TTFM100B SERIES

TRANSIT TIME FLOWMETER- PORTABLE TYPE

DESCRIPTION

The Transit Time Flowmeter of TTFM100B series measures flowrate by calculating the spreading time of an ultrasonic wave in a liquid, going upstream and downstreamgo into a full pipe.

This flowmeter is mostly used to measured the flowrate of homogeneus fluids , with a very little percentage of suspended solids and possibly without gas bubbles.

Its peculiar installation makes this devices suitable for measuring aggressive fluids (acids, basic and dissolvents) or very soiling fluids(oil and fuels).

The measuring system is composed of one or more couples of ultrasonic transducers acoustically coupled to the external pipe's wall (it is also possible to use transducers in direct contact with fluid to be measured) and a portable unit elaborating the sent and received signals from the transducers. The HOST unit has a DSP microprocessor, it gives signals to interfacing with the process or the control systems.

Main Characteristics

The TTFM100B series includes a range of ultrasonic flowmeters whose electronics is composed of a single board: high precision, high fidelity, high competitivity.

The devices main characteristics are:

•Clamp-on sensors: it is not necessary to stop the flow to install them. Or Insertion sensors.

•The device could make the signals gain automatically suitable to the pipe's diameter and to the measuring conditions.

•0.5% linearity.

•0.2% repeteability.

•4 flow totalizers.

•Battery supply lasting 8 hours in continuous functioning.

•The time difference during the measuring process could be 0.1 ns.

•Ultrasonic transducers with low voltage supply, patened.

•Possibility of saving up to 2000 internal measures, suitable to the selected parameters.

•Analog (4-20 ma), pulses (relays), frequence (OCT) and RS232 outputs.

•All the measures could be driven to the RS232 in order to save data into a PC or a serial printer.

Typical Use

•The TTFM100B flowmeter could be virtually used in a very huge range of measuring. The diameters could go from DN20 up to DN6000 and the application could be the following:

•Water treatment, slurry and process water pumping;

•Oil and chemical industries;

•Hydro-electric, cooling, anti-fire stations;

•Exploitation industries;

•Food, paper and pharmaceutical industries;

•Car industries;

•Flow balancing;

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Description- Transit Time Flowmeters Working Principle

When the ultrasonic spreads in the liquid, the flow will cause a changing in the spreading time in function of downstream or upstream current.

The ultrasonic wave going towards the same directions of the flow , increases the spreading speed, while the ultrasonic wave going towards the opposite side of the flow decreases the spreading speed.

If the difference between the two spreading times is accurately measured, it would be possible to calculate the flow speed (see the following picture).

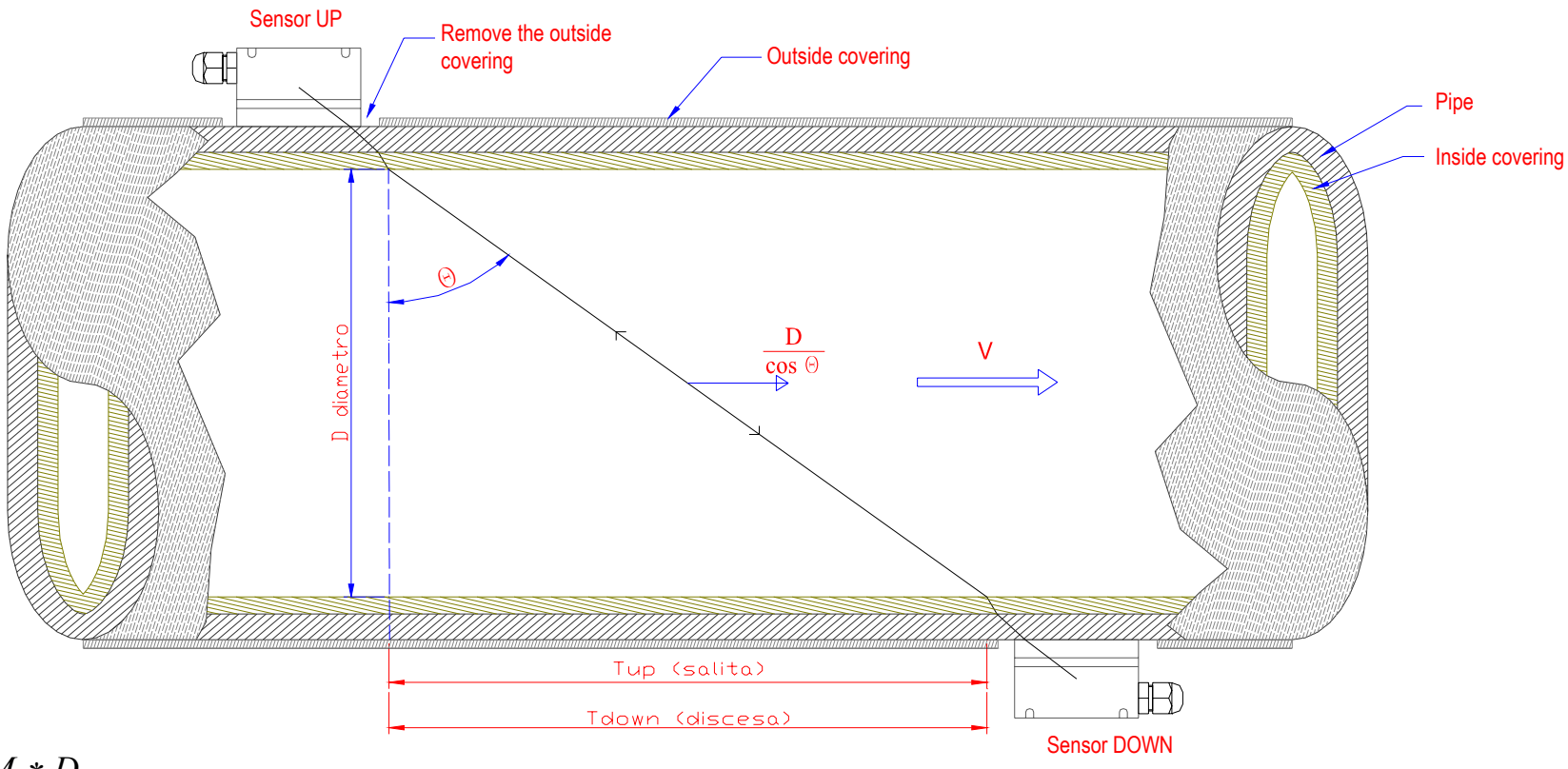
2 sensors in direct contact with the pipe's external surface are used to measure.

One sensor is placed on the upper side of the pipe's external surface, one sensor is placed on the lower side of the pipe's external surface.

The sensors positions could look like a "Z" or like a "V" or a "W", if the pipe has a small diameter (in the previous picture, the sensors are "Z" mounted).

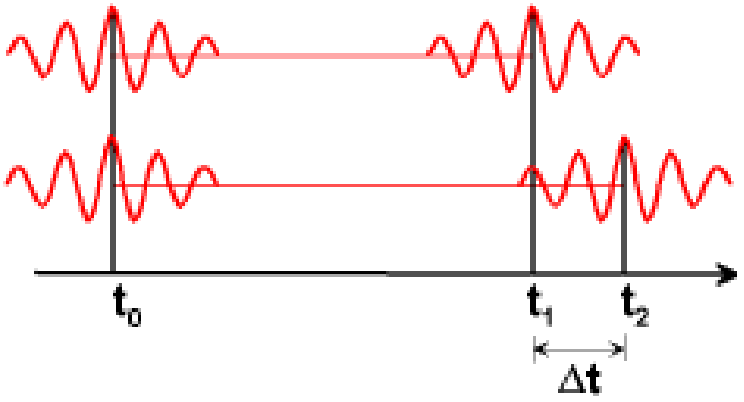
The sensors are alternatively used to receive the ultrasonic pulses sent through the way pipe- fluid- pipe.

The difference between the transmitted and received signals upstream and downstream are calculated as follows:



$$Tup = \frac{M * D}{Co + VSIN\,\theta} \cdot \frac{COS\,\theta}{} \qquad Tdown = \frac{M * D}{Co - VSIN\,\theta} \cdot \overline{COS\,\theta}$$

$$V = \frac{M * D}{SIN\,2\theta} * \frac{\Delta T}{Tup * Tdown}$$



Where:

M	Spreading time
D	Pipe's internal diameter
Θ	Transmission angle
Co	Sound spread speed through the fluid in static conditions
Tup	Positive spreading time
Tdown	Negative spreading time

DT value is the difference of spreading time into a homogenous fluid without gas bubbles.

The equation (3) for calculating the average speed "V" could be used for all the types of fluids in ideal conditions. The fluid speed measuring is in fact conditioned by different factors which make the precision decrease: for example the dumps on the pipe's internal walls: they change the measuring principle of the transit time flowmeter.

TTFM100B series has are a lot of solutions trying to solve these problems, compensating the temperature influence, the dumped internal walls and the asymmetry in the speed distribution, in order to measure in critical conditions too.

It is possible to adjust the zero point of the device: if the fluid is in static conditions, this operation makes the precision increase until reaching values near to 0.5%.

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Technical Features

FEATURE	SPECIFICATION
Linearity	0.5%
Repeatability	0.2%
Accuracy	+/- 1% of the reading value > = 0.2 m/s
Response time	From 0 to 999 seconds, set by the user.
Speed	+/- 32 m/s
Pipes diameter	From DN20 to DN 6000
Eng. Unis	Meters, Feet, Cubic meters, Cubic feet, USA Gallons, Imperial Gallons, USA Million Gallons, set by the user.
Totalizers	7 digit for positive, negative and net flowrate.
Measurable liquids	All the liquids (virtually)
Safety	Possible to set a password for blocking the device.
Display	Graphic dislya4 lines, 16 characters.
Interface	RS232-C from 75 to 57600 BPS. Ientek protocol compatible with Fuji.
Transducers	S1, M1, L1 on customers request.
Cable lengths	From 2 x 5 m up to 2 x 500 m
Supply	3 x AAA Ni-MH batteries (included) for 8 hours working
Data logger	Internal data logger to save up to 2000 lines of data.
Manual totalizer	7 digit totalizaer for manual acquisitions and calibrations.
Housing material	ABS
Housing dimensions	460 (L) x 400 (W) x 110 (H) mm
Weight	4.5 kg batteries included

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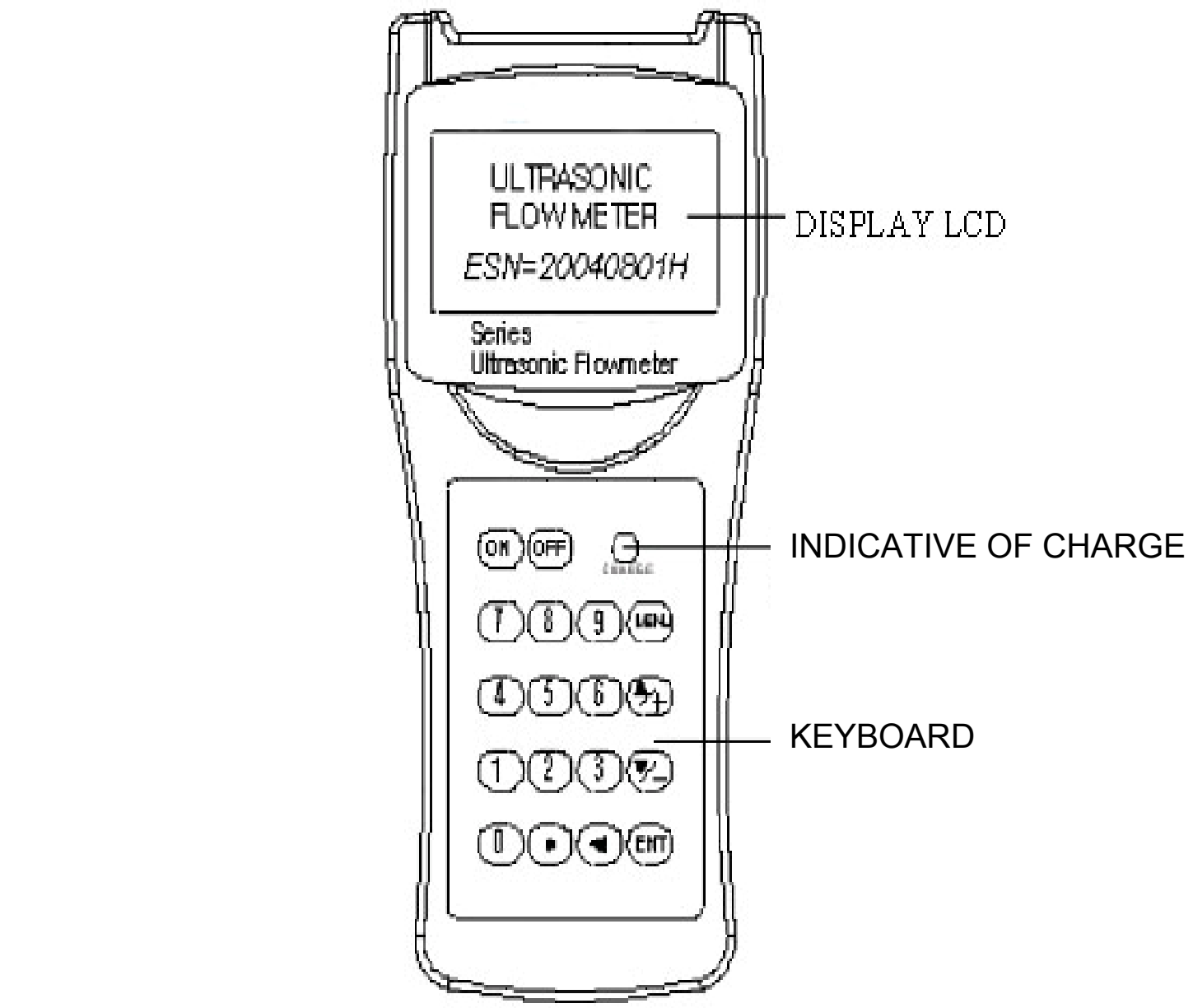
Flowmeter's Features



Each TTFM100B device has its own serial number that could not be changed by the user. The serial number should be communicated in case of malfunctioning and it could be displayed by menu M61.

Data safety and integrated Real Time Clock (RTC)

The settings that could be set by the user (up to 18) are keep in the device's mind for a period of 100 years, in case of voltage losses. The unauthorized access could be protected by a password.

The RTC keeps working until a battery discharge tension of 1.5V (normally the recharge is 2.8V).

Use M60 menu to re-set date and time checking that the date is set in this format: YY/MM/DD.

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Installation and Setting

The ultrasonic flow meter mounting is quite simple. To complete it is enough to determine the mounting point on the pipe and have some information about the pipe's dimensions.

• HOW TO SELECT THE MEASURING POINT :

The fluid should be a measurable fluid and the pipe's diameter, material and length should correspond to what foreseen for the application of technology.

Please contact the technicians of B.M. TECNOLOGIE INDUSTRIALI: bm@bmtecnologie.it.

To obtain a correct measure, please notice what follows:

1) Select the pipe's measuring point in order to have a turbulence-free flow.

2) The distance between the measurement points upstream is 10D, downstream is within 5D. If upstream there are pumps, curves or valves, this distance should reach 30DN.

3) It is possible to install the device in pipes with internal lining, but it is better to avoid this kind of installation, above all if the pipe is an old one and it was maybe damaged.

4) If possible, select similar pipes, with similar thickness in order to improve measures and accuracy.

The accuracy of the following information could improve relevantly the precision of the installation and the following measure:

- External pipe diameter, without lining.
- Internal diameter or pipe's thickness.
- Pipe's material or sound spreading speed through the material.
- Internal lining, material and thickness or spreading speed through this material.
- Type of fluid or sound spreading speed though this fluid.
- Transducers type.
- Type of mounting: "V", "Z", "N", or "W".

TRANDUSCERS MOUNTING METHODS

Before starting, it would be better to consider the transducers mounting methods.

The mounting position of the sensors depends from the pipe's diameter and from the type of sensors: "V" and "Z" mounting are the most common and the "V" mounting is the favourite one.

There also "N" and "W" mounting.

The letters indicate the number of crosses done by the signal between the two transducers.

- "Z"= 1 cross, suitable for big pipes > DN250 MM
- "V"= 2 crosses. Easy mounting for pipes until DN 600-800 mm with M1 or L1 transducers.
- "N"= 3 crosses, suitable for small pipes, DN100 or less, with L1 transducers.
- "W"= 4 crosses, suitable for pipes DN20 with S1 sensors.

The supply of TTFM100B includes s and L1 sensors.

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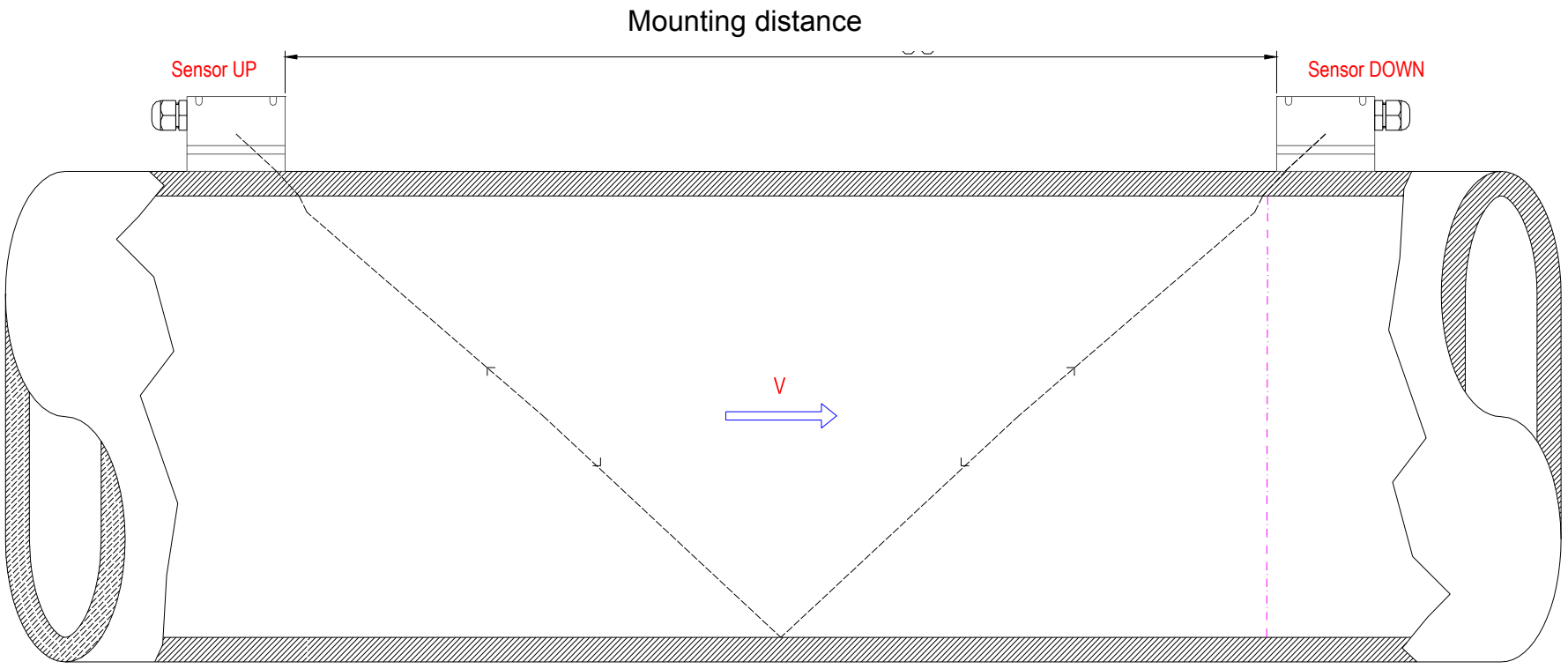
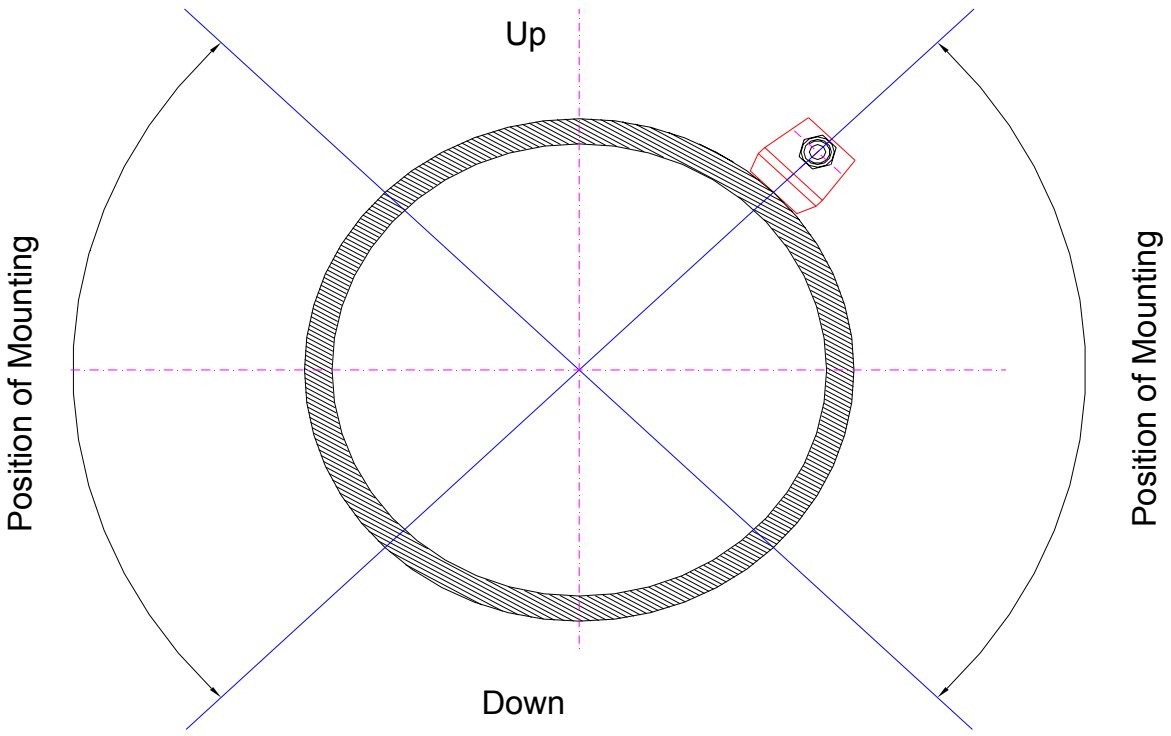
"V" MOUNTING



The "V" method uses a bounce inside the pipe and the ultrasonic route is longer.

The measuring principle is based on the time difference in a "V" route, the spreading time is bigger, the measuring accuracy is bigger.



If the mounting should be done in horizontal pipes, it is better to avoid mounting the transducers on the upper or lower part of the pipe. Air bubbles on the upper part of the pipe stop ultrasonic waves and bottom dump and diminish the ultrasonic entrance angle. Try to install the sensors as shown in the picture.

In case of mounting in vertical pipes, avoid mounting the transducers on slope pipes, even if they are under pressure. If the pipes have linings like tarred, polyethylene, epoxydal, the contact point with the transducer should be cleaned.

A tube of grease or silicone paste is delivered together with the device. Use a few of it to improve the contact between the sensor and the pipe's surface.

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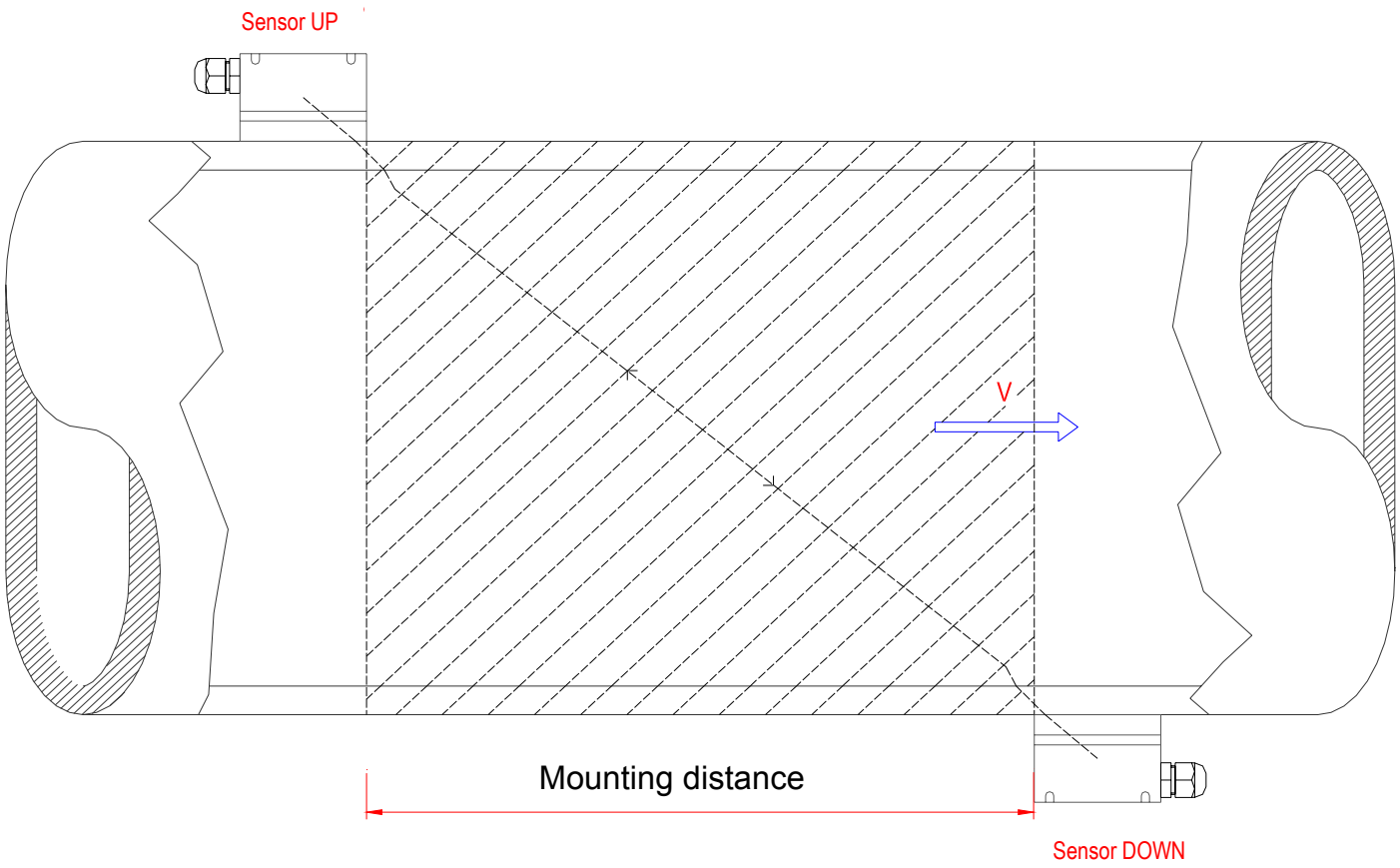
"Z" MOUNTING

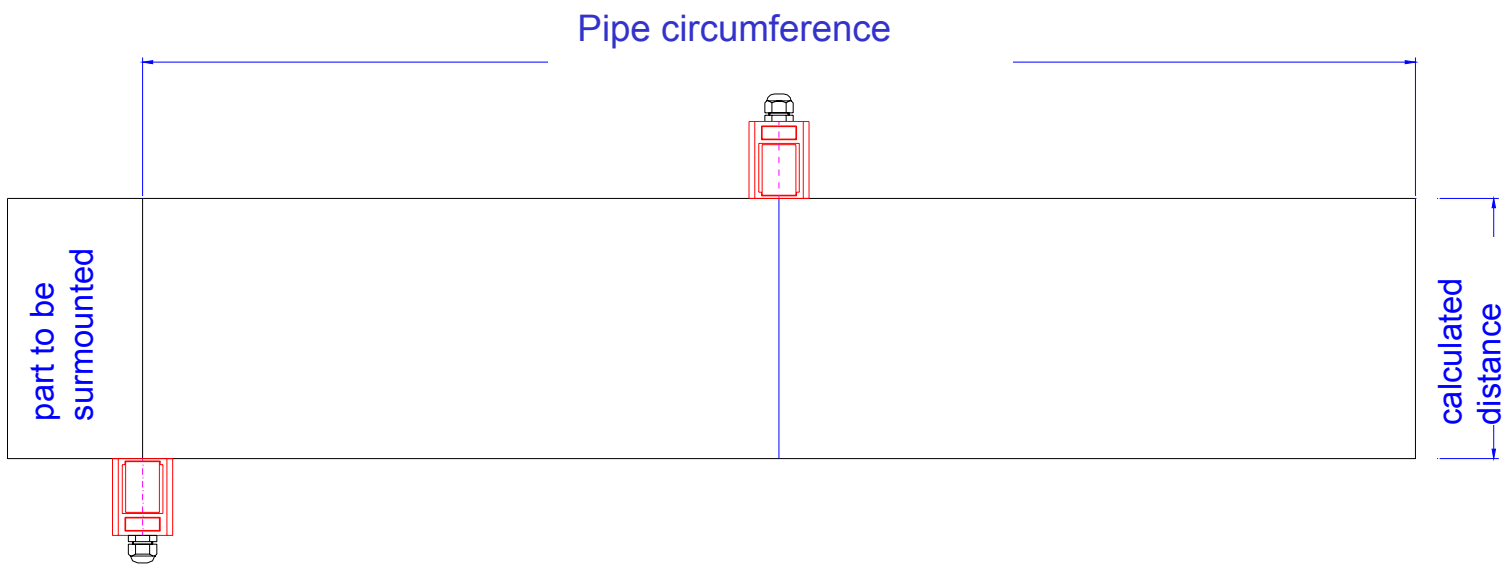


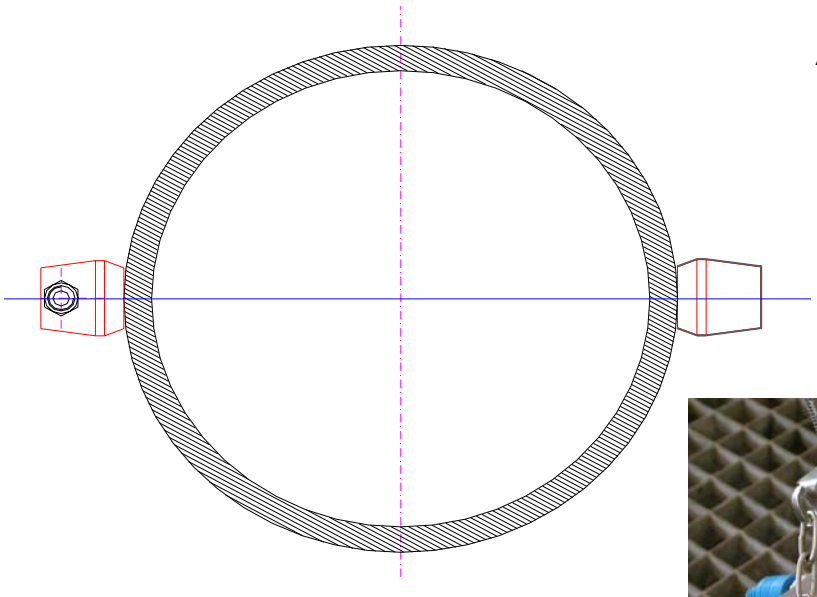
This kind of mounting method is a little bit more complicated than "V" method. The user should create a fascia foil which length should correspond to the circumference of the pipe and which width should correspond to what indicated in M25- Transducers Spacing.

Refer to the picture below to trace the two lines indicating the half point of the circumference.

Once that the foil is fixed on the pipe (using cellotape), it is possible to fix the sensors as shown in the picture.

If the pipe is in horizontal position, please refer to the picture below.





An example of mounting:

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Diagnostic and Problem Solving

TTFM 100B series includes a complete series of diagnostic functions: errors in measuring are continuously monitored. This function helps the user to identify the errors and unsuitable measuring conditions.

The device could display two kinds of errors: in switching on the device during the start-up checking or functioning errors, displayed in M08 window.

You could find the solutions in a table in the user's manual.

TTFM100B has also some windows permitting an easy and precise evaluation of the measure by analysing the following parameters:

- Sensors signal power.
- Signal quality.
- Received signal displayed wave.
- Transit and difference time measuring.
- Accurate sensors positioning through the relation between calculated and measured transit time.
- Spreading speed through the fluid.
- Display if Reynolds number, which indicates there is some movement inside the pipe.

90 – Signal strength, signal quality

91 – TOM/TOS* 100 % relation measured time/transit time

92 – Fluid sound speed

93 – Total, delta time

94 – Reynolds number and factor

95…99 – not used

M+8- Received shape

Sound Speed in Water

$C_0=1557 – 0.0245\ (74-t)^2(m/s)$

"t" temperatures in (°C)

in water of sea:

$C1=C_0 +1.39S$

C_0-- speed in drinkable water

S– salinity (%)

Ultrasonic Speed in potable water at different temperatures:

T	C0	T	C0(m/s)
0°C	1402.7	45°C	1536.7
5	1426.5	50	1542.9
10	1447.6	55	1547.7
15	1466.3	60	1551.3
20	1482.6	65	1553.76
25	1497.0	70	1555.12
30	1509.4	75	1555.45
35	1520.1	80	1554.81
40	1529.2	85	1553.25

EXAMPLES OF ULTRASONIC SPEED IN LIQUIDS

The temperature and the pureness of a liquid have effects on the ultrasonic speed.

Please refer to the following table:

1200m/s	Methanol, Ethanol, Octane, Ethanoic acid, Proponent, Ethyl
1400m/s	Light oil, Transformer oil, Spindle oil, O-dim ethyl benzene
1600m/s	Aniline, Diethyl alcohol.
1800m/s	Glycerin

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THE QUALITY OF THE EXPERIENCE

Flowrate, speed, time&date, totalkizers, battery voltage, expected working time displaying menu.

00 - Positive, Negative, Net Totalize, Signal Strength, Signal Quality

01 - POS Totalize, Flow Rate, Velocity, Signal Strength, Signal Quality

02 - NEG Totalize, Flow Rate, Velocity Signal Strength, Signal Quality

03 - NET Totalize, Flow Rate, Velocity Signal Strength, Signal Quality

04 - Date and Time, Flow Rate Signal Strength, Signal Quality

05 - Date and Time, Velocity Signal Strength, Signal Quality

06 - Receive Shape

07 - Battery Voltage, Battery Work Time

08 - Error Code, Signal Strength,Signal Quality

09 - NET Flow Today, Velocity,Signal Strength, Signal Quality

The Standard Supply Includes:

•Measuring device TTFM100B	1 pc.
•Clamp-on standard sensors M type	2 pcs.
•Acoustic couplant	1 pc.
•Sensors mounting kit (optional)	1 pc.
•Quality certificate	1 pc.
•Instruction manual	1 pc.

Pipes Materials

•0. Carbon Steel
•1. Stainless
•2. Cast Iron
•3. Ductile Iron
•4. Copper
•5. PVC
•6. Aluminium
•7. Asbestos
•8. Fibreglass-Epoxy
•9. Other

Internal Lining Materials

•0. No Liner
•1. Tar Epoxy
•2. Rubber
•3. Mortar
•4. Polypropylene
•5. Polystryol
•6. Polystyrene
•7. Polyester
•8. Polyethylene
•9. Ebonite
•10. Teflon
•11. Other

Selectable Liquids From the Main Menu

0. Water
1. Sea Water
2. Kerosene
3. Gasoline
4. Fuel Oil
5. Crude Oil
6. Propane (-45C)
7. Butane (0C)
8. Other
9. Diesel Oil
10. Castor Oil
11. Peanut Oil
12. Gasoline #90
13. Gasoline #93
14. Alcohol
15. Water (125C)

Data logger setting screens

1. Date, Time	ON / OFF
2. System Status	ON / OFF
3. Current Window	ON / OFF
4. Flow Rate	ON / OFF
5. Velocity	ON / OFF
6. NET Totalizer	ON / OFF
7. POS Totalize	ON / OFF
8. NEG Totalize	ON / OFF
9. Signal Strength	ON / OFF
10. Working Timer	ON / OFF
11. Flow Today	ON / OFF

50 - Logger Option
51 - Logger Setup
52 - Data Direction
53 - Buffer Viewer
54 - 59 Not Used
76 - Alarm #2 High Value
77 - Buzzer Setup
78 - OCT Output Setup
79 - Not Used
80 - Keypad Simulator
81 - Not Used
82 - Date Totalize
83 89 Not Used

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