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Operating Manual for

SMY-CA

version 3.0

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Contents

1 General Description **1**

2 Operating the Meter **2**
2.1 Safety requirements when using SMY-CA . . . 2
2.2 Instrument overload warning . . . 2
2.3 Installation . . . 2
2.3.1 Connection step by step . . . 3
2.3.2 Disconnection . . . 4
2.3.3 Communication peripherals . . . 5
2.4 Lock/unlock the instrument . . . 5
2.4.1 Locking the instrument . . . 5
2.4.2 Unlocking the instrument . . . 5
2.5 Basic instrument setup . . . 6
2.5.1 Installation type and options . . . 6
2.5.2 Communication options . . . 7
2.5.3 Time and date options . . . 8
2.6 Downloading data to PC . . . 8
2.7 Energy meter readings . . . 8

3 Technical Specifications **9**
3.1 Basic Parameters . . . 9
3.2 Measured Quantities . . . 11

4 Maintenance and Service **14**

1 General Description

The portable power analyser SMY-CA is specially designed for monitoring of energy and power quality in advanced power systems and smart grids. It uses standard USB port for local configuration and data acquisition and also Ethernet for communication with remote control systems.

It is equipped with three voltage inputs and three current inputs for current sensors with X/333mV outputs.

Warning ! The X/333 mV, options is specially designed to be used only in combination with provided external current sensors which are supported with the respective option.

SMY-CA is based on SMY 133 panel power meter and shares most of its features.

Basic set of SMY-CA contains following

- **SMY-CA** power analyser
- 4 wire voltage probe **SMY-CU3** with built-in fuses
- 4 pcs of croco-clips XKK-1001
- 5m UTP ethernet cable **ETH5m** with IP65 rated screw type connector from one side
- USB cable

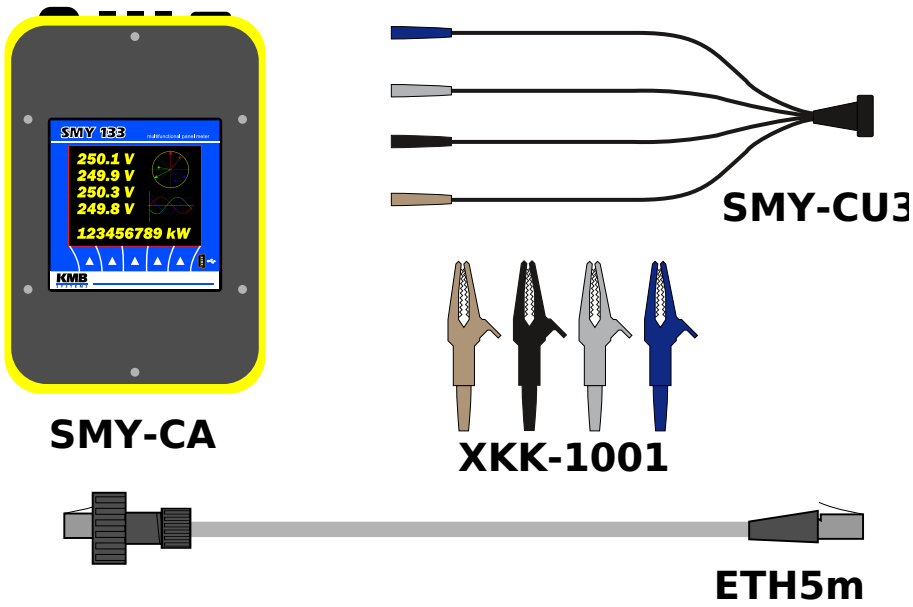


Figure 1

There are also range of different optional current sensors available (see. Table 1)

Sensor Model	Inom [A]	d [mm]	Description
CA-JRF MOI 333M-80 100	100 A	80 mm	Flexible current sensor, max. 100A, diameter 80mm, 3pin IP65 bayonet locking connector
CA-JRF MOI 333M-80 300	300 A	80 mm	Flexible current sensor, max. 300A, diameter 80mm, 3pin IP65 bayonet locking connector
CA-JRF MOI 333M-115 100	100 A	115 mm	Flexible current sensor, max. 100A, diameter 115mm, 3pin IP65 bayonet locking connector
CA-JRF MOI 333M-115 300	300 A	115 mm	Flexible current sensor, max. 300A, diameter 115mm, 3pin IP65 bayonet locking connector
CA-JRF MOI 333M-115 1000	1000 A	115 mm	Flexible current sensor, max. 1000A, diameter 115mm, 3pin IP65 bayonet locking connector
CA-JRF MOI 333M-115 2500	2500 A	115 mm	Flexible current sensor, max. 2500A, diameter 115mm, 3pin IP65 bayonet locking connector
CA-JRF MOI 333M-200 3000	3000 A	200 mm	Flexible current sensor, max. 3000A, diameter 200mm, 3pin IP65 bayonet locking connector

Table 1: Current sensor options

2 Operating the Meter

2.1 Safety requirements when using SMY-CA

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 Instrument overload warning

When connecting to the measured voltage using croco clips it is necessary to pay more attention to measured voltage levels.

Warning !: An incorrect connection of the conductors can cause built-in power supply overload and serious damage of the instrument!!!

2.3 Installation

The instrument can be used only in networks with maximum voltages not-exceeding its maximum available power supply voltage (see technical specifications). For its operation, the instrument requires supply voltage which is provided directly from measured voltage of phase L1. If current measurement is required too, use appropriate current sensors with 333mV output.

2.3.1 Connection step by step

1. Attach selected power cable to the instrument U connector and fasten it by mild tightening of the cap nut.
2. Check that recording control switch is in OFF position (O).
3. Now we will connect measured voltages to the instrument using voltage cable. In case of connection with croco clips wearing insulation gloves is strongly recommended while connecting the cable to the points of measurement! Use croco clips or magnetic adapters. Firstly connect the N (neutral, blue) wire to the neutral conductor of measured network; now, this connection should be properly checked to avoid confusion with any of the phase conductors! Then, connect the phase wire L1 (brown) to the measured phase conductor and by looking at the instrument display check if it has started running. Finally, connect remaining wires L2 (black) and L3 (grey)
4. Now you can check the connection on the instrument's display – phase voltage magnitudes should correspond to reality and in the phasor diagram phase rotating sequence can be verified.
5. If you want to measure currents as well, appropriate current sensors must be installed. During this, wearing the insulation gloves is strongly recommended again! Generally, the current sensors are interchangeable. But for better orientation we recommend to respect their marking – connect the brown sensor to the L1 current input, the black one to the L2 input and the gray sensor to the L3 input. Correct polarity must be observed while connecting current sensors. The arrow on the current sensor must show the direction of the nominal power flow (from the power source to point of consumption). After locking up the sensor lock, adjust the sensor position on measured conductor in order that the lock is as far of the conductor as possible – in such position the measurement accuracy is the best. Then we again recommend to check the sensors connection on the instrument's display – for example using the phasor diagram.
6. Now, if not already set, we will configure ratio of CTs and other settings through display or using ENVIS.Daq software.
7. Now we can do final verifycation of the conncetion. On the display we can list measured values of voltage and current. If we have also laptot we can use ENVIS.Daq to connect via USB or Ethernet to check live data.
8. If connection and configuration is correct, we can start the recording. To do so, switch recording control switch located on front panel to ON position (I). Since now, both the recording and the electricity meter operation is unblocked and measured values start being registered into the instrument archives.

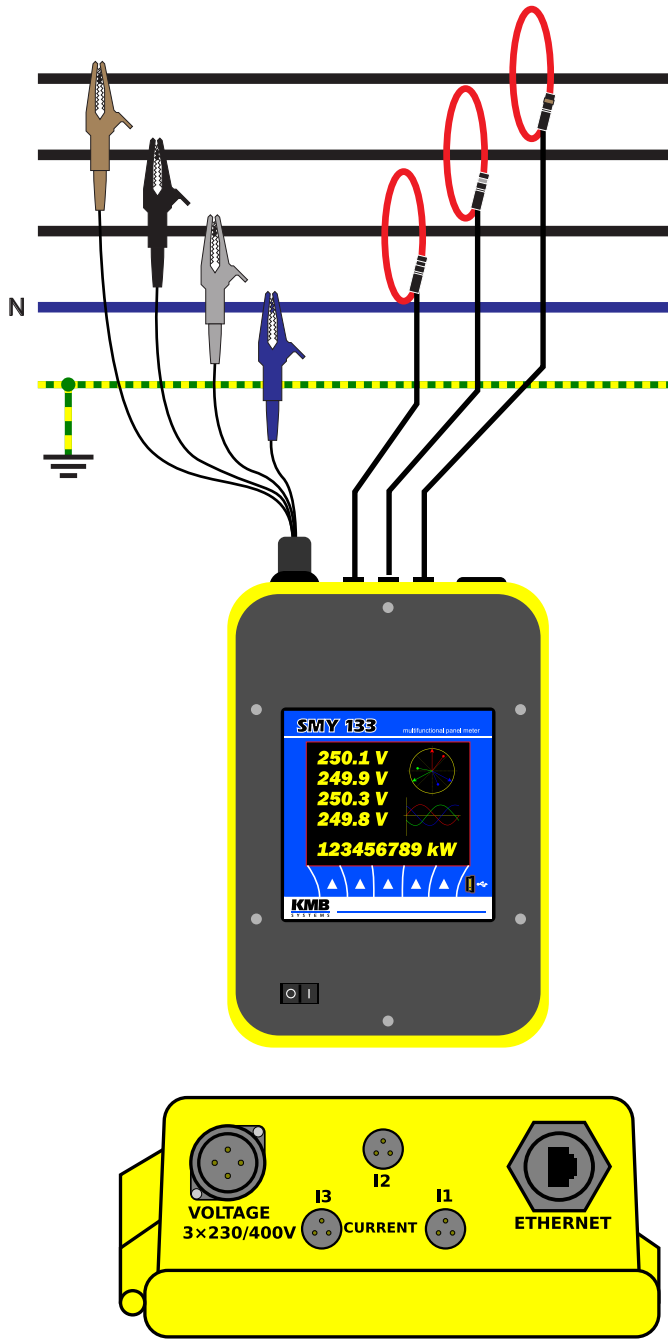


Figure 2: Typicall connection of SMY-CA in LV network

2.3.2 Disconnection

After recording of measurement for the desired period of time has been completed, it is necessary to disconnect the instrument from the points of measurement and transfer the data recorded to a computer. When disconnecting, the same precautions must be observed as those for connecting it and carry out all the steps in reversed order.

1. Turn off recording by switching recording control button to OFF position (O).
2. Disconnect all voltage cables and current sensors in revers order to connection – firstly from the points of measurement, then you can disconnect cables from the instrument.

2.3.3 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). SMY-CA 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 10Base-T Ethernet interface with RJ-45 connector described *ETH* is situated in front part of the case from side of the connectors. Ethernet interface can be used for connection of the device to LAN and for easy connection of remote control PC.

2.4 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.

2.4.1 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:* ✖
4. press ③ and choose lock option. Symbols ✔ and ✖ will be displayed
5. chose requested new state (✔...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 SMY-CA is now locked and all local modifications of configuration are not allowed.

2.4.2 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:* ✔
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

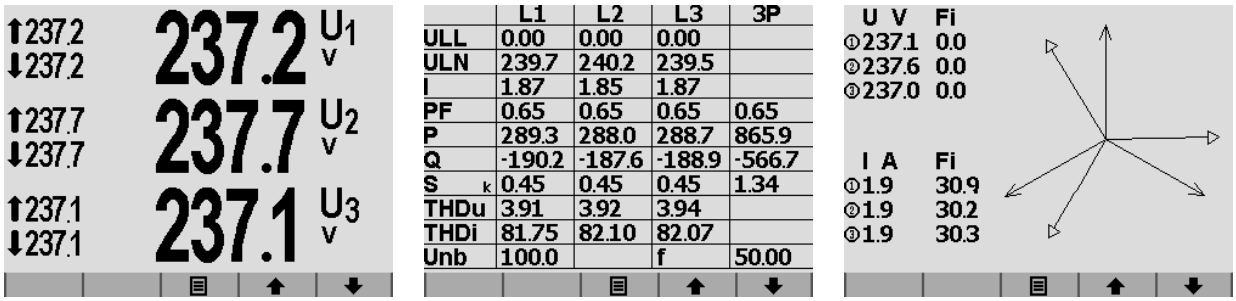
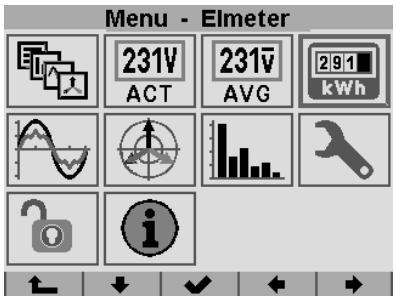
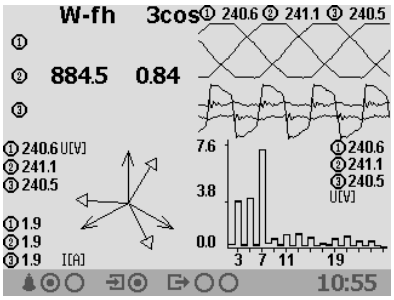


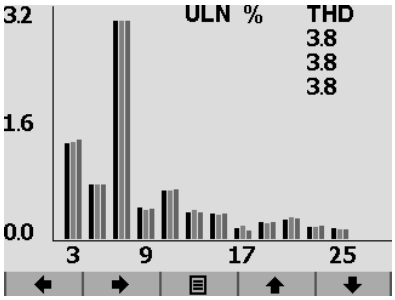
Figure 3: Screen of the SMY-CA : button ① - without function, ② - without function, ③ - menu, ④ - up arrow rotates displayed screens, ⑤ - down arrow rotates displayed screen. Default start-up screen is on the left.



(a) Main menu of the instrument.



(b) Special user defined split screen displays data compacted.



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

Figure 4: Examples of different actual data displayed on screen of the SMY-CA instrument.

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 SMY-CA is now unlocked and all local modifications are allowed.

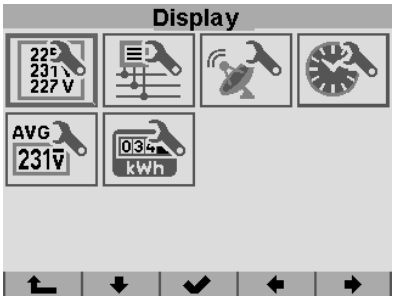
2.5 Basic instrument setup

To navigate the screen and to configure the SMY-CA 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. 3). For intention of use in this manual we are referring to these buttons as button ① to ⑤ from left to right.

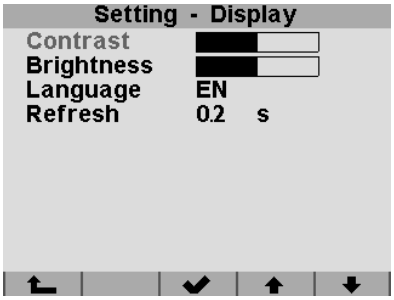
In general buttons ④ and ⑤ are navigational buttons. Button ③ is alternating *Confirm* function and *Return to main menu* function. Buttons ① and ② are either without function or they provide navigation and other functions in the context of each screen.

2.5.1 Installation type and options

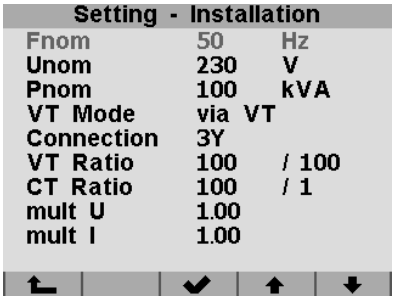
1. turn on the instrument and wait until it boots up. Start-up screen will be displayed (fig. 3).
2. press button ③ - main menu is displayed (fig. 4a). Buttons ②, ④ a ⑤ navigate selection cursor in this screen. Button ③ picks the highlighted menu item. Button ① returns back in the menu level.



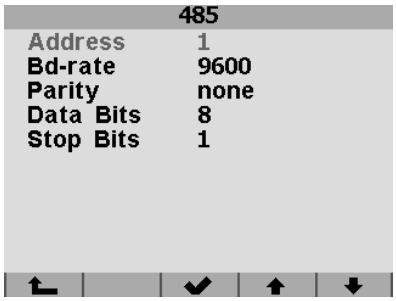
(a) Configuration menu of the SMY-CA analyzer.



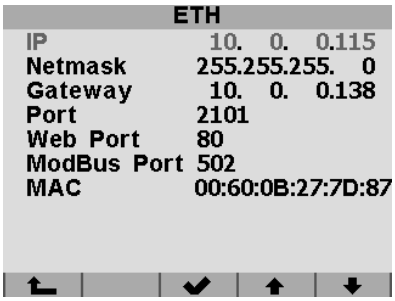
(b) Setting up the display options.



(c) Setting up the basic installation parameters of an instrument.



(d) Setting up the RS485 serial communication option.



(e) Setting up the Ethernet communication option.

(f) Setting up the time, date and time synchronization options.

Figure 5: Set up screens of the SMY-CA analyzer.

3. press multiple times button ⑤ and choose settings symbol - green french key.
4. press button ③. Configuration screen will be displayed (fig. 5a)
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.

2.5.2 Communication options

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

2.5.3 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.

2.6 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.

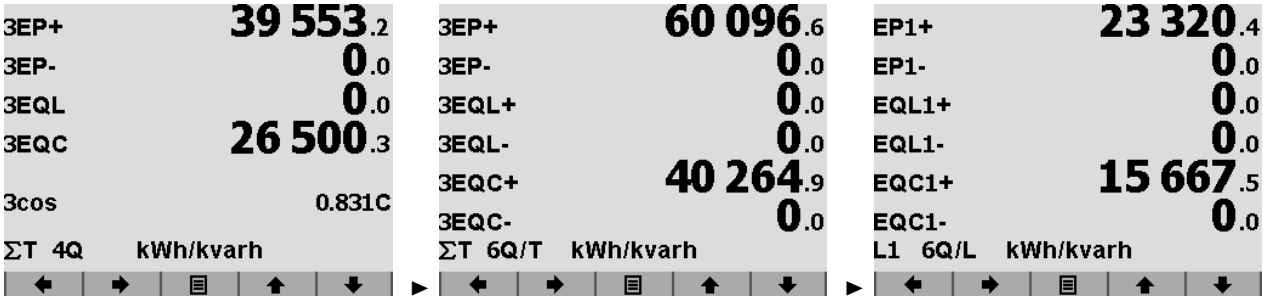
Device Information section contains editable description and name under which the actual record is stored. *Time Frame for Other Archives* tab allows you to limit the date ranges of all archives by the time interval of the main archive. In the *Destination* section the actual storage can be selected - 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.

2.7 Energy meter readings

SMY-CA 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. 6 — 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. 6a). Meter data readings can be downloaded and analyzed in ENVIS or via the standard ModBus protool in any other system.



(a) Three phase registers of active and reactive energy - sums of quadrants.

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

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

Figure 6: Meter reading screens of SMY-CA . 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.

3 Technical Specifications

3.1 Basic Parameters

Instrument Auxiliary Power Supply Voltage	
rated aux. voltage range (terminals L1-N)	110 ÷ 400 VAC
auxiliary voltage range (terminals L1-N)	100 ÷ 500 VAC, 40 ÷ 100 Hz
power supply	8 VA / 3 W
overvoltage category	III for UNOM <= 300 VAC; II for UNOM > 300 VAC
pollution degree	2
maximum operating altitude	2000 m
connection	common terminals L1-N with U1 measuring voltage

„X/333mV“ Instrument Model Auxiliary Voltage for Current Sensors	
connection	non-isolated (connected with the instrument internal circuitry)
output voltage	+5 VDC ± 5 %
maximum permanent load	60 mADC
short-circuit current, max. duration	approx. 100 mADC, 5 seconds

Other Specifications	
operational temperature	- 25 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 (not for home use)
communication ports	USB 2.0, Ethernet 100 Base-T
communication protocols	KMB, Modbus TCP, WEB server, JSON, DHCP, SNTP
display	colour TFT-LCD, 3.5" diagonal, 320 x 240 pixels
sampling frequency 50 Hz (60 Hz)	25,6 kHz (23,04 kHz)
RTC : accuracy	+/- 2 seconds per day
backup battery capacity	> 5 years (without supply voltage applied)
protection class	IP 65 (closed lid, connectors connected or covered with caps) IP 40 (open lid)
dimensions	250 x 170 x 100 mm
weight	max. 2 kg

3.2 Measured Quantities

Voltage characteristics	
Frequency	
f_{NOM}– nominal frequency	50 / 60 Hz
measuring range	40 ÷ 70 Hz
uncertainty	± 10 mHz
Voltage (L1-N terminals used simultaneously as auxiuliary power supply)	
U_{NOM} (U_{DIN})– rated voltage	180 ÷ 250 VAC
measuring range (line-to-neutral)	100 ÷ 500 VAC
measuring range (line-to-line)	170 ÷ 860 VAC
intrinsic uncertainty (t_A=23±2ºC)	+/- 0.05 % of rdg ± +/- 0.02 % of rng
temperature drift	+/- 0.03 % of rdg ± +/- 0.01 % of rng / 10 ºC
measurement category	250V CAT III
burden p.(L2,L3 only) / impedance	< 0.05 VA / Ri=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 (40th order @ 60 Hz)	
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/333mV“**
I_{NOM} (I_B) – rated (basic) current	I @ 333mV
measuring range	0.002 ÷ 0.5 VAC
intrinsic uncertainty (t_A=23±2ºC)	+/- 0.05 % of rdg ± +/- 0.02 % of rng
temperature drift	+/- 0.03 % of rdg ± +/- 0.01 % of rng / 10 ºC
measurement category	undefined
permanent overload	15 VAC
peak overload 1 second, maximum repetition frequency > 5 minutes	15 VAC
burden power (impedance)	< 3 µVA (Ri>100kΩ)
Current Unbalance	
measuring range	0 ÷ 100 %
measuring uncertainty	± 1 % of rdg or ± 0.5
Harmonics & Interharmonics up to 50th order (40th order @ 60 Hz)	
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% I_{NOM} : ± 1% I_{NOM}
	Ih > 10% I_{NOM} : ± 1% of rdg
THDI	
measuring range	0 ÷ 200 %
measuring uncertainty	THDI <= 100% : ± 0.6
	THDI > 100% : ± 0.6 % of 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 ($P_{NOM} = U_{NOM}$ 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 ± 0.005 % P_{NOM}
PF & cos φ uncertainty	+/- 0.005
“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	+/- 0.005
temperature drift of powers	+/- 0.05 % od 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 0.5S acc. to EN 62053 – 22
reactive energy uncertainty	class 1S acc. to EN 62053 – 24

4 Maintenance and Service

Maintenance: the SMY-CA 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 $10\,\mu A$. 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:

KMB Systems, s. r. o.
Tř. dr. M. Horákové 559
460 05 Liberec 7
Czech Republic
Tel. 485 130 314, Fax 482 739 957
E-mail: kmb@kmb.cz, Web: `www.kmb.cz`

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.