

NORTEK MANUALS

Integrator's Guide

Generation 2 Aquadopp



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1 Introduction

This document includes an overview of data formats and commands relevant for the Generation 2 Aquadopp products. You can see if this includes your instrument by looking at its serial number. The generation 2 Aquadopp is characterized by a six digit serial number preceded by a four letter combination (e.g. S2SP 123456). For data formats relevant for the previous generation of Aquadopp, please refer to [Integrators Guide - Classic](#). For more information about the difference between generation 2 Aquadopp and the previous generation please refer to [Release Notes for the Aquadopp and AWAC: Generation 2 Products](#)

This document is aimed at system integrators and engineers with interfacing experience. For most users, it will make sense to let the supplied Nortek software do most of the hardware configuration and then let the controller limit its task to starting/stopping data collection.

Nortek online

At our website, www.nortekgroup.com, you will find technical support, user manuals, FAQs and the latest software and firmware. General information, technical notes, and user experience can also be found here. Your feedback is appreciated. If you find errors, omissions, or sections poorly explained, please do not hesitate to contact us. We appreciate your comments and your fellow users will as well.

Contact Information

If you need more information, support or other assistance, you are always welcome to contact us or any of our subsidiaries by email or phone. We recommend first contacting your local sales representative before the Nortek main office. We strive to answer all requests to the support email within one working day. Please include as much information as possible in you initial request, such as instrument serial number, data files, configuration, and information about the set up.

Email: support@nortekgroup.com (for technical support), or inquiry@nortekgroup.com (for general inquiries)

Phone: +47 67 17 45 00

You can also write us at:

Nortek AS
Vangkroken 2
1351 RUD
Norway

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Version 2023.1	18.10.2023	First release
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Version 2024.4	04.12.2024	Minor updates to Commands chapter
Version 2025.1	28.02.2025	Updates to Data Formats and Commands chapter. Chapter describing GETALL response included. Minor corrections to the Telemetry Data Formats chapter

2 Basic interface concepts

The command interface for Aquadopp 2 is ASCII based and line oriented. Before diving into the chapters covering data formats and commands, the operational modes and how to change between the modes are described. Understanding the use and constraints of the modes is important as they are used frequently when communicating with the instrument.

2.1 Modes

The instrument operates in distinct modes. These modes have several explicit commands used to control the instrument. The majority of the commands are initiated from the Command mode. The possible modes for the instrument are:

- **Command:** Command and control
- **Data Retrieval:** Data download from recorder
- **Measurement:** Data collection mode
- **Confirmation :** Confirmation mode

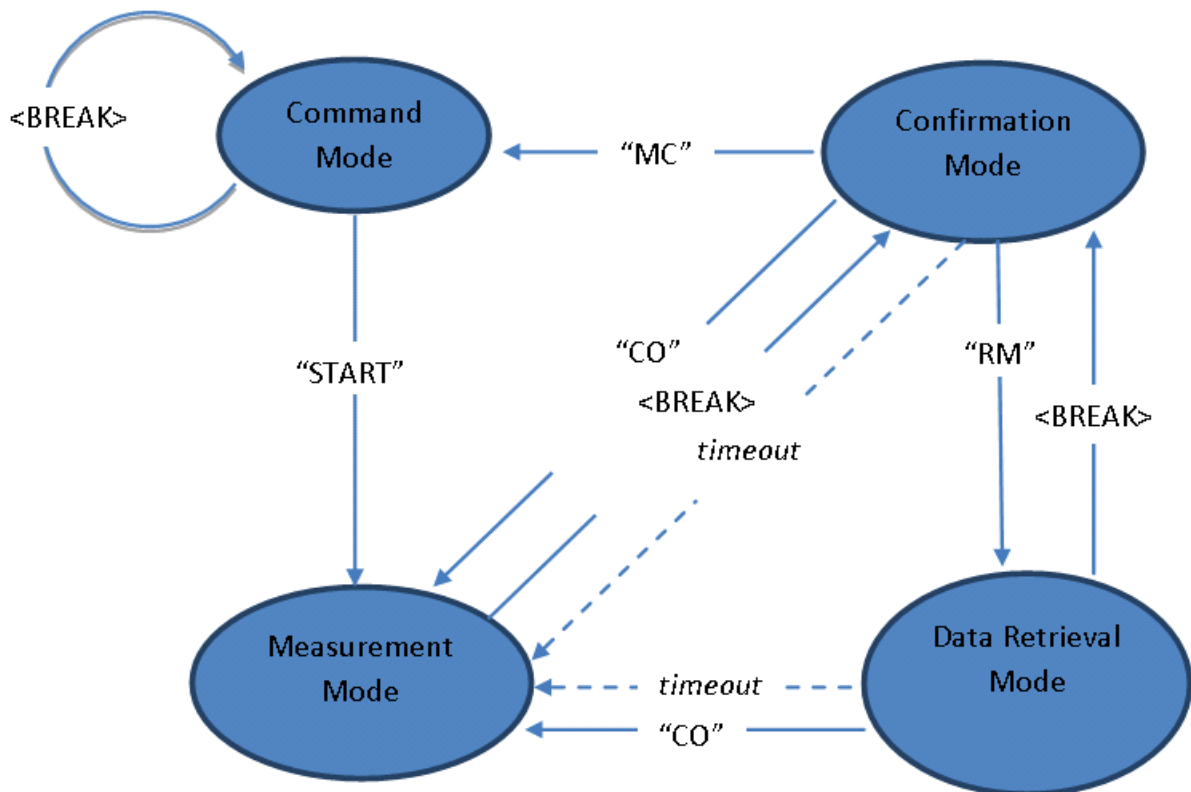


Figure 1: Instrument modes of operation

Initializing communication with the instrument is performed by sending a **<BREAK>**, which is defined in the next section. The **<BREAK>** will either set the instrument in Confirmation Mode or restart Command Mode. The options for changing mode depends on the present mode of the instrument (see Figure 1). The timeout shown in the diagram occurs if no commands are received in the various modes. A timer will then ensure that instrument operation continues. The timeout value in the Confirmation and Data Retrieval Modes is 60 seconds. There is also a timeout in Command Mode when operating over the serial interface. If no commands are received for 5 minutes, the instrument will go into sleep mode and a break or a sequence of @@@@ must be sent to wake up the processor.

2.2 Break

<BREAK> over the serial interface is defined as:

@@@@@ <delay 150 milliseconds> K1W%!Q <delay 400 milliseconds> K1W%!Q

The @@@@@ are used to wake up the processor when it is in sleep mode since the instrument will only be able to monitor activity on the serial line when it sleeps. The second sequence of the actual break characters is there to ensure that a break is detected even when the instrument is waking up due to some other cause (e.g. alarm from the real time clock). This ensures that the processor will interpret the following command correctly.

The figure and the table below show the specified timing of the <BREAK> sequence:

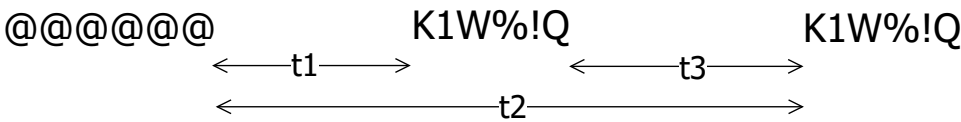


Figure: Break timing

Symbol	Parameter	Min.	Typical	Max.	Unit
t1	Time from end of @-sequence to start of first K1W%!Q-sequence.	100	150		ms
t2	Time from end of @-sequence to start of second K1W%!Q-sequence.	500	1000	2000	ms
t3	Time between first and second K1W%!Q-sequence.	300	400		ms

3 GETALL

The GETALL command retrieves all relevant configuration information for the instrument. This information can either be displayed on the command line or saved to a data file. For Nortek post-processing software to read a valid .ad2cp file it must contain both the Header and Data Record. The Header information can be obtained by using the command GETALL.

Argument	Description
FN	Write the output to this file

Example: The result from a GETALL command on a Aquadopp Profiler 400 kHz with a default Average plan. Different plans, e.g. with a Burst measurement enabled, will produce different parameters from a GETALL command. Calibration values are not modifiable.

Parameter	Example	Description
GETCLOCKSTR	TIME="2021-06-08 16:12:44"	Current time on the instrument real-time clock
ID	STR="Aquadopp Profiler 400 kHz S4VP",SN=12345	Instrument name and serial number
GETHW	FW=10002,FPGA=2018,DIGITAL="D-0",INTERFACE="E-0(AQD)",ANALOG="A-1(AQD)",SENSOR="",BOOT=203,FWMINOR=111,CRADLE="",AUX=""	Firmware and electronics revision numbers
BOARDSENSGET	AV=279,NB=3,HF=400,TTR=5.0000,TTRB5=0.0000	Production information
GETPWR	PLAN=71.37,BURST=0.00,AVG=578.59,PLAN1=0.00,BURST1=0.00,AVG1=0.00,TOTAL=71.37	Power consumption in mW for current plan
GETMEM	PLAN=0.004,BURST=0.000,AVG=0.004,PLAN1=0.000,BURST1=0.000,AVG1=0.000	Memory consumption in MB for current plan
GETPRECISION	AVGHORZ=1.02,BURSTHORZ=-9.99,BEAM5=-9.99,AVGBEAM=0.53,BURSTBEAM=-9.99,AVGZCELL=-9.99	Horizontal and along-beam precision values
GETPLAN	MIAVG=600,AVG=1,DIAVG=0,VD=0,MV=10,SA=35.0,BURST=0,MIBURST=3600,DIBURST=0,SV=0.00,FN="Data.aqd",SO=0,FREQ=400,NSTT=0	Current PLAN settings
GETAVG	NC=40,CS=2.50,BD=1.00,CY="ENU",PL=0.0,AI=60,VP=0.000,VR=2.50,DF=7,NPING=60,NB=3,CH=0,MUX=1,BW="NARROW",ALTI=0,BT=0,ICE=0,ALTISTART=0.50,ALTIEND=100.00,RAWALTI=0,ZCELL=0	Current AVG settings
GETXFAVG	ROWS=3,COLS=3,M11=1.5774,M12=-0.7888,M13=-0.7888,M21=0.0000,M22=-1.3662,M23=1.3662,M31=0.3677,M32=0.3677,M33=0.3677	Transformation matrix values

GETUSER	POFF=9.50,DECL=0.00,HX=0,HY=0,HZ=0	Pressure and compass offset values
GETINST	BR=115200,RS=422,LED="ON24H",ORIENT="AUTOZUPDOWN",CMTOUT=300,DMTOUT=60,CFMTO UT=60	Instrument settings
GETCOMPASS CAL	DX=0,DY=0,DZ=0,M11=0,M12=0,M13=0,M21=0,M 22=0,M23=0,M31=0,M32=0,M33=0	Current compass calibration values
RECSTAT	SS=512,CS=32768,FC=15248523264,TC=155189 24800,VS=15518924800,FF=4074,TF=4095	Recorder status
BEAMCFGLIST	BEAM=1,THETA=25.00,PHI=0.00,FREQ=400,BW =6,BRD=1,HWBEAM=1,ZNOM=75.00,DIA=0.00	Instrument beam configuration
	BEAM=2,THETA=25.00,PHI=- 120.00,FREQ=400,BW=6,BRD=1,HWBEAM=2,ZN OM=75.00,DIA=0.00	
	BEAM=3,THETA=25.00,PHI=120.00,FREQ=400,B W=6,BRD=1,HWBEAM=3,ZNOM=75.00,DIA=0.00	
LISTLICENSE	KEY="B4BHK6TF6BJ",DESC="16GB Recorder",TYPE=11	Installed instrument licenses
	KEY="7F9YW46Y6BJ",DESC="Averaging Mode",TYPE=1	
CALCOMPGET	DX=0,DY=0,DZ=0,M11=0,M12=0,M13=0,M21=0,M 22=0,M23=0,M31=0,M32=0,M33=0	Compass calibration values
CALTILTGET	PO=0.00,RO=0.00,MAGG=1,HO=0.00	Tilt sensor calibration values
CALACCLGET	AX=1.000000E+00,B0X=0.000000E+00,B1X=- 1.879400E-04,B2X=7.328800E-07,B3X=- 7.935100E- 09,A1X=0.000000E+00,A2X=0.000000E+00,A3X= 0.000000E+00	Accelerometer calibration values
	AY=1.000000E+00,B0Y=0.000000E+00,B1Y=7.42 1800E-05,B2Y=-6.422600E-07,B3Y=9.635200E- 09,A1Y=0.000000E+00,A2Y=0.000000E+00,A3Y= 0.000000E+00	
	AZ=1.000000E+00,B0Z=0.000000E+00,B1Z=2.681 900E-04,B2Z=-3.698300E-07,B3Z=1.678600E- 08,A1Z=0.000000E+00,A2Z=0.000000E+00,A3Z=0 .000000E+00	
CALACCLALIG NGET	M11=1,M12=0,M13=0,M21=0,M22=1,M23=0,M31= 0,M32=0,M33=1	
CALMAGNALIG NGET	M11=1,M12=0,M13=0,M21=0,M22=- 1,M23=0,M31=0,M32=0,M33=-1	
READPRESSIN FO	EQ=27,PLACE=42,FILE=2101,DATE="2023-12- 07",PMODE="PAA",PMIN=0.000,PMAX=4.000	

4 Commands

This chapter covers the commands that can be used to control the Generation 2 Aquadopps. Please note that not every command is relevant for every instrument. The commands relevant for your specific instrument depends on the instrument type and licenses.

Some pointers:

- A configuration of the instrument should always start with setting the default configuration, e.g.:

```
SETDEFAULT, CONFIG
```

```
OK
```

- All command parameters should be set explicitly, e.g.:

```
SETAVG, NC=10, BD=0.7
```

```
OK
```

- Sometimes you may get an ERROR response after trying to save the configuration or start/deploy the instrument. This doesn't necessarily mean that something is wrong with the instrument, but is most often a sign that the configuration isn't going to work. Any ERROR response can be interrogated with **GETERROR**, e.g.:

```
SAVE, CONFIG
```

```
ERROR
```

```
GETERROR
```

```
GETERROR, NUM=56, STR="Invalid setting: Avg Average Interval too low  
for the configured number of pings and profiling  
distance", LIM="GETAVG1LIM, AI=([360;1800])"
```

```
OK
```

Here, the instrument is reporting that we have set the average interval to be too short, and it provides the limits for the AI that are allowed if we are going to keep the same number of pings and profiling distance. You could increase the average interval, decrease the number of pings, or decrease the profiling distance (i.e. number/size of cells) to fix the error.

Data Limit Formats

The limits for the various arguments are returned as a list of valid values, and/or ranges, enclosed in parenthesis (). An empty list, (), is used for arguments that are unused/not yet implemented. Square brackets [] signify a range of valid values that includes the listed values. String arguments are encapsulated with "", like for normal parameter handling. A semicolon, ;, is used as separator between limits and values.

The argument format can also be inferred from the limits, integer values are shown without a decimal point, floating point values are shown with a decimal point and strings are either shown with the string specifier, "", or as a range of characters using " for specifying a character.

Examples:

[1;128] – Integer value, valid from 1 to 128

([1300.00;1700.00];0.0) – Floating point value, valid values are 0.0 and the range from 1300.00 to 1700.00.

('0';'9';['a';'z'];['A';'Z'];'.') – String argument with valid characters being . and the character ranges a-z, A-Z, 0-9 .

("BEAM") – String argument with BEAM being the only valid string.

(0;1) – Integer value with two valid values, 0 and 1.

NMEA interface example:

```
$PNOR,GETAVGLIM*22
```

```
$PNOR,GETAVGLIM,NC=([1;128]),CS=([0.25;2.00]),BD=([0.10;45.00]),CY=(  
"BEAM"),PL=([-40.0;0.0];-
```

```
100.0),AI=([1;300]),VP=([0.000;0.100]),VR=([1.25;5.00]),DF=([0;3]),N  
PING=([1;4])*46
```

```
$PNOR,OK*2B
```

Regular interface example:

```
GETPLANLIM
```

```
([1;3600]),(0;1),(),([0;2]),(),([0.0;50.0]),(0;1),([10;21600]),(),  
([1300.00;1700.00];0.0),(['0';'9'];['a';'z'];['A';'Z'];'.'),(0;1)
```

```
OK
```

4.1 List of Commands

Below is a list of all available commands with a short description and information about which mode they can be used in. For more information about each command see the following chapters. The arguments that can be used with each command are described in the respective chapter. Note that some of the commands requires at least one argument to be used.

Command	Description	Mode
SETCLOCK	Set instrument clock	COMMAND RETRIEVAL
GETCLOCK	Get instrument clock	COMMAND RETRIEVAL
SETCLOCKSTR	Set instrument clock as string	COMMAND RETRIEVAL
GETCLOCKSTR	Get instrument clock as string	COMMAND RETRIEVAL
SETPLAN	Set deployment plan parameters	COMMAND
GETPLAN	Get deployment plan parameters	COMMAND
GETPLANLIM	Get deployment plan parameter limits	COMMAND
SETAVG	Set instrument average mode settings	COMMAND
GETAVG	Get instrument average mode settings	COMMAND
GETAVGLIM	Get instrument average mode limits	COMMAND
SETAVGZCELL	Set ZCell average mode settings	COMMAND
GETAVGZCELL	Get ZCell average mode settings	COMMAND
GETAVGZCELLLIM		COMMAND
SETIMM	Set inductive modem settings	COMMAND
GETIMM	Get inductive modem settings	COMMAND
GETIMMLIM		COMMAND
SETBURST	Set burst settings	COMMAND
GETBURST	Get burst settings	COMMAND
GETBURSTLIM	Get burst setting limits	COMMAND
SETBURSTHR	Set high resolution profile burst settings	COMMAND
GETBURSTHR	Get high resolution profile burst settings	COMMAND
GETBURSTHRLIM	Get high resolution profile burst setting limits	COMMAND
READPRESSINFO	Read pressure sensor hardware information.	COMMAND
READIMCCT	Read impedance cable coupler test.	COMMAND
SETALTERNATE	Set instrument alternating plan configuration	COMMAND
GETALTERNATE	Get instrument alternating plan configuration	COMMAND

GETALTERNATELIM	Get instrument alternating plan limits	COMMAND
GETMEM	Get recorder data memory usage	COMMAND
SETEXTSENSOR	Set external sensor settings	COMMAND
GETEXTSENSOR	Get external sensor settings	COMMAND
GETEXTSENSORLIM	Get external sensor setting limits	COMMAND
GETPWR	Returns the power consumption in mW for the various measurements enabled as well as the overall value	COMMAND
GETPRECISION	Returns the precision for primary plan	COMMAND
GETPRECISION1	Returns the precision for secondary plan	COMMAND
SETUSER	Set instrument user settings	COMMAND
GETUSER	Get instrument user settings	COMMAND
GETUSERLIM	Get instrument calibration parameter limits	COMMAND
ID	Get instrument Id	COMMAND
SETDEFAULT	Reload default settings	COMMAND
SAVE	Save settings for next measurement	COMMAND
DEPLOY	Deploy the instrument	COMMAND
START	Start the instrument	COMMAND
MC	Go into command mode	CONFIRMATION
RM	Go into data retrieval mode	CONFIRMATION
CO	Go into measurement mode	CONFIRMATION RETRIEVAL
FWRITE	Write tag or string to file	COMMAND CONFIRMATION RETRIEVAL
POWERDOWN	Set instrument in sleep mode	COMMAND
ERASE	Erase all files on the recorder	COMMAND
FORMAT	Format the recorder	COMMAND
LISTFILES	Lists the files on instrument	COMMAND RETRIEVAL
DOWNLOAD	Read file data	COMMAND RETRIEVAL
INQ	Inquires the instrument state	COMMAND CONFIRMATION RETRIEVAL MEASUREMENT
GETSTATE	Returns information about the current operational state of the instrument	COMMAND CONFIRMATION

		MEASUREMENT RETRIEVAL
GETERROR	Returns a full description of the last error condition to occur	COMMAND CONFIRMATION MEASUREMENT RETRIEVAL
GETALL	Retrieves all relevant configuration information for the instrument	COMMAND
RECSTAT	Return recorder state	COMMAND RETRIEVAL
GETMISCLIM	This command returns configuration limits that cannot be returned through the relevant commands	COMMAND
GETXFAVG	Returns the "Beam to XYZ" transfer matrix for average measurements	COMMAND
GETXFBURST	Returns the "Beam to XYZ" transfer matrix for burst measurements	COMMAND
SETTMAVG	Set averaging mode telemetry settings	COMMAND
GETTMAVG	Get averaging mode telemetry settings	COMMAND
GETTMAVGLIM	Get instrument averaging mode limits	COMMAND
SETTMBURST	Set burst mode telemetry settings	COMMAND
GETTMBURST	Get burst mode telemetry settings	COMMAND
GETTMBURSTLIM	Get instrument burst mode limits	COMMAND
TMSTAT	Returns the length of the telemetry file	COMMAND RETRIEVAL
DOWNLOADTM	Read telemetry file data	COMMAND RETRIEVAL
STOREHEADERTM	Stores the GETALL to the telemetry file	COMMAND
ERASETM	Erase the telemetry file	COMMAND RETRIEVAL
TAG	Write a Tag to output file and data output	COMMAND CONFIRMATION MEASUREMENT RETRIEVAL
SETWAVEPROC	Set wave processing settings	COMMAND
GETWAVEPROC	Get wave processing settings	COMMAND
GETWAVEPROCLIM	Get wave processing setting limits	COMMAND
SETTMWAVE	Set wave telemetry settings	COMMAND
GETTMWAVE	Get wave telemetry settings	COMMAND
GETTMWAVELIM	Get wave telemetry setting limits	COMMAND

GETHW	Returns hardware specifications	COMMAND CONFIRMATION MEASUREMENT RETRIEVAL
ADDLICENSE	Add license key	COMMAND
DELETELICENSE	Delete license key	COMMAND
LISTLICENSE	Lists all license keys in instrument	COMMAND

4.2 Clock settings

Commands: SETCLOCK, GETCLOCK,

Command type: CONFIGURATION

Mode: COMMAND, RETRIEVAL

Instrument Real Time Clock specified in date parts

Argument	Description
YEAR	The year, e.g. 2020 Values: [0; 9999]
MONTH	The number of month 1-12 (Jan = 1) Values: [1; 12]
DAY	The number day of month 1-31 Values: [1; 31]
HOURL	The hour of day 0-23 Values: [0; 23]
MINUTE	The minute of hour 0-59 Values: [0; 59]
SECOND	The second of minute 0-59 Values: [0; 59]

Note: Note that all parameters must be set when using the set command

SETCLOCK

Set instrument clock

Example:

SETCLOCK, YEAR=2020, MONTH=11, DAY=28, HOUR=13, MINUTE:15, SECOND=45

GETCLOCK

Get instrument clock

Example:

```
GETCLOCK
2022,12,13,15,24,33
OK
```

4.3 Clock settings as strings

Commands: SETCLOCKSTR, GETCLOCKSTR,

Command type: CONFIGURATION

Mode: COMMAND, RETRIEVAL

Set or retrieve the Real Time Clock using a string. Must use the format as shown: yyyy-MM-dd HH:mm:ss

Argument	Description
TIME	Text string with this format yyyy-MM-dd HH:mm:ss (use UTC)

SETCLOCKSTR

Set instrument clock as string

Example:

```
SETCLOCKSTR, TIME="2020-11-12 14:27:42"
```

GETCLOCKSTR

Get instrument clock as string

Example:

```
GETCLOCKSTR
GETCLOCKSTR, TIME = "2014-11-12 14:27:42"
```

4.4 Deployment plan parameters

Commands: SETPLAN, GETPLAN, GETPLANLIM,

Command type: CONFIGURATION

Mode: COMMAND

Set and get high-level plan configuration settings.

Argument	Description
MIAVG	Averaging measurements interval Unit: [s]
AVG	Enable(1)/disable(0) averaging measurements.

SA	Salinity. Unit: [ppt]
BURST	Enable(1)/disable(0) burst measurements.
MIBURST	Burst measurements interval. Unit: [s]
SV	Sound velocity. SV = 0 will set sensor to use measured sound velocity Unit: [m/s]
FN	Filename of the raw data file where all the measured binary data will be stored. If FN="", no data is stored on the recorder. FN must be changed if a file FN with a different configuration already exists on the recorder. Values: ['a'; 'z']; ['A'; 'Z']; ['0'; '9']; '_'; '.' Max Length: 30
SO	Enable(1)/disable(0) serial output With this option enabled, the instrument will stream all collected raw binary data live, either over serial or ethernet connection.
FREQ	Transmit frequency. This is normally the instruments (one) frequency. In the case of the Signature 55 we may choose between 55Hz or 75Hz. Unit: [khz]
NSTT	Number slot time table. Set to 0 giving the default number of slots

Note: The valid range for the various arguments should be verified using the GETPLANLIM command, as the values listed here may change with firmware versions and instrument frequencies.

SETPLAN

Set deployment plan parameters

Example:

SETPLAN, FREQ=75

GETPLAN

Get deployment plan parameters

GETPLANLIM

Get deployment plan parameter limits

4.5 Average mode settings

Commands: SETAVG, GETAVG, GETAVGLIM,

Command type: CONFIGURATION

Mode: COMMAND

The instrument averaging mode settings and relevant limits.

Argument	Description
NC	Number of cells
CS	Cell size Unit: [m]
BD	Blanking distance Unit: [m]
DF	Data format 7: DF7 Binary v7
CY	Co-ordinate system BEAM, XYZ, ENU
PL	Power level (range -20.0 dB to 0.0 dB, -100 dB to switch off transmit). Unit: [dB] Values: [-20; 0]; -100
AI	Average interval Unit: [s]
VR	Velocity range along beam Unit: [m/s]
NPING	Number of pings
NB	Number of beams
CH	Beam selection. E.g. CH=123 will enable beams 1, 2 and 3.
MUX	Enable(1)/disable(0) multiplexing. 0: ping all beams in parallel 1: ping beams in sequence
BW	Bandwidth selection. NARROW
ZCELL	Enable(1)/disable(0) Z cell measurements

Note: The actual valid range for the various parameters for your specific instrument and firmware can be found by using the GETAVGLIM command. This command has the same arguments as the SETAVG/GETAVG commands shown in the list above. The output format for limits is described in Data Limit Formats

SETAVG

Set instrument average mode settings

Example:

SETAVG, BD=1

GETAVG

Get instrument average mode settings

GETAVGLIM

Get instrument average mode limits

4.6 ZCell average mode settings

Commands: SETAVGZCELL, GETAVGZCELL, GETAVGZCELLIM,

Command type: CONFIGURATION

Mode: COMMAND

The ZCell averaging mode settings and relevant limits.

Argument	Description
BD	Blanking distance Unit: [m]
CS	Cell size Unit: [m]
PL	Power level (range -20.0 dB to 0.0 dB, -100 dB to switch off transmit). Unit: [dB] Values: [-20; 0]; -100
VR	Velocity range along beam Unit: [m/s]

SETAVGZCELL

Set ZCell average mode settings

Example:

SETAVGZCELL, BD=0.4, CS=0.5, PL=-6, VR=5

OK

GETAVGZCELL

Get ZCell average mode settings

Example:

GETAVGZCELL, BD, CS, PL, VR

0.40, 0.50, -6.0, 5.0

OK

GETAVGZCELLIM

4.7 Inductive modem settings

Commands: SETIMM, GETIMM, GETIMMLIM,

Command type: CONFIGURATION

Mode: COMMAND

The inductive modem settings and relevant limits.

Argument	Description
EN	Enable inductive modem
ID	Inductive modem ID
PL	Power level LOW, HIGH
HOSTID	Host ID

SETIMM

Set inductive modem settings

Example:

SETIMM, EN=1, ID=32

OK

GETIMM

Get inductive modem settings

Example:

GETIMM, EN, ID

1, 32

OK

GETIMMLIM

4.8 Burst settings

Commands: SETBURST, GETBURST, GETBURSTLIM,

Command type: CONFIGURATION

Mode: COMMAND

Burst profile settings and relevant limits.

Argument	Description
NC	Number of cells.
NB	Number of beams.
CS	Cell size. Unit: [m]
BD	Blanking distance. Unit: [m]
DF	Data format 3: DF3 Binary v3
CY	Co-ordinate System. BEAM, XYZ, ENU
PL	Power level (range -20.0 dB to 0.0 dB, -100 dB to switch off transmit). This parameter is instrument dependent and dependent on the power consumption of the deployment as a whole. Unit: [dB] Values: [-20; 0]; -100
SR	Sampling rate. Unit: [Hz]
NS	Number of samples.
VR	Velocity range along beam. Unit: [m/s]
NPING	Number of pings.
CH	Beam selection. E.g. CH=123 will enable beams 1, 2 and 3.
HR	Enable(1)/disable(0) high resolution mode.

Note: The actual valid range for the various parameters for your specific instrument and firmware can be found by using the GETBURSTLIM command. This command has the same arguments as the SETBURST/GETBURST commands shown in the list above. The output format for limits is described in Data Limit Formats.

SETBURST

Set burst settings

Example:

`SETBURST, CS=1`

GETBURST

Get burst settings

GETBURSTLIM

Get burst setting limits

4.9 High resolution burst settings

Commands: SETBURSTHR, GETBURSTHR, GETBURSTHRLIM,

Command type: CONFIGURATION

Mode: COMMAND

License: High
Resolution

Burst high resolution profile settings and relevant limits.

Argument	Description
PROC	Input to processing the HR profile. 0: Pulse Coherent Processing using a single ambiguity. 1: Pulse Coherent Processing with Extended Velocity Range (EVR).
LAG	Distance between two transmit pulses on the slanted beams. Unit: [m]
SCORR	Number of ambiguities (side correlators) to resolve when using Extended Velocity Range (EVR).
NC	Number of cells.
CS	Cell size. Unit: [m]
BD	Blanking distance. Unit: [m]
PL	Power level (range -20.0 dB to 0.0 dB, -100 dB to switch off transmit). This parameter is instrument dependent and dependent on the power consumption of the deployment as a whole. Unit: [dB] Values: [-20; 0]; -100

SETBURSTHR

Set high resolution profile burst settings

Example:

SETBURSTHR, BD=3

GETBURSTHR

Get high resolution profile burst settings

GETBURSTHRLIM

Get high resolution profile burst setting limits

4.10 Pressure sensor hardware information.

Command: READPRESSINFO

Command type: INFO

Mode: COMMAND

Argument	Description
EQ	Equipment number.
PLACE	Place number.
FILE	File number.
DATE	Production date as string (yyyy-MM-dd)
PMODE	Pressure mode. PAA
PIN	Minimum pressure. Unit: [Bar]
PMAX	Maximum pressure. Unit: [Bar]

Example:

READPRESSINFO

34, 80, 2277, "2021-05-12", "PAA", 0.000, 30.000

OK

4.11 Impedance cable coupler test.

Command: READIMCCT

Command type: INFO

Mode: COMMAND

Argument	Description
STATUS	Status.
Z	Z value.

Example:

```
READIMCCT
"GOOD", 3174
OK
```

4.12 Alternating plan configuration

Commands: SETALTERNATE, GETALTERNATE, GETALTERNATELIM,

Command type: CONFIGURATION

Mode: COMMAND

The SETALTERNATE/GETALTERNATE command allows two different configurations to be run consecutively in time. The primary configuration (defined by SETPLAN, SETBURST, SETAVG, SETTMAVG, SETBT) is run for "PLAN" seconds, after which the unit powers down for a given period of time ("IDLE" seconds). The alternate configuration (defined by SETPLAN1, SETBURST1, SETAVG1, SETTMAVG1, SETBT1) is then run for "PLAN1" seconds and the unit powers down for "IDLE1" seconds. The configuration is then switched back to the primary and the process is repeated.

Argument	Description
EN	Enable or disable the alternate configuration mode
PLAN	Primary configuration run time Unit: [s]
IDLE	Primary configuration idle time Unit: [s]
PLAN1	Alternate configuration run time Unit: [s]
IDLE1	Alternate configuration idle time Unit: [s]

Note: The actual valid range for the various parameters for the firmware version is used can be found by using the GETALTERNATELIM command. This command has the same arguments as the SETALTERNATE/GETALTERNATE commands shown in the list above. The output format for limits is described in Data Limit Formats.

SETALTERNATE

Set instrument alternating plan configuration

Example:

```
SETALTERNATE, EN=1, PLAN=60, IDLE=60, PLAN1=60, IDLE1=60
```

GETALTERNATE

Get instrument alternating plan configuration

GETALTERNATELIM

Get instrument alternating plan limits

4.13 Get memory usage

Command: GETMEM

Command type: INFO

Mode: COMMAND

Returns the amount of memory that will be stored on the recorder per hour for the burst and average data as well as the combined plan value. Alternate mode values is also supported.

Argument	Description
PLAN	Combined burst and average memory usage for primary plan Unit: [MB/h]
BURST	Burst memory usage for primary plan Unit: [MB/h]
AVG	Average data memory usage for primary plan Unit: [MB/h]
PLAN1	Combined burst and average memory usage for secondary plan Unit: [MB/h]
BURST1	Burst memory usage for secondary plan Unit: [MB/h]
AVG1	Average data memory usage for secondary plan Unit: [MB/h]
TOTAL	Total memory usage Unit: [MB/h]

Example:

GETMEM, TOTAL

4.14 External sensor settings

Commands: SETTEXTSENSOR, GETTEXTSENSOR, GETTEXTSENSORLIM,

Command type: CONFIGURATION

Mode: COMMAND

External sensor configuration.

Argument	Description
EN	Enable external sensor.
PWROUT	Power settings to external sensor. OFF, 5V, 12V
TYPE	Type of external sensor. MicroCAT, STM-S,

SETTEXTSENSOR

Set external sensor settings

Example:

```
SETTEXTSENSOR, EN=1, PWROUT="OFF", TYPE="MicroCAT"  
OK
```

GETTEXTSENSOR

Get external sensor settings

Example:

```
GETTEXTSENSOR, EN, PWROUT, TYPE  
1, "OFF", "MicroCAT"  
OK
```

GETTEXTSENSORLIM

Get external sensor setting limits

4.15 Get power use

Command: GETPWR

Command type: INFO

Mode: COMMAND

Returns the power consumption in milliWatts for the various measurements enabled as well as the overall value. The plan values include the sleep mode power consumption in addition to the sum of average and burst mode values. The reported values are adjusted according to the input voltage to the system when the command is executed.

Argument	Description
PLAN	Combined power use on both burst and average sampling for secondary plan Unit: [mW]
BURST	Power use on burst data sampling for secondary plan Unit: [mW]
AVG	Power use on average data sampling for secondary plan Unit: [mW]
TOTAL	Total power use Unit: [mW]

Example:

GETPWR, TOTAL

4.16 Get measured precision

Commands: GETPRECISION, GETPRECISION1,

Command type: INFO

Mode: COMMAND

Returns the precision in the horizontal plane and along the beam in cm/s for the various measurement modes.

Argument	Description
AVGHORZ	Precision in the horizontal plane in average mode Unit: [cm/s]
BURSTHORZ	Precision in the horizontal plane in burst mode Unit: [cm/s]
AVGBEAM	Precision along beam in average mode Unit: [cm/s]
BURSTBEAM	Precision along beam in burst mode Unit: [cm/s]

GETPRECISION

Returns the precision for primary plan

Example:

GETPRECISION, AVGHORZ

GETPRECISION1

Returns the precision for secondary plan

Example:

```
GETPRECISION1,AVGHORZ
```

4.17 Instrument user settings

Commands: SETUSER, GETUSER, GETUSERLIM,

Command type: CONFIGURATION

Mode: COMMAND

The SAVE,USER command must be sent to save changes in USER parameters.

Argument	Description
POFF	Set the offset value of the pressure sensor. Unit: [dbar] Values: [0; 11]
DECL	Magnetic declination. Unit: [deg]
HX	Hard iron x-component. Unit: [Gauss]
HY	Hard iron y-component. Unit: [Gauss]
HZ	Hard iron z-component. Unit: [Gauss]

SETUSER

Set instrument user settings

Example:

```
SETUSER,POFF=4.5,DECL=1.4,HX=100,HY=100,HZ=100
```

```
OK
```

```
SAVEUSER
```

```
OK
```

GETUSER

Get instrument user settings

GETUSERLIM

Get instrument calibration parameter limits

4.18 Get instrument ID

Command: ID

Command type: INFO

Mode: COMMAND

Commands for accessing instrument name and serial number

Argument	Description
STR	Instrument name Values: '_' ':' Max Length: 64
SN	Serial number Values: [0; 2147483647]

Example:

ID

"Signature1000",900002

ID,STR

"Signature1000"

4.19 Reload default settings

Command: SETDEFAULT

Command type: ACTION

Mode: COMMAND

Reload default settings.

Argument	Description
CONFIG	Restore all settings below except USER and INST to default values. Legacy argument ALL acts as CONFIG.
AVG	Restore average mode settings to default.
INST	Restore instrument main settings to default.
TMAVG	Restore telemetry average settings to default.
PLAN	Restore plan settings to default.
BURST	Restore burst settings to default.
USER	Restore user calibration to default.
TMBURST	Restore telemetry burst to default.

Example:

SETDEFAULT, CONFIG

4.20 Save settings

Command: SAVE

Command type: ACTION

Mode: COMMAND

Save current settings for next measurement. At least one argument must be specified for the SAVE command.

Argument	Description
CONFIG	Save all settings except INST and USER settings. Legacy argument ALL acts as CONFIG.
AVG	Save AVG settings.
INST	Save INST settings.
TMAVG	Save telemetry average settings.
PLAN	Save plan settings.
BURST	Save burst settings.
USER	Save user instrument settings.
TMBURST	Save telemetry burst settings.

Example:

SAVE, CONFIG

4.21 Deploy instrument

Command: DEPLOY

Command type: ACTION

Mode: COMMAND

Deploy the instrument. Start the measurement at the time specified in the string argument. The format must be exactly as shown. If no time value is passed, the deployment will start immediately.

The number of seconds to the specified deployment time is returned.

The DEPLOY command will save the configuration as well as deploying the instrument, as if a SAVE,CONFIG command were sent.

Argument	Description
TIME	yyyy-MM-dd HH:mm:ss

Note: The difference between DEPLOY and START is that the latter will immediately start a measurement any time the instrument state returns to Measurement mode such as by applying power or timeout from Data Retrieval Mode. If DEPLOY is used, be aware that if the deployment time has passed when the battery is connected, the instrument will resynchronize its data sampling according to the deployment time and the instrument configuration. This means you may have to wait for one average measurement interval or one burst measurement interval before the instrument starts to ping.

Example:

```
DEPLOY, TIME="2020-12-18 15:30:00"  
592  
OK
```

4.22 Start instrument

Command: START

Command type: ACTION

Mode: COMMAND

Start the instrument (go in measurement mode). Specify the order of the alternating plans by using the PLAN argument.

Note that the START command will save the configuration as well as starting the measurement, as if a SAVE,CONFIG command were sent.

Argument	Description
PLAN	Select plan to start 0: Plan 1: Plan1

Example:

```
START, PLAN=0
```

4.23 Enter command mode

Command: MC

Command type: ACTION

Mode: CONFIRMATION

Sets instrument in command mode from confirmation mode.

Example:

```
MC
```

4.24 Data retrieval mode

Command: RM

Command type: ACTION

Mode: CONFIRMATION

Go into data retrieval mode from confirmation mode and access the instruments recorder.

Example:

RM

4.25 Enter measurement mode

Command: CO

Command type: ACTION

Mode: CONFIRMATION, RETRIEVAL

Continue in measurement mode from confirmation mode or data retrieval mode. Instrument returns to collecting data according to the current configuration.

Example:

CO

4.26 Write to file

Command: FWRITE

Command type: ACTION

Mode: COMMAND, CONFIRMATION, RETRIEVAL

Write tag or string to file

Argument	Description
FNUM	File identifier for telling which file the info is written to. Default is 0. 0: File defined in the PLAN command 1: Telemetry file Default: 0
ID	Identifier. Tell the parser how to interpret the string. Default value: 0 0: Comment 1: Dive location 2: Surface location Default: 0
STR	String. Max Length: 200

Note: Fwrite STR and B64STR cannot be set together.

Example:

`FWRITE, FNUM=1, STR="ABCDEF"`

4.27 Power down

Command: POWERDOWN

Command type: ACTION

Mode: COMMAND

Power down the instrument to set it in sleep mode.

Example:

`POWERDOWN`

4.28 Erase files on recorder

Command: ERASE

Command type: ACTION

Mode: COMMAND

Erase all files on the recorder

Argument	Description
CODE	Code should be 9999 9999

Example:

`ERASE, CODE=9999`

4.29 Format recorder

Command: FORMAT

Command type: ACTION

Mode: COMMAND

Format the recorder. Note that this can take minutes depending on the recorder size.

Argument	Description
CODE	Code should be 9999 9999

Example:

`FORMAT, CODE=9999`

4.30 List files

Command: LISTFILES

Command type: INFO

Mode: COMMAND, RETRIEVAL

Lists the files stored on the instrument recorder.

Argument	Description
OPT	Amount of file information to list. "normal": Normal file info. "la": Lists extended information.

Example:

```
LISTFILES,OPT="NORMAL"
```

4.31 Download

Command: DOWNLOAD

Command type: ACTION

Mode: COMMAND, RETRIEVAL

This command reads a file from the recorder to the terminal window.

Argument	Description
FN	Filename Values: ['a'; 'z']; ['A'; 'Z']; ['0'; '9']; '_' Max Length: 30
SA	Start address (offset) of the first byte to be returned
LEN	Number of bytes to be downloaded
CRC	Use Cyclic redundancy check
CKS	Use Checksum

Note: If no parameters other than the file name are sent with the DOWNLOAD command, the complete file is directly returned, without the number of bytes to follow. The end of the file can then be detected by parsing the OK<CR><LF>.

The parameters can be used to download the file in several pieces. The number of bytes to follow will then be returned in ASCII format and terminated with <CR><LF> before the data is output. The end of the file stream is terminated with OK<CR><LF>. A cyclic redundancy check or a checksum will then be added to verify data integrity during download. The complete file can also be downloaded in this way by specifying SA=0 and a large value for LEN. The actual file size is then returned before the data follows.

Example:

```
DOWNLOAD,FN="TestFile.ad2cp",SA=0,LEN=4096,CRC=1,CKS=0
4096
<binary or ASCII data>
```

23432
OK

4.32 Inquire state

Command: INQ

Command type: INFO

Mode: COMMAND, CONFIRMATION, RETRIEVAL, MEASUREMENT

The INQ command queries the instrument state. Note that when operating over RS232 or RS422 serial lines, it should be preceded with @@@@ <delay 400ms> and a flush of the input buffer in case the instrument is in power down or in a low power mode taking measurements.

Consult section "Modes" for a description of the Instrument modes.

Note: Parameters used to represent instrument mode:

0000: Bootloader/Firmware upgrade

0001: Measurement

0002: Command

0004: Data Retrieval

0005: Confirmation

0006: FTP-mode

Example:

(In command mode)

INQ
0002

(In measurement mode)

INQ
0001

(In confirmation mode)

INQ
0005

(In data retrieval mode)

INQ
0004

(In firmware upgrade mode)

INQ
0000

4.33 Get instrument state

Command: GETSTATE

Command type: INFO

Mode: COMMAND, CONFIRMATION, MEASUREMENT, RETRIEVAL

Returns information about the current operational state of the instrument

Argument	Description
MODE	Current instrument state. 1: Measurement (START command received). 2: In command mode. 3: DEPLOY command received and deployment running. 4: Data retrieval. 5: Confirmation. 6: Network FTP. 8: DEPLOY command received, but deployment has not, yet started. 9: Confirmation in measurement mode. 10: Confirmation in deploy mode. 11: Confirmation in pre-deploy mode. 12: internal processing in progress.
DEPTIME	Seconds since deployment: 0 – DEPLOY command has not been received. < 0 – Number of seconds until deployment starts. > 0 – Number of seconds that deployment has been running. Unit: [s]
MEASTIME	Seconds with measurements: 0 – START command has not been received. > 0 – Number of seconds that measurement has been running. Unit: [s]
CURRTIME	The current instrument time. Time format is "YYYY-MM-DD HH:MM:SS" Unit: [Time]
WAKEUP	Reason for instrument wakeup. 0: Last startup/reboot caused by loss/low voltage. 1: Last startup/reboot caused by power on. 2: Last startup/reboot caused by BREAK command. 3: Last startup/reboot caused by Wakeup by Real time clock. 4: Last startup/reboot caused by WatchDog
INTPROC	Internal processing Active

Example:

GETSTATE, WAKEUP, CURRTIME

4.34 Get error

Command: GETERROR

Command type: INFO

Mode: COMMAND, CONFIRMATION, MEASUREMENT, RETRIEVAL

GETERROR retrieves a full description of the last error condition to occur. The error number is returned first followed by a string with the text description of the last error condition. A second string is also returned which contains information on the valid range of the failing argument.

Argument	Description
NUM	Integer error value
STR	Text description
LIM	Valid limits as text

Example:

```
SETAVG,CS=2.5
OK
SAVE,CONFIG
ERROR
GETERROR
40,"Invalid setting: Avg Cell Size","GETAVGLIM,CS=([0.20;2.00])"
OK
```

4.35 Get all

Command: GETALL

Command type: INFO

Mode: COMMAND

GETALL retrieves all relevant configuration information for the instrument. This information can either be displayed on the command line or saved to a data file on the instrument. For the Nortek post-processing software to read a valid Nortek file it must contain both the Header and Data Record. The Header information can be obtained by using the command GETALL.

Argument	Description
FN	Write the output to this file saved on instrument

Example:

```
GETALL
GETPLAN,600,1,0,0,10,0.0,1,0,0,1500,"",1
GETAVG,20,1.00,0.30,"BEAM",-12.0,1,0.000,1.29,3,1,0,0
GETBURST,50,4,0.400,0.200,"BEAM",0.0,1,1024,4.00,0.000,0,1,0
GETUSER,0.00,0.00,0,0,0
GETINST,9600,232,1
BEAMCFGLIST,1,10.00,20.00,1000,500,1,1
BEAMCFGLIST,2,10.00,20.00,1000,500,1,2
BEAMCFGLIST,3,10.00,20.00,1000,500,1,3
BEAMCFGLIST,4,10.00,20.00,1000,500,1,4
OK
```


4.36 Get recorder state

Command: RECSTAT

Command type: INFO

Mode: COMMAND, RETRIEVAL

Returns recorder state.

Argument	Description
SS	Number of bytes in a sector. Unit: [bytes]
CS	Number of bytes in one cluster. Unit: [bytes]
FC	Number of bytes in free clusters. Unit: [bytes]
TC	Total number of bytes in clusters. Unit: [bytes]
VS	Volume Size in bytes. Unit: [bytes]
FF	Number of free files.
TF	Total number of files.

Example:

RECSTAT, VS

4.37 Get configuration limits

Command: GETMISCLIM

Command type: INFO

Mode: COMMAND

Returns configuration limits.

Argument	Description
AVGPR	Returns the total profiling range for averaged measurements (SETAVG) Unit: [m]
BURSTPR	Returns the total profiling range for burst profile measurements (SETBURST) Unit: [m]
BURSTHRPR	Returns the total profiling range for burst HR profile measurements (SETBURSTHR) Unit: [m]

Note: The output format for limits is described in Data Limit Formats

Example:

GETMISCLIM, BURSTPR

4.38 Get transfer matrices

Commands: GETXFAVG, GETXFBURST,

Command type: INFO

Mode: COMMAND

Returns the "Beam to XYZ" transfer matrix for the current setup. If the number of beams is 1 or 2, only ROWS and COLS are returned.

Argument	Description
ROWS	Number of rows
COLS	Number of rows
M11	
M12	
M13	
M14	
M21	
M22	
M23	
M24	
M31	
M32	
M33	
M34	
M41	
M42	
M43	
M44	

Note: Return is ROWS, COLS, M11, M12 ... M43, M44.

Cell indexes are: first number for row and second index for column.

GETXFAVG

Returns the "Beam to XYZ" transfer matrix for average measurements

Example:

GETXFAVG

GETXFBURST

Returns the "Beam to XYZ" transfer matrix for burst measurements

Example:

GETXFBURST

```
GETXFBURST, ROWS=4, COLS=4, M11=1.183, M12=0.000, M13=-
1.183, M14=0.000, M21=0.000, M22=1.183, M23=0.000, M24=-
1.183, M31=0.552, M32=0.000, M33=0.552, M34=0.000, M41=0.000, M42=0.552, M
43=0.000, M44=0.552
GETXFAVG, ROWS=3, COLS=3, M11=1.183, M12=0.000, M13=-
1.183, M21=1.183, M22=-2.366, M23=1.183, M31=0.552, M32=0.000, M33=0.552
```

4.39 Average mode telemetry settings

Commands: SETTMAVG, GETTMAVG, GETTMAVGLIM,

Command type: CONFIGURATION

Mode: COMMAND

The instrument averaging mode telemetry settings and relevant limits.

Argument	Description
EN	Enable averaging mode telemetry.
CD	Cells divisor. Define the interval at which cells should be outputted from your profile. If CD=1 every cell will be included, if CD=2 every second cell will be outputted etc.
PD	Profile divisor. Define how often the collected profile should be outputted. If PD=1 the profile from each ping will be outputted, if PD=2 every second profile will be outputted etc. Note that PD>1 is not available when averaging is enabled.
AVG	Number of seconds included in the telemetry average. If 0, no averaging is done and every ping will be outputted Unit: [s]
TV	Enable(1)/disable(0) velocity output.
TA	Enable(1)/disable(0) amplitude output
TC	Enable(1)/disable(0) correlation output.
CY	Coordinate system. BEAM, XYZ, ENU
FO	Enable(1)/disable(0) file output. The telemetry data will be written to the file named telemetryfile.bin on the recorder

SO	Enable(1)/disable(0) serial output. The telemetry data will be outputted live, either over serial or ethernet connection
DF	Telemetry data format. For examples, see Telemetry Data Format chapter.
DISTILT	Disable tilt.
TPG	Enable(1)/disable(0) output of the Percentage Good value.
MAPBINS	Enable vertical bin mapping.
CORRTH	Correlation threshold
IMMO	Inductive modem output

Note: It is recommended to enable TPG when averaging (AVG>0) is also enabled.

The actual valid range for the various parameters for your specific instrument and firmware can be found by using the GETTMAVGLIM command. This command has the same arguments as the SETTMAVG/GETTMAVG commands shown in the list above. The output format for limits is described in Data Limit Formats.

SETTMAVG

Set averaging mode telemetry settings

Example:

`SETTMAVG, EN=1, AVG=30`

GETTMAVG

Get averaging mode telemetry settings

GETTMAVGLIM

Get instrument averaging mode limits

4.40 Burst mode telemetry settings

Commands: SETTMBURST, GETTMBURST, GETTMBURSTLIM,

Command type: CONFIGURATION

Mode: COMMAND

The instrument burst mode telemetry settings and relevant limits.

Argument	Description
EN	Enable(1)/disable(0) burst telemetry
NS	Number of burst samples in telemetry to output

CY	Coordinate System BEAM, XYZ, ENU
FO	Enable(1)/disable(0) file output. The telemetry data will be written to the file named telemetryfile.bin on the recorder
SO	Enable(1)/disable(0) serial output. The telemetry data will be outputted live, either over serial or ethernet connection
DF	Telemetry data format. For examples, see Telemetry Data Format chapter.
ENAVG	Enable(1)/disable(0) averaging over the number of samples (NS) value
MAPBINS	Enable(1)/disable(0) vertical bin mapping

Note: The actual valid range for the various parameters for your specific instrument and firmware can be found by using the GETTMBURSTLIM command. This command has the same arguments as the SETTMBURST/GETTMBURST commands shown in the list above. The output format for limits is described in Data Limit Formats.

SETTMBURST

Set burst mode telemetry settings

Example:

```
SETTMBURST, EN=1, NS=0
```

GETTMBURST

Get burst mode telemetry settings

GETTMBURSTLIM

Get instrument burst mode limits

4.41 Get telemetry file size

Command: TMSTAT

Command type: ACTION

Mode: COMMAND, RETRIEVAL

This command returns the length (# of bytes) of the telemetry file.

Example:

```
TMSTAT
13500
OK
```

4.42 Download telemetry

Command: DOWNLOADTM

Command type: ACTION

Mode: COMMAND, RETRIEVAL

This command enables reading the telemetry file which can be created during measurement by using the appropriate SETTMxxx commands. The formats are described in the section detailing Data Formats.

Argument	Description
SA	Start address (offset) of the first byte to be returned.
LEN	Number of bytes to be downloaded.
CRC	Use Cyclic redundancy check (CRC-16). CRC=1 enables CRC. CRC cannot be enabled when CKS=1.
CKS	Use Checksum. CKS=1 enables checksum. CKS cannot be enabled when CRC=1.

Note: If no parameters are sent with the DOWNLOADTM command the complete file is directly returned, without the number of bytes to follow. The end of the file can then be detected by parsing the OK<CR><LF>.

The parameters can be used to download the telemetry file in several pieces. The number of bytes to follow will then be returned in ASCII format and terminated with <CR><LF> before the data is output. The end of telemetry stream is terminated with OK<CR><LF>. A cyclic redundancy check or a checksum will then be added to be able to verify data integrity during download. The complete file can also be downloaded in this way by specifying SA=0 and a large value for LEN. The actual file size is then returned before the data follows. See also TMSTAT for retrieving file information.

Example:

```
DOWNLOADTM, SA=0, LEN=4096, CRC=1, CKS=0
4096 (number of bytes that follow)
<binary or ASCII data>
23432 (checksum/crc value)
OK
```

4.43 Save configuration to file

Command: STOREHEADERTM

Command type: ACTION

Mode: COMMAND

This command stores the GETALL (complete configuration) to the telemetry file.

Example:

```
STOREHEADERTM
```

4.44 Erase telemetry file

Command: ERASETM

Command type: ACTION

Mode: COMMAND, RETRIEVAL

Erase the telemetry file.

Argument	Description
CODE	Code should be 9999 9999

Note: The telemetry file can also be erased over FTP.

Example:

```
ERASETM, CODE=9999
```

4.45 Write tag output

Command: TAG

Command type: ACTION

Mode: COMMAND, CONFIRMATION, MEASUREMENT, RETRIEVAL

Write a Tag to output file and data output.

The TAG command adds a tag to the both the output file and the output data, if enabled. The output is a String Record as defined in the FWRITE command. The ID of the String Record Data packet is 19dec.

Argument	Description
STR	Tag string. Maximum 200 bytes.
CLK	Add clock in tag.

Note: Remember to use the BBPWAKEUP command when sending commands to an instrument in Measurement mode, when using Ethernet.

Example:

```
TAG,STR="This is a test tag.",CLK=1
a5 0a a0 10 2f 00 42 8c 42 5d 13 32 // Binary header
30 31 37 2d 30 31 2d 32 34 20 30 38 // String Record ID = 19dec
3a 34 32 3a 35 37 2e 34 34 39 20 2d // "2017-01-24 08:42"
20 54 68 69 73 20 69 73 20 61 20 74 // ":57.449 - This i"
65 73 74 20 74 61 67 2e 00 // "s is a test tag."
OK
```

4.46 Wave processing settings

Commands: SETWAVEPROC, GETWAVEPROC, GETWAVEPROCLIM,

Command type: CONFIGURATION

Mode: COMMAND

License:
WaveProcessing

Wave processing settings.

Argument	Description
EN	Enable(1)/disable(0) internal wave processing.
MOUNTHEIGHT	Distance the instrument head (the pressure sensor location) is over the sea floor; this is used to correctly calculate the transfer functions used for the pressure and velocity. Unit: [m]
MODE	Processing method used in the calculation. "PUV":
BANDSEPFREQ	Frequency to separate between sea and swell. Unit: [Hz]
FREQSTART	Start frequency sets the start of the frequency range that processing is done over. Unit: [Hz]
FREQSTEP	Frequency step. Unit: [Hz]
FREQEND	End frequency sets the end of the frequency range that processing is done over. Unit: [Hz]

SETWAVEPROC

Set wave processing settings

Example:

```
SETWAVEPROC, EN=1, MOUNTHEIGHT=0.5, MODE="MLMST", BANDSEPFREQ=0.2, FREQSTART=0.02, FREQSTEP=0.01, FREQEND=0.99
```

OK

GETWAVEPROC

Get wave processing settings

GETWAVEPROCLIM

Get wave processing setting limits

4.47 Wave telemetry settings

Commands: SETTMWAVE, GETTMWAVE, GETTMWAVELIM,

Command type: CONFIGURATION

Mode: COMMAND

License:
WaveProcessing

Wave telemetry settings.

Argument	Description
EN	Enable/disable processed wave data telemetry.
DF	Telemetry data format. For examples, see Telemetry Data Format chapter. 500: Binary data format 501: Wave NMEA format 502: Legacy binary data format
TWAP	Enable output of wave parameter estimates
TEDS	Enable output of Energy Density Spectrum
TWBS	Enable output of Wave band estimates
TFS	Enable output of Fourier coefficient spectrum
SO	Enable Serial Output
FO	Enable File Output
TWDR	Enable Transmit Wave Direction

SETTMWAVE

Set wave telemetry settings

Example:

```
SETTMWAVE, EN=1, DF=501, TWAP=1, TEDS=0, TWBS=0, TFS=0, SO=1, FO=0, TWDR=0  
OK
```

GETTMWAVE

Get wave telemetry settings

GETTMWAVELIM

Get wave telemetry setting limits

4.48 Get hardware specifications

Command: GETHW

Command type: INFO

Mode: COMMAND, CONFIRMATION, MEASUREMENT, RETRIEVAL

Returns Firmware versions and Board revisions.

Argument	Description
FW	Running DSP FW version
FWMINOR	Running DSP FW version (minor part)
FPGA	Running FPGA FW version
BOOT	DSP bootloader FW Version
DIGITAL	Board revision. Example: C-0
INTERFACE	Board revision. Example: C-0
ANALOG	Board revision. Example: C-0
SENSOR	Board revision. Example: C-0
CRADLE	Cradle version information.

Example:

GETHW, FW, MINOR

4.49 Add license

Command: ADDLICENSE

Command type: PRODUCTION

Access: User

Mode: COMMAND

Reads a license key and checks it against the instrument serial number before adding it to the license key flash.

Argument	Description
KEY	The license key to add

Example:

ADDLICENSE, KEY="9H3F5PE47HUUB"

OK

4.50 Delete license

Command: DELETELICENSE

Command type: PRODUCTION

Access: User

Mode: COMMAND

Deletes a license key from the license key flash.

Argument	Description
KEY	The license key to delete

Example:

```
DELETELICENSE,KEY="9H3F5PE47HUUB"  
OK
```

4.51 Lists license keys

Command: LISTLICENSE

Command type: INFO

Access: User

Mode: COMMAND

Lists all license keys contained in the license key flash along with a description of the functionality enabled by the key and the variant number of the license.

Argument	Description
KEY	License key
DESC	Information about license type
TYPE	License id

Example:

```
LISTLICENSE  
LISTLICENSE,"4X218TRTRPNUB","High Resolution",4  
LISTLICENSE,"JKHHFNH3RPNUB","Wave Mode",6  
LISTLICENSE,"WF3CJR6PRPNUB","Current Profiler",1  
OK  
$PNOR,LISTLICENSE*76  
$PNOR,LISTLICENSE,KEY="4X218TRTRPNUB",DESC="High  
Resolution",TYPE=4*73  
$PNOR,LISTLICENSE,KEY="JKHHFNH3RPNUB",DESC="Wave Mode",TYPE=6*00  
$PNOR,LISTLICENSE,KEY="WF3CJR6PRPNUB",DESC="Current  
Profiler",TYPE=1*1C  
$PNOR,OK*2B
```

5 Data Formats

This chapter describes the binary data formats used by the Generation 2 Aquadopps, including both the current meters with shallow and deep depth rating and the profilers. With the Aquadopp instruments you get binary data stored to two files on the recorder:

[filename]_avgd.aqd - contains the average current data for Aquadopp 2. The data is averaged over the configured average interval and saved as Data Format 7. Note that some internal quality control has been applied to this data. For more information about the data format and the internal quality control, please refer to the Quality Control chapter. If the onboard wave processing has been enabled, the processed wave data can also be found in this file.

[filename].aqd contains the raw burst data for Aquadopp 2, such as raw wave data or high resolution measurements. The data is saved as Data Format 3. Note that if no burst applications are enabled this file will be empty. For Aquadopp Current Meters you will always find single ping data in Data Format 3 in this file, including raw magnetometer data.

Both Data Formats 3 and 7 are described in the following chapters. Note that the binary data formats all use a common header that specifies how the rest of the data block should be interpreted, containing information about data type, size etc. The header is documented separately as **_HeaderData**. A data block is the data from and including one header to the next, and can for example contain data from one velocity profile. We use the leading underscore in the chapter title to emphasize that this is not a complete data set, but is a part used by two or more other data formats. Note that for Data Format 3 we also have two other common data fields shared by several data formats (see illustration in the table below).

Binary data is always outputted as Little Endian.

_HeaderData			
_CommonData		DF7 CurrentProfileData	StringData
_DF3 CurrentProfileData			
DF3 VelocityData	DF3 SpectrumData		

Figure: Showing how common data fields (gray for header and blue for other common's) relate to the sensor specific data fields (green). Note that we use a leading underscore (_) to emphasize that this is not a sensor data format but is common and used by two or more data formats.

About the tables

Tables have the columns 'Field', 'Position/Size' and 'Description'. Position and size may need an explanation:

Position has the location of a field in the header or in the data that follows the header. E.g., the 'data series id' has position 2 (Note that we are counting from 0) in the header. Some positions are not fixed, but dependent on which fields are before it. In these cases, 'offset of data' (position 1 of the data - see `_CommonData`) can then be used to give the position of the following fields. In these cases, the position in the table will not be given as a number but as a variable name such as `OFFSET`. Variable descriptions are listed below the tables where they are used.

Size is the data type of field. In case of 'data series id' it is an unsigned integer of 8 bits (uint8). Note that not all fields have a specific data type but is an object using a required number of bits. E.g., the status bit masks often use 32 bits to provide 'ok'/'not ok' on several parts of the data. These object sizes and their descriptions are listed below the table where they are used.

5.1 `_HeaderData`

The header definition for binary data formats. Note that the header may be verified without reading the rest of the data block since it has its own checksum.

Field	Position Size	Description
Sync byte	0 uint8	Always 0xA5.
Header size	1 uint8	Number of bytes in the headers. Normally it is 10 bytes, but in a few cases it may be 12 bytes to hold data size of 32 bytes.
Data series id	2 uint8	Defines the type of the following Data Record. 0x15 - Burst data as DF3. 0x16 - Average data as DF3. 0x17 - Bottom Track Data Record. 0x18 - Interleaved Burst Data Record (beam 5). 0x1E - Altimeter Record. 0x1F - Avg Altimeter Raw Record. 0x1A - Burst Altimeter Raw Record. 0x1B - DVL Bottom Track Record. 0x1C - Echo Sounder Record. 0x23 - Echo Sounder Raw Record. 0x24 - Echo Sounder Raw Tx Record. 0x26 - Average data as DF7. 0x30 - Processed Wave Data Record. 0x1D - DVL Water Track Record. 0xC8 - Vector 2 data as DF8. 0xA0 - String Data Record, eg. GPS NMEA data, comment from the FWRITE command.
Family id	3 uint8	Defines the Instrument Family. 0x10 is the Signature Family. 0x30 is the Aquadopp Generation 2 family. 0x04 is the Awac Generation 2 family.

Data size	4 uint16/uint32	Number of bytes in the following Data Record. If header size is 10, the data size is represented with a uint16. For large datasets, header may have 12 bytes giving room for a uint32 to represent data size.
Data checksum	6/8 uint16	Checksum of the following Data Record.
Header checksum	8/10 uint16	Checksum of all fields of the Header except the Header Checksum itself.

5.2 _CommonData

Used By: _DF3 CurrentProfileData

Common data definitions for parsing Nortek data format 3 (DF3) and Nortek bottom track data format 20 (DF20).

Field	Position Size	Description
Version	0 uint8	Version number of the Data Record Definition. 3 - DF3 20 - DF20
Offset of data	1 uint8	Number of bytes from start of the record to start of the actual data. Unit: [# bytes]
Configuration bit mask	2 16 bits	Record Configuration Bit Mask Object reference given in table below
Serial number	4 uint32	Instrument serial number from factory.
Year	8 uint8	Number of years since 1900.
Month	9 uint8	Month number counting from 0 which is January.
Day	10 uint8	Day of the month
Hour	11 uint8	24 hour of the day
Minutes	12 uint8	Minutes.
Seconds	13 uint8	Seconds.
Hundred micro seconds	14 uint16	Hundred micro seconds from last whole second. Unit: [100 µs]
Speed of sound	16	Speed of sound used by the instrument.

	uint16	Raw data given as 0.1 m/s Unit: [m/s]
Temperature	18 int16	Reading from the temperature sensor. Raw data given as 0.01 °C Unit: [°C]
Pressure	20 uint32	Raw data given as 0.001 dBar Unit: [dBar]
Heading	24 uint16	Raw data given as 0.01 degrees Unit: [deg]
Pitch	26 int16	Raw data given as 0.01 degrees Unit: [deg]
Roll	28 int16	Raw data given as 0.01 degrees Unit: [deg]
Cell size	32 uint16	Size of each cell (resolution) on the beam. Raw data given as mm Unit: [m]
Nominal correlation	36 uint8	The nominal correlation for the configured combination of cell size and velocity range Unit: [%]
Battery voltage	38 uint16	Raw value given in 0.1 Volt Unit: [V]
Magnetometer.X	40 int16	X axis flux raw value in last measurement interval
Magnetometer.Y	42 int16	Y axis flux raw value in last measurement interval
Magnetometer.Z	44 int16	Z axis flux raw value in last measurement interval
Accelerometer.X	46 int16	Raw accelerometer X axis value in last measurement interval Raw value divided by 16384 will give vector [x,y,z] of length 1 Note: The unit of the instrument is gravity [g]. Conversion of Accelerometer unit less raw measurements to m/s ² : divide measurement by 16384, then multiply by calibrated gravity in Oslo, 9.819 m/s ² .
Accelerometer.Y	48 int16	Raw Y axis value in last measurement interval Raw value divided by 16384 will give vector [x,y,z] of length 1
Accelerometer.Z	50 int16	Raw Z axis value in last measurement interval. Raw value divided by 16384 will give vector [x,y,z] of length 1

Data set description	54/56 uint16	Data set description. 0-3 Physical beam used for 1st data set. 4-7 Physical beam used for 2nd data set. 8-11 Physical beam used for 3th data set. 12-16 Physical beam used for 4th data set.
Transmitted energy	56/58 uint16	Transmitted energy.
Velocity scaling	58/60 int8	Velocity scaling used to scale velocity data.
Power level	59/61 int8	Configured power level Unit: [dB]
Magnetometer temperature	60/62 int16	Magnetometer temperature reading. Uncalibrated Raw data in 1/1000 °C Unit: [°C]
Real time clock temperature	62/64 int16	Real Time Clock temperature reading Unit: [°C]
Error status	64/66 16 bits	Error bit mask Object reference given in table below
Status	68/70 32 bits	Status bit mask Object reference given in table below
Ensemble counter	72/74 uint32	Counts the number of ensembles in both averaged and burst data

Position and size variables:

Name	Description
54/56	The status field is at 54 or 56 depending on whether the ambiguity velocity (in DF3 CurrentProfileData) is 16bit or 32bit long.
56/58	The status field is at 56 or 58 depending on whether the ambiguity velocity (in DF3 CurrentProfileData) is 16bit or 32bit long.
58/60	The status field is at 58 or 60 depending on whether the ambiguity velocity (in DF3 CurrentProfileData) is 16bit or 32bit long.
59/61	The status field is at 59 or 61 depending on whether the ambiguity velocity (in DF3 CurrentProfileData) is 16bit or 32bit long.
60/62	The status field is at 60 or 62 depending on whether the ambiguity velocity (in DF3 CurrentProfileData) is 16bit or 32bit long.
62/64	The status field is at 62 or 64 depending on whether the ambiguity velocity (in DF3 CurrentProfileData) is 16bit or 32bit long.
64/66	The status field is at 64 or 66 depending on whether the ambiguity velocity (in DF3 CurrentProfileData) is 16bit or 32bit long.

68/70	The status field is at 68 or 70 depending on whether the ambiguity velocity (in DF3 CurrentProfileData) is 16bit or 32bit long.
72/74	The status field is at 72 or 74 depending on whether the ambiguity velocity (in DF3 CurrentProfileData) is 16bit or 32bit long.

Object reference: Configuration bit mask

Record Configuration Bit Mask

Field	Position Size	Description
Has pressure sensor	0 bit	Pressure sensor value valid
Has temperature sensor	1 bit	Temperature sensor value valid
Has compass sensor	2 bit	Compass sensor value valid
Has tilt sensor	3 bit	Tilt sensor value valid

Object reference: Error status

Error bit mask

Field	Position Size	Description
Data retrieval FIFO error	0 bit	Data retrieval FIFO error
Data retrieval overflow	1 bit	Data retrieval overflow
Data retrieval underrun	2 bit	Data retrieval Underrun
Data retrieval samples missing	3 bit	Data retrieval samples missing
Measurement not finished	4 bit	The Measurement and data storage/transmit didn't finish before next measurement started.
Sensor read failure	5 bit	Sensor read failure
Tag error beam 1 (In-phase)	8 bit	Tag error beam 1 (In-phase)
Tag error beam 1 (Quadrature-phase)	9 bit	Tag error beam 1 (Quadrature-phase)

Tag error beam 2 (In-phase)	10 bit	Tag error beam 2 (In-phase)
Tag error beam 2 (Quadrature-phase)	11 bit	Tag error beam 2 (Quadrature-phase)
Tag error beam 3 (In-phase)	12 bit	Tag error beam 3 (In-phase)
Tag error beam 3 (Quadrature-phase)	13 bit	Tag error beam 3 (Quadrature-phase)
Tag error beam 4 (In-Phase)	14 bit	Tag error beam 4 (In-phase)
Tag error beam 4 (Quadrature-phase)	15 bit	Tag Error Beam 4 (Quadrature-phase)

Object reference: Status

Status bit mask

Field	Position Size	Description
Wake up state	31-28 4 bits	00 = bad power 01 = power applied 10 = break 11 = RTC alarm
Orientation	27-25 3 bits	0: "XUP" Instrument x-axis defined up, heading reference axis is Z positive 1: "XDOWN" Instrument x-axis defined down, heading reference axis is Z positive 2: "YUP" Instrument y-axis defined up, heading reference axis is Z positive 3: "YDOWN" Instrument y-axis defined down, heading reference axis is Z positive 4: "ZUP" Instrument z-axis defined up, heading reference axis is X positive 5: "ZDOWN" Instrument z-axis defined down, heading reference axis is X positive 7: "AHRS" AHRS reports orientation any way it points. Example: Z down -> Roll = 180 deg.
Auto orientation	24-22 3 bits	0: "Fixed" Fixed orientation 1: "Auto" Auto Up Down 3: "AHRS3D" AHRS3D

5.3 _DF3 CurrentProfileData

Extends: _CommonData

Used By: DF3 VelocityData, DF3 SpectrumData

Common data definitions for Nortek data format 3 (DF3).

Field	Position Size	Description
Blanking	34 uint16	Distance from instrument to first data point on the beam. Raw data given as cm or mm depending on status.blankingDistanceScalingInCm Unit: [m]
Temperature PressureSensor	37 uint8	Temperature of pressure sensor: $T = (Val/5) - 4.0$ Raw value given as 0.2 °C Unit: [°C]
Ambiguity Velocity	52 uint16	Ambiguity velocity, corrected for sound velocity, scaled according to Velocity scaling. $10^{(Velocity\ scaling)}\ m/s$ Unit: [m/s]
Extended status	66 16 bits	Extended status bit mask Object reference given in table below
Status	68 32 bits	Status bit mask. Note that bits 0, 2, 3, 4 are unused. Object reference given in table below

Object reference: Extended status

Extended status bit mask

Field	Position Size	Description
Processor idles < 3%	0 bit	Indicates that the processor Idles less than 3 percent
Processor idles < 6%	1 bit	Indicates that the processor idles less than 6 percent
Processor idles < 12%	1 bit	Indicates that the processor idles less than 12 percent
Extended status should be interpreted	15 bit	If this bit is set the rest of the word/ extended status should be interpreted

Object reference: Status

Status bit mask. Note that bits 0, 2, 3, 4 are unused.

Field	Position Size	Description
Active configuration	16 bit	Bit 16: Active configuration 0: Settings for PLAN,BURST,AVG 1: Settings for PLAN1,BURST1,AVG1
Previous wakeup state	21-18 4 bits	00 = bad power 01 = power applied 10 = break 11 = RTC alarm
Previous measurement skipped due to low voltage	17 bit	Bit 17: Last measurement low voltage skip 0: normal operation 1: last measurement skipped due to low input voltage
Echosounder index	15-12 4 bits	Echosounder frequency index. Valid numbers are 0, 1 and 2 (or 0000, 0001 and 0010) referring to frequencies 1, 2 or 3 as used in SET-/GETECHO.
Telemetry data	11 bit	Telemetry data
Boost running	10 bit	Boost running
Echosounder frequency bin	9-5 5 bit	Used only on the Signature100 which supports up to 5 packages pr frequency index. Processing is then done on the different frequency bands.
Blanking distance scaling in cm	1 bit	Bit 1: Scaling of blanking distance 0: mm scaling 1: given in cm

5.4 DF7 CurrentProfileData

ID: 0x26

Data definitions for parsing Nortek data format DF7.

Field	Position Size	Description
Version	0 uint8	Revision number.
Instrument type	1 uint8	Type of instrument. 0x26 - The Generation 2 Aquadopp and AWAC.
Offset of data	2 uint16	Number of bytes from start of record to start of non-common data fields. Unit: [# bytes]
Configuration of instrument	4 32 bits	Configuration bit mask. Object reference given in table below

Types of data included	8 32 bits	Types of data included. Object reference given in table below
Valid data	12 64 bits	Bit is true if the chosen data is valid Object reference given in table below
Serial number	20 uint32	Instrument serial number from factory.
Year	24 uint8	Number of years since 1900.
Month	25 uint8	Month number counting from 0 which is January.
Day	26 uint8	Day of the month
Hour	27 uint8	24 hour of the day
Minutes	28 uint8	Minutes.
Seconds	29 uint8	Seconds.
Hundred micro seconds	30 uint16	Hundred micro seconds from last whole second. Unit: [100 μ s]
Speed of sound	32 float	Configured or measured sound velocity. Unit: [m/s]
Temperature	36 float	Reading from the temperature sensor. Unit: [°C]
Pressure	40 float	Pressure measurement. Unit: [dBar]
Absolute pressure	44 float	Absolute pressure measurement.. Unit: [dBar]
Heading	48 float	Heading measurement Unit: [deg]
Pitch	52 float	Pitch measurement Unit: [deg]
Roll	56 float	Roll measurement Unit: [deg]
Standard deviation data.Pressure	60 float	Standard deviation on pressure data Raw data in 0.01 dBar Unit: [dBar]
Standard deviation data.Heading	64 float	Standard deviation on heading data Raw data in 0.01 degrees Unit: [deg]

Standard deviation data.Pitch	68 float	Standard deviation on pitch data Raw data in 0.01 degrees Unit: [deg]
Standard deviation data.Roll	72 float	Standard deviation on roll data Raw data in 0.01 degrees Unit: [deg]
Beams, coordinates and cells.Number of beams	76 uint8	Number of beams used.
Beams, coordinates and cells.Coordinate system	77 uint8	Coordinate system: b00 = ENU b01 = XYZ b10 = BEAM b11 = not used
Beams, coordinates and cells.Number of cells	78 uint16	The number of cells Unit: [m]
Cell size	80 float	The size of each cell
Blanking	84 float	Blanking distance Unit: [m]
Battery voltage	88 float	Battery voltage
Pressure sensor temperature	92 float	Temperature measured by the pressure sensor Unit: [°C]
Magnetometer temperature	96 float	Temperature measured by the magnetometer Unit: [°C]
Real time clock temperature	100 float	Temperature measured by the real time clock Unit: [°C]
Magnetometer.X	104 float	raw X axis value in last measurement interval
Magnetometer.Y	108 float	raw Y axis value in last measurement interval
Magnetometer.Z	112 float	raw Z axis value in last measurement interval
Accelerometer.X	116 float	raw X axis value in last measurement interval
Accelerometer.Y	120 float	raw Y axis value in last measurement interval
Accelerometer.Z	124 float	raw Z axis value in last measurement interval

Ambiguity velocity	128 float	Ambiguity velocity Unit: [m/s]
Velocity scaling	132 float	Scale velocity data to m/s
Power level	136 float	Power level Unit: [dB]
Error status	140 32 bits	Error bit mask. Object reference given in table below
Status	144 32 bits	Status bit mask. Object reference given in table below
Average depth speed	148 float	Average depth speed Unit: [m/s]
Average depth direction	152 float	Average depth direction Unit: [deg]
Number average pings	156 uint16	The number of pings averaged over
Nominal correlation	158 uint16	Nominal correlation
Velocity data	OFFSET int16 *VEL_NB *VEL_NC	This field exists if the Velocity data included bit of the Config byte is set. Data is scaled with Velocity Scaling float value in position 132. Unit: [m/s]
Amplitude data	AMP_POS uint8 *AMP_NB *AMP_NC	This field exists if the amplitude data included bit of the Config byte is set 0.5 dB/count Unit: [dB]
Correlation data	CORR_POS uint8 *CORR_NB *CORR_NC	This field exists if the Correlation data included bit of the Config byte is set [0 – 100 %] Unit: [%]
Percentage good data	PGD_START uint8 *PGD_LEN	Percent Good Estimate per cell These fields exist if the Percentage Good data included Unit: [%]
Quality data	QTY_START uint16 *QTY_LEN	Quality mask for each cell. If value is 0, all controls are passed. Otherwise, the masks show why the data is flagged. For more information see the Data Quality Control chapter. Bit 0 - Not used Bit 1 - Fish Bit 2 - Correlation Bit 3 - Pressure Bit 4 - Not used

		Bit 5 - Sidelobe Bit 6 - Percentage good Bit 7 - Not used Bit 8 - Bin mapping Bit 9 - Tilt
CTD data.Conductivity	CTD_START float	Conductivity measured by CTD sensor
CTD data.Temperature	CTD_START + 4 float	Temperature measured by CTD sensor
CTD data.Pressure	CTD_START + 8 float	Pressure measured by CTD sensor
STM data.Scattering	STM_START float	Scattering measured by STM sensor
STM data.HighRange	STM_START + 4 float	High range measured by STM sensor
STM data.StdDevScattering	STM_START + 8 float	Standard deviation of scattering measured by STM sensor
STM data.StdDevHighRange	STM_START + 12 float	Standard deviation of high range measured by STM sensor

Position and size variables:

Name	Description
VEL_NB	Primary dimension of velocity data is number of beams. Length 0 if correlation data in configuration bit map is false.
VEL_NC	Second dimension of velocity data is number of cells pr beam. Length 0 if correlation data in configuration bit map is false.
OFFSET	Offset of data given at position 1 in this dataset. Number of bytes from start of record to start of data.
AMP_NB	Primary dimension of amplitude data is number of beams. Length 0 if correlation data in configuration bit map is false.
AMP_NC	Second dimension of amplitude data is number of cells pr beam. Length 0 if correlation data in configuration bit map is false.
AMP_POS	Correlation data starts after the amplitude data.
CORR_NB	Primary dimension of correlation data is number of beams. Length 0 if correlation data in configuration bit map is false.
CORR_NC	Second dimension of correlation data is number of cells pr beam. Length 0 if correlation data in configuration bit map is false.
CORR_POS	Correlation data starts after the amplitude data.

PGD_LEN	The length of percent good data is the number of cells in the data sett. If the percent good data in the config bitmap is false, length is 0.
PGD_START	Percent good data follows the AHRS data.
QTY_LEN	The length of Quality data is the number of cells in the dataset. If the Quality in the config bitmap is false, length is 0.
QTY_START	Quality data.
CTD_LEN	CTD length.
CTD_START	CTD data.
STM_LEN	STM length.
STM_START	STM data.

Object reference: Configuration of instrument

Configuration bit mask.

Field	Position Size	Description
Pressure sensor	0 bit	Has pressure sensor
Temperature sensor	1 bit	Has temperature sensor
Compass	2 bit	Has compass
Tilt sensor	3 bit	Has tilt sensor
Recharge battery	4 bit	Need to recharge battery
Number of slanted beams	8-11 4 bits	Number of slanted beams
Total number of beams	12-15 4 bits	Total number of beams

Object reference: Types of data included

Types of data included.

Field	Position Size	Description
Velocity included	0 bit	Velocity data is included
Amplitude included	1	Amplitude data is included

	bit	
Correlation included	2 bit	Correlation data is included
Percent good data included	3 bit	Percent good data included
Quality data included	4 bit	Quality data included
Altimeter data included	5 bit	Altimeter data included
Recharge battery included	6 bit	Information if the battery needs recharging is included
CTD included	7 bit	Information if CTD data is included
STM included	8 bit	Information if STM data is included

Object reference: Valid data

Bit is true if the chosen data is valid

Field	Position Size	Description
Serial number	0 bit	Serial number is valid
Year, month, day, hour, second	1 bit	Year, month, day, hour, second is valid
Microseconds valid	2 bit	Microseconds data is valid
Speed of sound	3 bit	Speed of sound is valid
Water temperature is valid	4 bit	Water temperature is valid
Pressure	5 bit	Pressure data included
Absolute pressure	6 bit	Absolute pressure data included
Heading	7 bit	Heading is valid
Pitch	8 bit	Pitch is valid
Roll	9	Roll is valid

	bit	
Standard deviation pressure	10 bit	Standard deviation pressure is valid
Standard deviation heading	11 bit	Standard deviation heading is valid
Standard deviation pitch	12 bit	Standard deviation pitch is valid
Standard deviation roll	13 bit	Standard deviation roll is valid
Number of beams	14 bit	Number of beams is valid
Coordinate system	15 bit	Coordinate system is valid
Number of cells	16 bit	Number of cells is valid
Cell size	17 bit	Cell size is valid
Blanking	18 bit	Blanking is valid
Battery voltage	19 bit	Battery voltage is valid
Temperature in pressure sensor	20 bit	Temperature in pressure sensor data is valid
Temperature in magnetometer is valid	21 bit	Pressure data included
Temperature real time clock	22 bit	Temperature in real time clock is valid
Magnetometer raw	23 bit	Magnetometer raw data is valid
Accelerometer raw data	24 bit	Accelerometer raw data is valid
Ambiguity velocity	25 bit	Ambiguity velocity is valid
Velocity scale	26 bit	Velocity scale is valid
Power level	27 bit	Power level is valid
Error	28 bit	Error is valid

Status	29 bit	Status is valid
Depth average speed	30 bit	Depth average speed is valid
Depth average direction	31 bit	Depth average direction is valid
Number of averaged pings	32 bit	Number of averaged pings data is valid
Nominal correlation	33 bit	Nominal correlation is valid
CTDtemperature	34 bit	CTDtemperature is valid
CTDpressure	35 bit	CTDpressure is valid
CTDconductivity	36 bit	CTDconductivity is valid
STMvalues	37 bit	STMvalues is valid

Object reference: Error status

Error bit mask.

Field	Position Size	Description
Data retrieval FIFO error	0 bit	Data retrieval FIFO error
Data retrieval overflow	1 bit	Data retrieval overflow
Data retrieval underrun	2 bit	Data retrieval Underrun
Data retrieval samples missing	3 bit	Data retrieval samples missing
Measurement not finished	4 bit	Measurement not finished The Measurement and data storage/transmit didn't finish before next measurement started.
Sensor read failure	5 bit	Sensor read failure
Tag error beam 1 (In-phase)	8 bit	Tag error beam 1 (In-phase)

Tag error beam 1 (Quadrature-phase)	9 bit	Tag error beam 1 (Quadrature-phase)
Tag error beam 2 (In-phase)	10 bit	Tag error beam 2 (In-phase)
Tag error beam 2 (Quadrature-phase)	11 bit	Tag error beam 2 (Quadrature-phase)
Tag error beam 3 (In-phase)	12 bit	Tag error beam 3 (In-phase)
Tag error beam 3 (Quadrature-phase)	13 bit	Tag error beam 3 (Quadrature-phase)
Tag error beam 4 (In-Phase)	14 bit	Tag error beam 4 (In-phase)
Tag error beam 4 (Quadrature-phase)	15 bit	Tag Error Beam 4 (Quadrature-phase)

Object reference: Status

Status bit mask.

Field	Position Size	Description
Is average data	0 bit	True if data is average
Active configuration	1 bit	True if active configuration
Last measured low voltage skip	2 bit	Last measured low voltage skip
In air	3 bit	True if instrument is in air
Previous wakeup state	16-19 4 bits	Bit 16-19: Wakeup State 00 = bad power 01 = power applied 10 = break 11 = RTC alarm
Auto orientation	20-22 3 bits	Bit 20-22: autoOrientation 0: "Fixed" Fixed orientation 1: "Auto" Auto Up Down 2: "Auto3D" 3: "AHRS3D" AHRS3D
Orientation	24-27 4 bits	Bit 24-27: Orientation 4: "UP" 5: "DOWN" 7: "AHRS"

Wake up state	28-31 4 bits	Bit 28-31: Wakeup State 00 = bad power 01 = power applied 10 = break 11 = RTC alarm
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5.5 DF3 VelocityData

Extends: _DF3 CurrentProfileData

ID: 0x15, 0x16, 0x18, 0x1e, 0x1a, 0x1f

Data definitions for parsing Nortek velocity data format 3.

Field	Position Size	Description
Configuration	2 16 bits	Record Configuration Bit Mask Object reference given in table below
Beams, coordinates and cells	30 16 bits	Number of beams, coordinate system and number of cells. Object reference given in table below
Velocity data	OFFSET int16 *VEL_NB *VEL_NC	This field exists if the Velocity data included bit of the Config byte is set. 10^(Velocity Scaling) Unit: [m/s]
Amplitude data	AMP_POS uint8 *AMP_NB *AMP_NC	This field exists if the amplitude data included bit of the Config byte is set 0.5 dB/count Unit: [dB]
Correlation data	CORR_POS uint8 *CORR_NB *CORR_NC	This field exists if the Correlation data included bit of the Config byte is set [0 – 100 %] Unit: [%]
Altimeter data.Altimeter distance	ALTI_POS float	Distance to surface from Leading Edge algorithm Unit: [m]
Altimeter data.Altimeter quality	ALTI_POS + 4 uint16	Result of LE algorithm. When quality is deemed too low according to instrument specific limits both the distance and quality are set to 0.
Altimeter data.Altimeter status	ALTI_POS + 6 16 bits	Altimeter status bit mask
AST data.AST distance	AST_POS float	Distance to surface from Max Peak/AST algorithm Unit: [m]
AST data.AST quality	AST_POS + 4 uint16	Amplitude at which surface is detected with the Max Peak/AST algorithm.

		Raw data in steps of 0.01 dB, i.e. quality of 8000 = 80 dB Unit: [dB]
AST data.AST offset	AST_POS + 6 int16	Offset in step of measurement to velocity measurement Raw data given in 100 µs Unit: [s]
AST data.AST pressure	AST_POS + 8 float	Pressure value measured during the AST/altimeter ping Unit: [dbar]
Altimeter raw data.Num RawSamples	ALTIRAW_START + 8 uint16	Altimeter Raw Data – Number of Samples
Altimeter raw data.Samples distance	ALTIRAW_START + 10 uint16	Distance between samples Raw data given in 0.1mm Unit: [m]
Altimeter raw data.Data samples	ALTIRAW_START + 12 int16 *NRS	Altimeter Raw Data – Samples Raw data given as 16 bits Signed fract
AHRS data.Rotation matrix	AHRS_START float *3 *3	AHRS Rotation Matrix [3x3]
AHRS data.Quaternion W	AHRS_START + 36 float	W quaternion
AHRS data.Quaternion X	AHRS_START + 40 float	X quaternion
AHRS data.Quaternion Y	AHRS_START + 44 float	Y quaternion
AHRS data.Quaternion Z	AHRS_START + 48 float	Z quaternion
AHRS data.Gyro X	AHRS_START + 52 float	Gyro in X direction in degrees pr second Unit: [dps]
AHRS data.Gyro Y	AHRS_START + 56 float	Gyro in Y direction in degrees pr second Unit: [dps]
AHRS data.Gyro Z	AHRS_START + 60 float	Gyro in Z direction in degrees pr second Unit: [dps]
Percentage good data	PGD_START uint8 *PGD_LEN	Percent Good Estimate per cell This field exists if the Percentage Good data is included. For the Signature instruments, this will only be relevant for the _avgd.ad2cp file. Unit: [%]
Standard deviation data.Pitch	SD_START int16	Standard deviation on pitch data Raw data in 0.01 degrees Unit: [deg]

Standard deviation data.Roll	SD_START + 2 int16	Standard deviation on roll data Raw data in 0.01 degrees Unit: [deg]
Standard deviation data.Heading	SD_START + 4 int16	Standard deviation on heading data Raw data in 0.01 degrees Unit: [deg]
Standard deviation data.Pressure	SD_START + 6 int16	Standard deviation on pressure data Raw data in 0.001 Bar Unit: [bar]

Position and size variables:

Name	Description
VEL_NB	Primary dimension of velocity data is number of beams. Length 0 if correlation data in configuration bit map is false.
VEL_NC	Second dimension of velocity data is number of cells pr beam. Length 0 if correlation data in configuration bit map is false.
OFFSET	Offset of data given at position 1 in this dataset. Number of bytes from start of record to start of data.
AMP_NB	Primary dimension of amplitude data is number of beams. Length 0 if correlation data in configuration bit map is false.
AMP_NC	Second dimension of amplitude data is number of cells pr beam. Length 0 if correlation data in configuration bit map is false.
AMP_POS	Correlation data starts after the amplitude data.
CORR_NB	Primary dimension of correlation data is number of beams. Length 0 if correlation data in configuration bit map is false.
CORR_NC	Second dimension of correlation data is number of cells pr beam. Length 0 if correlation data in configuration bit map is false.
CORR_POS	Correlation data starts after the amplitude data.
ALTI_POS	Altimeter data starts after the correlation data.
AST_POS	AST data starts after the altimeter data.
NRS	Number of raw samples given as first element of this object.
ALTIRAW_START	Altimeter raw data starts after the AST data.
AHRS_START	AHRS data follows the altimeter raw data.
PGD_START	Percent good data follows the AHRS data.
SD_START	The standard deviation data follows percent good data.

Object reference: Configuration

Record Configuration Bit Mask

Field	Position Size	Description
Has velocity data	5 bit	Velocity data included
Has amplitude data	6 bit	Amplitude data included
Has correlation data	7 bit	Correlation data included
Has altimeter data	8 bit	Altimeter data included
Has altimeter raw data	9 bit	Altimeter raw data included
Has AST data	10 bit	AST data included
Has AHRS data	12 bit	AHRS data included
Has percentage good data	13 bit	Percentage data included
Has standard deviation data	14 bit	Standard deviation data included

Object reference: Beams, coordinates and cells

Number of beams, coordinate system and number of cells.

Field	Position Size	Description
Number of beams	15-12 2 bits	Number of Beams (NB) Active beams represented as a 4 char string of 1s and 0s.
Coordinate system	11-10 2 bits	Coordinate system 00 = ENU 01 = XYZ 10 = BEAM 11 = not used
Number of cells	9-0 10 bits	Number of Cells (NC).

5.6 DF3 SpectrumData

Extends: _DF3 CurrentProfileData

ID: 0x20

Data definitions for parsing DF3 amplitude spectrum data.

Field	Position Size	Description
Configuration	2 16 bits	Record configuration bit mask. Object reference given in table below
Beams and bins	30 16 bits	Number of bins in the frequency spectrum. Object reference given in table below
Spectrum data.Start frequency	OFFSET float	Start frequency value Unit: [Hz]
Spectrum data.Step frequency	OFFSET + 4 float	Step frequency value Unit: [Hz]
Spectrum data.Frequency data	OFFSET + 64 int16 *BEAMS *BINS	Frequency spectrum amplitude data. There is room for 16 floating points for a spectrum header before the frequency data. Unit: [dB]

Position and size variables:

Name	Description
BEAMS	Matrix first dimension is number of beams. Eg: [[f_start, .., f_{start+step*(bins-1)}]_{beam1} [f_start, .., f_{start+step*(bins-1)}]_{beam2} .. [f_start, .., f_{start+step*(bins-1)}]_{beams}]
BINS	Per beam, frequencies are given as an array of length as number of bins. First element is the start frequency and frequencies increment by step frequency per element of the array. Eg: [[f_start, f_{start+step}, f_{start+step*2}, .., f_{start+step*(bins-1)}]_{beam1}, .., ..]
16+BEAMSxBINSx2	If configuration.hasSpectrumData is false, spectrum data is length 0. RAW: !this.configuration.hasSpectrumData ? 0 : this.beamsAndBins.numberOfBeams*this.beamsAndBins.numberOfBins*2 + 16*4
OFFSET	Number of bytes from start of record to start of data.

Object reference: Configuration

Record configuration bit mask.

Field	Position	Description
-------	----------	-------------

	Size	
Has spectrum data	15 bit	Amplitude spectrum data included.

Object reference: Beams and bins

Number of bins in the frequency spectrum.

Field	Position Size	Description
Number of beams	15-13 3 bits	Number of active beams.
Number of bins	12-0 13 bits	Number of bins.

5.7 StringData

ID: 0xa0

String Data Record, eg. GPS NMEA data, comment from the FWRITE command.

Field	Position Size	Description
String	0 Size of record	String data record.

5.8 WaveData

ID: 0x30

This chapter describes the Wave Data Format. In order to enable onboard processed wave data a wave processing license is required. Upon retrieval, the binary processed wave data can be found in the _avgd.ad2cp file. For more information about the processing routine, please refer to the Principles of Operation - Waves manual.

Field	Position Size	Description
Version	0 uint8	Version number of this Data Record Definition. Should be 1.
Offset of data	1 uint8	Number of bytes from start of record to start of non-common data fields. Unit: [bytes]
Included data	2 16 bits	Bit mask to enable/disable data output. Object reference given in table below
Serial number	4 uint32	Instrument serial number from factory.

Year	8 uint8	Number of years since 1900.
Month	9 uint8	Month number counting from 0 which is January.
Day	10 uint8	Day of the month
Hour	11 uint8	24 hour of the day
Minutes	12 uint8	Minutes.
Seconds	13 uint8	Seconds.
Hundred micro seconds	14 uint16	Hundred micro seconds from last whole second. Unit: [100 μ s]
Wave counter	16 uint16	Counting from 1
Error	18 32 bits	Error bitmask Object reference given in table below
Status	22 32 bits	Wave status bit mask. Object reference given in table below
Spectrum type	26 uint8	Spectrum type used in processing. Values may be: 0: Pressure 1: Velocity 2: Auto depth 3: AST only
Processing method	27 uint8	Processing method for direction. 2 = SUV , 4 = MLMST
Target cell	28 uint8	
Unused	29 uint8	Unused bytes
Number of no detects	30 uint16	Number of ST Bad detects Unit: [#]
Number of bad detects	32 uint16	Number of ST Bad detects Unit: [#]
Cut off frequency	34 float	Cut off frequency, directional estimates are valid for frequencies below this limit Unit: [Hz]
Processing time	38 float	Processing time duration Unit: [s]

Number of zero crossings	42 uint16	Number of wave zero crossings
Version string	44 4 bytes	Version as string
Unused	48 54 bytes	56 unused spare bytes
WaveData	OFFSET	Wave parameters Object reference given in table below
SwellWaves	SWELL_P	Wave Bands Data for swells (lower frequencies). There are two bands separated with BANDSEPFREQ in SETWAVEPROC Object reference given in table below
SeaWaves	SEA_P	Wave Bands Data for sea waves (higher bands). There are two bands separated with BANDSEPFREQ Object reference given in table below
EnergySpectrum	WS_P	Wave energy spectrum Object reference given in table below
FourierCoefficients	WFC_P	Wave fourier coefficients data Object reference given in table below
Direction	WDIR_P	Wave direction data Object reference given in table below

Position and size variables:

Name	Description
WD_L	If 'Wave Pars' is true in the 'Included' bit mask, Wave data length (WD_L) is given by 80 bytes (20 floats) and 20 spare bytes.
OFFSET	Offset of data given at position 1 in this dataset. Number of bytes from start of record to start of data.
SWELL_L	If 'Wave band' is true in the 'Included' bit mask, the length of swell band is given by 52 bytes.
SWELL_P	The position of the swell band data are the sum of OFFSET and WD_L.
SEA_L	If 'Wave band' is true in the 'Included' bit mask, the length of sea band is given by 52 bytes.
SEA_P	The position of the sea band data are the sum of OFFSET, WD_L and SWELL_L.
WS_L	If 'energy spectra' is true in the 'Included' bit mask, length is given by 14 bytes (3 floats and a unit16) and 22 spare bytes and 4 times nBins in the dataset.
WS_P	Position of wave spectrum data are the sum of OFFSET, WD_L and WB_L.
WFC_L	If 'Fourier spectra' is true in the 'Included' bit mask, the fourier coefficients data Length (FC_L) is given by 14 bytes (3 floats and a unit16) and 22 spare bytes and nBins times 4 coefficients each a float (nBins*4*4).

WFC_P	Position of wave fourier coefficients (FC_P) are the sum of OFFSET, WD_L, WB_L and WS_L.
WDIR_L	If 'Wave direction spectra' is true in the 'Included' bit, wave direction length (WDIR_L) is given by 14 bytes (3 floats and a unit16) and 22 spare bytes.
WDIR_P	Position of wave direction spectra (WDIR_P) is the sum of OFFSET, WD_L, WB_L, WS_L and WFC_L.

Object reference: Included data

Bit mask to enable/disable data output.

Field	Position Size	Description
Wave parameters	0 bit	When 1, wave parameters is included in dataset
Energy spectra	1 bit	When 1, energy spectra is included in dataset
Wave band	2 bit	When 1, wave band is included in dataset
Fourier spectra	3 bit	When 1, fourier spectra is included in output.
Wave direction spectra	4 bit	When 1, Wave direction spectra is included in dataset
Unused	5-16 11 bits	These bits a not used.

Object reference: Error

Error bitmask

Field	Position Size	Description
No pressure	0 bit	
Low pressure	1 bit	
Low amp	2 bit	
White noise	3 bit	
Unreasonable estimation	4 bit	

Never processed	5 bit	
AST out of bound	6 bit	
Direction ambiguity	7 bit	
No pressure peak	8 bit	
Close to clip	9 bit	
AST height loss	10 bit	
High tilt	11 bit	
Correlation	12 bit	
Unused	13-31 19 bits	These bits a not used.

Object reference: Status

Wave status bit mask.

Field	Position Size	Description
Unused	0-15 16 bits	These bits a not used.
Active configuration	16 bit	
Unused	17-32 15 bits	These bits a not used.

Object reference: WaveData

Wave parameters

Field	Position Size	Description
Height 0	0 float	Spectral significant wave height. Unit: [m]
Height 3	4 float	AST significant (33%) wave height. Unit: [m]

Height 10	8 float	AST wave height, top 10%. Unit: [m]
Height max	12 float	AST max wave height in wave ensemble. Unit: [m]
Height mean	16 float	AST mean wave height in wave ensemble. Unit: [m]
Period mean	20 float	Mean period spectrum based. Unit: [s]
Period peak	24 float	Peak period. Unit: [s]
Period Z	28 float	AST mean zero-crossing period. Unit: [s]
Period 1/3	32 float	Mean 1/3 period. Unit: [s]
Period 1/10	36 float	Mean 1/10 period. Unit: [s]
Period max	40 float	Period for maximum wave. Unit: [s]
Period energy	44 float	Wave energy period. Unit: [s]
Direction at peak period	48 float	Direction at peak period. Unit: [deg]
Spreading at peak period	52 float	Spreading at peak period. Unit: [deg]
Wave direction mean	56 float	Mean wave direction. Unit: [deg]
Unidirectivity index	60 float	Unidirectivity index [0-1].
Pressure mean	64 float	Mean pressure during burst. Unit: [m]
Current speed mean	68 float	Mean current speed - wave cells. Unit: [m/sec]
Current direction mean	72 float	Mean current direction - wave cells. Unit: [deg]
AST distance mean	76 float	Mean AST distance during burst. Unit: [m]
Unused	80 20 bytes	20 unused spare bytes

Object reference: SwellWaves

Wave Bands Data for swells (lower frequencies). There are two bands separated with BANDSEPFREQ in SETWAVEPROC

Field	Position Size	Description
Low frequency	0 float	Unit: [Hz]
High frequency	4 float	Unit: [Hz]
Height 0	8 float	Spectral significant wave height [m] Unit: [m]
Period mean	12 float	Mean period spectrum based. Unit: [s]
periodPeak	16 float	Peak period Unit: [s]
Direction at peak period	20 float	Direction at peak period. Unit: [deg]
Wave direction mean	24 float	Mean wave direction. Unit: [deg]
Spreading at peak period	28 float	Spreading at peak period. Unit: [deg]
Unused	32 20 bytes	Unused 20 bytes

Object reference: SeaWaves

Wave Bands Data for sea waves (higher bands). There are two bands separated with BANDSEPFREQ

Field	Position Size	Description
Low frequency	0 float	Unit: [Hz]
High frequency	4 float	Unit: [Hz]
Height 0	8 float	Spectral significant wave height [m] Unit: [m]
Period mean	12 float	Mean period spectrum based. Unit: [s]
periodPeak	16 float	Peak period Unit: [s]
Direction at peak period	20 float	Direction at peak period. Unit: [deg]

Wave direction mean	24 float	Mean wave direction. Unit: [deg]
Spreading at peak period	28 float	Spreading at peak period. Unit: [deg]
Unused	32 20 bytes	Unused 20 bytes

Object reference: EnergySpectrum

Wave energy spectrum

Field	Position Size	Description
Low frequency	0 float	Unit: [Hz]
High frequency	4 float	Unit: [Hz]
Step frequency	8 float	Unit: [Hz]
nBins	12 uint16	Number of spectral bins (default 98)
Unused	14 22 bytes	Unused 20 bytes
Data	36 float *1 *nBins	Energy spectrum data stored as an array of nBins length. Unit: [cm ² /Hz]

Object reference: FourierCoefficients

Wave fourier coefficients data

Field	Position Size	Description
Low frequency	0 float	Unit: [Hz]
High frequency	4 float	Unit: [Hz]
Step frequency	8 float	Unit: [Hz]
nBins	12 uint16	Number of spectral bins (default 98)
Unused	14	Unused 20 spare bytes

	22 bytes	
Coefficients	36 float *4 *nBins	Fourier coefficients stored as 4 x nBins matrix: [A1[nBins] B1[nBins] A2[nBins] B2[nBins]]. Values range from [-1, 1].

Object reference: Direction

Wave direction data

Field	Position Size	Description
Low frequency	0 float	Unit: [Hz]
High frequency	4 float	Unit: [Hz]
Step frequency	8 float	Unit: [Hz]
nBins	12 uint16	Number of spectral bins (default 98)
Unused	14 22 bytes	Unused spare 20 bytes
Data	36 float *2 *nBins	Wave direction data as a 2 x nBins matrix. Md[nBins] - Directional spectrum Ds[nBins] - Directional spread spectrum.

6 Data Quality Control

When collecting average current data with your Generation 2 Aquadopp instrument, the averaged data for each cell and each configured average interval is saved to the **[filename]_avgd.aqd** file. The data format used for the average current data is data format 7 (see [DF7 CurrentProfileData](#)). Single ping data is not saved, so to avoid bias from single pings with poor quality being included in the average, the instrument has an internal quality control which discards all pings with less than 50 % correlation before averaging. For more information about the correlation parameter, please refer to [Principles of Operation - Currents](#). Note that this internal quality control is only relevant for the average current data, as burst types of measurements like wave bursts use data format 3 (DF3 VelocityData) and saves individual pings in the **[filename].aqd** file.

In the DF7 average current data there is also a Percentage Good value which indicates how many pings have been discarded from each cell in each average interval. For example, if you have configured your instrument to do 10 pings within each average interval, and one ping in the first cell is removed because of low correlation, the resulting Percentage Good value will be 90 % for this cell. If the Percentage Good value is 0 all pings have been discarded due to low correlation and the velocity will be set to 0.

In addition to discarding the pings with less than 50 % correlation, the instrument will also give you a 16 bits Quality Code for each cell. The quality checks included in the quality control are the following:

Bit 0 (0000 0000 0001) - Not used

Bit 1 (0000 0000 0010) - Fish filter

Mask based on spike detection in each beam when compared to the mean values of the other beams.

Bit 2 (0000 0000 0100) - Correlation

Pings with correlation less than 50 % are masked.

Bit 3 (0000 0000 1000) - Pressure

Uses the pressure readings to detect if the collected data is out of water.

Bit 4 (0000 0001 0000) - Not used

Bit 5 (0000 0010 0000) - Sidelobe

Masks cells contaminated by surface sidelobes by comparing the minimum absolute pressure during the average interval to a conservative cutoff value of 1050 hPa for the corresponding surface pressure. For more information about sidelobes, refer to the following FAQ: [What is sidelobe interference?](#)

Bit 6 (0000 0100 0000) - Percent good

Masks the cell if the Percent Good value is below 50 %. The Percent Good is calculated by dividing the number of pings that have passed the correlation test by the total number of pings within the cell and average interval.

Bit 7 (0000 1000 0000) - Not used

Bit 8 (0001 0000 0000) - Bin map

Used when no cells could be mapped to this vertical position, for example due to a tilted instrument.

Bit 9 (0010 0000 0000) - Tilt

Masks entire profile where either the average pitch or roll exceeds 40° through the average interval or the pitch or roll standard deviation exceeds 5°.

If the Quality Code is 0, all controls are passed. Otherwise, the code itself indicates why the data is flagged. If a data point is flagged by several control parameters, the code will be a combination of the respective bits. For example if the cell has one or several pings that is removed due to low correlation and it is detected to be within the sidelobe interference area the status code will be 0000 0010 0100 with bit 2 and bit 5 used. Note that these checks do not remove or alter the data in any way, only flags it. In post processing, you can choose if you want to discard the data masked because of one or several of the quality parameters listed above or to keep them and do quality control manually.

6.1 Telemetry Quality Control

When your Generation 2 Aquadopp is set up to do telemetry of average current data all pings with too low correlation are discarded before the data is averaged and outputted. By default, the lower correlation threshold is set to 50 %, but this can be adjusted using the **CORRTH** with the **SETTMAVG** command. If more than 50 % of the data points within one cell and average interval are discarded due to too low correlation, the whole cell will be flagged as bad. The flagged data will show as extreme values in your data:

- Velocity: -32.767 m/s
- Speed: 46.34 m/s
- Direction: 225°

7 Telemetry Data Formats

This section describes the Telemetry Data formats. Telemetering data means to send data packets over the communications line while the instrument is measuring. While data is telemetered, the raw data will be saved on the recorder for later retrieval. Note that different data types have separate telemetry data formats (see the following chapters). Telemetry of each data type needs to be configured individually by their specific command. **SETTMAVG** is for example used to configure telemetry of average current data while **SETTMWAVE** is used to configure telemetry of processed wave data. The telemetry data formats can be configured both to be outputted over the serial communication line, or to be save to the recorder. The telemetry file output will be saved to the recorder in a file named "telemetryfile.bin" when enabled.

7.1 Averaging Mode

The telemetry of the average current data is controlled by the **SET/GETTMAVG** command. The DF parameter of this command sets the data format, this can also be set in the deployment software.

Data format (DF)	Description
3	Binary format as described in the data format chapter .
7	Binary format as described in the data format chapter .
100	Same NMEA format as previous generations of Aquadopp/AWAC (NMEA sentences: PNORI, PNORS and PNORC).
101	NMEA format 1 (without tags). (NMEA sentences: PNORI1, PNORS1 and PNORC1).
102	NMEA format 2 (with tags). (NMEA sentences: PNORI2, PNORS2 and PNORC2).
103	NMEA format 3 (with tags). (NMEA sentences: PNORH3, PNORS3 and PNORC3).
104	NMEA format 4 (without tags). (NMEA sentences: PNORH4, PNORS4 and PNORC4).
150	RDI Workhorse PD0 data format. Refer to RDI for documentation.
600	Legacy binary data format, same as used by the previous generation of Aquadopp Profilers. Described in the Integrators Guide - Classic
601	Legacy binary data format, same as used by the previous generation of Aquadopp Current Meters. Described in the Integrators Guide - Classic
602	Legacy ASCII data format, same as used by the previous generation of Aquadopp Current Meters. Described in the Integrators Guide - Classic

7.1.1 NMEA Format (DF=100)

Information (configuration): \$PNORI

Column	Description	Data format	Example
0	Identifier	"\$PNORI"	
1	Instrument type	N 0=Aquadopp 2=Aquadopp Profiler 4=Signature	2
2	Head ID	String	Aquadopp Profiler 2 MHz S2SP123456
3	Number of beams	N	3
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 0=ENU 1=XYZ 2=BEAM	0
8	Checksum	*hh	2E

Example (DF=100): \$PNORI,2,Aquadopp Profiler 2 MHz
S2SP123456,3,20,0.20,1.00,0*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	
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	
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	
19	Checksum	*hh	22

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

7.1.2 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 0=Aquadopp 2=Aquadopp Profiler 4=Signature	IT=2
2	Head ID		SN	N	SN=123456
3	Number of Beams		NB	N	NB=3
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):

\$PNORI1,2,123456,3,30,1.00,5.00,BEAM*5B

Example (DF=102):

\$PNORI2,IT=2,SN=123456,NB=3,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=083 013
2	Time		TIME	HHMMSS	TIME=1324 55
3	Error Code		EC	N	EC=0
4	Status Code		SC	hhhhhhhh	SC=340000 34
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
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
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	dd.ddd	V2=0.332
15	Velocity Beam 3 - only included if CY=BEAM	[m/s]	V3	dd.ddd	V3=-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
21	Correlation Beam 1	[%]	C1	N	C1=78
22	Correlation Beam 2	[%]	C2	N	C2=78
23	Correlation Beam 3	[%]	C3	N	C3=78

Example (DF=101, CY=ENU):

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

Example (DF=102, CY=ENU):

\$PNORC2,DATE=083013,TIME=132455,CN=3,CP=11.0,VE=0.332,VN=0.332,VU=0.332,A1=78.9,A2=78.9,A3=78.9,C1=78,C2=78,C3=78*6D

7.1.3 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=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

7.2 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	Legacy binary data format, same as used by the AWAC (described in chapter 5.6.1 in the Integrators Guide - Classic)

7.2.1 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 0 = Pressure 1 = Velocity 3 = AST
4	Processing method		N 1 = PUV 2 = SUV 3 = MLM 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 0 = Pressure 1 = Velocity 3 = AST
4	Processing method		N 1 = PUV 2 = SUV 3 = MLM 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 0 = Pressure 1 = Velocity 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 ² /Hz]	dddd.ddd
8	Energy density (frequency 2)	[cm ² /Hz]	dddd.ddd
N+6	Energy density (frequency N)	[cm ² /Hz]	dddd.ddd
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 0 = Pressure 1 = Velocity 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):

[illegible]

Wave directional spectra

Example (DF=501):

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