PQ monitor MEg39.1

User manual

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PQ monitor MEg39.1

1/ INTRODUCTION

The MEg39.1 PQ monitor is designed for indirect measurement of four voltages and four currents at HV level. It has one galvanically isolated two-stage input and two controlled independent output contacts. It is fitted with USB, RS485 and ETH interfaces. It can optionally include a GSM module and a GPS module. The measured data transmission via the ETH interface and GSM network can be secured by IKEv2/IPsec, L2TP/IPsec or other cryptographic protocols available in the LINUX operating system.

The MEg39.1 PQ monitor provides the functions of recording, electricity meter and analysis of voltage quality, all performed simultaneously. In the recording function, the MEg39.1 processes and records all measured quantities, harmonics and interharmonics up to order 64 in each phase and for the output. In the electric meter function, it measures and records the energies in four quadrants in time-spaced registers for individual phases and for the output. This allows subsequent evaluation of the energies for any time interval. In the function of voltage quality analysis, the Class A monitor evaluates all parameters for measured three voltages and three currents, as stipulated by the standard, using methods of Class A. It calculates harmonic and centred subgroups of interharmonic voltages and currents up to the order of 125. When recording events, the monitor, aside from recording the courses of $U_{RMS1/2}$ and $I_{RMS1/2}$, makes an oscillographic record of all measured values of voltage and current. The records are also with pre-trigger. The MEg39.1 can operate as an oscillograph with recording of measured values of voltage and current to the data memory. With the GPS module, it has a time uncertainty of 1 ms, which allows a more accurate determination of the cause of a fault and its development in large-scale systems.

The voltage and current measuring inputs are designed for indirect measurements by means of instrument transformers or sensors. Measurement, power and communication circuits are connected to the MEg39.1 monitor via disconnectable terminal blocks allowing easy disassembly during recalibration. A special jig can be used to easily remove loose parts of the disconnectable terminal blocks. The current disconnectable terminal blocks can be fitted with the PROT39 low-loss current disconnection protection.

In addition to the standard current inputs of 1 A, 5 A and voltages of 225 mV, 150 mV, 22.5 mV, the MEg39.1 is also available with a non-standard design of current inputs, allowing the connection of AMOSm type flexible current sensor loops. TORm or TORv

toroids and LCT split-core low power transformers can be used as current sensors. These low-power sensors are advantageous for retrofit installations and for installations where the mechanical layout needs to be adapted. User information for LCT, TOR and AMOSm sensors is provided in separate descriptions.

The MEg39.1 has a built-in CAT IV / 300 V category surge protector with high immunity to surges occurring in mains or DC supply voltages. It also has a power supply for supplying a safe small DC voltage with a nominal value from 24 V to 48 V. The MEg39.1 also includes a short-term uninterruptible power supply.

A USB serial interface is provided for local parametrization of the instrument and storage of measured data using a PC, tablet or authorized flash drive. Ethernet and RS485 interfaces are provided for connection to local and remote networks.

2/ SW INFORMATION

Local (USB) and remote (IP address) parametrization of the measurements, which includes specifying the recording interval, current transformer conversions and specification of the measured quantities, initiating the measurements and reading the measured data from the MEg39.1 monitor, is handled by the program **PQ_MEg** [1]. The program **DV_MEg** [2] displays the measured data in graphical and tabular form. This program always works with one instrument.

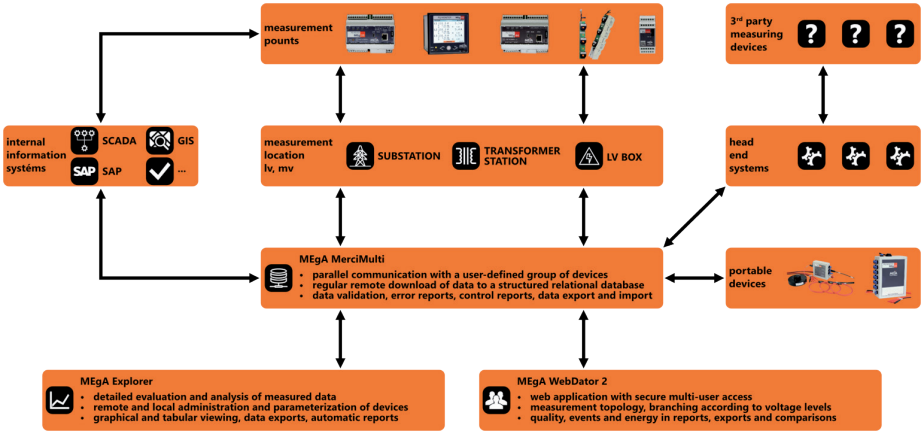
The program **MEgA_Explorer** [3] allows the display and detailed analysis of data from the local SQLite database. It is a Windows application installed on a PC or server. It is mainly focused on the detailed analysis of data from a single measurement, but also supports selected bulk functions (e.g. measurement reports).

The web application **WebDator2** [4] allows multiple access for data display. It is mainly focused on large groups of instruments, for overview and informative evaluations and summary analyses. The application works over a PostgreSQL or Oracle database.

Continuous remote automatic data reading of one, but especially multiple instruments available on the network, including monitoring of input states is performed by the **MEgA_Merci Multi** system [5], which works as a Windows OS service on the server. Periodic data reading is performed at a set interval, usually daily. The system reads newly measured data since the previous reading. The read data is stored in a SQLite, PostgreSQL or ORACLE database. The program also performs automatic exports in CSV format and reports on voltage quality in the form of emails. The program can be used to remotely update the DSP processor core FW after checking the transfer.

With the exception of the WebDatOr2 program, the mentioned programs, including their manuals, are available at http://www.e-mega.cz/DL/

The MEg39.1 PQ monitor also enables work with third-party SW through the MODBUS RTU (RS-485), MODBUS TCP (Ethernet), ČSN EN 60870-5-104 and DLMS/COSEM protocols. It is possible to set up automatic sending of measured values via the ČSN EN 60870-5-104 protocol according to deviation criteria or at regular intervals. For presentation in other systems, CSV formats can be used, which can be customized. The instrument has web interfaces enabling displaying actual values of selected variables over a web browser.



3/ DESCRIPTION OF THE INSTRUMENT

3.1 Design

The MEg39.1 PQ monitor in Fig. 1 is designed for fixed installation on a DIN TS35 rail. It is housed in a polycarbonate self-extinguished box measuring 108 × 90 × 61 mm. Fig. 1 also shows the protection module for disconnection of PROT39 current circuits. The structural elements of the MEg39.1 monitor are shown in Fig. 2. Above the monitor panel is a rotatable, transparent cap that can be sealed to secure the SIM card in the monitor panel. There is a cutout in the transparent cap at the ETH connector location, allowing access to the front panel elements without interrupting communication on the ETH interface. The GPS and GSM antenna cables are fitted with angled connectors and are routed vertically down under the cap. The measured voltages, currents, power supply, input and output signals, RS485 interface are connected via disconnectable terminal blocks. The MEg39.1 on a DIN rail can be installed under the panel of the mounting

cabinet that covers disconnectable terminal blocks and increases the resistance to mechanical stress.

The four measured voltages with the neutral conductor are applied to the five-pole disconnectable terminal blocks U1, U2, U3, U4 and Nm. The yellow LEDs under terminals U1, U2, U3 and U4 indicate by their steady glow the presence of voltages within the pre-set tolerances. If the measured voltage is outside the pre-set tolerances, the corresponding LED flashes. For the description of LED indication, see Table 1.

The measured currents I1 to I4 are applied to the eight-pole terminal block, with the input current terminal of the current being marked S1 and the output current terminal S2. The MEg39.1 has two standard current input designs.

The first standard design with 5 A and 1 A nominal current has electronic switching of nominal current 5 A or 1 A for standard solid-core or split-core current transformers MTPD.51 or flexible AMOS/1A sensors. In this version, the PROT39 module with disconnection protections for current circuits without screw connection can be used in addition to the connector with locking screws.

The second standard version with one of the voltages 225 mV, 150 mV, 22.5 mV is designed for low-power current sensors according to IEC 61869 e.g. for

- LCT split-core transformers with conductor hole diameters from 10 mm to 36 mm and nominal current from 5 A to 600 A.
- TORm external toroids with a nominal input current of 1 A or 5 A or TORv external toroids with a nominal current of 10 A or 50 A.

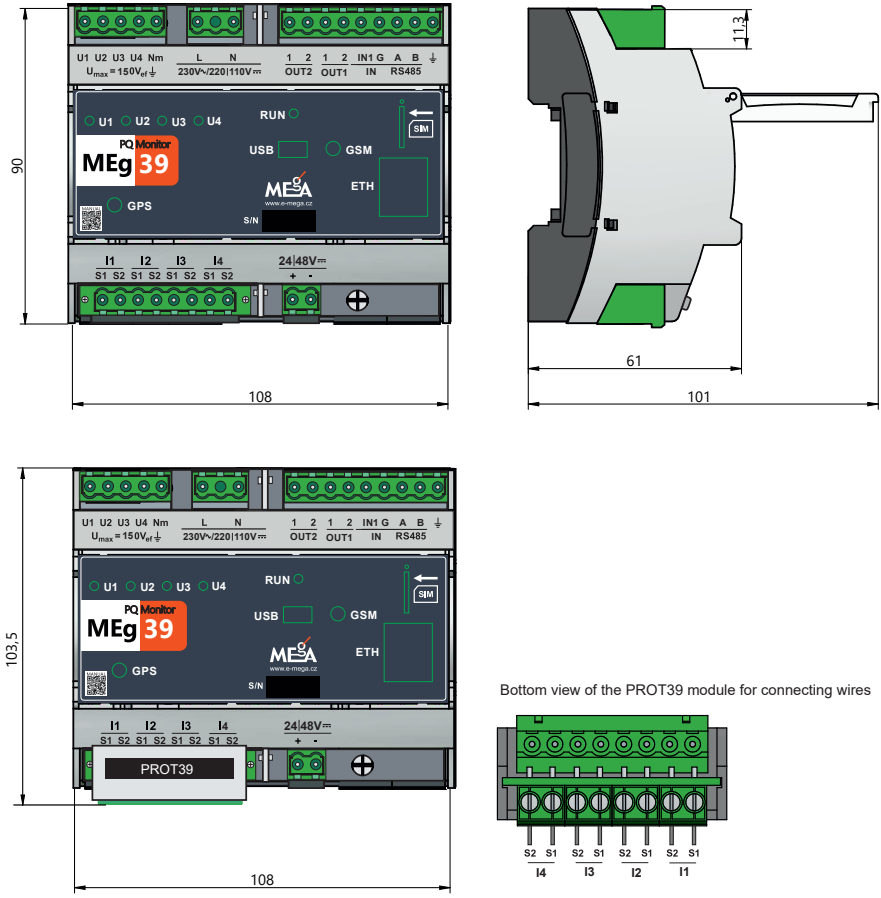
There is also a special version of the MEg39.1 available for directly connected loops of AMOSm flexible sensors of nominal current from the 30 A / 100 A / 300 A / 1000 A / 3000 A / 5000 A range. The sensor loop length can be 200 mm or 400 mm or 600 mm.

The MEg39.1 universal monitor has a mains and higher DC voltage supply and a small safe DC voltage supply. For the mains voltage supply, a three-pole connector with an unconnected middle pole is used, taking into account the CAT IV / 300 V overvoltage category. For the small safe DC voltage supply, a two-pole connector is used. Any of the supply voltages is sufficient to power the MEg39.1. The corresponding voltages can be connected to both power connectors at the same time.

On the unit's panel is a green RUN LED indicator indicating the activity of the MEg39.1. The RUN LED indicator states are described in Table 1.

Output signals OUT1 and OUT2 are realized by NO contacts of polarized relays, which keep the last state even after a power supply interruption.

Fig. 1: Dimensions of the MEg39.1 with hinged cover and drawing of the PROT39 protection module



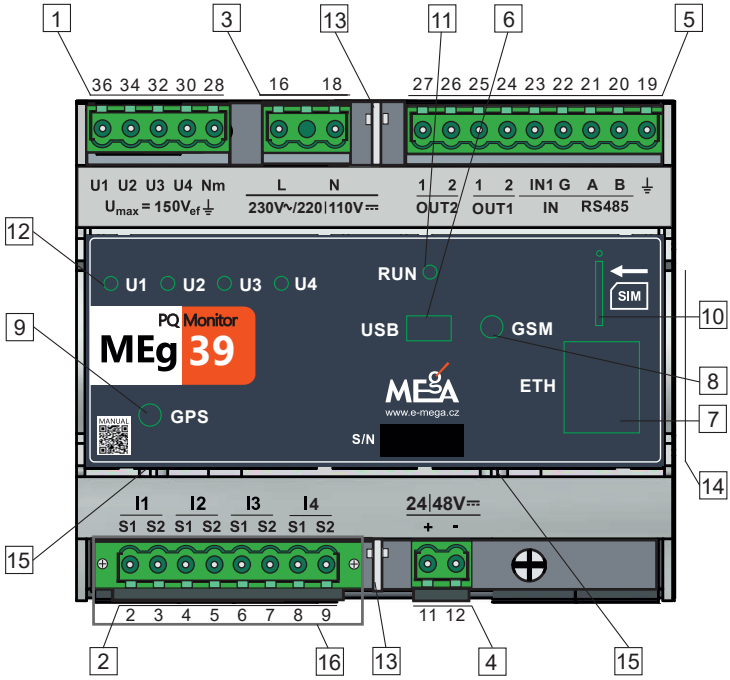
The IN terminal is to be connected to a galvanically free external NO contact and its power supply is 5 V internal voltage from the monitor. However, it can also be powered from an external power supply up to 30 V. In this case, the external contact must be a double-throw contact.

For local reading of measured data by a computer and measurement parametrization, there is a miniUSB connector on the panel of the instrument. Local parametrization and data reading can also be performed using a flash drive, where the measured data is stored encrypted (AES128) in CSV format. Remote communication is realized via an RS485 interface on terminals A, G, B. For remote communication and the built-in Webserver function, it is possible to use the Ethernet interface with an ETH RJ45 connector located

on the panel of the monitor. For remote communication by GPRS to LTE data transmission over GSM networks and for time synchronization by GPS system there are GSM and GPS connectors with latching mechanism on the front panel of the monitor, to which coaxial cables of corresponding antennas are to be connected via angled connectors. The SIM card is NANO SIM sized, and is accessible on the front panel under a hinged cover.

The panel indicates the type of the MEg39.1 monitor, S/N serial number and QR code with a description of the monitor. On the right side of the MEg39.1 monitor is a rating plate specifying the nominal values of measured voltages, currents, frequency, supply voltage and input power of the unit and safety pictograms.

Fig. 2: Designation of MEg39.1 elements



Tab. 1: Description of MEg39.1 elements

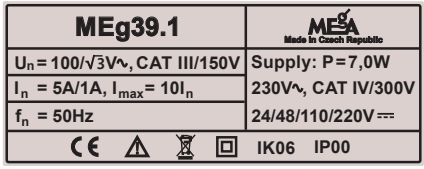
Item	Group name	Description
1	Voltage inputs	Five-pole disconnectable terminal block U1, U2, U3, U4 and Nm for connection of phase voltages L1, L2, L3, voltage UL4 and neutral conductor or ground
2	Current inputs	Eight-pole disconnectable terminal block of current circuits I1, I2, I3, I4 with contacts S1 and S2 of each current circuit for screw-locking of secondary currents or voltages of current sensors installed in circuits of phases L1, L2, L3 and current IL4. Contacts S1 are input and S2 are output. S1 contacts are connected to a common conductor, see Fig. 5.
3	Power supply connector $230\,V_{AC}$, $220\,|\,110\,V_{DC}$	Three-pole disconnectable terminal block for supplying mains and higher DC voltage to the monitor
4	Power supply connector $24\,|\,48\,V_{DC}$	Two-pole disconnectable terminal block for powering the monitor with small safe DC voltage
5	HF ground ⏚, RS485 interface, two--stage input IN, OUT1, OUT2 outputs	Nine-pole disconnectable terminal block – for connecting the HF ground of the monitor to PE or PEN, – for connecting the RS485 data interface with terminals A, B, and terminal G, which is also common for the galvanically isolated two-stage input with terminal IN, – for NO contacts OUT1 and OUT2 of bistable relays with monitoring contacts
6	USB 2.0 interface	Mini USB connector for local data transfer or flash drive connection
7	ETH interface	RJ45 connector for ETHERNET 100Base-Tx interface for remote data transfer. A wiring example is shown in Figure 10. Meaning of LED indicators: • green LINK; LED indicates the speed of the data line on 100 Mbit/s; off 10 Mbit/s • Orange ACTIVITY; LED indicates data transfer by lighting

Item	Group name	Description
8	GSM antenna	Angled connector with a latch mechanism for connecting a GSM antenna
9	GPS antenna	Angled connector with a latch mechanism for connecting a GPS antenna
10	SIM card	NANO SIM card goes into the indicated slot
11	RUN LED	– Once briefly interrupted illumination; the monitor measures according to the programmed parametrisation – Twice briefly interrupted illumination; recording of one or more measurement functions is either not programmed or data not stored due to exhaustion of dedicated memory – Repeated short flashing; the monitor is malfunctioning or is programmed, it does not measure yet. It is not the default measurement start time yet or the monitor has not been powered at the time of delayed start – Slow alternating illumination 1 : 1 – oscillographic record – Rapid flashing; power failure, instrument is measuring and powered from the internal uninterruptible power supply – Briefly lit after activation; indicates the progress of internal tests – Continuously on; indication of a fault condition – Continuously off; indication of a fault or deactivated power supply
12	LEDs U1, U2, U3	State of measured phase voltages on terminals U1, U2 and U3 – continuously on; - the voltage is in the pre-set working band (standardized 0.9 U_n to 1.1 U_n) – one flash; voltage is in the pre-set interruption band – two flashes; voltage is in the pre-set drop band – three flashes; voltage is in the pre-set increase band
13	Locks of the DIN rail	On the upper and lower side of the device base are orange latches that must be unlocked when removing the device from the DIN rail and inserted when installing the device on the DIN rail

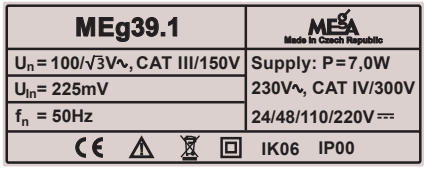
Item	Group name	Description
14	Rating plate	The rating plate lists information applicable to the monitor
15	Antenna holes	In the indicated areas are holes prepared for antenna cables
16	Module with disconnection protections	Optional connection of a module with low-loss disconnect protections for PROT39 current circuits with $I_n = 5\,A$ or $1\,A$

Figure 3: Examples of rating plates of the MEg39.1 monitor

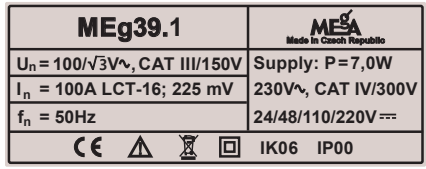
Standard version of MEg39.1
with disconnectable terminal block and screwing



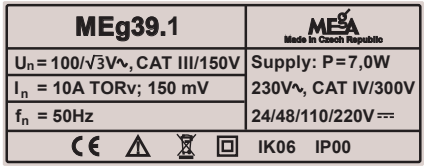
Standard version with nominal voltage of current sensor 225 mV



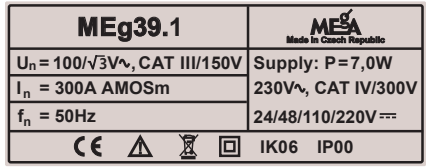
Example of version for current transformers LCT – example of LCT-16/100 A with $U_{in} = 225\,mV$



Example of version for TORv or TORm toroids – example of TORv / 10 A with $U_n = 150\,mV$



Example of version for AMOSm flexible sensors – example of AMOSm / 300 A with $U_n = 225\,mV$



Examples of variants of rating plates for individual versions of MEg39.1 monitors are shown in Fig. 3. The rating plate is located on the right side of the unit.

Voltage, power supply and the design are the same for all versions. The voltage inputs have a nominal phase voltage of $100/\sqrt{3}$ V. The maximum measured AC voltage in a CAT III environment is 150 V. The nominal value of AC voltage frequency is 50 Hz.

3.2 Functions of the monitor

The MEg39.1 PQ monitor is an accuracy class A or class S instrument whose measurement methods meet the Class A requirements of EN 61000-4-30, ed.3. The measurement methods and uncertainties of the measured quantities are tested according to EN 62586-2 and the effects of operating conditions according to the procedures specified in EN 62586-1. It measures voltage quality parameters without any interruptions or gaps. The device measures all voltage and current phenomena that have occurred at a measured point during measurement and performs statistical evaluations, including evaluations of extreme values of all measured variables. It measures signal size and records HDO telegrams. It measures energy in all four quadrants.

For voltage phenomena, events on currents up to $10\,I_n$, it records the time courses of RMS½ effective values with pre-trigger of two sets of values, i.e. 2 s, and oscillographic time courses with a pre-trigger of 20 periods. The MEg39.1 has a two-stage input with an internal supply voltage allowing simultaneous external power supply and two NO contacts of two relays whose second contacts are controlled by the processor.

The MEg39.1 PQ monitor can be set for the function of recording oscilloscope, in which it records measured voltage and current values for a defined period even with the pre-trigger function. During oscillographic recording of details and the recording oscilloscope function, four measured voltages and four measured currents are sampled simultaneously with a rate of 256 samples per period. The number of periods, i.e. the length of the oscillographic record, is SW-adjustable and depends on the extent of allocated memory space. Initiation of the recording can be derived from exceeding the specified limits by any of the eight mentioned variables or from the change of the state of the input two-stage signal.

Using the automatic function of remote transfer of the measured data reduces the need for extensive memory space in the monitor.

The instrument supports MODBUS RTU protocol on the RS485 interface and MODBUS TCP and P104 protocols (according to IEC 60870-5-104) on the Ethernet and GSM interfaces. Both protocols can be used to set the device, download data and update the firmware of measuring functions. Measured data are saved in CSV files. The DLMS/

COSEM protocol is implemented for data loading. Time synchronization is possible with NTP as well as PTP protocols.

To synchronize the function of multiple monitors, the positive zero-crossing of the first phase fundamental harmonic voltage can be used.

The MEg39.1 PQ monitor allows secure data transmission, e.g. via IKEv2/IPsec and 2TP/IPsec protocols. The SSH protocol can be used to connect for management of the Linux Debian system, running on the ARM core of the processor and enabling the implementation of advanced communication and other superstructure functions.

3.2.1 Indication on the MEg39.1 panel

After the power supply is switched on, the HW function check is delayed and the time required for minimum charging of the internal power supply is indicated by an intermittent RUN LED. The intermittent lighting of the RUN LED has the following meanings:

- Repeated one short flash (0.1 s); recording of measured values to dedicated memory space is in progress
- Repeated two short flashes (2 × 0.1 s); recording of at least one measurement function is suspended or the dedicated memory space is exhausted for at least one measurement function and memory overcycling is disabled
- Short flash (0.1 s); recording of measurement values is not in progress either due to a malfunction or measurement is suspended
- Fast flashing (0.1 s / 0.1 s); external power supply to the instrument has failed, power is supplied from the internal uninterruptible power supply, recording is in progress
- Slow flashing (0.5 s / 0.5 s); oscillographic record.

The RUN indicator continuously on or off signalizes a fault, LED going off can also mean a loss of power supply

The yellow LED indicators U1, U2, U3 and U4 indicate the states of the measured interphase voltages between the voltage inputs U1, U2 and U3 and the state of the voltage U4.

- Continuously on – voltage is in the pre-set working band (standardized 0.9 U_n to 1.1 U_n)
- One flash – voltage is in the pre-set interruption band
- Two flashes – the voltage is in the pre-set drop band
- Three flashes – the voltage is in the pre-set increase band.

LEDs in the ETH connector indicate:

- The green LINK_LED indicates the data line speed (on = 100 Mbit/s, off = 10 Mbit/s)
- An illuminated orange ACTIVITY_LED indicates data transmission.

3.2.2 Measuring functions

The scope of measured variables depends on the measurement connection and measurement parametrisation. Measured data can be divided into data of continuous phenomena of voltage quality, data during one-off voltage phenomena and events related to currents, recorder data, electric meter function data. Measurement methods are specified in EN 61000-4-30, ed.3.

Data of continuous phenomena of three-phase voltage quality at the terminal for each aggregation interval (10 min):

- Number of frequency values in the range ±1 % f_n and in the range +4 % to -6 % f_n
- Number of frequency values out of the range of ±1 % f_n and out of the range of +4 % to -6 % f_n
- Frequency f – average, minimum, maximum
- Unbalance of voltage u2 and current i2
- Zero-sequence imbalance of voltage u0 and current i0

Data of continuous quality phenomena of interphase input voltages U1, U2, U3 and phase currents I1, I2, I3 for each aggregation interval (10 min):

- voltage – average, minimum, maximum in time and frequency domain
- currents – average, minimum, maximum in time and frequency domain
- Voltage deviations U_{over}, U_{under}
- Flicker P_{st} and P_{lt}
- THD_U voltage harmonic distortion factor
- Direct current component U_{DC}
- Basic to 125th harmonic of voltage with a proportion of adjacent interharmonics
- Centred subgroups of interharmonic voltages up to the order of 125.
- Basic to 125th harmonic of current with a proportion of adjacent interharmonics
- Centred subgroups of phase currents up to the order of 125.
- Voltage signals (HDO) on mains voltage – average, maximum
- Number of 3 s intervals for voltage evaluation of signals in network voltage
- Number of 3 s voltage values of signal in network voltage above set limit.

Data during one-time phenomena on interphase voltages and phase currents:

- Time of phenomenon occurrence
- Phenomenon duration

- Moments when the limits for interruption, dip and swell of voltage and current are exceeded
- Residual and maximum values of voltage, maximum values of current
- Courses of voltage $U_{RMS1/2}$ and currents $I_{RMS1/2}$ with pre-trigger
- Oscillogram of the courses of voltage and current with pre-trigger during a one-time phenomenon
- Harmonic voltage and current values during a one-time phenomenon

Recorder data for each aggregation interval (from 1 s to 60 min, according to the parametrisation) and phase.

Phase or interphase depending on the type of network:

- Voltage U_{ef}, – average, minimum, maximum
- THD_U voltage harmonic distortion factor
- Direct-current component of voltage U_{DC},
- Harmonic components of voltage U_{Hn} of order n from 1st to 64th,
- Currents I_{ef}, – average, maximum
- THD_I current harmonic distortion factor
- Current harmonics I_{Hn} of order from 1st to 64th,
- Active power – average, minimum, maximum
- Reactive power – average, minimum, maximum
- Apparent power – average, minimum, maximum
- Deformation power – average, minimum, maximum
- Power factor PF and $\cos\varphi$
- Active power 1stH – average, minimum, maximum
- Reactive power 1stH – average, minimum, maximum
- Apparent power 1stH – average, minimum, maximum
- Active and reactive energy E_{P+}, E_{P-}, $E_{QC/P+}$, $E_{QL/P+}$, $E_{QC/P-}$, $E_{QL/P-}$.

Three-phase depending on the type of network:

- Active power – average, minimum, maximum
- Reactive power – average, minimum, maximum
- Apparent power – average, minimum, maximum
- Deformation power – average, minimum, maximum
- Unbalance power - average, minimum, maximum

- Power factor PF and cos φ
- Active power 1stH – average, minimum, maximum
- Reactive power 1stH – average, minimum, maximum
- Apparent power 1stH – average, minimum, maximum
- Unbalance power 1stH – average, minimum, maximum

HDO telegram data:

- HDO telegram transmission start time
- HDO telegram phase
- Address and command part of the HDO telegram
- Minimum and maximum voltage of HDO telegram marks
- HDO telegram carrier frequency

Data of electric meter function depending on the type of network for output and each phase from the beginning of factory setting and from the start of measurement:

- Active and reactive energy E_{P+}, E_{P-}, $E_{QC/P+}$, $E_{QL/P+}$, $E_{QC/P-}$, $E_{QL/P-}$.

4/ MEASURING AND COMMUNICATION CONNECTION, CONNECTION OF INPUTS AND OUTPUTS

The MEg39.1 PQ monitor is designed for measurements at high voltage level even under the most demanding operating conditions.

The measuring voltage terminals U1, U2, U3 and U4 have protective impedances and comply with CAT III / 150 V. Mains voltage supply circuits have a CAT IV / 300 V over-voltage category.

The MEg39.1 PQ has bidirectional data transmission. Already operated measuring and information systems can be additionally supplemented with functions provided by the MEg39.1 monitor using the local and remote communication interfaces RS485 and ETH.

The two-stage IN and two OUT signals are ready for connection to external devices. The IN input signal circuit for connecting an external contact is supplied by an internal galvanically free voltage source, which also supplies the RS485 interface circuits and has a common G terminal. An external DC voltage can also be connected to the IN input signal circuit. The wiring is shown in Figure 9. The OUT output signals are free NO contacts of bistable relays.

The high-frequency shielding of the ETH and USB interface connectors on the terminal is connected to the PE ground wire.

The MEg39.1 is powered by mains voltage and higher DC voltage with a nominal value of 110 V or 220 V.

It also has a small safe DC voltage supply with a nominal value from 24 V to 48 V. This is fed between the + and – terminals. The – terminal is connected to the common terminal of the PQ monitor, see Fig. 4.

Warning! If a small DC voltage source is used to supply the MEg39.1 with current sensors with grounded terminal S1, the small DC voltage source must not have its positive pole grounded, and for current sensors with grounded terminal S2, only a galvanically free small DC voltage source must be used.

The voltage inputs of the MEg39.1 are designed only for indirect measurements via voltage transformers or sensors. The interphase voltages are calculated in the monitor from the differences of the instantaneous values of the phase voltages U1, U2 and U3 measured against the neutral conductor. Voltage inputs of the instrument are marked U1, U2, U3 and U4; connecting to the neutral conductor is via the Nm terminal.

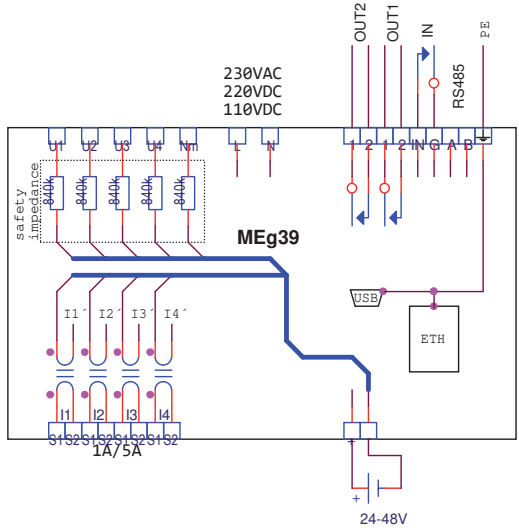
The MEg39.1 current inputs are only intended for indirect current measurement via current transformers or current sensors, which in addition to current conversion ensure the safety requirements at the installation site.

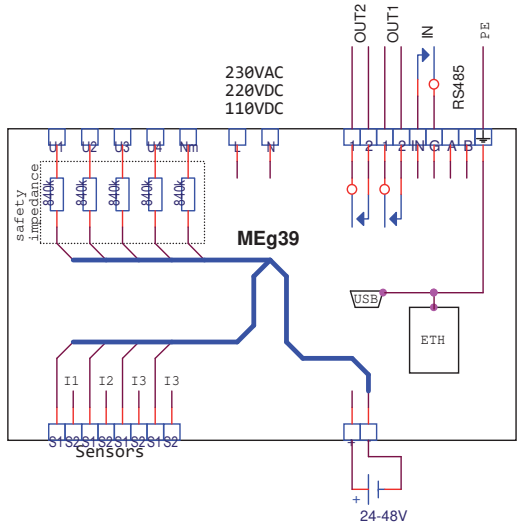
The current inputs of the MEg39.1 PQ monitors are manufactured with standard current nominal values of 5 A and 1 A according to EN 61869-2 or standard voltage nominal values of 225 mV, 150 mV and 22.5 mV according to EN 61869-10. The current input nominal value of the monitor and, if applicable, the type of connected sensor with its nominal output voltage is indicated on the rating plate of the monitor, see Fig. 3.

The type and nominal value are the same for all four current inputs. Each current input I1, I2, I3 and I4 of the monitor has input terminal S1 and output terminal S2 for the positive current direction. These are to be connected to the outputs of current sensors marked S1 and S2 or the original k and l. If it is necessary to ground the sensor circuits, ground the S1 terminals.

Current transformers or sensors with a nominal current of 5 A or 1 A can be connected to the MEg39.1 PQ monitor version via a low-loss protection module for disconnection of the current circuits from the monitor without first short-circuiting the outputs of the current transformers. Also, the disconnectable terminal block does not need to be fitted with locking screws.

Fig. 4: Connecting the common terminals in the MEg39.1 with 5 A / 1 A inputs and sensor inputs (225 mV, 150 mV, 22,5 mV)





5/ MEASURING CONNECTION WITH CURRENT TRANSFORMERS AND SENSORS, COMMUNICATION CONNECTION

During three-phase measurement of line voltage, voltages U1, U2 and U3 must be connected in the counter-clockwise direction at which the device is calibrated.

Unless voltage input U4 is used for measurement, it is recommended to connect this input with input Nm.

According to EN 50160, the measured phase voltage L1 must always be applied to the reference voltage input U1.

Tab. 2: Meaning of MEg39.1 terminals

Terminal No.	Identification	Function
36	U1	U1 voltage input
34	U2	U2 voltage input
32	U3	U3 voltage input
30	U4	U4 voltage input
28	Nm	Common measurement conductor U1, U2, U3, U4 of MV, HV and EHV level
16	L, 230 V_{AC}, 110|220 V_{DC}	Connection of the mains supply voltage phase conductor or the L1 phase of the measured voltage or any pole of a higher DC voltage source
18	N, 230 V_{AC}, 110|220 V_{DC}	Connection of the PEN mains supply voltage conductor or the L2 phase of the measured voltage or any pole of a higher DC voltage source
27	1, OUT2	First pole of the first polarized-relay NO contact
26	2, OUT2	Second pole of the first polarized-relay NO contact
25	1, OUT1	First pole of the second polarized-relay NO contact
24	2, OUT1	Second pole of the second polarized-relay NO contact
23	IN	First pole of the external contact, connected to the positive pole of the internal power supply
22	G	Second pole of the external contact, connected to the negative pole of the internal power supply common to the external contact and RS485 interface

Terminal No.	Identification	Function
21	A	RS485 A (positive quiet signal level)
20	B	RS485 B (negative quiet signal level)
19	⏚	RF grounding
2	S1, I1	Input terminal of current I1
3	S2, I1	Output terminal of current I1
4	S1, I2	Input terminal of current I2
5	S2, I2	Output terminal of current I2
6	S1, I3	Input terminal of current I3
7	S2, I3	Output terminal of current I3
8	S1, I4	Input terminal of current I4
9	S2, I4	Output terminal of current I4
11	+, 24|48 V_{DC}	Connecting the positive pole of a source of small DC voltage
12	–, 24|48 V_{DC}	Connecting the negative pole of a source of small DC voltage

Fig. 5: Three-phase measurement of the line voltages and phase currents in a MV, HV and EHV network with grounded centre via the Meg39.1 PQ monitor without and with PROT39 protection. Mains voltage supply.

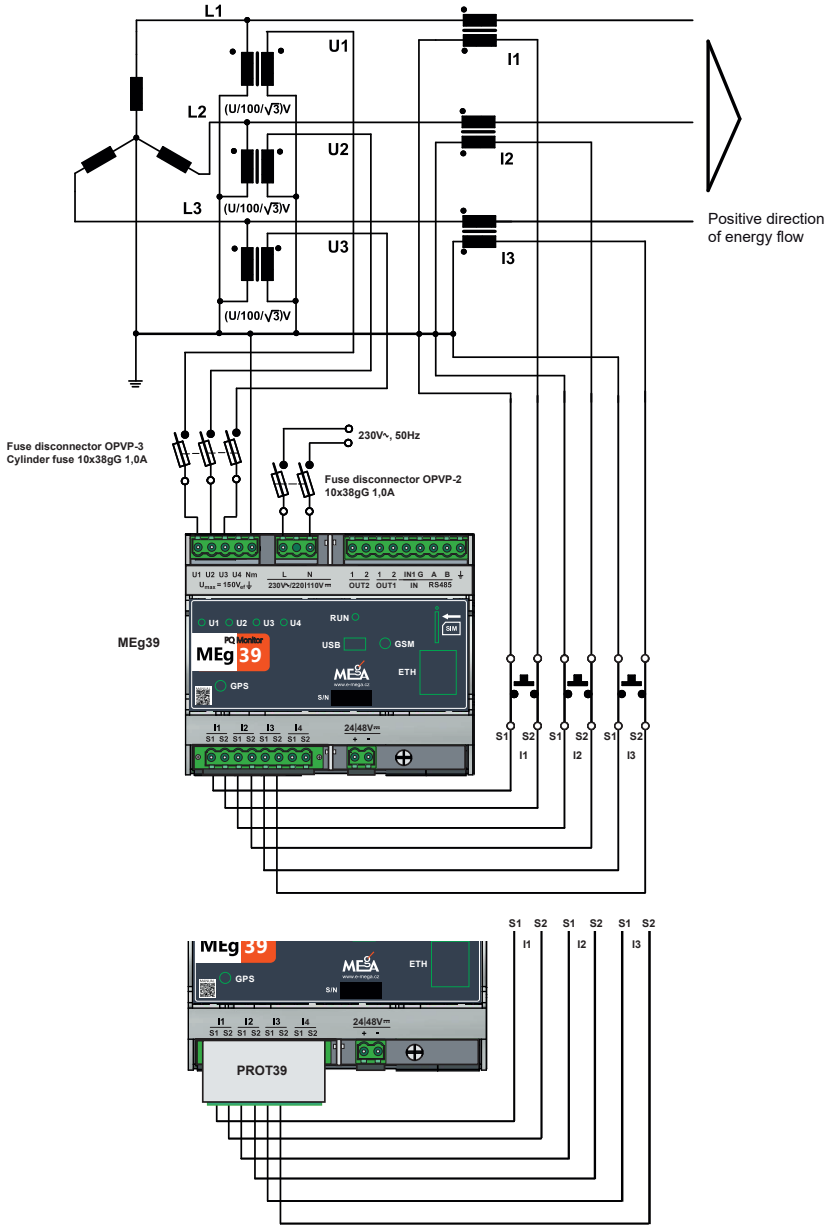


Fig. 6: Measurement of line voltages, voltage U0, phase currents and choke current in a compensated HV network. Power supply with line measured voltage U1-U2.

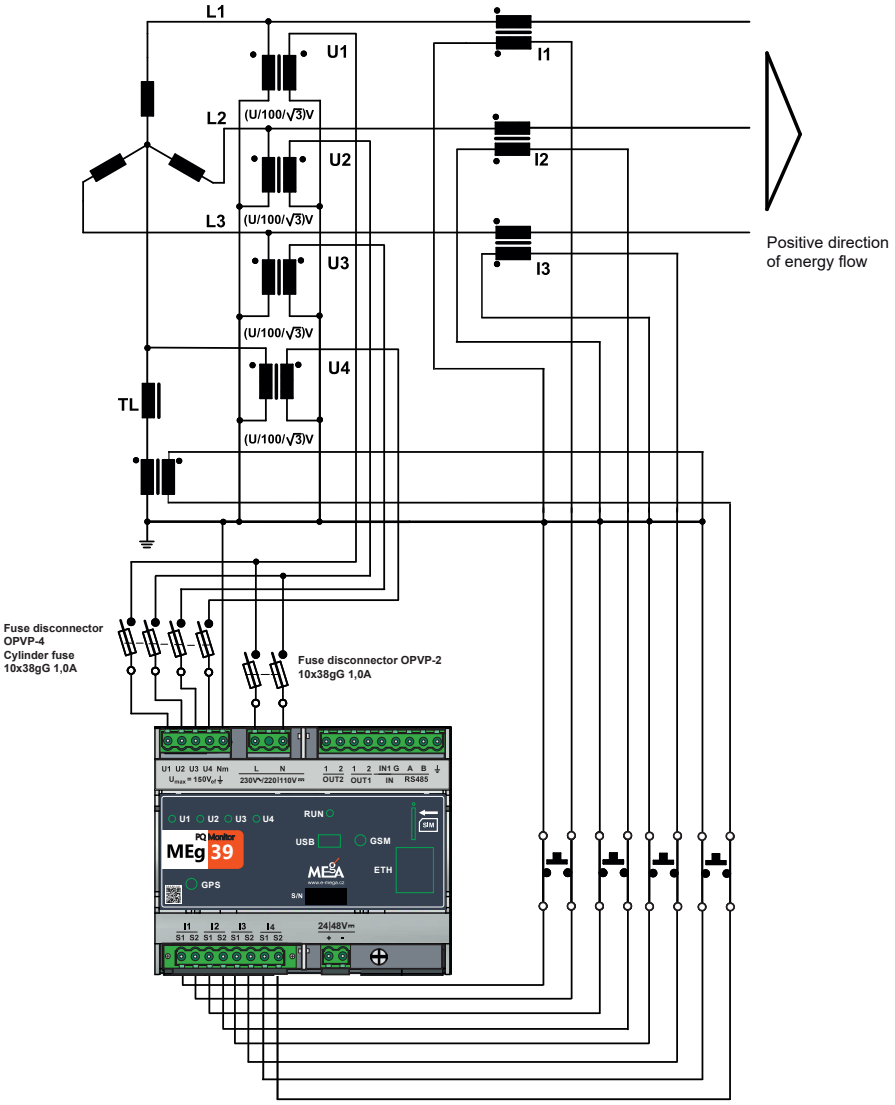


Fig. 7: Measurement of line voltages and phase currents in Aron connection at the HV level. Supply voltage 220 V_{DC}

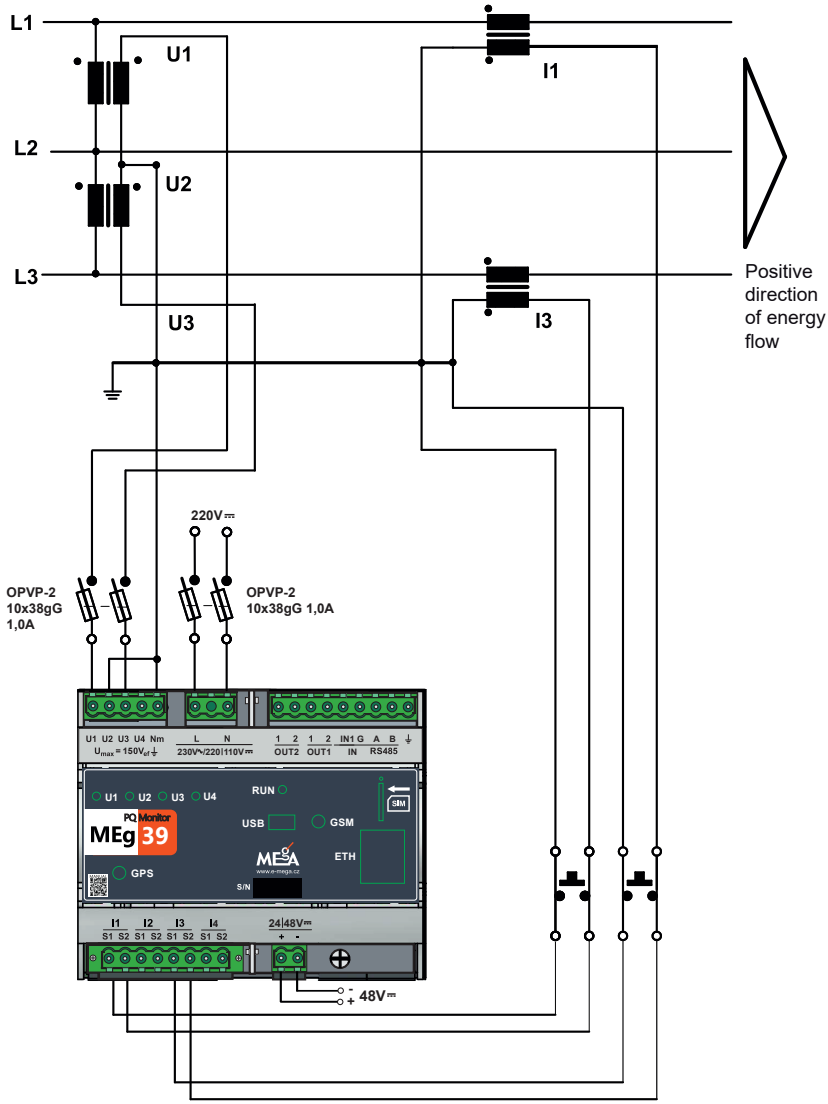


Fig. 8: Connection of the MEg39.1 with current measurement by TORm toroids connected in secondary circuits of current transformers, 24 V_{DC} power supply.

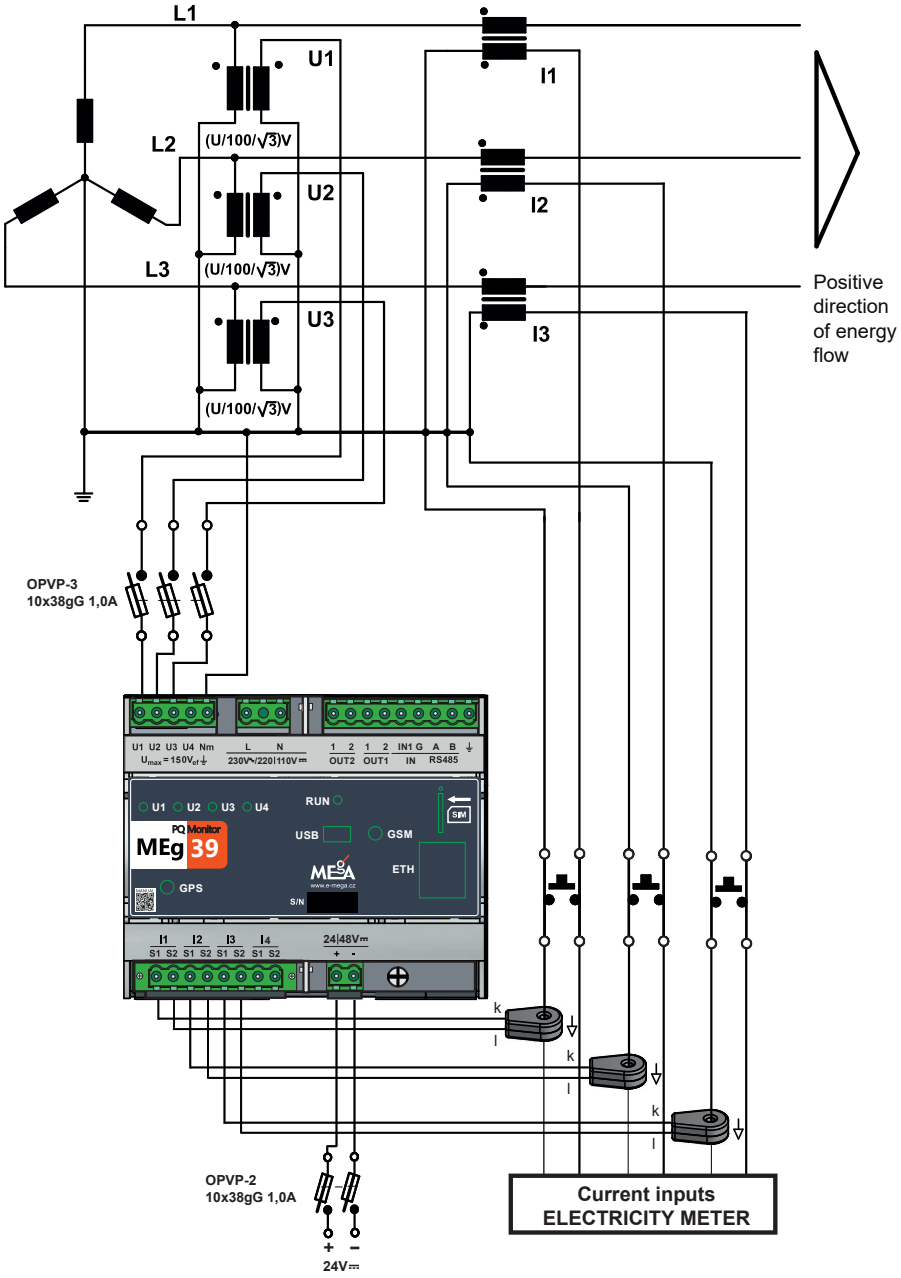


Fig. 9: Connection of the MEg39.1 two-stage input with internal and external DC voltage source.

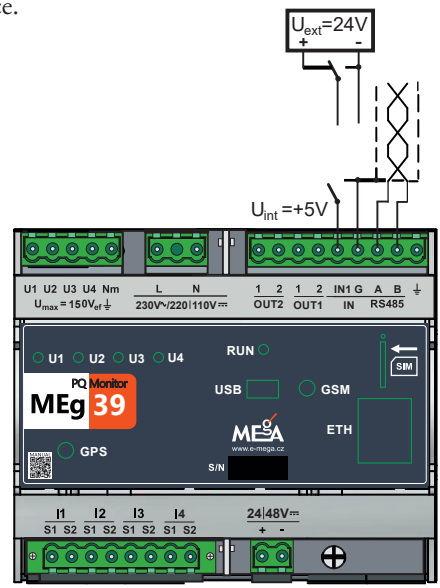
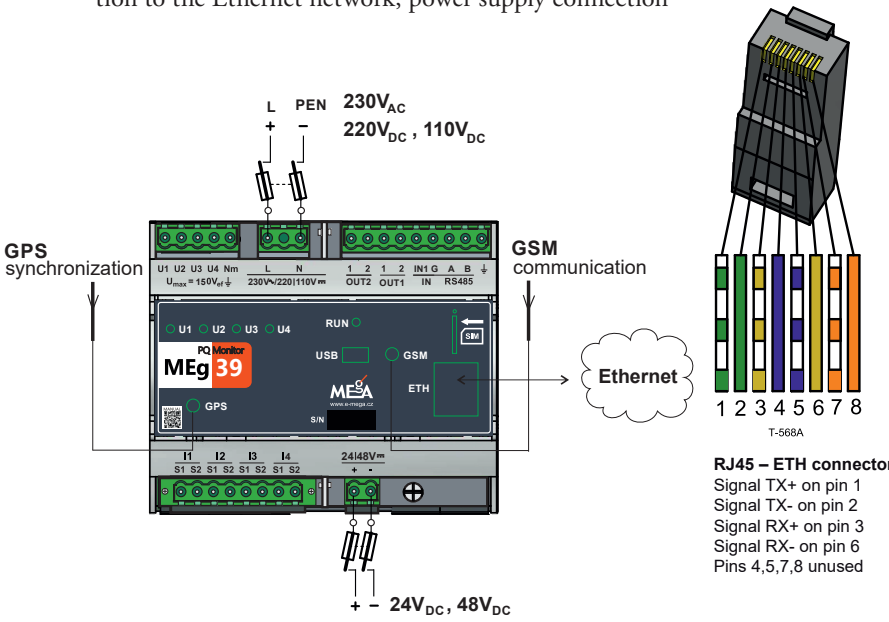


Fig. 10: Connection of the GPS and GSM antennas to the MEg39.1 and its connection to the Ethernet network, power supply connection



5.1 Interface characteristics and communication functions in the MEg39.1

The USB interface is of the USB2.0 type with a communication speed of 5.4 Mbit/s via the USBminiB connector to which a FLASH drive with a maximum power supply current of 100 mA can be connected.

The RS485 interface has

- default setting; 115.2 kbit/s, 8-bit parity-free with one stop bit
- Protocol; MODBUS RTU (Application Protocol Specification V1.1b3).

The ETH interface has the following characteristics

- Speed; 10/100 Mbps Ethernet,
- Standard; Ethernet version 2.0/IEEE 802.3
- Data reading protocols; MODBUS TCP, IEC 60870-5-104, DLMS/COSEM
- Protocols VPN; L2TP/IPsec, IKEv2/IPsec
- Management; SSH (including central management of user access by means of the RADIUS or TACACS+ protocol), SNMP, SYSLOG
- Other features; Firewall, static routing, dynamic routing protocols
- Connector; RJ45 type WS 8-8

When the instrument is connected via cable to the ETH network, the IP address is displayed with a mask in CIDR format, e.g. 192.168.11.221/24.

In the VPN (Virtual Private Network) section, a secure IPsec connection with the IP address is shown.

In the GW (gateway) section there is an IP address and if (interface) where packets that do not belong to the local network are routed. An example of an interface is a VPN.

When a GSM module is installed in the MEg39.1, the information about the connection via the GSM modem is integrated in the monitor. The following types of GSM networks are possible in which the modem is registered – LTE, HSDPA, EDGE, GPRS.

The GSM connection is characterized by the IP address e.g. 10.50.1.18/24 and the item.

The value after the slash represents the GSM signal level/quality in % or the modem status.

The following GSM modem states are distinguished:

- Nepřítomen (Not present); there is no modem communication board in the device
- Nenalezen (Not found); modem failure – the communication board is installed in the monitor, but the modem was not detected
- Nekompatibilní (Incompatible); the modem has been detected, but the installed software does not support it

- Porucha (Failure); the modem indicates an unknown failure
- Chybí SIM (SIM missing); SIM card not inserted
- Chyba SIM (SIM error); SIM card is damaged
- Neznámý stav (Unknown status); unknown or incommunicable status
- Inicializace (Initialization); modem is being initialized
- Uzamčen (Locked); request to enter PIN.
  Note that this may appear briefly even if the correct PIN is entered in the configuration. The next time the information is refreshed (after 3 minutes), this condition should disappear.
- Pozastaven (Suspended); modem operation is suspended (e.g. to save energy after a power failure)
- Pozastavování (Suspending); transition to the 'Suspended' state is in progress
- Povolování (Enabling); transition to normal operating state is in progress
- Povolen (Enabled); the modem has been put into operating state and subsequently SIM verification and network registration should take place
- Vyhledávání (Searching); the modem is searching for available mobile operator networks
- Registrován (Registered); the modem is registered to the mobile operator's network
- Odpojování (Disconnecting); disconnection from the APN (Access Point Name) is in progress
- Připojování (Connecting); connection to APN is in progress, activation of data transmissions
- Připojen (Connected); the data connection is successfully activated. This is the state the modem should normally be in.
- Rekonfigurace (Reconfiguration); reconfiguration of system parameters
- Chyba SW (SW error); a malfunction of the operating software has occurred.

The MEg39.1 PQ monitor contains a LINUX system on an SD card that controls remote communication and security. LINUX can be in the following states:

- Sleeping; Linux not running. This is in cases where Linux activity is not required
- Booting; system start that takes about one minute
- Active; normal system operation
- Failure; the system has either not booted or has stopped working. SD card damaged or not inserted
- Limited; status after a power supply failure.

The version and type of SD card running LINUX is also shown.

6/ SAFETY INFORMATION – MEANING OF SYMBOLS USED IN THE USER MANUAL

Pay maximum attention to this information.

- **Be careful, the operator performing the installation of the PQ monitor MEg39.1 to circuits and near live parts must be equipped with personal protective equipment and additional safety devices and use them during the installation.**
- **When the PQ monitor MEg39.1 is used in a different way than it is specified by the manufacturer, the protection provided by the PQ monitor MEg39.1 can be impaired.**
- The operator performing installation of the monitor must be qualified for work on or near to dangerous voltages. The operator must also be trained in providing first aid.
- The monitor may only be operated by skilled personnel
- Maintenance and repairs of monitors may only be carried out by the manufacturer or service organizations authorized by the manufacturer
- It is not permitted to use accessories other than those specified in this manual.


Caution, risk of danger / Note in documentation


Danger, risk of electric shock

CAT IV Overvoltage category, measuring category. Characterizes a transient overvoltage condition.
CAT IV / 300 V applies to DTS circuits at LV level with voltages up to 300 V.

CAT III Overvoltage category, measuring category. Characterizes a transient overvoltage condition.
CAT III / 150 V applies to circuits with voltages up to 150 V.

IP kód Degree of protection provided by enclosure


The product is intended for recycling and collection points

CE Declaration of Conformity – European Community

⏚ High-frequency grounding

7/ INSTALLATION OF THE MONITOR, PREPARATION FOR MEASUREMENT

The supply and measuring voltage circuits are connected under voltage-free state.

Secondary circuits of measuring current transformers with a nominal current of 5 A | 1 A must be short-circuited during installation or equipped with a low-loss protection module for disconnecting current circuits.

When installing current sensors in measuring circuits, the corresponding safety requirements must be followed. The output circuits of current sensors with a voltage output of 225 mV, 150 mV and 22,5 mV must be made with conductors whose insulation meets the safety requirements applicable to the installation environment.

CAT III / 150 V voltage inputs must not be connected to phase voltages higher than 150 V_{AC}.

The power supply input of the MEg39.1 is designed for CAT IV / 300 V overvoltage category. In a CAT IV environment, it is not permitted to connect to phase voltages higher than 300 V_{AC} and a line voltage higher than 520 V_{AC}.

1. The 120 mm long TS35 DIN rail should preferably be screwed horizontally to the installation site.
2. The MEg39.1 monitor unit is to be mounted on the DIN rail and secured with locks 13, see Fig. 2.
3. The voltage contacts U1, U2, U3 and possibly U4 of the five-pole disconnectable terminal block are to be connected via a disconnector to the beginning of the secondary windings of voltage measuring transformers whose primary windings are connected to the MV, HV or EHV voltage phases L1, L2 L3 and possibly the fourth indirectly measured HV voltage. Use a three- or four-pole disconnector, e.g. OPVP with 1.0 A cylinder fuses with a size of 10 × 38 mm. Voltages U1, U2, U3 must form a counter-clockwise system.
4. The fifth Nm terminal of the five-pole disconnectable terminal block shall be connected to ground, which is connected to the neutral conductor except for compensated HV networks. Connect the connector into the five-pole disconnectable terminal block.
5. Check that the information on the current inputs of the MEg39.1, as shown on its rating plate located on the right-hand wall of the unit, matches the sensor type and output nominal value of the current sensors and transformer. The 1 A or 5 A nominal current value of the current transformers is to be set into the monitor when it is parametrized.

6. a) To connect the measuring circuits of the current transformer phases L1, L2, L3 and possibly the fourth current transformer via short-circuit terminal blocks to the inputs I1, I2, I3 and possibly I4 with terminals S1 and S2 of the eight-pole disconnectable terminal block with screw locking, use either an eight-pole connector with locking screws or a removable low-loss protection module for disconnecting current circuits without the need for screw locking.

   The design of the PROT39 low-loss protection module and its connection to the disconnectable current terminal block is shown in Fig. 1. The technical data of the PROT39 module can be found at the end of the manual.

   b) For connection with low-power current sensors, e.g. TORm toroids with standardized millivolt output voltage, you can use an eight-pole connector without screw locking. In this case, use the MEg39.1 PQ monitor with the corresponding low-voltage current inputs marked on the rating plate.

7. Connect the galvanically free NO contact of the external device between the IN and G terminals of the nine-pole connector. The NO contact of the external device is powered by an internal galvanically isolated 5 V DC voltage from MEg39.1. When using an external power supply with a higher voltage value to power the external contact, a double-throw contact must be used. A wiring example is shown in Figure 9.
8. Output galvanically free NO contacts of two relays of the MEg39.1 on terminals 1 and 2 of OUT1 and OUT2 outputs allow closing of circuits with DC rated voltage up to 30 V_{DC} and current up to 0.27 A and circuits with AC voltage up to 30 V_{AC} and current up to 0.25 A. Check the function of the output contacts of the monitor by checking the function of the second separated contact of the output relay.
9. Figure 9 shows the connection of the MEg39.1 when communicating via the RS485 interface using a shielded twisted pair. For communication of multiple devices with the RS485 interface, interconnect the A terminals of all devices and the B terminals of all devices and connect the G terminals of all devices to the shielding of a twisted pair that should not be longer than 30 m in total. Connect a terminating resistor of 120 Ω between the A and B terminals of the last communicating device. In MEg39.1, they can also be connected via a SW command.
10. The connection of the GSM remote communication antenna and the GPS time synchronisation antenna to the MEg39.1 is shown in Figure 10. Antenna cables with angled connectors and latch mechanism are routed down through a hole under the hinged lid after insertion into the GPS and GSM monitor connectors. Figure 10 also shows an example of MEg39.1 connection to an Ethernet network through a cable inserted in a RJ45 WS 8-8 connector labelled ETH.

    If the monitor is to be connected to local and remote communication in a dangerous voltage environment, use a cable meeting the safety requirements for that environment or attach a standard cable so as to meet the safety surface and air distances.

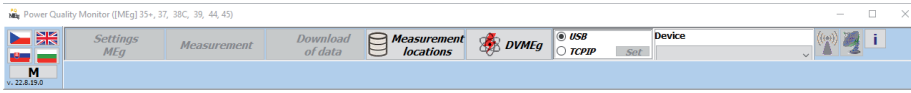
11. Mains or higher DC voltage supply to the MEg39.1 PQ monitor is to be lead through a two-pole disconnector fitted with T 1.0 A fuses on a 230 V_{AC}, 110|220 V_{DC} triple terminal with L and N contacts and an unconnected middle contact. Small safe DC voltage supply to the MEg39.1 PQ monitor is to be lead through a two-pole fuse disconnector fitted with T 1 A fuses on a 24|48 V_{DC} double terminal with + and – contacts. The MEg39.1 can be powered by both power supplies simultaneously. The wiring is shown in Figure 10.
12. When any supply voltage is switched on, after a delay of about 2 s required for the power supply to start up and for individual blocks of the monitor to be checked, the RUN LED starts flashing. The flashing pattern is determined by previous programming of the monitor, see paragraph 3.2.1.

    If the RUN LED is continuously on or off, the monitor or power supply is in a fault state.

    LINUX starts approximately 1 minute after connecting supply voltage.
13. On the MEg39.1, check that the U1, U2, U3 and U4 LEDs are lit; they signal the status of the measured voltage at corresponding inputs according to Table 1.
14. The software PQ_MEg launches in the inspection computer. If it launches correctly, the main window with a bar according to Fig. 11 is displayed, where USB communication is to be selected.

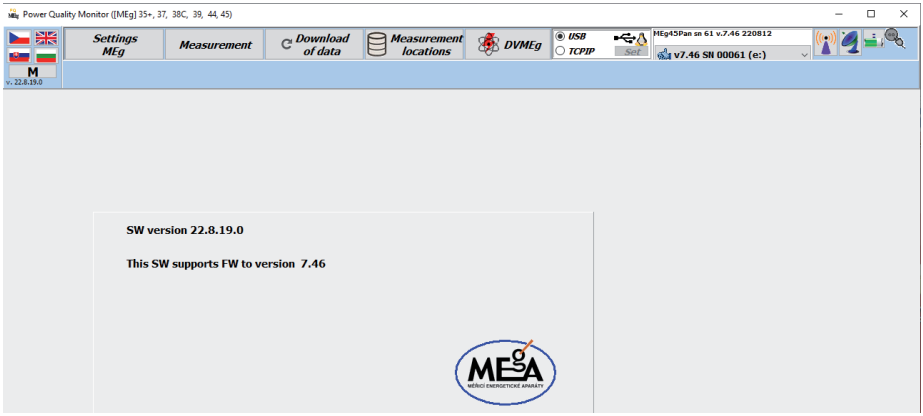
    For a detailed description of the PQ_MEg software in [1], visit www.e-mega.cz/DL.

Fig. 11: Start of the PQ_MEg software



15. Use a USBmini communication cable to connect the inspection computer to the MEg39.1 monitor. The main window of the program will display information on the SW and FW version. The bar in the main window displays the type and serial number of the connected monitor, see Figure 12.

Fig. 12: Confirmation of USB communication between MEg39.1 and an inspection computer



16. On the main bar, select "Měřidlo" (Meter) as shown in Fig. 13, which in the Samples view shows the values of connected line voltages and phase currents. To check the correct direction of current connection, correct direction of phase voltage rotation and correct assignment of phase currents to phase voltages, press the Test button next to the Samples button. An example of a correct test is shown in Figure 14.

Fig. 13: Connection of measured voltages and currents

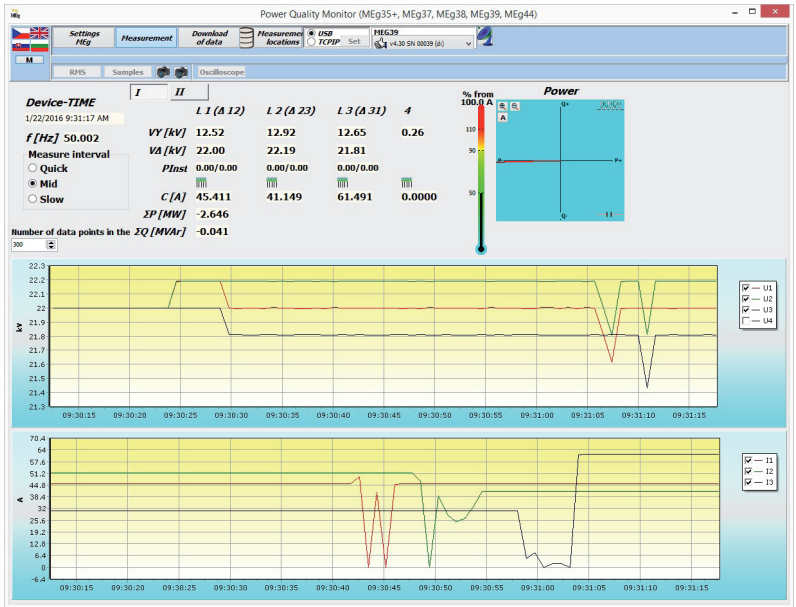
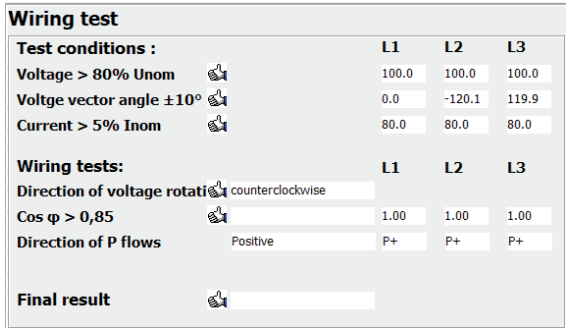
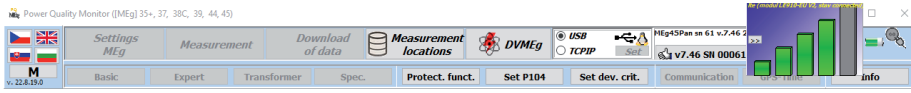


Fig. 14: Check of the correct connection of measured voltages and currents.



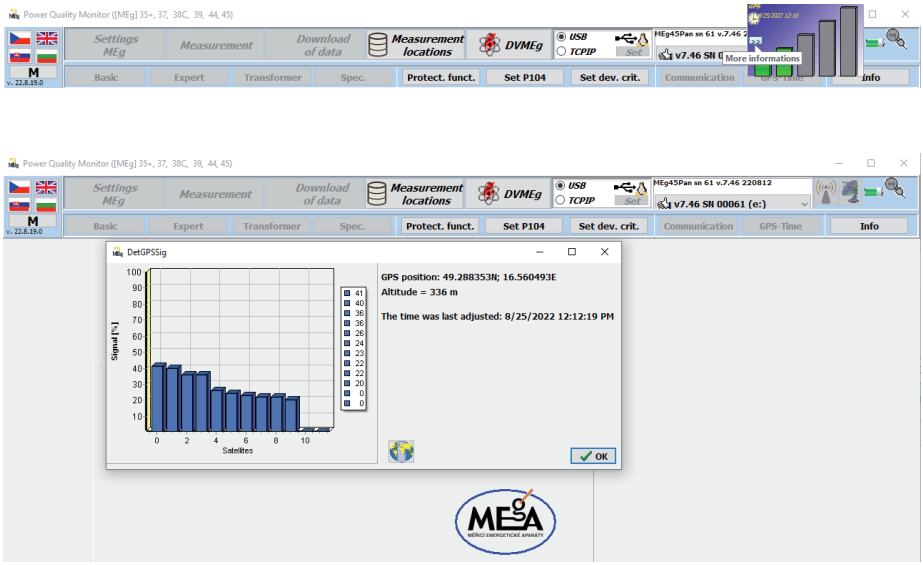
17.  A check of the correct connection of a GSM network antenna with sufficient GSM network signal intensity is indicated by a highlighted GSM network pictogram at the end of the main bar of the program. Click on the pictogram to display information on the GSM network signal intensity at the antenna installation location, see Fig. 15.

Fig. 15: Display of the GSM network signal intensity at the antenna installation location



18.  Approximately 2 minutes after connecting a GSM antenna installed with direct sky visibility, the GPS pictogram will be highlighted. After it is activated, a new window (see Fig. 16) will display the number of received satellites, the monitor installation location and the moment of the last synchronisation of the monitor time.

Fig. 16: Information on the GPS signal reception conditions at the antenna installation location and data in MEg39.1



8/ MAINTENANCE

⚠ Caution

- The repairs of the MEg39.1 universal monitor during the warranty period may only be carried out by the manufacturer's skilled and trained personnel or by the manufacturer's service organizations.
- The monitor may not be exposed to chemicals.
- The monitor must only be transported in original transport packaging supplied by the manufacturer.

The monitor does not require any special maintenance if properly used in compliance with this user manual. Only if dirty should the device be carefully cleaned with a damp cloth without using cleaning agents.

Batteries

The monitor uses the following batteries:

- type CR2032 lithium battery for the clock circuit,
- supercapacitors with a declared lifetime of 10 years.

Fuses

To protect the measuring voltage inputs of the monitor, use cylinder fuses 10×38gG 1,0 A.

To protect the power supply with AC and higher DC voltage through the 230 V_{AC}, 110|220 V_{DC} triple terminal, use cylinder fuses 10×38gG T 1,0 A.

To protect the DC power supply with small DC voltage via 24|48 V_{DC} double clamp, use cylinder fuses 10×38gG T 1,0 A.

9/ DISPOSAL

When the service life of the MEg39.1 PQ monitor is over, it must be recycled in waste disposal sites according to rules for electronic waste disposal.

10/ WARRANTY

The MEg39.1 PQ monitor is covered by a 24-month warranty from the date of purchase, however not longer than 30 months from the date of release from the manufacturer's warehouse. Defects originating during this period as a demonstrable result of defective design, manufacturing or using improper material will be repaired free of charge by the manufacturer.

It is not permitted to open the MEg39.1 universal monitor during the warranty period.

The warranty becomes void if the user carries out unauthorized modifications or changes on the MEg39.1 monitor, if the user connects the monitor incorrectly or if the monitor has not been operated in accordance with technical conditions.

Under no circumstances the manufacturer is liable for subsequent damage caused by using the MEg39.1 PQ monitor. This warranty does not in any case imply manufacturer's liability exceeding the price of the MEg39.1 monitor.

11/ ORDERS

An order shall include the quantity of MEg39.1 PQ monitors, supplemented with requested optional functions and accessories.

MEg39.1 PQ monitors can be ordered in accuracy class A or S according to EN 61000-4-30, ed.3.

The MEg39.1 version has a disconnectable current terminal block with a screw connector.

The basic version of MEg39.1 has:

100/√3 V voltage inputs, RS485 serial interface and ETH interface, one input and two output signals, mains, higher and low DC voltage supply and connectors.

The basic version of MEg39.1 includes:

- Current inputs with disconnectable terminals and a range of 5 A / 1 A or 225 mV or 150 mV or 22.5 mV [1)]
- Function W0, Recorder
- Function W1, Voltage quality
- Function W2, Voltage phenomena and events related to currents
- Function W5, Four-quadrant active and reactive electric meter
- connectors:
  - five-pole U1 to Nm 2EDGKA-5.08-05P-14-00A(H)
  - modified three-pole 230 V_{AC} / 220, 110 V_{DC} 2EDGKA-5.08-03P-14-00A(H)
  - nine-pole for inputs 2EDGKA-5.08-09P-14-00A(H)
  - double-pole 24 / 48 V_{DC} 2EDGKA-5.08-02P-14-00A(H)
  - eight-pole for current inputs 2EDGKA-5.08-08P-14-00A(H)
- 1 communication cable USBmini 1.5 m
- 1 socket for a nano SIM card 115S-ACA1

Optional accessories for the MEg39.1 variant:

- Function W3, Oscillographic measurement
- Function W4, Evaluation of HDO telegrams
- Function W8, Two-stage undervoltage and overvoltage protection
- Function W9, Protection according to voltage and current unbalance

[1)] One value only

- GPS time synchronisation module[2)]
- GSM remote communication module[2)]
- LTE/GPS PUCK, mounting antenna AO-AKOM-36SS/MEgA [2)]
- GPS PUCK, mounting antenna GPS PUCK AP-AGPS-36/MEgA [2)]
- LTE rod, rod antenna LTE AO-ALTE-G124S/MEgA [2)]
- GPS magnet, GPS magnetic antenna AP-A20C-M5RA/MEgA [2)]
- GPS extension cable / 10 m [3)] with increased insulation with a length of 2.5 m
- GSM extension cable / 2.5 m [3)]
- ETH extension cable, safe / 2.5 m [3)]
- Cable USB OTG AF to mini-BM, 15 cm for flash drive connection
- Three/four TORm toroids (1 A / 5 A)
- Three/four TORv toroids (10 A / 50 A)
- Three/four split-core LCT transformers (LCT-10, LCT-16, LCT-24, LCT-36)

[2)] Technical data are provided in Chapter "GSM and GPS antennas of the MEg39.1 PQ monitor"

[3)] Other lengths are available

Ordering scheme:

MEg39.1	cl	range	function	module	antenna
	A	5 A, 1 A[1)]	W3	GSM	LTE GPS puck
	S	225 mV [2)]	W4	GPS	GPS puck
		150 mV [2)]	W8	GSM+GPS	LTE prut
		22.5 mV [2)]	W9		GPS magnet
		AMOSm			

[1)] For 1 A range you can order MTPD.51 or AMOS/1A

[2)] For 225 mV and 150 mV range you can order TORm, TORv, LCT

12/ TECHNICAL PARAMETERS

General information

The MEg39.1 PQ monitor meets the measurement category CAT III / 150 V according to EN 61010-2-30 and the overvoltage category CAT IV / 300 V on the mains supply input.

The MEg39.1 PQ monitor is classified, according to EN 62586-1, as PQI-A-FI1-H or PQI-S-FI1-H.

The development and production of the monitor is in conformity with ISO 9001, ISO 14001:2005, OHSAS 18001:2008, ISO/IEC 27001:2014.

Operating conditions

Operating temperature:	-15 °C to +55 °C
Threshold operating temperature:	-25 °C to +55 °C for cl. A, -25 °C to +70 °C for cl. S
Relative humidity:	20 % to 90 % non-condensing
External magnetic field:	0,5 mT
Pollution degree:	2
Altitude:	up to 2000 m
Operating position:	any

Operation in indoor environments

Storage conditions

Storage temperature:	-30 °C to +70 °C

Protection against the effect of water and chemicals

Protection against long-term effect of UV radiation

Design data

Dimensions:	108 × 90 × 63 mm
Weight:	0.5 kg
Protection:	IP00
Impact protection:	IK06
Overvoltage measuring category:	CAT III / 150 V
Overvoltage category:	CAT IV / 300 V, power supply 230 V_{AC}, 110 / 220 V_{DC}

Power supply

Stabilisation period:	10 minutes after start-up
Nominal supply voltage U_N:	230 V_{AC} / 50 Hz, 220 V_{DC}, 110 V_{DC}, 48 V_{DC}, 24 V_{DC}
Range of supply voltage:	90 V to 300 V for terminals 230 V~ | 220 | 110 V⎓ 20 V to 50 V for terminals 24 | 48 V⎓
Input power:	18 VA, 7 W
Fuse type for power supply:	
230 V_{AC}, 110 / 220 V_{DC}:	2 pcs fuse 10×38gG T 1,0 A fuse disconnector,
24/48 V_{DC}:	2 pcs fuse 10×38gG T 1,0 A fuse disconnector,
Secured power supply without UPS:	at least 35 s with charged supercapacitors, charge time 5 minutes
Power supply from secured power supply:	unlimited

Measuring characteristics

A/D converter:	16 bit
Sampling frequency:	256 samples per period
Antialiasing filter:	digital filter, type FIR
Phase-locked loop:	controlled by the passage of the fundamental harmonic voltage U1 through zero
Aggregation intervals:	quality function – according to EN 61000-4-30, ed. 3 recorder function – from 1 s to 1 h
Synchronisation of aggregation:	according to EN 61000-4-30, ed. 3, class A
Time base:	±1 s in 24 h at the operating temperature without external synchronisation ±1 ms at the operating temperature with GPS
Data memory capacity:	512 MB, circular organization for each function

Voltage inputs U1, U2, U3 and U4

Nominal phase voltages U_{nP-N}:	$100/\sqrt{3}\ V_{AC}$
Nominal line voltages U_{nP-P}:	$100\ V_{AC}$
Measuring range of phase voltages:	double U_{nP-N}
Maximum output voltage P-N:	$150\ V_{AC}$
Maximum output voltage P-P:	$260\ V_{AC}$
Voltage measurement uncertainty P-P, cl. A:	±0.05 % M.V. ± 0.025 % U_n, f = 50 Hz
Voltage measurement uncertainty P-P, cl. S:	±0.2 % M.V. ± 0.025 % U_n, f = 50 Hz
Frequency range:	up to 7.2 kHz
Change of value with temperature:	0.05 % U_n / 10 K
Input resistance of voltage inputs:	0.84 MΩ

Voltage inputs with a common center conductor are separated by a high resistance.

Measurement:	indirect
Maximum conversion of the voltage transformer:	999 kV / 100 V (optional in the PQ MEg software)

Current inputs I1, I2, I3 and I4

Nominal current value I_n:	$5\ A_{AC}$ | $1\ A_{AC}$, electronically switched
Current measuring range:	1 % I_n to 200 % I_n
Frequency range:	40 Hz to 7,2 kHz
Current measurement uncertainty:	±0.2 % M.V. ± 0.025 % I_n (45 Hz to 60 Hz)
Overcurrent measuring range:	2 I_n to 10 I_n
Overcurrent measuring uncertainty [2]:	±0.5 % M.V. (45 Hz to 60 Hz)
Change of value with temperature:	0.05 % I_n / 10 K
Current harmonics measurement uncertainties to the 50th order:	±5 % I_{harm} at $I_{harm} \geq 3$ % I_n ±0.15 % I_n at $I_{harm} < 3$ % I_n
Input resistance of current inputs:	≤ 50 mΩ

Current inputs are galvanically free.

Nominal voltage U_n at I_n [1]:	$225\ mV_{AC}$, $150\ mV_{AC}$, $22{,}5\ mV_{AC}$
Current measuring range:	5 % I_n up to 200 % I_n

Current measuring uncertainty [2]:	±0.2 % M.V. ± 0.025 % I_n (45 Hz to 60 Hz)
Change of value with temperature:	0.05 % I_n / 10 K
Input impedance of current inputs:	2 MΩ / 47 pF

Active power, reactive power, PF, energy

Active power [3]:	±0.5 % M.V. ± 0.2 % P_n	at U ≥ 80 % U_n, I ≥ 5 % I_n, PF ≥ 0.5
Reactive power [3]:	±0.5 % M.V. ± 0.2 % Q_n	at U ≥ 80 % U_n, I ≥ 5 % I_n, PF ≤ 0.866
PF:	±0,01	at U ≥ 80 % U_n, I ≥ 5 % I_n
Active energy:	class B	EN 50470-1
Reactive energy:	class 1	TPM 2440-08, ČMI 2008

[1] One of the values [2] U_n at I_n = 225 mV, 150 mV
[3] at I_n = 1 A, 5 A and U_n at I_n = 225 mV, 150 mV
Note: M.V. = measured value

IN input contacts

Number:	1 galvanically free
	NO at internal galvanically isolated voltage of 5 V_{DC}
	double-throw at external voltage with U_N up to 24 V_{DC}
Max. resistance of contact circuit:	100 Ω

OUT output contacts

Number:	2, galvanically free NO contact
Maximum switched voltage:	30 V_{DC} / 30 V_{AC}
Maximum switched current:	0.27 A_{DC} / 0.25 A_{AC}

USB interface

Type:	USB2.0
Communication speed:	5.4 Mbit/s
Connector:	USBmini B
Flash drive:	maximum supply current 100 mA

RS485 interface

Default settings:	115.2 kbit/s, 8 bit, no parity, one stop bit
MODBUS RTU protocol:	Application Protocol Specification V1.1b3

ETH communication

Speed:	10 / 100 Mbps Ethernet,
Standard:	Ethernet version 2.0/IEEE 802.3
Protocols for data reading:	MODBUS TCP, IEC 60870-5-104, DLMS/COSEM,
VPN protocols:	L2TP/IPsec, IKEv2/IPsec
Management:	SSH (including central management of user access by means of the RADIUS or TACACS+ protocol), SNMP, SYSLOG
Other properties:	Firewall, static routing, dynamic routing protocols
Connector:	RJ45 type WS 8-8

GSM communication

SIM card type:		nano SIM in a 115S-AC1 slot
Technology:		LTE Cat. 4, HSPA+, EDGE, GPRS (class B, CS1 až CS4)
Frequency bands [MHz]	4G:	B1 (2100), B3 (1800), B7 (2600), B8 (900), B20 (800)
	3G:	B1 (2100), B8 (900)
	2G:	B3 (1800), B8 (900)

Watchdog for modem restart in case of communication loss

Protocols, management and other properties are the same as for ETH communication

ETH time synchronization

Protocols:	NTP, PTP, IEC 60870-5-104, MODBUS TCP

GPS time synchronization

Uncertainty:	± 1 ms
Standards:	NMEA, RTCM104
Frequency band:	GPS(L1)

Classification of the MEg39.1 PQ monitor according to IEC 62586-1

The MEg39.1 cl. A PQ monitor is classified PQI-A-FI1-H,
The MEg39.1 cl. S PQ monitor is classified PQI-S-FI1-H,
f = 50 Hz, CAT III / 150 V according to EN 61010-2-030:2011

Table of functions of the MEg39.1 PQ monitor according to IEC 61000-4-30, ed.3.

Function and measured data	Method of measurement	Measurement uncertainty, measuring range	
		MEg39.1 cl. S	MEg39.1 cl. A
Network frequency, 10 s data	Class A	Class S	Class A
Voltage value, 150 periods, 10 min, 2 hours	Class A	Class S	Class A
Flicker, 10 min P_{st}, 2 hours P_{lt}	Class A	Class S	Class A
Voltage drops and increases, residual and max. U, duration T	Class A	Class S	Class A
Supply voltage interruption, residual and maximum U, T time	Class A	Class S	Class A
Voltage unbalance, 150 periods, 10 min, 2 hours	Class A	Class S	Class A
Harmonic voltages, 150 periods, 10 min, 2 hours	Class A	Class S	Class A
Interharmonic voltages, 150 periods, 10 min, 2 hours	Class A	Class S	Class A
Voltage of signals in the supply voltage, voltage value	Class A	Class S	Class A
Positive and negative voltage deviations 150 periods, 10 min, 2 hours	Class A	Class S	Class A
Rapid voltage changes – RVC, $U_{RMS1/2}$	Class A	Class S	Class A

Note:
According to EN 61557-12, the MEg39.1 universal monitor is a measuring device of the PMD SS class (performance measuring and monitoring device) with current and voltage measurement by means of sensors.

The MEg39.1 PQ monitor combines recording, power and voltage quality measurements.

Measurement uncertainties and measurement ranges of voltage quality parameters at testing states 1, 2 and 3 according to EN 61000-4-30, ed. 3

Parameter	MEg39.1 cl. S		MEg39.1 cl. A	
	Uncertainty	Measuring range	Uncertainty	Measuring range
Frequency	± 2 mHz	42.5 Hz – 57.5 Hz	± 2 mHz	42.5 Hz – 57.5 Hz
Voltage deviation	± 0.2 % U_n	10 % U_n – 120 % U_n	± 0.1 % U_n	10 % U_n – 150 % U_n
Flicker P_{st}, P_{lt}	± 7.5 % P_{st}, P_{lt} IEC 61000-4-15, ed. 2	P_{st}, P_{lt} (0.4 – 4.0) 1–4000 changes/min	± 5.0 % P_{st}, P_{lt} IEC 61000-4-15, ed. 2	P_{st}, P_{lt} (0.2 – 10.0) 1–4000 changes/min
Flicker $P_{inst, max}$	8 % $P_{inst, max}$	$P_{inst, max}$ (0 – 4) sinus, right angle	8 % $P_{inst, max}$	$P_{inst, max}$ (0 – 10) sine, rectangular
Voltage phenomena	Amplitude: ± 0.5 % U_n Duration: ± 1 period	5 % U_n – 150 % U_n 0.02 s – 1.0 s [1)]	Amplitude: ± 0.2 % U_n Duration: ± 1 period	5 % U_n – 200 % U_n 0.02 s – 1.0 s [1)]
Interruption	Duration: ± 1 period	0.02 s – 1.0 s [1)]	Duration: ± 1 period	0.02 s – 1.0 s [1)]
Rapid voltage changes – RVC, $U_{RMS1/2}$	Amplitude: ± 0.5 % U_n Duration: ± 1 period	Treshold 1.0 – 10 % U_n Hysteresis 50 % tresh.	Amplitude: ± 0.2 % U_n Duration: ± 1 period	Treshold 1.0 – 10 % U_n Hysteresis 50 % tresh.
Unbalance	± 0.2 %	1.0 % u_2 – 5 % u_2 1.0 % u_0 – 5 % u_0	± 0.15 %	0.5 % u_2 – 5 % u_2 0.5 % u_0 – 5 % u_0
Harmonic voltages	± 5 % U_{harm}, $U_{harm} \geq 3$ % U_n ± 0.15 % U_n, $U_{harm} < 3$ % U_n	10 % – 100 % cl. 3 IEC 61000-2-4	± 5 % U_{harm}, $U_{harm} \geq 1$ % U_n ± 0.05 % U_n, $U_{harm} < 1$ % U_n	10 % – 200 % cl. 3 IEC 61000-2-4
Inter-harmonic voltages	± 5 % U_{harm}, $U_{harm} \geq 3$ % U_n ± 0.15 % U_n, $U_{harm} < 3$ % U_n	10 % – 100 % cl. 3 IEC 61000-2-4	± 5 % U_{harm}, $U_{harm} \geq 1$ % U_n ± 0.05 % U_n, $U_{harm} < 1$ % U_n	10 % – 200 % cl. 3 IEC 61000-2-4
Signals in voltage	± 10 % U_{sig} for 3 % $U_n \leq U_{sig} \leq 15$ % U_n, ± 0.3 % U_n for 1 % $U_n \leq U_{sig} \leq 3$ % U_n	0 % U_n – 15 % U_n	± 5 % U_{sig} for 3 % $U_n \leq U_{sig} \leq 15$ % U_n, ± 0.15 % U_n for 1 % $U_n \leq U_{sig} \leq 3$ % U_n	0 % U_n – 15 % U_n
Current	± 2 % $I_{measured}$	10 % – 100 % I_{max}	± 1 % $I_{measured}$	10 % – 100 % I_{max}
Time base	± 1 s per 24 h, ± 10 ms with GPS function	–	± 1 s per 24 h, ± 10 ms with GPS function	–

Overview of evaluated quantities in record function

F evaluated values during measurement of phase voltage
S evaluated values during measurement of line voltage

Quantity	Symbol	For each phase	For the three--phase terminal	Average / sum per interval [1)]
Effective voltage	U_{ef}	F, S		F, S
Voltage harmonics – 1st to 64th harmonic	$U_{1.h}$ to $U_{64.h}$	F, S		F, S
Overall harmonic distortion of voltage	THD_U	F, S		F, S
Effective current	I_{ef}	F, S		F, S
Current harmonics – 1st to 64th harmonic	$I_{1.h}$ až $I_{64.h}$	F, S		F, S
Overall harmonic distortion of current	THD_I	F, S		F, S
Power factor	cosφ	F	F, S	F, S
Power factor	PF	F	F, S	F, S
Active power	P	F	F, S	F, S
Reactive power	Q	F	F, S	F, S
Apparent power	S	F	F, S	F, S
Deformation power	D	F	F	F
Unbalance power [2)]	N		F, S	F, S
Active power (1st harmonic)	$P_{1.h}$	F	F, S	F, S
Reactive power (1st harmonic)	$Q_{1.h}$	F	F, S	F, S
Apparent power (1st harmonic)	$S_{1.h}$	F	F, S	F, S
Unbalance power (1st harmonic)	$N_{1.h}$		F, S	F, S
Active energy – consumption	EP+	F	F, S	F, S

Quantity	Symbol	For each phase	For the three--phase terminal	Average/sum per interval[1)]
Active energy – supply	EP-	F	F, S	F, S
Reactive inductive energy during active consumption	EQL/EP+	F	F, S	F, S
Reactive capacitive energy during active consumption	EQC/EP+	F	F, S	F, S
Reactive inductive energy during active supply	EQL/EP-	F	F, S	F, S
Reactive capacitive energy during active supply	EQC/EP-	F	F, S	F, S
Active energy – consumption (1st harmonic)	$EP+_{1.h}$	F	F, S	F, S
Active energy – supply (1st harmonic)	$EP-_{1.h}$	F	F, S	F, S
Reactive inductive energy during active consumption (1st harm)	$EQL/EP+_{1.h}$	F	F, S	F, S
Reactive capacitive energy during active consumption (1st harm)	EQC/ $EP+_{1.h}$	F	F, S	F, S
Reactive inductive energy during active supply (1st harm)	EQL/ $EP-_{1.h}$	F	F, S	F, S
Reactive capacitive energy during active supply (1st harm)	$EQC/EP-_{1.h}$	F	F, S	F, S

[1)] record interval adjustable from 1 s to 60 minutes. Energy represented by total value per interval, other quantities are average values per interval.

[2)] in the line voltage measuring mode, unbalance power also includes the effect of deformation

[3)] In the recorder function, the 200 ms maxima and 200 ms minima are evaluated for phase voltages and 200 ms maxima for phase currents at each recording interval.

Note:
The MEg39.1 PQ monitor is configured by default to measure line voltages.

AGSM AND AGPS ANTENNAS OF THE MEg39.1 UNIVERSAL PQ MONITOR

Antennas	**AO-AKOM-36SS/MEgA**	**AO-ALTE-G214S/MEgA**
Use	GSM/UMTS/LTE/GPS	GSM/UMTS/LTE
Frequency bands MHz	800 / 900 / 1700 / 1800 1900 / 2100 / 2600 2700 /1757.42	700 / 800 / 900 / 1700 1800 / 1900 / 2100 / 2600
Gain	0 / 30 dBi	6 dBi
VSWR	< 2.0 : 1	< 3.0: 1
Impedance	50 Ω	50 Ω
Direction	omnidirectional	omnidirectional
HPBW	H 360° V 30°	H 360° V 30°
Polarisation	linear / R.H.C.P.	vertical
Maximum output power	10 W	10 W
Supply voltage	2.7 - 5.5 V_{DC}	-
Dimensions	ø 54.4 × 24.6 mm	315 × ø 29.5 mm
Weight	165 g	55.99 g
Operating temperature	-30 °C to +90 °C	-40 °C to +85 °C
Design	PUCK	external
Mounting method	installation	magnetic
Cable type	2 × RG174/U	R174/U
Cable length	2 × 3 m	3 m
Connector type	MMCX(m) / MMCX(m)	MMCX(m)
Overvoltage category	CAT IV / 300 V 2.5 m	CAT IV / 300 V
Safety class	II 2.5 m	II 2.5 m

Antennas	**AP-AGPS-36/MEgA**	**AP-A20C-M5RA/MEgA**
Use	GPS	GPS
Frequency bands MHz	1575.42	1575.24
Gain	30 dBi	32 dBi
VSWR	< 2.0 : 1	< 2.0 : 1
Impedance	50 Ω	50 Ω
Direction	omnidirectional	omnidirectional
HPBW	H 360° V 30°	H 360° V 30°
Polarisation	R.H.C.P.	R.H.C.P.
Maximum output power	10 W	10 W
Supply voltage	2.7 - 5.0 V	2.7 - 5.0 V
Dimensions	ø 54.7 × 23 mm	38.5 × 34.5 × 12.3 mm
Weight	190 g	88.38 g
Operating temperature	-30 °C to +90 °C	-40 °C to +90 °C
Design	PUCK	external
Mounting method	installation	magnetic
Cable type	R174/U	R174/U
Cable length	10 m	5 m
Connector type	MMCX(m)	MMCX(m)
Overvoltage category	CAT IV / 300 V 2.5 m	CAT IV / 300 V 2.5 m
Safety class	II 2.5 m	II

PROT39 module
of low-loss protection for disconnecting current circuits

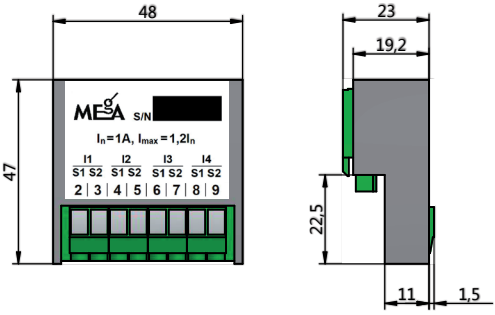
The low-loss protection module for disconnecting current circuits is designed for use primarily in the MEg39.1 PQ monitor. It can also be used elsewhere. It enables the disconnection of secondary current circuits of measuring current transformers with a nominal current of 5 A or 1 A without the need to mechanically short-circuit them in a shorting current terminal block. The short circuit is performed electronically. This eliminates the need to install a current shorting terminal block in the current circuits and eliminates the need to use locking screws in the current inputs of the connected MEg39.1 PQ monitor. This can be particularly advantageous during periodic accuracy checks.

⚠ The low-loss disconnection protection module is to be installed with the current transformers switched off or their secondary circuits shorted.

Plug the stripped wires into the module's terminal block after turning the module. The order of wiring the current circuits from left to right is I4, I3, I2 and I1 with the poles on the left being S2 and on the right S1.

Remove the shorting of the current transformer secondary circuits and insert the module with the connected current circuit wires into the current disconnection terminal block of the MEg39.1 PQ monitor.

Dimensions:	48 × 47 × 23 mm
Weight:	0.05 kg
Number of poles:	8 (four current circuits)
Cross-section of connected wires:	max. 2.5 mm^2
Wire stripping length:	7 mm
Wire connection screws:	M3
Torque:	0.5 to 0.6 Nm
Maximum current:	11 A
U_{max} on disconnected module:	0.1 V_{ef} at I_{jm} = 5 A_{ef}



Technical data of the TORm toroid

Nominal input current I_n:	1 A, 5 A
Output voltage [1]:	225 mV_{AC}, 150 mV_{AC}, 22.5 mV_{AC}
Measuring range:	5 % to 120 % I_n
Measurement error at f=50Hz [2]:	0.5 % from the range
Harmonics measurement uncertainty	± 10 % I_{harm} at $I_{harm} \geq 3$ % I_n
up to the order of 50. [2] [3] [4]	± 0.3 % I_n at $I_{harm} < 3$ % I_n
Measuring category:	CAT IV / 300 V
Safety class:	II
Ingress protection:	IP40
Operating temperature:	-20 °C to +60 °C
Temperature coefficient:	0.2 % / 10 K
Relative humidity:	≤ 85 %
Cable length:	2 m
Dimensions:	30 × 16 × 45 (70) mm
Max. diameter of measured conductor:	6 mm
Weight:	0.1 kg

Note:
[1] Only one of the values
[2] In the range of 5 % I_n to 120 % I_n
[3] Up to the order of 25 the maximum peak factor 2
[4] Class 1 according to EN 61000-4-7, ed. 2

Toroid TORm

Examples of the evaluation of data measured by the MEg39.1 program MEgA Explorer

Measuring function Záznamník (Recorder).

Average and extreme values with time data of voltages, currents, active and reactive powers of compensated HV lines

	L1	L1Time	L2	L2Time	L3	L3Time	Feeder	Feeder Time
Voltage [V]								
Average	19,948.0		21,998.7		21,873.7			
Max	129,941.0	06/03/2022 05:38	129,794.0	06/03/2022 09:14	129,846.5	06/03/2022 09:10		
Min	161.0	06/03/2022 05:32	868.0	12/21/2022 07:35	18,126.5	11/25/2022 09:43		
Max200	129,941.0	06/03/2022 05:37	129,794.0	06/03/2022 05:40	129,846.5	06/03/2022 09:10		
Min200	3.5	11/25/2022 09:42	3.5	06/03/2022 05:33	7.0	11/25/2022 09:42		
Current [A]								
Average	21.5		22.2		21.7			
Max	905.2	06/03/2022 05:36	1,123.5	06/03/2022 09:10	911.6	06/03/2022 09:10		
Min	0.1	06/03/2022 05:34	0.1	06/03/2022 05:34	0.1	06/03/2022 05:34		
Max200	905.2	06/03/2022 05:35	1,123.5	06/03/2022 09:10	911.6	06/03/2022 09:10		
Min200	0.0	06/03/2022 05:33	0.1	06/03/2022 05:33	0.1	06/03/2022 05:33		
Active power [W]								
Average	-366,411.4		-370,444.6		-368,792.4		-1,105,666.1	
Max	20,252,778.0	06/03/2022 05:36	20,202,596.0	06/03/2022 09:14	20,257,784.0	06/03/2022 05:36	60,711,916.0	06/03/2022 05:36
Min	-49,184,496.0	06/03/2022 10:20	-20,201,980.0	06/03/2022 09:12	-20,257,166.0	06/03/2022 10:17	-71,446,392.0	06/03/2022 10:19
Max200	33,257,210.0	06/03/2022 05:35	52,177,788.0	06/03/2022 10:22	33,263,206.0	06/03/2022 05:35	99,847,712.0	06/03/2022 05:35
Min200	-69,577,968.0	06/03/2022 10:18	-56,997,964.0	06/03/2022 10:21	-20,257,166.0	06/03/2022 10:16	-125,785,032.0	06/03/2022 10:21
Reactive power [VAr]								
Average	191,586.3		256,263.6		226,345.7		674,205.4	
Max	2,913,133.8	06/03/2022 10:18	570,958.0	11/10/2022 11:02	1,002,274.5	12/21/2022 07:35	2,765,294.3	06/03/2022 10:18
Min	-1,765,744.9	06/03/2022 10:21	-269,076.1	06/03/2022 10:21	-77,011.4	06/06/2022 01:30	-2,034,816.8	06/03/2022 10:21
Max200	23,846,204.0	06/03/2022 10:22	15,581,314.0	06/03/2022 10:19	6,454,430.0	06/06/2022 04:28	26,137,198.0	06/03/2022 10:21
Min200	-23,715,632.0	06/03/2022 10:22	-17,409,642.0	06/03/2022 10:21	-9,243,713.0	06/06/2022 04:38	-36,671,384.0	06/03/2022 10:21

Time course of average line voltages and average and maximum phase currents

Measuring function Napěťové jevy (Voltage phenomena)

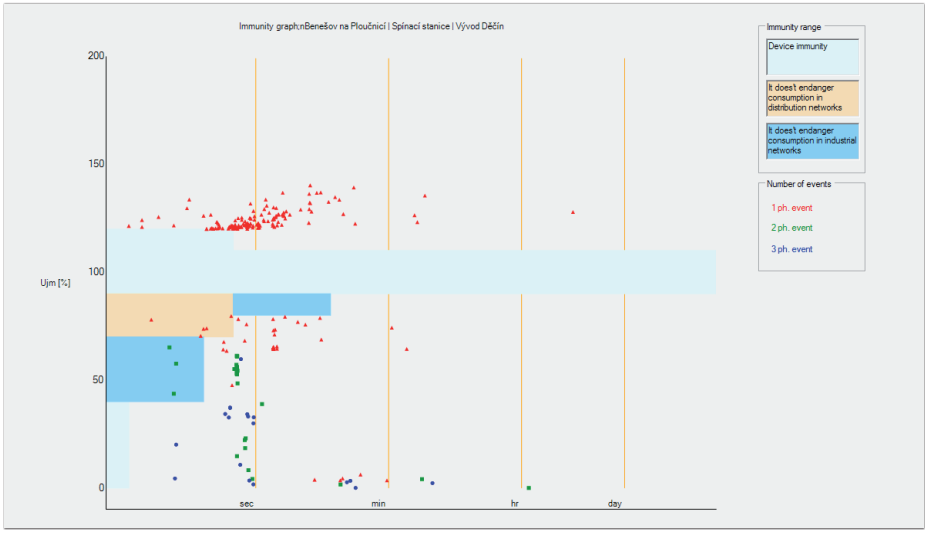
Standard parameters of voltage phenomena

Id	Event beginning	Duration	U1 max/min [%]	U2 max/min [%]	U3 max/min [%]
1	05/04/2022 11:52:44,355 AM	00:13,626	183.84/88.81	123.42/1.58	181.57/75.35
2	05/04/2022 01:02:41,065 PM	00:25,176	177.64/118.12	95.01/6.20	174.80/101.68
3	05/04/2022 01:17:42,704 PM	00:56,946	177.86/94.11	102.20/3.48	178.04/118.52
4	05/10/2022 10:36:12,434 AM	00:00,070	93.75/90.54	79.46/65.13	86.30/67.49
5	05/10/2022 11:39:07,239 AM	00:00,751	111.05/86.40	141.19/118.08	112.77/75.82
6	05/11/2022 11:22:54,957 AM	00:00,309	88.39/85.54	109.01/107.47	120.21/118.07
7	05/12/2022 11:50:25,700 AM	00:00,751	95.48/89.52	107.57/104.30	122.26/118.10
8	05/12/2022 11:56:14,745 AM	00:00,569	94.04/91.08	107.85/106.05	120.04/118.01
9	05/12/2022 11:57:29,940 AM	00:01,070	95.58/89.62	109.34/104.49	122.64/118.07
10	05/12/2022 12:11:54,867 PM	00:00,630	94.01/88.71	109.96/105.58	121.12/118.12
11	05/15/2022 08:28:10,979 AM	00:00,183	111.61/70.47	93.12/81.07	127.52/108.96
12	05/19/2022 02:10:02,134 PM	00:05,126	96.99/94.04	122.83/118.05	106.03/100.28
13	05/19/2022 03:43:16,586 PM	00:02,230	97.11/92.83	121.88/118.08	107.73/102.01
14	05/21/2022 02:44:42,155 AM	00:00,779	97.33/90.73	108.52/104.68	122.74/118.10
15	05/21/2022 02:59:47,747 AM	00:00,519	95.38/90.84	109.61/106.43	120.68/118.03
16	05/21/2022 03:12:23,611 AM	00:02,401	95.39/86.16	111.74/105.73	126.02/118.14
17	05/21/2022 03:12:26,792 AM	00:00,650	97.64/86.87	111.16/103.97	125.27/118.12

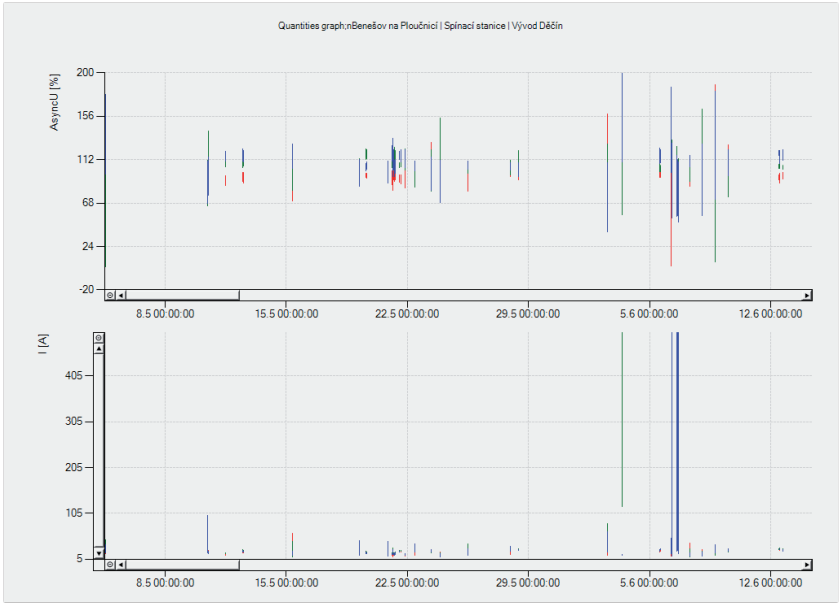
Contingency table of voltage drops

Ujm[%] / t[ms]	10<t <=200	200<t <=500	500<t <=1000	1000<t <=5000	5000<t <=60000
90 > U >= 80	6	7	16	12	12
80 > U >= 70	3	2	2	7	1
70 > U >= 40	3	4	23	14	1
40 > U >= 5	1	4	10	1	1
5 > U >= 0	1	0	3	0	8

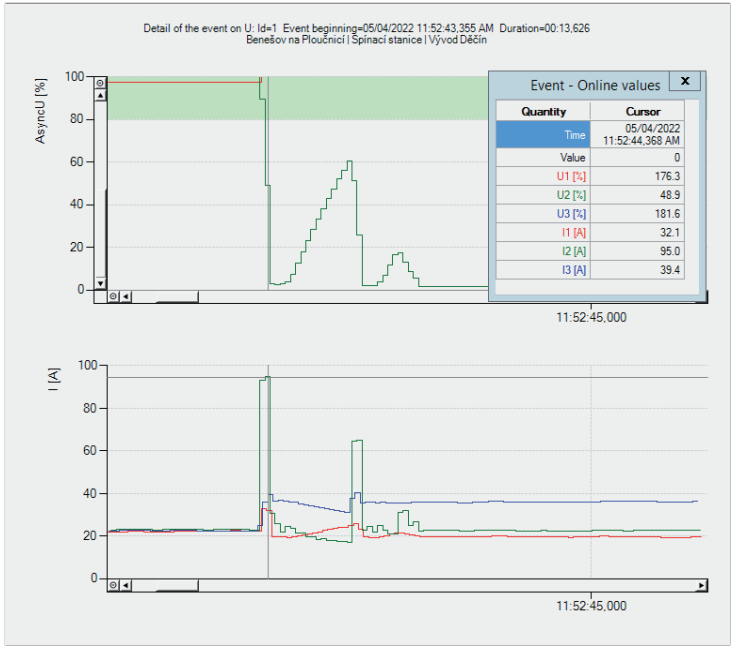
Graph of resistance against voltage phenomena



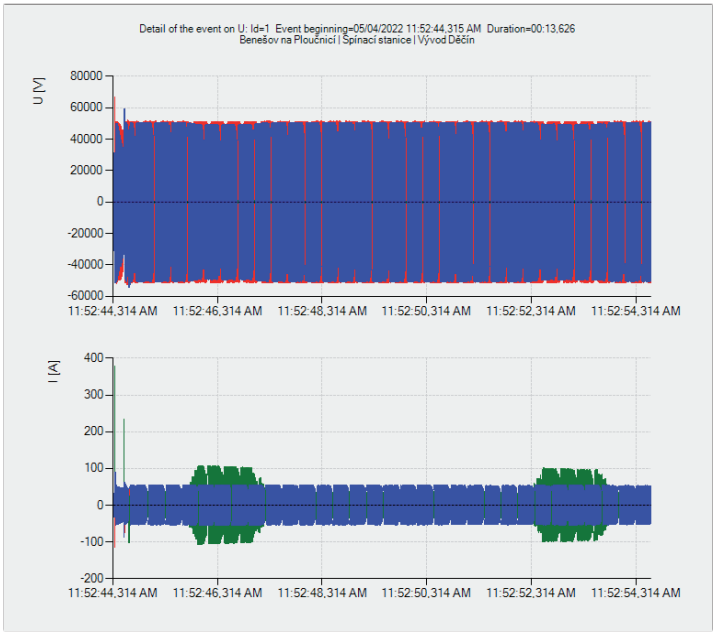
Record of voltage drops and current phenomena over the entire measurement period

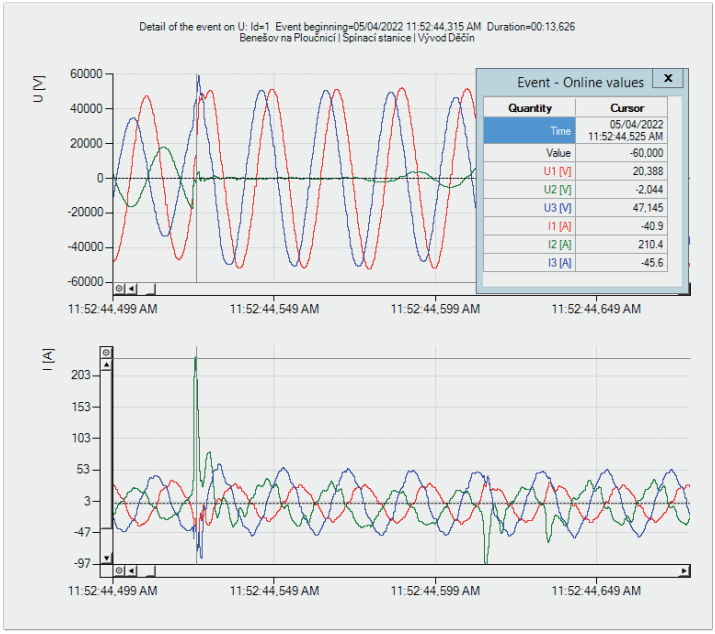


Record of the time courses of $U_{RMS1/2}$ and $I_{RMS1/2}$ during a voltage drop



Oscillographic time courses of line voltages and phase currents at interphase short circuit on 2021-07-30, from 18h11m37.350s to 18h11m37.918s



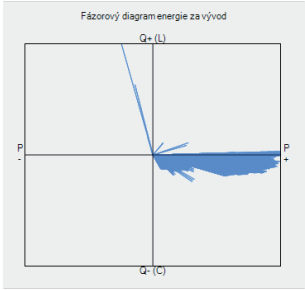


Measuring function Elektroměr (Electric meter)

Cumulative three-phase energies in a HV compensated network with phase diagram

05/04/2022 11:11:00.000 AM - 01/04/2023 04:27:00.000 AM

	Feeder	L1	L2	L3
EP+ [kWh]	56,952.986	6,241.439	21,294.954	29,416.594
EP- [kWh]	3,121,040.422	1,021,789.121	1,047,499.344	1,051,751.307
EQC_EP+ [kVArh]	112.016	9.550	81.926	20.539
EQL_EP+ [kVArh]	2,223.943	597.378	713.282	913.285
EQC_EP- [kVArh]	1,865,934.592	530,388.944	709,379.704	626,166.555
EQL_EP- [kVArh]	382.696	237.096	111.310	34.288



Monthly table of HV outlet energies

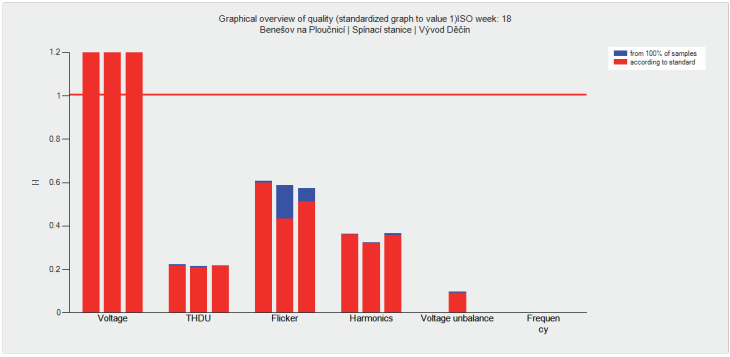
Datum	EP+ ∑L [kWh]	EP- ∑L [kWh]	EQL/EP+ ∑L [kVArh]	EQC/EP+ ∑L [kVArh]	EQC/EP- ∑L [kVArh]	EQL/EP- ∑L [kVArh]
01.01.2021 00:00:00-01.02.2021 00:00:00	306 588,2	0,4	12,2	79 523,4	0,0	0,7
01.02.2021 00:00:00-01.03.2021 00:00:00	248 863,3	0,0	0,0	70 563,0	0,0	0,0
01.03.2021 00:00:00-01.04.2021 00:00:00	245 475,7	0,0	0,2	81 510,1	0,0	0,0
01.04.2021 00:00:00-01.05.2021 00:00:00	214 436,6	11,8	15,3	80 443,9	0,0	35,0
01.05.2021 00:00:00-01.06.2021 00:00:00	176 457,8	0,0	0,3	89 723,5	0,0	0,0
01.06.2021 00:00:00-01.07.2021 00:00:00	145 226,2	0,0	0,6	86 293,0	0,0	0,0
01.07.2021 00:00:00-01.08.2021 00:00:00	148 320,8	0,0	1,3	88 027,3	0,0	0,0
01.08.2021 00:00:00-01.09.2021 00:00:00	41 226,1	0,0	0,0	24 348,6	0,0	0,0

Measuring function Kvalita napětí (Voltage quality), selected examples

Weekly voltage quality information

1. quarter												
2. quarter					18	19	20	21	22	23	24	
3. quarter												
4. quarter												

Graphical overview of continuous voltage quality parameters in week 31



Harmonic voltages in week 31 of measurement

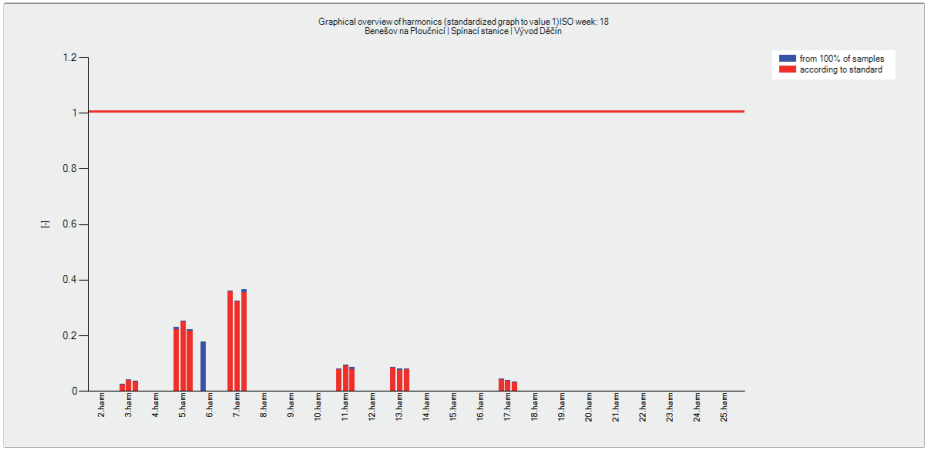


Table of voltage quality

Quality data	05/02/2022 01:00:01 AM	05/09/2022 01:00:01 AM	Time range 07.00:00:00	
Number of samples	L1=645, L2=527, L3=501	18.ISO week		
Measurement interval	10:00 [mm:ss]			
	EN50160-Edice3_A3 kap.4	Reality		
Voltage unbalance	x <= 2.0 / 95%	0.00 - 0.18 % / 100.0 %		
Frequency	49.5 <= x <= 50.5 / 99.5%	100.0%		
Frequency	47.0 <= x <= 52.0 / 100.0%	100.0%		
		Reality L1	Reality L2	Reality L3
Voltage	85.0% <= x <= 110.0% / 100.0%	18.99 - 22.33 kV / 0.0%	19.74 - 23.18 kV / 0.0%	20.85 - 22.92 kV / 0.0%
Voltage	90.0% <= x <= 110.0% / 95.0%	19.09 - 22.33 kV / 0.0%	20.07 - 23.18 kV / 0.0%	21.19 - 22.92 kV / 0.0%
Flicker Plt	x <= 1.0 / 95.0%	0.13 - 0.60 % / 100.0%	0.12 - 0.43 % / 100.0%	0.14 - 0.51 % / 100.0%
THD	x <= 8.0 / 95.0%	0.66 - 1.75 % / 100.0%	0.66 - 1.67 % / 100.0%	0.74 - 1.71 % / 100.0%
2.harmonic	x <= 2.0 / 95.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%
3.harmonic	x <= 5.0 / 95.0%	0.00 - 0.12 % / 100.0%	0.00 - 0.21 % / 100.0%	0.00 - 0.18 % / 100.0%
4.harmonic	x <= 1.0 / 95.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%
5.harmonic	x <= 6.0 / 95.0%	0.00 - 1.34 % / 100.0%	0.00 - 1.52 % / 100.0%	0.00 - 1.30 % / 100.0%
6.harmonic	x <= 0.5 / 95.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%
7.harmonic	x <= 5.0 / 95.0%	0.50 - 1.81 % / 100.0%	0.52 - 1.62 % / 100.0%	0.50 - 1.78 % / 100.0%
8.harmonic	x <= 0.5 / 95.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%
9.harmonic	x <= 1.5 / 95.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%
10.harmonic	x <= 0.5 / 95.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%
11.harmonic	x <= 3.5 / 95.0%	0.00 - 0.28 % / 100.0%	0.08 - 0.33 % / 100.0%	0.00 - 0.28 % / 100.0%
12.harmonic	x <= 0.5 / 95.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%
13.harmonic	x <= 3.0 / 95.0%	0.00 - 0.25 % / 100.0%	0.00 - 0.23 % / 100.0%	0.00 - 0.23 % / 100.0%
14.harmonic	x <= 0.5 / 95.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%
15.harmonic	x <= 1.0 / 95.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%
16.harmonic	x <= 0.5 / 95.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%
17.harmonic	x <= 2.0 / 95.0%	0.00 - 0.08 % / 100.0%	0.00 - 0.08 % / 100.0%	0.00 - 0.06 % / 100.0%
18.harmonic	x <= 0.5 / 95.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%
19.harmonic	x <= 1.5 / 95.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%
20.harmonic	x <= 0.5 / 95.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%
21.harmonic	x <= 0.75 / 95.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%
22.harmonic	x <= 0.5 / 95.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%
23.harmonic	x <= 1.5 / 95.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%
24.harmonic	x <= 0.5 / 95.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%
25.harmonic	x <= 1.5 / 95.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%	0.00 - 0.00 % / 100.0%
RCS 216.6 Hz	x <= 9.0 / 99.0% dne	100.00%	100.00%	100.00%

LITERATURE

[1] User Description of PQ_MEg, www.e-mega.cz/DL

[2] User Description of DV_MEg, www.e-mega.cz/DL

[3] User Description of MEgA Explorer, www.e-mega.cz/DL

[4] User Description of WebDator2, on request

[5] User Description of MEgA Merci Multi, www.e-mega.cz/DL

MANUFACTURER

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CONTENTS

PQ monitor MEg39.1
User manual

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