Iskra®

User 's Manual

EN

Power Monitoring Device MC 7x0

Power Quality Analyzer MC 770
Network Recorder MC 750
Multifunction Meter MC 740

PLEASE NOTE

Valid for devices with hardware version D and above, marked as a MC 7×0A (side label).

January 2020 • Version 1.00

Power Monitoring Device

MC 7x0

User and Installation manual

Security Advices and Warnings

Please read this chapter carefully and examine the equipment carefully for potential damages which might arise during transport and to become familiar with it before continue to install, energize and work with a *MC 7×0 Power Monitoring Device*.

This chapter deals with important information and warnings that should be considered for safe installation and handling with a device in order to assure its correct use and continuous operation.

Everyone using the product should become familiar with the contents of chapter »Security Advices and Warnings«.

If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

PLEASE NOTE

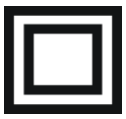
This booklet contains instructions for installation and use of a MC 7×0 Power Monitoring Device. Installation and use of a device also includes handling with dangerous currents and voltages therefore should be installed, operated, serviced and maintained by qualified personnel only. ISKRA Company assumes no responsibility in connection with installation and use of the product. If there is any doubt regarding installation and use of the system in which the device is used for measuring or supervision, please contact a person who is responsible for installation of such system.

Before switching the device ON

Check the following before switching on the device:

- Nominal voltage.
- Supply voltage.
- Nominal frequency.
- Voltage ratio and phase sequence.
- Current transformer ratio and terminals integrity.
- Protection fuse for voltage inputs (recommended maximal external fuse size is 6 A).
- External switch or circuit breaker must be included in the installation for disconnection of the device's aux. power supply. It must be suitably located and properly marked for reliable disconnection of the device when needed.
- Integrity of earth terminal.
- Proper connection and voltage level of I/O module.

Used symbols on device's housing and labels

SYMBOL	EXPLANATION
	**DANGER** Indicates proximity of hazardous high voltage, which might result in serious injury or death if not handled with care.
	**WARNING** Indicates situations where careful reading of this manual is required and following requested steps to avoid potential injury is advised.
	Double insulation in compliance with the EN 61010−1: 2010 standard.
	Functional ground potential. **Note:** This symbol is also used for marking a terminal for ground potential, which is used as a fourth voltage input channel.
	Compliance of the product with directive 2002/96/EC, as first priority, the prevention of waste electrical and electronic equipment (WEEE), and in addition, the reuse, recycling and other forms of recovery of such wastes so as to reduce the disposal of waste. It also seeks to improve the environmental performance of all operators involved in the life cycle of electrical and electronic equipment.
	Compliance of the product with European CE directives.

Disposal

It is strongly recommended that electrical and electronic equipment (WEEE) is not deposit as municipal waste. The manufacturer or provider shall take waste electrical and electronic equipment free of charge. The complete procedure after lifetime should comply with the Directive 2002/96/EC about restriction on the use of certain hazardous substances in electrical and electronic equipment.

Contents

Basic description and operation

The following chapter presents basic information about *MC 7×0 Power Monitoring Device* required to understand its purpose, applicability and basic features connected to its operation.

Besides that, this chapter contains navigational tips, description of used symbols and other useful information for understandable navigation through this manual.

In this chapter you will find:

Introduction

Regarding the options of a *MC 7×0 Power Monitoring Device*, different chapters should be considered since it might vary in functionality and design. More detailed description of device functions is given in chapter *Main Features, supported options and functionality, page 12.*

MC 7×0 Power Monitoring Device is available in housing for panel mounting. Specifications of housing and panel cut out for housing is specified in chapter *Dimensions on page 160*.

Description of symbols

In different chapters or tables different symbols may appear in User's Manual. According to the position of symbols, they have different meaning.

Subchapter

Symbols next to the subchapters indicate accessibility of functions described. Accessibility of functions is indicated with the following symbols:

PC Function accessible via communication (MiQen software)

Function accessible via navigation keys on the device front side

Tables

Supported functions and measurements are listed in tables. Symbols in tables indicate support of enabled functions for different connection schemes. Additionally a legend is placed below table of used symbols. Meaning of symbols is:

- ● Function is supported
- × Function is not supported
- ○ Symbol meaning varies and is described in the legend below the table

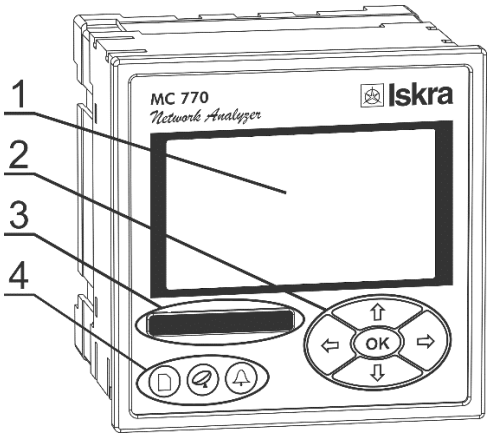
Description of the device

MC 7×0 Power Monitoring Device is a comprehensive device intended for permanent monitoring of power quality from its production (especially renewable), transmission, distribution to final consumers, who are most affected by insufficient quality of voltage. It is mostly applicable in medium and low voltage markets.

Lack of information about supplied quality of voltage can lead to unexplained production problems and malfunction or even damage to equipment used in production process. Therefore, this device can be used for utility purposes (evaluation against standards) as well as for industial purposes (e.g. for monitoring supplied power quality).

Appearance

1 Graphical LCD
2 Navigation keyboard
3 A slot with a cover for SD/MMC
4 LED indicators



Graphical LCD

A graphical LCD with back light is used for high resolution of displayed measuring quantities and for a display of selected functions when setting the device.

Navigation keyboard

The "OK" key is used for confirming the settings, selecting and exiting the display. Direction keys are used for shifting between screens and menus.

A slot with a cover Memory card

A Power monitoring device is provided with a slot for a SD card that is used for data transfer from the internal memory, device setting and software upgrading. A slot protection cover for the card prevents penetration of humidity and dust into device.

LED indicators

There are two types of LED indicators positioned on the front panel. General operation LED indicators and I/O status LED indicators.

General operation LED indicators warns of a certain state of the device. A left (red) indicator indicates the card activity and that it should not be pulled out. A middle (green) one is blinking when transmitting MC data via communication. A right (red) one is blinking when the condition for the alarm is fulfilled.

Purpose and use of the devices

MC 740 Multifunction Meter

MC 740 Multifunction Meter is intended for monitoring and measuring electric quantities of three-phase electrical power distribution system. It is provided with 32 programmable alarms, up to four input or output modules and communication. With the RS232/RS485 or Ethernet/USB communication, the device can be set and measurements can be checked. The device also functions as an energy counter, with the additional function of cost management by tariffs. A tariff input or a tariff clock can be set. At tariff clock setting, four seasons and four day groups as well as energy cost for each period and a day group (16 different cost periods) are available. Additionally, 20 places are available for setting holidays. As an energy counter it can record energy in all four quadrants in four tariffs.

MC 750 Network recorder

MC 750 Network recorder is used for monitoring, measuring and recording measurements of electric quantities of electrical power distribution system. Up to 64 measurements and up to 32 alarms are recorded in the internal memory. The memory is separated into four sections for measurements (A, B, C and D) and one section for recording alarms. The memory division is defined by the user via communication or a memory card.

MC 770 Power Quality Analyzer

MC 770 Power Quality Analyzer performs measurements in compliance with regulatory requested standard EN 61000-4-30 and evaluates recorded parameters for analysis according to parameters defined in European supply quality standard EN 50160:2011.

Moreover device stores measurements and quality reports in internal memory for further analysis over recorded measurements. From multiple devices installed on different locations, user can gain the overall picture of system behaviour. This can be achieved with regard to its accurate internal real time clock and wide range of synchronization sources support, which assure accurate, time-stamped measurements from dislocated units.

All required measurements, weekly PQ reports and alarms can also be stored locally in an internal memory. Stored data can be then transferred to a memory card or accessed through communication for post analysis.

The internal memory capacity enables storing of more than 170,000 variations of the measurements from the standard values, which enables finding eventual reasons for the problems in network. Limits and required quality in a monitored period can be defined for each monitored characteristic. The following characteristics are measured and recorded:

Power Quality indices as defined by EN 50160 table:

Phenomena	**PQ Parameters**
Frequency variations	Frequency distortion
Voltage variations	Voltage fluctuation Voltage unbalance
Voltage changes	Rapid voltage changes Flicker
Voltage events	Voltage dips Voltage interruptions Voltage swells
Harmonics & THD	THD Harmonics Inter-harmonics Signalling voltage

Main features, supported options and functionality

MC 7×0 Power Monitoring Device is a perfect tool for monitoring and analysing medium or low voltage systems in power distribution and industrial segments. It can be used as a standalone PQ monitoring device for detection of local PQ deviations. For this purpose it is normally positioned at the point-of-common-coupling (PCC) of small and medium industrial and commercial energy consumers to monitor quality of delivered electric energy or at medium or low voltage feeders to monitor, detect and record possible disturbances caused by (unauthorized) operation of consumers (PQ analysis for MC 770 only).

User can select different hardware modules that can be implemented in device. Wide range of variants can cover practically every user's requirements.

MC 7×0 Power Monitoring Device is a compact, user friendly and cost effective device that offers various features to suit most of the requirements for a demanding power system management:

- Evaluation of the electricity supply quality in compliance with EN 50160 with automatic report generation. (only for MC 770).
- Measurements of instantaneous values of more than 140 quantities including harmonics, flicker (only for MC 770), power line signalling voltage, unbalance, etc..
- Class A (0.1%) accuracy in compliance with EN61000-4-30 (only for MC 770).
- Class S (0.2%) accuracy in compliance with EN61000-4-30 (MC 750 and MC 740).
- Four quadrant energy measurement with class 0.5 S or 0.2 S for active energy (8 programmable energy counters, up to four tariffs, tariff clock, etc.).
- Automatic range selection of 3 current and 4 voltage channels (max. 12.5 A and 1000 V_{RMS}) with 32 kHz sampling rate.
- Recording all measured parameters including all voltage and current harmonics up to 63rd, 32 adjustable alarms, anomalies and quality reports in the internal memory. (only for MC 770)
- Recording all measured parameters including all voltage and current harmonics up to 65rd, 32 adjustable alarms in the internal memory (8 MB flash). (only for MC 750)
- Measurements of 40 minimal and maximal values in different time intervals (from 1 period to 256 periods).
- Frequency range from 16 Hz to 400 Hz.
- Up to three independent communication ports (RS232 or RS485 up to 115,200 bit/s, Ethernet and USB 2.0).
- MODBUS and DNP3 communication protocols.
- Support for NTP real time synchronisation.
- Support for effective sub metering applications (comprehensive counters settings, tariff and cost management).
- Up to 4 inputs and outputs (analogue inputs/outputs, digital inputs/outputs, alarm/watchdog outputs, pulse input/outputs, tariff inputs).

- Multilingual support.
- Universal or AC power supply.
- 96 mm square panel mounting.
- Extension unit with four configurable analogue outputs – EX104 (0.4 mA_{DC} … 20 mA_{DC}, 0 V_{DC} … 10 V_{DC}). (only for MC 740/MC 750)
- PQ analysis in compliance with EN 50160 with automatic report generation. (only for MC 770)
- User-friendly setting and evaluation software, MiQen.

General hardware Features	Default/Optional MC 740	Default/Optional MC 750	Default/Optional MC 770
General			
Class A measuring accuracy according to EN 61000-4-30			●
Class S measuring accuracy according to EN 61000-4-30	●	●	
Current auto range up to 12.5 A	●	●	●
4 voltage and 3 current channels with 32 kHz sampling time	●	●	●
Universal / AC power supply	●/○	●/○	●/○
Three independent communication ports (see data below)	○	○	○
Support for NTP real time synchronisation (versions with Ethernet communication only)	●	●	●
Up to 4 additional inputs and outputs (see data below)	○	○	○
Internal flash memory (8MB)		●	●
Real time clock (RTC)	●	●	●
Standard 96 mm DIN square panel mounting	●	●	●
Front panel			
Graphical LCD display with back light	●	●	●
LED indicator (card/com./alarm)	●	●	●
SD memory card slot for data transfer	●	●	●
Control keys on front panel (5 keys)	●	●	●

Communication			
COM1: Ethernet +USB/Serial (RS232/485)	○/●	○/●	○/●
COM2: serial RS232 or RS485 as I/O module 2	○	○	○
Serial communication for EX104	○	○	○

- ● – Function is supported (default)
- ○ – Optional (to be specified with an order)

General hardware Features	Default / Optional MC 740	Default / Optional MC 750	Default / Optional MC 770
Input and output modules			
Input/output module 1			
2×AO/2×AI/2×RO/2×PO/2×PI/2×TI/1×BO/2×DI/WO+RO	○/○/○/○/○/○/○/○/○	○/○/○/○/○/○/○/○/○	○/○/○/○/○/○/○/○/○
Input/output module 2			
2×AO/2×AI/2×RO/2×PO/2×PI/1×BO/2×DI/WO+RO/ COM2	○/○/○/○/○/○/○/○/○	○/○/○/○/○/○/○/○/○	○/○/○/○/○/○/○/○/○

●	Function is supported (default)
○	Optional (to be specified with an order)

PO	Pulse output module
TI	Tariff input module
RO	Relay output module
BO	Bistable relay output module
AO	Analogue output module
DI	Digital input module
PI	Pulse input module
AI	Analogue input module – U, I or R (PT100/1000)
WO	Status (watchdog) module – for supervision of proper operation
COM2	Secondary communication module (RS232, RS485 or Communication port for analogue extender EX104)

General software Features	Default / optional MC 740	Default / optional MC 750	Default/ optional MC 770
Setup wizard	●	●	●
Wrong connection warning	●	●	●
Custom screen settings (3 user defined screens on LCD)	●	●	●
Demonstration screen cycling	●	●	●
Programmable refresh time	●	●	●
MODBUS and DNP3 communication protocols	●	●	●
Tariff clock	●	●	●
MD calculation (TF, FW, SW)	●	●	●
Wide frequency measurement range 16 Hz– 400 Hz	●	●	●
Adjustable alarms (32 alarms)	●	●	●
Alarms recording		●	●
Measurements recording (140 quantities)		●	●
Measurements graphs (time / FFT)	●	●	●
Evaluation of voltage quality in compliance with EN 50160			●
Real time clock synchronisation (NTP) (versions with Ethernet communication only)	●	●	●

- ● Function is supported (default)
- ○ Optional (to be specified with an order)

Connection

This chapter deals with the instructions for *MC 7×0 Power Monitoring Device* connection. Both the use and connection of the device includes handling with dangerous currents and voltages. Connection shall therefore be performed ONLY a by a qualified person using an appropriate equipment. ISKRA, d.o.o. does not take any responsibility regarding the use and connection. If any doubt occurs regarding connection and use in the system which device is intended for, please contact a person who is responsible for such installations.

In this chapter you will find:

Introduction

A person qualified for installation and connection of a device should be familiar with all necessary precaution measures described in this document prior to its connection.

Contents

Contents and size of a packaging box can slightly vary depending on type of consignment.

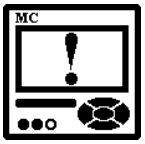
Single device shipment or a very small quantity of devices is shipped in a larger cardboard box, which offers better physical protection during transport. This type of contents contains:

- MC 7×0 Power Monitoring Device
- Fixation screws
- Pluggable terminals for connection of inputs, aux. power supply and I/O modules
- Short installation manual

When larger amount of devices is sent they are shipped in a smaller cardboard box for saving space and thus reducing shipment costs. This type of contents contains:

- MC 7×0 Power Monitoring Device
- Fixation screws
- Pluggable terminals for connection of inputs, aux. Power supply and I/O modules
- Short installation manual

This document and settings software MiQen can also be found on our web page:
https://www.iskra.eu/en/Iskra-Software/



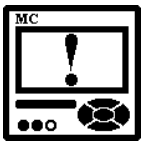
CAUTION

Please examine the equipment carefully for potential damages which might arise during transport!

Before use

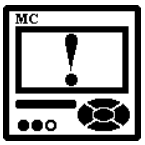
Before use please check the following:

- Nominal voltage ($U_{P\text{-}Pmax}$ = 1000VAC$_{rms}$; $U_{P\text{-}Nmax}$ = 600VAC$_{rms}$),
- Supply voltage,
- Nominal frequency,
- Voltage ratio and phase sequence,
- Current transformer ratio and terminals integrity,
- Protection fuse for voltage inputs (recommended maximal external fuse size is 6 A)
- External switch or circuit-breaker must be included in the installation for disconnection of the device's aux. power supply. It must be suitably located and properly marked for reliable disconnection of the device when needed. See CAUTION below.
- Integrity of earth terminal
- Proper connection and voltage level of I/O modules



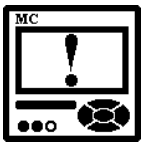
WARNING

Wrong or incomplete connection of voltage or other terminals can cause non-operation or damage to the device.



CAUTION

Aux. supply inrush current can be as high as 20 A for short period of time (<1 ms). Please choose an appropriate MCB for disconnection of aux. supply.



PLEASE NOTE

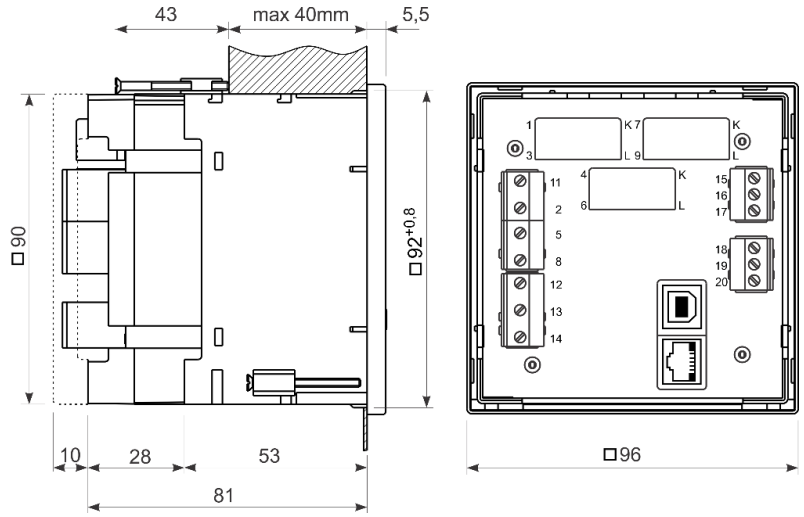
After connection, settings have to be performed via a keyboard on the front side of the device that reflect connection of device to voltage network (connection mode, current and voltage transformers ratio …). Settings can also be done via communication or a memory card.

Mounting

MC 7×0 Power Monitoring Device is intended only for panel mounting. Pluggable connection terminals allow easier installation and quick replacement should that be required.

This device is not intended for usage as portable equipment and should be used only as a fixed panel mounted device.

Dimensions for MC 7×0 (through-hole connection):



Dimensions for MC 7×0 (terminal assignment):

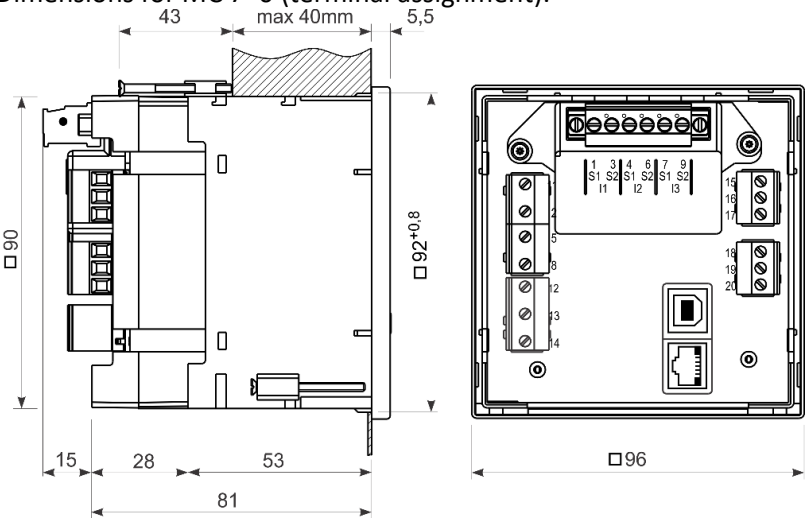


Figure 2: *Dimensional drawing and rear connection terminals position*

Recommended panel cut out is:

92 mm x 92 mm $^{+0.8}$

Please remove protection foil from the screen before use.

Electrical connection

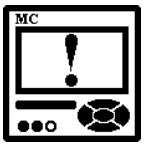
Voltage inputs of a device can be connected directly to low-voltage network or via a voltage measuring transformer to a high-voltage network.

Measuring current cables shall be attached as through-hole in current transformers or as detachable screw terminals (depends on the HW version of the device).

PLEASE NOTE

Current connection screw terminals will need to be wiring from outside, due to space restrictions. See the pictures below.

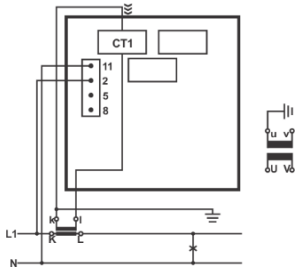
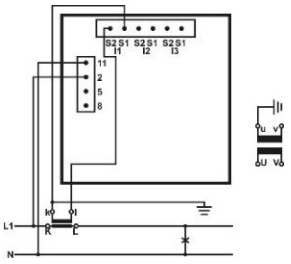
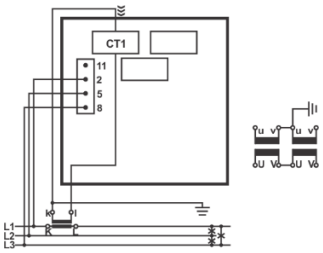
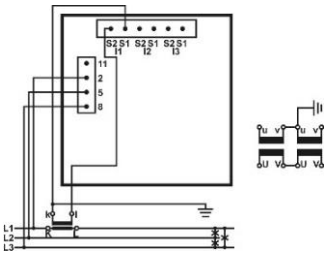
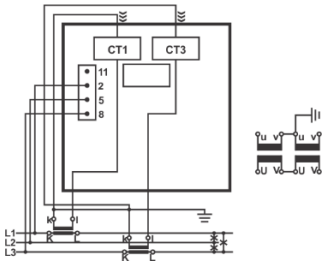
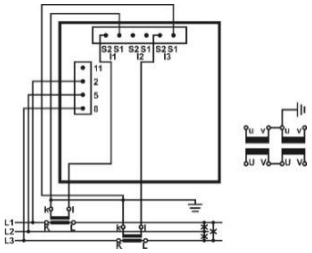
Choose corresponding connection from the figures below and connect corresponding voltages and currents. Information on electrical consumption of current and voltage inputs is given in a chapter *I/O modules on page 78*.

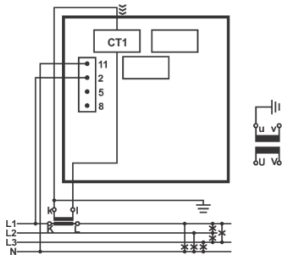
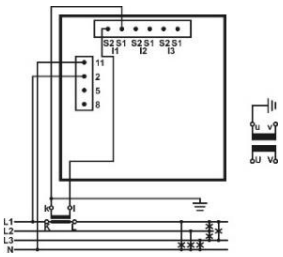
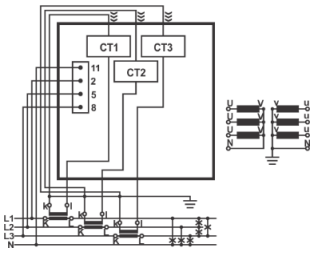
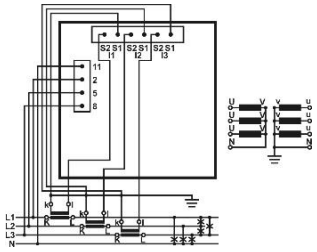


CAUTION

For accurate operation and to avoid measuring signal crosstalk it is important to avoid driving voltage measuring wires close to current measuring transformers.

MC 7×0

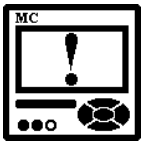
System/connection	Through-hole connection assignment	Terminal connection assignment
1b (1W1b) ***Single-phase connection***		
3b (1W3b) ***Three-phase, three-wire connection with balanced load***		
3u (2W3u) ***Three-phase, three-wire connection with unbalanced load.***		

System/ connection	Through-hole connection assignment	Terminal connection assignment
4b (1W4b) ***Three-phase, four wire connection with balanced load***		
4u (3W4) ***Three-phase, four wire connection with unbalanced load.***		

PLEASE NOTE

Additional GND terminal is added for better stability and accuracy.

Connection of input/output modules



WARNING

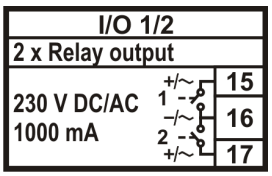
Check the module features that are specified on the label, before connecting module contacts. Wrong connection can cause damage or destruction of module and/or device.

PLEASE NOTE

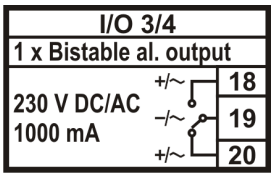
Examples of connections are given for device with built in two input/output modules and RS232/RS485 communication. Connection does not depend on a number of built-in modules and communication, and is shown on the device's label.

Connect module contacts as specified on the label. Examples of labels are given below and describe modules built in the device. Information on electrical properties of modules is given in a chapter *I/O modules on page 78.*

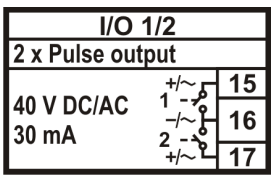
I/O module 1 and 2 (terminal numbers 15-20) – **output options**



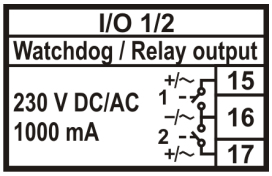
Alarm (relay) output module with two outputs.



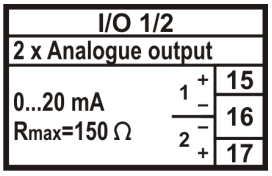
Bistable digital output module; keeps the state also in case of device power supply failure.



Pulse output (solid state) module with two pulse outputs for energy counters.

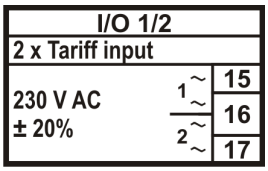


Status (watchdog) output module enables proper device operation supervision on one output (WD) and alarm output functionality on the other.

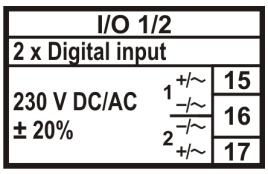


Analogue output module with two analogue outputs (0 - 20 mA), proportional to measured quantities.

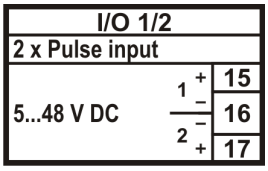
I/O module 1 and 2 *(terminal numbers 15-20)* ***– input options***



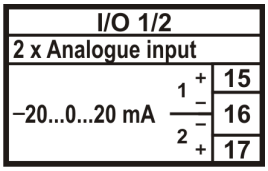
Tariff input module with two tariff inputs for changeover between up to four tariffs.



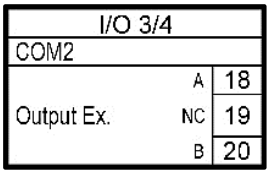
Digital input module with two digital inputs enables reception of impulse signals.



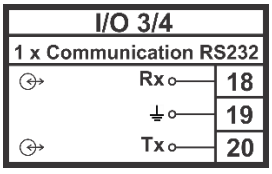
Pulse input module enables reception of pulses from various counters (water, gas, heat, flow,etc.).



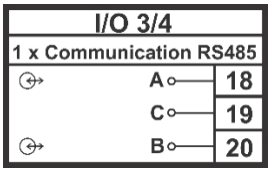
Analogue input module enables measurements of DC U, I, R or temp. (PT100, PT1000) values from external sources. Modules have different hardware, so programming is possible within one quantity.



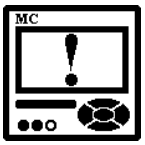
Communication module, for connection of Analogue extender EX104



2nd communication module, for connection of RS232 communication (COM2).



2nd communication module, for connection of RS485 communication (COM2).

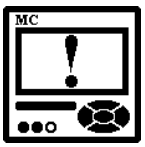


WARNING

In case when only one resistance-temperature analogue input is used, the other must be short-circuited.

Memory Card

MC 7×0 Power Monitoring Device is provided with a slot for a full size SD memory card, formatted to FAT16, that supports capacity up to 2 GB.



CAUTION

When memory slot is not used it should be covered with attached cover to avoid penetration of dust and small objects.

Memory card is useful for transferring stored data and performing other system operations (downloading settings, firmware update) when device is not connected to communication.

Memory card allows different operations. Immediately after insertion of a memory card devices' menu changes to show memory card options

Transferring data stored in internal memory

All data (readings, alarms, PQ reports (only for MC 770) and details), which are stored in internal memory can be transferred to a memory card.

PLEASE NOTE

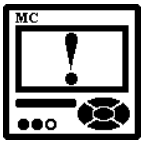
Measurements cannot be directly recorded to a memory card. Only data previously stored in internal memory can be transferred to a memory card.

Upload and download settings

This is a very convenient way of programming devices. Settings can be manually programmed once and stored to a memory card by Upload settings. Using that memory card more devices can be programmed very fast with identical settings.

Firmware update

When new features are added or when certain fixes should be implemented it is necessary to update devices' firmware. This can again be performed fastest by using memory card. New firmware should be transferred to a memory card from computer once. After that multiple devices can be updated only with memory card.



CAUTION

During firmware update aux. power supply must not be interrupted.

Communication connection

Primary communication interface (COM1) type is normally specified when placing an order. Device can support several types of communication:

- serial RS232/RS485 communication designed as a pluggable 5-pole screw terminal connector or DB9 connector,
- Ethernet communication designed as standard RJ-45 terminal and USB communication designed as standard USB-B type terminal

PLEASE NOTE

When connecting serial communication please note that only RS232 or RS485 should be used and not both at a time. Connector terminals that are not used should remain unconnected otherwise the communication could not work properly.

Connect a communication line by means of a corresponding terminal. Communication parameters are stated on the device label, regarding the selected/equipped type of communication. Connector terminals are marked on the label on a devices' rear side. More detailed information on communication is given in chapter *Communication on page 61*.

COMMUNICATION				
TERMINAL				
RS485		RS232		
A	B	Rx	⊥	Tx
21	22	23	24	25

Example of a label for RS232 and RS485 communication with a pluggable screw terminal connector

COMMUNICATION				
RS232			RS485	
Tx	Rx	⏚	B	A
2	3	5	7	8

Data for RS232 and RS485 communication with DB9 connector

COMMUNICATION
Ethernet
MAC No.: 00-1B-DF-54-7B-4A
USB 2.0 Type B

Example of a label for Ethernet/USB communication module equipped with RJ−45 and USB-B type connector

RS232

RS232 communication is intended for direct connection of the device to the personal computer. For proper operation it is necessary to assure the corresponding connection of individual terminals (see table below).

RS485

RS485 communication is intended for connection of multiple devices to a network where devices with RS485 communication are connected to a common communication interface. We suggest using one of the ISKRA, d.o.o. communication interfaces!

For proper operation it is necessary to assure the corresponding connection of individual terminals (see table below).

Communication for Analogue extender EX104, COM2 additional communication module
Operates as a predefined RS485 communication that can be used for data transfer between measuring centre and analogue extenders EX104.

Ethernet

Ethernet communication is used for connection of device to the Ethernet network for remote operation. Each device has its own MAC address that at some cases needs to be provided and is printed on the label on the device.

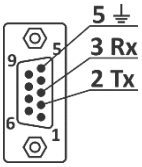
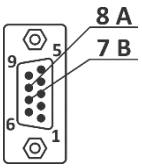
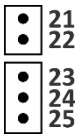
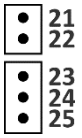
USB

USB communication serves as a fast peer-to-terminal data link. The device is detected by host as a USB 2.0 compatible device. The USB connection is provided through a USB standard Type B connector.

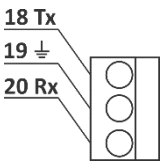
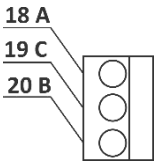
PLEASE NOTE

When device is connected to a PC through USB communication for the first time, a user is prompted to install a driver. The driver is provided on the CD, enclosed in the original shipment package, or it can be downloaded from the ISKRA, d.o.o. web page www.iskra.eu. With this driver installed, USB is redirected to a serial port, which should be selected when using MiQen setting software.

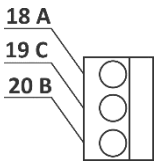
Survey of communication connection table:

	Connector	Terminals	Position	Data direction	Description
RS232	DB9		1	Not connected	-
			2	From	Data transmission (Tx)
			3	To	Data reception (Rx)
			4	Not connected	-
			5	-	Grounding (⏚)
			6	Not connected	-
			7	-	Do not connect!
			8	-	Do not connect!
			9	Not connected	-
RS485	DB9		1	Not connected	-
			2	-	Do not connect!
			3	-	Do not connect!
			4	Not connected	-
			5	-	Do not connect!
			6	Not connected	-
			7	To/From	B
			8	To/From	A
			9	Not connected	-
RS232	Screw terminal		21	Not connected	-
			22	Not connected	-
			23	To	Data reception (Rx)
			24	–	Grounding (⏚)
			25	From	Data transmission (Tx)
RS485	Screw terminal		21	To/From	A
			22	To/From	B
			23	Not connected	-
			24	Not connected	-
			25	Not connected	-
Ethernet	RJ−45		100BASE-T CAT5 cable recommended		
USB	USB-B		Standard USB 2.0 compatible cable recommended (Type B plug)		

Survey of secondary communication connection table:

	Connector	Terminals	Position	Data direction	Description
RS232	Screw terminal		18	From	Data transmission (Tx)
			19	-	Grounding ()
			20	To	Data reception (Rx)
RS485	Screw terminal		18	To/From	A
			19	-	Do not connect!
			20	To/From	B

Survey of secondary communication connection for Analogue extender EX104 table:

	Connector	Terminals	Position	Data direction	Description
Com. for EX104	Screw terminal		18	To/From	A
			19	-	Do not connect!
			20	To/From	B

Real Time Synchronization

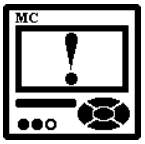
Synchronized real-time clock (RTC) is an essential part of any Power Quality Monitoring Device (especially Class A) for proper chronological determination of various events. To distinct cause from consequence, to follow a certain event from its origin to manifestation in other parameters, it is very important that each and every event and recorded measurement on one instrument can be compared with events and measurements on other devices. Even if instruments are dislocated, which is normally the case in electro distribution network events have to be time-comparable with accuracy better than a single period.

Network time protocol (NTP):

MC 7×0 supports NTP real time synchronisation. This is possible only with devices with built-in Ethernet communication module. Synchronization via Ethernet requires access to a NTP server.

PLEASE NOTE

NTP can usually maintain time to within tens of milliseconds over the public Internet, but the accuracy depends on infrastructure properties - asymmetry in outgoing and incoming communication delay affects systematic bias. It is recommended that dedicated network rather than public network is used for synchronisation purposes.



CAUTION

RTC synchronisation is essential part of Class A instrument. If no proper RTC synchronisation is provided device operates as Class S instrument.

First steps

Programming *MC 7×0 Power Monitoring Device* is very transparent and user friendly. Numerous settings are organized in groups according to their functionality.

Programming *MC 7×0 Power Monitoring Device* can be performed using the keypad and display on the front panel. Due to representation of certain settings not all settings can be programmed this way. All settings can be programmed using MiQen software.

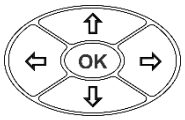
Information about which settings are available with keypad and which are available using communication and MiQen software is given next to each setting's name in a graphical form:

- Function accessible using communication (MiQen software)
- Function accessible using keypad and the display

In this chapter you will find basic programming steps which can be accessed by using keypad and display:

Keyboard navigation

The "OK" key is used for confirming the settings, selecting and exiting the display. Direction keys are used for shifting between screens and menus.



Navigation keypad and LCD enable basic device settings. During the operation some icons can be displayed in upper part of LCD. The significance of icons (from right to left) is explained in the table below.

Survey of notification icons:

Icon	*Meaning*
	Device is locked with a password of the second level (L2). The first level (L1) can be unlocked.
	Device can be wrongly connected at 4u connection. Energy flow direction is different by phases.
	The aux. power supply of the device supply is too low.
	Clock not set. (when disconnected from aux. supply for more then 2 days)

The meaning of icons is also explained on a LCD in the Information menu. See chapter *Display of device info on page 38.*

Installation wizard

After installation and electrical connection, basic parameters have to be set in order to assure correct operation. The easiest way to achieve that is to use the Installation wizard.

Main menu
Measurements
Settings
Resets
SD card
Info
14.11.2018 16:53:36

When entering the Installation menu (use navigation keys as shown in picture above and press OK button), settings follow one another when the previous one is confirmed. All required parameters shall be entered and confirmed. Exit from the menu is possible when all required settings are confirmed or with interruption (key ⇐ several times) without changes.

Installation wizard menu may vary, depending on built in communication modules. In description below is marked which menu appears for specific option.

PLEASE NOTE

All settings that are performed through the Installation wizard can be subsequently changed by means of the Settings menu or via MiQen by means of communication or a Memory card.

When entering installation wizard following display is shown:

Installation
Welcome to the Installation Wizard. Press OK to continue.
⇦ Main menu

Language

Set device language.

Date

Set device date.

Time

Set device time. If instrument is connected to one of supported time synchronisation sources, date and time are automatically set.

Connection mode

Choose connection from a list of supported connection modes.

Primary voltage

Set primary voltage of monitored system if a device is connected indirectly by means of a voltage transformer. If device is connected to directly to a low voltage enter this value.

Secondary voltage

Set secondary voltage if a voltage transformer is used; set voltage of low voltage network if connection is direct.

Primary current

Set primary current of monitored system if a device is connected indirectly by means of a current transformer. Otherwise primary and secondary current should remain the same.

Secondary current

Set secondary current of current transformer or the value of nominal current if connection is direct.

Common energy counter resolution

Define Common energy counter resolution as recommended in table below, where Individual counter resolution is at default value 10. Values of primary voltage and current determine proper Common energy counter resolution. For detailed information about setting energy parameters see chapter *Energy on page 72.*

Suggested Common energy counter resolutions:

Current / Voltage	1 A	5 A	50 A	100 A	1000 A
110 V	100 mWh	1 Wh	10 Wh	10 Wh	100 Wh
230 V	1 Wh	1 Wh	10 Wh	100 Wh	1 kWh
1000 V	1 Wh	10 Wh	100 Wh	1 kWh	10 kWh
30 kV	100 Wh	100 Wh	1 kWh	10 kWh	10 kWh *

* – Individual counter resolution should be at least 100

Device address

Set MODBUS address for the device. Default address is 33.

Baud rate

Set communication rate. Default rate is 115200 b/s. This setting is available only when RS232/RS485 communication is built in.

Parity

Set communication parity. Default value is “None”. This setting is available only when RS232/RS485 communication is built in.

Stop bit

Set communication stop bits. Default value is 2. This setting is available only when RS232/RS485 communication is built in.

IP Address

Set correct IP address of the device. Default setting is 0.0.0.0 and represents DHCP addressing. This setting is available only when Ethernet communication is built in.

TCP Port

Set TCP communication Port. Default value is 10001. This setting is available only when Ethernet communication is built in.

Subnet mask

Set network subnet mask. Default value is 255.255.255.0. This setting is available only when Ethernet communication is built in.

Display of the device info

A menu is divided into several submenus with data and information about device:

Welcome screen

Information

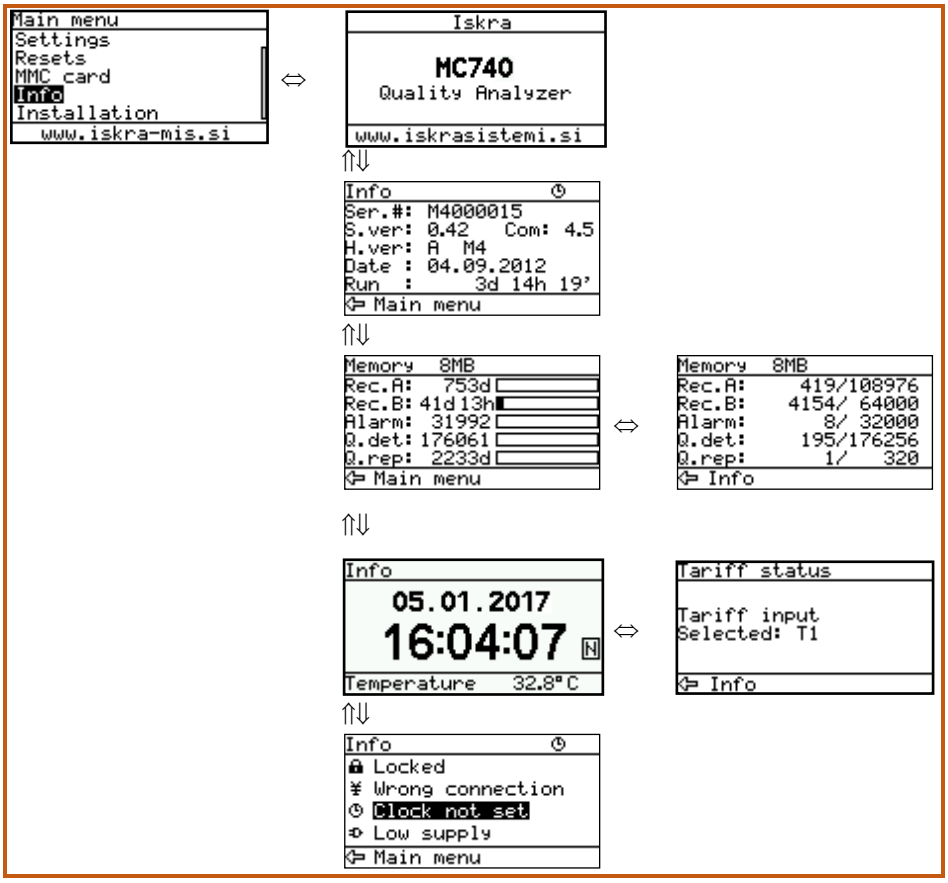
Serial number, Hardware and Firmware version, date of calibration and operational time.

Memory

Internal memory storage availability. Memory information shows available memory since last official data transfer. If official data transfer is performed, device will virtually erase entire memory. It will set memory counters to zero but it will not overwrite existing data. This data is still available as long as memory space overflows and starts overwriting older data.

Time, date, internal temperature and tariff status

Meaning of icons



Settings

A setting structure, which is similar to a file structure in an explorer is displayed in the left part of the MiQen setting window. Available settings of that segment are displayed in the right part by clicking any of the stated parameters.

In this chapter you will find detailed description of all *MC 7×0 Power Monitoring Devices* features and settings. Chapter is organized in a way to follow settings organisation as in setting software MiQen.

Introduction

Settings of *MC 7×0 Power Monitoring Device* can be performed via the front keypad and display or remotely using communication and MiQen software version 2.0 or higher. Setting is faster and easier by using MiQen. Basic and simpler settings are accessible via navigation keypad. For new setting to be activated settings file should be transferred to the device via communication (MiQen) or a memory card. Setting done via navigation keypad comes in to function after confirmation (OK button) followed by a bit longer sound notification (beep).

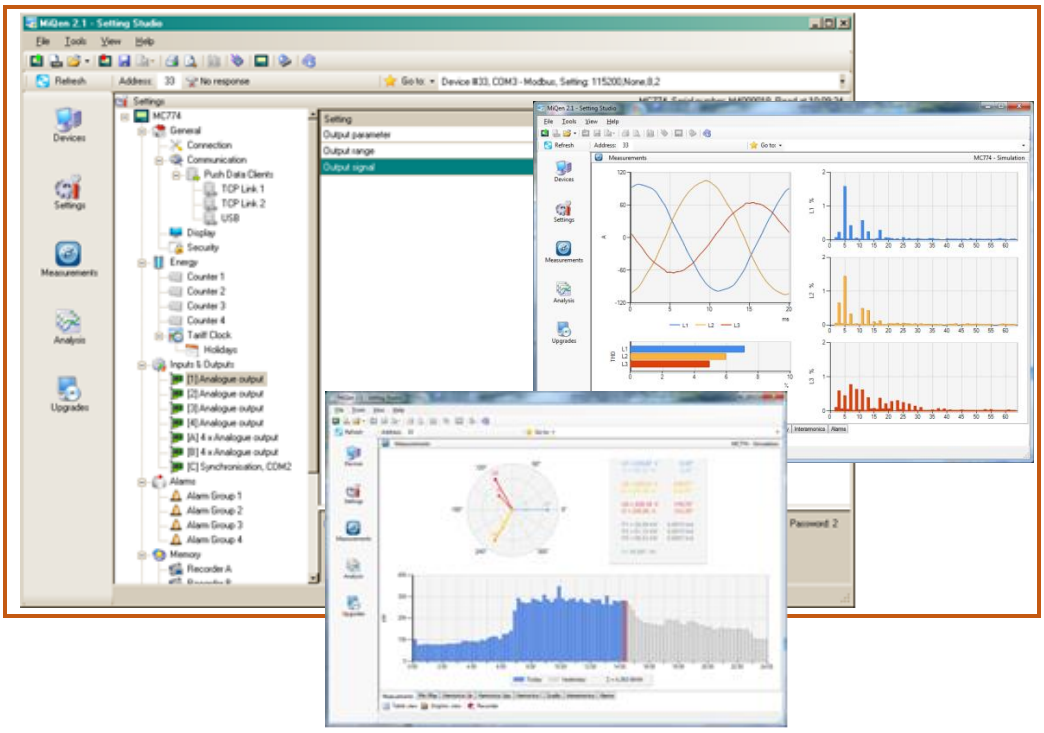
PLEASE NOTE

New versions of MC 7×0 (HW version D) represent themselves in MiQen software as MC 7×0A.

MiQen software

MiQen software is a tool for a complete programming and monitoring of ISKRA measuring instruments. Remote operation is possible by means of serial (RS485/RS232), USB or TCP/IP communication in connection with a PC. A user-friendly interface consists of six segments: devices management (Connection), device settings (Settings), real-time measurements (Measurements), data analysis (Analysis), saved preffered devices (My Devices) and software upgrading (Upgrades). These segments are easily accessed by means of five icons on the left side (see Figure 2).

Figure 2: *MiQen programming and monitoring software*



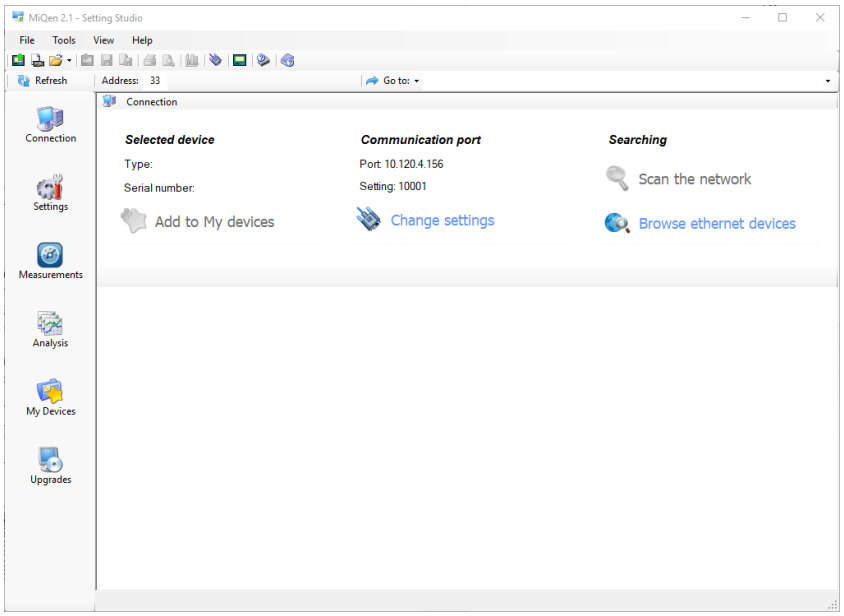
MiQen version 2.0 or higher is required for programming and monitoring *MC 7×0A Power Monitoring Device*. Software installation can be downloaded from www.iskra.eu.

PLEASE NOTE

MiQen has a very intuitive help system. All functions and settings are described in Info window on the bottom of MiQen window.

Devices management

***Figure** 3: MiQen Device Management window*



With MiQen it is very easy to manage devices. If dealing with the same device that has been accessed before it can be easily selected from a favourite's line.

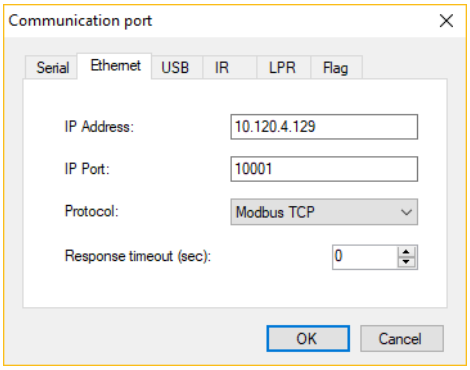
This way is Communication port set automatically as it was during last access.
To communicate with new device, following steps should be followed:
Connect a device to a communication interface

Depending on type of communication interface connect a device:

- Directly to a PC using RS232 cable
- Directly to a PC using RS232/USB or RS485/USB communication adapter
- To communnication adapter RS485/RS232 (suggested adapter is ISKRA MI485)
- Directly to a PC using USB cable
- Network connection using Ethernet cable

Set Communication port parameters

Under Communication port current communication parameters are displayed. To change those parameters click on Change settings button. A Communication port window opens with different communication interfaces.



Choose correct communication interface (Modbus, Ethernet or USB) and set correct communication parameters.

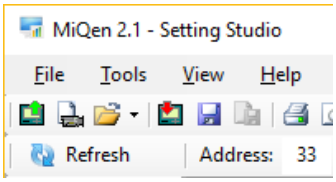
PLEASE NOTE

When device is connected to a PC through USB communication for the first time, a user is prompted to install a driver. The driver can be found in Driver folder in MiQen2.1 install directory.

For more information regarding parameters for serial, USB and Ethernet communication see chapters *Serial Communication on page 61*, *USB communication on page 63* and *Ethernet communication on page 64*.

Set device Modbus address number

Each device connected to a network has its unique Modbus address number. In order co-communicate with that device an appropriate address number should be set.



Factory default Modbus address for all devices is 33. Therefore it is required to change Modbus address number of devices if they are connected in the network so each device will have its unique address number.

Start communicating with a device

Click on REFRESH button and device's information will be displayed.

When devices are connected to a network and a certain device is required it is possible to browse a network for devices. For this purpose choose:

scan the network when device is connected to a RS485 bus,

browse ethernet devices when device is connected to the Ethernet.

Device settings

Programming devices can be performed ONLINE when device is connected to aux. power supply and is communicating with MiQen. When device is not connected it is possible to adjust settings OFFLINE.

ONLINE programming

After communication with a device is established, choose icon Settings from a list of MiQen functions on a left side.

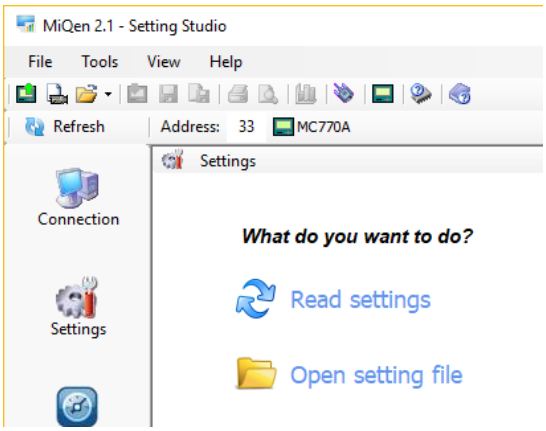


Figure 4: *MiQen Device Setting window*

Choose Read settings button to display all device's settings and begin adjusting them according to project requirement.

PLEASE NOTE

When finished programming, changes should be confirmed by pressing Download settings button in MiQen menu bar ( ) or with a mouse right click menu.

PLEASE NOTE

When finished programming, all settings can be saved in a setting file (.msf file). This way it is possible to archive settings in combination with a date. It is also possible to use saved settings for offline programming or to programme other devices with same settings. For more information see OFFLINE programming.*

OFFLINE programming

When device is not physically present or is unable to communicate it is still possible to perform OFFLINE programming. From MiQen Device Setting window (Figure 4) choose Open setting file button.

From a list of *.msf files choose either previously stored file (a setting file, which has been used for another MC 7×0A and stored) or a file MC 7×0A.msf, which holds default settings for this device.

When confirmed all device settings are displayed similar as with ONLINE programming.

CAUTION

MC7×0.msf file or any other original device setting file should not be modified as it contains device default settings. Before adjusting settings according to project requirements save setting file under another name.

When finished programming, all settings can be saved in a setting file with a meaningful name (e.g. MC7×0_location_date.msf). This file can be then transferred to a Memory card and used for programming on filed devices, which are not accessible with communication.

Real-time measurements

Measurements can be seen ONLINE when device is connected to aux. power supply and is communicating with MiQen. When device is not connected it is possible to see OFFLINE measurements simulation. The latter is useful for presentations and visualisation of measurements without presence of actual device.

In ONLINE mode all supported measurements and alarms can be seen in real time in a tabelaric or graphical form.

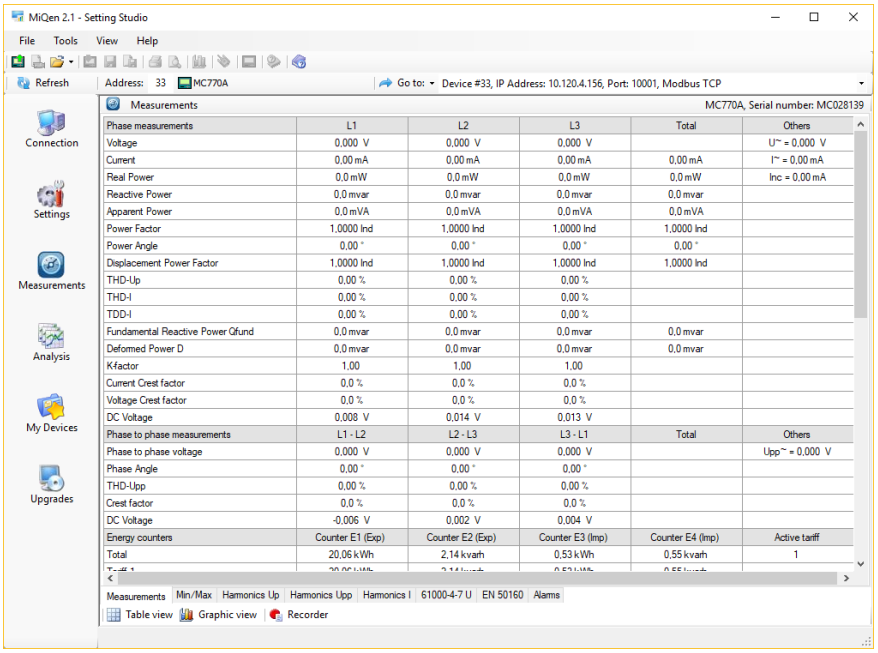


Figure 5: *Online measurements in tabelaric form*

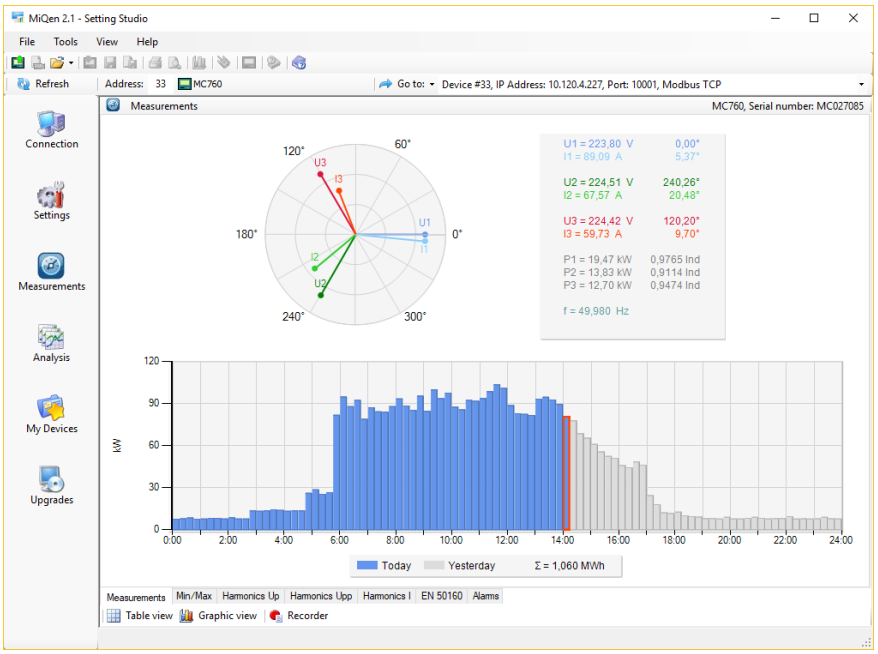


Figure 6: *Online measurements in graphical form – phaser diagram and daily total active power consumption histogram.*

Different measuring data can be accessed by means of tabs (Measurements, Min/Max …) in the lower part of MiQen window.

For further processing of the results of measurements, it is possible to set a recorder (Recorder button) on active device that will record and save selected measurements to MS Excel .csv file format.

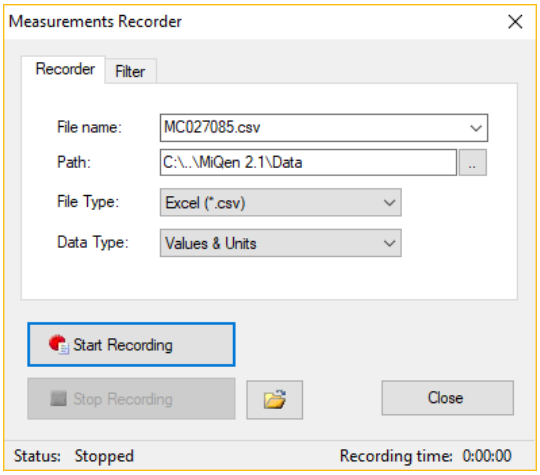
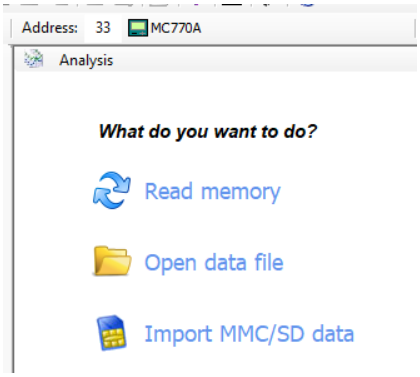


Figure 7: *Window for setting local database recording parameters*

Data analysis

In order to perform analysis data source has to be defined first. Data source can be one of the selected:



Read memory

Data is read directly from a devices internal memory.

Open data file

Data is read from a local database.

Import SD data

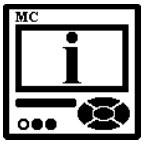
Data is imported from a SD memory card.

Figure 8: *Window for a choice of memory data to be analysed*

After data is read or imported recorded quantities can be monitored in a tabular or a graphical form. The events that triggered alarms can be analyzed or a report on supply voltage quality can be made. All data can be exported to an Access data base, Excel worksheets or as a text file.

Software upgrading

Always use the latest version of software, both MiQen and software in the device. The program automatically informs you about available upgrades (device firmware upgrades and MiQen software upgrades) that can be transferred from the web site and used for upgrading.



PLEASE NOTE

MiQen cannot be used for execution of firmware upgrades of a device. It only informs that new version is available and offers link to download it from the server. Software for execution of firmware upgrades is included in downloaded zip file together with upgrade file, upgrade procedure description and revision history.

General settings

Main menu
Measurements
Settings
Resets
SD card
Info
Installation
14.11.2018 16:53:36

⇨

Settings
General
Date & Time
Connection
Communication
LCD
Security
Energy
Inputs/Outputs
⇦ Main menu

General settings are essential for *MC 7×0 Power Monitoring Device*. They are divided into four additional sublevels (Connection, Communication, Display and Security).

Description and Location PC

These two parameters are intended for easier recognition of a certain unit. They are especially used for identification of the device or location on which measurements are performed.

Average interval PC OK

The averaging interval defines a refresh rate of measurements on display, communication and analogue outputs. It also defines response time for alarms set to Normal response (see chapter *Alarms on page 87*). Interval can be set from 0.1 s to 5 s. Default value is 1 s.

OK Main menu ⇨ Settings ⇨ General ⇨ Average interval

Average interval for Min/Max values PC

The averaging interval for Min/Max values defines an interval on which values will be averaged to track Min and Max values. By choosing shorter interval also very fast changes in the network will be detected. Interval can be set form 1 to 256 periods.

PLEASE NOTE

This setting applies only for min. and max. values displayed on LCD and accessible on communication. These values are not used for storing into internal recorder. For more information about recording min. and max. values see Min and Max values on page 127.

Language PC OK

Set language for display. When language is changed from or to Russian, characters of the password are changed too. For overview of character translation see chapter *Password and language on page 71.*

OK Main menu ⇨ Settings ⇨ General ⇨ Language

Currency PC OK

Choose currency for evaluating energy cost (see chapter *Energy*). A currency designation consists of up to four letters taken from the English or Russian alphabet and numbers and symbols stated in table below.

English	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z
Symbols		!	"	#	$	%	&	'	(	)	*	+	,	-	.	/	0 to 9			:	;	<	=	>	?	@
Russian	А	Б	В	Г	Д	Е	Ж	З	И	Й	К	Л	М	Н	О	П	Р	С	Т	У	Ф	Х	Ц	Ч	Ш	Щ
	а	б	в	г	д	е	ж	з	и	й	к	Л	м	н	о	п	р	с	т	у	ф	х	ц	ч	ш	щ

OK Main menu ⇨ Settings ⇨ General ⇨ Currency

Temperature unit PC OK

Choose a unit for temperature display. Degrees Celsius or degrees Fahrenheit are available.

OK Main menu ⇨ Settings ⇨ General ⇨ Temperature unit

Date format PC OK

Set a date format for time stamped values.

OK Main menu ⇨ Settings ⇨ Date & Time ⇨ Date format

Date and time PC OK

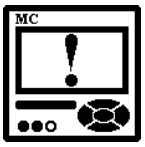
Set date and time of the device. Setting is important for correct memory operation, maximal values (MD), etc. If instrument is connected to one of supported time synchronisation sources, date and time are automatically set.

OK Main menu ⇨ Settings ⇨ Date & Time

Time synchronisation source PC

Synchronized real-time clock (RTC) is an essential part of any analyzer for proper chronological determination of various events. To distinct cause from consequence, to follow a certain event from its origin to manifestation in other parameters it is very important that each and every event and recorded measurement on one device can be compared with events and measurements on other devices. Even if devices are dislocated, which is normally the case in electro distribution network events have to be time-comparable with accuracy better than a single period.

For this purpose devices normally support highly accurate internal RTC. Still this is not enough, since temperature is location dependant and it influences its precision. For that reason it is required to implement periodical RTC synchronization.



CAUTION

RTC synchronisation is essential part of Class A instrument. If no proper RTC synchronisation is provided device operates as Class S instrument (MC 770).

This setting is used to choose primary synchronisation source.

NO synchronisation (not advisable, see CAUTION above)

NTP synchronisation

Synchronisation status can be checked on display when set to INFO display (see chapter *Display of device info on page 38*).

Notification icon N shows successful NTP synchronisation

Time zone PC

Set time cone in which device is mounted. Time zone influences internal time and time stamps. When UTC time is required, time zone 0 (GMT) should be chosen.

Automatic S/W time PC

If *Yes* is chosen, time will be automatically shifted to a winter or a summer time, regarding the time that is momentarily set.

Maximum demand calculation (MD mode) PC

The device provides maximum demand values from a variety of average demand values:

Thermal function

Fixed window

Sliding windows (up to 15)

Thermal function

A thermal function assures exponent thermal characteristic based on simulation of bimetal meters.

Maximal values and time of their occurrence are stored in device. A time constant can be set from 1 to 255 minutes and is 6 times thermal time constant (t. c. = 6 × thermal time constant).

Example:

Mode:	Thermal function
Time constant:	8 min.
Running MD and maximal MD:	Reset at 0 min.

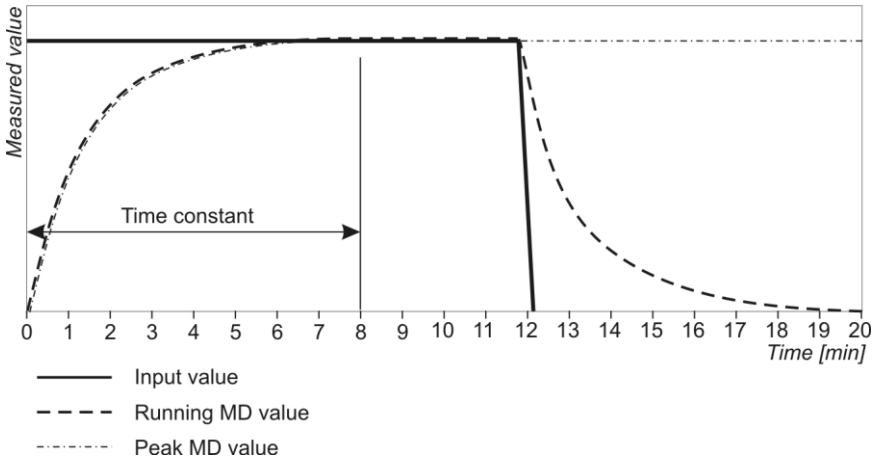


Figure 9: *Operation of thermal MD function*

Fixed window

A fixed window is a mode that calculates average value over a fixed time period. Time constant can be set from 1 to 255 min.

»*Time into period*« as displayed in MiQen actively shows the remaining time until the end of the period in which current MD and maximal MD from the last reset are calculated.

When displays for Pt(+/−), Qt(L/C), St, I1, I2 and I3 are updated, a new period and measurement of new average values are started. »TIME INTO PERIOD« then shows 0 of X min where X is Time Constant.

A new period also starts after a longer interruption of power supply (more than 1 s). If time constant is set to one of the values of 2, 3, 4, 5, 6, 10, 12, 15, 20, 30 or 60 minutes, »TIME INTO PERIOD« is set to such value that one of the following intervals will be terminated at a full hour. In other cases of time constants, »TIME INTO PERIOD« is set to 0.

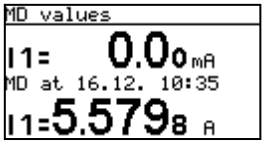


Figure above shows display of MD measurement for current I1. Running MD is displayed (0 mA), max. value of MD since last reset is displayed and its time of occurrence.

Example:

Mode:	Fixed window
Time constant:	8 min.
Running MD and maximal MD:	Reset at 0 min.

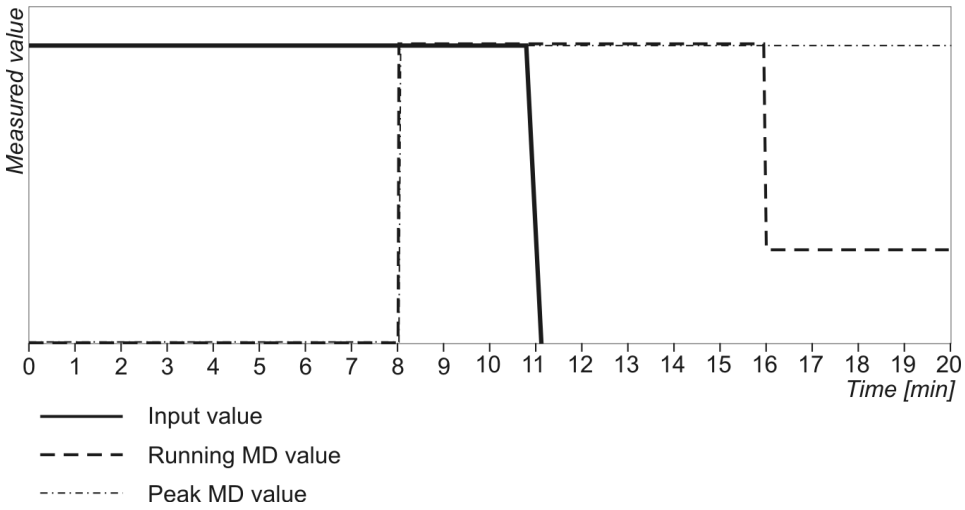


Figure 10: *Operation of Fixed window MD function*

Sliding windows

A mode of sliding windows enables multiple calculations of average in a period and thus more frequent refreshing of measuring results. Average value over a complete period is displayed. A running MD is updated every sub-period for average of previous sub-periods.

A number of sub-periods can be set from 2 to 15.

A time constant can be set from 1 to 255 minutes.

A new period also starts after a longer interruption of power supply (more than 1 s). If time constant is set to one of the values of 2, 3, 4, 5, 6, 10, 12, 15, 20, 30 or 60 minutes, »TIME INTO PERIOD« is set to such value that one of the following intervals will be terminated at a full hour. In other cases of time constants, »TIME INTO PERIOD« is set to 0.

Example:

Mode:	Sliding windows
Time constant:	2 min.
No. of sub-periods:	4
Running MD and maximal MD:	Reset at 0 min.

A complete period lasts for 8 minutes and consists of 4 sub-periods that are 2 minutes long. A running MD and a maximal MD are reset at 0 min. "Time into period" is data for a sub period so that the values for a running MD and a maximal MD are refreshed every two minutes. After 4 sub-periods (1 complete period) the oldest sub period is eliminated when a new one is added, so that average (a window) always covers the last 4 sub-periods.

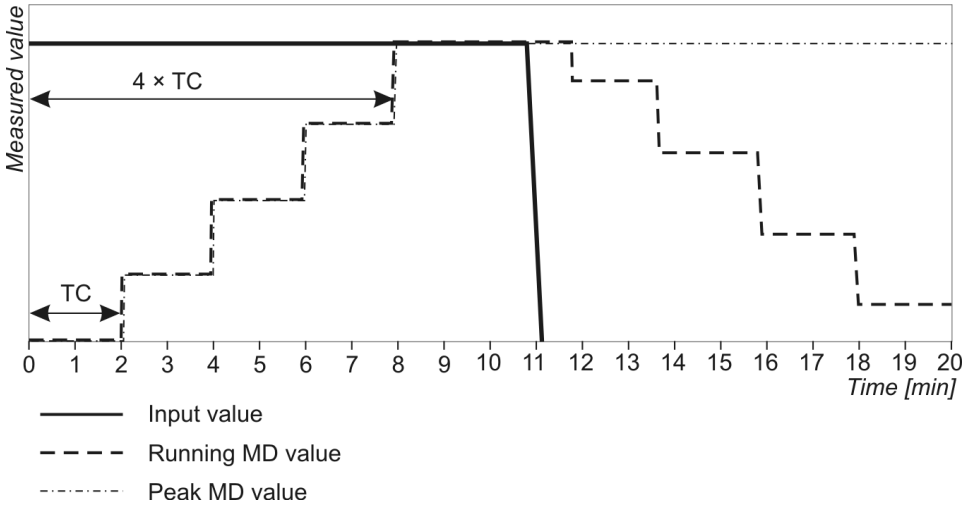


Figure 11: *Operation of Sliding window MD function*

Main menu ⇨ Settings ⇨ General ⇨ MD mode / MD time const.

Max demand reset mode PC

This setting defines a mode of resetting Max demand values. It can be set to:

Manual

User resets max demand value with keypad or setting software (see chapter *Reset*)

Automatic

Daily every day at 00:00,

Weekly on Monday at 00:00,

Monthly the first day in a month at 00:00,

Yearly the first day in a year 1.1. at 00:00

Min/Max reset mode PC OK

This setting defines a mode of resetting stored Min/Max values. It can be set to

Manual

User resets min/max values with keypad or setting software (see chapter *Reset*)

Automatic

Daily every day at 00:00,

Weekly on Monday at 00:00,

Monthly the first day in a month at 00:00,

Yearly the first day in a year 1.1. at 00:00

OK Main menu ⇨ Settings ⇨ General ⇨ Min/Max reset mode

Starting current for PF and PA (mA) PC

All measuring inputs are influenced by noise of various frequencies. It is more or less constant and its influence to the accuracy is increased by decreasing measuring signals. It is present also when measuring signals are not present or are very low. It causes very sporadic measurements.

This setting defines the lowest current that allows regular calculation of Power Factor (PF) and Power Angle (PA).

The value for starting current should be set according to conditions in a system (level of noise, random current fluctuation …)

Starting current for all powers (mA) PC

Noise is limited with a starting current also at measurements and calculations of powers.

The value for starting current should be set according to conditions in a system (level of noise, random current fluctuation …)

Starting voltage for SYNC (V) PC

Device needs to synchronize its sampling with measuring signals period to accurately determine its frequency. For that purpose, input signal has to large enough to be distinguished from a noise.

If all phase voltages are smaller than this (noise limit) setting, instrument uses current inputs for synchronization. If also all phase currents are smaller than *Starting current for PF and PA* setting, synchronization is not possible and frequency displayed is 0.

The value for starting voltage should be set according to conditions in a system (level of noise, random voltage, fluctuation…)

Starting voltage for all powers (V) PC

Noise is limited to a starting voltage also at measurements and calculations of powers.

The value for starting voltage should be set according to conditions in a system (level of noise, random voltage, fluctuation…)

Harmonics calculation PC

Relative harmonic values can be different according to used base unit. According to requirements relative harmonics can be calculated as:

percentage of RMS signal value (current, voltage) or

percentage of the fundamental (first harmonic).

Reactive power and energy calculation PC

Harmonic distortion can significantly influence reactive power and energy calculation. In absence of harmonic distortion both described methods will offer the same result. In reality harmonics are always present. Therefore it is up to project requirements, which method is applicable.

User can select between two different principles of reactive power and energy calculation:

Standard method:

With this method a reactive power and energy are calculated based on assumption that all power (energy), which is not active, is reactive.

$Q2 = S2 – P2$

This means also that all higher harmonics (out of phase with base harmonic) will be measured as reactive power (energy).

Displacement method:

With this method, reactive power (energy) is calculated by multiplication of voltage samples and by 90° displaced current samples (see chapter *Equations*):

$Q = U \times I|{+90°}$

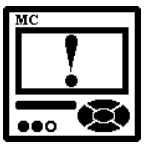
With this method, reactive power (energy) represents only true reactive component of apparent power (energy).

Connection

Main menu
Measurements
Settings
Resets
SD card
Info
Installation
14.11.2018 16:53:36

⇨

Settings
General
Date & Time
Connection
Communication
LCD
Security
Energy
Inputs/Outputs
⇦ Main menu



CAUTION

Settings of connections shall reflect actual state otherwise measurements could not be valid.

Connection mode PC OK

When connection is selected, load connection and the supported measurements are defined (see chapter *Selection of available quantities on page 113*).

OK Main menu ⇨ Settings ⇨ Connection ⇨ Connection mode

Setting of current and voltage ratios PC OK

Before setting current and voltage ratios it is necessary to be familiar with the conditions in which device will be used. All other measurements and calculations depend on these settings. Up to five decimal places can be set. To set decimal point and prefix position the cursor to last (empty) place or the decimal point.

Aux CT transformer ratios can be set separately from phase CT ratios since Aux CT could differ from phase CTs.

Range of CT and VT ratios table:

Settings range	VT primary	VT secondary	CT, Aux CT primary	CT, Aux CT secondary
Max value	1638.3 kV	16383 V	1638.3 kA	16383 A
Min value	0.1 V	1 mV	0.1 A	1 mA

OK Main menu ⇨ Settings ⇨ Connection ⇨ VT/CT/Aux CT

Used voltage and current range PC

Setting of used voltage and current range is connected with all settings of alarms, analogue outputs and measurements recording.

CAUTION

In case of subsequent change of those ranges shall be alarm and analogue output settings correspondingly changed as well.

Already recorded values will not be valid after change of used voltage and current range!

Nominal frequency PC

Nominal frequency range can be selected from a set of predefined values. A valid frequency measurement is within the range of nominal frequency ±30 Hz.

This setting is used for alarms and recorders only.

Max demand current for TDD PC

Select maximum current (CT or fuse rating) at a point of instrument connection for proper TDD calculation. Unlike THD, TDD is a measure of harmonics relative to a fixed value of max demand current. Therefore TDD is a demand independent measure of current harmonics.

Wrong connection warning PC

If all phase currents (active powers) do not have same sign (some are positive and some negative) and/or if phase voltages and phase currents are mixed, the warning will be activated if this setting is set to YES.

See *Survey of notification icons table on page 34.*

Energy flow direction PC

This setting allows manual change of energy flow direction (IMPORT to EXPORT or vice versa) in readings tab.

It has no influence on readings sent to communication or to memory!

CT connection PC

If this setting is set to REVERSED it has the same influence as if CT's would be reversely connected. All power readings will also change its sign.

This setting is useful to correct wrong CT connections.

Measuring input channel mapping PC

With this group of setting is possible to dedicate input measuring channel to measuring parameter. This might come in handy if the device is connected wrongly and if there would be a problem to rewire a device in a correct way.

Voltage channel mapping

For each voltage Measuring channel Ux, is possible to select connection terminal. Default value represents channel dedicated to this parameter as shown on the label.

Default voltage channel mapping table:

Measuring channel	Default value
Measuring channel U1	Terminal 2
Measuring channel U2	Terminal 5
Measuring channel U3	Terminal 8

Current channel mapping

For each current Measuring channel Ix, is possible to select connection terminal pair and direction. Default value represents channel and direction dedicated to this parameter as shown on the label.

Default current channel mapping table:

Measuring channel	Default value
Measuring channel I1	Terminals 1-3 CT1
Measuring channel I2	Terminals 4-6 CT1
Measuring channel I3	Terminals 7-9 CT1

Serial communication

Main menu
Measurements
Settings
Resets
SD card
Info
Installation
14.11.2018 16:53:36

⇨

Settings
General
Date & Time
Connection
Communication
LCD
Security
Energy
Inputs/Outputs
⇦ Main menu

Serial Communication

Communication parameters (only for main communication port COM1), which are important for the operation in RS485 network or connections with PC via RS232 communication.

Factory settings for serial communication are

MODBUS Address	#33	address range is 1 to 247
Comm. speed	115.200	speed range is 2400 to 115.200
Parity	none	
data bits	8	
stop bits	2	

Push Data Format PC

With this setting a required data format for sending data to receiver using PUSH communication mode is set. Currently supported format is XML-smart. For more information about PUSH communication mode and XML data format see chapter *Communication modes on page 144 and Appendix D on page 188.*

Push Response time PC

With this setting a maximum waiting time for acknowledgement of sent data in PUSH communication mode is set. If acknowledgement from a client is not sent within this time, scheduled data will be resend in next push period.

Push Time synchronisation PC

In case where no other synchronisation source is available (NTP), RTC can be synchronised by push data client. This type of synchronisation strongly depends on communication infrastructure and it is not as accurate as required by IEC 61000-4-30. It has the lowest priority and cannot override RTC synchronised by any of other sources.

USB communication

USB Communication PC

There is no special setting for USB communication. For more detailed information how to handle device with USB communication use Help section in MiQen software.

PLEASE NOTE

Device supports only a single communication input (USB or Ethernet) at a time when using primary communication port COM1. Priority has USB communication. If communication using ethernet is in progress, do not connect to USB since it will terminate ethernet connection. When USB cable is unplugged from the device ethernet communication is again available.

PLEASE NOTE

When device is connected to a PC through USB communication for the first time, a user is prompted to install a driver. The driver can be found in Driver folder in MiQen2.1 install directory. With this driver installed, USB is redirected to a serial port, which should be selected when using MiQen setting software.

Ethernet communication

Main menu ⇨ Settings ⇨ Communication ⇨ (all settings are not supported on keypad)

Device Address PC

Device Modbus address is important when user is trying to connect to device via MiQen software. Usable range of addresses is from 1 to 247. Default address number is 33.

IP address PC

Communication interface should have a unique IP address in the Ethernet network. Two modes for assigning IP are possible:

Fixed IP address:

In most installations a fixed IP address is required. A system provider usually defines IP addresses. An IP address should be within a valid IP range, unique for your network and in the same subnetwork as your PC.

DHCP:

Automatic (dynamic) method of assigning IP addressed (DHCP) is used in most networks. If you are not sure if DHPC is used in your network, check it at your system provider.

IP Hostname PC

It is the nickname that is given to a device. The setting is used in automatic (DHCP) mode only.

Local Port PC

When using Ethernet communication device has opened two local ports.

Fixed port number 502, which is a standard MODBUS port. Device allows multiple connections to this port.

User defined port. Any port number is allowed except reserved ports (*Table 7*). Only a single connection is allowed to this port. When this port is used all other connections (including connection to port 502) are disabled. This is a terminal type of connection.

Terminal type of connection is used when due to a performed function other connections are not allowed. This is the case when firmware update is performed. In other cases it is advised to use port 502.

When port 502 is used a remote application(s) can access device regardless the setting for *Local Port* in a device. This setting is applicable only when terminal access is required.

Reserved TCP Port numbers table:

Important port numbers	Function
1 – 1024, 9999, 30718, 33333	Reserved numbers!!!
502	Standard MODBUS port – fixed
33333	UDP port used for Device Discovery Service

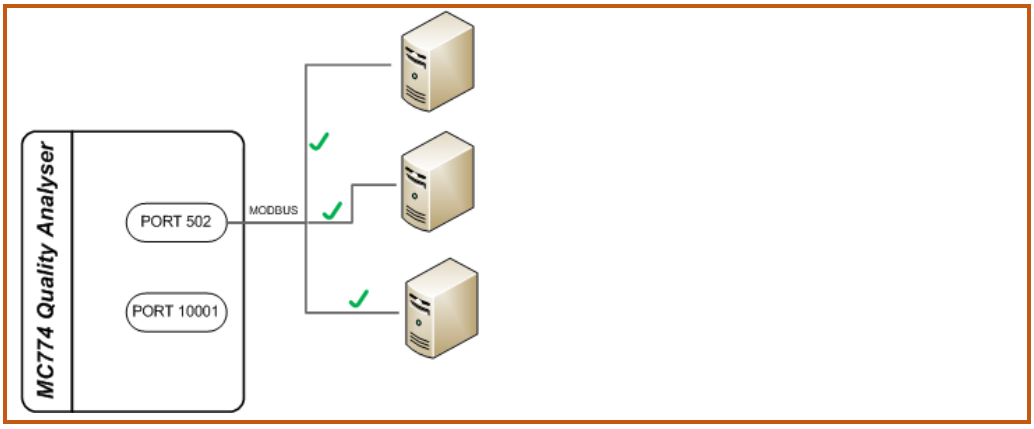


Figure 12: *Multiple connections to a device are possible when port 502 (special MODBUS port) is used*

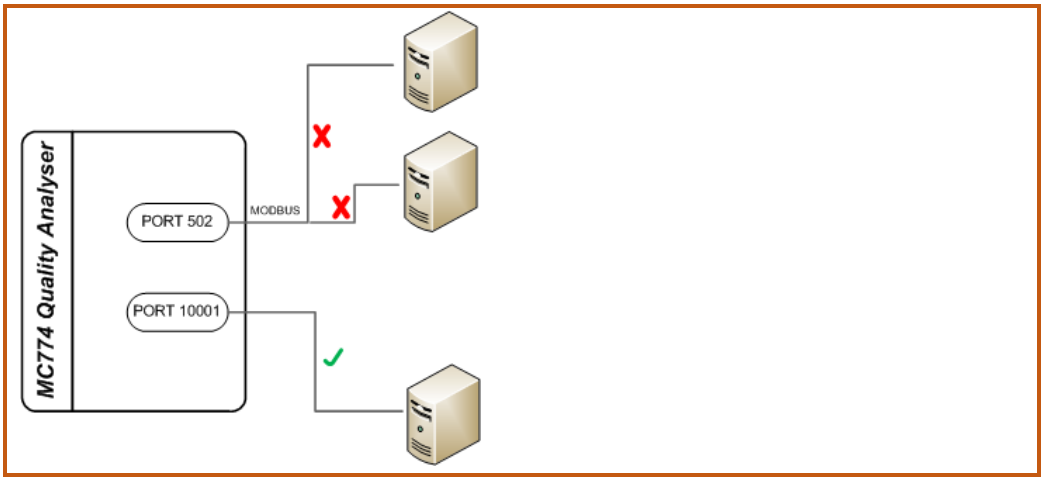


Figure 13: *When any other allowed port is used only a single connection is possible*

Port 502

Is standardized port to communicate with the device via MODBUS/TCP communication protocol and is fixed. Communication via this port allows multiple connections to the device. Communication over this port does not block any other traffic.

Port 33333

This UDP port is reserved for Discovery Service, a service run by MiQen software, to discover devices connected in to local Ethernet communication network.

Other available Ports

Other, allowed TCP ports, are acting as terminal port and when connected to it, it blocks all other connections until it is released.

Priority, when connected to this port, has PUSH functionality of the device.

Subnet Mask PC

It is used to determine what subnet an IP address belongs to.

Gateway Address PC

It is a gateway that connects separate network segments (LAN, WAN or internet).

NTP Server PC

IP address of a NTP server used for time synchronisation of the device.

NTP can usually maintain time to within tens of milliseconds over the public Internet, but the accuracy depends on infrastructure properties - asymmetry in outgoing and incoming communication delay affects systematic bias.

PLEASE NOTE

It is recommended that dedicated network rather than public network is used for synchronisation purposes.

Factory settings of Ethernet communication are:

IP Address	DHCP (automatically)
TCP Port (Terminal Port)	10001
Subnet Mask	255.255.255.0

PUSH communication settings PC

When PUSH communication mode is used, data can be sent (pushed) to two different servers. Within this setting, all parameters relevant to used servers should be set, as well as data type for sent data, time synchronization source and server response time.

For more information about PUSH communication mode and XML Data format see *Communication modes on page 144 and appendix D on page 188.*

TCP Link 1 and TCP Link 2 PC

IP address

IP address of the server collecting data from devices.

IP port

IP port of the serve collecting data from devices.

Data Format

With this setting a required data format for sending data to receiver using PUSH communication mode is set. Currently supported format is XML-smart. For more information about PUSH communication mode and XML data format see *Communication modes on page 144 and appendix D on page 188.*

Response Time (sec)

With this setting a maximum waiting time for acknowledgement of sent data in PUSH communication mode is set. If acknowledgement from a client is not sent within this time, scheduled data will be resend in next push period.

For devices connected in communication network with slow communication speed, values over 10 seconds needs to be selected.

If value lower than 10 second is selected, historical data from recorders are pushed immediately one after another. If value is higher than 10 seconds, automatic time delay length of 10 % of set value is integrated between the sent packets.

Display

Main menu
Measurements
Settings
Resets
SD card
Info
Installation
14.11.2018 16:53:36

⇨

Settings
General
Date & Time
Connection
Communication
LCD
Security
Energy
Inputs/Outputs
⇦ Main menu

Display settings PC OK

A combination of setting of the contrast and back light defines visibility and legibility of a display. Display settings shall be defined in compliance with the conditions in which it will be monitored. Economizing mode switches off back light according to the set time of inactivity.

OK Main menu ⇨ Settings ⇨ LCD ⇨ Contrast / Back light / Back light time off

Demo cycling period PC OK

For demonstration purposes it is useful for device to automatically switch between different displays of measurements.

This setting defines time in seconds for each displayed screen of measurements.

OK Main menu ⇨ Settings ⇨ LCD ⇨ Demo cycling period

Settings of customized screens PC OK

For easier and faster survey of measurements that are important for the user, three different settings of customized screens are available. Each customized screen displays three measurements. When setting customized screens the designations are displayed in shorter form, with up to 4 characters.

Example:

Desired result:

Customized screen 1	Customized screen 2	Customized screen 3	Combined customized screen 4
U1	I_{TOT}	$\varphi_{1\text{-}3\_RMS}$	U1
$U_{P\text{-}P\_avg}$	I_{NM}	f	$U_{P\text{-}P\_avg}$
$U_{UNBALANCE}$	I_{AVG}	THD-I1	$U_{UNBALANCE}$
-	-	-	I_{TOT}
-	-	-	I_{NM}

PLEASE NOTE

Customized screens defined here are selected in menu

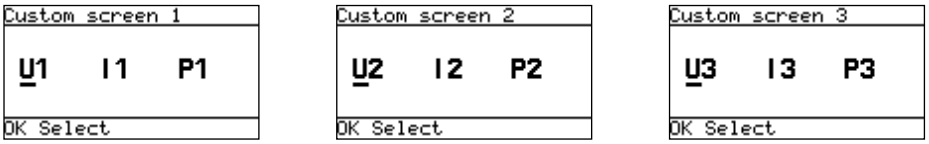
Main menu ⇨ Measurements ⇨ Present values ⇨ Custom

Setting can be made only for 3 customized screens. 4th customized screen is showing 5 parameters, three from Customized screen 1 and first two from Customized screen 2. See example above.

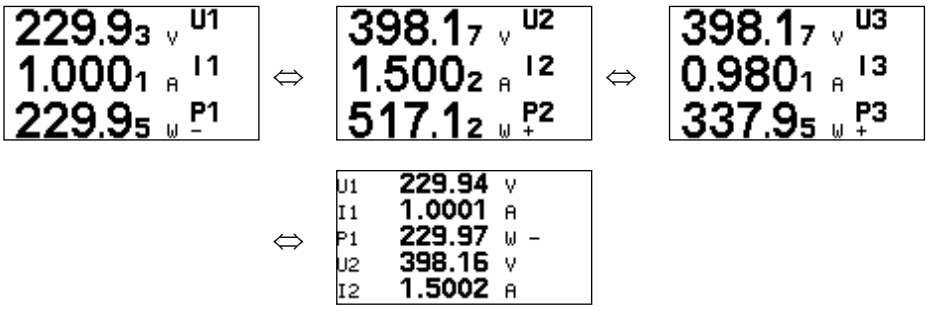
Setting:

Main menu ⇨ Settings ⇨ LCD ⇨ Custom screen 1 / 2 / 3 / (4)

Customized screen 1 Customized screen 2 Customized screen 3



Main menu ⇨ Measurements ⇨ Present values ⇨ Custom



Security

Main menu
Measurements
Settings
Resets
SD card
Info
Installation
14.11.2018 16:53:36

⇨

Settings
General
Date & Time
Connection
Communication
LCD
Security
Energy
Inputs/Outputs
⇦ Main menu

Settings parameters are divided into four groups regarding security level:

PL0 (password level 0)

- Password is not required.
- Available settings:
  - language
  - contrast and
  - LCD back light.

PL1 (password level 1)

- Password for first level is required.
- Available settings:
  - RTC settings
  - Energy meters reset
  - Max. Demand reset
  - Active tariff setting

PL2 (password level 2)

- Password for second level is required.
- Available settings:
  - All settings are available

A backup password (BP) is used if passwords at levels 1 (PL1) and 2 (PL2) have been forgotten, and it is different for each device (depending on a serial number of the device). The BP password is available in the user support department in ISKRA d.o.o., and is entered instead of the password PL1 or/and PL2. Do not forget to state the device serial number when contacting the personnel in ISKRA d.o.o.

PLEASE NOTE

A serial number of device is stated on the label, LCD (see example below) and is also accessible with MiQen software.

The access to the device serial number via a keyboard

Example:

OK Main menu ⇨ Info

Password setting PC OK

A password consists of four letters taken from the British alphabet from A to Z. When setting a password, only the letter being set is visible while others are hidden.

A password of the first (PL1) and the second (PL2) level is entered, and time of automatic activation is set.

OK Main menu ⇨ Settings ⇨ Security ⇨ Password level 1/Password level 2/Password lock time

Password modification PC OK

A password is optionally modified; however, only that password can be modified to which the access is unlocked at the moment.

Password disabling PC OK

A password is disabled by setting the "AAAA" password.

PLEASE NOTE

A factory set password is "AAAA" at both access levels (L1 and L2). This password does not limit access.

Password and language

Language change is possible without password input. When language is changed from or to Russian, character transformation has to be taken in to account. Character transformation table (English or Russian alphabet) is stated below.

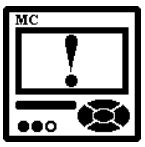
English	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Russian	А	Б	В	Г	Д	Е	Ж	З	И	Й	К	Л	М	Н	О	П	Р	С	Т	У	Ф	Х	Ц	Ч	Ш	Щ	

Energy

Main menu
Measurements
Settings
Resets
SD card
Info
Installation
14.11.2018 16:53:36

⇨

Settings
General
Date & Time
Connection
Communication
LCD
Security
Energy
Inputs/Outputs
⇦ Main menu



WARNING

Before modification, all energy counters should be read or if energy values are stored in recorders, recorder should be read with MiQen software or stored on Memory card to assure data consistency for the past.

After modification of energy parameters, the energy meters (counters) should be reset. All recorded measurements from this point back might have wrong values so they should not be transferred to any system for data acquisition and analysis. Data stored before modification should be used for this purpose.

Active tariff PC

When active tariff is set, one of the tariffs is defined as active; switching between tariffs is done either with a tariff clock or a tariff input. For the operation of the tariff clock other parameters of the tariff clock that are accessible only via communication or Memory card must be set correctly.

Common energy counter resolution PC

Common energy counter resolution defines minimal energy that can be displayed on the energy counter. On the basis of this and an Individual counter Resolution, a basic calculation prefix for energy is defined (−3 is 10^{-3}Wh = mWh, 4 is 10^{4}Wh = 10 kWh). A Common energy counter resolution also influences a number of impulses for energy of pulse output or alarm output functioning as an energy meter.

Define common energy counter resolution as recommended in table below, where Individual counter Resolution is at default value 10. Values of primary voltage and current determine proper Common energy counter resolution.

Suggested Common energy counter resolutions table:

Current / Voltage	1 A	5 A	50 A	100 A	1000 A
110 V	100 mWh	1 Wh	10 Wh	10 Wh	100 Wh
230 V	1 Wh	1 Wh	10 Wh	100 Wh	1 kWh
1000 V	1 Wh	10 Wh	100 Wh	1 kWh	10 kWh
30 kV	100 Wh	100 Wh	1 kWh	10 kWh	10 kWh *

* − Individual counter resolution should be at least 100

Total Energy calculation PC

Measured energy can be evaluated using two different methods.

Evaluation of the sum of the phases

With this settings Energy of all phases are summed together and the result is total import or export energy from all three phases.

Example:

On phases 1 and 2 is a consumption of 1.5 kW on each phase.

On phase 3 there is a production of 2 kW due to connected solar power supply and unbalanced loads.

Result will be calculation of Energy from total power Ptot = P1 + P2 + P3. If result is positive, Energy is treated as imported, if negative as exported.

Evaluation of individual phases

With this settings Energy of each phase is evaluated individually. Contribution of each phase goes to import or export active Energy register.

Example:

On phases 1 and 2 is a consumption of 1.5 kW on each phase.

On phase 3 there is a production of 2 kW due to connected solar power supply and unbalanced loads.

The result will be calculation of Energy for each individual phase Epx from its phase Px. All positive results from phase calculations are summarized and treated as import active Energy, all negative results from phase calculations are summarized and treated as export active Energy.

Common energy cost exponent PC

Setting enables resolving the cost display. On the basis of this and a counter divider constant, a basic calculation prefix for energy cost is defined.

Common Tariff Price Exponent and energy price in tariffs PC

Exponent and price represent energy price (active, reactive, common) in a tariff. The tariff price exponent is used for recording the price without decimal places. For example, to set a price for tariff 1 to 0.1567 €/kWh, the number in Price for energy in tariff 1 field should be 1567 and Common tariff price exponent should be -4 (1567 x 1E-4 = 0.1567)

An example for 12.345kWh of consumed active energy in the first tariff (price 0.1567 €/kWh) table:

Common Energy Counter Resolution	1 Wh	100 Wh	100 Wh
Individual Energy Counter Resolution	1	1	100
Common Energy Cost Exponent	−3	−2	0
Common Tariff Price Exponent	−4	−4	−4
Price for energy in Tariff 1	1567	1567	1567
Unit	EUR	EUR	EUR
Example of result, displayed	12.345 kWh 1.934 EUR	12.3 kWh 1.93 EUR	0.01 MWh 1 EUR

Tariff clock PC

Basic characteristics of a tariff clock:

4 tariffs (T1 to T4)

Separate settings for 4 seasons a year

Up to 4 time divisions per season in each Day program for tariff switching

Any combination of valid days in a week or holidays for each program

Combining of day groups

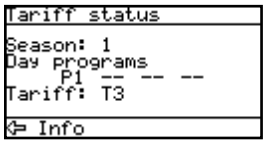
Up to 20 settable dates for holidays

Operation of internal tariff clock

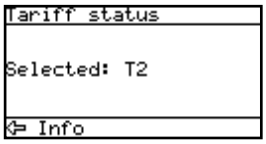
Tariff status is displayed in the Info menu.

Example of display for selected Active tariff:

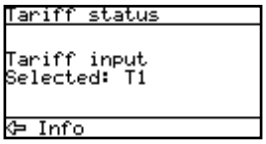
OK Main menu ⇨ Info



or



or



Day program sets up to 4 time divisions (rules) for each day group in a season for tariff switching.

A date of real time clock defines an active period. An individual period is active from the period starting date to the first next date of the beginning of other periods.

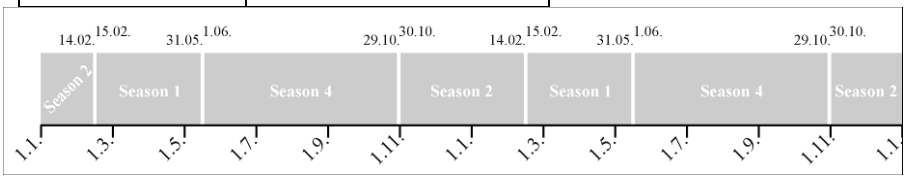
The order of seasons and starting dates is not important, except when two dates are equal. In that case the season with a higher successive number has priority, while the season with a lower number will never be active.

If no starting date of a season is active, the active period is 1.

If the present date is before the first starting date of any period, the period is active with the last starting date.

Example of season settings table:

Season	Season start day
Season 1:	15.02
Season 2:	30.10
Season 3:	–
Season 4:	01.06
Date	**Active season**
01.01. – 14.02.	2 (last in the year)
15.02. – 31.05.	1
01.06. – 29.10.	4
30.10. – 31.12.	2



Days in a week and selected dates for holidays define time divisions for each daily group in a period for tariff switching. Dates for holidays have priority over days in a week.

When the real time clock date is equal to one of a dates of holidays, tariff is switched to a holiday, within a period of active daily group with a selected holiday.

If there is no date of holidays that is equal to the real time clock date, all daily groups with the selected current day in a week are active.

Several daily groups can be active simultaneously, which enables more than 4 time divisions in one day (combine of day programs). If the time division is not set for a certain day, tariff T1 is chosen.

Time of a real time clock defines an active tariff regarding currently active day program. A selected tariff T1 to T4 of individual time division is active from the time of the time spot to the first next time of the remaining time divisions.

The order of time divisions is not important, except when two times are equal. In that case the time with a higher successive number has priority (if several time divisions are active, times of higher time divisions have higher successive numbers), while the time division with a lower number will never be active.

If current time is before the first time of any time division of active divisions, the time division with the last time is chosen.

If no time division of active programs is valid, tariff T1 is chosen.

Time selected tariff T1 to T4 or fixed selected tariff (via communication) defines activity of an energy counter.

Counter measured quantity PC

For each of eight (8) counters different measured quantities can be selected. User can select from a range of predefined options referring to measured total energy or energy on single phase. Or can even select its own option by selecting appropriate quantity, quadrant, absolute or inverse function.

Custom settings PC

From Custom setting user can access following additional Energy measurements calculated from:

- Active power for separate phase
- Reactive power for separate phase
- Reactive power Qfund for separate phase
- Reactive power D (Reactive power of harmonics)
- Reactive power D for separate phase
- Apparent power for separate phase

To energy counter also pulse / digital input can be attached. In this case Energy counter counts pulses from an outside source (water, gas, energy ... meter).

Individual counter Resolution PC

The individual counter resolution additionally defines precision of a certain counter, according to settings of common energy counter resolution.

Tariff selector PC

Here user defines tariffs where counter is active.

Measurement of Reactive energy evaluation class 0.5S according to IEC62053-24

Device is set to measure Reactive energy in class 0.5S according to IEC62053-24. Parameter Reactive Energy – Qfund is selected by default to match this demand (only fundamental frequency is used for calculation).

I/O Modules

Main menu
Measurements
Settings
Resets
SD card
Info
Installation
14.11.2018 16:53:36

⇨

Settings
General
Date & Time
Connection
Communication
LCD
Security
Energy
Inputs/Outputs
⇦ Main menu

I/O functionality is a powerful tool of *MC 7×0 Power Monitoring Device*. Using various I/O modules device can be used not only for monitoring main electrical quantities but also for monitoring process quantities (temperature, pressure, wind speed …) and for various control purposes.

Device can be equipped with different I/O modules with different functionality. For its technical specifications see chapter *Technical data on page 149*.

Main I/O Modules 1 & 2

MC 7×0 Power Monitoring Device is equipped with two main I/O slots. The following I/O modules are available:

List of available main I/O modules:

Module type	Number of modules per slot
Analogue input (AI)	2
Pulse input (PI)	2
Digital input (DI)	2
Tariff input (TI)	2
Analogue output (AO)	2
Pulse output (PO)	2
Relay (Alarm) output (RO)	2
Status output (WO)	1 + 1xRO
Digital output (DO)	2
Bistable alarm output (BO)	1
Communication module (COM2)	1

PLEASE NOTE

All modules have double input or output functionality, except Bistable alarm output and Watchdog output module. All modules with a double input or output are in MiQen presented as two separate modules.

An alarm output and a pulse output can also be selected with the keypad and display. When selecting settings of energy and quadrants for a certain counter, only preset selection is possible, while more demanding settings are accessible via communication. For other modules, information on a built-in module is available via LCD.

Analogue input module PC

Three types of analogue inputs are suitable for acquisition of low voltage DC signals from different sensors. According to application requirements it is possible to order current, voltage or resistance (temperature) analogue input. They all use the same output terminals.

MiQen software allows setting an appropriate calculation factor, exponent and required unit for representation of primary measured value (temperature, pressure, flux …)

Signals from Analogue input can also be stored in built-in memory of a device. They can also be included in alarm function (see chapter *Alarms on page 129)*.

DC current range:

Range setting allows bipolar ±20 mA max. input value

DC voltage range:

Range setting allows bipolar ±10 V max. input value

Resistance / temperature range:

Range setting allows 2000 Ω or 200 Ω max. input value

It is also possible to choose temperature sensor (PT100 or PT1000) with direct translation into temperature (-200°C to +850°C). Since only two-wire connection is possible it is recommended that wire resistance is also set, when long leads are used.

Pulse input module PC

Module has no settings. It is general purpose pulse counter from external meters (water, gas, heat …). Its value can be assigned to any of four energy counters. See chapter *Energy on page 72*.

It can also be used as digital input and included in alarm function to monitor signals from different sensors (see chapter *Alarms on page 87*).

Pulse input module has only one hardware configuration (5 V_{DC}…48 V_{DC}).

Digital input module PC

Module has no settings. General purpose is to collect digital signals from various devices, such as intrusion detection relay, different digital signals in transformer station, industry ... It is available in three different hardware versions.

It can also be included in alarm function (see chapter *Alarms on page 87*).

Tariff input module PC

Module has no setting. It operates by setting active tariff at a tariff input (see chapter *Active tariff on page 72*). The device can have maximal one module with 2 tariff inputs only. With the combination of 2 tariff inputs maximal 4 tariffs can be selected.

Active tariff selection table:

Active tariff	Signal presence on tariff input	
	Input T1/T2	Input T3/T4
Tariff 1	0	0
Tariff 2	1	0
Tariff 3	0	1
Tariff 4	1	1

Analogue output module PC

Analogue output module is useful for control and measurement visualisation purposes. It can be connected to analogue meters, PLC controllers … It has defined output range 20 mA DC. Quantity and shape (up to 6 break points) of an analogue output can be assigned by MiQen software.

Output parameter

Output parameter can be any measured value that is required for monitoring, recording, visualisation or control. Value is chosen from a drop-down menu.

Output signal

Output signal can be adjusted to meet all required purposes.

Shape of output signal (linear, Quadratic)

Number of break points for zoom function (up to 6)

Start and End output value

For better visualisation of set output signal parameters, graphical presentation of transfer function is displayed

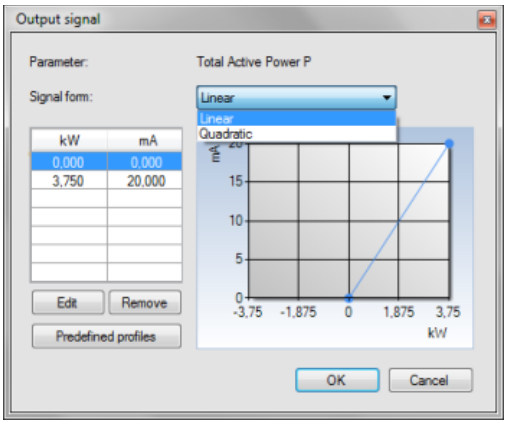


Figure 14: *MiQen window for output signal definition*

For more information, see Help section in MiQen software.

Pulse output module PC

Pulse output is a solid state, opto-coupler open collector switch. Its main purpose is pulse output for selected energy counter, but can also be used as an alarm or general purpose digital output.

For description of output functionality see chapter *Functions of Digital output modules* below.

Relay output module PC

Relay output module is a relay switch. Its main purpose is to be used as an alarm output, but can also be used as a pulse or general purpose digital output.

PLEASE NOTE

A parallel RC filter with time constant of at least 250 µs (R·C ≥ 250 µs) should be used in case of a sensitive pulse counter. RC filter attenuates relay transient signals.

For description of output functionality see chapter *Functions of Digital output modules* below.

Status (Watchdog) and Relay output module PC

Watchdog and relay module is a combination of two functionalities. One output is used for Watchdog functionality, the other acts as a Relay output module.

The purpose of a Watchdog relay is to detect potential malfunction of device or auxiliary power supply failure. This module can be set for normal operation (relay in close position) or for test purposes to open position (manual activation). After test module should be set back to normal operation.

For description of output functionality see chapter *Functions of Digital output modules* below.

Bistable alarm output module PC

A Bistable digital output module is a relay type. The only difference between relay alarm output and bistable relay alarm output is that it keeps the condition at output in case of device power failure.

Functions of Digital output modules PC

To Digital outputs, Pulse and Relay, different functions can be attached. All can be set with MiQen software.

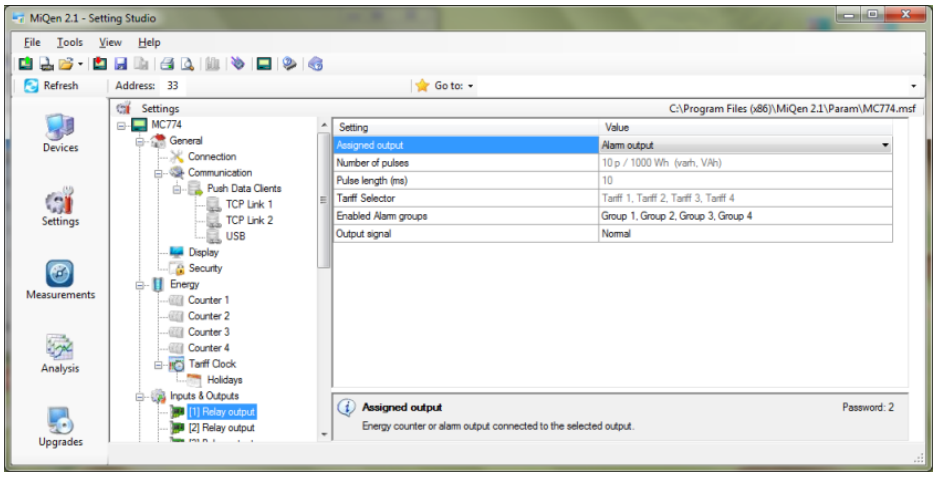


Figure 15: *MiQen window for digital output definition*

Pulse Output of Energy counter

A corresponding Energy counter (up to 8) can be defined to a digital output. A number of pulses per energy unit, pulse length, and a tariff set in which output is active are set.

PLEASE NOTE

Pulse parameters are defined by EN 62053−31 standard. In chapter Calculation of recommended pulse parameters, below a simplified rule is described to assist you in setting the pulse output parameters.

Main menu ⇨ Settings ⇨ Inputs/Outputs ⇨ I/O 1/2/3/4 ⇨ (Settings of pulse output)

Calculation of recommended pulse parameters

Number of pulses per energy unit should be in certain limits according to expected power. Otherwise the measurement from pulse output can be incorrect. Settings of current and voltage transformer ratios can help in estimation of expected power.

Principle described below for pulse setting satisfies EN 62053−31: 2001 standards pulse specifications:

$$1{,}5\ldots15\,\mathrm{eW} \rightarrow 100\,\mathrm{p}/1\,\mathrm{eWh}$$

e … exponent (k, M, G)

p … pulses

Examples:

Expected power	→	Pulse output settings
150 − 1500 kW	→	1 p / 1kWh
1.5 − 15 MW	→	100 p / 1MWh
15 − 150 MW	→	10 p / 1MWh
150 − 1500 MW	→	1 p / 1MWh

Alarm Output

If Digital output is defined as an Alarm output, its activity (trigger) is connected to Alarm groups. Multiple alarm groups can be attached to it and different signal shapes can be defined. For more information on how to define alarm groups, see chapter *Alarms on page 87*.

OK Main menu ⇨ Settings ⇨ Inputs/Outputs ⇨ I/O 1/2/3/4 ⇨ (Settings of alarm output)

Two parameters should be defined for each alarm output:

The source for assigned alarm (alarm group 1, 2 or both)

Type of output signal when alarm is detected.

Output signal types

Normal − A relay is closed as long as condition for the alarm is fulfilled.

Normal inverse − A relay is open as long as condition for the alarm is fulfilled. After that relay goes to closed state

Latched − A relay is closed when condition for the alarm is fulfilled, and remains closed until it is manually reset.

Latched inverse − A relay is open when condition for the alarm is fulfilled, and remains open until it is manually reset.

Pulsed − an impulse of the user set length is activated always when condition for the alarm is fulfilled.

Pulsed inversed – Normally relay is activated. An impulse of the user set length deactivates it always when condition for the alarm is fulfilled.

Always switched on/off (permanent) – A relay is permanently switched on or off irrespective of the condition for the alarm (general purpose digital output functionality).

Check an example in chapter *Alarms on page* for graphical demonstration of alarm functionality.

General purpose digital output

This functionality allows user to enable / disable digital output by software settings for example from SCADA system.

For this operation MODBUS registers need to be accessed by means of software. By modifying appropriate MODBUS registers (from SCADA) digital output can be set or reset.

For corresponding MODBUS registers and their values see table below.

MODBUS registers and their values for remotely driving digital outputs:

MODULE NUMBER	MODBUS REGISTER	REGISTER VALUE	
Module 1 (if installed)	40722	3 - ON	4 - OFF
Module 2 (if installed)	40725	3 - ON	4 - OFF
Module 3 (if installed)	40728	3 - ON	4 - OFF
Module 4 (if installed)	40731	3 - ON	4 - OFF

Tariff Output

Digital output module can act also as a tariff clock output. Different tariffs can be defined to trigger relay. For tariff clock settings see chapter *Active tariff on page 72*.

Communication modules

There are two different communication modules that can be used as an independent secondary communication connection.

- 2nd communication module (RS232 or RS485)
- Communication module for Analogue extender EX104

Communication module for Analogue extender EX104

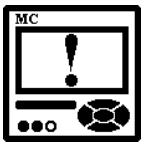
Module is preset for connection of up to 4 Analogue extender EX104 devices. It uses RS485 communication with fixed parameters to communicate with connected modules.

EX104 is a standalone unit with 4 programmable analogue outputs. Each connected unit needs to have unique device address (from 1 to 4).

For more detailed description of EX104 functionality and connection, check device technical documentation.

RTC Synchronisation PC

MC 7×0 Power Monitoring Device supports NTP time synchronisation (via Ethernet module).



CAUTION

RTC synchronisation is essential part of Class A instrument. If no proper RTC synchronisation is provided device operates as Class S instrument.

2nd Communication module (COM2)

Module is preset for RS232 or RS485 communication.

For other description see chapter *Serial communication on page* 61.

Alarms

Alarms are used for alarming exceeded set values of measured quantities and quantities from different input modules.

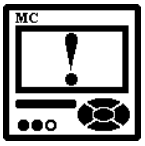
Alarms can also trigger different actions according to their settings:

Visual (alarms cause special alarm LED to lit)

Sound (alarms can cause sound signalisation)

Relay switch (alarms can switch digital outputs on main and aux. I/O modules)

Alarm condition can be set for any measured quantity, also for quantities measured on Analogue inputs or signals from Digital/Pulse input.



CAUTION

New values of alarms are calculated in percentage. At every modification of connection settings crosscheck if set alarm values are correct.

Alarms PUSH functionality PC

When PUSH communication mode is active, all alarms can be sent (pushed) to a predefined location inside local or wide area network. Settings allow choosing an appropriate destination for alarm data to be sent.

Alarm data is sent to the server immediately as alarm(s) occur. If they cannot be sent immediately due to communication problems, they are sent at next alarm event or data sending interval (whichever occurs first).

Alarms and time stamps of occurrence are also stored into internal memory.

For more information about PUSH functionality and XML data format see chapter *PUSH Communication mode on page 146* and *Appendix D on page 188*.

Push data to link

When PUSH communication mode is used a data receiving server (client) link should be defined. Data can be sent (according to a type of used communication interface) to COM1, TCP link 1 or TCP link 2. For definition of PUSH links see *PUSH communication settings on page 146*.

Alarms are unlike recorded values sent to chosen link immediately after occurrence. Therefore settings for pushing period and time delay are not applicable.

Alarm statistics reset

This setting is only for resetting online alarms statistics displayed in MiQen software.

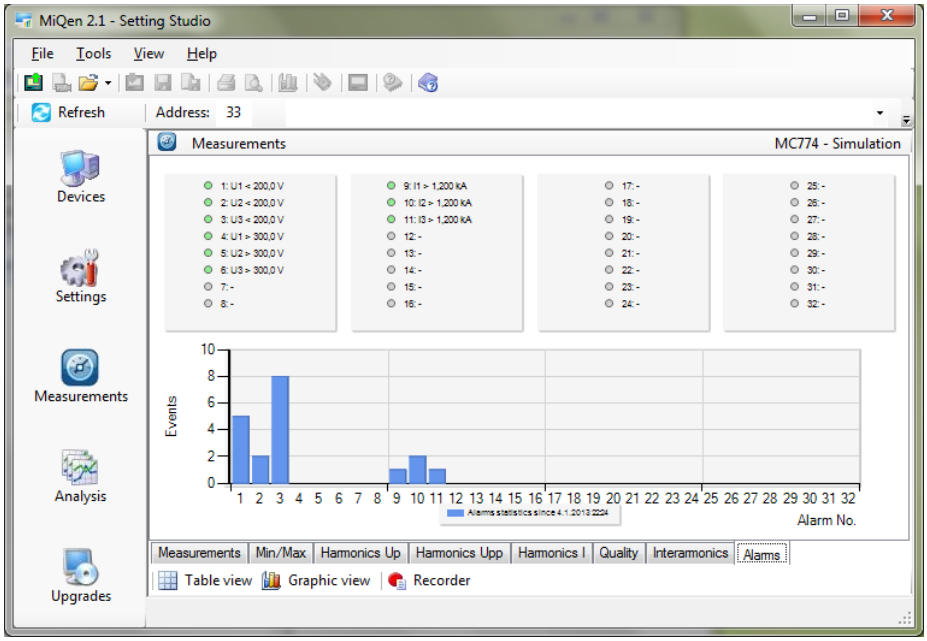


Figure 16: *Alarms statistics for showing graphical representation of frequency of alarms occurence*

Alarms group settings PC

MC 7×0 Power Monitoring Device supports recording and storing of 32 alarms that are divided into 4 groups of 8 alarms. Each group of alarms has some common settings applicable for all alarms within this group.

MD Time constant

Sets a thermal mode maximum demands time constant for the alarm group.

When monitoring certain quantity it is possible to monitor its actual value or its max. demand value. If latter is chosen then a time constant for calculation of thermal mode max. demand value should be set.

This setting is for alarm purposes only and is independent of max. demand calculation settings for monitoring and recording purposes as described in chapter *Maximum demand calculation on page 52*.

Compare time delay

This setting defines delay time (if required) between satisfying the alarm condition and alarm activation. If alarm condition is shorter then this setting alarm will not be triggered.

This setting is used to rule out sporadic and very short duration triggers.

Hysteresis

This setting defines alarm deactivation hysteresis.

When monitord quanitity is close to set limit line its slight variation can trigger numerous alarms.

Hysteresis should be sett according to estimated variation of monitored quantity.

Response time

This setting defines alarm response on monitored quantity.

Normal response: In this case monitored quantity is averaged according to display averaging settings (0.1 to 5s – see chapter *General settings / Average interval on page 49*.

Fast response: In this case alarms react on non-averaged measurements (1 signal period).

This setting should be used according to required functionality. Fast response is more prone to glitches and transient effects in a system but reaction time is fast.

Individual alarm settings PC

For each individual alarm different settings are possible.

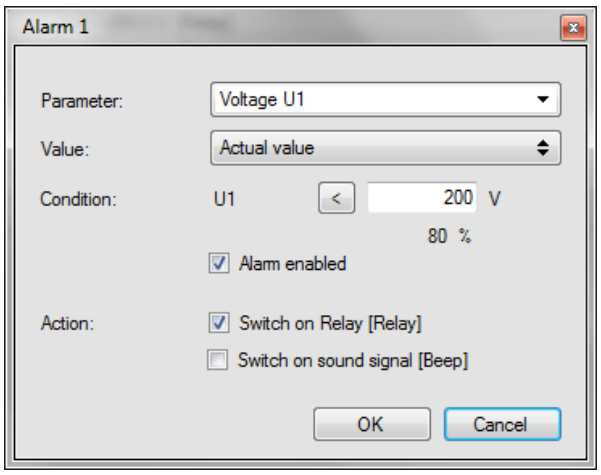


Figure 17: *Individual Alarms settings*

Slot is protected with a protection cover that can be simply removed before inserting the card. The protection cover shall be fixed back after work is done.

Parameter

This setting defines a quantity that should be monitored. It is also possible to select process quantities from I/O modules.

Value

For chosen monitoring parameter an actual value or MD value should be set.

Condition

It is a combination of a logical operator “Higher than” or “Lower than” and a limit value of the condition. For digital / pulse input it is possible to set condition is “Is high” or “Is low”.

Action

This section is consists of checkboxes that applies different functions to individual alarms.

Switch on Relay checkbox can be selected if user wants this alarm to trigger output(s) that are connected to its group of alarms (pulse, relay or bistable output module). When using relay outputs of I/O module A or B also a single alarm can be used as a trigger. In this case Switch on Relay setting has no influence.

Switch on sound signal checkbox would activate built in beeper if this alarm is active.

Alarm enabled checkbox, activates alarm setting.

Types of alarms

Visual alarm

When alarm is switched on, a red LED on the device front side is blinking (see figure shown on next page).

Sound alarm

When alarm is switched on, an audible alarm is given by the device (a beep). It can be switched off by pressing any key on the front plate (see figure shown on next page).

Alarm output (pulse) – setting mode for I/O module 1 and 2

According to the alarm signal shape the output relay will behave as shown below.

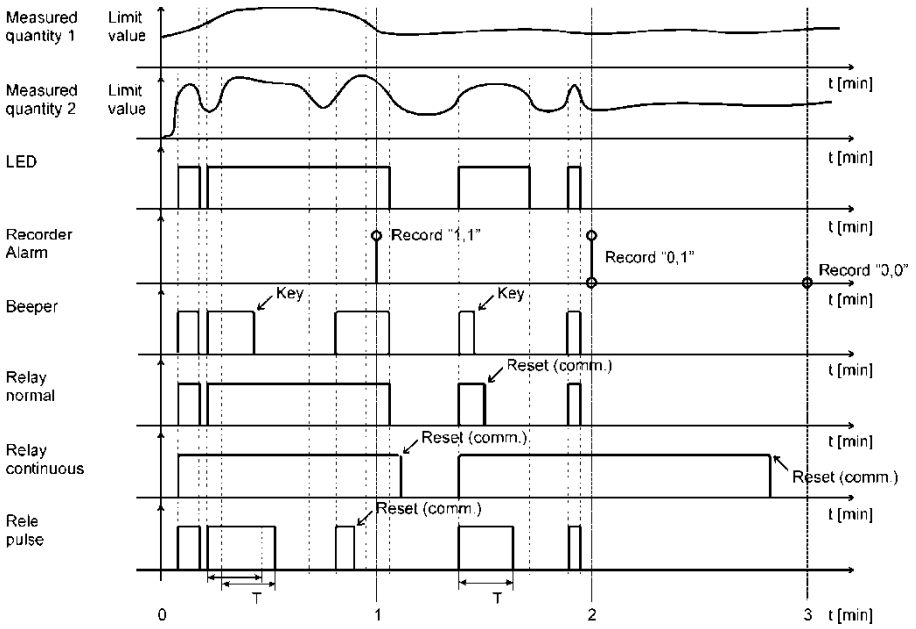


Figure 18: *Graphical presentation of alarms operation*

Internal memory

Measurements, alarms, PQ reports (only for MC 770) and details can be stored in a built in memory of *MC 7×0 Power Monitoring Device* 8 MB flash. This amount of memory suffices for storing EN 50160 compliant PQ reports with details for more than 12 month. All records stored in memory are accessible by communication or memory card and can be displayed with MiQen software.

Device has also a built in function that enables scheduled transmission of data, stored in memory, to remote data collecting system. For more information regarding this feature see chapter *PUSH Communication mode on page 146.*

Memory organisation PC

Device's internal memory has 8 MB of total memory space. It is divided into 5 partitions which size is defined by the user and 2 fixed partitions.

User defined partitions are A, B, C and D recorders that are intended for recording of measurements (each recorder can store up to 32 parameters), while all alarms that occurred are recorded in an alarm partition.

C and D recorders can be user defined as a standard trend recorders (like recorders A and B) or can be defined as dedicated harmonic recorders. As such they will record all 65 harmonics, voltage or current depends on user setting for each of those two recorders. Settings are available in general tab of *Standard recorders* section (*see figure 20 on next page*).

Fixed partitions are dedicated for recording PQ reports (only for MC 770) and details.

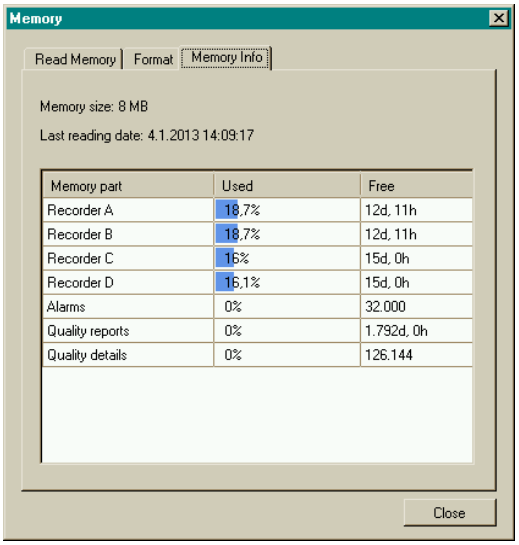


Figure 19: *Internal memory organisation*

Memory operation

Memory functions in a cyclic mode in compliance with the FIFO method. This means that only the latest records are stored in the memory that will replace the oldest ones.

A size of stored data or a storing period depends on selected partition size, a number of recorded quantities and a storage interval.

Storage availability of partitions is shown in the Information menu (see chapter *Display of device info on page 38*).

Memory clearing PC

There is usually no need to clear the memory, because it works in cyclic mode. If it is required anyway, the data storing must be stopped first. Read the device settings with MiQen and set “Recorder state” in Memory setting group to “stopped” as shown in a figure below.

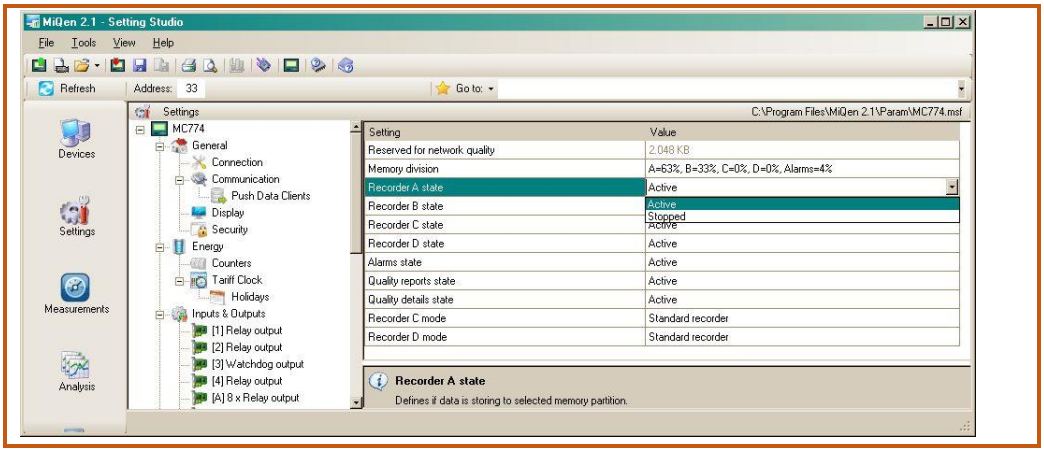
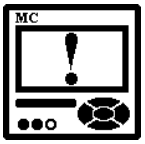


Figure 20: *Enabling or disabling data storage*

Download changes to the device and open Memory info form (Figure 19 on previous page) and Format tab. Choose memory partitions required to be cleared and click format button. After partitions are cleared set “Recorder state” setting back to active.



CAUTION

It is strongly advised to download recorder data before applying any changes to recorder or changes of settings for energy, type of connection, current and voltage transformer settings and used current and voltage ranges. These changes might have impact on recorded history so data might no longer be valid.

General purpose recorder settings PC

General purpose recorder consists from 4 partitions (A, B, C and D). General purpose recorder does not include alarm recorder or PQ reports and details recorder. Separately, for each of four partitions, following settings can be set:

Storage interval

Storage interval sets a time interval for readings to be recorded.

Which type of parameter should be stored each interval (avg., min., max., actual …) is defined in settings for each individual parameter described later in this chapter.

MD Time constant

When max. demand needs to be recorded, this setting sets a period for calculation of maximum and minimum value in thermal mode (Minimum (MD) or Maximum (MD)). Different parameters can be set for Recorded parameters 1-8, 17-24 and 9-16, 25-32. This setting is only available for recorders A and B.

PUSH settings

When PUSH communication mode is active, all measurements which are set to be written to the memory can be sent (pushed) to a predefined location inside local or wide area network (from the time that PUSH functionality has been activated, not for the past records). Settings allow choosing an appropriate destination for data to be sent, time interval of sent data and a delay time for sending data if they cannot be sent immediately due to restrictions in network.

For more information about PUSH functionality see chapter *PUSH Communication mode on page 146.*

Recorded quantities

For each measurement, which is to be recorded it is possible to set a required quantity and its type within storage interval.

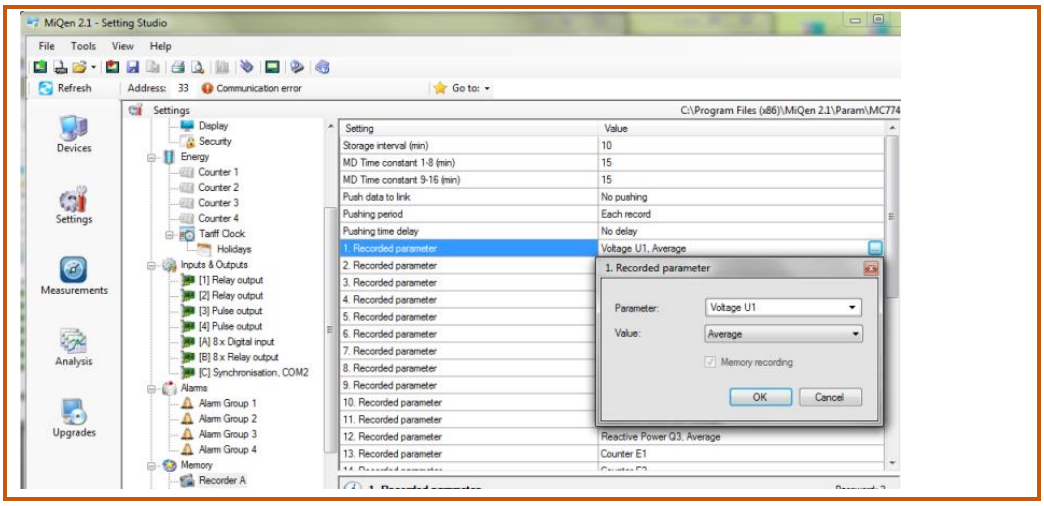


Figure 21: *Stored parameter settings*

Parameter

Here monitoring quantity can be selected from a list of supported measurements.

Besides primary electrical quantities also auxiliary quantities from input modules can be selected.

Value

A type of a selected quantity within set monitoring interval can be set to different conditions.

Minimum and Maximum value represents minimum or maximum of recorded averaged values within selected storage interval. Note that min./max. value is not a single period value but an average (0.1 s to 5 s; see chapter *General settings / Average interval on page 49*).

Minimum (MD) and Maximum (MD) value represents calculation of a MD value with applied thermal function. Thermal function time constant is described above (MD Time constant). It applies only to recorders A and B.

Average value represents calculated average value within selected storage interval.

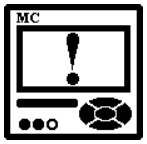
Actual value represents first momentary value within selected storage interval. Note that momentary value is not a single period value but an average (0.1 s to 5 s; see chapter *General settings / Average interval on page 49*).

Minimum and Maximum (Period) values represent min. or max. value within selected storage interval calculated in a single period. This function allows recording of very fast changes.

Conformity of voltage with EN 50160 standard (only for MC 770)

The EN 50160 standard deals with voltage characteristics of electricity supplied by public distribution systems. It specifies the limits or values of voltage characteristics in normal operation within public low or middle voltage system network. Following this definition the *MC 770 Power Quality Analyzer* is adapted for monitoring voltage characteristics of a distribution systems according to EN 50160 standard. Together with setting and monitoring software MiQen voltage characteristics can be monitored and weekly reports about power quality are issued.

Based on requirements stated in the standard, default parameters are set in the device according to which supervision of all required characteristics is performed. Parameters can also be changed in detailed settings for individual characteristics.



CAUTION

Factory default settings for PQ characteristics (only for MC 770) are in compliance with standard EN 50160. By changing individual parameters conformity of weekly reports with this standard is no longer valid.

Parameters of PQ characteristics are settable only by means of setting software MiQen.

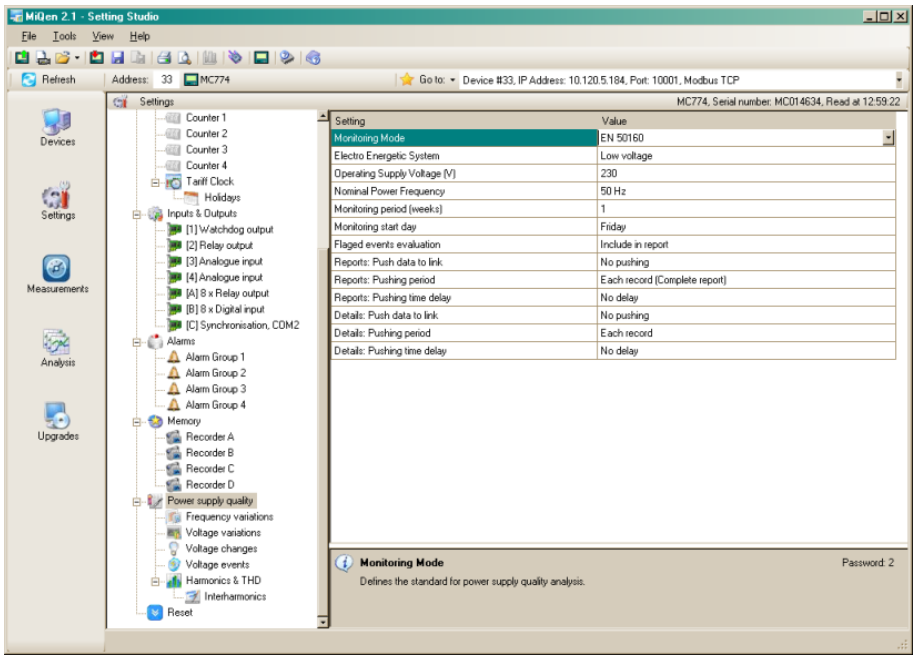


Figure 22: *General PQ settings*

General PQ settings (only for MC 770)

General PQ settings are basic parameters that influence other settings.

Monitoring mode

Monitoring mode can be set to:

- EN50160: Monitoring according to EN 50160 enabled. Weekly reports are issued according to set parameters
- No monitoring: Weekly reports for network compliance with the standard are disabled

Electro energetic system

Requirements for PQ monitoring differ regarding type of a monitored public distribution system. Therefore it is essential o choose proper type. This setting influences some of the predefined limit lines according to relevant standard EN 50160.

MC 770 Power Quality Analyzer can monitor PQ within following systems:

Low Voltage grid connected system

Medium Voltage grid connected system

Low Voltage islanded system

Medium Voltage islanded system

PLEASE NOTE

Choosing one of listed distribution systems automatically sets PQ characteristics according to requirements in EN 50160 for that particular system.

Nominal supply voltage

Set a voltage level of a monitored system. This value is used as a reference for calculation of power quality indices and is usually equal to nominal network voltage (also marked as Udin in various standards). Factory default value is EU standard low voltage value 230 V.

Nominal power frequency

Nominal frequency of monitored supply voltage is selected. Factory default value is EU standard frequency 50 Hz. It is also possible to choose 60 Hz.

Flicker calculation function

Low voltage level for residential lamps can be either 230 V or 110 V. Function for detection of flicker differs regarding this voltage. Since actual low voltage level can be different as secondary voltage of used VT (nominal measuring voltage) this setting must be set to a voltage level, which is used to supply residential lamps.

Monitoring period (weeks)

Monitoring period predefines period for issuing PQ reports. When Monitoring Mode is set to EN 50160, monitoring is performed continuously.

This setting defines how often should reports be issued.

Monitoring start day

A starting day in a week for monitoring period is selected. It starts at 00:00 (midnight) in the selected day. The selected day will be the first day in a report.

After Monitoring period and Monitoring start day are defined, PQ reports will be continuously issued at the end of each monitoring period. All reports and associated anomalies within monitored period are stored in devices internal memory and can be analysed by means of MiQen software.

Flagged events setting

Flagged evens setting specifies actions on data (recorded events) that has been flagged (marked) according to flagging concept IEC 61000-4-30.

Flagged data are power quality records, which has been influenced by one or more voltage events (interruptions, dips, swells).

The purpose of flagging data is to mark recorded parameters when certain disturbances might influenced measurements and caused corrupted data. For example, voltage dip can also trigger occurrence of flicker, interharmonics... In this case all parameters which were recorded at a time of voltage events are marked (flagged). In later evaluation those flagged records can be omitted from final report by choosing appropriate setting.

PLEASE NOTE

Regardless of this setting, readings will be always stored in recorder and available for analysis. Flagging only influences PQ reports as a whole.

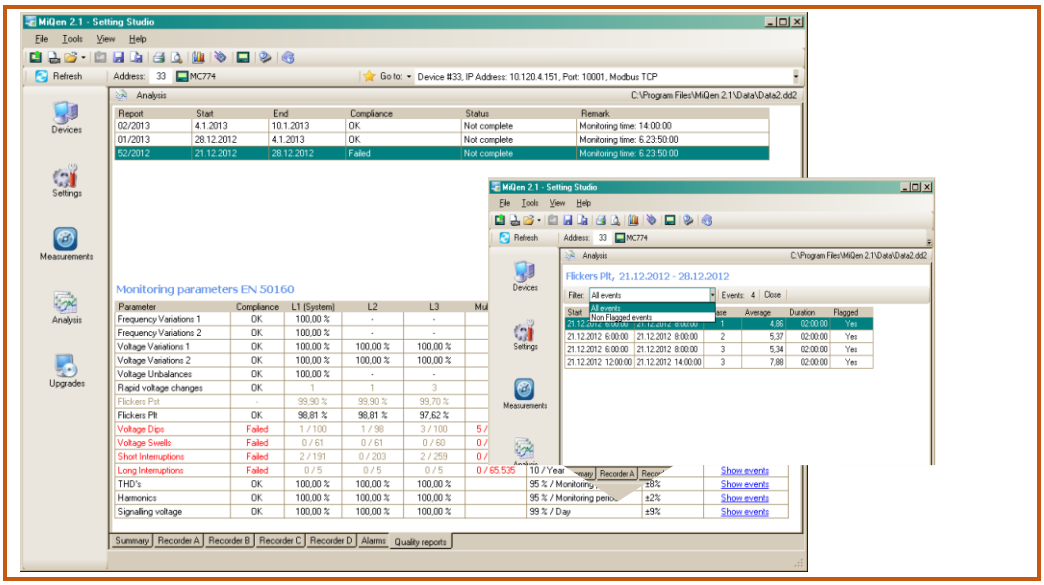


Figure 23: *Flagged data can be included or excluded from a PQ report*

Sending Reports and Report Details

When PUSH communication mode is active, reports about quality and report details for each parameter can be sent (pushed) to a predefined location inside local or wide area network. Settings allow choosing an appropriate destination for data to be sent, time interval of sent data and a delay time for sending data if they cannot be sent immediately due to restrictions in network.

For more information about *PUSH Communication mode* *see page 146.*

EN 50160 parameters settings (only for MC 770)

Power Quality indices as defined by EN 50160:

Phenomena	PQ Parameters
Frequency variations	Frequency distortion
Voltage variations	Voltage fluctuation Voltage unbalance
Voltage changes	Rapid voltage changes Flicker
Voltage events	Voltage dips Voltage interruptions Voltage swells
Harmonics & THD	THD Harmonics Inter-harmonics Signalling voltage

Standard EN 50160 describes in details PQ parameters and corresponding limit lines for monitoring whereas distribution system voltage operates in accordance with mentioned standard.

Settings of limit lines and required percentage of appropriate indices resembles requirements of standard EN 50160.

When monitoring according to this standard is required there is no need to make changes to PQ parameters settings.

More detailed description of certain parameter monitoring procedures is in a chapter *Measurements on page 110*.

There are some PQ parameters which are interesting for monitoring but are not required to be part of PQ reports. These settings do not have standardised limit values and an be set according to distribution network requirements.

- Short term flicker (limit Pst = 1)
- Interharmonics (10 values of user defined frequencies)

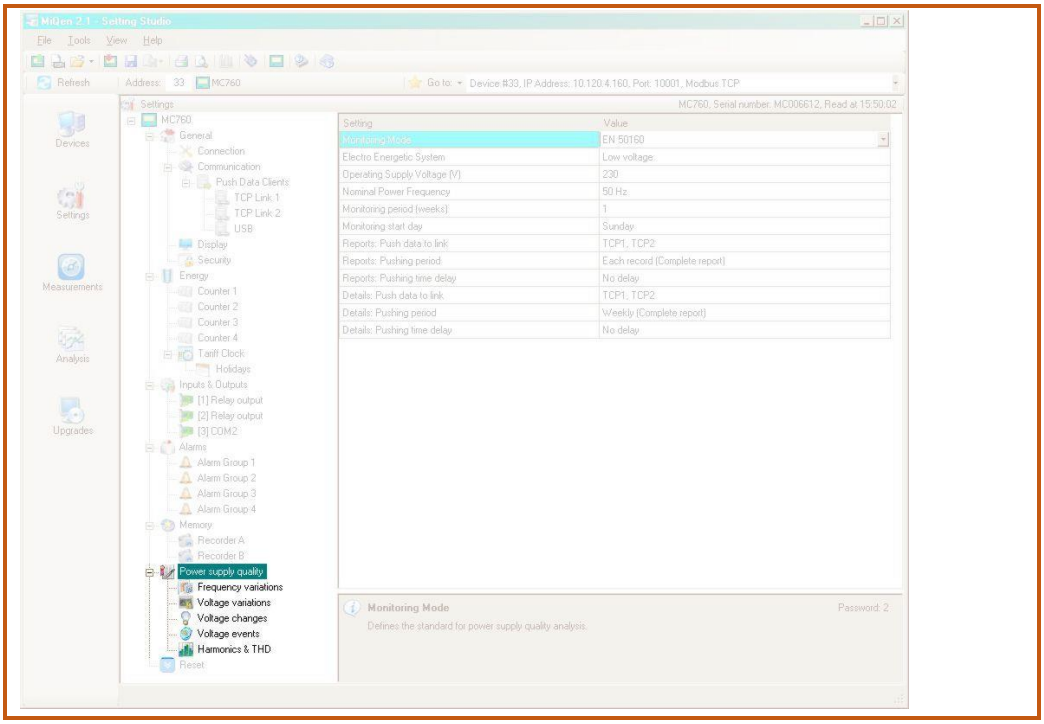


Figure 24: *Settings for power quality parameters are set with setting and monitoring software MiQen*

MiQen HELP description clearly marks PQ parameters, which are not required as a part of EN 50160 PQ report.

Below figure shows settings for interharmonic values:

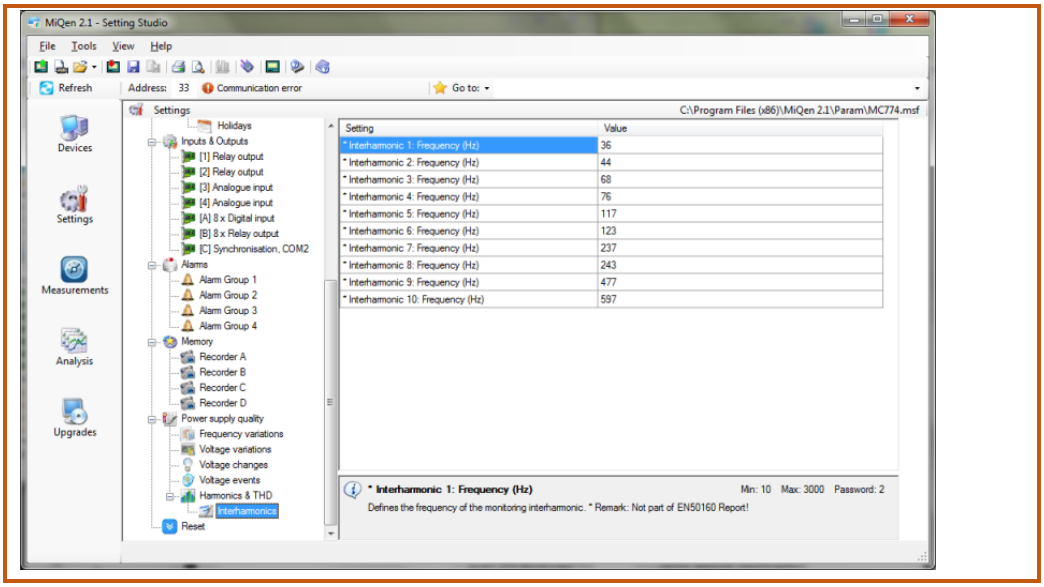


Figure 25: *Settings for 10 user defined interharmonic frequencies*

Reset operations

During normal operation of a device different counter s values need to be reset from time to time.

Reset energy counters (E1, E2, E3, E4) PC OK

All or individual energy meters (counters) are reset.

OK Main menu ⇨ Resets ⇨ Energy counters ⇨ All Energy counters / Energy counter E1/E2/E3/E4

Reset energy counters costs (E1, E2, E3, E4) PC OK

All or individual energy costs are reset.

OK Main menu ⇨ Resets ⇨ Energy counters ⇨ All Cost counters / Cost counter E1/E2/E3/E4

Reset maximal MD values PC OK

Thermal mode

Current and stored MDs are reset.

Fixed interval/Sliding windows

The values in the current time interval, in all sub-windows for sliding windows and stored MD are reset. In the same time, synchronization of time interval to the beginning of the first sub-window is also performed.

OK Main menu ⇨ Resets ⇨ MD values

Reset the last MD period PC OK

Thermal mode

Current MD value is reset.

Fixed interval / Sliding windows

Values in the current time interval and in all sub-windows for sliding windows are reset. In the same time, synchronization of the time interval is also performed.

OK Main menu ⇨ Resets ⇨ Last period MD

Synchronize MD

Thermal mode

In this mode, synchronization does not have any influence.

Fixed interval/Sliding windows

Synchronization sets time in a period or a sub-period for sliding windows to 0 (zero). If the interval is set to 2, 3, 4, 5, 6, 10, 12, 15, 20, 30 or 60 minutes, time in a period is set to such value that some intervals will be terminated at completed hour.

Example:

Main menu ⇨ Resets ⇨ Synchronize MD

Time constant (interval)	15 min	10 min	7 min
Synchronization start time	10:42	10:42	10:42
Time in a period	12 min	2 min	0 min
First final interval	10:45	10:50	10:49

Alarm relay Off

Turn off the alarm (relay output).

Main menu ⇨ Resets ⇨ Reset alarm status

Reset Min/Max values

All Min/Max values are reset.

Main menu ⇨ Resets ⇨ Reset Min. Max. values

Reset alarm statistic

Clears the alarm statistic. It can be made by MiQen software under Alarm settings. This setting is only for resetting online alarms statistics displayed in MiQen software.

Settings and memory card

MC 7×0 Power Monitoring Device is provided with a built in slot for a full size SD memory card that is used for measurements transfer from internal memory, device setting and software upgrading. The memory card shall be formatted with the FAT16 file system.

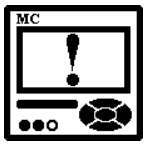
Directory structure on a memory card

A structure of directories is defined and enables correct data handling via a memory card. The memory card shall contain the following directories and files:

- DATA
- SETTING
- UPGRADE
- File: Automenu.txt (option)

DATA

Records from the internal memory are collected in the DATA directory. To upload data of several devices to the memory card, each device checks and, if necessary, creates its own subdirectory before data transfer. Each subdirectory uses a device serial number as its name and stores files with data in it. Each file name contains date (year, month and day) and a record sequence number of that day.



WARNING

When uploading data file to memory card and there is a file with sequence number 99 of that day, a file with sequence number 00 is generated. File with sequence number 00 of that day, is overwritten in case of any further uploading data that day.

SETTING

Settings are stored in the directory using two recording modes:

- With a type designation and a sequence number from 1 to 9
- With an device serial number

UPGRADE

A file with upgrades is available for upload with the MiQen software. A file has a name of a corresponding device type designation and suffix fl2 (e.g. MC7×0.FL2).

Automenu.txt

For faster and easier upgrading of the firmware there is »Automenu.txt« file in the root directory. When an memory card with a file is inserted and if upgrade version is higher, display automatically jumps into the memory card menu and suggests the Software upgrade menu, otherwise it automatically jumps into the Save data menu. When upgrading is finished and the OK key is pressed and memory card is removed, the menu that was displayed before inserting the memory card is displayed.

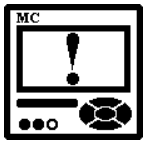
Automenu.txt file can be created by the user by means of the text editor. A new file has to be opened and saved under the correct name (Automenu.txt) and without content.

Example:

DATA
↳ MC003973
↳ 06050301.MMC
MC003974
↳ 06050301.MMC
06070301.MMC
MC009424
↳ 06060301.MMC
06070301.MMC
SETTING
↳ MC003973.MSF
MC770−1.MSF
MC770−2.MSF
MC750−1.MSF
UPGRADE
↳ MC770.FL2
Automenu.txt

Handling memory card

MC 7×0 Power Monitoring Device is on the front panel equipped with a slot for a Memory card. Slot is protected with a protection cover that can be simply removed before inserting the card. The protection cover shall be fixed back after work is done.



CAUTION

While memory card activity LED is blinking it should not be pulled out of the slot.

Memory card information

Device checks a file system and capacity of the inserted memory card.

Main menu ⇨ SD card ⇨ SD info

Save data

Sections

For each section define whether it is included for a record in a file.

Date

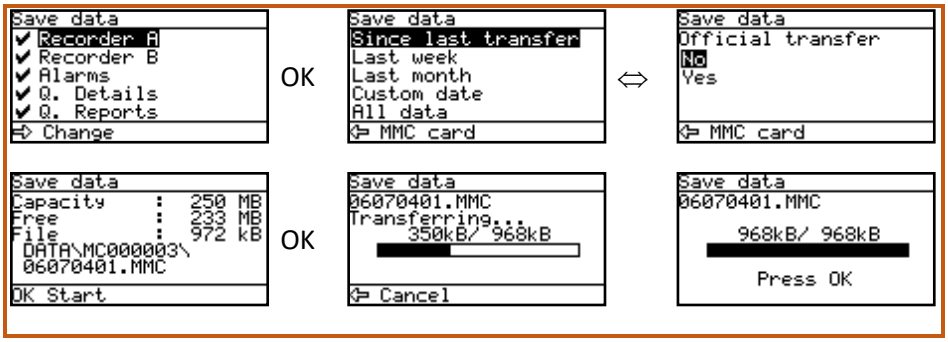
Since the last transfer, all available data from the last official reading with a password is included. For the Last week and the Last month, all data of the last complete unit (a week, a month) with the beginning in the first day at 00:00 is included. The selected date defines a day with the beginning at 00:00 from which further on to the current time of data transfer. When all data is selected, all data for an individual section, that are stored in the memory up to the moment when reading is started, are transferred.

Official reading

If official reading is selected date of reading is stored in device, and is applied at the next official reading.

Example:

Main menu ⇨ SD card ⇨ Save data



Save settings

File of current device settings is stored in SETTING directory. File name consists of device serial number and MSF extension. In case of file already stored on memory card, the device warns if file should be overwritten.

Load settings

For loading settings, the files that correspond to the device type are displayed on LCD. When a file is selected, it is necessary to choose the segments of settings that will be overwritten. A number of registers that will be modified is written next to each segment. After settings transfer, a warning on errors could be displayed. Errors occur when the module setting and a memory capacity differ from the used ones in the device. A number of settings (registers) that do not match and are neither modified is displayed after warning.

Basic settings

At transfer of basic settings, settings of connections, ratios, used voltage and current ranges as well as nominal frequency are not changed. New settings can influence energy counters if recorded in a memory.

Alarms

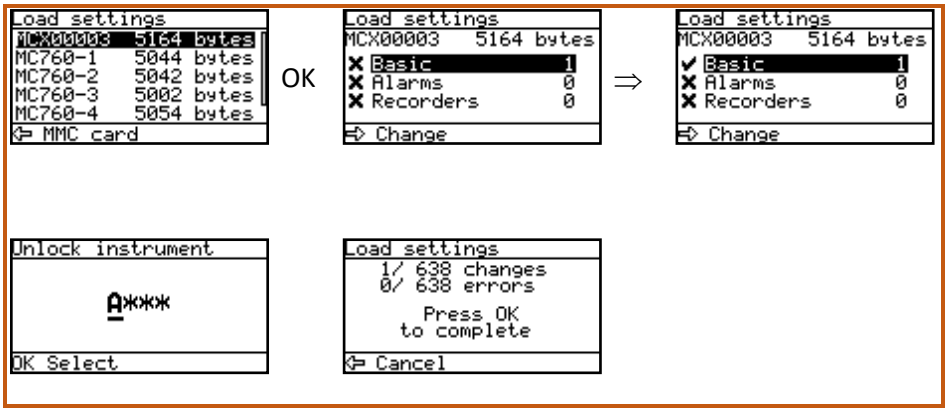
Settings of all alarms are changed, but old alarms with previous settings remain in the memory.

Recorders

Recorder overwriting enables modified setting of connection, ratio, used voltage and current ranges as well as nominal frequency. All other data in a memory is lost.

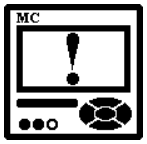
Example of a display on LCD for MC 7×0:

Main menu ⇨ SD card ⇨ Load settings



Firmware upgrading

Before upgrading files on memory card are checked first, this can last some time (approx. 1 minute). When both versions are displayed, upgrade can be performed if the device software version is lower or equal to the version in a file.



WARNING

When upgrading firmware software remove memory card and do not interrupt power supply - the device could become inoperative!

Repairing of device in this case is to be done by authorized service.

Upgrade error codes:

Error 1: memory card not inserted

Error 2: Error on FAT16 file system

Error 3: File not exist (.fl2)

Error 4: Error in .fl2 file

Error 5: File too long (.fl2)

Error 6: Invalid file (.fl2)

Error 7: Incorrect upgrade version (.fl2)

Measurements

MC 7×0 Power Monitoring Device performs measurements with a constant sampling frequency 31 kHz. Measurement methods differ for normal operation quantities, where values are averaged and aggregated according to aggregation requirements of IEC 61000-4-30 standard (Class A) and voltage events where half-period values are evaluated again according to Class A standard.

Introduction

Online measurements

Online measurements are available on display or can be monitored with setting and monitoring software MiQen.

Readings on display are performed continuously with refresh time dependent on set average interval whereas rate of readings monitored with MiQen is fixed and refreshed approx. each second.

For better overview over numerous readings, they are divided into several groups, which contain basic measurements, min. and max. values, harmonics, inter-harmonics, PQ parameters (only for MC 770) and alarms.

Each group can represent data in visually favoured graphical form or detailed tabelaric form. Latter allows freezing readings and/or copying data into various report generation software tools.

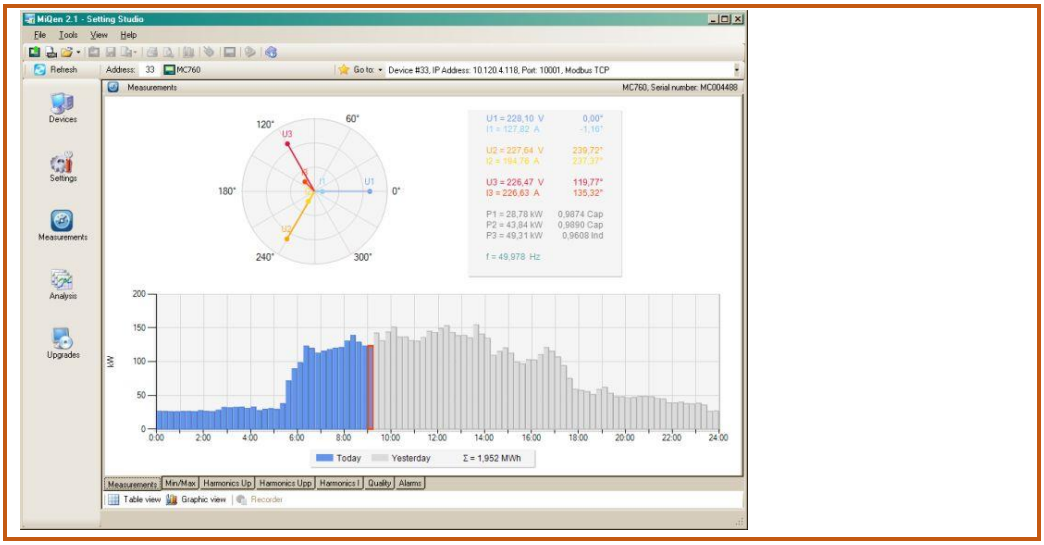


Figure 26: *Online measurements in graphical form – phaser diagram and daily total active power consumption histogram*

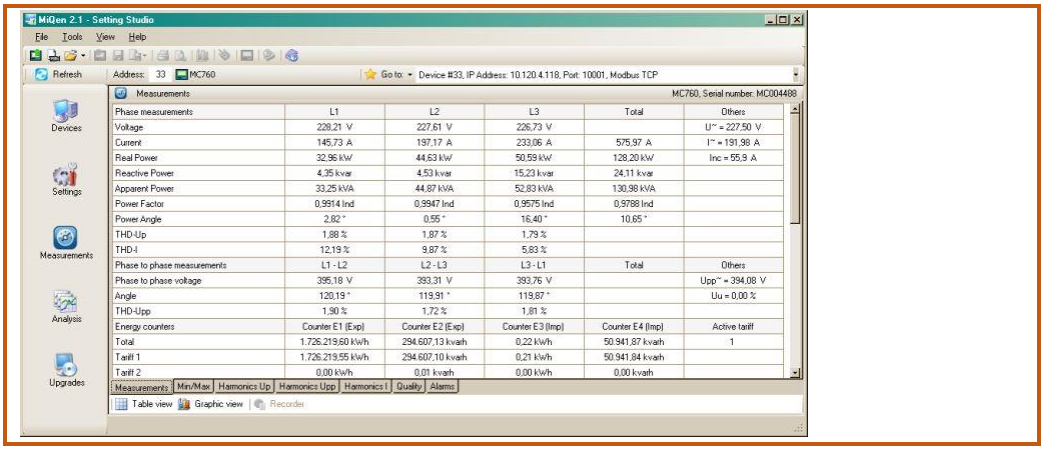


Figure 27: *Online measurements in tabelaric form*

Interactive instrument

Additional communication feature of a device allows interactive handling with a dislocated device as if it would be operational in front of user.

This feature is useful for presentations or product training.

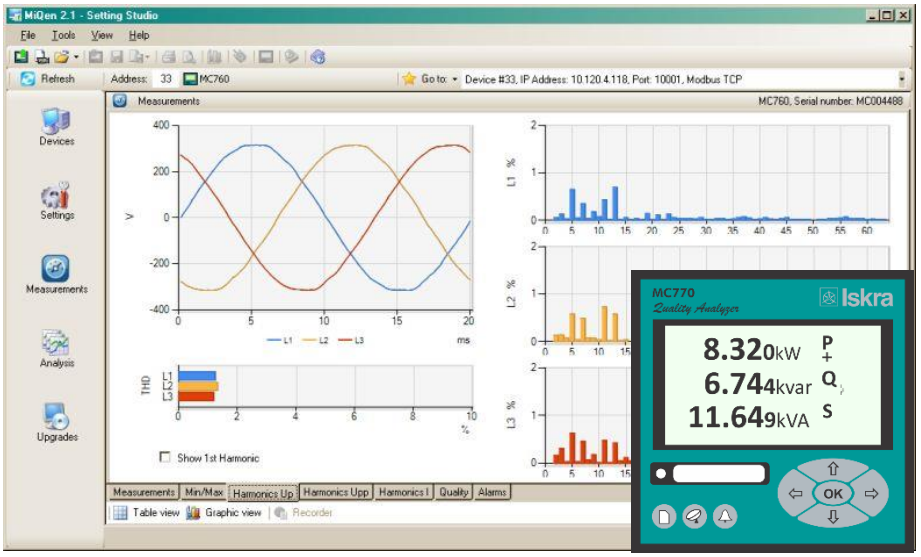


Figure 28: *Online harmonic measurements in graphical form and interactive instrument*

Selection of available quantities

Available online measuring quantities and their appearance can vary according to set type of power network and other settings such as; average interval, max. demand mode, reactive power calculation method …

Complete selection of available online measuring quantities is shown in a table on the next page.

PLEASE NOTE

Measurements support depends on connection mode the device type. Calculated measurements (for example voltages U_1 and U_2 when 3-phase, 4-wire connection with a balanced load is used) are only informative.

PLEASE NOTE

For 3b and 3u connection mode, only phase to phase voltages are measured. Because of that factor v3 is applied to calculation of quality considering nominal phase voltage. For 4u connection mode measurements support is same as for 1b.

Selection of available measurement quantities:

Meas. type	Measurement	3-phase 4-wire	3-phase 3-wire	1-phase	comments
Phase measurements	*Voltage*				
	U_{1-3_RMS}	☑		☑1ph	
	U_{AVG_RMS}	☑		☑	
	$U_{unbalance\_neg\_RMS}$	☑🕮	☑🕮		*(only for MC 770)*
	$U_{unbalance\_zero\_RMS}$	☑🕮	☑🕮		
	U_{1-3_DC}	☑		☑1ph	*DC component of phase voltages*
	Current				
	I_{1-3_RMS}	☑	☑	☑1ph	
	I_{TOT_RMS}	☑	☑	☑	
	I_{AVG_RMS}	☑	☑	☑	
	$I_{NEUTRAL\_calc}$	☑	☑	☑	*calculated neutral current*
	Power				
	P_{1-3_RMS}	☑		☑1ph	
	P_{TOT_RMS}	☑	☑	☑	
	Q_{1-3_RMS}	☑🕮		☑1ph🕮	*reactive power can be calculated as a squared difference between S and P or as delayed sample*
	Q_{TOT_RMS}	☑	☑	☑	
	S_{1-3_RMS}	☑		☑1ph	
	S_{TOT_RMS}	☑	☑	☑	
	$Q_{fund1-3\_RMS}$	☑🕮		☑1ph🕮	*fundamental reactive power of first harmonic*
	$Q_{fundTOT\_RMS}$	☑	☑	☑	
	D_{1-3_RMS}	☑🕮		☑1ph🕮	*deformed reactive power of harmonics (only for MC 770)*
	D_{TOT_RMS}	☑	☑	☑	
	PF_{1-3}	☑		☑1ph	
	PF_{TOT}	☑	☑	☑	
	dPF_{1-3}	☑		☑1ph	*displacement power factor (only for MC 770)*
	dPF_{TOT}	☑	☑	☑	
	φ_{1-3}	☑		☑1ph	*PA – power angle*
	Harmonic analysis				
	$THD\text{-}U_{1-3}$	☑		☑1ph	
	$THD\text{-}I_{1-3}$	☑	☑	☑1ph	
	$TDD\text{-}I_{1-3}$	☑	☑	☑1ph	
	$U_{1-3\_harmonic\_1-63\_\%}$	☑🕮		☑1ph🕮	*% of RMS or % of base*
	$U_{1-3\_harmonic\_1-63\_ABS}$	☑		☑1ph	
	$U_{1-3\_harmonic\_1-63\_\varphi}$	☑		☑1ph	
	$U_{1-3\_inter\text{-}harmonic\_\%}$	☑🕮		☑1ph🕮	*monitoring up to 10 different fixed frequencies. % of RMS or % of base (only for MC 770)*
	$U_{1-3\_inter\text{-}harmonic\_ABS}$	☑		☑1ph	
	$U_{1-3\_signaling\_\%}$	☑🕮		☑1ph🕮	*monitoring of signaling (ripple) voltage of set frequency. % of RMS or % of base (only for MC 770)*
	$U_{1-3\_signaling\_ABS}$	☑		☑1ph	
	$I_{1-3\_harmonic\_1-63\_\%}$	☑🕮	☑🕮	☑1ph🕮	*% of RMS or % of base*
	$I_{1-3\_harmonic\_1-63\_ABS}$	☑	☑	☑1ph	
	$I_{1-3\_harmonic\_1-63\_\varphi}$	☑	☑	☑1ph	

🕮 Further description is available in following subchapters

Meas. type	Measurement	3-phase 4-wire	3-phase 3-wire	1-phase	comments
Phase measurements	*Flickers*				*(only for MC 770)*
	Pi_{1-3}	☑		☑1ph	*instantaneous flicker sensation measured with 150 samples / sec (original sampling is 1200 smpl/sec)*
	Pst_{1-3}	☑		☑1ph	*10 min statistical evaluation (128 classes of CPF)*
	Plt_{1-3}	☑		☑1ph	*derived from 12 Pst acc. to EN 61000-4-15*
	Miscellaneous				
	K-$factor_{1-3}$	☑	☑	☑1ph	*(only for MC 770)*
	Current Crest $factor_{1-3}$	☑	☑	☑1ph	
Phase to phase measurements	*Voltage*				
	Upp_{1-3_RMS}	☑	☑		
	Upp_{AVG_RMS}	☑	☑		
	$\varphi_{x-y\_}$	☑	☑		*phase-to-phase angle*
	Harmonic analysis				
	THD-Upp_{1-3}	☑	☑		
	$Upp_{1-3\_harmonic\_1-63\_\%}$	☑📖	☑📖		*% of RMS or % of base*
	$Upp_{1-3\_harmonic\_1-63\_ABS}$	☑	☑		
	$Upp_{1-3\_harmonic\_1-63\_\varphi}$	☑	☑		
	$Upp_{1-3\_inter\_harmonic\_\%}$	☑	☑		*monitoring up to 10 different fixed frequencies. % of RMS or % of base (only for MC 770)*
	$Upp_{1-3\_inter\_harmonic\_ABS}$	☑	☑		
	$Upp_{1-3\_signaling\_\%}$	☑	☑		*monitoring of signaling (ripple) voltage of set frequency. % of RMS or % of base (only for MC 770)*
	$Upp_{1-3\_signaling\_ABS}$	☑	☑		
	Flickers				*(only for MC 770)*
	Pi_pp_{1-3}		☑		*Instantaneous flicker sensation measured with 150 samples / sec (original sampling is 1200 samples / sec)*
	Pst_pp_{1-3}		☑		*10 min statistical evaluation (128 classes of CPF)*
	Plt_pp_{1-3}		☑		*Derived from 12 Pst acc. to EN 61000-4-15*
	Miscellaneous				
	$U_{underdeviation}$	☑	☑	☑1ph	*Uunder. and Uover. are calculated for phase or phase-to-phase voltages regarding connection mode (only for MC 770).*
	$U_{overdeviation}$	☑	☑	☑1ph	
Metering	*Energy*	☑	☑	☑	
	Counter E_{1-8}	☑	☑	☑	*each counter can be dedicated to any of four quadrants (P-Q, import-export, L-C). Total energy is a sum of one counter for all tariffs. Tariffs can be fixed, date/time dependent or tariff input dependent*
	$E\_{}_{TOT\_1-8}$	☑	☑	☑	
	Active tariff	☑	☑	☑	
	$Cost\_by\_meters_{1-4}$	☑	☑	☑	*calculated costs depend on specified price per hour and currency*
	$Cost_{1-4\_TOT}$	☑	☑	☑	

📖 Further description is available in following subchapters

Meas. type	Measurement	3-phase 4-wire	3-phase 3-wire	1-phase	comments
Maximum demand measurements	*Maximum demand*				
	MD_I_{1-3}	☑	☑	☑1ph	
	MD_P_{import}	☑	☑	☑	
	MD_P_{export}	☑	☑	☑	
	MD_Q_{ind}	☑	☑	☑	
	MD_Q_{cap}	☑	☑	☑	
	MD_S	☑	☑	☑	
Min and max measurements	*Min and max*				
	$U_{1-3\_RMS\_MIN}$	☑		☑1ph	
	$U_{1-3\_RMS\_MAX}$	☑		☑1ph	
	$Upp_{1-3\_RMS\_MIN}$	☑	☑	☑	
	$Upp_{1-3\_RMS\_MAX}$	☑	☑	☑	
	$I_{1-3\_RMS\_MIN}$	☑	☑	☑1ph	
	$I_{1-3\_RMS\_MAX}$	☑	☑	☑1ph	
	$P_{1-3\_RMS\_MIN}$	☑		☑1ph	
	$P_{1-3\_RMS\_MAX}$	☑		☑1ph	
	$P_{TOT\_RMS\_MIN}$	☑	☑	☑1ph	
	$P_{TOT\_RMS\_MAX}$	☑	☑	☑1ph	
	$S_{1-3\_RMS\_MIN}$	☑		☑1ph	
	$S_{1-3\_RMS\_MAX}$	☑		☑1ph	
	$S_{TOT\_RMS\_MIN}$	☑	☑	☑1ph	
	$S_{TOT\_RMS\_MAX}$	☑	☑	☑1ph	
	$freq_{MIN}$	☑	☑	☑	
	$freq_{MAX}$	☑	☑	☑	
Other measurements	*Miscellaneous*				
	$freq_{MEAN}$	☑	☑	☑	
	Internal temp.	☑	☑	☑	
	Date, Time	☑	☑	☑	
	Last Sync. time	☑📖	☑📖	☑📖	*UTC*

📖 Further description is available in following subchapters

Explanation of basic concepts

Sample frequency

A device measures all primary quantities with a constant sampling rate of 31 kHz (625 s/per at 50 Hz).

Average interval

Operation of *MC 7×0 Power Monitoring Device* depends on several Average intervals, which should all be well understood and set to a proper value.

Average interval for measurements and display

Due to readability of measurements from LCD and communication, an Average interval can be selected from a range of predefined values (from 0.1s to 5 s). The Average interval (see chapter *Average interval on page 49*) defines refresh rate of displayed measurements.

Alarms response time is influenced by general average interval if their response time setting is set to “Normal response”. If it is set to “Fast response” alarms depend on a single period measurement.

This average interval has no influence on PQ measurements.

Average interval for min. max. values

Min. and max. values often require special averaging period, which enables or disables detection of short measuring spikes. With this seeting is possible to set averaging from 1 period to 256 periods.

Average (storage) interval for recorders

This storage interval defines a period for writing data into internal memory. It can be set from 1 min to 60 min. At the end of every interval different types of measured data can be stored into recorder.

Average (aggregation) interval for PQ parameters (only for MC 770)

Standard IEC61000-4-30 defines different aggregation intervals and procedures for aggregation of measured PQ parameters.

For each PQ parameter it is possible to set required aggregation interval. Standard aggregation intervals are:

- 10 periods (12 for 60 Hz system)
- 150 periods (180 for 60 Hz system)
- 10 sec
- 10 min (also basic time synchronisation tick interval)
- 2 h

It is also possible to set other aggregation intervals according to requirements. *MC 770 Power Monitoring Device* supports additional aggregation intervals; 30 sec, 1 min, 15 min, 1 h.

Power and energy flow

Figures below show a flow of active power, reactive power and energy for 4u connection.

Display of energy flow direction can be adjusted to connection and operation requirements by changing the *Energy flow direction settings on page 59*.

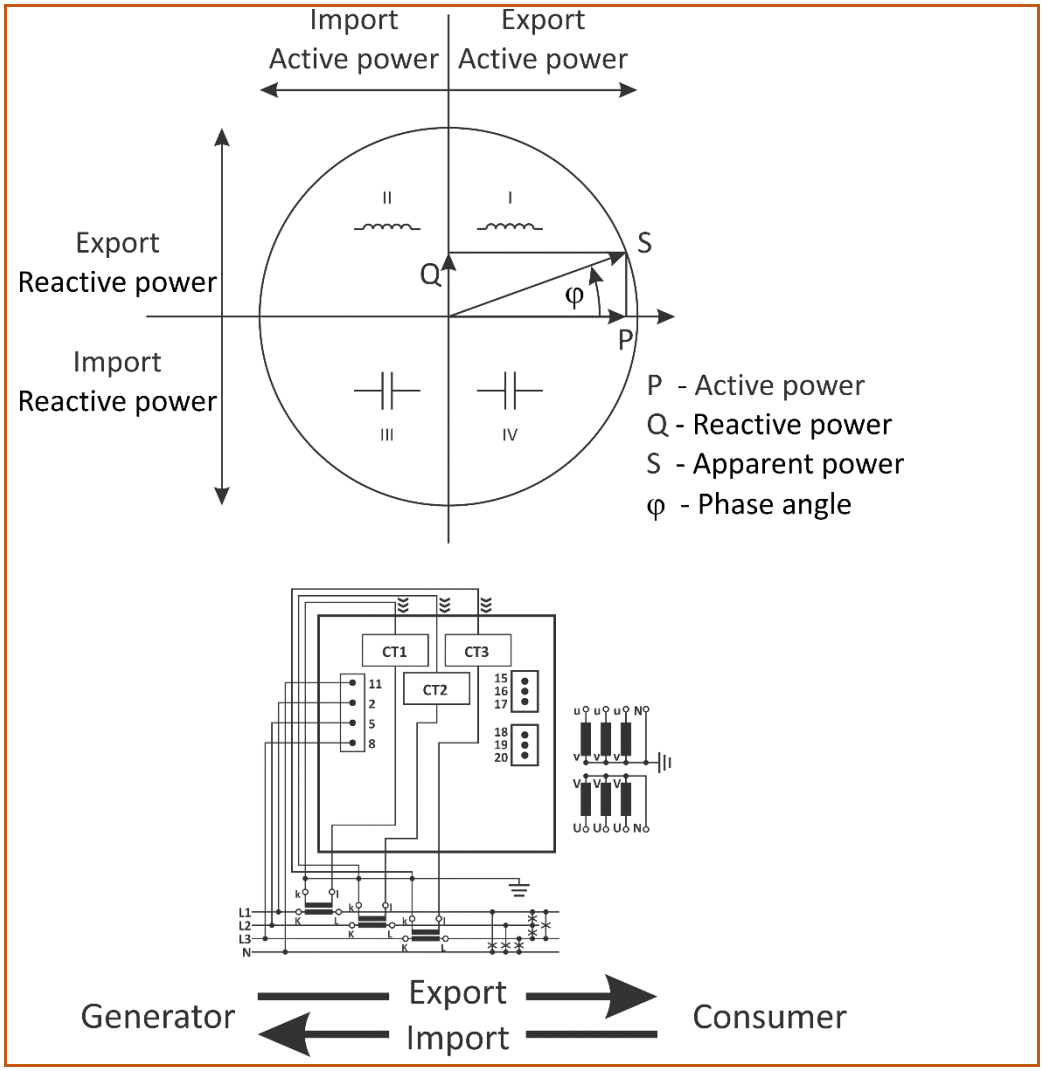


Figure 29: *Explanation of energy flow direction*

Calculation and display of measurements

This chapter deals with capture, calculation and display of all supported quantities of measurement. Only the most important equations are described; however, all of them are shown in a chapter *Equations on page 183* with additional descriptions and explanations.

PLEASE NOTE

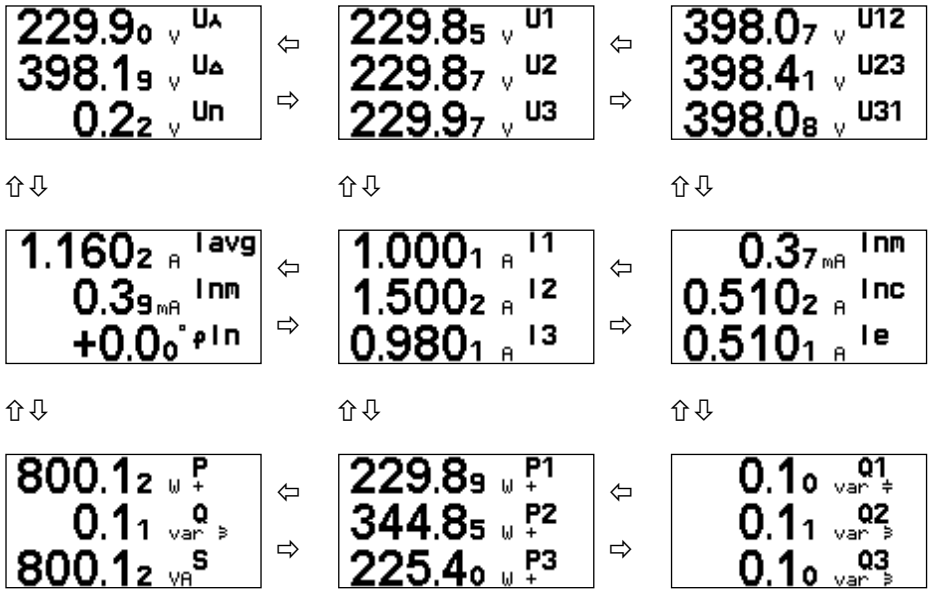
Calculation and display of measurements depend on the connection used. For more detailed information see chapter Survey of supported measurements.

Keyboard and display presentation

For entry and quitting measurements display menu, the **OK** key is used. Direction keys (⇦⇨⇧⇩) are used for passing between displays as show in example below.

Example for 4u connection mode:

Main menu ⇨ Measurements ⇨ Present values ⇨ Voltage



Present values

Main menu
Measurements
Settings
Resets
SD card
Info
Installation
14.11.2018 16:53:36

⇨

Measurements
Present values
Min/Max values
Alarms
Graphs time
Graphs FFT
Power supply quality
Demo cycling
⇦ Main menu

PLEASE NOTE

Display of present values depends on connection mode. Therefore display organisation slightly differs from one connection mode to another.

Voltage

The device measures:

real effective (rms) value of all phase voltages (U1, U2, U3), phase-to-phase voltages (U12, U23, U31) and neutral to earth voltage (Un).

Average phase voltage ($U_{\curlywedge}$) and average phase-to-phase voltage ($U_{\triangle}$)

Negative and zero sequence unbalance ratio (Uu, U_0)

Phase and phase-to-phase voltage angles (φ1-3, φ12, φ13, φ23)

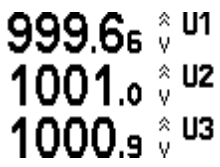
Signalling phase and phase-to-phase voltages (Us1-3, Us12, Us13, Us23)

DC component of phase and phase-to-phase voltages including neutral line

$$U_f = \sqrt{\frac{\sum_{n=1}^{N} u_n^2}{N}} \qquad U_{xy} = \sqrt{\frac{\sum_{n=1}^{N} (u_{xn} - u_{yn})^2}{N}}$$

All voltage measurements are available on communication and standard or customized displays on LCD.

Device warns if input signal is too large. In this case signal representation is not correct. Indicator is shown above parameter unit:



Main menu ⇨ Measurements ⇨ Present values ⇨ Voltage

Current

Device measures:

Real effective (rms) value of phase currents and neutral measured current (Inm), connected to current inputs

Neutral calculated current (Inc), Neutral error current (Ie = |Inm – Inc|),

Phase angle between Neutral voltage and Neutral Current (φIn), Average current (Ia) and a sum of all phase currents (It)

Crest factor of phase currents (CRI1-3)

$$I_{RMS} = \sqrt{\frac{\sum_{n=1}^{N} i_n^2}{N}}$$

All current measurements are available on communication, standard and customized displays on LCD.

Main menu ⇨ Measurements ⇨ Present values ⇨ Current

Active, reactive and apparent power

Active power is calculated from instantaneous phase voltages and currents. All measurements are seen on communication or are displayed on LCD. For more detailed information about calculation see chapter *Equations on page 183*.

There are two different methods of calculating reactive power. See chapter *Reactive power and energy calculation on page 56*.

Device warns if input signal is too large. In this case signal representation is not correct. Indicator is shown above parameter unit:

Main menu ⇨ Measurements ⇨ Present values ⇨ Power

Power factor and power angle

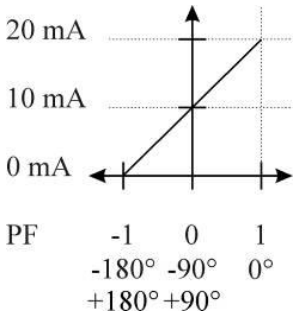
Power angle (or displacement Power Factor) is calculated as quotient of active and apparent power for each phase separately ($\cos\varphi_1$, $\cos\varphi_2$, $\cos\varphi_3$) and total power angle ($\cos\varphi_T$). It represents angle between first (base) voltage harmonic and first (base) current harmonic for each individual phase. Total power angle is calculated from total active and reactive power (see equation for Total power angle, chapter *Equations on page 183*). A symbol for a coil (positive sign) represents inductive load and a symbol for a capacitor (negative sign) represents capacitive load.

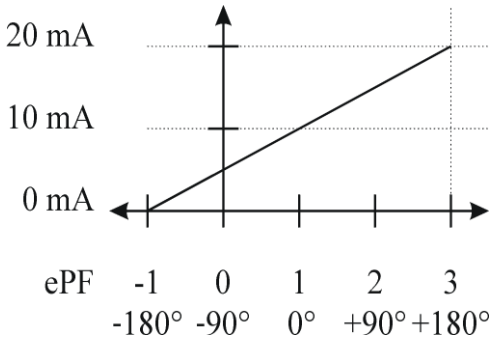
For correct display of PF via analogue output and application of the alarm, ePF (extended power factor) is applied. It illustrates power factor with one value as described in the table below. For a display on LCD both of them have equal display function: between −1 and −1 with the icon for inductive or capacitive load.

Presentation of extended PF (ePF):

Load	**C**	**→**		**←**	**L**
Angle [°]	**–180**	**–90**	**0**	**+90**	**+180 (179.99)**
PF	**–1**	**0**	**1**	**0**	**–1**
ePF	**–1**	**0**	**1**	**2**	**3**

Example of analogue output for PF and ePF:





Main menu ⇨ Measurements ⇨ Present values ⇨ PF & Power angle

Frequency PC OK

Network frequency is calculated from time periods of measured voltage. Device uses synchronisation method, which is highly immune to harmonic disturbances.

Device always synchronises to a phase voltage *U1*. If signal on that phase is too low it (re)synchronises to next phase. If all phase voltages are low (e.g. short circuit) device synchronises to phase currents. If there is no signal present on any voltage or current channels, device shows frequency 0 Hz.

Additionally frequency with 10−second averaging interval is displayed.

OK Main menu ⇨ Measurements ⇨ Present values ⇨ Frequency

Energy - counters PC OK

Three ways of Energy - counters display are available:

by individual counter,

by tariffs for each counter separately and

energy cost by counter

At a display of measured counter by tariffs, the sum in the upper line depends on the tariffs set in the device.

There are two different methods of calculating reactive energy. See chapter *Reactive power and energy calculation on page 56*.

Additional information, how to set and define a counter quantity is explained in chapter *ENERGY – counters on page 123*.

OK Main menu ⇨ Measurements ⇨ Present values ⇨ Energy

MD values PC OK

MD values and time stamp of occurrence are shown for:

Three phase currents

Active powers (import and export)

Reactive power (ind. and cap.)

Apparent power

OK Main menu ⇨ Measurements ⇨ Present values ⇨ MD values

Dynamic demands are continuously calculated according to set time constants and other parameters.

Reset demands are max. values of Dynamic demands since last reset.

Harmonic distortion

Device calculates different harmonic distortion parameters:

THD is calculated for phase currents, phase voltages and phase−to−phase voltages and is expressed as percent of high harmonic components regarding to fundamental harmonic

TDD is calculated for phase currents

K-factor is calculated for phase currents

Device uses measuring technique of real effective (rms) value that assures exact measurements with the presence of high harmonics up to 63rd harmonic (see chapter *Harmonics analysis on page 131*).

Main menu ⇨ Measurements ⇨ Present values ⇨ THD

Flickers (only for MC 770)

Flickers are one of most important PQ parameters directly (through light flickering) influencing human feeling.

Flickers are measured in statistically evaluated according to relevant standard IEC 61000-4-15.

For basic flicker measurements on all three voltage phases 1200 readings per second is used. Instantaneous flicker sensation decimates this sampling rate 8 times (150 instantaneous flicker calculations per second) and uses approx 3s averaging time.

With further statistical evaluation short term and long term flickers are calculated.

$Pi_{1\text{-}3}$ represents instantaneous flicker and is averaged and refreshed every 3 sec. *Pi* is averaged from 500 instantaneous flicker calculations.

$Pim_{1\text{-}3}$ represents max. value of instantaneous flicker *Pi* within 3 sec flicker averaging interval and is refreshed every 3 sec. This value is displayed only on display. It is not available on communication.

$Pst_{1\text{-}3}$ represents 10 min statistical evaluation of instantaneous flicker and is refresh every round 10 minutes (x:00, x:10, x:20 …)

$Plt_{1\text{-}3}$ represents 2 h statistical evaluation of short-time flicker *Pst* and is refreshed every even 2 hours (0:00, 2:00, 4:00 …)

Until the flicker value is calculated the symbol − is displayed.

Main menu ⇨ Measurements ⇨ Present values ⇨ Flickers

Customized screens PC OK

Here 4 different customised screens are shown. First three screens show 3 different user defined values. Fourth screen displays 5 different values as a combination of 3 values of first screen and first 2 values of second screen.

OK Main menu ⇨ Measurements ⇨ Present values ⇨ Custom

Overview OK

It combines several measurements on each display as the following screens are displayed:

Screen 1:

Current phase measurements			Current phase measurements		
U⩓	Average voltage $U^{\sim}$	V	P	Total active power P_t	W
1	Phase voltage U_1	V	P1	Active power P_1	W
2	Phase voltage U_2	V	P2	Active power P_2	W
3	Phase voltage U_3	V	P3	Active power P_3	W
I⩓	Average current $I^{\sim}$	A	Q	Total reactive power Q_t	var
1	Current I_1	A	Q1	Reactive power Q_1	var
2	Current I_2	A	Q2	Reactive power Q_1	var
3	Current I_3	A	Q3	Reactive power Q_1	var

Screen 2:

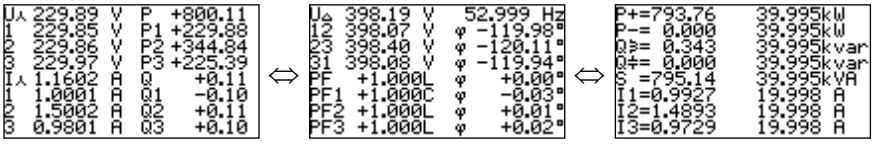
Current phase-to-phase measurements			Current phase-to-phase measurements		
U⩓	Average phase-to-phase $U^{\sim}$	V		Frequency f	Hz
12	Phase-to-phase voltage U_{12}	V	ϕ	Power angle ϕ_1	°
23	Phase-to-phase voltage U_{23}	V	ϕ	Power angle ϕ_2	°
31	Phase-to-phase voltage U_{31}	V	ϕ	Power angle ϕ_3	°
PF	Total power factor		ϕ	Average phase-to-phase angle $\phi^{\sim}$	°
PF1	Power factor PF_1		ϕ	Power angle ϕ_{12}	°
PF2	Power factor PF_2		ϕ	Power angle ϕ_{23}	°
PF3	Power factor PF_3		ϕ	Power angle ϕ_1	°

Screen 3:

Dynamic MD values			Maximal MD values		
P+	MD active power P (positive)	W		MD active power P (positive)	W
P−	MD active power P (negative)	W	ϕ	MD active power P (negative)	W
Q⋛	MD reactive power Q−L	var	ϕ	MD reactive power Q−L	var
Q≒	MD reactive power Q−C	var	ϕ	MD reactive power Q−C	var
S	MD apparent power S	VA	ϕ	MD apparent power S	VA
I1	MD current I1	A	ϕ	MD current I1	A
I2	MD current I2	A	ϕ	MD current I2	A
I3	MD current I3	A	ϕ	MD current I3	A

Example for MC 7×0 at connection 4u:

Main menu ⇨ Measurements ⇨ Present values ⇨ Overview



Min/Max values

Main menu
Measurements
Settings
Resets
SD card
Info
Installation
14.11.2018 16:53:36

⇨

Measurements
Present values
Min/Max values
Alarms
Graphs time
Graphs FFT
Power supply quality
Demo cycling
⇦ Main menu

All Min/Max values are displayed similar as Present values.

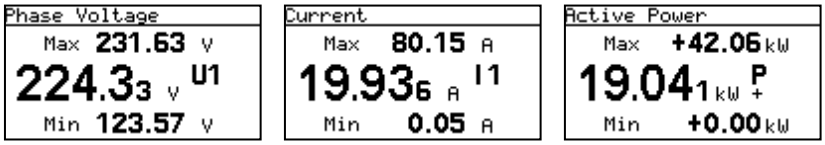
Average interval for min. max. values PC

Min. and max. values often require special averaging period, which enables or disables detection of short measuring spikes. With this seeting is possible to set averaging from 1 period to 256 periods.

Display of min. and max. values PC

Present values are displayed with larger font in the middle of the screen, while minimal and maximal values are displayed smaller above and below the present values.

Example of Min/Max screens



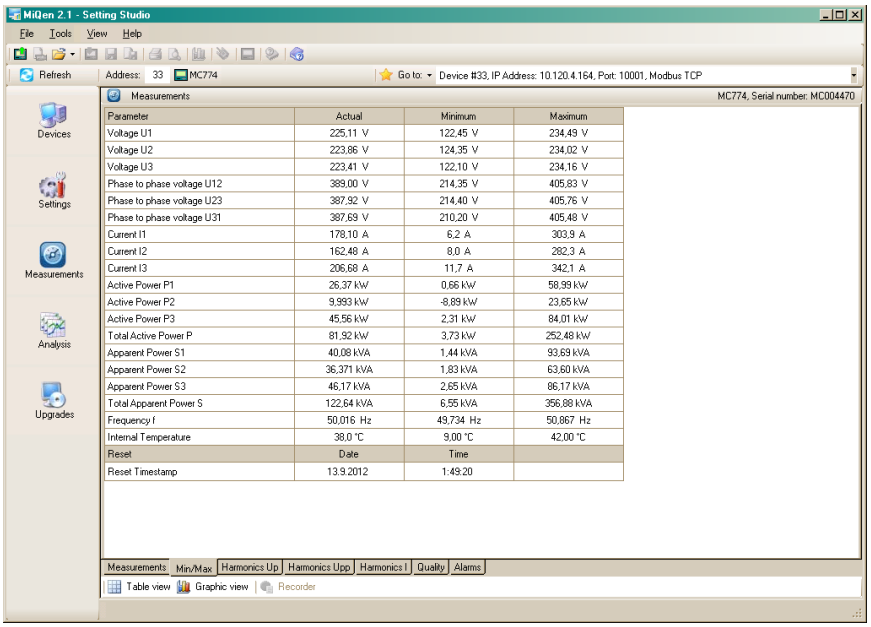


Figure 30: *Tabelaric presentation of min. max. values*

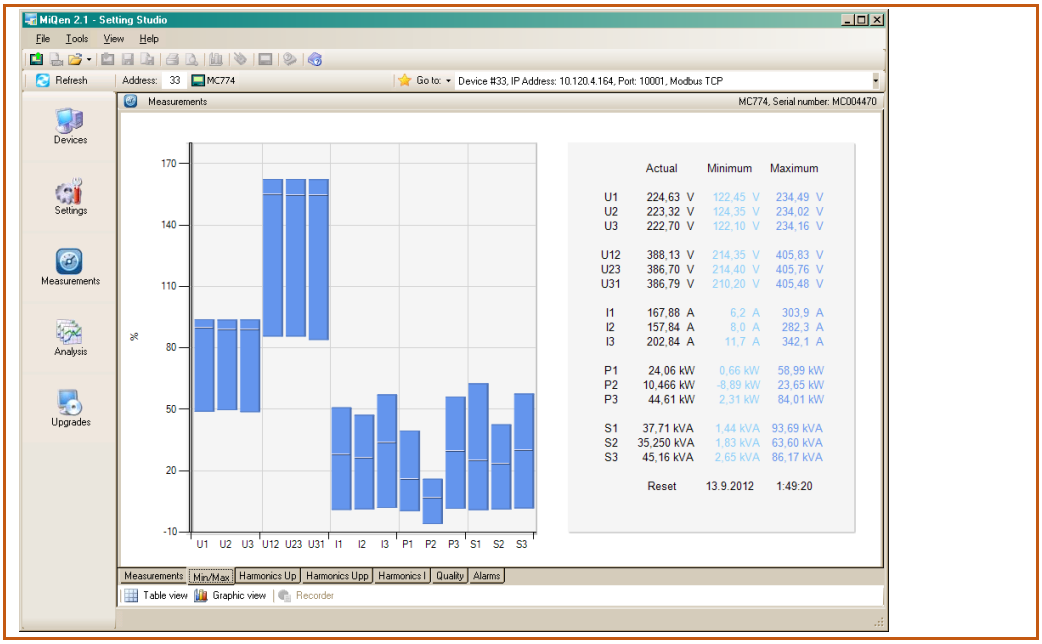


Figure 31: *Graphical presentation of min. max. values*

In graphical presentation of min. and max. values relative values are depicted. Base value for relative representation is defined in general settings/Connection mode/used voltage, current range.

For phase voltages and for phase-to-phase voltages the same value is used.

Alarms

Main menu
Measurements
Settings
Resets
SD card
Info
Installation
14.11.2018 16:53:36

⇨

Measurements
Present values
Min/Max values
Alarms
Graphs time
Graphs FFT
Power supply quality
Demo cycling
⇦ Main menu

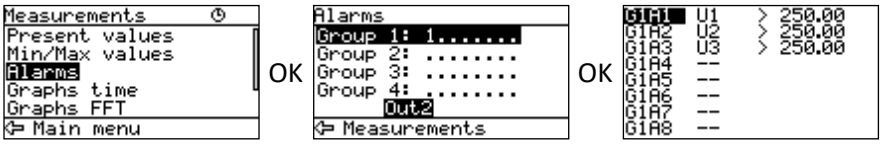
Alarms are important feature for notifying exceeded user predefined values. Not only for visualisation and recording certain events with exact time stamp. Alarms can be connected to digital/alarm outputs to trigger different processes (switch closures, line breaking, motors start or stop ...).

It is also very convenient to monitor alarms history. This is enabled on display and even better on communication by using monitoring and setting software MiQen.

Alarm menu on display enables surveying state of ongoing and past alarms.

In the alarm menu, groups of alarms with states of individual alarms are displayed. Also connected alarm outputs are displayed in the bottom line. If displayed alarm output is highlighted means it is active (relay closed). For each active alarm a number of alarms is written in a certain group at a certain place: Group 1: 1■ ■ ■45■ ■ ■8. Dot stands for alarm not active.

In example below there was 1 alarm, which happened under condition defined in Group1/Alarm1 (middle picture). Condition for that alarm was *U1 > 250.00 V* (right picture). Alarm activated Relay output 2 (middle picture, highlighted Out2).



Survey of alarms

In a detailed survey alarms are collected in groups. A number of a group and alarm is stated in the first column, a measurement designation in the second, and a condition for alarm in the third one. Active alarm is marked.

Main menu ⇨ Measurements ⇨ Alarms

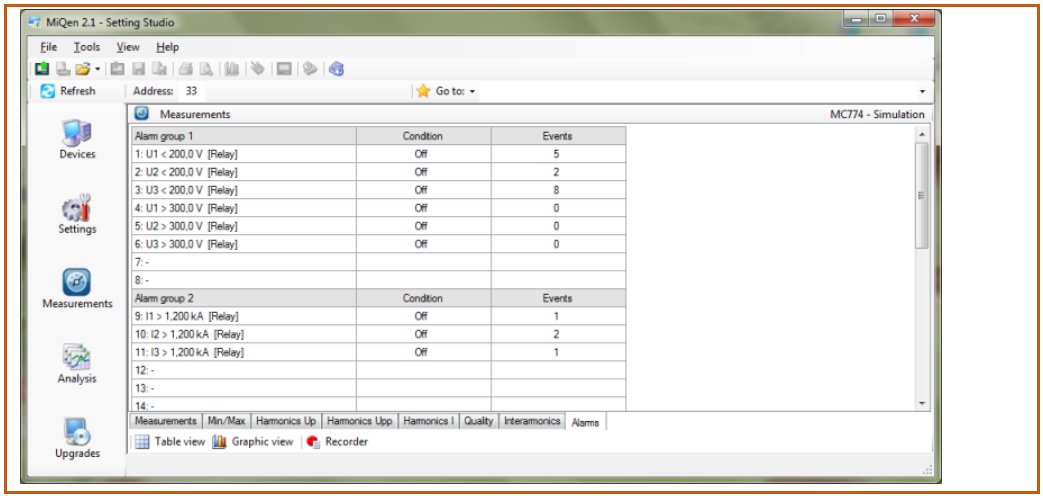


Figure 32: *Tabelaric presentation of alarms*

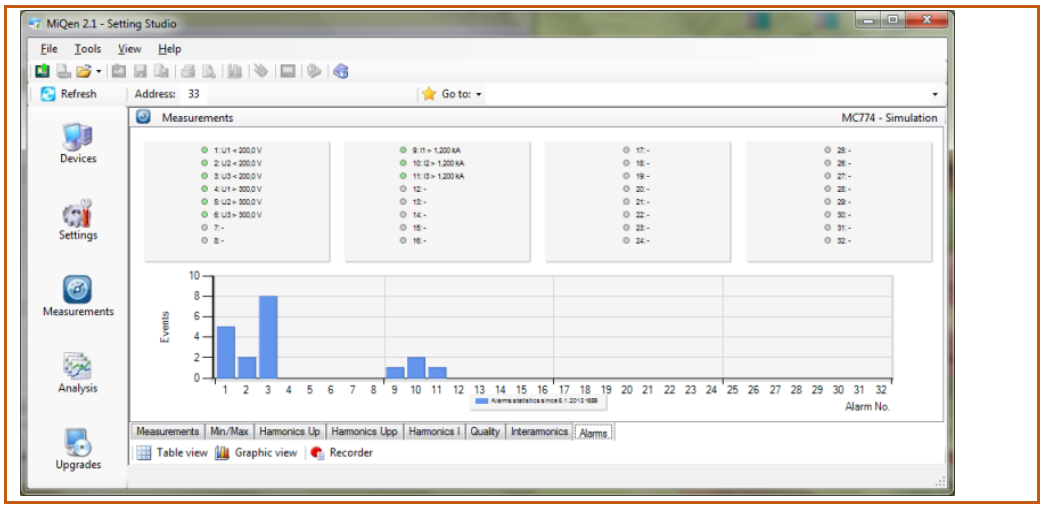


Figure 33: *Graphical presentation of alarms*

In MiQen software all alarms are presented in tabelaric and graphical form as shown in figures above. For each alarm is shown:

- Group association
- Group Alarm conditions
- Momentary alarm state
- Number of alarm events since last reset

Harmonic analysis

Main menu
Measurements
Settings
Resets
SD card
Info
Installation
14.11.2018 16:53:36

⇨

Measurements
Present values
Min/Max values
Alarms
Graphs time
Graphs FFT
Power supply quality
Demo cycling
⇦ Main menu

Harmonic analysis is an important part of PQ monitoring. Frequency converters, inverters, electronic motor drives, LED, halogen and other modern lamps. All this cause harmonic distortion of supply voltage and can influence other sensitive equipment to malfunction or even damage.

In particular vulnerable are distribution level compensation devices whose capacitor banks act like a drain for higher harmonics and amplify their influence. Higher harmonic currents flowing through capacitors can cause overheating and by that shortening their lifetime or even explosions.

Monitoring harmonic distortion is therefore important not only to prevent malfunction of household equipment and to prolong operation of motors but also to prevent serious damage to distribution equipment and to people working close to compensation devices.

Due to importance of harmonic analysis special standard IEC 61000-4-7 defines methods for measurement and calculation of harmonic parameters.

MC 7×0 Power Monitoring Device measures harmonics up to 63rd and evaluates following harmonic parameters:

Phase Voltage harmonic signals and THD U_{P-N}

Phase-to-phase Voltage harmonic signals and THD U_{P-P}

Phase or Phase-to-phase Voltage harmonic signals (depends on connection) and THD with side bands calculation as per IEC 61000-4-7 (only for MC 770).

Current harmonic signals and THD I

TDD total demand distortion for phase currents

CREST factor for proper dimensioning of connected equipment (only for MC 770)

K factor for proper dimensioning of power transformers (only for MC 770)

Interharmonics (10 user defined interharmonic values) (only for MC 770)

Signalling voltage (monitoring ripple control signal) (only for MC 770)

PLEASE NOTE

Interharmonics are available only on communication.

All of the listed harmonic parameters can be monitored online, stored in internal memory (not all at a time) and compared against alarm condition threshold limit.

The latter is in combination with alarm relay output suitable for notification and/or automatic disconnection of compensation devices, when too much harmonics could threaten capacitors.

Display of harmonic parameters PC OK

Harmonic parameters can be displayed on devices LCD in graphical form and as a data.

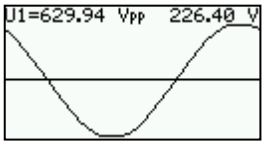
Representation of individual harmonics consists of:

- Absolute value
- Relative value
- Phase angle between base and observed harmonic
- According to IEC 61000-4-7 (data only) (only for MC 770)

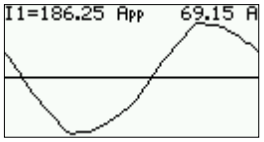
PLEASE NOTE

Relative value can be calculated as a percentage of base unit or as a percentage of RMS value. Setting for choice of this relative factor is under General settings (see Harmonic calculation setting on page 56)

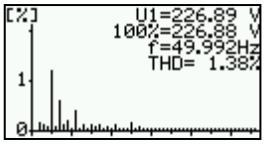
OK Main menu ⇨ Measurements ⇨ Graphs time / Graphs FFT



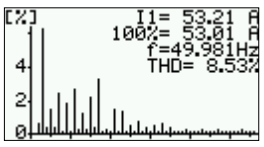
Display of a Phase Voltage in time space diagram. Displayed are also peak value of monitored phase voltage and its RMS value. Similar display is also for phase-to-phase voltages.



Display of a Current in time space diagram. Displayed are also peak value of monitored current and its RMS value.



Display of a Phase Voltage in frequency space diagram. Displayed are also RMS value, unit value (100%), system frequency and THD value. Similar display is also for phase-to-phase voltages.



Display of a Current in frequency space diagram. Displayed are also RMS value, unit value (100%), system frequency and THD value.

More information about harmonic parameters, especially individual harmonic values, can be obtained when device is connected to communication and monitoring and setting software MiQen is used.

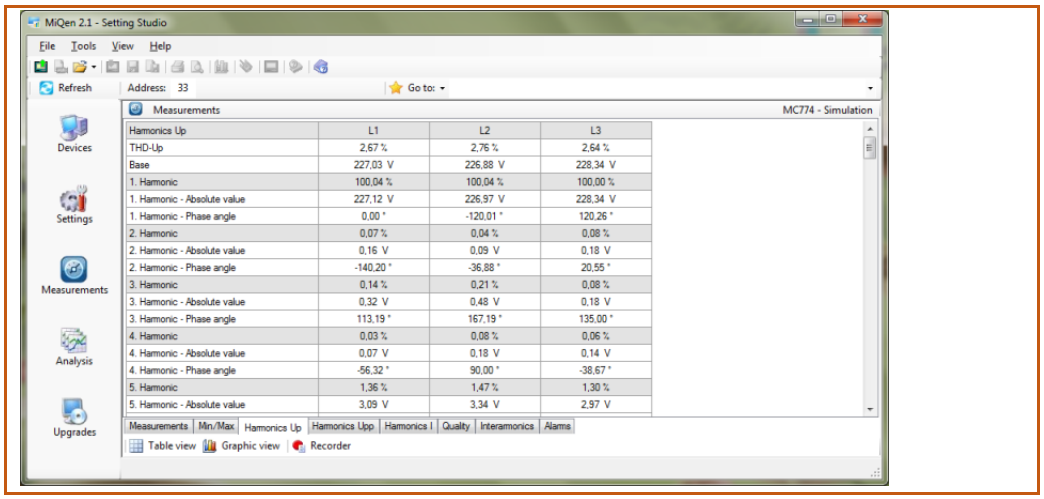


Figure 34: *Tabelaric presentation of phase voltage harmonic components*

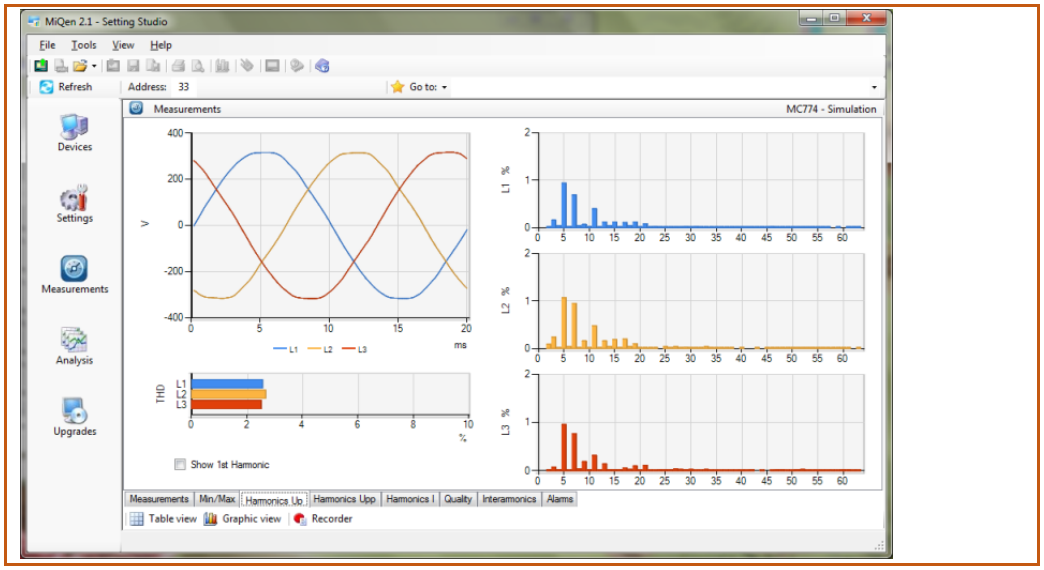
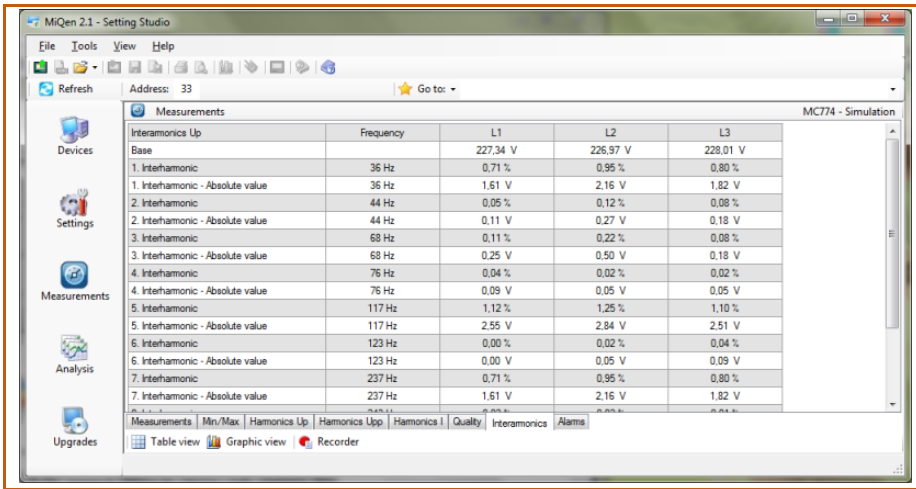


Figure 35: *Graphical presentation of phase voltage harmonic components*

PLEASE NOTE

According to standard IEC 61000-4-7 that defines methods for calculation of harmonic parameters, harmonic values and interharmonic values do not represent signal magnitude at exact harmonic frequency but weighted sum of cantered (harmonic) values and its sidebands. More information can be found in mentioned standard.



Interamonics Up	Frequency	L1	L2	L3
Base		227,34 V	226,97 V	228,01 V
1. Interharmonic	36 Hz	0,71 %	0,95 %	0,80 %
1. Interharmonic - Absolute value	36 Hz	1,61 V	2,16 V	1,82 V
2. Interharmonic	44 Hz	0,05 %	0,12 %	0,08 %
2. Interharmonic - Absolute value	44 Hz	0,11 V	0,27 V	0,18 V
3. Interharmonic	68 Hz	0,11 %	0,22 %	0,08 %
3. Interharmonic - Absolute value	68 Hz	0,25 V	0,50 V	0,18 V
4. Interharmonic	76 Hz	0,04 %	0,02 %	0,02 %
4. Interharmonic - Absolute value	76 Hz	0,09 V	0,05 V	0,05 V
5. Interharmonic	117 Hz	1,12 %	1,25 %	1,10 %
5. Interharmonic - Absolute value	117 Hz	2,55 V	2,84 V	2,51 V
6. Interharmonic	123 Hz	0,00 %	0,02 %	0,04 %
6. Interharmonic - Absolute value	123 Hz	0,00 V	0,05 V	0,09 V
7. Interharmonic	237 Hz	0,71 %	0,95 %	0,80 %
7. Interharmonic - Absolute value	237 Hz	1,61 V	2,16 V	1,82 V

Figure 36: *Tabelaric presentation of 10 phase voltage interharmonic components*

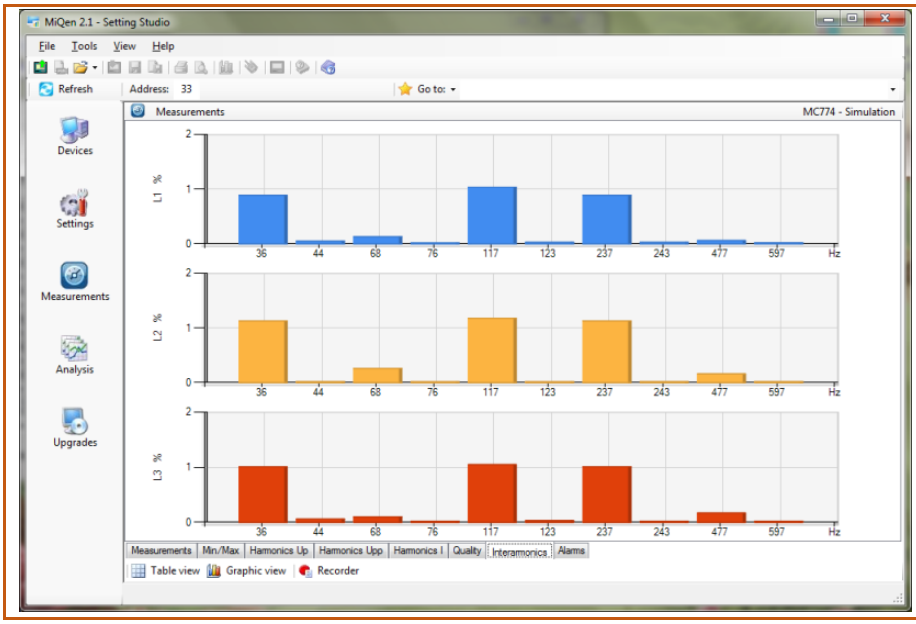


Figure 37: *Graphical presentation of phase voltage interharmonic component*

PQ Analysis (only for MC 770)

Main menu
Measurements
Settings
Resets
SD card
Info
Installation
14.11.2018 16:53:36

⇨

Measurements
Present values
Min/Max values
Alarms
Graphs time
Graphs FFT
Power supply quality
Demo cycling
⇦ Main menu

PQ analysis is a core functionality of *MC 770 Power Quality Analyzer*. PQ (Power Quality) is a very common and well understood expression. However it is not exactly in accordance with its actual meaning.

PQ analysis actually deals with Quality of Supply Voltage. Supply Voltage is a quantity for quality of which utility companies are responsible. It influences behaviour of connected apparatus and devices.

Current and power on the other hand are consequence of different loads and hence responsibility of consumers. With proper filtering load influence can be restricted within consumer internal network or at most within single feeder while poor supply voltage quality influences much wider area.

Therefore indices of supply voltage (alias PQ) are limited to anomalies connected only to supply voltage:

Power Quality indices as defined by EN 50160:

Phenomena	PQ Parameters
Frequency variations	Frequency distortion
Voltage variations	Voltage fluctuation Voltage unbalance
Voltage changes	Rapid voltage changes Flicker
Voltage events	Voltage dips Voltage interruptions Voltage swells
Harmonics & THD	THD Harmonics Inter-harmonics Signalling voltage

For evaluation of voltage quality, device can store main characteristics in the internal memory. The reports are made on the basis of stored data. Data of the last 300 weeks and up to 170,000 variations of the measured quantities from the standard values are stored in the report, which enables detection of anomalies in the network.

MiQen software offers a complete survey of reports with a detailed survey of individual measured quantities and anomalies. A survey of compliance of individual measured quantities in previous and actual monitored periods is possible.

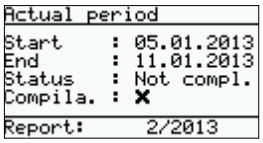
Online monitoring

When all PQ parameters are set and analysis is enabled. PQ starts with defined date and starts issuing weekly reports (if monitoring period setting is set to one week).

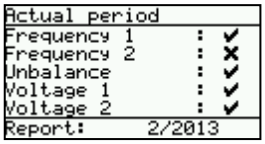
MiQen software enables monitoring state of actual period and of previous monitoring period. Both periods can be overviewed on a devices display as well.

Main menu ⇨ Measurements ⇨ Power supply quality ⇨ Actual period/Previous period

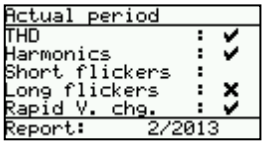
Example of PQ report for actual period generated on devices display. More detailed information about PQ is available on communication.



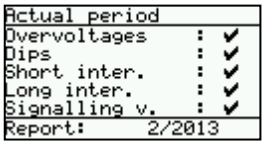
Basic information about actual monitoring period. Period is not completed and currently not in compliance with EN 50160



Display of current status of PQ parameters. Some are currently not in compliance with EN 50160

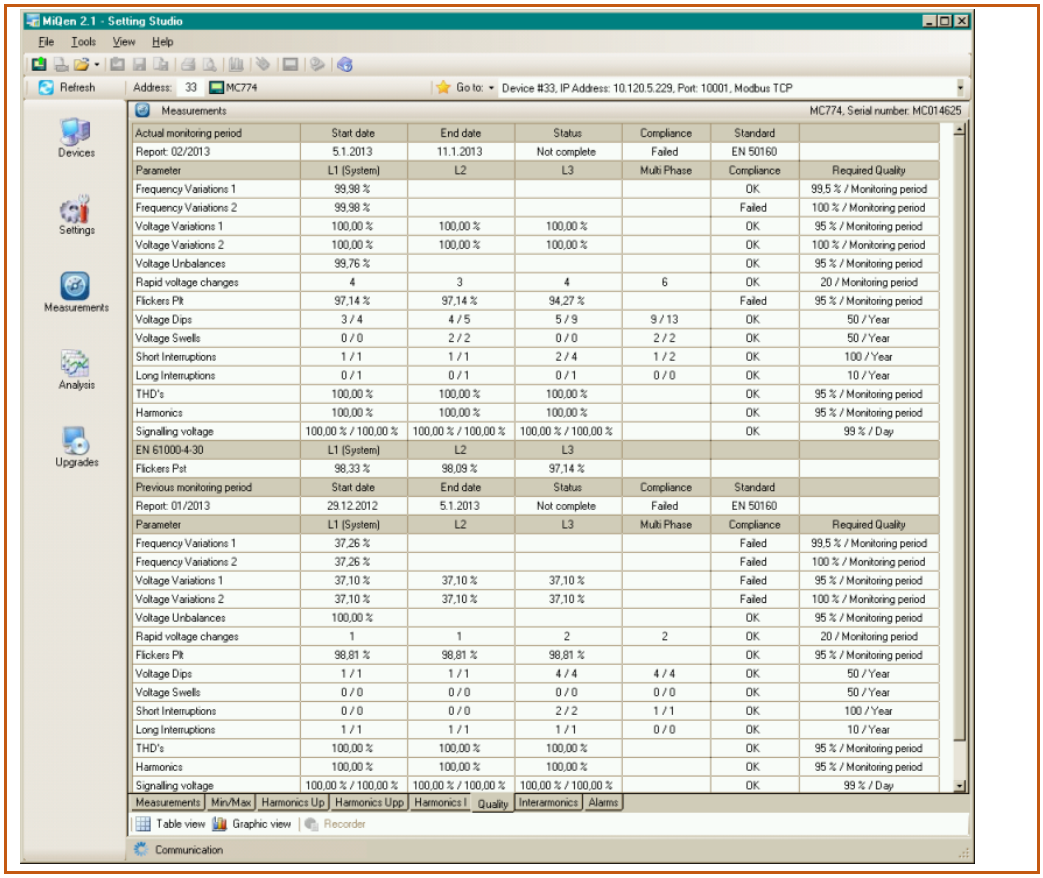


Display of current status of PQ parameters. Some are currently not in compliance with EN 50160



Display of current status of PQ parameters. Some are currently not in compliance with EN 50160

Online monitoring PQ parameters and over viewing reports is easier with MiQen.



Actual monitoring period	Start date	End date	Status	Compliance	Standard	
Report: 02/2013	5.1.2013	11.1.2013	Not complete	Failed	EN 50160	
Parameter	L1 (System)	L2	L3	Multi Phase	Compliance	Required Quality
Frequency Variations 1	99,98 %				OK	99,5 % / Monitoring period
Frequency Variations 2	99,98 %				Failed	100 % / Monitoring period
Voltage Variations 1	100,00 %	100,00 %	100,00 %		OK	95 % / Monitoring period
Voltage Variations 2	100,00 %	100,00 %	100,00 %		OK	100 % / Monitoring period
Voltage Unbalances	99,76 %				OK	95 % / Monitoring period
Rapid voltage changes	4	3	4	6	OK	20 / Monitoring period
Flickers Plt	97,14 %	97,14 %	94,27 %		Failed	95 % / Monitoring period
Voltage Dips	3 / 4	4 / 5	5 / 9	9 / 13	OK	50 / Year
Voltage Swells	0 / 0	2 / 2	0 / 0	2 / 2	OK	50 / Year
Short Interruptions	1 / 1	1 / 1	2 / 4	1 / 2	OK	100 / Year
Long Interruptions	0 / 1	0 / 1	0 / 1	0 / 0	OK	10 / Year
THD's	100,00 %	100,00 %	100,00 %		OK	95 % / Monitoring period
Harmonics	100,00 %	100,00 %	100,00 %		OK	95 % / Monitoring period
Signalling voltage	100,00 % / 100,00 %	100,00 % / 100,00 %	100,00 % / 100,00 %		OK	99 % / Day
EN 61000-4-30	L1 (System)	L2	L3			
Flickers Pst	98,33 %	98,09 %	97,14 %			
Previous monitoring period	Start date	End date	Status	Compliance	Standard	
Report: 01/2013	29.12.2012	5.1.2013	Not complete	Failed	EN 50160	
Parameter	L1 (System)	L2	L3	Multi Phase	Compliance	Required Quality
Frequency Variations 1	37,26 %				Failed	99,5 % / Monitoring period
Frequency Variations 2	37,26 %				Failed	100 % / Monitoring period
Voltage Variations 1	37,10 %	37,10 %	37,10 %		Failed	95 % / Monitoring period
Voltage Variations 2	37,10 %	37,10 %	37,10 %		Failed	100 % / Monitoring period
Voltage Unbalances	100,00 %				OK	95 % / Monitoring period
Rapid voltage changes	1	1	2	2	OK	20 / Monitoring period
Flickers Plt	98,81 %	98,81 %	98,81 %		OK	95 % / Monitoring period
Voltage Dips	1 / 1	1 / 1	4 / 4	4 / 4	OK	50 / Year
Voltage Swells	0 / 0	0 / 0	0 / 0	0 / 0	OK	50 / Year
Short Interruptions	0 / 0	0 / 0	2 / 2	1 / 1	OK	100 / Year
Long Interruptions	1 / 1	1 / 1	1 / 1	0 / 0	OK	10 / Year
THD's	100,00 %	100,00 %	100,00 %		OK	95 % / Monitoring period
Harmonics	100,00 %	100,00 %	100,00 %		OK	95 % / Monitoring period
Signalling voltage	100,00 % / 100,00 %	100,00 % / 100,00 %	100,00 % / 100,00 %		OK	99 % / Day

Figure 38: *Tabelaric presentation of PQ parameters and overall compliance status for actual and previous monitoring period.*

For all parameters basic information is shown:

Actual quality

Actual quality is for some parameters expressed as a percentage of time, when parameters were inside limit lines and for others (events) is expressed as a number of events within monitored period.

Actual quality is for some parameters measured in all three phases and for some only in a single phase (frequency). Events can also occur as Multi-Phase events (more about multiphase events is described in following chapters).

Events are according to EN 50160 evaluated on a yearly basis. Actual quality information is therefore combined from two numbers (x/y) as shown in a figure above, where:

X … number of events in monitored period

Y … total number of events in current year

Required quality

Required quality is limit for compliance with standard EN 50160 and is directly compared with actual quality. Result of comparison is actual status of compliance.

More information about required quality limits can be found in standard EN 50160.

PLEASE NOTE

To make the complete quality report the aux. power supply for the device should not be interrupted during the whole period for which the report is requested. If firmware is updated or power supply is interrupted within a monitoring period, quality report is incomplete – Status: Not complete.

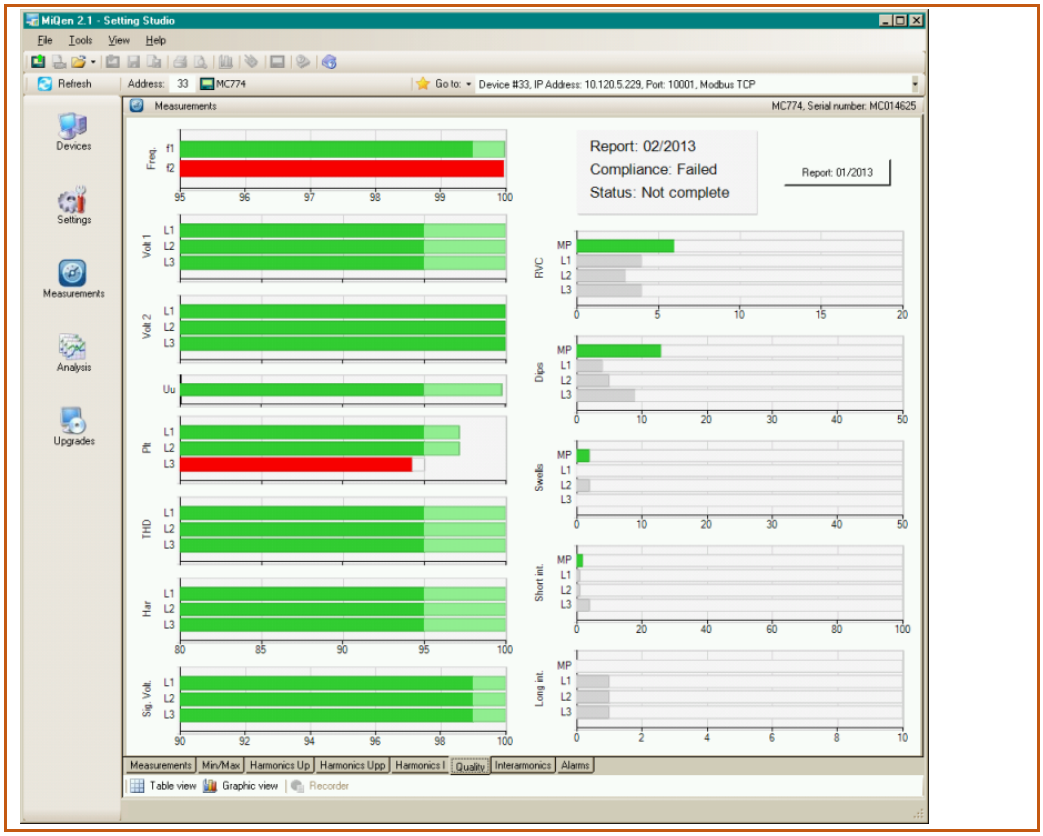


Figure 39: *Graphical presentation of PQ parameters and overall compliance are available only for actual monitoring period*

Darker green colour marks required quality.

Light green colour marks actual quality.

Red colour marks incompliance with standard EN 50160.

Grey colour at events marks number of events.

MP at events marks Multi phase events.

PQ records (only for MC 770)

Even more detailed description about PQ can be obtained by accessing PQ reports with details about anomalies in internal memory.

Structure and operation of internal memory and instructions on how to access data in internal memory is described in chapters *Devices management on page 42 and Internal memory on page 92*).

After memory has been read information about downloaded data is shown.

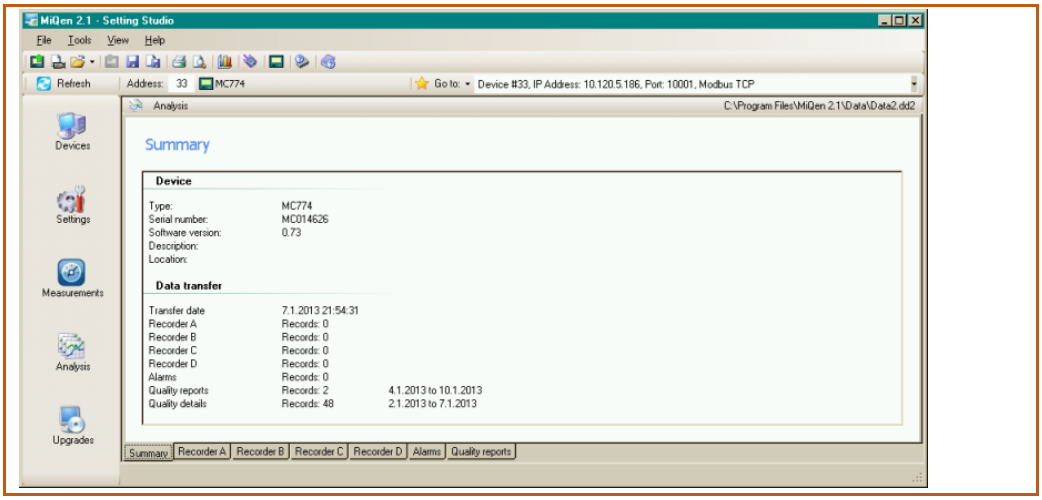


Figure 40: *Information about downloaded data with tabs for different memory partitions*

All information about PQ is stored in *Quality reports* tab.

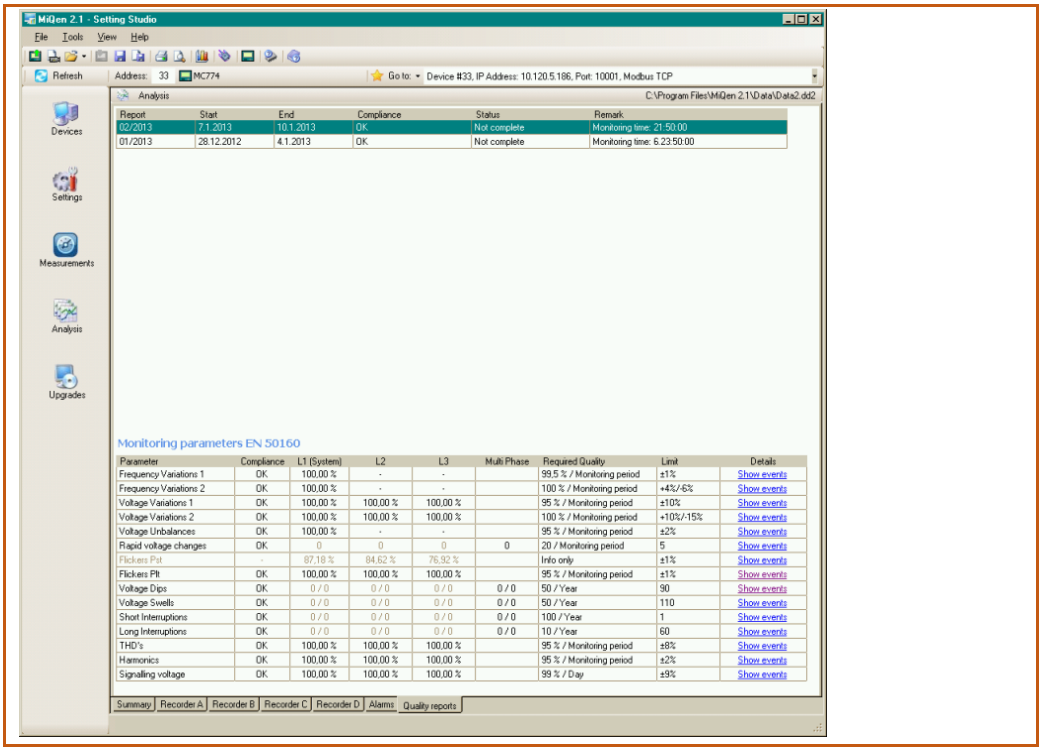


Figure 41: *Main window of recorded PQ reports*

Main window is divided into two parts. Upper part holds information about recorded periodic PQ reports and lower part holds detailed information about each of upper reports.

For each of monitored parameters it is possible to display anomaly report. This represents a complete list of accurately time stamped measurements that were outside PQ limit lines.

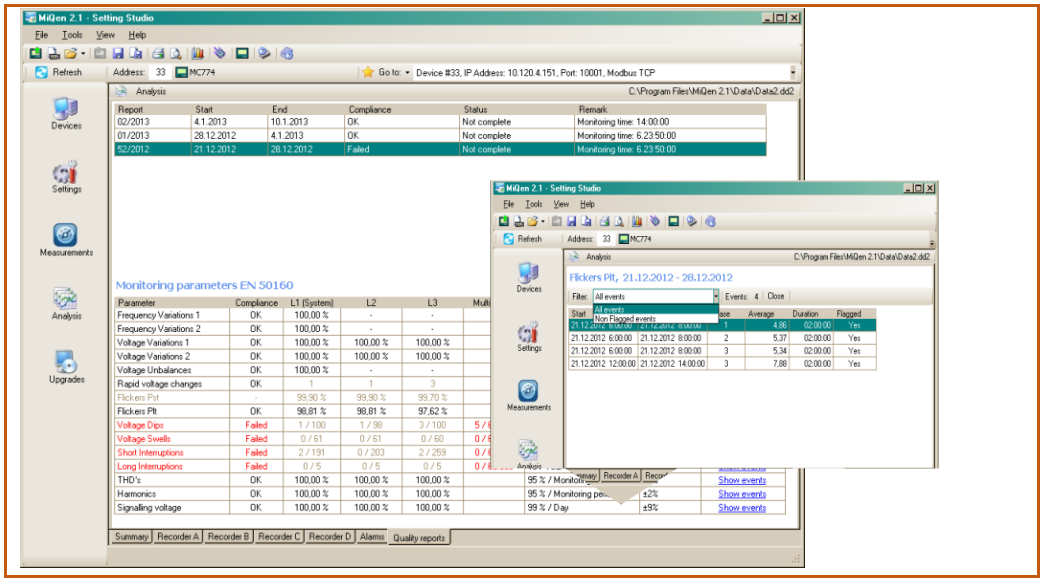


Figure 42: *By clicking on "Show details" for each PQ parameter MiQen displays time-stamped measurements (events), which were outside limit lines*

Flagged data evaluation

Flagged data represent data (recorded events) that has been flagged (marked) according to flagging concept IEC 61000-4-30.

Flagged data are power quality records, which has been influenced by one or more voltage events (interruptions, dips, swells).

The purpose of flagging data is to mark recorded parameters when certain disturbances might influenced measurements and caused corrupted data. For example, voltage dip can also trigger occurrence of flicker, interharmonics ... In this case all parameters which were recorded at a time of voltage events are marked (flagged).

PQ report will omit or include flagged data according to appropriate setting.

PLEASE NOTE

Regardless of this setting, readings will be always stored in recorder and available for analysis. Flagging only influences PQ reports as a whole.

In evaluation of PQ parameter details it is possible to show

- all events,
- non-flagged events,

as depicted in a figure below.

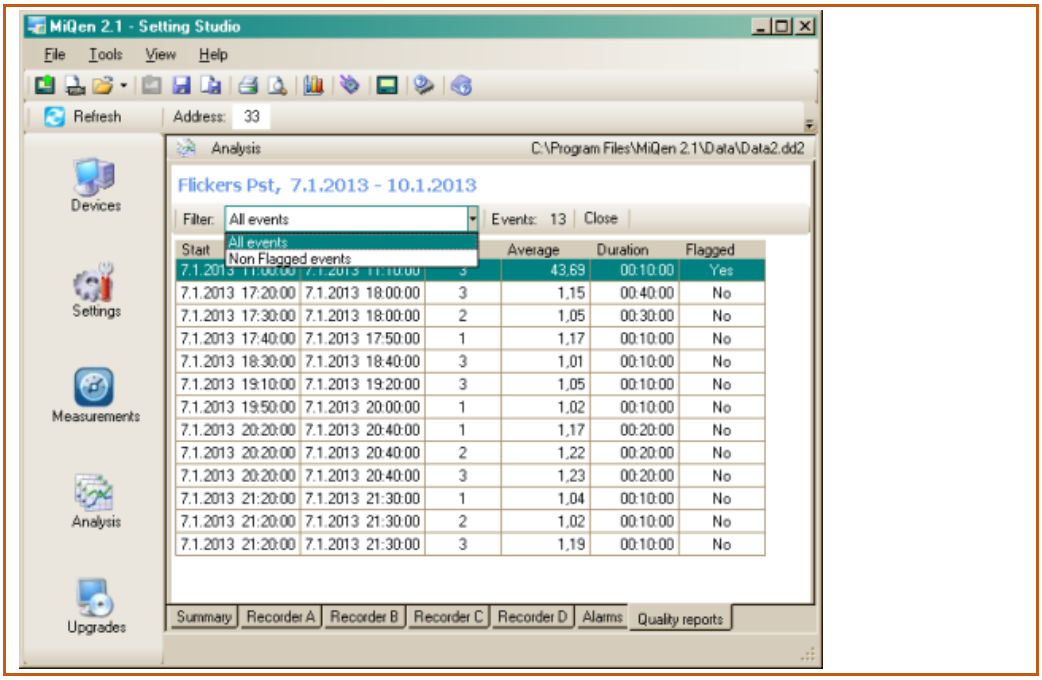


Figure 43: *Display of all or non-flagged events*

Multiphase events

According to standard EN 50160 events (interruptions, dips, swells) should be multiphase aggregated.

Multiphase aggregation is a method where events, which occur in all phases at a same time, are substituted with a single multiphase event since they were most likely triggered by a single anomaly in a network.

However, to eliminate possibility of lose of information all events should be recorded. Therefore during multiphase anomaly four events are recorded. Three events for each phase and an additional multiphase event.

Start	End	Phase	Minimum [%]	Minimum [V]	Duration
7.1.2013 11:06:02.097	7.1.2013 11:06:06.886	-	0,04	0,09	00:00:04.789
7.1.2013 11:06:02.097	7.1.2013 11:06:06.886	3	0,04	0,09	00:00:04.789
7.1.2013 11:06:07.327	7.1.2013 11:06:07.377	-	25,80	59,34	00:00:00.050
7.1.2013 11:06:07.327	7.1.2013 11:06:07.377	3	25,80	59,34	00:00:00.050

Figure 44: *"Phase" column in a list of events marks multiphase event with "-". In this example two events occur in 3rd line and events are multiphase events.*

Definition for multiphase dip and swell is:

“Multiphase event starts when voltage on one or more phases crosses threshold line for event detection and ends when voltage on all phases is restored to normal value”

Definition for multiphase interruption is:

“Multiphase interruption starts when voltage on all three phases crosses threshold line for interruption detection and ends when voltage on at least one phase is restored to normal value”

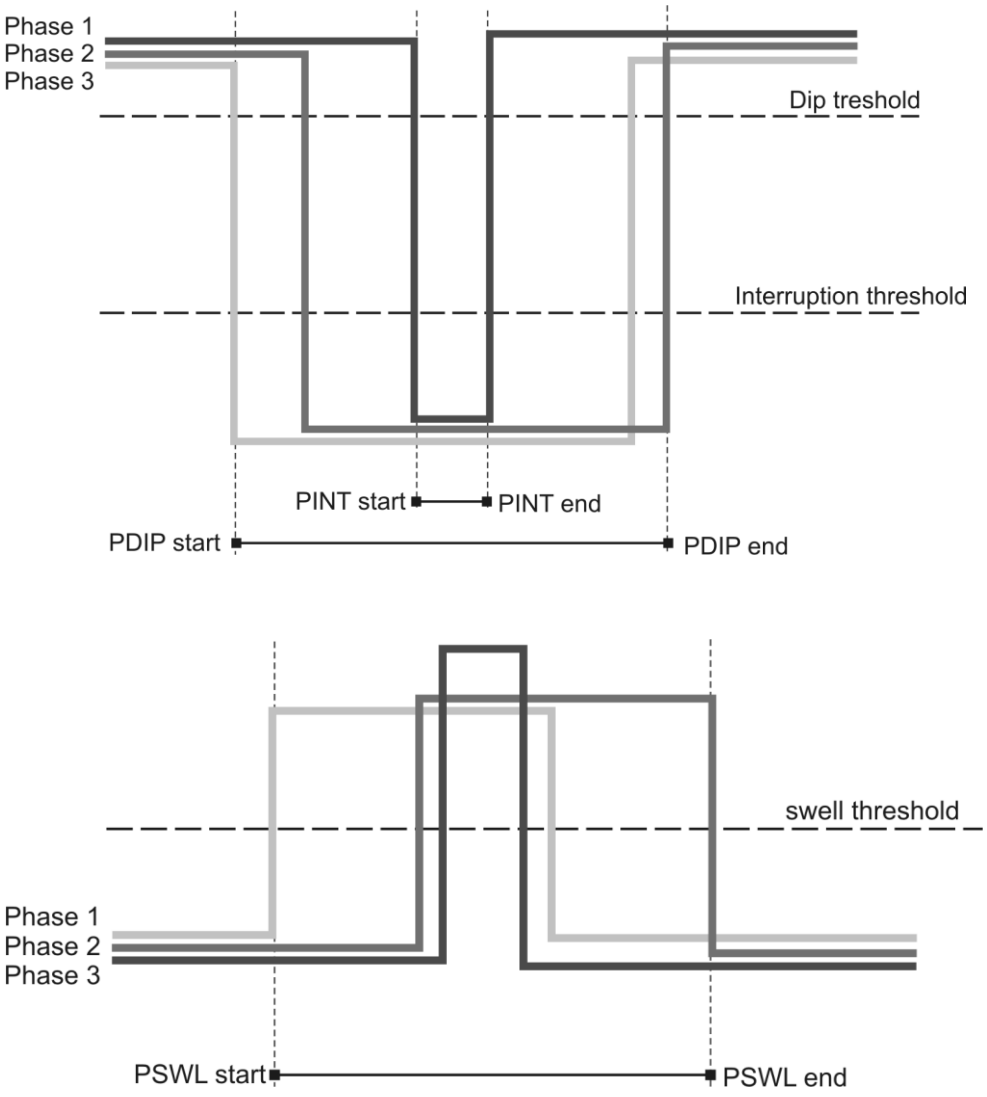


Figure 45: *Graphical presentation of multiphase (PDIP, PINT, PSWL) event detection*

Voltage event details are displayed in two ways. First as a list of all events with all details and second in a table according to UNIPEDE DISDIP specifications.

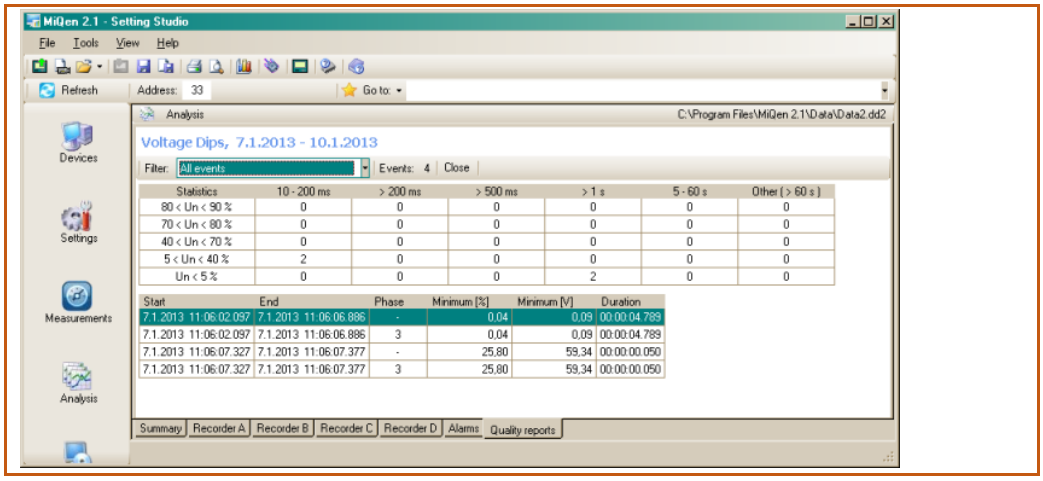


Figure 46: *Presentation of Dips and Interruptions in a list (only four events) and in a statistics table*

Communication modes

MC 7×0 Power Monitoring Device supports two communication modes to suit all demands about connectivity and flexibility.

Standard POLL communication mode is used for most user interaction purposes in combination with monitoring and setting software MiQen, SCADA systems and other MODBUS oriented data acquisition software.

PUSH communication mode is used for sending unsolicited data to predefined links for storing data do various data bases.

POLL communication mode

This is most commonly used communication mode. It services data-on-demand and is therefore suitable for direct connection of setting and / or supervising software to a single device or for a network connection of multiple devices, which requires setting up an appropriate communication infrastructure.

Data is sent from device when it is asked by external software according to MODBUS RTU or MODBUS TCP protocol.

This type of communication is normally used for a real-time on-demand measurement collection for control purposes.

To set up POLL communication mode, only basic communication settings are required according to communication type (serial, USB, ETHERNET). See chapter *Communication on page 154.*

PUSH communication

PUSH communication mode is mainly used for ISKRA ***MiSMART*** system for remote monitoring, analysis and reporting.

The most extensive benefits when using *MC 7×0 Power Quality Analyzer* are achieved when device is used as a part of an energy monitoring system comprising of strategically positioned meters connected to ***MiSMART*** software solution. This three-tier middleware software represents a perfect tool for utility companies, energy suppliers and other parties present on both ends of supply-demand chain.

MiSmart **data collector** with "push" communication system allows automatic records of all predefined measuring parameters. They are stored in

MiSmart **database**, while leaving a copy of same parameters stored locally in memory of each device as a backup copy. Database records in XML format can be searched and viewed in tabelaric and graphical form using

MiSmart client or used by third-party application software.

Database records can involve numerous parameters of three-phase system, power quality parameters, physical parameters (temp., pressure, wind speed …) as well as alarms and event logs.

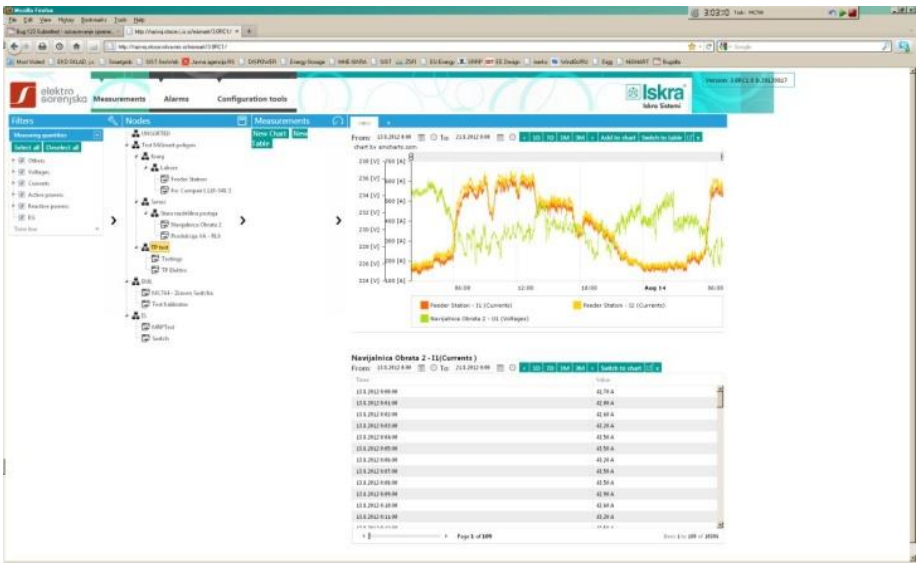


Figure 47: *MiSMART client window*

Explanation

When in this communication mode, device (master) is sending values of predefined quantities in predefined time intervals to two independent servers (data collectors - slave), who collect data into data base for further analysis.

This mode of communication is very useful for a periodic monitoring of readings in systems where real-time data are not required, but on the other side, reliability for collecting data is essential (e.g. for billing purposes, post processing and issuing trend warnings).

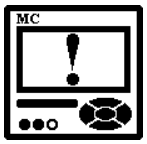
On the other hand, when operating in this mode, the device will send information about alarms immediately as they occur (real time alarm monitoring).

This type of communication also optimizes communication traffic.

Protocol and data format

Device uses XML format to send the data, which is very common and easy to use also for third party software solutions. Protocol used for data transmission is TCP/IP.

All sent readings are time-stamped for accurate reconstruction of received data (if communication is lost and data is sent afterwards). Therefore time synchronization of client and server is essential. For that purpose, server sends synchronization data packet to the device within every response to received data. If time difference is higher than +/- 2s, device resets its internal clock. For more information about used XML format see *Appendix D on page 188*.



CAUTION

Time synchronisation with push system has the lowest priority. If NTP synchronisation source is available it has priority to synchronise RTC.

By using time synchronisation with push functionality device does not meet requirements for Class A measuring device and can be used only as a Class S measuring device.

Data transmission

Every transmission from master side (device) must be acknowledged from client side (server) to verify successful data transmission. In case client fails to receive acknowledgment after predefined response time (see *Ethernet communication on page 64*) it will retry to send it in next time interval. This repeating of sending data will last until master responses to sent data. After that, client will send all available data from the moment it lost response from the master.

It is possible for POLL and PUSH communication mode to be active at the same time. Both communication modes can be handled at the same time if POLL communication is made over COM2 or over Ethernet module through port reserved for communication over MODBUS communication protocol (port 502 see *chapter Ethernet communication on page 64*).

Supported quantities and settings

Sending data in PUSH communication mode is closely related with storing measurements in a recorder. Device can sent to the selected server(s) a block of measure quantities that are stored in memory. For each memory division (recorders A to D, alarms recorder and quality reports with details recorder) separate settings can be made.

Step 1

With MiQen software set proper PUSH Communication settings where time synchronization source, response time, data format and receiving server's parameters are defined.

Step 2

Define data (quantities) for recorder / transmission. For each part of the recorder select to which of the server(s) data will data be sent. This setting can be made for Alarms, Recorder A to D, Quality reports and details.

More information about PUSH data transfer and MiSMART system for collecting of this data can be found on ISKRA web page or in documentation about MiSmart system.

Technical data

In following chapter all technical data regarding operation of *MC 7×0 Power Monitoring Device* is presented.

Accuracy

Measured values	*Measuring Range (Direct connection)*	*Standard*	*Accuracy class*	
			MC 740 & MC 750	*MC 770*
Active power	1.8 kW – 18 kW (In = 5 A)	IEC61557-12	0.2	0.2
	0 kW– 1.8 kW (In = 1 A)	IEC61557-12	0.5	0.5
Reactive power	0 kvar– 18 kvar	IEC61557-12	1	0.5
Apparent power	0 kVA– 18 kVA	IEC61557-12	0.5	0.2
Active energy	9 digit	IEC61557-12	0.5S	0.2S
Reactive energy	9 digit	IEC61557-12	1	0.5S
Apparent energy	9 digit	IEC61557-12	0.5	0.2
Rms current (I_1, I_2, I_3, Iavg) (I_{n_calc})	0.001 Arms to 12.5 Arms In = 1 A or 5 A In = 1 A or 5 A	IEC61557-12	 0.2 0.5	 0.1 0.5
Rms phase voltage (U_1, U_2, U_3, U_{n-g}, U_{avg})	U_{meas}:10 V $_{L-N}$ - 600 V $_{L-N}$ U_{din} = 120/230 V	IEC61557-12 IEC61000-4-30	0.2	0.1 Class A
Rms phase-to-phase voltage (U_{12}, U_{23}, U_{31}, U_{avg})	18 V $_{L-L}$ - 1000 V $_{L-L}$	IEC61557-12 IEC61000-4-30	0.2	0.1 Class A
Voltage negative sequence unbalance (1) (u_2)	10 V $_{L-N}$ - 600 V $_{L-N}$	IEC61557-12 IEC61000-4-30		0.2 Class A
Voltage zero sequence unbalance (1) (u_0)	10 V $_{L-N}$ - 600 V $_{L-N}$	IEC61557-12 IEC61000-4-30		0.2 Class A
Voltage flicker (Pst, Plt)	0.2 Pst – 10 Pst	IEC61000-4-15 IEC61000-4-30		Class F1 (2) Class A
Frequency – actual (f)	50 Hz/60 Hz	IEC61557-12 IEC61000-4-30	0.02 Class A	0.02 Class A
Frequency - (10 s average) (f_{10s})	50 Hz/60 Hz	IEC61557-12 IEC61000-4-30	0.02 Class A	0.02 Class A
Nominal frequency range	16 Hz…400 Hz	IEC61557-12	0.02	0.02

Measured values	***Measuring Range (Direct connection)***	***Standard***	***Accuracy class***	
			MC 740 & MC 750	***MC 770***
Power factor (PF_A)	−1(C)…0…+1(L)	IEC61557-12	0.5	0.5
Voltage swells (U_{swl})	100 % – 120 % U_{din}	IEC61557-12 IEC61000-4-30		0.2, ±1 cyc Class A
Volatge dips (U_{dip})	5 % – 100 % U_{din}	IEC61557-12 IEC61000-4-30		0.2, ±1 cyc Class A
Voltage interruptions (U_{int})	0 % – 5 % U_{din}	IEC61557-12 IEC61000-4-30		±1 cyc Class A
THDU(2)	10 % – 200% of IEC61000-4-2 Class 3 Up to 4 kHz	IEC61557-12 IEC61000-4-7 IEC61000-4-30	0.3 Class I Class A	0.3 Class I Class A
Voltage harmonics ($U_{h\_l\text{-}n}$, $U_{h\_l\text{-}l}$)	10 – 200% of IEC61000-4-2 Class 3 Up to 4 kHz (63rd)	IEC61557-12 IEC61000-4-7 IEC61000-4-30	0.15 Class I Class A	0.15 Class I Class A
Voltage interharmonics (U_{Ih})	10 – 200% of IEC61000-4-2 Class 3	IEC61000-4-7 IEC61000-4-30		Class I Class A
THDI(3)	Up to 4 kHz	IEC61557-12	0.3	0.3
Current harmonics (I_h)	Up to 4 kHz (63rd)	IEC61557-12	0.5	0.5
Signalling voltage (U_{msv})	Up to 3 kHz	IEC61000-4-30		Class A
Real time clock (RTC)	synchronised unsynchronised	IEC61000-4-30	Class A < ±1 sec/day	Class A < ±1 sec/day

(1) ***Voltage unbalance is measured as amplitude and phase unbalance U_{nb}***

(2) ***Test specifications for flickermeter according to standard IEC61000-4-15:2011***

(3) ***When measuring THD, user can set how it is calculated (as a % of fundamental or as a % from RMS value)***

Inputs

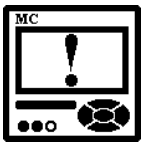
Voltage input		
	Number of channels	4 (1)
	Sampling rate	32 kHz
	Min. voltage for sync.	1 V_{rms}
	Nominal value (U_N)	500 V_{LN} , 866 V_{LL}
	Max. measured value (cont.)	600 V_{LN} ; 1000 V_{LL}
	Max. allowed value	1.2 × U_N permanently
		2 × U_N ; 10 s
	Consumption	< U^2 / 4.2 MΩ per phase
	Input impedance	4.2 MΩ per phase
	(1) 4th channel is used for measuring U EARTH-NEUTRAL	
Current input		
	Number of channels	3
	Sampling rate	32 kHz
	Nominal value (I_N)	1 A, 5 A
	Max. measured value	12.5 A sinusoidal
	Max. allowed value (thermal)	15 A cont.
		≤ 300 A; 1s
	Consumption	< I^2 × 0.01 Ω per phase
Frequency		
	Nominal frequency (f_n)	50 Hz, 60 Hz
	Measuring range	16 Hz…400 Hz
Supply		
	Universal power supply:	CAT III 300V
	Nominal voltage AC	48 V… 276 V
	Nominal frequency	40 Hz… 65 Hz
	Nominal voltage DC	20 V… 300 V
	Consumption (max. all I/O)	< 8 VA
	Power-on transient current	< 20 A; 1 ms
	AC power supply:	CAT III 300 V
	Nominal voltage AC	110 V, 230 V or 400 V
	Nominal frequency	40 Hz… 65 Hz
	Consumption (max. all I/O)	< 8 VA

Connection

Permitted conductor cross-sections

Terminals	*Max. conductor cross-sections*	
Voltage inputs (4)	2.5 mm^2	with pin terminal
	4 mm^2	solid wire
Current inputs (3)	≤ Ø 6 mm	one conductor with insulation[1]
Supply (3)	2.5 mm^2	with pin terminal
	4 mm^2	solid wire
Modules 1, 2 (2 x 3)	2.5 mm^2	with pin terminal
	4 mm^2	solid wire

[1] Insulation for current connection wire should be at least PVC with 4 kV dielectric strength and at least +75 °C working temperature (+100°C short time; <1 min)



WARNING

It is imperative that terminal 12 which represents fourth voltage measurement channel is connected to earth pole ONLY. This terminal should be connected to EARTH potential at all times!

Communication

	Ethernet	*USB*	*RS232*	*RS485*
Type of connection	Network	Direct		Network
Max. connection length	30 m	2 m	3 m	1000 m
Terminals	RJ−45	USB - B	Screw terminals or DB9 connector	
Insulation	In accordance with EN 61010−1:2010 standard			
Transfer mode	Asynchronous			
Protocol	MODBUS TCP / DNP3 auto detect	MODBUS RTU / DNP3 auto detect		
Transfer rate	10/100 Mb/s		(2.400 to 115.200) bit/s	

I/O modules

Digital input module	Main module (1, 2)	
	Purpose	Tariff input, Pulse input, General purpose digital input
	Tariff input	
	No. of inputs per module	2
	Rated voltage	5 V... 48 V AC/DC * 110 ±20 % V AC/DC * 230 ±20 % V AC/DC * * Depends on a built in hardware
	Frequency range	45 Hz…65 Hz
	Pulse input	
	No. of inputs per module	2
	Rated voltage	5 V– 48 V DC (±20 %)
	Max. Current	8 mA (at 48 V DC + 20 %
	Min. pulse width	0.5 ms
	Min. pulse period	2 ms
	SET voltage	40 %... 120 % of rated voltage
	RESET voltage	0 ... 10 % of rated voltage
	General purpose digital input	
	No. of inputs per module	2
	Voltage	5 V... 48 V AC/DC * 110 ±20 % V AC/DC * 230 ±20 % V AC/DC * * Depends on built in hardware
Digital output module	Main module (1, 2)	
	Type	Relay switch
	No. of outputs per module	2
	Purpose	Alarm output, General purpose Digital, Pulse output
	Rated voltage	230 VAC/DC ± 20 % max
	Max. switching current	1000 mA
	Contact resistance	≤ 100 mΩ (100 mA, 24 V)
	Impulse	Max. 4000 imp/hour Min. length 100 ms
	Type	Bistable Relay switch
	No. of outputs per module	1
	Purpose	Alarm output, General purpose digital output
	Max. switching power	40 VA
	Rated voltage	230 $V_{AC/DC}$ ± 20 % max
	Max. switching current	1000 mA
	Contact resistance	≤ 100 mΩ (100 mA, 24 V)

	Type	Optocoupler open collector switch
	No. of outputs per module	2
	Purpose	Pulse output
	Rated voltage	40 $V_{AC/DC}$
	Max. switching current	30 mA (R_{ONmax} = 8 Ω)
	Pulse length	programmable (2 ms… 999 ms)
Status (Watchdog) output module	Type	Relay switch
	Number of outputs	1 x watchdog + 1 x relay output
	Normal operation	Relay in ON position
	Failure detection delay	≈ 1.5 s
	Rated voltage	230 $V_{AC/DC}$ ±20 % max
	Max. switching current	1000 mA
	Contact resistance	≤ 100 mΩ (100 mA, 24 V)
Analogue output module	Output range	0 mA…20 mA
	Accuracy	0.5 % of range
	Max. burden	150 Ω
	Linearization	Linear, Quadratic
	No. of break points	5
	Output value limits	± 120 % of nominal output
	Response time (measurement and analogue output)	depends on set general average interval (0.1 s – 5 s)
	Residual ripple	< 1 % p.p.

Analogue input module		
DC current input	Nominal input range 1	–20 mA… 0 … 20 mA (±20 %)
	input resistance	20 Ω
	accuracy	0.5 % of range
	temperature drift	0.01% / °C
	conversion resolution	16 bit (sigma-delta) internally referenced
	Analogue input mode	Single-ended
DC voltage input	Nominal input range1	–10 V… 0 … 10 V (±20 %)
	input resistance	100 kΩ
	accuracy	0.5 % of range
	temperature drift	0.01% / °C
	conversion resolution	16 bit (sigma-delta) internally referenced
	Analogue input mode	Single-ended
Resistance/ temperature Input module	Nominal input range (low)*	0 Ω - 200 Ω (max. 400 Ω) PT100 (-200°C–850°C)
	Nominal input range (high)*	0 kΩ– 2 kΩ (max. 4 kΩ) PT1000 (-200°C–850°C)
	connection	2-wire
	accuracy	0.5 % of range
	conversion resolution	16 bit (sigma-delta) internally referenced
	Analogue input mode	Single-ended
	* Low or high input range and primary input value (resistance or temperature) are set by the MiQen setting software	

Safety

Safety	protection class II
⚠ ▣	In compliance with EN 61010−1:2010
	600 V rms, *installation category* II
	300 V rms, installation category III
	Pollution degree 2
Test voltage	Uaux against SELV circuits - 3.51 kV rms
	Other circuits to functional earth – 2.21 kV rms
EMC	Directive on electromagnetic compatibility 2004/108/EC
	In compliance with EN 61326-1:2013 for industrial environment
Protection	In compliance with EN 60529: 1997/A1:2000
	Front side (with protection cover for memory slot): IP40
	Rear side (with protection cover): IP20

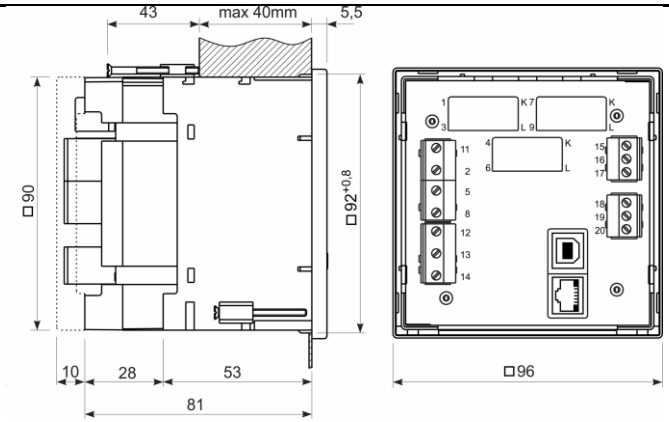
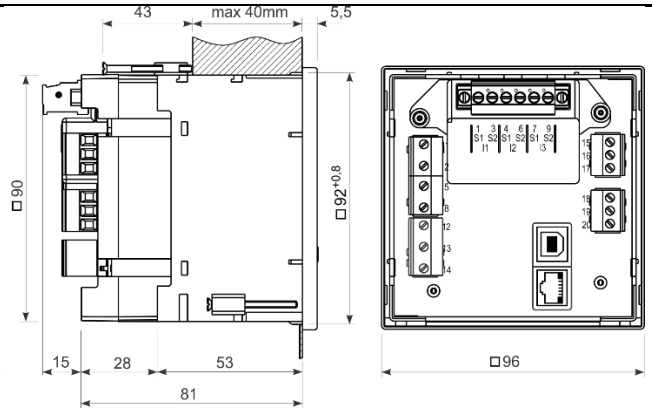
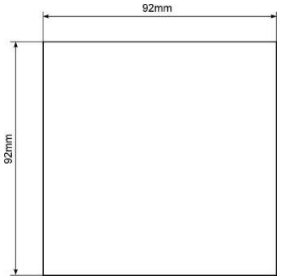
Operating conditions

Operating conditions which have been tested for proper operation of a device within specified accuracy are in accordance with requirements in standards IEC61557-12, IEC61326-1, IEC61000-4-30 and IEC61000-4-7.

Ambient conditions		
	Ambient temperature	K55 temperature class Acc. to EN 61557-12 -10 °C … 55 °C
	Storage temperature range	-40 °C … +70 °C
	Ambient humidity	≤ 75 % r.h. (no condensation)
	Max. storage and transport humidity	≤ 90 % r.h. (no condensation)
	Voltage and Current max. temperature influence limit	± 20 ppm / K (10 V-600 V; 0.05 A-10 A) (T_{amb} : -30°C to +70°C)
Influence of Auxiliary Supply		
	Voltage and Current max. aux. supply change influence limit (IEC61557-12)	< ± 0.02 % (Supply voltage magnitude and frequency in a specified range)
	Common mode input voltage rejection (IEC61557-12)	< ± 0.08 % (common mode voltage at 500 V)
Influence of EMC		
	External A.C. field IEC61326-1	< ±0.02 % Performance criteria A
	Electrostatic discharges IEC61326-1	(IEC61000-4-2) Performance criteria B
	Electromagnetic RF fields IEC61326-1	(IEC61000-4-3) Limit 1 %; < ±0.4 % [(a)] Performance criteria A
	Conducted disturbances IEC61326-1	(IEC61000-4-6) Limit 1 %; < ±0.4 % [(a)] Performance criteria A
	[(a)] Test performed my measuring active energy with pulse output. Error (0.4 %) is due to short measuring time	

Dimensions

Dimensional drawing

Construction	Appearance	
Dimensions *(through-hole connection assignment)* *All dimensions are in mm.*		
Dimensions *(terminal connection assignment)*		
Panel cut-out		
Enclosure	Dimensions	96 mm × 96 mm x 96.5 mm (CT 101.5 mm)
	Mounting	Panel mounting 144 × 144 mm
	Required mounting hole	92 × 92 mm
	Enclosure material	PC/ABS
	Flammability	Acc. to UL 94 V-0
	Weight	550 g
	Enclosure material	PC/ABS Acc. to UL 94 V-0

Connection table

Function			Connection	Comment
Measuring input:	AC current	IL1	1/3	⚠ CAT II 600V CAT III 300V
		IL2	4/6	
		IL3	7/9	
	AC voltage	UL1	2	⚠ CAT II 600V CAT III 300V
		UL2	5	
		UL3	8	
		UN	11	
Inputs/outputs:	Module 1/2	⊖→ +	15	
		⊖→ - (common)	16	
		⊖→ +	17	
	Module 3/4	⊖→ +	18	
		⊖→ - (common)	19	
		⊖→ +	20	
Auxiliary power supply:		+ / AC (L)	13	⚠ CAT III 300V ⚠ GROUND terminal must be always connected !!
		– / AC (N)	14	
		GROUND	12	
Communication:	RS485	A	21	RS232 and RS485 are both supported, but only one at the time can be used! In case of Ethernet/USB communication, terminals from 21 to 25 are not used (unconnected).
		B	22	
	RS232	RX	23	
		GND	24	
		TX	25	
Communication: DB9 female	RS232	Rx	3	
		⏚	5	
		Tx	2	
	RS485	B	7	
		A	8	

Abbreviations

Abbreviations are explained within the text where they appear the first time. Most common abbreviations and expressions are explained in the following table:

Term	Explanation
RMS	Root Mean Square value
Flash	Type of a memory module that keeps its content in case of power supply failure
Ethernet	IEEE 802.3 data layer protocol
MODBUS/DNP3	Industrial protocol for data transmission
Memory card	Multimedia memory card. Type SD supported.
MiQen	Setting Software for ISKRA instruments
PA total	Power Angle calculated from total active and apparent power
PA_{phase}	Angle between **fundamental** phase voltage and phase current
PF_{phase}	Power factor, calculated from apparent and active power (affected by harmonics)
THD (U, I)	Total harmonic distortion
MD	Max. Demand; Measurement of average values in time interval
FFT graphs	Graphical display of presence of harmonics
Harmonic voltage – harmonic	Sine voltage with frequency equal to integer multiple of basic frequency
InterHarmonic voltage – interharmonic	Sine voltage with frequency NOT equal to integer multiple of basic frequency
Flicker	Voltage fluctuation causes changes of luminous intensity of lamps, which causes the so-called flicker
RTC	Real Time Clock
Sample factor	Defines a number of periods for measuring calculation on the basis of measured frequency
M_p – Average interval	Defines frequency of refreshing displayed measurements
Hysteresis [%]	Percentage specifies increase or decrease of a measurement from a certain limit after exceeding it.
PO	Pulse output module
TI	Tariff input module
RO	Relay output module
BO	Bistable digital output module
AO	Analogue output module
DI	Digital input module
PI	Pulse input module
AI	Analogue input module
WO	Status (watchdog) module – for supervision of proper operation

APPENDIX A: MODBUS communication protocol

Communication protocols

Modbus and DNP3 protocol are enabled via RS232 and RS485 or Ethernet communication. Both communication protocols are supported on all communication ports of the device. The response is the same type as the request.

Modbus

Modbus protocol enables operation of device on Modbus networks. For device with serial communication the Modbus protocol enables point to point (for example Device to PC) communication via RS232 communication and multi drop communication via RS485 communication. Modbus protocol is a widely supported open interconnect originally designed by Modicon.

In this document main modbus registers are listed. For complete, latest, Modbus table please visit ISKRA web site.

The memory reference for input and holding registers is 30000 and 40000 respectively.

PLEASE NOTE

For the latest and complete MODBUS table please visit ISKRA web page.

Register table for the actual measurements (1)

Parameter	MODBUS		
	Register		Type
	Start	End	
Actual time	30101	30104	T_Time
Frequency	30105	30106	T5
Voltage U_1	30107	30108	T5
Voltage U_2	30109	30110	T5
Voltage U_3	30111	30112	T5
Average phase Voltage $U^{\sim}$	30113	30114	T5
Phase to phase voltage U_{12}	30118	30119	T5
Phase to phase voltage U_{23}	30120	30121	T5
Phase to phase voltage U_{31}	30122	30123	T5
Average phase to phase Voltage $U_{pp\sim}$	30124	30125	T5
Voltage neutral to ground $Uno_{\sim}$	30485	30486	T5
Current I_1	30126	30127	T5
Current I_2	30128	30129	T5
Current I_3	30130	30131	T5
Neutral Current Inc (calculated)	30132	30133	T5
Average Current	30136	30137	T5
Total Current I	30138	30139	T5
Real Power P_1	30142	30143	T6
Real Power P_2	30144	30145	T6
Real Power P_3	30146	30147	T6
Total Real Power P	30140	30141	T6
Reactive Power Q1	30150	30151	T6
Reactive Power Q2	30152	30153	T6
Reactive Power Q3	30154	30155	T6
Total Reactive Power Q	30148	30149	T6
Apparent Power S1	30158	30159	T5
Apparent Power S2	30160	30161	T5
Apparent Power S3	30162	30163	T5
Total Apparent Power S	30156	30157	T5

Register table for the actual measurements (2)

Parameter	MODBUS		
	Register		Type
	Start	End	
Power Factor PF1	30166	30167	T7
Power Factor PF2	30168	30169	T7
Power Factor PF3	30170	30171	T7
Total Power Factor PF	30164	30165	T7
Power Angle U1−I1	30173		T17
Power Angle U2−I2	30174		T17
Power Angle U3−I3	30175		T17
Angle between In and Un	30488		T17
Power Angle atan2 (Pt, Qt)	30172		T17
Angle U1−U2	30115		T17
Angle U2−U3	30116		T17
Angle U3−U1	30117		T17
Angle Un−U1	30487		T17
Voltage unbalance Uu	30176		T16
Voltage unb. zero sequence Uo	30177		T16
U1 Signal voltage Abs	30592	30593	T5
U2 Signal voltage Abs	30594	30595	T5
U2 Signal voltage Abs	30596	30597	T5
THD I1	30188		T16
THD I2	30189		T16
THD I3	30190		T16
THD U1	30182		T16
THD U2	30183		T16
THD U3	30184		T16
THD U12	30185		T16
THD U23	30186		T16
THD U31	30187		T16
Internal Temperature	30181		T2

Register table for the actual measurements (3)

Parameter	MODBUS		
	Register		Type
	Start	End	
Max Demand Since Last RESET			
MD Real Power P (positive)	30542	30543	T6
MD Real Power P (negative)	30548	30549	T6
MD Reactive Power Q – L	30554	30555	T6
MD Reactive Power Q – C	30560	30561	T6
MD Apparent Power S	30536	30537	T5
MD Current I1	30518	30519	T5
MD Current I2	30524	30525	T5
MD Current I3	30530	30531	T5
Dynamic Demand Values			
MD Real Power P (positive)	30510	30511	T6
MD Real Power P (negative)	30512	30513	T6
MD Reactive Power Q – L	30514	30515	T6
MD Reactive Power Q – C	30516	30517	T6
MD Apparent Power S	30508	30509	T5
MD Current I1	30502	30503	T5
MD Current I2	30504	30505	T5
MD Current I3	30506	30507	T5

Register table for the actual measurements (4)

Actual counter is calculated:
Cnt.× 10 exponent

Parameter	MODBUS		
	Register		Type
	Start	End	
Energy			
Energy Counter 1 Exponent	30401		T2
Energy Counter 2 Exponent	30402		T2
Energy Counter 3 Exponent	30403		T2
Energy Counter 4 Exponent	30404		T2
Counter E1	30406	30407	T3
Counter E2	30408	30409	T3
Counter E3	30410	30411	T3
Counter E4	30412	30413	T3
Counter E1 Tariff 1	30414	30415	T3
Counter E2 Tariff 1	30416	30417	T3
Counter E3 Tariff 1	30418	30419	T3
Counter E4 Tariff 1	30420	30421	T3
Counter E1 Tariff 2	30422	30423	T3
Counter E2 Tariff 2	30424	30425	T3
Counter E3 Tariff 2	30426	30427	T3
Counter E4 Tariff 2	30428	30429	T3
Counter E1 Tariff 3	30430	30431	T3
Counter E2 Tariff 3	30432	30433	T3
Counter E3 Tariff 3	30434	30435	T3
Counter E4 Tariff 3	30436	30437	T3
Counter E1 Tariff 4	30438	30439	T3
Counter E2 Tariff 4	30440	30441	T3
Counter E3 Tariff 4	30442	30443	T3
Counter E4 Tariff 4	30444	30445	T3
Counter E1 Cost	30446	30447	T3
Counter E2 Cost	30448	30449	T3
Counter E3 Cost	30450	30451	T3
Counter E4 Cost	30452	30453	T3
Active tariff	30405		T1

Register table for the actual measurements (5)

Parameter	MODBUS		
	Register		Type
	Start	End	
Flickers			
Flicker Pst1	30580		T17
Flicker Pst2	30581		T17
Flicker Pst3	30582		T17
Flicker Plt1	30583		T17
Flicker Plt2	30584		T17
Flicker Plt3	30585		T17
Flicker Pf5 - L1	30586	30587	T5
Flicker Pf5 - L2	30588	30589	T5
Flicker Pf5 - L3	30590	30591	T5
Phase voltage harmonic data			
U1 Harmonic Data			
Base for % calculation	31001	31002	T5
U1 1 Harmonic Abs %	31003		T16
U1 1 Harmonic Phase Angle	31004		T17
U1 Harmonics from 2 to 62			
U1 63 Harmonic Abs %	31127		T16
U1 63 Harmonic Phase Angle	31128		T17
U2 Harmonic Data			
Base for % calculation	31129	31130	T5
U2 1 Harmonic Abs %	31131		T16
U2 1 Harmonic Phase Angle	31132		T17
U2 Harmonics from 2 to 62			
U2 63 Harmonic Abs %	31255		T16
U2 63 Harmonic Phase Angle	31256		T17
U3 Harmonic Data			
Base for % calculation	31257	31258	T5
U3 2 Harmonic Abs %	31259		T16
U3 2 Harmonic Phase Angle	31260		T17
U3 Harmonics from 3rd to 30th			
U3 63 Harmonic Abs %	31383		T16
U3 63 Harmonic Phase Angle	31384		T17

Register table for the actual measurements (6)

Parameter	MODBUS		
	Register		Type
	Start	End	
Line voltage harmonic data			
U12 Harmonic Data			
Base for % calculation	31385	31386	T5
U12 1 Harmonic Abs %	31387		T16
U12 1 Harmonic Phase Angle	31388		T17
U12 Harmonics from 2 to 62			
U12 63 Harmonic Abs %	31511		T16
U12 63 Harmonic Phase Angle	31512		T17
U23 Harmonic Data			
Base for % calculation	31513	31514	T5
U23 1 Harmonic Abs %	31515		T16
U23 1 Harmonic Phase Angle	31516		T17
U23 Harmonics from 2 to 62			
U23 63 Harmonic Abs %	31639		T16
U23 63 Harmonic Phase Angle	31640		T17
U31 Harmonic Data			
Base for % calculation	31641	31642	T5
U31 2 Harmonic Abs %	31643		T16
U31 2 Harmonic Phase Angle	31644		T17
U31 Harmonics from 3^{rd} to 30^{th}			
U31 63 Harmonic Abs %	31767		T16
U31 63 Harmonic Phase Angle	31768		T17

Register table for the actual measurements (7)

Parameter	MODBUS		
	Register		Type
	Start	End	
Phase current harmonic data			
I1 Harmonic Data			
Base for % calculation	31769	31770	T5
I1 1 Harmonic Abs %	31771		T16
I1 1 Harmonic Phase Angle	31772		T17
I1 Harmonics from 2 to 62			
I1 63 Harmonic Abs %	31895		T16
I1 63 Harmonic Phase Angle	31896		T17
I2 Harmonic Data			
Base for % calculation	31897	31898	T5
I2 1 Harmonic Abs %	31899		T16
I2 1 Harmonic Phase Angle	31900		T17
I2 Harmonics from 2 to 62			
I2 63 Harmonic Abs %	32023		T16
I2 63 Harmonic Phase Angle	32024		T17
I3 Harmonic Data			
Base for % calculation	32025	32026	T5
I3 2 Harmonic Abs %	32027		T16
I3 2 Harmonic Phase Angle	32028		T17
I3 Harmonics from 3rd to 30th			
I3 63 Harmonic Abs %	32151		T16
I3 63 Harmonic Phase Angle	32152		T17

Register table for the actual measurements (8)

Parameter	MODBUS		
	Register		Type
	Start	End	
Phase voltage interharmonic data			
U1 Interharmonic Data			
Base for % calculation	32153	32154	T5
1. Interharmonic Abs %	32155		T16
2. Interharmonic Abs %	32156		T16
3. - 10 Interharmonic	32157	32164	T16
U2 Interharmonic Data			
Base for % calculation	3271	3272	T5
1. Interharmonic Abs %	32173		T16
2. Interharmonic Abs %	32174		T16
3. - 10 Interharmonic	32175	32182	T16
U3 Interharmonic Data			
Base for % calculation	32189	32190	T5
1. Interharmonic Abs %	32191		T16
2. Interharmonic Abs %	32192		T16
3. - 10 Interharmonic	32193	32200	T16

All other MODBUS regiters are a subject to change. For the latest MODBUS register defenitions go to ISKRA web page www.iskra.eu

Register table for the basic settings

Register	Content	Type	Ind	Values / Dependencies	Min	Max	Pass. Level
40143	Connection Mode	T1	0	No mode	1	5	2
			1	1b - Single Phase			
			2	3b - 3 phase 3 wire balanced			
			3	4b - 3 phase 4 wire balanced			
			4	3u - 3 phase 3 wire unbalanced			
			5	4u - 3 phase 4 wire unbalanced			
40144	CT Secondary	T4		mA			2
40145	CT Primary	T4		A/10			2
40146	VT Secondary	T4		mV			2
40147	VT Primary	T4		V/10			2
40148	Current input range (%)	T16		10000 for 100%	5,00	200,00	2
40149	Voltage input range (%)	T16		10000 for 100%	2,50	100,00	2
40150	Frequency nominal value	T1		Hz	10	1000	2

Data types decoding (1)

Type	Bit mask	Description
T1		Unsigned Value (16 bit) Example: 12345 = 3039(16)
T2		Signed Value (16 bit) Example: -12345 = CFC7(16)
T3		Signed Long Value (32 bit) Example: 123456789 = 075B CD 15(16)
T4	bits # 15…14 bits # 13…00	Short Unsigned float (16 bit) Decade Exponent(Unsigned 2 bit) Binary Unsigned Value (14 bit) Example: 10000*102 = A710(16)
T5	bits # 31…24 bits # 23…00	Unsigned Measurement (32 bit) Decade Exponent(Signed 8 bit) Binary Unsigned Value (24 bit) Example: 123456*10-3 = FD01 E240(16)
T6	bits # 31…24 bits # 23…00	Signed Measurement (32 bit) Decade Exponent (Signed 8 bit) Binary Signed value (24 bit) Example: - 123456*10-3 = FDFE 1DC0(16)
T7	bits # 31…24 bits # 23…16 bits # 15…00	Power Factor (32 bit) Sign: Import/Export (00/FF) Sign: Inductive/Capacitive (00/FF) Unsigned Value (16 bit), 4 decimal places Example: 0.9876 CAP = 00FF 2694(16)
T9	bits # 31…24 bits # 23…16 bits # 15…08 bits # 07…00	Time (32 bit) 1/100s 00 - 99 (BCD) Seconds 00 - 59 (BCD) Minutes 00 - 59 (BCD) Hours 00 - 24 (BCD) Example: 15:42:03.75 = 7503 4215(16)

Data types decoding (2)

Type	Bit mask	Description
T10	bits # 31…24 bits # 23…16 bits # 15…00	Date (32 bit) Day of month 01 - 31 (BCD) Month of year 01 - 12 (BCD) Year (unsigned integer) 1998..4095 Example: 10, SEP 2000 = 1009 07D0(16)
T16		Unsigned Value (16 bit), 2 decimal places Example: 123.45 = 3039(16)
T17		Signed Value (16 bit), 2 decimal places Example: -123.45 = CFC7(16)
T_float	bits # 31 bits # 31 bits # 31	IEEE 754 Floating-Point Single Precision Value (32bit) Sign Bit (1 bit) Exponent Field (8 bit) Significand (23 bit) Example: 123.45 stored as 123.45000 = 42F6 E666(16)
T_Str4		Text: 4 characters (2 characters for 16 bit register)
T_Str6		Text: 6 characters (2 characters for 16 bit register)
T_Str8		Text: 8 characters (2 characters for 16 bit register)
T_Str16		Text: 16 characters (2 characters for 16 bit register)
T_Str40		Text: 40 characters (2 characters for 16 bit register)

APPENDIX B: DNP3 communication

Communication protocols

Modbus and DNP3 protocol are enabled via RS232 and RS485 or Ethernet communication. Both communication protocols are supported on all communication ports of the device. The response is the same type as the request.

DNP3

DNP3 protocol enables operation of a device on DNP3 networks. For device with serial communication the DNP3 protocol enables point to point (for example device to PC) communication via RS232 communication and multi drop communication via RS485.

Device automatically responses to MODBUS or DNP3 request.

PLEASE NOTE

For the latest and complete DNP3 table please visit ISKRA web page.

DNP 3.0 **Device Profile Document**	Issue: E Date: 8 Jan 2013
Device Name: Power Quality Analyzer Vendor Name: **ISKRA d.o.o.** Models Covered: **MC744**	
Highest DNP Level Supported: For Requests: 1 For Responses: 1	Device Function: ❒ Master ☑ **Slave**
Notable objects, functions, and/or qualifiers supported in addition to the Highest DNP Levels Supported (the complete list is described in the DNP V3.0 Implementation table):	
Maximum Data Link Frame Size (octets): Transmitted: **292** Received: **249** Maximum Data Link Re-tries: ☑ **None** ❒ Configurable	Maximum Application Fragment Size (octets): Transmitted: **2048** Received: **249** Maximum Application Layer Re-tries: ☑ **None** ❒ Configurable
Requires Data Link Layer Confirmation: ☑ **Never** ❒ Always ❒ Sometimes ❒ Configurable	
Requires Application Layer Confirmation: ☑ **Never** ❒ Always ❒ Sometimes ❒ Configurable	

Timeouts while waiting for:				
Data Link Confirm:	☑ **None**	❒ Fixed at ____	❒ Variable	❒ Configurable
Complete Appl. Fragment:	☑ **None**	❒ Fixed at ____	❒ Variable	❒ Configurable
Application Confirm:	☑ **None**	❒ Fixed at ____	❒ Variable	❒ Configurable
Complete Appl. Response:	☑ **None**	❒ Fixed at ____	❒ Variable	❒ Configurable
Others:				

Sends/Executes Control Operations:				
WRITE Binary Outputs	☑ **Never**	❒ Always	❒ Sometimes	❒ Configurable
SELECT/OPERATE	☑ **Never**	❒ Always	❒ Sometimes	❒ Configurable
DIRECT OPERATE	☑ **Never**	❒ Always	❒ Sometimes	❒ Configurable
DIRECT OPERATE – NO ACK	☑ **Never**	❒ Always	❒ Sometimes	❒ Configurable
Count > 1	☑ **Never**	❒ Always	❒ Sometimes	❒ Configurable
Pulse On	☑ **Never**	❒ Always	❒ Sometimes	❒ Configurable
Pulse Off	☑ **Never**	❒ Always	❒ Sometimes	❒ Configurable
Latch On	☑ **Never**	❒ Always	❒ Sometimes	❒ Configurable
Latch Off	☑ **Never**	❒ Always	❒ Sometimes	❒ Configurable
Queue	☑ **Never**	❒ Always	❒ Sometimes	❒ Configurable
Clear Queue	☑ **Never**	❒ Always	❒ Sometimes	❒ Configurable

Reports Binary Input Change Events when no specific variation requested: ☑ **Never** ❒ Only non-time-tagged ❒ Configurable	Reports time-tagged Binary Input Change Events when no specific variation requested: ☑ **Never** ❒ Binary Input Change With Relative Time ❒ Configurable
Sends Unsolicited Responses: ☑ **Never** ❒ Configurable ❒ Only certain Objects ❒ Sometimes ❒ ENABLE/DISABLE UNSOLICITED Function codes supported	Sends Static Data in Unsolicited Responses: ☑ **Never** ❒ When Device Restarts ❒ When Status Flags Change No other options are permitted.
Default Counter Object/Variation: ❒ No Counters Reported ❒ Configurable ☑ **Default Object: 30** ☑ **Default Variation: 4** **Point-by-point list attached**	Counters Roll Over at: ❒ No Counters Reported ❒ Configurable ❒ 16 Bits ❒ 32 Bits ☑ **Other Value: 20000** **Point-by-point list attached**

Sends Multi-Fragment Responses:

❒ Yes

☑ **No**

Object			Request		Response	
Object Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
0	242	Device Attributes - software version	1	00	129	00, 17
0	243	Device Attributes – hardware version	1	00	129	00, 17
0	246	Device Attributes – user assigned ID	1	00	129	00, 17
0	248	Device Attributes – serial number	1	00	129	00, 17
0	250	Device Attributes – product name	1	00	129	00, 17
0	252	Device Attributes – manufacture name	1	00	129	00, 17
0	254	Device Attributes – nonspecific all attributes request	1	00, 06		
0	255	Device Attributes – list of attribute variation	1	00, 06	129	00, 5B

Points for object 0

0	Software version	T_Str3		Data	var	242	
0	Hardware version	T_Str2		Data	var	243	
0	user assigned ID	T_Str2		Data	var	246	
0	serial number	T_Str8		Data	var	248	
0	product name	T_Str16		Data	var	250	
0	manufacture name	T_Str20		Data	var	252	

Object			Request		Response	
Object Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
30	0	16-Bit Analog Input without flag	1	00, 01, 06		
30	2	16-Bit Analog Input with flag	1	00, 01, 06	129	00, 01
30	4	16-Bit Analog Input without flag	1	00, 01, 06	129	00, 01

Points for object 30

0	U1	T16		Data	-Un	+Un	
1	U2	T16		Data	-Un	+Un	
2	U3	T16		Data	-Un	+Un	
3	Uavg (phase to neutral)	T16		Data	-Un	+Un	
4	U12	T16		Data	-Un	+Un	
5	U23	T16		Data	-Un	+Un	
6	U31	T16		Data	-Un	+Un	
7	Uavg (phase to phase)	T16		Data	-Un	+Un	
8	I1	T16		Data	-In	+In	
9	I2	T16		Data	-In	+In	
10	I3	T16		Data	-In	+In	
11	I total	T16		Data	-In	+In	
12	I neutral (calculated)	T16		Data	-In	+In	
13	I neutral (measured)	T16		Data	-In	+In	
14	Iavg	T16		Data	-In	+In	
15	Active Power Phase L1 (P1)	T17		Data	-Pn	+Pn	
16	Active Power Phase L2 (P2)	T17		Data	-Pn	+Pn	
17	Active Power Phase L3 (P3)	T17		Data	-Pn	+Pn	
18	Active Power Total (Pt)	T17		Data	-Pt	+Pt	
19	Reactive Power Phase L1 (Q1)	T17		Data	-Pn	+Pn	
20	Reactive Power Phase L2 (Q2)	T17		Data	-Pn	+Pn	
21	Reactive Power Phase L3 (Q3)	T17		Data	-Pn	+Pn	
22	Reactive Power Total (Qt)	T17		Data	-Pt	+Pt	
23	Apparent Power Phase L1 (S1)	T16		Data	-Pn	+Pn	
24	Apparent Power Phase L2 (S2)	T16		Data	-Pn	+Pn	
25	Apparent Power Phase L3 (S3)	T16		Data	-Pn	+Pn	
26	Apparent Power Total (St)	T16		Data	-Pt	+Pt	
27	Power Factor Phase 1 (PF1)	T17		Data	-1	+1	
28	Power Factor Phase 2 (PF2)	T17		Data	-1	+1	
29	Power Factor Phase 3 (PF3)	T17		Data	-1	+1	

Points for object 30 (2)							
30	Power Factor Total (PFt)	T17		Data	-1	+1	
31	CAP/IND P. F. Phase 1 (PF1)	T17		Data	-1 CAP	+1	300% for -1 IND
32	CAP/IND P. F. Phase 2 (PF2)	T17		Data	-1 CAP	+1	300% for -1 IND
33	CAP/IND P. F. Phase 3 (PF3)	T17		Data	-1 CAP	+1	300% for -1 IND
34	CAP/IND P. F. Total (PFt)	T17		Data	-1 CAP	+1	300% for -1 IND
35	φ1 (angle between U1 and I1)	T17		Data	-100°	+100°	
36	φ 2 (angle between U2 and I2)	T17		Data	-100°	+100°	
37	φ 3 (angle between U3 and I3)	T17		Data	-100°	+100°	
38	Power Angle Total (atan2(Pt,Qt))	T17		Data	-100°	+100°	
39	φ 12 (angle between U1 and U2)	T17		Data	-100°	+100°	
40	φ 23 (angle between U2 and U3)	T17		Data	-100°	+100°	
41	φ 31 (angle between U3 and U1)	T17		Data	-100°	+100°	
42	Frequency	T17		Data	Fn-10Hz	Fn+10Hz	
43	U unbalace	T16		Data	-100%	+100%	
44	I1 THD%	T16		Data	-100%	+100%	
45	I2 THD%	T16		Data	-100%	+100%	
46	I3 THD%	T16		Data	-100%	+100%	
47	U1 THD%	T16		Data	-100%	+100%	
48	U2 THD%	T16		Data	-100%	+100%	
49	U3 THD%	T16		Data	-100%	+100%	
50	U12 THD%	T16		Data	-100%	+100%	
51	U23 THD%	T16		Data	-100%	+100%	
52	U31 THD%	T16		Data	-100%	+100%	
	MAX DEMAND SINCE LAST RESET						
53	Active Power Total (Pt) - (positive)	T16		Data	-Pt	+Pt	
54	Active Power Total (Pt) - (negative)	T16		Data	-Pt	+Pt	
55	Reactive Power Total (Qt) - L	T16		Data	-Pt	+Pt	
56	Reactive Power Total (Qt) - C	T16		Data	-Pt	+Pt	
57	Apparent Power Total (St)	T16		Data	-Pt	+Pt	
58	I1	T16		Data	-In	+In	
59	I2	T16		Data	-In	+In	
60	I3	T16		Data	-In	+In	
	DYNAMIC DEMAND VALUES						
61	Active Power Total (Pt) - (positive)	T16		Data	-Pt	+Pt	

Points for object 30 (3)							
62	Active Power Total (Pt) - (negative)	T16		Data	-Pt	+Pt	
63	Reactive Power Total (Qt) - L	T16		Data	-Pt	+Pt	
64	Reactive Power Total (Qt) - C	T16		Data	-Pt	+Pt	
65	Apparent Power Total (St)	T16		Data	-Pt	+Pt	
66	I1	T16		Data	-In	+In	
67	I2	T16		Data	-In	+In	
68	I3	T16		Data	-In	+In	
	ENERGY						
69	Energy Counter 1	T17		Data			(32-bit value) MOD 20000
70	Energy Counter 2	T17		Data			(32-bit value) MOD 20000
71	Energy Counter 3	T17		Data			(32-bit value) MOD 20000
72	Energy Counter 4	T17		Data			(32-bit value) MOD 20000
73	Energy Counter 1 Cost	T17		Data			(32-bit value) MOD 20000
74	Energy Counter 2 Cost	T17		Data			(32-bit value) MOD 20000
75	Energy Counter 3 Cost	T17		Data			(32-bit value) MOD 20000
76	Energy Counter 4 Cost	T17		Data			(32-bit value) MOD 20000
77	Total Energy Counter Cost	T17		Data			(32-bit value) MOD 20000
78	Aktiv Tariff	T1		Data			
79	Internal Temperature	T17		Data	-100°	+100°	

Object			Request		Response	
Object Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
40	0	16-bit Analog output status	1	00, 01, 06		
40	2	16-bit Analog output status	1	00, 01, 06	129	00, 01
Points for object 40						
0	Analog output 1	T1		Data	0	
1	Analog output 2	T1		Data	0	
2	Analog output 3	T1		Data	0	
3	Analog output 4	T1		Data	0	
4	Slot A - Analog output 1	T1		Data	0	
5	Slot A - Analog output 2	T1		Data	0	
6	Slot A - Analog output 3	T1		Data	0	
7	Slot A - Analog output 4	T1		Data	0	
8	Slot B - Analog output 1	T1		Data	0	
9	Slot B - Analog output 2	T1		Data	0	
10	Slot B - Analog output 3	T1		Data	0	
11	Slot B - Analog output 4	T1		Data	0	

Object			Request		Response	
Object Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
50	0	Time and Date – absolute time	2	7		
50	1	Time and Date – absolute time	2	7	129	7
Points for object 50						
0	Time and Date	T_Time		Data		

Object			Request		Response	
Object Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
60	1	CLASS 0 DATA	1	06		
60	2	CLASS 1 DATA	1,22*	06		
60	3	CLASS 2 DATA	1,22*	06		
60	4	CLASS 3 DATA	1,22*	06		

*only object 30

APPENDIX C: Equations

Definitions of symbols

No	Symbol	Definition
1	M_P	Average interval
2	U_f	Phase voltage (U_1, U_2 or U_3)
3	U_{ff}	Phase-to-phase voltage (U_{12}, U_{23} or U_{31})
4	N	Total number of samples in a period
5	n	Sample number ($0 \leq n \leq N$)
6	x, y	Phase number (1, 2 or 3)
7	i_n	Current sample n
8	u_{fn}	Phase voltage sample n
9	u_{fFn}	Phase-to-phase voltage sample n
10	φ_f	Power angle between current and phase voltage f (φ_1, φ_2 or φ_3)
11	U_u	Voltage unbalance
12	U_c	Agreed supply voltage

Voltage

$$U_f = \sqrt{\frac{\sum_{n=1}^{N} u_n^2}{N}}$$

Phase voltage

N – samples in averaging interval (up to 65 Hz)

$$U_{xy} = \sqrt{\frac{\sum_{n=1}^{N} \left(u_{xn} - u_{yn}\right)^2}{N}}$$

Phase-to-phase voltage

u_x, u_y – phase voltages (U_f)

N – a number of samples in averaging interval

$$U_u = \sqrt{\frac{1-\sqrt{3-6\beta}}{1+\sqrt{3-6\beta}}} \cdot 100\%$$

$$\beta = \frac{U_{12fund}^4 + U_{23fund}^4 + U_{31fund}^4}{\left(U_{12fund}^2 + U_{23fund}^2 + U_{31fund}^2\right)^2}$$

Voltage unbalance

U_{fund} – first harmonic of phase-to-phase voltage

Current

$$I_{RMS} = \sqrt{\frac{\sum_{n=1}^{N} i_n^2}{N}}$$

Phase current

N – samples in averaging interval (up to 65 Hz)

$$I_n = \sqrt{\frac{\sum_{n=1}^{N} \left(i_{1n} + i_{2n} + i_{3n}\right)^2}{N}}$$

Neutral current

i – n sample of phase current (1, 2 or 3)

N – samples in averaging interval (up to 65 Hz)

Power

$P_f = \frac{1}{N} \cdot \sum_{n=1}^{N} (u_{fn} \cdot i_{fn})$	***Active power by phases*** N – a number of periods n – index of sample in a period f – phase designation
$P_t = P_1 + P_2 + P_3$	***Total active power*** t – total power 1, 2, 3 – phase designation
$SignQ_f(\varphi)$ $\varphi \in [0° - 180°] \Rightarrow SignQ_f(\varphi) = +1$ $\varphi \in [180° - 360°] \Rightarrow SignQ_f(\varphi) = -1$	***Reactive power sign*** Q_f – reactive power (by phases) φ – power angle
$S_f = U_f \cdot I_f$	***Apparent power by phases*** U_f – phase voltage I_f – phase current
$S_t = S_1 + S_2 + S_3$	***Total apparent power*** S_t – apparent power by phases
$Q_f = SignQ_f(\varphi) \cdot \sqrt{S_f^2 - P_f^2}$	***Reactive power by phases*** S_f – apparent power by phases P_f – active power by phases
$Q_f = \frac{1}{N} \cdot \sum_{n=1}^{N} (u_{f\,n} \times i_{f\,[n+N/4]})$	***Reactive power by phases (displacement method)*** N – a number of samples in a period n – sample number (0 ≤ n ≤ N) f – phase designation
$Q_t = Q_1 + Q_2 + Q_3$	***Total reactive power*** Q_t – reactive power by phases
$\varphi_s = \arctan 2(P_t, Q_t)$ $\varphi_s = [-180°, 179{,}99°]$	***Total power angle*** P_t – total active power Q_t – total reactive power
$PF_t = \frac{P_t}{S_t}$	***Distortion factor*** P_t – total active power S_t – total apparent power
$PF_f = \frac{P_f}{S_f}$	***Distortion factor*** P_f – phase active power S_f – phase apparent power

THD, TDD

$I_f THD(\%) = \frac{\sqrt{\sum_{n=2}^{63} I_n^{\,2}}}{I_1} \cdot 100$	***Current THD*** I_1 – value of first harmonic n – number of harmonic
$I_f TDD(\%) = \frac{\sqrt{\sum_{n=2}^{63} I_n^{\,2}}}{I_L} \cdot 100$	***Current TDD*** I_L – value of max. load current (fixed, user defined value) n – number of harmonic
$U_f THD(\%) = \frac{\sqrt{\sum_{n=2}^{63} U_{fn}^{\,2}}}{U_{f1}} \cdot 100$	***Phase voltage THD*** U_1 – value of first harmonic n – number of harmonic
$U_{ff} THD(\%) = \frac{\sqrt{\sum_{n=2}^{63} U_{ffn}^{\,2}}}{U_{ff_1}} \cdot 100$	***Phase-to-phase voltage THD*** U_1 – value of first harmonic n – number of harmonic

Current factors

$CFI(\%) = \frac{I_{PEAK}}{I_{RMS}} \cdot 100$	***CREST factor*** I_{RMS} – RMS value of phase current I_{PEAK} – Peak value of current within cycle
$K_i = \frac{\sum_{n=1}^{63} (I_n \times n)^2}{\sum_{n=1}^{63} I_n^{\,2}}$	***K factor*** n – number of harmonic

Flickers

$$P_{50S} = \left(P_{30} + P_{50} + P_{80}\right)/3$$
$$P_{10S} = \left(P_6 + P_8 + P_{10} + P_{13} + P_{17}\right)/5$$
$$P_{3S} = \left(P_{2,2} + P_3 + P_4\right)/3$$
$$P_{1S} = \left(P_{1,7} + P_1 + P_{1,5}\right)/3$$
$$P_{st} = \sqrt{\begin{matrix}0{,}0314P_{0,1} + 00525P_{1S} + 0{,}0657P_{3S} \\ + 0{,}28P_{10S} + 0{,}08P_{50S}\end{matrix}}$$

Pst – Short-term flicker intensity

Short-term flicker intensity is measured in 10 minute periods.

P_x – flicker levels that are exceeded by x% in a 10-minute period (e.g. $P_{0,1}$ represents a flicker level that is exceeded by 0.1% samples)

$$P_{lt} = \sqrt[3]{\sum_{i=1}^{12} \frac{P_{sti}^3}{12}}$$

Plt – Long-term flicker intensity

Calculated from twelve successive values of short-term flicker intensity in a two-hour period

Energy

$$\text{Price in tariff} = \text{Price} \cdot 10^{\text{Tarif priceexponent}}$$

Total exponent of tariff price and energy price in all tariffs

APPENDIX D: XML DATA FORMAT

Explanation of XML data format

All data, which is prepared to be sent at next time interval is combined into element <*data*>. It comprises of elements <*value*>, which contain all information regarding every single reading.

Attributes of element <*value*> are:

- *logId: Identification code of data package. It is used as a confirmation key and should therefore be unique for each device.*
- *app: application type ??*
- *storeType: data type ("measurement" or "alarm") or quality report??*
- *dataProvider: "xml001" ??*
- *controlUnit: Serial number of the device that sent this data*
- *part: rekorder ??*
- *datetimeUTC: UTC date and time of the beginning of current time interval in which data was sent (yyyy-mm-dd hh:mm:ss).*
- *ident: ID code of particular reading*
- *tFunc: thermal function (1= ON / 0 = OFF)*
- *cond: condition (1 = lower than; 0 = higher then)*
- *condVal: limit value*
- *almNum: alarm serial number.*
- *unit: Measuring Parameter Unit (V, A, VA, W, VAr …)*
- *tInterval: sampling interval in minutes*
- *dst: (daylight savings time) in minutes*
- *tzone: timezone in minutes*

Example of alarms <data> package

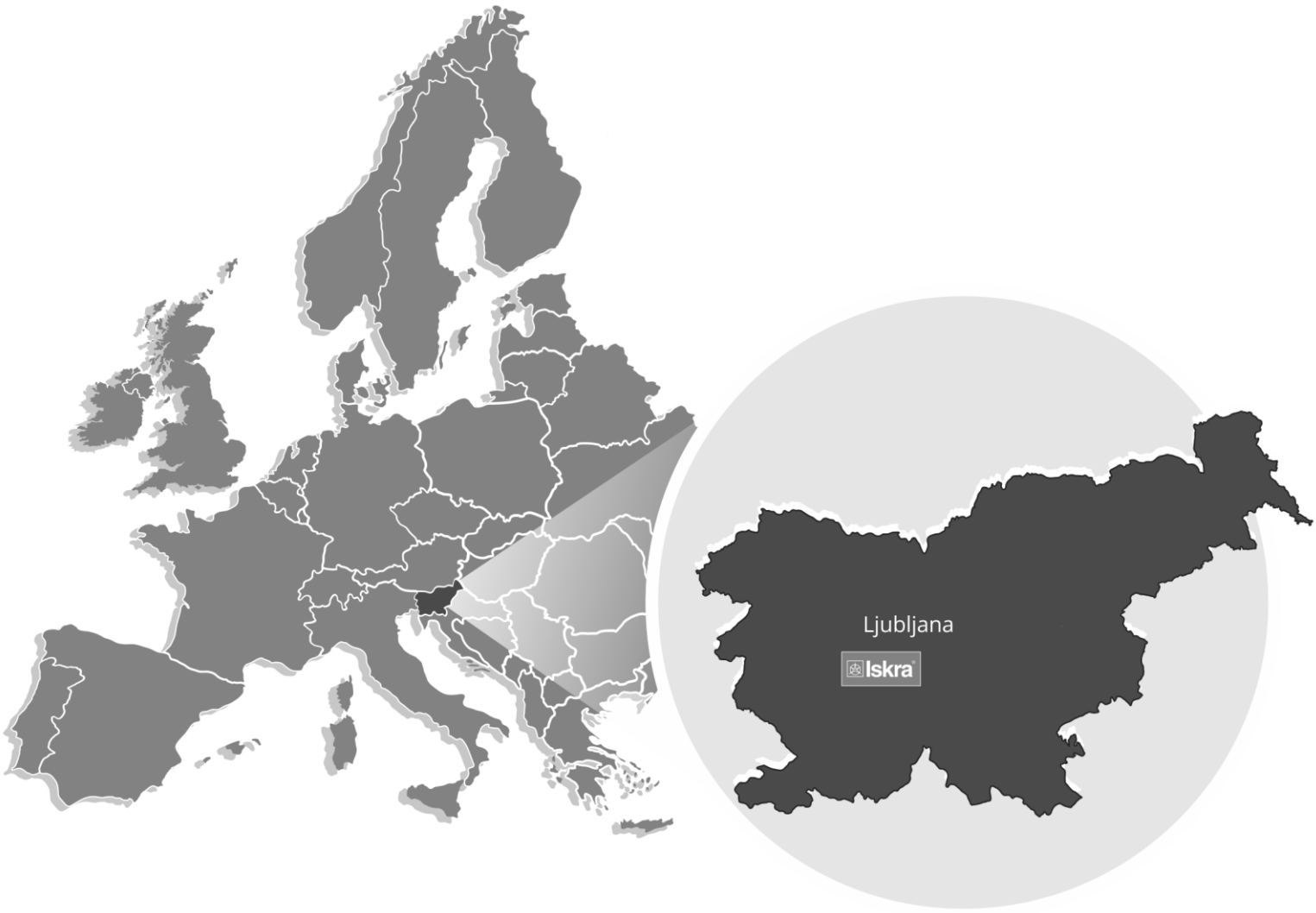
```
<data logId="033350088" app="ML" storeType="alarm" dataProvider="xml001"
controlUnit="MC004475" part="E" datetimeUTC="2009-07-15 21:29:07" dst="60" tzone=" 60">

       <value ident="U1  " unit="V   " tFunc="0" cond="0" condVal="200,00"
       almNum="01">100</value>

       <value ident="U2  " unit="V   " tFunc="0" cond="0" condVal="200,00"
       almNum="02">101</value>

       <value ident="U3  " unit="V   " tFunc="0" cond="0" condVal="200,00"
       almNum="03">99</value>

</data>
```

Example of readings <data> package

```
<data logId="033324218" app="ML" storeType="measurement" dataProvider="xml001"
controlUnit="MC004475" part="B" datetimeUTC="2009-09-16  3:00:00" dst="60" tzone=" 60"
tInterval="015">

       <value ident="U1  " unit="V   ">234,47</value>

       <value ident="U2  " unit="V   ">234,87</value>

       <value ident="U3  " unit="V   ">234,52</value>

       <value ident="I1  " unit="A   ">1,14</value>

       <value ident="I2  " unit="A   ">1,50</value>

       <value ident="I3  " unit="A   ">3,58</value>

       <value ident="P1  " unit="W ">-0,063e+03</value>

       <value ident="P2  " unit="W ">-0,101e+03</value>

       <value ident="P3  " unit="W ">0,281e+03</value>

       <value ident="P   " unit="W ">0,11e+03</value>

       <value ident="Q   " unit="var ">-1,37e+03</value>

       <value ident="E1  " unit="Wh">19620e+01</value>

       <value ident="E2  " unit="varh">6e+01</value>

       <value ident="E3  " unit="Wh">1303391e+01</value>

       <value ident="E4  " unit="varh">2999595e+01</value>

       <value ident="ePF " unit="    ">0,0820</value>

       </data>
```

Example of acknowledgement package:

```
<ack logId="033220002" datetimeUTC ="2008-01-31 23:00:50:000"></ack>
```



Iskra, d.o.o.
BU Ljubljana
Stegne 21
SI-1000 , Ljubljana
Phone: + 386 1 513 10 00

Iskra, d.o.o.
BU Capacitors
Vajdova ulica 71
SI-8333 , Semič
Phone: +386 7 38 49 200

Iskra, d.o.o.
BU MIS
Ljubljanska c. 24a
SI-4000 , Kranj
Phone: +386 4 237 21 12

Iskra, d.o.o.
BU Batteries & Potentiometers
Šentvid pri Stični 108
SI-1296 , Šentvid pri Stični
Phone: +386 1 780 08 00

Iskra, d.o.o.
BU Electroplating
Glinek 5
SI-1291 , Škofljica
Phone: +386 1 366 80 50

Iskra IP, d.o.o.
Vajdova ulica 71
SI-8333 , Semič
Phone: +386 7 384 94 54

Iskra STIK, d.o.o.
Ljubljanska cesta 24a
SI-4000 , Kranj
Phone: +386 4 237 22 33

Iskra Lotrič, d.o.o.
Otoče 5a
SI-4244 , Podnart
Phone: +386 4 535 91 68

Iskra ODM, d.o.o.
Otoče 5a
4244 , Podnart
Phone: +386 1 513 10 00

Iskra Tela L, d.o.o.
Omladinska 66
78250 , Laktaši
Phone: +387 51 535 890

Iskra Sistemi - M dooel
Ul, Dame Gruev br. 16/5 kat
1000 , Skopje
Phone: +389 75 444 498

Iskra Commerce, d.o.o.
Hadži Nikole Živkoviča br. 2
11000 , Beograd
Phone: +381 11 328 10 41

Iskra Hong Kong Ltd.
33 Canton Road, T.S.T.
1705 , China HK City
Phone: +852 273 00 917

Iskra®
Iskra, d.o.o.
Stegne 21
SI-1000 Ljubljana, Slovenia
Phone: +386 (0) 1 513 10 00
www.iskra.eu

EN
Published by Iskra, d.o.o. • Subject to change without notice • Version 1.00 januar 2020 • EN K22.440.500