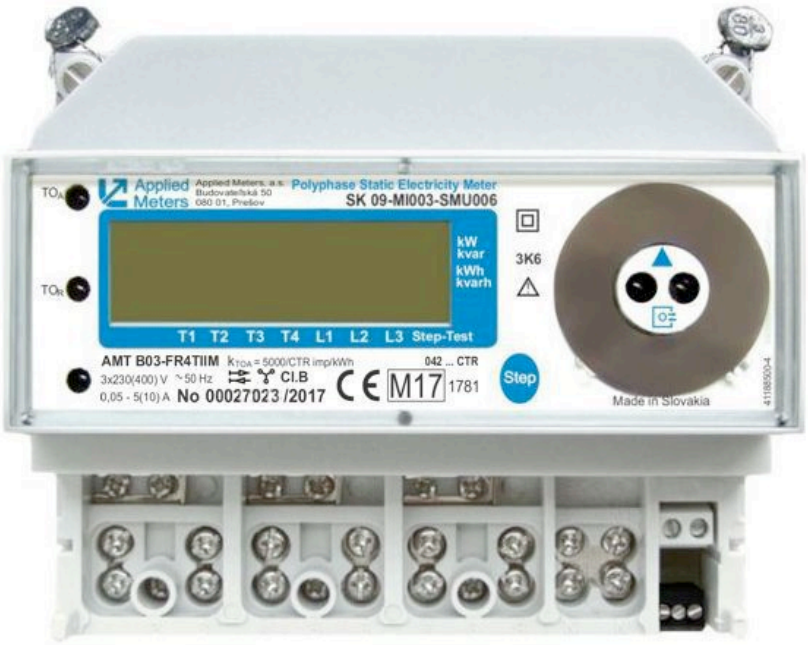
User's Manual

Three-phase static electricity meters for active energy and reactive energy measurement with LCD and internal clock

AMT B0x-FxxT



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1 Purpose and usage

Three-phase static electricity meters **AMT B0x-FxxT** are the programmable three-system electricity meters determined for the active and reactive electric energy measurement in 3-phase 4-wires networks and 2-phase 3-wires networks with the frequency of 50 Hz or 60 Hz, with data displaying on LCD.

The meters can be connected to the circuit directly or indirect through current transformers. They are intended for indoor mounting on DIN rail (35 mm). Electricity meter is placed in a plastic case of size 7M (1M = 18 mm).

Apart from the basic active energy measurement the electricity meters allow the reactive energy measurement in the rates controlled by the internal clock (four rates) or controlled from outside (two rates), active demand (+P) and reactive demand (+Q) measurement, active maximum demand (+P) and reactive maximum demand (+Q), instantaneous active power (+P) and (-P), energy history records and energy maximum records for previous period, data profile record, event record and time synchronization by communication.

The electricity meters allow displaying of the total energy, energy in rates and other data as active maximum demand, reactive maximum demand of the total energy – consumption (+A, +R), instantaneous active power for consumption (+P) and supply (-P), voltage and current in phases, total power factor and network frequency, message about the internal statuses, message about the internal errors, used firmware version, switching times table version, serial number, date, time.

Type of measured energy, measurement mode (*Summary mode* – measurement „using a mechanical register“, *Separate mode* – consumption and supply measurement and *Ferraris mode* – measurement of consumption and supply, “consumption – supply, Ferraris” mode), another measurement, recorded and displayed values are programmable.

The electricity meters complies with EN 50470-1, EN 50470-3, EN 62052-11, EN 62053-21 and EN 62053-22 standards and with the requirements of European Parliament and EC Directive 2014/32/EU (MID).

2 Technical description

2.1 Marking of product

AMT B0x_5-F$x_7$$x_8$TII x_{11}

AMT B0 .. type designation
x_5 ..... *overload capacity:* **3** – 200 %, **C** – 1300 %
F ..... *basic version:* multifunctional electricity meter with LCD and real-time clock
x_7 ..... *measured energy:* **A** - active energy, **F** - active energy - Ferraris mode, **R** - active energy and reactive energy
x_8 ..... *network connection:* **2** – 2-phase 3-wire, **4** – 3-phase 4-wire
T ..... *current converter:* **T** – transformer
II ..... used processor type: **II** – 2xTI
x_{11} ..... *special modules:* **4** - RS 485 interface, **M** - Mesh-wireless communication modude, **E** - external control of the second rate

Note: *Position x_{11} can contain more characters, e.g. 4E. The number of output terminals must not exceed 4. (The number of terminals necessary for: RS 485 = 2, E = 2)*

2.2 Technical data

Accuracy Class *active energy / reactive energy*		A, B (MID), 2, 1 / 3, 2
Reference voltage U_n [V] *direct and indirect connection*		3 x 220/380, 3 x 230/400, 3 x 240/415 (-30,+15%)
Reference current I_{ref} [A] *direct connection (I_{ref} = 10 I_{tr})*		5 and 10
Nominal current I_n [A] *indirect connection (I_n = 20 I_{tr})*		5
Transient current I_{tr} [A] *direct / indirect connection*		0,5 and 1 / 0,25
Starting current I_{st} [A] *direct / indirect connection (≤ 0,04 I_{tr})*		0,02 and 0,04 / 0,01
Minimum current I_{min} [A] *direct / indirect connection*		0,25 and 0,5 / 0,05
Maximum current I_{max} [A] *direct / indirect connection*		65 / 10
Current overloadability [%] *direct / indirect connection*		**C** – 1300 / **3** - 200
Nominal frequency f_n [Hz]		50 or 60
Consumption	*in voltage circuits [VA/W]*	≤ 1/ 0,4
	in current circuits [VA]	≤ 0,1
Climatic conditions	*Specified operating range*	from -25 °C to +55 °C (3K6) from -40 °C to +70 °C (3K7)
	Limiting operating range	from -40 °C to +70 °C (3K7)
	Limiting operating range for storage	from -40 °C to +70 °C (1K5)
	Limiting operating range for transport	from -40 °C to +70 °C (2K4)
	Humidity	<75 % ... annual average 95 %.... during 30 days naturally dissipated through the whole year 85 %... occasionally in other days
Mean temperature coefficient [%/K]		≤ 0,04
Pulse constant	*testing output k_{TOA} [imp/kWh]*	1 000, 5000
	testing output k_{TOR} [imp/kvarh]	1 000, 5000
	pulse output k_{SOA} [imp/kWh]	1000, 5000
	pulse output k_{SOR} [imp/kvarh]	1000, 5000
Transistor pulse output SO		24 V/ 30 mA
Mechanical and electromagnetic environment		M1, E2
Degree of protection		IP51
Terminals - *current; voltage; auxiliary* **[mm]**		ø 6 for I_{max} = 65 A); ø 3 ; ø 3
Maximum section of connecting current wires [mm^2]		25 (for I_{max} = 65 A);
Maximum section of connecting auxiliary wires [mm^2]		6
Weight [kg]		≤ 0,85
Dimensions - *W x H/H' x D* **[mm]**		126 x 105/131 x 59

Note: *The meter version with SO divider does not have the following functions: sliding demand, BPR2, abbreviated format of date and time, special days and time synchronization.*

2.3 Electricity meter case

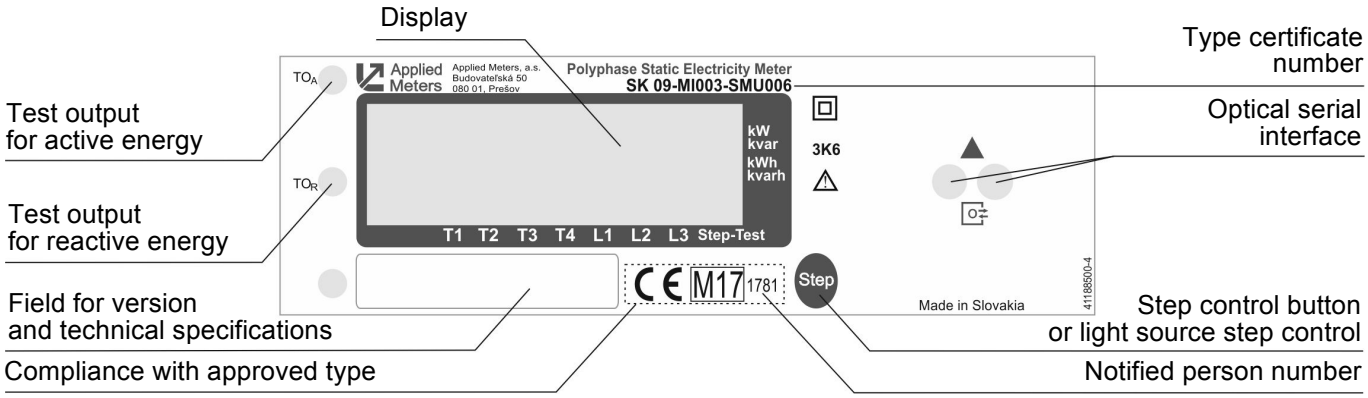
Electricity meter is placed in a plastic case, determined for mounting to the DIN bar 35. The case corresponds to the isolation class II. It consists of the base, terminal block, terminal block cover, meter cover and cover insertion. The cover insertion is made of transparent polycarbonate and is inserted in the cover. The meter cover and terminal block cover are sealable (each one 2 times).

3 Functional description

The electricity meter is made on the PCB using SMD technology.

3.1 Data representation on nameplate

Every electricity meter is equipped by a nameplate containing the mandatory data (technical data, type approval number, mark of conformity with MID directive), data required by customer, data necessary for understanding of the displayed units on a display (live rate – e.g. T1, display mode on a display – step, test, displayed item on a display – kWh, kW, kvarh), and it allows an access to some input/output elements (button, optical serial interface, testing outputs).



<u>There can be two types of the transformer operated meter:</u>

Electricity meter with secondary constant

The nameplate contain the information about the current of electricity meter in form: *minimum current - nominal current (maximum current), e.g. 0.05 - 5 (10) A*.

Apart form those the nameplate contains a mark, meaning that the register value must be multiplied by the multiplier (CTR – current transformer ratio). During the electricity meter installation the additional nameplate (self-adhesive) containing current transformer ratio (e.g. 200/5 A) and multipier CTR (e.g. 40) must be attached to the outside part of the terminal block cover.

Electricity meter with primary constant (for current transformer)

The nameplate contain the information about the current of electricity meter in form: *minimum current - nominal current (maximum current),* e.g. 0.05-5 (10) A.

The nameplate contains current transformer ratio, e.g. 200/5 A to which the electricity meter is connected. The electricity meter calculates measured energy using the CTR value. That means the electricity meter measures the energy on a primary side of the current transformer. Then the nameplate contains also TO testing output constant corresponding with the primary data.

If the meter is supplied with the possibility of ratio setting by customer, the multiplier (CTR) is displayed on LCD (OBIS 0.4.2). The nameplate contains the primary constand of the electricity meters e.g.: k_{TO}=5000/CTR imp/kWh (kvarh).

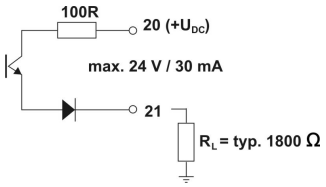
3.2 Input/output elements and circuits

TO_A and TO_R testing outputs

TO_A LED – testing output for active energy. LED flashing frequency depends on the testing output constant for active energy k_{TOA} [imp/kWh] and it is proportional to the measured active energy. The electricity meter nameplate contains k_{TOA} value. In the status without load (current is lower than Starting current) LED is off.
TO_R LED – testing output for reactive energy. LED flashing frequency depends on the testing output constant for reactive energy k_{TOR} [imp/kvarh] and it is proportional to the measured reactive energy. The electricity meter nameplate contains k_{TOR} value. In the status without load (current is lower than Starting current) LED is off.

SO pulse output

Impulse output for active energy is connected to the terminals 20(+) and 21(-), impulse output for active energy is connected to the terminals 22(+) and 21(-) and it is realized as SO passive output (open collector) requiring connection of the external power source with voltage up to 24 V and load up to max. 30 mA.



Optical serial interface

Optical interface is accessible from the front side of the meter cover. Optical interface represents a standard optic interface for two-way communication according to EN 62056-21, mode C, with communication speed of 300/9600 bauds, i.e. the initiatory speed of 300 baud, the proposed speed 9600 baud. The proposed speed (implicitly 9 600 Bd) is parameterizable and can take the values (according to EN 62056-21): 300, 600, 1 200, 2 400, 4 800, 9 600, 19 200 baud. Usage of the optical probe and PC or hand held unit (HHU) allows the electricity meter parametrizing, modification or zeroing of the programmed parameters and the read-out of the electricity meter data. Status of communication with PC/HHU is signaled on the display by ⍇ mark. For communication with AMT type electricity meters (also with the electricity meters from other producers containing the optical interface according to IEC 62056-21) Applied Meters, a.s. company supplies the optical probes with magnetic head AMOS.

RS 485 output

The electricity meter can be equipped by RS 485 communicating line. In this case, it is possible to use only one SO output. Communication protocol for RS 485 interface is the same as for optical interface, i.e. EN 62056-21, mode C, with communication speed of 9 600 / 9 600 baud, i.e. the initiatory speed of 9 600 baud, the proposed speed 9600 baud. The both speeds initiatory and proposed are parameterized and they can take any values (according to EN 62056-21): 300, 600, 1 200, 2 400, 4 800, 9 600, 19 200 baud. The AMR systems require communication on the same speed. Programmable speed allows mounting of the electricity meters in AMR systems with any speed.

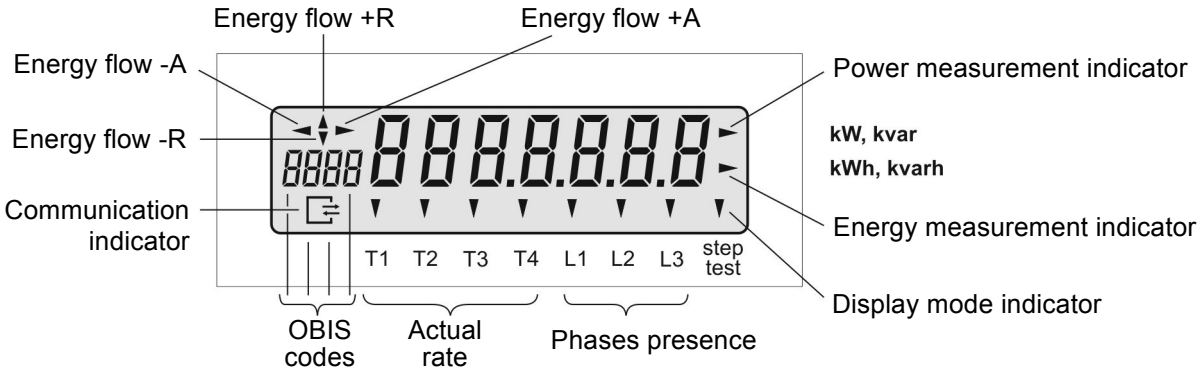
External input of rate control

The electricity meter can be equipped by the input intended for rate control by means of an external signal and there is a programmable selection between that external rate control or control by internal clock. External input is connected to the meter terminals (13, 15 as a standard) and the control signal is on the supply voltage level.

LCD display mode control input (STEP)

Controlling input is accessible from the electricity meter front side through the electricity meter cover and it is marked by description „**step** It can be realized by a mechanical button or a non-contact infrared sensor. The transmitting infrared diode or regular "flashlight" is a light source for sensor activation. Sensor activating time determines calling up of LCD display mode (cyclic, stepping or testing display mode).

3.3 Data displaying on LCD



Data are displayed on LCD containing couple of characters in the following groups:

- measured/calculated values are displayed in the field with 7 digits (dimensions 8 x 3,5 mm, line thickness 0,8 mm);
- displaying of OBIS codes (dimensions 4 x 1,75 mm, line thickness 0,4 mm);
- energy flow direction, energy measurement quadrant, active energy consumption (►), active energy supply or reverse wire connection (◄); reactive energy consumption (▲),reactive energy supply (▼). No load status or the electricity meter status when the meter does not register the energy (current is lower than the electricity meter Starting current) is indicated by permanent and simultaneous light of four arrows for the energy flow direction (◂▴▸).
- **T1-T4** rates. Arrow indicates the active rate.
  For double-rates electricity meters: **T3** indication of the terminal cover removal, **T4** indication of magnetic field influence (function is active for single, double- and three-rate elctricity meters, if the meter is fitted with a magnetic field sensor).
- **L1 L2 L3**. Arrows indicate presence of phases and correct phase sequence.

Indication of the measured energy quadrants on the display is stated in the following table:

Quadrant	Active energy	Reactive energy
QI	► +A	▲+R
QII	◄ -A	▲+R
QIII	◄ -A	▼-R
QIV	►+A	▼-R

Indication of Starting status and No-load status

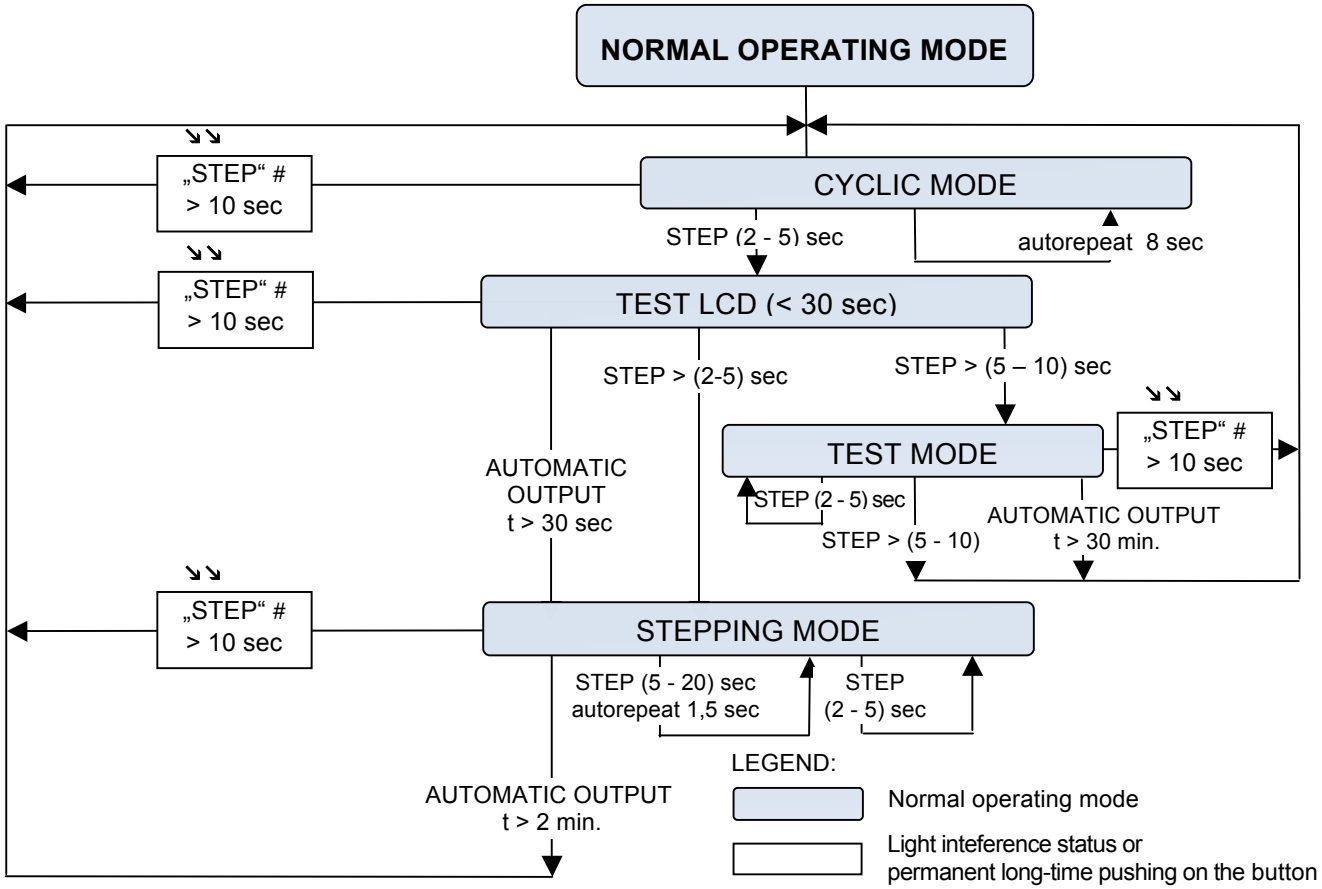
Starting status and no-load status are indicated on LCD by permanent and simultaneous light of four energy flow direction arrows (◂▴▸). The reaching Starting current is indicated by permanent light of the respective arrow. If the electricity meter measures both energies active and reactive two arrows can be switched on simultaneously: one for active and one for reactive energy. The value of the current and power factor affects which arrows light up.

Network voltage presence, phase sequence

Connection to voltage and correct phase sequence are indicated by L1 L2 L3 arrows on LCD. When the phase sequence is not correct, the arrows are flashing. When the voltage is missing, the respective arrow is off.

3.4 Initiation in to the operation and display modes

When the reference voltage is connected to the electricity meter terminals, LCD display goes to the cyclic mode automatically. Electricity measurement is indicated by flashing of the testing outputs red LEDs, TO_A and TO_R. Flashing frequency is proportional to the measured energy. The electricity meter design allows the data read-out visually in three display modes: cyclic, stepping and testing.



Display and control mode block diagram

<u>Cyclic display mode</u>

Displaying in this mode is the electricity meter standard mode intended for displaying of usual statuses, measured data and time data. Identificator **step/test** is off in this mode. The cyclic mode periodically displays the items, which list is programmed by the producer or authorized person at customer by means of AMsoft PFO program. The list of items for selection is shown in the table List of registers in article 3.22. Energy registers in this mode display with resolution according to setting (article 3.5.1) kWh or kvarh. One item is displayed for 8 seconds.

Data displayed on LCD contains:

- Item code OBIS;
- Item value;
- The arrow „►“ indicates measuring unit (kWh, kvarh);
- Current energy flow direction and quadrant: ◂▴▸, above OBIS code.

Mode termination: activating of **button/sensor step** (2-5 sec) with passing to LCD test.

At passing to cyclic mode from other modes, LCD displays **CYCLE** for short time**.**

LCD test

It is intended for checking of display faultlessness. During the test LCD test all display segments blink with 1 Hz frequency. Test is activated by **button/sensor step** (2-5 sec) during cyclic mode of displaying.

Test termination:

- activating of **button/sensor step** (2-5 sec) with passing to the stepping mode;
- activating of **button/sensor step** (5-10 sec) with passing to the testing mode;
- activating of **button/sensor step** for longer time (longer than 10 sec) with passing to the cyclic mode;
- automatically, without activating of **button/sensor step** (>30 sec) with passing to the stepping mode;
- when the display is backlit, activating of **button/sensor step** (>10 sec) changes the backlight intensity to higher level and passes to the cyclic mode.

Stepping display mode

Stepping mode is intended for displaying data, which are read out at visual reading of the electricity meter. The list of displayed data for this mode is programmed by the produces or authorized person at the customer by means of AMsoft-PFO program. The maximum number of displayed items in this mode is 16. The list of items for selection is stated in the List of the Registers table in the article 3.22.

Stepping mode is called out from LCD test by **button/sensor step** (2-5 sec).

The data displaying system on LCD is the same as in the cyclic mode (mode OBIS, value, measure unit indicator), apart from this the stepping mode indicator **step/test** "▼" flashes.

Data stepping can be performed:

- activating of **button/sensor step** (up to 5 sec). After displaying of last item the cycle returns to the start;
- activating of **button/sensor step** (5-20 sec) calls out an accelerated automatic stepping (so called autorepeat). The displayed items are stepped in 1.5 sec interval. Accelerated stepping is realized during activating **button/sensor step** only and it is stopped after release. Accelerated stepping can be interrupted and called up again any time.

Termination of the stepping mode and passing to the cyclic mode:

- activating of button/sensor step longer than 20 sec;
- automatically, after last activation of **button/sensor step** (> 2 min) with passing to the cyclic mode.

Testing display mode

Testing mode is intended for displaying of measured energy (total active energy consumption, supply, reactive energy consumption, supply etc.) with higher accuracy (3 decimal places) during the electricity meter testing and setup.

This mode is called out by:

- activating of button/sensor step (5-10 sec) from LCD test;
- direct order via serial interface - switch on of the testing mode for the electricity meters with optical serial interface

Testing mode indication permanently lights up the display mode **step/test** indicator "▼".

The display format (OBIS, value, measuring unit indicator) on the LCD is the same as in cyclic mode. The individual items can be stepped by activating of **button/sensor step** (2-5 sec). After displaying of last item the cycle returns to the start.

Termination of the testing mode and passing to the cyclic mode:

- by activating of **button/sensor step** for longer time (longer than 5 sec);
- automatically, after last activation of **button/sensor step** (> 30 min);
- by direct order via serial interface.

Resistance against permanent activation of the button/sensor step

Display in each mode is protected against:

- continuous long-term exposure ambient light on IR **sensor step**.
- permanent long-term pushing of **button step**.

Protection prevents the spontaneous activation and tampering modes.

Minimum time intervals of permanent activating **button/sensor step** not calling out the reaction to displaying:

- Cyclic mode: 10 seconds
- LCD test: 10 seconds
- Testing mode: 10 seconds
- Stepping mode: 20 seconds.

3.5 Measurement and Displaying

3.5.1 Energy measurement

The electricity meter measures active and reactive energy in both directions.

According to customer requirements, the manufacturer can set one of three measuring modes for **active energy**:

- ***Summary mode:*** summation of the energy absolute values in the individual phases irrespective of a direction – the whole energy is summing up as a consumption and the result is stored in register 1.8.0 (A=∑|+A|+∑|-A|). The supply is summarized separately and the result is stored in register 2.8.0 (A=∑|-A|).
- ***Separate mode - "consumption – supply":*** summation of the consumptions in the individual phases is stored in the register 1.8.0 A=∑|+A|, summation of the supplies is stored in the register 2.8.0 A=∑|-A|.
- ***Ferraris mode - "consumption – supply, Ferraris":*** energy is recorded to the register 1.8.0, when arithmetical sum of the energy values in the individual phases is consumption (+A + (-A) > 0) and energy is recorded to the register 2.8.0 when arithmetical sum of the energy values in the individual phases is supply (+A + (-A) < 0).

At separate mode can be canceled supply (or consumption) measuring mode, and then the meter measures the energy in one chosen direction.

Reactive energy can be measured only in ***separate mode*** – energy value in the register 3.8.0 represents the total consumption |+R|, to the register 4.8.0 is recorded total supply |-R|.

Note: *To simplify the following description, the energy in register 1.8.0 is indicated as +A, the energy in register 2.8.0 is indicated as -A, the energy in register 3.8.0 is indicated as +R, the energy in register 4.8.0 is indicated as -R.*

Rate registers

The AMT electricity meter allows energy measurement in 4 rates at internal rate control (ToU) and in 2 rates at external rate control. The meter has 4 total energy registers (+A, -A, +R, -R types) and 16 rate registers. For each type of energy can be assigned 4 rate registers (2 for external rate control). The rate registers are activated by means of the programmable table ToU.

Displaying of measured energy

Formats of the energy displaying – electricity meters for direct connection

User can select from the following formats of the energy displaying:

Format number	Format	LCD format [kWh]	LCD max. number [kWh]
0	5 + 2	XXXXX.XX	99999.99
1	6 + 1	XXXXXX.X	999999.9
2	6 + 0	XXXXXX	999999

Formats of the energy displaying – electricity meters for semi-direct connection

The format of the energy displaying is fixed and depends on the current transformer ratio:

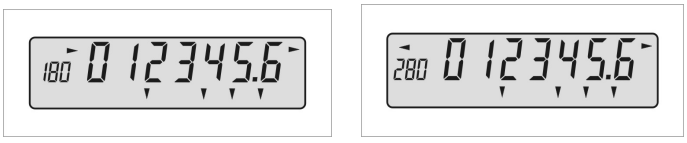
Current transformer ratio	Energy displaying format	LCD format	LCD max. number [kWh], [kvarh], [MWh], [Mvarh]
50/5, 60/5, 75/5, 100/5, 120/5, 125/5, 150/5, 200/5, 250/5, 300/5, 400/5 A, 500/5, 600/5, 750/5, 800/5, 1000/5, 1200/5,1250/5, 1500/5, 2000/5, 2400/5, 2500/5, 3000/5	7 + 0	XXXXXXX	9999999 k..h
* 4000/5 A	5 + 2	XXXXX.XX	99999.99 M..h
* 5000/5, 6000/5, 7500/5 A	6 + 1	XXXXXX.X	999999.9 M..h

**** Only on special request***

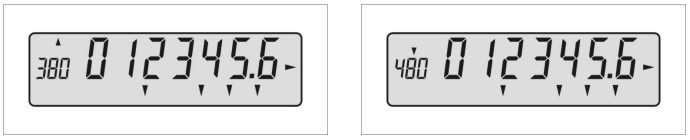
Part of the display value is identifier (OBIS code), stated before the value (1.8.0, 2.8.0, 3.8.0, 4.8.0) and measuring units indicator behind value (►). Other displayed segments describe the electricity meter actual status and are not directly related to the displayed value.

Format of the energy displaying in test mode is: **XXXX.XXX** (4 + 3) in kWh (kvarh) for direct meter connection and in kWh (kvarh) or v MWh (Mvarh) – according to current transformer ratio, for semi-direct meter connection.

Total energies displaying on LCD - examples:



Displaying of active energy +A and active energy –A, format 6 + 1



Displaying of reactive energy +R and reactive energy –R, format 6 + 1

3.5.2 Power measurement

Instantaneous power (register 1.7.0 and 2.7.0) – power +P (register 1.7.0) calculated from the total comsumed energy +A per 1 sec and power –P (register 2.7.0) calculated from the total supplied energy –A za 1 sec.

Current average demand +P and +Q (active - register 1.4.0, reactive - register 3.4.0) is evaluated after each minute of the measuring period and it is recalculated for the whole length of measuring period (e.g. 15 minutes). The values of the registers **1.4.0** and **3.4.0** are compared with the limit values of the relevant registers values (1.35.0, 3.35.0). Exceeding the limit values is indicated in the register F.0.1. Number of the limit values exceedances per each demand type of the current period is recorded in **Demand register counter threshold for active demand - register 1.36.0** and **Demand register counter threshold for reactive demand - register 3.36.0**.

Last average value of demand +P and +Q (registers 1.5.0 and 3.5.0) – the last value of the current demand (active – register 1.4.0 and reactive – register 3.4.0) is recorded in the register **1.5.0** for active power and in the register **3.5.0** for reactive power at the end of the measuring period. In case of "sliding demand" it is recorded at the end of the interval. The values can be displayed and readout during the next measuring period.

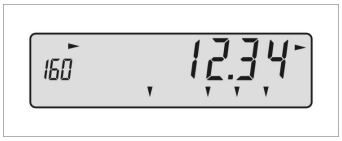
Maximum demand +P and +Q (active - register 1.6.0 and reactive - register 3.6.0) – is the highest value of maximum demand of the registers 1.5.0 and 3.5.0 for the current period. New value in the register 1.5.0 is compared with the current value of the register **1.6.0**. If it is higher, the value is recorded to the register **1.6.0**. This also applies to reactive power - registers 3.5.0 and **3.6.0**. Date and time of the record is the part of demand value. It is accessible during the readout by the programm AMsoft-PFO.

For more frequent maximum demand detection the demand measurement is performed by the sliding window method. The measuring period is then divided into subintervals each with duration t_0. The measuring period (symbol T) is expressed as follows: $T = k * t_0$, since the symbol k is used for number of intervals. Demand (in registers 1.5.0 and 3.5.0) is calculated at the end of each subinterval for the whole measuring period T. „Sliding window method“ of the demand calculation is performed when the number of subintervals is greater than 1.

Maximum demand form direct electricity meters is displayed in kW in format 2+2 and according to followwing table for electricity meters connected through current transformers:

Current transformer ratio	Format of the power displaying	Format LCD [kW], [kvar], [MW], [Mvar]
5/5, 50/5, 60/5, 75/5, 100/5, 120/5, 125/5, 150/5, 200/5, 250/5, 300/5, 400/5 A, 500/5, 600/5, 750/5, 800/5, 1000/5, 200/5,1250/5, 1500/5, 2000/5, 2400/5, 2500/5, 3000/5	od 1 + 1 do 3 + 1	X.X do XXX.X (k..)
4000/5 A	1 + 3	X.XXX (M..)
5000/5, 6000/5, 7500/5 A	2 + 2	XX.XX (M..)

Power displaying on LCD - example:



Maximum demand value in kW

Measuring period

Measuring period of demand is programmable and the following values can be set: 5, 10, 15, 20, 30, 60 min. The measuring period start is defined to 00 min.

The measuring period can be divided up to 15 subintervals. The number of subintervals is programmable.

Subintervals

Measuring period T [min]	Number of subintervals								
	1		**1**		**1**		1		1
	Duration of the interval [min]								
5	5	-	-	-	-	-	-	-	-
10	10	5	-	-	2	-	-	-	-
15	15	-	5	-	3	-	-	-	-
20	20	10	-	5	4	-	2	-	-
30	30	15	10	-	6	5	3	-	2
60	60	30	20	15	12	10	6	5	4

Historical maximum demand values (registers 1.6.0.F, 3.6.0.F)

It is a record of the active and reactive maximum demand values during the last 15 billing periods, excluding the current maximum value. At the end of the billing period (current month) the maximum values with time and date are recorded to the historical registers. After exceeding the maximum number of historical records, the oldest value is canceled.

Register 1.6.0.F - active maximum demand value register with a timestamp of forming maximum demand value.

Register 3.6.0.F - reactive maximum demand value register with a timestamp of forming maximum demand value.

Historical registers of Demand register counter threshold – registers 1.36.0.F, 3.36.0.F

It is going about records of number of the active demand limit exceedances (register **1.36.0.F**) and number of the reactive demand limit exceedances (register **3.36.0.F**) for the last 15 months. At the end of the billing period (current month) the current registers values are recorded into the historical registers and the current registers 1.36.0 and 3.36.0 are reset.

Register 1.36.0.F – Number of the active demand limit exceedances register

Register 3.36.0.F – Number of the reactive demand limit exceedances register

3.5.3 Measurement of currents, voltages, frequency and power factor

Voltages in phases L1, L2, L3 (registers 32, 52, 72)

The electricity meters measure the effective values of the voltages in all three phases. The voltages are displayed as real numbers with resolution to 1 decimal place of volt. Maximum format of the voltage displaying is **XXX.X** (3 + 1, e.g.: 109.9, 98.5).

Currents in phases L1, L2, L3 (registers 31, 51, 71)

The electricity meters measure the effective values of the currents in all three phases. The currents are displayed as real numbers with resolution to 2 decimal place of ampere. Maximum format of the current displaying is **XXX.XX** (3 + 2, e.g.:100.00, 9.98, 51.07).

Power factor (register 13)

The electricity meter calculates the power factor instantaneous value from the measured active and apparent energy independently from phase. The power factor is displayed as the absolute value in format **X.XX** (1 + 2) in range from 0.00 to 1.00 (e.g.: 0.50).

Frequency (register 14)

The electricity meter measures selected phase frequency instantaneous value. Phase selection is performed by the measuring circuit and phase 1, 2 ... has a priority. Frequency is displayed in Hz with 1 decimal place resolution (e.g.: 50.1).

3.6 Readout with zeroing function

At readout with zeroing the actual maximum demand registers are zeroed. The values in actual electrical energy registers stay without changes.

The historical registers are written by the circular mode of the record, i.e. circular queue FIFO type, i.e. if the new value is recorded, the oldest one is canceled. At each readout with zeroing a timestamp is also recorded.

- number of readout periods: 15
- blocking time between two manual resets: programmable between 0 minutes and 255 minutes.

Readout with zeroing method:

- automatically,
- manually via communication interface.

Automatic method is programmable:

- in the selected day of month from 1 to 28
- in the last day of month

Time is fixed to midnight.

At readout with zeroing there is made the copy of all actual energy registers and maximum demand registers content to historical registers in non-volatile memory.

Date and time of readout with zeroing (register 0.1.2.F)

At readout with zeroing the readout time and date is also recorded (register 0.1.2.F, F=0...99).

Historical registers

Historical registers are readout after historical periods. Only the registers activated for energy measurement are readout. The F OBIS field values are used for the readout periods identification, where F= 0..99 represents a readout with zeroing counter (VZ). VZ_{1} identifies the youngest readout period (last), VZ_{-1} second youngest readout period, etc.

List of energy historical registers:

- register of total active energy +A (register 1.8.0.F)
- register of total active energy -A (register 2.8.0.F)
- register of total reactive energy +R (register 3.8.0.F)
- register of total reactive energy -R (register 4.8.0.F)
- register of active energy: +A, rate 1 (register 1.8.1.F)
- register of active energy: +A, rate 2 (register 1.8.2.F)
- register of active energy: +A, rate 3 (register 1.8.3.F)
- register of active energy: +A, rate 4 (register 1.8.4.F)
- register of active energy -A, rate 1 (register 2.8.1.F)
- register of active energy -A, rate 2 (register 2.8.2.F)
- register of active energy -A, rate 3 (register 2.8.3.F)

- register of active energy -A, rate 4 (register 2.8.4.F)
- register of reactive energy +R, rate 1 (register 3.8.1.F)
- register of reactive energy +R, rate 2 (register 3.8.2.F)
- register of reactive energy +R, rate 3 (register 3.8.3.F)
- register of reactive energy +R, rate 4 (register 3.8.4.F)
- register of reactive energy -R, rate 1 (register 4.8.1.F)
- register of reactive energy -R, rate 2 (register 4.8.2.F)
- register of reactive energy -R, rate 3 (register 4.8.3.F)
- register of reactive energy -R, rate 4 (register 4.8.4.F)

Example of F OBIS field

F field value		Example
VZ	Last (youngest) value	1.8.0*01
VZ_{-1}	Second youngest value	1.8.0*00
VZ_{-2}	Third youngest value	1.8.0*99
VZ_{-3}	Fourth youngest value	1.8.0*98
VZ_{-4}	Fifth youngest value	1.8.0*97
	⋮	⋮
VZ_{-14}	Fifteenth value (the oldest value)	1.8.0*87

The separating character in OBIS behind the rate and before F indicates method of the performed readout with zeroing.

Example: *1.8.0*04 *04 readout with zeroing performed automatically*
1.8.0&04 &04 readout with zeroing performed manually
1.8.0&26 &26 readout with zeroing performed manually

3.7 Periodic records of active energy (Billing period 2)

Registers of the records represent the energy value measured during a measuring period. The period (register 0.8.7) is synchronized to the time 00 h 00 min and can be:

- day period (24 hours)
- hour period (1, 2, 3, 4, 6, 8, 12 hours).

During the period the energies are counted into the current registers. At the end of the billing period the values of the current registers are recorded into periodic records and the current registers are subsequently reset. There are 60 records of the FIFO type (when the new value is recorded, the oldest one is canceled). Each record includes a timestamp (register **0.1.5**).

Supported registers are listed in the table:

Registers (OBIS ID)	Name
1.9.0	Active energy +A, total (current registers)
1.9.0*F	Active energy +A, total (periodic record)
2.9.0	Active energy -A, total (current registers)
2.9.0*F	Active energy -A, total, (periodic record)
1.9.1	Active energy +A, rate 1 (current registers)
1.9.1*F	Active energy +A, rate 1 (periodic record)
1.9.2	Active energy +A, rate 2 (current registers)
1.9.2*F	Active energy +A, rate 2 (periodic record)
1.9.3	Active energy +A, rate 3 (current registers)
1.9.3*F	Active energy +A, rate 3 (periodic record)
1.9.4	Active energy +A, rate 4 (current registers)

1.9.4*F	Active energy +A, rate 4 (periodic record)
2.9.1	Active energy -A, rate 1 (current registers)
2.9.1.*F	Active energy -A, rate 1 (periodic record)
2.9.2	Active energy -A, rate 2 (current registers)
2.9.2*F	Active energy -A, rate 2 (periodic record)
2.9.3	Active energy -A, rate 3 (current registers)
2.9.3*F	Active energy -A, rate 3 (periodic record)
2.9.4	Active energy -A, rate 4 (current registers)
2.9.4*F	Active energy -A, rate 4 (periodic record)

Periodic records:

- For the periodic record register marking is used the field „F“ in the OBIS code, F = 0..99;
- There are 60 records and VZ represents the record register. VZ identifies the youngest (the newest) record, VZ_{-1} the second youngest record etc.

Example:

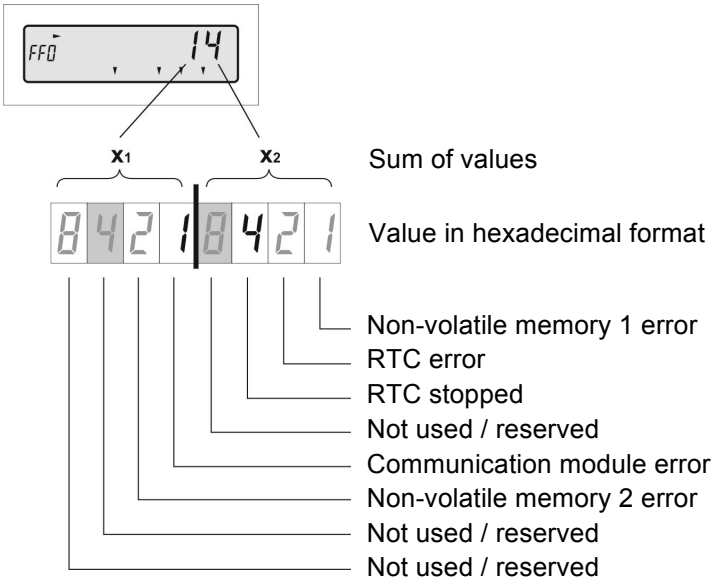
F field value		Example
VZ	Last (youngest) value	1.9.0*01
VZ_{-1}	Second youngest value	1.9.0*00
VZ_{-2}	Third youngest value	1.9.0*99
VZ_{-3}	Fourth youngest value	1.9.0*98
VZ_{-4}	Fifth youngest value	1.9.0*97
	⋮	⋮
VZ_{-59}	Sixty value (the oldest value)	1.9.0*42

3.8 Errors and events

Internal error message (register F.F.0)

During operation the electricity meter permanently monitors activities of some important circuits and prepares information for user in form of the internal error message. The running of the following circuits is monitored:

- non-volatile memory;
- microprocessor and its peripheries;
- RTC activity status.



In the case that the status of the monitored circuits is evaluated by the microprocessor as defective (voltage drop, incorrect communication with memory), then that fact is recorded in the modification of the respective status value:

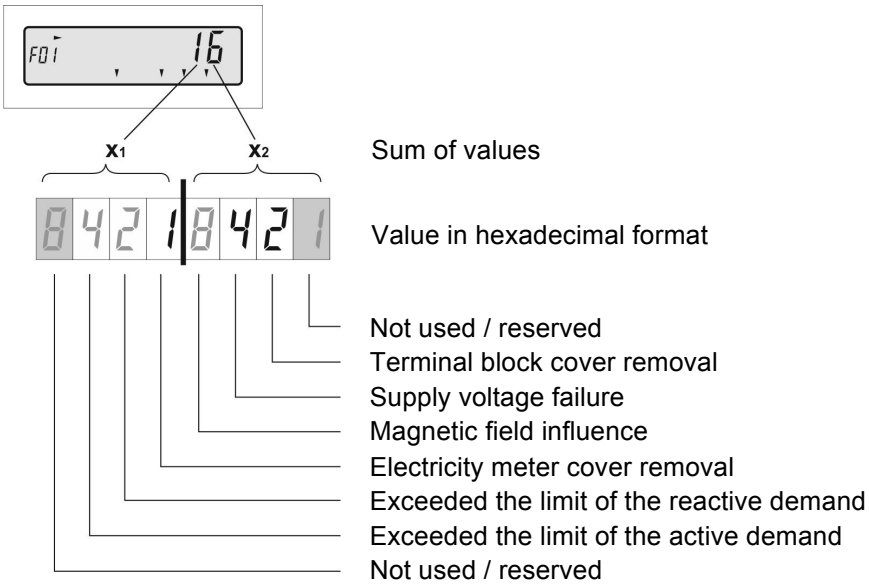
0 – status without failure, **1** – failure status. Internal error message is displayed on LCD in hexadecimal format $\mathbf{x_1x_2}$.

Part of displayed value is identifier OBIS - identification code before the value (F.F.0), without displaying of units. Other displayed segments describe the electricity meter actual status and are unrelated directly with the displayed value.

Internal status message (register F.0.1)

The electricity meter can registred in F.0.1 and record the following events:

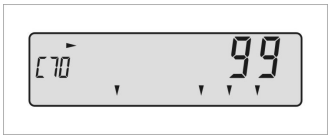
- power failure of all three phase,
- terminal block cover removal,
- tampering of measurement by magnetic field influence,
- electricity meter cover removal,
- exceeded the limit of the active demand,
- exceeded the limit of the reactive demand.



Event message can have 2 status values: **0** – event did not occur, **1** – event occurred. Internal status message is displayed on LCD in hexadecimal format $\mathbf{x_1x_2}$.

***Number of events (registers C.7.0** - number of phase voltage failures, **C.C.0** - number of terminal block cover violations, **C.C.2** - number of disturbances by magnetic field influence, **C.C.3** - number of electricity meter cover violations, **C.7.1** - number of phase L1 voltage failures, **C.7.2** - number of phase L2 voltage failures, **C.7.3** - number of phase L3 voltage failures)*

The events (tampering) are recorded as the number of occured events in appropriate counters. Maximum number of events can be 99 (00÷99). Afte number 99 follow 00, 01, 02 .... List and description of the registers are given in sec. 3.22 Marking of the electricity meter registers.



Example of display on the LCD Number of failures of all phase voltages simultaneously

3.9 Logbook

Every occurrence of the defined events is recorded by the electricity meter to the event profile (P.98) as an individual record.

- number of records: max. 570;
- recording to the memory by the circular mode of the record (i.e. circular queue FIFO type), i.e. if the new value is recorded, the oldest is deleted;
- readout is possible via optical communication interface and RS 485 (if any);
- readout is possible in one block or per partial blocks with the possibility of cancellation anytime during the readout. Number of items in partial blocks is set in programm AMsoft.

Structure of one record:

- event occurrence date/timestamp;
- event number.

Structure of one record at readout:

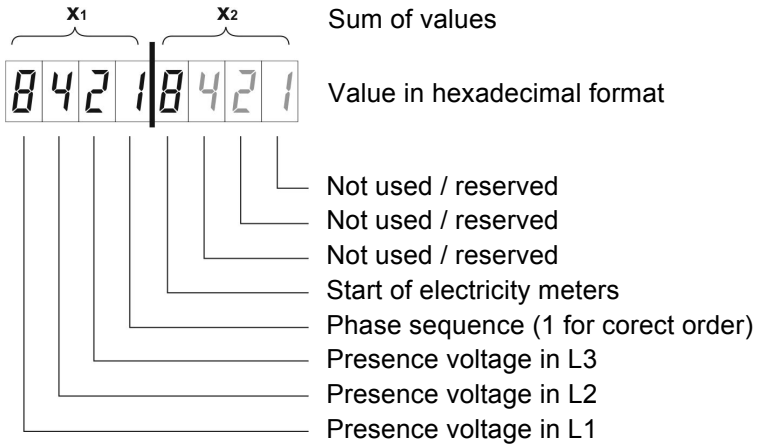
P.98 (ZYYMMDDHHMMSS)(SR)()(K)(OBIS)()(N)

where:

P.98 - code for event profile
Z=1 - summer time, **Z**=0 - winter time
YY - year, **MM** - month, **DD** - day
HH - hours, **MM** - minutes, **SS** - seconds
SR - Status Register
K - number of items
OBIS - OBIS code item
N - event code

Event status register (SR)

The status register indicates what event were monitored items during registered events. SR is displayed in hexadecimal format $\mathbf{x_1x_2}$.



The status register may acquire the following values at the time of recording events:

08 start of electricity meters
00 all phases failure
F0 all phases presence, correct phase sequence
E0 all phases presence, incorrect phase sequence
D0 missing phase L3
B0 missing phase L2
90 missing phase L2, L3
70 missing phases L1
50 missing phases L1, L3
30 missing phases L1, L2

Event types

Event code (N)	Event type
1	Missing Voltage L1
2	Restoration Voltage L1
3	Missing Voltage L2
4	Restoration Voltage L2
5	Missing Voltage L3
6	Restoration Voltage L3
7	All phases power fail
8	All phases power restoration
20	Terminal cover opened
21	Terminal cover closed
22	Meter cover opened
24	Meter cover closed
25	Magnetic field influence
91	Magnetic field influence terminated
92	Communication blocked, unauthorised access

Description of selected types of events

Measurement is disturbed by magnetic field influence (event 24)

A short-time (< 15 sec) influence is detected immediately on LCD by the arrow at mark **T4** in case of double-rate electricity meter.

The continuous influence of the magnetic field during at least 15 seconds is recorded to the event profile (Logbook) and to the internal status message F.0.1. Simultaneously the counter of the total disturbances by the magnetic field influence C.C.2 is incremented. At double-rate electricity meter the arrow at symbol **T4** lights permanently even when the magnetic field influence ended.

Electricity meter cover removal (event 22)

The electricity meter is not equipped with switch of meter. Counter of the meter cover removal C.C.3 is permanently on value 1.

Terminal block cover removal (event 20)

The event is indicated in internal status message F.0.1 and recorded to the event profile when it lasts continuously at least 7 seconds. It also increments the counter of the terminal block cover removal C.C.0. At meter version with 1 rate or 2 rates is removing of the terminal block cover immediately indicated by the arrow at symbol **T3**.

Missing voltage phases L1, L2, L3 (events 1, 3, 5, 7)

If there is no voltage in any phase the relevant arrow on LCD (at L1, L2 or L3) does not light up. The event is recorded to the event profile when it lasts continuously at least 7 seconds. When all three phases are missing, the event is indicated in the internal status message register F.0.1.

Events profile readout

Record readout can be performed by means of the optical probe or RS 485 and AMsoft PFO communication program AMsoft PFO.

***Readout example*:**

P.98 (0110302070513)(00)()(1)(201.152.0)()(8)	all 3 phases power restoration
P.98 (0110301150651)(00)()(1)(201.152.0)()(7)	all 3 phases missing
P.98 (0110301071524)(D0)()(1)(201.152.0)()(5)	missing phase L3
P.98 (0110301071524)(70)()(1)(201.152.0)()(1)	missing phase L1

Events profile zeroing and indication cancel

Deletion of the events, counter zeroing and cancel of the indications is possible by means of the optical probe or RS 485 and communication program AMsoft PFO.

3.10 Data profile

Electricity meter may record the values of some registers in its memory (according to meter version and setting) in the regular interval (registration period).
Data profile items selection and registration period is set by the program AMsoft.

Data profile allows:

- profile item variable selection
- number of items for selection to the profile: 13
- number of selected items (channels): max 5
- programmable registration period: 5, 10, 15, 20, 30, 60 minutes, synchronized to XX hours 00 minutes
- profile readout according to IEC
- readout of the whole profile or its part according to the entered start and end date
- profile readout in one block
- profile readout per partial blocks with the possibility of cancellation anytime during the readout.

Data profile deletion occurs:

- automatically at modification of the profile items selection
- automatically at modification of the actual time and date outside of the allowed range
- by command of the protocol via respective communication interface

Data profile message block contains:

- header, that is sent when the change of status code (SK) occured, or date (even at the beginning of a new day, or change the selection of at least 1 item
- one or more (maximum of five) items according to the selection

Header structure:

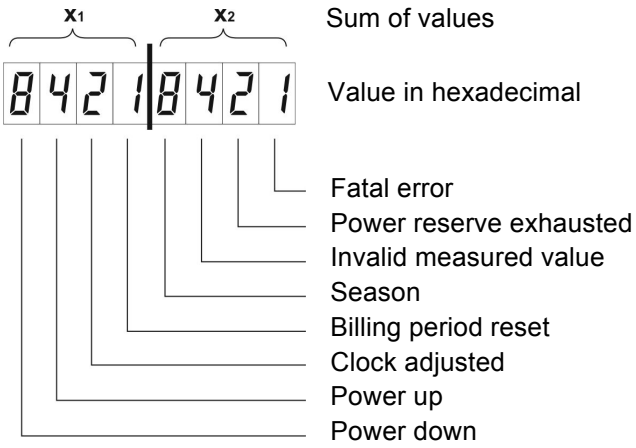
P.01 (ZYYMMDDHHMMSS)(SK)(RP)(K)(OBIS1)(UNIT1)(OBIS2)(UNIT2)...(OBIS5)(UNIT5)

where:
P.01 - OBIS code for data profile
Z=1 - summer time, **Z**=0.. winter time
YY - rok, **MM**...mesiac, **DD**...deň,
HH - hours, **MM**...minutes, **SS**...seconds
SK - status code
K - number of profile items
RP - registration period length (period of data record)
OBISx - OBIS code of x-th item (x=1..5)
UNITx - displayed value unit

SK data profile status code

Status code (SK) indicates that during registration period the event occurs. The list of events that may occur is given below and the status of each event is represented by one bit. SK final display consists of two characters in v hexadecimal format x_1x_2, where x_1, x_2 = 0...F.

If an event occurs, the corresponding bit is in state 1. If the event does not occur, the corresponding bit is in state 0.



Example: *If the SK value is 44, the individual events are in a state of 01000100, i.e.- power supply was connected measured value is invalid (during the registration period were set time).*

The list of the most frequently occurring values of SK:

00 During profile recording no event occured
C4 There was a disconnection of the power supply and then the power connection occured during the measured period, *invalid measured value*
84 Disconnection of the power supply occured, *invalid measured value*
44 Connection of the power supply occured, *invalid measured value*
5C There were a connection of the power supply, record to the historical registers, change of season, *invalid measured value* (electricity meter was without power supply at the time, when it was time for value recording to the historical registers, and also the change of seasons occured – from winter time to summer time or vice versa)
10 Record to historical registers occured
24 There have been setting the clock, *invalid measured value*
08 Change of seasons occured (from winter time to summer time or vice versa)

Data profile can be performed from the following items:

OBIS	Item (Register)
1.8.0	Active energy +A, total
2.8.0	Active energy –A, total
3.8.0	Reactive energy +R, total
4.8.0	Reactive energy -R, total
1.4.0	Active demand +P
2.4.0	Active demand -P
13	Power factor
32	Phase L1 voltage
52	Phase L2 voltage
72	Phase L3 voltage
31	Current in phase L1
51	Current in phase L2
71	Current in phase L3

Data profile readout from electricity meter is carried out using optical probe, RS 485 interface or Mesh module and program AMsoft PFO according to IEC. After readout the data profile header is shown and then selected registers data readout are displayed.

Data profile readout example (defined for the registration period: 5 minutes, registers: A+, A-, R+, R-, U2, number of registered items - channels in the readout: 5):

P.01(1110627075200)(44)(5)(5)(1.8.0)(kWh)(2.8.0)(kWh)(3.8.0)(kvarh)(4.8.0)(kvarh)(52)(V)	07.52 change SK=44, power supply connected, measured values can be invalid
(875.3)(437.6)(437.6)(437.7)(201.6)	07.52 measured values
P.01(1110627075500)(00)(5)(5)(1.8.0)(kWh)(2.8.0)(kWh)(3.8.0)(kvarh)(4.8.0)(kvarh)(52)(V)	07.55 change SK=0, all is OK
(875.6)(437.8)(437.8)(437.8)(204.0)	07.55 measured values
(876.3)(438.1)(438.1)(438.1)(204.7)	08.00 measured values
(877.0)(438.5)(438.5)(438.5)(205.5)	08.05 measured values
(877.7)(438.8)(438.8)(438.8)(204.4)	08.10 measured values
(878.3)(439.1)(439.1)(439.2)(202.7)	08.15 measured values
(879.0)(439.5)(439.5)(439.5)(204.8)	08.20 measured values
P.01(1110627082400)(84)(5)(5)(1.8.0)(kWh)(2.8.0)(kWh)(3.8.0)(kvarh)(4.8.0)(kvarh)(52)(V)	08.24 change SK=84, power supply disconnected measured values can be invalid
(879.6)(439.8)(439.8)(439.8)(191.0)	08.24 measured values
P.01(1110627082500)(44)(5)(5)(1.8.0)(kWh)(2.8.0)(kWh)(3.8.0)(kvarh)(4.8.0)(kvarh)(52)(V)	08.25 change SK=44, power supply connected measured values can be invalid
(879.6)(439.8)(439.8)(439.8)(191.0)	08.25 measured values
P.01(1110627083000)(00)(5)(5)(1.8.0)(kWh)(2.8.0)(kWh)(3.8.0)(kvarh)(4.8.0)(kvarh)(52)(V)	08.30 change SK=0, all is OK
(880.2)(440.1)(440.1)(440.1)(203.6)	08.30 measured values
(880.9)(440.4)(440.4)(440.4)(204.0)	08.35 measured values

Capacity

Data profile size depends on the number of the selected profile items and used memory. Minimum number of the celected profile items is 1, maximal 5. At recording period of 15 minutes the data profile can cover at least 115 days at one or two profile items and at using of basic memory. At selection of three and more profile items to make a record of the required number of days it is necessary to use a larger data memory. At maximum memory and configuration: recording period 15 minutes, 5 items (channels) cover 223 days.

Actual time and date setting effect

Date and time modification can cancel the data profile. Therefore it is recommended to readout the data profile before the date and time modification. Every actual time setting is recorded in the profile status code.

- Shifting of the actual time and date **forward**: Registration period is restarted, measured data are marked as invalid. Data profile is not deleted.
- Shifting of the actual time and date **backward**: Registration period is restarted. If the new time is outside of the running registration period, the whole data profile is deleted (data profile records with the same timestamps can not be processed correctly). If the new time is within of the previous registration period, measured data are marked as invalid and profile data is not deleted.

Profile deletion

- The whole data profile is deleted automatically, if the actual time and date is shifted backward and the new time and date is outside of the previous recording period.
- The whole profile is deleted, if the profile items are redefined.
- The data profile can be deleted externally by a command through optical interface.

3.11 Time display

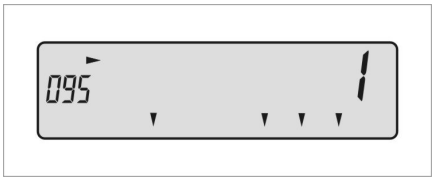
Real time function is provided by the real time circuit (RTC) providing the actual date, time and day of week. Those parameters can be set up or modified by means of optical probe and AMsoft-PFO program in two different ways: time synchronization with PC/HHU (hand held unit), or setting up from PC/HHU. Hundred years' calendar is programmed in RTC circuit. After date setup the day of week is set automatically according to that calendar. RTC circuit accuracy is within the range of ± 15 sec / month.

In the case of phase voltage failure the RTC circuit is supplied from the backup lithium battery (3V, 10 years lifetime).

Note: *Date (092) is displayed in YY.MM.DD format.*

Time display

Date display



Day of week display

Summer time (Daylight Saving time)

The electricity meter's time shift is set according to European Union standards.

Summer time starts on Sunday, 25th of March, or on the first Sunday after 25th of March. That day the real time clock is shifted from 02.00 hour to 03.00 hour. Summer time ends on Sunday, 25th of October, or on the first Sunday after 25th of October. That day the real time clock is shifted back from 03.00 hour to 02.00 hour. Time shift can be enabled or prohibited.

Format the date and time in Readout

The format is programmable:

- with separation characters: date RR-MM-DD, time HH:MM:SS, date and time: RR-MM-DD HH:MM:SS,
- without separation characters: ZRRMMDD, time: ZHHMMSS, date and time: ZRRMMDDHHMMSS,

where: Z – 1… summer time, 0… winter time, RR – last two digits of the year, MM – month, DD – day, HH – hour, MM – minutes, SS…seconds.

3.12 Time synchronization

Synchronization is performed on basis of received time setiing command via a communication interface. If the time difference between the current time of electricity meter and the new time received via the communication interface is higher than 1 sec, the synchronization occurs as follows:

- If the time difference is **smaller than 1 sec** - *no reaction*.
- If the time difference is between **1 sec and 9 sec** - *time shift by the time difference*.
- If the time difference is between **9 sec and 30 sec** - *time shift by 9 sec*.
- If we want to set the time, it is needed to repeat the commands for synchronization. Resyncing can be blocked for a period of 1 min up to 1 440 min (1 day).

  Example: *If the time difference is 25 sec, the exact time is achieved by repeated synchronization 9 sec + 9 sec + 7 sec.*
- If the time difference is **higher than 30 sec** - *new time setting*.

Note: *The synchronization does not affect the time meter operations (demand, data profiles), but time setting affects this operations.*

The program AMsoft allows:

- To enable or disable the synchronization feature.
- Not to block reapeating of the enabled synchronization or to block for a defined number of minutes (from 1 up to 1 440 min).

3.13 Data archiving

Processor stores all measured data in non-destructive memory. Data recording is performed automatically once per hour and at every voltage failure.

3.14 Rate switch (ToU)

Rate control

- programmable way of rate control
- number of rates: max. 4 for each energy type
- ways of rate switching: internal or external

Internal rate management

The electricity meter is equipped by the rate module controlled by the real time internal clock and calendar. It allows to use maximum 4 rates at measurement of all electricity types.

ToU is programmable and contains:

- 15 switching-on rate times daily, switching-on time step is 1 minute and it is synchronized to XX hours 00 min.,
- 8 daily tables,
- 5 weekly tables,
- 5 seasons,
- 50 special days.

The daily tables define the daily schedule of rate switching on. The weekly table allows allocation of the daily table to each day. One of 5 weekly tables can be allocated to the season table. The season start is defined as the first calendar day of month. The season end is the date of the new season.

External control of rates
The special version allows performing of the external control of the rates by connecting of power supply to the terminals 13-15. Such version of the electricity meter can be set up as one-rate or two-rates using AMsoft program. It is also possible to set up the rate selection when voltage is connected or disconnected.

3.15 Identification number (register C.1.1)

8-digit identification number is used for addressing at communications via RS 485. It can be parametrized by the user by means of optical probe and AMsoft PFO program.

3.16 Electricity meter password

The electricity meter password is 8-characters alphanumeric combination with starting value of 00000000. The password is required by the electricity meter in AMsoft PFO parametrizing program of each access level, at modification of any parameter or at zeroing of the allowed registers.

Password protected against guessing. Number of incorrect attempts is max 4. Fifth entering the wrong password causes the refusal of access (communication) at that level until the end of the day, even if the following entered password would be correct. Date and time of last unauthorized access are written in the object C.50.2. Access is automatically released on the following day. At the same time there are the events about blocking and unblocking communication recorded to the logbook.

3.17 Parametrization of the electricity meters

Electricity meters records:

- Date and time of the last parameterization (C.2.1),
- Number of the parametrication (C.2.0).

3.18 Setting of the current transformer ratio (CTR)

There are two possibilities of the current transformer ratio setting at the transormer operated meters (CT). **Ratio can be set up by the manufacturer** and by then it can not be changed by the user.

Manual setting. If a user wants to set up the ratio himself, it is possible after agreement with producer (it is necessary to put it in order). In this case, it is possible to set up the ratio only once when it is first connected to the power.

After connecting to the network the electricity meters get to cyclic mode and it measures with current transformer ratio 5/5 A.

After activating of **button/sensor step** can be set:

- Test mode
- Manual setting of the current transformer ratio

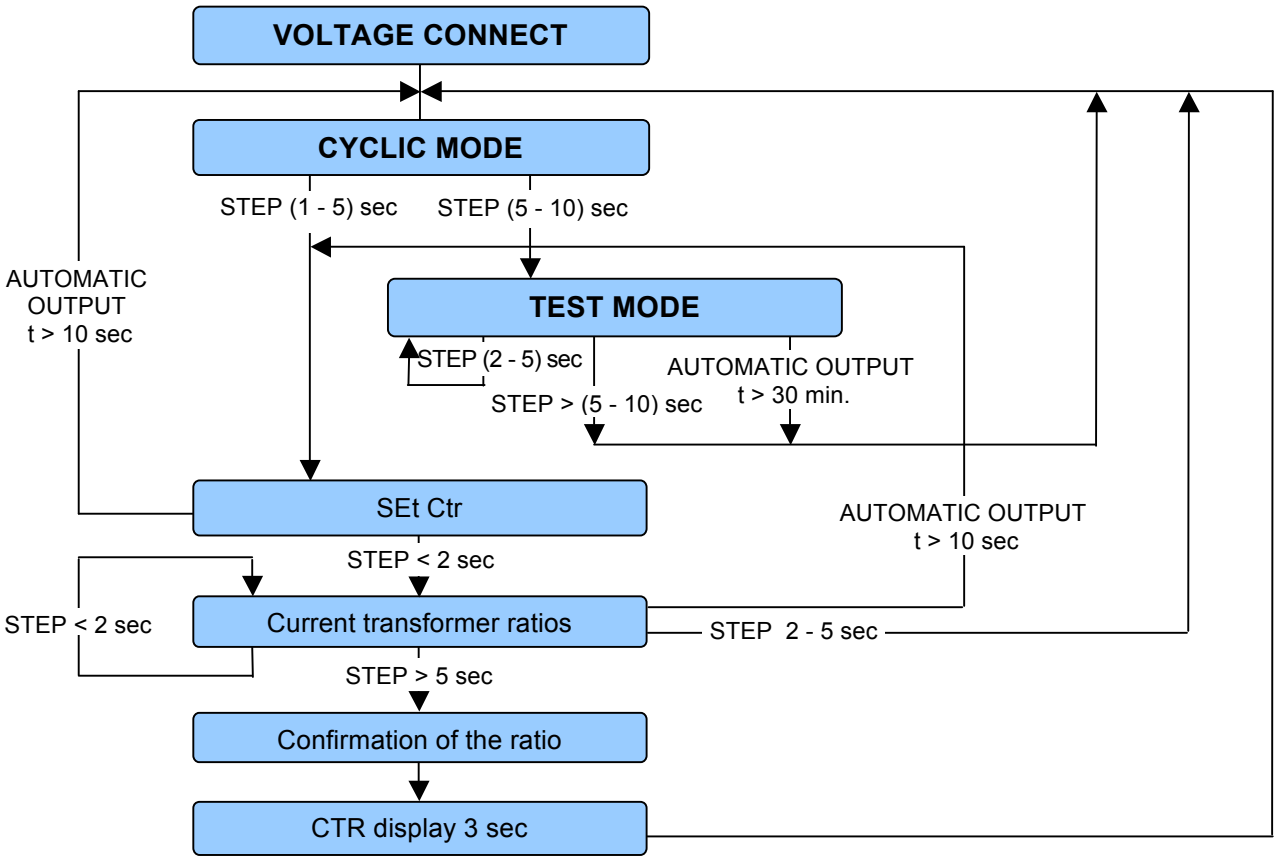
Electricity meter running at the **button/sensor step** activation in **cyclic** mode:

- activation time from 1 sec up to 5 sec: calling of manual setting of the current transformer ratio;
- activation time from 5 sec up to 10 sec: passing to the test mode;
- activation time more than 10 sec: No reaction, prevents to the effects of the permanent light on **sensor** and permanent long-time activated **button**.

Electricity meter running at the **button/sensor step** activation in **test** mode:

- activation time up to 2 sec: next item;
- activation time > 5 sec: termination of the test mode.

Manual setting of the current transformer ratio is possible only in cyclic mode.



Manual setting of the current transformer ratio

Manual setting of the ratio procedure:

- After calling of the manual setting the LCD displays „SEt Ctr“.
- When **button/sensor step** is not activated at least 10 sec the meter returns to the cyclic mode.
- After activation of the **button/sensor step** LCD displays „5–5“, the first flashing value from the current transformer ratio table (CTR=1).
- After short activation of the **button/sensor step** (< 2 sec) the following flashing value from the current transformer ratio table is shown.
- Long activation of the **button/sensor step** (from 2 up to 5 sec) causes the setting mode cancel and automatic return to the cyclic mode.

- When **button/sensor step** is activated longer than 5 sec, the displayed ratio is confirmed. On LCD is shown OBIS code of the ratio 0.4.2 and value of the multiplier CTR for 3 sec. Then automatically passes to the cyclic mode.
- When **button/sensor step** is not activated at least 10 sec the automatic return to the begining of the setting mode occurs. On LCD is displayed „SEt Ctr“.
- If during ratio setting disconnect and reconnect of the power supply occurs, ratio setting mode is cancelled.

Example: *If the ratio 3000 – 5 is confirmed, on LCD is displayed 0.4.2 600.*

After confirmation of the ratio other manual ratio setting is prohibited.

Timeouts in manual ratio setting:

1. On LCD is **SEt Ctr** (**button/sensor step** is not activated): **10** sec, return to the cyclic mode.
2. On LCD is flashing ratio displayed (**button/sensor step** is not activated): **10** sec, return to the bigining of the ratio setting. On LCD is displayed **SEt Ctr**.
3. On LCD is flashing ratio displayed (**button/sensor step** is not activated): **20** sec, return to the cyclic mode.
4. After confirmation of the ratio (**button/sensor step** is activated > 5 sec): for **3** sec is multiplier CTR with OBIS 0.4.2 displayed and then the return to the cyclic mode occurs.

There are the following defined CTR values: 1, 10, 12, 15, 20, 24, 25, 30, 40, 50, 60, 80, 100, 120, 150, 160, 200, 240, 250, 300, 400, 480, 500, 600 for measurement in kWh, on special request 800, 1000, 1200, 1500 in MWh.

At electricity meters with manual current transformer ratio setting is preset for the value 5/5. After calling the ratio setting mode it is necessary to select and confirm one of the ratio, otherwise it is not possible to pass to the other modes of the electricity meters.

3.19 Electricity meter setting

The electricity meters are set by manufacturer by means of the special procedure.

3.20 AMsoft communication program

Parametrizing, readout and zeroing of the registers can be performed by means of optical probe and **AMsoft-PFO** communication program. The program description is stated in the separate document.

3.21 Starting-up and operation

The electricity meter is connected to the measured network according to the external connection diagram (see connection diagram). Connection must correspond with the electricity meter version (direct, semi-direct). After connecting to a network LCD automatically passes to the cyclic mode of register displaying and the electricity network actual status is indicated by signaling elements.

3.22 Marking of the electricity meter registers (OBIS codes)

The electricity meter stores the measured and calculated data into its memory to the special registers. LCD allows displaying of selected registers in the cyclic, stepping or testing mode. Displaying of the other registers allows readout at Readout mode or at Data profile. Not all registers are active, it depends on the electricity meter version.

List of registers

Registers (OBIS ID)	Name
0.9.1	Actual time
0.9.2	Actual date
0.9.5	Day of week
1.8.0	Active energy +A, total
1.8.0.F	Active energy +A, total, historical registers
1.8.1	Active energy +A, rate 1
1.8.1.F	Active energy +A, rate 1, historical registers
1.8.2	Active energy +A, rate 2
1.8.2.F	Active energy +A, rate 2, historical registers
1.8.3	Active energy +A, rate 3
1.8.3.F	Active energy +A, rate 3, historical registers
1.8.4	Active energy +A, rate 4
1.8.4.F	Active energy +A, rate 4, historical registers
2.8.0	Active energy -A, total
2.8.0.F	Active energy -A, total, historical registers
2.8.1	Active energy -A, rate 1
2.8.1.F	Active energy -A, rate 1, historical registers
2.8.2	Active energy -A, rate 2
2.8.2.F	Active energy -A, rate 2, historical registers
2.8.3	Active energy -A, rate 3
2.8.3.F	Active energy -A, rate 3, historical registers
2.8.4	Active energy -A, rate 4
2.8.4.F	Active energy -A, rate 4, historical registers
3.8.0	Reactive energy +R, total
3.8.0.F	Reactive energy +R, total, historical registers
3.8.1	Reactive energy +R, rate 1
3.8.1.F	Reactive energy +R, rate 1, historical registers
3.8.2	Reactive energy +R, rate 2
3.8.2.F	Reactive energy +R, rate 2, historical registers
3.8.3	Reactive energy +R, rate 3
3.8.3.F	Reactive energy +R, rate 3, historical registers
3.8.4	Reactive energy +R, rate 4
3.8.4.F	Reactive energy +R, rate 4, historical registers
4.8.0	Reactive energy -R, total
4.8.0.F	Reactive energy -R, total, historical registers
4.8.1	Reactive energy -R, rate 1
4.8.1.F	Reactive energy -R, rate 1, historical registers
4.8.2	Reactive energy -R, rate 2
4.8.2.F	Reactive energy -R, rate 2, historical registers
4.8.3	Reactive energy -R, rate 3
4.8.3.F	Reactive energy -R, rate 3, historical registers
4.8.4	Reactive energy -R, rate 4
4.8.4.F	Reactive energy -R, rate 4, historical registers
C.1.0	Electricity meter serial number
C.7.0	Total number of phase voltage failures
C.7.1	Total number of phase L1 voltage failures
C.7.2	Total number of phase L2 voltage failures
C.7.3	Total number of phase L3 voltage failures
C.C.0	Total number of terminal block cover violations
C.C.2	Total number of disturbances by magnetic field influence
C.C.3	Total number of electricity meter cover violations
F.F.0	Internal error message
F.0.1	Internal status message

1.4.0	Current average demand, active +P
1.5.0	Last average value of demand (for the last measuring period), active +P
1.6.0	Maximum demand, active +P
1.6.0.F	Maximum demand, active, historical registers
1.35.0	Threshold for active demand overlimit
1.36.0	Number of the active demand limit exceedances register
1.36.0.F	Number of the active demand limit exceedances register, historical registers
3.4.0	Current average demand, reactive +Q
3.5.0	Last average value of demand (for the last measuring period), reactive +Q
3.6.0	Maximum demand, reactive +Q
3.6.0.F	Maximum demand, reactive, historical registers
3.35.0	Threshold for reactive demand overlimit
3.36.0	Number of the reactive demand limit exceedances register
3.36.0.F	Number of the reactive demand limit exceedances register, historical registers
1.7.0	Instantaneous active power +P (in 1 sec)
2.7.0	Instantaneous active power –P (in 1 sec)
0.2.0	Firmware version
32	Phase L1 voltage
52	Phase L2 voltage
72	Phase L3 voltage
31	Current in phase L1
51	Current in phase L2
71	Current in phase L3
13	Power factor
14	Phase frequency
0.1.0	Total number of readout with zeroing
0.4.2	Current transformer ratio multiplier
0.8.0	Measuring period (for power)
0.8.4	Registration period (for data profile)
C.2.1	Date of the last electricity meter parametrization
C.1.1	Identification number of the electricity meter (RS485 communication)
0.2.2	ToU table name
C.6.0	Battery usage time
C.6.1	Remaining battery capacity
C.50.1	Firmware checksum
C.10.1	Clock status register
C.2.0	Number of parametrization sessions
C.50.2	Date and time of last unauthorized access
0.0.5	customer ID5 (16 ASCII characters)
0.0.6	customer ID6 (16 ASCII characters)
0.0.7	customer ID7 (16 ASCII characters)
0.0.8	customer ID8 (16 ASCII characters)
0.0.9	customer ID9 (16 ASCII characters)

Notes:

1. *F identifies readout counter with VZ zeroing. F=0.. 99, hereof 15 archived. Separator before F is * or & according to the method of readout with zeroing.*
2. *Historical registers can only be displayed in Readout.*
3. *OBIS ID are displayed on LCD without dots, for example 1.8.0 is shown as 180.*
4. *Items with gray background can be displayed in a cyclic and step mode.*
5. *In testing mode are displayed total energy registers.*

3.23 Access levels

For the user of the electricity meter are available four access levels for: parameters record, direct command „perform“ and objects readout according to the following tables:

Access levels for parameters record and performing command

Level	**0**	**1**	**2**	**3**	**4**
Terminal block cover	**closed**	**closed**	**closed**	**opened**	**opened**
Password P2	**not required**	**not required**	**required**	**not required**	**required**
Password P1	**not required**	**required**	**required**	**not required**	**required**
Name of the object (group)					
Actual time, date, day	-	x	x	x	x
ToU tables (daily, weekly, seasonal, table name)	-	-	x	x	x
The display table (cyclic, step)	-	-	x	x	x
List of data for reading (readout list)	-	-	x	x	x
Permit of the shift time winter/summer	-	x	x	x	x
Enabling of the time synchronization	-	-	x	x	x
Block of the synchronization time set	-	-	x	x	x
Record to the historical registers (BPReset – cumulation)	-	x	x	x	x
Status register reset (events indication)	-	x	x	x	x
Modes switching cyclic / test	x	x	x	x	x
Display format (only direct electricity meter)	-	-	-	x	x
BPReset: Performing day	-	-	x	x	x
BPReset: Blocking time	-	-	x	x	x
Password P1	-	x	x	x	x
Error register reset	-	-	x	x	x
Performing of the Event zeroing (logbook), including counters	-	-	x	x	x
Measuring period (maximum)	-	-	-	x	x
Number of historical periods in readout: Optical communication	-	-	x	x	x
Number of historical periods in readout: RS485	-	-	x	x	x
Data profile: Integration period	-	-	x	x	x
Data profile: object selection	-	-	x	x	x
Data profile: Performing of the zeroing	-	-	x	x	x
Identification number (RS485 communication)	-	-	-	x	x
Configuration of external rates control	-	-	x	x	x
Current transformer ratio	-	-	-	-	x
Permit of the manual CTR setting	-	-	-	-	x
Optical port: proposed speed	-	x	x	x	x
RS485: speeds: initiatory and proposed speeds	-	x	x	x	x
Customer identification fields	-	-	x	x	x
Mesh parameters (customer): ID of the network, power, channel	-	-	x	x	x

Access levels for objects readout

Level	0	1	2	3	4
Terminal block cover	closed	closed	closed	opened	opened
Password P2	not required	not required	required	not required	required
Password P1	not required	required	required	not required	required
Name of the object (group)					
Readout	x	x	x	x	x
Any object readout	-	x	x	x	x

x available - inaccessible

4 Assembly, operation and maintenance

The electricity meter is intended for internal assembly. The meter is fixed on DIN 35 bar by using special holders. Terminal block protection is IP20 and it is needed to place electricity meters in the box with higher coverage than IP51. The electricity meter is connected according to the connection diagram located inside of the terminal block cover. Connecting of the meter to network can be performed only by persons with respective professional qualification.

After connecting to the network LCD automatically passes to the cyclic mode of data displaying.

Simultaneously it is necessary to verify the normal function of indicators. Connection to voltage and correct phase sequence is indicated by arrows at L1, L2, L3 on LCD. If the phase sequence is correct the arrows L1, L2, L3 lights permanently. Energy measurement is signaled by flashing of LED **TO_A**, (**TO_R**), which frequency corresponds to measured active (reactive) energy.

The correctness of the wire connections must be watched according to the indicators (arrows) of the energy measuring quadrants ◂▴▸ (QI up to QIV quadrant).

When the functioning correctness is verified, it is necessary to cover and seal the terminal block cover.

The electricity meters do not require operator, apart from the data readout and the regular verification of data in the intervals and according to the standards determined in the country of usage. The electricity meters do not require maintenance. It suffices to clean them from dust and dirt and to tighten the screws on the terminal block cover.

The producer is not responsible for possible damages arisen out by wrong assembly, operating or maintenance of the electricity meter.

Minimum necessary number of pulses for achieving of measurement repeatability at verifying:
Electricity meter with 1000 imp/kWh constant:

Current	Three-phase symmetric load			One-phase load	
	PF=1	PF=0.5i	PF=0.8k	PF=1	PF=0.5i
I_{min}	1	-	-	-	-
I_{tr}	1	1	1	1	1
$10I_{tr}$	1	1	1	2	1
I_{max}	12	6	10	4	2

Electricity meter with 5000 imp/kWh constant:

Current	Three-phase symmetric load			One-phase load	
	PF=1	PF=0.5i	PF=0.8k	PF=1	PF=0.5i
I_{min}	1	-	-	-	-
I_{tr}	1	1	1	1	1
$10I_{tr}$	5	3	4	2	1
I_{max}	60	30	50	20	10

Note: *The values mentioned above are valid for the constant of accuracy class B(1). The accuracy class A (2) needs minimally half number of the pulses.*

5 Packing, transport and storage

Each electricity meter is packed in a cardboard box. The packed electricity meters are sent in the cardboard boxes per 10 pieces individually or on pallets. The package is environmentally friendly and recyclable.

The packed electricity meter can be transported by usual transportation means. With respect to its sensitivity it is necessary to avoid the excessive impacts and to transport it at ambient temperature from -40 °C to +70 °C and at corresponding humidity max 95 % at temperature of +30 °C. The electricity meters must be stored at ambient temperature from -40 °C to +70 °C in dry environment without aggressive vapors, gases and dust. The average relative humidity must not exceed 75 %.

6 Service and guarantee

For this kind of product the service is provided by its manufacturer, the firm Applied Meters, with the seat in Prešov, Budovateľská 50, Slovak Republic, tel. No. 051 – 758 1169, fax No. 051 - 758 11 68, E-mail: info@appliedmeters.sk. The firm Applied Meters will provide the service in particular countries through the business partners and agreed service organizations.

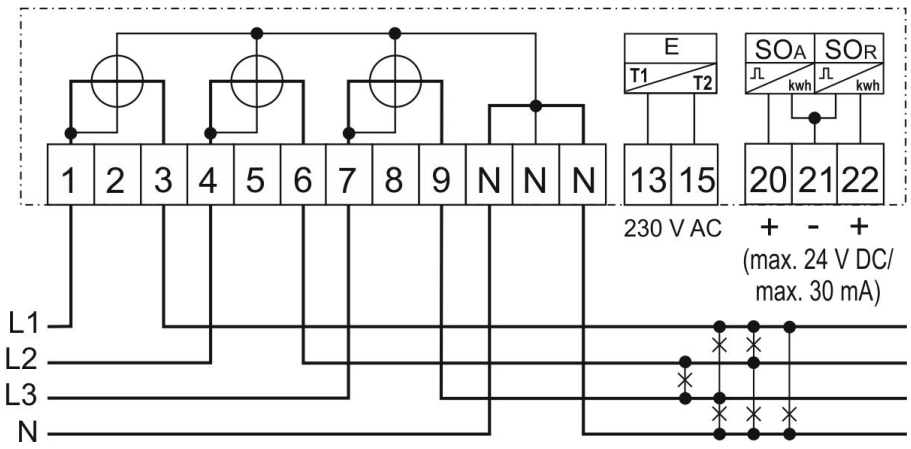
Guarantee period for this kind of meter is 24 months since the day of delivery. Length of the guarantee period may be modified in purchase agreement.

The seller is responsible for complexity of the product and for production errors, what were complained in time and in the written form. The seller is responsible for keeping the product performance settled by technical standards for prescribed period or other performance features, agreed in the purchase agreement, eventually usual performance described in catalogue sheet and in this user manual. The electricity meter, what during guarantee period has presented error of the manufacturer will be repaired by the manufacturer or by the firm, entitled to perform guarantee repairs free of charge or will change it for a new one.

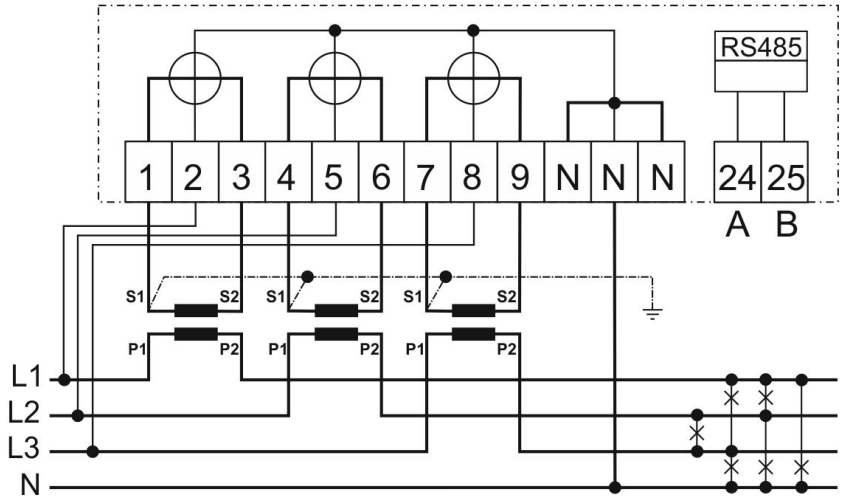
The seller is not responsible for the product features worsening or for its damage, what was caused by the purchaser or somebody else by not appropriate storing, transport, performing product modification, by violent or negligent influence of the product, or by other means, or if it was caused by unavoidable events.

After finishing the guarantee period, during life expectancy of the meter, the repairs are realized by the manufacturer or by service firm.

7 Connection diagrams - examples



Direct connection *(SO - transmitting outputs of active and reactive energy, E - external control of second rate)*



Indirect connection *(RS485 – interface)*

8 Dimensional drawing