VALEPORT LIMITED

Model 740 Portable Water Level Recorder

Operating Manual
(Magenta Switchable Radio Version)

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Valeport Limited,
St. Peter's Quay,
Totnes,
Devon, TQ9 5EW,
UK

Tel: +44 (0) 1803 869292
Fax: +44 (0) 1803 869293
e-mail: sales@valeport.co.uk
Web: www.valeport.co.uk

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1 INTRODUCTION

This document covers the operation of the Model 740 Portable Water Level Recorder, when used with Valeport Ltd TideLog PC software for Windows™.

1.1 DESCRIPTION

The Model 740 is a small cost effective Water Level Recorder, specifically designed for applications where the user requires an accurate record of water height or level, rather than the real time displays available from the larger Model 710 Tide Gauge system.

Comprising a corrosion resistant, titanium housed, vented pressure transducer, connected via a 20m vented (standard) cable to an above the water surface, battery powered logger, the Model 740 is simple to install, and requires minimal maintenance.

The logger is powered by 4 "D" type cells, which, together with the 128kbyte memory allows operation for up to 2 years (at a 20 minutes cycle with 15 second bursts).

The burst length, cycle time, delay start date/time and site information is set using TideLog, the PC software package supplied. This program also allows the calibration to be set up, battery voltage to be checked, the time and date to be set, and the recorded data to be extracted and viewed.

The addition of the radio option allows real time data telemetry from remote sites. All set up functions and data extraction may also be performed over the link. The power switching function in the 740 radio unit allows both the radio and/or 740 to be powered either internally or externally.

1.1.1 SPECIFICATION

Transducer

Type:	Druck PDCR 1830 (titanium shelled, vented strain gauge) with mounting bracket.
Range:	Standard 10 dBars (approx. 10 metres water depth). Other ranges available.
Accuracy:	± 0.1% Full Scale
Calibration:	Held within the logging unit.
Dimensions:	18mm diameter x 80mm excluding mounting plate

Logging unit

Housing:	Black anodized aluminum. Waterproof to IP67 (0.5m for 30 secs) with connectors mated, but transducer vented to atmosphere. The electronics are sealed from vent.
Power:	4 "D" cells within housing. 1.5V Alkaline cells provide power for over 2 years at 20 minute sampling with burst length of 15 secs, in logging only mode. The unit will also accept 3.6V lithium 'D' cells for extended life.
Memory:	128kbytes solid state, allowing over 65,000 data points. Equivalent to over 900 days at 20 minute sampling. New data file created every time the unit is switched on.
Sampling:	Raw data sampled at 4 Hz and data logged as average over burst. Burst length selectable between 1 and 60 seconds in 1 second steps. Time between burst cycles (Burst cycle time) selectable between 1 and 1440 minutes [1 day] in 1 minute steps.
Resolution:	Data logged to 1mm resolution. Raw data acquired at 14 bit resolution.
Comms:	RS232 via 3m cable to PC.
Dimensions:	Housing 47 x 110 x 235mm
Weight:	1.7Kgf (approx.) including batteries

Radio (Site Transceiver)

Housing:	Black painted aluminium. Sealed to !P67 (0.5m for 30 secs) with connectors mated.
Power input:	Requires 12 – 15vDC. Internal switch selects external power (via cable supplied) or internal power (from Model 740 unit).
Antenna:	Standard 0dB whip antenna, plugged directly onto housing. Optional 3dB omnidirectional antenna with 10m cable.
Frequency:	458.5125 to 458.9375 MHz
Channels:	35 @ 12.5kHz spacing
Channel select:	Push button switches inside housing
License:	Conforms to MPT 1329 and European ETSI 300-220 standards
Power output:	500mW maximum, to comply with UK MPT1329 regulations.
Dimensions:	200 x 200 x 70mm
Weight:	2kg

Radio (Base Transceiver)

Housing:	Desktop style painted aluminium housing, with connections for antenna, PC interface and external DC power.
Power input:	12vDC, via cable supplied.
Antenna:	3dB omnidirectional antenna with 10m cable.
Frequency:	458.5125 to 458.9375 MHz
Channels:	35 @ 12.5kHz spacing
Channel select:	Push button switches on front panel
License:	Conforms to MPT 1329 and European ETSI 300-220 standards
Power output:	500mW maximum, to comply with UK MPT1329 regulations.
PC Interface:	9 pin Dtype connector with RS232 output to PC. 9 pin to 9 pin interface cable supplied.
Dimensions:	200 x 180 x 90mm
Weight:	2kg

2 INSTALLATION

2.1 EQUIPMENT SUPPLIED

The Model 740 system comprises the following:

Model 740 Logger unit, with batteries
Transducer with 20m vented signal cable and mounting bracket
Switch plug
Data lead
Operating Manual
Windows software (TideLog)

User will need to provide:

PC running Windows (Version 3.1 or above)
A spreadsheet package may prove useful for advanced data manipulation.

Optional Radio Telemetry Equipment:

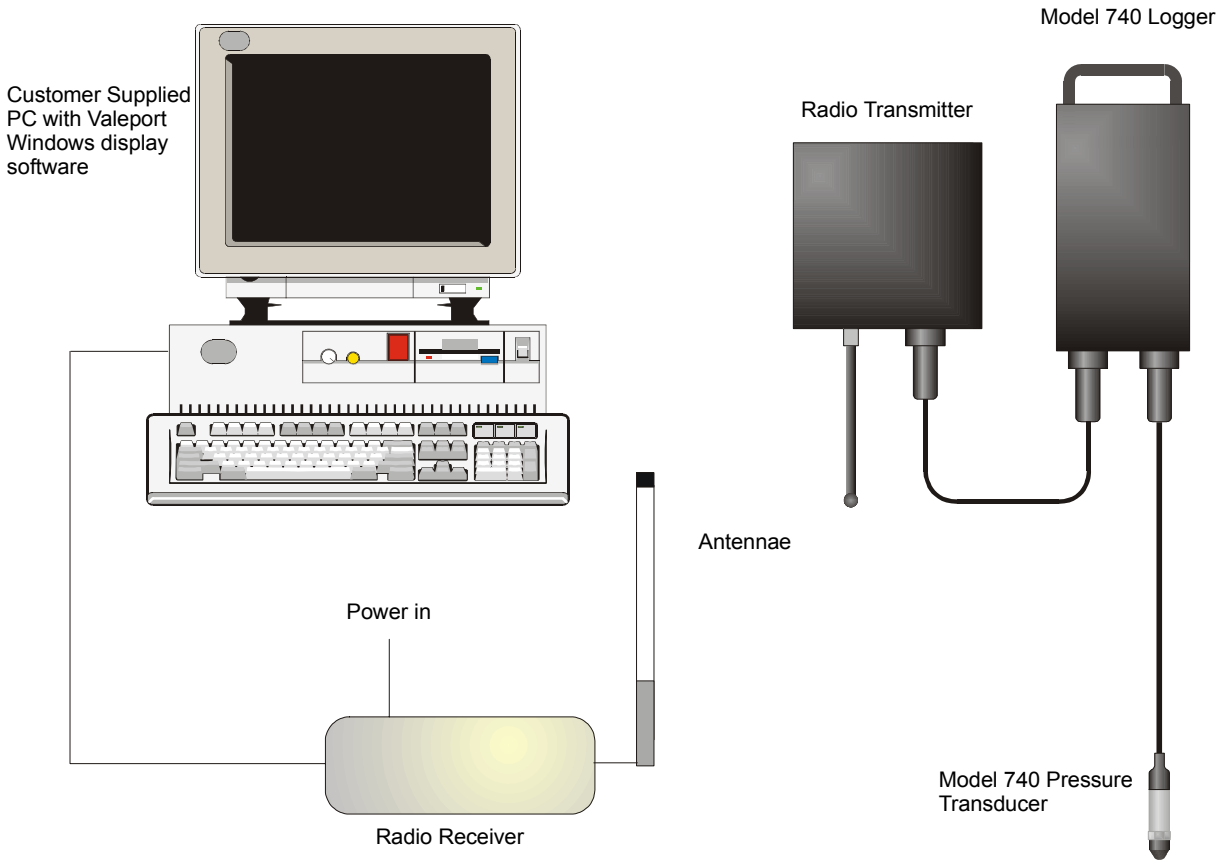
Radio transceiver unit in IP68 Housing
50cm communications lead to 740
0dB whip antenna
External power supply cable
Radio transceiver and desktop housing
2 metre RS232 communication lead to PC
External DC power lead
3db omni-directional antenna with 20 metre cable and 2 x 8-nut clamp

2.2 HARDWARE INSTALLATION

The following description refers to the installation of the Model 740 in the field. Obviously, workshop/laboratory setting up and testing can also be carried out (and is advised).

The sampling regime of the Model 740 can be set up in the workshop prior to deployment or on site, and then switching on is simply a process of connecting up the transducer and inserting the switch plug or radio comms lead.

FIGURE 1 MODEL 740 SYSTEM SCHEMATIC



2.2.1 TRANSDUCER

A mounting bracket is provided for the transducer. The transducer should be located below the lowest expected water level so that it does not dry out. For reference, the transducer pressure diaphragm [and therefore the pressure reference] is marked by the dark band on the transducer. A screw-on end cap protects the transducer. If this is removed for cleaning out of sediment, then care should be taken not to damage the diaphragm itself.

The transducer cable should be attached to convenient parts of the mounting structure with cable ties or clips [not supplied]. Care should be taken not to squeeze or crush the cable so that the vented tube within the cable becomes closed.

The transducer cable should be connected to the connector on the Model 740 marked “TRANSDUCER”.

The transducer is provided with an integral 20m length of signal cable. Excess length can be coiled up, or the cable shortened. See Appendix 2 for wiring details.

2.2.2 MODEL 740 LOGGING UNIT

This unit must be mounted above the highest expected water line and shielded as much as possible from other sources of water.

The unit is supplied with two mounting brackets and screws for the user to fix the unit to a convenient surface. Orientation of the Model 740 is not critical, and will normally be determined by cable routing, access to connectors, security and ease of fixing.

Care should be taken to ensure that the transducer vent is kept out of water. The 740 should be mounted so that this is facing downwards.

If the logger is installed, but not in use [i.e. the switch cap is not fitted] then ensure the bulkhead protective cap is fitted to protect the pins.

2.2.3 SITE RADIO UNIT

The radio unit should also be fixed above the water line, away from dripping water. It should be positioned close enough to the Model 740 to ensure that the comms cable is not under any tension when fitted. If external power is being used, connect to an external 12vDC power supply using the cable supplied.

Before applying power, ensure that the antenna is connected. Failure to do so may result in damage.

Try to ensure that the line of sight from the whip antenna to the base station is impeded as little as possible. If the optional 3dB antenna is being used, it should be sited as high as possible to minimise ground reflections, and the 10m cable should be clipped or tied along the route to the radio unit itself. See Section 2.2.6 for further information on antenna siting.

2.2.4 BASE STATION RADIO UNIT

The base station radio unit should be positioned adjacent to the PC which will be receiving the data. Connect the radio unit to a spare 9pin comm port on the PC, using the interface lead provided, and connect the radio unit to a DC power supply using the lead provided. The unit will accept a power input of 10 – 28vDC. The red pin should be connected to the +ve DC supply, the black pin to the 0v supply, and the green pin to a separate earth connection if required. If a separate earth connection is not required or unavailable, leave this pin disconnected.

Before applying power, ensure that the antenna is connected. Failure to do so may result in damage .

Site the antenna as high as possible, and with as clear line of sight to the gauge as possible. See Section 2.2.6 below for hints on antenna positioning. Clip or tie the antenna cable along its route to the radio unit.

2.2.5 SELECTING RADIO CHANNEL

The radio system is fitted with a selectable frequency transceiver at each end, with 35 channels in the range 458.5 to 458.9 MHz. A guide to the channel numbering is given in Appendix 3. The channel selector switch is located on the front panel of the Base Station Unit, and under the top cover of the Site Unit. To select a channel, simply use the +/- switches to select the required channel number. **Ensure that both units are set to the same channel**. Note that the system does not need to be turned off to perform this change. Avoid selecting channel numbers outside the range of 1 to 35.

2.2.6 HINTS ON SITING ANTENNAE

- UHF radio propagation is essentially line of sight.
- The maximum operating range is determined by obstructions to the line of sight, reflections from objects near the radio path and reflections from the ground.
- Locations producing reflections will produce large amounts of position dependent signal fading.
- The antennae should generally be as high as possible to reduce ground reflections. The final height and position of the antennae may need to be found by trial and error in highly reflective environments.
- In practice there will always be a certain amount of signal fading due to changing conditions, so it is usual to allow a fade margin in determining path performance. The amount depends primarily on the susceptibility of the path to fading and the acceptability of data corruption to the system. Fade margins of between 10dB and 30dB are common.
- Co-siting the receiving antenna with another UHF transmitting antenna may cause the receiver to be desensitised. In this situation the antenna should be sited as far away as possible from, and with its most insensitive axis towards, the interfering antenna.

2.3 SOFTWARE INSTALLATION

Communications with the Model 740 are via PC, either directly or through the optional radio link, using Valeport's own Windows based program TideLog.

It is recommended that an IBM compatible PC of Pentium II level or above be used, with Windows 95 or above. It is advisable to have at least 32Mb RAM fitted. The software will operate on Windows 3.1with as low as 8Mb memory, but opening too many windows may cause the system to "hang up".

To install TideLog follow the procedures as described below.

1. Place the installation Disk 1 in drive A.
2. In Windows 95 or above select Run in the Startup Menu, or Run from the File menu under the Program Manager in Windows 3.1
3. In the command line type A:SETUP followed by <CR>.
4. Insert Disk 2 when requested.
5. After a few seconds you will be asked to select the path and directory in which to install TideLog.
6. Select Continue to select default TideLog directory.

The installation will now commence. When finished an OK prompt will appear with the message INSTALLATION IS COMPLETE. The TideLog program is now available for use.

2.4 CALIBRATION

The unit is supplied with a factory calibration, which provides an output of pressure in decibars and takes out any non-linearity in the transducer characteristic. Note that the pressure calibration is specifically for a combination of Model 740 unit and transducer, and the unit and transducer serial numbers are held in the logger memory. I f the transducer is changed, the pressure calibration will be slightly in error, but the system can still be used provided an in-situ calibration of depth against pressure output is made.

The user can add this calibration to provide output in metres [or feet] above datum. This secondary calibration takes the form of a Gain factor [distance per dBar] and Offset [transducer position with respect to datum]. In order to determine this secondary calibration, some on site measurements will need to be taken to establish the relationship between decibars and depth with respect to a datum for the particular site. The exact calibration is effected by transducer offset, water density and gravity.

If users are prepared to apply the calibration corrections to pressure data in post processing on a spreadsheet, then an on site PC is not required, but some level measurements will need to be taken visually on site while the unit is logging and corrections applied after comparing these level measurements with logged pressure data.

The transducer is temperature compensated, but this compensation does rely on the temperature of all parts of the transducer being the same, so when the transducer is first put into water, time must be allowed for the temperature to stabilise before any calibration measurements are taken. Five minutes should be adequate.

For full calibration procedures, please see Section 3.4.

3 OPERATION

TideLog is an event driven program written in Visual Basic for Windows for use with the Valeport Model 740 portable water level recorder. The program allows the user to configure the sampling regime of the instruments, view data in real time using a selection of displays, and extract and view data.

Available displays include real time only displays for measured and calculated parameters (if applicable) tabulated scroll, and graphical output. The user can select suitable scales for the graphical displays.

Additional features of TideLog include:

- Recording of real time data to PC.
- Printing of data (tabulated scroll and graphs).
- Simple statistical analysis of data.

TideLog will perform all the above functions when the PC is connected directly to the Model 740, or over the optional radio link.

3.1 PC SETUP

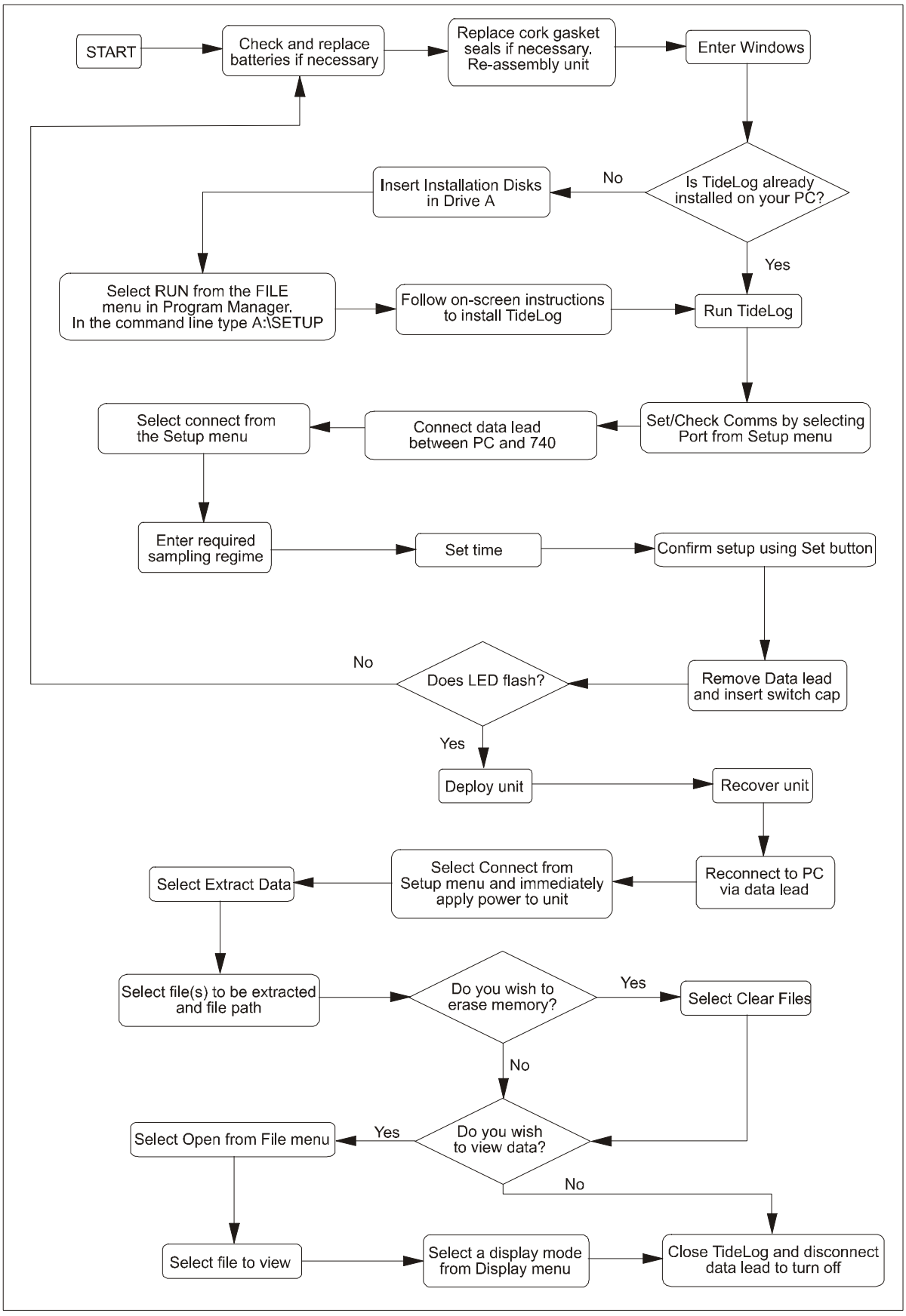
In order for TideLog to operate correctly, the format of the date, time and numbers must be correctly set within the Windows Control Panel.

Function		Format	Example
Date		dd/MM/yy	23/09/96
Time		HH:mm:ss (24 hr clock)	16:37:20
Numbers:	Decimal Mark	.	1.25
	Thousands separator	,	1,321,000

Failure to set the above parameters correctly may result in the software being unable to read data from the instrument.

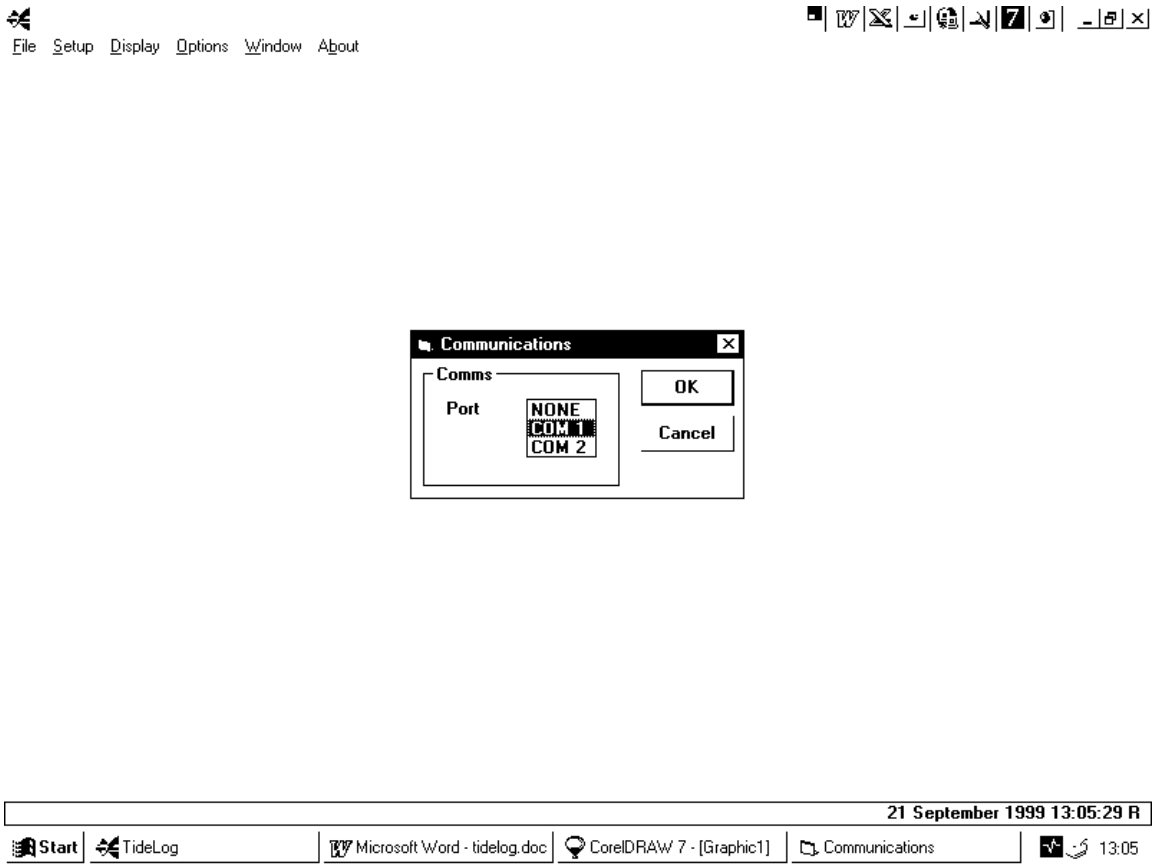
The flow chart on the next page indicates the principal steps in operating Model 740. For more detailed explanations and instructions, please refer to Sections 3.2 – 3.7 and Section 4.

FIGURE 2 OPERATION OF THE MODEL 740



3.2 PORT

Communications are via RS232 comms port. It is necessary to set the comms port configuration before any communications can be achieved. Do this by selecting ***Port*** from the ***Setup*** menu. The following display will be shown:



Select the correct comms port number using the mouse. Note that the default baud rate is 4800. For reference, the communications are pre-set to 8 data bits, 1 stop bit and no parity; these are not user changeable.

3.3 SETTING UP

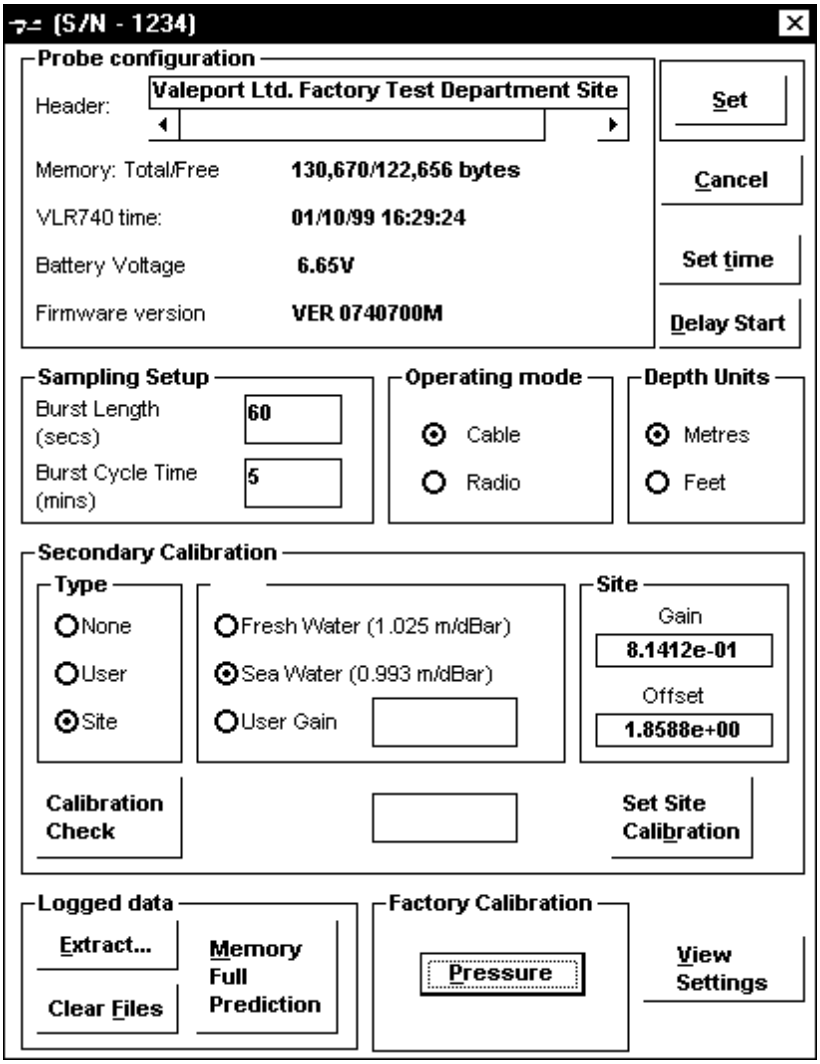
Having correctly configured the comms port, it is possible to communicate with the instrument.

Communications can only be established with the unit under two circumstances:

- Within 30 seconds of switching the Model 740 on (by connection of data or radio lead)
- Immediately after a measurement burst (single LED flash)

Select ***Connect*** from the ***Setup*** menu to send the interrupt command to the unit via the configuration/data extraction lead. The PC will continue to try to communicate with the instrument until successful or until the Connect command is cancelled.

On establishing communications, a Dialog box similar to that shown below will appear. Confirmed in the title block is the serial number of the unit (1234). This box allows changes to be made to the unit's setup. The different options are detailed below.



It is also possible to return to ***Connect*** stage from ***Run*** mode, if changes need to be implemented. ***Run*** mode must then be reselected once changes have been set.

3.3.1 PROBE CONFIGURATION

The amount of total memory and the amount available for recording data is shown together with the probe date/time. In the above example, the unit has a total of 130,670 bytes of which 122,656 are unused. Also displayed is the current battery voltage, the current time as judged by the Model 740 and the software version.

The header information can be used to allocate site information (or any information) to the file that will be created when the unit is next set into run mode. Simply click the cursor within the box and enter the new text as normal.

3.3.2 SET TIME

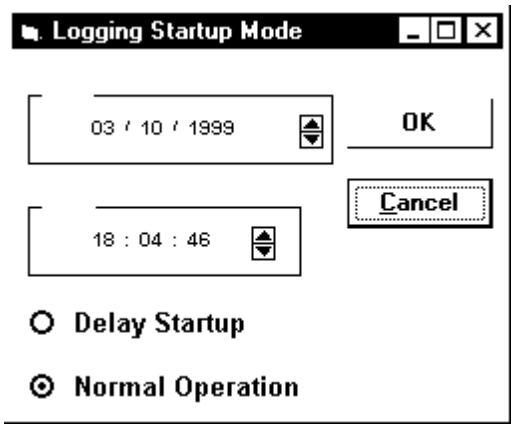
By selecting the **set time** function button the Model 740 is immediately set to the time of the PC.

NOTE: For the following functions, if the ***Set*** command is not implemented, the changes will **not** be made in the instrument. The user will be prompted again by a dialogue box asking for verification of parameters should set not be selected.

3.3.3 DELAY START

Selecting this option opens the following screen:

If the user wishes the instrument to begin taking readings as soon as the dummy switch is inserted then *Normal operation* should be selected.



If the user wishes for the Model 740 to begin taking readings at a specific time in the future then *Delay Startup* should be selected. The time and date the user wishes the unit to commence running should be entered in the date and time boxes. This can be performed by selecting the text with the cursor and entering the new values or scrolling up or down the values using the arrow keys.

N.B. You must still insert the switch plug into the data port of the Model 740 for the delay mode to work.

3.3.4 SAMPLE SETUP

Sampling setup consists of two sections:

- Burst length — the length of time pressure readings are taken for
- Burst cycle time — how often readings are taken (e.g. every 5 mins)

The burst length can be set to any number of whole seconds between 1 and 60 second. To accurately remove the signal caused by the presence of waves from the tidal signal, it is advised that a reasonable length of time be input into this section. For example, 40 or 60 seconds will allow the signals from wind waves to be accounted for and removed from the true tidal signal.

The burst cycle time is how often readings will be taken and logged. This is sometimes referred to as the repetition time. The burst cycle is selectable between 1 and 1440 minutes [1 day] in 1 minute steps.

3.3.5 OPERATING MODE

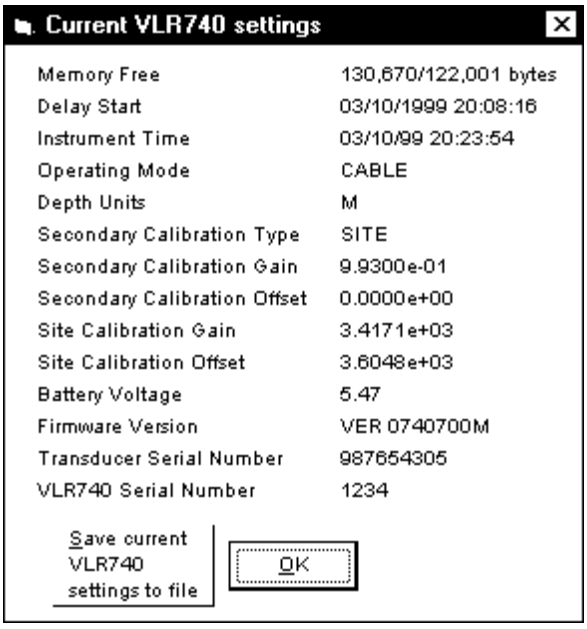
The operating mode is divided into cable or radio. For normal operation cable will be selected. When data telemetry is being used, the radio box is checked. This selection defines how the instrument will be interrupted by the user for configuration changes or data upload.

3.3.6 DEPTH UNITS

The data recorded by the unit is dBars. This can then be converted into metres or feet for realtime viewing or for the logged data. Select as required.

3.3.7 VIEW SETTINGS

The view settings function, as its name suggests, presents a screen of the current set up.



As can be seen in the screen, this can be saved to file. Simply select the button and a standard Windows file save dialogue box will appear. Saving the settings can be useful in the case of long deployments.

3.4 SECONDARY CALIBRATION

Using the Type section of the secondary calibration, the user can set the depth calibration to one of three types: NONE, USER or SITE. Select the required method.

NONE No depth calibration is applied and the unit only logs and uploads Pressure data in dBars.

USER The unit uses Gain and Offset values input by the user (see Section 3.4.1).

SITE The unit uses Site Calibration factors (see Section 3.4.2).

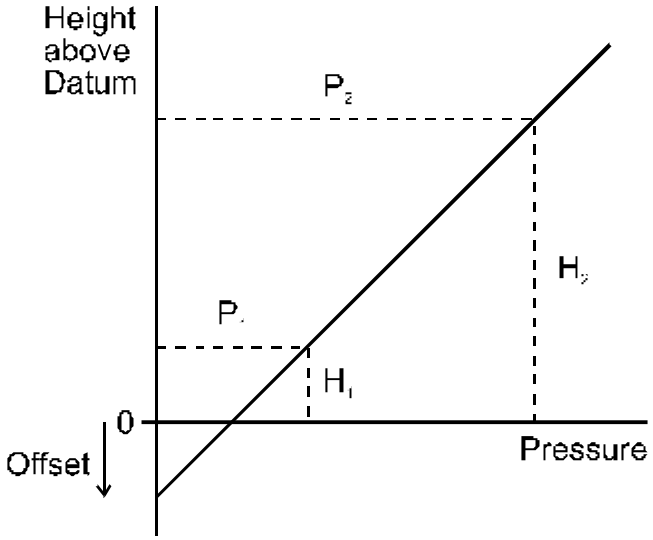
The relationship between pressure and depth in shallow water is a straight-line function:

Height above datum = (Gain x Pressure) + Offset

Where Offset = Transducer position with respect to Datum [+ve if above datum, -ve below]. E.g. if the transducer is 1.15 metres below datum, then the offset is –1.15 metres.

Gain = $(H_2 – H_1)/(P_2 – P_1)$

Offset = $H_1 – (P_1 * (H_2 – H_1)/(P_2 – P_1))$



3.4.1 USER CALIBRATION

If USER calibration method is set, the unit will set itself to output data calibrated according to user input Gain Factor and Datum Offset. These values must be entered by checking the appropriate box in the section immediately to the right of the Type section. This section is only active when User is selected, its border being faded when either of the other two forms of calibration are selected.

The user is given the option of either entering a previously calculated Gain value, or selecting standard values for FRESH or SEA water. The choice is dependent upon either having previously calculated the gain and offset or the type of water source being monitored.

If the user wishes to enter their own gain then select the user function and enter the values into the adjacent box. The user offset figure is then displayed directly beneath this section in the user gain box.

The relationship between depth and pressure for shallow water can also be expressed as:

$$\text{Depth } (m) = \left[\frac{\text{Pressure}}{\text{Density} \times \text{Acceleration due to Gravity}} \right] + \text{Offset}$$

Where, Pressure is measured in Pascals (1Bar = 10^5 Pascal, therefore 1 dBar = 10^4 Pascal)
And, (Density x Acceleration due to Gravity)$^{-1}$ is the Gain Factor

Fresh Water: Using a standard density of 994 kg/m^3 [pure water at 15°C] and a gravity figure of 9.81m/s^2,

$$\text{Depth(m)} = \frac{10^4}{994 \times 9.81}$$

then 1 decibar = 1.025 metres water depth
Therefore Gain Factor = 1.025

Sea Water: Using a standard density of 1025.97 kg/m^3 [standard seawater at 15°C] and a gravity figure of 9.81m/s^2,

$$\text{Depth(m)} = \frac{10^4}{1025.97 \times 9.81}$$

then 1 decibar = 0.993 metres water depth
Therefore Gain Factor = 0.993

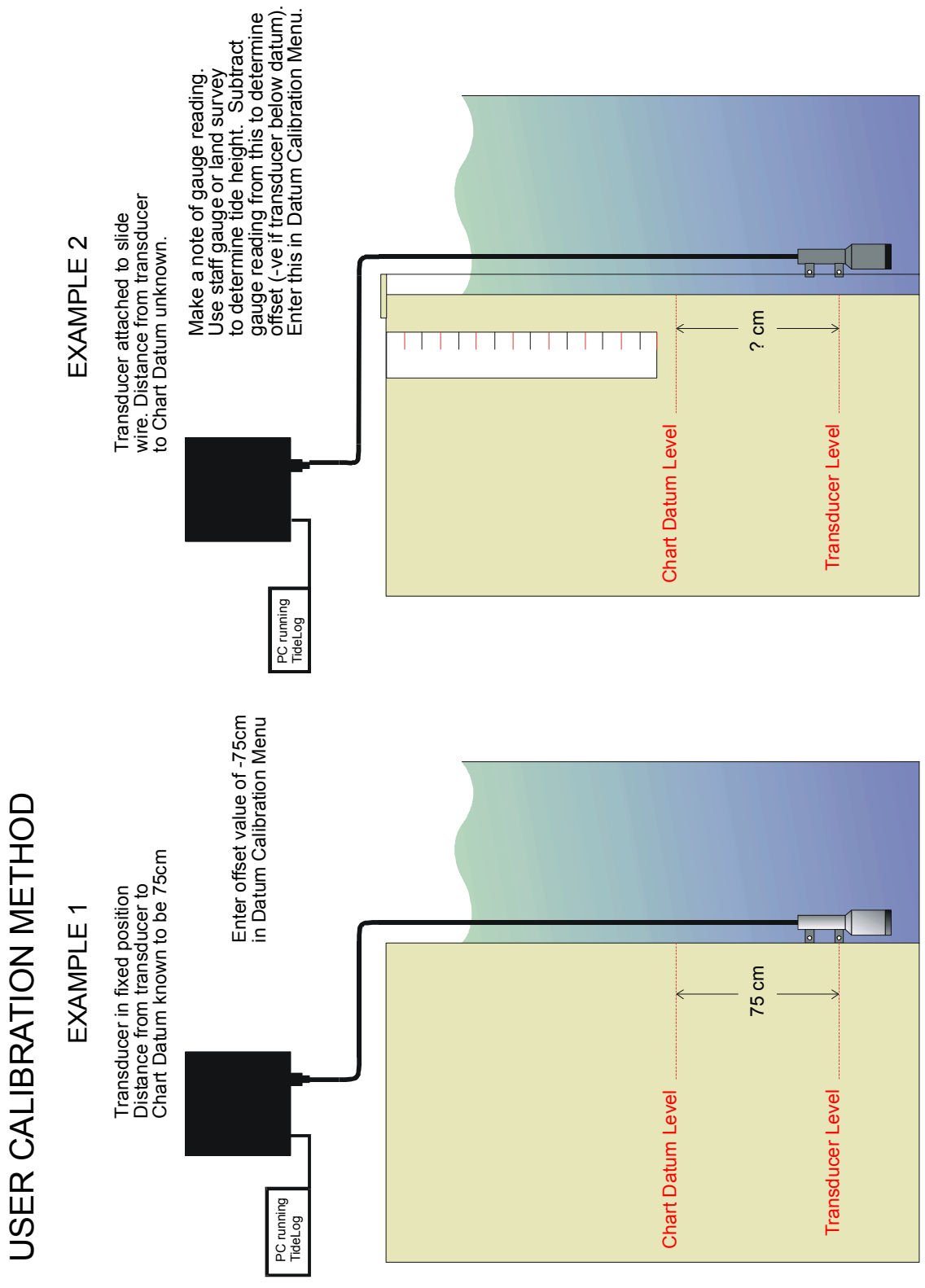
If the user therefore knows the density of the water (by using a hydrometer) and the local gravity value, the Gain Factor can be calculated.

To enter the Offset, enter the distance between the Transducer and the Datum Level. If the Transducer is below the Datum, the Offset should be entered as a negative value. If the transducer is above the Datum, the Offset should be entered as a positive value. Figure 3 illustrates how to perform the offset part of the user calibration.

To check the operation of the unit with these user input values, select to view real time data from the transducer in both pressure (dBar) and Depth (m/ft) formats.

In practice, however, it is much preferred to carry out a calibration of the transducer in-situ to take out the density and gravity variations and establish the datum, as described in Section 3.4.2, Site Calibration.

FIGURE 3 EXAMPLE OF THE USER CALIBRATION METHOD



3.4.2 SITE CALIBRATION

This function is only activated if the site box is checked in the Type screen. The offset and gain values output using this method are given in the offset and gain boxes on the right hand side of the screen.

For an example or the Site calibration method, please see Figure 4.

Site Calibrations can be carried out using either of two methods:

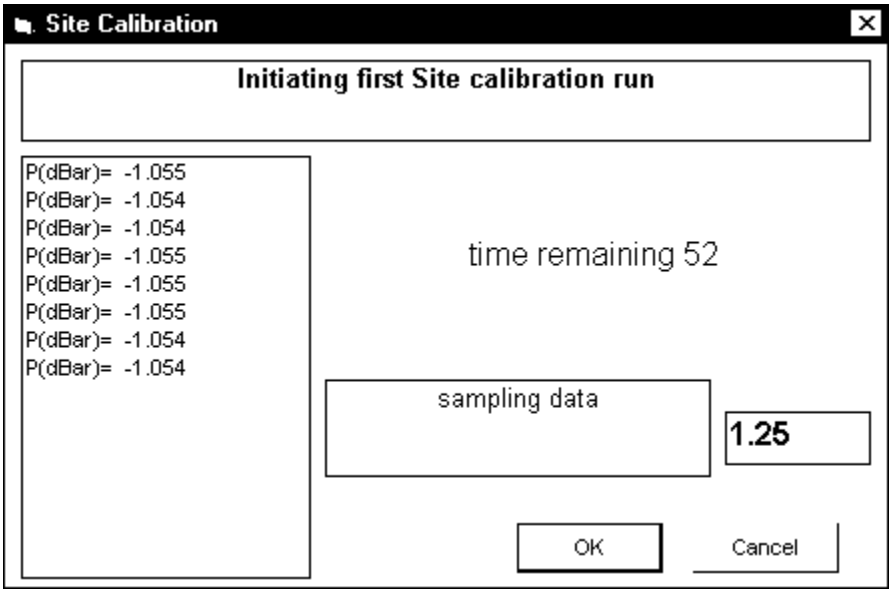
- A Fixed Transducer Method
- A Moving Transducer Method

The procedures given assume that the unit is connected to a PC, running TideLog, with the transducer mounted at the deployment site. The factor determining whether a fixed or moving transducer calibration should be performed is determined by how the transducer is mounted.
The fixed transducer method, as its name suggests, is used when the mounting of the transducer is static and thus cannot be raised or lowered.
The moving transducer method can be used when the transducer is mounted on the Valeport slide wiring kit (or similar construction) thus allowing the unit to be raised and lowered in the water column to simulate the change in water level of the rising or ebbing tide.
However, since it is not always practical to wait for a change in water level, or to move the transducer once installed, it is also possible to use a manual method, which is effectively a combination of the Fixed Transducer Method and the User Calibration described above.

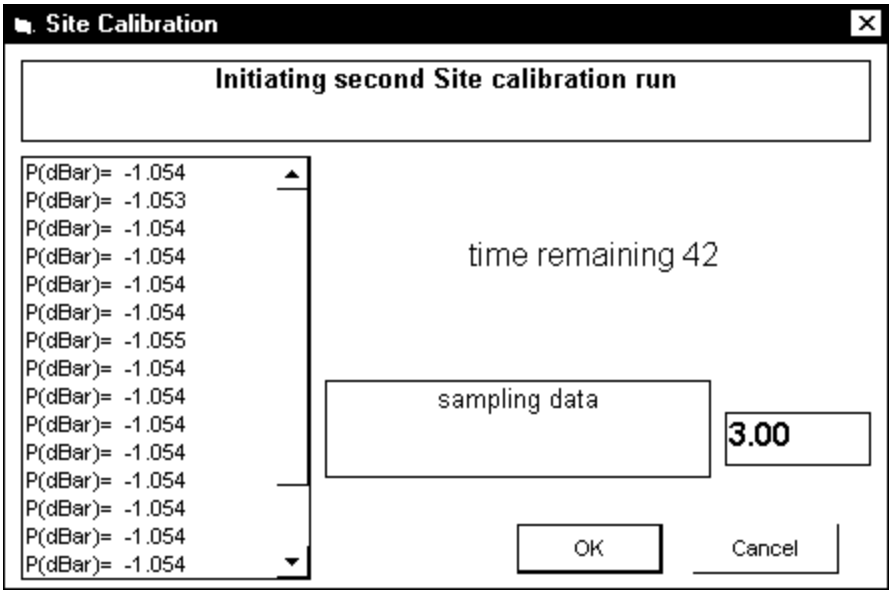
3.4.2.1 FIXED TRANSDUCER METHOD

Carry out the following procedure:

- Install and fix the transducer in the desired position, and connect it to the Model 740.
- Run the Tidelog.exe program on the PC.
- Connect the Model 740 to the PC, having previously selected the correct comms port, and within 15 seconds select Connect to "break in".
- Select Site from the type section and then click the Set Site calibration button to display Page 1 of the site calibration procedure.



- Enter current water height above chart datum in the box to the right hand side of the dialogue box.
- Select OK to force unit to measure current pressure.
- Wait for significant level change (e.g. tide coming in). It does not matter if this change is an increase or a decrease in level.
- Enter new water height above chart datum, in the second page of the site calibration procedure, in the box to the right hand side of the dialogue box.

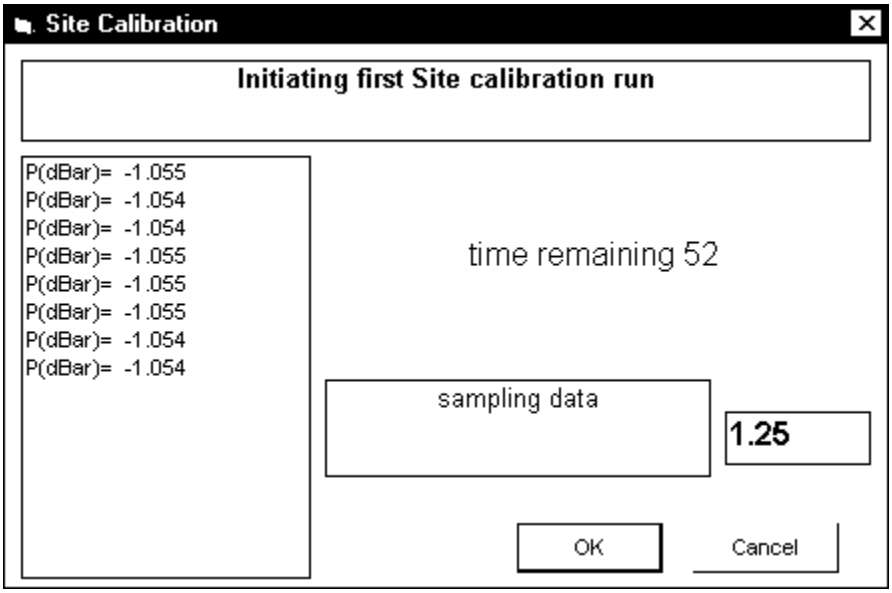


- Press Enter key to force unit to measure pressure.
- Site calibration will be automatically calculated, and used when unit is set to Run Mode.

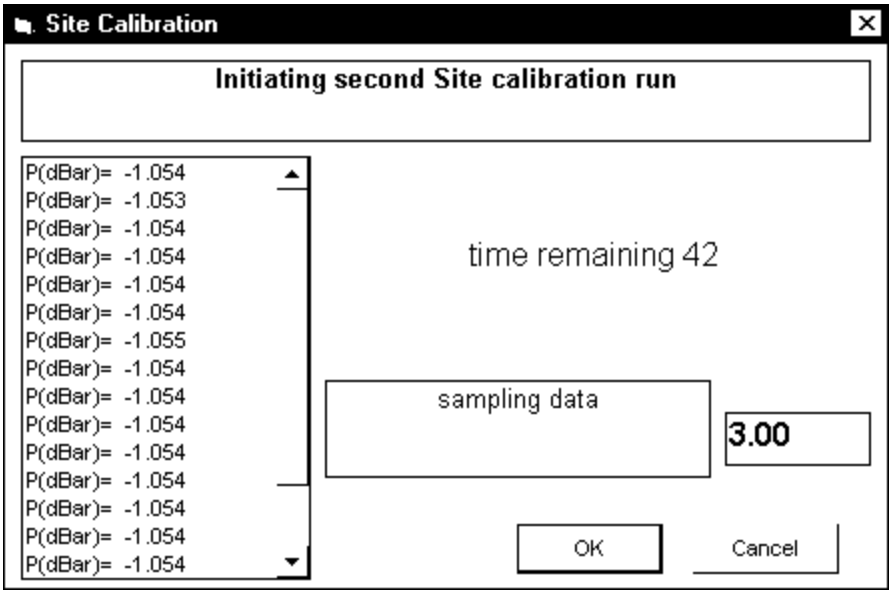
3.4.2.2 MOVING TRANSDUCER METHOD

This is essentially the same as the Fixed Transducer Method, but does not require a waiting period between level measurements:

- Install and the transducer in the desired position, and connect it to the Model 740.
- Run the Tidelog.EXE program on the PC.
- Connect the Model 740 to the PC, having previously selected the correct comms port, and within 15 seconds select Connect to "break in".
- Select Site from the type section and then click the Set Site calibration button to display Page 1 of the site calibration procedure.



- Enter current water height above chart datum in the box to the right hand side of the dialogue box.
- Press OK to force unit to measure current pressure.
- Move the transducer (either raise or lower) a known distance.
- Enter new water height above chart datum, in the second page of the site calibration procedure above chart datum (i.e., original water height, less or plus 'known distance') in the box to the right hand side of the dialogue box.



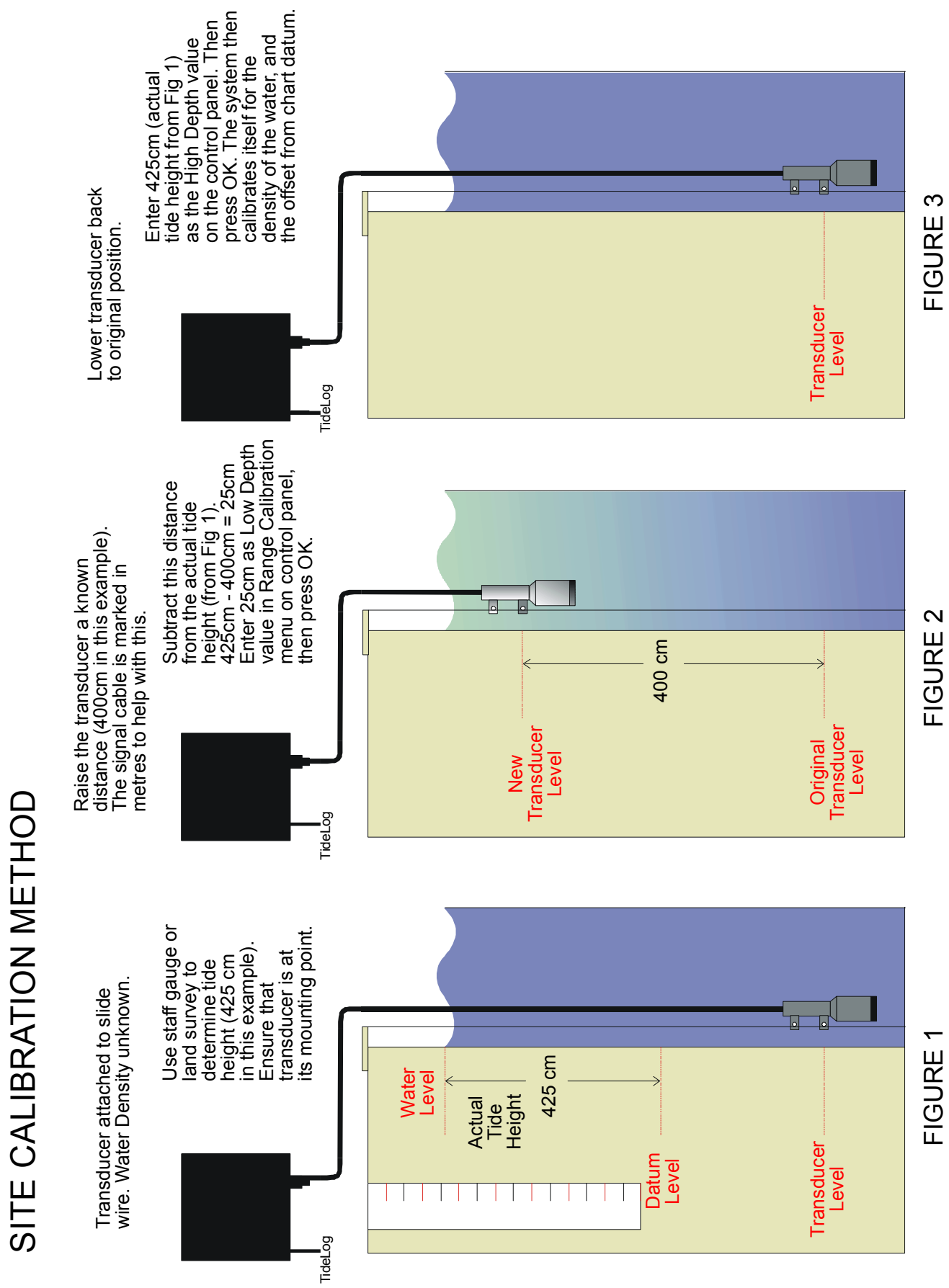
- Press OK key to force unit to measure pressure.
- Site calibration will be automatically calculated, and used when unit is set to Run Mode.

3.4.3 MANUAL METHOD

If it is not practical to perform either of the above procedures, the following Manual Method can be used:

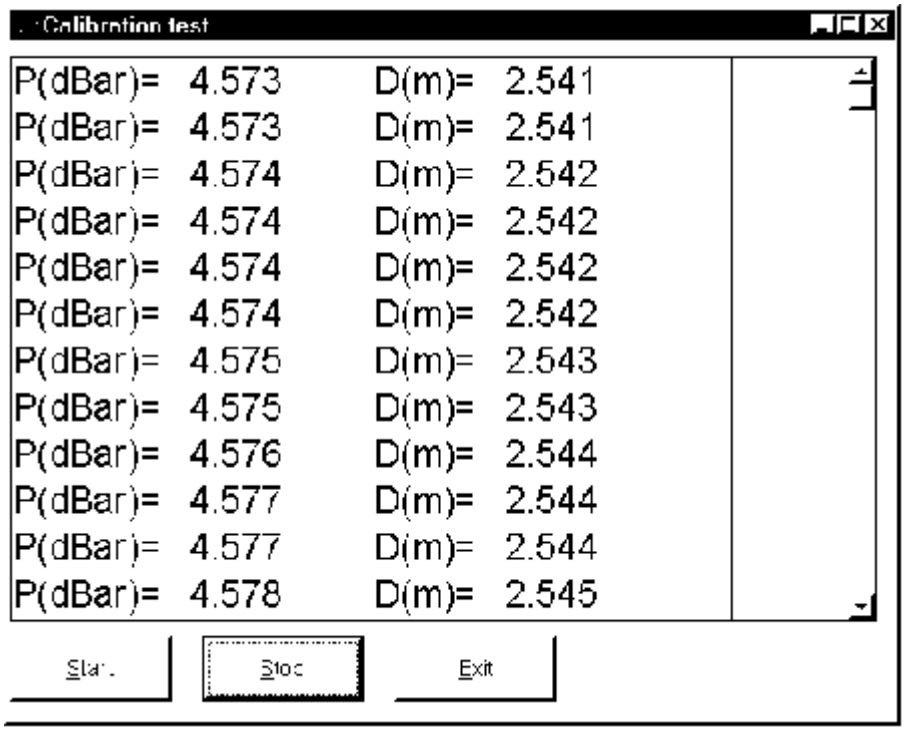
- Install and fix the transducer in the desired position, and connect it to the Model 740.
- Insert the switch cap. The unit will enter Run Mode, signified by the red LED.
- Note the water height above datum, and the time.
- Leave the unit until a significant level change has occurred.
- Make a note of the new water height above datum, and the time.
- Extract data from the Model 740 and compare logged pressure readings with observed water heights.
- Using the equations given in Section 3.4.1, calculate the Gain Factor and Offset Value.
- Enter these values as User Gain and User Offset.

FIGURE 4 EXAMPLE OF A SITE CALIBRATION METHOD



3.4.4 CALIBRATION CHECK

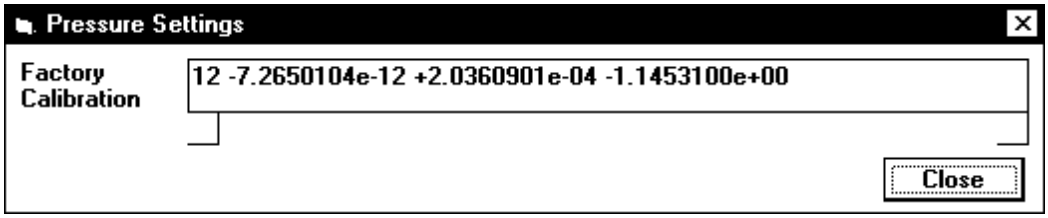
Selecting the calibration check button brings up the following screen:



Pressing start sends the unit into run mode outputting realtime data at 1Hz. This can be used as a quick calibration check procedure. Selecting stop will interrupt the output of data via the connect command. Selecting Exit will leave this screen, again via the connect command.

3.4.5 FACTORY CALIBRATION

Selecting this function brings up the calibration string entered into the unit following factory calibration. This calibration is obsolete when user or site calibrations are conducted.



The structure of the string is as follows:
The figure 12 indicates that the calibration curve is a second order polynomial, in the form:

$$y = (A2)x^2 + (A1)x + (A0)$$

The coefficients are as shown in the order A2, A1, A0, separated by spaces.

3.5 RUNNING THE INSTRUMENT

After the instrument configuration has been set as required, it is possible to begin the sampling program. If the user is using the Model 740 in Direct Reading Mode, this is achieved by selecting ***Run*** from the ***Setup*** menu. The unit enters an interrupt period for 30 seconds (the LED will flash once per second), during which the message *Initialising* is displayed in the bottom left hand corner of the Window.

Following this, the unit enters sampling mode (unless a delayed start has been entered). Here the LED will flash four times per second for the duration of the burst length. After the 740 has taken its second reading, the LED will flash only once each time a new reading is logged. The length of time between each reading is determined by the Burst Cycle time.

A watchdog function has been added to the Model 740 to ensure that the unit enters run mode should it be interrupted and then receive no further commands. The 740 will enter run mode if it is not prompted for more than five minutes. The unit must then be interrupted again to perform any changes.

If you are using the 740 in Logging Mode only,

YOU MUST REMOVE THE 3m DATA LEAD USED FOR SETTING UP THE UNIT AND FIT THE DUMMY CAP TO THE UNIT AFTER HAVING SET THE DESIRED CONFIGURATION AT THE ***PROBE CONFIGURATION*** SCREEN.

Fitting the cap automatically sets the unit into Run Mode, as above, after a 30 second period during which the LED cap flashes at a rate of once per second before initiating the first data burst.

To see real time Direct Reading data, use one of the display modes detailed in Section 4, by selecting the appropriate command from the Display pull down menu.

3.6 STOP

To stop the unit Running in Direct Reading mode, select ***Stop*** from the ***Setup*** pull down menu. The unit will also stop if ***Connect*** is selected. The unit must be stopped in order to allow certain functions to be used in the displaying of data.

3.7 RECORD

It is possible for real time data to be recorded on computer disk. After the desired configuration has been set proceed to run the unit as above. To record the data, select ***Record*** from the ***File*** pull down menu. You will be asked to specify a drive, directory and file name for the record. Then proceed to run the unit as above. The data will automatically be recorded as it is produced.

In order to view direct reading data, you must select a display mode from the ***Display*** pull down menu. Full details on these modes are in Section 4.

4 DATA HANDLING

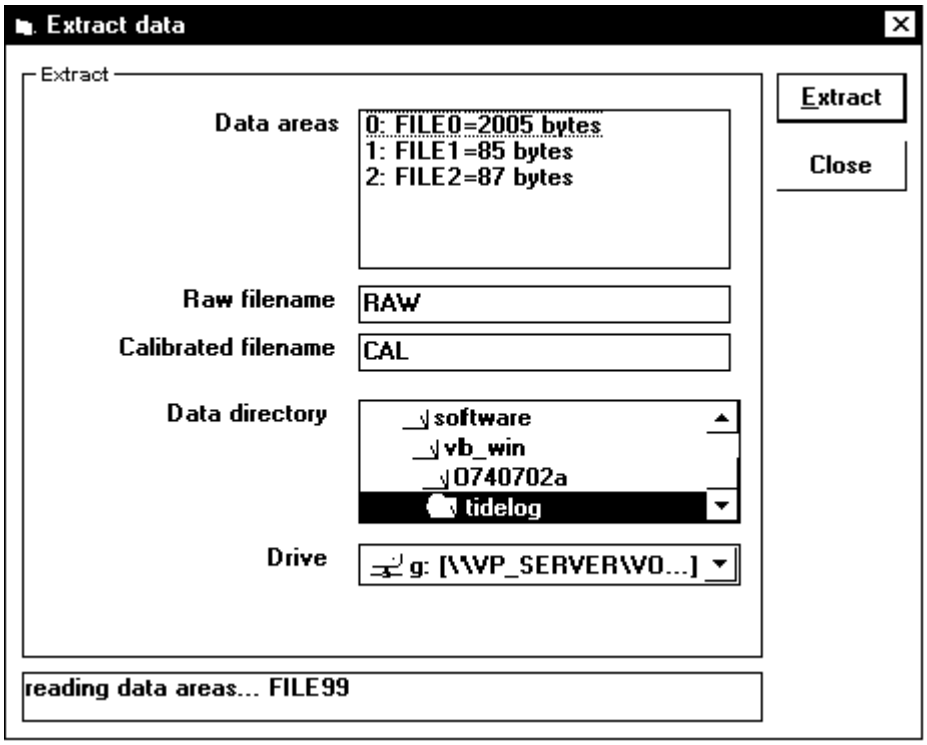
4.1 UPLOADING LOGGED DATA

Data are stored in internal battery backed RAM in binary format. Each time the unit is switched on or 'RUN', a new data file is created with its own header information containing sampling regime, etc. following which the data is recorded. These data files can be uploaded and saved to disk by selecting *Extract* from the *Connect* screen in *Setup*. A binary file is created initially which mirrors the requested stored data files; the default name is RAW.

Calibrated files (default name CAL) are created from the binary files.

The Calibrated files can later be displayed in the various formats available with this package or imported into spreadsheets for statistical analysis.

The Display will now show the following:



i) Data Areas: Scrollable text box containing file allocation within the instrument. If no data has been stored in the instrument, the message 'Nothing to upload' will be displayed.

ii) Raw filename: Binary format files in non engineering units. The default filename RAW may be changed; it should be restricted to 8 characters.

iii) Calibrated filename: Calibrated files generated from RAW binary files. The default filename CAL may be changed; it should be restricted to 8 characters.

iv) Data directory: Standard type Dialog box to allow alternative directory paths to be set. The default path is c:\TideLog.

As many files as you want can be selected at once with the mouse by holding down Ctrl while using the mouse to click on each file (as in the illustration above). Once the desired files have been highlighted, select *Upload*. Initially the RAW binary files will be created with an extension relating to file number e.g. RAW.005 corresponds to file number 5 in the instrument. The Calibrated data files are created using the same extension as the binary files from which they were created.

A header is created as default in the file, which contains various information about the file, with the following structure. To override this, select make Separate Header File. Please note that only files created with a header can be viewed in TideLog.

```
File header created by: TIDELOG on 03/10/99 19:28:10
Filename: CAL.000
Pressure calibration: P = 12 -7.2650104e-12 +2.0360901e-04 -1.1453100e+00
Battery voltage:  5.47
VLR740 Serial number: 1234
Transducer serial number: 987654305
File number:  0
Burst Cycle Time(mins):  5
Burst Length (secs):  60
filetime :08/09/99 13:31:00
Site_info: Valeport Ltd. Factory Test Department Site String
Secondary cal type: Site
Depth units: Metres
Secondary Gain coeff:  0.8141215
Secondary offset:  1.858785
```

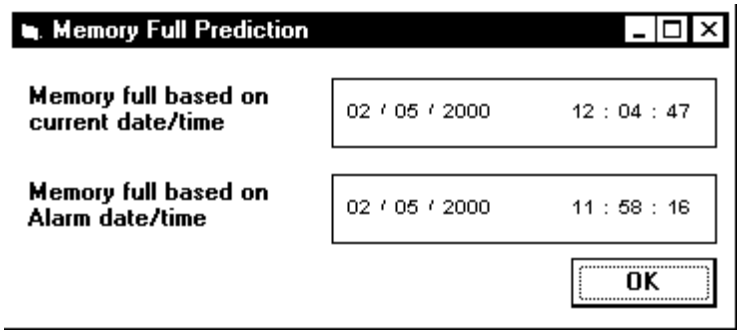
Note that the data in the instrument is not erased after uploading, further logging will occur after the last record.

4.2 CLEAR FILES

Click on this button to Erase the memory of the unit. A confirmation is displayed and clicking on OK erases memory.

4.3 MEMORY FULL PREDICTION

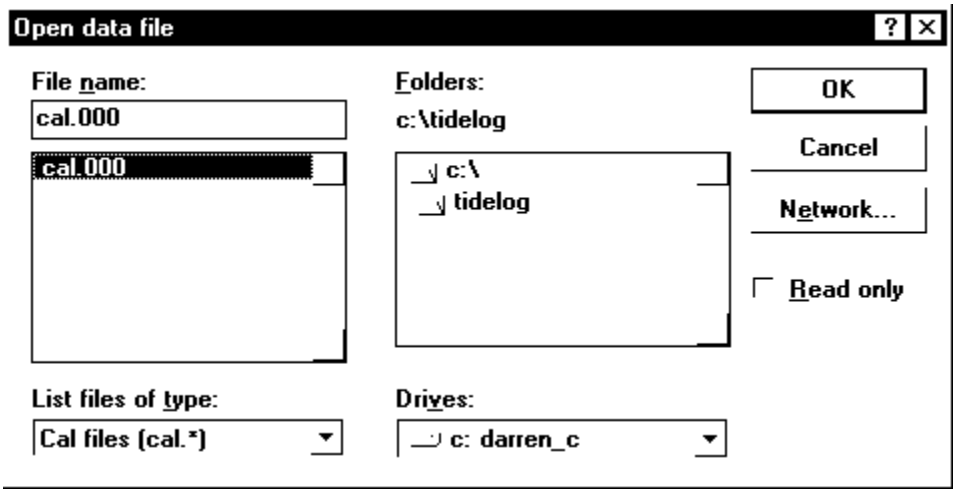
Activating this function will bring up the following screen:



This screen provides approximate times of when the memory will be full under normal (using the current sampling regime) and delayed startup operation.

4.4 SAVED DATA

If you wish to look at data already on the computer, either Uploaded from the unit or recorded from Direct Reading mode, select Open from the File menu.
The following screen will appear:



Select the desired drive, directory and file and push Enter. The correct file will then be opened.

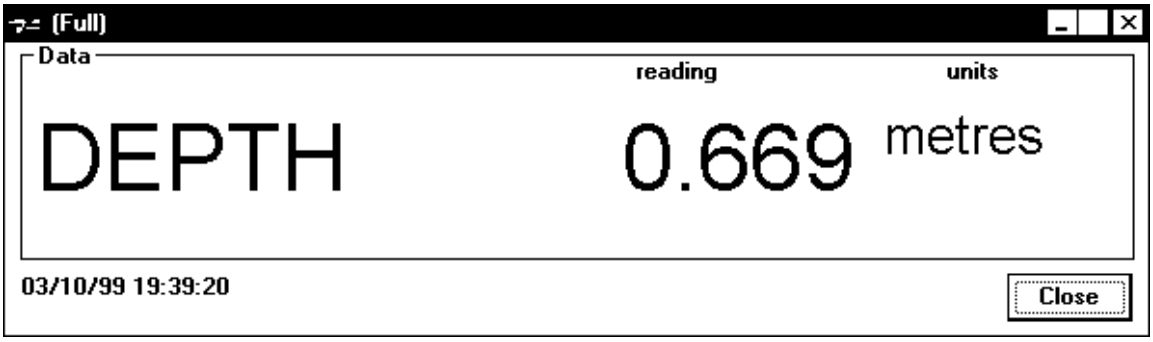
4.5 DISPLAYS

Data from the unit can be displayed in 3 formats. Several different displays can be shown simultaneously and iconized.

4.5.1 SINGLE

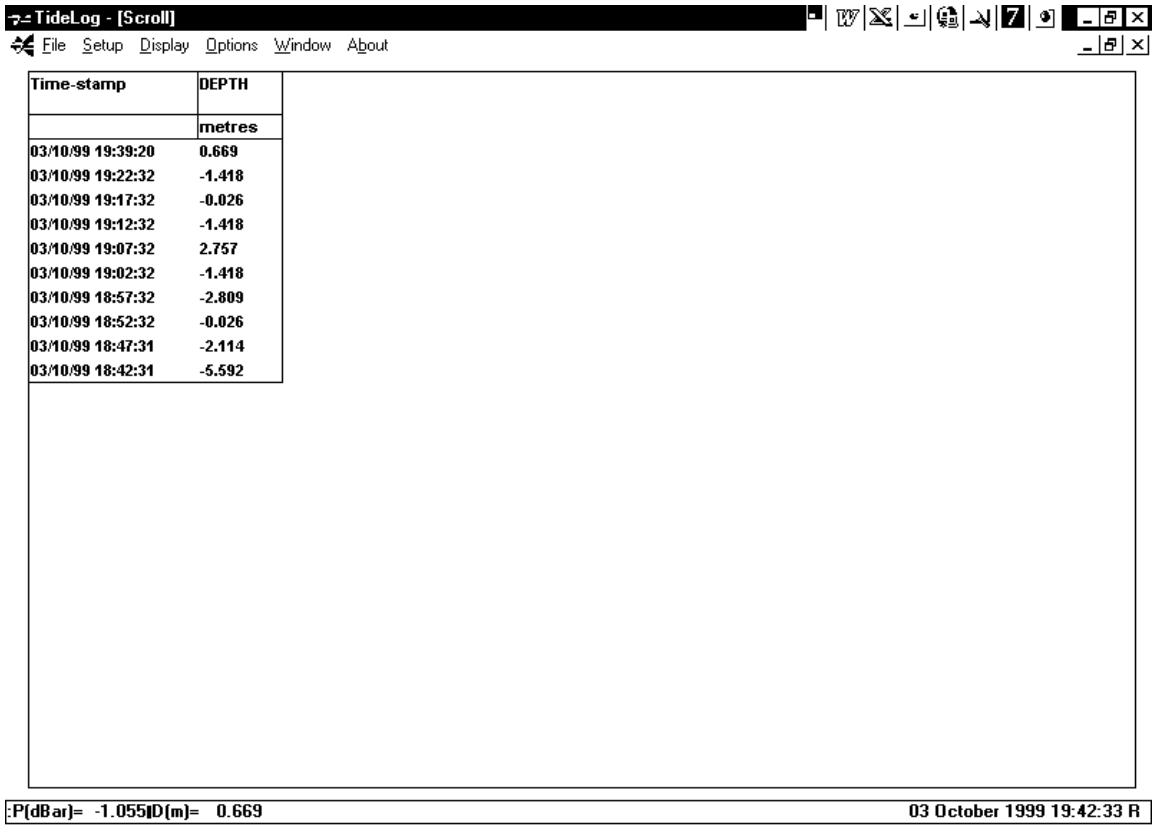
The ***single*** display will show the parameters transmitted by the instrument in real time mode only. It should be noted that data will only be updated at the end of a sample period. Data stored on disk cannot be displayed in this format.

This display is not sizeable, but can be iconized and moved outside the TideLog environment.



4.5.2 SCROLL

As the title suggests, a Scrolled display will be shown as below. The most recent data will be displayed at the top therefore scrolling data down. To view information outside the text box, shift the display using the arrow controls with the mouse. Unlike the ***single*** display options, data previously stored from real time recording (see section 3.7) or Uploaded from the instrument (see section 4.1) can be recalled and displayed in this format. The example below shows a typical scrolled display of recorded data.



Data displayed in this format can be printed, but not while the unit is actually running. If this screen is being used for real time display, ***Stop*** or ***Connect*** must be selected to allow data printing. To print off a table of data, select Print from the Options Menu. A standard Windows Print Options form will be displayed.

It is also possible to select the font in which the data is to be printed. Selecting ***Set Print Font*** before selecting the ***Print*** function reveals a display showing all available printer fonts. NB Some TrueType fonts will not size to the page correctly, so use of these is not recommended.

4.5.3 AVERAGE DATA

A display of average data values can be obtained from this screen. While the unit is stopped (or with recorded/uploaded data), the Scroll table has the property of allowing values within the table to be highlighted. This can be done either by dragging the mouse over the desired values, or by clicking on a column header to select the entire column. Then select ***Data Analysis*** from the ***Display*** menu. A table will be displayed, showing high and low values, the mean value of the data, and the Standard Deviation of the data.

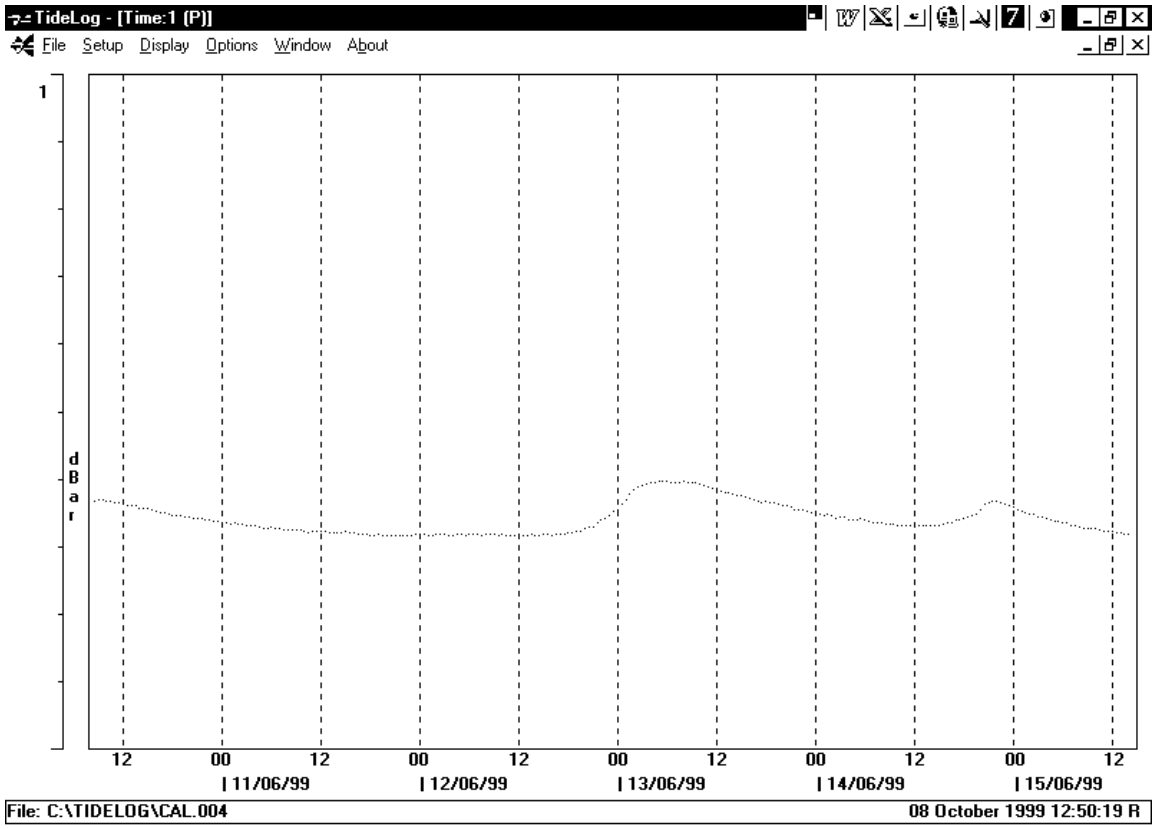
NOTE: It is not possible to perform Data Analysis on more than one parameter at once.

4.5.4 GRAPH

The Graphical display function can be used for either real time or recorded data, and allows the pressure readings, contained within a file, to be displayed as a function of time. The outputs provided show the pressure readings by way of engineering units. Several individual graphs can be displayed at once; the limitations of which would depend upon PC configuration and the number of tasks running in the Windows environment, such as statistical analysis packages, word processor, etc.

Graphical representation can be made of pressure readings in real time mode once the connection has been established. Each graph may be iconized, but will still be refreshed as new data appears. A hard copy of the plot can be produced by selecting the pull down menu ***Files*** and selecting ***Print*** which will then show a standard type Dialog box from which print resolution, number of copies etc. can be chosen.

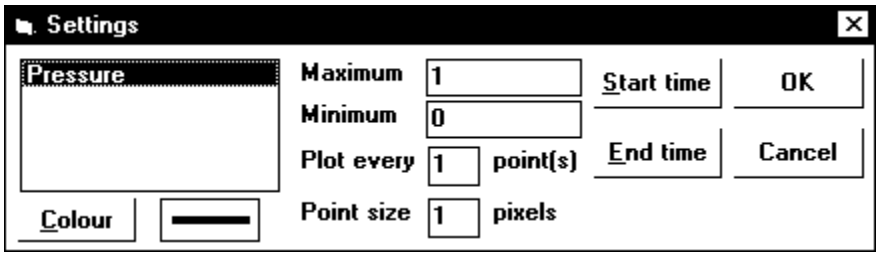
A typical graph is shown below as a function of Time.



4.5.4.1 GRAPH SETTINGS

Selecting ***Graph Settings*** from the ***Options*** menu in graph mode allows the user to change certain features of the display. Shown below is the settings Dialog box, to allow changes to be made to 'X' and 'Y' axes scales, and parameter display colour. Select the parameter, in the example below this is Pressure, and enter new maximum and minimum value for the scale. The colour can be changed by selecting ***Colour***, from which a set of basic and custom colours may be selected to suit.

As mentioned previously, the time axis can be changed, but this will be for all parameters displayed. Simply select ***Start time*** and enter required date/time, then select ***End time*** and enter as appropriate.

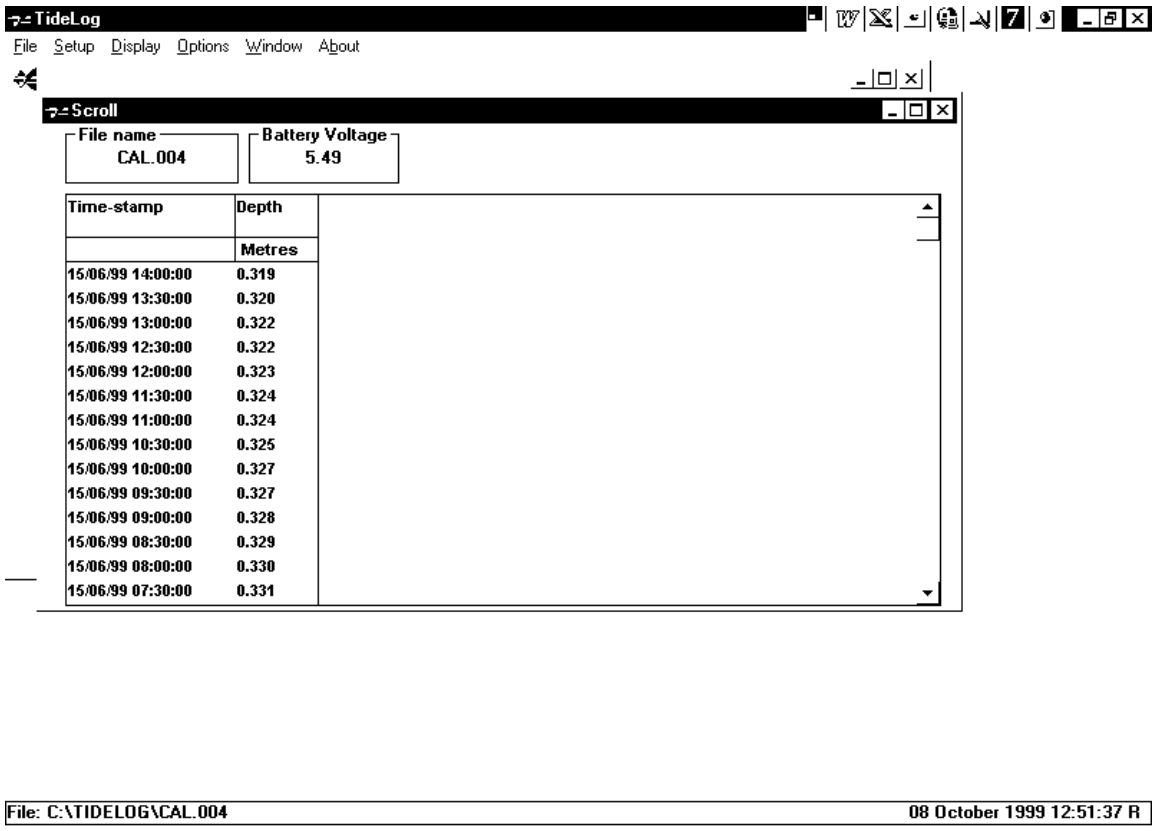


4.6 WINDOW

The *Window* pull down menu allows the user to configure the display to *Cascade*, *Tile* or *Arrange Icons* if showing. It should be noted however that the *single* displays are not affected by this command as they are created for display outside the TideLog window.

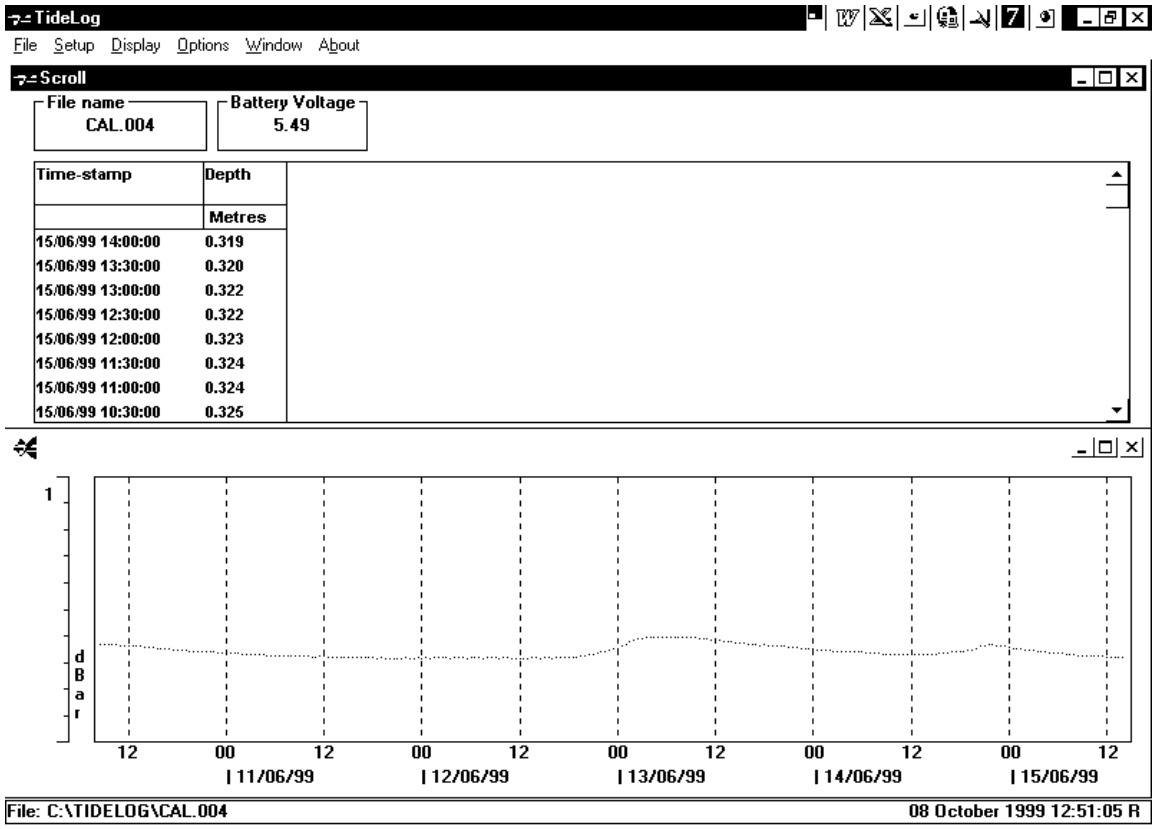
4.6.1 CASCADE

Below is an example of a cascaded display.



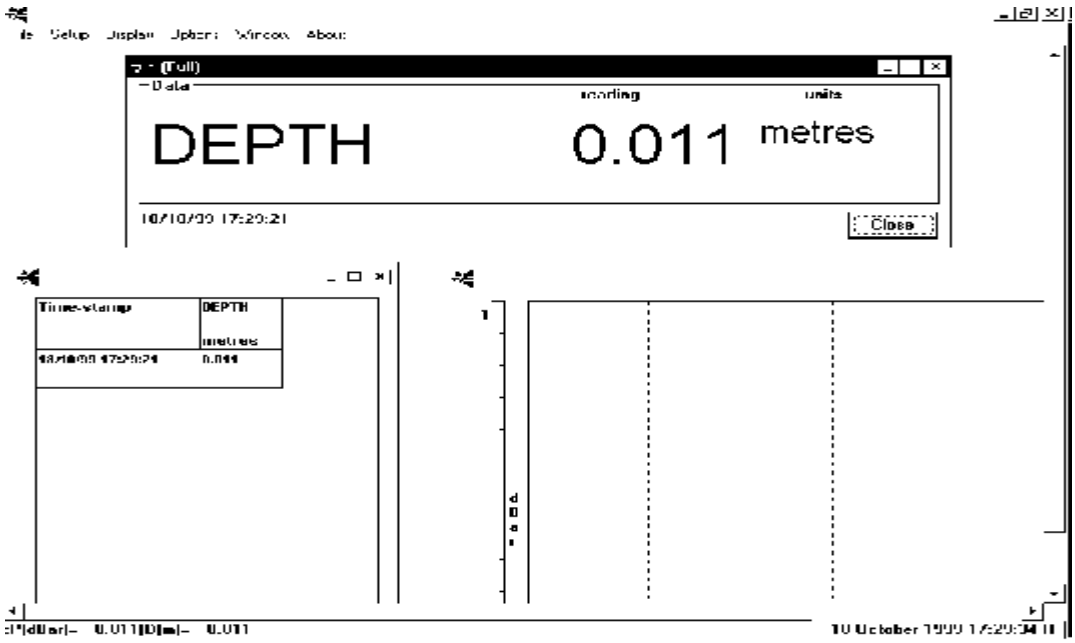
4.6.2 TILE

Below is an example of a Tiled display.



4.6.3 ARRANGE ICONS

The function allows the user to arrange the screens as required.



4.7 OPTIONS

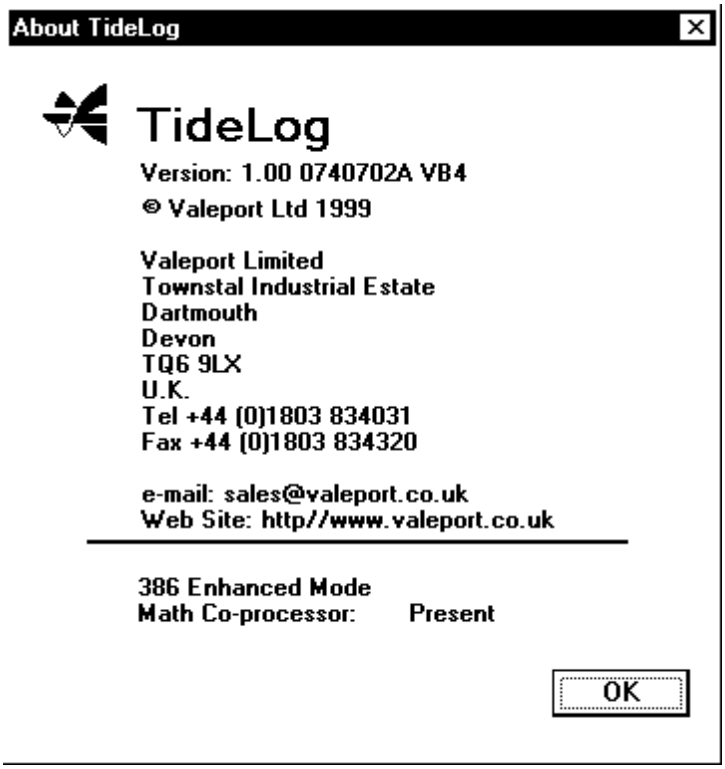
This function allows the user to set various options as detailed below. Some functions are only available at specific points within the software. At all times, ***Options*** allows the user to select/de-select the status line at the bottom of the page

4.7.1 STATUS LINE

The Status line in situated at the bottom of the TideLog window. Real time data/filename and PC time and Date are displayed here. This can be toggled on/off by selecting ***Status Line*** with the mouse.

4.8 ABOUT

To enable the user to determine which software version is operating, select the ***About*** function. A display similar to below will be shown which contains information with regard to PC configuration.



APPENDIX 1 DEPLOYMENT CAPACITIES

Any deployment scenario will be governed by two limiting factors: memory and battery capacity.

MEMORY CAPACITY

Each data record (1 record per burst) takes 2 bytes of data, plus an 80 byte header file for each data file. The unit is fitted with a 128 kbyte memory [131072 bytes], of which 402 bytes is used for a File Allocation Table, leaving 130670 bytes available for logging.

Presuming that a deployment consists of a single data file, a total number of records which can be logged is:

(130670 – 80)/2 = 65,295

With a typical logging scenario of one record every 10 minutes, the memory capacity would be 453 days.

POWER CONSUMPTION

The Model 740 will operate on voltage inputs from 5 to 15v. Power consumptions are:

Model 740:		Radio Unit:	
Sleep Mode	3.6mW	Sleep Mode (off)	0mW
Measuring	59mW	Warm up	300mW
Listening	155mW	Transmit (0.5W)	3600mW
(Passive comms	110mW)	Listening	600mW

The cycle pattern for the 740 is:

Measure for user set burst, listen for 5 seconds for interrupt, sleep until next burst. The passive comms mode is only achieved if interruption is successful. Calculations assume this is not done.

The cycle pattern for the radio is:

Warm up for 0.3 seconds, Listen for 0.893 seconds, Transmit for 0.123 seconds, Listen for 4.98 seconds, Off until next burst.

Using a scenario of 40 second sampling every 5 minutes, the Model 740 uses:

59*(40/300) + 155*(5/300) + 3.6*(255/300) = **13.51mW** equivalent continuous power drain.

The radio will use:

300*(0.3/300) + 600*(0.893/300) + 3600*(0.123/300) + 600*(4.98/300) = **13.52mW** equivalent continuous power drain.

For a Model 740 without radio telemetry, the internal battery pack can use either 4 x 1.5v alkaline D cells, or 4 x 3.6v Lithium D cells.

Alkaline cells have a nominal capacity of 18Ah. Assuming 75% efficiency, this gives 13,500mAh available for use. At a nominal 1.5v per cell, the 4 cell pack will give 6v output. The Model 740 will therefore use 13.51mW/6v = **2.25mA**, and the batteries will last for 13500/2.25 = **6000** hours (approx 250 days).

Lithium cells have a nominal capacity of 13Ah. Assuming 95% efficiency, this gives 12,350mAh available for use. At a nominal 3.6v per cell, the 4 sell pack will give 14.4v output. The Model 740 will therefore use 13.51mW/14.4v = **0.938mA**, and the batteries will last for 12350/0.938 = **13166** hours (approx 550 days).

For a Model 740 with radio, and both logger and radio taking power from the internal battery pack, Lithium cells must be used. Total power drain is therefore **27.03mW**.

Lithium cells have a nominal capacity of 13Ah. Assuming 95% efficiency, this gives 12,350mAh available for use. At a nominal 3.6v per cell, the 4 sell pack will give 14.4v output. The Model 740 will therefore use 27.03/14.4v = **1.877mA**, and the batteries will last for 12350/1.877 = **6580** hours (approx 275 days).

APPENDIX 2 MAINTENANCE & WIRING INFORMATION

CHANGING BATTERIES

The Logger unit requires minimal maintenance apart from battery changes.

The unit is fitted with 4 "D" cells. To replace the cells, the procedure outlined below should be followed:

- Remove the 4 slot head screws from "handle" end of the VLR740 unit.
- Slide out the handle end plate, which also holds the battery tray. Take care not to pull on the wires connecting the battery to the electronics PCB which is mounted at the other end cap.
- Remove the old batteries.
- Fit new batteries, taking care to ensure they are inserted with the correct polarity.
- Replace the end cap and re-fit the cap head screws.

CHANGING THE RAM BATTERY.

The memory of the unit is protected by a 3.7v $^{2}/_{3}$ AA size Lithium cell, soldered directly onto the circuit board of the unit. This cell should last for between 5 and 10 years, but if it does need replacing, then the procedure outlined below should be followed. A low battery will cause memory loss, or confused header information.

- Ensure power is switched off to the electronics PCB by removing the switching plug.
- Remove the 4 screws from the "connector" end of the VLR 740 unit.
- Slide out the end plate, which also supports the electronics PCB. Take care not to pull on the wires connecting the electronics to the battery pack which is mounted on the other end cap.
- Unsolder the existing cell and replace it with a similar one.
- Reassembly is a reversal of the above.

TRANSDUCER CABLE WIRING

If a user wishes to shorten the signal cable, then this can be done, but care has to be taken in re-terminating the connector in order to ensure the integral vent tube is properly terminated in the connector and can vent through to the corresponding hole in the mating bulkhead connector. If the cable is shortened, then the pressure calibration will alter very slightly, but provided the pressure to depth calibration [see 3.3. below] is carried out, then the user will take out any variations.

Connector terminations are:

Connector: Bulgin Line connector 6 way Female [Cable Socket]

Pin allocations:			
	1	Red	Drive +ve
	2	White	Drive –ve
	3	Yellow	Signal +ve
	4	Blue	Signal –ve
	5	Green	Screen

DATA CABLE WIRING

Model 740 end:

Connector: Bulgin Line connector 6 way Male [Cable Plug]

Pin allocations:			
	1	Blue	RS232 out from Model 740
	2	Yellow	RS232 in from Model 740
	3	Red	Power in to unit – Link to 4 in connector
	4	Red	Power from internal battery – Link to 3 in connector
	5	Green	Ground – Link to 6 in connector
	6	Green	Enable RS232 – Link to 5 in connector

PC end:

Connector: 9 way D type female

Pin allocations:			
	2	Blue	RS232 in to PC
	3	Yellow	RS232 out from PC
	5	Green	Ground
	1,6,8,9	Wire link in plug to pin 5 [Ground]	

RADIO COMMS LEAD WIRING

Model 740 end of 50cm comms lead:

Connector: 6 way male Bulgin

Pin allocations:			
	1	Red	TX RS232 from 740
	2	White	RX RS232 to 740
	3	Green	+V in to 740
	4	Blue	+ Battery from 740
	5	Black	Ground
	6	Orange	Radio enable

Radio Unit end of 50cm comms lead:

Connector: 6 way female Bulgin

Pin allocations:			
	1	Red	TX RS232 from 740
	2	White	RX RS232 to 740
	3	Green	+V in to 740
	4	Blue	+ Battery from 740
	5	Black	Ground
	6	Orange	Radio enable

APPENDIX 3 RADIO & ANTENNA SPECIFICATIONS

The standard radio transceivers used with the Model 740 radio telemetry option are of Type MP1401, manufactured by Magenta Products Ltd. Each radio radio is also fitted with a Type 2519A modem board, also from Magenta.

The transceivers feature selectable frequency transmission, in the UK licence exempt band of 458.5 to 458.9MHz. The channel is selected by means of push button switches connected to a Valeport microprocessor, pcb number

Valeport accept no liability for transmission failure due to interference on any specific frequency. Any necessary fees and licences are the sole responsibility of the end user.

Channel	Frequency/MHz	Channel	Frequency/MHz
01	458.5125	19	458.7375
02	458.5250	20	458.7500
03	458.5375	21	458.7625
04	458.5500	22	458.7750
05	458.5625	23	458.7875
06	458.5750	24	458.8000
07	458.5875	25	458.8125
08	458.6000	26	458.8250
09	458.6125	27	458.8375
10	458.6250	28	458.8500
11	458.6375	29	458.8625
12	458.6500	30	458.8750
13	458.6625	31	458.8875
14	458.6750	32	458.9000
15	458.6875	33	458.9125
16	458.7000	34	458.9250
17	458.7125	35	458.9375
18	458.7250		

As standard, the site radio unit is supplied with a 0dB whip antenna. The base station radio unit is supplied with a 3dB omnidirectional colinear antenna, which is also optionally available for the site radio. Both antennae have an impedance of at least 50ohm, and it is essential that they are connected to the radio before power is applied

SPECIFICATION OF RADIO STRUCTURES FUC-3 ANTENNA

Gain over ½ wave dipole	3dB
VSWR	Better than 1.5:1 over the operating band
Maximum Input Power Rating	150W
Input Impedance	50Ω
Bandwidth	±2% of centre frequency
Polarisation	Vertical
Half Power Beamwidth	32º
Connection	10m length of RG213 terminated N type socket and PVC sleeve
Radiating Elements	Brass rod plasfilm coated
Encapsulation	Reinforced glass fibre tube
Length	1.160m @ 460MHz
Weight	1.1kg
Wind Loading	6.4kgf @ wind velocity of 160kph

APPENDIX 4 CALIBRATION CERTIFICATE

Calibration Certificate inserted after this page

APPENDIX 5 PRE-DELIVERY CHECKLIST

Serial No:.....	Model No: ..... Model 740
Customer:	Con Number:.....
.....	Customer Ref: .....
.....	Del. Note:.....
.....	Calibration Cert.: .....

Item	Items Required		Quantity	Serial Number	Part Number
	Yes	No			
Model 740 Logger unit, with batteries fitted.					0740006
Transducer with 20m vented signal cable					0740001
Transducer mounting bracket, fixing screws.					
Radio Transmitter Unit					0740011
External Power lead					0740010
50cm Radio Comms Lead					0740009
0dB Whip Antenna					0740015
3dB Antenna with 10m cable & 2 x 8-nut fixing clamp					0740014
Switch plug					0740004
Data lead					0740005
Desktop Receiver Unit					0740012
DC Input Lead					0750010
PC Interface Lead					0710036
TideLog software disc (2)					0740702
Manual					0740825
Calibration certificate [in manual]					See appendix 4

SIGNED..... DATE.....

APPENDIX 6 INSTRUMENT AND RADIO SETUP INFORMATION

The following table outlines the set up of the main gauge and any radio configuration as set before leaving Valeport Ltd.

Contract number		Date	
Main Gauge (Type)			
Serial Number			
Local output baud rate (Baud rate to PC)			
Data Output format			
Software version supplied			
Is a radio supplied?			
Radio Transmitter Serial Number			
Type of radio installed			
Radio (serial number)			
Transmission baud rate			
Receiver (Type)			
Serial Number			
Type of radio installed			
Radio (serial number)			
Transceiver baud rate			
Local output baud rate (Baud rate to PC)			
Local output format			
Receiver (Type)			
Serial Number			
Type of radio installed			
Radio (serial number)			
Transceiver baud rate			
Local output baud rate (Baud rate to PC)			
Local output format			
Additional notes			

APPENDIX 7 GUARANTEE CERTIFICATE

All goods are subject to a 36 month guarantee against faulty materials and bad workmanship.
Any faults to be declared within 36 months from date of despatch, in writing to Valeport Limited, who will replace or repair (at their option) any faulty items caused by bad workmanship or materials, (except transducers, radios, displays and semiconductors which are only guaranteed for a 12 month period).

Valeport Limited shall be under no liability for:

1) Any consequential loss or damage of any kind whatsoever.

2) For any defect or deficiency judged by Valeport Limited to be caused by wear and tear or of improper or unskilled handling of the goods or by any repair or attempted repair or dismantling by any one other than Valeport Limited or person's authorised to do so by Valeport Limited.

3) Batteries and other consumables supplied with the equipment, which are not covered by this guarantee.

Due to the specialised nature of the instrument it should, if possible, be returned to the factory for repair or servicing. The type and serial numbers of the instrument should always be quoted, together with full details of any fault or the service required.

Equipment returned to Valeport Limited for servicing must be adequately packed, preferably in the special box supplied and shipped with transportation charges prepaid. Return transport charges are also to the account of the customer.

Note: Any items supplied as part of a system which are not manufactured by Valeport Limited are covered by the individual manufacturer's guarantee of the equipment supplied.

MODEL NUMBER ..... SERIAL NUMBER .....

DATE OF DESPATCH ..... SIGNATURE .....