EMK-01

Class A
Quality Analyzer

www.entes.eu

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1. Introduction

EMK-01 Class A quality analyzer is designed for measurement of network quality in LV and MV according to the norm EN 50160.
Technology of measurement is performed according to the norm “IEC 61000-4-30: Electromagnetic compatibility (EMC) – Part 4-30: Testing and measurement methods – Power quality measurement method “, measurement class “Class A”.
EMK-01 Class A quality analyzer is designed for measurement and monitoring of electrical parameters in 2, 3 and 4 conductor networks and in TN and TT grids.

2. Safety Instructions

The device comply the standard EN 61010-1: Safety requirements for electrical equipment for measurement, control and laboratory use.

- Installation of the device can be done by qualified and authorized person only.
- Device should not be installed in the environment with increased humidity and close to explosive gases.
- Use the device in accordance instructions written in the user manual.
- Before the disconnecting of CT measuring circuit assure that terminals of CT are short circuited.
- Installation and connection changes can be done without supply voltage only.
- Do not apply supply, measuring voltage and current higher than allowed.

3. Box Content

- EMK-01 Class A quality analyzer
- Mounting holder with screws – 2 pieces
- Temperature sensor
- User manual
- Test report

4. Device Description

4.1. Front Panel

Picture 1. Front panel label

Exit key for canceling or return

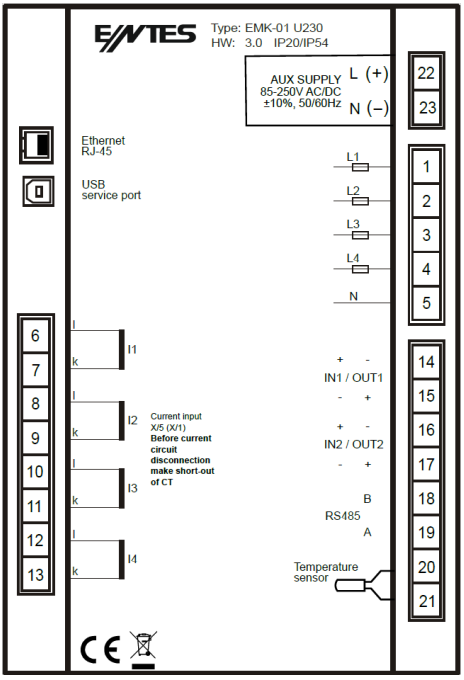
Cursor key for moving up in the menu and increasing parameter value

Cursor key for moving down in the menu and decreasing parameter value

OK key for entering the menu and parameters

Fn (zoom) key for changing function of other buttons

4.2. Rear Panel



5. Measured Parameters

EMK-01 Class A quality analyzer is designed for measurement and monitoring of electrical parameters in 2, 3 and 4 conductor networks in TN and TT grids. EMK-01 quality analyzer architecture is based on fast 32 bits RISC microprocessor which provides high computing power to assure the device being fully according to the norm IEC 61000-4-30 Class A

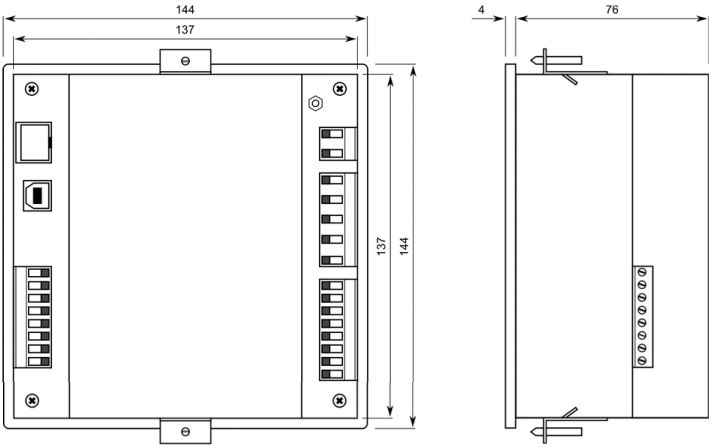
Parameter	L1	L2	L3	L4	L1-2	L2-3	L3-1	ΣL1-3	ΣL1-4	Max	Min	AVG	Measuring range	Displaying range	Accuracy
Phase voltage (Phase – neutral)	•	•	•	•						•	•	•	2 ... 600 V	0 ... 1 MV	± 0,1 %
Line voltage (Phase – phase)					•	•	•			•	•	•	4 ... 1000 V	0 ... 1 MV	± 0,1 %
Frequency	•									•	•	•	40 ... 70 Hz	40 ... 70 Hz	± 10 mHz
Current	•	•	•	•				•	•	•	•	•	0,001 ... 6 A	0 ... 1 MA	± 0,1 %
cosφ	•	•	•	•						•	•	•	0.01 L..... 0.01 C	0.01 L..... 0.01 C	± 1 %
Power factor	•	•	•	•						•	•	•	0.01 L..... 0.01 C	0.01 L..... 0.01 C	± 1 %
THD-U LN	•	•	•	•						•	•	•	0 ... %99,9	0 ... %99,9	± 1 %
THD-U LL					•	•	•			•	•	•	0 ... %99,9	0 ... %99,9	± 1 %
THD-I	•	•	•	•						•	•	•	0 ... %99,9	0 ... %99,9	± 1 %
Voltage harmonics	•	•	•	•						•	•	•	0 ... %99,9	0 ... %99,9	Class 1
Group of inter harmonics U	•	•	•	•									0 ... %99,9	0 ... %99,9	Class 1
Group of harmonics U	•	•	•	•									0 ... %99,9	0 ... %99,9	Class 1
Active power harmonics	•	•	•	•									0 ... %99,9	0 ... %99,9	Class 1
Reactive power harmonics	•	•	•	•									0 ... %99,9	0 ... %99,9	Class 1
Current harmonics	•	•	•	•						•	•	•	0 ... %99,9	0 ... %99,9	Class 1
Group of inter harmonics I	•	•	•	•									0 ... %99,9	0 ... %99,9	Class 1
Group of harmonics I	•	•	•	•									0 ... %99,9	0 ... %99,9	Class 1
Short-term flicker	•	•	•	•						•	•	•	0. 20.0 Pst	0. 20.0 Pst	Class A
Long-term flicker	•	•	•	•						•	•	•	0. 20.0 Plt	0. 20.0 Plt	Class A
Under voltage	•	•	•	•	•	•	•			•	•	•	0 ... %100	0 ... %100	± 0,2 %
Over voltage	•	•	•	•	•	•	•			•	•	•	0 ... %100	0 ... %100	± 0,2 %
Unbalanced U										•	•	•	0 ... %100	0 ... %100	± 0,15 %
Neutral point displacement										•	•	•	10 ... 600 V	0 ... 1 MV	± 0,2 %
K factor	•	•	•	•											
Unbalanced I										•	•	•			± 0,5 %
Transient	•	•	•	•											25 µs
Events	•	•	•	•											10 ms
Ripple control signal	•	•	•	•	•	•	•			•	•	•			
Active power	•	•	•	•				•	•	•	•	•	0... 10,8 kW	0 ... 999 GW	± 0,4 %
Reactive power	•	•	•	•				•	•	•	•	•	0... 10,8 kvar	0 ... 999 Gvar	± 0,4 %
Apparent power	•	•	•	•				•	•	•	•	•	0... 10,8 kVA	0 ... 999 GVA	± 0,2 %
Distortion power	•	•	•	•				•	•	•	•	•			± 0,5 %
Active energy +/-	•	•	•					•					0 ... 999 GWh	0 ... 999 GWh	Class 0.2
Inductive reactive energy +/-	•	•	•					•					0 ... 999 Gvarh	0 ... 999 Gvarh	Class 0.2*
Capacitive reactive energy +/-	•	•	•					•					0 ... 999 Gvarh	0 ... 999 Gvarh	Class 0.2*
Temperature										•	•	•			± 1 °C

* fundamental

Table 1. Measured and displayed parameters

6. Installation

EMK-01 is prepared for wall mounting in the fixed switch boards. In order to assure well ventilation, EMK-01 has to be installed vertically. There has to be empty space at least 60 mm at the top and bottom, and 20 mm at the sides..

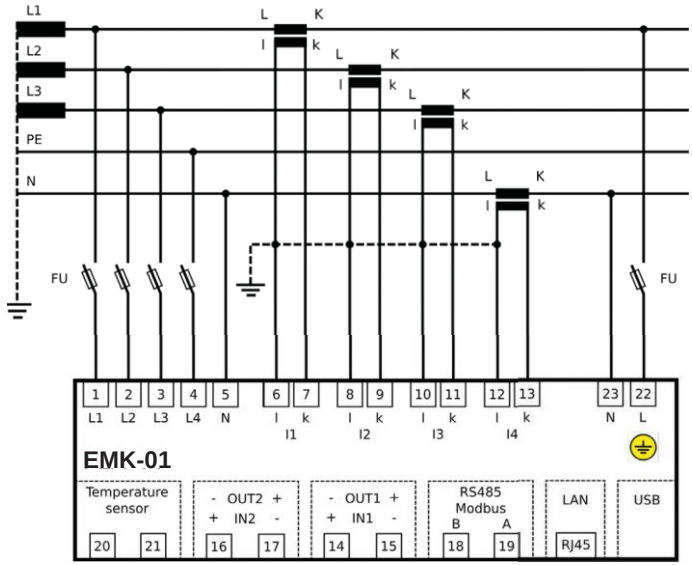


Picture 3. Dimensions

EMK-01 is fixed into switchboard wall by two clips that are placed on the device at the bottom and top.

7. Connection

The level and type of used power supply voltage has to be the same as it is written on the terminal plate label. The power supply voltage of the device is (24-60V)/(85-250V)AC/DC 50/60Hz (±10%). Voltage measurement circuit as well as power supply input have to be connected via circuit breaker or power switch, and fuse (2 ... 10 A) which are placed close to the device for easy access. Current measurement circuits have to be connected via current transformers, either ../5A or ../1A ratio.



Picture 4. Device connection at TN-C network

7.1. Grounding Conductor

The grounding conductor has to be connected as a first terminal. Grounding terminal is realized by threaded pole with 3 mm diameter and it is marked by symbol ⏚ .

7.2. Supply Voltage

Supply voltage is required to operate EMK-01. The type and level of necessary supply voltage is written on the rear label. Before applying the supply voltage, make sure that the voltage level and system frequency match the details on the label. The connection cables for the supply voltage must be connected using a fuse. It is recommend to use a fuse (6A characteristic C).

7.3. Voltage Measuring Inputs

Device has four measuring input with input impedance 4 MΩ suitable for measurement according to category CATIII 600 V.

Each voltage measurement input have to be connected via circuit breaker or power switch, and fuse (10A characteristic C) which are placed close to the device.

Important

Supply voltage has to be from the same grid as measuring voltages.

Notice

EMK-01is not designed for measuring DC voltage!
EMK-01 is not designed for usage in SELV grids!

Notice

If the voltage measuring inputs are connected over the voltage measuring transformers the power of measuring transformer power must be at appropriate level. Voltage measuring inputs have 5 mW self-consumption. Recommendation from measuring transformer producers is to have loaded voltage measuring transformer on 70% of maximum power for the best accuracy.

7.4. Current Measuring Inputs

Device has four current measuring inputs for indirect measurement via current measuring transformer, either ../5A or ../1A ratio. CT ratio is freely adjustable from a device or via PC software.

Important

Current inputs maximum permanent capability is 8.5A.

Important

Before opening the current circuit be sure that measuring terminals of current transformer are connected together.

Notice

EMK-01 is not designed for DC current measurement !

7.5. RS485

EMK-01 has built-in one RS485 interface supporting Modbus RTU protocol. Connection of RS485 bus to the device is on separate terminals by two wires A and B. Shielding is not required

Notice

EMK-01 does not have built in termination resistor. If the device is at the end of RS485 bus, it should be terminated by 120 Ω resistor.
RS485 interface is fully galvanic insulated.

7.6. Ethernet

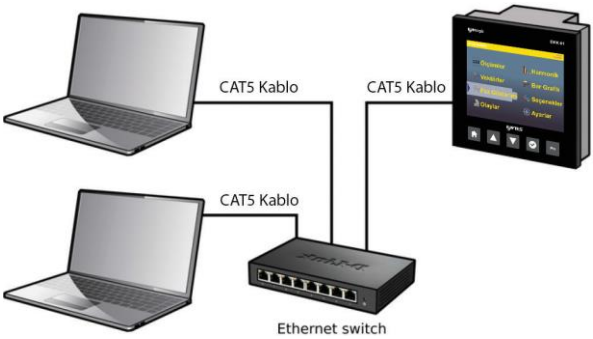
The device is equipped by Ethernet interface 10/100Mbit/s with RJ45 connector. It should be used the cable CAT5 type for connection. The configuration of Ethernet is defined by the network administrator and has to be set on EMK-01 correspondingly (See Chapter 8.3.1).

Important

If the network configuration is not known, the Ethernet cable should not be plugged into the device.

7.6.1. Connection of EMK-01 to LAN

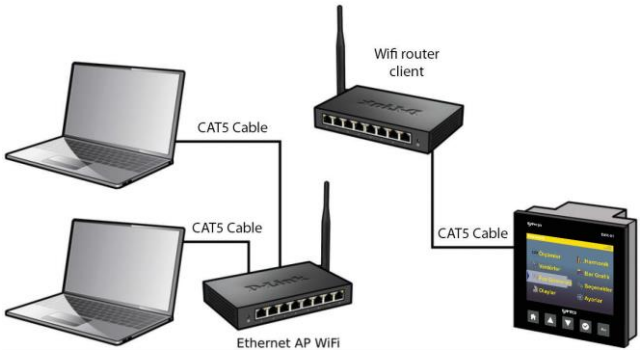
Make a connection to the active network item (switch, hub and router) via UTP cable.



Notice

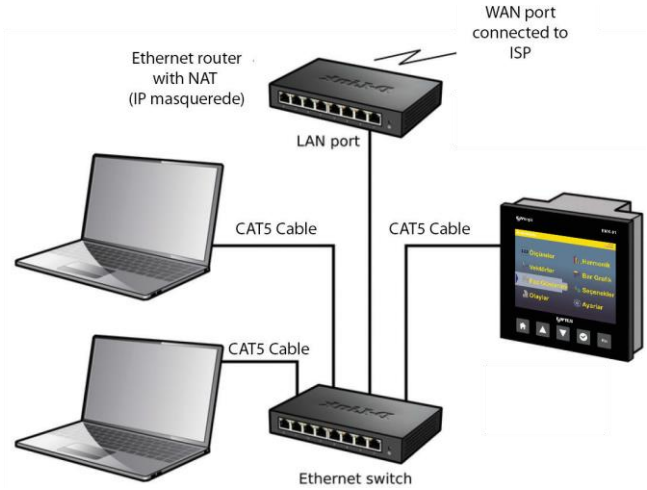
EMK-01 does not support DHCP. The device's IP address has to be configured manually at the device side.

7.6.2. Connection of EMK-01 to Wi-Fi



7.6.3. Connection of EMK-01 to LAN with NAT server

If there is request for remote access (from Internet) to EMK-01 which is placed in the local network behind the router with active NAT server, the following parameters configuration to be defined on the router.



For access to web server of EMK-01, there has to be created port forwarding (virtual server):

- router public IP address: port 80 --> IP address of EMK-01: port 80

For access to FTP server of EMK-01 (needed for software), there has to be created port forwarding (virtual server):

- router public IP address: port 21 --> IP of EMK-01: port 21
- router public IP address: port 50000...50005 --> IP of EMK-01: port 50000...50005

Notice

Number of port of 80, 21 is possible change on router. Range of ports 50000 … 50005 is fixed and it is not possible to change it.

On EMK-01 device, it is necessary to set following parameters in:

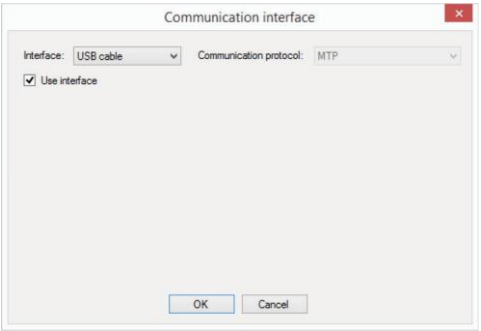
- IP - public
- FTP: 21 (factory value)
- user name: admin (factory value)
- password: 1234 (factory value)

Notice

For communication with FTP server of EMK-01 within local network is the IP-public parameter set on the same as IP of the device.
For communication with FTP server of EMK-01from the Internet is the IP-public parameter set on public IP obtained from Internet provider.

7.7.USB

The device has one USB interface of type B for direct connection of EMK-01 to the PC. After connection of EMK-01 via USB cable to the PC, it is necessary to select correct communication interface at software.

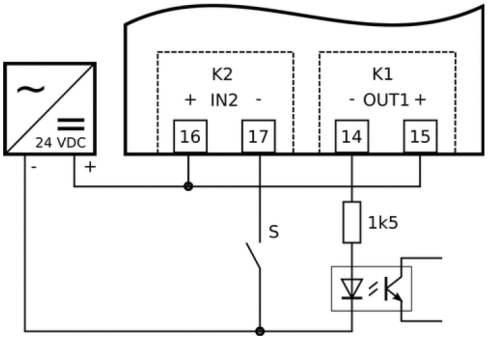


7.8. Temperature Sensor

Temperature sensor is connected directly to EMK-01 inputs 20 and 21 according to the picture 2. The sensor is NTC type with resistance 10 kΩ / 25°C.

7.9. Digital Inputs / Outputs

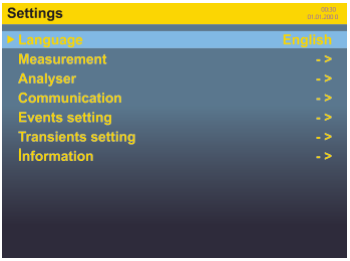
The device is equipped by two optically – isolated transistor inputs / outputs. The outputs working mode is fully adjustable as an alarm output, remotely controlled output or pulse output.



Picture 5. Connection of inputs / outputs

8. Device Settings

EMK-01 device can be configured from panel screen for most of essential parameters. All settings available at the device screen and several others are available also in software. In this chapter the settings of the device will be completed by appropriate settings via software.



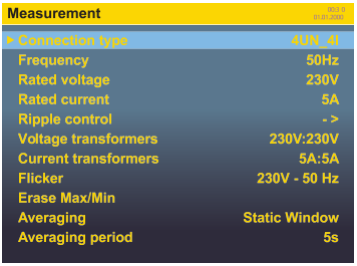
At main screen, move to parameter Settings to access device various configuration sub-menu. Some of the device parameters and functions can be enabled and configured only by PC and software.

8.1. Language

Default language of EMK-01 is English. Select the appropriate language from the list and confirm it. Device menu will turn immediately to the selected language.

8.2. Measurement – Main Parameters

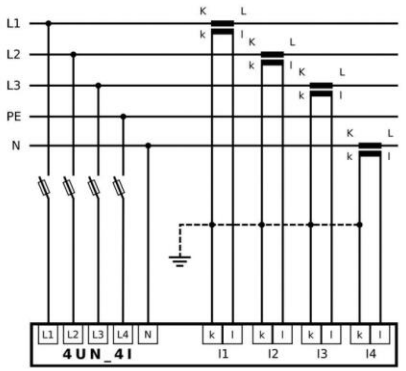
All settings related to measuring circuits connection type, measuring transformers and type of parameter calculation are adjusted in Measurement setting.



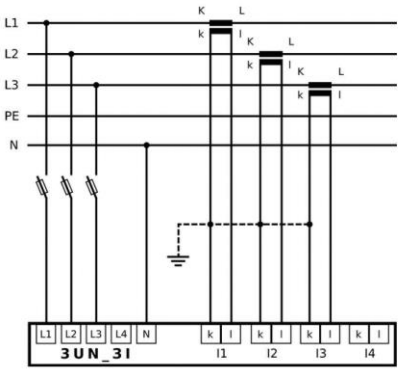
Parameter	Description	Factory setting	Setting range
Connection type	Defines the type of network and measuring circuit connection	4UN_4I	Chapter 8.2.1
Frequency	Defines the nominal system frequency	50 Hz	45 ... 75 Hz
Rated voltage	Network nominal phase voltage	230 V	1 V ... 750 kV
Rated current	Network nominal phase current	5 A	1 A ... 750 kA
Ripple control	Adjustable by software	50 Hz	50 Hz ... 3 kHz
Voltage Tr.	Primary and secondary voltage of measuring voltage transformer	230 V / 230 V	1 ... 750 kV
Current Tr.	Primary and secondary current of measuring current transformer	5 A / 5 A	1 ... 750 kA
Flicker	Settings of the nominal voltage and frequency for flicker calculation	230 V – 50 Hz	120/230 V, 50/60 Hz
Erase Max/Min	Deletes all saved maximum and minimum of measured parameters	No	Yes / No
Averaging	Type of averaging period	Static	Static / Sliding
Averaging period	Time for averaging period setting	5 s	1 ... 3600 s

8.2.1. Connection Type

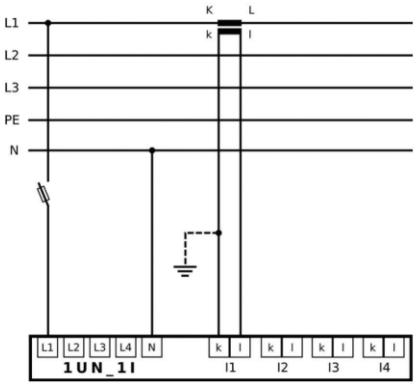
EMK-01 is designed for various connections according to the grid type and measurement needs. Connection setting defines the types of network system in which EMK-01 is connected. The main connection diagram of EMK-01 is shown in chapter 7.3. In the following tables are shown all possible connection variants that can be defined in the device menu..



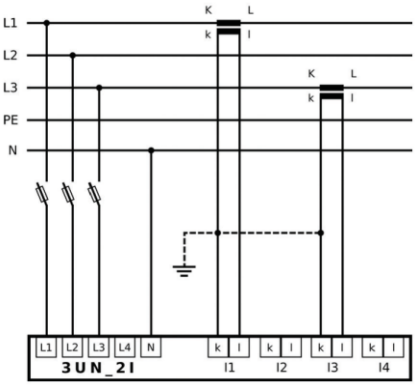
Connection for asymmetric loads in TN-C-S grids



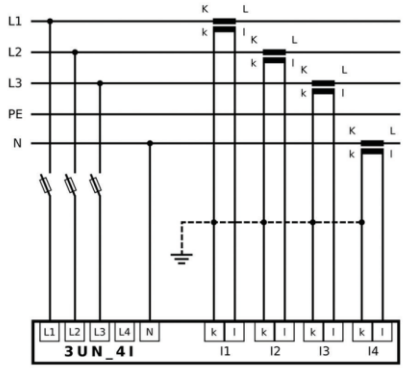
Connection for asymmetric loads in TN-C or TN-C-S grids



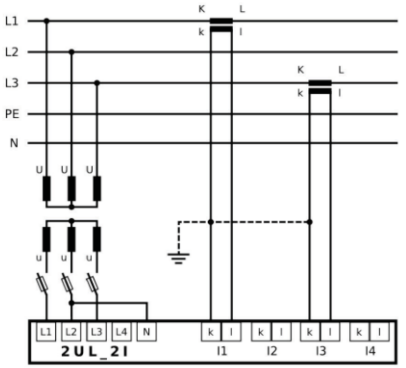
Connection for single-phase loads



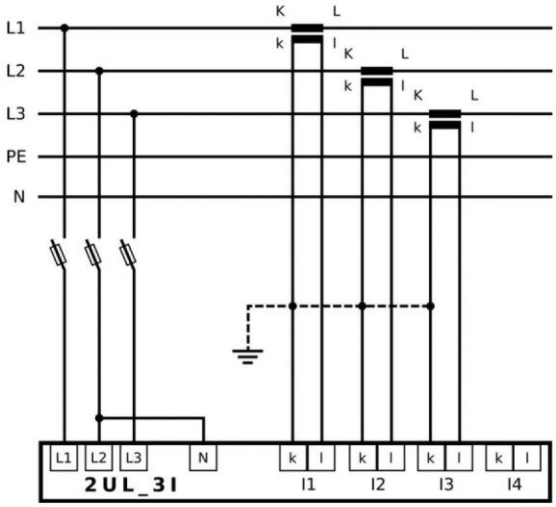
Connection for symmetric loads with two CTs only



Connection for asymmetric loads in TN-C-S grids



Connection for MV grid (Aron connection)



Connection for IT networks

8.2.2. Nominal Voltage

Nominal voltage setting is fundamental setting used for thresholds calculation for voltage events and transients. Appropriate value of phase nominal voltage has to be set.

8.2.3. Nominal Current

Nominal current setting is fundamental value setting used for threshold calculation for current events.

8.2.4. Flicker

Device calculates flicker according to the norm EN 61000-4-15. It provides values for short-term flicker (10 minutes), long-term flicker (2 hours). For correct calculation of both flickers, it is necessary to set correct nominal values used in the country standards. Available settings are:

- 230 V – 50 Hz
- 230 V – 60 Hz
- 120 V – 50 Hz
- 120 V – 60 Hz

8.2.5. Ripple Control

Ripple control offers feature that provides information about effective voltage value for particular harmonic frequency of measured signal. The frequency of ripple control is adjustable from 50 Hz till 3000 Hz with decimal setting option.

8.2.6. Voltage Transformers

If the voltage transformers are used, the settings of primary and secondary voltage have to be configured. Both voltage levels (primary and secondary) are set in Volts.

8.2.7. Current Transformers

EMK-01 device has 4 current inputs for indirect measurement via current transformers with secondary current 5A or 1A. In case of current transformer usage, the primary and secondary current value of CT has to be set.

8.2.8. Averaging

This setting defines type of averaging and period of average value calculation. Average values are available on the display of the device and in software.
There are two types of averaging method:

- **Static window** method cumulates measured values over the defined period. After the period ends, the average value are calculates and shown. Cumulated values are erased and new period is measured again.
- **Sliding window** method continually cumulates measured values over the defined period and over this period shows calculates average values. While the time is moving, the oldest values are erased and new values are added.

8.2.9. Energy

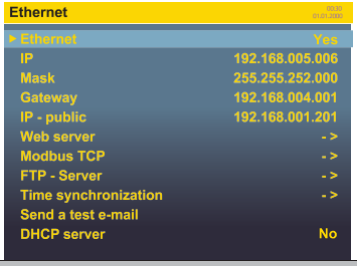
It provides setting of recording interval for historical values for energy counters available in EMK-01.

8.3. Communication Settings

The device is equipped by one Ethernet interface 10/100Mbit/s and RS485. All communication settings are adjusted from Communication section in the software.

8.3.1. Ethernet

It defines the configuration of Ethernet interface of device for visibility and accessibility on LAN and Internet.



Parameter	Description	Factory setting	Setting range
Ethernet	Enable or disable Ethernet interface	Yes	Yes / No
IP	EMK-01 IP address in the local network	192.168.001.201	
Subnet mask	Mask of Ethernet network	255.255.255.0	
Gateway	IP address of PC or router as a gateway to parent network	192.168.001.001	
IP – public	Public IP address of router	192.168.001.001	
Web server	Web server settings advance menu	►	
Modbus TCP	Modbus TCP settings advance menu	►	
FTP server	FTP server settings advance menu	►	
Time synchronization	Time synchronization settings advance menu	►	
Send a test e-mail	Send a test e-mail		
DHCP server	Enable or disable DHCP server	No	Yes / No

Important
Public IP is necessary to set for these cases where the device is accessed from different network, for example Internet, while it is located in Ethernet behind the NAT server.

8.3.2. Web Server

Device has built-in web server for remote online monitoring via Internet or local network. Following the table describes settings related to web server configuration of EMK-01.

Parameter	Description	Factory setting	Setting range
Web server	Enable or disable web server	Yes	Yes / No
Web port	Port on which the web server is accessible	80	0 ... 3850
Web name	User name for access to EMK-01 device web server	admin	
Web password	Password for access to EMK-01 device web server	1234	

Notice

Web server is optimized for portable instruments such as mobile phones and tablets.

8.3.3. Modbus TCP

Communication protocol Modbus TCP is used for communication with EMK-01 over the Ethernet interface.

Parameter	Description	Factory setting	Setting range
Modbus TCP	Enable or disable Modbus TCP feature	Yes	Yes / No
Modbus TCP - port	Port on which the Modbus TCP is accessible	502	1 ... 65535

8.3.4. FTP Server

FTP server is a fundamental communication protocol for reading the measured data, recorded data and configuration of the device. Enable FTP server is essential setting needed for correct work of EMK-01 with software.

Parameter	Description	Factory setting	Setting range
FTP server	Enable or disable FTP server	Yes	Yes / No
FTP port	Port of FTP service	21	1 ... 65535
FTP name	User name for access to EMK-01 device FTP server	admin	
FTP password	Password for access to EMK-01 device FTP server	1234	

8.3.5. TCP Converter

EMK-01 is equipped by function of Modbus TCP converter so it can provide access to devices connected on RS485 bus of EMK-01.

Parameter	Description	Factory setting	Setting range
TCP converter	Activates Modbus TCP converter of EMK-01	Yes	Yes / No
Converter timeout	Converter timeout	500 ms	100 ... 5000 ms

8.3.6. RS485

Serial port RS485 configuration is essential for the usage of EMK-01 as a TCP/IP converter.

Parameter	Description	Factory setting	Setting range
ID	Unique identification number in RS485 network	0	0 ... 255
Transfer rate	Communication speed of RS485 interface is adjustable in speed	9.6 kBd	9.6 kBd / 19.2 kBd/ 38.4 kBd/ 57.6 kBd 115 kBd
Parity	RS485 interface parity	odd	odd / even / none
Stop Bit	RS485 interface stop bit	1	1 / 2

8.4. Analyser

Settings related to the device itself such as display parameters, colours, time, password protection and reset of all settings.

Parameter	Description	Factory setting	Setting range
Display refresh	Speed of display refreshing. The optimal setting is 5 cycles.	5 cycle	1-5 cycle
Brightness	Brightness of display for operation while buttons are touched	90%	0 … 100%
Standby brightness	Defines level of brightness when the device is not pressed at any button	45%	0 … 60%
Standby time	Time delay after that device turns to standby level of display brightness	10 s	5 - 60
Password	Four digit password for access to device settings menu	0000	0 -9999
Date and time	Device internal clock configuration sub-menu	►	
Colours	Colours template of particular voltages and currents of phases for graphs	►	
Reset	Reset device to the factory settings		

8.5. NTP Server / Time Zone

The following date and time settings are adjusted from Date-Time sub-menu in Analyse menu.

Parameter	Description	Factory setting
Device time	Date and UTC time in format for date YYYY.MM.DD and HH:MM for time.	
UTC time offset	Time offset of the local time against to UTC. Offset is set in seconds.	3600 s
Daylight start	Beginning of the summer time season (Date and time format)	
Daylight stop	End of the summer time season (Date and time format)	
Daylight offset	Time shift for summer time season	3600 s

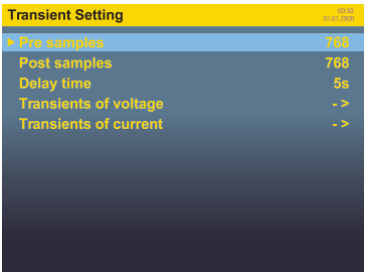
EMK-01 corrects internal clock according to NTP servers while it is connected to Internet. NTP time synchronization has always priority above manual clock settings. Clock synchronization by NTP is fully automatic and there is no need to set anything.
The selection of closest NTP server is adjustable in software. For the finding the closest NTP server refer to the following link http://support.ntp.org/bin/view/Servers/StratumOneTimeServers

8.6. E-mail

EMK-01 can notice several events and alarms by sending an e-mail up to 4 different e-mail addresses. The e-mail notification setting is available only from software.
In the software, obtain the SMTP server address from your provider for correct setting. If the SMTP server requires authentication enter the user name and password.
Select the requested e-mail notification and sending interval. Sending interval defines how often the e-mail is sent. Factory setting is 1 hour which means that all events and alarms that appear during the hour are sent in one e-mail. This interval prevents the device to send too many e-mails. For most recent 5 events and transients, the graphs are sent in the e-mail too. Other events and transients are shown as a recording in table.

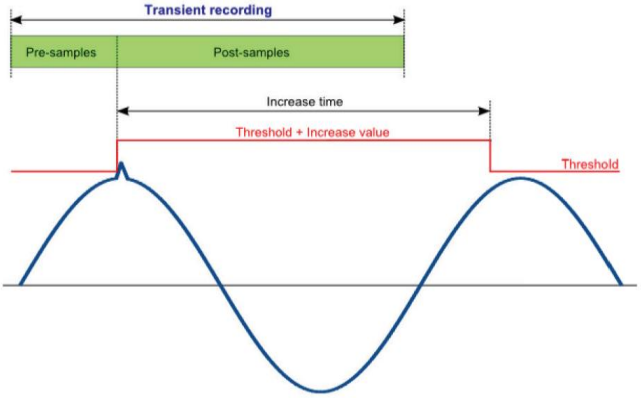
8.7. Transient

Voltage transients are short commutation, impulse or oscillatory events in electrical grid. Their source can be inductive load switching, power factor controller, atmospheric events, protection devices or malfunction of switching elements in the grid.



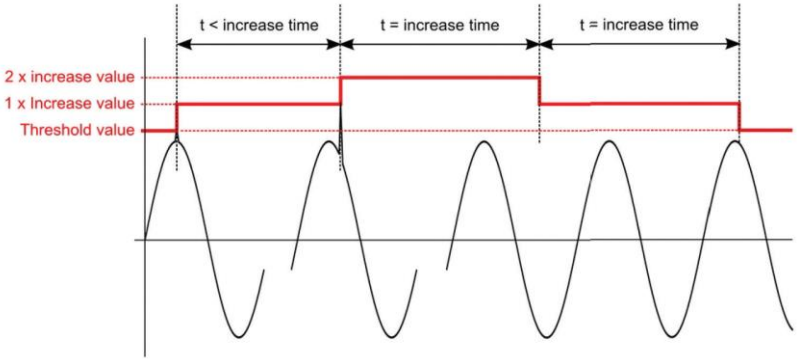
EMK-01 quality analyzer detects two types of transients: absolute transient and differential transient.

- **Absolute transients** are detected according to override of defined voltage level. The trigger for detection of the absolute transients is defined by absolute threshold (percentage of Udin).
- **Differential transients** are detected according to the difference between two consecutive voltage measurement. The difference between measurements is defined by differential threshold (percentage of Udin**)**.



Common settings for absolute and differential transients are for the parameters used for tuning the transients' detection and transient recording.

If the transient is detected and being recorded, the device increases the absolute and differential thresholds to prevent of misled transient detection. It prevents the device against wrong recordings. This is defined by two user adjustable parameters: increase value and increase time.

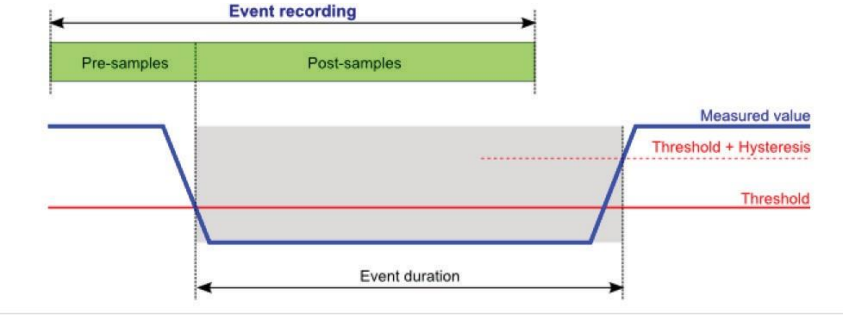


Increase value is the value that is used for increasing the absolute and differential threshold while transient is detected. Set value increases the threshold level for the defined time.
Increase time is a time delay for which the increased value of threshold is valid. After the increase time expires, the value of threshold is returned back the user set value.
If another transient appears while the increase time is still not expired, the threshold is increased again. After the increased time expires, the threshold is recovered to the previous level. After another period of increase time, it is threshold recovered to the user defined level of absolute and differential thresholds.

Parameter	Description	Factory setting	Setting range
Absolute transient	Absolute transient activation	No	Yes / No
Absolute threshold	Threshold absolute transient setting	110%	100...500%
Differential (Difference) transient	Differential (Difference) transient activation	No	Yes / No
Differential (Difference) threshold	Threshold differential (difference) transient setting	20%	1 ... 100%
Increase time	Time delay before next transient recording after transient start	5 s	1 ... 20 s
Increase value	Increment value for transient insensitivity after recording start	10 V	1 ... 750000 V
Post samples	Number of recorded samples after the transient start	768	0 ... 8000
Pre samples	Number of recorded samples before the transient start	768	0 ... 8000

Memory space for capturing of the particular transients is fixed on the maximum 8000 samples. Definition of number pre and post samples is limited by this maximum samples memory space.

8.8. Events



The events captured by EMK-01 can be adjusted with the parameters given in the table below.

Parameter	Description	Factory setting	Setting range
Reference	Reference voltage level type	Udin	Udin / Sliding
Pre samples	Number of recorded half periods Urms1/2 (10 ms = 1) before event	10	0 ... 4000
Post samples	Number of recorded half periods Urms1/2 (10 ms = 1) after event	150	0 ... 4000
Voltage swell (Over voltage) ►	Threshold	110%	100 ... 500%
	Hysteresis	5%	1 ... 20%
Voltage dip (Under voltage) ►	Threshold	90%	1 ... 100%
	Hysteresis	5%	1 ... 20%
Interruption	Threshold	5%	1 ... 100%
	Hysteresis	2%	1 ... 20%
Over current	Threshold	110%	100 ... 500%
	Hysteresis	5%	1 ... 20%

Memory for capturing the samples of RMS curves is fixed on the maximum 4000 samples. Definition of number pre and post samples is limited by this maximum samples memory space.

8.8.1. Voltage Dip

The dip threshold is a percentage of either Udin or the sliding voltage reference. The user should declare the reference voltage in use.
In single phase systems, a voltage dip begins when Urms voltage falls below the dip threshold, and ends when Urms voltage is equal to or above the dip threshold plus the hysteresis voltage.
In poly-phase systems, a voltage dip begins when Urms voltage of one or more channel is below the dip threshold, and ends when Urms voltage on all measurement channels is equal to or above the dip threshold plus the hysteresis voltage.
The dip threshold and the hysteresis voltage are both set by the user according to the use.

8.8.2. Voltage Swell

The swell threshold is a percentage of either Udin or the sliding voltage reference. The user should declare the reference voltage in use.
In single phase systems, a voltage swell begins when Urms voltage rises above the swell threshold, and ends when Urms voltage is equal to or below the swell threshold minus the hysteresis voltage.
In poly-phase systems, a voltage swell begins when Urms voltage of one or more channel is above the swell threshold, and ends when Urms voltage on all measurement channels is equal to or below the swell threshold minus the hysteresis voltage.
The swell threshold and the hysteresis voltage are both set by the user according to the use

8.8.3. Rapid Voltage Change (RVC)

A rapid voltage change (RVC) is an event characterized by a quick transition from one steady state voltage to another. Typically, RVC events are counted for a period of one hour or for each day. Mains signaling voltage, called ripple control signal in a certain applications, is a burst of signals, often applied a non-harmonic frequency, that remotely control industrial equipment, revenue meter and other devices.
If the change in voltage is sufficient to cross the dip threshold or swell threshold, then the event is not recorded as an RVC event. It is a dip or a swell.
The RVC threshold and the RVC hysteresis are both set by the user according to the use. The RVC threshold is a percentage of Udin. The RVC hysteresis is a smaller percentage of Udin.

Notice
Although RVC and flicker both may cause changes in illumination levels that irritate people, the two are different in concept. RVC is a discrete event while flicker is a quasi-stationary condition.

Parameter	Description	Factory setting	Setting range
RVC threshold	RVC threshold is a percentage of Udin	3.3%	1 ... 100%
RVC hysteresis	RVC hysteresis is a smaller percentage of Udin	1%	1 ... 20%

According to the norm, the ideal settings are RVC threshold on 3.5% of Udin and hysteresis on 1% of Udin

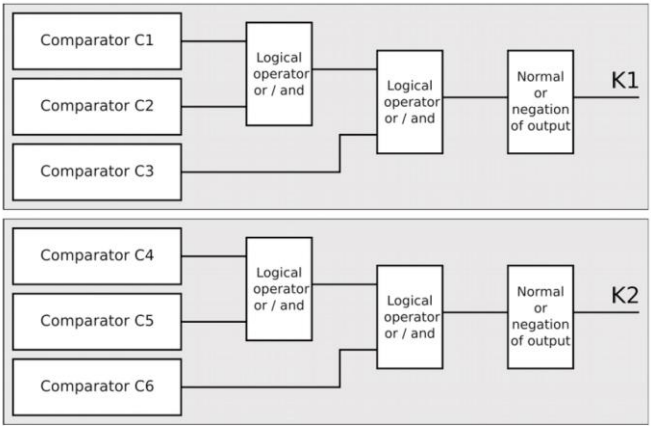
8.9. Inputs / Outputs

EMK-01 quality analyzer has two user configurable inputs / outputs. Connection of the inputs / outputs is displayed in the chapter 7.9.
The following input / output settings are configured through the software.

Parameter	Description	Factory setting	Setting range
Channel type	Defines the usage of the input and output interface	Digi in	Digi in / Digi out / Pulse in / Pulse out / Alarm
Source of pulses	Setting available only for Pulse out channel type		
Pulse weight	Setting available only for Pulse out and Pulse in channel type	0	
Unit	Setting available only for Pulse in channel type. Defines the unit of pulses.		
Digi out	Available only for Digi out channel type. Defines fundamental state of output.	Off	

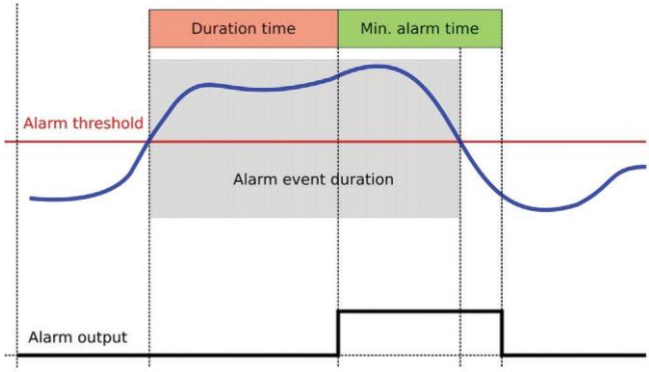
8.10. Alarms

The device is equipped by two input / output terminals which can be programmed to the four different states. Terminal one or two can be set to work as an alarm output.
Each output, while it is set to behave as an alarm, consists from three comparators. Comparators are sorted into logical function according to following diagram.



Comparators C1, C2 and C3 belong to output K1 and comparators C4, C5 and C6 belong to output K2.

From the picture is visible that there are logical functions between first two comparators of the group and between their result and last comparator of the group. There are two logical operators available, logical conjunction – AND and logical disjunction – OR.



The following settings must be done for each comparator. These settings are configured through software.

- Measured parameter – controlled parameter for an alarm
- Value – alarm threshold value of controlled parameter
- Relation – comparator type (<, >)
- Duration – duration time of an alarm event before the output reaction
- Min. time – minimum output reaction time

Important
For correct work of alarm, it is necessary set the device outputs to behave as an alarm outputs.

8.11. Analyser – Display Settings

Settings related to the device itself such as display parameters, colours, time, password protection and reset of all setting.

Parameter	Description	Factory setting	Setting range
Display refresh	Speed of display refreshing. The optimal setting is 5 cycles.	5 cycle	1-5 cycle
Brightness	Brightness of display for operation while buttons are touched	90%	0 … 100%
Standby brightness	Defines level of brightness when the device is not pressed at any button	45%	0 … 60%
Standby time	Time delay after that device turns to standby level of display brightness	10 s	5 - 60
Password	Four digit password for access to device settings menu	0000	0 -9999
Date and time	Device internal clock configuration sub-menu	►	
Colours	Colours template of particular voltages and currents of phases for graphs	►	
Reset	Reset device to the factory settings		

The following settings are configured through the software.

Parameter	Description	Factory setting	Setting range
Display language	Language used for an e-mail notification	English	Turkish, English, German, Czech, Chinese
Refresh time [cycle]	Refresh time of the displayed value	5	1 ... 50
Backlight [%]	Backlight intensity of device LCD display	50	0 ... 100

Without any action on keyboard, the device backlight will turn off in 120 seconds.
It is possible to set permanent ON of the display backlight. This case the backlight will light on 50%, Permanent OFF keeps the backlight with 5%.

8.12. Data Storage

Measured parameters can be recorded in the internal flash memory. Data storage offers the list of all parameters that can be stored. EMK-01 allows defining 5 different time intervals with adjustable time and recorded parameters.

List of recorded parameters of all intervals can be saved as a template for further usage. There is also predefined template according to power quality norm EN 50160.

8.13. Memory Settings

Memory of EMK-01 is possible to manage to obtain more space for preferred recordings. Simple move of particular memory are borders modify the size of available space.

8.14. About

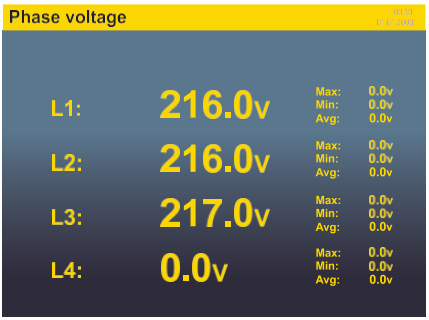
Information about the vendor and device firmware version.

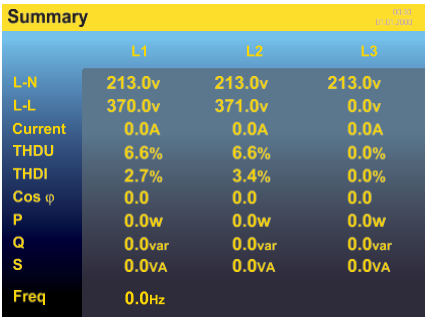
9. Operation

EMK-01 allows comfort operation by easy graphic main menu which is divided to groups of related features and functions. For the navigation in the menu, ▲ and ▼ cursor buttons are used. **OK** button is used for entering the selected menu or parameter. HOME button is used for returning back to previous menu or parameter.

9.1.Numeric

Numeric menu contains measured parameters in numeric form. Parameters are displayed on Summary menu in batches or grouped to separate screens according to logical order.





9.1.1. Flicker

Device calculates flicker according to the norm EN 61000-4-15. It provides value for short-term flicker (10 minutes) and long-term flicker (2 hours).

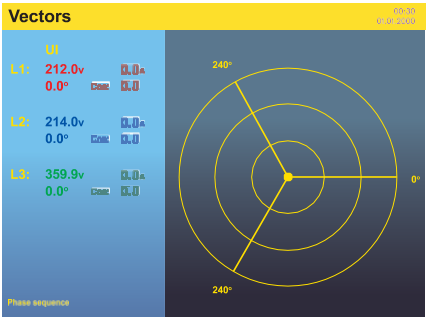
9.2. Harmonics

High harmonic frequencies of measured voltage and current are shown in the form of bar graphs for harmonics till 50th order.

By pressing the button OK, the cursor with value of particular harmonic is activated. The cursor pointer can be moved to display other harmonic details via cursor buttons.

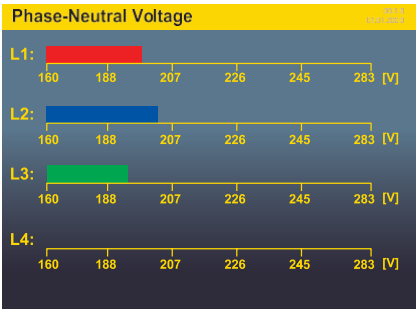
9.3. Vectors

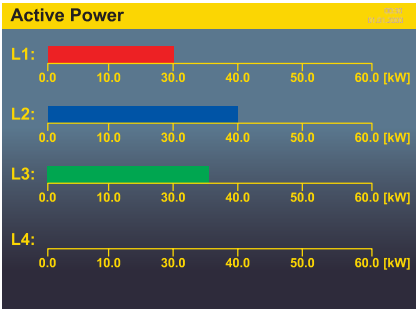
This screen shows the voltage and current vectors of all phases including the instantaneous values of voltage and current and phase angles of voltage and current vectors.



9.4. Bar Graphs

Voltage, current and power values (active power and apparent power)can be shown in bar graph form as well. Bar graphs have synchronized automatic scale which is adjusted according to min and max displayed values to provide fast and clear comparison of measured values in all phases.





9.5. Scope

EMK-01 shows scope of measured signal for voltage and current in all four phases. It is possible to select displayed phase or phases by pressing **OK** button and selecting the appropriate phase or phases. Escaping back from the phase selection is by pressing **HOME** button.

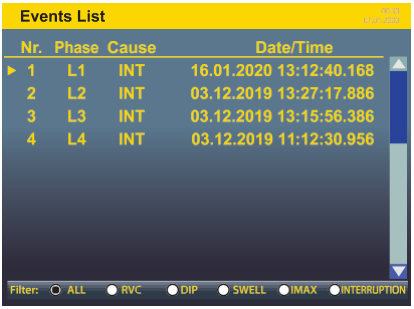
In order to show or hide curve of phase or phases on the graph, press OK button and select the phase or phases by ▲ and ▼ buttons.

9.6. Events

EMK-01 captures and records voltage and current events as well as voltage transients. Detail information and signal waveform are displayed on the device screen and also web-server.

9.6.1. List of Events

Last 50 events of each type are captured in the non-volatile memory with information about the start and end of the event and graph of event. On the device screen, the event graph can be displayed with all detail information.



There are following type of events are recorded in EMK-01 memory.

Type of event	Description
INTERRUPTION	Voltage interruption
DIP	Under voltage
SWELL	Over voltage
RVC	Rapid voltage change
IMAX	Over current

On the screen of Events list, it is possible to filter events according to their type.

1. Press Fn (Zoom) button to apply appropriate filter on list of events.
2. Move to event of your interest by ▲ and ▼ buttons and press OK button to display event details.
3. Use ▲ and ▼ buttons in order to move the graph right or left.
4. Press OK button in order to select the phase or phases to be shown on the graph and select desired phase.

9.6.2. Rapid Voltage Change (RVC)

A rapid voltage change (RVC) is an event characterized by a quick transition from one steady state voltage to another. Typically, RVC events are counted for a period of one hour or for each day.
If the change in voltage is sufficient to cross the dip threshold or swell threshold, then the event is not recorded as an RVC event. It is a dip or a swell.

9.6.3. List of Transients

EMK-01 captures transient of voltage as short as 25 μs and keeps last 50 transients of each type in the non-volatile memory.

Type of event	Description
Differential	Transients started by differential threshold defined by zone
Absolute	Transients started by threshold absolute value defined by set value of voltage

Waveform of transient event is possible to be zoomed to the detail view by pressing Fn (Zoom) button. The detail zoom view can be moved forward and back by ▲ and▼ buttons.

9.6.4. Power Cuts

Power cuts of a device supply voltage are recorded into the memory. Each recording is stored with date and time of power cuts start and end.
Last 15 supply voltage power cuts are captured in the non-volatile memory and displayed on the list.

10. Web Interface

EMK-01 has built in web server to show measured parameters in the Internet browser. For enabling the web server, please check chapter 8.3.2 and configure web server settings. Web server is designed web browsers compatible with HTML5 specification.

Web server of the device is available after setting the device's IP address to the web browser. Access to the web page is protected by user name and password.

Notice

Factory setting of user name is admin. Factory setting of password is 1234.

11. Firmware Update

Device firmware can be updated when the new firmware is released. Firmware file is prepared as an exe file that directly runs on Windows PC.

For successful firmware update, connect EMK-01 via Ethernet to PC where the update software will run. Enter the IP address of the device, user name and password. Pressing Connect button will verify accessibility of EMK-01 and prepare connection for firmware update start.

Important

While firmware update, the device should be on the stable power supply and Ethernet connection should not be removed or interrupted.

12. Technical Specifications

Parameter	Value
Supply voltage	24-60V AC/DC ±10%(optional), 85-250V AC/DC ±10%(optional), 50/60 Hz
Power consumption	< 8 VA
Voltage measurement range V L-N	2 ... 600 VAC
Voltage measurement range V L-L	4 ... 1000 VAC
Current measurement range	0,001 ... 6 A (8,5 A)
Frequency measurement range	40 ... 70 Hz
Clock accuracy	< 1 s/day
Number of input / output	2
Output type	NPN transistor free potential optical insulated
Maximum voltage for output usage	24 VDC
Maximum output load capacity	100 mA
Pulse width of pulse output	70 ms (10 ms minimum pause)
Input type	Optical insulated free potential
Maximum input voltage	24 VDC
Maximum input consumption	10 mA
Voltage transformer ratio	1 ... 750 000
Current transformer ratio	1 ... 750 000
Supply voltage power cuts memory	15 events
Sampling rate	40 kHz
Events trigger	10 ms
Memory	1 GB
Display type and size	VGA TFT 5.6”
Temperature input	NTC sensor 10 kΩ / 25°C
RS485 port	RS485 (optional) / Modbus RTU / 9.6; 19.2; 38.4 ; 57.6 ;115 kBd
Ethernet	RJ45 / 10 / 100 Mbit
USB	Type B
Over voltage category	600 V CAT III
Pollution degree	2
Ambient temperature	-25°C ... +70°C
Dimensions	144 x 144 mm
Panel cut-out	136,5 x 136,5 mm
Site depth	75 mm
Weight	1350 g
Protection class	IP20 rear panel / IP54 front panel
Related standards	IEC 61000-4-30 Class A, IEC 61000-4-7, IEC 61000-4-15, IEC61557-12

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