Wave logger additional notes & user information

The pressure meter of Environment Mapping & Surveying (EMS) is an instrument which measures the pressure at the bottom of a liquid body, such as a lake, sea, et cetera. With those measured values, the wave height and wave period can be easily found.

Two non-directional wave loggers are shown on Figure 1.

Figure 1: Environment Mapping & Surveying (EMS) non-directional wave loggers

If more than one wave logger is used, it is recommended to identify each wave logger by assigning a number to each one of them in order to recognize the output information when the measurements are finished.

The following sections describe the different components of one each logger and its functioning.

Housing

The housing is made from rigid PVC pipe. The fittings have been thermo welded to each other. There is a single o-ring seal for the unit. This o-ring should be kept clean and silicon applied after each deployment. The seal is compressed with the screw on the end cap.

Pressure sensor

The wave logger has a Honeywell MLH pressure sensor. More information can be found at: http://sensing.honeywell.com/index.php?ci_id=3108&la_id=1&pr_id=31550

The sensor has the following characteristics:

- MLH 050 PGP 06 A
- 50 psi gage
- Flying leads (20 AWG - 6 in)
- 1/6 in 27 NPT
- 0.5 Vdc to 4.5 Vdc ratiometric from 5 Vdc excitation

It can be found for sale at Mouser for €91.81 each:

http://nl.mouser.com/Search/ProductDetail.aspx?qs=pLJKYPamQJz9Ny66tbLCUQ%3D%3D

The pressure sensor has been soldered directly to the controller board. If for any reason, the logger is taken apart, make note of the pin outs, reversing the voltage to the sensor will destroy it! The sensor

has a stainless steel membrane which is exposed to the water. This hole should be kept clean and no tools should be used remove debris as this will damage the membrane.

Batteries

Each wave logger needs one D Cell 3.6v Lithium Ion 16500Ah battery.

It is sufficient with a Lithium-Thionyl ER34615 3.6V D SO Soldertag 10766 (10 Ah); price: € 14.52. The soldertag is otiose; therefore it has to be removed in order to work well. This can be done easily with nose pliers.

In 2012 we purchased these batteries at Batterypoint.nl

Battery and wave logger internal layout is shown in Figure 2.

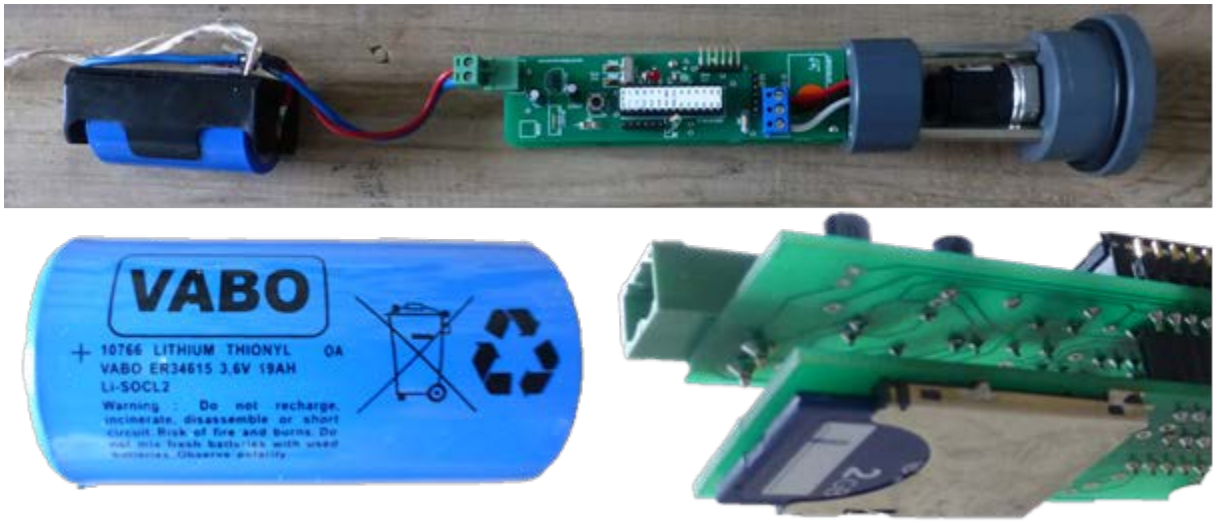

Figure 2: Wave logger details: battery, SD Card, et cetera

SD-Card

All SD cards used should be formatted FAT16. Some SD cards may not work due to speeds and or capacity.

Modifications done 01/01/2013:

1. The on board voltage regulator was removed and then it was added a 5V step up converter for Li batteries. This improves standby current draw considerably, but the unit can only be used with 3.6v batteries (and not any more with 4 AA batteries as the previous version). The unit should operate for at least 30 - 40 days on all configurations on one D Cell 3.6v.
2. A push button was added to close the file when the unit is logging if it is desired. If the bottom is pushed, the data is safe and both LEDs remain on.
3. New double sided silk screened PCB's was added.
4. Header format was changed to $S, BurstIndex,2012-11-01T00:00:00Z,Temp.
5. Burst Duration Options were added (1min, 5min, 10min, 20min, 30min).
6. Sample Intervals were added (15min, 30min, 60min & 180min); e.g. if 15min is chosen, log times will be 0:00, 0:15, 0:30, 0:45. Also e.g. if 180min is chosen, log times will be 0:00, 03:00, 06:00, 09:00, et cetera.

USB Cable:

The supplied USB cable has a built in FTDI chip, a driver may be installed and can be found here: http://www.ftdichip.com/FTDrivers.htm.

After driver's installation, the cable is energized with 5V from the computer's USB port. It is therefore necessary to connect the cable to the wave logger in the correct orientation or damage will result.

A connector near the green LED should be used. It is labelled GND FTDI Tx Rx. The black wire on the USB cable must be on the "GND" side.

After installation, device manager of Windows should be checked. Under "Ports" a USB serial port with a COM number should be found. Usually the COM number is COM6. For port settings see next section.

Configuring the Unit:

The device may be configured via the supplied USB cable. Any terminal program may be used to communicate with the device (Hyper Terminal is recommended). The date and time of the unit can be checked and changed and the sampling duration may be adopted.

Method (NOTE: the sequence of the actions below is of utmost importance!!)

- Remove power to the unit.
- Plug in the USB cable to the computer.
- Start Hyper Terminal or some other terminal program.
- Select to COM port that corresponds with the FDTI USB cable.
  - **Com port settings:**
    - Baud Rate: 9600.
    - Data Bits: 8
    - Parity: None
    - Stop Bits: 1
    - Flow Control: None
- Open the port.
- Connect the USB FTDI cable to the device (take note of orientation, black= GND).
- Connect power to the unit.
- Two LED's blink alternatively.
- In the terminal window, text should appear, prompting the user to enter the "M" (capital M) key to enter the setup.
- Follow the instructions on screen to complete the setup.

Note: the sequence of the above actions is essential, any other sequence will result in non-functioning !!!!

Hyperterminal is standard included in Windows XP and earlier. In Windows7 it is no longer included. However, you may copy the Hyperterminal files from an XP computer and run them (without installation) in Windows7.

Leds

Green slow blinking:	waiting time between intervals
Green no blinking:	measuring
Green & red fast blinking:	starting to measure
Green &red blinking:	waiting for data input via hyperterminal
Green & red permanent:	measuring stopped; data are written to SD card

Red permanent only Error SD card

Data logging

The unit will log data to a file called "datalog.txt". This file is created by the unit if it does not exist. If a file is present, it will be appended to. If you would like to deploy the instrument, it is recommended that you remove the existing datalog.txt from the SD card, so that only new data will be written.

The data is only saved to the file when the SD card is closed by the microcontroller at the end of each burst period. Therefore if the green LED is still flashing and power is removed the last burst will NOT be written to the card. There is a push button to close the file at any moment. When pushing the button, all data will be saved and both LEDs go solid.

The device is setup to log once per hour, when the minute variable is 0. The user may only change the number of samples to be recorded (done the menu).

The following file format is used to store data....

Data File Structure

$S (header), burst number, Date,Time , Temp ($S, BurstIndex,2012-11-01T00:00:00Z,Temp)
This is followed by the data at a rate of 4 Hz.
$D (header), Num (burst number), Raw ADC Reading
……
……
……
$E (header), Num (burst number). End Time

Calibration

Each individual wave logger has to be calibrated in order to get the right converting of Volts to pressure. Note that each individual wave logger will have its own calibration values, which means that each wave logger has to be calibrated before (or after) measuring waves for the first time.

The relation between pressure P and Volts V_m can be described as:

$$P = A * V_m + B$$

A and B are calibration coefficients. In order to obtain these coefficients, some different values for the pressure and measured Volts should be known. This is done by measuring the pressure in constant water depth, for example in a swimming pool. It Is advised to do it at several different water depths. The pressure can be determined when the water depth is known:

$$P = \rho * g * h$$

The best method is to lower the wave logger to a certain depth and keep it at that specific depth for several minutes. After that, the wave logger should be kept at another depth for a few extra minutes and so on, for at least three different water depths, however four or five different water levels is recommended.

When the results of this measurement are plotted, either vertical (fast water depth changing) or diagonal (slow water depth changing) lines represent the lowering or brining up of the wave logger. The horizontal lines represent the time the wave logger was laying at a certain depth. The average value of this horizontal line is used as V_m for that specific depth. The pressure can be determined since the water depth, the gravity acceleration and the density are known.

When these values are known, the points are plotted in a graph with V_m on the horizontal axis and P on the vertical axis. With a calculation spread sheet computer program is possible to make a trend line of these points. This trend line gives the calibration coefficients, since it describes the relation between V_m and P as:

$$P = A * V_m + B$$

The values obtained for A and B are the calibration coefficients for that specific wave logger; these values should be used when the wave logger is used to measure wave heights.

Calibration values

For the sensors of Delft University the following calibration values have been found in 2013:

Wave Logger I: Avolt = 477.66 - Bvolt = -43812.10

Wave Logger III: Avolt = 457.45 - Bvolt = -49879.95