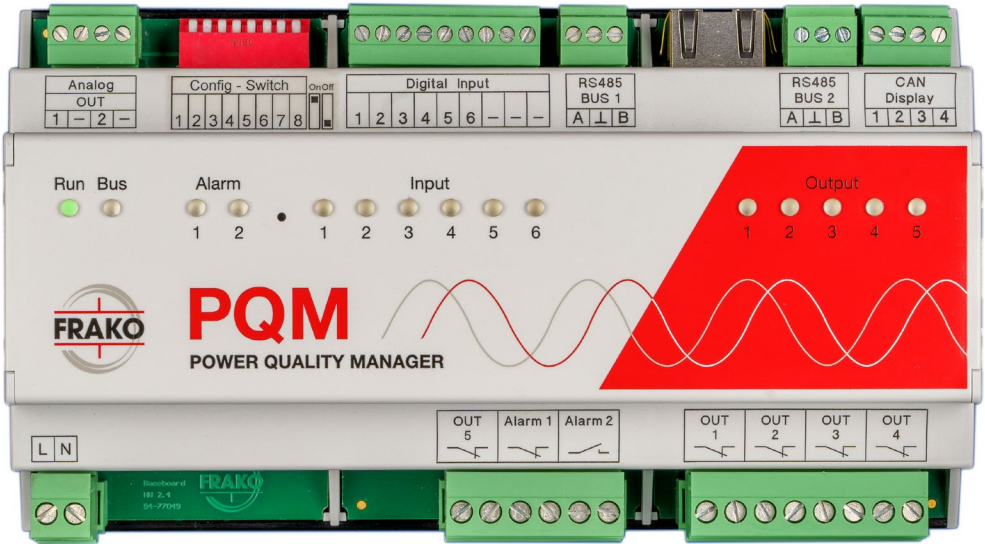




PQM

Power Quality Manager



Contents

1	Safety	4
1.1	Objective	4
1.2	Safety instructions	4
1.3	Intended use	5
1.4	Improper use	6
1.5	Repair	6
1.6	Symbols used	6
2	Technical Data	7
3	Instrument description	9
3.1	Function 1 – Gateway	9
3.2	Function 2 - Data collector	9
3.2.1	Recording and alarms	10
3.3	Service functions	10
3.3.1	OPC-UA DA Server	10
3.3.2	RS-485 Bus 1 – Modbus RTU	11
3.3.3	RS-485 Bus 2 – FRAKO Starkstrombus	11
3.3.4	Overview of server services	12
3.3.5	Overview of client services	12
4	Mounting the instrument	12
4.1	Suitable location	12
4.2	Installing the instrument	12
5	Installation	14
5.1	Electrical connections	14
5.2	Supply voltage	16
5.3	Relays	16
5.3.1	Alarm 1 Relays	17
5.3.2	Alarm 2 Relays	18
5.3.3	OUT 1 to OUT 5 Relays	18
5.4	RS-485	18
5.4.1	RS-485 BUS 1 - Modbus RTU	19
5.4.2	RS-485 BUS 2 - FRAKO Starkstrombus	20
5.5	Digital inputs	20
5.6	Analogue outputs	21
5.7	Inputs and outputs not yet in use	22
5.7.1	CAN Display – NOT TO BE USED!	22
6	Commissioning (initial start-up)	23
6.1	Safety precautions before start-up	23
6.2	Functional checkout	23
6.3	Initial configuration	23
6.3.1	Initial configuration of Function 1: Gateway	23
6.3.2	Initial configuration of Function 2: Data collector	24

7	Configuration.....	24
7.1	DIP switches	24
7.2	Network.	24
	7.2.1 User network settings	25
	7.2.2 Fallback network settings	25
7.3	Instrument website	25
	7.3.1 Configuration of the network settings	26
	7.3.2 Configuration: firmware update	27
	7.3.3 Service functions: OPC-UA	28
	7.3.4 Service functions: RS-485	29
	7.3.5 Service functions: S0 inputs	30
	7.3.6 REST API.	42
	7.3.7 Relay Outputs	42
	7.3.8 InfluxDB.	46
	7.3.9 MQTT	47
	7.3.10 Help: Tools.	47
8	Operation.....	48
9	Maintenance.....	48
9.1	Cleaning	48
10	Decommissioning and removal, storage and disposal.....	49
10.1	Decommissioning and removal	49
10.2	Storage	50
10.3	Disposal	50
11	General notes.....	52
12	Scope of supply.....	52
13	Notes.....	53

1 Safety

1.1 Objective

This operating manual has been prepared for persons who install, connect, commission and operate the PQM Power Quality Manager.

1.2 Safety instructions



No claims under guarantee shall be valid in the event of damages caused by failure to observe the instructions in this operating manual. We shall not be held liable for consequential damages!

Incorrect operation or failure to observe the safety instructions will invalidate all claims under the guarantee, and no liability is accepted for any injuries to persons or damages to assets arising therefrom or occasioned thereby!



DANGER!

The following instructions must be observed to prevent danger to life and limb or damage to equipment and other assets:

- Installation and commissioning of the instrument in industrial plant must be carried out in strict compliance with the standards IEC 61508 and DIN VDE 0801.
- Any other laws, standards, regulations and safety rules (IEC, EN, VDE etc.) relevant to this product and the protection of persons and assets must be observed. In Germany, it is essential to comply with the Equipment Safety Act (GSG) and the regulations of the German Social Accident Insurance Institutions. In other countries, the equivalent local regulations must be followed.
- Installation, commissioning, modifications and retrofitting may only be carried out by appropriately qualified personnel.
- In Germany, it is essential to comply with the regulations of the Social Accident Insurance Institution covering electrical installations. In other countries, the equivalent local regulations must be followed.
- The instrument contains live components at the AC supply voltage and must therefore not be opened.
- If the instrument is visibly damaged, it must not be installed, connected or commissioned.
- Only approved installation cables must be used.
- If the instrument does not work after commissioning, it must again be isolated from the power supply.

- The instrument must only be employed on duties up to the specified maximum power. Overloading the instrument can result in its destruction, create a fire hazard or cause an electrical accident. The load ratings for the various connections must not be exceeded.
- Do not expose the instrument to direct sunlight or high temperatures, as these could damage it or shorten its service life.
- Do not install the instrument near to sources of heat such as radiators or other devices that give out heat.
- Do not expose the instrument to rain, water, dampness or high levels of humidity. Avoid direct contact with water at all cost.
- Failure to observe the safety instructions can result in death, serious injury or severe damage to equipment and other assets.
- In commercial premises, the local accident prevention regulations must be complied with (e.g. in Germany, the regulations of the German Social Accident Insurance Institutions for electrical installations and equipment).
- The safety of the system in which the PQC is incorporated is the responsibility of the persons installing and operating the system.
- For safety reasons and to retain conformity with product approval requirements (CE marking), the user is not permitted to convert or otherwise modify the instrument.
- The instrument must always be handled with due care; if it is jolted, knocked or dropped from even a low height, it will be damaged.
- This operating manual may be changed without notification. Please consult our website www.frako.com for the up-to-date version.

When work is carried out on the instrument terminals and connecting cables, there is a risk of live components being touched inadvertently. The working voltage may present a hazard to health or may even be life-threatening.

The risk to life and limb can be significantly reduced by observing the above safety precautions.

-
- The user must ensure that all operators are familiarized with this operating manual and follow it at all times.
 - This operating manual must be read through carefully and completely before the instrument is installed, connected, commissioned and operated. All actions taken must be in accordance with this operating manual.
 - The operating manual must be held for future reference.
 - Δ Wherever this symbol is shown, the documentation must be referred to.

1.3 Intended use

The PQM Power Quality Manager is intended for the following applications within the

scope of the technical data „Technical Data“:

- Acquisition and recording of data
- Detection and forwarding of alarms
- Enabling FRAKO Starkstrombus and Modbus RTU bus system communication via Ethernet

The PQM is intended for installation in stationary, weather-protected control cabinets and enclosures located indoors. Exposure to dampness is not permitted. The instrument is installed on a standard 35 mm DIN rail (as per EN 50022) inside a control cabinet or other enclosure.

1.4 Improper use

Any use of the instrument that deviates from its intended use is considered improper and therefore not permitted. If the PQM is used in a way not specified in this operating manual, the protection supported by the instrument may be adversely affected.

1.5 Repair

Repairs may not be carried out by the customer or user. Should repair work be necessary, the customer or user must contact the manufacturer: FRAKO Kondensatoren- und Anlagenbau GmbH, Tscheulinstr. 21A in D-79331 Teningen, Germany www.frako.com

1.6 Symbols used

Special instructions in this operating manual are marked by symbols.

The corresponding word that expresses the extent of the danger is also printed above the instructions.

In order to avoid accidents, death or injury and damage to assets, these instructions must be complied with at all times.

Warnhinweise



Warning signs

Indicates an immediate danger that if not avoided can result in death or serious injury.



DANGER!

Indicates an immediate danger of electric shock that if not avoided can result in death or serious injury.

Notes for the correct functioning of the instrument



CAUTION!

These instructions indicate risks that could result in damage to equipment if the instructions are not followed.

They can also cover aspects of environmental protection.



NOTE!

These instructions, when followed, serve to ensure the correct functioning and fault-free operation of the instrument.

2 Technical Data

Power supply:

Supply voltage	100 V AC - 253 V AC (absolute limits), frequency 45 - 65 Hz or 100 V DC 230 V DC (absolute limits)
Power draw	Maximum 7W/18VA
Overcurrent protection	External, maximum 2 A (slow-blow) specified

Inputs:

Digital Inputs	6 × digital inputs S0 puls inputs (DIN 43864) for connecting to volt-free contacts Open-contact voltage: 15 V Max. line resistance: 800 Ω Short-circuit current: 18 mA Pulse frequency: 0.1 to 20 Hz
----------------	---

Outputs

Relay contacts	5 × bistable relay contacts 250 V / 2 A AC or 30 V / 2 A DC
Alarm contacts	1 × bistable alarm contact Bistabil, 250 V / 2 A AC or 30 V / 2 A DC 1 × NC alarm contact 250 V / 2 A AC or 30 V / 2 A DC

Interfaces:

Ethernet interfaces	10/100MBit/s, RJ45
RS-485 Bus 1 (from HW Ver. 2)	Modbus RTU
RS-485 Bus 2 (from HW Ver. 2)	FRAKO Starkstrombus

Connections: Pluggable screw terminals

Screw terminals	Conductor cross section max. 1.5 mm ² , min. 0.14 mm ² , Relays, alarm contacts and power supply: Conductor cross section max. 2.5 mm ² , min. 0.2 mm ² , Insulation rating: 250 V AC, 80° C
-----------------	---

Configuration switches:

DIP switches	8 × DIP switches
--------------	------------------

Annunciators:

LEDs	15 × LEDs
------	-----------

Design data:

Dimensions (W × H × D)	296 mm × 260 mm × 133 mm casing
Mounting	Standard 35 mm DIN rail as per EN 50022
Weight	approx. 0.4 kg without packaging
Ingress protection	Casing IP30 Terminals IP10 as per EN 60529 Pollution degree 2 as per EN 61010-1:2011-07
Elektrical Design	Casing protection class II as per EN 61010
Casing material	Flammability rating UL 94 V-0 according to casing manufacturer
EMC	EN 55022:2010 + AC:2011 Class B / EN 61000-3-2:2014 / EN 61000-3-3:2013 / EN 61000-6-3:2007 + A1:2011 EN 61000-6-2:2005 / EN 61000-4-2:2009 / EN 61000-4-3:2006 + A1 :2008 + A2:2010 / EN 61000-4-4:2012 / EN 61000-4-5:2014 / EN 61000-4-6:2014 / EN 61000-4-8:2010 / EN 61000-4-11:2004

Ambient conditions:

Temperature range	0°C bis +45°C
Installation altitude	Max. geographical altitude 2000 m above sea level

3 Instrument description

3.1 Function 1 – Gateway



NOTE!

This function is available for software version 2.28.50 or later.

The PQM has two RS-485 interfaces for use via Ethernet.

The table below specifies the protocols and interfaces from the bus to Ethernet:

Bus protocol	Medium	Hardware interface on PQM	Ethernet protocol (TCP)	TC port	Application
Modbus RTU	shielded 2core cable	RS-485 Bus 1	Modbus-RTU over TCP	8100	Higher-level PQM as data collector, device-specific Modbus RTU over TCP software
FRAKO Starkstrombus	shielded 2core cable	RS-485 Bus 2	FRAKO TCP protocol	8000	Higher-level PQM as data collector, devicespecific FRAKO software

Connection and configuration are described from pages 16 and 24 respectively.

3.2 Function 2 - Data collector

The Power Quality Manager collects and records data from the power quality management system. Alarms are also detected, recorded and forwarded.

The data acquisition process requires system points, which can be purchased separately as and when needed or are supplied with the instrument in the form of a licence key. The system points upgrading package (Article No. 20-10495) is used to increase the PQM system points to the required number in steps of 10.

When supplied with no license key, the PQM has no system points but can be used as a bus gateway as described in *section 3.1 „Funktion 1 – Gateway“* above.

The user can connect the PQM via Ethernet, with links to measuring devices via the

following Interfaces:

- Ethernet > Modbus TCP > Modbus TCP device
- Ethernet > M-Bus converter > MBus device
- Ethernet > EMG 1500-PN > FRAKO Starkstrombus
- Ethernet > COM server > FRAKO RS232 adapter > EM device
- Ethernet > COM server > EMP 1100 > FRAKO Starkstrombus
- Ethernet > COM server > Modbus RTU
- RS-485 Bus 1 > Modbus RTU
- RS-485 Bus 2 > FRAKO Starkstrombus



NOTE!

RS-485 is available for software version 2.28.50 or later.

The products *FRAKO RS232 adapter*, *COM-Server*, *EMP 1100* or *EMG 1500-PN* can be obtained from FRAKO as accessories. A PQM can use several connection paths simultaneously.

3.2.1 Recording and alarms

The Power Quality Manager maintains contact with the devices in the power quality management system via the connection paths that have been configured. It polls them continually and stores the collected data.

For some of these data, their average values, peak values and differential meter readings are computed and saved at set intervals.

Many devices in the power quality management system have an integrated alarm system. Their alarm data can be read by the PQM, which can also monitor any desired measurement readings to detect if they go outside settable limits.

If an alarm occurs, this event can be notified by various means, such as e-mail. It is also possible to record alarms in report files.

3.3 Service functions

Ongoing development of the PQM has endowed this instrument with a growing number of service functions and applications. When required, these can be enabled at the instrument website of the PQM see *ssection 7.3 „Webinterface“*.

3.3.1 OPC-UA DA Server

The OPC-UA DA Server in the PQM supports the OPC-UA Data Access (DA) protocol. The instrument is supplied with this server disabled, but it can be enabled at the instrument website see *section 7.3 „Webinterface“*.

All the devices configured in SYSTEM-SW, together with their measurement readings, can be accessed with OPC-UA DA via the TCP/IP port **4840**.

OPC-UA DA Server uses self-generated and self-signed certificates, which are generated when the Server is first started. The certificate is issued for the IP address of the instrument, therefore the IP configuration *described in section 7.3 „Webinterface“* must be carried out before OPC-UA Server is enabled. The certificates are deleted as soon as the service function is disabled.

In the customer-specific OPC-UA Client, the URL is given as follows:

opc.tcp://PQM-IP:4840



NOTE!

OPC-UA DA Server is available for software version 1.26.70 or later.

3.3.2 RS-485 Bus 1 – Modbus RTU



NOTE!

Direct connection to Modbus RTU is possible for software version 2.28.50 or later.

This connection makes direct communication with Modbus RTU devices possible. Depending on the configuration, devices on the bus can either be integrated into the data acquisition function of the PQM (mode: internal) or made accessible to external software (mode: gateway) via the TCP port 8100. Simultaneous use of both modes (internal and gateway) is not possible with Modbus RTU.

The basic configuration is described on page 30 in section „*RS-485 BUS 1 configuration*“.

If the PQM is to serve as gateway for the Modbus RTU bus, it must not be configured for the data acquisition function. Configuration is carried out in SYSTEM-SW, part of the FRAKONET software. Please refer to the online help section of SYSTEM-SW.

3.3.3 RS-485 Bus 2 – FRAKO Starkstrombus



NOTE!

Direct connection to the FRAKO Starkstrombus is possible for software version 2.28.50 or later.

The PQM acts as master on the FRAKO Starkstrombus and can access devices connected to the bus, which can thus be integrated into the PQM's data acquisition function. At the same time it is also possible to use the PQM as Ethernet gateway to the FRAKO Starkstrombus.

The basic configuration is described on page 30 in section „*RS-485 Bus 2 configuration*“.

3.3.4 Overview of server services

Server services	Port	Description
FTP	21	FRAKONET connection
SSH	22	for service purposes only
HTTP	80	PQM website
HTTPS	443	PQM website with SSL/TLS
MQTT Broker	e.g. 1883	internal MQTT broker can be activated
OPC-UA DA Server	4840	OPC-UA DA server can be activated
FRAKO-NET	8000	FRAKONET connection / FRAKO Starkstrombus Gateway
PQM REST	8080	PQM REST interface
Modbus RTU Gateway	8100	Modbus RTU over TCP Gateway
PQM REST HTTPS	8443	PQM REST interface with SSL/TLS

3.3.5 Overview of client services

Services as a client	Port	Description
FRAKO devices	8000	Access to FRAKO devices via TCP
Modbus RTU over TCP	e.g. 8100	Access to RTU-over-TCP Bus Couplers
Modbus TCP	e.g. 502	Access to Modbus TCP devices
MQTT	e.g. 1883	Access to external MQTT broker
InfluxDB	e.g. 8086	Access to external InfluxDB for data storage

4 Mounting the instrument

4.1 Suitable location

The PQM is intended for installation in stationary, weather-protected control cabinets and enclosures located indoors. Exposure to dampness is not permitted. The instrument is installed on a standard 35 mm DIN rail as follows:

4.2 Installing the instrument

- Use a screwdriver to withdraw all the orange retaining clips from the instrument base until they click into place (see *Figure 1: below*).
- Place the instrument over the DIN rail.

- Press the orange retaining clips back into the casing until they are flush with the front edge of the instrument base.

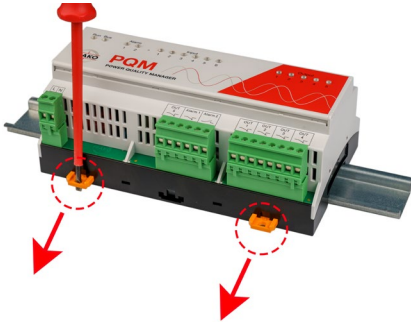


Figure 1 Mounting



DANGER!

To avoid accidents, the following must be observed:

- The PQM must be installed in accordance with its intended use before power is switched on.
- All the connectors supplied with the instrument must be plugged in.

If the above precautions are taken, the danger to life and limb can be significantly reduced.



DANGER!

To prevent the PQM overheating, the following must be observed:

- The PQM must be installed in an adequately ventilated space, and none of its ventilation slots must be covered.
- No sources of heat must be located in the vicinity.
- The PQM must not be exposed to direct sunlight.

If the above safety precautions are taken, the risk of damaging equipment and assets or endangering life and limb can be significantly reduced.

5 Installation

Prerequisite: the instrument has been correctly fitted to the DIN rail as described in section 4 „Mounting the instrument“.

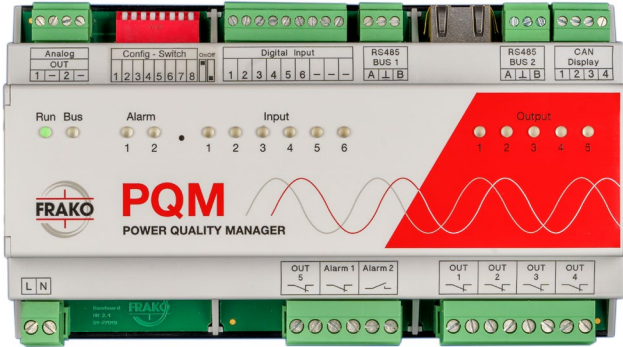


Figure 2 PQM connections

5.1 Electrical connections



DANGER!

The following instructions must be observed to avoid danger to life and limb:



- When the instrument is being installed or serviced, the instrument and the electrical system must be isolated from the power supply.
- The isolated electrical system must be locked out to prevent its being inadvertently switched on again.
- It must be verified that none of the terminals are live!
- The power supply and switched power terminals are live and must not be touched (risk of electric shock)!
- All live components in the vicinity must be covered to prevent inadvertent contact.
- If the power supply voltage exceeds the level specified in this operating manual and stated on the instrument, this may cause damage to the PQM. Consequential damage to other parts of the installation is also possible.
- A disconnecting device must be installed so that the connections of the PQM can be isolated from the electrical system and building electrical installation.
- Only the specified and appropriate voltages and signals may be connected to the respective terminals and ports provided for them.
- The cross sections of all cables used must be adequate for their purpose.

- Suitable measures must be taken to prevent cables operating at the power supply voltage being inadvertently pulled out and twisted.
- A disconnecting device, such as an isolator or circuit breaker, must be fitted in the building electrical installation in a suitable location, accessible by the user and appropriately labelled as a disconnecting device for the PQM. It must be able to isolate all cables operating at the power supply voltage from the instrument.
- If flexible stranded cables with their total cross-sectional area assembled from several fine filaments are used for the connections, ferrules must be crimped onto their ends. It must be ensured that no individual filament has been left out of the ferrule.

When work is carried out on the connecting cables and the instrument terminals, it is possible that live components may be touched inadvertently. If this occurs, the voltage present may be injurious to health or may even have fatal consequences.

The risk to life and limb can be significantly reduced by observing the above safety precautions.



NOTE!

The instrument can be damaged by incorrect operation.

- Only the specified and appropriate voltages and signals may be connected to the respective terminals and ports provided for them.
- The cross-sectional areas of all cables used must be adequate for the purpose.
- The required cable types are specified in *section 2 „Technical Data“*.

If any incorrect cables, voltages or signals are applied to the terminals, this can result in damage to the PQM and the electrical installation.



DANGER!

To avoid accidents, the following must be observed:

At the PQM installation site (e.g. control cabinet, enclosure), all wires and stranded cables must be adequately secured or grouped in harnesses.

If the above safety precautions are taken, the risk of damaging equipment and assets or endangering life and limb can be significantly reduced.



NOTE!

If flexible stranded cables are used for the connections, insulated ‘short’ ferrules 6 mm in length must be crimped onto their ends. When necessary, longer ferrules must be shortened to a length of 6 mm after crimping. Examples:

Manufacturer	Supplier	Conductor CSA	Ferrule length	Order No.
TE Connectivity	Farnell	0,5mm ²	6mm	966 067-1
TE Connectivity	Farnell	0,75mm ²	6mm	966 067-4

TE Connectivity	Farnell	1,0mm ²	6mm	966 067-8
TE Connectivity	Farnell	1,5mm ²	6mm	1-966 067-2

A disconnecting device must be installed so that the PQM connections can be isolated from the electrical system/building electrical installation.

5.2 Supply voltage



DANGER!

To avoid accidents, the following must be observed:

- The safety instructions in section *5.1 „Electrical connections“*.
- Connection of the instrument power supply as specified in this manual

When work is carried out on the instrument terminals and connecting cables, there is a risk of live components being touched inadvertently. The working voltage may present a hazard to health or may even be life-threatening.

If the above instructions are followed, and the precautions specified in section *1.2 „Safety instructions“*, are taken, the risk of damaging equipment and assets or endangering life and limb can be significantly reduced.



CAUTION!

- The cables leading to the instrument must be permanently connected. It is not permitted for these to have plug-in connections.
- An external disconnecting device, such as an isolator or circuit breaker, must be fitted in the power supply line to the instrument. This must be located in the vicinity of the PQM and must be able to isolate all cables connected to its power supply terminals. It must be suitable for this application, comply with the requirements of IEC 60947-1 and IEC 60947-3, and be appropriately labelled as a disconnecting device for the PQM.

5.3 Relays



DANGER!

To avoid accidents, the following must be observed:

- The safety instructions in section *5.1 „Electrical connections“*.
- Connection of the output relays as specified in this manual
- The maximum operating voltage across the relay contacts, as specified in section *2 „Technical Data“*.

When work is carried out on the instrument terminals and connecting cables, there is a risk of live components being touched inadvertently. The

working voltage may present a hazard to health or may even be life-threatening.

If the above instructions are followed, and the precautions specified in *section 1.2 „Safety instructions“* are taken, the risk of damaging equipment and assets or endangering life and limb can be significantly reduced.



CAUTION!

To ensure safe and reliable operation, the following must be observed:

- Each of the output relay connections **OUT 1** to **OUT 5** must not carry currents of more than 2 A AC, as specified in *section 2 „Technical Data“*.

If this point is observed, the risk of fire and possible damage to the instrument will be avoided.



DANGER!

To avoid accidents, the following must be observed:

- The safety instructions in *section 5.1 „Electrical connections“*.
- Connection of the alarm relays as specified in this manual
- The maximum operating voltage across the relay contacts, as specified in *section 2 „Technical Data“*.

When work is carried out on the instrument terminals and connecting cables, there is a risk of live components being touched inadvertently. The working voltage may present a hazard to health or may even be life-threatening.

If the above instructions are followed, and the precautions specified in *section 1.2 „Safety instructions“* are taken, the risk of damaging equipment and assets or endangering life and limb can be significantly reduced.

The PQM is equipped with seven output relays. Indicating units are connected to these via current-amplifying electromechanical devices (relays, contactors).

Alarm signals generated internally in the instrument can be assigned to the volt-free contacts of the alarm relays using the SYSTEM-SW software. These alarm signals can comprise status signals, status of the optional digital inputs, set alarm limits being exceeded or device faults.

See *section 2 „Technical Data“*, for the relevant technical data.

See *section 7 „Configuration“*, for the configuration procedure.

The connections to the terminals „**Alarm 1**, **Alarm 2** and **OUT 1** to **OUT 5**“, must be made as shown in *Figure 2: PQM connections*.

5.3.1 Alarm 1 Relays

Alarm relay 1 is a bistable type. This means that after a power outage, the relay contacts remain in the same state as they were before the outage.

5.3.2 Alarm 2 Relays

Alarm relay 2 is an NO ('normally open') type. Unlike alarm relay 1 it is not bistable. During operation with no interruptions to the power supply, its contacts remain closed. In the event of a fault they open. This means that an alarm is given even if power is cut off to the PQM or there is a break in the alarm circuit.

Under the Alarms heading in SYSTEM-SW alarms from various sources can be assigned to alarm paths. A switching output not yet allocated or an alarm contact can be selected as alarm path, but it is standard practice for the Alarm 2 contact—unlike the other switching outputs—to be 'inverted'. In other words, whereas the normal switching outputs and Alarm 1 close their contacts when an alarm occurs, the contacts of Alarm 2 open.

5.3.3 OUT 1 to OUT 5 Relays

The relays OUT 1 to OUT 5 are of the bistable type. This means that after a power outage, the relay contacts remain in the same state as they were before the outage.

5.4 RS-485

Two bus connections RS-485 BUS 1 and BUS 2 are available from hardware version 2 of the PQM onwards. The hardware version is stated on the nameplate; it also constitutes the first numeral of the software version.

These two connections can be seen to the left and the right of the Ethernet interface as shown below in (Figure 3: Bus connections).

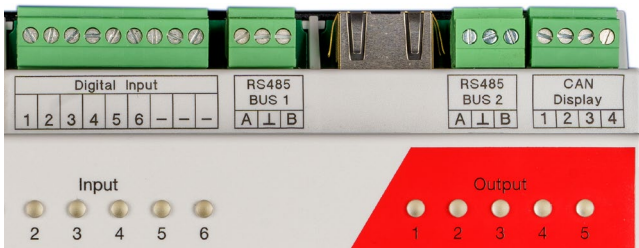


Figure 3 Bus connections

Recommended cable types:

Surge impedance 100 - 120 Ω ; $\varnothing \geq 0,3 \text{ mm}^2$; shielded twisted pairs

Manufacturer	Cable type	Artikel No.	KCable \varnothing
	Twinax 105 Ω		
Lapp	Unitronic® Bus CAN 1x2x0,34	2170263	6,8 mm
Helukabel	CAN BUS 1x2x0,34	801572	6,5 mm
Leoni	L-02YSCY 1x2x0.34/2.0-120 VI	L45551-P21-C5	6,8 mm

Table 5-1: Suitable cable types



NOTE!

Mixing of different cable types must always be avoided.

Configuration is carried out either at the instrument website or in SYSTEM-SW (FRAKONET software).

5.4.1 RS-485 BUS 1 - Modbus RTU

Connections are made to the terminals **A**, \perp and **B** of the connector marked **RS-485 BUS 1**.

- **A** signifies RxD - / TxD - , the **Minus** signal line
- **B** signifies RxD - / TxD - , the **Plus** signal line
- \perp signifies chassis, signal ground



NOTE!

Polarity must be taken into account; the signal lines must not be swapped over.

The shielding (\perp) of the bus cable must be earthed at some point in the bus system. If this has not already been done elsewhere, it should be earthed at the PQM.

A 120 Ω terminating resistor must be connected between terminals A and B at both the beginning and the end of the bus.

The maximum length of the bus depends on the set baud rate, but should not exceed 1200 m.

Please refer to the EIA-485 standard for further details.

5.4.2 RS-485 BUS 2 - FRAKO Starkstrombus

Connections are made to the terminals **A**, \perp and **B** of the connector marked **RS-485 BUS 2**.

The poles of the two-wire bus are connected to terminals **A** and **B**, and its shielding to the \perp terminal. The **A** terminal is thus commoned with all the other **A** connections on the bus. The same applies to the **B** and \perp terminals.



NOTE!

Polarity must be taken into account; the signal lines must not be swapped over.

The shielding (\perp) of the bus cable must be earthed at some point in the bus system. If this has not already been done elsewhere, it should be earthed at the PQM.

A bus topology (i.e. single line) must be used, with all devices wired in series or linked to the bus by drop lines no longer than 2 m. Star topologies can be constructed using an EMB 1101 Repeater, available as an accessory.

The total length of the bus should not exceed 1200 m. An EMB 1101 Repeater must be installed to cover greater distances.

A 120 Ω terminating resistor must be installed at each end of the bus by connecting it between the terminals A and B. In bus systems with fewer than 4 devices, a 1 k Ω resistor must also be connected between the terminals A and \perp . The resistors must be rated at 250 mW.

5.5 Digital inputs

The PQM has 6 digital inputs, which comply with the S0 standard DIN 43864.

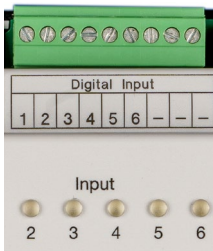


Figure 4 Digital inputs on PQM

Technical Data:

S0 interfaces (DIN43864) for connecting volt-free contacts

- Open-contact voltage: 15 V max.
- Max. line resistance: 800 Ohm

- Short-circuit current: 18 mA
- Max. pulse frequency: 20 Hz
- Min. pulse duration: 30 ms
- All pulses shorter than the set debounce time of 20 ms are ignored.

The configuration of the inputs is done at the instrument website.

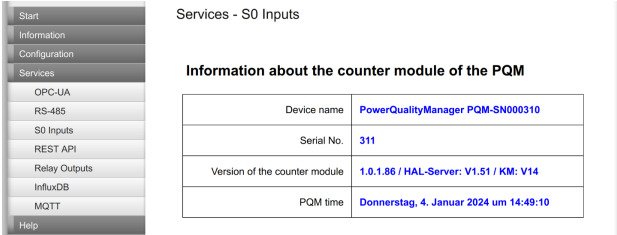


Figure 5 Opening the web page for the S0 inputs

See section 7.3.5

5.6 Analogue outputs

The PQM has 2 analogue outputs. Their standard output signals can be selected:

- 0-20 mA
- 0-10 V



PLEASE NOTE!

No external voltage sources may be connected to the analogue outputs, as they themselves supply the power required for their output signals.

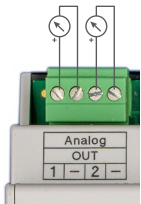


Figure 6 Analogue outputs

The DIP switches 8 and 7 can be set to select the outputs as current or voltage signals.

Analogue outputs	DIP switch	OFF	ON
1	8	0 - 20 mA	0 - 10 V
2	7	0 - 20 mA	0 - 10 V

As shown in Figure 6, no external sources of current or voltage are needed for the output signals.

The analogue signals are calibrated via Modbus TCP. Register addresses are obtained from the Modbus table for the PQM, which can be downloaded as a PDF file from the

5.7 Inputs and outputs not yet in use



DANGER!

To avoid accidents, the following must be observed:

- The safety instructions in *section 5.1 „Electrical connections“*
- All the inputs and outputs listed in this section must not be connected up.

If the above instructions are followed, and the precautions specified in *section 1.2 „Safety instructions“* are taken, the risk of damaging equipment and assets or endangering life and limb can be significantly reduced.



CAUTION!

The software associated with all the inputs and outputs listed in this section has not yet been configured. They cannot therefore be used until future versions of the PQM have been released.

5.7.1 CAN Display – NOT TO BE USED!

6 Commissioning (initial start-up)

6.1 Safety precautions before start-up



DANGER!

To avoid accidents, the following must be observed:

The PQC must be installed in accordance with its intended use before power is switched on. All the connectors supplied with the instrument must be plugged in.

Before start-up, it must be ensured, for example by means of a closed door or a suitable cover, that the instrument terminals can no longer be touched.

If the instrument terminals and connecting cables remain exposed during operation, there is a risk of live components being touched inadvertently. The working voltage may present a hazard to health or may even be life-threatening.

If the above instructions are followed, and the precautions specified in *section 1.2 „Safety instructions“* are taken, the risk of damaging equipment and assets or endangering life and limb can be significantly reduced.

After all installation work has been carried out as described in *section 5 „Installation“* and the above safety precautions have been taken, the power supply may be switched on and the PQM started up.

6.2 Functional checkout

When the power is switched on, it takes several seconds before the PQM starts up. This is indicated by all the LEDs lighting up, and then after about 3 seconds going out again. After this, the **Run** LED starts to flash at intervals similar to a normal heartbeat. Booting up is complete when all the LEDs light up briefly one after the other.

6.3 Initial configuration

6.3.1 Initial configuration of Function 1: Gateway

The initial configuration of the PQM as bus gateway is carried out at the instrument website. Details are given on page 29 and 30 in *„Service functions: RS-485“*.

6.3.2 Initial configuration of Function 2: Data collector

The software SYSTEM-SW is used for the initial configuration of the PQM, and is installed on the PC with the FRAKONET software package. Instructions for setting the PQM are given in the SYSTEM-SW online help section.

The FRAKONET software package is on the DVD supplied with the instrument.



NOTE!

Configuration of the PQM in SYSTEM-SW is comparable with that of the EMIS® 1500 Central Unit. Where the SYSTEM-SW online help section states 'data collector', EMIS or EMIS 1500, the information given can in most cases also be applied to the PQM.

7 Configuration

7.1 DIP switches

DIP V3	DIP V2	ON	OFF	Function	Section
1	8	0 - 10 V	0 - 20 mA	Analogue output 1 standard signal	5.6
2	7	0 - 10 V	0 - 20 mA	Analogue output 2 standard signal	5.6
3	6	activated	deactivated	CAN terminating resistor (120 Ω)	5.7.1
4..7	4..7			Reserved	
8	1	User network settings	Fallback network settings IP: 192.168.0.60 NM: 255.255.255.0	(De)activates user network settings	7.2 7.3.1

Table 7-1 Please refer to the labeling on the PQM for the DIP switch numbering.
DIP V3: This labeling is applicable for PQM hardware version V3 (HW: 3.0) and later.
DIP V2: This labeling is applicable up to and including PQM hardware version V2.1 (HW: 1.0 to 2.1).

7.2 Network

The network is the main interface of the PQM. In the instrument as delivered, the network settings are intended to be configured by DHCP section 7.2.1. If the instrument can no longer be accessed, due to faulty configuration or the loss of an IP address stored within it, the fallback network settings section 7.2.2 can resolve the situation.

7.2.1 User network settings

Network settings by DHCP

In this case the following procedure can be used to determine the IP address:

- IP via DNS
- The name of the PQM comprises PQM-SN followed by its 6-digit serial number, e.g. pqmsn000004
- If the DHCP server can forward the host name to the associated DNS Server (DHCP option 12), the PQM will become accessible under this name.
- MAC lookup via DHCP server
- The IP address can be determined from the MAC address (adhesive label on the PQM) with the help of the administrator of the DHCP server.

Static network settings

If DHCP is deactivated, the network settings stored in the instrument will be used. These can be changed as described in section 7.3.1. The factory default settings are as follows:

IP address::	192.168.0.60
Netmask:	255.255.255.0
Gateway:	192.168.0.1
Time server:	192.168.0.1
DNS server 1:	192.168.0.1

7.2.2 Fallback network settings

This mode can be used to reconfigure a PQM that is no longer accessible for making network settings as described in section 7.3.1.

If **DIP switch 1** is in the **OFF** position, as described in section 7.1 the network configuration of the PQM is given the following settings:

IP address:	192.168.0.60
Netmask:	255.255.255.0



NOTE!

These settings remain effective until **DIP switch 1** is moved to the **ON** position.

7.3 Instrument website

The instrument website is accessed at the IP address of the PQM, which can be entered in a browser, e.g. <http://192.168.0.60> or <http://pqm-snXXXXXX>, where XXXXXX is the serial number of the instrument with leading zeros. To access the site

via the host name it is first necessary to have DHCP enabled in the PQM and a DHCP server with DHCP option 12 activated.

Authentication at the instrument website is by entering the user name **frako**. The default password is also **frako**, but this can be changed if desired in SYSTEM-SW.

7.3.1 Configuration of the network settings

The network settings can be made at the menu item Configuration -> IP address.

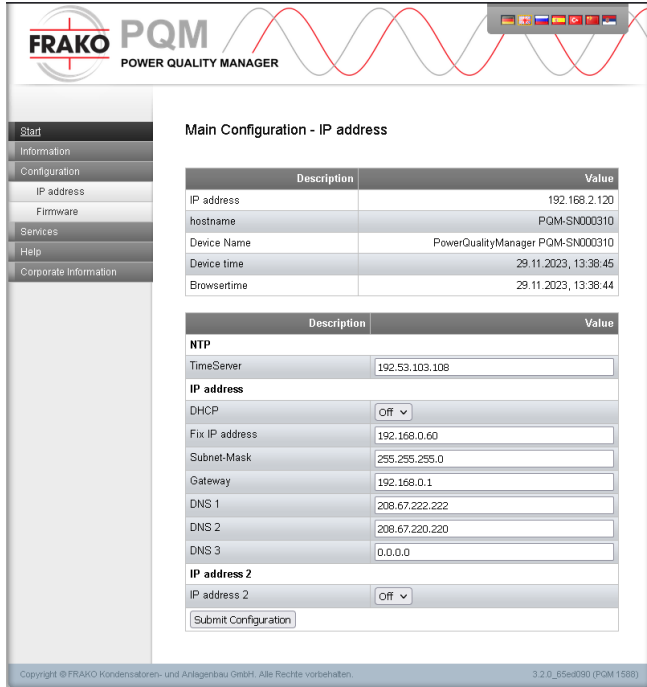


Figure 7 IP configuration web page

I. IP address determined by DHCP

The instrument leaves the factory with DHCP enabled. In this case only the instrument name, instrument description and the NTP server can be modified.

II. Assigning a fixed IP address

To assign a fixed IP address to the PQM, the following action must be taken:

- The menu option **DHCP** must be at **Off**.
Other data entry boxes for the configuration are displayed.
- Enter the desired **IP address** in the appropriate box.
- Enter the associated **subnet mask** in the appropriate box.

- Optionally, you can also enter a **gateway**.
- Optionally, you can enter up to 3 **DNS Servers**.

III. Assigning a second fixed IP address

In addition to the first IP address, regardless of whether this has been assigned as a fixed address or obtained via DHCP, a second fixed IP address can be assigned as follows:

- The menu option **IP address 2** must be at **On**.
- Enter the desired second **IP address** in the appropriate box.
- Enter the associated **subnet mask** in the appropriate box.

With this configuration, the PQM can be accessed by two different IP networks in the same physical Ethernet.

Configuration is completed when the **Send configuration** button is clicked to transfer it to the instrument. The instrument is then restarted and is accessible at the set IP address(es).



CAUTION!

Incorrect configuration can make the instrument either no longer accessible or disruptive to other network entities. It is **absolutely essential** to harmonize the configuration with the network administrator. The following configuration parameters must be obtained from the administrator:

- Free **IPv4 address** e.g. 192.168.1.123
- The **subnet mask** of the network e.g. 255.255.255.0
- One or more IP addresses of the **DNS Server**

Optional but advisable:

- IP address of the **gateway**
- IP address of the **time server**



NOTE!

If the instrument can no longer be accessed for setting purposes, the fall-back network settings described in section 7.2.2 can be activated.

7.3.2 Configuration: firmware update

A firmware update can be carried out either in SYSTEM-SW or at the instrument website.

To carry out a firmware update, use the **Search** button to select a firmware file with the format PQM1588_FIRMWARE_V01.XX.YY_rZZZZZZZ.zip, then click the **OK** button to start the update. This process can take several minutes. After the time indicated has expired, the website can be updated. If the update has been successful, the new version of the PQM firmware is stated against **Firmware Release** in the table (see below).

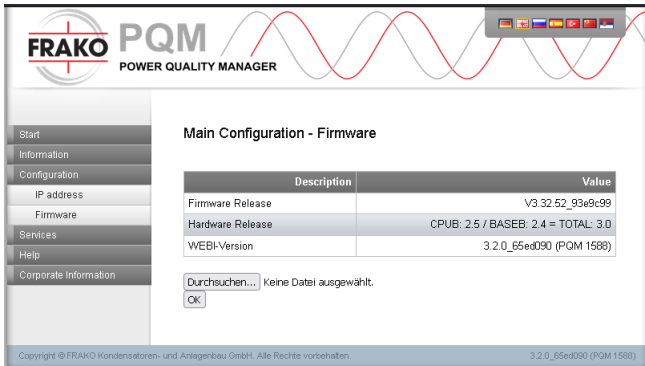


Figure 8 Firmware update



NOTE!

The configuration function described in this section 7.3.2 „*Configuration: firmware update*“ is available for software version 1.26.70 or later.

7.3.3 Service functions: OPC-UA

On this page the PQM service functions and applications can be enabled and disabled. After one or more service functions have been enabled or disabled, the **Send configuration** button must be clicked to complete the configuration process.

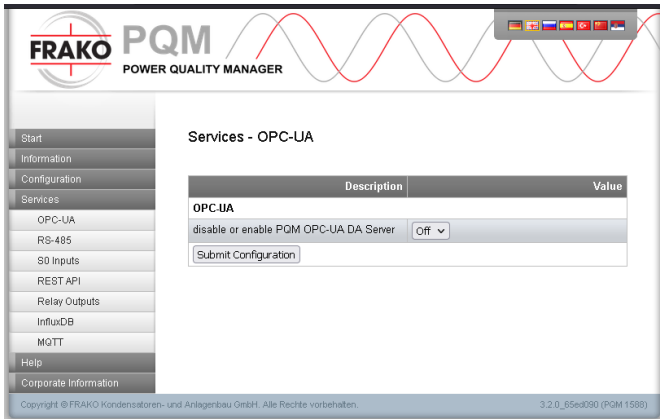


Figure 9 Service functions: OPC-UA



NOTE!

The function described in this section 7.3.3 „*Service functions: OPC-UA*“ is available for software version 1.26.70 or later.

7.3.4 Service functions: RS-485

On this page the settings for the two RS-485 bus interfaces can be adjusted. If it is found that the settings cannot be changed, the PQM hardware will not support an RS-485 interface.

The screenshot shows the FRAKO PQM Power Quality Manager web interface. The top header includes the FRAKO logo and the text 'PQM POWER QUALITY MANAGER'. A navigation menu on the left lists options: Start, Information, Configuration, Services, OPC-UA, RS-485, SO Inputs, REST API, Relay Outputs, InfluxDB, MQTT, Help, and Corporate Information. The main content area is titled 'Services - RS-485' and contains a table with two sections: 'RS 485 Bus 1 - Modbus RTU' and 'RS 485 Bus 2 - Frakobus'. Each section lists parameters with their current values and a 'Submit Configuration' button at the bottom.

Description	Value
RS 485 Bus 1 - Modbus RTU	
RS-485 state	on
Bus usage	gateway
baud	19200
databits	8
parity	NONE
stopbit(s)	1
RS 485 Bus 2 - Frakobus	
RS-485 state	on
Frakobus address	1
Frakobus max masters	8
Frakobus version	10152
<input type="button" value="Submit Configuration"/>	

Copyright © FRAKO Kondensatoren- und Anlagenbau GmbH. Alle Rechte vorbehalten. 3.2.0_RS485090 (PQM 1.588)

Figure 10 Service functions: RS-485



NOTE!

The function described in this section 7.3.4 „Service functions: RS-485“ is available for software version 2.28.50 or later. RS-485 is not available in versions earlier than 2.XX.XX.

The version can be seen by clicking Information in the menu.

Configuration of the two interfaces is by means of drop-down menus. The **Send configuration** button must be clicked to complete the process and implement the configuration. The PQM is restarted when necessary.

7.3.4.1 RS-485 BUS 1 configuration

Setting	Description
RS-485 state	Enable or disable the Modbus RTU interface
Bus usage	internal = The PQM is used as a data collector, the Modbus RTU interface being configured solely for internal use. The interface cannot be accessed via the TCP port 8100. gateway = The PQM is used as a data collector or provides the interface at TCP port 8100 as Modbus RTU over TCP gateway.
Baud	Baud rate of the bus: 9600 to 230400
Databits	7 or 8 data bits
Parity	NONE = no parity ODD = odd parity EVEN = even parity
Stop bit(s)	1 or 2 stop bit

7.3.4.2 RS-485 Bus 2 configuration

Setting	Description
RS-485 state	Enable or disable the FRAKO Starkstrombus
Frakobus address	Bus master address of the PQM
Frakobus max masters	Maximum number of Frakobus masters. Must be the same for all masters on the bus.

7.3.5 Service functions: S0 inputs



NOTE!

The service function *section 7.3.5 „Service functions: S0 inputs“* is available for software version 2.29.16 or later.

The PQM has 6 inputs for the reception of pulses or statuses. Typical sources of the pulses are a counter with pulse output signal, an analogue-frequency converter or a volt-free contact for signalling the state of a component.

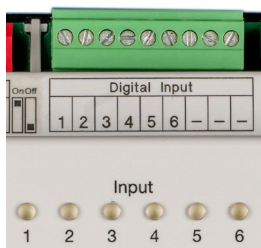


Figure 11 Digital inputs to the PQM

The measurement readings transmitted through the inputs can be acquired via Modbus TCP by the internal data collector or by another Modbus TCP client (e.g. another PQM).

Register addresses are obtained from the Modbus table for the PQM, which can be downloaded as a PDF file from the PQM instrument website at **Help / Downloads**.

7.3.5.1 Configuration

Configuration is carried out at the instrument website.

The screenshot shows the 'Services - S0 Inputs' page of the FRAKO PQM web interface. The page includes a navigation menu on the left with options like 'Start', 'Information', 'Configuration', 'Services', 'OPC-UA', 'RS-485', 'S0 Inputs', 'REST API', 'Relay Outputs', 'InfluxDB', 'MQTT', 'Help', and 'Corporate Information'. The main content area is titled 'Services - S0 Inputs' and contains two tables.

Information about the counter module of the PQM

Device name	PowerQualityManager PQM-SN000310
Serial No.	311
Version of the counter module	1.0.1.86 / HAL-Server: V1.01 / KM: V14
PQM time	Donnerstag, 4. Januar 2024 um 11:55:07

Current measured values of the S0 inputs

Input	Name	State	Derived variable	Counter
1	Kanal 1	OFF	0.00	0.0
2	Kanal 2	OFF	0.00	0.0
3	Kanal 3	ON	0.00	2.0
4	Kanal 4	OFF	0.00	0.0
5	Kanal 5	OFF	0.00	0.0
6	Kanal 6	OFF	0.00	0.0

Below the table, there are two buttons: 'Display measured values of the S0 inputs' and 'Configure S0 inputs'. There are also some explanatory text blocks and a link to 'Modbus table'.

Figure 12 Configuration of the inputs at the instrument website



PLEASE NOTE!

After the PQM is switched on, the web server of the S0 module needs 1 to 2 minutes before it becomes available. The user should therefore allow this time to elapse before accessing the website. If the website is accessed too early, it may be necessary to press the F5 key to reload it. Once the system is operating, the website is available immediately.

To configure the PQM-S0-Moduls follow these steps:

1. Click **Service functions / S0 inputs** in the navigation pane to display the page for the PQM S0 counter module.
This first page shows the momentary condition, the momentary 'derived variable' and the nonresettable counter total for each individual input. (The derived variable is calculated from the rate of change of each digital input. Expressed mathematically, it is the derivative with respect to time of the quantity being metered. Typical examples are electric power demand in kW, flow rate in litres per hour, manufacturing output in components per hour, or time pulses per hour from an electricity supplier.)
2. To display the configuration page, click the **Configure S0 inputs** button.
Depending on the browser setting, this page is opened either in a new tab or in a new window.
3. The configuration page thus displayed shows the current settings for the 1st input. The input to be configured can then be selected from the **S0 input** drop-down menu.

Input settings for Device: PowerQualityManager PQM-SN001174

S0 input	I6: Channel 6	Copy Param from 11	Copy	
Name	Channel 6			
Counter units	kWh			
Multiplier for counter	1	Determine from the parameters for derived variable calculation		
Parameters for derived variable calculation	Calculate from the multiplier for counter			Enter here the multiplier for calculating the counter value. This value range is not limited! For an el. meter without adjustable transformer ratios, the multiplier with kWh as unit is calculated from its VV pulses_per_kWh. If the transformer ratio is adjustable at the meter, the multiplier is calculated as 1 / (PQM-meter-ratio with the pulse value of 1000 pulses per kWh, this would result in a multiplier of 0.001 (or per pulse).
Name of variable	Power Channel 6			
Unit of variable	kW			
Minimum pulse frequency	0	Hz		
Variable at minimum pulse frequency	0	kW		
Maximum pulse frequency	5	Hz		
Variable at maximum pulse frequency	5	kW		
Averaging the variable calculation over	1	Pulses		
Uptime counter units	Sek			
Divisor for uptime counter	1			
Input is inverted	<input type="checkbox"/>			
Debounce time	20	ms		
Add/subtract counter to/from	no group			add

General settings

Name of counter group 1	Total energy group 1
Name of counter group 2	Total energy group 2
Name of counter group 3	Total energy group 3
Name of variable for group 1	Total power group 1
Name of variable for group 2	Total power group 2
Name of variable for group 3	Total power group 3

Accept Save... Load from... Configuration was accepted successfully!

Figure 13 Instrument web page for configuring the inputs

If several inputs are to be configured at the same time, the parameters can be adopted from an input that is already configured. This is done at **Param from** in the top row of the table by selecting one of the inputs **I1–6** from which the parameters are to be copied in the drop-down menu, and then clicking the **Copy** button. Note that the entries at **Name** and **Name of derived variable** are not copied.

- When all the inputs have been configured, the settings must then be transferred to the PQM by clicking the **Accept** button. A text box for entering the password is then displayed. The password consists of the last four numerals of the PQM's serial number.

Enter password to apply the configuration:

After the correct password has been entered, click the **Send configuration** button to write the configuration to the PQM. If this transfer has been successful, the following message appears:

Configuration was accepted successfully!

If an error has occurred, this message is displayed in red.

The entered password is not correct!

If the parameter transfer has been successful, the PQM works from this point onwards with the new inputs configuration.

A correctly entered password remains active for 5 minutes.

7.3.5.1.1 Saving the configuration on the PC

A configuration can also be downloaded to the PC. To do this, click the **Save...** button. The current configuration is then saved in the Downloads folder of the PC under the name S0-Config.JSON. If this file already exists, a sequential number is appended to the name of the new file.

Please note that it is always the configuration that has been edited on the website that is saved. This only corresponds to the configuration with which the PQM is working if this has not been changed since it was loaded or has not been successfully transferred to the PQM with the **Accept** button before the changes were saved.

7.3.5.1.2 Loading a saved configuration

To reload a saved configuration, click the **Load from...** button. A configuration file can then be selected in a file upload dialogue. This should normally have the extension '.JSON', but it is not the file name extension that is crucial but its content. If it is not a valid configuration file, an error message is displayed. When the file has been accepted, it is adopted into the configuration table, where it can then be edited. Clicking the **Accept** button writes the configuration to the PQM.

7.3.5.1.3 Configuration parameters

Possible applications of the inputs:

Depending on the application, not all the parameters need to be configured.

The following applications differ from each other:

- **Volt-free contact that indicates the state of a machine**

In this case the following boxes should be completed:

- Name
- Uptime counter units (optional)
- Divisor for uptime counter (optional)
- Input is inverted

- **Counter:**

In this case the following boxes should be completed:

- Name
- Counter units
- All parameters for derived variable calculation (The parameters can be calculated automatically from the value entered for 'Multiplier for counter'.)

- **Transducer that converts a measured variable, such as temperature, humidity or mg/m³ into a frequency**

In this case the following boxes should be completed:

- All parameters for derived variable calculation

Description of the parameters for the inputs:

Name:

Give each input a unique name relating to its function. The name is limited to 40 characters.

A typical counter input could have the name 'Press shop active energy meter'.

When the input is used to report a condition, an example could be 'Fault at Oven 3', or simply 'Oven 3' if the operational status is to be communicated.

Counter units:

Here enter the engineering units that the counter value is to have when the pulse value is multiplied, e.g. kWh, m³, litres. The length of this unit name or symbol is limited to 10 characters.

Multiplier for counter:

Here enter the multiplier for calculating the engineering units. There is no numerical limit to this factor!

In the case of an electricity meter with kWh as units, where the transformer ratios

cannot be adjusted, the multiplier is given by the formula $V_v \times V_i / \text{pulses_per_kWh}$, where V_v is the voltage transformer ratio and V_i is the current transformer ratio.

If the transformer ratios can be adjusted at the meter, the multiplier is given by $1 / \text{pulses_per_kWh}$.

If a water meter, for example, has m^3 as counter units and a pulse value of 1000 pulses per m^3 , the multiplier will be 0.001 (m^3 per pulse).

Parameters for derived variable calculation:

The derived variable calculation is used when a counter or transducer is connected to the input.

Connecting a counter:

In order to also determine the consumption per hour from counter inputs, the parameters can be calculated directly from the multiplier for the counter. To have this done, simply click the **Calculate from the multiplier for counter** button. The four data entry boxes – **Minimum pulse frequency, Variable at minimum pulse frequency, Maximum pulse frequency, Variable at maximum pulse frequency** – are then completed automatically.

Name	Channel 1
Counter units	kWh
Multiplier for counter	0.04 Determine from the parameters for derived variable calculation
Parameters for derived variable calculation	Calculate from the multiplier for counter
Name of variable	Power Channel 1
Unit of variable	kW
Minimum pulse frequency	0 Hz
Variable at minimum pulse frequency	0 kW
Maximum pulse frequency	1 Hz
Variable at maximum pulse frequency	144 kW
Averaging the variable calculation over	1 Pulses

Figure 14 Calculation of the parameters from the multiplier for the counter

Connecting a transducer:

The derived variable calculation is also used when a transducer with a frequency output signal is connected to the input. These devices measure process variables such as temperature, humidity, etc. and generate a pulse frequency that is proportional to the measured variable. In this case, the four data entry boxes – **Minimum pulse frequency, Variable at minimum pulse frequency, Maximum pulse frequency, Variable at maximum pulse frequency** – must be completed manually using the data specified for the transducer.



Figure 15 Temperature transducer

Name of variable	Temp. building 7
Unit of variable	°C
Minimum pulse frequency	0 Hz
Variable at minimum pulse frequency	-40 °C
Maximum pulse frequency	5 Hz
Variable at maximum pulse frequency	120 °C

Figure 16 Configuration of the temperature transducer shown above

Name of variable:

Here enter a name for the derived variable, e.g. 'Momentary output of press shop'.

Units of variable:

Here enter the units for the variable. Typical units, depending on the application, are kW, pcs/h or °C.

Minimum pulse frequency:

Lower pulse frequency of the transducer

Variable at minimum pulse frequency:

Value of the measured variable at the transducer's minimum pulse frequency

Maximum pulse frequency:

Upper pulse frequency of the transducer

Variable at maximum pulse frequency:

Value of the measured variable at the transducer's maximum pulse frequency

Averaging the derived variable calculation over n pulses:

The number of pulses over which the average is to be taken. This number must lie between 1 and 1000.

Uptime counter units:

Operating time (uptime) is normally expressed in seconds. Other units, such as hours or days, can also be used by selecting the appropriate divisor for the uptime counter.

Divisor for uptime counter:

The divisor must be selected to give the desired units for uptime:

Units	Divisor
seconds	1
hours	3600
days	86400

Input is inverted:

Normally an open input circuit signifies the OFF state, while a closed input circuit (input connected to chassis) means the ON state. Pulse acquisition then occurs at the change from ON to OFF.

With an inverted input, an open circuit signifies the ON state, while a closed input circuit means the OFF state. Pulse acquisition then occurs at the change from OFF to ON.

This inversion does not affect the LEDs on the PQM. These always show the state directly at the input, i.e. an LED always lights up when it is connected to the chassis (signal ground).

Debounce time:

The debounce time prevents several pulses being counted due to a relay contact bouncing when it closes.

It specifies the minimum period between two changes of state. If a change of state occurs in a period of time less than the set debounce time, it will be ignored. The debounce time is set at 0 ms in the factory and normally does not need to be changed.

Counter added to or subtracted from group n:

The counter reading of each of the 6 inputs can be added to or subtracted from one of the 3 available group counters. In addition, the derived variables from the counters of a group can be combined arithmetically to give a group value.

A typical example of when this function is useful is when the active energy consumption of 3 departments is to be recorded, but only Departments 1 and 2 have their own individual counters, although there is a counter for the combined consumption. The energy consumption of Department 3 can then be calculated from a group counter, i.e. $W^3 = W^{total} - W^1 - W^2$.

The 'Total' counter is added to group n.

The 'Department 1' counter is subtracted from group n.

The 'Department 2' counter is subtracted from group n.

The group counter n then corresponds to the energy consumption of Department 3.

7.3.5.1.3.1 General settings:

Name of counter group 1-3:

If a counter has been assigned to a group, the name for the consumption figure of the group can be entered here.

Name of variable for group 1-3

If a counter has been assigned to a group, the name for the arithmetically combined derived variable of the group can be entered here.

7.3.5.2 Display of measurement readings

Only the most important measured values are displayed on the main page:

- Momentary state, taking into account input inversion
- Momentary power, flow etc. (pulses/time)
- Non-resettable energy counter

FRAKO PQM POWER QUALITY MANAGER

Start
Information
Configuration
Services
OPC-UA
RS-485
S0 Inputs
REST API
Relay Outputs
InfluxDB
MQTT
Help
Corporate Information

Services - S0 Inputs

Information about the counter module of the PQM

Device name	PowerQualityManager PQM-SN000310
Serial No.	311
Version of the counter module	1.0.1.86 / HAL-Server: V1.51 / KM: V14
PQM time	Donnerstag, 4. Januar 2024 um 11:55:07

Current measured values of the S0 inputs

Input	Name	State	Derived variable	Counter
1	Kanal 1	OFF	0.00	0.0
2	Kanal 2	OFF	0.00	0.0
3	Kanal 3	ON	0.00	2.0
4	Kanal 4	OFF	0.00	0.0
5	Kanal 5	OFF	0.00	0.0
6	Kanal 6	OFF	0.00	0.0

Display measured values of the S0 inputs

Here you can display all recorded measured values of the S0 inputs and the group counters in full screen

Configure S0 inputs

Here you configure the name, unit, multiplier of the S0 inputs and group counter

[Modbus table](#)

Copyright © FRAKO Kondensatoren- und Anlagenbau GmbH. Alle Rechte vorbehalten. 3.2.0_65e090 (PQM 1588)

Figure 17 Web page for instrument S0 inputs

To show all the measured values, click the **Display measured values of the S0 inputs** button.

FRAKO PQM POWER QUALITY MANAGER

Current readings from device: PowerQualityManager PQM-SN001174

Input	Name	State	Derived variable	Derived variable avg.	Pulses	Counter	Counter A resettable	Counter B resettable	Time ON resettable	Time OFF resettable	Timestamp reset
1	Channel 1	OFF	0.00 kW	0.00 kW	0 Puls.	0.0 kWh	0.0 kWh	0.0 kWh	0.0 Sek.	322.0 Sek.	Counter A: 10.1.2024 09:52:24 Counter B: 10.1.2024 09:52:24 Time ON/OFF: 10.1.2024 09:52:24
2	Channel 2	OFF	0.00 kW	0.00 kW	0 Puls.	0.0 kWh	0.0 kWh	0.0 kWh	0.0 Sek.	322.0 Sek.	Counter A: 10.1.2024 09:52:24 Counter B: 10.1.2024 09:52:24 Time ON/OFF: 10.1.2024 09:52:24
3	Channel 3	OFF	0.00 kW	0.00 kW	0 Puls.	0.0 kWh	0.0 kWh	0.0 kWh	0.0 Sek.	322.0 Sek.	Counter A: 10.1.2024 09:52:24 Counter B: 10.1.2024 09:52:24 Time ON/OFF: 10.1.2024 09:52:24
4	Channel 4	OFF	0.00 kW	0.00 kW	0 Puls.	0.0 kWh	0.0 kWh	0.0 kWh	0.0 Sek.	322.0 Sek.	Counter A: 10.1.2024 09:52:24 Counter B: 10.1.2024 09:52:24 Time ON/OFF: 10.1.2024 09:52:24
5	Channel 5	OFF	0.00 kW	0.00 kW	0 Puls.	0.0 kWh	0.0 kWh	0.0 kWh	0.0 Sek.	322.0 Sek.	Counter A: 10.1.2024 09:52:24 Counter B: 10.1.2024 09:52:24 Time ON/OFF: 10.1.2024 09:52:24
6	Channel 6	OFF	0.00 kW	0.00 kW	0 Puls.	0.0 kWh	0.0 kWh	0.0 kWh	0.0 Sek.	322.0 Sek.	Counter A: 10.1.2024 09:52:24 Counter B: 10.1.2024 09:52:24 Time ON/OFF: 10.1.2024 09:52:24
Group 1	Total energy group 1		0.00			0.0					Counter A: 1.1.1980 01:00:00
Group 2	Total energy group 2		0.00			0.0					Counter A: 1.1.1980 01:00:00

Figure 18 Instrument web page displaying measured values

The following measured values are displayed:

State:

Here the momentary state is indicated, taking into account any inversion of the input. Please note that the LEDs on the PQM always show the state of the inputs without taking inversion into account.

Derived variable:

Here the derived variable calculated from the pulse frequency is displayed. If a transducer for a process variable such as °C, mg/m³ etc. is connected, the measured value is indicated here.

Derived variable average:

The value of the derived variable averaged over the number of pulses specified in the input configuration at averaging the variable calculation over n pulses. This is a rolling average, which enables a stable measurement reading to be obtained at a high pulse frequency.

Pulses:

The total number of pulses received is shown here. This counter is not resettable.

Counter:

Here the calculated counter reading is displayed.

The consumption figure is arrived at by periodically subtracting the most recently read pulse counter total from the momentary total and multiplying the difference by the pulse value:

$$W_{\text{diff}} = \text{Counter_Mul} \times (\text{Counter_Imp_new} - \text{Counter_Imp_old})$$

W_{diff} is then added to the calculated counter reading. A change in the multiplier (e.g. after installation of a larger current transformer) therefore only affects future pulses.

Counters A/B resettable:

Each input has two separately resettable counters. These can be used, for example, to directly display the utility consumption during the manufacture of a product or the number of items produced in that time. To do this, the counter is reset at the start of the manufacturing run.

Time ON/OFF resettable:

These two counters are used to show the time elapsed in the ON and OFF states for the configured unit. Please note that here any inversion is taken into account.

State at input	Inversion	Counter ON	Counter ON
Open	Not inverted		X
Closed	Not inverted	X	
Open	Inverted	X	
Closed	Inverted		X

Timestamp reset:

Here the date and time of the last reset are shown for all 3 resettable counters.

7.3.5.2.1 Zeroing resettable counters

There are 3 resettable counters for each input. These can be reset individually or together.

The button for starting the reset procedure is at the bottom of the web page displaying the measured values.

1. First select one input or all 6 inputs to be reset:

2. Then select one of the counters at the input or **All**:

3. Click the **Reset** button and enter the password, which consists of the last four numerals of the PQM serial number.

Enter password to reset the counters:

4. Click the **Send reset command** button to execute the reset.

If the correct password has been entered, the message **OK! Counters were successfully reset.** appears, highlighted in green. A correctly entered password remains active for 5 minutes.

7.3.6 REST API

The REST API can be accessed on port 8080 or 8443, where all endpoints of the REST API are documented with examples.

7.3.7 Relay Outputs



NOTE!

The following function is available for PQM version V3.0 (HW: 3.0 and SW: V3.XX.XX) and later.

With PQM firmware version 3.32.52 and later, the 7 internal relays (OUT 1-5 and the two alarm relays ALARM 1-2) can be switched via the web interface or Modbus-TCP. The configuration of the 7 relays is done through the PQM web interface.

Please note that relays already used by the PQM alarm system cannot be used for switching via Modbus-TCP or the web interface. In order to use a relay for external switching, all alarm paths using that relay must be removed from the PQM configuration. (See Define Alarm Paths in the SYSTEM-SW help).

Services - Relay Outputs

Information about the counter module of the PQM

Device name	PowerQualityManager PQM-SN000310
Serial no.	311
Version of the relay module	1.0.1.86 / HAL-Server: V1.51 / KM: V14
PQM time	Donnerstag, 4. Januar 2024 um 11:48:41

Current states of the relay outputs

Output	Name	State	User	Switch	Status
OUT 1	Ausgang 1	ON	Not used!		
OUT 2	Ausgang 2	ON	Not used!		
OUT 3	Ausgang 3	OFF	Not used!		
OUT 4	Ausgang 4	OFF	Not used!		
OUT 5	Ausgang 5	OFF	Not used!		
Alarm 1	Ausgang 6	OFF	PQM alarm		
Alarm 2	Ausgang 7	OFF	PQM alarm		

Here you can configure the relay outputs to switch them via Modbus TCP or the website

[Modbus table](#)

On the “Services - Relay Outputs” page, you can see the current relay states of the PQM.

Output: Designation on the PQM

Name: User-assigned name of the output

State: Current machine state. Unlike the relay state, this takes into account the output inversion.

That means, if the output inversion is active, the state “ON” is displayed here even though the relay is open. This is useful when a control input is used where a machine is switched on when the contact is open.

User: This column shows who has access to the output relays.

PQM Alarm: Only the PQM itself has access and outputs the alarm states of the internal alarm management.

Modbus/Web: Switching the relays is possible both via Modbus and through the web interface.

Switching: All outputs configured as “Modbus/Web” can be controlled using the “ON” and “OFF” buttons.

Status: If a timeout greater than 0 is configured for outputs switched via Modbus/Web, the time in seconds until the timeout counter expires and the relay switches to the pre-configured fault state is displayed here. This ensures that in case of a connection loss between Modbus Master (external control app) and Modbus Slave (PQM), all relays assume a defined state.

To configure the relay outputs, click on the “Configure Relay Outputs” button.

Relay output	OUT 1: Cold room	Parameter of	copy	Select here the output to be configured. You can accept the settings of an output from another output.
name	Cold room			Name of the device which is switched via this output.
Output used by modbus-TCP / Web	<input checked="" type="checkbox"/>			Mark this field if the output should be switched via Modbus-TCP or the web page.
Output is inverted	<input type="checkbox"/>			If enabled, the output is inverted. This affects the error and the LED on the device. On the website, however, the inversion is ignored and the condition of the connected device is displayed!
Timeout time until the error state is activated	120 sec.			The error state is activated if no writing to this output has been carried out for longer than the time specified here. A value of 0 deactivates this function.
Error state when write access no longer occurs	ON			Specify here which state the connected device should receive after the timeout period since the last write access.

Accept Save... Load from... **Settings were successfully adopted!**

Proceed as follows:

Select the relay output you want to configure from the “Relay Output” dropdown.

If you have already configured another output with the same properties, except for the name, you can choose that output from the “Copy parameters from” dropdown and then use the “Copy” button to transfer the parameters of that output to the current form.

Enter a meaningful designation for this output in the “Name” field. It would be sensible to use the name of the device that the output is intended to control.

Check the “Use output for Modbus-TCP/Web” checkbox so that this output can be controlled via Modbus-TCP or the web interface. The checkbox can only be activated if the output is not used in the PQM’s alarm management (see SYSTEM-SW help).

If the device has a control input where the device is turned on when the contact is open, you can invert the relay state by checking the “Invert output” checkbox. That means with active inversion, the relay is open in the ON state.

If you want to ensure that in case of a fault or interruption of the connection to the PQM, the controlled device switches to a defined state, enter a timeout period in seconds under “Timeout time until activation of the fault state”. After this time expires, the output switches to the state specified under “Fault state if no write access occurs”.

If you enter 0 seconds, this function is disabled, and the last written state remains permanently active. Note that when using the timeout function, the Modbus Master must cyclically send the current state to reset the timeout counter before it reaches 0.

The PQM provides relay data via Modbus-TCP on port 502. Using Modbus-TCP, relays that are not used by the PQM’s alarm system can be controlled.

Reading and writing to the relay outputs:

Base addresses: OUT 1 = 4002, OUT 2 = 4006, OUT 3 = 4010, OUT 4 = 4014, OUT 5 = 4018, Alarm 1 = 4022, Alarm 2 = 4026.

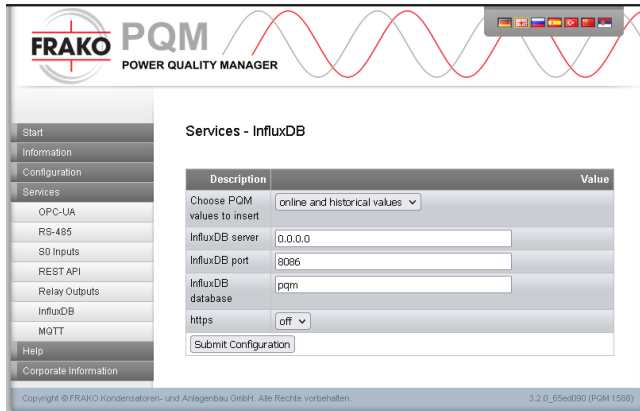
Offset to the base address of the output	Function Code	Daten- typ	Length in Bytes	Read Write		Comment
0	3, 6, 16	UINT16	2	R	User	User of the output: 1 = used by Modbus TCP Server, website 2 = used by PQM alarm system The value can only be read here.
1	3, 5, 6, 16	UINT16	2	R/W	State	Switching the output (machine state considering inversion): 0x0000 = OFF 0xFF00 = ON Registers for controlling the outputs by the EM-MC 2200. Address = OUT1: 4003, OUT2: 4007, OUT3: 4011, OUT4: 4015, OUT5: 4019, Alarm1: 4023, Alarm2: 4027 Function Code = 5
2	3	INT32	2	R	Time_ until Error_ State	> 0: Time in seconds until the fault state is activated. 0: Timeout expired < 0: Time in seconds since the fault state has been active.

7.3.8 InfluxDB



NOTE!

The following function is available for PQM version V3.0 (HW: 3.0 and SW: V3.XX.XX) and later.



The measurements captured by the PQM can be stored in an Influx database. Either current values, aggregated values, or both types can be stored in the specified database on the InfluxDB server.

The Influx server can be specified as DNS or IP. The specified database must already exist on the server.

7.3.9 MQTT



NOTE!

The following function is available for PQM version V3.0 (HW: 3.0 and SW: V3.XX.XX) and later.

The screenshot shows the FRAKO PQM web interface. The top left features the FRAKO logo and the text 'PQM POWER QUALITY MANAGER'. A navigation menu on the left includes 'Start', 'Information', 'Configuration', 'Services', 'OPC-UA', 'RS-485', 'S0 Inputs', 'REST API', 'Relay Outputs', 'InfluxDB', 'MQTT', 'Help', and 'Corporate Information'. The main content area is titled 'Services - MQTT' and contains a configuration table with the following data:

Description	Value
Internal MQTT Broker	
PQM MQTT broker	on
PQM MQTT broker port (default 1883)	1883
Publish	
Choose PQM values to publish	online and historical values
use PQM MQTT broker	no
Broker IP	localhost
Broker port (default 1883)	1883
Main MQTT topic	PQM-SN000310
<input type="button" value="Submit Configuration"/>	

At the bottom of the interface, there is a copyright notice: 'Copyright © FRAKO Kondensatoren- und Anlagenbau GmbH. Alle Rechte vorbehalten.' and a version identifier: '3.2.0_65ex030 (PQM 1588)'.

The measurements recorded by the PQM can be transmitted to an MQTT broker using the MQTT protocol.

Either current values, aggregated values, or both types of values can be published.

The PQM has its own MQTT broker, which can be activated and used. If an external broker is to be used, it must be specified in the settings.

7.3.10 Help: Tools

At the menu item **Tools** a “ping test” can be carried out to see whether the PQM can access another device.

The utility **nslookup** can be used to check the name resolution and thus the correct communication between the PQM and the DNS Server.

8 Operation

The software SYSTEM-SW is used for the configuration of the PQM, and is installed on the PC with the *FRAKONET* software package. Setting the PQM is described in the SYSTEMSW online Help section.

The *FRAKONET* software package is on the DVD supplied with the instrument.



NOTE!

Configuration of the PQM in SYSTEM-SW is comparable with that of the EMIS® 1500 Central Unit. Where the SYSTEM-SW online help section states 'data collector', EMIS or EMIS 1500, the information given can in most cases also be applied to the PQM.

9 Maintenance

9.1 Cleaning



DANGER!

The following instructions must be observed to avoid danger to life and limb:

- During cleaning, the instrument and the connecting cables must be isolated from the power supply.
- The isolated electrical system must be locked out to prevent its being inadvertently switched on again.
- The immediate vicinity must be covered.
- All connections must be checked to verify that they are no longer live!
- Power must not be switched on again to the installation until the cleaning work is completed.

When work is carried out in the vicinity of the instrument terminals and connecting cables, there is a risk of live components being touched inadvertently. A moist cleaning cloth, which conducts electricity, must never be used. The working voltage may present a hazard to health or may even be life-threatening.

If the above instructions are followed, the risk of endangering life and limb can be significantly reduced.

The instrument may only be cleaned with a dry cloth. When this is done, the above safety instructions must be followed. All power to the instrument must be switched

off before cleaning is begun. Power must not be switched on to the instrument again until the cleaning procedure is completed.

10 Decommissioning and removal, storage and disposal

10.1 Decommissioning and removal

When decommissioning and removal work is carried out, please note the following:



DANGER!

The following instructions must be observed to prevent danger to life and limb or damage to equipment and other assets:

- When the instrument is removed, it is essential to switch off the power to the instrument and the installation beforehand.
- The isolated electrical system must be locked out to prevent its being inadvertently switched on again.
- All connections must be checked to verify that they are no longer live!
- All live components in the immediate vicinity must be covered to prevent inadvertent contact.

When work is carried out on the instrument terminals and connecting cables, there is a risk of live components being touched inadvertently. The working voltage may present a hazard to health or may even be life-threatening.

If the above instructions are followed, the risk of endangering life and limb or damaging equipment can be significantly reduced.



DANGER!

The following instructions must be observed to prevent danger to life and limb or damage to equipment and other assets:

- All live cables must be disconnected from the instrument.
- All disconnected cables must be individually isolated and insulated, and measures must be taken to prevent their inadvertent contact with live components or electrically conducting parts.
- If it is intended that connecting cables that have been disconnected from the instrument are to become live again after the instrument has been removed, adequate measures must be taken to prevent their inadvertent contact with other live components or electrically conducting parts.

Exposed electrical conductors that can be touched are a hazard to life and

limb. If they come into contact with other electrically conducting components, the latter can also become live. In addition, cables designated only for low voltages can carry life-threatening higher voltages if they come into contact with cables at the supply network voltage.

To prevent this danger to life and limb, the exposed ends of disconnected cables must be individually insulated in a workmanlike manner. The ends of these cables must not be joined to each other, and it must be ensured that cable ends cannot be touched, and that they do not touch each other or other components.



CAUTION!

If the exposed ends of disconnected cables come into contact with each other, this can result in short circuits and overloading of the installation conductors, resulting in damage to equipment and other assets.

All disconnected cables must be individually isolated and insulated, and measures must be taken to prevent their inadvertent contact with live components or electrically conducting parts.

Instrument removal:



DANGER!

The following instructions must be observed to prevent danger to life and limb or damage to equipment and other assets:

– All power to the entire control cabinet must be switched off before the PQM is removed!



If the above instructions are followed, and the precautions specified in *section 1.2 „Safety instructions“* are taken, the risk of damaging equipment and assets or endangering life and limb can be significantly reduced.

The PQM is held on the DIN rail by its retaining clips. Before the instrument is removed, all the clips must first be withdrawn until they click into place. After instrument removal, the clips are pushed back into the instrument base.

10.2 Storage

- Der PQM must be stored in a clean, dry and dust-free location.
- The storage temperature must be within the range -20° C to +80° C.

10.3 Disposal

Any electronic instrument that is no longer required must be disposed of in an environmentally sound manner.



CAUTION!

Incorrect disposal can cause environmental pollution.

- In the European Union, electrical scrap and electronic components are subject to the WEEE (Waste Electrical and Electronic Equipment) Directive. These components must not be disposed of as normal domestic or commercial waste.

If this is not complied with, there is a danger that environmental pollution may result and a violation of the Directive will have occurred.

In countries that are not EU members, the equivalent local regulations must be followed when electronic instruments are disposed of. They must be handed in at special recycling centres.



One way of ensuring environmentally sound disposal is to return the instruments to FRAKO Kondensatoren und Anlagenbau GmbH in Teningen or the company's local representatives. Alternatively, the instruments can be given to a firm specializing in the recycling of electronic equipment.

11 General notes

The following points must be observed when the instrument is operated:

- The instrument must always be operated in a closed control cabinet as described in *section 4 „Mounting the instrument“*.
- All voltages applied to the instrument must never exceed the limits specified in the technical data.
- The ambient temperatures must always be within the range specified in the technical data.

Instrument operation is described in *section 8 „Operation“*.

12 Scope of supply

- 1x PQM
- 1x software DVD
- 1x operating manual

Power Capacitors
Reactive Power Control Relays
Power Factor Correction Systems
Modules
EMS Components
Measuring Instruments and Network Analysers
Power Quality
EMS ISO 50001



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