





POWER QUALITY ANALYZER
MC 784/iMC 784

- **CLASS A** ACCURACY CERTIFIED.
- EN 50160 **POWER QUALITY EVALUATION**.
- AUTOMATIC **PQ REPORT** GENERATION.
- DISTURBANCE, TREND & PQ EVENT RECORDING.
- WAVEFORM RECORDER WITH PROGRAMMABLE SAMPLING TIME.
- STANDARDIZED PQDIF AND COMTRADE FORMAT SUPPORT.
- SUPPORT FOR **MODBUS, DNP3, FTP, MQTT, IEC61850 ED.2 COMMUNICATION PROTOCOLS**.
- MIQEN USER FRIENDLY SETTING & ANALYSIS SOFTWARE.

Iskra®

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FEATURES

- Evaluation of the electricity supply quality in compliance with EN50160 with automatic report generation.
- Class A (0.1%) accuracy in compliance with EN61000-4-30 Ed.3.
- Instantaneous evaluation of over 700 electrical measurement quantities values including PQ related parameters, harmonics (voltage/current THDs, TDDs, up to 63rd voltage(PP, PN)/current harmonics and interharmonics).
- Automatic range selection of 4 current and 4 voltage channels (max. 12.5 A and 1000 VRMS) with 32 kHz sampling rate.
- Oscillography capability for recording waveforms and transients with up to 625 samples/cycle sampling frequency.
- Recording of waveform, disturbance, trend and Power Quality (PQ) events in trigger related recorders.
- All trigger related recorder data available on-demand through FTP and automatically on the MiSMART server via autonomous push communication or on demand.
- A sophisticated triggering mechanism to register and record events of various nature:
  - Current and voltage transient event generated triggers based on hold-off time (in ms), absolute peak value (% of Un) and fast change (in % Un/µs).
  - PQ event generated triggers based on the following events: voltage dip, voltage swell, voltage interruption, end of voltage interruption, rapid voltage change and inrush current.
  - External Ethernet triggers enabling trigger events with up to 8 different devices within the network.
  - External digital triggers based on logical/digital inputs.
  - Up to 16 combined triggers enabling logical operation on previously configured triggers of various nature.
- Recording a wide variety of data in the internal device 8GB flash memory based on trigger settings:
  - All activated triggers together with timestamp, duration, condition as well as a reference to an (optionally) generated transient, waveform, disturbance and fast trend record.
  - Waveform recorder with PQDIF/COMTRADE data format selection, selectable recorded channels (4×Voltage, 4×Current, 16×Logical input), 19 samples/cycle to 625 samples/cycle resolution, pre-trigger time from 0.01 s up to 1 s, post-trigger time from 0.01 s up to 40 s (20 s for 625 samples/cycle).
  - Disturbance recorder with PQDIF/COMTRADE data format selection, selectable recorded channels (4×P-N Voltage, 3×P-P Voltage, 4×Current, 8×Logical inputs), half/full cycle averaging interval, pre-trigger time up to 3000 cycles, post trigger time up to 60000 cycles.
  - Periodic measurements in 4 standard trend recorders A through D each containing up to 32 arbitrarily evaluated (maximum, minimum, average, maximum demand, minimum demand, actual, maximum period, minimum period) quantities with periods ranging from 1 min to 60 min.
  - Periodic measurements in advanced fast trend recorders 1 through 4 each containing over 700 arbitrarily evaluated (maximum, minimum, average, actual) quantities with periods ranging from 1s to 60min. The recorder can be set to PQDIF data format selection.
  - 32 adjustable alarms in 4 alarm groups each containing up to 8 alarms. Alarms relate to a particular quantity over/under threshold and serve the purpose of controlling on-device relay outputs as well as informing the server about the occurrence of alarm events.
  - Recording and on-board evaluation of PQ anomalies and PQ reports based on EN50160.
- Four quadrant energy measurement in 8 programmable counters with class 0.2S accuracy with up to four tariffs and an advanced tariff clock. Every counter resolution and range can be defined:
  - Active energy (Wh) import.
  - Active energy (Wh) export.
  - Reactive energy (varh) import.
  - Reactive energy (varh) export.
  - Total absolute active energy (Wh).
  - Total absolute reactive energy (varh).
  - Total absolute apparent energy (VAh).
  - Custom settings (phase dependent, four quadrant – P/Q/import/export selection).
- Measurements of 40 minimal and maximal values in different time intervals (from 1 to 256 periods)
- Frequency range from 16 Hz to 400 Hz.
- Ethernet and USB 2.0 communication support.
- Communication – MODBUS, DNP3, FTP, MQTT, upgradeable to IEC61850 Ed.2 (To order the option of IEC61850 Ed.2 Server please order the following additional SW option number: 022491017000).
- Support for GPS, IRIG-B (modulated and digital) and NTP real time clock synchronization.
- Up to 4 inputs/outputs on I/O module 1/2 and 3/4 (analogue inputs/outputs, digital inputs/outputs, alarm/watchdog outputs, pulse input/outputs, tariff inputs, bistable alarm outputs, relay output).
- Up to 20 inputs/outputs on I/O module A and B (relay output, digital input).
- MiQEN Setting studio User-friendly setting and analysis software with FTP communication feasibility for seamless device settings and single device advanced analysis.
- MiSMART system SW support for automatic (via autonomous push XML communication) as well as on demand data transfer (via FTP) from multiple

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instruments to the server through which relevant recorder data from each device in the system is available.

- On-board Web server support for basic measurement overview.
- Multilingual support (MC 784 only).
- Auxiliary power supply (two voltage ranges).
- 144 mm square panel mounting.
- Available with:
  - 5.7 inch color TFT display (iMC 784).
  - 128x64 pixel display (MC 784).

DESCRIPTION

Power Quality Analyzer MC 784/iMC 784 is an important device for permanent monitoring of power quality from its production (especially renewable), transmission and distribution all the way to the final consumers. 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, Power Quality Analyzer MC 784/iMC 784 can be used for utility purposes (evaluation against standards) as well as for industry purposes (monitoring supplied power quality).

Power Quality Analyzer MC 784/iMC 784 performs measurements in compliance with regulatory requested standard EN 61000-4-30 Ed.3 and evaluates recorded parameters for analysis according to parameters defined in European power quality standard EN50160.

The device enables storage of a wide variety of highly detailed oscillography data in 8 GB of internal flash memory based on a sophisticated trigger settings mechanism. Data can be stored in standardized PQDIF (IEEE 1159-3) and COMTRADE (IEEE C37.111) file formats which can be easily exchanged with third party PQ analysis SW systems.

Moreover Power Quality Analyzer MC 784/iMC 784 stores measurements and quality reports in internal memory for further analysis. By accessing recorded or real time values from multiple instruments installed on different locations it is possible to gain the overall picture of the complete systems' behavior. This can be achieved with regard to Power Quality Analyzer MC 784/iMC 784 accurate internal real time clock and wide range of synchronization sources support, which assure accurate, time-stamped measurements from dislocated units.

Stored data can then be transferred to a PC or server for post analysis. The simplest way this is done is by directly connecting a PC with installed MiQEN Setting Studio SW via USB cable. In cases where multiple devices are used the MiSMART system server usage is recommended where all relevant data from all system connected instruments is always available from a centralized database through the push XML communication mechanism. To save server space high precision data can also be transferred from a selected device on-demand using FTP.

APPLICATION AND BENEFITS

Power Quality Analyzer MC 784/iMC 784 can be used as a standalone PQ monitoring device for detection and analysis of local PQ deviations, transients, alarms and periodic measurements. For this purpose it is normally positioned at the point-of-common-coupling (PCC) of 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 operation of consumers.

Identifying relevant fixed measuring points is the most important task prior to complete system installation. The implementation of a PQ system itself will not prevent disturbances in network but rather help diagnose their origins and effects by comparing and scrutinizing data from multiple time synchronized measurement points.

Therefore the most extensive benefits are achieved when Power Quality Analyzer MC 784/iMC 784 is used as a part of a PQ monitoring system comprising of strategically positioned meters connected to the *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 measured parameters in the device. All sent data are stored in the *MiSMART database*, while leaving a copy of the same parameters stored locally in device memory of each device as a backup copy. Database records can be analyzed, searched as well as viewed in table and graphic form using the native *MiSMART web client application* or other third-party software. (e.g. SCADA systems, OPC server, PQ analysis established software's …) At the same time device data can also be visualized and analyzed on-demand by means of the powerful freely-downloadable *MiQEN setting studio SW*.

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Server database records (with a copy in device memory) include numerous parameters of three-phase systems, which have been setup in the device (PQ parameters, over 700 evaluated electrical quantities, I/O module related physical parameters (e.g. temp., pressure, wind speed…). On the other hand the database also holds data on alarms and detailed time-stamped transient, waveform, disturbance PQ data and fast trend trigger records with complete oscillography data in standardized PQDIF/COMTRADE file formats.

COMPLIANCE WITH STANDARDS

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

For this reason 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 (flickermeter)
- Procedures for evaluation of measured PQ indices according to limit levels described in European standard EN50160

Power Quality Analyzer MC 784/iMC 784 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 EN50160 and issues weekly reports within the device itself and if used also sends them to the *MiSMART* server at the same time. If certain PQ indices fail to meet the required power quality levels the device highlights details of problematic anomaly events, together with their corresponding timestamps and a detailed waveform/transient or disturbance record for further thorough analysis of the occurred PQ non-compliant event.

Standard EN	*Description*
61010-1	*Safety requirements for electrical equipment for measurement, control and laboratory use*
61557-12	*Electrical safety in LV distribution systems up to 1kV a.c. and 1.5kV d.c. – Combined performance measuring and monitoring devices for electrical parameters*
61000-4-30	*Electromagnetic compatibility (EMC) – Power quality measurements methods*
61000-4-7 + A1	*Electromagnetic compatibility (EMC) – General guide on harmonics and interharmonics measurements*
61000-4-15	*Electromagnetic compatibility (EMC) – Flickermeter*
50160	*Voltage characteristics of electricity supplied by public distribution networks*
62053-22	*Electricity metering equipment - Static meters for active energy (classes 0.2 S and 0.5 S)*
62053-24	*Electricity metering equipment - Static meters for reactive energy (class 0.5 S)*
62053-31	*Electricity metering equipment Particular requirements - Part 31: Pulse output devices for electromechanical and electronic meters (two wires only)*
61326-1	*EMC requirements for electrical equipment for measurement, control and laboratory use*
60529/A1	*Degrees of protection provided by enclosures (IP code)*
60068-2-1/-2/-6/-27/-30	*Environmental testing (-1 Cold, -2 Dry heat, -30 Damp heat, -6 Vibration, -27 Shock)*
UL 94	*Tests for flammability of plastic materials for parts in devices and appliances*
IEEE 1159-3	*Recommended Practice for the Transfer of Power Quality Data (PQDIF)*
IEEE C37.111	*Standard Common format for transient Data Exchange (COMTRADE) for Power Systems*

Table 1: ***List of applicable standards***

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VOLTAGE QUALITY

Voltage Quality is a 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 784/iMC 784 measures, detects, stores and evaluates parameters, which are defined in several standards. Evaluation is by default performed according to limits set in European standard EN50160. Beside that users can always alter parameters according to their own requirements or according to immunity of their equipment which operates within the analyzed power network.

PQ recording settings

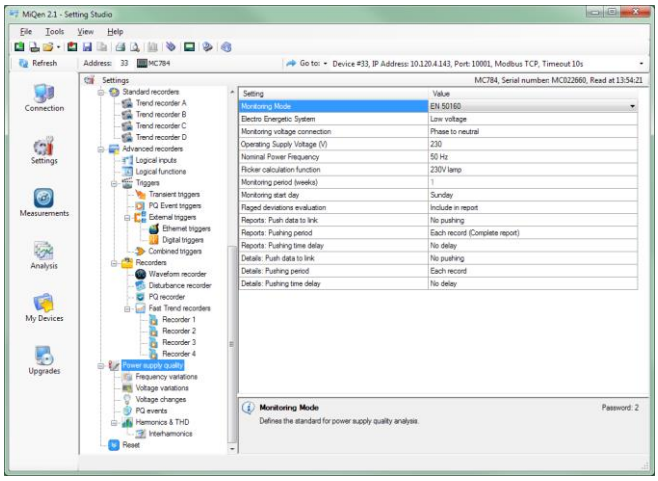


Figure 1: ***Settings for power quality report parameters as seen with MiQEN setting studio SW***

Characteristic parameters that describe power quality are shown below:

Phenomena	*PQ Parameters*
Frequency variations	Frequency variations
Voltage variations	Voltage variations Voltage unbalance
Voltage changes	Rapid voltage changes Flicker
Voltage events	Voltage dips Voltage interruptions Voltage swells Short interruptions Long interruptions
Harmonics & THD	Harmonics THD's Signaling voltage

Table 2: Voltage quality parameters as defined in EN50160

PQ reports and PQ event triggers

PQ reports are issued on a basis of chosen PQ parameters as well as generation period (normally weekly) and type of network. Each report record is internally stored for later analysis together with all related anomalies and PQ records which are generated based on a PQ event triggering mechanism. The MiQEN setting software allows the user to quickly view PQ reports with limit lines and compliance results as well as to analyze anomalies. During the time when certain parameters are outside limit lines it is possible to view (synchronized) time stamped anomalies, together with corresponding PQ event triggered records. With all that information the user can establish the true origin of the anomaly and determine its' consequences to the network.

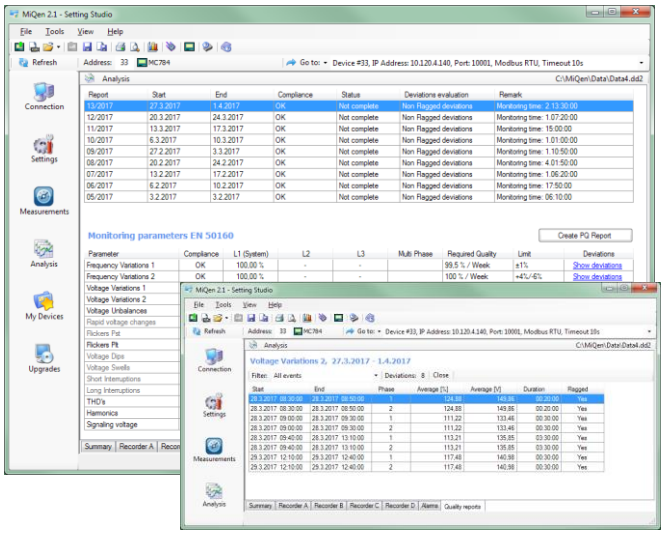


Figure 2: ***Viewing power quality report parameters and anomalies with MiQEN***

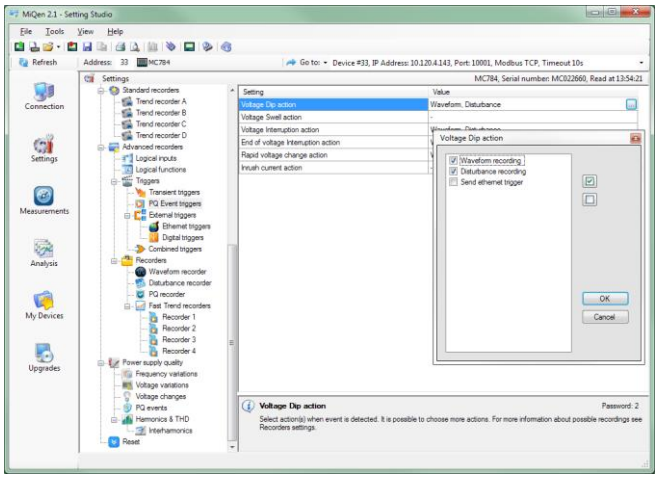


Figure 3: ***PQ event trigger settings in MiQEN***

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MEASMEASUREMENTS

Online measurements

Online measurements are available through the display or can be monitored with the *MiQEN SW*.

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

Each group can represent data in visually favored graphical form or as a detailed table form. The latter allows freezing readings and/or copying data into various report generation software tools.

Interactive instrument

A useful MiQEN SW communication feature allows interactive operation with a dislocated device as if it would be operational in front of the user.



Selection of available quantities

Available online measuring quantities and their appearance can vary according to the preset power network type 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.

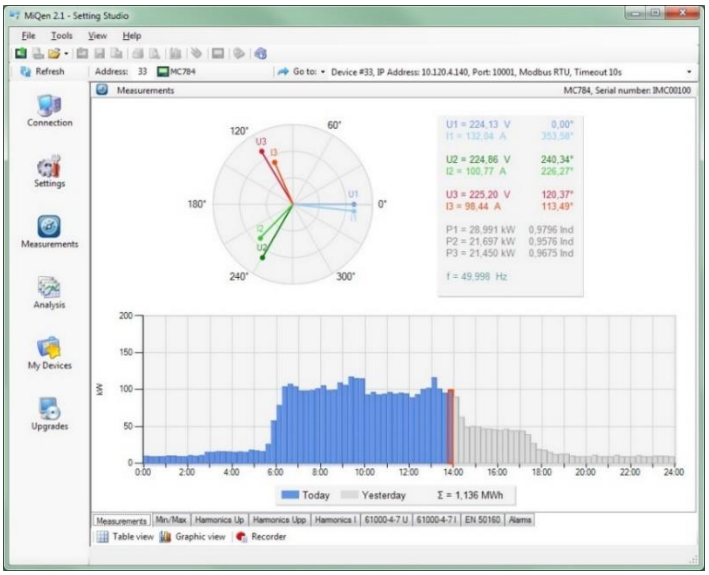


Figure 4: ***Online measurements in graphical form – phasor diagram and daily 24 hour total active power consumption histogram***

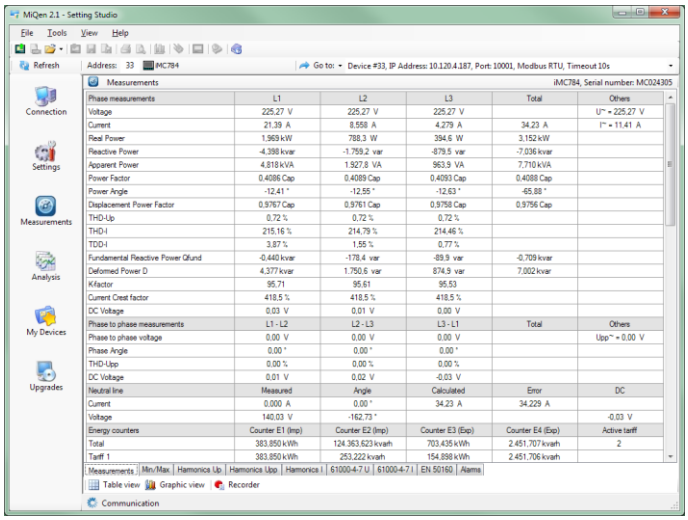


Figure 5: ***A complete list of online measurements in table form***

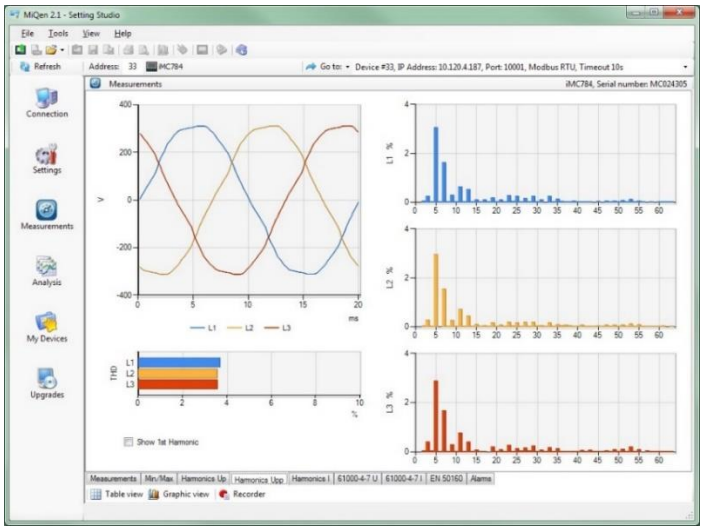


Figure 6: ***Online harmonics (phase voltage, phase-phase voltage, intra-phase, current/voltage THDs and current harmonics) in graphic form***

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Meas. type	Measurement	3-phase 4-wire	3-phase 3-wire	1-phase	comments
Phase measurements	Voltage				
	$U_{1\text{-}3_TRMS}$	☑		☑1ph	
	U_{AVG_TRMS}	☑		☑	
	$U_{unbalance_neg_TRMS}$	☑📖	☑📖		
	$U_{unbalance_zero_TRMS}$	☑📖	☑📖		
	$U_{1\text{-}3_DC}$	☑		☑1ph	DC component of phase voltages
	$U_{0_Zero_sequance_TRMS}$	☑	☑		Zero sequence voltage
	$U_{1_Positive_sequence_TRMS}$	☑	☑		Positive sequence voltage
	$U_{2_Negative_sequence_TRMS}$	☑	☑		Negative sequence voltage
	Current				
	$I_{1\text{-}3_TRMS}$	☑	☑	☑1ph	
	I_{TOT_TRMS}	☑	☑	☑	
	I_{AVG_TRMS}	☑	☑	☑	
	$I_{unbalance_TRMS}$	☑	☑		
	$I_{unbalance_zero_TRMS}$	☑	☑		
	$I_{0_Zero_sequance_TRMS}$	☑	☑		Zero sequence current
	$I_{1_Positive_sequence_TRMS}$	☑	☑		Positive sequence current
	$I_{2_Negative_sequence_TRMS}$	☑	☑		Negative sequence current
	Power				
	$P_{1\text{-}3_TRMS}$	☑		☑1ph	
	P_{TOT_TRMS}	☑	☑	☑	
	$Q_{1\text{-}3_TRMS}$	☑📖		☑1ph📖	Reactive power can be calculated as a squared difference between S and P or as sample delayed
	Q_{TOT_TRMS}	☑	☑	☑	
	$Qb_{1\text{-}3_TRMS}$	☑		☑1ph	Budeanu reactive power Phase
	Qb_{TOT_TRMS}	☑	☑	☑	Budeanu reactive power Total
	$S_{1\text{-}3_TRMS}$	☑		☑1ph	
	S_{TOT_TRMS}	☑	☑	☑	
	$D_{1\text{-}3_TRMS}$	☑		☑1ph	Deformed power Phase
	D_{TOT_TRMS}	☑	☑	☑	Deformed power Total
	$PF_{1\text{-}3_TRMS}$	☑		☑1ph	
	PF_{TOT}	☑	☑		
	$dPF_{1\text{-}3_TRMS}$	☑		☑	Displacement Power Factor Phase
	dPF_{TOT_TRMS}	☑	☑	☑1ph	Displacement Power Factor Total
	$\varphi_{1\text{-}3_TRMS}$	☑		☑1ph	
	Harmonic analysis				
	THD-$U_{1\text{-}3}$	☑		☑1ph	
	THD-$I_{1\text{-}3}$	☑	☑	☑1ph	
	TDD-$I_{1\text{-}3}$	☑	☑	☑1ph	
	$U_{1\text{-}3_harmonic_1\text{-}63_\%}$	☑📖		☑1ph📖	% of TRMS or % of base
	$U_{1\text{-}3_harmonic_1\text{-}63_ABS}$	☑		☑1ph	
	$U_{1\text{-}3_harmonic_1\text{-}63_\varphi}$	☑		☑1ph	
	$U_{1\text{-}3_inter\text{-}harmonic_\%}$	☑📖		☑1ph📖	Monitoring up to 10 different fixed frequencies
	$U_{1\text{-}3_inter\text{-}harmonic_ABS}$	☑		☑1ph	
	$U_{1\text{-}3_inter\text{-}harmonic_1\text{-}63_\%}$	☑📖		☑1ph📖	% of TRMS or % of base
	$U_{1\text{-}3_inter\text{-}harmonic_1\text{-}63_ABS}$	☑		☑1ph	
	$U_{1\text{-}3_signaling_\%}$	☑📖		☑1ph📖	Monitoring of signaling (ripple) voltage of set frequency. % of TRMS or % of base
	$U_{1\text{-}3_signaling_ABS}$	☑		☑1ph	
	$I_{1\text{-}3_harmonic_1\text{-}63_\%}$	☑📖	☑📖	☑1ph📖	% of TRMS or % of base
	$I_{1\text{-}3_harmonic_1\text{-}63_ABS}$	☑	☑	☑1ph	
	$I_{1\text{-}3_harmonic_1\text{-}63_\varphi}$	☑	☑	☑1ph	
	$I_{1\text{-}3_inter\text{-}harmonic_\%}$	☑📖	☑	☑1ph📖	Monitoring up to 10 different fixed frequencies
	$I_{1\text{-}3_inter\text{-}harmonic_ABS}$	☑	☑	☑1ph	
	$I_{1\text{-}3_inter\text{-}harmonic_1\text{-}63_\%}$	☑📖	☑	☑1ph📖	% of TRMS or % of base
	$I_{1\text{-}3_inter\text{-}harmonic_1\text{-}63_ABS}$	☑	☑	☑1ph	
	$I_{1\text{-}3_signaling_\%}$	☑📖		☑1ph📖	Monitoring of signaling (ripple) current of set frequency. % of TRMS or % of base
	$I_{1\text{-}3_signaling_ABS}$	☑		☑1ph	
	Flickers				
	$Pi_{1\text{-}3}$	☑		☑1ph	Instantaneous flicker sensation measured with 150 samples / sec (original sampling is 1200 samples / sec)
	$Pst_{1\text{-}3}$	☑		☑1ph	10 min statistical evaluation (128 classes of CPF)
	$Plt_{1\text{-}3}$	☑		☑1ph	Derived from 12 Pst acc. to EN 61000-4-15
	Miscellaneous				
	K-$factor_{1\text{-}3}$	☑	☑	☑1ph	
	Current Crest factor $I_{1\text{-}3}$	☑	☑	☑1ph	
	Voltage Crest factor $U_{1\text{-}3}$	☑		☑1ph	

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Meas. type	Measurement	3-phase 4-wire	3-phase 3-wire	1-phase	comments
Phase to phase measurements	Voltage				
	Upp_{1-3_TRMS}	☑	☑		
	Upp_{AVG_TRMS}	☑	☑		
	$THD\text{-}Upp_{1-3}$	☑	☑		
	$\varphi_{x\text{-}y_TRMS}$	☑			Phase-to-phase angle
	$Upp_{1-3_harmonic_1-63_\%}$	☑📖	☑📖		% of TRMS or % of base
	$Upp_{1-3_harmonic_1-63_ABS}$	☑	☑		
	$Upp_{1-3_harmonic_1-63_\varphi}$	☑	☑		
	$Upp_{1-3_interharmonic_1-63_\%}$	☑	☑	☑1ph	% of TRMS or % of base
	$Upp_{1-3_interharmonic_1-63_ABS}$	☑	☑	☑1ph	
	$U_{underdeviation}$	☑	☑	☑1ph	$U_{under.}$ and $U_{over.}$ are calculated for phase or phase-to-phase voltages regarding connection mode.
	$U_{overdeviation}$	☑	☑	☑1ph	
	Voltage Crest factor Upp_{1-3}	☑	☑	☑1ph	
	Flickers				
	Pi_pp_{1-3}		☑		Phase-to-phase flickers.
	Pst_pp_{1-3}		☑		
	Plt_pp_{1-3}		☑		
Metering	Energy	☑	☑	☑	
	Counter E_{1-8}	☑	☑	☑	Each counter can be dedicated to any of four quadrants (P-Q, import-export, L-C). Total energy is a sum of one counter for all tariffs. Tariffs can be fixed, date/time dependent or tariff input dependent
	$E_{}_{TOT_1-8}$	☑	☑	☑	
	Active tariff	☑	☑	☑	
Auxiliary Channel measurements	Aux. line				
	$U_{NEUTRAL\text{-}EARTH}$	☑		☑	Aux. voltage is dedicated for neutral-earth meas. only
	$I_{NEUTRAL_meas}$	☑		☑	Measured neutral current with 4th current input
	$I_{NEUTRAL_calc}$	☑	☑	☑	Calculated neutral current
	$I_{NEUTRAL_err}$	☑		☑	Error neutral current (difference between measured and calculated)
Maximum demand measurements	Maximum demand				
	MD_I_{1-3}	☑	☑	☑1ph	
	MD_P_{import}	☑	☑	☑	
	MD_P_{export}	☑	☑	☑	
	MD_Q_{ind}	☑	☑	☑	
	MD_Q_{cap}	☑	☑	☑	
	MD_S	☑	☑	☑	
Min and max measurements	Min and max				
	$U_{1-3_TRMS_MIN}$	☑		☑1ph	
	$U_{1-3_TRMS_MAX}$	☑		☑1ph	
	$U_{0_Zero_sequance_TRMS_MIN}$	☑	☑		Max/Min Zero sequence voltage
	$U_{0_Zero_sequance_TRMS_MAX}$	☑	☑		
	$U_{1_Positive_sequence_TRMS_MIN}$	☑	☑		Max/Min Positive sequence voltage
	$U_{1_Positive_sequence_TRMS_MAX}$	☑	☑		
	$U_{2_Negative_sequence_TRMS_MIN}$	☑	☑		Max/Min Negative sequence voltage
	$U_{2_Negative_sequence_TRMS_MAX}$	☑	☑		
	$Upp_{1-3_TRMS_MIN}$	☑	☑	☑	
	$Upp_{1-3_TRMS_MAX}$	☑	☑	☑	
	$I_{1-3_TRMS_MIN}$	☑	☑	☑1ph	
	$I_{1-3_TRMS_MAX}$	☑	☑	☑1ph	
	$I_{NEUTRAL_meas_TRMS_MIN}$	☑	☑	☑	
	$I_{NEUTRAL_meas_TRMS_MAX}$	☑	☑	☑	
	$I_{0_Zero_sequance_TRMS_MIN}$	☑	☑		Max/Min Zero sequence current
	$I_{0_Zero_sequance_TRMS_MAX}$	☑	☑		
	$I_{1_Positive_sequence_TRMS_MIN}$	☑	☑		Max/Min Positive sequence current
	$I_{1_Positive_sequence_TRMS_MAX}$	☑	☑		
	$I_{2_Negative_sequence_TRMS_MIN}$	☑	☑		Max/Min Negative sequence current
	$I_{2_Negative_sequence_TRMS_MAX}$	☑	☑		

📖 For more information see ***Power Quality Analyzer MC 784/iMC 784*** User's manual

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Meas. type	Measurement	3-phase 4-wire	3-phase 3-wire	1-phase	comments
Min and max measurements	$P_{1\text{-}3_TRMS_MIN}$	☑		☑1ph	
	$P_{1\text{-}3_TRMS_MAX}$	☑		☑1ph	
	$P_{TOT_TRMS_MIN}$	☑	☑	☑1ph	
	$P_{TOT_TRMS_MAX}$	☑	☑	☑1ph	
	$Qb_{TOT_TRMS_MIN}$	☑	☑		Max/Min Budeanu reactive power Total
	$Qb_{TOT_TRMS_MAX}$	☑	☑		
	$Qb_{1\text{-}3_TRMS_MIN}$	☑	☑		Max/Min Budeanu reactive power Phase
	$Qb_{1\text{-}3_TRMS_MAX}$	☑	☑		
	$S_{1\text{-}3_TRMS_MIN}$	☑		☑1ph	
	$S_{1\text{-}3_TRMS_MAX}$	☑		☑1ph	
	$S_{TOT_TRMS_MIN}$	☑	☑	☑1ph	
	$S_{TOT_TRMS_MAX}$	☑	☑	☑1ph	
	$D_{TOT_TRMS_MIN}$	☑	☑		Max/Min Deformed power Total
	$D_{TOT_TRMS_MAX}$	☑	☑		
	$D_{1\text{-}3_TRMS_MIN}$	☑	☑		Max/Min Deformed power Phase
	$D_{1\text{-}3_TRMS_MAX}$	☑	☑		
	$dPF_{TOT_TRMS_MIN}$	☑	☑		Max/Min Displacement Power Factor Total
	$dPF_{TOT_TRMS_MAX}$	☑	☑		
	$dPF_{1\text{-}3_TRMS_MIN}$	☑	☑		Max/Min Displacement Power Factor Phase
	$dPF_{1\text{-}3_TRMS_MAX}$	☑	☑		
	$freq_{MIN}$	☑	☑	☑	
	$freq_{MAX}$	☑	☑	☑	
Other measurements	Miscellaneous				
	Internal temp.	☑	☑	☑	
	Date, Time	☑	☑	☑	
	Last Sync. time	☑🕮	☑🕮	☑🕮	UTC
	GPS Time	☑🕮	☑🕮	☑🕮	If GPS receiver is connected to dedicated RTC time synchronization input
	GPS Longitude	☑🕮	☑🕮	☑🕮	
	GPS Latitude	☑🕮	☑🕮	☑🕮	
	GPS Altitude	☑🕮	☑🕮	☑🕮	

🕮 For more information see Power Quality Analyzer MC 784/iMC 784 User's manual

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RECORDERS

A built-in recorder (8 GB) enables storing periodic measurements, detected alarms, PQ reports with corresponding anomalies, trigger history as well as waveforms (including transients), disturbances and PQ recorder records (reports and anomalies). It supports recording of all measured quantities including voltage and current harmonics and inter-harmonics (up to 63rd) in multiple recorders. For each recorder it is possible to setup a storage interval (for periodic trend recorders) as well as other recording parameters. Apart from periodic trend recorder data recorders are also used to store the following data:

- Alarms where each alarm is triggered by means of a preset threshold and is stored in the form of alarm i.d. and its corresponding timestamp,
- PQ reports where each report in recorder is identified by a monitoring interval (date) – typically once per week,
- PQ report anomalies representing (synchronized) time stamped PQ values that are outside PQ limit lines,
- Trigger based recorders which store a timestamp related database of all triggers which have occurred together with (optional) PQDIF/COMTRADE related records which are recorded based on pre-set triggering conditions. These records can be of types: waveform, disturbance, PQ or fast trend record. The figure below shows waveform recorder settings:

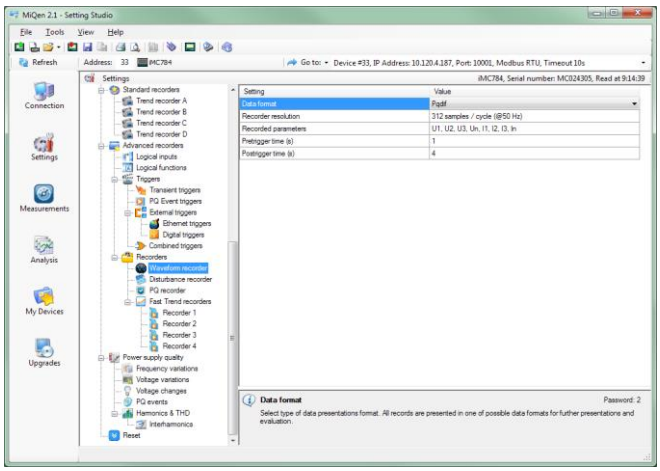


Figure 7: ***Setting trigger related recorders in MiQEN (example shown for waveform recorder)***

The complete content of the recorder can be viewed and downloaded with MiQEN setting SW in a detailed table or visually favored graphical form.

ALARMS AND TRIGGERS

Alarms and triggers represent powerful tool for Power Quality Analyzer MC 784/iMC 784 control, supervision and oscillography recording features. By using alarms the devices' performance can hence reach beyond just measuring and analyzing power network.

Power Quality Analyzer MC 784/iMC 784 supports recording and storing of 32 alarms in four groups. Time constant of maximal values in a thermal mode, compere time delay, hysteresis and response time are defined for each group of alarms.

For each parameter it is possible to set a 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:

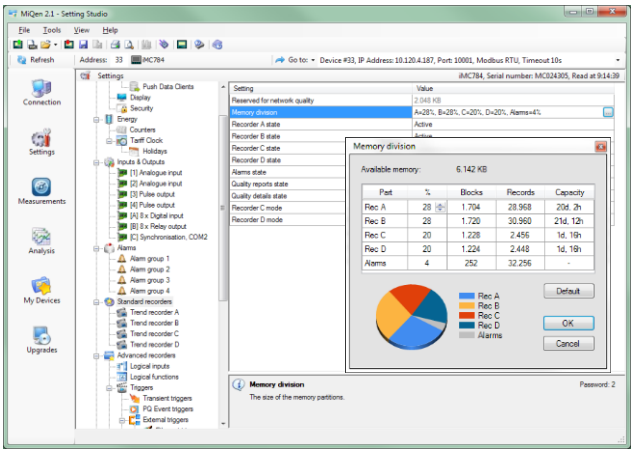


Figure 8: ***Setting recorder parameters and viewing memory consumption information***

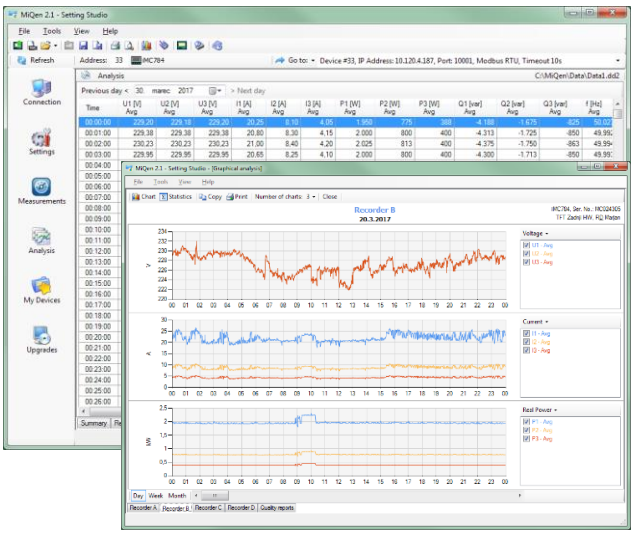


Figure 9: ***Viewing recorder content in table and graphical form***

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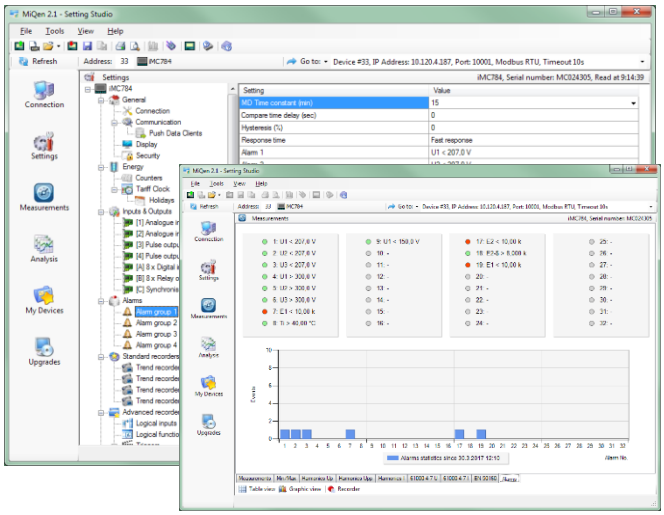


Figure 10: ***Setting and viewing alarms***

A sophisticated triggering mechanism is used to register and record events of various natures:

- Transient event generated triggers based on hold-off time (in ms), absolute peak value (in % of Un), fast change (in %Un/µs),
- PQ event generated triggers based on the following events: voltage dip, voltage swell, voltage interruption, end of voltage interruption, rapid voltage change and inrush current,
- External Ethernet triggers enabling trigger events with up to 8 different dislocated devices connected within the network,
- External digital triggers based on logical/digital inputs,
- Up to 16 combined triggers enabling logical operation on previously configured triggers of various natures.

An example of transient trigger settings in MiQEN SW is shown below:

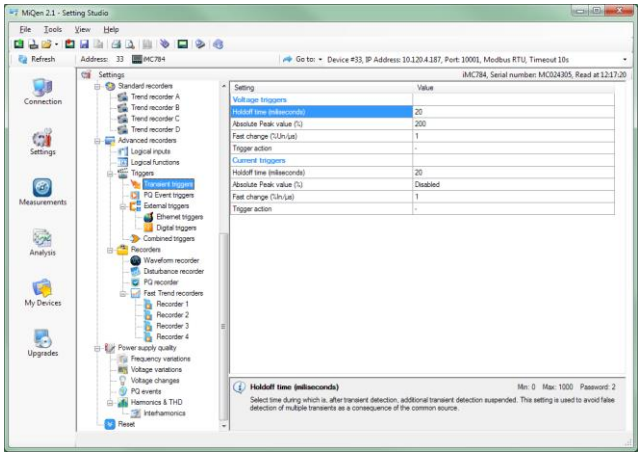


Figure 11: ***Setting trigger in MiQEN (example shown for transient trigger)***

REAL TIME SYNCHRONISATION

Synchronized real-time clock (RTC) is an essential part of any Class A analyzer for proper chronological determination of various events. Without RTC synchronization Power Quality Analyzer MC 784/iMC 784 acts as a Class S device.

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 and transmission 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 dependent and it influences its precision. For that reason it is required to implement periodical RTC synchronization.

Power Quality Analyzer MC 784/iMC 784 supports three types of RTC synchronization.

GPS time synchronization:

1pps and serial RS232 communication with NMEA 0183 sentence support.

GPS interface is designed as 5 pole pluggable terminal (+5V for receiver supply, 1pps input and standard RS232 communication interface).

Proposed GPS receiver is MEINBERG GPS164 or similar.

IRIG time code B (IRIG-B):

Unmodulated (DC 5V level shift) and modulated (1 kHz) serial coded format with support for 1pps, day of year, current year and straight seconds of day as described in standard IRIG-200-04. Supported serial time code formats are IRIG-B007 and IRIG-B127

Interface for modulated IRIG-B is designed as BNC-F terminal with 600 Ohm input impedance. Interface for unmodulated IRIG-B is designed as pluggable terminal.

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 synchronization purposes.*

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COMMUNICATION

Power Quality Analyzer MC 784/iMC 784 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.

Configuration	*COM1*	*COM2*
	Ethernet & USB [1]	*RS232/RS485* [2]

[1] *Galvanic separation between Eth. and USB is 1 kV_{ACRMS}. USB can be used as service port.*

[2] *RS232/RS485 communication and GPS time synchronization cannot be used at the same time. When GPS time synchronization is used, RS232/RS485 communication on COM2 is not available.*

Table 4: Communication configuration

Power Quality Analyzer MC 784/iMC 784 supports standard communication protocols MODBUS RTU, MODBUS TCP, DNP3 L1, MQTT, upgradeable to IEC61850 Ed.2 (optionally).

Additionally it supports the proprietary *PUSH or MQTT (M2M) communication mode*, which is used in system applications with multiple devices attached into the network. Devices autonomously send all preconfigured data (triggers, alarms, measurements, all records) into the MiSMART server (via XML PUSH data packages) or into the MQTT brokers. The server system software MiSMART collects data through the push receiver service or MQTT brokers and stores it into a relational database.

The version with MQTT protocol is specially developed for EU project TDX-ASSIST. The functionality of it is used in Elektro Gorenjska.

All stored data can then be viewed with the native MiSMART web based application which can be viewed with any web browser. At the same time MiSMART can serve as a middleware system to relay all device gathered data into a third-party system software (e.g. SCADA systems, OPC server, PQ analysis established softwares…). The main benefits offered to a typical customer after implementing the MiSMART system can be stated below:

Receiving relevant periodic measurement data and real time alarms and triggers from all crucial points in electro-distribution network to assure:

- better protection
- more reliable operation
- faster response on failures
- better maintenance
- control on power consumption and
- losses in network
- historical data for better planning
- better power quality
- better control on the installed equipment…

For more information about the PUSH communication mode and XML format see the Power Quality Analyzer MC 784/iMC 784 User's manual. For more information on the MiSMART system software please see the MiSMART User's manual. Some examples of MiSMART native web client usage are shown in the figures below:

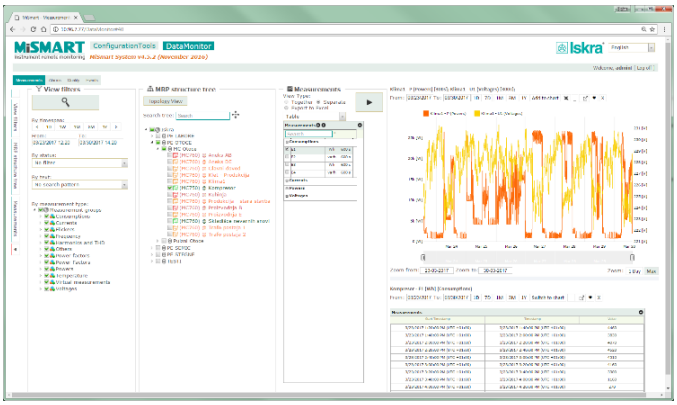


Figure 12: ***Viewing measurement data in graphic and table form with the MiSMART native web client***

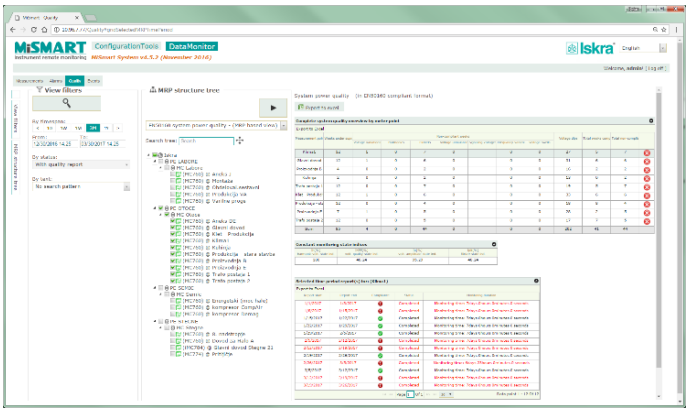


Figure 13: ***Viewing PQ data as MRP based view with the MiSMART native web client***

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TECHNICAL DATA

Measurement inputs

Frequency measurements:

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

Voltage measurements:

Number of channels	*4 (1)*
Nominal value (U_N)	*500 V_{LN} , 866 V_{LL}*
Min. voltage for sync.	*From starting voltage for SYNC (min value - 1 V_{rms})*
Min, measured value	*From starting voltage for all powers*
Max. measured value (cont.)	*600 V_{LN}; 1000 V_{LL}*
Max. allowed value	*1.2 × U_N permanently 2 × U_N ; 10 s*
Consumption	*< U^2 / 4.2 MΩ per phase*
Input impedance	*4.2 MΩ per phase*

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

Current measurements:

Number of channels	*4*
Nominal value (I_{NOM})	*1 A, 5 A*
Min. measured value	*From starting current for all powers*
Max. measured value (I_1-I_3 only)	*12.5 A sinusoidal*
Max. allowed value (thermal)	*15 A continuous ≤ 300 A; 1 s*
Consumption	*< I^2 × 0.01 Ω per phase*

Sampling and resolution:

Waveform sampling	*32 µs (625 Samples per Cycle)*
ADC resolution	*24 bit 8-ch simultaneous inputs*
Reading refresh rate	*100 ms – 5 s (User defined)*
Timestamp resolution	*1 ms*

System:

Voltage inputs can be connected either directly to low-voltage network or via a voltage transformer to a higher voltage network.

Current inputs can be connected either directly to low-voltage network or shall be connected to network via a corresponding current transformer (with standard 1 A or 5 A outputs).

Basic accuracy under reference conditions

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

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

Power Quality Analyzer MC 784/iMC 784 is equipped with two main I/O modules A and B, two auxiliary I/O modules 1/2 and 3/4 and special time-synchronization module C. The following I/O modules are available:

Module type	Number of modules per slot	
	Main slot	Aux slot
Analogue output (AO)	2	/
Analogue input (AI)	2	/
Pulse output (PO)	2	/
Pulse input (PI)	2	/
Tariff input (TI)	2	/
Relay output (RO)	2	8
Digital input (DI)	2	8
Bistable alarm output (BO)	1	/
Watchdog / Relay output	WO/RO	/

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 …).

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Analogue DC current input:

Nominal input range	*– 20 … 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*

Analogue DC voltage input:

Nominal input range	*– 10 … 0 … 10 V (± 20 %)*
Input resistance	*100 kΩ*
Accuracy	*0.5 % of range*
Temperature drift	*0.01 % / °C*
Conversion resolution	*16 bit (sigma-delta)*
Analogue input mode	*internally referenced Single-ended*

Analogue resistance (temperature) input:

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) 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 … 20 mA*
Accuracy	*0.5 % of range*
Max. burden	*150 Ω*
Linearization	*Linear, Quadratic*
No. of break points	*6*
Output value limits	*±120 % of nominal output*
Response time (measurement and analogue output)	*depends on set general average interval (0.1 s – 5 s)*
Residual ripple	*< 1 % p.p.*

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.

Tariff input (TI)

Rated voltage	*5 ... 48 V DC* *110 ± 20 % V AC/DC* *230 ± 20 % V AC/DC*
Frequency range	*45 … 65 Hz*

Pulse input (PI)

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*

Digital input (DI)

Rated voltage	*5 ... 48 V DC* *110 ± 20 % V AC/DC* *230 ± 20 % V AC/DC*
Frequency range	*45 … 65 Hz*

Bistable alarm output (BO)

Type	*Relay switch*
Purpose	*Alarm output*
Rated voltage	*230 $V_{AC/DC}$ ± 20 % max*
Max. switching current	*1000 mA (main slot)*
Contact resistance	*≤ 100 mΩ (100 mA, 24 V)*

Watchdog (WO)/Relay output (RO)

Type	*Relay switch*
Normal operation	*Relay in ON position*
Failure detection delay	*≈1.5 s*
Rated voltage	*230 VAC/DC ± 20 % max*
Max. switching current	*1000 mA*
Contact resistance	*≤ 100 mΩ (100 mA, 24 V)*

Pulse output (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 … 999 ms)*

Time synchronization input

Digital input	*GPS or IRIG-B TTL*
1pps voltage level	*TTL level (+ 5 V)*
Time code telegram	*RS232 (GPS)* *DC level shift (IRIG-B)*
AM analogue input	*IRIG-B AM modulated*
Carrier frequency	*1 kHz*
Input impedance	*600 Ohms*
Amplitude	*2.5 V_{P-Pmin}, 8 V_{P-Pmax}*
Modulation ration	*3:1 – 6:1*

Auxiliary Power Supply

Measurement category	*CAT III 300 V*
Nominal voltage AC	*100 V – 240 V; -20%....+15%*
Nominal frequency	*40 … 65 Hz*
Nominal voltage DC	*100 V - 250 V; +20%*
Consumption (typical)	*< 8 VA typical*
Consumption (max. all I/O)	*< 12 VA (MC 784)* *< 13 VA (iMC 784)*
Power-on transient current	*< 20 A ; 1 ms*

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 III ; 600 V*
Measuring inputs	*CAT IV ; 300 V* *Acc. to EN 61010-1*

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Mechanical

Dimensions	*144 × 144 × 100 mm*
Mounting	*Panel mounting 144 × 144 mm*
Required mounting hole	*137 × 137 mm*
Enclosure material	*PC / ABS*
Flammability	*Acc. to UL 94 V-0*
Weight	*550 g*
Enclosure material	*PC / ABS*
	Acc. to UL 94 V-0

Ambient conditions:

Ambient temperature	*K55 temperature class*
	Acc. to EN61557-12
	- 10 … 55 °C
Storage temperature	*- 40 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. It ensures auxiliary supply (for internal RTC only) for more than two days of operation.

Type	*Low power embedded RTC*
RTC stability	*< 1 sec / day*

Connection cables

Power Quality Analyzer MC 784/iMC 784 is equipped with European style pluggable terminals for measuring voltages, auxiliary supply, communication and I/O modules. Measuring current cables shall be attached as through-hole connection without screwing.

NOTE!

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

Voltage inputs (4)	*≤2.5 mm² , AWG 24-12 single wire*
Current inputs (3)	*≤Ø 6 mm one conductor with insulation*
Current inputs – neutral (1)	*≤ Ø 5 mm one conductor with insulation*
Supply (2)	*≤2.5 mm² , AWG 24-12 single wire*
I/O (31)	*≤2.5 mm² , AWG 24-12 single wire*
	≤2.5 mm² , AWG 24-12 single wire

MiQen - setting studio Software

MiQen software is intended for configuration and data analysis of a PC or network connected Power Quality Analyzer MC 784/iMC 784. 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 .scv formats as well as into the MiSMART database and PQDIF format. The software is multilingual and runs on all Windows operating systems since Windows XP.

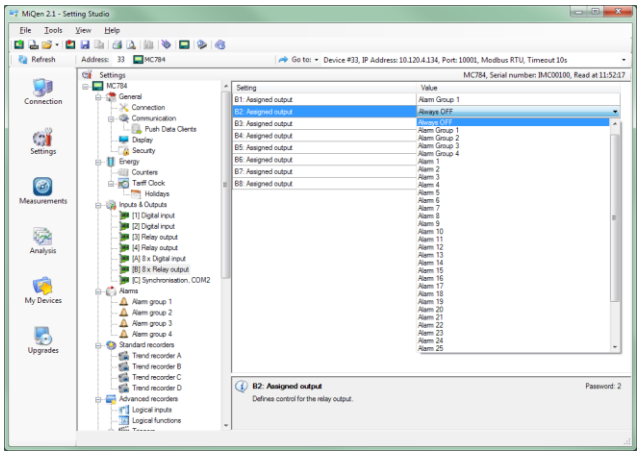


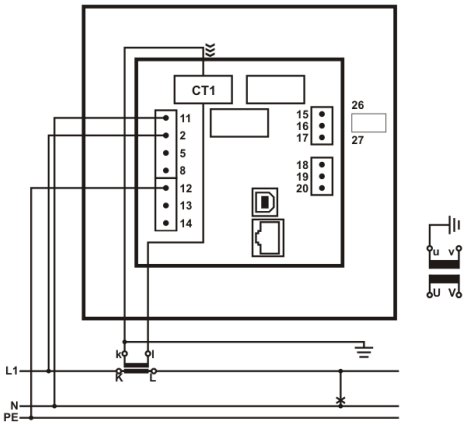
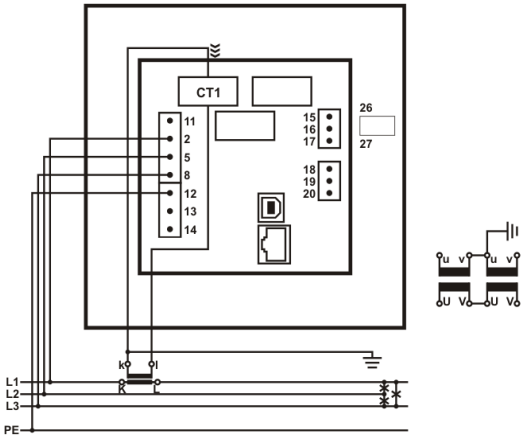
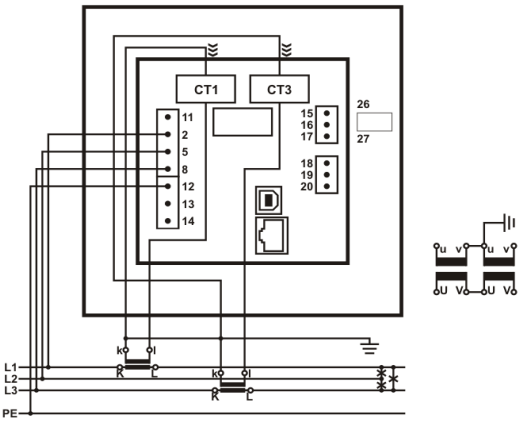
Figure 14: MiQen setting and acquisition software (relay output settings)

MiQen software is intended for the following use:

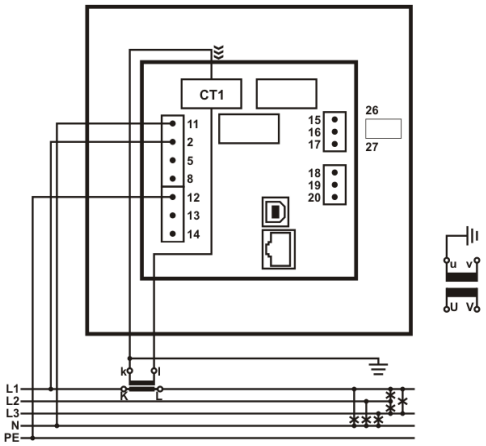
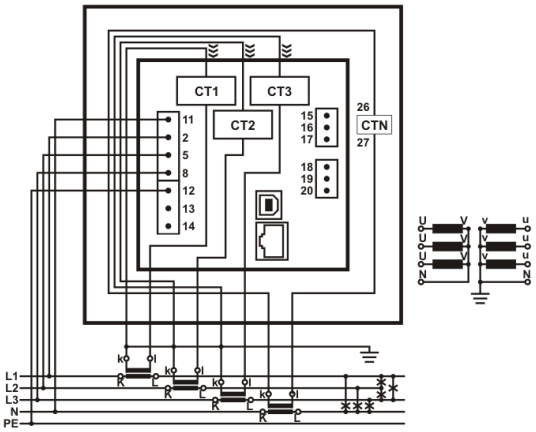
- Setting all of the instruments parameters (online and offline).
- Viewing current measured readings and stored data.
- Setting and resetting energy counters.
- Complete I/O modules configuration.
- Evaluation of the electricity supply quality in compliance with EN50160 and automatic PQ report generation.
- Viewing and exporting time-stamped PQ anomaly details.
- Upgrading instruments firmware.
- Searching the net for devices.
- Virtual interactive instrument.
- Downloading all recorded data from one selected device.
- Comprehensive help support.

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CONNECTION

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

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System/connection	Terminal assignment
Connection 4b (1W4b) ***Three phase, four wire connection with balanced load***	
Connection 4u (3W4) ***Three phase, four wire connection with unbalanced load*** ***With this connection, a neutral current can be measured with 4th current sensor***	

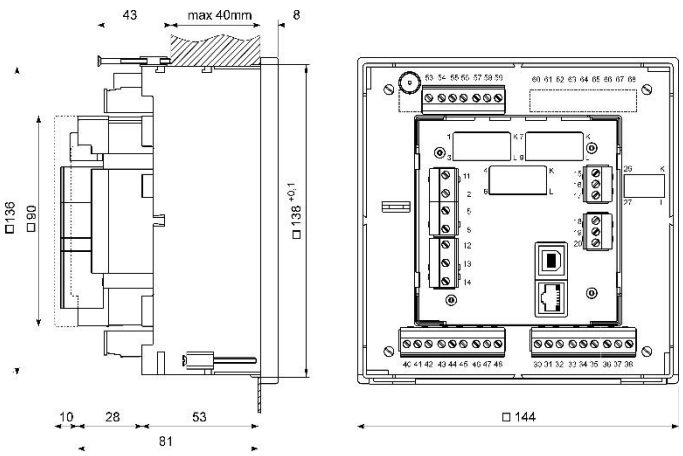
NOTE:

Terminal 12 (PE) must ALWAYS be connected regardless of system connection.

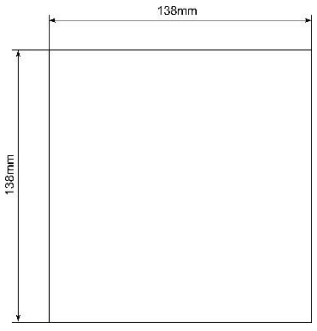
Fourth voltage channel is dedicated for measuring voltage between EARTH (PE, terminal 12) and NEUTRAL (N, terminal 11).

DIMENSIONAL DRAWING

Dimensions



Panel cut-out



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Connection table

Function			Connection	Comment
Measuring input	AC current	IL1	1/3	⚠ CAT III 600V
		IL2	4/6	
		IL3	7/9	
		ILN	26/27	
	AC voltage	UL1	2	⚠ CAT III 600V
		UL2	5	
		UL3	8	
		UN	11	
Inputs / outputs	I/O module 1/2	+ / ~	15	I/O function depends on type of I/O module
		– / ~	16	
		+ / ~	17	
	I/O module 3/4	+ / ~	18	
		– / ~	19	
		+ / ~	20	
	I/O module A	– / ~	30	
		+ / ~	31 - 38	
	I/O module B	– / ~	40	
		+ / ~	41 - 48	
	I/O module C	⦾ BNC input	BNC	IRIG-B modulated (1kHz) time sync. signal
		1 pps	53	TTL level 1 pps time sync. Signal or IRIG-B digital
		RS485	54, 55	A – 54, B – 55
		MODEM/RS232	56-59	Rx – 56, GND – 57, Tx – 58, +5V - 59
Auxiliary power supply		+ / ~ (L)	13	⚠ CAT III 300V ⚠ GROUND terminal must always be connected!!
		– / ~ (N)	14	
		⏚	12	
Communication		USB	Type B	USB 2.0 type B
		ETHERNET	RJ-45	10/100 BASE-TX Ethernet

Table 6: ***Connections***

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DATA FOR ORDERING

When ordering Power Quality Analyzer MC 784/iMC 784, 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.

Additional options:

To order the option of IEC61850 Ed.2 Server please order the following additional SW option number: 022491017000

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	I/O module A	I/O module B		
xMC 784	**X**	**H**	**X**	**X**	**X**	**X**	**X**		
						N		Without *	
						M		8x Relay (alarm) output	I/O module A only
						D		8x Digital input 230 VAC/DC	
						E		8x Digital input 110 VAC/DC	
						F		8x Digital input 5-48 VAC/DC	
				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 $_{AC/DC}$	I/O module 1/2 only
				Z				2× Tariff input 110 V $_{AC/DC}$	I/O module 1/2 only
				Y				2× Tariff input 5 - 48 V $_{AC/DC}$	I/O module 1/2 only
			E					Ethernet & USB *	
			S					Ethernet & USB -IEC 61850 Ed.2	
		H						80...300 V $_{DC}$, 80...276 V $_{AC}$ *	
	S							50, 60 Hz *	
	A							400 Hz	
iMC 784								Power Quality Analyzer with TFT 5.7” display	
MC 784								Power Quality Analyzer with Graphic 128x64 pixel display	

***- standard**

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Dictionary:

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

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