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MP400CM INSTALLATION AND OPERATION MANUAL

1. ASSEMBLY OF FLOWMETERS

The assembly of MP400 flowmeters may only be performed by an organization bearing the authorization certificate to install MP400 flowmeters based on the training of their accredited staff performed by the manufacturer. The one day training is provided on free basis and it's just necessary to agree appropriate date and time. In case of meters designated for billing purposes, the assembly organization must be registered with the regional metrological authorities as per local regulations.

Local directives governing the electrical equipment installation and operation safety also cover the flowmeters e.g. EN 60529, EN 33200-4-41. The staff engaged in projecting, assembling or operating the flowmeters must be acquainted with the installation and operation manual and must bear relevant welding or electrical qualification and must be acquainted with installation and operation manual.

This installation and operation manual is applicable to MP400CM flowmeters having rated inner diameters DN10 - DN800. For MP400C and MP400E flowmeters separate installation and operation manual is issued. Due to technical improvements, the installation and operation manual is subject to updates. Please always ask us for the latest version. The version release date (year - month) can be found at the bottom before the page number.

2. CONTENTS OF THE MEASURING DEVICE SUPPLY

a) Electronic circuitry box connected with the flow sensor by a cable - separate design -Fig.13 and Fig.16 or electronic circuitry integrated with the inductive flow sensor - compact design - Fig.12. Flow sensor gaskets for the wafer inductive flow sensor DN10-DN150 - Fig.14.

b) Optional assembly installation accessories to mount the wafer inductive flow sensor DN10-DN150 into piping: flanges, direct piping sections, studs , nuts and washers in accordance with Fig.15.

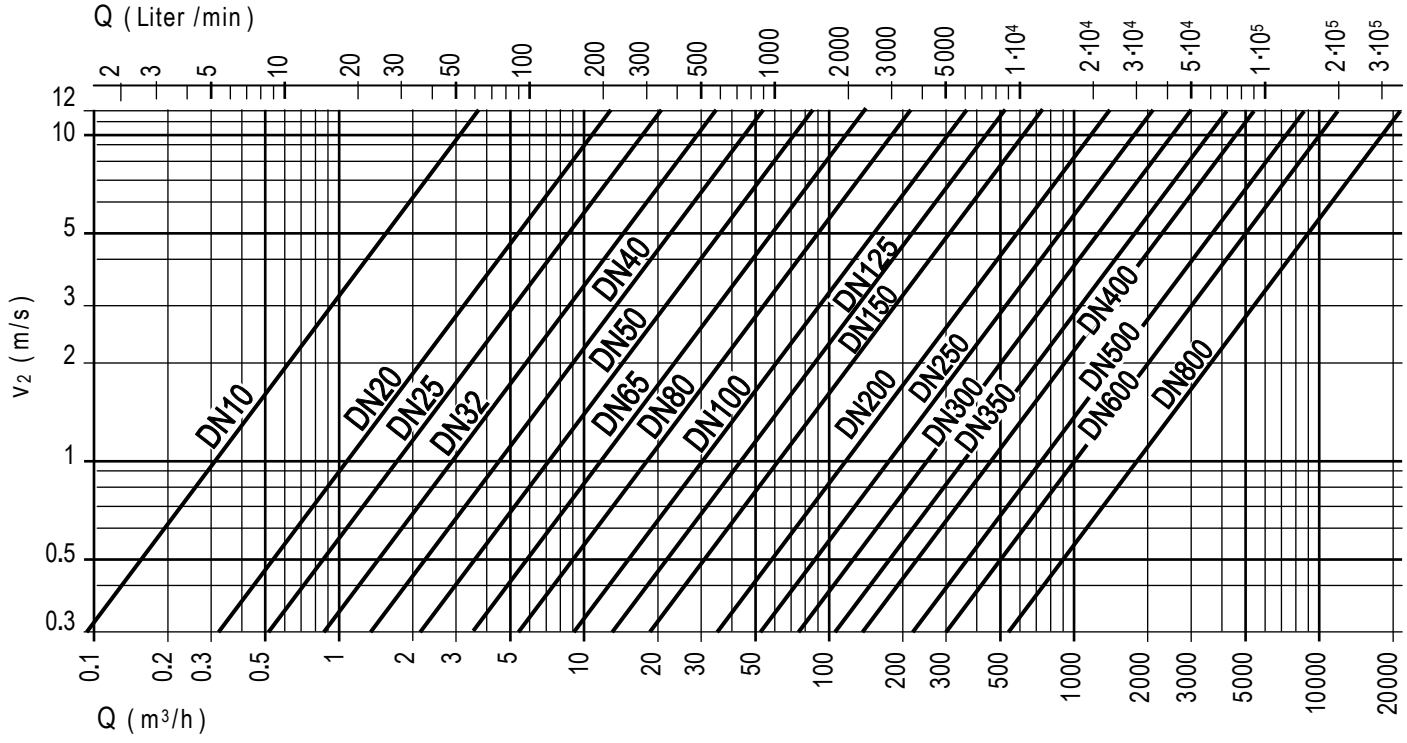
The flowmeters are stored and transported to the assembly site in their original factory packages. Each flowmeter including all the related loose parts is wrapped separately in a card box with polystyrene foam filling. Bulky parts are supplied in extra packaging or on transport pallet. It is recommended to check immediately completeness of the supplied items and intactness of the seals.

3. INNER DIAMETER SELECTION AND THE ASSEMBLY OF FLOWMETER

The inductive flow sensor or the compact flowmeter can be installed in horizontal, vertical or oblique piping. The flow measurement accuracy and trouble-free meter operation is guaranteed provided the conditions stated in following paragraphs are observed.

3.1 The fluid velocity in the flowmeter measuring tube is at its optimum

In order to make use of the wide measurement range of the inductive flowmeter, the selected maximum velocity in the inductive sensor should be as high as possible, particularly if accurate measuring of flow varying within wide range is required.

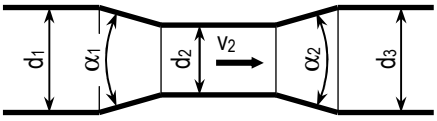


The diagram on the first page provides the easiest way of finding the velocity for the selected rated inner diameter DN of the sensor and the flow rate Q.

If the velocity is insufficient, select smaller DN so that velocity tends to 9 m/s. If greater pressure loss due to the reduction of piping diameter is acceptable, DN can be selected even smaller so that the velocity tends to 12 m/s. This will make the best of the flowmeter measuring range and accuracy.

The necessary rated inner diameter of the flow sensor usually comes out as smaller than piping inner diameter, which involves the use of reduction cones or standard coaxial welding reductions.

Using the following diagram, it is possible to determine the pressure loss Δp with the knowledge of the piping diameters ratio $d_1/d_2 = d_1/d_3$ and the medium velocity v_2 in the flow sensor. This diagram is applicable for water, reduction cones with the angle of $\alpha_1 = \alpha_2 = 20°$ and straight piping sections installed before and after the flow sensor having minimum length and diameter corresponding to requirements in paragraph 3.2. Multiply the result by relative density for fluids other than water.



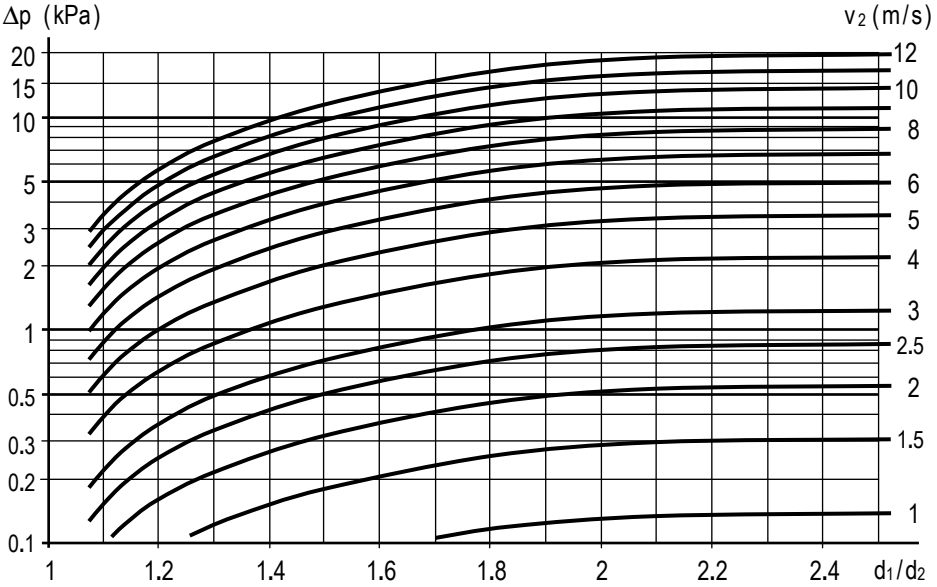
d_2 - inner diameter of flow sensor and connected straight piping sections

v_2 - fluid velocity within the flow sensor

$d_1 = d_3$ - piping inner diameter before and after the reduction cones

α_1 - confussor top angle

α_2 - diffuser top angle



By reducing the diffuser angle α_2 from 20° to 16°– 8°, the pressure losses being generated in the narrowed piping section can be reduced by 30% to 50%. The lowest pressure losses are at confussor angle of $\alpha_1 = 20°$ and diffuser angle $\alpha_2 = 8°$-16°.

3.2 The fluid flow within the flow sensor is steady and free of vortices

For this reason, straight-piping sections must be connected before and after the flow sensor having the same inner diameter as the flow sensor (with allowable tolerance of +5%). The minimum length of the straight piping section is 3 x d_2 upstream and 2 x d_2 downstream. If there is sufficient room, we recommend using the straight piping sections as long as possible, particularly upstream of flow sensor.

Straight piping sections with flanges DN10 – DN150 supplied as optional accessory with the flowmeters sufficiently meet the length requirements. In case of bigger inner diameters, one section to be placed before the flow sensor is longer. The dimensions of accessories are stated in paragraph 4.3.

If cone reductions with α_1, α_2 angle $\leq 16°$ are used and cone minor inner diameter is equal to flow sensor inner diameter (with allowable tolerance of +5%), then the cone reductions may be connected directly to the flow sensor.

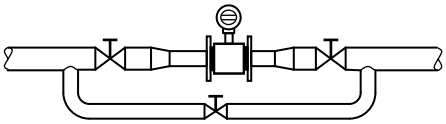
The specified straight piping sections must be free of any sources of disturbance to steady flow; such sources of disturbance must be positioned in the piping after or at a maximum possible distance before the flow sensor.

The following items are considered as sources of disturbance to steady flow :

- Sudden changes in the piping cross section area unless they are designed as a cone with the top angle of $\leq 16°$ as well as piping outlets from tanks, exchangers and filters.
- Anything that interferes with the fluid flow, such as a thermometer well.
- Poorly aligned gasket, gasket having small inner diameter or being made of soft elastic materials that are pushed into the inner cross section piping area after drawing the flanges together. Observe the gasket inner and outer diameter as stated on Fig.14.

- Branch pipes, T-pieces, bends, elbows, gate valves, cocks, throttles, closing and regulating valves and non-return valves. A spherical cock may not cause disturbances if its inner diameter is smooth and identical to that of the piping and if you make sure that, it is kept fully open during the measurement.
- The most severe disturbing elements are pumps and bends or elbows placed one right after another at different planes. Such elements should be placed at least 20 × d_2 upstream.

Fig. 1

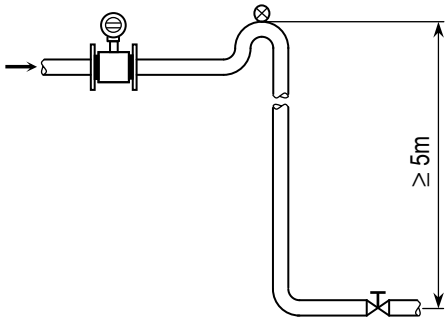


3.3 The fluid constantly fills the entire cross section area of the flow sensor tube.

For this reason, the flow sensor must not be positioned either at the highest point of the piping where it may be aerated or in descending / open-ended horizontal piping into which air may penetrate. The best installation point is the lowest or ascending piping section (Fig. 3, 4, 5).

It is required that sufficient pressure should be maintained at the flow sensor installation point in order to prevent steam or gas bubbles from being separated from the fluid. Fig. 2 shows descending piping section whose length exceeds 5m, which means the water column weight would make the pressure in the flow sensor fall below the vapor pressure. For this reason, an automatic air inlet valve is connected at the highest point of the piping. If hot water is used, the critical length of the vertical section (so called gravitation section) may result as even shorter.

Fig. 2



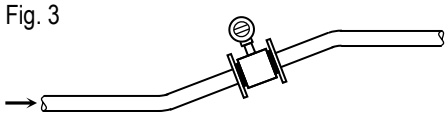
In case of a sudden decrease in pressure, gas bubbles are being separated from fluids. For this reason, regulating throttle valves and similar elements should be placed after the flowmeter. Similarly, the flow sensor should not be placed at the suction side of a pump. In order to prevent the bubbles from gathering within the flowmeter, it is recommended that the piping be slightly ascending (see Fig. 3).

3.4 The measured fluid is passing through the flow sensor in direction indicated by the arrow. Reverse flow cannot be measured unless special flowmeter setup is made according paragraph 8.4 c).

3.5 If possible, the measured fluid continuously floods the flow sensor electrodes.

Even in situations when the piping system becomes empty for longer periods of time, this can be achieved by installing the flow sensor in a siphon trap as shown on Fig. 4, preventing dirt from drying in the measuring tube or on the flow sensor electrodes.

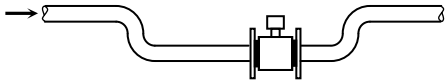
Fig. 3



3.6 The electrodes axis (connecting line) is approximately horizontal.

The tiny bubbles that may always occur in fluids are thus prevented from gathering near each electrode. In case of vertical piping, this requirement is always met. In other cases, the flowmeter head or the flow sensor terminal box must be positioned upwards.

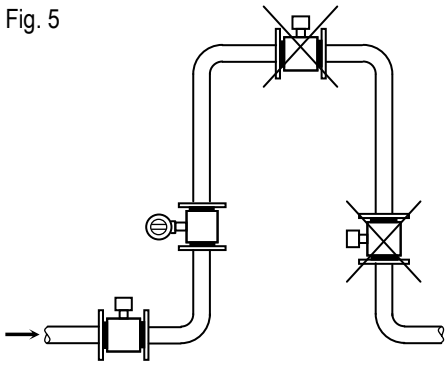
Fig. 4



3.7 No sludge is being formed inside the measuring tube or on the electrodes.

The measuring tube is quite smooth and if the fluid velocity is sufficient as stated in paragraph 3.1, the sludge has no possibility to catch on. If the flow velocity is continuously low with higher occurrence of sludge with heavier specific weight, it is useful to install the flowmeter in sloping or vertical ascending piping (Fig. 3 or Fig. 5).

Fig. 5



3.8 The influence of adverse environmental conditions on the device is minimized.

These conditions include temperature, humidity and mechanical stress.

The flowmeter circuitry head with must not be exposed to radiation from heat sources and its natural cooling by ambient airflow must be secured.

Heat insulation of the hot piping must be interrupted at the installation point of inductive flow sensor (or compact flowmeter). The room temperature should not fall below 0 ^{0}C. Maximum ambient temperature is 55 ^{0}C. The optimum ambient temperature ranges from 15 ^{0}C to 35 ^{0}C. Maximum air relative humidity is 90 %.

The flowmeters should not be placed under piping joints or similar points with risk of dripping water occurrence.

The flow sensors are resistant against all forces occurring in the piping during operation. However, big stress and especially bending one may cause damage to the gasket. For this purpose, the piping must be properly anchored. The heat expansion must also be considered. Any vibrations forced to the piping (for example caused by pumps) may also be harmful.

3.9 The flowmeter or the flow sensor can be easily installed and removed.

The arrangement and anchoring of the piping at the point of installation must enable a slight widening of the distance between the flanges so that flow sensor and gaskets can be inserted between flanges. Cut-off fittings should be placed before and after the flow sensor so that the relevant piping section can be emptied prior to the assembly.

In order to avoid the shutdown of technological or heating system during the installation, it is possible to install a bypass as shown on Fig. 1. In case of billing measurement, the bypass must be closed and seal secured.

Fig. 6

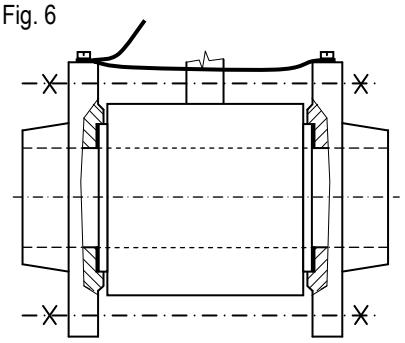


Fig. 7

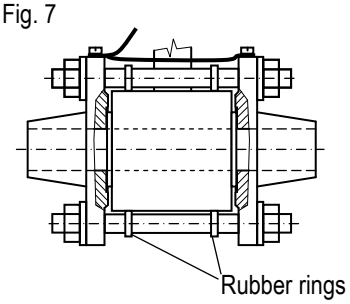


Fig. 8

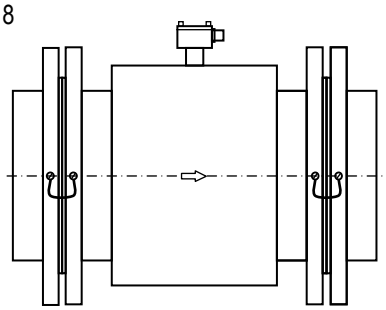


Fig. 9

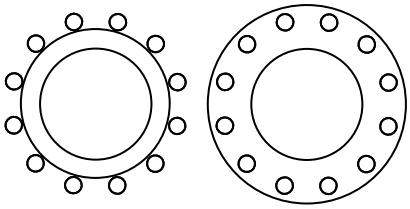
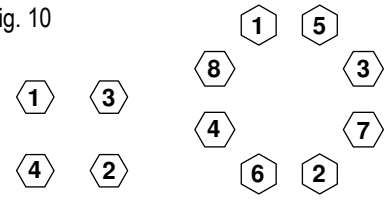


Fig. 10



DN (mm)	M_K (Nm)	Number of studs
10	15	4
20	15	4
32	35	4
40	40	4
50	40	4
80	50	8
100	70	8
150	90	8

3.10 The flowmeter sensor is installed in the piping in accordance with data on the flowmeter's nameplate. (maximum allowable temperature and pressure).

3.11 No interference is being induced in the inductive sensor cable.

The cable of the separate inductive flow sensor or any single part of it may not be routed parallel with the cables used for mains distribution or in the proximity of motors, electromagnets, contactors, frequency converters or similar sources of electromagnetic interference. In unavoidable cases, the cable must be placed in a grounded steel protection tube.
Both ends of flow sensor cable shielding must be connected as shown on Fig. 20.

3.12. Galvanic connection is provided between the flowmeter and the measured fluid.

The wire connected to the head's rear cover or to the flow sensor's terminal box must be connected to one flange and the flanges must be interconnected with another wire using M5 brass screws with toothed washers that are supplied as accessories (Fig. 6, 7, 8).

3.13. The assembly is carried out at a professional level.

While welding the flanges and/or the reduction cones, it is necessary to observe proper alignment of the entire assembly in order to eliminate the formation of any places causing fluid vortices.

To ensure reliable function of the gasket, it is necessary that the bearing surfaces of the flanges should be parallel. The difference of the highest to the smallest distance between the sealing surfaces of the flanges before mounting the flow sensor should not exceed 0.5mm. In addition, the alignment of the boltholes in both flanges must be observed and the positioning of the M5 threads for grounding screws must be considered.

The manufacturer recommends the use of an assembly spacer (dummy) while carrying out the welding. Because of possible heat damage, neither the flow sensor nor the compact flowmeter can be used instead of an assembly spacer for welding !

For aligning the DN32 to DN100 wafer flow sensor in the piping, recesses in the flanges as described on Fig. 6 are used (for dimensions, see paragraph 4.1). In case of DN10, DN20 and DN150 - PN25, rubber rings must be pulled over the studs as described on Fig. 7.

The installation of the inductive flow sensor or the flowmeter in compact design should not be launched until all building, welding and painting jobs are completed. When performing electric welding, avoid welding current to pass through the flow sensor !

The electrodes inside the flow sensor must never get into touch with hands or anything else**!**

The PTFE lining edges of DN10 and DN20 wafer inductive sensors that have not been mounted yet must be permanently tightened by a bolt with square or round washers. Do not remove them until just before the installation and save them for possible future use. We recommend saving the flowmeter's package for safe transport too.

The gasket must not protrude into the flow cross-section area. The gasket being used must not be made of soft elastic materials, otherwise it will be pushed into the inner cross section area as the flanges are drawn together, which may result in serious errors in the flow rate measurement.

The pair of gaskets according to paragraph 4.2 is supplied as accessories for wafer flow sensors DN10 to DN150. For flow sensor with flanges (Fig. 8), we recommend the using gaskets with centering holes or suitable outer diameter for dependable gasket alignment (Fig. 9).

The tightening of the wafer flow sensor assembly with the studs should be made uniformly and sequentially in the order shown on Fig. 10 with a wrench of standard length, while observing the maximum torque Mk as described in the table:

3.14 The measured data can be easily red on the display.

It is necessary to enable the access to the display control button on the rear side of head or on the right side of the circuitry box. No illumination of the installation site is required as the display is readable at full dark.

The flowmeters MP400CM in compact design leave the factory assembled in a manner that the measured fluid flows from left to right when when viewing the front cover of the head with the display window as shown on Fig. 11a).

After removing the two screws on the insulation ring perimeter, the head can be turned by 180^0 or 90^0 clockwise or by 90^0 counterclockwise. The screws should be returned in place and tightened as soon as the turning is done. Turning the head can also enable the access to the terminals under the rear cover. When the flowmeter in compact design is installed in vertical piping, the front cover of the head with the display can be turned by 90^0 after removing the four screws - Fig. 11 c), d), e), f). If you wish non-standard head and display position, please, specify this in your order as shown on Fig. 11 b), c), d), e), f), g), h).

Fig. 11

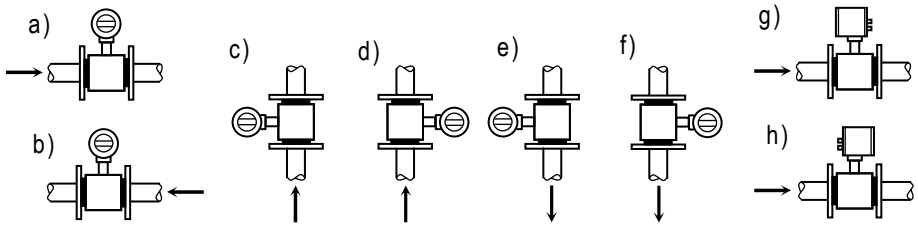
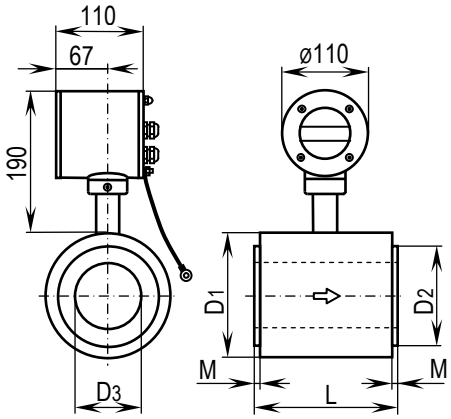


Fig. 12

MP400C/M
COMPACT DESIGN



4. MP400CM FLOWMETER DIMENSIONS

4.1 Dimensions and weights in relation to DN rated inner diameter (wafer flow sensor) DN10 – DN150 (Fig. 12, Fig. 13)

DN	D1	D2	D3	L	M	Weight
10	60	≈ 34	11	66	3	3.6 kg
20	60	≈ 46	19	66	3	3.6 kg
32	83	63 ± 0.2	32	100	3	4.2 kg
40	90	70 ± 0.2	40	100	3	4.8 kg
50	108	90 – 0.3	51	108	3	6.0 kg
80	140	115 – 0.3	80	163	3.5	8.7 kg
100	168	150 – 0.3	104	162	4	12.0 kg
150	220	-	142	190	-	17.2 kg

The weight in the table is applicable for compact design as shown on Fig. 12.

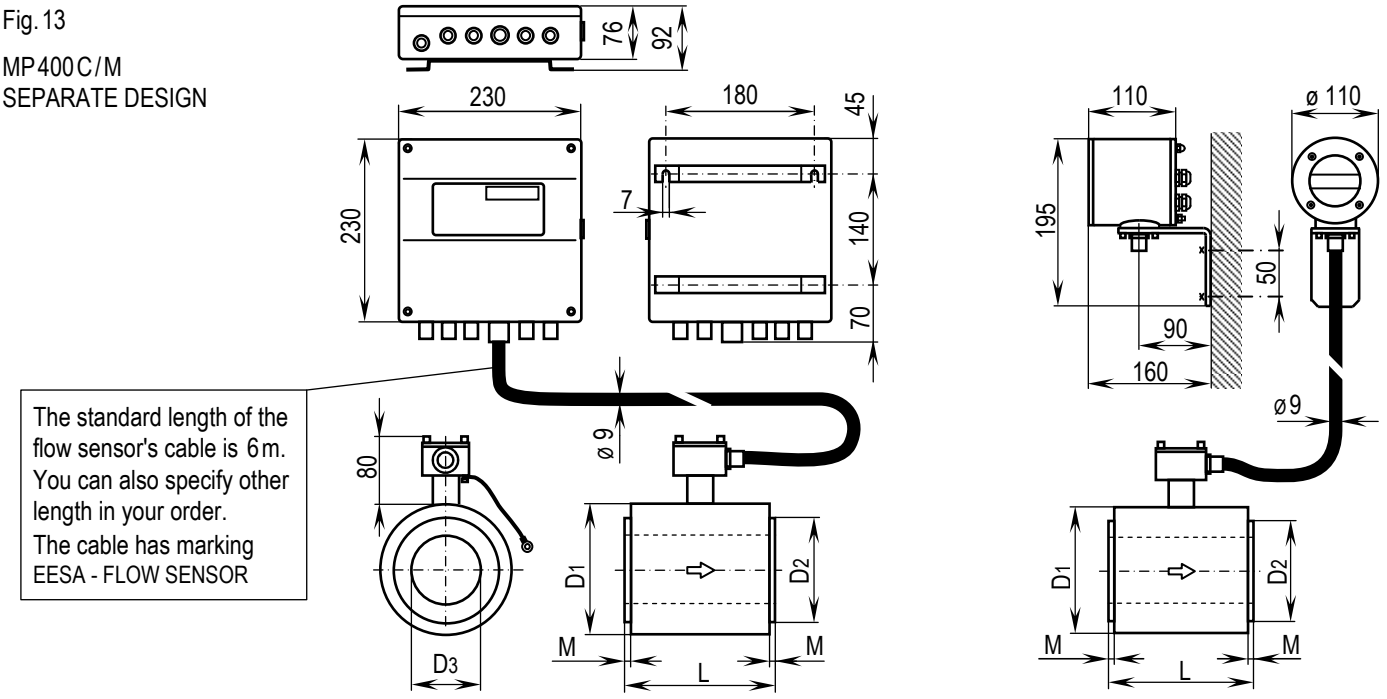
Add 1.6 kg for wafer separate design (Fig. 13) with a 6m cable.

1m of the flow sensor's cable weights 0.11 kg

Electronic circuitry box without cable weights 3.1kg.

Fig. 13

MP400C/M
SEPARATE DESIGN

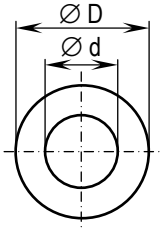


The standard length of the flow sensor's cable is 6 m. You can also specify other length in your order.
The cable has marking EESA - FLOW SENSOR

4.2 Dimensions of wafer flow sensor gaskets (Fig. 14)

DN	10	20	32	40	50	80	100	150	150
PN	25	25	25	25	25	25	25	25	16
∅ D	36	54	63	70	90	114	150	224	190
∅ d	12	20	34	42	53	82	106	154	152
Thickness	1	1	1	1	1	1	2	2	2

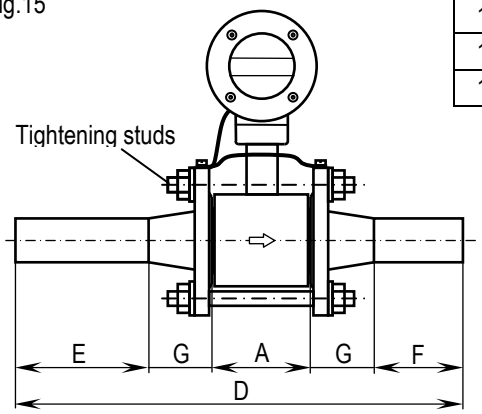
Fig. 14

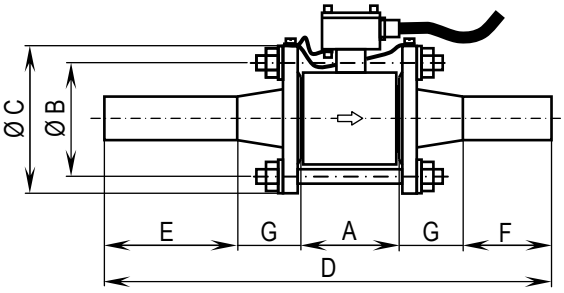


4.3 Dimensions of MP400 compact flowmeter or separate inductive wafer flow sensor DN10 – DN150 installed in piping with standard assembly accessory (Fig. 15)

DN	PN	A	B	C	D	E	F	G	Tightening studs	
10	25	68	75	105	188	–	–	60	M12 x 135	4 pcs
20	25	68	75	105	268	60	60	40	M12 x 135	4 pcs
32	25	96	100	140	500	160	160	42	M16 x 175	4 pcs
40	25	96	110	145	510	200	120	47	M16 x 175	4 pcs
50	25	104	125	160	520	210	110	48	M16 x 200	4 pcs
80	25	159	160	200	920	400	250	55.5	M16 x 245	8 pcs
100	25	158	190	230	968	440	240	65	M20 x 265	8 pcs
150	25	194	250	300	1550	750	450	78	M24 x 300	8 pcs
150	16	194	240	285	1510	750	450	58	M20 x 300	8 pcs

Fig.15

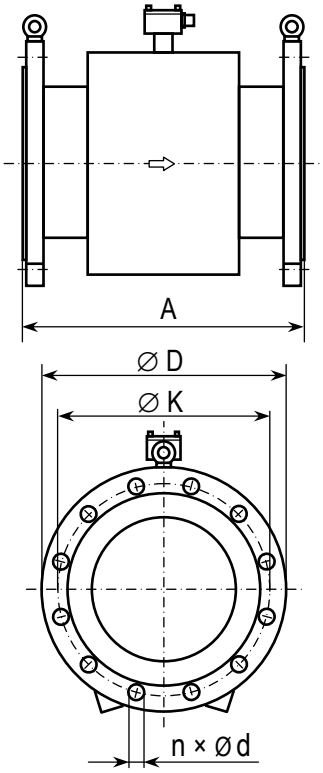




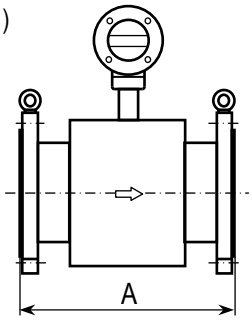
4.4 Dimensions and weight of flow sensor with flanges DN10 – DN800 (Fig. 16)

Dimensions and weight of flowmeter or flow sensor with DIN flanges are in the table below. Other flanges (ANSI, GOST, CSN) and/or other nominal pressure specify in your order. Other flow sensor length A can be specified in inevitable situations.

Fig. 16 a)



b)



DN	PN	A	Ø D	Ø K	n	Ø d	Weight
10	10, 16, 25	150	90	60	4	14	4.5 kg
20	10, 16, 25	150	105	75	4	14	6.5 kg
25	10, 16, 25	150	115	85	4	14	6.5 kg
32	10, 16, 25	150	140	100	4	18	7 kg
40	10, 16, 25	150	150	110	4	18	7 kg
50	10, 16, 25	200	165	125	4	18	8.5 kg
65	10, 16	200	185	145	4	18	12 kg
	25	200	185	145	8	18	12.5 kg
80	10, 16	200	200	160	8	18	12.5 kg
	25	200	200	160	8	18	13 kg
100	10, 16	250	220	180	8	18	14 kg
	25	250	235	190	8	22	14 kg
125	10,16	250	250	210	8	18	19 kg
	25	250	270	220	8	26	22 kg
150	10, 16	300	285	240	8	22	23 kg
	25	300	300	250	8	26	27 kg
200	10	350	340	295	8	22	39 kg
	16	350	340	295	12	22	39 kg
250	10	400	395	350	12	22	50 kg
	16	400	405	355	12	26	55 kg
300	10	500	445	400	12	22	68 kg
	16	500	460	410	12	26	73 kg
350	10	500	505	460	16	22	140 kg
	16	500	520	470	16	26	150 kg
400	10	600	565	515	16	26	185 kg
	16	600	580	525	16	30	200 kg
500	10	600	670	620	20	26	255 kg
	16	600	715	650	20	33	290 kg
600	10	600	780	725	20	27	360 kg
	16	600	840	770	20	33	420 kg
800	10	800	1015	950	24	33	600 kg
	16	800	1025	950	24	39	610 kg

5. CONNECTING MP400CM FLOWMETERS TO POWER SUPPLY

5.1 By standard, the flowmeters leave the factory set for 220 - 230 V / 50 - 60 Hz

You can specify the 110-120V / 50-60Hz AC or 24V DC power supply option and with the separate design 36V / 50-60Hz AC power supply option in your order. The rated power consumption is 14 VA.

The compact flowmeters are supplied with firmly attached, 1.5m long power supply cable with two 0.75mm^2 wires. This cable can be extended as shown on Fig.17 using an appropriate junction box.

In case of flowmeter in separate design, connect the power supply cable to the terminals on the power source board and secure it by a screw (position 5 in Fig. 21). Then, cover the terminals by a white cover. We recommend using a cable having 0.75-1.5mm^2 wires (AWG 18-14). Cable diameter should be maximal 9 mm.

Separate 1A circuit breaker is recommended for the power supply. In case of the billing meters, the circuit breaker and the junction box should be sealed.

5.2 MP400CM flowmeter design conforms to IEC safety class II

At the same time it is required that all the flowmeter inputs and outputs should be connected to the devices, where the electric shock protection is provided by circuits fed by small safe voltage and where the voltages being generated do not exceed the limits valid for the small safe voltage.

5.3 The screw on the back cover of the head is not intended for safety grounding

This screw only represents the measuring signal ground (see paragraph 3.12).

5.4 Fuses in MP400CM flowmeter power supply source

In case of flowmeter in compact design the miniature fuse (TR5 , ∅8.4mm , 5mm pin pitch) is located in the socket on the power source board under the front cover:

T100mA for 220-230Vac , T250mA for 110-120Vac.

In case of MP400CM flowmeter in separate design, the fuse ∅5x20mm is located on the power source board next to the mains terminals (FU5 in Fig. 21) :

T160mA for 220-230Vac, T350mA for 110-120Vac, T1A for 36Vac, T1A for 24Vdc

The secondary transformer windings of the source are in both cases protected by thermal self-resetting fuses (PTC resistors).

5.5 Eliminating the most common problems arising during operation.

Reverse installation of the flow sensor as well as poor connection of cables from the flow sensor or the external flowmeter; poor connection of communication cables; failure to galvanically separate the connected devices and routing the signal cables in the proximity of power cables are the most common causes of malfunctioning or even damage to the flowmeter during setup.

Please refer to 3.11 and 3.12 paragraphs. The wiring is shown in the following sections 6 and 7, but we still recommend disconnecting the cables that are already connected in inevitable situations only.

Fig.17 MP400C/M compact design

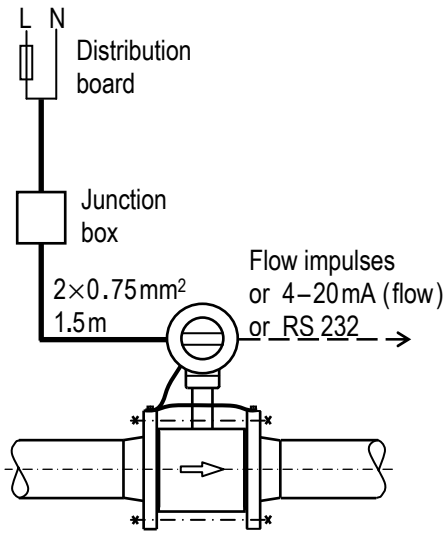
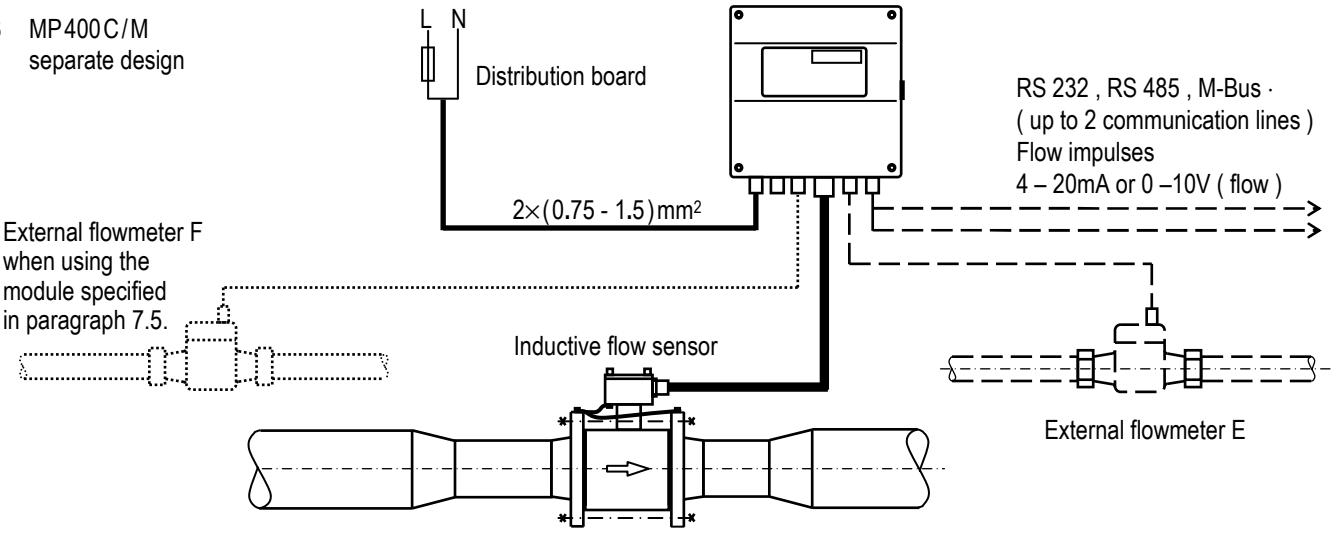


Fig. 18 MP400C/M separate design



6. TERMINALS AND JUMPERS OF MP400CM FLOWMETERS

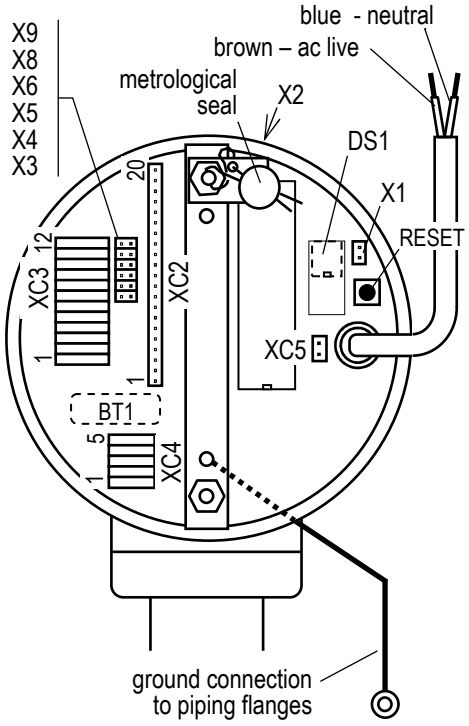
6.1 Terminals and jumpers of MP400CM flowmeter in compact design (Fig. 19)

The terminals and jumpers of the flowmeter can be found under the head's rear cover. The terminals can accept wires with the cross section area of up to 0.5 mm^2.

To facilitate the assembly in inaccessible places, the head can be rotated as explained in paragraph 3.14. We recommend that the cables should be routed through an external junction box or connectors rather than directly connected.

Fig. 19

MP400C/M
COMPACT DESIGN
(rear cover removed)



XC2 connector for interface module connection (COMM1). See Section 7.

XC3/1 EGND (isolated +5 V_{EXT} and +24 V_{EXT} power source ground)
XC3/2–6 subject to the interface module installed on the XC2, see Section 7
XC3/7 flow impulse output (+)
XC3/8 flow impulse output (–)
XC3/9 flow impulse output 2 (+)
XC3/10 flow impulse output 2 (–)
XC3/11 external impulses input E (+)
XC3/12 external impulses input E (–)

XC4/1 , XC4/2 wires from flow sensor excitation coils
XC4/3 shielding of wires from flow sensor electrodes
XC4/4 , XC4/5 wires from flow sensor electrodes

XC5 connector for display button connection

X1 service mode jumper - this must remain open during normal operation.
X2 calibration jumper - this is protected by a cover with a metrological seal
X3 , X4 jumpers of the internal power supply to flow impulse output
X5 , X6 jumpers of the internal power supply of flow impulse output 2
X8 , X9 jumpers of the internal power supply to impulse input E

6.2 Terminals and jumpers of MP400CM flowmeter in separate design (Fig.20, 21, 22)

The terminals can accept wires up to 2.5mm^2 cross section (AWG 12)

XC2 interface module connector COMM1. See Section 7.

XC3/1 EGND (isolated +5 V_{EXT} and +24 V_{EXT} power source ground)
XC3/2–6 subject to the interface module installed on the XC2. See Section 7
XC3/7 flow impulse output (+)
XC3/8 flow impulse output (–)
XC3/9 flow impulse output 2 (+)
XC3/10 flow impulse output 2 (–)
XC3/11 external impulses input E (+)
XC3/12 external impulses input E (–)

XC4 inductive flow sensor (Fig. 20)

XC5 connector for display button connection

XC6/1 +24 V_{EXT}
XC6/2 +5 V_{EXT}
XC6/3 EGND (isolated +5 V_{EXT} and +24 V_{EXT} power source ground)
XC6/4–9 subject to the interface module installed on the XC12 . See Section 7

XC 9 optional connector for IrDA interface module connection. See Section 7.

XC12 second interface module connector COMM2 (optional). See section 7

XC21 service connector (RJ4)

X1 service mode jumper; it must be disconnected in operating mode.

X2 , X3 calibration jumpers - these are protected by a cover with a metrological seal.

SW1/1 ON normal display mode,
OFF service display mode. See note at the end of paragraph 8.2.

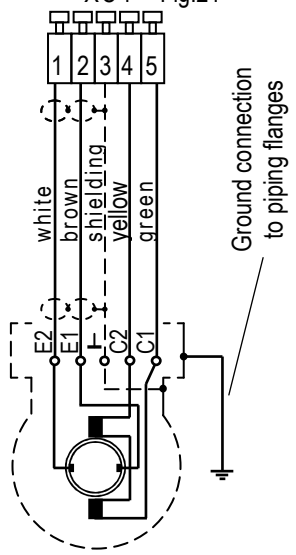
SW1/2 connecting an interference suppressor device to the impulse input E

SW1/3, SW1/4 internal power supply of flow impulse output
SW1/5, SW1/6 internal power supply of flow impulse output 2
SW1/7, SW1/8 internal power supply of impulse input E

L ac live (or dc –) N ac neutral (or dc +)

FU5 fuse Ø5 × 20mm : T160mA for 220-230Vac, T315mA for 110-120Vac,
T1A for 36Vac and 24Vdc

Fig. 20 XC4 - Fig.21



Inductive flow sensor

The resistance of the excitation coils is approximately 100Ω @ 20 ^{0}C.

The shielding of both leads from the electrodes in the flow sensor's cable must be connected to relevant terminals on both ends **!**

Fig. 21
MP400CM
separate design

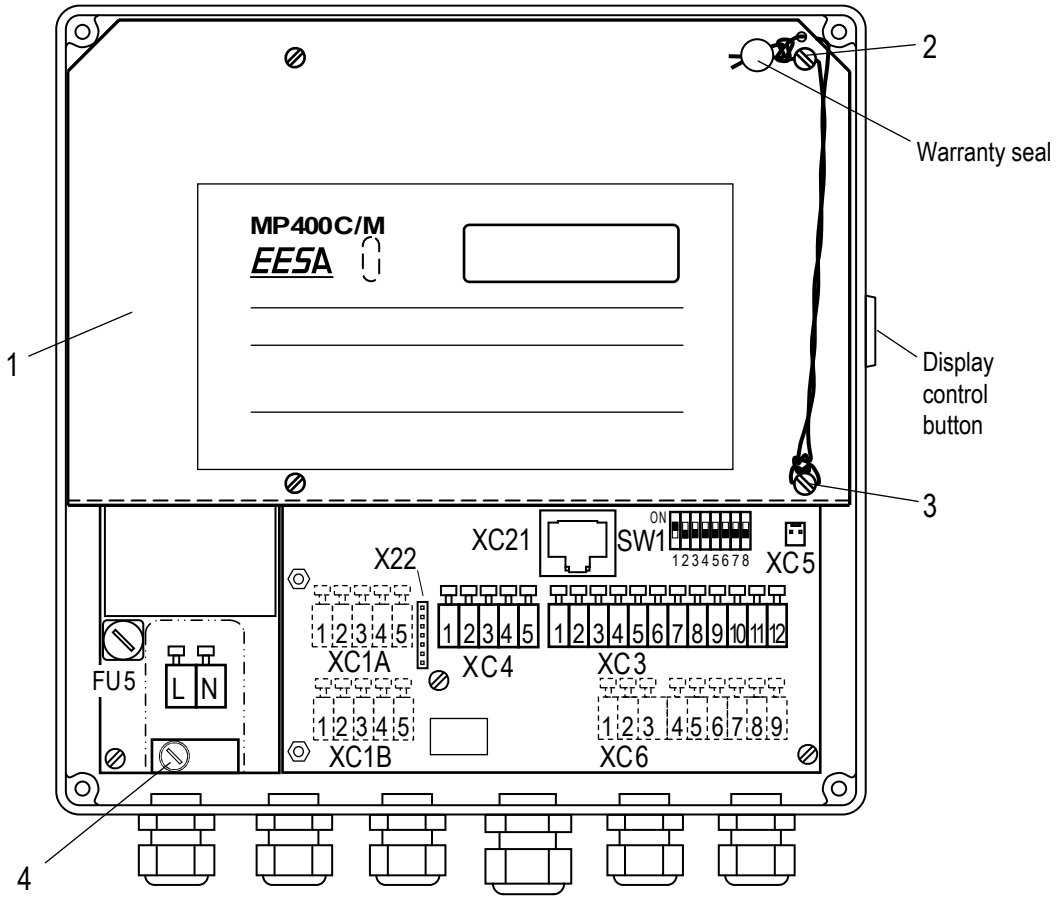
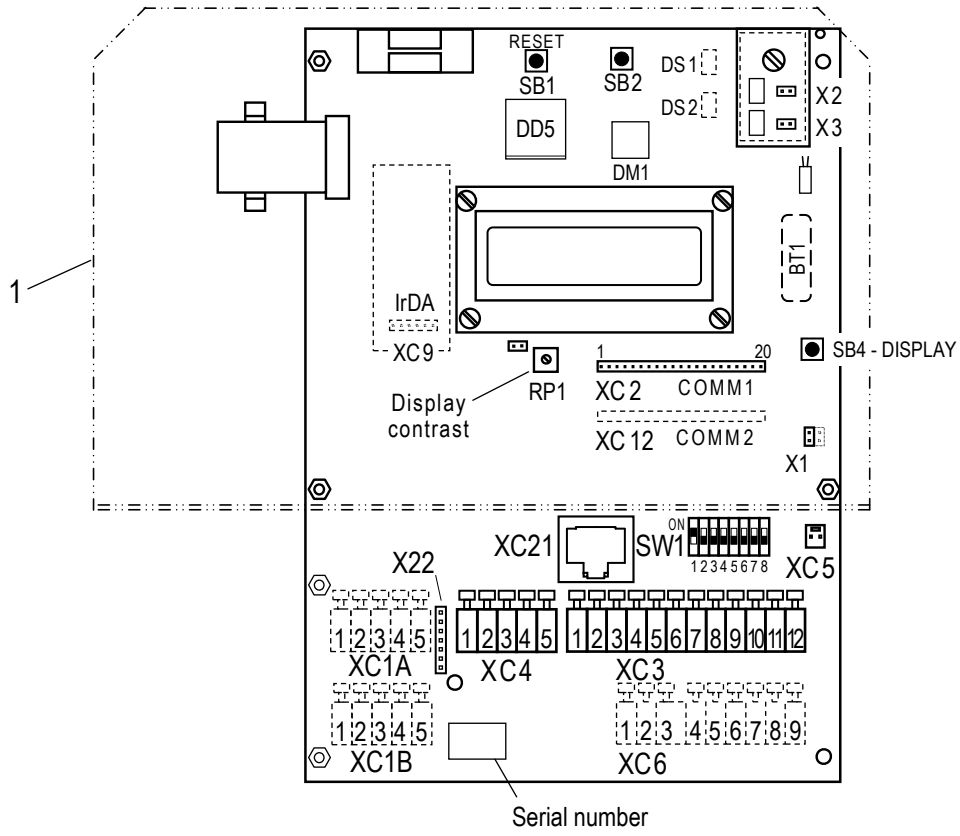
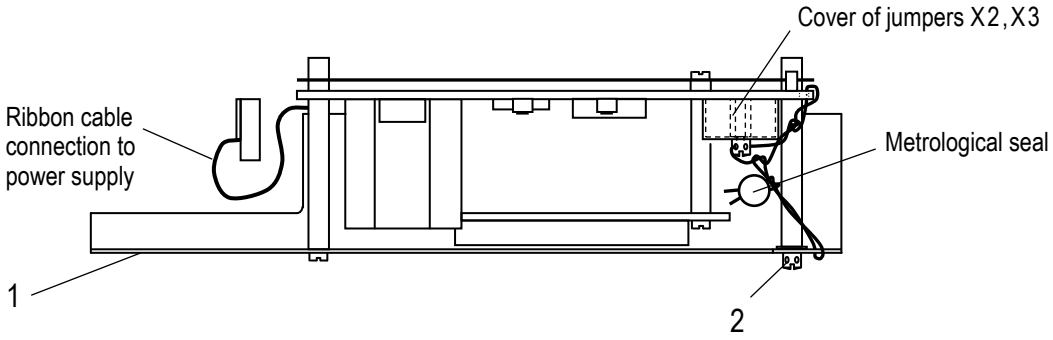


Fig. 22
Electronic unit removed
front view



Positions in Fig. 21-23 :
1 – electronic block cover with nameplate and display window
2 – bolt for securing of electronic block into box
3 – screw for securing of cover 2 to electronic block
4 – screw for securing of power cable

Fig. 23
Electronic unit removed top view

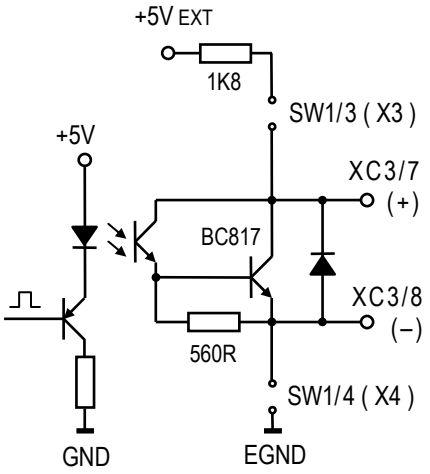


6.3 MP400CM flowmeter impulse outputs

The impulse outputs are performed by optically coupled transistor NPN switches whose collectors and emitters are connected to the (+) and (–) terminals respectively. The external voltage applied to these terminals can reach up to 28V if correct polarity is observed while the loading resistor's value should be specified in a manner as not to allow currents above 0.1A to pass through the transistor switch.

If required, the switching transistors can be fed via the embedded 1.8kΩ resistors from the internal $+5V_{EXT}$ - EGND power source by closing SW1/3, SW1/4 or SW1/5, SW1/6 switches. In case of the compact flowmeter design, this feeding can be done by using X3, X4 or X5, X6 jumpers. The $+5V_{EXT}$ - EGND power source is galvanically isolated from the flowmeter's measuring circuitry power supply.

Fig. 24



a) Flow impulse output (Fig. 24) is used for the remote transmission of the volume impulses and performing metrological testing. The number of transmitted impulses is proportional to the measured volume. At constant flow rate, the mark-to-space ratio of the impulses is 1:1 ($t_{ON} = t_{OFF}$). The impulse frequency is proportional to instantaneous flow rate:

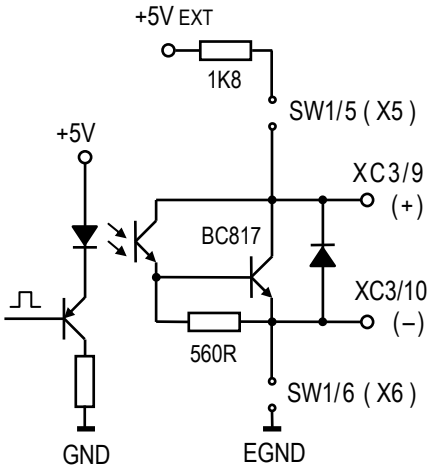
$$f = Q \cdot Kp \;/\; 60 \quad (\text{Hz} ; \text{dm}^3/\text{min} ; \text{imp}/\text{dm}^3).$$

By default, the Kp conversion constant of the impulse output is set to its maximum value for the inductive flow sensor's given rated DN diameter as described in the table below:

DN (mm)	10	20	25	32	40	50	65	80	100	125
Q_{max} (m^3/ h)	3.39	13.6	21.2	34.7	54.3	84.8	143	217	339	530
Q_{max} (dm^3/min)	56.5	226	353	579	904	1413	2383	3617	5650	8833
Kp (imp/dm^3)	1600	400	200	150	100	60	35	25	15	10

DN (mm)	150	200	250	300	350	400	500	600	800
Q_{max} (m^3/ h)	763	1360	2120	3050	4160	5430	8480	12200	21700
Q_{max} (dm^3/min)	12717	22700	35300	50800	69300	90500	141300	203300	361700
Kp (imp/dm^3)	7	4	2.5	1.6	1.25	1	0.5	0.4	0.25

Fig. 25



When specified in your order (or using the VIEW software), the Kp conversion constant can be set to any lower value, most preferably from the following numbers:

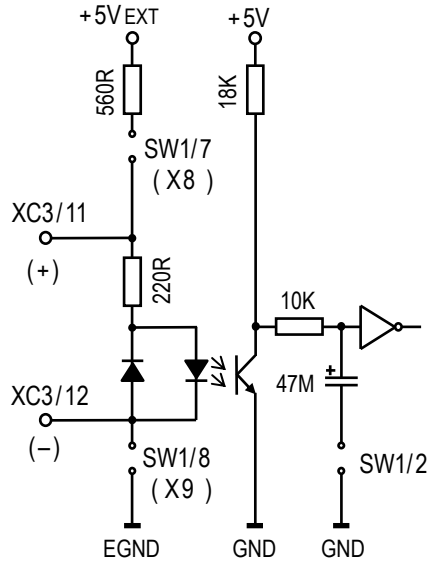
1000 / 400 / 200 / 100 / 40 / 20 / 10 / 4 / 2 / 1 / 0.4 / 0.2 / 0.1 / 0.04 / 0.02 / 0.01 / 0.004 / 0.002 / 0.001 / 0.0004 / 0.0002 / 0.0001 imp/dm^3.

By default, the impulse output rejection at low flow rates is set in a manner that the flowmeter will stop transmitting the flow impulses when the flow rate falls below 0.2%Q_{max}. If specified in your order, the impulse output rejection at low flow rates can be set to any value within the range of 0.2 - 2.5%Q_{max}.

While flowmeter does not transmit any flow impulses, there also the status of volume counters remains unchanged and the flowmeter's display reads zero flow rate.

b) Flowmeter impulse output 2 (Fig. 25) is used for remote transmission of volume impulses or indication of reverse flow of the flowmeter being operated in bi-directional flow measuring mode, as described in paragraph 8.4 c).

Fig. 26



6.4 External impulses input E (Fig. 26)

The external impulses input is used for the connection of external flowmeter or other device with impulse output to MP400CM flowmeter.

The input is realized by an optically coupled LED transmitter. The anode is connected to the XC3/11 terminal via an auxiliary 220Ω resistor, while the cathode is connected to the XC3/12 terminal.

The impulse width and the spaces between the impulses must be longer than 500 µs or 50 ms if the SW1/2 switch is ON.

If the impulse input is fed from the connected device's active impulse output, the SW1/7, SW1/8 switches or the X8 and X9 jumpers are open. External voltage applied to the impulse input should be 5V ±2V. If the current is limited to 5 - 20mA, this voltage may reach up to 28V. Always observe the external power source's polarity so that XC3/11 and XC3/12 terminal is connected to higher and lower potential respectively **!**

If an impulse source with a passive output is connected (such as a switching contact or an isolated switching element without its own power supply), it is necessary to connect the external $+5V_{EXT}$ - EGND power source via an embedded 560Ω resistor using the SW1/7, SW1/8 switches or the X8, X9 jumpers.

The flow impulse input's K_E conversion constant (imp/dm³) can be set to any value subject to the connected device's specifications, most preferably from the following numbers :

1000 / 400 / 200 / 100 / 40 / 20 / 10 / 4 / 2 / 1 / 0.4 / 0.2 / 0.1 / 0.04 / 0.02 / 0.01 / 0.004 / 0.002 / 0.001 / 0.0004 / 0.0002 / 0.0001 imp/dm³.

We recommend you to specify the setting when placing your order.

For example, for a water-meter having 0.01m³/imp value by its specifications, we make the settings as follows:

$$K_E = 1/(0.01 * 1000) = 0.1 \text{ imp/dm}^3.$$

For simple counting of impulses, we set $K_E = 1$.

Note: MP400CM flowmeter may be equipped with another impulse input F as described in paragraph 7.5.

7. INTERFACE MODULES AND REGISTRY MODULE

The interface module or the modules for the MP400CM flowmeter must be ordered separately.

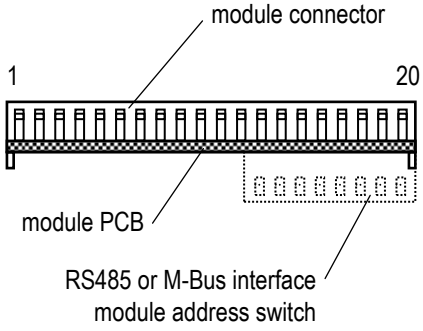
In case of the compact MT500 flowmeter as described on Fig. 19, only one interface module can be installed on the XC2 connector (COMM1). Although a communication module equipped with RS232 or RS485 interface must be installed within the flowmeter to enable the setup and testing, it does not have to be kept in the flowmeter during normal operation. However, it is not much recommended to use the interface module within the compact flowmeter during operation due to the limited room for the connection of necessary cables.

In case of the separate flowmeter design as described on Fig. 21, it is possible to use one or optional simultaneously two interface modules connected to XC2 (COMM1) terminal and XC12 (COMM2) terminal. Install the RS485 and M-Bus interface modules in the XC2 connector first, since the COMM1 interface has the highest priority.

In case of the separate flowmeter design, the XC21 service connector is dedicated for the setup and testing. The SIMPLE protocol and the transmission rate 9600 Bd is set for this purpose.

When connecting the interface module, make sure that all XC2 or XC12 male pins fit into the corresponding female pins of the interface module's connector (Fig. 27). While doing this, also make sure to turn off the flowmeter's power supply **!**

Fig. 27



By default, the transmission rate is set to 9600 Bd. The transmission rate can be set to any value from the following range: 300, 600, 1200, 2400, 4800, 9600, 19200 or 38400 Bd.

The communication protocols are described in paragraph 7.7.

In case of the compact flowmeter design, the SIMPLE communication protocol setting is used by default.

In case of the separate flowmeter design, the BitBus protocol is set for COMM1 and the SIMPLE protocol is set for COMM2 by default.

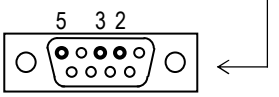
To communicate with the flowmeter, VISICAL and VIEW software are provided by the manufacturer. This software allows all set, measured and registered data to be displayed on a PC monitor independently on their appearance on the flowmeter's display.

The VIEW software offers the setting of various flowmeter features as well as performing the calibration in flow test laboratories.

Into the flowmeter meter in separate design the INFRA (IrDA) module can be installed on the XC9 connector. The INFRA module uses the SIMPLE protocol for communication at 9600 Bd transmission rate to communicate with the ESTER terminal or other optically coupled interface. The portable ESTER terminal allows convenient collection of the measured data from the individually installed flowmeters and heat consumption meters.

Tab.1

XC3	XC6		
COMM1	COMM2		
1	4	RS232 – GND	5
2	5	RS232 – RXD	3
3	6	RS232 – TXD	2
4 - 6	7 - 9	not used	



7.1 RS232 interface module

This module contains an interface using the three following wires for communication: TXD, RXD, GND and operates in accordance with the RS232C standard. The communication line is fed from the $+5V_{EXT}$ - EGND power source that is galvanically separated from the flowmeter's measuring circuitry. For connecting to a PC serial port, use a cable terminated by a 9-pin female D-sub connector with the pin assignment described in table 1.

The module enables the communication with an IBM PC computer or the connection to other device equipped with RS232 interface, such as a modem to communicate over telephone or wireless network. The RS232 communication has the following parameters:

8 bits , no parity , transmission - 1 or 2 stop bits , reception - 1 stop bit.

By default, the transmission rate is set to 9600 Bd. The baud rate can be set to any value from the following range: 300 , 600 , 1200 , 2400 , 4800 , 9600 , 19200 or 38400 Bd.

7.2 4-20mA or 0-10V analogue output modules with RS232 interface

The modules are equipped with a 16-bit D/A converter and the RS232 interface with specifications according to paragraph 7.1. The functions of XC3 or XC6 terminals of the flowmeter are described in table 2a (4 - 20mA) or in table 2b (0 - 10V).

Tab.2a

XC3	XC6		
COMM1	COMM2		
1	4	RS232 – GND	*)
2	5	RS232 – RXD	*)
3	6	RS232 – TXD	*)
4	7	4 – 20mA (+)	
5	8	4 – 20mA (–)	
6	9	not used	

Tab.2b

XC3	XC6		
COMM1	COMM2		
1	4	RS232 – GND	*)
2	5	RS232 – RXD	*)
3	6	RS232 – TXD	*)
4	7	not used	
5	8	0 – 10V (–)	
6	9	0 – 10V (+)	

*) Cheaper version of these modules without the RS232 interface can also be supplied.

The analogue output is supplied from +24V or +12V power source in case of separate or compact design respectively. The power source is galvanically separated from the flowmeter's measuring circuitry power supply, but has the EGND ground in common with $+5V_{EXT}$ source for the RS232 interface.

By default, the analogue output's current or voltage ranges from 4mA to 20mA or 0V to 10V subject to the instantaneous flow rate of the fluid. The 4 mA or 0V value corresponds to zero or negative flow rate of the fluid, while the 20 mA or 10V value corresponds to Q_{max} as described in the table in paragraph 6.3. If $Q \geq Q_{max}$, then the current or voltage value remains constant at 20mA or 10V.

If specified in your order, the analogue output response can be reprogrammed (using VIEW software) so that the 20mA or 10V value corresponds to any flow rate value less than Q_{max} (in dm^3/min) as described in the table in paragraph 6.3.

The instantaneous flow rate through the external flowmeter E can be assigned to the analogue output as well. Another possibility (current output in 4-12-20mA mode) is described in paragraph 8.4d). If the analogue output must inevitably work within the range of 0 - 20mA, an circuit modification of the interface module can be ordered.

7.3 RS485 interface module

This module is designed for data transmission within multi-user networks while operating in two or four-conductor wiring mode in accordance with the RS485 standard. The functions of XC3 or XC6 terminals of the flowmeter with this module are described in table 3.

Tab. 3

XC3	XC6	
COMM1	COMM2	
2	5	RS485 – DATA (+)
3	6	RS485 – DATA* (–)
4	7	RS485 – RTS (+)
5	8	RS485 – RTS* (–)
6	9	EGND via the embedded 150Ω resistor

The signal wires are galvanically separated from the measuring circuitry, while the power supply is provided from the $5V_{EXT}$ - EGND power source, which is galvanically separated from the flowmeter's measuring circuitry power supply.

The flowmeter's address within the RS485 network is set by a switch on the module in binary code as follows: ON = 0, OFF = 1. The lowest order is situated on the right of the switch when viewing the installed module as shown on Fig.27. The address may only be set within the range of 01_H - FA_H (1 - 250 in decimal).

7.4 M-Bus interface module

This module is designed for data transmission within multi-user networks while operating in two conductor wiring mode in accordance with the M-Bus standard. Detailed description of M-Bus protocol can be found at www.eesa.cz

The functions of XC3 or XC6 terminals of the flowmeter with this interface module are described in table 4.

Tab.4

XC3	XC6	
COMM1	COMM2	
1	4	EGND
2	5	M-Bus – DATA
3	6	M-Bus – DATA
4 - 6	7 - 9	not used

The power supply to the M-Bus interface module is provided from the $+5V_{EXT}$ - EGND power source, which is galvanically separated from the flowmeter's measuring circuitry power supply.

The flowmeter's address within the M-Bus network is set by the switch on the module just in the same way as with the RS485 interface.

7.5 Impulse input module with RS232 interface

The module consists two identical F and G impulse inputs (Fig. 29) and RS232 interface with specifications described in paragraph 7.1. However, the MP400CM flowmeter software enables the use of F input only so far.

The function of each terminal in XC3 or XC6 terminal block is described in table 5.

Tab. 5

XC3	XC6	
COMM1	COMM2	
1	4	RS232 – GND *)
2	5	RS232 – RXD *)
3	6	RS232 – TXD *)
4	7	F impulse input (+)
5	8	Imp. common (–)
(6)	(9)	G impulse input (+)

*) Less expensive option without RS232 interface is also available.

The conversion constant of F impulse input (K_F) can be set individually subject to the connected device specifications similarly as for the E impulse input, which is available as standard in MP400CM flowmeter (see paragraph 6.4).

The width of the impulse or the spaces between the impulses must be longer than 250µs.

If F and/or G impulse input is fed from the connected device's active impulse output, XJ1, XJ2 and/or XJ3 jumpers on the module are open (Fig. 28 and 29). External voltage applied to the impulse inputs should be 5V ±2V. If the current is limited to 5 - 20mA, this voltage may reach up to 28V. Always observe the external power source's polarity so that the XC6/7 or XC6/9 terminal and the XC6/8 terminal are connected to higher and lower potential respectively !

When connecting the impulse source with a passive output (such as a switching contact), XJ1 and XJ3 and/or XJ2 and XJ3 jumpers must be connected. The internal +5V_{EXT} source is galvanically separated from the flowmeter's measuring circuitry, but has shares the EGND ground the 5V_{EXT} source for the RS232 interface.

Fig. 28

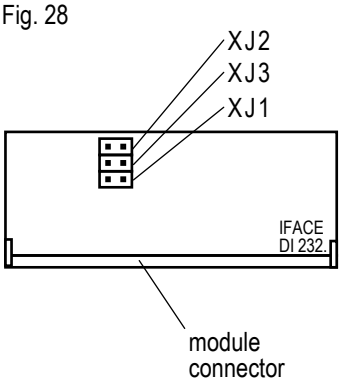
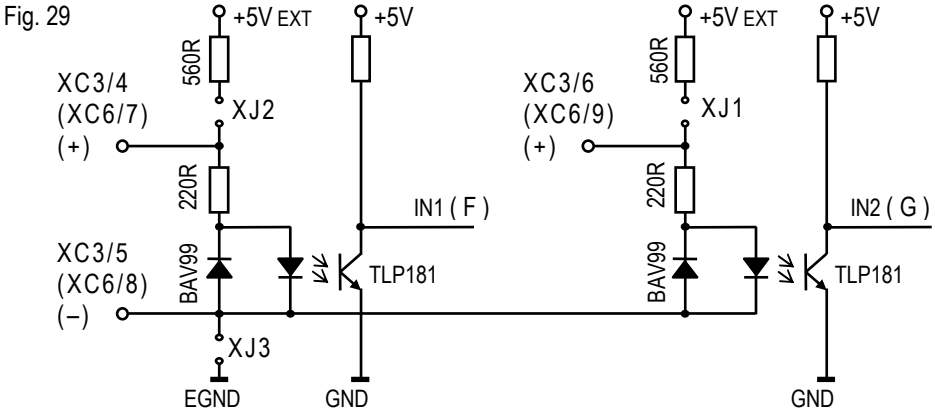


Fig. 29



7.6 Registry module

We recommend to order the registry module simultaneously with the flowmeter since any additional installation may only be performed by a skilled technician.

The registry module is formed by a non-volatile DS1 memory (EEPROM) and a BT1 clock back-up battery.

The flowmeter equipped with the registry module stores the measured data in a non-volatile memory of EEPROM type in regular time intervals.

Daily and hour registry is the default setting (390 days and 945 hours).

If specified in your order or by using VIEW software, the setting can be changed to daily and minute registry (390 days and 1908 minutes) or daily registry (390 days) and so called the user counters registry of changes (954 last events).

Examples of registry outputs are shown on Fig. 30, Fig. 31 and Fig. 32.

The daily registry is similar to hour registry shown on Fig. 31. It records each counter status at 23:59 at the end of relevant day.

Each event in registry of changes shown on Fig. 32 occupies two lines in the user counters registry of changes so that the status of relevant user counters before and after resetting or selection can be recorded. Simultaneously, date, time and status of the main volume counter are also recorded.

The entire contents of the registry or any single part of it can be read out using the portable ESTER terminal or a PC computer with VISIKAL or VIEW software running and these data can be viewed on a PC monitor, saved to disc or printed.

Fig. 30 Minute registry

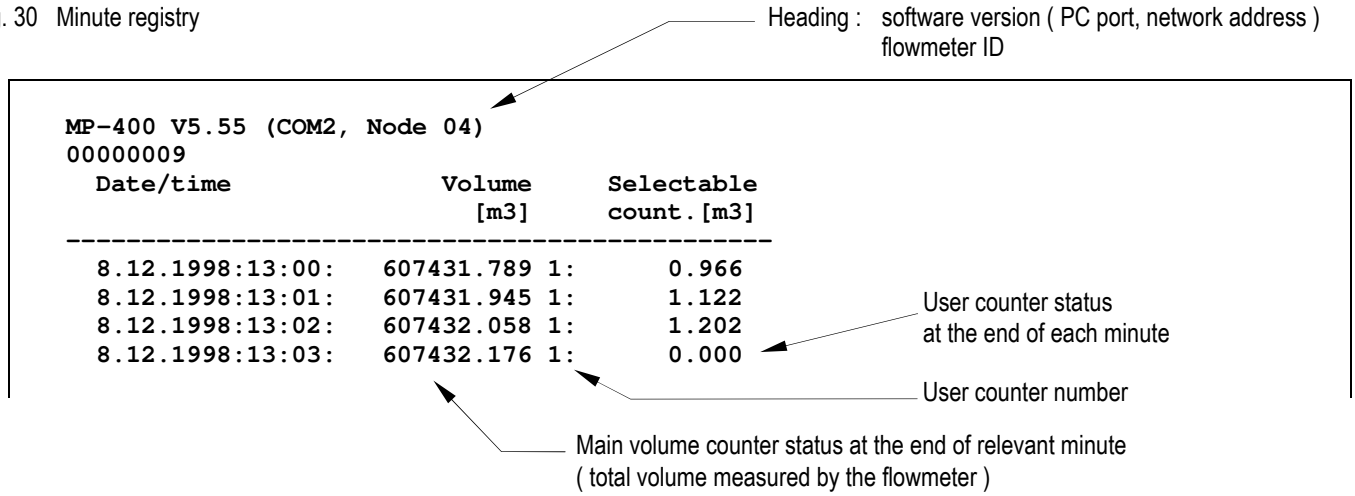


Fig. 31 Hour registry

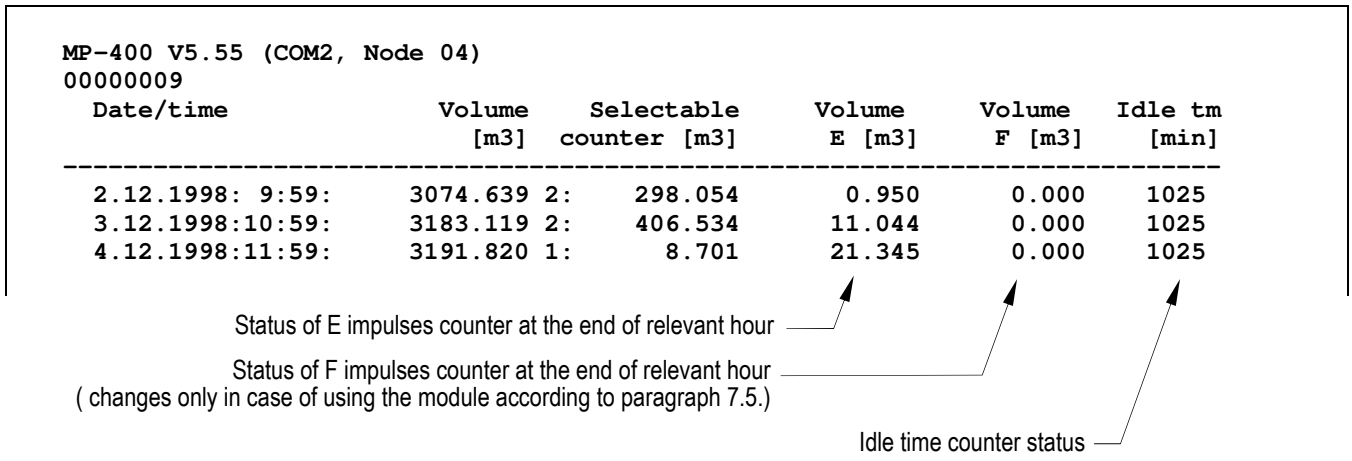
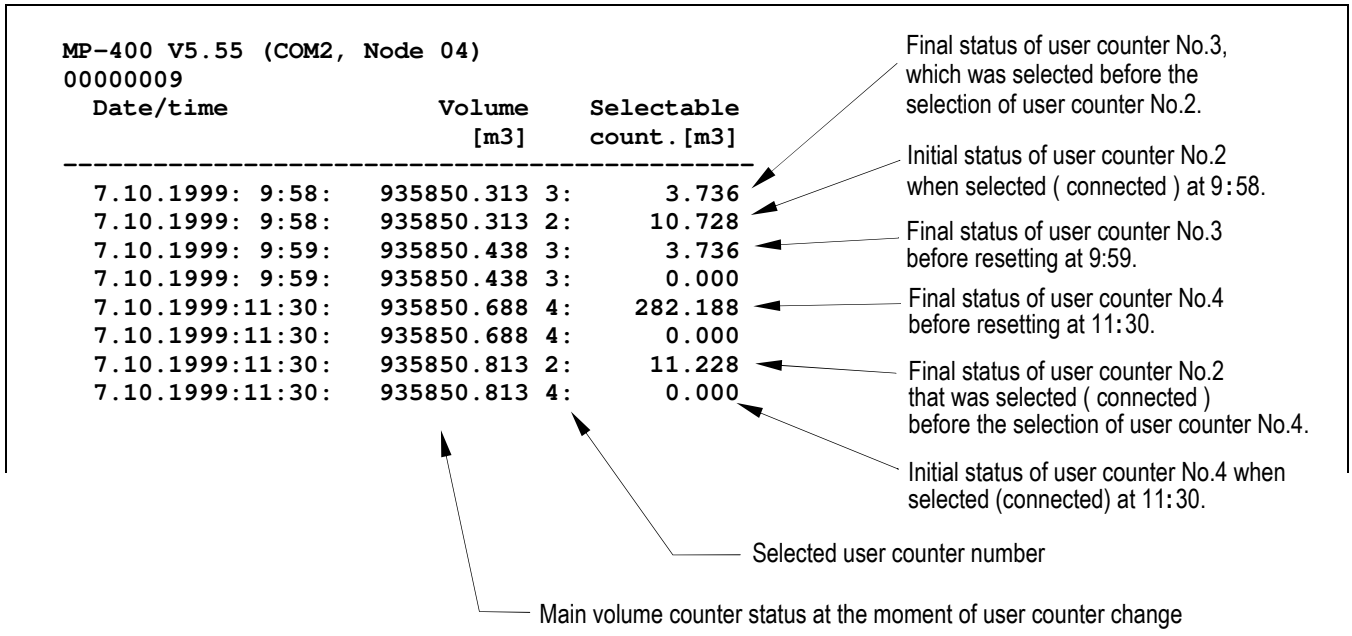


Fig. 32 User counters registry of changes



Tab. 6
CODES FOR DATA ACQUISITION

50_H	Flowmeter ID	1)
30_H	Volume flown total (m^3)	
31_H	Flow rate	2)
38_H	Status and error log	
39_H	Error-free operation time (min)	
$3A_H$	Total idle time (min)	
46_H	Flowmeter software version	
22_H	Volume flown + (m^3)	3)
24_H	Volume flown – (m^3)	3)
36_H	User counter No.1 (m^3)	
28_H	User counter No.2 (m^3)	
$2A_H$	User counter No.3 (m^3)	
$2C_H$	User counter No.4 (m^3)	
$2E_H$	User counter No.5 (m^3)	
$A9_H$	Selected user counter number	
60_H	External volume E (m^3)	
64_H	External flow rate E (m^3/h)	
63_H	External volume F (m^3)	
62_H	External flow rate F (m^3/h)	
42_H	RTC circuit date (ddmmyy)	
43_H	RTC circuit time (hhmm)	
26_H	Peak evaluation time (min)	
$5A_H$	Peak flow - time (ddmmhh)	4)
$5B_H$	Peak flow - value (m^3/h)	4)
65_H	Peak flow - time (ddmmhh)	5)
66_H	Peak flow - value (m^3/h)	5)
EE_H	Max. idle - time (ddmmhh)	4)
EF_H	Max. idle - duration (min)	4)
EB_H	Max. idle - time (ddmmhh)	5)
EC_H	Max. idle - duration (min)	5)
$F1_H$	Collecting request	6)

1) In default, the ID is equal to flowmeter's PCB number. Using VIEW software, any eight digit decimal number can be set.

2) In units set for the display (see paragraph 8.3).

3) See paragraph 8.5.c)

4) Recorded in current month.

5) Recorded in last month.

N o t e : In MP400C/M flowmeter without the registry module the time related data are not available (except error-free operation time) see paragraph 8.2.

6) Next to code $F1_H$ you can insert up to 16 codes in order you need.

Data in the response are appended by 0_H or "00" ASCII.

See last example on this page.

7.7 Communication protocols

a) Simple report protocol via RS232 :

Transmission to the flowmeter (8 bits, no parity, 1 stop bit) :

1st byte - total report length = $(m+3)_H$
m byte long report – code(s) according to table 6
last but one byte - 0_H
last byte - CHSUM

Receiving from the flowmeter (8 bits, no parity, 1 stop bit) :

1st byte - 0_H
ASCII report
last but one byte - 0_H
last byte - CHSUM

CHSUM = NOT(1st byte XOR 2nd byte XOR · · · · XOR last but one byte) + 1_H

An example :

Transmission to the flowmeter : 04 31 00 CB (m = 1)
Receiving from the flowmeter : 00 31 32 33 2E 34 35 36 00 D7
The received value is 123.456 (flow rate in units set for the display)

b) BitBus report protocol via RS485 :

During the address byte transmission, the parity bit is set to log 1.
In all other transmitted or received bytes, the parity bit is set to log 0.

Transmission to the RS485 net (8 bits + 1 parity bit, 1 stop bit) :

1st byte - flowmeter address
2nd byte - report length without address = $(m+3)_H$
m byte long report – code(s) according to table 6
last but one byte - 0_H
last byte - CHSUM

Receiving from the flowmeter (8 bits + 1 parity bit, 1 stop bit) :

1st byte - flowmeter address
2nd byte - report length without address = $(n+4)_H$
3rd byte - 0_H
n byte long ASCII report
last but one byte - 0_H
last byte - CHSUM

CHSUM = NOT(2nd byte XOR 3rd byte XOR · · · · XOR last but one byte) + 1_H

An example of data acquisition from flowmeter having address 15_d :

Transmission to the RS485 net : 0F 04 31 00 CB (m = 1)
Receiving from the flowmeter : 0F 0B 00 31 32 33 2E 34 35 36 00 DE (n = 7)
The received value is 123.456 (flow rate in units set for the display)

c) ASCII report protocol via RS485:

Transmission to the RS485 net (8 bits, no parity bit, 1 stop bit): The format is identical with BitBus except that it is sent as an ASCII chain starting with a colon.

Receiving from the flowmeter (8 bits, no parity bit, 1 stop bit): The format is identical with BitBus except that it is received as an ASCII chain starting with a colon.

An example of data acquisition from flowmeter having address 15_d :

Transmission to the RS485 net : ":0F043100CE"
Receiving from the flowmeter : ":0F0C003132332E3435363700EE"
The received value is 123.4567 in units set for the display

An example of using $F1_H$ code for data acquisition from flowmeter having address 7_d :

Transmission to the RS485 net : ":0706F13031000A" (m = 3)
Receiving from the flowmeter :
":07120039382E303132310037 2E3635340000EF"
The received values are 98.0121 7.654 (n = 14)
(volume flown total in m^3 and flow rate in units set for the display)

8. BASIC SPECIFICATION, DISPLAY

8.1 Basic specification

Type approval marks : TCM 142/94-1818, PK 1558-04, GOST 25593-03

Hygienic certificates : EXP 111650 (drinking & hot water), EX 413390 (food & beverage)

The MP400CM flowmeters are produced in separate design as described on Fig.13 or optionally in compact design as described on Fig.12 (DN10 to DN150 only). The flowmeters up to DN150 can be supplied in hygienic design with a certificate for food industry applications.

The flowmeters are subject to official tests prior to delivery. Manufacturer owns relevant testing equipment and provides subsequent testing after legal period.

Power supply: standard: 230V (+10;-18%) / 50 - 60 Hz
optional: 120V (+10;-18%) / 50 - 60 Hz or 24V DC
with separate design, also 36V (+10;-18%) / 50 - 60 Hz

Power consumption: 14 VA

Back-up battery lifetime in MP400CM with optional registry module: min. 5 years

Enclosure class: IP 54 IEC safety class: II

Ambient temperature: 5 - 55 °C Recommended ambient temperature: 15 - 35 °C

Relative air humidity: max. 90% Atmospheric pressure: 66 - 106 Pa

Rated inner diameter DN (mm)	10	20	25	32	40	50	65	80	100	125
Min. flow rate Q_0 *) (m^3/ h)	0.007	0.03	0.042	0.07	0.11	0.17	0.29	0.43	0.68	1.06
Min. flow rate Q_{min} (m^3/ h)	0.085	0.34	0.53	0.87	1.36	2.12	3.60	5.43	8.49	13.3
Max. flow rate Q_{max} (m^3/ h)	3.39	13.6	21.2	34.7	54.3	84.8	143	217	339	530
Max. Kp constant (imp/dm^3)	1600	400	200	150	100	60	35	25	15	10

Rated inner diameter DN (mm)	150	200	250	300	350	400	500	600	800
Min. flow rate Q_0 *) (m^3/ h)	1.52	2.7	4.2	6.1	8.3	10.9	17	24.4	43.4
Min. flow rate Q_{min} (m^3/ h)	19.1	33.9	53.0	76.3	104	136	212	305	543
Max. flow rate Q_{max} (m^3/ h)	763	1360	2120	3050	4160	5430	8480	12200	21700
Max. Kp constant (imp/dm^3)	7	4	2.5	1.6	1.25	1	0.5	0.4	0.25

Measuring range Q_0 – Q_{max}: 1 : 500 *)

Accuracy : ± 1% within Q_{min} – Q_{max} (Q_{min} = 2.5% Q_{max})
± 0.003 m/sec within Q_0 – Q_{min}

Sensor lining : PTFE (standard for wafer flow sensors up to DN150) or
hard rubber (standard for flow sensors with flanges).

Maximum fluid temperature: 150 °C with PTFE sensor lining **)
90 °C with hard rubber sensor lining

Rated pressure PN: 25 bar or according to flange rating

Electrode material: 316L stainless steel (standard), Hastelloy C, Titan (optional)

Minimum fluid conductivity: 5 µS/cm

*) Applicable for default setting: Q_0 = 0.2% Q_{max}
If specified in your order, Q_0 can be set from 0.2% Q_{max} to 2.5% Q_{max}

**) If the fluid temperature is continuously above 110°C, it is recommended to use the flowmeter with a separate flow sensor.

8.2 MP400CM flowmeter display (LCD, underlit, two row of 16 character)

Using a PC computer with VIEW software installed, it is possible to select any desired data items from the available list (see next page) to be shown sequentially on the display when the flowmeter button is pressed. The data items are being shown in the order corresponding to the list. When the last selected item has been shown, the cycle returns to the beginning.

Unless specified else in your order, the flowmeter with using the button shows items 1 to 5 , 10 to 14 and (with the registry module installed) 17 to 20.

When one minute has elapsed from the last pressing of the button, the display will switch into so called basic display mode; however, this will not happen if no data items have been selected to be shown in the basic display mode. Then is shown the item 1.

BASIC DISPLAY MODE : Unless specified else in your order, the flowmeter shows volume (m^3) and flow rate (m^3/h) in the basic display mode.

Using VIEW software, one or more data items can be selected from the available data list to be shown on the display in the basic mode (except items 5, 17, 18, 20 to 23). When three or more data items are selected, they will be shown sequentially. Time interval is selectable from 1 to 40 sec.

Other units can be also selected for display: l/h, hl/h, l/s, GPM; l, hl, UsGal.

AVAILABLE DATA LIST FOR DISPLAY

1	Volume flown total	0.001 … 999999999.999 m^3	
2	Instantaneous flow rate	0.00 … 99999.99 m^3/h or 0.00 … 999.99 … 999999.90 l/min	
3	Error-free operation time	0 … 999999 min	[1])
4	RS485 or M-Bus address and flowmeter ID	FA 99999999	
5	Flowmeter status code	O.K. or Error	[2])
6	External flowmeter volume E or number of external impulses	E0.001 … E999999999.999 m^3 E0 … E999999 pcs	[3])
7	External Instantaneous flow rate E or frequency	E0.00 … E99999.99 m^3/h E0.00 … E9999999.00 pcs/h	[3])
8	External flowmeter volume F or number of external impulses	F0.001 … F999999999.999 m^3 F0 … F999999 pcs	[4])
9	External Instantaneous flow rate F or frequency	F0.00 … F99999.99 m^3/h F0.00 … F9999999.00 pcs/h	[4])
10	User counter No.1	0.001 … 999999999.999 m^3 1	[5])
11	User counter No.2	0.001 … 999999999.999 m^3 *2	[5])
12	User counter No.3	0.001 … 999999999.999 m^3 3	[5])
13	User counter No.4	0.001 … 999999999.999 m^3 4	[5])
14	User counter No.5	0.001 … 999999999.999 m^3 5	[5])
15	Positive volume flown total	+0.001 ..+999999999.999 m^3	[5])
16	Negative volume flown total	-0.001 .. -999999999.999 m^3	[5])
17	Day, month, year	18.02.99	[7])
18	Time	15:05:56	[7])
19	Day, month, hour and peak flow rate in current month	160205 45.09m^3/h	[7]) [8])
20	Day, month, hour and peak flow rate in last month	210113M38.14m^3/h	[7]) [8])
21	Peak flow rate evaluation time	15 min	[7]) [8])
22	Day, month, hour and max. idle in current month	080209 3min	[7]) [8])
23	Day, month, hour and max. idle . in last month	190116M128min	[7]) [8])

[1]) In addition to error-free operation time, a flowmeter equipped with the registry module shows also idle time (e.g. due to power failure, fault, etc.).

[2]) At the service mode, one or more letters can be shown as described in Table 7.

[3]) "E" letter at the first display position indicates that the data belongs to the external source of impulses connected to XC3/11 and XC3/12 terminals.

[4]) Applicable only to a flowmeter having the interface module with impulse input installed (paragraph 6.5). "F" letter at the first display position indicates that the data belongs to the external source of impulses connected to the F impulse input.

[5]) The user counter number is shown at the 16th position of the display. Asterisk shown at the 15th display position marks the selected (connected) user counter.

[6]) Applicable only to "bi-directional flow" operating mode as described in paragraph 8.5c). There is "+" or "–" symbol at the first display position for identification.

[7]) Applicable only to a MP400CM flowmeter with the registry module installed.

[8]) The MP400CM flowmeter calculates average flow rate each minute for given peaks evaluation time retroactively. If the calculated value is higher than the value stored in the current month peak flow rate registry, that value will be replaced by new peak flow rate and new date and time. Peaks evaluation time default is 15min. It can be set from 1 to 60min using VIEW software. At end of month, flowmeter stores data in last month peak flow rate registry and resets current month peak registry. Resetting of current month peak registry using VIEW software is also possible. Current and last month idle time registry work similarly. "M" letter next to the date/time in display indicates that the data belongs to the last month.

Table 7

A	EEPROM error
D	Communication fault
E	AC power supply interruption *)
G	Serial I^2C bus fault
I	Flow less than 2.5% Q_{max}
J	Flow greater than Q_{max}
K	Watch Dog error
L	RTC circuit fault
N	Sensor type EEPROM reading fault
O	Reverse flow

*) More than 60 seconds in current hour

N o t e s : ♦ With default setting of MP400CM flowmeter, the display shows zero flow rate if the actual flow rate is less than 0.2%Q_{max}. If the impulse output suppression limit is set within the range of 0.2%Q_{max} – 20%Q_{max}, the display shows zero flow rate if the actual flow rate is less than this limit. ♦ All data items from the available data list can be displayed on the flowmeter display in service display mode (for separate design SW1/1 - OFF, for compact design XC1 short) or on the monitor of a personal computer with VISIKAL or VIEW software installed independently on their showing on the flowmeter display in normal display mode.

8.3 User counters in MP400CM flowmeter

a) With default setting, the volume measured by the inductive sensor of MP400CM flowmeter can be added to the reading any user counter. Any displayed user counter can be started, stopped or reset using the following procedure:

– Display one of the user counters at the 1st line by pressing the button briefly several times.
For example, user counter No.1: 10.123 m³ 1 .

– Keep the button pressed down for some time and the display will cycle through
Start ? , Clear ? and 10.123 m³ 1 messages sequentially.

– If you release the button as soon as the display is Start ? , the display will show the new user counter status with asterisk before the user counter number, indicating that this counter is running: 10.125 m³ ∗1.

– If you release the button as soon as the display is Clear ? , the user counter will be reset and the display will show the new status of user counter No.1: 0.000 m³ 1.

– If you release the button as soon as the display is 10.125 m³ 1 (counter status), nothing will happen except that the next available item will be shown, e.g. 980.785 m³ 2.

When the relevant user counter is running (with asterisk before its number), the procedure is similar, but with button pressed down the display will cycle through Stop ? , Clear ? and 10.123 m³ 1 messages sequentially.

b) If specified in your order, the operation mode of the user counters can be set in a manner that the measured volume is added only to one selected user counter while the status of unused user counters remains unchanged. See paragraph 8.5a). The selection (connection) or resetting of user counter can be made by pressing the flowmeter display button using the following procedure:

– Display one of the user counters at the 1st line by pressing the button briefly several times.
For example, user counter No.1: 10.123 m³ 1 .

– Keep the button pressed down for some time and the display will cycle through
Select ? , Clear ? and 10.123 m³ 1 messages sequentially.

– If you release the button as soon as the display is Select ? ,
the display will show the new user counter status with asterisk before the user counter number, indicating that only this counter is running: 10.125 m³ ∗1

– If you release the button as soon as the display is Clear ? , the user counter will be reset and the display will show the new status of user counter No.1: 0.000 m³ 1

– If you release the button as soon as the display is 10.123 m³ 1 (counter status), nothing will happen except that the next available item will be shown, e.g. . 980.785 m³ 2.

N o t e s :

Operating procedures and functions of the user counters described here are applicable to MP400CM flowmeters with software version V6.7X or V5.7X or higher (see paragraph 8.6).

In case of MP400CM flowmeter equipped with the registry module, the status of user counter No.1 with default setting in accordance with a) or the status of currently selected user counter with setting in accordance with b) is stored in daily and hour or daily and minute registry (Fig. 30 and 31 in paragraph 7.6).

User counters resetting and user counters selection is stored immediately in the user counters registry of changes including all relevant final and initial states (Fig. 32 in paragraph 7.6).

The user counters work independently on whether they are shown on the flowmeter display because reading, resetting and selection of the user counters can be also made via the serial interface module of the flowmeter.

8.4 MP400CM flowmeter operating modes

a) Resetting the counters by button

By default, the flowmeter is supplied in this operating mode. Optionally, the flowmeter having the user counters operating mode set in accordance with paragraph 8.3b) can be set in a manner that resetting the user counters by button is disabled and Clear ? message will not be shown in the procedure described in paragraph 8.3b).

b) Remote value setting

By default, the flowmeter is supplied in this operating mode. Optionally, the flowmeter can be set in a manner that the setting of user values and functions via the communication interface module (using VIEW software) is disabled unless the service mode jumper inside the flowmeter is used (X1 on Fig. 19 or X1 on Fig. 22).

c) Bi-directional flow

By default, this mode is disabled. It can be set to bi-directional flow measurement mode. In such case, the flowmeter works as follows:

The instantaneous flow rate through the inductive sensor is indicated with sign respectively of actual flow direction. Main volume counter and user counters show the volume that has flown through the inductive sensor respectively of actual flow direction. The symbol $\sum$ is displayed to indicate bidirectional algebraic total.

The counters of positive and negative flown volume (items 15 and 16 of available data list in paragraph 8.2) are active. Positive direction is indicated by the arrow on the inductive flow sensor.

The flow impulse output 2 (paragraph 6.3b) is active - see next paragraph e).

The impulse output rejection at low flow rates for flow impulse outputs is set at $0.2\%Q_{max}$ as standard in this case. Optionally, the Q_0 can be set within the range $0.2\% – 20\%Q_{max}$. If the flow rate drops below set Q_0 value, the flowmeter will stop transmitting the flow impulses and the states of all the flown volume counters stated above remain unchanged. See notes at the end of paragraphs 6.2 and 6.3a).

If the interface module with 4 - 20mA analogue output as described in paragraph 7.2 is used, the analogue output current will vary from 4mA to 20mA subject to the absolute value of instantaneous flow rate of the fluid through the flowmeter irrespectively of actual flow direction. 4mA current corresponds to zero or negative flow rate; 20mA current corresponds to Q_{max} as described in the table in paragraph 6.3a). If $|Q| \geq Q_{max}$, then the current is equal to 20mA. The analogue output response can be reprogrammed in a manner that 20mA current corresponds to any flow rate value in liters per minute that is less than Q_{max} in accordance with the table in paragraph 6.3. In addition, "current output in 4-12-20mA mode" can be selected as described in the next paragraph.

d) Current output in 4-12-20mA mode (when the interface module with analogue output is used as described in paragraph 7.2 with "bi-directional flow" mode selected) In this operating mode, the current output works in a manner that if the instantaneous flow rate varies from $-Q_{max}$ to $+Q_{max}$, the current changes linearly from 4 to 20mA. Then, 12mA current corresponds to zero flow rate.

e) Impulse output 2 in the frequency mode (with "bi-directional flow" mode selected)

In this operating mode, in accordance with paragraph 6.3a), the flow impulse output is sending the volume impulses only during positive flow direction, while the flow impulse output 2 is sending the volume impulses only during negative flow direction.

If this mode is not selected, the flow impulse output is sending the volume impulses irrespectively of actual flow direction as described in paragraph 6.3a) and the impulse flow output 2 is open during zero or positive flow and closed during negative flow.

f) All counters active

By default, the flowmeter is supplied in this operating mode in accordance with paragraph 8.3a).
Optionally, the flowmeter can be set in accordance with paragraph 8.3b).

g) Delayed reply

With default setting, the flowmeter responds immediately to a question during communication, which may cause problems in some cases. If the “Delayed reply” operating mode is selected, the flowmeter will respond with a 50ms delay. This may be desirable for example when several networked flowmeters are connected to a single telephone modem.

8.5 Older software versions for MP400CM flowmeter

Based on your order, the manufacturer can upgrade the flowmeter software to a newer version on service basis. When the power supply to the flowmeter is turned on or when RESET button inside the flowmeter is pressed, software version number will appear on the display for a few moments, such as `* MP-400 V6.XX *` for separate design or `* MP-400 V5.XX *` for compact design. If the flowmeter has no registry module, the last digit is 0, 1, 2, 3 or 4. If the registry module is installed, five is added lo the last digit for the same version.

9. SEALING AND ASSEMBLY DOCUMENTATION

a) Upon the completion of the assembly and performing the function checks following items must be sealed :

- Front and rear head cover in case compact design (Fig. 12) or electronic block cover according Fig.21 and box cover in case of separate design (Fig.13).
- Separate flow sensor terminal box.
- In case of billing meters, mains power supply as described in paragraph 5.1.

Seals serve for warranty purposes (also after repair).

b) In accordance with local metrological regulations in force, the assembly organization may be obliged to keep an assembling list of measurement sites which contains the following data:

- Flowmeter serial number.
- Date of putting the flowmeter into operation.
- The address of the installation site and the end user of the flowmeter.

In addition, the assembly organization will announce these data by returning the "Registration card" (which is attached to the warranty card) to the manufacturer.