized access from outside! Any integration into a network with Internet access must be undertaken with great caution. It is imperative to speak with your system administrator in advance.

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2. General product information

SIINEOS is a Linux-based operating system and IoT platform that is specifically tailored to meet the high requirements for data security and continuity of operations 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 enables simple data acquisition, data preprocessing and data connection to third-party systems, making it easier to get started and reducing the complexity of IoT and digitalization projects.

Comprehensive documentation on SIINEOS and a user-friendly software development kit (SDK) help you realise all the possibilities of our industrial gateways quickly and efficiently. Regular software updates continually ensure that the system is always up to date.

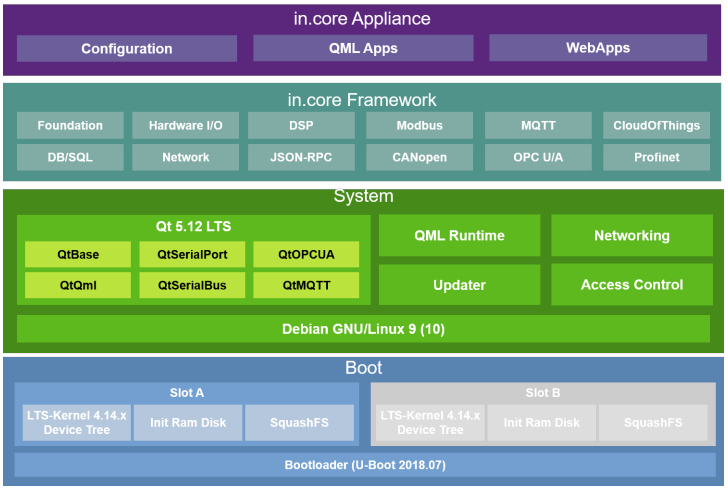
2.1. Software architecture

SIINEOS comprises four levels:

- Boot level
- System level
- In.Core framework

  This is a collection of software modules that can be used to quickly create both simple and complex IoT and Industrial Internet of Things (IIoT) applications.
- Application level with the In.Core apps

  These consist of generic and higher-level objects and can be easily configured and combined using QML (Qt Modelling Language). Each InCore module can be imported individually and contains the actual function objects.



SIINEOS software architecture

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3. Setting up the working environment with SIINEOS

This chapter gives you detailed step-by-step instructions for configuring SIINEOS and setting up your working environment.

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

You can also download all the latest technical documents, software packages, tutorials and installation instructions from the IPF download portal: https://www.ipf-electronic.de/en/online-shop/product-details/by000002

3.1. Preparing the IT infrastructure in your own company network

1. Ensure that the following ports are enabled in the system to allow communication between devices and applications:

TCP ports	Access to SMAC
80	HTTP
443	HTTPS
1988	SMAC interface (for http access)
1989	SMAC interface (for https access)

TCP ports	Access to device services and apps
502	Modbus TCP I/O endpoint
1880	**Node-RED** app
1883	MQTT broker If no direct access to the MQTT broker is required (**System > Serv- ices > MQTT broker** is deactivated), you do not need to unlock this port.
3000	If the IPF device is to be accessed via the **InGraf** (Grafana) app
4840	If the IPF device is to be accessed via the **OPC UA Server** app

2. If you want to encrypt communication with the gateway by using TLS certificates, create a security certificate via your organisation's Certification Authority (CA).

   You can upload this certificate together with the private key in SIINEOS, see Optional: Configuring TLS certificates [17].

3.2. Logging on to SIINEOS

We recommend that you use the latest versions of the **Firefox**, **Edge** or **Chrome** browsers for

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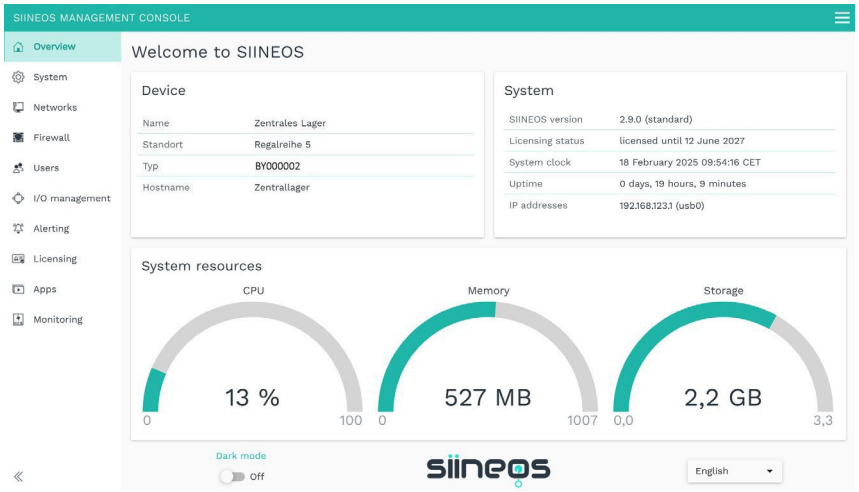
SIINEOS. Compatibility problems may occur with other or older browsers.

3.2.1. When logging on to SIINEOS for the first time

1. Connect the gateway or module to your PC using a micro USB cable (USB port on the front of the device).
2. Enter the following address in your browser:
   http://192.168.123.1
3. Log on with the initial user data (**hubadmin**/**hubadmin**).
   The SIINEOS Management Console opens.



SIINEOS start page (example)

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

4. Select the **Users** page and change the password for the user **hubadmin**.
   See the chapter Managing user accounts [33].

3.2.2. If you have already set up SIINEOS

1. In your browser, enter the individual IP network address that you have configured.
   See the chapter Setting up Ethernet 1 and Ethernet 2 [20].
2. Log on with your user data and click on **Log in**.
   The SIINEOS Management Console opens.

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3.3. Setting the colour mode and language

1. Go to the SIINEOS start page by selecting the **Overview** page on the left.

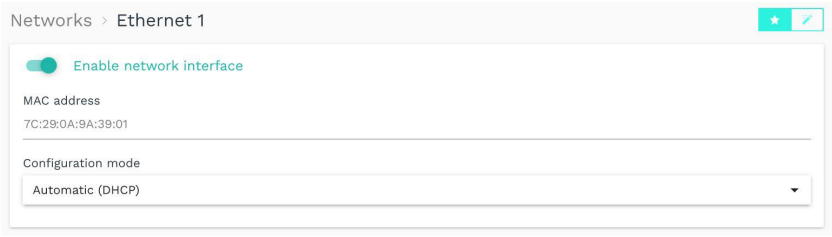
"Overview" page with colour mode and language setting (example)

2. The dark mode for the screen display is selected by default. To switch to the bright screen mode, set the **Dark mode** slider to **Off**.
3. To change the language, open the drop-down list.
   German and **English** are available.

3.4. Viewing mode: Standard and Advanced

You can only make configurations in SIINEOS in the system administrator role.
There are two viewing modes in this role, allowing you to display additional settings on some pages. You will find the two buttons for switching at top right.

- **Standard** mode is enabled when you start SIINEOS. You are only shown the parameters and setting options that are sufficient for most applications. This makes configuration easier for you.



"Standard" viewing mode, network settings example

- If you switch to **Advanced** mode, you will be shown further parameters and setting options that cover special cases. Here, you can define every detail of your configuration yourself.

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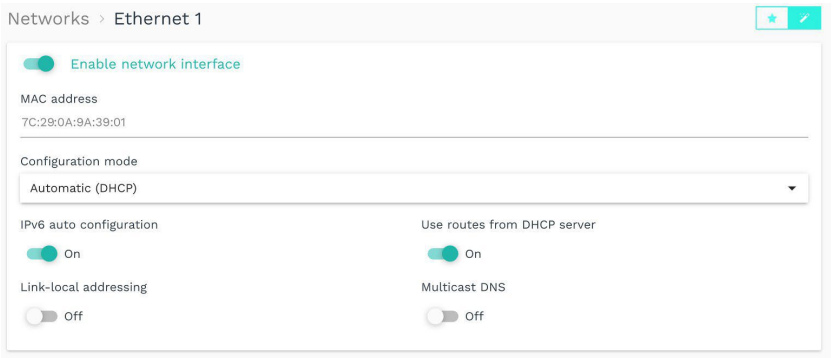
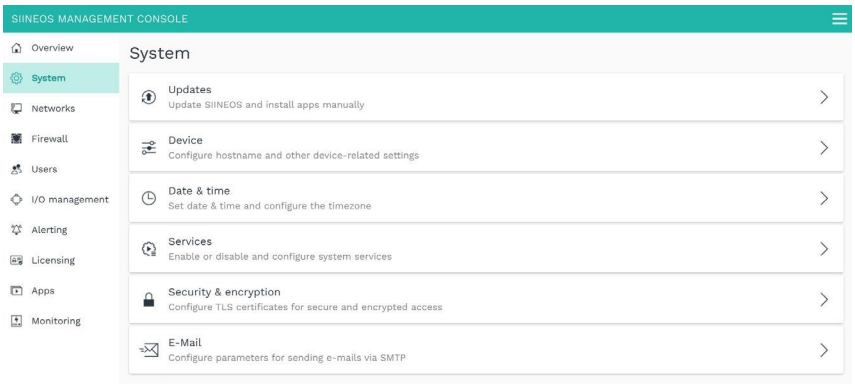


"Advanced" viewing mode, network settings example

3.5. Configuring the system

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



"System" page

3.5.1. Installing SIINEOS updates

NOTE

You can only upload updates on the **System** page if you have a valid S11NEOS licence.

If the licence has expired, you will be informed that you cannot import any updates.

Managing SIINEOS licences [44]

1. Go to the download portal at https://www.ipf-electronic.de/en/online- shop/product-details/by000002 and select the required SIINEOS package.
   Two variants are available:
   - The complete software package for the gateways and modules, such as the **BY000002** or the **AB000008**
     - The light version without Docker containers with a smaller file size for the **AB000009**
   - When the download is complete, go to the **System** page in SIINEOS and select **Updates**.

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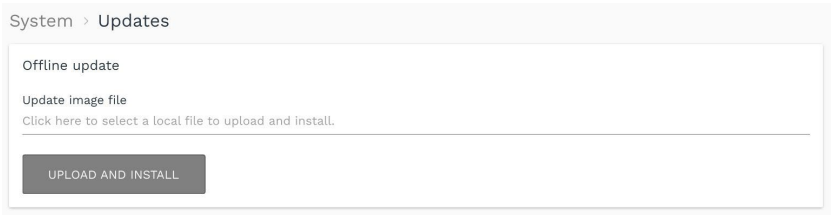
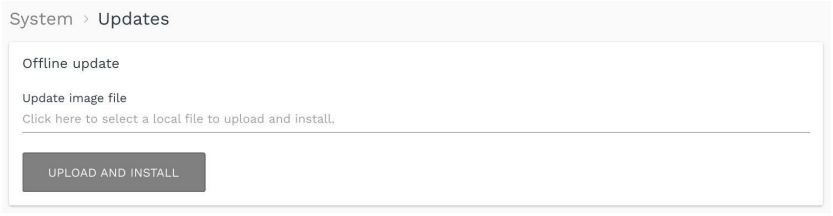


System > Updates

3. Click in the **Update image file** input field and select the software package provided by ipf electronic in *.raucb format from your local file-storage location.
4. Click on **Upload and install**.
   The installation will proceed automatically and takes about 1 minute. After a successful installation, you will be asked whether you want to restart the gateway.
5. Click on **Yes**.
6. After restarting, check that the new version of SIINEOS is displayed on the **Overview** page.
7. If the version has not been updated, proceed as follows:
   a. First delete your browser cache and refresh the page in your browser.
   b. If that doesn't work, switch off the power to the gateway and switch it on again after a few seconds.
   c. Start SIINEOS and check the version number.

3.5.2. Installing app updates

1. On the **System** page, click on **Updates**.



System > Updates

2. Click in the **Update image file** input field and select the software package provided by ipf electronic in *.raucb format from your local file-storage location.
3. Click on **Upload and install**. Installation will proceed automatically.
   After a successful installation, you will be asked whether you want to restart the gateway.
4. Click on **No**.
   You do not need to restart the gateway when uploading apps.

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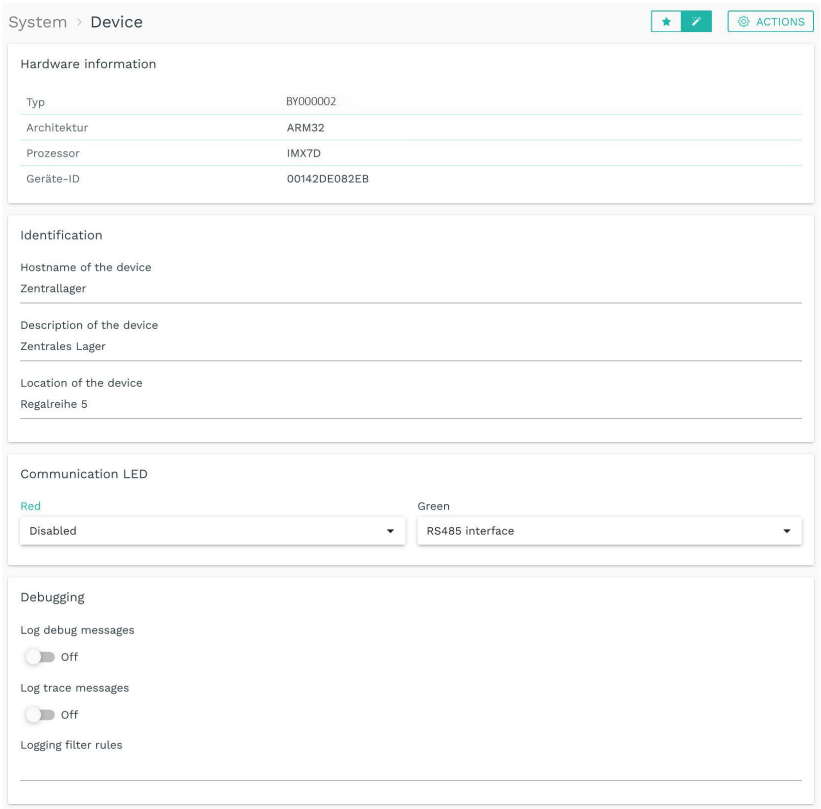
3.5.3. Configuring device settings

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



System > Device, “Advanced” viewing mode (example)

The **Hardware information** section shows the details of your gateway, such as the device ID and the installed processor.

2. Enter the following information in the input fields:
   a. **Hostname of the device**: Enter a name to uniquely identify the device in the network.
   b. **Description of the device**: Enter what the device is used for.
   c. **Location of the device**: Enter the physical location of the device so that you can quickly locate the control cabinet and device if necessary.
   d. Under **Communication LED**, you can configure LED 2 on the front of the device. It is a bicolour LED, so you can assign the colours red and/or green to the activity of the interface(s).
3. Additional settings are available in **Advanced** viewing mode:
   - **Log debug messages**: Messages from the SIINEOS management service are logged in the system journal to help ipf electronic with troubleshooting.
   - **Log trace messages**: Activate this function if detailed calls of system functions and the parameters used are to be logged in the system journal.
   - **Logging filter rules**: This field is reserved for ipf electronic for support purposes and for troubleshooting.

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NOTE
Do not use these functions during production – performance could be impaired.

On the **Monitoring** page, under **Journal**, you can view the debug and trace messages and download them by clicking on a button.

Please note that the messages are stored only temporarily and are lost after a restart. You should therefore save them in good time.

4. When you have completed the entry, click on **Save & close**.

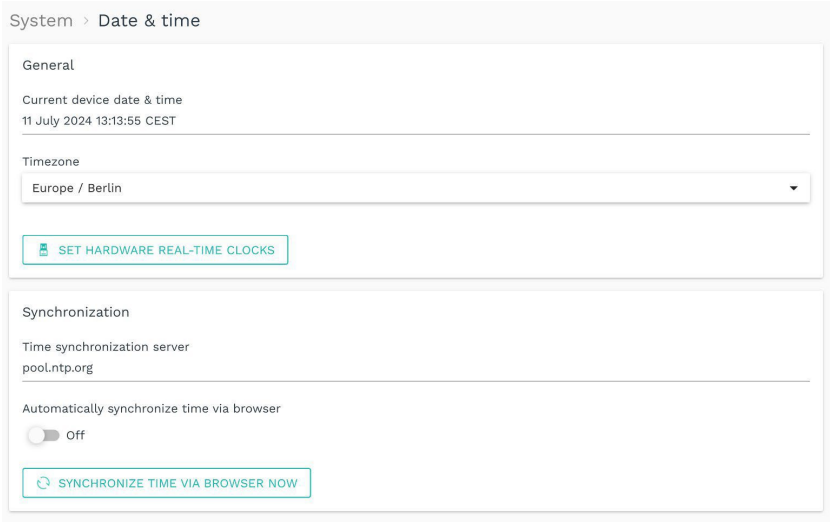
3.5.4. Locating the gateway in the control cabinet

To keep track of which device you are currently configuring when using multiple gateways, SIINEOS offers the **Identify via LEDs** function.

1. On the **System** page, click on **Device**.
2. Click on the **Actions** button and select **Identify via LEDs**.
   The LED for device identification on the front of the gateway on which you are currently located starts to flash alternately red and green for 10 seconds.

3.5.5. Setting the date and time

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



System > Date & time (example)

The gateway's current system time is displayed under **General**. (When you log on for the first time, the UTC time is still displayed by default.)

2. Select the **Timezone** in which your gateway is located.
3. Optional: If you are using a **AB000006**, you can write the system time of the gateway to the real-time clock of the USB stick by clicking on **Set hardware real-time clocks**.
   See also Optional: Calibrating the AB000006 [15].

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4. If you want to obtain the system time for 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 on **Synchronize time via browser now** to synchronize the gateway's date settings with your computer.
   If the gateway's power is disconnected and you are not using an external real-time clock for the time, this setting will be lost. You will then have to synchronize with the browser again. The time zone is retained.
7. When you have completed the entry, click on **Save & close**.

> **NOTE**
> If you enter an NTP server for synchronizing the time on this page, this is also be automatically transferred to the **Wi-Fi** and **Ethernet** network configurations. However, if an address is already entered there, it will not be overwritten. You should therefore check your entries for the NTP server.

3.5.6. Optional: Calibrating the AB000006

The AB000006 is a USB stick that stores the system clock time so that this information is not lost in the event of a power failure.

If you are using one of the two real-time clocks, a calibration function is available in SIINEOS. In order to transfer the system time of the gateway to the stick and save it there, proceed as follows:

1. Plug the **AB000006** 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 USB hub.
   As soon as the stick is plugged in, the LED in the stick lights up and indicates that the external real-time clock is operational.
2. In SIINEOS, navigate to **System > Date & time**.
3. First click on **Synchronize time via browser now** to ensure that the time on the gateway is synchronized with the computer.
4. Then click on **Set hardware real-time clocks** to transfer the system clock time to the external real-time clock.
5. Leave the stick permanently plugged into the device so that the gateway can always retrieve the time from the **AB000006** if the power supply is interrupted.

3.5.7. Configuring system services

1. On the **System** page, click on **Services**.
2. Activate the slider for the service you want to use. If there are further setting options, these will open.

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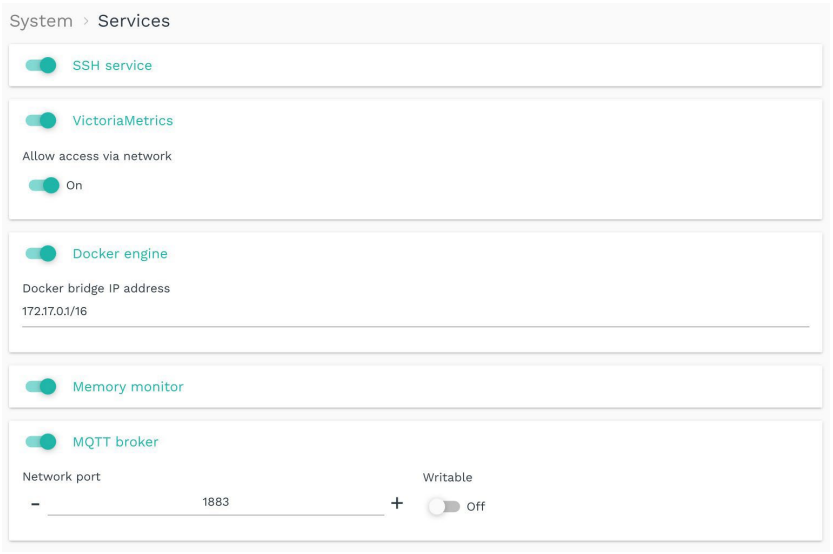

System > Services

3. 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 enables direct access to the system and data, as well as troubleshooting. In conjunction with the OpenVPN client, a gateway outside the local network can also be accessed.
VictoriaMetrics	If you want to use the local VictoriaMetrics time series database to record I/O signal values, set the slider to **On**. Set the **Allow access via network** slider to **On** if you want the VictoriaMetrics service to be publicly accessible via the network.
Docker engine	Set the slider to **On** if you want the Docker engine to start automatically at system startup. If you use your own Docker container with the “Always” restart policy, activate the Docker engine autostart here. If you are using an app in SIINEOS that uses the Docker engine anyway, such as Grafana, you can leave this slider off. You can enter a different IP address for the Docker bridge here if the default IP address is already in use in the company.
Memory monitor	Set the slider to **On** to restart the gateway automatically if the RAM is no longer sufficient.
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**.

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4. When you have completed the entry, click on **Save & close**.

3.5.8. Optional: Configuring TLS certificates

If you want to communicate with the gateway in encrypted form (https), you can upload the required security certificates on this page.

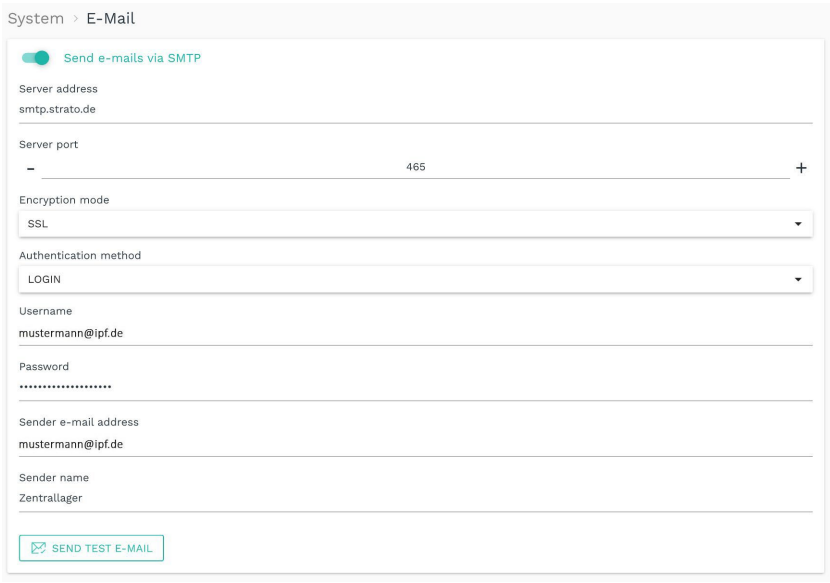
1. On the **System** page, click on **Security & encryption**.

System > Security & encryption

2. If the gateway is to communicate with other devices and services in encrypted form (e.g., MQTT), click on **CA certificate of the organization** to upload the CA certificate. With this CA certificate, the gateway can check whether the certificates of your organization's devices and services are valid. If this validity check fails, no encrypted connection can be established.
3. Click on **Device certificate** to upload the security certificate for this device created by your organization.
4. Click on **Private key** to upload the associated key for this device.

3.5.9. Setting up mail servers for notifications

1. On the **System** page, click on **E-mail**.



System > E-mail (example)

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2. Enter the **Server address** of your mail server.
3. Enter the **Server port** for the mail server.
4. Select the **Encryption mode** to be used for communication with the e-mail/SMTP serv- er. **SSL**, **TLS** and **No encryption** are available.
5. Select the **Authentication method**. **PLAIN**, **LOGIN** and **CRAM-MD5** are available.
6. Enter the **Username** and **Password** you use to log on to the mail server.
7. Enter the **Sender e-mail address** with which the notifications, alarms or e-mails should be provided.
8. Now enter the **Sender name**.
9. To test whether all entries are correct, click on **Send test e-mail** and check whether the test e-mail has arrived.
10. When you have completed the entry, click on **Save & close**.

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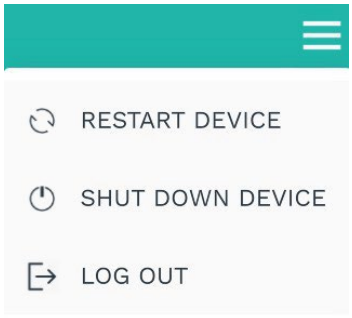
3.6. Restarting the gateway, shutting down and logging out

1. In the SIINEOS Management Console, click on ☰ at top right.



A menu will open.

Menu with actions for the current session

2. Select the action you want to perform:

Restart device	A system message is displayed asking whether you really want to restart the gateway. 1. Confirm with **Yes**. After restarting, the login window will be displayed again.	Possible reasons for restarting: • If the system is no longer responding • If you have postponed the restart after an update, for example, and want to catch up later • If the new version is not displayed after a SIINEOS software update
Shut down de- vice	A system message is displayed asking whether you really want to shut down the gateway. 1. Confirm with **Yes**.	Possible reasons for shutting down: • If you want to prepare for 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 an abrupt switch-off during a write process.
Log out	You log out of the system and allow another user to log on.	Possible reasons for logging out: • Shift change

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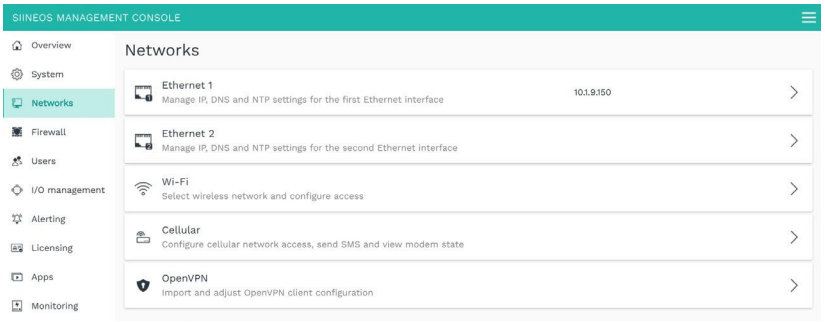
3.7. Configuring networks

You can configure the following connections on the **Networks** page:



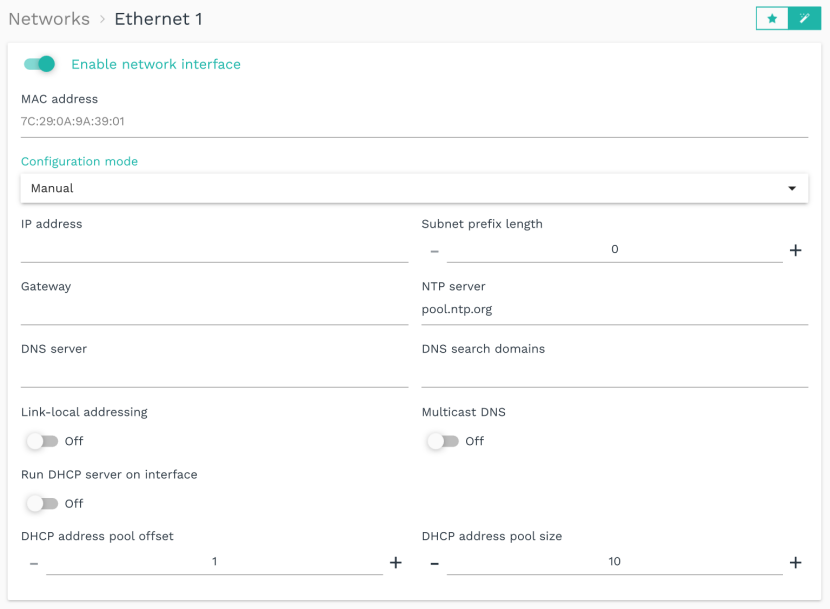
"Networks" page (example)

3.7.1. Setting up Ethernet 1 and Ethernet 2

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

RECOMMENDATION

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



Networks > Ethernet 1 > Configuration mode "Manual" (viewing mode "Advanced")

1. On the **Networks** page, select **Ethernet 1** or **Ethernet 2**.
2. To activate the interface, set the **Enable network interface** slider to **On**. The MAC address printed on the housing of the gateway is displayed.
3. To automatically obtain all network parameters via a DHCP server, leave the default setting **Automatic (DHCP)** selected in the **Configuration mode** drop-down list.

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You do not need to make any other entries in the **Standard** viewing mode. You can refine the network configuration in the **Advanced** viewing mode:

IPv6 autoconfiguration	By default, the slider is set to **On**, i.e. 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 received 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.
Link-local addressing	The slider is set to **On** by default. The gateway generates the link-local address automatically, so that communication within the same network segment is possible without DHCP or a static IP address. If you do not require a link-local address for local communication within the network segment, deactivate the function.
Multicast DNS	The slider is set to **On** by default. Instead of a request being sent to a DNS server, all subscribers in the network are addressed directly. Gateways can then be accessed in the network at **<hostname>.local**. You can find the hostname in SIINEOS on the **System > Device** page.

4. To configure the network parameters manually, select **Manual** from the **Configuration mode** drop-down list.
5. Complete the input fields.

   NOTE: For some parameters where you can make multiple entries, as in the case of the DNS server, separate them with a space, not a comma.

IP address	Enter the gateway IPv4 or IPv6 address to be assigned to the Ethernet 1 or Ethernet 2 interface, respectively. The address ranges **172.17.0.0/16** and **172.18.0.0/16** are reserved for the internal Docker network and can be changed in **System > Services** if required.
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 the subnet mask **255.255.255.0** or the value **16** for networks with the subnet mask **255.255.0.0**.
Gateway	Enter the IP address of the gateway.
NTP server (optional)	Enter the IP address or the computer name of the time server from which the gateway is to obtain its system time.

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DNS server	Enter the IP address of the DNS server used to resolve the names of computers in the network / on the Internet.
DNS search domains (optional)	Enter the internal DNS domain for your company network, e.g. lan.mycompany.com.
Run DHCP server on interface	Set the **Run DHCP server on interface** slider to **On** if the gateway is to take over the role of the DHCP server and assign IP addresses to the devices connected in the isolated machine network. **RECOMMENDATION**: Only use this function for a direct 1:1 connection between the gateway and a sensor, a PLC, an add-on module or a TBEN module. In a larger network with several machines, a central IT infrastructure is necessary.
DHCP address pool offset	Specify which IP addresses are to be assigned for the connected peripheral device. For example: You enter a “12”. Starting with the parameter entered under **IP address**, the number after the last point 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 peripheral devices 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.
Link-local addressing (only in Advanced viewing mode)	The slider is set to **On** by default. The gateway generates the link-local address automatically, so that communication within the same network segment is possible without DHCP or a static IP address. If you do not require a link-local address for local communication within the network segment, deactivate the function.
Multicast DNS (only in Advanced viewing mode)	The slider is set to **On** by default. Instead of a request being sent to a DNS server, all subscribers in the network are addressed directly. Gateways can then be accessed in the network at **<hostname>.local**. You can find the hostname in SIINEOS on the **System > Device** page.

6. If you have selected **None** in **Configuration mode**, the gateway is still accessible via a link-local IP address or using the name announced via multicast DNS (e.g. hub-gm.local) – but only locally and not across network boundaries.
   You can change this setting in the **Advanced** viewing mode:

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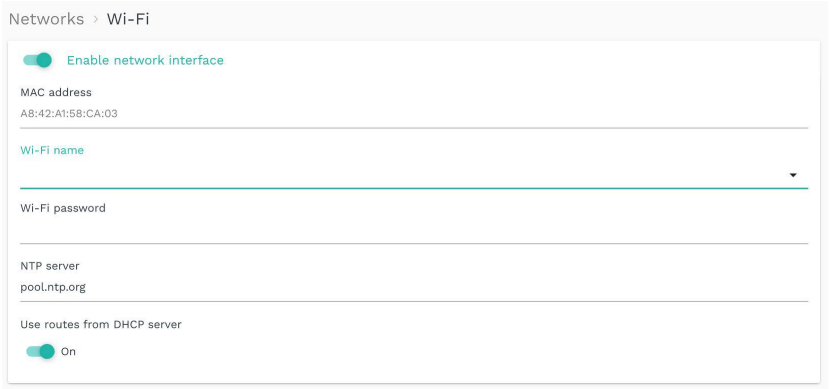
7. Finally, click on **Save & close**.
   This will take you back to the **Networks** page.

3.7.2. Setting up Wi-Fi

If a Wi-Fi stick is plugged in, you can configure the Wi-Fi connection on this page.



If the network interface is not used, you cannot make any entries.

Networks > Wi-Fi

1. If you want to connect to a Wi-Fi network, set the **Enable network interface** slider to **On**.
   The MAC address, which is also printed on the housing of the gateway, will be displayed.
2. Enter the name and password of the Wi-Fi you want to connect to.
3. Optional: Enter the IP address of an NTP server from which the gateway is to obtain its system time.
4. Optional: Set the **Use routes from DHCP server** slider to **Off** to only access the local network via this interface and access the Internet via another interface if necessary.
5. Finally, click on **Save & close**.
   This will take you back to the **Networks** page.

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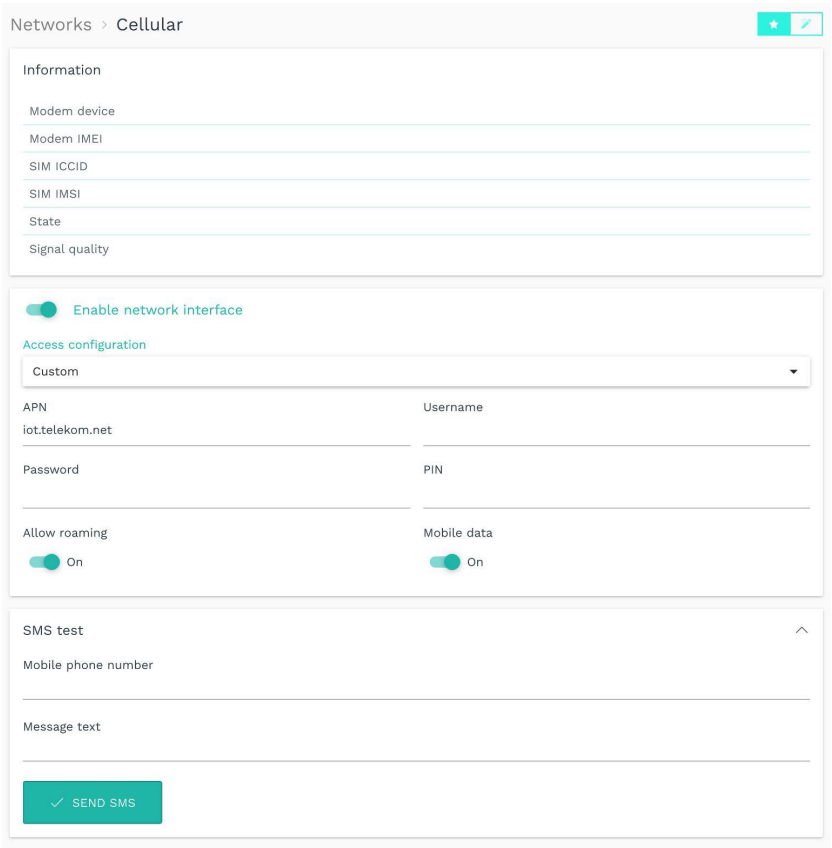
3.7.3. Setting up a mobile connection

The **AB000002** can be connected via a USB interface to access the Internet in environments without a network. The gateway can use this access to connect to a cloud, for example, or the gateway can be accessed remotely via the VPN (Virtual Private Network) tunnel.
If the network interface is not used, you cannot make any entries.



Networks > Cellular > Access configuration “Custom” (in “Standard” viewing mode)

1. If you want to use the **AB000002** 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 / mobile network provider or **Custom**.
3. If you have selected **Custom**, enter the following information:

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

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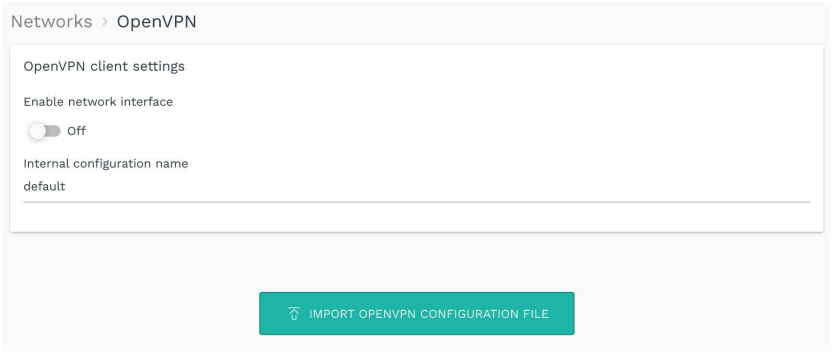
Password	If the network provider has specified a password in addition to the APN, enter it here.
PIN	Enter the pin for the SIM card. Make sure to use the correct PIN for the SIM card used. Otherwise, the card will be blocked after three unsuccessful attempts.
Allow roaming	If you want to allow roaming, set the slider to **On**. If you have a SIM card with roaming service, you can enable this function to dial into third-party-provider networks if required.
Mobile data	This function is switched on by default. If you only want to use the **AB000002** to send text messages, set the slider to **Off**.

4. To check whether your entries are correct, enter a message text and the mobile number of the terminal device under **SMS test** and click on **Send SMS**.
5. If no SMS arrives, check whether the signal quality is adequate.
6. Finally, click on **Save & close**.
   This will take you back to the **Networks** page.

3.7.4. Setting up OpenVPN

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



Networks > OpenVPN

1. If you want to use an OpenVPN, set the **Enable network interface** slider to **On**.
2. Click on **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** input field.
4. Finally, click on **Save & close**.
   This will take you back to the **Networks** page.

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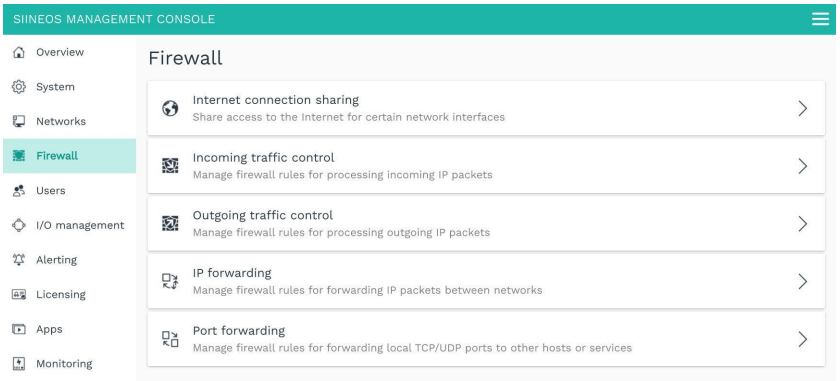
3.8. Configuring the firewall

RECOMMENDATION

When customizing or configuring the device's internal firewall, if possible, connect your computer via the micro USB port on the front of the gateway and open the SIINEOS Management Console via the USB network address http://192.168.123.1.

This prevents you from losing access to the gateway via the network due to an incomplete or incorrectly configured firewall rule.

On the **Firewall** page, you can configure the gateway's integrated network firewall and define rules that determine how the gateway communicates in the network and how it handles the network traffic it receives. The following functions are available:



"Firewall" page

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

You first specify whether data traffic passing through the gateway is to be processed or not.

- If you do not need this function, simply skip the **Firewall** page.
- If you do, you can follow the blacklisting approach that SIINEOS uses by default, whereby any data traffic that is not explicitly prohibited is allowed.

  Alternatively, you can follow the whitelisting approach, whereby any data traffic that is not explicitly permitted is not allowed.

ATTENTION

If you have made changes to the firewall configuration, restart the device so that all settings for Docker-based apps, such as Grafana or NodeRED, are applied correctly. Otherwise, access to these apps and communication between these apps and your network or the Internet may be limited.

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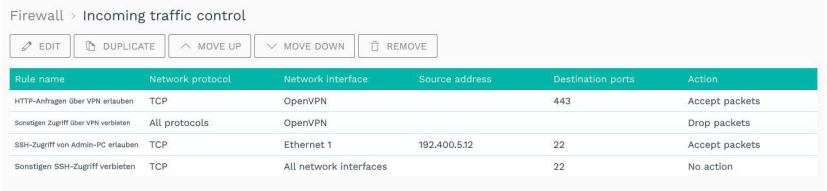
Notes on incoming and outgoing network traffic: All rules that you create are processed in sequence for each incoming data packet – from top to bottom in the list. At the point when all criteria of a rule are met by a data packet, rule processing is completed with the specified action. No further rules are processed.



Example of a list of rules for incoming network traffic

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

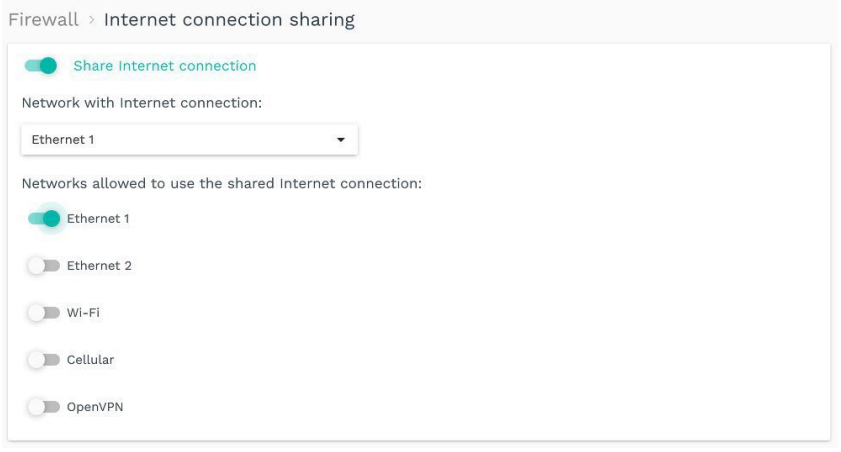
TIP

Create all positive rules first. In doing so, it must be very specifically defined which access is to be authorized by whom. At the end of the list, it is useful to have a rule in which no conditions are set. You can then only select in the **Actions** drop-down list whether the gateway ignores requests from the network (Drop packets) or actively rejects such requests (Reject packets).

3.8.1. Sharing Internet connections

In this window, you define the networks through which the devices connected to this network (e.g. machines) are authorized to access the Internet via the gateway.

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



Firewall > Internet connection sharing

2. Enable the **Share Internet connection** slider.
3. In the **Network with Internet connection** drop-down list, select the network through which the gateway accesses the Internet.
4. Enable the slider for the network that is allowed to use the shared Internet connection.
5. Click on **Save & close**.
   This will take you back to the **Firewall** page.

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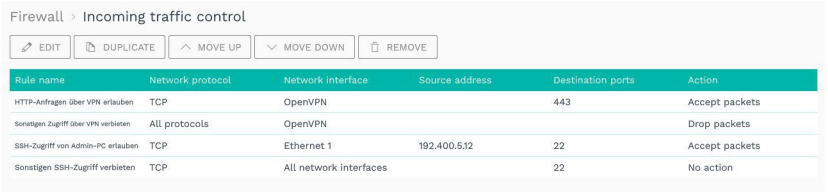
3.8.2. Controlling incoming traffic

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

All incoming packets are allowed by default, so that the respective network services of the gateway (e.g. SSH, MQTT, SMAC) can be accessed from all networks.

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

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



Firewall > Incoming traffic control (example)

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

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

3. Enter a name under **Rule name**.

4. Select the **Network protocol** for network packets to 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 through any interface for the rule to apply.

6. Enter a **Source address** if the rule should only apply 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 certain TCP/UDP ports of the gate- way. Then 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 is allowed or denied (depending on the action selected in the next step).

8. Under **Action**, select from the drop-down list what should happen to network packets that meet all the criteria of the rule.

   - **No action**: The rule is disabled, i.e. the process continues with the next rule.
   - **Accept packets**: The request is authorized and the packets are allowed to arrive.
   - **Drop packets**: The request is not authorized and the packet is dropped, i.e. effectively ignored. No answer is returned.

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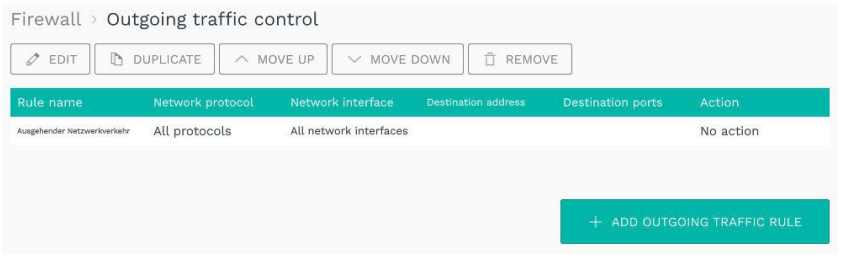
- **Reject packets**: The request is actively rejected and answered. A reject packet is sent back to the sender, so that establishing the connection fails.

9. Once you have made all the entries, click on **Finish**.
   This will take you back to the list with all the rules.
10. If you want to edit a rule, select it and click on **Edit** or double-click.
    A page opens where you can see and edit all the rule settings at a glance.
    To save your changes, click on **Save & close**.
11. If you want to duplicate a rule, select it and click on **Duplicate**.
    This will take you back to the setup wizard, where you can customise the rule.
12. If you want to remove a rule, select it and click on **Remove**.
13. If you want to change the order in which the rules are applied, select the rule and click on **Move up** or **Move down**.

3.8.3. Controlling outgoing traffic

In this window, you define firewall rules that determine how outgoing IP packets are handled by SIINEOS.
All outgoing packets are allowed by default, so the gateway can access all accessible networks and, if applicable, the Internet without restriction.
You can define rules here to block access to certain destination addresses.

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



Firewall > Outgoing traffic control (example)

2. To add a new rule, click on **Add outgoing traffic rule**.
   The setup wizard opens to guide you through the rule creation process. In the following, confirm each entry with **Next** or press **Enter**.
3. Enter a name under **Rule name**.
4. Select the **Network protocol** for network packets to which this rule applies.
   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 be sent through any interface for the rule to apply.
6. Enter a **Destination address** if the rule should only apply to packets sent to specific recipients (hosts/networks).

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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 can restrict access from the gateway to certain TCP/UDP ports of the target computer/network.

   Then 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 is allowed or denied (depending on the action selected).

8. Under **Action**, select from the drop-down list what should happen to network packets that meet all the criteria of the rule.
   - **No action**: The rule is disabled, i.e. the process continues with the next rule.
   - **Accept packets**: The packet may be sent via the corresponding network interface.
   - **Drop packets**: The packet is not sent, but dropped (discarded). The sending application receives no information that the packet has not been sent.
   - **Reject packets**: The packet is not sent and the sending application is informed that the network packet could not be sent / was not sent.

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

   This will take you back to the list with all the rules.

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

    A page opens where you can see and edit all the rule settings at a glance.

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

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

    This will take you back to the setup wizard, where you can customise the rule.

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

13. If you want to change the order in which the rules are applied, select the rule and click on **Move up** or **Move down**.

3.8.4. Defining and editing rules for IP forwarding

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

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

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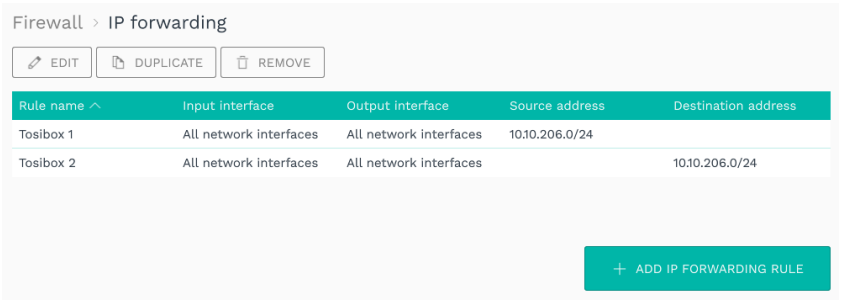
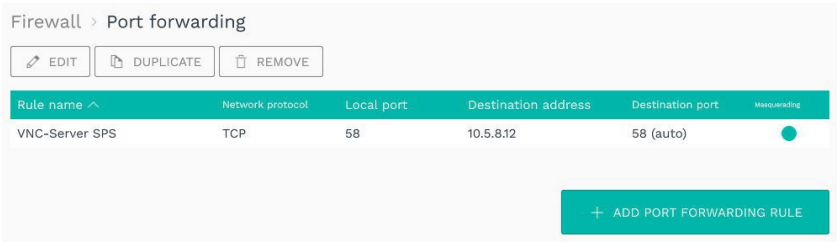


Firewall > IP forwarding (example)

2. To add a new rule, click on **Add IP forwarding rule**.
   The setup wizard opens to guide you through the rule creation process. In the following, confirm each entry with **Next** or press **Enter**.
3. Enter a **name**.
4. From the drop-down list, select the **Input interface** from which the data traffic is to be forwarded.
5. From the drop-down list, select the **Output interface** (destination) to which the data traffic is to be forwarded.
6. To limit data traffic only to a specific host or a defined 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, data traffic will not be restricted.
7. When you have completed the entry, click on **Save & close**.
   This will take you back to the list with all forwarding rules.
8. If you want to edit a rule, select it and click on **Edit** or double-click.
   A page opens where you can see and edit all the rule settings at a glance.
   To save your changes, click on **Save & close**.
9. If you want to duplicate a rule, select it and click on **Duplicate**.
   This will take you back to the setup wizard, where you can customise the rule.
10. If you want to remove a rule, select it and click on **Remove**.

3.8.5. Configuring port forwarding

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



Firewall > Port forwarding (example)

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2. To add a new rule, click on **Add port forwarding rule**.
   The setup wizard opens to guide you through the rule creation process. In the following, confirm each entry with **Next** or press **Enter**.
3. Enter a name under **Rule name**.
4. Select the **Network protocol** for network packets to which the port forwarding rule is to be applied.
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 data traffic is to be forwarded.
7. If you do not want to forward data traffic to a local port but to another port, enter the desired port number under **Destination port**.
   If you do not enter anything, the local port will be used.
8. Under **Masquerading**, the slider is automatically set to **On**. This means that the source address is replaced by the gateway's IP address for all forwarded packets.
   This is always necessary if direct IP routing between the sender and target host is not possible. This address translation ensures that replies from the target host are correctly returned to the original sender. In the most cases where port forwarding is required, masquerading is also necessary for communication to function as desired.
   If you do not want this to happen, set the slider to **Off**.
9. Once you have made all the entries, click on **Finish**.
   This will take you back to the list with all forwarding rules.
10. If you want to edit a rule, select it and click on **Edit** or double-click.
    A page opens where you can see and edit all the rule settings at a glance.
    To save your changes, click on **Save & close**.
11. If you want to duplicate a rule, select it and click on **Duplicate**.
    This will take you back to the setup wizard, where you can customise the rule.
12. If you want to remove a rule, select it and click on **Remove**.

3.9. User administration

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

- **System administrator**
  This role can log on to SIINEOS and configure the system, activate apps and open them in SIINEOS so that app users can access them.
  When logging on to SIINEOS for the first time, a user account (**hubadmin/hubadmin**) is created with the role of **System administrator**. You should change the preset password after logging on.
- **App administrator**
  This role can log on to the administration interface of an app (e.g. MADOW) and configure it.

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When logging on to the **InGraf** app for the first time, a user account (**ingrafadmin/ingra- fadmin**) is created with the role of **App administrator**.

Likewise, when logging on to the MADOW app for the first time, a user account (**mado-wadmin/madowadmin**) is created with the role of **App administrator**.

You should change the preset passwords after logging on.

- **App user**

  This role can log on to protected areas of an app where, for example, sensitive information is displayed.

All other user accounts are created and managed by you as the system administrator. The two user roles **App administrator** and **App user** are available for Apps.

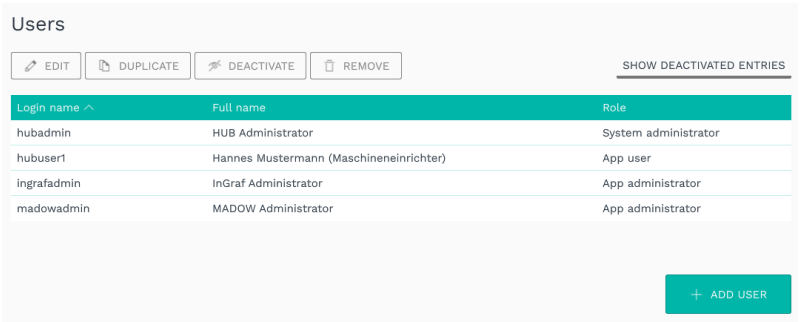
No authentication is required for some areas in apps. For example, a machine operator can connect directly to MADOW via the appropriate web address and view downtimes without having to log on.

3.9.1. Managing user accounts

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

NOTE

You can neither deactivate nor remove the preconfigured **System administrator** role.

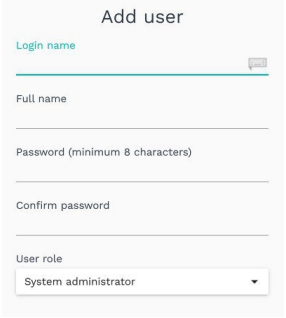


"Users" page (example)

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

   or –

   select an existing user and click on **Duplicate**.



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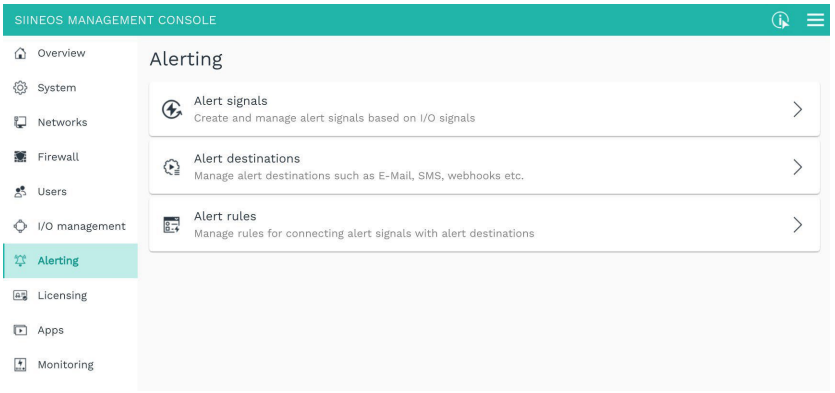
Users > Add user

2. Enter the **Login name**, the **Full name** and a **Password**. The password must consist of at least 8 characters.
3. Assign a **User role** to the user in the drop-down list.
4. When you have completed the entry, click on **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 on **Edit**.
   The same window opens as when creating a user. Here you can change all details and/or assign a different user role.
6. If you want to remove a user, select them and click on **Remove**.
7. To deactivate a user, e.g. because the user is absent for a longer period of time, select the corresponding line in the list and click on **Deactivate**.
8. To restore a deactivated user, click on the **Show deactivated entries** filter, select a user and click on **Activate**.

TIP
For many entries, you can search within the list. Click on the magnifying glass at top right and enter the username you are looking for.

3.10. Creating and configuring alert signals, destinations and rules

On the **Alerting** page, you can cause an alert signal to be triggered when a state you have defined is entered, see Creating alert signals [35].
You can forward this in various ways, for example by e-mail, SMS or webhook, see Managing alert destinations [36].
In addition, you can define alert rules that continuously process the alert signals and forward their statuses to the alert destinations, see Adding an alert rule [38].



"Alerting" page

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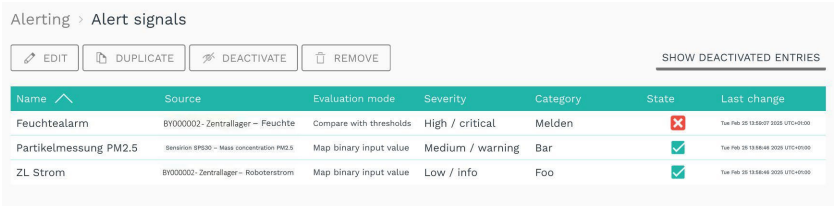
3.10.1. Creating alert signals

1. On the start page of **Alerting**, select **Alert signals**.
   If alert signals have already been created, they will be displayed in a list.



List with examples of alert signals

2. To create a new alert signal, click on **Add alert signal**.
   The setup wizard opens to guide you through the rule creation process. In the following, confirm each entry with **Next** or press **Enter**.
3. Enter the **Name** for the alert signal.
4. Under **Source**, select the I/O signal for which an alarm state is to be defined.
5. Under **Evaluation mode**, you can define how the source signal is to be evaluated. The following options are available:
   a. **Use binary input value**: The source signal represents the status of the alert signal as a binary value. This mode is, for example, well suited for a light barrier or if the input signal is a digital signal (an error or a condition) from a PLC.
   b. **Compare with thresholds**: The source signal must be within certain limits in order to remain in the OK state. This mode is, for example, well suited for process-related values such as humidity, speed, current, etc.
   c. **Follow counter**: The source signal is a counter that must increase steadily in order to remain in the OK state. This mode is well suited for piece counters, energy meters, metre counters, etc.
   d. **Follow cycles**: The incoming signal follows a cycle. The signal remains in the OK state only if the duration between two pulses does not exceed a specified time. This mode is, for example, well suited for processes and production cycles – as soon as the next pulse arrives late or not at all, the machine stops and the alarm is triggered.
6. Depending on which evaluation mode you have selected in the previous step, you can now configure what is an OK state and what is an alert state.
   a. After selecting **Use binary input value**, you can define under **Polarity** whether 0 is the OK state and 1 is the alert state or 0 is the alert state and 1 is the OK state.
   b. After selecting **Compare with thresholds**, you can define when the signal value should become an alert when it reaches one or more **Thresholds** you have set.
   c. After selecting **Follow counter**, you can enter the **Step size** by which the counter must be increased regularly to keep the alert signal in the OK state.
   d. After selecting **Follow cycles**, you can enter the **Thresholds** that the signal value must exceed in order to detect a pulse.

7. If you have selected **Follow counter** or **Follow cycles**, an additional page will be displayed. Here you can enter the **Cycle time** in milliseconds, i.e. define the time between two pulses or counters.

8. Under **State transition delays**, you can enter the time that should still elapse until the alert or OK state is entered.

   This is useful if outliers such as temperature or current peaks are to be ignored so that fewer messages are sent when the measured values or signal values vary around a limit range.

9. Under **Severity**, select how critical the alert signal is.

10. Optional: Under **Category**, assign a name if you want to assign this alert signal to a category.

    The category is stored as meta information and can be used as a variable in the alert destinations. For example, the variable is used by the **SIGNL4** app, where the category is important basic information.

11. Once you have made all the entries, click on **Finish**.

    You return to the list with all alert signals.

12. If you want to edit an alert signal, select it and click on **Edit** or double-click.

    This will take you back to the setup wizard.

13. If you want to duplicate an alert signal, select it and click on **Duplicate**.

    This will take you back to the setup wizard.

14. If you want to deactivate an entry because you want to perform a test run on your production line, for example, select the entry and click on **Deactivate**.

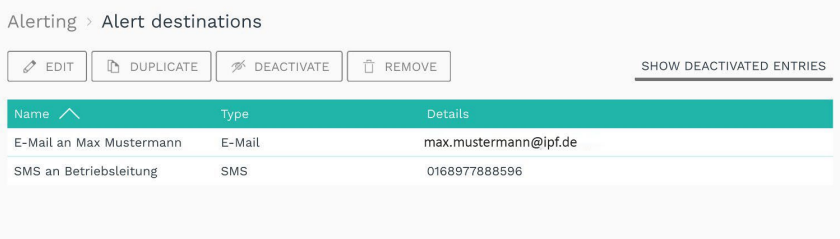
    The entry is now only visible if you click on **Show deactivated entries**. If you want to reactivate the entry, select it and click on **Activate**.

15. If you want to remove an alert signal, select it and click on **Remove**.

3.10.2. Managing alert destinations

1. On the start page of **Alerting**, select **Alert destinations**.

   If alert destinations have already been created, they will be displayed in a list.



List with examples of alert destinations

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2. To add a new alert destination, click on **Add alert destination**.
   The setup wizard opens to guide you through the rule creation process. In the following, confirm each entry with **Next** or press **Enter**.
3. Enter the **Name** for the alert destination.
4. Under **Type**, you can select the desired type of alert destination. The following options are available:
   a. **E-mail**
   b. **SMS**
   c. **Webhook**
   d. **VictoriaMetrics**
   e. **I/O signal**
   f. **MQTT**
   g. **App**
5. Depending on which type you have selected in the previous step, you can now specify the way in which the alert destination processes and forwards the alert signals under **Details**.
   TIP: Placeholders are available for free-text fields. They are displayed when clicking in the input field or on the **Placeholder variables** icon.
   a. After selecting **E-mail**, you can enter the e-mail addresses of the recipients, the subject and the text.
   b. After selecting **SMS**, you can enter the telephone numbers of the recipients and the message text.
   c. After selecting **Webhook**, you can enter the URL, the HTTP method and the data for the body of the HTTP request.
   d. After selecting **VictoriaMetrics**, you can enter the metric name.
   e. After selecting **I/O signal**, you can select the I/O signal from the existing I/O units into which the alert state is to be written, e.g. an LED or a digital output.
   f. After selecting **MQTT**, you can enter the MQTT broker address, topic name and topic data. In addition, you can select whether the published data is to be kept on the MQTT broker, so that later-connecting MQTT clients still receive this data.
   g. After selecting **App**, you can select the alert-processing app **SIGNL4** to which the notification is to be forwarded. The app must be installed in SIINEOS.
6. Once you have made all the entries, click on **Finish**.
   You return to the list with all alert destinations.
7. If you want to edit an alert destination, select it and click on **Edit** or double-click.
   This will take you back to the setup wizard.
8. If you want to duplicate an alert destination, select it and click on **Duplicate**.
   This will take you back to the setup wizard.

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9. If you want to deactivate an entry, select the entry and click on **Deactivate**. This may become necessary if, for example, the alert destination is not currently available and/or alert messages that are sent too frequently during set-up are to be temporarily muted.

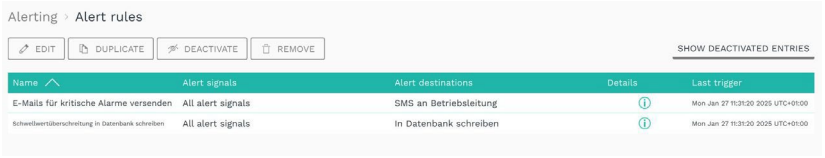
   The entry is now only visible if you click on **Show deactivated entries**.
   If you want to reactivate the entry, select it and click on **Activate**.

10. If you want to remove an alert destination, select it and click on **Remove**.

3.10.3. Adding an alert rule

1. On the start page of **Alerting**, select **Alert rules**.

   If alert rules have already been created, they will be displayed in a list.



List with examples of alert rules

   In the **Details** column, the most important parameters of the alert (trigger, repetition, severity levels) are summarized in a tooltip.

2. To create a new alert rule, click on **Add alert rule**.

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

3. Enter the **Name** for the alert rule.

4. Under **Alert signals**, leave the slider set to **On** if all alert signals are to be evaluated by this rule;

   – or –

   set the slider to **Off** and select individual alert signals to be evaluated by this rule.

5. Under **Trigger**, set the **Alert** slider to **On** so that the alert rule is applied when the alert signal changes to or remains in the alert state;

   – or –

   set the **OK** slider to **On** if the alert rule is applied as soon as the alert signal returns to or continues in the OK state.

6. Optional: Under **Repetition**, you can specify whether the rule sends alert messages via the alert destinations periodically with the alert signals in an unchanged state and, if so, how long the repetition interval should be.

   If you do not specify an interval, the rule will only ever be applied if the state changes.

7. Under **Severity levels**, select which severity level of an alert signal is to be included in the alert rule.

8. Under **Destinations**, you can select the alert destinations via which (alert) messages are to be sent when the selected alert signals are in the configured states.

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

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You return to the list with all alert rules.

10. If you want to edit an alert rule, select it and click on **Edit** or double-click.
    This will take you back to the setup wizard.
11. If you want to duplicate an alert rule, select it and click on **Duplicate**.
    This will take you back to the setup wizard.
12. If you want to deactivate an entry, for example, because you want to temporarily suspend alert forwarding to your alert destination, select the entry and click on **Deactivate**.
    The entry is now only visible if you click on **Show deactivated entries**. If you want to reactivate the entry, select it and click on **Activate**.
13. If you want to remove an alert rule, select it and click on **Remove**.

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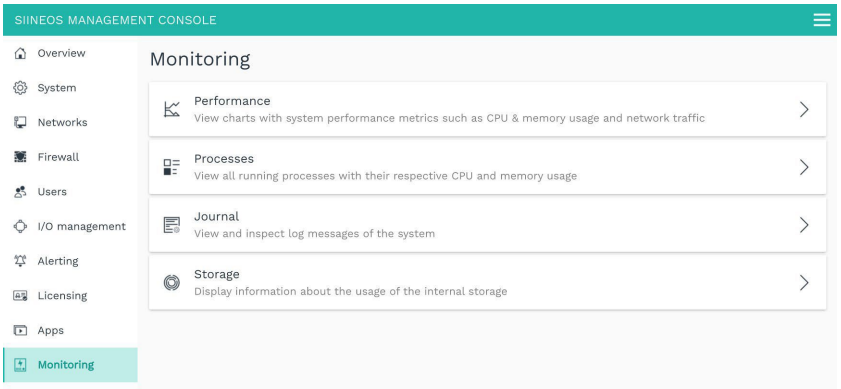
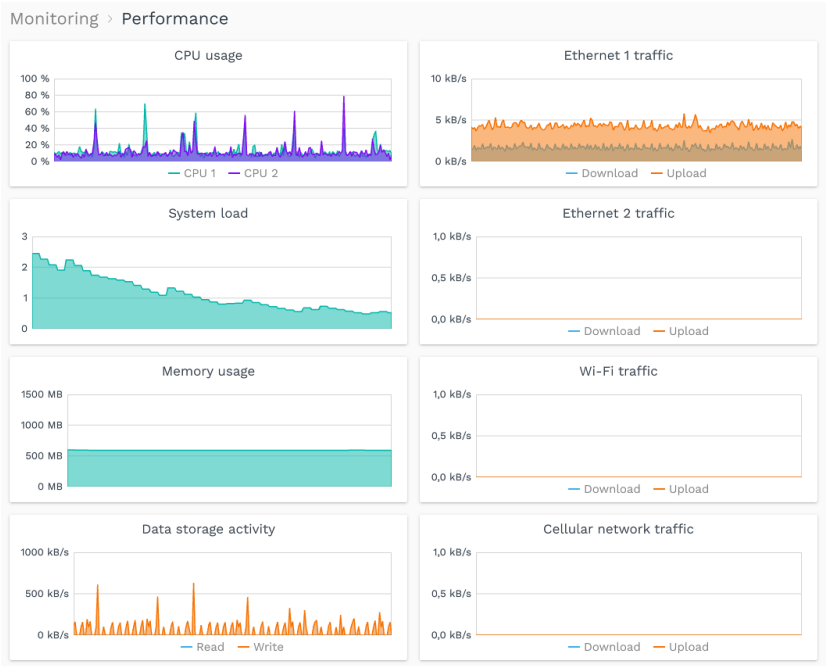
3.11. Monitoring the system

Various functions for device monitoring and diagnostic purposes are available on the **Monitoring** page:



"Monitoring" page

- **Performance**: Check the utilization of the processor and RAM live, as well as the activity of the storage and the network interfaces of your gateway.



Monitoring > Performance (example)

- **Processes**: Check whether the system has fully started up, which apps are active and at what CPU load they are working.

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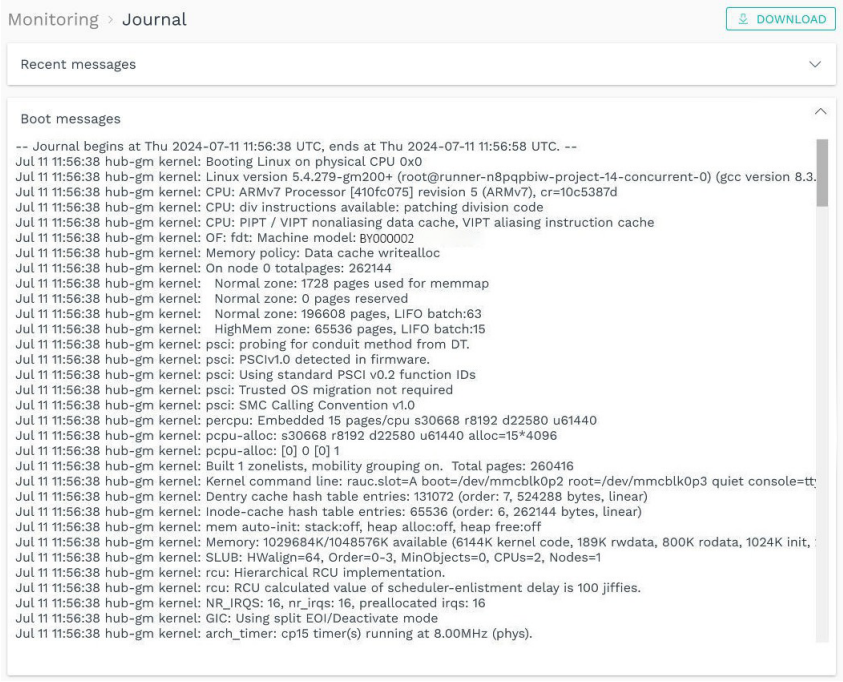
Monitoring › Processes

Process ID	Name	CPU usage	Memory usage
373	SMAC-Server	13 %	72 MB
485	victoria-metric	2 %	77 MB
22502	mosquitto	2 %	6 MB
299	Monitor Server	1 %	26 MB
7237	InGraf	1 %	22 MB
22819	OpcUaServer	1 %	26 MB
1	systemd	0 %	7 MB
2	kthreadd	0 %	< 1 MB
3	rcu_gp	0 %	< 1 MB
4	rcu_par_gp	0 %	< 1 MB
8	mm_percpu_wq	0 %	< 1 MB
9	ksoftirqd/0	0 %	< 1 MB
10	rcu_sched	0 %	< 1 MB
11	migration/0	0 %	< 1 MB
12	cpuhp/0	0 %	< 1 MB
13	cpuhp/1	0 %	< 1 MB
14	migration/1	0 %	< 1 MB
15	ksoftirqd/1	0 %	< 1 MB

Monitoring > Processes (example)

- **Journal**: Gain insight into the primary log files of SIINEOS, which contain important messages, especially error messages, for ongoing operations. In case of problems with SIINEOS, you can check whether any relevant error messages have been logged here.



Monitoring > Journal (example)

Click **Download** to save the displayed messages as a TXT file.

- **Storage**: Get an overview of the utilization of the internal storage as well as a breakdown into individual parts/components/areas and perform maintenance on the storage.

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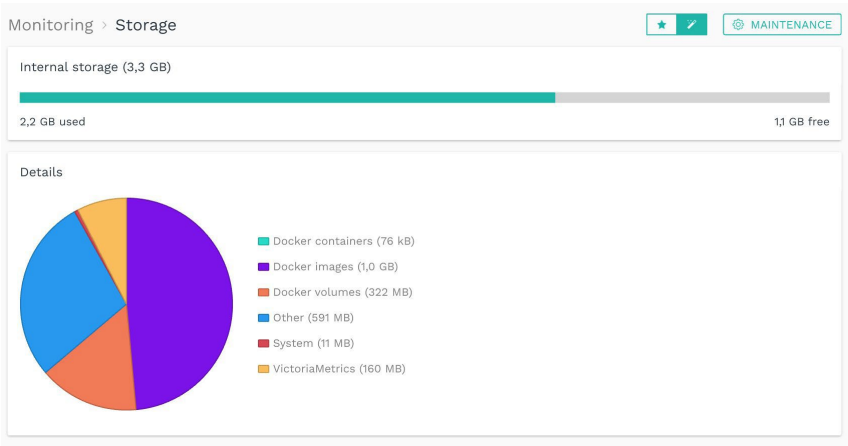
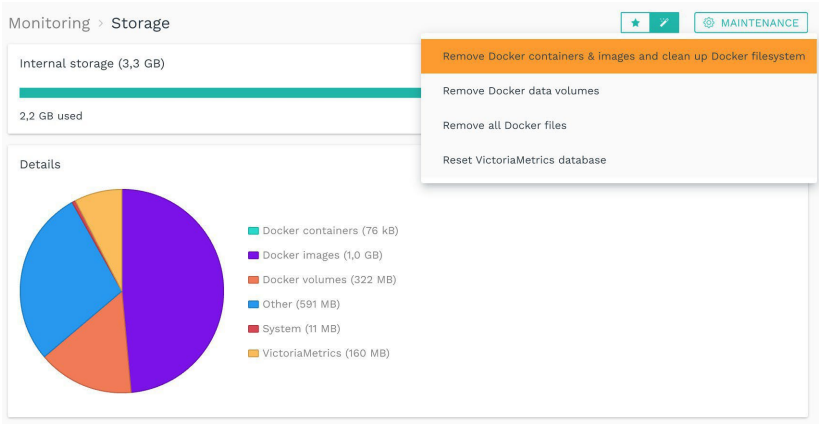


Monitoring > Storage, in "Advanced" viewing mode (example)

3.11.1. Storage maintenance

1. On the **Monitoring > Storage** page, switch to the **Advanced** viewing mode.
2. Click on the **Maintenance** button.



Functions for storage maintenance (first entry selected)

The following maintenance options are available:

a. **Remove Docker containers and images and clean up Docker file system**: All settings and data such as the Grafana dashboards or the Node-RED flows are retained. All Docker containers are removed and then have to be reinstalled.

b. **Remove Docker data volume**: All settings and data such as the Grafana dashboards or the Node-RED flows are deleted from the containers (reset to factory defaults). All Docker containers will be retained.

c. **Remove all Docker files**: All settings and data, as well as the Docker containers, will be removed. The Docker containers then have to be reinstalled.

d. **Reset VictoriaMetrics database**: The database memory is cleared.

3. Confirm your selection with **Yes**;

   – or –

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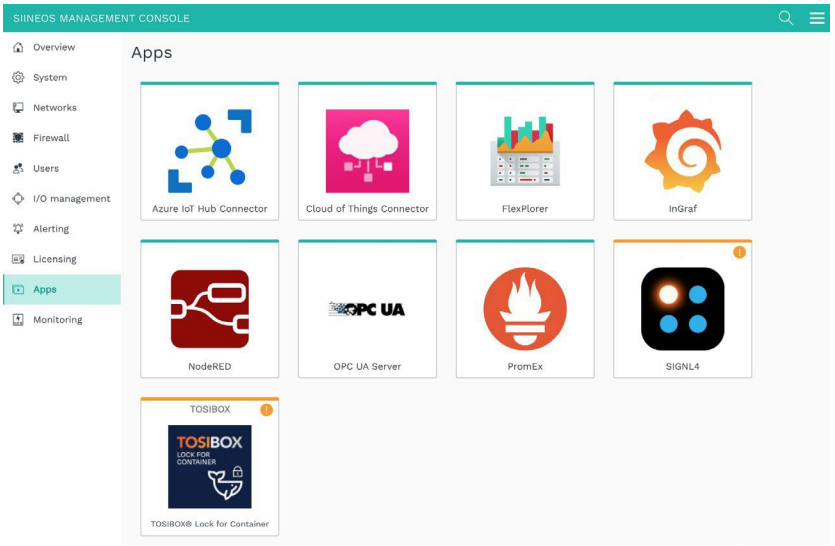
click on **No** if you want to reconsider your selection.

4. If you want to see a detailed view of how the storage is composed, click on a colour field in the pie chart.

3.12. Opening and managing apps

On the **Apps** page, you will find various applications that you can use to set up communication interfaces, data visualization or cloud connections, for example. How many apps are displayed on this page depends on which licences you have purchased.

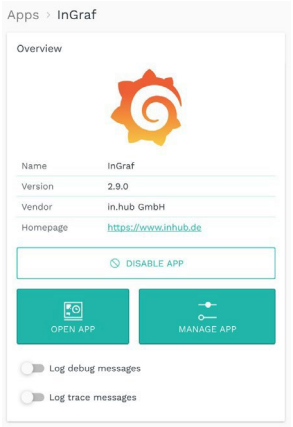
Apps that do not have a valid licence or whose licence has expired are identified in the view (orange bar and exclamation mark).



"Apps" page (example)

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

   A window opens from which you can activate, open and manage the app.



2. Additional settings are available in **Advanced** viewing mode:

   - **Log debug messages**: Messages from the SIINEOS management service are logged in the system journal to help ipf electronic with troubleshooting.

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- **Log trace messages**: Activate this function if detailed calls of system functions and the parameters used by the various apps are to be logged.

> **NOTE**
> Do not use these functions during production – performance could be impaired.

On the **Monitoring** page, under **Journal**, you can view the debug and trace messages and download them by clicking on a button.

Please note that the messages are stored only temporarily and are lost after a restart. You should therefore save them in good time.

3. To start an app, click on **Enable app**.
4. To view or change app settings, click on **Manage app**.
   Learn how to manage and configure apps in the chapter Managing apps [101].
5. Once the app has been activated, click on **Open app**.
   The app will then open in a new window or tab (depending on browser settings).
   If it is an external app, such as Grafana, you will be taken to the login page. Make sure that you have created a user account beforehand.

> **TIP**
> For many entries, you can search within the list. Click on the magnifying glass at top right and enter the username you are looking for.

3.13. Managing licences

With every new SIINEOS-enabled IPF device you purchase, you will automatically receive a SIINEOS licence for 3 years. You can update SIINEOS as often as you like during the licence period and install the latest version on the device.

Once the licence period has expired, you can either continue working with the currently installed version of SIINEOS or you can purchase another licence from ipf electronic to benefit from the further development and product improvement of SIINEOS.

If you need an app licence or want to extend one, please refer to the relevant User Manual.

3.13.1. Requesting a voucher and activating a software licence

1. Please contact hotline@ipf.de and let us know the term for which you would like to purchase the licence.
   SIINEOS licences can be purchased for 1 year or 3 years.
   You can activate the software licence with the voucher you receive from us.
2. Navigate to the website https://apps.inhub.de/ and register or log on if you are already registered.

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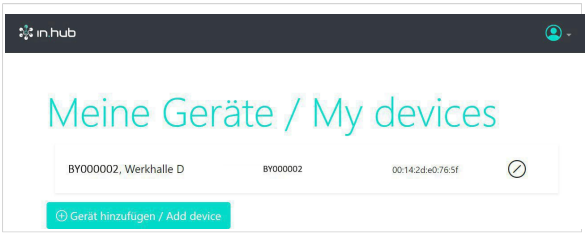
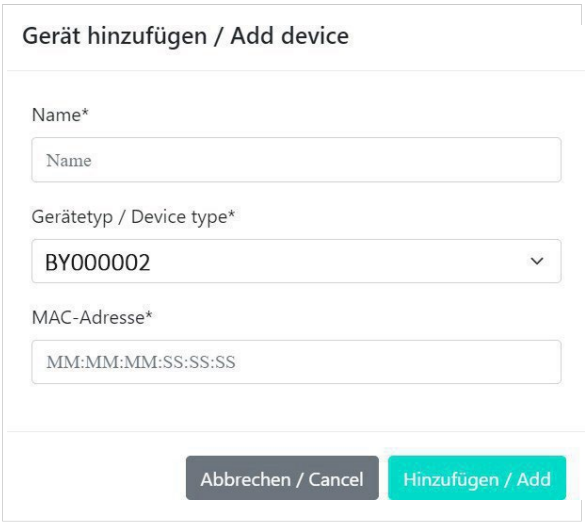


My devices (example)

3. If you want to extend a software licence, click on the device on which the software licence is to be renewed under **My devices**;

   – or –

   if you want to activate the software licence for a new device, click on **Add device**.



Add device

4. Enter the **Name** of the device, select the **Device Type** and enter the MAC address of the device.

   The MAC address can be found via **SIINEOS > Networks > Ethernet 1**. **NOTE**: Only the MAC address of Ethernet 1 is recognized and accepted.

5. Click on **Add**.

   The **License activation** page opens:

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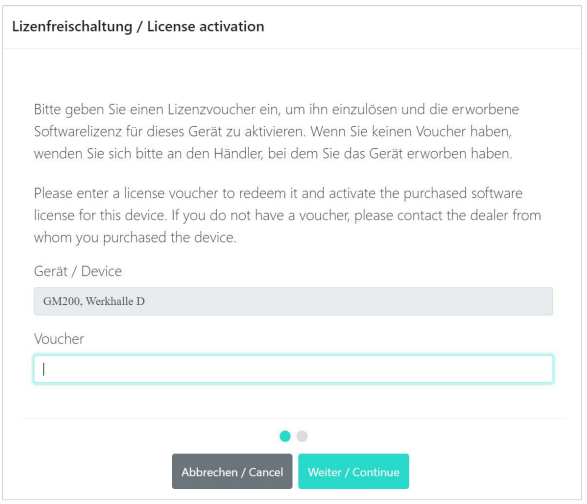
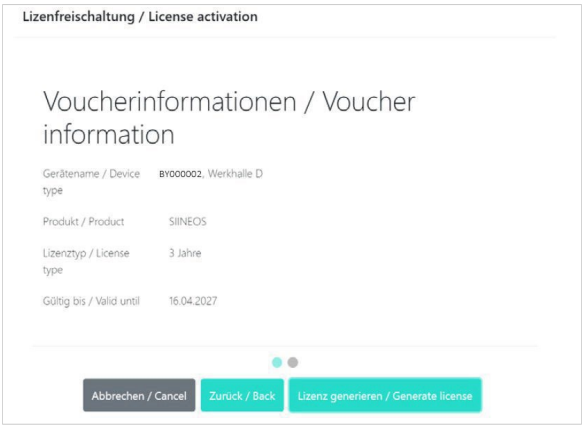


License activation

6. Copy the name of the voucher you received from ipf electronic into the **Voucher** field.
7. Click on **Next**.
   The information stored in the voucher, such as the term, product and validity, etc., will be displayed.



Voucher information (example: Activation of a SIINEOS licence valid for 3 years)

8. Check the details, especially whether the requested licence term matches the term specified here.
9. If the details are correct, click on Generate license.
   The licence file is downloaded automatically.

3.13.2. Adding a licence file to SIINEOS

1. In SIINEOS, navigate to **Licensing**.
   In the list, you will find all software licences that you have purchased and uploaded.

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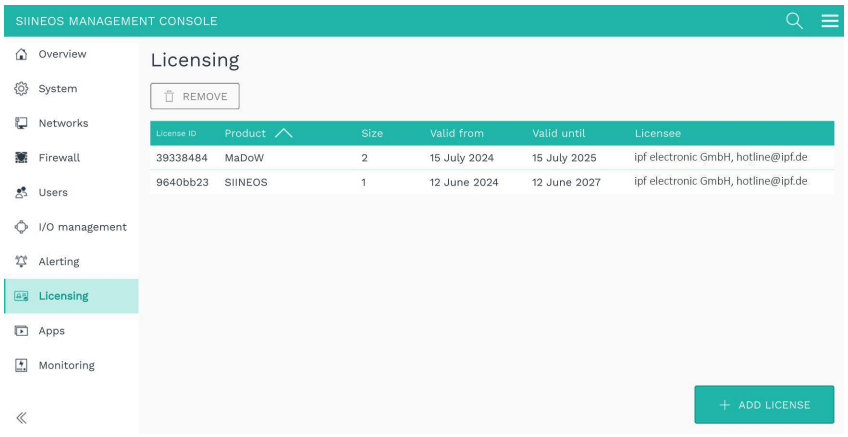

"Licensing" page (example)

2. Click on **Add license**.
3. Select the licence file from your file directory and click on **OK**.
   The licence is added to the list. From that point on, you can implement updates again or return to using a blocked app.
4. To remove a licence again – because it has become invalid, for example – select the licence ID and click on **Remove**.
   This will not delete the licence file itself, but only remove it from the list.

NOTE

Make sure that the system time ofyour device is correctly set and/or synchronized. Otherwise, the licence-file upload may **fail.**

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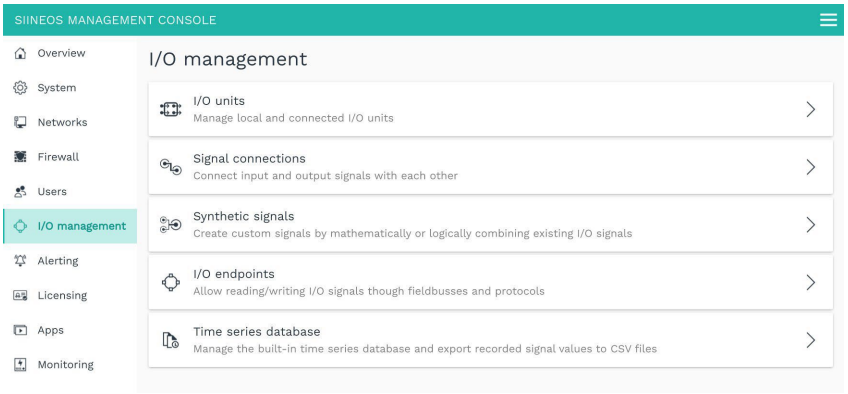
4. I/O management

You can connect a variety of external peripheral devices to one IPF gateway, such as sensors, Modbus clients or other IPF modules.

You configure the interfaces and signals from the peripheral devices so that measurements are output according to your requirements.

You can perform the following tasks on the **I/O management** page:

- Create I/O units, manage them and configure their interfaces.
  Creating I/O units [54]
- Connect input and output signals with each other to trigger actions when signal values or measurements fall outside a defined range.
  Configuring signal connections [91]
- Combine signals from the I/O units with each other to generate new, synthetic signals.
  Creating synthetic signals [93]
- Allow the reading and/or writing of I/O signals via fieldbuses and protocols
  Configure I/O endpoints [96]
- Manage the built-in time series database and export the recorded signal values as a CSV file
  Export time series database [98]



"I/O management" page

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4.1. Working with I/O management

If you use I/O management to create devices or clients and/or to configure signals and/or signal connections, there are a number of functions that can support you in your daily work. These include, for example, the sorting and filtering of long lists or the saving and reuse of settings that you have made for a specific I/O unit. These tools are presented in the next chapter.

4.1.1. Filtering I/O units and reading information

If a large number of devices appears on the **I/O units** page, it can be helpful to filter them. The following filters are available:

Filter criteria (the "Connected" filter is currently applied)

The following rules apply to the filtering of entries:

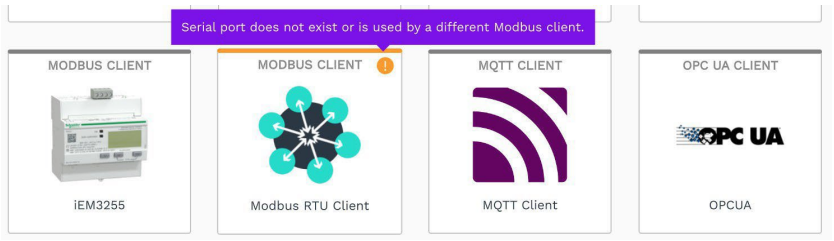
- An I/O unit can either be connected – i.e. the device is physically connected or the underlying network connection is established (e.g. to the MQTT broker or OPC UA server) – *or* disconnected.
- An I/O unit can either be enabled *or* disabled. This is done in the general settings for the unit.
- For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

Setting filters

1. On the **I/O management** start page, click a filter in the upper right corner to apply it. The filter changes its colour to turquoise.
2. Click on the filter again to deselect it.
   The filter changes its colour to grey.

Reading information

- Move the mouse over a tile. Further information on the I/O unit created is displayed.
- In cases of error messages, a symbol is displayed in the upper right corner. You can find more information about this error message in the tooltip.



Error message for the "Modbus client" I/O unit (example)

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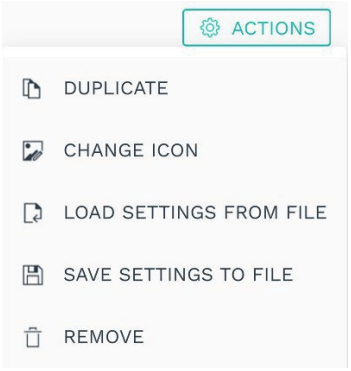
4.1.2. Using the “Actions” menu

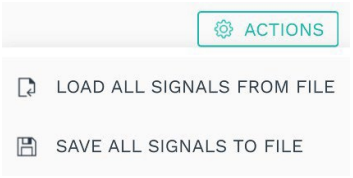
In I/O management, the **Actions** menu is also available for the device settings of the I/O units and for synthetic signals. This allows you to save the settings you have made so that you can reuse them elsewhere or you can import entries that have already been saved to the current device.

1. Open an I/O unit and click on **Actions**;



– or –

open the list of synthetic signals and click on **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 labelled with the suffix “**copy**”. You can now edit this I/O unit according to your requirements.
Change icon (image for an I/O unit)	A dialogue will appear, in which you can upload the new image. 1. Click in the **Image file** input field and select the new image in PNG format with a maximum file size of 128 kB from your local data directory. 2. Click on **Upload and update**. 3. If you want to restore the original image, click on **Reset to default**. 4. Confirm with **OK**. The image will then have been replaced.
Load settings from file	This allows you to apply already-saved settings to the I/O unit. Your local data directory will open.

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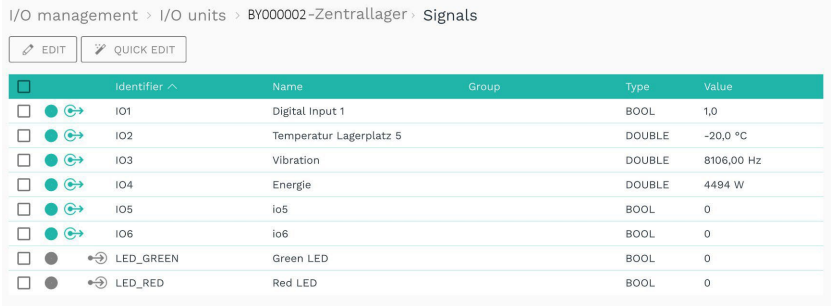
	1. Select the JSON file with the settings to upload it.
Save settings to file	Depending on your system, a file storage dialogue will open or the JSON file will be automatically downloaded to your download folder.
Remove	1. Confirm with **Yes**. The unit has now been removed.
Load all signals from file	This allows you to load all previously saved signals into the list. Your local data directory will open. 1. Select the JSON file with the settings to upload it.
Save all signals to file	All synthetic signals and their settings are saved in a JSON file and downloaded immediately.

4.1.3. Sorting lists and reading information

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



List view of BY000002 signals (example)

1. Open an I/O unit and go to the overview of signals;
   – or –
   on the **I/O management** start page, click on **Signal connections**; – or –
   on the **I/O management** start page, click on **Synthetic signals**. A list view will be displayed showing all signals or connections.
2. To sort them, click on the header of a table column.
   You can sort alphabetically forwards (A–Z) or alphabetically backwards (Z–A).
3. You can get information about the statuses of a signal or signal connection by noting the following icons:

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

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Signal / signal connection is activated

Signal / signal connection is deactivated

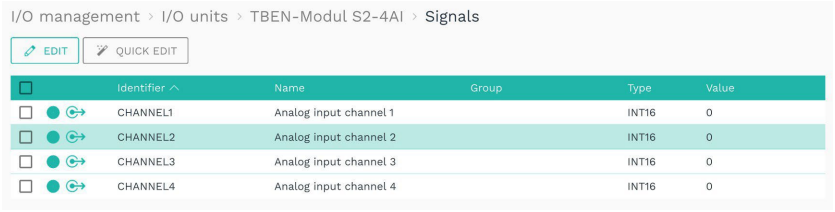
Only for signals: Signal is being written to the I/O unit (e.g. to a relay)

Only for signals: Signal is being read from the I/O unit (e.g. from a sensor connected to an analogue input)

NOTE
The icons may vary depending on the task you have selected on the **1/0 management** start page.

4.1.4. Editing, duplicating or removing list entries

Various buttons are available in each list view for editing signals, signal connections and synthetic signals.



List view with buttons for editing (example)

NOTE
The buttons for the signals may vary depending on the 1/0 unit selected. If a button is not displayed in a list view, this function is not available for the selected 1/0 unit.

1. Open an I/O unit and go to the overview of signals;
   – or –
   on the **I/O management** start page, click on **Signal connections**; – or –
   on the **I/O management** start page, click on **Synthetic signals**. A list view will be displayed showing all signals or connections.
2. Select one of the following buttons:

Edit	1. Select an entry and click on **Edit**; – or – double-click on the entry you want to edit.

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	This will either take you back to the setup wizard or to the signal settings.
Duplicate	1. Select a list entry and click on **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 permanently preconfigured signals or channels.
Remove	1. Select the signal using the checkbox; – or – select the signal connection. 2. Click on **Remove**. A message will be displayed asking whether 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 on **Edit signal properties**. A window opens in which you will find three tabs. 2. Enable and configure the synthetic signal on the **Signal settings** tab. 3. On the **Signal processing** tab, you can specify how the signal value is to be processed. You can find out more at Configuring the signal processing steps [88]. 4. Click on **Save**. 5. On the **Measurement modelling** tab, you specify how the measurements are to be visualized. You can find out more at Measurement modelling [89]. 6. Finally, click on **Save & close**.
Reset (only in “Synthetic signals”)	Resets an applied counter (**Infinite counter** or **Resettable counter**). 1. Select a synthetic signal and click on **Reset**. The counter will be reset.
Quick edit (only in “I/O unit > Signals”)	1. If you want to edit several signals at the same time, select the signals using the checkbox and then click on **Quick edit**. 2. Select one of the four actions to be applied to all selected signals: • **Enable/disable**: Enable or disable several signals at once.

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	• **Group**: Assign a common group name. • **Data series set**: Assign a common name for the data series set. This means that all signals with the same data series set are displayed in FlexPlorer under Live charts in a common chart, so that the signal values from different devices/sensors can be compared directly in live operation. • **Sampling interval**: Specify the sampling interval. • **Recording settings**: Specify whether you want to record the signal values in the VictoriaMetrics database and at what time interval [s] this should take place. • **Decimals**: Specify the number of decimal places. • **Unit**: Specify the unit. A dialogue window will open. 3. Enter the parameter required by the selected quick tool (e.g. the group name or number of decimal places). 4. Finally, click on **Save & close**.

4.1.5. Searching for entries

The search function is available in all list views. In **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 will be transferred directly into the search field at top right and the hits will be displayed dynamically 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, including device addresses, for example.

4.2. Creating I/O units

If you have selected the **I/O units** option on the **I/O management** page, you can now set up your peripheral devices. Each device has its own settings and parameters, which is why the following chapters describe how to set up each I/O unit separately.

On the IPF download portal you will also find the operating instructions for IPF's own devices for further information: https://www.ipf-electronic.de/en/online-shop/product-details/by000002.

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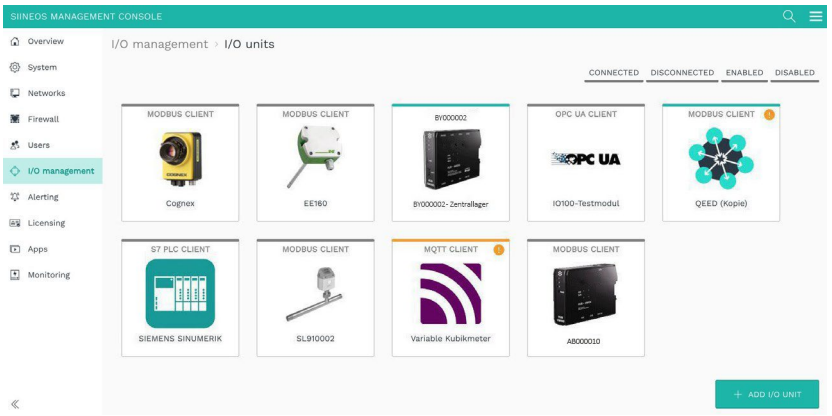


I/O management > I/O units (example)

4.2.1. Adding a BY000002

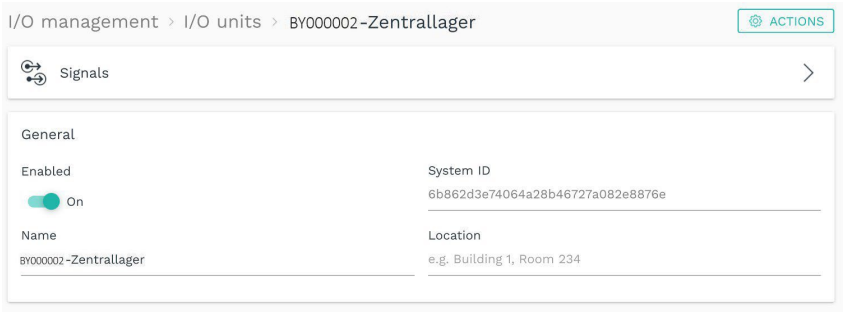
NOTE

This I/O unit refers to the local gateway on which you are currently located and allows you to access signals on the local interfaces.

1. On the **I/O management** start page, select **I/O units**.
2. Click on **Add I/O unit**.
3. Select **BY000002** as the type.

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

   A page will open where you can configure the settings for the unit.



Device settings for the BY000002 (example)

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

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

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7.

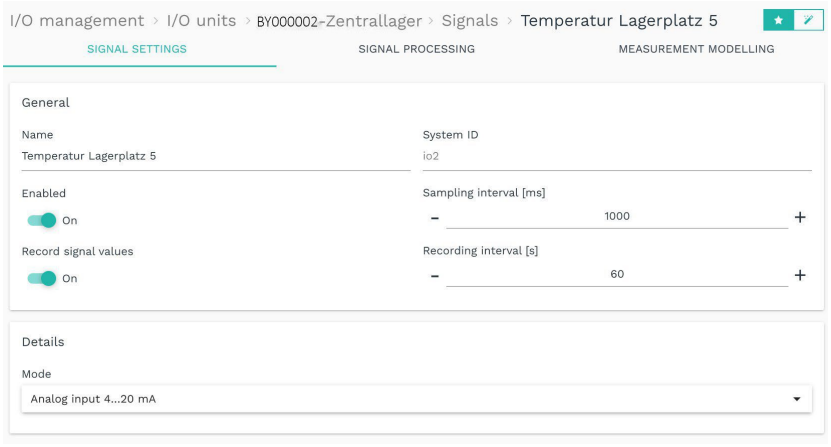
8. Click on **Signals**.

   The signals for all channels of the **BY000002** have already been created.

Signals for the BY000002 (example)

9. Select the signal you want to configure.

   A window opens in which you will find three tabs.



"Signal settings" tab (example)

10. Enable and configure the interface on the **Signal settings** tab.
    a. Optional: Change the name of the interface.
    b. Set the **Enabled** slider to **On**.
    c. In the **Sampling interval** field, specify the interval at which the signal is to be sampled (in milliseconds).
    d. Set the **Record signal values** slider to **On** if the values are to be recorded in the local VictoriaMetrics database.
    e. In the **Recording interval** field, enter the desired time interval for the recording (in seconds).
11. Additional settings are available in **Advanced** viewing mode:
    a. **Use custom identifiers**: Set the slider to **On** if you want to enter your own identifier name.
    b. **Custom identifier**: Enter your own identifier name.

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c. **Calibrate to 0 mA** button: Calibrate the analogue input so that the current analogue value is 0 mA.

d. **Reset calibration** button: This resets the calibration of the analogue input to 0 mA.

12. Depending on the type of signal and mode selected, further entries may be necessary under **Details**:

Selection as an **Analogue input**	Under **Mode**, select the type of analogue interface for the connected sensor. Available options: **0–10 V** and **4–20 mA**.
Selection as a **Digital input**	To continuously count how often the signal value has changed from 0 to 1, set the **Count rising edges** slider to **On**. To count how often the signal value has changed from 1 to 0, set the **Count falling edges** slider to **On**.
Selection as a **Digital output**	Under **Default state**, select which voltage should be output at the interface. Available options are **Off (0 V)** and **On (24 V)**.
LED	Specify whether the LED should be switched off or on in the **Default state**.
Power supply	Specify whether the power supply via the backplane bus or the RS485 interface should be switched on or off in the **Default state**.

13. On the **Signal processing** tab, you can specify how the signal value is to be processed. You can find out more at Configuring the signal processing steps [88].

14. Click on **Save**.

15. On the **Measurement modelling** tab, you specify how the measurements are to be visualized.
    You can find out more at Measurement modelling [89].

16. Finally, click on **Save & close**.

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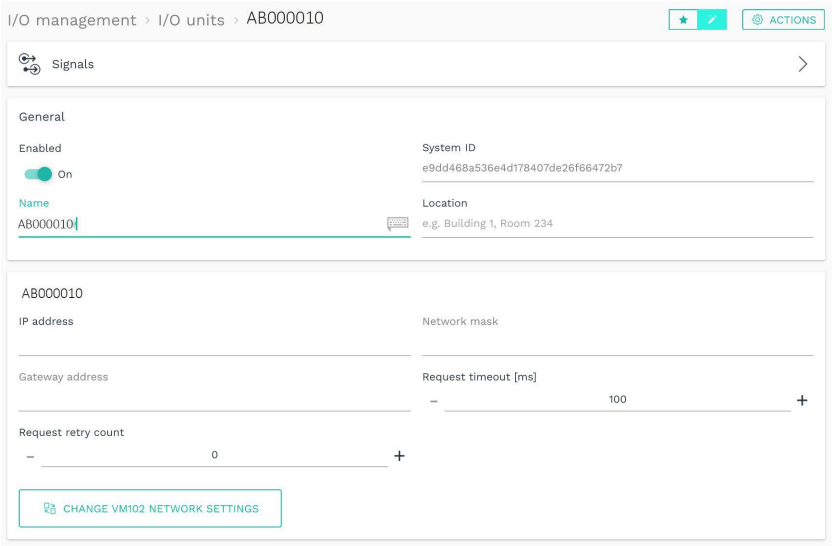
4.2.2. Establishing communication with the AB000010 via a network

The procedure described here applies if you integrate a **AB000010** via network (LAN). For data communication via the backplane bus, please create a Modbus client of the RTU type as usual, see Adding a Modbus client of the RTU type [63].

1. On the **I/O management** start page, select **I/O units**.
2. Click on **Add I/O unit**.
3. Select **AB000010** as the type.
   The setup wizard opens to guide you through the rule creation process. In the following, confirm each entry with **Next** or press **Enter**.
4. Enter the **Name** for the I/O unit.
5. Click on **Finish** to add the I/O unit.
   A page will open where you can configure the settings for the unit.



Device settings for the HUB-VM102 in “Advanced” viewing mode (example)

   The newly added I/O unit is automatically enabled. If you want to use it later, set the **Enabled** slider to **Off**.
6. Optional: Enter the **Location**.
7. Enter the IP address of the **AB000010**.
   Each **AB000010** has a factory-set IP address **192.168.1.200**, which is always the same.
8. If you want to use more than one **AB000010** in the network, you must change the IP address(-es) of the other devices.
   To do this, open the I/O units one after the other and give each **AB000010** a different IP address:
   a. Switch to **Advanced** viewing mode.
   b. Click on the **Change AB000010 network settings** button.

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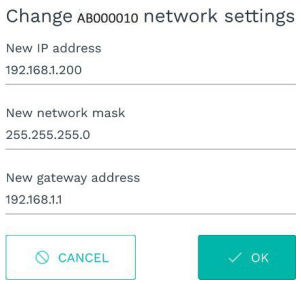


c. Enter a **New IP address**, a **New subnet mask** and a **New gateway address** and confirm with **OK**.

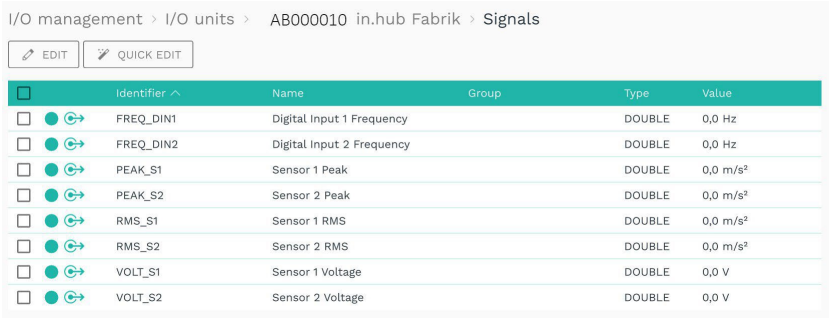
The new **Subnet mask** and **Gateway address** will be displayed in the device settings of the **AB000010** for your information.

d. In the **Request timeout [ms]** field, define after how many milliseconds without a response a request should be resent or discarded.

e. In the **Request retry count** field, enter how often a request should be sent if no response is received. After the entered number of attempts, the request is finally cancelled.

9. Click on **Signals**.

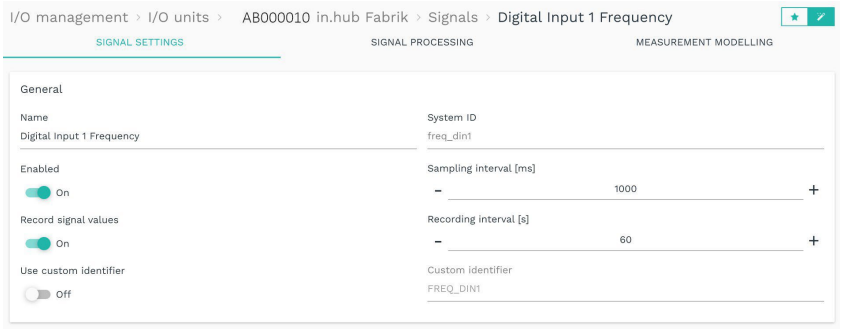
The signals for all channels of the **AB000010** have already been created.



Signals for the AB000010 (example)

10. Select the signal you want to configure.

A window opens in which you will find three tabs.



"Signal settings" tab in "Advanced" viewing mode

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11. Enable and configure the interface on the **Signal settings** tab.
    a. Optional: Change the name of the interface.
    b. Set the **Enabled** slider to **On**.
    c. In the **Sampling interval** field, specify the interval at which the signal is to be sampled (in milliseconds).
    d. Set the **Record signal values** slider to **On** if the values are to be recorded in the local VictoriaMetrics database.
    e. In the **Recording interval** field, enter the desired time interval for the recording (in seconds).
12. Additional settings are available in **Advanced** viewing mode:
    a. **Use custom identifiers**: Set the slider to **On** if you want to enter your own identifier name.
    b. **Custom identifier**: Enter your own identifier name.
13. On the **Signal processing** tab, you can specify how the signal value is to be processed. You can find out more at Configuring the signal processing steps [88].
14. Click on **Save**.
15. On the **Measurement modelling** tab, you specify how the measurements are to be visualized.
    You can find out more at Measurement modelling [89].
16. Finally, click on **Save & close**.

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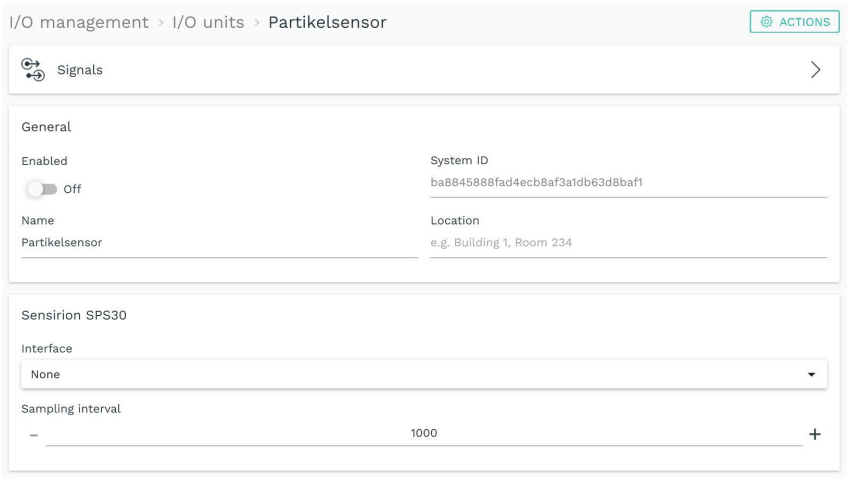
4.2.3. Adding a Sensirion SPS30 particle sensor

1. On the **I/O management** start page, select **I/O units**.
2. Click on **Add I/O unit**.
3. Select **Sensirion SPS30** as the type.
   The setup wizard opens to guide you through the rule creation process. In the following, confirm each entry with **Next** or press **Enter**.
4. Enter the **Name** for the I/O unit.
5. Click on **Finish** to add the I/O unit.
   A page will open where you can configure the settings for the unit.



Device settings for the Sensirion SPS30 particle sensor (example)

The newly added I/O unit is automatically enabled. If you want to use it later, set the **Enabled** 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 out if you have also connected sensors. If several sensors are connected - via a USB hub, for example - they will be numbered in the sequence of their being connected to the USB hub.

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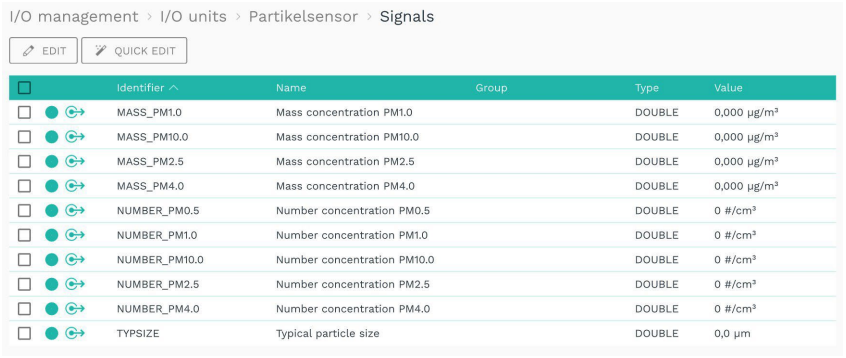
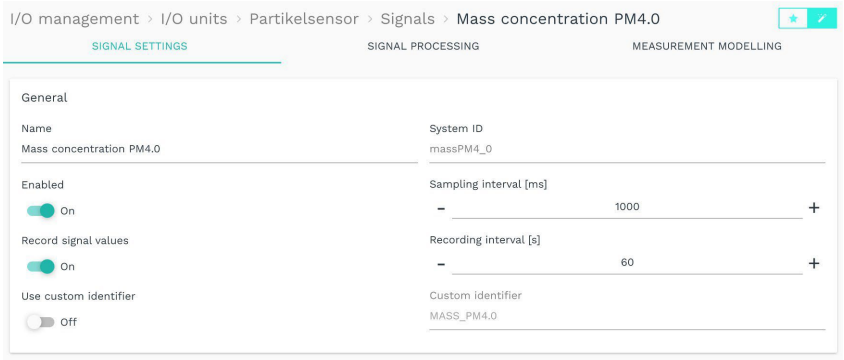
8. In the **Sampling interval** field, specify the interval at which the signal is to be sampled (in milliseconds).
9. Click on **Signals**.
   The signals for all measurements of the particle sensor have already been created.



Signals for the Sensirion SPS30 particle sensor

10. Select the signal you want to configure.
    A window opens in which you will find three tabs.



"Signal settings" tab in "Advanced" viewing mode

11. Enable and configure the interface on the **Signal settings** tab.
    a. Optional: Change the name of the interface.
    b. Set the **Enabled** slider to **On**.
    c. In the **Sampling interval** field, specify the interval at which the signal is to be sampled (in milliseconds).
    d. Set the **Record signal values** slider to **On** if the values are to be recorded in the local VictoriaMetrics database.
    e. In the **Recording interval** field, enter the desired time interval for the recording (in seconds).
12. Additional settings are available in **Advanced** viewing mode:
    a. **Use custom identifiers**: Set the slider to **On** if you want to enter your own identifier name.
    b. **Custom identifier**: Enter your own identifier name.

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13. On the **Signal processing** tab, you can specify how the signal value is to be processed. You can find out more at Configuring the signal processing steps [88].
14. Click on **Save**.
15. On the **Measurement modelling** tab, you specify how the measurements are to be visualized.
    You can find out more at Measurement modelling [89].
16. Finally, click on **Save & close**.

4.2.4. Adding a Modbus client of the RTU type

Before you create a new Modbus client of Modbus type RTU, please check whether a Modbus RTU client already exists.

Multiple Modbus clients (RTUs) can be created for both the built-in RS485 interface and the backplane bus via I/O management in order to communicate with multiple Modbus devices on the same bus.

IMPORTANT TO KNOW: The activated client with the lowest Modbus ID takes over the communication for all Modbus clients working on the same bus. If the client with the lowest Modbus ID is deactivated, the client with the next higher ID is used, etc. The settings therefore do not have to be synchronous, but should be, so that when the primary Modbus client is deactivated, the communication continues to work and the next higher Modbus client can take over.

If an RS485 or RS232 converter is connected via the external USB interface, more than one Modbus RTU client cannot access it at the same time. If you still want to communicate with several devices via this bus, only one I/O unit may be created. In this case, the appropriate Modbus ID must be set accordingly in the Modbus registers.

1. On the **I/O management** start page, select **I/O units**.
2. Click on **Add I/O unit**.
3. Select **Modbus client** as the type.
   The setup wizard opens to guide you through the rule creation process. In the following, confirm each entry with **Next** or press **Enter**.
4. Enter the **Name** for the I/O unit.
5. Click on **Finish** to add the I/O unit.
   A page will open where you can configure the settings for the unit.
   The newly added I/O unit is automatically enabled. If you want to use it later, set the **Enabled** slider to **Off**.

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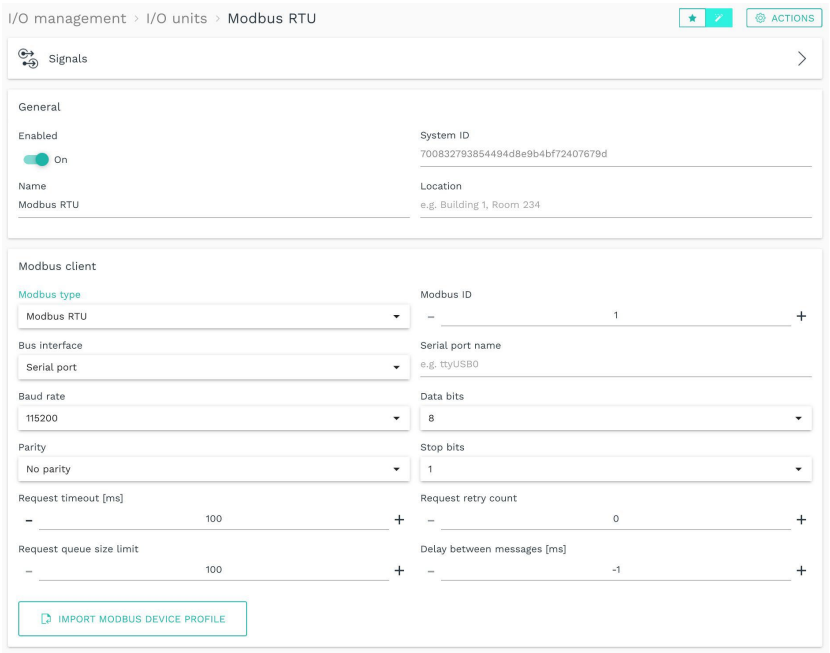

Device settings for the Modbus RTU client in “Advanced” viewing mode (example)

6. Optional: Enter the **Location**.
7. You can make further entries in the **Modbus client** section:
   a. **Modbus type**: Select the **Modbus RTU** entry.
   b. Under **Modbus ID**, enter the backplane bus ID, which is made up of the last three digits of the serial number of the IPF device with which you want to communicate.

      The range defined by ipf electronic for the Modbus ID is between 1 and 100. Therefore, an ID cannot be 0 and cannot be greater than 100.

      Example: The serial number is **13197240900021**. The backplane bus ID would be **21**.
   c. The appropriate **Bus interface** must be selected for communication with the Mod- bus device; in most cases, this will be the **Built-in RS485 interface**. For I/O mod- ules (such as the **AB000009** or **AB000008**), select **Backplane bus**. A **Serial inter- face** is then required if an RS485 or RS232 converter is connected via the external USB interface.

      NOTE

      When using serial interfaces, you must specify the **Serial port name**. This depends on the device and may need to be determined via SSH. Usually “ttyUSB0” is used, or in some cases “ttyACM0”.
   d. Complete all other input fields, such as **Baudrate** or **Parity**, according to the documentation of the connected device.
8. If you want to use an already-created Modbus device profile to save time during setup, for example, click on **Import Modbus device profile** and select the file from your file directory.
9. Additional settings are available in **Advanced** viewing mode:

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a. In the **Request timeout [ms]** field, define after how many milliseconds without a response a request should be resent or discarded.

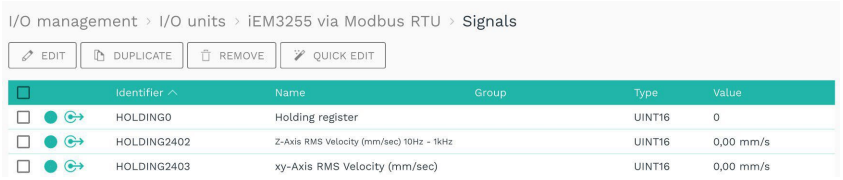
b. In the **Request retry count** field, enter how often a request should be sent if no response is received. After the entered number of attempts, the request is finally cancelled.

c. In the **Request queue size limit** field, enter the maximum number of requests to be included in the queue. If the value is set too low (lower than the number of Modbus registers), individual requests may not be sent to the bus. If the value is too high (significantly higher than the number of Modbus registers), the bus will be overloaded and the processing of requests will be delayed.

d. In the **Waiting time between messages [ms]** field, specify how many milliseconds should be waited between two consecutive Modbus messages. The default setting is **–1**, i.e. the waiting time between messages is calculated automatically based on the baud rate.

10. Click on **Save**.

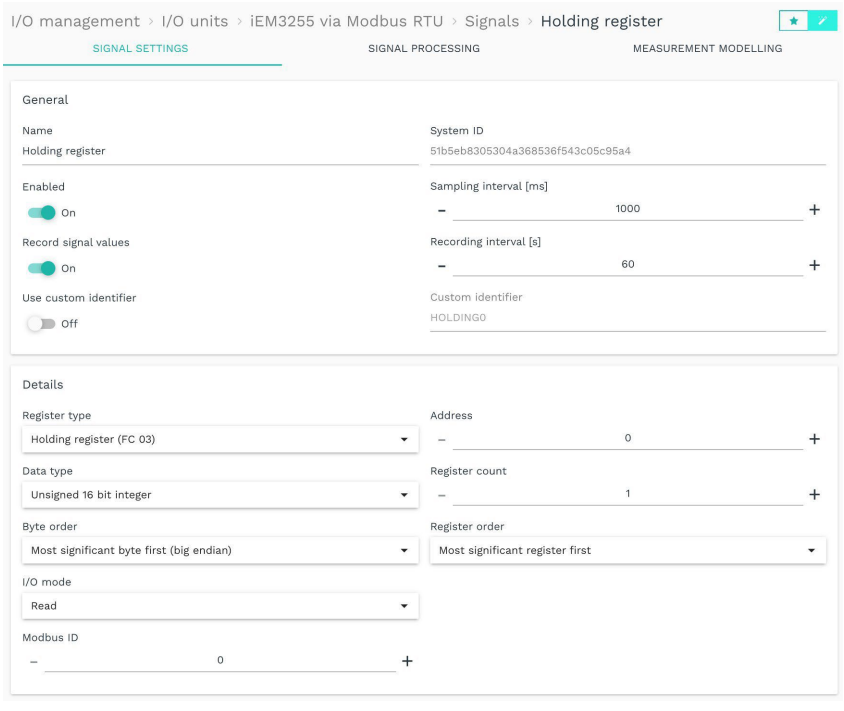
11. Click on **Signals**.



Signals for the Modbus RTU client (initially, no signals are predefined)

12. Click on **Add I/O unit**.

A window opens in which you will find three tabs.



"Signal settings" tab in "Advanced" viewing mode

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13. Enable and configure the interface on the **Signal settings** tab.
    a. Optional: Change the name of the interface.
    b. Set the **Enabled** slider to **On**.
    c. In the **Sampling interval** field, specify the interval 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 output value** is written on starting up and each time a change is made. If the register is connected to a source signal via a signal connection, the register is written each time the source signal changes.

    d. Set the **Record signal values** slider to **On** if the values are to be recorded in the local VictoriaMetrics database.
    e. In the **Recording interval** field, enter the desired time interval for the recording (in seconds).
14. Additional settings are available in **Advanced** viewing mode:
    a. **Use custom identifiers**: Set the slider to **On** if you want to enter your own identifier name.
    b. **Custom identifier**: Enter your own identifier name.
15. Further entries are required in the **Details** section.
    a. Depending on the selected register type, different entries can be made as to whether to read from the register or whether and what should be written to the register. Please also note the tooltips.
    b. If it is not possible to use several Modbus RTU clients (with different Modbus IDs) on the same bus interface (RS485/RS232 converter via USB), the respective ID of the device to be addressed can be specified instead. This means that the global setting of the Modbus Client (see point 8) is ignored and the Modbus ID entered here is used for this register instead (point to point).
       Otherwise, leave the default value (**0**).
    c. Complete all other parameters according to the documentation of the connected device.
16. On the **Signal processing** tab, you can specify how the signal value is to be processed. You can find out more at Configuring the signal processing steps [88].
17. Click on **Save**.
18. On the **Measurement modelling** tab, you specify how the measurements are to be visualized.
    You can find out more at Measurement modelling [89].
19. Finally, click on **Save & close**.

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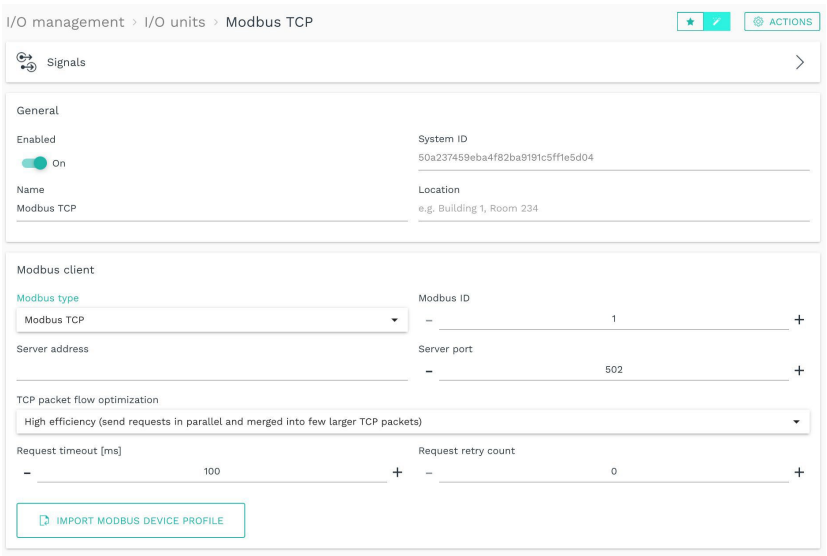
4.2.5. Adding a Modbus client of the TCP type

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

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

   A page will open where you can configure the settings for the unit.

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



Device settings for the Modbus TCP client in “Advanced” viewing mode (example)

6. Optional: Enter the **Location**.
7. You can make further entries in the **Modbus client** section:
   a. **Modbus type**: Select the **Modbus TCP** entry.
   b. Under **Modbus ID**, enter the backplane bus ID, which is made up of the last three digits of the serial number of the IPF device with which you want to communicate.

      The range defined by IPF for the Modbus ID is between 1 and 100. Therefore, an ID cannot be 0 and cannot be greater than 100.

      Example: The serial number is **13197240900021**. The backplane bus ID would be **21**.
   c. Enter the **Server address** and **Server port** of the Modbus TCP server.
   d. Under **TCP packet flow optimization**, you can select the sequence and compilation for sending Modbus queries. **High efficiency** is selected by default, i.e. the sending of requests and their combination into larger TCP packets take place in parallel.

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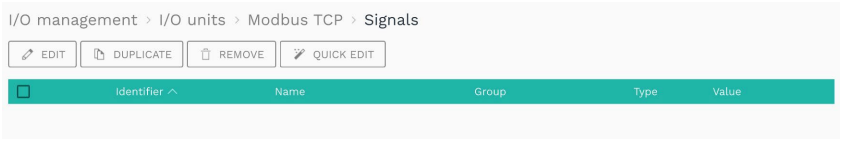
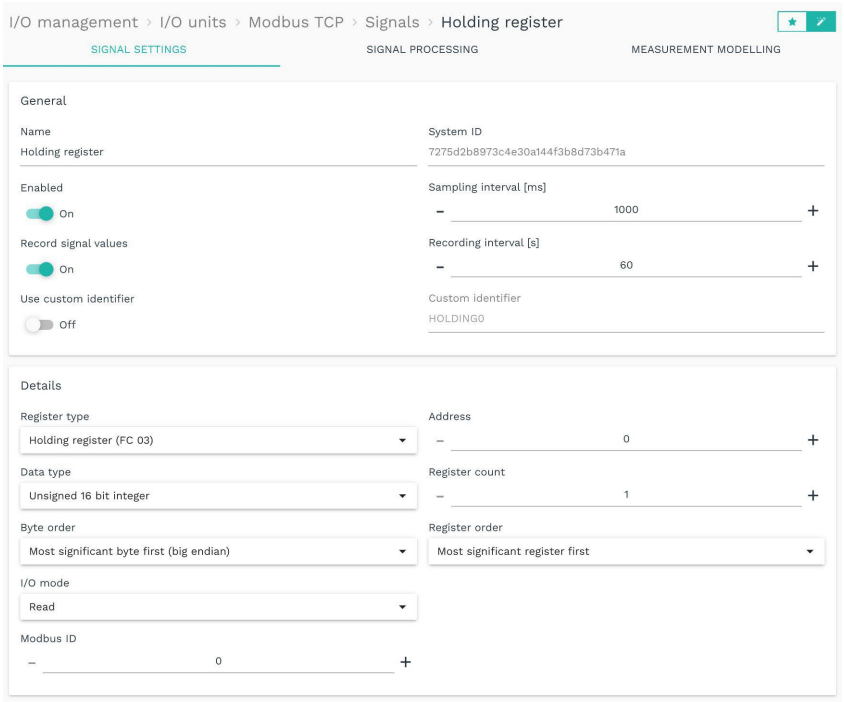
TIP: In the event of communication issues with the Modbus device, you can try switching to either **Low latency** as the next-best option or **Half-duplex** as the slowest option (with the best compatibility).

8. If you want to use an already-created Modbus device profile to save time during setup, for example, click on **Import Modbus device profile** and select the file from your file directory.
9. Additional settings are available in **Advanced** viewing mode:
   a. In the **Request timeout [ms]** field, define after how many milliseconds without a response a request should be resent or discarded.
   b. In the **Request retry count** field, enter how often a request should be sent if no response is received. After the entered number of attempts, the request is finally cancelled.
10. Click on **Save**.
11. Click on **Signals**.



Initially, no signals are predefined.

12. Click on **Add I/O unit**.
    A window opens in which you will find three tabs.



"Signal settings" tab in "Advanced" viewing mode

13. Enable and configure the interface on the **Signal settings** tab.
    a. Optional: Change the name of the interface.

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b. Set the **Enabled** slider to **On**.

c. In the **Sampling interval** field, specify the interval 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 output value** is written on starting up and each time a change is made. If the register is connected to a source signal via a signal connection, the register is written each time the source signal changes.

d. Set the **Record signal values** slider to **On** if the values are to be recorded in the local VictoriaMetrics database.

e. In the **Recording interval** field, enter the desired time interval for the recording (in seconds).

14. Additional settings are available in **Advanced** viewing mode:
    a. **Use custom identifiers**: Set the slider to **On** if you want to enter your own identifier name.
    b. **Custom identifier**: Enter your own identifier name.
15. Further entries are required in the **Details** section.
    a. Depending on the selected register type, different entries can be made as to whether to read from the register or whether and what should be written to the register. Please also note the tooltips.
    b. Complete all other parameters according to the documentation of the connected device.
16. On the **Signal processing** tab, you can specify how the signal value is to be processed. You can find out more at Configuring the signal processing steps [88].
17. Click on **Save**.
18. On the **Measurement modelling** tab, you specify how the measurements are to be visualized.
    You can find out more at Measurement modelling [89].
19. Finally, click on **Save & close**.

4.2.6. Adding an MQTT client

1. On the **I/O management** start page, select **I/O units**.
2. Click on **Add I/O unit**.
3. Select **MQTT client** as the type.
   The setup wizard opens to guide you through the rule creation process. In the following, confirm each entry with **Next** or press **Enter**.
4. Enter the **Name** for the I/O unit.

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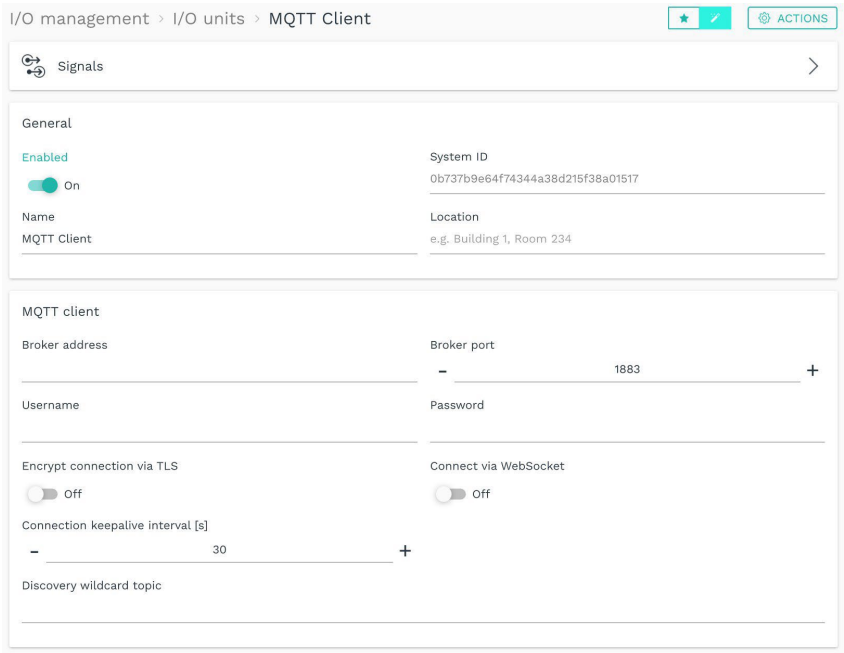
5. Click on **Finish** to add the I/O unit.

   A page will open where you can configure the settings for the unit.

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



Device settings for the MQTT client in “Advanced” viewing mode (example)

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

7. In the **MQTT client** section, enter the **Broker address**, **Broker port**, and optionally the **Discovery wildcard topic**.

   NOTE

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

   a. If authentication is required to connect to the broker, you must enter the corresponding **Username** and **Password**.

   b. If you want to encrypt MQTT, set the **Encrypt connection via TLS** slider to **On**. If the connection is established with a broker in the internal network, the certificate of the organization’s CA must be stored under **System > Security & encryption**.

8. Additional settings are available in **Advanced** viewing mode:

   a. Set the **Connect via WebSocket** slider to **On** if the MQTT broker only offers a connection via WebSockets.

   b. **Connection keepalive interval [s]**: Enter the interval, in seconds, after which a ping is used to check whether the connection has been established. If the broker does not respond, the connection is terminated and the MQTT client attempts to re-establish the connection. This function is used to actively recognize a connection interruption.

9. Click on **Save**.

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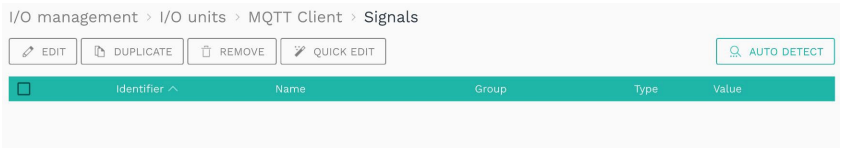
10. Click on **Signals**.



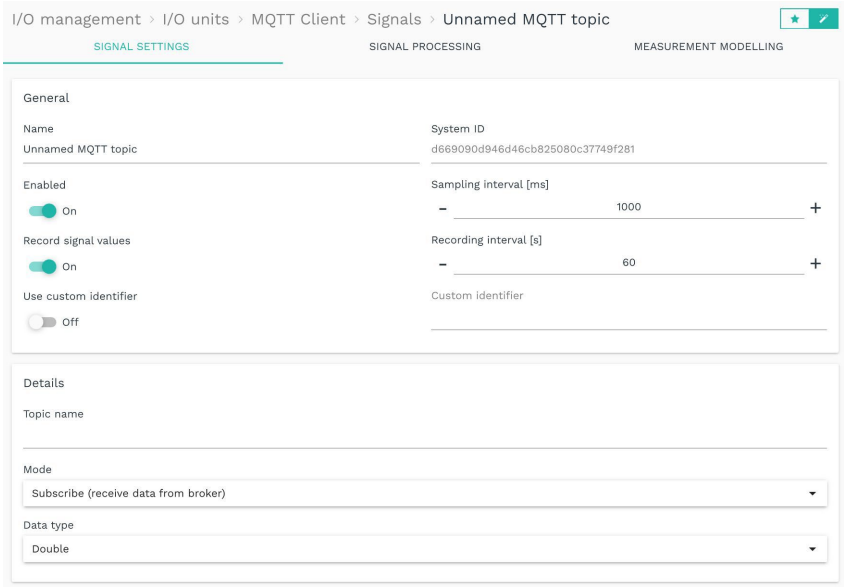
Initially, no signals are predefined.

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

    – or –

    Click on **Add I/O unit**.

    A window opens in which you will find three tabs.



"Signal settings" tab in "Advanced" viewing mode

12. Enable and configure the interface on the **Signal settings** tab.
    a. Optional: Change the name of the interface.
    b. Set the **Enabled** slider to **On**.
    c. In the **Sampling interval** field, specify the interval at which the signal is to be sampled (in milliseconds).
    d. Set the **Record signal values** slider to **On** if the values are to be recorded in the local VictoriaMetrics database.
    e. In the **Recording interval** field, enter the desired time interval for the recording (in seconds).
13. Additional settings are available in **Advanced** viewing mode:
    a. **Use custom identifiers**: Set the slider to **On** if you want to enter your own identifier name.
    b. **Custom identifier**: Enter your own identifier name.

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14. Further entries are required in the **Details** section.
    a. assign a **Topic name**.
    b. In the **Mode** drop-down list, select whether you want to receive data from the broker (**Subscribe**) or send data to the broker (**Publish**) via the MQTT broker.
    c. 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 floating point numbers with double precision.
       If the data is present in the MQTT topic as a JSON string, select the **JSON data** entry. Only then can you enter the key name containing the numerical value to be used in the **JSON data key** field.
    d. In **Publish** mode, set the **Publish as retained message** slider. In this case, the broker sends the last value published via this topic to all newly added clients.

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

15. On the **Signal processing** tab, you can specify how the signal value is to be processed. You can find out more at Configuring the signal processing steps [88].
16. Click on **Save**.
17. On the **Measurement modelling** tab, you specify how the measurements are to be visualized.
    You can find out more at Measurement modelling [89].
18. Finally, click on **Save & close**.

4.2.7. Adding an OPC UA client

1. On the **I/O management** start page, select **I/O units**.
2. Click on **Add I/O unit**.
3. Select **OPC UA client** as the type.
   The setup wizard opens to guide you through the rule creation process. In the following, confirm each entry with **Next** or press **Enter**.
4. Enter the **Name** for the I/O unit.
5. Click on **Finish** to add the I/O unit.
   A page will open where you can configure the settings for the unit.
   The newly added I/O unit is automatically enabled. If you want to use it later, set the **Enabled** slider to **Off**.

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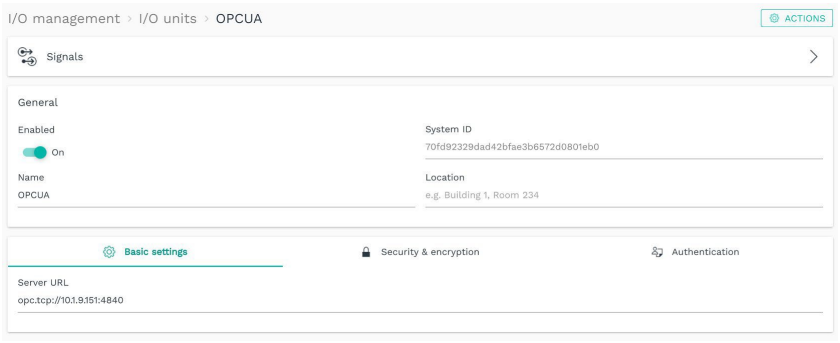

Device settings for the OPC UA client (example)

6. Optional: Enter the **Location**.
7. You can enter the **Server URL** in the **Basic settings**.
8. You can make the following settings under **Security & encryption**:
   a. Under **Security mode**, you first specify whether messages between the gateway and OPC UA server should be unsecured, only signed or encrypted and signed.
   b. Then, under **Security policy**, select which encryption algorithm should be used. If you are unsure, you can start with the Basic algorithm and, if necessary, try whether the server also supports the two other, more modern encryption algorithms.
   c. If a security mode and a security policy are selected, you have further input fields: Set the **Verify server certificate** slider to **On** if the server uses a specific certificate that "proves" the authenticity of the server. You must upload this certificate under **CA or server certificate** so that the clients cannot connect to any server. Alternatively, the certificate of the certification authority (CA) can be uploaded if the server certificate was issued by a CA.

      The **Use trusted client certificate** slider is set to **On** by default. Depending on the server's security settings, the server checks the authenticity of client certificates for connection encryption to prevent unknown clients from communicating with the server. To do this, a **Client certificate** must be uploaded and the **Private key** entered.

      If the slider is deactivated, the internal default certificate of SIINEOS is automatically used. Therefore, only deactivate this function if the server accepts any self-signed client certificate.

   NOTE: The settings on the OPC UA server are decisive. First, check the security level specified by the server before making any changes here.
9. You can select the following authentication methods under **Authentication**:
   a. **Anonymous**: No authentication is required.
   b. **Username and password**: On the OPC UA server, it is specified that authentication via user data is required. Enter the user data.
   c. **Client certificate with private key**: On the OPC UA server, it is specified that a client-certified connection is to be used. The client certificate that you have uploaded under **Security & encryption** is used for authentication.

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Use a separate client certificate for authentication: If a different client certificate is used, set the slider to **On**, upload the **Client certificate** and enter the **Private key**.

10. Click on **Save**.
11. Click on **Signals**.

Signals for the OPC UA client (initially, no signals are predefined)

12. Click on **Add I/O unit**.
    A new window opens, in which you can select an existing object from the OPC UA node.

"Add OPC UA node" window (example)

13. Select a node object and click on **Add**;
    – or –
    if you want to create a new signal, click on **Add signal with custom node ID**. A window opens in which you will find three tabs.

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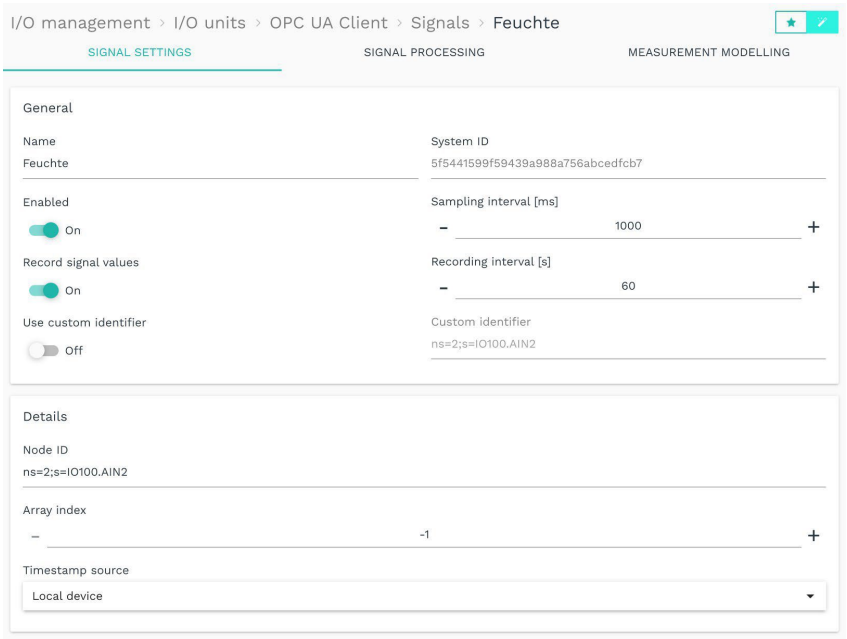

"Signal settings" tab in "Advanced" viewing mode

14. Enable and configure the interface on the **Signal settings** tab.
    a. Optional: Change the name of the interface.
    b. Set the **Enabled** slider to **On**.
    c. In the **Sampling interval** field, specify the interval at which the signal is to be sampled (in milliseconds).
    d. Set the **Record signal values** slider to **On** if the values are to be recorded in the local VictoriaMetrics database.
    e. In the **Recording interval** field, enter the desired time interval for the recording (in seconds).
15. In the **Details** section, enter the **Node ID**.

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

If an existing I/O signal has been recognized automatically, this field is filled in. If not, enter the complete node ID, e.g. "ns=2;s=Machine".

16. Additional settings are available in **Advanced** viewing mode:
    a. **Use custom identifiers**: Set the slider to **On** if you want to enter your own identifier name.
    b. **Custom identifier**: Enter your own identifier name.
    c. **Array index**: If the object node contains a one-dimensional array, you can specify the index (starting at 0) of the element that is to be read as the signal value. For a non-array, the default value **–1** is entered.
    d. **Timestamp source**: Select the timestamp source that the signal uses for its own timestamp.

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Local device: Timestamp of the local system of the time when the device received the value from the OPC UA server

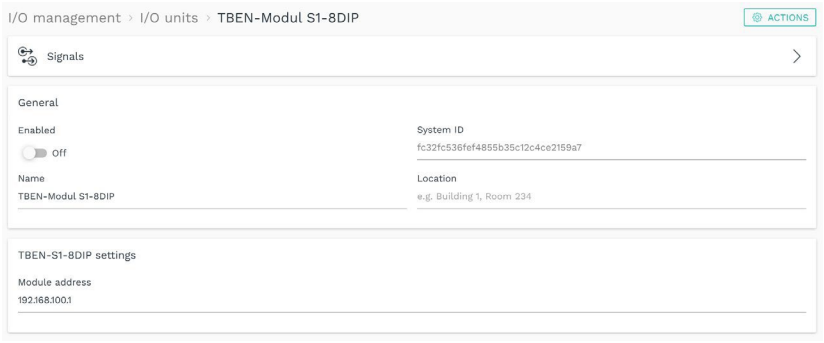
Server timestamp: Timestamp of the time at which the OPC UA server obtained the value from its own data source

Value source timestamp: Timestamp of the data source of the OPC UA server, provided that the data source also provides a timestamp in addition to the actual value. This timestamp can be identical to the timestamp of the OPC UA server. However, it can also be the time of a measurement if, for example, a PLC connected via OPC UA or a device has read an input/register/variable.

17. On the **Signal processing** tab, you can specify how the signal value is to be processed. You can find out more at Configuring the signal processing steps [88].
18. Click on **Save**.
19. On the **Measurement modelling** tab, you specify how the measurements are to be visualized.
    You can find out more at Measurement modelling [89].
20. Finally, click on **Save & close**.

4.2.8. Adding a TBEN-S1-8DIP module

1. On the **I/O management** start page, select **I/O units**.
2. Click on **Add I/O unit**.
3. Select **TBEN-S1-8DIP** as the type.
   The setup wizard opens to guide you through the rule creation process. In the following, confirm each entry with **Next** or press **Enter**.
4. Enter the **Name** for the I/O unit.
5. Click on **Finish** to add the I/O unit.
   A page will open where you can configure the settings for the unit.
   The newly added I/O unit is automatically enabled. If you want to use it later, set the **Enabled** slider to **Off**.



Device settings for the TBEN-S1-8DIP module (example)

6. Optional: Enter the **Location**.
7. In the **Module address** input field, enter the hostname and IP address of the TBEN module with which a connection is to be established.

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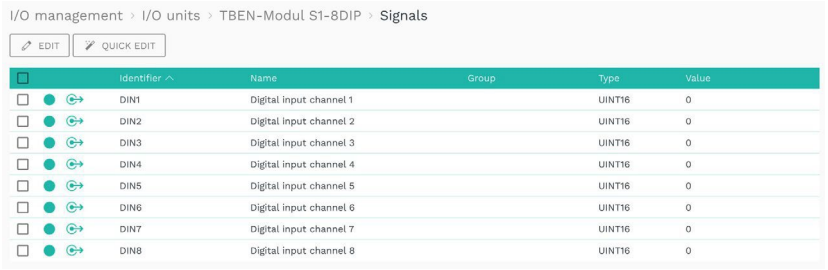
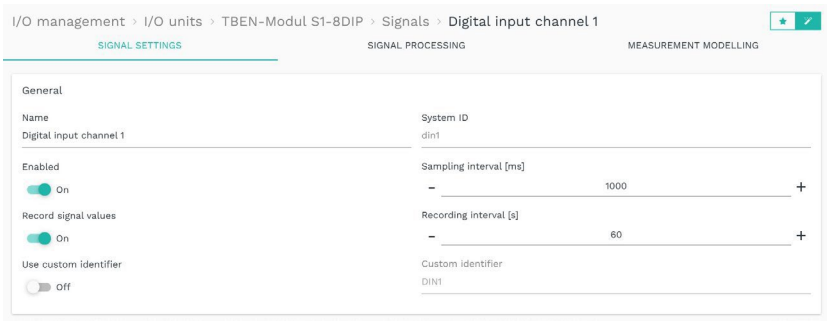
8. Click on **Save**.
9. Click on **Signals**.
   The signals for all digital inputs of the TBEN module have already been created.



Signals for the TBEN-S1-8DIP module (initially, no signals are predefined)

10. Select the signal you want to configure.
    A window opens in which you will find three tabs.



"Signal settings" tab in "Advanced" viewing mode

11. Enable and configure the interface on the **Signal settings** tab.
    a. Optional: Change the name of the interface.
    b. Set the **Enabled** slider to **On**.
    c. In the **Sampling interval** field, specify the interval at which the signal is to be sampled (in milliseconds).
    d. Set the **Record signal values** slider to **On** if the values are to be recorded in the local VictoriaMetrics database.
    e. In the **Recording interval** field, enter the desired time interval for the recording (in seconds).
12. Additional settings are available in **Advanced** viewing mode:
    a. **Use custom identifiers**: Set the slider to **On** if you want to enter your own identifier name.
    b. **Custom identifier**: Enter your own identifier name.
13. On the **Signal processing** tab, you can specify how the signal value is to be processed. You can find out more at Configuring the signal processing steps [88].
14. Click on **Save**.
15. On the **Measurement modelling** tab, you specify how the measurements are to be visualized.

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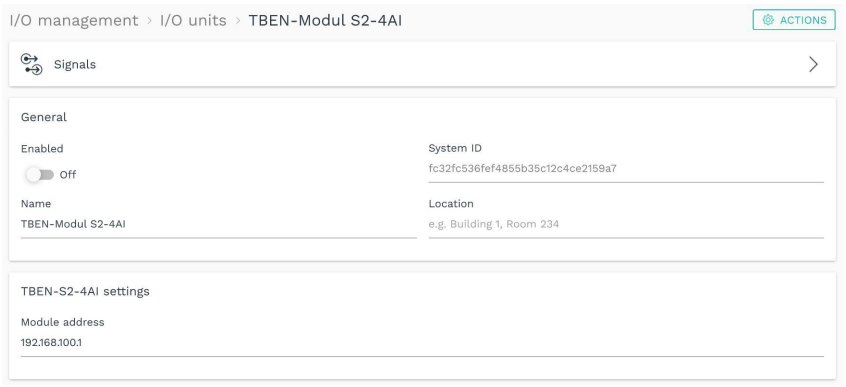
You can find out more at Measurement modelling [89].

16. Finally, click on **Save & close**.

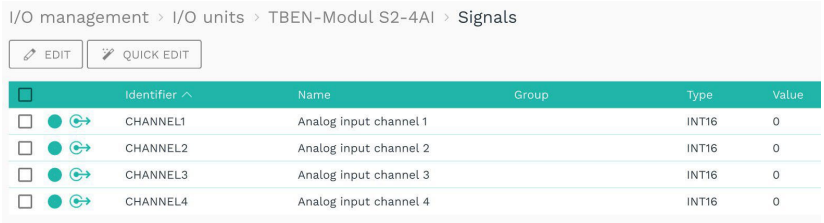
4.2.9. Adding a TBEN-S2-4AI module

1. On the **I/O management** start page, select **I/O units**.
2. Click on **Add I/O unit**.
3. Select **TBEN-S2-4AI** as the type.
   The setup wizard opens to guide you through the rule creation process. In the following, confirm each entry with **Next** or press **Enter**.
4. Enter the **Name** for the I/O unit.
5. Click on **Finish** to add the I/O unit.
   A page will open where you can configure the settings for the unit.
   The newly added I/O unit is automatically enabled. If you want to use it later, set the **Enabled** slider to **Off**.



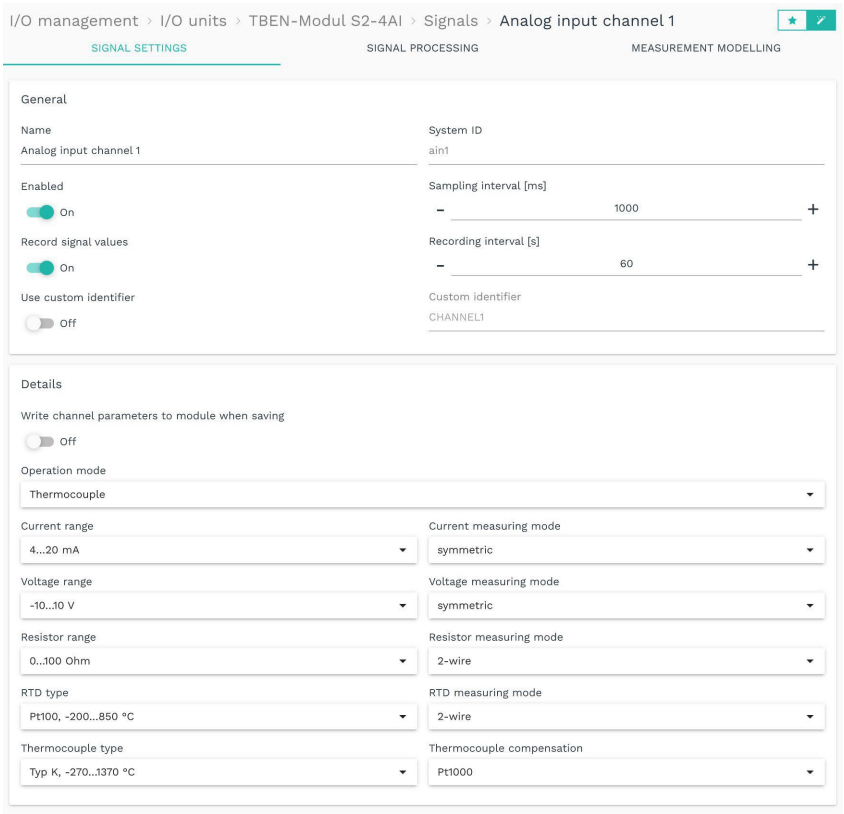
Device settings for the TBEN-S2-4AI module (example)

6. Optional: Enter the **Location**.
7. In the **Module address** input field, enter the hostname and IP address of the TBEN module with which a connection is to be established.
8. Click on **Save**.
9. Click on **Signals**.
   The signals for all analogue input channels have already been created.



Signals for the TBEN-S2-4AI module

10. Select the signal you want to configure.
    A window opens in which you will find three tabs.



"Signal settings" tab in "Advanced" viewing mode

11. Enable and configure the interface on the **Signal settings** tab.
    a. Optional: Change the name of the interface.
    b. Set the **Enabled** slider to **On**.
    c. In the **Sampling interval** field, specify the interval at which the signal is to be sampled (in milliseconds).
    d. Set the **Record signal values** slider to **On** if the values are to be recorded in the local VictoriaMetrics database.
    e. In the **Recording interval** field, enter the desired time interval for the recording (in seconds).
12. Additional settings are available in **Advanced** viewing mode:
    a. **Use custom identifiers**: Set the slider to **On** if you want to enter your own identifier name.
    b. **Custom identifier**: Enter your own identifier name.
13. The **Details** section shows the parameters read in from 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 in fact be written back to the module. The changes will only take effect if you then click on **Save**.

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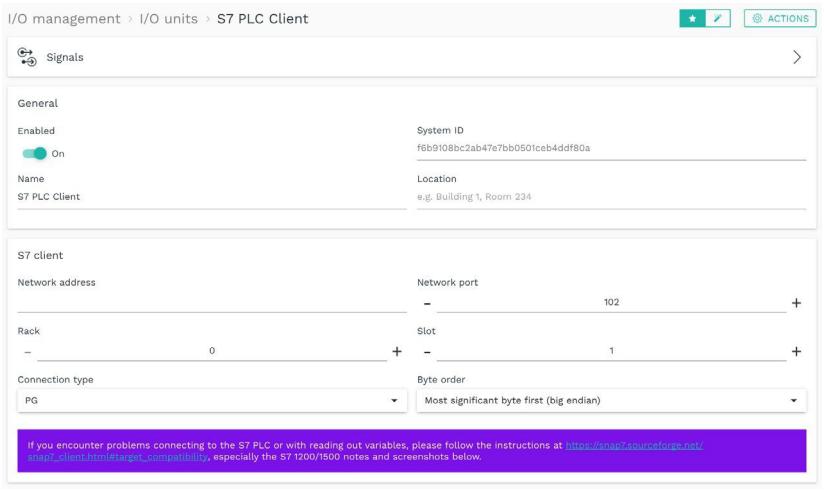
14. On the **Signal processing** tab, you can specify how the signal value is to be processed. You can find out more at Configuring the signal processing steps [88].
15. Click on **Save**.
16. On the **Measurement modelling** tab, you specify how the measurements are to be visualized.
    You can find out more at Measurement modelling [89].
17. Finally, click on **Save & close**.

4.2.10. Adding an S7 PLC client

The addition of an S7 PLC client is mandatory if you want to connect the device to a Siemens S7 controller.

1. On the **I/O management** start page, select **I/O units**.
2. Click on **Add I/O unit**.
3. Select **S7 PLC client** as the type.
   The setup wizard opens to guide you through the rule creation process. In the following, confirm each entry with **Next** or press **Enter**.
4. Enter the **Name** for the I/O unit.
5. Click on **Finish** to add the I/O unit.
   A page will open where you can configure the settings for the unit.
   The newly added I/O unit is automatically enabled. If you want to use it later, set the **Enabled** slider to **Off**.



Device settings for the S7 PLC client in “Advanced” viewing mode

6. Optional: Enter the **Location**.
7. You can configure the following settings in the **S7 client** section:
   a. **Network address**: Enter the hostname or IP address of the SIEMENS controller to which a connection is to be established.

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b. **Network port**: Enter the port through which the Siemens S7 controller can be accessed. As a rule, the default value “102” does not need to be changed.

c. **Rack** and **Slot**: Specify the position of the CPU module in the controller. Depending on the controller model, the CPU can also be located in slot “0” or “2”.

d. **Connection type**: Select the mode to be used for establishing the connection. The default value **PG** (programming device) only needs to be changed to **OP** (operating mode for HMI panels) or **Basic** (fallback) in exceptional cases.

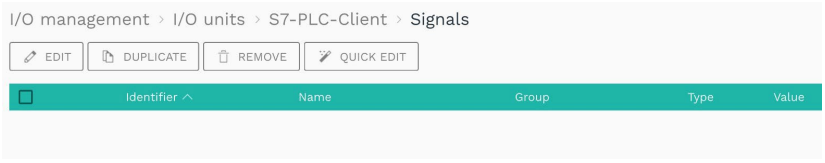
e. **Byte order**: Specify the byte order in which the PLC stores its data in the memory – whether with the **Most significant byte first (big endian)** or the **Least significant byte first (little endian)**. Change this setting if you notice that the data is implausible.

8. Additional settings are available in **Advanced** viewing mode:

   a. **Local TSAP** and **Remote TSAP**: If you have problems with the connection despite changing the rack and slot settings, these two parameters can be adjusted accordingly. Please contact the support team at ipf electronic and only make changes after consultation.

9. Click on **Save**.

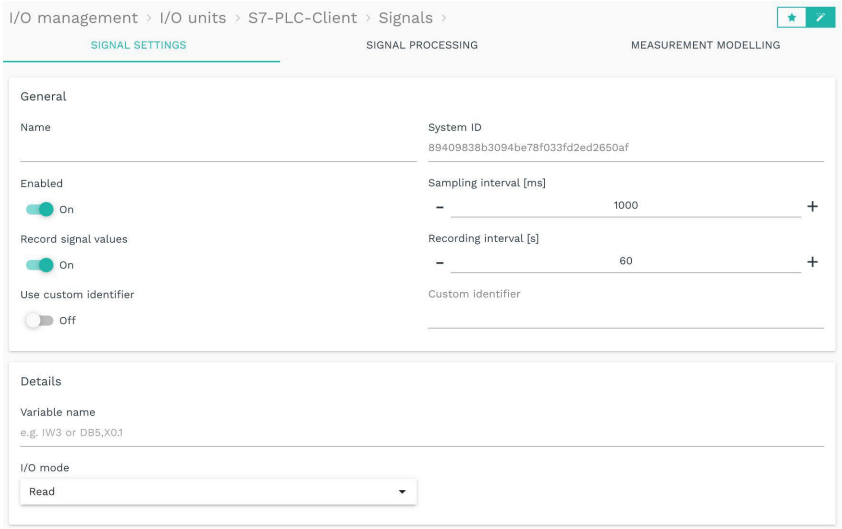
10. Click on **Signals**.



Signals for the S7 PLC client (initially, no signals are predefined)

11. Click on **Add I/O unit**.

    A window opens in which you will find three tabs.



“Signal settings” tab in “Advanced” viewing mode

12. Enable and configure the interface on the **Signal settings** tab.

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a. Optional: Change the name of the interface.

b. Set the **Enabled** slider to **On**.

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

> NOTE
> If you have selected **I/O mode** "Write", no sampling takes place and the sampling interval is ignored.

d. Set the **Record signal values** slider to **On** if the values are to be recorded in the local VictoriaMetrics database.

e. In the **Recording interval** field, enter the desired time interval for the recording (in seconds).

13. Additional settings are available in **Advanced** viewing mode:

a. **Use custom identifiers**: Set the slider to **On** if you want to enter your own identifier name.

b. **Custom identifier**: Enter your own identifier name.

14. Further entries are required in the **Details** section.

a. **Variable name**: The S7 variable name encodes which address is to be accessed with which data type in which section of the S7. There are different variable areas: Data block, digital inputs/outputs or memory/flags. For more information, see the PLC manufacturer's interface description or list of variables.
In case of problems with the connection to the S7 PLC, please also note the following information: https://flows.nodered.org/node/node-red-contrib-s7#variable-addressing.

b. **I/O mode**: Select whether a data value / date is to be read from the controller (**Read**) or written to the controller (**Write**).

15. On the **Signal processing** tab, you can specify how the signal value is to be processed. You can find out more at Configuring the signal processing steps [88].

16. Click on **Save**.

17. On the **Measurement modelling** tab, you specify how the measurements are to be visualized.
You can find out more at Measurement modelling [89].

18. Finally, click on **Save & close**.

4.2.11. Adding a ControlPlex® CPC12 bus controller

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

2. Click on **Add I/O unit**.

3. Select **ControlPlex® CPC12** as the type.
The setup wizard opens to guide you through the rule creation process. In the following, confirm each entry with **Next** or press **Enter**.

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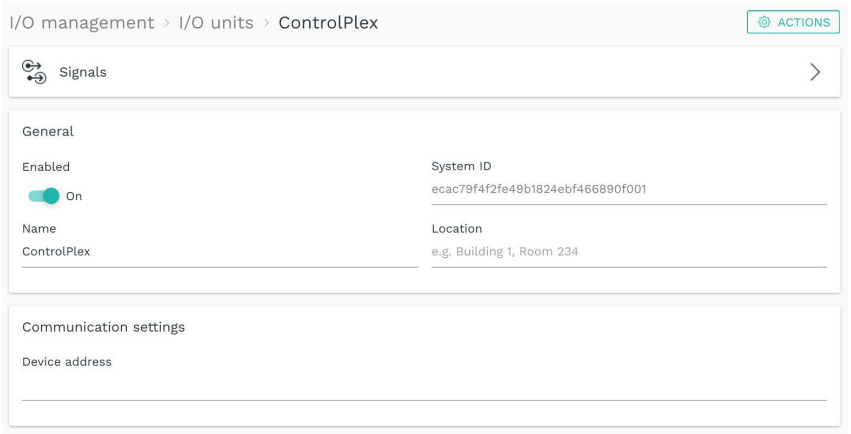
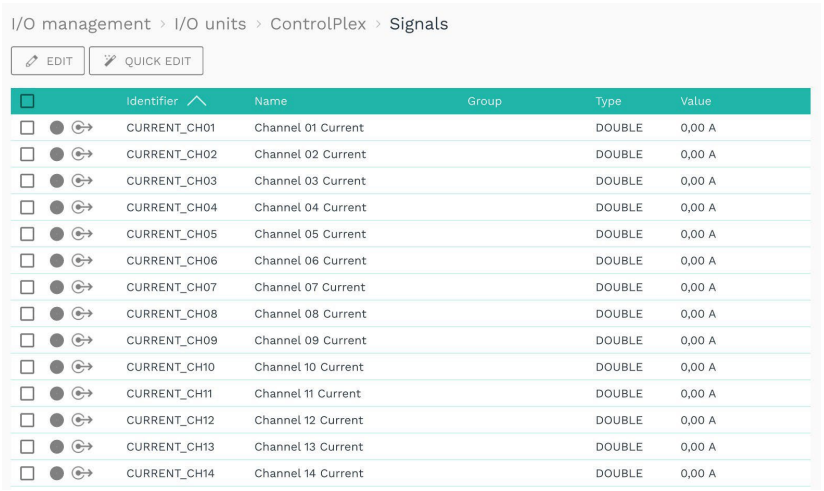
4. Enter the **Name** for the I/O unit.
5. Click on **Finish** to add the I/O unit.
   A page will open where you can configure the settings for the unit.



Device settings for the ControlPlex® CPC12 (example)

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

6. Optional: Enter the **Location**.
7. Click on **Signals**.
   The signals for all channels of the ControlPlex® CPC12 have already been created.



Identifier	Name	Group	Type	Value
CURRENT_CH01	Channel 01 Current		DOUBLE	0,00 A
CURRENT_CH02	Channel 02 Current		DOUBLE	0,00 A
CURRENT_CH03	Channel 03 Current		DOUBLE	0,00 A
CURRENT_CH04	Channel 04 Current		DOUBLE	0,00 A
CURRENT_CH05	Channel 05 Current		DOUBLE	0,00 A
CURRENT_CH06	Channel 06 Current		DOUBLE	0,00 A
CURRENT_CH07	Channel 07 Current		DOUBLE	0,00 A
CURRENT_CH08	Channel 08 Current		DOUBLE	0,00 A
CURRENT_CH09	Channel 09 Current		DOUBLE	0,00 A
CURRENT_CH10	Channel 10 Current		DOUBLE	0,00 A
CURRENT_CH11	Channel 11 Current		DOUBLE	0,00 A
CURRENT_CH12	Channel 12 Current		DOUBLE	0,00 A
CURRENT_CH13	Channel 13 Current		DOUBLE	0,00 A
CURRENT_CH14	Channel 14 Current		DOUBLE	0,00 A

Signals for the ControlPlex® CPC12 (example)

8. Select the signal you want to configure.
   A window opens in which you will find three tabs.
9. Enable and configure the interface on the **Signal settings** tab.
   a. Optional: Change the name of the interface.
   b. Set the **Enabled** slider to **On**.
   c. In the **Sampling interval** field, specify the interval at which the signal is to be sampled (in milliseconds).

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d. Set the **Record signal values** slider to **On** if the values are to be recorded in the local VictoriaMetrics database.

e. In the **Recording interval** field, enter the desired time interval for the recording (in seconds).

10. Additional settings are available in **Advanced** viewing mode:

a. **Use custom identifiers**: Set the slider to **On** if you want to enter your own identifier name.

b. **Custom identifier**: Enter your own identifier name.

11. On the **Signal processing** tab, you can specify how the signal value is to be processed. You can find out more at Configuring the signal processing steps [88].

12. Click on **Save**.

13. On the **Measurement modelling** tab, you specify how the measurements are to be visualized.
You can find out more at Measurement modelling [89].

14. Finally, click on **Save & close**.

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4.3. Signal processing

NOTE

SIINEOS version 2.7.4. and later use the expr-eval library. The following mathematical functions are thus available:

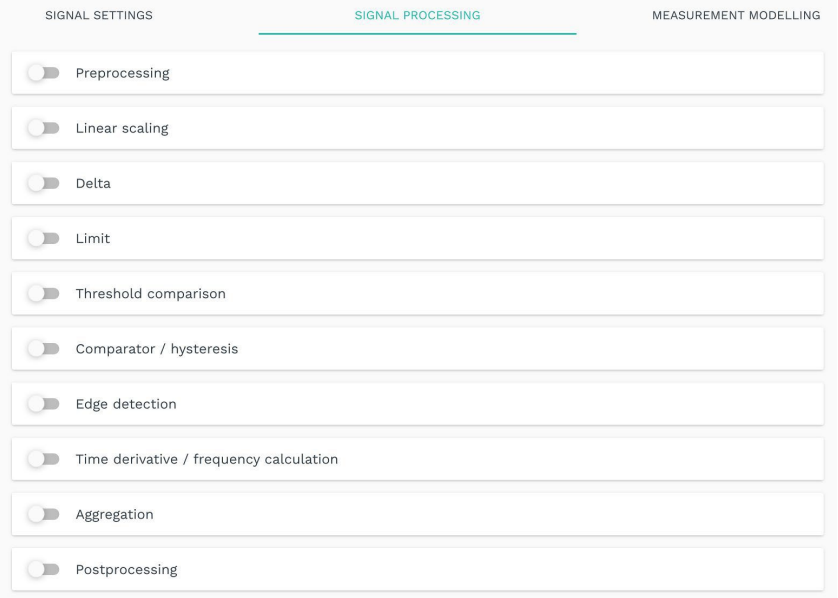
https://github.com/in-hub/expr-eval#expression-syntax

This can lead to incorrect results or improperly functioning signal-processing steps for signals that have already been configured. You should therefore check the mathematical functions of your existing signal-processing steps.

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

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

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



"Signal processing" tab

4.3.1. Signal processing functions

Function	Explanation
Preprocessing	This function can be used to preprocess the signal value using 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. Examples of mathematical expressions: • x – 2

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Function	Explanation
	• (x – 4) * 0.7 • sin(x * PI / 180) • max(x, 10) • abs(x)
Linear scaling	This function is used to apply a simple linear function to the input value. While in principle it is also possible to implement a linear function as a mathematical expression (e.g., x * 5 + 7) using the given parameters (slope/coefficient and constant) in the previous function, this function allows the simple input of 2 input and output values. These values are often known from data sheets, especially for analogue sensors. *For example*: A temperature sensor on a 4–20 mA interface can have a value range from –20°C to +80°C. In this case, you would enter the values **4** for **X1** and **20** for **X2**, as well as the values **–20** for **Y1** and **80** for **Y2**.
Delta	This function compares the current signal value with the previously measured signal value. There are various options in the drop-down list for 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 % • Leading sign difference to the previous value: If the value changes from a positive numerical value to a negative numerical value (or vice versa), –1 (or +1) is output. This can be used to detect anomalies, for example.
Limit	This function imposes lower and/or upper limits on the signal value, so if the signal falls below the minimum value, the gateway delivers the minimum value as the signal value. If the signal value is above the maximum value, this maximum value is used as the signal value.
Threshold comparison	This function converts the signal value into a logical value of 0 or 1, 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 from the device is 1 as long as the signal value is greater than 10. If it falls below this, the output is 0.
Comparator/hysteresis	The function compares the input value with lower and upper thresholds and returns the appropriate output value depending on the result.

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Function	Explanation
	This behavior is used to implement two-point control or hysteresis. Additionally, the progression over time can be included by setting the minimum undershoot and minimum overshoot duration to a value >0 ms. For the output signal to assume the upper output value, the input signal must be continuously above the upper threshold value for a certain number of milliseconds. Similarly, the output signal is only reset to the lower output value once the value falls below the lower threshold 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). Analogue signals can also be converted into digital signals with the help of upstream functions such as threshold comparison, e.g. by using the value 1 (rising edge) as the input for edge detection when a threshold value is exceeded and thus automatically using the value 0 when the value falls below it.
Time derivative / frequency calculation	The function determines the number of changes from 0 to non-0 (e.g. to 1 or any other level). The result is then no longer the original signal value, but the number per time unit or the frequency. This function can be used to implement a piece counter, for example, so that signal processing no longer outputs the digital input, but the number of parts produced per second/minute/hour. If necessary, this function can be combined with averaging directly afterwards, as the value can fluctuate greatly, especially at the beginning. To do this, go to the **Aggregation** step and select the **Average value** entry under **Aggregation type**.
Aggregation	If several signal values are to be summarized over time (also known as aggregation), the **Aggregation** function can be activated. With this, either a specific value (e.g. the largest or smallest), the sum of all values or the average value is determined from values that are received over a certain duration (**Aggregation interval**) and delivered as an output (**Aggregation type**). You can also specify whether the aggregate value is to be calculated at every sampling point (**continuously**) or only regularly at the end of the aggregation interval (**periodically**).
Postprocessing	Once the input signal has been processed by one or more functions, it can be postprocessed in the same way as by the preprocessing function, e.g. the accuracy can be adjusted by rounding or similar.

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Function	Explanation
	The format and syntax of the mathematical expression correspond to those of the **Preprocessing** function.

4.3.2. Configuring the signal processing steps

1. Use the slider to activate the desired signal processing step.
   The input section opens.
2. Complete the input fields for the signal processing steps you want to apply.
3. Click on **Save** and continue to the **Measurement modelling** tab.

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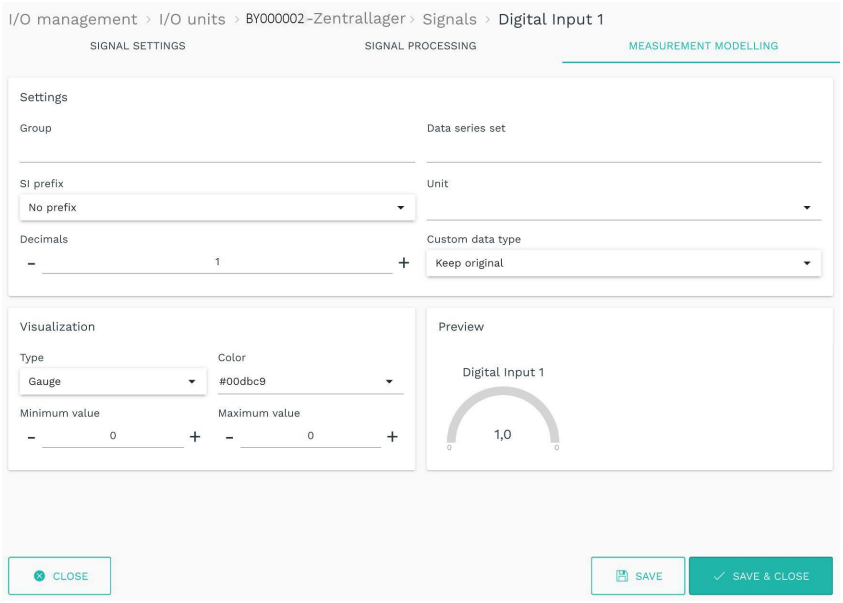
4.4. Measurement modelling

The **Measurement modelling** tab allows you to configure the same parameters for all I/O units and interfaces in order to display measurements.

NOTE

This configuration is optional. However, you can only visualize your data in the **FlexPlorer** app if this tab is filled out. For example, you should enter the number of decimal places, as otherwise measurements will always appear without decimal places by default, including in the apps that transfer the values to the cloud or write them to Grafana, for example.



"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 previews (preferably of the same type, e.g. Gauge) are lined up next to each other in **FlexPlorer**, so that measurements from different devices/sensors can be compared with each other.
Data series set	All signals with the same data series set are displayed in **FlexPlorer** under **Live charts** in a common chart, so that the signal values from different 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: **G** (giga, 10^9), **M** (mega, 10^6), **k** (kilo, 10^3), **h** (hecto, 10^2), **d** (deci, 10^{-1}), **c** (centi, 10^{-2}), **m** (milli, 10^{-3}), **µ** (micro, 10^{-6}), **n** (nano, 10^{-9}), **p** (pico, 10^{-12})

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Unit	Select the physical unit to be assigned to the value.
Decimal places	Enter the number of decimal places to be displayed.
Custom data type	Select a data type and overwrite the original data type for a signal. This is useful, for example, when calculating a float value from a Modbus UINT16 register or a digital input with a true/false value (Boolean).
Minimum value	Enter the value to be used as the minimum in the visualization element (e.g. a gauge). This may be the smallest measurable value for the connected device, but does not have to be.
Maximum val- ue	Enter the value to be used as the maximum in the visualization element (e.g. a gauge). This may be the largest measurable value for the connected device, but does not have to be.
Type	Select the type of visualization that best matches the output val- ues. Available options are **Gauge**, **Counter**, **LED** or **No visualization**.
Colour	Select a colour for displaying measurements.

2. When you have completed the input, click on **Save & close**.

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4.5. Configuring signal connections

If you want to control and/or 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**
>
> Readable input signals for the I/O units are only displayed in the signal connection setup wizard if they have previously been activated in the signal settings using the slider.

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

Example for signal connections (initially, no signal connections are predefined)

2. To create a new signal connection, click on **Add signal connection**.
   The setup wizard opens to guide you through the rule creation process. In the following, confirm each entry with **Next** or press **Enter**.
3. Enter the **Connection name**.
   The connection is enabled automatically. If you want to deactivate it temporarily or permanently, you can disable the connection.
4. Under **Source signal**, select the I/O unit and the associated signal to be read from, e.g. the digital input of the **BY000002** in the central warehouse.
5. Under **Signal processing**, you can optionally process or modify the source signal you have just selected before it is written to the destination signal, e.g. “0” and “1” if a threshold is exceeded.
   NOTE: This does not change the source signal itself; rather, this step relates exclusively to the calculation of the destination signal. Signal processing of the source signal, as you know from the I/O units, continues independently of this.
6. Under **Destination signal**, select the I/O unit and the associated signal to which the value is to be forwarded. This can be, for example, the **BY000002** with an LED that lights up when a threshold value is exceeded.
   The signal connection could now look as follows, for example:

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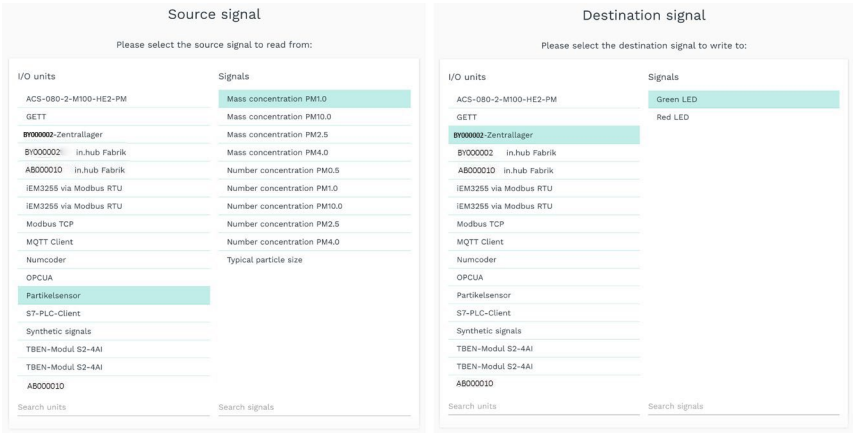

I/O management > Signal connections > Edit signal connection (example)

Example: A particle sensor is connected to digital input 1 of the BY000002. The green LED of the BY000002 is to light up if the PM1.0 particle concentration is undershot or exceeded.

7. For large entries, you can search for units or signals by entering at least one number or letter in the search field below the selection lists.
8. When you have completed the input, click on **Save & close**.

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4.6. Creating synthetic signals

You can use this function to logically link signals, e.g. from sensors or bus protocols, and thus generate new signals. This is particularly interesting in combination with software applications with which machine statuses can be analysed, e.g. with MADOW.

Case study 1: For example, you can link two signals – "Milling machine running" (signal 1) and "Coolant flowing" (signal 2) – together 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". On this basis, downtime is recognized 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 two measurements from a particle sensor for different particle sizes is above a limit value.

NOTE

Readable input signals for the I/O units are only displayed in the signal connection setup wizard if they have been activated in the signal settings using the slider.

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

Example for synthetic signals (initially, no synthetic signals are predefined)

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

   The setup wizard opens to guide you through the rule creation process. In the following, confirm each entry with **Next** or press **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. a temperature sensor.

5. Under **Second source signal**, select the I/O unit and the second signal to be read from, e.g. digital input DIO1.

   The synthetic signal could now look as follows, for example:

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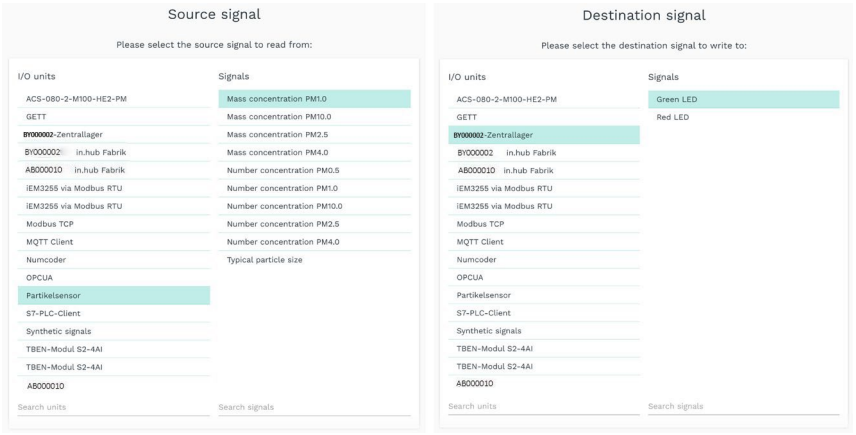

I/O management > Synthetic signals > Edit synthetic signal (example)

If the signal value of digital input 1 (DIO1) outputs that the “milling machine is running” and the signal value of digital input 2 (DIO2) outputs that the “coolant is flowing”, then the synthetic signal added here is generated, which outputs a machine status (however defined).

6. For large entries, you can search for units or signals by entering at least one number or letter in the search field below the selection lists.

7. Now, under **Calculation**, select one of the mathematical operations or logics with which the synthetic signal is to be calculated from the two source signals.

Add values	The values of the two source signals are added together.
Subtract values	The values of the two source signals are subtracted.
Multiply values	The values of the two source signals are multiplied.
Divide values	The values of the two source signals are divided.
Logical AND operation	The two source signals are linked with an “AND”, i.e. both signal values must be non-zero for the synthetic signal also to have the logical value “1”.
Logical OR operation	The two source signals are linked with an “OR”, i.e. at least one signal value must be non-zero for the synthetic signal also to have the logical value “1”.
RS flip-flop	This function allows you to model an RS flip-flop, whereby the output is controlled by the R (reset) and S (set) signals. The S signal sets the output to 1 until the output is reset to 0 by the R signal. The two inputs – S (set) and R (reset) – correspond to the first and second source signals. If a source signal has a value >0, it is interpreted as a logical “1”, i.e. the flip-flop is set or reset. During the setup process, the RS flip-flop can be reset to the value “0” at any time using the **Reset** button.

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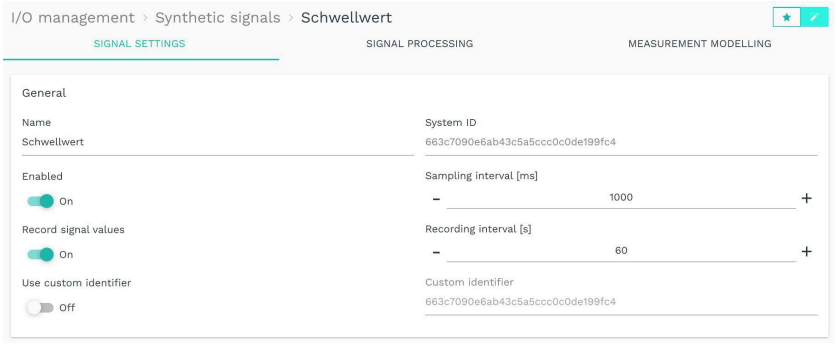
Infinite counter	Increases by the difference between the previous and current value of the source signal. The counter value is retained even when the device is restarted and can be reset to 0 if required using the **Reset** button in the signal overview. **Note**: As the second source signal is ignored, it makes sense to select the same signal as for the first source signal.
Resettable counter	Increases by the difference between the previous and current value of the source signal. If the second signal briefly (or for longer) assumes a value not equal to 0, the counter is reset.
Custom mathematical or logical ex- pression	Enter a mathematical formula in accordance with the syntax of the expreval library (https://github.com/oat-sa/expr-eval#ex-pression-syntax) to calculate the value of the synthetic signal from source signals 1 and 2. Examples for the input: • *A >= 1 or B >= 2*: Result = 1 if A ≥ 1 OR B ≥ 2, otherwise the result = 0 • *A > 0.5 and B < 10*: Result = 1 if A > 0.5 AND B < 10, otherwise the result = 0 • *max(A, B)*: The larger of the two signals is the result • *A^B*: Result = A to the power of B

8. When you have completed the input, click on **Finish**.
9. To save all signals in a file (to reuse them on another device, for example) or if you want to transfer synthetic signals from another device to the current one, click on **Actions** and select the corresponding menu item.
10. To reset dynamic features – such as infinite counters or RS flip-flops, which are retained even when the device is restarted – to 0, click on the **Reset** button. This is useful, for example, after setting up and testing a synthetic signal.
11. Like all other signals, you can disable the synthetic signal, make settings, process and model it. To do this, select the signal and click on **Edit signal properties** or double-click on the signal.

    A window opens in which you will find three tabs.



Signal settings of the selected synthetic signal in “Advanced” viewing mode

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12. Enable and configure the synthetic signal on the **Signal settings** tab.
    a. Optional: Change the name of the synthetic signal if necessary.
    b. Optional: Set the slider to **Off** if you do not want to use the synthetic signal at the moment.
    c. In the **Sampling interval** field, specify the interval at which the signal is to be sampled (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 setting the sampling interval very low (e.g., to the minimum of 50 ms) so that the synthetic signal is updated with very little delay.

    d. Set the **Record signal values** slider to **On** if the values are to be recorded in the local VictoriaMetrics database.
    e. In the **Recording interval** field, enter the desired time interval for the recording (in seconds).
13. Additional settings are available in **Advanced** viewing mode:
    a. **Use custom identifiers**: Set the slider to **On** if you want to enter your own identifier name.
    b. **Custom identifier**: Enter your own identifier name.
14. On the **Signal processing** tab, you can specify how the signal value is to be processed. You can find out more at Configuring the signal processing steps [88].
15. Click on **Save**.
16. On the **Measurement modelling** tab, you specify how the measurements are to be visualized.
    You can find out more at Measurement modelling [89].
17. Finally, click on **Save & close**.

4.7. Configure I/O endpoints

You can use this function to configure that I/O signals may be written or read via fieldbuses and protocols. These are called I/O endpoints. An endpoint can be both a device and a protocol.

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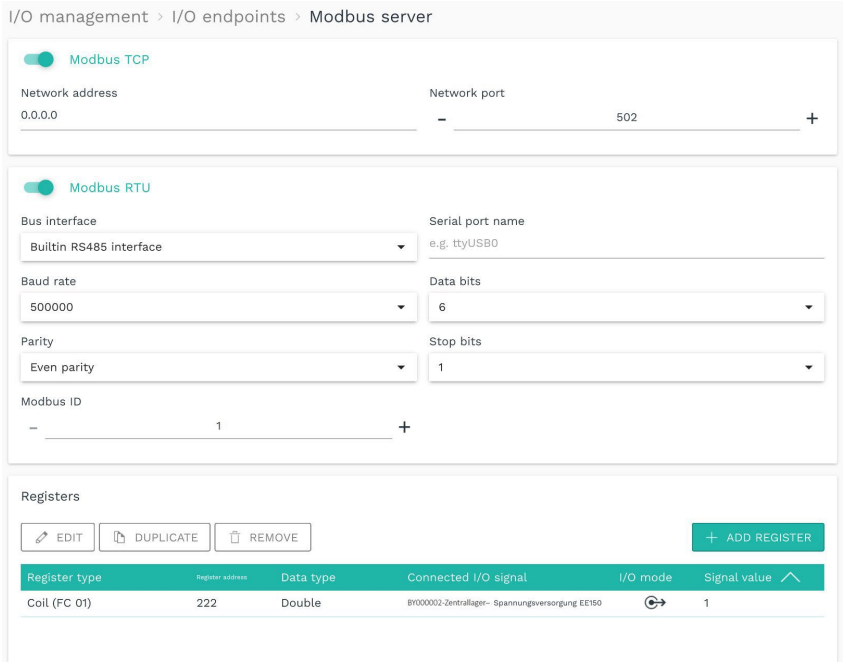
4.7.1. Modbus server

Make I/O signals available via Modbus TCP (network) or RTU (backplane bus) so that these signals can be read or written by the connected devices.

1. On the **I/O management** start page, select **I/O endpoints > Modbus server**.



I/O endpoints > Modbus server

2. If you would like to “enable” I/O signals via Modbus TCP, set the **Modbus TCP** slider to **On**.

   Enter the **Network address** and the **Network port** of the endpoint that is to have access to the I/O signal.

   If the field **Network address** contains “0.0.0.0”, this means that access is obtained via all local IPs/devices, e.g. via Ethernet 1, 2, WLAN, USB, etc. If you do not want to allow this, limit access by entering only the IP address of the allowed device.

3. If you want to “enable” I/O signals via Modbus RTU, set the **Modbus RTU** slider to **On**.

   a. The appropriate **Bus interface** must be selected for communication with the Mod- bus device; in most cases, this will be the **Built-in RS485 interface**.

      For I/O modules (such as the **AB000009** or **AB000008**), select **Backplane bus**.

      A **Serial interface** is then required if an RS485 or RS232 converter is connected via the external USB interface.

      When using serial interfaces, you must specify the **Serial port name**. This depends on the device and may need to be determined via SSH. Usually “ttyUSB0” is used, or in some cases “ttyACM0”.

   b. Complete all other input fields, such as **Baudrate** or **Parity**, according to the documentation of the connected device.

   c. Enter the **Modbus ID** of the device you wish to communicate with.

4. Under **Registers**, you can create the Modbus registers that are to read or write the I/O

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signal.

a. Click on **Add register**.

b. **Register type**: Select the register type.

c. **Register address**: Enter the desired address of the register.

d. **Data type**: Select the data type for the register.

e. **Connected I/O signal**: Select the signal to be read or written.

f. **I/O mode**: Select whether the I/O signal value is to be read and made available in the register or whether the register value is to be read and written to the I/O signal.

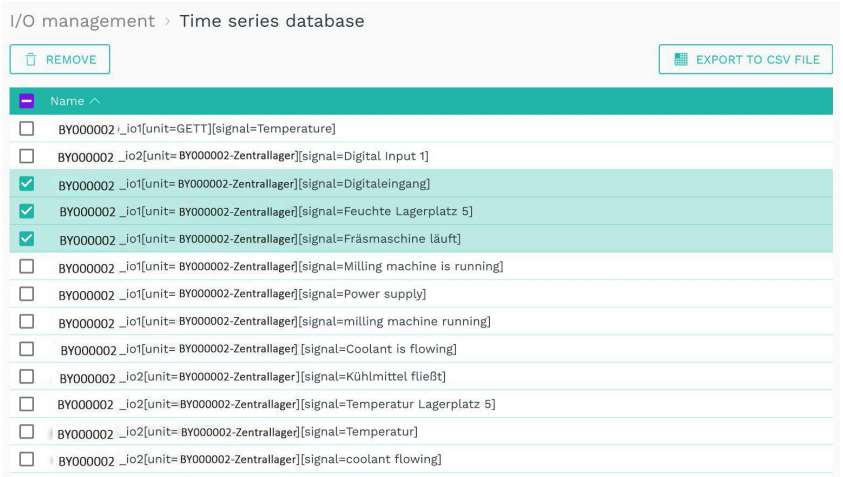
g. Click on **Finish**.
In the **Register** list, you will find all entries, which you can **Edit**, **Duplicate** or **Remove** as usual.

5. Finally, click on **Save & close**.

4.8. Export time series database

This function allows you to export or delete the recorded measurements from the time series database (VictoriaMetrics). This can be useful, for example, if you want to start productive operation and tidy up test data.

1. On the **I/O management** start page, select **Time series database**.



I/O management > Time series database

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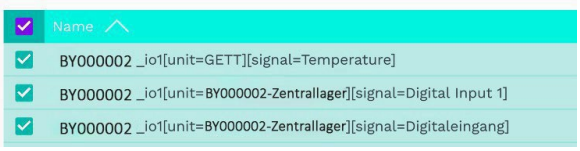
2. Select all database entries by activating the checkbox in the header;



– or –

Just start typing.

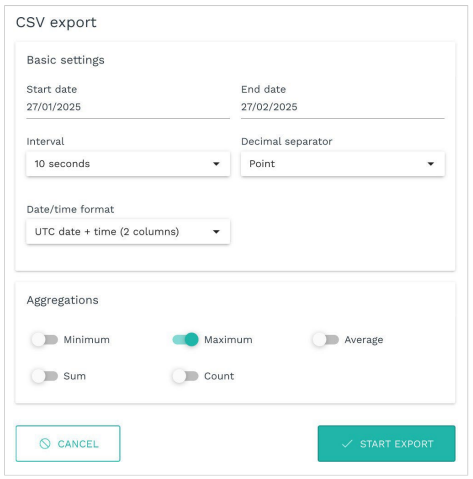
Your input will be transferred directly into the search field at top right and the hits will be displayed dynamically in the list.

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

you can then select the filtered hits again using the checkbox in the header.

3. To export the selected data, click on **Export to CSV file**.

A window opens in which you can make detailed settings for the CSV export.



"CSV export" dialogue window (example)

4. Make the following entries in the **CSV export** dialogue window:
   a. By default, the period of one month is entered retroactively.
      If you want to adjust this period, enter a new **Start date** and **End date**.
   b. In the **Interval** drop-down list, you specify the intervals at which the entries are to be exported.
   c. Under **Decimal separator**, specify whether the decimal place should be a point or a comma.
   d. Under **Aggregation**, you can output additional columns for each measurement series, in which either the **Minimum**, **Maximum**, **Average**, **Sum** or **Number** of values within an interval are listed.

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e. In the **Date/time format** drop-down list, you can select the format in which the date and time of the database entry is to be displayed in the CSV file.

Timestamp: A timestamp is set for each entry.

Local date + time (2 columns): The date and time are converted into the time zone that you have specified under **SIINEOS > System > Date & time** and are output in the format YYYY-MM-DDand hh:mm:ss.

UTC date + time (2 columns): The UTC date and UTC time are output in the format YYYY-MM-DD and hh:mm:ss.

ISO string: Date and time in a machine-readable character format

Localized string: Detailed date with day of the week and month written out in full. The format depends on the language environment.

TIP

The smaller the interval and/or the longer the time period, the more data has to be written and the longer the process takes.

If the recording interval of the signal is greater than the interval entered here, the same value is output for each time unit. This increases the size of the CSV file and therefore also the duration of the download.

5. Click on **Start export**.

   Depending on the selected interval, period and selected summaries, this may take a few minutes.

6. To save data in a file, select individual or all data and click on **Export to CSV file**.

7. To delete data from the time series database, select individual or all data and click **Remove**.

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5. Managing apps

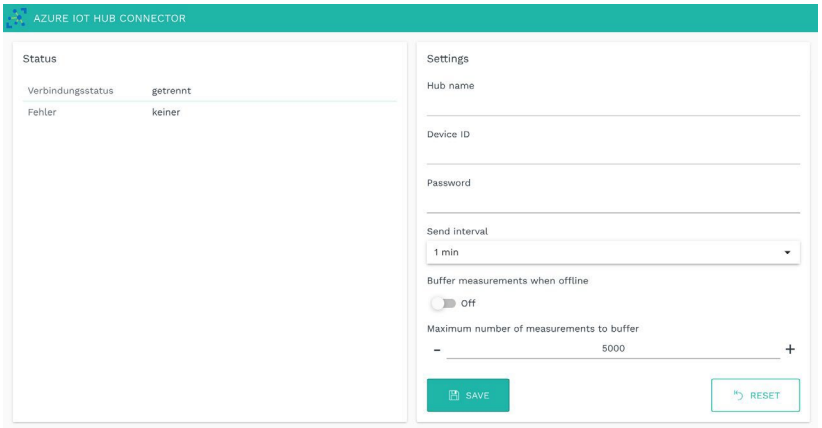
The following chapter provides you with an overview of the preinstalled apps in SIINEOS and how you can manage and configure them.

5.1. Azure IoT Hub Connector

The **Azure IoT Hub Connector** app allows you to establish a communication channel be- tween an IoT device (e.g. the **BY000002**) and Microsoft's IoT platform.

You must have previously purchased access to Microsoft's IoT platform from Microsoft. ipf electronic only establishes the connection with which you can send data directly to Azure.

The following input fields are available for configuring the Azure IoT Hub Connector:



Settings for the "Azure IoT Hub Connector" app

1. Enter the following details, then click on **Save**:
   a. **Hub name**: Enter the name of the device from which you want to send data to the Azure IoT platform.
   b. **Device ID**: Enter the device ID of the device whose data you would like to send to the Azure IoT platform. You can find this ID in your Azure IoT hub management interface.
   c. **Password**: Enter the password. You can find the password in your Azure IoT hub management interface.
   d. **Send interval**: From the drop-down list, select the time interval at which the data should be sent from the IoT device to Azure.
   e. **Buffer measurements when offline**: Switch the slider to **On** if you want the data to be saved as soon as the gateway is offline and you temporarily have no Internet access to the device (e.g. due to mobile-phone interference or network maintenance work).

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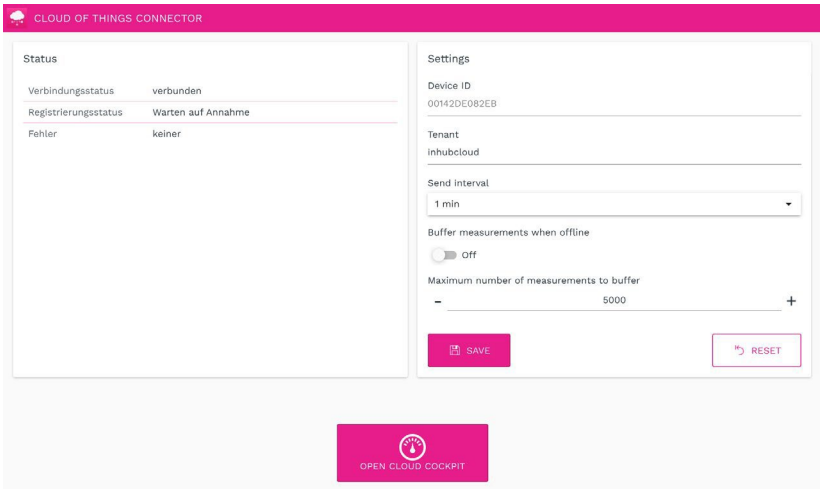
f. **Maximum number of measurements to buffer**: Specify the maximum number of measurements to be buffered.

5.2. Cloud of Things Connector

The **Cloud of Things Connector** app allows you to establish a communication channel be- tween an IoT device (e.g. the **BY000002**) and Telekom's IoT platform.

You must have previously purchased access to the IoT platform from Telekom. Ipf electronic only establishes the connection with which you can send data directly to the Telekom Cloud.



Settings for the "Cloud of Things Connector" app

1. In the **Status** section, you can view the following information about the status of the connection to the Telekom Cloud:
   - **Connection status**: Connection status between the app and the Telekom Cloud
   - **Registration status**: Status of registration in the Telekom Cloud
   - **Error**: If a connection error occurs, the reason is displayed in this field
2. The following input fields for configuring the Cloud of Things Connector are available in the Settings area:
   a. **Device ID**: Display of the device ID.
   b. **Tenant**: Enter the name of the (logical) unit under which all associated users and data are to be summarized and administered.
      If you have purchased cloud access via ipf electronic, you must enter the company ac- count, in this case "inhubcloud". This field is prefilled by default.
      If you want to use your own Telekom Cloud, you can also enter your own company account in this field.
   c. **Send interval**: Select the time interval at which data is to be sent from SIINEOS to the Telekom Cloud.
   d. **Buffer measurements when offline**: Switch the slider to **On** if the measurements are to be buffered in the event of a connection being interrupted.

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e. **Maximum number of measurements to buffer**: Enter the maximum number of measurements to be buffered.

3. Click on **Save**.

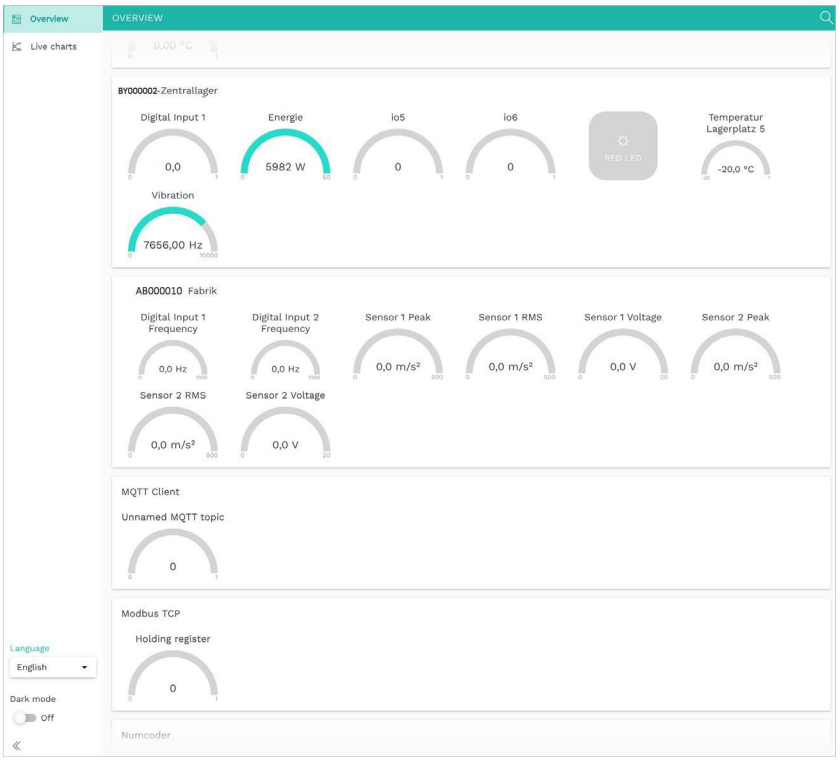
4. Click on **Open Cloud Cockpit**.
   The Telekom Cloud opens, where you can log on with your individual user data.

5.3. FlexPlorer

IPF's own visualization tool **FlexPlorer** displays the data that arrives and is processed in SIINEOS in dashboards. FlexPlorer is not as extensively configurable as Grafana, but provides a good initial overview of all active signals from the devices connected to the gateway. You do not need an additional user account for FlexPlorer.

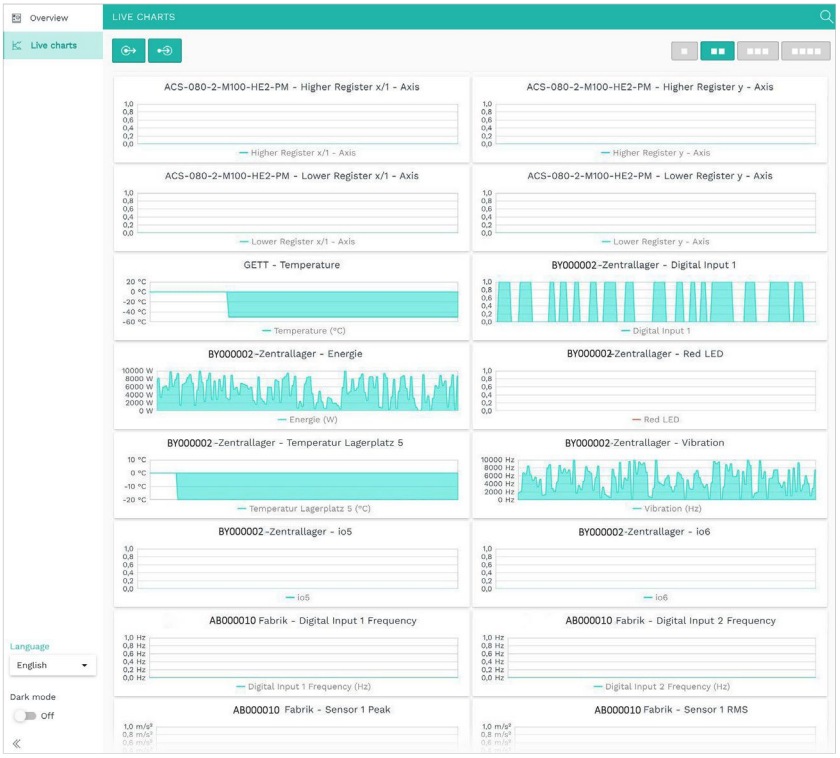
You can switch between two views in FlexPlorer: **Overview** and **Live charts**.

On the **Overview** page, you can see the signals of each activated I/O unit in a graphical representation. The display is based on your entries in the **Measurement modelling** tab.



Overview in FlexPlorer

You can monitor the progression of measurements live on the **Live charts** page:



Live charts in FlexPlorer

You can customise the view of the live charts using various buttons:

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

5.4. InGraf

The **InGraf** app integrates the cross-platform open-source application **Grafana** where you can visualize and display data from all I/O units and signals from SIINEOS.

Grafana accesses the built-in **VictoriaMetrics** database.

If you are updating from SIINEOS 2.8.0 and above to the current version, please ensure that the data source in Grafana is switched to VictoriaMetrics.

If you are updating from SIINEOS 2.7.7 and below to the current version, some settings are necessary. Please contact us beforehand at hotline@ipf.de.

NOTE

To manage the **InGraf** app, a separate user role – the app administrator – is created with the initial user data: **ingrafadmin/ingrafadmin**.

See also User administration [32].

The initial user data **admin/admin** is defined for access to **Grafana**. Log on and then change your access data.

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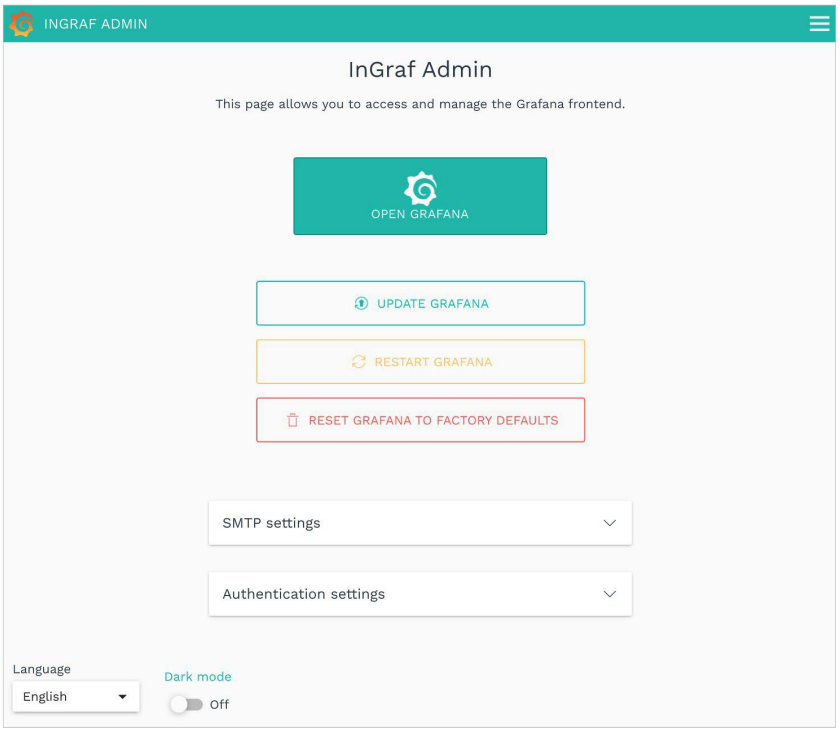
5.4.1. Configuring the Grafana connection



Settings for the Grafana front end

1. Use the following buttons as required:
   a. **Open Grafana**: Opens Grafana in a new window. Have your user data ready and log on.
   b. **Update Grafana**: Updates your Grafana version to the latest version. Your dashboards will remain unaffected.
   c. **Restart Grafana**: Restarts Grafana in case the programme fails to reply or respond.
   d. **Reset Grafana to factory defaults**: Resets all your settings in Grafana.

> ATTENTION
> With this, all dashboards, alarm configurations and other settings **will** be lost. This does not affect the data recorded in VictoriaMetrics.

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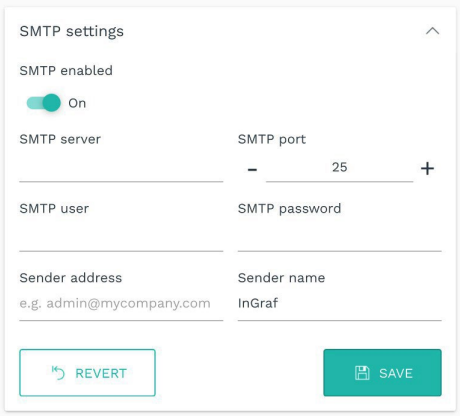
2. To activate alarms, you first have to configure the SMTP mail server. You have the following input fields for this purpose:



   a. **SMTP enabled**: Set the slider to **On** if you want Grafana to send via your SMTP server.

      Grafana cannot send e-mails without a SMTP server configuration, so the alerting function cannot be used, for example.

   b. **SMTP server**: Enter the name of your e-mail server.

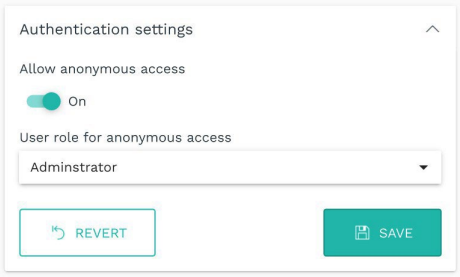
   c. **SMTP port**: Enter the port for your e-mail server.

   d. **SMTP user** and **SMTP password**: In order for Grafana to log on to your SMTP server, the details of an e-mail account are required. Ask your system administrator for the access data that Grafana is to use to send e-mails.

   e. **Sender address**: Enter the e-mail address that appears as the sender in the e- mails that Grafana sends. You configure the destination addresses individually in Grafana, as different recipients are also possible for different alarms, for example.

   f. **Sender name**: Enter a name under which Grafana should appear in your mailbox as the sender.

3. You can configure the authentication settings for Grafana with the following settings:



   a. **Allow anonymous access**: Set the slider to **On** if you want dashboards to be visible in Grafana even without prior login.

   b. **User role for anonymous access**: In the drop-down list, you can select which Grafana user role is used for anonymous access. **Viewer**, **Editor** and **Administrator** are available.

4. Click on **Save**.

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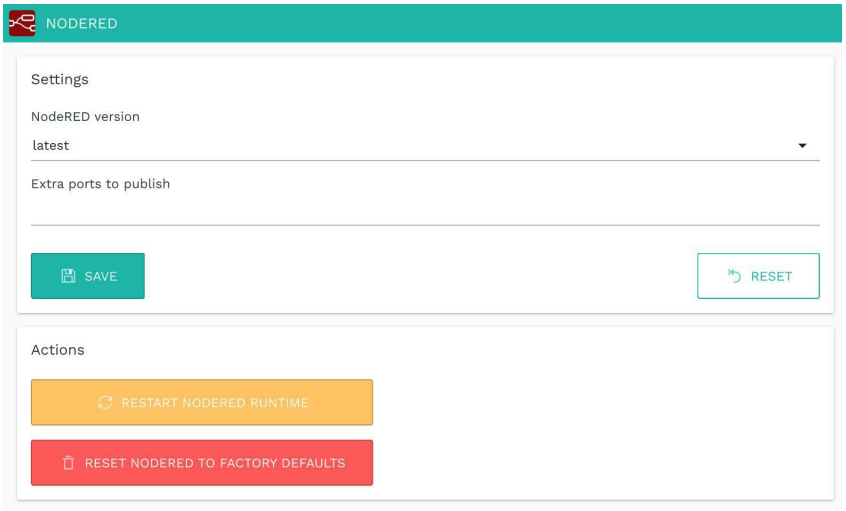
5.5. NodeRED

The **NodeRED** open-source application allows you to connect hardware, software, interfaces and services via graphical programming according to the modular principle. When this app is activated, the NodeRED Docker container is downloaded and executed. All further activities are your responsibility.



Settings for the Node-RED app

1. In the **Settings** section, select the Node-RED version you want to use.
   If an Internet connection is established, the selected version will be automatically downloaded and used.
2. **Additional ports to be published**: If you use Node-RED to provide other services and interfaces, you can enter the ports here to allow access to these services and interfaces from other devices and machines.
3. You can perform the following actions in the **Actions** section:
   a. **Restart NodeRed runtime**: If a message appears when you open the **NodeRED** app stating that the page cannot be accessed, you need to restart the app.
   b. **Reset NodeRED to factory defaults**: Everything that you have set up, programmed or installed in **NodeRED** yourself is reset with this button.

5.6. OPC UA Server

The **OPC UA Server** app allows you to implement the platform-independent OPC UA standard and make the data of all I/O units and I/O signals available externally via the standardized OPC UA interface.

For example, if you want to connect two IPF gateways with each other via OPC UA, you can activate the **OPC UA Server** app on one device (this will make this device act as a server) and set up the OPC UA client on the other device.

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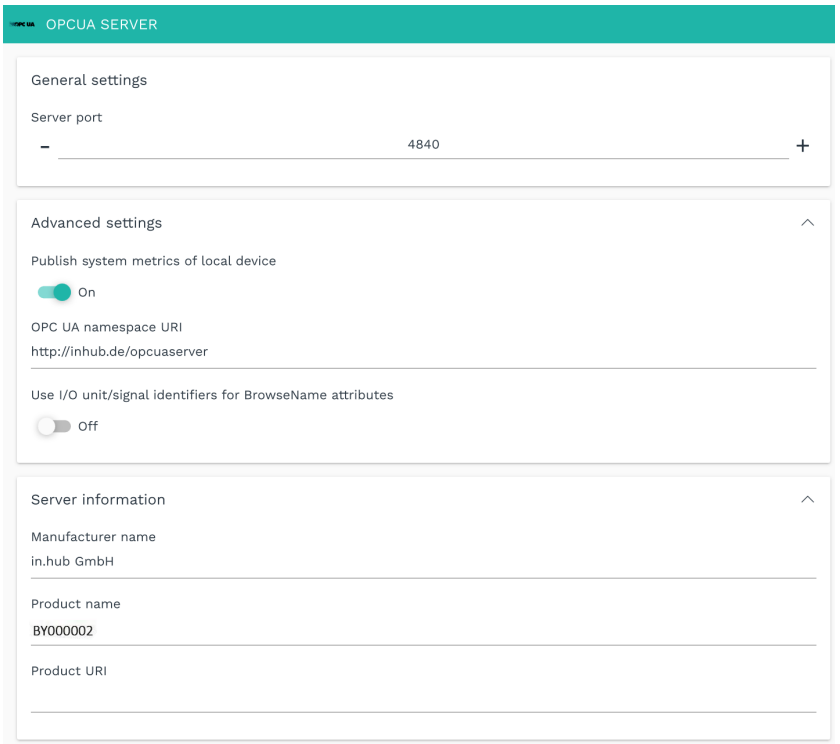


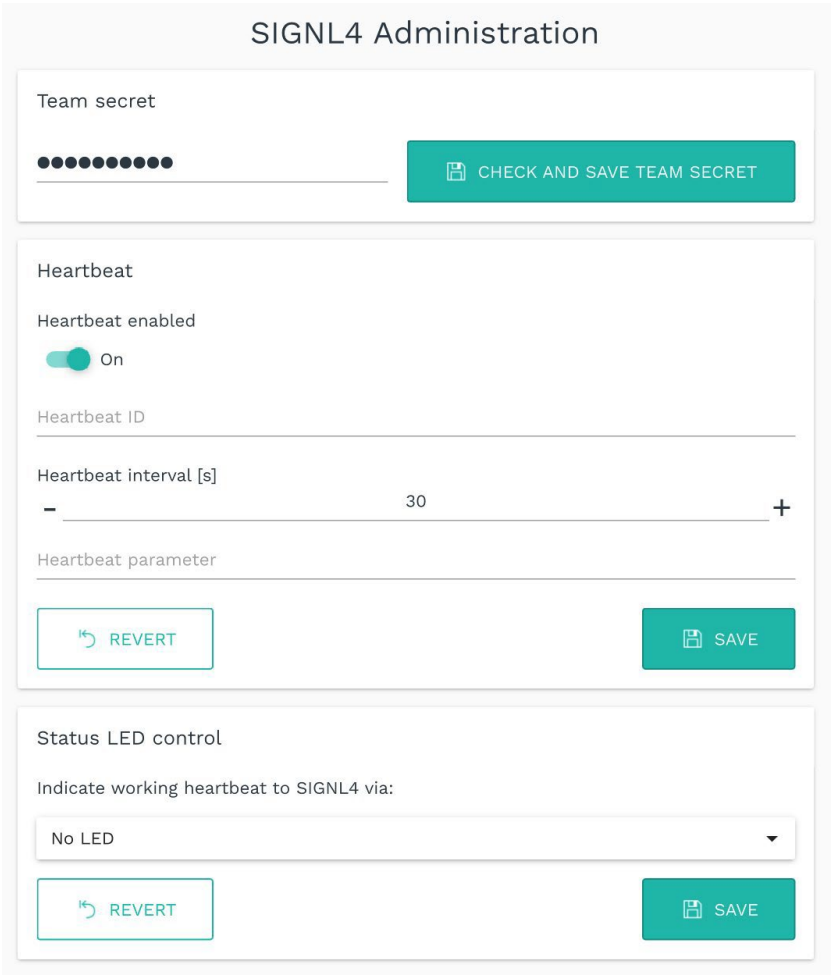
Settings for the OPC UA Server app (example)

The following input fields are available for configuring OPC UA Server:

Server port	This is where you enter the **Server port** on which the OPC UA server is to be accessible.
Advanced settings	• Set the **Publish system metrics of local device** slider to **On** to publish the system metrics CPU load, CPU usage, RAM utilization and data storage usage/utilization via OPC/UA in addition to the I/O units. This makes it easy to monitor the gateway by remote access. • Enter the **OPC UA namespace URI** that identifies the data schema for this OPC UA Server. • Set the **Use I/O unit/signal identifier for BrowseName at- tributes** slider to **On** (recommended) to use the respective OPC UA node ID string instead of the configured names of I/O units and I/O signals for the respective BrowseName at- tribute of the OPC UA object. The node ID string is a unique identifier that represents the path to the OPC UA node, e.g. **“s=BY000002Werkhalle.AIN1”**.
Server information	Enter additional information about the server, such as the **Manufacturer name**, **Product name** and **Product URI**.

5.7. SIGNL4

The SIGNL4 **app** establishes a connection to the SIGNL4 cloud so that alerts can be forwarded directly to it.



Administration for the SIGNL4 connector

The following input fields are available for forwarding alerts to the SIGNL4 cloud:

Team secret	Enter your Team Secret. You can find Team Secret in your SIGNL4 profile. Use the **Check and save Team Secret** button to check whether Team Secret is valid. This button is only activated if a key has been entered in the input field.
Heartbeat	**Heartbeat enabled**: Set the slider to **On** if you want your de- vice to send a continuous signal to the SIGNL4 cloud. **Heartbeat ID**: Enter the Heartbeat ID that is associated with the integration of your SIGNL4 cloud. To do this, log onto the SIGNL4 cloud with your account.

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	Heartbeat interval: Enter the time interval for sending alerts from the IPF device to the SIGNAL4 cloud. **TIP**: If, for example, the setting made in the SIGNL4 cloud is 5 minutes, you should enter half that time here to compensate for any delays in the network. **Heartbeat parameter**: Optionally enter, for example, the name of the IPF device from which the heartbeat is sent. This input field is only used to identify the device.
Status LED control	The following options are available in the drop-down list: • **No LED**: The heartbeat is not visualised. There is no visual indication that the alerts are being transmitted to the SIGNL4 cloud. • **Red LED**: The red LED of LED 3 (status LED) on the front of the device is used for visualisation. • **Green LED**: The green LED of LED 3 (status LED) on the front of the device is used for visualisation.

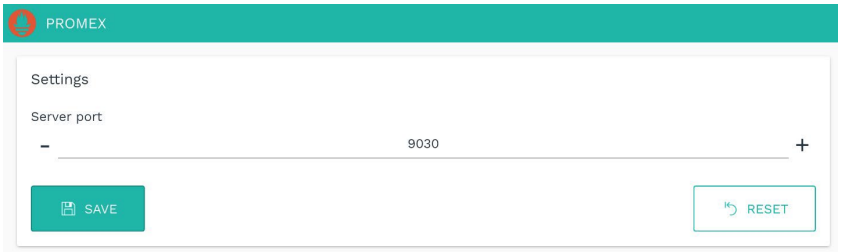
TIP

For a description of how to set up the heartbeat in the SIGNL4 cloud, see the SIGNL4 documentation at https://docs.signl4.com/integrations/heartbeat-monitoring/heartbeat-monitoring.html.

5.8. PromEx

The **PromEx** app provides an HTTP interface – a so-called "Prometheus exporter" – which can be used to retrieve the current values of all I/O signals from an external Prometheus database.

When you open the app's administration, you can only enter the port under which the exporter is available and/or under which Prometheus can retrieve the data from the device.



Settings for the PromEx app (example)

5.9. TOSIBOX® Lock for Container

TOSIBOX® Lock for Container ensures secure connections within your industrial IoT devices. It is a software-only solution that allows you to connect your IPCs, HMIs, PLCs, controllers and other devices to your TOSIBOX® network and acts as an endpoint for secure remote connections.

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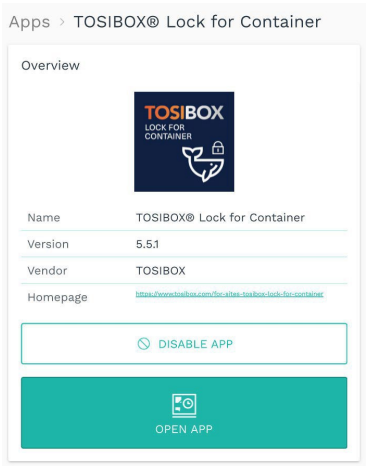
With TOSIBOX® Lock for Container, services running on the connected device can be securely accessed over the Internet and most LAN and Wi-Fi networks via a highly encrypted VPN connection. The app does not restrict the number of services or devices that can be administered. You can connect any service between any devices via any protocol.

NOTE

No administration is required for the **TOSIBOX® Lock for Container** app. You can open the app directly, but you will need the access data you received with the software.

If you have experienced connection problems after disabling and re-enabling the app, you should restart the device to ensure that all services and settings work correctly.



Settings for the TOSIBOX® Lock for Container app

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6. 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 IPF device's power supply was briefly disconnected and the time setting was lost.	1. In SIINEOS, select the **System** page and go to the **Date & time** section. 2. Click on **Synchronize time via browser now** to synchronize the device's date settings with your computer. If the device's power supply is disconnected, this setting is lost. You will then have to synchronize with the browser again.
	The database was corrupted due to a sudden loss of power (at the device) while writing.	1. In SIINEOS, select the **Monitoring** page and select **Data storage**. 2. Activate the **Advanced** viewing mode and click on the **Maintenance** button. 3. In the drop-down list, select **Reset VictoriaMetrics database** to completely reset the database.
The IPF device is no longer responding, e.g. during the updating process. The device cannot be started up even by switching it off and on (disconnecting and reconnecting the power supply).	–	Disconnect and connect the device's power supply three times in succession. In between, the LEDs on the front must have lit up for at least 5 seconds. After 3 unsuccessful boot attempts, the device switches to another boot slot and starts with the usually older version installed in that boot slot. All settings are retained.
Signal connections The required I/O unit or required 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 of the I/O unit or in the **Signal settings** of the signal, set the slider to **On**.

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Problem	Possible cause	Remedy
		
Update You have uploaded a SIINEOS update and the new software version is not being displayed.	The browser cache still contains an old version of the web interface; – or – the IPF device is no longer responding.	1. First delete your browser cache and refresh the page in your browser. 2. If that doesn't work: Switch off the power to the IPF device 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 opening the address http://192.168.123.1.	A proxy server is configured in the browser or system settings in the network settings of your local PC; – or – the firewall of the local PC (Windows firewall) or the firewall of the company network is preventing access to the IPF device or parts of the interface.	1. First, check whether the IPF device is connected via USB cable and is flashing. Make sure that it is a USB cable that also supports a data connection. 2. In the proxy-server settings of the system or browser, you or your administrator must ensure that no proxy server is being used for the IP address 192.168.123.1 so that the browser accesses the connected IPF device directly. Either temporarily disable the use of the proxy server or add the appropriate exception rule for the above-mentioned IP address; – or – make sure that the following ports are enabled in the settings of your local system firewall to allow access to the IPF device. Preparing the IT infrastructure in your own company network [8]
Connection problems	A firewall rule in SIINEOS is preventing data traffic to and from the SIINEOS device.	1. Go to the **Firewall** page and check which action is selected in the rules for both incoming and outgoing network traffic.

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Problem	Possible cause	Remedy
You can no longer access the IPF device in the net- work or a system service is not responding.		2. Select the **Accept packet** action to allow the data exchange.
Connection problems The IPF device is located in an isolated machine network and you cannot reach it in this network.	The communication between the machine network and the general company network is controlled by a firewall and only access to defined ports of certain IPF devices is allowed.	Make sure, or get the system administrator to make sure, that the network firewall allows access to the IPF device via the appropriate ports. Preparing the IT infrastructure in your own company network [8]
Connection problems An I/O module is integrated into the network via Ethernet and you are unable to access it in the network.	You have assigned the IPF device an IP ad- dress in the range be- tween 192.168.123.**1** and 192.168.123.**254**. This network address range is already used for the direct USB connection.	Assign a new IP address that is outside the range already assigned.
Network problems / connection problems The IPF device is integrated into the network via Ethernet and you are unable to access it in the network.	The device has been automatically or manually configured with an IP address that is in the range **172.17.0.0/16** and **172.18.0.0/16**. The Docker service uses this address range by default for the Docker networks.	Configure an IP address from a different IP address range for the Docker service. To do this, enter an IP address including subnet prefix from an unused IP address range under **System > Serv- ices > Docker engine > Docker bridge IP address**.
Signals from the Modbus RTU device are not arriving The Modbus RTU device is connected, but signals are not arriving at the IPF device.	The pins of the IPF device's RS485 socket and the corresponding pins on the Modbus RTU device are not correctly connected.	Check the RS485 socket on the IPF device to ensure that: • + is connected to bus line A • – is connected to bus line B **Note**: Occasionally, manufacturers name A and B differently. For this reason, compare the signs of the bus line in the manufacturer's data sheet with our connections and, if necessary, swap the pairing.

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Problem	Possible cause	Remedy
Docker-based apps, such as Grafana, Node-RED or Tosi- box, do not start or cannot be opened.	The IPF device itself has no Internet access – either intentionally to seal off the machine network or unintentionally due to a configuration error. You have three options for troubleshooting.	Fix possible configuration errors: Either allow the firewall on the network to grant access to the Internet by opening TCP ports 80 and/or 443; – or – check the WLAN configuration on the IPF device yourself; – or – check that the address of the **Gateway** and, if applicable, the **DNS server** are entered correctly under **Networks > Ethernet 1** (or 2) in the **Manual configuration mode**.
		Reinstall the Docker container: 1. Download the appropriate Docker container bundle for offline installation from the IPF download portal. 2. Install the bundle under **System > Updates**.
		Reset the Docker service: 1. Under **Monitoring > Storage**, click on the **Advanced** viewing mode and then on the **Maintenance** button. 2. First, select **Remove Docker containers and images and clean up Docker file system**: – or – if that doesn't work: Click on **Remove all Docker files** and reinstall the Docker containers. 3. Then restart the IPF device. The apps will re-initialize. 4. If the initialization did not work, download the Docker container bundle for offline installation via the IPF download portal:

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Problem	Possible cause	Remedy
		and install the bundle under **System > Updates**.
No further plug-ins can be installed within Grafana and Node-RED.	Docker-based apps are temporarily unable to establish an Internet connection after changes to the firewall rules.	Restart the IPF device. The firewall is reconfigured together with the Docker service.
The internal memory is full and off- line bundles can no longer be installed (e.g. if Grafana or Node-RED is updated manually).	Previous updates of Docker containers that were incomplete or incorrect; – or – Docker containers (InGraf, Tosibox, Node-RED) that have not been shut down cleanly due to sudden voltage loss; – or – log files from the Docker containers have become too large over time (especially Node-RED).	1. Under **Monitoring > Storage**, click on the **Advanced** viewing mode and then on the **Maintenance** but- ton. 2. Select **Remove Docker containers and images and clean up Docker file system**: 3. Confirm the Docker cleanup with **Yes**.
Communication problems with the Modbus TCP connection	Under certain circumstances, a very simple TCP/IP network stack and/or Modbus protocol stack, especially on microcontroller-based devices, may only be able to receive and answer individual requests. If several requests arrive in succession or bundled in a TCP packet, the device may not be able to handle the requests and may go into an error state.	1. Navigate to **I/O management > I/O units** and open the Modbus TCP client where the transmission problems are occurring. 2. **High efficiency** is set by default under **TCP packet flow optimization**. Therefore, switch to either **Low latency** or **Half-duplex** to simplify the sequence and compilation of Modbus queries. 3. Save the change and check whether communication now works.

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Problem	Possible cause	Remedy
The results of signal processing are 0 or incorrect. You have entered mathematical expressions on the **Signal processing** tab that cannot be evaluated correctly by the expr-eval library.	Since SIINEOS version 2.7.4, mathematical expressions have been calculated using an improved method for both signal processing and custom calculations of synthetic signals. Instead of internal functions with ECMAScript syntax, the more powerful expreval library is used. Existing formulas may have to be adapted accordingly.	Navigate to the **Signal processing** tab and convert your mathematical formulae according to the specifications of the expreval library: https://github.com/in-hub/expr-eval#expression-syntax

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