Bathy2 Operating Manual

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1 Introduction

The Bathy2 is designed to meet customer bathymetric requirements for a reliable, accurate and robust instrument with flexible functionality to suit specific operations up to 6000m depth.

Density corrected depth data directly from one instrument

An evolution of the popular Midas BathyPack, the new Bathy2 uses state-of-the-art sensors to generate density corrected depth with all calculations taking place in real time, in the instrument. This removes the need for data passing up and down the vehicle umbilical and, as a result provides precision depth and height data with a minimum of latency, vital for accurate level and positioning data especially when operating with Inertial sensors.

This new instrument brings together the benefits of density corrected output directly from one instrument, alongside the flexibility of interfacing and optional third-party pressure sensor, Digiquartz, and Valeport interchangeable pressure modules to allow users enhanced accuracy at different operational depths.

- Titanium housing
- RS232 or addressable RS485 data output
- ASCII and Modbus RTU output protocols
- Ethernet option (factory fit)
- Choice of calibrated data formats
- Interchangeable pressure sensor module
  - Pressure ranges from 10 to 600Bar (approx. 100m to 6,000m water)
  - Titanium diaphragm pressure sensor
  - No external diaphragms, oil reservoir or oil-filled tubes
  - Long term calibration stability
    - 2 year recommended recalibration cycle
- TEOS 10 seawater properties of water computation for depth calculation
- Choice of sampling modes

Improved user experience

Improving the user experience has been a key driver in the development of this superior bathymetric instrument and the addition of dedicated data output for INS allows bathymetric data to be efficiently communicated directly with users' own operational software.

Other helpful benefits include the flexible pressure options using Valeport's interchangeable pressure sensors, these field-swappable sensor heads make it easy for users to select the correct pressure for their working depth bringing benefits of exceptional reliability and a higher degree of accuracy.

Designed for surveyors requiring bathymetric data from underwater vehicles

Designed for surveyors requiring bathymetric data from ROVs, underwater vehicles or drop structures, Bathy2 also has an external pressure sensor input option for Digiquartz referencing. This comprehensive bathymetric package offers other useful parameters such as Altitude through an interface to a Valeport VA500 altimeter and other popular third party alternatives.

Seamless data transfer

Data transfer is via Ethernet or RS232/RS485 interfaces and the Bathy2 Interpreter function via the Valeport Configure software allows data out on extra ports (serial or TCP/IP serial) in industry-standard formats, this facility also allows for an atmospheric pressure data input to be fed to the instrument.

The Bathy2 converts pressure measurements to depth, taking account of the local variations in water column density to ensure the highest possible accuracy. In addition, Bathy2 accepts data from an altimeter to provide height above the seabed, scaled using the on-board Valeport "time of flight" sound velocity sensor, thus giving an overall location of the device within the water column. This concept is not new, the Bathy2 Pack builds on the standard specification you would expect, with several unique features that significantly enhance the performance of the product:

- Temperature compensated piezo-resistive pressure sensor that provides ±0.01% accuracy (full scale) with better stability and durability than a resonant quartz type sensors. In addition, there is no oil reservoir to protect the sensor, allowing easier maintenance and faster deployment. The Bathy2 has interchangeable pressure modules that allow the most suitable range to be selected for the operational depth of the project, maximising the potential accuracy of the system.
  - If required an external pressure sensor e.g. Digiquartz can also be interfaced as a separate unit and used in preference of the integrated unit. This should be interfaced to the AUX IN port
- Valeport's own inductive coil conductivity sensor, constructed from advanced composite materials to eliminate the effects of pressure on sensor performance, is used as part of the sensor suite. Other inductive cells can distort under pressure, giving errors in the measurement – even a few µm is enough to put the sensor out of specification at depth. The Valeport cell has no such errors. Inductive cells also have an advantage over electrode conductivity sensors, in that they are less susceptible to contamination by oil, growth or debris.
  - Full "in situ" factory calibration; inductive conductivity cells are affected by the presence of any object (conductive or non-conductive) that lies within the sensor's field (within approx. 5cm). Valeport's factory calibration against a salinometer, performed with all other sensors and guard in close proximity, guarantees in-field accuracy. A simple "resistor calibration" actually does nothing more than verify sensor operation. Further, the digital measurement technique virtually eliminates drift in sensor calibration, removing the need for "field calibration" procedures.
- Unique "synchronised sampling" means that all sensors are sampled at precisely the same instant, not in sequence. This removes alias and latency errors from the measurements.
- Altimeter input - fitted as standard – just plug in a correctly configured instrument.
- Titanium housing as standard; no corrosion issues, and a maximum depth rating of 6000m. Note that a selection of pressure sensor ranges are available, so your instrument's depth rating may be limited to less than the full 6000m.
- Full TEOS 10 calculations for a more accurate depth calculation; the system integrates the water density variations to calculate the depth from pressure, not the simplified method of averaging the density.
- The Bathy2 can be setup for operation using Valeport's Configure App.
- All data can be viewed on a topside PC, so no dedicated control unit is required. The intuitive Bathy2 Interface App allows you to view and distribute data, serially or through Ethernet protocols.
- The Bathy2 Interface App can interface an atmospheric pressure sensor for real-time compensation, the Bathy2 is updated without interrupting operations.

In summary, the Bathy2 sets out to "de-mystify" the accurate calculation of depth from water pressure. State of the art sensing technology gives you accurate data; precise calculations give you accurate answers; simple PC software gives you total control. Getting the right answer has never been easier.

2 Sensors

The Bathy2 is fitted with the following sensors:

2.1 Pressure Sensor

A high accuracy, 0.01% of full scale, temperature compensated piezo-resistive pressure transducer.

The Pressure Module is interchangeable

Sensor Type	Strain Gauge
Range: individual modules	10, 20, 30, 50, 100, 200, 300, 400 or 600 Bar 1 bar is approximately equal to 10m depth
Resolution:	0.001
Accuracy:	±0.01% of full range
Response Time:	1 millisecond
Units	dBar | Pascal | PSI

2.1.1 Interchangeable Pressure Sensor Modules

The Interchangeable Pressure Sensor Modules, with a titanium diaphragm, can be swapped to best suit the operational depth of the project. The accuracy of the sensor is a factor of the full-scale capability of the sensor - 0.01% and not the measured pressure. A 600 Bar module will offer the same ±0.60m accuracy at 6000m as it will at 250m while a correctly selected 30 Bar Pressure Module, for an operation at 250m, will provide an accuracy ± 0.03m

Bar	Maximum Operational Depth (metres)	Accuracy (0.01%) (± metres)
10	100	0.01
20	200	0.02
30	300	0.03
50	500	0.05
100	1000	0.10
200	2000	0.20
300	3000	0.30
400	4000	0.40
600	6000	0.60

Prior to changing out a Pressure Module the Bathy2 the instrument should be thoroughly rinsed in fresh water and dried.

A Pressure Module should ideally be changed in dry lab conditions but if this is not possible every effort must be made to keep water out of the module socket. Check the module and socket for any water and if found dry everything thoroughly before fitting. If water does get into the socket it could cause the connector to corrode.

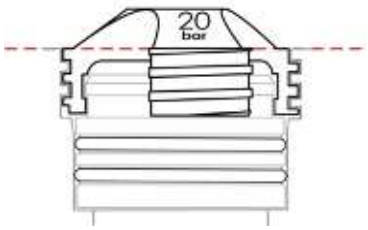
A special tool is provided to unscrew the fitted module and screw its replacement securely into place. Never use excessive force.

The three prongs should be carefully inserted into the lock screw cap of the Pressure Module and turned counter-clockwise (when looking directly at the module) to loosen it. Keep turning until the Pressure Module gently pops out of the socket. The tool will engage with the Pressure Module and allow you to very gentle pull if required.

Before fitting a replacement, Pressure Module check all surfaces for wear - especially the lock screw cap. Check the O rings are clean and free of any debris, wear or damage. There is no need to grease the O rings. The closing action of the system does not rely on surfaces sliding over one another and grease might attract debris that would compromise the seal.

The replacement Pressure Module should be placed into the socket with the connector approximately lined up with its pair. Fine adjustment is achieved by the shape of the module housing in the socket.

Engage the screw cap into the threads of the socket and then use the tool to tighten the Pressure Module into place. The module should be screwed down until the shoulder of the lock screw cap is in line with the shoulder of the titanium end-cap as shown below:



Do not over tighten.

2.2 Temperature Sensor

Temperature	
Type	Fast Response PRT (with guard)
Range	-5 to +35°C
Accuracy	±0.005°
Resolution	0.002°
Units	°C | °F

2.3 Conductivity Sensor

Conductivity	
Type	Valeport Inductive Coil
Range	0 – 80mS/cm
Accuracy	±0.01mS/cm
Resolution	0.002mS/cm
Stability	<±0.01mS/cm/year
Units	dBar | Pascal (Pa) | PSI

Be aware that when installing the Bathy2 there must be a minimum or 0.15 metres between the Conductivity sensor and any other metal object. The metal housing and protection cage around the senor have been calibrated out.

2.4 Sound Velocity Sensor

Sound Velocity (Measured)	
Type	Valeport miniSVS (50mm type)
Range	1400 – 1600 m/s
Accuracy	±0.02 m/s
Resolution	0.001 m/s
Units	metres/second | feet/second

2.5 Calculated Values

Salinity	
Method	Calculation (TEOS10)
Range	0.02 – 42 (calculation unverified at higher salinities)
Accuracy	±0.017 (at 500m depth)
Resolution	0.001
Units	g/Kg

Density	
Method	Calculation (TEOS10)
Range	994 – 1075 kg/m³
Accuracy	±0.016 kg/m³ (at 500m depth)
Resolution	0.001 kg/m³
Units	Kg/M^3

Depth	
Method	Calculation (TEOS10)
Range	N/A
Accuracy	See Note Below
Resolution	1mm (software limited)
Units	Metres | Feet

2.5.1

2.5.2 A Note About Depth Accuracy:

The true accuracy of the calculated Depth is a function of several parameters:

- The accuracy of the pressure sensor itself
- The error in density measurement resulting from the accuracy of the Conductivity measurement
- The error in density measurement resulting from accuracy of the Temperature measurement
- The error in density measurement resulting from accuracy of the Pressure measurement
- The significance of the above errors in relation to the depth range, and the ambient salinity and temperature conditions.
- The inherent accuracy of the equation used, which is estimated at 0.1m over 10000dBar
- The overall depth accuracy, therefore, relates to not only how good the sensors are, but will also vary according to the local conditions. For example, accuracy of a depth measurement in 500m water at 5°C and a salinity of 35 ppt will be different to that in 500m water at 1°C and a salinity of 36ppt.
  However, these variations are typically small, and it is therefore, reasonable to assume that the accuracy will be dominated by the performance of the pressure sensor and that of the UNESCO equation.

3 Electronic Specification

Power Source	External Supply Only	
Input Range	9 – 28V DC	
Consumption	Base system	195mA
	Base system + Digiquartz	225mA
	Base system + VA500	370mA
	Base system + Digiquartz + VA500	410mA

Bathy2 can be further enhanced by interfacing a VA500 Altimeter to provide true water column height. The Bathy2 will route external power to an altimeter; ensure sufficient power is supplied to suit the altimeter used.

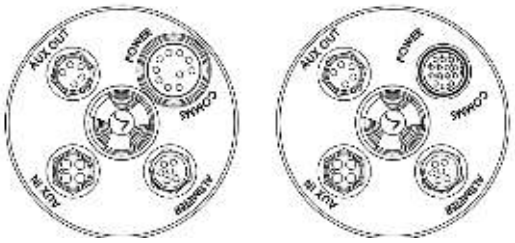
Data Output	RS232 & RS485 fitted as standard (choice made by pin selection on connector)
	Ethernet (factory fit option)
Protocol	8 data bits, 1 stop bit, no parity, no flow control
Baud Rate	User selectable from 2400 to 230400 (factory default 115200)
Update Rate	1, 2, 4 or 8Hz

4 Physical Characteristics

4.1.1 Materials

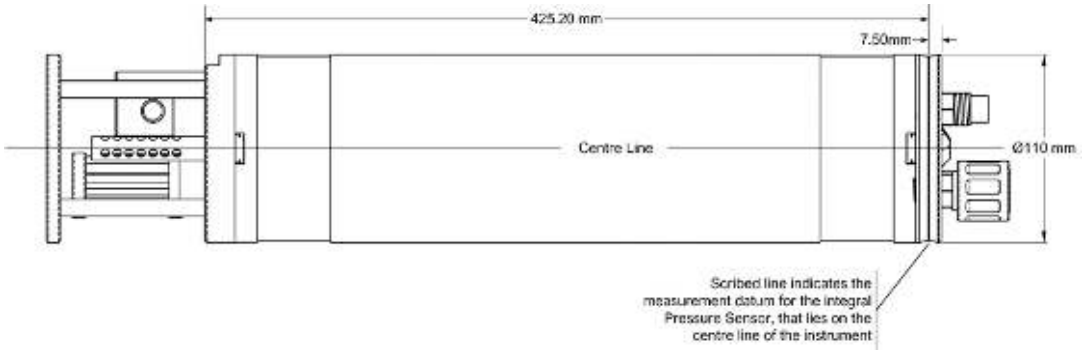
Housing & Bulkhead:	Titanium
Connectors:	SubConn MCBH10F (power / COMMS)
	SubConn MCBH6F (to altimeter)
	SubConn MCBH4F for AUX output (INS)
	SubConn MCBH5F for Digiquartz input
Specific connectors can be provided as required	
Weight:	<10 kg (in air)

4.2 Dimensions - Bathy2 and Bathy2e



Serial COMs Endcap Ethernet COMs Endcap

4.2.1 Internal Pressure Sensor Datum



All offsets are programmed in metres regardless of what Height\Depth unit is programmed for data output purposes

5 Principle of Operation

Unlike its predecessor the Bathy2 caries out all computations on board the instrument. This reduces latency to a minimum and reduces topside equipment.

All depth output is relative to the instrument. Offsets are available to define this datum in relation to the internal pressure sensor, an external pressure sensor and an Altimeter if fitted.

The relationship between pressure and depth is not a simple one and is a function of the water density. More specifically, the water density at every single point in the water column affects the pressure depth relationship at the bottom. It is, therefore, a requirement to know the density of water at every point above the pressure sensor in order to accurately calculate the depth from the pressure value. The Bathy2 builds an array table, or profile, of the water density at a predefined rate through the water column as it descends. It also updates this table as it ascends, or moves around in the column during the deployment. The resolution of this profile is limited to a maximum of 6000 points, which means that in 6000dBar of water pressure (approximately 6000m), it will store a Density value for every dBar (~ 1 metre). Greater resolution is possible at shallower depths, e.g. 0.25dBar in 1500dBar pressure.

The full TEOS10 formula uses a density integration function rather than density averaging, and therefore, properly accounts for the compressibility of water. In water depths of less than 100m, this distinction is negligible - less than 1mm - but the error due to use of the simpler averaging method increases dramatically at greater pressures, approaching 1m at 1000m depth.

5.1 Explanation of SAAR Table

A notable difference of TEOS-10 compared with EOS-80 is the adoption of **Absolute Salinity (rather than Practical Salinity)** to be used in scientific journals to describe the salinity of seawater and to be used as the salinity argument in the TEOS-10 algorithms that give the various thermodynamic properties of seawater. Practical salinity is essentially measuring the distribution of ions in the seawater. Absolute salinity is based on the mass of all non-H2O material, whether it's ions, gases, or solids.

www.teos-10.org/pubs/TEOS-10_Manual.pdf

In brief, practical salinity concentrated solely on the conducting ions of seawater whilst Absolute salinity includes the mass of the non conducting compounds which have an influence on the density. The relationship between practical salinity and absolute salinity has a geographical distribution.

The worldwide data for these corrections is too large to store in the instrument, so to apply the correction a geographic lookup is performed and a SAAR (Salinity Absolute Anomaly Ratio) correction table generated by Valeport Configure and passed down to the Bathy2 for use in its density and depth calculations.

5.2 Explanation of Density Profile

As the Bathy2 passes through the water column, it uses temperature, conductivity and pressure to calculate point values of salinity and density. These values are then used to update a running integration process that computes the density of the water column above the instrument location and calculate the accurate depth of the instrument based on this data.

6 Communications

Control of the Bathy2 is achieved through the use of "$ codes", as described in the sections below.

> All commands must be "sent" by pressing the Enter key
> with the exception of the single '$' character required to enter set up mode

6.1 Serial Comms - RS232 and RS485

Bathy2 is fitted with both RS232 and RS485 communications as standard. RS485 is enabled by grounding a pin in the communications lead (refer to Wiring Section).

Protocol is 8 data bits, 1 stop bit, no parity, no flow control.

Baud rate is factory set to 115200. User may choose between 2400 and 230400.

> Fast data rates and longer data string outputs may not be possible with low baud rates

6.2 Serial Comms – Modbus

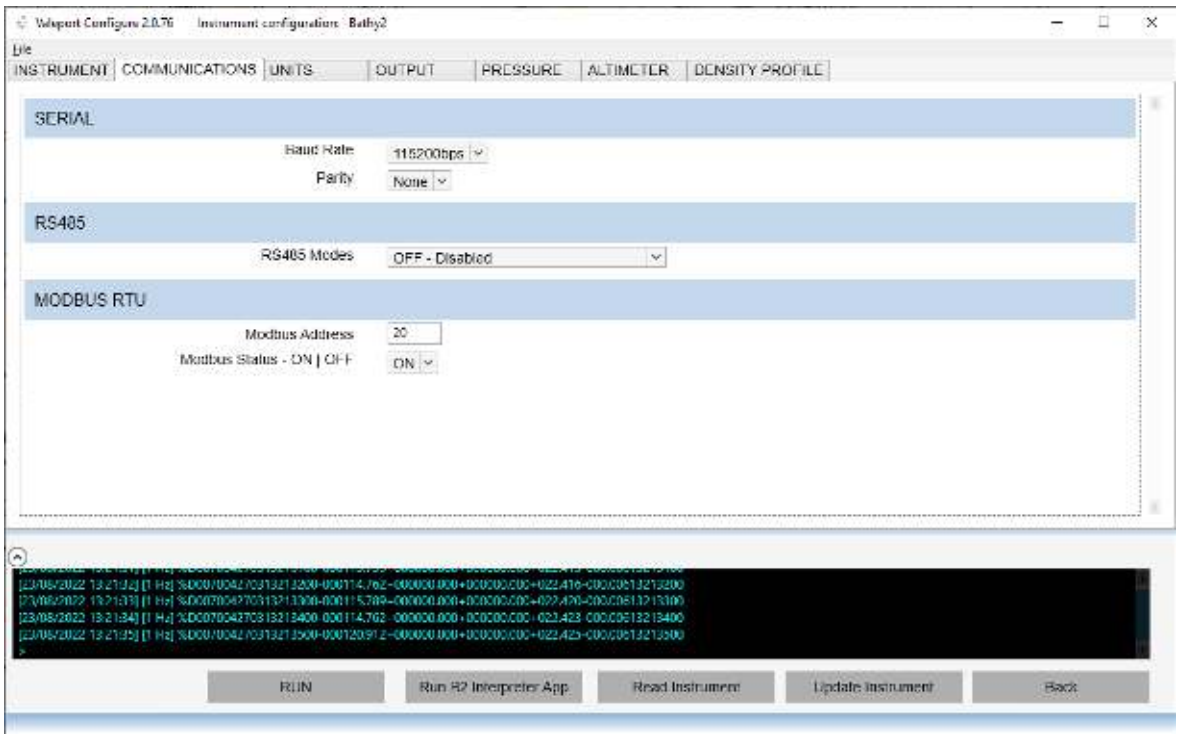
The Bathy 2 is fully compatible with Modbus RTU.

Modbus must be enabled to use a real-time atmospheric pressure correction through the Bathy2 Interpreter App.

Please contact Valeport if you would like to use Modbus and the relevant address can be provided.

6.3 Configure App – COMMUNICATIONS

Use the Configure App to setup the COMs settings as required see section Valeport Configure App



Modbus Status must be ON to operate with the Interpreter App.

7 Setting Up the Bathy2

Bathy2 can be configured for operation using Valeport's Configure App, available to download from https://Valeport.Download. See separate manual for general operation of the App. Specific operation with respect to the Bathy2 is outlined below.

The Bathy2 Interpreter App is also available to run alongside the Configure. The Interpreter App is used to view data, apply Atmospheric correction data and distribute specific data strings to up to 5 COM ports.

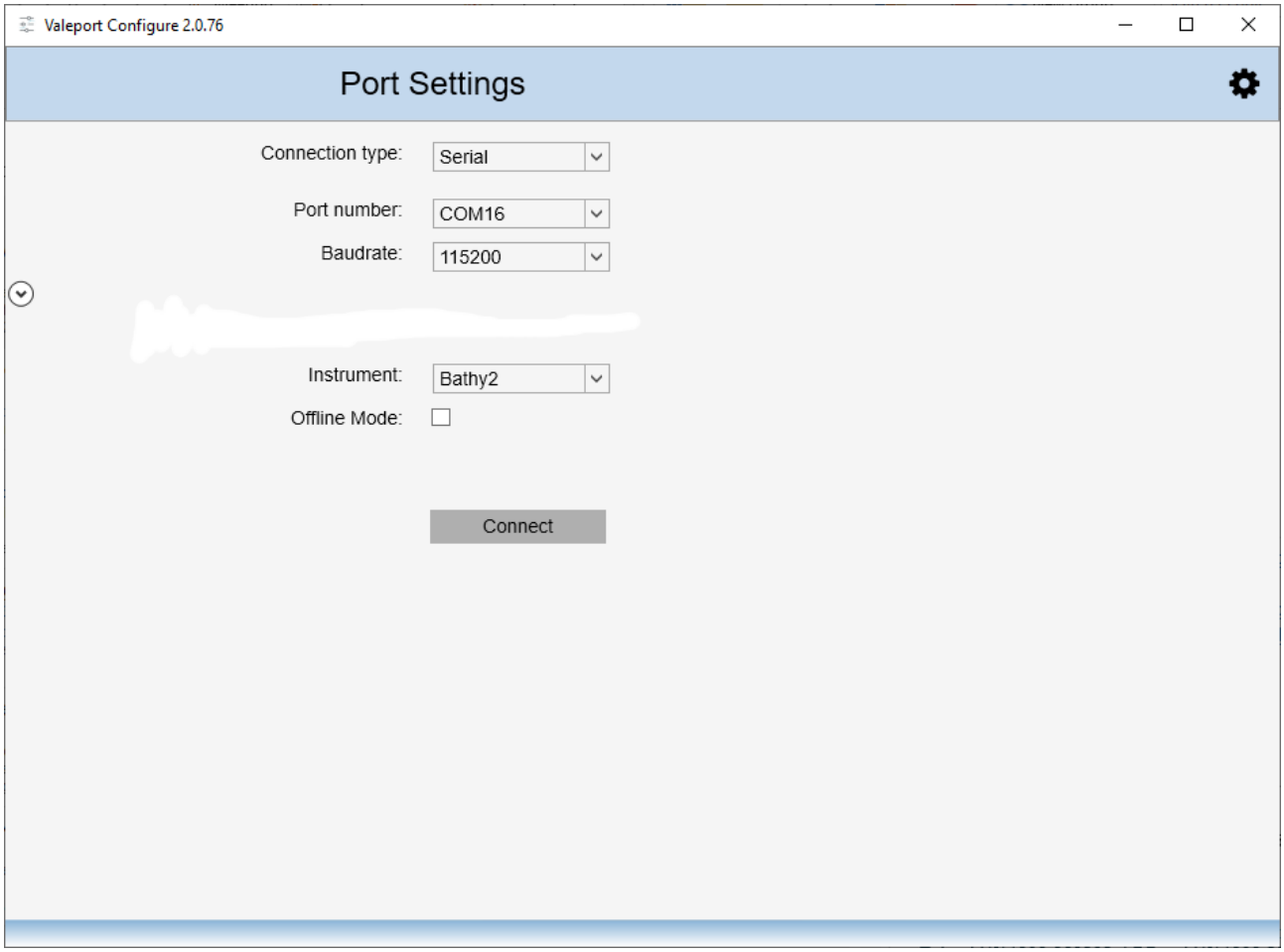
7.1 Start / Stop

When power is applied to the Bathy2, it will begin to operate according to the settings already programmed after a period of approximately 2 minutes. The most basic level of Stop / Start control is, therefore, by switching power on and off. The bathy2 will retain the density table on a power cycle.

# Code	Description
#	When the instrument is running, the Bathy2 may be put into set up mode at any time by typing the '#' character followed by the ENTER key. The device will respond with a command prompt '>' and wait the next instruction When interrupted an ERROR response is often seen. This is generated due to the <CR><LF> usually associated with the # and should not be interpreted as a problem with the Bathy2. A "watchdog" function is in operation within the Bathy2 If the unit is interrupted with the '#' character, and no further command is received for a period of 2 minutes, the sensor will automatically begin sampling data using the existing settings
$028	Starts sampling in the mode set, or takes a single reading if unit is in "Single" sampling mode

7.2 Valeport Configure App

Select your COM port and baud rate from the drop down menus, Select Bathy2 in the Instrument field and Click Connect

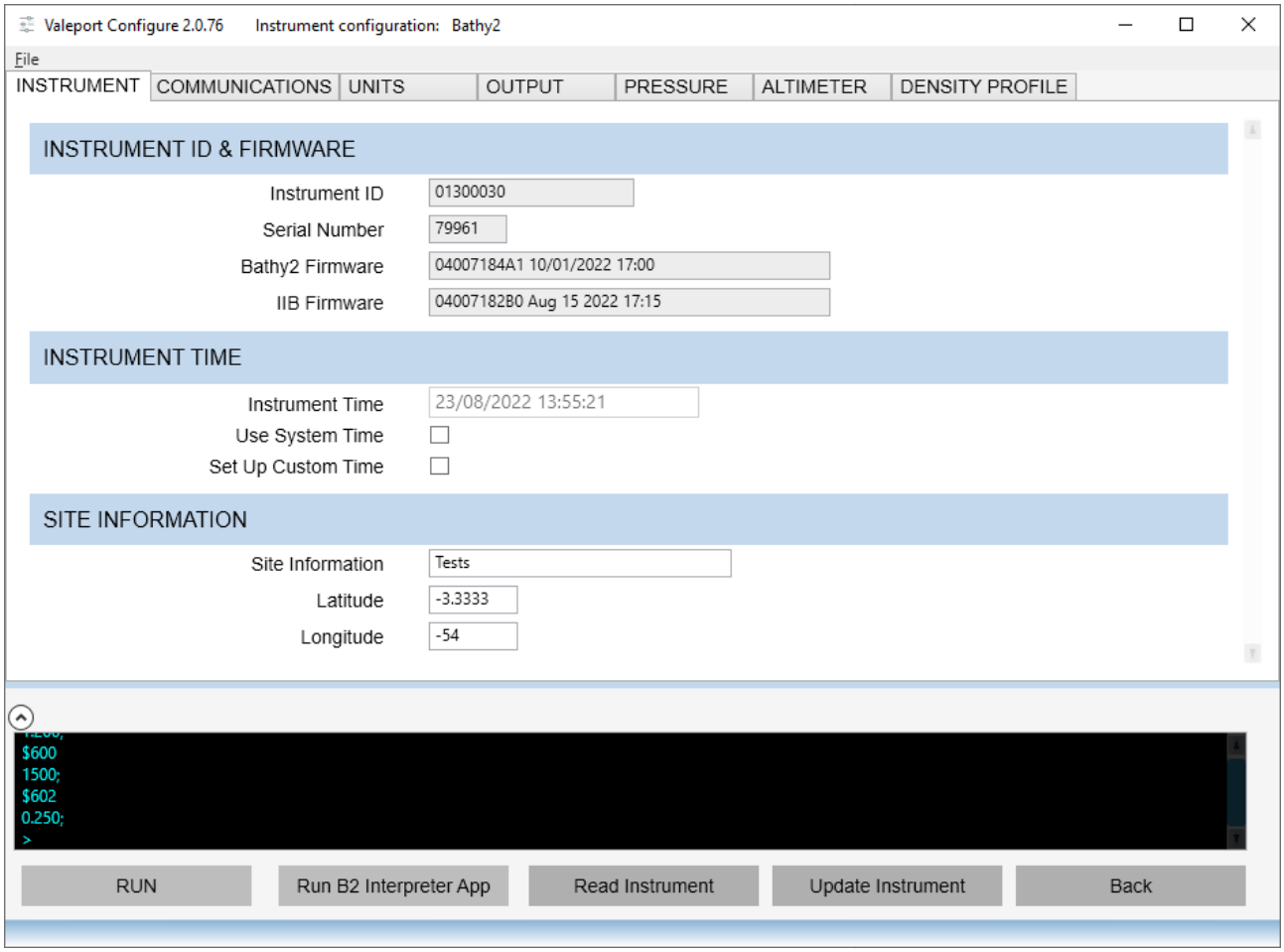


Once connected, it is advised that you 'Read' all the settings presently programmed into the instrument the Read Instrument button on the lower menu ribbon:

All the settings will be downloaded and the appropriate fields will be populated ready for you to configure as required.

7.2.1 Configure App – INSTRUMENT Tab

In the INSTRUMENT tab is a set of general parameters.



INSTRUMENT ID AND FIRMWARE

- Read only – details of the instruments ID, serial number and firmware

INSTRUMENT TIME

The Bathy2 time - sink to UTC, local or project time as required.

- Instrument Time - a display of the time currently set in the Instrument
- Use System Time – tick this option to sync the Bathy2 to your PC time
- Set Up Custom Time – click this option to edit the Instrument Time field as required

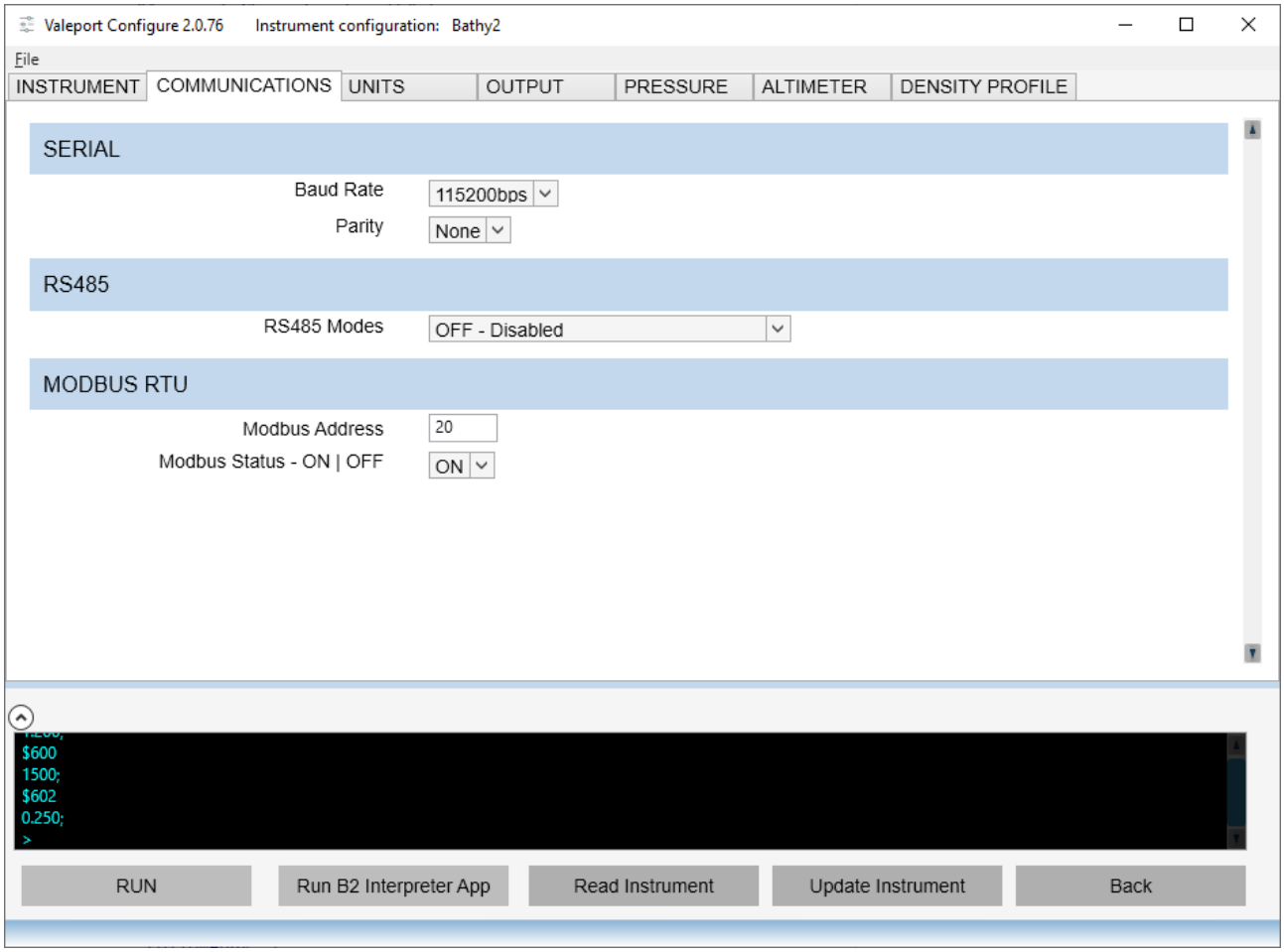
SITE INFORMATION

- Site Information - free text of 29 characters for you to identify your project.
- Latitude – Site Latitude
- Longitude - Site Longitude

Latitude and Longitude is required for SAAR Table generation and should be in the approximate centre of the project location.

click Update Instrument to apply all changes

7.2.2 Configure App – COMMUNICATIONS Tab

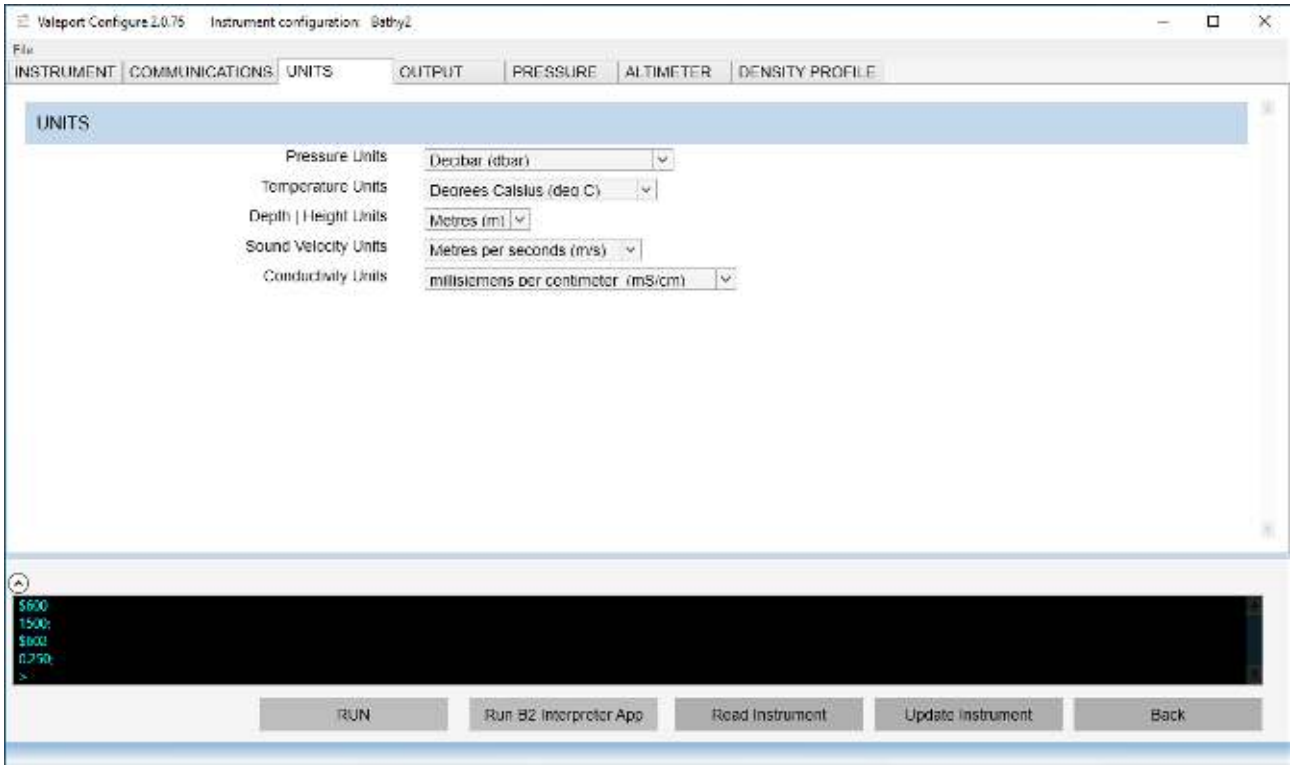


- Select communications protocols as required.
- Modbus and RS485 address will be the same
- Modbus Status must be ON to operate with the Interpreter App.

click Update Instrument to apply all changes

7.2.3 Configure App – UNITS Tab

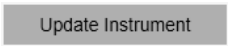
Select the required units from the dropdown menus.



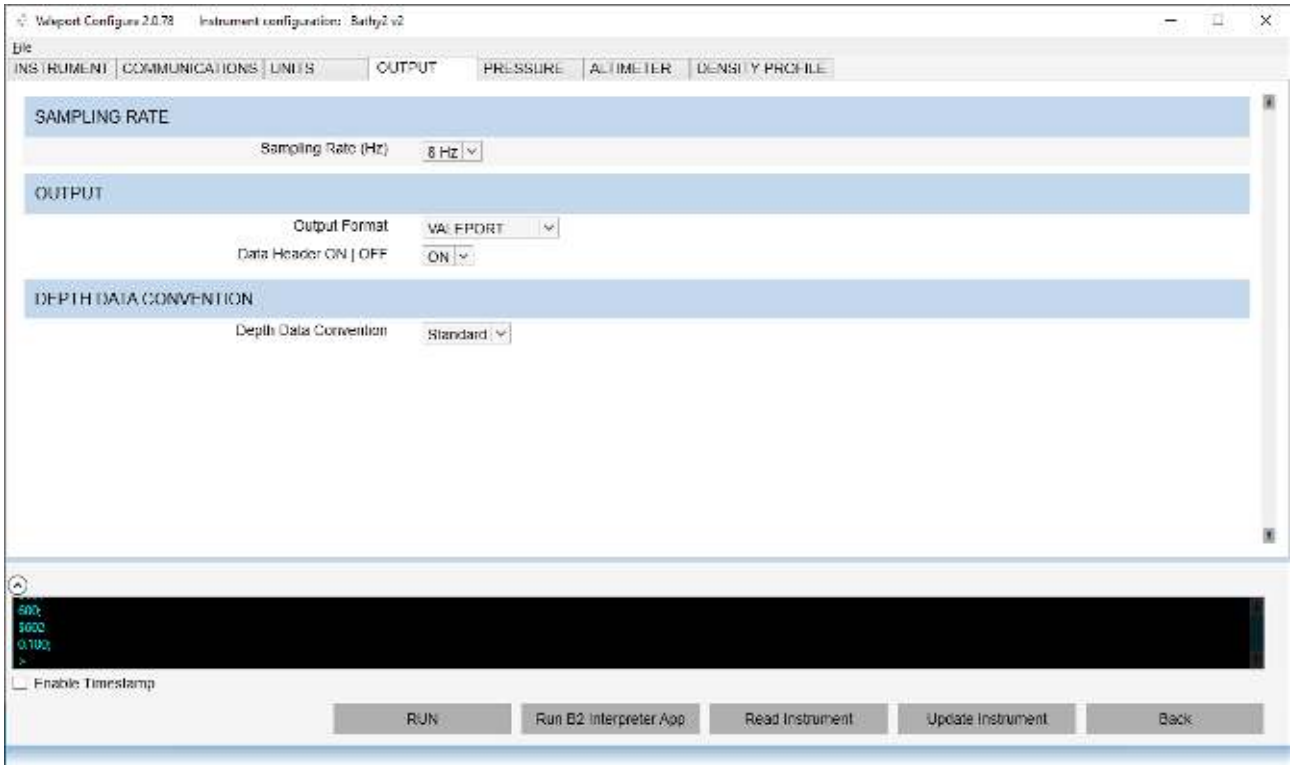
Standard units are as follows and will be used for all calculations.

- Pressure dBAR
- Temperature °C
- Depth | Height metres
- Sound Velocity ms-1
- Conductivity $mScm^{-1}$

Any changes to the above will be used in the appropriate output strings only.

click  to apply all changes

7.2.4 Configure App – OUPUT Tab



SAMPLING RATE

- Set your Sampling rate – 1, 2, 4 or 8Hz

OUTPUT

Use the dropdown menu to select your output string.

If you select VALEPORT as your output string there is an option to output a header with the string details on run #028.

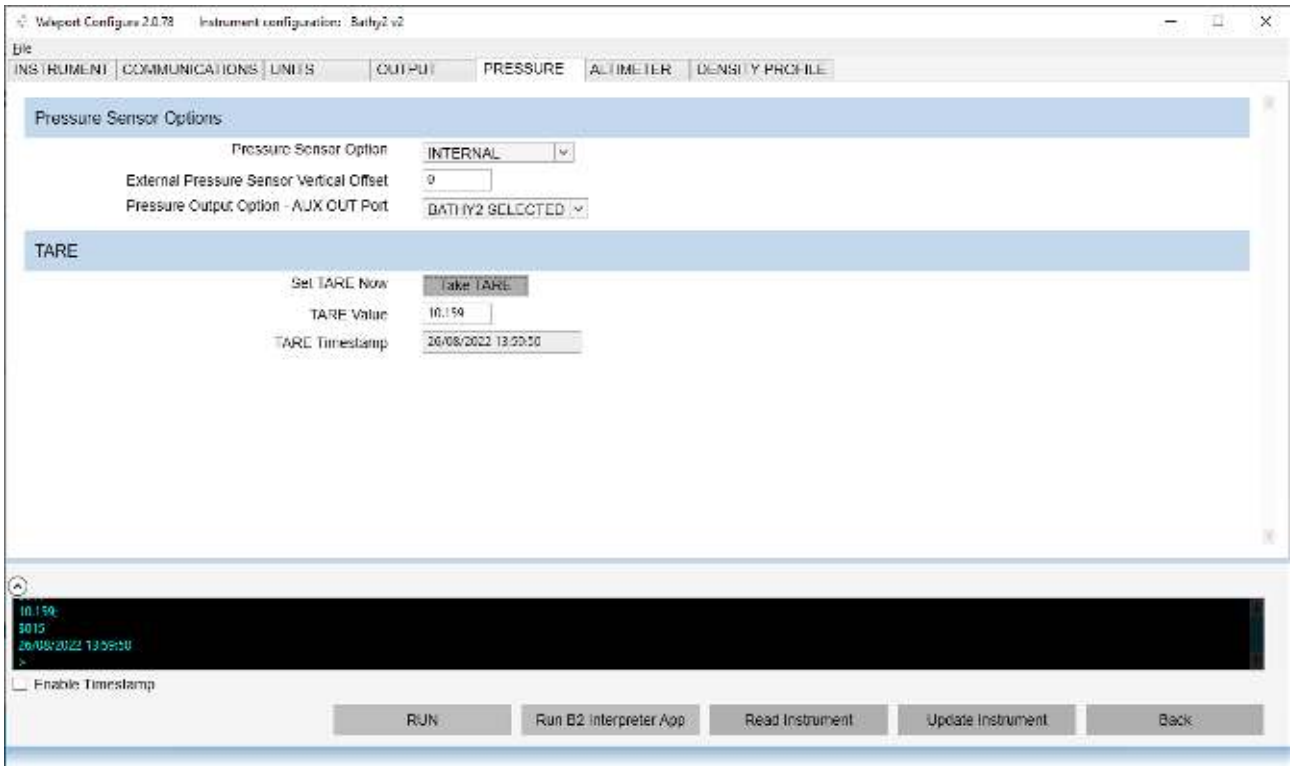
VALEPORT must be selected if you intend to run the Bathy2 Interpreter App

DEPTH DATA CONVENTION

Select a standard positive depth value or a TEOS10 negative depth value

click Update Instrument to apply all changes

7.2.5 Configure App – PRESSURE Tab

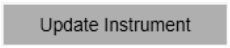


Pressure Sensor Options:

- Select which pressure sensor to use for the Calculated Depth
- External pressure offset – in metres
  - this value is added to the depth if the External Pressure sensor is selected the internal pressure sensor is the Bathy2 datum point
- Pressure Output Option AUX OUT port
  - A RAW output is data directly from the pressure sensor in its native format and update rate
  - BATHY2 SELECTED is the selected Pressure Sensor Option device in PPPP.PP<CRLF> format | Bathy2 sampling rate | 115200 baud

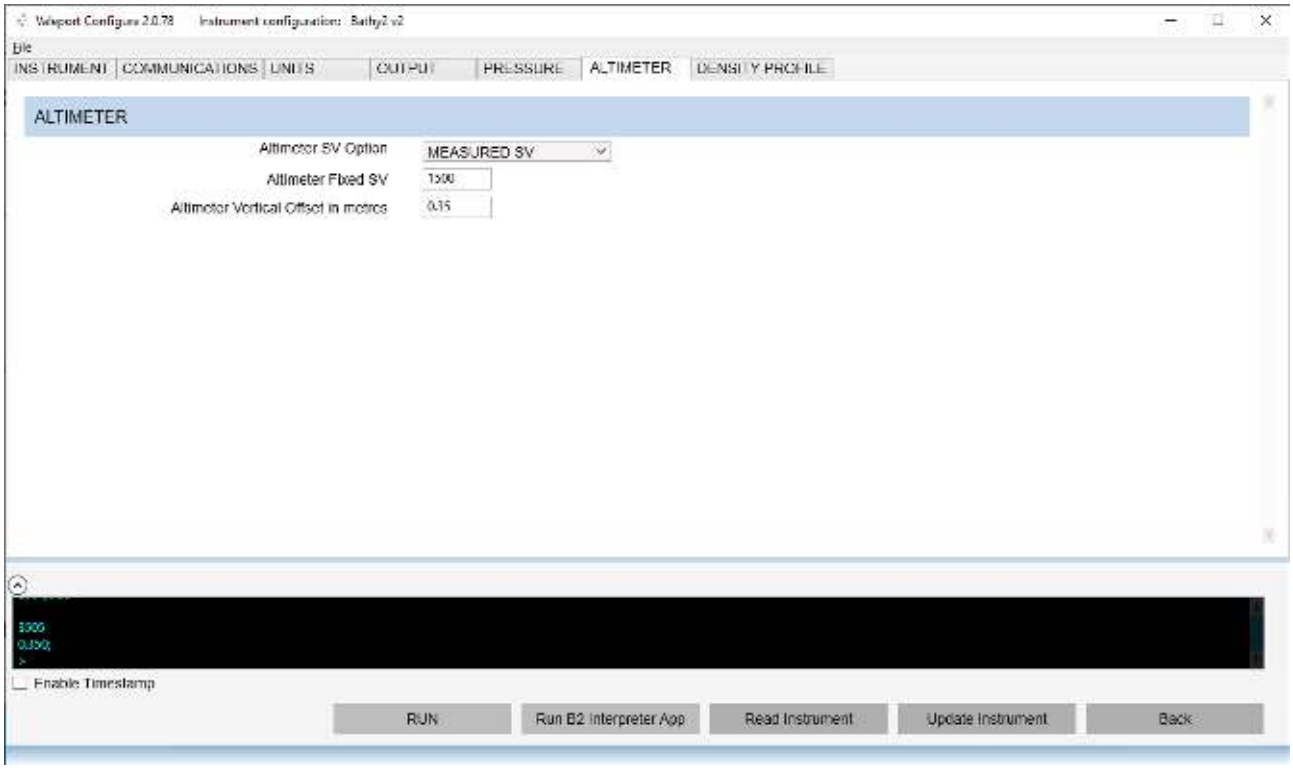
Tare

- Use the button to observe and apply a Tare value
  - only to be used to remove atmospheric data while on the surface – max value 20 dBar
- Tare Value – this is the value of the Tare observed and applied OR set a manual Tare in the window and click on 'Update Instrument' to apply
- Tare Timestamp – the time at which a TARE was observed

click  to apply all changes

7.2.6 Configure App – ALTIMETER Tab

Configure an Altimeter, if fitted

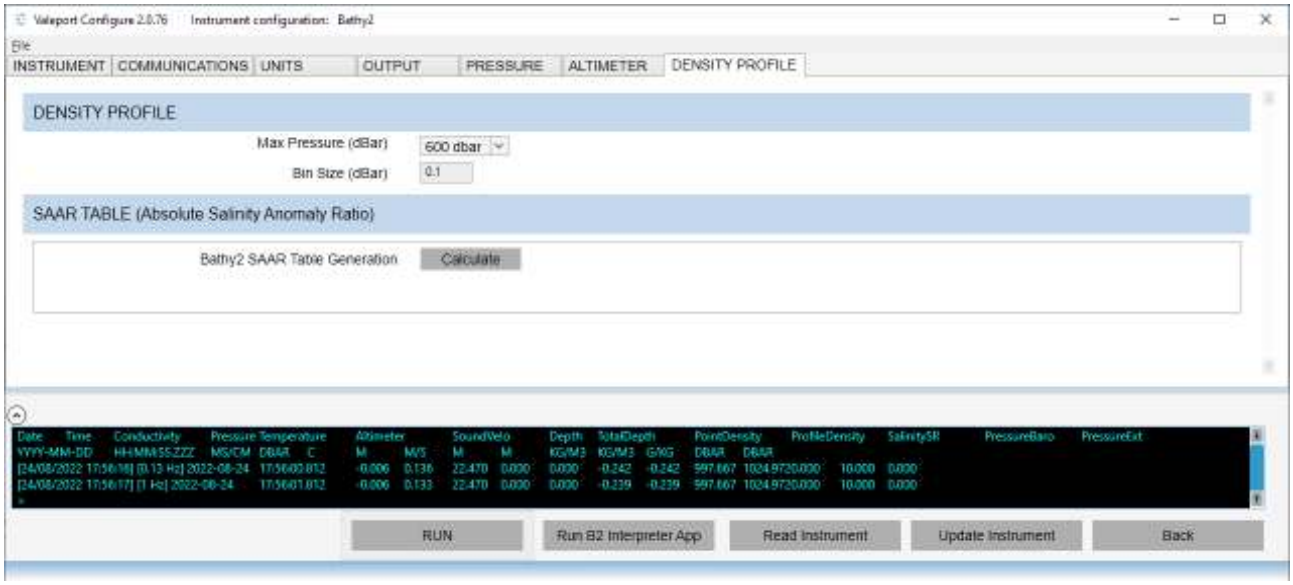


- Altimeter SV Option – use the dropdown menu to select which sound velocity you would like to use with the Altimeter – measured using the SV sensor, calculated (TEOS10) or a fixed value
- Altimeter Fixed SV - If you want to use a fixed sound velocity input it here
- Altimeter Vertical Offset – offset from Bathy2 datum – in metres
  - this value is added to the Altimeter Height if an Altimeter is interfaced

click Update Instrument to apply all changes

7.2.7 Configure App – DENSITY PROFILE Tab

This Tab is where the Density Profile is defined and the Absolute Salinity Anomaly Ratio (SAAR) Table is generated.



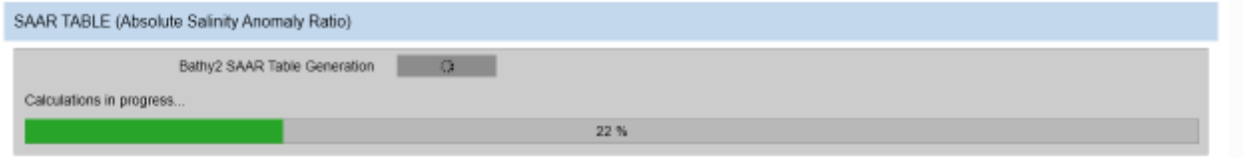
Density Profile

- Max Pressure (dBar) – what is the maximum depth of your survey site?
  - This value must be greater than that depth on site
  - The greater the selected depth the larger the observation bins will be and the coarser the profile – fewer bins
- Bin Size (dBar) – read only – the bin size in dBar
  - calculated by dividing the Max Pressure by 6000
  - The profile is made up of 6000 lines.

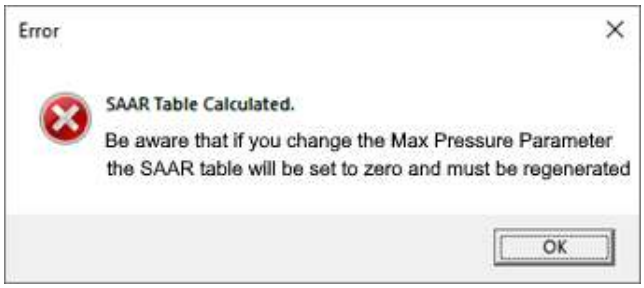
click Update Instrument to apply all changes

SAAR Table

- Bathy2 SAAR Table Generation – use the Calculate button to generate the table and program it to the Bathy2.
  - Before Clicking the button, you must have:
    - defined your site Latitude and Longitude – INSTRUMENT Tab
    - Selected the Max Pressure on site and therefore, the bin size for the profile
  - You can follow progress of the process:



On completion you will be presented with the following dialogue box:



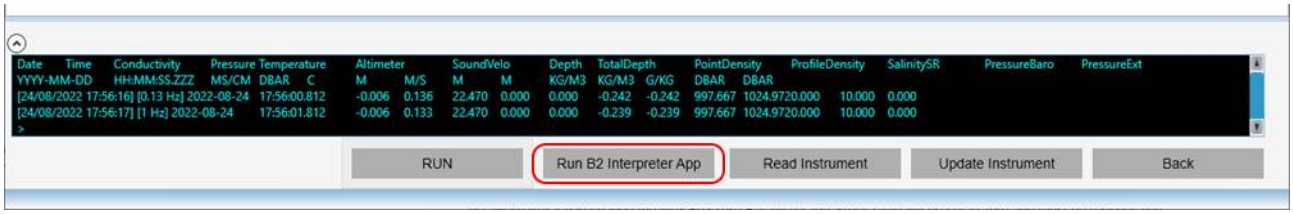
If you change the Max Pressure (dBar) setting the SAAR Table will be reset in the instrument
You must regenerate the table using the Calculate button
The SAAR Table generation tool is not valid for either the Baltic or Caspian Sea

7.3 Bathy2 Interpreter App

The Bathy2 Interpreter App is provided alongside the Valeport Configure App to provide a mechanism to:

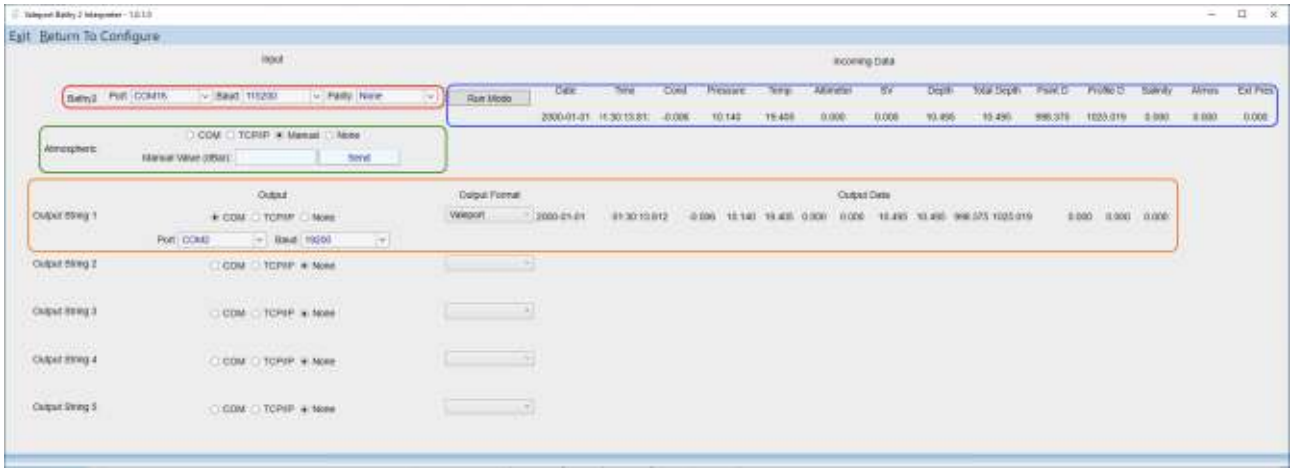
1. Distribute the Bathy2 data to a number of COM ports that can be of different format and baud rate
2. Provide Atmospheric data corrections to the instrument

The App can be initiated from Configure or run independently

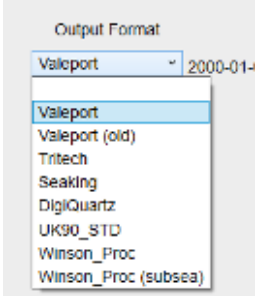


7.3.1 Configuring the Interpreter App

Launch the program:



- Set the Bathy2 COMs port up as required
- click Run Mode to receive data. The Bathy2 must be set to VALEPORT output format
- select how you will receive Atmospheric data – serially, TCP/IP or Manually
  - data should be in dBar and format: PPPP.PPP<CRLF>
  - a manually entered value can be typed into the window - click Send to send it to the Bathy2
- You can select up to 5 output string of the same or different format. Configure the port as required and select the output string format from the dropdown menu:



7.4 Interfacing an Altimeter

To Set up a VA500 Altimeter to operate with a Bathy2 send the following commands to the Altimeter using a terminal program:

#082;TRITEC<CR>

#059;9600

M4

The output from the Altimeter must be in this form for the Bathy2 to recognise the data.

There is a configuration button in the Valeport Configure App that will set the VA500 up as required on a single click.

7.5 Interfacing an External Pressure Sensor through AUX IN Port

For an external pressure sensor to be interfaced to the Bathy2 it must be set up as follows:

- Standard Digiquartz data string e.g. *00019.914<CRLF>
- 115200 baud rate, 8N1
- 4Hz update rate

8 Manual Setup Commands

Code	Followed by	Operation
$003	<CR><LF>	Read: serial number of the instrument
$009	;pp.ppp<CR><LF>	Set: Tare Value
$010	<CR><LF>	Read: Current Tare
$011	<CR><LF>	Read: Site information
$012	;Site_Information<CR><LF>	Set: Site Information
$014	<CR><LF>	Read: firmware version of the instrument
$015	<CR><LF>	Read: Tare Timestamp
$016	;x<CR><LF>	Set: Sampling Rate – 1, 2, 4, 8 Hz $016;4 = 4Hz
$017	<CR><LF>	Read: Sampling Rate
$019	;xxxx<CR><LF>	Set: baud rate in the instrument $019; 115200 = 115200 baud
$020	;header<CR><LF>	Set: Header output status $020;0 = OFF $020;1 = ON
$021	<CR><LF>	Read: Header output status
$022	;P<CR><LF>	Set: Pressure output units $022;0 = dBar $022;1 = Pascal (Pa) $022;2 = PSI
$023	<CR><LF>	Read: Pressure output units
$024	;T<CR><LF>	Set: Temperature output units $024;0 = °C $024;1 = °F
$025	<CR><LF>	Read: Temperature output units
$026	;d<CR><LF>	Set: output units for Depth/Height $026;0 = Metres $026;1 = Feet
$027	<CR><LF>	Read: output units for Depth/Height
$028	<CR><LF>	Set: units into run mode
$030	;c unit<CR><LF>	Set: Sound Velocity output units $030;0 = M\s $030;1 = F\sF
$031	<CR><LF>	Read: Sound Velocity output units
$032	;C<CR><LF>	Set: Conductivity output units $032;0 = mS/cm $032;1 = µS/cm
$033	<CR><LF>	Read: Conductivity output units
$042	;parity<CR><LF>	Set: Run Time Parity $042;0 = None $042;1 = Odd $042;2 = Evan
$043	<CR><LF>	Read: Parity
$048	;0<CR><LF>	Set: External Pressure Sensor (AUX IN) offset
$049	<CR><LF>	Read: External Pressure Sensor (AUX IN) offset
$052	;bathy_rtc<CR><LF>	Set: Instrument Time ;dd;mm;yy;hh;mm;ss<CR>
$053	<CR><LF>	Read: Instrument Time
$409	;modbus_slaveid<CR><LF>	Read: Modbus Address
$410	<CR><LF>	Set: Modbus Address (d35 = # d36 = $ do not use)

Code	Followed by	Operation
$411	<CR><LF>	Set: Modbus Status $411;0 = OFF $411;1 = ON
$412	;modbus_mode<CR><LF>	Read: Modbus Mode
$500	;altimeter_sv_option<CR><LF>	Set: Altimeter Sound Velocity option $500;0 = Measured $500;1 = Calculated (TEAS 10) $500;2 = Fixed (see cmd $506)
$501	<CR><LF>	Read: Altimeter Sound Velocity option
$504	;altimeter_offset<CR><LF>	Set: Altimeter offset (in metres, always) $504;-1.20
$505	<CR><LF>	Read: Altimeter offset
$506	;altimeter_fixedsSVvalue<CR><LF>	Set: Altimeter fixed Sound Velocity value (in m\s, always) $506;1500
$507	<CR><LF>	Read: Altimeter fixed Sound Velocity value
$600	<CR><LF>	Read: Density Profile maximum pressure (dBar)
$601	;6000<CR><LF>	Set: Density Profile maximum pressure (dBar) $601;0 = 600 dBar $601;0 = 1500 dBar $601;1 = 3000 dBar $601;2 = 6000 dBar
$602	<CR><LF>	Read: Density Profile resolution
$604	<CR><LF>	Read: Data Output format
$605	;output_format<CR><LF>	Set: Data Output format $605;0 = VALEPORT $605;3 = TRITECH $605;4 = SEAKING $605;5 = DIGIQUARTZ $605;6 = UK90_STD $605;7 = WINSON_PROC $605;8 = IN-SITU SENSORS $605;9 = SVX2
$606	<CR><LF>	Read: Site Latitude
$607	;user_Latitude<CR><LF>	Set: Site Latitude (-90 to 90) $607;50.426 = 50° 25’ 34” North $607;-50.426 = 50° 25’ 34” South
$608	<CR><LF>	Read: Site Longitude
$609	;user_Longitude<CR><LF>	Set: Site Longitude (-180 to 180) $609;90.426 = 90° 25’ 34” East $609;-90.426 = 90° 25’ 34” West
$613	;table;start line;endline <CR><LF>	Output: Memory Tables [0 | 1 | 2];start line;end line Where [0] = All [1] = Density [2] = SAAR TABLE - INDEX and SAAR VALUE For Example - $613;0;0,6000"
$622	;rs485_mode<CR><LF>	Set: RS485 mode $622;0 = OFF - Disabled $622;1 = ON – Full Duplex $622;2 = ON – Half Duplex $622;3 = ON – Half Duplex (no cmd echo)
$623	<CR><LF>	Read: RS485 mode

Code	Followed by	Operation
$630	;pressure_ins<CR><LF>	Set: AUX port Pressure output option $630;0 = RAW INTERNAL $630;1 = RAW EXTERNAL $630;2 = CORRECTED (pressure sensor option - $633)
$631	<CR><LF>	Read: AUX port Pressure output option
$632	<CR><LF>	Read: Pressure Options
$633	;pressure_options<CR><LF>	Set: Pressure Sensor used in calculations $633;0 = INTERNAL $633;1 = EXTERNAL

8.1 Pressure Tare

The Interchangeable pressure sensor fitted in the Bathy2 measures absolute pressure, that is, it includes atmospheric pressure. The pressure Tare function allows the atmospheric pressure (as measured by the sensor, normally before deployment) to be removed from the observations so the output is simply the pressure of water.

The pressure Tare observation should be taken with the sensor in the same orientation as it will be deployed (horizontal, pointing up or pointing down) to negate any effects of the weight of the sensing element itself

- Whilst this effect is small, it is an unnecessary contribution to the error budget

Code	Description
$009	Measure Tare (observes current pressure reading and programs the Tare value)
$009;nnnn.nnn	Sets specific Tare in dBar Example: #009;10.325 sets Tare to 10.325dBar
$010	Read the current Tare value in the units set at the time it was observed

8.2 Set Latitude and Longitude

The Latitude and Longitude are required to calculate the Absolute Salinity Anomaly Ratio lookup table.

# Code	Description
$607;nn.nnn	Sets the local operating latitude in decimal degrees Example: $607;50.426 Sets latitude to 50.426° (50° 25’ 34”) North North is positive South is negative
$606	Read the Latitude set in the instrument
$609;ee.eee	Sets the local operating longitude in decimal degrees Example: $609;-3.426 Sets latitude to 3.426° (3° 25’ 34”) West East is positive West is negative
$608	Read the Longitude set in the instrument

9 Data Output Formats

The Bathy2 has a selection of different data output formats built in, allowing easy interface to software packages and third-party instrumentation.

The Bathy2 Interpreter App is supplied with the Bathy2 as part of the Configure App. The Interpreter can be used to distribute up to 5 data strings of different formats to 5 COM ports or TCP/IP addresses.

9.1 Data String Formats

9.1.1 Format: VALEPORT

This is the default output string and must be selected to operate with the Bathy2 Interpreter App.

Command:	$605;0
Format:	yyyy-mm-dd^hh:mm:ss.sss^CC.CCC^pppp.ppp^TT.TTT^hh.hhh^cccc.ccc^pppp.ppp ^dddd.ddd^dddd.ddd^DDDD.DDD^DDDD.DDDD^s.sss^AA.AAA<CR><LF>

Notes:

Field	Format	Units
Date	yyyy-mm-dd	
Time	hh:mm:ss.sss	
Conductivity	CC.CCC	MS/CM | µS/CM
Pressure (selected)	pppp.ppp	DBAR | Pa | PSI
Temperature	tt.ttt	ºC | ºF
Altimeter height (zero if not interfaced)	hh.hhh	M | F
Sound Velocity (measured)	cccc.ccc	M/S | F/S
Depth	dddd.ddd	DBAR | Pa | PSI
Total Depth (Instrument dept + Altimeter)	dddd.ddd	M | F
Point Density	DDDD.DDD	KG/M3
Profile Density	DDDD.DDD	KG/M3
Salinity	s.sss	G/KG
Barometric Pressure\TARE value	pp.ppp	DBAR
External Pressure Sensor Data (zero if not interfaced)	pp.ppp	DBAR

The string data delimiter is a Tab (^)

Date	Time	Cond'tivity	Pressure	Temp	Altimeter	Sound Velocity	Depth	Total Depth	Point Density	Profile Density	Salinity	Pressure Baro	Pressure Ext
YYYY-MM-DD	HH:mm:SS	mS/cm	dbar	deg C	m	m/s	m	m	kg/m3	kg/m3	g/kg	dbar	dbar
2021-11-19	17:13:20	0.126	10.317	18.562	0.120	1478.152	0.252	0.372	998.546	1009.402	0.068	10.100	10.374
2021-11-19	17:13:20	0.120	10.317	18.562	0.120	1478.152	0.252	0.372	998.544	1009.402	0.065	10.100	10.376
2021-11-19	17:13:20	0.118	10.317	18.561	0.120	1478.154	0.252	0.372	998.543	1009.402	0.064	10.100	10.376

9.1.1.1 Header Message

When set to VALEPORT Output format a Header message can be sent each time the instrument is put into a run mode ($028):

Code	Description
$020;n	Enable | Disable Header output $020;0 disables Header output $020;1 enables Header output
$021	Read header

The message contains the following information

>[HEADER]

Field	Setup Function	Read Parameter
DataStartTime=09/08/2022 15:32:39	-	
Latitude=-3.0000	$607	$606
Longitude=54.0000	$609	$608
DeviceSeries=Bathy2	-	
VpdVersion=2	-	
InstrumentCode=01300030	-	$007
MainFirmware=04007182A9 Jul 8 2022 15:33	-	$014
BathyFirmware=04007184A1 10/01/2022 17:00		
SiteInfo=Factory Test Site	$012	$011
SerialNumber=XXXXX	-	$003
DensityProfileMaxPressure=xxxxx	$601	$600
DensityProfileResolution=xxxx	-	$602
SamplingInterval=1.000	$016	$017

Instrument output format

[COLUMNS]	Type	Format
Date	String	YYYY-MM-DD
Time	String	HH:MM:SS.ZZZ
Conductivity	Float	MS/CM | µS/CM
Pressure	Float	DBAR | Pa | PSI
Temperature	Float	ºC | ºF
Altimeter (zero if not interfaced) selected SV and offset applied	Float	M | F*
Sound Velocity - observed	Float	M/S | F/S
Depth	Float	M |F*
Total Depth (Calculated depth + Altimeter)	Float	M | F*
Point Density	Float	Kg/M^3
Profile Density	Float	Kg/M^3
Salinity	Float	g/Kg
Pressure Barometric (TARE if not interfaced)	Float	DBAR
Pressure External AUX IN port (zero if not interfaced)	Float	DBAR

* - single setting

9.1.2 Format: TRITECH

Command:	$605;3

9.1.3 Format Seaking

Command: $605;4

9.1.4 Format: Digiquartz

This format emulates the Paroscientific Digiquartz sensor output

Command:	$605;5

9.1.5 Format: UK90_STD

Command:	$605;6

9.1.6 Format: WINSON_PROC

Command:	$605;7

9.1.7 Format: VALEPORT SVX2

Command:	$605;9

9.2 Modbus RTU over RS485

Modbus RTU as implemented in the Bathy2 is an industry standard interface protocol that will run over RS232 or RS485.

The Baud rate is variable 4800 to 19200 with 8N1 or 8E1 framing.

This conforms to the minimum requirements of the MODBUS standard of 9600 and 19200 baud with 8E1 framing.

Full set up and operation through Modbus is outside the scope of this document, please contact Valeport for further details.

See section Instrument Communications Setup for details on how to enable Modbus

10 Wiring Details

1.1 BathyPack Main Bulkhead Connector

10 Way Female SubConn MCBH10F	Function
1	Power Ground
2	Power +V
3	RS422TxA
4	RS422TxB
5	RS422RxA
6	RS422RxB
7	RS232 Tx (To PC)
8	RS232 Rx (From PC)
9	RS232 Ground
10	N/C

Note: For half-duplex RS485 communications link Pin 3 to Pin 5, and Pin 4 to Pin 6 in the cable.

1.2 BathyPack Altimeter Bulkhead Connector

6 Way Female SubConn MCBH6F	Function
1	Sensor Power Ground / RS232 Ground
2	RS232 Rx In to BathyPack
3	RS232 Tx Out of BathyPack
4	Sensor Power (+24V max)
5	RS485B
6	RS485A

1.3 RS232 3m Y lead (as supplied)

10 Way Male SubConn MCIL10M	4mm Banana Plugs	9 Way D Type	Function
1	BLACK		Power Ground
2	RED		Power +V
3			
4			
5			
6			
7		2	RS232 Tx (To PC)
8		3	RS232 Rx (From PC)
9		5 (link to 1,6,8,9)	RS232 Ground
		SHELL	
10			Link to RS232 Ground

10.1.1 Serial Connection

6 Way Male SubConn (MCIL6M)	
PIN	FUNCTION
1	RS232 GND
2	RS232 Tx (Out of sensor) or RS485A
3	RS232 Rx (Into sensor) or RS485B
4	+V
5	Link to Pin 1 for RS485 Not Connected for RS232
6	Power GND

10.1.2 Ethernet Connection

WIRE TYPE /	WIRE COLOUR	END 1: SCDBH13FT2 SubConn		FUNCTION
		CONNECTOR	PIN	
20 AWG coloured wires	BLACK	13 Way SubConn Bulkhead	1	External Power (-Ve)
	WHITE		3	External Power (+Ve)
	ORANGE		2	Screen (Not connected)
	RED		12	Not connected
	GREEN		13	Not connected
CAT5E patch cable	WHITE/GREEN		11	Bi-Dir_DA+ (Rx +)
	GREEN		10	Bi-Dir_DA- (Rx -)
	WHITE/ORANGE		9	Bi-Dir_DB+ (Tx +)
	ORANGE		8	Bi-Dir_DB- (Tx -)
	WHITE/BLUE		7	Bi-Dir_ DC-
	BLUE		6	Bi-Dir_ DC+
	WHITE/BROWN		5	Bi-Dir_ DD+
	BROWN		4	Bi-Dir_ DD-

10.1.2.1 Ethernet Y lead

END 1: 13 WAY MALE SUBCONN		WIRE COLOUR	END 2: RJ45 CONNECTOR		END 3: BANANA PLUG	FUNCTION	
CONNECTOR	PIN		CONNECTOR	PIN	CONNECTOR	PIN	
SubConn, 13 way male SCDBH13MBR	1	Black			Black 4mm Plug	1	-V
	3	White			Red 4mm Plug	1	+V
	2	Orange					Screen (Not Connected)
	4	Brown	RJ45 Cable Mount Connector	8			Bi-Dir_ DD-
	5	Brown/White		7			Bi-Dir_ DD+
	6	Blue		4			Bi-Dir_ DC+
	7	Blue/White		5			Bi-Dir_ DC-
	8	Orange		2			Bi-Dir_DB- (Tx -)
	9	Orange/White		1			Bi-Dir_DB+ (Tx +)
	10	Green		6			Bi-Dir_DA- (Rx -)
	11	Green/White		3			Bi-Dir_DA+ (Rx +)
	12	Red					Not Connected
	13	Green					Not Connected

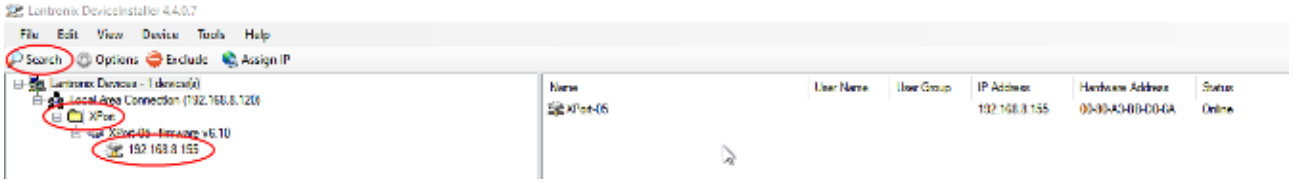
11 Ethernet – Bathy2e

The Bathy2 can be optionally fitted with a Transmission Control Protocol/Internet Protocol (TCP/IP) Ethernet module set up in Dynamic Host Configuration Protocol (DHCP). This means the instrument will automatically be assigned an IP address. Depending on how your router works, it should go back to that IP address each time it is interfaced although this is not guaranteed unless you provide it with a fixed IP in the router configuration.

11.1.1 Setting up Ethernet Connectivity

The Bathy2 has a Lantronix Ethernet module that will need to be configured. You can download the Lantronix Device Installer software from https://www.lantronix.com/products/deviceinstaller/.

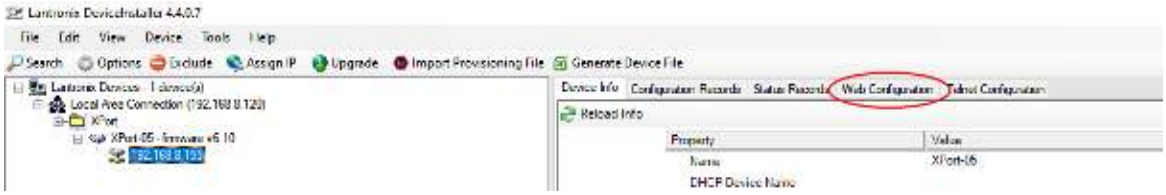
Connect the miniIPS2e to the network and run the software. If the device is not found after a few moments press Search, top left



Once the module has been found click on XPort to reveal the IP address - in the example above: 192.168.8.155

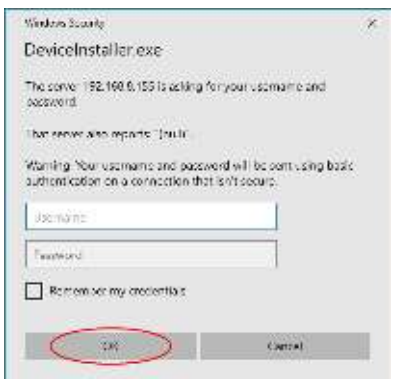
Click on the IP Address in the left hand panel to reveal more information in the right hand panel

Select Web Configuration



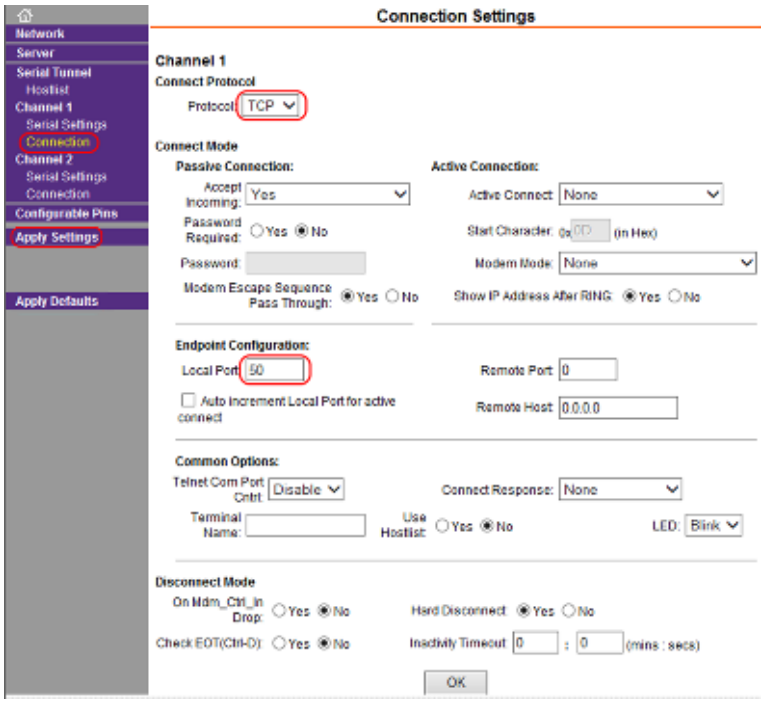
Select the green arrow to reveal the password entry dialogue

Do not enter a Username or Password - simply select OK



Select: Connection

Ensure settings are similar to those shown below:



Protocol: TCP

The Local Port number should be less than 10000.

Do not select or accept a Local Port number 23
Local Port number 23 is reserved for TelNet

Remote Port: 0

Select: **Apply Settings**
Perform a new search after the settings have been completed.

Select: Serial Settings:

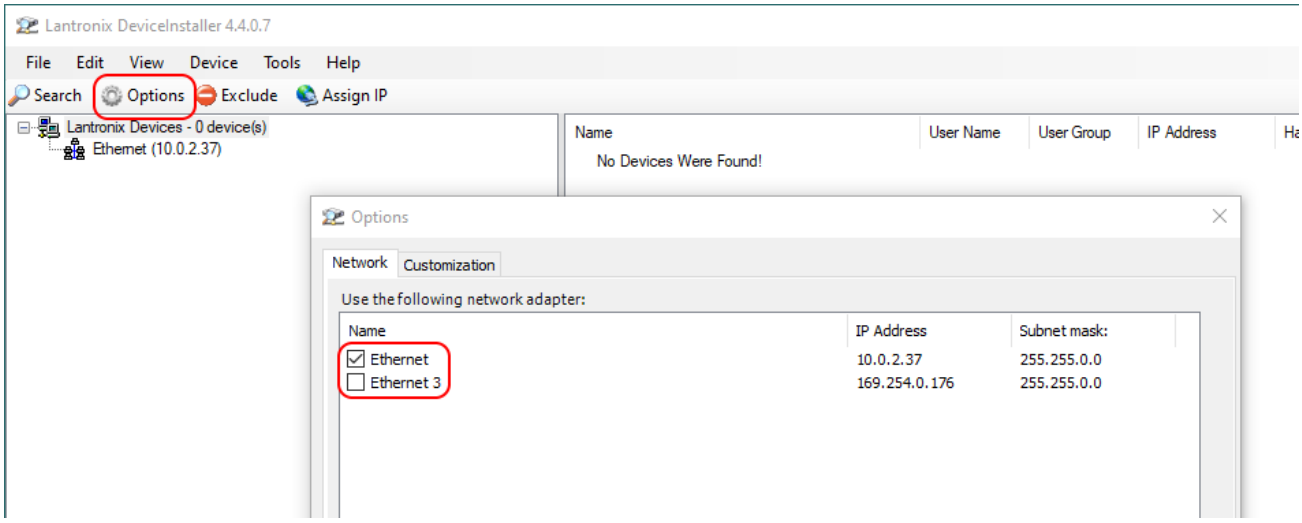
Baud Rate on Channel 1: 230400

Flow Control: None

Click on: **Apply Settings**
Perform a new search after the settings have been applied to ensure they have been saved.

11.1.1.1 If No Lantronix Devices are Found

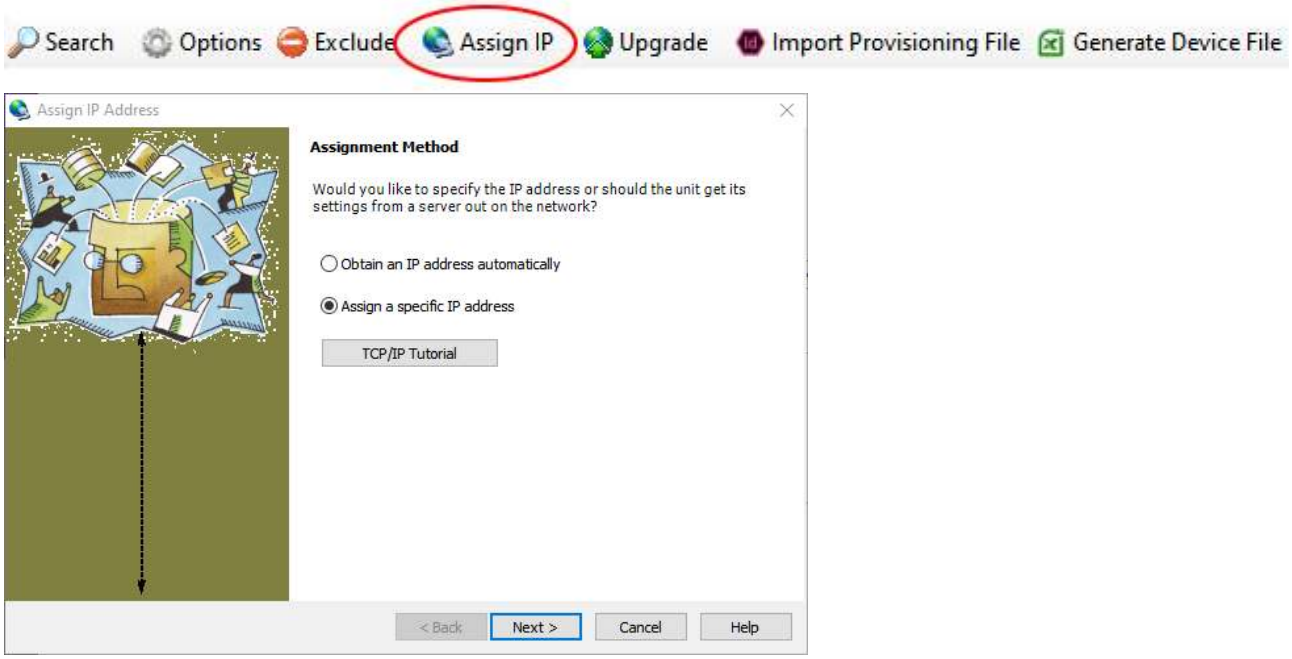
If no Lantronix devices are found, this can happen if you are using an Ethernet to Serial converter, click on the Options button: Options and check that you have the correct network adaptor selected.



Once a new network adaptor has been selected, click on the Search button: Search to locate and interface to the uvSVXe.

11.1.1.2 Fixed IP

To set a fixed IP address for the unit follow the wizard in the Lantronix App



11.1.2 Instrument Communications Setup

12 Care & Maintenance

The Bathy2 are remarkably robust, being primarily constructed of titanium. The only maintenance required, other than periodic recalibration as necessary or recommended at maximum of 2 years, is to keep the sensor as clean as possible. The instrument should be rinsed with freshwater when recovered and any debris or growth gently removed.

Do not attempt to remove the acetal Lock Screw Cap from the Pressure Module. If debris is caught under the cover attempt to remove it under slowly flowing water, use no tools. If this fails contact Valeport for further advice. If the sensor diaphragm is damaged in any way it will have to be replaced.

The instrument should be stored in its box when not in use. It is not necessary to remove the Interchangeable Pressure Sensor Module during storage.

Any damage to this diaphragm will render the Pressure Module warranty invalid

12.1 Calibration

The Bathy2 Interchangeable Pressure Modules can be returned to Valeport or one of its approved laboratories for recalibration.

Pressure sensors should be calibrated biennially

13 Updating the Bathy2

On occasion there will be updates to the Bathy2 firmware.

13.1 Updating the Intelligent Interface Board Firmware

The firmware will be available on https:\\valeport.download.

Select Bathy2 from the dropdown list to be presented with software and firmware relevant to Bathy2.

Windows Software

Product	Description	Suitable for:	Version/Size	Get
Bathy2 Interpreter	Software application to interpret incoming Bathy 2 data and convert it to various Output Formats. • Valeport • Valeport (old) • Tritech • SeaKing • Digiquartz • UK90_STD • Winson_Proc • Winson_Proc (subsea) What's new? Added TCP Input option for incoming Atmospheric data. Added TCP Output option for exporting Interpreted data.	• Bathy2	1.0.0.9 4.1 MB	
Valeport Configure	Valeport Configure is a generic program developed to operate with a number of Valeport Instruments; a specific module being loaded for each The list of instruments compatible with Configure will increase over time. Some important points to note about the download: Presently available for windows 10 PC only. Functionality: Instrument set up and set to work. What's new? Regarding to previous version, configuration file for Type-804 is updated.	• Bathy2 • miniIPS2 • uvSVX • Hyperion • Type 804 • Type 804 ExP • Type 810 • Type 812	2.0.31 15.99 MB	
Valeport Bootloader	A software tool to update your instrument to the latest firmware. What's new? Renamed BathyPack2 to Bathy2	• All SWiFT variants • All Hyperion variants • miniIPS2 • uvSVP • uvSVX • Type 804 • EnviroLog • Bathy2	2.0.2.5 2.55 MB	

Firmware

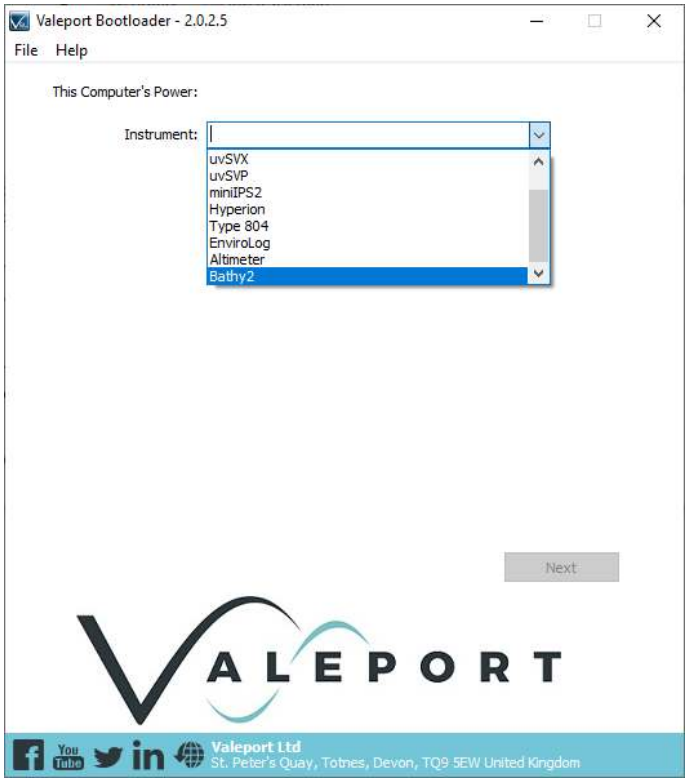
Product	Description	Suitable for:	Version/Size	Get
Bathy2 Intelligent Interface Board Firmware	The latest firmware version for your instrument. If you have any doubts as to the compatibility of this firmware with your instrument please contact Valeport before attempting to upgrade. This firmware should be loaded into your instrument using the Valeport Bootloader software tool; available to download from this page. What's new? Bathy2 Firmware	• Bathy2	B0 136.56 KB	

Download and install Valeport Bootloader – a shortcut should be added to your desktop:

Download and save the .zip file - do not 'unzip' it.

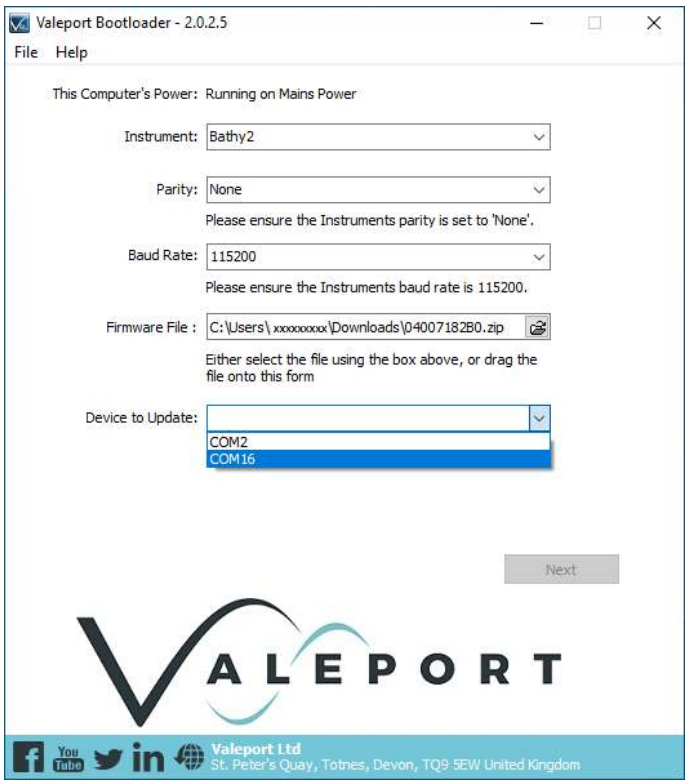
13.2 Valeport Bootloader App

Run the software and select Bathy2 from the dropdown list:

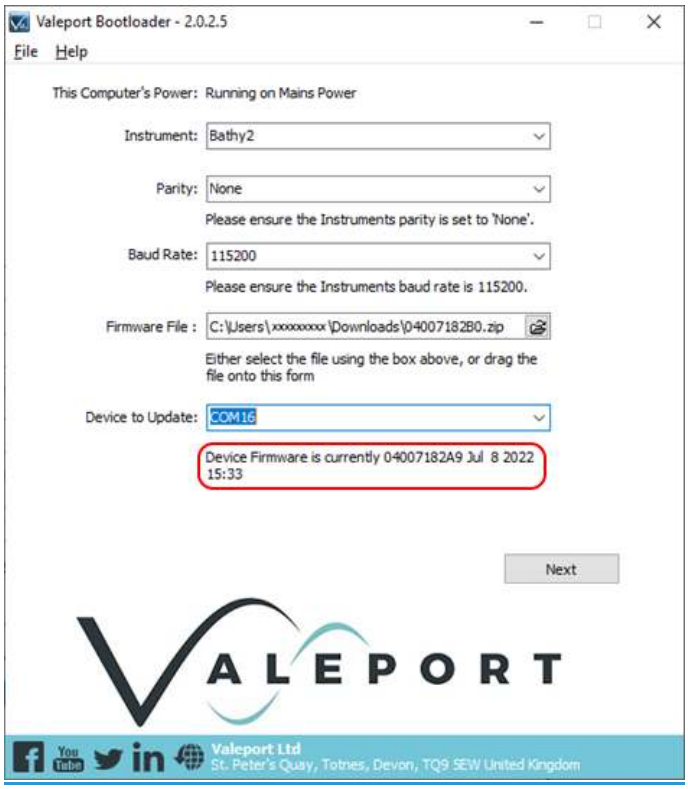


In the Firmware File: field use the dialogue button to select the zip file you downloaded earlier or simply drag and drop it on the window.

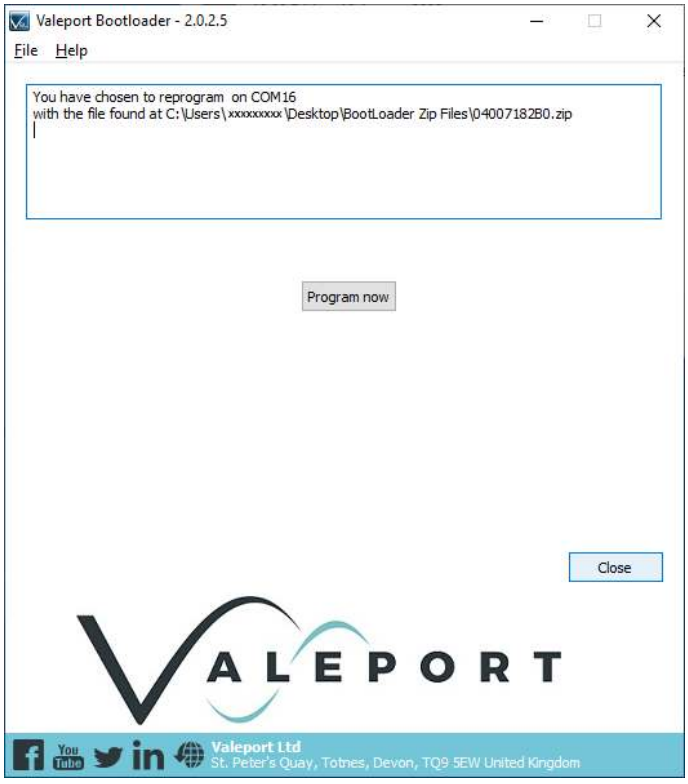
In the Device to Update: field use the drop down list to select the COM port the instrument is interfaced to



Once the instrument has been recognised it will show the installed firmware:

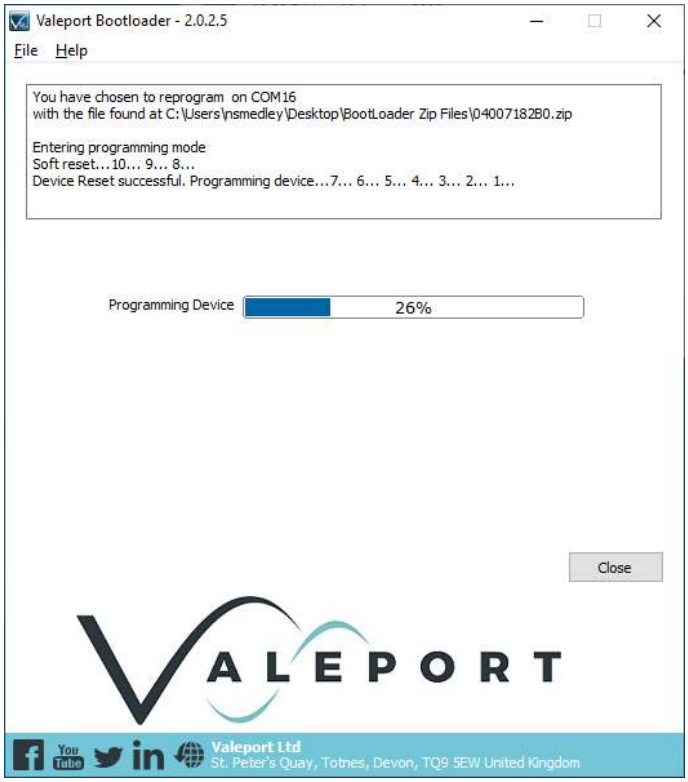


Click Next

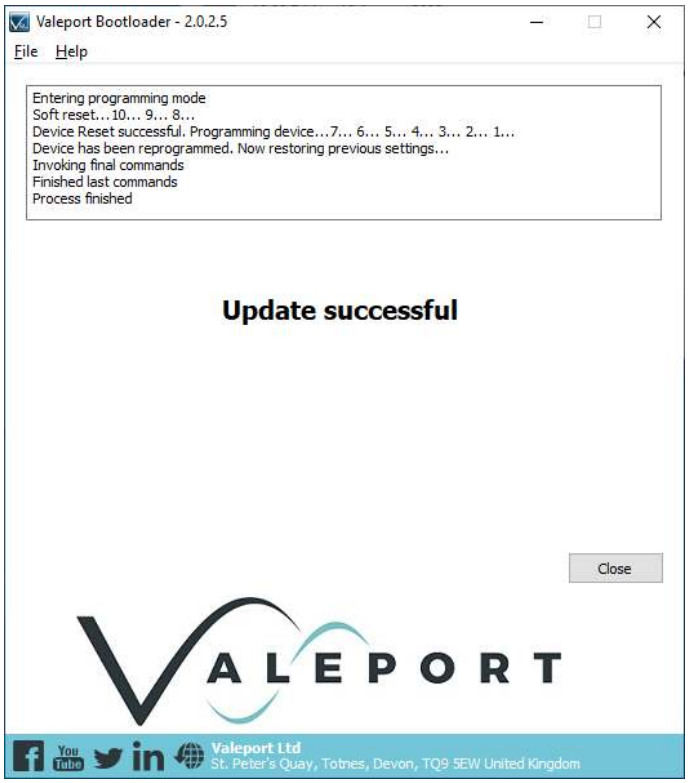


Click Program now

You can monitor progress as the new firmware is bootloaded:



You will be informed when the process in complete



Click Close to continue.

14 Ordering and Part Numbers

Part No.	Description
0608010	Bathy2 Base Unit - Titanium housing Fitted with: Fast Response PRT temperature sensor Pressure compensated conductivity cell 50mm path length sound velocity sensor Includes interfaces for Valeport VA500 altimeter External pressure sensor e.g. Digiquartz Auxiliary pressure output e.g. INS Supplied with Valeport Configure software | 4m interface lead | operating manual and system transit case. Altimeter and PTSA Pressure Transducer are not included
0608010-XXX	Bathy2 Base System - Titanium housing Fitted with: 0.01% piezo-resistive, interchangeable pressure sensor (XXXBar) where XXX = 100, 200, 300, 400 or 600 Bar Fast Response PRT temperature sensor Pressure compensated conductivity cell 50mm path length sound velocity sensor Includes interfaces for Valeport VA500 altimeter External pressure sensor e.g. Digiquartz Auxiliary pressure output e.g. INS Supplied with Valeport Configure software | 4m interface lead | operating manual and system transit case. Altimeter is not included
0608011-XXX	Bathy2 ETHERNET System - Titanium housing Fitted with: 0.01% piezo-resistive, interchangeable pressure sensor (XXXBar) where XXX = 100, 200, 300, 400 or 600 Bar Fast Response PRT temperature sensor Pressure compensated conductivity cell 50mm path length sound velocity sensor Includes interfaces for Valeport VA500 altimeter External pressure sensor e.g. Digiquartz Auxiliary pressure output e.g. INS Supplied with Valeport Configure software | 4m interface lead | operating manual and system transit case. Altimeter is not included
PTSAXX	Interchangeable Pressure Sensor Module (XXX Bar)
0760089	Pressure Module removal tool

15 Declarations of Conformity

Any changes or modifications to the product or accessories supplied, that are not authorised by Valeport Ltd, could void the CE compliance of the product and negate your authority to operate it. This product has demonstrated CE compliance under conditions that include the use of shielded cables. It is important that you use shielded cables compliant with the product's conformance, to protect from potential damage and reduce the possibility of interference to other electronic devices

15.1 EU Declaration of Conformity – CE Mark

15.1.1 Bathy2

EU Declaration of Conformity

Manufacturer:	Valeport Ltd
Address:	St Peter's Quay, Totnes, Devon, TQ9 5EW
Certification marking:	CE
Product Description:	Bathy2

We the manufacturer declare that the product **Bathy2**, is in conformity with the following EU Directives and harmonised standard(s):

EMC Directive 2014/30/EU	**Standards**
EMC (Article 3.1b)	BS EN 61326-1:2013 (Basic Level)

RoHS Directive 2015/863/EU	**Standards**
Prevention (Article 4.1)	BS EN IEC 63000:2018

Name:	D.Lakin
Position:	Development Engineer
Place of issue:	Valeport Ltd, Totnes, UK
Date of issue:	08 November 2021
Signature:	

15.1.2 Interchangeable Pressure Module

EU Declaration of Conformity

Manufacturer:	Valeport Ltd
Address:	St Peter's Quay, Totnes, Devon, TQ9 5EW
Certification marking:	CE
Product Description:	Interchangeable Pressure Sensor Module (IPSM)

We the manufacturer declare that the product **Interchangeable Pressure Sensor Module (IPSM)** is in conformity with the following EU Directives and harmonised standard(s):

EMC Directive 2014/30/EU	**Standards**
EMC (Article 3.1b)	BS EN 61326-1:2013 (Basic Level)

RoHS Directive 2015/863/EU	**Standards**
Prevention (Article 4.1)	BS EN IEC 63000:2018

Name:	James Bishop
Position:	Design Engineer
Place of issue:	Valeport Ltd, Totnes, UK
Date of issue:	27 February 2020
Signature:	

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Devon TQ9 5EW UK

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15.2 UK Declaration of Conformity – UKCA Mark

15.2.1 Bathy2

UK Declaration of Conformity

Manufacturer:	Valeport Ltd
Address:	St Peter's Quay, Totnes, Devon, TQ9 5EW
Certification marking:	UKCA
Product Description:	Bathy2

We the manufacturer declare that the product **Bathy2** is in conformity with the following UK Statutory requirements and designated standard(s):

Electromagnetic Compatibility Regulations 2016	**Standards**
EMC (SI 2016 No.1091)	BS EN 60945:2002 BS EN 61326-1:2013 (Basic Level)

ROHS Regulations 2012	**Standards**
SI 2012 No. 3032	BS EN IEC 63000:2018

Name:	D.Lakin
Position:	Development Engineer
Place of issue:	Valeport Ltd, Totnes, UK
Date of issue:	08 November 2021
Signature:	

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15.2.2 Interchangeable Pressure Module

UK Declaration of Conformity

Manufacturer:	Valeport Ltd
Address:	St Peter's Quay, Totnes, Devon, TQ9 5EW
Certification marking:	UKCA
Product Description:	Interchangeable Pressure Sensor Module (IPSM)

We the manufacturer declare that the product Interchangeable Pressure Sensor Module (IPSM) is in conformity with the following UK Statutory requirements and designated standard(s):

Electromagnetic Compatibility Regulations 2016	**Standards**
EMC (SI 2016 No.1091)	BS EN 61326-1:2013 (Basic Level)

ROHS Regulations 2012	**Standards**
SI 2012 No. 3032	BS EN IEC 63000:2018

Name:	Surya Dinesh
Position:	Product Support Manager
Place of issue:	Valeport Ltd, Totnes, UK
Date of issue:	16 June 2021
Signature:	

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