Calibration of CTD-equipped SRDLs

Connect the cable

Connect the D-connector to a serial port on the PC, and connect the USB connector to the PC. One of the two lights contained in the potted connector should now be illuminated, indicating that power is connected.

The second light indicates that the connection is active. With the connector positioned so that the switch is above the cable and the cable is towards you, toggle the switch to the right so that the second light is OFF.

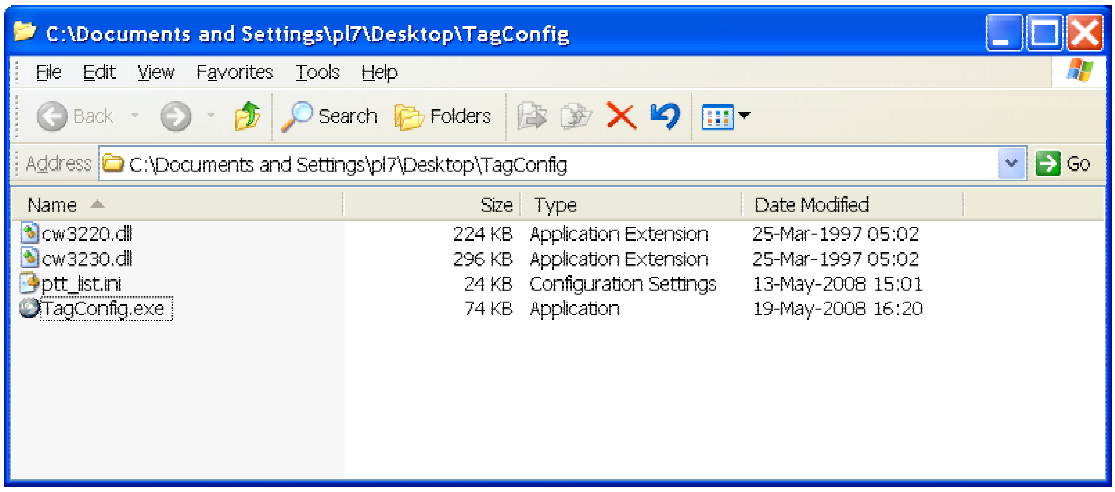
Connect the black end of the potted connector to the port on the side of the tag, aligning the blank in the connector with the missing pin in the port.

Install the TagConfig software

Extract the entire "TagConfig" folder to a local hard disk. Do not run directly from a CD since the program will be unable to write to its log files. According to the version of Windows, it may be necessary to run the program as a user with Local Administrator rights to get proper access to the serial port.

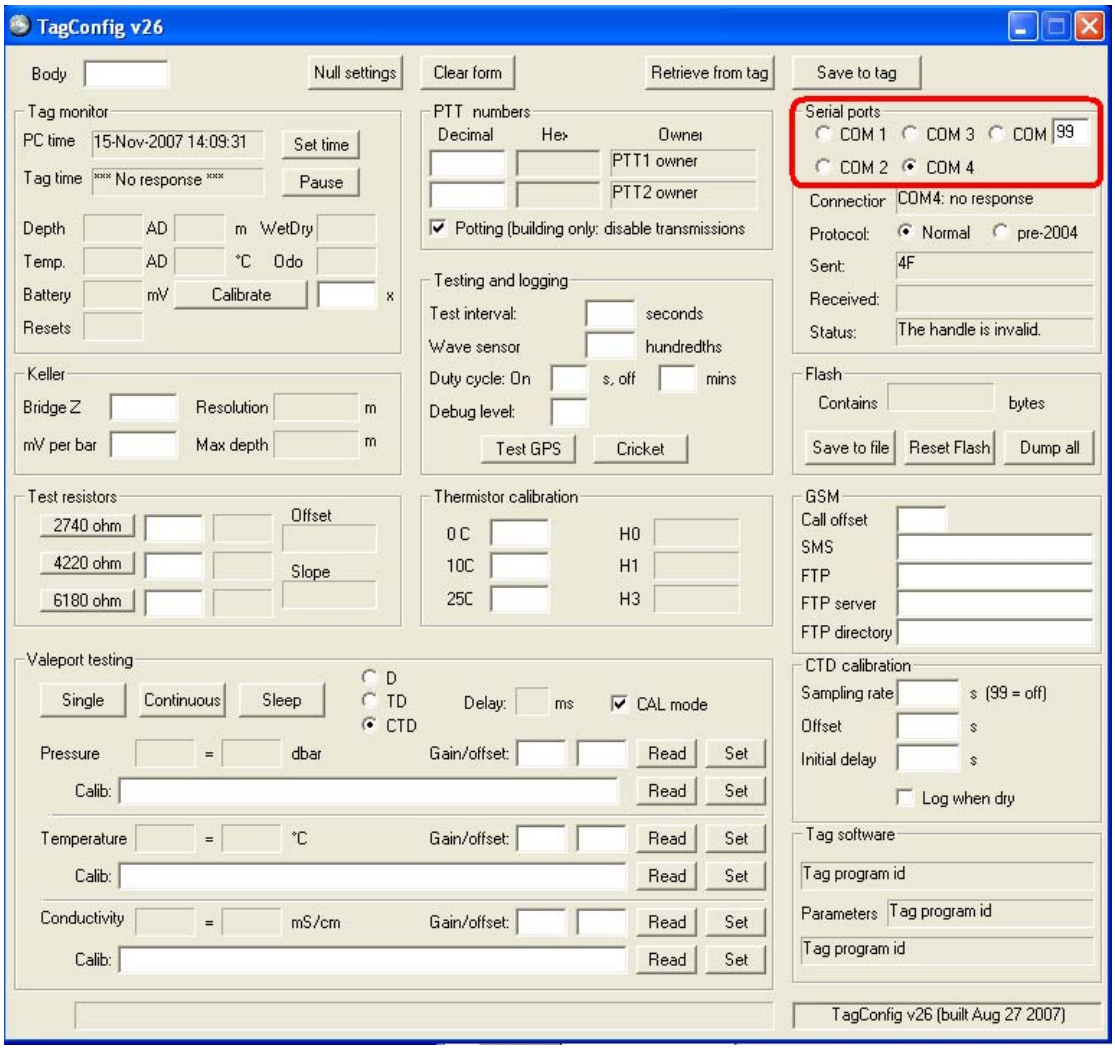
Start TagConfig

Double-click the file *TagConfig.exe* to run the program:



Connecting to the tag

Select the appropriate COM port from the list:

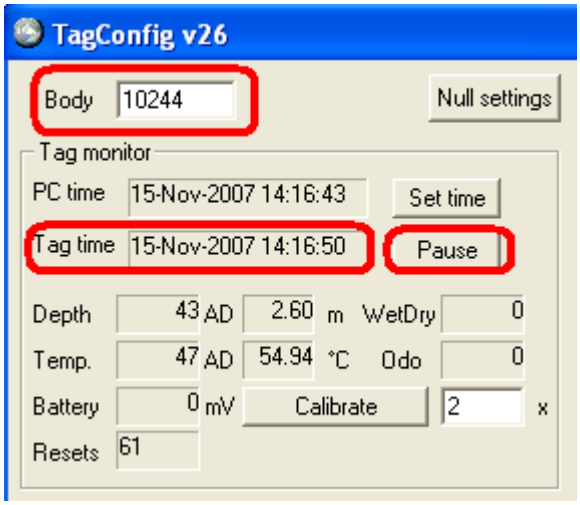


Move the toggle switch on the connector to the left (i.e. the ON position). The second light in the connector illuminates. In addition, the yellow light near the connector on the side of the tag changes state. This light indicates the status of the communication link between the tag and PC: it flashes once every 3 seconds when the link is inactive and a rapid sequence of double-flashes when the link is active.

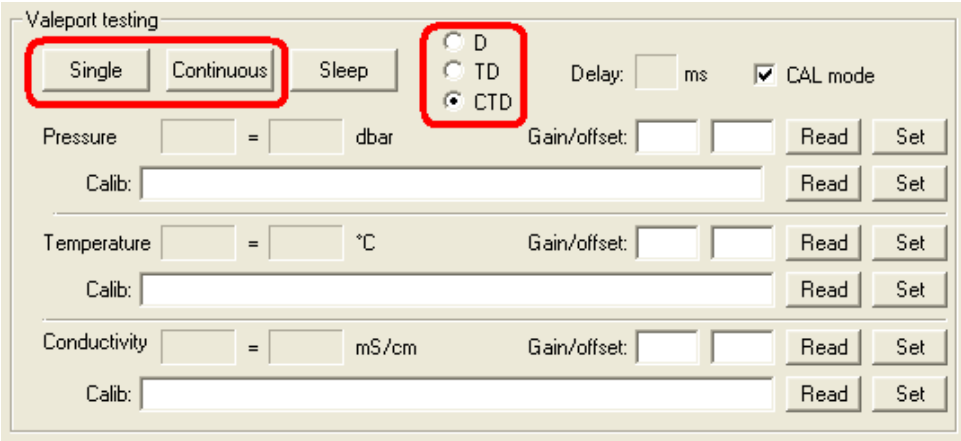
The “Body” serial number and other configuration data should now appear on the screen. The “Tag time” field should begin to increment, as the TagConfig program continuously interrogates the tag. All times must be in UTC. The “Tag time” field shows ***No response*** when no tag is detected on the specified serial port.

Monitoring CTD measurements in real-time

Click the “Pause” button to stop the interrogation process, since it can interfere with communication with the CTD device.

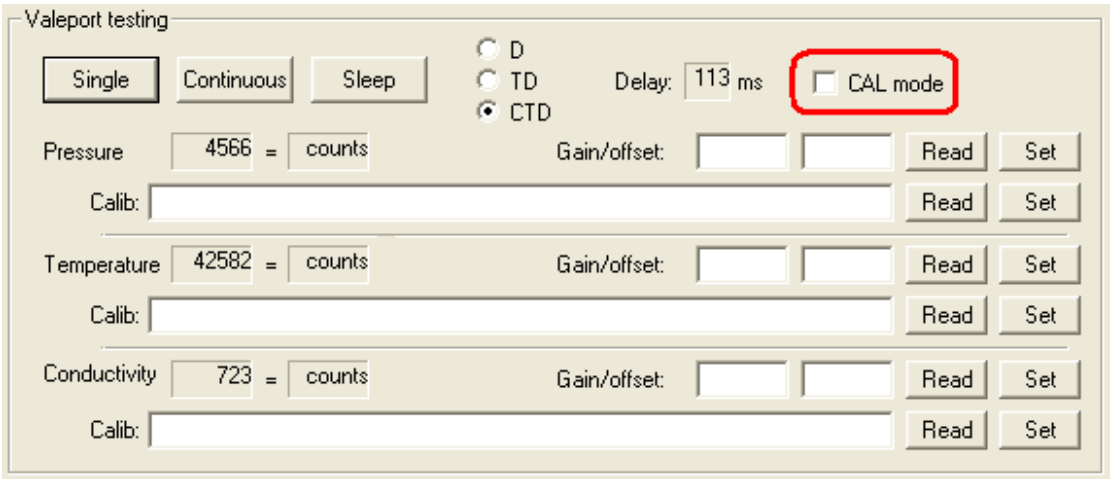


Select the measurements to be performed (“D”, “TD” or “CTD”). Do not immerse the tag’s port or the cable in water whilst connected. Click “Single” to perform measurements on demand, or “Continuous” to stream readings at 1 Hz.



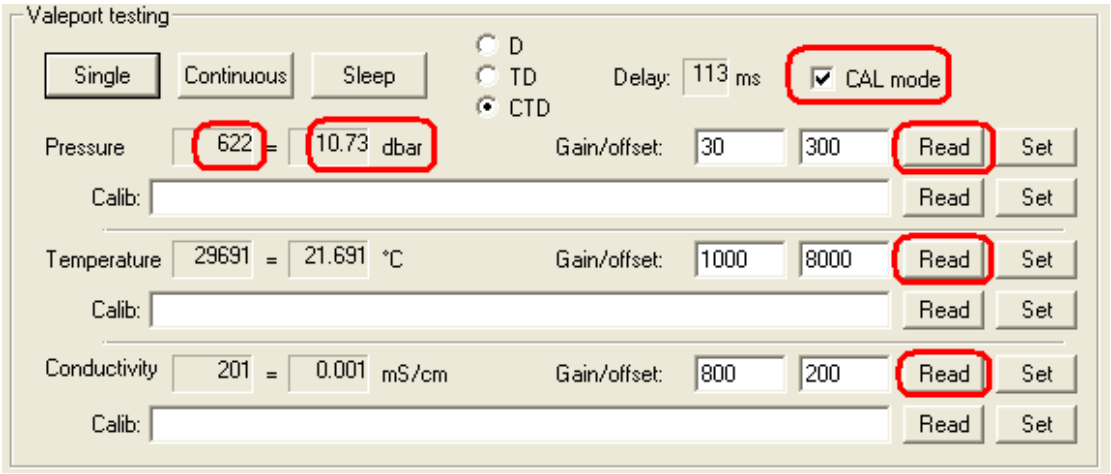
UNCAL mode

If the “CAL” checkbox is cleared, the values displayed are raw A/D counts, ignoring the Gain/Offset and Calibration String settings stored in the CTD device.



CAL mode

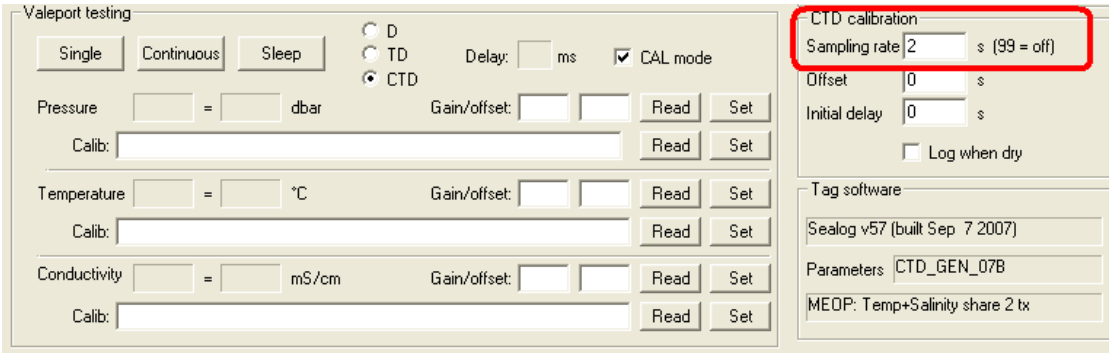
If the “CAL” checkbox is set, the values shown are the result of applying the calibration strings stored in the CTD device. The first value is the internal scaled integer representation and the second is the true value in real-world units after the Gain and Offset have been applied. This value can only be calculated if the Gain/Offset settings have been retrieved from the tag: to do this first press “Stop” if continuous monitoring is in progress, then click the “Read” button adjacent to each Gain/Offset pair. Because of buffering in the CTD device, it is necessary to click each button twice to be sure that the values displayed are correct (the defaults are 30/300 for Pressure, 1000/8000 for Temperature and 800/200 for Conductivity as shown here).



Logging CTD measurements

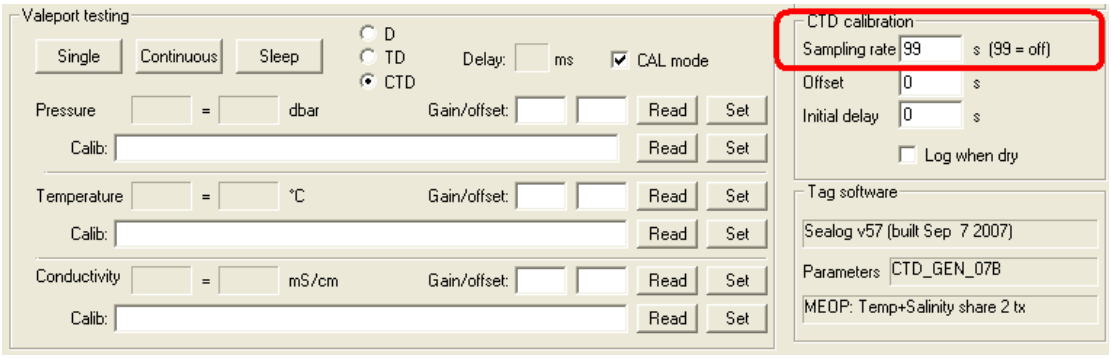
Select logging rate

The program loaded into the tags is the final program, which will acquire and transmit highly compressed data when the tag is deployed. However, it also has the facility to log data directly to its internal flash memory for calibration purposes. This behaviour is triggered by the value set for "Sampling rate" field. Entering a value between 1 and 10 causes the tag to record CTD readings at the specified interval (in seconds).



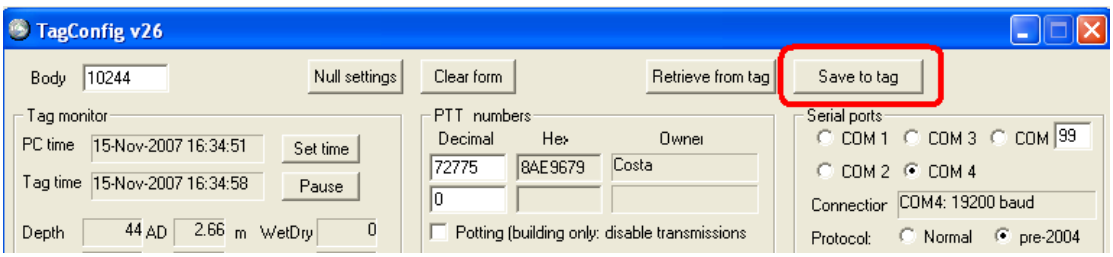
Calibration mode sampling every 2 secs

A value of 0 or >10 disables calibration mode and runs the deployment program proper:



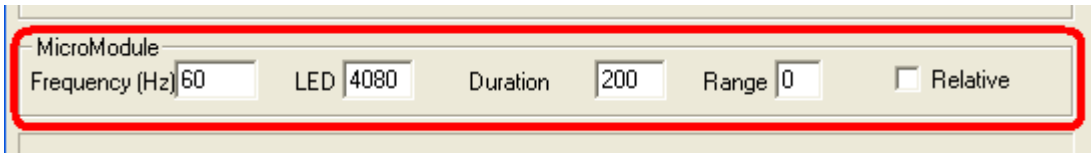
Calibration disabled ready for deployment

<u>After changing the value on the screen, click the "Save to Tag" button to transfer the new value to the tag.</u>



Fluorimeter tags

The section at the bottom of the screen controls the configuration of the MicroModule fluorimeter.



The fluorimeter pulses with a 1:1 duty cycle. The range of possible frequencies is 0.1 – 2000. Default 60

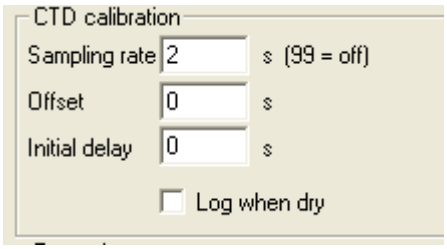
LED intensity: maximum 4096, minimum 1250 (the LED is off if the level is less than 1250) Default 3600

Range sets the gain of the fluorimeter in steps from 1 to 7 (49x to 344x). The default value 0 sets the maximum amplification (865x).

Samples are averaged and a result is produced after “duration” ms.

If “Relative” is selected , readings taken when the LED is off are subtracted from those taken when the LED is on.

Testing several tags simultaneously



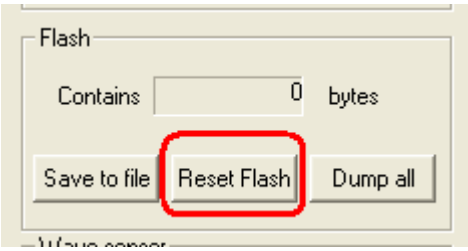
The “Offset” field can be used to control the synchronisation of several tags. It sets the elapsed time within each sampling interval at which the sample is actually taken. For example, if “Sampling rate” is set to 10 and “Offset” is 2, samples will be taken after 2, 12, 22, 32, 42… seconds. Another tag with an “Offset” of 5 would sample at 5, 15, 25, 35… seconds. Obviously, the tags’ clocks must be synchronised for this to be effective.

The “Initial delay” field specifies a pause, in seconds, before sampling begins. This is to avoid wasteful sampling if a long stabilisation period is required. The maximum permitted value is 65,500 (about 18 hours).

In tests performed at sea it is not useful to record samples unless the tag is submerged. “Log when dry” should be left unchecked and the tag can be safely attached to a frame on deck and activated as described below. It will begin sampling when it enters the water and stop when it re-emerges.

However, in the laboratory temperature calibration may be performed in fresh water. The tag’s submergence sensor is designed to detect saltwater, so it will not trigger in these circumstances. In this case “Log when dry” should be selected.

Clear flash memory



New readings are appended to any that may be left over from previous runs. It is therefore advisable to clear the flash memory between runs by clicking the “Reset Flash” button. It is

necessary to click “Reset Flash” before the first run to prepare the tag to log data. The reported size of the flash contents should return to zero.

Start logging

When the communications cable is disconnected the tag returns to standby mode, identified by a double flash of the red status light once per 10 seconds. To start logging, immerse the tag in saltwater for at least 20 seconds (or short out the two wet/dry sensor pins at the front of the tag with a piece of wire). The red light flashes every time a sample is taken. Logging continues until the cable is reconnected. “Sampling rate” should be reset to 99 before deployment to disable calibration mode. However, as a failsafe feature calibration is limited to a maximum of 6 hours, after which the tag begins to run the deployment program.

Download results

When logging is complete, reconnect the communications cable. A non-zero number of bytes should now be displayed in the “Contains __ bytes” field. To download the logged data, click the button labelled “Save to file”. The transfer speed is very slow: progress of the download is indicated in the status area at the bottom-left of the TagConfig window.

Data format

Each sample consists of an “UNCAL” reading (CondRaw, PressRaw, TempRaw) followed, about 120mS later, by a “CAL” reading (CondReal, PressReal, TempReal). CondLagged imposes an artificial exponential lag on the conductivity sensor with a time constant similar to the true time constant of the temperature sensor (approximately 1 second). This mimics the behaviour of the deployment code, which does this in order to improve the reliability of the calculated value of salinity. SalinityLagged is a calculated field based on CondLagged and TempReal.

Date Time CondRaw TempRaw PressRaw PressReal CondReal TempReal CondLagged SalinityLagged

2004/10/26 16:54:22 26514 28099 9106 194.300 43.619 26.067 43.619 27.408
2004/10/26 16:54:24 26512 28098 9103 194.267 43.599 26.066 43.599 27.394

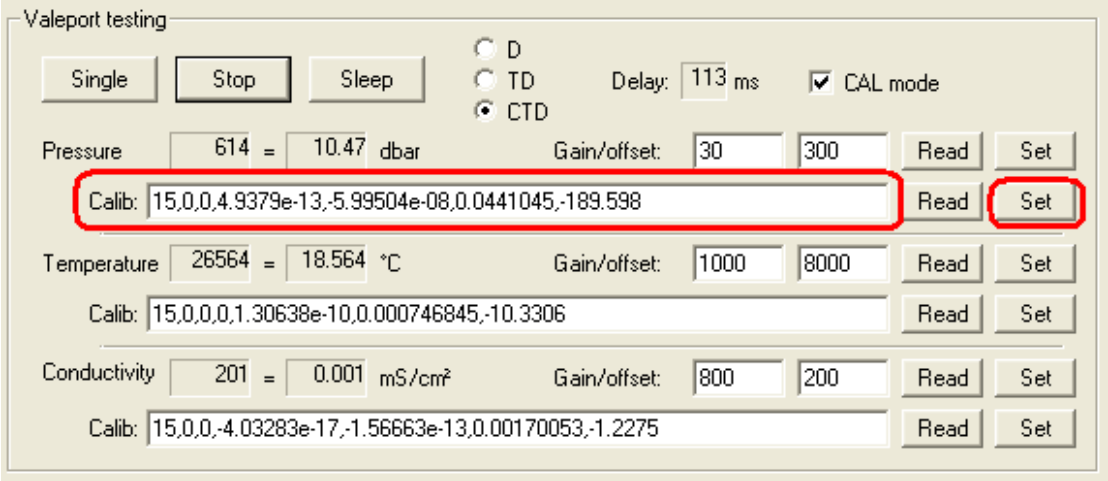
The units are

Date	yyyy/mm/dd
Time	hh:mm:ss
CondRaw, TempRaw, PressRaw	A/D counts
PressReal	dbar (with surface = 10 approx)
CondReal, CondLagged	mS/cm
TempReal	°C
SalinityLagged	PSU

The file is tab-delimited and can be opened directly by a spreadsheet program such as Excel.

Setting new calibration strings

The CTD device converts from raw A/D readings (as returned in UNCAL mode) to real units using a polynomial function for each channel. The current coefficients can be displayed by clicking the "Read" button adjacent to the "Calib" field for each channel. As with the Gain/Offset fields, it is necessary to click the "Read" button several times until the values stabilise.



Each channel may have up to a 5th-degree polynomial, although the default settings are 3rd-degree (cubic) functions for pressure and conductivity and 2nd-degree (quadratic) for temperature. The coefficients are displayed as a delimited text string in the form:

$15;c_5;c_4;c_3;c_2;c_1;c_0$

where 15 is a constant required by the CTD device and the higher degree coefficients c_5 and c_4 are usually zero.

In the example above, the calibration equation for pressure is:

$$\text{Pressure (dbar)} = 4.9379*10^{-13}\, x^3 - 5.99504*10^{-8}\, x^2 + 0.0441045\, x - 189.598$$

where x is the UNCAL A/D reading. In this case, the UNCAL reading (not shown) was 4563, giving a pressure of 10.47 dbar.

Note that the "Gain" and "Offset" values are not involved in this conversion. The calibration curve converts directly from UNCAL readings to true units. "Gain" and "Offset" are simply used to allow the CTD device to present the floating-point values as integers.

When modifying the calibration strings, it is advisable to prepare the coefficients in the delimited string format and then copy and paste the string into the "Calib" field. If necessary first click "Stop" to terminate continuous logging, then click the appropriate "Set" button.