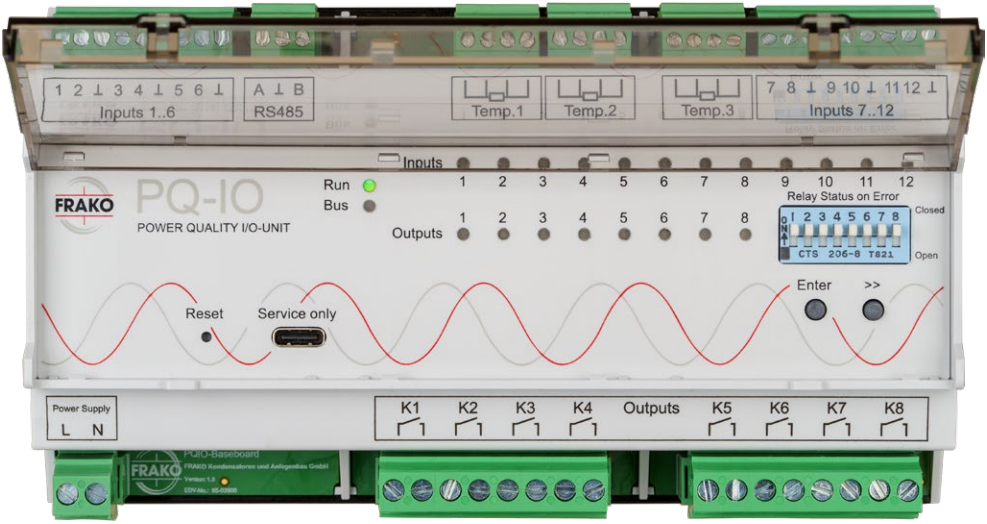
PQ-IO
POWER QUALITY I/O UNIT

8 relay outputs
12 S0 inputs
3 PT100 temperature inputs
Valid for firmware version 5.88 or higher



FRAKO Kondensatoren- und Anlagenbau GmbH
www.frako.com

Contents

1 About this document 4

1.1 Explanation of terms 4
1.2 Target group 4
1.3 Storage 4
1.4 Presentation in this document 5
1.5 Warning notices. 5

2 Safety instructions 6

2.1 Intended Use. 6
2.2 Device-specific hazards. 6
2.3 Organizational matters. 7
2.3.1 Additional operator obligations for network security. 7
2.4 Disclaimer of liability. 8
2.5 Applicable standards. 8
2.6 Repair 8

3 Technical Data 9

4 Device description 11

4.1 Function 11
4.1.1 Expansion station for the maximum demand optimization controller EM-MC 2200 / PQMC^{PRO} 11
4.1.2 Pulse and status acquisition unit with 12 inputs according to the S0 standard 12
4.1.3 Temperature measuring unit with 3 PT100 inputs 12
4.2 Operation 13
4.2.1 Factory reset 13

5 Installation 15

5.1 Assembly at the operating site 15
5.1.1 Prepare assembly 15
5.1.2 Scope of delivery. 15
5.1.3 Installation conditions 15
5.1.4 Carry out assembly 16
5.2 Electrical Installation 16
5.2.1 Performing the electrical installation. 16
5.2.2 Conditions for the electrical connection. 16
5.2.3 Supply voltage. 17

6 Commissioning. 20

6.1 Commissioning the PQ-IO. 20
6.1.1 Setting the busadresses und DHCP directly on device:. 20
6.1.2 Setting the fault states. 25
6.1.3 Advanced configuration of the PQ-IO via the web page 26
6.1.4 Service interface 37

7 Operation 38
7.1 Display. 38
7.2 Inputs 38
7.3 Outputs 39
7.4 Display on the website 39
7.4.1 Display of relay states 39
7.4.2 Display of the S0 inputs 41
7.4.3 Display of temperatures 45
8 Measured values of the pulse inputs 47
8.1 PQ-IO channels available in FRAKONET 47
8.1.1 Analog channels (continuous measured values, compatible with the EMF 1102) 47
8.1.2 Counter channels (cumulative meter readings, compatible with the EMF 1102) 48
8.1.3 Status channels (binary states) 49
8.1.4 Extended 64-bit counting channels 49
8.1.5 Summary of calculations 51
9 Connection of the PQ-IO to a EM-MC 2200 or PQMC[PRO] via Ethernet 53
9.1 Via FRAKO bus over Ethernet (Port 8000) 53
9.2 Via Modbus TCP (Port 502) 53
9.3 Security functions 54
9.3.1 TLS certificate 55
9.3.2 TLS certificate - procedure 56
9.3.3 Enable services 56
9.3.4 Whitelist 57
9.3.5 Whitelist - examples 57
10 Safety during cleaning and maintenance 58
10.1 Cleaning 58
10.2 Maintenance 58
11 Troubleshooting 59
11.1 Fault diagnosis 60
12 Decommissioning, dismantling, storage, disposal 61
12.1 Decommissioning the PQ-IO 61
12.2 Removing the PQ-IO from the DIN rail 61
12.3 Storage 61
12.4 Disposal 62

1 About this document

In these operating instructions, the Power Quality I/O unit is consistently referred to as PQ-IO designated. Because the device replaces the two older devices EMD 1101 and EMF 1102 the following terms are used:

- EMwF: For the input unit that records the 12 S0 inputs.

The current version of the operating instructions can be found on our website www.frako.com.

1.1 Explanation of terms

The following terms are used in these operating instructions:

Term	Meaning
EMG PN	Name of the gateway function for connecting Ethernet Networking to PNet.
FRAKO bus	Bus protocol from FRAKO, based on the PNet protocol and usually implemented via RS485.
FRAKO bus over Ethernet	Variant of the FRAKO bus, in which instead of an RS485 bus line Ethernet network is used as a transmission medium and the Bus coupler is included in the device itself.
Relay status	State of the output relays taking into account the switching channel configured inversion.
Machine condition	State of the connected load without taking into account the interan inversion, i.e. the actual state of the connected a consumer.

1.2 Target group

These operating instructions are aimed at people who assemble and install the PQ-IO clean, commission and operate. Before any work on and with the PQ-IO the operating instructions must be read carefully and completely. In all work must be carried out in accordance with the operating instructions.

1.3 Storage

This operating manual contains important information for the safe, proper, and efficient operation of the PQ-IO. It is part of the PQ-IO and must be kept readily available at all times.

1.4 Presentation in this document

Special information in these operating instructions is marked by symbols and separated from the rest of the text by lines.

1.5 Warning notices

To prevent accidents, personal injury, and property damage, the warning notices must be strictly observed. Warning notices are marked with the signal words “DANGER,” “WARNING,” “CAUTION,” or “NOTICE” and a yellow symbol at the left margin of the text. They are structured as follows:

WARNING!

Type of hazard!

Description of the hazard and possible consequences.

Measures to avoid the hazard.

Symbols and signal words classify the severity of the danger

Symbol	Signal word	Meaning
	DANGER	The signal word indicates a danger with a high level of risk which, if not avoided, results in death or serious injury.
	WARNING	The signal word indicates a danger with a medium level of risk, which if not avoided will result in death or serious injury can have.
	CAUTION	The signal word indicates a danger with a low level of risk that if not avoided will result in a minor or moderate injury
	Danger	Failure to observe these instructions may result in property damage.

Notices

Notices provide additional information about the text, the correct operation and trouble-free functioning of the PQ-IO. Notices are indicated by a blue symbol in the left margin:

Notice

Example of a Notice.

2 Safety instructions

2.1 Intended Use

The PQ-IO can be used in residential and industrial environments and, within the limits specified in the technical data, is intended for the following applications:

- I/O module for system automation and switching of non-safety-critical loads via K1–K8
- Acquisition of meter pulses (S0), frequency-proportional signals from analog frequency converters, and switching states in accordance with the S0 specification.
- Measurement of temperatures via PT100 inputs in the range of –50 to +180 °C

The device must be used within the limits and environmental conditions specified in the technical data. Modifications to the device, improper wiring, or operation outside the specified limits are considered improper use.

2.2 Device-specific hazards

The PQ-IO is built according to the current state of the art. Nevertheless, not all hazards can be completely avoided. Failure to observe the safety instructions may result in death, serious personal injury, or significant property damage.

WARNING!
Hazard due to electric voltage!

The PQ-IO carries mains voltage. Contact with live parts on supply lines and terminals may result in serious injury or death.

- Installation, commissioning, and decommissioning of the PQ-IO may only be carried out by qualified personnel who are familiar with and understand the contents of this operating manual.
- During installation and service work, the PQ-IO and the system must be disconnected from the power supply.
- Different electrical circuits may be connected to the 8 relay outputs. Therefore, the voltage must be disconnected and verified at each relay.
- The system must be secured against being switched on again.
- Verify that all terminals are de-energized.
- Adjacent live parts must be covered.
- Use approved installation cables only.
- Observe the maximum permissible load of the relay contacts.
- Do not open the PQ-IO. Do not touch the USB interface of the PQ-IO during operation.

2.3 Organizational matters

Qualification of users

The following user qualifications are required to work on the PQ-IO:

- Assembly, commissioning, troubleshooting (installation): qualified electrician.
- Operation, troubleshooting (misconfiguration): Personnel who have read and understood the operating instructions.
- Troubleshooting (device errors): FRAKO customer service.

Responsibility of the operator

In commercial facilities, the accident prevention regulations of the German Social Accident Insurance (DGUV) for electrical installations and equipment must be observed.

The safety of the system into which the PQ-IO is integrated is the responsibility of the system installer and the operator.

For safety and approval reasons (CE), unauthorized modifications and/or alterations to the product are not permitted

The operator must ensure that all users are familiar with this operating manual and act in accordance with its instructions.

2.3.1 Additional operator obligations for network security

The operator must operate the PQ-IO in a protected VLAN or in an equivalently separated automation network. Direct access from office, guest or public networks and from the Internet must be avoided. Access may be enabled only for the systems, persons and protocols required for operation, maintenance and diagnostics.

After commissioning, the PQ-IO security settings must be restricted as far as possible. This includes in particular:

- Disable communication services that are not required, or restrict their read and write permissions.
- Enable write access via web page or REST API only if it is required for operation or maintenance. If write access is not required, this function must be disabled.
- Restrict whitelist entries for Modbus TCP, FRAKO bus via Ethernet and Device Discovery to the IP addresses or networks that are actually required. The entry * allows all IP addresses and should be used only if this access is explicitly required and protected by the network security concept.
- Create user accounts only for authorized persons. The delivery password of the Admin account must be changed at the first login. Passwords must be treated confidentially and checked regularly according to organizational requirements.

After a factory reset or after changes to the network topology, the operator must check these settings again and restrict them again if necessary.

2.4 Disclaimer of liability

The relay outputs K1–K8 are not intended for safety-related applications. Connecting loads whose intended or unintended switching could pose a risk to persons, equipment, or the environment is not permitted. The operator is responsible for risk analysis, suitability assessment, protective measures, and compliance with all applicable standards. The manufacturer accepts no liability for damage resulting from improper use.

2.5 Applicable standards

Installation and commissioning in industrial systems may only be carried out by qualified personnel in accordance with the applicable standards and safety regulations.

For the PQ-IO, the following standards and directives in particular must be observed:

- **DIN EN 61010-1:2011 / VDE 0411-1**
  Safety requirements for electrical equipment for measurement, control, and laboratory use
- **DIN EN 61326-1:2013 / VDE 0843-20-1**
  Electrical equipment for measurement, control, and laboratory use – EMC requirements
- **Directive 2014/35/EU (Low Voltage Directive)**
  Safety of electrical equipment within certain voltage limits
- **Directive 2014/30/EU (EMC Directive)**
  Electromagnetic compatibility
- **Directive 2011/65/EU (RoHS Directive)**
  Restriction of the use of certain hazardous substances in electrical and electronic equipment

In addition, all other laws, standards, and regulations intended for the protection of persons and property (e.g. IEC, EN, and VDE regulations, the Product Safety Act, as well as the regulations of the employers' liability insurance associations) must be observed.

2.6 Repair

In the event of a necessary repair, the customer or the operator of the PQ-IO contact the manufacturer:

FRAKO Kondensatoren- und Anlagenbau GmbH, Tscheulinstraße 21A in D-79331 Teningen, www.frako.com.

3 Technical Data

Power supply:

Supply voltage	185V AC - 253V AC, frequency 45 - 65 Hz
Power consumption	maximum 5 VA
Hedging	External fuse required: max. 2 A (time-lag)

Inputs:

S0-Inputs	12 galvanically connected inputs. S0 interfaces (DIN43864) for connecting potential-free contacts. Voltage with open contact: 15V Max. line width Resistance: 800 Ω Short circuit current: 18mA
Temperature inputs	3 PT100 inputs for 4-wire measurement. Measuring range -50°C to 180°C Accuracy +/- 2°C

Outputs:

Relay outputs	8 bistable relays, potential-free, AC 250V AC, maximum 3A DC 30V DC, maximum 3A

Interfaces:

Ethernet interface (web interface, Modbus TCP, FRAKO bus over Ethernet)	100-Mbit/s-Ethernetstandard 100 BASE-T. Verwendete Ports: 80, 502, 8000
RS485 (FRAKO bus)	RS485, characteristic impedance 120 Ω, for connection to the FRAKO energy management system

Connection:

Connections	via pluggable screw terminals
AUX supply, Rated data	Conductor cross-section: max. 2.5 mm², min. 0.2 mm² min. 250 V AC, 70 °C
USB for update (service interface)	USB connector types USB-C
Ethernet interface	100BASE-TX (100 Mbit/s) Cat5e or higher, 4×2 TP RJ45 (8P8C), T568B Max. 100 m segment Shielded recommended (F/UTP or S/FTP)

FRAKO power bus (FRAKO bus)	Line type: 1 × 2 cores, twisted, shielded (foil + braid) Characteristic impedance: 120 Ω ± 20 % Conductor cross section: 0.25…0.34 mm² (AWG 24…22) Capacity: ≤ 60 pF/m (low cap recommended) E.g. LAPP UNITRONIC® BUS LD 1×2×0.34 mm², 120 Ω Topology: Line (bus), no star/ring topology Branch lines (stubs): as short as possible, ≤ 2 m

Construction data:

Dimensions (WxH×D)	162 mm x 90 mm x 62 mm case
Mounting	35 mm DIN rail according to DIN EN 50022
Weight	approx. 0.4 kg (without packaging)
Protection class	Housing IP30 Terminals IP10 according to DIN EN 60529 Pollution degree 2 according to EN 61010-1:2011-07
Electrical Execution	Housing, protection class II according to DIN EN 61010
Housing design	Flammability class according to UL 94 V0 according to the housing manufacturer's specifications
Duration of use	At ambient temperature +25 °C 15 years
EMC	Conducted interference emissions from network connections: EN 55011:2016+A1:2017+A11:2020 Radiated interference emissions: EN 55011:2016+A1:2017+A11:2020 ESD (electrostatic discharge): EN 61000-4-2:2009 Immunity to radiated RF electromagnetic fields: EN IEC 61000-4-3:2020 Immunity test against fast electrical transients Disturbances / Burst: EN 61000-4-4:2012 Surge immunity test: EN 61000-4-5:2014+A1:2017 Interference immunity tests in the event of voltage drops, Short-term interruptions and voltage fluctuations: EN IEC 61000-4-11:2020

Environmental conditions:

Temperature range	-25 °C to +65 °C, no condensation
Installation altitude	max. 2000 m above sea level (a.s.l.)

4 Device description

4.1 Function

The PQ-IO is designed as a replacement device for the EMD 1101 and EMF 1102, combining modern technology with proven functionality.

It is equipped with two communication interfaces:

1. **FRAKO bus:** For connection to the FRAKO bus or the expansion bus of the PQMC^{PRO} or EM-MC 2200
2. **Ethernet:** For connection via Modbus-TCP / FRAKO bus over Ethernet as well as for configuration and visualization via the web UI.

This flexibility allows for easy integration into both existing ones FRAKO systems as well as in third-party systems.

The device offers 8 relay outputs for switching external loads.

Additionally, 12 pulse inputs (S0) are available that can record both meter pulses and frequency-proportional signals from analog frequency converters (e.g. temperature –40…+120 °C corresponds to 0…5 Hz, linear).

Three inputs for PT100 sensors are integrated for temperature monitoring.

An integrated web server simplifies commissioning and configuration of the PQ-IO directly in a browser. Despite its extended functionality, the device remains fully compatible with EMD and EMF.

Key settings can be configured directly on the device.

4.1.1 Expansion station for the maximum demand optimization controller EM-MC 2200 / PQMC^{PRO}

With the PQ-IO, the number of load channels managed by the EM-MC 2200 or PQMC^{PRO} maximum demand optimization controller can be increased.

Each PQ-IO provides 8 additional load channels.

Up to 10 PQ-IO devices can be connected to the expansion bus of the EM-MC 2200 or PQMC^{PRO}.

This results in a maximum total of 85 load channels.

Alternatively, the device can also be connected to an existing FRAKO bus or via Ethernet (Modbus TCP / FRAKO bus over Ethernet).

Replacing an EMD with a PQ-IO is possible at any time without additional configuration once the bus address has been set on the device.

Replacing an EMF with a PQ-IO requires transferring the existing EMF configuration. This is performed using the EMF software.

Requirement: FRAKONET version V1.64.0105 or higher.

A new configuration can also be performed via the integrated web interface. In this case, the PQ-IO must additionally be connected via Ethernet.

4.1.2 Pulse and status acquisition unit with 12 inputs according to the S0 standard

The pulse and status acquisition unit of the PQ-IO is used for counting pulses and detecting states and alarms.

The PQ-IO has 12 inputs. Any type of pulse generator can be connected to these inputs, provided it has a potential-free mechanical or electronic contact according to the S0 specification (DIN 43864).

All inputs share a common ground potential and are galvanically isolated from the supply voltage.

The detected pulses can be accumulated and converted into consumption values. For applications using forward/backward meters, difference channels can be created. Separate recording according to tariffs is possible via a dedicated tariff switching input.

The pulse and status acquisition unit provides the following functions:

- Counting of input pulses in two counters (A/B); switchable via one of the 12 inputs.
- Adjustable debounce time and trigger edge
- Conversion of pulse count values into directly readable counter readings
- Capturing and forwarding states
- Input channels can also be used as operating hours counters
- Separate determination of the operating times ON/OFF (contact times closed /open) per input channel
- Determination of the current power (impulses per time)

4.1.3 Temperature measuring unit with 3 PT100 inputs

The PQ-IO has 3 temperature inputs for PT100 temperature sensors. These are connected using the 4-wire method, which allows long cable lengths without affecting the measurement result..

- Display of the current temperatures on the web page.
- Recording of the temperature trend and display of the last 15 days in 5-minute intervals as a temperature chart on the web page.
- Resettable minimum and maximum value recording with timestamp for each temperature input.

4.2 Operation

The device is operated using the two buttons on the right side of the device.

Button function in operating mode

Button	ENTER	>> (NEXT)
Action 1	**Press for 6 seconds:** Activate configuration mode	**Press for 3 seconds:** Show current IP address
Action 2	**Press for 12 seconds:** Perform factory reset	

Button function in configuration mode

Button	ENTER	>> (NEXT)
Action	Change value	Parameter or location of the Change parameters

Using the 8 DIP switches, the state of each relay output in the event of a connection loss to the master controller can be defined.

4.2.1 Factory reset

The factory reset restores the PQ-IO to factory defaults and then restarts the device automatically. Triggering on the device:

- Switch on the PQ-IO. The factory reset can be triggered only within the first 60 seconds after power-on.
- Within this time window, press and hold the ENTER button for at least 12 seconds.
- After the reset has been triggered, the device first switches off the relay and input LED indication. The red input LEDs then run on from 1 to 12 and off again. Afterwards the PN and RN LEDs flash several times.

Effects of the factory reset:

- The PQ-IO basic configuration is restored to factory defaults; the EMD and EMF addresses are set to 0.
- The EMD configuration is restored to factory defaults.
- The EMF configuration and EMF counter data are restored to factory defaults.
- Temperature minimum and maximum values are reset.
- The temperature history is deleted.
- The internal flash backups of the configuration are updated immediately with the factory defaults so that no old configuration is restored at the next start.

After the factory reset, commission the device again. Set the required bus addresses, network settings and security parameters again.

4.2.1.1 Security and passwords after factory reset

The factory reset also restores the PQ-IO security settings to factory defaults. After the automatic restart, the following applies:

- Admin account: The Admin account is enabled. The user name is Admin. The password is reset to the delivery password admin_XXXXXX. XXXXXX is the six-digit serial number of the PQ-IO. After the first login, a new Admin password must be assigned.
- User account: The User account is disabled. A previously assigned User password is deleted and is no longer valid. If a separate User account is required, it must be configured again after commissioning.
- Write access via web page or REST API: Web/REST write access is enabled again. Write functions are therefore generally available if the user is logged in, has the required permission and the corresponding service is enabled.
- Services: Modbus TCP read/write, FRAKO bus via Ethernet read/write, Device Discovery and FRAKO bus via RS485 read/write are enabled again.
- Whitelist: For Modbus TCP, FRAKO bus via Ethernet and Device Discovery, the entry * is set. This initially allows all IP addresses. Required restrictions must be entered again after the factory reset.
- TLS certificate: The security storage is rebuilt. A previously imported TLS certificate, including private key and certificate chain, is no longer available afterwards. The PQ-IO generates or activates a self-signed device certificate for the HTTPS connection again.

After a factory reset, the device must be commissioned again. This includes at least network settings, bus addresses, security permissions, whitelist entries, user accounts and any required company certificate.

5 Installation

The PQ-IO is installed in two steps:

- Assembly at the operating site (see Section 5.1).
- Electrical connection (see Section 5.1.3).

5.1 Assembly at the operating site

5.1.1 Prepare assembly

1. Check the scope of delivery for completeness (see Section 5.1.2)
2. Check the device for external damage.
   If the device is damaged, it must not be used for your own safety be taken.
   In case of doubt, contact the FRAKO service department contact.
3. Check whether the location of the PQ-IO is suitable (see Section 5.1.3).

5.1.2 Scope of delivery

The scope of delivery of the PQ-IO includes:

- PQ-IO
- Connector plug set (supplied separately)
- Operating instructions or information sheet with download link

5.1.3 Installation conditions

The following conditions must be observed at the installation site of the PQ-IO (see also Section 2 “Safety Instructions” and Section 3 “Technical Data”):

- Install the device only in areas where there is no risk of gas or dust explosions.
- Do not expose the PQ-IO to direct sunlight or high temperatures.
- Do not install the PQ-IO near heat-generating devices.
- The PQ-IO must be installed in a sufficiently ventilated area.The rear and side surfaces must not be covered.
- Do not expose the PQ-IO to rain, water, moisture, or high humidity.
  Direct contact with water must be avoided in all cases.
- Protect the PQ-IO from shocks and impacts.

5.1.4 Carry out assembly

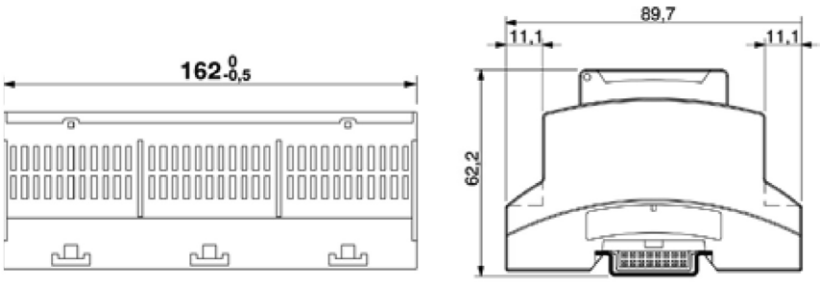


Figure 1

The PQ-IO is intended for permanent installation in control cabinets or enclosures (see Section 5.1.3 Installation conditions).

The PQ-IO has a standard housing for mounting on a 35 mm DIN rail (TS 35 according to EN 50022). The required rail length is 161.6 mm. The installation position is arbitrary.

The device is installed by snapping it onto a DIN rail (figure shown as an example).

1. Using a screwdriver, pull all orange retaining clips out of the bottom of the housing until they lock into place.
2. Place the device onto the DIN rail.
3. Press the orange retaining clips back into the housing until they are flush with the front of the housing base.
   They will audibly click into place.

5.2 Electrical Installation

5.2.1 Performing the electrical installation

Carry out the electrical connection according to the wiring diagram in Section 5.2.3.2. Connect the supply voltage using an external disconnecting device and fuse.

5.2.2 Conditions for the electrical connection

Approved cables or stranded conductors with sufficient cross-section and adequate voltage rating must be used for wiring.

- When using stranded conductors, wire ferrules with a sleeve length of 6 mm must be used.

- Suitable measures must be taken to provide strain relief for the wires and cables connected to the PQ-IO.
- The supplied connection plugs must be installed even if they are not used.

5.2.3 Supply voltage

For proper operation, the supply voltage should be between 185 V AC and 253 V AC.

5.2.3.1 External disconnecting device

An external disconnecting device, such as a switch or circuit breaker, must be provided in the supply line.This device should be located near the PQ-IO.

The disconnecting device must disconnect the conductors connected to the PQ-IO power supply terminals.

5.2.3.2 Wiring diagram

The supply line must be protected externally with a 2 A slow-blow fuse, 250 V AC. Loads with a current consumption greater than 3 A must be switched via contactors.

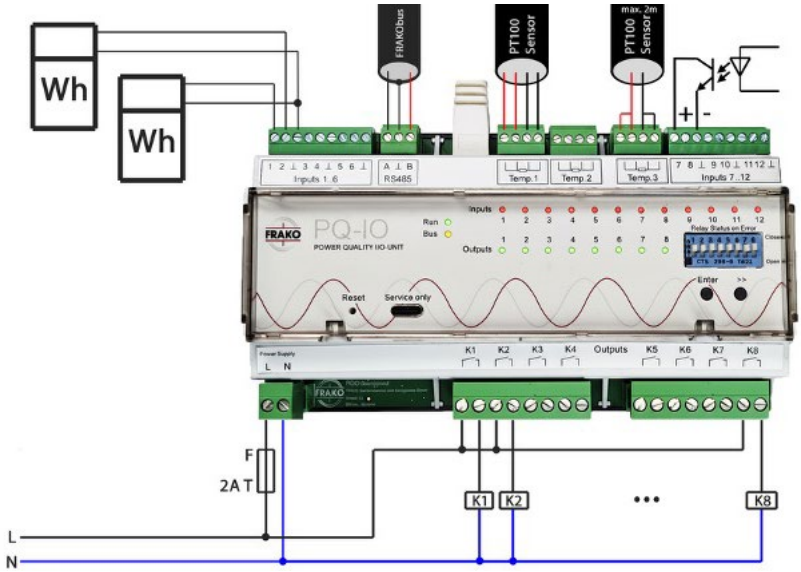


Figure 2

5.2.3.3 Connection “Input 1..6” and “Input 7..12”

A pulse generator must always be connected between “Inputs 1..6” or “Inputs 7..12” and a ⊥-terminal. All six ⊥-terminals share the same potential.

For a polarized pulse generator, such as an open-collector output, connect the positive output to terminals 1..12 and the negative output to one of the ⊥-terminals.

The line resistance between the pulse generator and the PQ-IO input must not exceed 800 Ω.

Inputs of the same or other PQ-IO devices may be connected in parallel.

Caution!
Risk of property damage.

The inputs must not be connected to an external voltage.

The inputs must not be connected in parallel with inputs of devices of a different type.

5.2.3.4 Connection “Outputs”

When switching larger loads, such as loads that are switched on and off by the PQMC^{PRO} or EM-MC 2200 for load optimization, these should be switched via power contactors.

Ideally, all power contactors should be controlled via the same control circuit.

Alternatively, different control circuits may be connected, as all 8 relay outputs are potential-free.

WARNING!
Hazard due to electric voltage.

Before performing work on the PQ-IO, both the supply voltage and all connected control circuits must be disconnected from the power supply.

5.2.3.5 Connection “Temperature inputs”

The PQ-IO provides three temperature inputs for PT100 temperature sensors with a 4-wire connection.

To avoid measurement errors caused by line resistance, particularly with longer cable lengths, PT100 sensors with a 4-wire connection should generally be used.

For cable lengths below 2 m, a 2-wire connection may alternatively be used.

Figure 3

In this case, the two left-hand terminals on the connector must be connected and the two right-hand terminals must be bridged together.

5.2.3.6 “RS485” connection

The connection plug marked “**RS485**” represents the FRAKO bus connection.

termination of the PQ-IO.

This can be connected to the expansion bus or FRAKO bus of a PQMC^{PRO} as well an EM-MC 2200 can be connected.

It is important to ensure that the bus structure (line topology) is correct. Spur lines are only permitted up to a maximum length of 2 m.

If the PQ-IO is the last device on the bus, a 120 Ω termination resistor must be connected between the bus lines A and B.

6 Commissioning

6.1 Commissioning the PQ-IO

Before switching on the operating voltage, make sure the electrical connection is correct. Check execution.

After switching on the PQ-IO, both the 12 input LEDs and the 8 output LEDs light up for approx. 3 seconds. After 10 seconds, all relays switch to the fault state preset by the 8 DIP switches. The green RUN LED should now be flashing. The BUS LED remains off, as no bus address has been programmed yet.

When commissioning, the bus addresses should be checked first and if Ethernet is used the IP address will be set.

6.1.1 Setting the bus adresses and DHCP directly on the device:

The user interface on the PQ-IO allows the following parameters to be adjusted:

- EMD_BusAddr - bus address of the EMD device. When operating on the expansion bus, observe Section 6.1.1.1 Setting the EMD bus address when operating on the expansion bus of an EM-MC 2200 or PQMC^{PRO}.
- EMF_BusAddr - bus address of the EMF device.
- DHCP_active - DHCP activation (on/off).
- Write Web/REST - writing via web page or REST API permitted (on/off).

Activate user interface mode (UI mode)

- Press and hold the **Enter button** for **5 seconds**.
- All **green output LEDs light up** to indicate UI mode.
- The first **output LED starts flashing**, indicating that the **hundreds digit of the EMD_BusAddr** is selected.

Select parameter

- Press the >> button to switch between parameters. After the last parameter, the system returns to the first parameter. This allows you to review and, if necessary, correct your settings at any time.
- The **flashing green output LED** indicates the current parameter:
  - **Output-LED 1:** Hundreds digit of **EMD_BusAddr** (0–1)
  - **Output-LED 2:** Tens digit of **EMD_BusAddr** (0–9)
  - **Output-LED 3:** Units digit of **EMD_BusAddr** (0–9)

  - **Output-LED 4:** Hundreds digit of **EMF_BusAddr** (0–1)
  - **Output-LED 5:** Tens digit of **EMF_BusAddr** (0–9)
  - **Output-LED 6:** Units digit of **EMF_BusAddr** (0–9)
  - **Output-LED 7: DHCP_active** (10 = off, 1 = on)
  - **Output-LED 8: REST/Web write access** (10 = off, 1 = on)
- The **input LEDs** display the current value of the selected digit.

Change value

- Press the **Enter button briefly (< 1 second)** to change the value of the selected parameter.
- The red **input LEDs** display the new value directly:
  - **Values 1–9: The corresponding input LED lights up.**
  - **Value 0: Input LED 10 lights up.**

Exit mode and verify values

- Press and hold the **Enter button again for 5 seconds**.
- The system then checks the validity of the values.
  - **Successful check:** All green output LEDs **flash three times** and the mode is exited.
  - **Failed check:** If an address is outside the range **(9–125)** or if **both bus addresses are identical**, the red **input LEDs flash three times** and the mode remains active. Adjust the value accordingly.

Automatic exit due to inactivity

- If **no input is made for 5 minutes**, the system automatically exits the mode.
- **Unsaved values will be lost.**

Return to normal operation

After successfully exiting user interface mode:

- **Input LEDs** display the current input states.
- **Output LEDs** indicate the output states.

Example:

In this example, the EMD bus address 17 is set:

Hundreds digit	=	0
Tens digit	=	1
Units digit	=	7

After activating UI mode, the first green output LED flashes.

The hundreds digit of the EMD address is selected.
The input LED shows 10, which corresponds to 0.
No change is required here.

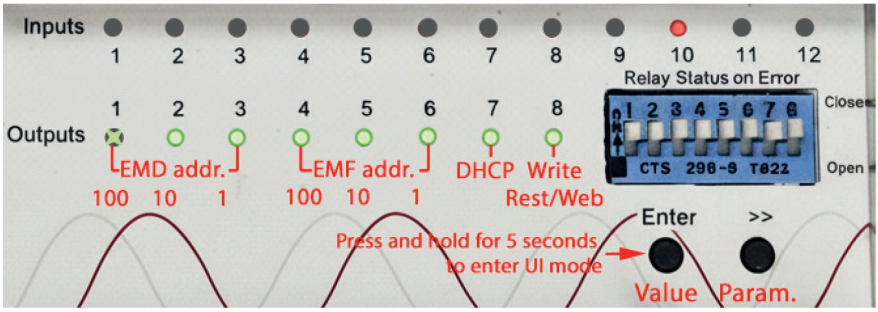


Figure 4

Press the >> key to switch to the 10th digit of the EMD address.
Press the ENTER button until the red input LED 1 lights up.

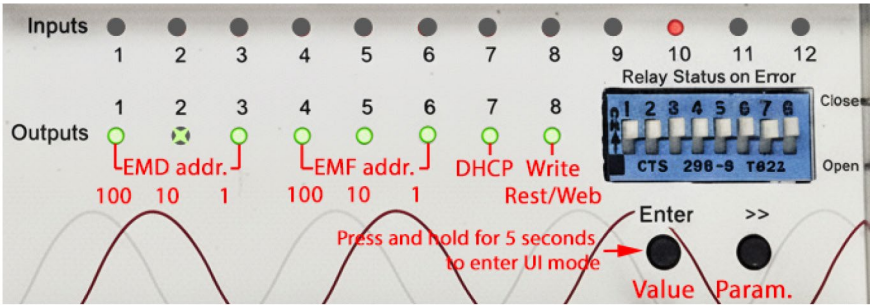


Figure 5

Press the >> key to switch to the 1st digit of the EMD address.
Press the ENTER key until the red input LED 7 lights up.

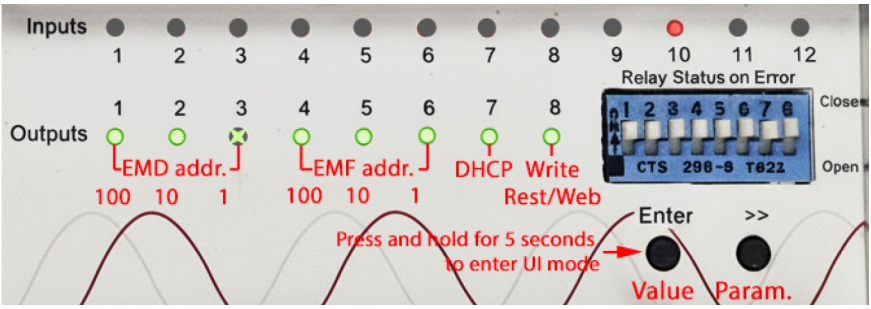


Figure 6

The EMF address, DHCP and REST/Web write access are set in the same way. You can exit UI mode at any time by pressing ENTER for 5 seconds.

6.1.1.1 Setting the EMD bus address when operating on Expansion bus of an EM-MC 2200 or PQMC^{PRO}

When operating on the expansion bus, select the bus address 1 to 10 in the Device Manager or on the PQMC^{PRO} web interface.

This does not correspond to the EMD bus address configured on the PQ-IO. Set the EMD bus address on the PQ-IO according to the following table.

Ensure that the bus address is not already used by another device on the same bus.

In Device Manager/ PQMC^{PRO} website set Bus address	1	2	3	4	5	6	7	8	9	10
To be set on the PQ-IO	17	18	19	20	21	22	23	24	25	16

6.1.1.2 Setting the IP address when connected via Ethernet

If you use the Ethernet interface additionally or exclusively for communication with the PQ-IO, the device requires an IP address. By default, DHCP is enabled, so the PQ-IO automatically receives an IP address after being powered on.
You can query the assigned IP address directly on the device.

6.1.1.2.1 Querying the current IP address on the device

- Press and hold the “>>” button for approximately 3 seconds, then release it. The IP display mode starts.
- The hundreds digit of the first IP byte appears on the red input LEDs.

- Press “>>” briefly → tens digit of the first byte.
- Press “>>” again → units digit of the first byte.
- Press “>>” again → switch to the second IP byte (hundreds digit), followed by the tens and units digits.
- Repeat the procedure for the third and fourth bytes.

The three left green LEDs indicate which digit (hundreds / tens / units) is currently displayed. The four right LEDs visualize the current byte.
After the last digit has been displayed, the system automatically returns to normal operating mode. If no button is pressed for 30 seconds, the device also returns automatically to normal operating mode.

6.1.1.2.2 Current IP address via PQDiscovery tool query

Alternatively, the IP address of the PQ-IO can also be determined using the tool **FRAKO PQ Device Discovery** included in the FRAKONET installation. After clicking the **“Scan”** button, the tool displays all FRAKO devices in the local network that support this function. You can find the tool in the FRAKONET folder under:..**\tools\Device_discovery\PQDiscovery_gui.exe**.

- Start the tool.
- select the correct network under Bind Address.
- Click **“Scan/Stop”**

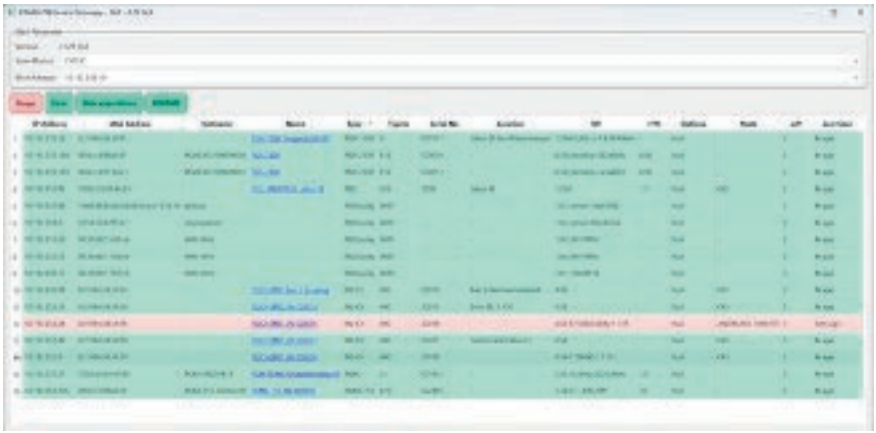


Figure 7

You can identify the correct PQ-IO by the type in the “Type” column and the serial number in the “Serial No.” column. To open the PQ-IO web page, click the link in the “Name” column.

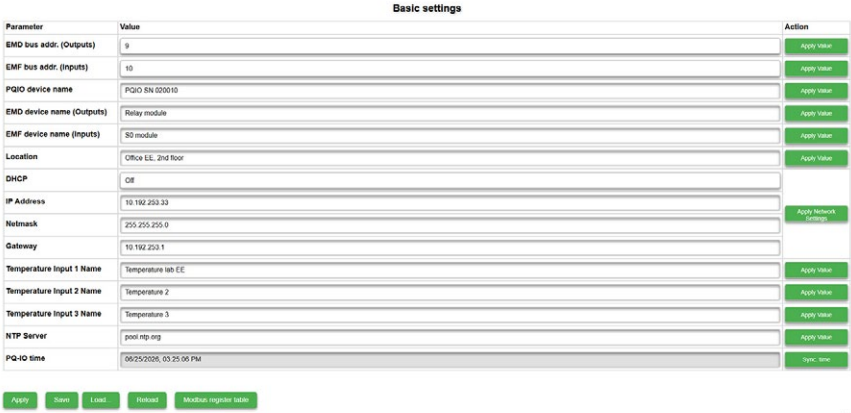


Figure 8

On the **“Basic Settings”** page, you can configure, among other parameters, both the IP address and the FRAKO bus addresses. Note that the IP address only becomes effective after DHCP has been disabled.

Before applying the network settings with DHCP disabled, verify that the IP address and subnet mask are correct and ensure that the PQ-IO can be reached at the new address after applying the settings.

6.1.2 Setting the fault states

Using the 8 DIP switches on the PQ-IO, you can define the fault state for each channel. Depending on the configured inversion, the fault state does not necessarily correspond to the relay state, but rather to the machine state.

In the **“Closed”** position, the connected load is switched on in the fault state.

In the **“Open”** position, the connected load is switched off in the fault state.

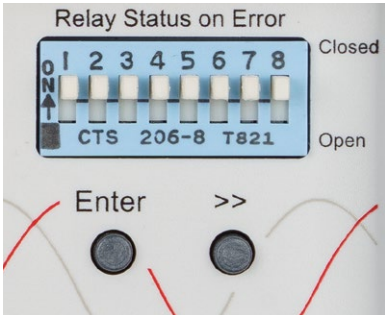


Figure 9

The fault state is activated:

- if no switching commands are received from the master device (EM-MC 2200, PQMC^{PRO}) for longer than the configured timeout period (factory setting: 10 seconds).
- if the PQ-IO supply voltage fails and the option **“Activate fault state”** is selected for the respective channel on the web page under **“Behavior on power failure”**.

Please note:

Activation of the fault state during a power failure only works reliably if the supply voltage is greater than 185 V AC. At lower supply voltages, the remaining energy is no longer sufficient to reliably switch the bistable relays into the fault state.

6.1.3 Advanced configuration of the PQ-IO via the web page

The parameters **“Timeout”**, **“channel inversion”** and **“Behavior on power failure”** can only be changed via the device web interface. For this purpose, the device must be connected to the PC via Ethernet. If the PQ-IO is not connected to the company network, configuration must be carried out locally using a laptop.

6.1.3.1 Login and changing the password

The web interface uses user login. The login page shows the device information and allows login as Admin or User.

As delivered, the user name is Admin. The delivery password is admin_XXXXXX; XXXXXX is the six-digit serial number of the PQ-IO, for example admin_020010.

The login is sent to the device authentication function with user name and password. If a password change is required for the logged-in session, the web interface opens the password change page directly.

A new password must contain at least 12 characters and must be entered twice for confirmation. Write access through the web interface is executed only with a valid login and matching session identifier.

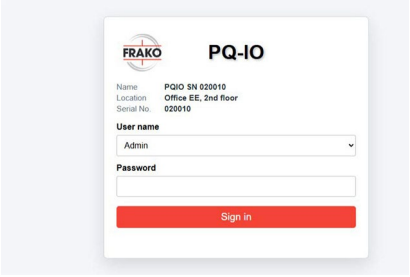


Figure 10

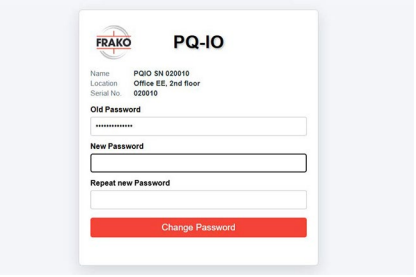


Figure 11

6.1.3.2 User management

User management is located in the Security Settings. This page is intended for the administrator.

The Admin password is changed by entering the current password, the new password and the repeated new password.

The User account can be enabled or disabled. A separate password is stored for User. Buttons for changes are disabled when web write access is not enabled.

Download PQIO log downloads the device log as a text file for diagnostics.

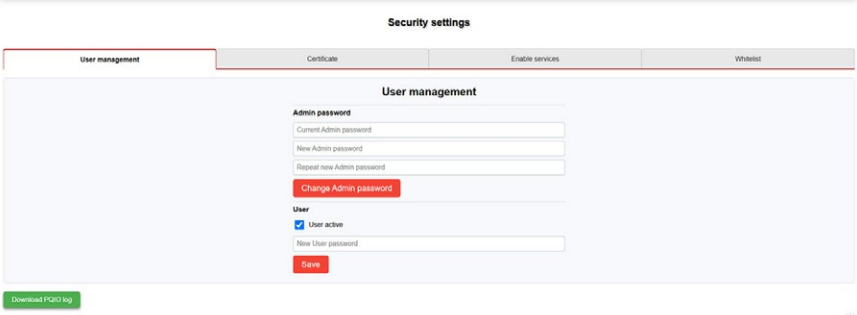


Figure 12

6.1.3.3 Configuration with a laptop on site

If the device will later be used without Ethernet, the configuration can be performed temporarily with a laptop on site.

Proceed as follows:

- Disable DHCP on the device (see Section 6.1.1 “Setting the bus addresses and DHCP directly on the device”). The device will then use the default IP address 192.168.0.63.
- Connect the PC to the PQ-IO using an Ethernet cable. Alternatively, the connection can also be established via a switch.
- If necessary, disable Wi-Fi to ensure that the Ethernet connection is used.
- In Windows 11, open the system settings: Start → Settings → Network & Internet → Advanced network settings → More network adapter options.
- Right-click the network adapter in use (Ethernet) and select “Properties”,
- Double-click “Internet Protocol Version 4 (TCP/IPv4)”,
- Select “Use the following IP address” and enter the following values:
  - IP address: 192.168.0.10
  - Subnet mask: 255.255.255.0
  - Default gateway: leave empty
  - Preferred DNS server: leave empty or enter 8.8.8.8
- Confirm with “OK” and close all windows. If necessary, briefly disable and re-enable the network adapter so that the settings take effect.
  Example:
  PC → 192.168.0.10/24 → PQ-IO → 192.168.0.63/24
- Open the Command Prompt (press the Windows key, type cmd, press Enter).
- Enter the following command:ping 192.168.0.63
- If four replies with a response time in milliseconds are displayed, the connection is successful. If you receive the message “Request timed out”, check:
  - whether the Ethernet cable is properly connected,
  - whether the IP address of the PC is in the same network (192.168.0.xxx),
  - whether the PQ-IO is powered on.
- Then open a web browser (e.g. Microsoft Edge or Google Chrome).
- Enter the following address in the address bar: http://192.168.0.63
- Press Enter. The PQ-IO start page will be displayed.

6.1.3.4 Configuration of the PQ-IO settings

On the **“Basic Settings”** page, configure the settings that apply generally to the PQ-IO.

Figure 13

EMD bus address (outputs)

Enter the FRAKO bus address used to control the relay outputs here. When operating the PQ-IO on the expansion bus of the EM-MC 2200 or PQMC^{PRO}, the bus address must be set according to the following table.

In Device Manager/ PQMC^{PRO} website set Bus address	1	2	3	4	5	6	7	8	9	10
To be set on the PQ-IO	17	18	19	20	21	22	23	24	25	16

When operating the PQ-IO on the FRAKO bus, a free bus address between 9 and 125 can be selected. The bus address 0 is the factory default. Devices with bus address 0 are not detected on the bus. If you do not require the EMD functionality, set the bus address to 0.

EMF bus address (inputs)

Here you configure the FRAKO bus address for acquiring the 12 S0 inputs.

When operating the PQ-IO on the FRAKO bus, a free bus address between 9 and 125 can be selected.The bus address 0 is the factory default. Devices with bus address 0 are not detected on the bus. If you do not require the EMF functionality, set the bus address to 0.

Please note:

If both functions, EMD and EMF, are required, two different bus addresses must be assigned.

PQ-IO device name

The PQ-IO device name is the unique identifier of the respective PQ-IO. It is displayed as the device name in the PQ-Display and in the "PQ Device Discovery" tool.

The device name is also relevant when the PQ-IO is added as a bus coupler in the FRAKONET configuration software **“SYSTEM-SW.”**

In this case, the device name corresponds to the designation of the bus coupler in the system.

EMD device name (outputs)

Here you can assign a name of up to 40 characters to the output device (8 relay outputs).

EMF device name (inputs)

Here you can assign a name of up to 40 characters to the input device (12 S0 inputs).

Location

Enter the location where the PQ-IO is installed. The location is displayed when searching for FRAKO devices in the network using the **PQ Device Discovery** tool.

DHCP

If DHCP is set to **ON**, the PQ-IO automatically receives its network settings from the DHCP server. The network settings below are ignored.

If DHCP is set to **OFF**, the network settings below become active. Before saving the settings, ensure that the IP address of the PC and the new IP address of the PQ-IO are in the same network according to the subnet mask, otherwise the device may no longer be reachable after saving. If the network configuration is correct, the web page will be reloaded under the new IP address after a short delay once the IP address has been changed.

IP address, netmask, gateway

Enter the static IP address, the subnet mask, and the gateway address in these fields. These settings are only used when DHCP is set to OFF. Before the static network settings are applied, a check is performed to determine whether the PQ-IO will still be reachable afterwards. If this is not the case, a warning message will appear, which you can choose to ignore. When configuring the device on site using a laptop with a direct connection, this warning must always be ignored.

Name temperature input 1...3

Enter here what is measured by each of the three temperature sensors.

NTP-Server

Enter the IP address of a local time server in the company network or a public time server, e.g. **pool.ntp.org.**

PQ-IO time

The current time of the PQ-IO is displayed here. You can synchronize the time with the PC time using the "**Synchronize time**" button. The time is required for recording temperature values and for capturing the minimum and maximum temperature values.

Button bar

Click **"Apply"** to write the basic settings to the PQ-IO. The changes only take effect after this action.

Click **"Save to file"** to store the relay output settings in a file in the Downloads folder. The file name consists of "PQ-IO_Config_" + device name.

Click **"Load from file…"** to open a dialog for selecting a configuration file. Only load files with the prefix "PQ-IO_Config_". Files in other formats are not accepted.

The parameters from the configuration file are initially only entered into the fields on the web page. They become active only after clicking **"Apply".**

Click **"Reload"** to read the settings again from the device.

All changes made on the page so far will be overwritten.

Click **"Modbus Register Table"** to display the **Modbus address table** of the PQ-IO in a browser window.

6.1.3.5 Configuration of the relay outputs

On the Relay Output Settings page, you can configure the settings for each output channel.

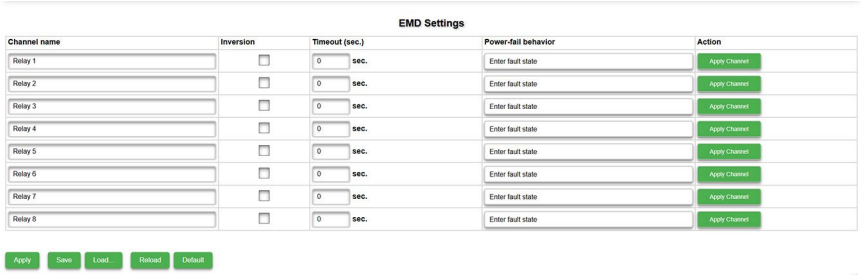


Figure 14

Channel name

You can assign a channel name of up to 27 characters for each channel. The channel name is used by the FRAKONET configuration software SYSTEM-SW when adding a status or alarm channel.

Inversion

The relay state of a channel can be reversed by selecting the **“Inversion”** checkbox. The inversion does not affect the LED display on the PQ-IO. The LEDs always indicate the state of the connected load, regardless of the inversion.

Inversion is used, for example, when a machine has a control input that is enabled by opening the contact.

Timeout

In the **“Timeout (sec.)”** column, you define the maximum time allowed between two write commands to this channel. If no new write command is received within this time, the PQ-IO switches the channel to the state defined by the corresponding DIP switch.

To prevent switching to the fault state in case of a connection loss, set this value to “0”.

Behavior in Case of Power Failure

- **Activate fault state:**
  In the event of a power supply failure, the channel switches to the fault state defined by the DIP switch.
- **Maintain condition:**
  In the event of a power supply failure, the last state is retained.

Button bar

By clicking the **“Apply”** button, the settings of all 8 channels are written to the PQ-IO. Only then do the changes take effect. Alternatively, by clicking the **“Apply Channel”** button, only the modified channel is written to the PQ-IO.

By clicking the **“Save to file”** button, the settings for the relay outputs are saved to a file in the download folder. The file name consists of “PQ-IO_EMD_Config_” plus the device name.

By clicking the **“Load from file”** button, a file selection dialog opens to choose a configuration file. Only load files with the prefix “PQIO_EMD_Config_”. Files with a different format will not be accepted. The parameters from the configuration file are initially only loaded into the fields on the web page. They become active only after clicking the **“Apply”** button.

By clicking the **“Read again”** button, the settings are reloaded from the device. Any changes made on the page will be overwritten.

By clicking the **“Default settings”** button, the factory settings are loaded. These parameters are initially only displayed in the fields on the web page and become active only after clicking the **“Apply”** button.

6.1.3.6 Configuration of S0 Inputs

The settings for the S0 inputs can be configured either in the EMF device software (included in the FRAKONET installation from version V1.64.0105 onward) or via the PQ-IO web interface.

If you want to replace an existing EMF 1101 or EMF 1102, it is recommended to configure the S0 inputs of the PQ-IO using the EMF device software, as this allows the existing configuration to be transferred to the PQ-IO.

On the **“Settings S0 inputs”** page you can set for each input channel make individual settings.

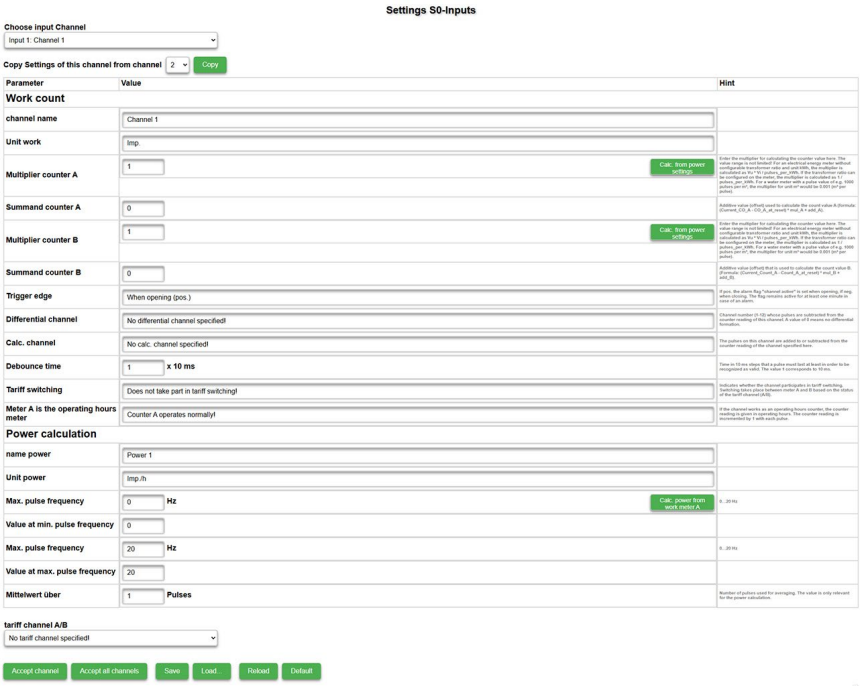


Figure 15

Select channel

Here you select one of the 12 input channels for configuration. All parameters of the selected channel are displayed in the input form below.

Copy settings of this channel from channel X

If multiple channels are to be configured identically, only one channel needs to be fully configured. This channel can then be used as a reference to automatically populate the current input form with the settings of channel X. Afterwards, only the channel names need to be adjusted.

Channel name

A name with a maximum of 40 characters can be assigned to each channel, e.g. “Active energy transformer 1, secondary”. This name is read from the PQ-IO during the configuration of the data logger (PQM).

Energy Unit

If pulses from an energy meter are to be recorded via this channel, specify here the unit into which the pulses are to be converted or displayed. A corresponding multiplier must also be defined.

Multiplier Counter A

Enter here the value of one pulse in the unit specified under **“Energy Unit”**. Each pulse is multiplied by this value and added to the calculated counter A.

Offset Counter A

The offset for counter A is a value that is always added to the calculated counter A. It can be used to align the counter reading in the PQ-IO with the display of the energy meter.

Multiplier Counter B

Enter here the value of one pulse in the unit specified under **“Energy Unit”**. Each pulse is multiplied by this value and added to the calculated counter B.

Offset Counter B

The offset for counter B is a value that is always added to the calculated counter B. It can be used to align the counter reading in the PQ-IO with the display of the energy meter.

Trigger Edge

The trigger edge defines whether counting is triggered when the contact at the input closes or opens.

If the channel is used for status monitoring, the trigger edge determines when the “Channel active” alarm flag is set:

- pos. edge: Alarm flag is set when the contact opens
- neg. edge: Alarm flag is set when the contact closes

In the event of an alarm, the alarm flag remains active for at least one minute.

The “Channel active” flag is a monitoring flag used in the alarm management of the FRAKONET configuration software SYSTEM-SW to capture short alarm pulses that would not be detected by standard status flags due to the relatively long polling interval of the PQM.

The disadvantage of this method is that even a short pulse, e.g. b. 100 ms, causes the associated alarm flag to remain active for a full minute

What is affected by the Trigger Slope setting?

Measurements readings	Influenced by trigger edge?
switching state	No, always shows the pure hardware level
Channel active	Yes, determines which level is considered “active”
Pulse counting	Yes, determines which edge increments the counter
Operating hours (ON/OFF time)	No, based on hardware level

Difference Channel

Each channel can optionally be assigned a difference channel. Every pulse received on the difference channel is subtracted from the absolute counter value of this channel.

Balancing Channel

The pulses of this channel are added to or subtracted from the counter value of the assigned balancing channel.

Debounce Time

The debounce function of the PQ-IO prevents multiple pulses from being recorded due to contact bounce of a mechanical input. This means that all edge changes occurring within the configured debounce time are ignored.

Tariff Switching

Defines whether the channel participates in tariff switching. If tariff switching is enabled, counting is no longer performed simultaneously on counters A and B, but instead depends on the tariff input:

- **Tariff input open:** Counting on **counter A**
- **Tariff input closed:** Counting on **counter B**

Counter A as Operating Hours Counter

Here, counter A can be used as an operating hours counter. In this case, counter A is incremented by 1 every second as long as the contact at the input is closed. To display the time in hours instead of seconds, set the **multiplier for counter A** to 1/3600 = 0.00027778.

Power Name

The power name is used in the FRAKONET configuration software SYSTEM-SW. It is automatically read from the PQ-IO within the channel module. The channel can then be selected under this name as the basis for calculated power.

Unit of Power Value

Here you define the unit of the calculated power value. This unit is used both on the web interface and in the channel module of the FRAKONET configuration software **SYSTEM-SW.**

The calculation parameters below must be selected so that the power value is calculated in the unit specified here.

Button “Adopt from Energy Meter”

If the channel input is connected to a consumption meter (e.g. active energy meter, water meter, pulse counter), you can click this button to automatically populate the four fields below so that the correct power value is displayed.

Minimum Frequency

Minimum frequency of the pulse generator. This value can be found in the operating manual of the pulse generator.

The minimum pulse frequency is 0 Hz.

Value at Minimum Frequency

Measured value at the minimum pulse frequency of the pulse generator. This value can be found in the operating manual of the pulse generator.

Maximum Frequency

Maximum frequency of the pulse generator. This value can be found in the operating manual of the pulse generator.

The maximum pulse frequency is 20 Hz.

Value at Maximum Frequency

Measured value at the maximum pulse frequency of the pulse generator. This value can be found in the operating manual of the pulse generator.

Averaging Over

To smooth the calculated power value, you can specify over how many pulses a new power value should be calculated. The value must be between 1 and 255.

6.1.4 Service interface

The PQ-IO features a service interface in the form of a USB-C connector, which can be used, among other things, to perform firmware updates and to access the SD card in order to update the website.

Notice

The use of the USB interface is a trained FRAKO service.
Reserved for staff.

For further information about firmware updates, please contact
FRAKO Service on +49 7641 453 544 or by email to service@frako.de.

7 Operation

The following points must be observed when operating the device:

- Always operate the device in a closed control cabinet.
- All applied voltages must never exceed the limit values specified in the technical data.
- The ambient temperature must always be within the range specified in the technical data.
- Different electrical circuits may be connected to the device's relay contacts. Therefore, when working on the device, always ensure that all relay contacts are de-energized.

7.1 Display

During operation, the PQ-IO indicates the status of the inputs (red LEDs) and outputs (green LEDs).

Figure 16

Under normal operation, the green Run LED should flash approximately every 1–2 seconds.

The yellow Bus LED briefly flashes to indicate each read or write access via RS485 or Ethernet (Modbus TCP).

If the yellow LED does not flash cyclically during operation on the FRAKO bus or the expansion bus, either a bus problem is present or the bus address of the master device does not match the bus address configured in the PQ-IO.

7.2 Inputs

The red input LEDs always indicate the status of the inputs. The LED of a channel lights up when the input of the channel is pulled to ground, i.e. when the contact at the input is closed.

7.3 Outputs

The green output LEDs always indicate the machine status. This means that the LED of a channel lights up when the connected load is switched on. Any internal inversion is not taken into account.

Example:

A cooling unit is activated via a control input. An internal logic prevents the compressor from restarting too early. If the PQ-IO contact requests operation when opening, the inversion must be activated for this channel. The illuminated LED on the PQ-IO indicates that the cooling unit may be switched on.

7.4 Display on the website

7.4.1 Display of relay states

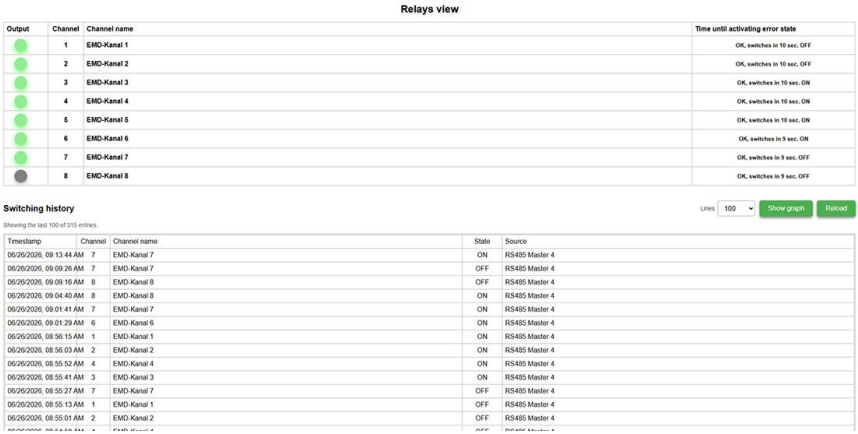


Figure 17

The **“Output”** column displays the current machine status, i.e. the actual state of the load. If no channel inversion is activated, this corresponds to the state of the relay in the PQ-IO.

The **“Channel”** column indicates the number of the output.

The **“Channel name”** column displays the channel name. It can be changed on the **“Relay Outputs Settings”** page.

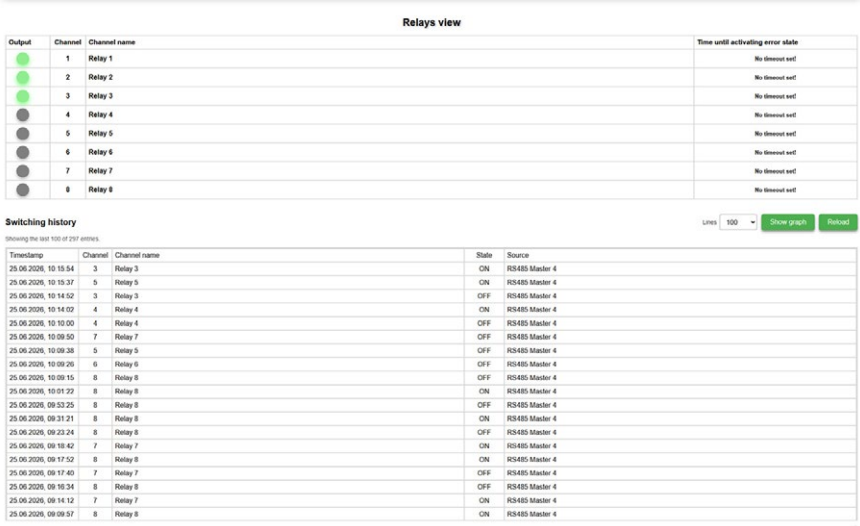
The **“Time until fault state activation”** column shows the remaining time until the fault state is activated if no further write access occurs. If the fault state is active, the time elapsed since the activation of the fault state is displayed.

7.4.1.1 Relay switching history

The relay view contains a switching history. The web interface reads the entries from the device relay log function and displays them as a table or as a graph.

The table shows timestamp, channel, channel name, state and source. The number of displayed rows can be set to 20, 100 or 500. Read again reloads the switching history. Show graph opens the graphical relay switching history.

The firmware log is stored at /fs/EMD/EMD_SWITCH.LOG and is rotated when its size exceeds 1 MiB. For changed relay states the firmware writes timestamp, channel and the state ON or OFF.



Relays view

Output	Channel	Channel name	Time until activating error state
	1	Relay 1	No timeout set!
	2	Relay 2	No timeout set!
	3	Relay 3	No timeout set!
	4	Relay 4	No timeout set!
	5	Relay 5	No timeout set!
	6	Relay 6	No timeout set!
	7	Relay 7	No timeout set!
	8	Relay 8	No timeout set!

Switching history

Lines 100 Show graph Reload

Showing the last 100 of 297 entries.

Timestamp	Channel	Channel name	State	Source
25.06.2026, 10:15:54	3	Relay 3	ON	RS485 Master 4
25.06.2026, 10:15:37	5	Relay 5	ON	RS485 Master 4
25.06.2026, 10:14:52	3	Relay 3	OFF	RS485 Master 4
25.06.2026, 10:14:02	4	Relay 4	ON	RS485 Master 4
25.06.2026, 10:10:00	4	Relay 4	OFF	RS485 Master 4
25.06.2026, 10:09:50	7	Relay 7	OFF	RS485 Master 4
25.06.2026, 10:09:38	5	Relay 5	OFF	RS485 Master 4
25.06.2026, 10:09:26	6	Relay 6	OFF	RS485 Master 4
25.06.2026, 10:09:15	8	Relay 8	OFF	RS485 Master 4
25.06.2026, 10:01:22	8	Relay 8	ON	RS485 Master 4
25.06.2026, 09:53:25	8	Relay 8	OFF	RS485 Master 4
25.06.2026, 09:31:21	8	Relay 8	ON	RS485 Master 4
25.06.2026, 09:23:24	8	Relay 8	OFF	RS485 Master 4
25.06.2026, 09:18:42	7	Relay 7	ON	RS485 Master 4
25.06.2026, 09:17:52	8	Relay 8	ON	RS485 Master 4
25.06.2026, 09:17:40	7	Relay 7	OFF	RS485 Master 4
25.06.2026, 09:16:34	8	Relay 8	OFF	RS485 Master 4
25.06.2026, 09:14:12	7	Relay 7	ON	RS485 Master 4
25.06.2026, 09:09:57	8	Relay 8	ON	RS485 Master 4

Figure 18

7.4.1.2 Graphical relay switching history

The graphical relay switching history displays the recorded switching states over time. The time range and the number of displayed entries can be selected in the view.

Figure 19

7.4.2 Display of the S0 inputs

The S0 view shows state, counter reading, power and ON operating time of the S0 inputs. The Graph column defines whether and how a channel is displayed in the S0 history.

Input shows the current input state. Channel and Channel name identify the input. Graph provides the modes None, States, Power and Counter reading. Calc. Counter A since Reset, Power and Operating time ON show the calculated values of the channel. Reset Counter and Reset Time reset the respective resettable values of the selected channel.

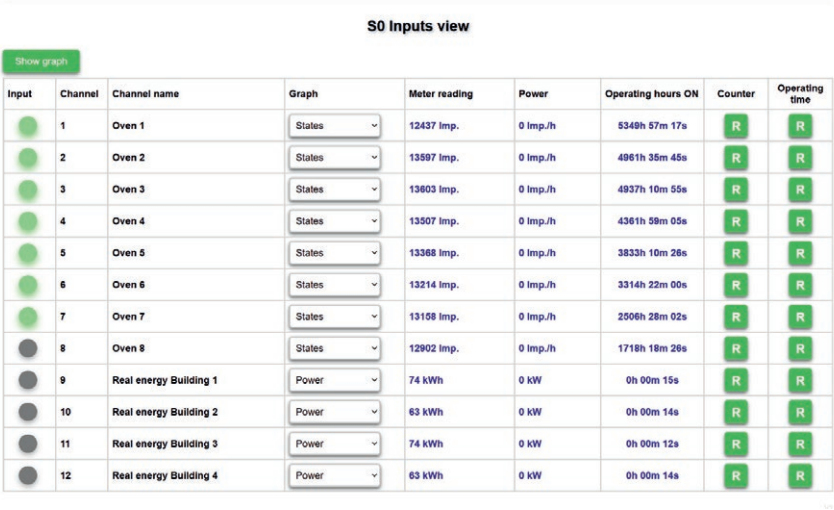


Figure 20

This page displays the status and measured values of the 12 inputs.

The LED in the **“Input”** column lights up when the corresponding input is connected to ground.

The **“Channel”** column displays the number of the input.

In the **“Channel name”** column, you can see the channel name that was entered under **“Channel name”** on the **“S0 Input Settings”** page.

The **“Calc. Counter A since Reset”** column displays the value of calculated counter A since the last reset.

The **“Operating time ON”** column shows the time since the last reset during which the corresponding input was connected to ground.

In the **“Reset Counter”** column, the **Calc. Counter A since Reset** and **Calc. Counter B since Reset** can be reset by clicking the **“R” button**.

In the **“Reset Time”** column, the two operating hour counters **“Operating hours ON”** and **“Operating hours OFF”** can be reset by clicking the **“R” button**.

7.4.2.1 S0 history

The S0 history is opened with Show graph. It uses only the measured values recorded in the web interface and displays the channels according to the selection in the Graph column.

Please note: Since the PQ-IO has no measured-value memory, only the measured values since the web page was opened are recorded.

Channels with Graph mode None are not displayed. States shows the input state over time. Power shows the calculated power value. Counter reading shows the calculated counter reading since reset.

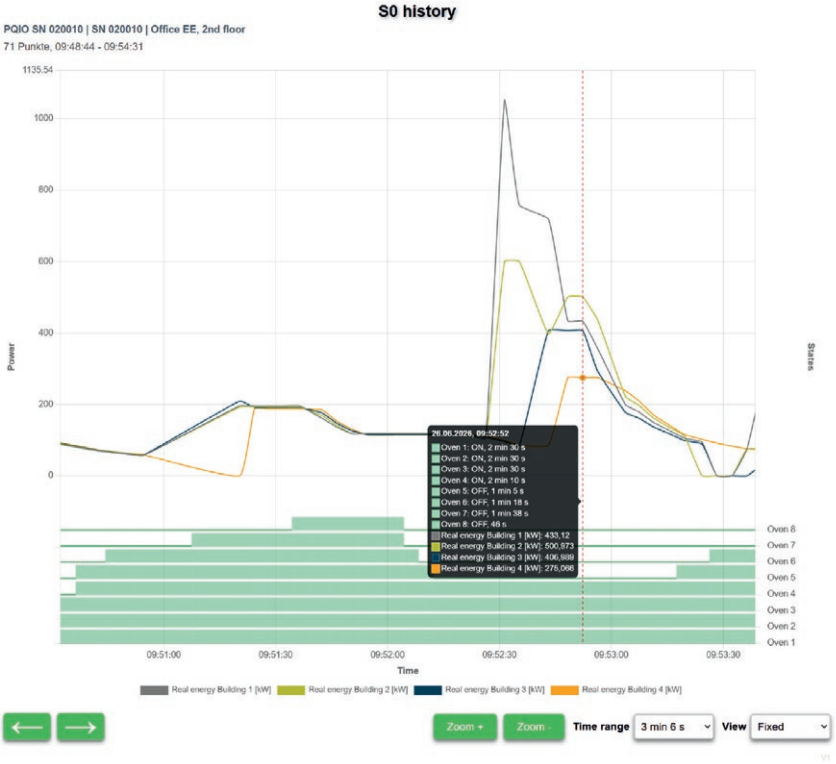


Figure 21 S0 history

The “Calc. Counter A since Reset” column displays the value of calculated counter A since the last reset.

The “Operating time ON” column shows the time since the last reset during which the corresponding input was connected to ground.

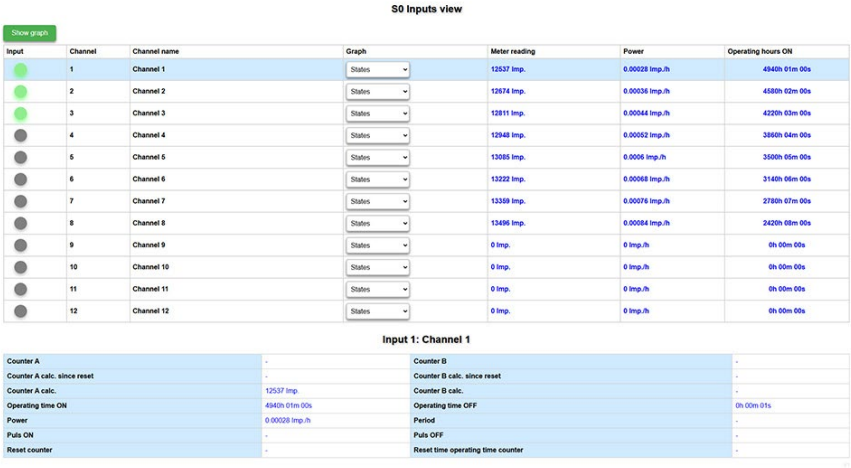
In the “Reset Counter” column, the Calc. Counter A since Reset and Calc. Coun-ter B since Reset can be reset by clicking the “R” button.

In the “Reset Time” column, the two operating hour counters “Operating hours ON” and “Operating hours OFF” can be reset by clicking the “R” button.

7.4.2.2 Extended representation of an input channel

If you select one of the input channels by clicking on the corresponding line choose,

an expanded display with all counter, performance, and Operating hours data is displayed.



S0 Inputs view

Show graph

Input	Channel	Channel name	Graph	Meter reading	Power	Operating hours ON
	1	Channel 1	States	12537 Imp.	0.00028 Imp./h	4940h 01m 00s
	2	Channel 2	States	12674 Imp.	0.00036 Imp./h	4580h 02m 00s
	3	Channel 3	States	12811 Imp.	0.00044 Imp./h	4220h 03m 00s
	4	Channel 4	States	12948 Imp.	0.00052 Imp./h	3860h 04m 00s
	5	Channel 5	States	13085 Imp.	0.0006 Imp./h	3500h 05m 00s
	6	Channel 6	States	13222 Imp.	0.00068 Imp./h	3140h 06m 00s
	7	Channel 7	States	13359 Imp.	0.00076 Imp./h	2780h 07m 00s
	8	Channel 8	States	13496 Imp.	0.00084 Imp./h	2420h 08m 00s
	9	Channel 9	States	0 Imp.	0 Imp./h	0h 00m 00s
	10	Channel 10	States	0 Imp.	0 Imp./h	0h 00m 00s
	11	Channel 11	States	0 Imp.	0 Imp./h	0h 00m 00s
	12	Channel 12	States	0 Imp.	0 Imp./h	0h 00m 00s

Input 1: Channel 1

Counter A	-	Counter B	-
Counter A calc. since reset	-	Counter B calc. since reset	-
Counter A calc.	12537 Imp	Counter B calc.	-
Operating time ON	4940h 01m 00s	Operating time OFF	0h 00m 01s
Power	0.00028 Imp./h	Period	-
Puls ON	-	Puls OFF	-
Reset counter	-	Reset time operating time counter	-

Figure 22

Counter A/B	Non-resettable counter A/B, which contains the pulses count at the entrance.
Calculated counter A/B	Non-resettable counter, which occurs with every pulse is increased by the **multiplier counter A/B**. The finished counter reading is still the **summand Counter A/BB** added.
Calculated counter A/B since reset	Resettable counter, which changes with every pulse the **Multiplier counter A/B** creased. The finished counter reading is still the **summand counter A/B** added.
Operating hours ON/OFF	Operating hours during which the corresponding input was grounded (ON) or open (OFF).
Power	Calculated power standardized to the power unit value, which is calculated from the pulse frequency
Period duration	Time between rising or falling edges of two consecutive pulses
Pulse ON/OFF	Time difference between the rising and falling Edge of a period (ON) or between the falling and the and rising edge of a period (OFF).
Reset time counter A/B	Timestamp of the last reset of the resettable counters
Reset time operating hours counter	Timestamp of the last reset of the operating hour counters.

7.4.3 Display of temperatures

The PQ-IO has three temperature inputs for connecting PT100 temperatures.

The measuring range extends from -50 °C to +180 °C.

An individual name can be assigned to each connected temperature sensor on the **“Basic Settings”** page.

In addition to the current temperature, the minimum and maximum values since the last reset are also stored.

The color of the temperature display is based on the extreme values recorded:
If the measured value is closer to the minimum value, the display appears increasingly bluish.
If the measured value is closer to the maximum value, the display turns increasingly reddish.

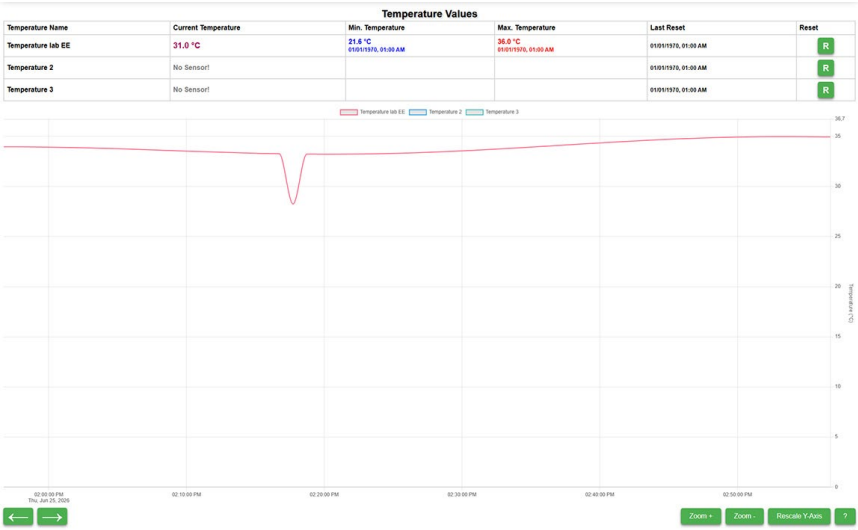


Figure 23

The measured temperatures are stored in a ring buffer every five minutes. This buffer covers a period of approximately 15 days.

When the webpage is opened, the last hour of operation is initially displayed in the diagram. By clicking anywhere in the diagram, the entire recorded time period is then displayed. The X-axis of the diagram can be zoomed using the mouse scroll wheel. Alternatively, on tablets the **“Zoom +”** and **“Zoom -”** buttons can be used.

Using the f and g keys, the displayed time range can be shifted left or right by 25% of the current display range.

Unneeded temperature channels can be hidden by clicking on the legend. The web-page remembers this selection.

The **“Rescale Y-axis”** button automatically adjusts the vertical scaling while ensuring that the 0 °C line always remains visible. Rescaling may be required if a temperature curve has been shown or hidden via the legend or if the display range has been shifted.

8 Measured values of the pulse inputs

The PQ-IO-EMF provides 12 independent pulse inputs (E01 to E12). Each input can record pulses from energy meters, flow meters, or similar pulse-generating devices and convert them into physical quantities (e.g. kWh, m^3, liters). The following description applies to channel E01; channels E02 to E12 are configured identically.

All data can be collected and visualized via the data collector (PQM).

8.1 PQ-IO channels available in FRAKONET

The following sections describe the data points of the PQ-IO that are available for selection in the FRAKONET software SYSTEM-SW.

8.1.1 Analog channels (continuous measured values, compatible with the EMF 1102)

The analog channels provide continuous measured values that are recorded as numerical values. Depending on the processing method, they are stored differently in the database.

Measured value	Processing	Description
Counter A (absolute value)	Absolute value every 15 min.	Current raw pulse counter value A (40-bit integer). Displays the current counter value without differential calculation. The value is converted into physical units using the configured multiplier (Mul) and addend (Add). Without tariff switching: counts all pulses. With tariff switching: counts only pulses during tariff A (e.g. high tariff).
Counter A (difference value)	Difference value every 15 min.	Consumption/increase of counter A within the last 15 minute intervals.
Counter B (absolute value)	Absolute value every 15 min.	Current calculated counter value B. Without tariff switching, it is identical to counter A. With tariff switching, it counts only the pulses in tariff B (e.g. low tariff).
Counter B (difference value)	Difference value every 15 min.	Consumption/increase of counter B within the last 15 minute intervals.
Operating hours counter ON	Absolute value every 15 min.	Cumulative ON time in seconds. Counts how long the input was closed. Application: e.g. motor runtime.
Operating hours counter OFF	Absolute value every 15 min.	Cumulative OFF time in seconds. Counts how long the input was open. Application: e.g. motor downtime.

Measured value	Processing	Description
Calculated Power (average value)	Average value every 5 min.	Average instantaneous power over the 5 minute interval. Calculated from the pulse frequency by linear interpolation between the configuration parameters “Minimum frequency / Value at minimum frequency” and “Maximum frequency / Value at maximum frequency.”
Calculated Power (minimum value)	Minimum value every 5 min.	Lowest power value within the 5-minute interval. Indicates the lowest load that occurred during this period.
Calculated Power (maximum value)	Maximum value every 5 min.	Highest power value within 5 minutes interval. Indicates the peak load (e.g. for peak demand detection).

8.1.2 Counter channels (cumulative meter readings, compatible with the EMF 1102)

The counter channels record continuously increasing counter values. They are stored as absolute values. During database import, the difference value (consumption per interval) is automatically calculated.

Measured value	Processing	Description
Counter A	Absolute value (with difference) every 15 min.	Raw pulse counter value A (40-bit integer). When imported into the database, the counter value is converted into physical units using the configured multiplier (Mul) and addend (Add): Value = Pulses × Mul + Add. The difference between successive absolute values results in the consumption per 15-minute interval. Without tariff switching: counts all pulses. With tariff switching: counts only pulses during tariff A (e.g. high tariff).
Counter B	Absolute value (with difference) every 15 min.	Raw pulse counter value B (40-bit integer). When imported into the database, the counter value is converted into physical units using the configured multiplier (Mul) and addend (Add): Value = Pulses × Mul + Add. The difference between successive absolute values results in the consumption per 15-minute interval. With tariff switching: counts only pulses during tariff B (e.g. low tariff). Without tariff switching: identical to counter A.
Operating hours counter ON	Absolute value (with difference) every 15 min.	Cumulative ON time in seconds. Records the total time during which the input was closed. The difference between successive values represents the ON time per interval.
Operating hours counter OFF	Absolute value (with difference) every 15 min.	Cumulative OFF time in seconds. Records the total time during which the input was open. The difference between successive values represents the OFF time per interval.

8.1.3 Status channels (binary states)

The status channels record binary (ON/OFF) states. For each status channel three values are recorded: Number of switching operations (how often the state has changed), percent ON (percentage of ON time within the interval), and current state (ON or OFF).

Status channel	Description
Switching state	Current level at the input (contact closed = 1, contact open = 0) regardless of the trigger edge. Directly displays the electrical status of the pulse input. The following values are recorded: number of switching operations, percentage of ON time, and current state.
Channel active	With a falling trigger edge: active when the contact is closed. With a rising trigger edge: active when the contact is open. In contrast to the switching state, the state is held for 60 seconds when activated to ensure reliable detection by the data collector. The following values are recorded: number of state changes, percentage of active time, and current state.

8.1.4 Extended 64-bit counting channels

In contrast to the EMF, the PQ-IO provides extended 64-bit counter channels in addition to the standard 32-bit counters. These allow the recording of very large counter values without overflow and provide higher accuracy for calculated values.

With the 64-bit double counters, the pulse weight (Mul) is added directly to the counter value in the PQ-IO for each individual pulse. The data collector therefore receives the already calculated value in physical units and does not perform its own multiplication.

In contrast to the EMF 1102, where the data collector multiplies the entire raw counter value by the multiplier, this method offers a significant advantage:
If, for example, the multiplier is changed after replacing a current transformer, the previously recorded counter value remains unchanged. Only the pulses received after the change are calculated using the new pulse weight.

Available 64-bit measured values per channel:

For each of the 12 pulse inputs (E01 to E12), the following 64-bit measured values are available:

Measured value	Data type	Description
Counter A (64-bit)	INT64	Raw pulse counter value A as a 64-bit integer. Increased by 1 for each detected pulse. Enables the recording of up to 9.2×10^{18} pulses without overflow. Recorded as an absolute value with difference calculation every 15 minutes.

Counter B (64-bit)	INT64	Raw pulse counter value B as a 64-bit integer. With tariff switching: counts pulses during tariff B (e.g. low tariff). Without tariff switching: identical to counter A.
Calculated Counter A (64-bit)	DOUBLE	Calculated counter value A in physical units. Calculation: the pulse weight (Mul) is added for each pulse. Stored as a 64-bit floating-point value (double) with 15 significant digits.
Calculated Counter B (64-bit)	DOUBLE	Calculated counter value B in physical units. The calculation is identical to Calculated counter value A, but applies to tariff B.
Calculated Counter A since reset	DOUBLE	Calculated counter value A since the last counter reset. Calculation: Current calculated counter A – counter value at reset + offset. Enables the recording of consumption since a defined point in time.
Calculated Counter B since reset	DOUBLE	Calculated counter value B since the last counter reset. Calculation: Current calculated counter B – counter value at reset + offset.

8.1.4.1 Reset-Function

The “since reset” counters can be reset via the web interface. When a reset is performed, the following occurs:

- The current value of the calculated counter is stored as a reference point.
- The timestamp of the reset is stored.

From this moment on, “since reset” displays the increase relative to the reference point. The main counters (Counter A/B and Calculated Counter A/B) continue running unchanged.

This allows, for example, the separate recording of consumption since commissioning, since the last maintenance, or since the beginning of the month without affecting the main counters.

8.1.4.2 Advantages compared to 32-bit counters

Overflow protection: Standard 32-bit counters can record a maximum of approximately 4.3 billion pulses. For an energy meter with 1000 pulses/kWh, this corresponds to approximately 4,300,000 kWh.

The 64-bit counters extend this range to practically unlimited values. Higher accuracy: DOUBLE floating-point numbers provide approximately 15 significant decimal digits, whereas SINGLE (32-bit float) provides only about 7 digits. This avoids rounding errors with large counter values and small pulse weights.

Parallel counting: Using the “since reset” values, total and partial counter values can be recorded simultaneously.

8.1.4.3 Processing and recording

All 64-bit counter channels are recorded using the processing method “Absolute value with difference calculation during database import”:

The current absolute value is stored every 15 minutes.

During import into the database, the difference from the previous value is calculated automatically.

This provides both the total counter value and the consumption per interval.

8.1.5 Summary of calculations

8.1.5.1 Counter value calculation

Calculated meter reading:

Initial value after a meter reset = Offset (Add). After each valid pulse:New calculated meter reading = previous calculated meter reading + pulse value (Mul). If Mul is changed later, for example after replacing the current transformer, previous pulses are not recalculated retroactively. Only new pulses are evaluated using the new Mul value.

The pulse weight specifies the physical value represented by a single pulse.
The offset allows the adoption of an existing counter value during commissioning.

Example: Energy meter with 1000 pulses/kWh, counter value at commissioning 15230.5 kWh: Mul = 0.001 / Add = 15230.5

After 500 pulses: 500 × 0.001 + 15230.5 = 15231.0 kWh

8.1.5.2 Power calculation from pulse frequency

The instantaneous power is calculated from the time interval between pulses (period duration).

Four values are entered on the configuration page:

Minimum frequency (Hz)

Value at minimum frequency (e.g. kW)

Maximum frequency (Hz)

Value at maximum frequency (e.g. kW)

The device performs a linear interpolation between these two reference points:

Power = ValueMin + (Frequency – FreqMin) × (ValueMax – ValueMin) / (FreqMax – FreqMin)

Example: Temperature–frequency converter, range –40 to +120 °C / 0 to 5 Hz.

Min. frequency = **0 Hz,** value at min. = **–40 °C**

Max. frequency = **5 Hz,** value at max. = **+120 °C**

At **2 Hz:**
temperature = –40 + (2 – 0) × (120 – (–40)) / (5 – 0) = –40 + 2 × 160 / 5 = **24 °C**

At **3.5 Hz:**
temperature = –40 + (3.5 – 0) × 160 / 5 = –40 + 112 = **72 °C**

Standstill detection: If the duration between two pulses exceeds five times the expected period duration, the power is set to 0.

8.1.5.3 Tariff switching

When tariff switching is activated, a separate input is used as a tariff switch (e.g. utility ripple control receiver):

Tariff switch OFF: Pulses are counted on counter A (e.g. HT).

Tariff switch ON: Pulses are counted on counter B (e.g. NT).

Total consumption = counter A + counter B. Without tariff switching, both counters count all pulses identically.

8.1.5.4 Operating hours counting

The PQ-IO continuously records, for each channel, the time during which the S0 input is closed (active) or open (inactive). This recording always runs in parallel with pulse counting with an accuracy of 1 millisecond.

- ON time: Cumulative duration in seconds during which the S0 contact was closed.
- OFF time: Cumulative duration in seconds during which the S0 contact was open.

Application example: Connecting the auxiliary contact of a motor contactor to the S0 input.

Operating hours counter mode:

In operating hours counter mode, the normal pulse counter (counter A) is increased by 1 every second as long as the S0 contact is closed. Using the multiplier, the value can then be converted into operating hours (e.g. multiplier 1/3600 = 0.000278), so that the calculated counter directly displays the operating hours.

9 Connection of the PQ-IO to a EM-MC 2200 or PQMC^{PRO} via Ethernet

The PQ-IO can be accessed directly via Ethernet from the EM-MC 2200 or PQMC^{PRO}. Two connection options are available:

9.1 Via FRAKO bus over Ethernet (Port 8000)

With this connection method, add a bus coupler of type **“EMG-PN”** under **“Bus couplers, I/O devices”** in the configuration of the EM-MC 2200 or PQMC^{PRO}, and enter the IP address of the PQ-IO.

Below this, add an I/O device of type **“EMD Outputs”** and specify the EMD bus address configured in the PQ-IO.

9.2 Via Modbus TCP (Port 502)

With this connection method, add a bus coupler of type “MODBUS” under “Bus couplers, I/O devices” in the configuration of the EM-MC 2200 or PQMC^{PRO}, and enter the IP address of the PQ-IO. The port is 502. Below this, add an I/O device of type “Modbus TCP Outputs”.

To address all 8 relays, use one of the following settings:

Function code 5:

Name	Bus-address	Adress	Func code	Value ON	Value OFF	Inverted
PQ-IO Kanal 1	255	13	5	0xFF00	0x0000	No
PQ-IO Kanal 2	255	14	5	0xFF00	0x0000	No
PQ-IO Kanal 3	255	15	5	0xFF00	0x0000	No
PQ-IO Kanal 4	255	16	5	0xFF00	0x0000	No
PQ-IO Kanal 5	255	17	5	0xFF00	0x0000	No
PQ-IO Kanal 6	255	18	5	0xFF00	0x0000	No
PQ-IO Kanal 7	255	19	5	0xFF00	0x0000	No
PQ-IO Kanal 8	255	20	5	0xFF00	0x0000	No

Function code 6:

Name	Bus-address	Adress	Func code	Value ON	Value OFF	Inverted
PQ-IO Kanal 1	255	13	6	1	0	No
PQ-IO Kanal 2	255	14	6	1	0	No
PQ-IO Kanal 3	255	15	6	1	0	No
PQ-IO Kanal 4	255	16	6	1	0	No
PQ-IO Kanal 5	255	17	6	1	0	No
PQ-IO Kanal 6	255	18	6	1	0	No
PQ-IO Kanal 7	255	19	6	1	0	No
PQ-IO Kanal 8	255	20	6	1	0	No

9.3 Security functions

The Security Settings page combines the security-related functions of the web interface. Access to this page requires an Admin session.

- User management: change the Admin password, enable or disable the User account and set the User password.
- Certificate: display TLS status, create a CSR, import a certificate or regenerate a self-signed certificate.
- Enable services: enable communication services separately for read and write access.
- Whitelist: restrict Ethernet access for Modbus TCP and Frakobus over Ethernet to defined IP addresses or networks.
- Download PQIO log downloads the device log for diagnostic purposes.

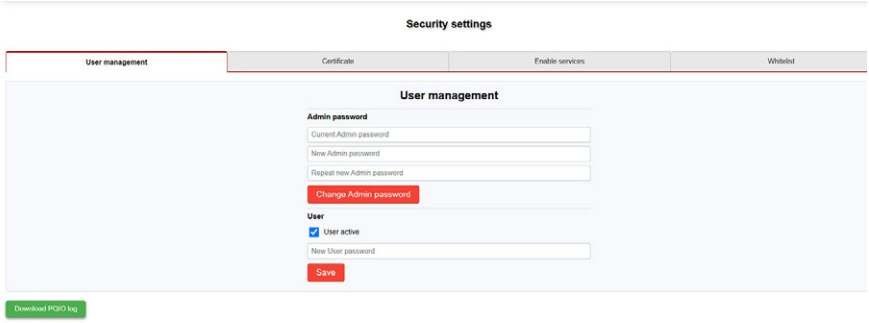


Figure 24

9.3.1 TLS certificate

TLS (Transport Layer Security) encrypts the HTTPS connection between the browser and the PQ-IO. The certificate identifies the device to the browser. A self-signed certificate also encrypts the connection, but the browser accepts it without warning only after this certificate or the issuing Certificate Authority is trusted.

Use this section when the PQ-IO web interface shall be opened via HTTPS or when the company network requires browser access without certificate warnings. The help button (?) next to the TLS Certificate heading opens detailed instructions; the help can also be opened in a separate browser tab.

CA means Certificate Authority, i.e. the issuing certification body, usually the IT department or an internal certificate service. CSR means Certificate Signing Request. The CSR is generated by the PQ-IO and sent to the CA. PEM is a text format for certificates and keys.

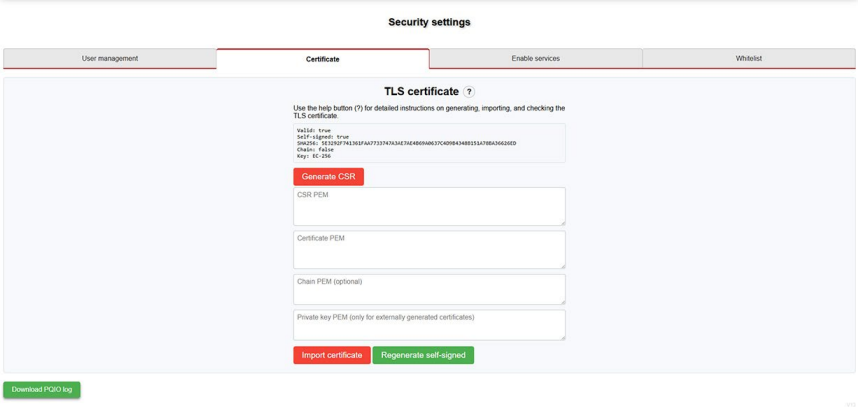


Figure 25

9.3.2 TLS certificate - procedure

Company network: create a CSR, send the complete CSR to IT or the CA, paste the signed server certificate into Certificate PEM and import it. When the CSR is generated in the PQ-IO, Private Key PEM remains empty because the private key remains in the device. Chain PEM is filled only if IT supplies intermediate certificates.

Laboratory or single PC without IT: use the automatically generated self-signed certificate and trust it on the PC, or import an externally generated self-signed certificate with private key. In this case Certificate PEM and Private Key PEM are filled.

Regenerate self-signed creates a new automatically generated device certificate. Afterwards the browser may show a certificate warning again. The status shows whether the certificate is valid and self-signed, the SHA-256 fingerprint, an available certificate chain and the validity period.

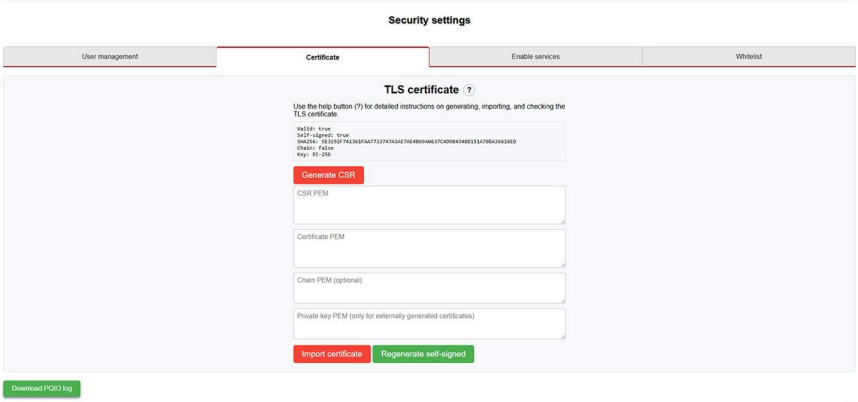


Figure 26

9.3.3 Enable services

Communication services can be enabled in the Security Settings and approved separately for read or write access. Changes are transferred to the device only after Save is pressed.

Read permission allows clients to retrieve values. Write permission allows clients to change values, reset counters or switch outputs where the respective protocol supports this. Enable write access only for the communication paths that are required by the installation.

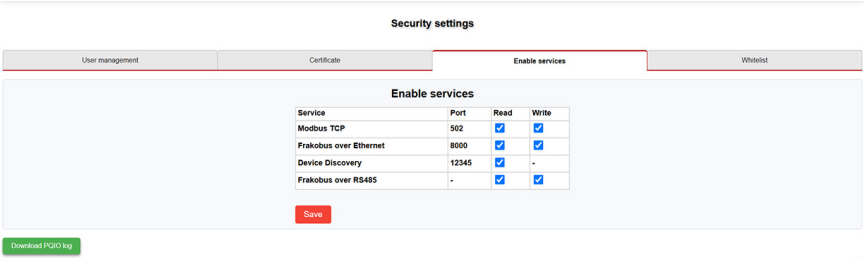


Figure 27

9.3.4 Whitelist

The whitelist limits which devices may access selected PQ-IO services via Ethernet. It is useful when Modbus TCP or Frakobus over Ethernet must not be reachable from the entire network.

Modbus TCP is Modbus communication via Ethernet, typically used by controllers or supervisory systems. Frakobus over Ethernet is FRAKO communication via Ethernet.

Enter one entry per line: a single IP address, a network with subnet mask, or * for all addresses. CIDR is the notation for a network with subnet mask, for example 10.192.253.0/24. Press Save after changes. Empty lines are ignored.

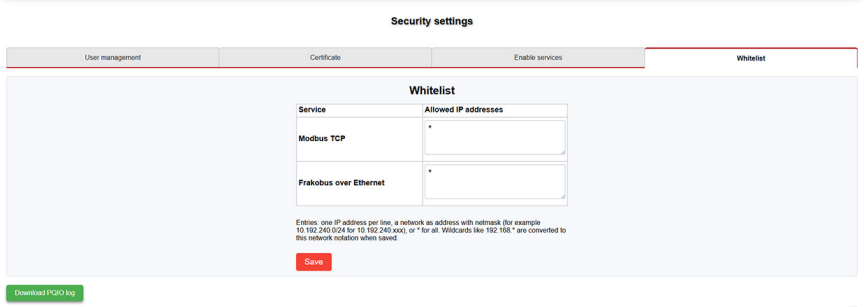


Figure 28

9.3.5 Whitelist - examples

Entry	Meaning
10.192.253.10	Only this device may use the service.
10.192.253.0/24	All addresses from 10.192.253.1 to 10.192.253.254 are allowed.
192.168.*	Is converted to network notation when saved.
*	All addresses are allowed; use only when no restriction is required.

10 Safety during cleaning and maintenance

DANGER!

Risk of personal injury

There are life-threatening voltages inside the enclosure. Contact with live parts on supply lines and terminals may result in serious injury or death.

- Do not open the enclosure.
- During cleaning and maintenance, disconnect the PQ-IO and the system from the power supply.
- Secure the system against being switched on again.
- Verify that all terminals are de-energized.
- Cover adjacent live parts.

10.1 Cleaning

The device may only be cleaned with a dry cloth. The use of aggressive or abrasive cleaning agents or solvents must be avoided.

10.2 Maintenance

The PQ-IO contains no components that require maintenance.

11 Troubleshooting

During operation of the PQ-IO, malfunctions may occur. The following table is intended to assist in identifying and resolving faults.

	Fault	Possible cause	Corrective action
Power supply	PQ-IO not operating; no indicators on the PQ-IO front panel.	No operating voltage present or incorrect operating voltage applied.	Check whether the correct operating voltage is present at the power supply connection. Is the upstream fuse intact?
FRAKO bus	Green LED flashing correctly, but all relay outputs are in the fault state. Bus LED remains off.	Incorrect bus address configured.	Set the correct bus address as described in Section 6.1.1.
		Bus connection interrupted	Disconnect the connector and check the voltage at A and B against ground using a multimeter. If no voltage in the range of 1 V to 3.6 V is present, check the wiring.
		Bus line polarity reversed	Swap connections A and B.
		Incorrect bus cable or no termination resistor at the last device in the bus line.	Connect a 120 Ω termination resistor at both ends of the bus. Use a bus cable compliant with EIA RS-485.
Ethernet	Device cannot be reached via Ethernet.	Incorrect IP address	Check whether DHCP is enabled. Check whether the current IP address is correct See Section 6.1.1.2
Generally	RUN and BUS LEDs flash rapidly for 5 seconds every 30 seconds.	SD card defective or not present. The device continues to operate normally. However, a backup system is used, which means that configuration changes can no longer be saved. Counter values are stored only once per day at midnight. Web pages can no longer be displayed.	Contact FRAKO Service to have a new SD card installed.

11.1 Fault diagnosis

The PQ-IO provides important diagnostic data and displays it in the FRAKO PQ Device Discovery tool included in the FRAKONET installation. After clicking the “Scan” button, the tool displays all FRAKO devices in the local network that support this function.

The tool can be found in the FRAKONET folder under:..\tools\Device_discovery\ PQDiscovery_gui.exe.

If the PQ-IO is not operating correctly, this will be indicated in the **“State”** column:

Figure 29

The following errors are detected and reported:

- SD card: corrupt file system.
- A configuration file was reset to the factory default because it could not be loaded from the SD card or from the backup.
- Temperature CPU is not accessible.
- I2C-bus access error.

If no error is present, **“OK!”** is displayed.

12 Decommissioning, dismantling, storage, disposal

12.1 Decommissioning the PQ-IO

- Contact with live parts on supply lines and terminals may result in serious injury or death.
- Installation, commissioning, and decommissioning of the PQ-IO may only be carried out by qualified personnel who are familiar with and understand the contents of this operating manual.
- To decommission the PQ-IO, disconnect the device and the system from the power supply.
- Secure the system against being switched on again.
- Verify that all terminals are de-energized.
- Cover adjacent live parts.

CAUTION!

Risk of property damage

Connecting exposed or disconnected cable ends may cause short circuits and overloads in the installation, resulting in property damage.

Insulate all disconnected cables individually and protect them against accidental contact with live parts as well as electrically conductive parts.

1. Disconnect all live supply lines from the device.
2. Insulate all disconnected cables individually and protect them against accidental contact with live parts as well as electrically conductive parts.

12.2 Removing the PQ-IO from the DIN rail

The PQ-IO is snapped onto the DIN rail with four orange retaining clips. To release the PQ-IO from the DIN rail, insert a suitable screwdriver into the tab of a retaining clip and lever it out until it locks into place. In this way, open either the two upper or the two lower retaining clips. The PQ-IO can then be removed from the DIN rail.

12.3 Storage

- The PQ-IO must be stored in a clean, dust-free, and dry location.
- The storage temperature must be within the range of –20 °C to +60 °C.

12.4 Disposal

CAUTION!

Risk of property damage

Environmental damage may occur if the device is disposed of improperly.

Dispose of the device in an environmentally responsible manner in accordance with the applicable national regulations.

Electronic devices that are no longer required must be disposed of properly.

Electrical and electronic waste is subject to the EU Waste Electrical and Electronic Equipment Directive (WEEE). These components must not be disposed of with household or commercial waste.

The applicable national regulations for the disposal of electronic devices must be observed. The devices must be disposed of at a specialized recycling or disposal center.

Devices can be returned for proper disposal to FRAKO Kondensatoren- und Anlagenbau GmbH, Teningen, Germany, or to one of its representatives. Alternatively, the devices may be handed over to a certified company specializing in the disposal of electronic equipment.

Power Capacitors
Reactive Power Controllers
Power Factor Correction Systems
Modules
EMS Components
Measuring Instruments and Network Analysers
Power Quality
Energy Management System (EMS) ISO 50001

FRAKO Kondensatoren- und Anlagenbau GmbH
Tscheulinstraße 21a
D-79331 Teningen
Phone: +49 7641 453-0
Fax: +49 7641 453-535
sales@frako.de
www.frako.com

FRAKO 55-06113/09/26/10556 Subject to technical changes