THE INSTITUTE OF FLOWMEASUREMENT

TECHNOLOGY *ELKORA*

VERTICAL ULTRASONIC

HEAT-WATER COUNTER

ELKORA B-34

TECHNICAL DESCRIPTION AND OPERATING INSTRUCTIONS

E1.015 TA V1

2004

CONTENT

1. INTRODUCTION

- Heat-water meter ELKORA B-34 is intended for measuring heat capacity and heat energy in open and closed heat supply systems, as well as for measuring water flow and volume. The heat-water meter is able to count two independent heat supply systems (for example, heating and hot water supply) at the same time.
- The ELKORA B-34 set can contain up to four flow and pressure transducers, as well as up to five temperature transducers.
- ELKORA B-34 has no moving parts, which ensures a long and
- continuous operation.
- The distance between the current transmitter and the computer can reach 300 m.
- The accumulated information can be printed by connecting the printer to the heat-water meter, as well as read with the help of a computer using the RS-232 port or modem.
- ELKORA B-34 meets the requirements of the European standard EN 1434.

2. CONSTRUCTION AND PRINCIPLES OF OPERATION

2.1. Composition of the heat-water meter

ELKORA B-34 consists of the following functional units:

- computer block;
- set of flow sensors (max. 4 pcs.);
- a set of resistance thermometers (max. 5 pcs.);
- a set of pressure sensors (max. 4 pcs.).

2.1. the image shows a preview of the computer block.

2.1. image. Counter block preview

Markings for 2.1. image:

1 - liquid crystal display;

2 - indicator LEDs of the parameter to be displayed (parameters related to system g are indicated by green color, parameters related to system r □ by red color);

3 - key «ON»;

4 - LED, which indicates that the parameter to be checked belongs to the system **g** (green light);

5 - LED, which indicates that the parameter to be checked belongs to the system **r** (red light);

6 - LEDs that signal the operating status of the flow, temperature and pressure transducers (green light - normal operating mode, red light - unacceptable operating mode);

7 - key «⇧»;

8 - key «⇩».

2.2. Flow measurement principle

The principle of flow measurements is based on the measurement of the frequency of eddies in the fluid flow behind the flowing body. A prism is installed inside the measured section of the flow sensor, perpendicular to the flow of the medium to be measured, behind which, at certain values of the flow speed and viscosity of the medium, a Karman vortex path is formed - vortices with a certain frequency, which in turn break off from the facets of the prism. Frequency, according to Struhal's criterion:

$$f = v \cdot \mathbf{Sh}/d,$$

proportional to **v/d**, therefore, at constant characteristic prism size **d**, proportional to speed **v**, therefore, proportional to volume consumption. Ultrasonic transducers are installed behind the flow body, which register the transverse velocity of the flow. Thus, the signal of the ultrasonic transducers is modulated with the frequency of the vortex formation, which is proportional to the flow.

The flow value is calculated by the processor of the electronic unit with the calibration coefficients for the vortex transducers, which are determined during the calibration run and written to the permanent memory.

2.3. Principle of temperature measurement

The temperature of the coolant in the pipeline is measured using resistance thermometers with 100π, Pt 100 or Ni 100 characteristic curves. The resistance thermometers are connected according to the 4-wire scheme, which ensures the independence of the measurement results from the length of the connecting cables.

With the help of an electronic commutator, the measuring current is passed alternately through resistance thermometers and reference resistors. The voltage drop measurements are processed in the computer block where the thermometer resistance R(t) is calculated. From now on, the temperature value is calculated according to the following relationship

$$T = \alpha \left[\frac{R(t)}{R_o} - 1\right] + \beta \left[\frac{R(t)}{R_o} - 1\right]^2$$

Where **R_0** = 100 Ω,

α and β – coefficients that depend on the characteristic curve of the resistance thermometer.

2.4. Principle of pressure measurement

Pressure is measured by pressure sensors that have a unified output current signal of 4 □ 20 mA. The connection is made according to the two-wire scheme, and the power source of the sensors is the heat-water meter itself.

2.5. Calculation of heat capacity and energy

Heat capacity and energy are calculated taking into account flow and heat carrier temperature measurements. The calculations used the values of water density and specific enthalpy from the tables: “ÃСССД 98-86: *Вода. Удельный объем и энтальпия при температурах 0...800 °С и давлениях 0,001...1000 МПа*. Ì.: 1995 - 68 ñ” and recorded in the permanent memory of the computer unit.

For a closed heat supply system with one flow sensor, heat capacity P calculated by the formula:

$$P = Q\pi \cdot (h_1 - h_2)$$

where Q – flow of the heat carrier (water), at the place of installation of the flow sensor (the flow sensor is installed on the forward or return pipeline),

π – water density at the installation location of the flow sensor,

h_1 – the specific enthalpy of the flow heat carrier,

h_2 – specific enthalpy of the reverse heat carrier.

For a closed heat supply system with two flow sensors, heat power P is calculated by the formula:

$$P = Q_1\pi_1 \cdot (h_1 - h_2)$$

where Q_1 – forward heat carrier flow,

π_1 – density of the flow heat carrier.

For an open heat supply system, heat capacity P, hot water, heat capacity P_W and heating heat capacities P_h calculation formulas:

$$P=Q_1\pi_1(h_1 - h_c) – Q_2\pi_2 (h_2 - h_c)$$

$$P_W = (Q_1\pi_1 - Q_2\pi_2) \times \left(\frac{h_1 + h_2}{2} - h_c\right)$$

$$P_h = P - P_W$$

where Q_2 – reverse heat carrier flow,

π_2 – density of the return heat carrier,

h_c – enthalpy of cold water for heat supply replenishment.

Siltuma enerģija tiek aprēķināta pēc formulas:

$$W = \int_{T_0}^{T} P(T)dT$$

where T_0 – the beginning of the thermal energy summation time,

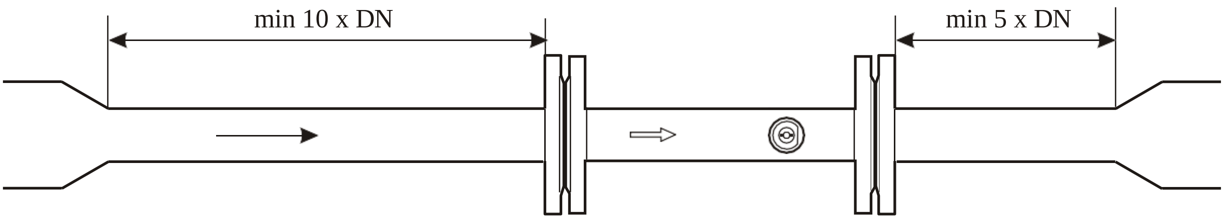
T – current time

3. MECHANICAL ASSEMBLY

3.1. Flow sensor assembly

When assembling the flow sensor, it is necessary to observe the following rules:

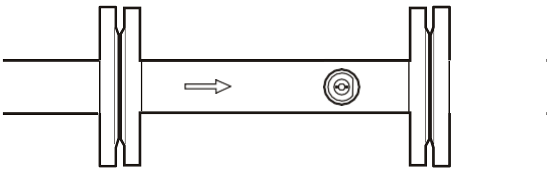
- The mounting location of the flow sensor must be located in a straight section of the pipeline, the length of which is not less than 10 internal diameters before the sensor and 5 internal diameters after the sensor (3.1. picture).



3.1. picture

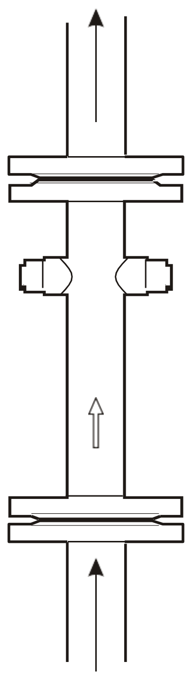
The spatial location of the flow sensor can be arbitrary, provided that it is completely filled with water.

- In case of horizontal placement, it is recommended to place the flow sensor so that the acoustic transducers are located in the horizontal plane (3.2.picture).



3.2. picture

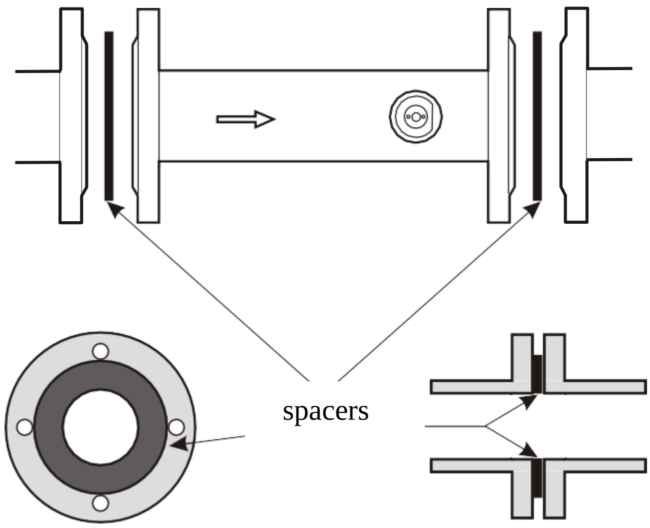
- In the case of vertical placement, it is recommended to place the flow sensor in the pipeline where the flow is directed upwards (3.3.picture).



3.3.picture

The flow direction must match the arrow direction of the flow sensor.

The inner diameter of the spacers and the pipeline must match the inner diameter of the flow sensor (3.4.picture).



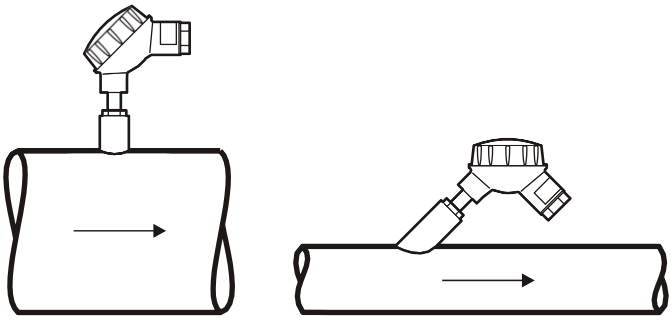
3.4.picture

3.2. Assembly of resistance thermometers

In a closed heat supply system, resistance thermometers are mounted on the forward and return pipelines, and in an open system also on the make-up cold water pipeline.

It is recommended to place resistance thermometers at a distance that is not
less than 5 DN after the flow sensor in the flow direction.

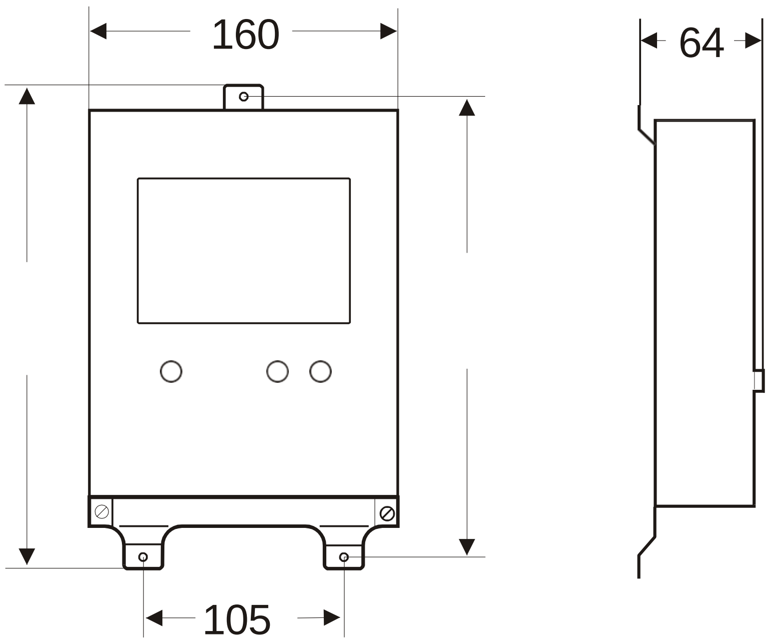
Mounting options for resistance thermometers are shown 3.5.image.



3.5.image

3.3. Assembly of the counter unit

The computer unit is fixed directly to the wall. Overall and installation dimensions are shown in 3.6. picture.

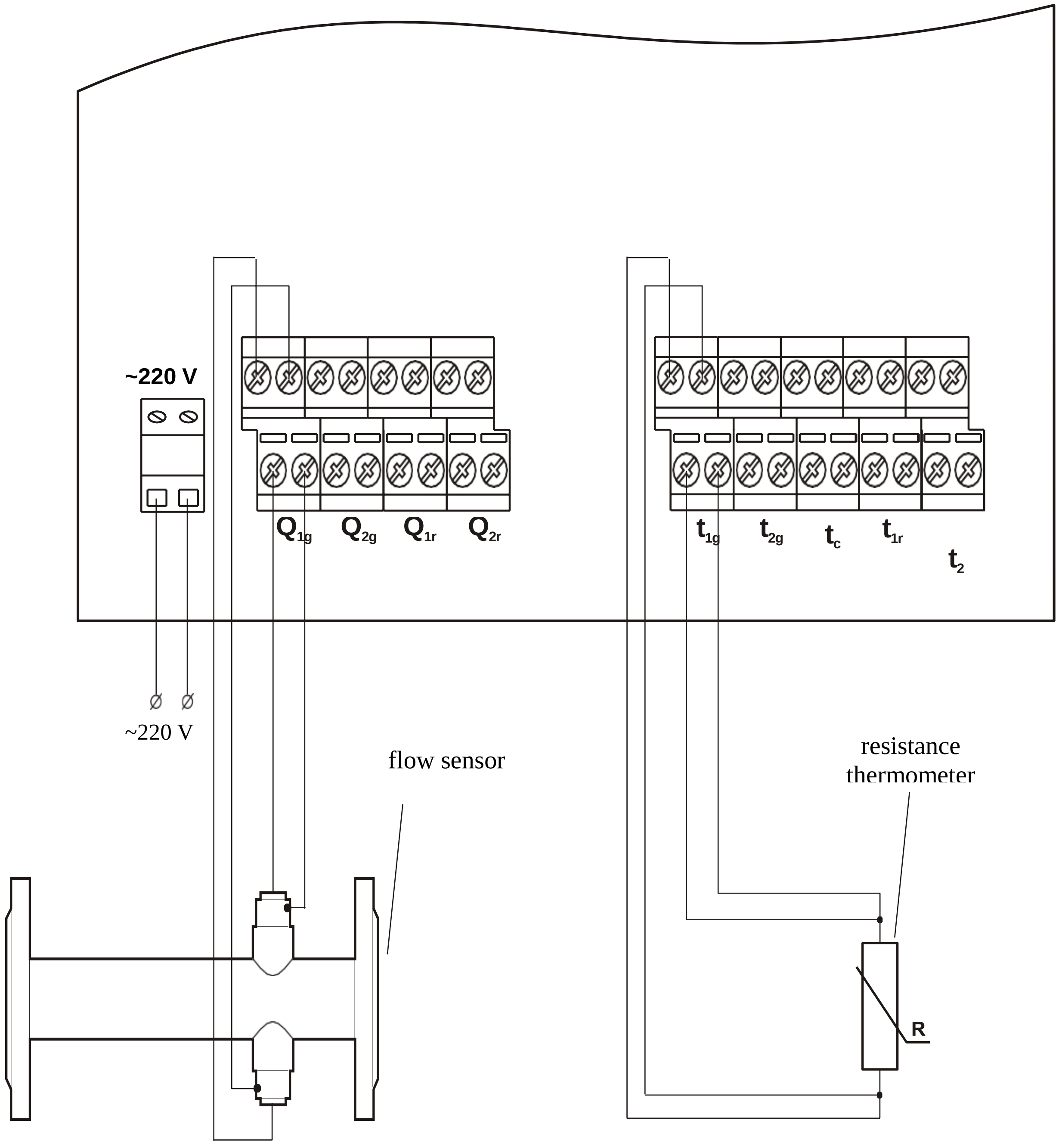


3.6. image

4. ELECTRICAL ASSEMBLY

The flow sensor is connected to the computer unit using a coaxial cable (for example, RG-59) with a length not exceeding 300 m and a diameter not exceeding 6 mm.

The resistance thermometers are connected to the computer unit using any 4-wire copper wire cable with a wire cross-sectional area of 0.25 mm^2 to 0.75 mm^2 and a length not exceeding 300 m.



4.1. image. Connection diagram of supply voltage, current transducers and resistance thermometers to the meter block.

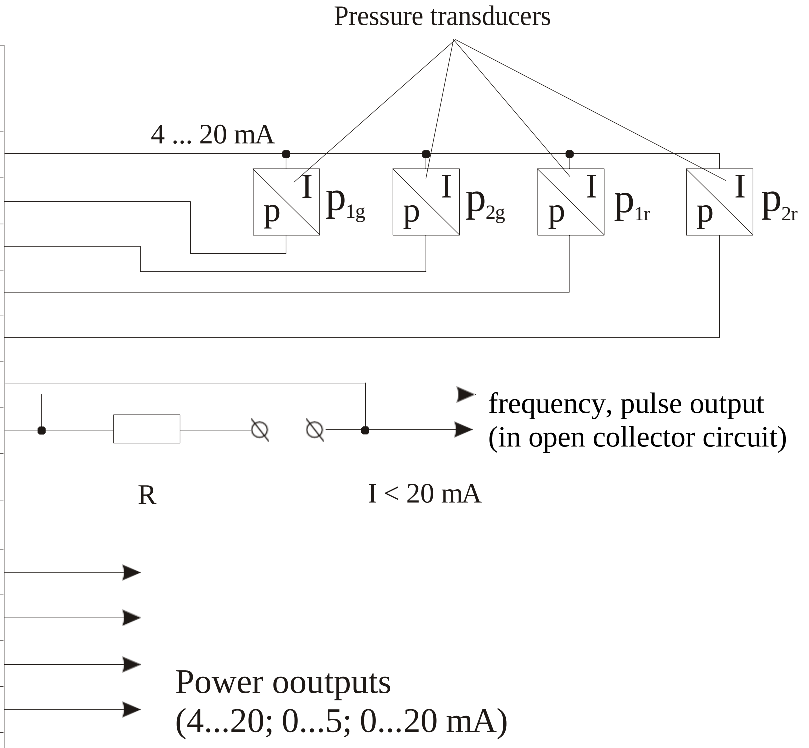
The connection of current transducers Q_{2g}, Q_{1r} and Q_{2r} is analogous to the connection scheme of Q_{1g}, the connection of resistance thermometers t_{2g}, t_c, t_{1r} and t_{2r} is analogous to the connection scheme of t_{1g} (indices g and r indicate belonging to the respective processing system)

The pressure sensor is connected to the computer unit using any 2-core copper cable with a wire cross-sectional area of 0.25 mm^2 to 0.75 mm^2.

Socket “**IN/OUT**”

DBRI - F15

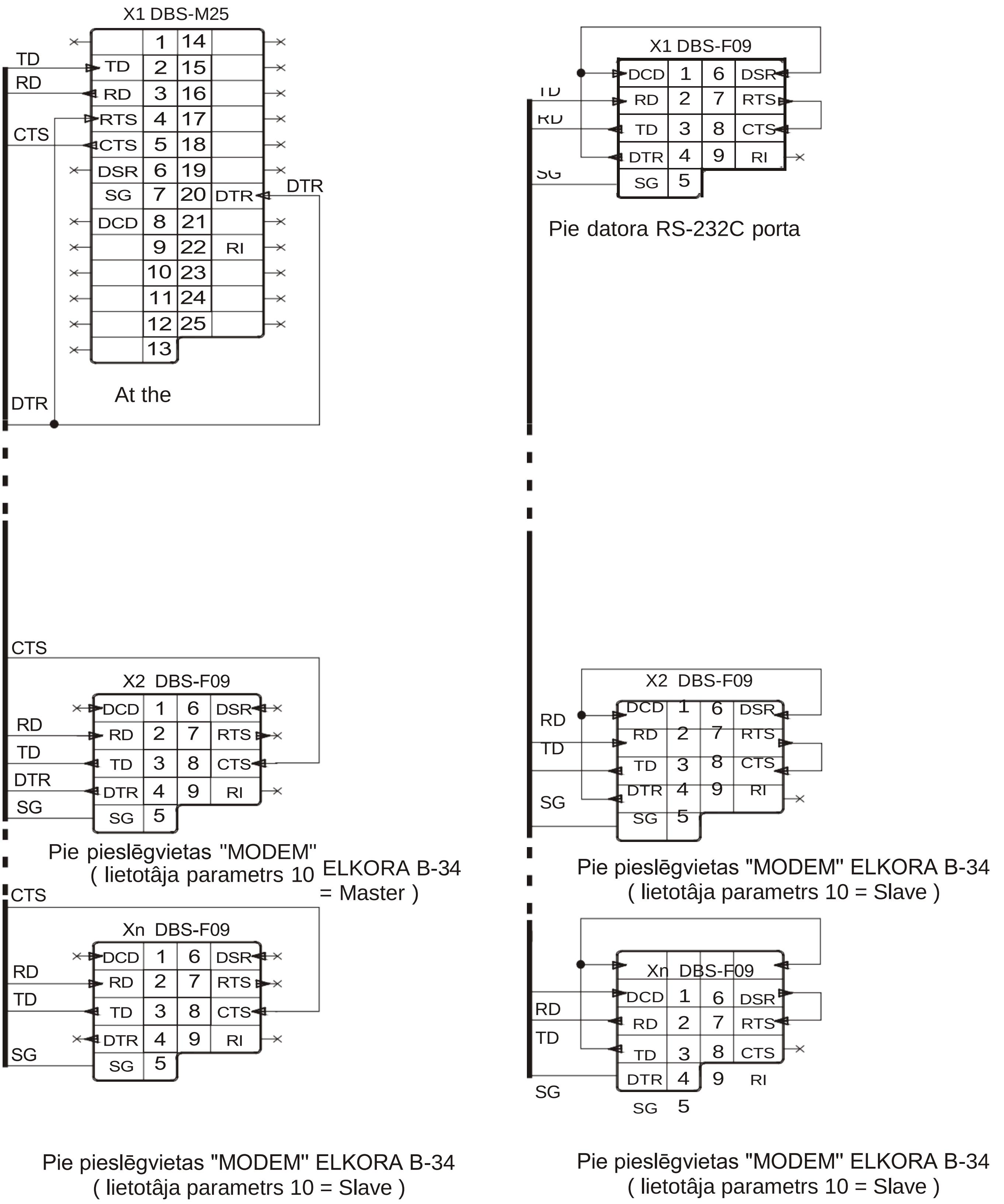
Contact	**Chain**
1	+24
2	P1G
3	P2G
4	P1R
5	P2R
6	FOE
7	FOK
8	-
9	GND
10	I1
11	I2
12	I3
13	I4
14	-
15	-



4.2. image. Connection diagram of pressure transducers, frequencies, pulses and current outputs

In order to connect the heat-water meter to a computer or modem, it has a built-in RS-232 serial interface. Using a remote connection to the heat-water meter, it is possible to read the measured values as well as the data stored in the meter. This option facilitates access to heat-water meter data, and also expands its operational capabilities using automated data collection and processing systems.

The connection can be made through a modem connected to the telephone line, or through the serial interface ports, connecting directly to the computer using a null modem cable. It is possible to simultaneously connect several heat-water meters (up to 10) with one line

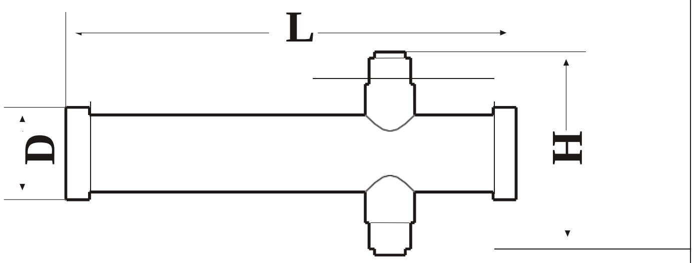


4.3. image. Connection diagram of a heat-water meter connected to a modem and a computer (the maximum length of connection cables is 50m).

5. TECHNICAL PRINCIPLES

5.1. Overall dimensions and mass

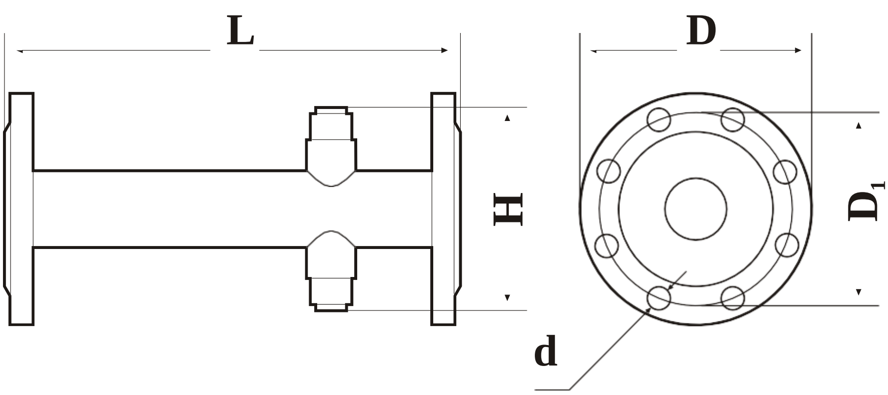
ELKORA B-34
(Thread attachment DN 20...50)



DN	L, mm	H, mm	D	Masa, kg
20	190	90	G1B	0,6
25	260	100	G1¼B	0,9
32	260	110	G1½B	1,2
40	300	120	G2B	1,5
50	300	130	G2½B	2,2

5.1. image. Flow sensor with thread connection

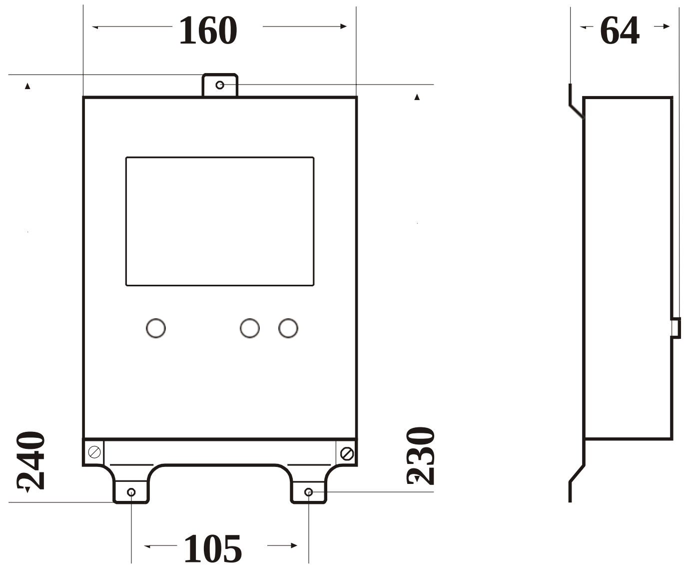
ELKORA B-34
(Atloku pievienojums DN 50...100)



DN	L, mm	H, mm	D, mm	D_1, mm	d, mm	Masa, kg
50	300	130	160	125	18	5
65	300	145	180	145	18	7
80	350	160	195	160	18	10
100	350	180	215	180	18	13

5.2. mage . Flow sensor with flange connection

ELKORA B-34
(Skaitļotāja bloks)



Masa	1,7 kg

5.3. image. Counter block

5.2. Measuring ranges

Table 5.1. shows the minimum water flows are given in the table **Q_{min}**, nominal **Q_{nom}** and maximal **Q_{max}** value and the upper limit of heat capacity **P_{max}** depending on the conditional diameter of the pipeline **DN**.

5.1 table

DN	Q_{min}, m³/h	Q_{nom}, m³/h	Q_{max}, m³/h	P_{max}, MW
20	0,16	4	8	1,0
25	0,20	5	10	1,5
32	0,24	12	25	3,2
40	0,30	15	30	5,1
50	0,40	20	40	7,7
65	0,50	50	100	12
80	0,70	70	140	19
100	0,90	140	180	28

- Temperature measurement range…………………………………………………………..0... +150 °C
- Temperature difference measurement range…… … … … … … … … … … … … +3... +150 °C
- Overpressure measurement range…………………………………………………………0... 16 bar

5.3. Measurement accuracy

5.2. table

Relative fundamental error of flow measurement	≤ ±0,2 % to the calculator; ≤ ±1,0 % for the meter.
Absolute fundamental error of temperature measurement	≤ ±0,1 °C to the calculator; ≤ ±(0,5 + 3$\Delta t_{min}/\Delta t$) °C for the meter.
The reduced fundamental error of pressure measurement	≤ ±0,5 % to the calculator; ≤ ±1,5 % for the meter.
Counter heat relative fundamental error of power and thermal energy measurement	≤$\delta E=\pm(3+4\Delta t_{min}/\Delta t+0{,}02Q_{max}/Q)$ %, Δt_{min} – the minimum temperature difference value of the heat carrier in the forward and return pipeline, Δt – temperature difference of the heat carrier in the forward and return pipeline, Q è Q_{max}– heat carrier flow and maximum flow value.

5.4. Other characteristics

5.3.table

power	**220 +10%/-15%V, 50 Hz**
Consumed power	**< 5 VA**
Environmental class	**class C of LV EN 1434 (+5...+55 C)**
Frequency and pulse output	**I_{max} = 20 mA, f_{max} = 32000 Hz**
Power outlet	**0...5; 0...20; 4...20 mA**
Interface	**line ″RS 232″** **parallel ″Centronics″**

6. USER DESCRIPTION

6.1. Parameter indication

The heat-water meter includes two independent processing systems **g** and **r** (g- green, r- red). When outputting the measured parameters on the liquid crystal display (LCD), belonging to the processing system g or r is indicated, respectively, by the glow of the green and red LEDs, which are located on the front panel of the meter. The parameters displayed on the LCD are selected with the «⇧», «⇩»keys. The left part of the clear crystal display shows the parameter, and the right part shows the numerical value of this parameter.

It is possible to output the following parameters to LCD:

6.1. table

	System **g**	System r
Energy	W_w, W_h, W	W
Capacity	V_1,V_2, V, ΔV	V_1,V_2
Work time	T	T
Time and date		
Power	P_w, P_h, P	P
Flow	Q_1,Q_2, Q, ΔQ	Q_1,Q_2
Temperature	t_1, t_2, t_C	t_1, t_2, Δt
Pressure	p, p_1, p_2	p, p_1, p_2

6.2. Average and integral values of parameters

To view average and integral parameter values, you need:

- With key «⇧», «⇩» choose the parameter you need.
- Press the key «**ON**» once or twice (watch 6.2 table.), the average or integral numerical value of the selected parameter is shown in the right part of the LCD, while in the left - the time interval during which the averaging or integration took place.
- With key «⇧», «⇩» selects the desired time interval.
- Switching back to work mode is done by pressing the key «**ON**» or automatically after 30 seconds.

6.2. table

	ON	**ON+ON**
Energy **Mass**	Monthly total value (archive 32 months) month. year	Daily summary values (archive 96 days) day. month
Working time	Monthly downtime (archive 32 months) month. year	24-hour idle time (archive 96 days) 24-hour. month
Power **Flow Temperature** **Pressure**	Hourly average value (archive 768 hours) month. year	Daily average values (archive 96 days) day. month. year

6.3. Notifications about errors during meter operation

- The LEDs and the LED display the operating mode of the transducers:
- The normal operating mode of the corresponding sensor (flow, temperature, pressure) is indicated by the blinking of the LEDs in green.
- Flashing of the LEDs in red, as well as the message “ERROR” instead of the parameter to be measured, indicates the damage of the respective sensor or an unacceptable operating mode.
- If the corresponding LED is not flashing, the sensor is off.

Archive in browse mode:

- Symbol ″*″ after the date, indicates that there has been a mains voltage disturbance during the given time period.
- Symbol ″*″ according to the value of the parameter indicates incorrect operation of the respective sensor during the time period shown in the left part of the liquid crystal case.
- A statement instead of the current parameter ″**POWER**″ indicates the absence of mains voltage throughout the period of time shown in the left part of the LCD.

6.4.Lietotâju parametru apraksts

User parameters are intended to set:

• printing mode;

• working with a modem;

• current outputs;

• frequency and pulse output;

• clock.

To set the parameters of the user's heat-water meter, it is necessary:

- With key «⇧», «⇩» choose parameter ″TIME AND DATE″.
- Press and hold the key «**ON**». After a few seconds, the heat-water meter will switch to user parameter setting mode. A flashing number on the left side of the LCD corresponds to the user parameter number.
- With key «⇧», «⇩» it is possible to select the required user parameter number.
- A key must be pressed to activate the selected user parameter «**ON**», then the value of the parameter starts flashing in the right part of the LCD.
- With key «⇧», «⇩» select the required parameter value.
- Switching back to user parameter selection mode is done by pressing the key «**ON**».
- Switching back to working mode is done by pressing the key «**ON**» again or automatically after 30 seconds.

Setting the printing parameters

01 *Printing form:*

`01 LP   Day form`

Average and summary parameter values for each hour of the day.

`01 LP Month form`

Average and summary parameter values for every hour of the day during the month.

`01 LP  Year form`

Average and summary parameter values for each month during the year.

02 *Setting the print start date:*

`02 LP B 01.01.04`

Setting the time (hours, days, months, years, depending on the set user parameter 01) from which the data will be printed.

03 *Start / stop printing:*

`03 LP      Start?`

Printing can be started with a selected command **Start?**, with key «⇧» vai «⇩».

`03 LP      Stop ?`

Printing can be stoped with a selected command **Stop?**, with key «⇧» vai «⇩».

04 *Selecting the printing language:*

`04 LP    English`

Printing in English.

`04 LP    Russian`

Printing in Russian.

Setting the parameters for working with the modem

```
10 Modem   Master
```

If only one heat-water meter is connected to the modem, then the value Master must be set.

If several heat-water meters are connected to the modem, then the value Master should be set only for the meter that is directly connected to the modem, all other counters must be set to the Slave value.

```
10 Modem   Slave
```

In addition, if more than three heat-water meters are connected to one modem, then for all meters that have the Slave value set, it is necessary to remove the switch located on processor board next to the power supply.

11 *Setting the speed of the serial interface:*

```
11 MdSpeed   1200
```

Setting the serial port speed for exchange with a remote machine (computer, etc.). It is possible to set the following link speed values1200; 2400; 4800; 9600; 19200; 38400 biti/s.

Power output installation

20 *Current output range setting:*

```
20 Iout   4-20 mA
```

Installation of all current output ranges. The following ranges of current values are possible: **4 ÷ 20**; **0** ÷ **5**; **0** ÷ **20 mA**.

21, 23, 25, 27 *Setting the parameters of current outputs* ***1,2,3*** *and* ***4****:*

```
21 I1Par Q1,m³/h
```

Setting the parameter whose value is set in the current output. It is possible to choose the following parameters: Q_1, Q_2, ΔQ [m^3/h]; G_1, G_2 , ΔG [t/h]; t_1, t_2, t_c [°C]; p_1, p_2 [bar]; P_h, P_w, P [MW (Gcal/h)].

22, 24, 26, 28 *Setting the value of the maximum current parameters of current outputs* **1,** ***2, 3*** *and* ***4***

```
22 I1max     240
```

Setting the maximum value of the current output parameter, which corresponds to the specified maximum current with user parameter 20 (zero value for the parameter to be measured corresponds to the minimum current value at the output set by user parameter 20).

Frequency and pulse output setting

30 *Frequency or pulse mode selection:*

`30 fout   freq.` Installation of frequency outputs.

`30 fout   impulse` Installation of pulse output.

Viewing and setting user parameters 31, 32 and 33 is only possible if user parameter 30 is set to frequency output.

31 *Setting the maximum frequency:*

`31 fmax   2400 Hz` Setting the maximum frequency in the frequency output, values from 10 Hz to 32000 Hz.

32 *Setting the output parameter in the frequency output:*

`32 fPar   Q1,m3/h` Setting the parameter whose value will be output to the frequency output. The content of the menu depends on the working mode of the heat-water meter. In general, there is the following parameters can be selected:: Q_1, Q_2, ΔQ [m^3/h]; G_1, G_2, ΔG [t/h]; t_1, t_2, t_c [°C]; p_1, p_2 [bar]; P_h, P_w, P [MW (Gcal/h)].

33 *Setting the maximum value of the frequency output parameter:*

`33 fParmax   240` Setting the maximum value of the frequency output parameter with the corresponding maximum frequency set by user parameter 31.

Viewing and setting user parameters 34 and 35 is possible only if user parameter 30 has pulse output set.

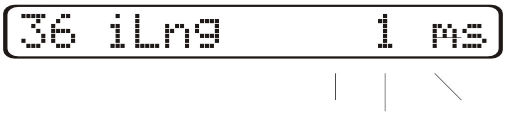
34 *Setting the output parameter in the pulse output:*

`34 iPar   V1,m3_` Setting the parameter whose value will be output to the pulse output. The content of the menu depends on the working mode of the heat-water meter. In general, it is possible to choose the following parameters V_1, V_2,V [m^3], M_1, M_2, ΔM [t]; W_h, W_w, W [MWh (Gcal)].

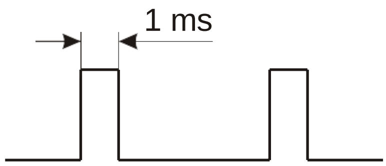
35 *Setting the pulse unit values:*

Setting the amount of volume, mass or energy (depending on user parameter 34) to which one pulse corresponds.

36 *Pulse length setting:*



Setting the pulse length at the pulse output.



Clock installation

50, 51, 52, 53, 54, 55 – according to the setting of hours, minutes, seconds, date, month and year.

7. SAFETY REGULATIONS

• Operation and maintenance of heat-water meters is allowed only to qualified personnel who are familiar with work safety regulations.

• When working with heat-water meters, increased attention should be paid to electrical assembly elements with high voltage.

• It is categorically forbidden to disconnect the cables from the heat-water meter, to carry out assembly and repair work when the supply voltage is switched on. The operation of heat-water meters with damaged or no grounding is prohibited.

8. WARRANTY OBLIGATIONS

The guaranteed service life of the heat-water meter 3 years from the moment of commissioning, provided that the user observes the assembly and operation rules found in this Technical Description.