AFLOWT

ELECTROMAGNETIC FLOW METER

AFLOWT MF

Modification “Lite M”

OPERATION MANUAL PART I

ISO 9001:2008

* * *

Manufacturer quality management system is certified to ISO 9001:2008

* * *

URL: http://www.aflowt.com

CONTENTS

INTRODUCTION 4
1. DESCRIPTION AND OPERATION 5
1.1. Application 5
1.2 Specifications 5
1.3. Contents of the delivery package 7
1.4. Design and operation 8
1.4.1. Design and operation principle 8
1.4.2. Modes of operation 9
1.4.3. Data output 9
1.4.4. Service features 11
1.4.5. Log 11
1.4.6. Design versions 11
1.5. Marking and sealing 12
2. OPERATION 13
2.1. Operating restrictions 13
2.2. Selecting standard size (DN) 14
2.3. Preparing for operation 16
2.4. Operation 17
3. MAINTENANCE 18
4. PACKING, STORAGE AND TRANSPORTATION 19
APPENDIX A. Flow rate measurement ranges 20
APPENDIX B. Exterior view 21
APPENDIX C Output stages of universal outputs, circuit diagram 27

This document covers "AFLOWT MF" electromagnetic flow meters, "Lite M" modification, hereinafter referred to as the flow meter and contains information about its operation and design.

Due to continuous improvement of product policy actual flow meter's specifications may differ from the data specified in this manual. However, this will not affect the metrological characteristics and functionality.

LIST OF ABBREVIATIONS

DN - Nominal diameter
LCD - Liquid-crystal display
EMF - Electromotive force
MU - Measuring unit

Validation documents are available on website **www.awlowt.com**

1. DESCRIPTION AND OPERATION

1.1. Application

AFLOWT MF flow meter of "Lite M" modification is designed to measure average volumetric flow rate and volume of hot, cold and waste waters or other non-aggressive electrically conductive liquids within wide temperature and conductivity ranges.

The flow meter is typically used as part of heat meters, metering systems and automatic process control systems in power industry and municipal engineering.

The flow meter is designed for use either in metal or plastic (metal-plastic) pipelines.

Optionally the flow meter can be adjusted for reverse flow measurements with indication of flow direction.

1.2. Specifications

1.2.1. Specifications are listed in Table 1.

Table 1

Parameter	Value										
1. Nominal diameter (standard size) of the pipeline, DN	20	25	32	40	50	65	80	100	150	200	300
2. Maximal measured average volumetric flow rate, Q_{max}, m^3/h	10.0	16.0	25.0	40.0	63.0	100	160	250	630	1000	2500
3. Sensitivity to flow velocity, m/s	0.01										
4. Pressure in the pipeline, MPa	no more than 2.5										
5. Specific conductivity of medium, S/m	no less than $5 \cdot 10^{-4}$										
6. Temperature of medium, °C	From - 10 to 150										
7. DC power supply voltage, V	24 *(see section1.2.4)*										
8. Power consumption, W	no more than 5										
9. Mean time to failure, h	75 000										
10. Mean life time, years	12										

1.2.2. AFLOWT MF legend representing options to be selected by the customer is shown in Fig.1.

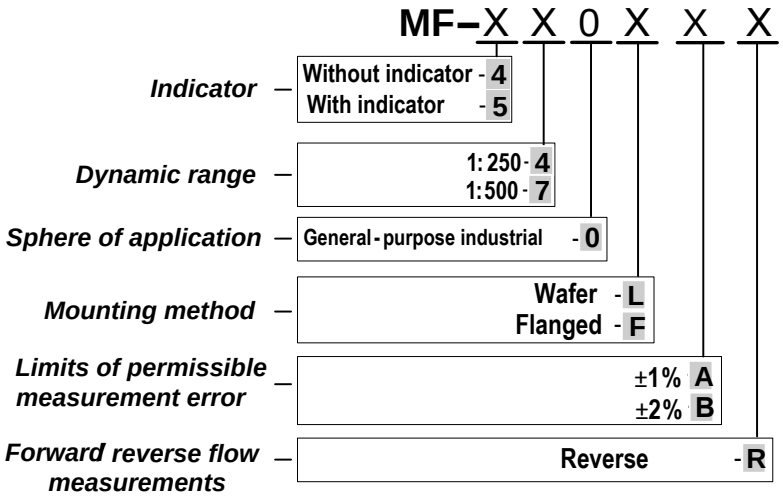


Fig.1. Design options available for Lite M modification

For example: Electromagnetic flow meter AFLOWT MF, "Lite M" modification, design version MF-540F BR:

- Flanged flow meter with indicator, operating range 1:250, reverse flow measurements available.

1.2.3. For AFLOWT MF flow meters, the limits of permissible error in the measurement of the mean volumetric flow (volume) does not exceed the values given in table 2.

Table 2

Design version	limits of permissible error	Measurement range of average volumetric flow rate (direct flow)	Measurement range of average volumetric flow rate (reverse flow)
MF-X40X AB	± 1% ± 2%	$0.01 \cdot Q_{max}$ to Q_{max} (1:100) $0.004 \cdot Q_{max}$ to $0.01 \cdot Q_{max}$ (1:250) to (1:100)	$0.01 \cdot Q_{max}$ to Q_{max} (1:100)
MF-X40X B	± 2%	$0.004 \cdot Q_{max}$ to Q_{max} (1:250)	$0.01 \cdot Q_{max}$ to Q_{max} (1:100)
MF-X40X BR	± 2%	$0.004 \cdot Q_{max}$ to Q_{max} (1:250)	$0.004 \cdot Q_{max}$ to Q_{max} (1:250)
MF-X70X B	± 2%	$0.002 \cdot Q_{max}$ to Q_{max} (1:500)	$0.01 \cdot Q_{max}$ to Q_{max} (1:100)
MF-X70X BR	± 2%	$0.002 \cdot Q_{max}$ to Q_{max} (1:500)	$0.002 \cdot Q_{max}$ to Q_{max} (1:500)

Flow rate measurement ranges for various design options are specified in Table A.1, Appendix A.

1.2.4. The flow meter is powered from stabilized (20...25 V) DC voltage with pulse level of no more than ±1.0 %. The flow meter can be powered from mains (220V, 50Hz) via Secondary Power Source (optional).

1.2.5. Environmental restrictions

- Ambient temperature: from 5 to 50 °C
- Relative humidity: up to 80 % at temperature of no more than 35 °C, without moisture condensation
- Vibration: within 10 ... 55 Hz range, with up to 0.35 mm amplitude
- Atmospheric pressure: from 66.0 to 106.7 kPa.

Protection provided by the enclosure: IP65 code.

1.2.6. View, overall dimensions and weight are given in Appendix B.

1.3. Contents of the delivery package

Items of the delivery package are specified in Table 3.

Table 3

Name	Qty	Notes
Flow meter	1	Notes 1,2
Secondary Power Source (DC 24 V)	1	Optional
USB-MF Adaptor	1	Optional
Installation kit	1	Notes 3, 4
Passport	1	
Operating documentation: - Operation manual, part I and II - Installation manual	1	

NOTES.

1. Nominal diameter and design type are specified in the purchase order.
2. Post-production factory settings are specified in Appendix A, part II of this manual. The flow meter can be set to other values on customer's request.
3. Seal gaskets, electrical jumpers, power supply cables and communication cables are included in the delivery package. Cable length is specified by the customer in the purchase order. Default length of the Secondary Power Source connection cable is 1.5 m.
4. For MF-XX0L, MF-XX0F flow meters, the pre-specified set of fittings is provided at customer's option.

   Permissible pressure for the fittings:

   - MF-XX0L,F DN20-DN65 flow meters – 1.6 MPa or 2.5 MPa (at customer's option)
   - MF-XX0L,F DN80-DN300 flow meters – 2.5 MPa.

Operating documentation and order sheets for this product and other products are available on **www.aflowt.com**.

1.4. Design and operation

1.4.1. Design and operation principle

The flow meter consists of the primary transducer (electromagnetic flow sensor) and secondary converter which is a microprocessor-based electronic block.

Operation principle of an electromagnetic flow meter is based on measuring electromotive force (EMF) induced in electrically conductive liquid when it moves in magnetic field. The magnetic field is furnished in the flow sensor's inner channel by a special electromagnetic system (see Fig.2)

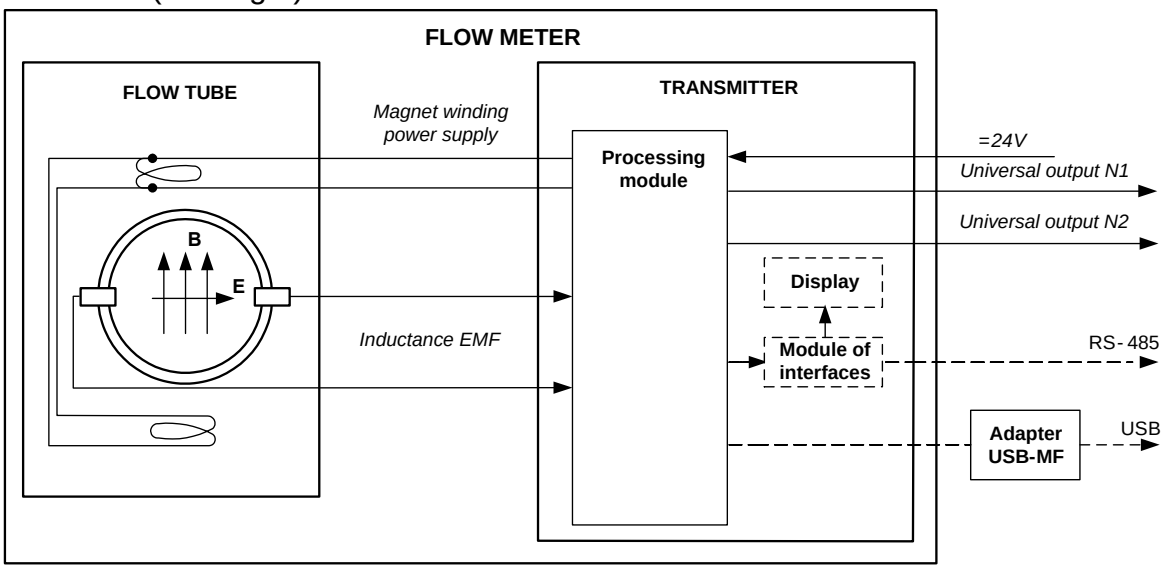


Fig.2. Block diagram

The primary transducer (Flow Sensor) is designed as a hollow magneto transparent cylinder through which a liquid under control is passed. Solenoid coils are located outside the cylinder. The inside of the cylinder is covered with an electrically insulating material. Alternatively, the entire cylinder is made of such material. The induced signal is picked up by two electrodes, which are in conductive contact with the liquid under control.

Inductive electromotive force (EMF) ***E*** is proportional to the mean flow velocity ***v***, distance between the electrodes ***d*** (which is equal to the sensor's inner diameter) and magnetic field strength ***B***:

$$E = k \cdot B \cdot d \cdot v,$$

where k is a linear factor.

B and ***d*** are constants for the flow meter of a given standard size. The value of electromotive force (EMF) is independent of liquid temperature, viscosity and conductivity provided that the value of conductivity is no less than specified in the flow meter’s specifications.

The Transmitter (Measuring Unit) includes Processing module and Indicator (if applicable) module.

The processing module:

- Provides power supply for solenoids

- Receives/processes the induced EMF signals and determines average volumetric flow rate
- Converts an average volumetric flow rate value into the sequence of output pulses
- Determines flow direction and generates a flow direction signal in the form of logic signal
- Issues commands to the Indicator (display) module (if ordered)
- Performs calculation of totalized volume and time of operation
- Performs diagnostics
- Stores configuration data, logs of service and configuration settings and data totalizing settings; time of data storage without power supply is no less that 1 year
- Protects data totalizing settings and configuration settings from unauthorized access.

The module of interfaces (by request) is equipped with an exit of the RS-485 interface and ensures functioning of the indicator (MF-540X versions).

1.4.2. Modes of operation

The flow meter operates in three modes. Information about selection of the modes and their functionality is given in Part II of this manual.

1.4.3. Data output

1.4.3.1. Displaying results

In MF-540X flow meters, measurement data can be viewed on Liquid Crystal Display (see Fig.3) with backlight function. LCD displays alpha-numeric data in two lines (16 characters per line). The display can show measurement data and error messages.

Measurement units and number of displayed digits are given in Table 4.

Table 4

Notation	Parameter	Units	Number of digits	
			integer part	fractional part
Q	Average volumetric flow rate	m^3/h, l/min	Up to 10	3
V	Total volume (cumulative sum)	m^3,l	Up to 9	3
V+	Volume of direct flow (cumulative sum)	m^3,l	Up to 9	3
V-	Volume of reverse flow (cumulative sum)	m^3,l	Up to 9	3
t	Operating time of totalizer operation (cumulative sum)	h, min	Up to 10	2
KP	Amplification factors of universal outputs	-	Up to 5	4
K, P	Metrological factors	-	Up to 3	6
CSB, CSD	Database and program checksums	-	6	-

NOTES:

1. Flow rate and volume of reverse flow and negative values of total volume are indicated by negative sign.
2. Totalized volume is the algebraic (considering the sign of the flow) sum of flow volumes totalized for both forward (positive) and reverse (negative) flows.
3. When the counter reaches an overflow value, it restarts counting from zero.

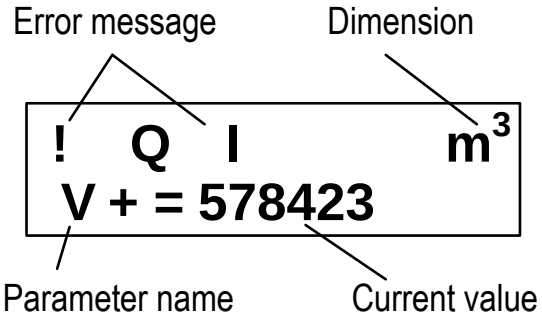


Fig.3. Display

The set of displayed parameters, measurement units, indication period and flow cutoff value may be set at the factory on customer request or on site when putting the flow meter into operation.

Option **Indication period** (time for one parameter to be displayed in the automatic indication switch mode) can be configured from 1 to 100 s (3 s is a factory set value).

In case of alarm pipeline conditions or flow meter's fault, the first display line indicates an error message (see Fig.3). Meanings of message symbols are explained in Part II of this manual.

1.4.3.2. Universal outputs

The flow meter is equipped with 2 multi-purpose (universal) galvanically insulated outputs. These outputs are versatile both with regard to operating mode (frequency, pulse or logical) and function.

Operating mode, function and parameters of the outputs are configured at the factory or on-site (if necessary) when putting the flow meter into operation. Information on how to apply and configure the outputs is given in Part II of the present manual.

To match output stages to inputs of different types, the outputs are designed to work with either the internal power source (active mode) or an external power source (passive mode). By default, the universal outputs are set to the passive mode. The outputs are set to the active mode by placing switches SK1 and SK2 to "ACTIVE" position. Circuit diagrams of the outputs and description of their operation are given in Appendix C.

For the universal outputs working in pulse and frequency modes, length of signal cables should be up to 300 m.

Default configuration settings are specified in Appendix A, Part II. The flow meter can be set to other values on customer's request.

To modify configuration settings on-site, the following tools are required:

- USB-MF adaptor (provided on request) or RS-485 interface (on request)
- "Viewer Aflowt MF" (modification "Lite M") software.

USB-MF adaptor is connected as specified in Appendix B of the Installation Manual.

1.4.4. Service features

The flow meter provides the possibility to set cutoffs for minimal flow rate values (as a percentage of Q_{max}): **On falling flow**, **On rising flow** and **Display's cutoff**. In addition, the user can activate the function of Signal Processing Filter or Automatic flow rate setup module. Filter constant and parameters of the Automatic flow rate setup module determine the time of response to changes in flow rate.

The "Empty pipe" alarm situation is detected when the level of sounding pulse exceeds the threshold determined on the basis of measuring signal in the empty pipe during calibration. The threshold value calculated as 0.01 of reference (determined during calibration) signal level is displayed in percent in Viewer Aflowt MF program.

The detailed information on how to set service functions is given in Part II of the present manual.

1.4.5. Log

The flow meter has the protected log. The log has the amount of 7000 records and is not re-recorded. At its filling further modification of adjusting and calibration parameters (i.e. everything, except communication and indication settings) becomes impossible.

1.4.6. Design versions

Design of the Flow Sensor depends on the pipe connection type and may be as follows:

- Wafer connection type (DN20-DN150): the flow sensor is fixed by studs between the flanges welded to the pipeline ends where the flow meter is cut in
- Flanged type (DN25-DN300): flanges of the flow sensor are fixed to the mating flanges of the pipeline by bolts.

Flow sensor's design version is indicated with the corresponding letter at the end of the product identification line: L – wafer connection type, F – flanged type.

Inner surface of the Flow Sensor is covered by fluoroplastic or is fully made of robust thermally-resistant polymeric material. Versions MF-470L, MF-570L are manufacturer only with fluoroplastic flow sensor.

For the flow sensors with fluoroplastic inner surface, protection rings are installed to protect the lining from damages during mounting and operation. The protection rings provide alignment of the Flow Sensor's inner channel with mating flanges. In addition, the protection rings have grounding leafs that provide electrical contact with liquid under control when the flow meter is installed in plastic (metal-plastic) pipelines.

The Measuring Unit (MU) includes one or two boards: Processor Board is placed inside MU case, and Display board is built in the transparent cover of the flow meter's case (front panel). The modules are connected by the signal flexible flat cable. Processor module is

equipped with the inner protective cover fixed to the board by two screws. The cover is designed so that access to the calibration and service setup terminals can be provided.

The power supply cable and signal cables are entered into the case through two seal cable glands of Pg7 standard size suitable for cables of round cross-section and 3.0 to 6.5 mm outer diameter.

The case of the flow sensor equipped with the stand (available for MF-XX0L flow meters of DN20…DN80 standard sizes) is made of polymeric material and consists of two halves fixed by 4 screws. The case of the Flow Sensor with the stand meant for DN100 and DN150 sizes is a one-piece metal structure. Flow sensor cases for flanged MF-XX0F flow meters (with stands) are metal irrespective of DN.

The screw on MU case is used as a grounding terminal. The wires for connection with the pipeline mating flanges are fastened to the screw.

The flow meters of above-described types and sizes are mounted in metal pipelines. Flow meters of wafer connection type (DN20-DN80) can be mounted in plastic (metal-plastic) pipes especially designed for plastic pipelines.

1.5. Marking and sealing

1.5.1. Front panel of the Measuring Unit bears:

- Name and identification
- Manufacturer’s trademark
- Mark of conformity with EU Directives
- Power supply voltage
- Temperature class.

Design code and standard size (DN) are indicated on separate nameplates located on the case of the Measuring Unit.

The MU face end bears the mark of power supply cable gland =24V. The nameplate with serial number is located on the opposite face end.

1.5.2. After calibration, the terminal used to enable modification of calibration settings is sealed. Screws fixing the protective cover to the Processor module are also sealed by manufacturer's sealing stamp.

1.5.3. The terminal used to enable modification of service settings can be sealed on completing start-up procedures.

In addition, to protect the device from unauthorized access during transportation, storage or operation, the customer may request to hang seals on the Measuring Unit cover.

2. OPERATION

2.1. Operating restrictions

2.1.1. Environmental restrictions are specified in section 1.2.5.

2.1.2. The flow meter may be mounted into the pipeline installed horizontally, vertically or obliquely. Special filters or dirt traps are not needed.

2.1.3. For precision and reliable operation, when choosing mounting location, the following conditions must be met:

- No air collection in the mounting location
- Liquid pressure in the pipeline must not be of values that may facilitate gas release
- Straight pipe runs of appropriate length and DN equal to DN of the flow meter must be provided upstream and downstream the flow sensor. The runs must not include devices or components that may disturb flow structure
- When the flow meter is operated, inner channel of the flow sensor must be fully filled with liquid
- Intensity of external magnetic field (commercial frequency) should not exceed 400 A/m.

CAUTION! DO NOT touch the electrodes in the inner channel of the flow sensor at any step of working with the flow meter.

Mounting considerations, mounting and dismounting instructions as well as description of fittings are given in “AFLOWT MF. Electromagnetic Flow meter, Modification Lite M” Installation Manual.

2.1.4. Type and composition of liquid under control (suspensions and their concentration, impurity substances, etc.) and pipeline operating conditions must not lead to sediments affecting performance and metrological characteristics of the flow meter.

To provide proper operation of the flow meter in pipelines equipped with carbon filters, it is necessary to keep the filters in good condition.

2.1.5. The need for protective grounding is determined by power supply and environment conditions under which the flow meter is operated.

2.1.6. Lightning protection system for the site where the flow meter is located protects the device against failures caused by lightning strokes.

2.1.7. Mounting location and operating conditions requirements specified in this operating documentation are based on the most typical factors affecting flow meter's performance.

The external factors that cannot be foreseen, evaluated or tested by the manufacturer during designing may exist or appear on site.

In this case such factors should be eliminated or flow meter should be placed in other location.

2.2. Selecting standard size (DN)

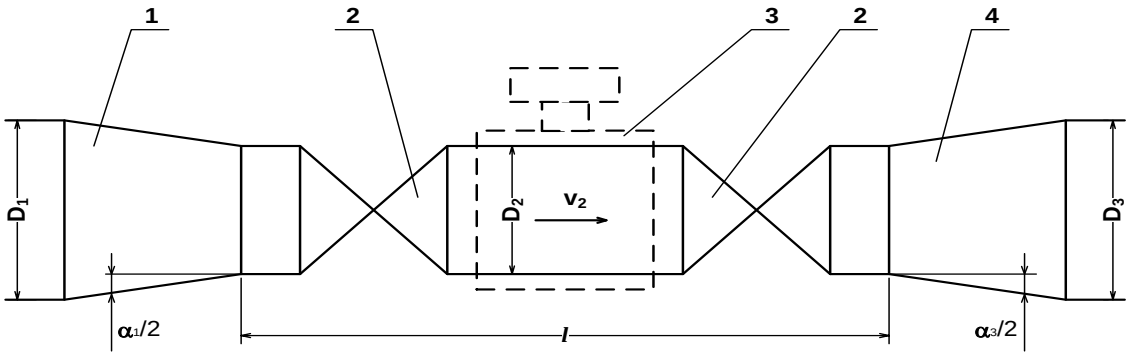
2.2.1. Flow meter's standard size is selected on the basis of flow rate range in the pipeline where it is installed. If several sizes are suitable, the standard size is selected from the specified limit of pressure losses.

2.2.2. If the selected DN is less than DN of the pipeline where the flow meter is expected to be installed, you may use pipe reducers (confusor and diffusor).

2.2.3. To evaluate hydraulic losses in <confusor – flow meter – diffusor> system shown in Fig.4, you may use the method described below.

2.2.3.1. The initial values for evaluation of the hydraulic losses:

- Liquid volumetric flow rate in the pipeline - Q [m^3/h];
- DN of the inlet pipeline - D1 [mm];
- DN of the flow meter - D2 [mm];
- DN of the outlet pipeline - D3 [mm];
- Confusor taper angle - α_1 [deg.];
- Diffusor taper angle - α_3 [deg.];
- Length of the straight pipe run - *l* [mm].



1 – confusor; 2 – full bore spherical valve; 3 – flow sensor; 4 – diffusor.

Fig.4. Flow meter installed in the pipeline

2.2.3.2. According to superposition principle, total pressure losses $\mathbf{h_h}$ in <confusor– flow meter – diffusor> system are the sum of pressure losses in the confusor $\mathbf{h_{h1}}$, losses in the straight pipe run (having length *l*) $\mathbf{h_{h2}}$ and losses in the diffusor $\mathbf{h_{h3}}$:

Hydraulic losses in the confusor are determined according to the graph shown in Fig.5a, where $\mathbf{v_2}$ is flow velocity in the straight pipe run. The Graph of hydraulic losses as a function of flow velocity is calculated for confusor taper angle $\alpha_1 = 20°$. To determine flow velocity from volumetric flow rate ***Q***, you may use the graph shown in Fig.6 or formula:

$$v\,(m/s) = \frac{Q\,(m^3/h)}{0.9 \times \pi \times DN^2\,(mm)} \times 10^3 .$$

Hydraulic losses in the straight pipe run are determined according to the graph in Fig.5b. The graph of hydraulic losses as a function of

flow velocity corresponds to straight pipe run legnth-to-diameter ratio 15; 20; 25 and 30.

Hydraulic losses in the diffusor are determined according to the graph in Fig. 5c. The graph of hydraulic losses as a function of flow velocity is calculated for diffusor taper angle α_3 = 20° and corresponds to diffusor's maximal-to-minimal diameter 2.0; 2.5; 3.5 and 4.0.

NOTE. Specialized software for accurate calculation of hydraulic losses in <confusor-flow meter-diffusor> system can be provided on request.

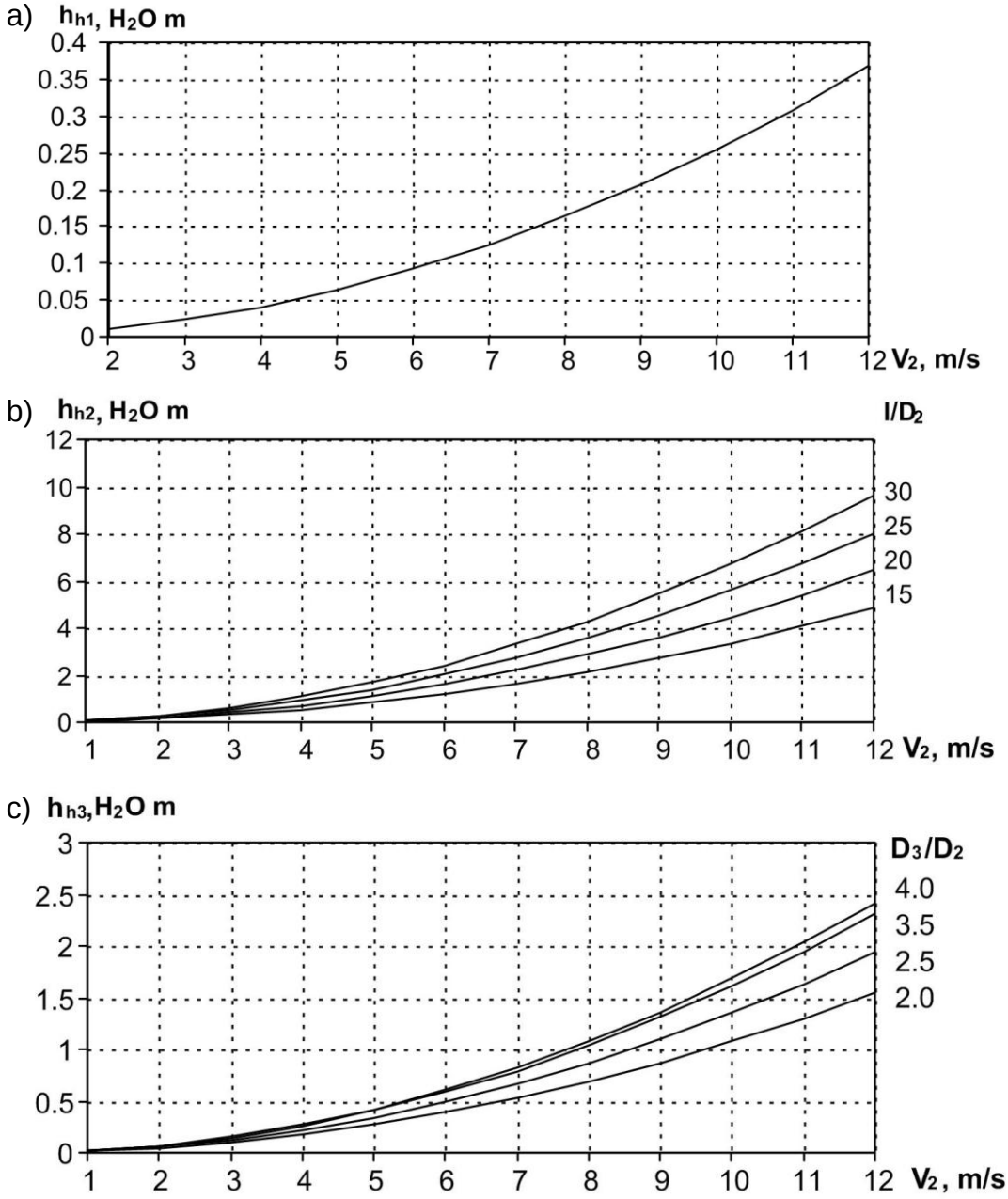


Fig.5. Graphs of hydraulic losses in confusor (a), straight pipe run (b) and diffusor (c).

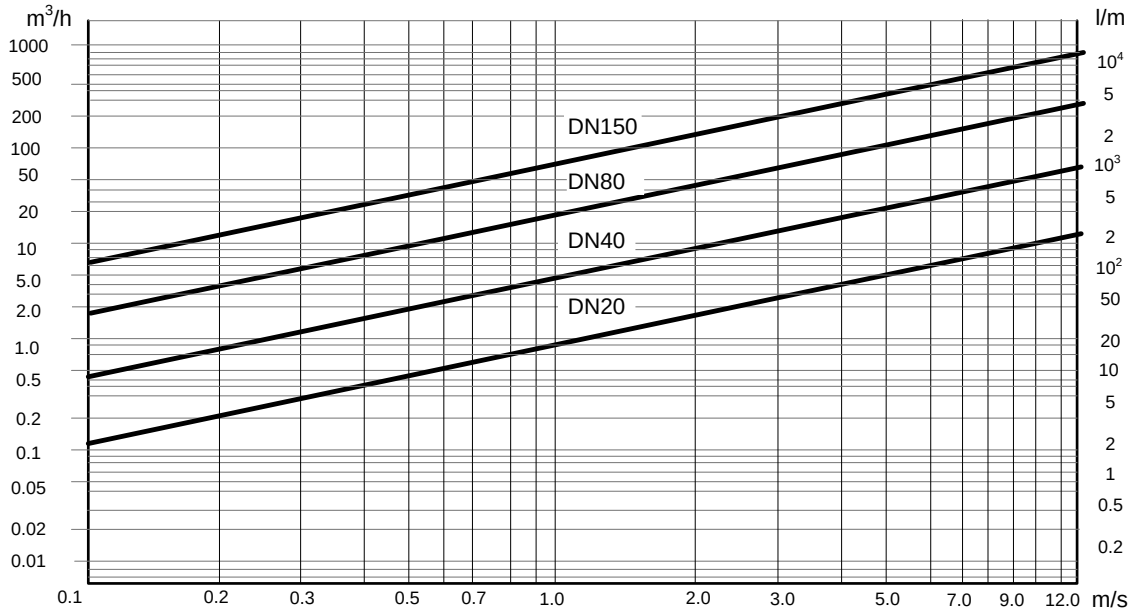


Fig.6. Graph of flow rate vs flow velocity for various DNs

2.3. Preparing for operation

2.3.1. Safety instructions

2.3.1.1. The flow meter should only be used by personnel familiar with all operational documentation for the product.

2.3.1.2. When working with the flow meter, dangerous factors are as follows:

- AC voltage (RMS value up to 264 V, frequency 50/60Hz)
- Pipeline pressure (up to 2.5 MPa)
- Medium temperature (up to 150°C)
- Other installation site-specific factors.

2.3.1.3. Do not use the flow meter in the pipelines with pressure exceeding 2.5 MPa.

2.3.1.4. In the course of mounting, start-up or repair works you must not:

- Connect to the flow meter, switch over modes and replace electronic components, if the flow meter is powered up
- Remove the flow meter from the pipeline until pressure in the pipeline section worked on is fully released
- Use defective electronic devices and electric tools or use them without proper grounding (neutral earthing).

2.3.2. When putting the flow meter into operation check the following:

- Power supply voltage corresponds to the specifications
- The flow is in the direction of the arrow on the flow meter's body
- Inlet and outlet straight pipe runs correspond to each other in length

The flow meter and related equipment are connected in accordance with the selected wiring diagram.

The outputs are configured in accordance with the required operation modes while considering their compatibility with the input settings of other equipment in use.

When the universal outputs are set to the active mode (the switch on the Processor board is placed in "ACTIVE" position), inputs of devices receiving signal from the flow meter's outputs shall work in the passive mode ("active input - passive output" combination).

Alternatively, when the universal outputs work in the passive mode, receiving inputs shall be in the active mode ("passive output - active input") combination.

2.3.3. At first power-up or after a long break in operation, the flow meter becomes operational after:

- Flow sensor is washed by medium for 30 minutes
- Flow meter is kept powered for 30 minutes.

2.3.4. It is necessary to seal the flow meter and bypass gate (if installed) before putting it into operation.

2.4. Operation

2.4.1. After putting into operation the flow meter works in automatic mode. Measurement results can be read from the display (if applicable).

While in operation, the flow meter informs about its status by blinking LED on the Processor module.

Under normal operation, frequency of blinks equals **0.5 Hz**. In case of alarm "**Empty pipe**" condition, LED blinks once in 3 s interval. High frequency of blinking (5 Hz) means that other operation error has been **detected.**

CAUTION! When the flow meter works in Verification or Service modes, LED located on the Processor module glows continuously with short (once per 10 s) interruptions irrespective of errors in operation. Indication of normal or error operation conditions becomes available only in the Work mode.

2.4.2. The list of possible faults and alarm situations detectable by the flow meter and indicated on the built-in display (if applicable) or on a PC display is given in Part II of this manual along with the correction methods.

2.4.3. If necessary, measured values and settings can be read from the flow meter's memory via USB ports with use of corresponding adaptors (optional), or via RS-485 port (optional).

3. MAINTENANCE

3.1. When the flow meter is in operation, it is recommended to check on regular basis that

- Its performance complies with the specifications
- Operating conditions are met
- Power supply voltage is present
- No external defects are detected
- Electrical and mechanical parts are reliably connected.

Under severe operation conditions, it is recommended to inspect the flow meter more often.

3.2. During the lifecycle, it is necessary to check the inner channel of the flow sensor for dirt or/and sediment no less than once a year. Slight layer of rust-colored sediment that can be removed with a soft damp cloth is permissible.

If dirt and/or sediment of other type or of considerable amount is detected, it is necessary to clean the inside of the flow sensor with a clean cloth moistened with water and non-abrasive detergent immediately after removing the flow meter from the pipeline.

The flow sensor must not be cleaned by flushing or submerging it in a liquid, even partially.

Considerable amount of dirt on inner channel of the Flow Sensor means that the pipeline is in poor condition.

3.3. If operating conditions specified in section 1.2.5 are not observed or the flow meter has external defects or the inside of the Flow Sensor is damaged, the flow meter may fail to operate, or the permissible limits of relative measurement error may be exceeded.

If external defects or damages to mains cabling are detected, contact the Service Center or regional dealer for the information about flow meter's operability.

Unscheduled testing (verification) of the flow meter is carried out on the basis of resolution on bad condition of the flow meter issued by an authorized supervisory body.

3.4. Before dispatching the flow meter for verification or repair, clean the inner channel of the flow sensor from sediment and liquid residues after dismounting.

Mounting and dismounting of the flow meter is regulated by the corresponding Installation Manual.

When the flow meter is sent for service, the Equipment Certificate must be enclosed.

Please specify post details, phone/fax numbers along with the way and address for redispatching.

4. PACKING, STORAGE AND TRANSPORTATION

4.1. AFLOWT MF flow meter is packed in a separate container (corrugated carton or wooden box).

The set of fittings is delivered as an assembly or in bulk in a separate box.

4.2. The flow meter should be kept in the manufacturer's box in a dry heated storeroom. The storeroom should be free from current-conductive dust, acid or alkali fumes and aggressive gases that may damage insulation.

During storage the flow meter does not require any special maintenance.

4.3. The flow meter can be transported by road, rail, sea or air (except for unsealed cargo compartments) provided that the following requirements are met:

- It is transported packed in the manufacturer’s box
- Protection against moisture is provided
- Temperature is within the range of -25 to 55 °C
- Humidity does not exceed 98 % at 35 °C
- Vibration is within the range of 10-500 Hz with maximum 0.35 mm amplitude or 49 m/s^2
- Impact acceleration does not exceed 98 m/s^2
- Devices are fixed to prevent damages.

APPENDIX A. Flow rate measurement ranges

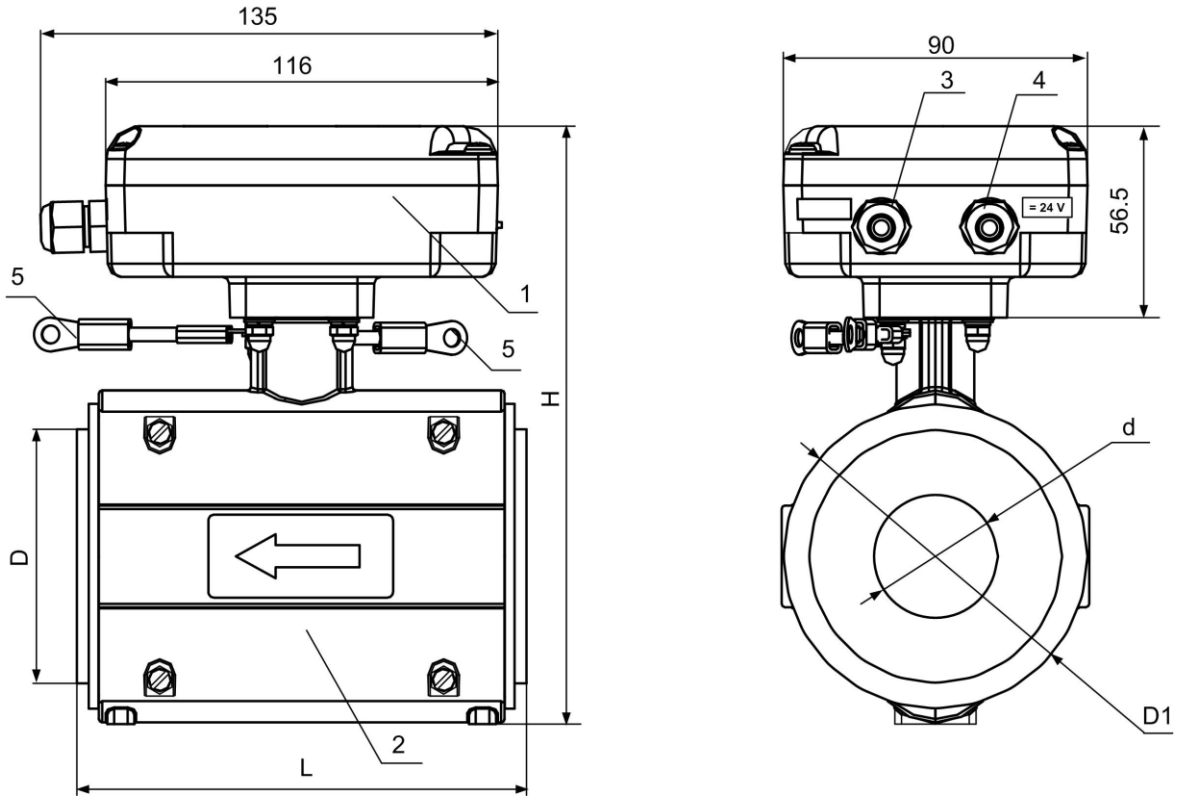
Table A.1. Flow rate measurement ranges for various design options

	Flow rate, m^3/h					
Design versions	All	440/470(L/F) B 540/570(L/F) B	440(L/F) B 540(L/F) B	470(L/F) B 570(L/F) B	440(L/F) BR 540(L/F) BR	470(L/F) BR 570(L/F) BR
Notation	Q_{max}	Q_{min}			Q_{min}	
Flow direction	Forward	Reverse	Forward		Any	
δ, %	±2.0	±2.0	±2.0		±2.0	
Ks / DN, mm	1:1	1:100	1:250	1:500	1:250	1:500
20	10.0	0.10	0.04	0.02	0.04	0.02
25	16.0	0.16	0.064	0.032	0.064	0.032
32	25.0	0.25	0.10	0.05	0.10	0.05
40	40.0	0.40	0.16	0.08	0.16	0.08
50	63.0	0.63	0.25	0.125	0.25	0.125
65	100.0	1.0	0.4	0.2	0.4	0.2
80	160.0	1.6	0.64	0.32	0.64	0.32
100	250.0	2.5	1.0	0.5	1.0	0.5
150	630.0	6.3	2.5	1.25	2.5	1.25
200	1000	10.0	4.0	2.0	4.0	2.0
300	2500	25.0	10.0	-	10.0	-

Q_{max} – maximal flow rate within the specified range
Q_{min} – minimal flow rate within the specified range
δ – permissible limits of relative error
Ks – range ability
DN – standard size.

NOTE. The given values of expenses are rounded to the third sign after a comma. These values are recommended at design.

APPENDIX B. Exterior view

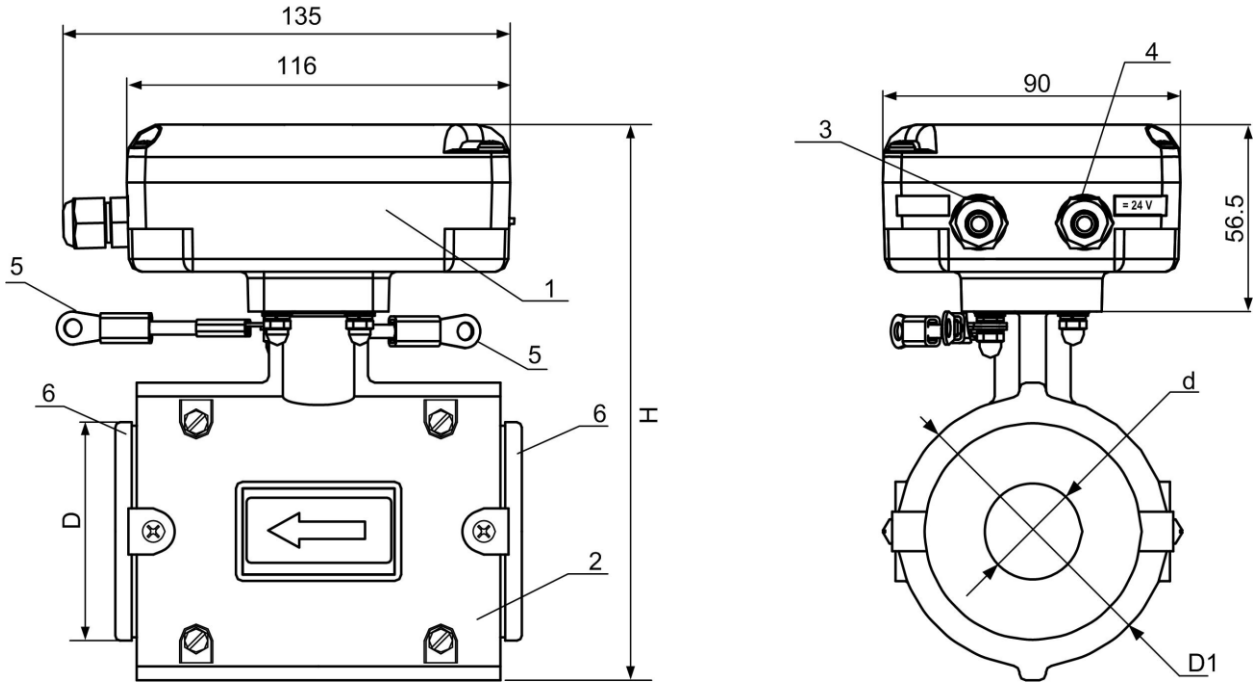


* - reference dimension

1 – Measuring Unit; 2 – Flow sensor; 3 – signal cable through; 4 – power supply cable through; 5 – wires for connection between flow meter's case and pipeline.

DN, mm	d*, mm	D*, mm	D1*, mm	L*, mm	H*, mm	Weight, no more than, kg
20	19	50	73	113	160	0.9
25	24.5	57.5	73	113	160	1.0
32	29	65	82	123	168	1.2
40	38	75	90	133	176	1.3
50	47	87	102	153	188	1.8

Fig.B.1. Flow meter MF-XX0L (DN20…DN50) with plastic Flow Sensor

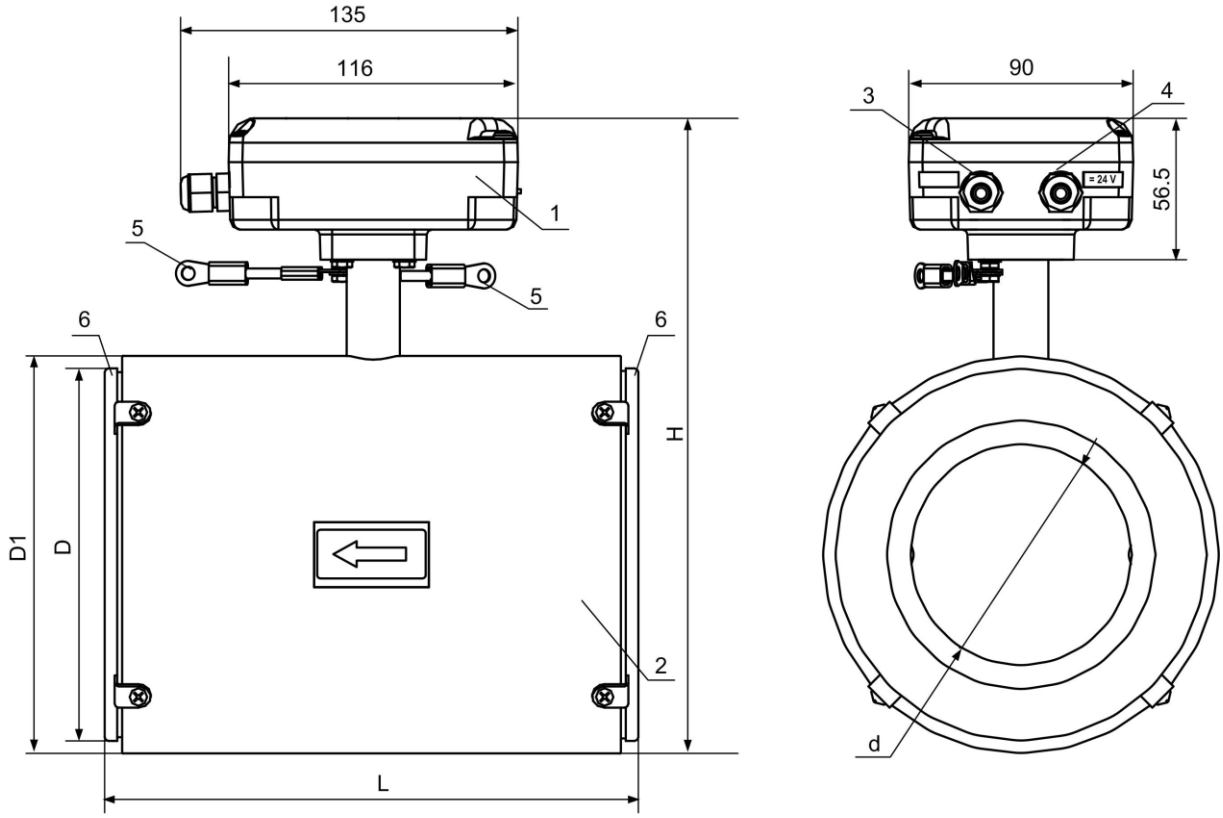


* - reference dimension

1 – Measuring Unit; 2 – Flow sensor; 3 – signal cable through; 4 – power supply cable through; 5 – wires for connection between flow meter's case and pipeline; 6 – protection rings.

DN, mm	d*, mm	D*, mm	D1*, mm	L*, mm	H*, mm	Weight, no more than, kg
65	61	109	122	174	208	3.7
80	74	120	141	174	228	4.9

Fig.B.2. Flow meter MF-XX0L in plastic case with fluoroplastic lining inside Flow Sensor

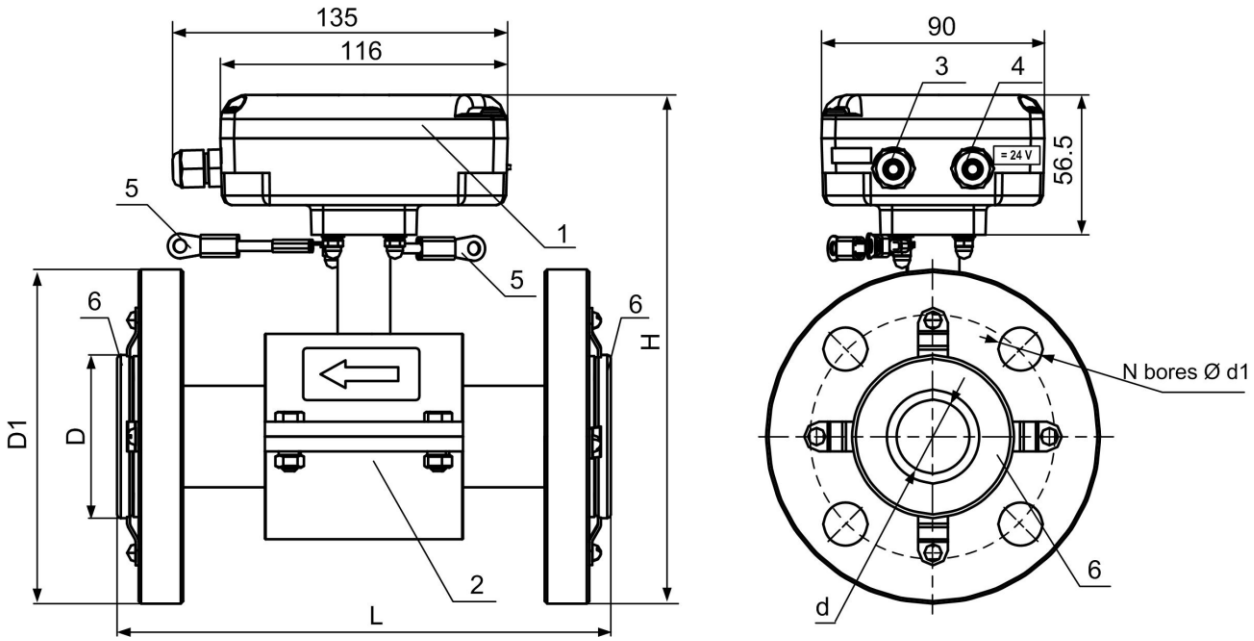


* - reference dimension

1 – Measuring Unit; 2 – Flow sensor; 3 – signal cable through; 4 – power supply cable through; 5 – wires for connection between flow meter's case and pipeline; 6 – protection rings.

DN, mm	d*, mm	D*, mm	D1*, mm	L*, mm	H*, mm	Weight, no more than, kg
100	90	149	159	216	256	9.4
150	139	202	219	236	316	15.6

Fig.B.3. Flow meter MF-XX0L in steel case with fluoroplastic lining inside Flow Sensor



* - reference dimension

1 – Measuring Unit; 2 – Flow sensor; 3 – signal cable through; 4 – power supply cable through; 5 – wires for connection between flow meter's case and pipeline; 6 – protection rings.

DN, mm	d*, mm	D*, mm	D1*, mm	L*, mm	H*, mm	d1*, mm	N	Weight, no more than, kg
20	19	50	105	158	186	14	4	3.6
25	24	57	115	158	191	14	4	3.8
32	29	65	135	202	207	18	4	5.6
40	39	75	145	202	215	18	4	6.8
50	48	87	160	203	229	18	4	8.7
65	61	109	180	220	249	18	8	11.2
80	74	120	195	230	266	18	8	13.9
100	90	149	230	251	293	22	8	19.8
150	139	202	300	324	358	26	8	36.2
200	194	258	358	362	414	26	12	58.8
300	295	362	485	514	531	30	16	120.2

Fig.B.4. Flow meter MF-XX0F (DN20...DN300) with fluoroplastic lining inside Flow Sensor

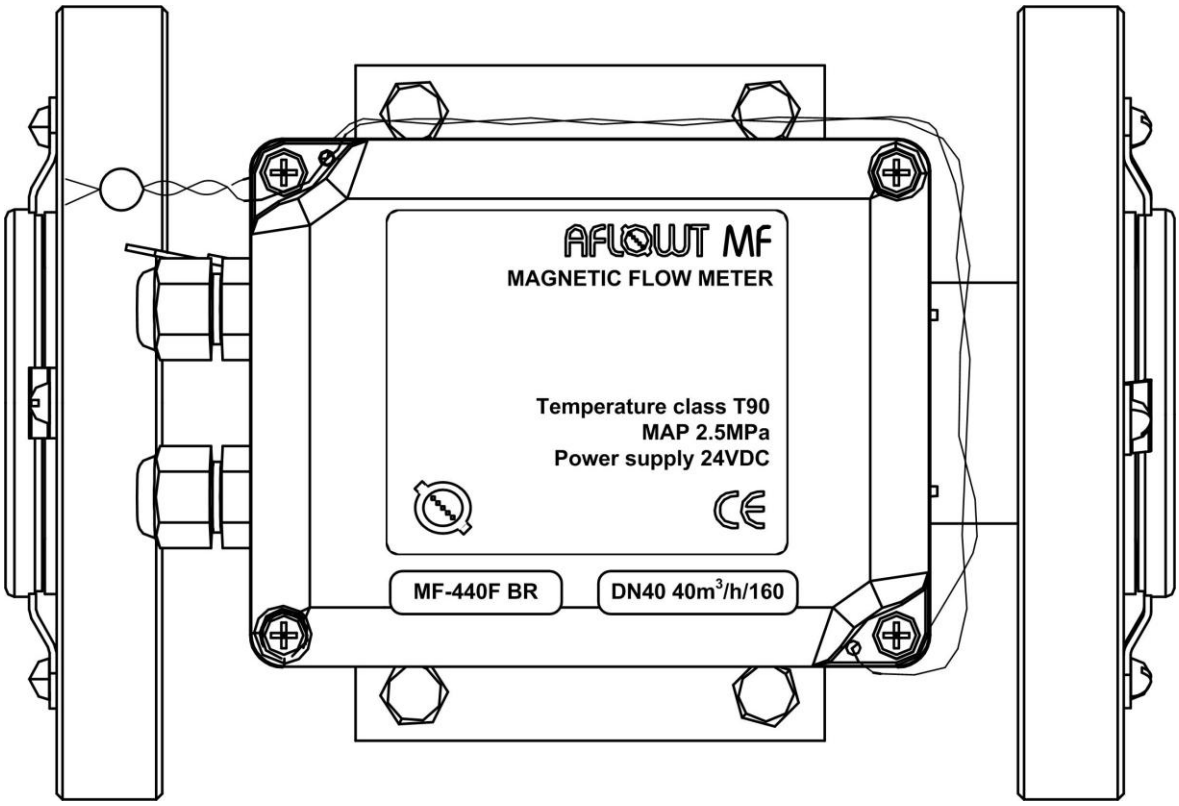
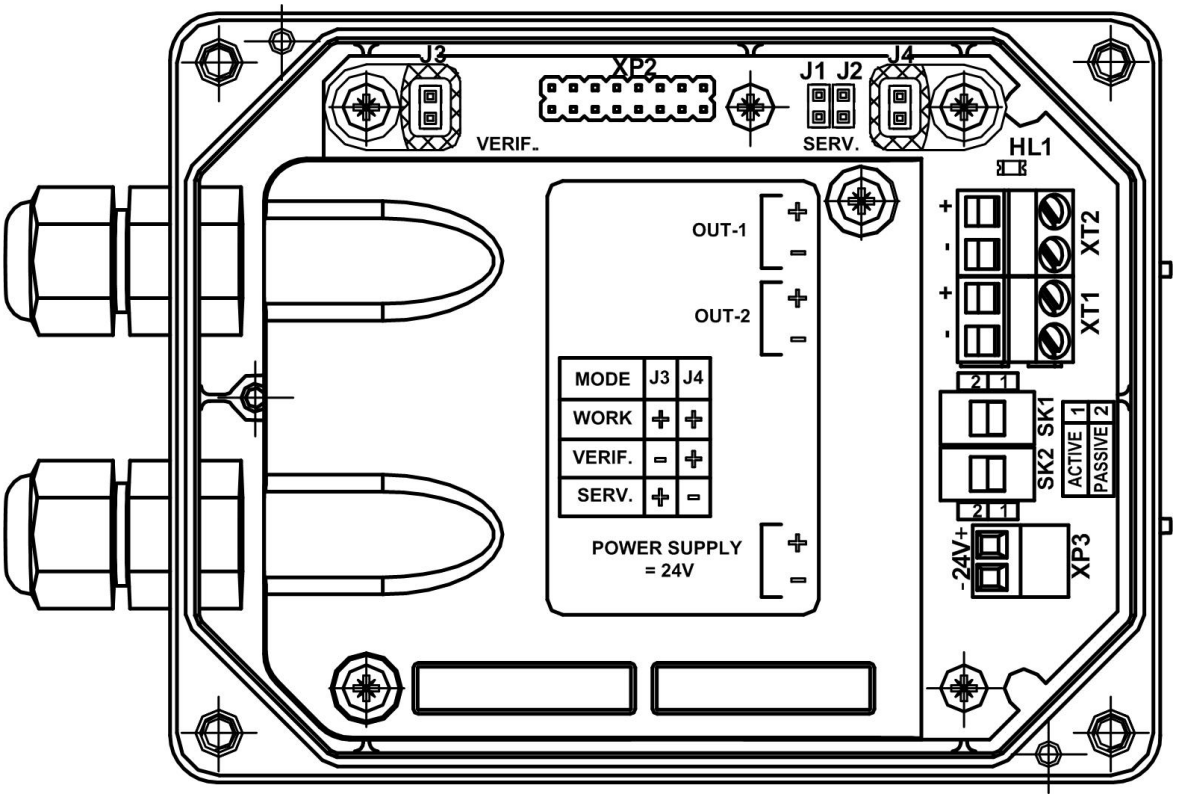


Fig.B.5. Top view – Measuring Unit of flanged flow meter



XP2 – connector for Module of interfaces flat cable or USB-MF adaptor
XP3 – connector for DC power supply cable =24V
XT1 – terminal block of universal output N2
XT2 – terminal block of universal output N1
SK1 – switch of output modes, universal output N1
SK2 – switch of output modes, universal output N2
J1, J2 – terminals used to set ***Coefficient KP*** *for universal output N1*
J3 – terminal used to enable modification of configuration settings
J4 – terminal used to enable modification of service settings
HL1 – status indication LED

Fig.B.6. Measuring Unit with front panel removed (view of Processor Module)

APPENDIX C. Output stages of universal outputs, circuit diagram

Output stages of the universal outputs have the same schematic design shown in Fig.C.1. Notations for terminals, connector pins and signals related to the universal output N2 are given in brackets.

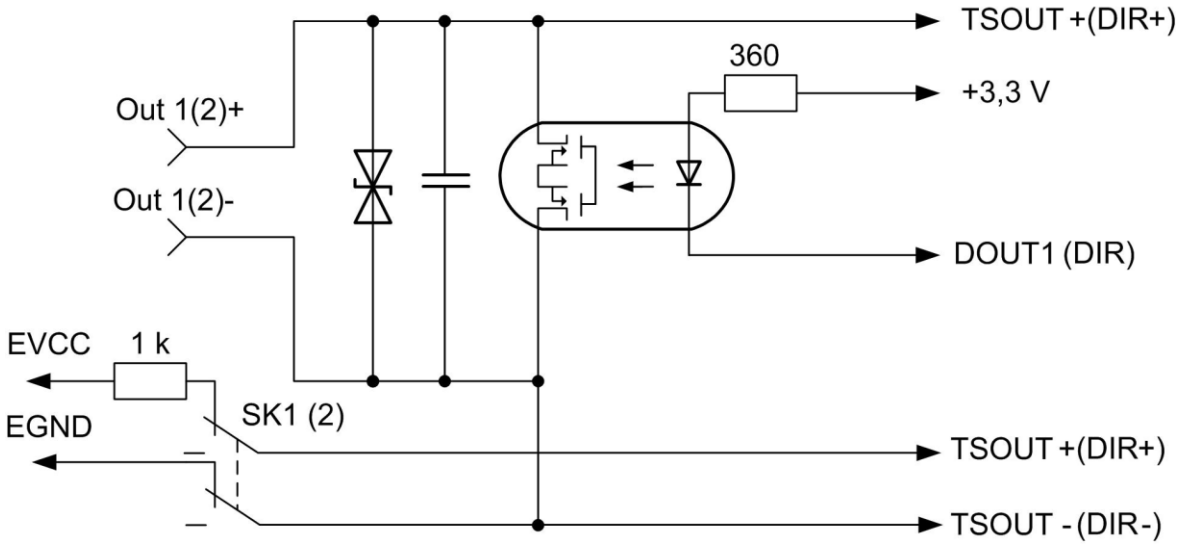


Fig.C.1. Output stages of universal outputs, circuit diagram

Selected **Activity level – High** setting means that "pulse" at the output in the pulse and frequency modes and "event" at the output in the logic mode correspond to the "open" state of the electronic switch. "No pulse" and "no event" at the output correspond to the "close" state.

Selected **Activity level – Low** setting is associated with inverse values at the outputs.

In the active mode, in case of no pulse or at logic **High**, output voltage can take values within 2.4 to 5.0 V. If pulse is present or at logic **Low**, output voltage is no more than 0.5 V. Permissible value of output load in the active mode is no less than 1 kOhm.

The universal outputs are set to the active mode by placing SK1 and SK2 switches to the corresponding position.

In the passive mode, power from an external power source with output DC voltage from 3 to 30 V may be applied. Permissible value of external load current is maximum 150 mA.

Length of communication (signal) cables – up to 300m.