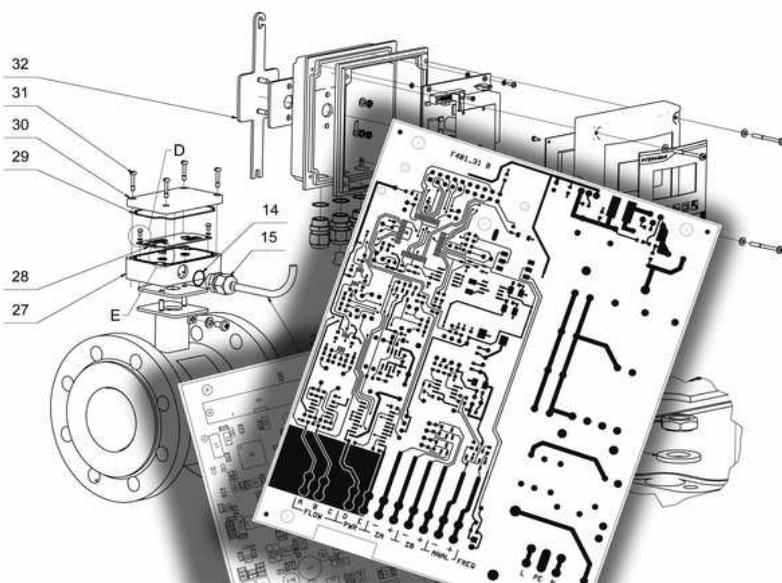


Induction Flow Meter

AcquaMAG[®]

Installation and Operating Manual



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CAUTION! We recommend to read carefully this manual and to follow the instructions mentioned here when installing the meter and putting it into operation!

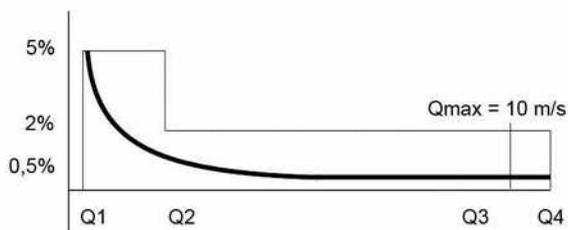
1 INTRODUCTION

The AcquaMAG® induction flow meter is designed for using in water management technologies for measuring both drinking and waste water.

It is certified in compliance with the European Parliament and Council Directive 2014/32/EC – (MID) and can be used as a prescribed – billing – gauge in all member states of the European Union.

It is manufactured in a compact version and in the so-called separated version in which the electronic unit is interconnected with the sensor by a special cable.

The instrument is characterized by the accuracy and stability of the bi-directional flow measurement within the range defined by OIML R 49-1 (see FLOW RANGE).



Meter error curve

The measured values can be read on a large graphical display; when setting parameters, the communication with the flow meter is carried out using the integrated keyboard of the device by selecting the firmware items displayed on the display, or via the RS232 data interface from the PC using the service application.

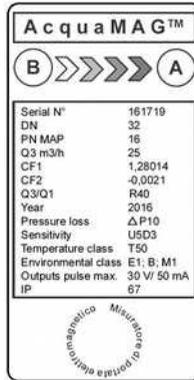
2 MOUNTING INSTRUCTIONS

2.1 LOCATION



CAUTION! When mounting the flow meter, follow the instructions given in EN 14154-2: 2005+A2:2011. Failure to follow the instructions specified in the standard or in this manual may result in erroneous measurement results for which the manufacturer is not responsible.

Place the flow meter into the tubing in such a way that the main flow direction matches the direction of the arrow on the flow sensor label. The main flow direction is indicated on the display by QA at the beginning of the upper line which displays the instantaneous flow, and by Σ A at the beginning of the third line which displays the volume counter in direction A. The reverse flow is then indicated by QB at the beginning of the upper line which displays the instantaneous flow, and by Σ B at the beginning of the fourth line which displays the volume counter in direction B.



CAUTION! For proper operation of the instrument, the specific cross-section of the induction flow meter sensor tube shall be completely filled with the measured liquid, and no bubbles may be generated in the measured medium flow!

In particular, observe the following principles:

1. If the technology uses any pumps, never install the sensor in the pump suction. Fig. 1A.
2. Place the sensor in the lowest point of the horizontal part of tubing or in ascending tubing. Fig. 1B.
3. Never place the sensor in descending tubing. Fig. 1C.
4. Ensure that the lengths of the steady (straight) parts of tubing are min. 5 x DN before the instrument and 3 x DN behind the instrument. Fig. 1D.
5. Tubing reduction with inclination up to 8° is considered as a straight part of tubing. Fig. 1E.
6. Do not expose the electronic unit to vibrations or direct sunlight. Fig. 1F.

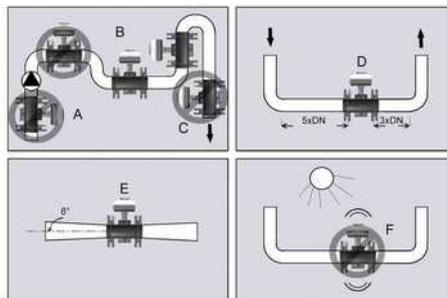


Fig. 1.

2.2 ELECTRIC CONNECTION



CAUTION! The induction flow meter is an electric device; therefore, the next steps can be performed by a qualified person only!

The terminals for connecting the power cable and for connecting the signal cables are accessible after releasing the screws and removing the cover of the electronic unit of the instrument. Fig. 2.

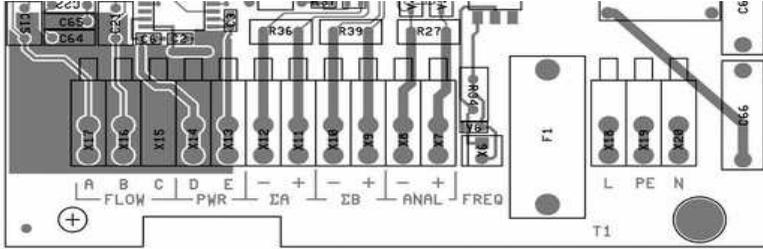


Fig. 2.

FLOW A, B, C.....measuring electrodes

PWR D, E.....electromagnet coil

ΣA.....pulse output for direction A

ΣB.....pulse output for direction B

ANAL.....analogue output

FREQ.....frequency output (for calibration only)

L, N.....instrument power supply 230 V/AC or 12–24 V AC/DC

PE.....protective conductor

1. Connect the earth terminal on the sensor casting to the earth potential. Fig. 3.



Fig. 3.

2. The induction flow meter is powered by the 230 V AC or by the 12-24 V AC/DC voltage applied to the terminal block marked L - PE - N. The version of the flow meter with the 230 V AC supply and with the 12-24 V AC/DC supply can be distinguished by the input power module which is located at the right side above the terminals for connecting the supply voltage on the flow meter panel.

	<p><i>Power module of 230 V AC</i> <i>Protection by the T250mA electrical fuse</i></p>
	<p><i>Power module of 12 V – 24 V AC/DC</i> <i>Protection by the T1A electrical fuse</i></p> <p><i>Current load of the power supply system</i></p> <p><i>12 V = 0.8 A</i> <i>24 V = 0.5 A</i></p>

3. Connect the power cable to the terminals. Always use a 3-wire cable. Connect the protective cable to the PE terminal; connect the working conductors to L, N terminals. **The polarity of the wires does not matter for the 12–24 V DC version.** The induction flow meter does not have its own On-Off switch so it must be fused and switched on/off in another device (e.g. switchboard).

4. The protection of electronic circuits is provided by an electrical fuse located next to the mains terminals. Its value is 250 mA for the 230 V AC version, and 1 A for the 12-24 V AC/DC version.



CAUTION! Switch on the power supply only after filling the sensor tube with the liquid to be measured and after connecting the jumper cable of the sensor and the signal cables of external devices!

5. Connect the external devices utilizing the current output or pulse outputs to the ΣA, ΣB and ANAL terminals. All outputs are isolated galvanically. The pulse outputs are of the so-called “open collector” type. The recommended power supply applied to the pulse output terminals should be within the range of min. 5 up to max 24 V DC, **the current load will not exceed 50 mA. Otherwise, the switching element can be destroyed!**

The following paragraph applies for the separated version only.

6. Connect the flow sensor cable to the ABCDE terminals in the housing of the flow meter electronics unit. The induction flow sensor in the separate version is supplied as standard with a 6 m cable that is connected to the sensor terminal block. For a better resistance to electromagnetic interference, it is advisable to protect the connecting cable between the sensor and the electronic unit by a metal protective hose or tube connected to the ground potential. . Fig. 4.



CAUTION! It is not permissible to connect and disconnect the connecting cable between the sensor and the electronic unit when the electronic unit of the flow meter is energized!

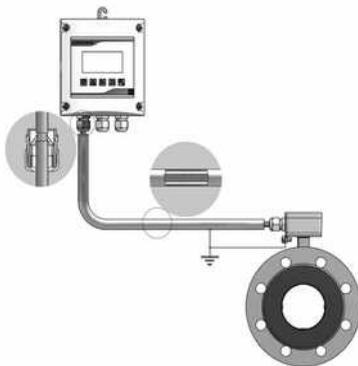


Fig. 4.

2.3 ELECTRONICS HOUSING SEALING

The design of the electronics housing is certified to comply with the IP 67 insulation class. In order to meet the reference conditions in which the tightness of the housing was tested by the testing laboratory, it is necessary to apply a thin layer of silicone grease to the openings in the rubber packing and along its perimeter before closing the plastic cover.

3 INSTRUMENT START

When the power supply is switched on, the instrument display shows POWER ON and the flow meter passes to the measuring mode. The basic data shown on the display are as follows: instantaneous flow in direction A indicated as QA, or in direction B indicated as QB in m³/hr or l/s; accumulated volume in the direction of flow A indicated as ΣA , and in the direction of flow B indicated as ΣB in m³; and, alternatively, in case that the EPD module is activated, the information of the course of the detection test for the presence of the measured liquid called EMPTY PIPE TEST.

4 INSTRUMENT CONFIGURATION



CAUTION! This manual describes how to configure items that are purposeful to change for the normal use of the instrument. However, it is recommended to change the parameters relating to the assigned sensor by the trained qualified personnel only. Any unauthorized intervention in the SENSOR SETUP section may result in erroneous measurement results.

A set of five keys situated under the graphical display serves to the basic user setting of the instrument. Fig. 5.



Fig. 5.

Key functions (from the left):

Movement among lines downwards, or editing to lower values.

Movement among lines upwards, or editing to higher values.

Movement on one line when editing to the right.

ESC key, termination of the action without saving any changes, or return to the previous menu.

ENTER key, activation of the editing line, or termination of the action with saving the changes.

Press the ENTER key and hold it pressed for approximately 2 seconds to switch the instrument from the measuring mode to the main menu mode. The main menu is accessible only after entering the correct four-figure PIN. The PIN is always set to 0000 in factory; then you can continue by pressing the ENTER key again.

**INSERT PIN
0000**

In case that an incorrect PIN is entered, the INCORRECT ENTRY message will appear on the display after pressing the ENTER key, and the instrument returns to the measuring mode.

The main menu includes individual sections for the user setting of data displaying, output setting, etc.

**DISPLAY SETUP
SENSOR SETUP
OUTPUTS SETUP
DAMPING
EMPTY PIPE DET.
PIN SETUP
EXIT**

To go back to the measuring mode, press EXIT in the main menu. You can switch to EXIT in the main menu from any main menu position by pressing the ESC key. After selecting it and pressing the ENTER key, the display will show:

**SAVE SETUP?

NO

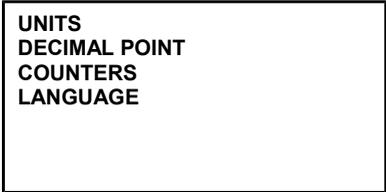
YES**

When you select NO and confirm it by ENTER, the instrument will go back to the measuring mode in the original state, without saving any changes. When you select YES and confirm it by ENTER, the original configuration is overwritten and the instrument will work with the new parameters.

4.1 DATA SETTING ON DISPLAY

The data shown on the display can be configured by the user. It is possible to set the language of passwords, units relating to the flow rate, displaying of volume counters and number of their decimal places.

Select DISPLAY SETUP in the main menu on the display and confirm the selection by ENTER. The following submenu will appear on the display:



Select UNITS in the submenu and confirm again by ENTER. Select the required unit in the following submenu and confirm again by the ENTER key. The sign confirming the selection in question will appear in the line of the selected item.



CAUTION! The change of unit applies to the instantaneous flow data only. The volume counter unit is always given in m³ and this unit cannot be changed!
When selecting the flow units of l/hr and l/min, it is also necessary to take into account the range of the measured flow rate and the number of places shown on the display. The l/min unit cannot be set for dimensions higher than DN 300, and the l/hr unit cannot be set for dimensions higher than DN 50 at the flow rate close to Q_{max}.

To go back to the preceding submenu, use the ESC key. To go back to the main menu, use ESC again, or use the same procedure as for setting the language by the LANGUAGE item, displaying the flown-through volume counters by the COUNTERS item for the concrete flow direction*, or for setting their decimal position by the DECIMAL POINT item.

* By selecting the counter display, the utilization of the pulse outputs and the analogue output for a concrete direction is defined, see the table of functions. If, for instance, only counter A display is defined, both pulse outputs work for flow direction A; while, if the “pulses” function is set for output B, output B takes over the volume setting per one pulse according to the setting of output A. If only the counter B display is defined, both pulse outputs work for direction B. When the displaying of counters A + B is defined, the pulse outputs work for both directions A and B according to the indication on the terminal block.

Flow direction A								
Interface		Pulse output						Analogue output
		A			B			
		Pulses	Signalization	Comparator	Pulses	Signalization	Comparator	
Displayed counter	A+B	Active	H	Active	L	L	L	Active
	A	Active	H	Active	Active	L	Active	Active
	B	Active	H	Active	L	L	L	4 mA

Flow direction B								
Interface		Pulse output						Analogue output
		A			B			
		Pulses	Signalization	Comparator	Pulses	Signalization	Comparator	
Displayed counter	A+B	L	L	L	Active	H	Active	Active
	A	L	L	L	Active	H	Active	4 mA
	B	Active	L	Active	Active	H	Active	Active

H – Output opened

L – Output closed

Active – The output works according to the set function

4.2 SENSOR ASSIGNMENT TO ELECTRONIC UNIT

The electronic unit of the induction flow meter may be configured for any sensor. The sensors are defined by the DN, CF1, CF2 parameters. The DN parameter determines the sensor dimension; CF1 determines the correcting amplification constant; CF2 determines the sensor offset. The function is accessible under the SENSOR SETUP item after inserting the X1 jumper. Fig. 6 (A).



CAUTION! For devices that are supplied as a billing gauge, any configuration of the metrological parameters of the sensor prevented by the so-called software seal; it means that it is not possible to set the parameters even after interconnecting the X1 jumper.

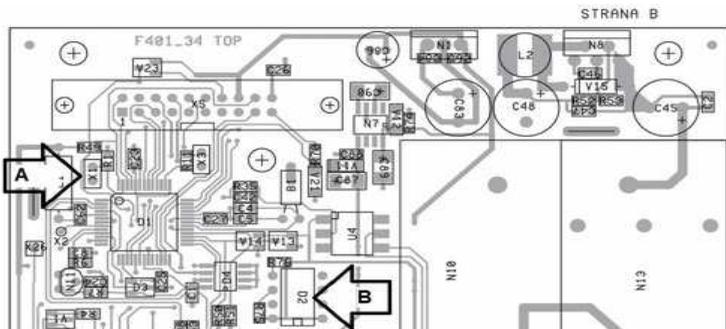


Fig. 6.

Select **SENSOR SETUP** in the main menu on the display and confirm the selection by **ENTER**. The following submenu will appear on the display:

DN	100
CF1	1.00000
CF2	0.00000

Select the item you wish to edit in the submenu and confirm again by **ENTER**. The editing function is activated and the position to be edited is highlighted by inverse illumination. Make the required changes and finish editing by **ENTER**. To go back to the main menu, use the **ESC** key.

4.3 TRANSFER OF CONFIGURATION PARAMETERS

In the event of a failure of the measuring board, it is possible to transfer the flow meter setting and the counter counts to a substitute board.



CAUTION For devices that are supplied as a billing gauge, this operation may be performed by the manufacturer only.

The flow meter setting and the counter counts are stored in the EPROM backup memory. Fig. 6 (B).

After replacing the damaged measuring board, remove the EPROM external memory from the original board and insert it into the new board. Ensure that the component is in correct position. Insert jumper X1. These operations must be performed when the power is off! Turn on the power. The data are automatically transferred back into the processor memory. Press **ENTER** to activate the main menu, go to **EXIT**, and then press **ENTER** again. In the next step, select **YES**, and then press the **ENTER** key.

SAVE SETUP?
NO
YES

The data is written permanently to the processor internal memory. Remove the X1 jumper. The backup memory is ready for further writing. If the X1 jumper is not removed, the configuration data and counter counts will not be archived.

4.4 ANALOGUE OUTPUT CONFIGURATION

The induction flow meter offers the active current output of 4-20 mA on the ANAL terminals. The output is in operation independently of the flow direction.



CAUTION! If it is not needed for the current output to be active in the reverse direction, it can be configured for one direction only by selecting the counter display. In the event of changing the flow direction, the current value of 4 mA remains at the ANAL terminals.

Select OUTPUTS SETUP in the main menu on the display and confirm the selection by ENTER. The following submenu will appear on the display:

CURRENT OUTPUT
PULSE OUTPUT A
PULSE OUTPUT B
COMPARATOR SETUP

Select CURRENT OUTPUT in the submenu on the display and confirm the selection by ENTER. Select the item determining the output type in the following submenu and confirm it by ENTER again. The sign confirming the selection in question will appear in the line of the selected item. When you press the ENTER key again, the display will show the data of the flow assigned to the 20 mA level. The flow unit is set automatically according to the unit selected in the DISPLAY SETUP* section. The repeated pressing of the ENTER key activates the editing function and the position to be edited is highlighted by inverse illumination. Make the required changes and terminate editing by pressing ENTER. To go back to the preceding submenu and the main menu, use the ESC key.

The FIX 20 mA, FIX 12 mA, FIX 4 mA and OFF items serve for checking the analogue output function. By selecting any of the items and by confirming it by ENTER, the analogue output gives permanently the level of current corresponding to the selected item. After pressing the ESC key and leaving the menu, the analogue output will be returned to the original state.

**Note: It concerns only the unit using l/s and m³/hr.*

4.5 PULSE OUTPUTS

The flow meter is equipped with two pulse outputs ΣA, ΣB that can serve as the indication of the flown-through volume, the indication of the change of the flow direction, or the indication of the flow direction change, or the signalization of the set minimum or maximum flow rate – the COMPARATOR function.

Using the COMPARATOR function in connection with the analogue output, it is possible, e.g., to monitor the instantaneous flow rate in the selected zone. Fig. 7.

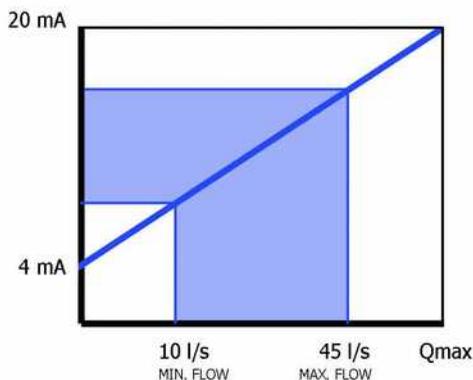


Fig. 7.



CAUTION! The pulse outputs consist of electronic components the external power supply of which will not exceed 30 V / 50 mA. The minimum voltage suitable for the correct function of the outputs is 5 V. It is recommended to place a FF 40 mA fuse to the circuit as protection against current overloading,

The volume per 1 pulse is set automatically according to the dimension of the sensor assigned to the electronic unit.

Volume per 1 pulse according to DN				
DN	15 – 32	40 – 100	125 – 350	400 – 1000
l/imp	1/10/100/1000	10/100/1000	100/1000	1000
m ³ /imp	0.001/0.01/0.1/1	0.01/0.1/1	0.1/1	1

The user has the possibility to change the value only in the upwards direction. The pulse length (pulse output in the on-state) is fixed to 50 ms ($f = 10$ Hz).

Select OUTPUTS SETUP in the main menu on the display and confirm the selection by ENTER. A submenu will appear on the display.

Select OUTPUTS SETUP A or B in the submenu and confirm the selection by ENTER again. In the following submenu that is in the format according to the selected measuring unit, select the required value of the volume per 1 pulse and confirm the selection by ENTER. The sign confirming the selection in question will appear in the line of the selected item.

l/imp (A)
1
10
100
1000
REVERSE FLOW ALARM
COMPARATOR

In the case of setting the REVERSE FLOW ALARM function, the pulse output is permanently in the on-state as long as the flow in the given direction (A or B) is indicated. If the COMPARATOR function is set, the output level changes according to the set values. The output is switched to the on-state when the flow reaches the set MIN. FLOW and remains in the on-state until the flow does not reach the set MAX. FLOW.

The levels are set under the COMPARATOR SETUP item.

**CURRENT OUTPUT
PULSE OUTPUT A
PULSE OUTPUT B
COMPARATOR SETUP**

Select the OUTPUTS SETUP item in the main menu on the display and confirm the selection by ENTER. A submenu appears on the display. Select COMPARATOR SETUP in the submenu and confirm the selection by ENTER.

Select the item you want to edit in the following submenu and confirm it by ENTER again.

**MIN. FLOW. = 0% Qmax
MAX. FLOW. = 100% Qmax**

Press the ENTER key to activate the editing function, and the editing position is highlighted by inverse backlighting.



CAUTION! The Qmax value is equal to the flow speed of 10 m/s.

Make the required changes and finish the editing by the ENTER key. To go back to the preceding submenus and the main menu, use the ESC key.

4.6 INSTRUMENT DAMPING

The instrument software enables to damp the influence of eventually uneven flow through the tube by means of the SAMPLING function which is the floating averaging of several second's measurement samples and the influence of the so-called fictitious flow caused by electromagnetic disturbances by means of the ZERO ZONE function.



CAUTION! For devices that are supplied as a billing gauge, any configuration of the parameters under the DAMPING item is prevented by the so-called software seal.

Select DAMPING in the main menu on the display and confirm the selection by ENTER. The following submenu will appear on the display:

SAMPLING	10 s
ZERO ZONE	0.99 %Qmax

Select SAMPLING in the submenu and confirm again by ENTER. The editing function is activated and the position to be edited is highlighted by inverse illumination. By setting the numeric data to higher values, the resulting figure of the flow is more stable but the flow meter reacts to any change in flowing with a higher time delay. Finish editing by ENTER. To go back to the main menu, use the ESC key.

To damp undesirable small fictitious flows, select DAMPING in the main menu on the display and confirm the selection by ENTER. A submenu will appear on the display. Select ZERO ZONE in the submenu and confirm it again by ENTER. The editing function is activated and the position to be edited is highlighted by inverse illumination. By setting the numeric data to higher values, the zone in which the flow meter does not measure increases. The maximum value that can be set is 0.99% Qmax. Finish editing by the ENTER key. To go back to the main menu, use the ESC key again.

4.7 EMPTY TUBING INDICATION

The flow meter can be equipped with a function which enables to detect, either one time, or in regular time intervals, whether the liquid is present in the tubing and whether the sensing electrodes are connected.

In the case that the sensing electrodes are not in contact with the measured liquid, no matter whether due to the empty tubing, or due to the disconnection of the flow sensor from the electronic unit, the state is evaluated as the zero flow and the EMPTY PIPE message appears on the display. After removing the failure, the instrument goes back to the measurement mode automatically.



CAUTION! The EMPTY PIPE TEST function is active only in instruments equipped by the EPD module. In the case that the instrument is not equipped with the module, the INCORRECT ENTRY message appears on the display after selecting the EMPTY PIPE TEST item and, after pressing the ENTER key, the instrument returns to the measuring mode.

Select EMPTY PIPE TEST in the main menu on the display and confirm the selection by ENTER. The following submenu will appear on the display:

**ONLY BY STARTUP
PERIODICAL
OFF
TEST**

Select the required item in the submenu and confirm it again by ENTER. The sign confirming the selection in question will appear in the line of the selected item. To go back to the main menu, use again the ESC key. Use the ESC key also to go back to the main menu. The ONLY BY STARTUP item offers the start of the function only when the power supply voltage is switched on; when you select PERIODICAL, the detection function is active permanently.

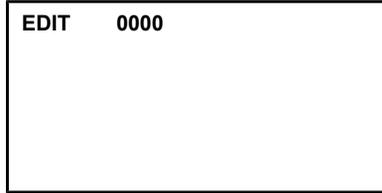
The TEST item enables to start the detection manually, outside the automatic mode. Select the EMPTY PIPE TEST item in the main menu on the display and confirm the selection by ENTER. A submenu will appear on the display. Select TEST in the submenu and confirm it by ENTER again. In the case that the state of the tubing is all right, the O.K. message appears. If the tubing is empty or the contact of the measuring electrodes with the liquid is disrupted, the EMPTY message appears. To go back to the main menu, use the ESC key again.



CAUTION! The empty pipe detection function cannot eliminate the incorrect positioning of the sensor in the tubing. For proper function of the meter from the metrological point of view, always observe the principles contained in chapter 2 MOUNTING INSTRUCTIONS/LOCATION. The empty pipe detection function is recommended to be used only in applications where long-term emptying of the piping can actually occur, e.g. when measuring the outflow from open rainwater tanks.

4.8 ACCESS PIN SETTING

Select PIN SETUP in the main menu on the display and confirm the selection by ENTER. The submenu with a visible access password will appear on the display.



By pressing the ENTER key, the editing function is activated and the position to be edited is highlighted by inverse illumination. Make the required changes and finish editing by ENTER again. Use the ESC key to go back to the main menu.

5 MODBUS RTU COMMUNICATION

The data output is available on the flow meter display board at the RxD, TxD and GND terminals. It is the output of the RS232 type that is not isolated galvanically. Fig. 8.

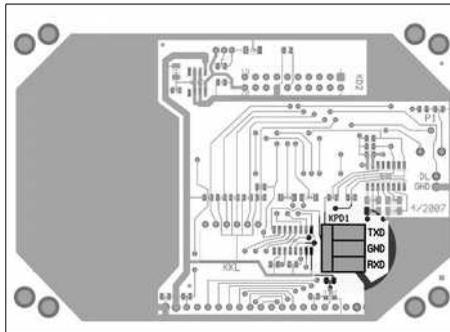


Fig. 8.



For industrial use, we recommend to convert the output to the RS485 type by a suitable RS232/RS485 converter with the galvanic insulation of the line.

5.1 MODBUS RTU PROTOCOL

Table of register addresses:

Address	Data (words) length	Quantity	Unit	Data format	Note *
0000h	2	Flow rate	l / s	float	1
0002h	3	Counter, A direction	l	BCD	2
0005h	3	Counter, B direction	l	BCD	2
0008h	1	Temperature of converter	°C	INT16	5
0009h	2	Working hours	h	INT32	6
0080h	1	Address		INT16	3, 4

*Notes:

1. The data format corresponds to the single type in Pascal or to float in C-language.
2. Each byte of the data contains two decimal digits in the order starting from the highest degree.
3. The permitted addresses are 1 and 3 – 247. The address 2 would conflict with the format used by the setup programme, therefore it cannot be used.
4. The address can be entered only using the 06 code function. Reading is not necessary because it could not be read without knowing the address.
5. A higher byte is a whole part of the figure with the step of 1°C, a lower byte is a fractional part (1 LSB = 1/256°C).
6. The lowest byte is transmitted as the first one.

The ModBus 1.1 AcquaMAG[®] application can be used to test the communication. Fig. 9.

The application, as well as a description of the software procedure for developing your own communication software, can be downloaded from the manufacturer's website (<http://vodomernatechnika.cz/eng/downloads>).

The application is not installed; it is only copied to the selected directory.

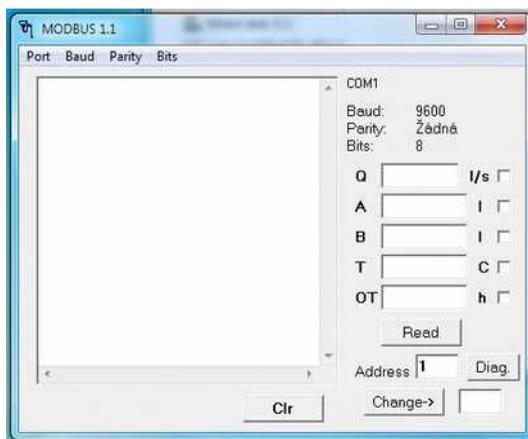


Fig. 9.

If the hardware is properly plugged in, simply set the PC port number, check the required quantity in the check boxes, set the correct address in the Address window (the address is always set to 1 in a new device) and press the Read button.

The commands and the answer of the flow meter are displayed in the hexadecimal format in the large window on the left, and the numeric figures are displayed in the windows on the right.

The address of the device can be changed by entering the desired address in the window next to the Change button and pressing the button.

If the user forgets the set address of the device, it is possible to bring it back using the Diag button.



The Diag function can be used only in the case that the flow meter is connected to the PC via the RS232 line!

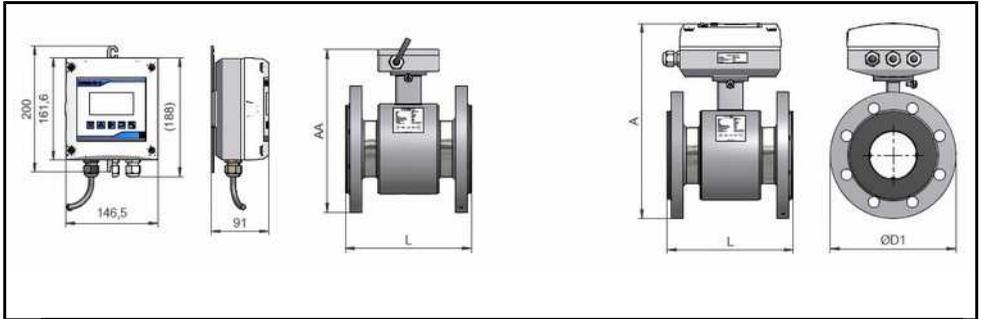
6 TECHNICAL PARAMETRES AND FLOW RANGE

Nominal pressure	PN 10 through PN 16
Connection to tubing	Flanges EN
Measuring tube lining	Rubber, PTFE
Sensing electrodes	Stainless steel AISI 316L
Measurement error	OIML R 49
Range	Q3/Q1 = 250/160/100 Q2/Q1 = 1.6 Q4/Q3 = 1.25
Ambient temperature	0 through 50 °C
Power supply	100–240 V AC (optionally 12–24V AC/DC)
Input power	10 VA max.
Outputs	2× passive pulse, galvanically separated, programmable output, 50 ms/imp (f=10 Hz, NPN transistor, loading of 30 V/50 mA max.) 1× active current, programmable output (4–20 mA up to loading of 500 Ω) 1× RS232
Communication	RS232, keyboard, graphical permanently illuminated display
Insulation class	IP 67

The table shows the flow values for the most common dimensions and the basic R40 range.

DN	Q3	Q1*	L	PN	T
mm	m ³ /hr	m ³ /hr	mm	MPa	°C
15	6.3	0.1575	165	1.6	30/50
20	10	0.25	165	1.6	30/50
25	16	0.4	200	1.6	30/50
32	25	0.625	200	1.6	30/50
40	40	1	200	1.6	30/50
50	63	1.575	200	1.6	30/50
65	100	2.5	200	1.6	30/50
80	160	4	200	1.6	30/50
100	250	6.25	250	1.6	30/50
125	400	10	250	1.6	30/50
150	630	15.75	300	1.6	30/50
200	1000	25	350	1.6	30/50
250	1600	40	450	1.6	30/50
300	2500	62.5	500	1.6	30/50

7 VERSIONS AND DIMENSIONS



	PN 16												PN 10 PN 16			PN 10						
DN	15	20	25	32	40	50	65	80	100	125	150	200	250	300	350	400	500	600	700	800	900	1000
L	165	165	200	200	200	200	200	200	250	250	300	350	450	500	500	600	600	800	800	1000	1000	1000
A	216	221	231	249	259	274	294	309	319	359	389	445	525	578	638	693	815	938	1033	1130	1220	1335
AA	163	168	178	196	206	221	241	256	266	306	336	392	472	525	585	640	762	885	980	1077	1167	1335
D1	95	105	115	140	150	165	185	200	220	250	285	340	405	460	520	580	715	840	910	1025	1125	1225
(kg)	2	2	2	3	5	6	9	11	13	20	24	34	41	55	65	110	120	155	230	325	420	510