Ultraflux

Ultraflux NT 217A GB1

Edition : 11/06/2004

**MiniSonic _ 600
MiniSonic_2000
* ULTRASONIC
FLOWMETERS**

PREAMBLE :

Thank you for choosing Ultraflux to make your flow measurement.

We offer a full range of portable or fixed flowmeters backed by 30 years' expertise and experience using Ultrasonic techniques:

> ➢ The Digisonic family of Portable flowmeters with integral loggers and signal analysis functions

> ➢ The UF322 family of Fixed flowmeters, applications include
> L - liquids,
> G - Gas ,
> MC - Multichord applications for Liquid and Gas measurement,
> CO / RV - Open Channel and River Measurement.

> ➢ The MiniSonic family with :
> P – Portable Metering with also a two pipe or dual path version P-B
> 600/2000 single-channel fixed flowmeters,
> 600-2 and 2000-2 for dual-chord flow metering ,
> 600-B and 2000-B for dual-pipe flow measurement configurations,
> Speed (1 or 2) is for open channel flow velocity measurements.

This manual is specifically concerned with MiniSonic 600 & 2000 single channel family and has been drafted to guide you in the stages of installation and commissioning.

Other documents and tools are available on paper or in electronic format:

> ➢ a training manual concerning ultrasound measurement, reference NT 122

> ➢ a guide about the use of our software in the Windows environment Ref NT 204

> ➢ the PC software specific to your application Ref LS 600W _version *** with an interconnection cord to the PC.

> ➢ the JBUS communication protocol with its address table NT 207

All our flowmeters work on the principle of transit time ultrasonics and can be associated with clamp-on or wetted probes depending on the application.

SUMMARY :

1 – TYPICAL APPLICATIONS:

The various versions of MiniSonic 600 & 2000 are essentially designed for high performance flow testing in terms of quality and precision at a very competitive cost, in particular if we take into consideration the reduced costs of installation. Through external probes, there is no need for a measurement sleeve or for full pipe drilling to obtain final precision comparable to that of a fixed station flowmeter, whatever the principle.

The design allows intelligent sharing of hardware and software resources to deal with the problem raised. For instance, the two 4-20 mA current outputs can be assigned to other values than flow rate (speed of sound, gain, etc.) to obtain full diagnosis incorporating the quality of the fluid.

MiniSonic gives the volume flow rate and direction. Normally used as an instrument assigned to a dedicated application, it can also be used as a temporary replacement for any defective flowmeter or meter.

The **external probe (SE)** solution is possible **with most fluids** circulating through metal or plastic pipes. Ultraflux offers a wide range of probes distributed in terms of frequency and signs to suit a multitude of applications on inside pipe diameters ranging from 10 mm to more than 3 meters. Accordingly, fields of use include petrochemicals and water, whatever the quality, and with no limits on conductivity.

This probe supply is filled out by a supply of **supports (SU)** designed to assist with installation and rigorous repositioning for maintenance purposes.

When the material of the pipe (concrete) or the conditions (corrosion, viscosity of fluid, etc.) are unsuitable for external probes, we propose the installation of **intrusive probes (SM)** on a sleeve, or by on-load tapping into the existing pipe.

MiniSonic is also capable of measuring **gas flow rates** under flow conditions. The external probe method requires a number of conditions regarding the gas pressure and has limits regarding the diameter of the pipes and their nature. The construction of a sleeve ensures reliable measurements at low and high pressure, offering a wide dynamic measurement spectrum from the lowest viscosities.

The instrument can be used for official metering. In this case, we recommend comparing its performance with a standard hydraulic bench to obtain a calibration certificate. As long as installation is correct, the instrument can be accepted as a **meter**. In this case, it is advisable to construct a sleeve.

Generally, we use a "**dry calibration**" method or a calculation calibration method, which is simpler and more economical and offer sufficient reliability for normal use.

In addition to its precision, MiniSonic offers very good ultrasound information **repetitiveness** and high **reproducibility**. An installation defined under hydraulic conditions that are not ideal or that are reproduced in a strictly identical manner will allow the setting of a corrosion factor or a linearization curve so that the results can be maintained with acceptable accuracy.

1-1 – __Principle of measurement:__

The principle of measurement is detailed and commented on in our training manual NT 106.

To summarize, note that it bears on the velocity difference (and therefore the ultrasound wave transit times) in a moving medium, depending on whether the movement is with or against the current.

To achieve this, it is necessary to establish dialogue between two sensors using an L-shaped route whose projection D on the control axis is sufficient, and to measure alternatively the route times $T_{1>2}$ and $T_{2>1}$.

The time measurement, combined with knowledge of the geometry parameters (diameter / thickness of pipe / L / D) allows the volume flow rate to be calculated whatever the developments of the product, its temperature or its pressure.

Precision is even better when the Delta T measurement resolution increases (0.01 nanosecond for MiniSonic) and when the geometrical parameters are controlled, not to forget considerations of a hydraulic order (straight lengths, flow configurations, zero setting) or the frequency of the probes.

An order of magnitude of this Delta T in nanoseconds can be obtained simply by multiplying the flow velocity (V in m/s) times D (in mm) or by the diameter of the pipe (mm).

1-2 –__Standard installation:__
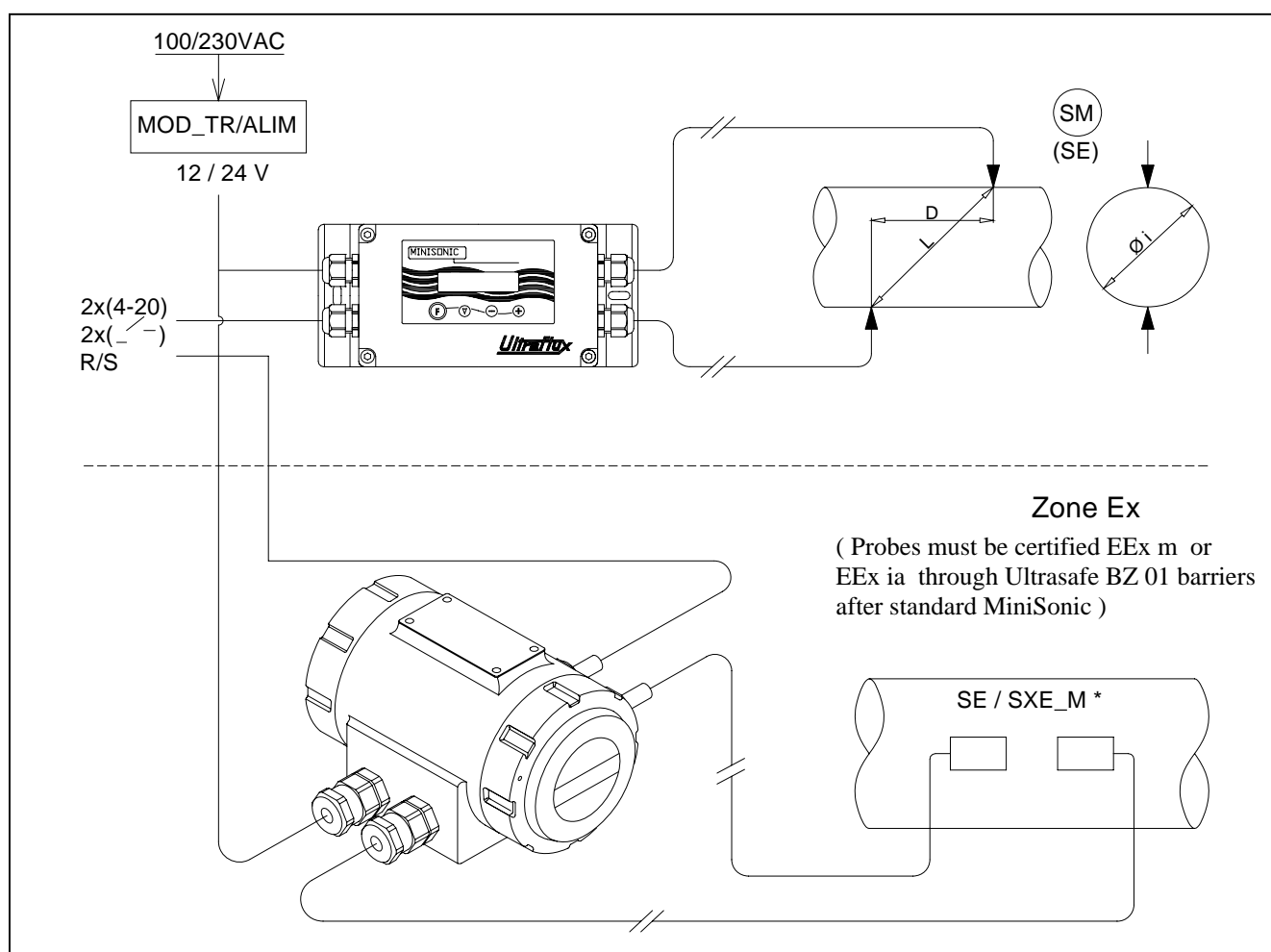
1-3 : <u>Speed of sound in fluids – Relation with density – Influence of P and T:</u>

The speed of sound in a fluid is a full-fledged physical characteristic which may be linked with others, such as density (d), pressure (P), temperature (T) or the % of two or several miscible products or with another magnitude having good analogy, like compressibility.

For most refined petroleum products or petrochemical bases, experience shows some relationship between the speed of sound and the density of the product for constant P and T, but there are many exceptions. For water, the reliability of the relation allows a number of tests to be run on the installation. Gases have lower speeds of sound than liquids, although some refrigerating fluids come close.

Case of water:

Water has a very reliable "speed of sound < > temperature" relationship which will be put to good use whenever possible for dimensional checking: a simple temperature measurement is a means of predicting the speed of sound to be compared with the result obtained by MiniSonic on the basis of the measured times and the dimensions as set up: A deviation may require these values to be reexamined, like L for intrusive probes or the diameter and thickness of the pipe for external probes.

The following simple equation gives a good estimation of C between 0 and 100°C:

$$C = 1557 – 0{,}0245.(74 – t)^2$$

The following table defines the customary values more accurately.

t (°C)	C (m/s)	t (°C)	C (m/s)
0	1 403	30	1 506.4
5	1 426.5	35	1 520.1
10	1 447.6	40	1 529.2
15	1 466.3	45	1 536.7
20	1 482.7	50	1 542.9
25	1 497		

The water load has little influence: this table applies to crude or used water.
When compared with other fluids, the water temperature coefficient for C is positive up to 74°C. Beyond that, the water becomes a conventional product again.
The water pressure coefficient is relatively low, at around 0.15 m/s per bar.

The presence of salts solutions increases the value of C by approximately 1 m/s per g / liter (seawater …)

The addition of glycol ethylene or a similar product also increases the speed of sound within the proportions of (50 / 50 % > 1550 m / s)

Superheated water involves curve or graph networks taking into consideration the pressure and the temperature: consult us.

Measurement on petroleum products – values at 15°C / 1 bar (except for butane and propane)**:**
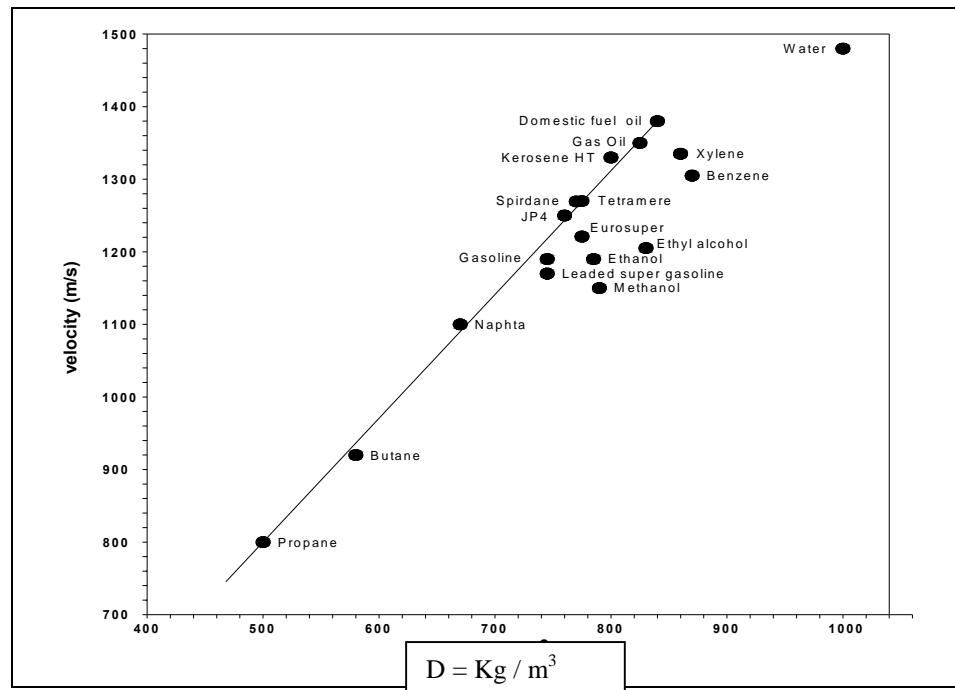
This speed of sound varies with the pressure and temperature and the coefficients rise in proportion to the reduction in the speed of sound. For instance:
- Influence of pressure = + 1 m/s per bar for liquid butane and + 0.4 m/s per bar for diesel oil.
- Influence of temperature = - 6 m/s per °C for butane and – 4 m/s per °C for diesel oil.

Measurements on Gases:

Gases are characterized by speeds of sound far lower than for liquids. Temperature coefficients are positive (0.2% per degree approximately), and pressure coefficients are of the second order. Consult us for more details.

As an example, we give an order of magnitude of these speeds in air and in natural gas:
- Air: C = 341 m/s at 20 °C / 1 bar
- Natural gas: C = 400 m/s at 15 °C / 1 bar

2 - COMPOSITION OF A MEASUREMENT POINT

- The two probes
- The integrated or optional supports (SU x 2)
- The coupling kit if external clamp-on probes.
- Integral or optional supports (SU)
- Probe / converter link cables
- MiniSonic converter.
- PC / converter link cable and software (CD-ROM).
- If required, external modules as A.C. transformer of DC supply, Zener barriers…

CERTIFICATIONS

All equipment is CE certified.

ATEX certification for the relevant probes and standards when this quality is required, accepted and documented. All equipment will be labeled accordingly.

IP Rated as shown on each item.

The IP 67 rating of a MiniSonic is only complied with if assembly is according to the manual and installations rules .

APPLICABLE STANDARDS :

- Concerning high voltage human safety risks: N/A – Only low voltage (< 60 V) .
- Concerning EMC : EN 61000 , EN 55022 et EN 50204
- Concerning tightness (IP) : EN 60529
- Concerning ATEX : Directive 94 / 4 / CE
  + EN 50014 :   General rules
  + EN 50018 :   EEx d enclosure
  + EN 50019 :   EEx e protection for connections .
  + EN 50028 :   EEx m – protection by encapsulation.
  + EN 50020 :   EEx i   - Intrinsic safety

MINISONIC LIMITATIONS :

MiniSonic –600 is designed for pipes from 10 up to 630 mm O.D.
MiniSonic-2000 accepts applications on pipes up to 3300 mm O.D.

The maximum lengths between transducers (L) are 1250 mm for Mini-600 and 6600 mm for Mini-2000 (SM probes)

The maximum axial distances (D) are respectively 850 and 4400 mm .(SM probes)

The flow display format is limited to 999999.9 in each flow unit from l/h to m3/s.

3 – ERGONOMICS AND DIMENSIONS OF MINI 600 & 2000 CONVERTERS

3-1 : Industrial version for wall mounting (IP 67):

The two stuffing boxes on the left-hand side are for the supply (top) and the outlets.
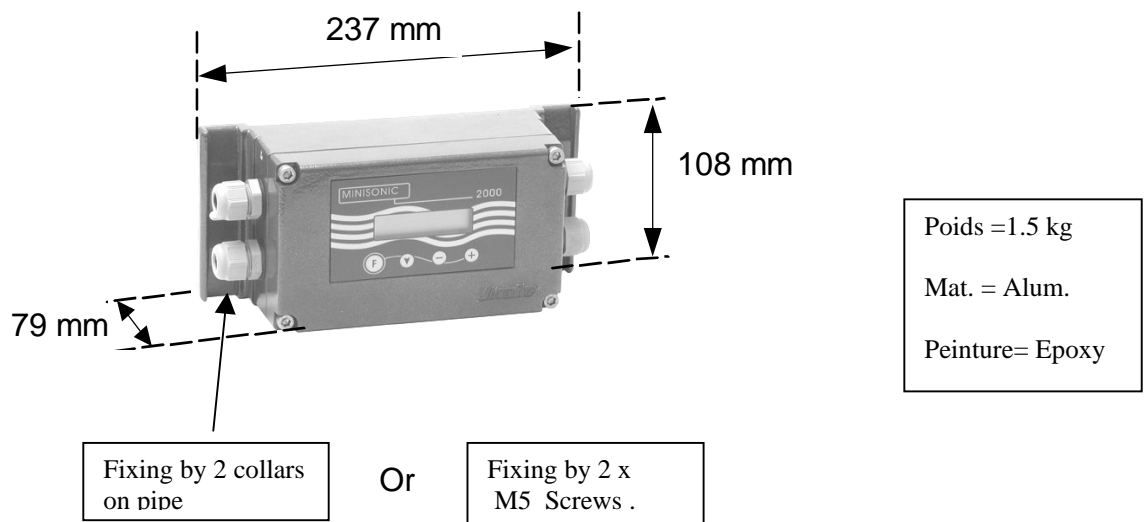The two stuffing boxes on the right are for probe cables.
To open the MiniSonic *(cabling or other), undo the four corner screws and remove the cover by disconnecting the flat interconnection cable from the display on the display side.

It is possible to leave this cable connected while temporarily attaching the face by 2 screws.

The unit is designed for wall mounting or mounting on a pipe or an electrical cabinet on a DIN rail. The arrangement of the outputs will allow the superimposed assembly of several units.
Use flexible cables that are in conformity and secure the stuffing boxes used (IP 67).

237 mm

108 mm

79 mm

Poids =1.5 kg

Mat. = Alum.

Peinture= Epoxy

Fixing by 2 collars on pipe   Or   Fixing by 2 x M5 Screws .

F = Function   ▼ = Choice (menu or parameter)   +/- = Modification

*N.B.: MiniSonic * must be supplied at low voltage, whether DC or AC.
When a conversion module is used from the 230 V AC or 110 V AC mains (transformer, 24 V DC power supply), the latter must include DBT protections and be situated near the MiniSonic. The same applies if it has to be incorporated.*

Meanwhile, the MiniSonic enclosure must be electrically earthed, both for human safety and to drive any noise collected by cables shields. This connection can be done from the outside by using the threaded hole near the upper left gland or from the inside by using the terminals at each P.C. Board corner.

3-2 : <u>EXD ATEX Version</u> (EEx d IIC T6) – IP 67:

- The keypad keys have the same functions as for the industrial version.
- The two stuffing boxes on the porthole side are reserved for cables to the probes.
- To carry out the internal cabling of the probe cables on the MiniSonic card, it is necessary to pull the support rack forwards: remove the three front panel screws.
- To comply better with EMC rules, stop and ensure the electrical connection of the cable braids in the stuffing box housings.
- Once all the connections have been terminated and before closing up the unit, connect the MiniSonic card to housing of the unit using the yellow / green wire at the rear.
- The unit must be grounded with respect to the external screw. Screw in and tighten the covers (IP 67), then secure the removal-prevention screws before powering-up.
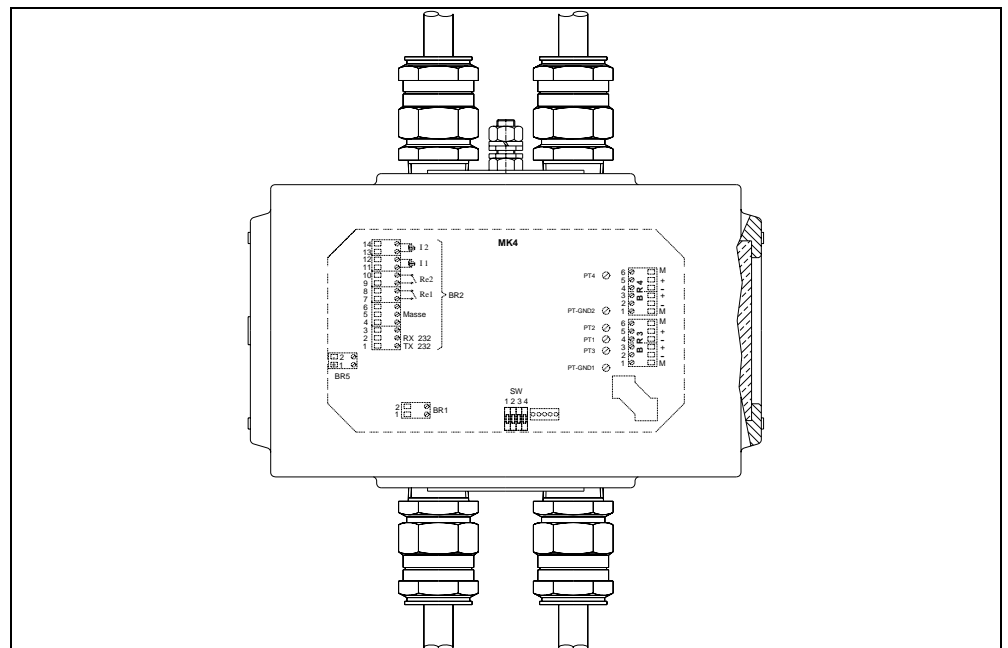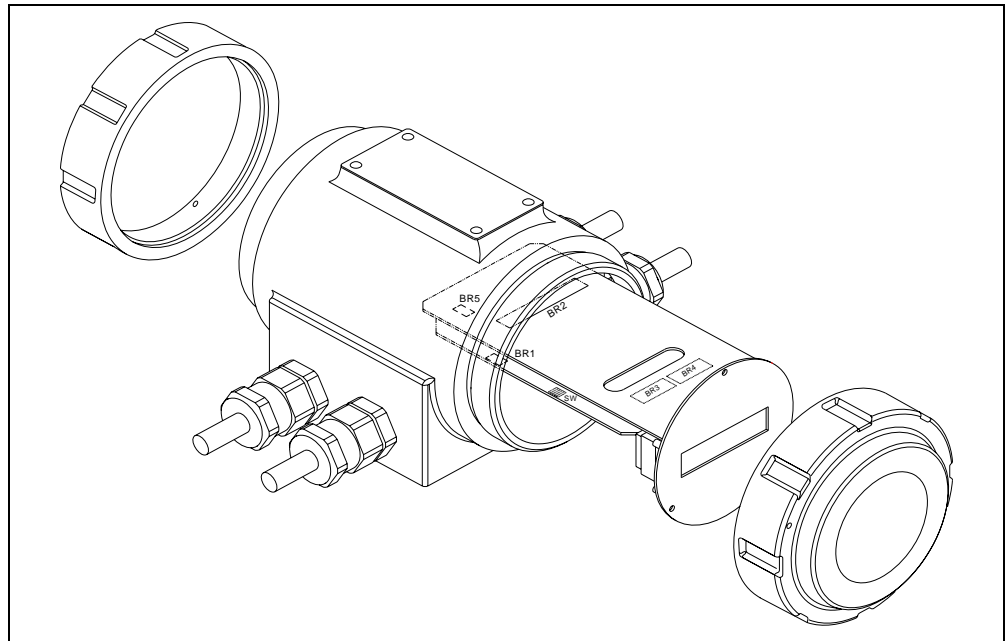
4 – MINISONIC 600 & 2000 WIRING PLAN:

- Internal cables must be kept as short as possible. Cables are to enter through the stuffing box facing the terminals.
- For the EXD unit, imagine the card turned over with access from underneath.
  - Plug-in connectors assist with cabling and maintenance. Choose flexible cables with a limited cross-section (1.5 mm2) to facilitate these operations.

RS Details

TX 232
RX 232

RTX - 485
RTX + 485

BR1

SW

BR5

RS

TX 232
RX 232

Masse

V < 100 v
I < 0,1 A
P < 2 W

Re1
Re2
+ I s1
- I s1
+ I s2
- I s2

I 1
I 2

BR2

MK4

PT-GND1
PT3
PT1
PT2
PT-GND2

PT4

BR 3
BR 4

Upstream = 1,2,3
Downstream= 4,5,6
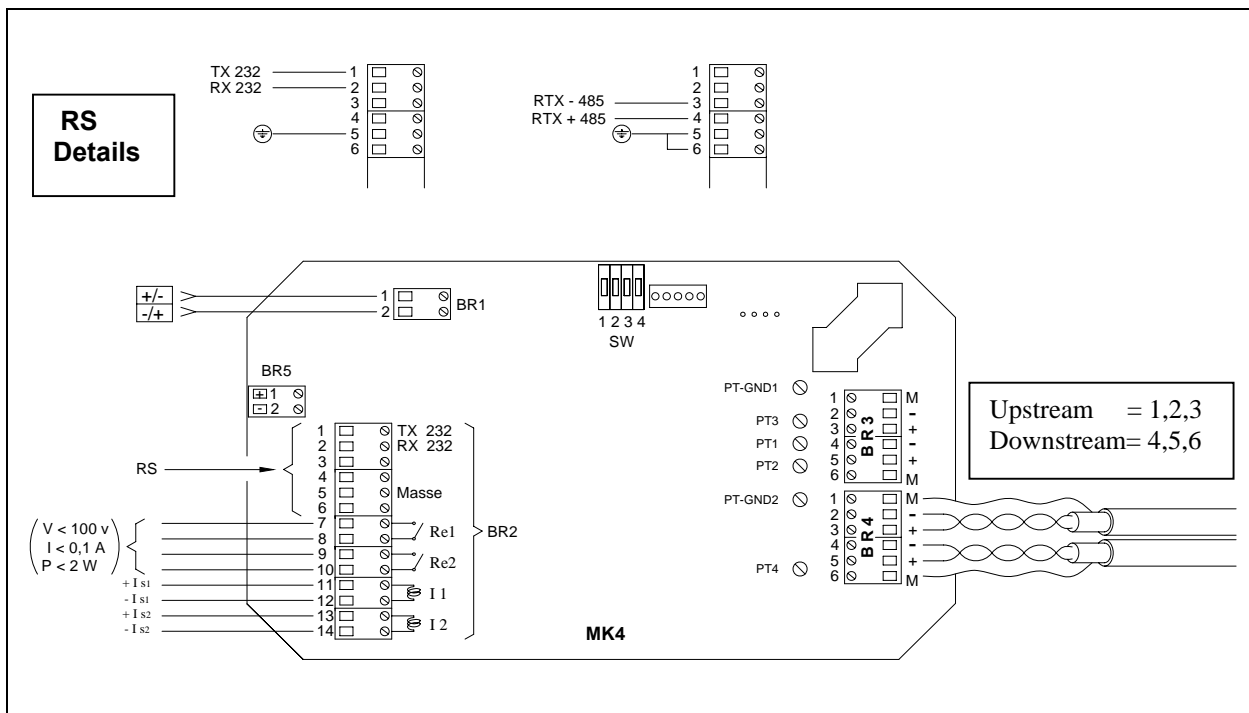
* Wiring for active output

+ I s1
+ I s2

BR5

- I s1
- I s2

BR 2

185 mm
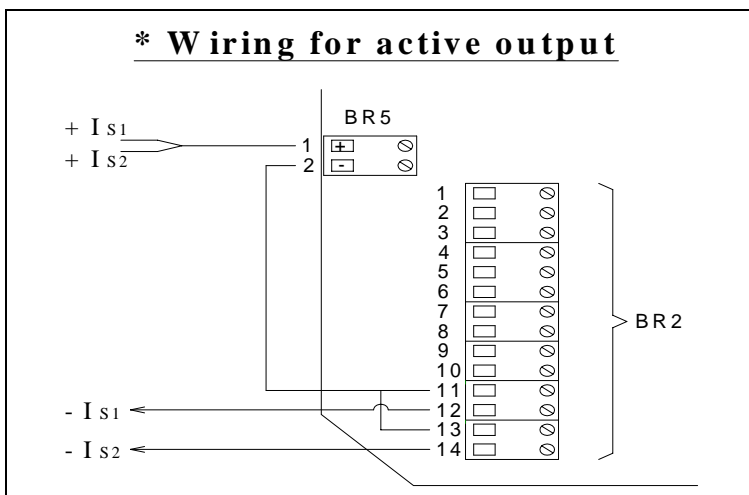
EXD Version : Cables preparation (to probes)
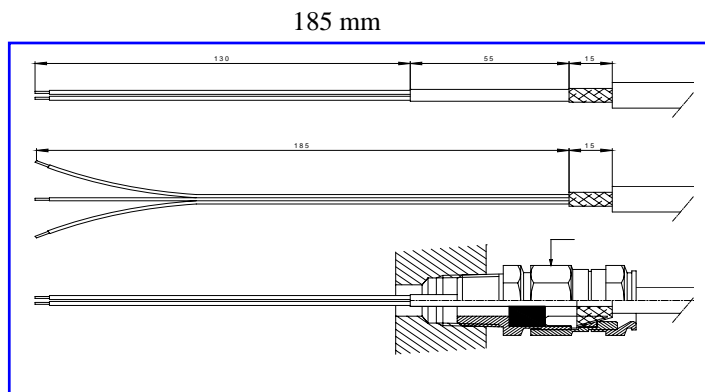
5 – <u>CONVERTER ASSEMBLY:</u>

5-1 : <u>Mechanical assembly</u>
Prefer conditions allowing easy access and legibility.
Avoid mounting on supports exposed to vibration.
Avoid extreme climatic conditions and direct exposure to sunlight.
Attachment is by two M5 screws for industrial boxes
  or on a 2" stake for a EEx d box.

5-2 : <u>Electrical Connections</u>: Refer to the diagram on the previous page.

<u>Power supply</u>: Connector BR 1 – Use a flexible cable having a section of 0.5 to 1.5 mm2
  - The recommended source is DC from 10 to 30 Volts (60 V as an option): 12 / 24 (48)
  - Any polarity will do. The required power is less than 2 Watt.
  - The source may also be alternating (9 to 18 Volts – 50/60 Hz) via a transformer.

<u>RS 232 or 485 digital outputs</u>: BR 2 , terminals 1 to 6.
  - The PC-DB9 cable uses RS 232 with Tx at 2, Rx at 3 and 0 Volt at 5 .
  - For a permanent link (logic controller, modem):
    . For RS 485: connect RTx – to terminal 3 and RTx + to terminal 4
    . For RS 232: connect Tx to terminal 1 , Rx to terminal 2 and common to terminal 5
    . The RS 232 output is activated by default. To activate RS 485 instead of RS   232 ,
    connect terminals 5 & 6

<u>On/Off outputs - Relay</u> (Static) : BR 2 , terminals 7 to 10 – flexible multipair cable.
  - Comply with the limits V < 100 V – I < 0,1 A and allow for R ON = 10 Ohm .
  - Each relay Re 1 (terminals 7 & 8) or Re 2 (terminal 9 & 10) will transmit the
    chosen status information from the "General Parameters" menu.

<u>Analog outputs 4 – 20 mA</u>: BR 2 , terminals 11 to 14 – Flexible multipair cable.
  - These outputs are independent and **galvanically isolated** from each other,
    but also from other MiniSonic circuits and by default are **passive**.
    They must be connected to a receiver providing the power supply (30 V max.)
    to allow a load of more than 1 kOhm .
  - Output No. 1 (terminals 11 & 12) and output No. 2 (13 & 14) will transmit magnitude
    and range variation information as chosen from the "General Parameters" menu: flow
    rate, but also speed of sound and gain.
  - Using the power supply voltage appearing on terminal block BR 5 (see diagram)
    the analog outputs are rendered **active** but with the drawback of losing some of the
    galvanic insulation.
    This configuration is particularly limited in terms of loop impedance in the case of a
    12 V AC or DC power supply (150 to 200 Ohms max.).

<u>Connection of two probes</u>: BR 4 (BR 3 is reserved for the dual-channel versions)
  - Use the twin-ax cable specified by Ultraflux or otherwise, coaxial or triaxial cables.
    For reinforced cable, stop the foil wrap before reaching or inside the stuffing boxes.
  - For a positive flow rate, connect the upstream probe across terminals 2 and 3 with a
    shield at 1, and the downstream probe across terminals 4 and 5 with a shield at 6 .
  - For coaxial cable, connect the cores to 3 and 5 and the braids to 2 and 4. For a
    triaxial cable, the external shields will be connected to 1 and 6.
  - For the EXD version, the braids will preferably be stopped and connected in the
    stuffing boxes, and the conductors will be approximately 15 cm long as far as the
    terminal blocks.

6- **PROBES INSTALLATION** – General Procedures.

The MiniSonic 600 & 2000 accept all standard or special transducers of Ultraflux catalogue with frequency from 250 KHz up to 2 MHz: clamp-on, insertion or wetted …

➢ Unless specified and instructed otherwise in the order, refer to the probe data sheet of the model used .

➢ The installation of the probes in a conduit should allow for the best the straight lengths, particularly upstream, but also downstream, in order to benefit from a predictable and stabilized hydraulic profile. Provide upstream a minimum of 15 times the pipe diameter.
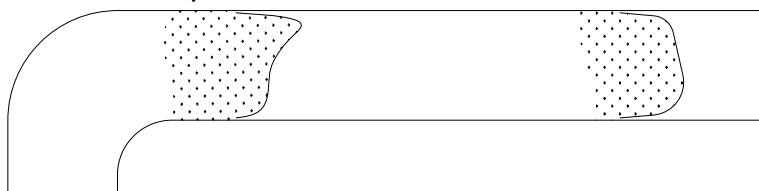
➢ Similarly, to avoid the nuisance of deposits or accumulation of gas, planes close to vertical (+/- 30°) will be avoided. A horizontal plane is a good choice excepted when the conduit is vertical.
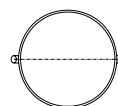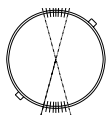
➢ **For intrusive probes**, adjust the insertion then the alignment or orientation of the probes for the same pair (> parallel faces) .

Important! : Once these adjustments finished, it is necessary to measure with accuracy the distance L between transducers face to face and its projection D on flow axis and note these values on a "as built " data sheet for further entering in instrument menu.

! The final accuracy depends on.

L , D

D

L
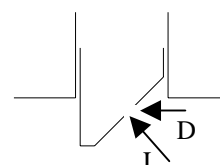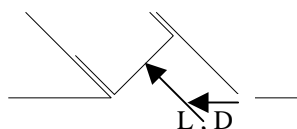
➢ For external probes, the freedom offered should not prompt the user to ignore the above rules.
However, the choice of direct (\), reflex (V) or even (N or W) installation mode will depend on the decision regarding the conduit (state) and the fluids to be measured.
Therefore, we advise initially a provisional installation known as a validation installation (coupled with gel or grease) and final assembly (supports, solid coupling) once the conditions have been validated.

Since the MiniSonic calculates for you the distance D.S required between the probes, the setting up operations will, in theory, take place once the converter parameters have been set.
Particular attention will be paid to cleaning the conduit at the probe location.

D.S
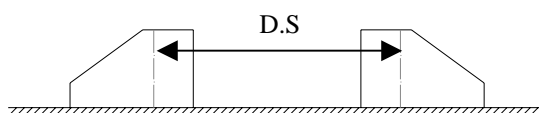
Probes installation : particular recommendations for a portable use :

Please read general recommendations as detailed in our training manual NT 122.
Under header § 2, we give some information about expected accuracy depending on available straight length and transducers mounting modes.

When you will arrive in front a new pipe to be measured, you must have some good reflex, and your experience will help for.

➢ **First , you must have in hands suitable probes for the application .**

We propose different sizes having each its own frequency: larger they are, lower is the frequency.

- High frequency and small probes are suitable for small pipes, thin pipe wall and highest accuracy in Delta T measurement. But signal could be distorted or damped is pipe or liquid conditions are becoming difficult.
    Example: our SE_1586-E2 – F=2 MHz

- Lower frequency transducers are less sensitive to above conditions and are more suitable for large pipes. For such pipes, the Delta T is more important and thus weights less on the results.
    Example: our SE_1599-I or SE_1595 – F=0.5 MHz

- Between them, we offer a compromise with probes F = 1 MHz
    Example: our SE_1662-A or SE_1596 or better SE_1515, which accept up to 200 °C

➢ **Most** of these above probes are delivered **with a support** which don't let other choice than to place them in <u>Reflex mode</u> . This **V** mode must be preferred to all other mode as far you can place the transducers (distance D.S. and signal = OK) .

The <u>probes coupling and its duration are very important</u> for reliable results.

Try always to have a compromise for pipe access and straight lengths. All becomes easier. When you have to do a measurement after a pump, please try as far as possible from it . You will have less disturbance or remaining bubbles from cavitations.

➢ **After installation finished and accepted, you shall be the first critic of the measurements you are doing.**
    For this, MiniSonic delivers you complementary information on signal (Gain), on physical measurement (Delta T), on sound speed (C – relation with T °C ?) and on hydraulics (Reynolds number – Kh) .

What to do with?
- A too high amplification gain would request to use lower frequency transducers.
- A low Delta T must be compared to the offset risk (Delta To) . You have to decide about a possible zero flow compensation.
- A sound speed very different from expected value would signify some mistake in pipe data.
- A Reynolds number near the turbulent to laminar transition area would request the highest attention to the probes location. Even if Reynolds number can predict a laminar flow, it is necessary to have more than 20 x Diam. to establish it after a disturbance.

7 - COMMISSIONING AND PARAMETERING OF MINISONIC 600 & 2000 :

1. Once the cabling has been carried out and verified, power up the system:

➢ The MiniSonic must display its home screens:
  - Hardware version = MiniSonic 600 or 2000 or EXD (2000)
  - Firmware version = <u>17</u>.10-01 (e.g. – make a note of the first figure)
  - Serial number = see if it is identical to the company nameplate
  - Technical information: parameterized probes
  Then it automatically switches to the measurement function (Q = …)

➢ Check the consistency of these messages with respect to your application. If your instrument is set ready to be used, you can start readings and records.

➢ However, it is recommended you to check and, if necessary, to optimize the adjustments, taking into consideration the exact dimensions and, if possible, zero flow conditions (see the "Self-zero Adjustment" menu).

2. Parameter settings using the PC software : *Use same version than Firmware*

➢ Refer to the manual supplied with the software (CD-ROM) .
➢ The fields of the main values to be entered are listed below under Heading **8**.
➢ The software offers extended configuration possibilities.
➢ At the end of the manual, a printout of a typical file is given.

3. Parameter settings using the keyboard

Successive pressing on the (**F**) key, or (**F**) then (**+**) or (**-**) gives access from the "Measurements Display" menu to the titles of the different menus :
  ➢ Access (Authorization) to Adjustments
  ➢ Pipe parameters
  ➢ Flow rate / Fluid parameters
  ➢ Probe parameters
  ➢ General parameters including Outlets
  ➢ Zero adjustment
  ➢ Tests
  ➢ Optionally : "Current outputs setting" and "Factory Adjustments".

To enter the Menu, use the (▽) key in the same way as to move to the next field to be filled in .

To modify (text or values), use (**–**) or (**+**)

Exit from the menu is by the (**F**) key with return to the "Measurement Display" menu
  If there is no action on the keypad for 1 mn , the MiniSonic automatically returns to "Measurement Display" menu .
  When inside a menu, the browser only scrolls forwards. When necessary, do a complete scroll.

8 - DETAILED REVIEW OF MENUS – MiniSonic Versions 600 and 2000 (EXD) :

Here below we list the different menus with values and data as displayed by the LCD and what it is allowed to modify to do the setting. At the end of the chapter, we list some other functions or menu, which require the use of our LS_600W software on a PC.

8 -1 : " Measurement Display " menu:

Every time you return to this menu, MiniSonic displays :

chosen probes and interprobe distances D.S.(if S.E.)

```
Probe = SE xxxx
D.S. = xxxx mm
```

Then flow rate (or other choice as first screen)
and associated messages .

```
Q  = xxx.xx m3/h
Seek Echo , Fault Q
```

▽   Gains (mode and value)
and I.Q. quality indicator.

```
Gain  (ESC) = xx dB
I.Q. = 100 %
```

*If **I.Q**. is less than 33 % , the last Measurement cycle is rejected.*

▽   Velocity of fluid and speed of sound
N.B.: This sound speed is a characteristic
of the fluid at actual conditions .
Compare this value to expected one
at a actual temperature (see NT 122)
It is a good indicator for water applications.

```
V = x.xxx m/s
s.sound = xxxx.x m/s
```

▽   Physical measurements: time of flight T
and difference delta T

```
T  = xxx.x µs
DT =      ns
```

▽   Totalizers - Reset possible by
simultaneously pressing + and -

$$t_1 = xxxx \text{ m}^3$$
$$t_2 = xxxx \text{ m}^3$$

▽   Date and time
➢ *Change by PC + Software*

```
06/02/2003
15 : 46 : 22
```

▽   Hydraulic Information
Calculated KH and Reynolds number

```
Kh   = 1. 055
Rey = 3,1E5
```

▽   Return to menu header

8-2 : « Calibration Allowed » Menu :

➢ Access = press **F** once from the Measurement Display menu

> ➢ If the display is :
> Enter this code (1 to 65535)

| Calibration Allowed : 0 |
| Code ? |

> ➢ If the display does not request "Code?", there is none (code = 0)

➢ Press ▽

| Access Code = xxxx |

> ➢ Enter a code:

! This code will become active after de-energizing.
Remember to make a note of it. It will be required for any subsequent intervention.

➢ In case of loss, contact Ultraflux giving the following informations ; the serial number of your MiniSonic MK4*/xx/xx/xxxx as it appears during energizing and the date or dates on which you want action to take place. An operation will be requested allowing a provisional code to be calculated.

➢ A second press on ▽ will provide access to the existing <u>Languages</u> choice field.

8-3 : « Pipe Settings » menu :

➢ Access = Press twice on **F** or **F** once, then **+** and Enter by ▽ (operations common to all the menus).

▽   External diameter (mm)
     or pipe circumference

| ext D = xxxx.x |
| ext C = xxxx.x |

▽   Chosen pipe material
     from programmed list :

| Pipe = |
| STEEL... PVC … OTHER |

If Other: Characterization of this material by its velocity or <u>CM</u>
This selection will resolve new or special cases and also optimize the parameters
for composite pipes having several materials (steel or cast iron + cement)

▽   Total pipe thickness:

| Thickness = xx.x |
| mm |

▽   If other:
     N.B. :only one input.

| CM = xxxx m/s |

8-4 : « Q Settings » menu (Flow / Fluid)

▽ Choice of Flow unit :
(l/h …tot … m3/s);

Q unit = m³/h

▽ Scale (graphics on PC only) :
Outputs: see menu « General »

Qmax (unit) +/xxxxx.x

▽ Product (+ / -) :

➢If WATER: C = 1300 to 1600 m/s

Product = WATER / OTHER

➢If OTHER :

▽ Fluid Characteristic
and speed of sound range :

Co = xxxx m/s

Delta C = xxx m/s

▽ Hydraulic corrections (+ / -)
Prefer mode AUTO .

K Hydro = AUTO / MANUAL

▽ Entry of Coefficient KH or data to do
its calculation :

➢ If MANUAL : entry of coefficient
depending on profile : Laminar = 1.333
or Turbulent = 1.03 to 1.08

K Hydro = 1.xxx

➢ If AUTO : entry of parameters :

▽ Fluid viscosity:

Viscosity (cst) x.x

▽ Pipe roughness:

Roughness (m m) xx.xx

As well as the critical Turbulent /
Laminar flow transition:

▽ Critical Reynolds Number (ReyC)

ReyC = 2800

▽ Transition range (LBR) :

LBR = 3

(Recommended values)

8-5 : « Probe / Echo parameter settings » menu :

▽ Choice of probe :
From this choice, it results Emitting Frequency, D.S. calculation (S.E.) or Opening of L and D fields (SM)

> **Probe = SE xxxx**
> **(or SM ou SP. A/B)**

▽ ➢ if SE (External probes)
/ = single traverse
V = reflex mode
N , W = 3 or 4 paths

➢ If SM (wetted internal probes)
See parameters L & D

> **Probe mounting = V**
> **(or / , N , W)**

▽ Management of amplification gains:
ESC Mode recommended .
(Echo Shape Control)

> **Gain = ESC**

Otherwise :

➢ If **MANUAL** :
(Gain adjustment.)

> **Gain = xx dB**

➢ If **AUTO** : Margin
(Over-amplification compared to critical gain Go.)

> **Margin = xx dB**

▽ If SM choice: position of probes depending on geometrical measurements .

➢ as distance L between probes ,
face to face (chord)

> **Length = xxx.x mm**

▽ ➢ as projected distance onto flow axis
(Part of L concerned with the flow)

> **Ax. D = xxx.x mm**

8-6 : « General Settings » menu

▽ Setting of LCD backlighting
(Depending on MiniSonic version)

| **Back Light**
ON / OFF / TIMED |

▽ Filter rate of measurements
(Number of 0.5 s cycles)

| **Filter = ∗∗** |

▽ Last accepted measure (IQ > 33%)
Memorising time:
(Mode ESC: enter Mém. = > 20)

| **Mémory (s)= ∗∗** |

▽ Setting of Totalizers 1 & 2

➢ depending on flow direction:

| **+ , - , +/-** |

▽ ➢ depending on weight or unit :
(from 1 cl to 100 m3)

| **Pulse weight =**
1 m3 |

▽ Setting of Relays 1 & 2
➢ by assignment :

| **Closed/Open /TOT.1 ou 2 /**
Fault Q/ Dir.Q/ Threshold Q |

▽ ➢ If copy of TOT 1 or TOT 2 :
= Relay closing time > F maxi

| **Pulse width (ms)** |

▽ ➢If Threshold: enter value for Q :

| **Threshold R2 (unit)**
Value |

▽ Reset to Zero of TOT 1 & 2
This function may be prohibited

| **Reset t1 & t2**
NO / YES |

▽ Parameter settings of two outputs
4-20 mA , SA 1 & SA 2
➢ by assignment :

| **SA 1/ SA2 Type**
Q , V , C , GAIN |

➢ by range (depending on unit)

| **4mA SA 1 & SA 2**
+ / - xxxx.x |

| **20 mA SA 1 & SA 2**
+ / - xxxx.x |

▽ RS 232 ou 485 Communication
Jbus slave No and Baud Rate :

| **N. JBUS = 1**
BAUD = 9600 |

8-7 : « Zero / Autozero Settings » menu

▽   Status display :

     Modification by **+ / -** :

Delta To (ns)
= xx.xx (ns)

     ➢ no compensation (reset) :

RST Delta To

     ➢ performs the zero under actual
        conditions (flow must be null)

Autozero

     Exit by **F**

! Caution = *to carry out Self-zeroing, the flow rate must be absolutely zero while the display indicates « * dTo * » .*

8-8 : « Output Current Settings» menu (normally reserved to Ultraflux)

It permits adjustment of coefficients
to convert min / max range to 4 / 20mA

4 mA (1 & 2) = xxxx

! Caution : *use an a approved instrument to measure milliamperes .*

20mA (1 & 2) = xxxx

8-9 : « Factory Settings » menu (normally reserved to Ultraflux)

It permits to adjust a coefficient which
optimises the compensation with
clamp on probes (value 0.6 to1.4)

Correction S.E. = 1.0

Another parameter named " Delta T band " permits to set a compromise between filtering an response time for some difficult applications : please contact Ultraflux .

Factory settings menu includes another facility but only through PC software : the entering of a linearization curve *.*

8-10 : « I / O Test » menu : simulation on outputs and relays .

▽   Simulated current on SA 1 or SA 2 :
      (Action by **+ / -**)

Current 1 & 2 = xx.xx
mA

▽   Simulation of status on Re 1 or Re 2 :
      (Action by **+ / -**)

Relay 1 & 2 =
Open / Closed

8-11 : <u>Additional adjustments possible using PC + Software only:</u>

The recommended values or states are entered by Ultraflux during testing before delivery.
However, it may be necessary to modify them to adjust them to the site. If most of the operations can be performed from the keyboard, some call for the LS_600W (be sure to choose the right version). Using the software will also allow the backup of the modified menu.

Parameter Menu Dialogue:

In addition to the fields already described, this menu will allow two text fields in order to give MiniSonic an application or client name and an instrument reference, for instance: *> Cf. General sub-men, line 1 & Line 2*

The MiniSonic internal clock time set is obtained by synchronizing it with that of the PC being used: *> Cf. General sub-menu, Synchronization with PC time = Yes*

The software will allow a Delta To to be set to compensate for a zero default assumed to be at zero flow and to prevent the Self-zero function from being launched. *> Probe sub-menu, Delta To*

The software will allow the input of a Q max defining the scale of the Measurement Dialogue menu graph. Using the scale of this Qmax, different from and independent of the 4-20 mA scales parameterized elsewhere, it is possible to enter an erase flow rate (display set to zero) at the bottom end of the scale: *> Cf. Flow rate sub-men, Q rms. = % Q max*

As long as they are accepted, and therefore as long as rights are justified and authorized by a confidential code, it is possible to work in a "Works Adjustment" menu. Contact Ultraflux while justifying your request.

Works Adjustment Menu Dialogue:

This menu will allow determining fields to be modified for the application and which we reserve for authorized people who have gone through in-depth training.
For information, we list some of the functions:

- Possible input of a *Linearization curve*, to compensate for an error curve characterized by metrological tests. This curve is symmetrical to the error curve and entered by 11 points defining 10 segments per 10% section through to a "reference" flow rate at the end of the scale. The input of Q ref = 0 renders the curve inoperative.
- Definition of one or two *special probes*.
- Input by *Delta T Filtering* of a threshold to deactivate measurement filtering and obtain the best "response time / measurement stability" tradeoff. In this way, MiniSonic will be able to respond quickly when the pump is started or after the opening of a solenoid valve, and will then present filtered and stable reading when the flow rate is established.
- The limitation of the amplification gain (*Max. Gain*) to avoid the acknowledgment of noise under default conditions.
- Adjustment of *External Probe Correction* parameter which we may optimize for measurements on multi-product conduits.
- *Simulation* Menu for testing.

9- RECOMMENDATIONS

Each application has its priorities. Accordingly, the MiniSonic is particularly flexible and can be adapted to extreme situations, meaning that many applications are possible.

Ultraflux fills in each value or text field before the final tests and delivery.

Nevertheless, it is advisable to verify them by running through the various menus, comparing them with files given at the time of order, or with your instructions or particular choices.

More particularly, geometrical descriptions specific to the site and the choice of scale are the responsibility of the end user.

During a run-through of the various menus, it is advisable to fill in the "Probes / Echoes" menu first, followed by those related to the Pipe and the Flow Rate / Fluid (Q) to obtain a measurement to be transmitted according to the instructions entered into the "General" menu

FINAL CHECKS AND TESTS

Once installation, connections and parameters have been set up, several possible situations may arise:

Case 1 – The measurement displayed and transmitted meets your expectations.

Case 2 – The measurement operates but may lack accuracy or is unstable.

Case 3 – The measurement is not reliable or the MiniSonic is displaying a Fault.

➢ **Case 1** : Although everything appears to be OK (Flow Rate = OK), check the other values:

- The echo or gain level compared to typical values.
    - For external probes, a gain exceeding 50/60 dB reveals certain difficulties such as the wrong choice of probes, incomplete installation or coupling, rusted pipe , absorbent fluid …
    - For intrusive probes, the gain level is usually low (excepted for gas))
  → *The ESC mode can decide a high gain margin. Take in account it in your diagnosis.*

- The quality index Q.I. is normally close to 100 % .
    By default, it indicates several perturbations = electrical interference, passage of bubbles, highly charged fluid …
  → *In this case, in-depth investigation is advisable.*

- The displayed speed of sound should be close to that expected, an index of good control of the geometry or application .

- If the flow rate can be interrupted, check the Zero
  → *If necessary, carry out adjustment using the Auto-Zero menu*
  → *By PC and software, it is possible to set the measurement to Zero at very low flow (cut-off = % of Q max) .It is better to don't use this function for portable applications .*

➢ **Case 2** : In addition to the points mentioned above, the possible causes are:

- Poor control of the installed dimensions, or of the product characterization or of the Zero point:
  → *Correct and reanalyse*

- An installation constructed with poor hydraulic conditions:
  → *If possible, change the location of the probes.*
  → *Otherwise, it is possible to choose KHydro = Manual and adjust this coefficient to display the expected flow value: Increasing it does flow value decrease.*
  → *With insertion probes, it is also possible to play on Axial D.*

- The range of speed of sound to be measured is too wide for the chosen setup:
  → *With S.E. probes, a direct mode (/) may be preferable to a reflex mode (V)*
  → *Have you correctly set Co and Delta C range) ?*

- An unstable fluid causing the ESC mode to restart too often:
  → *Try the AUTO mode with a reduced margin ($\sim$ 12 dB or less)*

- To permit a greater precision or a wider flow range, the MiniSonic allows the input of a "Linearization" correction law.
- → *Plot the error curve and use the software to enter the complementary law (Factory Adjustments Menu) .*

- The Delta t offered by the measurement conditions (Diameter, Flow Rate, Assembly, Choice of probes) is too low to claim any measurement accuracy.
  → *is it possible to revise these choices ?*

- The measurement conditions reveal poor control of transitions from turbulent to laminar configurations:
  → *Adapt declared Critical Reynolds and range (LBR) values or play with Kh=manual.*

➢ **Case 3** : The MiniSonic does not operate:

- There is no display or measurement transmission (4 – 20 mA) .
  → *Is the MiniSonic powered up? Check with a Voltmeter.*
  → *Has it failed? If yes, the only solution is to call in our after-sales service.*

- If the MiniSonic displays INIT constantly, attempt a power cutoff, then re-energize
  → *Would the MiniSonic supplied by a too low voltage or power source?*
  → *If the fault persists, contact Ultraflux (Problem with the microprocessor).*

- If the MiniSonic displays "Flow Rate Fault", this message does not mean that the MiniSonic has failed, but that the ultrasound signals have not reached the expected level or are outside the window [Co +/- Delta C]. There are several possibilities:
  → *Pipe empty?*
  → *Problem of site? Two-phase fluid or too highly charged or too viscous?*
  → *Old pipe and / or not transmitting ultrasound signals?*
  → *Unsuitable installation mode = try Direct mode (\) or other sensors .*
  → *Incorrect sensor installation (orientation , coupling …) .*

10 - <u>INVESTIGATIONS</u> :

If there is a difficulty or a problem, logical analysis can be assisted by the implementation of expert apparatus:

- Either an oscilloscope: the MiniSonic has internally on its P.C. Board test points :

  PT 0 = 0 Volt – Ground
  PT 1 = Selection windows. Echo must be inside.
  PT 2 = Synchro –Positive edge 0 to 5 Volt
  PT 1 = Selection windows. Echo must be inside.
  PT 3 = Emission < > Reception transit time.
  PT 4 = Echo – Alternating signal , peak to peak max = 4 Volt / 0.65 V negative threshold.

- Echoes display investigations can also be done by using a DigiSonic E / P portable flowmeter .
- This device permits also ultrasonic thickness gauge option .

- Or measuring instruments for dimensional or alignment measurements

<u>SPARE PARTS</u> :

Ultraflux offers possibilities of purchasing spare cards or, as long as acceptance is granted, the standard replacement of equipment in the event of failure.

→ *Contact the Ultraflux commercial services or the regional dealer.*

11 – APPENDIX

1 : Calibration file example of a MiniSonic- with clamp-on probes SE

Settings - C:\...\Ls600W 17\Data\SE 14 ENG Type.eta (11/06/2004 - 13:35:05)

General

N. JBus = 1   Filter = 5 Cycle   1st screen = Flow
              Memory = 30 Cycle   Back light = Timed
                                   Line 1 = UFX SE 14
                                   Line 2 = FIT 11
                                   Firmware = 17-10-

Probe

Probe = SE1516-I
Probe mounting = V
Stop meas. on = Zero Crossing
US Impulse = 1

Chord 1

Polarity = Normal
Type of Gain = E.S.C.
Margin = 12 dB
Delta T0 1 = 0.00 ns

Pipe - Product

Pipe 1
Ext. Diameter = 406.4 mm
Material = Steel
Thickness = 9.5 mm

Product = Other
C0 = 1300 m/s
Delta C = 300 m/s
KH Type = Automatic
Viscosity = 4.0 cSt
Roughness = 0.10 mm
Critical Reynolds = 2800
L.B.R. = 3

Flow

Q Unit = m3/h
Max Q = 2500.0
Cut OFF Q = 1 %

Totaliser 1   Totaliser 2

Direction = +   Direction = -
Pulse weight = 1m3

Relay 1   Relay 2

Type = Fault Q   Type = Totaliser 1
Direction = Normal Direction = Normal
pulse width = 33 ms

Analog Output 1   Analog Output 2

Type = Q   Type = C
4 mA = 0.0   4 mA = 1080.0
20 mA = 2000.0   20 mA = 1580.0

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2 – Calibration file example of a MiniSonic with SM insertion transducers :

Settings - C:\...\Ls600W 17\Data\SI_50_ENG_Type.eta (11/06/2004 - 13:36:52)

General
N. JBus = 1   Filter = 10 Cycle   1st screen =   Flow
                   Memory = 30 Cycle   Back light =   Timed
                                             Line 1 = UFX 2000 SI
                                             Line 2 =   FIT 21
                                             Firmware =   17-10-

Probe
Probe   =   SM-P1.0
Stop meas. on = Zero Crossing
US Impulse   =   1

Chord 1
Polarity   = Normal
Type of Gain = E.S.C.
Margin   =   12 dB
Path Length = 1765.0 mm
Axial D.   = 1248.0 mm
Delta TD 1   =   0.00 ns

Pipe - Product

Pipe 1
Ext. Diameter = 1269.0 mm
Material   = Steel
Thickness   =   8.5 mm

Product   =   Water
KH Type   = Automatic
Viscosity   =   1.0 cSt
Roughness   =   0.10 mm
Critical Reynolds =   2800
L.B.R.   =   3

Flow
Q Unit   =   m3/h
Max Q   = 5000.0
Out OFF Q =   1 %

Totalizer 1   Totalizer 2
Direction = +   Direction = -
Pulse weight = 10m3

Relay 1   Relay 2
Type   = Fault Q   Type   = Totalizer 1
Direction = Normal   Direction =   Normal
pulse width = 33 ms

Analog Output 1   Analog Output 2
Type =   Q   Type =   Q
4 mA =   0.0   4 mA =   0.0
20 mA = 4000.0   20 mA = -2000.0