HEAT METERS

LQM-III, CQM-III-K

HEAT METER CALCULATOR LQM-III

- complies with all requirements stipulated in OIML R 75, EN 1434 standards,
- battery operated calculator permanently with 5 year life plus 1 year,
- operation with any flow meters installed on the supply and return of the heating system,
- non volatile memory enabling to store data for last 48 hours, 60 days, 24 months and 12 years; memory could be enhanced,
- battery voltage measurement and indication,
- wide possibility of configuration of parameters and registers,
- programming of thresholds for heat power, flow rate and temperature in order to make calculations of over - threshold heat energy consumption,
- possibility of measure heat energy in the second heating system e.g. warm tap water (additional pair of temperature sensors is necessary),
- possible cooperation with 4 additional meters, with pulse output,
- optical port,
- communication interfaces: RS232, RS485 interfaces, M-BUS or Lon Works,
- communication of meters with LSD type local data station in M-BUS network.

PRINCIPLE OF OPERATION

The measurement of the volume of energy is reduced to the volume measurement of flowing water and temperature difference. The values measured are multiplied each other and heat coefficient and the products are integrated.

The calculator can be configured and operate as heat meter and cooling meter at the same time. In case of cooling meter, the temperature difference is calculated based on the formula t2-t1 and in case of heat meter, temperature difference is calculated based on the formula t1-t2. The calculator enables to set minimal temperature difference below which calculations for heat are avoided (within the range from 0° to 3°C).

The measurement of temperature is made every 12 seconds, adding the volumes is made after each pulse, integration of the heat is being made (integration period) minimum every 30 seconds, but only when the growth of the volume occurred in this period.

Heat coefficient is dependent on t1 and t2 and it is calculated based on algorithm produced by designers of the calculator.

LQM-III calculators operate based on microprocessors and they are made by SMD technology. The calculator cooperates with flow transducers mounted on inlet or outlet circuit of heat exchange system.

Indicated values being measured are read out on liquid crystal display and moreover they can be read by different interfaces for the remote reading with optical interface inclusive.

In order to measure the volume of water one should make use of the flow transducer with pulse output and there is possibility to configure any pulse constant.

BASIC TECHNICAL DATA OF LQM-III

Specification	Symbol	Unit	Value
Unit of heat energy (the main calculator contains 8 digits)	Qe	GJ mW	0,001 - 1 0,001 do 0,1
Unit of volume of the water	Ve	m^3	0,001 - 1
Temperature range of the water	t	°C	from 1 to 180
Temperature difference for heating	Δt	°C	from 3 to 160
Temperature difference for cooling	Δt	°C	from 0,5
Maximum permissible error	E_l	%	±(0,5+3/Δt)
Power range	Pp	kW MW	1 – 999 0,01 – 99,99
Flow range	Qd	m^3/h	0,001 – 1
Voltage supply	U_z	V	3,6
Time of battery operation	–	year	5
Protection degree IEC-529	IP	–	54
Ambient temperature	t_a	°C	from 5 to 55
Relative humidity of air	W	%	< 90

The data measured are stored in non volatile memory of archive registers in four time cycles. In hourly cycle 48 registrations of data are made, in daily cycle 60 registrations are made, in monthly cycle 24 registrations are made and in annual cycle 12 registrations are made. These data can be watched on the display. In further part of the description, the details regarding kind of data that are being registered in particular cycles were presented.

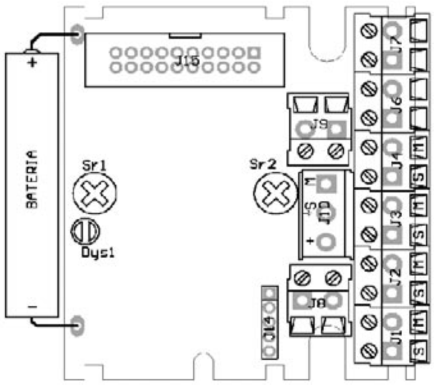
LQM-III-K can be configured as LQM-III-D that means that it can measure heat in two independent circuits for heat measurement. In such configuration four temperatures are being measured but one of additional pulse inputs is treated as the input of flow transducer of the second heat circuit for heat measurement. Both heat circuits have the same properties and can be configured as it was described above. All measurement units that concern the second heat circuit for heat measurement are being displayed with ‘ (prim) mark in the upper left corner of the display.

REMOTE READING OF DATA

Calculators of LQM-III type enable to make remote data reading and configuration with use of appropriate devices with the software. Generally, there are two possible methods of electronic reading and configuration. If there is direct access to the casing of the calculator then optical interface can be used which is programmed in accordance with appropriate standard and additional software of APATOR (they are not against the standard). Using the software of PC computer (or PSION or other ones) the reading of the following current data set can be made by use of optical interface: heat total, heat total for 2 tariff, cooling total, all volumes and pulse inputs, inlet and outlet temperature, power and flow rate, error code, time of operation, network number, the end user’s number and serial number.

Using optical interface the following parameters can be configured: thresholds for calculations of 2 tariff, calculation period, network numbers, current time and date, parameters of records to be stored, speed of (M-BUS) transmission, number of the end users. There is the interface on the printed circuit board of terminal strips that allows to connect any communication interfaces like M-BUS, RS 232, RS485, LonWorks and others to the calculator. It is possible to make completely

new transmission interfaces with any transmission protocols. In order to get to know more about transmission systems being offered by APATOR one should make contact with competent persons in APATOR. Different detailed descriptions are also available regarding particular interfaces and remote data reading systems.
Making use of communication interface it is possible to read absolutely all the data being gathered by the calculator of LQM-III- type. M-BUS interfaces with transmission protocol according to suitable standard are mostly applied. Communication interface enables to change any configurations of the calculator except those which require to be legalized again.
Mounting of the calculators of LQM-III-K (so called compact) is made on flow transducer and the remaining versions should be mounted on the wall or on special brackets (for boxes), each calculator should be equipped with two anchor bolts.
In order to connect temperature sensors and other equipment for calculations, bolt type terminal strips enabling to connect wires with maximum diameter of 2.5 mm^2 are used.
The system of terminal strips was presented in figure below.



Different terminal strips are mounted depending on type of calculator, terminal strips from J1 to J7, J14 and J15 are used for all makes. For all versions of calculators except LQM-III-K J10 strip is being mounted. For LQM-III-D version J8 and J9 strips are mounted. J14 strip serves to connect communication interfaces that to be mounted additionally on a spacing bracket in the place marked 'Dys1'.

Battery should be mounted with keeping proper polarity by soldering it to the poles marked '+' and '-', additionally the battery should be fasten with the circuit with fastening belt.
The detailed description of terminal strips is as follows:
J1 – inlet temperature sensor of the first heat circuit for heat measurement,
J2 – pulse input 1 or flow transducer of the second heat circuit for heat measurement (displayed with T1 mark),
J3 – pulse input 2 (displayed with T2 mark),
J4 – pulse input 3 (displayed with T3 mark),
J6 – pulse input 4 (displayed with T1T3 mark),
J7 – outlet temperature sensor of the first heat circuit for heat measurement,
J8 – inlet temperature sensor of the second heat circuit for heat measurement,
J9 – outlet temperature sensor of the second heat circuit for heat measurement,
J10 – flow transducer of the first heat circuit for heat measurement,
J14 – interface for communication interfaces.

The wires of Pt500 type sensors can be connected to J6-J9 interfaces regardless to polarity and it is similar case when potential free pulsers (reed relay or other contact type) were applied then wires can be connected freely. In case of application of pulsers of open collector type or electrical active signals one should remember about proper polarity.

In J1-J4 interfaces particular terminals are marked as follow:
S - signal input
M - grounding of the system

In J10 interface the following marking was made:
M - grounding of the system
S - signal input
+ - + battery

The attention should be drawn to not allow red pole of battery is grounded even for a moment.
Connection of communication interfaces to J14 interface is possible only in one way.
The description of interface outputs should be found in a manual for that equipment.
During mounting of all wires and also those to be connected to interfaces then suitable bushings should be applied which are provided with interfaces or mounted in the holes in casing of the calculator.

THE DISPLAY

Reading of a broad scope of information is possible on the LCD display. The LQM-III calculator in its basic mode displays heat energy for the first heat circuit. Through pushing, keeping pushed and releasing the button any measured value can be displayed. After 7 minutes without pushing the button, the calculator will return to display of the basic mode.
Generally there is the following principle: sequential pushing the button changes the displayed value within each group; keeping the button pushed for 4 seconds and releasing allow to change a group.

BASIC MODE
- Power of heat energy GJ(kWh, MWh)
- Water volume
- Heat tariff 2 (overthreshold)
- Supply temperature
- Return temperature
- Temperature difference
- Momentary flow rate m^3/h
- Momentary power kW (MW)
- Error code
- Metrological test

FL1
- Average flow rate
- Max. flow rate
- Min. flow rate
- Average power
- Max power
- Min power
- Average supply temperature
- Max. supply temperature
- Min. supply temperature
- Average return temperature
- Max. return temperature
- Min. return temperature

FL2
- Least significant digits of power
- Incorrect working time - hours
- Flow level of 2 tariff switching
- Power level of 2 tariff switching
- Temperature level of 2 tariff switching
- Pulse value of the main meter
- Flow meter mounting and heat or cold meter
- Net number of heat meter

FL3
- Storage time hour. minute
- Storage date year. month. day
- Heat
- Water volume
- Heat tariff 2 (overthreshold)
- Pulse input No 1
- Pulse input No 2
- Pulse input No 3
- Pulse input No 4
- Average flow rate
- Max. flow rate
- Min. flow rate
- Average power
- Max. power
- Min. power
- Average supply temperature
- Max. supply temperature
- Min. supply temperature
- Average return temperature
- Max. return temperature
- Min. return temperature
- Average temperature difference
- Max. temperature difference
- Min. temperature difference
- Error code

FL1 – data for the calculated period
FL2 – configuration data
FL3 – hourly data
FL4 – daily data
FL5 – monthly data
FL6 – annual data

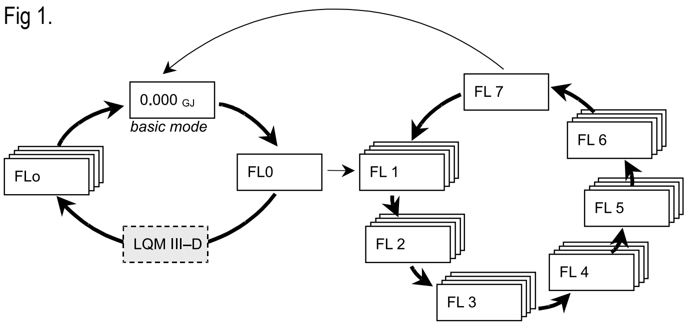
FLo – information about storage values
- Display test
- Water volume
- Pulse input No 1
- Pulse input No 2
- Pulse input No 3
- Pulse input No 4
- Working time
- Pulse value of main flow meter
- Pulse value No 1
- Pulse value No 2
- Pulse value No 3
- Pulse value No 4
- Time – hour. min
- Date – year. month. day
- Hour of daily storage
- Day of monthly storage
- Month of yearly storage
- Baud rate
- Even or No (parity)
- Customer number
- Battery voltage
- Serial number
- Software version

KIND OF DATA AND THEIR DISPLAY

Measured data, calculated data and stored data are located and displayed in structure which block diagram is presented in Fig. 1.
Measured and calculated data can be divided into current data, periodical data (set by the end user), stored data and configured data (service). In Fig. 1 the layout of data is presented in details for the LQM-III version (not for D one) with symbolic marked block of data for LQM-III-D version.
Layout of data in LQM-III-D is identical but GJ and FL1 to FL7 groups of data are copied and displayed with 'prim' mark. Current data (temporary values) are displayed in group of data and marked in Fig. 1 as block GJ (or GJ'). In FL1 (FL1') group data calculated for the period are placed. They are average, maximal and minimal data regarding flow, heat power and temperatures measured in given period. Configuration data that concern the measurement of heat are placed in FL2 (FL2') group, while configuration data concerning the whole equipment are in FLo group. FL3 to FL6 groups contain data being recorded in hour, daily, month and annual cycles. Blocks FL0 and FL7 do not contain any data but they serve to make easier the display. Block of data commencing from the main register of the first heat circuit is being displayed as a basic status and maintaining the display of another item will cause automatic return to the basic status after 7 minutes.

The following diagram allows an overview of the different modes.

Fig 1.

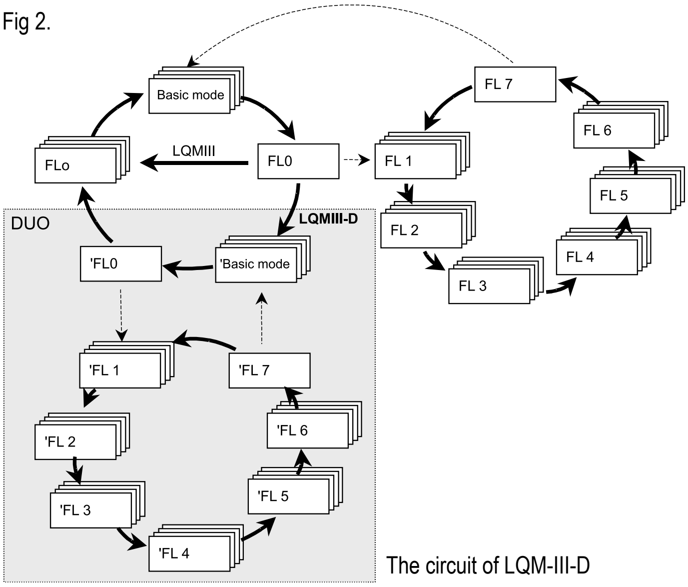


The display of total heat energy for LQM-III-D.
Calculator in its basic status displays total heat energy for the first heat circuit (after about 7 minutes without pushing the bottom, the calculator will return to display the same item).
Keeping the bottom pressed causes the change of data group being displayed. In order to pass to basic data of the second heat circuit one should proceed according to below diagram Fig 2.

LQM-III-D MODE – SECOND CIRCUIT

Optionally LQM-III-D can measure energy in a second circuit, keeping all its features like in the first one. Parameters from the second circuit are displayed with ‘ (prim) in the upper left corner.

Fig 2.



The circuit of LQM-III-D

CQM-III-K COMPACT TYPE

CQM-III-K compact heat meter includes LQM-III-K type heat integrator and velocity-type flow meter with pulse out put placed in one case where computer paired temperature sensors of Pt 500 type are connected.
The above version enables the heat meter of compact type to be mounted on supply and return of the heating system. Heat meters of compact type are designed mainly for heat energy to be measured in detached houses and multi strey houses with horizontal central heating installation. In case of additional flow meter and pair of temperature sensors mounted one can measure heat energy consumed in the second heating system. There is possibility to measure tap water consumption after four additional flow meters have been connected. We offer supplementary equipment to heat meters compact type like valves, filters, and connecting accessories.

The measurement of heat energy consumed consists in measure of volume of heating carrier and temperature difference.
The volume of heat energy is limited integral of the volumes resulted from the product of heat coefficient and temperature difference.

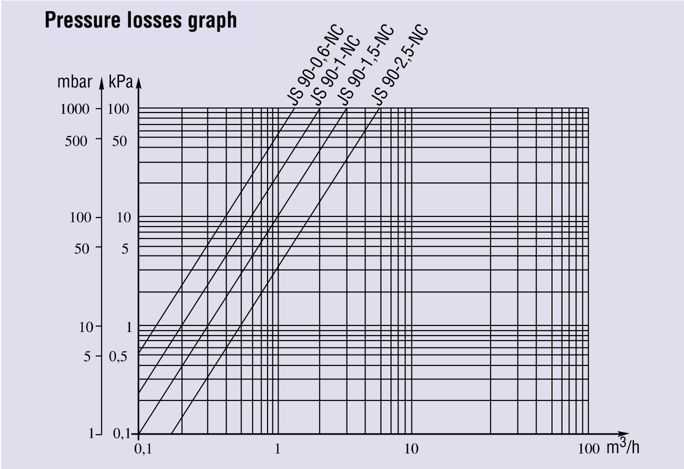
In order to measure the volume of flowing heat carrier, velocity-type flow meter with pulse output or ultrasonic flow meter with pulse emitter open pipe type are used. Temperature measurement of heat carrier is synchronised with pulses of the flow meter and then heat energy is calculated.

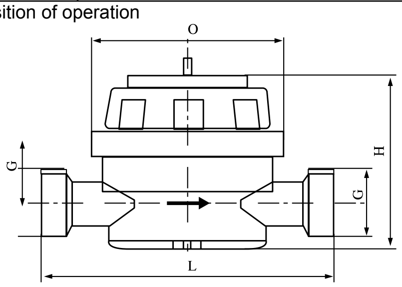
Heat coefficient “k” is depended on t1and t2 and the place of mounting of water meter. It is designated basing on algorithm developed by designers of the meter. Records in registers of RAM is being transferred to EEPROM non-volatile memory every hour in the moment when the function of transmission of data to reader is activated by the consumer. Calculations of heat energy are omitted in case when t1-t2<0, unless it is programmed as cooling meter.

Growth rates of volume taken from the following periods of integration are the sum of volume of the heat carrier and particular growth rates are designated as products of transducer constant and number of pulses calculated during that period.

Making use of Pt 500 type temperature sensors, LQM-III determines temperature values of the heat carrier with accuracy of 0,01°C on supply (t1) and return (t2). Those data are stored in register of RAM memory. The same method is used to determine the temperature difference.

The instantaneous power is determined after the integration period is over when temperature difference is higher than zero and it is calculated as the quotient of the heat energy growth rate and the length of integration period. Integration period is determined by pulses coming from water meter. Pulses are calculated and when they get the value equal to some constant figure /division scale/ then one integration period will be over and another one will start. After one minute passed from the beginning of the integration period and the amount of calculated pulses is smaller than division scale then the first pulse to be appeared will cause that the period of integration will be completed. The value of instantaneous power for the period of one hour is the maximal power.
The instantaneous and maximal flow rates are calculated by the same method like for suitable power.
There is possibility to measure over threshold energy by LQM–III. In such situation the threshold for power or flow rate should be settled over which over-threshold energy has to be calculated. The integrator counts the over threshold energy only from one threshold settled.



Designation of type			JS 90-0,6-NE	JS 90-1,0-NE	JS 90-1,5-NE	JS 90-1,5-G1-NE	JS 90-2,5-NE
Nominal diameter	DN	mm	15	15	15	20	20
Nominal flow rate	q_p	m^3/h	0,6	1,0	1,5	1,5	2,5
Maximal flow rate	q_i	m^3/h	1,2	2,0	3,0	3,0	5,0
Minimal flow rate – horizontal position of operation – H	q_i	dm^3/h	12	20	30	30	50
Minimal flow rate – vertical position of operation – V	q_i	dm^3/h	24	40	50	60	100
Start - up threshold - H	–	dm^3/h	3,5	5	8	5	15
Relative error	E_{Pd}	%	$E_{Pd} = (3 + 0,05\ q_p/q)$				
Pulse processing constant	V_i	imp/dm^3	124,780	85,334	60,000	60,000	34,892
Permissible pressure loss	Δp	MPa	0,1				
Nominal pressure	–	MPa	1,5				
Maximal temperature	–	°C	90				
Position of operation	–		horizontal H / vertical V				
	G		G 3/4	G 3/4	G 3/4	G 1	G 1
	L	mm	110	110	110	130	130
	H	mm	68				
	D	mm	73				
Weight (without connecting elements)		kg	0,4	0,4	0,4	0,45	0,45

LQM-III INTERFACES

- possible installation in meters in operation,
- ideal for remote readout systems, monitoring and AMR,
- a number of heat meter indications available.

DESCRIPTION

Each calculator is equipped in a socket suitable to connect different interfaces.

INTERFACE M-BUS

This module was developed according to EN 1434-3 Standard.

TRANSMITTED DATA:

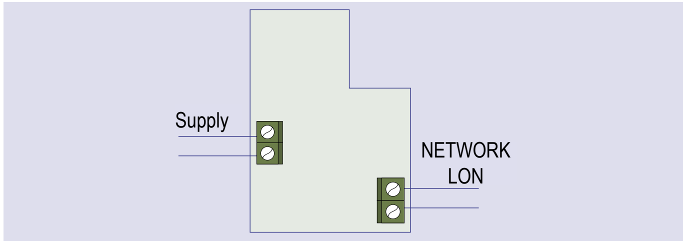
- User number
- Error code
- Serial number
- Energy
- Volume
- Power
- Flow rate
- Higher temperature
- Lower temperature
- Temperature differrence
- Tarriff energy
- Time of operation
- Time of operation with error
- Time and date of calculator clock
- Average temperature for last 24 h (higher)
- Average temperature for last 24 h (lower)
- Average flow rate for last 24 hours

INTERFACE LONWORKS

Technical data:

- Power supply: 24V AC/DC ± 30%
- Power input: 30 mA
- Transmission speed: 78 kBit/s
- Transceiver: FTT-10A
- Cable recommended: Belden 85102 2 x 1,3 type two wired cable spiral
- Length of segment: 500 - 2700 m, depending on network architecture
- Ambient temperature: from 0°C to 55°C
- 26 standard types of SNVT network variables.

LonWorks interface complies the requirements of LonMark standard. The list of SNVT is available at www.apator.com.pl



"FLAT" COMPREHENSIVE METERING SYSTEM FOR FLATS

Local Data Station (LDS)

LOCAL DATA STATION

Local data station (LDS) is the basic element of M-BUS network. This unit allows to concentrate particular network centres (M-BUS interfaces in heat integrator). Serial asynchronic interface in accordance with RS-232C standard makes possible data readout. The unit is powered from mains ~220V and it is adjusted to continuous operation.

DATA TRANSMISSION

Data transmission from local data station is possible by means of:
– GSM celluar phone modems,
– telecommunication modems,
– radio modem,
– internet interface.

APATOR S.A. offers "FLAT" comprehensive metering system for flats allowing to make the readout in one place the data from different meters showing the volume of medium consumed.

System is based on M-BUS network and it consists of the following elements:

1. Heat centres (maximal number 250)
   – LQM-II-K type heat integrator
   – Gas meter with pulse output
   – Electricity meter with pulse output
   – Four water meters with pulse output
   – M-BUS network interface
2. Network concentrator
   – (LDS) Local Data Station
   – (GZO) Remote reading socket
3. Readout sub-system (optional)
   – PSION type handheld computer with the software for data read out
   – radio module and PSION type handheld computer with software
   – IBM PC central computer with software
   – GSM cellular phone modem and IBM PC central computer with software
   – telecommunication modems and IBM PC central computer with software
   – internet link and IBM PC central computer with software
4. Auxiliary elements:
   – surge arrester
   – distribution box
   – power amplifier for M-BUS network

M-BUS NETWORK

M-BUS network is the local one allowing to integrate the metering equipment. Heat centres of network are linked by two arterial cables. Network interfaces are powered from arterial line. Each element of the network has got its own network number to be placed during the commissioning of the system. Data readout from the network is possible at selected point by use of concentrator.

NETWORK INSTALLATION

The arterial cable

It is suggested to use the following types of cables:
– I-Y(St)Y: 2x2x0.8
– YCYM: 2x2x0.8

The above-specified cables are two paired ones. In order to link M-BUS network single pair is used. Additional two cores are reserved ones which can be used for instance for automation in buildings, distribution of the auxiliary 24V-voltage etc. It should be stressed that any unscreened single or multi paired cable can be used instead of the arterial one.

The designer makes final selection regarding type of the cable.

ARTERIAL CABLE CONNECTION

The designer of the network should establish the method how to split the aerial cable. The best solution is to use special M-BUS type distribution boxes. Depending on operating conditions it should be used one branch-joint for several heat integrators or to make use of configuration of distribution box-integrator. It is possible to branch off arterial cable direct on M-BUS interface terminal strip.

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APATOR

ISO 9001

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