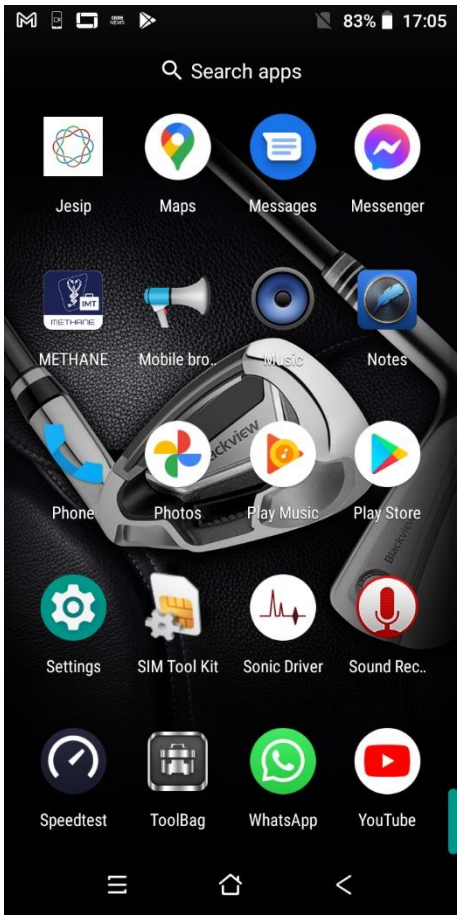
Made in Britain

POCKET MOBILE-UFM Ultrasonic Clamp-on Flowmeter

Installation Manual

Version 4.0



1st July 2024

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1.0 Introduction

Congratulations on choosing the Sonic Driver POCKET MOBILE-UFM ^{TM} clamp-on ultrasonic flowmeter, figure (1).

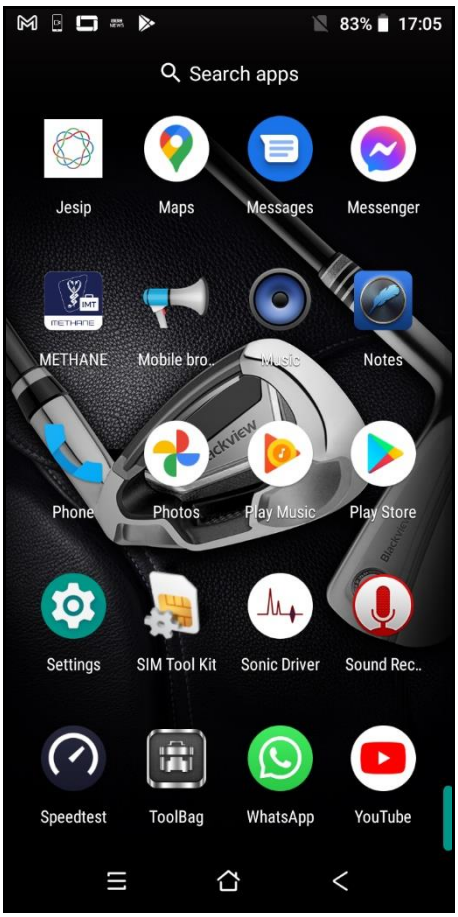


Figure (1) Sonic Driver POCKET MOBILE-UFM

The ultrasonic flowmeter (UFM) simply connects to your Android mobile smart phone or tablet device running the Sonic Driver App and turns it into an accurate and reliable clamp-on ultrasonic flowmeter

The UFM makes flow velocity measurements using advanced Digital Signal Processing (DSP) and transit time measurement techniques.

Using information about the installation, entered by the user, using the App and its intuitive and easy to use menu driven User Interface (UI) the UFM can display;

- Flow velocity (m/s, ft/s)
- Volumetric flow rate (l/min, m3/hr, GPM, GPH, ft3/min)
- Mass flow rate (kg/min)
- Totaliser (l)

1.1 Transit Time Measurement

The principle of flow measurement using ultrasonic clamp-on transit time measurement is simple, see figure (2).

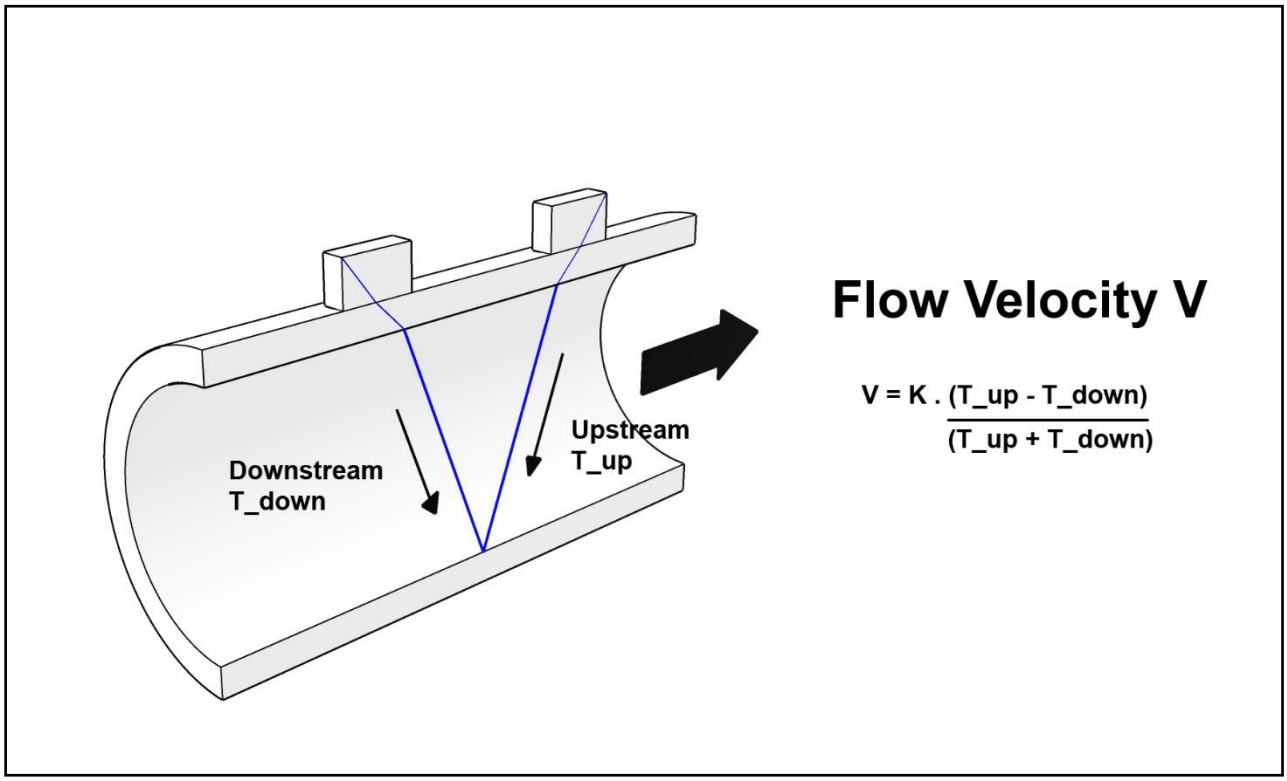


Figure (2) The principle of transit time flow measurement.

Two ultrasonic transducers are coupled or clamped to the outside of the pipe at a predetermined distance apart.

Ultrasonic pulses travel between the transducers through the pipe wall and the fluid within the pipe.

If the fluid is flowing then it takes slightly longer for the ultrasound to travel against the flow (upstream time T_up) than with the flow (downstream time T_down), see figure (2).

In a typical installation the individual times measured upstream and downstream are just a few hundred microseconds, the difference between them is typically measured in tens of nanoseconds.

This very small time difference (T_up - T_down) is measured by the UFM and is directly proportional to the flow velocity (V) of the fluid.

Knowing the pipe internal cross-sectional area the UFM can calculate volumetric flow rate in many common engineering units.

A further knowledge of the density of the fluid allows the UFM to calculate mass flow rate.

1.2 Packing List

Along with the UFM you should receive;

Item	Quantity
Pocket MOBILE-UFM	1
Chain Mounting Clamp	2
Tape Measure	1
Coupling Gel	1

Table (1) Packing List.

If any item on the packing list is missing or has been damaged in transit contact Service, see Appendix A.

1.3 General Precautions

The content of this manual has been carefully checked and is believed to be accurate.

Sonic Driver Ltd assumes no responsibility for any inaccuracies that may be contained in this manual.

In no event will Sonic Driver be liable for direct, indirect, special, incidental or consequential damages resulting from any defect or omission in this manual, even if we are advised of the possibility of such damages.

Sonic Driver Ltd reserves the right to make improvements to its manuals, instructions and products at any time, without notice or obligation. The latest revisions may be found on the company web site, www.sonic-driver.com

The UFM is a precision measuring instrument and should be handled and operated with care;

- Before operating the UFM for the first time read the installation manual and operating instruction fully.
- Only use the UFM in the way and for the purpose that it is intended.
- Do not subject the UFM to bumps and shocks such as caused by dropping the UFM.
- Keep the UFM and its transducers and probes clean.
- Only use the UFM within its ambient temperature and stated level of Ingress Protection.
- Avoid excessive stress and bending of transducer cables.
- Always connect the UFM to the mobile device with the device screen unlocked, section 4.0.
- Always use the Exit screen to correctly exit the App, section 12.0, figure (13). Failure to do so will result in multiple instances of the App running, which will each attempt to gain control and use of the mobile device’s single communication port. Reliable communication between the mobile device and UFM will fail.
- Unreliable communication between the mobile device and UFM will cause the communication globe to flash orange, section 5.1.10. In addition Device Information, section 5.1.1, USB Device, section 5.1.2 and Test Pattern, section 5.1.3 will become erratic.
- Ideally turn on Do Not Disturb to avoid background tasks interrupting the totaliser.

1.4 Cleaning

Wipe the UFM and sensors with tissue or soft cloth after use, remove excess coupling gel.

1.5 Storage

When not is use the UFM and transducers should ideally be cleaned and stored in a safe, dry location.

2.0 Using the App and the UFM

Before connecting the UFM to your phone or tablet ensure that the device is turned on and its screen lock is off.

Connect the UFM to your phone or tablet.

The device will automatically identify the UFM and request that you allow permissions. You may tick the Always Allow box.

The mobile App will now automatically run and attempt to connect to the UFM.

Once connected the UFM is controlled via the UI of the App running on the mobile device.

The UI is detailed in the POCKET MOBILE-UFM Operating Instructions.

The basic sequence is to work through the tabs;

- Connect
- Install
- Measure

These tabs take the user through the minimum sequence of parameters needed to get the UFM measuring reliably;

- Pipe Diameter
- Pipe Wall Thickness
- Pipe Material
- Fluid
- Fluid Temperature
- Transducer Type
- Transducer Mounting

Each parameter is described in the relevant section of the Operating Instructions.

3.0 Transducer Mounting

Mount the flow transducers on the pipe using the chain clamps supplied, see figure (3). Ensure that the arrow on the labels (arrowhead and flights) on the flow transducers is pointing in the direction of flow.

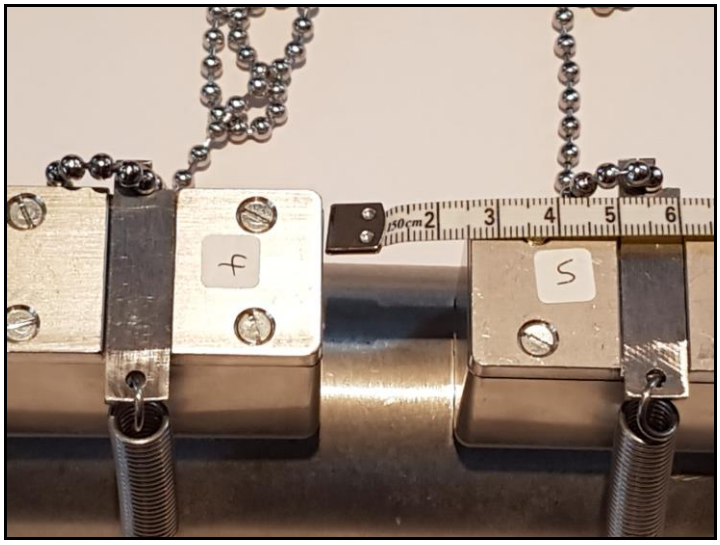


Figure (3) Flow transducer mounting, spacing is 25mm between front faces.

Use coupling gel between the transducers and the pipe to give good ultrasonic contact. Measure the spacing of the transducers using a ruler or tape measure, note that spacing is measured between the front faces of the transducers. Ensure the transducers are facing each other and aligned axially along the pipe.

In figure (4) and figure (5) the transducers are misaligned and twisted, as a result the UFM will make poor flow measurements.

Figure (4) Misaligned transducers.

Figure (5) Twisted transducers.

The user is required to enter the number of times the sound path crosses the pipe. Allowed values are 1 to 16 passes, the default is 4 passes.

Ideally choose a number of passes that results in a path length in the fluid of 100 mm or greater.

- 1 pass, most common on large diameter pipes, typically 100 mm or more in diameter. If the UFM suggests a negative spacing, then this is measured as in figure (6).

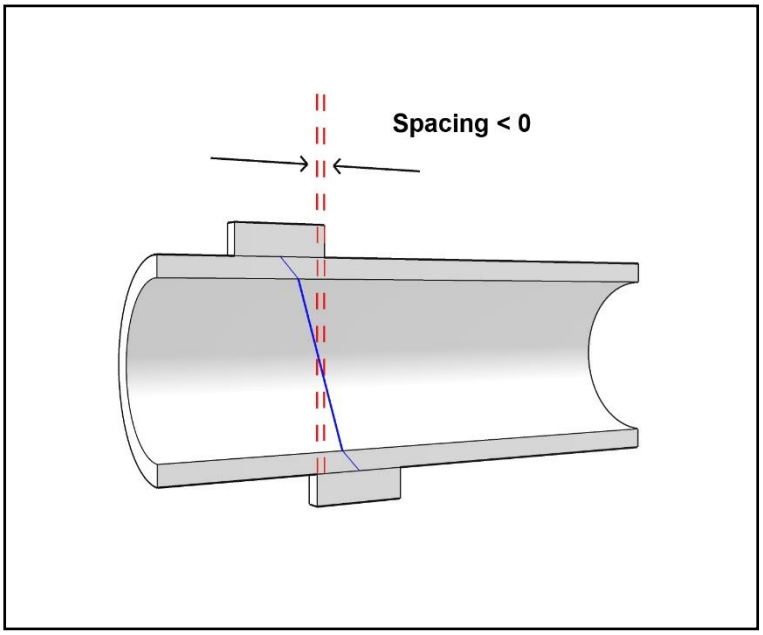


Figure (6) 1 pass, demonstrating a negative transducer spacing.

- 2 passes, the most commonly used method, this is the simplest to install as both sensors are on the same side of the pipe, see figure (7).

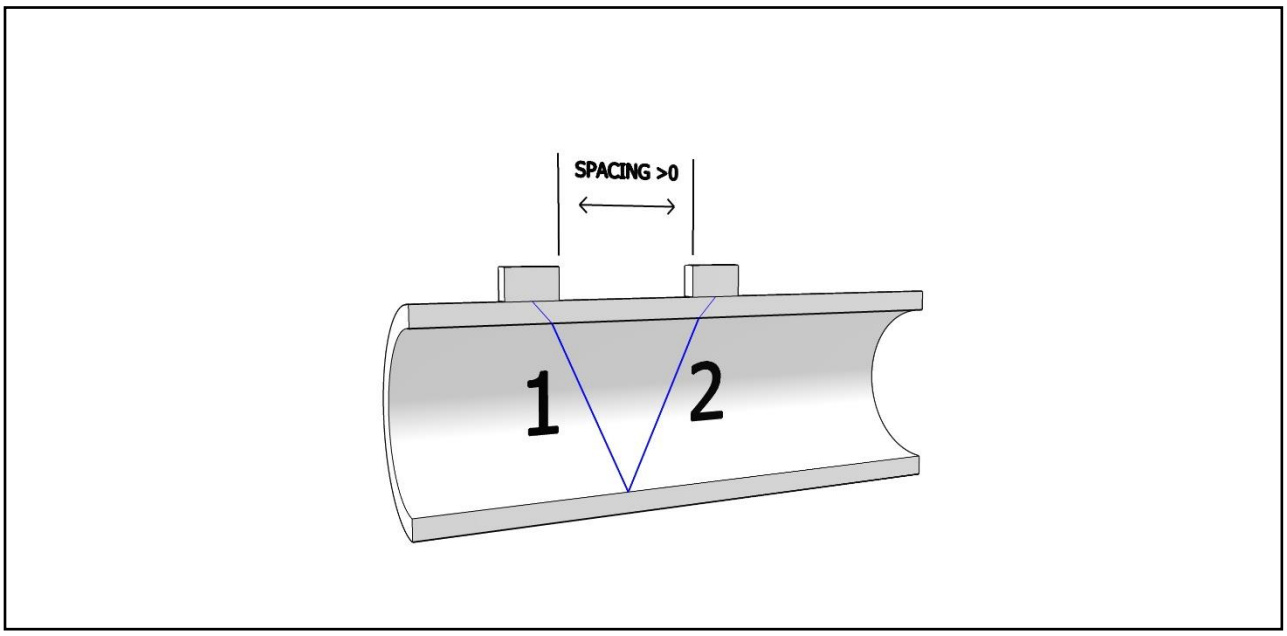


Figure (7) 2 passes.

- 3 passes, used on small diameter pipes.
- 4 passes, used on the smallest diameter pipes, see figure (8).

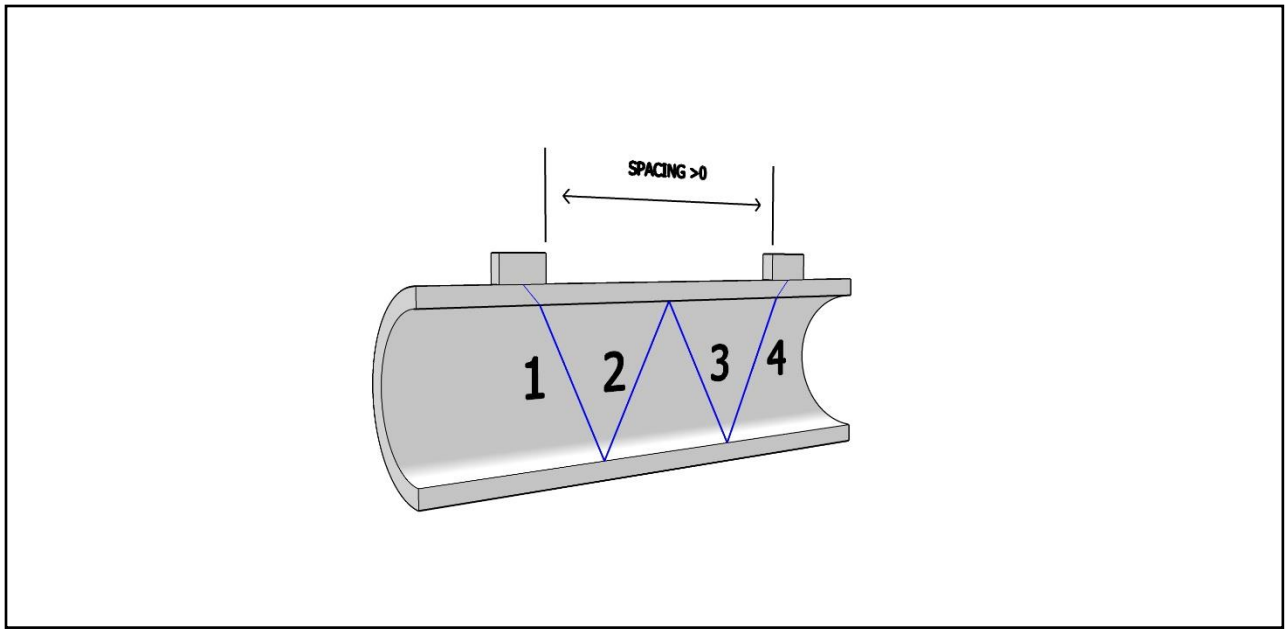


Figure (8) 4 passes.

- 5 to 15 and 16, etc.

It may be that on the smallest diameter pipes then the recommended transducer spacing at 16 passes is not sufficient to allow the transducers to be coupled on the same side of the pipe, using an even number of passes as they still touch. In this case it is unavoidable to couple the transducers on opposite sides of the pipe using an odd number of passes, for example 15 passes.

4.0 Transducer Positioning

After completing entry of all parameters in the Install tab sequence the UFM calculates the required transducer spacing on the pipe and displays it for the user.

Clamp the transducers on the pipe using the supplied chain clamps and coupling gel, measure the spacing using a ruler or tape.

The user is then presented with a sensor positioning screen in the Measure tab,

If the parameters entered are all correct, then the graph should appear as in figure (9).

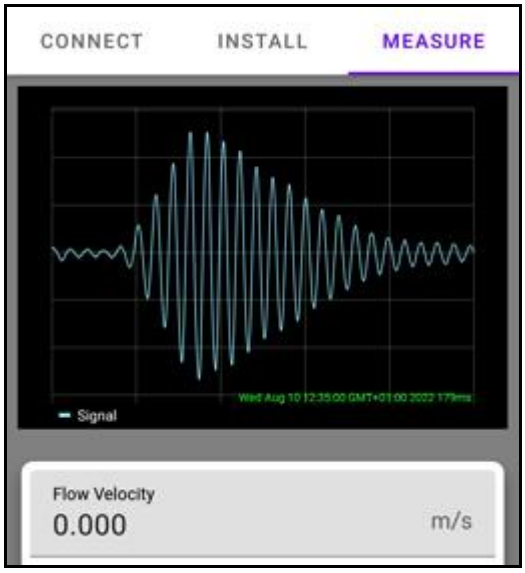


Figure (9) Ideal Sensor Positioning.

Note how the first arrival in the received signal appears at the first vertical line in the grid.

However, if the user has an incomplete knowledge of the pipe then the screen may look like figure (10) or figure (11).

Figure (10) Non-ideal Sensor Positioning, transducers too far apart.

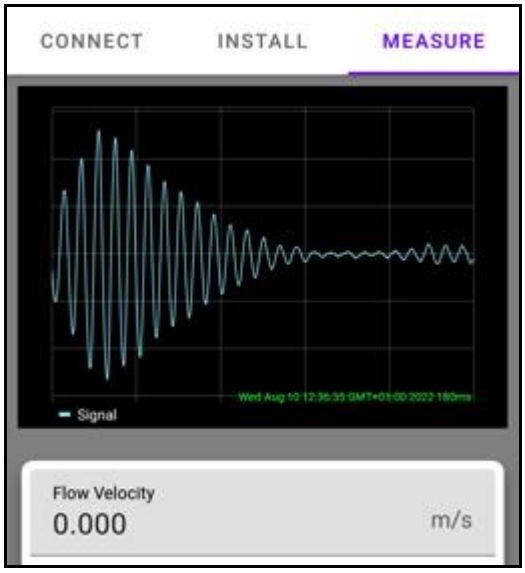


Figure (11) Non-ideal Sensor Positioning, transducers too close together.

In figure (10) the received signal is too far to the right; the user should slide the transducers closer together.

In figure (11) the received signal is too far to the left; the user should slide the transducers further apart.

The most common cause of an incomplete or incorrect spacing is a lack of knowledge about the pipe wall thickness.

As long as the signal is located as figure (9) resulting in an ATE/ETA value between 97 and 103 % then the UFM will measure accurately. It is acceptable to reposition the transducers to adjust their spacing by +/- 5 mm to optimise the positioning screen, the arrival marker will move on the screen accordingly.

SNR should peak and be above 24 dB.

4.1 Optimising Transducer Mounting Location

For the best results ensure that,

- Ideally the transducers are mounted on bare pipe material, for metal pipes this should be metal free from dust, rust and paint.
- Consider a location away from internal corrosion, sediment and streams of entrained air, do not mount the transducers top to bottom on the pipe, mount at 2 or 10 o'clock.
- Avoid mounting the transducers either on or opposite axial welds along the pipe.
- Ensure the transducers are aligned axially along the pipe.
- Mount the transducers away from bends, valves and other inserted instrumentation.
- Observe were practical the advised upstream and downstream straight sections, see below, figure (12).
- Ensure the pipe will always be full at the point of installation, ideally mount the transducers at a low point in the system.

- If mounting the transducers on a vertical pipe section, ensure the flow direction is upwards in the section.
- Composite pipes can have de-laminations in their wall thickness, this type of pipe is notoriously bad when installing a UFM.
- Ensure the temperature at the transducer location is within the transducers rated range.
- Ideally the fluid should be free of particulates and bubbles, in the limit then an alternative method such as Doppler flow measurement may be required.
- Pipe linings that are not bonded properly or are not conductive of ultrasound (rubber) will cause measurement problems.
- Porous pipes, such as concrete can cause measurement problems.
- Using information from Standard Pipe Tables can be inaccurate, it is always best to measure the pipe outer diameter and wall thickness.
- No matter how accurate the meter is at making a velocity measurement, an inaccurate knowledge of the internal cross-sectional area of the pipe will lead to inaccuracy in the conversion to volumetric flow rate.

4.2 Upstream and Downstream Pipe Runs

Ideally the UFM transducers should be installed on as long a section of straight pipe as is possible, see figure (12).

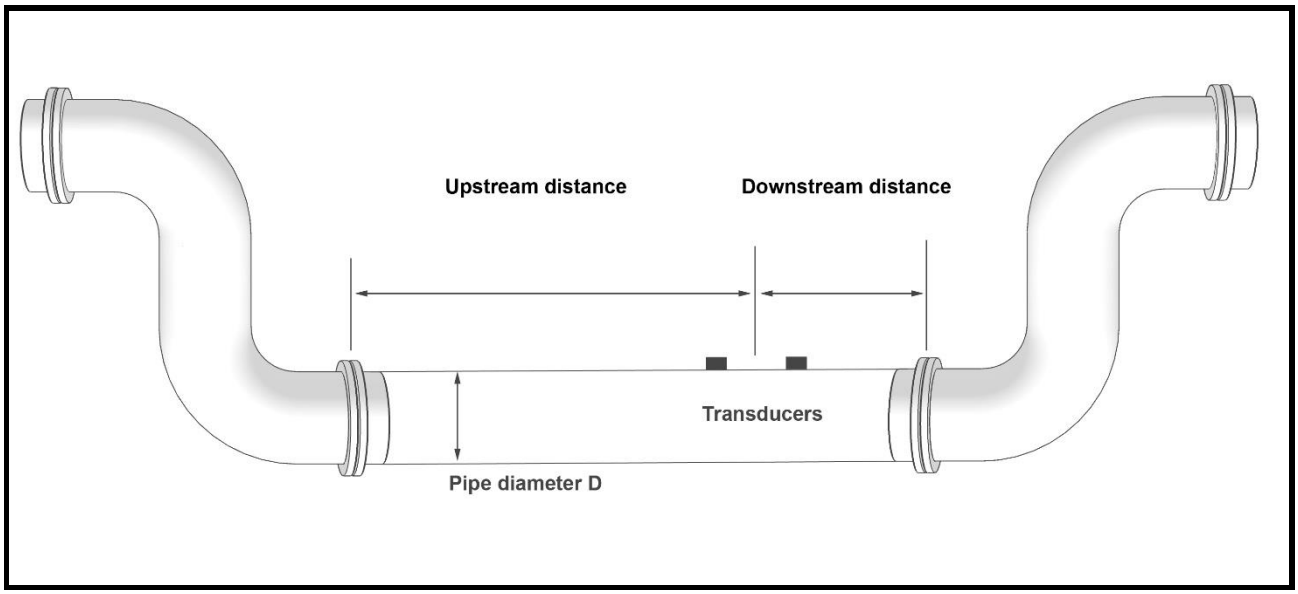


Figure (12) Upstream and downstream pipe lengths.

Considering a pipe with an outer diameter of D then if possible ensure at least 10D upstream distance between the transducers and a bend in the pipework.

In the case of an upstream Valve then if possible ensure at least 20D upstream.

In the case of an upstream Pump then if possible ensure at least 30D upstream.

In all cases ideally ensure 5D downstream exists before a bend or obstruction in the pipework.

4.3 Transducer Mounting

Locate an optimum position on the pipe following the advice above.

Use Coupling gel. Apply adequate couplant and ensure no gap exists between the transducer and the pipe surface.

Banding or clamping is required to keep the transducers in place. It is recommended to use the chain clamp supplied or 10 mm wide jubilee clips. Plastic cable ties are also an option as long as transducer alignment can be maintained.

4.4 Transducer Spacing

Given that all information regarding the installation has been entered accurately and the advice above has been followed then the UFM will measure reliably and accurately.

This is confirmed by,

- A strong received signal strength
- A high SNR value
- Value of ATA/ETA close to 100 %

If is acceptable to make small adjustments to the transducer spacing to optimise the received signal strength and ATA//ETA.

However, if large adjustments are necessary then the importance of wall thickness should be considered. Wall thickness is typically the parameter about which the user last the least knowledge.

If all other avenues have been explored, including recoupling the transducers at several different locations on the pipework then adjusting the wall thickness parameter may help.

5.0 Battery Life

The MOBILE-UFM is powered by the mobile device.

Under normal operating conditions the battery life of the UFM is in excess of 6 hours continuous measurement (Mobile device dependent).

6.0 Specification

The UFM has the following specification, features and performance;

- Pipe outer diameters ranging from 15 to 500 mm.
- Temperature range for UFM -10 to +65 degC.
- Weight 220 g.
- Dimensions 140 x 40 x 20 mm.
- IP54 enclosure.
- Battery life up to 6 hours continuous (Mobile device dependent).

Features

- Light weight and small for ease of use.
- Intuitive installation using menu driven UI.
- Full set of flow measurement and diagnostic values.
- Signal oscilloscope for sensor positioning and diagnostics.
- Internal database of pipe and fluid materials.

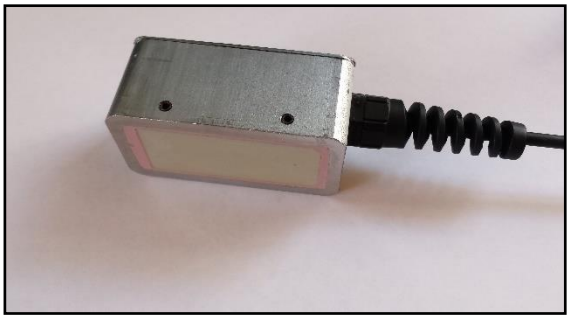
Performance

- Measurement principle ultrasonic transit time difference.
- Flow velocity range 0.01 to 25 m/s.
- Resolution 0.25 mm/s.
- Repeatability 0.15 % of measured value.
- Accuracy +/- 0.5 to +/- 3.0 % of measured value for velocity greater than 0.2 m/s, depending on application.
- Turn down ratio 1/100.
- Measurement rate 1 Hz as standard.
- Gas/solids < 10 % of volume.

Quantity and units of measurement

- Flow velocity (m/s, fts)
- Volumetric flow rate (l/min, m3/hr, GPM, GPH, ft3/min)
- Mass flow rate (kg/min)
- Totaliser (l).

Transducers



Figure(13) PEEK/stainless steel transducers.

- 2 operating frequencies to cover the range of pipe outer diameter 15 to 500 mm (specified with order).
- DM10, 1 MHz for pipes of 25 to 500 mm
- DM20, 2 MHz for pipes less than 25 mm.
- Dimensions 40 x 20 x 24 mm for locations with limited access.
- Material stainless steel and PEEK.
- Temperature range -10 to +80 degC.
- Ingress Protection rated IP54, with IP68 option.
- Cable length 1.5 m as standard.
- Matched pairs for accurate zero flow measurement.

7.0 Product Identification

Each UFM and pair of flow transducers comes with a unique Identification code.

In the case of the UFM this is written into the software and can be read using the HMI.

In the event of a need to contact Sonic Driver please have these codes available to quote.

8.0 Service

The UFM is a sophisticated measuring instrument and contains no user serviceable parts.

For all operational problems please contact our service department by telephone or email, see Appendix A.

Sonic Driver do offer a software upgrade service. Please contact the factory for information about the latest software.

9.0 Limited Warranty and Disclaimer

Sonic Driver Ltd warrants to the end purchaser, for a period of one year from the date of shipment from our factory, that all new products manufactured by it are free from defects in materials and workmanship.

This warranty does not cover products that have been damaged due to normal use, misapplication, abuse, lack of maintenance, or improper installation.

Sonic Driver obligation under this warranty is limited to the repair or replacement of a defective product, if the product is inspected by Sonic Driver Ltd and found to be defective. Repair or replacement is at the discretion of Sonic Driver Ltd.

If the product is outside of the warranty period a purchase order must be received from the end purchaser before repair work will start.

The product must be thoroughly cleaned, and any contamination removed before it will be accepted for return.

The purchaser must determine the applicability of the product for its desired use and assumes all risks in connection therewith. Sonic Driver Ltd assumes no responsibility or liability for any omissions or errors in connection with the use of its products.

Sonic Driver Ltd will under no circumstances be liable for any incidental, consequential, contingent or special damages or loss to any person or property arising out of the failure of any product, component or accessory.

All expressed or implied warranties, including the implied warranty of merchantability and the implied warranty of fitness for a particular purpose or application are expressly disclaimed and shall not apply to any products sold or services rendered by Sonic Driver Ltd.

The above warranty supersedes and is in lieu of all other warranties, either expressed or implied and all other obligations or liabilities.

No agent or representative of Sonic Driver Ltd has any authority to alter the terms of this warranty in any way.

Appendix A Contact Details

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