User Manual

Minisonic PSD
Pig and sphere detector

Explosion-proof
enclosure

Minisonic ISD
Interface, pig and sphere detector

Ultraflux

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Ultraflux NT 216C GB1

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PREAMBLE:

Thank you for choosing Ultraflux to help your **petroleum product quality survey** during pumping operations by pipe-line or other process as pipe cleaning or product separators detection .

We offer a new range of detectors backed by 30 years' expertise and experience using Ultrasonic techniques.

® UF 801-P family, high features portable flow meters, with integral loggers and signal analysis functions.

® UF 8xx families of fixed flowmeters, applications include
L - Liquids,
G - Gas,
MC: Multi-chord applications, Liquid and Gas flow measurement,
CO / RV: Open Channel and River Flow Measurement.

® The MiniSonic family with:
P – Portable Metering with also a two pipes 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 & 2 are devices for open channel flow velocity measurements.

This manual is specifically concerned by the Interface & Pig or Sphere Detection and has been drafted to guide you in the stages of installation and commissioning these MINI-ISD & PSD.

Other documents and tools are available on electronic format only:

> A training manual concerning ultrasonic measurements, reference **NT 122**

> A guide about the use of our software in the Windows environment Ref **NT 203**

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

> The JBUS communication protocol with its address table **NT 202**

Other devices concern the interface detection when Pressure or Temperature effects need to be corrected: the M 1189 – S (Analog) or the **M 1189-N** (Digital) or any module having implemented functions (as **BRIO** …).

SUMMARY:

1 – <u>TYPICAL APPLICATIONS</u>

The MiniSonic-ISD main purpose is to do control nature and quality of a petroleum product flowing in a pipe-line. Based on relationship between sound velocity and other physical characteristics as density or concentration, it permits a very accurate survey about any change in the process.

As device requires only a clamp on transducer, it can be installed everywhere on the pipe, for instance at 1 km upstream from a tank farm or a pumping station. Thus MiniSonic-ISD is currently used as an <u>earliest advanced information densitometer</u>. Meanwhile, it cannot be considered as a densitometer for custody purpose.

It is possible to get sound velocity information from an ultrasonic flowmeter as our MiniSonic-600 , with two clamp-on transducers , but the oblique angle is not constant and so the variable path length don't permit the same measurement accuracy .

Moreover, principle can be applied to other process in <u>chemical industry : concentration analyser</u> , <u>proportion of mixture</u> as long as sound velocity is representing the data to be followed up . For instance, there is a very interesting relation with sulfuric acid at concentrations between 75 % and 100 %. Same, any ionized salt changes sound speed of water solvent: NaOH does ~+ 1 m/s per +1 g/l.

MiniSonic-ISD other function and MiniSonic-PSD main purpose is to be a <u>reliable</u> and <u>low installation cost</u> **Sphere or Pig-Sig detector**. With no need of any hole (with liquid products only) , no moving part , they can replace any out from condition old mechanical Pig-Sig Detector and are also very interesting for any new project as well . Moreover, they can be used for temporary detection during mechanical works on pipe-line and give information on product in the pipe (oil or water ?) .

Their detection is as so sensitive that they can count two successive sphere closed to each other, that is very difficult with a standard mechanical detector. In these conditions, MiniSonic-* gives a 5 seconds delayed second pulse.

® *The detection time corresponds to the end of the passed sphere or pig.*

When MiniSonic-ISD is connected to an Ultraflux digital correcting unit (M 1189-N …), it is possible to repeat a sphere or pig passage from this correcting unit if they are connected by R/S serial link .

1-1 <u>Measurement principle</u>: Calculation of the sound velocity in the product

The equipment is connected to a single probe being perpendicular to a pipe generating line.

At a rate set by the user, the probe sends a pulse which is reflected by the opposite pipe inner wall. Based on the knowledge of:
  - The measured time (t) between the emitting pulse and the receipt of its echo,
  - The pipe inner diameter D (resulting from the outside diameter and the pipe thickness)
  - The dead time (pulse transit time in the probe face and through the pipe wall),

the equipment determines the sound velocity inside the product under the actual conditions of pressure and temperature.

More precisely, time t between emission and receipt is equal to :
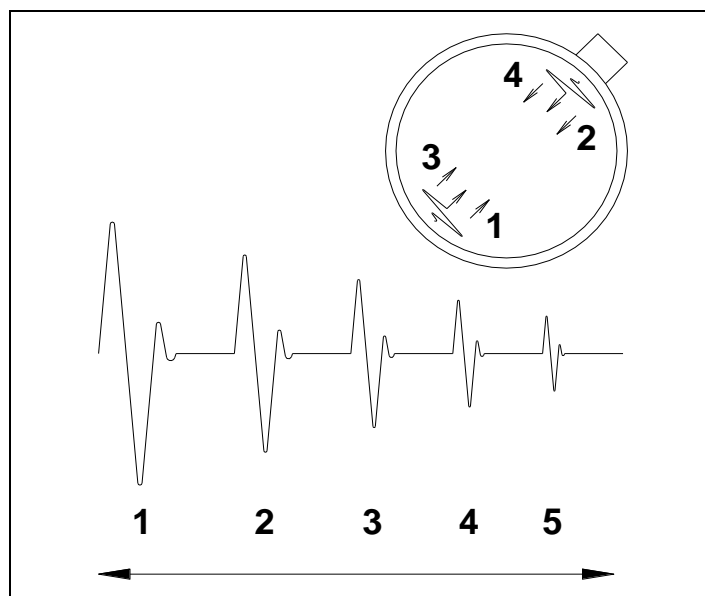 t = 2 x (time in probe) + 2 x (time in wall) + 2 x (time in product)

That is to say:

$$t = 2t_0 + \frac{2e}{Cm} + \frac{2D}{Cp}$$

With : D : inside diameter of the pipe / e : pipe thickness / Cm : sound velocity inside pipe material / Cp : sound velocity inside the product .

If time $2t_0 + \frac{2e}{Cm}$ is the dead time, the sound speed in the product is equal to:

$$Cp = C = \frac{2D}{t - t_{dead}}$$

Remarks: In the event of a new and smooth pipe, numerous reflection phenomena intended to disappear with time can be observed.

These numerous echo phenomena can make necessary to reduce the measurement rate of the MiniSonic ISD or PSD so that the echo phenomena generated by the preceding transmission can be completely absorbed before a new transmission.

1-2: <u>**Sound velocity in petroleum products – Relation with density :**</u>

   The sound velocity in any fluid can be related to some other physical characteristics such as density but also fluid pressure (P) and temperature (T) , mixture ratio if two or many products …and another data which presents a good analogy for liquids : the compressibility.

   For most of the refined products, experiences show a linear proportional relationship between density and sound velocity at given P and T. We name them **"Aligned Products"** by opposition to some which present some divergence and are named "<u>Petrol non-aligned products</u>" as we can observe when gasoline includes additives (old leaded gasoline, Grade 95 or 98 Premium Super with MTBE…), which influence compressibility.

   The addition of alcohol in gasoline or vegetal origin oil in diesel does some slight deviation, but with no consequence for interface detection capability.

   Sometimes such a divergence becomes an advantage and permits to detect a change that is called interface, between two successive products that have the same density.

   Meanwhile, end user must take care about a possible confusion between two successive products having a very closed density.

   Other products that don't belong to the same family can be not aligned.

   Here below, we give a list of usual products with their approximate density and sound velocity characteristic at 1 bar pressure (but propane & butane) and 15/20 °C temperature.

	Product Name	Density (kg / m^3)	Sound Velocity (m/s)
Aligned Products	Liquid *Propane	500	810
	Liquid Butane	580	920
	Light Naphta	670	1100
	JP4 – Jet petroleum	760	1240
	Jet A1	795	1290
	Spirdane	770	1260
	Tetramere	775	1270
	Kerosene HT	800	1310
	Diesel	820	1340
	Domestic Fuel	840	1370
	Petrol	750	1230
Not aligned Or other Products	Leaded Gasoline Normal	745	1190
	Leaded Gasoline Premium	745	1170
	Eurosuper 95	775	1220
	Crude Oils	850 –900	1340 – 1430
	Xylene	860	860
	Benzene	870	870
	Methanol	790	1155
	Ethanol	785	1195
	Ethyl alcohol	825	1205
	Water	1000	1480

Theoretical relation curve between sound velocity and density (1 bar / 15 °C) :

$$D = Kg / m^3$$
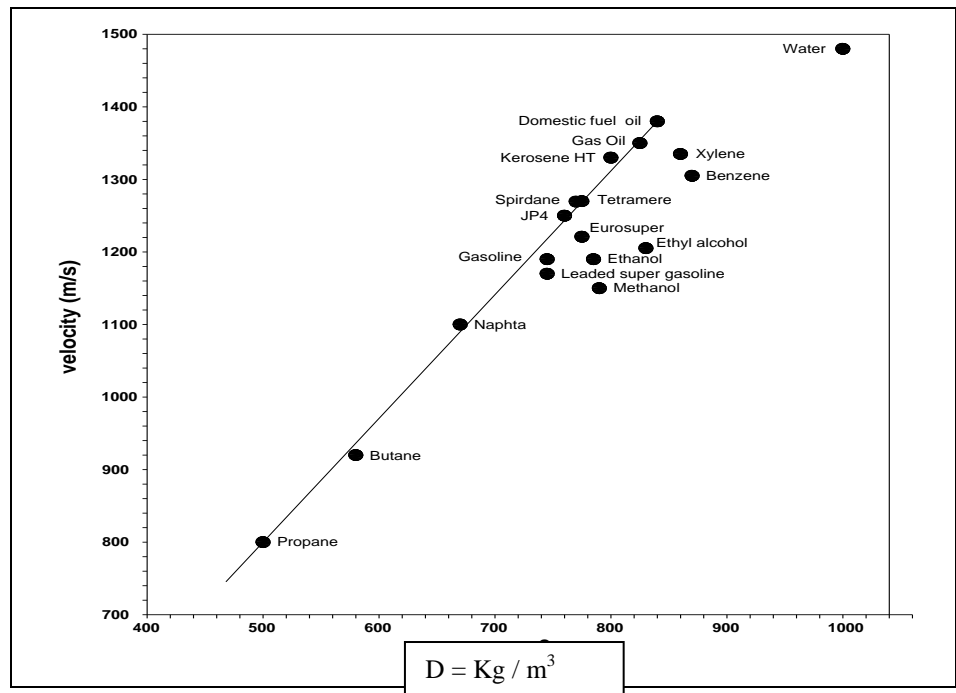
Most of usual pure refined products are aligned.
As a standard range by default, we propose :
C = 1060 < > 1560 m/s   for   D = 64O < > 940 kg / m³

Sound velocity change in a variable binary mixture, during an interface:
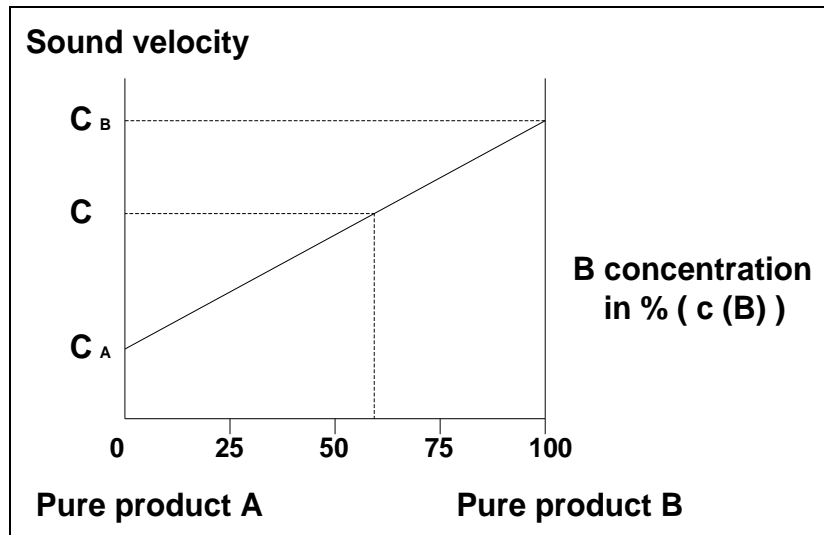
The relation is perfectly linear.
A MiniSonic ISD can be used as a dosimeter or concentration analyzer.

Effect of Pressure (P) and Temperature (T) on sound velocity :

We remind that P and T are also influencing actual density.

® Pressure influence:
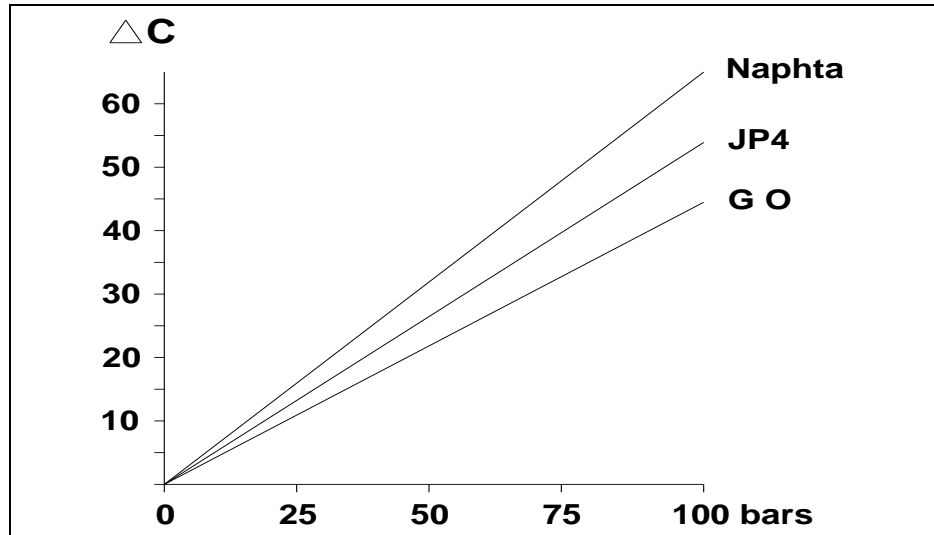
Global Coefficient varies with density range. Here we have from + 0.4 up to 0.7 m/s per bar.

® Temperature influence:

Average coefficient is more or less - 4 m/s per °C.

® Correction of P & T influence:

When pressure variations are higher than 10 bars, it is recommended to correct its effect.

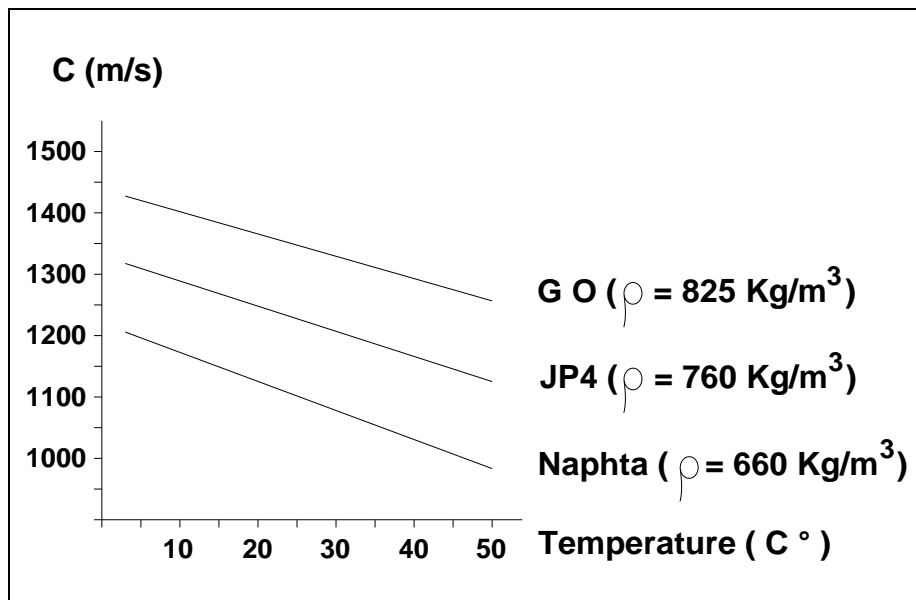Same, when temperature can vary fast, as it is when the detection is just by a refinery with successive pumping of cold or hot product, it is recommended to do a correction from a reliable temperature information, with a the sensor closed to our ultrasonic probe.

But, when the temperature varies only with seasons, it is not absolutely necessary to do a correction until end user accepts that the equivalent density display can show some deviation.

Interface Detection sensibility will not be affected.

If the correction function is needed and requested, we propose digital device as M_1189-N which is designed to receive the raw sound speed value (from R/S or 4-20 mA) and shall receive P & T information from 4-20 mA proportional signals.

Corrected output is 4-20 mA and R/S with Modbus protocol.

1-3: <u>Pig Detection in Gas pipe-lines:</u>

Beside the sound velocity is a very interesting data to know a gas composition; MiniSonic-PSD (or ISD) is more and more used for Pig detection in new projects. Gas pipelines use mainly foam pigs to clean oil or other deposits. Foam pigs are not very hard and their speed is as so fast as flow velocity, which gives problems to mechanical pig-sig detectors.

Same, detection by pig noise hearing (some companies call such detectors Ultrasonic) can work with a new foam pig, but this noise can be lower than ambient noise with a used pig, with a risk of no detection.

Thus, the detection by an ultrasonic barrier presents many advantages in such situations. The only condition is to have a good ultrasonic signal level.

- It is possible with two clamp on probes mounted at the opposite of each other on a same diameter, one being the emitter the other one being the receiver. The signal limitations come from the gas pressure (high pressure rate is necessary) and the pipe thickness, which limit frequency choice and could transmit noise.
Thus, a preliminary test must be done before any installation.

- The best solution to ensure the signal is to install an insertion transducer and let it just lined with pipe inner surface.
Such a transducer can be flanged (flange to be designed for pressure rate, as ANSI # 600 and more is needed). Installation and maintenance are done out from pressure conditions.

We also propose transducers to be installed by hot tapping up to 80 bars.

The measurement principle is the same than with clamp on transducers but with no care about the pipe thickness and dead time.

In both cases the emitting pulse rate must be increased to its possible maximum to ensure a reliable detection: pig speed can be very fast and thus successive loss of echoes are not many.

2 - COMPOSITION OF A MEASUREMENT POINT

- The probe: Standard models are SXN_M_1524 / F=0.5, 1or 2 MHz with attached cable (Ex mb IIC T6 CE_ATEX certified) and SXN_ME_1679 / F=1 MHz or SXN_1691 / F 0.25 MHz, with Ex mb e IIC T6 CE ATEX certification, connection box with gland for cable included.
- Optional support: SU_1629 for SXN_1679 or SU_1691 for SXN_1691.
- Coupling kit with stainless steel straps (* 2 for SU_1629 or SU_1691).
- Probe / converter link cable, with possibility of armored cable.
- The converter associated with its accessories (software, PC cable)
- If required, accessory modules: power supply transformer, Zener barrier

CERTIFICATIONS

All equipment is CE certified.

ATEX certification for the relevant equipment 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 or 65 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 60079-0:   General rules.
  + EN 60079-1 :   Ex d enclosures.
  + EN 60079-7 :   Ex e protection for connections.
  + EN 60079-18 : Ex mb x – protection by encapsulation.
  + EN 60079-11 : Ex ia   - Intrinsic safety
  + EN 60079-25 to guide you for your I.S. systems

- Beware to take in account the energised lightings (from thunderstorms for instance) and to place adapted modules when this risk can exist.

MINISONIC LIMITATIONS:

 MiniSonic ISD & PSD are designed for pipes from 100 mm (4") up to 1500 mm (60")
 MiniSonic ISD follows up with accuracy the product quality through its sound speed characteristics up to 2000 m/s.
 MiniSonic PSD has only Pig / Sphere detection function. It has a faster emitting / receiving rate than MiniSonic-ISD and thus can detect faster sphere passage (> 10 m/s) . But it is less accurate to measure sound speed and don't have any 4-20 mA output.
 MiniSonic ISD can optionally receive a Pressure and / or Temperature correction unit , as our M 1189-N . Necessity of such corrections depends on P & T variations and expected accuracy of the product quality survey.

3 - ERGONOMICS AND DIMENSIONS OF THE MINI ISD & PSD CONVERTERS

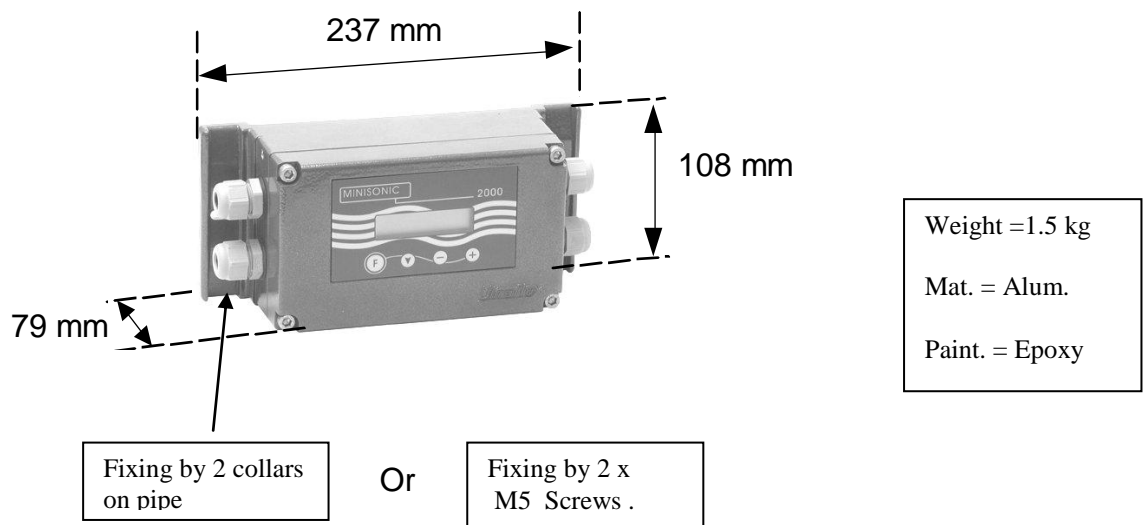### ® __Wall-mounted industrial version__ (IP 67):

The two glands on the left side are for the supply cable (upper one) and the outputs.
The two glands on the right side are for probe(s) cable(s).
To open the MiniSonic for wiring operations, unscrew the cover and disconnect the flat cable from the display.

It is also possible to fix it temporary above by two screws and keep cable connected.

The used cables and glands + screws tightening must comply with the IP 67 preservation.
The unit can be wall mounted or attached to the pipe but its small size and shape permit to mount it directly on a DIN rail inside an electrical enclosure.

237 mm

108 mm

79 mm

| Weight =1.5 kg |
| Mat. = Alum. |
| Paint. = Epoxy |

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

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

N.B: MiniSonic is normally supplied from a low voltage AC or DC source (24 V DC).

To supply it from Mains, you can use an external module as a AC transformer (110 or 230 V / 18 V) or a AC/DC=24V converter that is installed nearby the MiniSonic.

It also possible to order the MiniSonic with our GP01 AC/DC converter already installed.

® **Version Ex d ATEX (Ex d IIC T6) – IP 67 : See also NT 219B**

- Each touch of the keypad has the same function as above.
- The two glands near the front are reserved for probe cable(s). When only one is used, please keep he other one closed and tight.
- To do the internal wiring on MiniSonic, it is necessary to remove the front of the MiniSonic board with its support. Remove the 3 screws which fix the front panel.
- The EMC is improved when cable screens or shields are earthen to the enclosure inside the glands.
- After the internal connections are finished, earth the MiniSonic board support with the green / yellow cable at the rear.
- The Enclosure itself must be earthen.
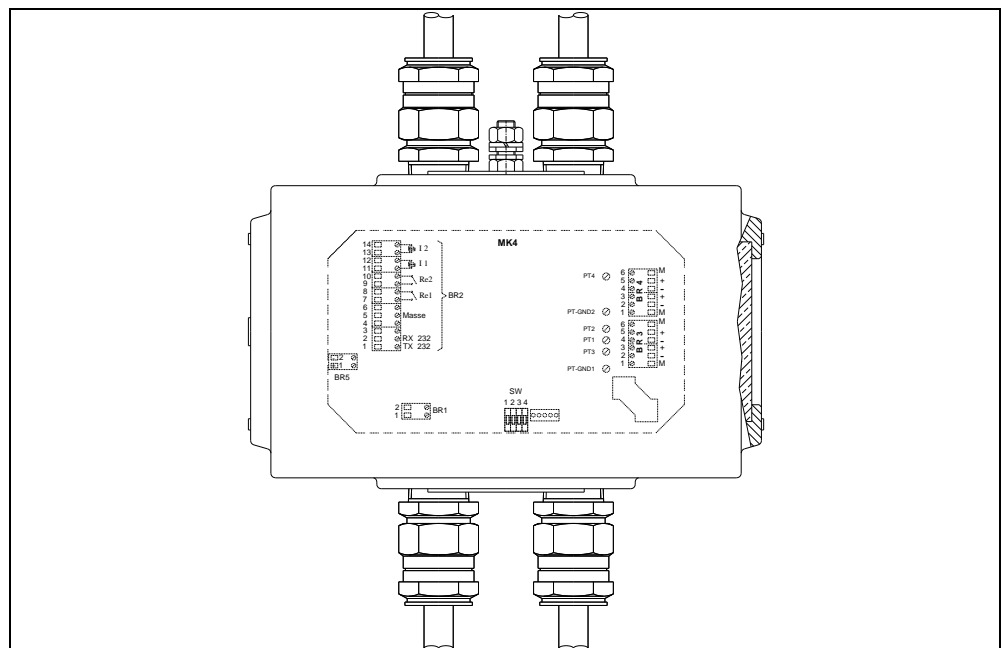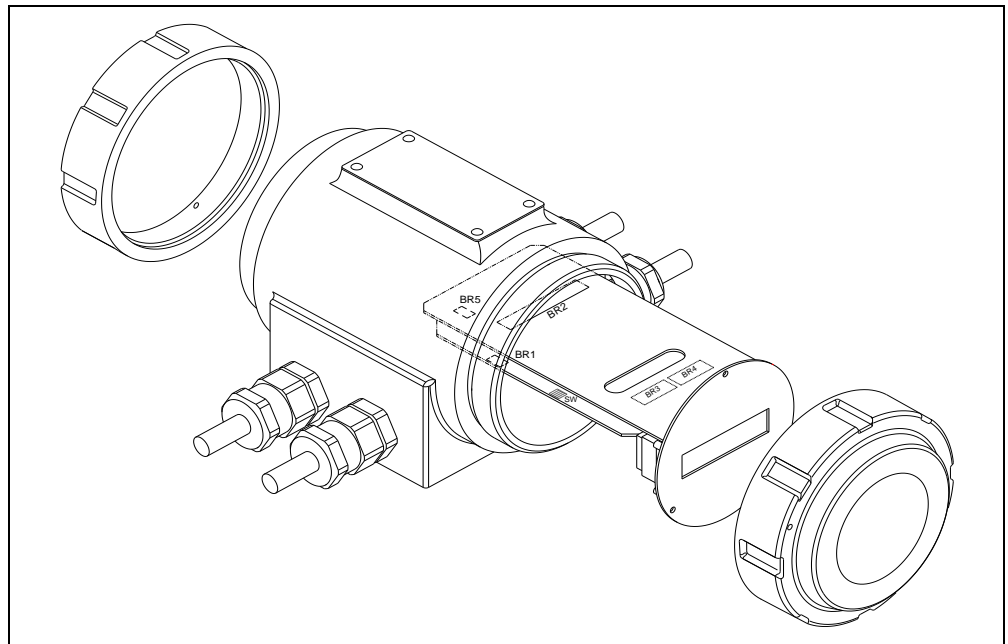
4 – WIRING DIAGRAM FOR MINISONIC ISD & PSD : (Low Voltage Supply).
If the GP 01 module for 90 to 230 V AC supply is installed, see also NT 218

® The internal cables must be kept as short as possible. The cable connections must use the adjacent gland.

® For the Ex d version, the board is inverted (access is from underneath).

® The removable connectors are useful for wiring and maintenance purposes.
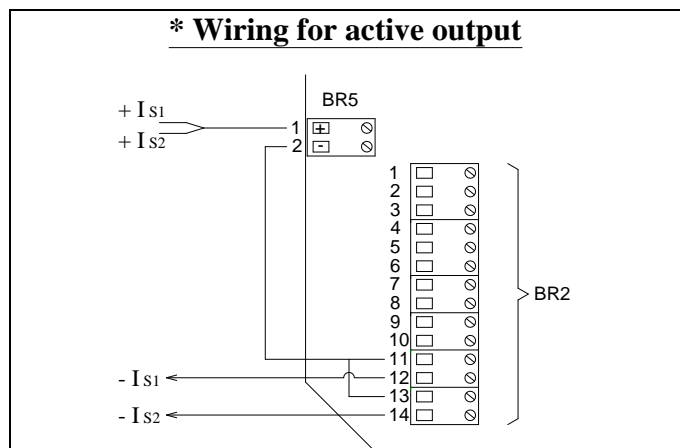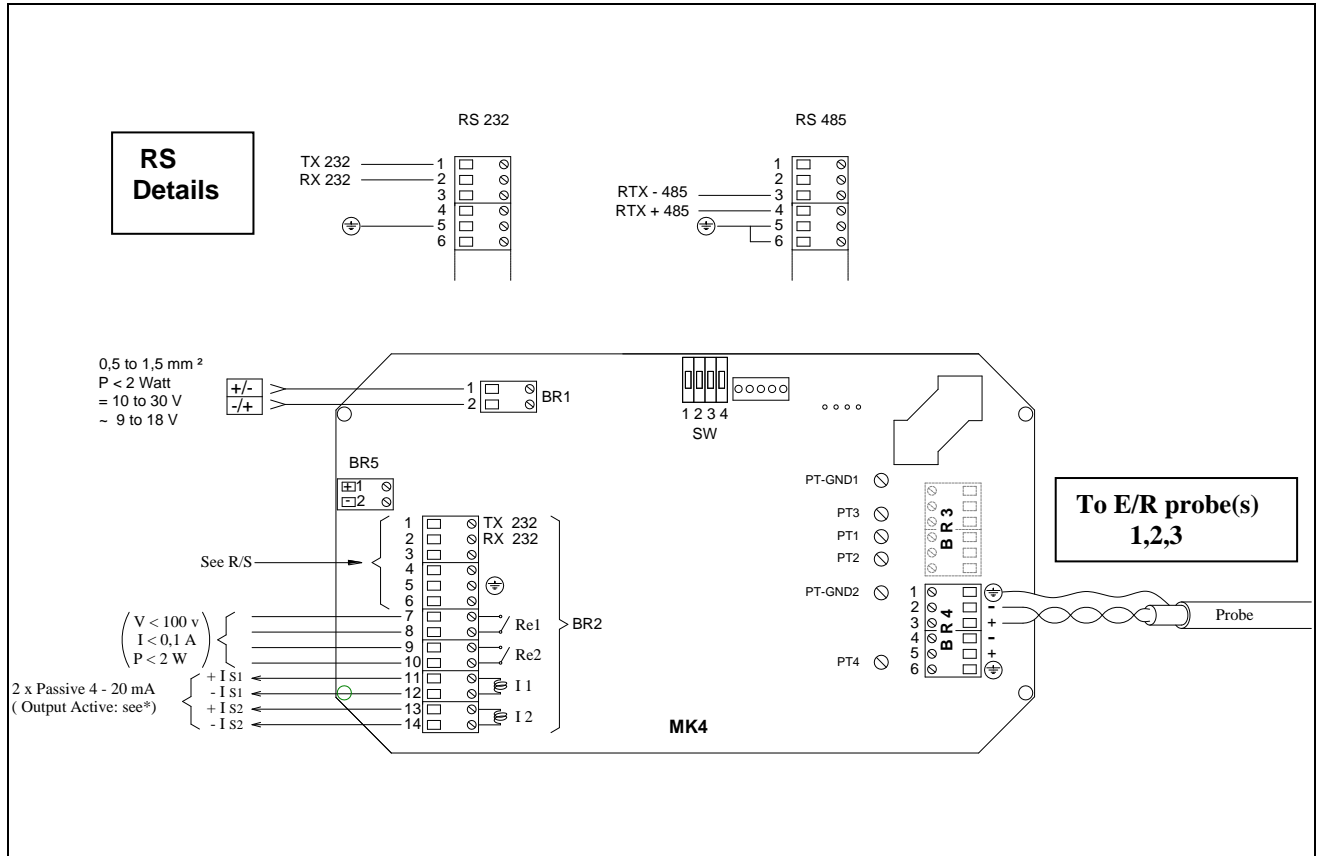
Ex d Version : How to prepare cables to probe cable
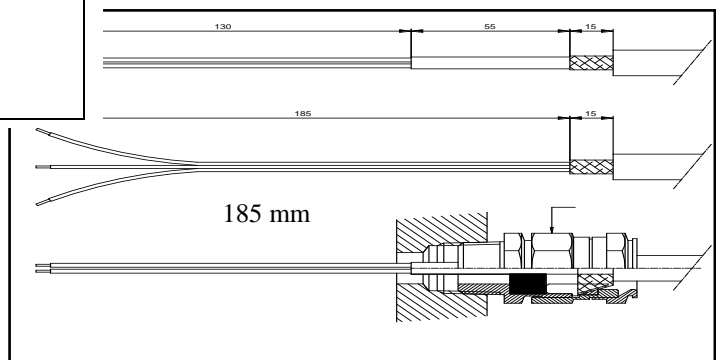
5 - <u>CONVERTER ASSEMBLY</u>

® <u>**Mechanical fittings**</u>
> Use a location that offers preferential conditions for easy access and vision.
> Avoid mounting on supports exposed to vibration.
> Avoid extreme weather conditions and direct exposure to the sun.
> Wall fitting is done by two M5 screws for industrial enclosures, or by using our support
   and fixing on a 2 '' vertical tube with our Ex d version.

® <u>**Electrical connections**</u>: Refer to the diagram on the previous page.

> <u>Power supply</u>: Connectors BR 1 – Use flexible cables with section 0.5 to 1.5 mm2.
  - The recommended source is DC, 10 to 30 Volts (60 V on option): 12 / 24 (48).
  - Any polarity will do. The required power is less than 2 Watt.
    The source may also be A.C. (9 to 18 Volts – 50/60 Hz) via a transformer.

> <u>RS 232 or 485</u> digital outputs: BR 2 , terminals 1 to 6 .
  - Cable PC-DB9 uses RS 232 with Tx on 2, Rx on 3 and 0 Volt on 5.
  - For a permanent link (logic controller, modem …) :
    . For RS 485 : connect Rx – to terminal 3 and Tx + to terminal 4
    . For RS 232 : connect Tx to terminal 1 and Rx to terminal 2 with common to 5 .
    . No need of other connection to validate RS 232. Connect terminals 5 to 6 to validate
      RS 485.

>- <u>On/Off outputs - Relays</u> (Static): BR 2, terminals 7 to 10 – multi-pair cables
  - Comply with the limits V < 100 V ; I < 0.1 A ; R ON = 10 Ohm.
  - Each relay Re 1 (terminals 7 & 8) or Re 2 (terminals 9 & 10) will transmit the chosen
    status information in the "General Parameters" menu.

> <u>4 – 20 mA</u> analog outputs: BR 2, terminals 11 to 14 – Multi-pair cables.
    - These are independent outputs, **galvanically insulated** in respect to each other, but
    also with respect to the other MiniSonic circuits and by default are **passive** and need
    to be connected to a receiver supplying the power (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
    magnitudes and ranges of variation as chosen in the "General Settings" menu
    concerning Speed of Sound (output N° 1) and Gain (output N° 2) .
    - It is possible to carry out internal wiring to allow **active** outputs by associating the
    terminal block BR 5 (see diagram) already linked to power supply voltage connected to
    BR1, but with the drawback of losing part of the galvanic insulation.
       ! With a 12 V DC or AC supply, R "loop" is limited to 150 or 200 Ohms.
       Attention! If this R loop is too high for the supply, the curent fall down to 4 mA

> <u>Connection to probe(s)</u>: BR 4.
   BR 3 is normally not mounted and reserved to dual-channel MiniSonic versions
  - Use Twin-ax cables (ET1217 & ET1217A) specified by Ultraflux.
  - For standard applications, only one cable is used. Connect it to terminals 1, 2, 3.
  - To connect a triaxial cable, connect Ext. screen to 1, Int. shield to 2 and wire to 1
  - Terminals 4, 5, 6 are reserved for a second probe to be mounted at the opposite of the
     first one. They do a single barrier (only one ultrasonic travel) for difficult conditions
  - In the EXD version, the shields are stopped and connected in the stuffing boxes and
     the conductors will be approximately 15 cm long up to the terminal blocks.

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

The MiniSonic ISD & PSD 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, <u>refer to the probe data sheet</u> of the model used .

® <u>The installation</u> of the probe(s) <u>doesn't require any straight length</u> upstream or downstream and is not sensitive to flow profiles. Only avoid to place probe on a bend or too near a pipe welding

® Similarly, to avoid the nuisance of deposits or accumulation of gas, planes close to vertical (+/- 30°) will be avoided. A <u>horizontal plane or a 45° plane is good</u> choices.

® We usually promote **external probes** to be <u>clamped on the pipe</u>. They normally are suitable for all petroleum liquid products to be delivered by pumping through pipelines. Only primary choice with our sales department or agent must be concerning probe frequency (small pipe and not viscous product > higher frequency is better) and sometimes to decide if two probes mounted as a barrier would be better (large pipe and very viscous oil) . By default we use F = 1 MHz.

Particular attention will be paid to cleaning the pipe at the probe(s) location. Remove all old paints.
The probe body has no contact with internal wires. It should preserve pipe-line cathodic protection. Anyway, control insulation and insure it will be preserved.

A first test or provisional installation can be done with gel or grease coupling.
When location is validated , install probe support (if any) and do definitive coupling by placing our solid tape with some grease on both sides between probe face and pipe and tight all together by screwing strap attach or support plate .

When there are two probes to do a barrier, please check first their correct lining.

® For <u>Pig Detection in Gas pipelines</u>, we recommend to install **insertion transducers**, flanged type or to be installed by hot tapping.
Apart the safety conditions to be respected during installation, the highest attention must be put to have probe support perfectly perpendicular to the pipe at its location point.
The second attention is to don't have the probe face penetrating inside the pipe to prevent any damage from the pig passages.

7 - COMMISSIONING AND PARAMETERING OF MINISONIC ISD & PSD

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

> The MiniSonic must display its home screens:
  - Hardware version = MiniSonic ISD or PSD
  - Firmware version =<u>10</u>.01 -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 (C= …+ Sphere counter)

> Check the consistency of these messages with respect to your application.
  If the converter has been delivered pre-parameterized, startup can stop there.

> However, it is recommended you check and, if necessary, to optimize the adjustments, taking into consideration the exact pipe dimensions and, if possible actual petroleum product quality (density …) from a sample with pressure and temperature influences.

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.
> The software is the only way to edit sphere passage data logger.
> 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
- Probe parameters and amplification modes
- Pipe and product parameters
- Sphere or Pig parameters
- General parameters / Relays / Analog outputs
- Tests and simulations
- 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 -1 : " Measurement Display " menu:

Every time you return to this menu,
MiniSonic displays, after welcome messages
the first screen as selected from the Software,
which is normally the <u>sound velocity</u> for an **ISD**

Plus <u>warning messages</u> if any,
Or the <u>Sphere Counter</u> + <u>Last Sphere</u> for a **PSD**:

C (m/s) = xxxx.x **Seek echo , Fault**

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

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

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

▽ Physical measurement (time of flight T)
(only ISD version)

T = xxx.x µs

▽ Date and time
® Change by PC + Software

06/03/2004 **15 : 46 : 22**

▽ Last Sphere or Pig passage
And Sphere counter since last reset

02/03/2004   10 : 24 :43 **PIG = xxxxx**

▽ 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 ▽

       ® Enter a code:

Access Code = xxxx

! 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 : « Probe / Echo Settings » menu :

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

▽   Probe Frequency (MHz)
             (Choice = O.25 , 0.5 , 1 or 2)

Freq. = 1 MHz

▽   Dead Time To through probe face
             (Typical value = 4 to 6 microsec.)
             It includes time in coupling tape

To = xx.x Micro Sec

▽   Amplification Gain mode
             We recommend ESC mode
             Other options : **Auto** and Manual

Gain = ESC **(Auto / Manual)**

▽   If Auto : enter over amplification
             Recommended value = 12 to 16 dB

Margin = xx dB

▽   If Manual : enter Gain in dB

Gain = xx dB

8-4 : « Pipe & Product Settings » menu (Flowing Fluid)

▽   Pipe external diameter:
Compare it to API standards:
(6 "5/8 , 8" 5/8 , 10" ¾ , 12" ¾ , 14" ,16"…)

Ext. D = xxxx.x mm

▽   Pipe material:
Other choices: Stainless steel, PVC
Cast iron, copper, polyethylene…

Pipe = Steel

▽   Pipe thickness (mm):

To be measured accurately

Thickness = xx.x mm

▽   Fluid product Characteristics
as sound speed range :

This range is Co + / - Delta C

Co can be set from 200 to 2000 m/s
Delta C can be set up to 500 m/s

Co = xxxx m/s

Delta C = xxx m/s

> *Enter it wider than typical values at 15 °C / 1 bar to take in accounts P & T effects.*
These values will determine the window width which valid ultrasonic signals.
Thus a Delta C increased of 50 or 100 m/s would prevent risks.

> *Please refer to typical values as given under header 1-2 or those from your typical application and product range.*

8-5 : « Sphere / Pig parameters settings » menu :

The validation of a sphere or a pig depends on the echo loss duration.

The MiniSonic-ISD or PSD calculates this duration min. / max limits from the Pig Length (if only Spheres, then L = Pipe I.D.) and from the flow velocity. Correct data range must be entered as follows.

Choice of the data to calculate velocity

V = flow velocity (then m/s entry)
Q = flow value (then m³ / h entry)

V sphere / Q sphere

Entry of V min or Q min:

Min speed sphere = xx.x m/s **(Q min sphere = xxxx m3/h)**

Entry of V max. or Q max.:

Max speed sphere = xx.x m/s **(Q max sphere = xxxx m3/h)**

Shorter length for Pigs (Spheres):

L min sphere = xxxx.x mm

Longer dimension of Pigs (Spheres):

L max sphere = xxxx.x mm

8-6 : « General settings & Relays / Outputs » 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.
Memorising time (if IQ < 33%) =
(mode ESC : enter Mém. = > 20)

> **Mémory (s)= ✴✴**

🔽 Setting of Relays 1 & 2
Alarm C +/- set two thresholds on C
Relays switch **On** *at set point and*
Release after an Hysteresis of 2%

> **Relay 1 = Sphere**
> **(closed , open , fault , alarm…)**

> **Relay 2 = Fault**
> **(sphere , alarm – C , alarm +C)**

! Current outputs are available only
on MiniSonic-ISD

🔽 Settings of current output 1
Current output is reserved to the
Interface detection information
Set in relation with density range

> **O.C.1**
> **C 4 mA = xxxx.x m/s**

> **O.C.1**
> **C 20 mA = xxxx.x m/s**

🔽 Settings of current output 2
Current output 2 can copy the
Ultrasonic signal result (Gain=Auto)
It gives information on mixtures as
it flows in a drainage tube .

> **O.C.2**
> **Gain 4 mA = xx dB**

> **O.C.2**
> **Gain 20 mA = XX dB**

🔽 RS 232 / 485 Jbus Slave Nbr
By Default, our Software asks 1
(Possibility up to 255 – Zero= none)

> **N. JBUS = 1**

🔽 RS 232 / 485 Baud Rate
(300, 600, 1200, 2400, 4800)

> **BAUD = 9600**

8-7 : « **I / O Test** » **menu** : simulation on outputs and relays .

! Test on current output is only available on MiniSonic-ISD

▽ 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**

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

It permits adjustment of coefficients
for min / max range to 4 / 20mA
conversion.

> **4 mA (1 & 2) = xxxx**

> **20mA (1 & 2) = xxxx**

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

8-9 : Complementary Adjustments to be done by PC / Software only :

The recommended status or values are entered by Ultraflux before delivery.
But, it could be necessary to modify some for site adaptation. As so:

Rest status of the relays: we deliver them in normal configuration that corresponds to a
positive logic:
No supply: relays are opened
All OK > fault relay is closed
Sphere passage > relay closes during 5 seconds
Sound speed below threshold > relay closed

First LCD screen: in place of sound speed or sphere counter , it is allowed to display
Amplification Gain + I.Q. or Date and Time .

It is allowed to give a name to the unit : Pipe-line direction ; FIT …

Period Tx: a delay time before a new cycle can be entered , this to avoid to trig on an
multiple echo from the previous cycle . Such a delay is not necessary in PSD application .

CAG time: with the entered value , it is possible to hurry or slow down the automatic gain
control reaction . Number 10 means that every 10 measuring cycles an E / R is done to
actualise the new gain. In PSD application, it should be better to enter 30, this to limit the
gain reaction during a long Pig passage.

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.

Each value or text field is filled in by Ultraflux 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 Product / Fluid range to obtain a reliable measurement to be transmitted according to the instructions entered into the "General" menu.

The data to be entered for Sphere / Pig Detection are very dependent from site conditions: What kind of Pigs? What flow range …Wrong data can lead MiniSonic to don't valid an echo loss as a sphere or a pig.

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 , check the other values:

- The echo or gain level compared to typical values.
  - For external probes, a gain exceeding 50 dB reveals certain difficulties such as the wrong choice of probes, incomplete installation or coupling, rusted pipe, absorbent fluid …
  - For intrusive probes (gas), the gain level depends on gas pressure.

  The ESC mode can decide a high gain margin. Take in account it in your diagnosis. ESC mode can be used first to automatically set Auto Gain values.

- The quality index I.D. 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 (oscilloscope).

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

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

- Poor control of the installed dimensions, or of the product characterisation

  Correct and reanalyse

  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 typical margin ($\sim$ 12 to 15 dB)

- The expected measurement requires greater precision :

  The MiniSonic-ISD cannot be considered as an exact density meter.
  It has an excellent repeatability, but calculated density presents some divergence on some petroleum products with additive or between products which don't belong to the same category (Example: water and crude oil).

> 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.

  If the fault persists, contact Ultraflux (Problem with the microprocessor).
  If the fault disappears, it may come back and could be due to excessively high impedance in the supply source.

- If the MiniSonic displays "Fault" or "Seek Echo" , this message does not mean that the MiniSonic has failed, but that the ultrasonic signal don't exist or don't have reached the expected level or is outside the window [Co +/- Delta C]. There are several possibilities :

  Pipe is empty?
  Problem of site?: Two-phase fluid or too highly charged or too viscous ?
  Too old and corroded pipe, that doesn't transmit ultrasonic signals at the chosen frequency?
  Unsuitable installation mode = try Direct mode (\) with two facing probes, or try other sensors with a lower frequency.
  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 test points for the purpose:

  From low to high referring to wiring diagram   § 4:

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

- Or a MiniSonic ISD-P portable device.

- Or measuring instruments for dimensional (Our DigiSonic portable flowmeter with thickness gauge option)

- Or alignment measurement tools

<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: EXAMPLE OF SETTING FILE FOR A 12 " ¾ PIPE

Settings - C:\...lux\LslsdW 10\Data\CONF. MODEL.eta (05/04/2004 - 09:37:41)

General

N. JBus	= 1	1st screen	= Sp. Sound
Language	= English	Back light =	On
Filter	= 1 Cycle		
Memory	= 30 Cycle		

Unit Name

Line 1	= PIPE LINE 12"	Function	= Measure
Line 2	=		
Firmware	= 10-11-		

Probe

Probe Freq.	=	1 MHz
Dead time	=	5.0 µs
TX/RX Mode	=	Tx U. Rx U.
Polarity	=	Reverse
Stop meas. on	= Zero Crossing	
Type of Gain	=	E.S.C.
Margin	=	15 dB
Max Gain	=	60 dB
US Impulse	=	1
CAG Time	=	10 Cycle
Period TX	=	1000 µs

Pipe - Product

Ext. Diameter	= 323.9 mm	C0	= 1300 m/s	
Material	= Steel	Delta C	= 300 m/s	
Thickness	= 9.5 mm			

Sphere

Choice	= Velocity	
Min Velocity Sphere	=	0.250 m/s
Max Velocity Sphere	=	3.000 m/s
Min Length Sphere	=	250.0 mm
Max Length Sphere	=	400.0 mm

Outputs

Relay 1	Relay 2	Analog Output 1	Analog Output 2
Type = Fault Q	Type = Sphere	C 4mA = 1060.0 m/s	Gain 4mA = 20 dB
Direction = Normal	Direction = Normal	C 20mA = 1560.0 m/s	Gain 20mA = 60 dB