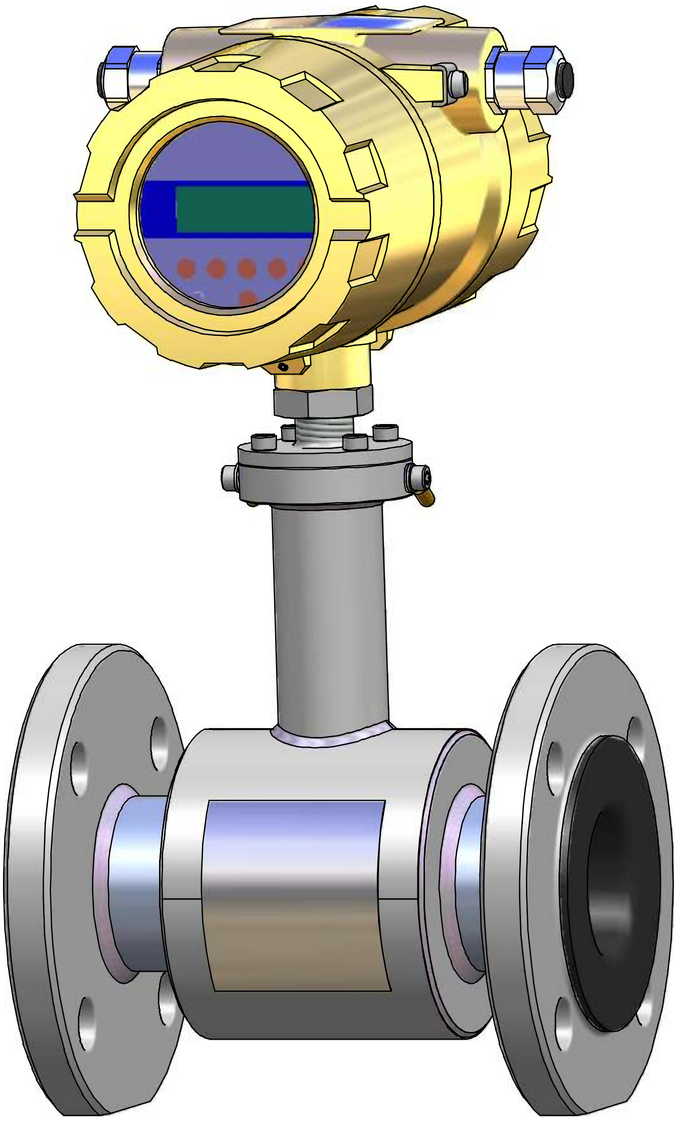
Electromagnetic Flow Meter

FLONET FH20XX



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1. APPLICATION

The FLONET FH20XX electromagnetic flow meter has been designed to measure volume flow rates of electrically conductive liquids in closed piping systems. Measurements can be done in both flow directions, with high measurement accuracy over a wide range of flow rates (0.1 to 10 m/s). The minimum required conductivity of the measured medium is 5 µS/cm.

The microprocessor controlled FLONET FH20XX transmitter processes measurement data and displays and transmits various types of measurement results. The FLONET FH20XX is communication enabled and supports optional the HART® protocol. Although basic configuration settings such as transmitter calibration are realized at the factory, other settings such as those for measurement data processing, analysis, display and output are user definable.

User settings are protected by a user definable password.

Settings that are essential for proper operation of the transmitter in conjunction with the sensor (e.g. calibration and initialization values) are accessible only to service technicians via a password that is not provided to customers.

2. MEASUREMENT PRINCIPLE

The function of an electromagnetic flow meter is based on Faraday's electromagnetic law. The meter sensor consists of a non-magnetic and non-conductive tube with two embedded measuring electrodes to pick up the induced voltage. To create an alternating magnetic field, two coils are fitted onto the tube in parallel with the plane defined by the active parts of the measuring electrodes. Now if a conductive liquid flows across magnetic field **B**, voltage **U** will appear on the measuring electrodes proportional to the flow velocity v and the conductor length **l**.

U = B x l x v

U	induced voltage
B	magnetic flux density
l	distance between the measuring electrodes
v	liquid flow velocity

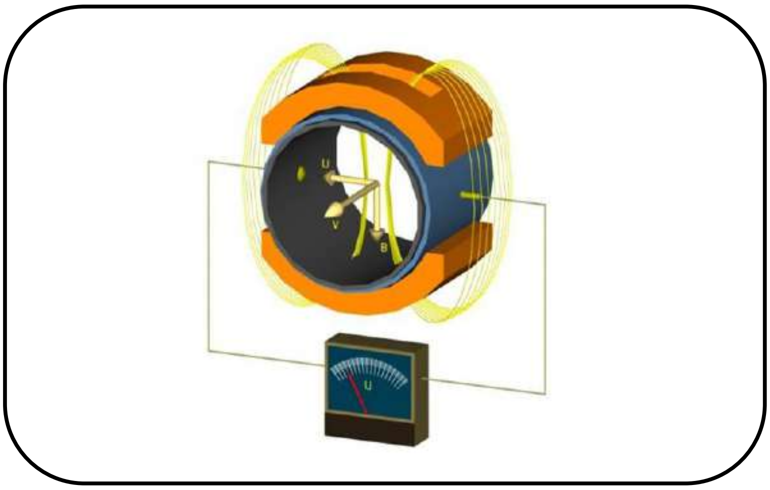


Fig. 1 – Measurement principle

As the magnetic flux density and distance between the electrodes are constant, the induced voltage is proportional to the liquid flow velocity in the tube. The value of the volume flow rate can then be readily determined as a product of the flow velocity and square section of the tube, **Q = v x S.**

3. TECHNICAL DESCRIPTION

The electromagnetic flow meter consists of a sensor through which the measured liquid flows and an electronic unit where the low-level signal from the sensor is modified to a standardised form suitable for further processing in various industrial electronic devices. The output signal is proportional to the volume flow rate of the measured liquid. The only factor limiting the application of electromagnetic flow meters is the requirement that the measured liquid shall be conductive and non-magnetic. The electromagnetic flow meter can be designed either as a compact device or with the sensor remote from the associated electronic unit. In the former case, the electronic unit is fitted directly onto the meter sensor, in the latter case it is connected to the sensor by a special cable.
The sensor design shall take into consideration the type of the measured liquid and its operational parameters. To facilitate fitting into the liquid piping, the sensor can be provided with end flanges, screwing, or it may be of a sandwich design. The supply voltage, types of output signal and communication interface can be selected according to the customer requirements.
The basic configuration of the electromagnetic flow meter includes insulated passive binary outputs (each with an optocoupler including a transistor output) and the current with HART communication interface.

4. SENSOR TECHNICAL PARAMETERS

The sensor environment must be free of any strong magnetic fields.

4.1 Selection of correct sensor size

The following table shows minimum and maximum flow rates for various sensor sizes and flow velocities ranging from 0.1 to 10 m/s. The best operational properties will be achieved at the flow-velocity range of 0.5 to 5 m/s. For lower flow velocities, the measurement accuracy is worse while at higher flow velocities the turbulences at contact edges may cause undesirable interference.

Minimum and maximum flow rates for various sensor sizes
Qmin corresponds to flow velocity 0.1 m/s
Qmax corresponds to flow velocity 10.0 m/s

DN	litre / s		m^3 / hour	
	Qmin	Qmax	Qmin	Qmax
15	0.018	1.8	0.065	6.5
20	0.0333	3.33	0.12	12
25	0.05	5	0.18	18
32	0.0833	8.33	0.30	30
40	0.125	12.5	0.45	45
50	0.2	20	0.72	72
65	0.3333	33.33	1.2	120
80	0.5	50	1.8	180
100	0.7777	77.77	2.8	280
125	1.1944	119.44	4.3	430
150	1.8055	180.55	6.5	650
200	3.194	319.4	11.5	1150
250	5	500	18	1800
300	7	700	25.2	2520
350	9.72	972	35	3500
400	12.5	1250	45	4500
500	20	2000	72	7200
600	27.78	2778	100	10000
700	38.89	3889	140	14000
800	50	5000	180	18000
900	63.89	6389	230	23000
1000	77.78	7778	280	28000
1200	111.11	11111	400	40000

Table 1 - Minimum and maximum flow rates

Operational flow rates and flow velocities for various sensor sizes

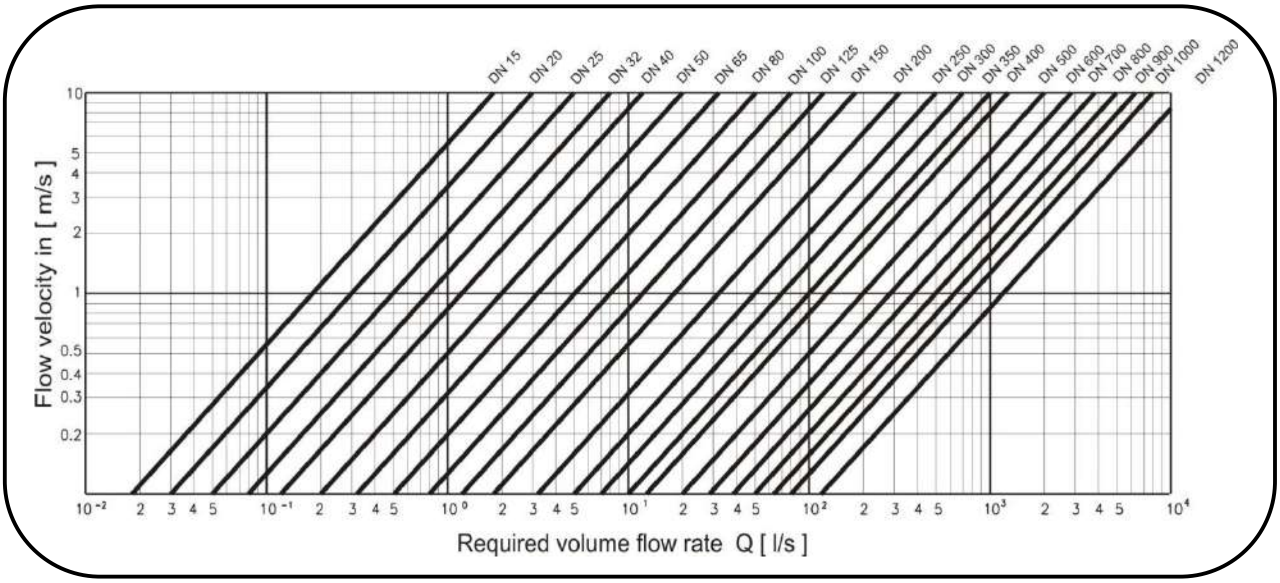


Fig. 2 - Operational flow rates

4.2 Operational pressure of measured liquid

The standard flow-sensor versions have the following pressure ratings:

Flanges according EN1092-1

Nominal size of sensor	Pressure rating
DN 15 – DN 40	PN 40
DN 50 – DN 200	PN 16
DN 250 – DN 300	PN 10

Tab. 2a Nominal size and pressure rating

Flanges according ASME B16.5

Nominal size of sensor	Pressure rating
NPS ½“ ÷ 12“	Class 150

Tab. 2b Nominal size and pressure rating

On request, any sensor can be supplied for pressure rating PN 6 to PN 40. The choice of pressure rating is primarily derived from the maximum allowable working pressure of the measured liquid, taking into account the nominal size and pressure rating of the flanges on the associated piping. Consideration shall also be given to the liquid temperature.

4.3 Selection of electrode material

In most cases, electrodes made of stainless steel, quality grade 1.4571 (316Ti) are satisfactory. However, in special applications it may be necessary to select a higher-quality material.
It is possible to do a choice from following electrodes materials: hastelloy C276, titanium, tantalum, platinum-rhodium (PtRh10). It is possible to use other kind of material under an agreement with the producer of flow meters.

4.4 Selection of sensor tube lining

The sensor lining material selection depends on the operational parameters of the measured liquid.

Hard rubber (HR)
Hard rubber is suitable for almost application in water industry. It is possible to use it for acids and alkalis of middle concentration and with working temperature +5°C to 80°C (158°F to 176°F).

Soft rubber (SR)

Soft rubber with high resistance against abrasion is suitable for less chemical aggressive non-oxidation environment, but with a range of abrasive parts. It is well resistive against dilatation and rapid temperature changes in max range 0°C to 80°C (32°F to 176°F).

Rubber for drinking water
Hard rubber is suitable for almost all applications in water industry. It has the certificate for using for drinking water. It is suitable for acids and alkalis of middle concentration and with working temperature +5°C to 80°C (158°F to 176°F).

PTFE
PTFE lining is a universal solution for highly corrosive liquids and temperatures ranging from –20°C to +110°C (-4°F to 230°F), on request up to +150°C (302°F). Typical applications are in the chemical and food processing industries.

E-CTFE
E-CTFE lining is a universal solution for flow meters from DN 300 and higher for corrosive liquids and temperatures ranging from -20°C to +110°C (-4°F to 230°F), on request up to 130°C (266°F). Typical applications are in the chemical processing industries.

4.5 Operating conditions

4.5.1 Installation conditions

The Electronic unit can be installed directly on the sensor (compact version) observing the operating conditions of the sensor or be mounted remotely on the outside (remote version).

4.5.2 Compact version

At the compact version the transmitter housing SG2 is mounted on the sensor. Therefore no cable is necessary between sensor and transmitter.

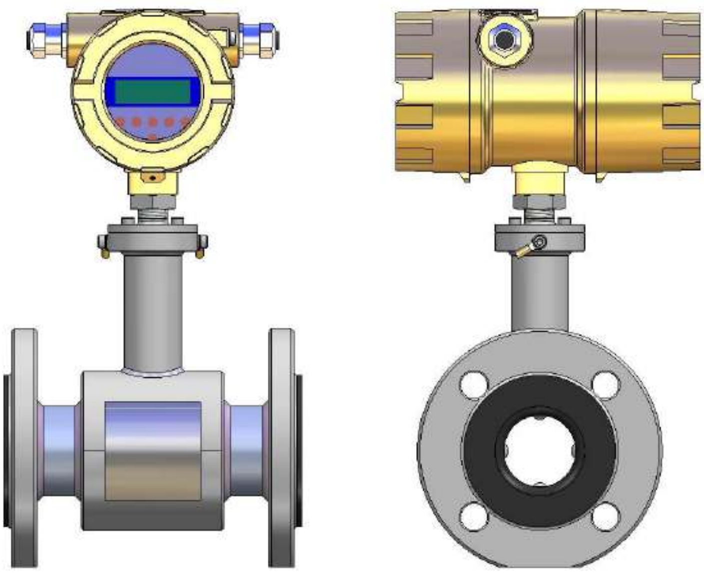


Fig. 4 - Compact design solution for a flanged sensor with associated electronic unit

4.5.3 Remote version

The remote meter version is used at the measurement spots with ambient temperature exceeding 60°C (140°F) where the reliable function of the electronic unit would not be ensured at all times. In such cases, use the remote meter version and place the remote electronic unit at a location where the ambient temperature never exceeds 60°C (140°F).

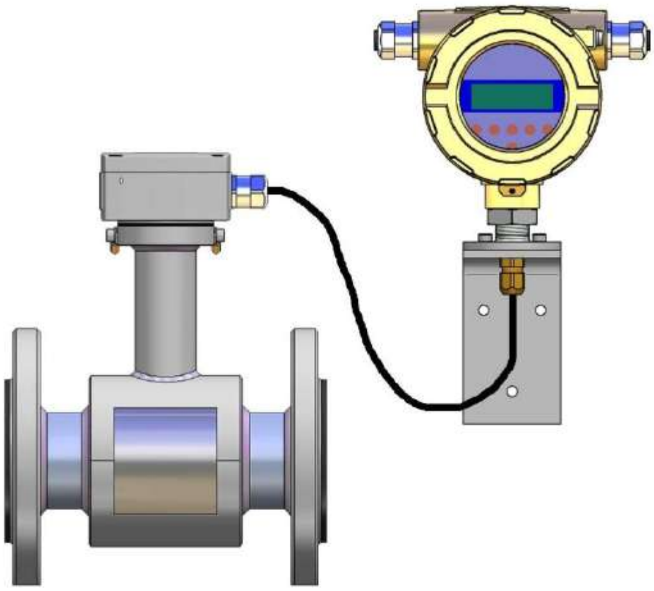


Fig. 5 - Flanged sensor connected by a cable with the associated remote electronic unit

Furthermore, the transmitter needs to be mounted remotely from the sensor if

- the mounting area is difficult to access
- there is a lack of space
- there is strong vibration
- medium and ambient temperatures are extremely high

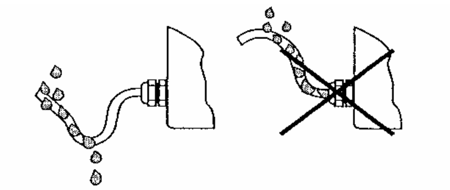


Fig. 6 - Proper installation of cables at high humidity and wetness

The Electronic unit has to be mounted free of vibrations!

To prevent electromagnetic interference via the connecting cable, the sensor and remote electronic unit of the meter in the remote version should be located as close as possible to one another.
The maximum cable length depends on the conductivity of the measured liquid (see Fig. 5).

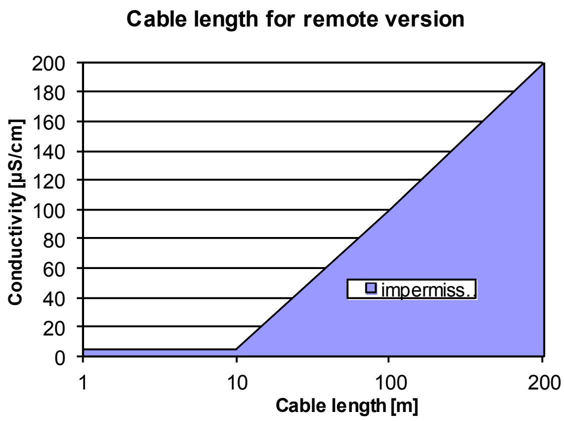


Fig. 7 - The maximum cable length

⚠	**Caution:** For the remote version, the minimum permissible conductivity of the medium is determined by the distance between the sensor and the transmitter. The maximum cable length to ensure accuracy is 200 m. For the cable type see Section 12.6 Cable specification

⚠	**Caution:** • The electrode cable must be fixed. If the conductivity of the medium is low, cable movements may change the capacity considerably and thus disturb the measuring signal. • Do not lay the cables close to electrical machines and switching elements. • Equipotential bonding must be ensured between sensor and transmitter. • Do not connect or disconnect the field coil cable before the primary power of the meter has been disconnected!

4.5.3.1 Terminal box for remote version

In a remote version of flow meter FLONET FH20XX is placed on the body of the sensor aluminum housing with connection terminals box.

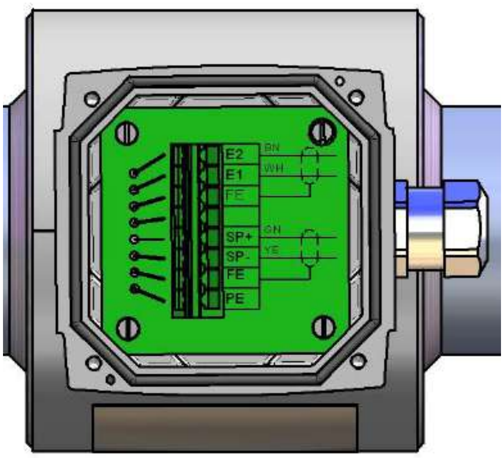


Fig. 8 – Connection of terminal box for remote version

The transmitter is supplied with a permanently attached connecting cable in protection class IP67. The other end of the connecting cable is loose. The customer connects the cable to the sensor terminal box itself. Terminal box is equipped with a gland M20x1.5 and terminal board with WAGO terminals. The housing is capped with O - ring. In this case it is the sensor with IP67 protection.

If it is required non-standard protection class of sensor IP68, inside of the sensor´s terminal box is the connecting cable already connected into terminal and the box is fully filled with sealing compound.

4.6 Dimensions of flanged sensor

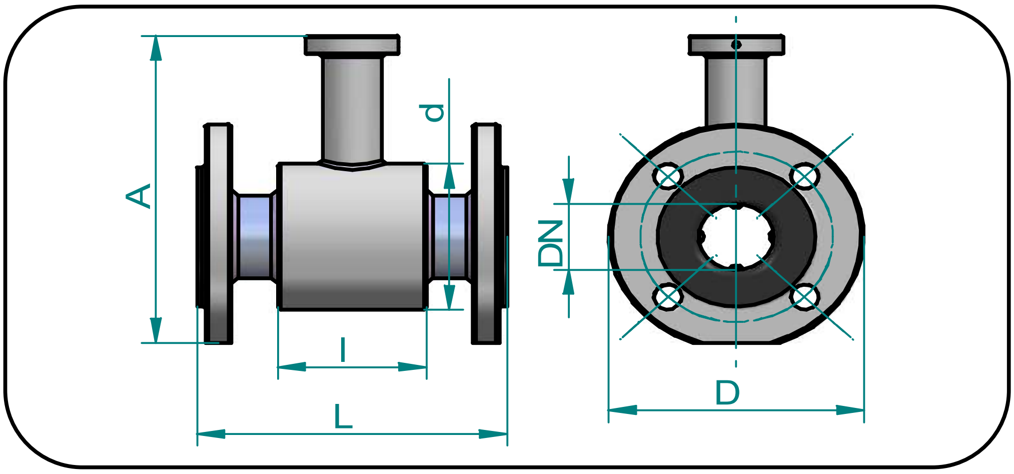


Fig. 9 - Dimensions of flanged sensor

Dimensions of sensors with flanges according to EN 1092-1.

Pressure rating	DN	D	d	A*	L	l	Weight [kg]
PN 40	15	95	62	164	200	66	3
	20	105	62	170	200	66	3
	25	115	72	180	200	96	3
	32	140	82	199	200	96	4
	40	150	92	209	200	96	4
	50	165	107	223	200	96	6
PN 16	65	185	127	244	200	96	9
	80	200	142	260	200	96	14
	100	220	162	280	250	96	16
	125	250	192	310	250	126	19
	150	285	218	340	300	126	25
	200	340	274	398	350	211	41
PN 10	250	395	370	480	450	211	54
	300	445	420	535	500	320	77
	350	505	480	584	550	320	92
	400	565	530	642	600	320	116
	450	615	581	695	600	320	150
	500	670	640	752	600	320	167
	600	780	760	870	600	320	315
	700	895	880	990	700	420	360
PN 6	800	975	960	1100	800	420	427
	900	1075	1040	1185	900	520	510
	1000	1175	1140	1290	1000	520	580
	1200	1405	1340	1510	1200	520	680

Table 3 – Dimensions of sensor with flanges according to EN 1092-1

* Dimension A (sensor height) is net of the electronic unit box (or terminal box in the remote meter version).

The sensor weight data are only approximate.

Dimensions of sensors with flanges according to
ASME (ANSI) B16.5 class 150 (from 1/2” to 24”) and AWWA class B (from 28” to 48”)

Pressure rating	NPS	D	d	A*	L	l	Weight [kg]
class 150 (according to ASME)	1/2"	88.9	62	172	200	66	3
	3/4"	98.6	62	177	200	66	3
	1"	108	72	187	200	96	3
	1 1/4"	117.3	82	197	200	96	4
	1 1/2"	127	92	207	200	96	4
	2"	152.4	107	227	200	96	6
	2 1/2"	177.8	127	249	200	96	9
	3"	190.5	142	263	200	96	14
	4"	228.6	162	292	250	96	16
	5"	254	192	320	250	126	19
	6"	279.4	218	346	300	126	25
	8"	342.9	274	405	350	211	41
	10"	406.4	370	485	450	211	54
	12"	482.6	420	548	500	320	77
	14"	533.4	480	604	550	320	92
	16"	596.9	530	660	600	320	116
	18"	635	581	705	600	320	150
	20"	698.5	640	766	600	320	167
	24"	812.8	760	883	600	320	315
class B (according to AWWA)	28"	927.1	863	992	700	420	360
	32"	1060.45	957	1106	800	420	427
	36"	1168.4	1058	1210	900	520	510
	40"	1289.05	1156	1320	1000	520	580
	48"	1511.3	1373	1539	1200	520	680

Table 4 - Sensor dimensions for various rated diameters

* Dimension A (sensor height) is net of the electronic unit box (or terminal box in the remote meter version).
The sensor weight data are only approximate.

4.7 Dimensions of flangeless sensor

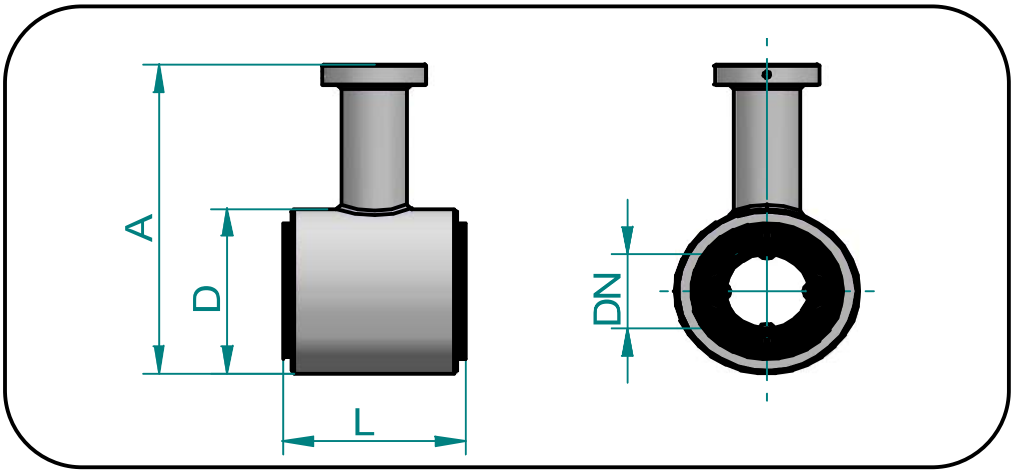


Fig. 10 - Dimensions of flangeless sensor

Dimensions of flangeless sensors

	DN	D	A*	L	Weight [kg]
PN 40	20	62	145	74	1
	25	72	158	104	2
	32	82	168	104	2
	40	92	179	104	2
	50	107	192	104	3
PN 16	65	127	212	104	3
	80	142	227	104	4
	100	162	247	104	4
	125	192	277	134	6
	150	218	303	134	8
	200	274	359	219	10

Table 5 - Dimensions of flangeless sensors diameters

* Dimension A (sensor height) is net of the electronic unit box (or terminal box in the remote meter version).
The sensor weight data are only approximate.

Caution: Connection for counter flanges ASME (ANSI) for flangeless version is produced from DN25 to DN200.
(Sensors are one dimension smaller due the installation from DN25 up to DN80; for example: request from customer DN25 means sensor DN20).
From DN100 to DN200 sensors are the same diameters.

Note: The grounding rings for flangeless version: size of the grounding rings should be the same size as a size of the existing pipe - valid for standard EN 1092-1 and ASME (ANSI).

4.8 Flow sensor specifications

Sensor size	Flanged sensors, DN 15 to DN 1200 (NPS ½” to 48”) Flangeless sensors, DN 20 to DN 200 (NPS 1” to 8”)
Maximum allowable working pressure	with EN 1092-1 flanges 40 bar at RT* for DN 15 to 50/ PN40 16 bar at RT* for DN 65 to 200/ PN16 10 bar at RT* for DN 250 to 750/ PN10 6 bar at RT* for DN 800 to 1200/ PN6 *RT – reference temperature - -10 to +50°C with ASME(ANSI) B16.5 flanges 230 psig at -20° to +100°F (NPS ½“ to 10“ class 150) 150 psig at -20° to +100°F (NPS 12“ to 24” class 150) with AWWA flanges 86 psig at -20° to +100°F (NPS 28” to 48” class B)
Mechanical connection	Flanges according to EN 1092-1, ASME (ANSI) B16.5, AWWA Standards Flangeless Others
Earthing	On flanges Earthing rings Earthing electrode
Flow velocity of measured liquid	From 0.1 m/s to 10 m/s
Maximum temperature of measured liquid	Up to 110ºC (230°F) up to 150°C (302°F) for request (for detailed information see article 4.4)
Minimum conductivity of measured liquid	20 µS/cm, 5 µS/cm in special applications
Empty pipe alarm	With measurement electrodes, all DNs
Lining	Soft rubber Hard rubber Rubber for drinking water PTFE E-CTFE
Measuring electrodes	Stainless steel, grade 1.4571 (316Ti) Hastelloy C276 Titanium Tantalum Platinum Other materials on request
Protection class	IP 67, IP 68
Storage temperature	-10ºC to +70ºC (14°F to 158°F) at max. relative air humidity 70% (for PTFE, E-CTFE, Soft Rubber) +5°C to +70ºC (41°F to 158°F) at max. relative air humidity 70% (for Hard Rubber and Rubber for drinking water)

Table 6 - Flow sensor specifications

5. METER APPLICATION RULES

5.1 Sensor placement in piping

No chemical injection or batching unit (such as chlorine compound injector) should be located at the input side of the sensor. The insufficient homogeneity of the flowing liquid may affect the flow-rate values indicated by the meter.

The meter performance will be the best if the liquid flow in the piping is well stabilised; therefore it is necessary to observe specific rules for the sensor placement in piping. In the contact planes between the sensor and the adjoining piping sections should be no edges as these would cause flow turbulence. Make sure that straight piping sections are provided before and after the sensor; their required length is proportional to the inner diameter of the piping concerned.

If more than one flow-disturbing element such as pipe bend or fitting are located near the sensor, the required length of straight piping section on the sensor side concerned should be multiplied by the quantity of such elements.

As required by clause 4.2.1 of standard EN 29104, the inner diameter of the connected pipe should not differ by more than 3% from that of the sensor.

In the cases of bi-directional flow-rate measurement, the same conditions concerning flow stability shall be met at the input and output sides of the sensor.

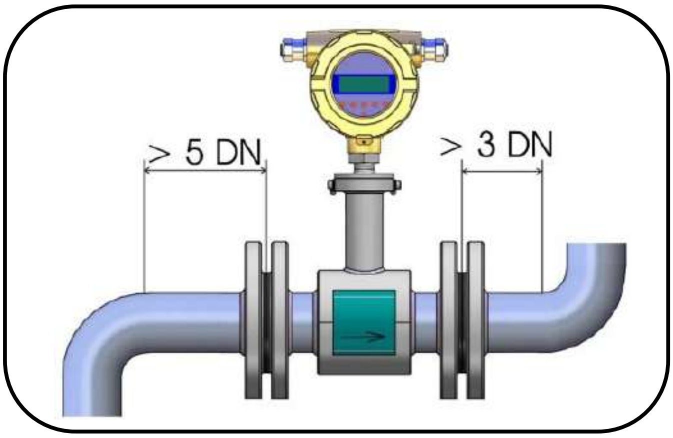


Fig. 11 - Required straight piping sections

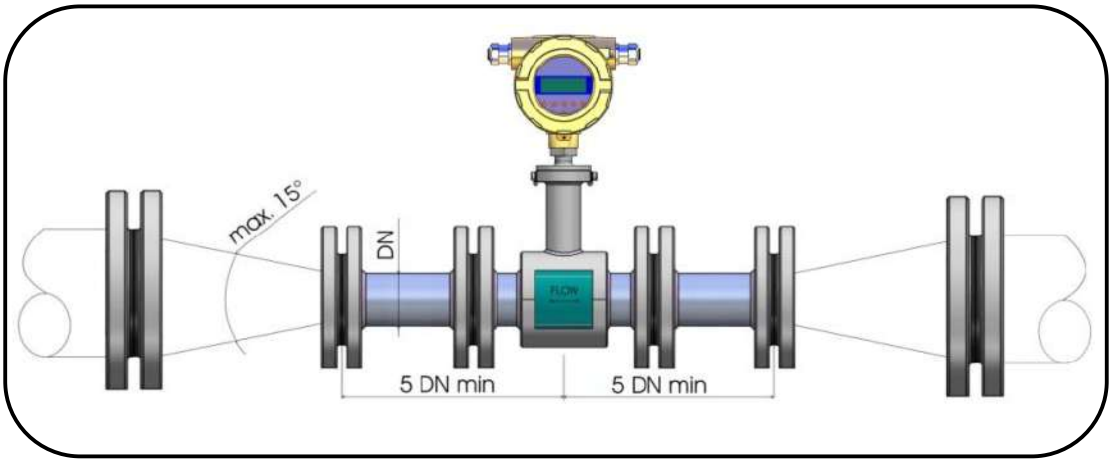
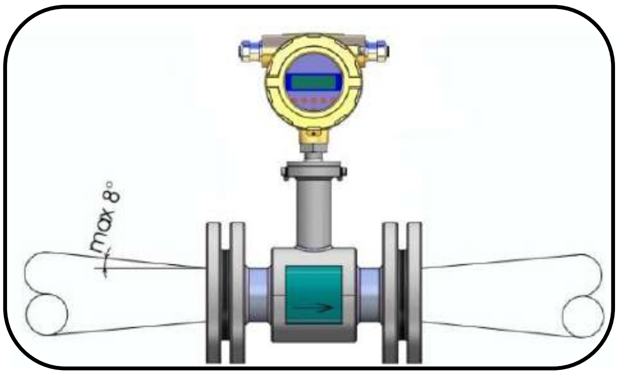


Fig. 12 - Pipe narrowing



In the cases where the pipe size larger than that of the meter sensor, it is necessary to use conical reduction pieces with the angle of taper not exceeding 15° (see the picture). In the cases of bi-directional flow measurement, the minimum length of straight piping sections on both sides is 5 DN. In horizontal sensor installations, to prevent bubbling, use eccentrically-fitted reduction pieces (see standard EN ISO 6817).

Fig. 13 - Pipe narrowing sections with angles not exceeding 8° can be taken for straight sections.

In the cases where the liquid is pumped, the flow sensor shall always be placed at the output side of the pump to prevent under pressure in the piping which might damage the sensor. The required length of the straight piping section between the pump and sensor is then at least 25 DN.

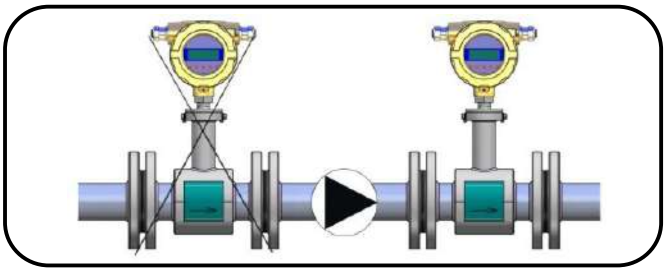


Fig. 14 - Pump in the piping

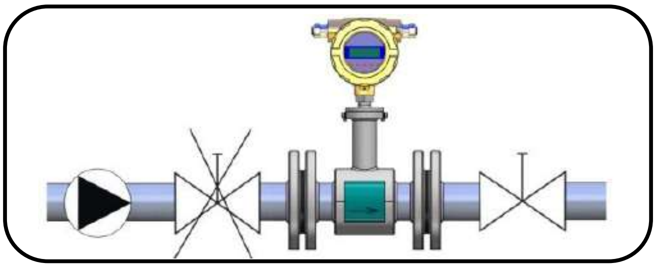


Fig. 15 - Closing valve in the piping

For the same reason, the sensor shall be always placed before the closing valve in the piping.

The sensor can be fitted in the piping in either horizontal or vertical position. However, make sure that the electrode axis is always horizontal and, if the sensor is mounted in a horizontal position, the flange section for attachment of the electronic unit box faces upwards.

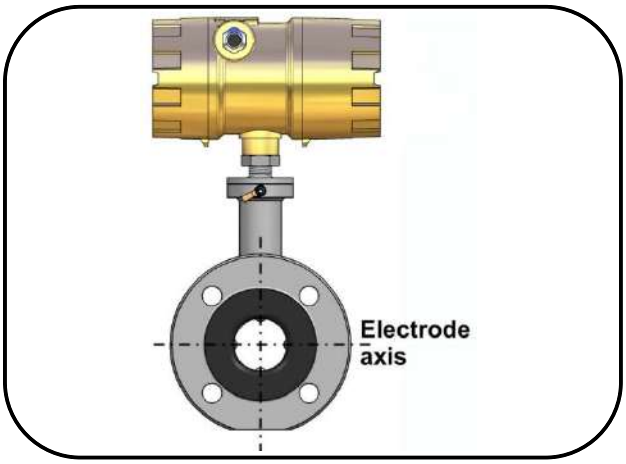


Fig. 16 - Electrode axis

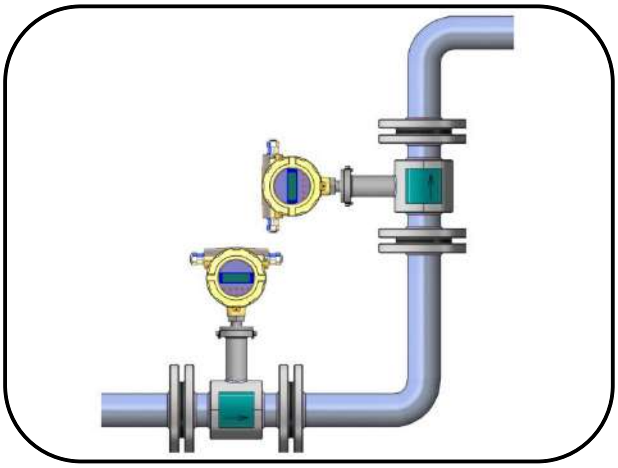


Fig. 17 - Sensor mounted in a vertical position

In the cases where the sensor is mounted in a vertical position, the flow direction shall always be upwards.

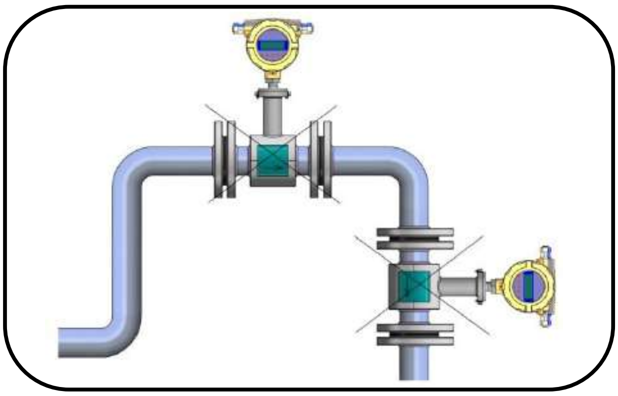


Fig. 18 - Risk of liquid aeration

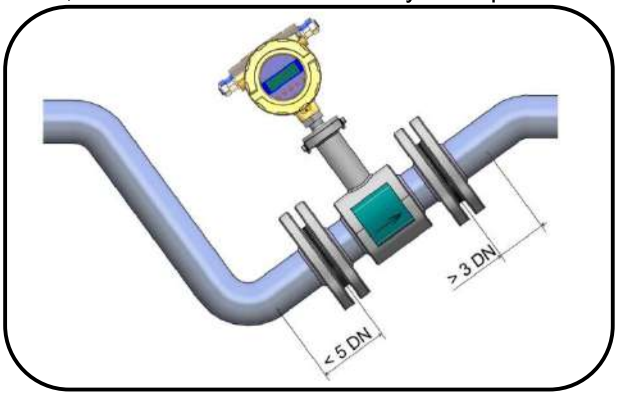


Fig. 19 - Permanent flooding of sensor

To ensure correct meter function at all times, the measured liquid shall completely fill up the sensor and no air bubbles shall be permitted to accumulate or develop in the sensor tube. Therefore the sensor shall never be placed in the upper pocket of the piping o in a vertical piping section where the flow direction is downwards.
In piping systems where complete flooding of the piping cannot always be guaranteed, consider placing the sensor in a bottom pocket where full flooding is ensured.

If the sensor is located near a free discharge point, such point shall be by at least 2 DN higher than the top part of the sensor.

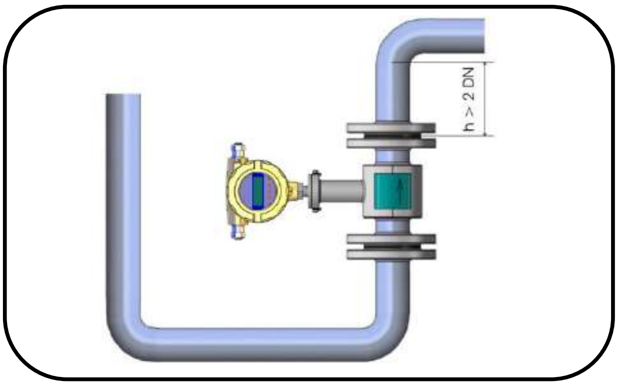


Fig. 20 - Sensor placement near free discharge point

Make sure that the adjoining piping is clamped/supported as close to the sensor as possible, to prevent vibrations and damage to the sensor.

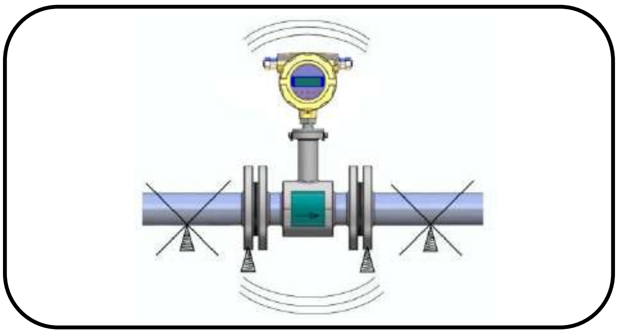


Fig. 21 - Undesirable sensor vibrations

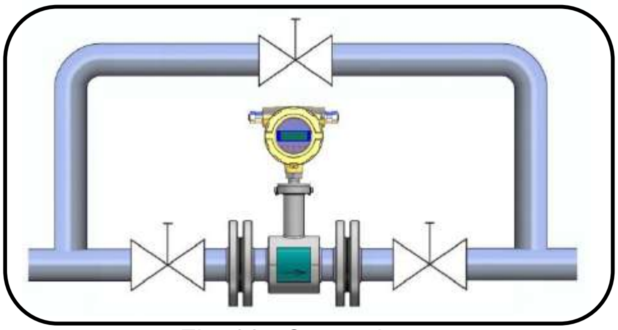


Fig. 22 - Sensor bypass

In applications where continuous liquid flow is essential, a bypass shall be provided to allow for sensor servicing. A sensor bypass may also be a reasonable solution in the cases where, to dismantle the flow sensor from the piping, liquid from a very long piping section would have to be discharged.

5.2 Sensor earthing

The correct meter function requires that the sensor and adjoining piping sections be connected by low-impedance earthing conductors to the earth potential and the protection conductor of the power source. The overall arrangement shall be such that the potentials of the measured liquid at the sensor input and output sides are close to the ground.

With a flanged sensor installed in electrically conductive piping, the flanges shall be electrically connected with the piping and the piping put to earth.

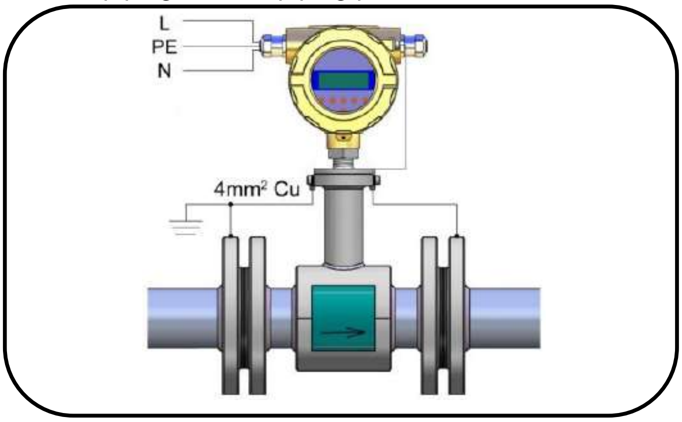


Fig. 23 - Flange earthing connection

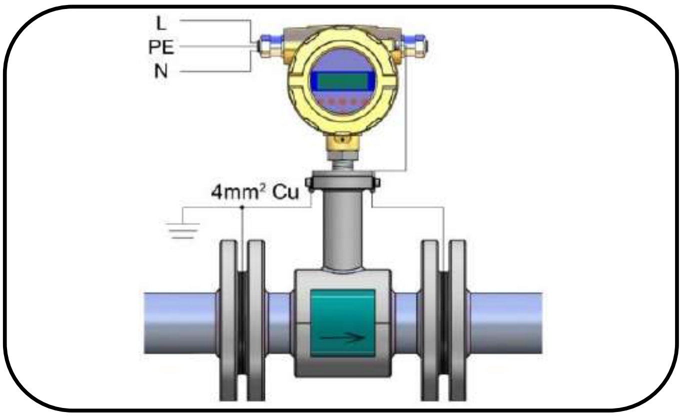


Fig. 24 - Earthing rings

Should the adjoining piping sections be non-conductive, earthing rings or similar arrangement shall be used to ensure that the electric potential of the measured liquid is put to earth.

With a flangeless sensor, the flanges clamping the sensor shall be electrically connected and the connecting conductor interconnected with the earthing point on the sensor.

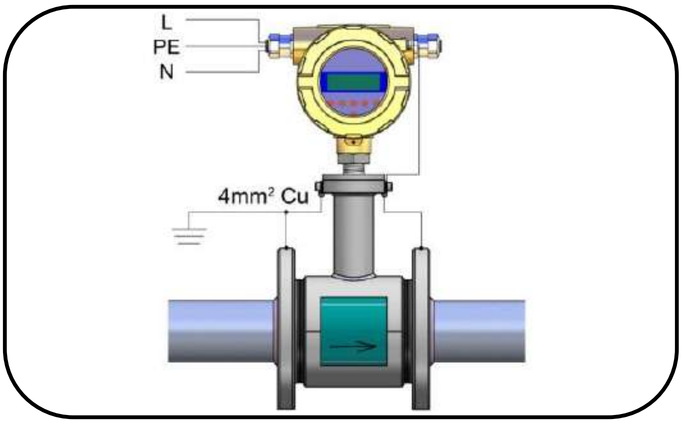


Fig. 25 - Flangeless sensor

Remote version is earthed on the same earth points which are used in compact version.
With the remote meter version, to ensure potential equalisation, it is recommended to connect the flow sensor body with the electronic unit box using a copper conductor of cross-section $4mm^2$.

6. COMMISSIONING

6.1 Installation of magnetic-inductive flow meters

The meter installation work shall be performed in strict observance of the procedures and rules described in this manual.

To prevent undesirable interference, the power cables shall be laid at least 25cm away from all signal cables. The signal cables include the cable connecting the sensor and the associated electronic unit (in the case of a remote meter version) and output signal cables. All cables shall be laid outside the thermal insulation layer on the piping (if any). Only shielded conductors shall be used to connect the output signals.

In applications where high levels of electromagnetic field interference at the measuring location can be expected (e.g. in the vicinity of power frequency converters), the remote meter version should be avoided. In these cases it is also recommended to include a filter in the power supply line to the electronic unit.

Filter specification: The filter is intended to suppress dissemination of the undesirable high frequency disturbances from the power supply cable to the flow meter system. Use any commercial filter of suitable parameters including protection class, and install it is close to the meter as possible. If need be, the filter can be placed in a special protection housing. When installing the filter, observe the applicable safety regulations.

Rated voltage:	250V/50Hz
Rated current:	0.5A and more
Suppression characteristic:	10kHz: 10 to 20dB
	10MHz: 40dB

6.2 Potentials

All outputs are electrically isolated from the auxiliary power, the sensor circuit and from each other. The housing and the interference suppression filters of the power supply are connected to the sensor.

The electrodes and measuring electronics are related to the potential of the function earth FE of the sensor. FE is not connected to the sensor, but may be connected with each other in the sensor junction box. If the sensor is grounded by using ground disks (earthing rings), these must in connected with the function earth FE.

At a remote assembly of sensor and transmitter the outer screen of the connecting cable is connected to the transmitter housing and has a sensor potential. The inner screens of the electrode line are connected to FE inside the junction box of the sensor and to the mass (Gnd) of the transmitters electronic.

Details of all wirings, terminals and drawing can be found in the chapter Electrical connections.

6.3 Cathode protective units

Using a cathode protective unit to avoid corrosion, which put a voltage to the tube wall, it must be connected to terminal FE. The transmitter boards, control panel and internal switches are on the same potential as FE.

Warning
According to EN 50178:1997 all electrical circuits with protective safety isolation without any protection against contacts must observe the following maximum voltages:

- Maximum AC voltage (root mean square value) 25 V
- Maximum DC voltage 60 V

It is strictly forbidden to connect FE to any higher voltage!

6.4 Zero point calibration

In order to ensure that precise measurements are obtained, zero point calibration is to be realized the first time the device is put into operation and before any regular operations are carried out. Zero point calibration is to be carried out using a fluid.
The zero calibration procedure is as follows:

- Install the sensor as described in the manufacturer's instructions.
- Check to ensure that the sensor is completely filled with fluid and that there are no gas bubbles in the flow tubes.
- Define the process conditions such as pressure, temperature and density.
- Close a potential shut-off device behind the sensor.
- Operate the transmitter in accordance with the instructions in chapter 0
- Zero point calibration
- Make sure that sufficient time is allowed for the electronics to warm up.
- Allowing fluid to flow through the sensor during the zero calibration procedure will skew the zero point and result in false readings.

7. APPLICATION DOMAIN OF CH1.10 TRANSMITTER

The microprocessor controlling the electronic unit (hereinafter referred to as CH1.10) is a programmable transmitter that processes measurement data and displays and transmits various types of measurement results.
The CH1.10 is communication enabled and supports optional the HART® protocol. The device can be customized using the keyboard in the comfort version. Although basic configuration settings such as transmitter calibration are realized at the factory, other settings such as those for measurement data processing, analysis, display and output are user definable.
User settings are protected by a user definable password.
Settings that are essential for proper operation of the transmitter in conjunction with the sensor (e.g. calibration and initialization values) are accessible only to service technicians via a password that is not provided to customers.

8. CH1.10 TRANSMITTER: MODE OF OPERATION AND CONFIGURATION

8.1 System design

The meter consists of a sensor and a CH1.10 unit. The device can be used to perform measurements with any liquid, conductive media, providing that the sensor's material is suitable for the product being used.
The CH1.10 transmitter generates the inductive current necessary for the magnetic field and preprocesses the induced voltage at the electrodes.

8.1.1 Control unit

A LCD display with backlight is a standard feature. The display shows measured values as well as diagnostics. With 6 keypads customers are able to configure comfortable and simple the transmitter without any other tool.

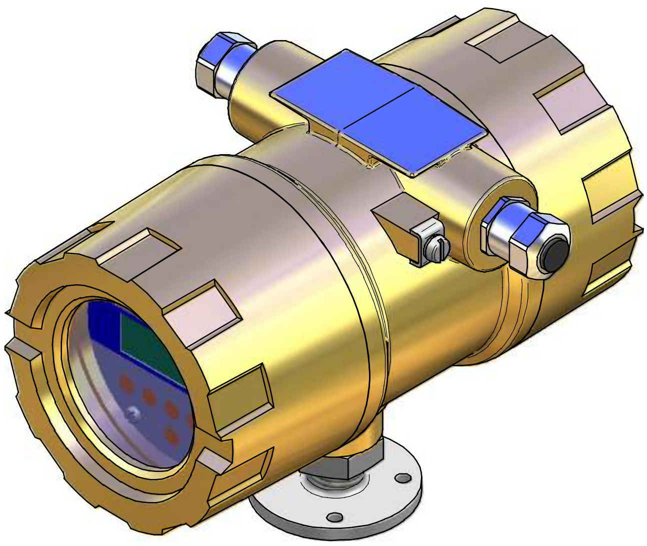


Fig. 26 – control unit

8.1.2 Optional equipment

8.1.2.1 HART-Interface

An analog 0/4–20 mA output is a standard feature and digital data transmission via HART® protocol as an optional feature of the device. A retrofit by customer is not possible.

8.1.2.2 Empty pipe detection

Transmitters have an on and off switch able empty pipe detection. The operating reliability depends on the conductivity of the liquid medium and the cleanliness of the electrodes. As bigger the conductivity is, as more reliable operates the empty pipe detection. Insulation coatings on the electrodes surface worse the empty pipe detection.

8.1.3 Data memory chip DSM

The replaceable data memory chip (DSM) is an EEPROM device in DIL-8 housing, located in a socket on the power supply board. It contains all characteristic data of the sensor e.g. sensor constant, version or serial number. Consequently, the memory module is linked to the sensor and in case of a transmitter replacement it has to remain by the sensor!

After replacing the transmitter or its electronics, the DSM will be installed in the new transmitter. After the measuring system has been started, the measuring point will continue working with the characteristic values stored in the DSM. Thus, the DSM offers maximum safety and high comfort when exchanging device components.
Power supply board CH1.10

Slot DSM

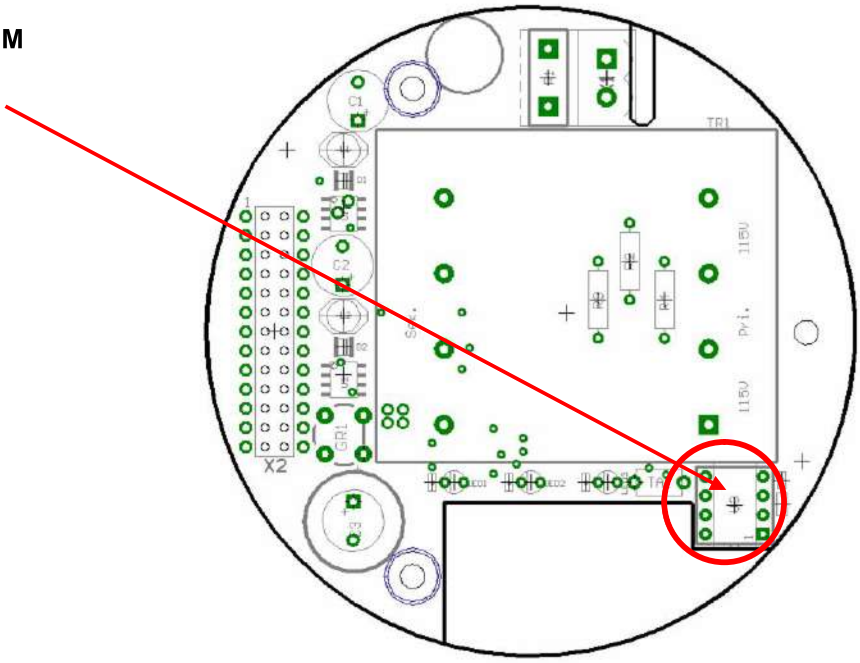


Fig. 27 - Power supply board CH1.10

At any exchange watch the polarity of the memory chip. Pin 1 is signed by a dot or a notch.

8.1.4 Safety of operation

A comprehensive self-monitoring system ensures maximum safety of operation.

- Potential errors can be reported immediately via the configurable status output. The corresponding error messages will also be displayed on the transmitter display. A failure of the auxiliary power can also be detected via the status output.
- When the auxiliary power fails, all data of the measuring system will remain in the DSM (without back-up battery).
- All outputs are electrically isolated from the auxiliary power, the sensor circuit and from each other.

9. OUTPUT

9.1 Output signal

All signal outputs: Electrically isolated from each other and from ground.

Analog output: 0/4-mA current output, electrically isolated, optional with HART®
Volume flow or flow speed
(Using the HART®-protocol the current output has to be assigned to volume flow in the mode of 4-20mA)

Pulse output: Pulse duration; default value 50 ms,
Pulse duration adjustable range is 0.1 ... 2000 ms
Mark-to-space ratio is 1:1, if the set pulse duration is not reached.

When programming the pulse duration, a plausibility check is carried out. If the selected pulse duration is too long for the set upper range value, an error message will be displayed.

f_{max} = 1 kHz

passive via optocoupler
U = 24 V
U_{max} = 30 V
I_{max} = 60 mA
P_{max} = 1,8 W

Pulse value: 1 pulse/unit

The pulse value can be multiplied by a factor between 0.001 - 100.0 (decade increments) of the selected pulse unit (e.g. m^3)

Status output: for: forward and reverse flow, MIN flow rate, MAX flow rate or alarm,

passive via optocoupler
U = 24 V
U_{max} = 30 V
I_{max} = 60 mA
P_{max} = 1,8 W

9.2 Failure signal

A failure in the meter can be indicated via the current output or the status output. The current output can be set to a failure signal (alarm) of I < 3.8 mA or I > 22 mA.

The status output can be configured as make or break contact.

9.3 Load of the current output

Standard version:	≤	600 Ohm
HART® minimum load	>	250 Ohm

9.4 Damping

Programmable from 0 to 60 seconds

9.5 Low flow cut-off

The low-flow cut-off can be set to values between 0 and 20% using the software. The set value refers to the upper range value. If the measured value is lower than the set volume, the flow rate will set to 0.0 (l/h). This results in the analog output being set to 0/4 mA, and the pulse output will stop generating pulses.

The configurable hysteresis takes effect in only one side while exceeding this limit.

10. FLONET FH20XX PERFORMANCE CHARACTERISTICS

10.1 Reference conditions

In conformity with IEC 770: temperature: 20° C, relative humidity: 65%, air pressure: 101.3 kPa

10.2 Measuring tolerance

See characteristic values of the corresponding sensor.

10.3 Repeatability

See characteristic values of the corresponding sensor.

10.4 Influence of ambient temperature

For the pulse output: ± 0.05 % per 10 K.
For the current output: ± 0.1 % per 10 K.

11. FLONET FH20XX OPERATING CONDITIONS

11.1 Environmental conditions

11.1.1 Ambient temperature range

-20 °C to + 60 °C (-4 °F to 140°F)

In the case of an outdoor installation, the device must be protected against direct solar irradiation with a weather shield.

11.1.2 Storage temperature

-10ºC to +70ºC (14°F to 158°F) at max. relative air humidity 70%
+5°C to +70ºC (41°F to 158°F) at max. relative air humidity 70% (for Hard Rubber and Rubber for drinking water)

11.1.3 Degree of protection

FLONET FH20XX standard housing is IP 67.

⚠	Caution: Ingress protection IP 68 is only achieved if suitable and tightly screwed down cable glands or conduits are used. If the cable glands are only tightened manually water may leak into the terminal compartment in the housing.

⚠	Danger: Particular care must be taken if the window in the housing becomes fogged over or discolored because moisture, water or product might seep through the wire sheath into the terminal compartment in the housing!

⚠	Warning Electromagnetic compatibility is only achieved if the electronics housing is closed. Leaving the enclosure open can lead to electromagnetic disturbances.

11.2 Process conditions

11.2.1 Fluid temperature

The data sheet/rating plate of the connected transmitter must be observed. With directly mounted transmitter on the sensor the heat entry must be considered from the process to the transmitter.

11.2.2 State of aggregation

Liquid

11.2.3 Viscosity

No restrictions.
The data sheet/rating plate of the connected transmitter must be observed.

11.2.4 Fluid temperature limit

The data sheet/rating plate of the connected transmitter must be observed.

11.2.5 Flow rate limit

The data sheet/rating plate of the connected transmitter must be observed.

11.2.6 Pressure loss

The data sheet/rating plate of the connected transmitter must be observed.

11.2.7 Empty pipe detection

Transmitters, in comfort version, have an on and off switch able empty pipe detection. The operating reliability depends on the conductivity of the liquid medium and the cleanliness of the electrodes.

12. CONSTRUCTION DETAILS

12.1 Type of construction / dimensions of remote version

Transmitter housing compact version FLONET FH20XX

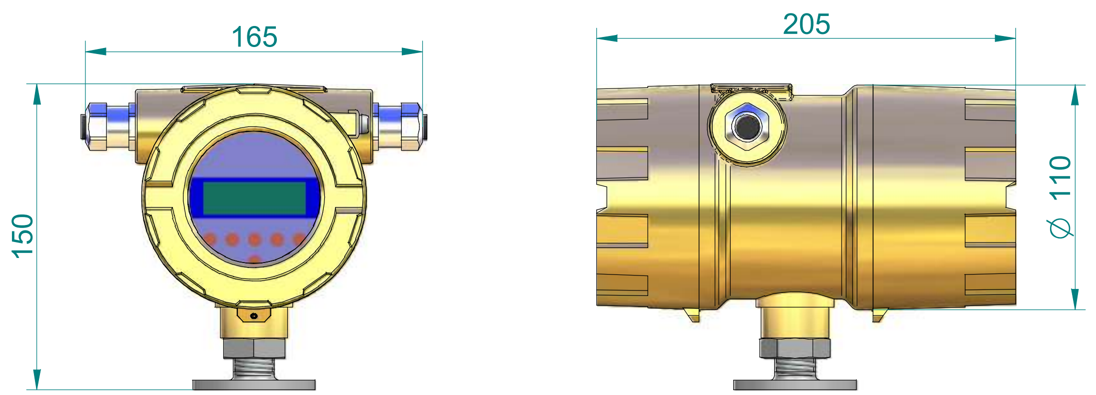


Fig. 28 - Transmitter housing

Transmitter housing remote version FLONET FH20XX

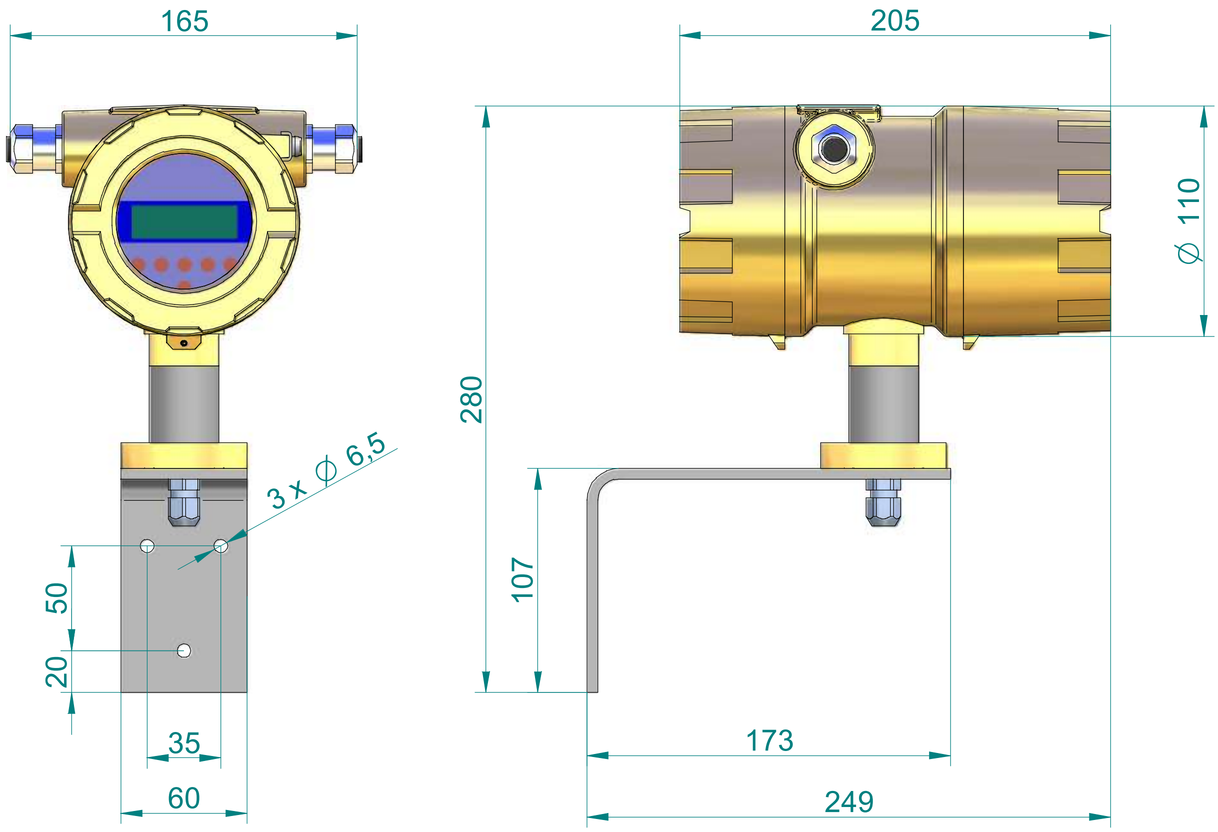


Fig. 29 – remote version

Possibility of installation of transmitter for remote version

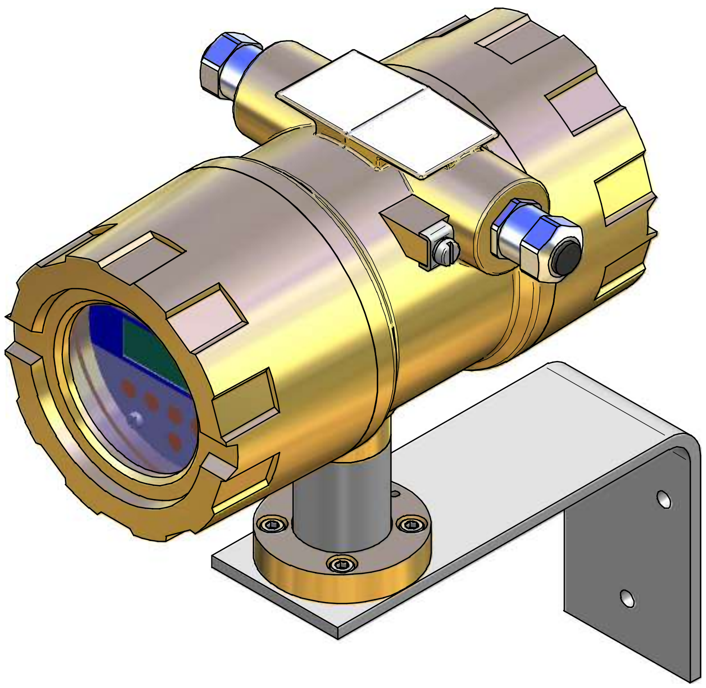


Fig. 30 - Wall mounting

12.2 Weight

Approx. 2.48 kg (remote transmitter)

12.3 Material

Housing: aluminum die-cast housing, powder-coated

12.4 Electrical connections

Mains	230 V AC	+10%, -15%	50/60 Hz
	115 V AC;	+10%, -15%;	50/60 Hz
	or		
	24 V DC	±15 %	
Power input	10 VA		
Mains fuse:	5x20mm DIN 41571-3		

Mains voltage	r. Current	rated voltage	breaking capacity
230 V AC	100mAT	250V AC	80A / 250V AC
115 V AV	100mAT	250V AC	80A / 250V AC
24 V DC	1 AT	250V AC	80A / 250V AC

e. g. Fa. Wickmann series 201

12.5 *Process terminals*

Terminals located at the rear side of the transmitter's housing.

Fig. 31 - CH1.10 process terminals

12.5.1 Mains and signal terminals

CH1.10 mains and signal terminals

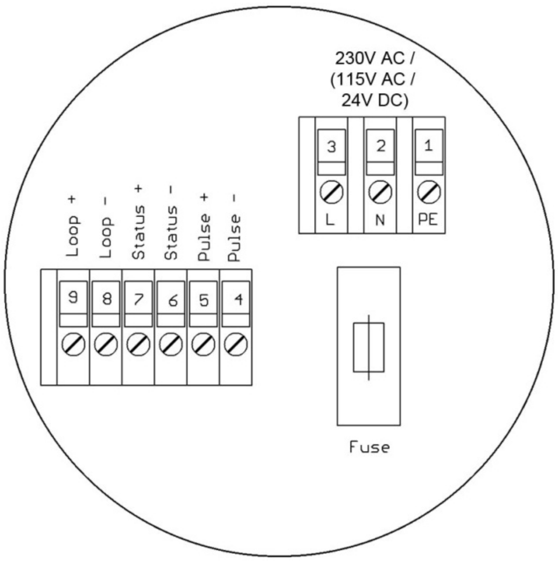


Fig. 32 - CH1.10 mains and signal terminals

Process terminals			
Terminal	**Label**	**Polarity**	**Function**
1	PE		Protective conductor
2	N		Mains
3	L		Mains
4	Pulse	-	Pulse output (passive)
5	Pulse	+	Pulse output (passive)
6	Status	-	Status output (passive)
7	Status	+	Status output (passive)
8	Current Out.	-	Current output (active)
9	Current Out.	+	Current output (active)

Table 7 – Process terminals

12.5.2 Wiring diagram for the remote version

For cable specification see Section 12.6 Cable specification. The outer shield has to be connected to the metalized cable glands at both ends. The inner shields are connected to each other and are plugged into the terminal labeled „Schirm / shield“. They are are related to the potential of the function earth FE. (See also Section 6.2 Potentials”

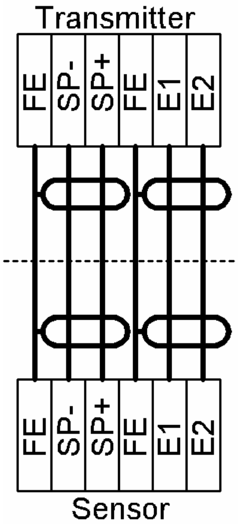


Fig. 33 - Wiring diagram for the remote version

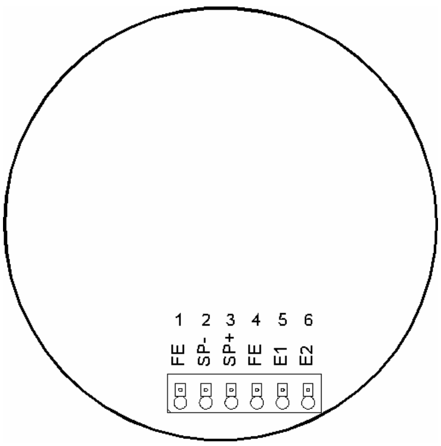
	Note: terminal diagram Schematic representation of a wiring between flow sensor and remote mounted transmitter. Terminal diagram is always shown is the documentation of flow sensor.

	Caution: Do not connect or disconnect the field coil cable before the primary power of the meter has been disconnected!

12.5.3 CH1.10 sensor terminals

Sensor terminals			
Terminal	Label	Polarity	Function
1	FE		Screen field coil
2	SP -	-	Field coil
3	SP +	+	Field coil
4	FE		Shield / Functional ground
5	E1		Elektrod 1
6	E2		Elektrod 2

Table 8 - CH1.10 sensor terminals



Observe also the advices in chapter 11.1 Environmental conditions.

12.6 Cable specification

If the transmitter is mounted remotely from the sensor, the following cables must be used:

Electrode cable and field coil cable as shielded twisted pair. In order to protect the cable from external interference, the twisted-pair wires are covered by an additional, overall shield e.g. PAARTRONIC CY-CY-LiYCY (TP) 2x2x0.25mm² (UNITRONIC CYPiDY (TP) 2x2x0.25mm²).

At cable length more than 10m a wire cross section of at least 0,5mm² is required e.g. PAARTRONIC CY-CY-LiYCY (TP) 2x2x0.5mm².

The outer shield is grounded by means of special EMC-compliant cable glands at both ends of the cable.

Connecting the cable shield in the cable gland

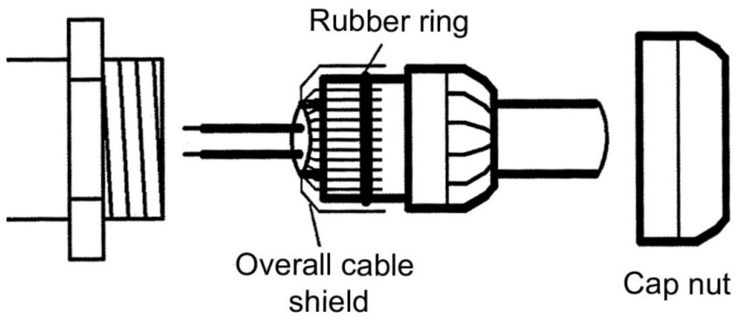


Fig. 34 - Connecting the cable shield in the cable gland

12.7 HART® connection

A number of options are available for HART® communication. However, for all these options loop resistance must be less than the maximum load specified in Section 9.3 Load of the current output. The HART®-Interface is connected via terminals 8 and 9 of the active current output. The minimum load impedance must be 250Ω.

13. MAINTENANCE AND REPAIR

The FLONET FH20XX meter is designed as maintenance-free performance. It contains no parts, which have to be replaced or adjusted cyclically.

While commissioning or maintenance, mains power must be switched off. Do not connect or disconnect the wirings between sensor and transmitter while power is on!

13.1 Mains fuse

The mains fuse is located in the terminal compartment. Before exchanging the fuse, the power has to be switched off. Check, if voltage free. The fuse may only be exchanged by the exactly same kind of fuse! (See also 12.4 Electrical connections)

13.2 Replacement of terminal board

The terminal board is located in the terminal compartment. Before exchanging the board, the power has to be switched off. Check, if voltage free. The board may only be exchanged by the exactly same kind of board.

To exchange the terminal board, all pluggable connectors have to be released. The board is fixed by 4 screws. To exchange the board, these screws have to be loosened.

Installing the board, the screws have to be secured again by toothed washers. Only after all connectors are plugged in, the power can be switched on again.

13.3 Exchange of transmitter electronic

The transmitter electronic may be exchanged only as complete module. With the exchange of individual components the transmitter is afterwards no longer calibrated neither regarding its measuring characteristics nor its analog outputs. The exchange has to be done as described in the following:

1. Mains power off.
2. Unclamp the 6 pole tab connector in the terminal compartment.
3. Remove the control unit BE3 or decoration foil inside the electronic compartment.
4. Unplug the green connector on the power supply board.
5. Disconnect the sensor’s wires on the power supply board.
6. Screw out all 3 studs consistently and simultaneously.
7. Pull out carefully the electronic boards.
8. The data memory chip (DSM) has to be plug out of the socket and to be placed into the same socket of the new electronic stack.
9. Insert the new electronics and feed the tab connection again into the terminal compartment through the hole in the compartment partitions wall.
10. Reverse to item 1 to 6 of this list assemble the transmitter.
11. Before powering on, check all connectors to be plugged in correctly and all wires and devices are fixed.

After the exchange the transmitter is calibrated by the take-over of the data memory chip (DSM) for the sensor. All totalized counts and settings are taken on.

14. CH1.10 TRANSMITTER WITH KEYBOARD (COMFORT VERSION)

14.1 Introduction

The CH1.10 unit can be operated depending on equipment by using the keyboard or via a HART® interface.

In the following, transmitter operation and parameterization using the keyboard are described. The keyboard is located in the electronic compartment and covered by an inspection window.

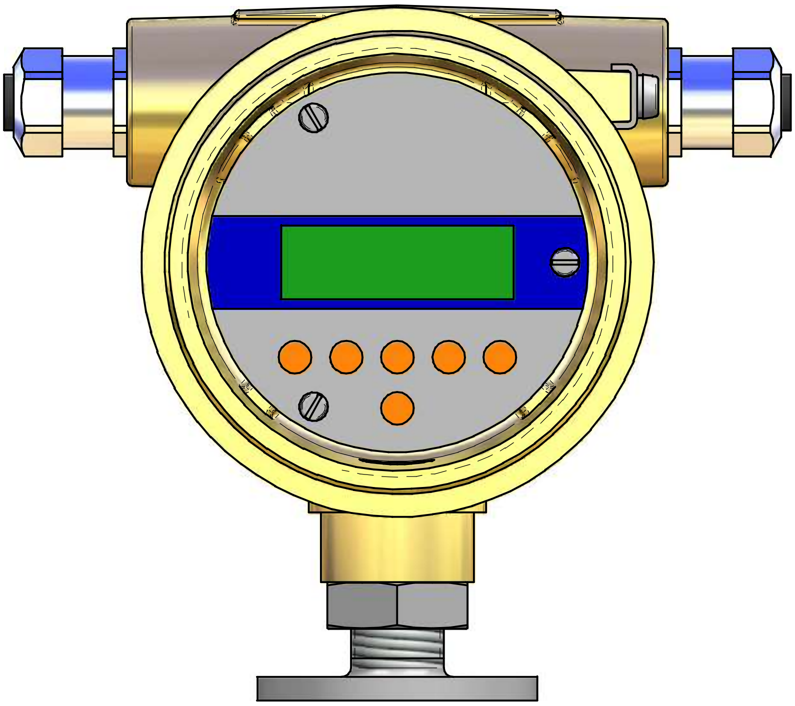


Fig. 35 - CH1.10 Transmitter with keyboard

14.2 Display

The control unit BE3 in the transmitter has an integrated back lighted, alphanumeric display with two 16-character lines (format 16 x 60 mm). Measurement data and settings can be read directly from this display.

The LCD display is designed to be operated at temperatures ranging from − 20 °C to + 60 °C (-4° F to 140 °F) without incurring any damage. However, at freezing or near-freezing temperatures, the display becomes slow and readability of the measured values is reduced. At temperatures below − 10 C° (14 °F), only static values (parameter settings) can be displayed. At temperatures exceeding 60 C° (140 °F), contrast decreases substantially on the LCD and the liquid crystals can dry out.

14.3 Operating modes

The CH1.10 can be operated in the following modes:

1. Display mode: In display mode, measured values can be displayed in various combinations and settings can also be displayed. Parameter settings cannot be changed in this mode. Display mode is the standard (default) operating mode when the device is switched on.

2. Programming mode: In programming mode, parameters can be redefined. After entering the correct password, changes that are permissible for the customer (customer password) or all functions (service password for technicians) can be realized.

14.4 Operation

14.4.1 Operation interface

Functional classes are displayed as headings beneath which displays and parameters are shown in logical groups.

Beneath this is the **menu level**, which lists all measured value displays or the headings for their underlying parameters (**parameter level**).

All functional classes are interlinked horizontally, while all sub points that are assigned to a functional class are displayed beneath the relevant class.

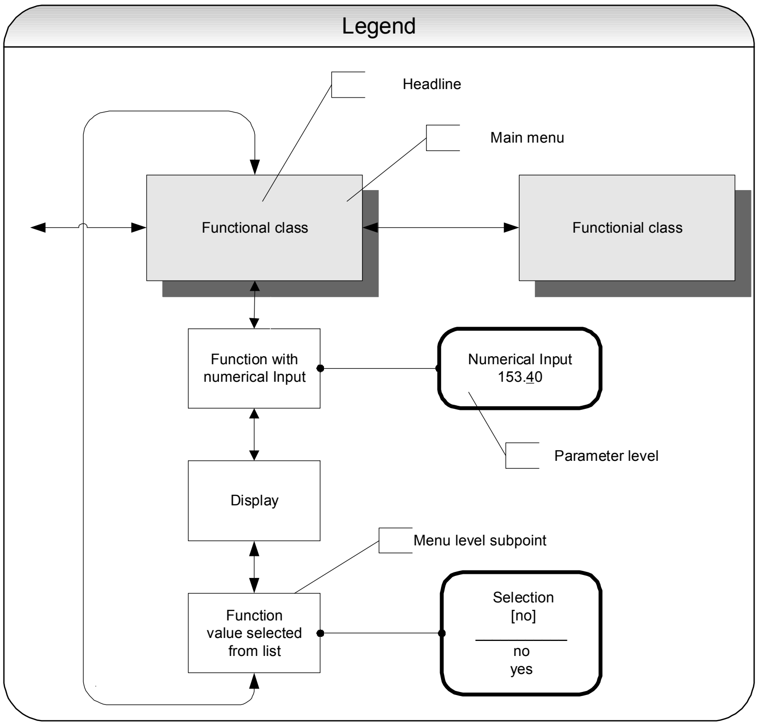


Fig. 36 - Operation interface

14.4.2 The keys and their functions

There are six keys to change the settings.

Caution
Do not press these keys with sharp or sharp-edged objects such as pencils or screwdrivers!

Cursor keys: Using the cursor keys, the operator can change numerical values, give YES/NO answers and select parameters. Each key is assigned a symbol in the following table:

Descriptor	Symbol
Cursor key, arrow to the right	▶
Cursor key, arrow to the left	◀
Cursor key, arrow to the top	▲
Cursor key, arrow to the bottom	▼

Table 9 - Cursor keys

Esc key: **The “Esc” key allows you to cancel the current action.** Pressing Esc moves you to the next higher level where the operator can repeat the action. Pressing Esc twice moves you directly to the MEASURED VALUES functional class.

ENTER key: Pressing ↵ (ENTER key) moves you from the menu level to the parameter level. **You confirm all entries with the ↵ key.**

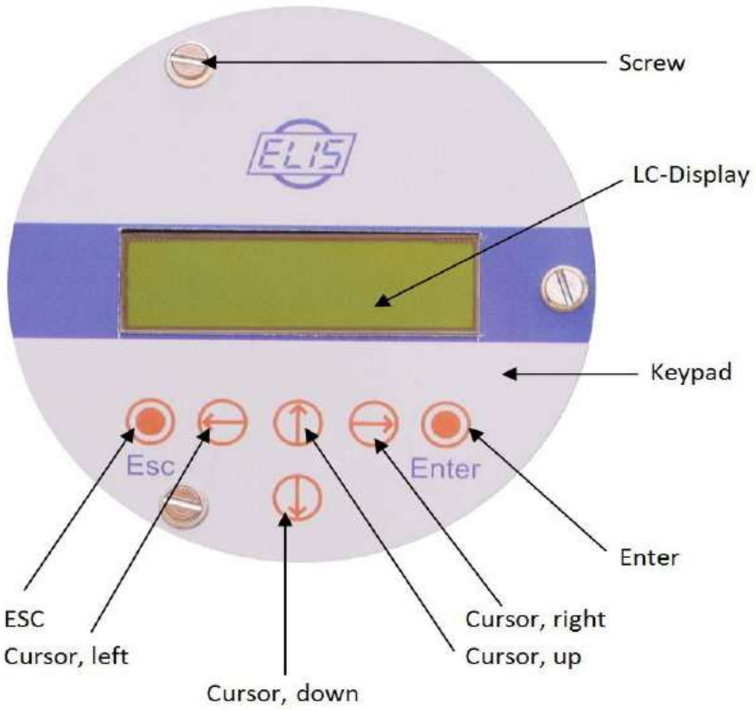


Fig. 37 - The keys and their functions

14.4.3 Functional classes, functions and parameters

Functional classes are written in all upper case letters (headings). The functions beneath each functional class are written in upper and lower case.

The various functional classes and functions are describes in Section 15. CH1.10 FUNCTIONS.

The lower line contains the following elements:
- Informational texts
- YES/NO answers
- Alternative values
- Numerical values (with dimensions, if applicable)
- Error messages.

If the user attempts to modify values for any of these parameters without entering the required password, the message “Access denied” will be displayed (see Section Operating modes and Passwords)

14.4.3.1 Selection window / make a selection

In the selection window, the first line of the LCD always contains the heading, while the second line displays the current setting. This setting is shown in square brackets if the system is in Programming mode.

Function name
[Selection]

In Programming mode (see Section 14.3 Operating modes), i.e. after a password has been entered (see Section 14.4.3.3 Passwords and 15.2 PASSWORD functional class), the operator can navigate to the desired setting by using the ▲ key or the ▼ key and the operator can then confirm your selection by pressing ↵ (ENTER key). To retain the current setting, press Esc.

14.4.3.2 Input window / modify a value

In the input window, the first line of the LCD always shows the heading, while the second line shows the current setting.

Example:

Function name
-4,567 Unit

These modifications can only be made in Programming mode (refer to 14.3 Operating modes), which means that a correct password (see Section 14.4.3.3 Passwords and 15.2 PASSWORD functional class) must be entered. To move the cursor from one decimal place to the next, use the ◀ or ▶ keys. To increase the value of the decimal place just under the cursor by “1,” use the ▲ key, and use ▼ key to lower the number by 1. To change the minus and plus sign, place the cursor in front of the first digit. To confirm and apply the change, press ↵. To retain the current value, press Esc.

14.4.3.3 Passwords

Programming mode is password protected. The customer password allows all changes to be made that are permissible for customers. This password can be changed when the device is first put into operation. Such changes should be kept in a safe place.

The FLONET FH20XX customer password in the device when delivered is 0002.

The service password allows for modification of all FLONET FH20XX functions. This password is not given to customers.

For further information on customer passwords, see Section 15.2 PASSWORD functional class.

15. CH1.10 FUNCTIONS

The software functions of the transmitter are divided into functional classes, are arrayed in a circle and can be navigated by using the ◀ or ▶ cursor keys. To go back to your starting point (the MEASURED VALUES functional class) press Esc.

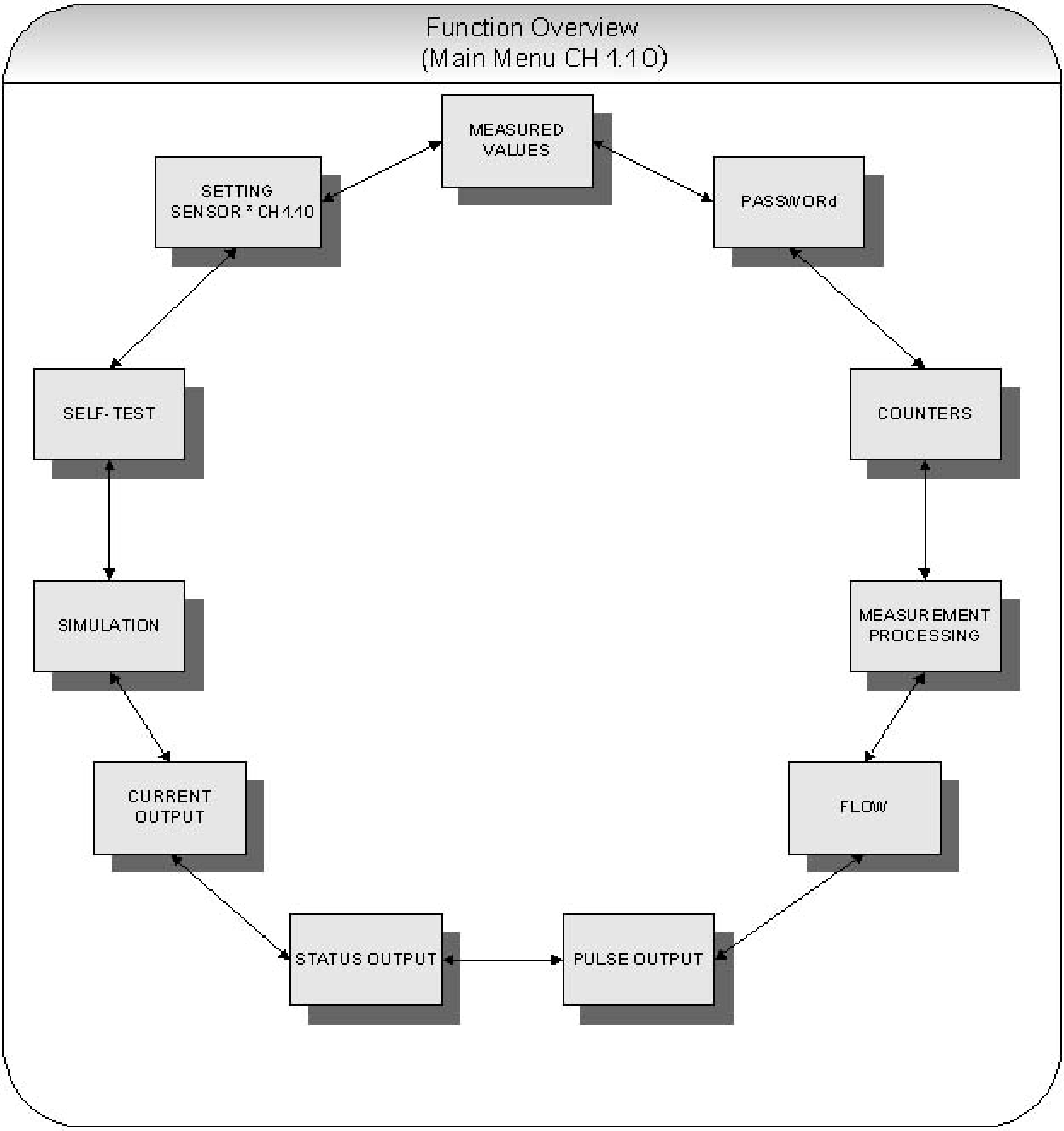


Fig. 38 – CH1.10 FUNCTIONS

In the following, all software functions that can be accessed using the customer password are described. Functions that are only accessible to the vendor (service functions) are not described in the present document.

15.1 MEASURED VALUES functional class

The MEASURED VALUES functional class contains all functions for displaying the measured values.

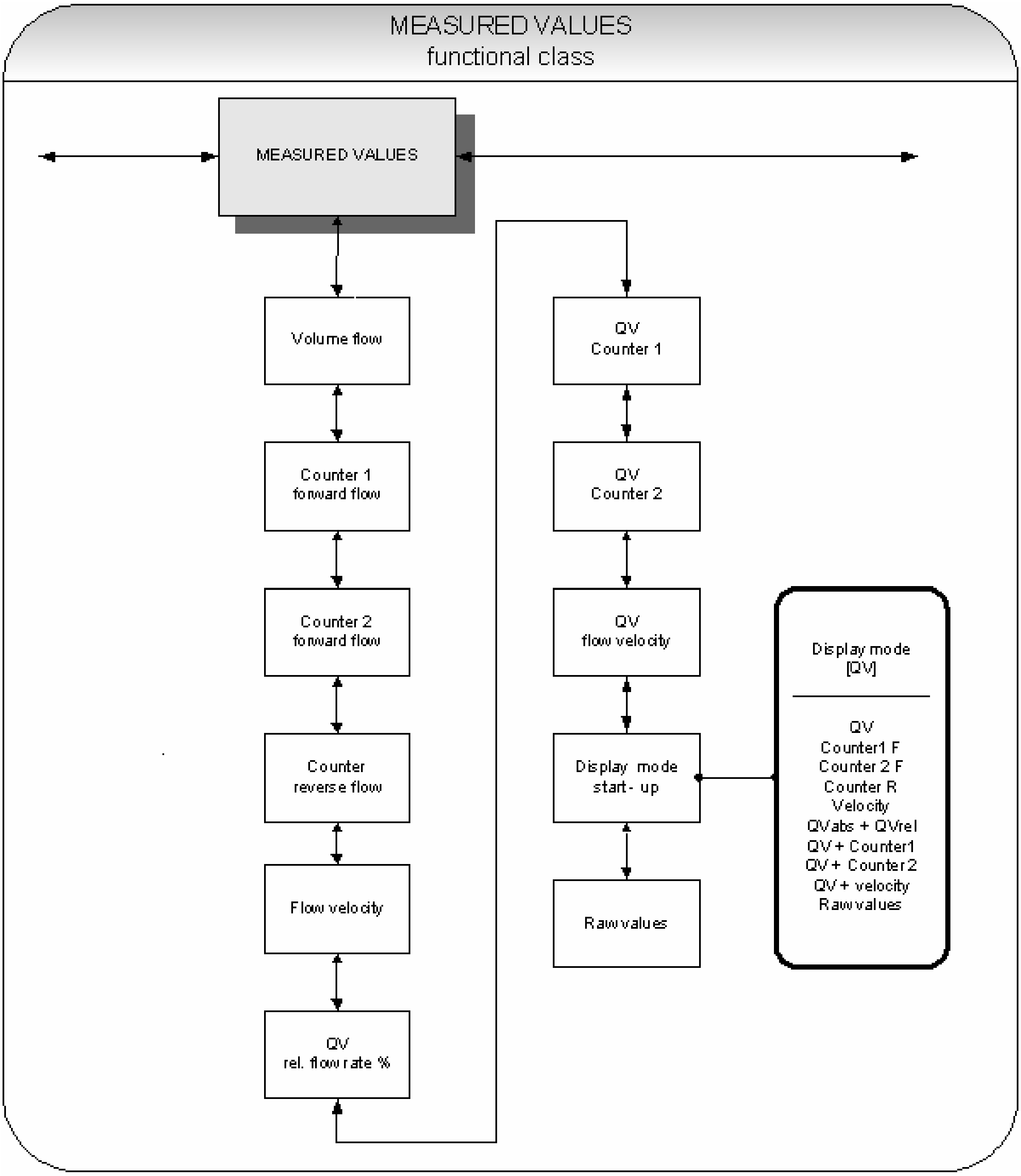


Fig. 39 – MEASURED VALUES functional class

15.1.1 Volume flow rate

If you select the function “volume flow,” the following will be displayed (example):

Volume flow
100.0 l/h

The LCD shows the current volume flow rate. You define the display unit in the functional class FLOW using the function “volume flow unit".

15.1.2 Forward flow counter 1

Forward flow counter 1 and forward flow counter 2 are independent counters that can also be reset remotely. With counter 1, for example, you can measure the yearly or monthly volume. If you select the function “forward flow counter 1”, the following will be displayed (example):

Counter 1 forw.
+ 000001.0 l

The LCD shows the current value of forward flow counter 1. You define the display unit in the functional class COUNTERS using the function “unit of counter”.

15.1.3 Forward flow counter 2

The function is identical with the function of forward flow counter 1. For example, forward flow counter 2 can be used as a daily counter. If you select the function “forward flow counter 2”, the following will be displayed (example):

Counter 2 forw.
+ 000001.0 l

The LCD shows the current value of forward flow counter 2. You define the display unit in the functional class COUNTERS using the function “unit of counter”.

15.1.4 Reverse flow counter

If you select the function “reverse flow counter”, the following will be displayed (example):

Counter reverse
000000.0 l

The LCD shows the current value of the reverse flow counter. You define the display unit in the functional class COUNTERS using the function “unit of counter”.

15.1.5 Flow velocity

If you select the function “flow velocity,” the following will be displayed (example):

flow velocity
1.5 m/s

The LCD shows the current value of the mean flow velocity of the medium. The display unit is always meters per second (m/s). The mean velocity is calculated from the measured volume flow and the flow area of the meter tube. In order to calculate the flow area of the meter tube, enter the inside diameter of the meter tube. To do so, use the “inside diameter” function in the functional class SETTINGS SENSOR + CH1.10.

15.1.6 Relative flow rate

The relative flow rate is the percentage ratio of the (current) volume flow and the entered upper range value of the volume flow. You set this upper range value in the functional class FLOW using the function "volume flow QV URV."

The calculation of the relative flow rate is based on the following formula:

Relative flow rate = 100% x (Qabs – lower range limit) / (upper range limit – lower range limit)

If you select the function "relative flow," the following will be displayed (example):

Relative flow
95.3%

15.1.7 QV + Forward flow counter

If the function "QV+ forward flow counter 1" is selected, in the second line the content of the forward flow counter 1 will be displayed:

XXX.XX l/h
XXX.X l

In the first line the LCD shows the current value of the actual volume flow of the medium. The displayed unit is defined in the functional class FLOW using the function "volume flow unit". The unit of the counter is defined in the functional class COUNTER using the function "counter unit".

15.1.8 QV + Forward flow counter 2

If the function "QV+ forward flow counter 2" is selected, in the second line the content of the forward flow counter 2 will be displayed:

XXX.XX l/h
XXX.X l

In the first line the LCD shows the current value of the actual volume flow of the medium. The displayed unit is defined in the functional class FLOW using the function "volume flow unit". The unit of the counter is defined in the functional class COUNTER using the function "counter unit".

15.1.9 QV + flow velocity

If the function "QV + flow velocity" is selected, the following will be displayed:

XXX.X l/h
XXX.X m/s

In the first line of the LCD display the current value of volume flow and in the second line the flow velocity of the medium. The displayed volume flow unit is defined in the functional class FLOW using the function "volume flow unit", the unit of the medium's velocity is always m/s.

15.1.10 Display mode during startup

By choosing the *Display mode during startup* function the operator can define the default display. After the operator switched the device on and did not touch any keys for a longer period of time, the defined default display will be shown.

Display mode [QV]

According to the description in Section 14.4.3.1 Selection window / make a selection, one of the following default displays can be selected.
QV (volume flow rate),
Counter 1 forward flow,
Counter 2 forward flow,
Counter reverse flow,

- Velocity,
- QVabs + QVrel,
- QV + counter 1,
- QV + counter 2,
- QV + velocity,
- and raw values.

15.1.11 Raw values

The "Raw value display" supports fault diagnostics and trouble shooting. Please inform our service department about the clear text error messages and contents of the "Raw value display".

xxx.xxx	ggooo
iiii	gguuu

The displayed values are decimals and have the following meaning:

xxx.xxx:	Is a gauge for the measured electrode voltage.
ggooo:	Is a gauge for the upper value of the reference calibration.
iiii:	Is a gauge for the current to generate the field coil's magnetic field.
gguuu:	Is a gauge for the lower value of the reference calibration.

15.2 PASSWORD functional class

The PASSWORD functional class is comprised of the functions for entering and changing the customer password and entering the service password. To cancel the current action, press Esc.

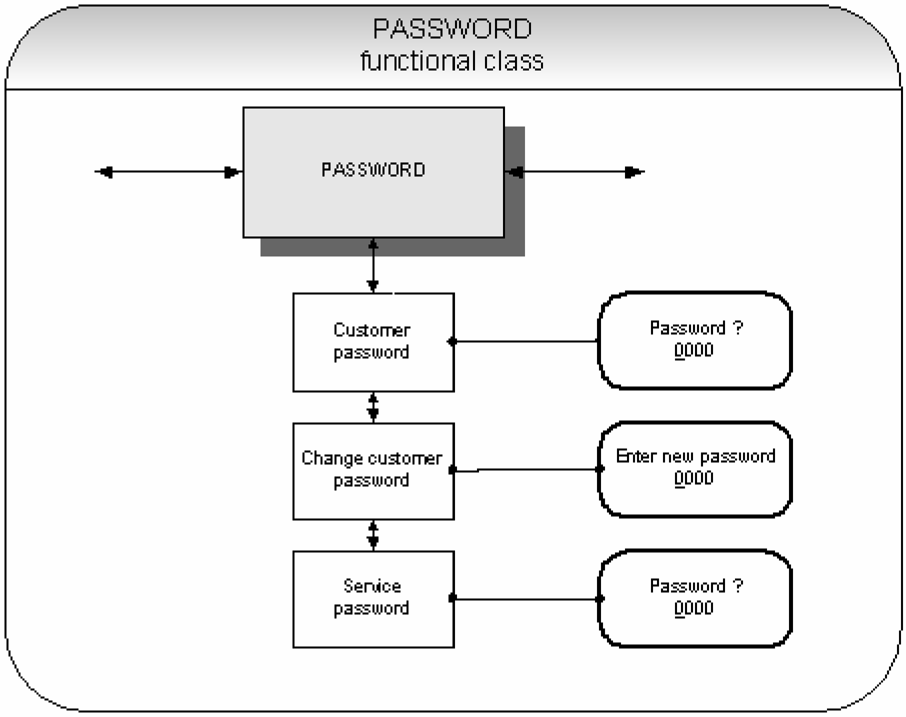


Fig. 40 - PASSWORD functional class

15.2.1 Customer-password

After selecting the *Customer password* function and pressing ↵, the following will be displayed:

Password?
0000

According to the description in Section 14.4.3.2 Input window / modify a value/", the password can be changed. If the entered password is correct, the following message will be displayed

Password
valid

If the entered password is not correct, the following message will be displayed

Password
invalid

The customer password in the device when delivered is **0002**.

A valid customer password allows all software parameter changes to be made that are permissible for customers. After the operator switched the device off or did not touch any keys for about 15 minutes, the authorization to change settings related to password entry will automatically be canceled. If the operator does not enter a valid password, all settings can be displayed but not changed. Parameter changes via HART may be carried out any time without entering password.

15.2.2 Change customer password

After entering a valid customer password, you may change the existing password and enter a new one. After selecting the *Change customer password* function and pressing ↵, the following will be displayed.

Enter New password
0000

According to the description in Section 14.4.3.2 Input window / modify a value the current value can be changed.

Press ↵ to confirm and save the new password. Make sure that you entered the desired password!

A copy of the password should be kept in a safe place. Reactivation of a transmitter at the vendor's site due to a lost password is not part of our warranty!

15.2.3 Service password

You do not need the service password for setting the functions necessary for operation.

The service password is reserved for service technicians and not provided to customers. Correct settings are essential for proper operation of the device (e.g. parameterization and calibration values).

15.3 Counter functional class

The COUNTERS functional class is comprised of the following functions:

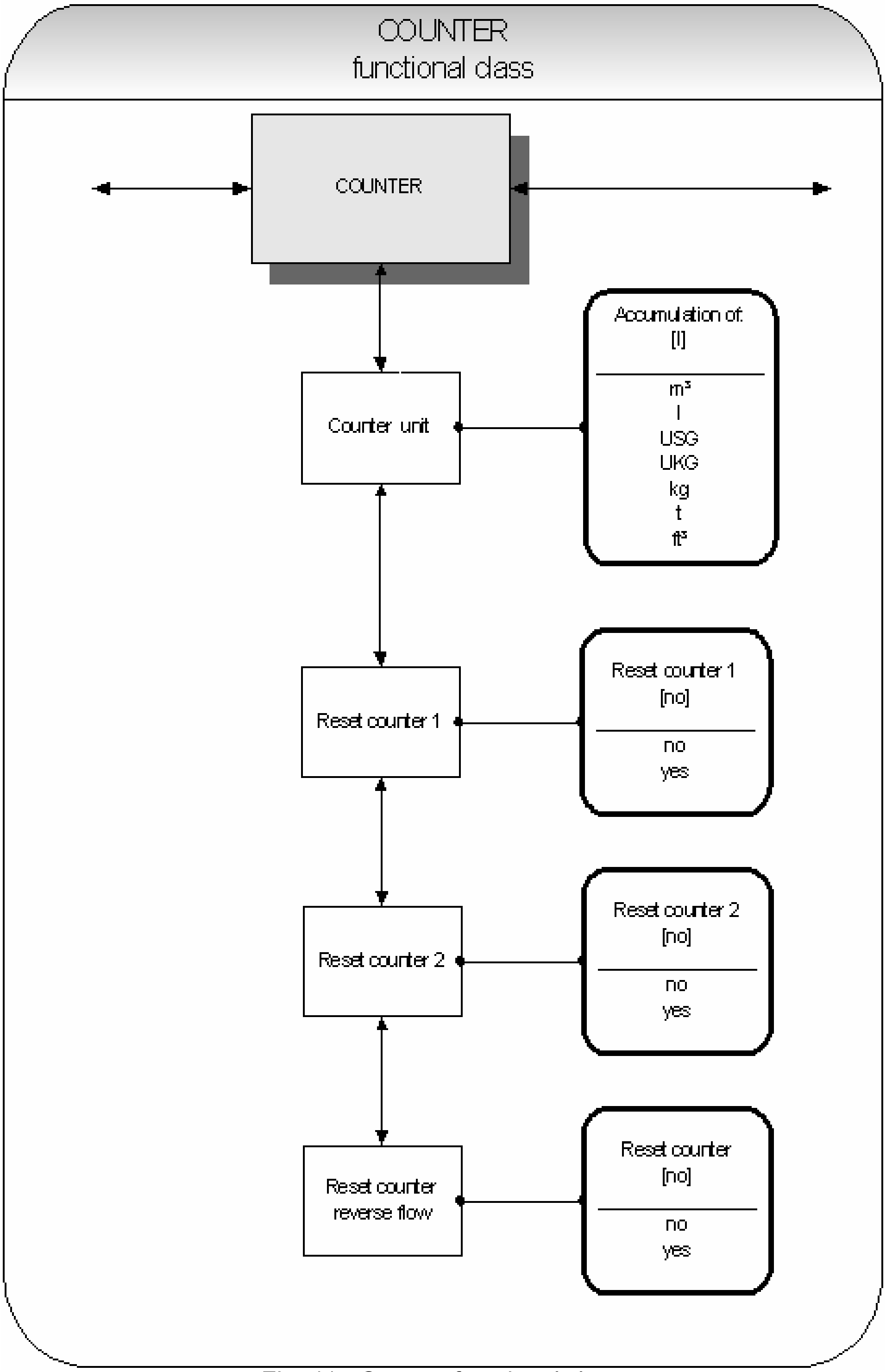


Fig. 41 - Counter functional class

To change the current settings, enter the customer password. Otherwise, the settings can only be displayed but not changed. To cancel the current action, press Esc.

15.3.1 Unit of counters

After choosing the *Unit of counters* function and pressing ↵, the current forward and reverse counter unit will be displayed:

Accumulation of:
[kg]

According to the description in Section 14.4.3.1 Selection window / make a selection, one of the following units can be selected.

- Volume units: m³ and l, as well as USG, UKG, ft³ or
- Mass units: kg and t.

When the unit is changed, the counters will be reset to 0.00 automatically.

The volume unit only makes sense if the sensor has been calibrated for density measurement. Press ↵ to confirm and save the selection. Forward and reverse counters will now show the selected unit.

15.3.2 Reset counter

The CH1.10 has 3 independent totalizing counters. Counter 1 and Counter 2 for forward flow and a reverse flow counter. Each of them can be reset individually on the initial value 0.00.

To reset one of the totalizing counters, you definitely need to toggle to [yes].

Reset counter
[no]

According to the description in Section "14.4.3.1 Selection window / make a selection", "yes" or "no" can be selected. By pressing Esc or toggling to [no] the operator can cancel the current action without changing the counter readings.

15.4 MEASUREMENT PROCESSING functional class

The MEASUREMENT PROCESSING functional class is comprised of all functions that affect the processing of the measured values.

To change the current settings, enter the customer password. Otherwise, the settings can only be displayed but not changed. To cancel the current action, press Esc.

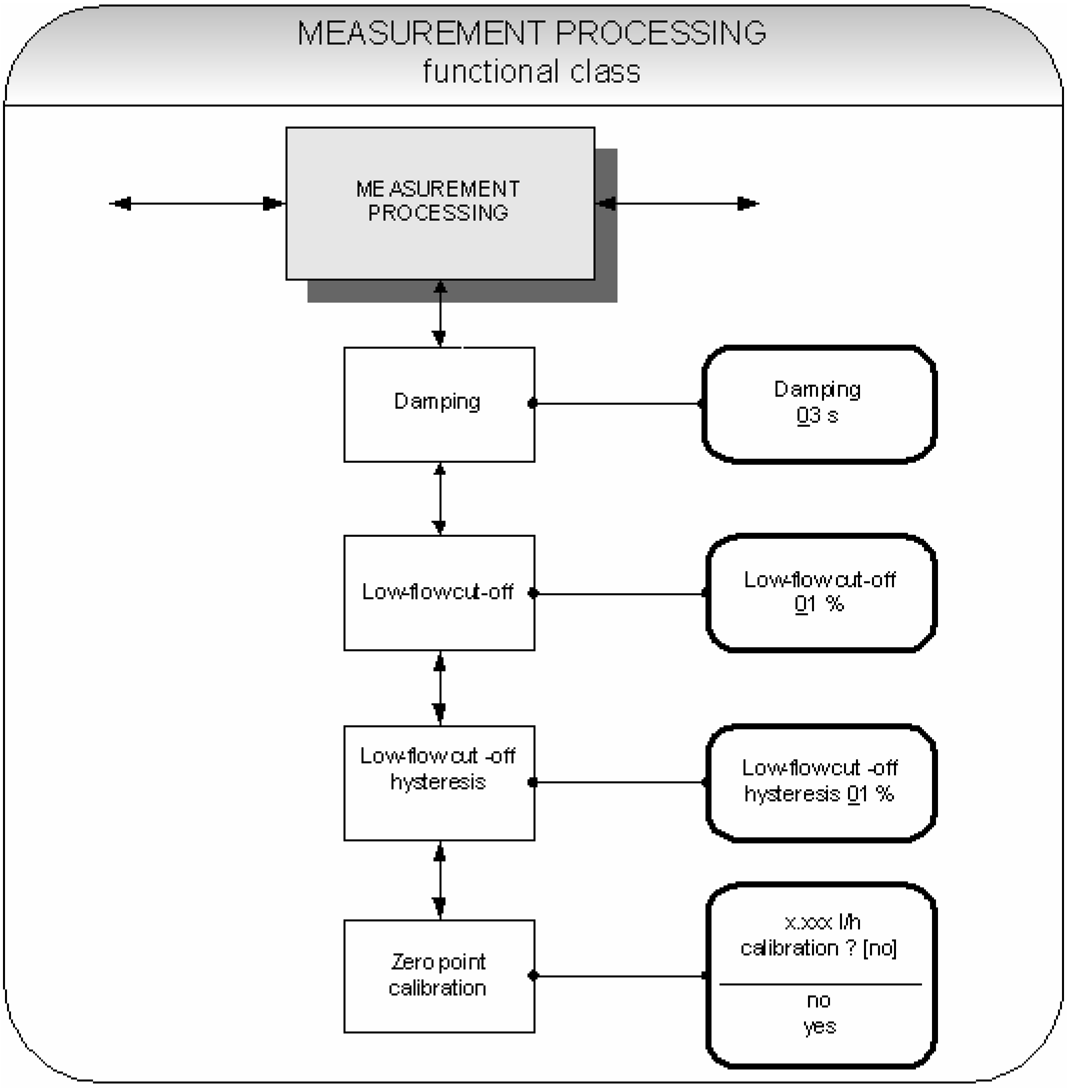


Fig. 42 – Measurement processing functional class

15.4.1 Damping

The damping value is intended to dampen abrupt flow rate changes or disturbances. It affects the measured value display and the current and pulse outputs. It can be set in intervals of 1 second from 1 to 60 seconds. After choosing the *Damping value* function and pressing ↵, the following selection field will be displayed:

Damping
03 s

The current damping value will be displayed. According to the description in Section “14.4.3.2 Input window / modify a value”, the current value can be changed. After setting the new damping value, press ↵ to confirm your entry.

15.4.2 Low flow cut-off

The value for low flow cut-off (low flow volume) is a limiting value stated as a percentage that relates to the upper-range value of the flow rate. If the volume drops below this value (e.g. leakage), the displayed value and the current outputs will be set to “ZERO.” The value for low flow cut-off can be set from 0 to 20 % in 1-percent increments. After choosing the *Low flow cut-off* function and pressing ↵, the following selection field will be displayed:

Low flow cut-off
00 %

The low flow volume will be displayed. According to the description in Section “14.4.3.2 Input window / modify a value”, the current value can be changed. After setting the new low flow volume, you confirm your entry with ↵.

15.4.3 Low flow cut-off hysteresis

The hysteresis of the low flow volume is the flow rate expressed as a percentage of the upper range value by which the volume must fall below or surpass the set low flow volume in order to activate or deactivate the function. The hysteresis of the low flow volume can be set in 0.1-percent increments from 0 to 10 %. After selecting the *Low flow cut-off hysteresis* function and pressing ↵, the following selection field will be displayed:

Low flow cut-off
hysteresis 00 %

The current hysteresis will be displayed. According to the description in Section “14.4.3.2 Input window / modify a value”, the current value can be changed. After setting the new hysteresis value, you confirm your entry with ↵.

15.4.4 Zero point calibration

Using the *Zero point calibration* function the operator can recalibrate the zero point of your meter in the measuring system. Zero point calibration is to be realized after any installation procedure or after any type of work has been performed on in the pipes near the sensor. Refer also Section 6.4 Zero point calibration.

⚠	**CAUTION:** This function may only be carried out if it is certain that the fluid in the sensor is not flowing. Otherwise, the flow rates measured subsequently will be incorrect. The sensor must be completely filled with fluid. A partially filled sensor or air bubbles will lead to an incorrect zero point calibration.

After choosing the *Zero point calibration* function and pressing ↵, the current remaining flow will be displayed:

0.00 l/h cal.? [no]

According to the description in Section “14.4.3.1 Selection window / make a selection”, “yes” or “no” can be selected. By pressing Esc or toggling to [no] the operator can cancel the current action. Enter [yes] to have the zero point recalibrated.

15.5 Flow functional class

The FLOW functional class is comprised of functions that affect lower- and upper-range values and the processing of the measured flow rates. In Programming mode (see 14.3 Operating modes), i.e. after a password has been entered (see 14.4.3.3 Passwords, 15.2 PASSWORD functional class), the operator can change the settings regarding flow.

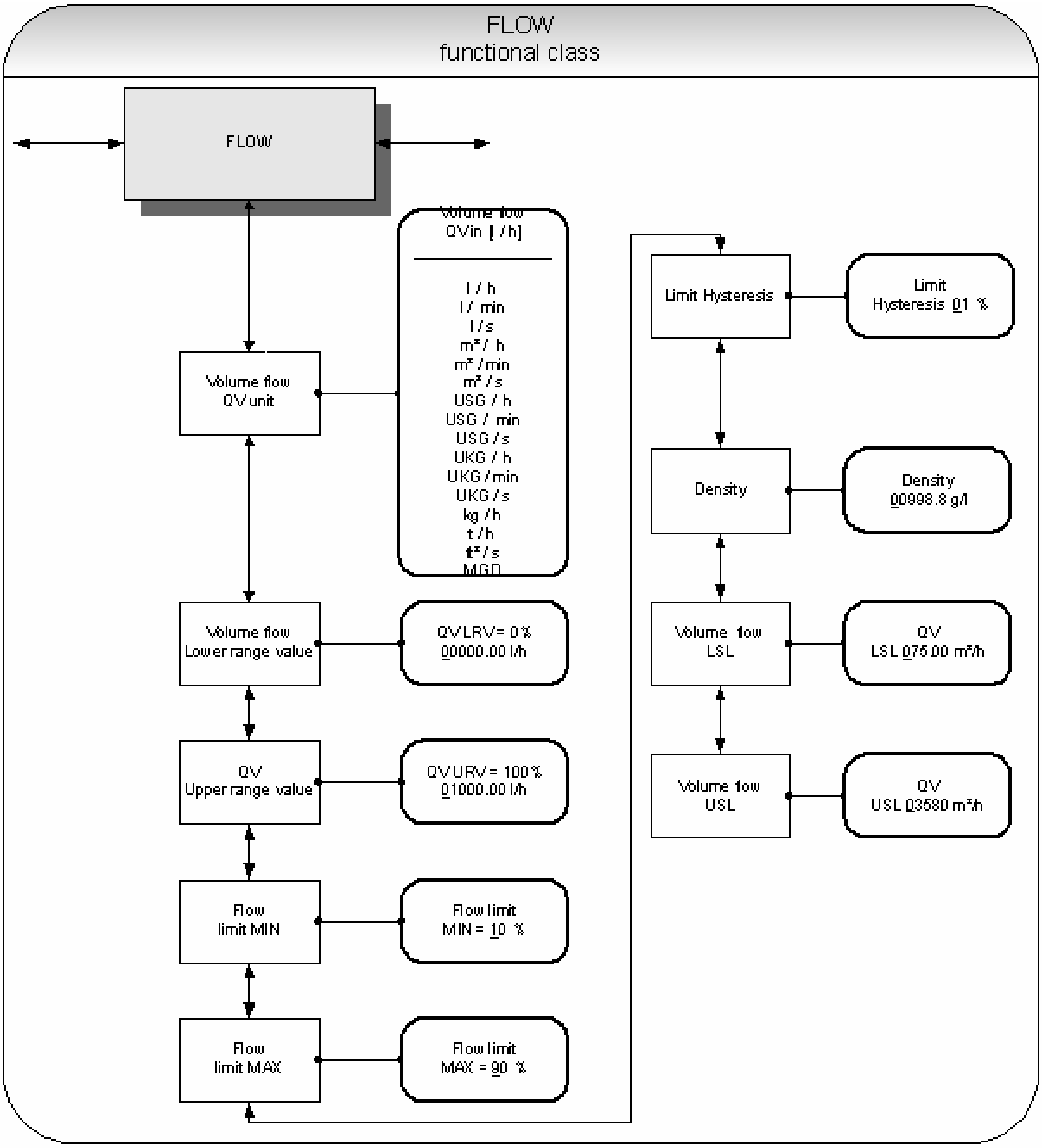


Fig. 43 - Flow functional class

To change the current settings, enter the customer password. Otherwise, the settings can only be displayed but not changed. To cancel the current action, press Esc.

15.5.1 Volume flow QV unit

Using this function, the operator can define the physical unit for all display functions, limit values and the upper-range value of volume flow. After choosing the *Volume flow QV unit* function and pressing ↵, the following selection field will be displayed:

Volume flow QV in [l/h]

According to the description in Section 14.4.3.2 Input window / modify a value, one of the following units can be selected:

- l/h, l/min, l/s
- m³/h, m³/min, m³/s
- USG/h, USG/min, USG/s,
- UKG/h, UKG/min, UKG/s,
- Kg/h, t/h,
- ft³/s, MGD (Mega US Gallons / day).

Press ↵ to confirm and save the selection.

15.5.2 Volume flow lower-range value

This function allows the operator to set the lower-range value for volume flow. The lower-range value takes on the unit defined using the *Volume flow unit* function. The lower-range value will scale the current and frequency outputs assigned to volume flow. After choosing the *Volume flow lower-range value* function and pressing ↵, the following selection field will be displayed:

QV LRV = 0% XXXXX.XX l/h

The current lower-range value for volume flow will be displayed. According to the description in Section 14.4.3.2 Input window / modify a value, the current value can be changed.

15.5.3 Volume flow upper-range value

This function allows the operator to set the upper-range value for volume flow. The upper-range value takes on the unit defined using the *Volume flow unit* function. The upper-range value will scale the current and frequency outputs assigned to volume flow. After choosing the *Volume flow upper-range value* function and pressing ↵, the following selection field will be displayed:

QV URV = 0% XXXXX.XX l/h

The current upper-range value for volume flow will be displayed. According to the description in Section 14.4.3.2 Input window / modify a value", the current value can be changed.

15.5.4 Volume flow limit MIN

The MIN limiting value for volume flow can be evaluated via the status output. You enter the value as a percentage of the set upper-range value. If the volume flow is lower than that limit value, the status output will be set in case the corresponding assignment has been made. If the alarm function has also been activated for the current output, the applied current will change to < 3.2 mA or > 20.5 mA / 22 mA. After choosing the *Volume flow limit MIN* function and pressing ↵, the following selection field will be displayed:

Volume flow limit
MIN = 10 %

The current MIN upper-range value for volume flow will be displayed. According to the description in Section 14.4.3.2 Input window / modify a value the current value can be changed.

15.5.5 Volume flow limit MAX

The MAX limiting value for volume flow can be evaluated via the status output. You enter the value as a percentage of the set upper-range value. If the volume flow surpasses this limit value, the status output will be set in case the corresponding assignment has been made. If the alarm function has also been activated for the current output, the applied current will change to < 3.2 mA or > 20.5 mA / 22 mA. After choosing the *Volume flow limit MAX* function and pressing ↵, the following selection field will be displayed:

Volume flow limit
MAX = 90 %

The current MAX upper-range value for volume flow will be displayed. According to the description in Section 14.4.3.2 Input window / modify a value, the current value can be changed.

15.5.6 QV limit hysteresis

The hysteresis of the QV limiting values is the flow rate in percent based on the upper-range value and indicates the value which must fall below or surpass the set limiting values in order to activate or deactivate the function. The hysteresis of the QV limiting values can be set in 1-percent increments from 0 to 10 %. After choosing the *QV limit hysteresis* function and pressing ↵, the following selection field will be displayed:

QV limit
Hysteresis 00 %

The current hysteresis value will be displayed. According to the description in Section 14.4.3.2 Input window / modify a value, the current value can be changed.

15.5.7 Density

If a mass unit in kg or t is used as flow unit (Volume flow QV unit), the density of the medium must be entered in the unit of g/l. Using the entered density value, the mass flow is calculated from the volume flow measurement.

After choosing the *Density* function and pressing ↵, the following selection field will be displayed:

Density
998.2 g/l

The current density value will be displayed. According to the description in Section 14.4.3.2 Input window / modify a value, the current value can be changed.

The value of the density is not measured. It is a parameter.

15.5.8 Volume flow LSL (information field)

This value represents the minimum lower range value based on the inside diameter of the sensor. This value is normally set for a flow velocity of 0.25 m/s.

QV LSL
XX.XXX l/h

15.5.9 Volume flow USL (information field)

This value represents the maximum upper range value based on the inside diameter of the sensor. This value is normally set for a flow velocity of 11 m/s.

QV USL
XX.XXX l/h

15.6 PULSE OUTPUT functional class

The PULSE OUTPUT functional class is comprised of the functions regarding the pulse output.

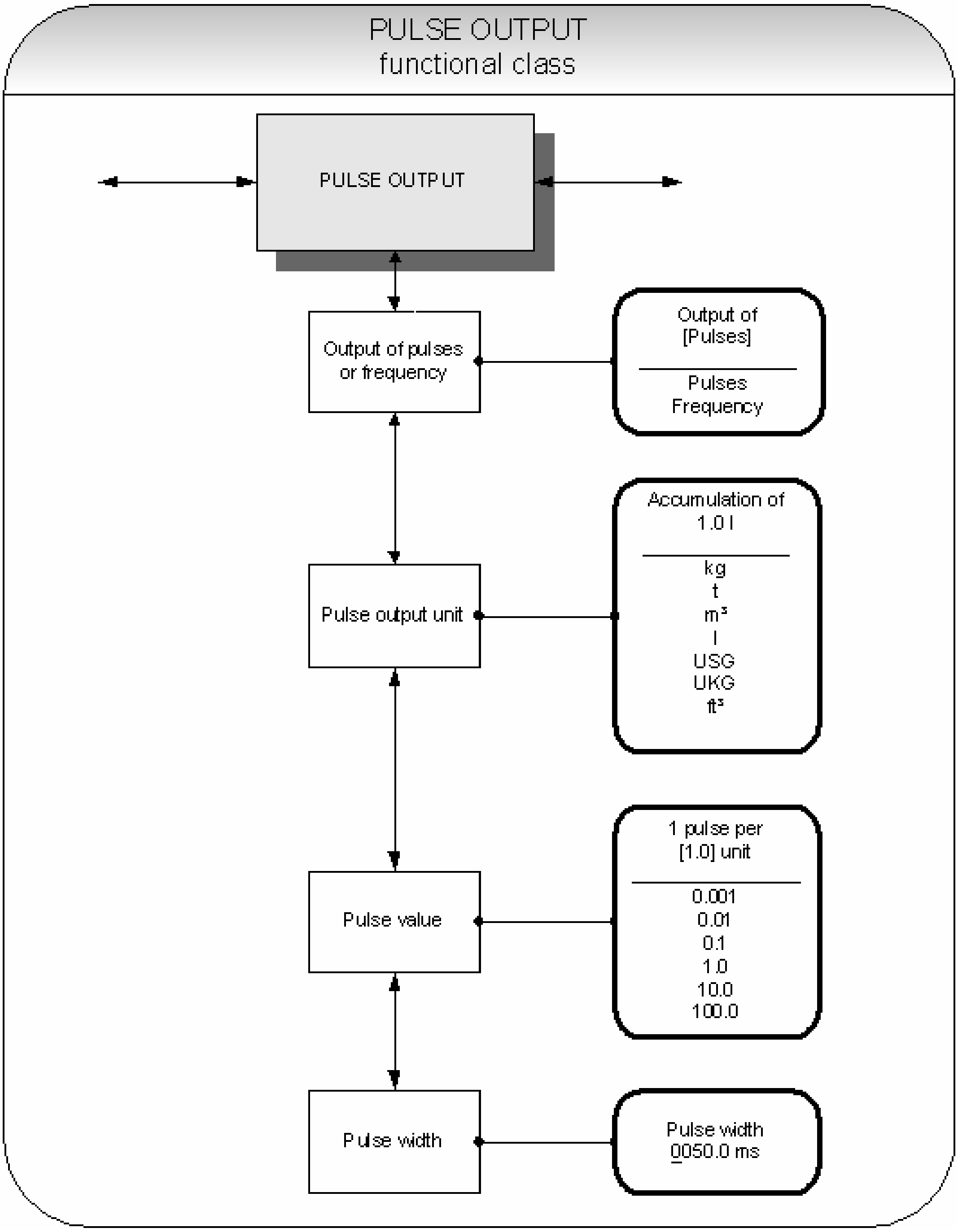


Fig. 44 – Pulse output functional class

15.6.1 Pulse or frequency output

The *Pulse or frequency output* function allows the operator to define whether pulses per represent a unit of flow or a frequency between 0 and 1 kHz that represents an analog output over the measuring range.

After selecting the frequency setting, the maximum frequency of 1 kHz will be generated when the upper-range value for mass or volume flow is reached (depending on the selected pulse unit). If the flow rate falls below the low flow volume, the actual frequency is 0 Hz.

After selecting the pulse setting, pulse value and unit the transmitter will determine the number of pulses per flow volume. When choosing a combination of these settings that cannot be fulfilled in real time for the upper-range value (e.g. the number of pulses per time unit cannot be generated due to the pulse width which is too large), the error message “Pulse width too large” or “Inconsistent parameter” will be displayed.

Press ↵ to display the current setting:

Output of [Pulses]

According to the description in Section 14.4.3.2 Input window / modify a value, the operator can toggle between frequency and pulse output (default setting).

15.6.2 Pulse output unit

This function allows the operator to define the unit to be counted. After selecting the *Pulse output unit* function, press ↵ to display the following selection field:

Accumulation of 1.0 l

The current value will be displayed. As mentioned in Section 14.4.3.2 Input window / modify a value, the operator can choose between the following units:

- Mass units:
  - kg, t
- Volume units:
  - m³, l, USG, UKG, ft³.

15.6.3 Pulse value

This function allows the operator to define how many pulses will be output per unit counted. After selecting the *Pulse value* function, press ↵ to display the current unit:

1 pulse per [1.0] unit

As mentioned in Section 14.4.3.2 Input window / modify a value, the operator can choose between the following pulse values:

- Values:
  - 0.001, 0.01, 0.1, 1.0, 10.0, 100.0

15.6.4 Pulse width

This function allows the operator to change the width of the output pulse to be output. If the pulse width is too large for the actual pulse number, it will be reduced automatically. In this case the warning “Pulse output saturated” will be displayed.

After selecting the *Pulse width* function, press ↵ to display the following selection field:

Pulse width
0050.0 ms

The current pulse width will be displayed. As mentioned in Section 14.4.3.2 Input window / modify a value, the operator can change the current value.

The maximum output frequency can be calculated from the following formula:

$$f = \frac{1}{2 * pulsewidth[s]} \leq 1000Hz$$

If connecting to electrical counter relays, we recommend pulse widths greater than 4 ms; for electromechanical counter relays the pre set value should be 50 ms.

15.7 STATUS OUTPUT functional class

The functional class OUTPUT is comprised of the functions for setting the status output.

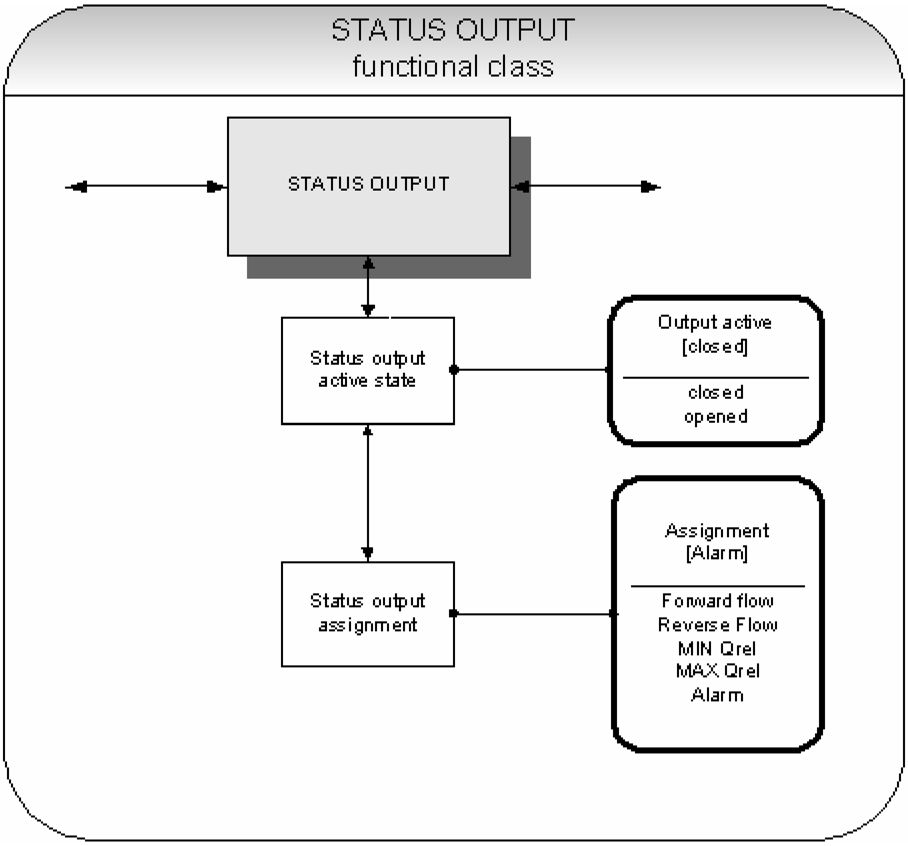


Fig. 45 – Status output functional class

15.7.1 Status output active state

The status output can be compared to an electrical relay that can function as make or break contact. For safety-relevant applications, the operator will choose the break contact setting so that a power failure or failure of the electronics can be detected like an alarm. In standard applications, the output is used as make contact.

The *Status output state active state* function allows the operator to define the behavior of the status output.

Output active [closed]

As mentioned in Section 14.4.3.1 Selection window / make a selection, the operator can choose between the following settings:

- Closed.
- Open.

15.7.2 Status output assignment

This function allows the operator to define to which event the status output is to be assigned. The most general assignment is the reverse flow assignment.

After selecting the *Status output assignment* function, press ↵ to display the current assignment.

Output assigned to
[Reverse flow]

As mentioned in Section 14.4.3.1 Selection window / make a selection, the operator can choose between the following settings:

- Flow direction recognition
  - Forward flow
  - Reverse flow
- Limiting values:
  - MIN QV
  - MAX QV
- All limiting values and error detection
  - Alarm.

15.8 CURRENT OUTPUT functional class

The CURRENT OUTPUT functional class allows the operator to perform the settings for the current outputs of the transmitter.

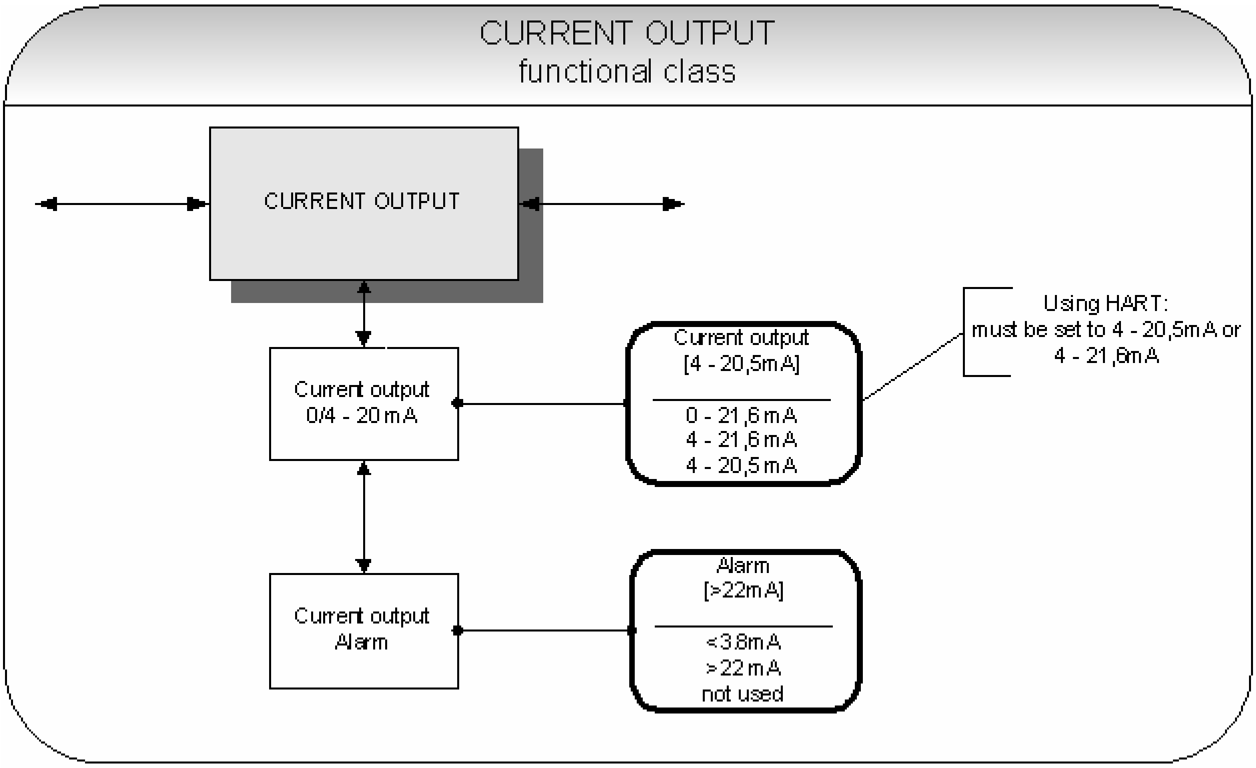


Fig. 46 – Current output functional class

The current output is always assigned to volume flow.

15.8.1 Current output 0/4 - 20 mA

The *Current output 0/4 to 20 mA* function allows the operator to define the range in which the current output is to be operated. Within the range from 0 to 21.6 mA (= 0 ... 110 %) HART® communication is not possible. The range from 4 to 20.5 mA follows the NAMUR recommendation and covers the range from 0 to 104 % of the measuring range. The standard range from 4 to 21.6 mA allows for a control of the measuring range of up to 110 %.

Press ↵ to display the current setting.

Current output I1
[4] – 21.6 mA

As mentioned in Section 14.4.3.1 Selection window / make a selection, the operator can choose between the following settings:

- 0 – 21.6 m
- 4 – 21.6 mA
- 4 – 20.5 mA

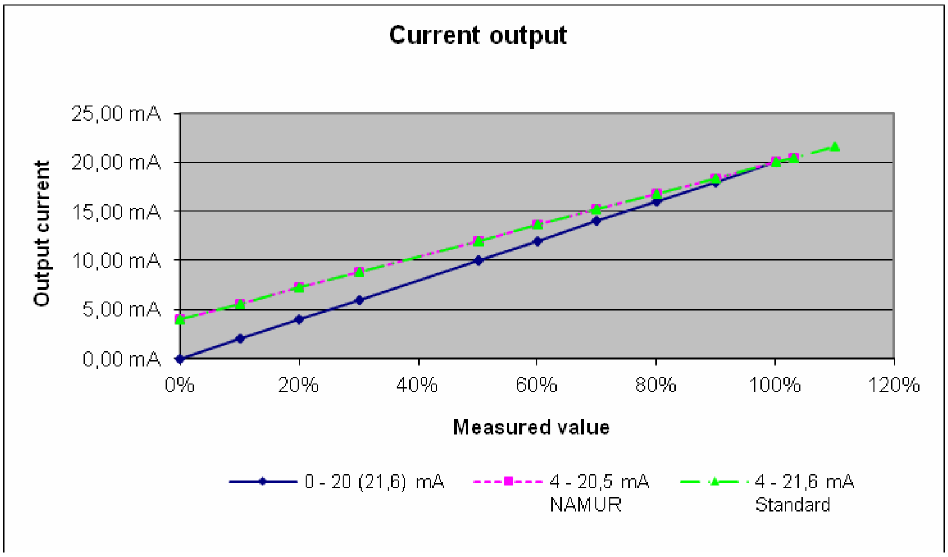


Fig. 47 – Current output

15.8.2 Current output alarm

This function allows the operator to define the state taken on by the current output when a state of alarm is detected. This information can be analyzed in the control system. Press ↵ to display the current setting:

Alarm
[>22mA]

As mentioned in Section 14.4.3.1 Selection window / make a selection, the operator can choose between the following settings:

- not used — no alarm function
- > 22 mA — current rise in the case of an alarm
- < 3.8 mA — current reduction in the case of an alarm

15.9 SIMULATION functional class

The functional class SIMULATION is comprised of the functions for simulating the outputs. If simulation is activated, all output signals will be generated based on the selected type of simulation. The peripherals connected to the device can be tested without a flowing product.

Simulation will be deactivated automatically if the operator switched the device off or did not touch any control unit keys for about 10 minutes. Simulation can also be activated and controlled via HART® commands.

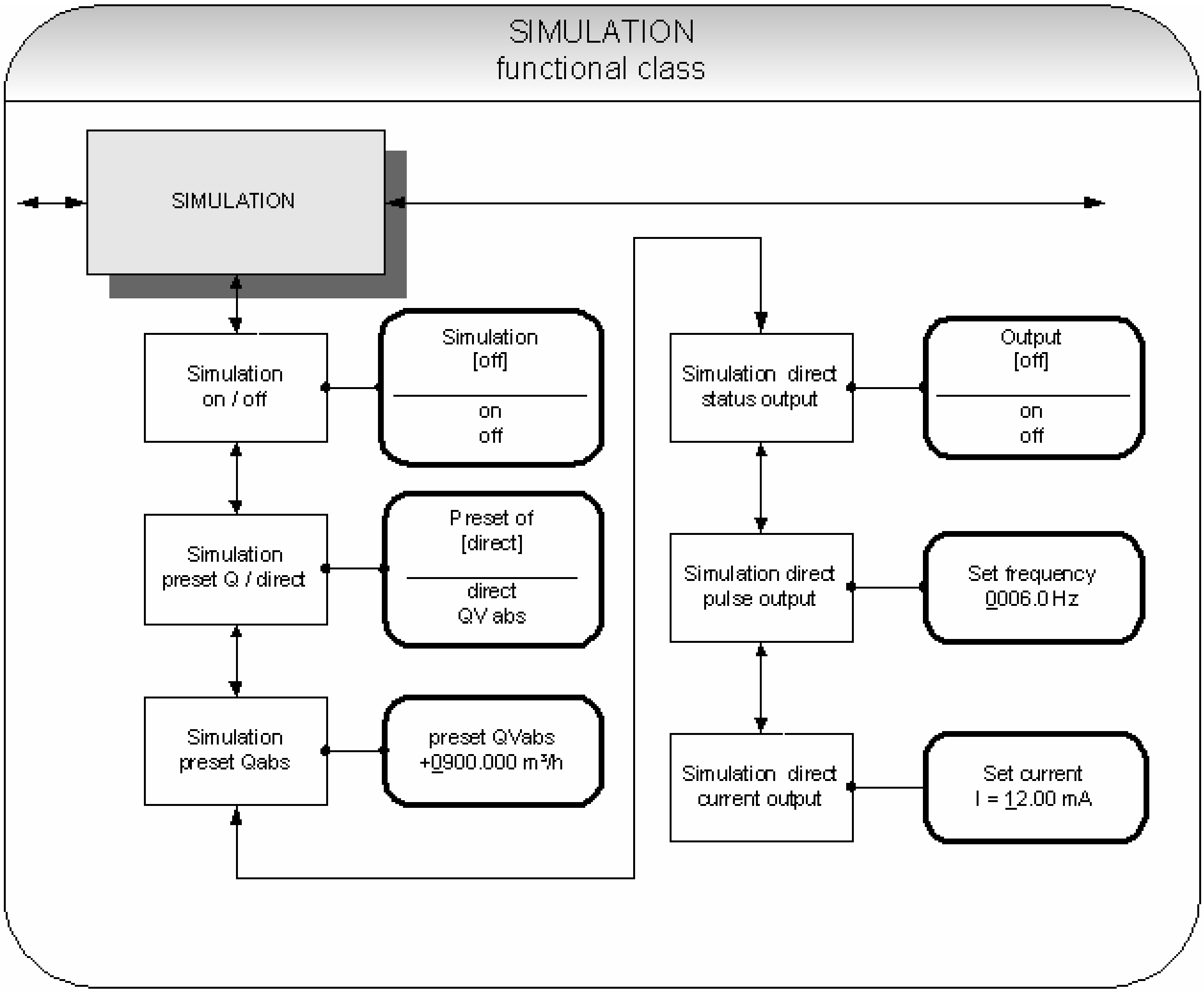


Fig. 48 – Simulator functional class

15.9.1 Simulation on / off

The *Simulation on/off* function allows the operator to activate or deactivate simulation. If simulation is activated, all output signals will be generated based on the selected type of simulation. The peripherals connected to the device can be tested without a flowing product. Press ↵ to display the current status.

Simulation
[off]

As mentioned in Section 14.4.3.1 Selection window / make a selection, the operator toggles between the "on" and "off."

Simulation will be deactivated automatically if the operator switched the device off or did not touch any control unit keys for about 10 minutes.

15.9.2 Simulation direct / preset value Q

This function allows the operator to define whether simulation is comprised of the measurement of the volume flow or whether the outputs will be set directly. Press ↵ to display the selected type of simulation.

Simulation
[direct]

As mentioned in Section 14.4.3.1 Selection window / make a selection, the operator can choose between the following settings:

- Direct — pulse and current outputs are programmed directly
- QV_{abs} — a measurement is simulated

If "direct" simulation is activated, any output will perform based on the settings described in Sections 15.9.4.1 Status output simulation to 15.9.4.3 Current output simulation. It is therefore recommended that the settings be defined before starting simulation. They can then be purposefully changed during simulation.

Simulation will be deactivated automatically if the operator switched the device off or did not touch any control unit keys for about 10 minutes.

15.9.3 Simulation measured flow Q

If the operator selected the setting "QV_{abs}" described in 15.9.2 Section Simulation direct / preset value Q, the following settings of a volume flow will affect the output behavior during measured value simulation.

In order to simulate volume flow, the operator can define a "measured value." The flow rates will be simulated in both directions. All outputs will perform based on the simulated measured value.

Preset QVabs
±0900.0 l/h

The simulation value is entered as described in Section "14.4.3.1 Input window / modify a value".

15.9.4 Direct simulation of outputs

If the operator selected the setting "Direct simulation" described in Section 15.9.2 Simulation direct / preset value Q, the following 3 possible settings will affect the output. All outputs are simulated at the same time by these settings.

15.9.4.1 Status output simulation

The *Status output simulation* function allows the operator to purposefully activate the status output.
Press ↵ to display the current state.

Status output
[off]

As mentioned in Section 14.4.3.1 Selection window / make a selection, the operator can toggle between "on" and "off".

15.9.4.2 Pulse output simulation

The *Pulse output simulation* function allows the operator to define a frequency to be assigned to the pulse output. After selecting this function and pressing ↵, the following selection field will be displayed:

Set frequency
0210.0 Hz

This field shows the current frequency. As mentioned in Section 14.4.3.2 Input window / modify a value, the definable frequency ranges from 6 Hz to 1100 Hz.

15.9.4.3 Current output simulation

This function allows the operator to define a current for current interface 1. Press ↵ to display the set current.

Set I1
I1 = 10.50 mA

As mentioned in Section 14.4.3.2 Input window / modify a value, the current value can be changed.

15.10 SELF-TEST functional class

The SELF-TEST function class is comprised of the functions relating to the self-test of the sensor. The diagnostic functions of the transmitter, which monitor the proper functioning of the electronics and the software, are always active and cannot be switched off. The excitation current can be monitored in addition.

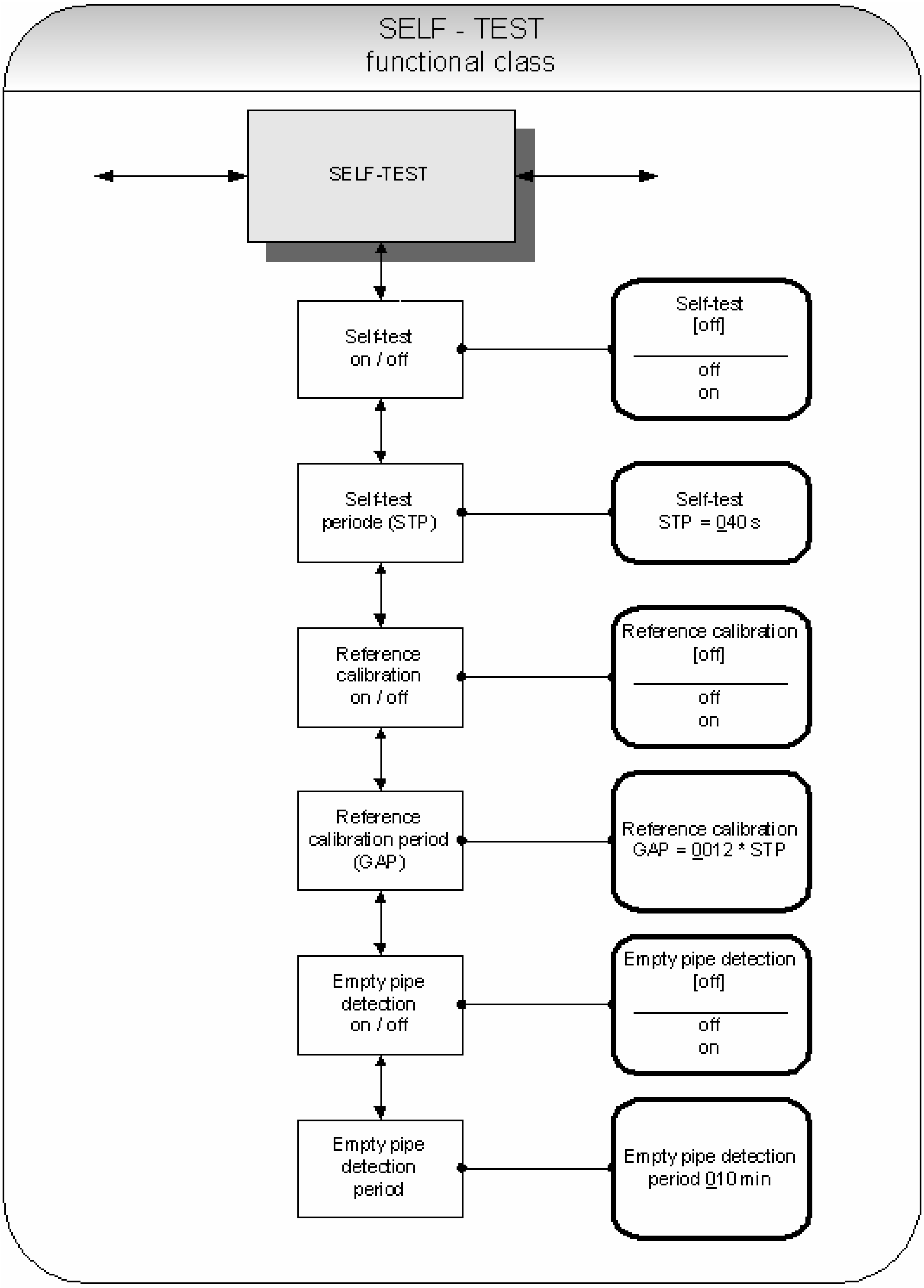


Fig. 49 - SELF-TEST function class

15.10.1 Self-test test on / off

The *Self-test on/off* function allows the operator to activate or deactivate the monitoring function of the field coil current.

Self-test
[off]

According to the description in Section 14.4.3.1 Selection window / make a selection, the operator can toggle between “on” and “off.” The standard factory setting is “on.”

The measurement is intended to suppress temperature dependences of the transmitter. During the sampling time of 0.5 seconds, the transmitter is offline; the last measured value will be displayed at the signal outputs.

15.10.2 Self-test period (STP)

With the help of this function, you set the time period after which the field coil current will be measured periodically. You can set periods between 35 seconds and 999 seconds.

Self-test
STP = 040 s

This field shows the current self-test period. As mentioned in Section 14.4.3.2 Input window / modify a value, the current value can be changed.

15.10.3 Reference calibration on / off

With the help of the function *Reference calibration on/off*, the periodic recalibration of the transmitter can be activated or deactivated. The objectives of the function are periodic self-monitoring and an increase in long-term stability. During the automatic reference calibration of 30 seconds, the transmitter is offline; the last measured value will be displayed at the signal outputs. After choosing this function and pressing ↵, the following selection field will be displayed:

Reference calibration
[off]

According to the description in Section 14.4.3.1 Selection window / make a selection, the operator can toggle between “on” and “off.” If switched on, the reference calibration will be done periodically.

15.10.4 Reference calibration period (GAP)

The function R*eference calibration period* is a multiplication of the function “self-test period”. With the help of this function, you define after how many STP’s the reference calibration is to be performed.

Reference calibration
GAP = 5400 * STP

This field shows the current reference calibration period. As mentioned in Section 14.4.3.2 Input window / modify a value, the current value can be changed.

Example: The “self-test period” has been set to 40 seconds; a reference calibration is to be carried out every 6 hours.

GAP = **6** * 3600s / 40s = **5400**

15.10.5 Empty pipe detection on / off

With the help of the function *Empty pipe detection on / off*, continuous empty-pipe detection can be activated or deactivated. After selecting this function and pressing ↵, the following selection field will be displayed:

Empty pipe detection
[off]

According to the description in Section 14.4.3.1 Selection window / make a selection, the operator can toggle between “on” and “off.” If switched on, the empty pipe detection will be done periodically.

15.10.6 Empty pipe detection period

With the help of the function *Empty pipe detection period*, the time after which the detection will be carried out can be set. When entered 00 minutes, the detection will be performed continuously.
After choosing this function and pressing ↵, the following selection field will be displayed:

Empty pipe
every 10 Min

This field shows the current empty pipe detection period. As mentioned in Section 14.4.3.2 Input window / modify a value, the current value can be changed.

15.11 SETTINGS SENSOR + CH1.10 functional class

This functional class is comprised of the general settings affecting the behavior of the transmitter.

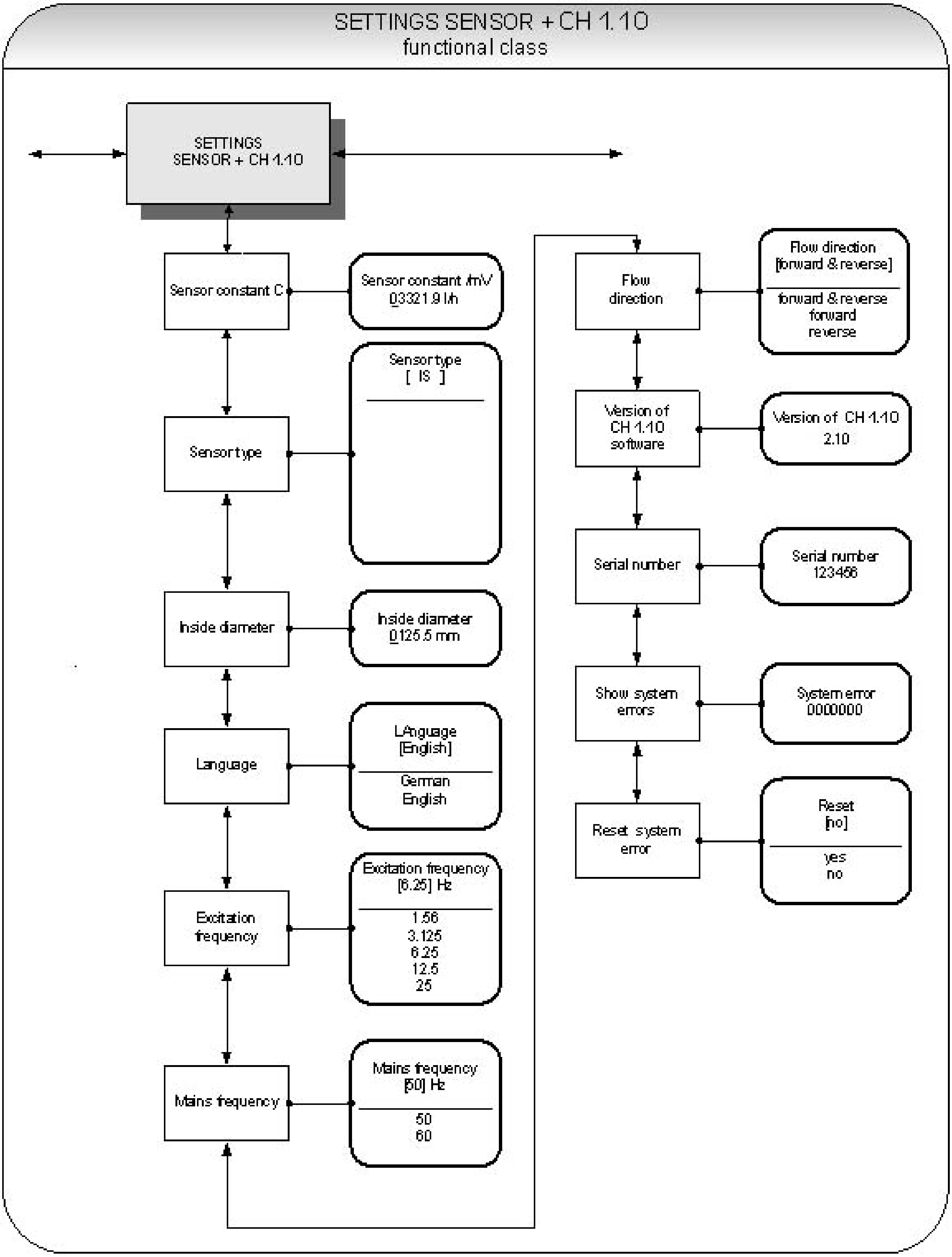


Fig. 50 – Settings sensor + CH1.10 functional class

15.11.1 Sensor constant C

The sensor constant C is the calibration value of the sensor connected to the transmitter. The calibration value must be entered in the CH1.10 to ensure a correct measurement. The constant will be defined after the calibration of the meters and can be found on the rating plate of the sensor.
After selecting the *Sensor constant* function, press ↵ to display the current setting.

Sensor constant /mV
01234.56 l/h

As mentioned in Section 14.4.3.2 Input window / modify a value, the current value can be changed.

CAUTION:
Changing sensor constant C to a value that differs from the value on the rating plate of the sensor connected to the flow meter will result in false readings!

Note:
The sensor constant must always be preceded by a plus or minus sign. The delivery default setting is a plus sign. If inlet and outlet section are interchanged when the device is installed (the flow direction is indicated by an arrow on the sensor), the transmitter will display a “forward flow” negative measurement value. If the (plus or minus) sign of the sensor constant is then changed without changing the actual value, a plus sign will again be displayed. No changes need be made in the disposition of the electrical connections (wires).

15.11.2 Sensor type

The function *Sensor type* contains the type of the sensor with which the transmitter has been delivered. The distinction is necessary and required because the flow rate measurement uses different calculations depending on the type of the used sensor. After selecting this function, press ↵ to display the current setting.

Sensor type
[IS]

This type code can be found on the sensor rating plate. This setting is defined by the vendor when the device is first put into operation at the factory. It should only be changed if the transmitter is mounted onto another sensor.

15.11.3 Inside diameter

The inside diameter of the sensor connected to the transmitter is necessary for calculating the mean flow velocity. The inside diameter must be checked in the CH1.10 (on mm exact) to ensure a correct measurement. After choosing the function “inside diameter” and pressing ↵, the following selection field will be displayed:

Inside diameter
50 mm

As mentioned in Section 14.4.3.2 Input window / modify a value, the current value can be changed.

15.11.4 Language

Two languages are available in the control unit: German and English.

Language [English]

As mentioned in Section 14.4.3.1 Selection window / make a selection, the operator can toggle between these languages:

- German,
- English.

15.11.5 Excitation frequency

With the help of the function *Excitation frequency*, you can set the excitation frequency of the field coil current. Since the excitation frequency depends on the sensor, it cannot be assigned freely. The excitation frequency defaults to 6.25 Hz.

Excitation frequency [6.25 Hz]

The selection is confirmed and taken over with the ↵-key.

⚠	**Caution!** If the excitation frequency is changed, then a reference calibration (Section 15.10.3 Reference calibration on / off) must be accomplished! Otherwise the measuring accuracy is not ensured.

15.11.6 Mains frequency

In order to ensure with mains frequency (50 Hz or 60 Hz per second) optimal interference suppression, the input of the frequency is necessary. The standard setting is 50 Hz.
After choosing the function *Mains frequency* and pressing ↵, the following selection field will be displayed:

Mains frequency [50 Hz]

The selection is confirmed and taken over with the ↵-key.

15.11.7 Flow direction

This function allows the operator to define the flow direction that the transmitter will evaluate. Only "forward" should be selected so as to prevent reverse flow from being measured. The standard factory setting is "forward & reverse." After selecting the *Flow direction* function, press ↵ to display the current setting.

Flow direction [forward]

As mentioned in Section 14.4.3.1 Selection window / make a selection the operator can choose between:

- forward
- reverse
- forward & reverse

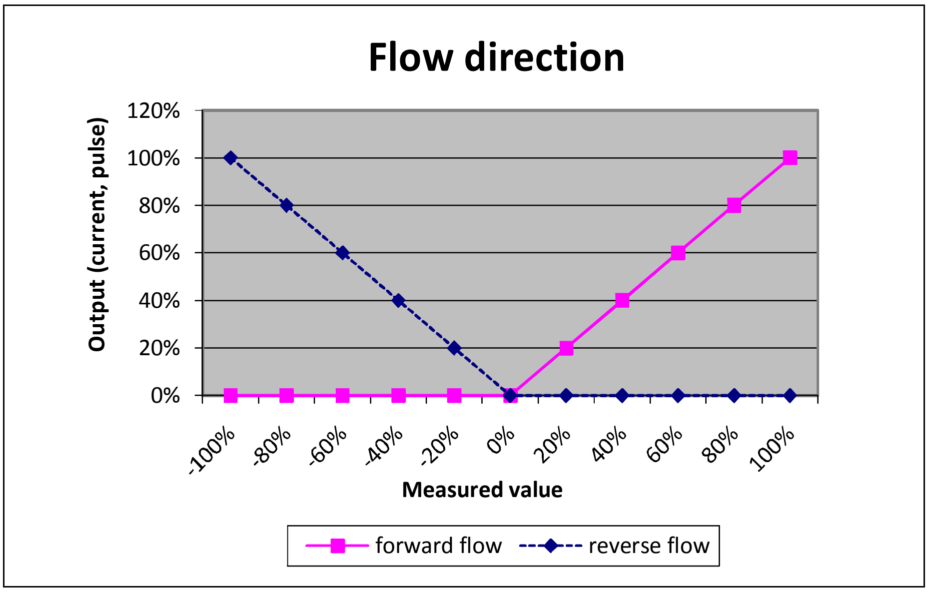


Fig. 51 – Flow direction

15.11.8 Software version (information field)

After selecting this function, the version of the transmitter software will be shown (example: 2.10):

Version of CH1.10
2.10

15.11.9 Serial number (information field)

With the help of the *Serial number* function, the transmitter is assigned to an order. This number provides access to internal vendor data if the device needs servicing. The serial number is printed on the rating plate of the transmitter. After selecting this function, press ↵ to display the following information field:

Serial number:
100683

This entry should never be changed so as to ensure that the sensor, the transmitter and the documents created within quality management are assigned correctly.

15.11.10 Show system errors

With the help of this function, you can show the error code of the system errors that have occurred.

The integrated diagnostic system of the CH1.10 distinguishes between two types of errors (see also Section 16. CH1.10 ERROR MESSAGES). Self-test errors such as problems with a sensor line or inconsistent parameter inputs are displayed as textual error messages. Once the error has been eliminated, the message automatically disappears from the display. For further information, see Section 16.2.1 Display of self-test errors.

Errors that are attributable to system memory or software, division by zero, or a fault in the electronics unit are designated as system errors. These error messages are not reset automatically after the error (usually of very brief duration) is eliminated.

15.11.11 Reset system error

Before resetting a system error manually, we advise that you contact our technical service department. For further information, see Section “16.2.2 Display of system error”.

Reset error
[no]

If the operator toggles to [yes] and confirms the action according to the description in Section 14.4.3.1 Selection window / make a selection, the error messages disappears from the display. If the message reappears shortly after, do contact our technical service department.

16. CH1.10 ERROR MESSAGES

The integrated diagnostic system of the FLONET FH20XX distinguishes between two types of errors. Self-test errors such as problems with a sensor line or inconsistent parameter inputs are displayed as textual error messages. Once the error has been eliminated, the message automatically disappears from the display. For further information, see Section “16.2.1 Display of self-test errors”.

Errors that are attributable to system memory or software, division by zero, or a fault in the electronics unit are designated as system errors. These error messages are not reset automatically after the error (usually of very brief duration) is eliminated. **Before resetting a system error manually, we advise that you contact our technical service department.** For further information, see Section “16.2.2 Display of system error”.

If the cause of any of the error messages described below cannot be eliminated, contact the device vendor.

16.1 Standard operating mode

The transmitter operates as described above. After the cause of the error message has been eliminated, the message automatically disappears.

16.2 List of error messages

16.2.1 Display of self-test errors

Self-test errors are displayed as plain text in the set language (German or English) on the second line of the LCD.

Display (German)	Display (English)	Description	Possible cause of error and remedy
Rohr leer	empty pipe	Empty-pipe detection has been activated. Fluid density is below the limit value for density; empty-pipe detection, pipe is empty.	Product contains air bubbles/pipe is empty. Bubble-free filling must be ensured.
Spulenstrom	Exciter current?	Interruption / short circuit in the connection of excitation coil. All signal outputs will be set to no flow.	Check the wiring between transmitter and sensor.
Messkreis überst.	meas. circ. sat.	The flow measurement circuit is overloaded. The measured electrode voltage is too high. All signal outputs will be set to no flow.	Flow rate exceeds the upper range value (URL). High electrostatic voltage at the electrodes.
Strom überst.	curr. saturated	The output of current interface is overloaded. Based on the selected settings and the currently assigned measured variable, the current to be output is > 21.6 mA.	Check the upper-range value and the flow rate settings.
IMP übersteuert	pulse out satur.	The pulse output is overloaded. The current measured value requires a pulse rate, which can no longer be generated with the help of the set pulse duration and pulse value.	Check pulse duration, pulse value, and measuring range. Check the flow rate.
Parameter inkons.	params inconsist	Parameter is inconsistent.	Check the parameter settings. The set parameters are contradictory. Example: Upper-range value, pulse value and pulse duration must be matched in such a way that the combination fits for all measured values.
ext EEPROM fehlt	missing EEPROM	The data memory module (DSM) with the calibration data of the sensor and the customer-specific settings of the transmitter is not plugged-in.	Insert the data storage module (DSM) in the socket on the power supply board CH1.10.

Table 10 - Display of self-test errors

	Information:
	Error message: "Parameter is inconsistent" (system error 0x0400)? To generate a list of the inconsistencies, first enter a valid password and then an invalid password. The control unit will show a list of current errors (only once). The operator can then correct the inconsistent settings after entering a valid password.

16.2.2 Display of system error

System errors consist of the message text "system error" and a 5-digit number in hexadecimal code. The meaning of the individual error codes is described in the following table. If several errors occur at the same time, the hexadecimal sum of the individual errors will be displayed. The errors are coded in such a way that the individual errors can be easily identified. The sums are unique.

Descriptor label (never displayed)	Constant/ display	Description
SystemfehlerExtEEProm	0x00002	External EEPROM (data memory chip DSM) plugged in but empty, not initialized
SystemfehlerIntEEProm	0x00004	Internal EEPROM (calibration CH1.10) erased, CH1.10 not calibrated
SystemfehlerEEPROM	0x00010	Unsuccessful saving or reading of memory data / defective memory

Table 11 - Display of system error

16.2.3 Reset system error

After the fault recovery the displayed system error message can be reset.

- For this purpose the customer password has to be entered. (Refer to 15.2.1 Customer-password).
- Select the function Show system error. (Refer to 15.11.10 Show system errors). Analyze the fault and repair the transmitter or sensor.
- Finally reset the system error message. (Refer to 15.11.11 Reset system error)

17. METER APPLICATION RULES

17.1 Sensor placement in piping

No chemical injection or batching unit (such as chlorine compound injector) should be located at the input side of the sensor. The insufficient homogeneity of the flowing liquid may affect the flow-rate values indicated by the meter.

The meter performance will be the best if the liquid flow in the piping is well stabilized; therefore it is necessary to observe specific rules for the sensor placement in piping. In the contact planes between the sensor and the adjoining piping sections should be no edges as these would cause flow turbulence. Make sure that straight piping sections are provided before and after the sensor; their required length is proportional to the inner diameter of the piping concerned.

If more than one flow-disturbing element such as pipe bend or fitting are located near the sensor, the required length of straight piping section on the sensor side concerned should be multiplied by the quantity of such elements.

As required by clause of standard EN 29104, the inner diameter of the connected pipe should not differ by more than 3% from that of the sensor.

In the cases of bi-directional flow-rate measurement, the same conditions concerning flow stability shall be met at the input and output sides of the sensor.

In the cases where the pipe size larger than that of the meter sensor, it is necessary to use conical reduction pieces with the angle of taper not exceeding 15° (see the picture). In the cases of bi-directional flow measurement, the minimum length of straight piping sections on both sides is 5 DN. In horizontal sensor installations, to prevent bubbling, use eccentrically-fitted reduction pieces (see standard EN ISO 6817).

Pipe narrowing sections with angles not exceeding 8° can be taken for straight sections.

In the cases where the liquid is pumped, the flow sensor shall always be placed at the output side of the pump to prevent under pressure in the piping which might damage the sensor. The required length of the straight piping section between the pump and sensor is then at least 25 DN.

For the same reason, the sensor shall be always placed before the closing valve in the piping.

The sensor can be fitted in the piping in either horizontal or vertical position. However, make sure that the electrode axis is always horizontal and, if the sensor is mounted in a horizontal position, the flange section for attachment of the CH1.10 box faces upwards.

In the cases where the sensor is mounted in a vertical position, the flow direction shall always be upwards.

To ensure correct meter function at all times, the measured liquid shall completely fill up the sensor and no air bubbles shall be permitted to accumulate or develop in the sensor tube. Therefore the sensor shall never be placed in the upper pocket of the piping or in a vertical piping section where the flow direction is downwards.
In piping systems where complete flooding of the piping cannot always be guaranteed, consider placing the sensor in a bottom pocket where full flooding is ensured.

If the sensor is located near a free discharge point, such point shall be by at least 2 DN higher than the top part of the sensor.

Make sure that the adjoining piping is clamped/supported as close to the sensor as possible, to prevent vibrations and damage to the sensor.

In applications where continuous liquid flow is essential, a bypass shall be provided to allow for sensor servicing. A sensor bypass may also be a reasonable solution in the cases where, to dismantle the flow sensor from the piping, liquid from a very long piping section would have to be discharged.

18. SERVICE ACTIVITIES

18.1 Warranty services

The product warranty services are understood to include any repair work executed free of charge either on site or at the manufacturer's premises during the product warranty period. Warranty repairs shall be executed within the terms agreed between the customer and manufacturer (service provider). Warranty repairs concern product defects due to the use of non-standard materials, parts or incorrect manufacturing procedures. Should such defects prove irreparable, the product shall be replaced at no costs to the customer.

Warranty repairs shall be performed either by the manufacturer (ELIS PLZEŇ a. s.) or duly authorized service centers or distribution agents. However, these need to have the manufacturer's authorization in writing and have staffs properly trained to execute flow meter repairs.

The manufacturer's warranty shall not cover
- products where the installation and/or metrological seals have been removed
- product defects due to incorrect installation
- product defects due to non-standard product use
- product pilferage
- product defects due to circumstances classified as force majeure.

Any requirement for warranty repair shall be submitted in writing (using fax, electronic mail or registered letter) to the official address of the manufacturer. Should the manufacturer establish that the subject product repair does not fall within the warranty conditions, this fact will be made known to the customer in writing and the respective repair costs will be invoiced to the same. In the cases of a commercial meter, the parameters of a repaired product shall be verified at a duly authorized metrological centre.

18.2 Post-warranty services

The post-warranty services are understood to include any repair work necessitated by the product defects or deficiencies identified after the warranty period. All such repair work, whether executed at the manufacturer's plant or on site, shall be invoiced and paid for by the customer. In the cases of a commercial meter, the parameters of a repaired product shall be verified at a duly authorized metrological centre. Any requirement for a post-warranty repair shall be delivered in writing (using fax, electronic mail or registered letter) to the official address of the manufacturer.

19. STANDARD TESTS

Each finished product is thoroughly checked to establish the product completeness and compliance with the manufacturer's quality assurance standards. Subsequently the product functions are verified according to specifications of the approved test procedures.

20. CALIBRATION AND VERIFICATION TESTS

The FLONET FH20XX electromagnetic flow meters are supplied from the manufacturing plant calibrated at three points on the meter characteristic. Upon agreement with the customer, the number of calibration points can be extended to 5 or 9. The meter calibration services can also be provided by duly authorized commercial partners who shall have executed contracts to this effect with the manufacturer and have the necessary measuring equipment.

In the cases of a commercial (invoicing) meter, the manufacturer shall provide for initial product testing at a duly authorized Metrological Centre. There the meter functions and accuracy are verified under three different operational conditions within the specified range of the fluid flow rate.

21. STANDARDS AND AUTHORIZATIONS

21.1 General standards and directives

EN 60529 Ingress protection class (IP code)
EN 61010 Safety requirements for electrical metering, control and laboratory devices
NAMUR guideline NE21, Version 22/08/2007

21.2 Electromagnetic compatibility

EMC Directive 2004/108/EC
EN 61000-6-2:2005 (immunity for industrial environments)
EN 61000-6-3:2007 (emissions residential environments)
EN 55011:2007 group 1, class B (emitted interference)
EN 61000-4-2 to EN 61000-4-6
EN 61000-4-8
EN 61000-4-11
EN 61000-4-29
EN 61326

22. PACKAGING

The product packaging shall meet the requirements regarding safe domestic and international transport or other conditions agreed to with the customer. In that, the manufacturer uses its own in-company packaging directives and standards.

23. PRODUCT ACCEPTANCE

The product acceptance procedure consists of visual inspection and check on the completeness of the delivered items with reference to the delivery note. On delivery to the customer, enclosed to the flow meter FLONET FH20XX shall be a delivery note, operation and maintenance manual and a statement on the product compliance with the respective standards.

24. WARRANTY CONDITIONS

Unless agreed otherwise between the manufacturer and the customer, the warranty period for electromagnetic flow meters is 12 months counted from the delivery date. Within the warranty period, the manufacturer shall repair, free of charge, any product defects due to faulty materials or parts. In the case of a warranty repair, the warranty period shall be extended by the time the flow meter was inoperative because of such repair. Manufacturer’s warranty shall not cover product defects or malfunctions due to incorrect product installation, operation, intentional damage, pilferage or damage due to force majeure circumstances.

Manufacturer's address:

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