WinFrog Device Group:	**Elevation**
Device Name/Model:	**Paroscientific 8B** (Intelligent Depth Sensor)
Device Manufacturer:	Paroscientific Inc. 4500 148th Ave NE Redmond, WA, 98052 Tel: (425) 883-8700 Fax: (425) 867-5407 www.paroscientific.com
Device Data String(s) Output to WinFrog:	Pressure plus responses to various commands**.** Refer to Paroscientific manual.
WinFrog Data String(s) Output to Device:	Various commands. Refer to Paroscientific manual.
WinFrog .raw Data Record Type(s):	Type 372 record. See section Raw Record Below.

DEVICE DESCRIPTION:

This device measures pressure, which can be converted to a depth. The configuration allows you to choose between two methods to convert pressure to depth.

a) UNESCO formula
b) Using observed density

In either case, the latitude is required to compute the acceleration of gravity. (In the later case you can also enter a fixed gravity value thus allowing a different gravity formula to be used.) (See below for formulae.)

The UNESCO formula method also allows you to add one of the regional corrections described by Leroy and Parthoit in the Journal Acoustical Society of America Vol. 103, No. 3 March 1998.

Both methods use the same international gravity formula.

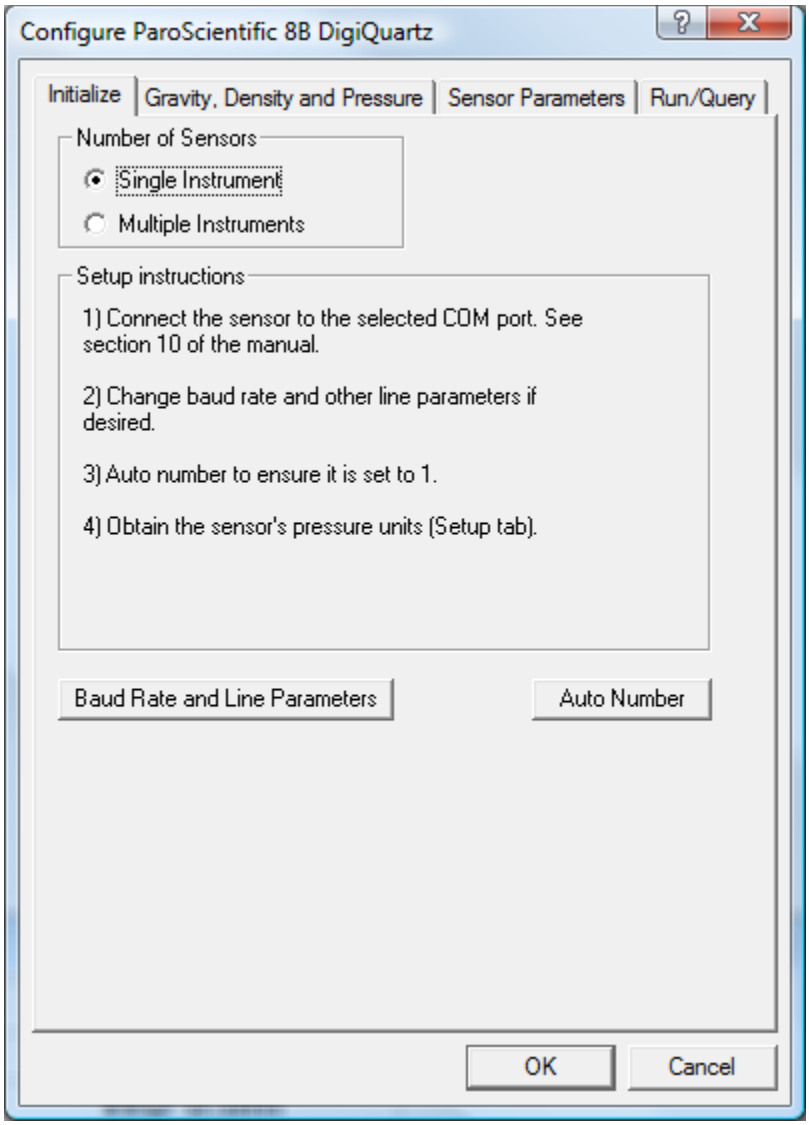
The observed density method also allows you to apply the free air anomaly to increase gravity with depth. There are three choices here: 1) to an entered depth, this matches what may be available on a spread sheet for this instrument, but is not recommended, 2) to the sensor depth or, 3) to half the sensor depth. If the density entered is a harmonic mean from measurements through the water column then the gravity value used to calculate the depth should probably be the midpoint of the depth of the sensor.

The UNESCO formula incorporates an increase of gravity with depth, but it is in terms of pressure to half the depth. This device also supports this adjustment to gravity as a fourth option when using observed density to compute the depth.

DEVICE CONFIGURATION INSTRUCTIONS:
Baud rate and line parameters are configurable. During testing the sensor would not alter its line parameters but would change its baud rate.

WINFROG I/O DEVICES > CONFIG OPTIONS:
The Paroscientific 8B is accessed via the Elevation device types. The device requires configuration prior to first usage. After the device is added to WinFrog, right-click on the device in the I/O Device window and select Configure Device to obtain the following dialog:

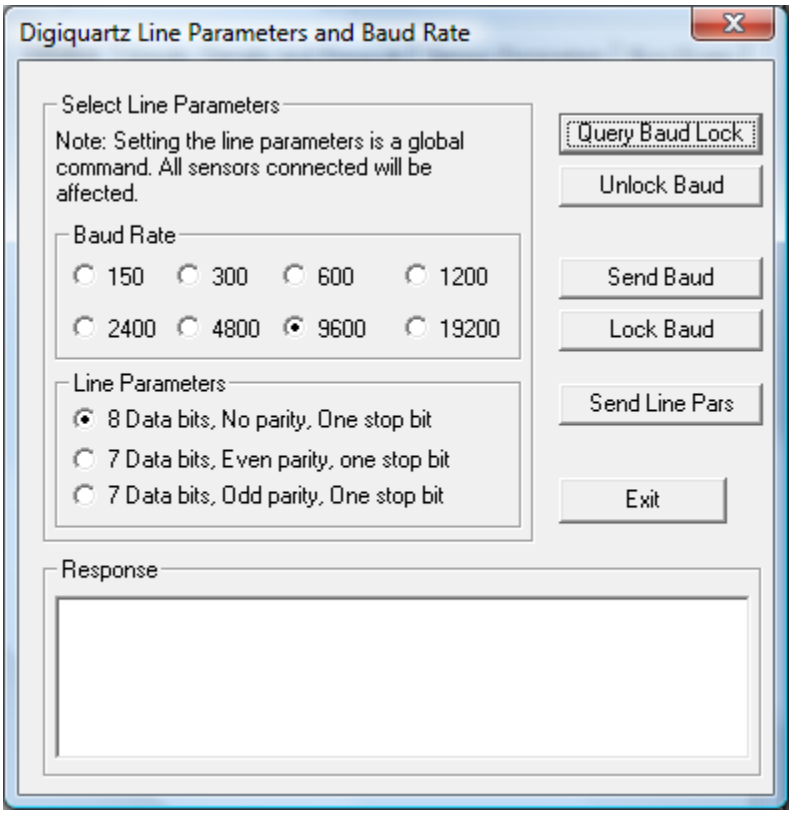
Initialize Tab



Clicking on the Single or Multiple Instruments buttons merely changes the information displayed in Setup instructions box. This gives a brief description of the setup. If multiple sensors are to be used, individually connect each one to WinFrog and ensure there is communications. Clicking the temperature button on the Run/Query tab will perform a quick check of communications. If the sensor is connected properly and the baud rate and line parameters are the same, the temperature will be displayed on this same tab. Set each sensor to the same baud rate and line parameters then wire them together with the WinFrog computer according to the sensor's manual.

Baud Rate and Line Parameters

To change the baud rate parameters, click the Baud Rate and Line Parameters button to get the following dialog:



Each of the commands sent, by clicking a button on this dialog, is a global command that will be processed by all the sensors. The result from each sensor will be displayed. The baud rate lock must be off prior to changing the baud rate. During testing the line parameters of a sensor could not be changed. The response to a baud rate change is at the original baud rate. If the baud rate is changed, the driver's COM port baud rate must be changed before any other commands are sent.

Auto Number

When first configuring the device driver, it is mandatory to click the Auto Number, which causes the sensors to number themselves. Even if there is just one

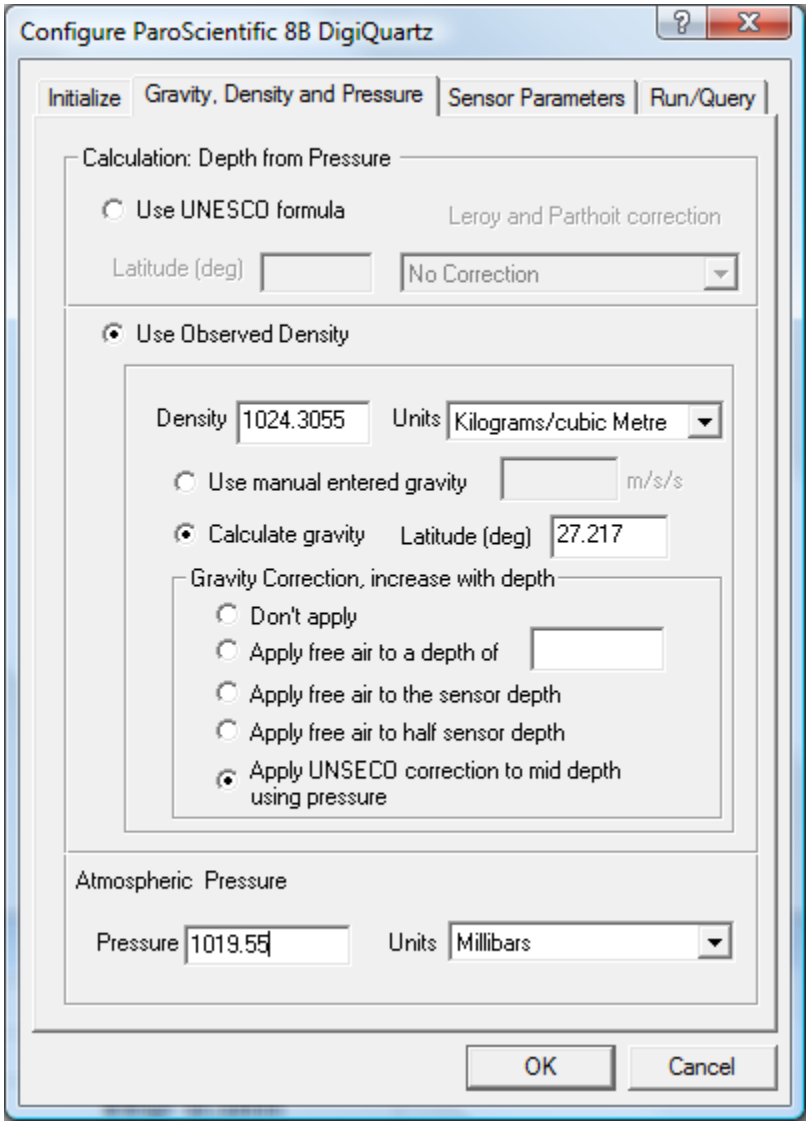
sensor, the button must be clicked to ensure it is set to number one. If there is more than one sensor the first connected to the PC will be numbered one, the next will be numbered two and so on. (See section 10 of the Paroscientific manual.)

Density
This is required to convert the pressure to depth. Enter the desired value and corresponding units.

Atmospheric Pressure
Atmospheric pressure is subtracted from the sensor's reading before conversion to depth. Enter the value and corresponding units. This value does not have to be in the units that the sensor is using. Note if the sensor is compensating for atmospheric pressure by the use of the Pressure Adder set by the PA command, then 0 should be entered here.

Gravity Density and Pressure Tab

This tab is used to set the method of converting pressure to depth. Clicking on this tab displays the following dialog.



UNESCO Formula

Based upon the equation of state (EOS80) taken from the UNESCO technical papers in marine science 44, Algorithms for Computation of Fundamental Properties of Seawater. See below for the formula.

Latitude

Enter the latitude for the area you are working. This is used to compute gravity.

Leroy and Parthoit Correction
This allows you to select certain corrections for various areas of the world. Some have a fixed latitude that will be entered for you, others allow you to enter a latitude. This is from Depth-pressure relationships in oceans and seas Leroy and Parthoit, Journal of Acoustical society of America, Vol. 103, No. 3, March 1998.

Observed Density
If a density profile is available, the harmonic mean can be used to compute the depth.

Density
Enter the density.

Units
Select the units from the list.

Manual Gravity
If you have a value that you want to use rather than the calculated one, select this radio button and enter the value in metres/sec^2.

Calculate Gravity
Select this radio button to use the international formula (see below) and enter the latitude in decimal degrees.

Gravity Correction
Here you can apply a correction for depth using the free air anomaly or the same correction used by the UNESCO formula. See formula below.

Applying the free air correction to an arbitrary depth is not recommended, but is included so you can compare the results to third party calculations that may support this.

The free air anomaly can also be applied to the depth of the sensor or to half the depth. This is done iteratively.

The correction to gravity used by the UNESCO formula uses pressure and is to half the depth. It varies slightly from the free air anomaly.

Atmospheric Pressure
Enter the observed atmospheric pressure to be subtracted from the observed underwater pressure and the units.

Sensor Parameters Tab

Prior to first usage, each sensor must be queried to determine the pressure units it is reporting the data in. First select the sensor then click the Query Setup button and WinFrog will request all the information listed and display it for that sensor. This must be repeated for each sensor. The data can be saved to a file by clicking the Save Setup button. None of these parameters can be set using a button in WinFrog. There is a small terminal on the next tab that can be used to change these parameters. Changing the calibration parameters will change the results. If the pressure reporting units are changed, then the sensor must be queried again from this tab. Querying the sensor halts the cyclic output of pressure data; go to the Run/Query tab to place the sensor in run mode.

NOTE: If the pressure reporting units are set to code 0, user defined, (*0001UN=0) then you must scale the result with the UF command so that the units of pressure are actually millibars. Otherwise the units become arbitrary and WinFrog cannot calculate the depth.

Run/Query Tab

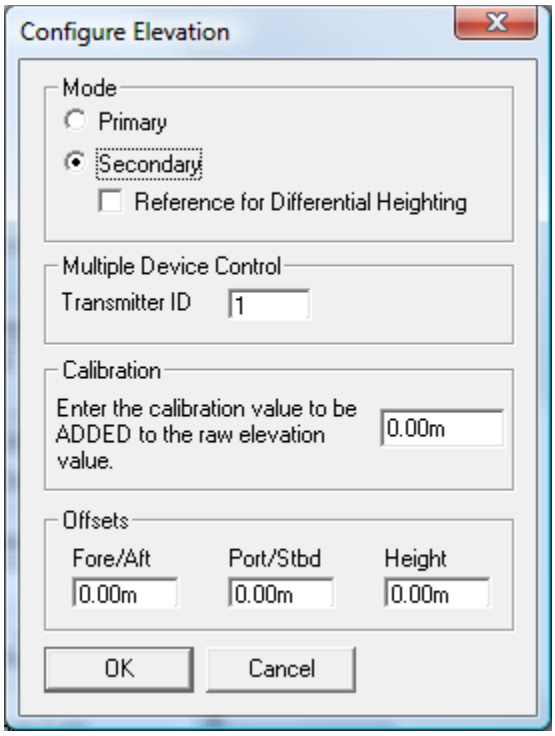
Run Scenarios (Global Commands)

WinFrog expects pressure to be automatically output from the sensor in a continuous pattern, either by the use of the P7 or P4 commands. Sending any other preprogrammed command to the sensor will cancel the continuous output of pressure. Similarly, if any command is manually sent to the sensor it will cancel the P4 or P7 commands. To start the continuous output of pressure, select the appropriate radio button, select the Start Reading Upon Exit checkbox and click OK. See the Paroscientific manual to determine which command to use. To reread the temperature for the P7 command, select the checkbox and enter a time interval for rereading the temperature.

Single Observations and Manual Command

To read an individual sensor's pressure or temperature, select the sensor then click the appropriate button. The result should appear in the result window. To send any command to the sensor, type it in the edit box then click XMIT. The result, as received from the sensor, will be displayed in the result window.

WINFROG VEHICLE TEXT WINDOW > CONFIGURE VEHICLE DEVICES > DEVICE > EDIT OPTIONS:
Add the ELEVATION data item to the vehicle that the sensor is physically on. Up to five may be added to the same vehicle. Edit the data item to get the following dialog:



Set the mode to primary if this device is to determine the vehicles depth. The default is secondary. Other devices that can also determine depth need to be set to secondary for depth.

Enter the code or transmitter ID of the sensor to use. Also enter the offsets of the sensor from the CRP of the vehicle.

RAW RECORD

372, name, time, elevation, status, center elevation, raw data, temperature, relative humidity, sensor number

where:

- *372* is the raw data record identifier for an ELEVATION data type
- *name* is the operator assigned device name
- *time* is the time the computer received the data
- *elevation* is the elevation in metres (- for depth)
- *status* is the status flag for the data, 1 = OK, 0 = Bad
- *center elevation* is the elevation reduced to the CRP
- *raw data* is the raw elevation data which is the pressure as output in the units of the sensor
- *0* not used
- *0* not used
- *Sensor number* is number of the sensor that generated this data

Formulae:

UNESCO formula:

$$z = \frac{9.72659\mathbf{P} - 2.2512\text{X}10^{-5}\mathbf{P}^2 + 2.279\text{X}10^{-10}\mathbf{P}^3 - 1.82\text{X}10^{-15}\mathbf{P}^4}{\mathbf{g} + \frac{1}{2}(2.184\text{X}10^{-6})\mathbf{P}}$$

Where:

z = depth in metres
P = pressure in decibars
g = gravity see below

From UNESCO technical papers in marine science 44
Algorithms for computation of fundamental properties of seawater

Depth from density formula:

$$\boldsymbol{z} = \frac{\boldsymbol{P}}{(\mathbf{g} + \boldsymbol{c})\boldsymbol{\rho}}$$

Where:

z = depth in metres
P = pressure
g = gravity see below
ρ = density
c **=** free air anomaly given by $.3086\text{X}10^{-5}\text{H}$ where H is the depth in metres or
c **=** adjustment for depth but in terms of pressure $\frac{1}{2}(2.184\text{X}10^{-6})\mathbf{P}$ same value in UNESCO formula. See Leroy and Parthoit Journal of Acoustical Society of America Vol. 103, No. 3, March 1998

International Gravity formula:

$$\mathbf{g} = 9.780318\left(1.0 + 5.2788\text{X}10^{-3}\sin^2(\emptyset) + 2.36\text{X}10^{-5}\sin^4(\emptyset)\right)$$

Where:

g = acceleration due to gravity, m/sec^2

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