Instructions manual

Series FLOMAT
Sensor FLOMAT-FX
Converter XT5

HART COMMUNICATION FOUNDATION

The art of measuring

R-MI-FAXT5 Rev.: 0 english version

PREFACE

Thank you for choosing a product from Tecfluid S.A.

This instruction manual allows the installation, configuration, programming and maintenance. It is recommended to read it before using the equipment.

WARNINGS

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- Make sure this manual goes to the end user.
- Keep this manual in a place where you can find it when you need it.
- In case of loss, ask for a new manual or download it directly from our website www.tecfluid.com Downloads section.
- Any deviation from the procedures described in this instruction manual, may cause user safety risks, damage of the unit or cause errors in the equipment performance.
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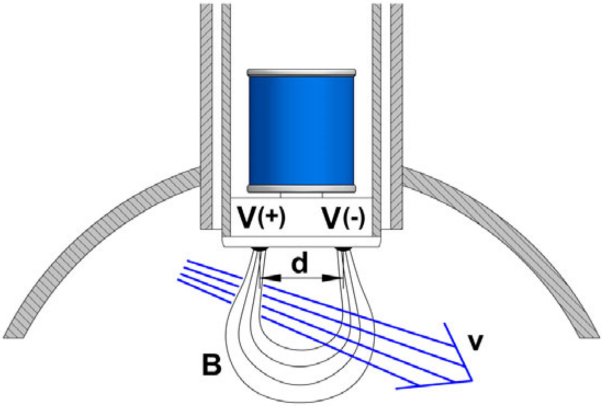
SENSOR FLOMAT-FX

1 WORKING PRINCIPLE

The FLOMAT electromagnetic flowmeters are based on Faraday's induction law.

When an electrically conductive liquid flows through a magnetic field, perpendicular to the flow direction, it induces a voltage V proportional to the liquid velocity.

Two electrodes in contact with the liquid and positioned perpendicularly to the magnetic field, sense this voltage V.



$$V = B \cdot v \cdot d$$

Where:

V = Measured voltage in the electrodes
B = Magnetic field
v = Liquid velocity
d = Distance between electrodes

2 RECEPTION

The FLOMAT electromagnetic flowmeters are supplied conveniently packaged for transportation together with their instruction manual for installation and operation.

All the flowmeters have been verified in our calibration rigs to obtain the gain factor Fc for each sensor.

2.1 Unpacking

Unpack the instrument carefully, removing any remains of the packing.

2.2 Storage temperature

-20ºC ...... +60ºC

3 HANDLING

It should always be done with care and without knocks.

4 INSTALLATION

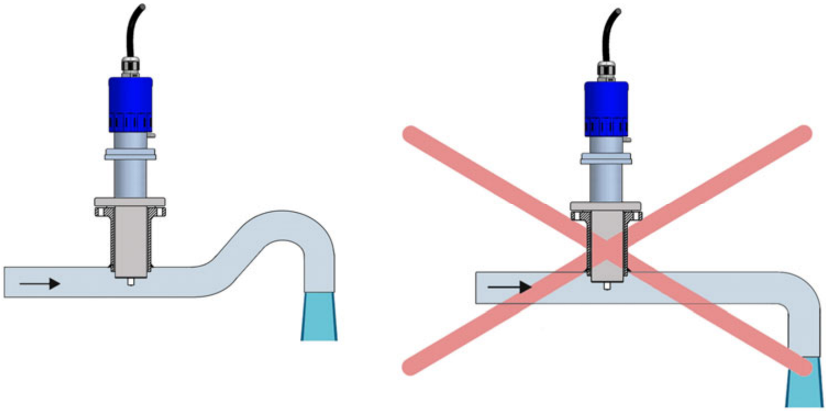
This should be made in a straight pipe run that guarantees that the pipe is always completely full and where there is a fully developed turbulent flow profile (follow indications on point 4.2).

Avoid high points of the pipes where air pockets usually form, or pipes with downwards flow where vacuums can occur.

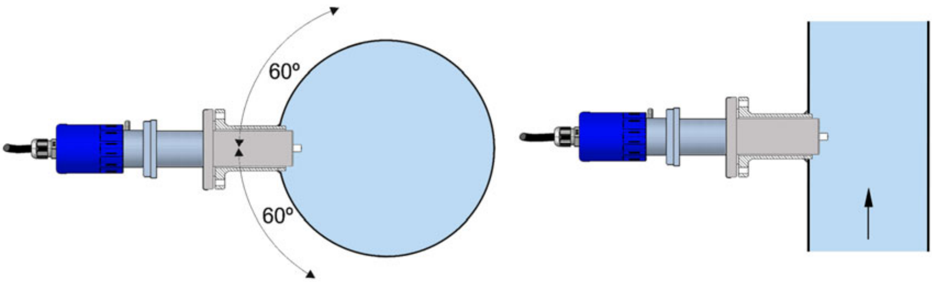
Partially full pipes can involve important reading errors.

Flow rate measurement with open discharge makes it necessary to install the flowmeter in a pipe section with a siphon which avoids stagnation of air in the sensor.

4.1 Sensor position



The optimum position to install the sensor is with the electrodes in the side of the pipe. This way, air pockets at the top of the pipe are avoided.



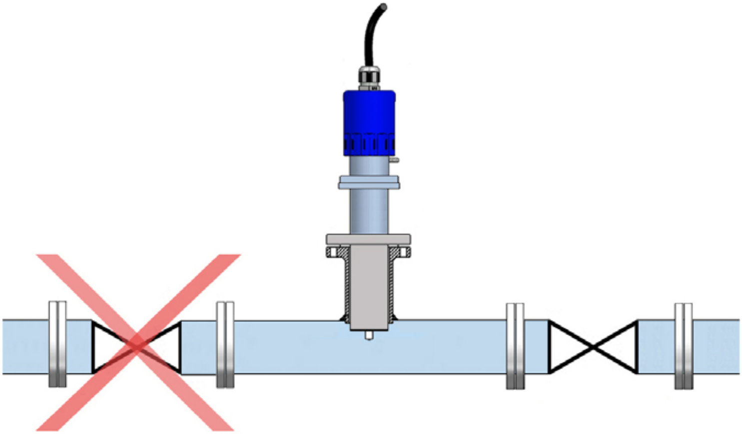
4.2 Straight pipe sections

The point where the FLOMAT sensor will be installed must be a straight pipe section, separated from elements that can disturb the flow profile, such as elbows, diameter changes, etc. Depending on the element the minimum necessary distances upstream from the sensor are shown on the next page (BS 1042-2.2:1983 standard).

Downstream, the minimum recommended distance to a disturbing element is 5 x DN.

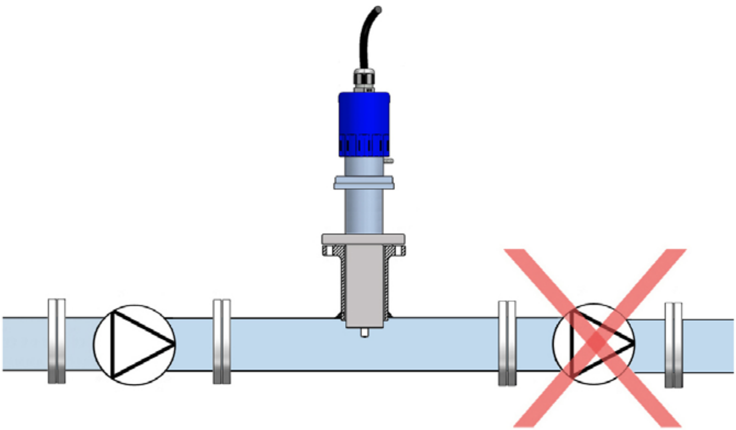
4.3 Valves

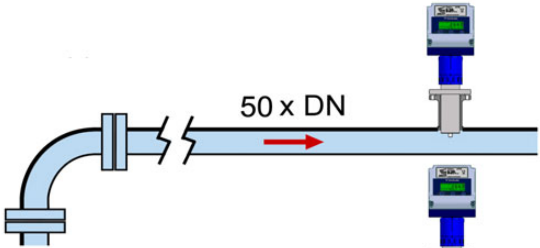
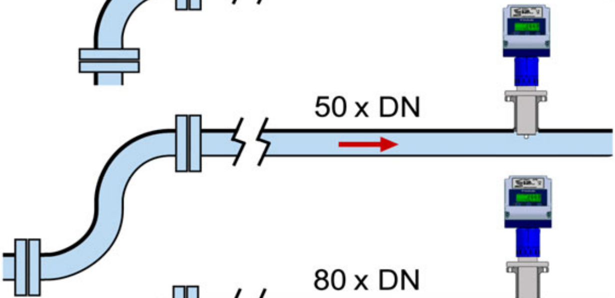
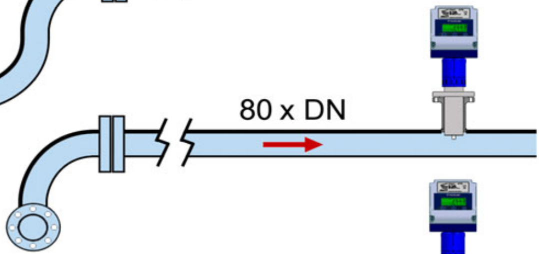
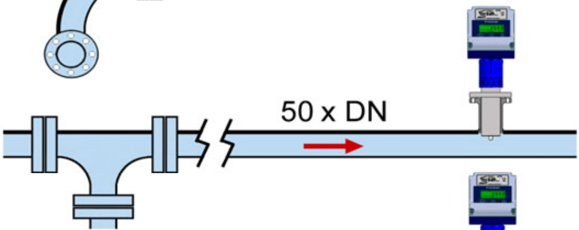
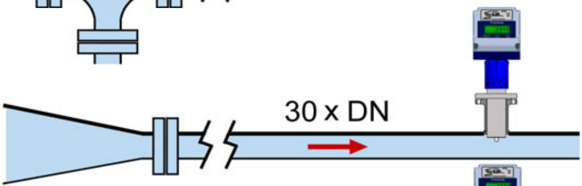
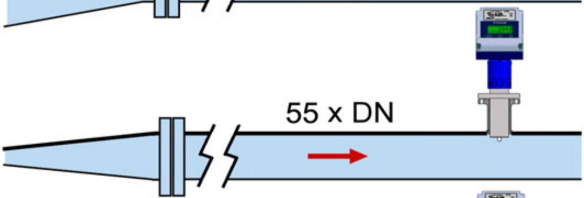
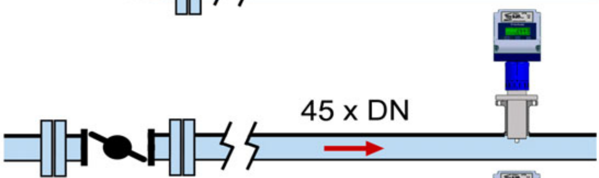
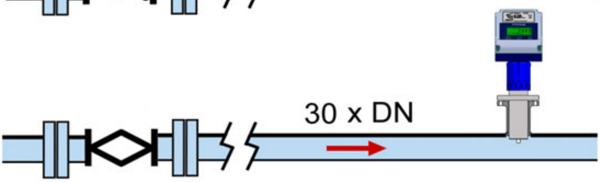
Control valves or shut-off valves should always be installed downstream from the sensor to assure that the pipe is always full of liquid.



4.4 Pumps

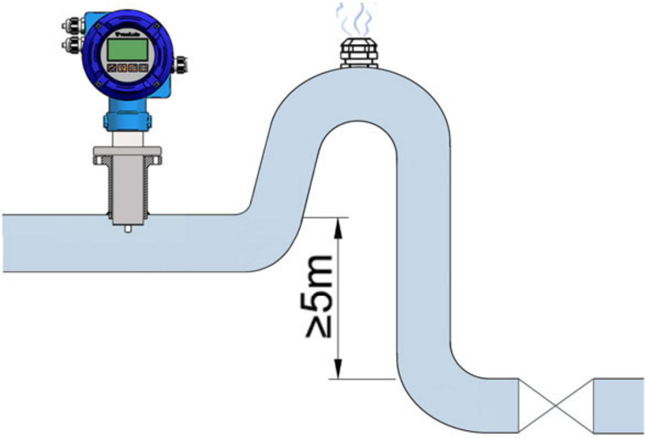
Pumps should be mounted upstream from the sensor to avoid the suction of the pump (vacuum).



Disturbing element upstream the sensor	Minimum distance between the sensor and the element
90º elbow	
Several 90º coplanar bends	
Several 90º non-coplanar bends	
T accessory	
Total angle convergent 18 to	
Total angle divergent 14 to 28°	
Fully opened butterfly valve	
Fully opened plug valve	

4.5 Aeration

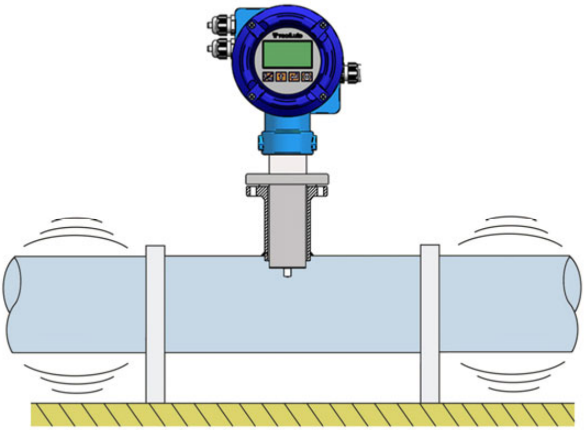
If there is a point where the difference in level is higher than 5 m an air inlet valve should be installed after the sensor to avoid a vacuum effect that could damage the sensor.



4.6 Vibrations

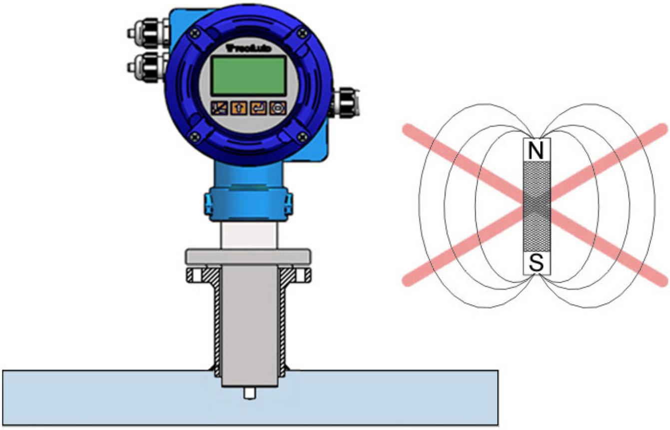
Vibrations of the pipes should be avoided by anchoring the pipe before and after the sensor.

The vibration level should be less than 2.2 g in the range of 20 -150 Hz according to IEC 068 -2-34.



4.7 Magnetic fields

Strong magnetic fields close to the sensor should be avoided.

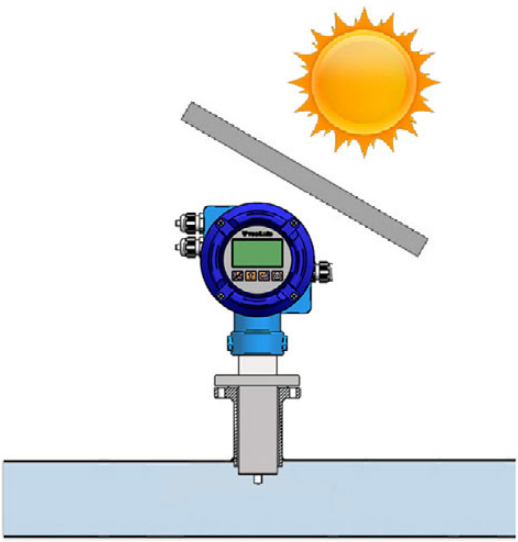


4.8 Temperature

In open air installations it is recommended to install a protection to avoid direct sun light on the flowmeter.

With thermally insulated pipes DO NOT insulate the sensor. High temperatures can damage it.

The maximum liquid temperatures are shown on page 36.



5 MOUNTING

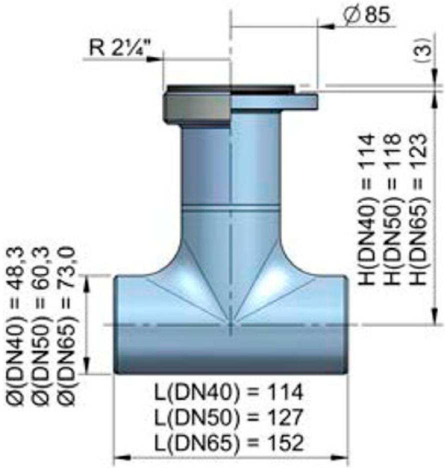
5.1 Pipe adaptor mounting

The sensor is normally supplied mounted in its pipe adaptor. Before welding the adaptor to the pipe, the sensor must be removed to avoid irreparable damage due to excessive temperatures.

There are two basic types of pipe adaptors: with threaded or with flanged connection.

For the smallest pipe diameters (DN40, 50 & 65) the pipe adaptor is supplied welded to a short length of pipe with a “T” form. For this type just couple it to the pipe by welding or gluing in the case of PVC, PP, PE or other plastics.

For DN80 and bigger, there are three lengths for each of the two types of fittings.



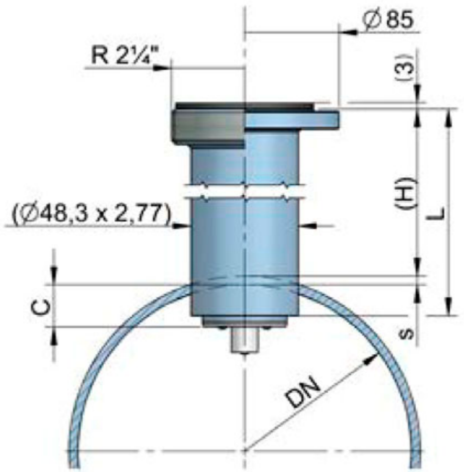
The process of putting the pipe adaptor in should be done accurately. The distance (H) (see drawings on next page) which is what the pipe adaptor should protrude above the surface of the pipe is important.

As shown in the following table, to know the distance, the thickness of the pipe ***s*** must be known.

In order to make the positioning of the pipe adaptor in the pipe easier, there is a label on one of its sides with markings indicating the position of the internal pipe diameter for each DN. Cut this label above the line corresponding to the DN of the pipe, at a distance equal to the pipe thickness. Peel off the bottom part of the label. Once the pipe adaptor is placed into its final position, where the label was cut must coincide with the outer diameter of the pipe.

This ensures that the measuring electrodes penetrate far enough in the area of flow profile that will allow an accurate measurement.

DN	C (mm)	Insert pipe adaptor	
		L (mm)	H (mm)
80	10	93	88-s
100	12.5		85.5-s
125	15.5		82.5-s
150	19		79-s
200	25		73-s
250	31		67-s
300	37.5		60.5-s
350	44		54-s
400	50		48-s
450	56		42-s
500	62,5	145	140.5-s
600	75		128-s
700	87.5		115.5-s
800	100		103-s
900	112.5		90.5-s
1000	125		78-s
1200	150	205	203-s
1400	175		178-s
1600	200		153-s
1800	225		128-s
2000	250		103-s



Example:

Suppose a pipe of 300 mm inner diameter (DN300) and 5.5 mm thick. In the chart we can see that the distance that the pipe adaptor must extend above the external wall is H = 60.5 - s = 60.5 - 5.5 = 55 mm.

The values in the chart are calculated considering the gasket supplied with the instrument, which is 3 mm thick. If the thickness of the gasket is changed, the value of H will change.

The equation to calculate H' for a gasket of thickness d is the following:

$$H' = H + 3 - d$$

In the previous example, if the gasket was 5 mm thick, the distance that the adaptor should extend above the external wall would be H' = 55 + 3 - 5 = 53 mm.

Drill a 48.5 mm diameter hole in the pipe to insert the pipe adaptor and weld the fitting to the pipe.

If the pipe is made of concrete or other material to which the pipe adaptor cannot be welded, a clamp-on accessory or saddle should be used. In this case, please contact us to inform about the suitable sensor length.

The axis of the pipe adaptor should be perfectly perpendicular to the pipe axis.

5.2 Sensor mounting

Once the pipe adaptor is mounted, place the flat seal in its position and install the sensor with the arrow pointing in the flow direction. The electrodes must be perfectly perpendicular to the pipe axis.

In order to align the sensor, the bolt or pin situated on the cylinder at the top of the FLOMAT sensor must be aligned with the axis of the pipe and the arrow pointing in the flow direction.

5.3 Tightening torque

The tightening torque for the flange screws should not exceed 7.1 Nm.

The tightening torque for the threaded fitting should not exceed 21 Nm.

5.4 Electronic converter connection

See point 2.1 on page 15.

5.5 Electronic converter programming

FLOMAT sensor is insertion type, so it can be installed in pipes with different diameters.

NOTE: It is essential to program the internal diameter of the pipe, in order that the converter can indicate the correct flow rate (see point 5.3 on page 27).

XT5 CONVERTER

INTRODUCTION

The XT5 converter unit can be used with the different FLOMID and FLOMAT series of electromagnetic flow sensors. The electronic circuit is based on the most advanced technology, in order to obtain accurate and reliable measurements.

The device provides the following features:

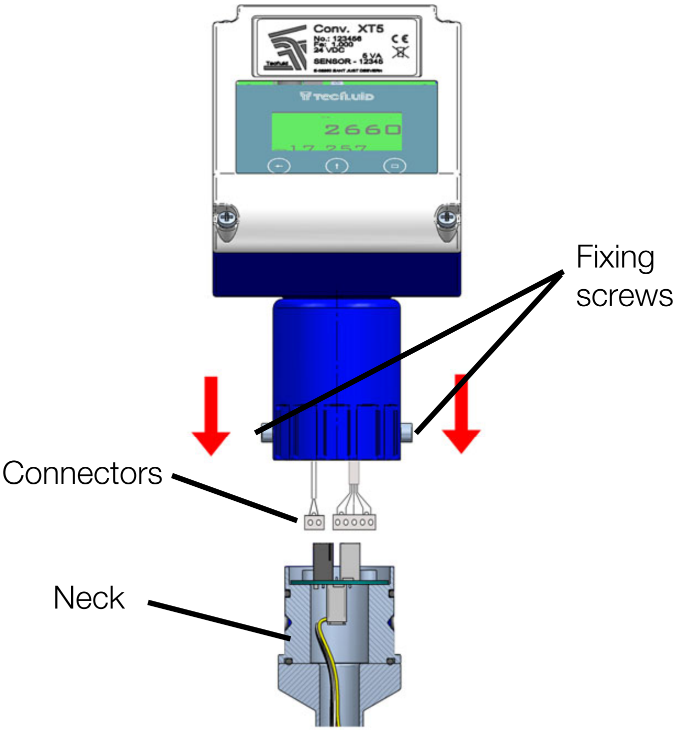
- Coil excitation by means of pulsed signal to obtain a negligible zero offset.
- Pulse and analog current outputs proportional to the flow rate and user configurable.
- Local and separate mounting.
- Easy interchangeability with other sensors.
- Display orientable 180º to adapt to the installation position.
- HART protocol compatibility (XT5H model).

2 INSTALLATION

2.1 Sensor connection

2.1.1 Compact converter

The converter provides two cables to be connected to the sensor. Once connected, slide the converter along the sensor neck until the stop. Tight the two fixing screws.



2.1.2 Remote converter

One of the ends of the cable has a header and two wires, to connect them to the sensor. The connection is as explained in point 2.1.1.

The other end has to be connected to the converter, and has five wires. The cable must be passed through the cable gland and the connection for each wire is explained in chapter 3.

2.2 Electrical connection

For the electrical connection, the XT5 has two screw terminal strip. To help in the connecting of the equipment, the description of the terminals is marked on the printed circuit.

For the electrical installation it is recommended to use multiple conductor cables with individual cable sections in the order of 0.25 to 0.5 mm^2 in order to make it easier to connect. It is better to maintain the cables with mains voltage (power supply) separated from the cables with low level signals (4-20 mA, etc.).

Before starting the installation, check that the PG11 cable glands are the right size for the cables to be used, in order to guarantee the instrument will stay watertight. The cable glands used are for cables with outside diameters between 3.5 mm and 10 mm.

To connect them, peel the outside insulation to free the inner cables. It is recommended to tin the ends of the wires to avoid loose ends. Pass the cables through the cable glands and screw down in the corresponding positions of the terminal strip. Once the wiring is finished make sure that the cables are well gripped by the cable glands to maintain the degree of protection.

Incorrect installation of the cable gland or inadequate cable placement can cause irreparable damage to the converter.

IMPORTANT NOTE: In order to comply with the electrical safety requirements as per EN-61010-1 (IEC 1010-1), the installation of the equipment must take into account the following:

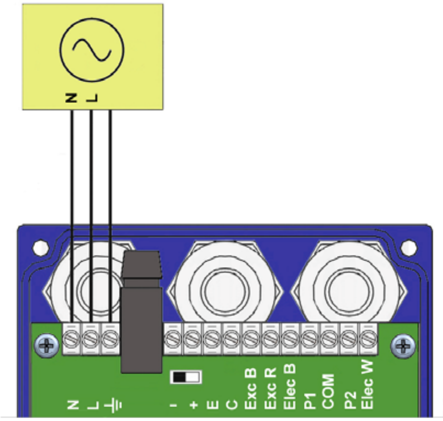
- A mains switch must be provided to disconnect the equipment. This switch must be marked as the disconnecting device for the equipment and be within easy reach of the operator.
- The mains supply must have an earth line.
- The housing must not be opened when the instrument has mains supply connected.

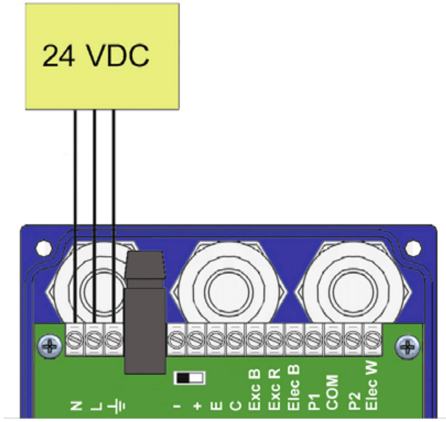
IMPORTANT NOTE: To ensure proper operation of the equipment, it is recommended to make the connection paying attention to the following points:

- For the output signals, use shielded cable when possible.
- Keep the cables away from strong sources of noise.

2.2.1 Power supply wiring

Before connecting the converter, check that the supply voltage available is the same as marked on the label of the instrument.

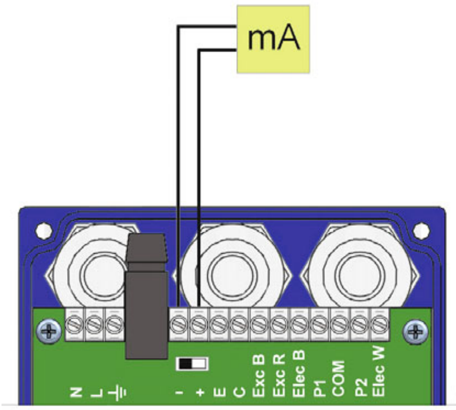




Terminal	AC power supply	DC power supply
⏚	Earth	Earth
N	Neutral	0 V
L	Phase	24 V (+)

It is important to connect the mains earth to the instruments with AC power supply due to the presence of a mains filter inside that requires this connection.

2.2.2 Analog output wiring



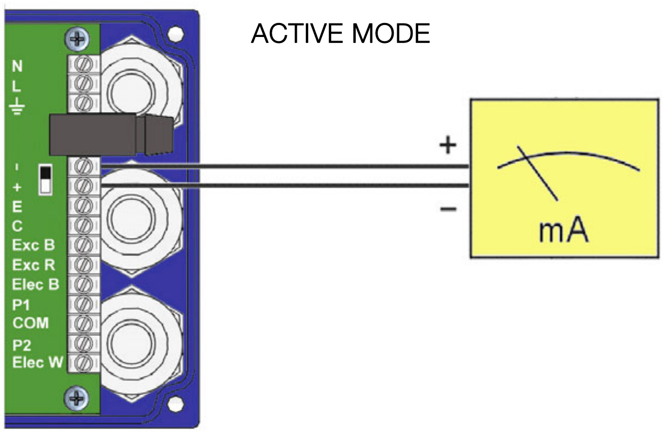
Terminal	
+	mA (positive)
-	mA (negative)

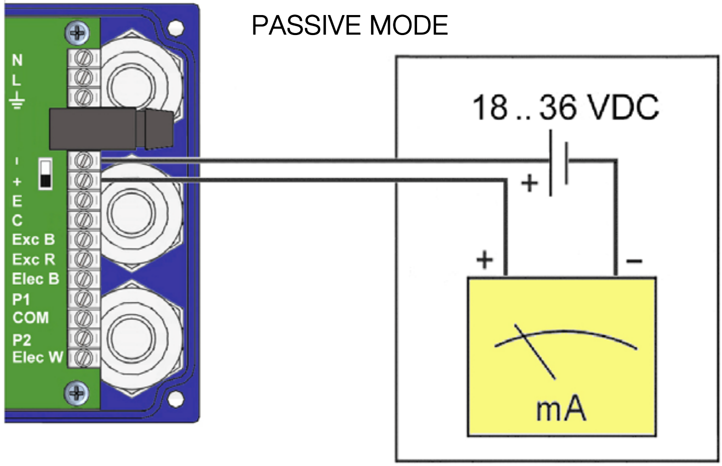
The analog output is galvanically isolated. It can be either active (that means the receptor must be passive) or passive (that means the receptor must supply the power for the current loop). It is recommended to use a receptor with an input resistance of less than 700 Ω to guarantee correct operation.

To configure the analog output type (active or passive) there is a slide switch situated just behind the terminal strip. For the passive mode the switch must be towards the positive terminal and for active mode the switch must be towards the negative terminal. To move the switch use the point of a small screwdriver.

In the case of using HART communication the output mode should be passive. Normally a HART master is active.

NOTE: The analog output has protection against reversed polarity. Due to another protection against over voltages, if an inverted supply voltage greater than 32 V is connected to the loop, the equipment may be damaged.





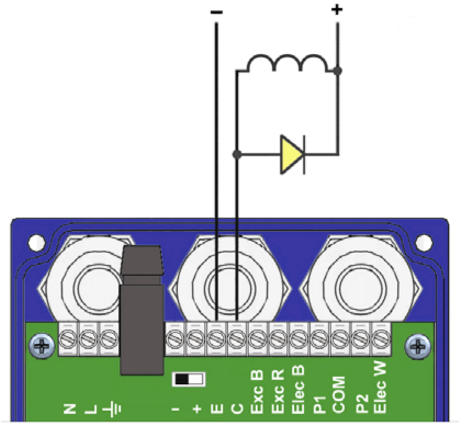
NOTE: Never connect the load between terminals + and –. The analog output could be damaged.

2.2.3 Pulse output wiring

Terminal	
E	Emitter
C	Collector

The pulse output is opto-isolated. The terminals are the collector and emitter of an NPN bipolar transistor.

In the case of using inductive loads, in order to protect the output transistor, the use of free wheeling diodes is required.

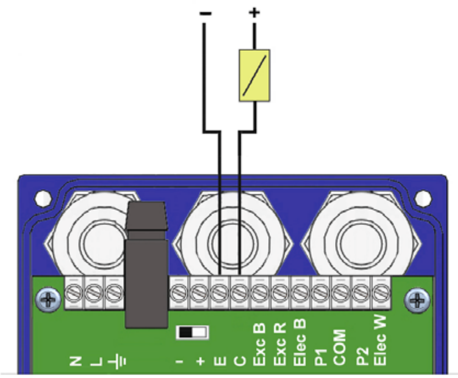


Connection examples

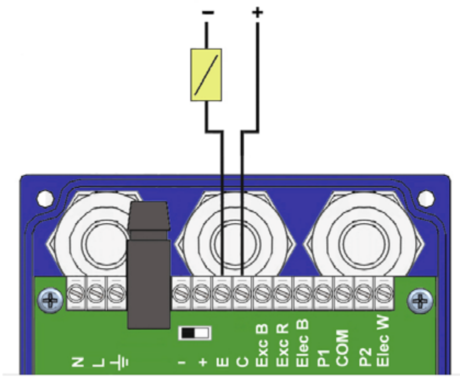
The two usual ways to connect the alarm outputs are NPN or PNP modes, depending on if the load is connected to the positive or negative terminal.

In the following figures, an example of connection for the alarm 2 in NPN and PNP mode can be seen.

NPN connection



PNP connection



3 REMOTE SENSOR

When an installation requires that the electromagnetic sensor is separated from the control unit, the union between these two elements must be made by means of an interconnection cable.

These cables are supplied by Tecfluid S.A., already prepared for their direct connection to the sensor and the converter.

Important: The interconnection cable between the sensor and the converter must always be a single piece, without any kind of joint.

In the event of having to repair a broken cable at one of its ends, it should be cut at the breakage point and reworked for the connection at that point.

3.1 Preparing the cable

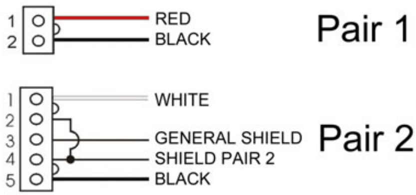
The ends of the cable should be prepared as shown in the drawing on next page. Special care should be taken to avoid possible short circuits between the shields. The point at which the shields are cut refers to the aluminium shields.

Electronics side

At the electronic unit’s end, the ends of the cables should be stripped at about 5 mm and then tined. Pair 1 (Red & Black) is for the excitation coils and Pair 2 (White & Black) is for the electrodes.

Sensor side

Pass the sensor side end through the cable gland of the sensor connector and then connect the cables of this end to the IDC connectors as shown in the following drawing. (the union between terminals 2 and 4 in Pair 2 must be taken into account).



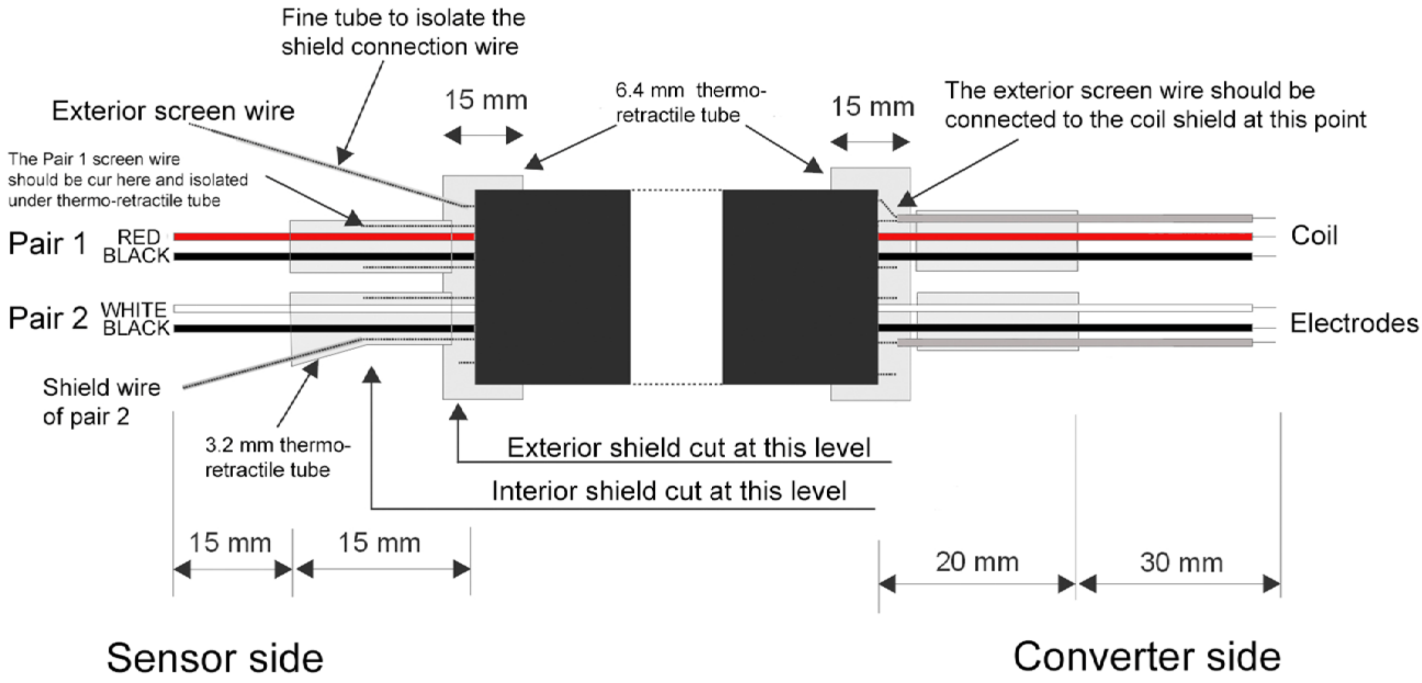
3.2 Cable installation

The following points must be taken into account:

- The cable should be installed in a conduit or should be securely fixed, given that movements of the cable can induce reading errors.

- The cable should be placed as far as possible from sources of electrical noise such as switching gear and electrical machines.

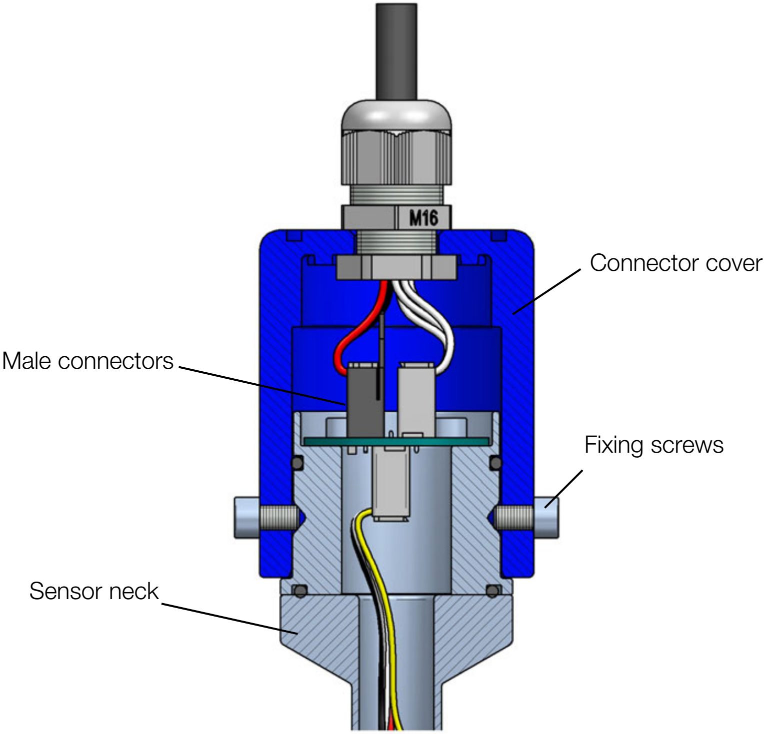
- The maximum length of the connection cable depends on the fluid conductivity. For liquids with a conductivity higher than 500 µS/cm cable length can be up to 150 m.


Fine tube to isolate the
shield connection wire
Exterior screen wire
15 mm
6.4 mm thermo-
retractile tube
15 mm
The exterior screen wire should be
connected to the coil shield at this point
The Pair 1 screen wire
should be cur here and isolated
under thermo-retractile tube
Pair 1
RED
BLACK
Coil
Pair 2
WHITE
BLACK
Electrodes
Shield wire
of pair 2
3.2 mm thermo-
retractile tube
Exterior shield cut at this level
Interior shield cut at this level
15 mm
15 mm
20 mm
30 mm
Sensor side
Converter side

3.3 Cable connection to the sensor

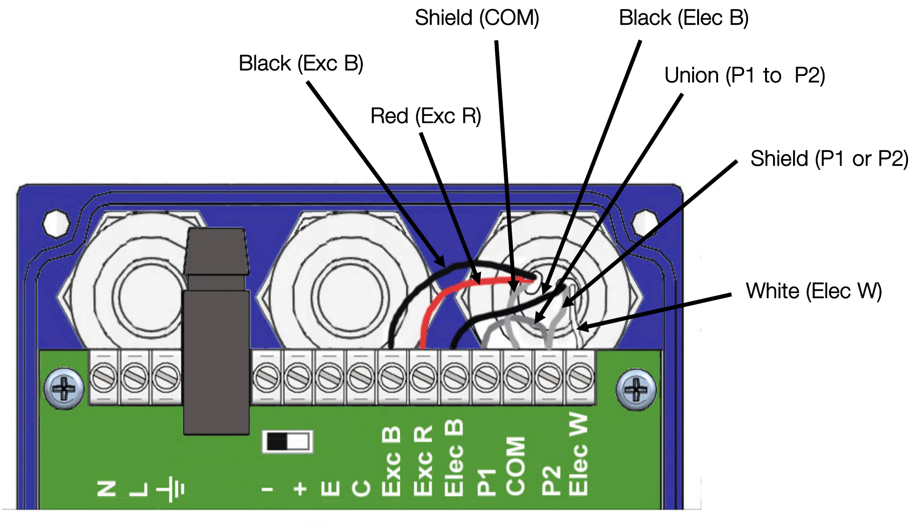
For the sensor connection, first loosen the cable gland to allow the cable to slide in it.

- Make sure that the two fixing screws of the cover do not protrude inside the cover (this avoids damaging the O-ring of the sensor neck).
- Apply a few vaseline on the sensor neck to aid inserting in the cover, specially on the O-rings.



- Connect the two cable connectors in their corresponding male connectors on the sensor, mating the bumps in the guide of the male connectors.
- Slide the cover on the sensor neck until it meets its stop.
- Tighten the two fixing screws to anchor the cover.
- Tighten the cable gland to guarantee water tightness.

3.4 Cable connection to the converter



Terminal	
Exc B	Top coil (black cable)
Exc R	Bottom coil (red cable)
Elec W	Rear electrode (white cable)
COM	Process ground (general shield)
Elec B	Front electrode (black cable)

In the case of using a par-pos cable, which has two shielded pairs of cables (one for the electrodes and one for the coils) there is only one shield for the two electrode cables. In this case P1, P2 and COM terminals should be connected together and the electrode shield should be connected to one of these terminals and to the COM terminal.

So that the flow direction shown in the instrument matches the actual direction, please take into account the cables colour scheme according to previous figure.

3.5 Cable specifications

Model:	CERVITRONIC PAR-POS Code 04754502

Construction

Conductor:	Annealed electrolytic copper, tinned
As Norm:	UNE 21064
Isolator:	Polyolefin (PE - Solid)
Composition:	By pars
Par shield:	Tape Al/Pet + Drain Cu Sn
Cover :	100 % Physical
All over shield:	Tape Al/Pet + Drain Cu Sn
Cover:	100 % Physical
Exterior cover:	PVC
Colour:	Black

Electrical characteristics

Working Voltage:	250 V
Testing Voltage:	1000 V
Electrical resistance:	≤ 52,2 Ω/km
Capacity: C* / C**	90-170 pF/m

C* capacity between conductors

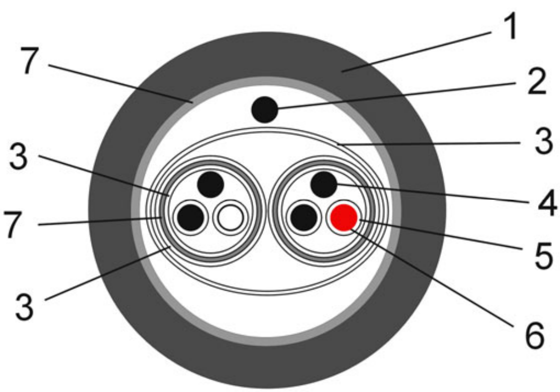
C** capacity between one conductor and the rest connected to the shields

Physical characteristics

External diameter:	6.6 mm
Bending radius:	66 mm
Working temperature:	-5ºC ... +70ºC
Fire risk:	Does not propagate flame as per Norm IEC 60332-1 and EN 50265
Section:	0.34 mm2
Weight:	51 kg/km

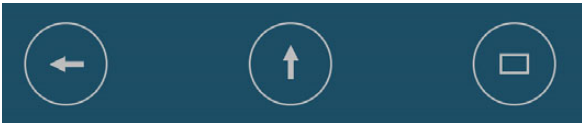
Cable section

1 PVC cover
2 External shield wire
3 Insulating film
4 Pair 1/2 shield wire
5 PVC insulation
6 Pair 1/2 conductor
7 Aluminium shield

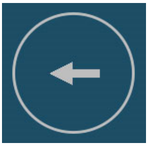


4 CONVERTER INTERFACE

The XT5 converter has an LCD and a keyboard with 3 capacitive buttons to introduce the values of installation and programming. Two of these keys are used also as cursors.

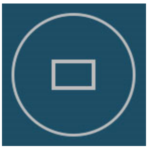


The following figure shows the functionality of the converter keys.



(Left) To change to the digit on the left. To enter into offset adjustment. With (Up), to enter into installation and to validate the data. With (Escape), to reset the totalizer.

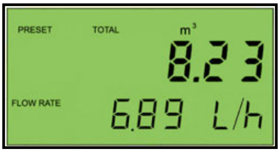
(Up) To increase the digit.
With (Left), to enter into installation and to validate the data. With (Escape), to enter into programming.



(Escape) To exit from a screen without validating data. With (Up), to enter into programming. To exit from an informative text. With (Left), to reset the totalizer.

The equipment is normally delivered calibrated and configured with its sensor so that it indicates the true flow rate and volume. If any configuration parameter is to be changed, this can be done without having to remove the top cover.

If the instrument has not been previously configured or, due to alteration of data in the memory the instrument recovers the default configuration, the word “PRESET” appears on the display. This indication disappears when the sequence of configuration has been completed.



In all the configuration screens the (□) key is used to jump to the next screen without making any changes in the configuration data even if digits have been changed.

5 INSTALLATION PARAMETERS

Power on the electronic converter with the voltage indicated on the label.

Touching the two keys (↑) y (⟵) at the same time, the first installation screen is accessed for the flow rate measurement calculation.

5.1 Sensor factor

The first screen is to configure the sensor factor (Fc), which is given on the sensor label.

Touching the key (↑) the flashing digit will be increased. When the value of 9 is reached, on the next increment the digit will go to zero. With the key (⟵) we move to the next digit to the left. If we are on the seventh digit we will go back to the first digit.

When the required factor is on the screen, touching the two keys (↑) & (⟵) at the same time, the data will be stored in memory and the next screen will appear.

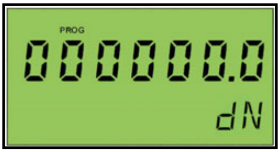
If not specified, the keys for the next screens have the same functions as in this first screen.

5.2 Electronic converter factor

In this screen the electronics factor (Fe), which is indicated on the label on the front cover can be programmed.

5.3 Nominal diameter

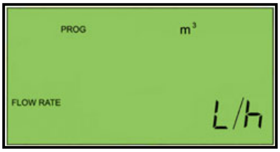
The nominal diameter is always the internal diameter in millimetres of the pipe where the FLOMAT is inserted.



5.4 Measuring units

In the next screen the flow rate and volume totalizer units are selected.

To change the flow rate units, press the key (↑). To change the volume totalizer units, press the key (←).



The possible units for the flow rate and the volume totalizer are the following:

Flow rate:

There are 9 combinations for the 3 units for volume and the 3 units for time.

Volume	/	Time
l (litres)	/	s (second)
m3 (cubic metres)	/	m (minute)
ga (US gallons)	/	h (hour)

Volume totalizer:

There are 3 possible units for volume, l (litres), m^3 (cubic metres), ga (US gallons).

Note: 1ga = 3.785 litres.

If the instrument has a mains power supply connection with the selected working units, touching the two keys (↑) & (←) at the same time, we return to the normal working screen.

5.5 Mains frequency

If the instrument has a DC power supply, user must configure the mains frequency of the country where the instrument is installed. This is done for filtering out line frequency noise found in the electrodes signal.

With the (↑) key the local mains frequency is selected (50 Hz or 60 Hz) and touching the two keys (↑) & (←) at the same time, we return to the normal working screen.

6 CONVERTER PROGRAMMING

By means of the converter programming, the visualization and the outputs of the instrument can be configured.

Power on the electronic converter and touch the two keys (↑) y (□) at the same time. The first programming screen is accessed for the visualization and output parameters.

6.1 Decimals for the flow rate indication

In the first screen the number of decimals for the flow rate indication can be configured.

For this, touching the key (↑) the flashing digit will be increased. When the value of 2 is reached, on the next increment the digit will go to zero. When we have the required factor on the screen, touching the two keys (↑) & (←) at the same time, the data will be stored in memory.

To select the number of decimals it must be taken into account that the instrument has 4 digits for flow rate indication. If two decimals have been selected, these will be seen whilst the flow rate is not greater than 99.99. Above this value the indication will automatically change to one decimal, and when the flow rate is greater than 999.9 the indication will be done without decimals.

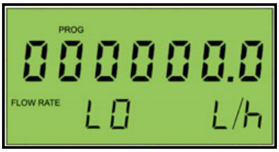
If one decimal is selected, the flow rate indication will have a maximum of one decimal.

If indication without decimals is selected, the flow rate will always be shown without decimals.

For the selection of the flow rate units and the number of decimals it must be taken into account that an indication with an excess of decimals may give the false sensation of instability of the reading. As a general rule it can be considered that the reading should not have more than a total of 3 digits (integer + decimals).

6.2 Current output (4-20 mA) configuration

Once the decimals are programmed, the current loop range can be configured. On these screens the measuring units are those selected previously.



In the first screen the flow rate for the 4 mA point (lower range) is configured. In the next screen the flow rate for the 20 mA point (upper range) is configured.

6.3 Pulse output

In this screen, there are two options.

a) Frequency output (Hz). This is meant for transmitting the instantaneous flow rate to a remote unit. The output pulse frequency for a flow velocity of 5 m/s is programmed here (see limits in point 14).

b) Pulse output per unit of volume (P/U). This is meant for remote totalizing. The number of pulses per unit of volume totalizer are programmed here. The pulse width is 80 ms. The maximum frequency is 6.25 Hz.

First the pulse output mode (Hz or P/U) is selected using the (↑) key. Once the output mode is selected, touch the (←) key and then enter the corresponding numerical value for the frequency at 5 m/s or pulses/unit according to the output mode selected.

6.4 Cut off

The sensor FLOMAT with converter XT5, being an electromagnetic flow meter, has its maximum deviation in the low end of its working range. Due to this, a cut off flow rate can be configured, that means, the flow rate below which the flow rate indication will be zero.

6.5 Damping

The XT5 converter has an adaptive filter (damping) to provide stable flow rate and analog output readings in the presence of continuous flow rate fluctuations.

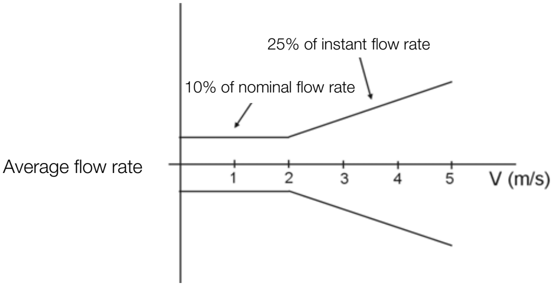
The configuration of this filter can be very useful in the cases where the flow rate readings have some instability (due to air bubbles, solids in suspension, etc).

Only the flow rate indication of the display and the analog output are affected by the filter. The pulse output and the totalizer act according to the instant flow rate. By selecting a filter with a longer or shorter integration time, responses to flow rate variations in more or less time can be obtained.

The integration time is selected in seconds, with a minimum value of 0.1 and a maximum value of 20.0 seconds. For example, with an integration time of 15 seconds, the display will indicate the flow rate reading of the average flow rate over the last 15 seconds from the last update of the display. This does not mean that the display is refreshing its data every 15 seconds. The display shows a new value several times per second, indicating an average of the flow rate values of the last 15 seconds.

When there is a sudden variation of the flow rate then the filter should react as fast as possible to give a correct reading of the new value. For this, the filter controls for each reading the deviation of the instant flow rate with respect to a reference. If this deviation exceeds the established limits, the filter will stop acting, indicating the instant value, and will start again the filtering process.

In the following figure we can see the allowed deviation for the filter to continue giving average values.



For example, consider a DN100 flow meter whose average flow rate is 100 m^3/h.

100 m^3/h corresponds to a liquid velocity of 3.54 m/s, situated in the second zone of the graphic. This means that the filter will continue giving average readings whilst the instant flow rate does not deviate more that 25% (25 m^3/h) from the average flow rate.

Since the average flow rate is 100 m^3/h, the filter acts whilst the instant flow rate is within 75 m^3/h and 125 m^3/h.

If the average flow rate is for example 50 m^3/h, it corresponds to a liquid velocity of 1.77 m/s, in this case we are in the first zone of the figure. This means that the filter will continue acting whilst the instant flow rate does not deviate from the average flow rate more that 10% from the nominal flow rate, that is 14 m^3/h (flow rate at 0.5 m/s in a DN100 = 14 m^3/h).

Since the average flow rate is 50 m^3/h, the filter continues to act whilst the instant flow rate is within 36 m^3/h and 64 m^3/h.

6.6 Flow rate direction

In this screen the flow direction for which the flow rate indication will show a positive value can be programmed.

Using the (↑) key we change the positive flow direction from left to right (R) to right to left (L).

Note: In a FLOMAT sensor the left and right correspond to the engraved arrow, which always points to the right.

When the flow rate is negative the volume totalizer will not make any action.

6.7 Empty pipe

In the last screen the empty pipe detection (EP) can be enabled or disabled, using the (↑) key to change from ON (enabled) to OFF (disabled).

6.8 Zero drift adjustment

In order to obtain a perfect linearization of the instrument, it is recommended to make an adjustment of the zero drift.

IMPORTANT: The flowmeter is delivered with the zero offset adjusted. Do not make a new adjustment if not necessary. An adjustment not done properly can become in incorrect flow rate values.

In order to make the adjustment, it is necessary that the flow rate through the instrument is zero.

The first step is to deactivate the adjustment. To do this, press the key (⟵) and the following screen is displayed.

Press the key (↑) until the word OFF appears. Press then the keys (⟵) & (↑). With this, the adjustment is deactivate.

Before doing the next step, be sure that the pipe is full and that there is not flow rate through the instrument.

Press the key (↑) again and change until the word ON appear. Press the keys (⟵) & (↑) and the zero offset adjustment is completed.

7 SERIAL NUMBER AND FIRMWARE VERSION

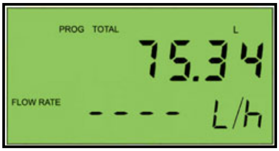
Touching the three keys at the same time we access a screen where the serial number of the converter is shown.

In order to see the software version and return to the normal working screen, touch any key.

8 EMPTY PIPE INDICATION

When the XT5 converter detects that the pipe is empty the flow rate indication will disappear and in its place 4 dashes will be shown.

NOTE: When the XT5 is connected to the power supply the screen shows empty pipe until this state has been checked.



9 RESET

Touching the (⟵) and (□) keys at the same time the volume totalizer counter will be reset to zero and it will continue counting.

10 KEYBOARD DISABLE AND “WRITE PROTECT”

The instrument has a jumper, placed behind the display on the left side, which can be used to avoid changes in the configuration. When the jumper is connected the instrument can be configured by means of the keyboard and via HART. When the jumper is removed, the keyboard is disabled and “Write Protect” is activated for HART, thus avoiding any changes in the configuration.

11 CHANGING THE POSITION OF THE DISPLAY

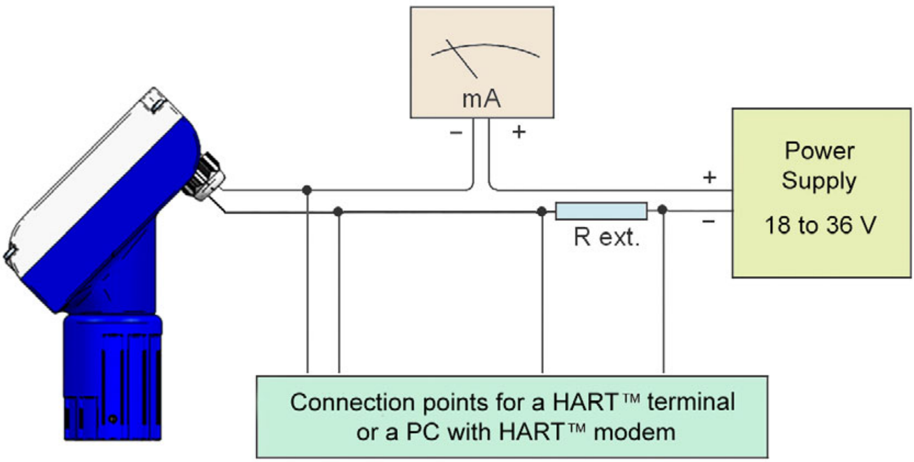
To change the orientation of the display in order to adapt it to the instrument mounting position, first disconnect the equipment from the power supply and remove the front cover. Remove the three screws that hold the display PCB to the base PCB (two screws in the corners opposite to the terminal strip and one central screw next to the terminal strip). Holding the PCB, pull on it to disconnect it. Rotate the display PCB 180º and reconnect it to its connector avoiding the pins to be bent. Reassemble the three screws that hold the display PCB and reassemble the front cover. Reconnect the instrument to its power supply.

12 HART COMMUNICATION

The XT5H converter has a MODEM for HART communication.

The detail of the characteristics with respect to the HART communication are available in the corresponding “Field Device Specification” document.

To be able to use HART communication, a resistance (R ext.), whose value must not be lower than 200 Ohms, should be added to the current loop. The points at which a terminal or a PC with a HART modem can be connected are shown in the following figure.



In a XT5H converter, if during the programming sequence a HART command is received, that must be attended, the local programming will not be valid and all the data previously programmed will be lost. The screen will return to the normal working model and the word PROG will light on the screen, indicating this event. To remove the word PROG from the display, touch any of the two keys (↑) or (←).

Summary of the principal communication characteristics:

Manufacturer, Model and Revision	Tecfluid S.A., converter XT5H, Rev. 1
Device type	Transmitter
Hart Revision	6.0
Device Description available	No
Number and type of sensors	1, exterior
Number and type of actuators	0
Number and type of host side signals	1, 4 – 20 mA analog
Number of Device Variables	2
Number of Dynamic Variables	1
Mappable Dynamic Variables	No
Number of Common Practice Commands	14
Number of Device Specific Commands	8
Bits of Additional Device Status	17
Burst mode?	No
Write Protection?	Yes

13 EXAMPLES OF USEFUL CALCULATIONS

13.1 Measurement error correction

The calibration of flowmeters is made with water at 20ºC, obtaining a calibration for a liquid density of 1 kg/l and viscosity of 1 mPa·s. For reasons of turbulences in the flow, measurement errors can be induced.

To correct these types of errors we can modify the value of the Fc factor programmed in the instrument.

Example - Shortage of volume

If we have a flowmeter body which specifies Fc = 0.985, and when we check the volume of a batch, we find that instead of having 100 litres as programmed, we only have 95 litres (5% less), then the following correction must applied:

Fc = Original sensor factor = 0.985

V = Expected Volume = 100

Vr = Real Volume = 95

Fcn = New sensor factor = ? (1.037)

$$F_{cn} = \frac{F_c \cdot V}{V_r}$$

13.2 Configuration of pulses / unit of volume

As indicated in the point 6.3, the maximum frequency of the pulse output in mode pulses / unit is 6.25 Hz. In order to know if the desired number of pulses per unit of volume can reach this frequency, the following formula can be applied:

$$f_{max} = \text{Flow rate}_{max} \text{ (units/s) x Factor (p/unit)}$$

Where

f_{max} = Maximum frequency at the output

Flow rate_{max} (u/s) = Maximum flow rate in units of volume per second

$F_{p/u}$ = Factor of pulses per unit of volume programmed in the converter

Example - Sensor DN100 and programmed Factor = 10 pulses / litre

Firstly, we need to know what is the maximum flow rate that could pass through the flow meter. For example 150 m^3/h.

Changing the flow rate to units of volume per second, we obtain:

$$150000 / 3600 = 41.7 \text{ l/s}$$

Note that the units of volume are litres because in this example the programmed factor is 10 pulses / litre.

In this case, applying the formula, the maximum frequency at the output is:

$$f_{max} = 41.7 \text{ x } 10 = 417 \text{ Hz}$$

As the value exceeds 6.25 Hz, this factor can not be applied.

In this case there would be several solutions:

1. To change the factor to 0.1 pulses / litre, becoming the maximum frequency 100 times smaller, fmax = 4.17 Hz.
2. To change the units of volume to m^3. With this, the maximum flow rate is divided by 1000 and therefore the maximum frequency becomes fmax = 0.41 Hz.
3. To change the factor to 100 pulses / m^3, becoming the maximum frequency fmax = 4.17 Hz. Note that it is equivalent to the point 1 (0.1 pulses / litre = 100 pulses / m^3).

14 TECHNICAL CHARACTERISTICS

Accuracy

±3.5% reading value for $v \geq 0.5$ m/s

$\frac{\pm 1.75}{v\ (m/s)}$ % reading value for ≤ 0.5 m/s

Repeatability

±0,14 % VFE. Time between measurements of 15s and a filter of 250 samples.

Velocity range

0.15 ...10 m/s

Temperature

Process temperature: -20ºC ... +120ºC
Ambient temperature: -20ºC ... +60ºC

Minimum conductivity

20 µS/cm

Power supply

230, 240, 115, 24 VAC 50, 60 Hz	Power consumption: ≤ 5 VA
24 VDC	Power consumption: ≤ 5 W

Analog output

4-20 mA. Active or passive. Galvanically opto-isolated from the power supply.

Pulse output

Opto-isolated. Transistor bipolar NPN. Vmax: 30 VDC. Imax: 30 mA.

Maximum frequency in mode "P/U"	: 6.25 Hz
Maximum frequency in mode "Hz"	: 10000 Hz
Minimum frequency in mode "Hz"	: 0,04 Hz

Totalizer

N. of digits:	7 (2 decimals)**
Digit size:	8 mm
Reset:	by means of keyboard

Flow rate indication

N. of digits:	4 (up to 2 decimals configurable)**
Digit size:	5 mm

** When the available digits are full and the integers overflow a decimal is automatically lost.

General characteristics

Sensor materials:

Body	Head	Electrodes
EN 1.4404 (AISI 316L)	PVDF	Hastelloy C22 AISI 316L Titanium Zirconium Tantalum
PVDF	PVDF	

Converter material: Polycarbonate (UV resistant)

Ingress protection:

Sensor: IP68, 10m H_2O

XT5 converter: IP66 / IP67

Maximum cable length (remote version): 150 m

Electrical characteristics refered to the analog loop and communications:

Reception impedance:

Rx	>	8.5 MΩ
Cx	<	200 pF

15 MAINTENANCE

Sensor:

It is recommended to clean the electrodes in installations where build ups or appreciable sedimentations can occur.
Cleaning can be done using liquid detergents and medium hard brushes.

Converter:

No special maintenance is required.

For external cleaning a wet cloth can be used, and if necessary a little soap. Do not use solvents or other aggressive liquids that can damage the enclosure material (polycarbonate).

15.1 Fuse

In the event that the fuse blows, this should be replaced with a slow blow “T” fuse, size Ø5 x 20 mm with the value indicated on the label inside the equipment.

16 SAFETY INSTRUCTIONS

The series FLOMAT flowmeters are in conformity with all essential requirements of all EC directives applicable to them:

2014/68/EU	Pressure equipment directive (PED)
2014/30/EU	Electromagnetic compatibility directive (EMC)
2012/19/EU	Waste electric and electronic equipment (WEEE).
2011/65/EU	Restriction of the use of certain hazardous substances in electrical and electronic equipment (ROHS).

The declarations UE of conformity can be downloaded from the section "Download" of the Tecfluid S.A. website. www.tecfluid.com

16.1 Pressure equipment directive

Series FLOMAT of flowmeters, due to their size, are not subject to conformity assessment, are considered outside the scope of the directive and therefore they have not the CE mark according to pressure directive. These devices are subject to applicable sound engineering practice (SEP).

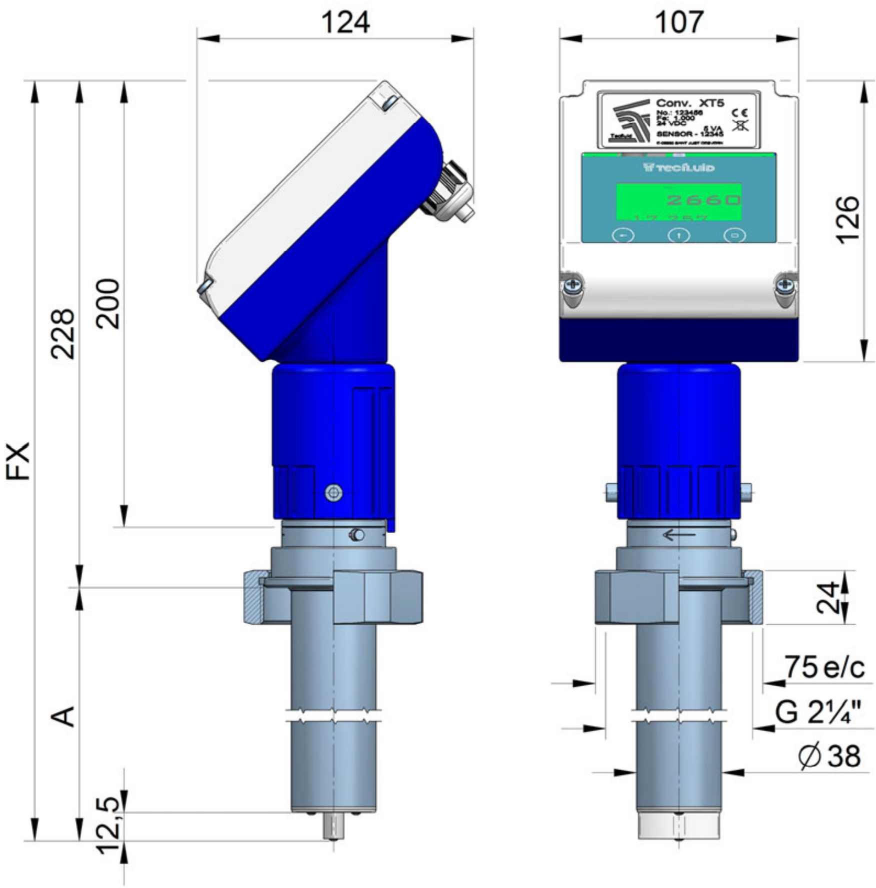
This equipment is considered as being a pressure accessory and **NOT** a safety accessory as defined in the 2014/68/EU directive, Article 2, paragraph 4.

16.2 Certificate of conformity TR CU (EAC marking)

Tecfluid S.A. have subjected the series FLOMAT of flowmeters to a certification procedure according to the technical regulations of the Customs Union of the Eurasian Economic Union (EEU).

This Certificate is an official document confirming the quality of production with the standards on the territory of the Customs Union, particularly regarding safety requirements and electromagnetic compatibility.

17 DIMENSIONS

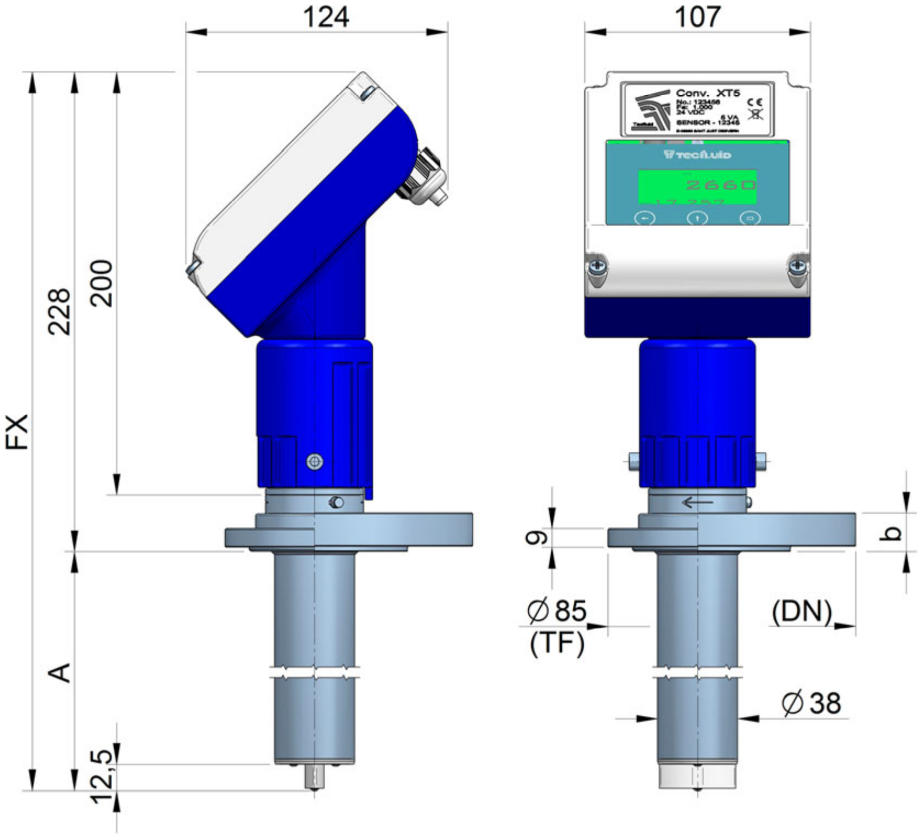


FLOMAT-FX/1 (R 2 ¼)

DN	A	FM *
40 … 450	113,5	328
500 … 1000	218,5	433
1200 … 2000	368,5	583

* FX is the minimum length to remove the instrument from the pipe

(All dimensions in mm)

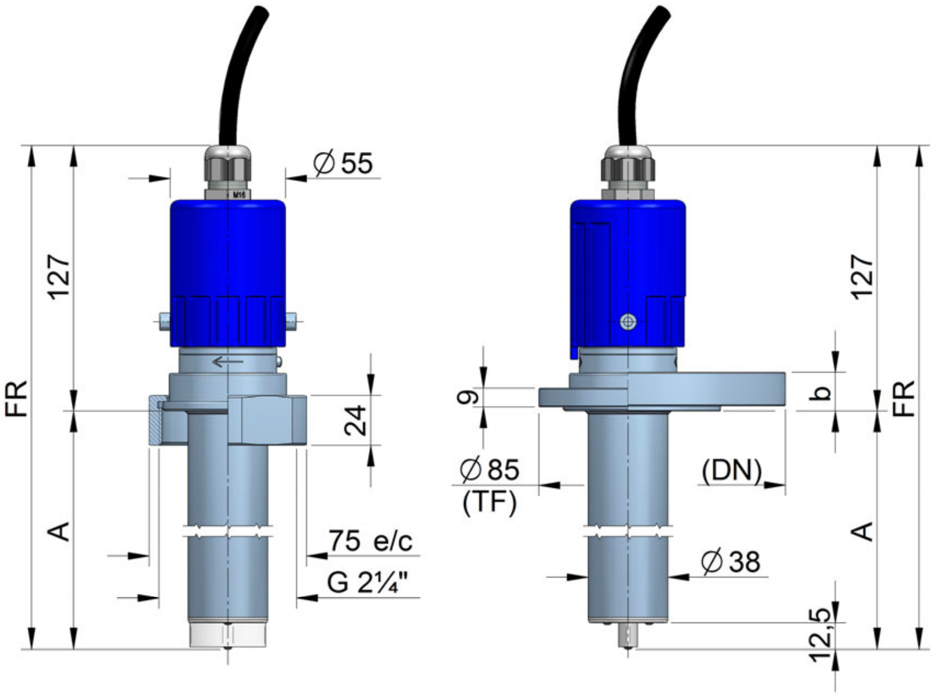


FLOMAT-FX/2 (TF flange and standards)

DN	A	FX *
40 … 450	113,5	341,5
500 … 1000	218,5	446,5
1200 … 2000	368,5	596,5

* FX is the minimum length to remove the instrument from the pipe

(All dimensions in mm)

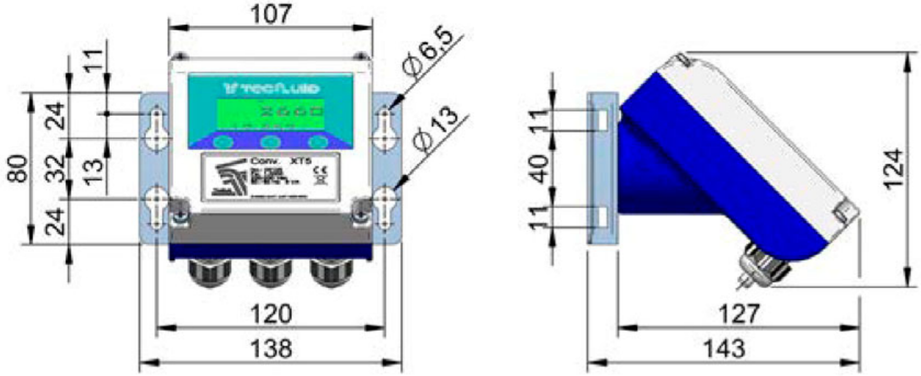


DN	A	FR *
40 … 450	113,5	240,5
500 … 1000	218,5	345,5
1200 … 2000	368,5	495,5

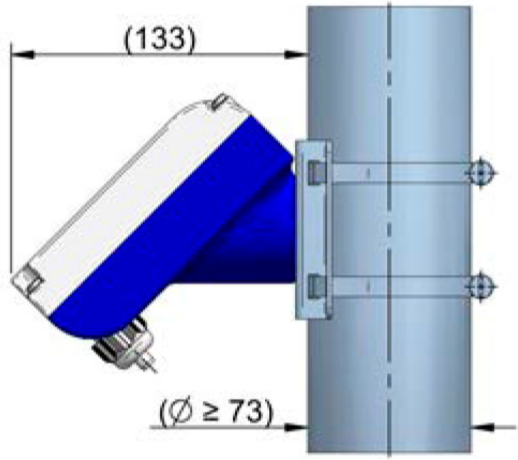
* FR is the minimum length to remove the instrument from the pipe

(All dimensions in mm)

XT5 REMOTE CONVERTER (wall)



XT5 REMOTE CONVERTER (pipe)



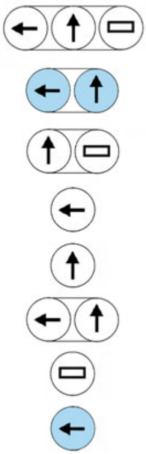
(All dimensions in mm)

18 TROUBLESHOOTING

Problem	Probable cause	Remedy
The flow rate is not displayed. In its place there are dashes	The pipe is empty	Make sure that the pipe is completely full, installing the flowmeter in a section upstream of the pipe
	Isolation of the electrodes	Clean the sensor electrodes.
	Electrode cable disconnected	Connect the cable between the sensor and the electronic converter
	Liquid with very low conductivity	The flowmeter is not adequate for the application
The flow rate is unstable	Dirt on the electrodes	Clean the sensor electrodes
	The product contains air or non-conductive particles in suspension	Verify that the flowmeter is adequate for this application
	The instrument is misaligned	Align according to point 5.2 on page 14
The flow rate displayed is 0	Coil cable disconnected	Connect the cable between the sensor and the electronic converter
	The flow rate is smaller than programmed as CUT OFF	Decrease the value of the cut off (see page 29)
	The instrument is mounted perpendicularly to its correct position	Install the instrument correctly (see point 5.2 on page 14)
The instrument displays a value when there is no flow	The sensor is damaged due to electrodes corrosion	Electrode material not adequate for the liquid
The flow rate displayed is higher than expected	The electrodes are immersed but the pipe is not completely full	Make sure that the pipe is completely full, installing the flow meter in a section upstream of the pipe

Problem	Probable cause	Remedy
The display is blank	Fused fuse	Change the fuse
The analog output gives always 4 mA or 20 mA	Current output range not properly programmed	Program the range properly (see page 28)
The analog output gives 0 mA	Cable disconnected	Check the cable connection
The pulse output does not work well	In pulse / unit of volume mode, the frequency is higher than 6.25 Hz	Decrease the pulses / unit of volume or change to frequency output mode (see page 29)
The totalizer does not change its value	The flow rate is negative (with respect to the fluid direction)	Program the positive flow rate direction according to the fluid direction (see page 31)
The keys do not act	The keys are locked “write protect”	Unlock the keys by placing the jumper (see page 32)

19 PROGRAMMING DIAGRAM



Display serial number and version

Flow rate configuration

Configuration of the rest of parameters

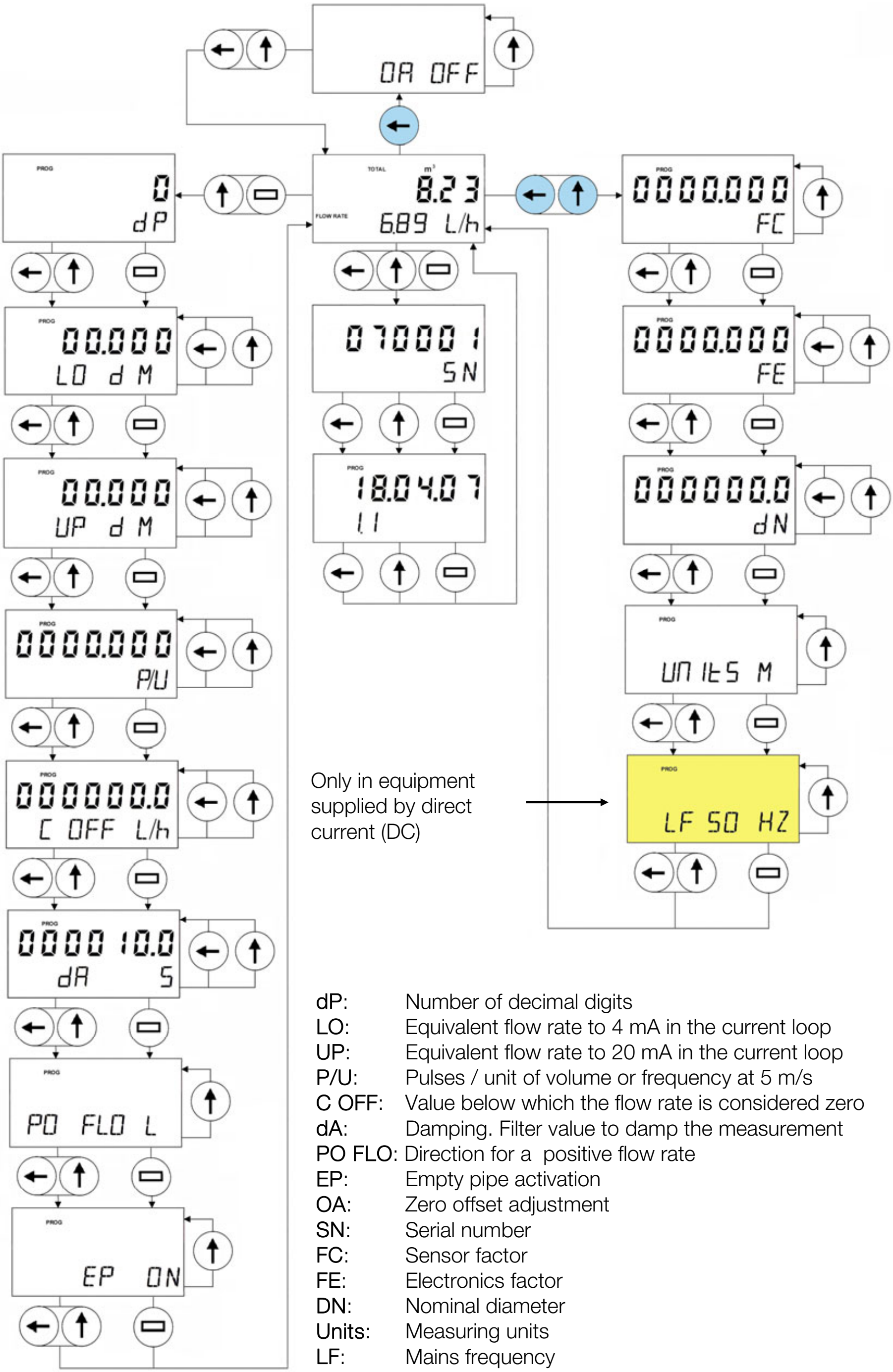
Change to next digit

Change the value

Save into memory

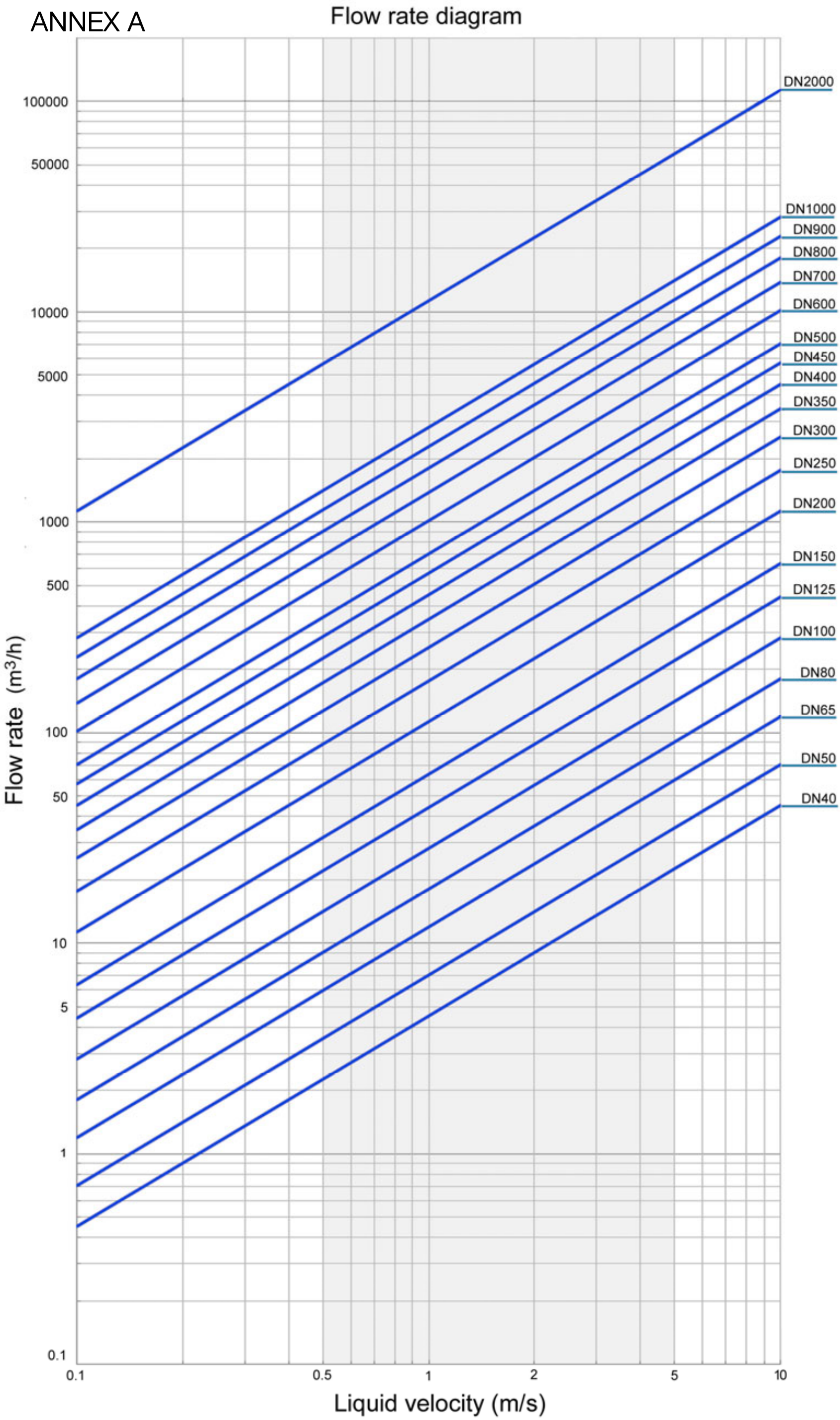
Exit without saving into memory

Zero offset adjustment



dP:	Number of decimal digits
LO:	Equivalent flow rate to 4 mA in the current loop
UP:	Equivalent flow rate to 20 mA in the current loop
P/U:	Pulses / unit of volume or frequency at 5 m/s
C OFF:	Value below which the flow rate is considered zero
dA:	Damping. Filter value to damp the measurement
PO FLO:	Direction for a positive flow rate
EP:	Empty pipe activation
OA:	Zero offset adjustment
SN:	Serial number
FC:	Sensor factor
FE:	Electronics factor
DN:	Nominal diameter
Units:	Measuring units
LF:	Mains frequency

ANNEX A


Flow rate diagram
Flow rate (m³/h)
100000
50000
10000
5000
1000
500
100
50
10
5
1
0.1
0.1
0.5
1
2
5
10
Liquid velocity (m/s)
DN2000
DN1000
DN900
DN800
DN700
DN600
DN500
DN450
DN400
DN350
DN300
DN250
DN200
DN150
DN125
DN100
DN80
DN65
DN50
DN40

WARRANTY

Tecfluid S.A. guarantee all the products for a period of 24 months from their sale, against all faulty materials, manufacturing or performance. This warranty does not cover failures which might be imputed to misuse, use in an application different to that specified in the order, the result of service or modification carried out by personnel not authorized by Tecfluid S.A., wrong handling or accident.

This warranty is limited to cover the replacement or repair of the defective parts which have not damaged due to misuse, being excluded all responsibility due to any other damage or the effects of wear caused by the normal use of the devices.

Any consignment of devices for repair must observe a procedure which can be consulted in the website www.tecfluid.com, “After-Sales” section.

All materials sent to our factory must be correctly packaged, clean and completely exempt of any liquid, grease or toxic substances.

The devices sent for repair must enclose the corresponding form, which can be filled in via website from the same “After-Sales” section.

Warranty for repaired or replaced components applies 6 months from repair or replacement date. Anyway, the warranty period will last at least until the initial supply warranty period is over.

TRANSPORTATION

All consignments from the Buyer to the Seller´s installations for their credit, repair or replacement must always be done at freight cost paid unless previous agreement.

The Seller will not accept any responsibility for possible damages caused on the devices during transportation.

The art of measuring

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Pressure Equipment Directive certified by

ATEX European Directive certified by

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