



FLOWMASTER V

Ultrasonic Open Channel Flow Measurement System

User Manual

Serial Number

Date of Purchase

Factory Set Security Code

Supply 24VDC/AC

110VAC

230VAC

COMMUNICATIONS

RS232

4-20mA

2 RELAYS

5 RELAY

TEMPERATURE COMPENSATION

AUTOMATIC

MANUAL

© Copyright Notice February 2009

Pulsonic Technologies Ltd
Riverside House
North Dean Business Park
Greetland
Halifax
HX4 8LR. United Kingdom

Tel : +44 (0) 1422 363462
Fax: +44 (0) 1422 363275

CONTENTS

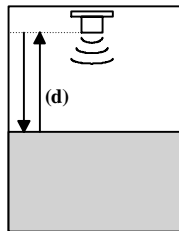
		Page
1.0	Introduction	1
2.0	Operating and Programming	2
	2.1	Run Mode 3
	2.2	Main Menu 4
	2.2.1	Set-up sensor 5
	2.2.2	Set-up relays 9
	2.2.3	Set-up System 10
	2.2.4	Display Set-up 12
3.0	Mounting Instructions	12
	3.2	Correct Location 14
	3.3	Blanking Distance, Deadband and Safety Procedure 14
APPENDIX A	Tank Dimensions	15
APPENDIX B	Terminal Connections - FlowMaster Plus	17
	Connections and Wiring	18
APPENDIX C	Terminal Connections - FlowMaster Plus V	19
APPENDIX D	Fault Finding	23
APPENDIX E	Parshall Flumes	25a

1.0 Introduction

The Flow Master V instrumentation unit is for use in conjunction with the PenMet 018 non-contact ultrasonic sensor head. The Flow Master V 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.



Time of Flight

The flow master measures.

- (i). Volumetric Flow.
- (ii). Total Flow.
- (iii). Distance.
- (iiii). Temperature.

The 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.

distance (**d**) = Time of Flight x Ultrasonic Velocity

2

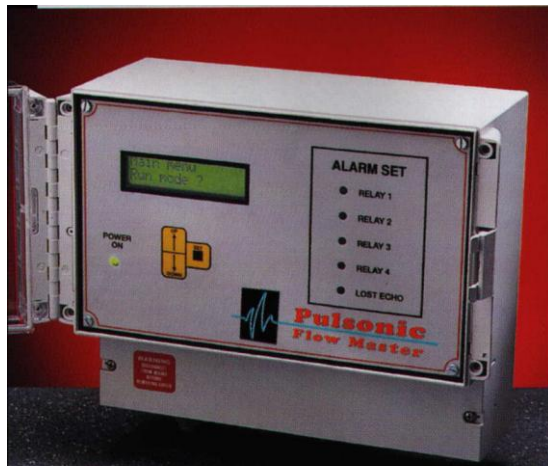


Figure 1

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.

Figure 1. shows the facia layout of the FMP.

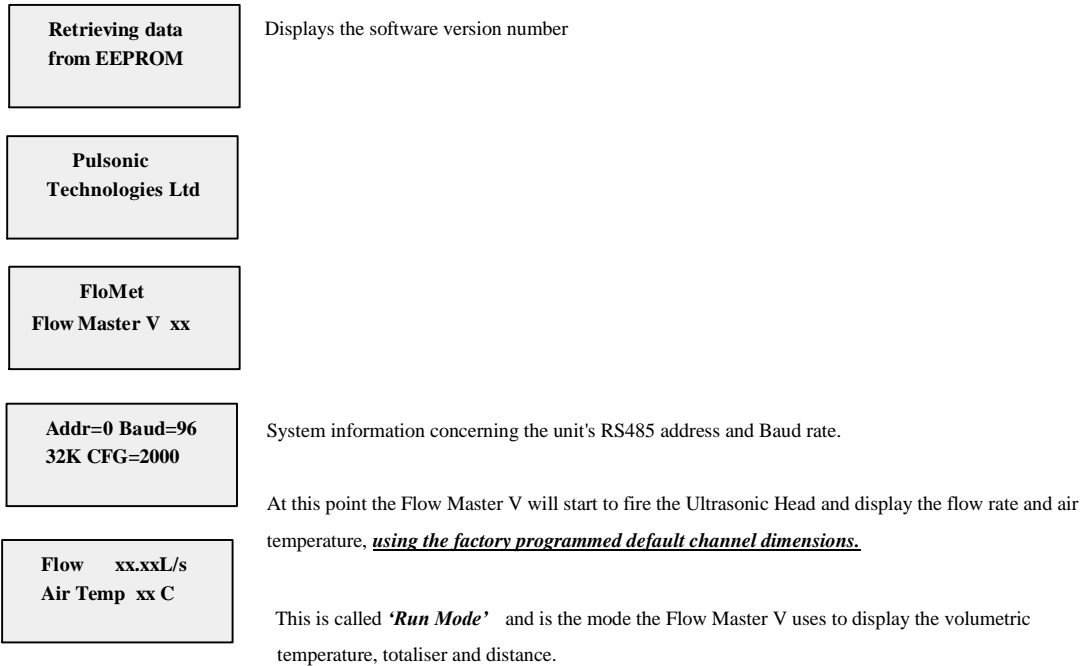
On the front panel facia you will find the LCD display, the **Alarm Set** LED's underneath and the **Programming Keys**.

2.0 Operation and Programming

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

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

This means the Flow Master V is retrieving the system set-up data from the non-volatile memory.



To programme the Flow Master V, 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 Flow Master V also emits a short 'bleep' as an acknowledgement of a key press or when the auto repeat function is in use.

2.1 Run Mode

The Flow Master V 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 through the following :-

Flow xx.xxL/s
Air Temp xx C

Displays the flow rate and air temperature in the Channel. The flow is displayed in Litres/second (L/s) or in other pre-set units and the air temperature in degrees Celsius (°C).

Distance xx.xxm
Air Temp xx C

Total xx.xxm3
Air Temp xx C

Displays the totalised flow up to 999,999,99m³.

All the information regarding the shape and size of the channel, the head offset etc. are programmed into the Flow Master V 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

Security
Code ? x

To bring the Flow Master V 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 Flow Master V returns to run mode.

***** 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 Flow Master V 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 flow Master V through the following menu options :-
Press 'SET' to select the required option.

**Main Menu
Run Mode ?**

Returns the Flow Master V to 'Run Mode'

**Main Menu
Setup sensor ?**

Programmes the flumes, weirs lookup table and the ultrasonic head parameters.

**Main Menu
Setup relay ?**

Programmes the relays parameters.

**Main Menu
Setup System ?**

Programmes the temperature, new password and RS485/RS232 data communications address.

**Main Menu
Display setup ?**

Displays the pre-programmed system settings for use in Engineering diagnostics.
(for use only by Pulsonic Technologies Service personnel)

Each of the above menus should be programmed as appropriate when first installing the Flow Master V.

Definition of Terms :-

No flow distance

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.

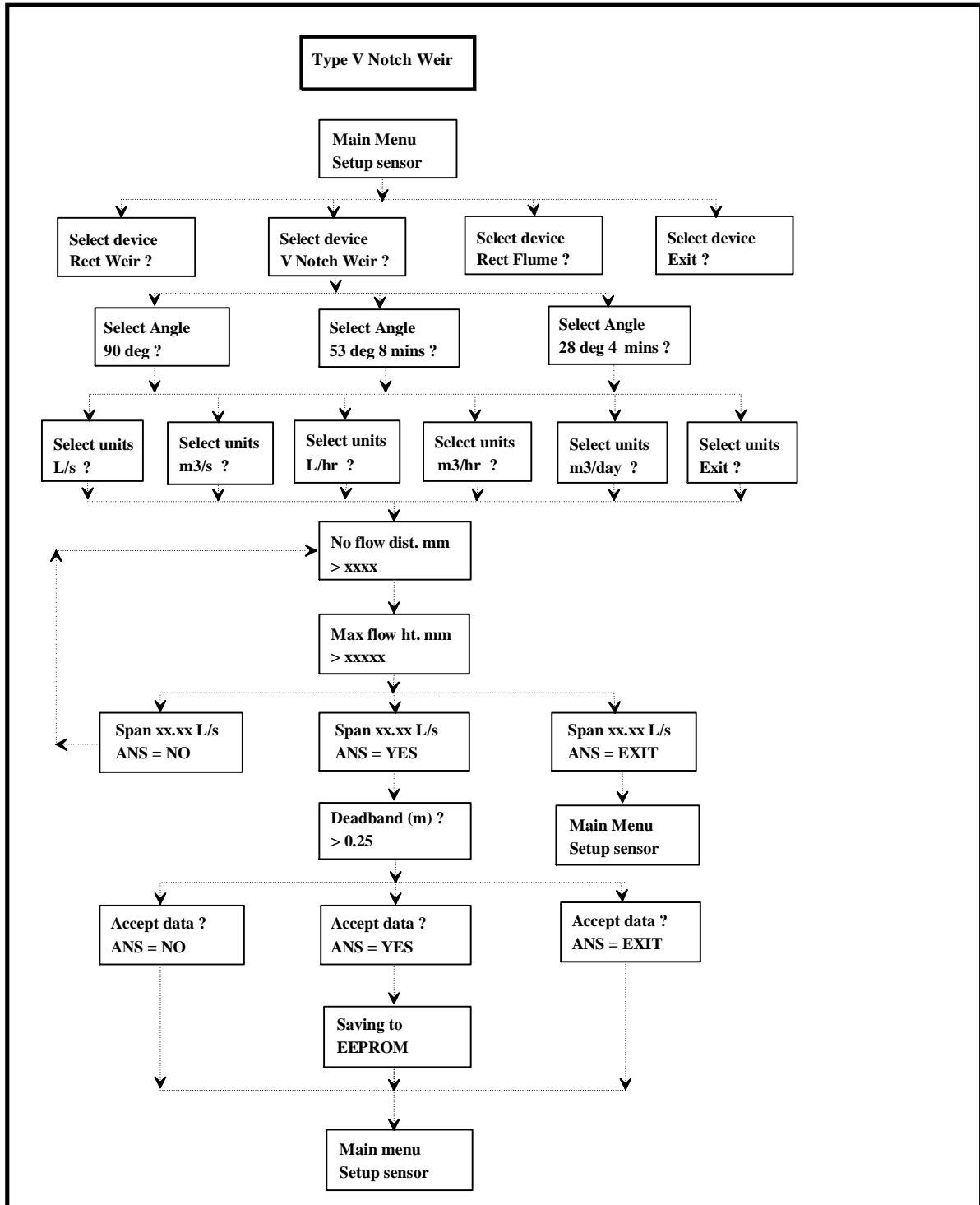
Deadband

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 echo.

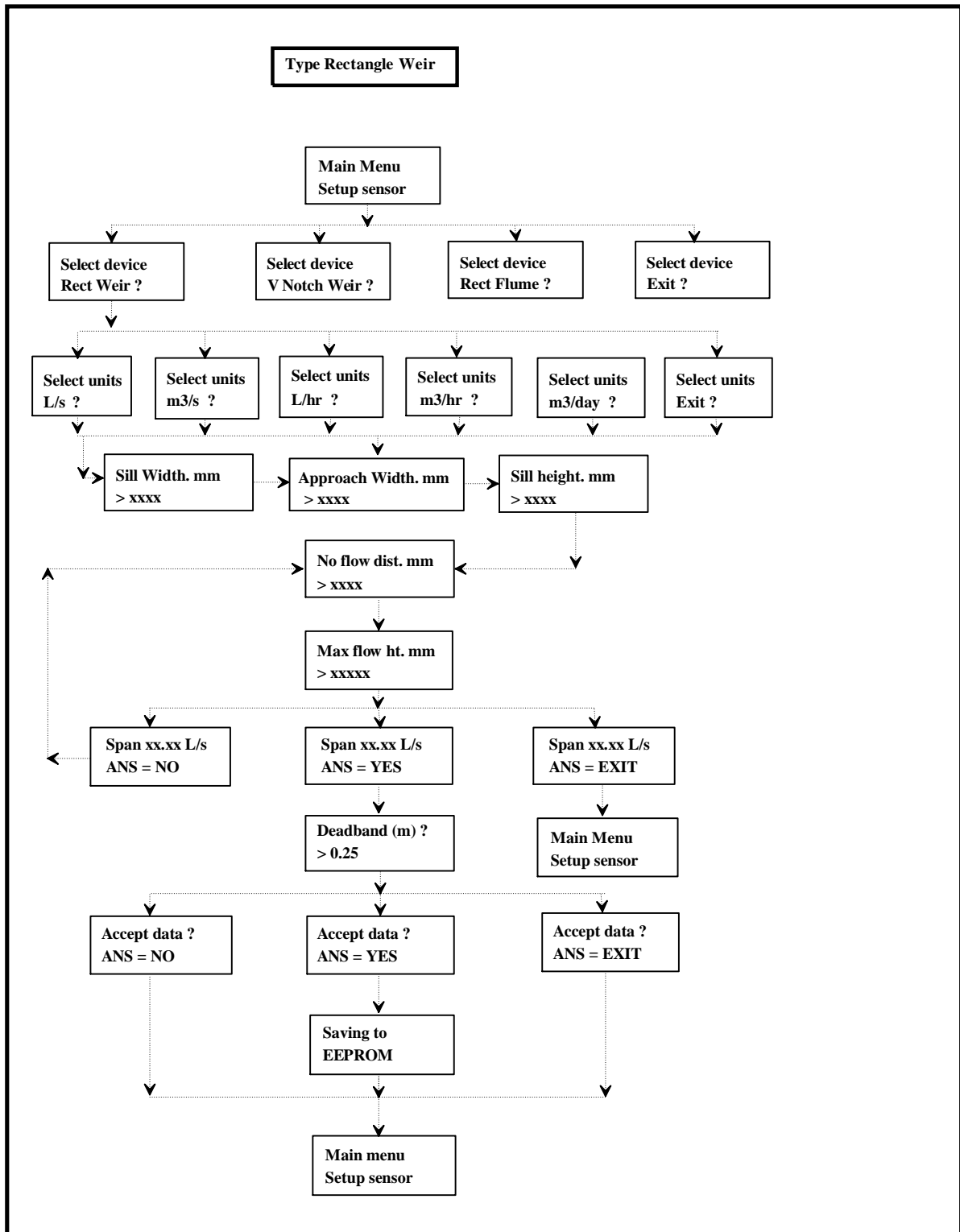
2.2.1 Set-up sensor

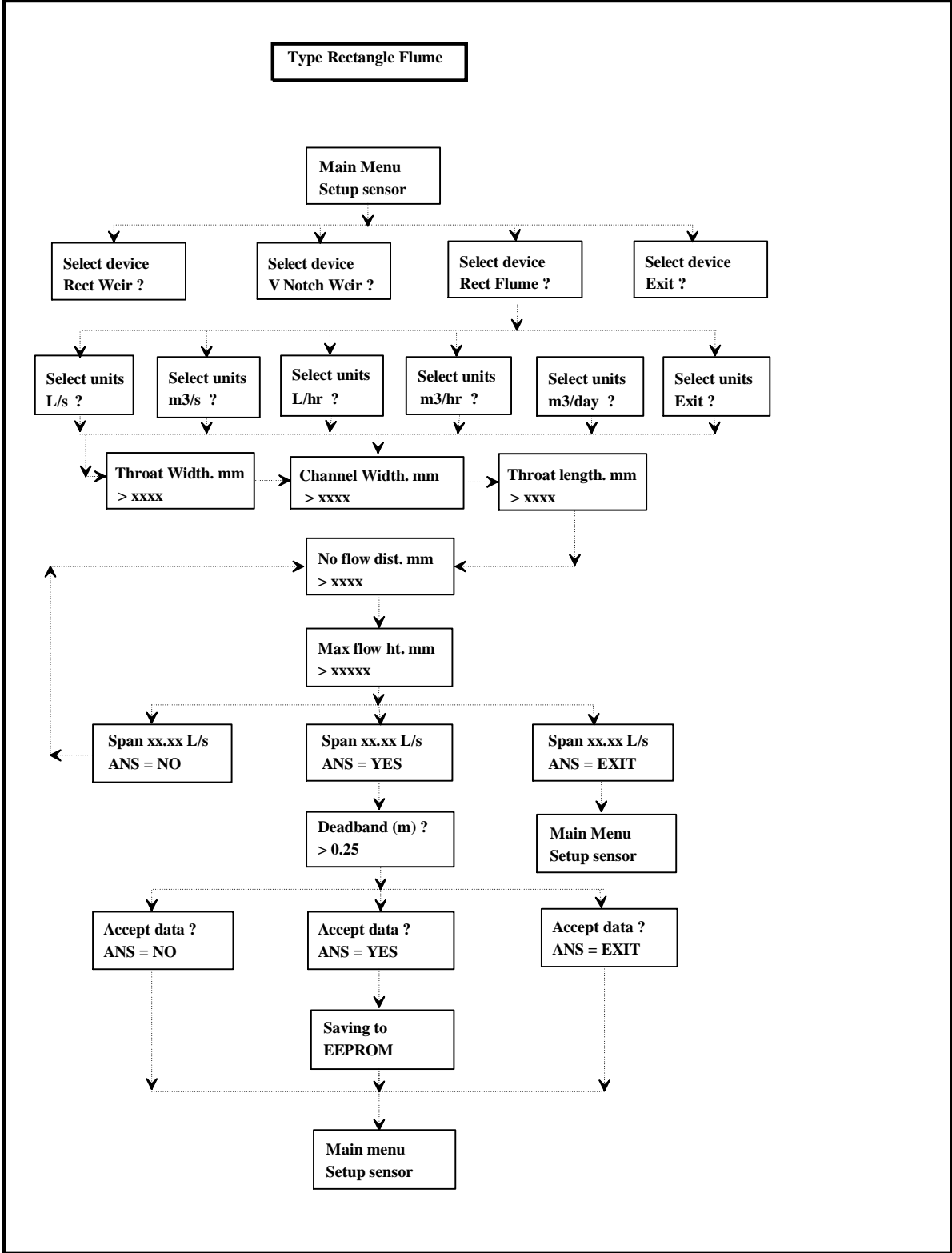
The 'Set-up sensor' menu is where the flume and weir tank shape and size and the ultrasonic transducer parameters are entered into the Flow Master V. For dimensional definitions see Appendix A



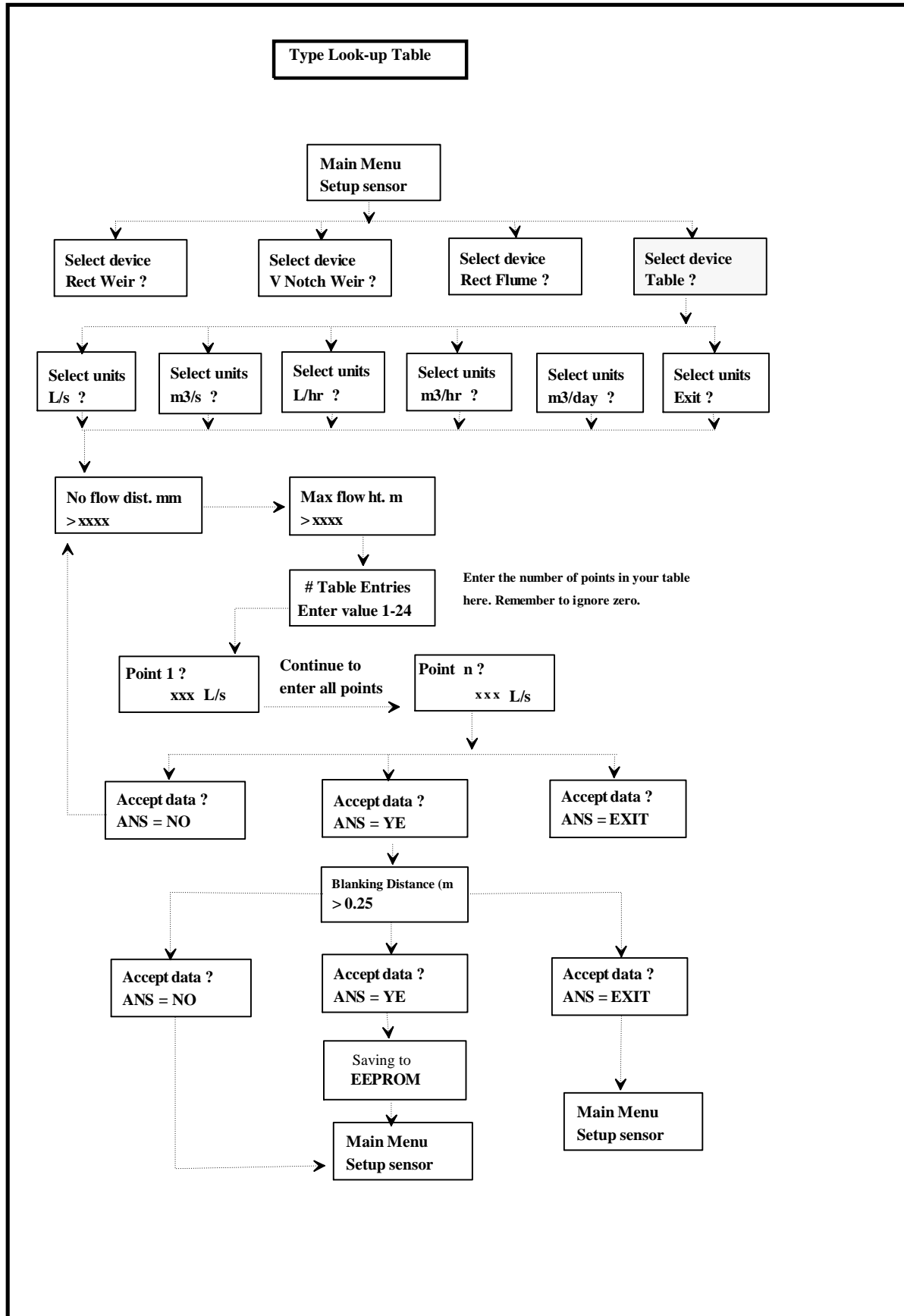
For dimensional definitions see appendix A.

For dimensional definitions see appendix A.





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.



2.2.2 Edit relay

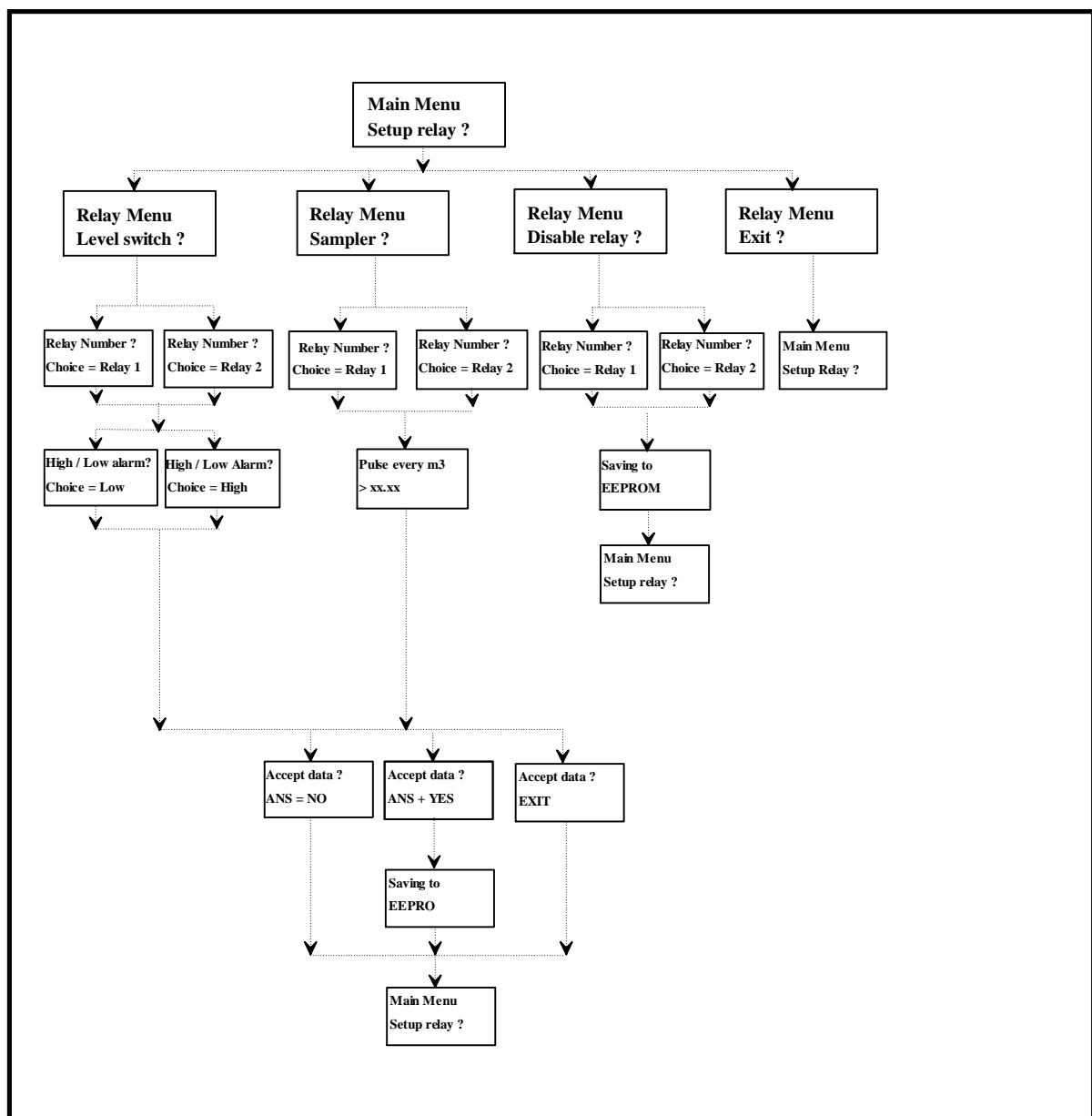
The 'Set-up relay' menu is where the programmable relay information is entered into the Flow Master V.

The relays can be programmed via the 'Set-up relay' option of the main menu. There are 4 relays on the Flowmaster V of both **Normally Open (NO)** and **Normally Closed (NC)** configuration.

The 4 relays on the Pulsonic Technologies Flow Master V 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 |

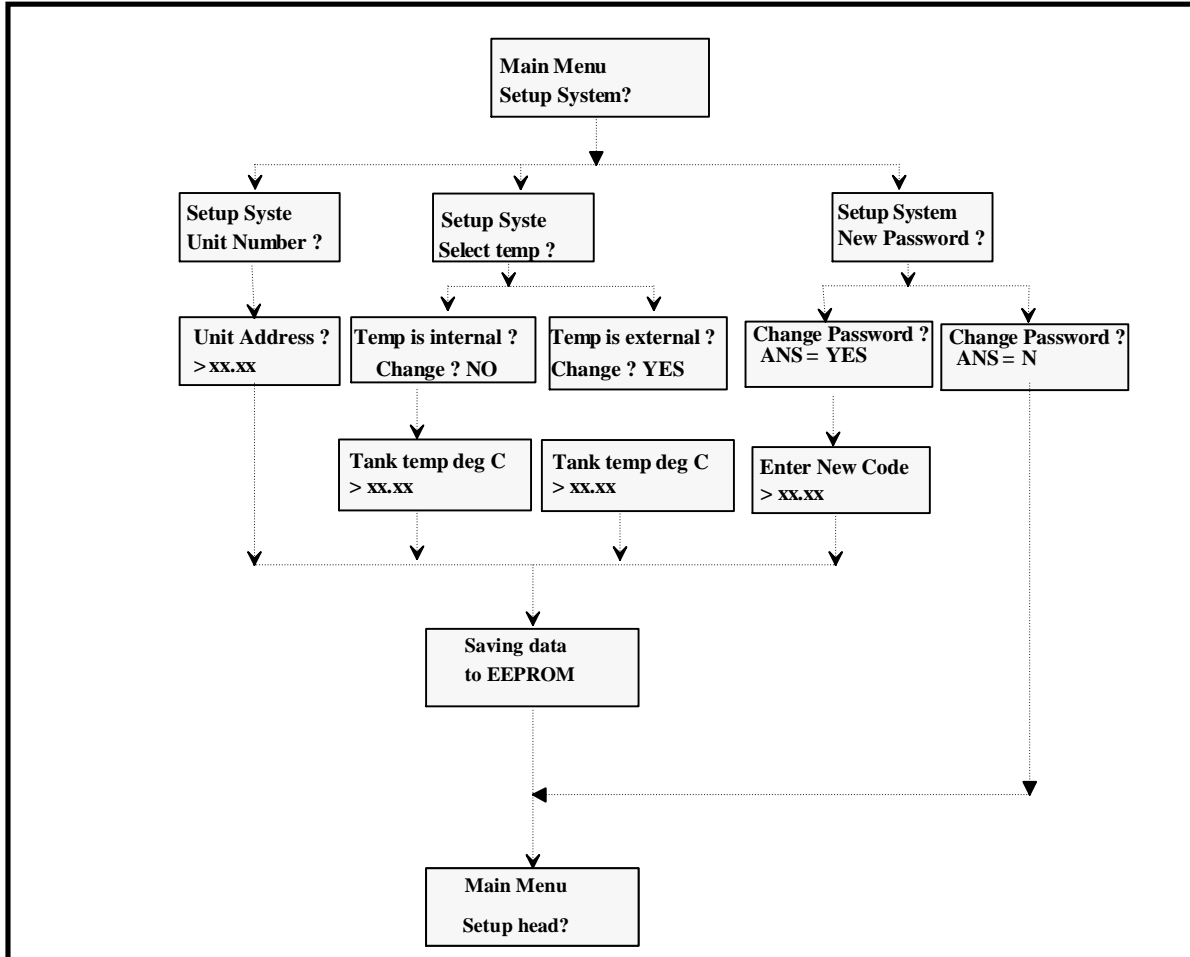
Once you have selected 'Set-up relay' you may cycle through these choices until you select one of them. You will then be asked to enter the appropriate values.



2.2.5 Set-up System

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

The menu structure is displayed below :-



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)

Lost Echo :

The Lost Echo function is signalled on the 4-20mA output as 0mA (i.e Open Circuit). To ensure the unit fails to a safe condition under power loss or malfunction the lost echo function must always be used.

NOTE :

The velocity of sound changes by 0.18% per °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. This is a useful means of checking all the programme parameters have been correctly entered.

3.0 Mounting

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. The sensor must be held rigidly over the channel and directed towards the liquid face.

- 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.

3.1 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 screw it is important that the natural turning moment of the transducer is resisted with a suitable 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, EITHER WHILE IT IS BEING SECURED OR WHEN IN USE.

NOTES

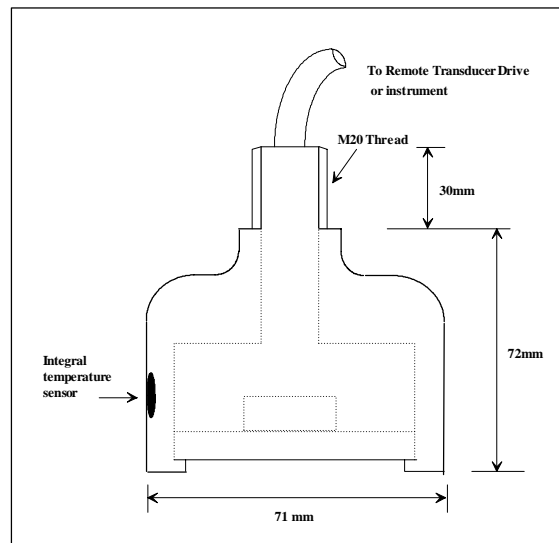
- A. Support and restrain sensor cables to avoid damage.
- B. Route sensor cables away from power cables and other sources of interference.
- C. Where cables pass through a junction box, maintain continuity of the screen.

NOTE

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.

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.



3.2 Correct Location

The transducers should be placed such that the ultrasonic beam does not reflect from interfering structures during its flight path.

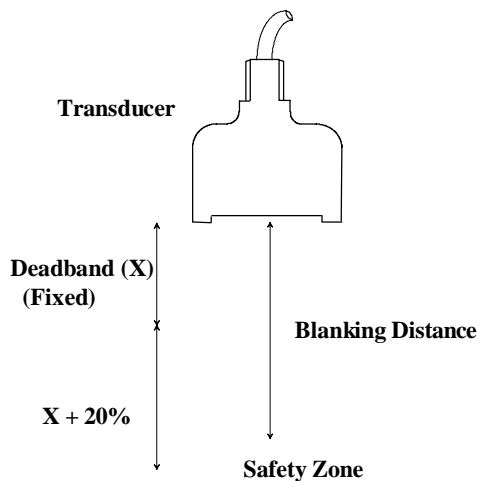
The table below gives the beam spread for the ultrasonic wave as it travels from the transducer for an angle of 6 degrees..

Ensure that at the maximum distance to be measured, the beam does not collide with interfering structures.

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	

3

3 Blanking Distance, Deadband and Safety Procedure



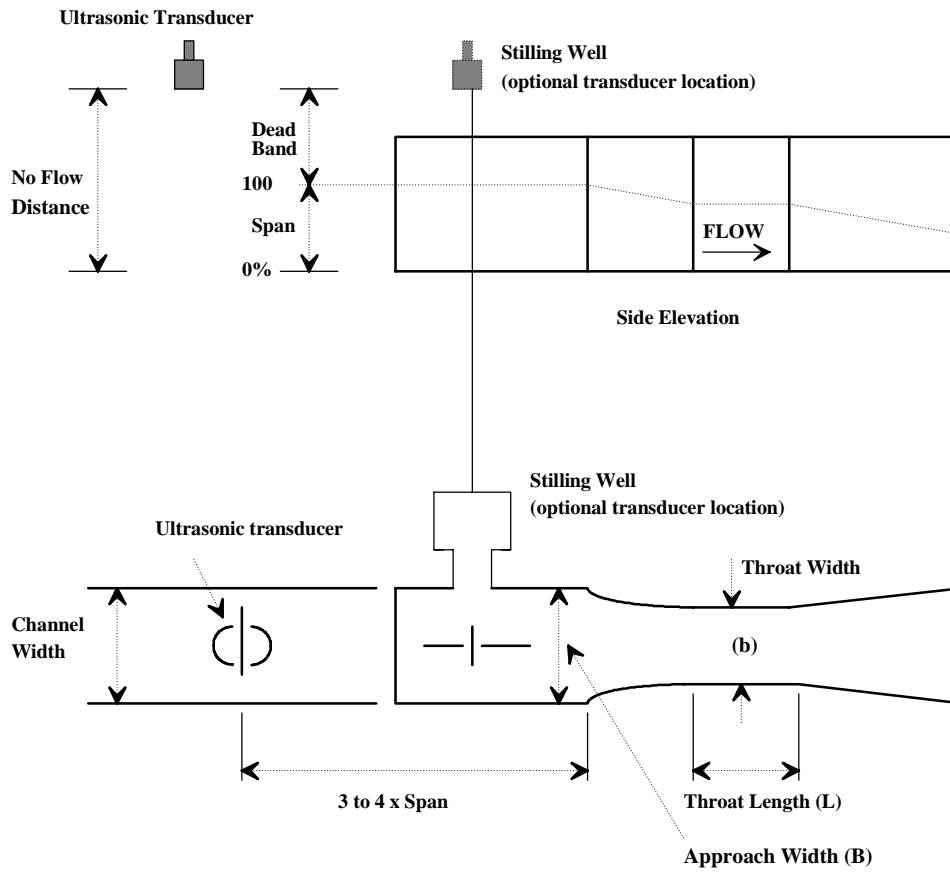
There may be instances where obstructions in the channel give rise to false echoes. If such obstructions are above the maximum level to be measured then they may be gated out by instructing the computer to ignore any return echo in the flight path up to such an obstruction. This is performed in the calibration 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.

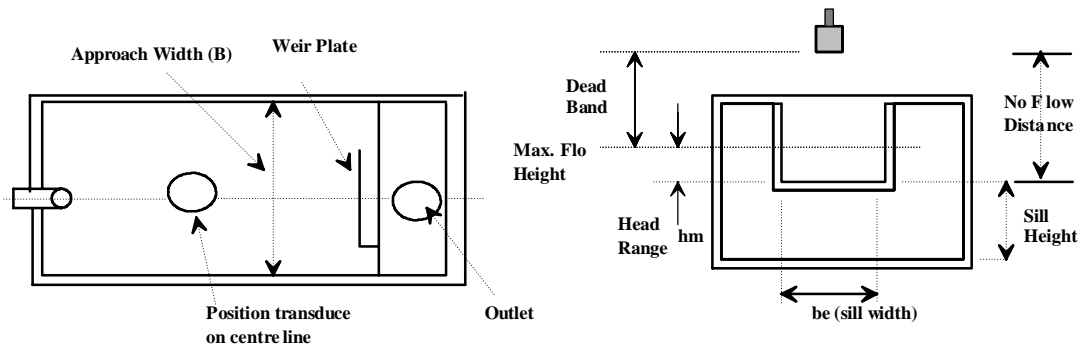
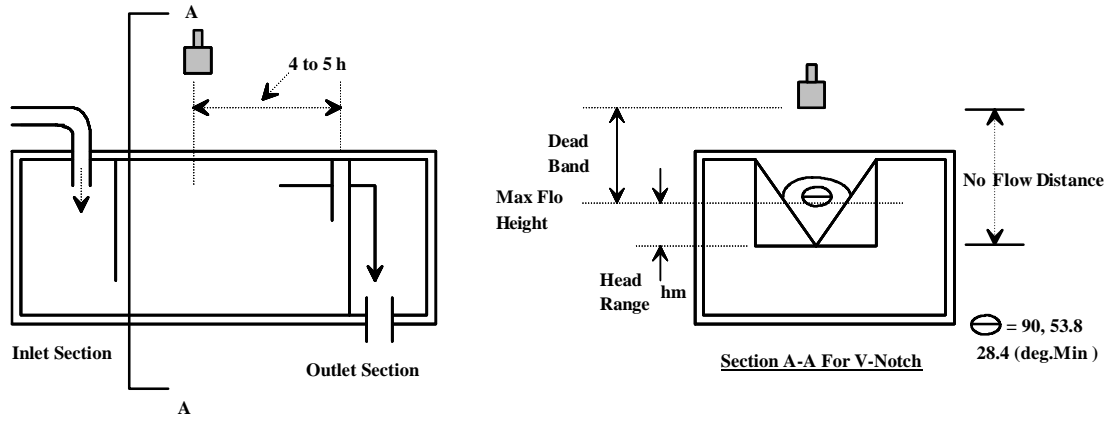
In order to prevent this occurrence you should always assign one of the relays to a high alarm condition.. The level of this high alarm must be below the dead band zone which is given in metres in the set-up head menu for each head type. It is recommended that you make this alarm setting equal to the distance of the deadband plus 20%. For example an 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.

Transducer Location For Rectangular Flumes



Transducer Location For Weir Tanks



Appendix B : Terminal Connections for Flowmaster Plus

All connections to the unit are located on the rear section of the unit housing. The Ultrasonic Transducer has been supplied with 2m standard cable unless ordered with longer length with the wires labelled (see Connections and Wiring). A weatherproof IP68 gland must be used to make any termination's or when extending cable length. Access into the transducer will invalidate the guarantee.

All wiring must be to the latest IEE regulations.

Power Connections

The unit can be powered from mains 110/230VAC. The details of the Power connections are given in the diagram below.

The Power drawn is 5 Watts.

Fuse Rating : 20mm 1A Anti-surge

Relay Connections

There are 4 programmable relays. 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 and voltage	1A @ 24VDC
Electrical life at full load	min. 8×10^4 operations
Mechanical life	min. 5×10^6 operations

Communications

The RS232 is factory set to:-

8 Data bits
1 Start bit
1 Stop bit
No Parity

The data 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.

Connections and Wiring

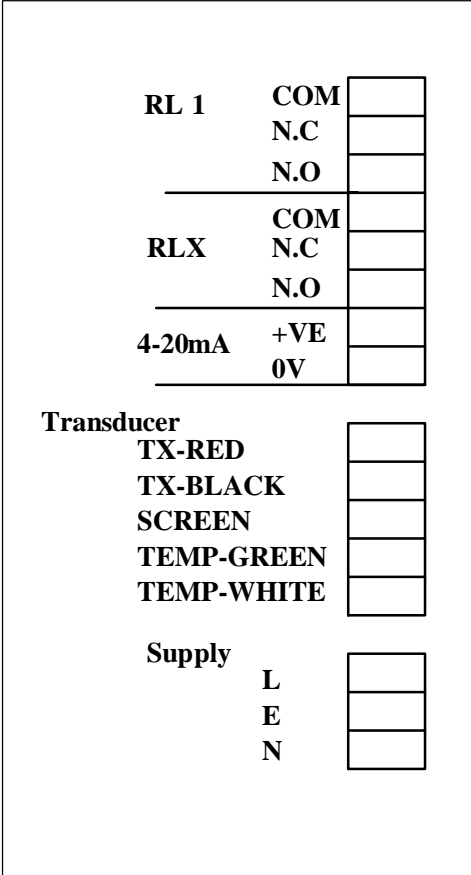
Relay 1 RL1
 Common COM
 Normally Closed NC
 Normally Open NO

Relay 2 RL2
 Common COM
 Normally Closed NC
 Normally Open NO

4-20mA Isolated
 +Ve
 0V

Transducer
 TX RED
 TX BLACK
 SCREEN
 TEMP GREEN
 TEMP WHITE

Supply
 L Live
 E Earth
 N Neutral



Cable type :- 4 Core Cable Copperbraid, Screened. Max. current per Core 1A. Max. Temp 70 deg C.

Transducer Remote Driver

Where the transducer cable exceeds 50m you will be provided with a remote driver interface box. The connection to this driver is via a 6 core cable type Defence Standard 61-12, Sub miniature Cable Specification 16-2-6C. See page 22. Connection details are printed on the rear of the units

Appendix C : Terminal Connections for Flowmaster V

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.

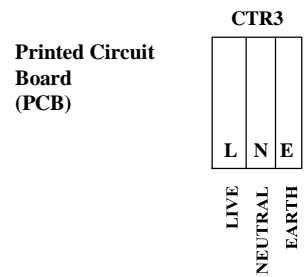
The unit supply voltage must be provided via a double pole spur.

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.

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

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



Relay Connections

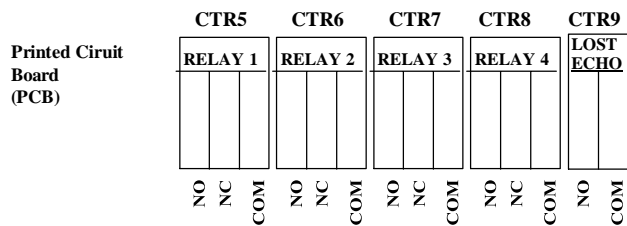
There are 4 programmable relays and 1 lost echo relay that are available to external circuitry. These relays have both normally open (NO) and normally closed (NC) contacts so that they can be used in any configuration.

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 10⁴ operations
- Mechanical life min. 10⁷ operations



The connections for the relays are shown below



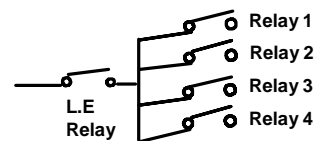
Lost Echo Relay :

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.



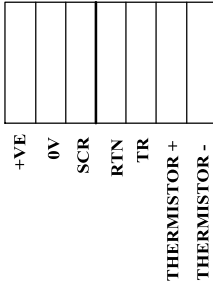
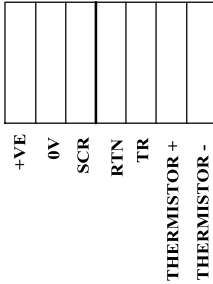
Ultrasonic Head Connections from Enclosure to Remote Transducer Driver

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.

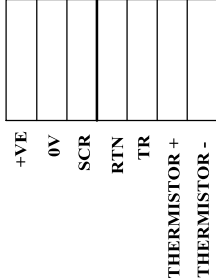
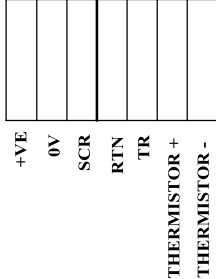
The 'RTN' connection is the pulse from the instrumentation unit that instructs the head to send a packet of ultrasound.

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	Printed Circuit Board (PCB) <u>Note</u> <u>Ensure connector block from transducer is correctly wired</u>		
0V	Green			
SCR	Screen			
RTN	Blue			
TR	Yellow			
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	Printed Circuit Board (PCB)		
0V	No Connection			
SCR	Screen			
RTN	Red			
TR	Black			
Thermistor +	White (Temperature sensor)			
Thermistor -	Green (Temperature sensor)			

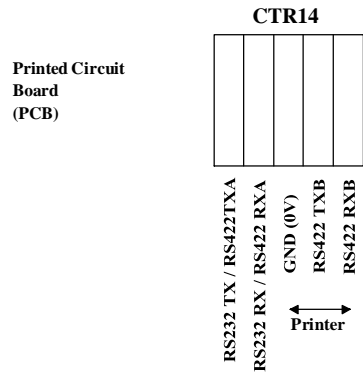
Communications

The RS232/422 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.



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:-

Printed Circuit Board (PCB)



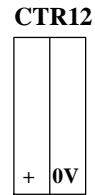
24 V AC / +24V DC
24 V AC / 0V DC

THIS MUST BE FACTORY SET

4 - 20mA Output

The unit can be provided with a 4-20mA output option.

Printed Circuit Board (PCB)



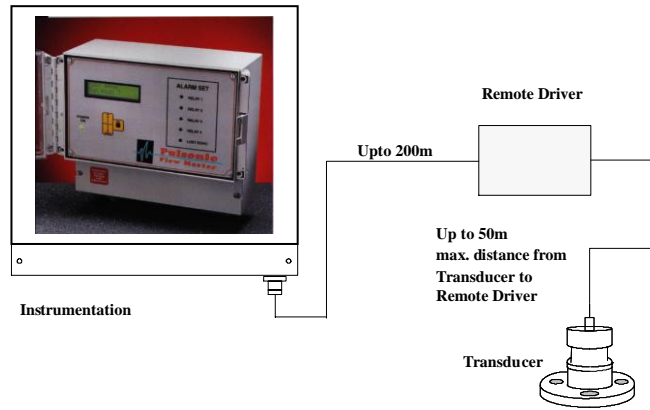
4 - 20mA Out
Isolated GND

The terminal connections for this are shown below:-

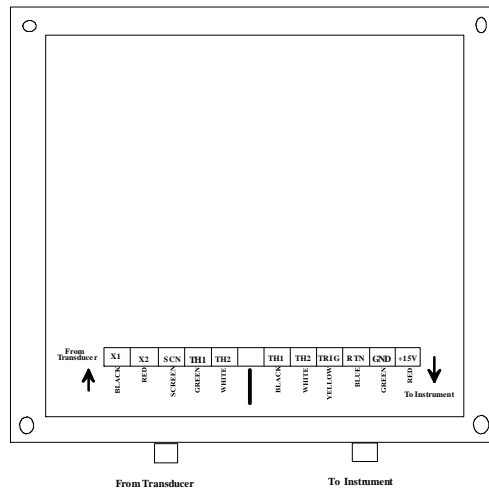
Installation With Remote Driver Electronics

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



<u>CONNECTION</u>	<u>ID</u>	
<u>To Instrument</u>		
TH1	- Instrument White	: Temperature sensor
TH2	- Instrument Black	: Temperature sensor
TRIG	- Instrument Yellow	
RTN	- Instrument Blue	
GND	- Instrument Green	
+15V	- Instrument Red	
<u>From Transducer</u>		
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: Where multiple sensors are connected to the instrumentation ensure that the cables are kept at least 300mm apart to prevent magnetic coupling. Always ensure grounds and screens are connected.

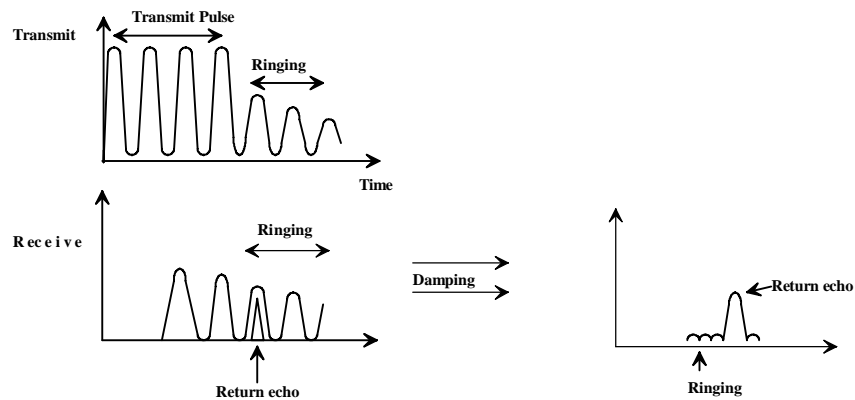
Appendix D: Fault Finding

Ringling

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 ringling always use gaskets and never over-tighten bolts. Increasing the blanking distance beyond the ringling time will also lock out its effect.

No Display showing FMP not firing:



Check supply to FMP.

Carefully unscrew the four screws and remove fascia 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)

Stilling 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.

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