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	Electromagnetic flowmeter FLONET FF50xx	

Electromagnetic flowmeter


FLONET FF50xx




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1 BASIC INFORMATION

1.1 *Application*

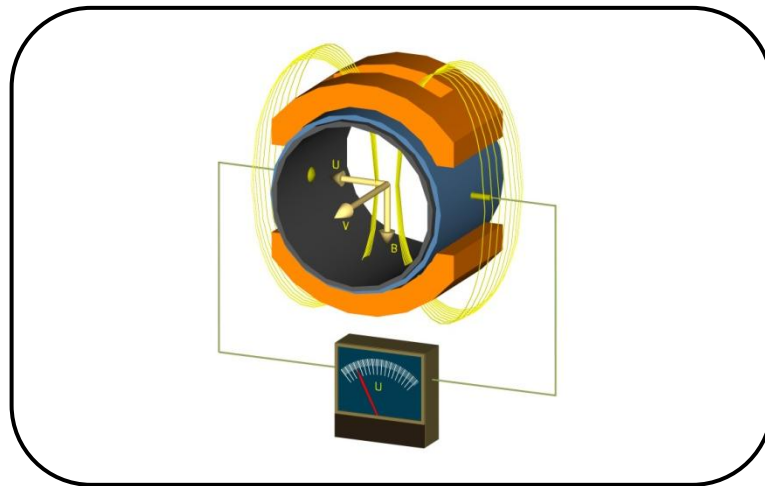
FLONET FF50xx is an electromagnetic flowmeter intended for measurement of volume flow rate of electrically conductive liquids in closed piping. The meter facilitates high-accuracy bi-directional flow rate measurements at flow velocities ranging from 0.025 to 10 m/s. The minimum required conductivity of the measured fluid is 10 µS/cm, for de-mineralised water it is 20 µS/cm.

1.2. Measurement principle


The function of electromagnetic flowmeter is based on the Faraday induction law. The meter sensor consists of a non-magnetic electrically non-conductive tube and two inbuilt electrodes that pick up the induced voltage in a plane perpendicular to the direction of the magnetic power lines. The magnetic field is generated by electric current flowing through two coils wound on the tube. The flow of the conductive liquid through the tube gives rise to induced voltage **U** proportional to the magnetic flux density **B**, flow velocity **v** and the length of the virtual conductor **l**:

$$U = B \times l \times v$$

- U** induced voltage
- B** flux density
- l** distance between the measuring electrodes
- v** flow velocity of the measured liquid



For the given sensor size, the values of flux density and distance between electrodes are constant. Therefore, the voltage induced on the electrodes is proportional to the velocity of the liquid flowing through the sensor tube. The volume flow rate is then the product of the liquid flow velocity and the tube cross-section: **Q = v × S**.

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1.3 Meter properties and functions

The functions of the meter transmitter include visualisation of the measured values and, using the associated control pushbuttons, setting of the operational meter parameters.

Main flowmeter functions:

- Bi-directional measurements of:
 - volume flow rate;
 - aggregate fluid volume passed through the meter sensor;
- Archiving of the measured data and information on specific operational events;
- Checking on sensor flooding condition.

Flowmeter interface facilities:

- Two binary outputs, one current output
- Communication interface RS-485 MODBUS RTU

1.4 Important user information

Electromagnetic flowmeters of the FLONET FF50xx type series are manufactured and tested in accordance with the applicable international regulations and standards. To ensure successful meter commissioning and meeting the specified metrological parameters, the user shall duly observe all directions and recommendations given in the product manual.

1.4.1 Safety instructions


- Prior to any meter handling, the user and/or the meter installation staff shall get acquainted with the meter documentation.
- When connecting the flowmeter to the power supply, due attention shall be paid to the applicable national regulations and standards with special regard to the issues of labour safety and health protection.
- The meter installation, electrical connection and commissioning work shall be performed by suitably qualified operators.
- It is essential to observe all conditions and instructions given in the product manual regarding the meter installation and electrical connection, and to pay due attention to all warning labels.
- If the product shows signs of malfunction, the user shall not attempt to dismantle the meter. Any repair work is reserved to the meter manufacturer or their duly authorised partners. When sending a meter for repair, make sure to attach representation on decontamination as of Chapter 17 (ANNEX) hereof (see page 71).
- The key meter parts are protected against dismantling by company seals. If any seal will be broken, the customer will forfeit their right to claim free warranty services.

1.4.2 Liability

ELIS PLZEŇ a.s., the manufacturer of flowmeters for liquids, delivers its products in the highest possible quality. All products developed by ELIS PLZEŇ are part of intellectual property of the company and are a subject of copyrights. The same rights also apply to the documents delivered together with the product.

It is forbidden to supplement, amend or otherwise alter documents without prior consent of ELIS PLZEŇ a.s. Any infringement of the aforementioned intellectual property is punishable.

The documents delivered with the product are meant for familiarizing with the product itself and with the conditions of its use and installation. All flowmeter users are obliged to get familiar in detail with these documents and follow manufacturer's instructions as described therein. Following the above-mentioned instructions will prevent the loss of warranty for reasons of incorrect installation and misapplication.

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Installation of this flowmeter shall be performed only by a company trained for this purpose by ELIS PLZEŇ a.s. Such a company, after receiving the training, shall be fully responsible for the correct installation and commissioning. ELIS PLZEŇ a.s. bears no responsibility for defects in the product caused by an incorrect installation, its wrong application or incompetent configuration or programming.

These products, that ELIS PLZEŇ a. s. makes available on the market, are certified according to applicable standards. The accompanying documentation consists of *Project design, installation and service manual* and *Declaration of Conformity*. The products have a warranty as stated in the *Confirmation of Purchase Order* or in the *Purchase Contract*.

All product manuals are regularly updated and the current version is delivered together with the product and also available on the Internet under www.elis.cz/en.

ELIS PLZEŇ a. s. shall have the sole right to update technical documentation for its products.

When ordering a flowmeter, the buyer shall provide all required parameters. ELIS PLZEŇ a.s., as the purchaser, shall confirm the received Purchase Order and send it back together with manufacturer's General Terms and Conditions.

Deliveries of flowmeters shall be governed by the Czech Civil Code. The product is delivered pursuant to the confirmed Purchase Order or Purchase Contract. ELIS PLZEŇ a. s. is not responsible for differences in flowmeter parameters that were not confirmed in writing.

The following icons are used in the *Project design, installation and service manual*:



Warning: incorrect operation or erroneous flowmeter configuration may cause damage to product or injury to persons.



Information about another flowmeter features or types of documents delivered together with the product.

1.5 Product warranty

The flowmeter manufacturer provides product warranty in accordance with their valid commercial conditions.

Additional information regarding warranty is included in Chapter 14 hereof.

1.6 Representations and certificates

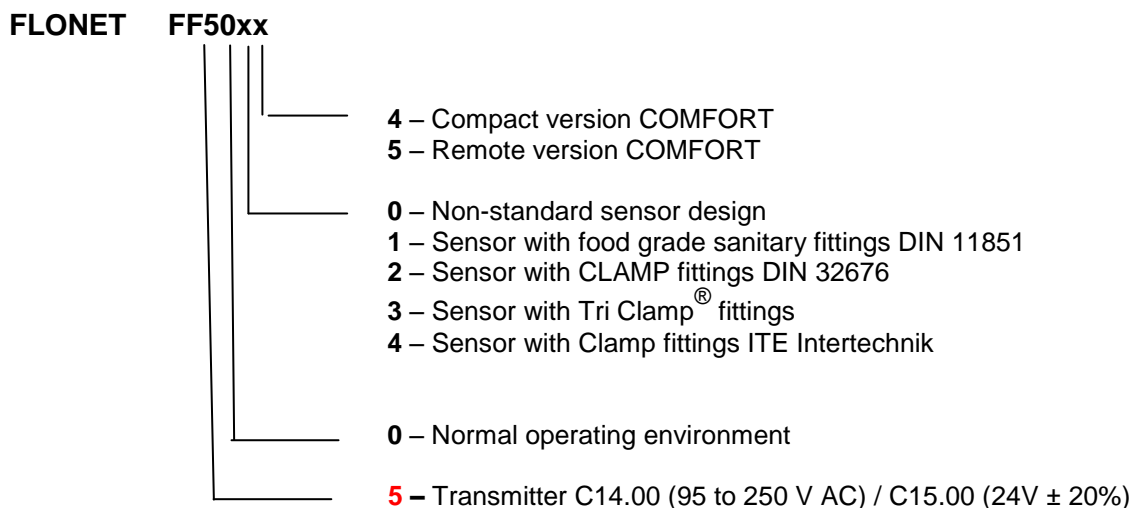
Applicable to electromagnetic flowmeters of the FLONET FF50xx type series are representations and certificates referred to in Chapter 17 below, namely:

- **Representation on CE compliance**

2 METER IDENTIFICATION

2.1 *FLONET FF50xx flowmeter type designation*

Review of the flowmeter FLONET FF50xx design versions:



2.2 *Scope of delivery*

2.2.1 Compact meter version FLONET FF50x4

- Flowmeter FLONET FF50x4 with interfaces RS-485 MODBUS RTU
- Product manual – Electromagnetic flowmeter FLONET FF50xx
- Product manual – Electromagnetic flowmeters of the type series FLONEX FXx11x and FLONET FF50xx Meter control instructions
- Product manual – Communication interface RS-485 MODBUS RTU
Electromagnetic flowmeters FLONET FF50xx and FLONEX FXx11x

2.2.2 Remote meter version FLONET FF50x5

- Transmitter for FLONET FF50x5 including signal cable / connector, communication interface RS-485 MODBUS RTU
- Meter sensor and connection box
- Product manual – Electromagnetic flowmeter FLONET FF50xx
- Product manual – Electromagnetic flowmeters of the type series FLONEX FXx11x and FLONET FF50xx Meter control instructions
- Product manual – Communication interface RS-485 MODBUS RTU
Electromagnetic flowmeters FLONET FF50xx and FLONEX FXx11x
- Transmitter holder

2.3 Associated documents

- Representation on CE compliance
- Calibration report – optional (provided on request)

2.4 Flowmeter rating plates

2.4.1 Main meter plate

The main meter rating plate is located on top of the meter housing.

Both compact and remote meter versions



Example of the main meter plate

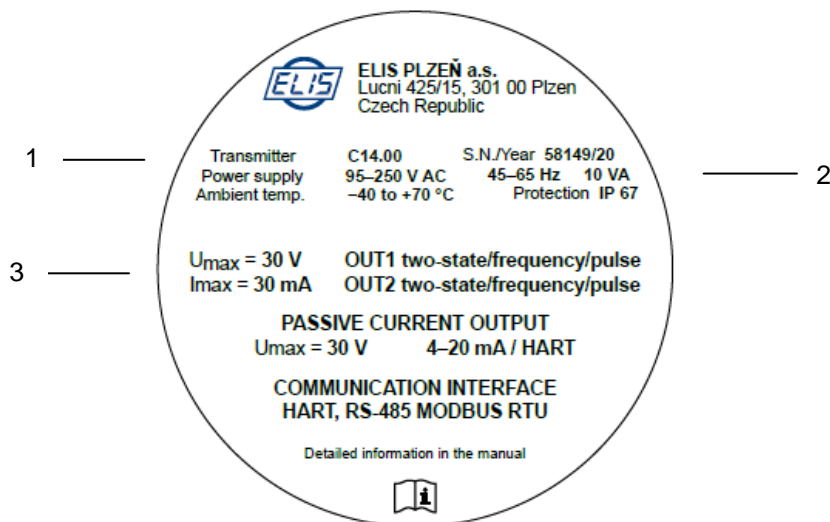
Comments

- 1 Manufacturer's name and address
- 2 CE mark and identification numbers of relevant authorities

2.4.2 Transmitter plate

The transmitter rating plate is attached to the rear cover of the transmitter terminal box.

Both compact and remote meter versions



Example of the transmitter plate

Comments

- 1 Transmitter for both compact and remote meter versions
- 2 Power supply 95 to 250VAC, 45 to 65Hz, 3VA max., or 24 ± 20% VDC, 3W max.
- 3 Output functions (binary, frequency, pulse or current outputs, communication interface) are pre-set in production as required in the product order documentation, but the user may subsequently change the setting.

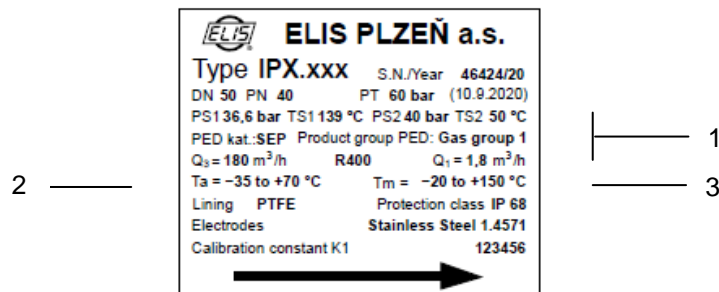


The initial output parameter setting is described in the flowmeter delivery note.

2.4.3 Sensor plate

The sensor rating plate is attached to the induction sensor housing.

Both compact and remote meter versions



Example of the sensor plate

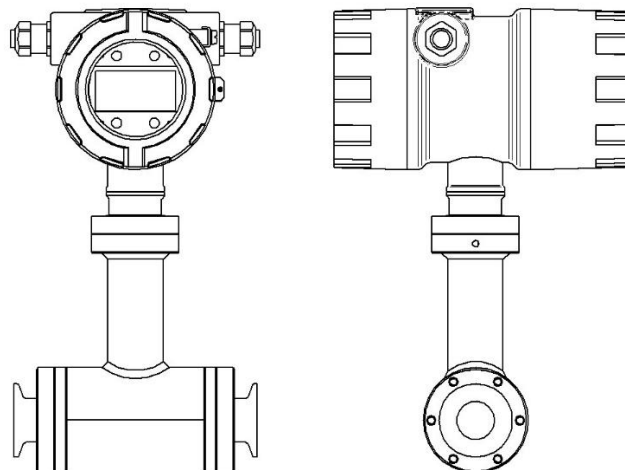
Comments

- 1 Sensor pressure parameters in reference to the PED directive
- 2 Ambient temperature
- 3 Temperature of the measured fluid

3 METER DESIGN AND MATERIAL VERSIONS

3.1 Compact and remote meter versions

In the cases of compact flowmeter version, the meter sensor and transmitter are connected internally and are integrated into a single unit.



In the remote meter version, the sensor and transmitter are connected by a cable.

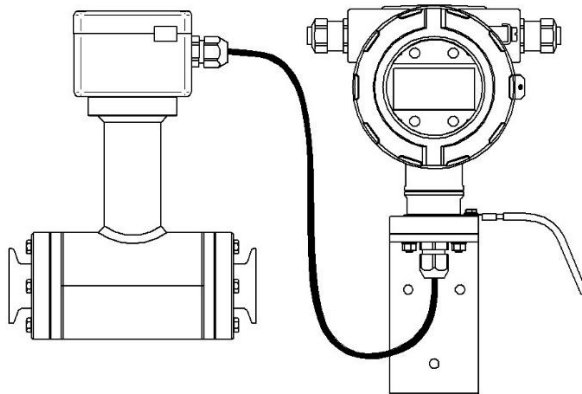
The remote flowmeter version is preferable in the following cases:

- the measured fluid temperatures more than 70°C;
- space limitations not permitting application of the compact meter version;
- where the meter installation spot is difficult to reach.

To eliminate the risk of electromagnetic interference acting on the connecting cable, the transmitter should be as close as possible to the meter sensor.

Remote meter version including a sensor of protection class IP67

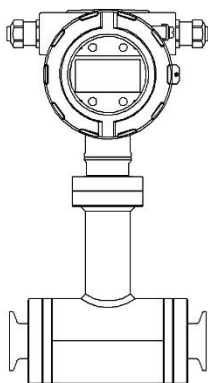
The meter sensor is supplied including a signal cable of the length specified by the customer. During the on-site meter installation, the cable shall be brought to the transmitter connection box and connected to the transmitter terminals.



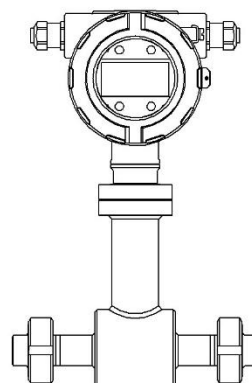
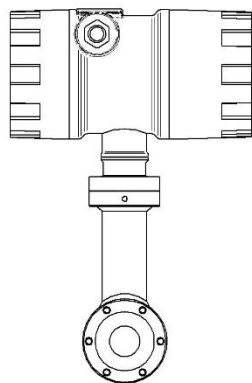
Remote meter version – IP 67 sensor

Meter installation in the fluid piping:

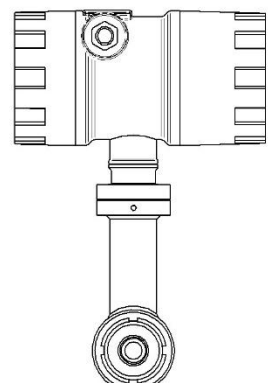
- Flanged meter version
- Wafer meter version (sensor to be fitted between two flanges)



Compact sensor with TRI – CLAMP fittings



Compact sensor with food grade sanitary fittings DIN 11851



3.2 Sensor dimensions

Electromagnetic flowmeters FF50xx are intended for flow rate measurements with the fluid flow velocity within the range of 0.025 to 10 m/s. In practical situations it is recommended to limit the fluid flow velocity values to the range of 0.5 to 5 m/s. At low fluid flow velocities, the relative measurement error tends to increase, while at high velocities flow turbulences may occur.

If the inner sensor diameter is the same as those of the connecting piping, the pressure loss at the meter sensor is negligible.



If the operating fluid flow velocity is too low and the measurement error too high, it is possible to increase the fluid velocity by using a meter sensor of a smaller size with the corresponding reduction of the inner diameters of the connecting piping. The disadvantage of this solution consists of a pressure loss at the pipe reduction area. Therefore, in practical situations, to reduce the pressure loss to a reasonable value, the pipe size reduction should be limited to a single degree.

Fluid flow velocity in a piping can be calculated using the formula:

$$v = \frac{0.0003536 \times Q}{DN^2} \quad (\text{m/s, m}^3/\text{h, m})$$

Flow rates for various sensor dimensions

DN	NPS	l / s		m ³ / h	
		Qmin	Qmax	Qmin	Qmax
10		0,00156	0,778	0,0056	2,8
15	½"	0,0036	1,8	0,013	6,5
20	¾"	0,0067	3,33	0,024	12
25	1"	0,0100	5	0,036	18
32	1 ¼"	0,0167	8,33	0,060	30
40	1 ½"	0,0250	12,5	0,090	45
50	2"	0,0400	20	0,144	72
65	2 ½"	0,0667	33,33	0,240	120
80	3"	0,1000	50	0,360	180
100	4"	0,1556	77,77	0,560	280

3.3 Sensor lining

The sensor lining material shall be chosen with respect to the type and properties of the measured fluid. In cases of the meter application in chemical or food-processing industries, the user should consult the choice of the best suitable lining with the meter manufacturer.


The sensors used with flowmeters FLONET FF50xx can be supplied lined with the following material:

- PTFE

General properties

PTFE

PTFE lining is suitable for applications in chemical and food-processing industries. It can also be used with aggressive liquids at operating temperatures ranging from -20°C to +110°C (on request, -35°C to +150°C). PTFE lining can also be used in applications with the occurrence of under pressure 0 to 0,5 bar depending on medium temperature and flowmeter size. Manufacturer's prior consent is required.

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3.4 *Electrode materials*

Standard materials for the measuring and grounding electrodes:

- Hastelloy C276

Optional materials:

- Hastelloy C276
- Titanium
- Tantalum
- Platinum and Rhodium

4 INSTALLATION

4.1 *Taking over*

When taking over a delivered product, visual inspection shall be carried out to confirm the integrity of both the product and its packaging.

The correct scope of delivery shall be checked in reference to the product order, delivery note and product rating plates.

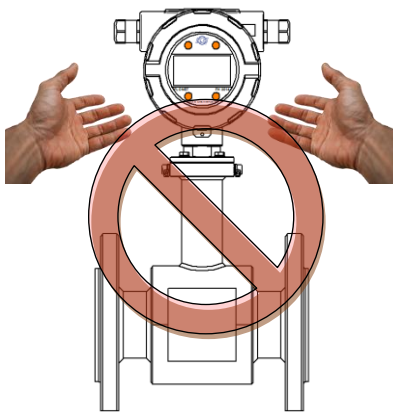
4.2 *Meter handling*

Avoid lifting the meter by holding onto any transmitter part or connection box; use for this purpose the meter flanges or lifting eyes only.

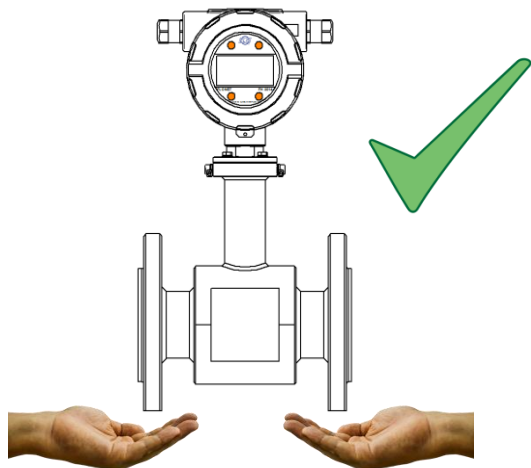


In transport, to avoid irreversible damage to the meter lining, do not place any auxiliary component parts into the meter piping.

Forbidden gripping



Recommended gripping




When using lifting equipment, apply suitable textile slings; application of metal chains or cables might result in damage to the meter.

It is recommended to transport the meter to the installation site in transport packaging.

4.3 *Storage*

For a flowmeter in storage, it is essential to:

- Observe the specified storage conditions regarding temperature and humidity;
- Avoid long-term meter exposure to direct sunshine (risk of damage to the meter display).

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It is recommended to store the meter in complete transport packaging and remove the covers and packaging materials only immediately before installation.

4.4 Installation conditions

4.4.1 General principles

Applicable to mechanical installation of the flowmeter are the following rules:

- The protection covers and packaging shall only be removed immediately before the meter installation;
- The arrow on the sensor housing shall point at the positive fluid flow direction;
- In cases of sensor installation into vertical piping the fluid flow direction shall be upwards;
- The piping flanges shall be parallel to one another;
- The inner piping and seal diameters shall correspond to the inner sensor diameter;
- The seals and grounding rings shall be correctly fitted between the flanges and not extend in the flow profile;
- The piping supports before and after the flowmeter location shall minimise the mechanical stresses acting on the sensor (vibration, tension, bend and others);
- No piping support shall be located under the meter sensor;
- The transmitter shall be protected from direct sunshine;
- The meter installation location shall be selected to ensure easy access for the operator to the transmitter and all meter rating plates;
- The meter sensor shall always be fully flooded by the measured fluid to avoid aeration;
- In cases of electrically non-conductive piping the measured fluid shall be grounded by means of grounding rings.



The sensor shall be inserted between the piping flanges by a shifting movement. With larger sensor sizes it is recommended to use installation inserts. It is also advisable, during the sensor insertion in the piping, to protect the sealing surfaces on the lining by a metal sheet or similar material.



Following the meter installation, no subsequent electric-arc welding operations shall be carried out on the piping at the sensor location. In particular, avoid welding on the piping flanges connected to the meter sensor.

4.4.2 Straight piping sections

To ensure correct functioning of an electromagnetic flowmeter, conditions shall be provided for continuous fluid flow and flow profile stability in the meter sensor.

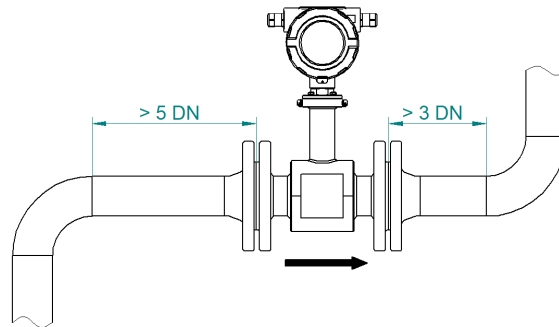
Before and after the meter sensor there shall be straight piping sections the required lengths of which are specified as multiples of the inner piping diameter. In cases of bi-directional measurements, the same requirements concern straight piping sections before and after the sensor. If there are flow-disturbing elements (such as bend or fitting) in the piping near the sensor location, the required length of straight piping section shall be increased – multiplied by the number of such elements.

At the contact plane between the sensor and the attached piping there shall not be any protruding edges causing the flow turbulence. The inner diameter of the piping shall not be smaller or greater by more than 3% than that of the sensor.

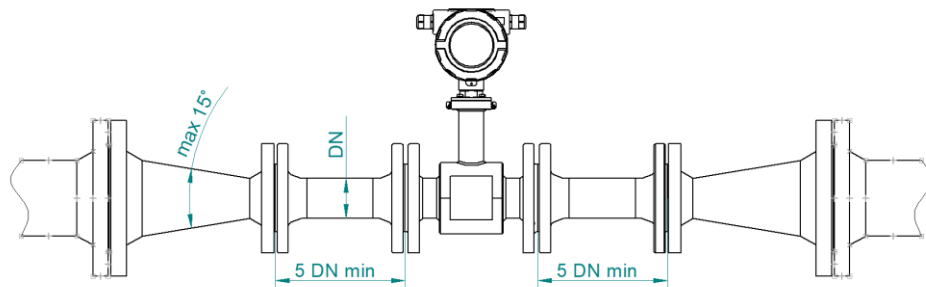
Avoid sensor placement at locations where at the sensor input are chemicals (especially chloride compounds) injected or dosed in the measured fluid. Imperfect blending of the fluid components may cause errors in the flow rate measurements or, in extreme cases, reduction of the measured flow rate to nil.

Preferable are flowmeter sensor installation locations before any piping elements affecting the smooth flow of the measured fluid.

In cases of bi-directional flow measurement, the basic required length of straight piping sections in front of and behind the flowmeter is 5DN.

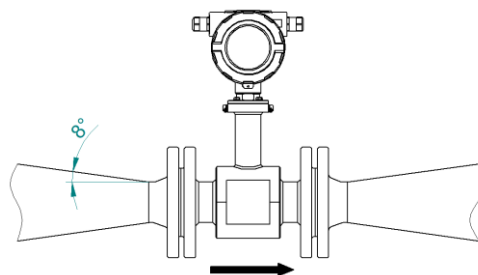


Installation of a flowmeter of a smaller size than that the attached piping requires the use of cone-shaped reduction pieces with the angle of inclination not exceeding 15°.



In cases of sensor installation in horizontal piping, to prevent generation of air bubbles in the fluid, it is recommended to use eccentric reduction pieces (see standard EN 6817).

Reduction pieces with angle of inclination up to 8° can be included in the straight piping length.



4.4.3 Suppression of the pump effects

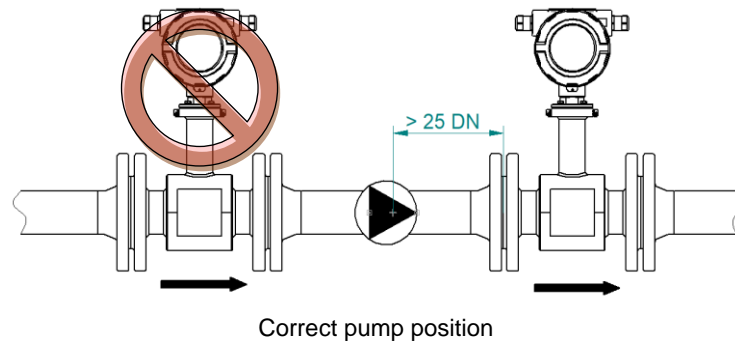
To prevent creation of a low-pressure zone in the sensor and possible damage to the sensor lining, a pump shall always be placed before (at the input side of) the sensor. The length of the straight piping section between the pump and the sensor shall be at least 25 DN.



Placing the pump before the meter sensor reduces the cavitation effect and release of gases from the measured fluid. Increased pressure in the piping system will keep the fluid above the saturated vapour pressure and prevent cavitation effects.

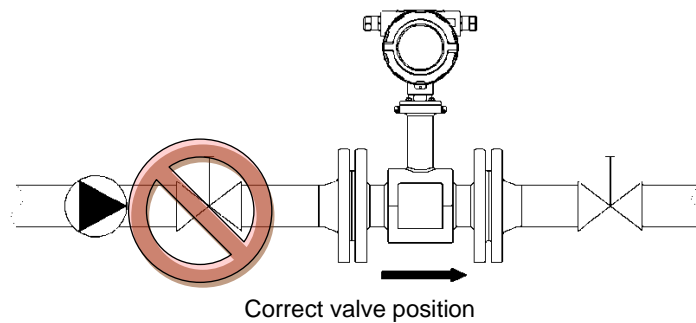


The movement of the fluid in piping should be continuous and stable. If a pump generates fluid pressure pulses (e.g., pneumatic pump) a suitable pulse damping device should be included in the piping.



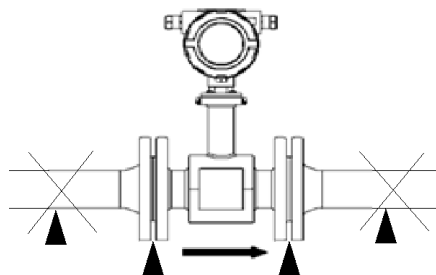
4.4.4 Suppression of the effects of closing valves

To eliminate the disturbing effects on the fluid flow velocity profile in the sensor and prevent the action of the cavitation phenomenon, the closing and throttling valves shall always be located after (at the output side of) the sensor.



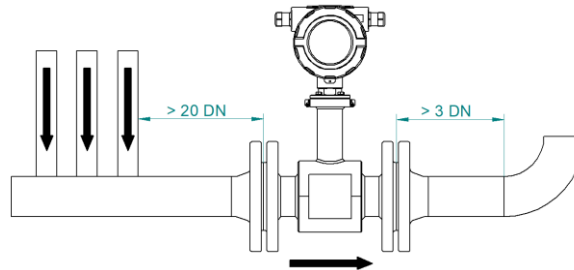
4.4.5 Suppression of vibration effects

Mechanical stresses and vibrations acting on the meter sensor might be detrimental to its function or integrity. It is therefore necessary to fix the position (support) the attached piping as close to the sensor housing as possible. It is assumed that the number of events involving particularly large stresses on the piping, such as filling or draining the piping system, or major fluid pressure changes, does not exceed 1,000 over the meter lifetime.



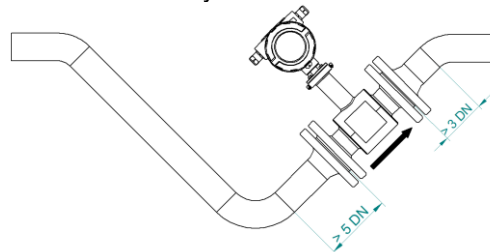
4.4.6 Piping stacks

The nearest stack on the piping system on the sensor input side should be at the distance of at least 20DN from the sensor.



4.4.7 Sensor flooding

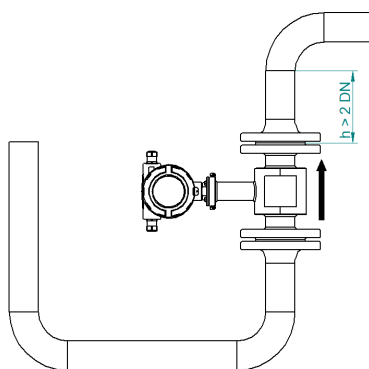
The meter sensor shall be completely filled with the measured fluid at all times. In cases where complete flooding of the whole cross-section of the connecting piping cannot be ensured, the meter sensor shall be located at such spot where this condition is always met.



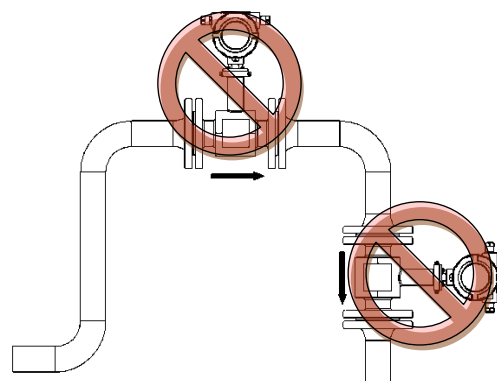
Permanent sensor flooding

4.4.8 Free discharge points

The sensor shall not be located at the highest piping section or in a vertical piping section with the flow direction downwards, especially in cases where a free discharge point is close by. Observation of this rule will prevent measuring errors due to a higher air bubble concentration within the sensor.



Free discharge

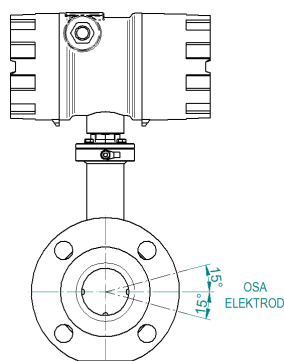


Risk of fluid aeration

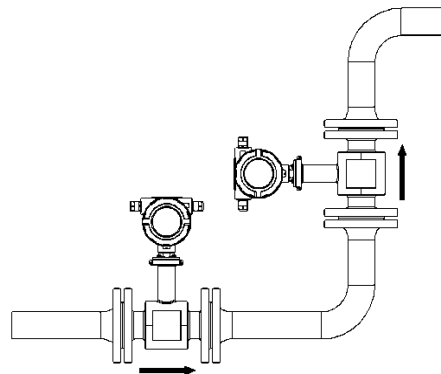
The sensor will work equally well in both horizontal and vertical positions. However, care shall be taken that the measuring electrode axis in the sensor be to the extent possible in a horizontal plane and the fluid flow direction be upwards.

The permitted deviation of the electrode axis from the horizontal plane is 15° in both fluid flow directions.

The free discharge point shall be higher by 2DN than the sensor output end.



Electrode axis



Vertical sensor position

4.5 Tightening torque

Electromagnetic flowmeters of the type series FF50xx are supplied without bolts, nuts and other fasteners or sealing elements.

The entity contracted to perform the meter installation work shall provide the necessary fasteners and seals and carry out the installation work in observance of the applicable standards, paying due attention to the given operational requirements and conditions.

Electromagnetic flowmeters with PTFE lining do not require any additional sealing. The sealing function is facilitated by the flared sensor lining. However, it is necessary for the sealing planes on the piping flanges to be free of any sharp edges. Due attention shall also be paid to observance of the recommended tightening torque.

In cases where the meter sensor is to be attached to flanges made glass, ceramics, enamel, or other smooth-surface materials, it is recommended to use additional sealing rings at the contact planes. The tightening torque shall be determined with respect to the specific material properties of the connecting flanges.



The sealing material shall not contain any electrically conductive components that might get loose during the sensor operation, collect on the sensor lining and deteriorate its insulation properties.

Bolt tightening:

- Tighten the flange bolts using a suitable torque wrench, never an impact wrench.
- The connecting bolts shall be undamaged, preferable new, slightly greased.
- Stop tightening the bolts as soon as the required tightness has been achieved.
- Tighten the bolts along the flange perimeter in a crosswise manner, each in three steps: 50, 80 and 100% of the specified torque. Do not use torque more than the recommended/specified value.

4.6 Thermal insulation

When installed in thermally insulated piping, to prevent unnecessary heat loss, the meter sensor is usually provided with thermal insulation too.

In such cases, the following rules need be observed:

- Insulation shall be applied onto the meter sensor only;
- The maximum insulation thickness shall not exceed 40mm (the thermal conductivity coefficient $\lambda_D \leq 0.045 \text{ [Wm}^{-1}\text{K}^{-1}]$ at 50°C; see standard EN 13787);
- In the cases of compact meter version, the part connecting the meter sensor and transmitter shall always remain bare;
- The transmitter shall be protected from additional heating (by direct sunshine or heat emanating from nearby equipment).

4.7 Flowmeter heating

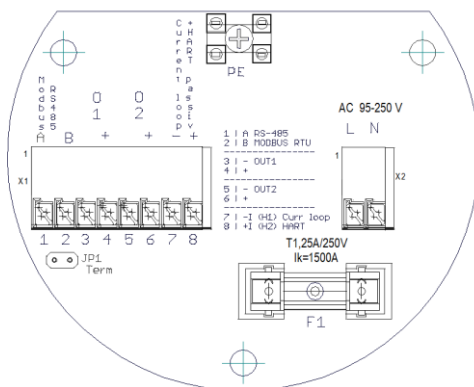
In measuring fluids with sub-zero operational temperatures, or at ambient temperatures close to the specified minimum fluid temperatures, it is permitted to provide the meter sensor with thermal insulation and auxiliary heating system.

- The sensor heating can be facilitated by electricity, or a suitable heat-carrying medium supplied through a special piping system;
- In cases of electric heating, it is recommended to use a regulated AC power source with current switching at zero.

5 ELECTRICAL CONNECTIONS

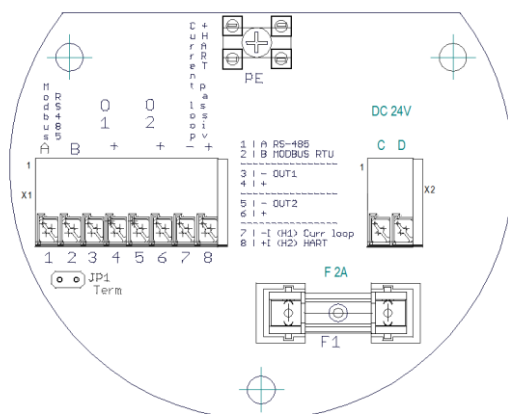
5.1 Transmitter

5.1.1 Terminal box



Terminals	AC power source
L	95 to 250VAC, 45 to 65Hz
N	
PE	

Terminals	DC power source
-----------	-----------------



C (+)	24V ± 20% (19.2 to 28.8VDC)
D (-)	
PE	

Output signals		
Terminals		Functions
1	A	RS-485 MODBUS RTU
2	B	
3	-	Binary output
4	+	
5	-	
6	+	
7	-I (H1)	Current output
8	+I (H2)	

The output and communication signals shall be connected to the target devices via shielded cables. The cable shielding shall be connected at one end only, to the PE terminal, located on the terminal blocks.

5.1.2 Excitation circuit

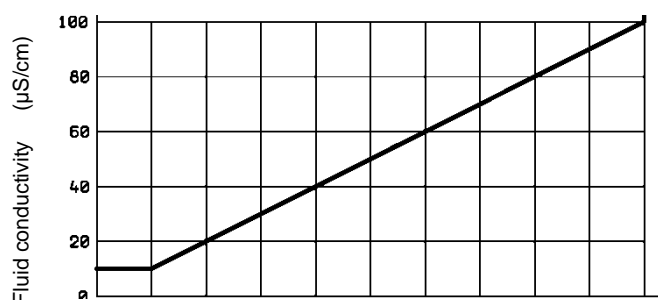
Excitation current $I = 200\text{mA}$
Maximum voltage: $U_{\text{max}} = 30\text{V}$

5.1.3 Signal cables

The maximum length of the signal cables depends on the measured fluid conductivity and electric parameters of the cables themselves.

To eliminate risk of electromagnetic interference via the connecting cables, the transmitter shall be located as close as possible to the meter sensor.

The relationship between the measured fluid conductivity and the maximum length of the cables connecting the meter transmitter and sensor is shown in the following graph:



15 30 45 60 75 90 105 120 135 150
Cable length (m)

The above graph applies to sensor sizes up to DN80. For sizes more than DN80, the maximum cable length shown in the graph shall be derated as follows:

$$L_{DNXX} = \frac{L_{DN80} \times DN80}{DNXX} \quad (\text{m})$$

where L_{DN80} is maximum cable length determined from the graph for sensor sizes up to DN80
 L_{DNXX} is maximum cable length for the given sensor size (more than DN80)
 $DNXX$ sensor size more than DN80

Distance between the sensor and transmitter not exceeding 10m:

Fixed connection of the signal cable conductors to the transmitter terminals
Cable parameters: R = 80 Ω/km (loop 2 × 80 Ω/km)

Distance between the sensor and transmitter 10 to 150m:

The signal cable end provided with a connector with the matching counter piece at the transmitter
Cable parameters: R = 26 Ω/km (loop 2 × 26 Ω/km)



The signal cables are included in the product delivery scope. In their order, the customer shall specify the cable length.

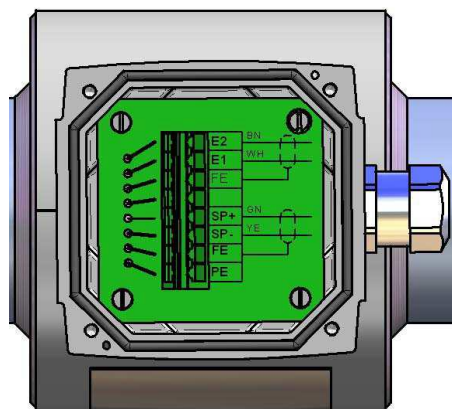


The flowmeter is calibrated with the connecting signal cable in place. The customer shall not modify or exchange the cable; such action shall be reserved to the authorised service staff or the meter manufacturer.

The connecting cable shall be fixed in position. Should it be left free, changes in the cable capacity due to its movement might adversely affect the measurement accuracy, especially at low fluid flow velocities.

Cable extension or shortening is not permitted. Replacement of a damaged cable shall be arranged with the meter manufacturer.

5.2 Sensor connection box



Sensor connection box

Signal cable connection table – the sensor protection class IP 67/IP 68

Terminal	Description	Conductor colour
E2	Electrode E2	Brown BN
E1	Electrode E1	White WH

FE	Grounding electrode	Blue BU (shielding for the conductor pair BN, WH)
SP+	Excitation winding	Green GN
SP-	Excitation winding	Yellow YE
FE	Grounding electrode	Blue BU (shielding for the conductor pair GN, YE)
PE	Protection conductor	Yellow and green GNYE (the cable shielding)



Conductors leading to terminals SP+ and SP- may be connected or disconnected only with the transmitter power source switched off.



The sensor designed with protection class IP 68 has a fixed connection of the signal cable conductors to the sensor terminals. In production, the terminal box is sealed and the terminals embedded in an impregnation compound protecting the sensor from the ambient humidity. The other end of the cable is provided with a connector facilitating connection to the meter transmitter.

5.3 Power and information cables

In operating environments free of explosion risk, the power and information cable connections do not require any special arrangement. Applicable to the meter installation work are standard procedures known from conventional measurement and control systems. However, due attention shall be paid to the applicable national regulations and standards.



The flowmeter does not include any integrated line circuit breaker. Unless the meter configuration includes a moveable power cord and plug, a separate power switch or circuit breaker shall be used (see the provisions of section 6.11.3.1 of standard EN 61010-1). The protective conductor of the power supply cable to be connected to the PE terminal must be longer than the L and N conductors. The PE conductor must be disconnected as last if the power cable is removed from the bushing. This PE terminal is located at the bottom of the terminal box of the instrument box.

5.4 Cable placement

To minimise the effect of electromagnetic interference, the cables connecting the sensor and the meter transmitter shall be laid at least 25cm away from the power cables of other electric equipment.

In selecting cable routes, attention shall be paid to the risk of thermal degradation of the cable insulation due to nearby technological heat sources. All cables shall be laid outside the thermal insulation layers on piping.

The cable glands shall be properly sealed and tightened with suitable tooling. To prevent cables from being pulled out of the glands, their position shall be mechanically fixed no further than 0.3m away from each gland.

Outside the gland, the cable shall be bent to form a “dripping loop” (the straight length of about 30mm of the cable is led horizontally from the gland and then bent down to form a loop).

5.5 Power supply specifications

The electrical circuits of the transmitter forming part of a FLONET FF50xx flowmeter are designed as floating, insulated from the ground potential.


The FF50xx electromagnetic flowmeter can be delivered with either AC or DC power supply.

AC power supply

- 95 to 250VAC, 45 to 65Hz, 3VA max.
- Internal fuse T 1.25A/250 V, 5 x 20 mm

DC power supply

- 24V ± 20% (19.2 to 28.8VDC), 3W max.
- Internal fuse T 2A/250V, 5 x 20mm

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Special attention shall be paid to the power supply arrangement in cases of an electromagnetic flowmeter installed in a piping system provided with cathodic protection. For more detailed information, see Section 5.7. (*Grounding and potential equalising*) hereof.

In locations with strong electromagnetic interference (e.g., in the vicinity of frequency converters), it is recommended to include a filter in the power supply lines. The filter shall be installed as close as possible to the meter transmitter.

Filter parameters:

Rated voltage:	250V/50Hz
Rated current:	0.5A or higher
Attenuation characteristic:	10kHz 10 to 20dB 10MHz 40dB

5.6 Input and output connections

5.6.1 Multifunction outputs OUT1, OUT2

Functions and parameters

- Passive outputs: electrically insulated from the ground and other inputs and outputs
- Open collector: $U_{max} = 30V$, $I_{max} = 30mA$
- Status in cases of power cut: open
- Output operational modes:
 - Frequency: Frequency range 0 to 10kHz, duty cycle 1:1
 - Pulse: Maximum frequency 100Hz
Selectable pulse number
Pulse length setting 1 to 999ms
 - Binary: Exceedance of set limit values of measured quantities
Permanently closed
No-error condition

The output parameters of the frequency output are influenced by the capacity of the connected cable. When transmitting a frequency output signal with a value reaching up to 10 kHz over long distances, this negative effect on the quality of the transmitted signal at the evaluation point must be considered.

Multifunction outputs – selectable functions

- Pulses/frequency for $Q+$
- Pulses/frequency for $Q-$
- Pulses/frequency for $|Q|$
- $Q > Q_{max}$
- $|Q| > Q_{max}$
- Output negation

Pulse number determination for the pulse output

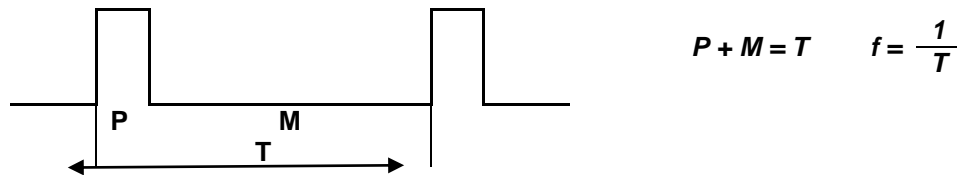
Restrictive conditions in setting the pulse output parameters:



- Maximum output frequency: $f_{max} = 100Hz$
- The middle period between pulses **M** shall be equal to or wider than the pulse width **P**. Breaching this condition will result in an error message.

It holds:

$$M \geq P$$



In selecting the pulse number, the following requirement shall be met:

$$Q_{\max} \leq 3.6 \times V \times f_{\max} \quad (\text{m}^3/\text{h}, \text{l/imp}, \text{imp/s})$$

where: Q ... fluid flow rate (m³/hod)
 V ... volume per one pulse (l)
 P ... pulse length (s)
 f ... pulse output frequency (Hz)
 T ... cycle length (s)

The flowmeter software permits setting the V values in steps shown in the table below:

V (l)							
0.001	0.01	0.1	1	10	100	1000	10000



The pulse length in cases of electronic determination of the fluid volume passed through the sensor is recommended to be set at $P_{\min} = 5\text{ms}$, which meets the condition for f_{\max} at the pulse output equal to 100Hz. In cases of electro-mechanical counters, P_{\min} is usually set at 50ms, corresponding to the maximum frequency at the pulse output of 10Hz.

Example:

Assume that a user specified for their flowmeter of DN100 the maximum operating flow rate:

$$Q_{\max} = 150 \text{ m}^3/\text{h} \quad (Q_{\max} = 41.66 \text{ l/s} \dots v = 5.3 \text{ m/s})$$

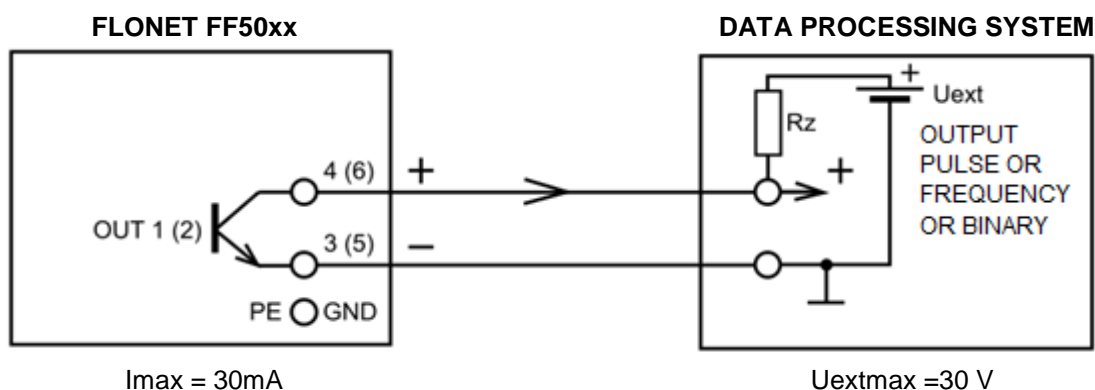
For the fluid volume corresponding to one pulse (of length 5ms, f_{\max} 100Hz) it holds:

$$V \geq \frac{Q_{\max}}{3.6 \times f_{\max}} \quad (\text{l/pulse}, \text{m}^3/\text{h}, \text{Hz})$$

$$V \geq 0.416 \quad (\text{l/pulse})$$

By selecting the next higher pulse number from the above table (1 litre per pulse) the user will make sure that the pulse output frequency will not exceed (for the specified Q_{\max} of 150 m³/hour) the value of 100Hz and, at the same time, verify the selection of the pulse length (5ms). The user may choose the V values other than those from the basic selection in the above table, e.g., 0,5 litres/pulse.

Passive output



Assignment of terminals		
Output	Terminal	
OUT1	3	-
	4	+
OUT2	5	-
	6	+

Shielded cables must be used to connect the output signals.
The shield is only connected on one side, namely the PE terminal located on the terminal board.

5.6.2 Current output 4 to 20mA

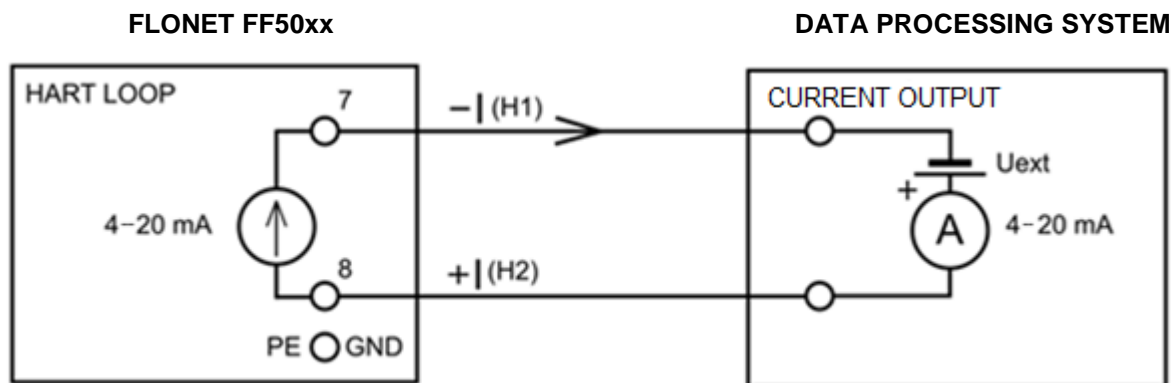
Functions and parameters

- Passive current output electrically insulated from the ground and other inputs and outputs
- $U_{\max} = 30\text{V}$
- $R_{\text{zmin}} = 250\Omega$
- Programmable function:
 - Volume flow rate
- Fixed current setting in the range of 4 to 20mA



In cases of power cut, the current output will preserve the last value prior to the power failure.

Passive output



$I_{max} = 20\text{mA}$
 $I_{min} = 4\text{mA}$

$U_{extmax} = 30\text{V}$

Current loop resistance:

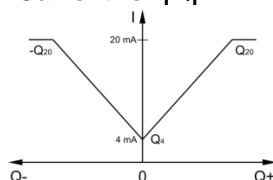
$$R_z = \frac{U_{ext} - 8}{0.02} \quad (\Omega, \text{V}, \text{A})$$

$R_{zmin} = 250\Omega$
 $R_{zmax} = 800\Omega$

Selectable functions of the current output

- Output $-Q \dots +Q$
- Output $0 \dots |Q|$
- Fixed current $4 \dots 20\text{mA}$

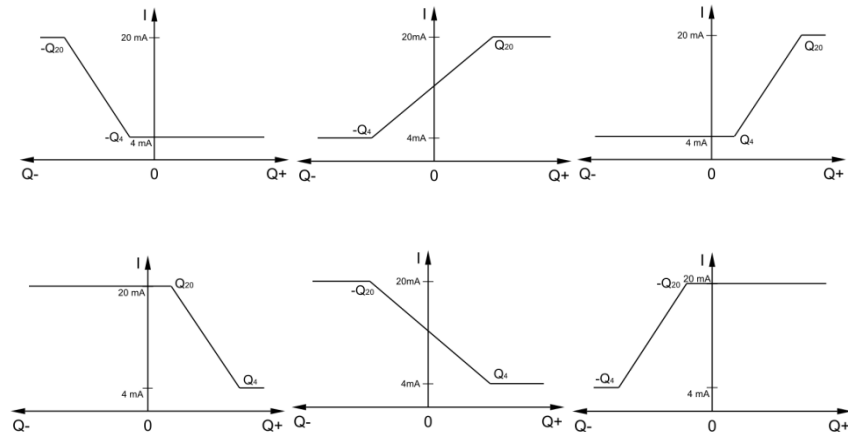
Current for $|Q|$



Current for $-Q \dots +Q$



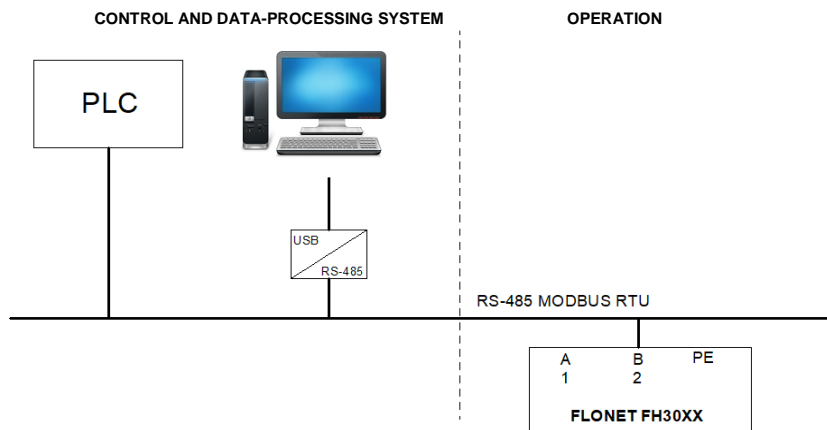
The flow rates corresponding to 4 or 20mA can be either positive or negative, and their mutual relationships can be either "greater than" or "lower than". Therefore, the user may select any one of six possible functions of I_{out} vs. flow rate Q :



Shielded cables must be used to connect the output signals.
The shielding is only connected on one side, namely on the PE terminal, which is located on the terminal board.

5.6.3 Communication interfaces

5.6.3.1 Communication interface RS-485 MODBUS RTU




Communication interface: RS-485 MODBUS RTU according to standard EN 61158, electrically insulated

PC requirements: Windows 7 or higher OS upgrade (Linux, iOS) with JAVA 8u40 or higher, the FLOSET 4.0 communication software installed
* .flo configuration file

Connecting cable: USB / RS-485 converter with connection cables
Type A according to EN 61158-2 (a twisted pair of conductors, 90% shielding)

Interconnection:

FH 30xx	Bus conductor
1	A
2	B
PE	Shielding

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Detailed instructions regarding application of the RS-485 MODBUS RTU communication interface can be found the manual:

Es 90684K

**Communication interface RS-485 MODBUS RTU
Electromagnetic flowmeters FLONET FF50xx and FLONEX FXx11x**

5.7 Grounding and potential equalising

To guarantee correct operation of the FF50xx electromagnetic flowmeter, it is necessary to ensure that the potential of the measured fluid before and after the flowmeter, the reference meter potential and the PE protection conductor be equalised with the ground potential at the meter installation site. For the equipment grounding and potential equalising, use Cu conductor of cross-section 4mm^2 .



The external PE terminal on the transmitter box shall be internally connected to the reference meter potential.

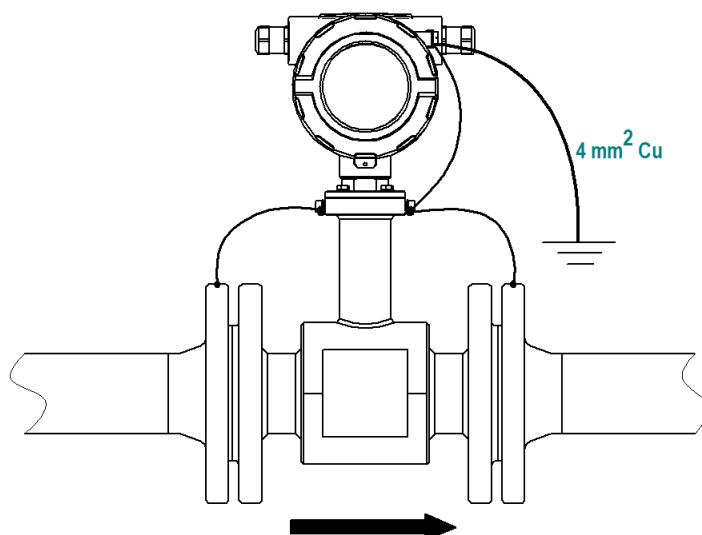
Electrically conductive piping

Flanges on the conductive piping shall be connected to the PE terminals on the sensor and transmitter housings and to the ground potential.



The bolted connections between the piping and sensor flanges cannot be taken for a reliable and satisfactory conductive connection. It is recommended to provide threaded holes on the flanges for a reliable bolted connection of the grounding/equalising conductor.

It is not recommended to place the grounding or equalising conductors under the heads of the main flange bolts; such connection may be subject to corrosion and adversely affect the measurement accuracy.

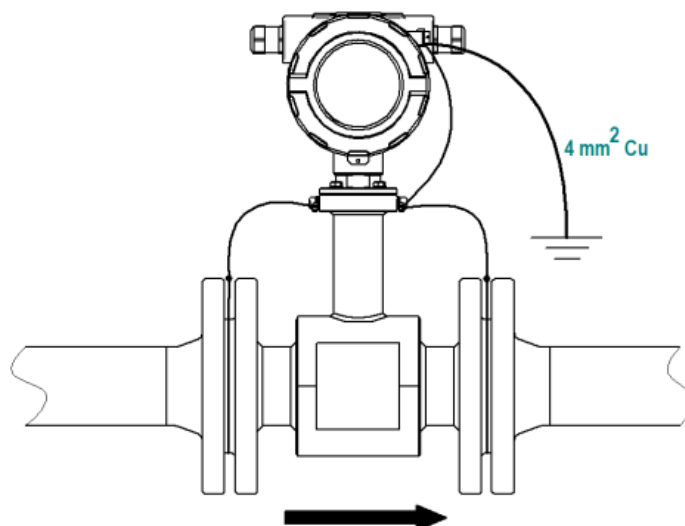


Piping made of insulating materials or piping with insulating lining

In such cases, the requirement for the fluid potential equalisation shall be met by two grounding rings installed before and after the flowmeter. Each grounding ring shall be inserted between two sealing rings.



The grounding rings are not included among the standard meter accessories, but they can be ordered with the product. Regarding chemical stability and resistance with respect to the measured fluid, the grounding rings shall meet the same criteria as the measuring electrodes.



In the cases of remote meter version, the PE terminal on the meter sensor and the transmitter box shall be interconnected by a Cu conductor of cross-section 4mm².



This connection shall not serve the purpose of potential equalisation with any other equipment or devices.

Piping with cathodic protection

If an electromagnetic flowmeter is to be installed into piping with cathodic protection, it is necessary to ensure that all flowmeter parts be electrically insulated from the piping. At the same time, the meter power source shall be insulated from the power grid. To ensure the overall piping conductivity, the installed meter shall be bypassed by Cu conductor of cross-section 6 mm² (connected to the piping flanges before and after the flowmeter).


The fluid potential shall be equalised with the reference meter potential (the PE terminal potential) by means of grounding rings. The grounding rings shall also be insulated from the piping.

6 METER COMMISSIONING

6.1 Check on electrical connections

Prior to meter energising, check and make sure that:

- The power network voltage complies with the specifications on the meter rating plate;
- The power network is properly protected;
- All terminals and electrical connections are properly tightened;
- The installation cables are:
 - intact,
 - connected at their ends to the correct terminals in the flowmeter and the co-operating equipment,
 - secured against incidental excessive stress (pulling out of the respective glands), and

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- The meter grounding and potential equalising has been carried out as specified in the product manual.

6.2 Check on meter housing tightness

To attain the parameters of the equipment protection class referred to in Chapter 8 (METER SPECIFICATIONS), the flowmeter installation shall be carried out in observance of the following directions:

- Use only cables of external diameters corresponding to the sizes of the cable glands installed;
- Form dripping loops on the cables;
- Avoid meter installation position where the cable glands lead upwards;
- Tighten properly all covers and lids on the meter housings.

Following every service action:

- Check the condition (integrity and intactness) of all sealing elements and surfaces;
- Using suitable tooling, tighten all cable glands and meter housing covers.

6.3 Check on the installed meter

The flowmeters are supplied calibrated with verified functions and parameters set according to the customer specifications.

Prior to the meter commissioning, inspect the meter installation site in reference to the requirements of Section 4.4 above, and assess the possible adverse effects from the nearby technological equipment such as:

- Undesirable meter warming by external heat sources;
- Excessive temperature stress on cable insulation;
- Vibrations and shocks in the piping, and others.

6.4 Check on the meter operation conditions

Prior to filling the piping and the installed meter sensor with the fluid to be measured, make sure that the fluid parameters (temperature and pressure) are within the limits specified on the meter plate, and that any risk to life or health of personnel is excluded.

7 OPERATION

7.1 Meter energising

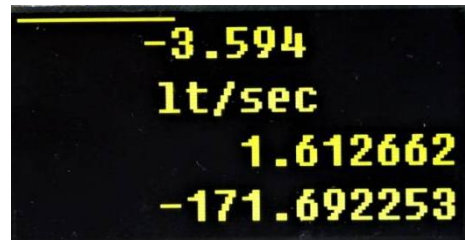
7.1.1 Display status

Upon turning the power on, all meter modules will undergo the initiation procedure. Following the display test, the basic screen format with the following data will be shown:

- Current volume flow rate
(If an error is detected, an error code is displayed next to the current flow)
- Aggregate fluid volume passed through the meter sensor in the positive direction;
- Aggregate fluid volume passed through the meter sensor in the negative direction.

The bar chart at the top of the display shows the current flow rate related to the specified maximum flow rate.

Basic screen format



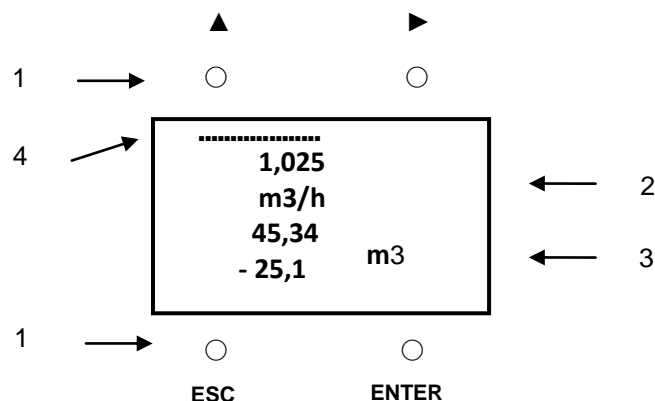
7.2 Front panel and control buttons

7.2.1 Display

The meter is provided with a colour OLED display of 128 x 64 pixels where all the measured quantities, flowmeter parameters and important user information can be visualised. The display control is facilitated by means of four optical buttons (optical reflex sensors).

7.2.2 Control button functions

Button locations with respect to the display



Comments:

- 1 Optical button (optical reflex sensors)
- 2 Instantaneous flow rates
- 3 Item selected from MENU – DISPLAY, or error messages
- 4 Instantaneous flow rates in the form of a bar chart

Control button functions

Buttons ▲, ►, **ENTER** are actuated by a short touch with a finger on the button.

Button **ESC** is actuated by either a short (0.3s) or long (> 2s) touch with a finger.

- ▲ Moving in a menu to the next item above
Cyclic functions: Setting a numeric value 0 – 9 (increasing)
 Change in sign +/-

- Moving in a menu to the next item below
Moving the position mark (cursor) in setting numeric values


ENTER Confirmation of selected action

ESC Departure from current operation to the previous menu item without any parameter change

ESC 2 s Finger touch > 2s: return to the basic screen format.



Actuated can be just one button at a time; the other buttons shall remain uncovered.
To press the button repeatedly, you must first zoom out the finger and then reinsert.

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7.3 Flowmeter control

7.3.1 Manual control

Manual meter control and selection of menu items using optical buttons do not require any specific skills; these functions are intuitive and user-friendly.

7.3.1.1 Basic screen

1,025	
m3/h	
45,34	m3
- 25,1	

The basic screen always shows information on instantaneous flow rate (lines 1 and 2).

The remaining two lines are reserved for supplementary data the user may select from the menu **Display**.

The meter is supplied with these two lines pre-set to show the aggregate flow volumes passed through the sensor in the positive and negative directions.

If the flowmeter diagnoses a condition that may adversely affect the meter's operation, an error code is displayed next to the instantaneous flow value in line 1. If there is a serious error that can significantly affect the accuracy of the measurement, zero is displayed in the instantaneous flow field (e.g., ADC failure, interrupted or short-circuit excitation, unfilled piping, strong electromagnetic interference, etc.).

Error and diagnostic messages

Error code	Error description
E00	No error
E01	ADC range overflow
E02	Step change in flow
E03	Error reading / writing to memory
E04	Other electronics block error
E05	Warning - zero flow cannot be calibrated
E06	Low current excitation
E07	Short circuit in coil circuit
E08	Information - zeroing in progress, not measuring
E09	High resistance of measured medium
E10	OUT1 output error
E11	OUT2 output error
E12	Information - IOUT out of range
E13	The time is not set correctly
E14	Overload flow Q4 exceeded



If you move in the control or parameter-setting menus, the display remains in the active mode (backlighted).
The backlighting time can be set in the menu item **Backlighting time**. Deactivated display will automatically be activated upon touching any control button.

User password

To enter the Main menu from the Basic screen, actuate the **ESC 2 s** button and enter your user password.

The initial user password pre-set in production is 0000.



Billing device has no password, the keyboard can only be used to show set specifications.

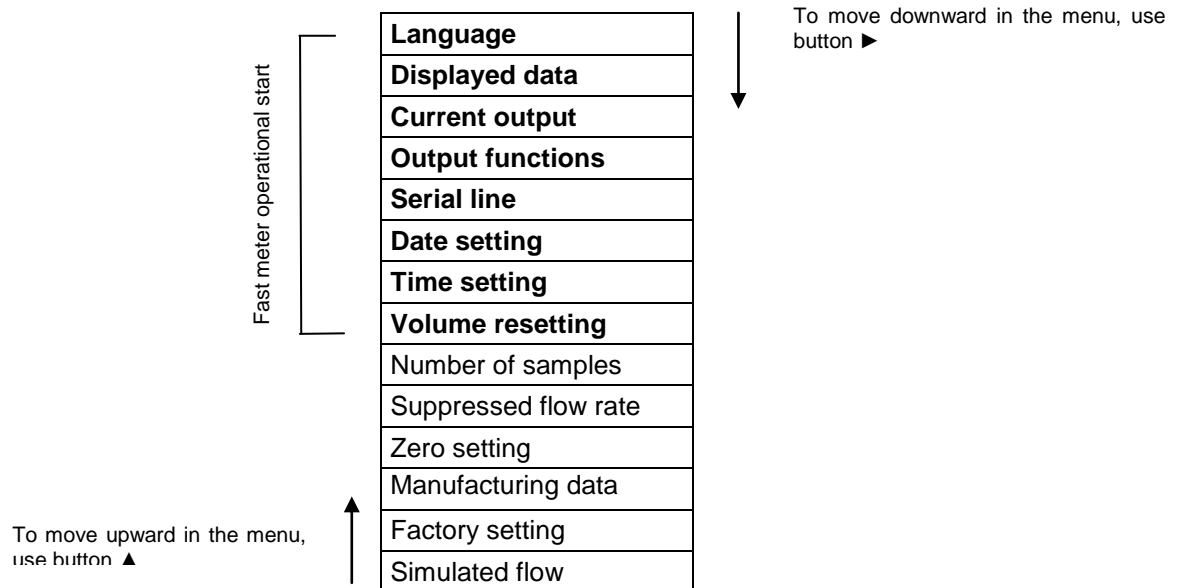


Changing the access password is possible only with the FLOSET 4.0 program via the RS-485 MODBUS RTU communication link.

To return to the Basic screen format actuate the **ESC 2 s** button.

Should no control button (**▲**, **►**, **ESC**, **ENTER**) be actuated during the recent three minutes, or should the specified backlighting time elapse before that, the display will return automatically to the Basic screen format.

7.3.1.2 Main menu



The selected item will be shown in a highlighted window where it can be opened by actuating the ENTER control button. When scrolling up or down in the menu, always four neighbouring items will be shown.



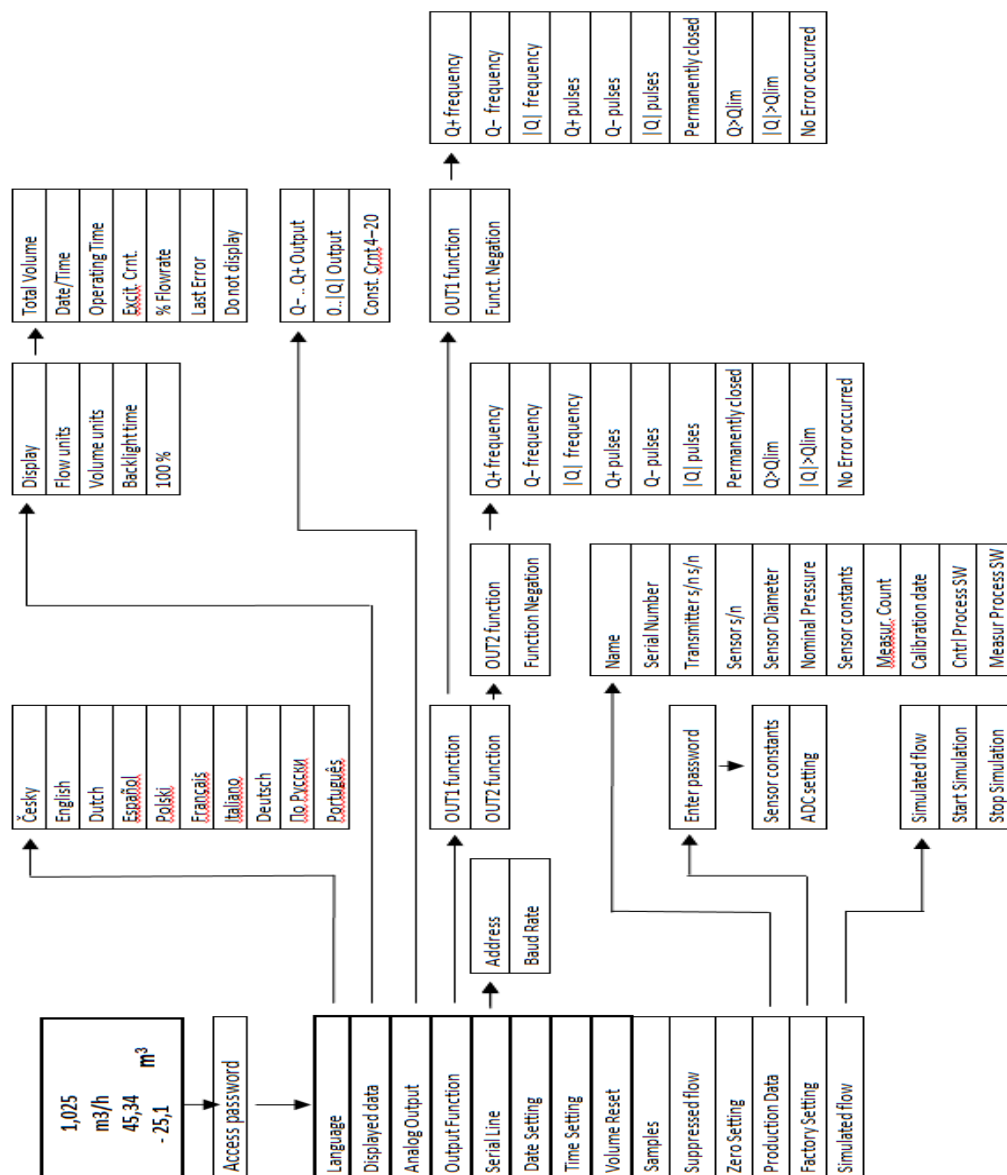
The manufacturer supplies the flowmeter verified as to its functions, calibrated and with parameters set according to the customer's order. If installed in the user's technology in observance of the requirements specified in the product manual, the flowmeter will be ready for immediate operational start.

In cases where the user requires an accelerated procedure for the meter commissioning and setting of the meter parameters with respect to the given operational conditions and the co-operating higher-level control system, it suffices to set the parameters shown in bold print in the above list of the main menu items.

Detailed description of the meter control procedures is given in the manual:

Es 90686K Electromagnetic flowmeters of the type series FLONEX FXx11x and FLONET FH


FLONET FF50xx control menu structure



7.3.2 Remote meter control using the FLOSET 4.0 program

Flowmeters of the type series FLONET FF50xx are provided with the digital interface RS-485 MODBUS RTU

Through an interface RS-485 and communication software FLOSET 4.0 the meter can be connected as subordinated equipment to a computer (a personal, notebook or tablet computer) with Windows 7 or higher OS upgrade (Linux, iOS) with JAVA 8u40 or higher.

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FLOSET 4.0 is not included in the scope of delivery.
On request we can deliver:

- **FLOSET 4.0 software**
- **FLOSET 4.0 software User Guide**
- **Flowmeter configuration data * .flo**
- **USB / RS-485 converter with connection cables**

Program FLOSET 4.0 makes it possible to:

- read the measured quantities (volume flow rate and flow volumes passed through the meter sensor in both directions);
- set the parameters of the measured quantities to be displayed (units and number of decimal positions);
- set the multifunction output parameters (in the binary, pulse, or frequency operational modes), and the current output parameters;
- set the flowmeter language, date and time;
- set the digital interface parameters;
- set the data archiving parameters and read the archived data;
- monitor extraordinary operational events and read the archived data on such occurrences.


7.3.2.1 Communication interface MODBUS RTU

The physical form of this interface consists of a serial line RS-485 of the following parameters:

- Speed 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600 Bd;
- 8 data bits, 1 stop bit;
- No parity.

Detailed description of communication via interface RS485 MODBUS RTU is given in the manual:


Es 90664K Communication interface RS-485 MODBUS RTU
Electromagnetic flowmeters FLONET FF50xx and FLONEX FXx11x

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DC power supply	24V \pm 20% (19.2 to 28.8 VDC), 3W max. Internal fuse: T 2A/250V, 5 x 20mm
Magnetic field	Pulse unidirectional field Selectable frequencies 1.56Hz; 3.125Hz; 6.25Hz; 12.5Hz
Back-up battery	CR2032
Operating environment	Free of explosion risk
Protection class	Transmitter: IP 67, optional IP 68 Sensor: standard IP 67, optional IP 68 (remote meter version)
Pressure loss	Negligible provided the sensor and connected piping are of the same inner diameter
Starting time	30min

Functions and properties	
Meter display	Graphic backlighted OLED, 128 x 64 pixels
Control elements	Optical reflex sensors actuated by touch across the front viewing window in the transmitter
Language	Czech, English, Dutch, Spanish, Polish, French, Italiano, German, Russian or Portuguese
Physical units of displayed quantities	Metric US Imperial
Functions	Bidirectional measurements of: <ul style="list-style-type: none"> • Volume flow rate • Aggregate fluid volume passed through the meter sensor Communication with external equipment Archiving of measured data and extraordinary operational events Sensor flooding check
Zero insensitivity	Selectable
Condition following power cut	Summary counters: No change Meter configuration and setting: No change Diagnostic and error messages: Stored Multifunction outputs: Open Current output: The last value prior to the power cut retained

Process parameters	
Fluid temperature	Compact meter version: standard -20°C to $+70^{\circ}\text{C}$ optional -35°C to $+70^{\circ}\text{C}$ Remote meter version: standard -20°C to $+110^{\circ}\text{C}$ optional -35°C to $+150^{\circ}\text{C}$
Pressure class	PN 10 (1.0MPa)
Solid particle content	$\leq 2\%$
Gas content	$\leq 5\%$


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Environment	
Ambient temperature	Standard: -20°C to +70°C, no condensation
Storage temperature	-10°C to +70°C, no condensation (for MG, PTFE, E-CTFE)

Measurement accuracy	
Reference conditions	See Chapter 9 (CALIBRATION)
Measurement accuracy at reference conditions	Standard: Class 2 acc. to EN ISO 4064-1 $Q_3/Q_1 = 400$ On request, for example: $\pm 0.5\%$ of the measured value for flow rate 5 to 100% Q_4 $\pm 0.2\%$ of the measured value for flow rate 10 to 100% Q_4

Outputs	
1 × Current output 4 to 20mA	Passive: electrically insulated from the ground and other outputs; $U_{extmax} = 30V$, $U_{extmin} = 8V$, $R_{zmax} = 800\Omega$, $R_{zmin} = 250\Omega$
2 × Multifunctional output	Passive: electrically insulated from the ground and other outputs; $U_{extmax} = 30V$, $I_{max} = 50mA$ Open collector Operational modes: Frequency: frequency range 0 to 10kHz, duty cycle 1:1 Pulse: Maximum frequency 100Hz Pulse length 1 to 999ms Selectable pulse number Output negation Binary: Exceeding limit values of measured quantities Error messages Output negation
Communication interfaces	<ul style="list-style-type: none"> RS-485 MODBUS RTU, electrically insulated from the ground and other outputs

Cables	
Data and power cables	Common cables for application in measurement and regulation systems Data cables: twisted pair of conductors, 90% shielding
Signal cable for remote meter version	Supplied with the meter: <ul style="list-style-type: none"> Sensor version of IP 67: maximum cable length 150 m Sensor version of IP 68: maximum cable length 150 m
Communication cable	Twisted pair of conductors with common shielding; bus-bar cable, type A according to standard EN 61158-2
Cable glands	Compact meter version: <ul style="list-style-type: none"> Transmitter: 2 pcs of glands M20x1.5 Remote meter version: <ul style="list-style-type: none"> Transmitter: 2 pcs of glands M20x1.5 Sensor connection box: 1 pc of gland M20x1

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9 CALIBRATION

9.1 General

The flowmeter is supplied verified as to its functions, calibrated and with parameters set according to the customer's requirements.

The measurement accuracy of the flowmeter in its standard form and configuration is guaranteed to meet the provisions of the international standard EN ISO 4064-1: **Water meters for cold drinking water and hot water**.

Unless agreed otherwise with the customer, the flowmeters are calibrated using the frequency output 0 – 10kHz.

Upon special requirement and agreement with the flowmeter manufacturer, the meter calibration may be carried out using alternative, i.e., pulse or current outputs.

The guaranteed measurement accuracy parameters shall always be related to the type of output which was used for the meter calibration. The remaining two types of output are recommended to be used for measurements with accuracy lower by 1 to 2% compared to that associated with the calibrated output.

For inspection or comparison measurements at the customer's premises, or metrological verification of the meter parameters, the same type of electric output as that used for the initial calibration at the manufacturing plant shall be selected. Such measurements shall be performed under specified reference conditions.



At such measurements it is important to connect the hydraulic meter section (the sensor) into the hydraulic circuit on the test stand using connection elements (flanges, threaded fittings, fittings used in food-processing lines or others) of the same type, size and design as found on the meter sensor, to prevent occurrence of hydraulic disturbances that might significantly affect the meter measurement accuracy.

9.2 Reference conditions

Measured fluid: water, temperature 22°C ± 4K

Ambient temperature: 22°C ± 2K

Electrical conductivity of the measured fluid: > 300µS

Straight piping sections: ≥ 10DN before and 5DN after the flowmeter

Minimum medium pressure at the meter output: 1 bar

Time for the meter temperature stabilisation: > 30min

The sensor to be centred, grounded and supplied with power as required by the product manual

The meter shall be set for zero flow rate

9.3 Measurement accuracy

9.3.1 Flowmeter FLONET FF50xx – standard measurement accuracy

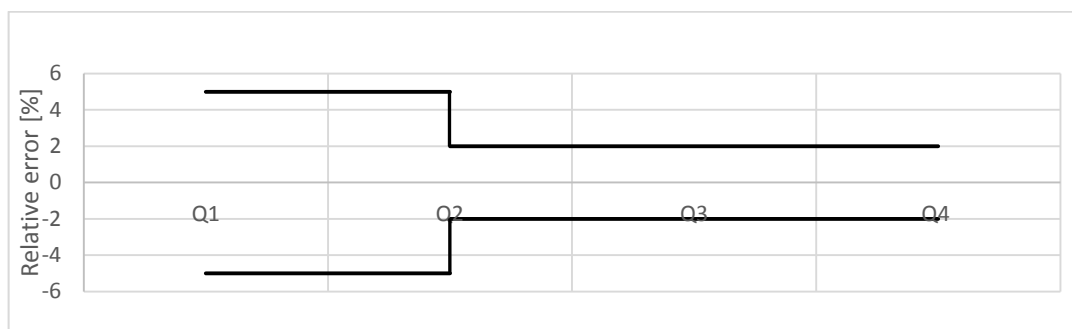
The meter accuracy shall meet the requirements of standard **EN ISO 4064-1** (Water meters for cold drinking water and hot water).

Definitions according to EN ISO 4064-1:

$$\frac{Q_4}{Q_3} = 1.25 \qquad \frac{Q_2}{Q_1} = 1.6$$

Q_4 flow rate for fluid flow velocity at the meter sensor of 10 m/s.

Q_1 flow rate for fluid flow velocity at the meter sensor of 0.025 m/s



Flow rates Q_1 , Q_2 , Q_3 and Q_4 for various meter sizes

Rated inner diameter	Overloading flow rate Q_4	Continuous flow rate Q_3	Transient flow rate Q_2	Minimum flow rate Q_1	Measurement range Q_3/Q_1
DN	(m ³ /h)	(m ³ /h)	(m ³ /h)	(m ³ /h)	
15	7,9	6,30	0,0252	0,0157	400
20	12	10	0,0384	0,0240	
25	20	16	0,0640	0,0400	
32	31,25	25	0,1000	0,0625	
40	50	40	0,1600	0,1000	
50	79	63	0,2528	0,1575	
65	125	100	0,4000	0,2500	
80	200	160	0,6400	0,4000	
100	313	250	1,00	0,63	



Billing device according to EN4064-1 can only be ordered for DN15 to DN400 with max flow rate $Q_4 = 2\,000\text{ m}^3/\text{h}$

9.3.2 Flowmeter FLONET FF50xx – increased measurement accuracy

For zero flowrate setting and reference conditions:

Relative error


$\pm 0.5\%$

of the measured value

Flow rate range

5–100% Q_4

Upon agreement with the manufacturer, flowmeters may be supplied with other (optional) accuracy parameters.

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10 METER DESIGN DETAILS

10.1 *Transmitter*

Transmitter C14.00/C15.00 is fitted in a box made of aluminium alloy with removable front and rear covers.

Behind the window in the front cover there is a backlighted OLED display of 128x64 pixels. The flowmeter control is facilitated by optical buttons (optical reflex sensors) actuated by touching the respective spots on the front window.

The transmitter terminals can be accessed upon removal of the solid rear cover. When closed, the lid position is secured by means of an Allen bolt.

External cables can be brought into the terminal compartment via two glands accommodated in threaded holes M20 x 1.5. Should the meter configuration or higher number of output signals require so, inserted in the cable gland can be a sealing insert with more holes to hold the required number of cables.



This sealing insert is not included among the standard meter accessories.

Located at the top of the transmitter box is a grounding bolt and a flat area intended for the flowmeter rating plate. The transmitter plate is attached to the rear cover on the transmitter housing.

The surface finish of the housing consists of powder paint coating.

The connections of the transmitter terminals are described in Chapter 5 (ELECTRICAL CONNECTIONS).



The transmitter for the compact meter version (including a sensor of protection class IP67) is supplied with the signal cable attached.

The transmitter for the remote meter version (used in combination with a sensor of protection class IP 68) is provided with a connector for the signal cable connection. The other end of the signal cable is attached to the sensor where the terminals inside the hermetic connection box are embedded in an insulating compound.

10.2 *Sensor*

The induction sensor consists of a measuring tube made of non-magnetic steel with insulation lining, two measuring electrodes and, in some cases, one grounding electrode. Located outside the measuring tube is a winding the function of which is to generate electromagnetic field perpendicular to the measuring electrode axis. The excitation winding and measuring electrodes are protected by the sensor housing made of carbon or stainless steel. In its standard design version, the sensor is provided with flanges according to EN 1092-1 or ANSI B16.5. Upon agreement with the manufacturer, other types of flanges can be provided.

The sensor can also be supplied in all-stainless-steel design.


Sensor for compact meter version

In compact meter version, the transmitter is attached to the meter sensor by means of a steel column with a stainless-steel flange. This flange is provided with two threaded holes to facilitate connections for potential equalising conductors.

Sensor for remote meter version

Sensor manufactured in the standard protection class IP 67 includes a terminal box. In the case of the sensor protection class IP 68, the signal cable conductors are permanently connected to the sensor terminals and the terminals inside the connection box are embedded in an insulation compound. The other end of the signal cable is provided with a connector facilitating connection to the meter transmitter.

The flowmeter component parts made of carbon steel are coated with polyurethane paint, the connection box with powder paint. The surface finish of all-stainless-steel sensor housing consists of shot blasting.

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Attached to the sensor housings are sensor rating plate and an arrow indicating the positive fluid flow direction.

The connections to the sensor terminal box are described in Chapter 5 (ELECTRICAL CONNECTIONS).

10.3 Cable gland sizes

Compact meter version

- Transmitter terminal box is provided with 2 glands with threaded plugs M20x1.5

Remote meter version

- Transmitter: 2 pcs of glands M20x1.5
- Sensor terminal box: 1 pc of gland M20x1.5

10.4 Company seals

Electromagnetic flowmeters of the type series FLONET FF50xx are supplied calibrated, verified as to their functions and with parameters set according to the customer's order specifications. Upon completion of all fabrication and testing procedures, the meters are provided with the manufacturer's (company) seals.

Company seal

- Upon closing the meter transmitter housing, the front lid including a viewing window is secured against opening or removal by a self-adhesive company seal.
- In the cases of compact meter version, a self-adhesive company seal is applied onto the flanges connecting the meter transmitter and sensor.



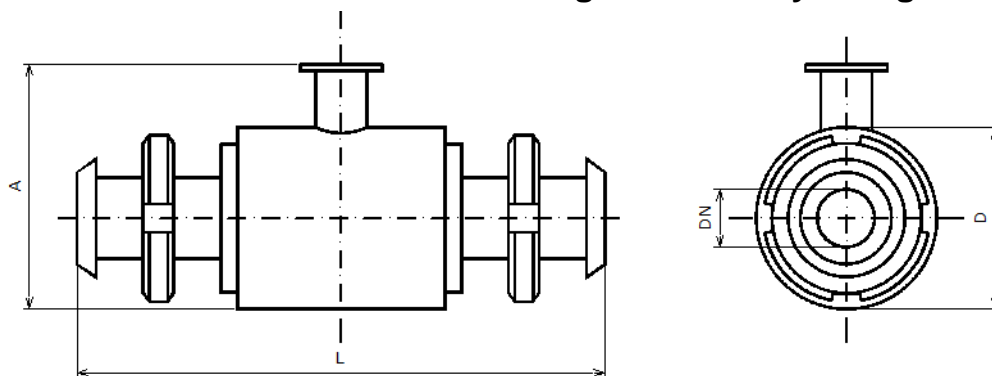
If a company seal is broken, the user will forfeit their right to warranty services, i.e., free-of-charge meter repair during the agreed product warranty period.

Assembly seal

Following electrical connection of the meter and closing the terminal compartment on the meter transmitter, the organisation responsible for the meter installation will secure the lid position by a self-adhesive seal.

10.5 Dimensions and weight

10.5.1 Dimensions of Sensor with food grade sanitary fittings DIN 11851

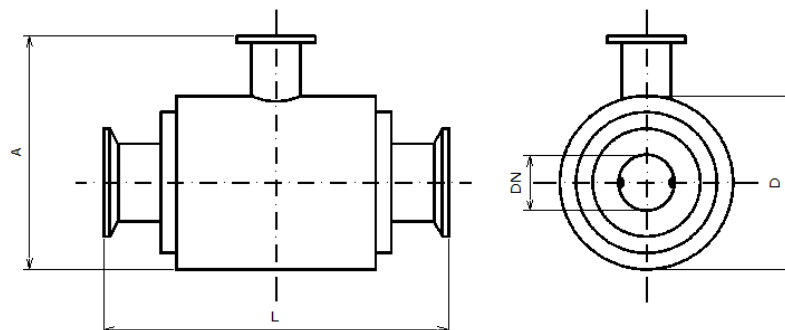


Proportions of sensor according to DN

	DN	D	A*	L	Weight [kg]
PN10	10	74	144	170 ₋₂	
	15	74	144	170 ₋₂	
	20	74	144	170 ₋₂	
	25	74	144	225 ₋₂	
	32	84	154	225 ₋₂	
	40	94	164	225 ₋₂	
	50	104	174	225 ₋₂	
	65	129	199	280 ₋₂	
	80	140	210	280 ₋₂	
	100	156	226	280 ₋₂	

** The height is measured without the terminal box.
The weight might be slightly different.*

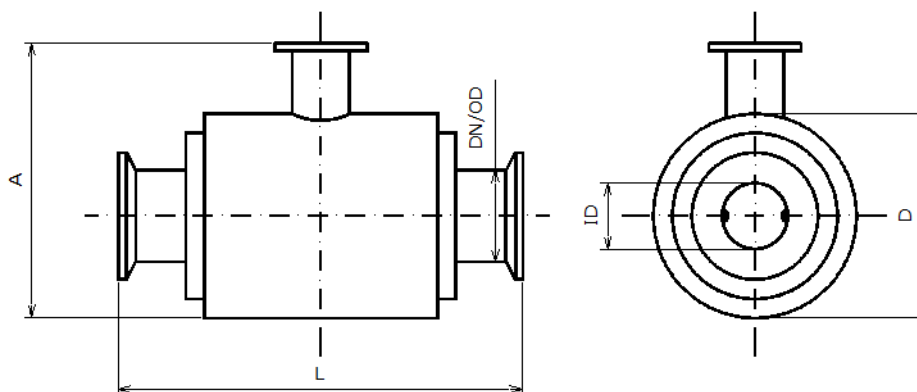
10.5.2 Dimensions of Sensors with CLAMP fittings ITE Intertechnik and CLAMP fittings DIN 32676



	DN	D	A*	L	Hmotnost [kg]
PN10	10	74	144	145-2	
	15	74	144	145-2	
	20	74	144	145-2	
	25	74	144	145-2	
	32	84	154	145-2	
	40	94	164	145-2	
	50	104	174	145-2	
	65	129	199	200-2	
	80	140	210	200-2	
	100	156	226	200-2	

* The height is measured without the terminal box.
The weight might be slightly different.

10.5.3 Dimensions of Sensor with Tri Clamp® fittings (Tri Clover® system)



Dimensions of sensor according to DN

Tri Clover fittings
 OD outside diameter of the connection
 ID inside diameter

	DN/OD Inches (mm)	ID	D	A*	L	Weight [kg]
PN10	½" (12.70)	9.40	74	144	137-2	1.6
	¾" (19.05)	15.75	74	144	137-2	1.6
	1" (25.40)	22.1	74	144	137-2	1.7
	1 ½" (38.10)	34.8	94	164	137-2	4.8
	2" (50.80)	47.5	104	174	137-2	
	2 ½" (63.50)	60.2	129	199	192-2	

* The height is measured without the terminal box.
 The weight might be slightly different.

Table of min and max flow rate with various dimensions and Tri Clover

Qmin stands for velocity of flow 0.025 m/s

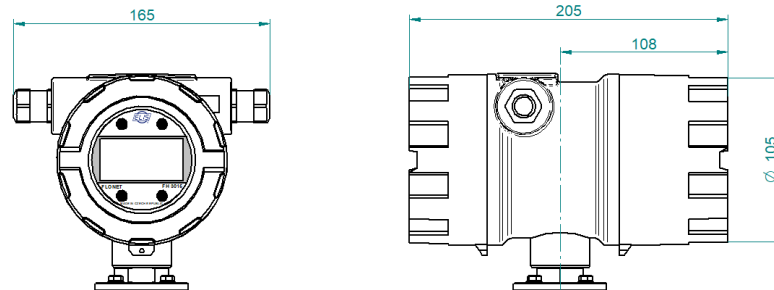
Qmax stands for velocity of flow 10.0 m/s

DN/OD Inch (mm)	ID mm	l / s		m3 / hour	
		Qmin	Qmax	Qmin	Qmax
½ (12.70)	9.40	0.0014	0.6940	0.005	2.4984
¾ (19.05)	15.75	0.0039	1.9483	0.0140	7.0139
1 (25.40)	22.1	0.0077	3.8360	0.0276	13.8096
1 ½ (38.10)	34.8	0.0190	9.5115	0.0685	34.2414
2 (50.80)	47.5	0.0354	17.7205	0,1276	63.7938
2 ½ (63.50)	60.2	0.0569	28.4631	0,2049	102.4672

10.5.4 Transmitter

10.5.4.1 Transmitter for compact meter version

COMFORT

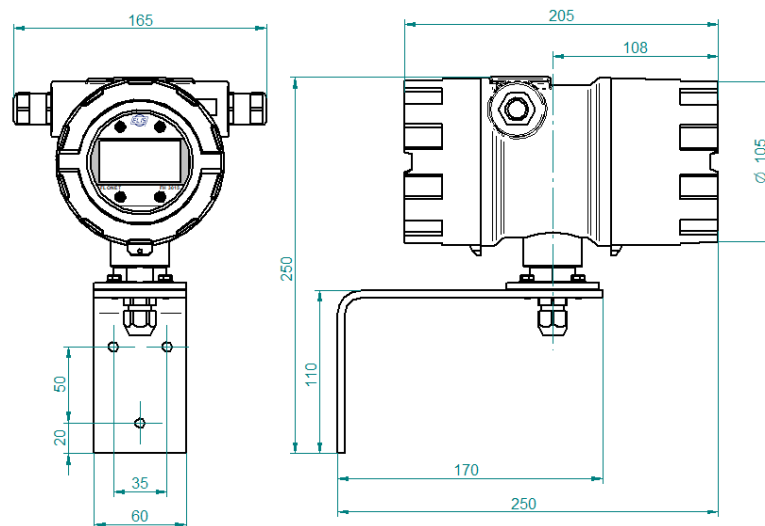


Transmitter weight: approx. 3kg

10.5.4.2 Transmitter for remote meter version – sensor protection class IP 67

The signal cable is permanently attached to the transmitter.

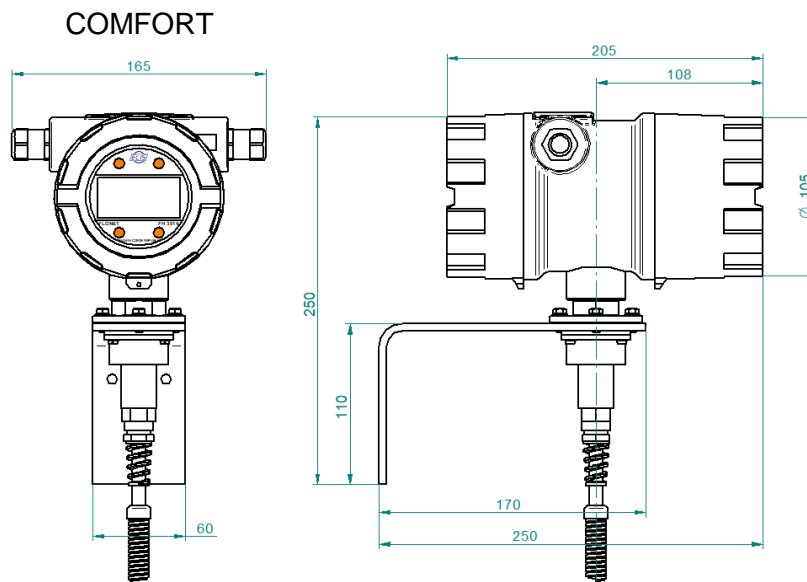
COMFORT



Transmitter including holder: approx. weight 4kg.

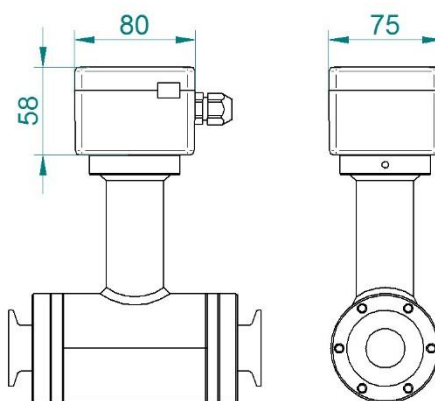
10.5.4.3 Transmitter for remote meter version – sensor protection class IP 68

Transmitter is provided with a connector facilitating the signal cable connection.



Transmitter including holder: approx. weight 4kg.

10.5.5 Sensor connection box



Connection box weight: 0.4kg

11 FLOWMETER FAULTS

11.1 *General rules*

Prior to any flowmeter handling, it is necessary for the staff (of the user or servicing organisation) concerned to study carefully the product documentation.

The staff authorised to correct/repair flowmeter defects shall:

- Be duly qualified to perform repair of electronic equipment and measuring devices, and be certified for work on electrical equipment with rated voltage up to 1,000V according to Czech Regulation 50/1978 Coll. or a corresponding national standard in other countries;
- Be professionally trained for repair of flowmeters of the type series FLONET FH under the authority of the meter manufacturer;
- Observe the relevant national regulations and standards applicable to work on electrical equipment with special regard to labour safety and health protection.



The meter manufacturer shall not be liable for any damage due to unprofessional conduct on the side of the user or their service organisation.

Some service actions require that the flowmeter or a part thereof be energised. Such actions shall be performed with due care to prevent the risk of electric shock.

11.2 *Spare PC boards and components*

To access PC boards installed in the meter transmitter housing, open the:

Front cover:

- Processor board
 - Output board
 - Measuring board
 - Connector board
 - Sub-panel board
 - Display board
- } electronic unit

Rear cover:

- Power source board
- Terminal board

The processor, output and measuring boards are interconnected via the connector board to form the meter electronic unit.

11.3 *Software and simulation devices*

To check the functions and identify defects or faults in the FLONET flowmeter, the user will need:

- Design, installation and service Manuals:
 - Electromagnetic flowmeter FLONET FF50xx
 - Control of FLONET FF50xx and FLONEX FXx11x electromagnetic flow meters
 - FLOSET 4.0 User Guide
- FLOSET 4.0 communication software
- Configuration file * .flo
- Computer with Windows 7 or a higher OS upgrade (Linux, iOS) including JAVA 8u40 and higher
- USB/ RS-485 converter with connection cables
- Sensor SF1.0 simulator and connecting cable to FLONET FH and FLONEX FX;
- Fixture FLONET KV1.0 including a connecting flat cable

11.4 Fault identification

Make sure to de-energise the meter prior to starting any actions related to fault identification and repair, such as opening the transmitter housing, checking the power cable connections, disconnecting the meter sensor, or removing PC boards from the transmitter housing.

Nevertheless, some operations require that parts of the meter or its PC boards remain live. In such cases proceed with utmost care to minimise the risk of electric shock.

Operational/functional tests on the flowmeter can be performed using the RS-485 MODBUS RTU serial communication line and program FLOSET 4.0.

To carry out any on-site meter repair actions the user will need a set of spare PC boards tested and pre-set at the manufacturing company. Such repair actions consist of replacement of the defective PC boards. If the given type of defect is associated with a malfunction of any specific PC board, the user may try to replace such board upon opening the respective cover of the meter transmitter.

The flowmeter software includes internal control and diagnostic algorithms the purpose of which is to identify meter defects and show the corresponding error code on the meter display.


Should the error code displayed imply a sensor defect, the sensor can be substituted by the sensor simulator SF1.0 (applicable to the remote meter version only).

Error code	Error description	Likely error cause and error removal procedure
E00	No error	-
E01	AD range overflow	Excessive flow rate (a short-term step change in flow rate from 0 to Q ₄). If the error condition is of a continuous nature, the fault will be in the measuring PC board.
E02	Flow-rate step change	See error code E01
E03	Memory read/write error	If RTC time error is too big, replace back-up battery on the processor board. Should this not help, replace electronic unit (the processor, output and/or measuring PC boards).
E04	Other types of electronic unit error	Should the error condition continue, replace electronic unit (the processor, output and/or measuring PC boards).
E05	Error message in cases where it is not possible to calibrate zero flow rate	Wait for a few seconds and repeat zero flow rate calibration. Should the error condition continue, replace electronic unit (the processor, output and/or measuring PC board).
E06	Low excitation current	Disconnected excitation circuit – defective sensor or broken connection between the transmitter and sensor. Defective measuring PC board. Should the error condition continue, replace electronic unit (the processor, output and/or measuring PC board).
E07	Shorted coil circuit	Short in excitation circuit – defective sensor or a short circuit in the connection between the transmitter and sensor. Check the conditions of signal cables. Replace sensor by sensor simulator SF1.0.
E08	Information – zero setting in progress, measurement discontinued	Flow measurement discontinued for one minute. Upon completion of the zero-setting procedure, this information message disappears from the display and measurement can continue.
E09	High resistance of measured fluid	Indication of a not fully flooded piping condition.
E10	OUT1 output error	Output frequency more than 10kHz. pulse output frequency more than 100Hz. Time period between pulses is shorter than pulse length.
E11	OUT2 output error	See comments to error E09 related to the OUT2 output.
E12	Information on excessive current	Incorrect configuration of the current output. Current beyond the range of 4 to 20mA The output current does not correspond to the flow rate range.
E13	Incorrect time setting	Incorrect time setting following back-up battery replacement. Should the error condition continue, replace electronic unit (the processor, output and/or measuring PC board).
E14	Exceeding the value of the overload flow rate Q ₄	Check the setting of Q 100%. Should the error condition continue, replace electronic unit (the processor, output and/or measuring PC board).

Extraordinary operational conditions of the flowmeter

At the time of the flowmeter commissioning, when the setting of the meter parameters with respect to the co-operating technology and/or the higher-level computer control system may still have to be optimised, it can happen that the meter behaviour is irregular.

Description	Likely cause	Corrective action
Unintelligible text on the display	Display or processor board fault	Switch off and on the meter power; if it does not help, follow the standard meter repair procedure (replace processor board or display)
Meter including display is functioning well, the meter menu control does not work	Incorrect procedure in working with the optical reflex sensors.	See the manual: touch just one optical sensor at a time.
The measured values of instantaneous flow rates fluctuate excessively including drops to zero flow rate	Imperfect transmitter or fluid grounding. In cases of remote meter version, signal interference. Loose signal cable. Power line interference. Excessive content of air bubbles or solid particles in measured fluid.	In reference to the manual, check potential equalisation connections and sensor and fluid grounding. Connect a line voltage filter. Eliminate the effects of external interference sources. Check the correct sensor installation in the target technology. Replace sensor by sensor simulator (remote meter version only). Prevent aeration of the fluid in piping.
Meter is apparently fully functional, but it does not perform measurements	Fluid conductivity too low.	Check the fluid conductivity, consult the problem with the product manufacturer.

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11.5 Meter repair procedures

If the flowmeter is not functioning as it should, where:

- No data appear on the display;
- Connection via the RS-485 communication line does not work; and/or
- Meter outputs (current, frequency and pulse outputs) are not activated, check the meter power source and power supply connections.

The power supply terminals and connections can be accessed upon removal of the rear cover on the transmitter housing.

Procedure

1. Switch off the meter power source.
2. Release the Allen bolt securing the closed position of the rear cover on the transmitter housing.
3. Remove the rear cover on the transmitter housing.
4. Check the tightness of the power supply cable conductor connections in the respective terminals.
5. Switch on the meter power source.



Warning: risk of electric shock

6. Check the live condition of the transmitter terminals and the value of the power supply voltage.
7. If the line voltage is within the required range (consult the product manual) and the error condition still prevails, check the condition of fuse F1 5 x 20mm on the terminal plate.

Fuse specifications according to the manual

- AC power source: T 1.25A/250V, breaking capacity 1500A/250V
- DC power source: T 2A/250 V



When checking the fuse condition, observe the standard rules applicable to repair of electronic equipment and measuring devices – remove the fuse from its holder only after switching off the meter power supply.

8. If fuse F1 is in order or if upon its replacement the error condition still exists, dismantle the terminal board and remove the power supply board located underneath.
9. Loosen three bolts M4 and take away the terminal board. Unscrew distance columns M4 x 25 and remove the power supply board from the transmitter housing.
10. Connect both PC boards (the power-supply and terminal boards) removed from the transmitter housing. Bring the external power supply voltage (AC or DC, as the case may be) to the terminal board.

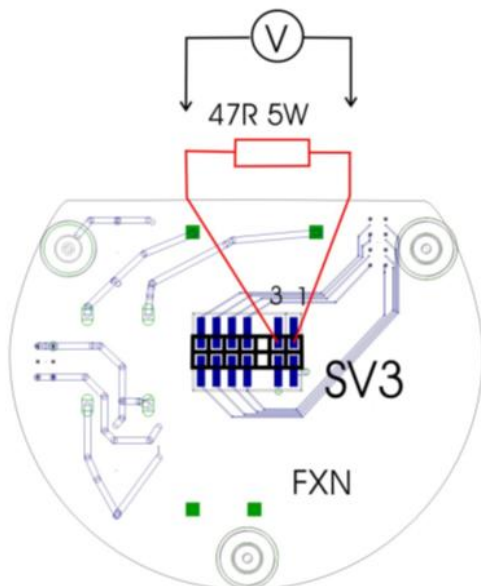


Warning: risk of electric shock

Check on the power supply board

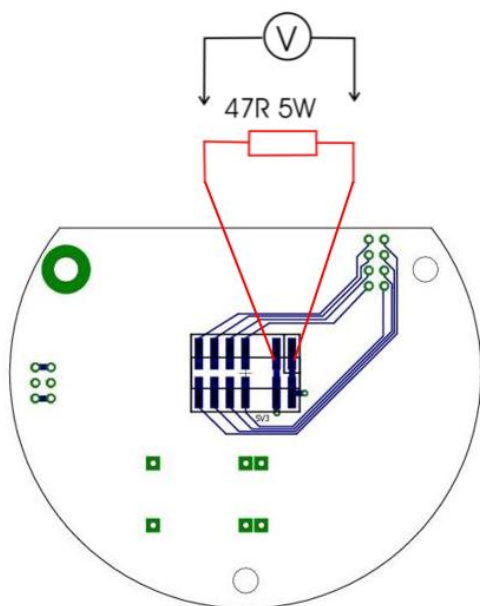
AC power supply 95 to 250VAC

Connect loading resistor 47R to the connector terminals shown in the picture below. After five minutes, the voltage across this resistor shall be in the range of 14.7 to 15.3V. Should it not be so, the power supply board is defective and it shall be replaced.




DC power supply 19.2 to 28.8VDC

Connect loading resistor 47R to the connector terminals shown in the picture below. After five minutes, the voltage across this resistor shall be in the range of 14.7 to 15.3V. Should it not be so, the power supply board is defective and it shall be replaced.



If the power supply section is in order, the cause of the error should be sought in the meter circuits on the PC boards located under the front cover of the transmitter housing.

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Procedure

1. Switch off the meter power source.
2. Release the Allen bolt securing the closed position of the front cover on the transmitter housing.
3. Remove the front cover on the transmitter housing.
4. Loosen four bolts M2.5 and take away the cover panel on the display. Remove the display board from the transmitter housing by carefully displacing it in the direction of the transmitter axis.
5. In cases of defective display, replace the display board and check its correct function.
6. Should the error condition continue even after the power circuit and display unit checks, proceed with replacement of the electronic unit. Unscrew four distance columns M4 x 10 and remove and replace the electronic unit (consisting of the processor, output and measuring PC boards mutually interconnected by the connector board). Verify the flowmeter functions.




Upon the meter re-installation, tighten the bolts on the transmitter and sensor covers using the torque not exceeding 8Nm.



Upon replacement of the electronic unit it is not necessary to repeat the meter calibration procedure.

Using the FLOSET 4.0 software, restore the original setting of the meter parameters.

Should you fail to rectify the meter defect using the above procedures, contact the authorised flowmeter service centre or directly the meter manufacturer.

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12 MAINTENANCE

The FLONET FF50xx flowmeter does not require any special maintenance. During regular product inspections, apart from visual check on the mechanical integrity and absence of signs of damage to the external meter parts, it is recommended to check the tightness of cable glands and grounding terminals.

Transmitter

The transmitter housing exterior is coated with a layer of powder paint. For cleaning, use standard procedures applicable to maintenance of measuring devices.



When cleaning the viewing window and rubber seals, avoid application of abrasive cleaning agents.

Sensor

To clean the sensor surface, use standard procedures applicable to maintenance of measuring devices. The PIGS method (mechanical cleaning) is not permitted for maintenance of the inner parts of the sensor as it implies a risk of damage to the sensor lining and measuring electrodes. The inner surfaces of a dismantled sensor should be cleaned using a piece of cloth or brush and a cleaning agent with degreasing and mild abrasive effects (for example a liquid cleaning cream).

13 SEALINGS

Flowmeter FLONET FF50x is supplied calibrated by the order of the customer. To avoid unauthorized usage provided by user important parts of the device are sealed with assembly seals:

Electric device

- 1 pc screws holding the front side of the box
- 1 pc connection of the box and the sensor

Sensor

- 1 pc connection of the flowmeter rating plate and the sensor
- 1 pc sensor connection box for remote meter version

Note: In case of usage of remote meter version it is necessary to seal the cover of the sensor connection box with assembly seals after connection of cables and sensor is done!!

14 SERVICES

General principles


Prior to leaving the meter for service with the meter manufacturer or an authorised service centre, the product shall be thoroughly decontaminated.

Representation on product decontamination

In observance of the applicable environment conservation, labour safety and health protection regulations, attached to any requirement for meter repair shall be a **representation in writing on the meter decontamination**. A recommended form to be used for these purposes is included in this manual (see Chapter 17).

Any costs of the meter decontamination needed to be performed at the manufacturer's laboratories shall be invoiced to the customer concerned.



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A meter that cannot be decontaminated shall not be sent away for any service action.

15 WARRANTY

15.1 *Warranty services*

Warranty services consist of product maintenance or repair actions carried out free of charge within the agreed warranty period by the product manufacturer or a duly authorised manufacturer's partner organisation. A warranty repair action is product repair carried out free of charge within the agreed warranty period where the product fault concerned has been caused by defective material, meter component part or workmanship. Should the product fault as of the preceding paragraph be found irreparable, the product will be replaced at no cost to the customer. Warranty services may only be performed by the product manufacturer, their duly authorised service centre or an authorised distributor who may prove their qualifications by a licence in writing received after thorough training at the manufacturer's plant.

Excluded from warranty services shall be:


- Products with broken company seals;
- Products with defects caused by incorrect installation or electric connection;
- Transmitters damaged due to incorrect electric connection;
- Defects caused by non-standard meter application;
- Defects due to mechanical damage;
- Defects caused by force majeure or natural disaster;
- Alienated products.

Any warranty service or repair claims shall be communicated to the manufacturer **in writing** (by E-mail, fax, or registered post). The manufacturer should reject a warranty claim. Such position shall be made known to the customer **in writing** whereby the repair costs will be invoiced to the customer.

15.2 *Post-warranty services*

Post-warranty services consist of any product maintenance or repair actions related to conditions and/or defects occurring upon expiry of the agreed warranty period. Any such action irrespective of the location where it is to be carried out and whether performed by the manufacturer or their duly authorised partner organisation, shall be invoiced to and paid for by the customer.

Post-warranty product service or repair requirements shall be communicated to the manufacturer **in writing** (by E-mail, fax, or registered post).

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16 ASSOCIATED DOCUMENTS AND STANDARDS

Standards

EN ISO 6817	Flow rate measurement of conductive liquids in closed profiles – Measuring method using electromagnetic flowmeters
EN 29104	Flow rate measurements of liquids in closed profiles
EN ISO 4064-1	Water meters for cold drinking water and hot water
EN 1092-1	Flanges and flanged connections
ASME B16.5	Pipe flanges and flanged fittings
EN 13480	Metal pipes for industrial application
EN 61010-1	Electrical measuring, control and laboratory equipment; safety requirements
EN 60664-1	Low voltage equipment insulation co-ordination

Manuals

Es 90666K Control of flow meter FLONEX FXx11x a FLONET FH30xx


Es 90664K Communication RS-485 MODBUS RTU Flowmeters FLONET FH30xx and FLONET FXx11x

17 ANNEXES

17.1 *Representation on meter decontamination*

Representation on decontamination

CUSTOMER	ADDRESS	
	Name	Telephone
FLOWMETER TYPE	Delivery date	Delivery note
Production serial number		
MEASURED FLUID		
FLUID PROPERTIES AND ASSOCIATED RISKS		
Toxic		Implied biological hazard
Corrosive		Caustic agent
Flammable		Detrimental to environment
Other types of risk		
The sensor cavities have been emptied and cleaned		
Meter surface is free of fluid traces		
Residual contamination	Yes	
	No	
METER HANDLING SAFETY PRECAUTIONS AND PROTECTIVE EQUIPMENT		
Protection gloves		
Protection glasses		
Protection face shield		
Respirator		
Protection clothing		
Fume chamber		
Safety precautions:		
<p>We confirm that the flowmeter has been properly decontaminated.</p> <p>Provided the above safety precautions are observed and the recommended protective equipment used, the flowmeter handling will not constitute any risk to health or environment.</p>		
Date	Place	Signature


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18 PRODUCT ORDERING

To order and specify the flowmeters, you can use the Order Number generated by the Specification Table after entering the required technical parameters.

This Specification Table for the required type of flow meter can be found on the website www.elis.cz/en in the "download" section.

If you need help, please contact us.

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