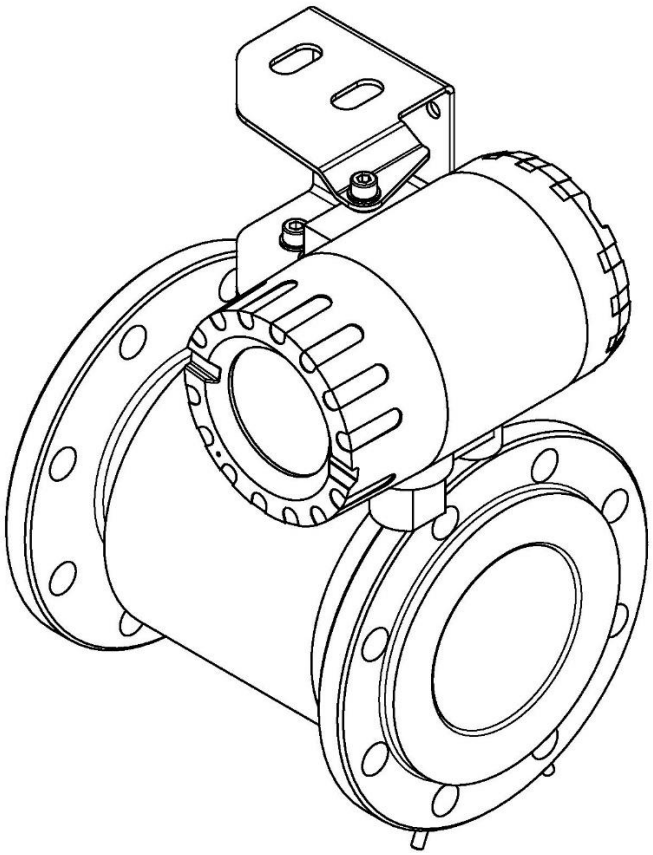
USER'S MANUAL

ELECTROMAGNETIC FLOWMETER

PEM-1000



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Used markings

Symbol	Description
	Warning signifying that it is necessary to follow the information in the documentation precisely in order to ensure device safety and complete functionality.
	Information particularly useful during device installation and operation.
	Information concerning dealing with used equipment.

BASIC REQUIREMENTS AND SAFETY OF OPERATION

- The manufacturer is not responsible for damage caused by improper installation of the device, not maintaining the device in good technical condition and operating the device contrary to its intended use.
- Installation should be carried out by qualified personnel authorized to install electrical devices and control and measuring equipment. The installer is responsible for carrying out the installation in accordance with this manual as well as safety and electromagnetic compatibility standards and regulations applicable to a given type of installation.
- In case of an installation with control and measuring equipment, in the event of a leak, medium under pressure causes a risk to the personnel. During device installation, operation and inspection all safety and precautionary requirements must be taken into account.
- If the device malfunctions, it should be disconnected and handed over to the manufacturer or to a body authorized by the manufacturer for repairs.

In order to minimize probability of failure and resultant danger to personnel, avoid installing the device under particularly unfavourable conditions when the following dangers are present:

- Danger of mechanical impacts, excessive shocks and vibrations.
- Excessive temperature variations.
- Vapour condensation, dust, icing.

Changes in product manufacture may precede an update to the user's paper documentation. Up-to-date operating manuals can be found on manufacturer's website at www.aplisens.com

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1. INTRODUCTION

This manual concerns electromagnetic flow meters, manufactured in two versions:

- A compact version designated **PEM-1000ALW** - with transmitter placed directly on the measuring sensor**;**
- A remote version designated **PEM-1000NW** - with transmitter connected via cable and placed up to 50 m from measuring sensor.

The manual contains data, guidelines and recommendations concerning installing and operating, as well as procedure in the event of a failure.

The description of device configuration can be found in the IK.PEM-1000*(ENG)* configuration manual, and the Modbus communication is described in the IM.PEM-1000*(ENG).* They are available on the manufacturer's website www.aplisens.com

2. SAFETY

- Installation and start-up of the device, as well as any actions related to operation, should be carried out only after carefully reading this manual.
- Installation and maintenance should be carried out by qualified personnel authorized to install electrical devices and control and measuring equipment.
- Device should be used in accordance with intended use (item 6.1) and within permissible parameters.
- Protections ensuring device safety utilized by the manufacturer may be less effective if the device is operated contrary to its intended use.
- Before installing or removing the device make absolutely sure that it is disconnected from power source.
- Repairing or otherwise tampering with the electronic system of the device is not permitted. Only the manufacturer or a body authorized by the manufacturer may carry out damage assessment and necessary repairs.
- Do not use damaged equipment. In case of malfunction, the device should be removed from operation.

3. COMPLETENESS LIST

Along with the flow meter, the user receives:

a) Product Certificate, which also acts as a warranty card;
b) Declaration of conformity (on request);
c) Operating Manual designated "IO.PEM-1000(ENG)"
d) Calibration certificate

Items b) and c) are available on-line at www.aplisens.pl

On the manufacturer's website are also available:

- Configuration Instructions for the flowmeter “IK.PEM-1000(ENG)”.
- Instructions for handling flowmeters via the Modbus protocol “IM.PEM-1000(ENG)”

4. TRANSPORT AND STORAGE

4.1. Transport

Flow meters should be transported in individual packages via means which provide cover. Packages should be protected against moving and direct exposure to weather.

4.2. Storage

The flow meter should be stored in factory-provided packaging, in a covered room with no vapors or aggressive substances, at temperature and relative humidity within permissible conditions (see item 10.6).

5. WARRANTY

The manufacturer grants warranty on terms and conditions stated in the Product Certificate which also acts as a warranty card.

Warranty shall be revoked if the device is used contrary to its intended use, this operating manual is not followed, the device is operated by unqualified personnel or the device has been tampered with.

6. DESIGN

6.1. Intended use and properties

The PEM-1000 electromagnetic flow meter is a precise device for measuring flow of conducting liquids within pipeline installations.

The electromagnetic flow meter converter is intended to work only with the sensor with which it was provided.
Replacing any of these elements on one's own is not permitted. Contact the manufacturer if either the converter or the sensor requires replacing.

Flow meter sensor has no internal mechanical elements, which ensures uninterrupted flow of measured medium through the entire section of the pipeline. Flow measurement does not depend on:

- liquid pressure,
- viscosity,
- density,
- temperature,
- electrical conductivity (above minimal value).

The flow meter can measure the flow of purified liquids, slurries, pulps and solutions of varying chemical aggressivity. The lack of mechanical elements ensure a long service life of the instrument even in the case of media with strong abrasive properties. The basic areas of application are:

- water management, the measurements of drinking water and wastewater,
- the chemical, textile, paper industries as well as mining,
- the food industry,
- energy and heating installations,
- agriculture.

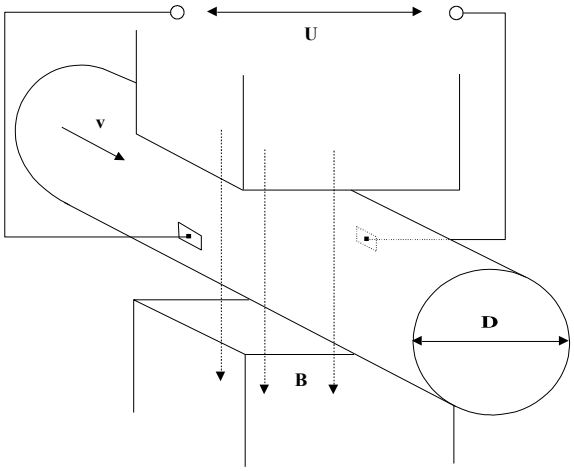
The converter processes the measuring signal from the measuring sensor into the 4...20 [mA] signal and Modbus RTU/RS 485.

6.2. The operating principle

The measurement flow uses the phenomenon of electromagnetic induction. In accordance with the law of Faraday the conductor moving in the magnetic field induces the electrical voltage. To designate the induced voltage the following equation is applied:

$$U=B \times D \times v$$

where:
U – induced voltage
v – the average flow velocity vector
D – diameter of the pipe
B – magnetic flux density



If magnetic flux density B and the pipe diameter D are constant the induced voltage is proportional to the average flow velocity. The fluid flows through the flow meter perpendicularly to the magnetic field. The electrical voltage, which is controlled by two electrodes, placed at right angles to both the magnetic field and the flow, is induced by the stream of the electrical conductive fluid. The excitation of the rectangular-wave shape current is generated in the converter and fed to the spool coils of the measuring sensor, producing the magnetic field of the flow meter. The power supply provides the coil with constant excitation in all working condition of the flow meter.

6.3. Design and dimensions

The electromagnetic flow meter PEM-1000 comprises the converter and the measuring sensor. In the compact version the converter placed in the aluminum housing is embedded directly on the sensor. In the remote version the converter is mounted using the assembly equipment to the pipe or flat surface.

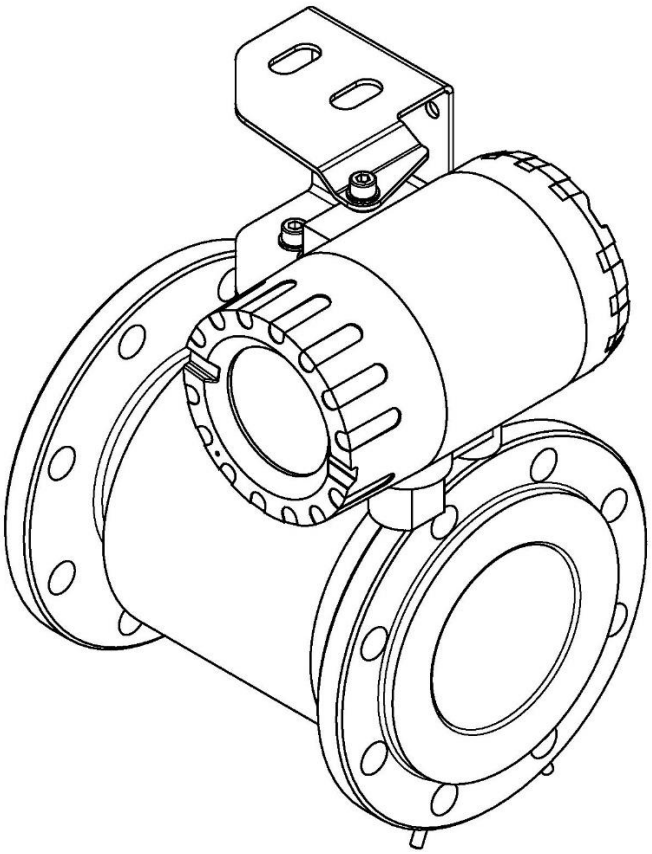


Figure 1. The flow meter PEM-1000ALW. The compact version

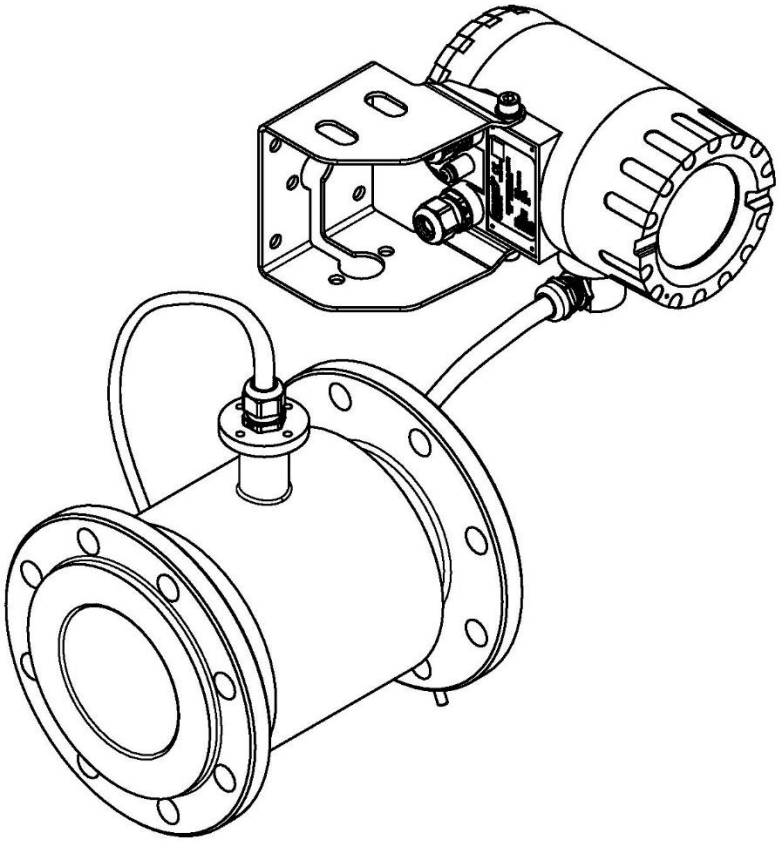


Figure 2. The flow meter PEM-1000NW. The remote version.

6.3.1. The sensor design

The housing of the sensor is made of non-magnetic material, welded with flanges and fasteners. The insulating insert of the required properties is installed inside the pipe (compatible with the medium type). The system of the electromagnet coils generating the required magnetic field is mounted directly on the measuring pipe.
A pair of electrodes placed opposite to each other and passing through the lined measuring pipe is made of stainless steel (standard) or of other electrically conductive materials matched to the properties of the measured medium.
The electrical system of the sensor is welded in the steel housing with the internal wiring lead.

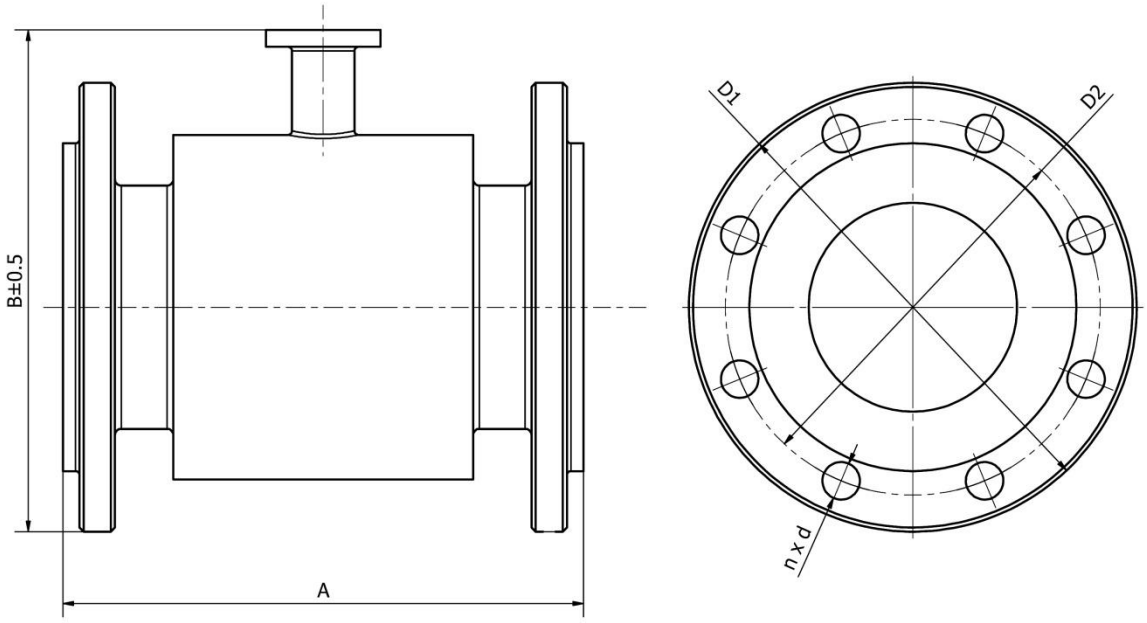


Figure 3. The flow meter sensor. Overall dimensions

Mechanical data of the sensor PN16								
		Dimensions [mm]						Weight
DN	*PN*	*A*	*B*	*D1*	*D2*	*d*	*n*	*kg*
10	16	150 or 200	153	90	60	14	4	2.5
15			155	95	65	14	4	2.5
20			160	105	75	14	4	3
25			167	115	85	14	4	3.5
32			180	140	100	18	4	5
40			185	150	110	18	4	6
50		200	191	165	125	18	4	7
65			209	185	145	18	4	8
80			224	200	160	18	8	9.5
100		250	245	220	180	18	8	12
125			276	250	210	18	8	15
150		300	305	285	240	22	8	20
200		350	375	340	295	22	12	36
250		400	430	405	355	26	12	58
300		500	487	460	410	26	12	70
350			542	520	470	26	16	85
400		600	615	580	525	30	16	100
450			657	640	585	30	20	120
500			750	715	650	33	20	160
600			870	840	770	36	20	190
700		700	927	910	840	36	24	260
800		800	1050	1025	950	39	24	350
900		900	1145	1125	1050	39	28	450
1000		1000	1285	1255	1170	42	28	550

Table 1. Mechanical data of the sensor – PN 16

Mechanical data of the PN 25 sensor								
		Dimensions [mm]						Weight
DN	*PN*	*A*	*B*	*D1*	*D2*	*d*	*n*	*kg*
10	25	150 or 200	153	90	60	14	4	2.5
15			155	95	65	14	4	2.5
20			160	105	75	14	4	3
25			167	115	85	14	4	3.5
32			180	140	100	18	4	5
40			185	150	110	18	4	6
50		200	191	165	125	18	4	7
65			209	185	145	18	4	8
80			224	200	160	18	8	9.5
100		250	245	235	190	22	8	12
125			276	270	220	26	8	15
150		300	305	300	250	26	8	20
200		350	375	360	310	26	12	36
250		400	430	425	370	30	12	58
300		500	487	485	430	30	16	70
350			542	555	490	33	16	85
400		600	615	620	550	36	16	100
450			657	670	600	36	20	120
500			750	730	660	36	20	160
600			870	845	770	39	20	190
700		700	927	960	875	42	24	260
800		800	1050	1085	990	48	24	350
900		900	1145	1185	1090	48	28	450
1000		1000	1285	1320	1210	56	28	550

Table 2. Mechanical data of the sensor – PN 25

Mechanical data of the PN 40 sensor								
		Dimensions [mm]						Weight
DN	*PN*	*A*	*B*	*D1*	*D2*	*d*	*n*	*kg*
10	40	150 or 200	153	90	60	14	4	2.5
15			155	95	65	14	4	2.5
20			160	105	75	14	4	3
25			167	115	85	14	4	3.5
32			180	140	100	18	4	5
40			185	150	110	18	4	6
50		200	191	165	125	18	4	7
65			209	185	145	18	4	8
80			224	200	160	18	8	9.5
100		250	245	235	190	22	8	12
125			276	270	220	26	8	15
150		300	305	300	250	26	8	20
200		350	375	375	320	30	12	36
250		400	430	450	385	33	12	58
300		500	487	515	450	33	16	70

350			542	580	510	36	16	85
400		600	615	660	585	39	16	100
450			657	685	610	39	20	120
500			750	755	670	42	20	160
600			870	890	795	48	20	190

Table 3. Mechanical data of the sensor – PN 40

6.3.2. Electrodes

- The material of the flow meter electrodes should be matched according to its chemical resistance to the liquid in which the electrodes are immersed.
- The cleanliness of the electrodes may affect the precision of the measurement, and the accumulation of the impurities may have impact on the measurement process (isolation form the liquid).
- The cleaning of the electrodes is conducted together with the cleansing of the pipeline. Any damage to the liner must be avoided.
- The electrodes must be cleansed directly after the delivery, right before the installation.
- For most liquids, the electrodes do not require cleansing throughout the entire service period, the self-cleaning by the flowing liquid is sufficient. Self-cleaning is particularly effective at the flow speed of about 3m/s.

6.3.3. The converter design

The electronic module of the converter is placed in a solid aluminum housing. The housing has two screwed-off covers. The cover with a glass pane allows for the permanent, local data view on the display. The unscrewing of the lid enables the access to the three buttons of the local device operation.

The unscrewing of the cover located opposite to the glass pane secures the access to the connecting terminals (see: p.8.1).

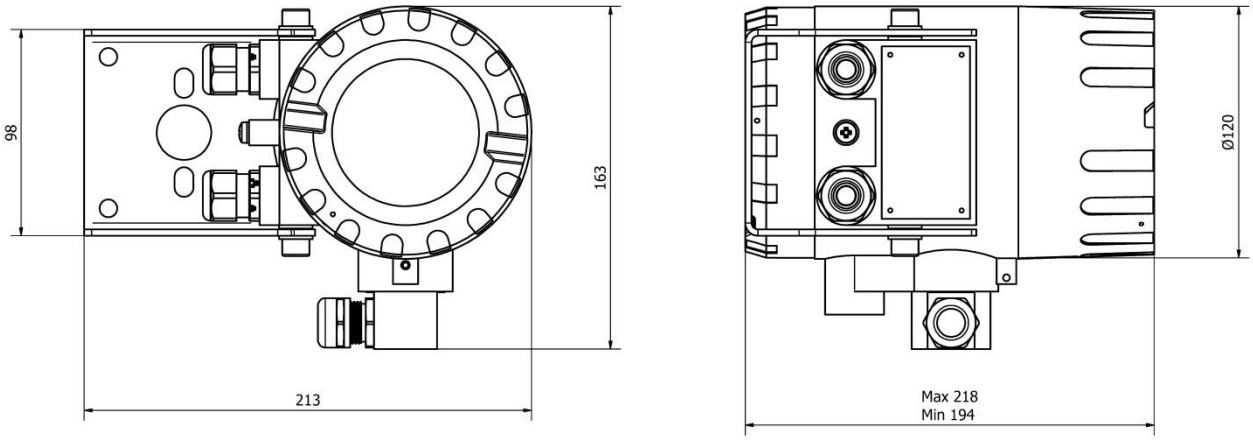


Figure 4. Converter of the flow meter PEM-1000 with the mounting bracket. Overall dimensions

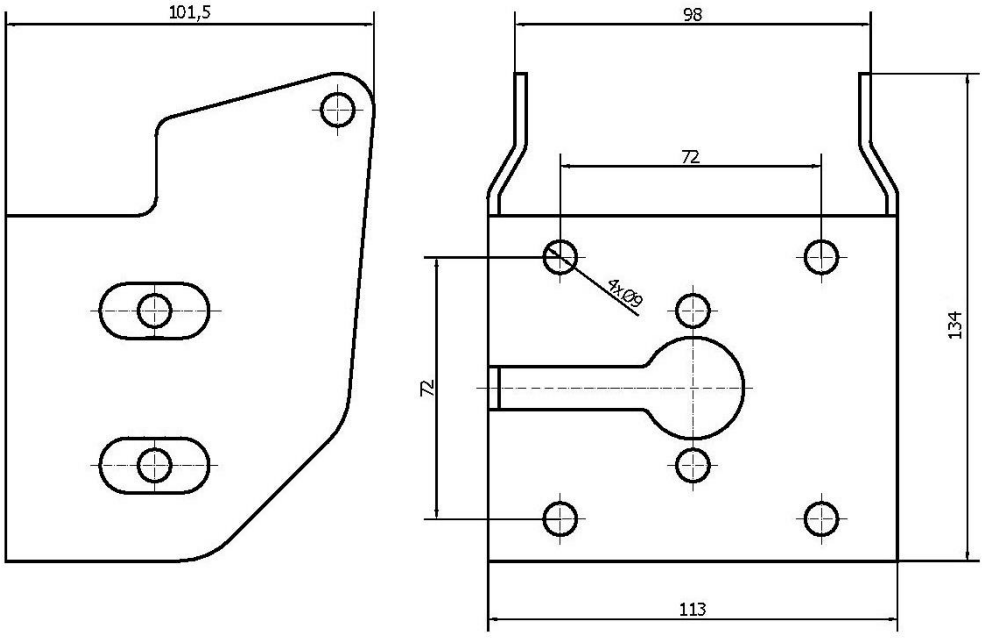


Figure 5. Mounting bracket. Overall dimensions

6.4. Identification markings

Each converter is equipped with the rating plate containing the following data:

1. Logotype or name of the manufacturer;
2. The marking of the flow meter;
3. Product code;
4. CE Marking;
5. Serial number;
6. Maximum flow – Qmax;
7. Supply parameters;
8. Output signal;
9. IP class according to EN 60529;
10. Year of manufacture;
11. "Caution" Symbol. See important information contained in the service manual,
12. The information symbol concerning dealing with used equipment.

Each sensor is equipped with a plate containing the following data:

1. Logotype or name of the manufacturer;
2. CE Mark
3. Product code
4. Name and type of the sensor
5. Nominal diameter DN
6. Serial number of the sensor;
7. Year of manufacture;
8. Maximum pressure;
9. Liner material;
10. IP class according to EN 60529;
11. "Caution" Symbol. See important information contained in the service manual;
12. Marking of flow direction.

7. ASSEMBLY

7.1. General recommendations

- Sensor of the electromagnetic flowmeter can be installed in any position in accordance with the requirements but in case of vertical installation axis of the electrodes should be always horizontal.
- Entire space inside the sensor should be filled with the measured liquid during the measurements.
- It is recommended to ensure that direction of flow is consistent with direction of the arrow on cover of the sensor; converter is factory set for operation in this direction. It is possible to reverse direction of flow on operating device but then also direction of flow in converter parameters should be changed.
- It needs to be checked before the assembly whether there is enough space at the flange to mount the flow meter using the available screws and nuts.
- To avoid the influence on the vibration measurement as well as on the deflection installation, the piping system must be fixed on both sides of the flow meter.
- If the flow meter is installed on the pipeline with an greater inside diameter, a reducer must be applied to ensure the axial fastening without the increase of stress in pipes and flanges of the sensor.
- During installation the straight sections should be of nominal diameter of the sensor (DN) with lengths of at least 5DN before and 3DN after the sensor.
- When installing the sensor on an insulated pipe (e.g. glass, plastics etc.) please insulate the system with earthing rings connected with ground terminal of the sensor - (fig. 15).
- Conductive connection between ground (enclosure) of the sensor and liquid is necessary for correct measurements.
- It is essential to assemble the seal on both sides of the earthing ring during the installation. It must be ascertained that no element of the seal is not included in the clearance of the pipeline, as it may generate turbulence and disturb the flow meter operation.

7.2. Recommended assembly method for the sensor

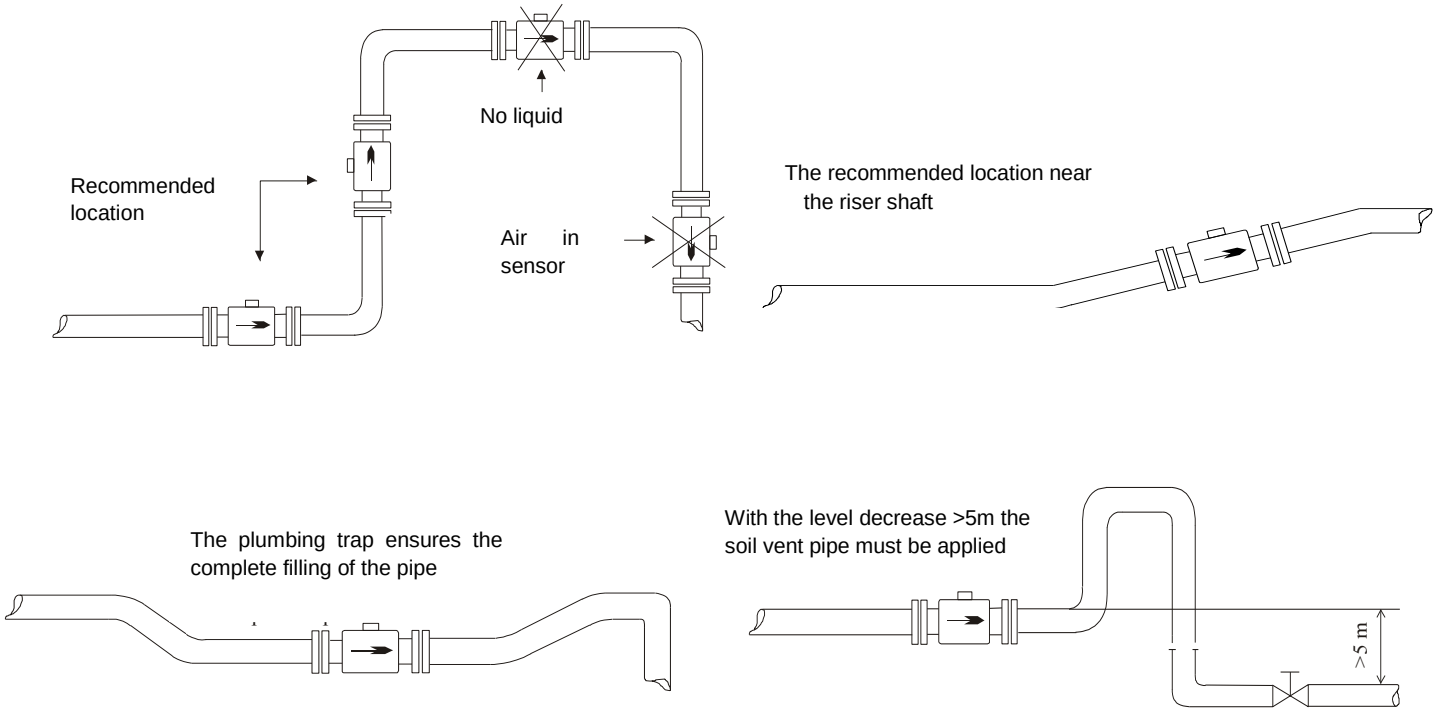


Figure 6. Recommended assembly method for the sensor

To avoid metrological errors caused by air bubbles or liner damage, consider the following recommendations:

- During the assembly set the sensor properly, tighten the screws of the flanges, placed opposite each other, evenly one after another.
- The properly selected seal of the flanges ensures better effect than the excessive compressive force which may deform the flanges.
- The sensor should be mounted on the pipe to guarantee the axis of the measuring electrodes of the sensor to be always horizontal.
- Teflon liner requires particular attention during servicing and assembly. During the installation process the excessive negative pressure in the pipeline should be avoided. The stub-ups of the liner to the external surfaces of the flanges on both sides of the sensor must not be damaged. The sensors are supplied by the manufacturer containing special covers, which prevent deformation of the Teflon liner. The covers must be removed directly before the assembly, right before the insertion between the counter flanges.
- Seal – the part of the liner extended to the external surfaces of flanges fails to function as a seal, hence it must be placed between the flanges of the sensor and the pipeline. The seal protruding inside the pipe generates the flow turbulence and reduces the accuracy of measurements.

7.3. Assembly of the compact version of the converter

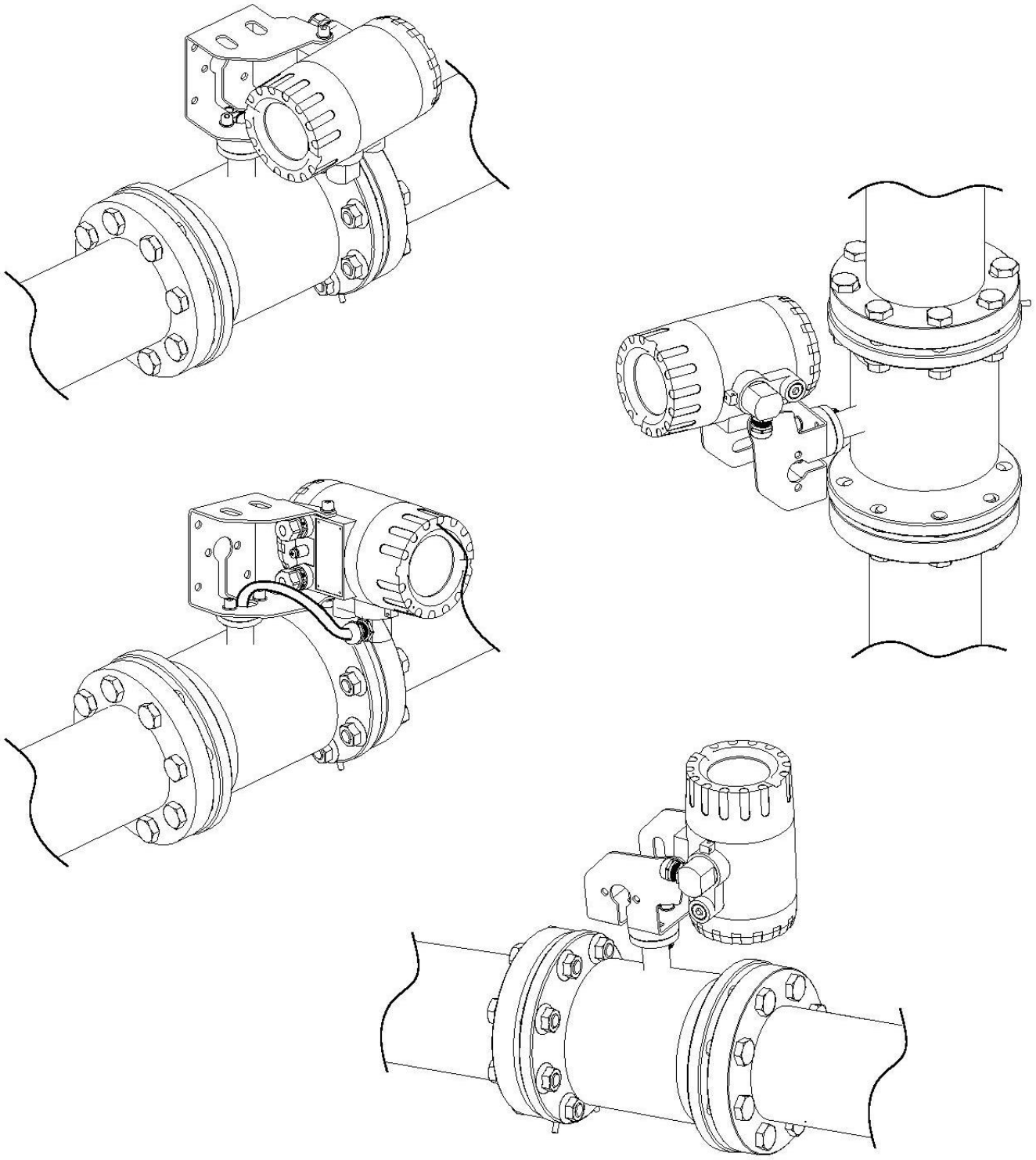


Figure 7. Assembly of the flow meter PEM-1000ALW – examples.

7.4. Assembly of the remote version of the flow meter

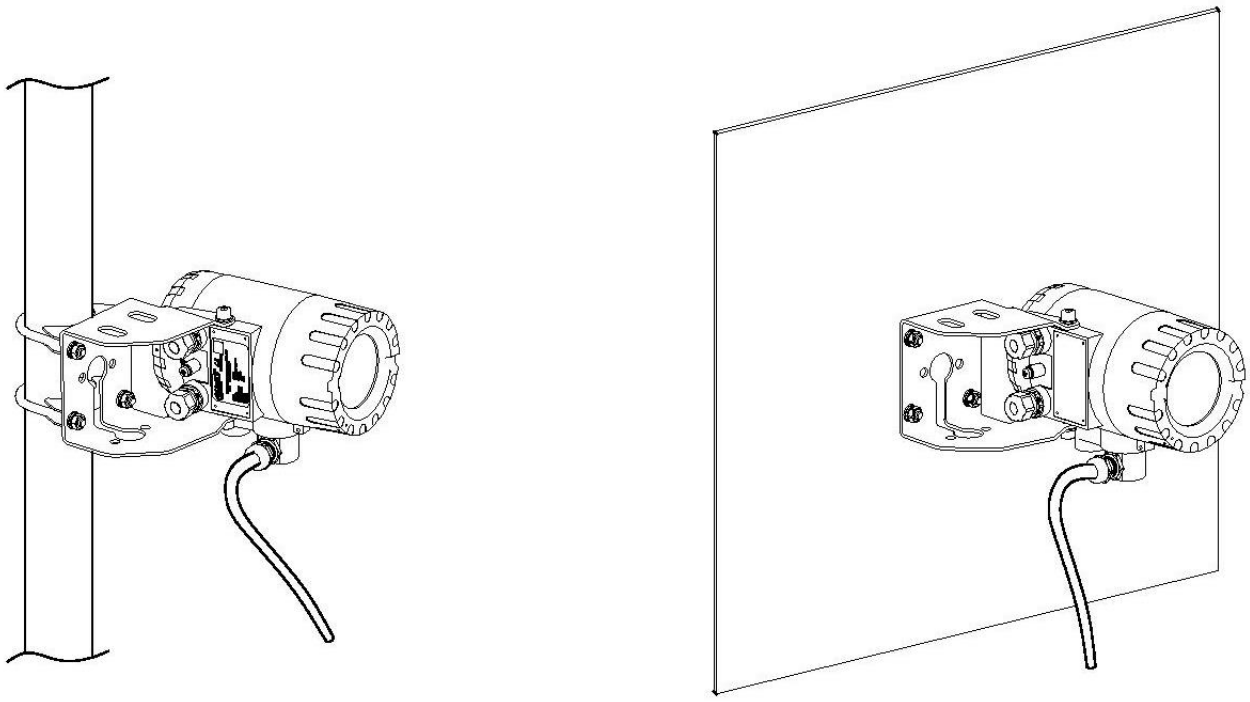


Figure 8. Assembly of the flow meter PEM-1000NW – examples

8. CONNECTION

- All connection and installation activities must be performed with the disconnected power supply as well as other external voltages, if such are applied.
- Within close proximity to the converter of the flow meter (in the same room) the protected power switch must be mounted on the power supply line of the flow meter. It should be easily accessible and marked in a way which is distinct and in accordance with symbols complying with local electrical device safety regulations.

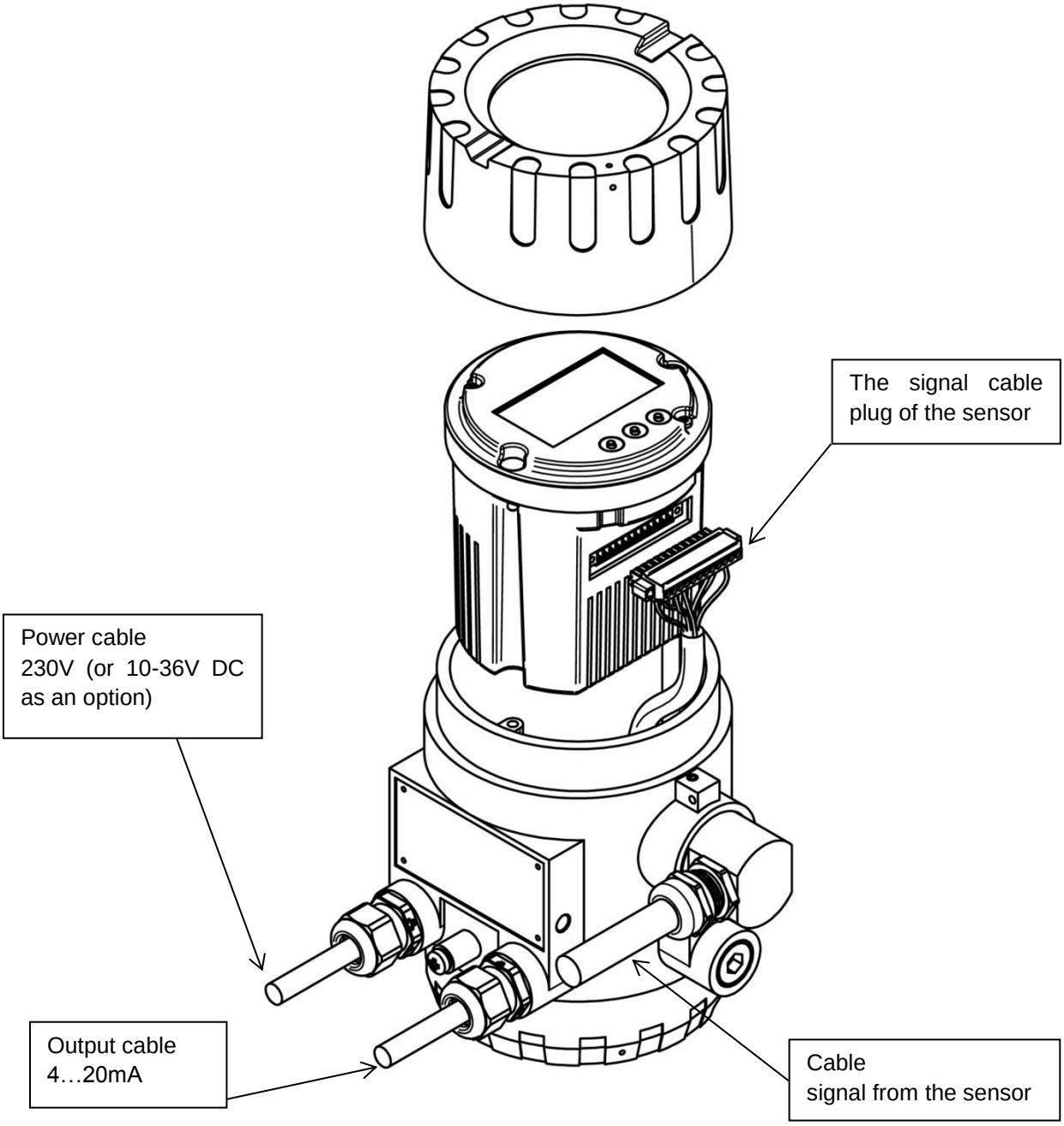
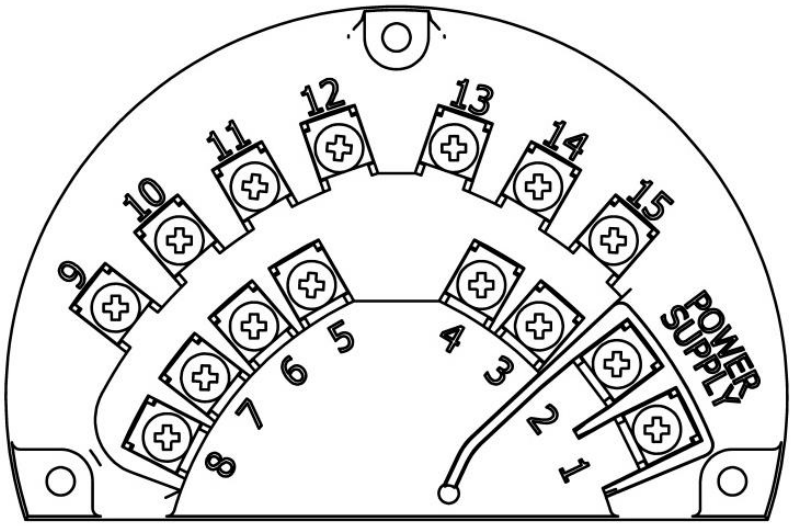


Figure 9 Stub-ups of electrical cables from the converter of the flow meter PEM-1000.

8.1. Electrical connection of the flow meter

Access to electrical terminals of the flow meter is obtained when the side cover of the housing of the converter gets unscrewed.
The following figure and the table show the distribution and purpose of individual terminals.



	Terminal no.	Description		
Power supply	1	mains power	(-)	low-voltage DC power supply (optional)
	2		(+)	
Binary output 1	3	any polarity galvanically isolated passive		
	4			
Pulse/frequency output	5	passive any polarity, galvanically isolated		
	6			
Analog current output 4 ÷ 20 Ma	7	(+)	active / passive (default active)	
	8	(-)		
Communication	9	RS 485 A	galvanically isolated ground should be connected	
	10	RS 485 B		
	11	RS 485 ground/screen		
Passive binary input	12	any polarity galvanically isolated		
	13			
Binary output 2	14	any polarity galvanically isolated passive		
	15			

Figure 10. Marking and descriptions of connecting PINs of the flowmeter PEM-1000.

For security reasons the power supply and output cables must be carried to the inside of the housing through separate cable glands.

Cords (links) attached to screw terminals must be ended with sleeve tips of 0,75 mm ^{2}.

When connecting the flow meter to the power supply the following rules must be observed:

- Connections of electrical devices;
- Electrical safety;
- Rules on safe use of electrical installations by staff

  Electrical protection of the device enables to operate in a variety of environments, and in consultation with the manufacturer it is possible to perform additional modifications to use the device in specific environmental conditions of a user. The signal cables of the sensor and the output cables of the converter should not be conducted alongside the energy cables or any other ones, which may generate interruptions.

  Devices interoperating with the flow meter should be resistant to electromagnetic disturbances generated in the environment and according to the requirements of compatibility existing in the place of application.

Feeding the converter with the low-voltage power supply unit (optional) is connected to the same POWER SUPPLY terminals as the main power supply itself. It is not possible to connect the main power supply to the POWER SUPPLY terminals of the flow meter with the low-voltage feeder.

8.1.1. Power cable

The power cable must be adjusted to the cable gland in accordance with p. 11.3.2. with certified cables of operating voltage 300/500V.

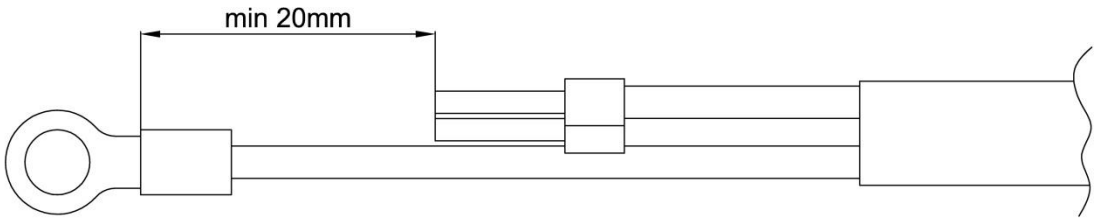


Figure 11. Preparation of the power cable

For safety reason the power cable should be prepared in a way enabling the earthing cable (yellow-green) to be longer than the remaining cables to the minimum of 20 mm (fig. 11). The end of the earthing cable must be extended with the tip of M5 bolt loop. The crimp must be tightened on the earthing conductor with the sleeve press tool of properly adjusted size.

8.2. Connection of the signal cable to the sensor

- The values of the signals transmitted from the electrode system of the sensor to the flow meter are at the level of millivolts. These signals are extremely sensitive to magnetic and electrostatic disturbances which are generated by the adjacent high-voltage cables, energy cables or power supply lines feeding the high power electrical devices. The disturbances are compensated by the internal noise filter of the flow meter, however, if it is possible to eliminate the unwanted sources of signals it should be applied. For the PEM-1000NW flow meters it is recommended to place the signal cable from the sensor in separate cable channels.
- The signal cable extending from the sensor is of special design and constitutes the part of the order, hence its length should not be altered (in case of a certified device it must not be changed).
- The outer sheath (insulation) of the cable should remain intact along its entire length.

The cable conductors of the sensor must be connected to the plug in accordance with the table and the figures.

The incorrect connection of the cable conductors to the plug of the converter will cause a lot of measurement irregularities.

Socket/PIN in plug	Type of conductor of a cable	Colour of conductor of a cable
1	External screen of the cable	-
2	Internal screen of pair of the electrodes	-
3	-	-
4	A pair of electrodes	White
5	A pair of electrodes	Brown
6	-	-
7	-	-
8	-	-
9	-	-
10	Internal screen of pair of the coils	-
11	A pair of coils	Green
12	A pair of coils	Yellow

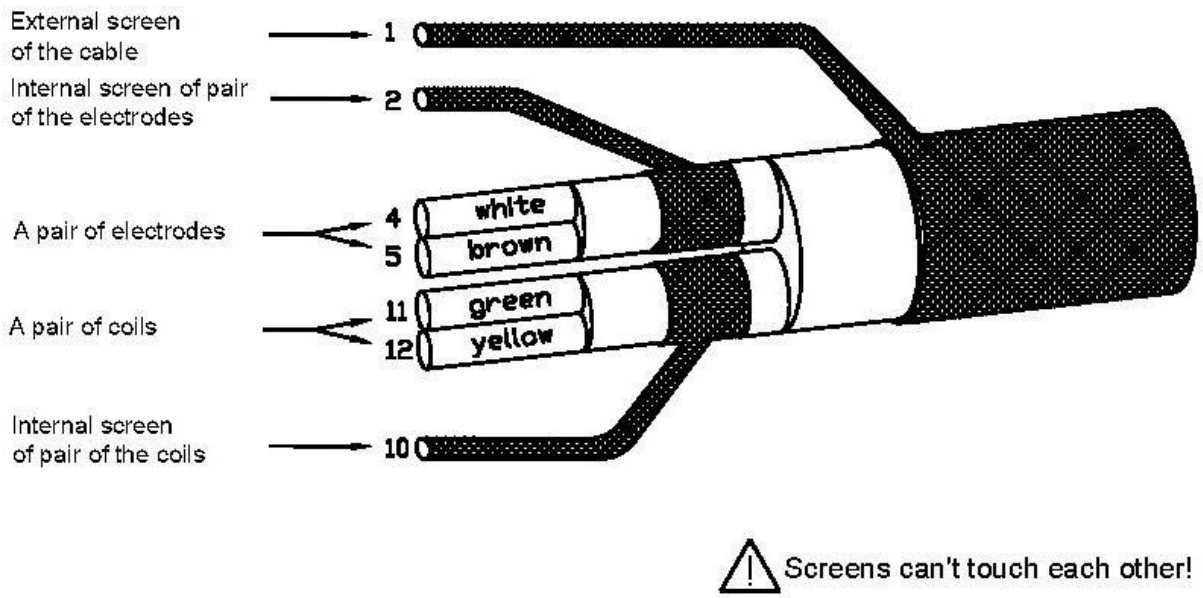


Figure 12 Marking of the stub-ups of the sensor cable conductors

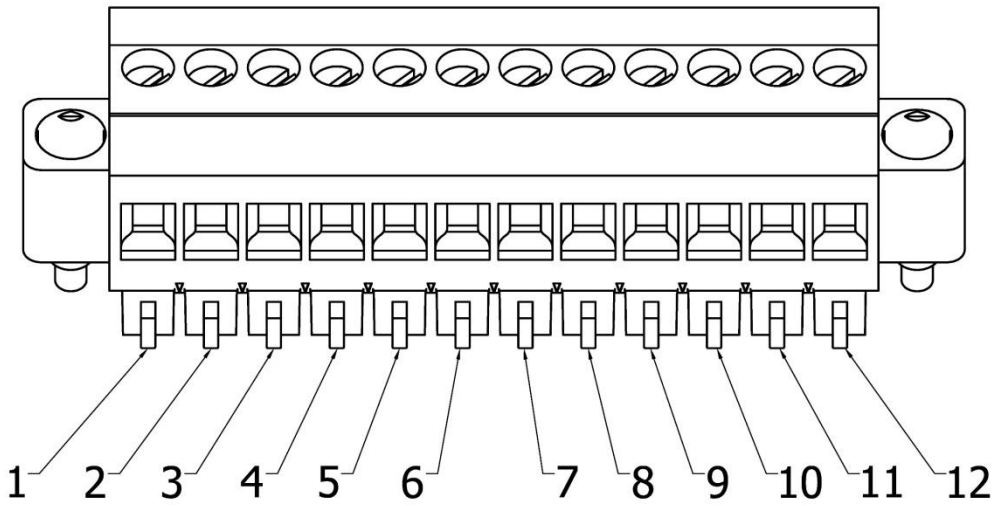


Figure 13 Connecting PINs of the sensor cable plug

8.3. Earthing

The device must be earthed in accordance with the rules existing at the place of installation. The relevant earthing terminals are placed on the housings of the sensor and the converter.

8.3.1. Protective earth

The protective terminal is located in the switching chamber of the converter housing. Cable connection is shown in the figure 14.

Marking of the protective earth connection point in the housing of the converter.

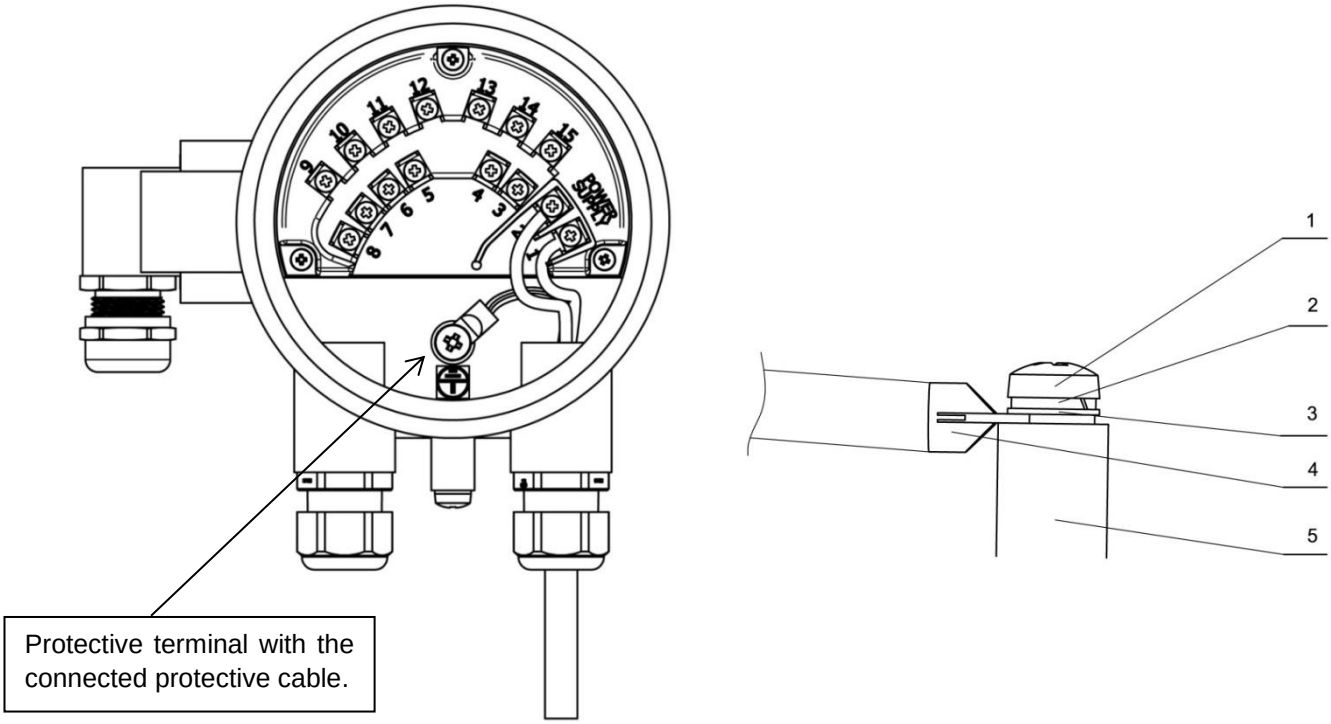


Figure 14 Manner of connection of the protective earth for the flow meter.

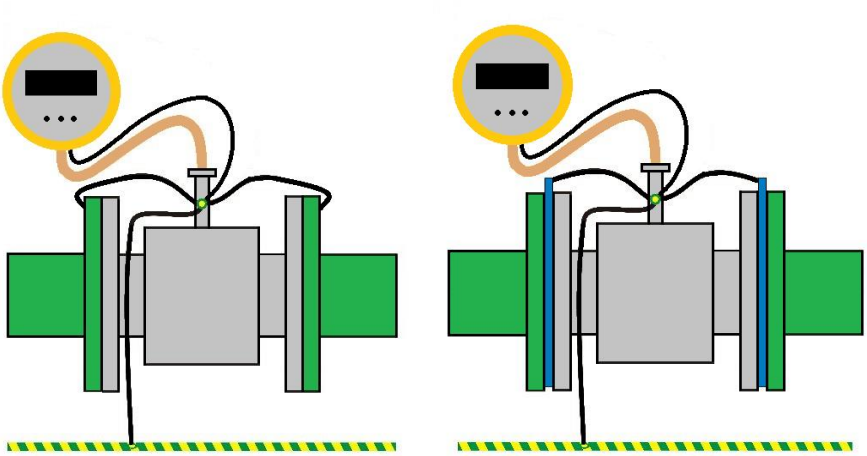
The sequence of elements in the properly provided connection of the protective earth (order of elements illustrated in the figure from the top):

1. M5 screw
2. Spring washer M5
3. Tooth washer
   acc. to DIN 6797 J-M5
4. Wire terminated with a tip clamped with M5 loop
5. Enclosure

8.3.2. Functional earthing

When installing the flow meter in the remote version the proper connection of the earth housings of both the converter and the sensor must be ensured. The housing of the converter should always be connected to the housing of the sensor and attached to the earth point of the sensor as illustrated in the figures below, and the earth point of the sensor should be connected to a metal pipeline or to earthing rings in the case of non-conductive pipelines.

Marking of the earth connection points functional on the housings of the converter and the sensor.



Earthing of the sensor mounted on the pipeline; earthing cables have been marked in black

The use of the earthing rings for the sizes of DN 10÷DN 40 sensor mounted on plastic pipelines.

Figure 15 Manner of driving the line of the earthing functional in the PEM-1000 flow meter.

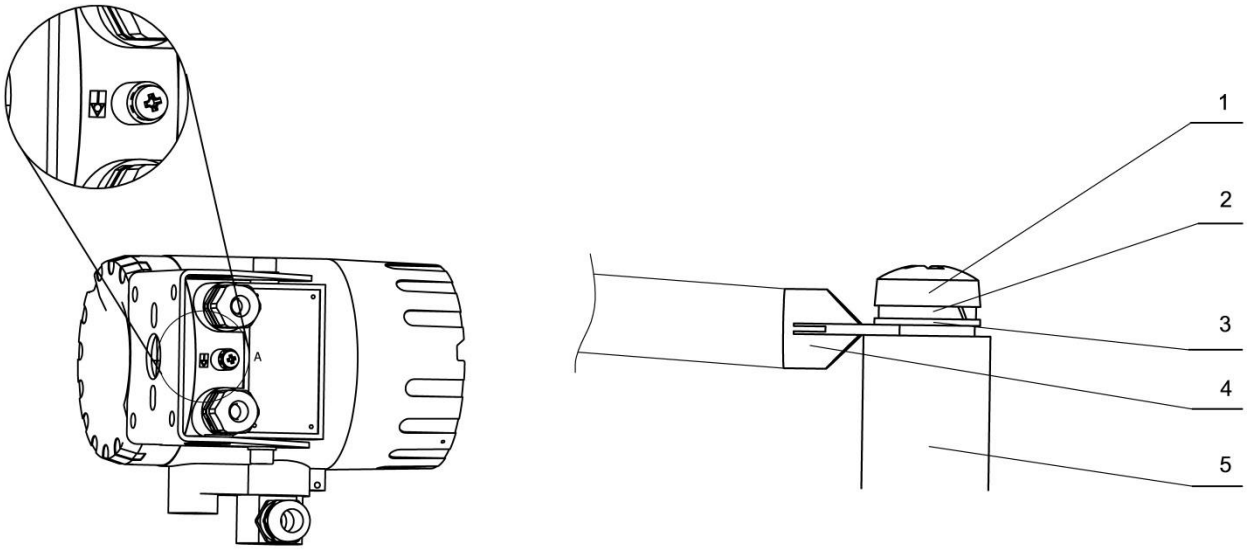


Figure 16 Manner of connection of the earthing functional for the converter housing.

The sequence of elements in the properly provided connection of the converter earthing (on fig. from the top):

1. M5 screw
2. Spring washer M5
3. Tooth washer acc. to DIN 6797 J-M5
4. Wire terminated with a tip with M5 loop
5. Enclosure

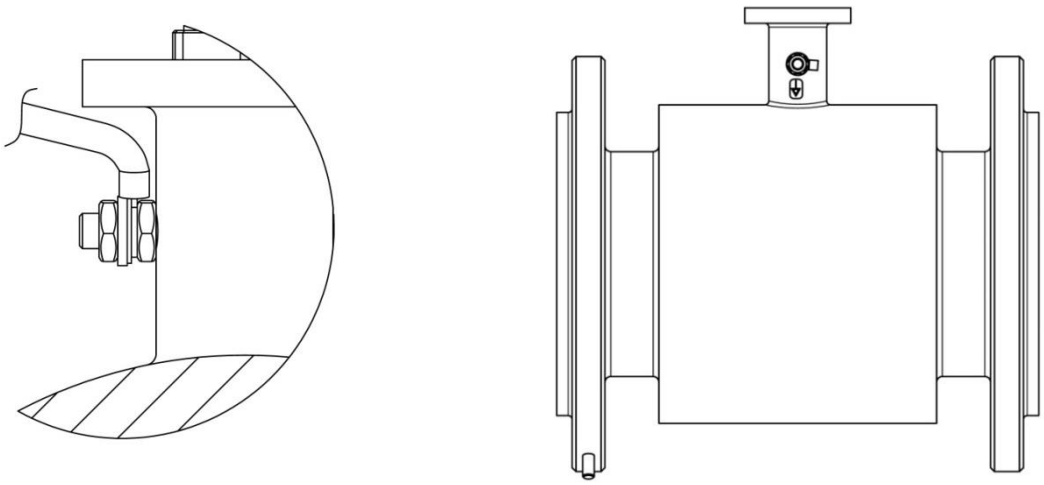


Figure 17 Manner of connection of the earthing functional for the sensor housing.

Connection components in assembly order:

1. Nut M6
2. Wire terminated with a tip with M6 loop
3. Tooth washer acc. to DIN 6797 J-M6
4. Spring washer M6
5. Nut M6

9. START-UP

After assembly and electrical connection of the flowmeter you should check the system and connections as follows:

- Check correctness of sensor and grounding selection.
- Tighten all cable connections, terminals and plugs in all connectors.
- Check completeness of the set, conformity with the serial number of sensor and converter.
- Check correctness of electric supply; pay attention to the label on the converter.
- Verify shock protections of the system.
- If no damages and defects are discovered in the system you should fill the pipeline with liquid and check its tightness. After short flushing switch the system - switch on - switch off - switch on and start measurement.

Description of device configuration can be found in the IK.PEM-1000(ENG) manual, while the description of Modbus communication in the IM.PEM-1000(ENG) manual. They are available on the manufacturer's website www.aplisens.com

10. TECHNICAL PARAMETERS

10.1. Electrical connections

10.1.1. Output signals

Analog output	Active or passive (depending on the order) 4 … 20mA / 500Ω
Pulse/frequency output	Passive Max. 24V/10mA DC, any polarity 0.1 …500Hz
Binary outputs OC	Quantity: two, open collector Max. 35V DC / 100mA for each output Galvanic isolation Any polarity
Communication output	Modbus RTU/RS 485 Galvanic isolation

10.1.2. Power supply

Standard version:	Mains power	90-260V AC 50Hz 15VA
Optional version:	Low-voltage power supply:	10-36V DC 15W Supply inlet protected against reverse polarity of the voltage.

10.2. Protection class

The device has class I protection; it is equipped with protective terminal to which you should connect protective conductor. Measuring circuits (to sensor) are separated from hazardous voltages with reinforced insulation according to the requirements of PN-EN 61010-1.

10.3. Technical parameters

10.3.1. Technical specification of the sensor

Nominal diameters	DN 10÷1000
Connecting cables to the converter	Double shielded conductor e.g. Paar Tronic CY-CY 2x2x0.25mm2 lub 2x2x0.34mm2 (Helukabel) Unitronic CY PIDY 2x2x0.25mm2 or 2x2x0.34mm2 (Lapp Kabel) or equivalent. Length of cable: 0.5m - ALW version 8m or 12m,24m,32m,40m,48m - NW version
Measuring principle	Electromagnetic
Supply ofexciting coil of the sensor	From converter
Insulation class of exciting coil	Class E
Field connections	Flanges DIN (ANSI, BS) / hygienic acc. to DIN 11851
Maximum pressure	Standard 1.6 MPa (option 2.5/4.0 MPa) operation with negative pressure is forbidden
Ingress protection	Standard IP 67, option IP 68 acc. to EN 60529, NEMA 5 (NEMA 6)
Insulation lining	Hard, soft rubber DN20÷DN1000 Teflon (PTFE) DN10÷DN500
Range of temperatures for insulating liners	Rubber (soft), hard -5÷90°C, Version PEM-1000NW Rubber (soft), hard ÷60°C, Version PEM-1000ALW Teflon -25÷130°C, Version PEM-1000NW Teflon 0÷60°C, Version PEM-1000ALW
Ambient temperature ranges	-20÷60°C
Electrodes	Steel 1.4571 (316Ti) 1.4404(316L), Hastelloy, Tantalum, Titanium, Platinum
Outer enclosure and flanges	Carbon steel, steel 1.4301 (304), steel 1.4541 (321)
Sensor pipe	Steel 1.4541 (321)
Protection coating	Multi-compound Acrymetal varnish
Accessories	Stainless steel earthing rings for plastic pipes for versions DN10..40
Optional versions of the sensor	Stainless steel, versions with hygienic grade connectors
Dimensions and weight	According to the table 1, 2, 3.

10.3.2. Technical specifications of the converter

Minimum conductance of the medium	≥ 5μS/cm, ≥ 20 μS/cm for demineralized water
Precision of the measurement	±0.5% value indications in the range from 20% Qmax (inclusive) to 100% Qmax ±1% value indications in the range from 10% Qmax (inclusive) to 20% Qmax (for given reference conditions *)
Cut-off level for small flows	Settable value, arbitrary
Instantaneous flow	2-way (l/s, m^3/h, m^3/s)
Balance of flows	bi-directional m^3, I stored in separate counters S+, S-
Balance of directional flows	Difference of flows (S+)-(S-) in separate meter S
Flow direction	Automatically recognized
Flowmeter zero	Automatic zeroing
Empty pipe detection	Cyclic, programmed
Astronomical time	The calendar to the year 2099 battery-backed
Display	4 x 16 characters, illuminated
Keyboard	3 buttons
Operating mode of relay	Programmed by the user
Cable glands	Gland M20x1.5 Circular supply cable 6-12 mm, with multi-conductor wires (line), with approved cables with operation voltage 300/500V, 3x 0.75 mm^2 Cu (or 3x0.5mm^2 Cu if the design allows such case) intended for "soft" industrial applications and, if required, for humid environment*.
Fuse	250 mA T/ 250 V non-replaceable 2,5 A T/ 250V non-replaceable
Ingress protection	IP 66 or IP 67 (special version) acc. to EN 60529
Range of working environment temperatures	-20÷60°C
Dimensions	In accordance with the fig. 2.
Weight	approx. 3 kg
Enclosure material	Aluminum alloy ZL 102
Finishing of surface of converter enclosure	paint coat

* Cross-section and type of cable should be selected by the designer of the electrical installation.

10.4. Reference conditions

Flow	0.3 - 12m/s
Measured medium	Water 10-30ºC
Conductivity	> 300µS/cm
Supply variability	Un ± 2% (Un – supply voltage)
Ambient temperature	18 - 25 ºC, constant humidity
Stabilization time after switching on the power supply	Minimum 20 min.
Straight sections of flow	10 diameters upstream the sensor, 3 diameters downstream the sensor
Measuring sensor	Centrally located, earthed in accordance with the fig. 15.

10.5. Metrological parameters

10.5.1. Standard measuring ranges

- **PEM-1000** flowmeters are available in the size ranges of flange connections specified by the DIN standard within the range DN10 ÷ DN1000 or optionally can be executed in the size range of flange connections in accordance to the ANSI, BS standard.
- Standard flow values **Qmax** for the individual versions of the flowmeters with flange connections in accordance with DIN in the range DN10 ÷ DN1000 are presented in the table below. It is possible to set the other **Qmax** flow values for the individual versions of the flowmeters greater than twice the standard value of measuring range.

DN according to DIN	Volumetric flow	Volumetric flow	Linear velocity
	Qmax [m3/h]	*Qmax [l/sec.]*	*Vmax [m/s]*
10	1	0.278	3.54
15	2	0.556	3.14
20	4	1.111	3.54
25	5	1.389	2.83
32	10	2.778	3.45
40	15	4.167	3.32
50	20	5.556	2.83
65	30	8.333	2.51
80	50	13.889	2.76
100	100	27.778	3.54
125	150	41.667	3.40
150	200	55.556	3.14
200	360	100.000	3.18
250	500	138.889	2.83
300	760	211.111	2.99
350	1000	277.778	2.89
400	1300	361.111	2.87
500	2000	555.556	2.83
600	3000	833.333	2.95
800	5000	1388.889	2.76
1000	8000	2222.222	2.83

Table 4. Standard measuring ranges for the PEM-1000 flowmeter.

10.5.2. Table of volumetric flows calculated for the characteristic flow velocities of the medium for the versions with flanges according to DIN.

Volumetric flow is calculated based on measured linear velocity of the flow and geometry of cross-section of the flowmeter. The table presents values of the volumetric flows for the given DN for characteristic linear velocities of the flow.

DN	Flow velocity V [m/s]							
	0.300	1.000	2.000	3.000	4.000	5.000	6.000	
10	0.085	0.283	0.565	0.848	1.131	1.414	1.696	
15	0.191	0.636	1.272	1.909	2.545	3.181	3.817	
20	0.339	1.131	2.262	3.393	4.524	5.655	6.786	
25	0.530	1.767	3.534	5.301	7.069	8.836	10.603	
32	0.869	2.895	5.791	8.686	11.581	14.476	17.372	
40	1.357	4.524	9.048	13.572	18.096	22.619	27.143	
50	2.121	7.069	14.137	21.206	28.274	35.343	42.411	
65	3.584	11.946	23.892	35.838	47.784	59.729	71.675	
80	5.429	18.096	36.191	54.287	72.382	90.478	108.573	Flow
100	8.482	28.274	56.549	84.823	113.097	141.372	169.646	
125	13.254	44.179	88.357	132.536	176.714	220.893	265.072	[m3/h]
150	19.085	63.617	127.234	190.852	254.469	318.086	381.703	
200	33.929	113.097	226.194	339.292	452.389	565.486	678.583	
250	53.014	176.714	353.429	530.143	706.858	883.572	1060.287	
300	76.341	254.469	508.938	763.406	1017.875	1272.344	1526.813	
350	103.908	346.360	692.721	1039.081	1385.441	1731.801	2078.162	
400	135.717	452.389	904.778	1357.167	1809.556	2261.945	2714.334	
500	212.057	706.858	1413.716	2120.573	2827.431	3534.289	4241.147	
600	305.363	1017.875	2035.750	3053.625	4071.501	5089.376	6107.251	
800	542.867	1809.556	3619.112	5428.668	7238.223	9047.779	10857.335	
1000	848.229	2827.431	5654.862	8482.293	11309.724	14137.155	16964.586	

Table 5. Volumetric flow as a function of linear velocity of the medium

Values of flows corresponding to the velocity 1 m/s			
DN	*m^3 / h*	*l / min.*	*l / s*
10	0.283	4.712	0.079
15	0.637	10.62	0.177
20	1.131	18.85	0.314
25	1.767	29.452	0.491
32	2.895	48.255	0.804
40	4.524	75.398	1.257
50	7.069	117.81	1.964
65	11.946	199.1	3.318
80	18.096	301.59	5.027
100	28.274	471.23	7.854
125	44.179	736.31	12.272
150	63.617	1060.3	17.671
200	113.10	1885	31.42
250	176.71	2945.2	49.087
300	254.47	4241.2	70.686
350	346.36	5772.7	96.211
400	452.39	7539.8	125.66
450	572.26	9537.5	158.96
500	706.86	11781	196.35
600	1017.9	16965	282.74
700	1384.7	23079	384.65
800	1809.6	30159	502.65
900	2289.1	38151	635.85
1000	2827.4	47124	785.4

Table 6. Values of flows corresponding to the velocity 1 m/s

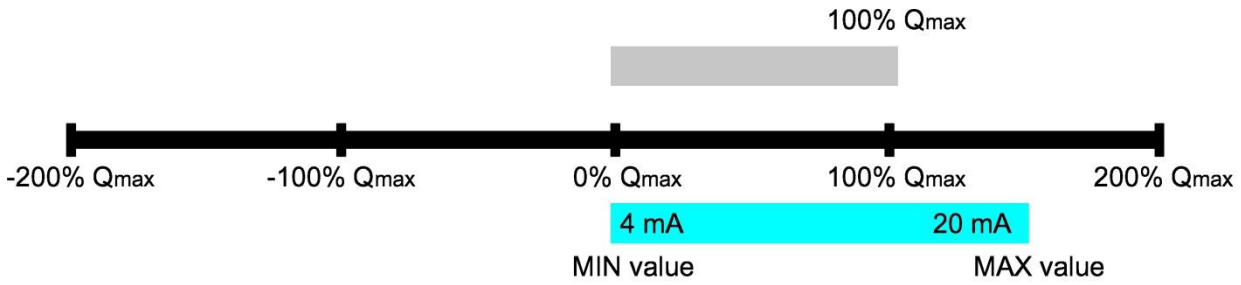
10.5.3. Available pressure ranges acc. to DIN, ANSI for operation of the flowmeters for the individual versions for DN flanged connections

DIN PN16	DIN PN25	DIN PN40	ANSI150lb	ANSI 300lb
DN10	DN10	DN10	DN10	DN10
DN15	DN15	DN15	DN15	DN15
DN20	DN20	DN20	DN20	DN20
DN25	DN25	DN25	DN25	DN25
DN32	DN32	DN32	DN32	DN32
DN40	DN40	DN40	DN40	DN40
DN50	DN50	DN50	DN50	DN50
DN65	DN65	DN65	DN65	DN65
DN80	DN80	DN80	DN80	DN80
DN100	DN100	DN100	DN100	DN100
DN125	DN125	DN125	DN125	DN125
DN150	DN150	DN150	DN150	DN150
DN200	DN200	DN200	DN200	DN200
DN250	DN250	DN250	DN250	DN250
DN300	DN300	DN300	DN300	DN300
DN350	DN350	DN350	DN350	DN350
DN400	DN400	DN400	DN400	DN400
DN500	DN500	DN500	DN500	DN500
DN600	DN600	DN600	DN600	DN600
DN800	DN800		DN800	
DN1000	DN1000		DN1000	

10.5.4. Basic principles for selection of the DN size (acc. to DIN) of the flowmeter for the nominal flow Qn

- Electromagnetic flowmeters have the declared measurement class for linear velocity in the range 0.3 ÷ 10 m/s and simultaneous complete filling of the sensor with liquid and meeting the requirements for the physical and chemical parameters of the medium and the environment in the specification of the sensor.
- The basic parameter necessary for selection of the **DN** size of the flowmeter is knowledge of expected nominal flow **Qn** [m3/h, l/s]. **DN** value of the flowmeter should be selected so that for nominal flow **Qn** [m3/h, l/s] the linear velocity of the flow **Vn** [m/s] is as close as possible to 3 m/s. Selecting **DN** size for the flowmeter user should use the standard values of the flow resulting from the parameter **Qmax**[m3/h]. Values of **Qmax** flow for the individual **DN** values of the flowmeters are selected for the linear value of the flow **V** [m/s] equal to approx. 3 m/s.
- Design of the flowmeter ensures measurement (balancing) in the range of the flows up to 200% **Qmax**.

Representation of instantaneous flow value with a current signal 4-20 is limited to range of flows determined by the MIN value and MAX value parameters (the same unit as set in Flow unit option) included in the Outputs config subgroup.



Measuring range of the flowmeter determined by Qmax parameter

The manufacturer ensures maintaining of declared accuracy class in the range from 10% to 100% Qmax.

If it is necessary to adapt the flowmeter to linear velocity Vn>3m/s you should contact with the manufacturer of the flowmeter.

10.6. Allowable ambient and operation parameters

Ambient temperature	-20…60 ºC
Relative humidity	to 80%
Ambient atmosphere	no aggressive components
Altitude above sea level	to 2000m

Do not exceed allowable ambient and device operation parameters. Exceeding can cause more measurement errors, occurrence of irregularities in operation of display and whole equipment.

10.6.1. Electromagnetic compatibility, immunity

Assessment acc. to PN-EN 61326-1, 2 for industrial applications:

Electrostatic discharges (ESD):
PN-EN 61000-4-2
Level S3; Contact ±6kV; Air ±8kV; Criterion B;

Conducted interferences induced by fields with radio frequency:
PN-EN 61000-4-6
0,15…80MHz, 10V; Criterion A;

Electromagnetic fields (radiated interferences):
PN-EN 61000-4-3
80…2000MHz - 10V/m; …2700MHz - 1V/m; Criterion A;

Fast electrical transient conditions (Burst):
PN-EN 61000-4-4
± 2kV supply lines - enclosure; ± 1kV signal lines - enclosure; Criterion B (A);

Surges:
PN-EN 61000-4-5
± 0,5kV (±1kV) signal lines - enclosure ± 1kV (±2kV) supply lines - enclosure; Criterion B;

10.6.2. Electromagnetic compatibility, emissions

Measurements acc. to CISPR 16-1, CISPR 16-2, class B;
Distance of antenna 3m, quasi-peak measurements:

Radiation:
0,15…30MHz; 80-52dBµV/m;
30…2000MHz; <54dBµV/m;

Induction:
0.01…0.15MHz; 96-50dBµV/m;
0.15…0.35MHz; 60-50dBµV/m;
0.35…30MHz; <50dBµV/m;

10.6.3. Mechanical resistance

Impacts:
PN-EN 60068-2-27, 31
50g/11ms

Sinusoidal vibrations:
PN-EN 60068-2-6, test Fc;
To 1.6mm; 2…25Hz;
To 4g for 25…100Hz;

10.6.4. Insulation resistance

>100MΩ @110V DC

10.6.5. Insulation resistance

1330 V AC (1880 V DC), 5 s – rising, 5s - test

10.6.6. Ingress protection of the enclosure

acc. to PN-EN 60529:2003
Sensor - IP 67
Converter – IP 66 or IP 67.

11. INSPECTIONS. CLEANING. SPARE PARTS

11.1. Periodic inspections

Periodic inspections should be carried out in accordance with the standards valid for the user.
Condition of the electrical connections on terminals (reliability of the connections) and stability of display mounting shall be checked during the inspection.

11.2. Non-periodic inspections

If converter could be endangered to mechanical damages, electric overvoltages or incorrect operation will be stated - then inspections shall be carried out.
If signal in measuring line is missing or its value is incorrect you should check condition of cable, condition of connections on terminals etc. Check whether value of supply voltage and load resistance is correct. If the line is in good working order you should check operation of the flowmeter.

11.3. Cleaning/washing.

To remove dirt from external surfaces of the flowmeter they should be wiped/swept dry or, if necessary, additional rubbed through with cloth moisten with water.

12. SCRAPPING, DISPOSAL

Worn-out or damaged devices should be disposed in accordance with the WEEE directive (2012/19/UE) on waste electrical and electronic equipment or it should returned to the manufacturer.

13. ADDITIONAL INFORMATION

13.1. Additional information

The manufacturer reserves the right to introduce design and process changes in the device not decreasing its performance parameters.

14. REVISION LOG

No. of revision	Document edition	Description of review
1	02.A.002	Editorial changes.
2	02.A.003	Editorial changes.