

## 9 Telemetry Data Formats

This section describes the Telemetry Data formats. For more information about the telemetry functionality in general, refer to the [Telemetry](#) chapter. Note that all averaged telemetry current data undergo an internal quality control as described in the [Telemetry Quality Control](#) chapter.

The checksum calculation is part of the NMEA standard. It is the representation of two hexadecimal characters of an XOR if all characters in the sentence between – but not including – the \$ and the \* character.

### 9.1 Averaging Mode

The telemetry of the AVG mode is controlled by the **SET/GETTMAVG** command. The DF parameter of this command sets the data format.

| Data format (DF) | Description   |
|------------------|---|
| 3                | Binary format as described in the <a href="#">binary data formats chapter</a> .   |
| 100              | Same NMEA format as previous generations of Aquadopp/AWAC. Note that Signatures produce extra columns for the fourth beam.<br>(NMEA sentences: PNORI, PNORS and PNORC). |
| 101              | NMEA format 1 (without tags).<br>(NMEA sentences: PNORI1, PNORS1 and PNORC1).   |
| 102              | NMEA format 2 (with tags).<br>(NMEA sentences: PNORI2, PNORS2 and PNORC2).  |
| 103              | NMEA format 3 (with tags).<br>(NMEA sentences: PNORH3, PNORS3 and PNORC3).  |
| 104              | NMEA format 4 (without tags).<br>(NMEA sentences: PNORH4, PNORS4 and PNORC4).   |
| 150              | RDI Workhorse PD0 data format. Refer to RDI for documentation.  |

### 9.1.1 NMEA Format (DF=100)

Information (configuration): \$PNORI

| Column | Description       | Data format   | Example                 |
|--------|-------------------|---|-------------------------|
| 0      | Identifier        | "\$PNORI"   |                         |
| 1      | Instrument type   | N<br>0=Aquadopp<br>2=Aquadopp Profiler<br>4=Signature | 4                       |
| 2      | Head ID           | String  | Signature10009<br>00001 |
| 3      | Number of beams   | N   | 4                       |
| 4      | Number of cells   | N   | 20                      |
| 5      | Blanking (m)      | dd.dd   | 0.20                    |
| 6      | Cell size (m)     | dd.dd   | 1.00                    |
| 7      | Coordinate system | N<br>0=ENU<br>1=XYZ<br>2=BEAM                         | 0                       |
| 8      | Checksum          | *hh   | 2E                      |

Example (DF=100): \$PNORI,4,Signature1000900001,4,20,0.20,1.00,0\*2E

Sensor data: \$PNORS

| Column | Description         | Data format | Example  |
|--------|---------------------|-------------|----------|
| 0      | Identifier          | "\$PNORS"   |          |
| 1      | Date                | MMDDYY      | 102115   |
| 2      | Time                | HHMMSS      | 090715   |
| 3      | Error Code (hex)    | hh          | 00000000 |
| 4      | Status Code (hex)   | hh          | 2A480000 |
| 5      | Battery Voltage     | dd.d        | 14.4     |
| 6      | Sound Speed         | dddd.d      | 1523.0   |
| 7      | Heading             | ddd.d       | 275.9    |
| 8      | Pitch (deg)         | dd.d        | 15.7     |
| 9      | Roll (deg)          | dd.d        | -2.3     |
| 10     | Pressure (dBar)     | ddd.ddd     | 0.000    |
| 11     | Temperature (deg C) | dd.dd       | 22.45    |

|    |                 |     |    |
|----|-----------------|-----|----|
| 12 | Analog input #1 | n/a | 0  |
| 13 | Analog input #2 | n/a | 0  |
| 14 | Checksum        | *hh | 1C |

**Example (DF=100):**

\$PNORS,102115,090715,00000000,2A480000,14.4,1523.0,275.9,15.7,2.3,0.000,22.45,0,0\*1C

**Current velocity data: \$PNORC**

| Column | Description  | Data format | Example |
|--------|--|-------------|---------|
| 0      | Identifier   | "\$PNORC"   |         |
| 1      | Date   | MMDDYY      | 102115  |
| 2      | Time   | HHMMSS      | 090715  |
| 3      | Cell number  | N           | 4       |
| 4      | Velocity 1 (m/s) (Beam1/X/East)  | dd.dd       | 0.56    |
| 5      | Velocity 2 (m/s) (Beam2/Y/North)   | dd.dd       | -0.80   |
| 6      | Velocity 3 (m/s) (Beam3/Z1/Up1)  | dd.dd       | -1.99   |
| 7      | Velocity 4 (m/s) (Beam4/Z2/Up2) - not relevant for three beam systems, will be empty | dd.dd       | -1.33   |
| 8      | Speed (m/s)  | dd.dd       | 0.98    |
| 9      | Direction (deg)  | ddd.d       | 305.2   |
| 10     | Amplitude unit   | C=Counts    | C       |
| 11     | Amplitude (Beam 1)   | N           | 80      |
| 12     | Amplitude (Beam 2)   | N           | 88      |
| 13     | Amplitude (Beam 3)   | N           | 67      |
| 14     | Amplitude (Beam 4) - not relevant for three beam systems, will be empty              | N           | 78      |
| 15     | Correlation (%) (Beam1)  | N           | 13      |
| 16     | Correlation (%) (Beam2)  | N           | 17      |
| 17     | Correlation (%) (Beam3)  | N           | 10      |
| 18     | Correlation (%) (Beam4) - not relevant for three beam systems, will be empty         | N           | 18      |
| 19     | Checksum   | *hh         | 22      |

**Example (DF=100):** \$PNORC,102115,090715,4,0.56,-0.80,-1.99,-1.33,0.98,305.2,C,80,88,67,78,13,17,10,18\*22

### 9.1.2 NMEA Format 1 and 2 (DF=101/102)

#### Information Data:

Identifier:

PNORI1 for DF = 101 (without tags)

PNORI2 for DF = 102 (with tags)

| Column | Description                      | Unit | TAG | Data format   | Example   |
|--------|----------------------------------|------|-----|---|-----------|
| 1      | Instrument type                  |      | IT  | N<br>0=Aquadopp<br>2=Aquadopp Profiler<br>4=Signature | IT=4      |
| 2      | Head ID                          |      | SN  | N   | SN=123456 |
| 3      | Number of Beams                  |      | NB  | N   | NB=4      |
| 4      | Number of Cells                  |      | NC  | N   | NC=30     |
| 5      | Blanking Distance                | [m]  | BD  | dd.dd   | BD=1.00   |
| 6      | Cell Size                        | [m]  | CS  | dd.dd   | CS=5.00   |
| 7      | Coordinate System (ENU,BEAM,XYZ) |      | CY  | N   | CY=BEAM   |

#### Example (DF=101):

\$PNORI1,4,123456,4,30,1.00,5.00,BEAM\*5B

#### Example (DF=102):

\$PNORI2,IT=4,SN=123456,NB=4,NC=30,BD=1.00,CS=5.00,CY=BEAM\*68

#### Sensors Data:

Identifier:

PNORS1 for DF = 101 (without tags)

PNORS2 for DF = 102 (with tags)

| Column | Description      | Unit  | TAG  | Data format | Example     |
|--------|------------------|-------|------|-------------|-------------|
| 1      | Date             |       | DATE | MMDDYY      | DATE=083013 |
| 2      | Time             |       | TIME | HHMMSS      | TIME=132455 |
| 3      | Error Code       |       | EC   | N           | EC=0        |
| 4      | Status Code      |       | SC   | hhhhhhhh    | SC=34000034 |
| 5      | Battery Voltage  | [V]   | BV   | dd.d        | BV=22.9     |
| 6      | Sound Speed      | [m/s] | SS   | dddd.d      | SS=1500.0   |
| 7      | Heading Std.Dev. | [deg] | HSD  | dd.dd       | HSD=0.02    |
| 8      | Heading          | [deg] | H    | ddd.d       | H=123.4     |

|    |                 |         |      |         |           |
|----|-----------------|---------|------|---------|-----------|
| 9  | Pitch           | [deg]   | PI   | dd.d    | PI=45.6   |
| 10 | Pitch Std.Dev   | [deg]   | PISD | dd.dd   | PISD=0.02 |
| 11 | Roll            | [deg]   | R    | dd.d    | R=23.4    |
| 12 | Roll Std.Dev.   | [deg]   | RSD  | dd.dd   | RSD=0.02  |
| 13 | Pressure        | [dBar]  | P    | ddd.ddd | P=123.456 |
| 14 | Pressure StdDev | [dBar]  | PSD  | dd.dd   | PSD=0.02  |
| 15 | Temperature     | [deg C] | T    | dd.dd   | T=24.56   |

**Example (DF=101):**

\$PNORS1,083013,132455,0,34000034,22.9,1500.0,0.02,123.4,45.6,0.02,R=23.4,0.02,123.456,0.02,24.56\*39

**Example (DF=102):**

\$PNORS2,DATE=083013,TIME=132455,EC=0,SC=34000034,BV=22.9,SS=1500.0,HSD=0.02,H=123.4,PI=45.6,PISD=0.02,R=23.4,RSD=0.02,P=123.456,PSD=0.02,T=24.56\*3F

**Averaged Data:**

Identifier:

PNORC1 for DF = 101 (without tags)

PNORC2 for DF = 102 (with tags)

The averaged data is repeated for each measurement cell.

| Column | Description                                | Unit  | TAG  | Data format | Example     |
|--------|--|-------|------|-------------|-------------|
| 1      | Date                                       |       | DATE | MMDDYY      | DATE=083013 |
| 2      | Time                                       |       | TIME | HHMMSS      | TIME=132455 |
| 3      | Cell Number                                |       | CN   | N           | CN=3        |
| 4      | Cell Position                              | [m]   | CP   | dd.d        | CP=11.0     |
| 5      | Velocity East - only included if CY=ENU    | [m/s] | VE   | dd.ddd      | VE=0.332    |
| 6      | Velocity North - only included if CY=ENU   | [m/s] | VN   | dd.ddd      | VN=0.332    |
| 7      | Velocity Up - only included if CY=ENU      | [m/s] | VU   | dd.ddd      | VU=0.332    |
| 8      | Velocity Up 2 - only included if CY=ENU    | [m/s] | VU2  | dd.ddd0     | VU2=0.332   |
| 9      | Velocity X - only included if CY = XYZ     | [m/s] | VX   | dd.ddd      | VX=0.332    |
| 10     | Velocity Y - only included if CY = XYZ     | [m/s] | VY   | dd.ddd      | VY=0.332    |
| 11     | Velocity Z - only included if CY = XYZ     | [m/s] | VZ   | dd.ddd      | VZ=0.332    |
| 12     | Velocity Z 2 - only included if CY=XYZ     | [m/s] | VZ2  | dd.ddd      | VZ2=0.332   |
| 13     | Velocity Beam 1 - only included if CY=BEAM | [m/s] | V1   | dd.ddd      | V1=0.332    |

| Column | Description                                | Unit  | TAG | Data format | Example  |
|--------|--|-------|-----|-------------|----------|
| 14     | Velocity Beam 2 - only included if CY=BEAM | [m/s] | V2  | ddddd       | V2=0.332 |
| 15     | Velocity Beam 3 - only included if CY=BEAM | [m/s] | V3  | ddddd       | V3=0.332 |
| 16     | Velocity Beam 4 - only included if CY=BEAM | [m/s] | V4  | ddddd       | V4=0.332 |
| 17     | Amplitude Beam 1                           | [dB]  | A1  | ddd.d       | A1=78.9  |
| 18     | Amplitude Beam 2                           | [dB]  | A2  | ddd.d       | A2=78.9  |
| 19     | Amplitude Beam 3                           | [dB]  | A3  | ddd.d       | A3=78.9  |
| 20     | Amplitude Beam 4                           | [dB]  | A4  | ddd.d       | A4=78.9  |
| 21     | Correlation Beam 1                         | [%]   | C1  | N           | C1=78    |
| 22     | Correlation Beam 2                         | [%]   | C2  | N           | C2=78    |
| 23     | Correlation Beam 3                         | [%]   | C3  | N           | C3=78    |
| 24     | Correlation Beam 4                         | [%]   | C4  | N           | C4=78    |

**Example (DF=101, CY=ENU):**

\$PNORC1,083013,132455,3,11.0,0.332,0.332,0.332,0.332,78.9,78.9,78.9,78.9,78.9,78.9,78.9,78.9,78.9,78.9\*46

**Example (DF=102, CY=ENU):**

\$PNORC2,DATE=083013,TIME=132455,CN=3,CP=11.0,V1=0.332,V2=0.332,V3=-0.332,V4=-0.332,A1=78.9,A2=78.9,A3=78.9,A4=78.9,C1=78,C2=78,C3=78,C4=78\*49

**9.1.3 NMEA Format 3 and 4 (DF=103/104)****Header Data:**

Identifier:

PNORH3 for DF = 103 (with tags)

PNORH4 for DF = 104 (without tags)

| Column | Description | Unit | TAG  | Data format | Example       |
|--------|-------------|------|------|-------------|---------------|
| 1      | Date        |      | DATE | YYMMDD      | DATE=141112   |
| 2      | Time        |      | TIME | HHMMSS      | TIME=081946   |
| 3      | Error Code  |      | EC   | N           | EC=0          |
| 4      | Status Code |      | SC   | hhhhhhh     | SC=2A4C000000 |

**Example (DF=103):**

\$PNORH3,DATE=141112,TIME=081946,EC=0,SC=2A4C0000\*5F

**Example (DF=104):**

\$PNORH4,141112,083149,0,2A4C0000\*4A68

### Sensors Data:

Identifier:

PNORS3 for DF = 103 (with tags)

PNORS4 for DF = 104 (without tags)

| Column | Description | Unit    | TAG | Data format | Example   |
|--------|-------------|---------|-----|-------------|-----------|
| 1      | Battery     | [V]     | BV  | dd.d        | BV=22.9   |
| 2      | Sound Speed | [m/s]   | SS  | ddd.d       | SS=1500.0 |
| 3      | Heading     | [deg]   | H   | ddd.d       | H=123.4   |
| 4      | Pitch       | [deg]   | PI  | dd.d        | PI=45.6   |
| 5      | Roll        | [deg]   | R   | dd.d        | R=23.4    |
| 6      | Pressure    | [dBar]  | P   | ddd.ddd     | P=123.456 |
| 7      | Temperature | [deg C] | T   | dd.dd       | T=24.56   |

### Example (DF=103):

\$PNORS3,BV=22.9,SS=1546.1,H=151.1,PI=-12.0,R=-5.2,P=705.669,T=24.96\*7A

### Example (DF=104):

\$PNORS4,22.9,1546.1,151.2,-11.9,-5.3,705.658,24.95\*5A

### Averaged Data:

Identifier:

PNORC3 for DF = 103 (with tags)

PNORC4 for DF = 104 (without tags)

The averaged data is repeated for each measurement cell.

| Column | Description          | Unit  | TAG | Data format | Example   |
|--------|----------------------|-------|-----|-------------|-----------|
| 1      | Cell position        | [m]   | CP  | dd.d        | CP=2.5    |
| 2      | Speed                | [m/s] | SP  | dd.ddd      | SP=0.751  |
| 3      | Direction            | [deg] | DIR | ddd.d       | DIR=170.1 |
| 4      | Averaged Correlation |       | AC  | N           | AC=5      |
| 5      | Averaged Amplitude   |       | AA  | N           | AA=28     |

### Example (DF=103):

\$PNORC3,CP=4.5,SP=3.519,DIR=110.9,AC=6,AA=28\*3B

### Example (DF=104):

\$PNORC4,27.5,1.815,322.6,4,28\*70

## 9.2 Burst

The telemetry of the BURST mode is controlled by the **SET/GETTMBURST** command. The DF parameter of this command sets the data format.

| Data format (DF) | Description   |
|------------------|---|
| 3                | Binary format as described in 'Data Record Definition (version 3)'.           |
| 101              | NMEA format 1 (without tags).<br>(NMEA sentences: PNORI1, PNORS1 and PNORC1). |
| 102              | NMEA format 2 (with tags).<br>(NMEA sentences: PNORI2, PNORS2 and PNORC2).    |
| 103              | NMEA format 3 (with tags).<br>(NMEA sentences: PNORH3, PNORS3 and PNORC3).    |
| 104              | NMEA format 4 (without tags).<br>(NMEA sentences: PNORH4, PNORS4 and PNORC4). |

### 9.2.1 NMEA Format 1 and 2 (DF=101/102)

#### Information Data:

Identifier:

PNORI1 for DF = 101 (without tags)

PNORI2 for DF = 102 (with tags)

| Column | Description                      | Unit | TAG | Data format   | Example   |
|--------|----------------------------------|------|-----|---|-----------|
| 1      | Instrument type                  |      | IT  | N<br>0=Aquadopp<br>2=Aquadopp Profiler<br>4=Signature | IT=4      |
| 2      | Head ID                          |      | SN  | N   | SN=123456 |
| 3      | Number of Beams                  |      | NB  | N   | NB=4      |
| 4      | Number of Cells                  |      | NC  | N   | NC=30     |
| 5      | Blanking Distance                | [m]  | BD  | dd.dd   | BD=1.00   |
| 6      | Cell Size                        | [m]  | CS  | dd.dd   | CS=5.00   |
| 7      | Coordinate System (ENU,BEAM,XYZ) |      | CY  | N   | CY=BEAM   |

#### Example (DF=101):

\$PNORI1,4,123456,4,30,1.00,5.00,BEAM\*5B

#### Example (DF=102):

\$PNORI2,IT=4,SN=123456,NB=4,NC=30,BD=1.00,CS=5.00,CY=BEAM\*68

#### Sensors Data:

Identifier:

PNORS1 for DF = 101 (without tags)

PNORS2 for DF = 102 (with tags)

| Column | Description      | Unit    | TAG  | Data format | Example     |
|--------|------------------|---------|------|-------------|-------------|
| 1      | Date             |         | DATE | MMDDYY      | DATE=083013 |
| 2      | Time             |         | TIME | HHMMSS      | TIME=132455 |
| 3      | Error Code       |         | EC   | N           | EC=0        |
| 4      | Status Code      |         | SC   | hhhhhhh     | SC=34000034 |
| 5      | Battery Voltage  | [V]     | BV   | dd.d        | BV=22.9     |
| 6      | Sound Speed      | [m/s]   | SS   | dddd.d      | SS=1500.0   |
| 7      | Heading Std.Dev. | [deg]   | HSD  | dd.dd       | HSD=0.02    |
| 8      | Heading          | [deg]   | H    | ddd.d       | H=123.4     |
| 9      | Pitch            | [deg]   | PI   | dd.d        | PI=45.6     |
| 10     | Pitch Std.Dev.   | [deg]   | PISD | dd.dd       | PISD=0.02   |
| 11     | Roll             | [deg]   | R    | dd.d        | R=23.4      |
| 12     | Roll Std.Dev.    | [deg]   | RSD  | dd.dd       | RSD=0.02    |
| 13     | Pressure         | [dBar]  | P    | ddd.ddd     | P=123.456   |
| 14     | Pressure StdDev  | [dBar]  | PSD  | dd.dd       | PSD=0.02    |
| 15     | Temperature      | [deg C] | T    | dd.dd       | T=24.56     |

**Example (DF=101):**

\$PNORS1,083013,132455,0,34000034,22.9,1500.0,0.02,123.4,45.6,0.02,R=23.4,0.02,123.456,0.02,24.56\*39

**Example (DF=102):**

\$PNORS2,DATE=083013,TIME=132455,EC=0,SC=34000034,BV=22.9,SS=1500.0,HSD=0.02,H=123.4,PI=45.6,PISD=0.02,R=23.4,RSD=0.02,P=123.456,PSD=0.02,T=24.56\*3F

**Averaged Data:**

Identifier:

PNORC1 for DF = 101 (without tags)

PNORC2 for DF = 102 (with tags)

The averaged data is repeated for each measurement cell.

| Column | Description | Unit | TAG  | Data format | Example     |
|--------|-------------|------|------|-------------|-------------|
| 1      | Date        |      | DATE | MMDDYY      | DATE=083013 |
| 2      | Time        |      | TIME | HHMMSS      | TIME=132455 |
| 3      | Cell Number |      | CN   | N           | CN=3        |

| Column | Description                                | Unit  | TAG | Data format | Example   |
|--------|--|-------|-----|-------------|-----------|
| 4      | Cell Position                              | [m]   | CP  | dd.d        | CP=11.0   |
| 5      | Velocity East - only included if CY=ENU    | [m/s] | VE  | dd.ddd      | VE=0.332  |
| 6      | Velocity North - only included if CY=ENU   | [m/s] | VN  | dd.ddd      | VN=0.332  |
| 7      | Velocity Up - only included if CY=ENU      | [m/s] | VU  | dd.ddd      | VU=0.332  |
| 8      | Velocity Up 2 - only included if CY=ENU    | [m/s] | VU2 | dd.ddd0     | VU2=0.332 |
| 9      | Velocity X - only included if CY = XYZ     | [m/s] | VX  | dd.ddd      | VX=0.332  |
| 10     | Velocity Y - only included if CY = XYZ     | [m/s] | VY  | dd.ddd      | VY=0.332  |
| 11     | Velocity Z - only included if CY = XYZ     | [m/s] | VZ  | dd.ddd      | VZ=0.332  |
| 12     | Velocity Z 2 - only included if CY=XYZ     | [m/s] | VZ2 | dd.ddd      | VZ2=0.332 |
| 13     | Velocity Beam 1 - only included if CY=BEAM | [m/s] | V1  | dd.ddd      | V1=0.332  |
| 14     | Velocity Beam 2 - only included if CY=BEAM | [m/s] | V2  | dd.ddd      | V2=0.332  |
| 15     | Velocity Beam 3 - only included if CY=BEAM | [m/s] | V3  | dd.ddd      | V3=0.332  |
| 16     | Velocity Beam 4 - only included if CY=BEAM | [m/s] | V4  | dd.ddd      | V4=0.332  |
| 17     | Amplitude Beam 1                           | [dB]  | A1  | ddd.d       | A1=78.9   |
| 18     | Amplitude Beam 2                           | [dB]  | A2  | ddd.d       | A2=78.9   |
| 19     | Amplitude Beam 3                           | [dB]  | A3  | ddd.d       | A3=78.9   |
| 20     | Amplitude Beam 4                           | [dB]  | A4  | ddd.d       | A4=78.9   |
| 21     | Correlation Beam 1                         | [%]   | C1  | N           | C1=78     |
| 22     | Correlation Beam 2                         | [%]   | C2  | N           | C2=78     |
| 23     | Correlation Beam 3                         | [%]   | C3  | N           | C3=78     |
| 24     | Correlation Beam 4                         | [%]   | C4  | N           | C4=78     |

**Example (DF=101, CY=ENU):**

\$PNORC1,083013,132455,3,11.0,0.332,0.332,0.332,78.9,78.9,78.9,78.9,78,78,78\*46

**Example (DF=102, CY=ENU):**

\$PNORC2,DATE=083013,TIME=132455,CN=3,CP=11.0,V1=0.332,V2=0.332,V3=-0.332,V4=-0.332,A1=78.9,A2=78.9,A3=78.9,A4=78.9,C1=78,C2=78,C3=78,C4=78\*49

### 9.2.2 NMEA Format 3 and 4 (DF=103/104)

#### Header Data:

Identifier:

PNORH3 for DF = 103 (with tags)

PNORH4 for DF = 104 (without tags)

| Column | Description | Unit | TAG  | Data format | Example     |
|--------|-------------|------|------|-------------|-------------|
| 1      | Date        |      | DATE | YYMMDD      | DATE=141112 |
| 2      | Time        |      | TIME | HHMMSS      | TIME=081946 |
| 3      | Error Code  |      | EC   | N           | EC=0        |
| 4      | Status Code |      | SC   | hhhhhhhh    | SC=2A4C0000 |

#### Example (DF=103):

\$PNORH3,DATE=141112,TIME=081946,EC=0,SC=2A4C0000\*5F

#### Example (DF=104):

\$PNORH4,141112,083149,0,2A4C0000\*4A68

#### Sensors Data:

Identifier:

PNORS3 for DF = 103 (with tags)

PNORS4 for DF = 104 (without tags)

| Column | Description | Unit    | TAG | Data format | Example   |
|--------|-------------|---------|-----|-------------|-----------|
| 1      | Battery     | [V]     | BV  | dd.d        | BV=22.9   |
| 2      | Sound Speed | [m/s]   | SS  | dddd.d      | SS=1500.0 |
| 3      | Heading     | [deg]   | H   | ddd.d       | H=123.4   |
| 4      | Pitch       | [deg]   | PI  | dd.d        | PI=45.6   |
| 5      | Roll        | [deg]   | R   | dd.d        | R=23.4    |
| 6      | Pressure    | [dBar]  | P   | ddd.ddd     | P=123.456 |
| 7      | Temperature | [deg C] | T   | dd.dd       | T=24.56   |

#### Example (DF=103):

\$PNORS3,BV=22.9,SS=1546.1,H=151.1,PI=-12.0,R=-5.2,P=705.669,T=24.96\*7A

#### Example (DF=104):

\$PNORS4,22.9,1546.1,151.2,-11.9,-5.3,705.658,24.95\*5A

#### Averaged Data:

Identifier:

PNORC3 for DF = 103 (with tags)

PNORC4 for DF = 104 (without tags)

The averaged data is repeated for each measurement cell.

| Column | Description          | Unit  | TAG | Data format | Example   |
|--------|----------------------|-------|-----|-------------|-----------|
| 1      | Cell position        | [m]   | CP  | dd.d        | CP=2.5    |
| 2      | Speed                | [m/s] | SP  | dd.ddd      | SP=0.751  |
| 3      | Direction            | [deg] | DIR | ddd.d       | DIR=170.1 |
| 4      | Averaged Correlation |       | AC  | N           | AC=5      |
| 5      | Averaged Amplitude   |       | AA  | N           | AA=28     |

**Example (DF=103):**

\$PNORC3, CP=4.5, SP=3.519, DIR=110.9, AC=6, AA=28\*3B

**Example (DF=104):**

\$PNORC4, 27.5, 1.815, 322.6, 4, 28\*70

### 9.3 Altimeter

The telemetry for the Altimeter is controlled by the **SET/GETTMALTI** command. The DF parameter of this command sets the data format. Please note that telemetered altimeter data is always derived from the Leading Edge algorithm.

| Data format (DF) | Description                       |
|------------------|-----------------------------------|
| 200              | NMEA (PNORA) format without Tags. |
| 201              | NMEA (PNORA) format with Tags.    |

| Column | Description                          | Unit   | TAG   | Data format | Example     |
|--------|--------------------------------------|--------|-------|-------------|-------------|
| 1      | Date                                 |        | DAT E | YYMMDD      | DATE=130830 |
| 2      | Time                                 |        | TIM E | hhmmss      | TIME=132455 |
| 3      | Pressure                             | [dBar] | P     | ddd.ddd     | P=123.456   |
| 4      | Altimeter Distance<br>(Leading Edge) | [m]    | A     | ddd.ddd     | A=112.233   |
| 5      | Quality Parameter                    |        | Q     | N           | Q=13068     |
| 6      | Status                               |        | ST    | XX          | ST=00       |
| 7      | Pitch                                | [deg]  | PI    | d.d         | PI=2.3      |
| 8      | Roll                                 | [deg]  | R     | d.d         | R=1.3       |

**Example (DF=200):**

\$PNORA,190902,122341,0.000,24.274,13068,08,-2.6,-0.8\*7E

**Example (DF=201):**

\$PNORA,DATE=190902,TIME=122341,P=0.000,A=24.274,Q=13068,ST=08,PI=-2.6,R=-0.8\*72

## 9.4 Waves

The telemetry of internally processed wave data is controlled by the **SET/GETTMWAVE** command. The DF parameter of this command sets the data format.

| Data format (DF) | Description  |
|------------------|--|
| 500              | Binary format  |
| 501              | NMEA format (NMEA sentences: PNORW, PNORB, PNORE, PNORF, PNORWD)   |
| 502              | Binary format, same as used by the AWAC (described in chapter 5.6.1 in the <a href="#">Integrators Guide - Classic</a> ) |

### 9.4.1 NMEA Waves DF501

- Data with variants of -9 (-9.00, -999...) are invalid data.
- Empty fields are unused.
- The checksum calculation is part of the NMEA standard. It is the representation of two hexadecimal characters of an XOR if all characters in the sentence between – but not including – the \$ and the \* characters.

#### Wave parameters

| Column | Description         | Unit | Data format                                    |
|--------|---------------------|------|--|
| 0      | Identifier          |      | "\$PNORW"                                      |
| 1      | Date                |      | MMDDYY   |
| 2      | Time                |      | hhmmss   |
| 3      | Spectrum basis type |      | N<br>0 = Pressure<br>1 = Velocity<br>3 = AST   |
| 4      | Processing method   |      | N<br>1 = PUV<br>2 = SUV<br>3= MLM<br>4 = MLMST |
| 5      | Hm0                 | [m]  | dd.dd  |
| 6      | H3                  | [m]  | dd.dd  |
| 7      | H10                 | [m]  | dd.dd  |
| 8      | Hmax                | [m]  | dd.dd  |
| 9      | Tm02                | [s]  | dd.dd  |
| 10     | Tp                  | [s]  | dd.dd  |
| 11     | Tz                  | [s]  | dd.dd  |

|    |                                |        |        |
|----|--------------------------------|--------|--------|
| 12 | DirTp                          | [deg]  | ddd.dd |
| 13 | SprTp                          | [deg]  | ddd.dd |
| 14 | Main direction                 | [deg]  | ddd.dd |
| 15 | Unidirectivity index           |        | dd.dd  |
| 16 | Mean pressure                  | [dbar] | dd.dd  |
| 17 | Number of no detects           |        | N      |
| 18 | Number of bad detects          |        | N      |
| 19 | Near surface current speed     | [m/s]  | dd.dd  |
| 20 | Near surface current direction | [deg]  | ddd.dd |
| 21 | Wave error code                |        | hhhh   |
| 22 | Checksum                       |        | *hh    |

**Example (DF=501):**

\$PNORW,120720,093150,0,1,0.89,-9.00,1.13,1.49,1.41,1.03,-  
9.00,190.03,80.67,113.52,0.54,0.00,1024,0,1.19,144.11,0D8B\*7B

**Wave band parameters**

| Column | Description         | Unit  | Data format                                     |
|--------|---------------------|-------|---|
| 0      | Identifier          |       | "\$PNORB"                                       |
| 1      | Date                |       | MMDDYY  |
| 2      | Time                |       | hhmmss  |
| 3      | Spectrum basis type |       | N<br>0 = Pressure<br>1 = Velocity<br>3 = AST    |
| 4      | Processing method   |       | N<br>1 = PUV<br>2 = SUV<br>3 = MLM<br>4 = MLMST |
| 5      | Frequency Low       |       | d.dd  |
| 6      | Frequency High      |       | d.dd  |
| 7      | Hmo                 | [m]   | dd.dd   |
| 8      | Tm02                | [s]   | dd.dd   |
| 9      | Tp                  | [s]   | dd.dd   |
| 10     | DirTp               | [deg] | ddd.dd  |

|    |                 |       |        |
|----|-----------------|-------|--------|
| 11 | SprTp           | [deg] | ddd.dd |
| 12 | Main direction  | [deg] | ddd.dd |
| 13 | Wave error code |       | hhhh   |
| 14 | Checksum        |       | *hh    |

**Example (DF=501):**

\$PNORB,120720,093150,1,4,0.02,0.20,0.27,7.54,12.00,82.42,75.46,82.10,0000\*67  
 \$PNORB,120720,093150,1,4,0.21,0.99,0.83,1.36,1.03,45.00,0.00,172.16,0000\*5C

**Wave energy density spectrum**

| Column | Description                  | Unit                  | Data format                                  |
|--------|------------------------------|-----------------------|--|
| 0      | Identifier                   |                       | "\$PNORE"                                    |
| 1      | Date                         |                       | MMDDYY                                       |
| 2      | Time                         |                       | hhmmss                                       |
| 3      | Spectrum basis type          |                       | N<br>0 = Pressure<br>1 = Velocity<br>3 = AST |
| 4      | Start Frequency              | [Hz]                  | d.dd   |
| 5      | Step Frequency               | [Hz]                  | d.dd   |
| 6      | Number of Frequencies - N    |                       | nnn  |
| 7      | Energy density (frequency 1) | [cm <sup>2</sup> /Hz] | ddddddd                                      |
| 8      | Energy density (frequency 2) | [cm <sup>2</sup> /Hz] | ddddddd                                      |
| N+6    | Energy density (frequency N) | [cm <sup>2</sup> /Hz] | ddddddd                                      |
| N+7    | Checksum                     |                       | *hh  |

**Example (DF=501):**

\$PNORE,120720,093150,1,0.02,0.01,98,0.000,0.000,0.000,0.000,0.003,0.012,0.046,0.039,0.041,0.039,0.036,0.039,0.041,0.034,0.034,0.031,0.026,0.027,0.025,0.024,0.023,0.025,0.023,0.020,0.020,0.025,0.023,0.027,0.029,0.033,0.029,0.033,0.028,0.032,0.031,0.033,0.029,0.032,0.032,0.031,0.041,0.038,0.043,0.050,0.048,0.042,0.034,0.030,0.033,0.039,0.036,0.035,0.042,0.039,0.038,0.044,0.042,0.054,0.065,0.064,0.054,0.051,0.064,0.062,0.051,0.049,0.066,0.068,0.073,0.062,0.064,0.062,0.063,0.061,0.062,0.059,0.060,0.051,0.049,0.059,0.075,0.096,0.093,0.084,0.084,0.074,0.081,0.076,0.103,0.098,0.114,0.103,0.117,0.125,0.131,0.144,0.143,0.129\*71

**Fourier coefficient spectra**

| Column | Description | Unit | Data format |
|--------|-------------|------|-------------|
| 0      | Identifier  |      | "\$PNORF"   |

|     |  |      |  |
|-----|--|------|--|
| 1   | Fourier coefficient flag (A1/B1/A2/B2) |      | "CC"   |
| 2   | Date                                   |      | MMDDYY                                       |
| 3   | Time                                   |      | hhmmss                                       |
| 4   | Spectrum basis type                    |      | N<br>0 = Pressure<br>1 = Velocity<br>3 = AST |
| 5   | Start Frequency                        | [Hz] | d.dd   |
| 6   | Step Frequency                         | [Hz] | d.dd   |
| 7   | Number of Frequencies - N              |      | nnn  |
| 8   | Fourier coefficient CC (frequency 1)   |      | dddd.ddd                                     |
| 9   | Fourier coefficient CC (frequency 2)   |      | dddd.ddd                                     |
| N+7 | Fourier coefficient CC (frequency N)   |      | dddd.ddd                                     |
| N+8 | Checksum                               |      | *hh  |

## Example (DF=501):

## Wave directional spectra

| Column | Description                               | Unit  | Data format                                  |
|--------|---|-------|--|
| 0      | Identifier                                |       | "\$PNORWD"                                   |
| 1      | Main direction/directional spread (MD/DS) |       | "CC"   |
| 2      | Date                                      |       | MMDDYY                                       |
| 3      | Time                                      |       | hhmmss                                       |
| 4      | Spectrum basis type                       |       | N<br>0 = Pressure<br>1 = Velocity<br>3 = AST |
| 5      | Start Frequency                           | [Hz]  | d.dd   |
| 6      | Step Frequency                            | [Hz]  | d.dd   |
| 7      | Number of Frequencies - N                 |       | nnn  |
| 8      | Direction/spread (frequency 1)            | [deg] | dddd.ddd                                     |
| 9      | Direction/spread (frequency 2)            | [deg] | dddd.ddd                                     |
| N+7    | Direction/spread (frequency N)            | [deg] | dddd.ddd                                     |
| N+8    | Checksum                                  |       | *hh  |

### Example (DF=501):