Iskra®
Iskra Sistemi

User's Manual

GB

Network Analyzer MC760 / UMC760
Network Recorder MC750 / UMC750
Multifunction Meter MC740/ UMC740

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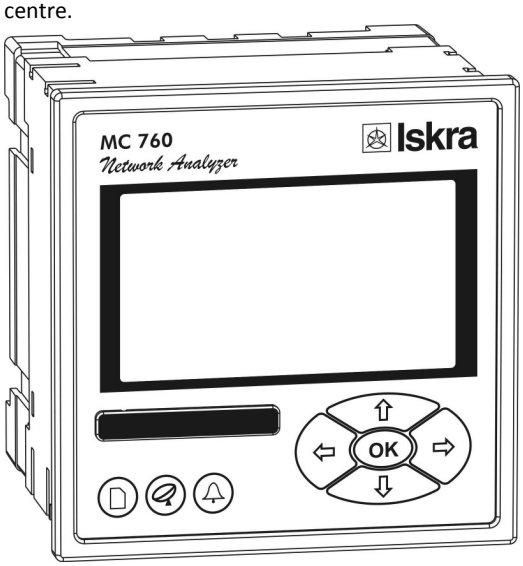
Table of Contents

1 SECURITY ADVICE AND WARNINGS

1.1 Welcome

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 Measuring centre.
This chapter deals with important information and warnings that should be considered for safe handling with a Measuring centre.



1.2 Introduction

This booklet contains instructions for installation and use of Measuring centres MC760, MC750, MC740 and UMC760, UMC750, UMC740. Installation and use of devices also includes work with dangerous currents and voltages, therefore should be installed, operated, serviced and maintained by qualified personnel only. The *ISKRA SISTEMI d.d.* 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.

1.3 Health and safety

The purpose of this chapter is to provide a user with information on safe installation and handling with the product in order to assure its correct use and continuous operation.
We expect that everyone using the product will be 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.

1.4 Safety warnings and instructions for use

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 (recommended maximal external fuse size is 6 A – a type with a red dot or equivalent),
- Integrity of earth terminals (where necessary)

Important: A current transformer secondary should be short circuited before connecting the device.

Real time clock

As a backup power supply for Real time clock supercap or battery is built in. Support time with supercap is up to 2 days (after each power supply down), with battery 6 years from manufacture.

Device switch-off Warning!

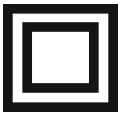
Auxiliary supply circuits for (external) relays can include capacitors between supply and ground. In order to prevent electrical shock hazard, the capacitors should be discharged via external terminals after having completely disconnected auxiliary supply (both poles of any DC supply).

Waste

It is forbidden to deposit electrical and electronic equipment 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 EZ 2002/96/EG about restriction on the use of certain hazardous substances in electrical and electronic equipment or a corresponding Url 118/04.

1.5 Warnings, information and notes regarding designation of the product

Used symbols on devices' housing:

	See product documentation.
	Double insulation in compliance with the **EN 61010–1** standard.
	Functional ground potential. Note: This symbol is also used for marking a terminal for protective ground potential if it is used as a part of connection terminal or auxiliary supply terminals.
	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.

1.6 Contents of consignment

The consignment includes:

- Measuring centres MC760, MC750, MC740 or UMC760, UMC750, UMC740
- User's Manual

2 BASIC DESCRIPTION AND OPERATION OF MEASURING CENTRE

2.1 Introduction

Regarding the type of a Measuring centre different chapters should be considered since the types differ in functionality and design. More detailed description of device functions is given in chapter *Type differences*, pages 11. Al types of measuring centres are available in DIN or ANSI housing. Devices in DIN housing are marked as types MC7xx, devices in ANSI housing are marked as types UMC7xx. Specifications of housing and panel cut out for both housings are specified in chapter *Dimensions* on page 73.

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.

Chapter

Due to differences among devices, some chapters might not be related to your device. Five symbols next to chapter heading are for faster surveying. Type of symbol indicates to which extent the chapter applies for each type of measuring centre. Meaning of each symbol is:

○ - Function not supported
◖ - Function partially supported (see a note)
● - Function completely supported

Each of the five positions, where the symbols are indicates a measuring centre type. Positions follow from left to right: (U)MC740 / (U)MC750 / (U)MC760.

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)
MC - Function accessible via Memory card
- Function accessible via navigation keys on the device front side

Tables

Supported functions and measurements are listed in tables for all types. Symbols in tables indicate support of enabled functions for each type. 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

User information

For all unknown technical words see chapter Glossary on next page.

2.2 Glossary

Term	Explanation
AC	Alternating voltage
AI	Analogue input module
AL	Alarm output module
AO	Analogue output module
BO	Bistable alarm output module
COM2	2nd communication port module
COMEX	Communication port module for Analogue extender EX104
DI	Digital input module
Ethernet	IEEE 802.3 data layer protocol
FFT graphs	Graphical display of presence of harmonics
Flash	Type of a memory module that keeps its content in case of power supply failure
Flicker	Voltage fluctuation causes changes of luminous intensity of lamps, which causes the so-called flicker
Hand-over place	Connection spot of consumer installation in public network
Harmonic voltage - harmonic	Sine voltage with frequency equal to integer multiple of basic frequency
Hysteresis expressed as percentage [%]	Percentage specifies increase or decrease of a measurement from a certain limit after exceeding it.
MD	Maximum demand measurement in time interval
Memory card	Multimedia memory card. Type MMC and SD supported
MiQen	Software for Iskra devices
MODBUS / DNP3	Industrial protocol for data transmission
M_p - Average interval	Defines frequency of refreshing displayed measurements on the basis of a Sample factor
M_v - Sample factor	Defines a number of periods for measuring calculation on the basis of measured frequency
PA total	Angle calculated from total active and apparent power
PA1, PA2, PA3	Angle between fundamental phase voltage and phase current
PF	Power factor
PI	Pulse input module
PO	Pulse output module
RMS	Root Mean Square value
RTC	Real Time Clock
THD	Total harmonic distortion
TI	Tariff input module
WO	Watch dog module - for supervision of operation

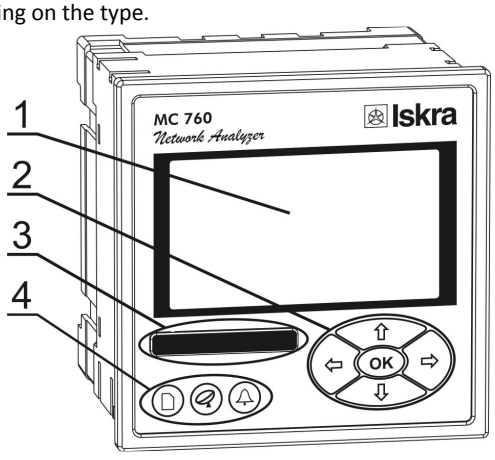
2.3 Description of the product

A measuring centre is used for measuring, analyzing and monitoring three phase electrical power network. Using the latest technologies and numerical methods we have reached high accuracy over a wide measuring range of voltage, current and integrated quantities.

Appearance

The device figure can differ from yours depending on the type.

1 - Graphical LCD
2 - Navigation keyboard
3 - A slot with a cover for memory card
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 for MMC or SD Memory card

The device is provided with a slot for a full size MMC or 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

LED indicators warn 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.

2.4 Purpose and use of different types of measuring centers

Multifunction meter MC740 / UMC740

The device is used 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.

Network recorder MC750 / UMC750

The device 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.

Network analyzer MC760 / UMC760

The device is used for permanent analysis of electricity supply quality in compliance with the EN 50160 standard. A partition in the internal memory is reserved for storing reports for a period of the last seven years. 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:

- Frequency variations
- Voltage variations
- Voltage unbalances
- Voltage dips
- Voltage interruptions
- Rapid voltage changes
- Flickers Pst & Plt
- Temporary over voltages
- THD's
- Harmonics

2.5 Type differences

Different types differ on functionality and equipment as shown in the following table.

User can select different hardware modules that can be implemented in device. By selection of right device and module combination practically every user's demand can be cowered.

Differences in hardware

Feature		**MC740 UMC740**	**MC750 UMC750**	**MC760 UMC760**
Graphical LCD display		●	●	●
Back light of LCD display		●	●	●
LED indicator (card/com./alarm)		●/●/●	●/●/●	●/●/●
Slot for card		●	●	●
Control keys on front panel (5)		●	●	●
Internal flash memory		×	8Mb	8Mb
Real time clock (RTC)		●	●	●
Communication interface RS232 and RS485 or Ethernet/USB		●/○	●/○	●/○
I/O 1	AO/AI/AL/PO/PI/TI/DO/DI/WD	○	○	○
I/O 2	AO/AI/AL//PO/PI/TI/DO/DI/-	○	○	○
I/O 3	AO/AI/AL/COM2/COMEX/PO/PI/TI/DO/DI/WD	○	○	○
I/O 4	AO/AI/AL/COM2/COMEX/PO/PI/TI/DO/DI/-	○	○	○
Automatic current range		●	●	●
AC or universal supply		●/○	●/○	●/○

● - serial ○ - option × - not supported

Software functions

	Functions	**MC740 UMC740**	**MC750 UMC750**	**MC760 UMC760**
Basic	Setup wizard	●	●	●
	Wrong connection warning	●	●	●
	Custom screens (3)	●	●	●
	Demonstration screen cycling	●	●	●
	Programmable refresh time	●	●	●
Additional	MODBUS and DNP3 protocols	●	●	●
	Tariff clock	●	●	●
	MD calculation (TF, FW, SW)	●/●/●	●/●/●	●/●/●
	Programmable alarms (32)	●	●	●
	Alarms recording	×	●	●
	Measurements recording	×	●	●
	Measurements graphs (time/FFT)	●/●	●/●	●/●
	Evaluation of voltage quality in compliance with EN 50160	×	×	●

● - serial × - not supported

Supported measurements

	Basic measurements	**MC740 UMC740**	**MC750 UMC750**	**MC760 UMC760**
Phase	Voltage U_1, U_2, U_3 and $U^{\sim}$	●	●	●
	Current I_1, I_2, I_3, I_n, I_t and I_a	●	●	●
	Active power P_1, P_2, P_3, and P_t	●	●	●
	Reactive power Q_1, Q_2, Q_3, and Q_t	●	●	●
	Apparent power S_1, S_2, S_3, and S_t	●	●	●
	Power factor PF_1, PF_2, PF_3 and $PF^{\sim}$	●	●	●
	Power angle ϕ_1, ϕ_2, ϕ_3 and $\phi^{\sim}$	●	●	●
	THD of phase voltage U_{f1}, U_{f2} and U_{f3}	●	●	●
	THD of power angle I_1, I_2 and I_3	●	●	●
Phase-to-phase	Phase-to-phase voltage U_{12}, U_{23}, U_{31}	●	●	●
	Average phase-to-phase voltage U_{ff}	●	●	●
	Phase-to-phase angle ϕ_{12}, ϕ_{23}, ϕ_{31}	●	●	●
	Voltage unbalance U_u	●	●	●
	THD of phase-to-phase voltage	●	●	●
Energy	Counter 1	●	●	●
	Counter 2	●	●	●
	Counter 3	●	●	●
	Counter 4	●	●	●
	Total	●	●	●
	Active tariff	●	●	●
	Cost by counters	●	●	●
	Total cost	●	●	●

● - serial × - not supported

	Other measurements	**MC740 UMC740**	**MC750 UMC750**	**MC760 UMC760**
Min / Max	Voltage U_1, U_2, U_3	●	●	●
	Phase-to-phase voltage U_{12}, U_{23}, U_{31}	●	●	●
	Phase current I_1, I_2, I_3	●	●	●
	Active power P_1, P_2, P_3, P	●	●	●
	Apparent power S_1, S_2, S_3, S	●	●	●
	Frequency f	●	●	●
	Internal temperature	●	●	●
MD values	Phase current I_1, I_2, I_3	●	●	●
	Active power P (Positive)	●	●	●
	Active power P (Negative)	●	●	●
	Reactive power Q – L	●	●	●
	Reactive power Q – C	●	●	●
	Apparent power S	●	●	●
Measurement	Frequency	●	●	●
	Internal temperature	●	●	●
	Date & Time	●	●	●
	Time graphs (I_1, I_2, I_3,U_1, U_2, U_3, U_{12}, U_{23} and U_{31})	●	●	●
	FFT graphs (I_1, I_2, I_3,U_1, U_2, U_3, U_{12}, U_{23} and U_{31})	●	●	●
	Phase voltage harmonics	●	●	●
	Phase-to-phase voltage harmonics	●	●	●
	Current harmonics	●	●	●
	Flicker (Pst, Plt, Pi, Pim)	×	×	●
	Analysis in compliance with EN 50160	×	×	●

● - serial × - not supported

Harmonics up to 63rd

Flicker Pi and Pim on display only.

3 CONNECTION

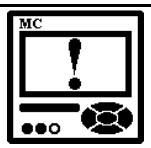
3.1 Introduction

This chapter deals with the instructions for measuring centre connection. Both the use and connection of the device includes handling with dangerous currents and voltages. Connection shall therefore be performed by a qualified person. Iskra Sistemi d.d. 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.

Before use: Check voltages and phase rotation, proper supply voltage and nominal frequency and proper voltage level of used I/O modules.

Check protective fuse rating (the recommended maximum rating of the external protective fuse for this equipment is 6A - Red Spot type or equivalent).

Warning!



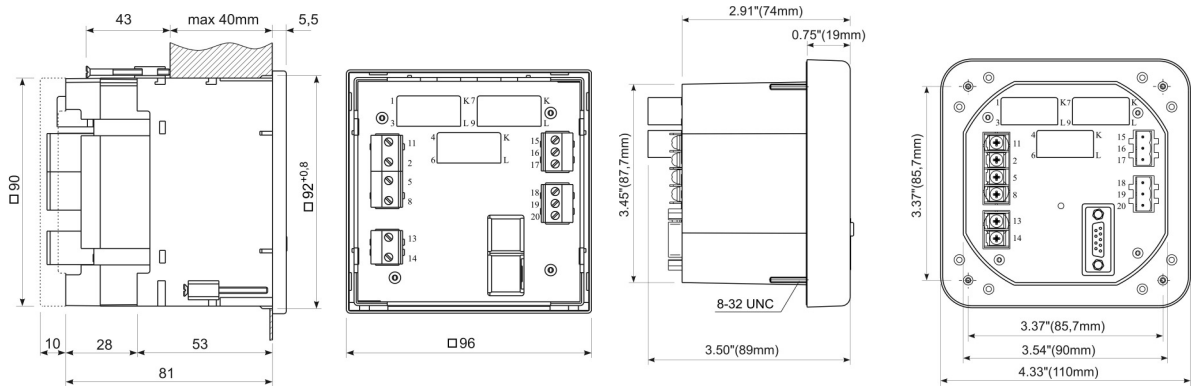
Wrong or incomplete connection of voltage or other terminals can cause non-operation or damage to the device.

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.

3.2 Mounting

1. **DIN housing**: Before inserting device into the panel cut out, remove four screws, insert device and position the screws correctly. Fix device to the panel.
   ANSI housing: Before inserting device into the panel cut out, remove four nuts and flat washers, insert device and position the nuts and flat washers. Fix device to the panel.



Panel cut out:
DIN 92 x 92 mm + 0.8
ANSI 4 inch round

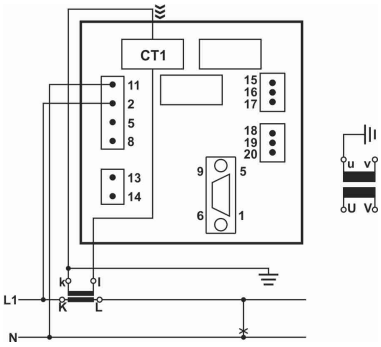
2. Remove protection foil from the screen.

3.3 Electric connection

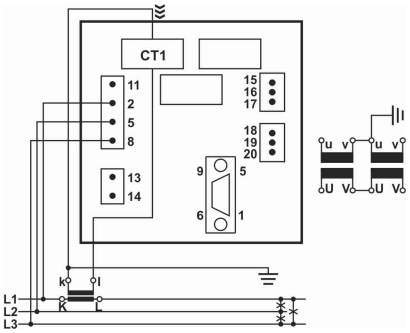
Voltage inputs of measuring centre can be connected directly to low-voltage network or via a voltage measuring transformer to high-voltage network.

Current inputs of measuring centre are led through a hole in current transformers. Connection to network is performed via a corresponding current transformer.

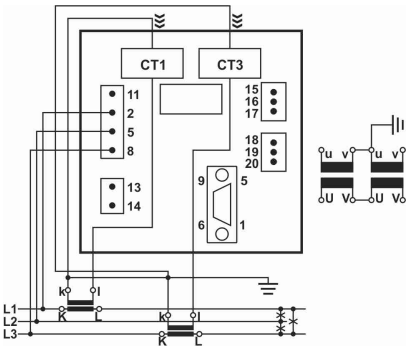
3. Choose corresponding connection from the figures below and connect corresponding voltages and currents. Information on electrical consumption of current and voltage inputs is given in chapter *Inputs* on page 69.



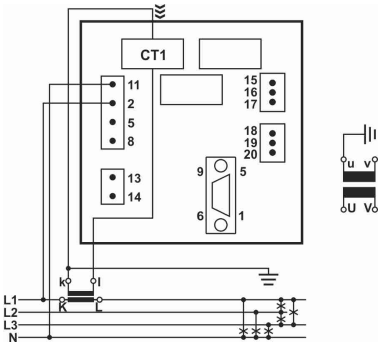
Connection 1b (1W);
Single-phase connection



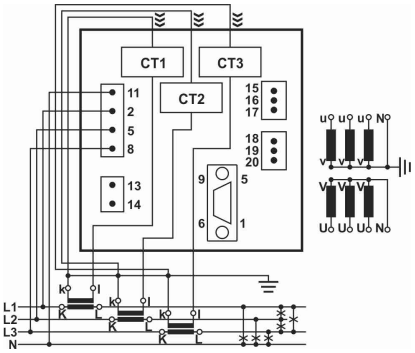
Connection 3b (1W3)
Three-phase - three-wire connection with balanced load



Connection 3u (2W3)
Three-phase - three-wire connection with unbalanced load



Connection 4b (1W4)
Three-phase - four-wire connection with balanced load



Connection 4u (3W4)
Three-phase - four-wire connection with unbalanced load

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 label.

3.4 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.

Note

Frequency of the tariff input voltage signal should not essentially deviate from the frequency of the measuring input signal. At no signal on the measuring inputs the tariff triggering is not reliable.

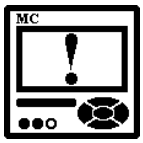
4. Connect module contacts as specified on the label. Examples of labels are given below and describe modules built in the device. Information on electrical properties of modules is given in chapter *Modules* on page 70.

INPUT/OUTPUT Module 1: 2 X Tarif input U=230V AC ±20% T1/2 — 15 C — 16 T3/4 — 17	Tariff input module with two tariff inputs for changeover between up to four tariffs.
INPUT/OUTPUT Module 1: 2 X Alarm output U_{max}=40V I_{max}=1A A1 — 15 C1 — 16 A2 — 17	Alarm (relay) output module with two outputs.
INPUT/OUTPUT Module 1: 1 X Bistab. al. output U_{max}=40V I_{max}=1A No — 15 C1 — 16 Nc — 17	Bistable alarm output module; keeps the state also in case of device power supply failure.
INPUT/OUTPUT Module 1: 2 X Pulse output U_{max}=40V I_{max}=30mA P1 — 15 C1 — 16 P2 — 17	Pulse output (solid state) module with two pulse outputs for energy counters.
INPUT/OUTPUT Module 1: 2 X Analog output 0...20mA R_{max}=150Ω A1+ — 15 C1− — 16 A2+ — 17	Analogue output module with two analogue outputs (0…20mA), proportional to measured quantities.
INPUT/OUTPUT Module 1: 2 X Digital input U=230V AC ±20% D1 — 15 C — 16 D2 — 17	Digital input module with two digital inputs enables reception of impulse signals.
INPUT/OUTPUT Module 2: 1 X Communication RS232 Rx — 18 ⏚ — 19 Tx — 20	2nd communication module, for connection of RS232 communication (COM2).
INPUT/OUTPUT Module 2: 1 X Communication RS485 A — 18 C — 19 B — 20	2nd communication module, for connection of RS485 communication (COM2).
I/O 3/4 COM2 A — 18 Output Ex. NC — 19 B — 20	Communication module, for connection of Analogue extender EX104
I/O 1/2 2 x Pulse input 5...48 V DC 1 + — 15 − — 16 2 − / + — 17	Pulse input module enables reception of pulses from various counters (water, gas, heat, flow …).
I/O 1/2 2 x Analogue input -10...0...10 V 1 + — 15 − — 16 2 − / + — 17	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.
I/O 3/4 Watchdog / Relay output 35 V DC 40 V AC 1000 mA +/~ 1 — 18 −/~ — 19 2 ~ +/~ — 20	Watchdog output and alarm (relay) module enables proper device operation supervision

3.5 Communication connection

A type of connector depends on ordered communication. Primary RS232 and RS485 communication can be equipped with DB9 terminal or screw terminal connector, RJ - 45 terminal is used for Ethernet communication and USB-B type terminal for USB communication. Secondary serial communication, COM2 additional communication module (RS232 or RS485), is equipped with screw terminal connector.

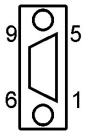
Warning!



When connecting primary serial communication, either equipped with a DB9 communication connector or screw terminal connector, it is necessary to assure that only RS232 or RS485 communication is used. Terminals of a connector that are not necessary for the used communication should remain unconnected, otherwise the communication module and/or device can be damaged or destroyed. For proper connection see a table on page 19.
If device has built in secondary communication as a COM2 module (RS232 or RS485), one primary communication and secondary communication can be used at the same time, since they are independent from each other.

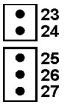
5. Connect a communication line by means of a corresponding terminal. Corresponding data are stated on the device label, regarding the selected communication. Connector terminals are marked on the label on the upper side of the device. More detailed information on communication is given in chapter *Communication* on page 34.

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



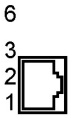
Data for RS232 and RS485 communication with DB9 connector

COMMUNICATION				
TERMINAL				
RS232			RS485	
Rx	⏚	Tx	A	B
25	26	27	23	24



Data for RS232 and RS485 communication with pluggable screw terminal connector

COMMUNICATION			
Ethernet			
TD+	TD-	RD+	RD-
1	2	3	6
Mac Nº:00-20-4A-8A-94-13			



Data for Ethernet communication with RJ - 45 connector

USB-B type connector

RS232

RS232 communication is intended for direct connection of the Measuring centre to the personal computer. For proper operation it is necessary to assure the corresponding connection of individual terminals (see table on next page).

Serial RS232 as secondary communication, COM2 additional communication module

Operates as an independent communication. Separate communication parameters can be set for this communication module.

RS485

RS485 communication is intended for connection of devices to network where several devices with RS485 communication are connected to a common communication interface. We suggest using one of the Iskra Sistemi d.d. communication interfaces! For proper operation it is necessary to assure the corresponding connection of individual terminals (see table on next page).

Serial RS485 as secondary communication, COM2 additional communication module

Operates as an independent communication. Separate communication parameters can be set for this communication module.

Communication for Analogue extender EX104, COM2 additional communication module

Operates as an predefined RS485 communication that can be used for data transfer between measuring centre and analogue extenders EX104.

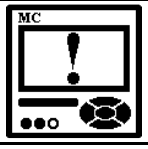
Ethernet

Ethernet communication is used for connection of device to the Ethernet network for remote inspection. Each device has its own MAC code that at some cases needs to be provided and is printed on the label on the device. For operation correct connection of individual terminals of the RJ−45 connector (see a table on the next page).

USB

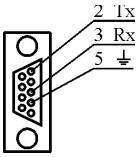
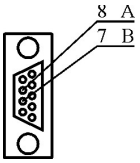
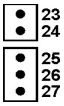
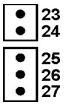
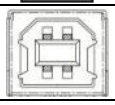
USB communication serves as a fast peer-to-terminal data link. The device is detected by host as a USB 2.0 compatible device. The USB connection is provided through a USB standard Type B connector.

Note

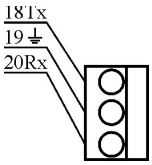
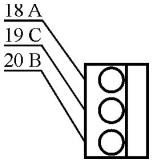


When (U)MC7xx is connected to a PC through USB communication for the first time, a user is prompted to install a driver. The driver is integrated in MiQen software or can be downloaded from the Iskra Sistemi d.d. web page www.iskrasistemi.si. With this driver installed, USB is redirected to a serial port, which should be selected when using MiQen software.

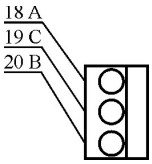
Survey of communication connection

	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		23	Not connected	-
			24	Not connected	-
			25	To	Data reception (Rx)
			26	-	Grounding (⏚)
			27	From	Data transmission (Tx)
RS485	Screw terminal		23	To/From	A
			24	To/From	B
			25	Not connected	-
			26	Not connected	-
			27	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

	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 communication connection for Analogue extender EX104

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

3.6 Connection of power supply

Measuring centre has adaptable power supply. It enables connection to certain AC power supply or universal (AC/DC) power supply. Power supply voltage depends on ordered voltage. Information on electric consumption is given in chapter *Technical data* on page 67.

6. Regarding power supply voltage specification on the label choose and connect the power supply voltage:

INPUTS		
Curent:5 A		
Voltage:240 V		
Freqency:50 Hz		
Connection:4u		
SUPPLY:		
20...300 V DC<12VA 48...276 V; 40...70 Hz		
Terminal	13	⎓
	14	⎓

Connection of universal power supply to terminals 13 and 14.

INPUTS		
Curent:5 A		
Voltage:500 V		
Freqency:50 Hz		
Connection:4u		
SUPPLY:		
230 V AC 45...65 Hz		
Terminal	13	~
	14	~

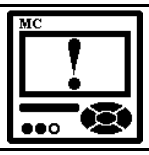
Connection of AC power supply to terminals 13 and 14.

4 FIRST STEPS

4.1 Introduction

Instruction for work with measuring centre is given in the following chapters. Procedure can differ regarding the types and their configuration (functions support). More than one procedure can be used for some types.

Warning!



Measuring centre start-up begins after electrical connection. After proper connection it is assured that the user security is not threatened.
After correct switch-on and respected safety measures the work with device does not represent any danger for a user.

Basic concepts

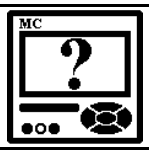
Navigation keys and LCD enable application and basic device settings. During the operation some icons can be displayed in upper part of LCD. The significance of icons (from right to left) is explained in the table below.

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.
	A built-in battery (for RTC) shall be replaced. A battery test is carried out at power supply connection (for devices with built in battery)
	The device supply is too low.
	Clock not set (for devices with built in super cap)

Example:

OK Main menu ⇒ Info OK ⇑

User information



Meaning of icons is displayed on LCD in the Information menu.

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 use the Installation wizard. When entering the Installation menu, 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.

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.

Main menu ⇒ Installation ⇒
The menus follow one after another:

Start menu

Start screen is displayed on LCD.

Language

Set device language.

Date

Set device date.

Time

Set device time.

Connection mode

Choose connection and define load connection.

Primary voltage

Set primary voltage if a voltage transformer is used.

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 a used current transformer (if current transformer is used, otherwise primary and secondary current should remain the same).

Secondary current

Set secondary current.

Common energy exponent (Common Energy Counter Resolution - MiQen 2.x and above)

Define common energy exponent as recommended in table below, where counter divider is at default value 10. Values of primary voltage and current determine proper Common energy exponent. For detailed information see chapter *Energy* on page 38.

In MiQen setting software version 2.x and above, this setting parameter is renamed in Common Energy Counter Resolution. Also setting values are changed to give user better perspective of represented value.

In table below, new setting values are quoted in parenthesis.

Current / Voltage	1 A	5 A	50 A	100 A	1000 A
110 V	-1 (100 mWh)	0 (1 Wh)	1 (10 Wh)	1 (10 Wh)	2 (100 Wh)
230 V	0 (1 Wh)	0 (1 Wh)	1 (10 Wh)	2 (100 Wh)	3 (1 kWh)
1000 V	0 (1 Wh)	1 (10 Wh)	2 (100 Wh)	3 (1 kWh)	4 (10 kWh)
30 kV	2 (100 Wh)	2 (100 Wh)	3 (1 kWh)	4 (10 kWh)	4* (10 kWh)

* - Counter divider (MiQen 2.x and above - Individual Counter Resolution) should be at least 100

Device address

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

Bits per second (if RS232 / RS485 communication is built in)

Set communication rate. Default rate is 115200 b/s.

Parity (if RS232 / RS485 communication is built in)

Set communication parity. Default value is None.

Stop bit (if RS232 / RS485 communication is built in)

Set communication stop bits. Default value is 2.

IP Address (if Ethernet communication is built in)

Set correct IP address of the device. Default setting is 0.0.0.0 and represents DHCP addressing.

TCP Port (if Ethernet communication is built in)

Set TCP communication Port. Default value is 10001.

Subnet mask (if Ethernet communication is built in)

Set network subnet mask. Default value is 255.255.255.0

4.2 Display of device info

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

7. Welcome screen
8. Information
9. Memory
10. Time, date, internal temperature and tariff status
11. Meaning of icons

◖ - Information display is subordinated to supported functions of an individual MC type.

Welcome screen

When entering the information menu, a welcome screen is displayed on LCD showing type designation and name of measuring centre.

Main menu ⇒ Info OK

Information PC

Data on a device are collected in the Information menu. They include a serial number, a software version, a hardware version, date of manufacture and a number of operational hours in days, hours and minutes.

Main menu ⇒ Info OK ⇓

Memory PC

A memory state is displayed in two ways. In a basic display the recording time or a number of records until a scale division is full is displayed, since the last official reading. A graphical display of occupation of individual scale division is used as a help. A more detailed display shows a number of records of a maximal number for each scale division.

◖ - (U)MC740 has no info about the memory

Main menu ⇒ Info OK ⇓ ⇓

User information

More data can be stored in the internal memory than displayed, since the display depends upon the official transfer. For transfer of all available data to memory card or via communication “All data” should be selected when saving data.

Time, date and temperature PC

Data on current date, time, internal temperature and tariff status in submenu are displayed on LCD.

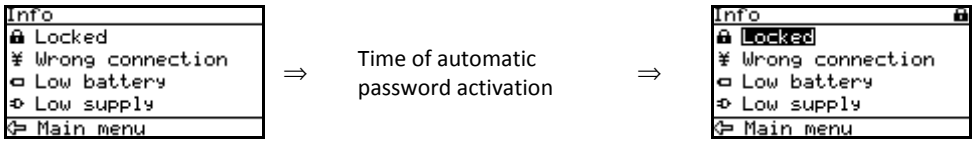
Main menu ⇒ Info OK ⇓ ⇓ ⇓ (⇒)

Meaning of icons

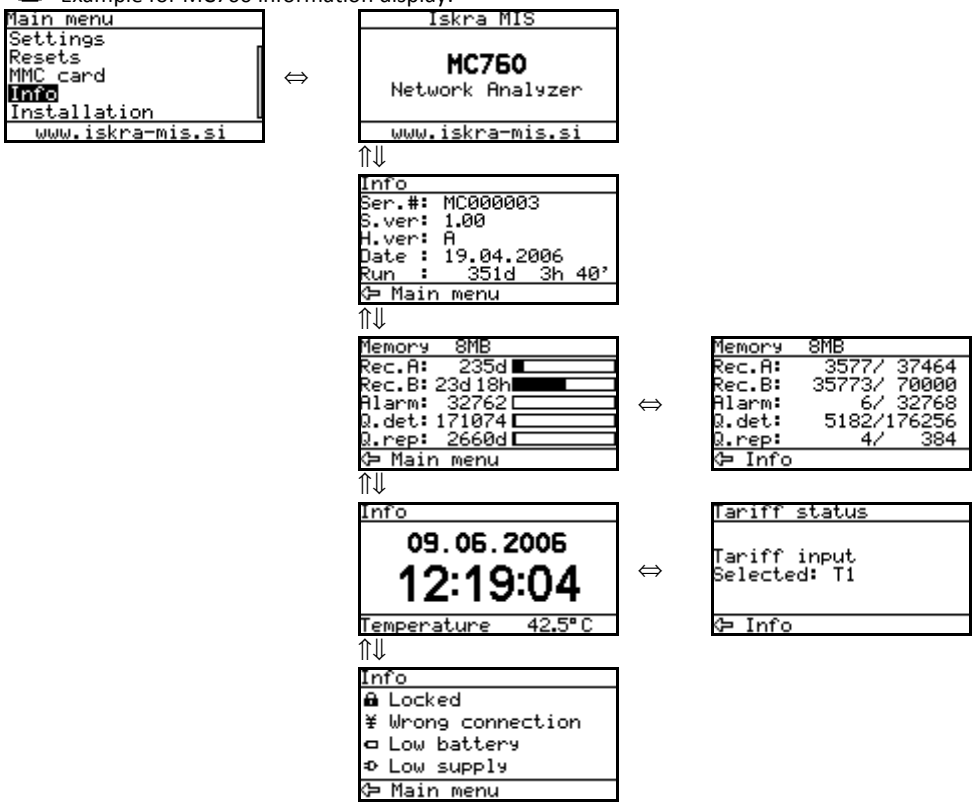
All possible icons with their meaning are displayed.

Main menu ⇒ Info OK ⇓⇓⇓⇓

Example of display of icons with their meaning without active icons and at locked MC:



Example for MC760 information display:



5 SETTINGS

5.1 Introduction

Settings of measuring centre can be done via the front keyboard or with a PC and MiQen software. Setting is easier using MiQen. Basic and simpler settings are accessible via navigation keyboard. For new setting to be activated settings file should be transferred to the device via communication (MiQen) or memory card. Setting done via navigation keyboard comes in to function after confirmation (OK).

5.2 MiQen software

MiQen software is a tool for complete monitoring of the measuring devices. RS485/RS232, USB/TCP/IP communication is used for connection with a PC. A user-friendly interface consists of five segments: devices management, device settings, real-time measurements, data analysis and software upgrading.

Devices management

In MiQen it is very easy to manage devices. If dealing with the same device, it can be easily selected from a favourite's line. Use the network explorer to set and explore the devices in serial network or browser for Ethernet devices connected in local Ethernet network. Also setting of communication parameters to establish communication with a single device can easily be done.

Device settings

Multi Register Edit technology assures a simple modification of settings that are organized in a tree structure. Besides transferring settings into the device, storing and reading from the setting files and memory cards are also available.

Real-time measurements

All supported measurements can be seen in real time in a table or graphical form. For further processing of the results of measurements, it is possible to set a recorder on active device that will record and save selected measurements to MS Excel .csv file format.

Data analysis

Analysis can be performed for the devices with a built-in memory. 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.

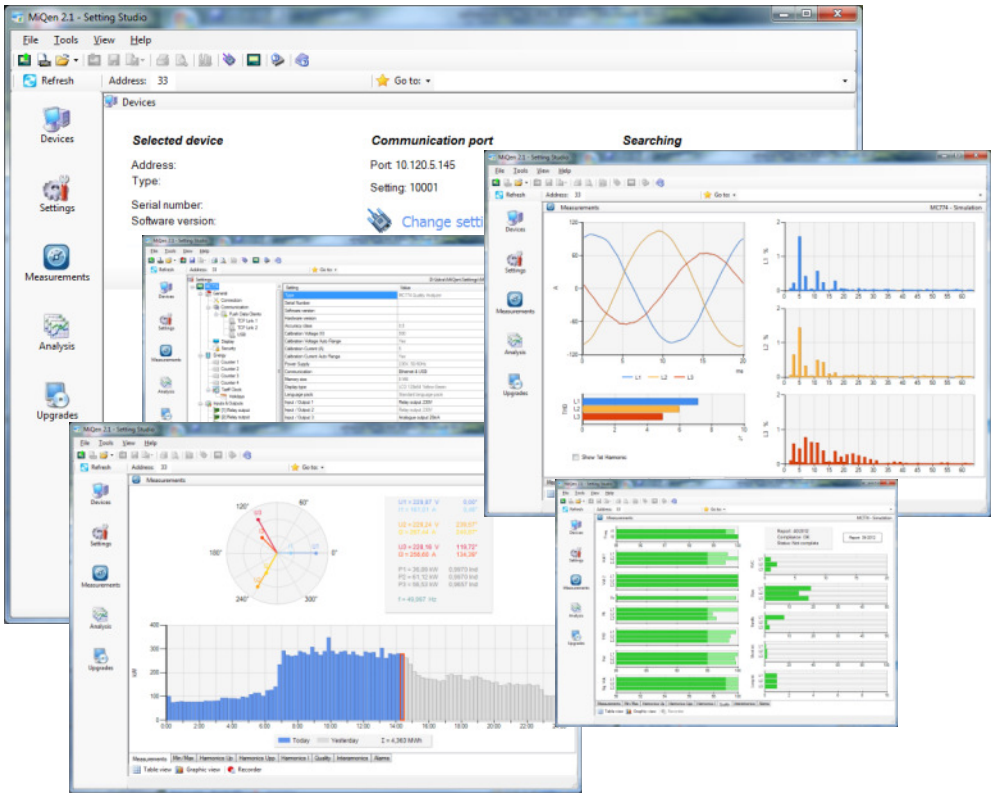
Software upgrading

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

Note

More information about MiQen software can be found in MiQen Help system!

PC MiQen 2.x user interface



Note

MC

You can download freeware MiQen from: www.iskrasistemi.si

5.3 Setting procedure

Before setting the device by means of MiQen, the current settings should be read first. Reading is available either via communication (RS232/RS485, USB/Ethernet) or from a file stored on a PC local disk or a Memory. A setting structure that 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.

Note

MC

Some settings might be unavailable due to unsupported measurements and/or functions that depend on the device type. For a survey of supported measurements and functions see chapter *Type differences*, pages 11.

5.4 General settings

General settings are essential for measuring centre. They are divided into four additional sublevels (Connection, Communication, Display and Security).

Description and Location PC MC

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 MC

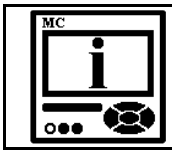
The averaging interval defines a refresh rate of measurements on LCD, communication and analogue outputs. It also defines response time for alarms set to Normal response and average interval used when Minimum or Maximum values are selected to be recorded.

Language PC MC

Set language on LCD. 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 37.

OK Main menu ⇒ Settings ⇒ General ⇒ Language

Note



OK If a wrong language is set, a menu of languages can be displayed by simultaneous pressing up and down keys.

Currency PC MC

Choose currency for evaluating energy cost (see chapter *Energy* on page 38). 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 MC OK

Choose a unit for temperature display.

OK Main menu ⇒ Settings ⇒ General ⇒ Temperature unit

Date format PC MC OK

Set a date format.

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.

OK Main menu ⇒ Settings ⇒ Date & Time ⇒ Date / Time

Time Synchronisation source PC MC

Enable or disable NTP synchronisation. To set NTP server check chapter *Ethernet communication* on page 34.
Functionality supported only for devices with built in Ethernet module with Firmware version 5.6 and above!

Time zone PC MC

Set time cone in which device is mounted.

Auto Summer/Winter time PC OK

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

OK Main menu ⇒ Settings ⇒ Date & Time ⇒ Automatic S/W time

Maximum demand calculation (MD mode) PC MC OK

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

- Thermal function
- Fixed window
- Sliding windows (up to 15)

OK Main menu ⇒ Settings ⇒ General ⇒ MD mode / MD time constant

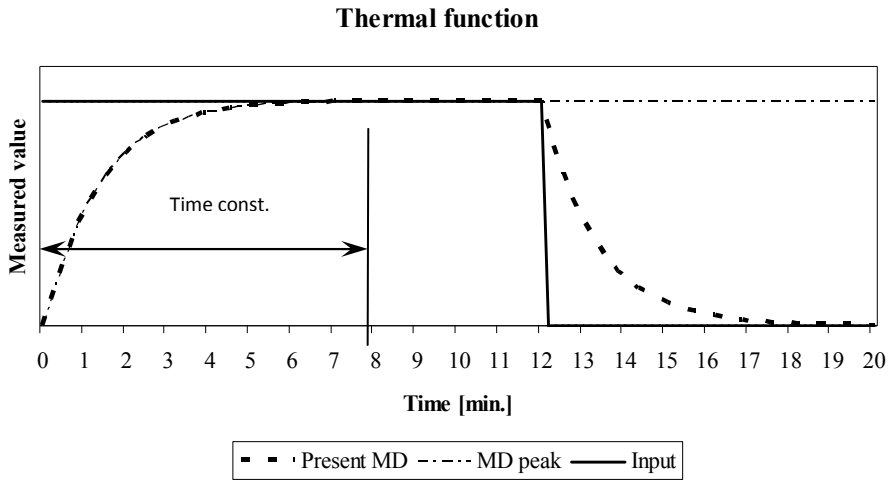
Thermal function

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 (t. c.) can be set from 1 to 255 minutes and is 6 − time thermal time constant (t. c. = 6 * thermal time constant).

Example:

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



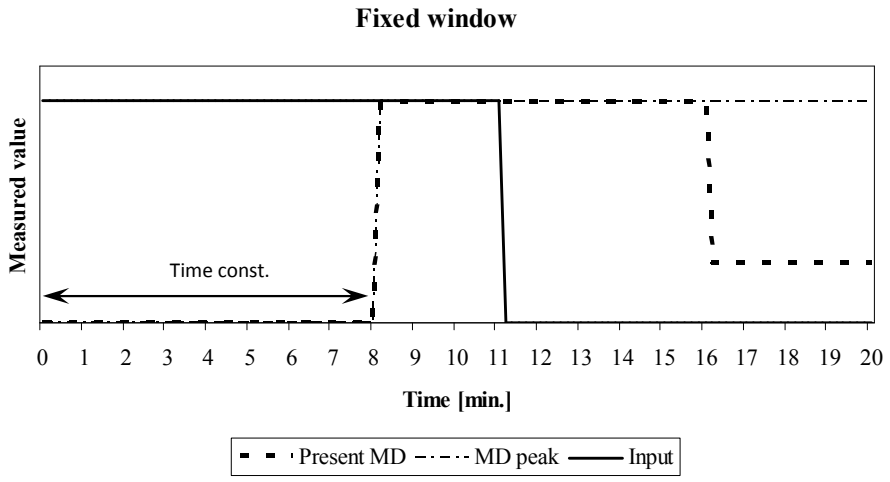
Fixed window

A fixed window is a mode that calculates average value over a fixed time period. This (t. c. – time constant) can be set from 1 to 255 min.

»TIME IN A PERIOD« will actively show the remaining time until the end of the period, until a 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 IN A PERIOD« then shows 0 of X min.

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 IN A 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 IN A PERIOD« is set to 0.

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



Sliding windows

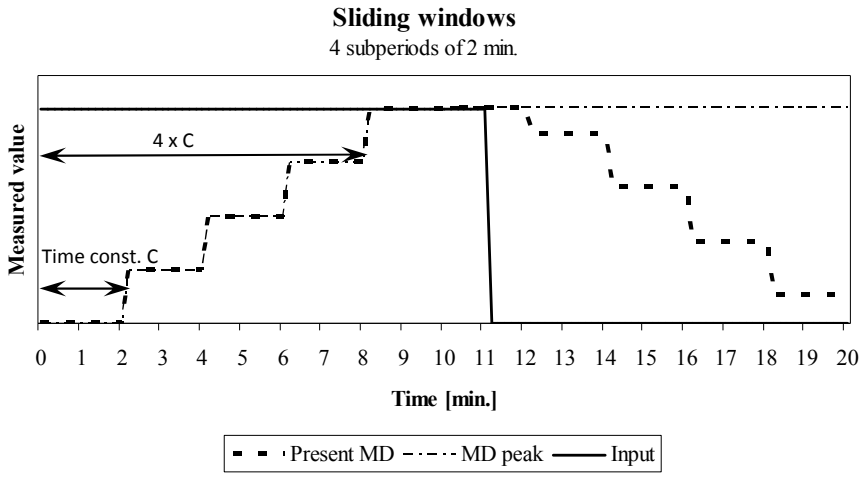
A mode of sliding windows enables multiple calculation of average in a period and thus more frequent regeneration of measuring results. Average value over a complete period is displayed. A current MD is updated every sub period for average of previous sub periods.

A number of sub periods can be set from 2 to 15.
A time period (t. c.) 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 IN A 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 IN A PERIOD« is set to 0.

Example:
Mode: Sliding windows
Time constant: 2 min.
No. of sub periods: 4
Current 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 current MD and a maximal MD are reset at 0 min. "TIME IN A PERIOD" is data for a sub period so that the values for a current MD and a maximal MD are regenerated 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.



Resetting Min/Max PC MC

A mode of stored values deletion of Min/Max values is set. It can be set to a manual (see chapter *Reset* on page 47) or automatic mode (daily, weekly, monthly or yearly reset). Resets are performed at the beginning of a certain term at midnight. Daily - every day, weekly on Monday at 00:00, monthly - the first day in a month at 00:00, and yearly - the first day in a year 1.1. at 00:00.

Main menu ⇒ Settings ⇒ General ⇒ Min/Max reset mode

Starting current for PF and PA (mA) PC MC

At all measuring inputs noise is usually present. It is constant and its influence on the accuracy is increased by decreasing measuring signals. It is present also when measuring signals are not connected and it occurs at all further calculations as very sporadic measurements. By setting a common starting current, a limit of input signal is defined where measurements and all other calculations are still performed.

Starting current for all powers (mA) PC MC

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

Calculation of harmonics PC MC

Selection of reference for calculation is important for calculation of absolute values of harmonics. It is possible to select between a percentage of harmonic of RMS signal value (current, voltage) or relative to the fundamental (first harmonic). At percentage of RMS, a signal rate is calculated for all harmonics. At percentage of 1st harmonic, all other harmonics are calculated relatively to 1st harmonic.

Reactive power and energy calculation PC

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) that is not active is reactive.

$Q^2 = S^2 - P^2$

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

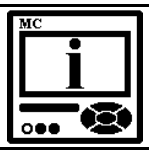
Delayed current method:
With this method, reactive power (energy) is calculated by multiplication of voltage samples and delayed current samples (see chapter *Equations* on page 88):

$Q = U \times I|_{+90°}$

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

5.5 Connection

Note



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

Connection PC MC OK

When connection is selected, load connection and the supported measurements are defined (see chapter *Survey of supported measurements regarding Connection mode* on page 64).

OK Main menu ⇒ Settings ⇒ Connection ⇒ Connection mode

Setting of current and voltage ratios PC MC 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 (up / down). To set decimal point and prefix (up / down) position the cursor (left /right) to last (empty) place or the decimal point.

Settings range	VT primary	VT secondary	CT primary	CT secondary
Maximal value	1638,3 kV	13383 V	1638,3 kA	13383 A
Minimal value	0,1 V	1 mV	0,1 A	1 mA

OK Main menu ⇒ Settings ⇒ Connection ⇒ VT primary / VT secondary / CT primary / CT secondary

Used voltage and current range PC MC

Setting of the range is connected with all settings of alarms, analogue outputs and a display (calculation) of energy and measurements recording, where 100% represents 500 V. In case of subsequent change of the range, alarms settings shall be correspondingly changed, as well.

Nominal frequency PC MC

Nominal frequency range can be selected from a set of predefined values (16Hz currently not supported). A valid frequency measurement is within the range of nominal frequency ±30 Hz. This setting is used for alarms and recorders only.

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. This warning is seen only on remote display.

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.

5.6 Serial communication

Serial Communication (COM1) PC MC

Communication parameters (only for COM1): Parameters which are important for the operation in RS485 network or connections with PC via RS232 communication. Factory settings of communication are #33\115200,n,8,2 (address 1 to 247\rate 2400 to 115200 b/s, parity, data bits, stop bit).

Main menu ⇒ Settings ⇒ Communication ⇒

Push Data Format (XML-smart, XML-logic) *: With this setting a required data format for sending data to receiver using PUSH communication mode is set. For more information about PUSH communication mode and XML data format see chapter 7 on page 64 and appendix D on page91.

Push Response Time *: With this setting a maximum waiting time for acknowledgement of sent data in PUSH communication mode is set.

Time synchronization *: Which type of communication is used for synchronization of time for PUSH communication mode purpose.

* Setting comes in to consideration only if device is connected to MiSmart system via serial communication.

2nd Communication module (COM2) PC

Module is preset for RS485 or RS232 communication on I/O 3/4 terminals.

Module settings define parameters which are important for the operation in RS485 network or connections with PC via RS232 communication. Factory settings of communication are #33/115200,n,8,2 (address 1 to 247/rate 2400 to 115200 b/s, parity, data bits, stop bit). By default, addresses of COM1 and COM2 are the same (#33). In this case, change of COM1 address sets COM2 to the same address. When COM1 and COM2 addresses are not equal, change of COM1 address has no influence on COM2 address. Change of COM2 address has no influence on COM1 address. (U)MC7xx can be connected to the same network using COM1 or COM2 (if available).

5.7 USB communication

USB Communication PC

Has no setting. Device is automatically recognized in Windows environment if device driver has been correctly installed. For more detailed information how to handle device with USB communication use Help section in MiQen software.

When connected to USB port all other connections to allowed TCP ports are blocked or limited, until it is released. Priority, when connected to this port, has PUSH functionality of the device.

5.8 Ethernet communication

Ethernet communication PC

Device Address: Device 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: 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: Nickname that is assigned to a device connected to a network and is used to identify the device in various forms of electronic communication. Hostnames may be simple names consisting of a single word or phrase, or they may be structured.

Local Port: The physical connector on a device enabling the connection to be made. Use a non reserved port number from 1025 to 65535.

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

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.

Factory settings of Ethernet communication are:

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

Subnet Mask: is used to determine what subnet an IP address belongs to.

Gateway Address: Gateway (node) IP that serves as an access point to other network.

NTP Server: If Ethernet NTP synchronisation is selected in General/Time Synchronisation source setting, in this field IP of NTP server needs to be entered.

Note

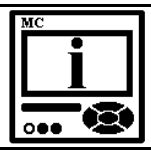
If device is connected in MiSmart system and has synchronisation set to MiSmart server, NTP synchronisation should be disabled.

Main menu ⇒ Settings ⇒ Communication ⇒ (not all settings are supported via keyboard)

PUSH communication settings
When PUSH communication mode is used, data can be send (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 chapter 12 on page 92 and *Appendix D* on page 91.

Time synchronization: One of defined servers TCP Link 1 or TCP Link 2 need to be selected in Push Data Clients sections to enable synchronization of the device with the server. Operation of synchronization is described in section 7.2 PUSH communication mode on page 65.

Note



If device is synchronised to any of TCP Links, NTP synchronisation should be disabled.

TCP Link 1 and TCP Link 2: Here information such as IP address, IP Port, Data Format and response time are defined.

IP address: IP address of the server collecting data from devices.
IP port: IP port of the server collecting data from devices.

Data Format: For use of the device in MiSmart system, *XML - Smart* data format needs to be selected.
Response Time (sec): Here response time from the server needs to be set. 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.

5.9 Display

Display settings PC MC

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 MC

It defines time in seconds for each displayed screen of measurements on LCD.

OK Main menu ⇒ Settings ⇒ LCD ⇒ Demo cycling period

Settings of customized screens PC MC

For easier and faster survey of measurements that are important for the user, three 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. For survey of all designations see chapter *Survey of supported measurements regarding Connection* on page 13.

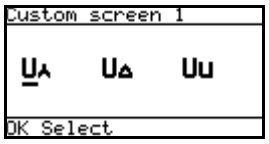
Example:
Desired result:

Customized screen 1	Customized screen 2	Customized screen 3	Combined customized screen 4
Average ph. voltage	Total current	Power angle (U_1-I_1)	Average ph. voltage
Av. ph. to ph. volts	Neutral current	Frequency	Av. ph. to ph. volts
Voltage unbalance	Average current	THD of PA I_1	Voltage unbalance
-	-	-	Total current
-	-	-	Neutral current

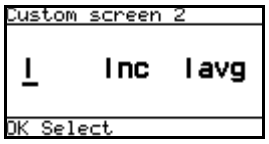
Setting can be made only for 3 customized screens. 4th customized screen is showing 5 values, three from Customized screen 1 and first two from Customized screen 2.
Setting:

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

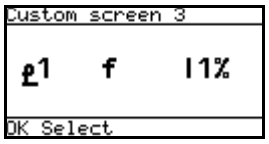
Customized screen 1



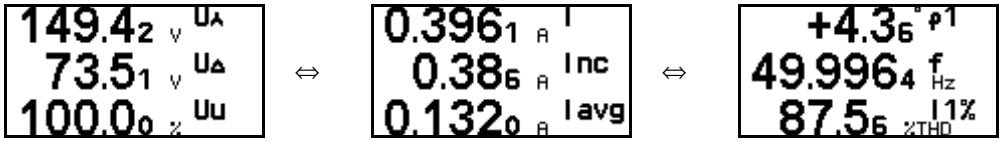
Customized screen 2



Customized screen 3



OK Main menu ⇒ Measurements ⇒ Present values ⇒ Custom OK



5.10 Security

Settings parameters are divided into four groups regarding security level:

1. *At the lowest level (PL0), where a password is not required, parameters of LCD can be set: language, contrast and LCD back light.*
2. *At the first level (PL1), settings of a real time clock (U)MC740 / (U)MC750 / (U)MC760 can be changed, and energy meters (counters) and MD can be reset.*
3. *At the second level (PL2), the access to all data that are protected with the first level (PL1) and setting of all other parameters in the »SETTINGS« menu are available.*
4. *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 SISTEMI d.d., and is entered instead of the password PL1 or/and PL2. Do not forget to state the devices' serial number when contacting the personnel in ISKRA SISTEMI d.d.*

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 OK ⇓

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 the others are covered with *.
A password of the first (L1) and the second (L2) 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.

OK Main menu ⇒ Settings ⇒ Security ⇒ Password level 1 / Password level 2

Password disabling PC OK

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

OK Main menu ⇒ Settings ⇒ Security ⇒ Password level 1 / Password level 2 ⇒ "AAAA" OK

Note

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

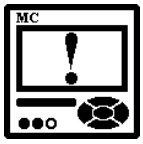
Password and language

Language change is possible without password input. When language is changed from or to Russian or Hebrew, 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	

5.11 Energy - counters

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 MC

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 exponent PC MC **(Common Energy Counter Resolution – MiQen 2.x and above)**

Common energy exponent defines minimal energy that can be displayed on the energy counter. On the basis of this and a counter divider, a basic calculation prefix for energy is defined (−3 is 10^{-3}Wh = mWh, 4 is 10^{4}Wh = 10 kWh). A common energy exponent also influences in setting a number of impulses for energy of pulse output or alarm output functioning as an energy meter.
Define common energy exponent as recommended in table below, where counter divider is at default value 10. Values of primary voltage and current determine proper Common energy exponent.

In MiQen setting software version 2.x and above, this setting parameter is renamed in Common Energy Counter Resolution. Also setting values are changed to give user better perspective of represented value.

In table below, new setting values are quoted in parenthesis.

Current / Voltage	1 A	5 A	50 A	100 A	1000 A
110 V	-1 (100 mWh)	0 (1 Wh)	1 (10 Wh)	1 (10 Wh)	2 (100 Wh)
230 V	0 (1 Wh)	0 (1 Wh)	1 (10 Wh)	2 (100 Wh)	3 (1 kWh)
1000 V	0 (1 Wh)	1 (10 Wh)	2 (100 Wh)	3 (1 kWh)	4 (10 kWh)
30 kV	2 (100 Wh)	2 (100 Wh)	3 (1 kWh)	4 (10 kWh)	4* (10 kWh)

* - Counter divider (MiQen 2.x and above - Individual Counter Resolution) should be at least 100

Counter divider PC MC **(Individual counter Resolution – MiQen 2.x and above)**

The counter divider additionally defines precision of a certain counter, according to settings of common energy exponent.

Common exponent of energy cost PC MC

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

Common exponent of tariff price and energy price in tariffs PC MC

Exponent and price represent energy price (active, reactive, common) in a tariff. The 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):

Common energy exponent	0	2	2
Counter divider	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	12.3 kWh	0.01 MWh

Tariff clock PC MC

Basic characteristics of a program tariff clock:

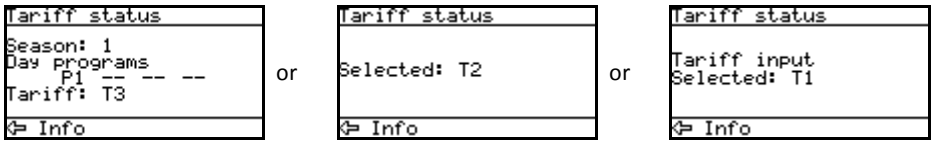
- 4 tariffs (T1 to T4)
- Up to 4 time spots in each Day program for tariff switching
- Whichever combination of valid days in a week or holidays for each program
- Combining of day groups (use of over 4 time spots for certain days in a week)
- Separate settings for 4 seasons a year
- Up to 20 settable 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 OK ⇓⇓⇓⇒



Day program sets up to 4 time spots (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.

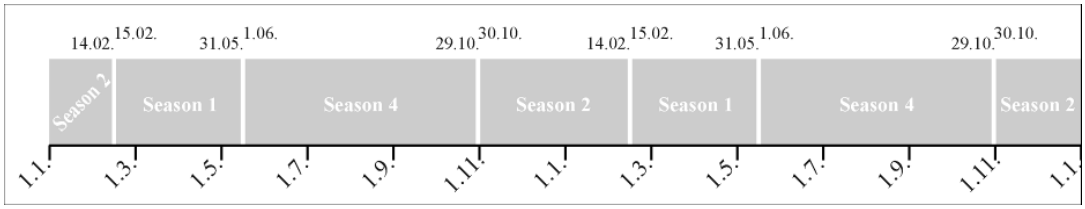
The order of seasons and starting dates is not important, except when two dates are equal. In that case the season with a higher successive number has priority, while the season with a lower number will never be active.

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 settings:

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 spots 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 date of holidays, tariff is switched to 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 spots in one day (combine of day programs). **If the time spot 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 spot is active from the time of the time spot to the first next time of the remaining time spots.

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

If current time is before the first time of any time spot of active spots, the time spot with the last time is chosen.

If no time spot 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 MC

For each of four (4) counters different measured quantity 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.

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).

5.12 Inputs and outputs

MC7xx MC774 can be equipped with different I/O or communication modules. For its technical specifications see chapter *Technical data* on page 67.

For I/O 1 and 2 following options are available.

Inputs: There are seven main different input modules.

- DC current analogue input
- DC voltage analogue input
- Resistance (temperature) analogue input
- Pulse input
- Digital input
- Tariff input

Tariff and digital input can be ordered as three different hardware types with different voltage level, but the same functionality.

Outputs: There are five main different output modules.

- Analogue output
- Pulse output (solid state)
- Relay output (relay)
- Bistable alarm output (bistable relay)
- Watchdog (status) output

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

An alarm output and a pulse output can also be selected via a keyboard. 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.

Communication modules: There are two different communication modules.

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

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 (see supported types in *Memory* section on page 45). They can also be included in alarm function (see chapter *Alarms* on page 43).

DC current range:

Range setting allows bipolar ±20 mA or ±2 mA max. input value

DC voltage range:

Range setting allows bipolar ±10 V or ±1 V max. input value

Resistance / temperature range:

Range setting allows 2000Ω 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 setting. 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 38.
It can also be used as digital input and included in alarm function to monitor signals from different sensors (see chapter *Alarms* on page 43).

Pulse input module has only one hardware configuration (5…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 43).

When used in DC mode it can also be used as Pulse counter (see functionality of Pulse input module above).

Tariff input module PC MC

Tariff input

Has no setting. It operates by setting active tariff at a tariff input (see chapter *Tariff clock* on page 39). 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 MC

Analogue output module has defined output range 20mA DC. Quantity and shape (up to 6 break points) of an analogue output can be assigned via MiQen software. For more information see Help section in MiQen software.

Pulse output module PC MC

It is a solid state, optocoupler open collector switch. Its main intention is to be used as a 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 (Pulse and Relay) modules below.

Alarm output module (Relay output module) PC MC

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

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 (Pulse and Relay) modules below.

Watchdog and Relay output module PC MC

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 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 (Pulse and Relay) modules below.

Bistable alarm output module PC MC

A Bistable alarm module is a relay type and keeps the condition at output in case of device power failure.

Alarm output

Reaction of Bistable alarm module is connected to Alarm groups. Multiple alarm groups can be attached to it and different signal shapes defined. For more information on how to define alarm groups, see chapter *Alarms* on page 43.

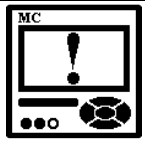
Functions of Digital output (Pulse and Relay) modules PC MC

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

Pulse Output of Energy counter

A corresponding Energy counter 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.

Warning!



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.

OK Main menu ⇒ Settings ⇒ Inputs/Outputs ⇒ I/O 1 / 2 / 3 / 4 ⇒ Setting of pulse output OK

Calculation of recommended pulse parameters

Number of pulses per energy unit should be in certain limits according to expected power. If not so the measurement from pulse output can be incorrect. Settings of current and voltage transformers can help in estimation of expected power.

Principle described below for pulse setting, where e is prefix, satisfies EN 62053-31: 2001 standards pulse specifications:

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

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 defined. For more information on how to define alarm groups, see chapter *Alarms* on page 43.

Main menu ⇒ Settings ⇒ Inputs/Outputs ⇒ V/I 1 / 2 / 3 / 4 ⇒ Setting of alarm output OK

Signal shape:

- Normal - A relay is closed until condition for the alarm is fulfilled.
- Normal inverse - A relay is open until condition for the alarm is fulfilled.
- Holds - A relay is closed when condition for the alarm is fulfilled, and remains closed until it is reset via communication.
- Pulse - an impulse of the set length is sent always when condition for the alarm is fulfilled.
- Always switched on / off (permanent) - A relay is permanently switched on or switched off irrespective of the condition for the alarm.

Check an example in chapter *Alarms* on page 43 to have better perspective on alarm functionality.

User information

This possibility of permanent alarm setting enables remote control via communication.

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 check chapter *Tariff clock* on page 39.

2nd Communication module (COM2) PC MC

Module is preset for RS232 or RS485 communication.

For other description see chapter *Serial communication* on page 34.

Communication module for Analogue extender EX104 PC MC

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.

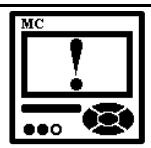
5.13 Alarms

Alarms are used for alarming exceeded set values of the measured quantities.

◖ – (U)MC740 do not support alarms recording into memory

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

Warning!



New values of alarms are calculated in percentage at modification of connection settings.

Alarms setting PC MC

Measuring centre supports recording and storing of 32 alarms that are divided in to 4 groups of 8 alarms. For each group of alarms a time constant of maximal values in thermal mode, a delay time, alarm deactivation hysteresis and response time can be defined. For each separate alarm additional individual conditions can be set.

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

Compare time delay: defines delay time between satisfying the alarm condition and alarm activation.

Hysteresis: defines alarm deactivation hysteresis.

Response time: defines alarm response on monitored quantity.

Normal response averaged measurements, according to display averaging settings (8 to 256 signal periods - see chapter *General settings / Average interval* on page 29) are used with this settings.

Fast response reacts on non-averaged measurements (1 signal period).

Individual alarm settings

For each individual alarm different settings are possible. It is possible to select:

Parameter: Quantity that would be monitored. Also selection of digital / pulse input from Digital input module 1 or 2 is possible if it is built in.

Value: current value or MD thermal function with time constant set in Alarm Group settings).

Condition: 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 equipped with 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). This action only applies to I/O modules 1 and 2. To relay outputs of I/O module A or B only single alarm can be attached. 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

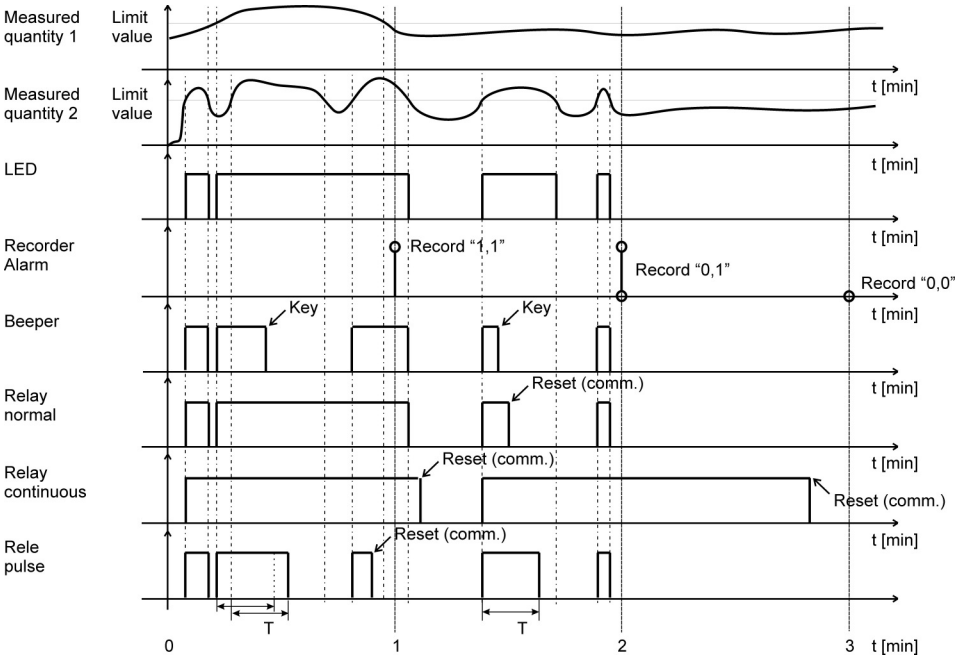
When alarm is switched on, a red LED on the device front side is blinking (see figure shown on next page).

Audible 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)

According to the alarm signal shape the output relay will behave as shown on next page.



Alarms PUSH functionality

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 data to be sent. Data are sent to the server immediately as alarms occur. If they can not be sent immediately due to communication problems, they are sent at next alarm event (on or off) or data sending interval (whichever occurs first).

For more information about PUSH *Communication mode* see chapter 6 on page 64.

5.14 Memory

Measurements, alarms, reports and details of supply voltage quality are stored in a built in memory in the (U)MC750 and (U)MC760 8MB flash. All records stored in memory are accessible via communication or memory card with MiQen software. Device also has a built in function that enables scheduled transmission of data, stored in memory, to MiSmart system. For more information regarding this check chapter *PUSH Communication mode* on page 64.
O - (U)MC740 has no built-in memory

Memory division PC MC

MMC memory is divided into 5 partitions which size is defined by the user. The A, B, C and D recorders are intended for recording measurements, while all alarms that occurred are recorded in an alarm partition. (U)MC760 has 2 additional partitions for recording reports and details on the quality of supply voltage (see chapter *Quality of supply*, next page).

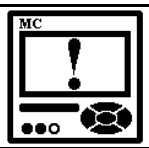
Memory operation

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 number of stored data or a storing period depends on selected partition size, a number of recorded quantities and time of division sampling. Occupancy of partitions is shown in the Information menu (see chapter *Display* of device info on page 36).

Memory clearing PC MC

There is usually no need to clear the memory, because it works in cyclic mode. If you want to clear memory data anyway, the data storing must be stopped first. Read the device settings with MiQen and set "Recorder state" in Memory setting group to stopped. Download changes to the device and open Memory info form and then click on Clear memory button. Select memory partitions to be cleared on Memory clearing form and click on OK button. Set "Recorder state" setting back to active.

Warning!



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

Recorders A, B, C and D setting PC

Separately, for each of the recorders, settings can be set:

Storage interval: sets a time interval for readings to be written to a recorder

MD Time constant: sets a period for calculation of maximum and minimum value in thermal mode (Minimum (MD) or Maximum (MD)). Different parameter can be set for Recorded parameters 1-8 and 9-16.

PUSH settings: when PUSH communication mode is active, all measurements which are set to be written to the memory (max. 64 in all four recorders), 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 can not be sent immediately due to restrictions in network.
For more information about PUSH *Communication mode* see chapter 6 on page 64.

Recorded quantities: for each of 16 measurements, which are to be recorded it is possible to set a required value and its representation within storage interval (min., max., avg. …).

Parameter: here monitoring quantity can be selected from a list of supported measurements.

Value: representation of a value within set monitoring interval can be set to different conditions.
- Average value represents calculated average value
- Actual value represents value of recorded quantity at sampling intervals. (recommended for Pst and Plt measurements)
- Minimum and Maximum value represents minimum or maximum of recorded quantity in selected storage interval. Minimum or maximum in this case represents averaged value according to average interval selected in General settings (see page 29)
- 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).
- Minimum (Periode) and Maximum (Periode) value represents one period minimum or maximum of recorded quantity in selected storage interval.

5.15 Conformity of voltage with EN 50160 standard

The EN 50160 standard deals with voltage characteristics of electricity supplied by public distribution systems. This specifies the limits or values within which a customer can expect voltage characteristics to lie. Within this definition the Network analyzer is adapted for supervising the compliance of distribution systems with the EN 50160 standard.

● - (U)MC760 enables supervision of network compliance with the EN 50160 standard

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

Power supply Quality PC MC

Basic parameters are defined that influence other settings.

User information

Un – Nominal supply voltage with which network is marked and to which individual operation parameters refer.
Uc – Agreed supply voltage is usually network voltage (Un). If a client and a supplier agree about voltage that is different from nominal voltage, that voltage is considered as agreed supply voltage.

Monitoring mode

It defines if the device performs measurements for network compliance with the standard.

Electric energetic system

Public distribution system and, if necessary, all default settings are selected in this section. This setting influences some of the predefined limit lines according to relevant standard EN 50160.

Operating supply voltage

A voltage level of the monitored system. This value is used as a reference for calculation of power quality indices. If meter is connected directly, nominal network voltage must be used (L-N). If meter is connected via measuring transformer, secondary voltage (L-N) needs to be used.

Always use nominal voltage that is actually connected to meter.

Nominal power frequency

Nominal frequency of monitored supply voltage is selected. In combination with setting of Flicker calculation method defines model for correct flicker measurements.

Flicker calculation method

Flicker calculation method is selected. Method should be selected regarding the system in which device is used. In combination with setting of Nominal power frequency defines model for correct flicker measurements.

Monitoring period

For a report of electric voltage quality, a monitoring period is defined. A number of monitored weeks is entered.

Monitoring start day

A starting day in a week is selected. It starts at 00:00 (midnight). The selected day will be the first day in a 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 can not be sent immediately due to restrictions in network.

For more information about *PUSH Communication mode* see chapter 6 on page 64.

Frequency variations PC MC

All frequency measurements are performed in 10−second intervals of averaging. For both required quality variations a range of variation is defined in percentage. Percentage of required measurements within the limits (required quality) in the monitored period is also defined.

Voltage variations PC MC

All voltage measurements are performed in 10−minute intervals of averaging. For all required variations a range of deviation is defined in percentage. Percentage of required measurements (required quality) within the limits in the monitored period is also defined.

Voltage changes PC MC

For Rapid Voltage changes a change limit in percentage of nominal voltage and permitted number of events in a monitored period are defined.

For both types of flickers, Short-term flicker intensity (P_{st}) and Long-term flicker intensity (P_{lt}), required quality in a monitored period is also defined here.

Voltage events PC MC

A voltage Hysteresis and limits for voltage Dips, Swells and Interruptions are defined in percentage with regard to nominal voltage. A limit between short-term and long-term interruption is defined in seconds. Other parameters define limits of events in a monitored period.

Harmonics & THD PC MC

Permitted limits for the first 25 harmonic components and required quality in a monitored period are defined.

5.16 Reset operations

◖ – (U)MC740 do not have some measurements for reset supported (see chapter *Type differences*, pages 11.)

Reset Min / Max values PC

All Min / Max values are reset.

OK Main menu ⇒ Resets ⇒ Min/Max values ⇒

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

All or individual energy meters are reset.

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

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

All or individual energy costs are reset.

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

Reset maximal MD values PC

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.

Main menu ⇒ Resets ⇒ MD values ⇒

Reset the last MD period PC

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.

Main menu ⇒ Resets ⇒ Last period MD ⇒

MD synchronization PC

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 (1 or 2) Off PC

Turn off the alarm (relay output).

Main menu ⇒ Resets ⇒ Reset alarm output ⇒

Reset Min / Max values PC

All Min / Max values are reset.

Main menu ⇒ Resets ⇒ Min/Max values ⇒

Reset alarm statistic PC

Clears the alarm statistic. It can be made via MiQen software under Alarm settings.

5.17 Settings and memory card

Measuring centre is provided with a built in slot for a full size MMC or 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.

Supported memory cards

Measuring centre supports full size MMC memory card and MMC compatible SD memory card. Since not all SD card types are supported it is recommended to order it from *Iskra Sistemi d.d*.

Directory structure on memory card

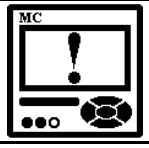
A structure of directories is defined and enables correct data handling via a memory card. The memory card shall contain the following directories and files:

- 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 devices' 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. MC760.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.

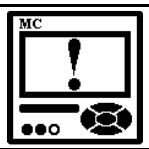
Automenu.txt file can be created by the user by means of the text editor. A new file has to be opened and saved under the correct name (Automenu.txt) and without content.
MC Example:

```
DATA
↳          MC003973
           ↳          06050301.MC
           MC003974
           ↳          06050301.MC
                      06070301.MC
           MC009424
           ↳          06060301.MC
                      06070301.MC
SETTING
↳          MC003973.MSF
           MC760−1.MSF
           MC760−2.MSF
           MC750−1.MSF
UPGRADE
↳          MC760.FL2
Automenu.txt
```

Handling memory card

Measuring centre 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 the work is done.

Warning!



While memory card activity LED is pulsating memory card should not be touched or pulled out of the slot.

Memory card information OK MC

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

OK Main menu ⇒ MMC card ⇒ MMC info OK

Save data OK MC

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.

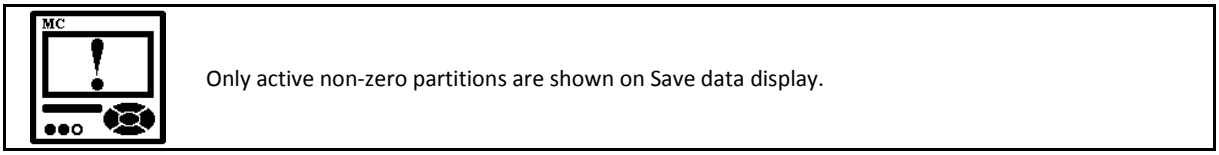
Official reading

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

Example:

Main menu ⇒ MMC card ⇒ Save data OK

Note



Only active non-zero partitions are shown on Save data display.

Save settings MC

File of current device settings are 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 MC

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

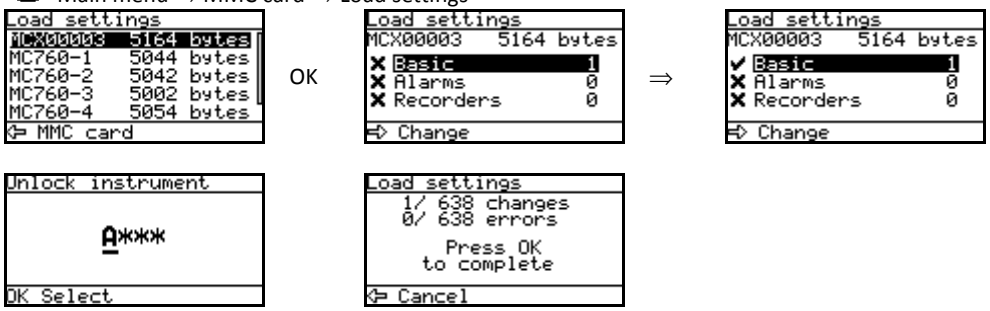
Settings of all alarms are changed, but old alarms with previous settings remain in the memory.

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 MC760:

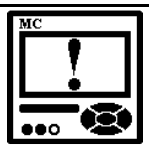
Main menu ⇒ MMC card ⇒ Load settings



Firmware upgrading MC

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 don't touch or pull out memory card and don't 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)

6 MEASUREMENTS

6.1 Introduction

In the following chapters operation of the devices is explained more in detail.

6.2 Supported measurements

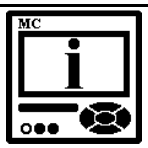
Measurements support regarding the device type is described in chapter *Type differences*, pages 11. Selection of supported measurements of individual device type is changed with the connection settings.

6.3 Available connections

Different electric connections are described more in detail in chapter *Electric connection* on page 15. Connections are marked as follows:

- Connection 1b (1W) - Single phase connection
- Connection 3b (1W3) - Three-phase - three-wire connection with balanced load
- Connection 4b (1W4) - Three-phase - four-wire connection with balanced load
- Connection 3u (2W3) - Three-phase - three-wire connection with unbalanced load
- Connection 4u (3W4) - Tree-phase - four-wire connection with unbalanced load

Note



Measurements support depends on connection mode and the device type.
Calculated measurements are only informative.

Survey of supported measurements regarding connection mode

All measurements, with designations can be displayed on customized screens.

	Basic measurements	Designat.	Unit	1b	3b	3u	4b	4u
Phase	Voltage U_1	U1	V	●	×	×	●	●
	Voltage U_2	U2	V	×	×	×	○	●
	Voltage U_3	U3	V	×	×	×	○	●
	Average voltage $U^{\sim}$	Uᴀ	V	×	×	×	○	●
	Current I_1	I1	A	●	●	●	●	●
	Current I_2	I2	A	×	○	●	○	●
	Current I_3	I3	A	×	○	●	○	●
	Current I_n	Inc	A	×	○	○	○	●
	Total current I_t	I	A	●	○	○	○	●
	Average current I_a	Iavg	A	×	○	○	○	●
	Active power P_1	P1	W	●	×	×	●	●
	Active power P_2	P2	W	×	×	×	○	●
	Active power P_3	P3	W	×	×	×	○	●
	Total active power P_t	P	W	●	●	●	○	●
	Reactive power Q_1	Q1	var	●	×	×	●	●
	Reactive power Q_2	Q2	var	×	×	×	○	●
	Reactive power Q_3	Q3	var	×	×	×	○	●
	Total reactive power Q_t	Q	var	●	●	●	○	●
	Apparent power S_1	S1	VA	●	×	×	●	●
	Apparent power S_2	S2	VA	×	×	×	○	●
	Apparent power S_3	S3	VA	×	×	×	○	●
	Total apparent power S_t	S	VA	●	●	●	○	●
	Power factor PF_1	PF1/ePF1		●	×	×	●	●
	Power factor PF_2	PF2/ePF2		×	×	×	○	●
	Power factor PF_3	PF3/ePF3		×	×	×	○	●
	Total power factor $PF^{\sim}$	PF/ePF		●	●	●	○	●
	Power angle ϕ_1	ϕ1	°	●	×	×	●	●
	Power angle ϕ_2	ϕ2	°	×	×	×	○	●
	Power angle ϕ_3	ϕ3	°	×	×	×	○	●
	Total power angle $\phi^{\sim\sim}$	ϕ	°	●	●	●	○	●
	THD of phase voltage U_{f1}	U1%	%THD	●	×	×	●	●
	THD of phase voltage U_{f2}	U2%	%THD	×	×	×	○	●
	THD of phase voltage U_{f3}	U3%	%THD	×	×	×	○	●
	THD of phase current I_1	I1%	%THD	●	●	●	●	●
	THD of phase current I_2	I2%	%THD	×	○	●	○	●
	THD of phase current I_3	I3%	%THD	×	○	●	○	●

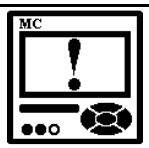
	Basic measurements	Designat.	Unit	1b	3b	3u	4b	4u
Phase-to-phase	Phase-to-phase voltage U_{12}	U12	V	×	●	●	○	●
	Phase-to-phase voltage U_{23}	U23	V	×	●	●	○	●
	Phase-to-phase voltage U_{31}	U31	V	×	●	●	○	●
	Average phase-to-phase voltage (U_{ff})	U△	V	×	●	●	○	●
	Phase-to-phase angle ϕ_{12}	ϕ12	°	×	×	×	○	●
	Phase-to-phase angle ϕ_{23}	ϕ23	°	×	×	×	○	●
	Phase-to-phase angle ϕ_{31}	ϕ31	°	×	×	×	○	●
	Voltage unbalance U_u	Uu	%	×	●	●	×	●
	THD of phase-to-phase voltage THD_{U12}	U12%	%THD	×	●	●	○	●
	THD of phase-to-phase voltage THD_{U23}	U23%	%THD	×	●	●	○	●
	THD of phase-to-phase voltage THD_{U31}	U31%	%THD	×	●	●	○	●
Energy	Counters 1-4	E1, E2, E3, E4	Wh VAh varh	●	●	●	●	●
	Active tariff	Atar		●	●	●	●	●
	Cost by meters	E1$, E2$, E3$, E4$	XXXX	●	●	●	●	●
	Total cost	E$	XXXX	●	●	●	●	●
Max. values MD	MD current I_1	I1	A	●	●	●	●	●
	MD current I_2	I2	A	×	○	●	○	●
	MD current I_3	I3	A	×	○	●	○	●
	MD active power P (positive)	P+	W	●	●	●	●	●
	MD active power P (negative)	P-	W	●	●	●	●	●
	MD reactive power Q-L	Q⫤	var	●	●	●	●	●
	MD reactive power Q-C	Q⫩	var	●	●	●	●	●
	MD apparent power S	S	VA	●	●	●	●	●

● - supported ○ - calculated × - not supported

Note

Basic and MD measurements have designations for recognition via LCD. In this way they can be selected via LCD for a display on customized screens.

Warning!



When, due to mode of connection, unsupported measurement is selected for customized screen an undefined value is displayed.

	Flicker measurement	Designat.	Unit	1b	3b	3u	4b	4u
Flickers Pst / Plt	Short term f. 1. phase voltage	Plt1		●	×	×	●	●
	Short term f. 2. phase voltage	Plt2		×	×	×	○	●
	Short term f. 3. phase voltage	Plt3		×	×	×	○	●
	Short term f. 1. Phase-to-phase voltage	Pst1		×	●	●	×	×
	Short term f. 2. phase-to-phase voltage	Pst2		×	●	●	×	×
	Short term f. 3. phase-to-phase voltage	Pst3		×	●	●	×	×
	Long term f. 1. phase voltage	Plt1		●	×	×	●	●
	Long term f. 2. phase voltage	Plt2		×	×	×	○	●
	Long term f. 3. phase voltage	Plt3		×	×	×	○	●
	Long term f. 1. phase-to-phase voltage	Pst1		×	●	●	×	×
	Long term f. 2. phase-to-phase voltage	Pst2		×	●	●	×	×
	Long term f. 3. phase-to-phase voltage	Pst3		×	●	●	×	×

● - supported ○ - calculated × - not supported

	Min/max measurements	**1b**	**3b**	**3u**	**4b**	**4u**
Instantaneous / Maximal / Minimal values	Voltage U_1	●	×	×	●	●
	Voltage U_2	×	×	×	○	●
	Voltage U_3	×	×	×	○	●
	Phase-to-phase voltage U_{12}	×	●	●	○	●
	Phase-to-phase voltage U_{23}	×	●	●	○	●
	Phase-to-phase voltage U_{31}	×	●	●	○	●
	Phase current I_1	●	●	●	●	●
	Phase current I_2	×	○	●	○	●
	Phase current I_3	×	○	●	○	●
	Active power P_1	●	×	×	●	●
	Active power P_2	×	×	×	○	●
	Active power P_3	×	×	×	○	●
	Total active power P	×	●	●	○	●
	Apparent power S_1	●	×	×	●	●
	Apparent power S_2	×	×	×	○	●
	Apparent power S_3	×	×	×	○	●
	Total apparent power S	×	●	●	○	●
	Frequency f	●	●	●	●	●
	Internal temperature	●	●	●	●	●

● - supported ○ - calculated × - not supported

	Measurements of harmonics	**1b**	**3b**	**3u**	**4b**	**4u**
Harmonics up to 63rd	Phase voltage U_1	●	×	×	●	●
	Phase voltage U_2	×	×	×	○	●
	Phase voltage U_3	×	×	×	○	●
	Phase-to-phase voltage U_{12}	×	●	●	○	●
	Phase-to-phase voltage U_{23}	×	●	●	○	●
	Phase-to-phase voltage U_{31}	×	●	●	○	●
	Phase current I_1	●	●	●	●	●
	Phase current I_2	×	○	●	○	●
	Phase current I_3	×	○	●	○	●

● - supported ○ - calculated × - not supported

	Graphical display	**1b**	**3b**	**3u**	**4b**	**4u**
Time / FFT	Phase voltage U_1	●	×	×	●	●
	Phase voltage U_2	×	×	×	○	●
	Phase voltage U_3	×	×	×	○	●
	Phase-to-phase voltage U_{12}	×	●	●	○	●
	Phase-to-phase voltage U_{23}	×	●	●	○	●
	Phase-to-phase voltage U_{31}	×	●	●	○	●
	Phase current I_1	●	●	●	●	●
	Phase current I_2	×	○	●	○	●
	Phase current I_3	×	○	●	○	●

● - supported ○ - calculated × - not supported

	Voltage quality measurements	**1b**	**3b**	**3u**	**4b**	**4u**
Quality parameters	Frequency variations 1 / 2	●	●	●	●	●
	Voltage variations 1 / 2	●	●	●	●	
	Voltage unbalances	×	●	●	×	●
	Voltage dips	●	●	●	○	●
	Voltage interruptions	●	●	●	○	●
	Long interruptions	×	●	●	○	●
	Rapid voltage changes	×	●	●	○	●
	Flickers Pst / Plt	×	●	●	○	●
	Temporary overvoltages	●	●	●	●	●
	THD's	×	○	●	○	●
	Harmonics	×	○	●	○	●

● - supported ○ - calculated × - not supported

Note

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

6.4 Explanation of basic concepts

Sample factor – MV

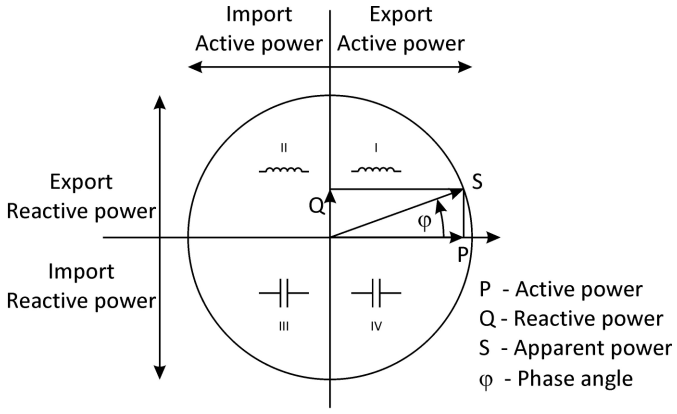
A device measures all primary quantities with sample frequency which can not exceed a certain number of samples in a time period. Based on these limitations (65Hz·128 samples) a sample factor is calculated. A sample factor (M_V), depending on frequency of a measured signal, defines a number of periods for a measurement calculation and thus a number of harmonics considered in calculations.

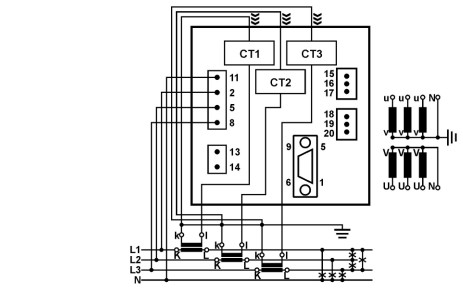
Average interval – MP

Due to readability of measurements from LCD and via communication, an Average interval (M_P) is calculated with regard to the measured signal frequency. The Average interval (see chapter *Average interval* on page 57) defines refresh rate of displayed measurements based on a sampling factor.

Power and energy flow

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





Note

Display of energy flow direction can be adjusted to connection and operation requirements by changing the *Energy flow direction* settings in general / connection (see page 33).

6.5 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 chapter *Equations* on page 88 with additional descriptions and explanations.

◖ – (U)MC740 do not have all described measurements supported (see chapter *Type differences* on pages 11.)

Note

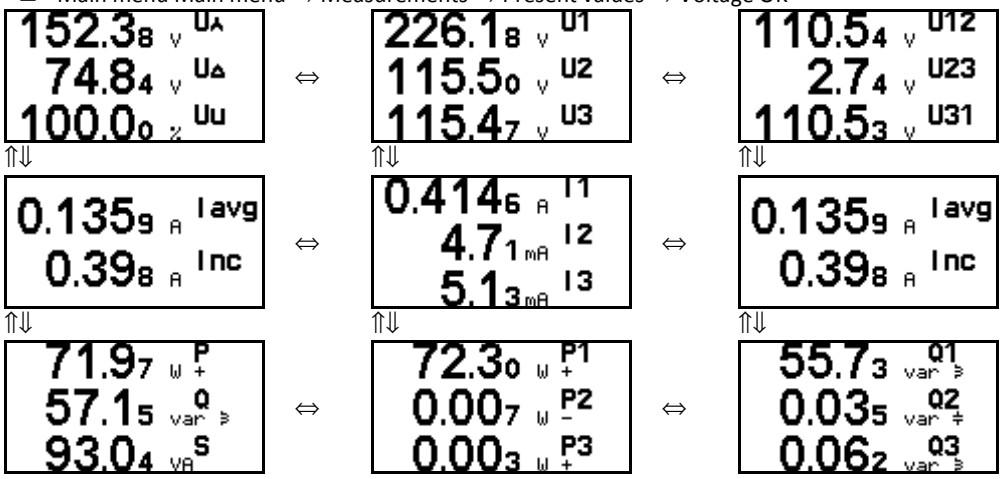
Calculation and display of measurements depend on the device type and connection used. For more detailed information see *chapters Survey of supported measurements regarding connection mode* on page 54.

Keyboard and display presentation

For entry and quitting measurement display menu, the OK key is used. Direction keys (left / right / up / down) are used for passing between displays as show in example below.

Example for MC740 at 4u connection mode:

OK Main menu Main menu ⇒ Measurements ⇒ Present values ⇒ Voltage OK



6.6 Present values

◖ – (U)MC740 do not have all described measurements supported (see chapter *Type differences*, pages 11.)

Note

Since measurement support depends on connection mode some display groups can be combined in to one, within Measurements menu.

Voltage PC OK

The device measures real effective (rms) value of all phase voltages (U_1, U_2, U_3), connected to it. Phase-to-phase voltages (U_{12}, U_{23}, U_{31}), average phase voltage (U_f) and average phase-to-phase voltage (U_a) are calculated from measured phase voltages (U_1, U_2, U_3). Voltage unbalance is calculated from phase-to-phase voltages (U_{12}, U_{23}, U_{31}).

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

All voltage measurements are available via communication, serial and customized displays on LCD.

OK Main menu ⇒ Measurements ⇒ Present values ⇒ Voltage OK

Current PC

The device measures real effective (rms) value of phase currents, connected to current inputs. Neutral current (I_n), average current (I_a) and a sum of all phase currents (I_t) are calculated from phase currents.

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

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

OK Main menu ⇒ Measurements ⇒ Present values ⇒ Current OK

Active, reactive and apparent power PC

Active power is calculated from instantaneous phase voltages and currents. All measurements are seen via communication or are displayed on LCD. For more detailed information about calculation see chapter *Equations* on page 88.

There are two different methods of calculating reactive power. See chapter *Reactive power and energy calculation* on page 33.

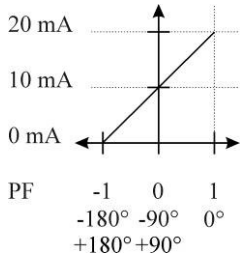
OK Main menu ⇒ Measurements ⇒ Present values ⇒ Power OK

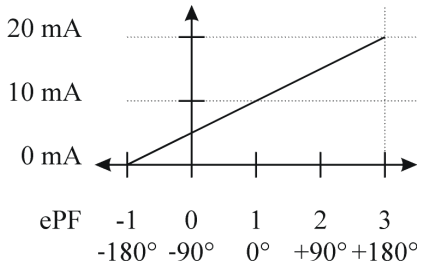
Power factor and power angle PC

Power angle 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 ($\cos\varphi_t$). A symbol for a coil represents inductive load and a symbol for a capacitor 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.

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:





Power angle represents angle between first voltage harmonic and first 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 88). A positive sign shows inductive load, and a negative sign shows capacitive load.

OK Main menu ⇒ Measurements ⇒ Present values ⇒ PF & Power angle OK

Frequency PC

Network frequency is calculated from time periods of measured voltage. Additionally frequency with 10–second averaging interval is displayed.

OK Main menu ⇒ Measurements ⇒ Present values ⇒ Frequency OK

Energy - counters PC

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 33.

Additional information, how to set and define a counter quantity is explained in chapter *ENERGY – counters* on page 38.

Example:

OK Main menu ⇒ Measurements ⇒ Present values ⇒ Energy OK

MD values PC

Display of MD values and time of recording (time stamp).

OK Main menu ⇒ Measurements ⇒ Present values ⇒ MD values OK

THD - Total harmonic distortion PC

THD is calculated for phase currents, phase and phase−to−phase voltages and is expressed as percent of high harmonic components regarding RMS value or relative to first harmonic (see chapter *Calculation of harmonics* on page 32).

Device uses measuring technique of real effective (rms) value that assures exact measurements with the presence of high harmonics up to 63rd harmonic.

OK Main menu ⇒ Measurements ⇒ Present values ⇒ THD OK

Flickers PC

Display of current Short term and Long term flickers for phase or phase-to-phase voltage (depending on mode of connection). Until the flicker value is calculated the symbol − is displayed.

OK Main menu ⇒ Measurements ⇒ Present values ⇒ Flickers OK

Customized screens PC

A display of customized screens depends on settings. See chapter *Settings of customized screens* on page 36.

OK Main menu ⇒ Measurements ⇒ Present values ⇒ Custom OK

Overview PC

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

OK Explanation of measurements for MC760 at connection mode 4u:

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:

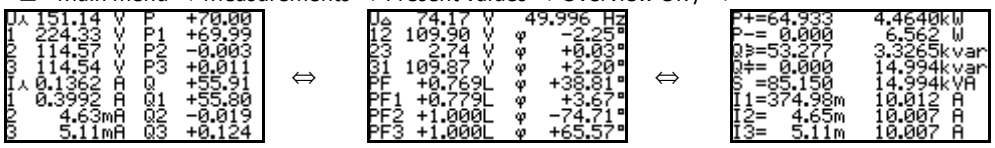
	Current phase-to-phase measurements			Current phase-to-phase measurements	
U△	Average phase-to-phase $U^{\sim}$	V		Frequency f	Hz
12	Phase-to-phase voltage U_{12}	V	ϕ	Power angle φ_1	°
23	Phase-to-phase voltage U_{23}	V	ϕ	Power angle ϕ_2	°
31	Phase-to-phase voltage U_{31}	V	ϕ	Power angle ϕ_3	°
PF	Total power factor		ϕ	Average phase-to-phase angle ϕ	°
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	MD active power P (negative)	W
Q⋑	MD reactive power Q-L	var	MD reactive power Q−L	var
Q⋐	MD reactive power Q-C	var	MD reactive power Q−C	var
S	MD apparent power S	VA	MD apparent power S	VA
I1	MD current I1	A	MD current I1	A
I2	MD current I2	A	MD current I2	A
I3	MD current I3	A	MD current I3	A

Example for MC760 at connection 4u:

Main menu ⇒ Measurements ⇒ Present values ⇒ Overview OK / ⇒



6.7 Min/Max values

All Min/Max values are displayed in the same way. Current values are displayed large in the middle of the screen, while minimal and maximal values are displayed smaller above and below the current values. Next to the current value is also measurement designation (see chapter *Survey of supported measurements regarding Connection* on page 20)

Phase voltage Min/Max PC

Display of phase voltages U_1, U_2 and U_3.

Main menu ⇒ Measurements ⇒ Min/Max values ⇒ Phase voltage OK

Phase-to-phase voltage PC

Display of phase-to-phase voltages U_{12}, U_{23} and U_{13}.

Main menu ⇒ Measurements ⇒ Min/Max values ⇒ Phase to Phase voltage OK

Current Min/Max PC

Display of currents I_1, I_2 and I_3.

Main menu ⇒ Measurements ⇒ Min/Max values ⇒ Current OK

Active power Min/Max PC

Display of active power P_1, P_2, P_2 and P_t.

Main menu ⇒ Measurements ⇒ Min/Max values ⇒ Active power OK

Apparent power Min/Max PC

Display of apparent power S_1, S_2, S_2 and S_t.

Main menu ⇒ Measurements ⇒ Min/Max values ⇒ Apparent power OK

Frequency Min/Max PC

Display of current frequency (f) and frequency with 10−second averaging

Main menu ⇒ Measurements ⇒ Min/Max values ⇒ Frequency OK

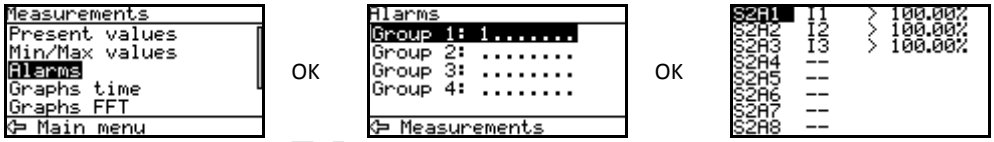
Date and time of reset Min/Max PC

Display of date and time of the last reset and possibility of resetting Min/Max values.

Main menu ⇒ Measurements ⇒ Min/Max values ⇒ Date and time of reset OK

6.8 Alarms

An alarm menu enables surveying state of alarms. In the basic alarm menu, groups of alarms with the states of individual alarms and data on alarm outputs are displayed in the bottom line. For each active alarm a number of an alarm is written in a certain group at a certain place: Group 1: 1**...**45**...**8. Dot stands for alarm not active.



6.9 Survey of alarms PC

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.

OK Main menu ⇒ Measurements ⇒ Alarms OK / ⇒

6.10 Power supply quality

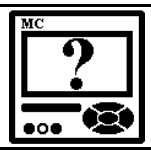
For evaluation of voltage quality, the (U)MC760 network analyzer can store main characteristics in the internal memory. The reports are made on the basis of stored data. Data of the last 7 years and up to 170,000 variations of the measured quantities from the standard values are stored in the report, which enables detection of eventual reasons for troubles on network. The MiQen software offers a complete survey of reports with a detailed survey of individual measured quantities. Via the network analyzer LCD a survey of compliance of individual measured quantities in previous and actual monitored periods is made possible.

● - (U)MC760 enables supervision of voltage compliance with the EN 50160 standard.

Monitoring periods PC MC

Device displays status, compliance and quality of individual parameters without details for actual and previous monitoring period. MiQen supports survey of actual and previous quality reports with all the details for past 7 years that have been registered. Compliance of voltage, status, start and end date, as well as exact monitoring time is register for each report. Displayed status for each report states if whole period was monitored.

User information



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.

Actual monitoring period PC

A survey of compliance of voltage quality by measured quantities in previous period.

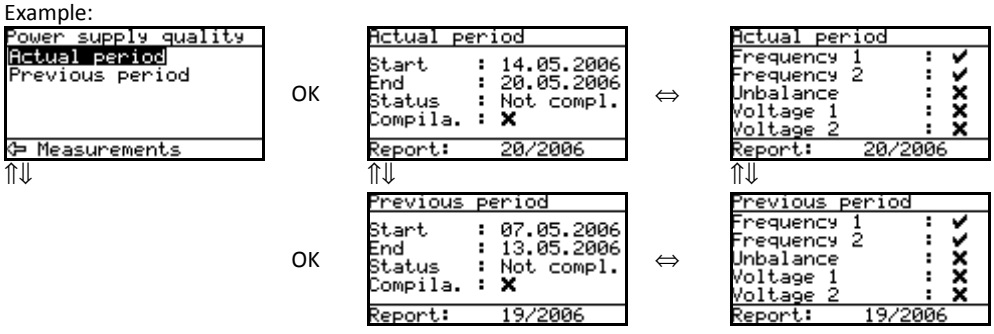
OK Main menu ⇒ Measurements ⇒ Power supply quality ⇒ Actual period OK / ⇒

Previous monitoring period PC

A survey of compliance of voltage quality by measured quantities in previous period.

OK Main menu ⇒ Measurements ⇒ Power supply quality ⇒ Previous period OK / ⇒

Example:



User information

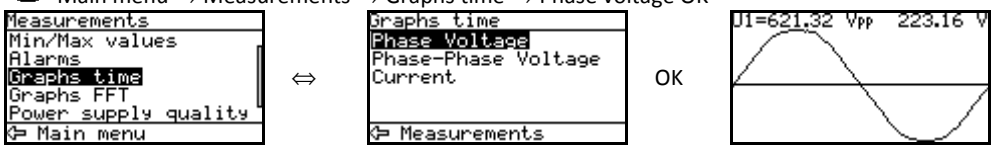
When surveying quality report via measuring centre, parameters which are not monitored, have no sign (✔, ✘) of quality compliance.

6.11 Time graphical display (Graphs time)

All time graphs of measured signals are made in the same way. In the upper part of LCD there is a measurement designation that is followed by a pea-to-peak signal value, and on the extreme right there is RMS value. In the central part of LCD a signal shape is drawn. For a better survey of the measured signal a scale is automatically adapted to the peak-to-peak signal value.

Example:

OK Main menu ⇒ Measurements ⇒ Graphs time ⇒ Phase voltage OK



Phase voltage PC OK

Display of time flow of voltage signals U_1, U_2 and U_3.

OK Main menu ⇒ Measurements ⇒ Time graphs ⇒ Phase voltage OK / ⇒

Phase-to-phase voltage PC OK

Display of time flow of phase-to-phase voltage signals U_{12}, U_{23} and U_{31}.

OK Main menu ⇒ Measurements ⇒ Time graphs ⇒ Phase–phase voltage OK / ⇒

Current PC OK

Display of time flow of current signals I_1, I_2 and I_3.

OK Main menu ⇒ Measurements ⇒ Time graphs ⇒ Current OK / ⇒

6.12 FFT graphical display (Graphs FFT)

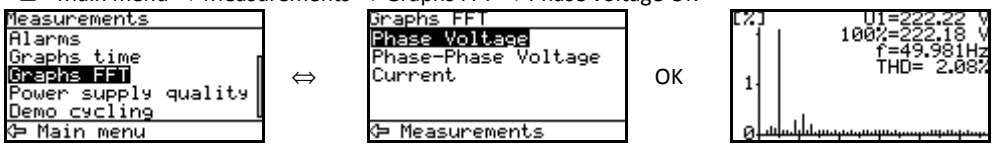
All FFT graphs of the measured signals are made in the same way. In the upper right angle of LCD the following measurements are stated:

- Designation of measurement with current RMS value
- Value of first harmonic
- Current frequency
- THD signal value

The remaining part is used for a (bar) graphic display of relative values of harmonics regarding the first one. For better resolution, first harmonic is not displayed and rating is automatically adapted according to highest harmonic values.

Example:

OK Main menu ⇒ Measurements ⇒ Graphs FFT ⇒ Phase voltage OK



Phase voltage PC OK

Display of harmonics of phase voltage signals U_1, U_2 and U_3.

OK Main menu ⇒ Measurements ⇒ Time FFT ⇒ Phase voltage OK / ⇒

Phase-to-phase voltage PC OK

Display of harmonics phase-to-phase voltage signals U_{12}, U_{23} and U_{31}.

OK Main menu ⇒ Measurements ⇒ Time FFT ⇒ Phase–phase voltage OK / ⇒

Current PC OK

Display of harmonics of current signals I_1, I_2 and I_3.

OK Main menu ⇒ Measurements ⇒ Time FFT ⇒ Current OK / ⇒

Demonstration measurements

Demo cycling OK

Regarding the period that is defined in settings, measurement screen cycling is started until any key is pressed.

OK Main menu ⇒ Measurements ⇒ Demo cycling OK

7 COMMUNICATION MODES

(U)MC7x0 series measuring centers in general support two different communication modes to suit all demands about connectivity and flexibility.

7.1 PULL 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 PULL communication mode, only basic communication settings are required according to communication type (serial, USB, ETHERNET). See chapter *Communication* on page 13.

7.2 PUSH communication mode

PUSH communication mode is mainly used in *Iskra Sistemi d.d.* MiSmart system for remote monitoring, analysis and reporting.

◖ – (U)MC740 supports only PUSH functionality on alarms. Since it has no built-in memory, alarm information can not be resent if communication with server at the time of alarm could not be established.

Explanation

When in this communication mode, the 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 (for *Setting / Ethernet communication* see page 34) 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 91.

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 (for Setting / Ethernet communication see page 34) 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 PULL and PUSH communication mode to be active at the same time. Both communication modes can be handled at the same time if PULL communication is made over 2nd Communication module or over Ethernet module through port reserved for communication over MODBUS communication protocol (port 502 see chapter *Settings / Ethernet communication* on page 34).

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, B, C and D, alarms recorder and quality reports with details recorder) separate settings can be made.

Step 1: In MiQen software, menu general/communication, set proper PUSH *Communication settings* (see page 34), where time synchronization source, response time, data format and receiving servers parameters are defined.

Step 2: Define data (quantities) for recorder / transmission (see section *Memory* on page 45). For each part of the recorder select to which of the server(s) will data be sent. This setting can be made for Alarms, Recorders A, B, C and D, Electric Quality reports and Electric Quality details. Parameters that can be set for some parts of recorders are:

- *Push data link*, sets the link to the server(s) defined in communication settings (see page 34).
- *Pushing period*, which set how often data shall be sent to server. This can either at every new reading, or at predefined time intervals (hourly, daily, weekly). When one of those intervals is used all data recorded between two time intervals is sent.
- *Pushing time delay* sets a delay time according to regular transmission period. This is useful in some situations to avoid simultaneous transmissions of multiple devices. Transmission delay can be disabled or user defined.

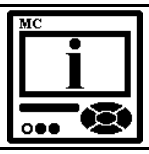
More information about PUSH data transfer and MiSmart system for collecting of this data can be found on *ISKRA SISTEMI d.d.* web page or in documentation about MiSmart system.

8 TECHNICAL DATA

8.1 Accuracy

Measured values	Range		Accuracy class*
Rms current (I_1, I_2, I_3, Iavg, I_n)	1 A 5 A		0.5 (optional 0.2)
Maximum current	12.5 A		0.5**
Rms phase voltage (U_1, U_2, U_3, Uavg)	75 V_{L-N} 120 V_{L-N} 250 V_{L-N} 500 V_{L-N}		0.5 (optional 0.2)
Maximum voltage	ANSI 300 V, DIN 600 V		0.5**
Rms phase-to-phase voltage (U_{12}, U_{23}, U_{31}, Uavg)	120 V_{L-L} 210 V_{L-L} 400 V_{L-L} 800 V_{L-L}		0.5 (optional 0.2)
Frequency (f) - actual	50 / 60Hz		10 mHz
Frequency (10 s average)	50 / 60 Hz		
Nominal frequency range	16…400 Hz		
Power angle (ϕ)	-180 … 0 … 180°		0.5°
Power factor (PF)	-1 … 0 … +1 U = 50 … 120 % U_n I = 2 % … 200 % I_n		0.5
Maximal values (MD)	75 120 250 500 [W/var/VA] I_n = 1 A	375 600 1250 2500 [W/var/VA] I_n = 5 A	1.0
THD	5…500 V 0…400 %		0.5
Active power	75 120 250 500 [W/var/VA] I_n = 1 A	375 600 1250 2500 [W/var/VA] I_n = 5 A	0.5 (optional 0.2)
Reactive power			0.5
Apparent power			0.5
Active energy	EN 62053-21		Class 1***
Active energy (optional)	EN 62053-22		Class 0.5S***
Reactive energy	EN 62053-23		Class 2***
Real time clock (RTC)	-		1 min/month (30 ppm)
Analogue output (internal supply)	0…20 mA		± 200 µA

Note



* – All measurements are calculated with high harmonic signals. For voltage up to 65 Hz or less, harmonics up to 63th are measured.
** – From range
*** – Partial compliance

8.2 Inputs

Voltage input		
	Nominal voltage (Un)	ANSI 240 V_{L-N}, DIN 500 V_{L-N}
	Rating	ANSI: 75 V_{L-N} / 250 V_{L-N} DIN: 75 V_{L-N} / 250 V_{L-N} / 500 V_{L-N}
	Overload	1.2 x U_n permanently
	Minimal measurement	2 V sinusoidal
	Maximal measurement	ANSI 300 V_{L-N}, DIN 600 V_{L-N}
	Consumption	< 0.1 VA per phase
Current input		
	Nominal current (In)	5 A
	Rating	1 A / 5 A
	Overload	3 x I_n permanently, 25 x I_n - 3 s, 50 x I_n - 1 s
	Minimal measurement	Settings from starting current for all powers
	Maximal measurement	12.5 A sinusoidal
	Consumption	< 0.1 VA per phase
Frequency		
	Nominal frequency (f_n)	50, 60 Hz
	Measuring range	16 … 400 Hz
	Maximum range	10 Hz … 1 kHz
Supply		
Universal	AC voltage range	48 … 276 V
	AC frequency range	40 … 70 Hz
	DC voltage range	20 … 300 V
	Consumption	< 12 VA
AC (DIN case only)	Voltage range	57.7 / 63.5 / 100 / 110 / 230 / 400 / 460 / 500 V
	Frequency range	40 … 65 Hz
	Consumption	< 8 VA

8.3 Connection

Permitted conductor cross-sections

Terminals	Max. conductor cross-sections DIN / ANSI housing
Voltage inputs (4)	≤ 2.5 mm^2 / 0,05 … 2,5 mm^2 one conductor
Current inputs (3)	≤ Ø 6 mm one conductor with insulation
Supply (2)	≤ 2.5 mm^2 / 0,05 … 2,5 mm^2 one conductor
Modules (2 x 3)	≤ 2.5 mm^2 / 0,05 … 2,5 mm^2 one conductor

8.4 Modules

Alarm (Relay) output module		
	No. of outputs	2
	Max. switching power	40 VA
	Max. switching voltage AC	40 V
	Max. switching voltage DC	35 V
	Max. switching current	1 A
	Impulse	Max. 4000 imp/hour Min. length 100 ms
	Signal shape	
	Normal	Until the condition is fulfilled
	Impulse	Start at any new condition
	Permanent	Since condition
Bistable alarm output module		
	No. Of outputs	1
	Max. switching power	40 VA
	Max. switching voltage AC	40 V
	Max. switching voltage DC	35 V
	Max. switching current	1 A
	Signal shape	
	Normal	Until the condition is fulfilled
	Impulse	Start at any new condition
	Permanent	Since condition
Alarm/Watchdog /Digital output module		
	Type	Relay switch
	Rated voltage	48 V AC/DC (+40% max)
	Max. switching current	1000 mA
	Contact resistance	≤ 100 mΩ (100 mA, 24V)
	Impulse	Max. 4000 imp/hour Min. length 100 ms
	Signal shape	
	Normal	Until the condition is fulfilled
	Impulse	Start at any new condition
	Permanent	Since condition
Pulse output module		
	No. of outputs	2
	Pulse lenght	2 ... 1000 ms
	Maximal voltage	40 V AC/DC
	Maximal current	30 mA
Analogue output module		
	No. of outputs	2
	Maximal load	150 Ω
	Output range	0 … 20 mA
	Supply	Internal

Analogue input module		
DC current input	Nominal input range 1	-20 … 0 … 20 mA (±20%)
	Nominal input range 2	-2 … 0 … 2 mA (± 20%)
	input resistance	20 Ω
	accuracy	0.5 % of range
	temperature drift	0.1% / °C (for range 2 only)
	conversion resolution	16 bit (sigma-delta)
	Analogue input mode	internally referenced Single-ended
DC voltage input	Nominal input range1	-10 … 0 … 10 V (±20%)
	Nominal input range 2	-1 … 0 … 1 V (±20%)
	input resistance	100 kΩ
	accuracy	0.5 % of range
	temperature drift	0.1% / °C (for range 2 only)
	conversion resolution	16 bit (sigma-delta)
	Analogue input mode	internally referenced Single-ended
Resistance/ temperature Input module	Nominal input range (low)*	0 - 200 Ω (max. 400 Ω) PT100 (-200°C–850°C)
	Nominal input range (high)*	0 - 2 kΩ (max. 4 kΩ)
	connection	PT1000 (-200°C- 850°C)
	accuracy	2-wire
	conversion resolution	0.5 % of range
	Analogue input mode	16 bit (sigma-delta) internally referenced Single-ended
	* Low or high input range and primary input value (resistance or temperature) are set by the MiQen setting software	
Tariff input module	No. of inputs	2
	Voltage	5 ... 48 V DC * 110 ±20% V AC/DC * 230 ±20% V AC/DC *
	* Depends on a built in hardware	
Digital input module	No. of inputs	2
	Voltage	5 ... 48 V DC * 110 ±20% V AC/DC * 230 ±20% V AC/DC *
	* Depends on built in hardware	
Pulse input module	Rated voltage	5 ... 48 V DC
	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
2nd Comm. module (RS232 / RS485)	No. of communications	1
	Type of connection	Direct / Network
	Max. connection length	3 m / 1000 m

8.5 Communication

	Ethernet	RS485	RS232	USB
Type of connection	Network		Direct	
Max. conn. length	-	1000 m	3 m	5 m
Terminals	RJ-45	DB9 female connector or screw terminals		USB-B type
Insulation	3.7 kV rms., 1 minute between terminals and other circuits			
Transfer mode	Asynchronous			
Protocol	MODBUS RTU / DNP3			
Transfer rate	10/100 Mb/s	1.200 to 115.200 bit/s		115.200 bit/s

8.6 Electronic features

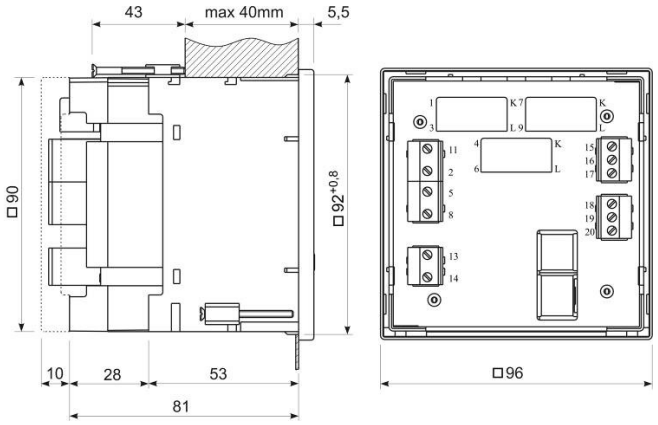
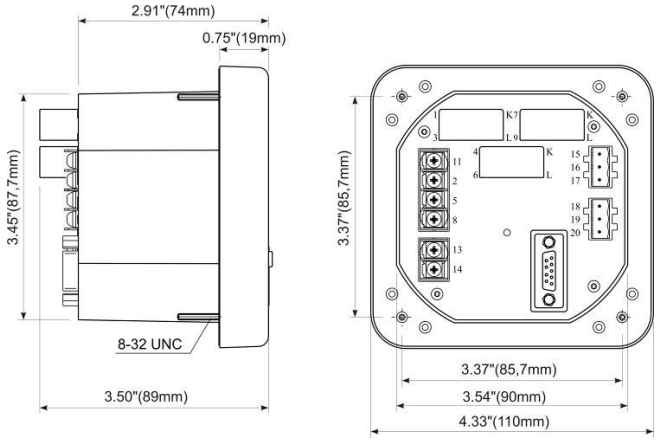
LCD		
Type	Graphic LCD	
Size	128 x 64 dots	
LCD refreshing	Every 200 ms	
Response time		
Input – screen Input – communication Input – relay	All calculations are averaged over an interval of between 8 to 256 periods. Preset interval is 64 periods, which is 1.28 second at 50 Hz.	
Memory	MC750	MC760
Capacity	8 Mb	8 Mb
Divisions	Recorder A Recorder B Recorder C Recorder D	Recorder A Recorder B Recorder C Recorder D
	Alarms recorder	Alarms recorder Q reports Q details
Selection of limit values	minimal maximal minimal (period) maximal (period) average actual minimal (thermal function) maximal (thermal function)	
Sampling period	1 to 60 min	
LED's		
Memory card	Green	Activity of memory card
Communication	Green	Transmission of MC via communication
Alarm	Red	Fulfilled condition for alarm
RTC backup supply		
Battery	Lifespan	6 years (typical at 23°C)
Supercap	Lifespan	2 days

8.7 Safety features

Safety	In compliance with **EN 61010-1** 600 V rms, installation category II 300 V rms, installation category III Pollution degree 2
Test voltage	3.7 kV rms, in compliance with **EN 61010-1**
EMC	Directive on electromagnetic compatibility 2004/108/EC In compliance with **EN 61326-1**
Protection	In compliance with **EN 60529** Front side (with protection cover for memory slot): IP52 Rear side (with protection cover): IP20
Ambient conditions	
Climatic class	3 In compliance with **EN 62052-11** In compliance with **EN 62052-21**
Temperature range of operation	-10 to +65°C
Storage temperature range	-40 to +70°C
Max. storage and transport humidity	≤ 75% r.h.
Enclosure	
DIN	PC, incombustibility - self-extinguishability, in compliance with UL 94 V0
ANSI	ABS & Polycarbonate Blend - self-extinguishability, in compliance with UL 94 V0
Weight	AC up to 600g

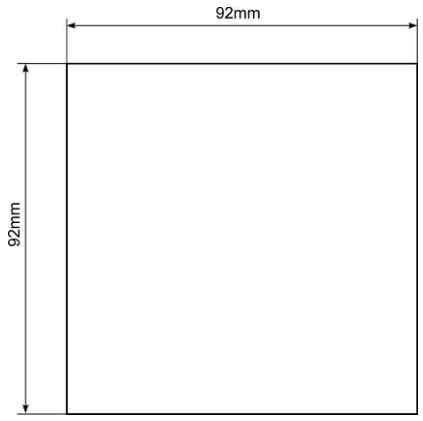
8.8 Dimensions

Casing

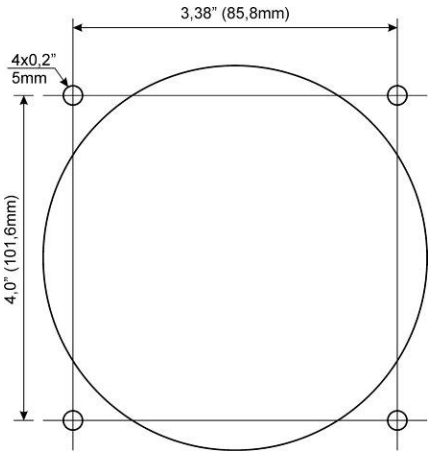
Construction	Appearance
DIN	All dimensions are in mm 
ANSI	

Panel cut out

DIN



ANSI



9 APPENDIX A: MODBUS PROTOCOL

9.1 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.

The memory reference for input and holding registers is 30000 and 40000 respectively.

Register table for the actual measurements

Parameter	MODBUS		
	Register		Type
	Start	End	
Voltage U_1	30107	30108	T5
Voltage U_2	30109	30110	T5
Voltage U_3	30111	30112	T5
Average phase Voltage U~	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
Current I_1	30126	30127	T5
Current I_2	30128	30129	T5
Current I_3	30130	30131	T5
Total Current I	30138	30139	T5
Neutral current In	30132	30133	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 Q_1	30150	30151	T6
Reactive Power Q_2	30152	30153	T6
Reactive Power Q_3	30154	30155	T6
Total Reactive Power Q	30148	30149	T6
Apparent Power S_1	30158	30159	T5
Apparent Power S_2	30160	30161	T5
Apparent Power S_3	30162	30163	T5
Total Apparent Power S	30156	30157	T5
Power Factor PF_1	30166	30167	T7
Power Factor PF_2	30168	30169	T7
Power Factor PF_3	30170	30171	T7
Total Power Factor PF	30164	30165	T7
Power Angle U_1–I_1	30173		T2
Power Angle U_2–I_2	30174		T2
Power Angle U_3–I_3	30175		T2
Power Angle atan2(Pt, Qt)	30172		T2
Angle U_1–U_2	30115		T2
Angle U_2–U_3	30116		T2
Angle U_3–U_1	30117		T2
Frequency f	30105	30106	T5
Voltage unbalance Uu	30176		T1

Parameter	MODBUS			
	Register		Type	
	Start	End		
THD I_1	30188		T1	
THD I_2	30189		T1	
THD I_3	30190		T1	
THD U_1	30182		T1	
THD U_2	30183		T1	
THD U_3	30184		T1	
THD U_{12}	30185		T1	
THD U_{23}	30186		T1	
THD U_{31}	30187		T1	
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 I_1	30518	30519	T5	
MD Current I_2	30524	30525	T5	
MD Current I_3	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 –	30516	30517	T6	
MD Apparent Power S	30508	30509	T5	
MD Current I_1	30502	30503	T5	
MD Current I_2	30504	30505	T5	
MD Current I_3	30506	30507	T5	
Energy				
Energy Counter 1 Exponent	30401		T2	Actual counter value is calculated: Counter * 10 Exponent
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, Cost	30446	30447	T3	Actual counter value is calculated: Counter * 10 Exponent
Counter E2, Cost	30448	30449	T3	
Counter E3, Cost	30450	30451	T3	
Counter E4, Cost	30452	30453	T3	
Active tariff	30405		T1	
Internal Temperature	30181		T2	

Register table for the normalized actual measurements (IEEE 754) Floating-Point Single Precision Value (32 bit)

Parameter	MODBUS		
	Register		
	Start	End	Type
Uavg (phase to neutral)	32484	32485	T_float
Uavg (phase to phase)	32486	32487	T_float
Σ I	32488	32489	T_float
Active Power Total (Pt)	32490	32491	T_float
Reactive Power Total (Qt)	32492	32493	T_float
Apparent Power Total (St)	32494	32495	T_float
Power Factor Total (PFt)	32496	32497	T_float
Frequency	32498	32499	T_float
U1	32500	32501	T_float
U2	32502	32503	T_float
U3	32504	32505	T_float
Uavg (phase to neutral)	32506	32507	T_float
U12	32508	32509	T_float
U23	32510	32511	T_float
U31	32512	32513	T_float
Uavg (phase to phase)	32514	32515	T_float
I1	32516	32517	T_float
I2	32518	32519	T_float
I3	32520	32521	T_float
I	32522	32523	T_float
I neutral (calculated)	32524	32525	T_float
I neutral (measured)	32526	32527	T_float
Iavg	32528	32529	T_float
Active Power Phase L1 (P1)	32530	32531	T_float
Active Power Phase L2 (P2)	32532	32533	T_float
Active Power Phase L3 (P3)	32534	32535	T_float
Active Power Total (Pt)	32536	32537	T_float
Reactive Power Phase L1 (Q1)	32538	32539	T_float
Reactive Power Phase L2 (Q2)	32540	32541	T_float
Reactive Power Phase L3 (Q3)	32542	32543	T_float
Reactive Power Total (Qt)	32544	32545	T_float
Apparent Power Phase L1 (S1)	32546	32547	T_float
Apparent Power Phase L2 (S2)	32548	32549	T_float
Apparent Power Phase L3 (S3)	32550	32551	T_float
Apparent Power Total (St)	32552	32553	T_float
Power Factor Phase 1 (PF1)	32554	32555	T_float
Power Factor Phase 2 (PF2)	32556	32557	T_float
Power Factor Phase 3 (PF3)	32558	32559	T_float
Power Factor Total (PFt)	32560	32561	T_float
CAP/IND P. F. Phase 1 (PF1)	32562	32563	T_float
CAP/IND P. F. Phase 2 (PF2)	32564	32565	T_float
CAP/IND P. F. Phase 3 (PF3)	32566	32567	T_float
CAP/IND P. F. Total (PFt)	32568	32569	T_float
φ1 (angle between U1 and I1)	32570	32571	T_float
φ2 (angle between U2 and I2)	32572	32573	T_float
φ3 (angle between U3 and I3)	32574	32575	T_float

Parameter	MODBUS		
	Register		
	Start	End	Type
Power Angle Total (atan2(Pt,Qt))	32576	32577	T_float
φ12 (angle between U1 and U2)	32578	32579	T_float
φ23 (angle between U2 and U3)	32580	32581	T_float
φ31 (angle between U3 and U1)	32582	32583	T_float
Frequency	32584	32585	T_float
U unbalace	32586	32587	T_float
I1 THD%	32588	32589	T_float
I2 THD%	32590	32591	T_float
I3 THD%	32592	32593	T_float
U1 THD%	32594	32595	T_float
U2 THD%	32596	32597	T_float
U3 THD%	32598	32599	T_float
U12 THD%	32600	32601	T_float
U23 THD%	32602	32603	T_float
U31 THD%	32604	32605	T_float
Max Demand Since Last RESET			
Active Power Total (Pt) - (positive)	32606	32607	T_float
Active Power Total (Pt) - (negative)	32608	32609	T_float
Reactive Power Total (Qt) - L	32610	32611	T_float
Reactive Power Total (Qt) - C	32612	32613	T_float
Apparent Power Total (St)	32614	32615	T_float
I1	32616	32617	T_float
I2	32618	32619	T_float
I3	32620	32621	T_float
Dynamic Demand Values			
Active Power Total (Pt) - (positive)	32622	32623	T_float
Active Power Total (Pt) - (negative)	32624	32625	T_float
Reactive Power Total (Qt) - L	32626	32627	T_float
Reactive Power Total (Qt) - C	32628	32629	T_float
Apparent Power Total (St)	32630	32631	T_float
I1	32632	32633	T_float
I2	32634	32635	T_float
I3	32636	32637	T_float
Energy			
Energy Counter 1	32638	32639	T_float
Energy Counter 2	32640	32641	T_float
Energy Counter 3	32642	32643	T_float
Energy Counter 4	32644	32645	T_float
Energy Counter 1 Cost	32646	32647	T_float
Energy Counter 2 Cost	32648	32649	T_float
Energy Counter 3 Cost	32650	32651	T_float
Energy Counter 4 Cost	32652	32653	T_float
Total Energy Counter Cost	32654	32655	T_float
Active Tariff	32656	32657	T_float
Internal Temperature	32658	32659	T_float

Register table for the normalized actual measurements

Parameter	MODBUS		100% value
	Register	Type	
Voltage U_1	30801	T16	Un
Voltage U_2	30802	T16	Un
Voltage U_3	30803	T16	Un
Average phase Voltage U~	30804	T16	Un
Phase to phase voltage U_{12}	30805	T16	Un
Phase to phase voltage U_{23}	30806	T16	Un
Phase to phase voltage U_{31}	30807	T16	Un
Average phase to phase Voltage $U_{pp\sim}$	30808	T16	Un
Current I_1	30809	T16	In
Current I_2	30810	T16	In
Current I_3	30811	T16	In
Total Current I	30812	T16	It
Neutral current In	30813	T16	In
Average Current I~	30815	T16	In
Real Power P_1	30816	T17	Pn
Real Power P_2	30817	T17	Pn
Real Power P_3	30818	T17	Pn
Total Real Power P	30819	T17	Pt
Reactive Power Q_1	30820	T17	Pn
Reactive Power Q_2	30821	T17	Pn
Reactive Power Q_3	30822	T17	Pn
Total Reactive Power Q	30823	T17	Pt
Apparent Power S_1	30824	T16	Pn
Apparent Power S_2	30825	T16	Pn
Apparent Power S_3	30826	T16	Pn
Total Apparent Power S	30827	T16	Pt
Power Factor PF_1	30828	T17	1
Power Factor PF_2	30829	T17	1
Power Factor PF_3	30830	T17	1
Total Power Factor PF	30831	T17	1
CAP/IND P.F. Phase 1 (PF_1)	30832	T17	1
CAP/IND P.F. Phase 2 (PF_2)	30833	T17	1
CAP/IND P.F. Phase 3 (PF_3)	30834	T17	1
CAP/IND P.F. Total (PFt)	30835	T17	1
Power Angle U_1–I_1	30836	T17	100°
Power Angle U_2–I_2	30837	T17	100°
Power Angle U_3–I_3	30838	T17	100°
Power Angle atan2(Pt, Qt)	30839	T17	100°
Angle U_1–U_2	30840	T17	100°
Angle U_2–U_3	30841	T17	100°
Angle U_3–U_1	30842	T17	100°
Frequency	30843	T17	Fn+10Hz
Voltage unbalance Uu	30844	T16	100%
THD I_1	30845	T16	100%
THD I_2	30846	T16	100%
THD I_3	30847	T16	100%
THD U_1	30848	T16	100%
THD U_2	30849	T16	100%
THD U_3	30850	T16	100%
THD U_{12}	30851	T16	100%
THD U_{23}	30852	T16	100%
THD U_{31}	30853	T16	100%

Parameter	MODBUS		100% value
	Register	Type	
Max Demand Since Last Reset			
MD Real Power P (positive)	30854	T16	Pt
MD Real Power P (negative)	30855	T16	Pt
MD Reactive Power Q – L	30856	T16	Pt
MD Reactive Power Q – C	30857	T16	Pt
MD Apparent Power S	30858	T16	Pt
MD Current I_1	30859	T16	In
MD Current I_2	30860	T16	In
MD Current I_3	30861	T16	In
Dynamic Demand Values			
MD Real Power P (positive)	30862	T16	Pt
MD Real Power P (negative)	30863	T16	Pt
MD Reactive Power Q – L	30864	T16	Pt
MD Reactive Power Q – C	30865	T16	Pt
MD Apparent Power S	30866	T16	Pt
MD Current I_1	30867	T16	In
MD Current I_2	30868	T16	In
MD Current I_3	30869	T16	In
Energy			
Energy Counter 1	30870	T17	Actual counter value MOD 20000 is returned
Energy Counter 2	30871	T17	
Energy Counter 3	30872	T17	
Energy Counter 4	30873	T17	
Energy Counter 1 Cost	30874	T17	
Energy Counter 2 Cost	30875	T17	
Energy Counter 3 Cost	30876	T17	
Energy Counter 4 Cost	30877	T17	
Total Energy Counter Cost	30878	T17	
Active Tariff	30879	T1	
Internal Temperature	30880	T17	100°
Frequency (wide range) 0.00 – 655.35 Hz	30891	T16	100 Hz

100% values calculations for normalized measurements

Un =	(R40147 / R40146) * R30015 * R40149	
In =	(R40145 / R40144) * R30017 * R40148	
Pn =	Un*In	
It =	In	Connection Mode: 1b
It =	3*In	Connection Modes: 3b, 4b, 3u, 4u
Pt =	Pn	Connection Mode: 1b
Pt =	3*Pn	Connection Modes: 3b, 4b, 3u, 4u
Fn =	R40150	

All other MODBUS registers are a subject to change. For the latest MODBUS register definitions go to ISKRA SISTEMI's web page www.iskrasistemi.si

Register	Content
30015	Calibration voltage
30017	Calibration current

Register table for the basic settings

Register	Content	Type	Ind	Values / Dependencies	Min	Max	P. 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

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)
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) Significant (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)

10 APPENDIX B: DNP3 PROTOCOL

10.1 DNP3 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.

DNP3

DNP3 protocol enables operation of MC 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.

Object			Request		Response	
Object Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
30	2	16-Bit Analogue Input with flag	1	00, 01, 02, 06	129	00, 01, 02, 00
30	4	16-Bit Analogue Input without flag	1	00, 01, 02, 06	129	00, 01, 02, 00

Register table for the actual measurements

DNP3 Point	Parameter	Type	100% value
0	Voltage U1	T16	Un
1	Voltage U2	T16	Un
2	Voltage U3	T16	Un
3	Average phase Voltage U~	T16	Un
4	Phase to phase voltage U12	T16	Un
5	Phase to phase voltage U23	T16	Un
6	Phase to phase voltage U31	T16	Un
7	Average phase to phase Voltage Upp~	T16	Un
8	Current I1	T16	In
9	Current I2	T16	In
10	Current I3	T16	In
11	Total Current I	T16	In
12	Neutral current In	T16	In
13	Reserved	T16	In
14	Average Current I~	T16	In
15	Real Power P1	T17	Pn
16	Real Power P2	T17	Pn
17	Real Power P3	T17	Pn
18	Total Real Power P	T17	Pt
19	Reactive Power Q1	T17	Pn
20	Reactive Power Q2	T17	Pn
21	Reactive Power Q3	T17	Pn
22	Total Reactive Power Q	T17	Pt
23	Apparent Power S1	T16	Pn
24	Apparent Power S2	T16	Pn
25	Apparent Power S3	T16	Pn
26	Total Apparent Power S	T16	Pt
27	Power Factor PF1	T17	1
28	Power Factor PF2	T17	1
29	Power Factor PF3	T17	1
30	Total Power Factor PF	T17	1
31	CAP/IND P. F. Phase 1 (PF1)	T17	1

32	CAP/IND P. F. Phase 2 (PF2)	T17	1
DNP3 Point	**Parameter**	**Type**	**100% value**
33	CAP/IND P. F. Phase 3 (PF3)	T17	1
34	CAP/IND P. F. Total (PFt)	T17	1
35	Power Angle U1−I1	T17	100°
36	Power Angle U2−I2	T17	100°
37	Power Angle U3−I3	T17	100°
38	Power Angle atan2(Pt, Qt)	T17	100°
39	Angle U1−U2	T17	100°
40	Angle U2−U3	T17	100°
41	Angle U3−U1	T17	100°
42	Frequency	T17	Fn+10Hz
43	Voltage unbalance Uu	T16	100%
44	THD I1	T16	100%
45	THD I2	T16	100%
46	THD I3	T16	100%
47	THD U1	T16	100%
48	THD U2	T16	100%
49	THD U3	T16	100%
50	THD U12	T16	100%
51	THD U23	T16	100%
52	THD U31	T16	100%
	Max Demand Since Last Reset		
53	MD Real Power P (positive)	T16	Pt
54	MD Real Power P (negative)	T16	Pt
55	MD Reactive Power Q - L	T16	Pt
56	MD Reactive Power Q - C	T16	Pt
57	MD Apparent Power S	T16	Pt
58	MD Current I1	T16	In
59	MD Current I2	T16	In
60	MD Current I3	T16	In
	Dynamic Demand Values		
61	MD Real Power P (positive)	T16	Pt
62	MD Real Power P (negative)	T16	Pt
63	MD Reactive Power Q - L	T16	Pt
64	MD Reactive Power Q - C	T16	Pt
65	MD Apparent Power S	T16	Pt
66	MD Current I1	T16	In
67	MD Current I2	T16	In
68	MD Current I3	T16	In

DNP3 Point	Parameter	Type	100% value
69	Energy Counter 1	T17	Actual counter value MOD 20000 is returned
70	Energy Counter 2	T17	
71	Energy Counter 3	T17	
72	Energy Counter 4	T17	
73	Energy Counter 1 Cost	T17	
74	Energy Counter 2 Cost	T17	
75	Energy Counter 3 Cost	T17	
76	Energy Counter 4 Cost	T17	
77	Total Energy Counter Cost	T17	
78	Active Tariff	T1	

Data types decoding

See Data types decoding in *Appendix A: Modbus protocol* on page 74.

100% values calculations

See 100% values calculations for normalized measurements in *Appendix A: Modbus protocol* on page 74

11 APPENDIX C: CALCULATIONS & EQUATIONS

11.1 Calculations

Definitions of symbols

No	Symbol	Definition
1	M_v	Sample factor
2	M_P	Average interval
3	U_f	Phase voltage (U_1, U_2 or U_3)
4	U_{ff}	Phase-to-phase voltage (U_{12}, U_{23} or U_{31})
5	N	Total number of samples in a period
6	n	Sample number ($0 \le n \le N$)
7	x, y	Phase number (1, 2 or 3)
8	i_n	Current sample n
9	u_{fn}	Phase voltage sample n
10	u_{fFn}	Phase-to-phase voltage sample n
11	ϕ_f	Power angle between current and phase voltage f (ϕ_1, ϕ_2 or ϕ_3)
12	U_u	Voltage unbalance
13	U_c	Agreed supply voltage

11.2 Equations

Voltage

$$U_f = \sqrt{\frac{\sum_{n=1}^{N} u_n^2}{N}}$$

Phase voltage
N - 128 samples in one period (up to 65 Hz)
N - 128 samples in M_v periods (above 65Hz)
Example: 400 Hz → $M_v = 7$

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

Phase-to-phase voltage
u_x, u_y - phase voltages (U_f)
N - a number of samples in a period

$$U_u = \sqrt{\frac{1-\sqrt{3-6\beta}}{1+\sqrt{3-6\beta}}} \cdot 100\%$$

$$\beta = \frac{U_{12fund}^4 + U_{23fund}^4 + U_{31fund}^4}{\left(U_{12fund}^2 + U_{23fund}^2 + U_{31fund}^2\right)^2}$$

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 - 128 samples in a period (up to 65 Hz) N - 128 samples in more periods (above 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 - 128 samples in a period (up to 65 Hz)

Power

$P_f = \frac{1}{N} \cdot \sum_{n=1}^{N} \left(u_{fn} \cdot i_{fn}\right)$	**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
$\mathrm{SignQ}_f(\varphi)$ $\varphi \in [0° - 180°] \Rightarrow \mathrm{SignQ}_f(\varphi) = +1$ $\varphi \in [180° - 360°] \Rightarrow \mathrm{SignQ}_f(\varphi) = -1$	**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_f - apparent power by phases
$Q_f = \mathrm{SignQ}_f(\varphi) \cdot \sqrt{S_f^2 - P_f^2}$	**Reactive power by phases** S_f - apparent power by phases P_f - active power by phases
$Q_f = \frac{1}{N} \cdot \sum_{n=1}^{N} \left(u_{f\,n} \times i_{f\,[n+N/4]}\right)$	**Reactive power by phases (delayed current 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_f - reactive power by phases
$\varphi_s = \arctan2(P_t, Q_t)$ $\varphi_s = [-180°, 179{,}99°]$	**Total power angle** P_t - total active power S_t - total apparent power
$PF_t = \frac{P_t}{S_t}$	**Distortion factor** P - total active power S - total apparent power
$PF_f = \frac{P_f}{S_f}$	**Distortion factor** P_t - phase active power S_t - phase apparent power

THD

$$I_f THD(\%) = \frac{\sqrt{\sum_{n=2}^{63} I_n^{\,2}}}{I_1} \cdot 100$$

Current THD
I_1 - value of first harmonic
n - number of harmonic

$$U_f THD(\%) = \frac{\sqrt{\sum_{n=2}^{63} U_{fn}^{\,2}}}{U_{f1}} \cdot 100$$

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

Flickers

$$P_{50S} = (P_{30} + P_{50} + P_{80})/3$$
$$P_{10S} = (P_6 + P_8 + P_{10} + P_{13} + P_{17})/5$$
$$P_{3S} = (P_{2,2} + P_3 + P_4)/3$$
$$P_{1S} = (P_{1,7} + P_1 + P_{1,5})/3$$
$$P_{st} = \sqrt{\begin{matrix}0{,}0314P_{0,1} + 00525P_{1S} + 0{,}0657P_{3S} \\ + 0{,}28P_{10S} + 0{,}08P_{50S}\end{matrix}}$$

P_{st} - 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)

$$P_{lt} = \sqrt[3]{\sum_{i=1}^{12} \frac{P_{sti}^3}{12}}$$

P_{lt} - Long-term flicker intensity
Calculated from twelve successive values of short-term flicker intensity in a two-hour period

Energy

$$\text{Price in tariff} = \text{Price} \cdot 10^{\text{Tarif price exponent}}$$

Total exponent of tariff price and energy price in all tariffs

12 APPENDIX D: DATA FORMATS

XML data format

Currently, two XML formats are available. XML-smart is general purpose XML format whereas XML-logic is more proprietary, suitable for special customers. For this purpose only XML-smart format will be explained.

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*: recorder ??
- *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>
```

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