

## Appendix C: Utility to Convert FlowQuest Binary File to an ASCII File

### Conversion Tool A

The output ASCII file will contain all the ensemble data as in the binary file. Each ensemble has several data sections, and their format will be discussed in detail. Below is an example of the ensemble data file:

```
$#FQ.ENS CRC_OK
2 Thu May 25 10:18:26 2006 20.9 22.3 5 0 0xFF 36 44 61 71 79 87 91 101 14 -383 -
312 -293 -301 5 5 1 21 0 560 0 0 1 75
E0 6 -4.34 0.04 -15.68 0.04 58.40 0.00
E1 15 -4.28 -15.71 58.30 -4.33 -15.62 58.30 -4.40 -15.73 58.40 -4.32 -15.64 58.40 -
4.39 -15.70 58.40
E2 8 191.53 -4665 -4669 -4673 0 -930 -4667
E3 6 6932 -5108 -475 13490 -253 -1426
E4 6 7986 3224 -475 7297 11347 -1426
E5 2 5 3
E6 8 -33.50 -47.50 -77.75 -78.00 -73.50 -85.75 -75.25 -75.25
E7 8 84.50 70.50 22.50 22.25 22.00 9.75 22.25 22.25
```

The ensemble contains nine sections at most depending on the configuration:

- The ensemble header starting with \$#FQ.ENS;
- The roll/pitch/heading average and standard deviation starting with E0;
- The roll pitch heading for each ping starting with E1;
- The radial velocity in mm/s starting with E2;
- The velocity in instrument coordinates in mm/s starting with E3;
- The velocity in earth coordinates in mm/s starting with E4;
- The percentage good starting with E5;
- The signal strength in dBm starting with E6;
- The SNR in dB starting with E7;
- The pressure in PSI starting with E8;

#### 1. Ensemble Header

Ensemble data (binary raw data format) is in the following structure:

**<\$#FQ.ENS> <Ens\_header 32 words> <Data> <CRC> <CR/LF>**

The converted ensemble header structure is:

Header CRC(interpreted result, OK/WRONG)

Word 1: ensemble number

Word 2-3: timestamp (interpreted string)

Word 4: temperature in degrees (celcius)

Word 5: battery voltage in volts

Word 6: number of pings in the ensemble

Word 7: one reserved  
 Word 8: ensemble\_output\_switch with the following format:  
 bit0=1: rph for average rph and standard deviation (ID='E0')  
 bit1=1: rph for each ping (ID='E1')  
 bit2=1: radial velocity (ID='E2')  
 bit3=1: HV velocity (ID='E3')  
 bit4=1: NAV velocity (ID='E4')  
 bit5=1: percentage good (ID='E5')  
 bit6=1: signal strength (ID='E6')  
 bit7=1: SNR (ID='E7')  
 bit8=1: Pressure (ID='E8')  
 bit8-bit15: reserved  
 Word 9-16: eight reserved  
 Word 17: bin length in meter  
 Word 18-25: eight reserved  
 Word 26: transducer depth in meter  
 Word 27: blank distance in cm  
 Word 28: error code, 0 indicates no error and non-zero indicates error in the ensemble.  
 Word 29: rph abnormal, indicates the number of pings with abnormal roll, pitch and these pings are discarded in the ensemble.  
 Word 30: flag\_forward, the flag to control if the ensemble results to be output or not.  
 Word 31-32: data length in word, which does not include the crc and the concluding CR/LF.

## 2. Roll Pitch Heading

The format is:

<'E0'> <length> <mr><std\_r><mp> <std\_p>, <mh>, <std\_h>

mr, mp, mh: the average roll, pitch, heading in degrees respectively

std\_r, std\_p, std\_h: the standard deviation of roll, pitch heading in degrees respectively.

## 3. Roll Pitch Heading for Each Ping

The format is:

<'E1'> <3\*ping\_num> <r0,p0,h0> <r1, p1, h1>.....

The roll pitch heading for each ping, and the unit is degree.

## 4. Radial Velocity

The format is:

<'E2'> <4\*num\_bin> <vrad array for ch0> <vrad array for ch1> <vrad array for ch2> <vrad array for ch3>

radial velocity unit is mm/s.

## 5. Velocity in Instrument Coordinate

The format is:

<'E3'> <3\*num\_bin> <Vx, Vy, Vz for bin0> <vx Vx, Vy, Vz for bin1>....

Vx: the velocity along x, (3->1 direction, please refer to the manual)  
 Vy: the velocity along y, (4->2 direction, please refer to the manual)  
 Vz: the vertical direction following the right-hand rule.  
 All velocity is in mm/s.

## 6. Velocity in Earth Coordinate

The format is:

<'E4'> <3\*num\_bin> < Vx, Vy, Vz for bin0> < Vx, Vy, Vz for bin1>....

Vx: the velocity along north in mm/s;

Vy: the velocity along east in mm/s;

Vz: the velocity along down in mm/s;

## 7. Percentage Good

The format is:

<'E5'><num\_bin><good\_ping for bin0>< good\_ping for bin1>.....

It indicates number of good ping along each bin;

## 8. Signal Strength in dBm

The format is:

<'E6'><4\*num\_bin><sig\_str array for ch0> <sig\_str array for ch1> <sig\_str array for ch2> <sig\_str array for ch3>

## 9. SNR in dB

The format is:

<'E7'> <4\*num\_bin> <snr array for ch0> <snr array for ch1> <snr array for ch2> <snr array for ch3>

## 10. Pressure in PSI

<'E8'><4><Pressure in PSI>

## Conversion Tool B

This utility reads a binary ensemble data file and extracts all the velocity in earth coordinate into an ASCII file, either in Cartesian Coordinate or Cylinder Coordinate.

### 1. Output in Cartesian Coordinate

The ASCII file contains multiple ensembles. Each ensemble is in a fixed format. An example is shown below:

```
126 05 07 38 05 14 2007 19.1 16.3 256 98 15 70 0 0 15
13.81 -49 -50 10
12.83 -82 -76 0
11.85 -116 -79 0
10.87 -124 -86 0
9.89 -113 -57 0
8.91 -87 -48 0
7.93 -66 -34 -1
```

6.95	-84	-17	5
5.97	-118	-39	12
4.99	-124	-50	11
4.01	-102	-29	5
3.03	-125	127	4
2.05	-204	281	-8
1.07	-188	181	-14
0.09	-94	0	-10

The structure of the data is:

One line of ensemble information;

Depth,  $V_{\text{north}}$ ,  $V_{\text{east}}$ ,  $V_{\text{down}}$  for each cell, one cell per line;

Depth is in meters. It is along the gravity direction. Negative means above the water surface.

$V_{\text{north}}$ ,  $V_{\text{east}}$ ,  $V_{\text{down}}$  are all in mm/s.

The ensemble information lines are:

1: Ensemble number

2-7: Hour, minute, second, month, day, year

8: Temperature

9: Voltage

10: Number of pings

11: Bin length in cm

12: Transducer depth in meter

13: Blank distance in cm

14: Error code

15: Rph abnormal

16: Number of velocity bins followed.

## 2. Output in Cylinder Coordinate

The ASCII file contains multiple ensembles. Each ensemble is in a fixed format. An example is shown below:

13.81	70.0	225.6	10
12.83	111.8	222.8	0
11.85	140.3	214.3	0
10.87	150.9	214.7	0
9.89	126.6	206.8	0
8.91	99.4	208.9	0
7.93	74.2	207.3	-1
6.95	85.7	191.4	5
5.97	124.3	198.3	12
4.99	133.7	202.0	11
4.01	106.0	195.9	5

3.03	178.2	134.5	4
2.05	347.2	126.0	-8
1.07	261.0	136.1	-14
0.09	94.0	180.0	-10

The structure of the data is:

One line of ensemble information which is the same as in Section 1.

Depth,  $V_{xy}$ ,  $\theta$ ,  $V_{down}$  for each cell, one cell per line.

Depth is in meters. It is along the gravity direction. Negative means above the water surface.

$V_{xy}$ ,  $V_{down}$  are all in mm/s.

$\theta$  is the velocity direction angle in the horizontal plane, in degrees. Its range is from 0 to 360 degrees, where the north is 0, east is 90, south 180 and west 270 degrees.