Ultrasonic Heat Meter

SVTU11H RP

Technical description S14.D.001

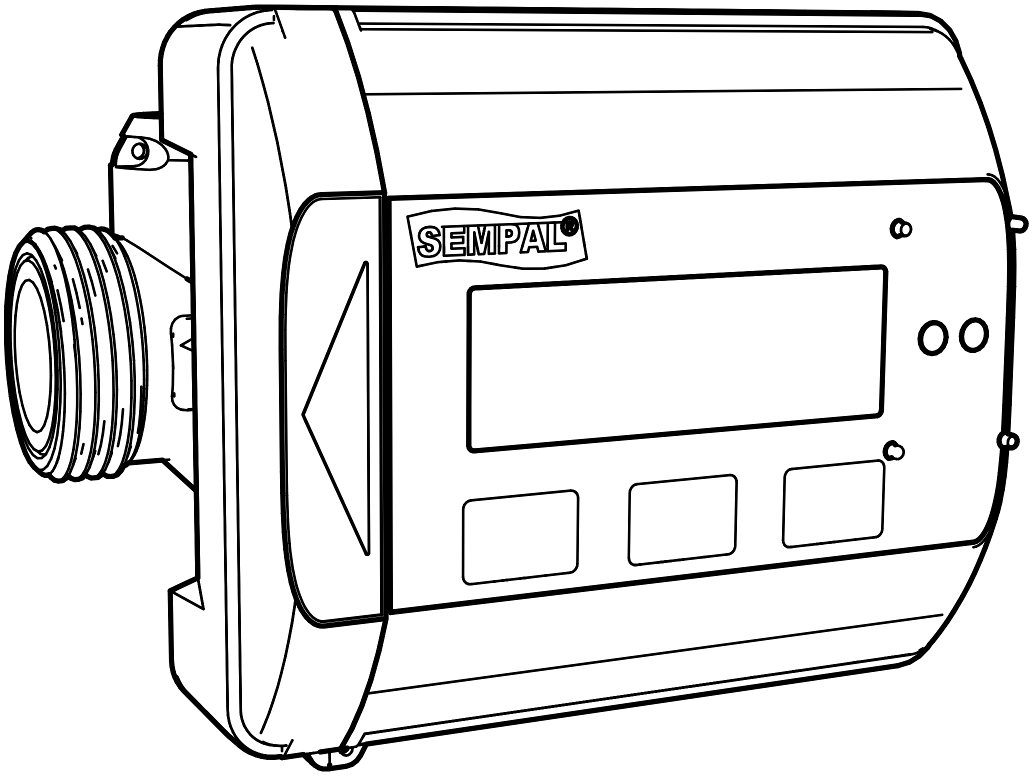


Table of Contents

1 General description

Heat meter SVTU11H RP type is an ultrasonic meter of heating energy, cooling or heating/cooling energy. The meter is intended for measuring energy in any water systems used for district heating, heating and hot water supply.

In accordance with EN1434, meter is recognized as hybrid (or compact) one. It means that in the course of its manufacture and primary verification the meter consists of a calculator, a pair of temperature sensors and flow metering section. However, once produced, the meter will be deemed a single heat meter with integrated component parts.

That is, if any of its parts is separated from the meter and lead seals are damaged, the meters will become unsuitable for commercial use and warranty therefor will be lost.

The meter employs ultrasonic principle of the flow rate measurement. Ultrasonic waves are in turn transmitted downstream and upstream the flow; current volumetric water flow rate is measured based on the difference between the propagation times of said waves.

The temperature is measured by virtue of a pair of calibrated Pt1000 platinum temperature sensors. Calibration coefficients are entered into the calculator thus allowing to measure the temperature and temperature differential with very high accuracy. The meter is delivered with a pair of calibrated temperature sensors 5 mm in diameter. One of these is installed into the flow metering section, while the second temperature sensors will be mounted in the course of meter installation (into a ball cock usually).

The measured heat energy may be displayed in kWh, MWh, GJ, GCal. Indicator displays 8 significant digits.

The indicator will never be turned off thus allowing to monitor operation of the meter and to take readings without pressing any pushbuttons.

Additional measured and displayed parameters (measurement units are shown in brackets) includes:

- flow rate (m^3/h or l/h)
- accumulated volume (m^3)
- accumulated mass (t)
- thermal energy (MW, kW, GCal/h)
- temperature and temperature differential.

The meter includes 4 tariff counters to accumulate data on the thermal energy (heating and cooling), volume and mass.

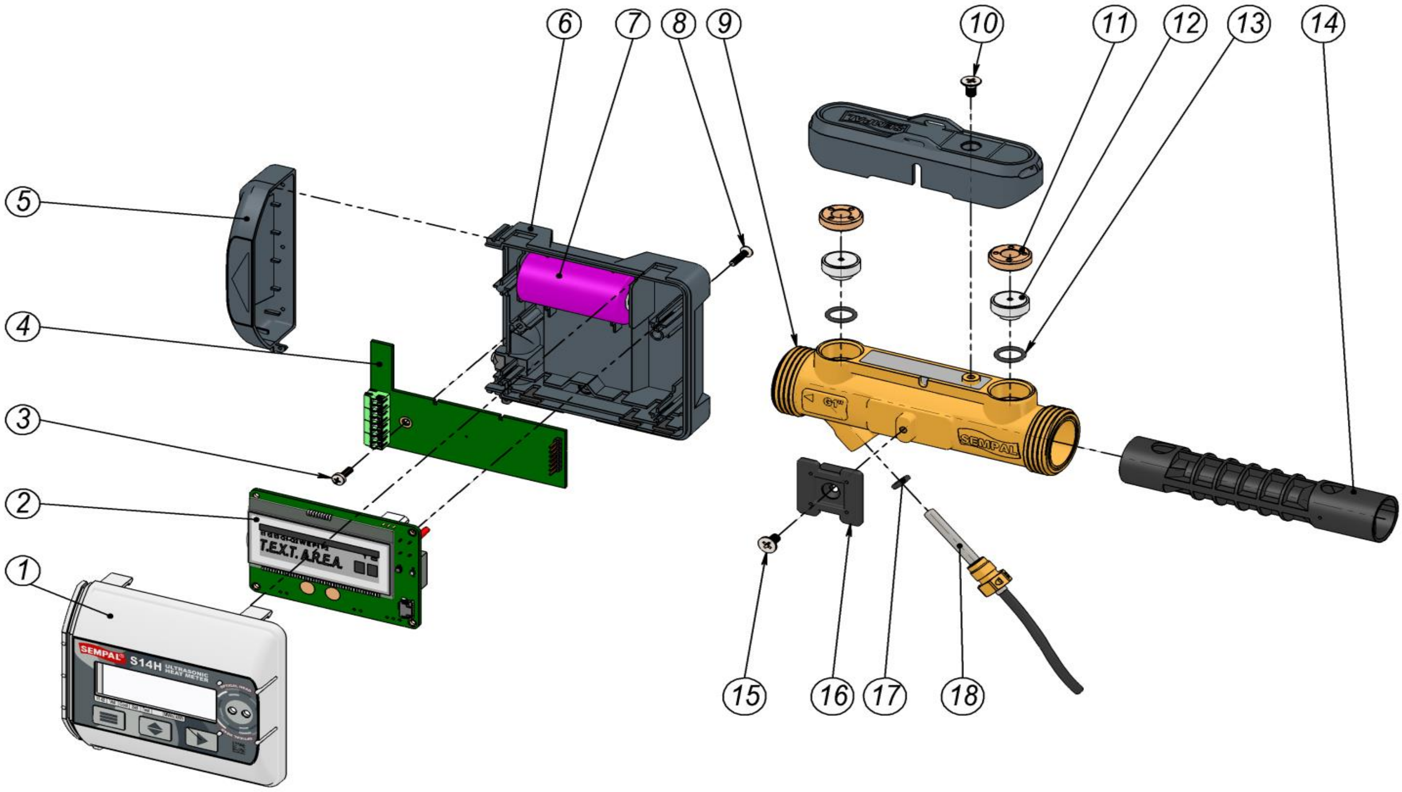
Power source of the meter - built-in lithium battery. Service life of such battery is 16 years.

The meter may be equipped (in the course of its manufacture) by an additional communication module extending communication ability of the meters (M-Bus, WMBus, RS232…) thus allowing to connect two additional flow rate meters with output pulse signals to register water consumption.

Besides the built-in communication modules, data may be obtained from the meter through an iRDA head at the rate of 300 baud or 9600 baud. EN1434 A Mode and Sempal protocols are supported.

This technical description is intended for operating service units, installers and for verifying and testing organizations.

1.1 Structure of the meter



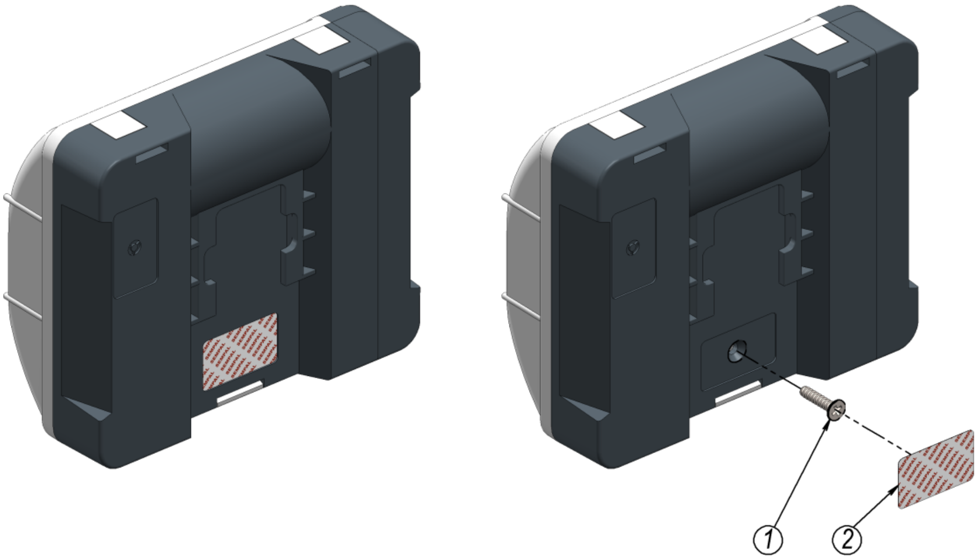
Item No.	Description	Item No.	Description
1	Upper calculator cover	10	Screw fastening of the flow metering section cover
2	Printed board with electronics	11	Clamp of flow sensor
3	Screw fastening the communication module	12	Flow sensor
4	Communication module	13	Flow sensor sealing element
5	Side calculator cover	14	Measuring insert
6	Lower calculator cover	15	Screw fastening of the calculator holder
7	Battery	16	Calculator holder
8	Screw fastening the upper cover	17	Sealing element of temperature sensor
9	Flow metering section	18	Temperature sensor

1.2 Sealing

1.2.1 Calculator sealing

The upper cover of the calculator is connected with the lower one by means of three snaps that are not sealed. To seal the calculator a fastening screw is used, head of which is covered with a sealing sticker.

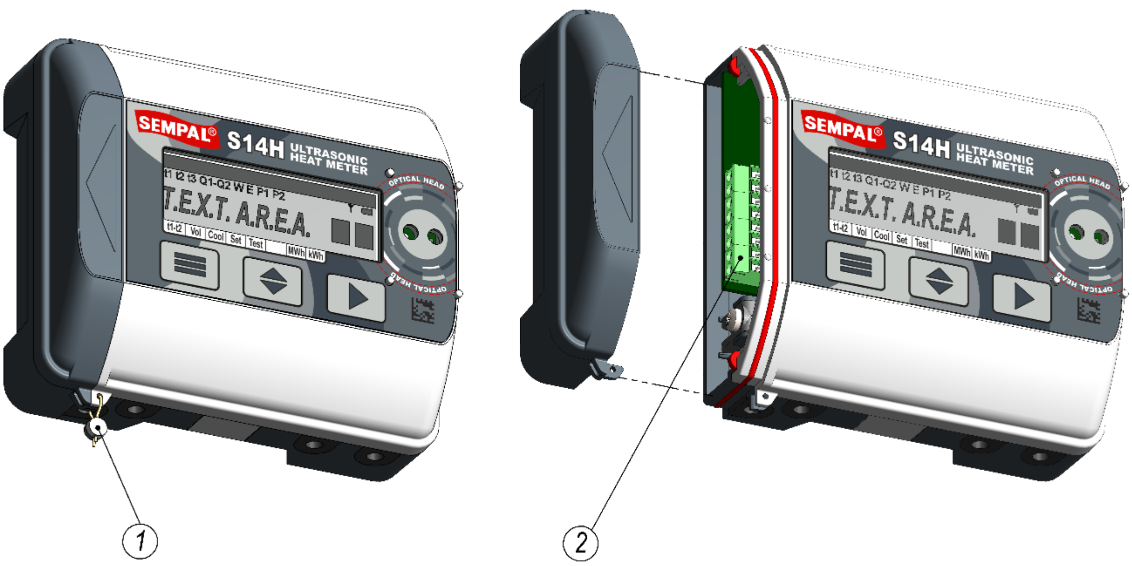
If the screw is not removed, the calculator may be disassembled only by breaking the snaps.



1 – fastening screw; 2 – sealing sticker

If the snaps or the sealing sticker is damaged, the meter may not be used for billing and its warranty will become null and void.

The side cover providing access to communication module contacts will be sealed by an organization registering the instrument.



1 – lead sealing; 2 - contacts for the communication module connection

1.2.2 Electronic sealing of the calculator

As electronic sealing is used special key which is disconnected on opening the cover.

The fact of cover removing is displayed by the meter indicator. Such signal may be disabled only when you enter into Setup or Test mode.

OPEnEd

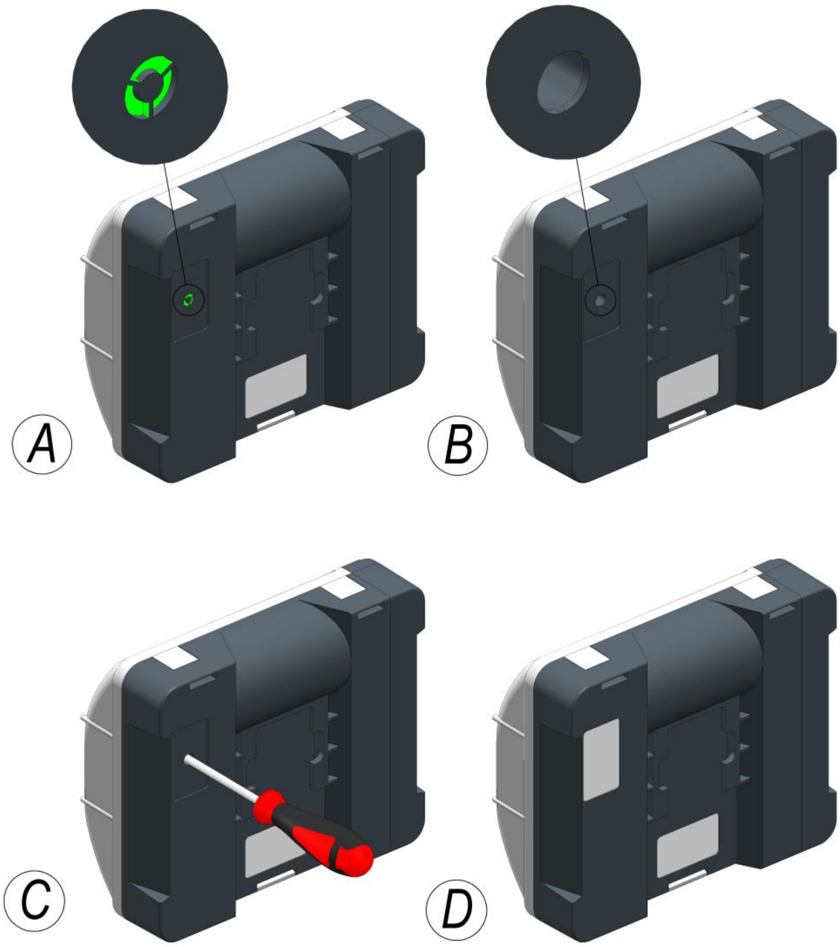
Such text on the indicator evidences that the upper cover of the meter has been opened.

1.2.3 Transition to Setup and Test modes

Setup mode is used for initial setting of the instrument, while **Test** mode is used for its regular verifications.

Transition to these modes will be carried out by depressing a special pushbutton located on the lover calculator cover.

After manufacture, this pushbutton is hidden under a solid plastic protecting element. Access to the pushbutton will be provided only if such protecting element is broken. Such protecting element will be glued with a sealing label after the check.



A – status of the protecting element after manufacture; B- status of the protecting element when broken; C – depressing the pushbutton; D – installed sealing sticker

2 Specifications

2.1 Metrological parameters

Temperature measurement range	Θ: 2 °C …+130 °C	- for error characteristics rating
Temperature differential range	ΔΘ: 3 K…130 K	
Measurement temperature range	Θ: -49 °C …+150 °C	- limiting values to be measured
Temperature differential range	ΔΘ: 0 K…200 K	by the meter
Temperature sensors	Pt1000 - EN60751, 2-wire fixed soldered connection	
Rating of the characteristics	As provided for in EN1434	
Accuracy class	2	
Climatic environment class	A, C	

Type of flow metering section	Permanent flow rate, qp	Min. flow rate, qi	Max flow rate, qs	Sensitivity threshold	Flow rate limit	Pressure loss, Δp@qp	Flow metering section connection	Length
	[m^3/h]	[m^3/h]	[m^3/h]	[m^3/h]	[m^3/h]	[bar]		[mm]
DN15-A	1.5	0.015	3	0.003	5	0.17	G ¾ B	110
DN20-A	1.5	0.015	3	0.003	5	0.1	G 1 B	130
DN25-A	3.5	0.035	7	0.007	10	0.12	G 1 ¼ B	160
DN32-A	22	0.22	30	0.044	50	0.25	Flange ∅84 mm	180
DN40-A	36	0.36	50	0.07	80	0.25	Flange ∅98 mm	200
DN50-A	60	0.6	90	0.12	150	0.2	Flange ∅122 mm	180
DN65-A	100	1.0	160	0.20	270	0.17	Flange ∅144 mm	200
DN80-A	150	1.5	230	0.30	390	0.11	Flange ∅155 mm	210
DN100-A	250	2.5	360	0.50	610	0.09	Flange ∅184 mm	230

2.2 Electrical parameters

Calculator

Errors	Calculator: Ec = ±(0.1+2/ΔΘ) % Et = ±(0.1+5/ΔΘ) %
Indicator	Consists of two areas: Main LCD – 8 significant digits. It is operated permanently. Menu line: a text line. It is operable only during the navigation through menu.
Energy measurement units	kWh, MWh, GJ, GCal
Flow rate measurement units	m^3/h or l/h
Thermal energy content measurement units	MW, kW, GCal/h
Archiving	1680 hours (70 days), 500 days, 36 months, 16 years. User actions log – 100 entries
Clock/Calendar	Real time clock (clock deviation does not exceed 3 seconds a day); calendar with consideration of leap years, summer/winter time, accounting month commencement date
Data exchange through iRDA optical port	- EN1434 protocol for iRDA, mode A with CRC (read only) - Sempal protocol– reading and configuring

Communication modules	- wired M-Bus. Load: 1 unit (1.5 mA). EN 1434-3, EN 13757-2 and EN 13757-3. Transfer rate may be selected from the sequence: 300, 600, 1200, 2400, 4800 and 9600 baud. - RS232. Transfer rate is 9600 baud, 8 bit, parity check – none, 1 stop bit. Sempal protocol. - pulse signal outputs. Two passive pulse signal outputs. Maximum frequency is 100 Hz. Weight of a pulse and data to be transferred are adjustable. - WM-Bus (wireless M-Bus). Frequency is 868 MHz Transmission protocol C1. Data will be transferred once every 15 seconds. Transmission protocol T1. Data will be transferred once every 15 minutes.
Pulse signal inputs	Pulse signal inputs (up to 2 inputs) may be used only that the communication module is available. Such inputs are used to measure water volumes by meters with electrically isolated outputs. The loading resistance of 680 kOhm is connected with +3 V. Maximum pulse signal frequency is 1 Hz.
Electromagnetic compatibility	Meets requirements of EN1434, class C
Power supply voltage	$3.6^{+0.1}_{-0.3}$ B

Temperature measurement		
Pt1000, two-wire connection; cable length is 1.15 m, unless the latter temperature sensor is built into flow metering section	T1, T2 Temperatures of supply and return waters	ΔΘ Measurement of hot/cold water
Measurement range	-49 °C …+150 °C	0 K…200 K

Battery	3.6 V DC, 1 lithium cell of C size
Replacement interval	16 years More frequent replacement may be needed when communication modules are used or data are read frequently or when the meter is used at a high temperature
Lithium content	2.5 g

2.3 Structural features

Climatic Environment class EN1434, class C

<table>
<tr><th></th><th>Ingress protection</th><th>Ambient temperature</th><th colspan="2">Classification with respect to environment</th></tr>
<tr><td>Calculator</td><td>IP65</td><td rowspan="2">5…55 °C</td><td>Non-condensed humidity</td><td rowspan="2">Indoors</td></tr>
<tr><td>Flow metering section (assembled)</td><td>IP68</td><td>Condensed humidity</td></tr>
</table>

Heat transfer liquid temperature	2…130 °C	If the heat transfer liquid temperature is below 15°C or above 90°C, installation of the calculator on a wall will be obligatory requirement (to avoid moisture condensing and calculator overheating, respectively).
Heat transfer liquid type	Water	
Storage temperature	-25…+60 °C	
Operating pressure	16 bar	
Testing pressure	25 bar	
Cable length to flow metering section	1 m (cannot be disconnected)	
Cable length to temperature sensor	1.15 m (cannot be disconnected)	

2.4 Materials

Wetted parts

	flow metering section	Stainless steel
	flow sensor	PES+30% GF
	sealing elements	EPDM
Flow metering section cover, calculator, wall installation fixtures		ABS+PC
Cables		Cable: Silicone + PTFE

2.5 Errors

Error components	Rated as provided for in EN1434	Rated for the meter
Flow rate measurement	$Ef = \pm(2 + 0.02q_p/q)$ %	$Ef = \pm(2 + 0.02q_p/q)$ %
Calculator	$Ec = \pm(0.5 + \Delta\Theta_{min}/\Delta\Theta)$ %	$Ec = \pm(0.1 + 2/\Delta\Theta)$ %
Temperature measurement	$Et = \pm(0.5 + 3\ \Delta\Theta_{min}/\Delta\Theta)$ %	$Et = \pm(0.1 + 5/\Delta\Theta)$ %
Total error	$Etot = Ef + Ec + Et =$ $\pm(3 + 0.02q_p/q + 4\Delta\Theta_{min}/\Delta\Theta)$ %	$Etot = Ef + Ec + Et =$ $\pm(2.2 + 0.02q_p/q + 7/\Delta\Theta)$ %

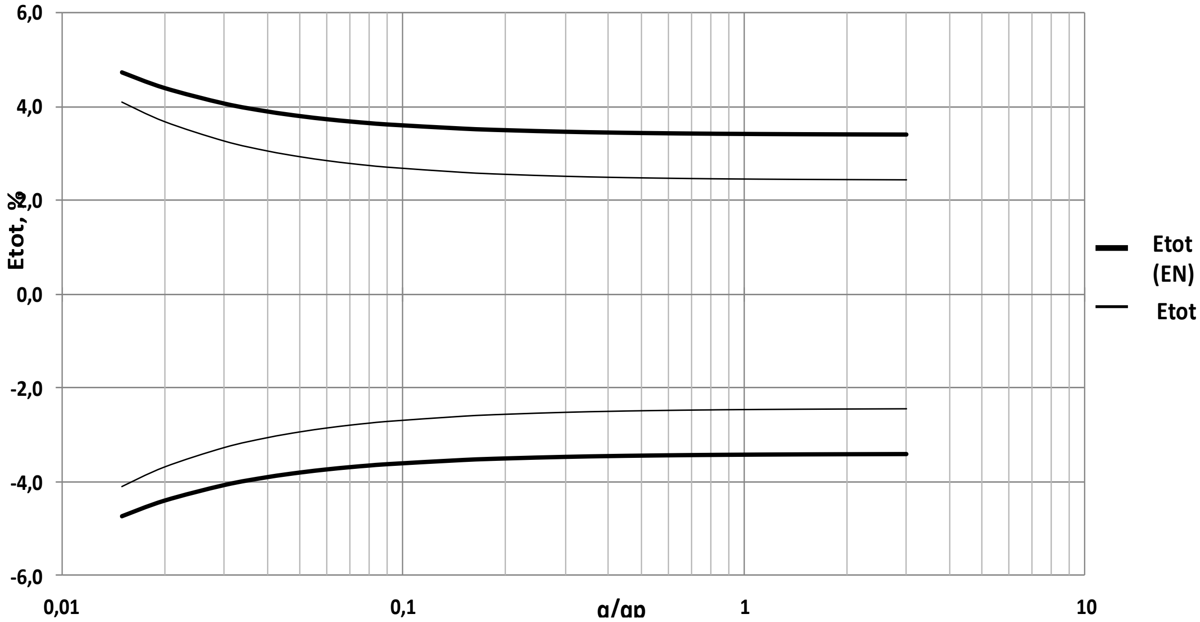


Figure 1: Total error as compared with requirements of EN1434-1
$\Delta\theta = 30$ K

3 Meter type and configuration

3.1 Meter type

The meter type are indicated on the upper cover of the calculator and may not be changed.

SVTU11H RP - □□□□

Flow metering section

qp [m³/h]	DN	Connection	Installation length [mm]	
1.5	DN15	Thread G ¾ B	110	015A
1.5	DN20	Thread G 1 B	130	032A
3.5	DN25	Thread G 1 ¼ B	160	025A
22	DN32	Flange ∅ 84 mm	180	032A
36	DN40	Flange ∅ 98 mm	200	040A
60	DN50	Flange ∅ 122 mm	180	050A
100	DN65	Flange ∅ 144 mm	200	065A
150	DN80	Flange ∅ 155 mm	210	080A
250	DN100	Flange ∅ 184 mm	230	100A

An example of the meter type: **SVTU11H RP - 032A**

3.2 Heat meter configuration

Configuration will be shown in the menu line on the instrument indicator.

Cfg – □□ □ – □ □ – □ □ □ – □ – □ □

Communication module (3.2.1)

Not installed	**00**
RS232	**10**
M-Bus	**20**
2 pulse signal outputs	**30**
WM-Bus protocol C1	**40**
WM-Bus protocol T1	**41**

Pulse inputs in the communication module

No pulse inputs	**0**
Pulse inputs are available	**1**

Flow metering section position (supply/return) (0)

Supply	**1**
Return	**2**

Number of temperature sensors	**2**

Integration periodicity (3.2.3)

Integration period, s	Flow rate measurement period, s	
2	0.5	**1**
4	1	**2**
8	1	**3**
16	2	**4**
32	4	**5**

System of heat energy units (3.2.4)

Energy units	Power units	
GJ	MW	**1**
kWh	kW	**2**
MWh	MW	**3**
GCal	GCal/h	**4**

Flow rate units system (3.2.5)

m^3/h	**1**
l/h	**2**

Tariffing (3.2.6)

Not used	**0**
P (power)	**1**
Q (flow rate)	**2**
dT (temperature differential)	**3**
T1 (supply water temperature)	**4**
T2 (return water temperature)	**5**
Time	**6**
PQ (power and flow rate)	**7**
HC (Heating/cooling amount)	**8**

Region code (3.2.7)

Ukraine

Interface language (3.2.8)

Ukrainian	**3**
English	**2**

The meter can be configured during put into operation by means of SmpSetup program (need Windows 7 and higher) or from the instrument keyboard. Any configuration can be changed only when the instrument is in **Setup** mode.

3.2.1 Communication module

The Communication module are installed in the course of instrument manufacture and cannot be changed by the user.

Pulse inputs

Each of communication modules may be delivered either with pulse signal inputs or without them.

The meter will support up to 2 pulse signal inputs. Each of the inputs may be connected with an additional water meter with pulse signal outputs, for which the volume will be accumulated.

Parameters of pulse signal inputs:

Pulse signal input class according to EN1434	IB
Maximum pulse repetition rate	1 Hz
Pulse duration	≥ 100 ms
Loading resistor (boosting to 3 V voltage)	680 kOhm

Must be used only with electrically isolated contacts

Communication module RS232

It uses TxD, RxD and GND signals

Port parameters:

Dara transfer speed	9600 baud
Data length	8 bit
Parity check	None
Stop bit	1
Protocol used	Sempal

M-Bus communication module

Load	1 unit (1.5 mA)
Data length	8 bit
Parity check	Even
Stop bit	1
Speed	300, 600, 1200, 2400, 4800, 9600 baud
Addressing	Primary and secondary

WM-Bus communication module

Frequency	868 MHz
Protocol	C1, transmission frequency: once every 15 seconds T1, transmission frequency: once every 15 minutes

Module of pulse signal outputs

Parameters of outputs:

Output class according to EN1434	OB
Pulse length	4 ms
Max frequency	100 Hz
Max voltage	30 V
Incorporation resistance	4 Ohm

3.2.2 Position of flow metering section and temperature sensor

Flow metering section may be installed either in supply or in return pipeline (reverse water supply).

When positioned in the supply pipeline, temperature sensor T1 will measure the supply water temperature, while T2 will measure the temperature of reverse water supply.

When positioned in the return pipeline temperature sensor T1 will measure the reverse water supply temperature, while T2 will measure the supply water temperature.

3.2.3 Integration periodicity

Integration periodicity determines the time interval to calculate volume, thermal energy content and information updating on the indicator.

Periodicity of the flow rate measurement will depend on the integration periodicity.

Temperature measurement periodicity is always equal to 32 seconds.

3.2.4 System of thermal energy content units

The meter will always measure the thermal energy content in GJ, while any other units are intended for indication purposes only.

3.2.5 System of flow rate units

The meter will always measure the flow rate in m^3/h, while conversion to any other units will be made for indication purposes only.

Volume will always be displayed in **m^3**.

Number of digits displayed on the indicator will depend upon the selected measurement units.

Total number of significant digits of the indicator will always be equal to 8. Only the number of figures after the decimal point will be changed:

	Number of digits (figures after decimal point)									
qp, m^3/h	**MW**	**kW**	**GCal/h**	**kWh**	**MWh**	**GJ**	**GCal**	**m^3**	**l/h**	**m^3/h**
0.6	3	1	3	1	3	3	3	3	0	3
1.5	3	1	3	1	3	3	3	3	0	3
2.5	3	1	3	1	3	3	3	3	0	3

Temperature and temperature differential will always be 0.01°C.

3.2.6 Tariffing

The instrument is provided with 4 tariff cells. Depending on the tariffing mode, different parameters will be stored in T1…T4 cells. Regardless of the mode, the tariffed value will be accumulated in any case in the basic adder and will additionally be accumulated in tariff counters. The tariffing will be described in more details below (clause 3.4).

3.2.7 Region code

The region code determines initial settings of time zone, usage of summer time …

3.2.8 Interface language

The interface language will determine the language of inscriptions on the instrument and language of the instrument menu.

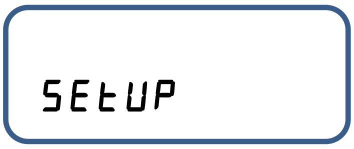
3.3 Setup and Test service modes

The meter has two service modes: **Setup** and **Test**

Setup mode will be used for initial setting of the instrument, while **Test** mode will be used for periodical verifications of the instrument.

These modes may be accessed by means of a special covered pushbutton placed on the rear instrument cover. When the instrument leaves the production line, said pushbutton is covered with a plastic protecting element to be broken if access to the pushbutton is needed. Further, this hole will be covered with a special sealing sticker.

To enter into **Setup** mode, you have to depress the pushbutton and hold it depressed for 5 – 15 seconds. The indicator during such operation will display



If you release the pushbutton during the above-mentioned time interval, the instrument will switch over to **Setup** mode

If the pushbutton will be held depressed for another time interval (from 15 to 30 seconds), message on the indicator will be changed as follows:

On release the pushbutton during the above-mentioned time interval, the instrument will switch over to **Test** mode

If you continue to hold the pushbutton depressed, the indicator will be switched to the standard display mode and operating mode of the instrument will not change.

Configuration of the meter will be set before registration of the meter. Configuration can be set only in **Setup** mode.

When the meter leaves the production line, a special transport mode is set. This mode is equivalent to **Setup** mode, but unlike it, flow rate and temperature will be measured once every 60 seconds. The indicator is switched off and will be switched on when any pushbutton will be depressed.

3.4 Tariffing

The instrument has 4 tariff counters. Each tariff counter includes an adder (T1… T4) and a threshold (TT1… TT4). Logics of their operation depend on the type of the selected tariffing mode.

Regardless of the tariffing type, data is **ALWAYS** accumulated in the basic adder (thermal energy, volume,…) and is **additionally** summed in tariff adders in the events when a condition for relevant tariff is met.

Threshold values is set in the same units that are used to display data on the indicator.

3.4.1 Tariffing mode 0

When such mode is set, no tariffing will be carried out.

3.4.2 Tariffing mode P (code 1 in configuration)

Such mode is used in heating or cooling mode (this will not be used in the automatic mode).

Tariff counters will accumulate thermal energy.

Tariffing will be made by thermal power thresholds (heating or cooling).

$\lvert P \rvert \le TT1$	Basic register only
$TT1 < \lvert P \rvert \le TT2$	Basic register and T1
$TT2 < \lvert P \rvert \le TT3$	Basic register and T2
$TT3 < \lvert P \rvert \le TT4$	Basic register and T3
$\lvert P \rvert > TT4$	Basic register and T4

$TT1<TT2<TT3<TT4$

3.4.3 Tariffing mode Q (code 2 in configuration)

Volumetric flow rate is analyzed.

Tariff counters will accumulate thermal energy.

q ≤ TT1	Basic register only
TT1 < q ≤ TT2	Basic register and T1
TT2 < q ≤ TT3	Basic register and T2
q > TT3	Basic register and T3
q < qi	Basic register and T4. Values when the flow rate is below *qi* but exceeds the sensitivity threshold will be added here

TT1>TT2>TT3

3.4.4 Tariffing mode dT (code 3 in configuration)

Module of differential temperature **Δt = |t1-t2|** is analyzed

Tariff counters will accumulate thermal energy.

Δt ≥ TT1	Basic register only
TT2 ≤ Δt < TT1	Basic register and T1
TT3 ≤ Δt < TT2	Basic register and T2
TT4 ≤ Δt < TT3	Basic register and T3
Δt < TT4	Basic register and T4

TT1>TT2>TT3>TT4

3.4.5 Tariffing mode T1 (code 4 in configuration)

Supply water temperature is analyzed

Tariff counters will accumulate thermal energy.

When flow metering section is installed in the supply pipeline, this means t1 temperature, while when installed in the return pipeline, this means t2.

t ≥ TT1	Basic register only
TT2 ≤ t < TT1	Basic register and T1
TT3 ≤ t < TT2	Basic register and T2
TT4 ≤ t < TT3	Basic register and T3
t < TT4	Basic register and T4

TT1>TT2>TT3>TT4

3.4.6 Tariffing mode T2 (code 5 in configuration)

Return water temperature is analyzed.

Tariff counters will accumulate thermal energy.

When flow metering section is installed in the supply pipeline, this means t2 temperature, while when installed in the return pipeline, this means t1.

t ≤ TT1	Basic register only
TT1 < t ≤ TT2	Basic register and T1
TT2 < t ≤ TT3	Basic register and T2
TT3 < t ≤ TT4	Basic register and T3
t > TT4	Basic register and T4

TT1<TT2<TT3<TT4

3.4.7 Tariffing mode *Time* (code 6 in configuration)

Tariffing is made depending on the time of the day

Tariff counters will accumulate thermal energy.

Tariff threshold contain time of the day: hours and minutes

TT1 ≤ time < TT2	Basic register and T1
TT2 ≤ time < TT3	Basic register and T2
TT3 ≤ time < TT4	Basic register and T3
TT4 ≤ time or time < TT1	Basic register and T4

TT1<TT2<TT3<TT4

If some of the thresholds are not defined and if time is in interval between maximal threshold and TT1, then accumulation are produced in main register and T4. For example, if TT3 and TT4 are not defined, then if time exceeds TT2 or less TT1, accumulation will be in T4.

3.4.8 Tariffing mode PQ (code 7 in configuration)

Capacity and flow rate are analyzed. T1 and T2 tariffs will be used for the capacity, while T3 and T4 will be used for the flow rate.

Tariff counters will accumulate thermal energy.

P ≤ TT1 and q ≤ TT3	Basic register only
TT1 < P ≤ TT2	Basic register and T1
P > TT2	Basic register and T2
TT3 < q ≤ TT4	Basic register and T3
q > TT4	Basic register and T4

Values may be accumulated in T1 (T2) and T3 (T4) simultaneously

TT1<TT2

TT3<TT4

3.4.9 Tariffing mode HC (code 7 in configuration)

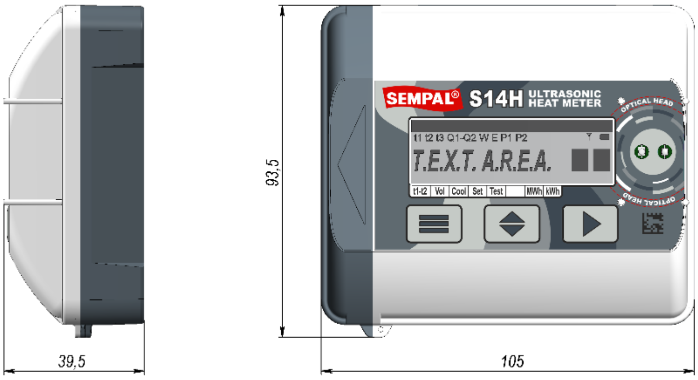
This tariff will be used in the automatic switching mode heat/cold only.

Only tariff counters T1 and T2 are used. Threshold values are not used.

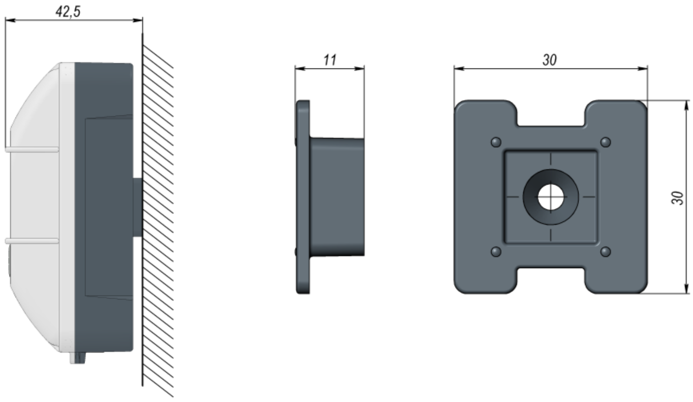
T1 will accumulate the heating water volume, while T2 will accumulate the cooling water volume.

4 Overall dimensions

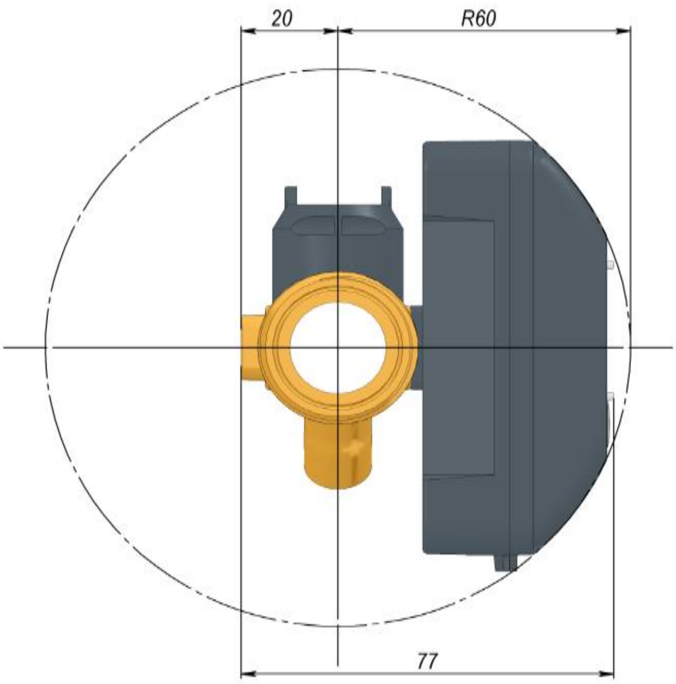
Calculator

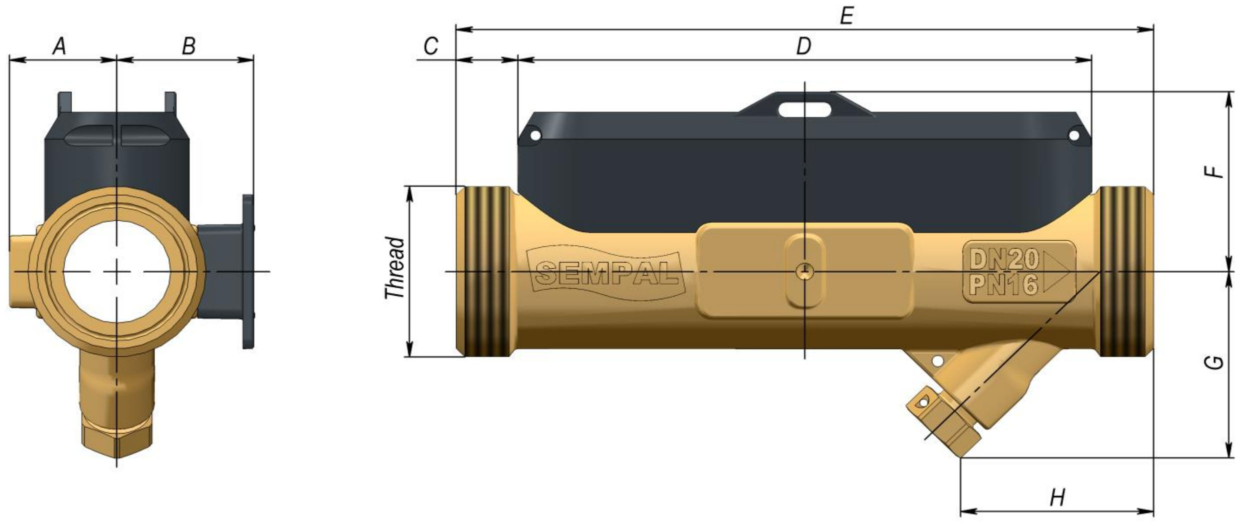


Wall mounting



Calculator installation onto flow metering section



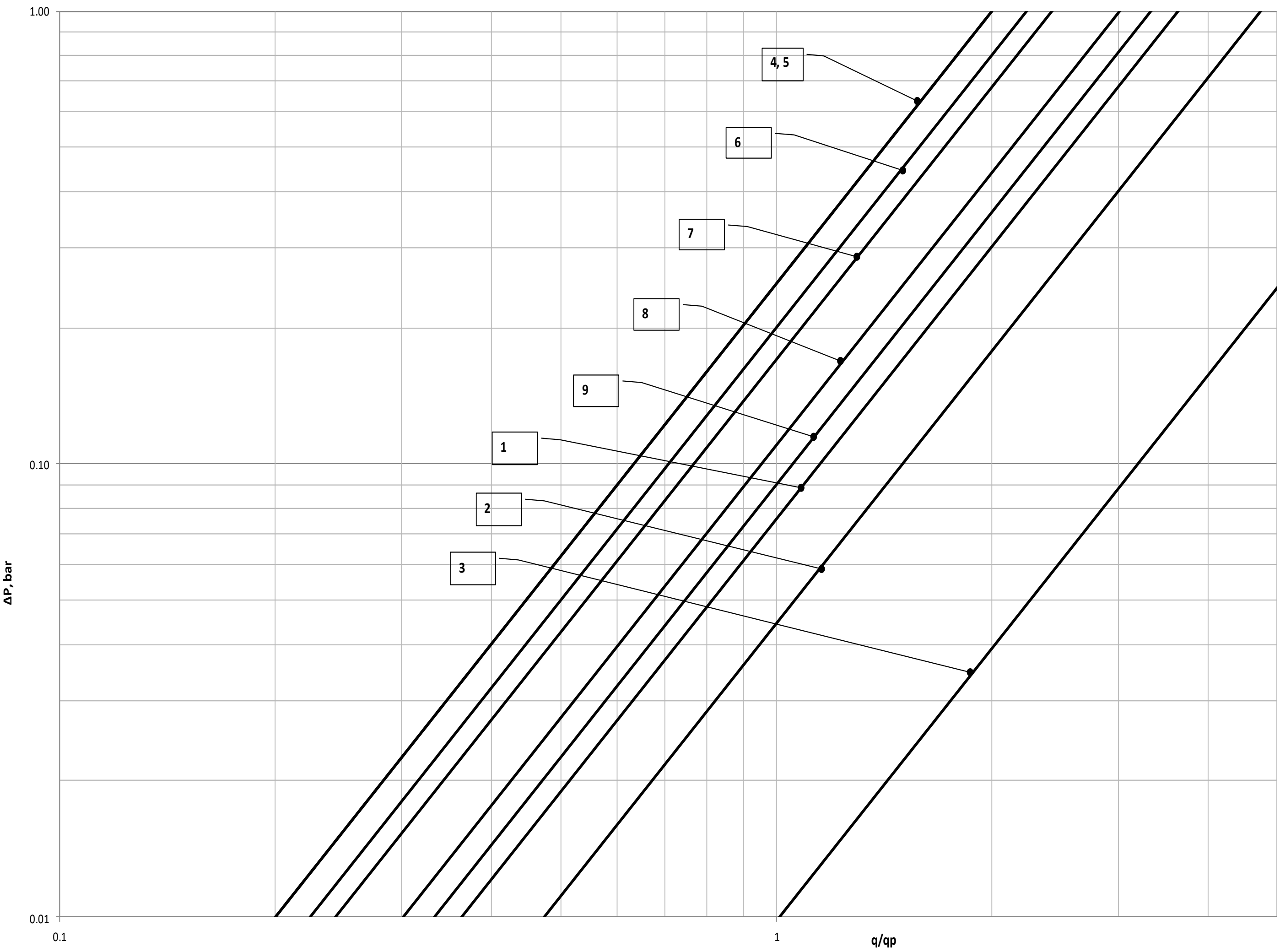


Dia.	Thread	A	B	C	D	E	F	G	H
DN15	G ¾ B	20	25.5	11.5	107	130	35	36	36
DN20	G 1 B	20	25.5	11.5	87	110	32.5	33	30
DN25	G 1 ¼ B	24	29.5	16	128	160	39	40	40

5 Pressure losses

Standard EN1434 specifies the pressure losses as 0.25 bar for *qp* flow rate.
Pressure losses in flow metering section depend on the flow rate as a quadratic loss function.
Pressure loss graph is shown below.

Flow metering section type in the type designation	ΔP @ qp [bar]	Designation on the graph
015A	0.17	1
020A	0.09	2
025A	0.12	3
032A	0.25	4
040A	0.25	5
050A	0.2	6
060A	0.17	7
080A	0.11	8
100A	0.09	9



Pressure losses graphs

6 Installation

6.1 Installation requirements

Prior to the meter installation, the system must be flushed to remove big pieces of iron scale, stones and the like. Flushing must be made with a repair insert.

Only new sealing elements included into the delivery set must be used for flow metering section installation.

Before tightening the screw connections to make sure that progress is sufficient to seal the thread

To facilitate maintenance of the meter, it is advisable to install ball cocks before and after the meter.

Installation of flow metering section onto the supply or return pipeline will depend upon the meter configuration to be read on the indicator.

Operating conditions

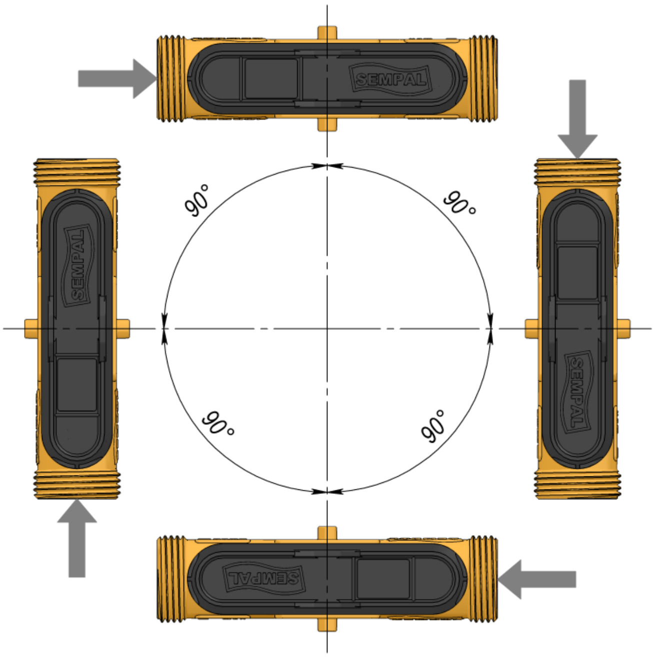
Ambient temperature	5…55 °C (indoors installation) The temperature must not exceed 30 °C for maximum lifetime of the battery
Heat transfer liquid temperature	2…130 °C when the calculator is installed on a wall 15…90 °C when the calculator is installed onto the flow metering section
Pressure in the system	1…16 bar

There is no necessity in straight line sections before or after flow metering section under normal operating conditions.

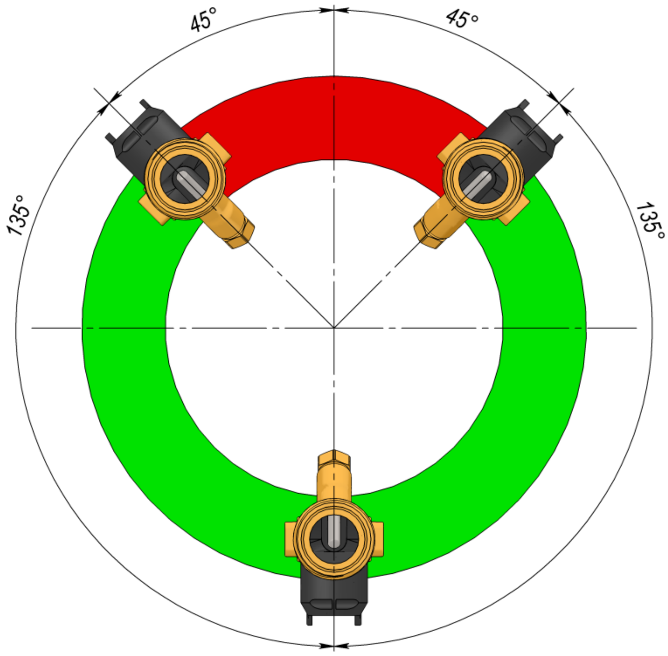
Maintenance

Once the meter is installed, any welding operations or meter freezing is not allowed. The meter must be removed prior to any welding operations.

6.2 Flow metering section location in a pipeline



Flow metering section may be installed vertically, horizontally or at any arbitrary angle.

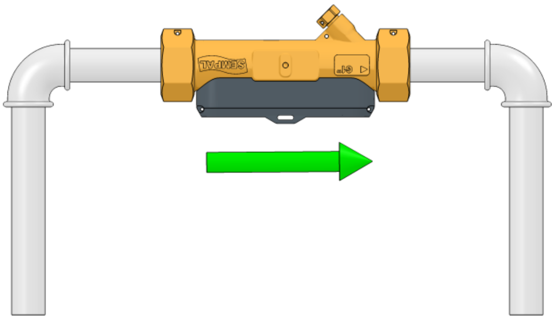
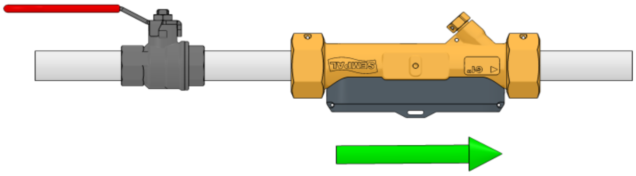
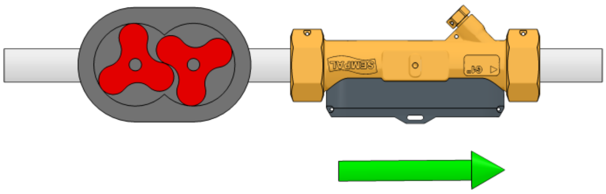
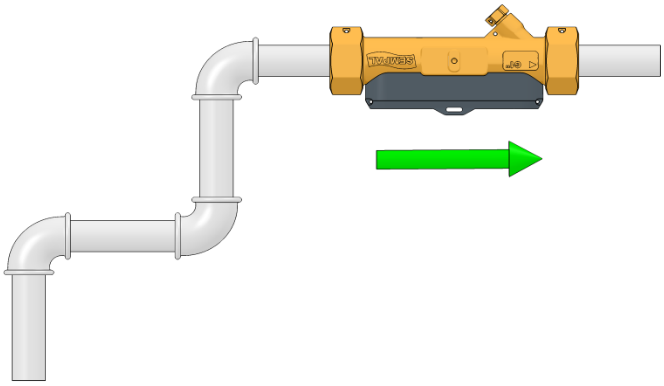


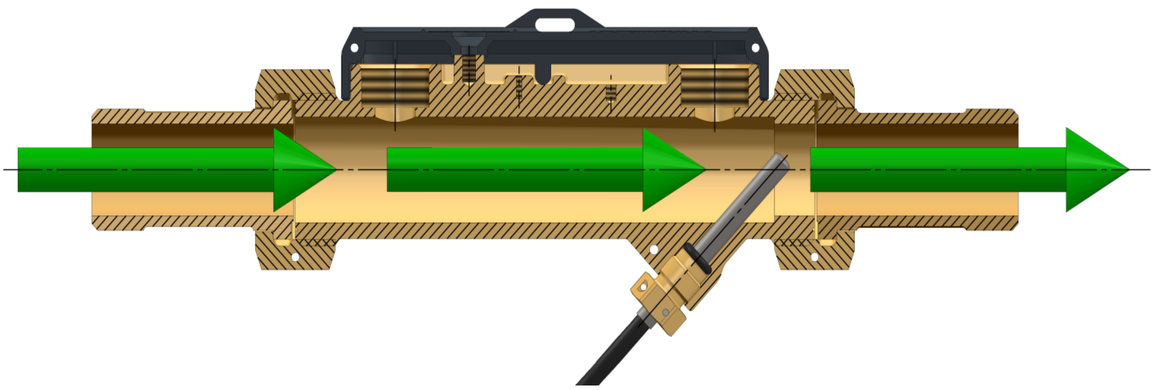
Flow metering section must be turned 45° and more degrees. Vertical installation or installation with the turn angle less than 45° is not allowed.

6.3 Requirements for straight line sections

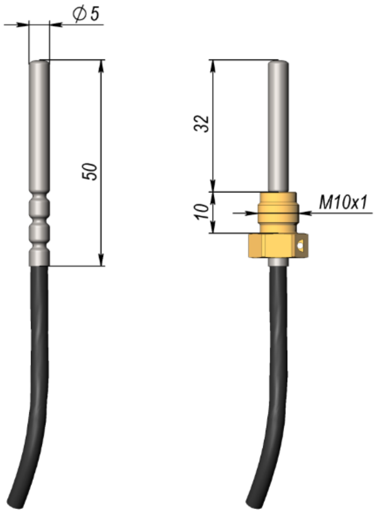
Installation of the meter does not require straight line section before and after the flow metering section.

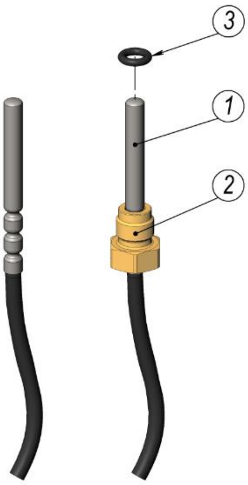
Such straight line sections are required only in the case of strong flow disturbance in front of flow metering section. Such disturbances may be caused by a pump, double turn in different planes, availability of shutoff fittings (fully opened full-bore ball cock excluded).

 Installation at the highest point of the system is not allowed	 Installation after the valve at a distance shorter than 5D mm is not allowed (fully opened full-bore ball cock excluded).
 Installation after the pump at a distance shorter than 5D mm is not allowed	 Installation at a distance shorter than 5D mm to a double bend is not allowed

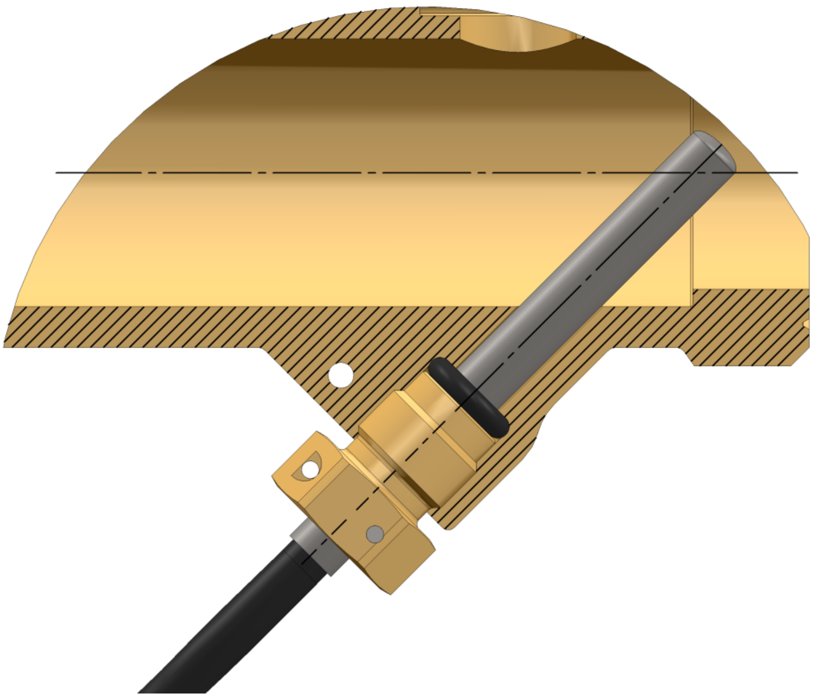


6.4 Temperature sensor installation

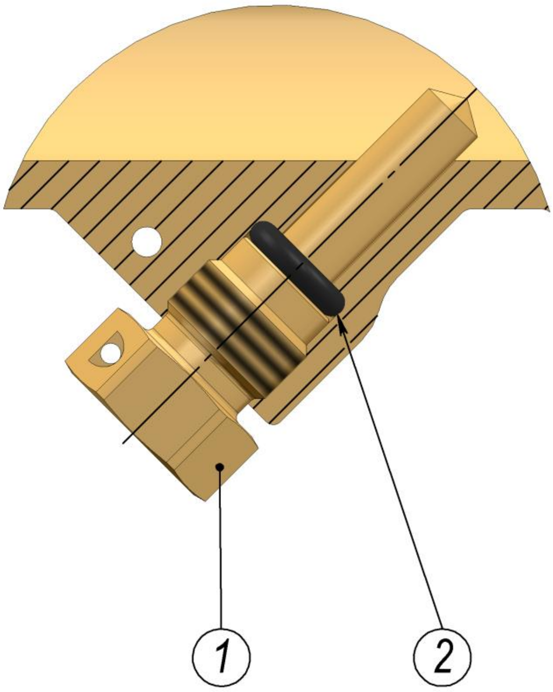




1 – temperature sensor; 2 – Temperature sensor holder; 3 – Sealing ring



If Temperature sensor t1 has to be installed separately (not inside flow metering section), orifice in the flow metering section must be plugged with a blind plug from the delivery set of the meter.



1 – blind plug; 2 – sealing ring

7 Calculator

7.1 Performance of measurements

Measurement cycle of a meter consists of two independent cycles – integration cycle and temperature measurement cycle.

The temperature measurement cycle during a normal measurement mode will always be equal to 32 seconds.

The integration cycle may be changed in the course of the meter setting (see clause 3.2). Flow measurement cycle depends on the integration cycle.

When the meter is shipped, its integration cycle will be set to 16 seconds. Periodicity of the flow rate measurement then will be once every two seconds.

If shorter measurement cycles are installed, you must take into account that service life of the battery will be shorter as a result.

7.1.1 Energy calculation

IAPWS-97 formulations are used to calculate energy.

Enthalpy is calculated for pressure of 16 bar.

Energy E is calculated from the formula:

$E = M *(E_1(tf) – E_2(tb))$

where M – mass of heat carrier

$E_1(tf)$ and $E_2(tb)$ enthalpy respectively for supply and return pipelines as a function of temperatures therein.

All internal calculations are made in GJ; expression of energy in other measurement units is made by virtue of the following calculations:

E[MWh] =	E[GJ] * 0.27778
E[kWh] =	E[GJ] * 277.778
E[GCal] =	E[GJ] * 0.23885

7.2 Working modes of the meter

7.2.1 Transportation mode

The transportation mode is equivalent to **Setup** mode except for the periodicity of measurement and the indicator work.

This mode is set when the meter leaves the production line. It is intended for maximum curtailment of the consumption.

In this mode, the integration cycle and temperature measurement cycle will be equal to 60 seconds each. The indicator is turned off. When any pushbutton is depressed, the indicator will be turned on. It will be turned off again 5 minutes thereafter, if no pushbutton is depressed.

iRDA port continues its work as in the normal mode.

When the possibility of correct flow rate measurement (flow metering section is filled with water) appears, periodicity of measurement becomes equal to that in normal operation mode.

If absence of water in flow metering section is registered for 5 minutes, the meter will be switched over to the transportation mode again.

7.2.2 Sleep mode

In this mode, the integration cycle and temperature measurement cycle will be equal to 60 seconds each. The indicator is turned on.

Sleep mode of the meter will be turned on, if absence of water in flow metering section is registered for an hour.

If flow metering section is filled with water, the meter will be switched over to the normal mode.

Parameters are archived.

7.2.3 Normal mode

This is the main working mode of the meter. The integration cycle here is set to a value to be determined by the user. The temperature measurement cycle will be 32 seconds.

Indicator is on. iRDA port is operable.

All measured parameters are archived and tariffed in this mode.

7.2.4 Setup mode

This mode is intended for initial meter setting.

Periodicity of measurements in this mode will correspond to the periodicity of measurements in the normal mode.

Integral parameters in this mode will be accumulated but will not be memorized. That is, when this mode is turned on, the integral parameters will have the same meaning as of immediately before entering this mode.

No archive is kept.

Log of user's actions is kept.

Duration of this mode will not exceed 2 hours if no pushbuttons are depressed. When this period expires, the instrument will automatically be switched over to the normal operation mode. If any introduced changes require archive emptying and initial parameters resetting, these will be performed automatically, without additional requests of the user.

7.2.5 Test mode

This mode is intended for verification of the meter.

In this mode, integration cycle is 2 seconds, while periodicity of flow rate measurement will be 2 times a second. The temperature measurement cycle will be 2 seconds.

It is made to accelerate the verification process.

Integral parameters will not be memorized in this mode. That is, when you exit from this mode, the integral parameters will restore the values they have prior to entering this mode.

Duration of this mode will not exceed 8 hours if no pushbuttons are depressed.

7.3 Functions of the meter

7.3.1 Log

The meter will keep a log of user's actions to register everything that can influence over the measurement result.

The following events will be registered in the log:

- Entering into and exiting from **Setup** and **Test** modes;
- Editing of any parameters while in **Setup** mode

Depth of the logging: 100 entries

In addition, every entry into service modes will increment the relevant entry counter. Readings of these counters may be seen on the indicator and their current status may be read through any available interface.

7.3.2 Combined measurement of heating/cooling

When you are in this mode, switching over from heating to cooling measurement and vice versa is made automatically depending on the sign of the temperature differential between supply and return waters.

If T1>T2, heating will be measured, while if T1<T2, cooling will be measured.

The heating and cooling energies will be summarized and memorized in different cells.

Thermal energy content will be displayed with a sign, '+' sign will mean heating, while '-' will mean cooling.

7.3.3 Maximum values

The meter will register maximum values of flow rate, heating and cooling capacities. Such values will be memorized in all archive types. This means that hourly, monthly and yearly maximum values will be stored.

Such maximum values will be calculated as the maximum for averaged measurement results during a fixed time interval. Possible values of the averaging interval: 1, 2, 3, 4, 5, 10, 15, 20, 30 minutes. When the meter is shipped, the averaging time is set to 30 minutes.

7.3.4 Archiving

When operated in the normal mode, the meter will keep the following archives:

Archive type	Depth
Hourly	1680 hours (70 days)
Daily	500 days
Monthly	36 months (3 years)
Yearly	16 years

The following data will be placed into archives;

- date
- volume and mass
- average weighted temperature of supply and return water
- heating and cooling energy
- tariff counters (4 items) (if used)
- volumes by pulse signal inputs (if used)
- maximum values of volume, heat and cold
- codes and durations of errors registered during the time interval corresponding to the archive type

7.3.5 Average weighted temperature

In order to be able to calculate energy content based on the archive data, so-called average weighted temperature will be placed into archive instead of the average temperature.

Such average weighted temperature will be calculated with the formula:

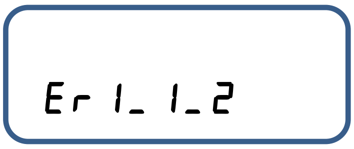
$$\bar{t} = \frac{\sum_i t_i \times M_i}{\sum_i M_i}$$

where i stands for the index of current measurement.

7.4 Processing errors

The counter in the course of its operation will continuously monitor correctness of measurements made. If any errors are detected, they will be displayed in the main area of the indicator. If that is the case, the measured parameter will appear in turn with the error code with 4-second interval. The measured parameter will be displayed for 4 seconds followed by indication of the error for another 4 seconds. If several errors are detected simultaneously, they will be displayed in turn.

An example of a displayed error



Any error code consist of three groups of digits (from the left to the right)

- Error group
- Error No.
- Channel No. where the error took place

In the above example, error code indicates the following: error group – temperature measurement (1), error code – 1 (temperature sensor wiring break), Channel – 2 (error took place in Temperature sensor2).

More detailed description of any error may be seen in the instrument menu. In this case, the menu line will contain a text describing the error, while the main display will show the error code.

Error codes

Group	Code error	Description
1	**Temperature errors**	
	1	Temperature sensor wiring break
	2	Temperature sensor short-circuit
	3	Erroneous calibration coefficients
	4	Temperature is below the permitted limit (-49 °C)
	5	Temperature is above the permitted limit (+150 °C)
3	**Flow rate measurement errors**	
	1	No water
	2	Low signal level
	3	Determination of the water temperature in flow metering section is impossible
	4	Flow rate exceeds a permitted limit
	5	Reverse direction of the flow
4	**Heat calculation errors**	
	1	The return water temperature exceeds the supply water temperature for more than 2 °C For heating measurement
	2	The supply water temperature exceeds the return water temperature for more than 2 °C For cooling measurement

If any error is detected, calculation of heat will be stopped.

7.4.1 System errors

System errors means errors in the calculator hardware, which make measurement impossible completely and cannot be remedied in site. To remedy any system errors (or faults causing systemic errors), the instrument will be sent to the manufacturing enterprise.

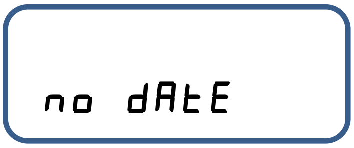
The system errors will be displayed on the indicator as follows:

Figure denotes the error number.

7.4.2 Setting date and time

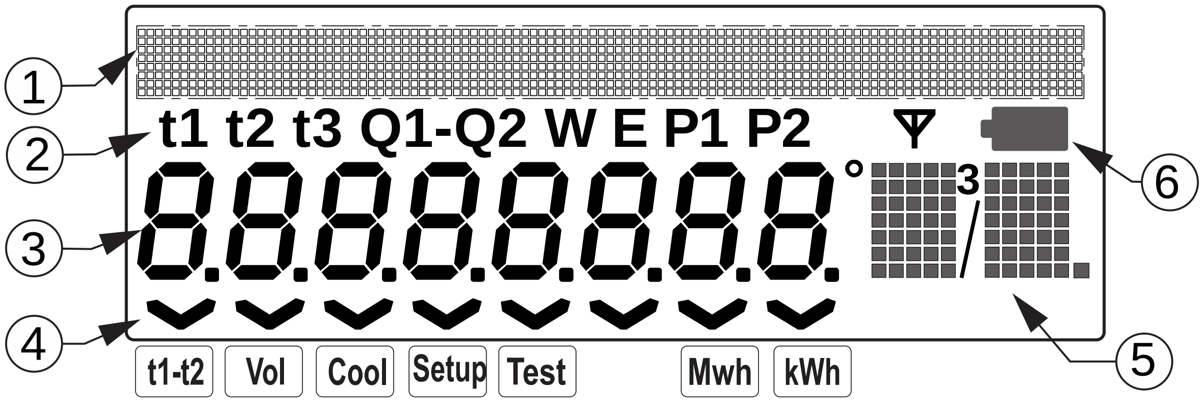
The instrument will be shipped with pre-set date and time corresponding to the relevant time zone of the supplying country.

Where necessary, date and time may be set by SmpSetup program. If no data is set, the following message will appear on the indicator



7.5 Indicator and keyboard

7.5.1 Indicator



7.5.1

1 – Menu line
2 – Displayed value
3 – Main screen
4 – Mode indicators
5 – Measurement units
6 – Battery charge indicator

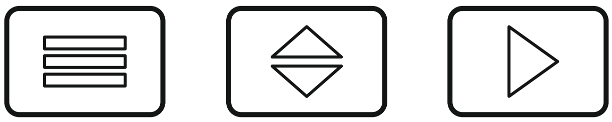
Indicator is divided into two areas: main screen and menu line

Main screen is operable always (except for transportation mode), while the menu line will be displayed only when work with menu is commenced. The menu will remain active for 2 minutes, if no pushbutton is depressed. If no pushbuttons were depressed for 2 minutes, the menu line will be turned off and the instrument will be switched over to the main indication mode.

Mode indicators in the bottom section of the indicator extend the displaying ability of the indicator main screen. Thus, when cooling energy will be displayed, the displayed value line will highlight **'E'** together with the **Cool** mode indicator.

7.5.2 Keyboard

The meter is equipped with a keyboard comprising three pushbuttons: 'to the right', 'up/down' and 'menu'



"Menu" "Up/Down" "Right"

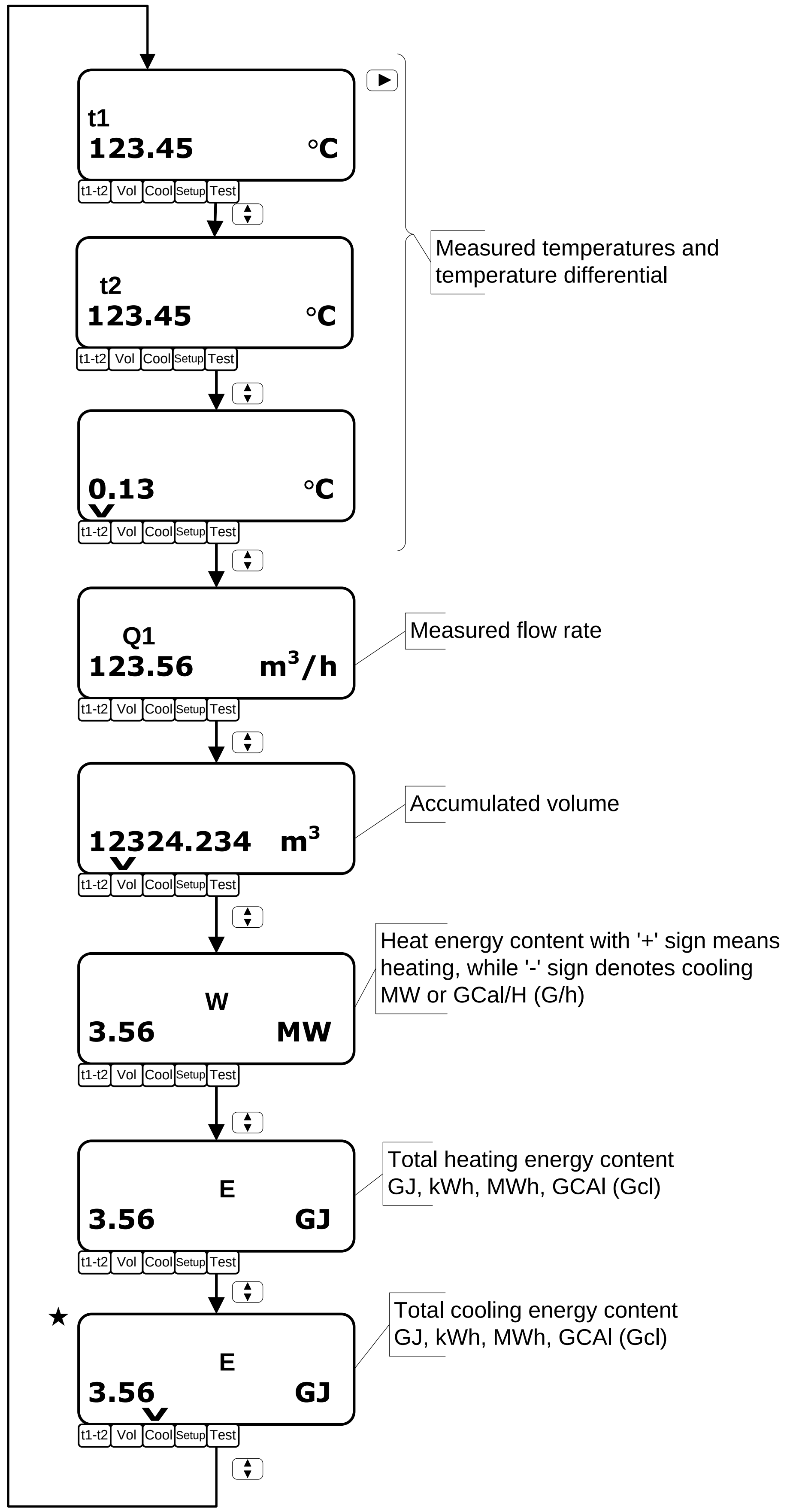
'To the right' pushbutton will allow entry to menu from the main display mode, as well as allows transition to the next level menu.

'Up/Down' pushbutton switches over displayed parameters in the main mode, as well as allows movement through menu items on the same level.

'Menu' pushbutton will return you to the preceding menu level. If the instrument is in main mode, it will switch over the meter to the display mode of heat energy content.

When you are navigating through menu, the left-side portion of the line will display the menu item number. Such number may contain both figures and letters. Each digit in such number will correspond to the one menu nesting level.

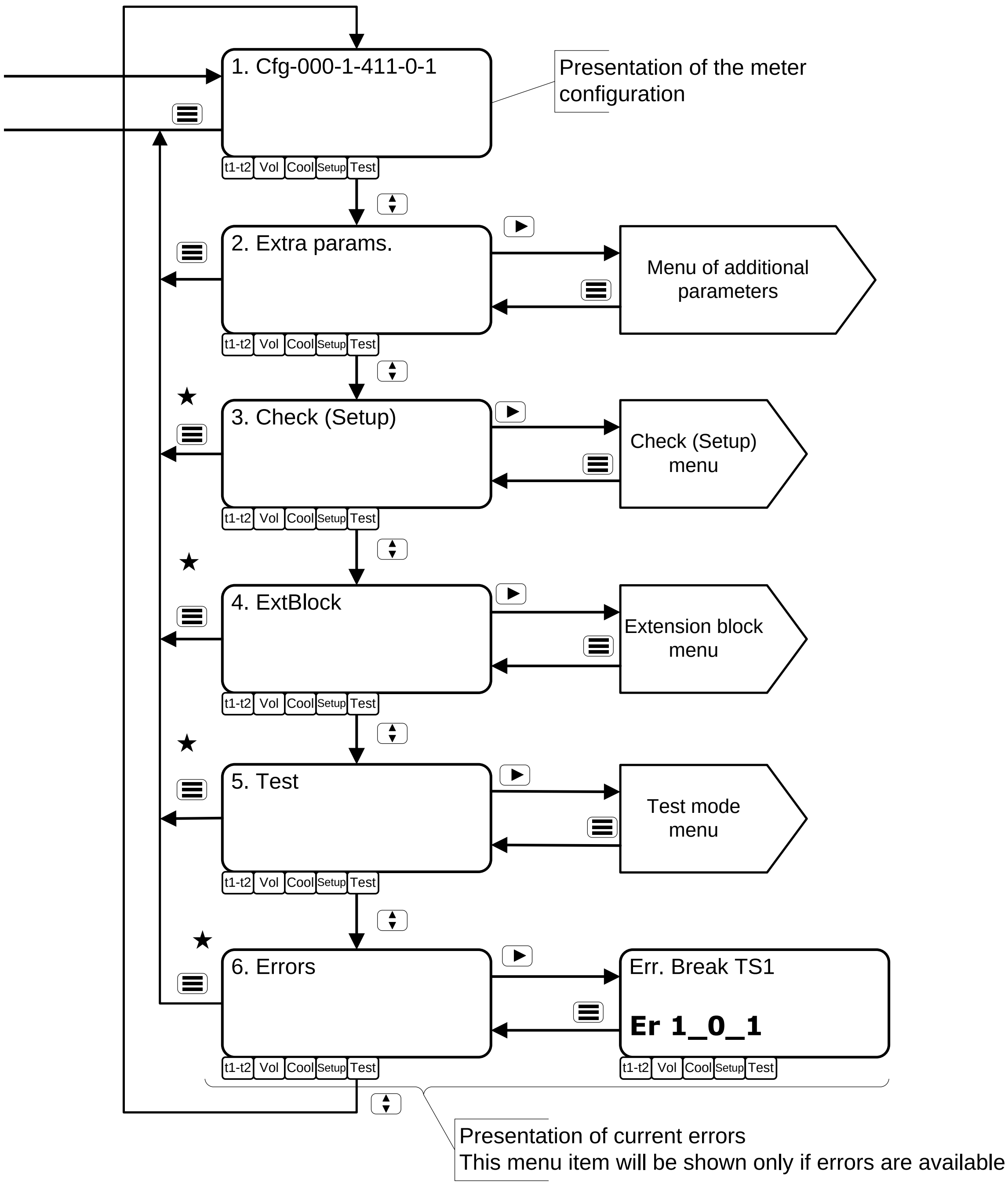
7.6 Information displayed in main mode



* Denotes menu items visible under certain conditions depending on the configuration and instrument operation mode

7.7 Main menu

The main menu can be entered from the basic mode by depressing 'to the right' pushbutton.



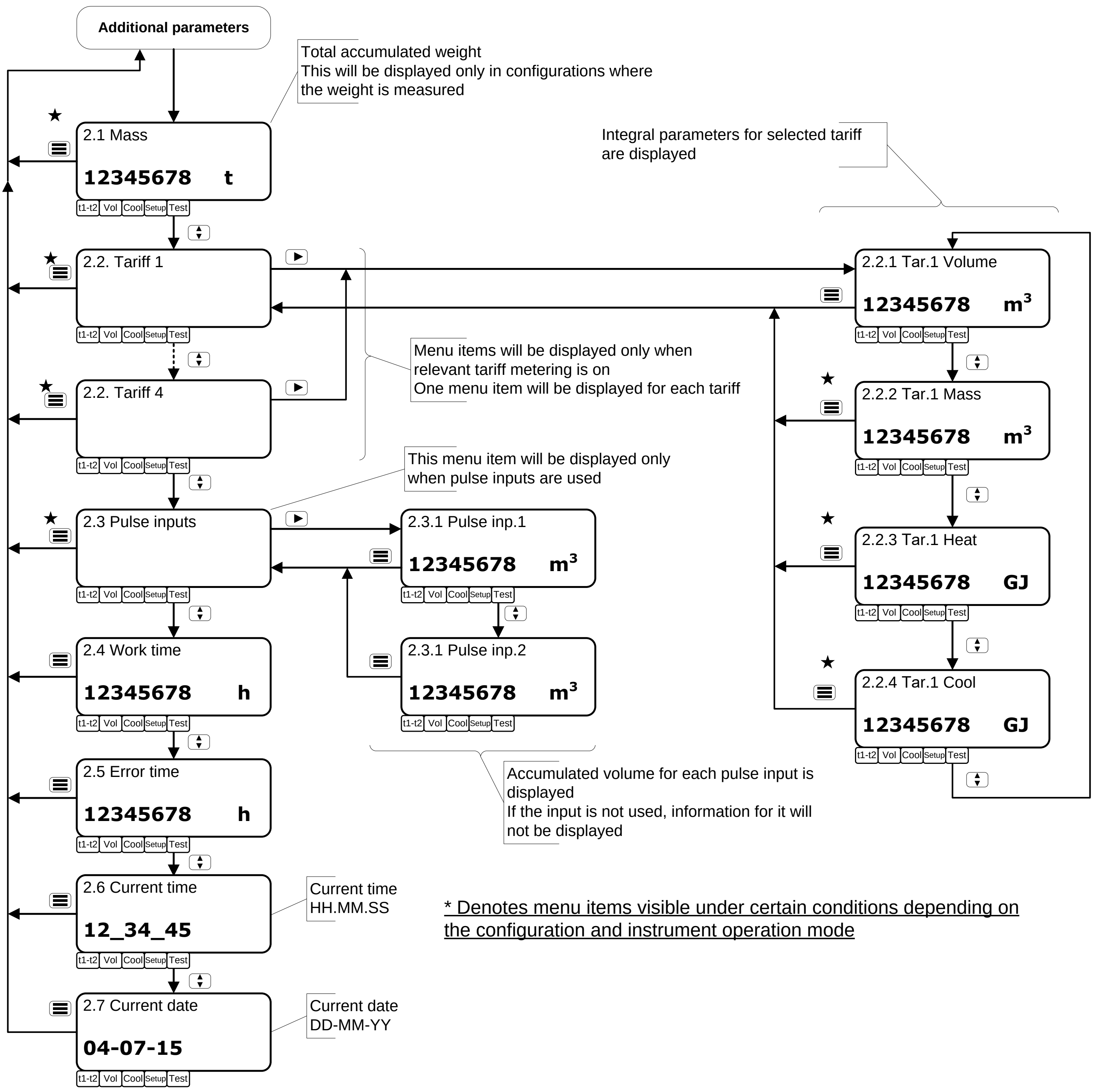
Check (Setup) menu is used to review and edit parameters needed to put the instrument into operation. Parameters may be reviewed always, but can be edited only in the Setup mode.

Test menu will appear only after entering into relevant modes by virtue of the pushbutton switching over the modes.

ExtBlock menu will appear only if the extension block is connected with the instrument. Content of this menu will depend on the connected extension block

<u>* Denotes menu items visible under certain conditions depending on the configuration and instrument operation mode</u>

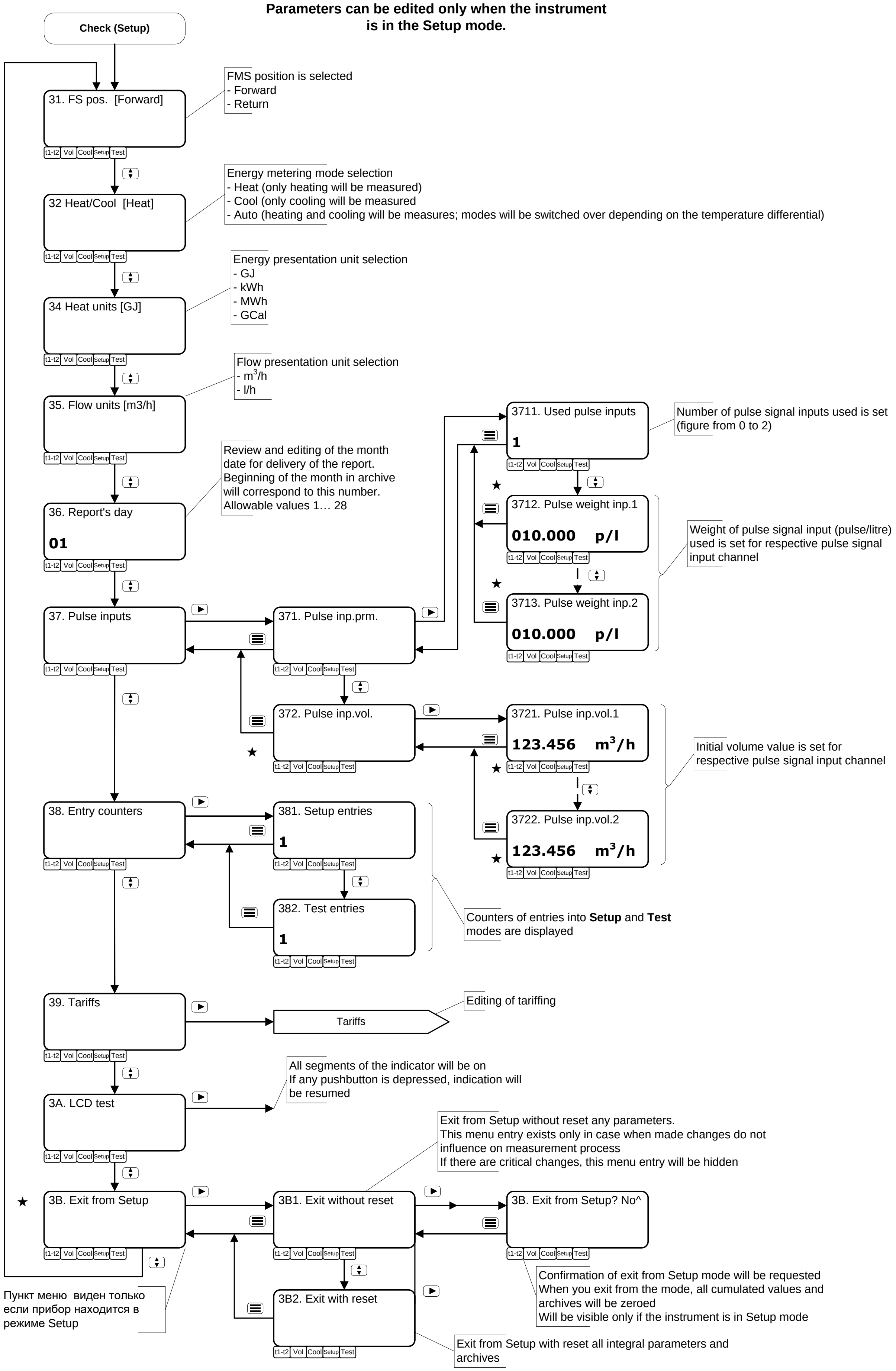
7.8 Additional parameters



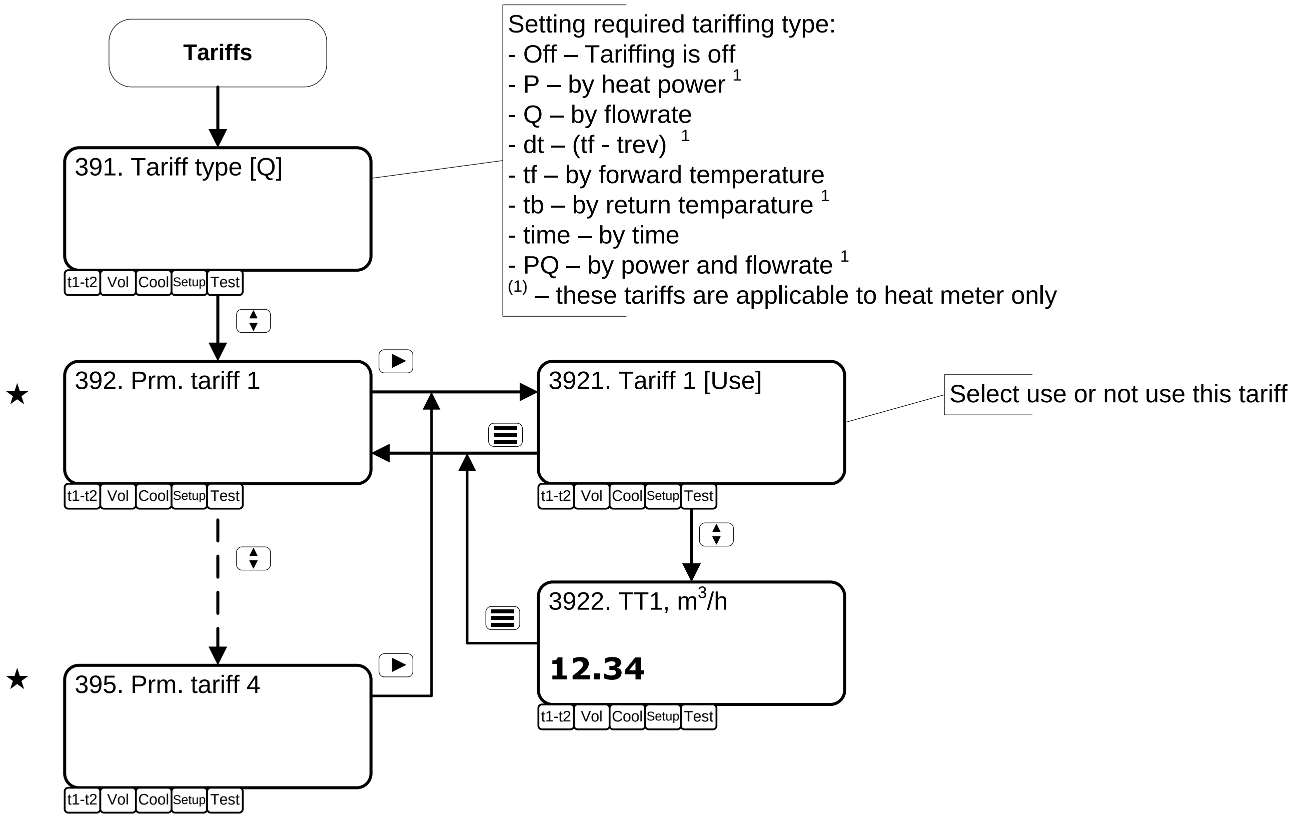
<u>* Denotes menu items visible under certain conditions depending on the configuration and instrument operation mode</u>

7.9 Check menu

Parameters can be edited only when the instrument is in the Setup mode.



<u>* Denotes menu items visible under certain conditions depending on the configuration and instrument operation mode</u>



* Denotes menu items visible under certain conditions depending on the configuration and instrument operation mode

8 Manufacturer's warranty

The manufacturer warrants operation of the meter for 4 years following the shipment date of the meter to a user.

The warranty provides for replacement of any defective parts and checking operability of the instrument within the premises of a service centre of the manufacturing enterprise.

The warranty covers defects of any component parts of the instrument included into the delivery set if caused by workmanship defects, defects of materials and component items.

Any failed instrument must be delivered to the manufacturing enterprise for testing and repairing.

The calculator may not be opened (integrity of seal lead may not be damaged) under any circumstances prior to redelivery of the instrument to the manufacturing enterprise.

Warranty will not include any indemnification of any costs related to de-installation, return and reinstallation of the instrument, as well as indemnification of any consequential damages related to the failure.

If any defect is found during the warranty term, the user will be obliged to produce the claim to the manufacture enterprise at the following address:

3 Kulibina Street, Kyiv 03062, Sempal Co. Ltd.

Phone/fax: (044) 239-21-97, 239-21-98

No claims related to the heat meter will be recognised in the following cases:

– Installation and commissioning works have been carried out by any organisation not authorised by the manufacturing enterprise to carry on such works;

– Integrity of lead seals on the calculator is damaged;

– Expiry of the warranty period;

– Infringement by user of the operation, storage and transportation rules as prescribed in operating documentation.

If the warranty period expires or if the right for free of charge warranty services is lost, the manufacturing enterprise will carry out paid repair of the heat meters.

9 Utilization

Utilization of the meter parts:

Description	Material	Utilisation method
Lithium battery C	Lithium and thionyl chloride 2.5 g of lithium	Certified places for storage of lithium batteries
Printed circuit board without LCD	Metallized glass fiber laminate with components installed thereon	Metal extraction from the printed circuit boards
Liquid crystal display	Glass and liquid crystals	LCD recycling
Cables to temperature sensor and flow sensor	Copper and silicone casing	Cable recycling
Upper calculator cover Lower calculator cover Calculator holder	Polycarbonate Acrylonitrile-butadiene-styrene Polycarbonate	Plastics recycling
Flow metering section	Brass	Metal recycling
Package	Cardboard	Waste paper recycling