

Axioma Metering UAB

# ULTRASONIC FLOW SENSOR QALCOSONIC F2



TECHNICAL DESCRIPTION, INSTALLATION AND USER INSTRUCTIONS

PEF2V02

KAUNAS

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**EU DECLARATION OF CONFORMITY**

Axioma Metering UAB herewith declares, that flow sensor for heat meter QALCOSONIC F2 complies with the relevant requirements of the following directives:

2014/32/EU	Directive 2014/32/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the member states relating to the making available on the market of measuring instruments
2014/30/EU	Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility
2014/35/EU	Directive 2014/35/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits

Kaunas, 2018-08-20  
Head of Innovation and Technology Division

Virgilijus Pamakštis

(signature)

**EC-type examination certificate: LT-1621-MI004-021**  
**Quality system certificate No: KS-1621-MP-003.18**

Notified body:  
Lithuanian Energy Institute, Laboratory of heat equipment research and testing, Lithuania  
Body No: 1621

**For EU Customers only - WEEE Marking.**

The device is classified as waste electronic equipment in terms of the European Directive 2012/19/EU (WEEE). Marking of electrical and electronic equipment in accordance with Article 14 (2) of Directive 2012/19/EU

This symbol on the product indicates that it must not be disposed of as unsorted municipal waste. It must be handed over to the applicable take-back scheme for the recycling of electrical and electronic equipment. Observe all local and applicable laws. For more detailed information about the recycling of this product, please contact your local municipal office.



## SAFETY INFORMATION

**Before beginning installation works you must to read this document and follow its instructions.**

- Risk factors during the flowmeter installation and service is a heat conveying fluid flowing within flow sensor with inner pressure up to 1,6 (2,5) MPa and temperature up to 130 °C.
- To eliminate this risk the service and installation works must be performed by qualified technical personnel. Personnel must be familiar with appropriate technical documentation and general safety instructions.
- It is necessary to follow general safety requirements during installation and maintenance process.
- Protective grounding is not required, because housing is made from plastics, and conductive parts are not exposed to the surface.
- Safety guarantees at installation and service of meter is:
  - Reliable insulation of electrical circuits,
  - Hermetic fitting of primary flow sensor into the pipeline,
  - Reliable fastening of sub-assemblies of heat meter at installation.



**Warning! Mounting of the flowmeter is permissible only after ensuring of absence of heat conveying fluid in the pipeline.**



**By connecting the flow sensor to the external pulse registration device which is powered via AC 230V check the proper grounding of external device.**

**Caution:** If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

## 1. APPLICATION FIELD

Ultrasonic flow sensor QALCOSONIC F2 is designed as sub-assembly of heat meter for measuring heat-conveying liquid volume in heating/cooling systems and conversion it into electrical pulse signal. It is used in conjunction with the type approved heating/cooling energy calculator.

As a component of heat energy meter the QALCOSONIC F2 flow sensor could be used for commercial account of energy quantity in district heating plants, in factories, in single or multifamily houses.

The flow sensor can be mounted in both flow and return pipe.

QALCOSONIC F2 corresponds to essential requirements of the Technical Regulation for Measuring Instruments, dated 30 October 2015 (transposing in the NB's country law Directive 2014/32/EU of 26 February 2014 on measuring instruments):

- |                     |                        |
|---------------------|------------------------|
| - Annex I           | Essential requirements |
| - Annex VI (MI-004) | Thermal energy meters  |

QALCOSONIC F2 complies with the standard EN 1434 "Heat meters".

QALCOSONIC F2 meets the requirements according to accuracy class 2 of EN1434

QALCOSONIC F2 fulfils "C" class environment protection requirements according to EN1434-1

Climatic ambient temperature range: from 5 ° to 55 ° C,

Humidity level: condensing, location: closed,

Mechanical environment class: M1 ,

Electromagnetic environment class: E2.

Storage and transportation temperature: -25°C...60 °C (drained flow part)

Type number combination of the ultrasonic flow sensor:

**QALCOSONIC F2- 1 1 1 -NM - 1 - 0\***

<b>Type</b>						
<b>Ratio of flow-rate limits (<math>q_p/q_l</math>):</b>		<b>Code</b>				
100		1				
250 (with the exceptions of sensors $q_p=0,6 \text{ m}^3/\text{h}$ ; $1,0 \text{ m}^3/\text{h}$ ; $3,5 \text{ m}^3/\text{h}$ )		2				
<b>Technical data of the flow sensor:</b>						
<b>Permanent flow-rate, <math>\text{m}^3/\text{h}</math></b>	<b>Overall length, mm</b>	<b>End connections</b>	<b>Code</b>			
0,6	110	G $\frac{3}{4}$	1			
1,0	110	G $\frac{3}{4}$	2			
1,5	110	G $\frac{3}{4}$	3			
1,5	165	G $\frac{3}{4}$	N			
1,5	130	G1	M			
2,5	130	G1	4			
3,5	260	G1 $\frac{1}{4}$	5			
6,0	260	G1 $\frac{1}{4}$	6			
10,0	300	G2	7			
10,0	300	DN40	8			
15,0	270	DN50	9			
3,5	260	DN25	A			
6,0	260	DN25	B			
0,6	190	G1	C			
1,0	190	G1	D			
1,5	190	G1	E			
2,5	190	G1	F			
0,6	190	DN20	G			
1,0	190	DN20	H			
1,5	190	DN20	K			
2,5	190	DN20	L			
3,5	260	DN32	O			
6,0	260	DN32	P			
25	300	DN65	R			
40	350	DN80	S			
40	300	DN80	U			
60	350	DN100	T			
60	360	DN100	V			
<b>Length of the connection cable between measuring section and electronic unit:</b>						
<b>Cable length</b>		<b>Code</b>				
1,2 m		1				
2,5 m		2				
5 m		3				
<b>Pulse value of the flow sensor <math>N \cdot 10^{-M} \text{ m}^3/\text{pulse}^*</math></b>						
* - where N- possible number 1...9, M – possible number 1...6.						
<b>Power supply:</b>		<b>Code</b>				
Internal battery 3,6 V		1				
External 24 V AC/DC		2				
<b>Length of the pulse output device connection cable, m:</b>						
3: 5: 10: 15... 200. 0 (or omitted) - none						

Remark:

\* - marked numbers are used for order numbering only

## 2. TECHNICAL DATA

Accuracy class

2 by LST EN1434-1.

### Flow measurement

The ratio of the permanent flow-rate to the lower limit of the flow-rate (the user selects during order):

$$q_p/q_i = 100,$$

or  $q_p/q_i = 250$  (with the exceptions of sensors  $q_p = 0,6 \text{ m}^3/\text{h}; 1,0 \text{ m}^3/\text{h}; 3,5 \text{ m}^3/\text{h}$ )

Flow sensor can be delivered for threaded connection (up to  $q_p = 10,0 \text{ m}^3/\text{h}$ ) or flanged.

Technical data of the flow sensor are presented in table 1.1

Table 1.1

Limits of flow rate, m <sup>3</sup> /h			Threshold value of flow rate, m <sup>3</sup> /h	Overall length L, mm	Pressure losses at q <sub>p</sub> , kPa	Joining to the pipeline (Thread – G, flange– DN)
Permanent flow rate q <sub>p</sub> , m <sup>3</sup> /h	Upper flow rate q <sub>s</sub> , m <sup>3</sup> /h	Lower flow rate q <sub>i</sub> , m <sup>3</sup> /h				
0,6	1,2	0,006	0,003	110	7	G3/4"
0,6	1,2	0,006	0,003	190	0,9	G1", DN20
1,0	2,0	0,01	0,005	110	11,3	G3/4"
1,0	2,0	0,01	0,005	190	2,5	G1", DN20
1,5	3,0	0,006	0,003	110; 165	17,1	G3/4"
1,5	3,0	0,006	0,003	190	5,8	G1", DN20
1,5	3,0	0,015	0,003	110; 165	17,1	G3/4"
1,5	3,0	0,015	0,003	190	5,8	G1", DN20
1,5	3,0	0,015	0,005	130	7,2	G1"
2,5	5,0	0,01	0,005	130	19,8	G1"
2,5	5,0	0,01	0,005	190	9,4	G1", DN20
2,5	5,0	0,025	0,005	130	19,8	G1"
2,5	5,0	0,025	0,005	190	9,4	G1", DN20
3,5	7,0	0,035	0,017	260	4	G1 1/4", DN25, DN32
6,0	12,0	0,024	0,012	260	10	G1 1/4", DN25, DN32
6,0	12,0	0,06	0,012	260	10	G1 1/4", DN25, DN32
10,0	20,0	0,04	0,02	300	18	G2", DN40
10,0	20,0	0,100	0,02	300	18	G2", DN40
15,0	30,0	0,06	0,03	270	12	DN50
15,0	30,0	0,15	0,03	270	12	DN50
25	50	0,1	0,05	300	20	DN65
25	50	0,25	0,05	300	20	DN65
40	80	0,16	0,08	300; 350	18	DN80
40	80	0,4	0,08	300; 350	18	DN80
60	120	0,24	0,12	350; 360	18	DN100
60	120	0,6	0,12	350; 360	18	DN100

Temperature limits of heat conveying liquid:

5 °C....130 °C.

#### Note:

For heating medium temperature below 90 °C

the electronic unit can remain on the flow sensor or be mounted on the wall,

For heating medium temperature above 90 °C

the electronic unit must be mounted on the wall

Connection cable length between the electronic unit and the flow sensor

1,2 m- standard version  
(2,5 m; 5 m. – optional)

Maximum admissible working pressure PS  
(Nominal pressure PN)

16 bar or 25 bar

Behaviour of the meter, when the flow rate exceeds the maximum value q<sub>s</sub>:

- At the flow rate  $q < 1,2 \cdot q_s$  - linear,

- At the flow rate  $q > 1,2 \cdot q_s$  - constant ( $q = 1,2 \cdot q_s$  is applied to calculations of thermal energy). The error „Maximum allowable value of flow rate is exceeded“ is registered and duration of error is calculated.

### Pulse outputs

Class of flow output device

OD according to EN1434-2

Pulse value is freely ordered of the range of values  $N \cdot 10^{-M}$  m<sup>3</sup>/imp (where N - possible number from 1 to 9, M - possible number from 1 to 6)

Permissible minimal pulse value of volume and recommended pulse value, depending on the permanent flow rate:

Table 1.2

Permanent flow rate $q_p$ , m <sup>3</sup> /h	0,6	1 1,5	2,5	3,5	6	10 15	25	40	60
Permissible minimal pulse value of volume, l/pulse	0,01	0,01	0,02	0,05	0,1	0,1	0,2	0,5	1
Recommended pulse value, l/pulse, if the flow sensor is operating in conjunction with calculator, which is powered from battery, (in brackets – recommended pulse value code NM)	0,2 (24)	0,5 (54)	1 (13)	1 (13)	2 (23)	5 (53)	10 (12)	10 (12)	20 (22)

**Supply voltage:**

Internal battery

size AA, 3,6 V, 2,4 Ah, lithium battery (Li-SOCl<sub>2</sub>)

service life not less than 12 years;

Or two internal batteries

size AA, 3.6 V 2.4 Ah, service life not less than 16 years,

External power supply

12 V...42 V DC or 12 V...36 V, 50/60 Hz AC, 10 mA<sub>max</sub>

+ internal backup battery: size AA, 3,6 V, 2,4 Ah, lithium battery (Li-SOCl<sub>2</sub>) service life not less than 12 years (without data reading via a digital interface) – for powering of the meter, when the external power supply is turned off.

External power supply module is mounted inside in the meter.

**Mechanical data:**

Dimensions of electronic unit, not more than

117 mm x 44 mm x 89,5 mm,

Dimensions of flow sensors

According to Annex B

Weight:

Table 1.3

Connection type and mounting length in mm of flow sensor	Weight of sensor, not more than, kg
G3/4", 110 mm	0,7
G3/4", 165 mm	0,8
G1", 130 mm	0,8
G1", 190 mm	0,9
DN20	2,5
G1 1/4"	3,2
DN25	5,6
DN32	6,1
G2"	3,7
DN40	6,8
DN50	8,5
DN65	13,0
DN80	15,0
DN100	18,0

Environmental class

Meets EN1434 class C

Ambient temperature:

at +5 °C to +55 °C  
(Non-condensing, indoor installation)

Electronic unit

at -30 °C to 55 °C

Flow sensors

Relative humidity

< 93 %

Mechanical environment class:

M1

Electromagnetic environment class:

E2

Protection class of electronic unit enclosure

IP65

Protection class of flow sensor enclosure

IP65 (IP67 –by special order)

### 3. OPERATING PRINCIPLE

The flow measuring principle is based on ultrasonic measurement method. The ultrasonic signal along the measuring section moves many times upstream and downstream between the ultrasonic sensors, who alternately performs transmitter and receiver functions. From the resulting time difference the flow rate is calculated. Measured flow rate is converted into the pulses quantity that is transferred in output pulse terminal.

### 4. MARKING AND SEALING

#### 4.1. Marking:

Marking of electronic unit

There are following information on the front panel of electronic unit - manufacturer's trade mark, type of sensor, serial number, year of manufacture, EC-type examination certificate number, accuracy class, environmental class by LST EN1434-1, electromagnetic and mechanical environmental class, enclosure protection class, the limiting values of the flow rate ( $q_i, q_p, q_s$ ), output pulse value, maximum temperature range for flow sensor, the maximum admissible working pressure.

Numbers of terminal pins are marked close to the terminal

Marking of flow sensor

There are following information on the flow sensor:

- nominal diameter,
- arrow for indication of a flow direction

#### 4.2. Security seals:

**The following sealing of electronic unit is provided**

Manufacturer's adhesive seal-sticker on the access to the adjustment activation jumper (see Annex C, fig.C1, pos.1) and on the fixer on the cover protecting electronic wiring plate (see Annex C, fig.C1, pos.2)

**The following measuring section sealing is provided**

Manufacturer's adhesive seal-sticker on the screws of protective cover of flow sensor (see Annex C, fig.C2a; b; c; d; e).

Manufacturer's hanged seals on ultrasonic transducers for flow sensors with steel body (see Annex C, fig.C2 f).

#### Mounting seal

After installation the case and cover of the electronic unit (see Annex C, fig.C1, pos.3) are sealed with two hanged seals of heat supplier.

### 5. SAFETY REQUIREMENTS

**Before beginning installation works you must to read this document and follow its instructions.**

- Risk factors during the flowmeter installation and service is a heat conveying fluid flowing within flow sensor with inner pressure up to 1,6 (2,5) MPa and temperature up to 130 °C.
- To eliminate this risk the service and installation works must be performed by qualified technical personnel. Personnel must be familiar with appropriate technical documentation and general safety instructions.
- It is necessary to follow general safety requirements during installation and maintenance process.
- Protective grounding is not required, because housing is made from plastics, and conductive parts are not exposed to the surface.
- Safety guarantees at installation and service of meter is:
  - Reliable insulation of electrical circuits,
  - Hermetic fitting of primary flow sensor into the pipeline,
  - Reliable fastening of sub-assemblies of heat meter at installation.



**Warning! Mounting of the flowmeter is permissible only after ensuring of absence of heat conveying fluid in the pipeline.**

**By connecting the flow sensor to the external pulse registration device which is powered via AC 230V check the proper grounding of external device.**

## 6. INSTALLATION

### 6.1. Basic requirements

Before installing the device:

- check if all parts listed in the documentation are available,
- check if there are no visible mechanical defects,
- check if there are valid labels of manufacturer and certification authority.

Only qualified personnel may install the equipment, following the requirements listed in this document, in technical documentation of other system components and in heat meter installation project

It is forbidden to wire signal cables nearby (less than 5 cm) with power cables or cables of other devices.

### 6.2. Electrical wiring

#### Factory installed pulse cable

The cable cannot be removed, shortened or extended, if the pulse cable is already installed.

#### Customer pulse cable

Connection of the customer pulse cable. It is recommended to use copper wire cable with the cross-section (0.2 ... 0.5) mm<sup>2</sup>.

By means of tweezers remove a protective knoll from 1 sealant hole of electronic unit. Run the cable through the hole and anchor with clamp. Use two wire connection methods –connect to the terminals 18 and 19 as shown in Annex A, Fig.A1.

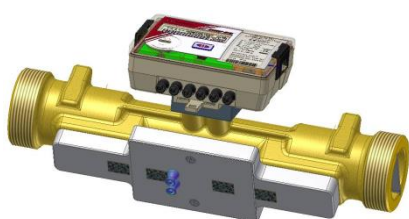
### 6.3 Mounting

#### Mounting of electronic unit

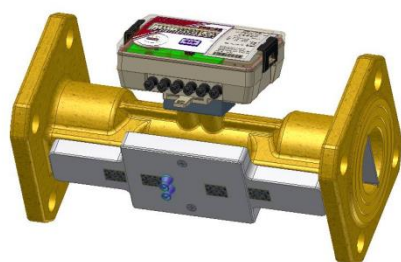
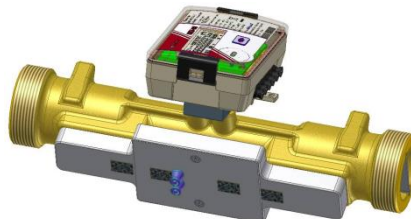
Electronic unit may be installed in heated premises; working ambient temperature shall be not more than 55 ° C. It may not be exposed to direct sunlight.

Electronic unit can be mounted in several different ways:

- Direct mounting on ultrasonic flow sensor housing, turning every 90° (only when the temperature of the flow does not exceed 90 ° C):

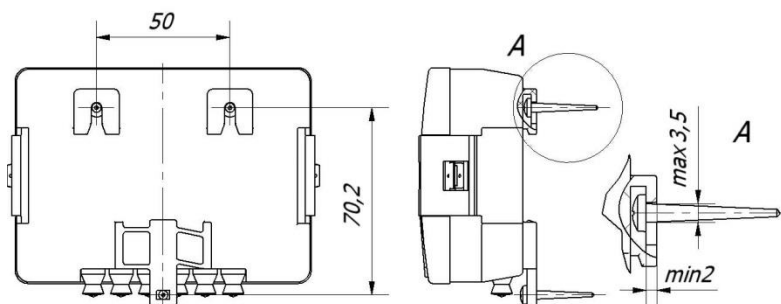
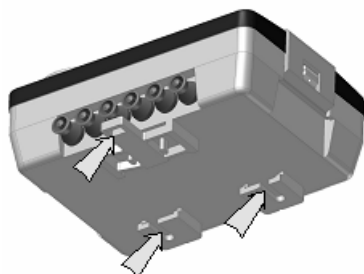


a) On the flow sensor with a thread connection



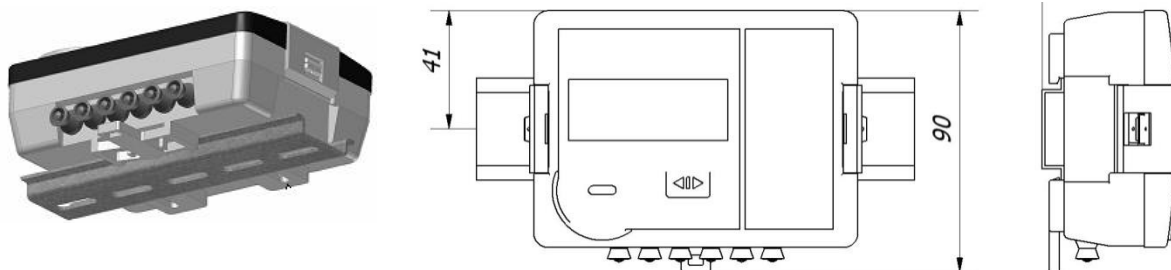
b) On the flow sensor with flange connection

- Wall mounting:





- Mounting on standard DIN-rail:



**!Important: It is forbidden to attach the electronic unit directly to a wall if there is a risk that on walls can be condensed humidity or temperature of a surface of a wall can fall lower than 5 °. In this case, it is recommended to attach the calculator so that between it and wall surfaces there were an air gap not less than 5 cm.**

#### Mounting of flow sensor measuring section

Sizes and mounting dimensions of flow sensors are provided in Annex B.

Requirements for flow sensor installation in pipeline:

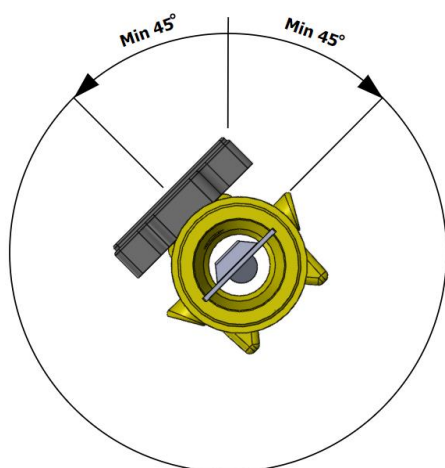
- For flow sensors DN15...DN50 no requirements for straight pipeline length in upstream and downstream directions.

- For flow sensors DN65, DN80 and DN100 necessary straight pipelines lengths are: upstream straight pipeline length must be not less 5DN and downstream straight pipeline length must be not less 3DN.

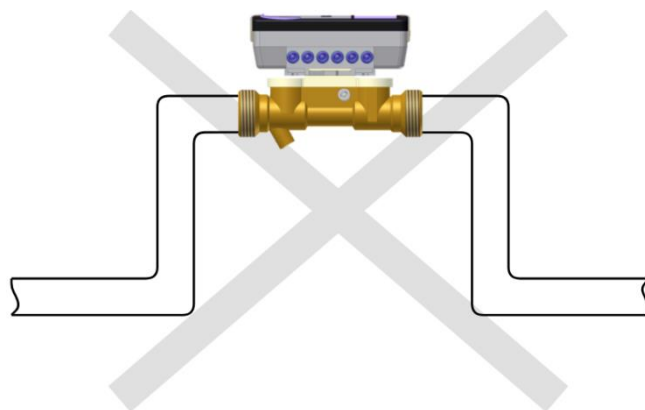
Avoid the flow sensor installation near after the pumps which can cause cavitations.

Flow sensor can be mounted in horizontal, vertical or inclined positions in return or flow. Necessary condition in normal working mode: pipeline must be under pressure and fully filled with heat conveying liquid.

The location and position of the flow sensor must be selected in such a way as to reduce the risk of accumulation of air bubbles in the zone of ultrasonic sensors (Fig. 6.1).



a) Permissible installation position



b) The installation position is prohibited.  
(the air bubbles may accumulate)

**Fig.6.1.** Mounting Position of the flow sensors qp 3,5 m<sup>3</sup>/h... qp 60 m<sup>3</sup>/h

The direction of the sensor installation (is indicated with the arrow on the label of flow sensor) must match with the flow direction in pipeline.

The flange gaskets must match with the pipe diameter. During the installation gasket must be exactly centred with the centre of the pipe cross-section to avoid sticking out gaskets inside the pipe.

#### 6.4. Sealing after installation

The sensor must be sealed according to p.4.2 to ensure that after the installation, it is not possibility of dismantle, remove or altering the meter without evident damage on the meter or the seal.

Mounting seal:

After installation the case and cover of the electronic unit (see Annex C, fig.C1, pos.3) are sealed with two hanged seals of heat supplier.

Connection of flow sensor with the pipeline should be sealed in addition.

## 7. OPERATION

### Destination of contacts of connector J

The 2-line, 10-pole connector is on the electronic unit plate. Destination of contacts of connector J is presented in fig. 7.1.

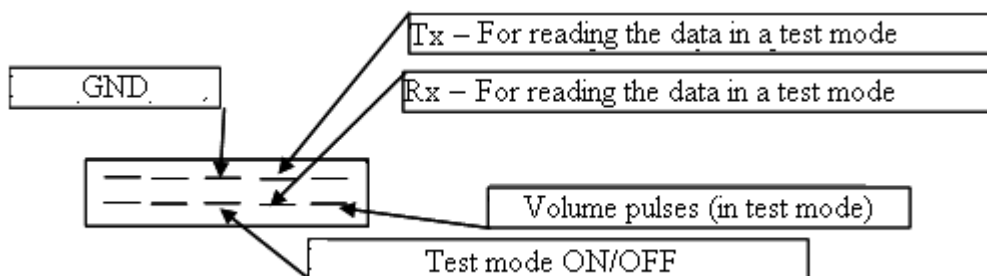


Fig. 7.1. Destination of contacts of connector J

Values of output pulses in test mode are presented in Table 7.1

Table 7.1. Values of output pulses

Nominal (permanent) flow rate $q_p$	Pulse value, l/pulse
0,6/1,0	0,002
1,5	0,004
2,5	0,005
3,5/6	0,02
10/15/25	0,05
40/60	0,2

### Activation of test (verification) mode

In test mode it is possible to achieve precise results within short measuring time.

For activation of Verification (Test) mode you must opening device and set up jumper on the connector (J) contacts as shown in Figure 7.2.

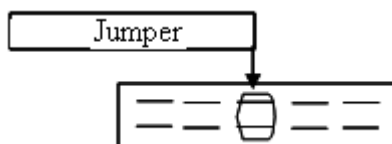


Fig. 7.2. Test mode activation

For working in this mode, the calculator cannot be closed.  
When the jumper "J" is set, output pulses are formed.

### Ending of verification mode

Remove jumper "J" to leave test mode and return to normal mode.

**Note:** In normal mode the jumper "J" must be removed.

## 8. VERIFICATION

Metrological control of flow sensor parameters is performed according to requirements defined in EN 1434-5.

## 9. TRANSPORTATION AND STORAGE REQUIREMENTS

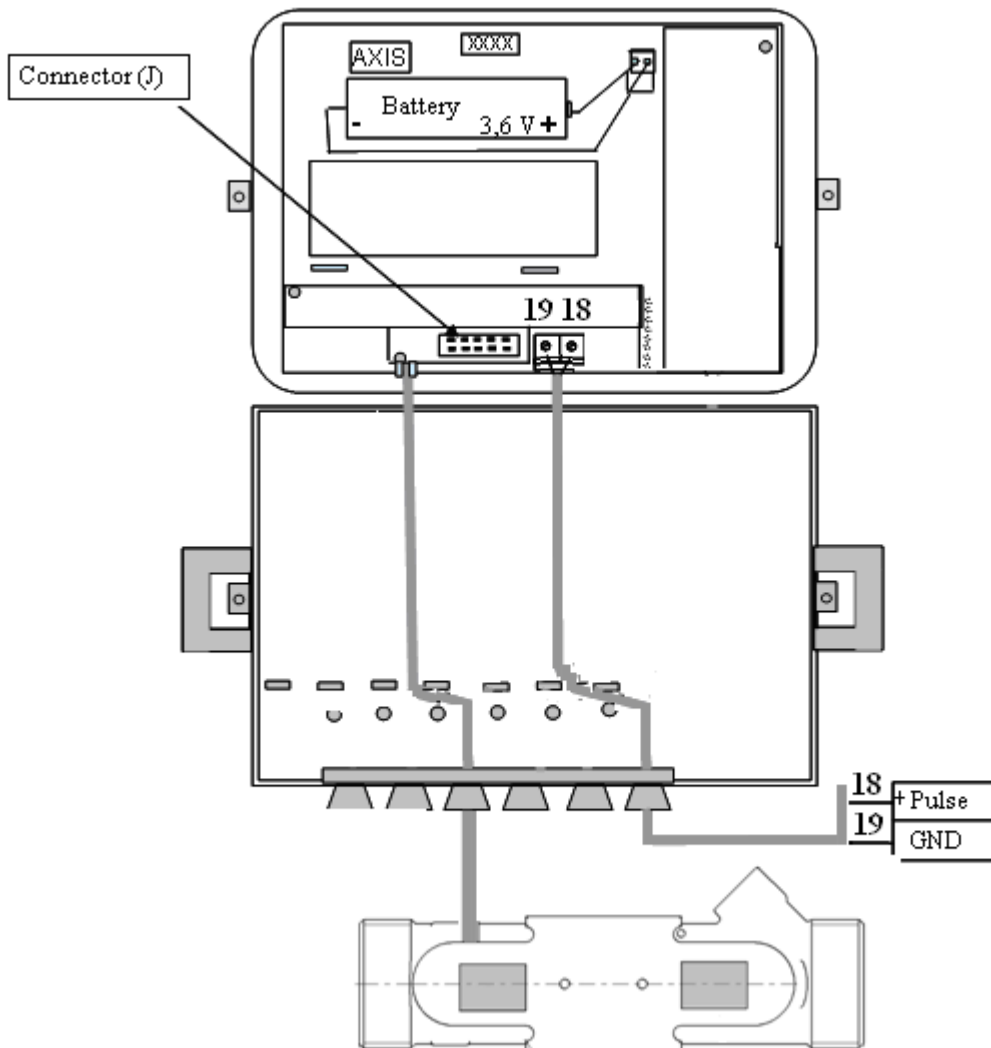
Requirements for safe transportation and storage of temperature and pressure sensors are provided in relevant technical documentation.

Packed equipment may be transported in any type of covered vehicle. Equipment should be anchored reliably to avoid shock and possibility to shift inside vehicle.

Equipment should be protected against mechanical damage and shock.

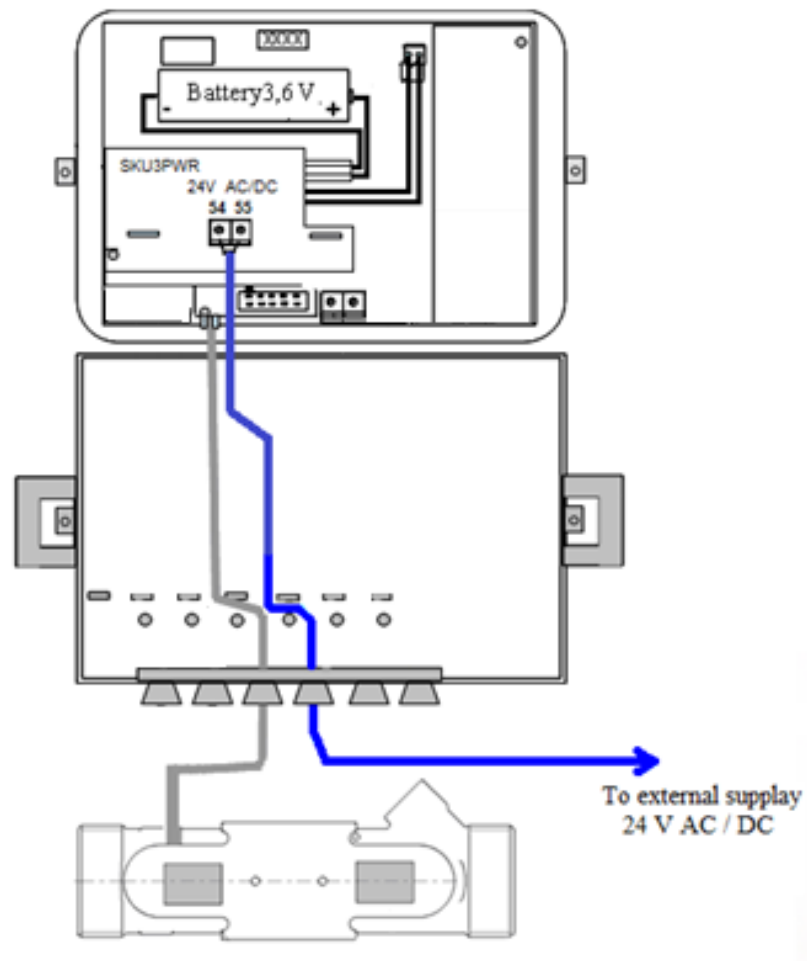
No aggressive chemical substances should be stored together because of corrosion hazard.

**Annex A**  
**Electrical wiring diagrams of flow sensor QALCOSONIC F2**



**Fig.A1. Electrical wiring diagram**

## Annex A



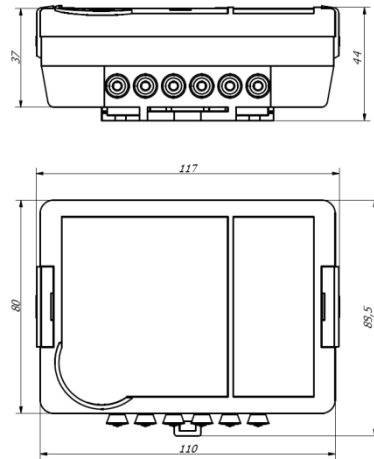
**Fig.A2.** Wiring diagrams for connecting of the sensor to the external power supply

**Table A1.** Numbering of terminals

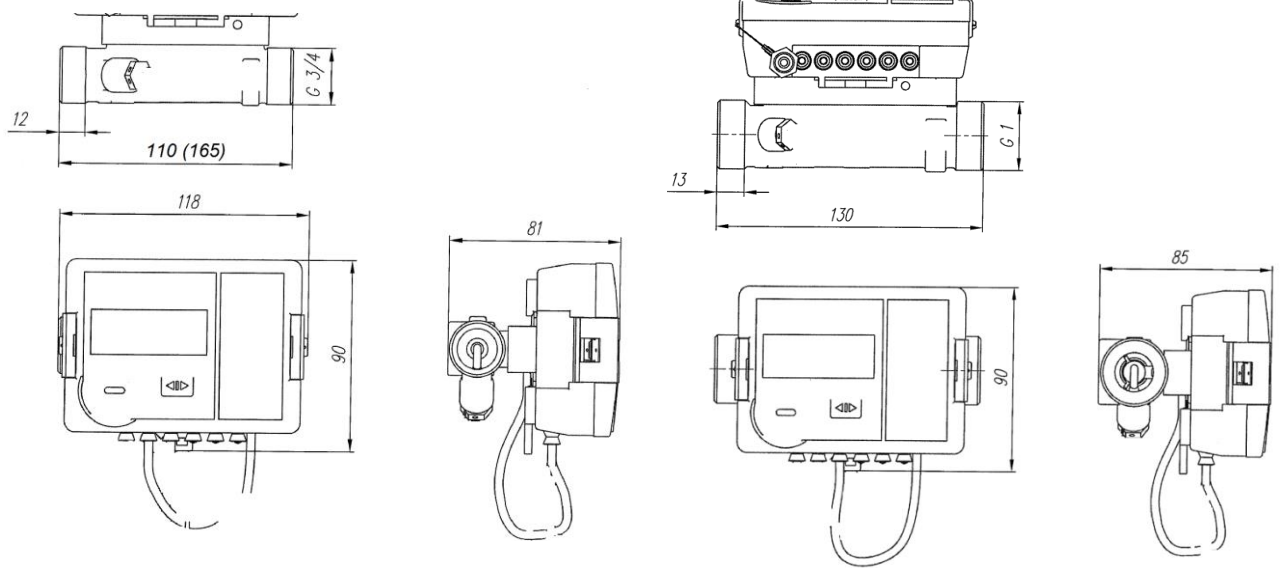
Terminal No.	Destination
18	Output pulses of volume (+)
19	GND (-)
Numbering of external power supply module terminals	
Terminal No.	Destination
54	24 V AC/DC external power supply voltage
55	24 V AC/DC external power supply voltage

## Annex B

**Fig. B1. Mechanical dimensions of electronic unit of the flow sensor**

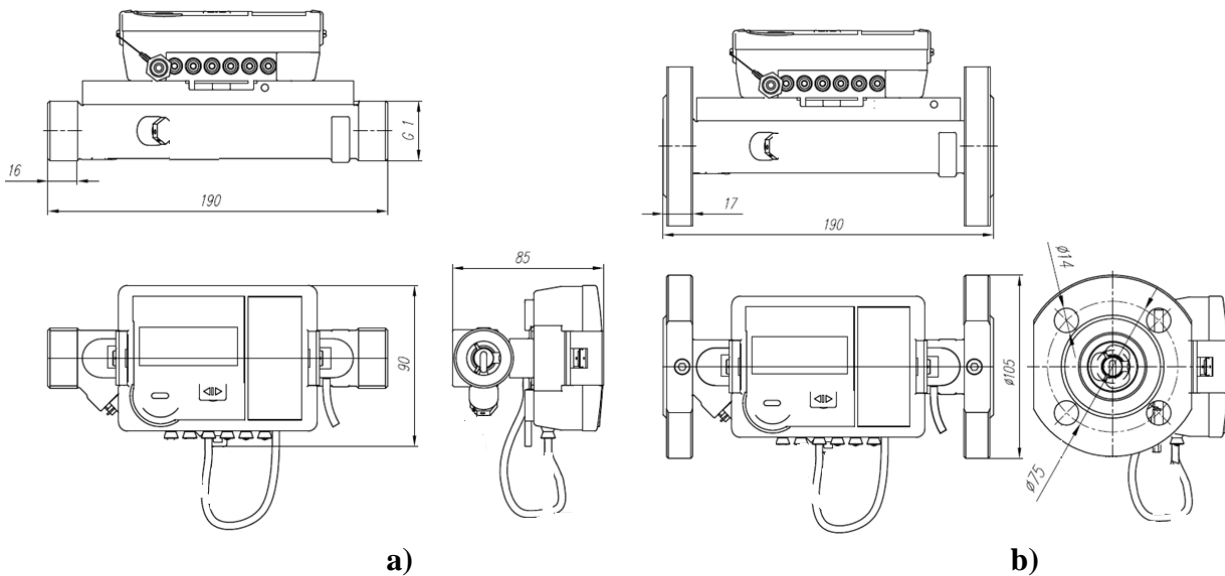


**Fig.B2. Sizes and dimensions of the flow sensor**



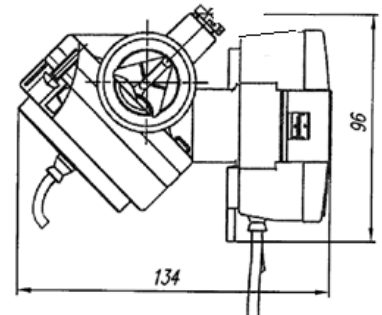
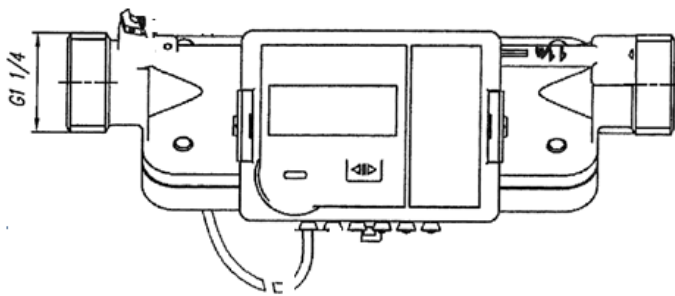
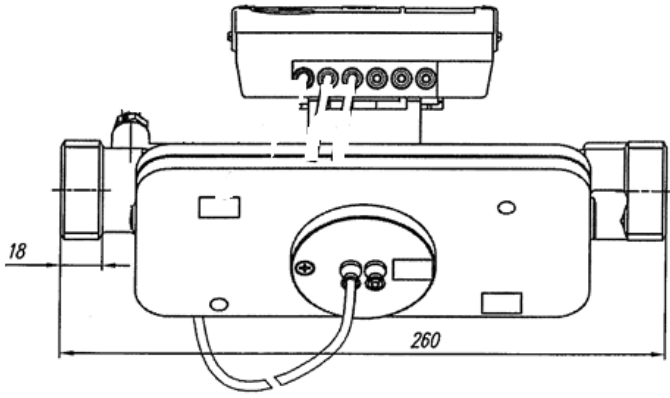
**Fig.B2.1.** Threaded end connections G3/4",  
Mounting length L=110 mm or L=165 mm

**Fig.B2.2.** Threaded end connections G1",  
mounting length L=130 mm

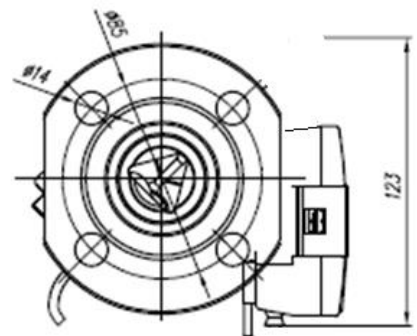
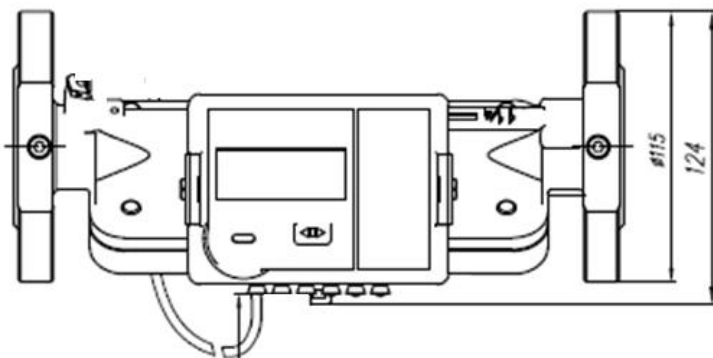
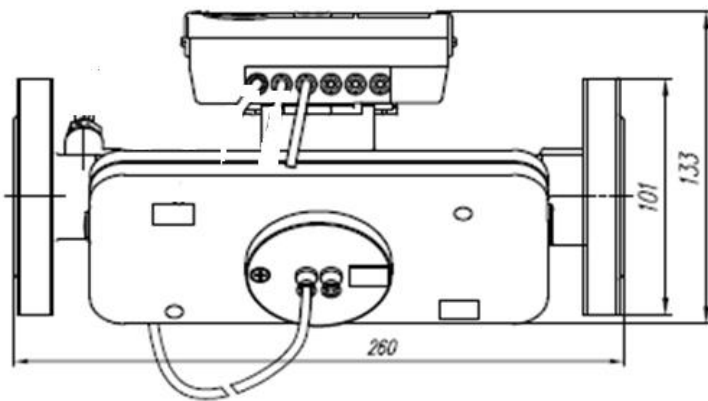


**Fig.B2.3.** Threaded end connections G1"(a); Flanged end connection DN20 (b)  
Mounting length L=190 mm

Annex B

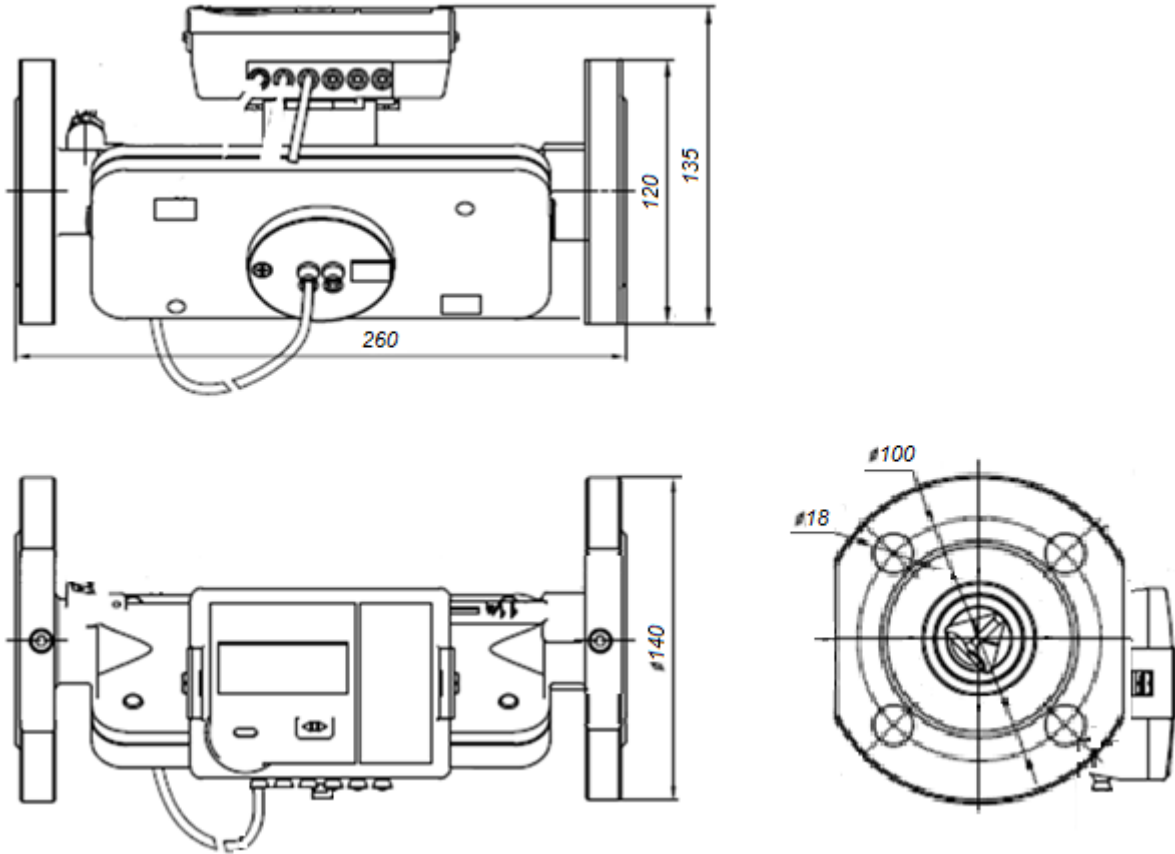


a) Threaded end connections G1 1/4



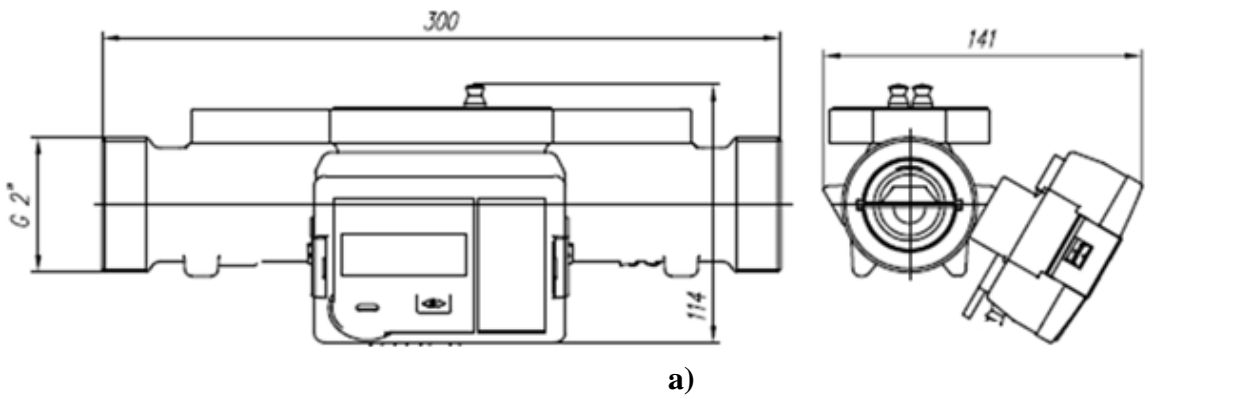
b) Flanged end connection DN25

Annex B

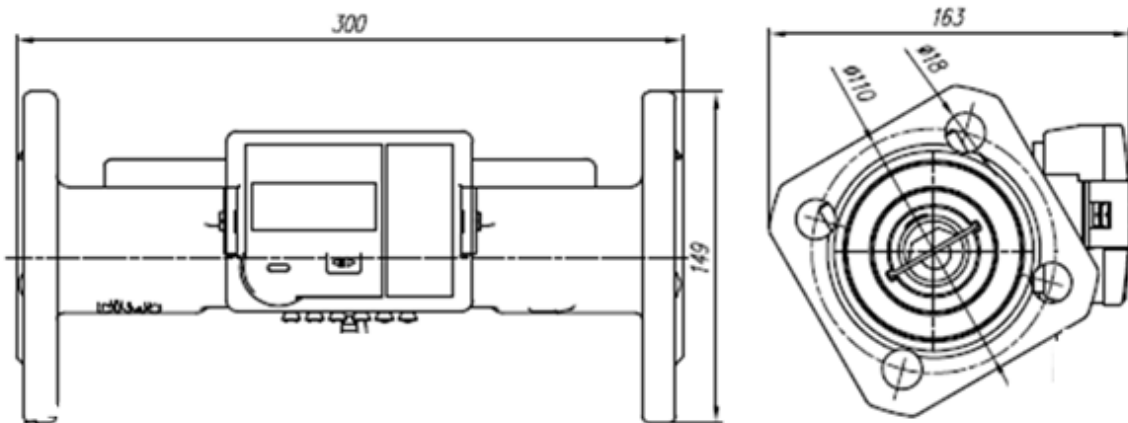


c) Flanged end connection DN32

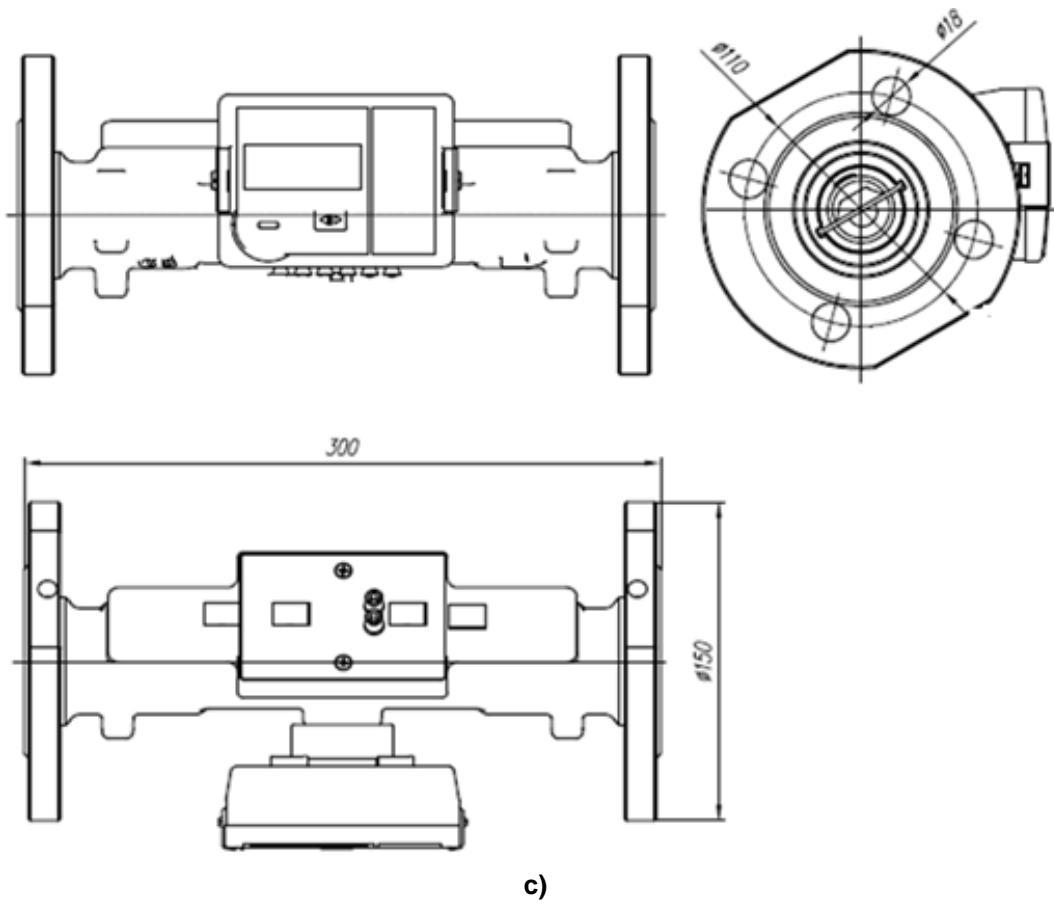
Fig.B2.4. Threaded end connections G1 1/4"(a); Flanged end connection DN25 (b); Flanged end connection DN32 (c); mounting length L=260 mm



a)



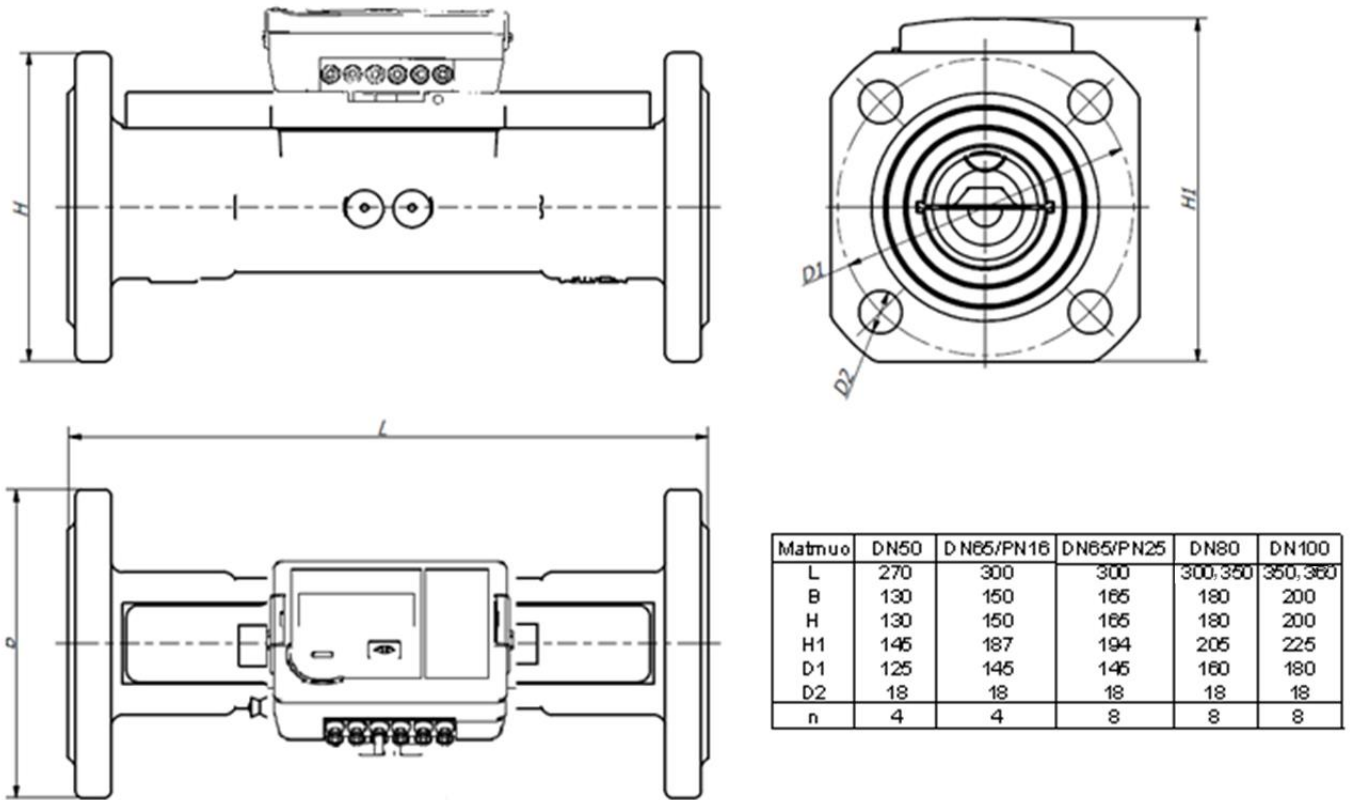
b)



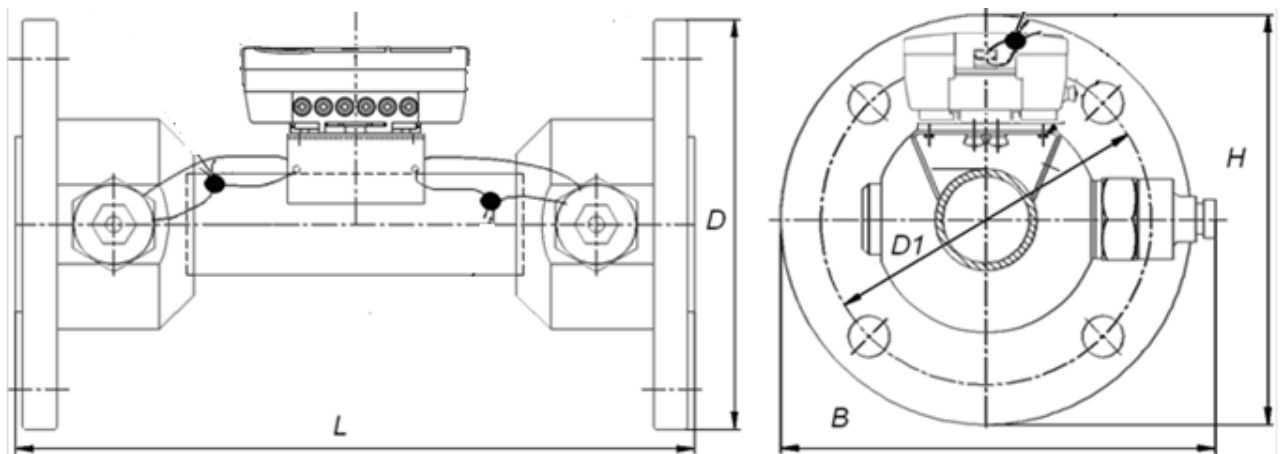
**Fig.B2.5.** Threaded end connections G2"(a); flanged end connection DN40 (b;c) (two design options)  
Mounting length L=300 mm



**Annex B**



a) Dimensions of flow sensors DN50, DN65, DN80, DN100 ( Brass housing)

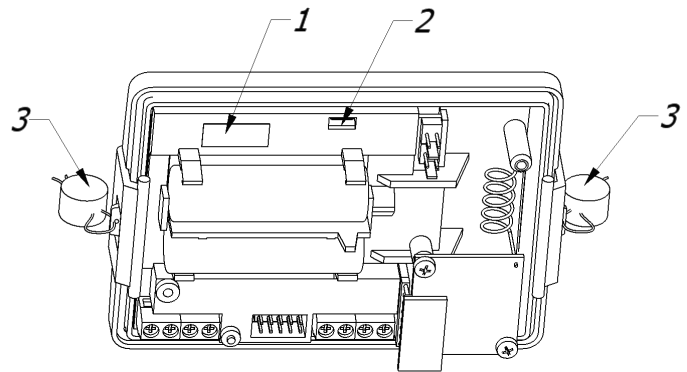


	DN65/PN16	DN65/PN25	DN80	DN100
L	300	300	350	350
D	185	185	200	220
H	185	185	200	220
D1	145	145	160	180
B	200	200	215	235
D2	18	18	18	18
n	4	8	8	8

b) Dimensions of flow sensors DN65, DN80, DN100 (Steel housing)

**Fig. B2.6.** Dimensions of flow sensors DN50, DN65, DN80, and DN100

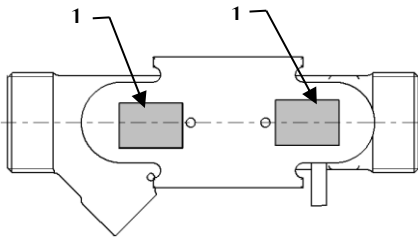
**Annex C  
Security sealing**



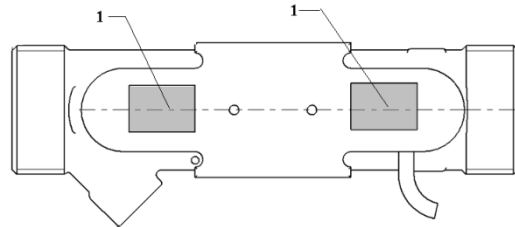
**Fig.C1. Sealing of the electronic unit for flow sensor QALCOSONIC F2**

Electronic general view: the cover is closed, and the cover is opened

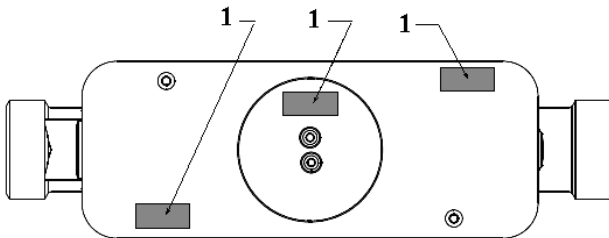
(1-Manufacturer security seal- adhesive sticker, 2-manufacturer warranty seal- adhesive sticker, 3 –mounting seal)



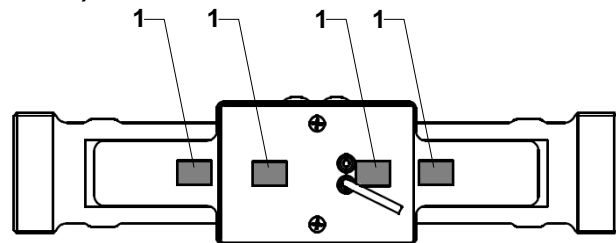
**a) Flow sensor G 3/4"**



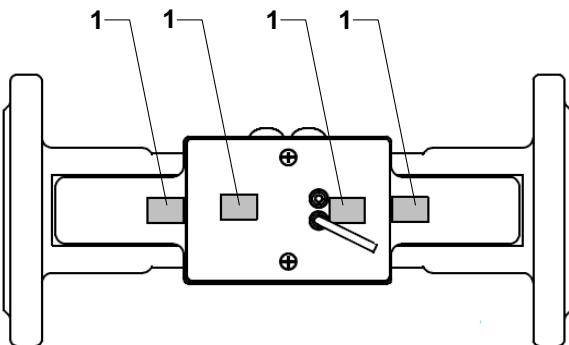
**b) Flow sensor G 1" or DN20**



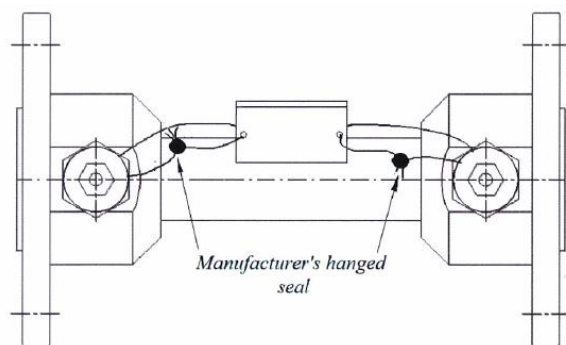
**c) Flow sensor G 1 1/4"; DN25 or DN32**



**d) Flow sensor G 2" or DN40**



**e) Flow sensor DN50, DN65, DN80, DN100  
(Brass housing)**



**f) Flow sensor DN65, DN80, DN100  
(Steel housing)**

**Fig.C2. Flow sensors sealing** (a;b;c;d;e - 1- manufacturer's adhesive seal-sticker on the bolts of the cover; f – manufacturer's hanged seal)

## **WARRANTY**

Manufacturer gives the warranty that equipment parameters will meet the technical requirements, listed in the paragraph 2 of this document, if transportation, storage and operation conditions will be followed.

Warranty period - 12 months from bringing into operation, but not more than 18 months from manufacturing date.

Manufacturer's address:

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