



POWER QUALITY ANALYZER MC 770

- **Class A** measuring accuracy according to EN61000-4-30.
- **Evaluation of power quality** in compliance with EN 50160.
- Voltage and current auto range measurements up to 1000 V_{RMS}, 12.5 A.
- **Wide frequency** measurement range 16 Hz – 400 Hz.
- Up to **three independent communication ports**.
- Support for **NTP real time synchronisation**.
- Up to **4 inputs/outputs**.

FEATURES

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

DESCRIPTION

Power quality analyzer MC 770 is an important device for permanent monitoring of power quality from its production (especially renewable), transmission, distribution to final consumers, who are most affected by insufficient quality of voltage. Lack of information about supplied quality of voltage can lead to unexplained production problems and malfunction or even damage to equipment used in production process. Therefore, **MC 770** can be used for utility purposes (evaluation against standards) as well as for industry purposes (monitoring supplied power quality).

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

Moreover **MC 770** stores measurements and quality reports in internal memory for further analysis over recorded measurements. By accessing recorded or real time values from multiple instruments installed on different locations it is possible to gain the overall picture of systems' behaviour. This can be achieved with regard to **MC 770** accurate internal real time clock and NTP synchronisation support, which assure accurate, time-stamped measurements from dislocated units.

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

APPLICATION AND BENEFITS

Power quality analyzer MC 770 can be used as a standalone PQ monitoring device for detection of local PQ deviations. For this purpose it is normally positioned at the point-of-common-coupling (PCC) of small and medium industrial and commercial energy consumers to monitor quality of delivered electric energy or at medium or low voltage feeders to monitor, detect and record possible disturbances caused by (unauthorized) operation of consumers.

Identifying relevant fixed measuring points is the most important task prior to complete system installation. This system itself will not prevent disturbances in network but it will help diagnose their origin and effects. This is possible only with system approach by using time synchronized meters with wide range of measuring parameters.

Therefore the most extensive benefits are achieved when **MC 770** is used as a part of an energy monitoring system comprising of strategically positioned meters connected to **MiSMART** software solution. This three-tier middleware software represents a perfect tool for utility companies, energy suppliers and other parties on both ends of supply-demand chain. **MiSMART data collector** with "push" communication system allows automatic recording of all predefined measuring parameters. They are stored in **MiSMART database**, while leaving a copy of same parameters stored locally in memory of each device as a backup copy. Database records in XML format can be searched and viewed in tabular and graphical form using **MiSMART client** or other third-party application software.

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

COMPLIANCE WITH STANDARDS

Measurements and reports of power (voltage) quality (PQ) indexes are only useful when can be compared with measurements and reports from other PQ measuring devices in the supply network and evaluated against agreed limits for assessment of measured PQ indexes to establish an overall view about PQ issues in the network.

For this purpose it is essential to follow guidelines described in series of international and local standards. Beside requirements for safe operation (LVD directive) and immunity against more and more demanding disturbances (EMC directive), PQ measuring depends on two levels of standardization.

Procedures for proper acquirement of PQ indexes, their timed aggregation and required accuracy are described in a standard IEC EN 61000-4-30 and two supplementary standards IEC EN 61000-4-7 (harmonics), IEC EN 61000-4-15 (flicker meter).

Procedures for evaluation of measured PQ indexes according to limit levels described in European standard EN 50160.

Power quality analyzer MC 770 follows required procedures and meets the precision requirements for class A measuring device as described in standard IEC EN 61000-4-30. It uses acquired measurements to perform automatic evaluation of PQ according to EN 50160 and issues weekly reports. In case if certain PQ indexes fail to meet required quality it also shows details of problematic measurements and time of occurrence of discrepancy.

Standard EN	Description
61010-1:2010	<i>Safety requirements for electrical equipment for measurement, control and laboratory use.</i>
61557-12:2008	<i>Electrical safety in LV distribution systems up to 1 kV a.c. and 1.5 kV d.c. – Combined performance measuring and monitoring devices for electrical parameters.</i>
61000-4-30:2009	<i>Electromagnetic compatibility (EMC) – Power quality measurements methods.</i>
61000-4-7:2003 + A1:2009	<i>Electromagnetic compatibility (EMC) – General guide on harmonics and inter-harmonics measurements.</i>
61000-4-15:2010	<i>Electromagnetic compatibility (EMC) – Flicker meter.</i>
50160:2011	<i>Voltage characteristics of electricity supplied by public distribution networks.</i>
62053-22:2003	<i>Electricity metering equipment - Static meters for active energy (classes 0.2 S and 0.5 S).</i>
62053-24:2014	<i>Electricity metering equipment – Static meters for reactive energy at fundamental frequency (classes 0,5 S, 1 S and 1)</i>
62053-23:2003	<i>Electricity metering equipment -Static meters for reactive energy (classes 2 and 3).</i>
61326-1:2006	<i>EMC requirements for electrical equipment for measurement, control and laboratory use.</i>
60529:1997/A1:2000	<i>Degrees of protection provided by enclosures (IP code).</i>
60068-2-1/-2/-6/-27/-30	<i>Environmental testing (-1 Cold, -2 Dry heat, -30 Damp heat, -6 Vibration, -27 Shock).</i>
UL 94	<i>Tests for flammability of plastic materials for parts in devices and appliances.</i>

Table 1: List of applicable standards

VOLTAGE QUALITY

Voltage Quality is well defined term (sometimes also termed Power Quality – PQ) and is covered with a selection of parameters, each of which represents certain phenomenon. They represent only most common types of phenomena which can describe operation of electrical network with closest approximation.

Power quality analyzer MC 770 measures, detects, stores and evaluates parameters, which are defined in several standards. Evaluation is by default performed according to limits set in European standard EN50150. Beside that users can always alter parameters according to their requirements or according to immunity of their equipment which operates within analyzed power network.

PQ recording settings

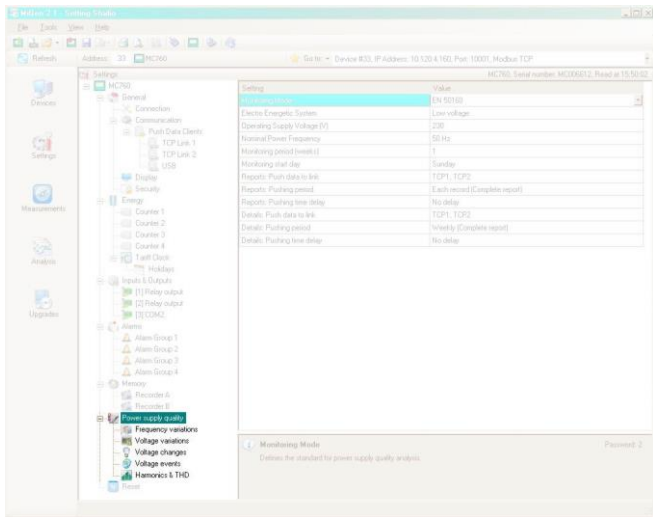


Figure 1: The sample of settings for power quality parameters are set with setting and monitoring software MiQen

Characteristic parameters that describe power quality are shown in table 1.

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

Table 2: Voltage quality parameters as defined in EN50160

PQ reports

PQ report is issued on a basis of chosen PQ parameters as well as information about a period of tracking and place of tracking (type of network).

Each record is internally stored for later analysis. Settings software allows user to quickly view PQ report with limit lines and compliance results.

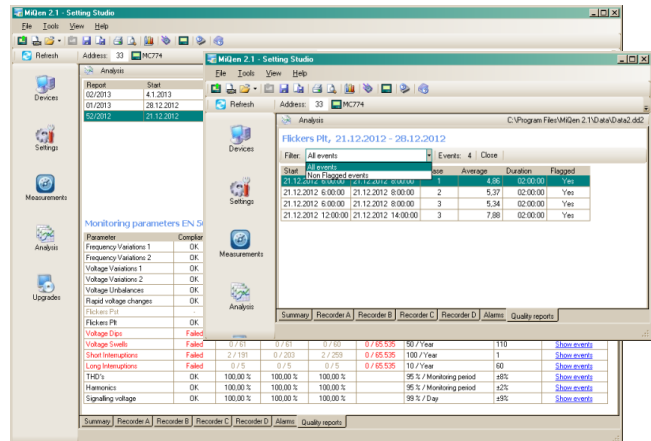


Figure 2: The sample of viewing power quality report parameters and log details with setting software MiQen

To analyze in **details** which and when certain parameters are outside limit lines it is possible to view time stamped details and with that establish true origin of anomaly and its consequences.

MEASUREMENTS

ONLINE MEASUREMENTS

NOTE!
In MiQen settings, software device will represent itself as MC 770A.

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

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

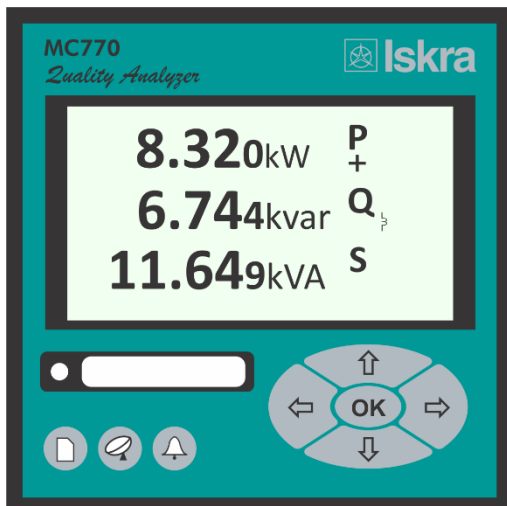
For better overview over numerous readings, they are divided into several groups, which contain basic measurements, min. and max. values, harmonics, interharmonics, PQ parameters and alarms.

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

INTERACTIVE INSTRUMENT

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

This feature is useful for presentations or product training.



SELECTION OF AVAILABLE QUANTITIES

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

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

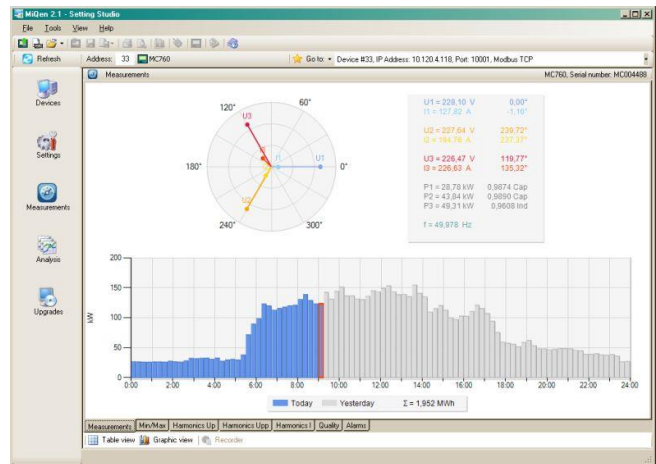


Figure 3: The sample of online measurements in graphical form – phase diagram and daily total active power consumption histogram

Phase measurements	L1	L2	L3	Total	Others
Voltage	226.21 V	227.61 V	226.73 V	227.50 V	U ₀ = 27.50 V
Current	146.73 A	187.17 A	223.08 A	576.97 A	I ₀ = 151.98 A
Real Power	32.96 kW	44.63 kW	50.59 kW	128.20 kW	Inc = 95.9 A
Reactive Power	4.35 kvar	4.53 kvar	15.23 kvar	24.11 kvar	
Apparent Power	33.25 kVA	44.87 kVA	52.83 kVA	130.98 kVA	
Power Factor	0.9914 Ind	0.9947 Ind	0.9575 Ind	0.9788 Ind	
Power Angle	2.82 °	0.55 °	16.40 °	10.65 °	
THD-Upp	1.88 %	1.87 %	1.79 %		
THD-I	12.19 %	9.87 %	5.63 %		
Phase to phase measurements	L1-L2	L2-L3	L3-L1	Total	Others
Phase to phase voltage	395.16 V	393.31 V	393.76 V		U ₀ = 394.08 V
Angle	120.19 °	119.91 °	119.87 °		U ₀ = 0.00 %
THD-Upp	1.90 %	1.72 %	1.81 %		
Energy counters	Counter E1 (Exp)	Counter E2 (Exp)	Counter E3 (Imp)	Counter E4 (Imp)	Active tariff
Total	1.726.219.60 kWh	294.607.13 kvah	0.22 kWh	50.941.87 kvah	1
Tarif 1	1.726.219.55 kWh	294.607.10 kvah	0.21 kWh	50.941.84 kvah	
Tarif 2	0.00 kWh	0.01 kvah	0.00 kWh	0.00 kvah	

Figure 4: The sample of online measurements in tabular form

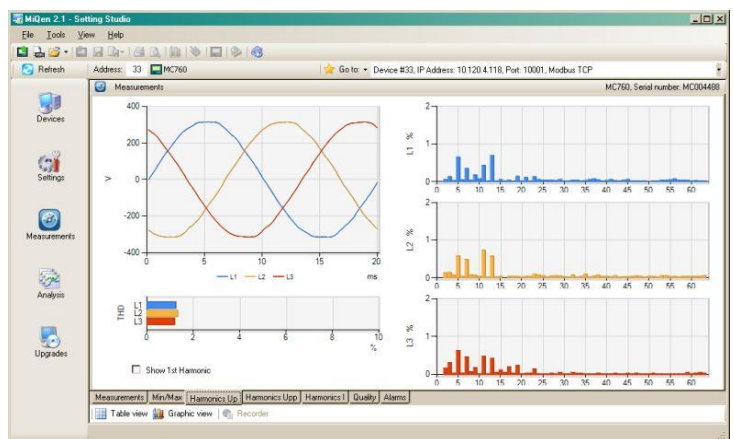





Figure 5: The sample of online harmonic measurements in graphical form

Meas. type	Measurement	3-phase 4-wire	3-phase 3-wire	1-phase	comments
Phase measurements	<i>Voltage</i>				
	U _{1-3_RMS}	☑		☑1ph	
	U _{AVG_RMS}	☑		☑	
	U _{unbalance_neg_RMS}	☑📖	☑📖		
	U _{unbalance_zero_RMS}	☑📖	☑📖		
	U _{1-3_DC}	☑		☑1ph	DC component of phase voltages
	<i>Current</i>				
	I _{1-3_RMS}	☑	☑	☑1ph	
	I _{TOT_RMS}	☑	☑	☑	
	I _{AVG_RMS}	☑	☑	☑	
	I _{NEUTRAL_calc}	☑	☑	☑	Calculated neutral current
	<i>Power</i>				
	P _{1-3_RMS}	☑		☑1ph	
	P _{TOT_RMS}	☑	☑	☑	
	Q _{1-3_RMS}	☑📖		☑1ph📖	Reactive power can be calculated as a squared difference between S and P or as delayed sample
	Q _{TOT_RMS}	☑	☑	☑	
	Q _{b1-3_RMS}	☑		☑1ph	Budeanu reactive power Phase
	Q _{bTOT_RMS}	☑	☑	☑	Budeanu reactive power Total
	S _{1-3_RMS}	☑		☑1ph	
	S _{TOT_RMS}	☑	☑	☑	
	D _{1-3_RMS}	☑		☑1ph	Deformed power Phase
	D _{TOT_RMS}	☑	☑	☑	Deformed power Total
	PF _{1-3_RMS}	☑		☑1ph	
	PF _{TOT_RMS}	☑	☑	☑	
	dPF _{1-3_RMS}	☑		☑1ph	Displacement Power Factor Phase
	dPF _{TOT_RMS}	☑	☑	☑	Displacement Power Factor Total
	φ _{1-3_RMS}	☑		☑1ph	PA – Power angle
	<i>Harmonic analysis</i>				
	THD-U ₁₋₃	☑		☑1ph	
	THD-I ₁₋₃	☑	☑	☑1ph	
	TDD-I ₁₋₃	☑	☑	☑1ph	
	U _{1-3_harmonic_1-63_%}	☑📖		☑1ph📖	% of RMS or % of base
	U _{1-3_harmonic_1-63_ABS}	☑		☑1ph	
	U _{1-3_harmonic_1-63_φ}	☑		☑1ph	
	U _{1-3_inter-harmonic_%}	☑📖		☑1ph📖	Monitoring up to 10 different fixed frequencies. % of RMS or % of base
	U _{1-3_inter-harmonic_ABS}	☑		☑1ph	
U _{1-3_signaling_%}	☑📖		☑1ph📖	Monitoring of signaling (ripple) voltage of set frequency. % of RMS or % of base	
U _{1-3_signaling_ABS}	☑		☑1ph		
I _{1-3_harmonic_1-63_%}	☑📖	☑📖	☑1ph📖	% of RMS or % of base	
I _{1-3_harmonic_1-63_ABS}	☑	☑	☑1ph		
I _{1-3_harmonic_1-63_φ}	☑	☑	☑1ph		

📖 For more information see **MC 770 Quality Analyzer** User's manual (K_MC 770_EN_22440500_Ver_1.00)

Table 3: Selection of available measurement quantities

Meas. type	Measurement	3-phase 4-wire	3-phase 3-wire	1-phase	comments
Phase measurements	Flickers				
	Pi ₁₋₃	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/> 1ph	Instantaneous flicker sensation measured with 150 samples / sec (original sampling is 1200 samples / sec)
	Pst ₁₋₃	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/> 1ph	10 min statistical evaluation (128 classes of CPF)
	Plt ₁₋₃	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/> 1ph	Derived from 12 Pst acc. to EN 61000-4-15
	Miscellaneous				
	K-factor ₁₋₃	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> 1ph	
	Current Crest factor I ₁₋₃	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> 1ph	
	Voltage Crest factor U ₁₋₃	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/> 1ph	
Phase to phase measurements	Voltage				
	Upp _{1-3_RMS}	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
	Upp _{AVG_RMS}	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
	THD-Upp ₁₋₃	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
	Φ _{x-y_RMS}	<input checked="" type="checkbox"/>			Phase-to-phase angle
	Upp _{1-3_harmonic_1-63_%}	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		% of RMS or % of base
	Upp _{1-3_harmonic_1-63_ABS}	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
	Upp _{1-3_harmonic_1-63_φ}	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
	U _{underdeviation}	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> 1ph	U _{under} and U _{over} are calculated for phase or phase-to-phase voltages regarding connection mode.
	U _{overdeviation}	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> 1ph	
	Voltage Crest factor Upp ₁₋₃	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> 1ph	
	Flickers				
	Pi _{pp1-3}		<input checked="" type="checkbox"/>		
	Pst _{pp1-3}		<input checked="" type="checkbox"/>		
Plt _{pp1-3}		<input checked="" type="checkbox"/>			
Metering	Energy				
	Counter E ₁₋₈	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Each counter can be dedicated to any of four quadrants (P-Q, import-export, L-C). Total energy is a sum of one counter for all tariffs. Tariffs can be fixed, date/time dependent or tariff input dependent
	E _{TOT_1-8}	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	Active tariff	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Maximum demand measurements	Maximum demand				
	MD_I ₁₋₃	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> 1ph	
	MD_P _{import}	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	MD_P _{export}	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	MD_Q _{ind}	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	MD_Q _{cap}	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Min and max measurements	Min and max				
	U _{1-3_RMS_MIN}	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/> 1ph	
	U _{1-3_RMS_MAX}	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/> 1ph	
	Upp _{1-3_RMS_MIN}	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
	Upp _{1-3_RMS_MAX}	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		

	I ₁₋₃ _RMS_MIN	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> 1ph	
	I ₁₋₃ _RMS_MAX	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> 1ph	
	P ₁₋₃ _RMS_MIN	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/> 1ph	
	P ₁₋₃ _RMS_MAX	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/> 1ph	
	P _{TOT} _RMS_MIN	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> 1ph	
	P _{TOT} _RMS_MAX	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> 1ph	
	S ₁₋₃ _RMS_MIN	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/> 1ph	
	S ₁₋₃ _RMS_MAX	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/> 1ph	
	S _{TOT} _RMS_MIN	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> 1ph	
	S _{TOT} _RMS_MAX	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> 1ph	
	freq _{MIN}	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	freq _{MAX}	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Other measurements	<i>Miscellaneous</i>				
	freq _{MEAN}	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	Internal temp.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	Date, Time	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	Last Sync. time	<input checked="" type="checkbox"/> 	<input checked="" type="checkbox"/> 	<input checked="" type="checkbox"/> 	UTC

 For more information see **MC 770 Quality Analyzer** User's manual (K_MC 770_EN_22440500_Ver_1.00)

Table 3: Selection of available measurement quantities

DESCRIPTION OF PROPERTIES

RECORDER

A built-in recorder (8 Mb) enables storing measurements, detected alarms and PQ reports with details. It supports recording of all measured quantities including voltage and current harmonics and inter-harmonics (up to 10 selected in a range to 63,5th) in 4 configurable partitions. For each partition is possible to set storage interval and other recording parameters.

Fifth partition is used for recording alarms. Each alarm triggered by preset limit lines is stored in a form of alarm i.d. and its timestamp.

Sixth partition is used for PQ reports. Each report in recorder is identified by a monitoring interval (date).

Last partition is used for PQ report details. They represent time stamped PQ values that are outside PQ limit lines.

Content of recorder can be viewed with monitoring software **MiQen** in a detailed tabular or visually favoured graphical form.

Memory card

MC 770 Power Quality Analyzer is equipped with a front panel slot for full sized SD memory card that supports capacity up to 2 GB. It is intended for downloading internally stored data, uploading setting file and performing firmware upgrade.

Alarms

Alarms are powerful tool for **MC 770 Quality Analyzer** control and supervision features. Devices' performance can with this features reach beyond measuring and analyzing power network.

MC 770 Quality Analyzer supports recording and storing of 32 alarms in four groups. A time constant of maximal values in a thermal mode, a delay time and switch-off hysteresis are defined for each group of alarms.

For each parameter is possible to set limit value, condition and alarm activation action (sound signal and/or digital output switch if available).

All alarms are also stored in internal memory for post-analysis.

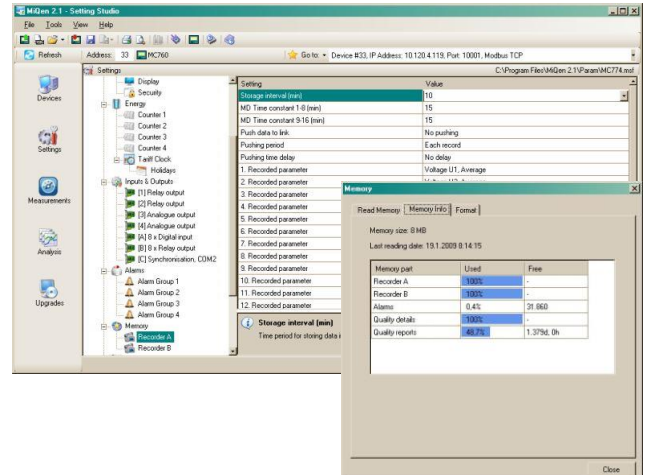


Figure 6: The sample of setting recorder parameters and viewing memory consumption information

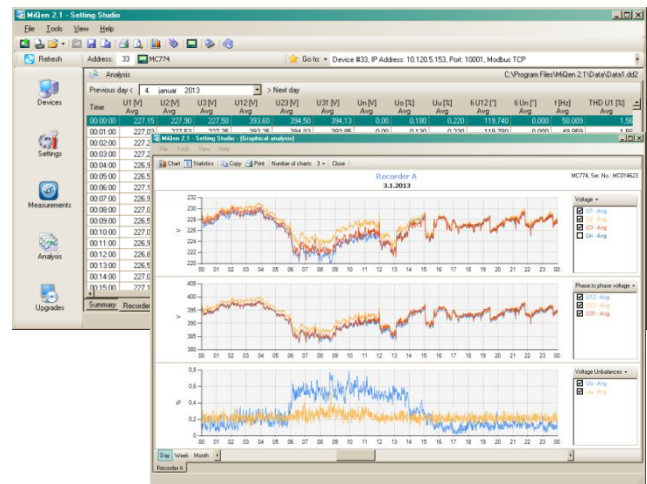


Figure 7: The sample of viewing recorder content in tabular and graphical form

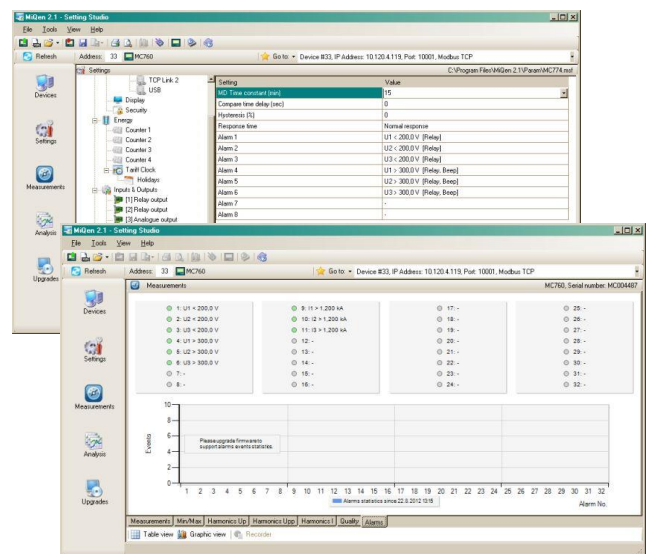


Figure 8: The sample of setting and viewing alarms

REAL TIME SYNCHRONISATION

Synchronized real-time clock (RTC) is an essential part of any Class A analyzer for proper chronological determination of various events.

To distinct cause from consequence, to follow a certain event from its origin to manifestation in other parameters it is very important that each and every event and recorded measurement on one instrument can be compared with events and measurements on other devices. Even if instruments are dislocated, which is normally the case in electro distribution network events have to be time-comparable with accuracy better than a single period.

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

Power quality analyzer MC 770 supports Network time protocol synchronization (NTP).

Network time protocol (NTP):

Synchronization via Ethernet requires access to a NTP server.

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

COMMUNICATION

Power quality analyzer MC 770 has a wide variety of communication possibilities to suit specific demands. It is equipped with standard communication port COM1 and auxiliary communication port COM2. This allows two different users to access data from a device simultaneously and by using TCP/IP communication, data can be accessed worldwide.

COM2 port is optional and can be ordered as one of I/O modules.

Different configurations are possible (to be specified with an order).

Configuration	COM1	COM2
1	RS232/485	/
2	RS232/485	RS232 or RS485
3 ⁽¹⁾	Ethernet & USB	/
4 ⁽¹⁾	Ethernet & USB	RS232 or RS485

⁽¹⁾ Galvanic separation between Eth. and USB is 1 kVACRMS

Table 4: List of communication configurations

Power quality analyzer MC 770 supports standard communication protocols MODBUS RTU, TCP and DNP3 L1.

Additionally it supports proprietary PUSH communication mode, which is used in system applications where devices send predefined readings in predefined time intervals in XML format. Web based software MiSMART collects data and stores it into database. Stored data can then be viewed with MiSMART client software.

For more information about PUSH communication mode and XML format see **MC 770 Quality Analyzer** User's manual.

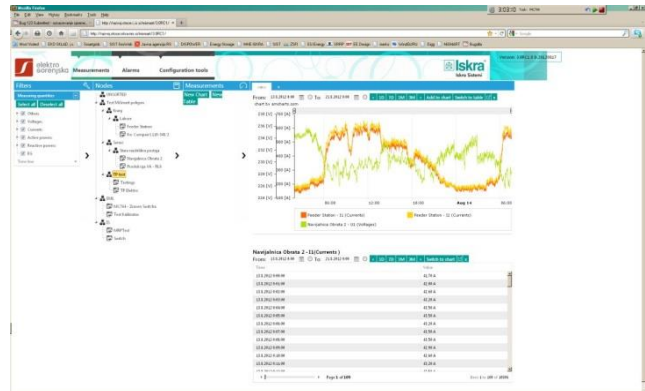


Figure 9: MiSMART client window

TECHNICAL DATA

Measurement inputs

Nominal frequency range	50 Hz, 60 Hz
Measuring frequency range	16 Hz–400 Hz

Voltage measurements:

Number of channels	4 ⁽¹⁾
Sampling rate	32 kHz
Min. voltage for sync.	1 V _{rms}
Nominal value (U _N)	500 V _{LN} , 866 V _{LL}
Max. measured value (cont.)	600 V _{LN} ; 1000 V _{LL}
Max. allowed value	1.2 × U _N permanently 2 × U _N ; 10 s
Consumption	< U ² / 4.2MΩ per phase
Input impedance	4.2MΩ per phase

⁽¹⁾ 4th channel is used for measuring U_{EARTH-NEUTRAL}

Current measurements:

Number of channels	3
Sampling rate	32 kHz
Nominal value (I _{NOM})	1 A, 5 A
Max. measured value (I ₁ -I ₃ only)	12.5 A sin.
Max. allowed value (thermal)	15 A cont.
	≤ 300 A; 1s
Consumption	< I ² × 0.01Ω per phase

Basic accuracy under reference conditions

Accuracy is presented as percentage of reading of the measurand except when it is stated as an absolute value.

Measurand	Accuracy	According to
Voltage L-N, L-L	± 0.1 %	EN 61557-12
Current	± 0.1 %	EN 61557-12
Active power (I _N = 5 A)	± 0.2 %	EN 61557-12
Active power (I _N = 1 A)	± 0.5 %	EN 61557-12
Active energy	Cl. 0.2S	EN 62053-22
Reactive energy	CL 0.5S	EN 62053-24
Frequency (f)	± 0.01 Hz	EN 61557-12
Power factor (PF)	± 0.5 %	EN 61557-12
THD (U)	± 0.3 %	EN 61557-12
THD (I)	± 0.3 %	EN 61557-12
Real time clock (RTC)	< ± 1 s/day	IEC61000-4-30

All values required for PQ analysis, which should be measured according to IEC61000-4-30 correspond to Class A accuracy.

For complete overview of accuracy for all measured parameters and measuring ranges see Users' manual.

INPUT/OUTPUT modules

MC 770 Quality Analyzer is equipped with two main I/O slots. According to order, each slots' function can be as presented in a table below.

Module type	Number of I/O per module
Relay output (RO)	2
Analogue output (AO)	2 x 20 mA
Analogue input (AI)	2
Pulse output (PO)	2
Pulse input (PI)	2
Bistable Digital output (BO)	1
Digital output (DO)	2
Digital input (DI)	2
Tariff input (TI)	2
Additional communication port (COM2)	1
Status output (WO)	1 + 1xRO
Communication port for analogue extender EX104	1

Table 5: List of available I/O modules

Analogue input (AI):

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 choose 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, wind speed ...)

DC current input:

Nominal input range	-20 mA...0...20 mA (±20%)
Input resistance	20 Ω
Accuracy	0.5 % of range
temperature drift	0.01% / °C
conversion resolution	16 bit (sigma-delta)
Analogue input mode	internally referenced Single-ended

DC voltage input:

Nominal input range	-10 V...0...10 V ($\pm 20\%$)
input resistance	100 k Ω
accuracy	0.5 % of range
temperature drift	0.01% / °C
conversion resolution	16 bit (sigma-delta)
Analogue input mode	internally referenced Single-ended

Resistance (temperature) input:

Nominal input range (low)*	0 Ω - 200 Ω (max. 400 Ω) PT100 (-200°C–850°C)
Nominal input range (high)*	0 k Ω – 2 k Ω (max. 4 k Ω) PT1000 (-200°C–850°C)
Connection	2-wire
Accuracy	0.5 % of range
Conversion resolution	16 bit (sigma-delta)
Analogue input mode	internally referenced Single-ended

* Low or high input range and primary input value (resistance or temperature) are set by the MiQen setting software

Analogue output (AO):

Output range	0 mA...20 mA
Accuracy	0.5% of range
Max. burden	150 Ω
Linearization	Linear, Quadratic
No. of break points	5
Output value limits	$\pm 120\%$ of nominal output
Response time (measurement and analogue output)	depends on set general average interval (0.1 s – 5 s)
Residual ripple	< 1 % p.p.

Outputs may be either short or open-circuited. They are electrically insulated from each other and from all other circuits.

Output range values can be altered subsequently (zoom scale) using the setting software, but a supplementary error results.

Digital input (DI)

Purpose	Tariff input, Pulse input, General purpose digital input
Max. current	8 mA (48 V), <0.6 mA (110 V, 230V)
SET voltage	(40...120) % of rated voltage
RESET voltage	(0...10) % of rated voltage
Tariff input	
Rated voltage	(5 V...48 V), 110 V, 230 V $\pm 20\%$ V _{AC/DC}
Frequency range	45 Hz...65 Hz
Pulse input	
Rated voltage	5 V- 48 V _{DC}
Min. pulse width	0.5 ms
Min. pulse period	2 ms

Digital input	(5 V...48 V), 110 V, 230 V $\pm 20\%$ V _{AC/DC}
Min. signal width	20 ms
Min. pause width	40 ms

Digital output (RO, BO, WO)

Type	Relay switch
Purpose	Alarm output, General purpose Digital output, Pulse output, Status output (watchdog)
Rated voltage	230 V _{AC/DC} $\pm 20\%$ max
Max. switching current	1000 mA
Contact resistance	≤ 100 m Ω (100 mA, 24 V)
Impulse	Max. 4000 imp/hour Min. length 100 ms

Digital output (DO, PO)

Type	Optocoupler open collector switch
Purpose	Pulse output
Rated voltage	40 V _{AC/DC}
Max. switching current	30 mA (R _{ONmax} = 8 Ω)
Pulse length	programmable (2 ms... 999 ms)

UNIVERSAL POWER SUPPLY

Standard:	CAT III 300V
Nominal voltage AC	48 V... 276 V
Nominal frequency	40 Hz... 70 Hz
Nominal voltage DC	20 V... 300 V
Consumption (max. all I/O)	< 8 VA

SAFETY:

Protection: protection class II
functional earth terminal must be connected to earth potential!



Voltage inputs via high impedance
Double insulation for I/O ports and COM ports

Pollution degree 2
Installation category CAT II ; 600 V
CAT III ; 300 V
Acc. to EN 61010-1

Test voltages U_{AUX}↔I/O, COM1: 3510 V_{ACrms}
U_{AUX}↔U, I inputs: 3510 V_{ACrms}
U, I inputs↔I/O, COM1: 3510 V_{ACrms}
HV I/O ↔ I/O, COM1: 3510 V_{ACrms}
U inputs↔I inputs: 3510 V_{ACrms}

MECHANICAL

Dimensions	96 mm × 96 mm × 96.5 mm (CT 101.5 mm)
Mounting	Panel mounting 96 mm × 96 mm
Required mounting hole	92 mm × 92 mm
Enclosure material	PC/ABS
Flammability	Acc. to UL 94 V-0
Weight	600 g
Enclosure material	PC/ABS
	Acc. to UL 94 V-0

AMBIENT CONDITIONS:

Ambient temperature	K55 temperature class Acc. to EN61557-12 -10 °C ...55 °C
Storage temperature	-40 °C to +70 °C
Average annual humidity	≤90% r.h. (no condensation)
Pollution degree	2
Enclosure protection	IP 40 (front plate) IP 20 (rear side)
Installation altitude	≤2000 m

REAL TIME CLOCK

A built-in real time clock is also without external synchronization very stable when device is connected to auxiliary power supply. For handling shorter power interruptions without influence on RTC, device uses high capacity capacitor battery. It ensures auxiliary supply (for internal RTC only) for more than two days of operation (6 years with battery).

To enable clock operation backup supercap or battery is built-in.

Supercap life span	approx. 2 days
Type	Low power embedded RTC
RTC stability	< 1 sec / day
Battery life span	approx.. 6 years (at 23 °C)

CONNECTION CABLES

MC 770 Quality Analyzer is equipped with European style pluggable terminals for measuring voltages, auxiliary supply, communication and I/O modules.

Measuring current cables can be connected in two ways. They shall be attached as through-hole connection without screwing or as detachable screw terminals.

NOTE: Stranded wire must be used with insulated end sleeve to assure firm connection.

Voltage inputs (4)	≤2.5 mm ² , AWG 24-12 single wire
Current inputs (3)	≤∅ 6 mm one conductor with insulation
Supply (3)	≤2.5 mm ² , AWG 24-12 single wire
Com (5), I/O (6)	≤2.5 mm ² , AWG 24-12 single wire

MiQen - setting and acquisition Software

MiQen software is intended for supervision of **MC 770** and many other instruments on a PC. Network and the device setting, display of measured and stored values and analysis of stored data in the device are possible via the serial, Ethernet or USB communication. The information and stored measurements can be exported in standard Windows formats. Multilingual software functions on Windows XP operating system or higher.

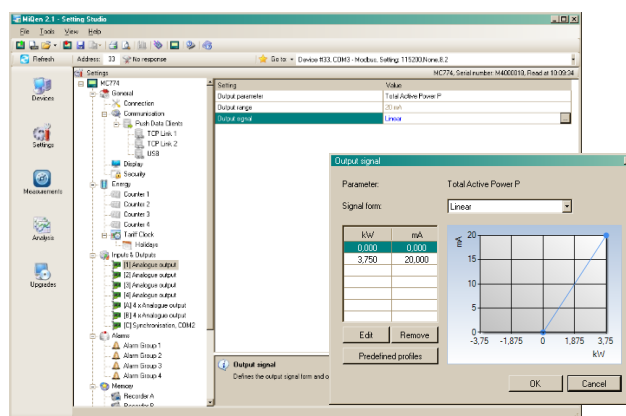


Figure 9 MiQen setting and acquisition software

MiQen software is intended for:

- Setting all of the instruments parameters (online and offline).
- Viewing current measured readings and stored data.
- Setting and resetting energy counters.
- Complete I/O modules configuration.
- Evaluation of the electricity supply quality in compliance with SIST EN 50160.
- Viewing and exporting time-stamped PQ anomaly details.
- Upgrading instruments firmware.
- Searching the net for devices.
- Virtual interactive instrument.
- Comprehensive help support.

NOTE!
MiQen software functions depend on the type of connected device.

CONNECTION

Two possible connections of current are available, through-hole connection and terminal connection (see pictures below).

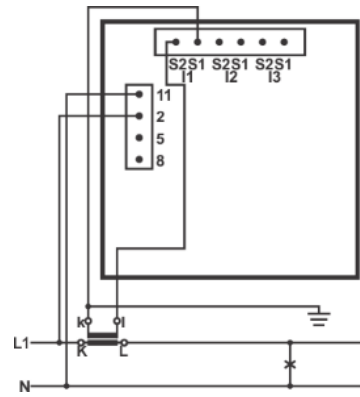
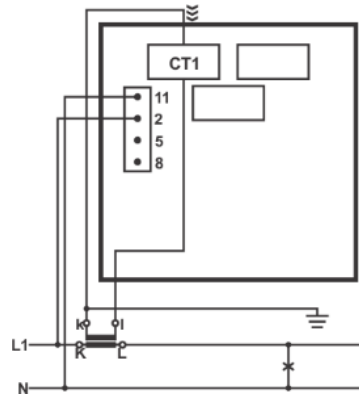
System/connection

Through-hole connection assignment

Terminal connection assignment

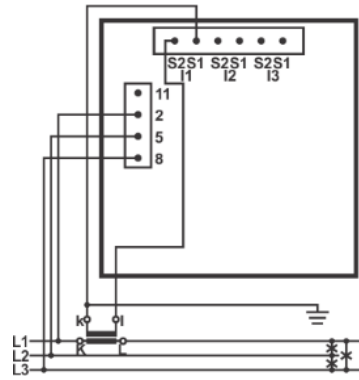
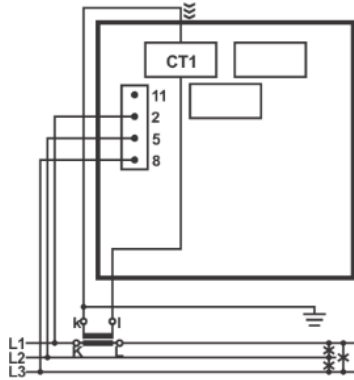
1b (1W1b)

Single-phase connection



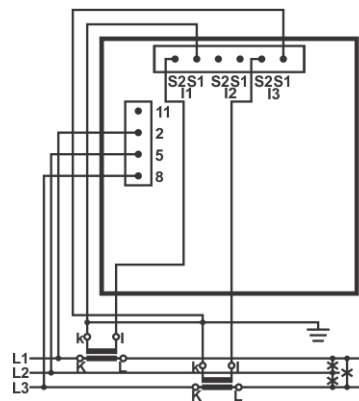
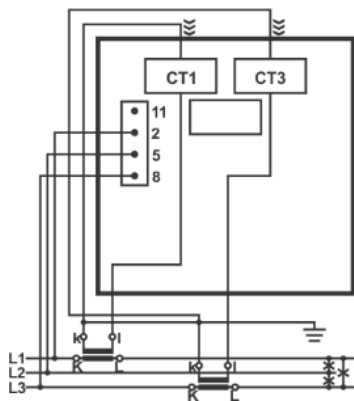
3b (1W3b)

Three-phase, three-wire connection with balanced load



3u (2W3u)

Three-phase, three-wire connection with unbalanced load.



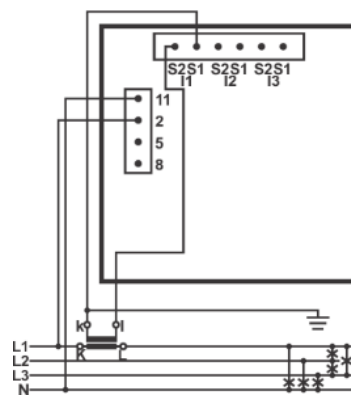
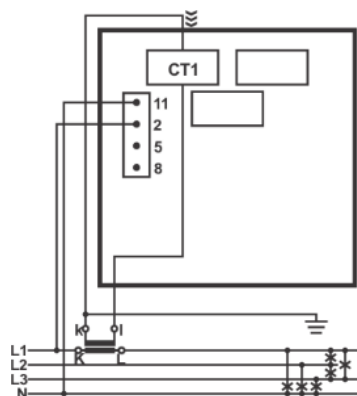
System/connection

Through-hole connection assignment

Terminal connection assignment

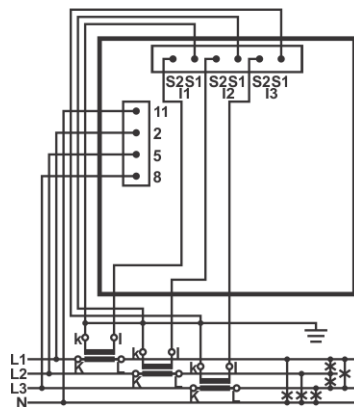
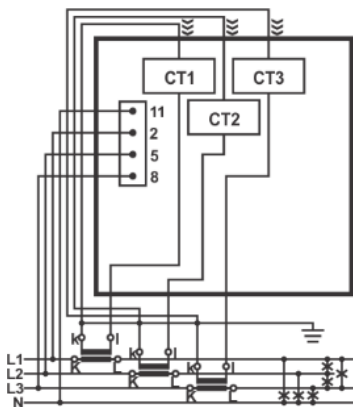
4b (1W4b)

Three-phase, four wire connection with balanced load



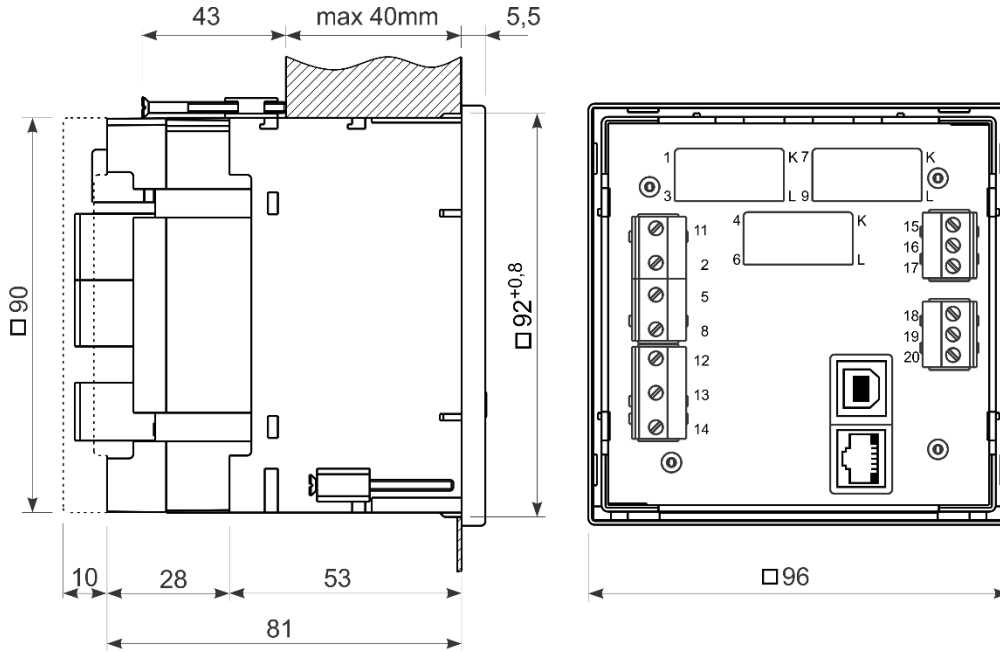
4u (3W4)

Three-phase, four wire connection with unbalanced load.

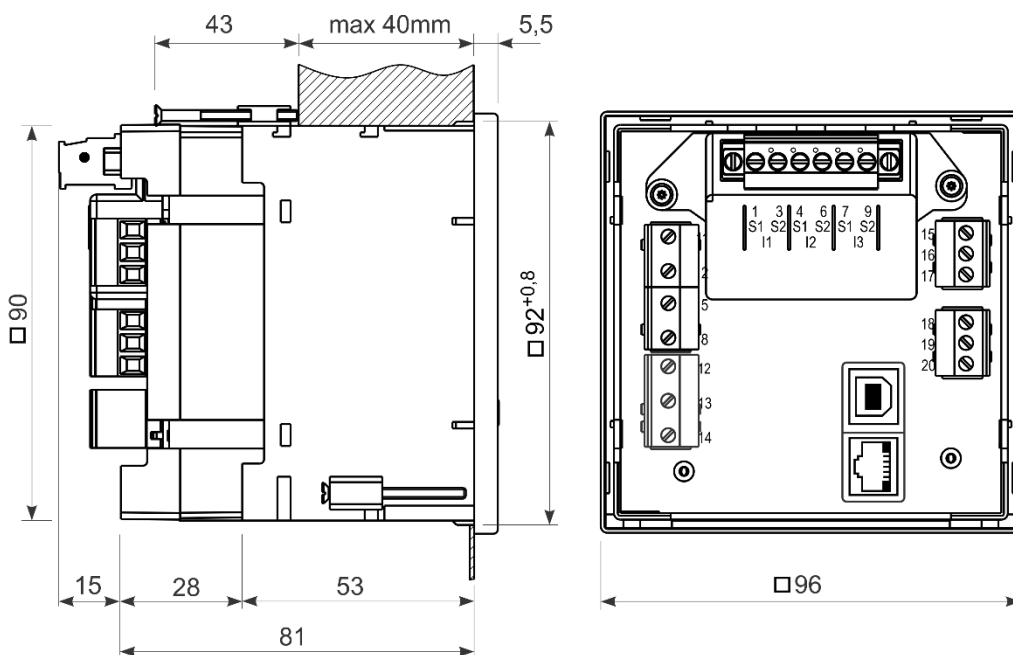


DIMENSIONAL DRAWING

Dimensions for MC 770 (through-hole connection assignment):



Dimensions for MC 770 (terminal connection assignment):



Connection table

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

Table 6: Connections

DATA FOR ORDERING

When ordering **MC 770 Quality Analyzer**, all required specifications shall be stated in compliance with the ordering code. Additional information could be stated. Note that fixed or programmable specifications are not part of ordering code

General ordering code

The following specifications shall be stated:

Device Type	Nominal freq.	Aux. power supply	Comm. COM1	I/O module 1/2	I/O module 3/4	RTC backup supply	Current connection
MC 770	X	X	X	X	X	X	X
							T Through Hole Transformer *
							C Screw Terminal Connector
						C	Supercap*
						B	Battery
				N			Without *
				A			2× Analogue output
				S			2× Pulse output
				M			2× Relay (alarm) output
				B			1× Bistable relay (alarm) output
				W			1× Status + 1× Relay output
				I			2× Analogue input - mA _{DC}
				U			2× Analogue input - V _{DC}
				R			2× Analogue input - R/Temp.
				P			2× Pulse input 5 - 48 V _{DC}
				D			2× Digital input 230 V _{AC/DC}
				E			2× Digital input 110 V _{AC/DC}
				F			2× Digital input 5 - 48 V _{AC/DC}
				T			2× Tariff input 230 V _{AC/DC}
				Z			2× Tariff input 110 V _{AC/DC}
				Y			2× Tariff input 5 - 48 V _{AC/DC}
				G			RS232 Communication - COM2
				C			RS485 Communication - COM2
				X			Output Extender - COM2
			T				RS232 & RS485 Terminal *
			R				RS232 & 485 DB9
			E				Ethernet & USB
	U						20 ... 300 V _{DC} , 80 ... 276 V _{AC} *
	D						110 V _{AC}
	E						230 V _{AC}
	F						400 V _{AC}
	S						50, 60 Hz *
	A						400 Hz
	B						16 2/3 Hz

Not available for Nominal freq. 16 2/3 Hz

I/O module 1/2 only

I/O module 1/2 only

I/O module 1/2 only

I/O module 3/4 only

I/O module 3/4 only

I/O module 3/4 only

*- standard

Example of ordering:

MC 770 with a universal-HI supply is connected to a universal high voltage and 5 A secondary current on 50 Hz network. Ethernet & USB communication, watchdog output (plus one relay output) as I/O 1/2 and two pulse outputs as I/O 3/4. RTC with supercap supply. Through-hole type current transformers.

Voltage and current nominal value are due to auto-range fixed to max. nominal value and are therefore omitted from ordering code.

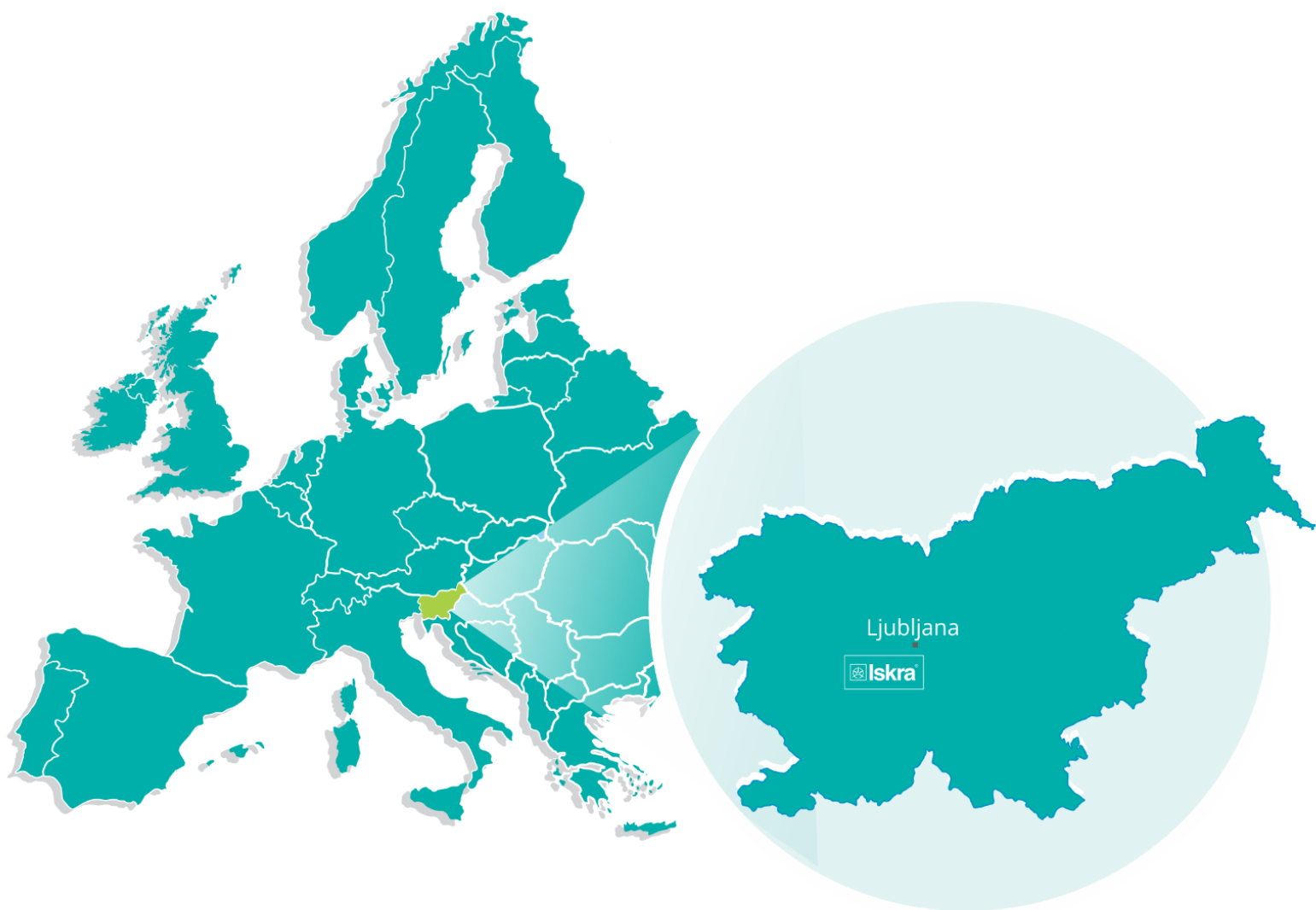
Connection type is user programmable and is therefore omitted from ordering code. Default is 4u connection.

Example ordering code:

MC 770	S	U	E	W	S	C	T	
								Through Hole Transformer
								Supercap
								2× Pulse output
								1× Status + 1× Relay output
								Ethernet & USB
								Universal HIGH (20 V DC... 300 V DC, 80 V AC... 276 V AC)
								50 Hz, 60 Hz

DICTIONARY:

<i>PQ</i>	<i>Power Quality alias Voltage Quality</i>
<i>RMS</i>	<i>Root Mean Square</i>
<i>PA</i>	<i>Power angle (between current and voltage)</i>
<i>PF</i>	<i>Power factor</i>
<i>VT</i>	<i>Voltage measuring transformer</i>
<i>CT</i>	<i>Current measuring transformer</i>
<i>THD</i>	<i>Total harmonic distortion</i>
<i>Ethernet</i>	<i>IEEE 802.3 data layer protocol</i>
<i>MODBUS / DNP3</i>	<i>Industrial protocol for data transmission</i>
<i>MiQen</i>	<i>ISKRA setting and acquisition Software</i>
<i>AC</i>	<i>Alternating quantity</i>
<i>RTC</i>	<i>Real Time Clock</i>
<i>IRIG</i>	<i>Inter-range instrumentation group time codes</i>
<i>NTP</i>	<i>Network Time Protocol</i>



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PE MIS

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Phone: +386 4 237 21 12

PE Baterije in potenciometri

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PE Galvanotehnika

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