

NORTEK MANUALS

# Integrator's Guide

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Generation 2 Vector





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# 1 Introduction

The primary objective of this manual is to provide the information needed to control a Nortek product that is based on the ADV hardware platform. This includes the generation 2 Vector. It is aimed at system integrators and engineers with interfacing experience, but it also includes examples on how to configure and start the instrument for more inexperienced integrators. The document's scope is limited to interfacing and does not address general performance issues of the instrument. For a more thorough understanding of the principles, we recommend the [Principles of Operation](#). For more information about the difference between generation 2 Vector and the previous generation please refer to [Release notes for the generation 2 Vector](#). For data formats relevant for the previous generation of Vector, please refer to [The Comprehensive Manual for Velocimeters](#). 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.

The document is complete in the sense that it describes all available commands and modes of communication.

## Nortek online

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| Version/revision | Date | Comments      |
|------------------|------|---------------|
| Version 2025.1   | 2025 | First version |
|                  |      |               |
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## 1.1 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 Retrieval: Data download from recorder (not yet implemented)
- **Measurement:** Data collection mode
- **Confirmation:** Confirmation mode

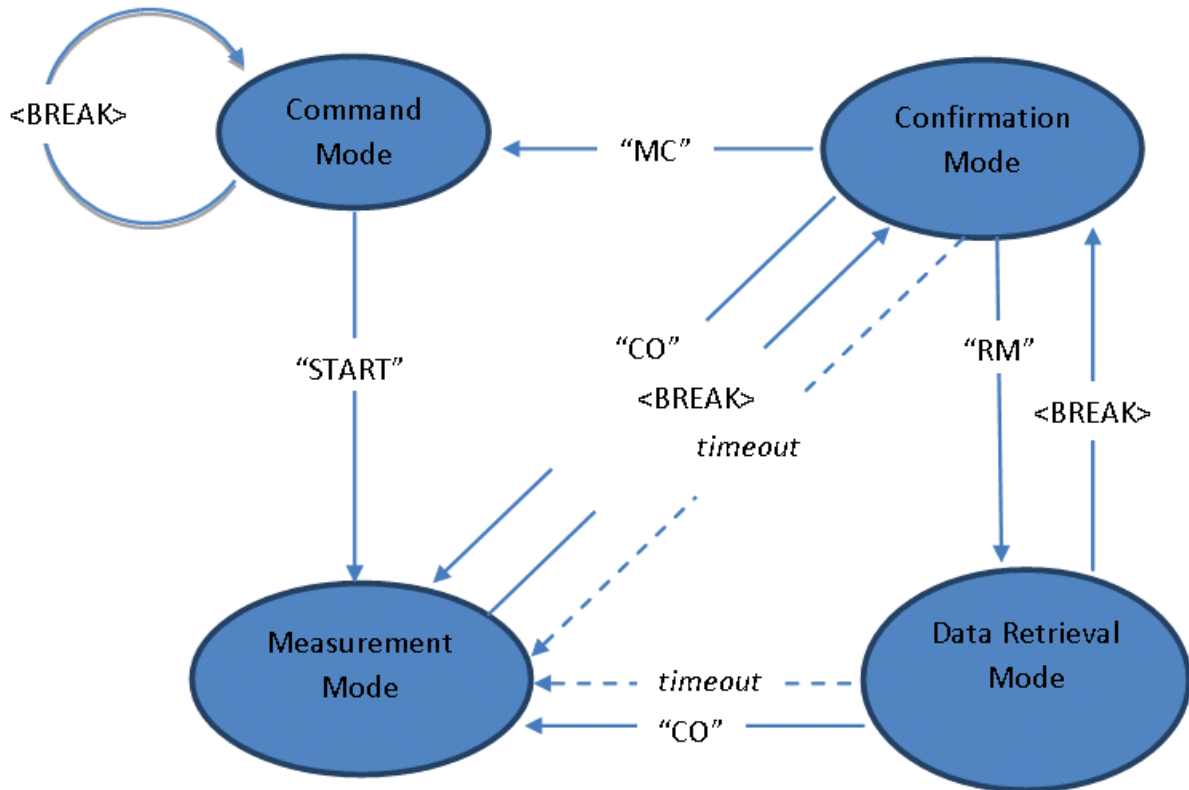


Figure 1: Instrument modes of operation

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 Basic interface concepts

The command interface for the Vector 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.

While the instrument supports both serial and Ethernet interfaces, current functionality over Ethernet is limited. Features such as configuration and data transfer via File Transfer Protocol (FTP) or telnet are not fully implemented at this stage. As a result, this manual focuses on usage through the serial interface, which is fully supported and sufficient for all standard online applications. Support for Ethernet-based operation, including port configuration and file transfer protocols, will be introduced in future firmware revisions and updated versions of this manual released.

## 2.1 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:

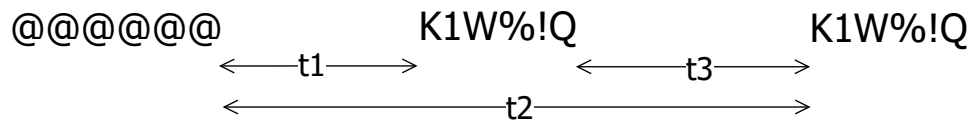


Figure: Break timing

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

### 3 Commands

This chapter covers the commands that can be used to control an Vector generation 2 instrument. 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]),
```

```
NPING=([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
```

### 3.1 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                 |
|----------------|-------------------------------------------------------------------------------------------------------|----------------------|
| SETINST        | Set instrument main settings                                                                          | COMMAND              |
| GETINST        | Get instrument main settings                                                                          | COMMAND              |
| GETINSTLIM     | Set instrument main setting limits                                                                    | COMMAND              |
| WRITECLOCK     | Set instrument clock.,Note! All parameters must be provided.                                          | COMMAND<br>RETRIEVAL |
| READCLOCK      | Read instrument clock                                                                                 | COMMAND<br>RETRIEVAL |
| WRITECLOCKSTR  | Write instrument clock as string                                                                      | COMMAND<br>RETRIEVAL |
| READCLOCKSTR   | Read instrument clock as string                                                                       | COMMAND<br>RETRIEVAL |
| SETPLAN        | Set plan settings                                                                                     | COMMAND              |
| GETPLAN        | Get plan settings                                                                                     | COMMAND              |
| GETPLANLIM     | Get plan setting limits                                                                               | COMMAND              |
| SETBURST       | Set burst settings                                                                                    | COMMAND              |
| GETBURST       | Get burst settings                                                                                    | COMMAND              |
| GETBURSTLIM    | Get burst setting limits                                                                              | COMMAND              |
| SETECHO        | Set echosounder settings                                                                              | COMMAND              |
| GETECHO        | Get echosounder settings                                                                              | COMMAND              |
| GETECHOLIM     | Get echosounder setting limits                                                                        | COMMAND              |
| READMEM        | Read recorder data memory usage                                                                       | COMMAND              |
| READPWR        | Returns the power consumption in mW for the various measurements enabled as well as the overall value | COMMAND              |
| SETECHOMISC    | Set echo measurement miscellaneous settings                                                           | COMMAND              |
| GETECHOMISC    | Get echo measurement miscellaneous settings                                                           | COMMAND              |
| GETECHOMISCLIM | Get echo miscellaneous limits                                                                         | COMMAND              |
| SETVEL         | Set velocity measurement settings                                                                     | COMMAND              |
| GETVEL         | Get velocity measurement settings                                                                     | COMMAND              |
| GETVELLIM      | Get velocity limits                                                                                   | COMMAND              |

|                          |                                                                                                                 |                                                     |
|--------------------------|-----------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|
| SETVELMISC               | Set velocity measurement miscellaneous settings                                                                 | COMMAND                                             |
| GETVELMISC               | Get velocity measurement miscellaneous settings                                                                 | COMMAND                                             |
| GETVELMISCLIM            | Get velocity miscellaneous limits                                                                               | COMMAND                                             |
| SETEXTSENSORA            | Set external sensor settings                                                                                    | COMMAND                                             |
| GETEXTSENSORA            | Get external sensor settings                                                                                    | COMMAND                                             |
| GETEXTSENSORALIM         | Get external sensor limits                                                                                      | COMMAND                                             |
| READEXTSENS-<br>ORAUNITS | Describes each field and unit used in the external sensor data format, depending on the type of external sensor | COMMAND                                             |
| SETPROBE                 | Set probe settings                                                                                              | COMMAND                                             |
| GETPROBE                 | Get probe settings                                                                                              | COMMAND                                             |
| GETPROBELIM              | Get probe limits                                                                                                | COMMAND                                             |
| READID                   | Get instrument Id                                                                                               | COMMAND<br>CONFIRMATION<br>MEASUREMENT<br>RETRIEVAL |
| SETSPECTRUM              | Set frequency spectrum settings                                                                                 | COMMAND                                             |
| GETSPECTRUM              | Get frequency spectrum settings                                                                                 | COMMAND                                             |
| GETSPECTRUMLIM           | Get frequency spectrum settings limits                                                                          | COMMAND                                             |
| LOADDEFAULT              | Reload default settings                                                                                         | COMMAND                                             |
| READBATTERY              | Read battery measurement                                                                                        | COMMAND                                             |
| SETTMVEL                 | Set velocity telemetry settings                                                                                 | COMMAND                                             |
| GETTMVEL                 | Get velocity telemetry settings                                                                                 | COMMAND                                             |
| GETTMVELLIM              | Get instrument velocity telemetry limits                                                                        | COMMAND                                             |
| SETTMAHRS                | Set AHRS telemetry settings                                                                                     | COMMAND                                             |
| GETTMAHRS                | Get AHRS telemetry settings                                                                                     | COMMAND                                             |
| GETTMAHRSLIM             | Get instrument AHRS telemetry limits                                                                            | COMMAND                                             |
| SAVE                     | Save settings for next measurement                                                                              | COMMAND                                             |
| START                    | Start the instrument                                                                                            | COMMAND                                             |
| MC                       | Go into command mode                                                                                            | COMMAND<br>CONFIRMATION                             |
| CO                       | Go into measurement mode                                                                                        | CONFIRMATION<br>RETRIEVAL                           |
| LISTCFG                  | List current configuration                                                                                      | COMMAND                                             |
| READSTATE                | Returns information about the current operational state of the instrument                                       | COMMAND<br>CONFIRMATION<br>MEASUREMENT              |

|               |                                                                                                            |                                                     |
|---------------|------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|
|               |                                                                                                            | RETRIEVAL                                           |
| READERROR     | Returns a full description of the last error condition to occur                                            | COMMAND<br>CONFIRMATION<br>MEASUREMENT<br>RETRIEVAL |
| READXFVEL     | Get the "Beam to XYZ" transformation matrix                                                                | COMMAND                                             |
| READHW        | Returns hardware revisions.                                                                                | COMMAND<br>CONFIRMATION<br>MEASUREMENT<br>RETRIEVAL |
| READFW        | Read firmware version                                                                                      | COMMAND<br>CONFIRMATION<br>MEASUREMENT<br>RETRIEVAL |
| LISTVER       | List versions for all software components                                                                  | COMMAND                                             |
| ADDLICENSE    | Add license key                                                                                            | COMMAND                                             |
| DELETELICENSE | Delete license key                                                                                         | COMMAND                                             |
| LISTLICENSE   | Lists all license keys in instrument                                                                       | COMMAND                                             |
| WRITEMODBUS   | Perform a modbus write transaction (FC16). This command writes to a single Modbus address per transaction. | COMMAND                                             |
| LISTMODBUS    | Perform a modbus read transaction (FC03, FC04) and list the register values.                               | COMMAND                                             |

### 3.2 Instrument main settings

**Commands:** SETINST, GETINST, GETINSTLIM,

**Command type:** CONFIGURATION

**Access:** User

**Mode:** COMMAND

Instrument main settings

| Argument | Description                                                                                                             |
|----------|-------------------------------------------------------------------------------------------------------------------------|
| BR       | Baud Rate<br>115200, 230400, 460800, 921600<br>Unit: [bit/s]                                                            |
| RS       | Serial protocol<br>232, 422                                                                                             |
| LED      | Enable/disable LED blink in head.<br>When set to "ON24H" the LED will illuminate the first 24 hours of the measurement. |

|         |                                                                                                                                                    |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------------|
|         | ON, OFF, ON24H                                                                                                                                     |
| ORIENT  | Sets the instrument orientation.<br>Not used for DVL.<br>AUTOXUPDOWN, AUTOYUPDOWN, AUTOZUPDOWN, ZUP, ZDOWN, XUP, XDOWN, YUP, YDOWN, AUTO3D, AHRS3D |
| CMTOUT  | Command mode timeout<br>Unit: [s]                                                                                                                  |
| DMTOUT  | Data retrieval mode timeout<br>Unit: [s]                                                                                                           |
| CFMTOUT | Confirmation mode timeout<br>Unit: [s]                                                                                                             |

## SETINST

Set instrument main settings

**Example:**

```
SETINST, BR=230400
```

OK

## GETINST

Get instrument main settings

**Example:**

```
GETINST, BR=460800, RS=232, LED="ON", ORIENT="AUTOZUPDOWN", CMTOUT=300, DMTOUT=60, CFMTOUT=60
```

## GETINSTLIM

Set instrument main setting limits

### 3.3 Clock commands

**Commands:** WRITECLOCK, READCLOCK,

**Command type:** CONFIGURATION

**Access:** User

**Mode:** COMMAND, RETRIEVAL

Set and read instrument clock

| Argument | Description |
|----------|-------------|
|----------|-------------|

|        |                          |
|--------|--------------------------|
| YEAR   | Year (four digits)       |
| MONTH  | Month 1-12 (Jan = 1)     |
| DAY    | Day of month (1-31)      |
| HOURL  | Hour of day (0-23)       |
| MINUTE | Minute of hour (0-59)    |
| SECOND | Seconds of minute (0-59) |

## WRITECLOCK

Set instrument clock.,Note! All parameters must be provided.

**Example:**

```
WRITECLOCK, YEAR=2024, MONTH=3, DAY=11, HOUR=8, MINUTE=16, SECOND=9
OK
```

## READCLOCK

Read instrument clock

**Example:**

```
$PNOR, READCLOCK*75
$PNOR, READCLOCK, YEAR=2024, MONTH=3, DAY=11, HOUR=8, MINUTE=16, SECOND=9*
59
$PNOR, OK*2B
```

### 3.4 Clock as string

**Commands:** WRITECLOCKSTR, READCLOCKSTR,

**Command type:** CONFIGURATION

**Access:** User

**Mode:** COMMAND, RETRIEVAL

Write and read instrument clock as string

| Argument | Description                                                        |
|----------|--------------------------------------------------------------------|
| TIME     | Text string on the following format: yyyy-MM-dd HH:mm:ss (use UTC) |

## WRITECLOCKSTR

Write instrument clock as string

**Example:**

```
WRITECLOCKSTR, TIME="2024-02-11 08:16:09"
```

OK

## READCLOCKSTR

Read instrument clock as string

**Example:**

READCLOCKSTR

"2024-02-11 08:16:09"

OK

## 3.5 Plan settings

**Commands:** SETPLAN, GETPLAN, GETPLANLIM,

**Command type:** CONFIGURATION

**Mode:** COMMAND

Plan profile settings and relevant limits.

| Argument | Description                                                                                                  |
|----------|--------------------------------------------------------------------------------------------------------------|
| SA       | Salinity value.                                                                                              |
| SV       | Sound velocity. When set to 0, the sound velocity is computed from water temperature, pressure and salinity. |
| BURST    | Enable/disable burst measurements.                                                                           |
| FN       | Filename.<br>Values: ['a'; 'z']; ['A'; 'Z']; ['0'; '9']; '_'   Max Length: 30                                |
| SO       | Enable/disable velocity measurement.                                                                         |

## SETPLAN

Set plan settings

## GETPLAN

Get plan settings

## GETPLANLIM

Get plan setting limits

### 3.6 Burst settings

**Commands:** SETBURST, GETBURST, GETBURSTLIM,

**Command type:** CONFIGURATION

**Mode:** COMMAND

Burst profile settings and relevant limits.

| Argument | Description                          |
|----------|--------------------------------------|
| MI       | Measurement interval.<br>Unit: [s]   |
| DURATION | Measurement duration.<br>Unit: [sec] |
| VEL      | Enable/disable velocity measurement. |
| ECHO     | Enable/disable echo measurement.     |
| SPECTRUM | Enable/disable spectrum measurement. |

**Note:** The actual valid range for the various parameters for the firmware version is used 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

#### GETBURST

Get burst settings

#### GETBURSTLIM

Get burst setting limits

### 3.7 Echosounder settings

**Commands:** SETECHO, GETECHO, GETECHOLIM,

**Command type:** CONFIGURATION

**Mode:** COMMAND

Echosounder settings and relevant limits

| Argument | Description    |
|----------|----------------|
| SR       | Sampling rate. |

|            |                                                                                                                                                                                                                  |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|            | Unit: [Hz]                                                                                                                                                                                                       |
| NBINS      | Number of echsounder bins                                                                                                                                                                                        |
| BINSIZE    | Bin size in mm. Min. value is 2.0 mm<br>Unit: [mm]                                                                                                                                                               |
| BD         | Blanking distance<br>Unit: [m]                                                                                                                                                                                   |
| DF         | Dataformat.<br>8: DF8 Binary                                                                                                                                                                                     |
| FREQ1      | Enable and set frequency 1 of echogram.<br>Unit: [kHz]                                                                                                                                                           |
| XMIT1      | Transmission length on frequency 1.<br>Unit: [msec]                                                                                                                                                              |
| PL1        | Power level on frequency 1 (range -13.0 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.<br>Unit: [dB] |
| PULSECOMP1 | Enable/disable pulse compression on frequency 1.                                                                                                                                                                 |
| CH1        | Frequency 1 channel beam selection. E.g. CH=123 will enable beams 1, 2 and 3.                                                                                                                                    |
| RAW1       | Frequency 1 raw echo data recording interval.                                                                                                                                                                    |
| FREQ2      | Enable and set frequency 2 of echogram.<br>Unit: [kHz]                                                                                                                                                           |
| XMIT2      | Transmission length on frequency 2.<br>Unit: [msec]                                                                                                                                                              |
| PL2        | Power level on frequency 2 (range -13.0 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.<br>Unit: [dB] |
| PULSECOMP2 | Enable/disable pulse compression on frequency 2.                                                                                                                                                                 |
| CH2        | Frequency 2 channel beam selection. E.g. CH=123 will enable beams 1, 2 and 3.                                                                                                                                    |
| RAW2       | Frequency 2 raw echo data recording interval.                                                                                                                                                                    |

**Note:** Note that Pulse Compression may only be enabled for one echogram.

## SETECHO

Set echosounder settings

### Example:

SETECHO, SR=10, BINSIZE=2

OK

## GETECHO

Get echosounder settings

## GETECHOLIM

Get echosounder setting limits

### 3.8 Read memory usage

**Command:** READMEM

**Command type:** INFO

**Access:** User

**Mode:** COMMAND

Recorder data memory usage in MB/day for the current configuration and sub configurations.

| Argument | Description                                     |
|----------|-------------------------------------------------|
| TOTAL    | Total memory usage<br>Unit: [MB/day]            |
| VEL      | Velocity memory usage<br>Unit: [MB/day]         |
| ECHO     | Echo memory usage<br>Unit: [MB/day]             |
| EXTSENS  | External sensors memory usage<br>Unit: [MB/day] |
| AHRS     | AHRS sensors memory usage<br>Unit: [MB/day]     |

### 3.9 Read power use

**Command:** READPWR

**Command type:** INFO

**Access:** User

**Mode:** COMMAND

Power usage.

| Argument | Description                     |
|----------|---------------------------------|
| TOTAL    | Total power usage<br>Unit: [mW] |

|         |                                            |
|---------|--------------------------------------------|
| VEL     | Velocity power usage<br>Unit: [mW]         |
| ECHO    | Echo power usage<br>Unit: [mW]             |
| EXTSENS | External sensors power usage<br>Unit: [mW] |
| AHRS    | AHRS sensors power usage<br>Unit: [mW]     |

### 3.10 Echo measurement miscellaneous settings

**Commands:** SETECHOMISC, GETECHOMISC, GETECHOMISCLIM,

**Command type:** CONFIGURATION

**Mode:** COMMAND

Echo measurement miscellaneous settings.

| Argument | Description                          |
|----------|--------------------------------------|
| EN       | Enable echo extended blanking        |
| BD       | Echo blanking distance.<br>Unit: [m] |

#### SETECHOMISC

Set echo measurement miscellaneous settings

#### GETECHOMISC

Get echo measurement miscellaneous settings

#### GETECHOMISCLIM

Get echo miscellaneous limits

### 3.11 Velocity measurement settings

**Commands:** SETVEL, GETVEL, GETVELLIM,

**Command type:** CONFIGURATION

**Mode:** COMMAND

Velocity measurement settings.

| Argument | Description |
|----------|-------------|
|----------|-------------|

|        |                                                        |
|--------|--------------------------------------------------------|
| SR     | Sampling rate.<br>1, 2, 4, 8, 16, 32, 64<br>Unit: [Hz] |
| PL     | Power level.<br>Unit: [dB]                             |
| DF     | Data format.<br>8: DF8 Binary                          |
| XMIT   | Transmit length.<br>Unit: [mm]                         |
| RECV   | Receive length.<br>Unit: [mm]                          |
| VR     | Velocity range.<br>Unit: [m/s]                         |
| CY     | Coordinate system<br>ENU, XYZ, BEAM                    |
| NPINGS | Number of pings for averaging                          |
| BW     | Bandwidth<br>NARROW, BROAD, ULTRA                      |

## SETVEL

Set velocity measurement settings

## GETVEL

Get velocity measurement settings

## GETVELLIM

Get velocity limits

### 3.12 Velocity measurement miscellaneous settings

**Commands:** SETVELMISC, GETVELMISC, GETVELMISCLIM,

**Command type:** CONFIGURATION

**Mode:** COMMAND

Velocity measurement miscellaneous settings.

| Argument | Description                    |
|----------|--------------------------------|
| EN       | Enable extended velocity range |
| VRFINE   | Fine velocity range.           |

|     |                                                  |
|-----|--------------------------------------------------|
|     | Unit: [m/s]                                      |
| EVR | Extended velocity range [0-6].<br>Values: [0; 6] |

## SETVELMISC

Set velocity measurement miscellaneous settings

## GETVELMISC

Get velocity measurement miscellaneous settings

## GETVELMISCLIM

Get velocity miscellaneous limits

### 3.13 External sensor settings

**Commands:** SETEXTSENSOR, GETEXTSENSOR, GETEXTSENSORALIM,

**Command type:** CONFIGURATION

**Access:** User

**Mode:** COMMAND

External sensor configuration settings.

If enabled, the configured sensor will be sampled as close as possible to the configured sampling rate.

The sensor output will be included in velocity data formats.

| Argument | Description                                                                                                                                                                                                                   |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EN       | Enable/disable external sensor.                                                                                                                                                                                               |
| ID       | Modbus ID of external sensor.                                                                                                                                                                                                 |
| TYPE     | Type of external sensor.<br>"NOSENSOR": No sensor<br>"AQUAPHOX": PyroScience AquapHOx-Tx oxygen sensor<br>"RINKO_EC": RINKO-EC oxygen sensor                                                                                  |
| SR       | Sampling rate.<br>Set to 0 to sample sensor together with velocity measurements.<br>Note that the actual maximum sampling rate depends on sensor type.<br>This will be checked when the configuration is saved.<br>Unit: [Hz] |

## SETEXTSENSORA

Set external sensor settings

## GETEXTSENSORA

Get external sensor settings

## GETEXTSENSORALIM

Get external sensor limits

### 3.14 External sensor units

**Command:** READEXTSENSORAUNITS

**Command type:** INFO

**Access:** User

**Mode:** COMMAND

External sensor field and unit description.

Describes each field and unit used in the external sensor data format, depending on the type of external sensor.

An empty description means the field is unused.

| Argument | Description         |
|----------|---------------------|
| VAL1     | Value 1 description |
| VAL2     | Value 2 description |
| VAL3     | Value 3 description |
| VAL4     | Value 4 description |
| VAL5     | Value 5 description |
| VAL6     | Value 6 description |
| VAL7     | Value 7 description |
| VAL8     | Value 8 description |

**Example:**

```
READEXTSENSORAUNITS
```

```
"", "", "", "", "", "", "", "", ""
```

```
OK
```

```
READEXTSENSORAUNITS
```

```
"Dissolved oxygen concentration (umolar)", "Oxygen volume fraction (%)", "Sample temperature (celsius)", "", "", "", "", ""
```

OK

### 3.15 Probe check settings

**Commands:** SETPROBE, GETPROBE, GETPROBELIM,**Command type:** CONFIGURATION**Mode:** COMMAND

Probe check settings.

| Argument | Description                                |
|----------|--------------------------------------------|
| SR       | Sampling rate.<br>1, 2, 4, 8<br>Unit: [Hz] |
| DF       | Dataformat.<br>8: DF8 Binary               |
| NC       | Number of cells                            |
| BD       | Blanking distance<br>Unit: [m]             |
| PL       | Powerlevel.<br>Unit: [dB]                  |
| NPINGS   | Number of pings for averaging<br>Unit: [-] |

#### SETPROBE

Set probe settings

#### GETPROBE

Get probe settings

#### GETPROBELIM

Get probe limits

### 3.16 Read instrument ID

**Command:** READID**Command type:** INFO**Access:** User**Mode:** COMMAND, CONFIRMATION, MEASUREMENT, RETRIEVAL

Commands for accessing instrument name and serial number

| Argument | Description     |
|----------|-----------------|
| STR      | Instrument name |
| SN       | Serial number   |

**Example:**

```
READID  
"Vector 2",500146  
READID,STR  
"Vector 2"
```

### 3.17 Frequency spectrum settings

**Commands:** SETSPECTRUM, GETSPECTRUM, GETSPECTRUMLIM,

**Command type:** CONFIGURATION

**Mode:** COMMAND

Configures the spectrum analyzer tool to identify external noise sources or interference.

| Argument | Description                                                                                                                             |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------|
| SR       | Sampling rate.<br>Unit: [Hz]                                                                                                            |
| BW       | Bandwidth<br>NARROW, BROAD, ULTRA, FULL                                                                                                 |
| DEC      | Decimate raw data.                                                                                                                      |
| NFFT     | Number of FFT bins.<br>256, 512, 1024, 2048                                                                                             |
| NB       | Number of beams.                                                                                                                        |
| CHFULL   | Selects the channel (beam) to use when bandwidth is FULL.                                                                               |
| CH       | Selects the channel (beam) to use when bandwidth is not FULL.<br>Example: 123 will enable beams 1, 2 and 3.<br>1, 2, 3, 12, 13, 23, 123 |
| DF       | Data format.<br>3: DF3 Binary                                                                                                           |
| NPINGS   | Number of pings for averaging                                                                                                           |
| BD       | Blanking distance<br>Unit: [m]                                                                                                          |

#### SETSPECTRUM

Set frequency spectrum settings

**Example:**

```
SETSPECTRUM, SR=1, BW="NARROW", NFFT=1024, CH=123
```

```
OK
```

**GETSPECTRUM**

Get frequency spectrum settings

**GETSPECTRUM LIM**

Get frequency spectrum settings limits

### 3.18 Load default settings

**Command:** LOADDEFAULT

**Command type:** ACTION

**Access:** User

**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. |
| INST     | Restore instrument main settings to default.                                                           |
| USER     | Restore user calibration to default.                                                                   |

**Example:**

```
LOADDEFAULT, CONFIG
```

```
OK
```

### 3.19 Battery measurement information

**Command:** READBATTERY

**Command type:** INFO

**Access:** User

**Mode:** COMMAND

Battery measurement information.

| Argument | Description |
|----------|-------------|
| VOLTAGE  | Voltage     |

|         |                      |
|---------|----------------------|
|         | Unit: [V]            |
| CURRENT | Current<br>Unit: [A] |
| POWER   | Power<br>Unit: [W]   |

**Example:**

READBATTERY

16.0000,0.1500,2.4000

OK

READBATTERY,VOLTAGE

16.0000

OK

### 3.20 Velocity telemetry settings

**Commands:** SETTMVEL, GETTMVEL, GETTMVELLIM,

**Command type:** CONFIGURATION

**Mode:** COMMAND

The instrument velocity telemetry settings and relevant limits.

| Argument | Description                                                                       |
|----------|-----------------------------------------------------------------------------------|
| EN       | Enable velocity telemetry                                                         |
| NS       | Number of velocity samples to output. If set to 0, all samples will be outputted. |
| CY       | Co-ordinate System<br>ENU, XYZ, BEAM                                              |
| FO       | Enable file output                                                                |
| SO       | Enable serial output                                                              |
| DF       | Telemetry data format.<br>700                                                     |

#### SETTMVEL

Set velocity telemetry settings

**Example:**

SETTMVEL, EN=1, NS=1

#### GETTMVEL

Get velocity telemetry settings

## GETTMVELLIM

Get instrument velocity telemetry limits

### 3.21 Ahrs telemetry settings

**Commands:** SETTMAHRS, GETTMAHRS, GETTMAHRSLIM,

**Command type:** CONFIGURATION

**Mode:** COMMAND

The instrument AHRS telemetry settings and relevant limits.

| Argument | Description                   |
|----------|-------------------------------|
| EN       | Enable AHRS telemetry         |
| FO       | Enable file output            |
| SO       | Enable serial output          |
| DF       | Telemetry data format.<br>750 |

## SETTMAHRS

Set AHRS telemetry settings

## GETTMAHRS

Get AHRS telemetry settings

## GETTMAHRSLIM

Get instrument AHRS telemetry limits

### 3.22 Save settings

**Command:** SAVE

**Command type:** ACTION

**Access:** User

**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. |
| INST   | Save INST settings.                              |
| USER   | Save user instrument settings.                   |

**Example:**

SAVE, CONFIG

OK

### 3.23 Start instrument

**Command:** START

**Command type:** ACTION

**Mode:** COMMAND

Start the instrument (go in measurement mode).

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

### 3.24 Enter command mode

**Command:** MC

**Command type:** ACTION

**Access:** User

**Mode:** COMMAND, CONFIRMATION

Sets instrument in command mode from confirmation mode.

**Example:**

MC

OK

### 3.25 Enter measurement mode

**Command:** CO

**Command type:** ACTION

**Access:** User

**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

OK

### 3.26 List configuration

**Command:** LISTCFG

**Command type:** CONFIGURATION

**Access:** User

**Mode:** COMMAND

List current configuration. If a filename parameter is given the current configuration is stored to a file. If no parameter is given the current configuration is written to console.

The output of this command can be used to configure the instrument to a known configuration.

| Argument | Description                                                                                         |
|----------|-----------------------------------------------------------------------------------------------------|
| FN       | Write the output to file.<br>Values: ['a'; 'z']; ['A'; 'Z']; ['0'; '9']; '_'   '.'   Max Length: 30 |

**Example:**

LISTCFG

LOADDEFAULT, CONFIG

SETPLAN, SA=35.00, SV=0.00, BURST=1, FN="Data", SO=1

SETBURST, MI=300, DURATION=300, VEL=1, ECHO=0, SPECTRUM=0, ALTI=0, EXTSENS=0, AHRS=1, SENS=0, PROBE=0

SETVEL, SR=8, PL=0.00, DF=8, XMIT=4.00, RECV=8.00, VR=0.30, CY="ENU", NPING S=2, BW="BROAD"

SETAHRS, SR=0, DF=8, ALG="STATIC"

SAVE, CONFIG

OK

### 3.27 Read instrument state

**Command:** READSTATE

**Command type:** INFO

**Access:** User

**Mode:** COMMAND, CONFIRMATION, MEASUREMENT, RETRIEVAL

Returns information about the current operational state of the instrument

| Argument | Description                                                                                                                                                                                                                                                                                                                                             |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MODE     | Current instrument state.<br>1: Measurement mode (START command received).<br>2: Command mode.<br>3: DEPLOY command received and deployment running.<br>4: Data retrieval mode.<br>5: Confirmation mode.<br>8: DEPLOY command received, but deployment has not yet started.<br>9: Confirmation in measurement mode.<br>10: Confirmation in deploy mode. |

|          |                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          | 11: Confirmation in pre-deploy mode.                                                                                                                                                                                                                                                                                                                                                                               |
| DEPTIME  | Seconds since deployment:<br>0 – DEPLOY command has not been received.<br>< 0 – Number of seconds until deployment starts.<br>> 0 – Number of seconds that deployment has been running.<br>Unit: [s]                                                                                                                                                                                                               |
| MEASTIME | Seconds with measurements:<br>0 – START command has not been received.<br>> 0 – Number of seconds that measurement has been running.<br>Unit: [s]                                                                                                                                                                                                                                                                  |
| CURRTIME | The current instrument time.<br>Time format is "YYYY-MM-DD HH:MM:SS"<br>Unit: [Time]                                                                                                                                                                                                                                                                                                                               |
| WAKEUP   | Reason for instrument wakeup.<br>0: Last startup/reboot caused by loss/low voltage.<br>1: Last startup/reboot caused by power on.<br>2: Last startup/reboot caused by wakeup by real time clock.<br>3: Last startup/reboot caused by wakeup by serial activity.<br>4: Last startup/reboot caused by BREAK command.<br>5: Last startup/reboot caused by BREAK timeout.<br>6: Last startup/reboot caused by watchDog |
| INTPROC  | Internal processing active                                                                                                                                                                                                                                                                                                                                                                                         |

**Example:**

READSTATE, WAKEUP, CURRTIME

### 3.28 Read error

**Command:** READERROR

**Command type:** INFO

**Access:** User

**Mode:** COMMAND, CONFIRMATION, MEASUREMENT, RETRIEVAL

READERROR 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
READERROR
40,"Invalid setting: Avg Cell Size","GETAVGLIM,CS=([0.20;2.00])"
OK

```

### 3.29 Get the "Beam to XYZ" transformation matrix

**Command:** READXFVEL

**Command type:** INFO

**Access:** User

**Mode:** COMMAND

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

### 3.30 Read hardware specifications

**Command:** READHW

**Command type:** INFO

**Access:** User

**Mode:** COMMAND, CONFIRMATION, MEASUREMENT, RETRIEVAL

Returns hardware board revisions. By default, each field contains the bill of material (BOM), board revision and type. The SOM is an exception and uses major.minor for its hardware revision.

| Argument | Description                                |
|----------|--------------------------------------------|
| DIGITAL  | Get digital board revision.                |
| ANALOG   | Get analog board revision.                 |
| SOM      | Get system on module (SOM) board revision. |

**Example:**

READHW

"B-0 (Vector) ", "A-1 (Vector) ", "1.1 (SOM) "

OK

### 3.31 Read firmware version

**Command:** READFW

**Command type:** INFO

**Access:** User

**Mode:** COMMAND, CONFIRMATION, MEASUREMENT, RETRIEVAL

This command returns version information for the main firmware in the instrument.

Use LISTVER to get version information for all software components.

| Argument | Description                               |
|----------|-------------------------------------------|
| STR      | Firmware version string                   |
| MAJOR    | Major part of the firmware version        |
| MINOR    | Minor part of the firmware version        |
| PATCH    | Patch part of the firmware version        |
| EXTRA    | Extra description of the firmware version |
| HASH     | Unique hash of the firmware source code   |

**Example:**

READFW, STR

"1.0.3"

OK

### 3.32 List versions for all software components

**Command:** LISTVER

**Command type:** INFO

**Access:** User

**Mode:** COMMAND

The instrument contains multiple software and firmware components. This command lists the version number for each component.

The "FW" component is considered the "main firmware" in the instrument, and is the one that defines the version of the embedded software bundle (the .swu file). This information can also be read using the READFW command, which also contains some additional version information.

| Argument  | Description                              |
|-----------|------------------------------------------|
| COMPONENT | Software component                       |
| STR       | Version string for software component    |
| MAJOR     | Major part of the component version      |
| MINOR     | Minor part of the component version      |
| PATCH     | Patch part of the component version      |
| HASH      | Unique hash of the component source code |

**Example:**

```
$PNOR, LISTVER*6C
```

```
$PNOR, LISTVER, COMPONENT="FW", STR="1.0.3", MAJOR=1, MINOR=0, PATCH=3, HASH="a7f9b64e"*1D
```

```
$PNOR, LISTVER, COMPONENT="SW", STR="1.1.2", MAJOR=1, MINOR=1, PATCH=2, HASH="7b11c4e5"*70
```

```
$PNOR, LISTVER, COMPONENT="PMC", STR="0.25", MAJOR=0, MINOR=25, PATCH=0, HASH="c89700b8"*38
```

```
$PNOR, LISTVER, COMPONENT="BOOT", STR="1.2.0", MAJOR=1, MINOR=2, PATCH=0, HASH="gcbd7eb1"*33
```

```
$PNOR, LISTVER, COMPONENT="FPGA", STR="18", MAJOR=18, MINOR=0, PATCH=0, HASH=""*25
```

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

### 3.33 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
```

### 3.34 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
```

### 3.35 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,"K28FDJF7RPNUB","All features",0
```

```
LISTLICENSE,"4X218TRTRPNUB","High Resolution",4
```

```
LISTLICENSE,"JKHHFNH3RPNUB","Wave Mode",6
```

```
LISTLICENSE,"WF3CJR6PRPNUB","Current Profiler",1
```

```
OK
$PNOR,LISTLICENSE*76
$PNOR,LISTLICENSE,KEY="K28FDJF7RPNUB",DESC="All features",TYPE=0*4C
$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
```

### 3.36 Modbus write

**Command:** WRITEMODBUS

**Command type:** CONFIGURATION

**Access:** User

**Mode:** COMMAND

Perform a Modbus write transaction (FC16).

This command writes to a single Modbus address per transaction.

All arguments are required and, except for PWROUT, must be unsigned integers in base-10 (decimal) format.

| Argument | Description                                                   |
|----------|---------------------------------------------------------------|
| PWROUT   | Modbus output voltage.<br>0V, 5V, 12V<br>Unit: [V]            |
| ID       | Target device modbus ID (0 - 247). Note: ID = 0 is broadcast. |
| REG      | Modbus register. Note: Must be a holding register             |
| VAL      | Write value.                                                  |

**Example:**

```
WRITEMODBUS, PWROUT="12V", ID=1, REG=2, VAL=10
OK
```

### 3.37 Modbus list

**Command:** LISTMODBUS

**Command type:** CONFIGURATION

**Access:** User

**Mode:** COMMAND

Perform a Modbus read transaction (FC03, FC04) and list register values.

All arguments, except for PWROUT and TYPE, must be unsigned integers in base-10 (decimal) format.

Register values in the output are also represented in base-10.

All arguments must be provided unless explicitly marked as optional.

| Argument | Description                                                                                                     |
|----------|-----------------------------------------------------------------------------------------------------------------|
| PWROUT   | Modbus output voltage.<br>5V, 12V<br>Unit: [V]                                                                  |
| ID       | Target device modbus ID (1 - 247).                                                                              |
| REG      | Modbus register.                                                                                                |
| NWORDS   | Number of 16-bit words to read. Optional, defaults to 1.                                                        |
| TYPE     | Register type to read. Optional, defaults to "INPUT".<br>"INPUT": Input register<br>"HOLDING": Holding register |

**Example:**

```
LISTMODBUS, PWROUT="12V", ID=1, REG=1
0001
OK
LISTMODBUS, PWROUT="12V", ID=1, REG=1, NWORDS=4
0001
0002
0003
0004
OK
LISTMODBUS, PWROUT="12V", ID=1, REG=1, NWORDS=4, TYPE="HOLDING"
0010
0020
0030
0040
OK
```

## 4 Binary data formats

This chapter describes the Vector generation 2 binary data formats for sensor output. Note that the binary data formats all use a common header that specifies how the rest of the data block should be interpreted. A data block is the data from and including one header to the next. Binary data are always sent as Little Endian.

## About these chapters

Each data format is described in the following chapters. To avoid duplicating rows in the following tables, we have documented header and common data separately. This way, the chapter on one data format will only contain the fields unique for this data format. Take DF3 velocity data as an example:

**In short:** The data format is the sum of header data, two parts that are shared with other types of data blocks, and the part that is unique for velocity. See figure below.

**A little longer:** The header is the same for all data blocks. It is compact and quick to parse, and it contains information about the rest of the data (e.g. data type and size). This is documented separately as `_HeaderData`. We use the leading underscore to emphasize that this is not a complete data format, but it is a part used by two or more data formats.

The same goes for other common data such as data format version number, offset to data and timestamp etc. This is documented separately in `_CommonData`. Note that for DF3 velocity data there is also another part that is shared.

Last, there are the unique fields such as beam configuration, velocity data, amplitude data etc. that is given in the table in DF3 velocity data.

The table below is an illustration on how common data fields (gray for header and blue for other common's) relate to the sensor specific data fields (green).

| _HeaderData             |                  |                       |            |
|-------------------------|------------------|-----------------------|------------|
| _CommonData             |                  | DF8 NortekDataformat8 | 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.

### 4.1 \_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<br>Size | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----------------|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sync byte      | 0<br>uint8       | Always 0xA5.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Header size    | 1<br>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<br>uint8       | Defines the type of the following Data Record.<br>0x15 - Burst data as DF3.<br>0x16 - Average data as DF3.<br>0x17 - Bottom Track Data Record.<br>0x18 - Interleaved Burst Data Record (beam 5).<br>0x1E - Altimeter Record.<br>0x1F - Avg Altimeter Raw Record.<br>0x1A - Burst Altimeter Raw Record.<br>0x1B - DVL Bottom Track Record.<br>0x1C - Echo Sounder Record.<br>0x23 - Echo Sounder Raw Record.<br>0x24 - Echo Sounder Raw Tx Record.<br>0x26 - Average data as DF7.<br>0x30 - Processed Wave Data Record.<br>0x1D - DVL Water Track Record.<br>0xC8 - Vector 2 data as DF8. |

|                 |                    |                                                                                                                                                                                                               |
|-----------------|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                 |                    | 0xA0 - String Data Record, eg. GPS NMEA data, comment from the FWRITE command.                                                                                                                                |
| Family id       | 3<br>uint8         | Defines the instrument family. 0x30 is the latest Aquadopp range of products.                                                                                                                                 |
| Data size       | 4<br>unit16/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<br>uint16      | Checksum of the following Data Record.                                                                                                                                                                        |
| Header checksum | 8/10<br>uint16     | Checksum of all fields of the Header except the Header Checksum itself.                                                                                                                                       |

## 4.2 NortekDataFormat8

ID: 0xc8

DF8 - Nortek Data Format 8

| Field                  | Position<br>Size | Description                                                                                        |
|------------------------|------------------|----------------------------------------------------------------------------------------------------|
| Version                | 0<br>uint16      | Version number of this Data Record Definition.                                                     |
| Offset of data         | 2<br>uint16      | Number of bytes from start of record to start of non-common data fields.<br><b>Unit: [# bytes]</b> |
| Types of data included | 4<br>4 * 8 bits  | Types of data included.<br><a href="#">Object reference given in table below</a>                   |
| Unix time              | 8<br>uint32      | Seconds since 1970-01-01 00:00:00 UTC. Based on struct timespec                                    |
| Nano seconds           | 12<br>uint32     | Nano seconds from last whole second. Based on struct timespec                                      |
| Ensemble counter       | 16<br>uint32     | Ensemble counter.                                                                                  |
| Water temperature      | 20<br>float      | Reading from the temperature sensor.<br><b>Unit: [°C]</b>                                          |
| Speed of sound         | 24<br>float      | Configured or measured sound velocity.<br><b>Unit: [m/s]</b>                                       |
| Battery voltage        | 28<br>float      | Battery voltage                                                                                    |
| Current drain          | 32<br>float      | <b>Unit: [Ampere]</b>                                                                              |

|                              |                                                                                                   |                                                                                                                                              |
|------------------------------|---------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| Dew point temperature        | 36<br>float                                                                                       | Unit: [°C]                                                                                                                                   |
| CPU temperature              | 40<br>float                                                                                       | Unit: [°C]                                                                                                                                   |
| FPGA temperature             | 44<br>float                                                                                       | Unit: [°C]                                                                                                                                   |
| RTC temperature              | 48<br>float                                                                                       | Unit: [°C]                                                                                                                                   |
| Status                       | 52<br>4 * 8 bits                                                                                  | Status bit mask.<br><a href="#">Object reference given in table below</a>                                                                    |
| Error TBD                    | 56<br>4 * 8 bits                                                                                  | Error bit mask. TDB- DUMMY MASK<br><a href="#">Object reference given in table below</a>                                                     |
| reserved                     | 60<br>float * 5                                                                                   | 5 reserved floats                                                                                                                            |
| Velocity data                | OFFSET<br>VEL_SIZE bytes                                                                          | This object exists if the Velocity data included bit of the config byte is set.<br><a href="#">Object reference given in table below</a>     |
| Pressure data                | OFFSET + VEL_SIZE<br>PRESS_SIZE bytes                                                             | This object exists if the pressure data included bit of the config byte is set.<br><a href="#">Object reference given in table below</a>     |
| Euler angles data            | OFFSET + VEL_SIZE +<br>PRESS_SIZE<br>EULER_SIZE bytes                                             | This object exists if the Euler angles data included bit of the config byte is set.<br><a href="#">Object reference given in table below</a> |
| Direction Cosine Matrix data | OFFSET + VEL_SIZE +<br>PRESS_SIZE +<br>EULER_SIZE<br>float * DIM1 SIZE *<br>DIM2 SIZE             | This object exists if the Direction Cosine Matrix data included bit of the config byte is set. dcm00, dcm01, dcm02, dcm10...dcm22,           |
| Quaternion data              | OFFSET + VEL_SIZE +<br>PRESS_SIZE +<br>EULER_SIZE +<br>DCM_SIZE<br>QUAT_SIZE bytes                | This object exists if the Quaternion data included bit of the config byte is set.<br><a href="#">Object reference given in table below</a>   |
| Raw Compass data             | OFFSET + VEL_SIZE +<br>PRESS_SIZE +<br>EULER_SIZE +<br>DCM_SIZE + QUAT_SIZE<br>COMPASS_SIZE bytes | This object exists if the raw Compass data included bit of the config byte is set.<br><a href="#">Object reference given in table below</a>  |
| Raw AHRS data                | OFFSET + VEL_SIZE +<br>PRESS_SIZE +<br>EULER_SIZE +                                               | This object exists if the raw AHRS data included bit of the config byte is set.<br><a href="#">Object reference given in table below</a>     |

|                      |                                                                                                                                                                       |                                                                                                                                                                                              |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                      | DCM_SIZE + QUAT_SIZE<br>+ COMPASS_SIZE<br>AHRS_SIZE bytes                                                                                                             |                                                                                                                                                                                              |
| External sensor data | OFFSET + VEL_SIZE +<br>PRESS_SIZE +<br>EULER_SIZE +<br>DCM_SIZE + QUAT_SIZE<br>+ COMPASS_SIZE +<br>AHRS_SIZE<br>EXT_SENSORS_SIZE<br>bytes                             | This object exists if the external data included bit of the config byte is set. It is a generic structure for external sensor data.<br><a href="#">Object reference given in table below</a> |
| Probe check data     | OFFSET + VEL_SIZE +<br>PRESS_SIZE +<br>EULER_SIZE +<br>DCM_SIZE + QUAT_SIZE<br>+ COMPASS_SIZE +<br>AHRS_SIZE +<br>EXT_SENSORS_SIZE<br>PROBE_SIZE bytes                | This object exists if the probe check data included bit of the config byte is set.<br><a href="#">Object reference given in table below</a>                                                  |
| Echosounder data     | OFFSET + VEL_SIZE +<br>PRESS_SIZE +<br>EULER_SIZE +<br>DCM_SIZE + QUAT_SIZE<br>+ COMPASS_SIZE +<br>AHRS_SIZE +<br>EXT_SENSORS_SIZE +<br>PROBE_SIZE<br>ECHO_SIZE bytes | This object exists if the echosounder data included bit of the config byte is set.<br><a href="#">Object reference given in table below</a>                                                  |

**Position and size variables:**

| Name             | Description                                                                                                                                                  |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| VEL_SIZE         | Size of velocity data. 28 bytes if the Velocity data included bit of the config byte is set. Else 0.                                                         |
| OFFSET           | Number of bytes from start of record to start of data.                                                                                                       |
| PRESS_SIZE       | Size of pressure data. 8 bytes if the pressure data included bit of the config byte is set. Else 0.                                                          |
| EXT_SENSORS_SIZE | Size of external sensor data. 36 bytes if the external data included bit of the config byte is set. Else 0.                                                  |
| NB               | Primary dimension of amplitude data is 3 which is the number beams.                                                                                          |
| PROBE_NS         | Second dimension of amplitude data is number of samples pr beam.                                                                                             |
| PROBE_SIZE       | Size of probe check data. If the Probe check data included bit of the included byte is set, the size is $10 + 2 * \text{number of beams} * \text{number of}$ |

|           |                                                                                                                                                               |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           | samples pr beam. Else 0.                                                                                                                                      |
| CB        | Primary dimension of amplitude data is 1 which is the center beam.                                                                                            |
| ECHO_NS   | Second dimension of amplitude data is number of samples pr beam.                                                                                              |
| ECHO_SIZE | Size of echosounder data. If the Echosounder data included bit of the included byte is set, the size is $14 + 2 * \text{number of samples pr beam}$ . Else 0. |

**Object reference:** Types of data included

Types of data included.

| Field                            | Position Size | Description                                          |
|----------------------------------|---------------|------------------------------------------------------|
| Velocity included                | 0 bit         | Velocity, correlation and amplitude data is included |
| Pressure included                | 1 bit         | Pressure data is included                            |
| Euler angles included            | 2 bit         | Euler angles are included                            |
| Direction cosine matrix included | 3 bit         | Direction cosine matrix is included                  |
| Quaternions included             | 4 bit         | Quaternions are included                             |
| Raw compass data included        | 5 bit         | Raw compass data is included                         |
| Raw AHRS data included           | 6 bit         | Raw AHRS data is included                            |
| External sensors included        | 7 bit         | External sensors data is included                    |
| Probe check included             | 8 bit         | Probe check data is included                         |
| Echo sounder included            | 9 bit         | Echo sounder data is included                        |

**Object reference:** Status

Status bit mask.

| Field         | Position Size | Description           |
|---------------|---------------|-----------------------|
| Wake up state | 0-3           | Bit 0-3: Wakeup State |

|                           |                 |                                                                                                                                                                                    |
|---------------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                           | 4 bits          | 0000 = Bad Power<br>0001 = Power Applied<br>0010 = RTC Alarm<br>0011 = Wakeup RS422<br>0100 = BREAK<br>0101 = BREAK (timeout)<br>0110 = WatchDog                                   |
| Previous wakeup state     | 4-7<br>4 bits   | Bit 4-7: Previous Wakeup State<br>0000 = Bad Power<br>0001 = Power Applied<br>0010 = RTC Alarm<br>0011 = Wakeup RS422<br>0100 = BREAK<br>0101 = BREAK (timeout)<br>0110 = WatchDog |
| Coordinate system         | 8-9<br>2 bits   | Bit 8-9: Coordinate system<br>00 = ENU (East North Up)<br>01 = XYZ<br>10 = BEAM<br>11 = na                                                                                         |
| Number of beams           | 10-12<br>3 bits | Bit 10-12: Number of beams                                                                                                                                                         |
| Last Measure Voltage Skip | 13<br>bit       | Last measure voltage skip                                                                                                                                                          |
| Active Configuration      | 14<br>bit       | True if active configuration                                                                                                                                                       |

**Object reference:** Error TBD

Error bit mask. TDB- DUMMY MASK

| Field                          | Position Size | Description                    |
|--------------------------------|---------------|--------------------------------|
| Data retrieval FIFO error      | 0<br>bit      | Data retrieval FIFO error      |
| Data retrieval overflow        | 1<br>bit      | Data retrieval overflow        |
| Data retrieval underrun        | 2<br>bit      | Data retrieval Underrun        |
| Data retrieval samples missing | 3<br>bit      | Data retrieval samples missing |

|                                        |        |                                                                                                                      |
|----------------------------------------|--------|----------------------------------------------------------------------------------------------------------------------|
| Measurement not finished               | 4 bit  | Measurement not finished<br>The Measurement and data storage/transmit didn't finish before next measurement started. |
| Sensor read failure                    | 5 bit  | Sensor read failure                                                                                                  |
| FPGA clock PLL Lock failure            | 6 bit  | FPGA clock PLL Lock 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)                                                                                  |
| Error Reading Pressure Sensor          | 16 bit | Error Reading Pressure Sensor                                                                                        |
| Error Reading Water temperature Sensor | 17 bit | Error Reading Water temperature Sensor                                                                               |
| Error Reading Battery Sensor           | 18 bit | Error Reading Battery Sensor                                                                                         |
| Error Reading Humidity Sensor          | 19 bit | Error Reading Humidity Sensor                                                                                        |
| Error Reading IMU                      | 20 bit | Error Reading IMU                                                                                                    |
| Error Reading Magnetometer             | 21 bit | Error Reading Magnetometer                                                                                           |

**Object reference:** Velocity data

This object exists if the Velocity data included bit of the config byte is set.

| Field              | Position<br>Size | Description                                                                                           |
|--------------------|------------------|-------------------------------------------------------------------------------------------------------|
| Ambiguity velocity | 0<br>float       | Ambiguity velocity<br>Required bit: Velocity included   Unit: [m/s]                                   |
| Velocity data      | 4<br>float * 3   | Required bit: Velocity included   Unit: [m/s]                                                         |
| Amplitude data     | 16<br>uint16 * 3 | Amplitude data, raw data given as 0.01 %<br>Required bit: Velocity included   Unit: [dB]              |
| Correlation data   | 22<br>uint16 * 3 | Correlation data [0 - 100 %], raw data given as 0.01 %<br>Required bit: Velocity included   Unit: [%] |

**Object reference:** Pressure data

This object exists if the pressure data included bit of the config byte is set.

| Field                       | Position<br>Size | Description                                                                                 |
|-----------------------------|------------------|---------------------------------------------------------------------------------------------|
| Pressure                    | 0<br>float       | Pressure measurement<br>Required bit: Pressure included   Unit: [Bar]                       |
| Pressure sensor temperature | 4<br>float       | Temperature measured by the pressure sensor<br>Required bit: Pressure included   Unit: [°C] |

**Object reference:** Euler angles data

This object exists if the Euler angles data included bit of the config byte is set.

| Field   | Position<br>Size | Description                   |
|---------|------------------|-------------------------------|
| Heading | 0<br>float       | Heading angle.<br>Unit: [deg] |
| Pitch   | 4<br>float       | Pitch angle.<br>Unit: [deg]   |
| Roll    | 8<br>float       | Roll angle.<br>Unit: [deg]    |

**Object reference:** Quaternion data

This object exists if the Quaternion data included bit of the config byte is set.

| Field | Position<br>Size | Description                   |
|-------|------------------|-------------------------------|
| W     | 0<br>float       | W component of the quaternion |
| X     | 4<br>float       | X component of the quaternion |
| Y     | 8<br>float       | Y component of the quaternion |
| Z     | 12<br>float      | Z component of the quaternion |

**Object reference:** Raw Compass data

This object exists if the raw Compass data included bit of the config byte is set.

| Field           | Position<br>Size | Description                                   |
|-----------------|------------------|-----------------------------------------------|
| Magnetometer.X  | 0<br>float       | Raw X axis value in last measurement interval |
| Magnetometer.Y  | 4<br>float       | Raw Y axis value in last measurement interval |
| Magnetometer.Z  | 8<br>float       | Raw Z axis value in last measurement interval |
| Accelerometer.X | 12<br>float      | Raw X axis value in last measurement interval |
| Accelerometer.Y | 16<br>float      | Raw Y axis value in last measurement interval |
| Accelerometer.Z | 20<br>float      | Raw Z axis value in last measurement interval |

**Object reference:** Raw AHRS data

This object exists if the raw AHRS data included bit of the config byte is set.

| Field  | Position<br>Size | Description                                   |
|--------|------------------|-----------------------------------------------|
| Gyro.X | 0<br>float       | Raw X axis value in last measurement interval |

|                      |             |                                                       |
|----------------------|-------------|-------------------------------------------------------|
| Gyro.Y               | 4<br>float  | Raw Y axis value in last measurement interval         |
| Gyro.Z               | 8<br>float  | Raw Z axis value in last measurement interval         |
| AHRS Figure of merit | 12<br>float | Figure of merit describing data quality.              |
| IMU temperature      | 16<br>float | Temperature measured by the IMU sensor.<br>Unit: [°C] |

**Object reference:** External sensor data

This object exists if the external data included bit of the config byte is set. It is a generic structure for external sensor data.

| Field  | Position<br>Size | Description                                                                                                                                                                                                                                                                                                                              |
|--------|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Status | 0<br>4 * 8 bits  | Status bit mask of external sensor.<br><a href="#">Object reference given in table below</a>                                                                                                                                                                                                                                             |
| Values | 4<br>float * 8   | 8 generic floats from external sensor. Field names are sensor specific.<br><br>For AQUAPHOX 3 floats are used and are:<br>Field1: Dissolved oxygen concentration (umolar)<br>Field2: Oxygen volume fraction (%)<br>Field3: Sample temperature (celsius)<br><br>Field names and units may also be found with READEXTSENSORAUNITS command. |

**Object reference:** Probe check data

This object exists if the probe check data included bit of the config byte is set.

| Field             | Position<br>Size | Description                                                        |
|-------------------|------------------|--------------------------------------------------------------------|
| Blanking          | 0<br>float       | Blanking length<br>Required bit: Probe check included   Unit: [m]  |
| Sample distance   | 4<br>float       | Sample distance.<br>Required bit: Probe check included   Unit: [m] |
| Number of samples | 8<br>uint16      | Number of samples per beam.<br>Required bit: Probe check included  |

|                            |                             |                                                                                                                                                                          |
|----------------------------|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Probe check amplitude data | 10<br>int16 * NB * PROBE_NS | Probe check amplitude data. This field exists if the Probe check data included bit of the included byte is set<br><b>Required bit: Probe check included   Unit: [dB]</b> |
|----------------------------|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Object reference:** Echosounder data

This object exists if the echosounder data included bit of the config byte is set.

| Field                      | Position<br>Size           | Description                                                                                                                                                              |
|----------------------------|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Blanking                   | 0<br>float                 | Blanking length<br><b>Required bit: Echosounder included   Unit: [m]</b>                                                                                                 |
| Binsize                    | 4<br>float                 | Binsize.<br><b>Required bit: Echosounder included   Unit: [m]</b>                                                                                                        |
| Frequency                  | 8<br>float                 | Frequency.<br><b>Required bit: Echosounder included   Unit: [Hz]</b>                                                                                                     |
| Number of samples          | 12<br>uint16               | Number of samples per beam. Only the center beam is used.<br><b>Required bit: Echosounder included</b>                                                                   |
| Echosounder amplitude data | 14<br>int16 * CB * ECHO_NS | Echosounder amplitude data. This field exists if the Echosounder data included bit of the included byte is set<br><b>Required bit: Echosounder included   Unit: [dB]</b> |

**Object reference:** Status

Status bit mask of external sensor.

| Field         | Position<br>Size | Description                                                            |
|---------------|------------------|------------------------------------------------------------------------|
| Sensor type   | 0<br>uint32      | Available sensor types<br>0 = NOSENSOR<br>1 = AQUAPHOX<br>2 = RINKO_EC |
| Valid value 1 | 4<br>bit         | True if value 1 is valid                                               |
| Valid value 2 | 5<br>bit         | True if value 2 is valid                                               |
| Valid value 3 | 6<br>bit         | True if value 3 is valid                                               |

|               |           |                          |
|---------------|-----------|--------------------------|
| Valid value 4 | 7<br>bit  | True if value 4 is valid |
| Valid value 5 | 8<br>bit  | True if value 5 is valid |
| Valid value 6 | 9<br>bit  | True if value 6 is valid |
| Valid value 7 | 10<br>bit | True if value 7 is valid |
| Valid value 8 | 11<br>bit | True if value 8 is valid |

### 4.3 **\_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<br>Size | Description                                                                                     |
|-----------------------|------------------|-------------------------------------------------------------------------------------------------|
| Version               | 0<br>uint8       | Version number of the Data Record Definition.<br>3 - DF3<br>20 - DF20                           |
| Offset of data        | 1<br>uint8       | Number of bytes from start of the record to start of the actual data.<br><b>Unit: [# bytes]</b> |
| Serial number         | 4<br>uint32      | Instrument serial number from factory.                                                          |
| Year                  | 8<br>uint8       | Number of years since 1900.                                                                     |
| Month                 | 9<br>uint8       | Month number counting from 0 which is January.                                                  |
| Day                   | 10<br>uint8      | Day of the month                                                                                |
| Hour                  | 11<br>uint8      | 24 hour of the day                                                                              |
| Minutes               | 12<br>uint8      | Minutes.                                                                                        |
| Seconds               | 13<br>uint8      | Seconds.                                                                                        |
| Hundred micro seconds | 14<br>uint16     | Hundred micro seconds from last whole second.<br><b>Unit: [100 µs]</b>                          |

|                     |              |                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Speed of sound      | 16<br>uint16 | Speed of sound used by the instrument.<br>Raw data given as 0.1 m/s<br>Unit: [m/s]                                                                                                                                                                                                                                                                                    |
| Temperature         | 18<br>int16  | Reading from the temperature sensor.<br>Raw data given as 0.01 °C<br>Unit: [°C]                                                                                                                                                                                                                                                                                       |
| Pressure            | 20<br>uint32 | Raw data given as 0.001 dBar<br>Unit: [dBar]                                                                                                                                                                                                                                                                                                                          |
| Heading             | 24<br>uint16 | Raw data given as 0.01 degrees<br>Unit: [deg]                                                                                                                                                                                                                                                                                                                         |
| Pitch               | 26<br>int16  | Raw data given as 0.01 degrees<br>Unit: [deg]                                                                                                                                                                                                                                                                                                                         |
| Roll                | 28<br>int16  | Raw data given as 0.01 degrees<br>Unit: [deg]                                                                                                                                                                                                                                                                                                                         |
| Cell size           | 32<br>uint16 | Size of each cell (resolution) on the beam.<br>Raw data given as mm<br>Unit: [m]                                                                                                                                                                                                                                                                                      |
| Nominal correlation | 36<br>uint8  | The nominal correlation for the configured combination of cell size and velocity range<br>Unit: [%]                                                                                                                                                                                                                                                                   |
| Battery voltage     | 38<br>uint16 | Raw value given in 0.1 Volt<br>Unit: [V]                                                                                                                                                                                                                                                                                                                              |
| Magnetometer.X      | 40<br>int16  | X axis flux raw value in last measurement interval                                                                                                                                                                                                                                                                                                                    |
| Magnetometer.Y      | 42<br>int16  | Y axis flux raw value in last measurement interval                                                                                                                                                                                                                                                                                                                    |
| Magnetometer.Z      | 44<br>int16  | Z axis flux raw value in last measurement interval                                                                                                                                                                                                                                                                                                                    |
| Accelerometer.X     | 46<br>int16  | Raw accelerometer X axis value in last measurement interval<br>Raw value divided by 16384 will give vector [x,y,z] of length 1<br>Note: The unit of the instrument is gravity [g].<br>Conversion of Accelerometer unit less raw measurements to m/s <sup>2</sup> : divide measurement by 16384, then multiply by calibrated gravity in Oslo, 9.819 m/s <sup>2</sup> . |
| Accelerometer.Y     | 48<br>int16  | Raw Y axis value in last measurement interval<br>Raw value divided by 16384 will give vector [x,y,z] of length 1                                                                                                                                                                                                                                                      |
| Accelerometer.Z     | 50<br>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<br>uint16     | Data set description.<br>0-3 Physical beam used for 1st data set.<br>4-7 Physical beam used for 2nd data set.<br>8-11 Physical beam used for 3th data set.<br>12-16 Physical beam used for 4th data set. |
| Transmitted energy          | 56/58<br>uint16     | Transmitted energy.                                                                                                                                                                                      |
| Velocity scaling            | 58/60<br>int8       | Velocity scaling used to scale velocity data.                                                                                                                                                            |
| Power level                 | 59/61<br>int8       | Configured power level<br>Unit: [dB]                                                                                                                                                                     |
| Magnetometer temperature    | 60/62<br>int16      | Magnetometer temperature reading.<br>Uncalibrated<br>Raw data in 1/1000 °C<br>Unit: [°C]                                                                                                                 |
| Real time clock temperature | 62/64<br>int16      | Real Time Clock temperature reading<br>Unit: [°C]                                                                                                                                                        |
| Error status                | 64/66<br>2 * 8 bits | Error bit mask<br><a href="#">Object reference given in table below</a>                                                                                                                                  |
| Ensemble counter            | 72/74<br>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. |

|       |                                                                                                                                 |
|-------|---------------------------------------------------------------------------------------------------------------------------------|
| 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:** Error status

## Error bit mask

| Field                               | Position<br>Size | Description                                                                              |
|-------------------------------------|------------------|------------------------------------------------------------------------------------------|
| Data retrieval FIFO error           | 0<br>bit         | Data retrieval FIFO error                                                                |
| Data retrieval overflow             | 1<br>bit         | Data retrieval overflow                                                                  |
| Data retrieval underrun             | 2<br>bit         | Data retrieval Underrun                                                                  |
| Data retrieval samples missing      | 3<br>bit         | Data retrieval samples missing                                                           |
| Measurement not finished            | 4<br>bit         | The Measurement and data storage/transmit didn't finish before next measurement started. |
| Sensor read failure                 | 5<br>bit         | Sensor read failure                                                                      |
| Tag error beam 1 (In-phase)         | 8<br>bit         | Tag error beam 1 (In-phase)                                                              |
| Tag error beam 1 (Quadrature-phase) | 9<br>bit         | Tag error beam 1 (Quadrature-phase)                                                      |
| Tag error beam 2 (In-phase)         | 10<br>bit        | Tag error beam 2 (In-phase)                                                              |
| Tag error beam 2 (Quadrature-phase) | 11<br>bit        | Tag error beam 2 (Quadrature-phase)                                                      |
| Tag error beam 3 (In-phase)         | 12<br>bit        | Tag error beam 3 (In-phase)                                                              |
| Tag error beam 3 (Quadrature-phase) | 13<br>bit        | Tag error beam 3 (Quadrature-phase)                                                      |
| Tag error beam 4 (In-Phase)         | 14<br>bit        | Tag error beam 4 (In-phase)                                                              |
| Tag error beam 4 (Quadrature-phase) | 15<br>bit        | Tag Error Beam 4 (Quadrature-phase)                                                      |

#### 4.4 \_DF3 CurrentProfileData

**Extends:** \_CommonData

**Used By:** DF3 SpectrumData

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

| Field                         | Position<br>Size | Description                                                                                                                                          |
|-------------------------------|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| Configuration bit mask        | 2<br>2 * 8 bits  | Record Configuration Bit Mask<br><a href="#">Object reference given in table below</a>                                                               |
| Blanking                      | 34<br>uint16     | Distance from instrument to first data point on the beam.<br>Raw data given as cm or mm depending on status.blankingDistanceScalingInCm<br>Unit: [m] |
| Temperature<br>PressureSensor | 37<br>uint8      | Temperature of pressure sensor: $T = (Val/5) - 4.0$<br>Raw value given as 0.2 °C<br>Unit: [°C]                                                       |
| Ambiguity Velocity            | 52<br>uint16     | Ambiguity velocity, corrected for sound velocity, scaled according to Velocity scaling.<br>$10^{(Velocity\ scaling)}\ m/s$<br>Unit: [m/s]            |
| Extended status               | 66<br>2 * 8 bits | Extended status bit mask<br><a href="#">Object reference given in table below</a>                                                                    |
| Status                        | 68<br>4 * 8 bits | Status bit mask. Note that bits 0, 2, 3, 4 are unused.<br><a href="#">Object reference given in table below</a>                                      |

**Object reference:** Configuration bit mask

Record Configuration Bit Mask

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

|                             |        |                                   |
|-----------------------------|--------|-----------------------------------|
| Has external sensor         | 4 bit  | External sensor value valid       |
| 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 echosounder data        | 11 bit | Echosounder 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  |
| Has spectrum data           | 15 bit | Amplitude spectrum data included. |

**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%         | 2 bit         | Indicates that the processor idles less than 12 percent |
| External sound velocity probe | 3 bit         | Sound velocity probe velocity received                  |

|                                             |        |                                                                                |
|---------------------------------------------|--------|--------------------------------------------------------------------------------|
| External heading, pitch, roll, and position | 4 bit  | External heading, pitch, roll and position received from NMEA NTKNAV           |
| External heading                            | 5 bit  | External heading received from NMEA input                                      |
| External pitch and roll                     | 6 bit  | External pitch and roll received from NMEA input                               |
| File system flush                           | 13 bit | File system flush in progress                                                  |
| Internal processing                         | 14 bit | Internal processing in progress (e.g. wave processing)                         |
| 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                                                                                                                                    |
|-------------------------------------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| Blanking distance scaling in cm                 | 1 bit           | Bit 1: Scaling of blanking distance<br>0: mm scaling<br>1: given in cm                                                                         |
| Echosounder frequency bin                       | 5-9<br>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.    |
| Boost running                                   | 10 bit          | Boost running                                                                                                                                  |
| Telemetry data                                  | 11 bit          | Telemetry data                                                                                                                                 |
| Echosounder index                               | 12-15<br>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. |
| Active configuration                            | 16 bit          | Bit 16: Active configuration<br>0: Settings for PLAN,BURST,AVG<br>1: Settings for PLAN1,BURST1,AVG1                                            |
| Previous measurement skipped due to low voltage | 17 bit          | Bit 17: Last measurement low voltage skip<br>0: normal operation<br>1: last measurement skipped due to low input voltage                       |

|                       |                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-----------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Previous wakeup state | 18-21<br>4 bits | 00 = bad power<br>01 = power applied<br>10 = break<br>11 = RTC alarm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Auto orientation      | 22-24<br>3 bits | 0: "Fixed" Fixed orientation<br>1: "Auto" Auto Up Down<br>3: "AHRS3D" AHRS3D                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Orientation           | 25-27<br>3 bits | 0: "XUP" Instrument x-axis defined up, heading reference axis is Z positive<br>1: "XDOWN" Instrument x-axis defined down, heading reference axis is Z positive<br>2: "YUP" Instrument y-axis defined up, heading reference axis is Z positive<br>3: "YDOWN" Instrument y-axis defined down, heading reference axis is Z positive<br>4: "ZUP" Instrument z-axis defined up, heading reference axis is X positive<br>5: "ZDOWN" Instrument z-axis defined down, heading reference axis is X positive<br>7: "AHRS" AHRS reports orientation any way it points. Example: Z down -> Roll = 180 deg. |
| Wake up state         | 28-31<br>4 bits | 00 = bad power<br>01 = power applied<br>10 = break<br>11 = RTC alarm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

## 4.5 DF3 SpectrumData

**Extends:** \_DF3 CurrentProfileData

**ID:** 0x20

Data definitions for parsing DF3 amplitude spectrum data.

| Field                         | Position<br>Size                    | Description                                                                                          |
|-------------------------------|-------------------------------------|------------------------------------------------------------------------------------------------------|
| Beams and bins                | 30<br>2 bytes                       | Number of bins in the frequency spectrum.<br><a href="#">Object reference given in table below</a>   |
| Spectrum data.Start frequency | OFFSET<br>float                     | Start frequency value<br><b>Unit:</b> [Hz]                                                           |
| Spectrum data.Step frequency  | OFFSET + 4<br>float                 | Step frequency value<br><b>Unit:</b> [Hz]                                                            |
| Spectrum data.Frequency       | OFFSET + 64<br>int16 * BEAMS * BINS | Frequency spectrum amplitude data. There is room for 16 floating points for a spectrum header before |

|      |  |                                   |
|------|--|-----------------------------------|
| data |  | the frequency data.<br>Unit: [dB] |
|------|--|-----------------------------------|

**Position and size variables:**

| Name            | Description                                                                                                                                                                                                                                                                           |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| BEAMS           | Matrix first dimension is number of beams. Eg:<br>[[f_start, .., f_{start+step*(bins-1)}]_{beam1}<br>[f_start, .., f_{start+step*(bins-1)}]_{beam2}<br>..<br>[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:<br>[[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.<br>RAW: !this.configuration.hasSpectrumData ? 0 :<br>this.beamsAndBins.numberOfBeams*this.beamsAndBins.numberOfBins*2 + 16*4                                                                                    |
| OFFSET          | Number of bytes from start of record to start of data.                                                                                                                                                                                                                                |

**Object reference:** Beams and bins

Number of bins in the frequency spectrum.

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

## 4.6 StringData

ID: 0xa0

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

| Field  | Position<br>Size          | Description         |
|--------|---------------------------|---------------------|
| String | 0<br>Size of record bytes | String data record. |

## 5 Telemetry Data Formats

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                                                                                                                                                  |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 700              | Legacy binary data format, same as used by the previous generation of the Vector current meter. Described in the <a href="#">Integrators Guide - Classic</a> |

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