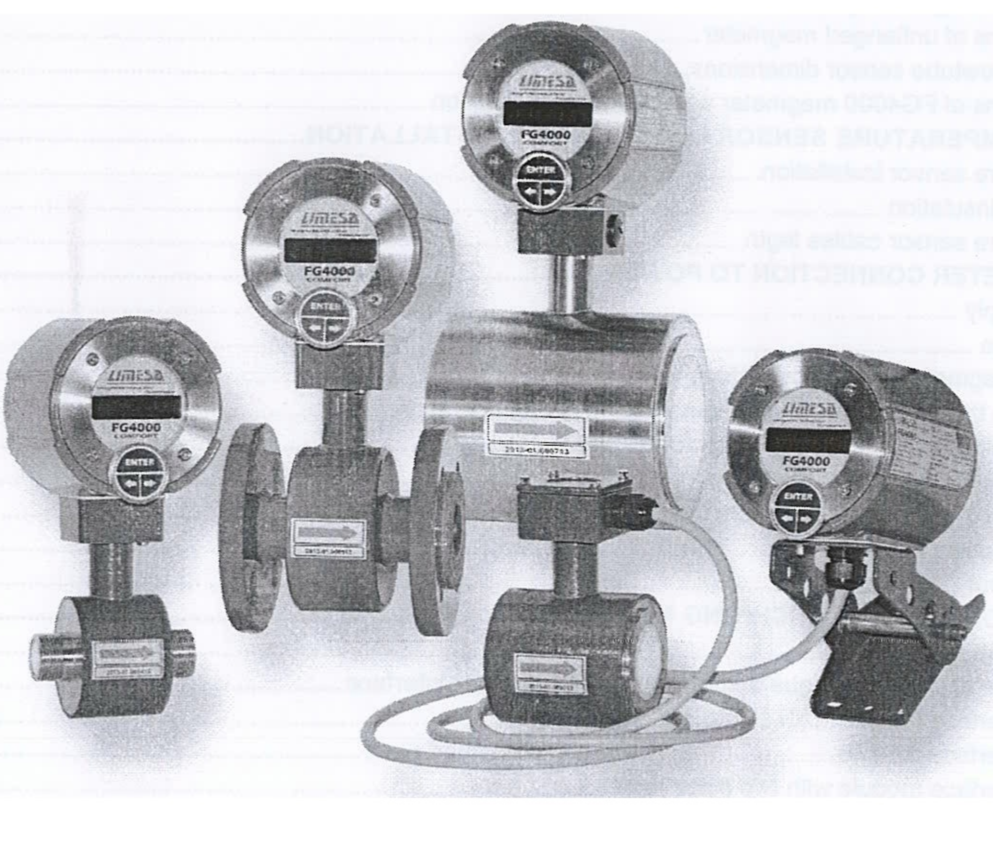
Rev.11th February 2014

FG4000 - Electromagnetic Flowmeter

Installation and Specifications



Content

1. MAGMETER INSTALLATION

The assembly of FG4000 flowmeters may only be performed by an organization bearing the authorization certificate to install FG4000 flowmeters based on the training of their accredited staff performed by the manufacturer.

In case of meters designated for billing purposes, the assembly organization must be registered with the regional metrological authorities as per local regulations.

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. Legal requirements for electrical equipment installation and operation apply to magnetic flowmeters.

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) Terminal unit and flowtube sensor connected as in figure 12 or 13, Flowtube sensor gaskets for the wafer inductive flowtube sensor DN 10 - DN 150 - Fig. 14.

b) Optional assembly installation accessories to mount the wafer inductive flowtube sensor DN 10 - DN 150 into piping: flanges, direct piping sections, studs, nuts and washers in accordance with Fig.15.

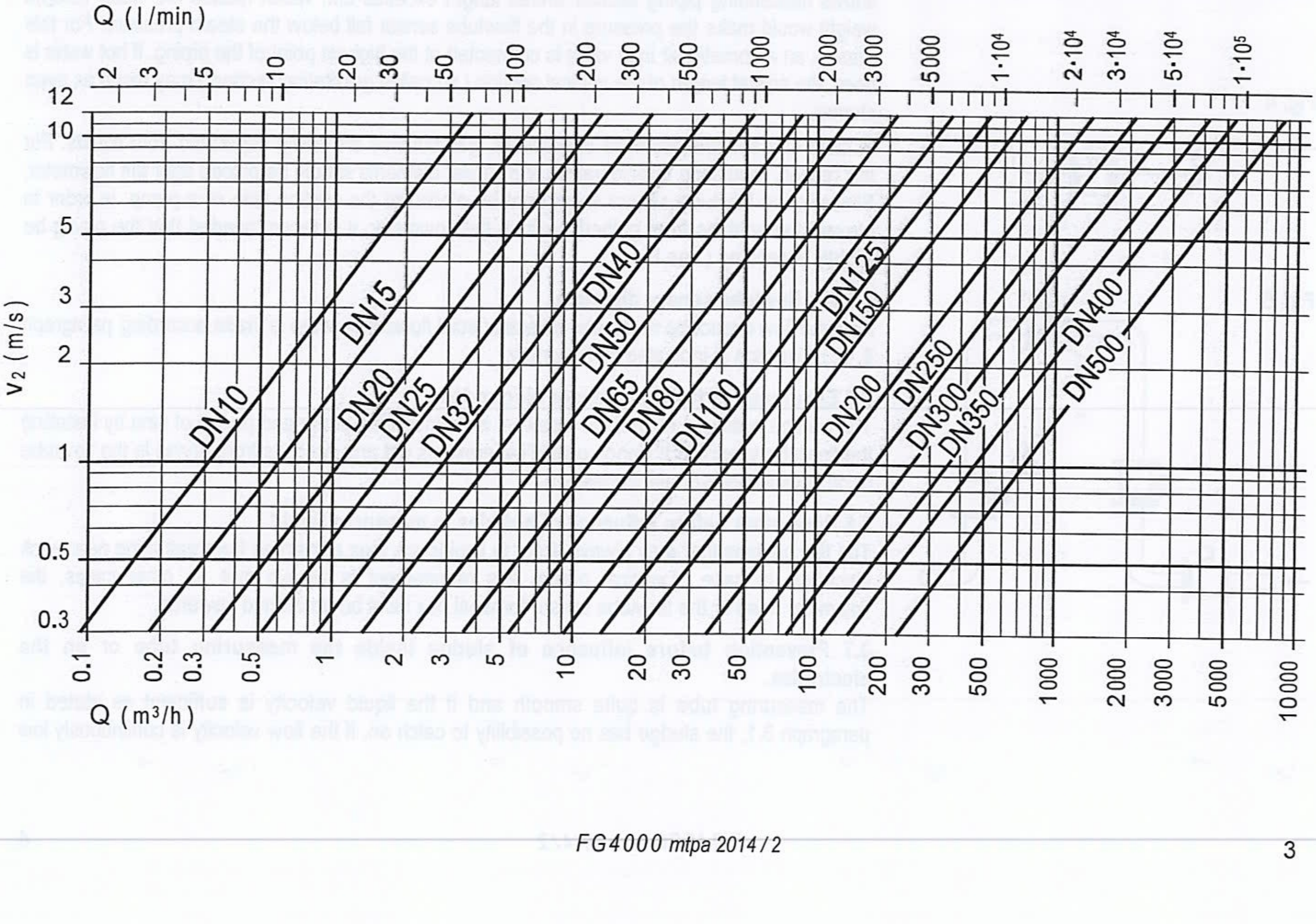
FG4000 magmeter terminal can be supplied with a module for connection of two resistance temperature detectors Pt500 or Pt100.

There is an optional terminal design with no display and operation buttons.

It is recommended to check immediately completeness of the supplied items and intactness of the seals. The flowmeters are to be stored and transported to the spot of installation in the original package.

3. SELECTING SIZE OF AND INSTALLING MAGMETER

The inductive flowtube 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 Optimum liquid velocity in the flowmeter measuring tube

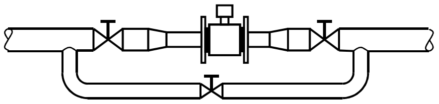
You should as high liquid flow rate through magmeter as possible, especially if accurate measurement of flow that fluctuates over a large range of values is required. Liquid velocity for the meter nominal diameter DN and flow Q selected is determined using the chart on page 1.

If the velocity is insufficient, select smaller DN to increase it. The necessary rated inner diameter of the flowtube sensor usually comes out as smaller than piping inner diameter, which involves the use of reduction cones or standard coaxial welding reductions.

3.2 Conditions for steady flow inside of the flow sensor.

For this reason, straight-piping sections must be connected before and after the flowtube sensor having the same inner diameter as the flowtube 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 flowtube sensor.

Fig. 1

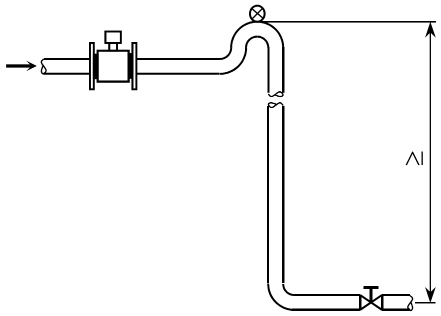


No sources of interference that would disturb stable flow are allowed in the straight pipe sections prescribed. They must be located in the pipe past the flowtube sensor or as long a distance before the sensor down the stream.

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 α 16° as well as piping outlets from tanks, exchangers and filters.
- Anything that interferes with the liquid flow, such as a thermometer well.
- Junctions, T pieces, bends, elbows, slide valves, stopcocks, flap valves. Closing, control, butterfly and return valves. Outlet pipes from tanks, heat exchangers, and filters.
- 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.
- 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.

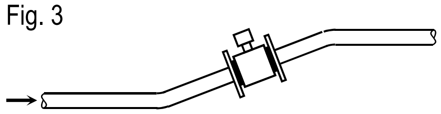
Fig. 2



3.3 Ensurance of the filling the entire cross section area of the flowtube.

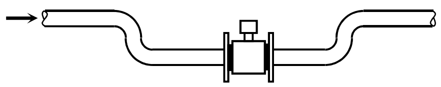
For this reason, the flowtube sensor must not be positioned either at the highest point of the piping where it may be aerated or in descending / open-ended horizontal piping into which air may penetrate. The best installation point is the lowest or ascending piping section (Fig. 3, 4, 5).

Fig. 3



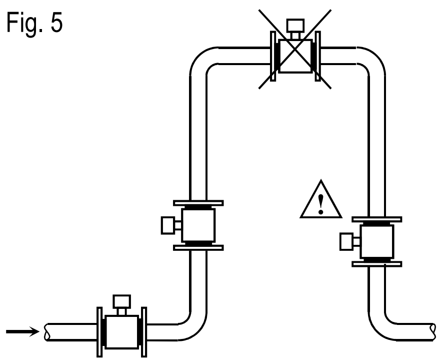
It is required that sufficient pressure should be maintained at the flowtube sensor installation point in order to prevent steam or gas bubbles from being separated from the liquid. Fig. 2 shows descending piping section whose length exceeds 5m, which means the water column weight would make the pressure in the flowtube sensor fall below the steam 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. 4



In case of a sudden decrease in pressure, gas bubbles are being separated from liquids. For this reason, regulating throttle valves and similar elements should be placed after the flowmeter. Similarly, the flowtube 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).

Fig. 5



3.4 The flowtube sensor direction..

Reverse flow cannot be measured unless special flowmeter setup is made according paragraph 8.4c). Direction is indicated by the arrow.

3.5 Ensurance of flooding sensor electrodes.

This can be achieved even if the pipework is drained for a prolonged period of time by installing the flowtube sensor in a siphon pipe. This prevents dirt and deposits from drying in the flowtube or on flowtube sensor electrodes.

3.6 Prevention before influence of bubbles in measured liquid.

The tiny bubbles that may always occur in liquids 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 flowtube sensor terminal box must be positioned upwards.

3.7 Prevention before influence of sludge inside the measuring tube or on the electrodes.

The measuring tube is quite smooth and if the liquid velocity is sufficient as stated in paragraph 3.1, the sludge has no possibility to catch on. If the flow velocity is continuously low

Fig. 6

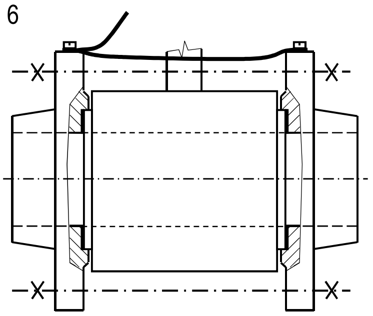


Fig. 7

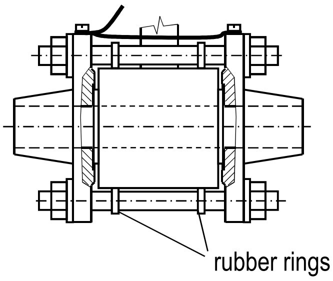


Fig. 8

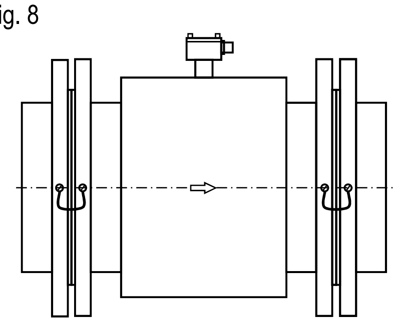
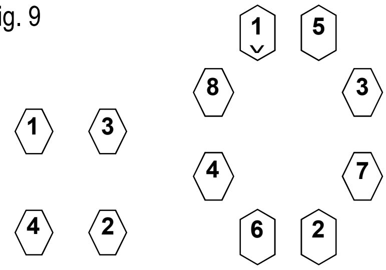


Fig. 9



DN (mm)	M_K (Nm)	number of clamping bolts
10	15	4
15	15	4
20	15	4
25	24	4
32	35	4
40	40	4
50	40	4
65	45	4/8
80	50	8
100	70	8
150	90	8

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).

3.8 The ambient conditions (temperature, humidity, vibrations)

The flowmeter circuitry head with must not be exposed to radiation from heat sources and its natural cooling by ambient airflow must be secured. The room temperature should not fall below 0°C. Maximum room temperature is 55 °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. Flowmeter parts should not be installed under pipe joints, fittings, and similar places with dropping water hazard.

The pipe must be securely supported, in a way, however, which allows heat expansion and reduces flowtube sensor bending stress. Pipe vibrations are no way allowed (such as from pump operation).

Installation of billing meters in spaces with admission to authorized personnel only is recommended.

3.9 Temperature and pressure of measured liquid.

Maximum allowed temperature and nominal pressure depend on the flowtube sensor design and they are shown on the flow meter nameplate. See paragraph 8.1.

3.10 Installation of sensor cable by separate design.

The cable of the separate inductive flowtube 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 flowtube sensor cable shielding must be connected as shown on Fig. 23.

3.11 Reliable galvanic connection between the flowmeter and measured liquid.

Conductor connected to the terminal or flowtube sensor body must be connected to a flange and flanges must be interconnected with another conductor and brass M5 bolts with tooth lock washers.

3.12 Mechanical installation of magmeter end flow sensor.

Pipework configuration and attachment in installation must allow a minor increase in flange distance to insert gaskets and an unflanged flowtube sensor DN32 to DN100 for installation between flanges. There must be enough space to put in clamping bolts and tighten nuts.

Cut-off fittings should be placed before and after the flowtube 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.

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 liquid 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 flowtube sensor should not exceed 0.5mm. In addition, the alignment of the bolt holes in both flanges must be observed and the positioning of the M5 threads for grounding screws must be considered. Also see paragraphs 3.9, 3.12, and 3.14.

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

When performing electric welding, avoid welding current to pass through the flowtube sensor !

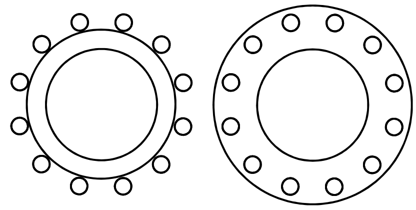
The installation of the inductive flowtube sensor or the flowmeter in compact design should not be launched until all building, welding and painting jobs are completed.

Flange seating as in figure 6 (flowtube sensor shoulder dimensions in paragraph 4.1) provide DN32 to DN100 unflanged flowtube sensor coaxial alignment. Rubber rings, supplied as accessory shown in figure 7, need putting on the clamping bolts with inner diameters DN10, DN20, and DN150-PN25.

The electrodes inside the flowtube 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.

Fig. 10



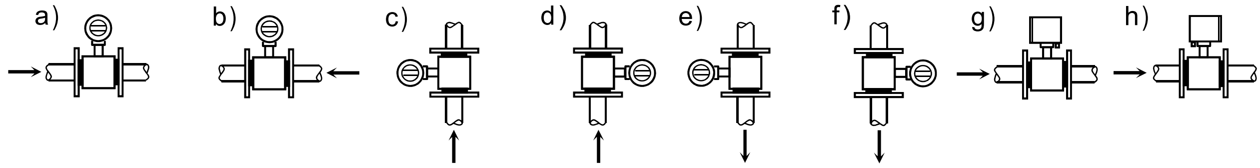
The pair of gaskets according to paragraph 4.2 is supplied as accessories for wafer flowtube sensors DN 10 to DN 150. The gasket must not protrude into the flow cross-section area. The gasket being used must not be made of soft elastic materials. Such gaskets will be pushed into the inner cross section area as the flanges are drawn together, which may result in serious errors in the flow rate measurement. The tightening of the wafer flowtube 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:

No gaskets are required for flowtube sensors DN200 to DN800 since they are replaced in functionality with sensor's Teflon or rubber liner rim. If you do decide to use gaskets, ones that are concentrically aligned with flange clamping bolts and have convenient outer diameter or openings as in figure 10 are recommended.

3.13 Mechanical installation of control head with the display.

The display is to be about 1.5 metres above floor level. You can read the display in dark.
The flowmeters FG4000CM in compact design leave the factory assembled in a manner that the measured liquid flows from left to right when viewing the front cover of the head with the display window as shown on Fig. 11 a).
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), and h).

Fig. 11

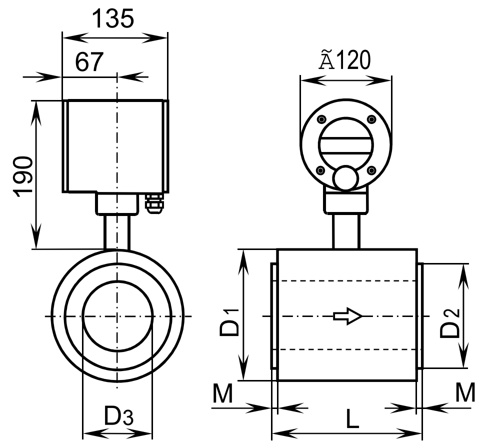


3.14 Unflanged magmeter dimensions

(Fig. 12, Fig 13). The mass applies to the compact design as in figure 12.

Fig.12

FG4000
compact unflanged design

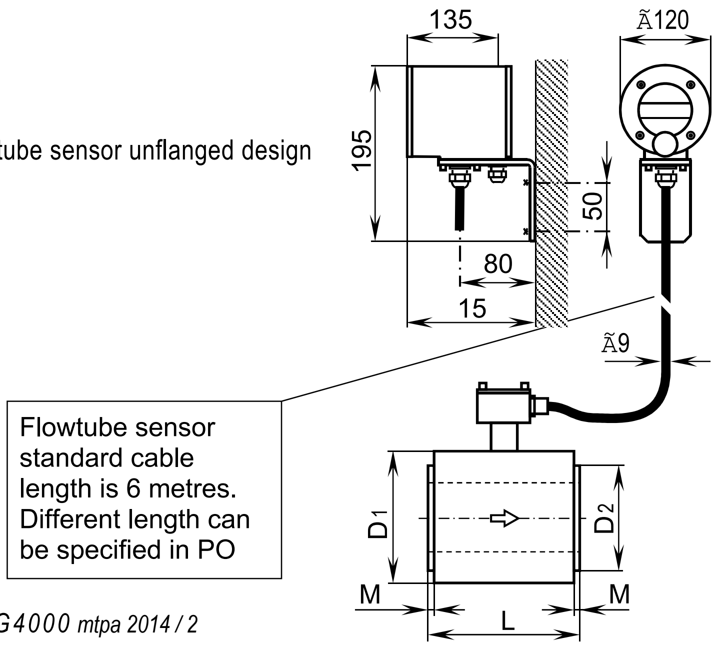


DN	D_1	D_2	D_3	L	M	mass
10	60	≈ 36	11	100	3	3.6 kg
15	60	≈42	15	100	3	3.6 kg
20	60	≈ 46	19	100	3	3.6 kg
25	70	≈58	25	100	3	3.8 kg
32	83	63 ± 0,2	32	100	3	4.2 kg
40	90	70 ± 0,2	40	100	3	4.8 kg
50	108	90 – 0,3	51	110	3	6.0 kg
65	121	102– 0,3	64	110	3	7.5 kg
80	140	115 – 0,3	80	160	3,5	8.9 kg
100	168	150 – 0,3	104	160	4	12.0 kg
150	220	-	142	190	-	17.2 kg

Add .6 kg for wafer separate design (Fig. 13) with a 6m cable.
Mass of 1 meter of flowtube sensor cable is around 0.11 kg.

Fig.13

FG4000
split flowtube sensor unflanged design

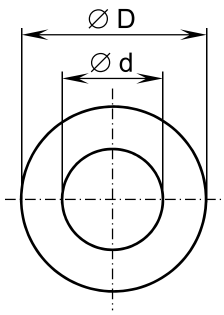


3.15 Unflanged magmeter gasket dimensions

(Fig. 14)

DN	PN	∅ D	∅ d	T
10	25	36	12	1.5
15	25	48	16	1.5
20	25	54	20	1.5
25	25	58	25	1.5
32	25	63	34	1.5
40	25	70	42	1.5
50	25	90	53	1.5
65	25	102	65	1.5
80	25	114	82	1.5
100	25	150	106	2
150	25	224	154	2
150	16	190	152	2

Fig. 14

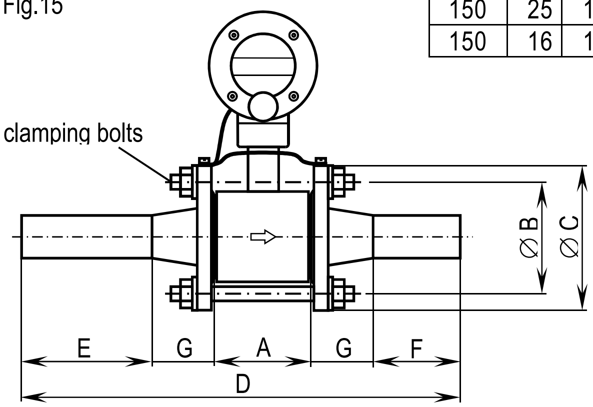


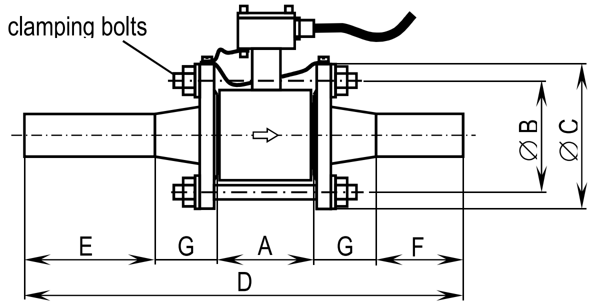
3.16 Dimensions of unflanged magmeter

FG4000 unflanged magmeter or split unflanged flowtube sensor installed within a pipe using LIMESA meters installation accessories (Fig. 15)

DN	PN	A	∅ B	∅ C	D	E	F	G	clamping bolts	
10	25	100	75	105	223	0	0	60	M12 x 170	4 pcs
15	25	100	75	105	283	50	50	40	M12 x 170	4 pcs
20	25	100	75	105	303	60	60	40	M12 x 170	4 pcs
25	25	100	85	115	353	85	85	40	M12 x 170	4 pcs
32	25	100	100	140	500	160	160	42	M16 x 175	4 pcs
40	25	100	110	145	510	200	120	47	M16 x 175	4 pcs
50	25	110	125	160	524	210	110	48	M16 x 195	4 pcs
65	25	110	145	180	633	275	145	52	M16 x 195	8 pcs
80	25	160	160	200	928	400	250	55,5	M16 x 245	8 pcs
100	25	160	190	230	966	440	240	65	M20 x 265	8 pcs
150	25	190	250	300	1550	750	450	78	M24 x 300	8 pcs
150	16	190	240	285	1510	750	450	58	M20 x 300	8 pcs

Fig.15





3.17 Flanged flowtube sensor dimensions

Dimensions and weight of flowmeter or flowtube sensor with DIN flanges are in the table below. (Fig. 16)
Other flanges (ANSI, GOST, CSN) and / or other nominal pressure specify in your order.
Other flowtube sensor length A can be specified in a purchase order..

DN	PN	A	∅ D	∅ K	n	∅ d	mass
10	10, 16, 40	150(200)	90	60	4	14	4.5 kg
15	10, 16, 40	150(200)	95	65	4	14	5 kg
20	10, 16, 40	150(200)	105	75	4	14	6.5 kg
25	10, 16, 40	150(200)	115	85	4	14	6.5 kg

32	10, 16, 40	150(200)	140	100	4	18	7 kg
40	10, 16, 40	150(200)	150	110	4	18	7 kg
50	10, 16, 40	200	165	125	4	18	8.5 kg
65	10, 16	200	185	145	4	18	12 kg
	40	200	185	145	8	18	12.5 kg
80	10, 16	200	200	160	8	18	12.5 kg
	40	200	200	160	8	18	13 kg
100	10 , 16	250	220	180	8	18	14 kg
	40	250	235	190	8	22	16 kg
125	10 , 16	250	245	210	8	18	19 kg
	40	250	270	220	8	26	21 kg
150	10 , 16	300	285	240	8	22	23 kg
	40	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

Fig. 16a

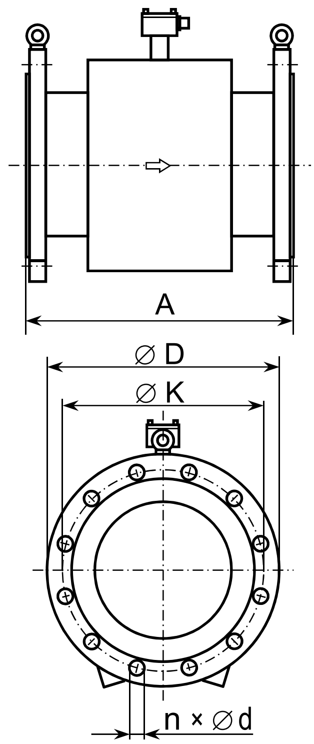
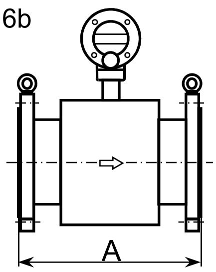


Fig. 16b



3.19 Dimensions of FG4000 magmeter with threaded connection

DN	Z	L	L1	D	mass
15	G 1"	110	66	83	4.5 kg
32	G 1¼"	110	78	108	6.5 kg

Fig.17a
split flowtube sensor

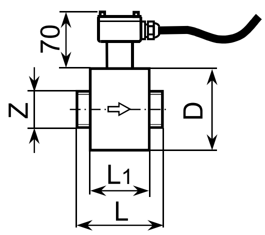


Fig.17b
compact
design

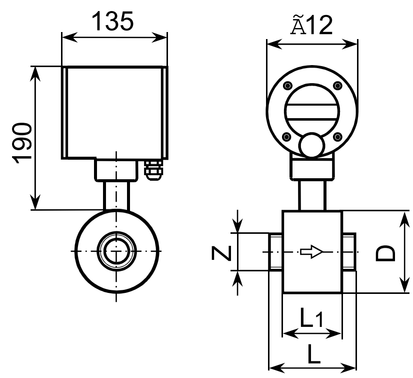


Fig. 18

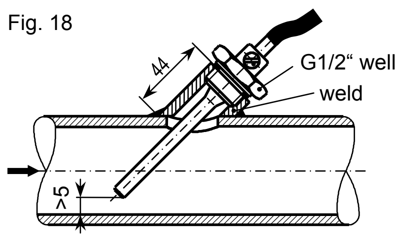
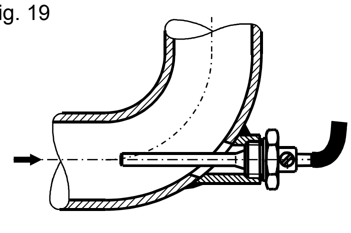


Fig. 19



4. OPTIONAL TEMPERATURE SENSOR LOCATION AND INSTALLATION

Temperature measurement accuracy and reliability will be guaranteed if you make sure the following conditions, described in paragraphs 4.1 through 4.4, are met.

4.1 Temperature sensor installation.

They are at least 5 mm from the opposite pipe wall. They are at least at half of their lengths in the flow of water. Therefore the pipe sections where temperature sensors are installed should be of sufficient diameter. Temperature sensor stem or its well does not get in contact with the pipe wall anywhere.

If the pipe diameter is insufficient, the well is to be positioned at 45° against stream as in figure 18 or in an elbow as in figure 19. Wells allow replacing temperature sensors without having to drain the pipe.

4.2 Tube heat-insulation

Piping is heat-insulated, including welds for temperature sensor or its well.
(at least in the spot of temperature sensor installation).

4.3 Temperature sensor cables legth.

Temperature sensor cables have the same resistance as in calibration and validation.

That is why they must not be cut shorter. Their validity would thus become void as well as the possibility of another re-certification. Four-wire temperature sensors are to be connected as shown in figure 24. Two-wire temperature sensors are to be connected as shown in figure 25. The two-wire cables may not be extended!

Temperature sensor cables are not to go near sources of electromagnetic interference or in parallel with other cables. As large the length of both cables as possible should be laid together. The cables' shielding may only be connected to the caloric meter terminal bar and may not be connected with temperature sensor or other conductive objects. The cables must not be in contact with piping.

5. FG4000 MAGMETER CONNECTION TO POWER

5.1 Power supply

The magmeter standard power supply system is 220-230 V / 50-60 Hz.
In purchase order you can specify power supply systems 110-120V / 50-60Hz or 36V / 50-60Hz. 24V DC power supply system magmeter is also available. The rated power consumption is 14 VA.

FG4000 magmeters come with a fixed 2x 0.075mm^2 power cable 1.5 metres long. This cable can be extended as shown in figure 21 using a suitable conduit junction box.

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 Safety class

FG4000 magmeter design is in EN 61010-1 safety class I.
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 FG4000 magmeter power supply fuse links.

The power supply printed circuit board holds a miniature fuse link (TR5 – dia. 8.4 mm, pin spacing 5 mm) under the terminal front cover. T 100 mA for 220-230Vac , T 250 mA for 110-120Vac.

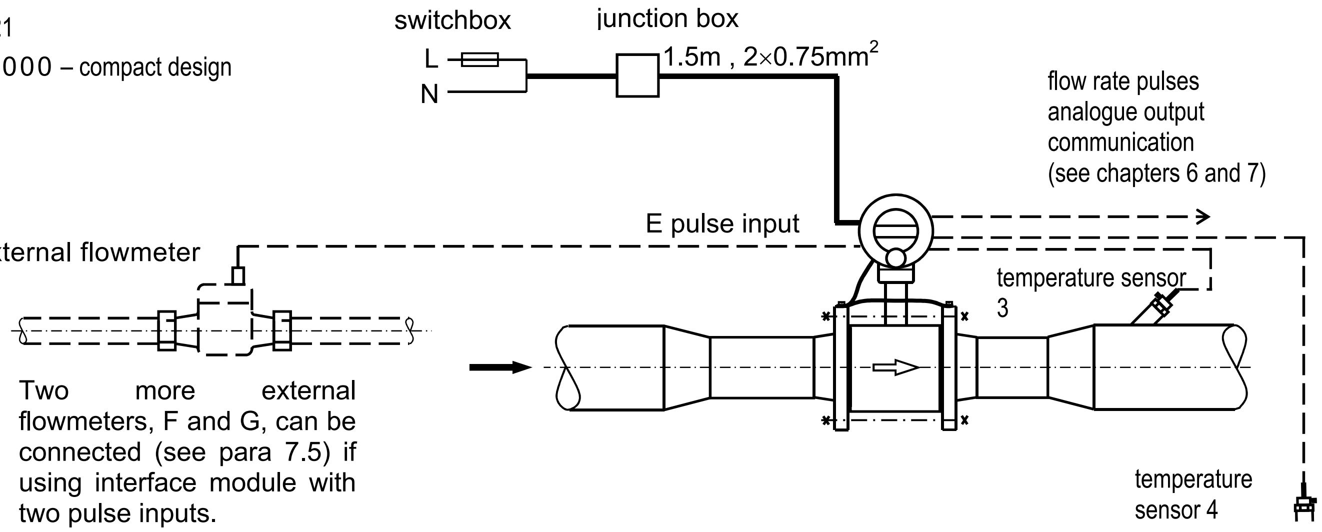
The transformer secondary windings are protected with resettable thermal fuses (PTS resistors).

5.4 Eliminating the most common problems arising during operation.

Reverse installation of the flowtube sensor as well as poor connection of cables from the flowtube 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. See paragraphs 3.11, 4.1 and 4.7.

The following chapters describe cable wiring. In spite of that, we only recommend disconnecting already wired cables in installation if necessary.

Fig. 21
FG4000 – compact design



Two more external flowmeters, F and G, can be connected (see para 7.5) if using interface module with two pulse inputs.

6. TERMINAL BARS, CONNECTORS AND JUMPERS

6.1 Terminal bars, connectors and jumpers (figure 22)

Terminal bars, connectors and jumpers are under the terminal back cover. The terminals can accept wires with the cross section area of 0.8 to 1.5 mm^2.

To facilitate the assembly in inaccessible places, the head can be rotated as explained in paragraph 3.14.

Obr. 22

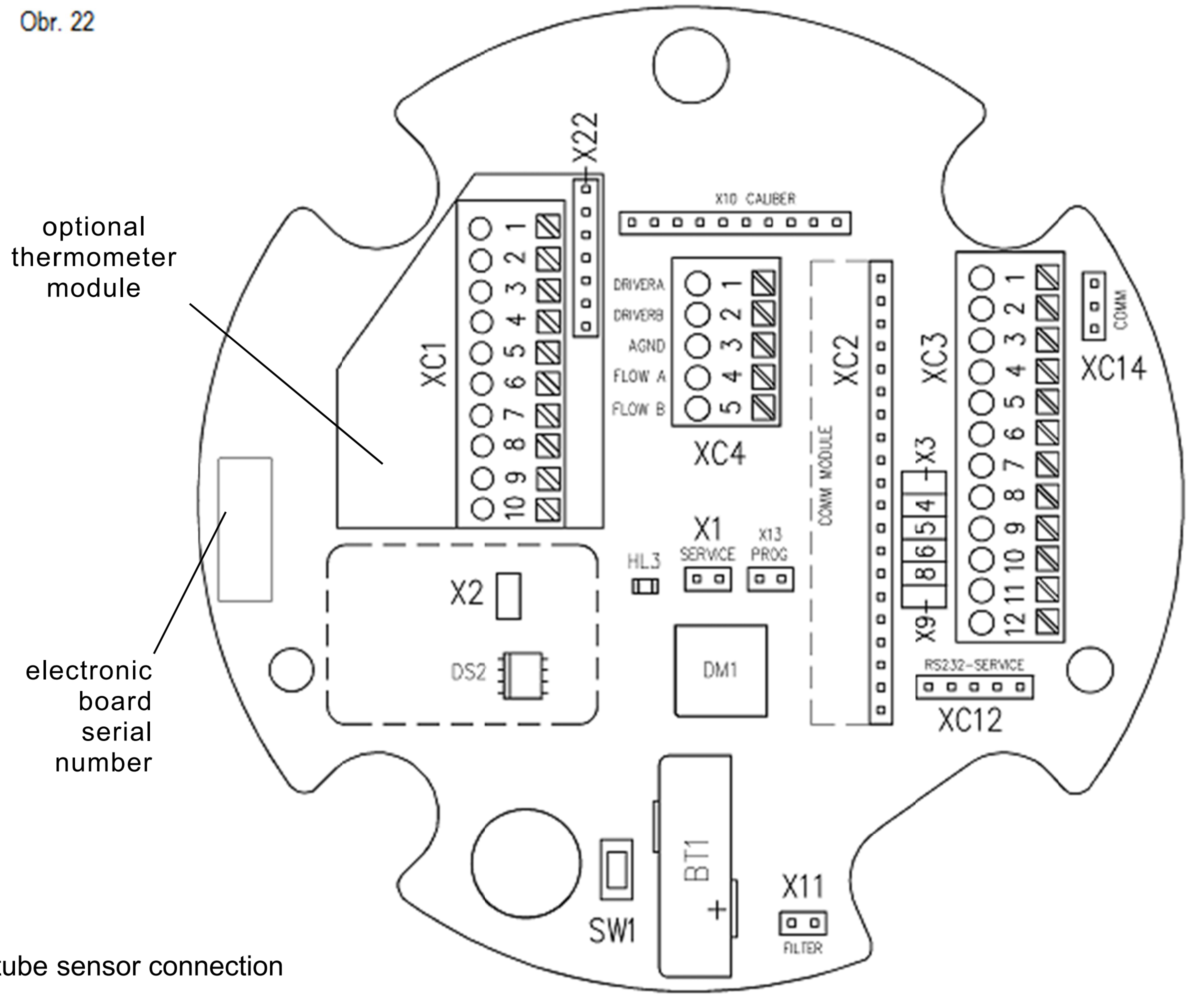
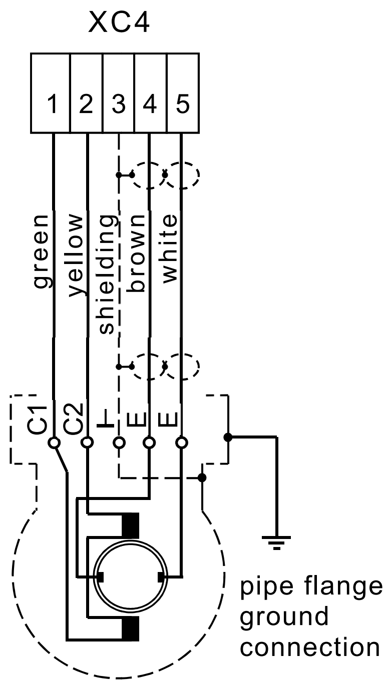


Fig. 23
split flowtube sensor connection pinout



XC1 temperature sensor terminal bar on optional thermometer module as in paragraph 6.2

XC2 interface module connector COMM1. See section 7

XC3 terminal bar for connection of external signals

- XC3/1 EGND (isolated +5 V_{EXT} and +24 V_{EXT} power source ground)
- XC3/2 through XC3/6 depends on interface module installed at XC2 connector (COMM1) terminal assignments described in paragraphs 7.1 through 7.5
- XC3/7 flow pulse output (**+**)
- XC3/8 flow pulse output (**–**)
- XC3/9 flow pulse output 2 (**+**)
- XC3/10 flow pulse output 2 (**–**)
- XC3/11 external pulse input E (**+**)
- XC3/12 external pulse input E (**–**)

XC4 magnetic flowmeter terminal bar (do not disconnect!)

- XC4/1, XC4/2 flowtube sensor excitation coil wires
- XC4/3 flowtube sensor electrode wire shielding
- XC4/4, XC4/5 flowtube sensor electrode wires

Split flowtube sensor external wiring is shown in figure 23. Do not disconnect wires connected to XC4 with magmeter compact design as in figure 12 (different colour coding)!

XC12 service connector

Description of jumpers (Fig. 22)

X1 display service mode jumper It must be open in regular operation.
X2 magmeter calibration jumper. It is covered and sealed.
X3, X4 flow pulse output internal power supply jumpers (Fig. 29)
X5, X6 caloric pulse output internal power supply jumpers (Fig. 30)
X8, X9 flow pulse input internal power supply jumpers (Fig. 31)
X11 flow pulse input noise suppression filter jumper (figure 31)

6.2 Connection of temperature sensors to optional thermometer module

FG4000 magmeter can be equipped with an optional thermometer module with XC1 terminal bar to connect two temperature sensors (figure 22).

The terminals can accept wires with the cross section area of 0.8 to 1.5 mm^2.

Stabilized metering current, as shown in figures 24 a 25 with arrows, passes through each temperature sensor (terminals XC1/4 and XC1/6 are interconnected on the printed circuit board).

If the metering current circuit gets broken, the temperature sensors stop working.

Fig. 24
temperature sensor four-wire

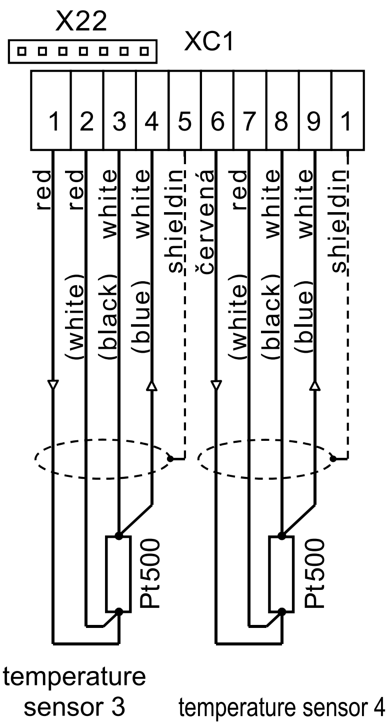
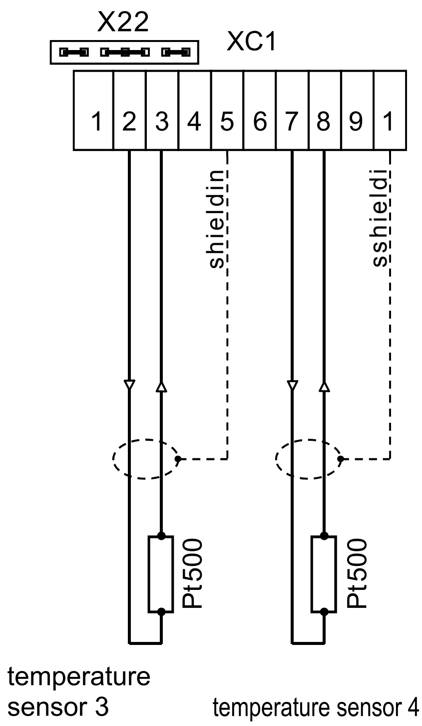


Fig. 25
temperature sensor two-wire



Terminals 1-2, 3-4, 6-7, and 8-9 must be interconnected to allow metering current with the two-wire configuration (figure 24). You achieve this by using a jumper on the thermometer module connector X22 pins, next to the XC1 terminal bar.

The temperature sensor cables with the four-wire configuration may be extended as required using a suitable conduit junction box and shielded four-wire cable (such as JQTQ 0.8 mm^2).
The two-wire cables may not be extended!

6.3 Magmeter pulse outputs

The pulse 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 may draw power from the internal power supply +5V$_{EXT}$– EGND via inbuilt resistors 1.8 kΩ using jumpers X3, X4 (figure 29) or X5, X6 (figure).
The +5V$_{EXT}$ - EGND power source is galvanically isolated from the flowmeter's measuring circuitry power supply.

Fig. 29
flow rate pulse output

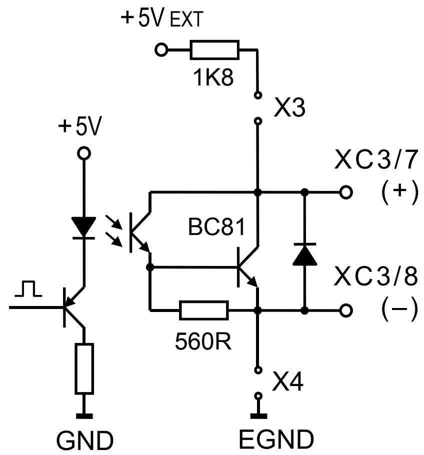
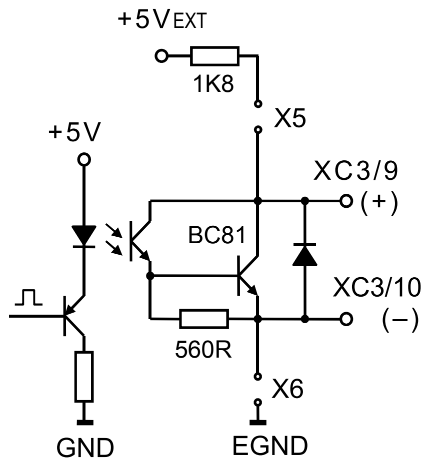


Fig. 30
flow rate pulse output 2



a) **Flow pulse output** (figure 29)
provides remote access to volumetric pulses and magmeter testing. The number of transmitted pulses is proportional to the measured volume. At constant flow rate, the mark-to-space ratio of the pulses is 1 : 1 ($t_{ON} = t_{OFF}$). The pulse frequency is proportional to instantaneous flow rate:

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

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

DN (mm)	10	15	20	25	32	40	50	65	80	100	125	150
Q_{max} (m³/h)	3.39	7.63	13.6	21.2	34.7	54.3	84.8	143	217	339	530	763
Q_{max} (dm³/min)	56.5	127	226	353	579	904	1413	2388	3617	5650	8830	12720
K_p (imp / dm³)	1600	700	400	200	150	100	60	35	25	15	10	7

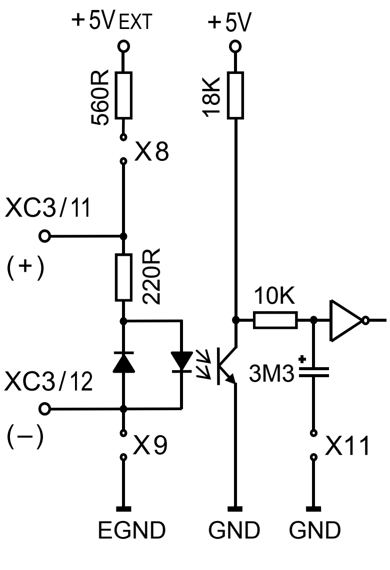
DN (mm)	200	250	300	350	400	450	500	600
Q_{max} (m³/h)	1360	2120	3050	4160	5430	6867	8480	12200
Q_{max} (dm³/min)	22608	35320	50870	69240	90430	114450	141300	203470
K_p (imp / dm³)	4	2.5	1.6	1.25	1	0.75	0.5	0.4

When specified in your order (or using the VISIKAL 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/dm³.
Q_{max} is flow corresponding to the theoretical median liquid velocity through flowtube sensor of 12 m/s.

By default, the pulse output rejection at low flow rates is set in a manner that the flowmeter will stop transmitting the flow pulses when the flow rate falls below 0.2 % Q_{max}. Pulse output suppression at low flow rates can be set in the range from 0.2 to 0.7% of Q_{max} as specified in the purchase order. If the magmeter is not sending flow pulses, the volumetric counters values are not changing and the displays shows zero flow rate.

b) Flow pulse output 2 (figure 30) provides remote access to volumetric pulses or reverse flow indication for magmeter that operates in bidirectional flow metering mode as described in paragraph 8.4 c. It is disabled in billing flow meters.

Fig. 31
E pulse input



6.4 E pulse input

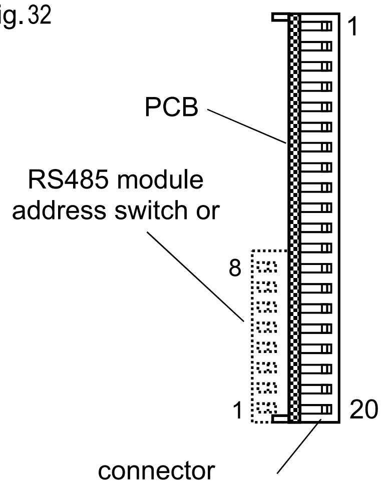
(F and G pulse inputs are described in paragraph 7.5)
The E pulse input is used for the connection of an external flowmeter or other device with pulse output (unit or event count). The input comprises an optically isolated LED transmitter. The anode goes to terminal XC3/11 via resistor 220 Ω, the cathode goes to terminal XC3/12 (figure 31). The pulse width and the spaces between the pulses must be longer than 500 µs (or 50 ms if X11 is closed). The flow pulse input's K_E conversion constant (imp/dm³) can be set to any value subject to the connected device's specifications, most preferably within the range 1000 / … / 0,0001 (imp/dm³), shown in paragraph 6.3a: We recommend specifying the setting in purchase order. For example, for a water-meter having 0.01m³/imp value by its specifications, we make the settings as follows: $K_E = 1 / (0.01 * 1000) = 0.1$ imp/dm³.

If the pulse input draws power from the device connected, terminals X8 and X9 are open. External voltage applied to the pulse input should be 5V ±2V.
If the current is limited to 5 to 20 mA, the voltage can be 28 V.

Always observe the external power source's polarity so that the XC3/11 terminal and the XC3/12 terminal are connected to higher and lower potential, respectively! If a pulse 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 supply via an embedded 560 Ω resistor using the X8, X9 jumpers.

7. INTERFACE MODULES AND ARCHIVING MODULE

Fig. 32



One interface module connected to XC2 (COMM1) can be used with the FG4000 magmeter. The interface module must be ordered separately.

When connecting the interface module, make sure that all XC2 male pins fit into the corresponding female pins of the interface module's connector (Fig. 32).

Magmeter power supply must be disabled while doing this!

The communication rate can be set to 300, 600, 1200, 2400, 4800, 9600, 19200 or 38400 Bd. If not specified in purchase order otherwise, the communication rate is set to 9600 Bd by the manufacturer.
Paragraph 7.7 explains the communication protocols.
Default communication protocol for interface COMM1 is BitBus.

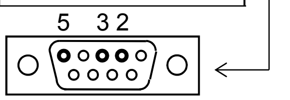
To communicate with the flowmeter, VISIKAL software are provided by the manufacturer. This software allows all set, measured and registered data to be displayed on a PC monitor independently on their appearance on the flowmeter's display. The VISIKAL software offers the setting of various flowmeter features as well as performing the calibration in flow test laboratories.

Notes: Service connector XC12 is used for communication in setting up and testing the FG4000 magmeter using a special conversion cable TTL-RS232. This communication interface may not be used for other purposes!

The interface module installed at XC2 must be removed before using the service connector. The SIMPLE protocol and the transmission rate 9600 Bd is set for this purpose.

Tab.1

XC3		
1	RS232 – GND	5
2	RS232 – RXD	3
3	RS232 – TXD	2
4 - 6	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.

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. Communication parameters: 8 bits, no parity, 1 stop bit for transmission, 1 stop bit for reception.

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.

Tab.2a

XC3	
1	RS232 – GND *)
2	RS232 – RXD *)
3	RS232 – TXD *)
4	4 – 20mA (+)
5	4 – 20mA (–)
6	not used

Tab.2b

XC3	
1	RS232 – GND *)
2	RS232 – RXD *)
3	RS232 – TXD *)
4	not used
5	0 – 10V (–)
6	0 – 10V (+)

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).

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

The analogue output draws power from +24V$_{EXT}$ power supply. The power supply 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.

At default setting, the analogue output current (or voltage) fluctuates between 4 mA (0 V) and 20 mA (10 V) reflecting the liquid flow rate. The 4 mA or 0V value corresponds to zero or negative flow rate of the liquid, while the 20 mA or 10V value corresponds to Q_{max} as described in the table in paragraph 6.3.
At $Q \geq Q_{max}$ the current (voltage) is constant at 20 mA (10 V).

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

You can assign instantaneous flow rate in external E flow meter to the analogue output in the same manner. Value 4 mA (0 V) then corresponds to zero or negative value of the quantity selected while 20 mA (10 V) corresponds to the positive value in l/min selected.

Analogue output operation with bidirectional flow rate metering is described in paragraphs 8.3c and 8.3d.

If the analogue output must inevitably work within the range of 0 - 20mA, circuit modification of the interface module can be ordered.

7.3 RS232 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. 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).

Tab. 3

XC3	
2	RS485 – DATA (+)
3	RS485 – DATA∗ (–)
4	RS485 – RTS (+)
5	RS485 – RTS∗ (–)
6	EGND via inbuilt resistor 150Ω

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 communication protocol description is on the website at www.limesa.net. Use of magmeter X3 terminal bar terminals with this interface module is shown in table 4.

The $+5V_{EXT}$ – EGND power supply, which is galvanically isolated from magmeter metering circuitry power supply, provides power for the M-Bus interface module.

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. 32. The address may only be set within the range of 01_H - FA_H (1 - 250 in decimal).

Tab. 4

XC3	
2	M-Bus – DATA
3	M-Bus – DATA
4 - 6	not used

7.5 RS232 interface module with two pulse inputs

The module consists of two identical F and G pulse inputs and RS232 interface. However, the flowmeter software enables the use of F input only at the moment. Use of magmeter X3 terminal bar terminals with this module is shown in table 5.

*) This module is also available in an economical version without RS232.

Tab.5

XC3		
1	RS232 – GND	*)
2	RS232 – RXD	*)
3	RS232 – TXD	*)
4	F pulse input	(+)
5	F and G input common	(–)
6	G input reserved	(+)

The F and G pulse input conversion constants may be set independently to follow parameters of the devices connected in way similar to using E pulse input, which FG4000 magmeter’s standard feature (paragraph 6.4).

The width of the pulse or the spaces between the pulses must be longer than 250μs.

Always observe the external power source's polarity so that the XC3/4 terminal and the XC3/5 terminal are connected to higher and lower potential, respectively!

If F and/or G pulse input is fed from the connected device's active pulse output, XJ1, XJ2 and/or XJ 2 and XJ3 jumpers on the module are open (Fig. 33 and 34). External voltage applied to the pulse inputs should be 5V ±2V. If the current is limited to 5 - 20mA, this voltage may reach up to 28V.

If source of pulses with passive output is connected (such as switching contact), jumpers XJ1 and XJ3 and/or XJ2 and XJ3 need bridging. 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. 33

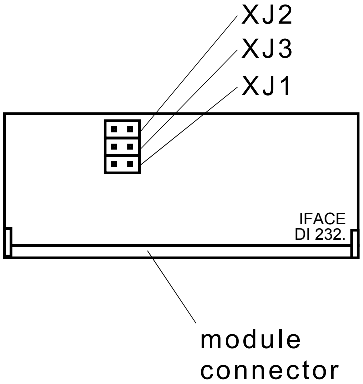
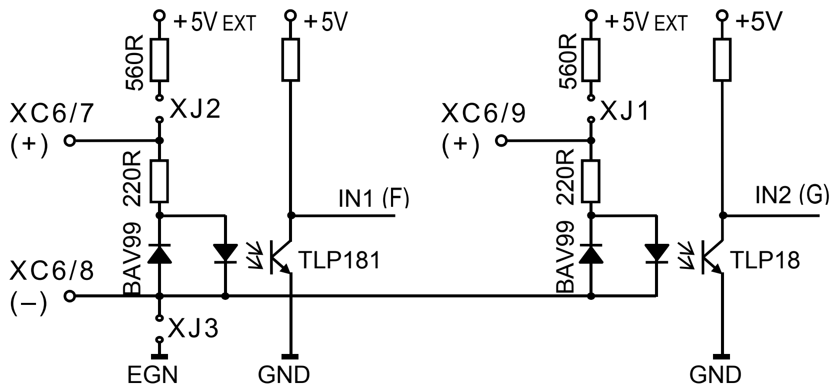


Fig. 34



7.6 Archiving module

We recommend ordering the archiving module simultaneously with the flowmeter since any additional installation may only be performed by a skilled technician. The archiving module is formed by an independent memory and a BT1 clock back-up battery (Fig. 22).

By default daily and hourly archiving (390 days and 954 hours) is set using the VISIKAL program. If specified in your order or by using VISIKAL software, the setting can be changed to daily and minute archiving (390 days and 1908 minutes) or daily archiving (390 days) and so called the user counters archiving of changes (390 days and last 954 events).

Daily archiving differs from hourly in figure 30 only by recording counter values at the end of each day, at 23:59. The minutely archive does not record volumes measured by external flow meters or idle time. User counter event archive records resets and user counter settings described in paragraph 8.3. Each event in archiving of changes occupies two lines in the user counters archiving 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 (figure 31).

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

Fig. 30 hourly archive

header:
firmware version (PC port, RS485 or M-Bus address)
flowmeter identifier

main volume counter value as of end of hour
(volume measured by the flowmeter)

user counter number

user counter value as of end of hour

```
FG4000 V5.55 (COM2, Node 04)
00000009
    Date/Time                 Volume    Optional      Quantity   Quantity   Idle
                                [m3]   counter [m3]      E [m3]     F [m3]   [min]
   ----------------------------------------------------------------------------
    2.12.1998: 9:59:     3074.639 2:    298.054        0.950      0.000    1025
    3.12.1998:10:59:     3183.119 2:    406.534       11.044      0.000    1025
    4.12.1998:11:59:     3191.820 1:      8.701       21.345      0.000    1025
```

E pulse counter value as of end of hour

F pulse counter value as of end of hour
(value only changes if using module as in paragraph 7.5.)

idle time counter value

Fig. 31 user counter change archive

```
FG4000 V5.55 (COM2, Node 04)
00000009
  Date/Time                 Volume    Optional
                              [m3]   counter [m3]
   -------------------------------------------
    7.10.1999: 9:58:   935850.313 3:      3.736
    7.10.1999: 9:58:   935850.313 2:     10.728
    7.10.1999: 9:59:   935850.438 3:      3.736
    7.10.1999: 9:59:   935850.438 3:      0.000
    7.10.1999:11:30:   935850.688 4:    282.188
    7.10.1999:11:30:   935850.688 4:      0.000
    7.10.1999:11:30:   935850.813 2:     11.228
    7.10.1999:11:30:   935850.813 4:      0.000
```

user counter 3 final value,
selected (conected)
before selecting user counter 2

user counter 2 initial value
when selected (connected) at

user counter 3 final value
before resetting at 9:59

user counter 4 final value
before resetting at 11:30

user couner 2 final value,
selected (connected)
before selecting user counter 4

user counter 4 initial value
when selected (connected) at

user counter 4

main volume counter value on switching user counter

Tab. 6 (see also para 8.2)

50$_H$	flowmeter identifier 1)
30$_H$	volume (m^3)
31$_H$	instantaneous flow rate 2)
38$_H$	status and error recorder
39$_H$	Error-free operation time (min.)
3A$_H$	idle time (min.)
42$_H$	RTC date (ddmmyy)
43$_H$	RTC time (hhmm)
46$_H$	firmware version
5A$_H$	peak flow rate time (ddmmyy) 3)
5B$_H$	maximum flow rate (m^3/ hour) 3)
65$_H$	peak flow rate time (ddmmyy) 4)
66$_H$	maximum flow rate (m^3/ hour) 4)
60$_H$	E external volume (m^3)
64$_H$	E external flow rate (m^3/ hour)
63$_H$	F external volume (m^3)
62$_H$	F external flow rate (m^3/ hour)
22$_H$	volume + (m^3) 5)
24$_H$	volume – (m^3) 5)
26$_H$	peak flow rate evaluation time (min.)
36$_H$	user counter 1 (m^3)
28$_H$	user counter 2 (m^3)
2A$_H$	user counter 3 (m^3)
2C$_H$	user counter 4 (m^3)
2E$_H$	user counter 5 (m^3)
A9$_H$	selected user counter number
EE$_H$	longest idle time (ddmmhh) 3)
EF$_H$	longest idle time (min.) 3)
EB$_H$	longest idle time (ddmmhh) 4)
EC$_H$	longest idle time (min.) 4)
F1$_H$	simultaneous multiple data query 6)

1) electronic board serial number
Different eight-digit code can be set using VISIKAL.

2) in units of measure set for display

3) in current month

4) last month

5) only in mode as in paragraph 8.5c

6) list of up to 16 codes in the desired order of reception follows F1$_H$ code
separator 0$_H$ or 00 ASCII is after every piece of data
See last example on this page.

7.7 Communication protocols for data collection by FG4000 magmeter

Simple via RS232 : 8 bits, no parity, 1 stop bit

Transmission to the flowmeter :
- 1st byte - total report length = $(m+3)_H$
- m byte long report – code(s) according to table 6
- penultimate byte - 0$_H$
- last byte - CHSUM

Receiving from the flowmeter :
- 1st byte - 0$_H$
- ASCII report
- penultimate byte - 0$_H$
- last byte - CHSUM

CHSUM = NOT(1st byte XOR 2nd byte XOR ... XOR penultimate byte) + 1$_H$

An example of getting instantaneous flow rate value:
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 123.4567 (in units set for the display)

BitBus via RS485: 8 bits + 1 parity bit, 1 stop bit.
Parity bit set to 1 while transmitting address byte.
Parity bit set to 0 for all other bytes transmitted or received.:

Transmission to the network:
- 1st byte - flowmeter address
- 2nd byte – message without address length = $(m+3)_H$
- m byte long report – code(s) according to table 6
- penultimate byte - 0$_H$
- last byte - CHSUM

Receiving from the flowmeter :
- 1st byte - flowmeter address
- 2nd byte – message without address length = $(n+4)_H$
- 3rd byte - 0$_H$
- n byte long ASCII message
- penultimate byte - 0$_H$
- last byte - CHSUM

CHSUM = NOT(2nd byte XOR 3rd byte XOR ... XOR penultimate byte) + 1$_H$

An example of getting instantaneous flow rate value from flowmeter at address 15$_d$:
Transmission to the network: 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 (in units set for the display)

ASCII via RS485: 8 bits, no parity, 1 stop bit

Transmission to network and reception from flowmeter.. Message format is identical with BitBus.But messages are transmitted and received as ASCII strings with an initial colon.

An example of getting instantaneous flow rate value from flowmeter at address 15$_d$:
Transmission to the network: “:0F043100CB“
Receiving from the flowmeter : “:0F0B003132332E34353600DE“
The received value is 123.456 (in units set for the display)

An example of concurrent reception of volume values and instantaneous flow rate values from flowmeter at address 7$_d$:
Transmission to the network: “:0706F13031000A“ (m = 3)
Receiving from the flowmeter :
“:07120039382E3031323100372E3635340000EF“
The received values are 98.0121 7.654 (n = 14)
(volume in m^3 and flow rate in units set for the display)

Notes:
- If the FE address is used in the protocol for transmission, the flowmeter will respond irrespective of its set address. This enables to communicate with the heat flowmeter via RS232 interface using ASCII protocol (e.g. by modem or PC).
- Some data are not available from a flowmeter without the archiving module. See paragraph 8.2.
- If the requested numerical data are not available, the flowmeter may send also the following messages: “NaN“, “+INF“, “–INF“ or “Not implemented“.

8. BASIC SPECIFICATION, DISPLAY

8.1 FG4000 magmeter basic specifications

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

Design: FG4000 magnetic flowmeter uses flanged flowtube sensors as in figure 16 and, up to inner diameter DN150, also unflanged flowtube sensors as in figure 12 or 13. FG4000 magmeter terminal may optionally feature an archiving module and thermometer module.

The magmeters come with official certification. The certification expires in four years in the Czech Republic's jurisdiction.
LIMESA meters has appropriate testing equipment and provides subsequent re-certification for another four years.

Power Supply: standard: 230V (+10;-18%) / 50÷60 Hz
optional: 120V (+10;-18%) / 50 - 60 Hz or 24V DC
Input Power Demand: 14 VA , Archiving module battery service life: min. 5 years
Enclosure Rating: IP 67 IEC 536 Protection Class: I
Climatic and mechanical conditions: B Electromagnetic conditions: E2
Ambient temperature: 5 - 55 °C Recommended ambient temperature: 15 - 35 °C
Relative Humidity: max. 90% Atmospheric pressure: 66 - 106 Pa

Nominal diameter DN (mm)	10	15	20	25	32	40	50	65	80	100	125
Initial flow Q_{min} (m^3/h)	0.007	0.015	0.027	0.042	0.07	0.11	0.17	0.29	0.43	0.68	1.1
Minimum flow Q_{min} (m^3/h)	0.08	0.2	0.3	0.5	0.9	1.4	2.1	3.6	5.4	8.5	13
Maximum flow Q_{max} (m^3/h)	3.39	7.6	13.6	21.2	34.7	54.3	84.8	143	217	339	530
Flow conv. const. K_p (imp/dm^3)	1600	700	400	200	150	100	60	35	25	15	10

Nominal diameter DN (mm)	150	200	250	300	350	400	450	500	600
Initial flow Q_{min} (m^3/h)	1.5	2.7	4.2	6.1	8.3	10.9	13.7	17.0	24.4
Minimum flow Q_{min} (m^3/h)	19	33.9	53	76.3	104	136	172	212	305.2
Maximum flow Q_{max} (m^3/h)	763	1360	2120	3050	4160	5430	6867	8480	12200
Flow conv. const. K_p (imp/dm^3)	7	4	2.5	1.6	1.25	1	0.75	0.5	0.4

Flow pulse output Kp conversion constant can be set to a lower value on order (paragraph 6.3).

Measuring range Q_0 to Q_4: 1 : 500 to 1: 240 depending on nominal inner diameter *)
Constant flow operation: no time limit
Flowtube Sensor Liner: PTFE (standard for unflanged flowtube sensors) or hard rubber
Electrode Material: 316L stainless steel (standard), Hastelloy C, Titanium (optional)
Liquid under measurement maximum temperature: 150 °C - PTFE **) 90 °C – hard rubber
Liquid under measurement conductivity: minimum 5 μS / cm
Nominal Pressure: 25 bar for unflanged flowtube sensors, for flanged flowtubes depending on flange pressure rating, 16 bar for flowtube sensor with threaded connection
Pressure drop class ΔP10
Irregular velocity field sensitivity classes: D5 before meter, D3 after meter

*) Applicable for default setting: Q_0 = 0.2% Q_{max}
Q_0 can be set in range from 0.2% of Q_{max} to 0.7% of Q_{max} (Q_{max} as in table in paragraph 6.3a)

**) If liquid under measurement temperature permanently exceeds 110°C or ambient temperatures are high, application of split flowtube sensor flowmeter is recommended.

8.2 FG4000 flowmeter display (alphanumeric backlit LCD, two rows of 16 character)

Using a PC with VISIKAL 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 or ENTER is pressed momentarily and repeatedly. Two items selected are displayed at a time. Displaying order corresponds to list order. When the last selected item has been shown, the cycle returns to the beginning.

When one minute has elapsed from the last pressing of the button, the display will switch into so called basic display mode. If no items have been selected for viewing in display basic mode, item 1 is shown.

BASIC DISPLAY MODE :

Using VISIKAL software, one or more data items can be selected from the available data list to be shown on the display in the basic mode (no buttons used). When multiple data items are selected, they will be shown sequentially in intervals that are selectable in range from 1 to 40 seconds. Two items selected are displayed at a time.. Items 5 and 17 through 23 may not be displayed in the basic mode:

Other units of measure can be used for viewing (GPM; l, hl, UsGal, l/h, hl/h, l/s).

Unless specified otherwise in your order, the flowmeter shows volume (m^3) and flow rate (m^3/h) in the basic display mode. If using button, items 1 through 5, 10 through 14, and with flowmeter featuring archiving module also items 17 through 20.

AVAILABLE DATA LIST FOR DISPLAY Table 8

1	Volume	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 pulses	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 pulses	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 total	+0.001 ..+999999999.999 m^3	6)
16	Negative volume total	-0.001 ...-999999999.999 m^3	6)
17	Day, month, year	18.02.99	7)
18	Time	15:05:56	7)
19	Day, hour and peak flow rate in current month	160205 45.09m^3/h	7) 8)
20	Day, 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, hour and max. idle time in current month	080209 3min	7) 8)
23	Day, hour and max. idle time last month	190116M128min	7) 8)
24	Temperature 3	−69.999 ... 0.000 ... 199.999 °C 3	9)
25	Temperature 4	−69.999 ... 0.000 ... 199.999 °C 4	9)

1) In addition to error-free operation time, a flowmeter equipped with the archiving module shows also idle time (e.g. due to power failure, fault, etc.).
2) One or more letters as in table 7 may be displayed in service mode.
3) "E" letter at the first display position indicates that the data belongs to the external source of pulses connected to XC3/11 and XC3/12 terminals.
4) Applicable only to a flowmeter having the interface module with pulse input installed (paragraph 7.5). "F" letter at the first display position indicates that the data belongs to the external source of pulses connected to terminals XC3/4 and CX3/5.
5) The user counter number is shown at the 16th position of the display. Asterisk shown at the 15th display position marks the current or selected user counter as in paragraph. 8.3.
6) Applicable only to "bi-directional flow" operating mode as described in paragraph 8.4 c).
7) For flowmeter with archiving module only..

Tab.7

A	EEPROM error
D	communication error
E	power supply failure *)
G	I^2C bus error
I	flow rate less than 2.5% of Q_{max}
J	flow rate greater than Q_{max}
K	Watch Dog error
L	RTC error
N	sensor type EEPROM reading error
O	reverse flow

*) more than 60 seconds in current hour

[8]) Every minute the flowmeter renders average flow rate for the preset period of time of back evaluation of peaks. If the value rendered is higher than the maximum flow rate register value, new peak and date/time stamp are written in the register. At end of month, flowmeter stores data in last month peak flow rate register and resets current month peak register (last day of month is the reference date). Peaks evaluation time can be set from 1 to 60min. Current and last month idle time registry work similarly. Resetting of current month peak register using VISIKAL software is also possible. Last month peak values show letter M on display after the time (ddhhmm).

[9]) For flowmeter with thermometer module only..

All data items from the available data list can be displayed on the monitor of a personal computer using VISIKAL software installed independently of being shown on the flowmeter display. If you switch to display service mode (SW1/1 in position OFF), these and other data can be displayed on the flowmeter display as well. Do not forget to put SW1/1 back to position ON!

8.3 User counters in FG4000 flowmeter

a) In user counter default mode, the volume measured by the flowmeter's flowtube sensor can be added to the value of 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 ENTER briefly several times. For example, user counter No.1: 10,123 m^3 1
- Hold ENTER pressed for a prolonged time. The display will cycle through:
  Start ? , Clear ? and counter value 10,123 m^3 1
- – If you release the button when the display shows Start ? ,
  user counter's new value is displayed with an asterisk before the user counter number,
  which means user counter 1 is just running: 10.125 m^3 ∗1.
- – If you release the button when the display shows Clear ? , the user counter will be reset and the display will show the new value of user counter 1: 0.000 m^3 1
- – If you release the button whent he display shows 10.123 m^3 1, nothing will happen. Only the next available item will be shown. For example next counter: 980,785 m^3 2

If the user counter displayed is just running, an asterisk is shown before its number.
The procedure is then analogous, but while holding ENTER pressed, the display cycles through:
Stop ? , Clear ? and counter value 10.135 m^3 ∗1

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 value of unused user counters remains unchanged. See paragraph 8.4f.

- 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 ENTER briefly several times. For example, user counter No.1: 10,123 m^3 1
- Hold ENTER pressed for a prolonged time. The display will cycle through:
  Select ? , Clear ? and counter value 10,123 m^3 1
- – If you release the button when the display shows Select ? , the display will show the new user counter value with asterisk before the user counter number, indicating that this counter is just selected and running: 10.125 m^3 ∗1
- – If you release the button when the display shows Clear ? , the user counter
  will be reset and the display will show the new value of user counter 1: 0.000 m^3 1
- – If you release the button when the display shows 10.123 m^3 1, nothing will happen. Only the next available item will be shown. For example next counter: 980,785 m^3 2

If only user counter 1 is selected using a button for display as in paragraph 8.2, you can have it displayed by repeated short pressing of ENTER or →, and reset it by prolonged pressing of ENTER.
Items Select ? , Clear ? are not shown on display in such a situation.

Notes:

- FG4000 user counters work independently of 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.

- If the flowmeter is equipped with the archiving module, the value of user counter 1 with default setting in accordance with a) or the value of currently selected user counter with setting in accordance with b) is stored in daily and hour or daily and minute archive. See paragraph 7.6 and figure 31.
- User counters resetting and user counters selection is stored immediately in the user counters archive of changes including all relevant final and initial values. See paragraph 7.6 and figure 32.
- User counter resetting with button can be disabled as in paragraph 8.4a.

8.4 FG4000 flowmeter operating modes

a) Resetting the counters with button
By default, the flowmeter is supplied in this operating mode, so resetting with button is enabled. Optionally, the flowmeter can be set to disabled resetting of user counters and Clear ? 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 VISIKAL software) is disabled unless the service mode X1 jumper under electronics box cover is used.

c) Bi-directional flow
By default, this mode is disabled. If FG4000 is not used for billing purposes, it can be set to bi-directional flow measurement mode. Positive direction of flow is indicated with an arrow on the magnetic flowtube sensor. The flowmeter operation is then as follows:

- Flow rate value is shown with a sign that indicates the instantaneous flow direction.
- Main volume counter and user counters show the volume that has flown through the inductive sensor with respect to current flow direction. ∑ symbol is used before main counter volume value.
- Counters for positive and negative volumes are enabled.
  (items 15 and 16 in list in paragraph 8.2).
- Flow rate pulse output 2 as in paragraph 6.3b is enabled. See the following paragraph, e.
- The pulse output suppression at low flow rates for flow pulse outputs as in paragraph 6.3a and 6.3b can be set in range from 0.2% to 20% of Q_{max} (default setting Q_O = 0.2% of 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.
- If the interface module with analogue output as described in paragraph 7.2 is used, the analogue output value will vary from 4 mA to 20 mA or 0 to 10 V in proportion to absolute value of instantaneous flow rate of the liquid irrespective of current flow direction. 4 mA current corresponds to zero or negative flow rate; 20mA current corresponds to Q_{max} as described in the table in paragraph 6.3a). Při $|Q| \geq Q_{max}$ je výstup konstantní 20 mA nebo 10V.

  The analogue output response can be reprogrammed in a manner that 20 mA current (or 10 V voltage) corresponds to any flow rate value in litres per minute that is less than Q_{max} irrespective of flow direction.
- In addition, current output in 4-12-20 mA (0-5-10 V) mode can be selected as well as pulse output 2 in the frequency mode as described in the following paragraphs..

d) Current output in 4-12-20 mA (0-5-10 V) mode (only with bi-directional flow mode)
The interface module operates the analogue output as in paragraph 7.2 in this mode, so that if the instantaneous flow rate fluctuates from $-Q_{max}$ do $+Q_{max}$, the output follows the value proportionately from 4 to 20 mA or from 0 to 10 V. Then, 12 mA current or 5 V voltage corresponds to zero flow rate.

e) Pulse output 2 in the frequency mode with bi-directional flow mode only
In this operating mode, in accordance with paragraph 6.3a), the flow pulse output is sending the volume pulses only for positive flow direction, while the flow pulse output 2 as in paragraph 6.3b sends volume pulses only for negative flow direction. If this mode is not selected, the flow pulse output sends volume pulses as in paragraph 6.3a irrespectively of current flow direction and the pulse flow output 2 as in paragraph 6.3b 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. See paragraph 8.3a.
Optionally, the flowmeter can be set in a way that the user counters operate as in paragraphs 8.3b or 8.3b1.

g) Delayed reply
With default setting, the flowmeter responds immediately to a query during communication, which may cause problems in some situations. If mode of operation is selected, the flowmeter will respond with a 50 ms delay. This may be necessary for example if several networked flowmeters are connected to a single modem.

8.5 FG4000 firmware versions

Firmware version number shows up momentarily on the display on powering up the unit or pressing the RESET button.

For example:	∗ FG4000 V5.90 ∗	for version with no archiving module.
or:	∗ FG4000 V5.95 ∗	the same version with archiving module.

8.6 Setting menu structure

The flow meter FG4000 provides also setting of meter parameters by keypad and display.

a) Menu Structure
There are 8 main items in the flow meter menu

- VOLUME OUTPUT
- COMMUNICAT.PORTS
- VOL.INPUTS E,F
- ANALOG OUTPUTS
- Disp.menu type
- Displaylab.items
- METER
- Exit

VOLUME OUTPUT
In this submenu, you can choose the units of measure as well as configure the dynamic properties in the basic flow meter. These are
(a) Unit of volume (Disp.volume unit); options: [l, m3, hl, gal, pcs] – select
(b) Unit of flow (Disp.flow unit), options: [l/min, m3/h, l/h, hl/h, pcs/h, l/s, GPM] – select
(c) Instrument pulse number (Constant [imp/l]) – edit
(d) Minimum flow measured (Flow min.[%max]) – edit
(e) Measuring dynamics (Dynamics [sam/cyc]) – edit; this number determines how many measuring cycles it takes before the instrument renders the quantity measured. The higher this number, the slower the update of the quantity measured but also the lower the fluctuation of the values measured.

COMMUNICAT.PORTS
You can configure the instrument communication interface. The configuration is set up by selecting the options presented.

VOL.INPUTS E,F
The instrument allows connection of up to two peripheral pulse flow meters. In a manner similar to configuring the instrument, you can select the unit of flow and unit of volume as options presented and edit the input pulse number (copy it from the pulse flow meter nameplate) for them.

ANALOG OUTPUTS
The instrument allows entering up to two analogue outputs. You can select the output quantity from the options offered: [flow, flow E, flow F]. You can calibrate the instrument by editing the value at which the output current is 20mA.

Disp.menu type
If the instrument operates without interventions, it rotates displaying the values selected with YES/NO options in the menu.

Displaylab.items
If one of the buttons, or , is pressed, the display in turns shows details whose list can be updated here by selecting YES or NO in the menu.

METER
In this submenu, you can edit the date and time, the pace of items displayed taking turns in the automatic mode (items displayed rotate without intervention; for item selection see “Disp. menu type”) and PIN – a numeric passcode preventing unauthorized access to the menu.

Exit
Quits the instrument configuration process. If at least one menu item has been changed, “Save changes?” is displayed with the YES and NO options presented. WARNING! The Enter button changes if YES or NO is selected. It does not confirm the option selection. This is how the Enter button always works in selecting an option in a menu. To confirm the option selection, press the button.

b) Operation

Using Menu

An instrument menu is opened by pressing and holding the Enter button for about 2 seconds. Having to enter a PIN prevents from unauthorized access to the instrument menu. The default PIN value is “0000”, which is displayed on entering the menu. If the PIN has already been changed, you need to enter the new PIN. The PIN is entered by editing the default value – see further. To enter the PIN, press the Enter button. If the PIN entered is correct, the first basic item in the menu is displayed. The basic items may be scrolled through using ▯▯or ▯. By pressing Enter you open the submenu options. The submenu items can again be scrolled through and changed. Changing the default PIN to your own after instrument installation is recommended.

Changing Menu Item

If you want to change a submenu item, scroll to it and press Enter. The cursor starts blinking at the item selected and that is when you can change it. There are two ways of changing an item: by editing it or selecting one of the options presented.

(a) Editing Item – a way of changing a numeric value whether it is an integer, decimal number or date and time. You can change the digit at the blinking cursor position by pressing Enter. The digit is changed to the next value in a cyclic sequence 0 through 9 incrementing by 1. The sequence ranges are different for dates and times where the values of days, months, hours, minutes, seconds have their required intervals. Each item can be saved (confirmed) by pressing Enter if the blinking cursor position is after the last digit; otherwise pressing Enter always changes the blinking position value.

(b) Selecting Option – you cannot move the blinking cursor position with these items and it is placed always after the item value. Using the arrows, ▯ and ▯, you can scroll through the options and save (confirm) your selection by pressing the Enter button. Selecting YES/NO options works differently to simplify editing menu items “Disp.menu type” and “Displaylab.items”. Here you can use the arrows to save (confirm) the change as well as move to the previous or next item. WARNING! This approach is also applied in the Exit submenu, which is always displayed with the YES option on scrolling to this item. The arrow is used to confirm the selection. If you do not want to save the changes made, press Enter and the selection changes to NO. Subsequently press an arrow to exit the menu without saving the changes made.

9. SEALING AND INSTALLATION DOCUMENTATION

After installation and testing for correct operation, the installation provider shall seal:

- terminal front and back covers unless there is already manufacturer’s seal,
- flowtube sensor terminal bar for split flowtube sensor design unless there is already manufacturer’s seal,
- also temperature sensors, power supply and bypass closing fitting (see paragraphs 3.9, 4.8, and 5.1) with billing meters.

All meters are to be sealed since the seals are also a warranty condition.
Therefore seals must be renewed after every repair too.

Pursuant to metrological regulations, the installation provider must keep log records with the following details:

- flowmeter serial number,
- date of putting magnetic flowmeter in operation,
- end user address,
- magmeter installation site address.

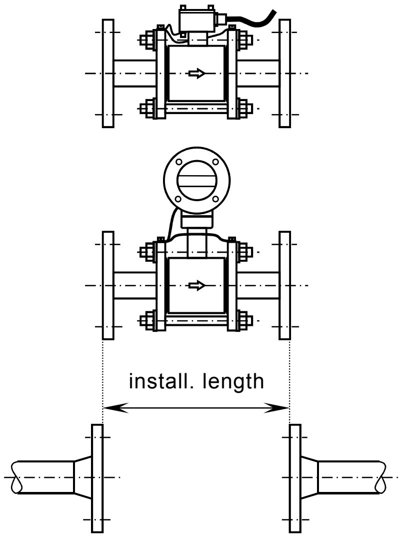
In addition, the installation provider will announce these data by returning the "Registration card" (which is attached to the warranty card) to the manufacturer.
The Registration Card must be returned without delay as it is a manufacturer warranty condition.

10. ORDERING

If you only specify the inner diameter in your purchase order, standard design flowmeter will be delivered (paragraph 8.1) with default settings (paragraphs 3.14, 5.1, 6.3, and 8.2) without interface or archiving module. Accessories as in paragraph 3.17 are recommended for flowmeters with unflanged flowtube sensor. The standard designs are shown in the manufacturer's price list and they have the shortest delivery times. Choose nominal inner diameter DN in correspondence with maximum operation flow rate (paragraph 3.1).

If you, however, require a flowmeter that will match your application conditions and will provide all the features desired right on putting it in operation, detailed specifications of design and settings within the purchase order are recommended.

Manufacturer's service engineer can change the user settings in an installed flowmeter too. Factory setting in accordance with your purchase order specifications prior to shipment is free of charge though.



NOTE:

FG4000 flowmeter Installation dimensions and its features are fully compatible with and can thus be used as replacements for flowmeters of EESA company, models FG4000CM , FG4000C, and FG4000E.

Replacement of mechanical flowmeter with magnetic flowmeter.

LIMESA meters can supply a magmeter kit with flanges (figure 35) that can be installed where a mechanical flanged flowmeter has been installed without any modifications. More benefits: greater measuring range and accuracy, elimination of errors caused by wear and tear or dirt in liquid under measurement as well as lower pressure drop.

This replacement is now available for DN20, installation length 190 mm; DN40, installation length 300 mm; DN50, installation length 270 mm; and DN80, installation length 300 mm. Our sales department will gladly give your more details.