Process Instrumentation

LEVEL HUNTER

Ultrasonic Level Measurement & Pump Controller

User Manual

Security Code Default = 1

ECHO Process Instrumentation, Inc.
70 6th Ave. or PO Box 800
Shalimar, FL 32579 USA

Phone: 850-609-1300
Fax: 850-651-4777
Email: info@echopi.com
Website: www.echopi.com

CONTENTS

			Page
	General Specification		1
1.0	**Introduction**		2
2.0	**Operating and Programming**		2
	2.1	Run Mode	3
	2.2	Main Menu	4
	2.2.1	Set-up Transducer	4
	2..2.2	Edit Tank	5
		Cylinder Tank	6
		Rectangle Tank	7
		Sphere Tank	8
	2.2.3	Editing Relays	9
		Edit Relay	10
	2.2.4	Set-up 4-20mA	11
	2.2.5	Set-up System	12
	2.2.6	Display Set-up	13
	2.2.7	Keyboard Simulation	14
3.0	**Mounting Instructions**		15
	3.1	Offset Pipe	16
	3.2	Blanking Distance, Deadband and Safety Procedure	16
	3.3	Correct Location	17
	3.4	Solids	17
4.0	**Transducer Mounting**		18
	Flange Mounted		18
	Three Head Transducer 034		18
	Screw Mounted		19
	Installation Kit		19
APPENDIX A	**Tank Dimensions and Head Offset Convention**		20
APPENDIX B	**Terminal Connections**		21
	Mains Connection		21
	Relay Connections		21
	Lost Echo Relay		21
	Ultrasonic Transducer Connections		22
	Communications		22
	Low Voltage Power Connections		23
	4-20mA Output		23
	pH Input		23
	Installation With Remote Driver Electronics		24
	Wiring Connection For Remote Transducer Driver		24
APPENDIX C	**Fault Finding**		25
	NOTES:		27

General Specification

The Level Hunter is the latest addition to the family of Ultrasonic Level Measurement and Control Systems available from ECHO. The Level Hunter is a low cost single channel ultrasonic level/ volume monitor and pump controller which uses the latest state-of-the-art technology.

High in functionality, the Level Hunter offers non-contact level measurement of liquids and solids. Standard features include the measurement of level , volume, target distance and tons if SG known.

By eliminating the need for complex setting up programs, the Level Hunter can be configured by using the four line integral programming and status LCD display, simply by scrolling through the menu and selecting the appropriate answers.

Calibration, relay settings and communications are all programmable, with in-built software traps to prevent the user programming the unit incorrectly.

In the run state, the LCD window simultaneously displays level, volume, distance and temperature.

APPLICATIONS - *Multiple Pump Control, Filling and Discharge Control, Overflow & Dry Running Pump Protection, Level / Volume Indication and Object Proximity Detection*

FEATURES - *Simple user friendly programming, Four line programming and status display, 4 programmable and 1 lost echo relay, Relay status LED's, Analog isolated 4-20mA output and RS232 or RS422 output*

***Big in functionality but small in price the* Level Hunter**
is ideal for low budget applications which require a flexible solution!

Specifications

Operating Performance

Range
Up to 132 ft (40 metres) depending on transducer

Resolution
Xducer 06: 0.2 mm (0.007"), Xducer 10,20,40: 1 mm

Accuracy
Xducer 06: +/- 0.02% of measured range or +/-1 mm (whichever is greater)
Xducer 10,20,40: +/- 0.2% of measured range or 5 mm (whichever is greater)

Outputs

Analog
Galvanically Isolated 4-20mA into 500 ohms (max)

Digital
RS232 or RS422 output (optional)

Relay
4 programmable SPDT contact relays rated
at 5A at 230VAC non-inductive
1 lost echo relay

Control relays
Programmable for Pump Control or Level alarms,
Pump control - Duty/Assist (Lead/Lag)
High or Low level alarms
Rate of rise or Rate of fall
Temperature alarm

Indication
Four line LCD programming and status display.
Indication of distance, level, volume and weight in tons.
LED's for relay/echo status and power.

Enclosure
NEMA 4X. IP65 rated wall mount enclosure

Dimension
11.0W x 8.6H x 6.1D inch (263 x 217 x 132.5 mm)

Power Supply
Selectable 115/230VAC @ 20VA
or Optional: 24VAC/DC (Factory Set)

Programmable Features

Calibration Menu
Security code entry into programming mode.
Four programmable relays for pump control, level, and volume.
Volume conversion for up to 8 tank shapes.
Other tank shapes, factory programd.
Level, Volume, Distance - weight conversion in in tons
Damping filter
Firing delay
Turbulence Filter

Communications Menu
Independent 4-20mA, RS232 or RS422

Keyboard Simulation
User test mode to verify running status

Options Available

Data logging (external module)

ECHO Process Instrumentation, Inc.
70 6th Ave. or PO Box 800
Shalimar, FL 32579 USA
Tel: 850-609-1300
Fax: 850-651-4777
Email: info@echopi.com
Website: www.echopi.com

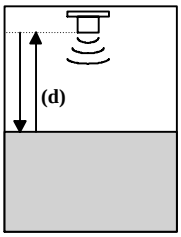
ECHO Process Instrumentation, Inc. policy is one of continuous product development and consequently we reserve the right to alter specifications and prices without prior notice.

1.0 Introduction

The ECHO Level Hunter instrumentation unit is for use in conjunction with the ECHO range of ultrasonic sensors. It provides distance, level, volume and tons measurements for a range of tank shapes and dimensions.

The universal instrumentation unit will operate one transducer from the ECHO range. The choice of ultrasonic transducer you have been supplied with is dependent on the far-field operational range you require.

MODEL	RANGE
Xducer 06	0.82 – 20ft (.25 – 6m)
Xducer 10	1.15 – 33ft (.35 – 10m)
Xducer 20	1.64 – 66ft (0.5 – 20m)
Xducer 40	3.0 – 132ft (0.9 – 40m)



Time of Flight

Each transducer 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, level or volume information.

distance (**d**) = Time of Flight x Ultrasonic Velocity
2

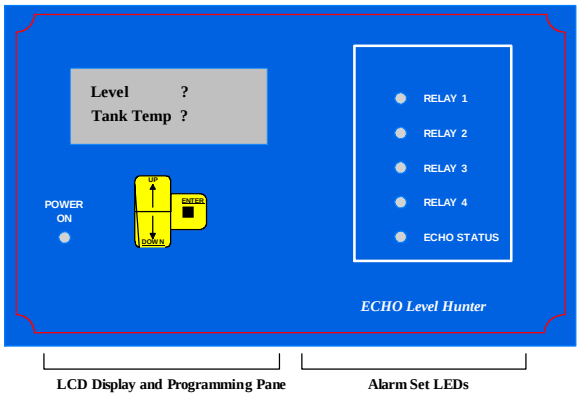


Figure 1

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.
You will notice that the instrumentation unit is divided into two sections, On the left hand side of the facia you will find the **programming keys** and LCD display. On the right hand side you will find the **Alarm Set** LEDs.

2.0 Operation and Programming

When installing the Level Hunter, first fit the Ultrasonic transducer to the tank as per the instructions in Section 3.0 and wire it to the instrumentation unit as described in Appendix B of this manual.
When power is first applied to the Level Hunter, it will show the following messages on the LCD display quickly in succession:

Retrieving data from EEPROM	This means the Level Hunter is retrieving the system set-up data from the non-volatile memory.
ECHO PI www.echopi.com	
ECHO LEVEL HUNTER X . X	Displays the software version number
Addr=0 Baud=96 32K CFG=2000	System information concerning the unit's RS485 address and Baud rate.
Level xx.xx ft Tank Temp xx F	At this point the Level Hunter will start to fire the Ultrasonic transducer and display the level and temperature of the tank ***using the factory programd defaults.***

This is called ***'Run Mode'*** and is the mode the Level Hunter uses to display the tank contents.
To program the Level Hunter, 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 'ENTER' button when the relevant menu option is displayed.
For all numeric values, the menu statement displays the currently programd value and allows the user to increase or decrease this value by pressing and holding 'UP' or 'DOWN'. Pressing 'ENTER' will set the new value into the system and overwrite the old value. If the old value is on the display and the user presses 'ENTER', 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 Level Hunter 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 Level Hunter will normally remain in 'Run Mode' displaying the contents of the tank. All the relay outputs are active during this mode. Depending on the options programd, pressing the 'UP' or 'DOWN' buttons will scroll the display through the following:

Level xx.xx ft **Tank Temp xx F**	Displays the level (default is feet) and temperature (default is ^{o}F) of in the measurement application.
Level xx.xx% **Tank Temp xx F**	Displays the tank level as a percentage of full i.e. 100% = full 0% = empty.
Distance xx.xx ft **Tank Temp xx F**	Displays the distance from the Ultrasonic transducer face to the liquid or solid surface.
Volume xx.xxft3 **Tank Temp xx F**	Displays the volume of the tank contents in cubic feet (ft^3).
Volume xx.xx% **Tank Temp xx F**	Displays the tank volume as a percentage of full i.e. 100% = full 0% = empty.
Tons xx.x T **Tank Temp xx F**	Displays the weight of the tank contents in tons (T).
Tank Lost Echo **Tank Temp xx F**	If the Ultrasonic transducer should fail to receive valid echoes above the threshold, the 'Lost Echo' error message is displayed. If the echo is lost for longer than 3 minutes (default), the Lost Echo Relay will then be de-energised. The relay coil is re-energised when the echo returns. This can be disabled
Security **Code ? 1**	To bring the Level Hunter out of 'Run Mode', press the 'ENTER' button. The unit will then ask for the Security Code number to be entered. The factory pre-set code number (**1**) 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 'ENTER' to set the code. If no code is entered within 12 seconds, the Level Hunter 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 Level Hunter stops firing the transducer, 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 Level Hunter through the following menu options: - Press ‘ENTER’ to select the required option.

Main Menu **Run Mode ?**	Returns the Level Hunter to ‘Run Mode’
Main Menu **Quick Setup ?**	Programs Level or Volume, transducer model, offset, blanking distance, and distance to Empty parameters.
Main Menu **4-20mA Setup ?**	Programs the 4-20mA output.
Main Menu **Relay Setup**	Programs relays: Level, Fixed Pump, Alt/Duty Pump, Volume, Rate of Rise/Fall, Temperature or Disable
Main Menu **Advanced Setup**	Programs Advanced Settings for Communication, Temperature Compensation, Password, Filters, Lost Echo and Simulation.
Main Menu **Review Setup**	Displays all settings for review purposes.

Each of the above menus should be programd as appropriate when first installing the Level Hunter.

2.2.1 Quick Setup Menu

Selecting ‘Set-up head’ brings the Level Hunter to the ‘Calibrate Menu’. This is where the tank details and relay settings can be entered.

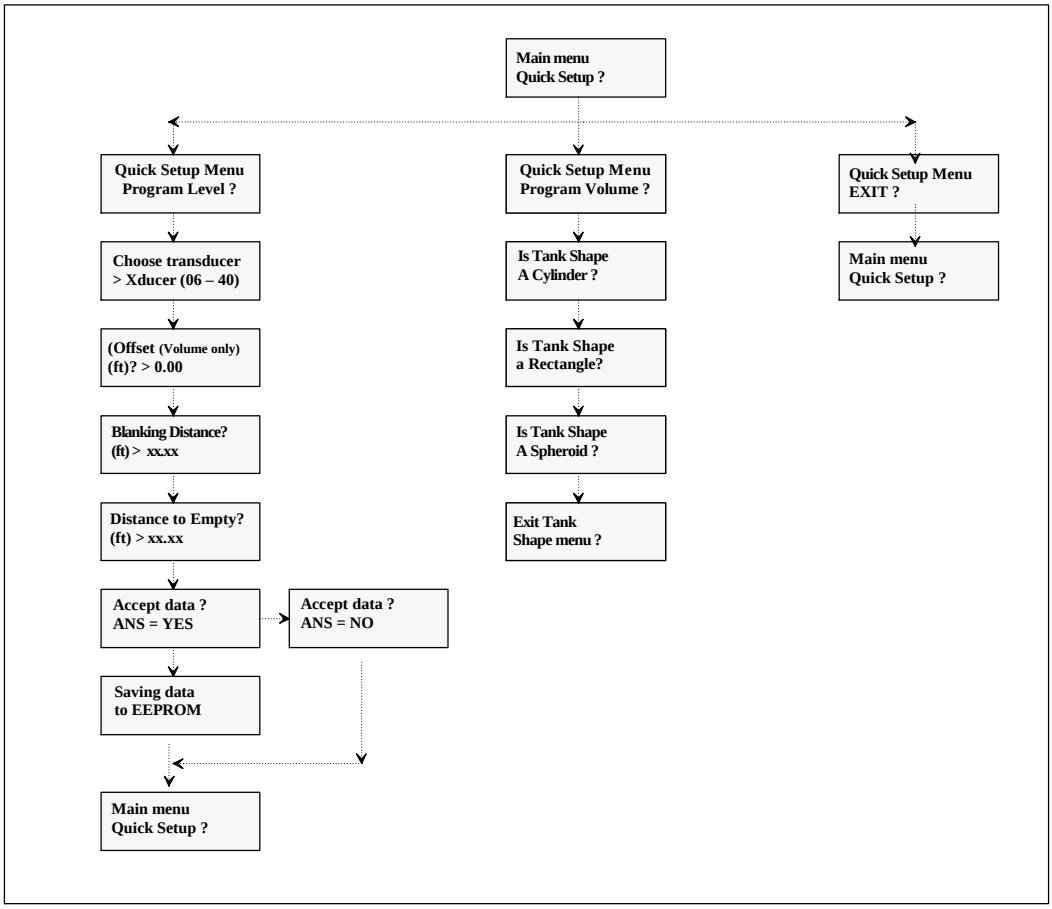
The LCD shows the following options in conjunction with the ‘UP’, ‘DOWN’ and ‘ENTER’ keys.

Quick Setup menu **Program Level ?**	Programs for Level Measurment.
Quick Setup menu **Program Volume ?**	Programs for Volume Measurment.
Quick Setup menu **Exit ?**	Returns to ‘Main Menu’.

2.2.2 Quick Setup Flow Chart

The 'Quick Setup' menu is where the basic parameters are inputted into the Level Hunter. See Appendix A for the definition of tank shapes as recognized by the instrumentation unit.

The 'Quick Setup Menu' displays the following programming structure:

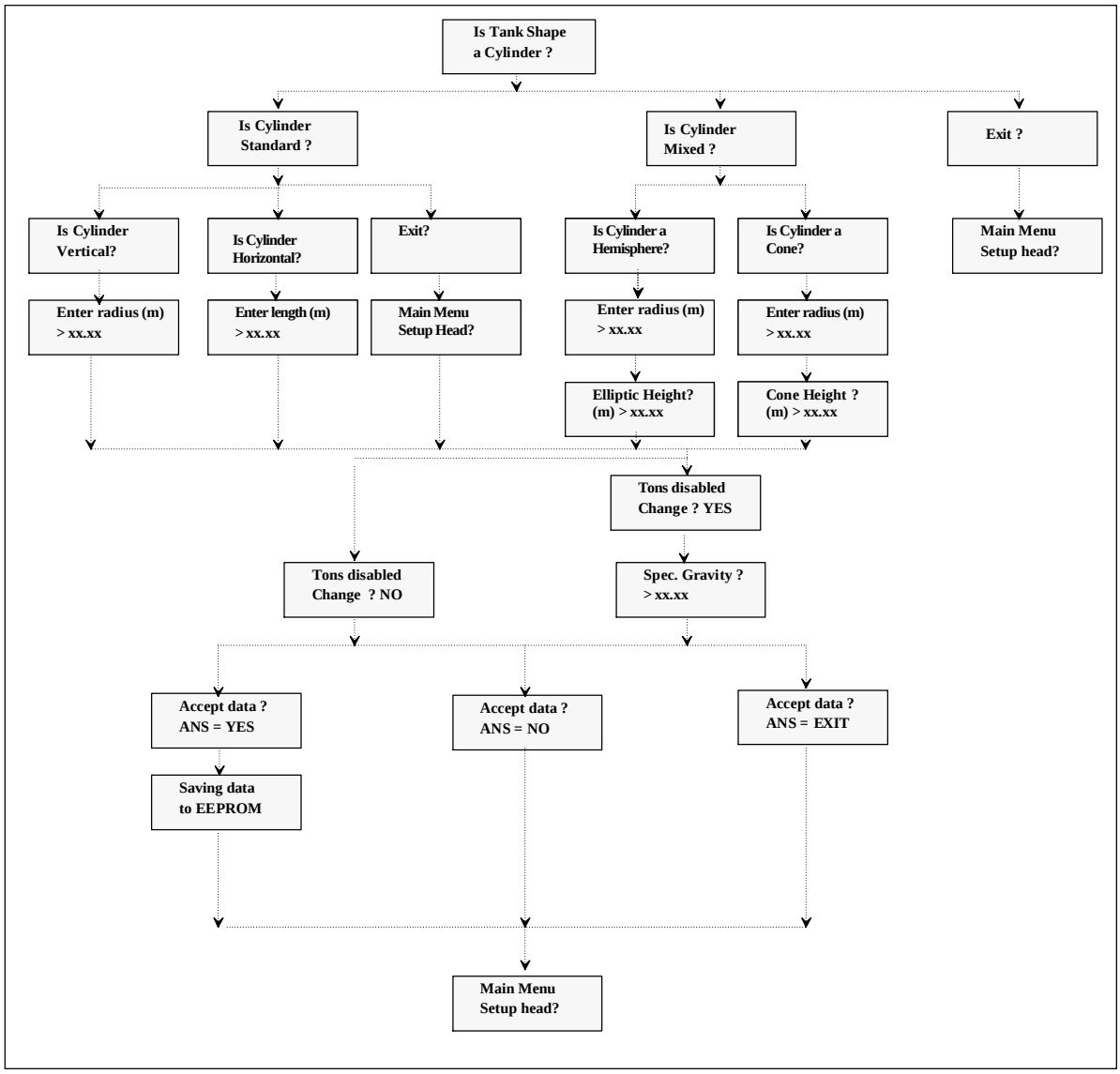


If the Level Hunter is only required to display the level then the only parameters that need to be programd are the tank height, standpipe offset, transducer type and blanking distance. See the 'Offset Distance' and 'Blanking Distance' sections of this manual for further details concerning these parameters. The instrument displays '>' when the user is required to enter a numeric value.

However, if the Level Hunter is required to display the tank volume, then further parameters have to be programd in addition to those stated above regarding the shape of the tank and its dimensions. The tank level **must be programd** before the instrument will allow volume settings to be entered. Reprogramming the level will disable any relays already set to switch on volume settings. The volume of the tank needs to be reprogramd before volume switching relays can be used. The Level Hunter recognizes several variations of 3 basic tank shapes: Cylinders, Rectangles or Spheres (see Appendix A). The menu structure for programming each of these 3 tank shapes is explained separately.

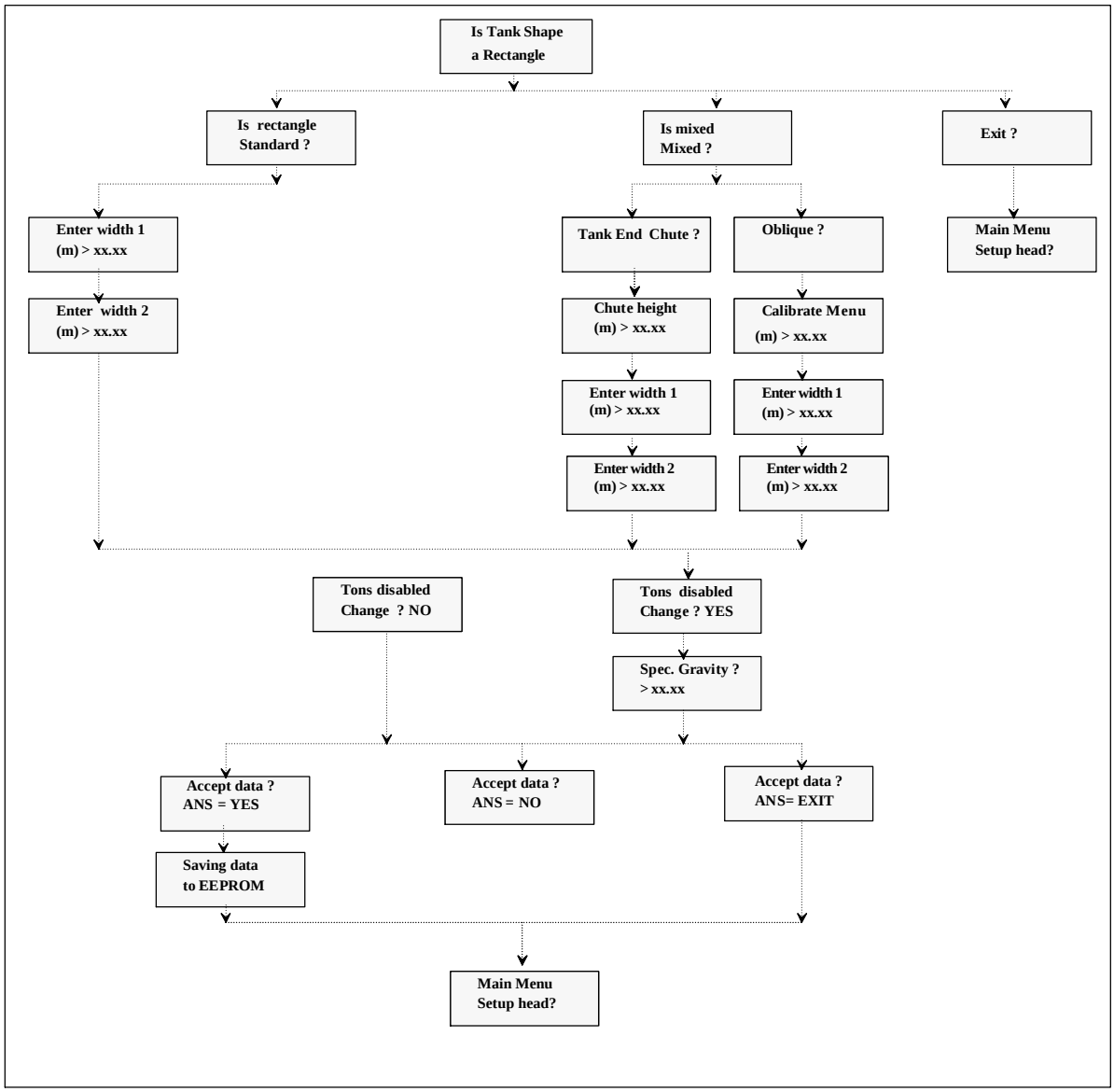
Cylinder Tank

If the tank to be programd is cylindrical in shape, the following menu structure is displayed on the LCD display:



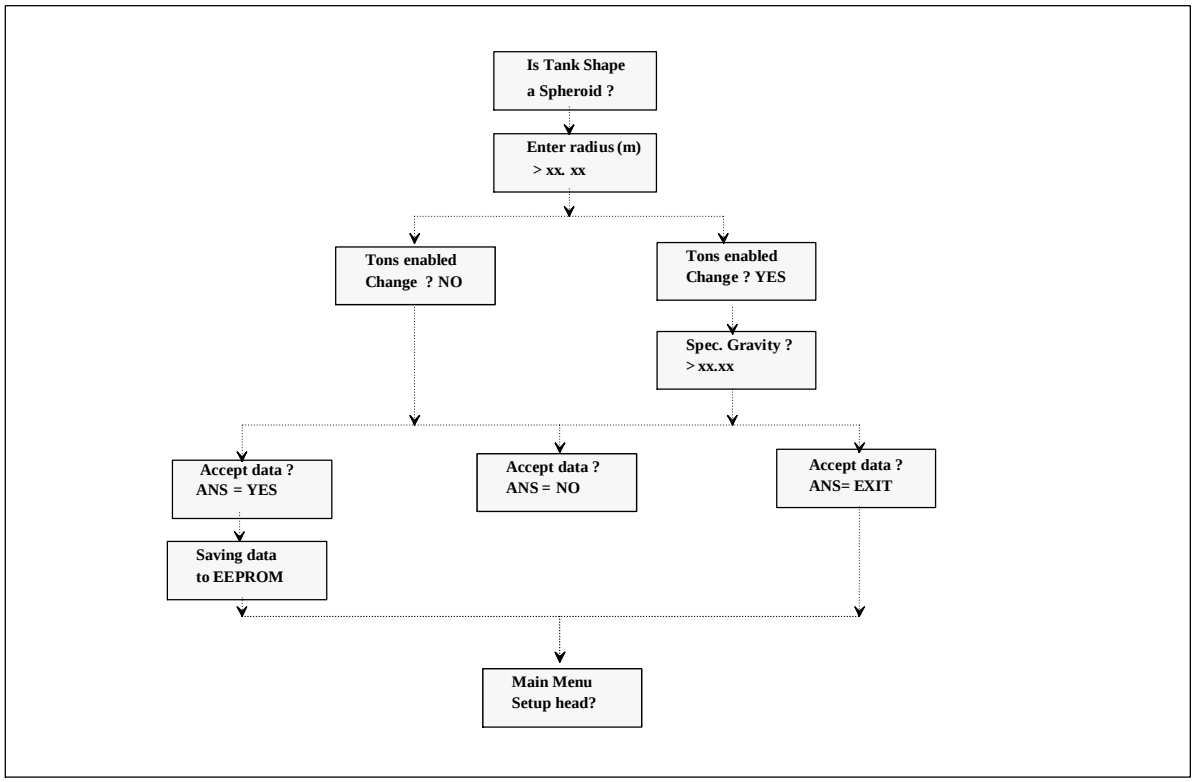
Rectangle Tank

If the tank to be programd is rectangular in shape, the following menu structure is displayed:



Sphere Tank

If the tank to be programd is spherical in shape, the following menu structure is displayed:



2.2.3 Relay Setup Menu

The relays can be programd via the 'Relay Setup' option of the main menu. There are 4 full programmable relay outputs of both **Normally Open** (NO) and **Normally Closed** (NC) configuration, (refer to Appendix B). There is also a fixed lost echo relay with Normally Open (NO) contacts.

The relays on the Level Hunter can be programd to switch on the following choices:

1.	**Level Relay?**	Alarm relay used for High and Low level conditions.
2.	**Fixed Pump Relay?**	Pump relay used for Fixed Sequence. No rotation cycle.
3.	**Alt/Duty Pump Relay?**	Pump relay used for Alternating Duty Assist (Lead/lag rotation sequence) to reduce pump wear.
	The relays can be programmed for:	a) Duplex Station, Relay Numbers 1 & 2 b) TriPlex Station, Relay Numbers 1, 2 & 3 c) 4-Pump Station, Relay Numbers 1, 2, 3 & 4
4.	**Volume Relay?**	Alarm relay used for High and Low level conditions.
5.	**Rate of Rise Relay?**	Alarm relay used for rate of change: Rising conditions.
6.	**Rate of Fall Relay?**	Alarm relay used for rate of change: Falling conditions.
7.	**Temperature Relay?**	Alarm relay used for High and Low temperature conditions.
8.	**Disable Relay?**	Removes all switching actions for a selected relay.

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

NOTE:

When the relays have been set in volume mode, the relays will be disabled when the tank level parameters are changed from the initial set-up. In order to enable the relays in the volume mode, the Volume set-up must be entered again. The previous values will be stored, therefore there is no need to set-up the values again unless changing.

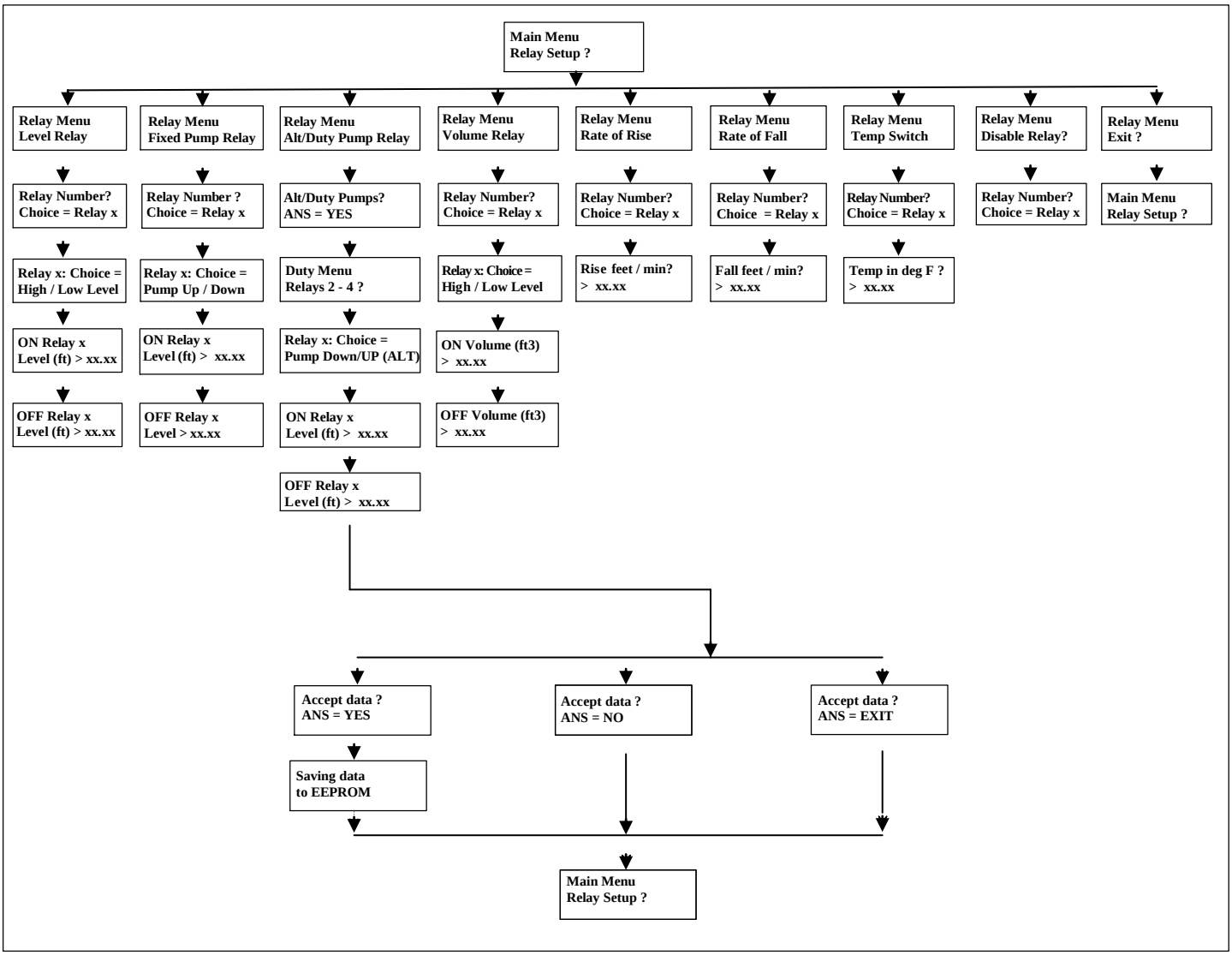
NOTE:

There is a delay of approximately 10 seconds after starting 'Run Mode' before any relays will switch. This is to allow the measured level to stabilize before relay actions are performed on its value.

Relay Setup Flow Chart

The ‘Relay Setup’ menu is where the programmable relay information is entered into the Level Hunter.

Below displays this flow structure:



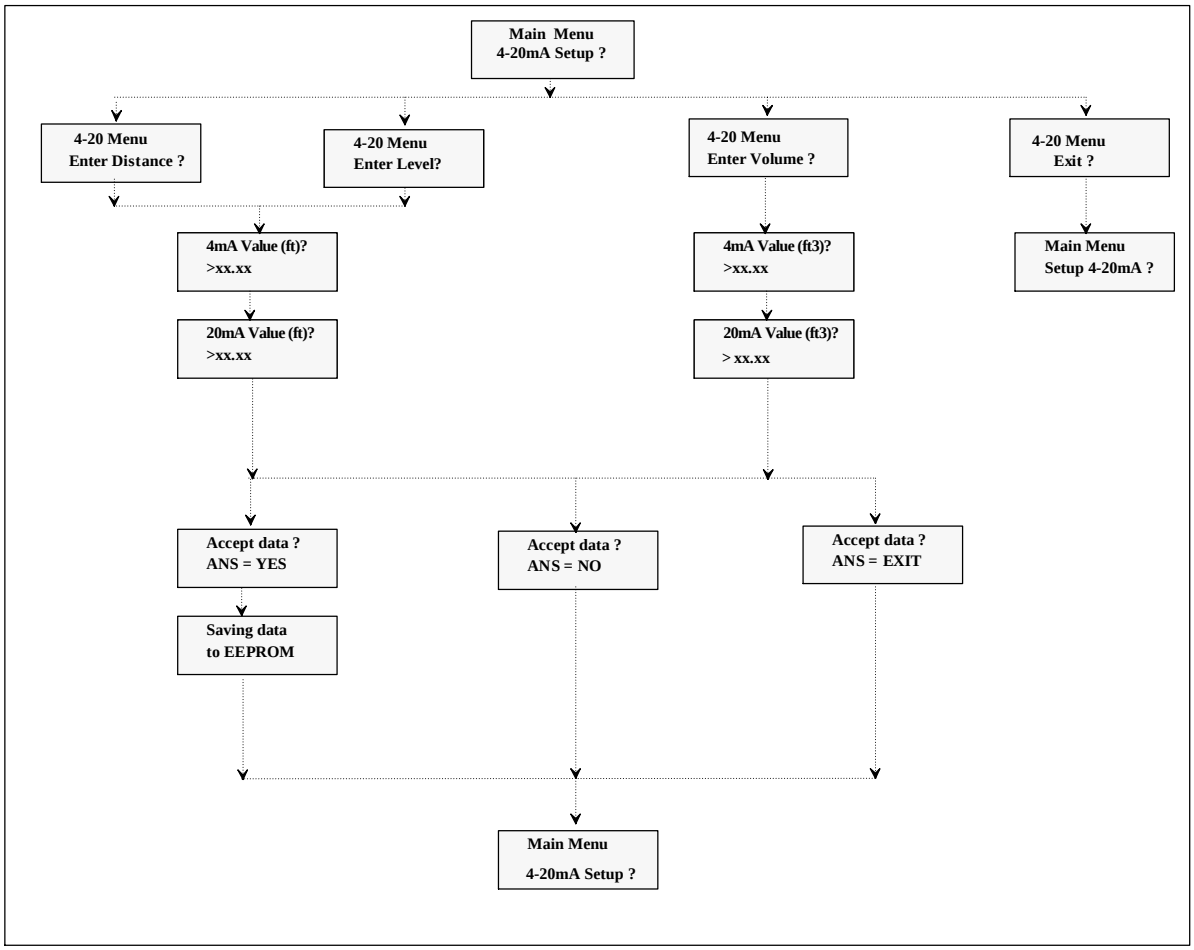
The user tries to program a relay that is already set to duty assisted level alarm, then a message is displayed saying 'Cannot use Relay-Assigned to Duty'. The user is then returned back to the Main Menu.

To remove the duty assist, go into the Duty Assist menu and select 'Remove All'. This removes the duty assist and disables all relevant relays.

2.2.4 4-20mA Setup Menu

In this menu, the span of the 4-20mA output signal can be programmed. The signal is proportional to the distance, level or volume of the measured tank.

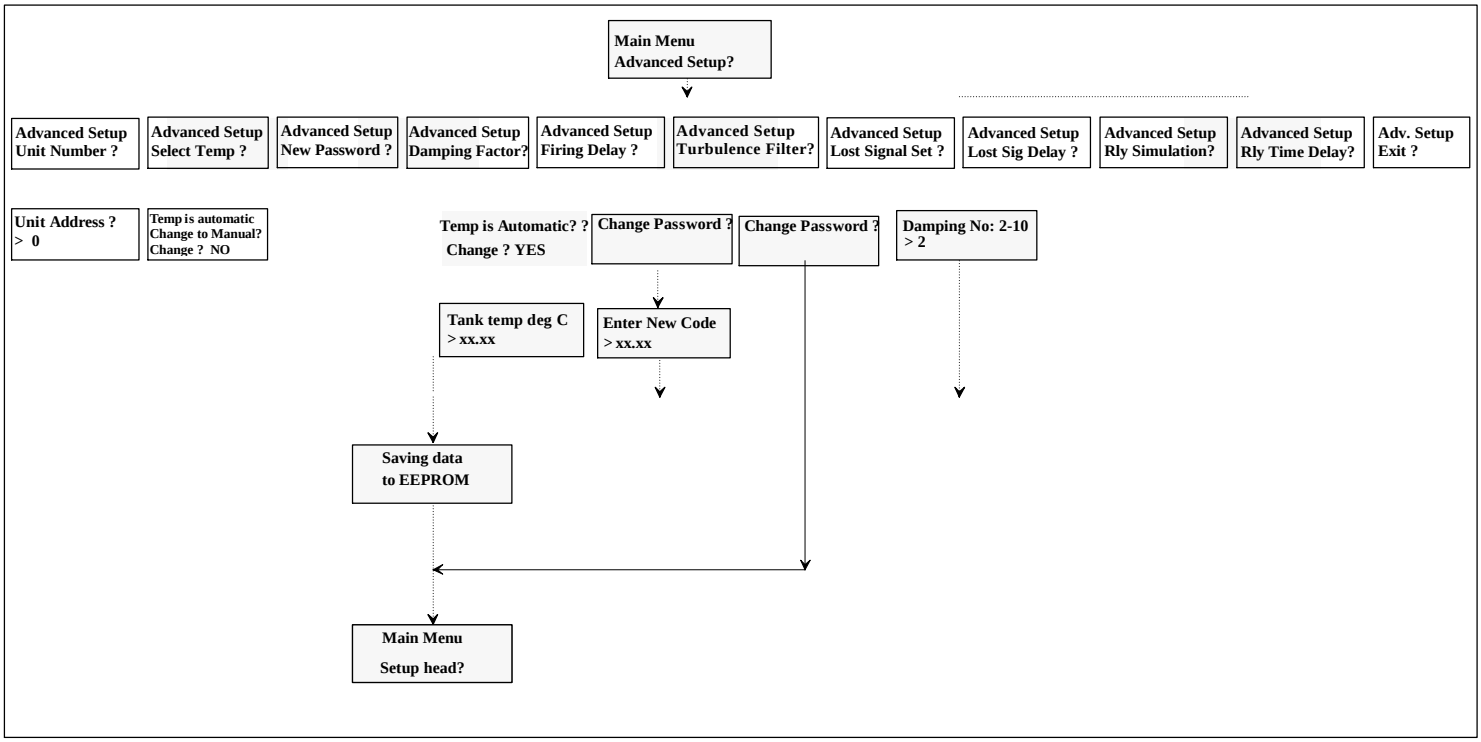
The displayed menu structure is as follows:



2.2.5 Advanced Set-up Menu

In this menu, the settings of the unit address (RS422/485 only), temperature compensation, passcode, lost echo and damping/ firing/ turbulence filters can be changed. The level simulation can also be selected.

The menu structure is displayed below:



NOTE:

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

Damping Factor (Increase = Increase Damping)

The damping factor should be increased with increased turbulence of the liquid surface to give a smoother output, representative of the average level.

Firing Delay (Decrease = Increase Pulses)

This is the time delay between each firing of the ultrasonic transducer pulse. The minimum number is 2 which will fire the head quickly and the maximum is 40 which will fire the head approximately once every 2.5 seconds. The factory default firing delay is 6.

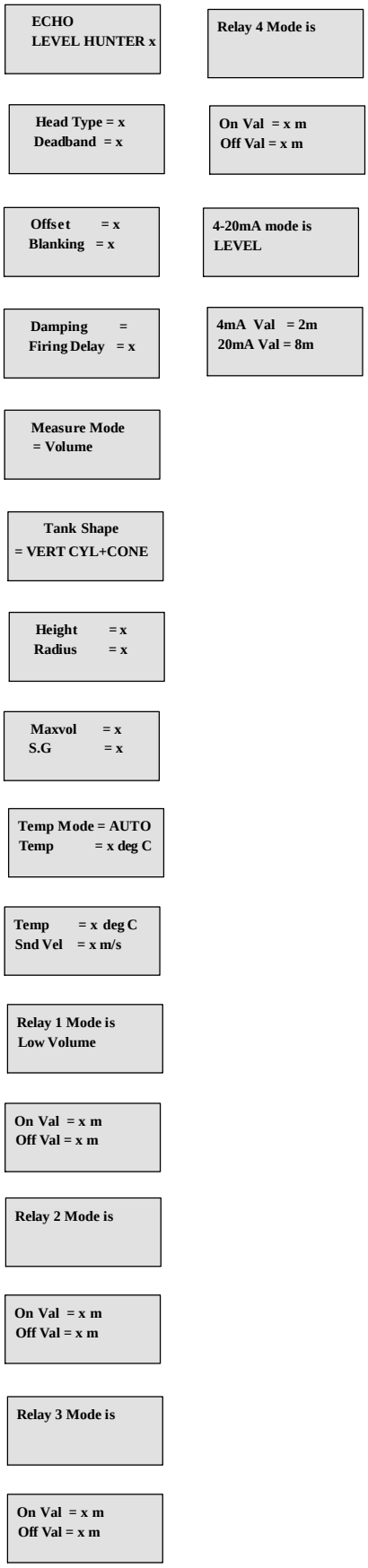
The firing delay would usually only be increased if multiple echo's cause the transducer to read incorrectly when the level was near the top on an enclosed tank or close to the transducer face when full.

Filter Coefficent (Decrease = Increase filter for greater damping)

Adjust the filter coefficent to reduce fluctuations caused by an undulating surface. Decrease the filter coefficient for greater smoothing/damping effect. Increase the filter coefficient to reduce the smoothing effect.

2.2.6 Display Set-up

In this menu, the settings of the unit can be confirmed. Press any key to scroll through the display:



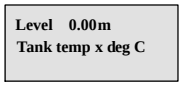
2.2.7 Keyboard Simulation

This mode can be used in conjunction with 'Display Set-up' and can be used as a final check of the programming and operation of the unit by allowing a simulated tank level to be entered and observing the relay actions, volume calculations and 4-20mA output.

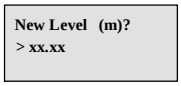
If this option is selected the message:

"Simulation Enabled" is displayed.

After a few seconds, the display returns to the menu as normal.
When the user next selects 'Run Mode', the Level Hunter functions normally but does not fire the ultrasonic transducer. The screen display will show:



If the user press 'ENTER' the Level Hunter will display:



By pressing the UP or DOWN keys, the displayed level can be adjusted within the range of the programd tank height. Press ENTER to accept the simulated level. The new level will be displayed. By pressing UP or DOWN keys the user can then scroll through all the calculated measurements of Level, Level as Percentage, Distance, Volume, Volume as Percentage and Tons for the given level.

The 4-20mA output will also set itself to the appropriate value depending on the mode and range of the 4-20mA set-up (sec. 2.2.4).

Any relays programd for level or volume will also switch if the entered level is of an appropriate value.

If any relays are programd for 'Rate of Rise or Rate of Fall', they will switch on immediately for a few seconds, then switch off again because simulating a level this way causes a step change in the value from one level to the next. This is seen by the instrument as a rapid rise or fall in the tank level causing these relays to switch appropriately.

Press ENTER again to set a new simulated level.

There are 2 ways to exit the simulation mode.

1. Press UP and DOWN keys together. This returns the unit to proper 'Run Mode'. i.e. firing the transducer.

2. Wait 3 minutes without pressing any keys while the simulated level is displayed. The unit then returns to proper 'Run Mode' automatically.

Note:

If it is required to test any relays ENTER to switch on temperature, this has to be done as follows:

1. Program the required relays accordingly.

2. Go into 'Set-up System' menu.

3. Select Temperature Compensation to 'Manual'.

4. Emter the tank temperature greater than or equal to the programd relay temperature.

5. Select 'Keyboard Simulation' active on the 'Set-up System' menu.

6. Enter 'Run Mode'.

After the initial delay of approximately 10 seconds, the appropriate relays will energise because the tank temperature equals or exceeds the relays pre-set temperature.

Remember to enter the temperature compensation back to automatic before the unit is left in 'Run Mode' for normal operation.

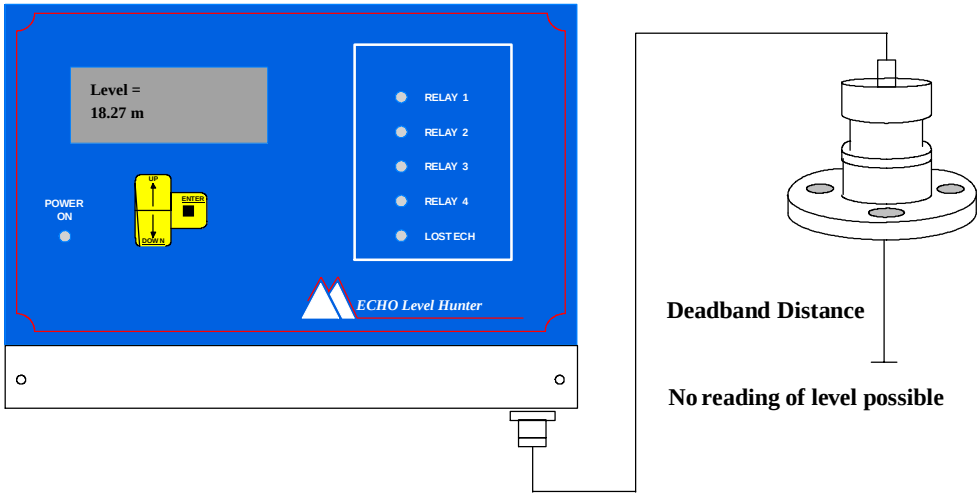
3.0 Mounting Instructions

On closed tank applications with the transducer flange mounted, it is recommended that the mounting flange on the tank is located on a stub pipe of appropriate diameter and height above the tank to overcome the deadband of the transducer as follows:

Xducer 06 – Minimum Deadband = 0.82 ft (0.25m)
Xducer 10 – Minimum Deadband = 1.1 ft (0.3m)
Xducer 20 – Minimum Deadband = 1.65 ft (0.5m)
Xducer 40 – Minimum Deadband = 3.0 ft (1.0m)

This arrangement allows the transducer's operating range to cover the full tank height. The mounting details for the transducers are shown in section 4.

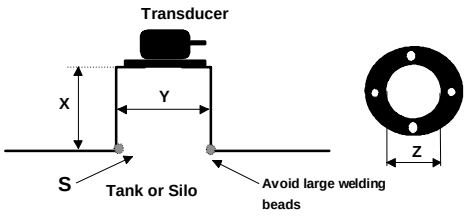
For applications where the transducer is bracket mounted and hangs inside the tank it is important that the maximum filling height does not enter the deadband zone as this will give erroneous readings.



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. Any attempt to rewire the transducer through accessing the top enclosure invalidates the guarantee. Always use the nylon mounting bolts provided.

3.1 Offset Pipe



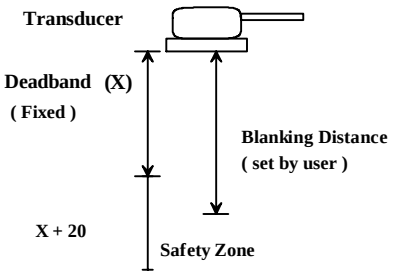
- If you require to measure level to the top of the tank you must place the transducer on a stand-off pipe of length (X) equal to the deadband distance of the transducer. Note when programming the unit this offset must be programd as a negative offset. Should the transducer hang inside the tank this would be a positive offset.
- For optimum performance ensure the diameter of the stand-off pipe (Y) is twice the diameter of the active transducer face (Z). Should this not be possible you may receive a false echo from point (S), where the pipe enters the tank. To avoid this you should program the unit's blanking distance to ignore any echoes within the distance X + 10% from the transducer face. See 'Blanking Distance' below.
- Avoid large welding beads as they may give rise to false echoes.

3.2 Blanking Distance, Deadband and Safety Procedure

There may be instances where obstructions in the tank 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 programd should be the distance from the transducer plus a nominal 10% to overcome variations due to temperature.

Blanking distance programming is also useful to implement in situations where the diameter of the offset pipe is narrower than recommended. This gives rise to a false echo at the interface between the end of the pipe and the tank due to a pressure differential.

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 or solid 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. As a result your tank will continue to fill and may reach an overflow condition[1].



In order to prevent this occurrence you should always assign one of the relays to a high alarm condition which can terminate the fill sequence. The level of this high alarm must be below the dead band zone which is given in metres in the set-up sensor menu for each transducer type. It is recommended that you make this alarm setting equal to the distance of the deadband plus 20%. For example an Xducer 06 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 face.

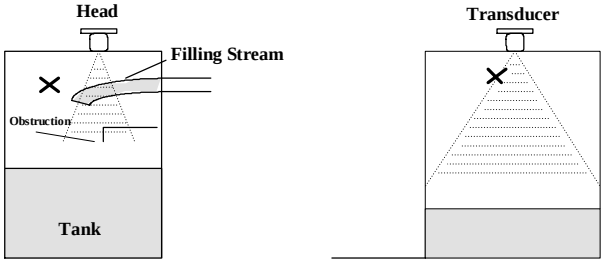
If you have programd the unit with a blanking distance to overcome obstructions or false echoes from a offset pipe stub the unit treats the blanking distance as an extended deadband and as a result the same condition occurs. In this event you should again assign a relay in the same manner to prevent filling into the blanking zone.

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

1. See general conditions of sale.

3.3 Correct Location

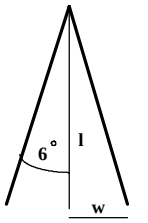
The transducers should be placed such that the ultrasonic beam does not reflect from interfering structures during it's flight path.



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

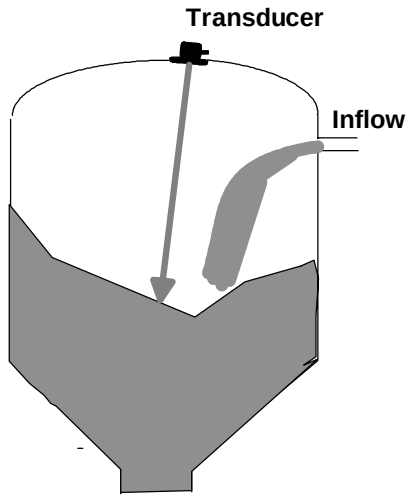
Ensure that at the maximum distance to be measured, the beam does not collide with the wall of the tank.

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	



3.4 Solids

- Ensure that the filling curtain does not interfere with the ultrasonic beam.
- Solids often lie in a non-uniform manner. For the most reliable reading angle the transducer such that it is at right angles to the most regular slope of the material.
- Direct the transducer such that it measures over the maximum range required which is often the outflow of the silo.



The maximum measurement range is affected by the angle of repose of the solid, the granular size and the presence of dust clouds. This should be taken into account when choosing the transducer.

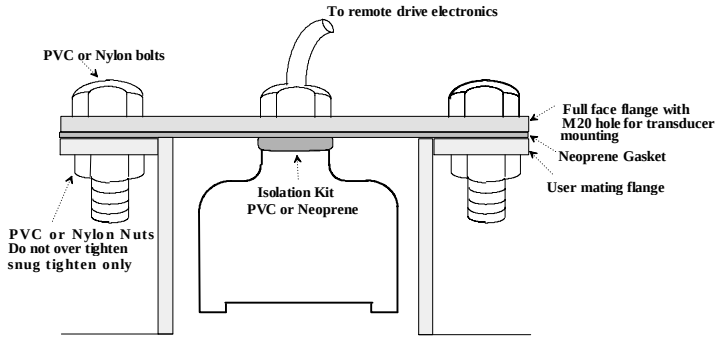
4.0 TRANSDUCER MOUNTING

Flange Mounted

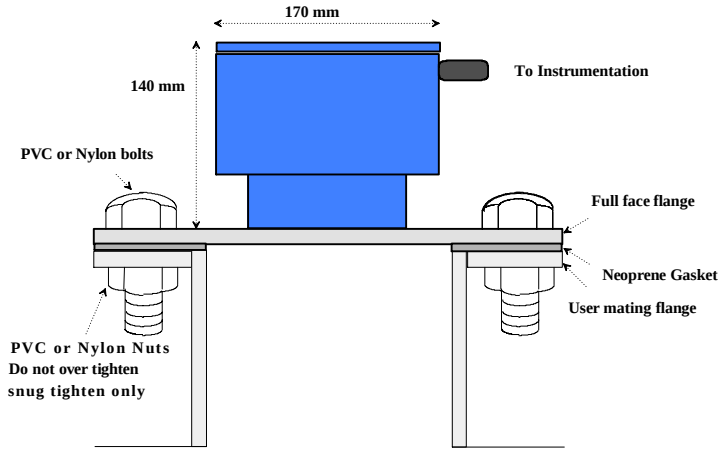
Always insert the gasket provided between the transducer and its mating flange. When aggressive chemicals are present you should use an appropriate gasket such as PVDF or PTFE.

Use the nylon bolts provided to secure the transducer. Do not over-tighten the bolts as this can lead to the transducer "RINGING" (see F ault Finding)

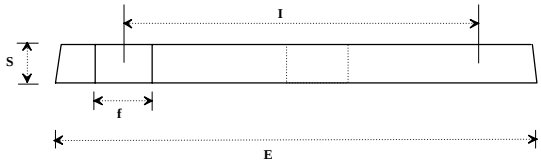
Transducer 018 / 014 With 1" NPT Thread Mount onto Integral Flange



Smart Ultrasonic Transducer Mounting



Flange Dimensions



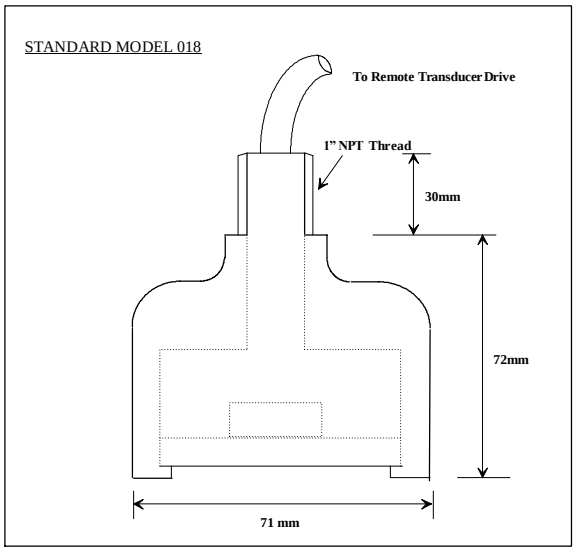
Drilled To BS4504 NP16 Dimensions in mm

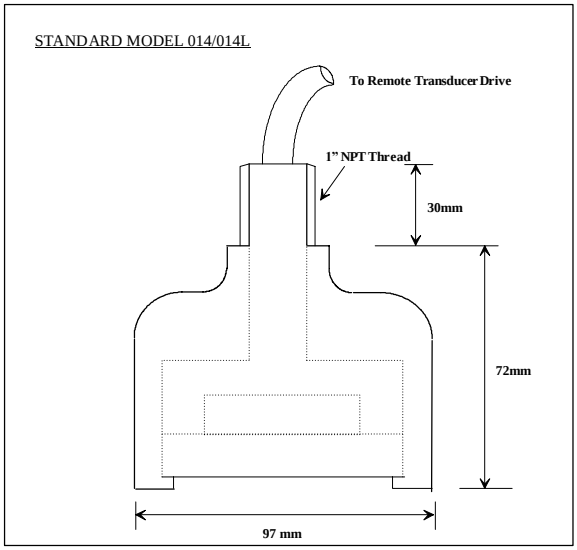
D	Code	E	S	I	f	Holes	Bolts	gru	
63	FCI.0630	165	18	125	18	4	M16x80	370	Xducer 06
90	FCI.0900	200	20	160	18	8	M16x90	630	Xducer 20

Screw Mounted

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

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



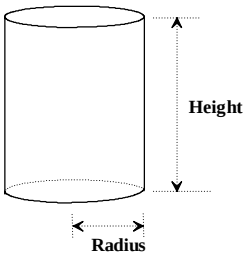


Installation Kit

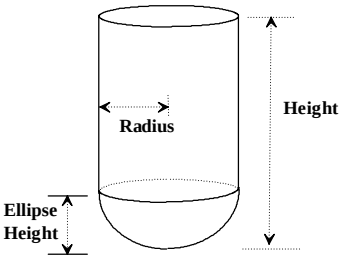
Each transducer will have been provided with an Installation kit for mounting, which consists of 4 PVC / nylon screws and a gasket.
It is **essential** that the installation kit is used with the Isolation Adapter if provided.

Appendix A: Tank Dimensions and Head Offset Convention

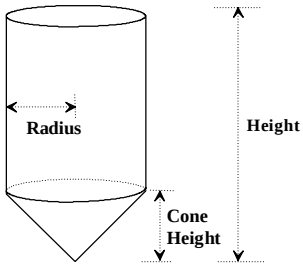
CYLINDER / Standard



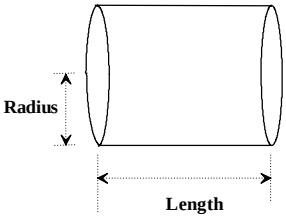
CYLINDER / Hemisphere Mix



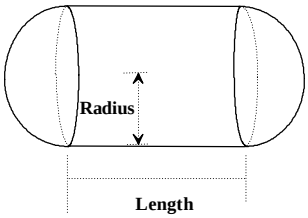
CYLINDER / Cone Mix



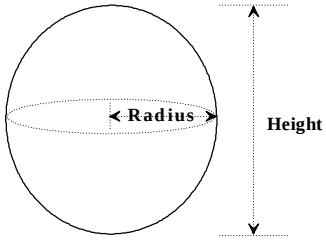
CYLINDER / Horizontal



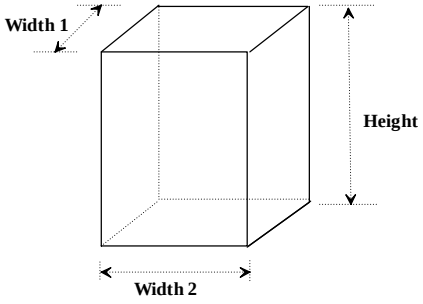
CYLINDER /Horizontal Hemisphere Mix (customised)



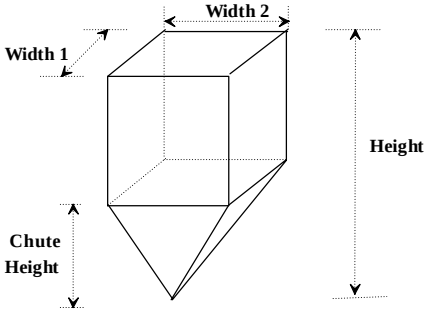
SPHERE / Ellipsoid



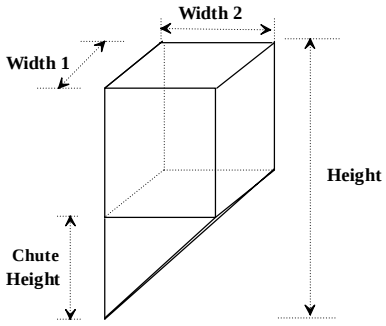
RECTANGULAR /Standard



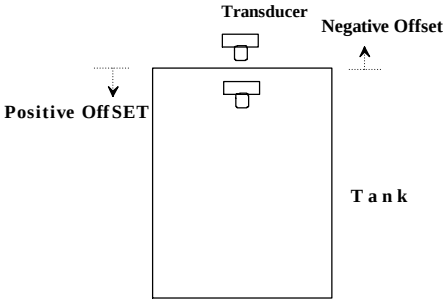
RECTANGULAR / Chute Mix



RECTANGULAR/ Oblique Mix



HEAD OFFSET CONVENTION



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 spur.

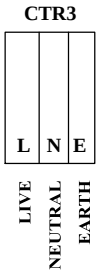
Mains Connection

The units are factory set to operate from either 115V or 230V, 60/50Hz 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.

Printed Circuit Board (PCB)

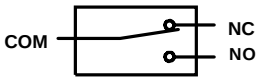


Relay Connections

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.

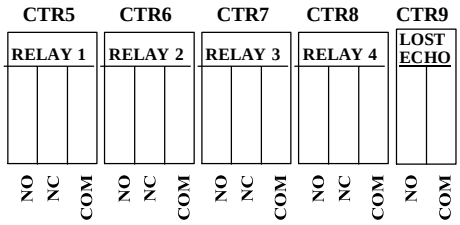
The ratings for the relays are as follows:

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

Printed Ciruit Board (PCB)

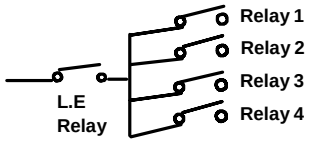


Lost Echo Relay:

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. The ensures that all power to external equipment is removed when the Level Hunter 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 Level Hunter because these relays will de-energise. i.e. NC contact is made.



Ultrasonic Transducer Connections from Enclosure to Remote Transducer Driver (ONLY FOR LONG RUNS)

The connections for the ultrasonic transducer is shown below. Normally the transducer 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.

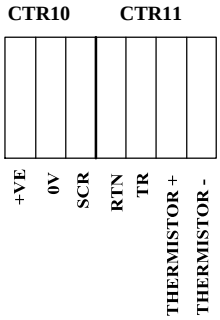
The 'TR' connections are the pulses sent back from the head relating to echoes.

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

Connection	Head Cable Color
+VE	Red
0V	Green
SCR	Screen
RTN	Blue
TR	Yellow
Thermistor +	White OR Temperature sensor
Thermistor -	Black " " "

Printed Circuit Board (PCB)

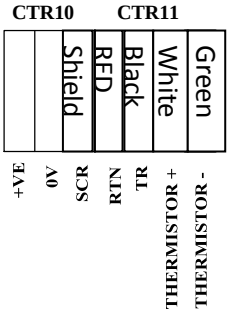
Note
Ensure connector block from transducer is correctly wired



Ultrasonic Head Connections with Internal Transducer Driver (STANDARD WIRING, NO J-BOX)

Connection	Transducer Cable Color
+VE	No Connection
0V	No Connection
SCR	Screen
RTN	Red
TR	Black
Thermistor +	White (Temperature sensor)
Thermistor -	Green (Temperature sensor)

Printed Circuit Board (PCB)



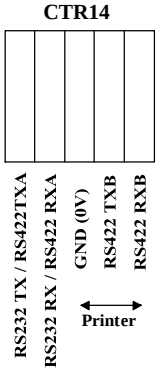
Communications

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.

Printed Circuit Board (PCB)



--

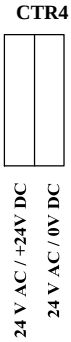
--

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)

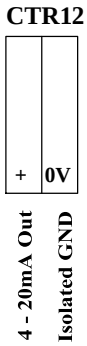


4 - 20mA Output

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

The terminal connections for this are shown below:

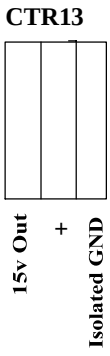
Printed Circuit Board (PCB)



pH Input

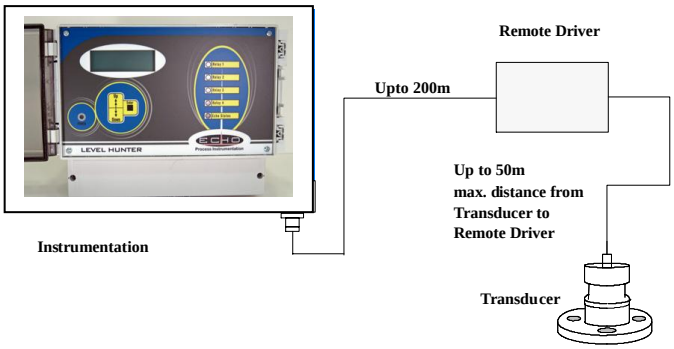
The pH input is used when the instrument has open channel flow monitor software.

Printed Circuit Board (PCB)

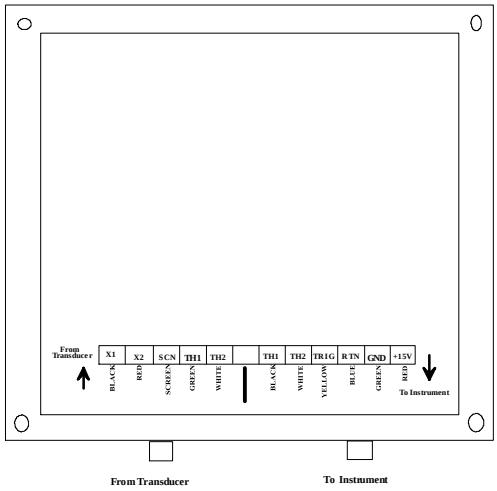


Installation With Remote Driver Electronics

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	ID	
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 Box or From Instrument to Transducers: 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.

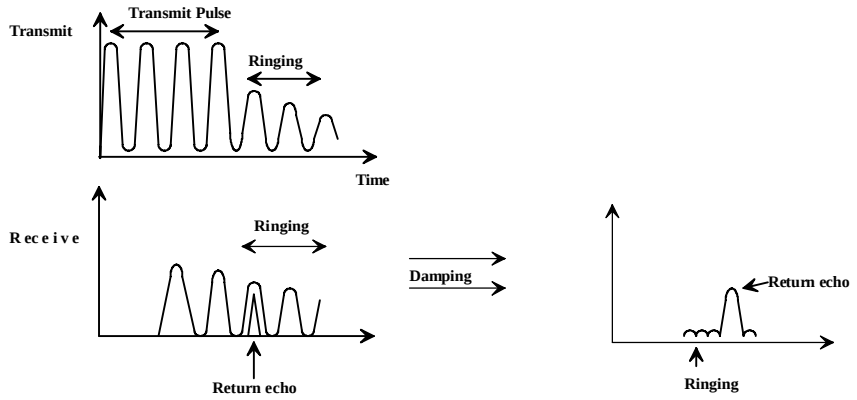
From Transducer To Remote Transducer Drive Electronics: 4 Core Screened twisted Pair with Integral Drain Wire And Individually Screened. Impedance 54 ohms, Capacitance core/core 115pF.

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 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 recognize the returning echo and as a result the system cannot calculate range.



Ring

ing can be recognized 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:

Check mains connection and fuse.

Check mains rating agrees with serial plate rating.

Display shows higher than expected reading:

Ringing of transducer - check bolts have not been over-tightened and gasket is fitted.

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

Velocity of sound not set correctly - reprogram to correct temperature setting or install temp 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.

Incorrect tank dimensions entered - Check height dimensions and temperature settings.

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

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

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

Particle absorption - temperature thermals - foam occasionally present; use stand pipe and / or increase transducer damping factor.

Display shows periodic lost echo:

Large undulating surface associated with solids or 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.

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 at 25deg.C)

Display fluctuates:

Periodic lost echo - check all factors above.

Rapid fluctuation in surface level due to filling / stirrers etc. - increase damping factor.

Incorrect cable used.

Cables running close together or close to interfering power or signal sources

Display Shows Zero

If the echo from a reflecting surface takes a longer time to return than the height of the tank, the unit will return a zero level. This may occur where the tank has a conical bottom or a large undulation in a solid surface causes the echo to reflect at an angle. Where this occurs the echo will bounce against the walls of the tank before returning to the transducer which would normally indicate a level beyond the height of the tank.. Rather than return a negative level value the unit indicates the tank is empty.

Where this is undesirable, particularly with solids, reposition the transducer or align it such that the reflecting surface is normal to the transducer beam.

NOTES:

14.