

User manual

Branch Circuit Power Monitoring System — Voltage Measurement Module

EMU 3

Document revision	Release date	Valid for versions			
		Hardware	Bootloader	Firmware	Software ENVIS
1.5	12.4.2021	2.0	4.0	3.7	1.9

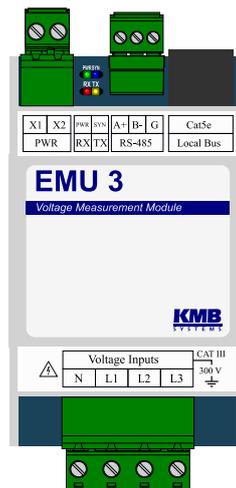


Figure 1: EMU 3 S 230

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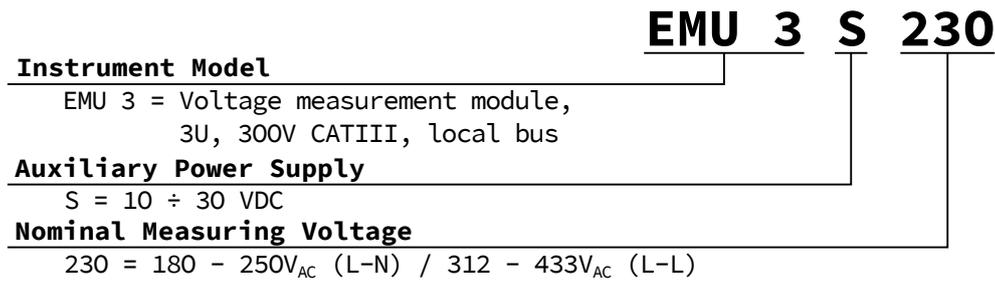


Figure 2: Ordering codes and schemas.

1 Basic description

The EMU 3 is designed for remote monitoring of energy consumption. It is designed for installation on a DIN rail or mounting panel and does not have a local display. This concept is suitable for a wide range of applications in power engineering and smart networks, in building automation and individual production processes, for remote infrastructure supervision and also for automatic load management. The device is not equipped with local controls and therefore cannot easily interfere with the functions it performs — in simple terms, it should not attract the special attention of lay people in easily accessible places. To protect settings and collected data, the device can be locked with a pin or password. It uses the RS-485 communication line for connection to a superior system. The instrument measures three voltages. In addition, the local bus allows up to 5 EMI 12 devices to measure basic electrical parameters of up to 20 three-phase branches (60 currents).

1.1 Types and options

The EMU 3 is available in various configurations according to the customer's specifications¹. On figure 2 marking schema of all available options is drawn.

1.2 News in version 3.0

- four quadrant measurement of powers and energies, booth active and reactive
- extended, more accurate and continuous measurement of harmonic phasors (amplitudes and angles)
- possibility to synchronize device time from network frequency
- modular firmware - modules for RCS/HDO
- Locking the device: new features for user access management have been added (see AppNote 0004).

1.3 Accessories

In table 1 is a list of accessories that are automatically delivered to each EMU 3 and accessories that can be specified when ordering or additionally purchased.

1.4 Measuring principles and signal processing

Connection and measurement

- DC supply voltage 10 ÷ 30 V
- three voltage inputs (L_1, L_2, L_3) for direct or indirect measurement of star or delta voltage, single-phase and Aron
 - measurement category III/300 V
- 6.4 kHz sampling, continuous measurement

¹A complete and up-to-date list of optional accessories can be obtained from your dealer upon request.

Table 1: Standard and optional accessories

Ordering code	Accessory		Description
	Standard	Number of pcs.	
GMSTB 2,5/ 4-ST-7,62	☑	1	4-pin plug-in connector 7,62 mm
MSTB 2,5/ 2-ST-5,08	☑	1	2-pin plug-in connector 5,08 mm
MC 1,5/ 3-ST-3,81	☑	1	3-pin plug-in connector 3,81 mm
Cable LocalBus, 0,1m	☒		Local bus cable 0,1 m
Cable LocalBus, 0,5m	☒		Local bus cable 0,5 m
Cable LocalBus, 1m	☒		Local bus cable 1 m
Cable LocalBus, 3m	☒		Local bus cable 3 m
Cable LocalBus, KIT	☒		50 m of cable and 50 pcs of RJ45 connectors

- calculate 25 components of harmonic voltages
- evaluation of all commonly measured single- and three-phase quantities such as power (active, reactive, apparent, deformation and fundamental active and reactive power), power factors, voltage harmonics and THD for voltages and currents, ...

Measured data recording

- built-in precise real time circuit with backup battery
- the connected EMI 12 devices only back up the electricity meter counters in the event of a power failure

Data transmission and evaluation

- ENVIS 1.9 or higher is available for free download
- system service ENVIS.Online for downloading and processing of archived measurement data
- tools for downloading, exporting and processing data using custom scripts or via command line
- data library for developing custom applications in C # / . NET or for Linux (C / C ++, .NET Core)
- for data transfer, instrument setting and firmware update, the RS-485 communication interface is used

Supported firmware modules

- Ripple Control Signals (RCS) — Allows you to record telegrams of remote remote control (RCS) and their voltage levels.

2 Operating the measuring instrument

2.1 Safety requirements for use of the EMU 3



When working with the device, all necessary precautions must be taken to protect persons and property against injury and electric shock.

- The device must be operated by a person with the required qualifications for such operation and this person must be familiar with the principles of working with the device described in this description!
- If the unit is connected to parts that are under dangerous voltage, all necessary precautions should be taken to protect users and equipment from electric shock.
- The operator performing installation or maintenance of the equipment must be equipped with personal protective equipment and other safety equipment at work.
- If the device is used in a manner not specified by the manufacturer, the protection provided by the analyzer may be reduced.
- If the device or its accessories appear to be damaged or not working properly, do not use it and send it for repair.

2.1.1 The meaning of the symbols used on the device

Table 2: Symbols

Symbol	Description
	Warning
	Warning, possibility of electric shock
	Alternating current
	Direct current
	CE mark declaring conformity with European regulations and regulations
	The device must not be disposed of with household waste
	Equipment with double or reinforced insulation

2.2 Installing the device in a switchboard

The EMU 3 is designed for mounting on a DIN rail. In the figure 3, the dimensions of the device are drawn. The hole positions for the wall mounting are dimensioned by a dashed line, which is screwed with two screws. The maximum cable cross-section for plug-in power and voltage measurement connectors is 2.5 mm² and 1.5 mm² for the RS-485 connector.

Natural air circulation should be allowed inside the switchgear at the installation site and its immediate surroundings. Do not install other equipment that could be a significant source of heat near to the instrument.

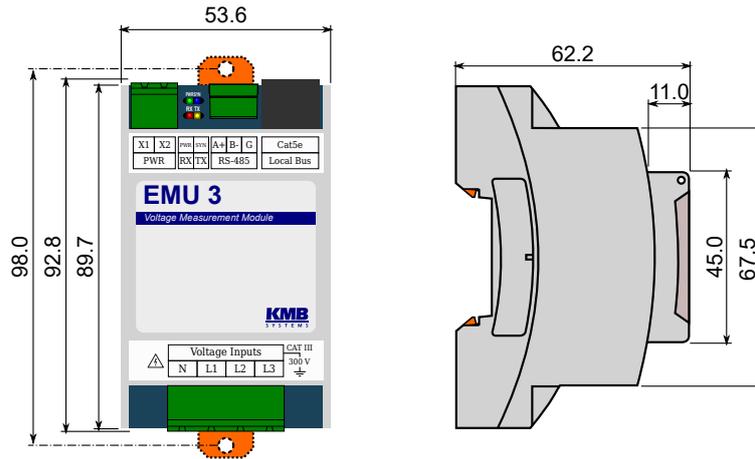


Figure 3: Dimensions of EMU 3.

2.2.1 Auxiliary voltage



The device only has a low voltage power supply (option S) input. Caution should be taken when selecting a suitable power supply.

The instrument supply voltage must be connected to the terminals X1 and X2 via suitable fuses with appropriate characteristics for the respective environment (see diagram in figure 4 for power off). The disconnecter must be located on the left side of the device within reach of the operator. The circuit breaker must be marked as a disconnect switch. A 0.5A circuit breaker is a suitable circuit breaker, but its location and function must be clearly identified (using the '0' and 'I' symbols according to EN 61010-1). The power supply galvanically separates the power terminals of the device from other internal circuits.

Recommended type of conductor	H07V-U (CY)
Recommended minimum conductor cross-section:	0,75 mm ²
Maximum conductor cross section:	2,5 mm ²

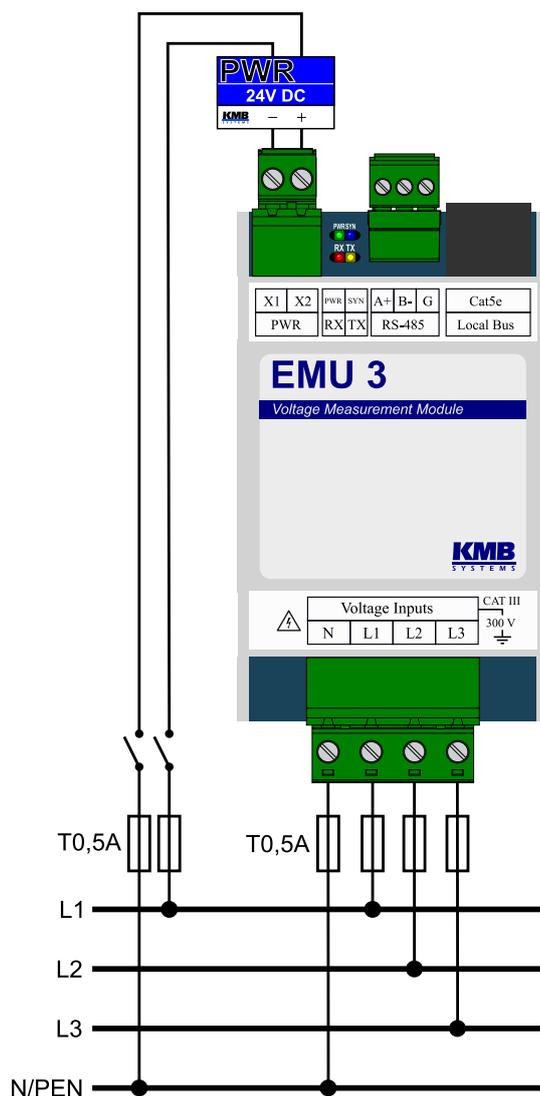


Figure 4: In a 300V/CAT III network it is necessary to use a power supply with the corresponding overvoltage category!



If the unit is operated with external EMI 12 modules connected, the power supply sizing must be adjusted accordingly. EMI 12 modules are powered by local bus from terminals X1 and X2 and will increase the total system consumption to a value exceeding the label parameters of the instrument EMU 3.

2.2.2 Measured voltages

Overvoltage category signals 300 V/CAT III can be directly connected to the voltage measurement inputs.

The measured voltages are connected to terminals L1, L2 and L3. The center conductor connection terminal is marked N — not connected in a triangle or in Aron's wiring. All voltage measuring inputs are connected to the internal circuits via high impedance.

Measured voltages should be protected, for example, by a 0.5A fuse with a suitable tripping characteristic.

Recommended type of conductor	H07V-U (CY)
Recommended minimum conductor cross-section:	0,75 mm ²
Maximum conductor cross section:	2,5 mm ²

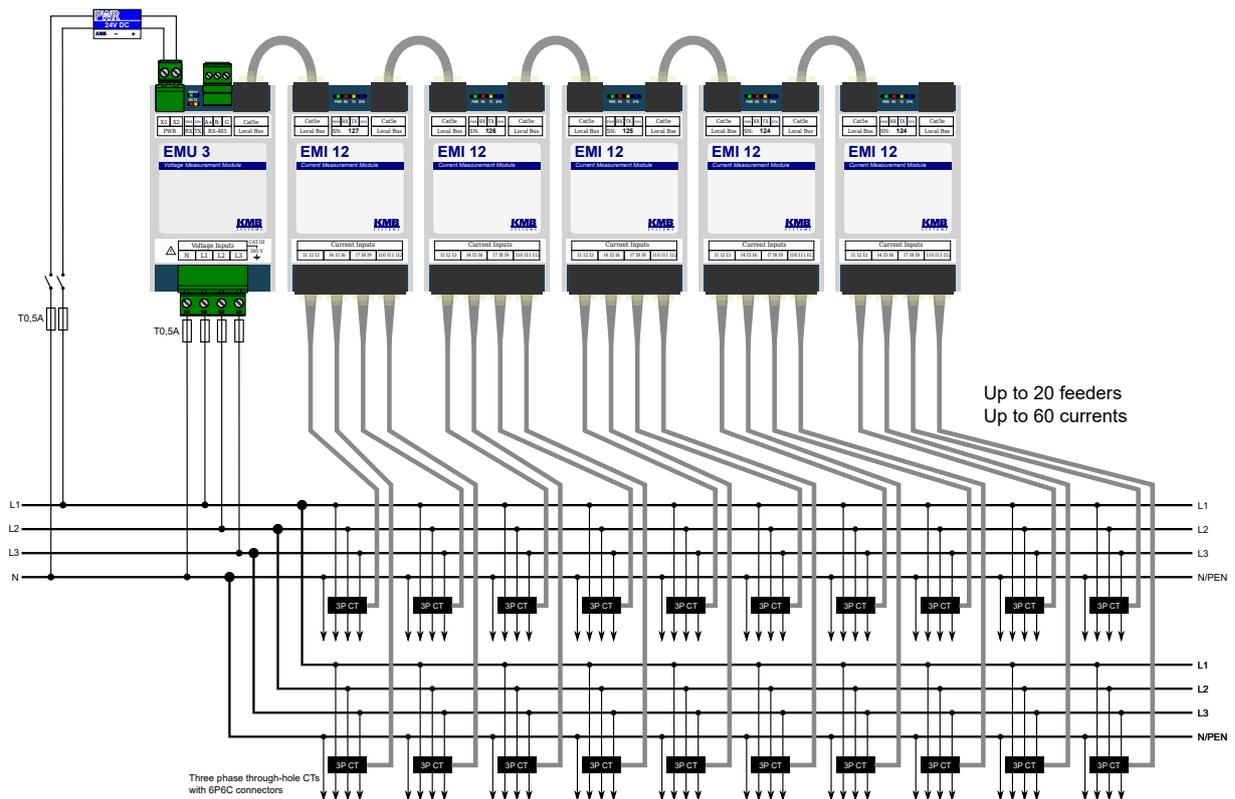


Figure 5: An example of a typical connection of EMU 3 when measuring many three-phase branches. The device is extended by 4 pieces of EMI 12 modules connected via local bus.

2.2.3 Local bus

The local bus uses the 8P8C connector to connect the external EMI 12 modules for current measurement on multiple branches. It is a proprietary bus combining signals for communication, synchronization and powering of external modules².



The physical layer of the local bus is not Ethernet compatible! Only EMI 12 modules can be connected to the device. Never connect the port labeled Local Bus to any Ethernet device, hub, etc. — they may be damaged!

The EMI 12 modules are equipped with two local bus connectors, allowing creation of a bus. An example of a connection is illustrated in the figure 5. EMU 3 allows the connection of up to five EMI 12 modules.

EMU 3 automatically detects module connections and performs their subsequent configuration. Measured variables are available in the current data immediately after connection and user configurations of newly detected modules can be done in the settings. To uniquely identify the modules in the settings, their serial numbers are used, which are printed on the label near the local bus connectors for ease of installation.

Recommended type of conductor	UTP CAT5e 8×AWG24
Crimp connector type:	8P8C (RJ45)
Pin wiring standard:	TIA/EIA-568-B
Cable variants:	Straight or crossed (T568A ↔ T568B)
Maximum total bus length:	15 m

2.2.4 Connection of communication channel



The RS-485 interface is not galvanically isolated from the local bus and their reference potential corresponds to the negative supply voltage.

²Other compatible modules may arise in the future. It is recommended to consult the manufacturer and upgrade the firmware before connecting them to the existing installation

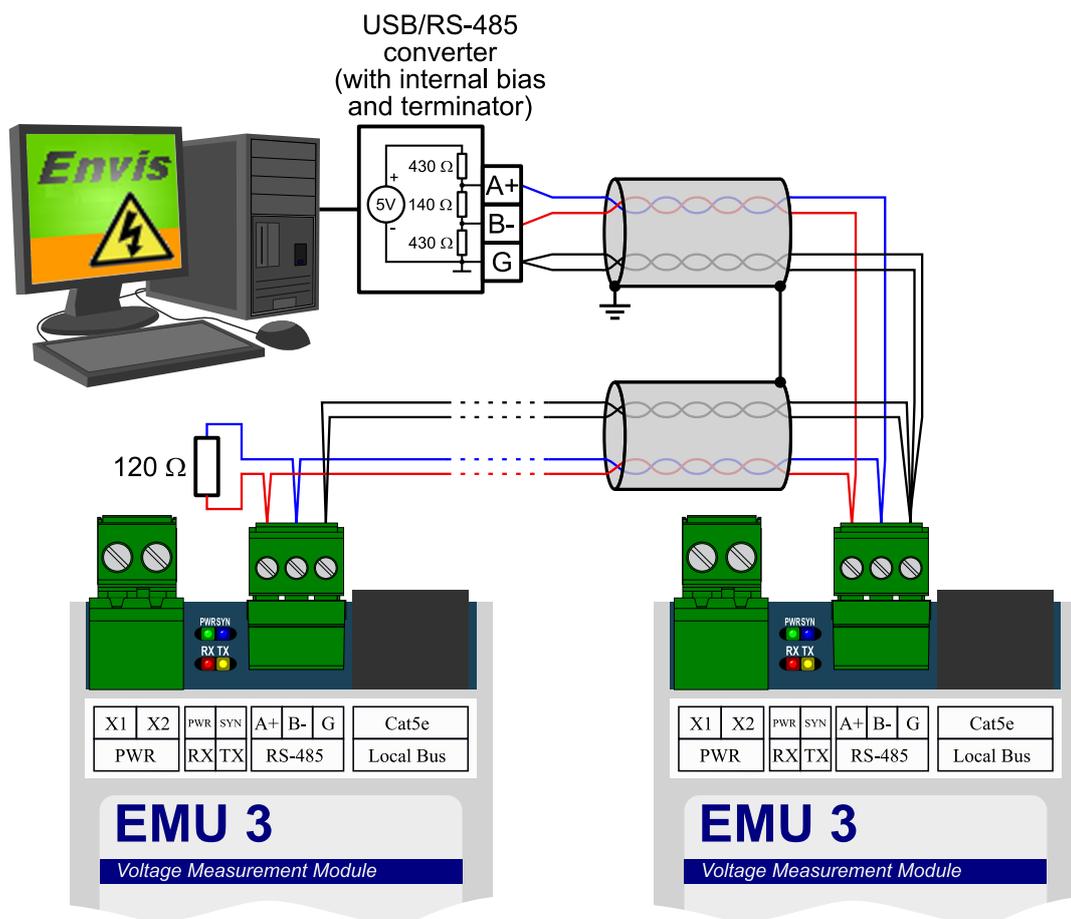


Figure 6: Connection of RS-485 communication lines to EMU 3 devices.

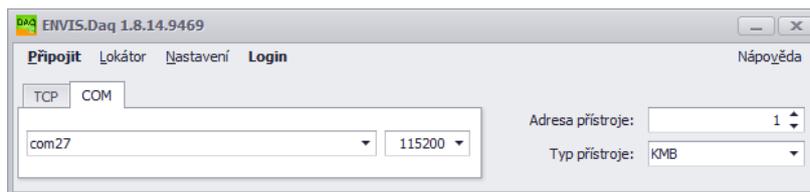


Figure 7: Main window of ENVIS.Daq application after its launch — select the type of communication used, set its parameters and press Connect in menu to continue.

RS-485 It is usually used as an interface for remote reading of current values, archive records, and instrument settings. The RS-485 serial line uses the A +, B-, and G-signal terminals on the terminals described by RS-485 (fig. 6). The ends of the communication line must be terminated with the specified resistance.

For common use (cable length up to 100 m, communication speed up to 9600 Bd), the choice of cable type is not critical. It is possible to use virtually any shielded cable with two pairs of conductors and to connect the shield at one point to the PE conductor. If the cable length is over 100 m, or when the communication speed is higher (about 20 kbit/s), it is advisable to use a shielded communication cable with twisted pairs (so-called "twisted pair"), which has a defined wave impedance (usually about 100 Ω). Signals A and B are connected by one pair, signal G by the other pair.

The RS-485 interface requires impedance termination of the end nodes using terminating resistors, especially at higher communication speeds and distances. Terminating resistors are only installed at the end points of the line (eg one at the PC and the other at the most remote device). They are connected between terminals A and B. A typical value of the terminating resistor is 120 Ω .

Recommended type of conductor	shielded twisted pair 2×2×0,2 mm ² , e.g. Belden 9842
Recommended minimum conductor cross-section:	0,25 mm ²
Maximum conductor cross section:	1,5 mm ²

2.3 Description of LED indicators

PWR green illuminates when supply voltage is present.

SYN blue flashes synchronously with the synchronization pulse every ten periods of the network frequency.

TX green flashes when sending data to the local bus.

RX red blinks when receiving data from the local bus.

2.4 Detailed instrument settings on the PC

It is advisable to set the EMU 3 instrument before starting the measurement. The settings can be made from the computer in the ENVIS³.

1. Turn the power on. Its presence will be indicated by the illuminated green PWR LED. If everything is OK, the instrument will go through the start phase and the SYN and TX LEDs will blink.
2. Connect EMU 3 to a computer via RS-485. The device is now ready for configuration.
3. Run the ENVIS.Daq application and select the COM communication interface type tab (Fig. 7).
4. Select the appropriate serial port, speed, address, and device type from the list.
 - (a) The default speed is 9600 Bd, which is also called service speed. It will always be possible to connect the device with a service speed even if you change the RS-485 speed in the device settings.
 - (b) The default address is 1. If the device address is forgotten, it is possible to use the *Find on 232/485* function, which is part of the *Locator* window.
 - (c) Device type is KMB.

³Daq application. ENVIS.Daq is also part of the ENVIS installation package. A detailed description can be found in the ENVIS user manual.

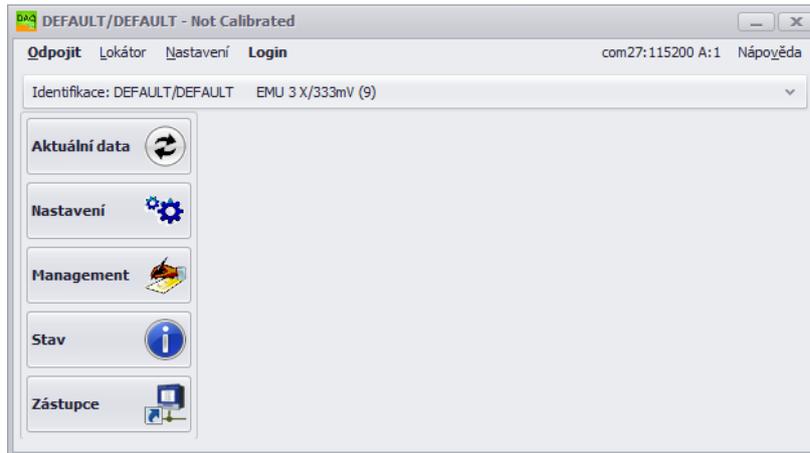


Figure 8: ENVIS.Daq application window with connected EMU 3 instrument.

5. Press *Connect* on menu or *ENTER*. The application attempts to connect to the specified device. If the connection is successful, it loads the settings stored in the device and displays a summary window (fig. 8).
6. Press the *Configs* button in the left column of the menu. A new window with device settings tabs appears.

The *Instrument Configuration* contains individual tabs with device parameters divided by meaning. User can change any parameters in individual tabs. Changes to settings are made only in the application and uploaded to the device by pressing the *Send* button. The *Receive* button can be used to retrieve the current valid settings from the device at any time. Bookmarks that have been changed locally and have not yet been written to the device are marked with a warning symbol ⚠. The *Save* and *Load* buttons are used to archive the current settings to or from a file.

In particular, the *Installation* and *Local Bus* tabs are essential for proper operation.

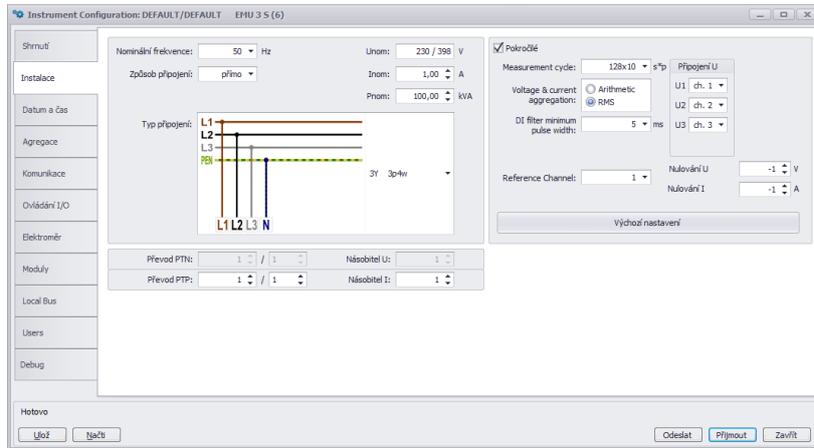
2.4.1 Installation (fig. 9a)

- *Nominal frequency* — set according to the nominal frequency of the measured network (50 or 60Hz).
- *Connection mode* — Sets how the device is connected either as a voltage measurement directly or via a voltage measuring transformer (usually a HV and VHV network).
- *Connection type* — connection method in three-phase systems — star connection. The connection options for the instrument are illustrated in Fig. 9 a 9c.
- U_{NOM} (nominal voltage) — correct setting of U_{NOM} affects the relatively displayed voltage values and how the measurement is interpreted in ENVIS. We determine U_{NOM} according to the nominal voltage of the measured network.
- *VT ratio* — if the *connection mode via VT* is selected, the conversion according to the used voltage transformers must also be set. The ratio you enter is:
 - Rated primary voltage: usual value is 22 000.
 - Nominal secondary voltage: usual value is 100 (other common 110, 120, 230 V, ...)
- *Multiplier U* — this coefficient is rarely changed, but it can be used for corrections when measuring the voltage at the VT output with a non-standard ratio. The default is 1.

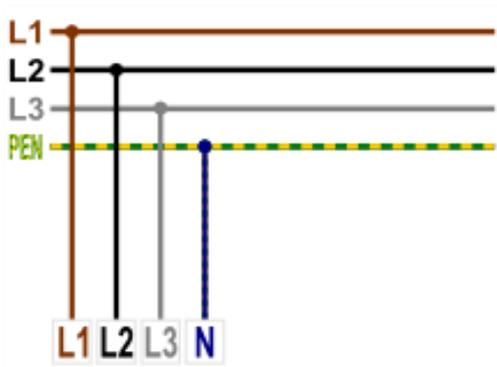
2.4.2 Local bus (fig. 10)

The window consists of five blocks:

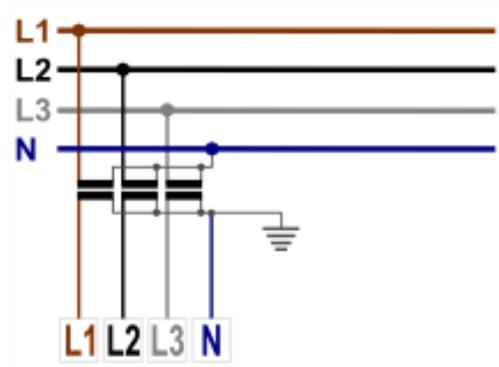
- AVG



(a) Setting of basic device connection parameters in ENVIS.Daq application.



(b) Connection of the device in LV networks (direct connection).



(c) Indirect connection of the device via voltage measuring transformer (in HV, HV networks, etc.).

Figure 9: ENVIS.Daq — device installation settings.

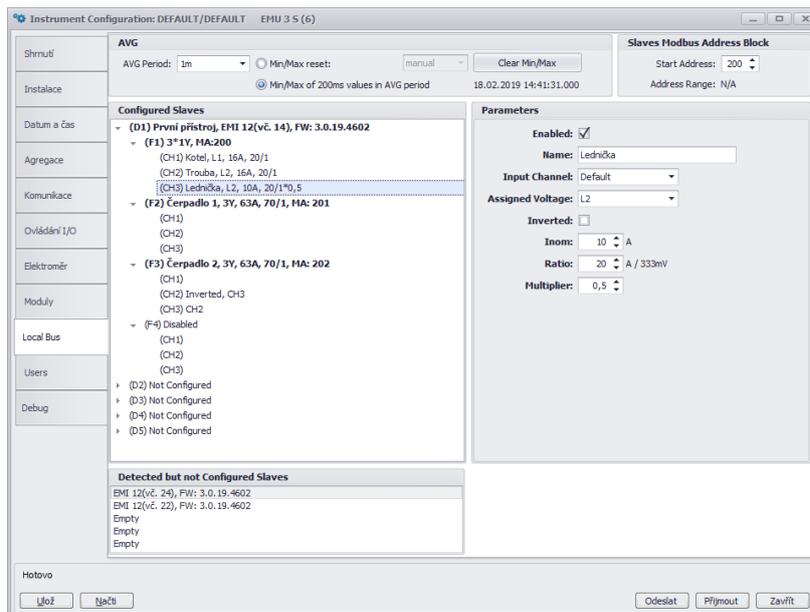


Figure 10: ENVIS.Daq — Local bus tab for EMI 12 modules configuration for branch circuit measurement.

- AVG Period — allows you to set the averaging interval, the way to evaluate minima and maxima and to manually reset them.
- Slaves Modbus Address Block
 - Start Address — sets the Modbus address at which data from the first measured terminal will be available. Additional branches are available on consecutive addresses.
- Configured Slaves — Tree structure of set modules.
 - At the highest level, there are 5 positions for up to 5 EMI 12 modules with information displayed: *Device Name, Device Type, Serial Number, Firmware Version*.
 - Under each module there are 4 positions for each three-phase branch with information displayed: *Branch Name, Connection Type, Inom, CT Ratio, Current Multiplier, Modbus Address (MA)*.
 - Under each branch there are 3 positions for each measurement channel with information displayed: *Inverted, Input Channel, Assigned Voltage, Inom, CT Ratio and Multiplier* (for 3*1Y connection).
- Detected but not Configured Slaves — List of detected modules that are not yet set for measurement.
 - Each module here reports its type, serial number and firmware version.
 - Empty — This slot is empty.
- Parameters — Used to set individual tree items. The adjustable parameters vary according to the selected item (module/branch/channel) and also depend on the selected connection type.
 - Enabled — Enables/disables the selected branch or channel. It is not possible to display measured data from deactivated branches/channels. Deactivate when the branch/channel is not used for measurement.
 - Name — Sets the module, branch or channel name. It serves mainly for easier orientation in measured data.
 - Serial Number — Used to pair the module in the tree with the detected EMI 12 module.
 - Clear — Button to remove the pairing of the selected item with the set module.
 - Connection — Selects the connection type of the selected branch. Three-phase connection types are available: star (3Y), triangle (3D) and Aron (3A). It is also possible to use the 3*1Y mode, which allows the measurement of three independent single-phase powers.
 - Inom — Nominal current of selected branch (3Y, 3D or 3A) or channel (3*1Y).
 - Ratio — The conversion ratio of current transformers on selected branch (3Y, 3D, or 3A) or channel (3*1Y).
 - Multiplier — Current multiplier of the selected branch or channel serving, for example, to correct the measured value in case of sensitivity increase by passing multiple turns through the CT. Default value is 1 and has no effect.
 - Input Channel — Allows software to correct wiring by assigning physical measurement channel CH1 through CH3 to logical channel CH1 through CH3. It is not set by default and the *Default* option is left.
 - Assigned Voltage — With a 3*1Y connection, it allows you to select the reference voltage channel L1 through L3 for the selected channel CH1 through CH3, against which powers, phase shift, etc. is calculated. The *Default* option assigns CH1-L1, CH2-L2, and CH3-L3.
 - Inverted — It allows software to correct the wrong connection of the selected channel. If the check box is checked, the polarity of the corresponding channel is inverted. The inversion is not performed by default and the field is not checked.

2.4.3 Date and time (fig. 11)

This tab contains settings related to the date and time on your device.

The *Instrument Time* panel displays the current date and time in the machine and the difference with the PC time. When you open the tab, it immediately loads the time from the device which is then updated regularly. Pressing the *Refresh* button will reload the current time from the device.

The *Set Instrument Time* panel offers elements for changing the time on your device.

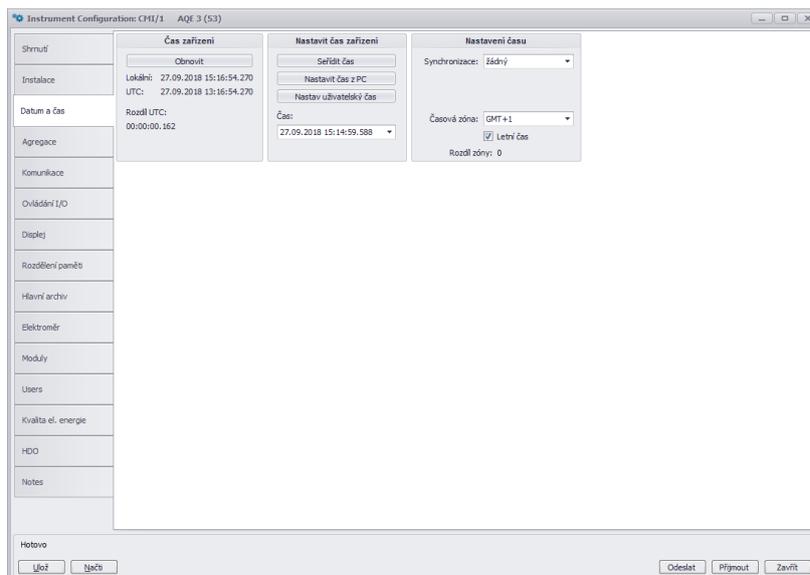


Figure 11: ENVIS.Daq — set date, time and time synchronization options in the device.

- *Set time from PC* — sets the time in the device according to the current time on the computer.
- *Set user time* — sets the time in the device to the user-specified value.

Time settings panel — sets type of synchronization and how the device interprets and displays the time and date.

- *Synchronization* — this parameter determines how the device synchronizes its time. Supported methods include:
 - *None* — the device does not synchronize the internal clock. This is the default setting.
 - *System frequency* synchronization is performed by measuring the network frequency for a period of one month and defining the time deviation therefrom, if this value differs from the current time by more than 40s, the time in the following measurement interval is adjusted.
- *Time zone* — Time zone must be set according to local requirements. The setting is important for the correct interpretation of local time, which determines the current tariff zone allocation of the meter.
- *Daylight Saving* — This parameter can be set to automatically switch local time according to the season (summer or winter time).

2.4.4 Communication (fig. 12)

The device is always equipped with a RS-485 communication interface for parameterization and data download.

- *Device Address* — Assign a unique address to each device on one serial line.

COM

- *Port speed* — baud-rate of a communication line. The default is 9600 Bd.
- *Protocol* — select default settings for KMB or M-Bus.
- *Parity* — even, odd or none.
- *Data bits + parity* — specifies the number of data bits including parity bits. For 8 bit + parity, select 9. For 8 bit without parity, select 8.
- *Stop Bits* — specifies the number of synchronization bits transmitted by the interface after each character sent.

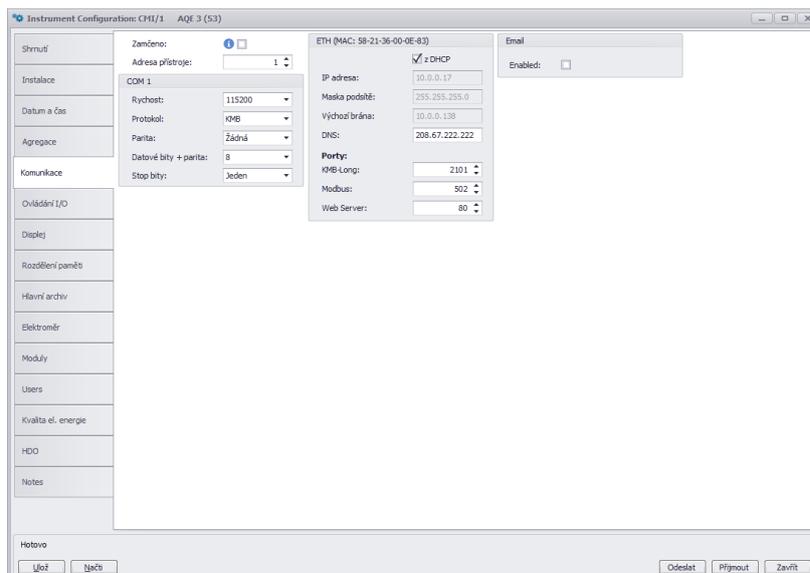


Figure 12: ENVIS.Daq — setting of communication line parameters.

2.4.5 I/O Management (fig. 13)

EMU 3 is not equipped with any physical inputs and outputs. Therefore, only the internal states of the device are available in the *I/O Management*.

- As a digital signal entering the equation, it is possible to use the status of the instrument, exceeding the set limit of the measured quantity, comparing the time or an internal variable.
- The controlled output can be a function of sending a message via RS-485, a clock counter (available via Modbus) or a variable (also available via Modbus).

Modules (fig. 14) This special device settings tab is only used to activate and deactivate optional firmware modules by entering the correct activation code in the text field and sending it to the device. The activation status of each supported module is signaled.

2.5 Setting measurement identification

This setting is done in the main window of the ENVIS.Daq application. It is used to correctly identify and categorize measurement data while processing on a computer.

- *Object* - Naming the measurement location. This is a text string value of up to 32 characters. With this identifier, records are stored in a database or file.
- *Record Name* — Record naming helps to differentiate multiple measurements in one object (e.g. using the ID of the transformer to be measured). Again, this is a text string value of up to 32 characters. With this identifier, records are stored in a database or file.

To write the *Object* and *Record Name* to the instrument, press the *Send* button in the *Identify* panel. Other parameters displayed in this tab are only informational and cannot be changed. Displayed type of connected device (model, serial number, firmware version and hardware, etc.)

2.6 Transfer of measured data to PC

Connect the device to your computer and start ENVIS.Daq (fig. 7). Select the appropriate communication parameters (as described in 2.4) and connect to the device.

EMU 3 does not allow recording of archives and it is necessary to use the ENVIS.Online application or any application reading data via Modbus to transfer data to the PC.

However, using the *Act data* button it is possible to display all measured quantities from EMU 3 and from all branches, which can be switched by selection in the upper part of the window (see fig. 16).

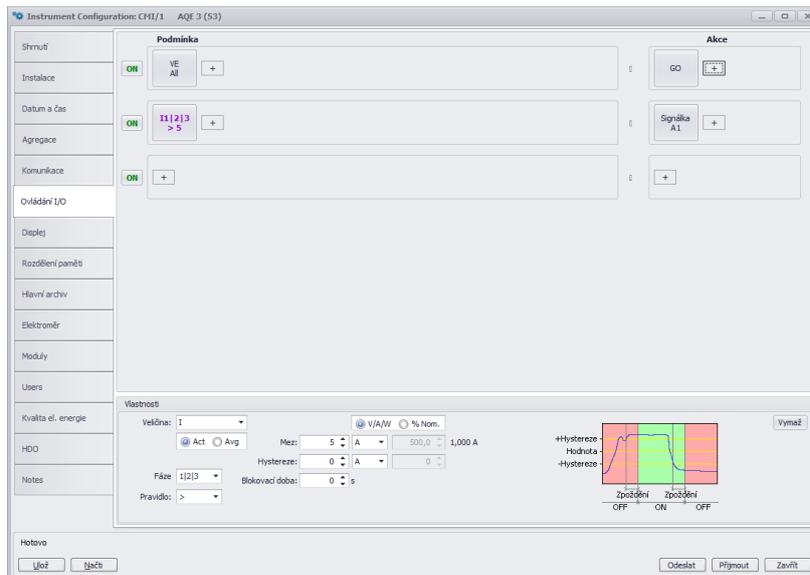


Figure 13: ENVIS.Daq - configuration of programmable inputs and outputs behavior.



Figure 14: ENVIS.Daq — Activation of special firmware modules.

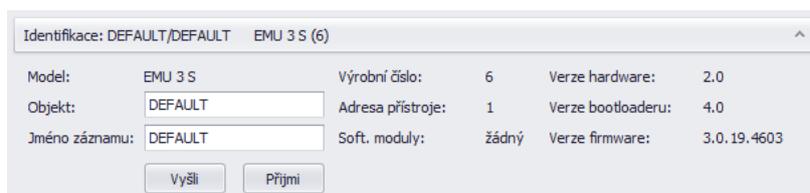


Figure 15: ENVIS.Daq — identification.

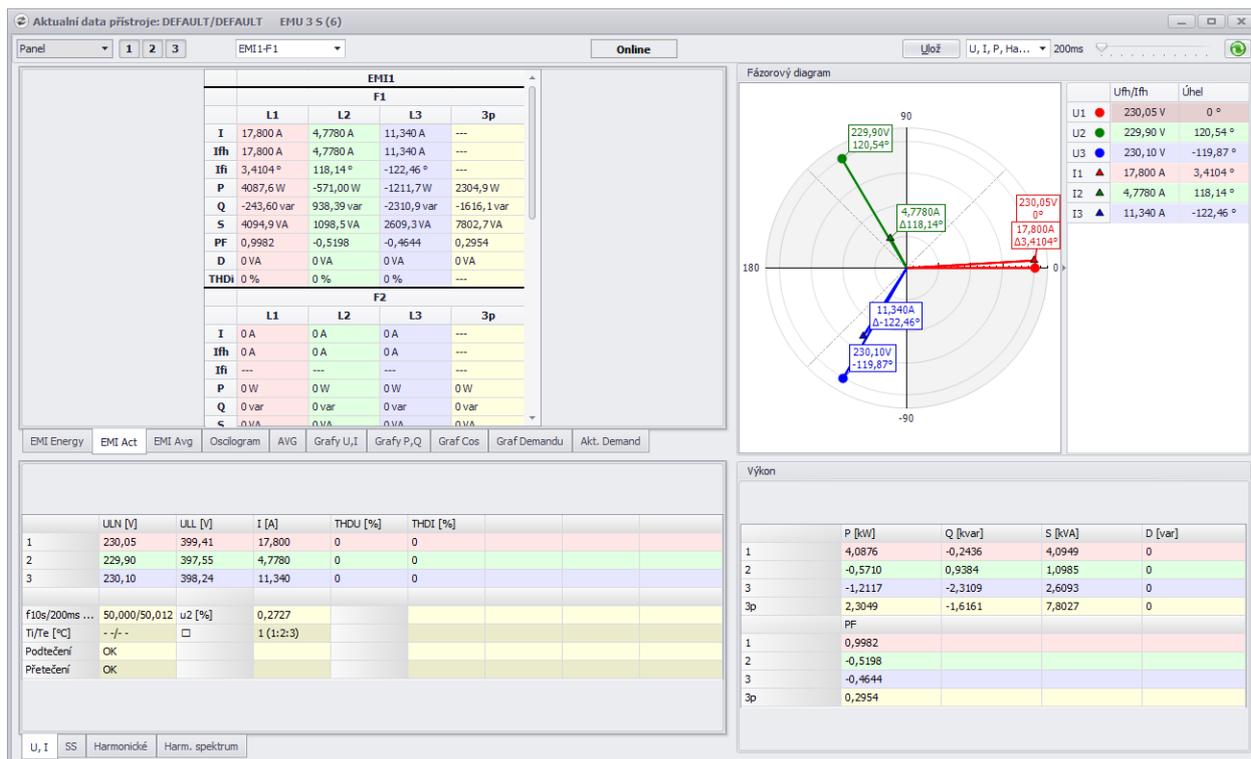


Figure 16: ENVIS.Daq — Actual data window.

2.7 Display of electricity meter reading

EMU 3 has a built-in three-phase, four-quadrant electricity meter for all branches. The instrument separately registers the active imported EP+ and exported EP- energy. For reactive energy, it registers character — capacitive EQC and inductive EQL resp. capacitive EQC+, EQC- and inductive EQL+, EQL- especially in case of active energy import or export. Primarily it offers the sum values of all phases. For star-connection and single-phase connection, it also registers the values of all energy types in each individual phase.

Values can be recorded and processed in ENVIS or via the ModBus communication protocol in any other program.

3 Technical parameters

3.1 Basic parameters

Auxiliary Voltage	
rated auxiliary voltage range	12 ÷ 26 V _{DC}
DC auxiliary voltage range	10 ÷ 29 V _{DC}
power supply	1.5 W
pollution degree	2
maximum operating altitude	2000 m
connection	galvanically isolated from internal circuits galvanically connected to local bus polarity free

Other Specifications	
operational temperature	- 25 to 60°C
storage temperature	- 40 to 80°C
operational and storage humidity	< 95% - non-condensable environment
EMC – generic standards	EN 61326-1 ed. 2 EN 61000-6-2 ed. 3
EMC – immunity	EN 61000-4-2 ed. 2: level 3 (6/8 kV) EN 61000-4-3 ed. 3: level 3 (10 V/m, 80 – 3000 MHz) EN 61000-4-4 ed. 3: level 4 (4 kV) EN 61000-4-5 ed. 3: level 4 (4/2 kV) measuring inputs EN 61000-4-5 ed. 3: level 3 (2 kV) communication EN 61000-4-6 ed. 4: level 3 (10 V, 0.15 – 80 MHz)
EMC – emissions	EN 55011 ed. 4, class A EN 61000-6-4 ed. 2 EN 61000-3-2 ed. 4 EN 61000-3-3 ed. 3
communication ports	RS-485 (2400 ÷ 921600 Bd), local bus
communication protocols	KMB, Modbus RTU
sampling frequency 50 Hz (60 Hz)	6,4 kHz (5,76 kHz)
ingress protection	
front panel	IP 40
whole instrument	IP 20
protection class	II
dimensions	
front panel	54 x 45 mm
whole instrument	54 x 94 x 61 mm
weight	max. 0.11 kg

3.2 Measured quantities (with EMI 12)

Measured Quantities – Voltage	
Frequency	
f_{NOM} – nominal frequency	50 / 60 Hz
measuring range	40 ÷ 57,5 Hz (50 Hz) / 40 ÷ 70 Hz (60 Hz)
uncertainty	± 10 mHz
Voltage	
voltage input option	standard variant („230“)
U_{NOM} (U_{DIN})– rated voltage	180 ÷ 250 V _{AC}
crest factor at U_{NOM}	2
measuring range line-to-neutral	8 ÷ 350 V _{AC}
measuring range line-to-line	14 ÷ 610 V _{AC}
intrinsic uncertainty ($t_A=23\pm 2^\circ\text{C}$)	+/- 0.05% of rdg ± +/- 0.02% of rng
temperature drift	+/- 0.03 % of rdg ± +/- 0.01 % of rng / 10 °C
measurement category	300V CAT III
permanent overload	1355 V _{AC} (UL–N)
peak overload, 1 second	2140 V _{AC} (UL–N)
burden power (impedance)	< 0.05 VA ($R_i = 6.12 \text{ M}\Omega$)
Voltage Unbalance	
measuring range	0 ÷ 10%
measuring uncertainty	± 0.3
THDU	
measuring range	0 ÷ 20%
measuring uncertainty	± 0.5
Harmonics up to 25th 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

Mains Signalling Voltage (with optional firmware module „RCS“ only)	
measuring range	TBD
frequency range	TBD
measuring uncertainty	TBD

Measured Quantities – Power, Power Factor, Energy	
Active / Reactive Power, Power Factor (PF), cos φ (P_{NOM} = U_{NOM} x I_{NOM})	
reference conditions "A": ambient temperature (t _A) U, I for active power, PF, cos φ for reactive power	23 ± 2 °C U = 80 ÷ 120% U _{NOM} , I = 1 ÷ 120% I _{NOM} PF = 1.00 PF = 0.00
act. / react. power uncertainty	± 0.5% of rdg ± 0.01% P _{NOM}
PF & cos φ uncertainty	± 0.01
reference conditions "B": ambient temperature (t _A) U, I for active power, PF, cos φ for reactive power	23 ± 2 °C U = 80 ÷ 120% U _{NOM} , I = 2 ÷ 120% I _{NOM} PF ≥ 0.5 PF ≤ 0.87
act. / react. power uncertainty	± 1% of rdg ± 0.01% P _{NOM}
PF & cos φ uncertainty	± 0.01
temperature drift of powers	± 0.05% of rdg ± 0.02% P _{NOM} / 10 °C
Energy	
measuring range	corresponds to U & I measuring ranges 4 quadrant energy counters for both active and reactive energies
active energy uncertainty	class 1 acc. to EN 62053 – 21
reactive energy uncertainty	class 2 acc. to EN 62053 – 23

Table 3: IEC 61557-12: Equipment for measuring and monitoring electrical parameters

Instrument characteristics according to IEC 61557-12	
power quality assessment function	
classification according to par. 4.3	
direct voltage connection	SD
voltage connection via VT	SS
temperature according to par. 4.5.2.2	K55
humidity + altitude according to par. 4.5.2.3	< 95% - noncondensation conditions < 2000 m
active power/energy function performance class	1

Function characteristics according to IEC 61557-12				
Model „X/333mV“ with „xxx/333mV“ CTs, I _{NOM} = xxx A, U _{NOM} = 230 V				
Symbol	Function	Class	Measuring range	Notes
P	total effective power	1	0 ÷ (993.6 * I _{NOM}) W	
Q_A, Q_V	total reactive power	2	0 ÷ (993.6 * I _{NOM}) var	
S_A, S_V	total apparent power	1	0 ÷ (993.6 * I _{NOM}) VA	
E_a	total active energy	1	0 ÷ (993.6 * I _{NOM}) Wh	
E_{rA}, E_{rV}	total reactive energy	2	0 ÷ (993.6 * I _{NOM}) varh	
E_{apA}, E_{apV}	total apparent energy	1	0 ÷ (993.6 * I _{NOM}) Vah	
f	frequency	0.02	40 ÷ 70 Hz	
I	phase current	0.5	0.1 ÷ 1.2 * I _{NOM} AAC	
I_N	neutral current measured	–	–	
I_{Nc}	neutral current calculated	0.5	0.1 ÷ 1.2 * I _{NOM} AAC	
U_{LN}	line-to-neutral voltage	0.05	40 ÷ 280 VAC	
U_{LL}	line-to-line voltage	0.05	70 ÷ 480 VAC	
P_{FA}, P_{FV}	power factor	0.5	0 ÷ 1	
P_{st}, P_{It}	flicker	–	–	
U_{dip}	voltage dips	–	–	
U_{swl}	voltage swells	–	–	
U_{tr}	transients overvoltage	–	–	
U_{int}	voltage interruption	–	–	
U_{nba}	voltage unbalance (amp.)	0.5	0 ÷ 10%	
U_{nb}	voltage unbalance (ph. & amp.)	0.5	0 ÷ 10%	
U_h	voltage harmonics	1	up to 25 th order	1)
THD_u	voltage total harmonic distortion (rel. to fund.)	1	0 ÷ 20%	1)
THD-R_u	voltage total harmonic distortion (rel. to RMS)	1	0 ÷ 20%	1)
I_h	current harmonics	–	–	1)
THD_i	current total harmonic distortion (rel. to fund.)	5	0 ÷ 200%	1)
THD-R_i	voltage total harmonic distortion (rel. to RMS)	5	0 ÷ 200%	1)
M_{sv}	mains signalling voltage	TBD	TBD	1, 2)

1) ... according to IEC 61000-4-7

2) ... with optional firmware module „RCS“

4 Maintenance, service and warranty

Maintenance The instrument EMU 3 does not require any special maintenance. For reliable operation, it is only necessary to adhere to the specified operating conditions and not to expose it to rough handling and exposure to water or various chemicals that could cause damage.

The lithium battery installed in the instrument is capable of backing up memory and RTC for approximately 5 years without a power supply at an average temperature of 20°C and a typical load current in the instrument ($< 10 \mu A$). If the battery is discharged, it is necessary to send the instrument to the manufacturer for battery replacement.

Service In case of product failure, a warranty must be claimed with the manufacturer at:

K M B systems, s.r.o.
Dr. Milady Horakove 559
Liberec VII-Horni Ruzodol
460 07 Liberec
Czech republic
Tel.: +420 485 130 314
E-mail: kmb@kmb.cz
Web: www.kmbsystems.com

The product must be properly packed to avoid shipping damage. A description of the fault must be provided with the product.

If warranty repair is claimed, the warranty card must also be sent. If an out-of-warranty repair is required, an order for this repair must be attached.

Warranty card: The device is warranted for a period of 24 months from the date of purchase, but no longer than 30 months from the manufacturer's delivery date. Defects that arise within these time limits demonstrably due to defective design, faulty construction or unsuitable material will be repaired free of charge by the manufacturer or authorized service organization.

The warranty also expires during the warranty period if the user performs unauthorized modifications or changes on the device, if the device connects to incorrectly selected values, if the device has been violated by unauthorized falls or improper handling, or if it has been operated in contrary to the specified technical parameters.

Product type:	.....	Serial number:	.....
Delivery date:	.....	Checkout control:	.....
		Manufacturer's stamp:	.....
Date of sale:	.....	Seller's stamp:	.....