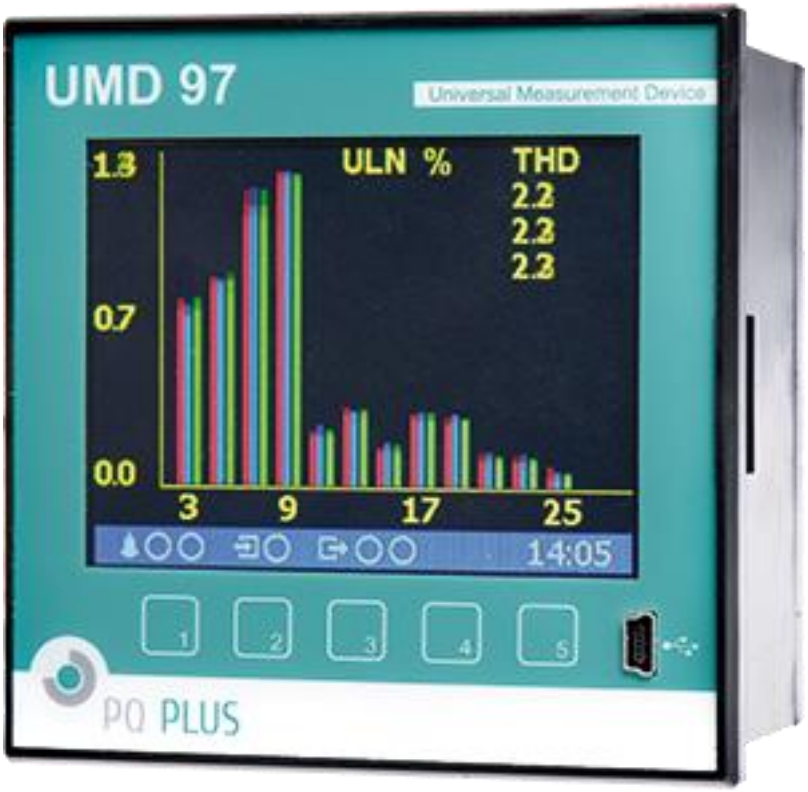
Operating Manual for

UMD 97



Contents

1 General Description

The UMD 97 is specially designed for monitoring of energy and power quality in advanced power systems and smart grids. The instrument is designed for installation to the panel. Its graphical display presents advanced information locally without the necessity to use PC. It is suitable for a wide spectrum of automation tasks in modern buildings and industrial plants as well as for power generation and transmission systems. To protect the actual setup and collected data each instrument can be locked by a custom pin. It uses standard USB port for communication with remote control systems. Optionally it can be equipped with other communication peripherals such as RS485, USB, WiFi and Ethernet interface.
It is equipped with three voltage input and three current inputs. The default option X/5A uses common X/5A or X/1A current transformers. The instrument can be also supplied with for current transformers with X/100 mA ratio, for current probes with voltage outputs with X/333 mV.
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Warning!

The X/100mA, X/333 mV, options are specially designed to be used only in combination with provided external current sensors which are supported with the respective option. The UMD 97 is available in several configurations according to the customer requirements.

2 Operating the Meter

2.1 Safety requirements when using UMD 97

Warning!

When working with the instrument it is necessary to perform all necessary measures for the protection of persons and property against injury and electric shock.

- The device must be operated by a person with all required qualifications for such work and this person must know in detail the operation principles of the equipment listed in this description!
- When the device is being connected to the parts which are under dangerous voltage it is necessary to comply with all the necessary measures to protect users and equipment against injury with electrical shock.
- Person, performing the installation or maintenance of the instrument must be equipped with and must use personal protective clothing and tools.
- If the analyzer is used in a manner not specified by the manufacturer, the protection provided by the analyzer may be impaired.
- If the analyzer or its accessories appear to be impaired or not functioning properly, do not use it and send it in for repair.

2.2 Installation of the instrument

The UMD 97 instrument is built in a plastic box to be installed in a distribution board panel. It's position must be fixed with the provided locks. Natural air circulation should be provided inside the distribution board cabinet, and in the instrument's neighborhood, especially underneath the instrument. No other instrumentation that is source of heat should be installed or the temperature value measured may be false.

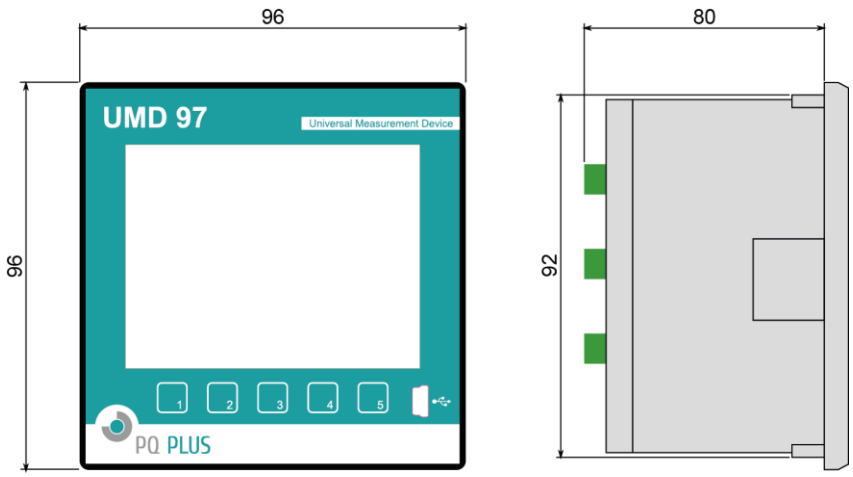
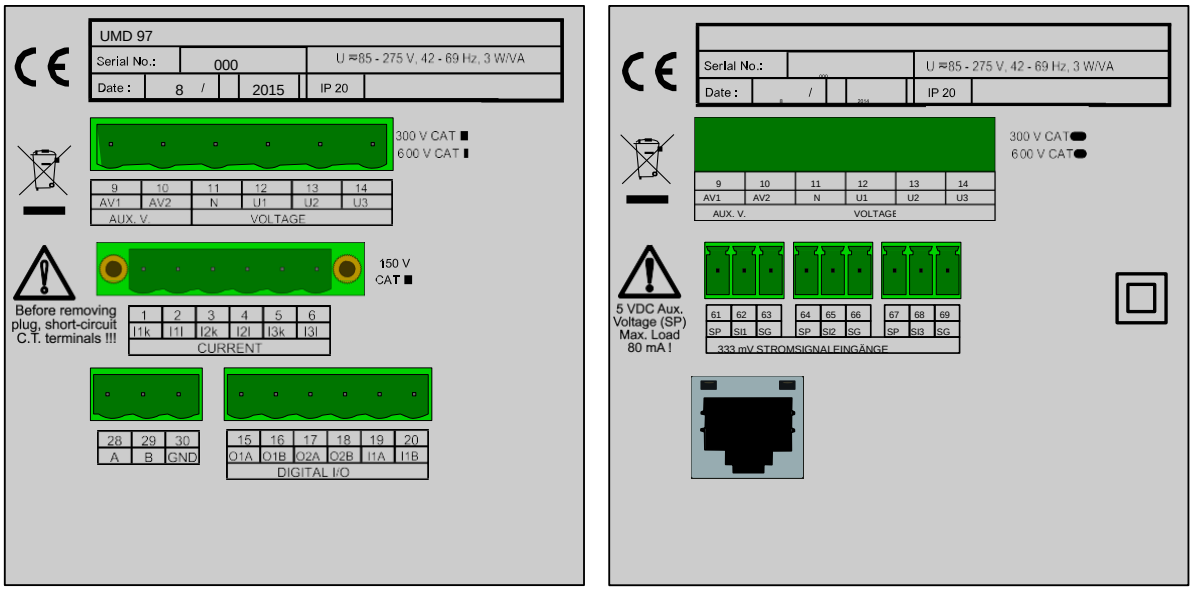


Figure 2: Dimensions of the UMD 97 analyzer.



Terminals for RS485 serial line communication (option 4) and a digital input with two relay or solid state outputs (options RR, RI or II).

Option for current CTs or flexible probes with X/333 mV output, RJ-45 connector for Ethernet (option E), without inputs and outputs (option N in I/O).

Figure 3: Back side of the UMD 97 with terminals for serial line, I/O and Ethernet options.

2.2.1 Supply voltage

The supply voltage (according to the technical specifications and the instrument type) connects to terminals AV1 (no. 9) and AV2 (no. 10) via a disconnecting device (switch). It must be located at the instrument's proximity and easily accessible by the operator. The disconnecting device must be marked as such. A circuit breaker for nominal current of 1 Amp of the required rating makes a suitable disconnecting device. Its function and working positions must be clearly marked (symbols 'O' and 'I' according to IEC EN 61010-1).

2.2.2 Measured voltage

The measured phase voltages are connected to terminals U1 (no. 12), U2 (no. 13), U3 (no. 14). The common terminal to connect the neutral wire is identified as N (no. 11; it remains unused with delta and Aron connections). It is suitable to protect the measured voltage lines for example with 1A fuses of the required rating. Measured voltages can also be connected via instrument voltage transformers. A connection cable maximum cross section area is 2.5 mm^2 for voltage terminals.

2.2.3 Measured currents

The instruments are designed for indirect current measurement via external CT only. Proper current signal polarity (k, l terminals) must be observed. You can check the polarity by the sign of phase active powers on the instrument display (in case of energy transfer direction is known, of course).

X/5A current input option

The current signals from 5A or 1A instrument current transformers must be connected to the terminal pairs I1k, I1l, I2k, I2l, I3k, I3l (No. 1 ÷ 6). A connection cable maximum cross section area is 2.5 mm^2.

X/100mA current input option

The supplied current transformers (which are standard accessory) must be clamped on measured wires and interconnected with corresponding terminal pairs I1k, I1l, I2k, I2l, I3k, I3l (no. 41 ÷ 46) using a twisted-pair cable of maximum length of 3 m.

Warming!

Connection of the common X/5A, X/1A or another unsupported current transformers to an instrument with X/100mA option is strictly forbidden !!! The instrument can be seriously damaged!

The secondary winding of the X/100mA transformers is led to the screw terminals. The orientation is marked on the CT guide groove. A connection cable maximum cross section area is 1.5 mm^2.

X/333 mV current input option (333mV CT or RCT only)

These instruments are supplied with separate terminal connector for each current input. The current transformers with nominal output voltage 333 mV must be clamped on measured wires and interconnected with corresponding terminal pairs using a twisted-pair cable of maximum length of 3 m. Again, proper current signal polarity (k and l terminals) must be observed.

Connection of the current inputs with X/333mV option is shown in fig. 5: terminals SI1, SI2 and SI3 (nr. 62, 65 and 68) are input signals corresponding to currents I1, I2 and I3 (terminal “k” of the measuring CT or white wire of the RCT). SG terminals (nr. 63, 66 and 69) are a common pole for signals I1, I2 and I3 (terminal “l” of the measuring CT or black wire of the RCT) and also a negative pole of the internal 5V auxiliary voltage supply. These terminals are internally interconnected. SP terminals (nr. 61, 64 and 67) are the positive pole of the internal 5V auxiliary voltage supply for the connected RCT sensors.

Warning!

Connection of unsupported type of current transformer such as the common type with 5A, 1A, 100mA or other unsupported secondary to an 333mV option instrument is strictly forbidden! The instrument can be seriously damaged!

Warning!

Do not connect the current input signals of the 333mV option with neither ground nor other potential! Otherwise, measurement accuracy can be affected or the instrument can be damaged!

The flexible current sensors with embedded integrator usually require a power supply. For such purpose the instruments are equipped with auxiliary power supply 5V. Maximum load of each sensor connected is 20 mA.

2.2.4 Communication peripherals

USB

communication port for USB slave is located on the front panel. This communication port is intended for easy local configuration and fast download of archived data to the local PC. Use the supplied USB cable only (USB-A/mini). UMD 97 is a USB 2.0 slave device. For correct operation it needs a driver installed in your operating system (see the ENVIS user guide for more info).

Ethernet interface (optional)

10Base-T Ethernet interface with RJ-45 connector described ETH is situated on a back side (terminal panel) of the device. Ethernet interface can be used as substitution for the primary RS-485 for connection of the device to LAN and for easy connection of remote control PC.

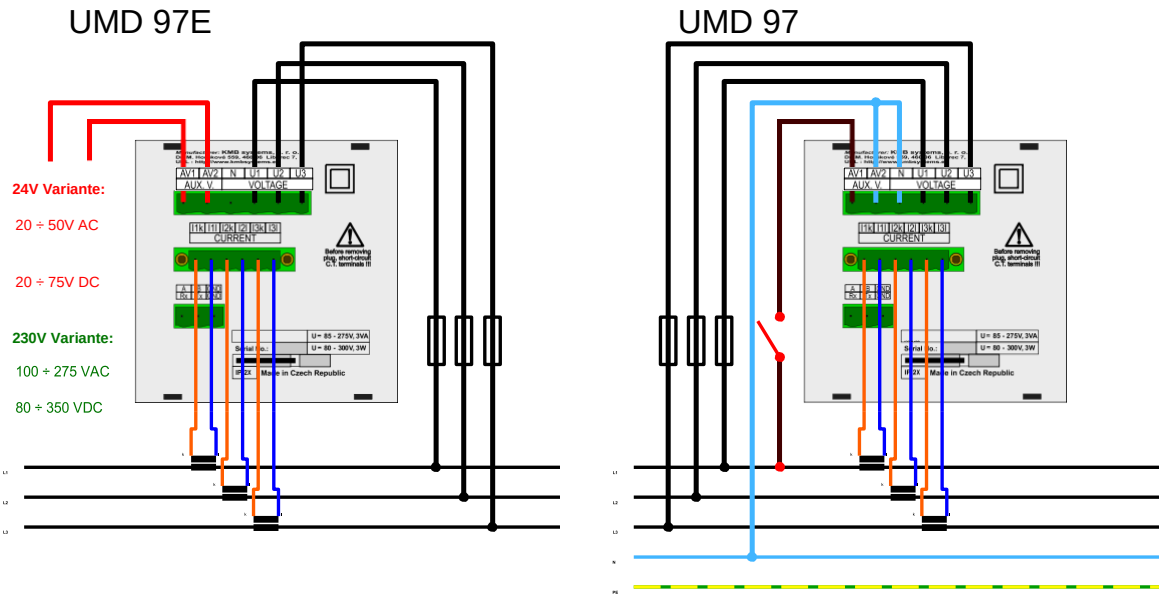


Figure 4: An example of typical installation of UMD 97 instrument in a low voltage network — option U (left) with power supplied from the measured channel in a star connection and option S (right) with low voltage DC power supply, measurement connected as delta connection — based on the power supply option various AC and DC power supplies can be used including battery backed UPC etc.

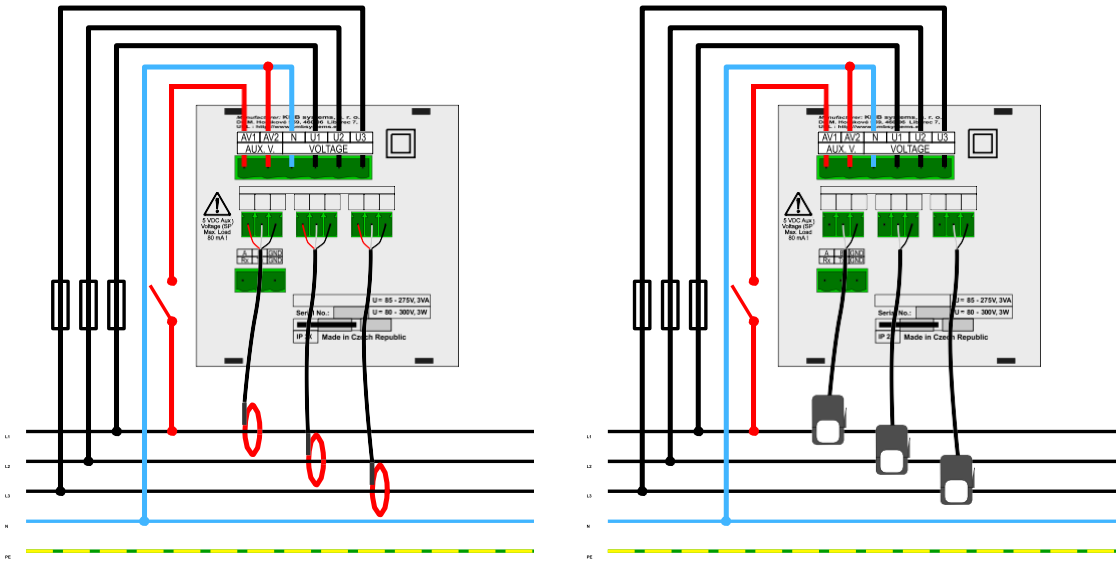


Figure 5: Typical installation of a X/333mV option of UMD 97 instrument in a low voltage network with power supplied independently. Three RCTs (flexible rogowski probes) powered from the instruments internal power supply (left) or split core current transformers with secondary output 333mV (right).

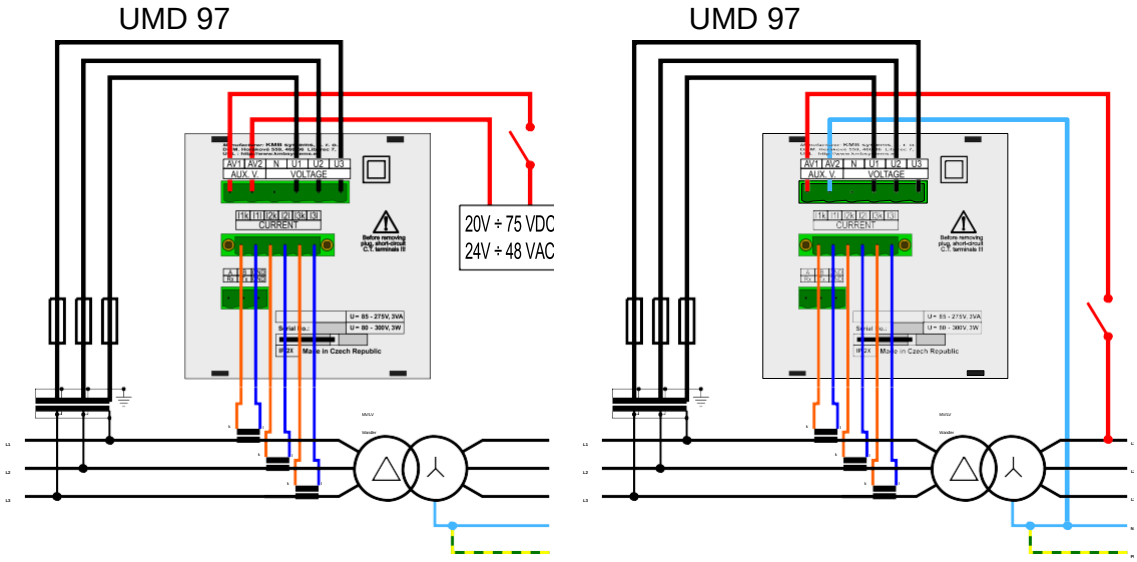


Figure 6: Example of typical connection of UMD 97 in MV or HV network with indirect measurement via voltage transformers. Option L on left side is supplied from a backup power supply. Option U on the right side is supplied from L1 of the LV network.

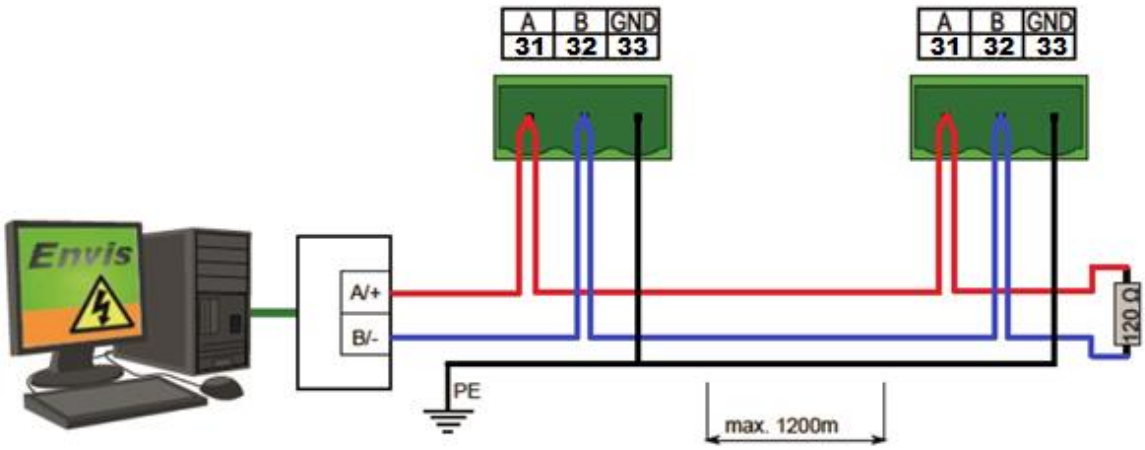


Figure 7: Typical wiring of the RS-485 communication line terminals in UMD 97

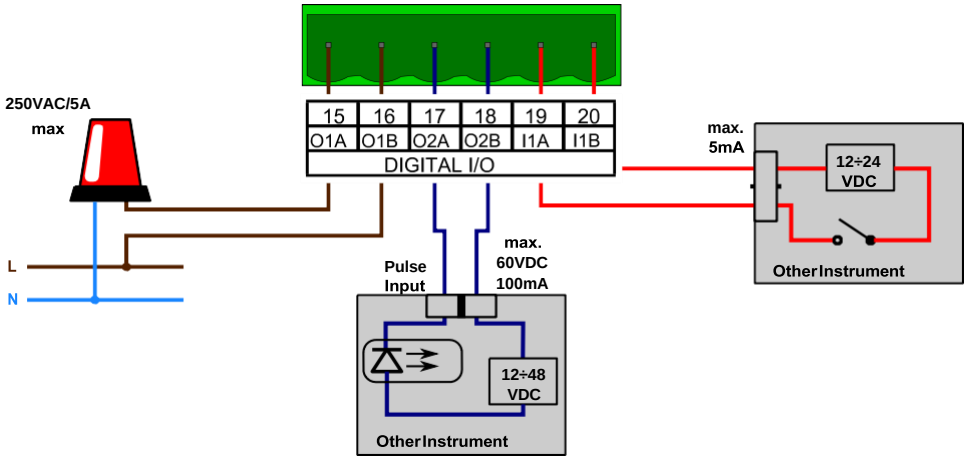


Figure 8: An example of wiring connection for inputs and outputs in UMD 97

RS-485 serial line (optional) serves usually as a remote communication for reading of actual data, archive downloading and device configuration. Serial RS-485 line uses terminals A, B and GND (no. 28, 29 and 30 on fig. 3a and 7). The end point of the communication line must be properly terminated with ˜120n resistor.

2.2.5 Outputs and inputs

Instruments can be equipped with optional outputs and inputs. Two digital outputs DO1, DO2 (electromechan- ical relay or solid-state according to the option), one digital input DI1 and two virtual programmable alarms A1 and A2 are available in the instrument. Outputs are connected to the terminal no. 15 to 18 on the rear panel of an instrument. Input signal can be connected to terminal nr. 19 and 20. A cable maximum cross section area is 2.5 mm^2. Both inputs and outputs are isolated from the instrument internal circuits as well as between each other.

Digital outputs DO1 and DO2 (optional with RR, RI and II) can be configured to generate pulses from an electricity meter or other quantity, as a simple programmable two-position controller or as a remote application controlled output.
Relay output (R) (SPST-NO: single-pole, single-throw, normally open relay) is used. Maximum allowable voltage and load current according to the technical specifications must be fulfilled.
Impulse output (I) is accomplished by a semiconductor switching device. It is assumed that the input opto- couplers of the external recording or control system will be connected to these outputs via proper current–limiting resistors. The signal polarity is not significant to the device.

Digital Input DI1 (optional with RR, RI and II) state is indicated on display and in remote software. Connect a voltage signal of appropriate magnitude to the the DI1 terminals. The signal polarity is not significant to the device. If the voltage exceeds declared level, the input is activated and the symbol is displayed. Usual 12 or 24 V DC/AC signals can be connected directly. If you need to connect a voltage signal of magnitude exceeding maximum digital input voltage, an external limiting resistor of appropriate rating must be used.

2.3 Lock/unlock the instrument

From the manufacturer the instrument is shipped in an unlocked state. It is however possible to lock the instrument so as to prevent any unwanted modifications of its configuration by aliens.

2.3.1 Locking the instrument

1. press the button ③ in the default start screen
2. choose lock/unlock symbol with buttons ④ and ⑤. Unlocked instrument presents open lock symbol.
3. press button ③ and enter the locking/unlocking sub-menu of the instrument. It displays Unlocked: X
4. press ③ and choose lock option. Symbols a/ and X will be displayed
5. chose requested new state (a/...locked) by pressing ④ and ⑤
6. confirm your selection with pressing button ③
7. leave the locking screen by pressing button ①
8. press button ② and confirm locking of the instrument. Your UMD 97 is now locked and all local modifi- cations of configuration are not allowed.

2.3.2 Unlocking the instrument

1. press button ③ in the default start screen
2. choose lock/unlock symbol with buttons ④ and ⑤. Locked instrument presents closed lock symbol
3. press button ③ and enter the locking/unlocking sub-menu of the instrument. It displays Locked: a/
4. press ③ and choose lock option. PIN code entry field will be displayed on locked instruments
5. enter the PIN code (instrument serial number) by pressing buttons ②, ④ and ⑤
6. press button ③ to confirm the choice
7. leave the locking menu with button ①
8. press button ② and confirm locking of the instrument. Your UMD 97 is now unlocked and all local modifications are allowed.

2.4 Basic instrument setup

To navigate the screen and to configure the UMD 97 instrument locally there is 5 multifunction buttons located under the display area. its actual function is dynamic and is symbolized by a pictogram on the lower edge of the screen above each button (fig. 9). For intention of use in this manual we are referring to these buttons as button ① to ⑤ from left to right. In general buttons ④ and ⑤ are navigational buttons. Button ③ is alternating Confirm function and Return to main menu function. Buttons ① and ② are either without function or they provide navigation and other functions in the context of each screen.

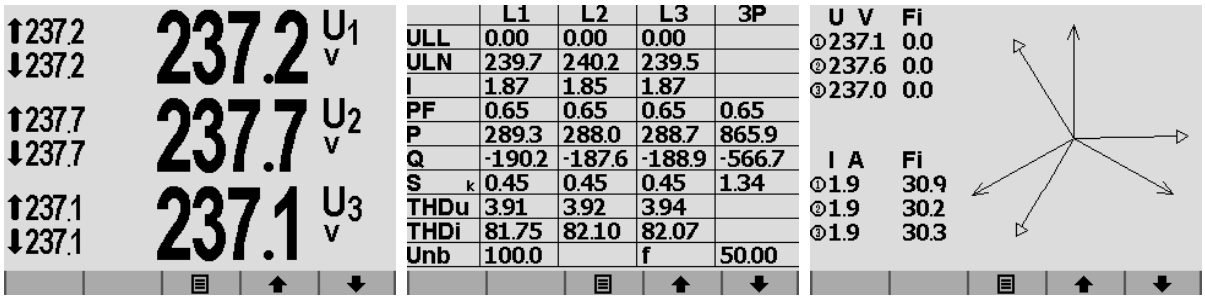
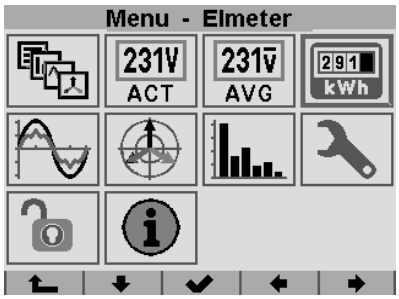
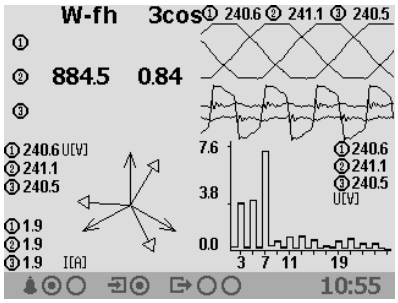


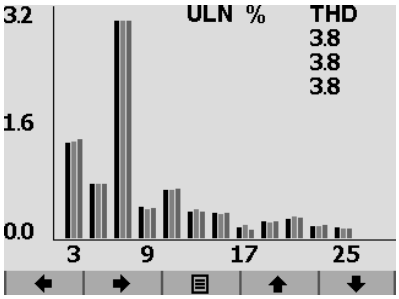
Figure 9: Screen of the UMD 97 : button ① - without function, ② - without function, ③ - menu, ④ - up arrow rotates displayed screens, ⑤ - down arrow rotates displayed screen. Default start-up screen is on the left.



Main menu of the instrument

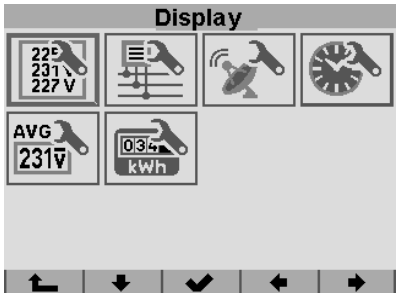


Special user defined split screen displays data compacted

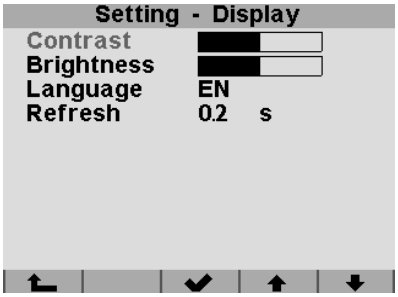


Graphical display of the measured harmonics (here phase voltage).

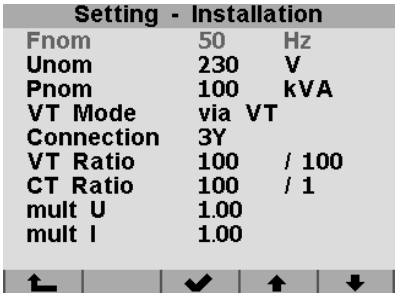
Figure 10: Examples of different actual data displayed on screen of the UMD 97 instrument.



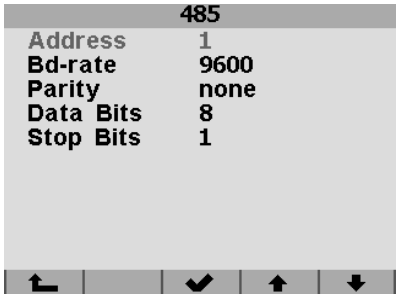
Configuration menu of the UMD 97 analyzer.



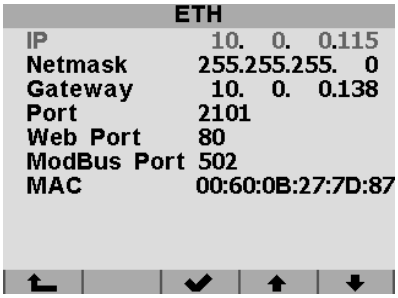
Setting up the display options



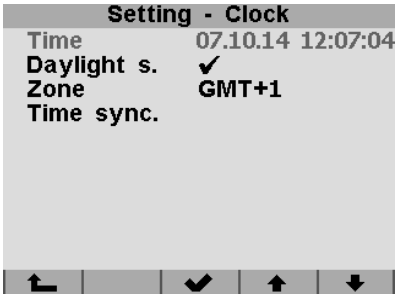
Setting up the basic installation parameters of an instrumen.



Setting up the RS485 serial communication option.



Setting up the Ethernet communication option.



Setting up the time, date and time synchronization options.

Figure 11: Set up screens of the UMD 97 analyzer.

2.4.1 Installation type and options

1. turn on the instrument and wait until it boots up. Start-up screen will be displayed (fig. 9).
2. press button ③ - main menu is displayed (fig. 10a). Buttons ②, ④ a ⑤ navigate selection cursor in this screen. Button ③ picks the highlighted menu item. Button ① returns back in the menu level.
3. press multiple times button ⑤ and choose settings symbol - green french key.
4. press button ③. Configuration screen will be displayed (fig. 11a)
5. press multiple times button ⑤ and select Install Config item.
6. press button ③. Install Config screen is displayed.
7. select Connection Type according to the physical connection of the instrument.
8. insert correct value of voltage and current transformer ratio according to the used VT and CT.
9. press button ① and accept the settings modifications on a displayed screen.
10. press button ② to confirm the change or button ④ to cancel the previous modifications

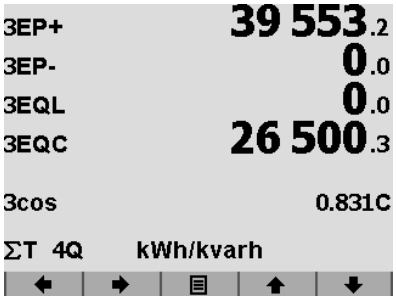
2.4.2 Communication options

1. select the Communication item in menu
2. confirm ETH or RS-485 configuration according to the instrument option.
   - ETH: enter IP address, network mask and gateway
   - RS-485: enter communication line parameters according to your setup

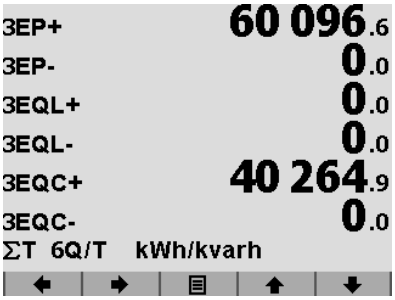
2.4.3 Time and date options

1. select the Time and Date item in menu
2. enter time and date value, valid at the time of end of editing.
3. select if instrument uses Summer Time option.
4. choose the valid Time Zone
5. Time Synchronization is usually not required.

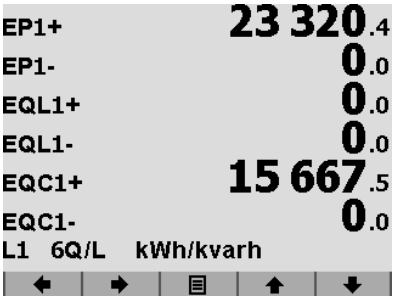
Now the instrument is configured and is ready to be used in typical application.



Three phase registers of active and re- active energy - sums of quadrants.



Three phase active energy + and -, reactive energy displayed separately for each quadrant.



Active energy + and -, reactive energy separately for each quadrant, values shown for each phase separately.

Figure 12: Meter reading screens of UMD 97 . Scrolling the instrument screens vertically user lists meter readings for each tarif and sums (EP, EQL+, EQL-, EQC+ a EQC-) and single phase (L1, L2 and L3) values respectively.

2.5 Downloading data to PC

Connect the instrument to the PC and run ENVIS.Daq application. Select the appropriate communication option and connect to the instrument. In the next screen press Refresh All. This will load and display the actual status of each supported archive. Device Information section contains editable description and name under which the actual record is stored. Time Frame for Other Archives tab allows you to limit the date ranges of all archives by the time interval of the main archive. In the Destination section the actual storage can be selected - either to the SQL database or to the file. The check boxes in Archives to Download determines which specific archive(s) you want to download. The actual download will start by pressing the Download All button. progress is displayed on screen. When finished the archive can be viewed in the ENVIS application. User can open the downloaded file directly from ENVIS.Daq.

2.6 Energy meter readings

UMD 97 has an embedded three phase, four-quadrant energy meter with automatic meter reading functions and multiple programmable tariffs (Time-of-Use, TOU). The instrument registers active energy (EP, EP+, EP-) and reactive energy (EQL, EQC or EQC+, EQC-, EQL+, EQL-). According to the configuration of meter readings are shuffled to the respective tariffs. It automatically provides summaries per phase. For star connections and single phase measurements it can also register energy for each phase separately. Readings can be displayed on the instrument screen. Basic hierarchy is shown on the fig. 12 — button ③ enters the main instrument menu, use buttons ④ and ⑤) to navigate to electricity meter icon, press button ③ again and enter the meter reading screen (fig. 12a). Meter data readings can be downloaded and analyzed in ENVIS or via the standard ModBus protool in any other system.

3 Technical Specifications

3.1 Basic Parameters

Instrument Auxiliary Power Supply Voltage		
	model „230V“	model "24V"
aux. voltage range AC: f = 40 ÷ 450 Hz; DC	100 ÷ 275 VAC 90 ÷ 350 VAC	20 ÷ 50 VAC 20 ÷ 75 VAC
power supply	3 VA / 3 W	
overvoltage category	III	
pollution degree	2	
connection	isolated, polarity free	

„X/333mV“ Instrument Model Auxiliary Voltage for Current Sensors	
connection	connection
output voltage	output voltage
maximum permanent load	maximum permanent load
short-circuit current, max. duration	short-circuit current, max. duration

Other Specifications	
operational temperature	- 20 to 60°C
storage temperature	- 40 to 80°C
operational and storage humidity	< 95 % - non-condensable environment
EMC – immunity	EN 61000 – 4 - 2 (4kV / 8kV) EN 61000 – 4 - 3 (10 V/m up to 1 GHz) EN 61000 – 4 - 4 (2 kV) EN 61000 – 4 - 5 (2 kV) EN 61000 – 4 - 6 (3 V) EN 61000 – 4 - 11 (5 periods)
EMC – emissions	EN 55011, class A EN 55022, class A (not for home use)
communication ports	USB 2.0, optional RS-485(1.2÷460 kBd), Ethernet 10 Base-T
communication protocols	KMB, Modbus RTU and TCP, web server, DHCP
display	colour TFT-LCD, 320 x 240 pixels
RTC : accuracy	+/- 2 seconds per day
backup battery capacity	> 5 years (without supply voltage applied)
protection class front panel back panel	 IP 40 (IP 54 with cover sheeting) IP 20
Dimensions front panel built-in depth installation cutout	 96 x 96 mm 80 mm 92^{+1} x 92^{+1} mm
weight	max. 0,3 kg

3.2 Measured Quantities

Voltage characteristics		
Frequency		
f_{NOM}– nominal frequency	50 / 60 Hz	
measuring range	40 ÷ 70 Hz	
uncertainty	± 10 mHz	
Voltage		
voltage input option	„400“	„230“
UNOM (UDIN)– rated voltage	300 ÷ 415 VAC	180 ÷ 250 VAC
measuring range (line-to-line)	10 ÷ 600 VAC	6 ÷ 360 VAC
measuring range (line-to-neutral)	20 ÷ 1040 VAC	8 ÷ 620 VAC
intrinsic uncertainty (t_A=23±2ºC)	+/- 0,05 % rdg ± +/- 0,02 % rng	
temperature drift	+/- 0,03 % rdg ± +/- 0,01 % rng / 10 °C	
measurement category	300 V CAT III, 600 V CAT II	300 V CAT III
permanent overload	1000 VAC (UL–N)	600 VAC (UL–N)
peak overload, 1 second	2000 VAC (UL–N)	1200 VAC (UL–N)
burden power (impedance)	< 0,05 VA (Ri=6 MΩ)	< 0,025 VA (Ri=3,6 MΩ)
Voltrage Unbalance		
measuring range	0 ÷ 10 %	
measuring uncertainty	± 0,3	
THDU		
measuring range	0 ÷ 20 %	
measuring uncertainty	± 0.5	
Harmonics (up to 50th order)		
reference conditions	other harmonics up to 200 % of class 3 acc. to IEC 61000–2-4 ed.2	
measuring range	10 ÷ 100 % of class 3 acc. to IEC 61000–2-4 ed.2	
measuring uncertainty	twice the levels of class II acc. to IEC 61000–4-7 ed.2	

Measured Quantities – Current, Temperature			
Current			
current input option	„X/5A“	„X/100mA“	„X/333mV“
INOM (IB) – rated (basic) current	1 ÷ 5 AAC	0,1 AAC	I @ 333mV
measuring range	0,005 ÷ 7 AAC	0,001 ÷ 0,39 AAC	0,002 ÷ 0,5 VAC
intrinsic uncertainty (t_A=23±2ºC)	+/- 0.05 % rdg ± +/- 0.02 % rng		
temperature drift	+/- 0,03 % rdg ± +/- 0,01 % rng / 10 ºC		
measurement category	150V CAT III	150V CAT III	undefiniert
permanent overload	7,5 AAC	1 AAC	15 VAC
peak overload 1 second, maximum repetition frequency > 5 minutes	70 AAC	10 AAC	15 VAC
burden power (impedance)	< 0,5 VA (Ri < 10 mΩ)	< 0,01 VA (Ri < 40 mΩ)	< 3 µVA (Ri > 100 kΩ)
Current Unbalance			
measuring range	0 ÷ 100 %		
measuring uncertainty	± 1 % rdg oder ± 0,5		

Harmonics & Interharmonics (up to 50th order)	
reference conditions	other harmonics up to 1000 % of class 3 acc. to IEC 61000–2-4 ed.2
measuring range	500 % of class 3 acc. to IEC 61000–2-4 ed.2
measuring uncertainty	Ih <= 10% INOM : ± 1% INOM
	Ih > 10% INOM : ± 1% of rdg
THDI	
measuring range	0 ÷ 200 %
measuring uncertainty	THDI <= 100 %: ± 0,6
	THDI > 100 %: ± 0,6 % rdg
Temperature (internal sensor, measured value affected by the instrument power dissipation)	
measuring range	-40 ÷ 80 °C
measuring uncertainty	± 2 ºC

Measured Quantities – Power, Power Factor, Energy	
Active / Reactive Power, Power Factor (PF), cos φ (PNOM = UNOM x INOM)	
reference conditions “A” : ambient temperature (tA) U, I for active power, PF, cos φ for reactive power	 23 ±2 ºC U = 80 ÷ 120 % UNOM, I = 1 ÷ 120 % INOM PF = 1.00 PF = 0.00
act. / react. power uncertainty	± 0,5 % rdg ± 0,005 % PNOM
PF & cos φ uncertainty	± 0,005
“reference conditions ”B”: ambient temperature (tA) U, I for active power, PF, cos φ for reactive power	 23 ± 2 ºC U = 80 ÷ 120 % UNOM, I = 2 ÷ 120 % INOM PF >= 0.5 PF <= 0,87
act. / react. power uncertainty	± 1 % rdg ± 0,01 % PNOM
PF & cos φ uncertainty	± 0,005
temperature drift of powers	+/- 0,05 % rdg ± +/- 0,02 % PNOM / 10 ºC
Energy	
measuring range	corresponds to U & I measuring ranges 4 quadrant energy counters for both active and reactive energies
active energy uncertainty	class 0.5S acc. to EN 62053 – 22
reactive energy uncertainty	class 2 acc. to EN 62053 – 23

4 Maintenance, Service, Warranty

Maintenance: the UMD 97 power analyzer does not require any maintenance during its operation. For reliable operation it is only necessary to meet the operating conditions specified and not expose the instrument to violent handling and contact with water or chemicals which could cause mechanical damage.
The lithium cell built in the instrument can backup a real time circuit for more than 5 years without power supply, at average temperature 20°C and load current in the instrument less than 10 µA. If the cell is empty, it is necessary to ship the instrument to the manufacturer for battery replacement

Service:

in the case of failure or a breakdown of the product, you should contact the supplier at their address:

PQ PLUS GmbH
Hagenauer Str. 6
91094 Langensendelbach
info@pq-plus.de
09133-60640-101

The product must be in proper packaging to prevent damage during transit. A description of the problem or its symptoms must be delivered together with the product.

If a warranty repair is claimed, the warranty certificate must be sent in. In case of an out-of-warranty repair you have to enclose an order for the repair.

Warranty certificate: warranty period of 24 months from the date of purchase is provided for the instrument, however, no longer than 30 months from the day of dispatch from the manufacturer. Problems in the warranty period, provably because of faulty workmanship, design or inconvenient material, will be repaired free of charge by the manufacturer or an authorized servicing organization.

The warranty ceases even within the warranty period if the user makes unauthorized modifications or changes to the instrument, connects it to out-of-range quantities, if the instrument is damaged due to ineligible or improper handling by the user, or when it is operated in contradiction with the technical specifications presented

Type of product:	UMD 97	Serial number:	
Date of dispatch:		Final quality inspection:	
		Manufacturer's seal:	
Date of purchase:		Supplier's seal:	