



Aqualogger

Ultrasonic Open Channel Flow Data Logger

User Manual

Serial Number

Date of Purchase

Factory Set Security Code

CONFIGURATION

- Supply 24VDC/AC
110VAC
230VAC

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COMMUNICATIONS

- RS232
4-20mA
5 RELAYS

Pulsonic Technologies Ltd
Riverside House
North Dean Business Park
Stainland Road
Halifax
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TEMPERATURE COMPENSATION

- AUTOMATIC
MANUAL

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Printer Installed

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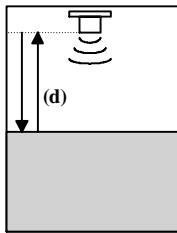
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1.0 Introduction

The Aqualogger instrumentation unit is for use in conjunction with the PenMet 018 non-contact ultrasonic sensor head. The Aqualogger is a fully programmable open channel flow unit conforming to BS3680 calculations for the following channels :-

	Range
Model	Liquid
PenMet 018	0.25 - 6m

- (i) V Notch Weir.
- (ii) Rectangular Weir.
- (iii) Rectangular Flume.
- (iv) Look-up Table.
- (v) Parshall Flume



**Time
of
Flight**

The Aqualogger measures.

- (i) Volumetric Flow.
- (ii) Total Flow.
- (iii) Distance.
- (iv) Temperature
- (v) pH.

The ultrasonic head measures the time of flight of an ultrasonic pulse to travel from the sensor to the reflecting surface and back to the transducer. This information is transmitted to the instrumentation unit where it is converted into distance and flow information.

$$\text{Distance (d)} = \frac{\text{Time of Flight} \times \text{Ultrasonic Velocity}}{2}$$

2

The instrumentation unit contains a versatile fully programmable computer which enables a number of processing functions to be carried out. These functions must be configured on first power up of the system. This is known as 'CALIBRATION'.

Programming the unit is simple as the unit is fully menu driven and prompts the user for his preferred choice.

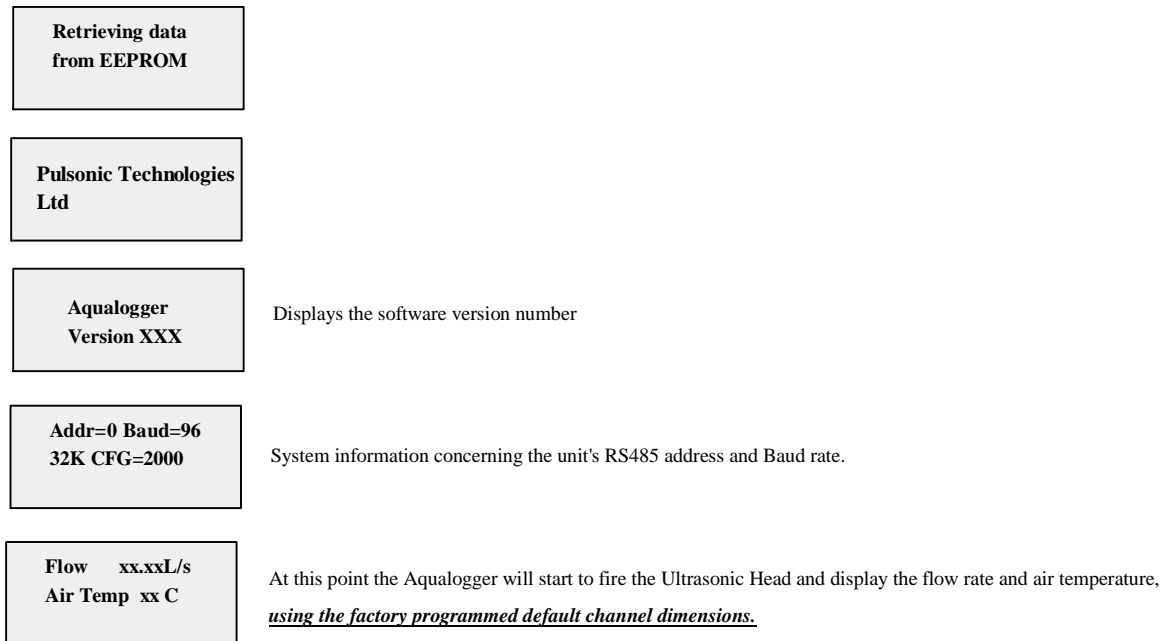
On the front panel facia you will find the LCD display, the **Alarm Set** LED's and the **Programming Keys**.

2.0 Operation and Programming

When installing the Aqualogger, first install the transducer above the channel as per the instructions in Appendix A.

When power is first applied to the Aqualogger, it will show the following messages on the LCD display quickly in succession :-

This means the Aqualogger is retrieving the system set-up data from the non-volatile memory.



This is called '*Run Mode*' and is the mode the Aqualogger uses to display the volumetric flow, temperature, totaliser and distance.

To programme the Aqualogger, the user is presented with several menus each of which contain numerous options that can be toggled on/off or a numeric value entered.

The menus are all presented on the display as a series of statements which 'cycle round' each time the 'UP' or 'DOWN' push-button is pressed. To select a particular option, the user has to press the 'SET' button when the relevant menu option is displayed.

For all numeric values, the menu statement displays the currently programmed value and allows the user to increase or decrease this value by pressing and holding 'UP' or 'DOWN'. Pressing 'SET' will enter the new value into the system and overwrite the old value. If the old value is on the display and the user presses 'SET', it has the effect of leaving the number unchanged. The push-buttons automatically repeat if held pressed. The user will see the numbers displayed change slowly at first then increase in speed every few seconds as long as a push-button remains held down. The Aqualogger also emits a short 'bleep' as an acknowledgement of a key press or when the auto repeat function is in use.

2.0 Programming the Aqualogger

2.1 Run Mode

The Aqualogger will normally remain in 'Run Mode' displaying the flow information. All the relay outputs are active during this mode. Depending on the options programmed, pressing the 'UP' or 'DOWN' buttons will scroll the display. The information seen on the display is shown in section 3.5.

All the information regarding the shape and size of the channel, the head offset etc. are programmed into the Aqualogger in the calibration menus.

If the Ultrasonic Head should fail to receive echo's from the flow surface, the 'Lost Echo' error message is displayed. If the echo is lost for longer than 20 seconds, the Lost Echo Relay will then be de-energised. The relay coil is re-energised when the echo returns.

Lost Echo
Air Temp xx C

To bring the Aqualogger out of 'Run Mode', press the 'SET' button. The unit will then ask for the Security Code number to be entered. The factory pre-set code number is indicated on the front cover of this manual but this can be changed by the authorised user at any time. Use the 'UP' or 'DOWN' buttons to change the displayed number then press 'SET' to enter the code. If no code is entered within 12 seconds, the Aqualogger returns to run mode.

Security
Code ? x

***** ERROR *****
INVALID ENTRY

If an incorrect Security Code is entered, this error message is displayed and the unit returns to 'Run Mode'.

2.2 Main Menu

When the correct security code has been entered, the Aqualogger stops firing the head, turns off all the relays and displays the main menu. This is where the system set-up and calibration parameters can be entered.

The 'UP' and 'DOWN' buttons move the Aqualogger through the following menu options :-

Press 'SET' to select the required option.

Main Menu Run Mode ?	Returns the Aqualogger to 'Run Mode'
Main Menu Setup sensor ?	Programmes the flumes, weirs lookup table and all the ultrasonic head parameters.
Main Menu Setup relay ?	Programmes the relays parameters.
Main Menu Setup System ?	Programmes the temperature, pH, new password and RS485/RS232 data communications address.
Main Menu Display setup ?	Allows the user to view all the programmed parameters. A useful way of confirming your programming.
Main Menu Setup System Logger	Programmes the clock, Log interval and printer report interval.
Main Menu Setup System Printer	Enables or disables the printer

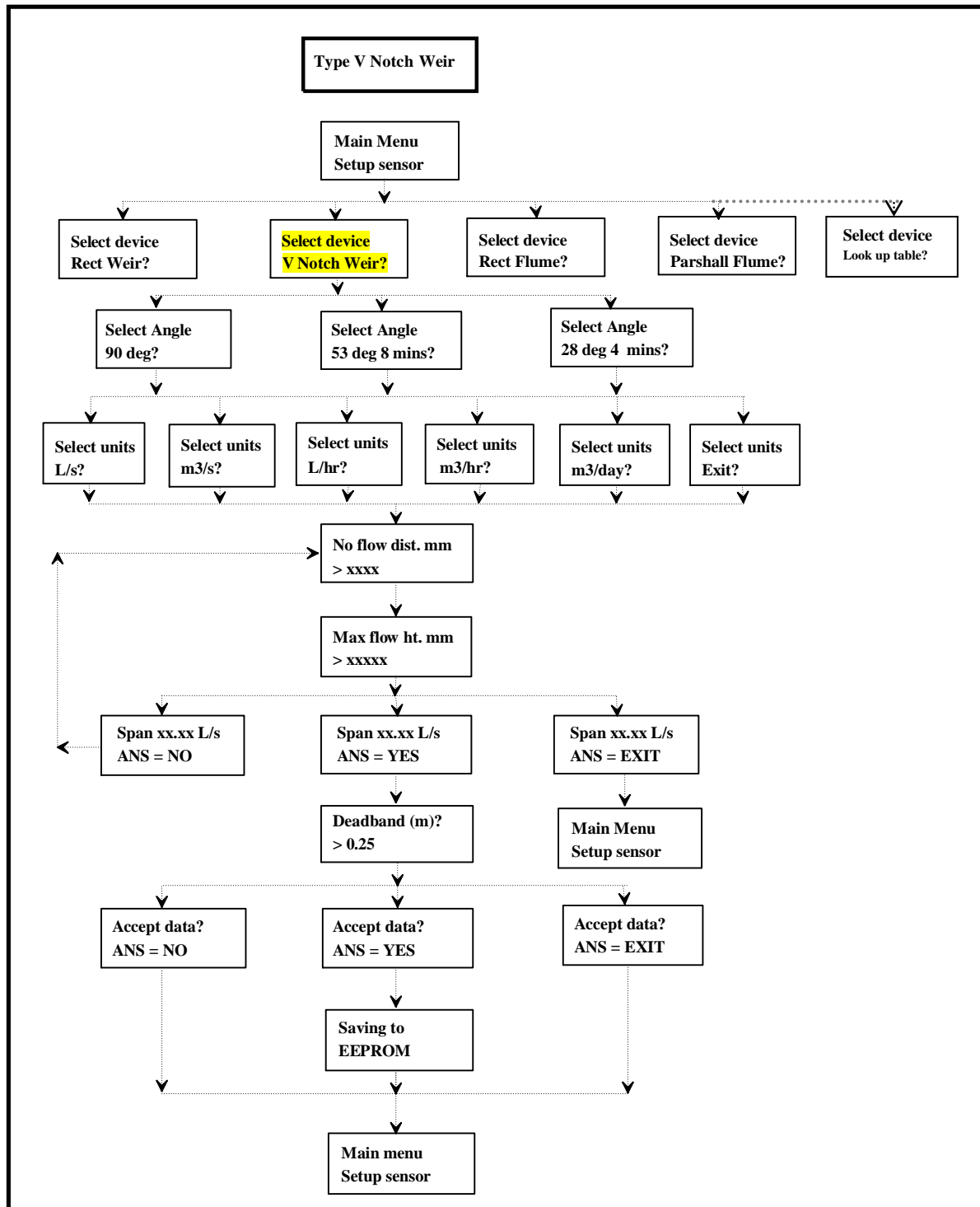
Each of the above menus should be programmed as appropriate when first installing the Aqualogger.

Definition of Terms (see also appendix A) :-

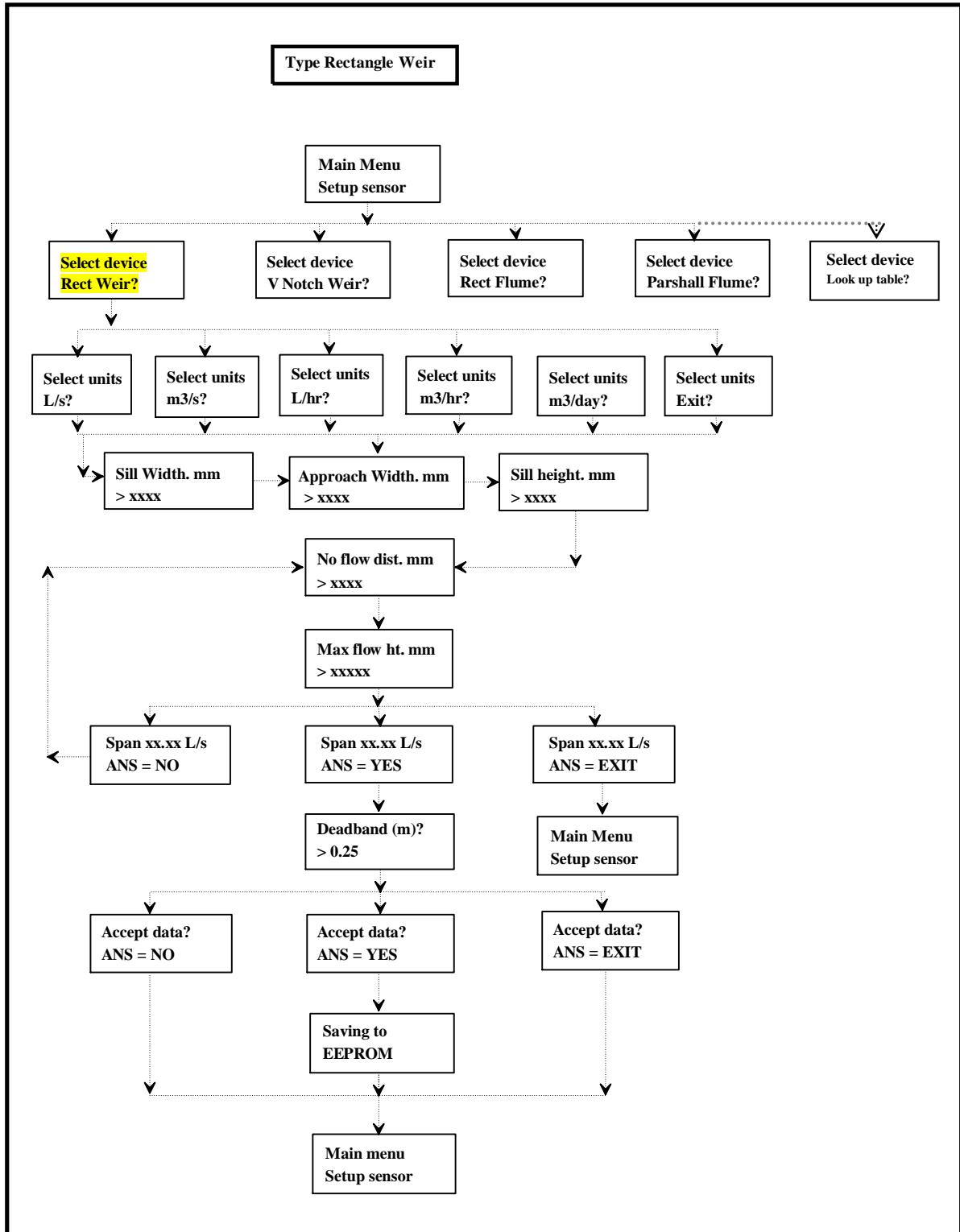
No flow distance:	from face of sensor to zero flow point in channel. Used to calculate the span and fixes the 4mA output value.
Max. flow height:	distance from zero to maximum expected height corresponding to maximum expected flow. This is used to calculate the flow span and fixes the 20mA output value.
Span:	calculated flow span = (max. flow - min flow) according to BS3680 standards. This should agree with your flow calculations.
Deadband :	minimum = 0.25metres (250mm). Should be increased as required to overcome interfering objects / structures between the sensor and max. flow height. Such interference can lead to false echoes.

2.2.1 Set-up sensor

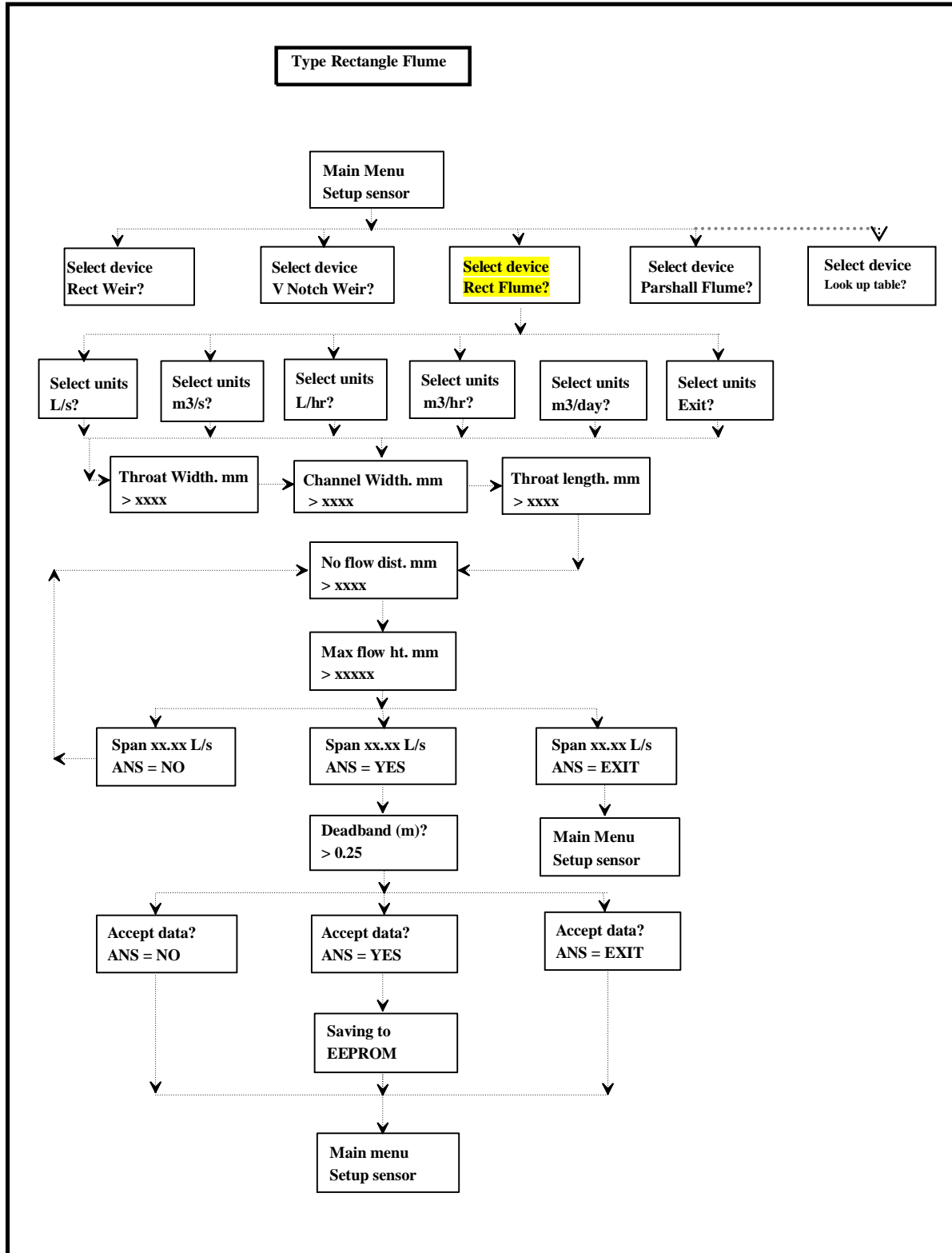
The 'Set-up sensor' menu is where the flume and weir tank shape and size and the ultrasonic transducer parameters are entered into the Aqualogger. For dimensional definitions see Appendix A



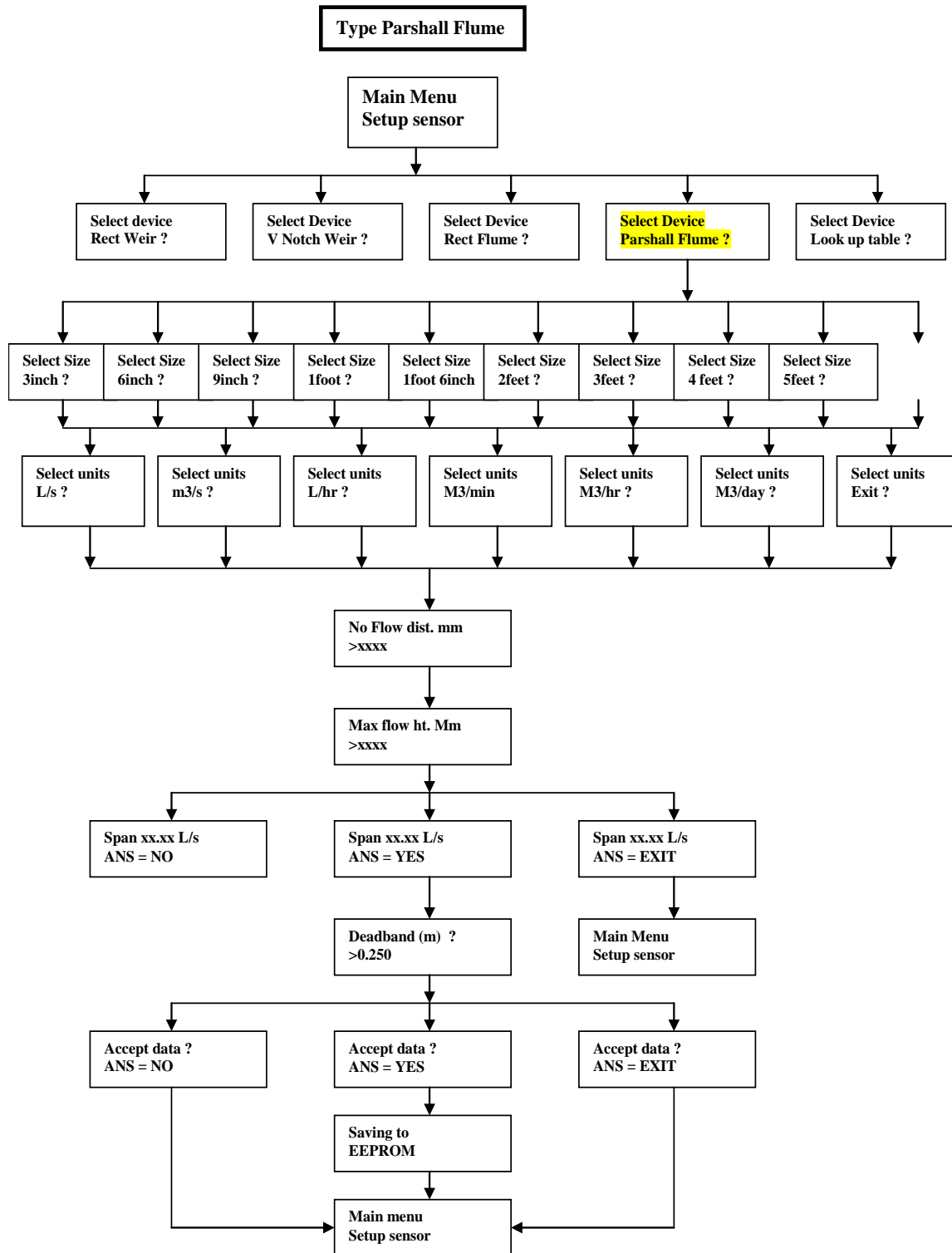
For dimensional definitions see appendix A.



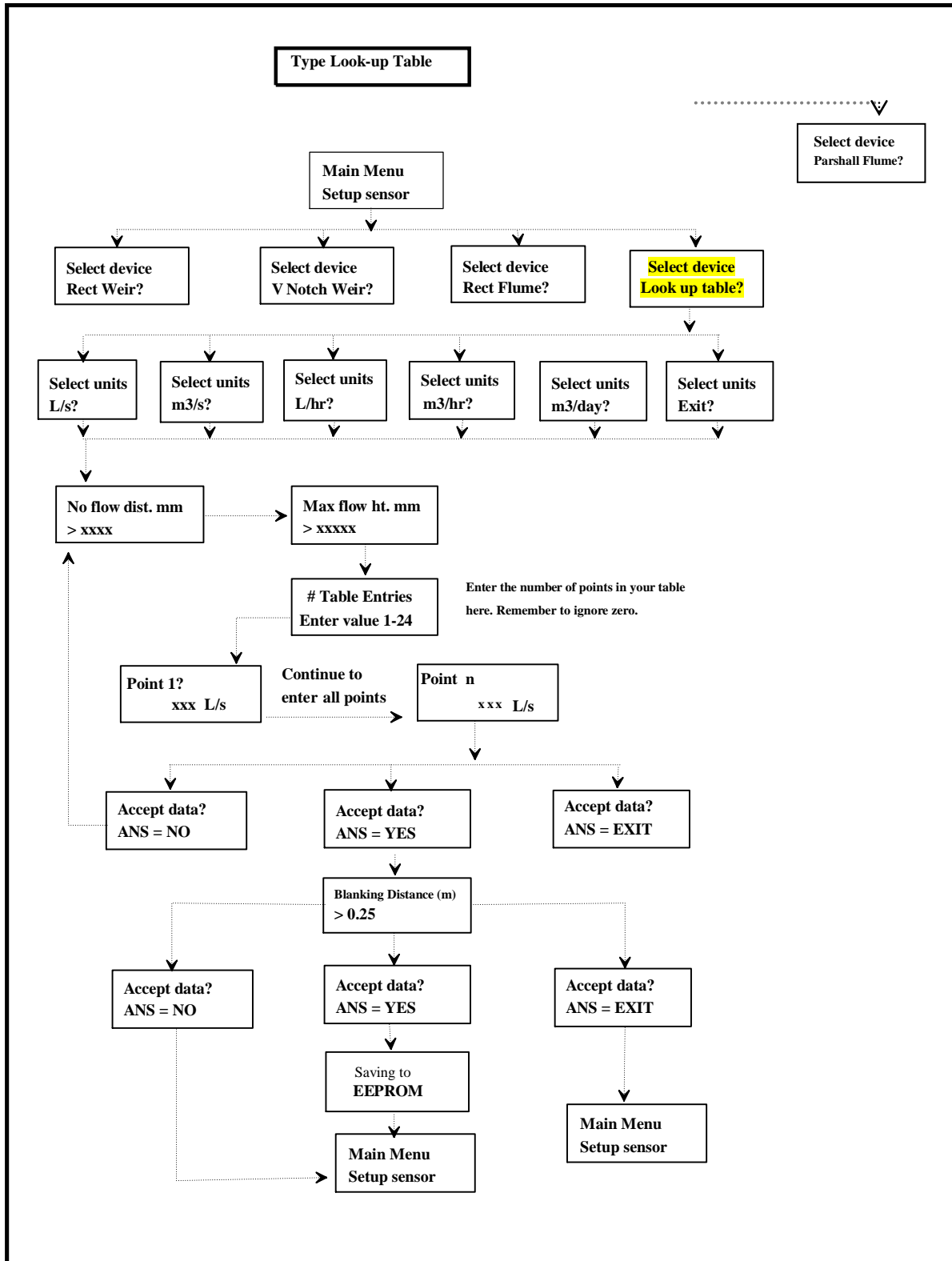
For dimensional definitions see appendix A.



For dimensional definitions see appendix



To programme the look up table you must have available the flow to head curve. This can then be split into any number of segments between 1-24. For each point, record a flow and height figure. Obviously the greater the number of segments the more accurate your flow reading will be. Enter each of the points into the main lookup table. Verify your entries in the display setup menu.



2.2.2 Setup Relay

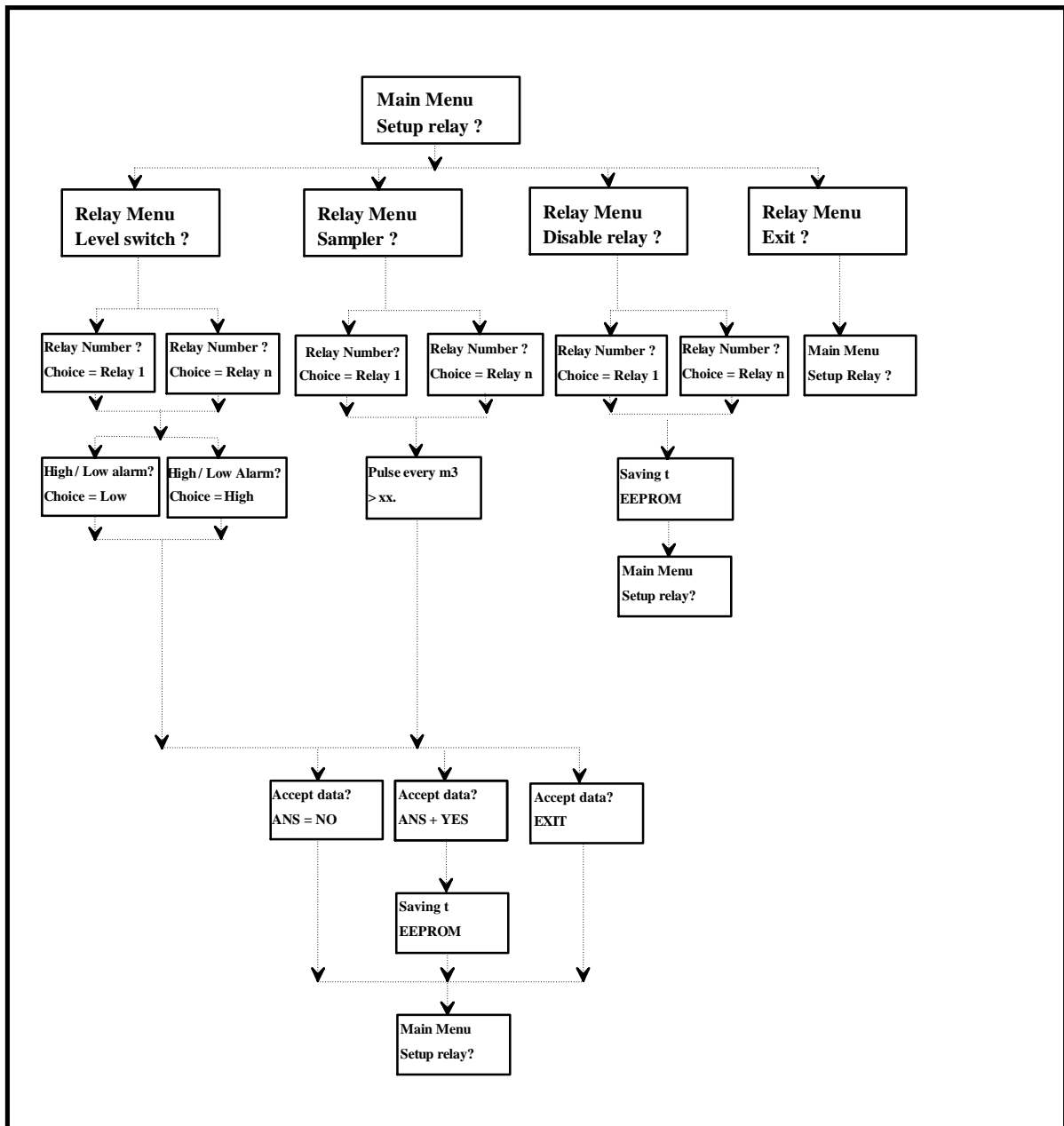
The 'Set-up relay' menu is where the programmable relay information is entered into the Aqualogger.

The relays can be programmed via the 'Set-up relay' option of the main menu. There are 4 relay outputs of both **Normally Open** (NO) and **Normally Closed** (NC) configuration. There is also a lost echo relay which should be programmed as a fail-safe interrupt (see Appendix B)

The relays on the PenMet Aqualogger can be programmed individually to switch on the following choices :-

- | | | |
|----------------|----|--|
| Flow | 1. | High flow alarm based on a maximum level value |
| | 2. | Low flow alarm based on a minimum level value |
| Sampler | 3. | Pulsed every total m ³ |

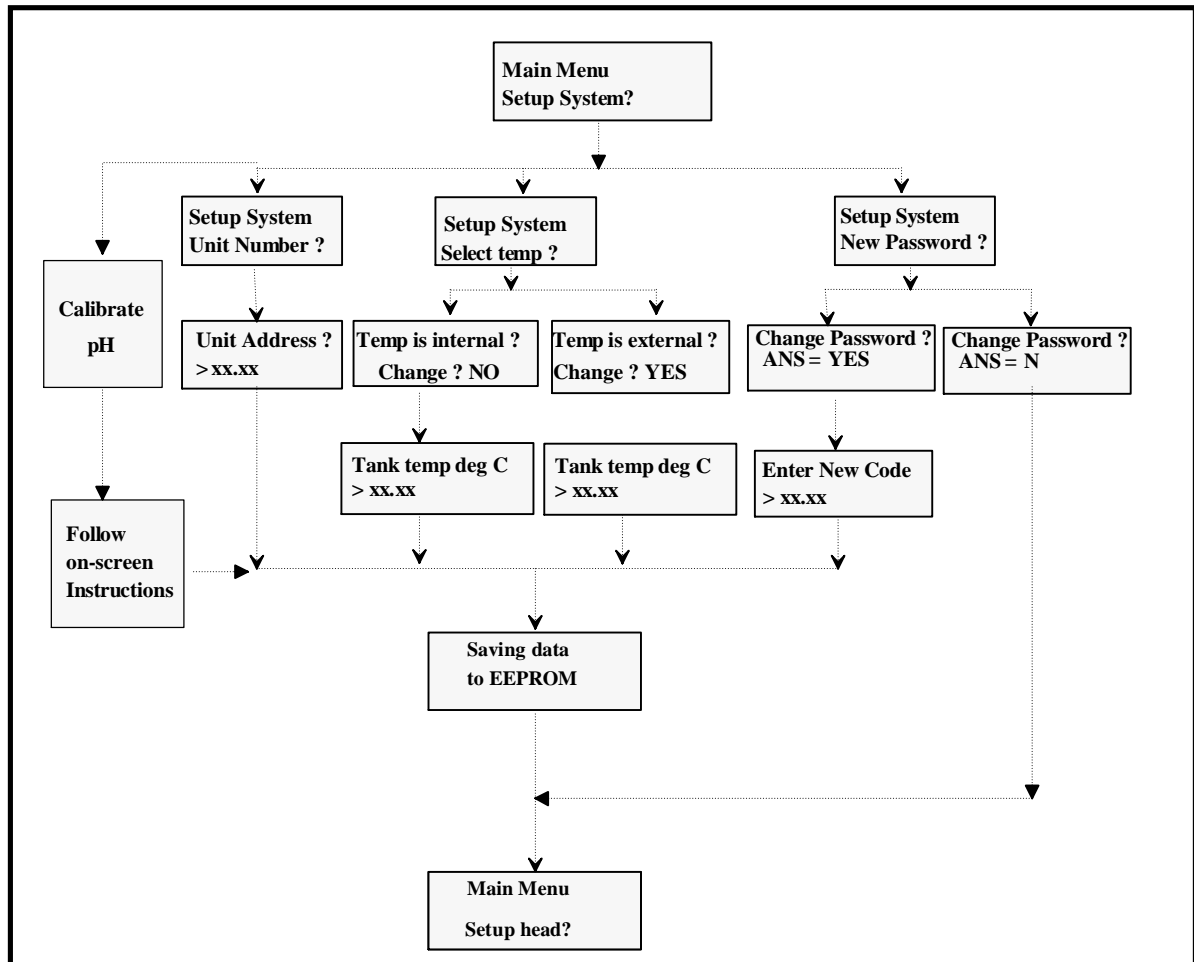
Once you have selected 'Set-up relay' you may cycle through these choices until you select one of them. You will then be asked to enter the appropriate values.



2.2.3 Set-up System

In this menu, the settings of the unit address for logger download (RS485 only), temperature compensation, pH and operator security code can be changed.

The menu structure is displayed below :-



NOTE :

The velocity of sound changes by 0.18% per^o C change in temperatures. If a temperature sensor fails or is not used for automatic compensation you should regularly manually update the temperature.

2.2.4 Display Set-up

In this menu, the settings of the unit can be confirmed. Press any key to scroll through the display. All the user programmed options will be displayed sequentially. This is a useful method of checking that you have programmed the unit correctly.

3.0 Data Logger

The Aqualogger can be used to log flow data in either or both of the following two modes:

1. With printer.
2. With internal memory

3.1 Printer Mode

The Aqualogger can be programmed to monitor flow over a report interval which can be "user" defined as 1, 3, 6, 12 or 24 hours. At the end of this period the Aqualogger will automatically print a report which gives a summary of the flow information for that interval. An example of a typical report along with the meaning for each data line is shown here.

A 24 HOUR CLOCK IS ALWAYS USED

<i>Ticket Information</i>	<i>Meaning</i>
Report Interval 0	Current report interval
Report Time 14.00	Current time
Report Date 27/05/97	Current date
Started at 14.00	Start time for report interval
For 24 hours	Length of report interval
Status [Active]	The report printout is automatic, not manual.
Powered down time 01.20 [hh.mm]	The unit has been powered down for 1hr, 20mins during the 24 hour interval
Total Flow for Interval 86.329m ³	Total flow for the 24 hour interval
Current Totaliser 284918.536	Totaliser value at the time of printing
Max Flow 15.6 L/s	Maximum recorded flow during the 24 hour interval
Max pH 9.0 Min pH 3.0	Maximum and minimum recorded pH during the interval
Temp Max 21 deg C Min 12 deg C	Maximum and minimum recorded ambient air temperature during the interval

3.1.1 Manual Printout

When the unit is in the run mode, i.e. collecting data, a manual printout can be obtained. This is performed by pressing the "SET" key and when asked for the password, enter (-5): minus five. The unit will then print a list of report summaries. These will be the report summaries for the current interval, and the 3 previous intervals. For example if the unit had been programmed to print a summary every 24 hours then when a manual print is performed you will receive a print out of the current summary (up to the time of print) and the previous 3 days summaries. The printed summary will contain the following additional 2 lines.

<i>Ticket Information</i>	<i>Meaning</i>
Manual Print	This is a manual print, not an automatically generated print
At 15.28	Time of performing print

The current report interval is always given the number 0. The previous report interval is given the number -1 (minus 1) etc. back to -3 which is the third previous interval.

Note: When doing a manual print out it is likely that the current report interval has not been completed. For example if the unit has been programmed to print out at 12.00 midday and a manual print is made at 9.00 am, then 3 hours of the current report time will be missing. The printout will reflect this by indicating a 3 hour power down.

3.2 Aqualogger memory based system

The Aqualogger is at all times a self contained logger with a memory capacity of 125kBytes. This memory holds records of all flow information. The memory will take approximately 56 days to fill when a record of the flow is captured every 5 minutes. This interval is user programmable and can be 2 minutes, 5 minutes, 15 minutes or 1 hour. Clearly the shorter the interval the faster the memory will fill and conversely the slower the interval the longer it will take to fill. You must use your judgement depending on the flow conditions that prevail!

Once the memory is full the unit will overwrite the memory, starting at the oldest recorded memory location; this is known as wrap round memory filling.

3.2.1 How is the Information Stored?

The Aqualogger works by updating a capture register every second with the following information.

Totaliser Value : Instant Flow : Instant pH : Instant Temperature

During each logging interval, the capture register updates the instant flow, instant pH and instant temperature values only when a greater value than that currently held is measured. This enables the capture register to always hold the maximum flow, pH and temperature readings.

At the end of the log interval (i.e., 2,5,15 or 60 minutes) the contents of this register are stored to the 125K memory. It is these reading that are logged for later analysis on a PC.

3.2.2 Memory Download

The contents of the Aqualogger memory can be downloaded to a PC either directly or through a modem using Pulsonic Technologies windows based software package "Inquisitor". The data can then be reproduced in tabular and/or graphical form.

To download the data connect a serial communications cable to the unit (available from Pulsonic Technologies) and follow the instructions given in the Inquisitor manual. All data transfer is controlled from the PC and not the Aqualogger.

Note: When the Aqualogger is downloading it will suspend all flow measurements for the period it takes to complete the task. This could take up to 30 minutes if downloading the full memory capacity.

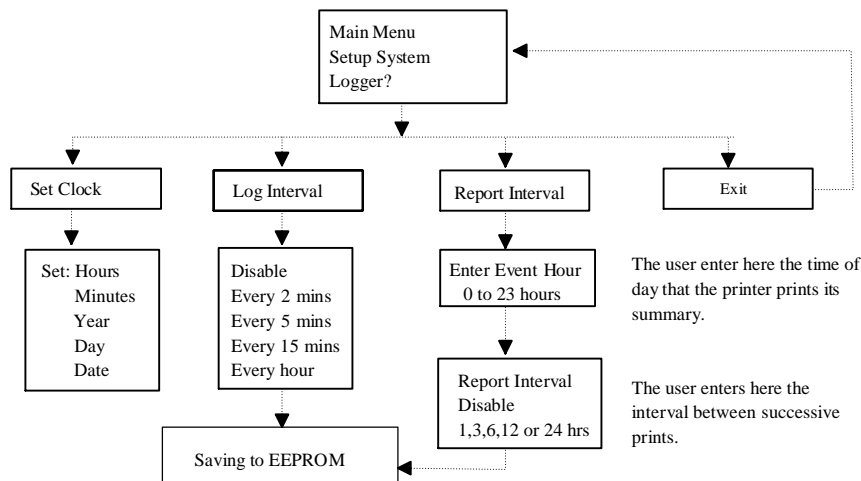
3.3 Programming the Logging Parameters

Definitions:

Log Interval: the interval between successive transfers of flow information into each Aqualogger memory location.

Report Interval: The time that data is collected for before each automatic printout.

Event Hour: The time that the printout occurs.



3.4 Enable/Disable Printer

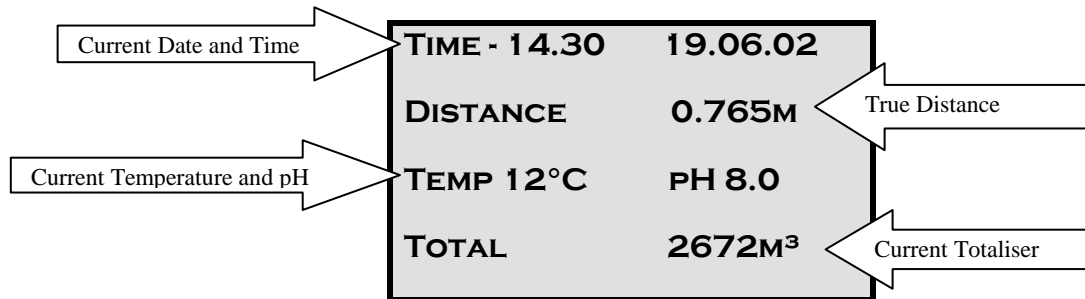
The printer can be disabled at any time by choosing "Setup System Printer" option found in the main menu.

3.5 LCD Display Format when Running

The Aqualogger has an extremely powerful running display which enables the user to view the real time flow information as well as the 3 previous summary records. These summary records relate to the report interval times of 1, 3, 6, 12 or 24 hours, as programmed in the previous section. For example if the unit had been programmed to print a summary every 24 hours then the user can scroll back through the 4 line display to view the summary information for the previous 3 days.

On Power up the unit will default to factory settings for a V Notch weir. However once programmed the user can scroll through the 4 line display pages by pressing the up/down arrow keys.

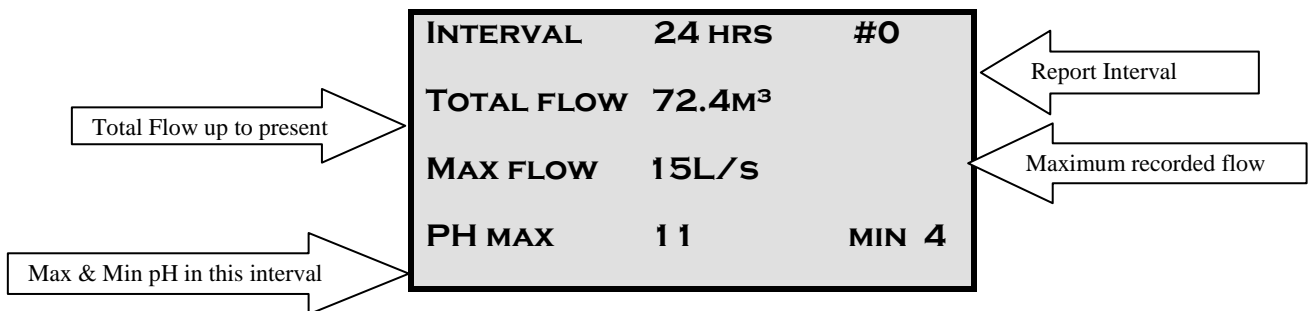
The running display with the current flow information will be viewed when the unit is set to run. This will be of the present form:



Note:

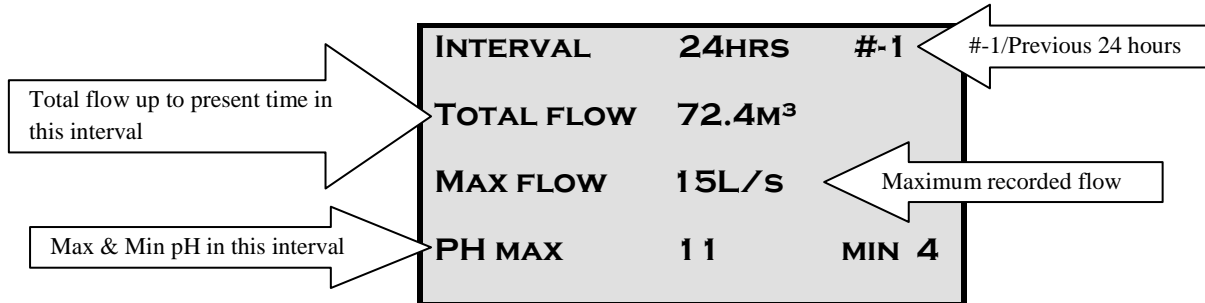
The Aqualogger always measures the true distance from the sensor face to the liquid level. This cannot be interfered with in any way. Hence when the unit is first powered up this is an extremely useful and accurate method of measuring the no-flow distance without the need for a tape measure.

Now Press the "UP" key to view the next screen



The display now shows a summary of the important flow parameters up to the present time within the current interval: #0 indicates it is the current interval.

Now Press the "UP" key again. The display will now change to depict the previous summary interval.



By continuing to scroll the display you can go back in time to view the summary information for the 3rd previous interval; this will be denoted # -3.

4 - 20mA Output

The unit is provided with a 4-20mA isolated output as standard.

The 4-20mA output is automatically scaled to the selected span (max. flow height) you have programmed.

e.g. If you have programmed a span of 50 l/sec then the unit will output 4mA as Zero (0) flow and 20mA as max. flow (50 l/sec)

4.0 Transducer Location

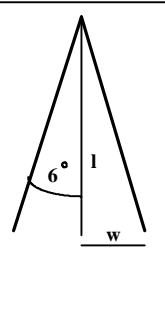
Correct positioning of the sensor is vital if accurate results are to be obtained. A basic error in installing the sensor will cause inaccuracies in all other aspects of flow metering. Always:

- i. Locate the sensor at least 600mm above the maximum level.
- ii. Ensure that the ultrasonic beam has a clear path to its target and is not going to strike objects on the wall of the channel
- iii. Fix the sensor in a vertical position.
- iv. Try to avoid situations where the temperature sensor is exposed to sunlight especially at dawn and evening.
- v. In the event of the transducer being exposed to prolonged strong sunlight a simple heat-shield erected above the sensor will ensure correct temperature compensation in the most severe conditions. A suitable shield is available from Pulsonic Technologies.

The table below gives the beam spread for the ultrasonic wave as it travels from the transducer for an angle of 6 degrees.

Ensure that at the maximum distance to be measured, the beam does not collide with interfering structures. This is a common fault.

Tank Height l (metres)	Beam Half Width w (metres)
1	0.11
2	0.21
3	0.32
4	0.42
5	0.53
6	0.63
7	0.74
8	0.84
9	0.95
10	1.05



4.1 Mounting Instructions

It is recommended that the Ultrasonic transducer is mounted on a bracket above the channel to overcome the deadband of the transducer as follows :

PM-018 - Deadband = 0.25m

This arrangement allows the transducer to cover the full operating range.

The top of the sensor is provided with a M20 tapped thread allowing it to be bolted to a suitable bracket.

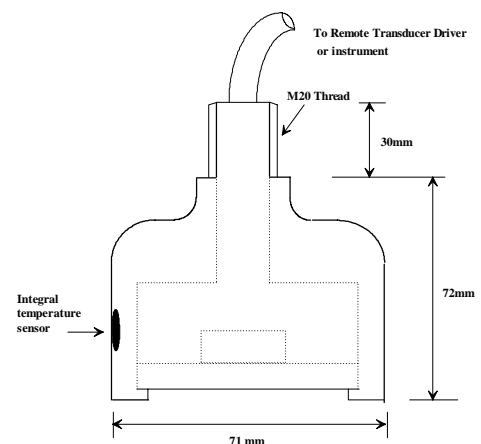
When tightening the transducer securing nut it is important that the natural turning moment of the transducer is resisted with a suitable either by hand or with an open-ended spanner. Failure to observe this precaution could result in the damage of the transducer.

UNDER NO CIRCUMSTANCE SHOULD THE BODY OF THE TRANSDUCER BE CLAMPED WHEN IN USE.

NOTES

- A. Support and restrain sensor cables to avoid damage.
- B. Route sensor cables away from power cables and other sources of interference.
- C. Where cables pass through a junction box, maintain continuity of the screen.

You will have been provided with the correct/requested length of transducer cable for your application-should you wish to extend this cable length it should only be done by adding to the existing length through an IP68 gland.



Remember:

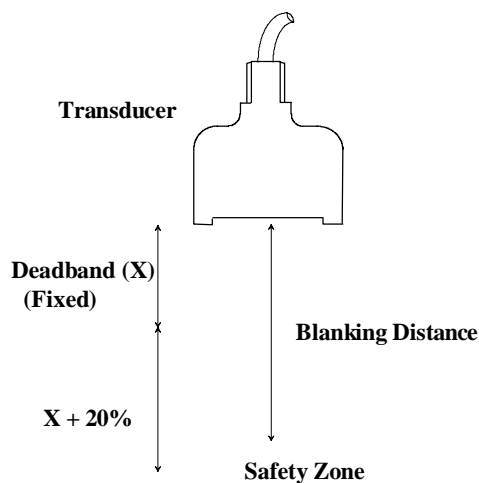
Always use the nut provided and insert the damping washers. Do not over-tighten the nut as ringing may occur.

Use a spirit level or a plumb line to ensure the transducer is aligned "normal" to the reflecting surface.

4.2 Blanking Distance, Deadband and Safety Procedure

There may be instances where obstructions in the channel cannot be avoided and they give rise to false echoes. If such obstructions are above the maximum level to be measured then they may be gated out by instructing the Aqualogger to ignore any return echo in the flight path up to such an

obstruction. This is performed in the calibration mode by programming in a blanking distance. The blanking distance programmed should be the distance from the transducer plus a nominal 10% to overcome variations due to temperature.



All ultrasonic transducers have a blind area called the "deadband". Within this area the sensor cannot detect the true echo. This should be borne in mind when setting up the unit since if you allow your liquid to fill into this area the instrumentation unit will not return lost echo but give an erroneous reading which relates to a multiple echo, which in the time base is perceived to be outside the deadband region.

In order to prevent this occurrence you should always assign one of the relays to a high alarm condition. The level of this high alarm must be below the dead band zone which is given in metres in the set-up head menu for each head type. It is recommended that you make this alarm setting equal to the distance

of the deadband plus 20%. For example a 018 head with a deadband of 0.25 metres should have a high level alarm set at a distance of 0.3 metres from the surface of the transducer head.

A safety margin of 0.2 metre above the blanking zone should be sufficient for most applications.

4.3 Instrument Mounting

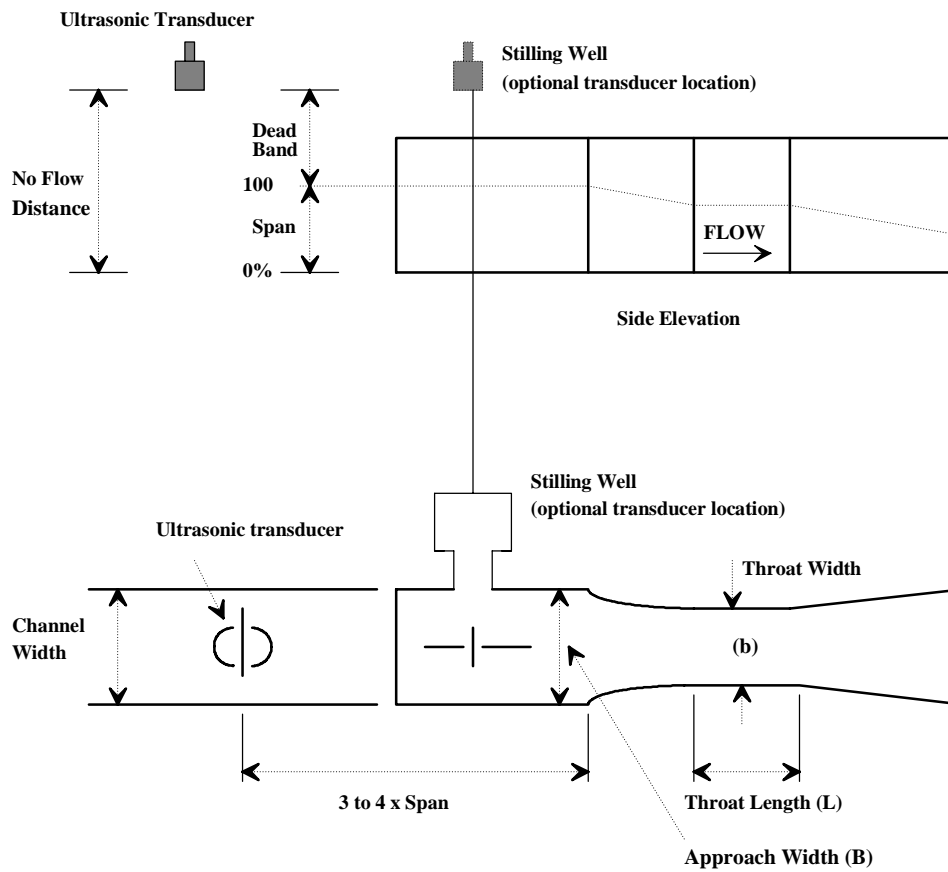
The instrument should be wall mounted using the 2 location holes found behind bottom access panel and the lug on the rear of the unit. The Aqualogger is IP65 rated and as such may be mounted in an open environment. However the printer is not IP rated and must be mounted in a weatherproof area. A printer cable is provided as standard with the printer but the data logger cable is an optional extra.

Normally the maximum distance between the Aqualogger and the sensor is 50 metres. Where a greater distance is required the transducer driver board normally resident inside the Aqualogger is provided in a separate interface box (see appendix B).

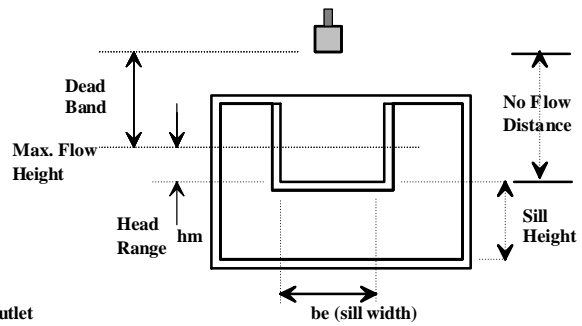
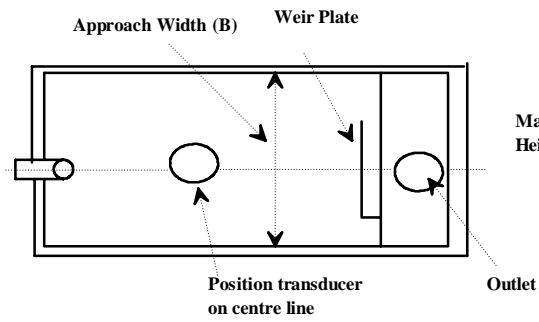
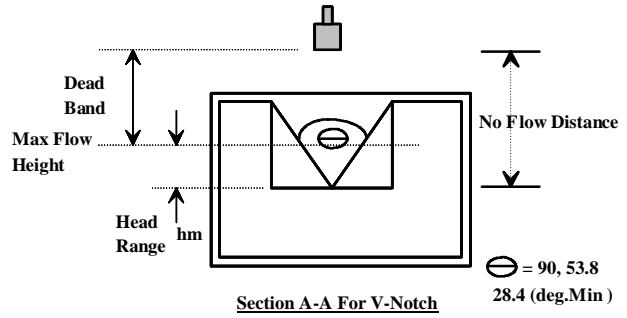
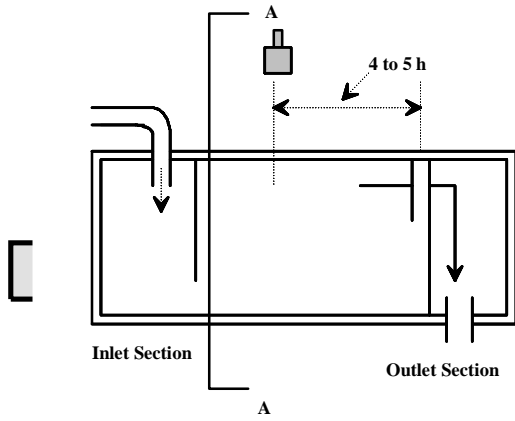
This must be stated at the time of ordering the unit.

Appendix A: Channel types and dimensions

Transducer Location For Rectangular Flumes



Transducer Location For Weir Tanks



Appendix B: Terminal Connections

All connections to the unit are located in the lower section of the unit housing. Access to this area does not invalidate the guarantee.

All wiring must be to the latest IEE regulations.

The unit supply voltage must be provided via a double pole fused spur.

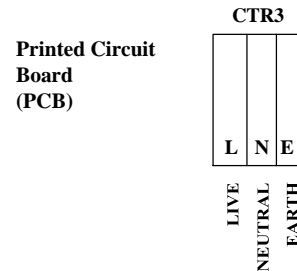
Mains Connection

The units are factory set to operate from either 115V or 230V, 50Hz mains. This is indicated on the rating label adhered to the unit. This can be switched by removing the front facia and allocating the 115/230V changeover switch.

Fuse Rating :- 20mm 250V, 250mA Anti-Surge.

The diagram shows the connections for Live, Neutral and Earth.

The unit can be operated at 24V but this **must** be done by the manufacturers



Relay Connections

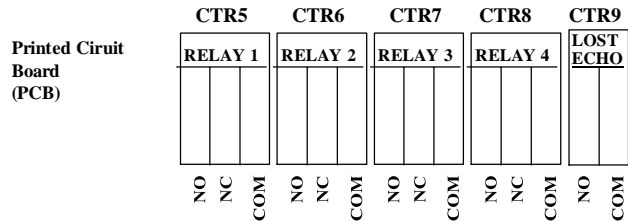
There are 4 programmable relays and 1 lost echo relay that are available to external circuitry. These relays have both normally open (NO) and normally closed (NC) contacts so that they can be used in any configuration.

The ratings for the relays are as follows :-

Max. Switched current	5A
Max. Switched voltage	30V DC / 250V AC
Electrical life at full load	min. 8 x 10 ⁴ operations
Mechanical life	min. 10 ⁷ operations



The connections for the relays are shown below

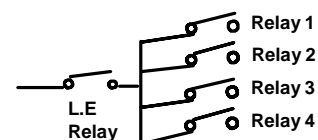


Lost Echo Relay :

Normal procedure for the lost echo relay would be to connect the NO and COM terminals since this relay is energised during normal operation of the transducers.

On a lost echo condition the relay is de-energised.

The L.E relay should be used as a fail-safe relay connected in series with the other 4 programmable relays. This ensures that all power to external equipment is removed when the Locator V is not in the 'Run Mode' or if there is a power failure to the unit. If the L.E relay is not used, any equipment connected to the NC connections of the other relays will run if power is removed to the Locator V because these relays will de-energise. i.e. NC contact is made.



Ultrasonic Head Connections from Enclosure to Remote Transducer Driver

The connections for the ultrasonic head is shown below. Normally the head uses four wires, red, green, yellow and blue as indicated in the table below.

The 'RTN' connection is the pulse from the instrumentation unit that instructs the head to send a packet of ultrasound.

The 'TR' connections are the pulses sent back from the head relating to echoes.

The 'THERMISTOR' connections relate to the thermistor sensor associated with the ultrasonic head and are only used if purchased as an optional extra.

<u>Connection</u>	<u>Head Cable Colour</u>		CTR10	CTR11
+VE	Red			
0V	Green			
SCR	Screen	Printed Circuit Board (PCB)		
RTN	Blue	<u>Note</u>		
TR	Yellow	<u>Ensure connector block from transducer is correctly wired</u>		
Thermistor +	White OR Temperature sensor			
Thermistor -	Black " " "			

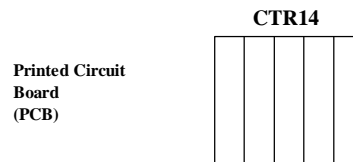
Ultrasonic Head Connections with Internal Transducer Driver

<u>Connection</u>	<u>Head Cable Colour</u>		CTR10	CTR11
+VE	No Connection			
0V	No Connection			
SCR	Screen			
RTN	Red	Printed Circuit Board (PCB)		
TR	Black			
Thermistor +	White (Temperature sensor)			
Thermistor -	Green (Temperature sensor)			

Communications

The RS 232/422 is factory set to:-

- 8 Data bits
- 1 Start bit
- 1 Stop bit
- No Parity



The data rate is fixed at 9600 baud. The information format is an ASCII string of characters that is terminated by a ZERO character before the information is repeated. The connections are as shown.

The RS232 connections are used for memory download.



Low Voltage Power Connections

The unit can be powered from either 24 Volts AC or 24 Volts DC. The details of the low Voltage power connections are:-

THIS MUST BE FACTORY SET

Printed Circuit Board (PCB)

CTR4



24 V AC / +24V DC
24 V AC / 0V DC

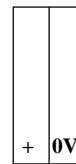
4 - 20mA Output

The unit is provided with a 4-20mA galvanically isolated flow proportional output as standard.

The terminal connections for this are shown below:-

Printed Circuit Board (PCB)

CTR12



4 - 20mA Out
Isolated GND

pH Input

The pH input is a 4 - 20 mA input with an optional 15V supply if required.

Printed Circuit Board (PCB)

CTR13



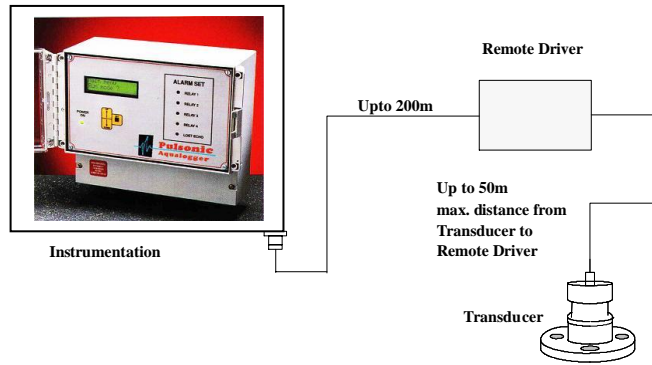
15v Out
+
Isolated GND

Installation With Remote Driver Electronics

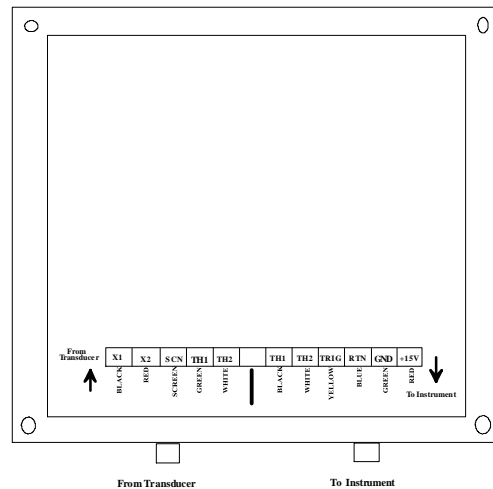
Note:

If you have specified the distance from the instrument to the transducer less than 50m, the instrument supplied may have an integral transducer driver board built in.

Consult the front of your instruction manual for details



Wiring Connection For Remote Transducer Driver



CONNECTION

To Instrument

TH1	- Instrument White	: Temperature sensor
TH2	- Instrument Black	: Temperature sensor
TRIG	- Instrument Yellow	
RTN	- Instrument Blue	
GND	- Instrument Green	
+15V	- Instrument Red	

From Transducer

X1	- Transducer Red	
SCN	- Transducer Screen	
X2	- Transducer Black	
TH1	- Transducer Green	: Temperature sensor
TH2	- Transducer White	: Temperature sensor

Cable Type and Cable Installation :

From Instrument to Remote Transducer Drive Electronics: Defence Standard, 61-12 Sub-miniature Cable Specification 16-2-6C. It is essential to use this cable type or cable with cores in the same orientation. Failure to do so will cause fluctuating readings due to cross coupling of transmit and receive signals.

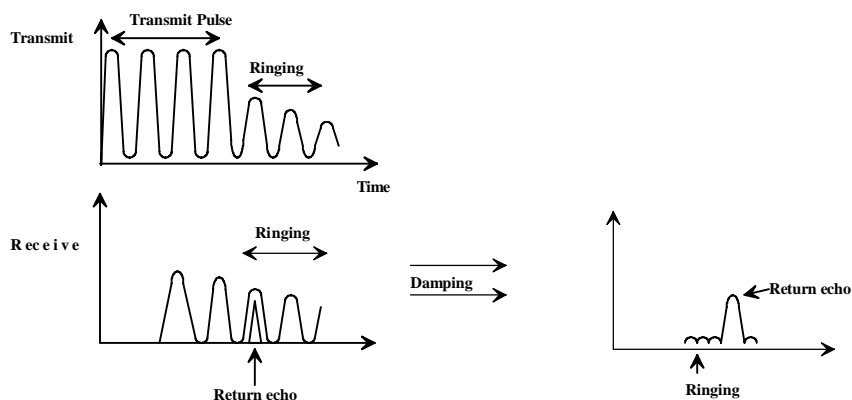
From Transducer To Remote Transducer Drive Electronics : 4 Core Screened twisted Pair with Integral Drain Wire And Individually Screened. Impedance 54 ohms, Capacitance core/core 115pF. **General Notes:** Ensure that all signal cables are kept at least 300mm apart to prevent magnetic coupling. Always ensure grounds and screens are connected.

Appendix C: Fault Finding

Ringing

When in the transmit mode, ultrasonic transducers convert electrical energy into mechanical energy causing the transducer to vibrate, like a loudspeaker. Most of this energy is converted into an ultrasonic acoustic wave but some is transmitted into the transducer housing. This is analogous to striking a bell whereby you hear a sound but also you can observe the bell mechanically "RINGING". If this is excessive it will take a long time to die away and can still be present when the return echo arrives back at the transducer. In such cases the transducer cannot recognise the returning echo and as a result the system cannot calculate range.

Ringling can be recognised by a higher than expected level indicated. To reduce ringing always use gaskets and never over-tighten bolts. Increasing the blanking distance beyond the ringing time will also lock out its effect.



No Display showing/Aqualogger not firing :

Check supply to Aqualogger.

Carefully unscrew the four screws and remove facia label plate and check fuse, if blown replace with 1.0 Amp anti-surge fuse.

Display shows higher than expected reading :

Ringling of transducer - check bolts have not been over-tightened and the damping washer is fitted.

False echo from object in transmission path - reposition transducer or extend blanking distance.

Velocity of sound not set correctly - re-programme to correct temperature setting or install new temperature sensor.

Display shows lost echo :

Transducer incorrectly wired - check wiring diagrams against installation.

Poor wiring connection - ensure all wires are securely connected.

Poor earth - meter earth connection and rewire if necessary.

Liquid level has entered the blanking zone and / or the near field - reduce level until reading returns (see Section 3.2)

Stillling well has curved bottom and is empty - this will cause the ultrasonic signal to bounce around the well arriving back at the transducer outside its permissible time for the set height - ensure transducer is positioned as central as possible and the well always has liquid present below the transducer.

Foam present - foam absorbs ultrasound - reposition transducer away from foam. Placing in a stand (stilling pipe) pipe will suffice provided foam does not penetrate the pipe.

Temperature thermals - foam occasionally present ; use stand pipe

Display shows periodic lost echo :

Large undulating surface associated with very turbulent liquids causing unfavourable reflecting surface; reposition transducer above flattest surface or in the case of liquids use a stilling pipe.

Transducer not mounted to the normal reflecting surface - using a spirit level realign transducer.

Ultrasonic beam occasionally catches edge of weir tank or flume; Lower transducer or place in stilling pipe.

Temperature fluctuations :

Damage to thermocouple - using a multimeter check the resistance of the thermocouple. It should read between 400 ohms and 100K ohms depending on the temperature being measured. (10K ohms @ 25 deg. C)

Display fluctuates :

Periodic lost echo - check all factors above.

Totaliser gives lower than expected readings

Low flow rate operating outside the BS standards. Increase flow rate through weir.

PULSONIC TECHNOLOGIES LIMITED

GENERAL CONDITIONS OF SALE

1. Application

Unless otherwise specifically agreed in writing, these conditions shall be incorporated in every offer, quotation and contract for the sale of goods and services by Pulsonic Technologies Limited (the Company). Any conditions proposed by the customer are hereby excluded and receipt of the customer's order shall be deemed acceptance of these conditions.

2. Acceptance

All quotations are given conformation by the Company upon receipt of the customer's order and no contracts shall be concluded until such conformation is given or the customer's order is otherwise accepted.

3. Pricing

Prices quoted are those running at the time of the quotation and may be subject to revision without notice to allow for material or labour cost increases occurring before delivery (plus taxes). Prices unless otherwise quoted, are:-

- a) UK Sales - Carriage and insurance to the customer's premises will be arranged by the company and charged as an extra.
- b) Overseas sales CIP.

Certain orders will be subject to advanced payment terms and/or progress payments at the vendor's discretion.

4. Terms of Payment

- a) UK Sales - Strictly nett 30 days from invoice date. We reserve the right to charge interest at the rate of 2% for each month or part of month that payment is delayed. For orders above £10k, Pulsonic Technologies shall invoice 30% of the total value on acceptance of the order.
- b) Overseas Sales - Orders not greater than £5,000 shall be paid by SWIFT bank transfer. Orders greater than £5,000 shall be paid by Irrevocable Letter of Credit established on a recognised London bank. All bank charges to opener's account other than internal UK bank transfer charges which will be paid by Pulsonic Technologies Ltd.

5. Default

In the event that payment is not made in compliance with Clause 4 above the customer shall be responsible for all costs reasonably incurred by the Company in collecting payment including the Company's legal fees on a full indemnity basis.

6. Title and Risk

For overseas sales title and risk shall pass to the customer upon leaving the Company's premises. For UK sales title shall only pass to the customer on receipt of full payment.

7. Cancellation or Amendments

The purchaser may not cancel or amend an order after it has been confirmed unless agreed in writing and on terms acceptable to the Company.

8. Trial or Loan of Goods

Any goods delivered to the customer on loan or trial and evaluation shall remain the property of the Company. The Company reserves the right to charge the customer for any loss or damage incurred to the goods during the period of loan/trial.

9. Guarantee

Equipment found to be defective in material, design or workmanship within 12 months of commissioning or 12 months of delivery, whichever is shorter, will be replaced or repaired by the Company provided the goods have not been damaged by the customer or have not been improperly installed or operated, or the design altered, or for any other reason such a defect is not attributed to any act or omission on the part of the Company, and provided that prompt notice is given to the Company as soon as the defect or apparent defect is known to the customer, and the goods or defective part are returned to the Company at the customer's cost.

The foregoing states the Company's entire liability in contract and in negligence in respect of defects in material, design and workmanship and neither the Company nor any of its sub-contractors, employees or agents shall be liable in contract tort or otherwise for any injury, damage or loss of whatever kind attributed to such defects.

The Company shall not be liable in the event of the manufacture delivery or commissioning of any goods sold hereunder being prevented or delayed by any act or circumstance beyond the Company's control including therein (but without prejudice to such generality) strikes or trade disputes (whether or not involving the Company) difficulty in obtaining raw materials or fuel interruptions.

10. Product Use and Application

Unless otherwise stated all electrical ratings must be adhered to as representative of safe working conditions. Dimensions and physical dimensions are subject to normal mechanical tolerances. The product must be installed in accordance with the instructions given in each product instruction manual and the customer shall be responsible for ensuring the fitness of the product for the customer's application.

Where the product is purchased by the customer for supply to any other party, the original customer will be responsible for ensuring all conditions of sale are met.

11. Cancellations Prior to Despatch.

Any purported cancellation of orders will only be deemed effective if:

- 1) made in writing.
- 2) agreed by the Company.
- 3) all Company expenses and loss of profit associated with the transaction are indemnified by the customer.

12 Cancellations Following Despatch.

Subject to Pulsonic Technologies consent having been obtained in writing, products must be returned in an unused condition within 14 days of the invoice date. If the product packaging is unopened a handling charge of 25% will apply. A higher charge will apply if the goods are returned after more than 14 days from the invoice date or in an opened but unused condition. Such charges will reflect the work that the company will be required to undertake to return the goods to stock. Where goods have been found to have been used the full invoice amount will be charged.

13. Copyrights

Goods offered for sale by the company are subject to any copyright, patent, trade mark or other right of any person.

14. English Law shall apply to the sale of all goods and services hereunder with the jurisdiction of the English