CALOR 40

For 0-80% ethylene-glycol mixture measurement

Installation manual and specifications

Contents:

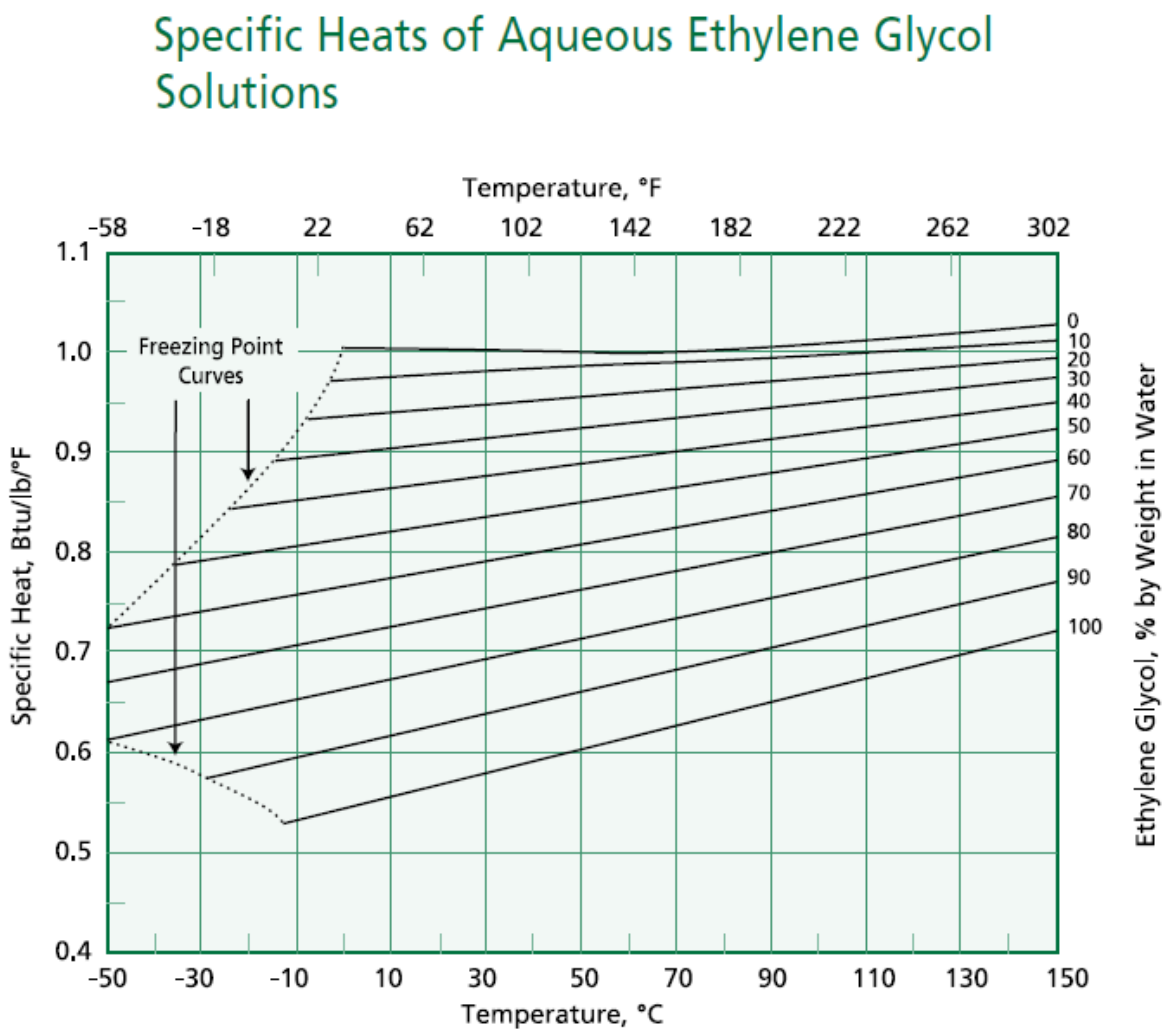
Description of the unit

The Calor 40 is a flow meter based on the measuring principle of Faraday's electromagnetic induction law, according to which a voltage is induced when a conductive fluid flows through the magnetic field of the flow meter. This voltage is picked up with two electrodes that are in direct contact with the liquid measured and it is evaluated in the electronic unit.

The inductive meter Calor 40 is suitable exclusively for measuring volumetric flow of conductive liquids with a minimum conductivity of 2 μS/cm.

The meters are designed for flow measuring where the speed of liquid is within the range 0.01 ÷ 10 m/s. The greatest accuracy of measurement is reached within the range 1 ÷ 10 m/s.

The special version of CALOR 40 provides for measurement of heat delivered by the ethylene glycol-water mixture. For correct measurement, the correct mixture rate must be set up in the meter. Incorrect setting or using other medium than it is presented in the chart below may result in incorrect measurement.



Scope of delivery

The accessories vary according to an optional flow sensor and some above standard optional features.

Threaded construction
The electronic evaluation unit with a wall-mounting holder (not for the compact design), a flow sensor (in case of the compact design, the electronic unit is an integral part of the flow sensor), a grounding cable, and installation instructions, wells with paired temperature sensors and assembly instructions

Sandwich construction
The electronic evaluation unit with a wall-mounting holder (not for the compact design), a flow sensor (in case of the compact design, the electronic unit is an integral part of the flow sensor), bolts to install the sensor between flanges (see the quantity as per Torque Chart below) with nuts and washers (it is not allowed to replace the washers delivered, especially when these are spring washers), 2 fibre-rubber seals (part of the meter), connecting earth cable, mounting instructions, wells with paired temperature sensors and assembly instructions

Flange construction
The electronic evaluation unit with a wall-mounting holder (not for the compact design), a flow sensor (in case of the compact design, the electronic unit is an integral part of the flow sensor), screws to install the sensor between flanges (two-fold quantity as per Torque Chart below) with nuts and washers, 2 fibre-rubber seals, connecting earth cable, mounting instructions, wells with paired temperature sensors and assembly instructions

Construction for food processing industry
The electronic evaluation unit with a wall-mounting stamping (not for the compact design), a flow sensor (in case of the compact design, the electronic unit is an integral part of the flow sensor), welded pipe adapter as per DIN 11851, mounting instructions, wells with paired temperature sensors and assembly instructions

In the event of the separate construction, the induction sensor is equipped with a special cable to connect the meter (it must not be lengthened or shortened).

Storage conditions

The transportation and storage temperature must be within the range -10 °C up to 50 °C.

Warranty

Incompetent installation or application of inductive meters (devices) may result in loss of warranty as well as failure to comply with mounting and/or operating conditions pursuant to this Manual.

When the meters are shipped out to the COMAC CAL plant to be checked and/or repaired, enclose please the completed form, refer to the last page of this manual. Unfortunately, we

will not be able to process correctly and promptly your requirement for modification and/or repair of your meter.

In-pipe installation

Relevant information for selection of location

!!! In the event of the separate construction, the cable must not be lengthened or shortened !!!

Outdoor conditions
It is necessary to prevent the flow sensor from being directly exposed to weather conditions and prevent the liquid to be measured from freezing over inside the flow sensor, which might damage the measuring tube.

In the case that the Electronic Evaluation Unit is located outdoors, the manufacturer recommends a protective case, and if appropriate, a roof to avoid direct sunshine so that the evaluation electronics cannot warm up excessively.

Sources of disturbance

These are the sources disturbing the steady flow of a liquid:

- Pumps and bends or elbows located closely in series in various planes. These elements should be at a distance of at least 20×d ("d" stands for inside diameter of the sensor in mm) before the flow sensor.
- Sudden variations in the pipe section unless constructed as a cone with angle $\alpha \leq 16°$ (where α is the angle between the bevelled walls of the pipe adapter).
- Incorrectly centred seal, the seal with a mall internal diameter, or the seal made of Soft elastic materials which penetrate into internal section of the pipe after the flanges have been tightened.
- Anything that interferes with the flow of liquid, e.g. the thermometer well.
- Branches, T-pieces, bends, elbows, slide valves, taps, and throttles. Shut-off valves, control valves, butterfly valves, and check valves. Pipe outlets from tanks, heat exchangers, and filters.

No strong electromagnetic field must take effect close to the inductive flow sensor (pick-up).

Vibrations
We recommend you to support the connecting pipes at both sides of the meter to partially eliminate vibrations. The level and range of vibrations must be below 2.2g within frequency range of 20 ÷ 50 Hz according to IEC 068-2-34 standard.

Proper location
The flow sensor must not be at the top of the pipeline where air intake occurs or in the declining and also in horizontal pipeline with open end where air may penetrate. Sedimentation of impurities may occur during a long-run measurement of very low flow rates $Q < 0.1$ m/s. The site where the flow sensor is installed there must be a sufficient pressure so that vapour or gas bubbles cannot be discharged from the liquid. The tiny bubbles occurring in liquids all the time can accumulate at any of the electrodes and they can cause incorrect function of the meter. The gas bubbles are discharged from liquids also during a sudden drop

of pressure. Therefore, the control butterfly valves and similar components should be inserted **behind the flow sensor**. For the same reason, the flow sensor should not be installed at the suction side of the pump. To prevent the bubbles from accumulating in the flow sensor while the flow is slow, it is useful for the pipeline either to be slightly ascending or the sensor is put into the vertical part of the pipeline.

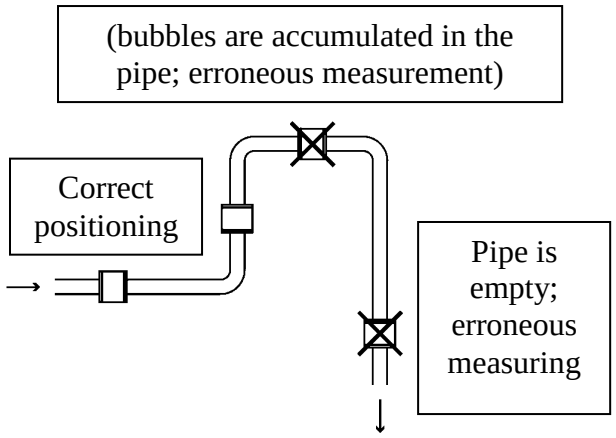
If the meter is populated with measuring electrodes only (2 or 3 electrodes located **beyond the upper profile** of the tube), it is necessary for proper function of the meter, to fill up the flow sensor with the fluid to be measured so that erroneous measurement of quantity of liquid passing through the meter can be avoided when the pipe is empty. It is necessary to select the location of the meter in such a way that the flow sensor aeration is avoided.

In the case of an open system, the flow sensor is placed in the bottom position of the U-profile, ensuring that the fluid will not flow out of the sensor.

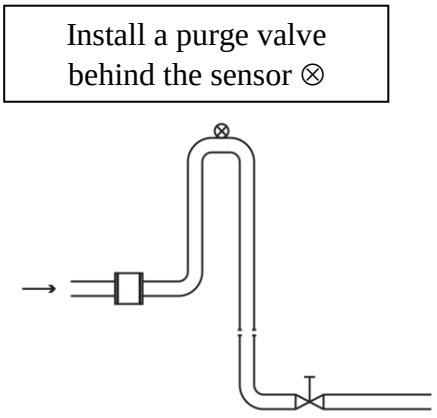
Examples of installation

The trouble free and accurate operation of the meter depends on correct location in the system, especially when the internal PTFE or rubber lining is used where there is a risk of damage as a result of negative pressure. The most frequent methods of positioning are illustrated in the following figures:

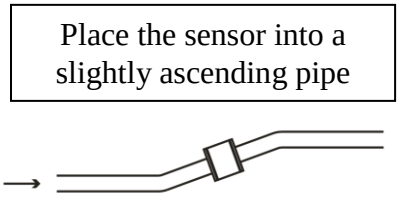
Recommended positions for installation



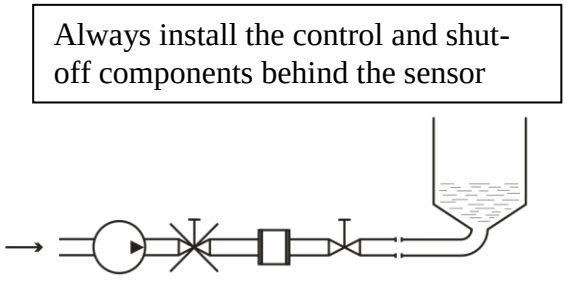
Down pipe



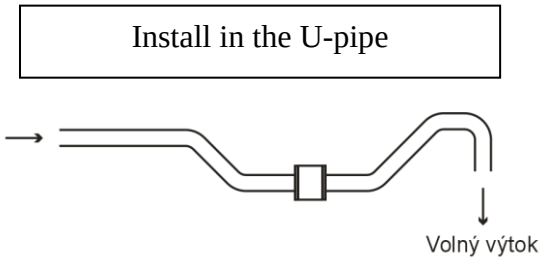
Horizontally positioned pipe



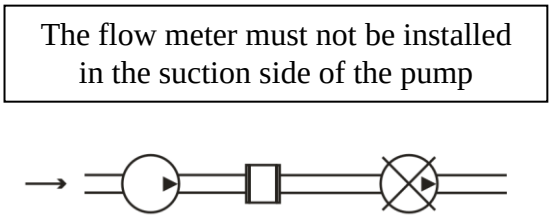
Long pipe



Free inlet or outlet



Pumps



The flow of liquid in the flow sensor should be **steady and with no whirls**. For this reason, straight pipe sections of the same diameter as that of the sensor (permitted deviation +5%) are usually inserted before and behind the flow sensor. The minimum length of the sections is $3\times d$ before the flow sensor and $2\times d$ behind the flow sensor.
It is not necessary to adhere to the minimum length of the straight section when conical junctions with angles $\alpha_1, \alpha_2 \leq 16°$ (α_1 – angle of the cone before the flow meter, $\alpha 2$ – angle of the cone after the flow meter) are used if their minimum internal diameter is identical to the internal diameter of the flow sensor (with permissible deviation +5%).
No sources disturbing the steady flow must be found in the specified straight sections. They must be positioned in the pipe behind the flow sensor or at the longest possible distance before it.
The sources of disturbance may substantially decrease the measuring range and accuracy of the flow meters.

Recommendation
When the flow is whirled up, increase the stabilizing sections of the pipe or install the flow conditioner.
When mixtures are blended, it is necessary to install the flow meter either before the blending spot or at a sufficient distance behind it (30xd min.) otherwise it may result in unstable readouts.
The grounding rings are necessary when plastic or metal pipes with the internal non-conductive layer are used.

Compact construction of the meter:
When the compact heat meter or flow meter is used, it is necessary to respect the maximum temperature of liquid up to 90 °C. If this temperature is exceeded, correct operation of the Electronic Evaluation Unit is not secured, eventually there is a risk of its destruction.

Do not pick up the meter during installation by means of the Evaluation Unit housing.

If the pipe is exposed to excessive vibrations (e.g. from pumps), the use of compact meters is not recommended.

The designer, or in some case, the user himself are responsible for suitability and adequacy of application of compact inductive meters.

Actual in-pipe installation

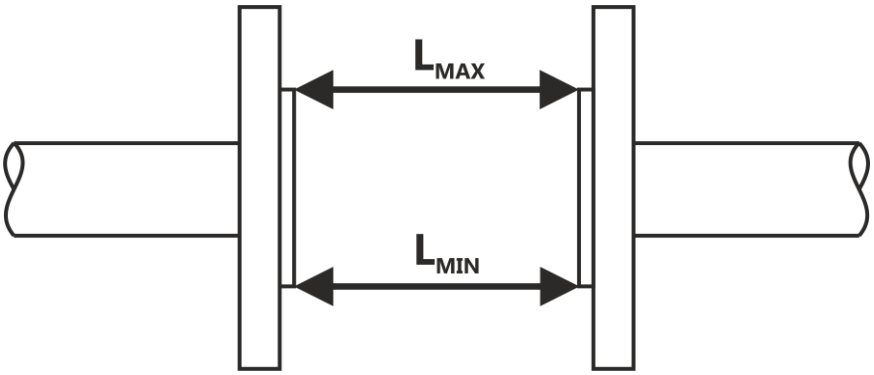
The flow meter is installed and put in operation only by the organization with authorization to conduct such activity and whose staff has passed the appropriate training course in installation

of these meters and flow meters in terms of this manual at the manufacturer. The manufacturer will issue certificates, confirming that the workers have passed this training course.

The inductive flow sensor is installed in arbitrary position in vertical piping. In the case of horizontal piping, it is necessary to make sure that the sensor is installed with its measuring electrodes in horizontal position. If the version with grounding electrode, or empty pipe test is in question, then the installation is always carried out with a cable grommet for the sensor, or with the evaluating unit in the upright position (in case of compact version). Then the grounding electrode is in the bottom position and the sensing electrode in the top position of the flow sensor.

The assembly is carried out by fixing between the counter-flanges (sandwich) that are welded to the modulating piping (5×d before and 3×d behind in the flow direction) whereas the fluid must flow through the flow sensor in the direction that is **indicated with an arrow** on it.

When counter flanges are being welded on the pipe, it is essential to maintain their **alignment** so as to ensure uniformity of seating faces of the flanges on the face areas of the sensor (however, this must not be reached by uneven tightening of the connecting bolts because there is a risk of leakage resulting from temperature strain in the future and, in some case, the measuring tube might crack when being tightened unevenly). The difference in L_{MAX} and L_{MIN} distances of the both sealing faces on the flanges before the flow sensor is installed, **must not be longer than 0.5 mm.**



In the same way, the mating positions of holes for connecting bolts in counter-flanges should be ensured as well as ample room behind the flanges for the connecting bolts and nuts in order to ensure proper installation of the sensor in the pipe and the attachment by connecting bolts.

The manufacturer recommends using a fitting adapter for welding. It is absolutely inadmissible to use the flow meter as a fitting adapter due to possible thermal destruction. The welding current must not flow through the flow sensor during electric welding. The installation of the flow sensor itself is carried out after all welding, painting, building, and similar jobs are finished.

If the flow sensor has a fibre-rubber sealing, it is inevitable to lubricate it using graphite grease or oil with graphite.

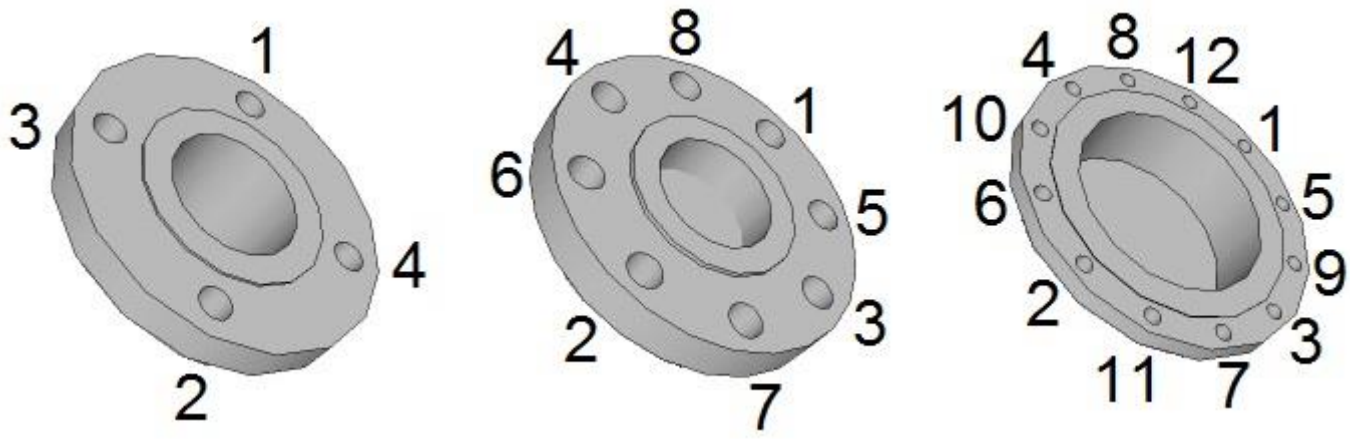
When a threaded connection is used, it is essential to check the thread on the sensor, while it is being tightened, to prevent it from moving round a slight amount.

Avoid during the installation:

- Dropping the meter on the floor and causing injury especially to the ceramic measuring tube.
- Contamination of electrodes (do not touch the electrodes as contamination occurs).
- Using any additional seal so as to prevent it from extending to the flow profile of the sensor between its flanges and the pipe, otherwise the error in flow measurement may be increased.

Tightening torque values

It is absolutely essential to tighten the connecting bolts and nuts evenly and subsequently on opposite sides and in the order illustrated in the figure with the maximum torque indicated in the table below.



Measuring tube	Corundum/ PVDF	Corundum/ PVDF	Corundum/ PVDF	Corundum	Rubber/ PTFE	Rubber/ PTFE	Rubber/ PTFE
DN (mm)	6 ÷ 20	25	32 ÷ 50	65 ÷ 80	100	150	200
No. of bolts	4	4	4	8	8	8	12
Mk (Nm)	20	25	50	60	75	80	90

When the thermoplastic tube in flange construction is used, the same torque figures apply as those for the corundum tube.

If you do not find your inside diameter or construction in the Torque table, it is a special or non-standard construction. In this case contact the manufacturer for detailed information please.

Tightening is necessary to be done three times; for the first time to 50% of max. torque as per the table above. For the second time, to 80% and for the third time, to 100% of the max. torque.

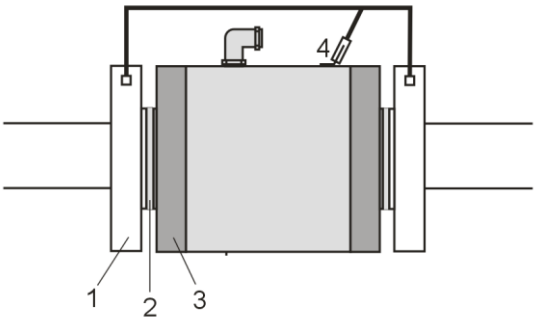
It is recommended to check the tightening of the bolts approx. 24 hours after the meter has been installed.

When the flow sensors over 200 mm are installed, it is essential to observe, apart from the above mentioned rules, also simultaneous tightening of the parallel screws on both counter flanges to prevent the electrodes or the measuring tube from possible injury (symmetrical stretching of the lining).

Grounding

Each of the flow meters must be perfectly and effectively grounded. The grounding line must not transfer interference voltage, therefore, this line must not be used simultaneously for grounding other electric meters.

The flow sensor is equipped with a stainless grounding screw with washer and nut for the grounding cable being delivered with mounting accessories. This must be conductively connected with the counter flanges. If it is not ensured that the counter flanges are in direct contact with the measured liquid and they are conductive, it is essential to apply grounding rings, see hereinafter.



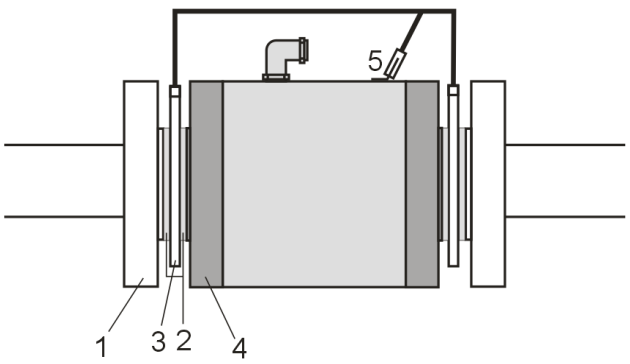
1 – opposite flange
2 – seal
3 – sensor
4 – grounding connector

Grounding rings

Only if they are ordered. They are applied for plastic or metal pipes with the inside layer for the measuring tube elevated or put out onto the faces of the flow sensor. The conductive rings made of stainless steel provide conductive connection with the measured fluid.

The flow sensor is furnished with a stainless grounding screw for the grounding cable being delivered with mounting accessories. This must be conductively connected with the grounding rings.

1 – opposite flange
2 – seal
3 – grounding ring
4 – sensor
5 – grounding connector



Pipeline at high temperatures
When the temperature of the measured liquid is above 100°C, it is necessary to compensate the forces caused by linear expansion of the pipeline due to its warming. It is necessary to use a flexible seal for short pipelines. Flexible pipeline components are to be used for long pipelines (such as bends).

PTFE lining
Install at the lowest position of the pipeline to avoid negative pressure to develop. Never separate and foul up the rim of PTFE lining extended over the faces of the flow sensor. Remove the caps from the inlet and outlet ends just before insertion of the sensor between the pipeline flanges and replace them with metal plates (0.3 ÷ 0.6 mm in thickness). Remove the metal plates after the sensor has been inserted.

Resistance temperature detectors
The resistance temperature detectors Pt 500 are installed in piping or angular tubes that are provided with inclined or straight welded-on pieces with G 1/2“ thread according to the temperature sensor manufacturer. The sensors are usually placed in protective wells and their lengths are selected according to nominal inside diameter of the pipes. The wells are provided with G 1/2“ thread.
Temperature sensors are assembled at the angle of 45° in the direction opposite to the flow of the medium. The temperature sensor is sealed in the protective well against unauthorized removal.

Well length selection example:
For piping with outside diameter:
- up to 40 mm - well length approx. 50 mm
- 50 to 125 mm - well length approx. 80 mm
- 150 to 300 mm - well length approx. 150 mm

Installation check

After the flow sensor has been installed in the pipe, it is necessary to check:
- According to the label, if there is a corresponding meter at the given measuring place (pressure, temperature, dimensions, etc.).
- If the arrow direction on the device corresponds to the fluid flow direction in the pipe.
- The correct position of the measuring electrodes (horizontal).
- The correct position of the electrode for detecting empty pipe (up).
- If all the terminals (bolts) are tightened properly.
- If grounding rings are used, if they have been installed correctly and if they are connected to the sensor.
- Correct flow sensor grounding.
- Correct installation of the restful sections of the pipe.
- If the sensor is protected against vibrations and mechanic tension.
- If the label (serial number) on the sensor corresponds to the label of the electronics.

Wiring system

This works can be done just by a competent person with the appropriate electro technical qualification in accordance with terms of Law Regulation!!!
The warranty for errors resulting from incompetent implementation of operations described below becomes null and void!!!
Turn off the power every time before the Evaluation Unit is opened!!!
It must be remembered that Electronic Evaluation Unit and flow meter sensor are whole system that is uniquely paired and calibrated. Always assure that serial numbers of both parts are identical!!!

Meter wiring

In the event of the separate construction, the special cable to connect the meter must not be lengthened or shortened.

The signal cable of the separated inductive flow sensor cannot be run in parallel even partially with cables for line voltage distribution or close to motors, electromagnets, contactors, frequency converters, and similar sources of electromagnetic disturbance. In inevitable cases it is necessary to run the cable inside the ferrous and grounded conduit.

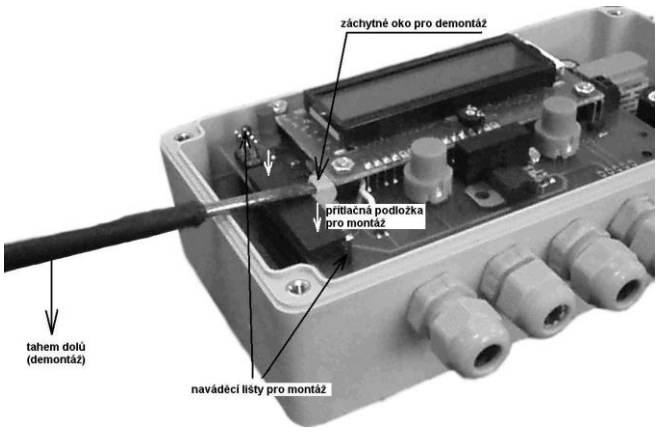
In order to ensure the impermeability of the evaluation unit cover, it is necessary to keep the gasket intact and clean and always covered with grease (the impaired seal should be replaced immediately). If the cable grommets are not stemmed, it is necessary to do so.

Evaluation unit
The evaluation unit is delivered for 230 V / 50÷60 Hz power supply.
The signal inputs and outputs of the flow meter may only be connected to devices where personal accident protection is ensured by safety extra-low voltage and where the generated voltages do not exceed the limits specified for the safety extra-low voltage.

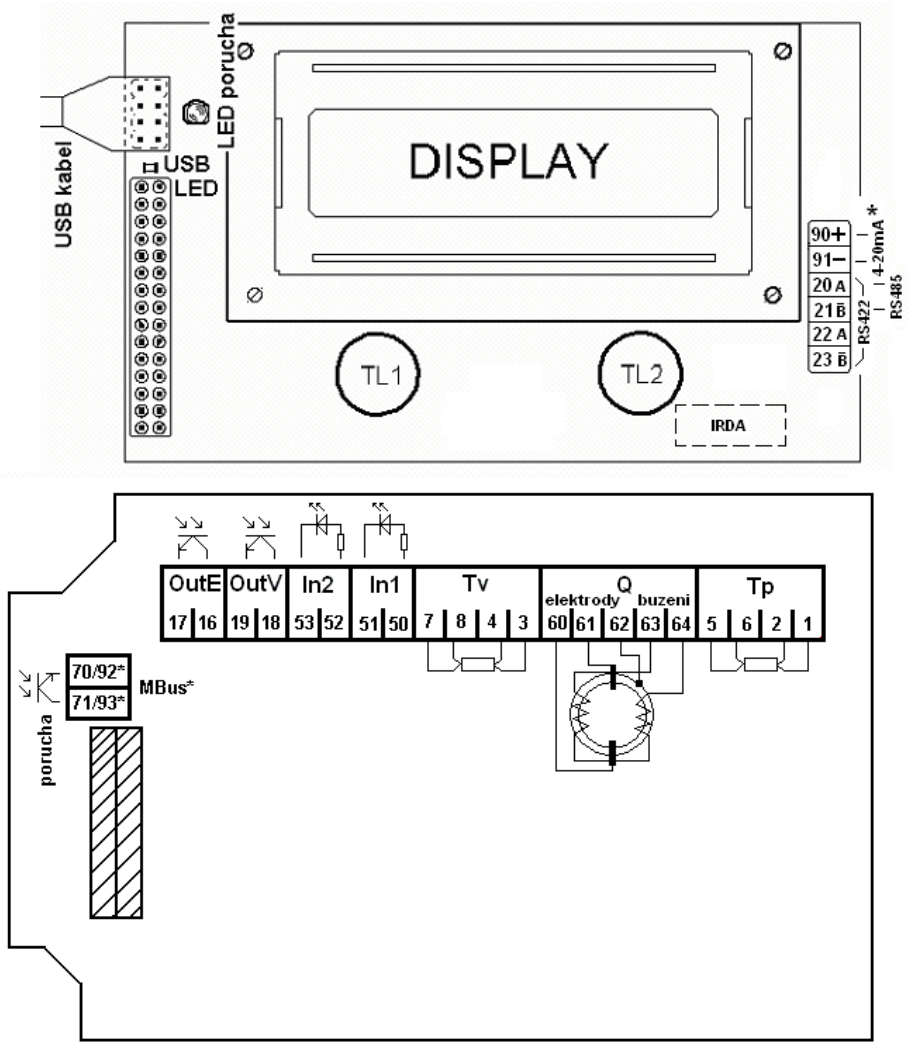
Evaluation unit wiring
The terminal board for connection of individual interconnecting cables is located inside the temperature meter cover. The cover can be removed after four clamp bolts are unscrewed. The upper part of the meter should be removed as shown in the figure below. The terminal board is found on the lower part.

Upper part removal procedure:
1) Insert a screwdriver in the lug for removal.
2) By pulling the handle downward disengage the upper part carefully from guides.

Upper part assembly procedure:
1) Put the upper part onto the guides.
2) By pressing gently onto the thrust washer, push the upper part connector into the lower PCB.



Terminal board wiring



Terminal No.	Signal description	Signal identification
1	Sensor into supply piping/assigned to No.5 (* 4-wire only)	
2	Sensor into supply piping/assigned to No.6	
3	Sensor into return piping/assigned to No.7 (* 4-wire only)	
4	Sensor into return piping/assigned to No.8	
5	Sensor into supply piping (* 4-wire only)	
6	Sensor into supply piping	
7	Sensor into return piping (* 4-wire only)	
8	Sensor into return piping	
16	Energy output for remote pulse counting *	CE
17	Energy output for remote pulse counting – ref. level *	
18	Volume output for remote pulse counting *	CV
19	Volume output for remote pulse counting – ref. level *	
50	Pulse input 1 *	
51	Pulse input 1 – ref. level *	

52	Pulse input 2 *	
53	Pulse input 2 – ref. level *	
70	Output - Failure *	
71	Output - Failure – ref. level *	RTX+
20	RS485/422 (Tx/Rx A+) *	RTX-
21	RS485/422 (Tx/Rx B -) *	
22	RS422 (Rx A+) *	
23	RS422 (Rx B -) *	
90	4÷20mA (+) *	
91	4÷20mA (-) *	
92	MBUS *	
93	MBUS *	
60	Electrodes sensor flow (red wire)	
61	Electrodes sensor flow (blue wire)	
62	Sensor – ground	
63	Stimulus – sensor (white wire)	
64	Stimulus – sensor (black wire)	
27	Mains terminal N	
28	Mains terminal L	

Note *) Terminals are not dependent on the meter's configuration

All the pulse inputs and outputs are isolated by optocouplers U_{CE} max = 80V
Ic max = 50mA
P max = 100mW
I_F max = 50mA

The polycarbonate box of the electronic evaluation unit is provided with PG 7 type of grommet (max. outside diameter of the cable = 7 mm).

Make the connections without power supply in the following order:

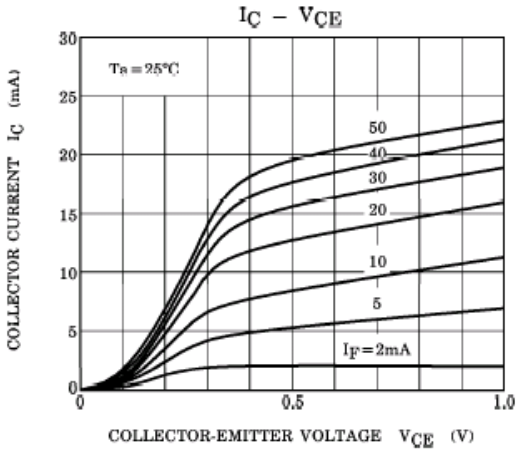
1. Connect the inductive flow sensor to terminals 60,61,62,63,64 according to the Table. ***!!! The shielded conductor must not be in direct (conductive) contact with the lower sealing metallic cover.***
2. Connect the connecting cables of the resistance temperature detectors (orange terminals = the sensor in supply piping, grey terminals = the sensor in return piping) to terminals 1 to 8. If twin line connection is used, the temperature sensors are connected to terminals 2 and 6 for the supply temperature sensor and to 8 and 4 for the return temperature sensor.
3. Other terminals (communication, input/output signals) are connected as needed according to the above given table.
   !!! The wires from the flow meter, temperature sensors and communication must not be laid close to power cables and must not be exposed to effects of electromagnetic fields, especially those generated by switch-mode power supplies.
4. Connect the power supply cable to terminals L, N. Install as an independent supply circuit with its own protection. Bring the 230V/50 Hz supply voltage using a separate two-wire cable without a disconnect switch with protection (0.,5 to 1Amp). The circuit breaker must be sealed against unauthorized tripping.

Avoid making kinks in the cable or in individual conductors and do not allow their mutual crossing in the terminal board area and always use a separate cable grommet for power supply lead. The flow sensor shielding wire must not be in direct (electrically conductive) contact with the interior metallic cover of the meter.
Use pieces of cable or plastic pins to plug up the unused grommets (impermeability).

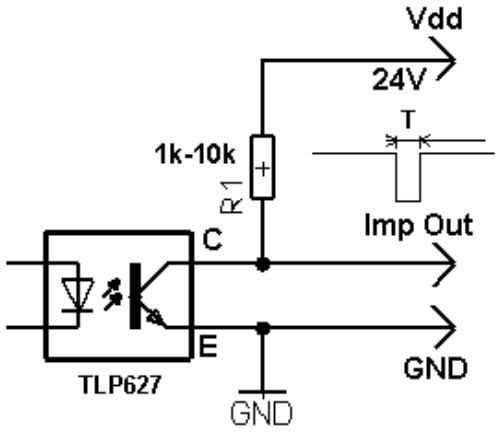
E & V pulse outputs

The output of energy and volume pulses is implemented by an optocoupler with an NPN switching transistor. Limit parameters of this optocoupler are 80V/100mA/100mW max. The volume and energy pulse output serves for remote transmission of volume and energy pulses. The conversion constant is arbitrarily adjustable (float data type) using user software. Setting must be carried out in such a manner that fout<15Hz.
The optocoupler load should be selected in such a way that its limit parameters cannot be exceeded:

Load characteristic (**I_f = 2.5mA**)



Wiring example



Owing to CTR≈100%, it is necessary to select the collector current of 2.5mA at the most.

Pulse inputs

As a standard, the meter is equipped with 2 pulse inputs isolated by optocouplers. The 560R resistor is inserted in the input. Max. permissible current of the LED is 50mA, which makes it possible to connect the input up to 24V voltage directly. The conversion constant is arbitrarily adjustable (float data type) using user software and fin<1.2kHz must be accepted.

Current output

The CALOR40 has a sixteen-bit D/A - converter with data update approx. every second. The converter is isolated from the meter itself by means of optocouplers. The current loop is

connected to terminals 90 and 91. The current output must be fed from an external power supply. The external power supply U_e voltage can be within 12 to 24 V.
The loop resistance must not be higher than $R = U_e / 0.02\ (\Omega; V)$.
As a standard, it is adjusted in such a way that with the maximum flow Q_{max} the loop current is 20mA and with zero or negative flows, the loop current is 4mA. The limits can be set up by user software.
The value of the current is directly proportional to the value of the flow in the sample.
As the converter is fully digital, it will save the last value also after flow meter power loss.
For the sake of a failure, it is possible to use the failure status output which can be connected with the current output in series and thus detect the error state with a higher-level system.

Output - Failure

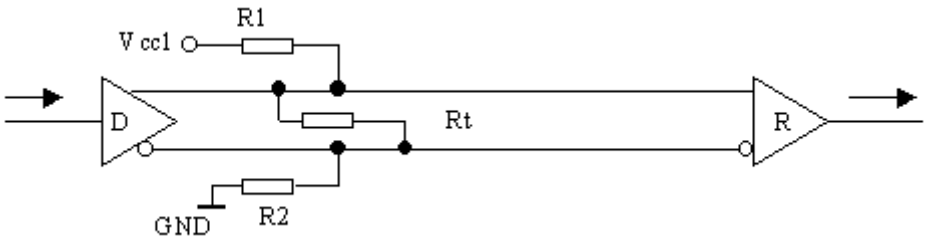
The output is implemented by an optocoupler with an NPN switching transistor, the collector of which is connected to terminal 70 and the emitter to terminal 71. Limit parameters of this optocoupler are identical to the parameters of the pulse output. The optocoupler is closed during the trouble-free operation. The optocoupler is open when there is a failure (such as power loss).
The failure-output on the meter is brought out only when the meter has no MBUS communication interface.

Data output

The CALOR40 meters support several communication protocols and physical interfaces.
Physical layer types:

1) MBus
2) RS485
3) RS422
4) IrDa
5) GSM

Note to RS485/422 physical layer*)
The connection of Rt terminators to the line ends are recommended. These resistors can be activated on CALOR40 meters using the integrated jumper. Owing to bit rates, the terminators do not serve for impedance matching (echo elimination), but for definition of levels with disconnected drivers during networking.
For definition of idle state with disconnected drivers it is recommended to connect resistors R1 and R2 to conductors A and B with a value of 1-2kΩ on the control equipment side.



However, the A and B conductors are marked by different manufacturers in a different way and their mutual potential in idle state is not apparent even from the EIA standard. If the identification of the conductors is not clear, the only solution is to put the equipment in idle state during transmission and measure the polarity or find correct wiring by swapping the conductors. The line drivers cannot be destroyed by swapping the conductors.
The CALOR 40 meters suppose that the B conductor in idle state is more negative than the A conductor. For example, this wiring is reverse for MOXA converters.
Terminals for connection of individual interfaces are illustrated in the section: Terminal board wiring.

Supported communication protocols:

1) MBus
2) Amset
3) CALOR30 (* this protocol is here for compatibility purpose only- further support is terminated)

Starting up

Before connecting power, check the installation of the unit if it is correct according to "Installation in pipework" a "Electrical installation" chapters.
The meter is not connected to mains power supply during assembling before the system is filled up with the measured medium and the meter is disconnected from mains before the system is discharged.
In the case of ceramic measuring tube, it is important to adhere to gradual warming or cooling down the tube always by 50°C maximum and always after 5 minutes while the pipework is filled up with the medium. Failing to adhere to these preconditions, the measuring tube may be destroyed.
If the system is flushed, put the equipment in operation by switching the supply voltage of (the circuit breaker on). Right after powering up, the message "Initialization is in progress" is indicated on the display and the meter starts taking measurement (the measured quantities are stabilized after approx. 20 seconds). After a few seconds, the display is switched into date and time mode. The meter is under operation. In Settings menu, check the set points for correct setting (DN, return, supply, constant of outputs/inputs, Baud rate, zero adjustment, etc…).
If the meter operates in accordance with operating instructions, seal the meter and the circuit breaker.

Functional description

Controls
The buttons on the front panel of the meter, according to its version and model, are used for selection of the required information to be shown on the display. After connection of the meter to mains, the message "initialization in progress" is shown on the display. After a few seconds, the display is switched into date and time mode. The meter is under operation. When any of the buttons is operated, the display backlight is turned on. After a few minutes from the last press of any of the buttons, the display backlight is turned off and the first line of the basic menu (date and time) is displayed. When any of the buttons is operated, the display

backlight is turned on. After a few minutes from the last press of any of the buttons, the display backlight is turned off and the first line of the basic menu (date and time) is displayed. The <> button is used for viewing the data in the current menu. The **M** button is used for moving to submenu. Returning from submenu is carried out by the longer press of the **M** or <> **buttons.** The long press of the **M** button always results in returning to basic menu to date and time menu item. The long press of the <>button results in returning to one level back if it is possible.
User settings are performed by CALOR40-setup software via USB interface.

MENU structure
Menu is divided into 5 basic menu items:

1) Basic menu and its submenu:

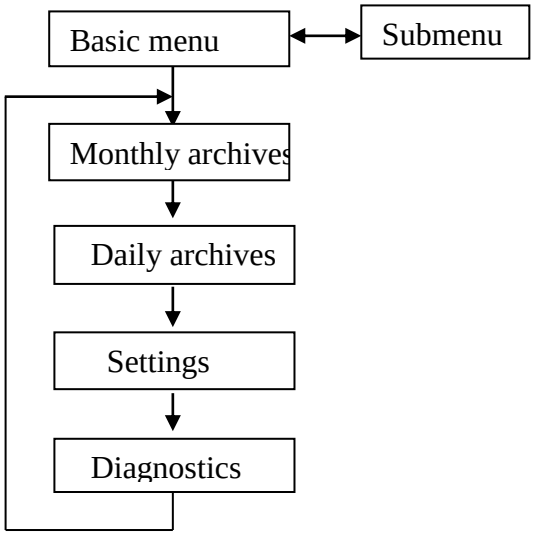
Basic menu:	**Submenu** (button **M**)**:**
Date and time	None
E [GJ]	Em, Etar1, Etar2, Etar3 [GJ]
V [m^3]	Vin1, Vin2, Vm, Vin1m,Vin2m [m^3]
Tp [°C]	Tpmax+time [°C], [hr]
Tv [°C]	Tvmax+time [°C], [hr]
dT [°C]	dTmax+time [°C], [hr]
Q [m^3/h]	Qmax+time [m^3/h], [hr]
P [kW]	Pmax+times [kW], [hr]

2) Monthly archives menu:
Em [GJ]
Etar1m [GJ]
Etar2m [GJ]
Etar3m [GJ]
Vm [m^3]
Vin1m [m^3]
Vin2m [m^3]
Monthly downtime [Days-hrs]

3) Daily Archives Menu:
Ed [GJ]
Vd [m^3]
Tpmax+time [°C], [hr]
Tvmax+time [°C], [hr]
dTmax+time [°C], [hr]
Qmax+time [m^3/h], [hr]
Pmax+time [kW], [hr]
Daily downtime [hrs]

4) Settings Menu:
Serial number
DN
Version
Year of examination
Location
Meter's address
Baud rate

Menu bloc diagram



<u>Description of control buttons:</u>
Left button <> – Listing
Right button **M** – Selection of individual

Tariff1 setting
Tariff2 setting
Tariff3 setting
Qmin [m^3/h] setting
Qmax [m^3/h] setting
Pulse output constant E [MJ/pulse]
Pulse output constant V [l/pulse]
Pulse input constant V1 [pulse/l]
Ethylene glycol mixture ratio [%]

5) Diagnostics Menu:

Energy factor [kJ/m^3]
Enthalpy - supply [kJ/kg]
Enthalpy - return [kJ/kg]
Reverse volume [m^3] (reverse volume in reverse direction flow)
Sensor offset [mV] (service data for sensor diagnostics)
Uptime [Days-hrs]
Total downtime [Days-hrs]
Error code
Number of samples out of parameters

Menu nomenclature:

E	energy	Tp	temperature - supply
Etar	energy in given time tariff	Tv	temperature - return
Em	monthly energy	dT	temperature difference
V	volume	Q	flow rate
Vm	monthly volume	P	power
VinX	volume from external water meter X	max	maxima
VinXm	monthly volume from external water meter X	min	minima

Basic parameter setting

As this is a billing meter, any intervention in the set-up is illegal. Any tampering with the seals on the meter and on thermometer wells, flow meter and inside the evaluation electronics is also illegal.

The equipment is delivered with adjusted date, time and the other parameters as per customer requirements and the basic data are indicated on the front panel of the meter or flow meter. Any modification to setting cam only be performed by the manufacturer or by the organization authorized by him which will attach new production or assembly seals. The metrology seals must not be damaged during these operations!

User settings

User settings can be modified by means of integrated USB interface. Setting is carried out by means of the "CALOR-40 Setup" configuration software.

It is possible to modify the constants of the following items:

Eout [MJ/pulse]
Vout [l/pulse]

Vin1 [pulse/l]
Ethylene glycol mixture ratio [%]
Q/P_{4mA} [l/h, kW]
Q/P_{20mA} [l/h, kW]
Baud rate
Meter's address
Energy - time tariff1
Energy - time tariff2
Energy - time tariff3
Reinitialization

The reinitialization option is suitable for industrial environments with frequent occurrence of interfering electrostatic voltages and electromagnetic fields. When this option is checked, the meter reloads system constants of the entire meter once a day.

Setting procedure:
1) Remove the top cover.
2) Connect the USB cable with PC with the meter switched on.
3) Set the constants in Setup menu according to your requirements.
4) Write the constants by selecting the Zapsat (Write) menu option.
5) Check the changes using the Nacist (Load) menu option.
6) The changes will take effect after the meter is restarted or during reinitialization.

Archives
Archives are accessible from meter's menu (see Menu structure) or by means of user software "CALOR-40 Setup" – Data section.

Procedure for reading the archives by means of user software:
1) Remove the top cover.
2) Connect the USB cable with PC with the meter switched on.
3)Select the parameters for loading the archives according to your requirements.
4) Select the Nacist (Load) menu option to load the archives.

Note: The SYLK menu option creates an "Arch.slk" file in the existing directory compatible with the SYLK format. This format can be opened, e.g. in Excel or any other spreadsheet.

Backup in case of total destruction of RAM memory
The billing data are backed up in several ways. The total energy data is backed up by every saving along with daily archives. Besides this backup, all of the incremental counters (E,V+,V-,Vin1,and Vin2 and total disable state) are backed up at a certain increment to the so-called Crash sector. In the case of total data loss, the data can be loaded from the Crash sector.
Loading can be performed again by means of user software "CALOR-40 Setup" – Crash sector section.

Safety rules for operator
The operator is allowed to operate this equipment only in terms of *CONTROLLING*item.
Any interference with the induction flow sensor, resistance temperature sensors and the meter itself by the operator are illegal and they may lead to direct scalding by the medium in the

case of improper manipulation with the induction flow sensor and the warranty will become null and void. Carry out electric connections always after powering off.

Certification and maintenance
The manufacturer delivers the CALOR 40 heat meter and FLOW 40 flow meters after certification and with seals identified with the certification year.
The equipment does not require any maintenance by the operator.

Technical data

Evaluation electronics technical parameters

Measured medium:	water and ethylene glycol mixture up to 80% ratio
Supply voltage:	230V (+10%; -20%) 50 ÷ 60Hz
Input power:	6 VA
Dimensions:	165 x 85 x 55mm
Degree of protection:	IP 65
Ambient temperature:	5 ÷ 55°C
Ambient humidity:	max. 90%
Display:	LCD 2 x 16 characters
Sampling:	7.5 samples per second
Display response:	1.2 sec
I/O response:	1.2 sec

Flow sensor technical parameters

MEASURING TUBE MATERIAL	Special thermoplastic			Ceramics		Teflon
INTERNAL DIAMETER RANGE	DN 6 ÷ DN 40			DN 6 ÷ DN 100		DN 100 ÷ DN 200
MAXIMUM OPERATING TEMPERATURE [°C]	90	115	150	115	180	150
MAXIMUM OPERATING PRESSURE [Mpa]	1.6	2.5	2.5	4.0	4.0	2.5
THREADED CONNECTION	•	•	•	-	-	-
FLANGED CONNECTION (sandwich design)	•	•	•	•	•	•
SENSOR IP PROTECTION	IP 54					
ELECTRODE MATERIAL	CrNi steel DIN 1.4571 (AISI 316 TI) or as required (Ta, Ti, Pt)					

If you do not find your ID or design in sensor technical parameters table, it is a special or non-standard design. In these cases, you will find this information on the sensor plate where this is always indicated or contact the manufacturer for more detailed information.

Operation checks

When the below mentioned operations are carried out unprofessionally, the claim to warranty covering the errors that may occur, becomes null and void !!!
Turn off the power before any manipulation with the evaluation unit !!!

Failures and their symptoms in the course of measurement

Unstable indication and outputs may appear with:

- high portion of solids
- non-homogeneities in state of aggregation
- dislocation of blending
- chemical reactions in measured substance are still in progress
- using diaphragm pumps or piston pumps

Evaluation unit checking

Troubleshooting

- **No data shown on display, red LED is OFF** – supply voltage for meter has failed. After restoration of the supply voltage, the meter registers the supply voltage failure and continues in taking measurement.
- The **meter is under voltage but no data indicated on display** – apply a long press on the right **M** button of the meter for display reinitialization. If the display fails to light up, contact the nearest service centre (the power supply can be measured according to the description below).
- **Red LED is ON** – find the error code on display and eliminate the error or contact the service centre.
- **Meter does not respond to the front panel buttons pressed down** – apply the long press to the right **M** button of the meter until the display is reinitialized. If the display fails to light up after pressing the button, contact the service centre.
- **After failure of the supply voltage, measured values are set to zero** – contact the service centre.
- **In any other suspicion of malfunction** – check in service mode if the data correspond to rated and set point values.

Error code

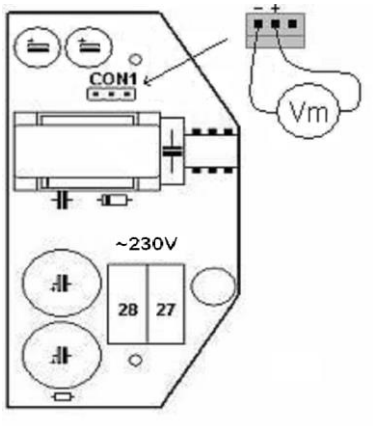
1 data write error
2 data read error
4 EEPROM error
8 volumetric gain out of permissible range
16 energy gain out of permissible range
32 Tp error
64 Tv error
128 dT out of range

The gross error is given by the sum of individual errors.

Power supply check

This check may only be performed by a skilled person with relevant electrical qualification according to Regulation No.50/1978 Coll.

Hook up a voltmeter to CON1 connector according to the Figure. The measured value should be within 8 to18V.



If the measured value is out of the given interval and the 230V mains is in order, the power supply unit is faulty. Its replacement without necessary recalibration is sufficient for the service.

Flow sensor checking

Necessary measuring instruments and tools:

- cross-head screwdriver
- ohmmeter with at least 3V measuring voltage

Preparatory work

- Switch off power
- Unscrew the top cover of the electronic evaluation unit
- Disconnect the flow sensor from the terminal board
- The flow sensor must be flooded with the measured medium of with water

Operation	Standard result	False drop
Measure the resistance between conductors (white and black)	20 ÷ 60Ω	If lower, the winding is short-circuited
		If higher, the winding is open
Measure the resistance between the shielding and the excitation conductors (white and black)	> 30MΩ	If lower, a short circuit to ground – shielding
Measure the resistance between the shielding and the electrode wires (red and blue or red and yellow)	1 kΩ ÷ 1 MΩ (both of the measured values should be approximately identical)	If it is lower, empty the sensor and repeat the measurement, if it is still lower, then the electrode wires are short-circuited
		If it is higher, the lines from electrodes are open or the electrodes are dirty
		Different values, the electrode wires are open or the electrodes are dirty

Note: The measurements across the electrodes should not take a long time otherwise electrodes become polarized and the measurement result will be biased. When the measurement takes longer, swap the measuring wires across the measured ones so that polarity is changed (capacitor effect)!!!

If any of the measurement results is wrong, it is necessary to return the meter to the production plant. When returning the meter to COMAC CAL s.r.o., follow the instructions given on the last page.

Checking the evaluation unit by flow simulator (optional)

CANON connector pinout

Pin 1 - excitation (coil)
Pin 2 - not connected
(electrode)
Pin 3 - not connected
Pin 4 - signal from sensor (electrode)
Pin 5 - signal from sensor (electrode)
Pin 6 - excitation (coil)
Pin 7 - not connected
Pin 8 - not connected
Pin 9 - shielding (sensor body)

Cable wiring

Black, white - excitation (coil)
Blue, red - signal from sensor

Shielding - ground

The function of the leads for the existing flow sensor is indicated in brackets.

Meter routine checking:
When checking the meter, it is possible to recognize tentatively the correctness of flow measurement by replacing the flow sensor with the flow simulator (cable wiring is identical to that of flow sensor according to colour insulation) and adjust, in successive steps, on the potentiometer dial, the values that you have written down for given flow rates after installation of the meter (e.g. 624) and monitor if the displayed reading corresponds to the reading at the moment of installation (e.g. 42 m^3/hr). The recognized values should approximate to the values registered during installation of the meter as much as possible. If the registered values differ significantly from the recognized ones (by 5 and more per cents), it will be advisable to have the meter checked in terms of metrology.

Troubleshooting:

- the meter fails to indicate the flow - If the meter with the simulator indicates the flow and the values correspond approximately to the previously registered values, then there is a failure in the flow sensor itself. If the meter fails to indicate the flow with the simulator as well (it indicates 0 or negative values), it is possible that the meter discriminates the direction of fluid flow, or there is a failure in the evaluation unit electronics. In case that the meter discriminates the direction, simply swap the excitation wires (white and black wires) or the electrode wires (blue and red wires).
- the meter "does not keep" zero - If the meter does not keep zero with the simulator either, there will be a failure in the electronics, if it be to the contrary, the failure will be in the flow sensor most likely, or the shielding is not connected, or the pipeline is empty, or some of the valves leaks and water is still flowing through the sensor.
- is it suspected that the meter indicates a higher or lower flow than the correct Q flow - If the meter with the simulator indicated the values corresponding approximately to the previously registered values, then the failure may be found in the flow sensor, or the estimation of the correct flow was wrong and the meter is in order. If it is the other way round (the values are different from those registered), the failure is in the evaluation unit electronics.

Service

All warranty and after-warranty repairs are carried out only by the manufacturer **COMAC CAL s. r.o.**

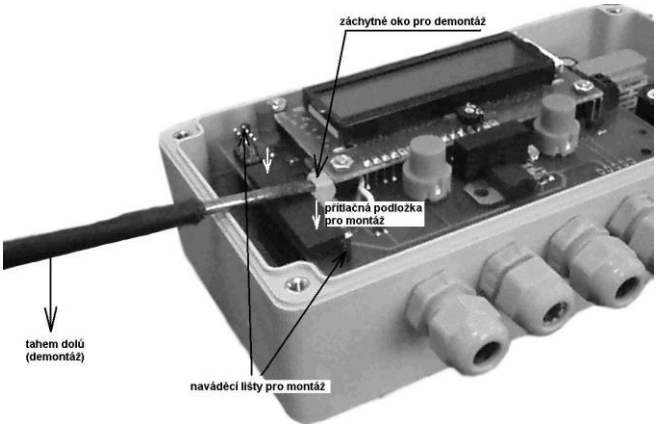
When the below mentioned operations are carried out unprofessionally, the claim to warranty covering the errors that may occur, become null and void !!!
Turn off the power before any manipulation with the evaluation unit !!!

Replacement of the top PCB with the display unit

If you need to extend the communication (which is on the upper PCB) or if there is a failure in the top PCB, the board can be replaced. The upper part of the meter should be removed as explained in the procedure below.

Upper part assembly procedure

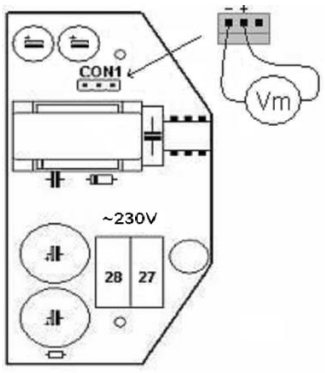
- Switch off the power
- Unscrew the meter cover
- Unscrew the screws in the top PCB
- Insert a screwdriver in the lug for removal.
- By pulling the handle downward disengage the upper part carefully from guides.
- Put the upper part onto the guides.
- By pressing gently onto the thrust washer, push the upper part connector into the lower PCB.
- Screw in the screws to fix the PCB
- Replace the cover and retighten the securing screws
- Restore the supply voltage



Power supply replacement

Power supply replacement procedure

- Switch off the power
- Unscrew the meter cover
- Disconnect the CON1 connector
- Unscrew the power supply PCB screws
- Replace the power supply
- Replace the cover and retighten the securing screws
- Restore the supply voltage



Factory settings

In the case that the customer does not provide the parameters to some settings of the meter, the configuration will be carried out according to the following table:

Diameter nominal	Limits set for 4 ÷ 20 mA current loop					
	Performance monitoring		Monitoring of flow rate within A range		Monitoring of flow rate within B range	
DN	Pmin4÷20 [kW]	Pmax4÷20 [kW]	Qmin4÷20 [l/h]	Qmax4÷20 [l/h]	Qmin4-20 [l/h]	Qmax4÷20 [l/h]
6	0	100	6	1200	20	1200
8	0	150	11	2200	40	2200
10	0	250	17	3400	60	3400
15	0	500	38	7600	130	7600
20	0	1000	71	14200	240	14200
25	0	1500	105	21000	350	21000
32	0	2500	170	34000	600	34000
40	0	3500	270	54000	900	54000
50	0	6000	420	84000	1400	84000
65	0	10000	720	144000	2400	144000
80	0	15000	1100	220000	3600	220000
100	0	25000	1700	340000	5600	340000
150	0	50000	3800	760000	13000	760000
200	0	90000	6800	1350000	23000	1350000
300	0	200000	15300	3052000	51000	3052000

Diameter nominal	Pulse constants			
	Output		Input	
DN	Eout[MJ/pulse]	Vout[l/pulse]	In1 [pulse/l]	In2 [pulse/l]
6	1	1	1	1
8	1	1	1	1
10	1	1	1	1
15	1	1	1	1
20	1	1	1	1
25	1	1	1	1
32	10	10	1	1
40	10	10	1	1
50	10	10	1	1
65	10	10	1	1
80	10	10	1	1
100	100	100	1	1
150	100	100	1	1
200	100	100	1	1
300	100	100	1	1

Time tariffs	Set periods
1	6:00 - 14:00
2	14:00 - 22:00
3	22:00 - 06:00

The meter's address is set to 1 and the communication baud rate to 1200 Bd.

Form for shipment of the meter back to COMAC CAL s.r.o.

The meter you have was made with the maximum precision and it has been checked many times and wet calibrated.

If the meter is used in agreement with this manual, the occurrence of faults is very rare. Should they ever occur, contact our service department. If you return the meter to the manufacturing plant, adhere to the conditions stated below:

- Clear the meter of contaminations stuck to the sensor and measuring tube (eventually to the Evaluation Unit).
- If the meter was run with poisonous, etching, combustible liquids or with fluids dangerous to water, check it and if appropriate, flush and neutralize the cavities inside the sensor.

Fill in the following data please and the form duly completed attach to your consignment. COMAC CAL s.r.o. will not be able to process your request promptly and correctly without this form.

Customer

Company…… City……

Department……... Name……

Phone no…….

Enclosed meter

Type…… Serial number…….

Measured liquid…….

Description of a fault or modifications required……
……
……
……
……

We confirm that the meter was duly cleaned, and if required, it was flushed out and neutralized. Therefore, this consignment does not constitute any risk to humans and environment due to remnants of the measured fluid.

Date…….. Signature and stamp…….