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	Battery-powered ultrasonic water and flow meters of the type series FLOMIC FL50x4 and FL50x5	

Battery-powered ultrasonic water and flow meters

FLOMIC FL50x4, FL50x5



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1. APPLICATION

Battery-powered ultrasonic water meters and flow meters of the type series FLOMIC FL50x4 and FL50x5 are intended for operational and commercial measurements with storage of the measured data on instantaneous flow rate, pressure and water consumption in water-supply systems and various industries. The meter design and parameters meet the requirements of standard EN 14154. The technical capabilities and parameters of the FLOMIC meters make them an ideal solution for not only water consumption measurement but also for water leakage and water-supply network condition monitoring with optional wireless data transfer features.

The compact meter version is intended for operational environments free of water condensation.

2. MEASUREMENT PRINCIPLE

The meter utilises the "transit-time" impulse measurement method where the flow rate information is derived from the difference between the measured transit times of ultrasonic signals travelling between ultrasonic probes in and against the flow direction of the measured fluid.

3. TECHNICAL DESCRIPTION

FLOMIC FL50xx

4	Compact version
	Distributed version
2	Water meter, 1 measuring beam
4	Water meter, 2 measuring beams
3	Flow meter, 1 measuring beam
5	Flow meter, 2 measuring beams

3.1. *Meter versions*

Battery-powered ultrasonic water and flow meters of the type series FLOMIC FL50xx are manufactured in the following design variants:

3.1.1 Meter sensors

The difference between a water meter and a flow meter consists of the measuring sensor design.

The water meter measuring sensor is designed for operation under conditions typical for conventional mechanical water meters regarding the scope of measured values including the fluid pressure (not exceeding 16 bar).

The flow meter measuring sensor design is essentially the same as that used with standard flow meters, i.e. for the maximum flow velocity of 10 m/s and the maximum fluid pressure 16 or 40 bar.

3.1.2 Electronic unit

All water and flow meters work in combination with an electronic unit of a unified design.

The **standard electronic unit version** includes the following functions:

- Measurement and display of instantaneous flow rate values in one flow direction [m³/h, gal/min];
- Display of the aggregate volume passed through the meter sensor in one flow direction [m³, 10³ gal];
- Flow rate information communicated via a passive insulated pulse output.

Electronic unit with additional functions makes possible/includes:

- Measurement and display of instantaneous flow rate and flow volume data in both flow directions with graphic indication of the actual flow direction on the meter display;
- Measurement and display of instantaneous fluid pressure values;
- Passive current output 4-20mA corresponding to the instantaneous flow rate and fluid pressure values (only one parameter at a time);
- Fluid flow direction indication via:
 - binary output for a current loop 4 to 20mA (in cases of bi-directional flow rate measurement)
- Two-wire power supply to the electronic unit using a current loop 4 to 20mA;
- Mutually independent measured data storage in periods one minute to one year;
- Measured and stored data reading using optically insulated interface USB or RS232 line;
- Connection to a wireless data transfer system using a GSM module.

Available for the electronic unit with additional functions are the associated accessories such as interconnection cables, optical probe or software programs.

Comment: Application of additional electronic unit functions shortens the effective battery life.

3.2. Meter design

Taking into account the meter sensor design and number of ultrasonic beams, the meter series consists of the following meter types:

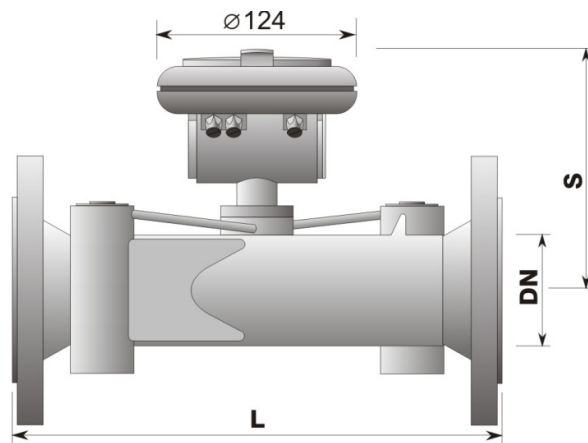
Type	DN	Type of sensor	Note
Water meter FL5024, FL5025	32 to 200/ 1 ¼" to 8"	UC 6.0	casting – single beam sensor without pressure sensor
		UC 6.1	casting – single beam sensor with pressure sensor (DN50 to DN200 / 2½" to 8")*
Water meter FL5044, FL5045	65 to 200/ 2 ½" to 8"	UC 6.2	casting – dual beam sensor without pressure sensor
		UC 6.3	casting – dual beam sensor with pressure sensor (for FL5044(DN65 to DN200/ 2½" to 8") only) *
Flow meter FL5034, FL5035	32 to 300/ 1 ¼" to 12"	UC 3.0	weldment – single beam sensor without pressure sensor
		UC 3.1	weldment – single beam sensor with pressure sensor (DN50 to DN300 / 2" to 12")*
Flow meter FL5054, FL5055	40 to 300 / 1 ½" to 12"	UC 5.0	weldment – dual beam sensor without pressure sensor
		UC 5.1	weldment – dual beam sensor with pressure sensor (for FL5054 from DN50/ 2" to 12") *

* **NOTE:**

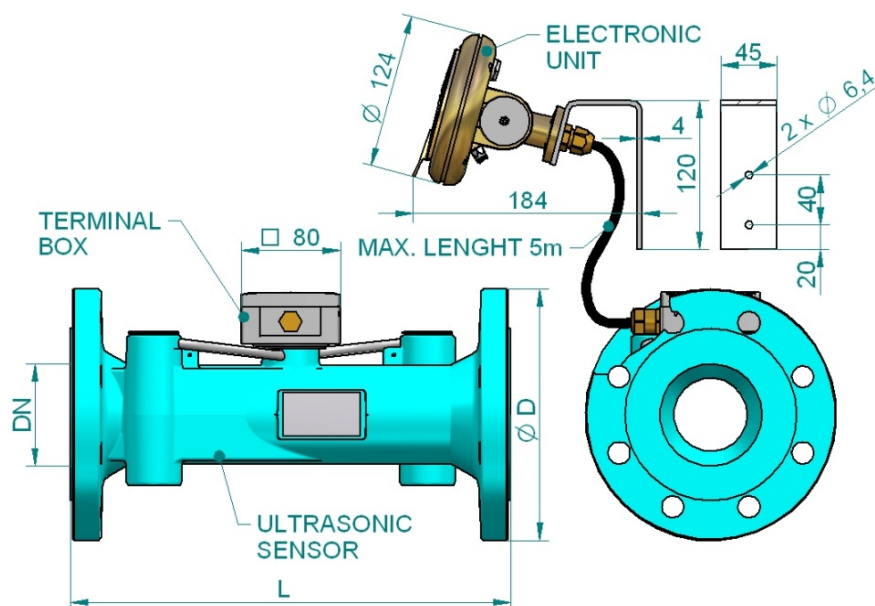
- 1) The pressure sensor can be installed in the **compact version** or in the **remote version** for **single beam ultrasonic water meter FLOMIC FL502x**(DN50 to DN200/2" to 8") or for **single beam ultrasonic flow meter FLOMIC FL503x**.
- 2) The pressure sensor can be installed in the **compact version** of the **dual beam** water meter of type **FLOMIC FL 5044**(DN65 to DN200 / 2 ½" to 8") **only**.
- 3) The pressure sensor can be installed in the **compact version** of the **dual beam** flow meter of type **FLOMIC FL 5054**(DN50 to DN300 / 2" to 12") **only**.

3.2.1. Dimensional drawing

FLOMIC FL5024 and FL5044



FLOMIC FL5025, FL5045



DN	32	40	50	65	80	100	125	150	200
L [mm]	260	300	300	300	350	350	350	350	350
S [mm]	140	145	150	155	160	165	180	190	205
Weight [kg]	7	8	10	11	15	17,5	22,5	26	36,5
ø D [mm] for EN 1092-1	140	150	165	185	200	220	250	285	340



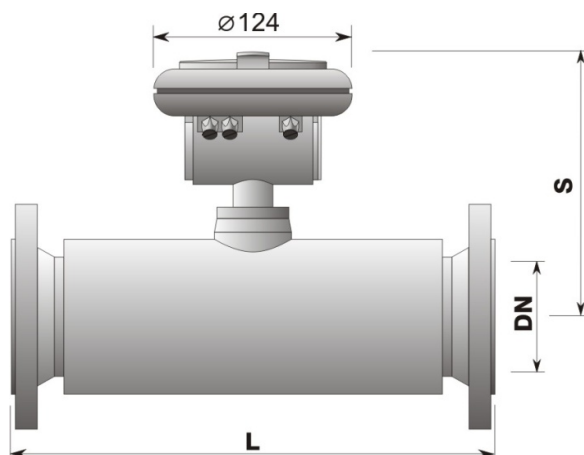
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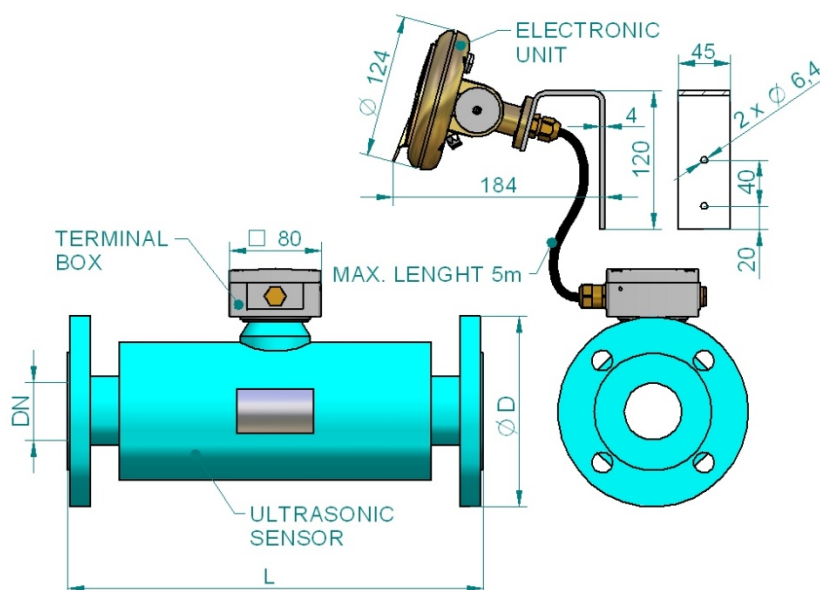
Battery-powered ultrasonic water and flow meters of the type
series FLOMIC FL50x4 and FL50x5

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FLOMIC FL5034, FL5054



FLOMIC FL5035, FL5055



DN	32	40	50	65	80	100	125	150	200	250	300
L [mm]	360	360	360	360	360	360	360	360	450	450	450
S [mm]	175	180	185	190	200	210	225	235	255	280	305
weight [kg] 1,6 MPa 4 MPa	10	10	12	13	16	18	19	20	29	50	61
	10	10	12	13	16	18	21	22	38	71	85
ø D[mm] 1,6 MPa for EN1092-1	140	150	165	185	200	220	250	285	340	405	460
ø D[mm] 4 MPa for EN1092-1	140	150	165	185	200	235	270	300	375	450	515

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3.2.2. Electronic unit

The electronic circuits and the meter battery are accommodated in an aluminium box with a plastic cap and a lift-off protective cover. The box is further provided with a pressure equaliser preventing air humidity condensation inside the electronic unit box.

The external box surface is painted with a powder paint of hue RAL1017 (saffron yellow).

Located under the protective cover are the meter rating plate, control push-button and a recession to accommodate the optical probe. A window in the plastic cap facilitates view of the meter display showing the measured values and the respective physical units:

- Instantaneous flow rate;
- Aggregate volume passed through the meter in the +direction;
- Instantaneous fluid pressure;
- Aggregate volume passed through the meter in the -direction;
- Check sum.

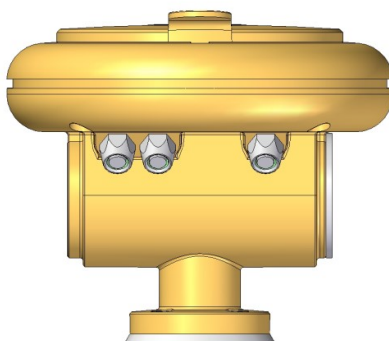
The displayed quantity can be selected by repeated pressing of the control pushbutton (depress for 1s and leave the pushbutton free for 1s before next depression).

In the case of the standard electronics unit version, only connector X2 (pulse outputs) is installed; the openings for connectors X1 and X3 are blinded. In the case of electronic unit with additional functions, all three connectors (X1, X2 and X3) can be active. When installed, each connector is provided with a water-proof cap sealed with an O-ring.

Connector specifications:

- X1- communication line RS232 (a 4-pole connector);
- X2- twopulse outputs (a 3-pole connector);
- X3- onecurrent and one binary output (a 4-pole connector).

The interconnection of individual outputs is described in Section 6.2., Electric outputs.




Upon customer's request, the supplied meter can be the necessary connecting cables meeting the IP68 standards.

Cable specifications:

- Connector X1: a 4-pole plug, 5m cable and a 9-pin Canon connector;
Connector X2: a 3-pole plug, 5m cable and free wires for connection to the master control system;
Connector X3: a 4-pole plug, 5m cable and free wires for connection to the master control system.

CAUTION: Prior to putting the meter in operation, make sure that all connectors are tightly screwed on and the openings of unused connected properly blinded. The electronic unit shall not be exposed to direct sunlight.

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3.2.3. Ultrasonic sensor

The ultrasonic sensor used with water meters of type designation UC 6.X is embedded in a malleable iron casting.

The ultrasonic sensor used with flow meters of type designation UC 3.X and UC 5.X is embedded in either a compact all-stainless-steel weldment or a weldment made of a combination of carbon-steel flanges and cover and a stainless-steel measuring tube.

Each sensor includes either two or four ultrasonic probes (single- or double-beam sensor versions). The probe bodies are made of stainless steel.

Water and flow meter sensors may also include pressure detectors.

Unless required otherwise, the sensors are provided with flanges meeting the EN 1092-1 specifications. Other types of flange such as according to standards ANSI, JIS, AS and others may be used on agreement with the sensor manufacturer. The rating plate attached to the sensor body includes information and data in reference to standard EN 14154-1+A1, clause 6.

All-stainless-steel sensors have the external surface blast-finished, the other sensors are painted with powder epoxy-polyester paint of hue RAL7035 (light grey) or, in cases of drinking water application, hue RAL 5017 (blue). The sensors used with water meters UC6.X may also be painted with polyamide RILSAN 7443MAC paint (blue).



UC 3.X and UC 5.X



UC 6.X


3.2.4. Sensor terminal board (the distributed meter design version)

In cases of distributed design of the FLOMIC FL50x5 water or flow meters, the aluminium box containing the sensor terminal board is attached to the sensor body.

The flow meter is supplied complete with a cable of length 5m meeting the protection class IP68 requirements intended to provide connection between the electronic unit and meter sensor.

The terminal box includes an M12 grommet and a lid with a sealing O-ring.

To ensure meeting the requirements of the specified protection class (IP68), the terminal box interior is sealed with waterproof resin.

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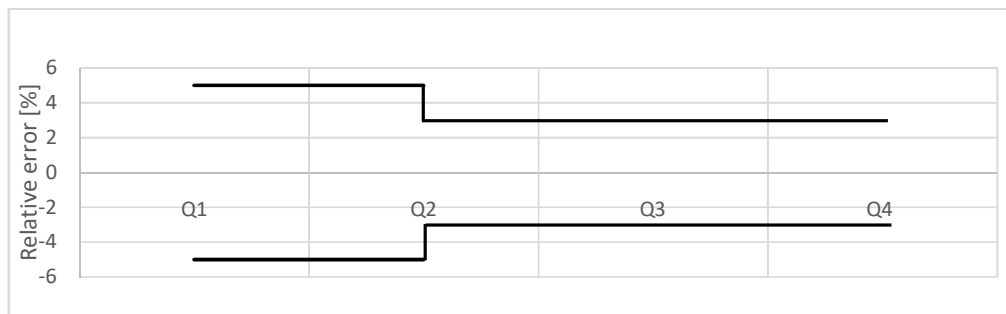
4. TECHNICAL PARAMETERS

The symbols and abbreviations used in the following technical specifications comply with the provisions of standard EN 14154-1+A2, part 3, Terms and definitions.

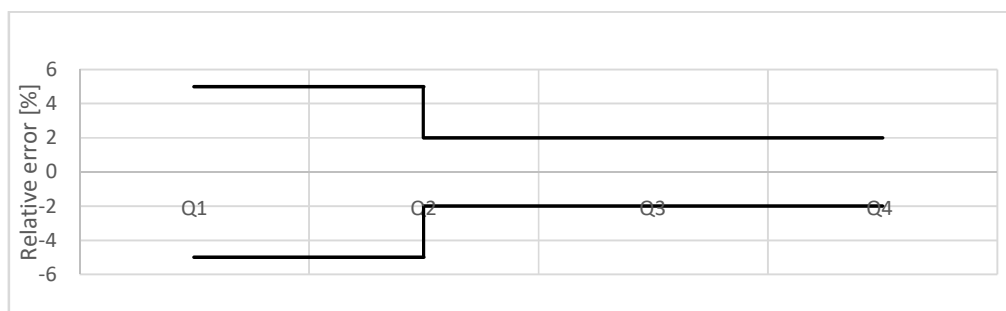
Meter pressure class	Water meters	MAP 16 1 beam FL502x(DN32 – DN200) 2 beams FL504x(DN65 – DN200)
	Flow meters	MAP 16 1 beam FL503x(DN100 – DN300) 2 beams FL505x (DN100 – DN300) MAP 40 1 beam FL503x (DN32 – DN300) 2 beams FL505x (DN40 – DN300)
Temperature class	Compact version	T50 (water meters/flow meters FL50x4)
	Remote version	T90 (water meters FL50x5) T130 (flow meters FL50x5)
Flow profile sensitivity class	Single beam sensor	U10, D5 U10S, D5 for DN32
	Dual beam sensor	U5, D3
Pressure loss class	ΔP 25 (the highest pressure class 0,25 bar)	
Climatic and mechanical environment	Class B (static meters installed in a building) – type approved meters Class B, C (static meters installed outside) – non-certified meters	
Accuracy of flow	Referential condition in compliance EN 14154-3+A2 ± 5% for flow $Q_1 \leq Q < Q_2$ ± 3% for flow $Q_2 \leq Q \leq Q_4$ T50, T90, T130 ± 2% for flow $Q_2 \leq Q \leq Q_4$ T30	
Accuracy of pressure	± 0,5% FSO for pressure 0 to 16 bar relative	
Electromagnetic environment	E1, E2 (environment of flats, shops and light industry, industrial environment)	
Measurement cycle period	1 s	
Display unit	Single-line 8-digits LC display	
Power supply	Lithium battery 3,6 V/19 Ah, live time min. 8 years in standard version	
Operational ambient	-5°C to +55°C (protection against direct sunshine)	
Storage temperature	-10°C to +70°C (by relative humidity max. 70%)	
Protection	IP 68 (2m)	
Outputs and functions Each passive output must be powered from individual galvanic insulated remote source	Standard	One direction measurement of flow with 1 passive pulse output 1x open collector NPN: $U = 3 \div 30$ V, $I = 0.002 \div 10$ mA, $t_{imp} = 30$ ms
	Non-standard	Passive current output $4 \div 20$ mA, $U = 10 \div 24$ V (flow or pressure)
		Bidirectional measurement of flow with 2 passive pulse outputs 2x open collector NPN: $U = 3 \div 30$ V, $I = 0.002 \div 10$ mA, $t_{imp} = 30$ ms
		Bidirectional measurement of flow with passive current output $4 \div 20$ mA, $U = 10 \div 24$ V with indication of flow direction of flow by static passive output - transistor NMOS-FET: $U = 3 \div 30$ V, $I = 0,002 \div 10$ mA
		Optical interface USB, RS232, RS232+USB driver Measurement of pressure (non for remote version and for temperature over 120°C) Data transfer by GSM module FLODAT

The value of minimum flow rate at which the meter starts to indicate and measure the flow data (Q_{NEC}) has been set at the manufacturing company at 20 mm/s. Upon the customer's request, this setting can be modified within the range $Q_{NEC} = 0,1$ to 25% Q_4 .

Water and flow meter precision rating in accordance with standard EN 14154 (OIML R 49)
for temperature classes T50, T90 and T130



Water and flow meter precision rating in accordance with standard EN 14154 (OIML R 49)
for temperature classes T30



According to EN 14154, it holds:

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

The flow rate values Q_1, Q_3 and Q_4 related to individual design versions and meter dimensions are shown in Section 4.1.

Meter capabilities and functions:

- Single- or double-beam sensor;
- Measurements in one or both fluid flow directions (with flow velocity not exceeding 10 m/s);
- Measurements of fluid volumes passed through the meter sensor in both flow directions;
- Measurement of relative pressure of the flowing fluid;
- Storage of data concerning:
 - flow rate,
 - fluid volume passed through the meter in one direction (+),
 - fluid volume passed through the meter in the other direction (-),
 - pressure,
 - real time of commencement of failure condition,
 - real time of termination of failure condition,
 - diagnosed failure conditions,
 - watch dog(WD) actions;
- Firmware consistency test - check sum CRC32 once every 24 hours;
- LC display test consisting of lighting-up all display segments.

4.1 Sensor dimensions and flow-rate ranges

FLOMIC **FL5024** (water meter, 1 beam, compact version)
FL5025 (water meter, 1 beam, remote version)

Nominal diameter DN	32	40	50	65	80	100	125	150	200*
Overload flow Q_4 [m ³ /h]	12,5	20	31,25	50	78,75	125	200	312,5	500
Permanent flow Q_3 [m ³ /h]	10	16	25	40	63	100	160	250	400
Minimum flow Q_1 [m ³ /h]	0,04	0,064	0,1	0,16	0,200	0,317	0,508	0,794	1,270
Constant of pulse output K_i [l/imp]	10	10	25	50	50	100	100	100	250
Range of measurement Q_3/Q_1	250				315				

FLOMIC **FL5044** (water meter, 2 beams, compact version)
FL5045 (water meter, 2 beams, remote version)

Nominal diameter DN	65	80	100	125	150	200*
Overload flow Q_4 [m ³ /h]	50	79	125	200	313	500
Permanent flow Q_3 [m ³ /h]	40	63	100	160	250	400
Minimum flow Q_1 [m ³ /h]	0,127	0,157	0,25	0,4	0,625	1,0
Constant of pulse output K_i [l/imp]	50	50	100	100	100	250
Range of measurement Q_3/Q_1	315	400				

FLOMIC **FL5034** (flow meter, 1 beam, compact version)
FL5035 (flow meter, 1 beam, remote version)

Nominal diameter DN	32	40	50	65	80	100	125	150	200*	250*	300*
Overload flow Q_4 [m ³ /h]	20	31,25	50	78,75	125	200	250	312,5	500	787,5	1250
Permanent flow Q_3 [m ³ /h]	16	25	40	63	100	160	200	250	400	630	1000
Minimum flow Q_1 [m ³ /h]	0,05	0,079	0,127	0,2	0,25	0,4	0,5	0,625	1,0	1,575	2,50
Constant of pulse output K_i [l/imp]	10	10	25	50	50	100	100	100	250	250	500
Range of measurement Q_3/Q_1	315				400						

FLOMIC **FL5054** (flow meter, 2 beams, compact version)
FL5055 (flow meter, 2 beams, remote version)

Nominal diameter DN	40	50	65	80	100	125	150	200*	250*	300*
Overload flow Q_4 [m ³ /h]	31,25	50	78,75	125	200	250	312,5	500	787,5	1250
Permanent flow Q_3 [m ³ /h]	25	40	63	100	160	200	250	400	630	1000
Minimum flow Q_1 [m ³ /h]	0,0625	0,1	0,157	0,2	0,32	0,4	0,5	0,8	1,26	2,0
Constant of pulse output K_i [l/imp]	10	25	50	50	100	100	100	250	250	500
Range of measurement Q_3/Q_1	400				500					

* With these dimensions, the data shown on display are one tenth of the actual values (see Section 6.1.)

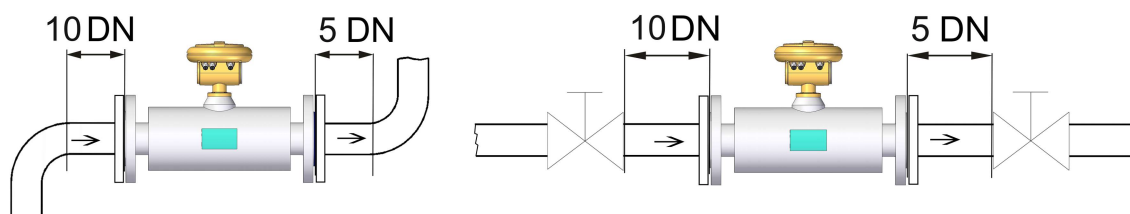
5. PROJECT DESIGN AND METER INSTALLATION

5.1. *Project design of systems including ultrasonic water and flow meters*

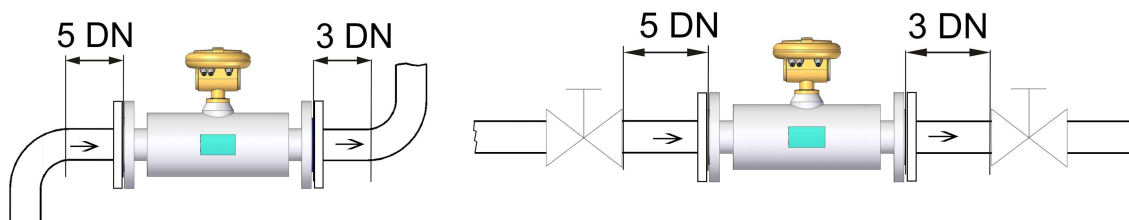
In project designing and installation of ultrasonic water meters and flow meters of the type series FLOMIC FL50xx, the general rules regarding placement of water meters in piping as outlined in standard EN 14 154 need be observed. The following text includes specific requirements concerning the minimum lengths of the straight piping sections at the sensor input and output with respect to various nearby-located flow-disturbing elements and measures to ensure full flooding of the sensor space.

5.1.1. Straight piping sections before and after the sensor

For a single-beam sensor, the minimum straight lengths are: U10, D5.



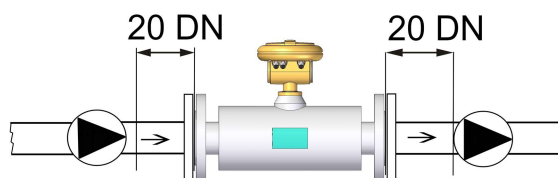
For a dual-beam sensor, the minimum straight lengths are: U5, D3.



5.1.2. Elimination of the effect of pumps in the piping

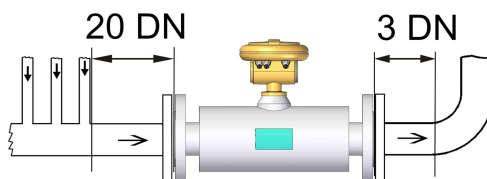
The nearest pump in the piping shall be located at least 20 DN away from the meter sensor.

To eliminate the effects of cavitation and gas release from the measured fluid, it is recommended to place the pump at the input side of the sensor. The cavitation effects can also be effectively suppressed by sufficiently high pressure in the piping system.



5.1.3. Piping stacks

The nearest stack in the piping system at the sensor input side shall be at least 20 DN away.

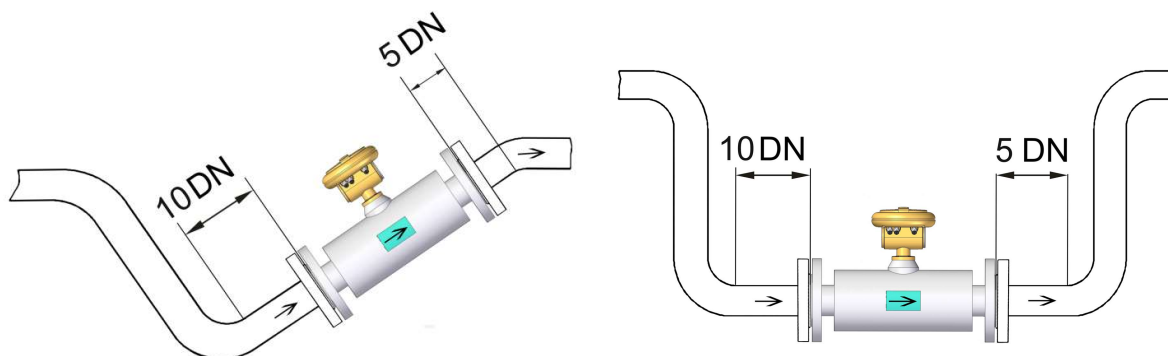


5.1.4. Flooding of the piping cross-section

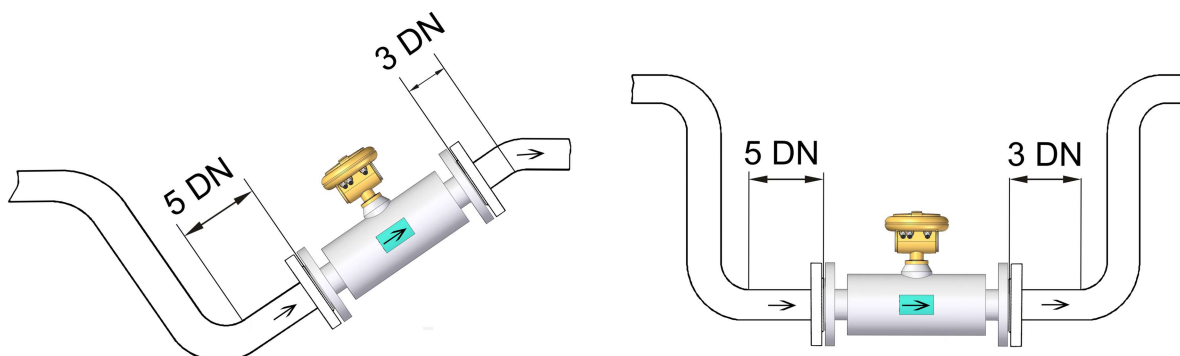
The meter sensor shall always be fully flooded with the measured fluid (water).

In cases where complete flooding of the whole piping system cannot be ensured at all times, the sensor placement shall be such that this condition is always met at the piping section concerned.

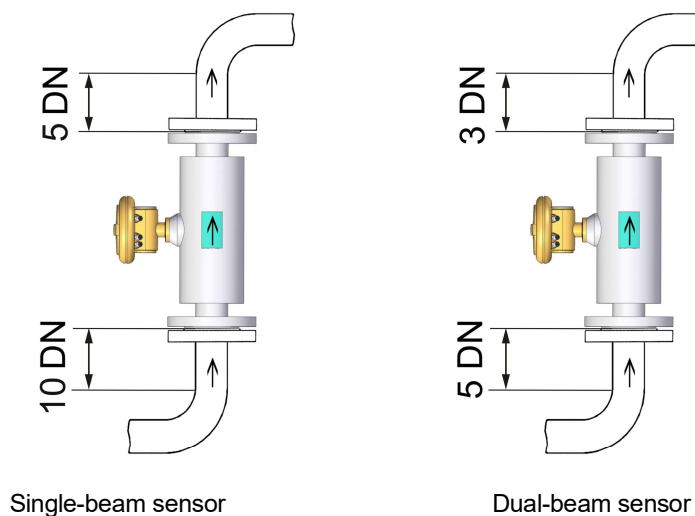
Preferred placement of single-beam sensors in the fluid piping



Preferred placement of dual-beam sensors in the fluid piping

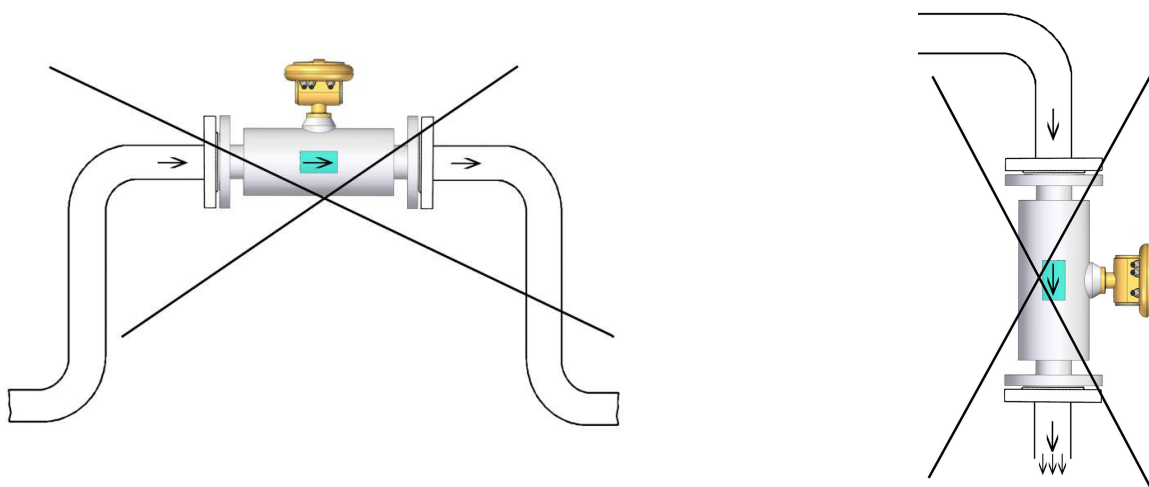


If the meter sensor is placed in a vertical piping section, the flow direction shall be upwards.



It is not recommended to place the meter sensor at the highest piping section or, in cases of the sensor placement in a vertical piping section, with the fluid flow direction downwards, in particular if a discharge opening is anywhere near at the sensor output side. Observance of this rule will prevent measurement errors due to increased air bubble concentration inside the sensor space.

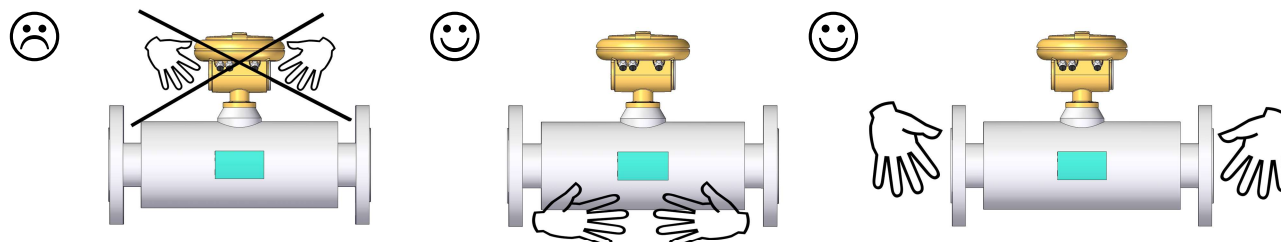
Examples of incorrect sensor placement



WARNING! In cases of external placement, the electronic unit shall be protected against direct sunlight. However, the unit shall not be placed in an enclosed box.

5.1.5. Meter handling rules

When lifting the meter, **never** hold it by any part of the electronic unit, but **always** by the sensor flanges or sensor body.



Meter storage

During storage and transport, the meter shall be protected against excessive mechanical shocks and vibrations. The best protection is provided by the original packaging.
 Permitted storage temperature range: -10 to $+70^{\circ}\text{C}$ at relative humidity of the air not exceeding 70%.
 Long-term exposure of the meter to direct sunlight shall be avoided.

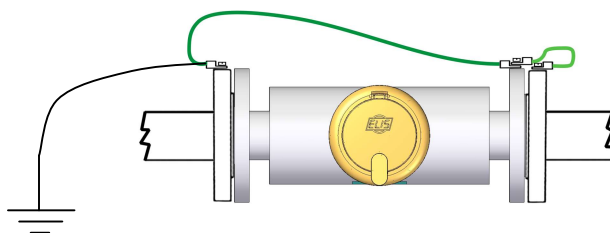
5.1.6. Mechanical connections

The ultrasonic sensor shall be installed in the piping using suitable counter-flanges meeting the requirements of standard EN 1092-1 (or, upon the customer's request, ANSI, JIS or AS).

During the sensor installation, make sure that:

- The arrow on the sensor body points at the fluid flow direction;
- The inner piping and seal diameters correspond to that of the flow meter sensor;
- The sealing elements are properly placed between the flanges;
- The piping supports minimise the mechanical stress acting on the sensor (vibration, tension, bend etc.).

The sensor needs be properly earthed. To ensure that, use the green and yellow earthing conductor of minimum cross section 4mm^2 to connect the earthing bolt on the sensor flange to the piping flanges and the ground potential at the measurement location.



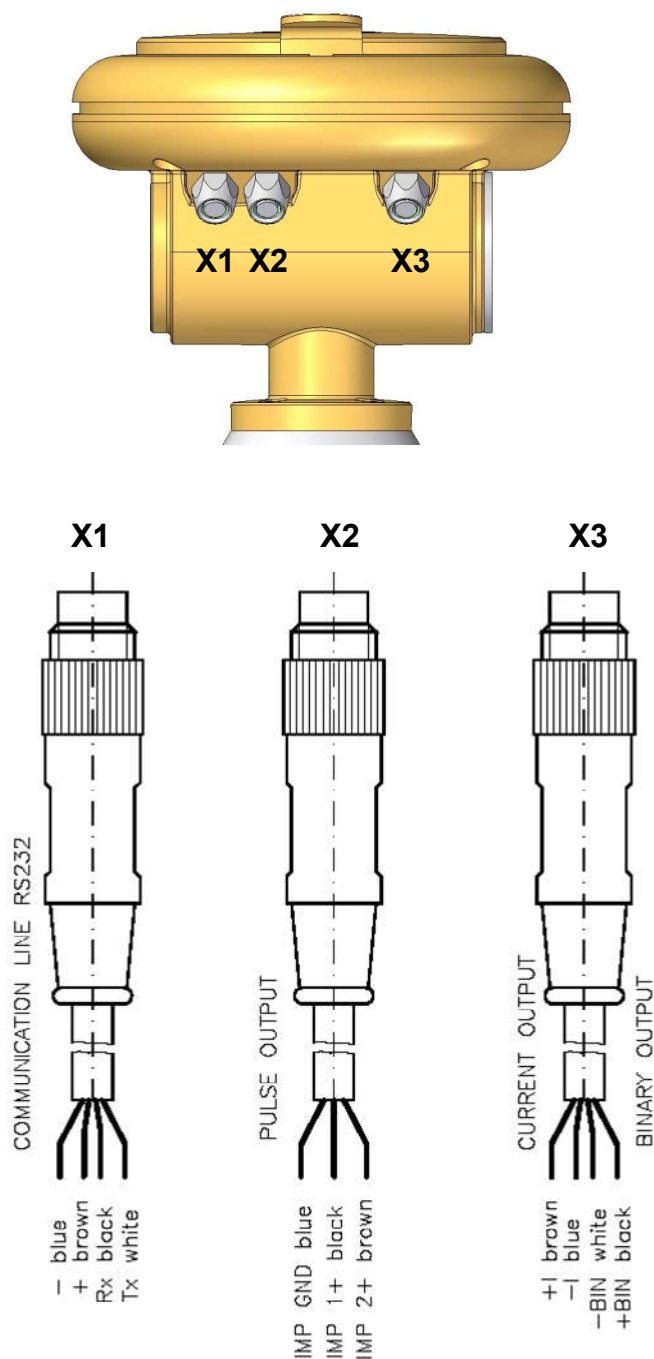



5.1.7. Electrical connections

The only active connector on FLOMIC FL50xx water and flow meters of standard design is connector X2 - pulse output. The openings provided for connectors X1 and X3 are blinded with metal lids meeting the requirements of protection class IP 68.

In cases of meter with additional functions all three connectors (X1, X2 and X3) may be installed. Should any of the outputs be unused, the respective connector shall be blinded with a screw-on cover M8x1 meeting the requirements of IP 68.

To avoid electromagnetic interference, the connecting cables to the electronic unit shall be laid at least 25cm away from the power cables of any other equipment.



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5.1.8. Sealed meters

The FLOMIC FL50xx water and flow meters are supplied with parameters set according to the customer requirements.

To prevent unauthorised interference with the meter setting, important meter parts are provided with stick-on assembly seals located on/at:

Electronic unit

- 2x bolts at the bottom of the electronic unit box
- 1x connection between the electronic unit box and the meter sensor
- 1x connection between the battery lid and the electronic unit box

Sensor

- 1x connection between the meter rating plate and the sensor body
- 2x connection between the ultrasonic probe covers and the sensor body

The FLOMIC water meters of the type series FL5024 and FL5044 can also be supplied as certified commercial meters based on type approval MID (OIML R 49), see Section 10 -ES TYPE TEST CERTIFICATE No: TMC 142/11-4817. In these cases, the locations of the seals/marks are strictly specified in the certification document (all assembly seals/marks with the exception of that placed at the connection between the battery lid and the sensor body are official).

5.2. *Operational start*

The meters are supplied calibrated and in a fully operational condition. The correct meter function is indicated by the vertical slash sign flashing with the measuring frequency (1Hz) and the display of the ERR symbol on the LC display. Upon the meter installation in the piping, its flooding and bleeding, the ERR symbol will disappear and the meter will start its normal measuring functions. Use the control pushbutton to check switching between the measured quantities shown on the display.

6. OPERATION

6.1. Reading of the measured data from the display

The display can show the values of up to four measured quantities and a check sum. The selection of the desired quantity is done by means of the control pushbutton (depress for 1s and wait for another second). In cases where the meter does not include any additional measuring functions, the display will show zero values for the missing measured quantities.

The correct meter operation is indicated by a vertical slash sign blinking with the measurement frequency (1Hz).

The need to replace the source battery will be indicated by a lighted battery sign.

In cases of error, the ERR sign will appear on the display (see Section 6.5. below).

With water meters of DN 200 and flow meters of DN 200, DN 250 and DN 300 dimensions, the sign ▼ at the bottom right-hand corner of the display indicates that the real values of instantaneous flow rate and of the aggregate fluid volume passed through the meter sensor are 10 times as great as the respective values shown on the display. The same applies to the stored flow rate and fluid volume data that are 10 times smaller than the actual/real values.

The standard meter version

Single-direction fluid flow measurements with the following data appearing on the meter display:

- Instantaneous flow rate with a + sign indicating the correct fluid flow direction (in agreement with the arrow sign on the meter sensor) and the word FLOW displayed; selectable measurement units [m^3/h , l/s, gal/min];
- The aggregate fluid volume passed through the meter sensor with a + sign indicating the correct fluid flow directions; selectable measurement units [m^3 , 10^3 gal].

The meter version including additional functions

Fluid flow measurements in both directions with the following data appearing on the meter display:

- Instantaneous flow rate with + or - sign and the word FLOW displayed; selectable measurement units [m^3/h , l/s, gal/min];
- The aggregate fluid volume passed through the meter sensor in either flow direction with + or - sign displayed, selectable measurement units [m^3 , 10^3 gal].

Fluid pressure measurements:

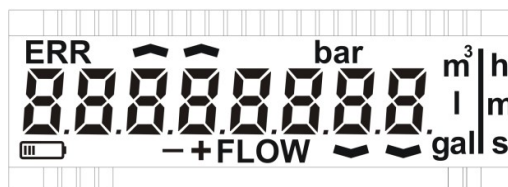
- Fluid pressure value in [bar].

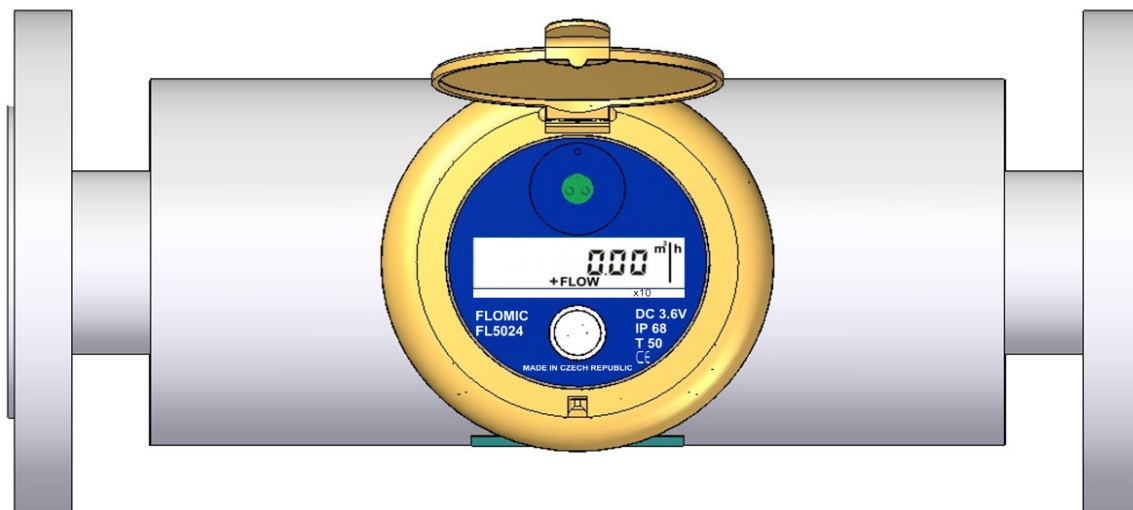
Both meter versions

In-flight fluid volume for calibration purposes. When switched to this item in the menu, the in-flight volume starts counting and displaying. After the menu is moved again to in-flight volume, the value is reset and the new in-flight volume calculation and display begins.

Display test

To test the meter display, keep the control pushbutton depressed for 5s whereby all display segments and signs should light up. Upon releasing the control pushbutton, the display will return to the instantaneous flow rate value display mode.





Measured data processing algorithms

- Instantaneous flow rate - double-beam sensor
The data shown on the display as well as those contained in the impulse and current outputs of a double-beam FLOMIC FL50xx meter are the arithmetic average of the latest six measurements.
- Instantaneous flow rate – single-beam sensor
The data shown on the display as well as those contained in the meter outputs are the product of a statistical processing of the measured data (statistic filter).

The aggregate fluid volume passed through the meter sensor

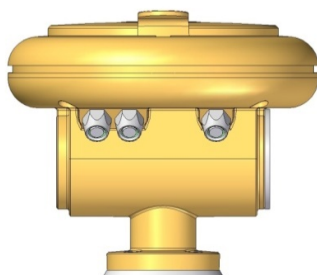
The fluid volume data are displayed with the precision of three valid digits after the decimal point of the selected measurement unit [m^3 , 10^3 gal] up to the maximum value 99999.999.

Upon exceeding this limit value, the decimal point will shift to the left so that the maximum aggregate fluid volume indicated on the meter is 999999.99 and, eventually, 9999999.9 [m^3 , 10^3 gal].

Taking into account practical measurement conditions and the meter lifetime, any further increase of the meter measurement range is considered unnecessary.

6.2. Electric outputs

The electric outputs are accessible via connectors X2 and X3.



6.2.1. Pulse outputs

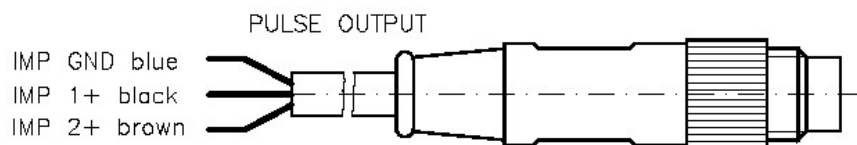
The pulse outputs for both flow directions (+/- FLOW) are connected to the socket of a 3-pole connector (X2). **These are passive and insulated outputs.**

Each passive output shall be powered from an independent insulated power source.

As optional accessory, the meter manufacturer offers to meters with pulse outputs a 5m cable terminated on one end with a matching 3-pole plug and free wires on the other cable end for interconnection to a master control system.

Interconnection cable for connector X2

Indication	Color of wire	Function
IMP1 +	black	Flow in direction of arrow on a sensor
IMP2 +	brown	Flow against direction of arrow on a sensor
IMP GND	blue	Common wire



The pulse output is insulated by means of an optocoupler with an open-collector NPN transistor:

- External power source voltage $U_z = 3V$ to $30V$
- Output current loading $2\mu A$ to $10mA$

Load resistance value:

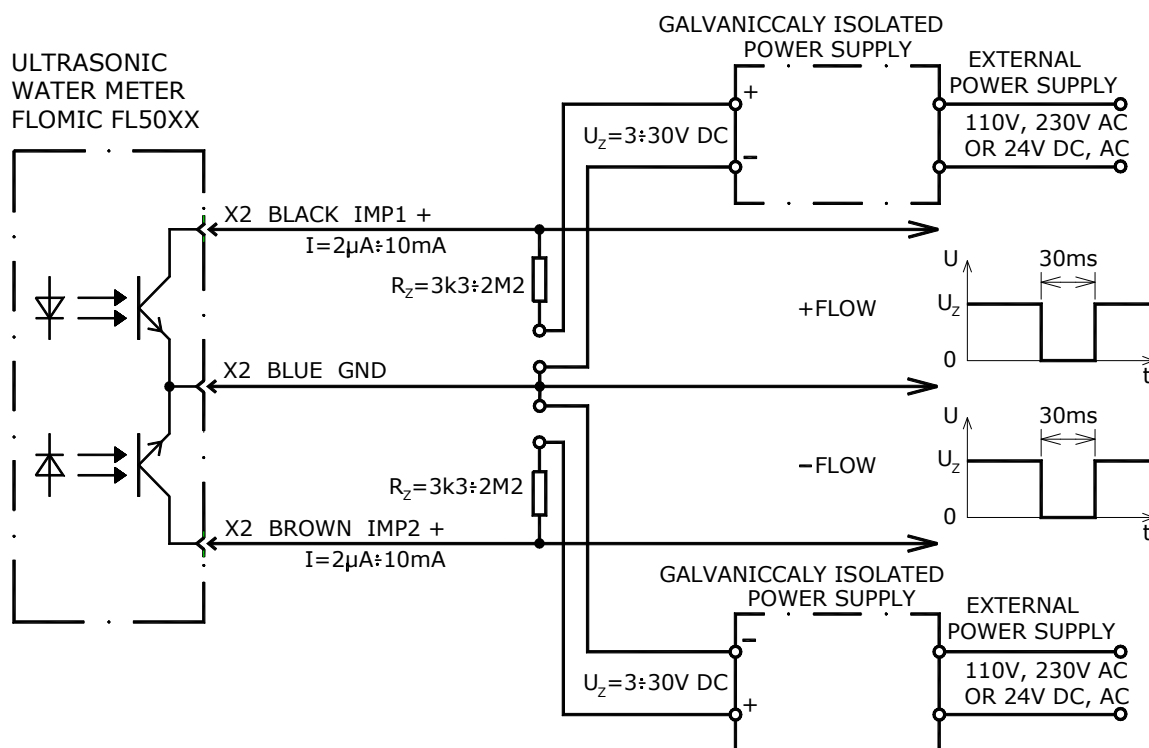
$$R_z [\Omega] = \frac{U_z [V]}{I [A]}$$

Maximum impulse frequency: 1 Hz
 Impulse width: 30 ms (fixed)

The maximum impulse frequency imposes a limit on the maximum flow rate. The flow rate ranges for individual sensor dimensions are given in Section 3.3.

In cases of short-term increase of the flow-rate values above the permitted maximum (Q_4), an ERR message on the display will indicate this condition and the corresponding information will be recorded in the data archive. The impulse frequency will not increase but the impulses that have not appeared at the outputs will be saved and sent later when the flow rate values drop below the maximum value again. Thus these immediately unsent impulses will not be lost and the master system will receive the correct number of impulses corresponding to the flow volume passed through the measuring point. However, in cases of long-term excess of the maximum flow rate value, the processor memory may overflow whereby some of the impulses will be lost.

Pulse output connection diagram



6.2.2. Current output associated with flow rate or fluid pressure quantities


The current output 4 to 20mA is connected to the socket of a 4-pole connector (X3). It is a passive and insulated output.

Each passive output shall be powered from an independent insulated power source.

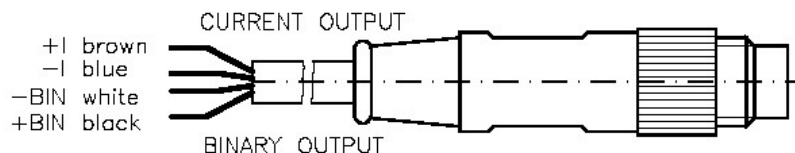
As optional accessory, the meter manufacturer offers to meters with a current output a 5m cable terminated on one end with a matching 4-pole plug and free wires on the other cable end for interconnection to a master control system.

Interconnection cable for connector X3

Indication	Color of wire	Function
+ I	brown	Current loop (instantaneous flow or pressure)
-I	blue	Current loop (instantaneous flow or pressure)
+ BIN	black	Binary output for indication of direction of flow

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– BIN	white	Binary output for indication of direction of flow
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External power source voltage: $U_z = 10V$ to $24V$

The highest possible resistance of the current loop (including the input resistance of the connected signal processing equipment):

$$R_z[\Omega] = \frac{U_z[V] - 7}{0.02}$$

Example: for power source voltage $U_z = 12V$ the maximum current loop resistance is 250Ω .

Flow rate measurement

In cases where the current output is associated with instantaneous flow rate of the measured fluid, then, upon exceeding the maximum flow-rate value (Q_4), the output current signal will no longer grow and the error message (ERR) will appear on the meter display.

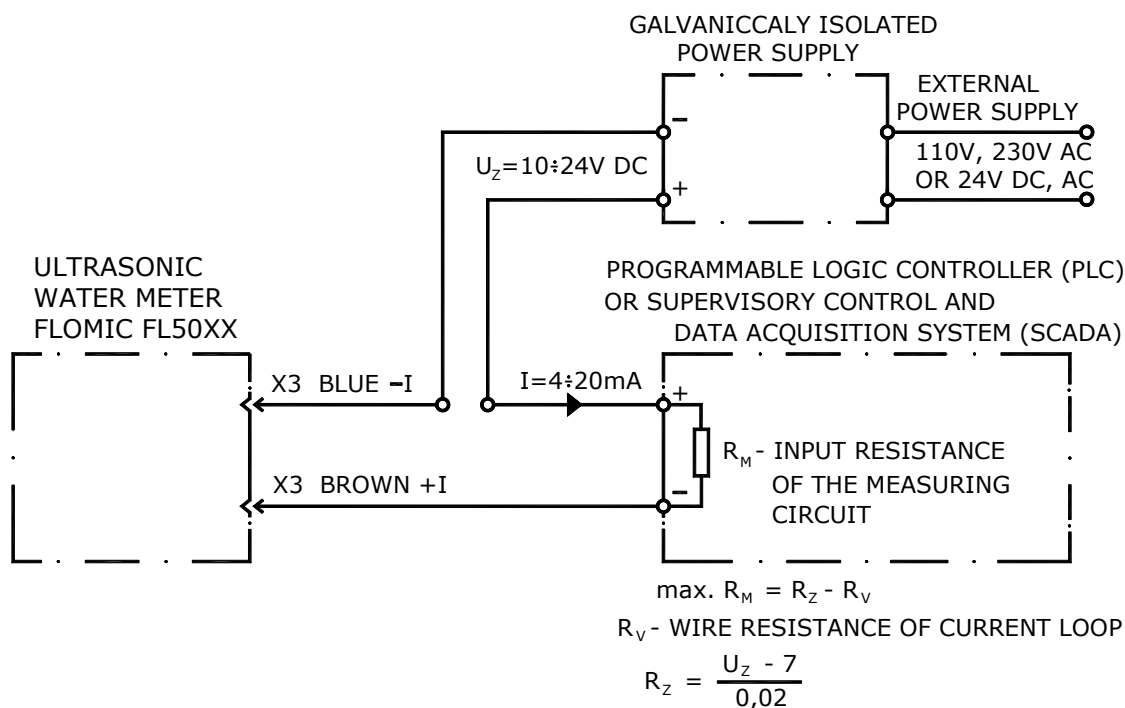
Pressure measurement

The FLOMIC FL50x4 water and flow meters of compact design may use a current loop for indication of instantaneous values of the flowing fluid pressure. This is one of the additional meter functions that need be preset during the meter manufacture.

The pressure measurement function can either be configured independently or in combination with the pulse output feature (see Section 6.2.1.).

The current output 4 to 20mA corresponds to the relative pressure values of 0 to 16 bar (the pressure indicated at empty piping is 0 bar).

Current output connection diagram



6.2.3. Binary flow-direction indication

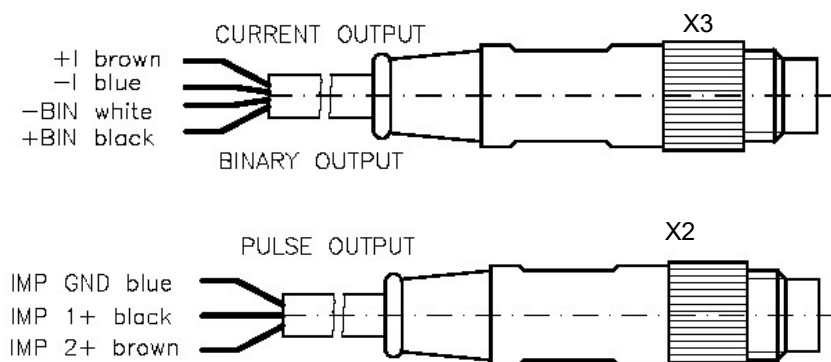
In cases where the current output 4 to 20mA is used for the purposes of instantaneous flow rate measurement (see Section 6.2.2. below), the flow direction can be indicated using the binary output. To process the binary output signals, the electronic unit need be preset for this function during the meter manufacture.

Binary output signals +BIN and - BIN are connected to the socket of connector X3. It is a **passive and insulated output**.

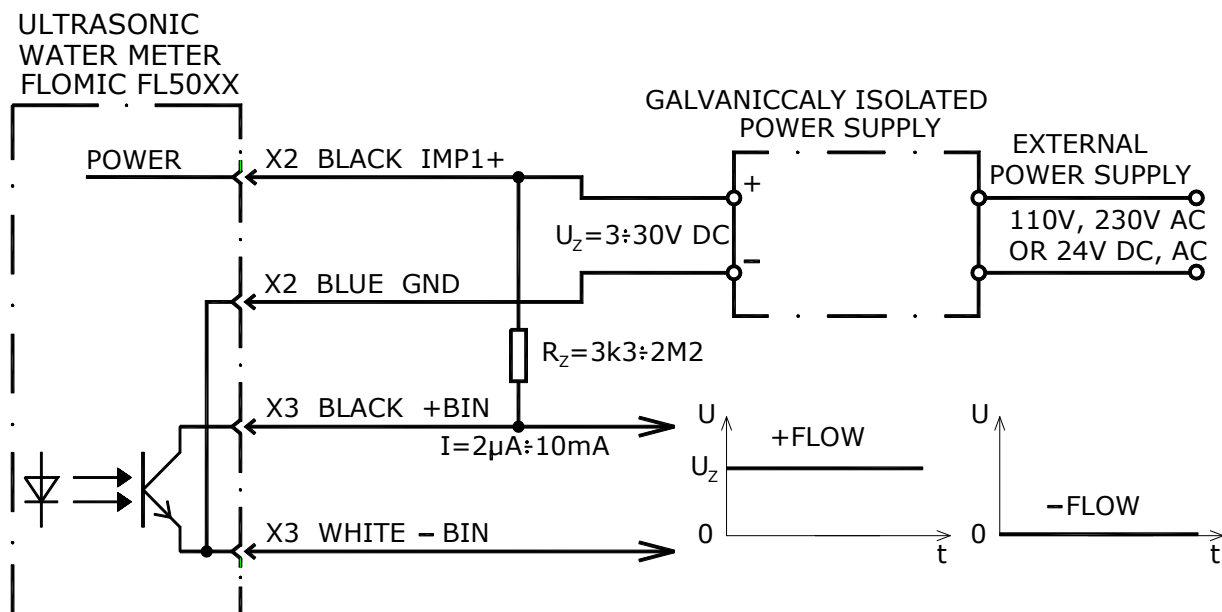
Each passive output shall be powered from an independent insulated power source.

The binary output function requires external power supply connected to the pulse output IMP1. That is why both connectors X3 and X2 (and the associated signal cables) need be used.

The black conductor of the X2 cable shall be connected to external power source of voltage U_z across resistor 100kΩ. The brown and blue conductor of the same cable shall remain unconnected.



Binary output connection diagram



If the fluid flow direction is as indicated by the arrow on the sensor body (+FLOW), the binary output will be at the source voltage level (U_z). In cases of opposite flow direction (-FLOW), the binary output voltage will be 0V.

Binary output parameters (a MOSFET transistor, channel N):

- External power source voltage $U_z = 3\text{V}$ to 30V
- Current loading: $2\mu\text{A}$ to 10mA

Load resistance value:

$$R_z [\Omega] = \frac{U_z [\text{V}]}{I [\text{A}]}$$

6.3. Power source

6.3.1. Battery lifetime and replacement

In cases of standard water/flow meter configuration, the battery lifetime is 8 years. The need for battery replacement will be indicated by the corresponding symbol shown on the meter display. To access the battery compartment, it is necessary to remove the assembly seals at the top and at the bottom of the electronic unit box.


Upon the battery removal, the following data will be saved in the meter memory:

- The aggregate fluid volume passed through the meter sensor in either fluid flow direction;
- The meter parameter setting;
- The archived data.

The electronic unit does not include any real-time circuit independent of power supply.

To retain the stored time data during the battery replacement operation, the following procedure should be carried out (with water and flow meters including the data archiving function):

- Prior to battery removal, read out the archived data using the ArchTermC program;

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- After the battery replacement, use the ArchTermC program again to read the archive setting parameters, whereby the correct time and date will automatically be set;
- Delete the archived data.

Recommended battery type

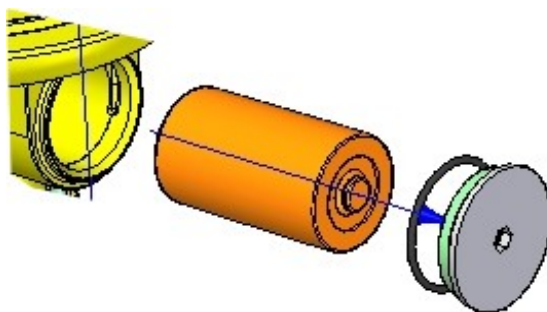
In consideration of the long lifetime requirement, the recommended battery type is TADIRAN SL 2780/S 3,6 V/19 Ah. In cases of air transport where the permitted lithium content in the battery is <1 g, a smaller battery SAFT Lithium 3,6 V/3,6 Ah, type designation LSH 14 light, accommodated in a plastic container of size D can also be used. The lifetime of that alternative battery in the water/flow meter of standard configuration is 1 year. This battery can be at any time replaced by recommended battery type with capacity 19Ah.

Battery replacement procedure

To remove the old battery, screw off, using Alien wrench 6, the lid on the battery compartment sealed with an O-ring 33x1.5mm. Lift the front contact (against the forcing spring) and remove the battery. The new battery shall be inserted into its compartment in the electronic unit with the negative pole at the bottom.


Mind the battery polarity – the incorrect polarity may irreparably damage the electronic unit circuits.

Insert the new battery in its compartment; while pressing the battery down, return the front contact to operating position. The positive battery pole must have a reliable contact with the front spring-loaded contact. Screw on the lid with the sealing O-ring, tighten and attach a stick-on assembly seal onto the contact plane.



6.3.2. Electronic unit powered from current loop

The power to the electronic unit of the FLOMIC water and flow meters of the type series FL50xx including additional functions can be supplied directly from a current loop. In that case, a special electronic module shall be inserted into the battery compartment.

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This current output function must be preset during the meter manufacture.

Upon selection of the current-loop feeding option, the data archiving and reading functions cannot be used.

Meter operational start in cases of power supply from the current loop

Unlike the battery-powered meter, water and flow meters configured for power supply from the current loop are dispatched in deactivated condition (including the display).

Install the meter sensor into the piping. The display will light up only after the current loop has been connected and energised. The correct meter function is then indicated by the vertical slash blinking with the measurement frequency (1Hz) and the ERR message shown on the LC display. Following the sensor flooding and bleeding, the ERR symbol will disappear and the meter will start its normal measuring functions. Using the control pushbutton, check the function of selecting the desired measured quantity to be shown on the display.

The current output connection (connector X3) is as described in Section 6.2.2.

6.4. Communication interface

The FLOMIC water and flow meters of the type series FL50x4 and FL50x5 are provided with insulated communication interface RS232 facilitating:

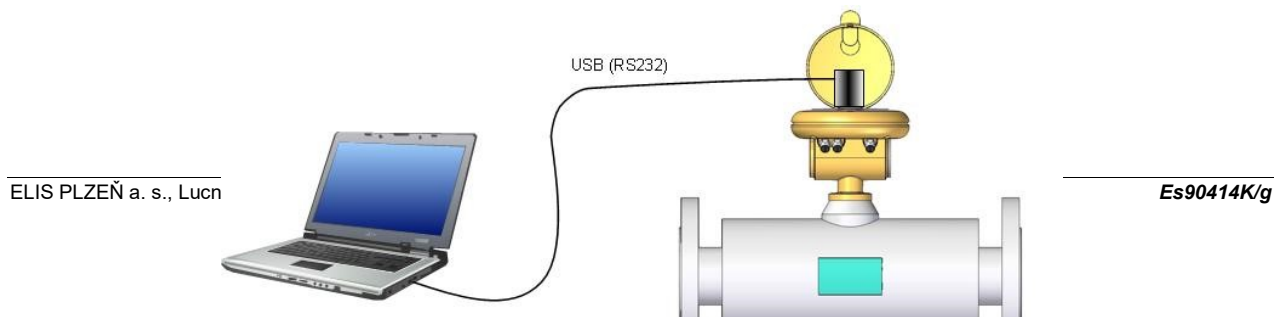
- Reading of all measured quantities:
 - Instantaneous flow rate + /-
 - Aggregate fluid volume passed through the meter sensor + /-
 - Fluid pressure in the sensor
- Flow-meter parameter setting
- Reading of the archived data, including:
 - Flow rate
 - Aggregate fluid volume passed through the meter sensor in the given direction (+or -)
 - Pressure of the flowing fluid
 - Real times of any error condition start and termination
 - Descriptions of diagnosed errors
 - Watch dog (WD) actions

Connection to the communication interface RS232 is possible using:

- Optical probe, or
- Cable via connector X1

6.4.1. Communication via optical probe

The optical probe shall be placed in a recession on the electronic unit cover where the exact probe position is secured by an arrest pin and the probe is held on the cover by means of a permanent magnet.



The meter software makes it possible to archive all measured quantities with sampling frequency selectable in the range from 1 minute to 1 year. Apart from the measured data, archived also are error messages (see Section 6.5.) and date and time of their occurrence.

To set the archive parameters and read the archived data, the meter user shall have the necessary tools herein referred to as "SVAO 1 set".

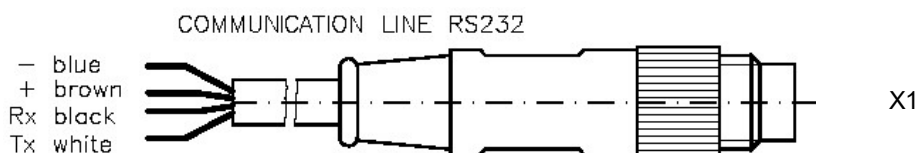
The SVAO 1 set includes:

- Optical probe OS 7.0 and a 2m cable terminated with an USB connector
- CD including:
 - Program ArchTermC for setting the archive parameters and reading the archived data
 - Program ArchTermC manual
 - Controllers for optical probe OS7.0USB

6.4.2. Communication via RS232 cable

The meter software makes it possible to archive all measured quantities with sampling frequency independently selectable in the range from 1 minute to 1 year. Apart from the measured data, archived also are error messages (see Section 6.5.) and date and time of their occurrence.

The insulated RS232 communication interface is accessible via connector X1.



To set the archive parameters and read the archived data, the meter user shall have the necessary tools herein referred to as "SVAK 1 set".

The SVAK 1 set includes:

- The RS232 communication cable 5 metres long, provided with a plug matching connector X1 on one end and a 9-pin Canon connector on the other end (to be connected to a computer).
- CD including:
 - Program ArchTermC for setting the archive parameters and reading the archived data
 - Program ArchTermC manual

Should the meter location be difficult to access, additional tools described below are available to ensure higher operator comfort.

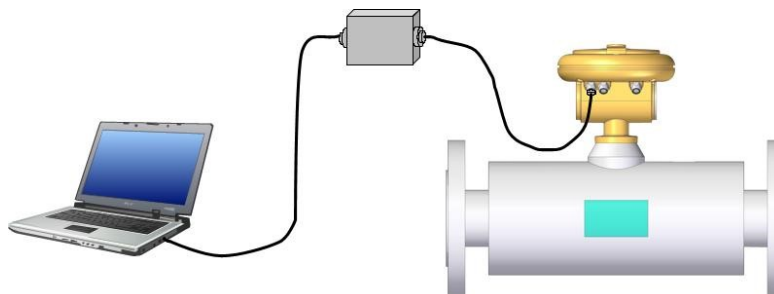
Connection to RS232 interface:

- Connecting box meeting the IP68 requirements with a 5m cable terminated with a 9-pin Canon connector

Connection to USB interface:

- Connecting box meeting the IP68 requirements with a 5m cable terminated with a 9-pin Canon connector
- RS232-USB convertor
- CD including:
 - RS232-USB convertor user manual
 - Controllers for the Windows operation system

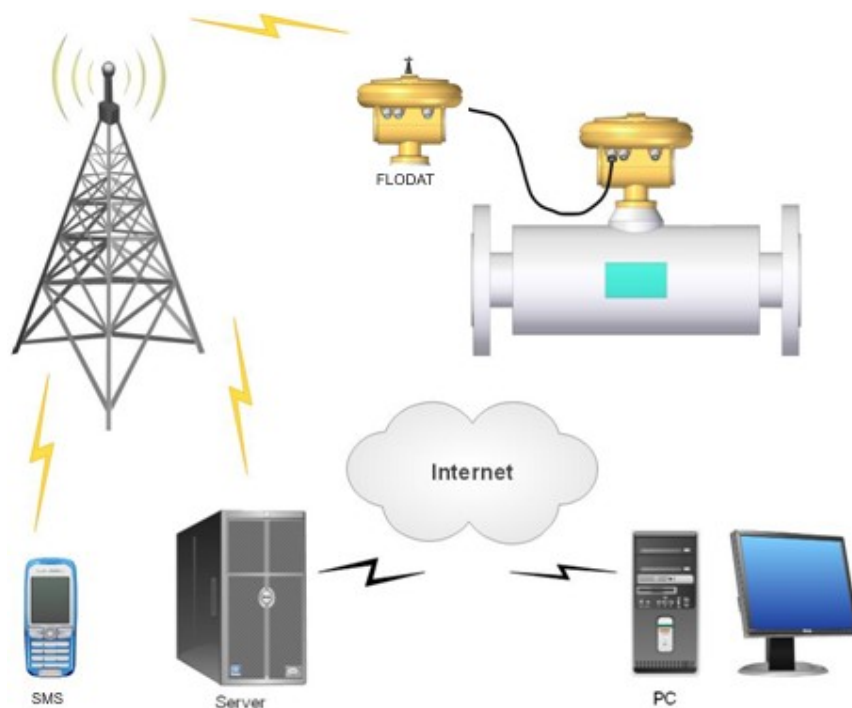
At all times when the communication interface is not used, connector X1 shall be tightly closed using a screw-on cover M8x1 in combination with a matching O-ring.




RS232 (USB Driver)

6.4.3. GSM module

The battery-powered communication module FLODAT is intended for collection and transfer of digital data from the FLOMIC water and flow meters of the type series FL50xx operated on sites with no line voltage available. The communication module facilitates data transfer to a server by means of GPRS, monitoring of all measured quantities, as well as evaluation of the pre-set limit and slope conditions that may initiate immediate data transfer and dispatch of warning SMSs. Each meter must have its own communication module. Detailed description of the module functions and application can be found in the FLODAT Data Communicator manual.



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6.5. Identification of errors listed in the archive

Any meter failure will be reported at the meter display by means of the ERR symbol.

The detailed information on failures is stored in the archive in the format Date, Time, EBx or EEx where x is the error number (1 to 4), EB indicates the error condition start and EE the error condition termination.

ERR1 - the sensor is impenetrable for ultrasonic signal

The frequent cause of this error condition is aerated sensor, air bubbles or mechanical particles scattered in the measured fluid, or disregarding the system design rules referred to in Section 5 hereof. In the latter case, check the meter placement for possible nonconformities. **Defects originating from incorrect meter placement in piping cannot be claimed and subject to manufacturer's warranty.**

ERR2 - too great difference between the signal flight times in and against the fluid flow direction

The cause of this error can be aeration of one ultrasonic probe which may be a temporary condition at the time when the piping system is being filled with the fluid. Heavy contamination of the head part of one probe may have a similar effect. The method of correction should be consulted with the meter manufacturer.

ERR3 - error of internal A/D converter


The cause of this error can be strong electromagnetic interference or a meter defect. Check the meter placement and electrical connections in reference to the correct system design rules as referred to in Section 5 hereof.

ERR4 - instantaneous flow rate is higher than overloading flow rate value Q_4

The archived data include, apart from the error messages, information on any WD actions. The Watch Dog action consists of the meter restart in cases of discontinuation of the normal meter operation due to extreme external interference or internal hardware malfunction.

Low battery voltage and the need to replace the battery will be indicated by the battery sign lighted on the meter display. Information on the battery voltage can also be obtained via the system communication channel or, in cases where the FLODAT communication module is used, via the GSM network.

If the display goes completely out, check the battery voltage. It should be higher than 3V. To replace the flat battery, follow the instructions in Section 6.3.1. Should the meter fail to restore its functions with the new battery, send it to the manufacturer for repair.

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7. CALIBRATION

Ultrasonic water and flow meters FLOMIC FL50x4 and FL50x5 are supplied calibrated in three points according to standard EN 14154-3.

On customer's request, calibration can be carried out in 5 or 9 points or otherwise as agreed with the meter manufacturer.

To check the meter functions, precision or calibration, use always the test methods specified in or conforming to the requirements of standard EN 14154-3.

Warning:

The standard calibration is done on pulse output. Upon agreement with the manufacturer, water and flowmeters can be calibrated nominal by means of current output.

Guaranteed parameters of measurement accuracy always apply only to the electrical output used for the flowmeter calibration. The current output, not used for calibration purposes, are recommended to be used only for measurements with the permissible accuracy that is 1 – 2 % lower than the accuracy achieved when calibrated with the pulse output.

Optionally it is possible under an agreement with the manufacturer to do the calibration of water and flow meters on current output only.

During a checking measurement carried out by the customer is necessary to use the same electrical output that was used for calibration by manufacturer.

8. WARRANTY AND POST-WARRANTY SERVICES

8.1. Warranty services

Warranty services include product repairs performed free of charge within the warranty period either by the meter manufacturer or their duly authorised partner service centre.

Product repair is performed free of charge in the cases where the product defect has been identified within the specified warranty period as caused by defective material, component part or non-standard workmanship.

Should a product be found irreparable due to the above reasons, it will be replaced free of charge.

Warranty services shall be provided either directly by the manufacturer, a duly authorised service centre or product distributor (provided these have been duly trained to perform such activities and can prove their capabilities by a certificate in writing).

Warranty services are not applicable to:

- products with broken/damaged assembly or metrological seals;
- products with defects caused by incorrect assembly or installation - disregarding the rules of correct meter application as outlined in Section 5 hereof;
- products with defects caused by non-standard use;
- products where the electronic unit was damaged by reversing the battery polarity;
- products alienated or stolen;
- products with defects caused by force majeure or elementary disaster;
- products bearing traces of mechanical damage.

Requirements for warranty services or repair shall be communicated to the manufacturer **in writing** (by e-mail, fax or registered letter).

Should the manufacturer not acknowledge any warranty claim, this fact will be made known to the customer **in writing** whereby the product repair costs will be invoiced to the customer.

In cases of commercial meters, any service action shall be followed by metrological verification of the meter parameters performed by a certified metrological centre.

Representation on product decontamination

In reference to the applicable environmental, labour safety and health protection regulations, attached to any request for service action shall be a **representation in writing on meter decontamination** in cases the meter has been exposed to the action of any of the following substances:



biologically corrosive
dangerous



detrimental



toxic unknown or
to health



dangerous

8.2. Post-warranty services

Post-warranty services include any and all product repairs where the subject defects originated after expiry of the agreed warranty term. Such services (whether performed at the manufacturer's premises or anywhere else as directed by the customer) will be invoiced by the manufacturer to the customer.

In the cases of commercial meters, each repair action shall be followed by metrological verification of specified meter parameters by a certified metrological centre.

Requirements for post-warranty services shall be communicated to the manufacturer **in writing** (by e-mail, fax or registered letter).

9. PRODUCT ORDERING

ASSOCIATED DOCUMENTS, STANDARDS AND CERTIFICATES

Standards


EN 14154-1+A2	Water meters - Part 1: General requirements
EN 14154-2+A2	Water meters - Part 2: Installation and application conditions
EN 14154-3+A2	Water meters - Part 3: Test methods and equipment

Manuals

FLODAT Data Communicator ELIS PLZEŇ a.s.

Product type verification, ES certificate

Certificate No: TMC 142/11-4817, ultrasonic water meters, type designation FLOMIC FL5024 and FLOMIC FL5044 (ČMI - the Czech Metrological Institute)

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