**VALEPORT LIMITED**

**Model 801**
**Electromagnetic Flow Meter**

**Operation Manual**



Valeport Limited
St Peters Quay,
TOTNES,
Devon, TQ9 5EW,
UK

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

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# CONTENTS

# 1. INTRODUCTION

This manual covers the operation of the Valeport Model 801 Electromagnetic Flow Meter.

# 2. EQUIPMENT

## 2.1. Standard 801 System

The standard 801 system has a choice of sensors and comprises the following. Both can be used with either 19 or 20mm diameter wading rods which customers may already have for use with impeller current meters:

0801013 Single axis, cylindrical sensor c/w 2m cable and connector

or

0801004 Single axis, flat sensor c/w 2m cable and connector
0801006 Wading Rod adaptor [only supplied for the flat sensor 0801004]
0801007 Allen Key for wading rod adaptor

0801005 Control and Display Unit

0801008 Carrying case

0801811 Operating manual

## 2.2. Wading Accessories

The following accessories are available for wading operations:

0801003 Set of 3 off 0.5 metre wading rods, graduated in centimetres, base and direction knob

0801010 Canvas shoulder bag for wading accessories

## 2.3. Options

0300012 Data cable to computer

0801011 Larger carrying case to take complete system with wading rods [instead of standard case and canvas shoulder bag]

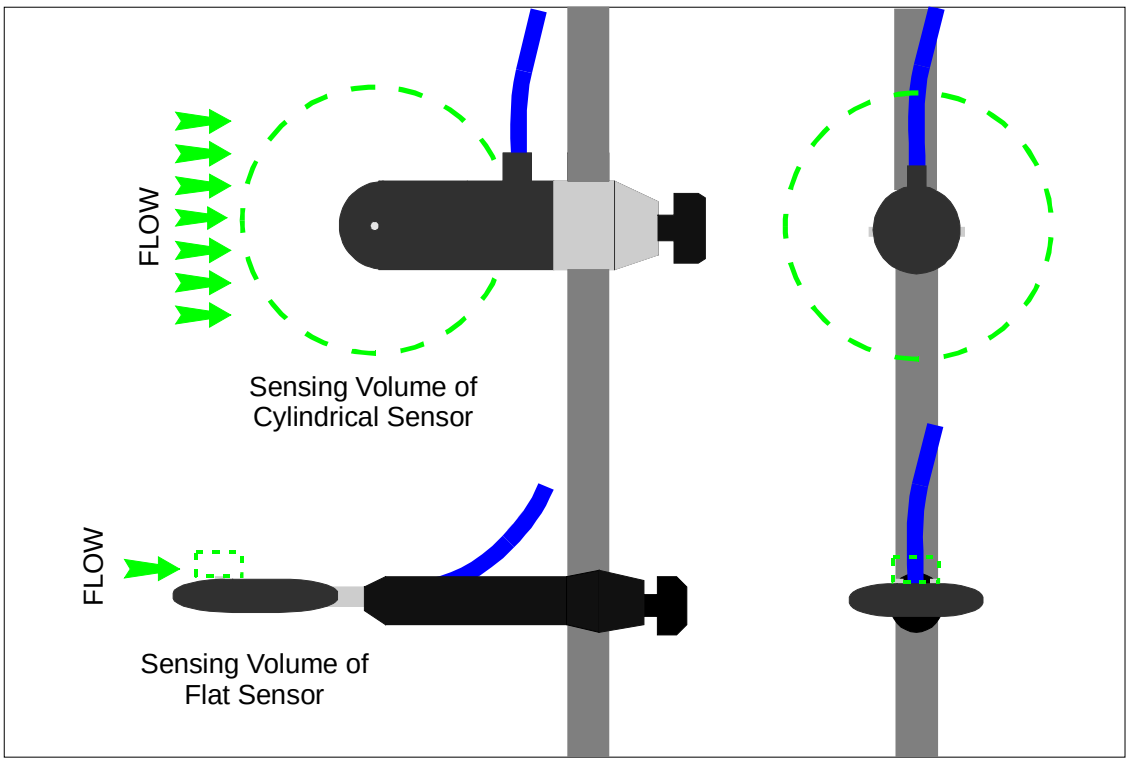
0801017 Analogue output option

## 3. DESCRIPTION

The 801 electromagnetic flow meter uses the Faraday principle to measure the flow of water past the sensor. Two different types of sensor are available for the 801: the cylindrical sensor and flat sensor.

The cylindrical sensor has its electrodes on the side and the volume of water that is being sensed is a spherical volume around the sensor to a diameter of about 120mm. Because of this relatively large sensing volume, the cylindrical sensor should not be used in situations where the water boundary [bottom, sides or surface] is closer than 40mm to the sensor.

The flat sensor has the sensing electrodes on one surface of the sensor and these should normally be facing uppermost. The volume of water whose flow is being sensed is a cylinder between the electrodes and extending to approximately 10mm above the sensor. This sensor is therefore also suited to shallow applications. Because of the small sensing volume, if the water is turbulent, the real time readings of the flat sensor will fluctuate more than those of the cylindrical sensor.




The sensor should be aligned into the flow and the calibration is determined for +ve flow [flow on to the sensor at the electrode end] with the sensor upstream of the wading rod.

The sensor will detect negative flow and the same calibration is used, although there will normally be some interference caused by the turbulence from the wading rods. The unit is set to measure speeds up to 5 M/sec in both directions.

The system is calibrated as a combination of sensor with electronics in the Control Display Unit, and the serial number of both the probe and the CDU are displayed on the display on start up.

The system will operate in any conducting fluid, and the conductivity does not effect calibration. At very low conductivities the signal will, however, become noisier. A simple check is to check the noise in still water.

The CDU has its own internal batteries, and bulkhead connectors for the data interface to PC and the sensor. There is also a waterproof pressure equalising valve, to compensate for changes in temperature and atmospheric pressure that would otherwise cause the display membrane to distort. The connectors have waterproof pro-caps for when not in use. The CDU is designed for operation in rain conditions and for temporary immersion in water to 0.3m for 10 seconds, provided all connectors or pro-caps are fitted.

The EM system measures the flow twice every second, and calculates the real time flow every second as the average of the half second readings. The REAL TIME display is updated every second. The average speeds are computed as the average of the one second real time values over the averaging period which has been set [maximum period of 600 seconds]. If an average period is terminated early, then the calculation is based on the time since the average was started.

The 2Hz data from the EM system has been digitally filtered from raw 96Hz data. The filter is a Digital FIR filter with a fixed time delay and no frequency dependent phase shift. The filter –3dB cut off is 0.61Hz, and the delay time is 4.0 seconds.

The STANDARD DEVIATION [SD] is calculated from real time samples taken during the averaging period and gives an indication of the quality of the measurements. A high standard deviation indicates either a high variability in the flow, or the probe has not been held steady during the measurement.

There are 3 types of Averaging Modes**:**

**Fixed average:**
The unit performs one average over the period set. At the end of the averaging period the unit stops and displays the average and SD. It will commence another averaging period when requested by pressing START.

**Free running:**
This is fixed average with automatic restart of averaging period at the end of each period. The average and SD from the previous period are displayed and held during the subsequent period, until updated.

**Moving average:**
The average and SD are calculated over the averaging period set, and is updated every second. When STOP is selected, the display is frozen at the last average.

If the measurement period is terminated prematurely [by pressing the STOP key], the average values and standard deviation will be calculated over the time since the start of the current averaging period.
The data [speed, SD, averaging period] is available for direct interfacing to a PC in real time [see Section 4.6.3. for interfacing information]:

In fixed average a data string of average data is outputted at the end of averaging period.
In moving average the last saved average is outputted when the user presses the STOP key.
In free running mode the data is outputted at the end of each fixed average period and also when the user presses the STOP key.

The CDU can log up to 999 averages for subsequent display and/or transfer to a PC.

The optional analogue output is +/-5volts for the speed range +/-5 M/sec, and the analogue signal is based on the latest average figure shown on the CDU. The analogue output connector also enables external DC to be applied.

# 4. SYSTEM OPERATION

## 4.1. Setting up

To prepare the system for use:

i] Clean the probe electrodes to remove any grease or dirt.

ii] Insert batteries [8 off 1.5v C type cells], if external power not being used. It is recommended that alkaline type cells are used for maximum life.

iii] Connect cables for particular combination of hardware being used.

iv] If using with probe fixed to wading rods then assemble probe into adaptor [clamping using the small grub screw] and fix to rods, base and direction knob assembly.

v] If mounting the probe by other means, it should be noted that the mounting may affect the flow characteristics and thus introduce an error into the measurement. Users can of course adjust results by carrying out their own calibration.

Once the system has been connected up, it is ready for use. For testing purposes, all of the CDU operations can be carried out without the sensor in water, but the real time data will be meaningless.

## 4.2. Switch on

**ON** Switch unit On using ON button. This is acknowledged by a beep from the unit. This key is also used to switch the unit Off at any point during operation. Switching the unit On causes the following display to appear:

```
        801 SINGLE AXIS EM FLOW METER

          VALEPORT MODEL 801 VER 2.00

     EM Ser No 17668 UNIT Ser No 17115

<<<OPTIONS SETUP                CONTINUE>>>
```

**CONTINUE** Places the unit in Run Mode. See Section 4.3.

**OPTIONS SET-UP** This key selects the OPTIONS menu, which allows the user to set up various hardware configurations [Logging On/Off, Beeper On/Off and Backlight On/Off]. This menu also allows access to the USER CALIBRATION menu, and to the LOGGING MENU. For further information refer to Section 4.5.

### 4.3. Running the unit

Pressing **CONTINUE** at the title screen, or pressing **EXIT** at any of the OPTION SET-UP screens [see Section 3.6] reveals one of the three possible displays shown below, depending on what mode the unit was in when last used [note that until START is pressed, no flow data is displayed].

**DISPLAY 1: FIXED AVERAGE**

```
      FIXED AVERAGE 801    HH:MM:SS
                                    STOP>>>
TTT       SSS  SECS
                                   SETUP>>>
 REAL   AVERAGE

 +X.XXX  +X.XXX M/SEC   SD=X.XXX   START>>>
                                  LOW BATT
```

**DISPLAY 2: MOVING AVERAGE**

```
    MOVING AVERAGE 801    HH:MM:SS
                                    STOP>>>
SSS       SSS  SECS
                                   SETUP>>>
 REAL   AVERAGE

 +X.XXX  +X.XXX M/SEC   SD=X.XXX   START>>>
```

**DISPLAY 3: FREE RUNNING**

```
       FREE RUNNING 801    HH:MM:SS
                                    STOP>>>
TTT       SSS  SECS
                                   SETUP>>>
 REAL   AVERAGE

 +X.XXX  +X.XXX M/SEC   SD=X.XXX   START>>>
```

An explanation of the different averaging modes can be found in the Description, Section 3.

**SETUP** Press this key to alter current sampling regime. See Section 4.4.

**START** After an initialisation period of about 10 seconds, during which the following display will appear, the unit will begin sampling in the mode which has been set. The real time data will be displayed at the bottom of the screen, updated every second. In Free Running and Fixed Average modes, the count down within the average period is displayed. If the unit is in logging mode, the current record number will be displayed at the top right hand side of the screen. If the data interface lead is connected, the end of average values will also be sent to the PC.

```
I N I T I A L I S I N G  E M

P L E A S E  W A I T
```

**STOP**

Press to cease sampling. This will force an early end to an averaging period at the next second.

**LOW BATT**

When there is approximately 4 hours of battery life remaining [with backlight], this message will be displayed at the bottom right hand corner of the screen [see DISPLAY 1 for an example]. The message will remain until batteries are replaced. See Section 5. for more information on power consumption and battery life.

### 4.4. Setting Units, Averaging Mode and Averaging Period

Selecting **SET-UP** in the Run Menu reveals the following display.


**M/SEC FT/SEC** — Toggles between measuring the Speed in metres and feet per second.

**FIXED MOVING FREE** — Toggles the averaging mode between the three states. Refer to Section 3 for further details.

**AVERAGING PERIOD** — The Averaging Period which has been set is displayed. If it is required to change this, then press the key to move to the “Change Sampling” page. Refer to Section 4.4.1.

**OPTIONS** — Press this key to return to the OPTIONS menu [Section 4.5.]

**ACCEPT** — When the sampling regime is correctly set up, press this key to return to the RUN menu [Section 4.3.].

### 4.4.1. Changing Averaging Period

Selecting **AVERAGING PERIOD** in the RUN SET UP screen reveals the following display:


| | |
|---|---|
| **INCR DECR** | Toggles between increasing and decreasing the number of seconds when the relevant key is pressed. |
| **100'S** | Changes the number of 100's of seconds in the averaging period. |
| **10'S** | Changes the number of 10's of seconds in the averaging period. |
| **1's** | Changes the number of 1's of seconds in the averaging period. |
| **EXIT** | Returns to the RUN MENU SETUP screen [Section 4.4]. |

Note that "000" seconds cannot be set, and the maximum is 600 seconds.

## 4.5. OPTIONS menu [Logging, Beeper, Backlight, Sub Options]

Pressing **OPTIONS SET-UP** at the Title Screen or **OPTIONS** in the Run Menu Setup screens reveals the following display.


**LOGGING YES/NO** — This key switches the logging facility On and Off. Up to 999 records may be stored.

**BEEPER ON/OFF** — Toggles audible indication [once per second] that measurements are being made.

**BACKLIGHT ON/OFF** — This key toggles it On and Off. Refer to POWER CONSUMPTION, Section 5 for details of battery life with and without backlight.

**LOGGING MENU** — Allows access to LOGGING MENU. This enables the user to view or erase stored data, to extract it to a PC [via data interface lead], and to set the unit date and time. Refer to Section 4.6.

**SUB OPTIONS** — This enables the user to go into the sub – options menu which allows direct EM communications with a PC [via data interface lead] for viewing EM data and setting of the calibration coefficients. Refer to Section 6. This sub-options menu also allows, if the options are fitted, frequency outputs and alarms to be set.

**EXIT** — Puts the unit into Run Mode, using the hardware configurations selected [see Section 4.3].

## 4.6. LOGGING menu

Selecting **LOGGING MENU** at the OPTIONS MENU reveals the following display.

```
                    L O G G I N G   M E N U
< < < S E T   D A T E / T I M E          E X T R A C T   D A T A > > >

< < < R E S E T   # I D E N T            E R A S E   M E M O R Y > > >


< < < V I E W   D A T A                                  E X I T > > >
```

**SET DATE/TIME** — Allows access to the CHANGE DATE/TIME screen. This allows the user to alter the unit's internal clock, for the purpose of correctly time stamping the recorded data. See Section 4.6.1.

**RESET #IDENT** — Sets the memory pointer to record #1 and updates the series letter. For example, a second series of records would begin with record #001B.

**VIEW DATA** — Allows user to see logged data. See Section 4.6.2.

**EXTRACT DATA** — Allows user to upload stored data to a PC. See Section 4.6.3.

**ERASE MEMORY** — Clears all stored data from the unit and resets data series identification to "A"; it does not reset #IDENT to zero which has to be done by the RESET #IDENT key, which should be done first otherwise the series B identification will be set. A screen will appear, requesting confirmation that the user wishes to erase memory. Press **YES** to continue, or **EXIT** to return to LOGGING MENU. If **YES** is pressed, a message will confirm that memory has been erased. Press **EXIT** to return to LOGGING MENU.

**EXIT** — Returns user to OPTIONS MENU. Refer to Section 4.5.

### 4.6.1. Change Date/Time

Selecting **SET DATE/TIME** at the LOGGING MENU reveals the following display.

```
                    C H A N G E   D A T E / T I M E
< < < N E X T                                   I N C R E A S E > > >

T I M E :   H H : M M                           D E C R E A S E > > >
D A T E :   D D / M M / Y Y Y Y

                                                          E X I T > > >
```

| | |
|---|---|
| **INCREASE** | Increases the currently selected number by 1. |
| **DECREASE** | Decreases the currently selected number by 1. |
| **NEXT** | Selects the next number in the time/date sequence. |
| **EXIT** | Returns user to LOGGING MENU. Refer to Section 4.6. |

### 4.6.2. Viewing stored data

Selecting **VIEW DATA** at the LOGGING MENU reveals a display similar to that shown below. If no data has been stored, the message NO DATA STORED will be displayed.

```
# I D E N T   F F F R
E M   S E R   N O . X X X X X X                          U P > > >
U N I T S   X X X X X X
R U N   M O D E   X X X X X X X X X X X X X X      D O W N > > >
D D / M M / Y Y Y Y   H H : M M : S S

< < < V I E W                                          E X I T > > >
```

The display shows the record number, serial number, units in which velocity is measured [metres or feet per second], run mode, and time at which the record was stored [i.e. the end of the averaging period].

**UP** Toggles the record to be viewed up by one.

**DOWN** Toggles the record to be viewed down by one

**VIEW** Allows user to view the record currently selected. A display of the format shown below will be seen. Press **EXIT** on this screen to return to the VIEW DATA screen, allowing another record to be seen.

**EXIT** Returns to the LOGGING MENU. Refer to Section 4.6.

```
# I D E N T   F F F R

S P E E D     + X . X X X
S D =           X . X X X

A V   P E R I O D   S E C S     S S S
                                                       E X I T > > >
```

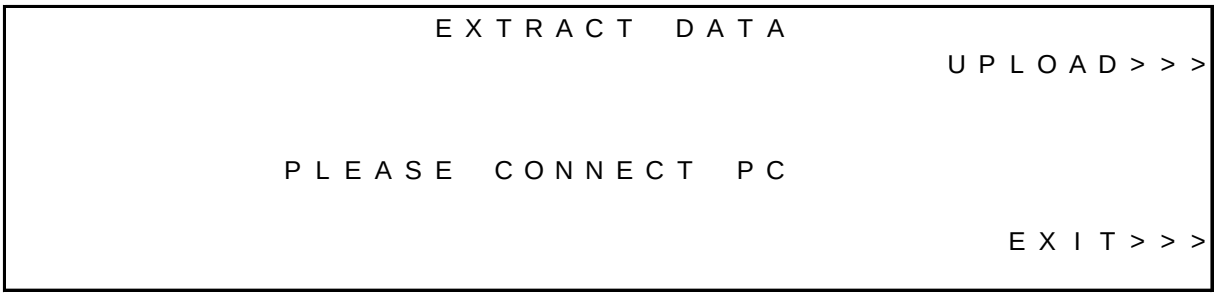
```
# I D E N T   F F F R

S P E E D     + X . X X X
S D =           X . X X X

A V   P E R I O D   S E C S     S S S
                                                       E X I T > > >
```

### 4.6.3. Extracting data

Selecting **EXTRACT DATA** at the LOGGING MENU reveals the following display.



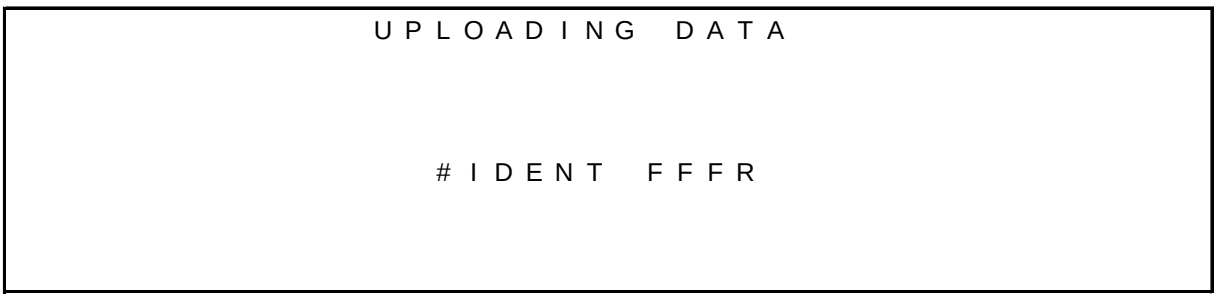

Connect the unit to a PC via the data interface lead supplied. Run a terminal emulation program on the PC, ensuring that communications are correctly set to 4800 baud, 8 data bits, 1 stop bit, no parity bits, flow control NONE. If the data is to be saved on the PC, make sure that the data is directed to a file name. It is uploaded as a text file, with "Tab" delimiters, so it can be read into a word processor or spreadsheet application.

The data lead connector information is:

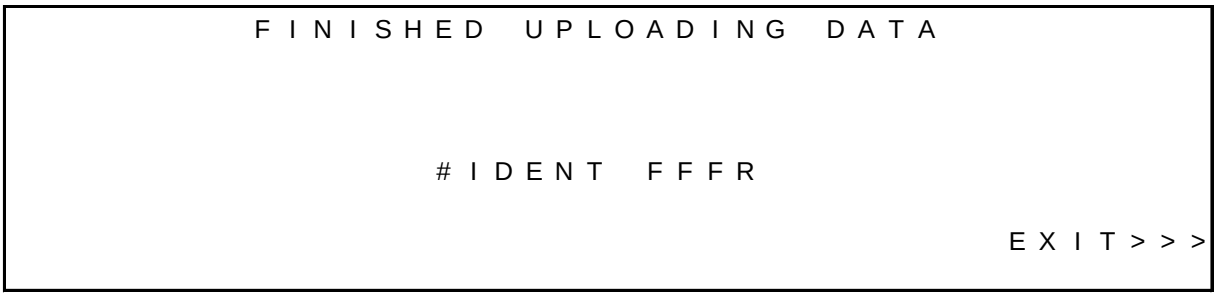
| CDU end | Function | PC end |
|---|---|---|
| 4 way in-line Male MilSpec connector [LMH06F 08 04 PN] [pins] | | 9 way "D" type female [sockets] |
| Pin A | RTS from PC [not used] | Socket 7 |
| Pin B | Tx RS232 from PC to CDU | Socket 3 |
| Pin C | Gnd | Socket 5 |
| Pin D | Rx RS232C to PC | Socket 2 |

**UPLOAD** Begins to upload data to PC. Screens similar to those shown below will appear, and during uploading the #IDENT will increment.

**EXIT** Returns to LOGGING MENU. Refer to Section 4.6.




When data uploading is finished, the following screen appears, showing the #IDENT of the last record to be uploaded.

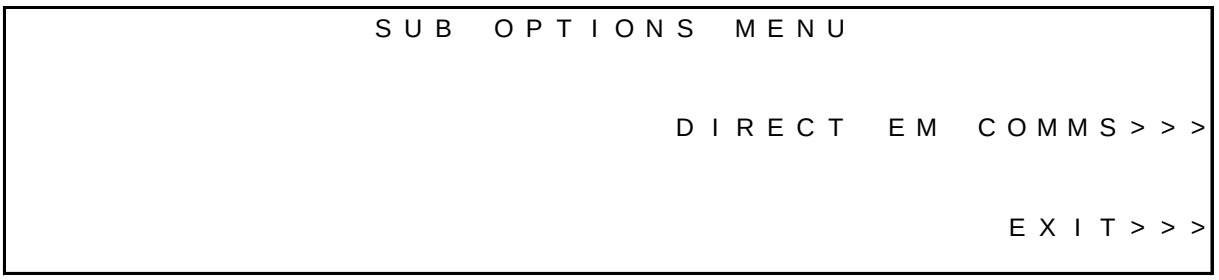



**EXIT** Returns to LOGGING MENU. Refer to Section 4.6.

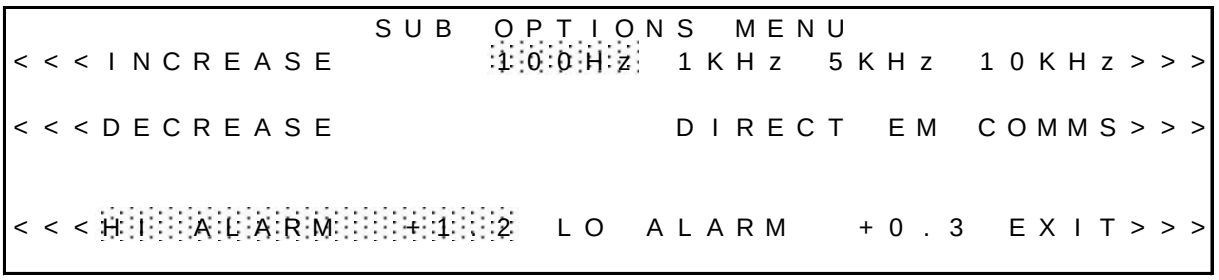
### 4.7. SUB OPTIONS Menu

Selecting **SUB OPTIONS** from the OPTIONS MENU reveals one of the following displays.

i] If Frequency or Alarm outputs not fitted




ii] If Frequency or Alarm outputs fitted [Factory option]



### 4.8. Analogue output [factory fit option]

The analogue output is factory set to provide +/- 5v for the range +/- 5 m/s. The voltage is derived from a D/A from the last updated average velocity figure. Alternatives analogue outputs are available including 4-20mA where the Control Display Unit provides the power for the 4-20mA. The wiring schedule for this is given in the second table.

The analogue output is made available from a data lead which has analogue out. A mating 6 way connector [LMH 06F 10 06 PN] is provided to enable users to terminate their own cable to this connector.

Connection details of the Y cable are:

| CDU end | Function | Analogue output |
|---|---|---|
| 6 way female MilSpec bulkhead connector LMH 07A 10 06 SN [sockets] | | 6 way male Milspec connector LMH 06F 10 06 PN [pins] |
| Pin A | Signal Ground | Socket A |
| Pin B | Signal | Socket B |
| | | |
| | | |
| | | |
| | | |
| | | |

* These two are connected together in the mating connector. This “senses” that external DC is being applied.

Connection details of the 6 way bulkhead connector for a 4-20mA output are:

| CDU end | Function | Analogue output |
|---|---|---|
| 6 way female MilSpec bulkhead connector LMH 07A 10 06 SN [sockets] | | 6 way male Milspec connector LMH 06F 10 06 PN [pins] |
| Pin A | GROUND - 4/20 Ma OUTPUT | Pin A |
| Pin B | CURRENT SINK (SIGNAL OUT) - 4/20 Ma OUTPUT | Pin B |
| Pin C | +20VDC SUPPLY - 4/20 Ma OUTPUT | Pin C |
| Pin D | RS 232 IN TO UNIT | Pin D |
| Pin E | RS 232 SIG GND | Pin E |
| Pin F | RS 232 OUT FROM UNIT | Pin F |

# 5. POWER SUPPLY

## 5.1. Changing batteries

The 8 “C” cells are housed in the battery compartment in the bottom of the CDU. Access is gained by unscrewing the central retaining screw and pulling out the end cap and pcb assembly. The cells can then be removed. When putting in new cells, be careful to ensure they are inserted the correct way. Labels are located in the compartment to indicate the correct way [note the large springs touch the -ve end on each cell, small springs the +ve end].

## 5.2. Battery Life

The current consumption of the units is as follows [all measured at 10vDC]:

| | Backlight On | Backlight Off |
|---|---|---|
| Standby | 92 mA | 33 mA |
| Run | 229 mA | 171 mA |

The battery life, based on good quality alkaline cells, operating at approximately 15 degC [note performance can reduce with low temperatures] and working on a duty cycle of 5 minutes On / 1 minute Standby is as follows:

| | Elapsed time Hours | Elapsed time Low Battery to stop Hours | Actual on time Hours | On time LB to stop Hours | % Duration to low battery |
|---|---|---|---|---|---|
| Backlight off | | | | | |
| Duration to low battery | 34.00 | 3.50 | 28.33 | 2.91 | 91% |
| Duration to stop | 37.50 | | 31.25 | | |
| Backlight on | | | | | |
| Duration to low battery | 20.50 | 7.00 | 17.08 | 5.82 | 75% |
| Duration to stop | 27.50 | | 22.92 | | |

If the unit is left in standby, and if no button has been pressed for 5 minutes, the beeper emits 5 beeps to remind the user that the unit is still switched on. This feature does not operate when the CDU is connected to a PC for communications such as downloading data.

## 5.3. External power [factory fit option]

The unit will operate on an input voltage range of 7 to 15 vDC. The optional External DC power cable has 4mm plugs [Red +ve, Black -ve]. If these are connected using the wrong polarity, an internal fuse will blow. Refer to factory for instructions for repair.

The External DC power cable connection details are:

| CDU end | Function | Free End |
|---|---|---|
| 3 way in-line Male MilSpec connector [LMH06F 08 33 SN] [sockets] | | 4mm “banana” plugs |
| Pin A | +ve | Red |
| Pin B | -ve | Black |

## 6. CALIBRATION

Selecting **DIRECT EM COMMS** at the OPTIONS MENU enables the user, using a PC in terminal mode via the optional DC data lead to read and alter the EM calibration.

Connect the unit to a PC via the data interface lead supplied. Connection details are given in Section 4.6.3. Run a terminal emulation program on the PC, ensuring that communications are correctly set to 4800 baud, 8 data bits, 1 stop bit, no parity bits, flow control NONE.

The EM calibration has 3 parts to it:

**HYDRO CAL** This is the "shape" of the calibration curve and for normal routine calibrations the same calibration is used for all units of the same type.

**SYSTEM GAIN FACTOR** The Gain Factor is specific to a combination of sensor and CDU, and is the factor by which all raw data from the electronics are multiplied to normalise the data to a standard counts per metre/sec.

**SYSTEM ZERO OFFSET** The Zero Offset is specific to a combination of sensor and CDU, and the number of counts which the unit outputs at zero flow. See section 6.1 below for details on re-setting zero offset.

Having connected up the CDU and PC and entered DIRECT EM COMMS, the unit will output EM data at a rate of 2 Hz. Calibrated data from the EM electronics is in mm/sec. To communicate to the unit and interrupt it, press and hold the "#" key on the PC. When the unit responds with a §, enter a single # and press <cr>. The unit will respond with a "□" [this may not be visible in all terminal programs if the font is not available] and then await a command. These commands are a series of "#" codes

| Code | Followed By space and | Operation |
|---|---|---|
| #007 | Output_Format<cr> | Sets the output format of the unit to CAL or NOCAL. CAL is data in calibrated units, NOCAL is raw counts and is used for calibrating purposes |
| #030 | Nothing<cr> | Reads the output format CAL or NOCAL |
| #028 | Nothing<cr> | Sets the unit into run mode. Data is outputted at the 2Hz rate. |
| #170 | Zero_offset<cr> | Sets the zero offset in counts |
| #172 | Nothing<cr> | Reads the zero offset which has been set |
| #174 | Gain_Factor<cr> | Sets the GAIN_FACTOR |
| #176 | Nothing<cr> | Reads the GAIN_FACTOR which has been set |
| #190 | Nothing<cr> | Reads the Hydro Calibration which has been set |
| #192 | Calibration<cr> | Sets the Hydro Calibration |

If the user wishes to alter the calibration from the factory setting, it is necessary to enter the calibration coefficients. The calibration coefficients are stored within the micro-controller in an ASCII text string. The format of this string depends on the type of calibration (line fit or polynomial fit). The first part of the string will be the calibration function number, selected from the table below, which defines the type of fit.

| Calibration Function No. | OPERATION |
|---|---|
| 0 | Not defined |
| 1 | One straight line fit |
| 2 | Two straight line fit |
| 3 | Three straight line fit |
| 4 | Four straight line fit |
| 5 | Five straight line fit |

The calibration takes the A/D counts, and calculates the engineering value from calibration coefficients. In all cases it is assumed that the –ve and +ve flow characteristics are the same.

Thus, for example, a three line fit calibration will be entered in the format shown below (note the single space between each value):

3 Coefficient1 Offset1 Max_lt1 Coefficient2 Offset2 Max_lt2 Coefficient3 Offset3 Max_limit3<cr>

The offset is the y axis [engineering value output] intercept at zero counts for the straight line segment
The coefficient is the slope of the straight line in engineering units per count.
The limit is the number of counts up to which the straight line is to be used [must be a positive number]

Where Max_lt is the range up to but not including, which the straight line operates over.
The first straight line starts from 0 up to Max_lt1 in A/D counts (WHOLE numbers).
The second straight line starts from Max_lt1 and including it up to Max_lt2 but not including it.
The third straight line starts from Max_lt2 and including it , up to Max_lt3 but not including it.

The last line limit [e.g. Max_lt3 in the example above] must be set to more than the maximum number of counts, and Valeport usually use the figure 40000.

## 6.1 Adjusting zero offset

In the event that the zero offset requires adjusting from the factory set calibration, this can be done by the user using the following procedure.

### 6.1.2 Determining the updated offset

#### 6.1.2.1 Method 1 - Using data displayed at zero flow

- Note the zero reading [$Z_r$] in still water in mm/sec [note the display reading is in M/sec]. Great care should be taken to ensure that the water is still.
- From the calibration sheet, note the zero offset figure [in counts] defined for the unit [$Z_{c1}$]. This figure can also be read from the unit by the **#172<cr>** command [see above].
- Calculate the new zero offset counts, $Z_{c2}$ from the equation:

$$Z_{c2} = Z_{c1} - (Z_r * (\text{Counts per mm/sec}))$$

The calibration is approximately 1mm/sec is 1 count, so the equation becomes:

$$Z_{c2} = Z_{c1} - Z_r$$

For example

Original zero offset in counts, $Z_{c1}$ = - 6.45

Zero reading in still water, $Z_r$ = - 0.005 M/sec
= - 5 mm/sec

New zero offset in counts, $Z_{c2}$ = - 6.45 – (-5)
= - 6.45 + 5
= - 1.45 counts

Note that it is important to use the correct signs

#### 6.1.2.2 Method 2 – Reading raw real time counts

- Interrupt the unit using the **#<cr>** command detailed above
- Put the EM unit into NOCAL mode [i.e. to output data in raw counts], by entering **#007** "space" **NOCAL <cr>**. Note that each time the unit is interrupted, it automatically goes back into CAL output mode, so the **#007 NOCAL<cr>** command has to be re-entered.
- The output mode can be checked by entering **#030<cr>** and the unit will respond with CAL or NOCAL as appropriate
- Make the unit go into RUN mode by entering **#028<cr>**
- The unit will output data at 2Hz, and with the sensor in still water, the counts for zero flow can be observed. Using the terminal emulation programme the data can be captured as a text file for averaging etc.

### 6.1.3 Setting the new zero offset

The new zero offset is entered by the command

**#170** "space" **zero offset<cr>**

in the example above **#170 –1.45<cr>**

and is checked by **#172**

## 7. CARE AND MAINTENANCE

While the instrument has been designed for field use, it is not indestructible and care should be taken not to damage either the sensor, cable or Control Display Unit.

In principle the calibration is for life, but as with most instruments it is advisable that check calibrations should be carried out on an annual basis.

**APPENDIX 1**

## G U A R A N T E E  C E R T I F I C A T E

**********

All goods are subject to a 36 month guarantee against faulty materials and bad workmanship. This does not apply to batteries and consumables
Any faults are 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.

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 by improper or unskilled handling of the goods or by any repair or attempted repair or dismantling by any one other than Valeport Limited or persons authorised to do so by Valeport Limited.

3] Batteries and other consumables supplied with the equipment that 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 .....

# APPENDIX 2

# EQUIPMENT SUPPLIED

| | |
|---|---|
| Serial No. ..... | Model No. ..... |
| Customer: ..... | Contract Number: ..... |
| ..... | Customer Ref:..... |
| ..... | Del. Note: ..... |
| ..... | Calibration Cert.: ..... |

| Item | | Items Required | | Quantity | Serial Number | Checked by | Date |
|---|---|---|---|---|---|---|---|
| | | Yes | No | | | | |
| Cylindrical Sensor c/w 2m cable | 0801013 | | | | | | |
| | | | | | | | |
| Flat Sensor c/w 2m cable | 0801004 | | | | | | |
| Wading rod adaptor | 0801006 | | | | - | | |
| M3 Allen key | 0801007 | | | | - | | |
| | | | | | | | |
| Control Display Unit | 0801005 | | | | | | |
| Analogue output option | 0801817 | | | | | | |
| Operating manual | 0801811 | | | | - | | |
| TERM.EXE disc | | | | | - | | |
| Carrying case - standard | 0801008 | | | | - | | |
| AC/DC Adaptor c/w connector. | | | | | | | |
| Computer interface lead | 0300012 | | | | - | | |
| External DC power cable | 0300013 | | | | - | | |
| Analogue output cable and connector | | | | | | | |
| 0.5m Wading rod | 0010-005 | | | | - | | |
| Wading rod base | 0010-007 | | | | - | | |
| Wading rod stub shaft | 0010-007A | | | | | | |
| Wading rod direction knob | 0010-008 | | | | - | | |
| Canvas bag for wading accessories | 0801010 | | | | - | | |
| | | | | | | | |
| Transit case - large | 0801011 | | | | - | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

# APPENDIX 3

# CALIBRATION INFORMATION

The following sheet provides the calibration information for the instrument. Calibrations are carried out in Valeport's Tow tank at speeds up to about 1.1 M/sec and extrapolation is used to 5 M/sec. Specific calibrations can be carried to 5 M/sec at HR Wallingford.