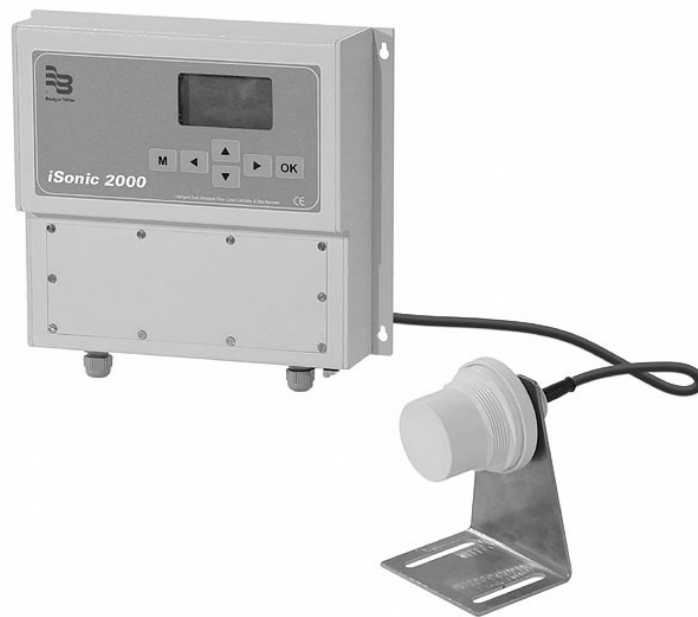® **Badger Meter Europa GmbH**

iSonic 2000

Intelligent ultrasonic meter and controller

PC Interface

October 2005 (Applicable to iSonic PC Software Version 2.0.0)

UF_iSonic2000_PC-Schnittstelle_0704_e.doc

1. Introduction

The PC interface for the iSonic ultrasonic level and flow meter is a custom written software package able to run on any PC Windows platform. The interface provides for:

Creation of configuration files for multiple iSonic units

Creation of Template Configuration Files that can be re-used to create new configurations for units

Communication with iSonic units, either directly via serial port or via dial-up link. The communication allows for remote configuration and data retrieval.

Easy data storage, management and inspection

Event data viewing, printing

Advanced graphical data representation and manipulation

Data export functionality to other PC software

Live data tracking

The interface is multi-lingual; users can select English, Afrikaans, Spanish, French or German. The entire interface, including data file representation, can be language changed whilst the program is executing.

All configuration, event and data log information can be printed from this interface; the program performs special print formatting for each type of file.

A multi-document interface is used as user interface, this means that multiple data files can be inspected and manipulated simultaneously. The interface allows for multiple window tiling, cascading, all the standard windows functions.

2. Screen basics

When the program starts, the first look the user gets is as follows:
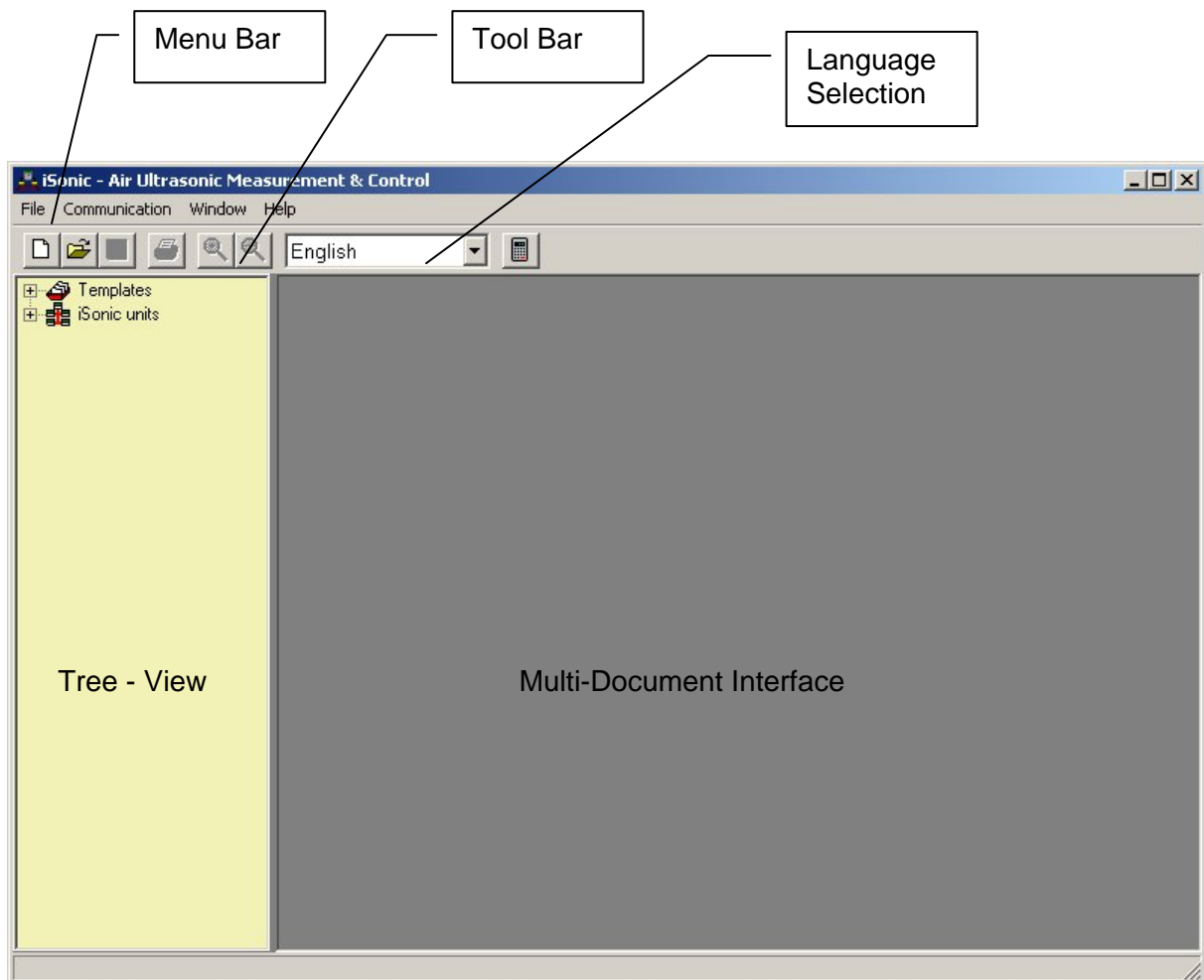
A menu bar runs across the top section of the program, here the user can reach most of the functions that can be performed. The toolbar just below it makes accessing certain standard functions easier.

The empty area that dominates the picture is the multi-document interface area that is used to show configuration information, data and event files. When the program starts up, the multi-document area is empty since there are no open files, except if the program was started from the Windows Explorer by selecting a file registered to be one of the iSonic file types (*.ibl, *.lrm, *.cfg).

The Language drop-down box allows for other language selections. Currently the program allows for "English", "Afrikaans", "Español", "Français" and "Deutsch". Changing the language selection causes the interface to instantaneously change to the selected language.

The yellow area on the left hand side is called the tree-view area, in it the user can explore what data was stored, create new units, perform new configurations, and other things. The tree-view interface works similarly to the Windows Explorer interface, double-clicking on any item with the boxed plus sign in front of it, will expand that particular branch, click on any other item in the list and the relevant file will open.

The following icon's are used in the tree-view operation:

✔ Blue Tick mark, signifying that particular file is open in the multi-document interface.

👆 Hand icon, this file is currently active on the multi-document interface.

✗ This particular file is a configuration file

▣ This icon signifies the start of a unit's branch, in it is the configuration file and all the event and data files.

▤ Event file icon, which is a text based file

▦ This icon signifies a data file, which can be graphically represented

A screen shot after some of the branches have been opened up:
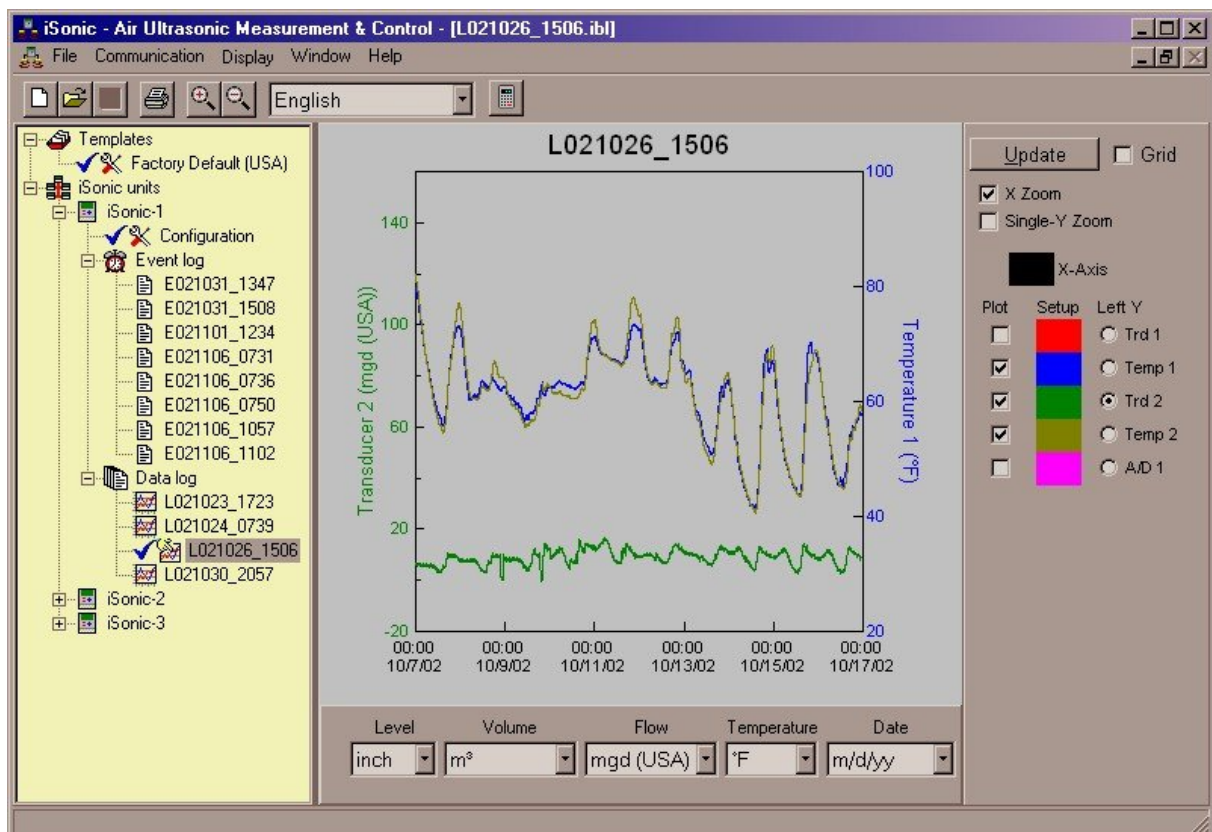
The program's caption will always display the currently open file name.

In the previous picture the user has "Drilled Down" to a data log from "iSonic-1", there are in total 3 files open: a template file (Factory Default (USA), a configuration file (iSonic-1), and a data file which is the active file.

The Templates are provided to make configuration of a new unit easier. Once a new unit has been created, simply 'drag-n-drop' the proper configuration from the templates to the new unit.
At a later stage, once a unit's configuration has been adjusted properly, it is possible to create a new template from this units configuration. To do this, select the units configuration file and click on "File"-> "Save As".

It is also possible to "Import" a configuration file from another source, for instance when transferring a configuration from another PC. To do this, use the "Import Configuration" option. A unit will be created using the name of the imported configuration file.

The multi-document allows the user to view multiple data at the same time, as shown below:
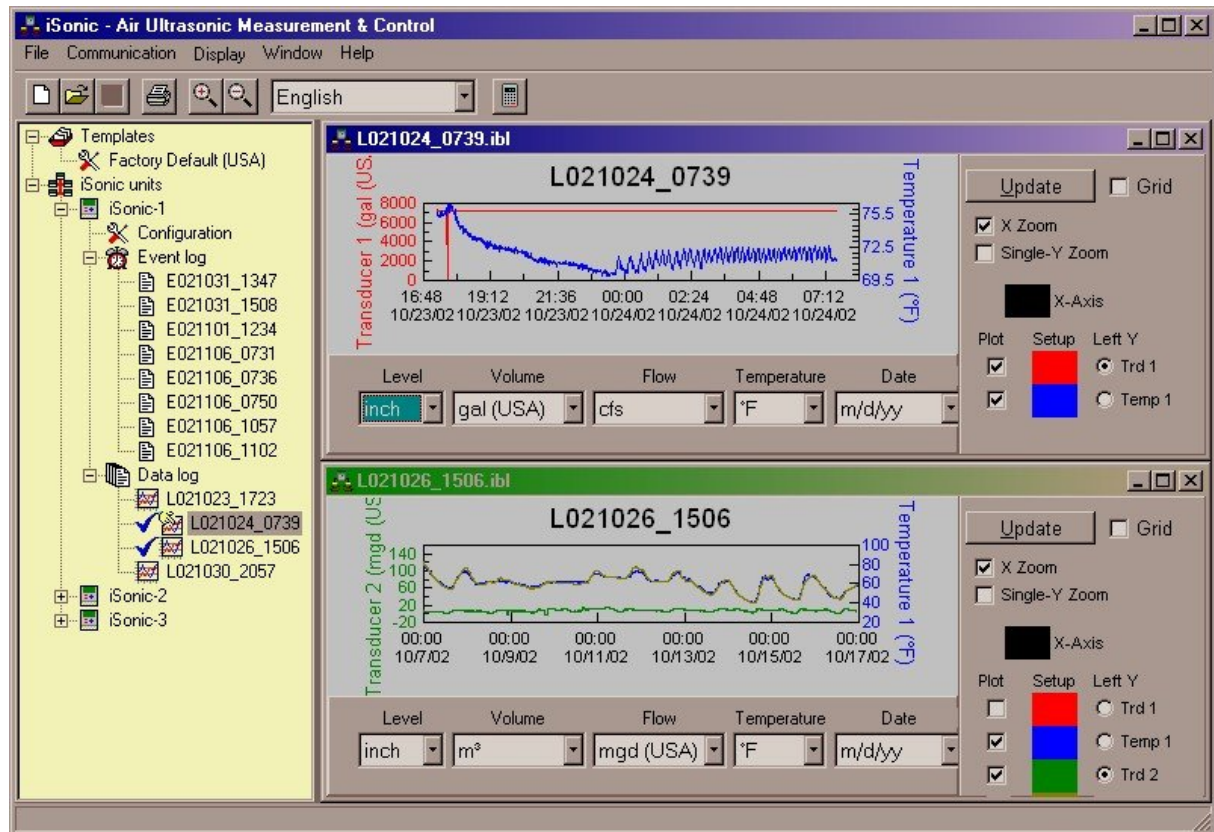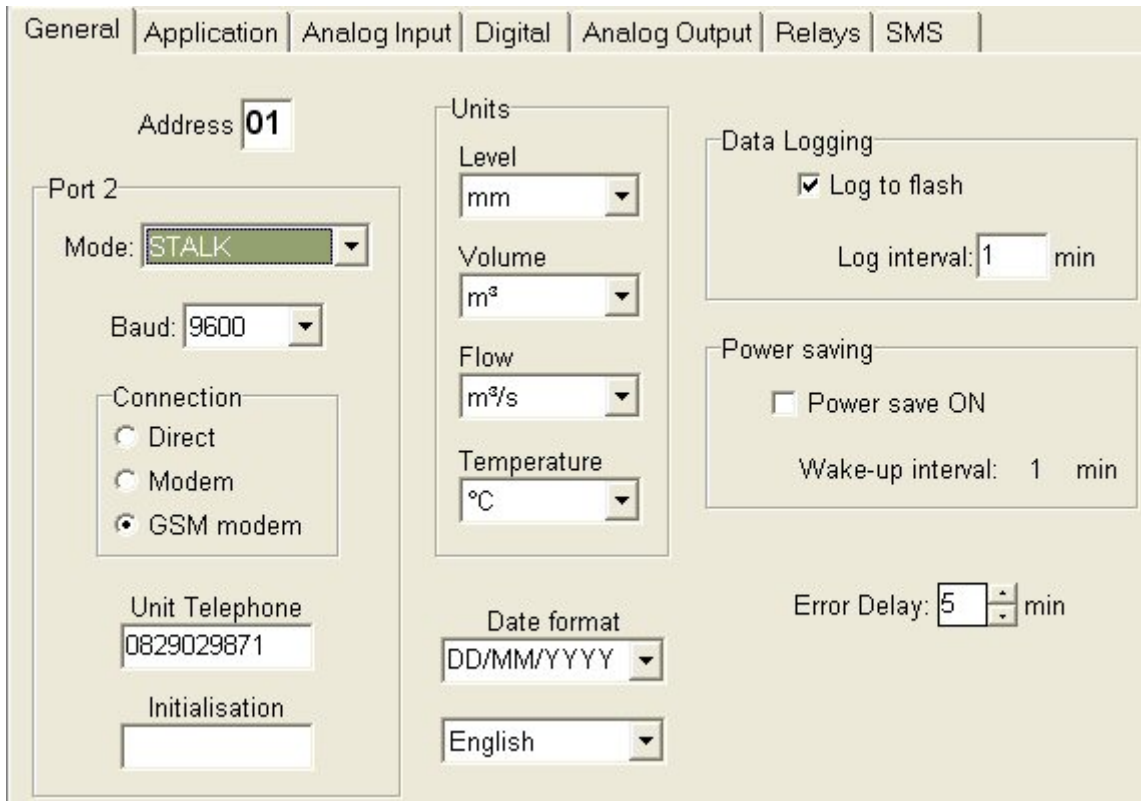

Via the "Window" menu pull-down, files can be Cascaded, Horizontally or Vertically Tiled. Alternatively, the user can arrange the windows manually to suit the situation.

3. General configuration

When clicking on a configuration file of a unit, the following screen is presented:

This screen is the first of six configuration screens that together make up the entire configuration of a unit. By selecting General, Application, Analog, Digital, Relays and SMS, the user can select different parts of the configuration information.

The "General" area shows:

- **"Address";** this address is used in communication when the unit is coupled onto an RS485 network.

- **"Port2";** configures how the data reporting port is configured. The STALK selection is the proprietary protocol which can be used over RS232 / RS485 or via a MODEM. This protocol allows live data and status requests, data log retrieval and even unit configuration changes. The "TEXT" selection results in the unit reporting the measured data every second, this can then be easily interfaced with a data capturing application. The connection radio buttons, mark whether the connection on Port2 is a direct connection or via a line or GSM MODEM. The iSonic will initialise the MODEM automatically, handle the connect sequence and, once connected, will apply the selected communications mode (STALK or TEXT). The software can handle standard AT compatible modems but also GSM modems. If a PIN is required for the latter, then this can be configured in the SMS screen.

- **"Unit Telephone";** used for communications to/from the unit via a telephone connection. This number is used when a telephonic connection (Select "MODEM") is made to an iSonic unit.

- **"Initialisation";** is used on the iSonic side, in it extra configuration commands for the MODEM can be specified. These commands are the standard AT command set and they must be separated by the '|' sign in case of multiple commands.

- **"Units";** here the user can configure the iSonic unit which units to use for Level, Volume, Flow & Temperature measurements.
  The iSonic supports:
    o Temperature: C°, F°
    o Level: mm, m, inch, ft
    o Volume: m^3, l, acft (Acre Feet), gal(USA), gal(UK), bbl (Barrel)
    o Flow: m^3/s, m^3/d, l/s, cfs, Mgd(USA), gpm(USA), Mgd(UK), gpm(UK)

- **"Date Format";** the date format used for display purposes

- **"Language";** available languages are English, French and Spanish. This selects the interface language on the LCD of the iSonic unit.

- **"Data Logging";** data logging operations on the unit can be enabled here, the logging interval can be set in 1 to 255 minutes resolution. Please note that the event logging occurs asynchronously from this interval, entries into the event log are made whenever a relevant event occurs. The instrument has provision for 1000 event entries and 46080 data log entries. When the data log interval is set for 1 minute, enough space is available for 32 days worth of data. Setting the interval to a lower value, results in a longer duration data log. For instance when setting the interval to 5 minutes, there will be space for roughly 5 months worth of data.

- **"Power Saving";** selects low power operation, a unit can go into sleep mode and wake up every interval to perform measurements and put them into the data-log. If power saving is selected, the data-logging operation is automatically enabled, the data-logging interval also sets the power wake-up interval.

- **"Error Delay";** is the duration of time whereby the unit keeps a last known good measurement value. If no sensible echo information can be found, the last known good value is maintained until this time lapses. After this timeout, the error current is applied on the analogue outputs.
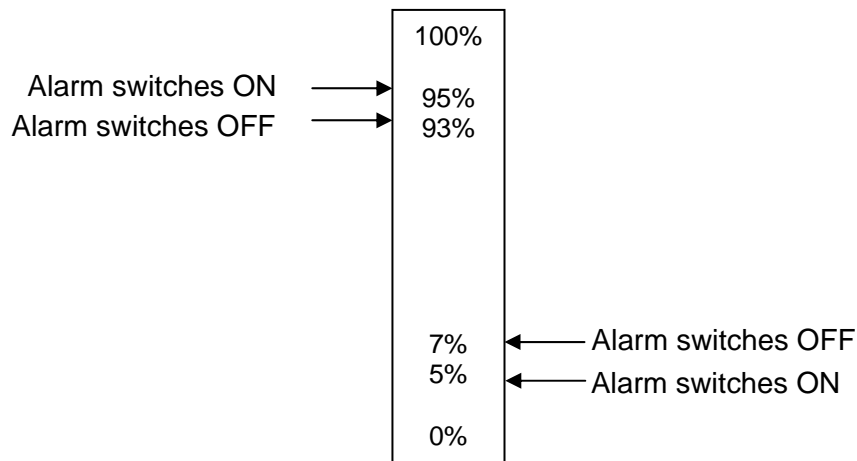
4. Application configuration

Here each transducer's application is configured. The "Enabled" tick-box enables or disables the specific transducer's operation. The "Application" area shows:

- **"Name:";** from iSonic Version 2.0.0 onwards, it is possible to name the Inputs and ouputs of the iSonic. Users can customise Sensor, Digital input, Relay and Analog output names; each of these pages on the configuration dialog now has a field "Name". Although customisation can only be done from the PC interface, the customised names are displayed and used in GSM communications by the iSonic. Names are limited to maximum 15 characters, but some of the controller screens will truncate them to shorter strings. Some special characters are not available in the GSM character set we use (GSM 03.38) and will be converted to a standard ASCII character (e.g. ó and ô to o) for GSM messages.

- **"Model:";** this sets the transducer type that is connected to the first transducer connections of the iSonic. Three standard types are defined; 20, 34 and 52kHz. In addition, non-standard transducer types can be defined by selecting "other". With this selection, the "Frequency" box is enabled for editing and the relevant frequency can be entered.

- **"Type:"**; indicates the application that is measured, this can be Level, Volume, Flow, Function, or Speed of Sound. The tabbed interface situated in the middle of this configuration screen, changes in response to a selection made in the "Type" box. The 'Function' entry marks the fact that the user wants to make use of both transducers to perform a combined measurement. The Speed of Sound type is used when a non-standard environment has to be measured, a special compensation transducer is then used on the transducer two connection.

- **"Function:";** is only enabled when the user has selected "Function" in the "Type" box. Here the combined operation can be selected which can be Add, Subtract, Average or Differential Flow. For more details on this configuration, which can be confusing to set-up, please refer to Appendix 1, "Dual Functions".

- **"Alarm:";** can be enabled or disabled. The "Set at PV above" and "Set at PV below", refer to percentages of the Processed Value. For "above", the alarm will go off at or above the entered value, only to stop once the hysteresis value has been passed. The same goes for the "below" entry. In the below example the alarm is set for 95% and 5% with a hysteresis of 2%:

```
                                        ┌──────────┐
                                        │  100%    │
                                        │          │
     Alarm switches ON   ──────────────►│  95%     │
     Alarm switches OFF  ──────────────►│  93%     │
                                        │          │
                                        │          │
                                        │          │
                                        │  7%  ◄───│─── Alarm switches OFF
                                        │  5%  ◄───│─── Alarm switches ON
                                        │          │
                                        │  0%      │
                                        └──────────┘
```

In the above, the alarm will go off at a Process Value of 95% and will only stop once the PV drops down to 93% again. On the bottom end, the alarm goes off at a Process Value of 5% and will only stop once the PV rises to 7% again.

Please note that 0% and 100% corresponds respectively to the Minimum and Maximum as set in Level, Volume or Flow. This also implies that 0% might be a larger process value than 100%.

When clicking on the "Echo Processing" button, the following settings are shown:
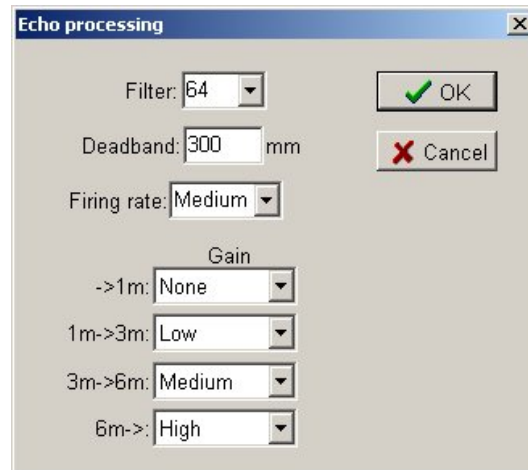
- **"Filter:";** this configures the averaging that takes place for this transducer. Available entries are; None, 16, 32, 64 and 128. If fast changing targets need to be tracked, care should be taken to select a lower averaging number. For greater stability, a higher average can be chosen.

- **"Deadband:";** configures the size of the area in front of the transducer which should not be measured. Different transducer types have different deadzone areas, in addition to this the user might want to configure an area that should not be measured.

- **"Firing Rate";** sets the repeat rate of the transducer transmit pulses. This setting can be Fast, Medium or Slow. This setting can be used to either make the system react to very rapid changes or, in combination with the Filter setting, ensure an even longer stabilisation period.

- **"Gain";** this section allows the user to customise the installation even further. It allows a gain profile to be set over the total span of the measurement. If for instance a difficult target is measured, then high gain can be selected. Inside tanks, because of the enclosed space, a "No gain" setting is more often than not the best solution.

The central area of the configuration screen shows Level, Volume or Flow, depending on what "Type" was selected by the user.

For application selection:

- **"Level",** enter the Process Values of the minimum and maximum to be measured values. The 'Min" and 'Max' values can be entered with values in any order.

- **"Volume",** the 'Min' and 'Max' describe the minimum and maximum measurement points. Click the button on this section to describe the vessel that has to be measured. The "Tank setup" screen appears:

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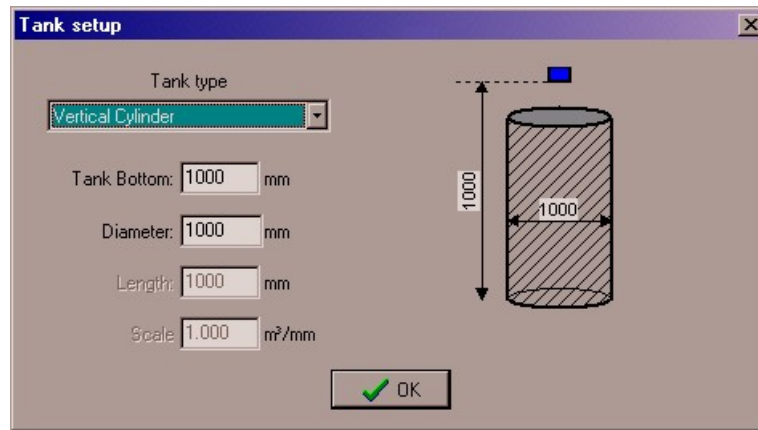
Here a description can be made to select what sort of volume is to be measured. In all cases volume will be calculated in the units selected under the general set-up.

Available selections for volume calculations are:
- Vertical Cylinder; here Tank Bottom describes how far away the bottom of the tank is from the face of the transducer. The diameter is the tank diameter. No other parameters are needed.
- Vertical Cylinder + Cone; as per vertical cylinder but this time a cone is added on the bottom end. An extra text box is made available which describes the length of the cone, the iSonic will perform the relevant calculations.
- Horizontal Cylinder; again Bottom and Diameter are available as parameters, this time an extra parameter called Length describes the length of the cylinder.
- Sphere; only Bottom and Diameter are available, describing a round tank.
- Scaled; allows easy entry of a calibrated tank. Often, in Oil and Chemical industries, tanks have been calibrated in Gallons per Inch or similar calibration values. Entering this value together with the Tank Bottom value is enough to describe the tank.
- Custom; this is a reference to a non-standard tank shape. In this case the user can use a table of entries, but the Tank Bottom is still required for calculating the head. After this selection has been made, the Custom table will automatically appear.

- **"Flow",** an entry similar in style to the volume entry, the following "Weir/Flume specification" screen appears:
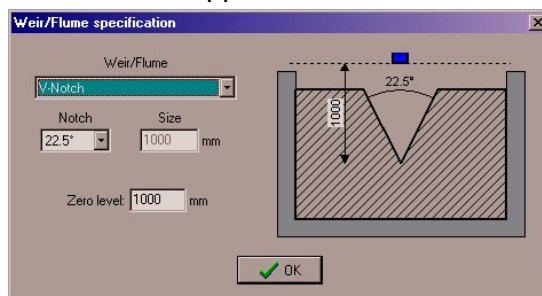

Here a description can be made what flow measurement construction is used. The available settings are:

- V-Notch weirs
- Rectangular weirs with end contractions ("Contr. Rect.")
- Rectangular weirs without end contractions ("Suppr. Rect.")
- Trapezoidal weirs ("Cipolletti")
- Parshall flumes ("Parshall")
- Leopold-Lagco flumes ("Leopold-Lagco")

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The last entry is "Custom"; here a non-standard flow can be described using up to 15 entries in a custom table.
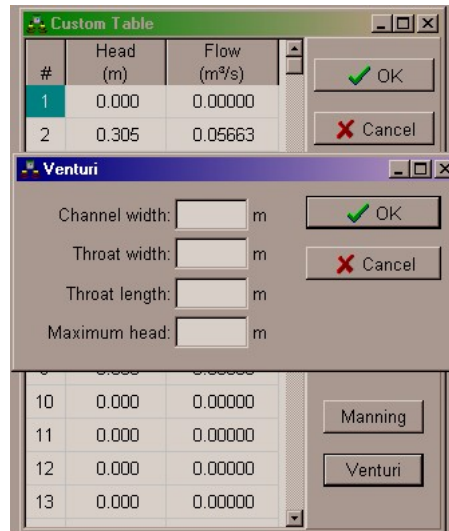

Special assist features are available here, in the form of buttons marked "Manning" and "Venturi". Use either of these two buttons to have the PC software fill in the custom table for these respective applications.

Please note that the "Manning" calculations are intended for partly filled round conduits, and that the roughness table is a guide only.

5. Analog input configuration

This configuration screen looks as follows:
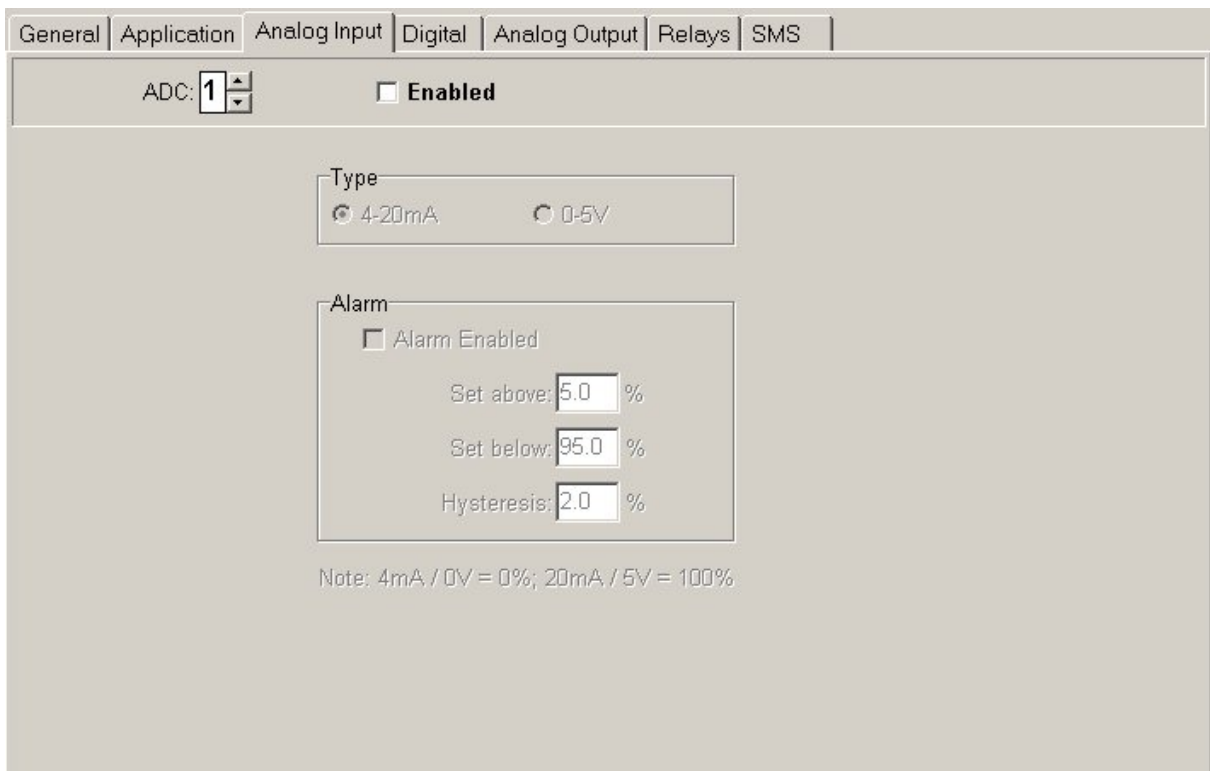
This screen allows the configuration of the two analogue inputs on the iSonic instrument.

The analogue inputs can be:
- Logged only
- Used as an alarm input
- Used as a control for a relays
- Used as a control for the Analogue Outputs

The "Enabled" tick-box marks whether the specific input has been enabled.
The "Type" can be used to specify the input type, either a 4-20mA current input or 0-5V voltage input.

The alarm works as all other alarms in the system, above a certain value or below a certain value the alarm will trigger. The hysteresis percentage sets the boundary width to ensure a stable alarm condition. In the above example the alarm would trigger at 95% and would stop again at 93%. Similarly at the bottom end of the input, the alarm will trigger at 5% or below and stop at 7%.

6. Digital configuration

The Digital Inputs can be used as "Trip Lines" for process control or as counter input from for instance a water meter or similar device.

If configured as a control input, the user can specify which relay is controlled by this input. If the input is active, the relay will switch off regardless of other process values.
The "Invert Logic" allows the configuration of negative logic, if set, the controlled relay will switch off when the input is inactive. Typical usage for the inputs in this configuration is an out-of-process alarm and disabling of the control.

If configured as a counter, the count is incremented for the duration of the set window and logged, at the beginning of each window period the count is set to zero. The "Scale" indicates what each count pulse means, if volume is set for cubic meters then in our example, each count is one cubic meter.

7. Analog output configuration

This configuration screen looks as follows:

This screen allows the configuration of the two analogue outputs on the iSonic instrument.

The analogue outputs of the instrument are always a 4-20mA signal. They can be set to either plain retransmit a scaled process/measured value or to perform a set point control (PID). The controlling channel can be set to Transducer 1, Transducer 2, A/D Converter 1 or A/D Converter 2.

As per usual the name of the Analog Ouput can be set in the "Name" field.

In the case of retransmit the current output of a channel is set by selecting a relevant range of process values or measured values (A measured value is the distance measured by the transducer, before the value is converted to a volume or flow).
The iSonic will interpolate the 4-20mA current output between the two selected percentage values.

The "Error Current" is output on the channel when the input process value has an error. (for example: lost echo)

In case of "Setpoint control" a PID regulation process kicks in action where the channel's output current is set in response to changes in the process value. The instrument will attempt to control the process in such a way that the required setpoint is always correct. The controlling action can be set to be "Direct" or "Reverse" indicating whether the response should be normal or inverse to the measured error. The PID values can all be individually set by the user to tune the process to the required response speed and stability. For more details on PID refer to a PID handbook or access the Internet, many useful tutorials are freely available.

The "Deadband" setting defines the area around the Setpoint where the output is kept constant. When regulating from outside the deadband the output is only made constant after the input has crossed the Setpoint. (Known as zero-crossing)

For instance, if the "Setpoint" is set for 30% and the "Deadband" is set for 1%, then the output will not change for process values between 31% - 29%. This deadband value can be made as small or as big as the process demands, it entirely depends on the required activity of the controlled device.

The above described "Setpoint control" section allows each output channel to control an individual output based on an individual input. In addition to this mode it is also possible to link both outputs to a single measured process. This is done by setting the "Interlocked" option. In this case the PID settings are taken from "DAC1".

This will result in both outputs being used to control a process, where the outputs mirror at the 4mA point. The entire regulation range can be graphically represented as follows:

```
                         Regulation
                         Range:
          ─────────────┬───────────
            20mA        │  100%
 Output 1              │
                       │
            4mA        ┼─  50%
            4mA        │
 Output 2              │
            20mA        │  0%
          ─────────────┴───────────
                       │
```

Meaning that Output 1 and Output 2 are mutually exclusive, if the PID response is in the 100% to 50% domain, then Output 1 is active and Output 2 is 4mA, if the response is in the 50% to 0% domain, then Output 1 is 4mA and Output2 is active.

As an example, if a flow has to be controlled by either taking away some water (Valve1) or by adding some water (Valve2) then this can be done by connecting each valve to an analogue output and by setting the "Interlocked" mode.
Assuming a start condition where both valves are closed (4mA), then the following will occur:

If the process value is set for 30% but is measured as 35% (flow rises) then in response the Output1 current will increase. The Output2 current will remain 4mA.
In process terms this means that Valve1 opens and Valve2 remains closed. If the flow returns to 30% then the valve openings will remain as they are.
For a decreasing flow, Valve1 / Output1 will initially close, if the flow continues to be too low, then Valve2 / Output 2 will start to open whilst Valve1 remains closed.

8. Relay configuration

This screen looks as follows:

There are four relays that can be controlled by this configuration screen, the fifth relay on the instrument is reserved as an alarm relay. Each relay can be controlled by one selectable process variable, each process variable can control multiple relays.

In addition to this there are two timing mechanisms available to drive each relay. The daily timer can be used to enable the relay for a set daily period only. The second timer is a periodic timer, which can be set to activate and de-activate for a set number of minutes.

A combination of time function and process value is possible, but please note that the timer function has priority. Between the two timer functions, the daily timer has priority. If used in combination with a sensor, the timer function can only de-activate and not activate a relay.

The digital inputs are listed on the screen and they have absolute priority, if a configured input is active then the relay stays off, no matter what.

The items on the screen are:

"Activated By", this is where the controlling variable is chosen. This can be the transducers or the analogue inputs, but the user can also select to use a timer only by selecting "none" as the activating control.

"Timer", can be disabled, daily and daily + periodic. To achieve a periodic timer without a daily time, simply ensure the daily time on and off values are identical.

"Sensor", defines at which values of the process variables the relays are switched.
The program clarifies the behaviour of the relay by representing it graphically:
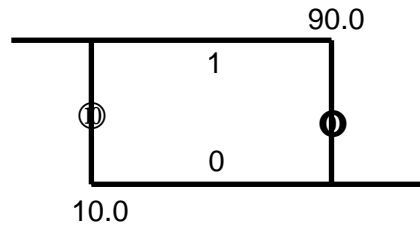
The bottom line is the "Off" state for the relay and the top line is the "On" state for the relay. The left hand upright defines the "On" cycle and the right hand upright represents the "Off cycle".
In the above case, the relay will switch on when the PV drops to 10% and will stay on until 90% PV is reached.

If the set up is inverted:
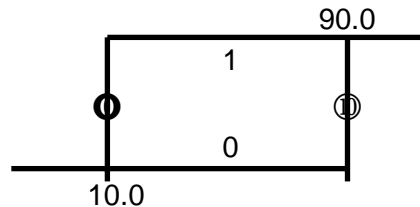
In this case, the relay will switch on when process value rises to meet 90% and will switch off again when the PV drops below 10%.

"Daily", defines the start and stop points for the daily timer. If these values are identical, the daily timer will not work, even if "Daily" is selected

"Digital Inputs as trip lines", lists for the users information which digital inputs have been configured to "trip" this relay.

"Pump Rotation", this allows a pump rotation option between a single set of relays. The relays that have been selected with the rotation option will automatically cycle to ensure even wear on the switched equipment. This option is especially useful when multiple pumps are used on a single tank/vessel, although the pumps can still be set to operate at different levels, each pump's usage will be cycled so that each pump gets the same average operational time. If digital inputs are used, when activated, they will remove the relevant pump from the queue (making maintenance on a single pump possible whilst continuing normal operation).

"Periodic", defines the time durations of the On and Off cycles of the periodic timer. These durations can be specified with a resolution of 0.01 minutes.

"Delay Before", defines the delay before a relay action should take place or after a relay action should stop. All relays (alarm and normal) can have an activation and a de-activation delay independently specified with seconds resolution (0-999s). The relay waits a specified time before reacting to a process state requesting (de-)activation. The relay reacts only if, after the wait period has elapsed, this state still exists. Delay of 0s = no delay. One can have e.g. activation delay of 10s and de-activation of 0s. An ON-delay of 0, with non-zero OFF-delay would emphasise spurious process states, and an OFF-delay of 0, with non-zero ON-delay would filter out spurious process states. Delays are only applicable when related to the process value; an alarm triggered by a digital input would not have a delay, and if a normal relay is only switched by timers, there's no delay either. If a periodic timer is linked to a process relay, the timer cycle would only start once the relay's activation delay has elapsed, ensuring the usual synchronisation with the process. An event file entry for an alarm is only made after the delay has elapsed, i.e. once the alarm relay is actually triggered. Factory default = 0s delays.

The instrument relay percentage settings are calculated according to the 0% and 100% settings of the channel that is measured.

The formula for calculating the measured percentage is as follows:

$$\frac{MeasuredValue - Val_{0\%}}{Val_{100\%} - Val_{0\%}}$$

Example 1:

Here the 0% value is smaller than the 100% value.
If the 0% value = 100mm
And the 100% value = 1000mm
And the measured distance = 300mm
Then:

$$\frac{300 - 100}{1000 - 100} = 0.222 \times 100\% = 22.2\%$$

Example 2:

Here the 0% value is bigger than the 100% value.
If the 0% value = 1000mm
And the 100% value = 100mm
And the measured distance = 300mm
Then:

$$\frac{300 - 1000}{100 - 1000} = 0.777 \times 100\% = 77.7\%$$

These percentages are also available on certain running screens of the unit.

A few examples for relay set-ups:

- A tank is filled with water from a borehole, and is discharged into a household. The rule is that the borehole pump should only run when the tank is emptied below 50% and also that the tank should never fill above 95%.
  In this case, set the ON percentage to 50% and the OFF percentage to 95%. As soon as the tank empties below 50%, the relay (pump) will activate and will only de-activate when the measured level/volume is above 95%.

- A stream empties into a holding tank for further distribution into a network, the network is only allowed to take water when enough supply is available (Tank above 50%), when the tank reaches a critical level (10%) a valve shuts off the outflow.
  In this case, set the ON percentage to 50% and the OFF percentage to 10%. The valve will open once the measured level/volume is above 50% and will only close once the process reaches 10% or less.

Other combinations of the above are also possible. With the Normally Open and Normally Closed contacts being available, other logical combinations can be made.

9. SMS configuration

| General | Application | Analog Input | Digital | Analog Output | Relays | SMS |

Events available for SMS messages

Station ID	☐ Inside measurement range	☐ Measured value above 4-20mA range
Rooiwal	☐ No valid echo	☐ Measured value below 4-20mA range
	☐ Echo before minimum range	☐ Event file cleared
Mobile phone #1	☐ Unit RESET	☐ Data log cleared
0834464336	☐ Flash formatted	☐ Factory default loaded
Mobile phone #2	☐ Run started	☐ Digital input de-activated relay
	☐ Run ABORTED	☑ Temperature sensor open circuit
Unit Telephone	☑ Calibrated	☐ Temperature sensor short circuited
0829029871	☐ Date/Time set	☑ No transducer
Initialisation	☐ Data log cleared	☐ Temperature sensor OK
	☐ Power failure	☐ Transducer OK
PIN	☐ Alarm reset	☐ On Battery power
	☐ High alarm	☐ Back on Mains power
	☐ Low alarm	☼ Restore Defaults

The iSonic unit contains software to drive a standard GSM modem. The GSM modem can be used for normal data traffic but can also be used to send SMS alarms and status messages.

- The Station ID is a text string that is used in the SMS message to identify where the message originates.
- Mobile Phone #1 and #2 are the numbers that unsolicited SMS's are sent to in case of an alarm condition. The user can select to only sent to one number by leaving the second number blank. The SMS's are only enabled if at least Mobile Phone #1 is entered.
- Unit Telephone and Initialisation are the same fields as displayed on the "General" configuration page. For details, please refer to the description under "Config – General"
- The "PIN" field is optional, it contains the PIN code for the SIM as used in the GSM MODEM. If this field is filled, the iSonic assumes a PIN has to be communicated to the MODEM on start-up.
- Under "Events available for SMS messages" the user can select which alarms he wishes to receive on his mobile GSM phone.

All event messages can be customised by the user by simply right-clicking on the message. The maximum length is 44 characters, and this customisation can only be done from the PC interface. The hints message displays, in the interface language, the default messages. The user can also select to replace all the messages by their language-specific default strings via a button positioned at the end of the message list.

The format of the transmitted SMS is as follows: "Station: [Channel name -]message"; if the event does not relate to a specific channel (e.g. Datafile cleared), no channel name is sent. The channel name is as customised in (1). Please note that no translation is done on any customisable string, be it a name or an SMS message.

In addition to this functionality, the user can also interrogate the iSonic unit using a GSM phone.

By sending an SMS with a certain message content from a mobile phone, the iSonic will respond to that message.

The request message content is defined as follows:

The first four characters must match the unit's password, the fifth character must be a command character. If this message is received by the iSonic, the unit will send the appropriate response back to the originator of the SMS.

Allowed status request messages are:

'0' – for status request, this returns only active channels, and includes channel names (as customised) and proper formatting.
'S' – Sensor Status
'D' – Digital Inputs
'R' – Relay Status
'A' – for Analog Inputs

It's obvious that the maximum sms length may be exceeded if many channels are active, or long names are chosen. In that case, the message is simply truncated.

As an example; if the password for the iSonic unit is set up to be 1234, then simply send an SMS with the content: 12340. This will result in the unit responding with an SMS to your phone, showing the current measurements.

It is also possible to control the behaviour of the iSonic by using SMS messages. The setpoints for analog outputs configured for PID control can be set via the same type of SMS message.

Use "xxxxcddd.d" to set channel 'c' (1 or 2) to ddd.d percent; e.g. 0000135.5 will adjust channel 1's setpoint to 35.5%. After a successful change, a confirmation SMS is returned to the sender.
A request to adjust the setpoint to 0% will be ignored (0.1% is lowest acceptable value). The second channel of a linked pair will ignore this message.

10. Communications – connecting to a unit

The program has basic settings for communication with external units. When selecting from the menu bar: "Communication ➔ Port", the user can set which PC communications port to use at which speed and which modem to use should that connection be required. All settings, once made, are automatically stored by the program.

An iSonic unit always communicates on Port 1 at 115200 baud and on Port 2 at 9600 baud. Port 1 is typically used to connect via RS232 to a nearby computer (laptop), and Port 2 is typically used to drive a Modem or RS485 network.

To communicate with a unit, click on the unit name in the tree view and then select from the menu bar: "Communication ➔ Connect". An alternative method would be to right-click on the unit name and then selecting "Connect". In both cases the "Connect to iSonic" panel appears:
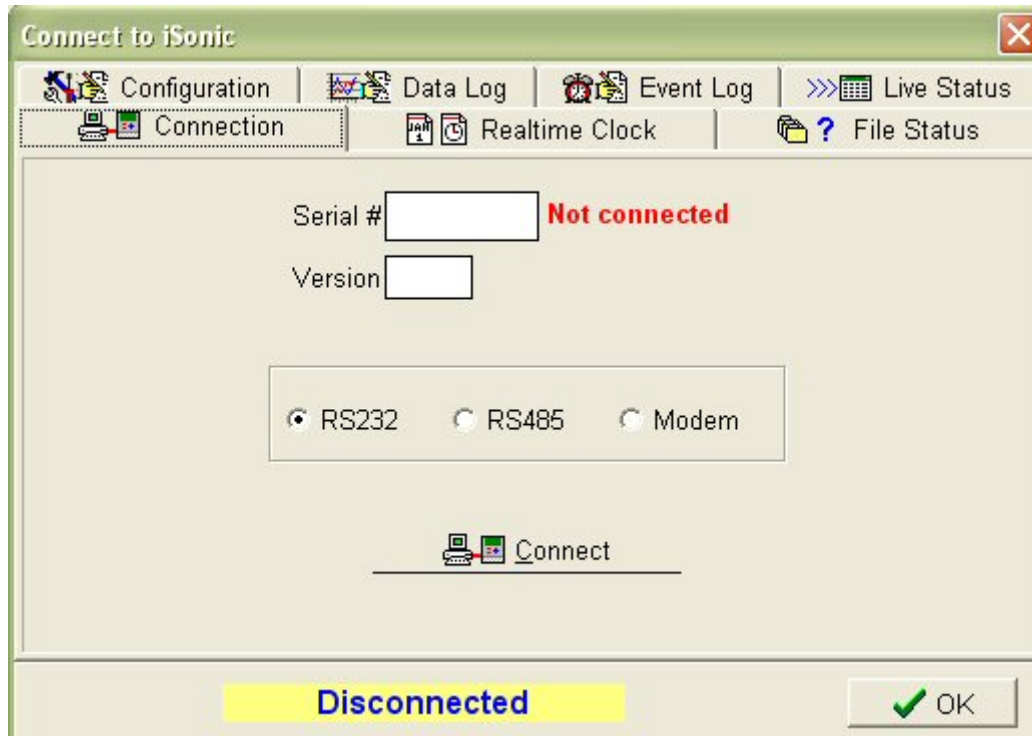
If we assume the connection is via a serial line to the computer, the RS232 selection can stay as it is. For other types of connection, via an RS485 network or a Modem, click on the correct option before connecting.

Click on the Connect button to establish a connection with the instrument. Once the unit is connected, the serial and version number appear and the bottom "Connecting" message changes to "Connected". In case of a MODEM connection the "Connecting" message will first change to "Answered" and then to "Connected".

At this stage it will become possible to click on any tab of the connect box and perform the following actions:

- **"Realtime Clock",** shows the user what the time is according to the iSonic and according to the PC. The "Write Clock" button allows setting of the iSonic time from the PC time.

- **"File Status",** shows the size of the Event and Data log files.

- **"Configuration",** allows for upload (Read Config.) and download (Send Config.) of the configuration information for the iSonic. If the configuration file is sent, the current configuration information for this unit is passed on to the unit. If the configuration information is read from the unit, it will be automatically stored in the current configuration file for this unit on the PC.

- **"Data Log",** allows reading of the data log from the unit, this information is stored in the tree view under the current unit's group. The "Clear Data" button re-initialises the unit's data log to zero entries. Not all the data has to be transferred every time a connection is made, the user can select the required start and stop times.

- **"Event Log",** allows reading and clearing of the event messages on the unit. Again, the information is stored in the tree view under the current unit's branch.

- **"Live Status",** shows the status of the unit. Shown are: the transducer and analogue measurements, plus the status of the digital inputs and the relays.

11. Signal capture

It is possible to capture and display the echo signals from each of the transducers. This is done via the "Signal" command, which is available from the menu bar or by right clicking on a unit in the tree view.
The resulting screen looks as follows:

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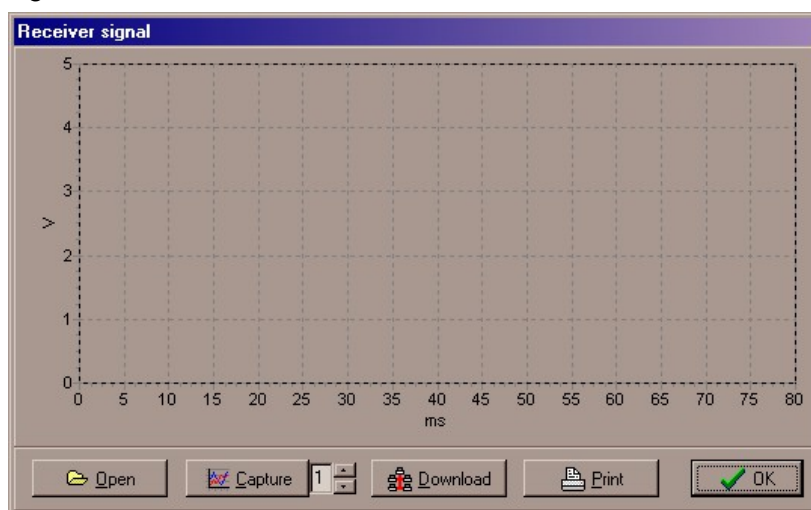
Note that "Capture" and "Download" are only highlighted if a unit was selected before the "Signal" command was given.

- • **"Open",** allows a previously stored signal file to be inspected.
- • **"Capture",** captures the echo signal from the selected channel to the instrument's buffer.
- • **"Download",** retrieves the signal data from an instrument. At this stage the user is prompted for a filename under which the information should be saved.

Once a signal is loaded onto the graph section it can be zoomed manually by mouse clicking on the area to be inspected from left top, dragging a window to right bottom:
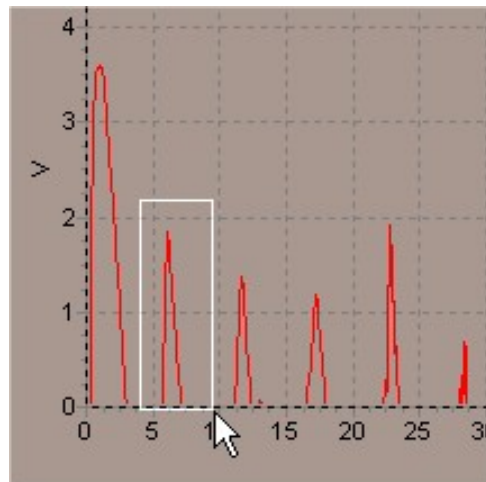
It is also possible to pan the view, right click on the graph and drag it along.
Zooming back to full screen is achieved by a reverse zoom-in action, drag a window from bottom right to left top, any size, anywhere in the graphic area.

12. Event file operations

Event files, once stored, can be opened from the tree view by clicking on their file names. Once an event file has been opened, the user can scroll up and down to view through the file.
Printing can be done for the whole file or when a selection has been made, that specific section will be printed.
In addition to these functions, the user can also export the data to a text based file, select "Save As" from the "File" entry on the menu bar. Either the whole file is exported or, when a selection was made, that particular selection is exported.
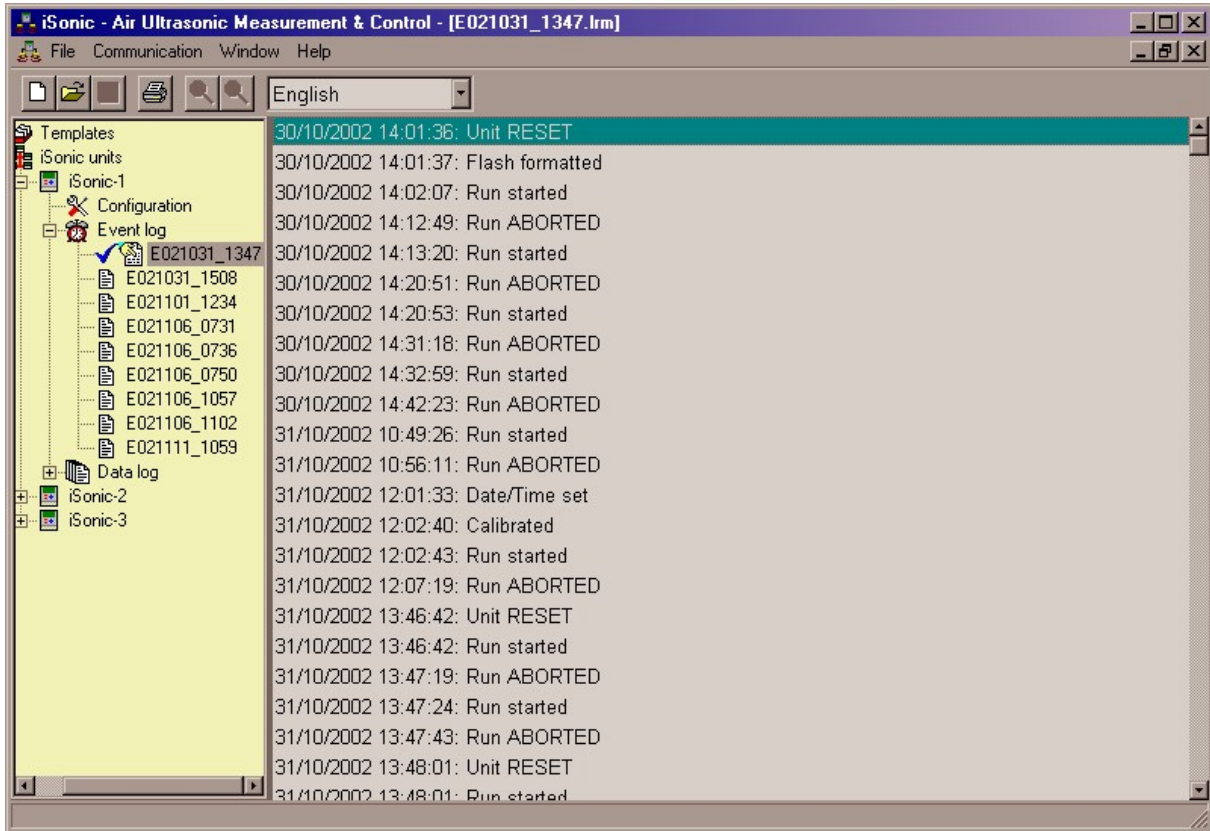
An opened event file can be closed again by selecting "File → Close", or selecting the bottom 'x' mark of the two 'x' marks on the right top of the program.
To remove an event file from the PC system, either select: "File → Delete" or right click on the file and select "Delete log".

13. Data-log file operations

Data log files, once stored, can be opened from the tree view by clicking on their file names. What appears is the data represented in graphical format:
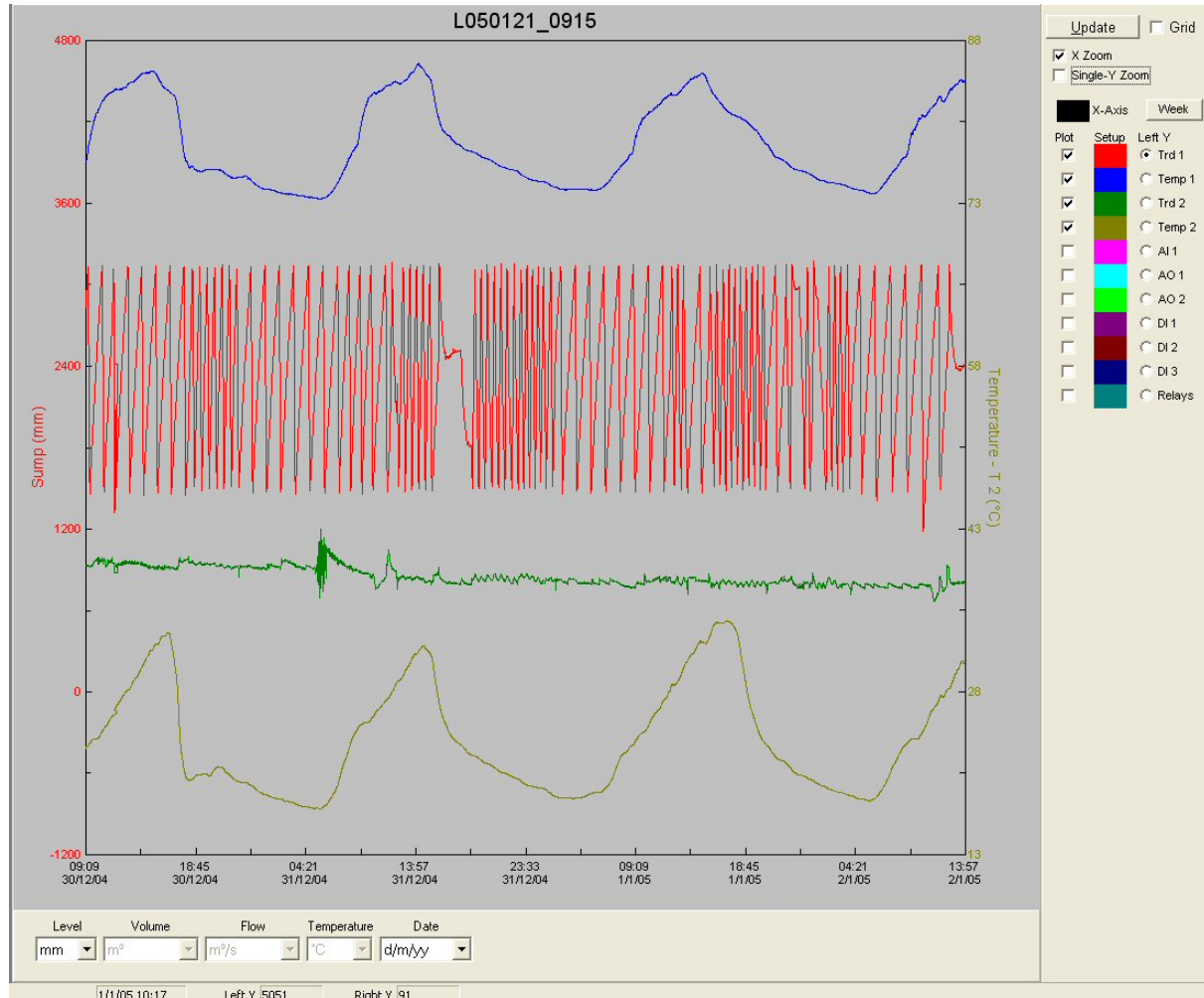
All logged (Enabled) traces are shown, and each trace can be manipulated individually to inspect the data. The data can be shown in its original logged units or can be displayed for other unit types. In the above graph, flow is displayed in "mgd" (million gallon per day), but by selecting another unit under "Flow", this can be changed to any other flow measurement type.

During navigation with the cursor over the data area, the bottom tool bar in continuously updated with the cursor position information, in this way it is very easy to determine the exact information of a data point.

To zoom into a section, drag a window around the to be inspected data from the top left side to the bottom right side. To reverse zoom, perform the reverse action, from bottom right to top left. Once data is zoomed, it can be dragged by right click & dragging the mouse.

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The **"Update"** button allows the user to update the display if needed, sometimes this is required if traces are disabled or enabled by the user.
The **"Grid"** enables/disables a grid display.
The **"X Zoom"** tick box enables / disables zooming into higher time detail.
The **"Single Y Zoom"** tick box enables/disables zooming of a single trace only. If enabled, only those traces that are listed on the left and right hand side axes are zoomed.

The program will automatically show the traces that were logged, and the user has the option to enable/disable the available traces in the tick boxes underneath "Plot".
When clicking on the coloured boxes of each trace, the user has the option to change colours, use this trace as the right hand axis, and even apply manual scaling.

Under **"Left Y"**, the user can select which data has to be shown on the left hand axis, only one set of data can be shown on the left axis and only one set of data can be shown on the right hand axis.

The channel names are also used in the data, status and stats displays. Names on a data graph can be changed via the axis dialog (click on the coloured square). These changes can be saved with the file via Save As.

The **"Week"** button arranges the data in a weekly interval, starting from the current leftmost position. In this way it is possible to view the data in a week-by-week fashion.

The user also has the option to cut certain sections of data out of the graph; this is achieved through right clicking on the graph and selecting the "Select Data Segment" function. Two white bars appear which can be positioned anywhere on the graph. When right clicking again, select the "Hide Data Segment" function and the selected area of the graph will be hidden. The data, once manipulated, can be saved as a new data file (Use File->Save As). The original log file will always retain the same data; it cannot be changed by a user. If mistakes were made in the selection process, close the file and re-open it again.

Multiple data sets can be put together into a single file, by using the function "Append" which can be found under the "Display" tab. The full integrated set can then be saved via the "Save As" option.
Select the earliest data-log to start with, and then append other files, either sequentially or in one step by selecting multiple files. Please note that once append has taken place, only newer files can be added, older files are not integrated correctly. Multiple files with similar data are handled correctly.

It is possible to export the graph in a CSV format (Comma Separated Values), which can be read by external spreadsheet programs such as Excel. Select from the menu bar "File → Save As" and then select in "Save as Type" the "Comma Delimited File (.csv)" entry. In this manner, the data log can be exported partially or as a whole, depending on whether the user has "hidden" data.
Alternative methods are the "Display → Save as Metafile" and "Display → Save as Bitmap" functions. These functions store a graphical image of the data as it is currently shown on the screen.

14. Data-log statistics

Once a data-log has been selected (see previous section), it is also possible to extract statistical information. Do this by selecting from the toolbar the option; "Display, Tabulate Statistics".

The selected Y-axis (left hand side) will be processed and a totals display will be shown:

Interval Ending...	Minimum	Average	Maximum	Peak:Average	Total
16/07/2003 13:00	13.3	13.8	14.4	1.041	33201.5
16/07/2003 14:00	6.9	12.2	14.4	1.180	41719.3
16/07/2003 15:00	8.4	13.2	14.9	1.130	43533.6
16/07/2003 16:00	**0.0**	12.7	27.3	2.150	48352.5
16/07/2003 17:00	9.6	13.2	14.4	1.091	43711.0
16/07/2003 18:00	5.4	10.9	13.9	1.267	35959.8
16/07/2003 19:00	6.2	10.5	13.9	1.323	34566.8
16/07/2003 20:00	5.6	8.9	12.3	1.383	30393.1
16/07/2003 21:00	6.2	9.1	13.1	1.430	29058.2
16/07/2003 22:00	7.1	10.1	14.4	1.427	32804.6
16/07/2003 23:00	7.3	10.1	15.2	1.511	33667.5
17/07/2003 00:00	8.0	11.9	14.7	1.233	38617.4
17/07/2003 01:00	9.8	12.5	14.9	1.197	42094.0

Interval: ○ Hour ○ Day ○ Week ○ Month   Scale (Total): 1

The user is allowed to make different interval selections (Hour, Day, Week, Month) and change the scaling of the totals column.
The data is arranged into Minimum, Average, Maximum and Peak:Average columns, in each column the maximum (or minimum) is indicated in Bold-Red. At the bottom of the columns, once again a summary of the peak values is shown in a yellow-marked row.

The data can be printed or saved to a .csv file, which can be read into a spreadsheet.

The data can also be graphically displayed, do this by selecting the "Graph" tab.

The resulting screen looks as follows:
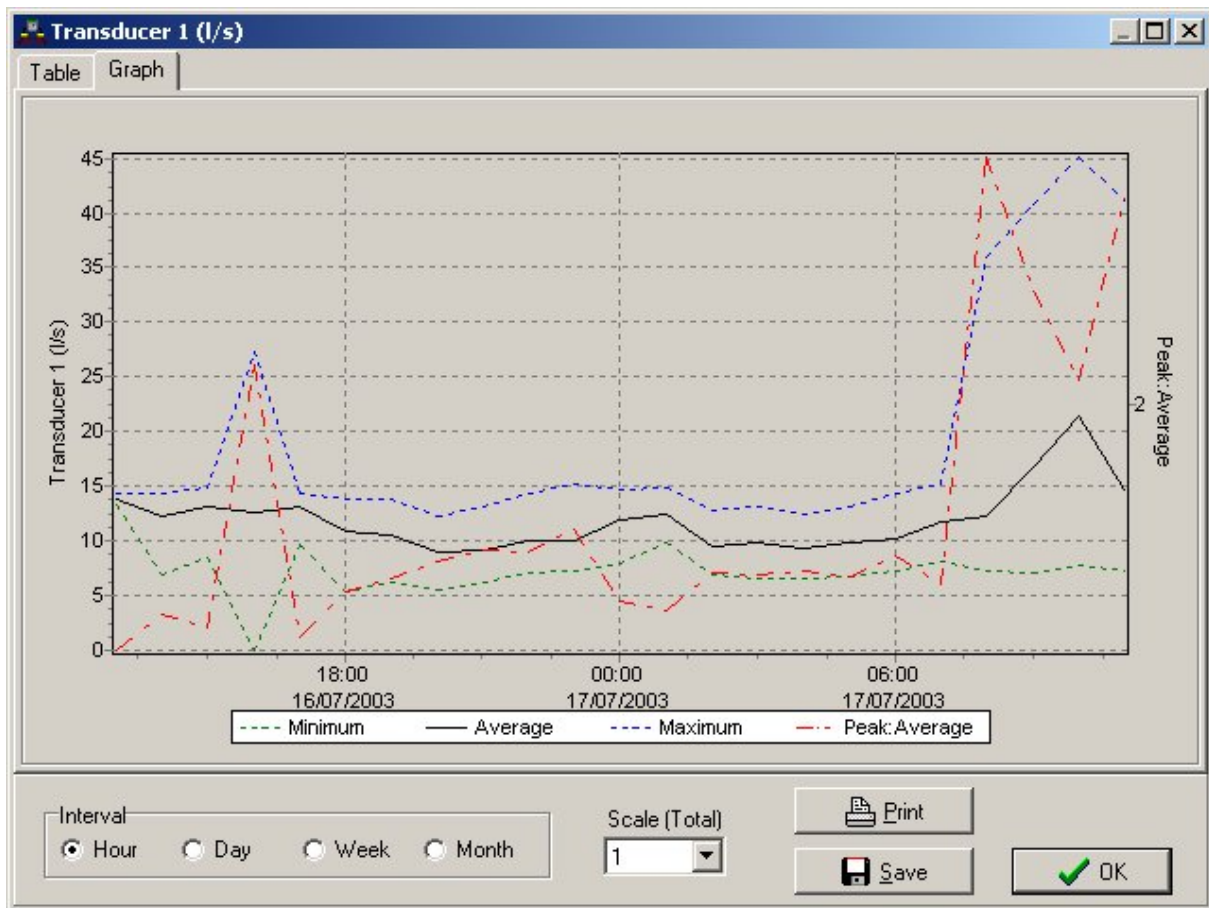
15. Dual functions

This appendix describes in detail the configuration of dual transducer set up's, this section is provided since these type of configurations can be confusing.
Even though the measurements are combined, individual transducers can still be used for control purposes. For example where a total level is calculated from two transducers, transducer 2 can still be used to control a relay.

The three easier to understand configurations are the options **Add**, **Subtract** and **Average**. When selecting these options the program displays the following comment:

Trd 1 selects function; Trd 2 selects type

What is meant by this is that when selecting Transducer 1, the "Function" block is enabled and the relevant option (Add, Subtract, Average) can be selected.
The actual type of measurement (Level, Volume, Flow) is selected under the "Transducer 2" configuration.

Measurement details must be entered for each transducer. The measurement for each transducer is performed by the instrument separately and then the results are added, subtracted or averaged, resulting in a final measurement result.
The measurement result is always represented on the Transducer 1 channel.

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The somewhat more complex dual function is the "**Differential Flow**" configuration.
This function has been implemented to allow measurement on flumes or weirs using a dual transducer set-up. In all cases Transducer 1 must be the transducer that sees the most "Head". This usually means that Transducer 1 is the upstream unit and Transducer 2 is the downstream unit.
This operation only works for:

- Parshall Flumes with submerged flow
- Custom Table

On Parshall flumes, flow compensation is performed when there is submerged flow (Flume overloaded). This compensation only functions under the following conditions:

- Where the throat size is between 1 and 8 foot and a submergence ratio greater than 0.7.
- Where the throat size is bigger than 8 foot and the submergence ratio is greater than 0.8.

The correction factor that is applied is an approximation of various published tables and graphs, and may not be accurate in all situations. From a technical point of view, it would in any case be better to use a correctly sized Parshall flume, rather than rely on submerged flow correction factors.

For the custom table selection, the principle behind this set-up is to measure the levels of both transducers, subtract them (measured level = level TRD1 – level TRD2), and then process the level according to a customised look-up table.

When selecting this option under Transducer 1, the following message is displayed:

DIFFERENTIAL FLOW: Trd 1 type is 'Flow'; Trd 2 type is 'Level'

With this is meant that the entire flow operation is configured under Transducer 1. For Transducer 2 the type is automatically locked into "Level" and the user can only configure the minimum and maximum level values for that transducer.
The only allowed weir type ("Select Weir") is Parshall Flume or "Custom".

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