# SGM-100F

Transit time ultrasonic flowmeter

825B109A

## Features

| | |
|---|---|
| Protection class transmitter: | **IP65** |
| Protection class transducer: | **IP68** |
| Display: | **2x20 digit alphanumeric backlighted** |
| Keypad: | **4x4** |
| Displayed data: | **istantaneous flowrate, flow totalizer** |
| Housing: | **Aluminium** |
| Mounting: | **wall** |
| Input: | **up to 5 4÷20mA input** |
| Output:: | **Sel. 4÷20m A or 0÷20mA** |
| Total accuracy: | **± 1%** |
| Repeatibility: | **±0,2÷0,5%** |
| Linearity: | **±0,5%** |
| Basic measurement period: | **500ms** |
| Serial port: | **RS 232 (optional RS 485)** |
| Programmable frequency output: | **12÷9999HZ** |
| Relay output: | **for pulse totalizer or alarm** |
| Medium speed: | **±32m/s** |
| Working temperature: | **-30÷80°C** |
| Instrument humidity: | **non condensing 85% RH (40°C)** |
| Sensor process temperature: | **0÷150°C** |
| Sensor humidity: | **non condensing 98% RH (40°C)** |
| Power supply: | **30Vac / 24Vdc** |
| Dimensions: | **251x192x80mm** |
| Weight: | **3,1Kg** |

## General

The **SGM-100F** is composed by a digital converter and two clamp-on or insertion type ultrasonic trannducers. It is designed to measure the fluid velocity of a liquid inside a closed conduit. The transducers are a non-contacting, clamp-on type, which provide benefits of non-fouling operation and easy installation.
The DSP digital technology (Digital Signal Processing) ensure a low sensibility of the instrument against potential transient factors.

## 0. Working principle

The **SGM-100F** utilizes two transducers which work as ultrasonic transmitters and receivers.
They are clamped on the outside of a closed pipe at a specific distance from each other. They can be mounted in V position (the sound crosses the pipe twice), in W position (the sound crosses the pipe 4 times) or in Z position (mounted on opposite sides of the pipe - the sound crosses the pipe once). The selection of the mounting position depends on pipe and on liquid characteristics.
the **SGM-100F** operates by alternately transmitting and receiving a frequency modulated burst of sound energy between the two transducers and measuring the transit time that takes the sound to travel between them. The difference in measured transit time is directly and exactly related to the velocity of the liquid inside the pipe (fig.1).

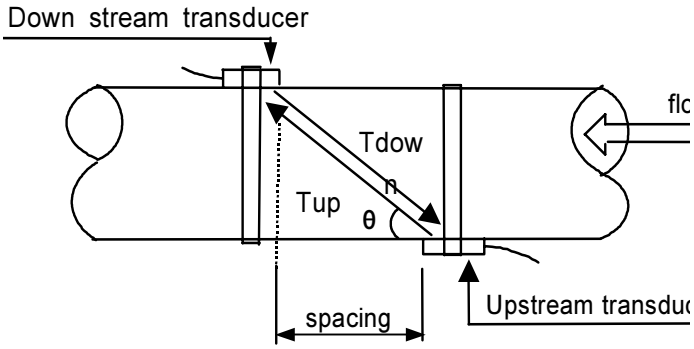



Fig. 1

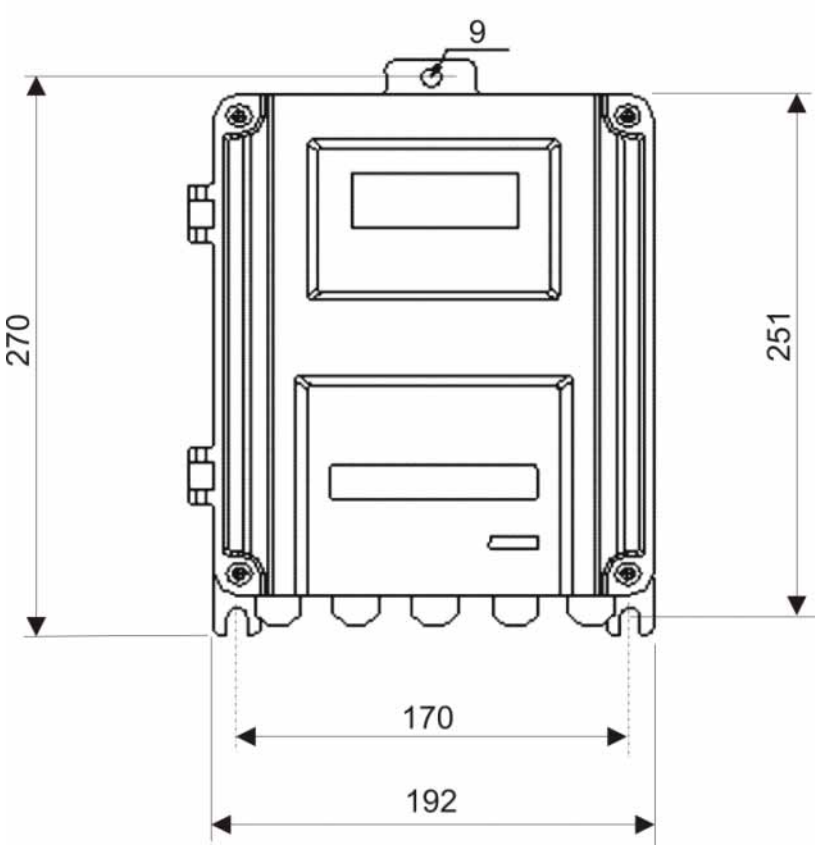
$$V = \frac{MD}{\sin 2\theta} \times \frac{\Delta T}{T_{up} \bullet T_{down}}$$

Where:

| | |
|---|---|
| $\theta$ = | include angle for the flow direction |
| M = | transit time of the ultrasonic signal |
| D= | Internal pipe diameter |
| Tp= | Transit time in the forward direction |
| Tdown= | Transit time in the reverse direction |
| $\Delta$T= | Tup-Tdown |

# 1 Features

## 1.1 Mechanical dimensions




## 1.2 Application

1. water, sewagew with low paticle content and seawater
2. water supply and drainage water
3. power plants, nuclear power plant, thermal and hydropower plants, heat energy, boiler feed water and energy management system
4. metallurgy and mining application
5. petroleum and chemicals
6. food, beverage and pharmaceutical
7. pulp and paper
8. pipeline leak detection
9. network monitoring system, energy and flow computer management

### 1.3 Product Identification

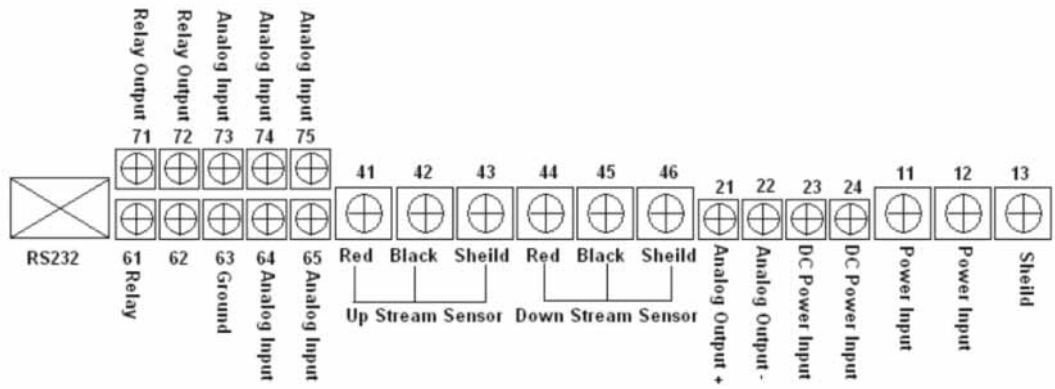
Every instrument has an 8 digit identification number (ESN) which provides the information of version and manufacring date. It is displayed on menu M61 and can be employed for instrumentation management.

### 1.4 Specifications

| Item | | Specifications |
|---|---|---|
| **Main Unit** | **Principle** | Low voltage, multipulse |
| | **Accuracy** | 1% or better, repeatability of 0.5% measuring period: 500ms |
| | Backlitghted LCD display shows instantaneous flow and accumulated flow ,flowrate, time etc | |
| | **Output** | Electric current output of 4-20 Ma or 0-20mA,impedance of 0-1KO precision of 0.1% |
| | | Open Collector (OCT) output: positive/negative/net flow or integrating flow rate pulse signal or instance flow rate frequency signal |
| | **Input** | Five electric current signals input (temperature, pressure, level ) |
| | Automatic memory of a accumulative flow of last 64 days 64 months, 5 years | |
| **Transducers connection cable** | 2x5 mt - max length: 200m **Warning**: connection cable must be placed far from high power and switching cable connections | |
| **Piping** | Steel, stainless steel, cast iron, current pipe, copper, PVC, aluminum, glass steel | |
| | 20mm-4000mm | |
| | Installation suggestions: Upstream 10D, downstream 5D, 30D away from the pump | |
| **Fluids** | Water, seawater, sewage, oils and other liquids capable of ultrasonic wave propagation | |
| | | |
| **Operating condition** | Temperature | Transmitter -30~80°C Transducers 0~+150°C |
| | Umidity | Main unit: 85%RH Transducer: can work under water of depth lower than 3m |
| **Power supply** | | 2w, AC230V / DC24V |

## 2 Operation

### 2.1 Connections



## 2.2 Power on

Standard power supply of **SGM-100F** is 230VAC. Please check power supply voltage before connecting the unit. Once the instrument is switched on, it will run a self diagnostic program. If there's any anomaly the corresponding error message will be displayed. Generally, there should be no display of error messages, and the flow meter will go to the most commonly used Menu Window Number 01 (short for M01) to display the Velocity, Flow Rate, Positive Totalizer, Signal Strength and Signal Quality, based on the pipe parameters configured last time by the user or by the initial program.
The operation on the keypad does not interfer with the measurement because there's the simultaneous processing technology.
When power is on, the user can see on menu window M01 that it is adjusting the gain of the amplifier. Progress S1, S2, S3 and S4 will be displayed on the left upper corner of the display and after the adjustment the flowmeter will go into the normal measurement mode, with "R" displayed on the left upper corner.
If the instrument is running for the first time or it has been installed in a new position, the user needs to enter new pipe parameters. Any parameter will be recorded permanently into the NVRAM of the SGM-100F, until new modification.

## 2.3 Keypad

The **SGM-100F** keypad has 16+2 keys.
Keys from 0 to 9 and ● are to enter numbers or menu numbers
Key ▲/+ is for entering the previous menu window. It can be also used to increase a numeric value.
Key ▼/- is for entering the next menu window. It can be also used to decrease a numeric value.
Key ◄ is for moving left or to delete the left character.
Key ENT is for selecting a menu option or for confirm a modification.
Key MENU is for the direct menu window jump over

## 2.4 Menu windows

The interface has about 100 different menu windows, numbered from M00 to M99.
There are two methods to enter menu windows:
(1)Direct entering by pressing MENU followed by two digit-number keys. For example, to enter M11 menu (pipe external diameter) press in sequence MENU 1 1
(2)Research by ▲/+ and ▼/-, scrolling the windows numbers. By pressing ▲/+ the user will display the previous menu window and by pressing ▼/- will display the next one.

There are three different types of menu windows:
(1) for number/value entering, like pipe diameter dimensions
(2) for options selection, like pipe material
(3) for values display, like velocity, flow rate ecc.
For number entering windows press directly the digit-numbers and ENT to confirm. For example, if the outer diameter of the pipe is 219.2345, select the menu window M11 and press in sequence:
2 1 9 ● 2 3 4 5 ENT
For selecting and modifying the parameters, press ENT and select the option by pressing ▲/+ and ▼/- . Press then ENT to confirm.
For example, if the pipe material is SS316, select menu window M14, press ENT and select the pipe material by pressing ▲/+ or ▼/- or by digiting the number showed before the material (in this case 1).
Press then ENT to confirm the choice.

## 2.4 Menu windows types

M00÷M09 for values display (flowrate, velocity, date and time, totalizer, battery volatge and estiomated working time)
M10÷M29 for entering pipe parameters
M30~M38 for selecting flow rate unit and totalizer unit
M40÷M49 for response time, zero and calibration setup and password modification
M50÷M53 for data logger setup
M60÷M78 for time-keeper setup, ESN information and alarms
M82 for totalizer data display
M90÷M94 for diagnostic
M97÷M99 command windows
M+0÷M+8 additional fucntions, as calculator, and for displaying total working hours, turn-on and turn-off times and date and time of the single operations.

## 2.5 Parameters setting

In order to achieve a proper measurement, proceed with the configuration of the following parameters:
(1) Pipe outer diameter
(2) Pipe wall thickness
(3) Pipe material. In case of non standard materials (not listed) it's necessary to enter also the relevant medium sound speed.
(4) Liner material, if present, and the relevant medium sound speed and thickness
(5) Liquid type. In case on non standard liquid (not listed) it's necessary to enter also the relevant medium sound speed.
(6) Transducers type
(7) Transducers mounting method
(8) Transducers mounting distance (showed on menu window M25)

For standard pipe materials and standard liquids refer to the following instructions:

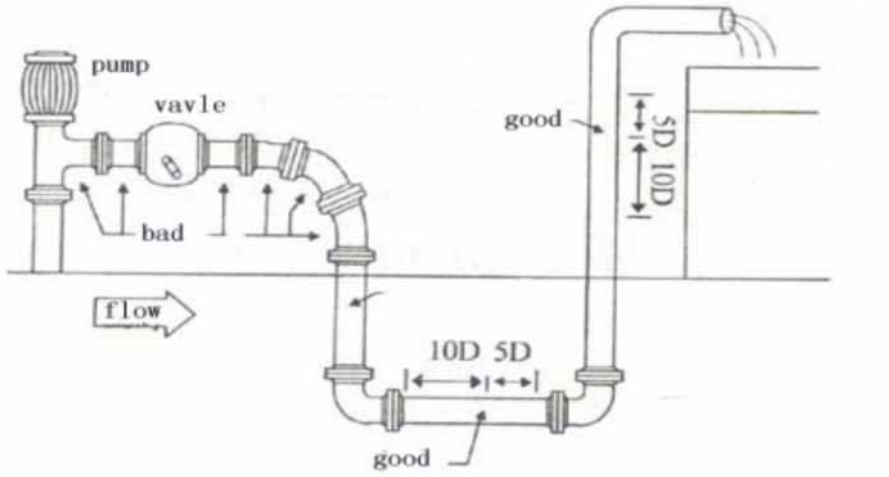
(1) Press MENU 1 1 to input the pipe outer diameter and press ENT to confirm.
(2) Press ▼/- to enter menu M12 and input the pipe wall thickness. Press ENT to confirm.
(3) Press ▼/- to enter menu M14 and press ENT to enter selection mode. Use ▲/+ or ▼/- to select the material and press ENT to confirm.
(4) Press ▼/- to enter menu M16 and press ENT to enter selection mode. Use ▲/+ or ▼/- to select the lining material and press ENT to confirm.
(5) Press ▼/- to enter menu M20 and press ENT to enter selection mode.Use ▲/+ or ▼/- to select the liquid and press ENT to confirm.
(6) Press ▼/- to enter menu M23 and press ENT to enter selection mode. Use ▲/+ or ▼/- to select the transducers and press ENT to confirm.
(7) Press ▼/- to enter menu M24 and press ENT to enter selection mode. Use ▲/+ or ▼/- to select transducers mounting method and press ENT to confirm
(8) Press ▼/- to enter menu M24 to install the transducers on the pipe and then press ENT to go to menu M01 to check the parameters.

# 3 Installation

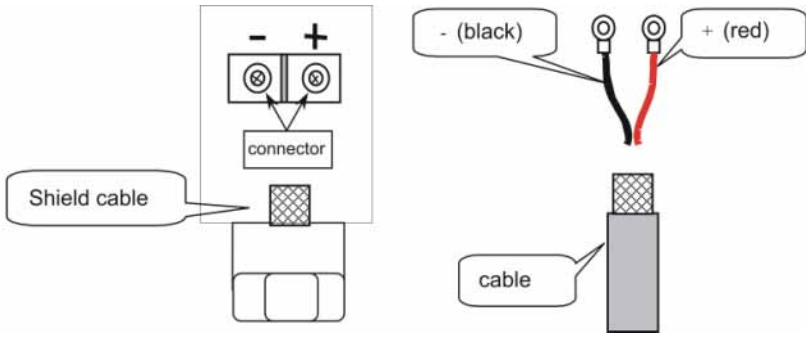
## 3.1 Measuring location

The first step of the installation process is the selection of an optimum place in order to obtain a more accurate measurement. For this reason it is important to have a basic knowledge of the piping and of its plumbimg system. An optimum place would be defined as a straight pipe length full of liquid, horizontally or vertically positioned.
Selection principles for an optimum installation:

(1) Install the transducers on the longer length of the pipe and make sure that the pipe is completely full of liquid.
(2) Make sure that the temperature on the location does not exceed the temperature range of the transducers. In general the closer to the room temperature the better.
(3) Take the pipe fouling into consideration. Select a straight length of a relatively newer pipe. If the condition is not satisfying, consider the fouling thickness as part of the liner for a better result.
(4) Remember that gas fase in the liquids is in the upper part of the pipe. Consequently on horizontal pipe installations avoid to put the trasducers in the upper part.




## 3.2. Transducers installation




The **SGM-100F** transducers are made of piezoelectric crystals, both for transmitting and receiving the ultrasonic signals through the wall of the liquid piping system. The measurement is realized by measuring the traveling time difference of the ultrasonic signals. Since the difference is very small, the spacing and the alignment of the transducers are important factors for the accuracy of the measurement and the performance of the measuring system.

How to proceed with the installation:
(1) Locate an optimum position on the pipe, which has to be in good condition (no rust)
(2) Clean and dust the pipe surface.
(3) Apply adeguate coupler on the spot where the transducers have to be installed and leave no gap between the pipe surface and the transducers.

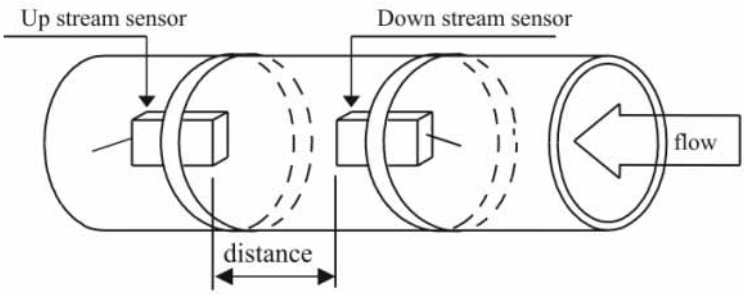
To avoid gas bubbles (gas fase) inside the upper part of the pipe, the transducers should be installed horizontally by the side of the pipe.

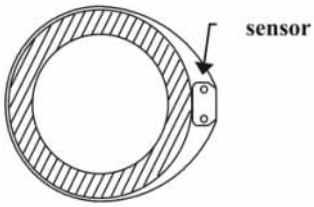
### 3.2.1 Transducers spacing

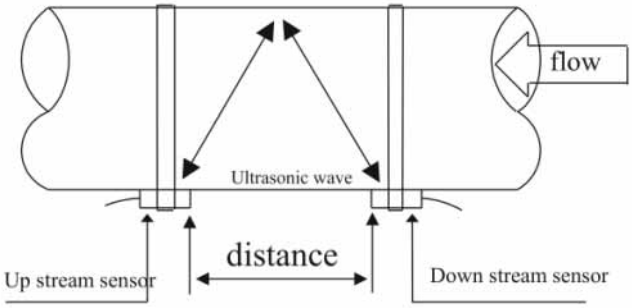
The spacing value shown in menu M25 refers to inner distance between the two transducers. The actual trasducers spacing should be as close as possible to the spacing value. (see figures on next page).

### 3.2.2 V method installation

It is the most common used method for pipe with diameters ranging from 20 to 300 millimeters.

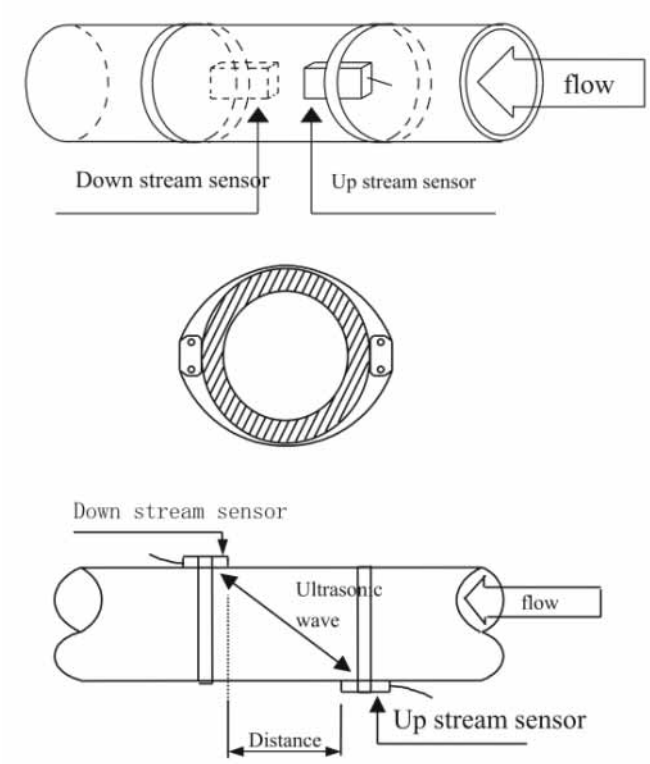


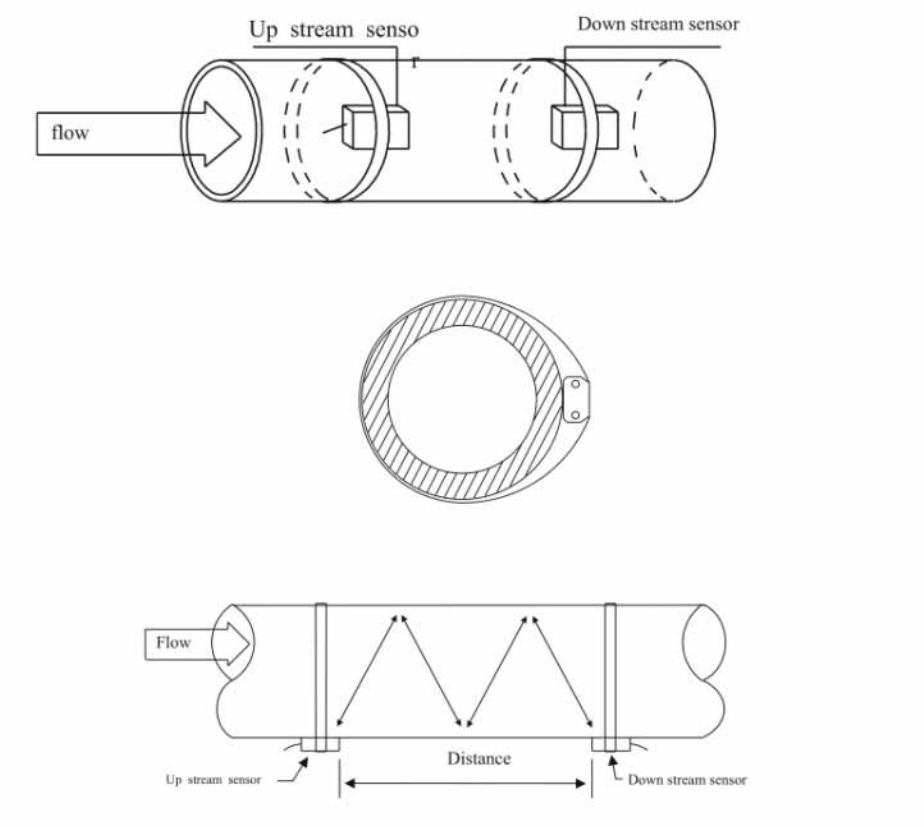
### 3.2.3 Z method installation

It is commonly used when the pipe diameter is between 300 and 500 millimeters.




### 3.2.4 W method installation

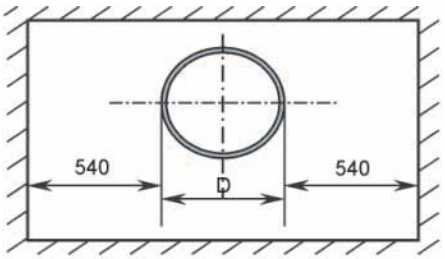
It is usually used on little pipes with a diameter from 10 to 100 millimiters.



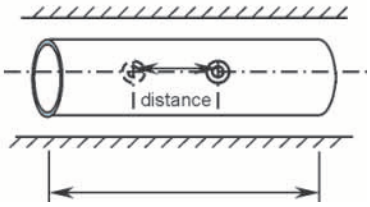
### 3.2.6 Insert sensor installation

Steps for a correct installation:

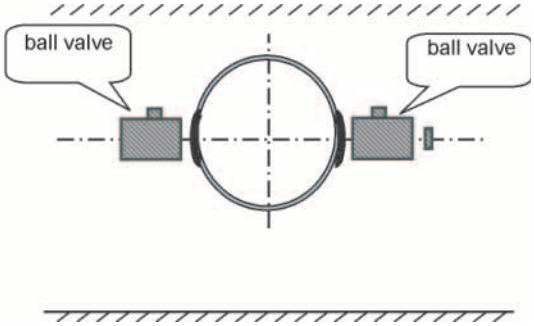
1- If the pipe is placed inside the wall, check that there's sufficient space for the mounting of the insertion sensor (min. distance between the wall and the pipe = 540mm)



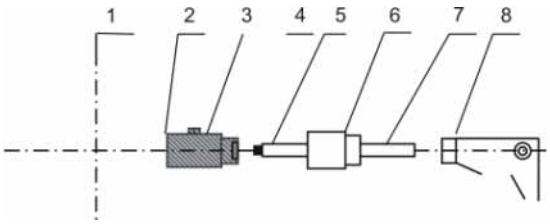

Pipe length : L> (D+100) mm




2- Procure a drilling tool
3- Enter pipe parameter (in menu M23 choose option 5. "insertion B sensor" - in menu M24 choose 1. "Z method" - in menu M25 input installation distance)
4- Choose the right position and calculate the distance
5- Install the ball valve

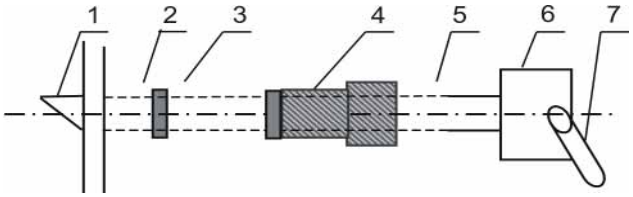


6- Drill the pipe

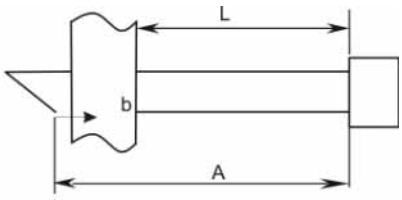



1 sensor 2 bottom of ball valve 3 ball valve 4 screw
5 tight screw 6 connection 7 cable

7- Insert the sensor



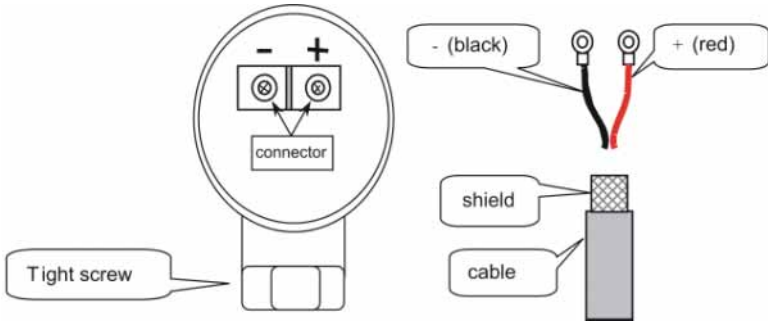

1 sensor 2 bottom of ball valve 3 ball valve 4 screw
5 tight screw 6 connection 7 cable




**L= A - b**

A = sensor length b = pipe thickness L= external sensor length

8- Proceed with the electrical connection



### 3.3 Installation check-up

Through the checkup of the installation, one can: check the receiving signal strength, the signal quality Q value, the traveling time difference of the signals, the estimated liquid speed, the measured traveling time of the signals and the calculated traveling time ratio.

#### 3.3.1 Signal strength

Signal strength indicates the amplitude of receiving ultrasonic signals by a 3-digit number. [000] means there is no signal detected, and [999] refers to the maximum signal strength that can be received.
Although the instrument works well if the signal strength ranges from 500 to 999, stronger signal strength should be pursued, because a stronger signal means a better result. The following methods are recommended to obtain stronger signals:

(1) Relocate a more favorable location, if the current location is not good enough for a stable and reliable flow reading, or if the signal strength is lower than 700.
(2) Try to polish the outer surface of the pipe, and apply more coupler to increase the signal strength.
(3) Adjust the transducers both vertically and horizontally while checking the varying signal strength, stop at the highest position, and then check the transducers spacing to make sure the transducers spacing is the same as shown in menu M25 .

#### 3.3.2 Signal quality (Q)

Signal quality is indicated as the Q value on the instrument. A higher Q value would mean a higher Signal and Noise Ratio (short for SNR), and accordingly a higher degree of accuracy would be achieved. Under normal pipe condition, the Q value is in the range of 600-900, the higher the better.
Causes for a lower Q value could be:

(1) Interference of other instruments and devices such as a powerful transverter working nearby. Try to relocate the flow meter to a new place where the interference can be reduced.
(2) Bad sonic coupling for the transducers with the pipe. Try to apply more coupler or clean the surface etc
(3) Pipes are difficult to be measured. Relocation is recommended.

#### 3.3.3 Total transit time and Delta Time

The numbers displayed on menu window M93 are called total transit time and delta time respectively. They are the primitive data for the instrument to calculate the flow rate inside the pipe. So the flow rate indication will vary accordingly with the total time and delta time.
The total transit time should remain stable or vary little.
If the delta time fluctuates higher than 20%, it means there are certain kinds of problems with the transducer installation.

#### 3.3.4 Time ratio between the Measured Total Transit Time and the Calculated Time

This ratio would be used to check the transducer installation. If the pipe parameters are entered correctly and the transducers are installed properly, the value for this ratio should be in the range of 100±3. If this range is exceeded, the user should check:

(1) If the pipe parameters are correctly entered.
(2) If the actual spacing of the transducers is right and the same as what the window M25 shows.
(3) If the transducers are installed properly in the right directions.
(4) If the mounting location is good and if the pipe has changed shape.
(5) If there is too much fouling inside the pipe.

# 4 Use

## 4.1 How to check if the instrument works properly

When 'R' is displayed in the lowest right corner of LCD display, the instrument is working properly.
If an 'H' flashes on that place, there could be poor signal received. Please refer to the chapters on diagnosis.
If an 'I' is displayed, it means that there is no signal detected.
If a 'J' is displayed, it means that the hardware of this instrument could be out of order. Refer to the chapter on diagnosis.

## 4.2 How to check the liquid flow direction

Make sure that the instrument works properly
Check the flow rate for the indication. If the displayed value is POSITIVE, the direction of the flow will be from the RED transducers to the BLUE transducers; if the displayed value is NEGATIVE, the direction will be from the BLUE transducers to the RED transducers.

## 4.3 How to select unit system

Use menu window M30 for the selection of unit system in English or Metric system.

## 4.4 How to select a required flow rate unit

Use menu window M31 to select the flow unit first and then the timing unit.

## 4.5. How to use the totalizer multiplier

Use window M33 to select a proper totalizer. Make sure that the totalizer pulse is appropriately speeded. It should not be too fast and neither too slow. A speed of producing a pulse in several seconds or minutes is preferable.
If the totalizer multiplier is too small, there can be a loss of accumulation pulse because the output device can output only one pulse in a measurement period (500milliseconds)
If the totalizer multiplier is too large, the output pulse will be too fewer for the devices that are connected with the instrument for a quicker response.

## 4.6 How to enable or disable the totalizers

Use M34, M35 and M36 to turn on or turn off the POS, NEG, or NET totalizer respectively.

## 4.7 How to reset the totalizers

Use M37 to reset the proper totalizer.

## 4.8 How to restore the flow meter with default values setted by the producer

Use M37, when the 'selection' message is displayed. Press the dot key first and the message 'Master Erase' will display, then press the backspace key ◄
The master erase step will erase all the parameters entered by the user and setup the instrument with default values.

## 4.9 How to use the damper

The damper acts as a filter for a stable reading. If '0' is entered in window M40, that means there is no damping. A bigger number brings a more stable effect. But bigger damper numbers will prevent the instrument from acting quickly. Numbers from 0 to 10 are commonly used for the damper value.

## 4.10 How to use the zero-cutoff function

The number displayed in window M41 is called the low-cutoff value. The flow meter will replace these flow rate values that are absolutely less than the low-cutoff value with '0'. This means the flow meter will avoid any invalid accumulation when the actual flow is below the zero-cutoff value.
The low-cutoff value does not affect the flow measurement when the actual flow is absolutely greater than the low-cutoff value.

## 4.11 How to setup a zero point

There exists a 'Zero Point' with certain installation which means the flow meter will display a non-zero value when the flow is absolutely stopped. In this case, setting a zero point with the function in window M42 will bring a more accurate measurement result.
Make sure that the flow is absolutely stopped, then run the function in window M42 by pressing the ENT key.

### 4.12 How to get a range factor for calibration

A range factor is the ratio between the 'actual flow rate' and the indicated value by the flow meter.
The range factor can be determined by calibration with flow calibration equipment.

### 4.13 How to use the operation locker

The system locker provides a means of preventing accidental configuration changes or totalizer resets.
When the system is locked, menu window browsing can be done without affecting any change, but any modifications are prohibited.
The system can be locked without a password or with a one 1 to 4 digit password. With a no-password locking, directly press the ENT key when the password input prompt displays.
If the password is forgotten, please contact the factory

### 4.14 How to use the built-in data logger

The data logger has a space of 24K bytes of memory, which will hold about 2000 lines of data.
Use M50 to turn on the logger and for the selection for the items that is going to be logged.
Use M51 for the times when the logging begins and at how long an interval sustains and how long the data logging will last.
Use M52 for the direction of logging data. The default setting will permit the logging data to be stored in the logger buffer.
Logging data can be redirected to the RS-232C interface without being stored into the logger buffer.
Use M53 to view the data in the logger buffer.
Dumping the logging data through the RS-232C interface and the clearing of the buffer can be operated with a function in window M52.

### 4.15 How to use the Frequency Output

The frequency output signal, which represents the flow rate, is intended to make connection with other instruments.
The Frequency Output is totally user-configurable. Generally, four parameters should be configured for the setups.
Enter the lower flow rate value in window M68 and the higher flow rate value in window M69.
Enter the frequency range in window M67.
For example, assume that the flow rate varies in a range 0m3/h to 3000m3/h, and an output signal is at a maximum frequency of 1000Hz, the minimum of 200Hz is going to be required for other instrumentation. The user should enter 0 in M68 and 3000 in M69, and enter 200 and 1000 in window M67.
Please note that the user has to make the selection with OCT setups in window M78 by selecting the 13$^{th}$ option reading like 'FO output' to direct the frequency output to the OCT OUTPUT hardware device.

### 4.16 How to use the Totalizer Pulse Output

The totalizer output will produce a pulse output with every unit flow of the totalizer.
Refer to point **4.4** and **4.5** for the setups of the totalizer units and multiplier.
The totalizer pulse output can only be realized by mapping the pulse output to the OCT or BUZZER hardware devices.
For example, assume that the POS totalizer pulse output is needed, and every pulse should represent 0.1cubic meter of liquid flow; the pulse output will be mapped to the internal Buzzer, so that with every 0.1 cubic meter of flow the BUZZER will beep for a while.
The following setups should be taken/performed:
Select the unit Cubic Meter under window M32.
Select the Multiplier as '2. X0.1' under window M33.
Select the output option '9. POS INT Pulse' under window M77. (INT stands for totalized )

### 4.17 How to produce an alarm signal

There are 2 types of hardware alarm signals that are available with this instrument. One is acustic (the Buzzer), and the other one is the attivation of an Open Collector put (OCT). For both the Buzzer and OCT output the triggering sources of the event include the following:

(1) no receiving signal
(2) poor signal received
(3) flow meter not in normal measurement mode
(4) reverse flow
(5) overflow of the Frequency Output
(6) flow out of the setted range

There are two out-of-normal-range alarms in this instrument. They are called #1 Alarm and #2 Alarm. The flow range can be user-configurable through M73, M74, M75, M76.
For example, assume that the Buzzer should start beeping when the flow rate is less than 300 m3/h and greater than 2000m3/h, the following steps for setups would be recommended:

(1) Enter 300 under M73 for #1 alarm low flow rate
(2) Enter 2000 under M74 for #1 alarm high flow rate
(3) Select the item '6. Alarm #1' under M77.

**4.18 How to use the acustic alarms (Buzzer)**
The built-in buzzer is user-configurable. It can be used as an alarm. Use M77 for setups.

**4.19 How to use the OCT output (Open Collector)**
The OCT output is user-configurable, which can be performed by selecting the proper input source such as pulse output.Use M78 for the setups.Please make sure that the Frequency Output shares the OCT.
The OCT output shares pins with the RS-232C interface, and the terminal is at Pin 6 and the ground is at Pin 6.

**4.20 How to modify the built-in calendar**
Modification will be required only in such cases as when the battery is totally consumed, or when the changing of the battery takes a long time.
Press the ENT key under M61 for Modification. Use the dot key to skip over these digits that need no modification.

**4.21 How to adjust the LCD contrast**
Use M70 to the LCD contrast. The adjusted result will be stored in the EEPROM so that the MASTER ERASE will make no effect on the contrast.

**4.22 How to use the RS232 serial interface**
Use M62 for the setup of the RS-232C serial interface.

**4.23 How to view the Date Totalizers**
Use M82 to view the date totalizers that are comprised of a daily totalizer, a monthly totalizer and a yearly totalizer.

**4.24 How to use the manual totalizer**
Use M28 for the manual totalizer. Press ENT key to start and stop the totalizer.

**4.25 How to check the ESN and other minor details**
Every set of the series flow meter utilizes a unique ESN to identify the meter. The ESN is an 8-digit number that provides the information of version and manufacturing date.The user can also employ the ESN for instrumentation management.The ESN is displayed in window M61.
Other details about the instrument are the total working hours displayed in window M+1, and the total power-on times displayed in window M+4.