Multifunction Meter of active, reactive and apparent Electric Energy

EPQS

User Manual

Version 5

"ELGAMA – ELEKTRONIKA", Lithuania 2007

“ELGAMA-ELEKTRONIKA”

EPQS
Multifunction Meter of Active, Reactive and Apparent Electric Energy

User Manual

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This user manual describes the electronic multifunction EPQS meter of electric energy and the use of the meter. Please read this document carefully before installing and using the meter. The manufacturer’s warranty shall not apply if the meter is damaged as a result of failure to comply with the requirements described in this manual or registration certificate or those of work safety.

The manufacturer shall not be held liable for any kind of loss incurred by the meter parameterization performed not following instructions described in the users program as well as recommendations and State-defined tariffs. The manufacturer shall be not held liable for any damage related to partial or total data loss due to unprofessional actions of authorized persons.

This user manual describes all possible features, functions, and auxiliary outputs of the electrical energy meter. Your meter might not have some features, functions, or auxiliary outputs described in this document. The exact configuration, features, accessories, and connection diagram of the meter is provided in its registration certificate.

Table of Contents

1. Purpose and Features

The EPQS meter is a multifunction device for measurement of electric energy. CT operated meters comply with requirements of IEC 62053-22 standard, class 0,5 or 0,2s.

The meter data structure is compatible with DLMS standard. Each measured parameter has its OBIS (OBject Identification System) code describing the parameter or value. OBIS codes together with allocated parameters are transmitted through the communication interfaces and displayed on the meter LCD display screen.

The meter measures, registers, and collects data on active energy of both directions (+A, -A), reactive energy of both directions (+R, -R), reactive energy in four quadrants (R1, R2, R3, R4), and apparent energy of both directions (+W, -W). The meter also registers maximums of average power, collects load profiles and registers cumulative powers.

Besides the aforementioned values, the EPQS meter can display or transmit via its communication interfaces the following profiles stored in any of 16 freely programmed channels: phase and line voltages; currents; instantaneous active, reactive, and apparent power; frequency; power factor (cos φ). It can also analyze power quality and generate weekly reports of power grid quality.

Up to eight of energy and the same number of power maximum tariffs can be activated for tariffication of energy and power. The structure of tariff module lets adapt the meter for virtually any of existing tariff program.

For remote data transmission, the meter has two independent electrical communication interfaces. For local data readout, optical interface D0 is provided.

Several modifications of EPQS meter are manufactured. They may differ in nominal current, voltage, connection type, and the meter hardware or software. The designation of different modifications of EPQS meter is explained in Table 1-1.

1.1. Marking of meter modifications

Table 1-1. Explanation of meter modification code

EPQS	**X**	**X**	**X.**	**XX.**	**XX**
Measuring elements:					
3 elements, 4 – wire connection	1				
Rated voltage, V:					
3x57,7/100; 3x63,5/110; 3x69,2/120; 3x100; 3x110; 3x120		1			
multi range (3x57,7 ...230/100 ...400)		2			
3x220/380; 3x230/400; 3x380; 3x400		3			
3x120/208; 3x127/220; 3x220; 3x230		4			
Rated (maximal) current, A:					
CT connection 5(6,25)			1		
CT connection 5(10)			2		
CT connection 1(2), 1(1,25)			3		
CT connection 1(6)			4		
			5		
Software code:					
Hardware code:					
Hardware of class 0.2s					2X

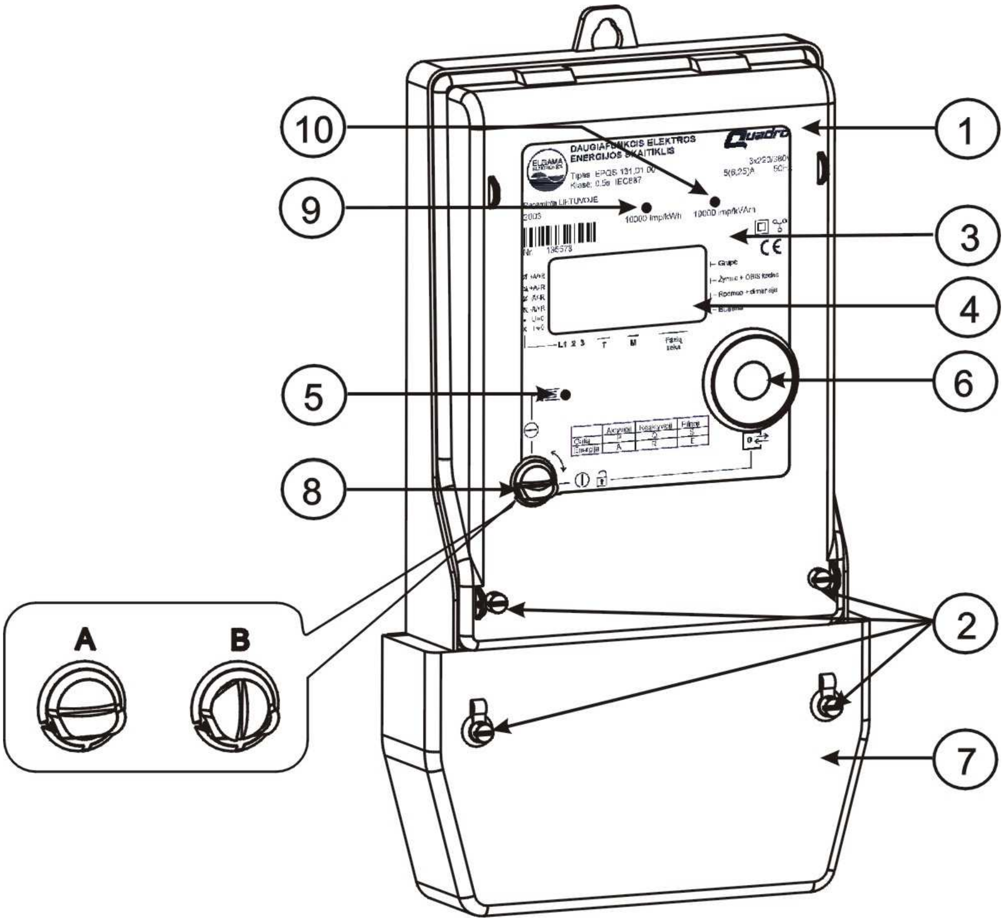
1.2. Technical Specifications

Accuracy class:	
CT operated	0.2s or 0.5s (IEC 62053-22)
Rated voltage, V	see table 1-1
Rated (maximum) current, A	see table 1-1
Rated frequency, Hz	50 or 60
Sensitivity threshold, %I_{nom}	
CT operated	0,1
Power consumption, VA	
in voltage circuits	2 (0,76W)
in current circuits	0,4/phase (CT operated)
Meter constant, imp/kWh	≤130000
Communication interfaces:	
optical interface D0	IEC 62056-21
electrical interface I	IEC 62056-31
electrical interface II	IEC 62056-31
pulse outputs:	
number:	6 (independent)
output constant, imp/kWh (imp/kVArh):	≤130000
pulse duration, ms	≥ 30
External backup power supply:	= 12V
Tariff module:	
number of energy tariffs:	programmable (1 … 8)
number of maximum demand tariffs:	programmable (1 … 8)
Data storage without power supply:	20 years (t=20℃); 2 years (t=60°C)
Backup supply of internal clock:	Li battery
Battery resource for not connected meter	> 5 years
Insulation:	
pulse voltage test (IEC 60060-1)	6kV
alternating voltage test	4kV
Operating temperatures	-40℃ … +60℃
Storage and transportation temperatures	-50℃ … +70℃
Weight, Kg:	< 1,5
Dimensions, mm^3	325 x 177 x 55

2. Design

2.1. Case

Picture 2-1 presents the external view of the device.



Picture 2-1. Meter exterior

1	Transparent cover	6	Optical communication interface;
2	Sealed screws;	7	Terminal block cover
3	Meter panel;	8	Button
4	Liquid Crystal Display;	9	Light emitting diode (LED) 1;
5	Display control photo sensor	10	Light emitting diode (LED) 2;

The meter panel is covered by transparent cover moulded from UV ray-stabilised polycarbonate cover providing protection from external mechanical factors and moisture.

The cover is fixed to the case by two sealed screws.

The liquid crystal display (LCD) is located in the frontal part of the meter. It allows the display of all values stored in the memory, instantaneous values and parameters.
On the lower left, a display control photo sensor is located. In order to display specific information on the display, a corresponding light signal must be transmitted to the photo sensor.

The D0 optical interface is located on the right side of the frontal part. The purpose of this interface is data transfer between the meter and a portable computer or terminal and the meter parameterisation.

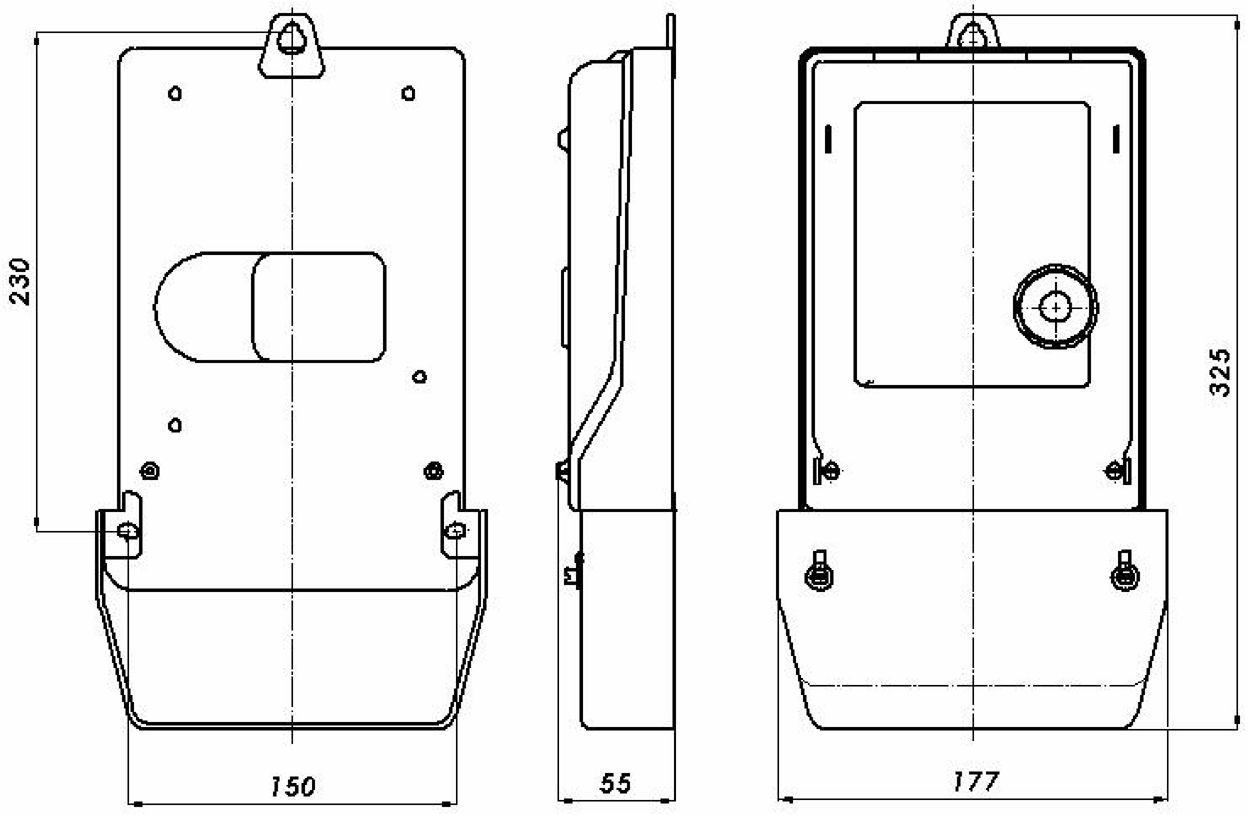
The meter has its own backup power supply that provides power to the internal clock should the main electrical network fail. The backup supply consists of a standard 3.6 V Li-Ion battery. If a *–Battery low-* message appears on the display, the battery must be replaced.

Only the manufacturer or its authorised representative may replace the battery!

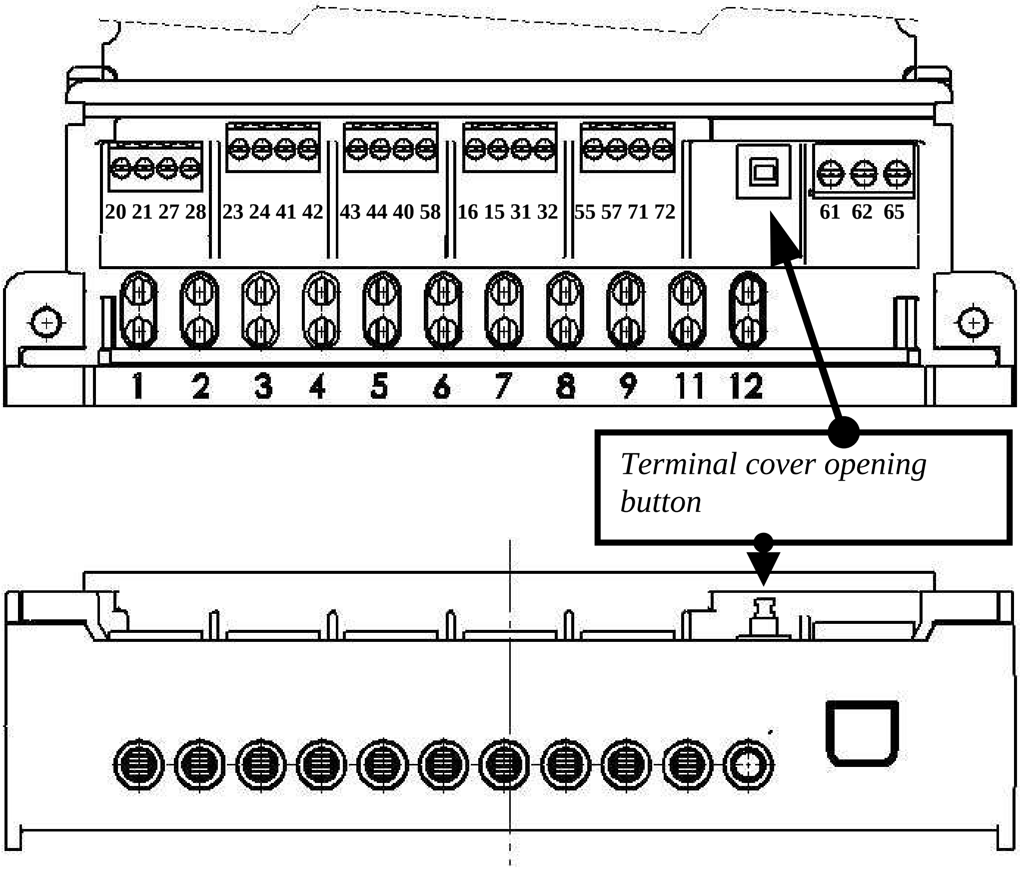
The power and auxiliary terminal block is located on the bottom of the meter. All connections having been completed and checked, the terminal block shall be covered with sealed cover.

2.2. General Requirements and Installation Procedure

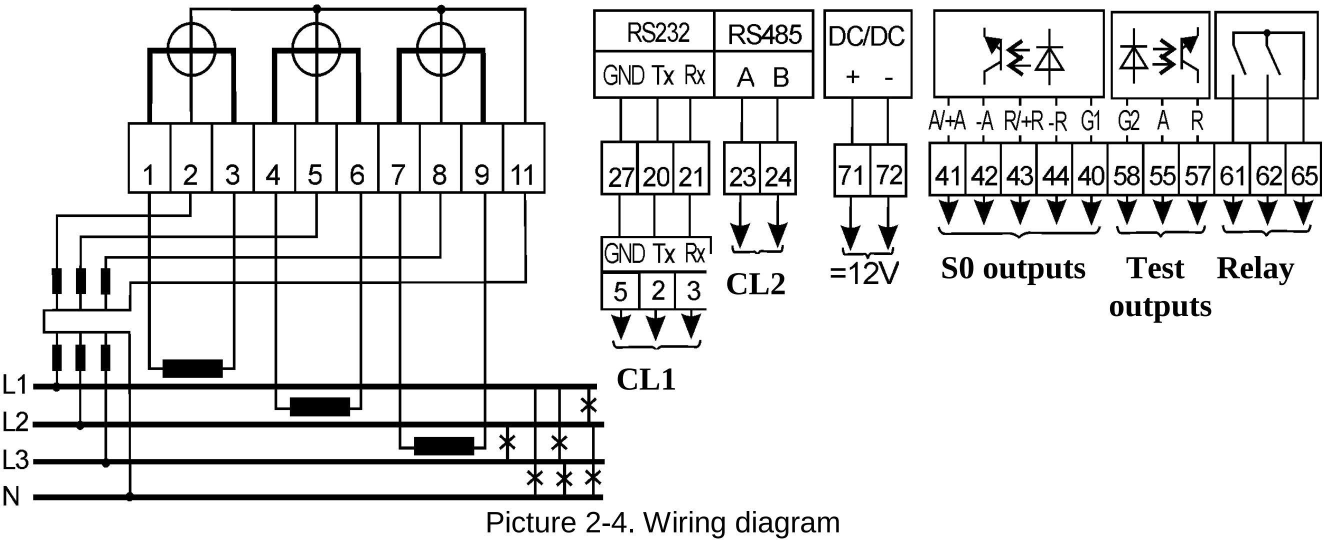
1. Only personnel authorised by the Electric Utility can carry out the meter installation, disconnection, repair, any subsequent parameterisation, and sealing; the rules of installation of electrical devises must be observed. The manufacturer shall not be held liable for the meter malfunction should the user fail to adhere to the relevant requirements.
2. The meter is installed in dry premises containing no chemically aggressive gases or vapour.
3. The meter is fixed with three screws. The meter overall dimensions and distances between the mounting holes are shown in picture 2-2.
4. The meters are connected according to the scheme shown on the cover of the meter terminal box diagrams. Picture 2-4 shows the general connection of EPQS meters through current and voltage transformers.
5. Regular verification of the meter shall be carried once in eight years.
6. Only natural or legal persons authorised by the manufacturer can repair the meter.



Picture 2-2. The Overall Dimensions and Mounting Holes of EPQS Meter

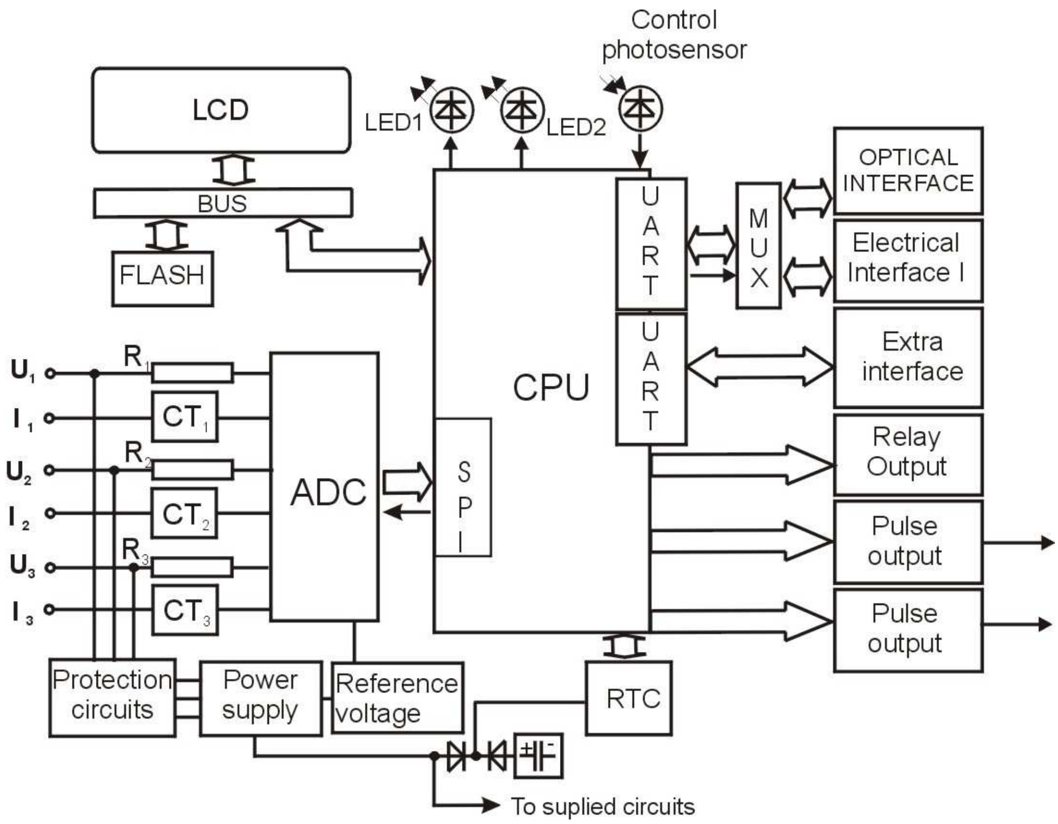


Picture 2-3. Meter terminal box



Picture 2-4. Wiring diagram

2.3. Electronic circuitry and principles of operation



Picture 2-5. Block diagram of the meter

2.3.1. Measurement module

The measurement module converts the electricity network voltage and current values to corresponding analog signals.

The voltage value is converted by a resistive voltage divider, and the current value is converted by a precise current transformer. Firmware of the central processor unit compensates a phase shift in the current measurement circuit. The voltage and current of each phase is measured by a separate respective measurement module (further referred to as “measurement element”).

2.3.2. Analog to Digital Signal Conversion

From the measurement module, the analog voltage and current signals further go to a 6-channel ADC (Analog to Digital Converter) (Sigma – Delta integrator). The integrator converts the analog signals into digital 16-bit codes 72 times during a single AC period. A logical multiplexer unit integrated in the same chip combines signals of different phases into a single sequence of digital codes.

2.3.3. Central Processor Unit

Multiplexer unit output codes are further sent to the central processor unit (CPU) where they are multiplied by calibration constants entered during calibration. Based on the result, the processor then calculates square voltage and square current for each phase and voltage with 90° phase shift (necessary for calculating of reactive energy): I^2_A, I^2_B, I^2_C, U^2_A, U^2_B, U^2_C, U'_A, U'_B, U'_C. From these values, active, reactive and apparent powers and energies are calculated. The CPU also acts as a controller of memory unit, LCD, and communication interfaces, generates calibration (LED) signals and performs other functions.

2.3.4. Non-volatile RAM Unit

With exception of instantaneous values, all meter data are stored in non-volatile RAM (NVRAM) unit. This FLASH type memory unit does not require any power supply for data storage. The data are written to the memory at the end of each integration period, day, or month and in case of power failure.

2.3.5. Internal Clock

The meter has a built-in independent real-time clock that counts real time (hours, minutes, seconds), date (year, month, day, week day), generates control signals corresponding to 8 tariff time zones (**T1 … T8; M1 ... M8**). In case of disconnection of the meter's power supply, the clock is powered from a built-in lithium battery. After a shutdown of the electricity network, the clock preserves the tariff time zone control function and counts time for a period of no less than 10 years. If the power supply is restored after that period has passed, the meter will perform as a single-tariff device, and the data will be assigned to the tariff zone specified during the parameterisation. It can be any of activated energy or power tariffs.
The internal clock has a quartz resonator temperature error compensator. The clock can be corrected by programming the meter as well. The correction range is [-20 ... +20] seconds, but the annual cumulative correction value cannot exceed +/- 10 min.

The clock can automatically adjust for summer time. The date and time of the start and end of summer time are stored during the meter parameterisation. The adjustment time must be set in the MM-DD-HH (month-day-hour) format. The adjustment offset in hours must also be set.
There are the following options of adjustment to daylight time:

- Adjustment month, day, hour, and offset are set. At the specified moment the clock is adjusted by the specified offset.
- Month and day are set. In this case summer time starts at 2 AM and ends at 3 AM. The clock is adjusted by the specified offset.
- Only month is set. In this summer time starts at 2 AM on the last Sunday of the month specified and ends at 3 AM on the last Sunday of the month specified. The clock is adjusted by the specified offset.
- No adjustment date/time is specified. In this case summer time starts at 2 AM on the last Sunday of March and ends at 3 AM on the last Sunday of October.
- Changes are disabled. No clock adjustment is made.

Note: *both date and time formats for summer time start and end must match.*

2.3.6. Liquid Crystal Display (LCD)

The meter has a built-in alphanumerical 64-symbol four-line LCD with backlight. The display can be conventionally divided into 13 information fields. Picture 2-3 shows LCD information fields.

Table 2-1. Information fields of LCD

1	Caption of the sequence	8	Measurement unit
2	Number of readout in sequence	9	Indicators of load quadrant for each phase
3	Display mode indicator	10	Active energy tariff
4	Number of readouts in current sequence	11	Active demand tariff
5	Abbreviated name of readout	12	Indicator of phase sequence
6	Readout OBIS code	13	"Extended review available" indicator
7	Value		

Warnings and error messages are shown on first row of LCD, every 2 seconds changing
For detailed information about data review on LCD, see chapter 5.

2.4. Communication Interfaces

For data exchange with external units (i. e. computer or manual data reading terminal), the EPQS meter has standard optical and electrical communication interfaces.

2.4.1. Optical Interface (D0)

This interface is used for the meter parameterisation and for transferring of data stored in the meter to a data reading terminal or portable PC with a **QuadrCom** software installed in it. The optical interface transfer protocol is IEC 62056-21compatible. The maximum transfer rate is 9600 bps.

2.4.2. Electrical communication Interface

This interface is used for the meter parameterisation and for data transfer via local network. The electrical communication interface implements IEC 62056-31transfer protocol. The maximum data transfer rate is 19200 bps. There can be following implementations of electrical interface:

- RS 232;
- RS 485;
- Current loop interface (CL)

2.4.3. Auxiliary Communication Interface (optional)

The following auxiliary communication interface that operates independently from the optical and the first electrical interfaces can be built in upon a request:

- Current loop interface (CL2);
- Electric interface RS 485 ;
- Electric interface RS 232.

2.4.4. Interface Priorities

Communication through the optical interface D0 and the first electrical interface is provided by the same single universal asynchronous receiver-transmitter unit (UART), so it is impossible to use both interfaces for data transfer concurrently. The meter has strict software defined priorities for communication interfaces, and a certain priority of one or another interface is determined by the following rules:

- Optical interface has higher priority than electrical;
- If request is received through the optical interface while a communication session is going on through the electrical interface, communication through electrical interface is interrupted, and a request received through the optical interface is carried out. Communication through the electrical interface is not interrupted only if an answer to a request is currently transmitted through electrical interface. In that case communication is interrupted only after the answer has been sent.

2.5. The Meter Inputs and Outputs

2.5.1. Optical LED Output (Red Light Emission Diodes)

The optical LED output is located on the front panel. It is used for the meter calibration and verification. The LED emits light signals whose frequency corresponds to calculated electrical energy. LED signals are generated by the meter CPU. Meter constant is the main parameter of the LED output. The meter constant means a number of light signals emitted by LED for 1 kWh (1 kVAr or 1 kVA) of electrical energy.

The EPQS meter has two optical LED outputs. The meter constant is set by the manufacturer. Both LED outputs can generate signals for active, reactive, or apparent electrical energy and the first output (see Diagram 2-1) can additionally transmit the meter clock time signals in order to estimate time count error. Table 2-3 lists LED output parameters.

Table 2-3. LED output parameters

Meter constant, imp/kWh (imp/kVArh)	1 – 65000
Pulse duration, ms	30
Pulse duration for clock testing, s	0,5
Pause between pulses while testing clock, s	0,5

2.5.2. Pulse Output contacts

Meter pulse output contacts transmit telemetry pulses for energy accounting systems. The EPQS meter has six pulse outputs (see picture 2-4). Outputs can be programmed for any kind of energy (+A, -A, R1, R2, R3, R4, A, R); A and R outputs are not programmable. Table 2-4 lists output parameters. Outputs are galvanically separated.

Table 2-4. Characteristics of outputs

Maximum voltage, V	220V
Minimum voltage, V	10V
Maximum current, mA	100
Output constant, imp/kWh (imp/kVArh, imp/kVAh)	1 … 130000
Pulse duration, ms	10 … 250
Pause between pulses, ms	10 … 250

The parameters of pulse outputs must be set in a way that the following inequality is met:

$$K < \frac{3{,}6 \cdot 10^6}{\mathrm{N} \cdot (t_\mathrm{i} + t_p) \cdot U_{\max} \cdot I_{\max}}$$

K– output constant [imp/kWh, imp/kVArh or imp/kVAh];
N – number of measuring elements;
t_i – pulse duration [sec];
t_p – pause duration [sec];
U_{max} – maximum permissible voltage of electricity network;
I_{max} – maximum load current.

2.5.3. Relay Outputs (Optional)

The EPQS meter may have up to two built-in electronic semiconductor relays. The relay output can be programmed to operate on the following conditions:

- A certain energy (T1 … T8) or power (M1 … M8) tariff comes into force
- Daily, at certain time intervals (up to 4 intervals daily). Resolution is 1 minute.
- Average power of current integration period exceeds a set value after n seconds from the beginning of integration period. In that case the relay may operate until:
  - The end of integration period;
  - The end of the next integration period;
- New event or state has been registered, such as:
  - Power failure at any phase;
  - Phase sequence change;
  - Meter damage or malfunction.

Table 2-5. Relay output parameters

Maximum switching voltage, V	350
Maximum switching current, mA	50 ($U=U_{max}$)

2.5.4. External Backup Power Supply (optional)

An external backup power supply allows reading meter data while there is no power in the network meter is connected to. Main parameters of the backup power supply is presented in table 2-6.

Table 2-6. External backup power supply parameters

Voltage, V	12,5±0,6
Power consumption, mA	<200

If all phases are disconnected and the backup power supply is used, a “L - - -” sign is displayed on the phase sequence indicator.
Notes:

- *It is not mandatory to disconnect the backup power supply after the meter has been connected to the electrical network*
- *The meter is supplied with backup power terminals upon a separate request only!*

2.6. Power Supply

The components of the meter electronic circuitry are powered by a multi-voltage power supply. It ensures smooth operation within the permissible voltage range from 50 V to 260 V of network voltage. The power supply protects the meter from brief “lightning-type” voltage surges and is not associated with any single phase so the meter is operating as long as there is voltage at least in one phase. If the “ground” terminal is disconnected, the meter is operating as long as there is voltage at least in two phases.

The power circuit incorporates a high capacity capacitor. A special circuit checks its voltage, and if it drops below a certain critical value the CPU writes vital data on the meter state and measured values to FLASH memory. After the voltage is on again, the meter restores its state variables from the stored data, switches tariffs if necessary and resumes measurements. In that way, the meter data are reliably protected from unexpected consequences of power failure.

2.7. Push Button

Meter has bifunctional push button (see picture 2-1). There is possibility to seal button in position A (see fig. 2-1) so, that switching to position B without damage of seal is impossible.
In position A, push button is used to display specific information on LCD. Button provides following commands:

- short signal (push and hold button for 0,5s);
- long signal (push and hold button for 2s).

Signals user provides by push button are identical to signals user provides to photosensor.

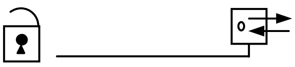
For detailed information about data display on LCD and readout sequences see chapter 5.

The position B of the push button is used for cumulation/reset (“end of the billing period”). For detailed information see chapter 3.5.

Function of position “B” depends on user request and can be one of the following:

- “Cumulation/Reset”. Pushing button in this position provides “End of billing period”. For more information, see chapter 3.5.
- Lock of optical interface. For more information see chapter 7.2.2

Implemented function of position “B” can be recognized by picture near to button:



- Position “B” is used for interface lock

Position “B” is used for Cumulation/ Reset

3. Data Registration

This chapter describes the way measured and calculated data are stored in the meter memory.

The data and parameter structure of the EPQS meter fully complies with international DLMS standard (COSEM Identification System and Interface Objects, DLMS UA 100-1:2000). As provided by the Standard, each value and parameter has its own OBIS (OBject Identification System) code that is displayed on the indicator and stored in the meter memory.

The meter has two memory units: RAM memory and energetically independent FLASH memory for data storage. In the case of power outage the data stored in RAM are lost while the data stored in FLASH remain. The most of measured values are stored in RAM and are written in FLASH unit only after the end of integration period, day, or month or when the power supply voltage drops below a critical level.

At the end of each demand interval, energies of this period [+A, -A, R1, R2, R3, R4, +W, -W] are written into the FLASH memory. From that data, a profile of average power demand of integration period, i.e. load profile, is formed.

At the end of each day, a daily profile is written into appropriate FLASH memory registers. This profile consists of the following data:

1. Daily energy consumption [+A, -A, R1, R2, R3, R4, +W, -W] by all tariffs [T1…T8].
2. Daily maximum demand [+P, -P, Q1, Q2, Q3, Q4, +S, -S] by all tariffs [M1…M8].
3. Timestamps of daily maximum demands.

The number of daily profiles stored in the meter memory depends on the number of activated demand and energy tariffs. Table 3-1 lists the maximum number of daily profiles that can be stored in the memory when a certain number of energy and power tariffs are activated.

Table 3-1. Number of Daily Profile Records Stored in the Memory

		Number of demand tariffs							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Number of energy tariffs	**1**	817	510	370	290	238	202	176	155
	2	583	407	313	254	213	184	161	144
	3	453	339	271	225	193	168	149	134
	4	370	290	238	202	176	155	139	126
	5	313	254	213	184	161	144	130	118
	6	271	225	193	168	149	134	122	111
	7	238	202	176	155	139	126	115	105
	8	213	184	161	144	130	118	108	100

At the end of each month, a monthly profile is written into the non-volatile memory. This profile consists of the following data:

1. Total energy [+A, -A, R1, R2, R3, R4, +W, -W] by all tariffs [T1…T8].
2. Monthly energy [+A, -A, R1, R2, R3, R4, +W, -W] by all tariffs [T1…T8].
3. Monthly maximum demand [+P, -P, Q1, Q2, Q3, Q4, +S, -S] by all tariffs [M1…M8].
4. Timestamps of monthly maximum demands.
5. Cumulative demand [+P, -P, Q1, Q2, Q3, Q4, +S, -S] by all tariffs [M1…M8].
6. Date time stamp of the end of billing period.

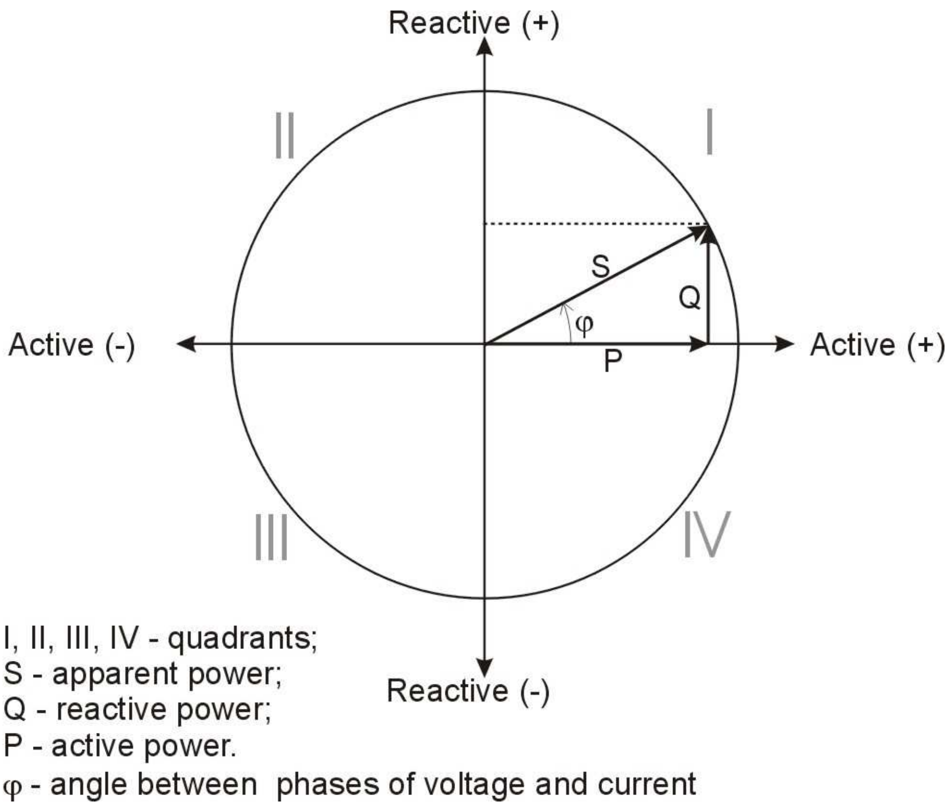
The number of monthly profiles stored in the meter memory depends on the number of demand and energy tariffs. Table 3-2 lists the maximum number of monthly profiles that can be stored at given number of energy and demand tariffs.

Table 3-2. Number of Monthly Profile Records Stored in the Memory

Number of energy tariffs	Number of demand tariffs							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	440	285	210	166	138	117	102	90
2	307	222	174	142	121	105	92	82
3	235	182	148	125	107	94	84	76
4	190	154	129	110	97	86	77	70
5	160	133	114	99	88	79	72	65
6	138	117	102	90	81	73	67	61
7	121	105	92	82	74	68	62	58
8	107	94	84	76	69	64	58	54

3.1. Energy Registration

The EPQS meter measures active electrical energy in both directions +A and –A; reactive electrical energy in each quadrant R1, R2, R3, and R4; apparent electrical energy in both directions +W and –W. All measured values of those parameters are stored in RAM memory unit. At the end of integration period or in case of power failure, those values are written into appropriate FLASH memory registers. During the registration, the appropriate quadrant into whose register data must be written is determined by the direction of active electrical energy and the sign of reactive electrical energy. Diagram 3-1 shows the way of determining of the energy and power quadrant by the signs of active and reactive electrical energy.



Picture 3-1. The Way of Determining of Energy Quadrant

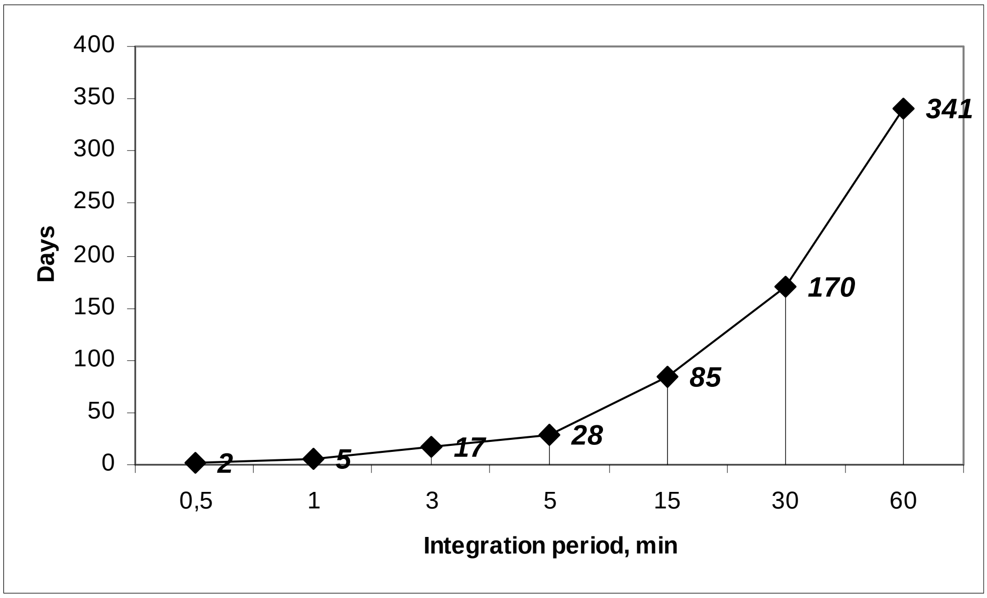
On the meter LCD, the load quadrant is indicated by different signs and letters.

The following electrical energy values are accumulated and stored in the meter memory:

- Integration period energy;
- Daily energy – by all tariffs and total.
- Monthly energy – by all tariffs and total.
- Total energy of each tariff and sum of all tariffs.

3.2. Demand registration

The meter calculates average power over integration period and based on the calculated data, determines and registers maximum demands with their respective timestamps.
The EPQS meter registers values of maximum demand of active (+P, -P), reactive (Q1, Q2, Q3, Q4), and apparent (+S, -S) power of each demand on daily and monthly basis. Monthly maximum demand values are stored in monthly profiles and daily maximum demand - in daily profiles (see above).
The meter collects load profiles of active +A and -A; reactive R1, R2, R3, R4; apparent +W, -W energy.
The values of average power of integration period are stored into appropriate load profile registers of FLASH memory after the end of an integration period.
The meter memory can hold at least 8190 of values of average power of integration period for each kind of energy. The duration of load profile data storage in the meter memory depends on the duration of integration period. The duration of integration period can be set from 30 s to 3600 s at 1 s step. The integration period is set upon the condition that the time interval of 1 hour can be divided into a whole number of integration periods.



Picture 3-2. Load profile length dependency on integration period

3.3. Registration of Instantaneous Values

For registration of instantaneous values, the EPQS meter provides 16 freely programmed channels. Table 3-5 lists values that can be registered by those freely programmed channels.

A freely programmed channel is an area in the meter FLASH memory.

A time interval between the two successive moments of registration of chosen value is called query period. In the case of EPQS meter, all freely programmed channels have a common query period that

can be set from 30 s to 3600 s during parameterisation. The query period must be set so that the time interval of 1 hour can be divided into a whole number of query periods.
The values are registered in freely programmed channels by one of the following algorithms:
At the time intervals of query period, an instantaneous value of chosen parameter is registered

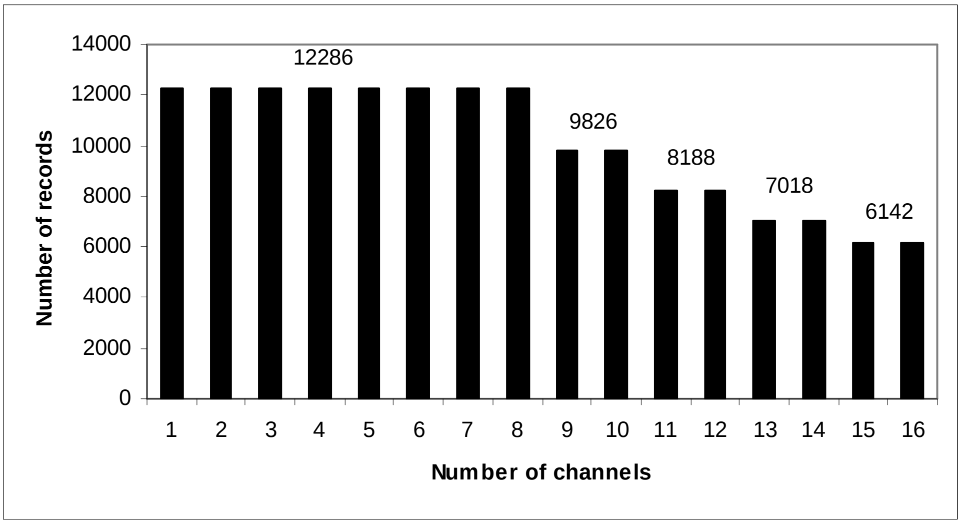
- The minimum value over the query period is registered.
- The average value over the query period is registered.
- The maximum value over the query period is registered.

Algorithm is set independently for each channel.

Table 3-3. List of data, available to log into programmable channels

Instantaneous quantity	OBIS code
Current of phase L1	31.7.0()
Current of phase L2	51.7.0()
Current of phase L3	71.7.0()
Voltage of phase L1	32.7.0()
Voltage of phase L1	52.7.0()
Voltage of phase L1	72.7.0()
L1L2 line -to -line voltage	12.7.1()
L1L3 line -to -line voltage	12.7.2()
L2L3 line -to -line voltage	12.7.3()
Total active power	1.7.0()
Active power of phase L1	21.7.0()
Active power of phase L2	41.7.0()
Active power of phase L3	61.7.0()
Total apparent power	9.7.0()
Apparent power of phase L1	29.7.0()
Apparent power of phase L2	49.7.0()
Apparent power of phase L3	69.7.0()
Total reactive power	3.7.0()
Reactive power of phase L1	23.7.0()
Reactive power of phase L2	43.7.0()
Reactive power of phase L3	63.7.0()
Frequency	14.7.0()
Total power factor cos(φ)	13.7.0()
Power factor cos (φ) of phase L1	33.7.0()
Power factor cos (φ) of phase L2	53.7.0()
Power factor cos (φ) of phase L3	73.7.0()
Temperature	130.0.17()
Battery voltage	130.0.18()

The amount of information that can be accumulated in a single channel depends on the number of activated channels.
Picture 3-3 shows this dependence.



Picture 3-3. Channel capacity dependence on number of activated channels

In order to calculate how many days a record will be held in a freely programmed channel, formula 1 is used:

$$T = \frac{N_{\max} \cdot t_{\text{int}}}{1440}$$

T – Duration of record storage in days
N_{max} – Channel capacity (see chart 3-3)
t_{int} – measuring interval duration in minutes

3.4. Power Quality Registration

The EPQS meter can register several parameters of power quality. During the parameterisation, the permissible range of electrical network voltage and frequency fluctuations is set together with power quality monitoring start date. At the date and time specified, the meter starts calculating the average frequency value each 10 seconds, and the average voltage value – each 10 minutes.
The meter registers periods when the average frequency or voltage value does not comply with requirements set during parameterisation and calculates voltage failures on each phase. According to the calculated data, the following quality parameters are established:

- Time percentage when the network voltage and/or frequency did not meet the requirements at least in one phase
- Number of power outages in each phase

Power quality parameters are recorded in weekly reports. The meter memory can hold up to 256 weekly reports of power quality.
Power quality measurement methods described in this document comply with the requirements of EN 50160 European Standard.

3.5. “End of billing period”

Meter automatically ends billing period at the end of calendar month. Therefore there are a few possibilities to end billing period manually:

- By pushing button in position “Cumulation/Reset”;
- Sending command via optical interface (communication protocol IEC 62056-21);
- Sending command via electrical interface (communication protocol IEC 62056-31).

When user pushes button “Cumulation/Reset” or sends command via communication interface, a message “Cumulative+Reset!” is displayed on the first line of the LCD.

Billing period can be manually ended only once per calendar month. If user attempts to end billing period second time per calendar month, a message “Blocked” is displayed on first line of the LCD.

If billing period is ended manually, meter does not ends billing period automatically at the end of that calendar month.

4. Tariff Module

The EPQS meter supports up to 8 energy and 8 demand tariffs. The number of energy and demand tariffs is set during parameterisation. Tariff module of the meter provides multi-tariff accounting according to meter's tariff program. Owner of the meter can change and configure tariff program (operator password required). Tariff program is designed from 3 levels:

- Day program;
- Week program;
- Tariff seasons.

4.1. Day program

Day program is schedule that describes tariff switching during a day. Each tariff switchover is described by one record in day program. It contains time of switchover, number of energy tariff to be activated and number of demand tariff to be activated. Switchover time must be sinchronised with hour raster. One day program supports up to 16 switchovers. Meter supports up to 127 different day programs.
Energy tariffs and demand tariffs can be changed independently. That means switching energy tariff it is not necessary to change demand tariff and visa versa.
Table 4-1 shows an example of the day program.

Table 4-1. An example of day program

Day program #1		
07:00	T2	M2
09:00	T1	M1
12:00	T2	M2
19:00	T1	M1
21:00	T2	M2
23:00	T4	M4

4.2. Week program

The week program describes what day program is assigned for each day of week. Week program is a list containing 8 numbers.
of them determines which day program is activated for each day of the week and for days-off. Up to 32 different week programs can be created. Different day programs may be applied for each day of week or the same day program may be applied throughout the whole week. Table 4-2 shows an example of week program.

Table 4-2. An example of week program

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Days-off
1	1	1	1	1	1	2	2	2

4.3. Tariff Seasons

Tariff seasons let to change tariff application order several times per year, i. e. activate different week programs on different seasons. A season defines date and time when necessary week program is activated. Active and passive season program can be created, each describing up to 16 seasons.
The active season profile is a season profile used at the present moment.
The passive season profile is a season profile currently inactive but becoming active at the specified year, month, day, and hour. The passive schedule lets to enter a new tariff schedule beforehand (keeping the active schedule) and switch to it at some moment in the future. Table 4-3 shows an example of active season profile.

Table 4-3. An example of tariff seasons

Date time	**Week program**
04.01 00:00	2
05.01 00:00	3
09.01 00:00	2
10.01 00:00	1

4.4. Special days

The meter has a special day register. When a new special day is entered into the register, the date and day profile applicable on that day is specified. Each special day can be allocated a different day program or several special days can share the same day program. The special day register holds up to 256 days. If a year is specified besides a month and a day during the creation of a new special day entry, this day shall be treated as a special day only in the specified year.

Table 4-4 shows an example of special day list.

Day	Day program
2004.03.31	2
2004.04.01	2
****.01.01	2
****.02.16	2
****.03.11	2
****.12.25	2
****.12.26	2

4.5. Tariff Module Operation in Case of Clock Failure

The tariff module manages tariff schedule on the basis of data received from a real-time clock. In the case of clock failure (i. e., clock provides incorrect time data or no data at all), the management of tariff schedule becomes impossible because real time is unknown. Should this happen, the performance of tariff schedule is interrupted, and all energy and maximum power data are recorder upon “default on failure” energy and power tariffs. Those “default on failure “ tariffs are defined during the meter parameterisation.

5. Data Display Modes

All parameterisation constants entered into the meter, energy and power demand registers, as well as electrical network monitoring data can be displayed on liquid crystal display (LCD). Data, meter displays on LCD, sequence of display and other display settings are completely configurable parameters.

Data display is organized in the following way:

1. All the data are divided into data groups, called sequences.
    a. One sequence can contain up to 32 data to display. Data available to display on LCD are listed in appendix A.
    b. Sequence is recognized by the caption of the sequence (see picture 2-3). Caption is set of 11 ASCII symbols.
    c. Meter supports up to 32 sequences for automatic data display and up to 32 sequences for manual data display.

There are two modes of data display: automatic cyclic data indication mode and static data indication (manual data display).

5.1. Automatic Cyclic Data Indication Mode

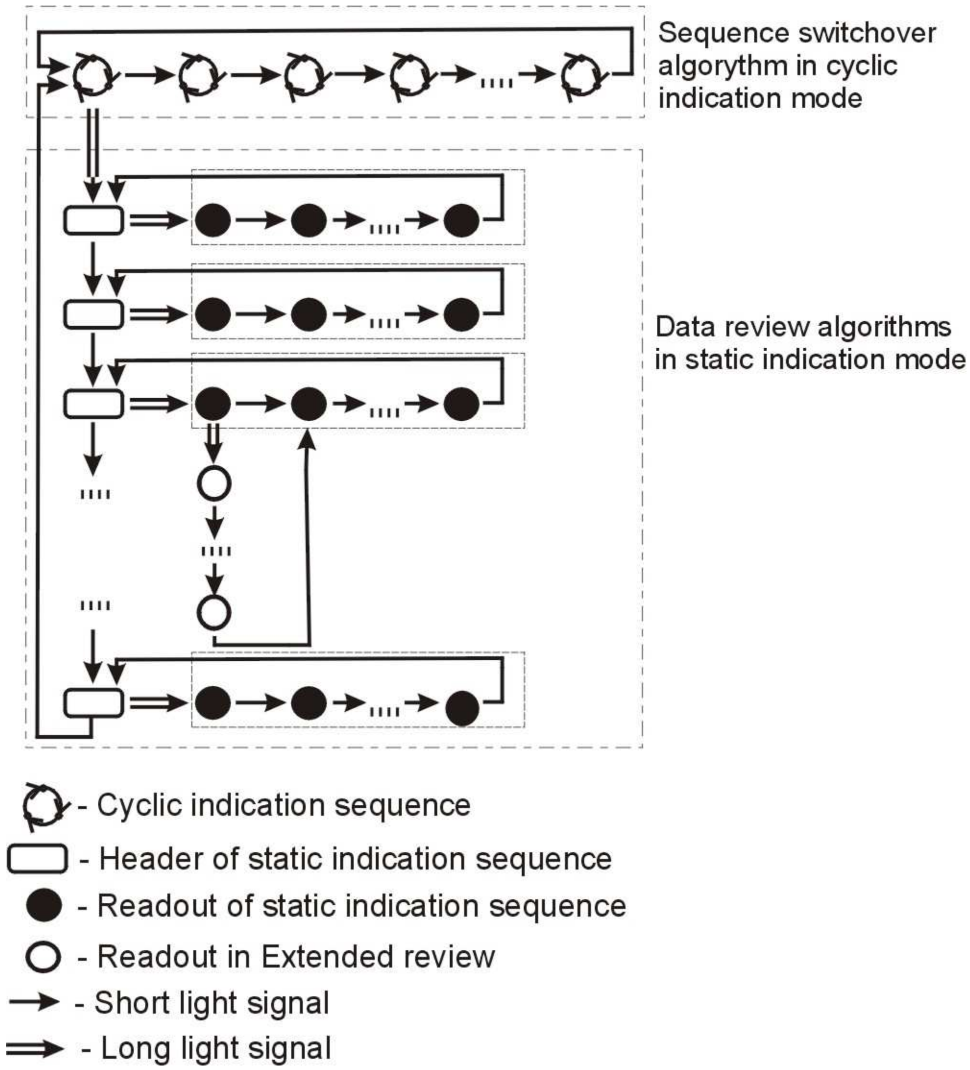
While the meter is operating in its usual mode, selected data or parameters are displayed on the screen at certain intervals. In this indication mode, display mode indicator is blinking symbol "%". The data to be displayed, their sequence, and screen refresh period is defined during the parameterisation. Time of single readout display can be 1-600 s. Automatic cyclic data indication mode is activated after no control signals are received specified time interval called "static indication time".
The sequence type indicator indicates automatic cyclic data indication mode. See chapter 5.3 "Data Review Algorithms" for instructions how to switch between sequences in automatic cyclic indication mode.

5.2. Static Data Indication Mode

When this mode is active, data are called up by actuating the control photo sensor by means of long and short signals. In static data indication mode, display mode indicator is symbol "/".
A signal is considered "long" if its duration is 2 s.
A signal is considered "short" if its duration is 0.5 s.
The static mode is activated by means of long signal and the cyclic indication mode if activated automatically if no signals are received during the specified time interval called "static indication time". This interval is defined during the parameterisation and can be from 1 s to 600 s.
For data review algorithm in static indication mode, see the chapter "Data Review Algorithms"**.**

5.3. Data Review Algorithms

Picture 5-1 shows a data review algorithm demonstrating the way of activating the necessary cyclic indication sequence. The diagram also shows algorithms for data review in static indication mode.
After the meter switches to cyclic indication mode, it activates a cyclic indication sequence with the same number as the sequence of static indication mode that was active before the switchover. If no cyclic indication sequence bears that number, the first sequence is activated. If the first static indication sequence has been activated, the cyclic indication mode does not activate automatically.



Picture 5-1. Data scrolling diagram

When the meter operates in cyclic indication mode, the sequences can be switched by means of short light signals.
When the meter operates in cyclic indication mode, static indication mode is activated by means of long light signal.

6. Parameterisation

The EPQS meter is parameterised through the optical or first electrical interface. For parameterisation, QuadrCom software developed by ELGAMA-ELEKTRONIKA Ltd. is used. Each parameterisation session is recorded in the event logbook together with timestamp. Before each parameterisation, it is necessary to download all data to a computer because some accounting data might be erased from the memory during the parameterisation. Table 6-1 lists what data on what conditions are erased from the memory during the parameterisation.

Table 6-1

Changed parameters	Data								
	Load Profiles	Programmable channels	Daily energy	Daily max. demand	Monthly energy	Monthly max. demand	Cumulative demand	Quality monitoring report	Log book
Date and Time	+	+	+	+	+	+	+	+	-
Clock adjustment	-	-	-	-	-	-	-	-	-
Integration period	+	-	+	+	+	+	+	-	-
Transformation coefficients	+	+	+	+	+	+	+	-	-
Programmable channels	-	+	-	-	-	-	-	-	-
Measurement interval	-	+	-	-	-	-	-	-	-
Start date of quality monitoring	-	-	-	-	-	-	-	+	-
Other parameters	-	-	-	-	-	-	-	-	-

7. Meter Data Protection

The EPQS meter has features of physical and software protection of data and parameters from unauthorised actions.

7.1. Physical Protection of Data and Parameters

The meter is protected from an unauthorised access by the following physical measures:

- Sealed front cover
- Sealed terminal block
- Registration of cover opening actions in event logbok

The sealed front cover moulded from transparent plastic restricts the access to the meter circuitry located under the front panel. The transparent plastic cover is fixed by two sealed screws. One screw is sealed with the manufacturer's seal, the other – with metrology centre seal.

The terminal block is sealed after the meter is installed at the user premises. The sealing is performed by a representative of the organisation that installed the meter.

7.2. Software Protection

The meter has software measures of data protection and the event logbook, for recording parameter changes and attempts to affect the accuracy of calculations.

7.2.1. Password

All data stored in the meter are password-protected and have various access levels. There are two levels of access to the meter data and parameters: "user" level (allows data review and changing of some parameters) and "operator" level (allows review of all data and changing of almost all meter parameters).

The user password grants rights to change only some of the parameters. Table 7-1 lists parameter access levels. Each time the connection is established through the communication interfaces, the meter asks the password. The password consists of any 8 symbols. No parameters can be changed until the correct password has been provided. If incorrect password is entered four times in a day, the communication interfaces will be locked for 24 hours. During that period communication is impossible.

7.2.2. Lock of optical interface (optional)

On the user request, meter can be equipped with function "lock of optical interface". There are following types of lock:

- Full lock. User is not allowed to communicate with meter until interface is unlocked.
- Lock of parameters. User is not allowed to change meter parameters, but permitted to read all the meter data.

To unlock optical interface, user needs to push and hold button in position "B" for a second.

7.2.3. Event logbook

The event logbook is a meter memory area that stores the data on the last 8190 events or states. Table A-5 of Annex A lists events and states that are recorded in the event logbook.

Each event is recorded together with its date and time stamp; if a state is recorded, its beginning and end date and time stamps are recorded as well.

This information can be displayed on the screen or transmitted through the communication interfaces.

7.2.4. Counters and Timers

The EPQS meter has a set of counters and timers for counting of events and registering of state durations. After a certain event takes place, the value of respective counter increases by one, and after a state has been registered, a respective timer starts counting its duration.

7.2.5. Protection of Factory Constants

During factory parameterisation, various factory constants are entered in the meter memory. Changes of those constants may affect measurement accuracy; therefore software and mechanical measures for protection of factory constants are installed. Factory constants may be changed only with the meter cover taken off and with special software

Table 7-1. Access levels

Parameter	**Access level**
Telemetry output constant	Operator
Customer name (15 symbols)	Operator
Location (15 symbols)	Operator
Configuration bits	Operator
Current and voltage transformer ratios	Operator
Values of nominal, minimum, and maximum voltage, current, and frequency	Operator
Integration period duration	Operator
Beginning of settlement period	Operator
Clock adjustment to daylight saving changes	Operator
Duration of cyclic data indication	User
Duration of static data indication	User
Number of activated energy and demand tariffs	Operator
Activation of passive seasons	Operator
Tariff application order	Operator
Measurement period of freely programmed channel	Operator
Start of power quality monitoring	Operator
Telemetry outputs	Operator
User password	User
Operator password	Operator
Daily tariff schedules	Operator
Static indicator sequence tables	User
Cyclic indicator sequence tables	User
Static indicator sequence headings	User
Cyclic indicator sequence headings	User
Special days	Operator
Week programs	Operator
Active tariff seasons	Operator
Passive tariff seasons	Operator
Freely programmed channels	Operator
Formats of data output to display screen	Operator

Annex A. Data available to display on LCD

Table A-1. Energy Data

Name		OBIS code	Comments
Full	Abbreviated		
Total positive active energy	+Atot_T1…T8, TΣ	1.8.T	T - energy tariff[1 … 8] T=0 - sum of all tariffsIt is also possible to review total energies registered at the end of previous billing periods (months).
Total negative active energy	-Atot_T1…T8, TΣ	2.8.T	
Total positive reactive energy	+Rtot_T1…T8, TΣ	3.8.T	
Total negative reactive energy	-Rtot_T1…T8, TΣ	4.8.T	
Total reactive energy of I quadrant	R1tot_T1…T8, TΣ	5.8.T	
Total reactive energy of II quadrant	R2tot_T1…T8, TΣ	6.8.T	
Total reactive energy of III quadrant	R3tot_T1…T8, TΣ	7.8.T	
Total reactive energy of IV quadrant	R4tot_T1…T8, TΣ	8.8.T	
Positive apparent energy	+Wtot_T1…T8, TΣ	9.8.T	
Negative apparent energy	-Wtot_T1…T8, TΣ	10.8.T	
Monthly positive active energy	+Amon_T1...T8, TΣ	1.9.T	T - energy tariff[1 … 8] T=0 - sum of all tariffsIt is also possible to review energies over previous billing periods
Monthly negative active energy	-Amon_T1...T8, TΣ	2.9.T	
Monthly positive reactive energy	+Rmon_T1…T8, TΣ	3.9.T	
Monthly negative reactive energy	-Rmon_T1…T8, TΣ	4.9.T	
Monthly reactive energy of I quadrant	R1mon_T1...T8, TΣ	5.9.T	
Monthly reactive energy of II quadrant	R2mon_T1...T8, TΣ	6.9.T	
Monthly reactive energy of III quadrant	R3mon_T1...T8, TΣ	7.9.T	
Monthly reactive energy of IV quadrant	R4mon_T1...T8, TΣ	8.9.T	
Monthly positive apparent energy	+Wmon_T1..T8, TΣ	9.9.T	
Monthly negative apparent energy	-Wmon_T1...T8, TΣ	10.9.T	
Daily positive active energy	+Aday_T1...T8, TΣ	1.10.T	T - energy tariff[1 … 8] T=0 - sum of all tariffsIt is also possible to review energies over previous days.
Daily negative active energy	-Aday_T1...T8, TΣ	2.10.T	
Daily positive reactive energy	+Rday_T1...T8, TΣ	3.10.T	
Daily negative reactive energy	-Rday_T1...T8, TΣ	4.10.T	
Daily reactive energy of I quadrant	R1day_T1...T8, TΣ	5.10.T	
Daily reactive energy of II quadrant	R2day_T1...T8, TΣ	6.10.T	
Daily reactive energy of III quadrant	R3day_T1...T8, TΣ	7.10.T	
Daily reactive energy of IV quadrant	R4day_T1...T8, TΣ	8.10.T	
Daily positive apparent energy	Wday_T1...T8, TΣ	9.10.T	
Daily negative apparent energy	Wday_T1…T8, TΣ	10.10.T	
Positive active energy of integration period	+A_per	1.29.0	It is also possible to review energies of previous integration periods.The 4th row on the LCD screen indicates timestamp of the displayed data.
Negative active energy of integration period	-A_per	2.29.0	
Positive reactive energy of integration period	+R_per	3.29.0	
Negative reactive energy of integration period	-R_per	4.29.0	
Energy of I quadrant of integration period	R1_per	5.29.0	
Energy of II quadrant of integration period	R2_per	6.29.0	
Energy of III quadrant of integration period	R3_per	7.29.0	
Energy of IV quadrant of integration period	R4_per	8.29.0	
Positive apparent energy of integration period	+W _per	9.29.0	
Negative apparent energy of integration period	-W _per	10.29.0	

Table A-2. Demand Data

Name (Full)	Name (Abbreviated)	OBIS code	Comments
Demand of current integration period	+P_curr	1.4.0	On the 4th row on the LCD screen, the integration period duration [s] and time left until the end of current integration period is indicated
	-P_curr	2.4.0	
	Q1_curr	5.4.0	
	Q2_curr	6.4.0	
	Q3_curr	7.4.0	
	Q4_curr	8.4.0	
	+S_curr	9.4.0	
	-S_curr	10.4.0	
Demand of last integration period	+P_last	1.5.0	On the 4th row on the LCD, duration of integ-ration period [s] and time left until the end of current integration period is indicated.
	-P_last	2.5.0	
	Q1_last	5.5.0	
	Q2_last	6.5.0	
	Q3_last	7.5.0	
	Q4_last	8.5.0	
	+S_last	9.5.0	
	-S_last	10.5.0	

Table A-2 (continue). Demand Data

Daily maximum demand	+P_dayM1...M8	1.26.M	M - demand tariff [1 … 8]. The 4th row indicates timestamp. The 4th symbol of OBIS code indicates the position number of day (0 - current day, 1 - yesterday, etc.).
	-P_dayM1...M8	2.26.M	
	Q1_dayM1...M8	5.26.M	
	Q2_dayM1...M8	6.26.M	
	Q3_dayM1...M8	7.26.M	
	Q4_dayM1...M8	8.26.M	
	+S_dayM1...M8	9.26.M	
	-S_dayM1...M8	10.26.M	
Monthly maximum demand	+P_monM1...M8	1.16.M	M - demand tariff [1 … 8]. The 4th row indicates timestamp. The 4th symbol of OBIS code indicates the position number of month (0 - current month, 1 - last month, etc.).
	-P_monM1...M8	2.16.M	
	Q1_monM1...M8	5.16.M	
	Q2_monM1...M8	6.16.M	
	Q3_monM1...M8	7.16.M	
	Q4_monM1...M8	8.16.M	
	+S_monM1...M8	9.16.M	
	-S_monM1...M8	10.16.M	
Cumulative demand	+P_cumM1…M8	1.12.M	M - demand tariff [1 … 8].The 4th symbol of OBIS code indicates the month to which belongs the data currently displayed (0 - current month, 1 - last month, etc.)
	-P_cumM1…M8	2.12.M	
	Q1_cumM1…M8	5.12.M	
	Q2_cumM1…M8	6.12.M	
	Q3_cumM1…M8	7.12.M	
	Q4_cumM1…M8	8.12.M	
	+S_cumM1…M8	9.12.M	
	-S_cumM1…M8	10.12.M	

Table A-3. Instantaneous Data

Name		OBIS code	Comments
Full	Abbreviated		
Current in phase L1	Irms_L1	31.7.0	
Current in phase L2	Irms_L2	51.7.0	
Current in phase L3	Irms_L3	71.7.0	
Voltage in phase L1	Urms_L1	32.7.0	
Voltage in phase L2	Urms_L2	52.7.0	
Voltage in phase L3	Urms_L3	72.7.0	
Line voltage of phases L1 L2	Urms_L12	12.7.1	
Line voltage of phases L1 L3	Urms_L13	12.7.2	
Line voltage of phases L2 L3	Urms_L23	12.7.3	
Total active power in all phases	Pins_LS	1.7.0	
Active power in phase L1	Pins_L1	21.7.0	
Active power in phase L2	Pins_L2	41.7.0	
Active power in phase L3	Pins_L3	61.7.0	
Total apparent power in all phases	Sins_LS	9.7.0	
Apparent power in phase L1	Sins_L1	29.7.0	
Apparent power in phase L2	Sins_L2	49.7.0	
Apparent power in phase L3	Sins_L3	69.7.0	
Total reactive power in all phases	Qins_LS	3.7.0	
Reactive power in phase L1	Qins_L1	23.7.0	
Reactive power in phase L2	Qins_L2	43.7.0	
Reactive power in phase L3	Qins_L3	63.7.0	
Frequency	Freq_	14.7.0	
Resultant cos(φ) in all phases	PFins_LS	13.7.0	
cos(φ) power in phase L1	PFins_L1	33.7.0	
cos(φ) power in phase L2	PFins_L2	53.7.0	
cos(φ) power in phase L3	PFins_L3	73.7.0	

Table A-4. Parameters

Name		OBIS code	Comments
Full	Abbreviated		
IDENTIFIERS			
Vendor ID	Vendor	96.1.1	
Model ID	Model	96.1.2	
Version ID	Version	96.1.3	
Meter number	Number	96.1.4	
User ID	User	96.1.5	
Location ID	Location	96.1.6	
User password	Passw_1	0.61.0	
Operator password	Passw_2	0.62.0	
Manufacturer password	Passw_3	0.63.0	
CALIBRATION CONSTANTS			
Current and voltage	IU_cal.	96.60.0	
Current phase shift	ph_cal	96.61.0	
Active power offset	Poffset	96.62.0	
Reactive power offset	Qoffset	96.63.0	
Hilbert's transformation constant	Hilbert	96.64.0	
Sensitivity threshold	Thresh	96.65.0	
Clock adjustment factor	Clock adjustment	96.66.0	
PARAMETERISATION CONSTANTS			
LED output constant	LED out	0.3.0	
pulse output constant	TM out	0.3.3	
Current and voltage transformer ratio	Transf.	0.4.0	
Nominal values and their permissible ranges	Nominal	0.6.0	Extended
Demand and billing periods	IntgPer	0.8.0	
Summer/Winter time changeover	DaySave	0.50.0	
Duration of static and cyclic LCD sequences	Show_tm	0.51.0	
Number of tariffs and default on failure tariffs	Tariffs	0.52.0	
Query period of freely programmed channels	FreePer	0.53.0	
Power quality monitoring start	PQM_beg	0.54.0	
Telemetry outputs	S0	0.55.0	
Temperature range		0.56.0	
Passive tariff activation date		0.57.0	
Relay 1		0.58.0	
Relay 2		0.59.0	
Data display formats		0.60.0	
INDICATION PROFILES			
Tariff table	Tariffs	13.0.0	Extended
Special day table	Specday	11.0.0	Extended
Programmed channels		130.0.K	K-channel No.
PARAMETERISED PROFILES			
Day profiles		99.60.0	
Static indication sequence table		99.61.0	
Cyclic indication sequence table		99.62.0	
Static indication sequence headers		99.63.0	
Cyclic indication sequence headers		99.64.0	
Special days		99.65.0	
Week profiles		99.66.0	
Active tariff seasons		99.67.0	
Passive tariff seasons		99.68.0	
Programmed channels		99.69.0	

Table A-5. Events and States

Name		OBIS code	Comments
Full	Abbreviated		
Voltage of all phases	Power	140.0.1	State
Voltage in phase L1	U_L1	140.0.2	State
Voltage in phase L2	U_L2	140.0.3	State
Voltage in phase L3	U_L3	140.0.4	State
Meter error	Error	140.0.5	Event
Meter reset	Reset	140.0.6	Event
Watchdog reset	WatchDg	140.0.7	Event
Incorrect operation	Illegal	140.0.8	Event
Effect of magnetic field	Magnet	140.0.9	State
Effect of unfavourable temperature	Temper.	140.0.10	State
Wrong password: access blocked	Blocked	140.0.11	State
Manufacturer access granted	VendorA	140.0.12	State
Case open	Cover_o	140.0.13	Event
Clock adjustment	Clock_s	140.0.14	Event
Reset of cumulative demand data	Cum_res	140.0.15	Event
Remote parameterisation	Conf_re	140.0.16	Event
Local parameterisation	Conf_lo	140.0.17	Event
Summer time	Summer	140.0.21	State
Reverse phase sequence	L132	140.0.22	State
MKI 1 relay state	MKI 1	140.0.23	State
MKI 2 relay state	MKI 2	140.0.24	State
Reset of daily energy data	Eday_re	140.0.25	Event
Reset of monthly energy data	Emon_re	140.0.26	Event
Reset of daily maximum demand data	Pday_re	140.0.27	Event
Reset of monthly maximum demand data	Pmon_re	140.0.28	Event
Clock		1.0.0	
Temperature		130.0.18	
Battery voltage		130.0.18	

Table A-6. Timers and Counters

Name		OBIS code
Full	Abbreviated	
Meter operation timer	Work_tm	96.70.1
Battery operation timer	Batt_tm	96.70.2
Timer of magnetic field effect duration	Magn_tm	96.70.3
Timer of unfavourable temperature effect duration	Temp_tm	96.70.4
Three-phase voltage failure counter	Outages	96.70.5
Magnetic field effect counter	Magn_ct	96.70.6
Unfavourable temperature effect counter	Temp_ct	96.70.7
Billing period counter	Account	96.70.8
Cover opening event counter	Cover_o	96.70.9
Wrong password counter	Passw_e	96.70.10
Clock adjustment counter	Clock_s	96.70.11
Counter of cumulative power demand data reset	Cum_res	96.70.12
Remote parameterisation session counter	Conf_re	96.70.13
Local parameterisation session counter	Conf_lo	96.70.14
Watchdog reset counter	WDg_res	96.70.15
Illegal operation counter	Ill_ops	96.70.16
Meter reset counter	Err_res	96.70.17
Meter error counter	Err_cnt	96.70.18

Table A-6. Energy Quality Monitoring

Name		OBIS code
Full	Abbreviated	
Voltage in phase L1 under limit occurrence counter	Uund_L1	32.32.0
Voltage in phase L2 under limit occurrence counter	Uund_L2	52.32.0
Voltage in phase L3 under limit occurrence counter	Uund_L3	72.32.0
Voltage in phase L1 over limit occurrence counter	Uove_L1	32.36.0
Voltage in phase L2 over limit occurrence counter	Uove_L2	52.36.0
Voltage in phase L3 over limit occurrence counter	Uove_L3	72.36.0
Frequency under limit occurrence counter	f_under	14.32.0
Frequency over limit occurrence counter	f_over	14.36.0
Power outages in phase L1 counter	Uoff_L1	32.40.0
Power outages in phase L2 counter	Uoff_L2	52.40.0
Power outages in phase L3 counter	Uoff_L3	72.40.0