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Description of the ICES *HAC* Standard Data Exchange Format, Version 1.60

I. H. McQuinn, D. Reid, L. Berger, N. Diner, D. Heatley,
I. Higginbottom, L. N. Andersen, O. Langeland, J. P. Lapierre

International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer
H.C. Andersens Boulevard 44-46
DK-1553 Copenhagen V
Denmark
Telephone (+45) 33 38 67 00
Telefax (+45) 33 93 42 15
www.ices.dk
info@ices.dk

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Contents

1 Abstract

The ***HAC*** standard format for the exchange of fisheries acoustics raw and edited data was adopted by the ICES-Fisheries Acoustics Science and Technology Working Group (WGFAST) in 1999. Since 2000, the ICES ***HAC*** Planning Group (PGHAC) has overseen modifications and additions to the format so that it would evolve to meet the needs of the international fisheries acoustics community. The present report is based on the original adopted version and consolidates into one document the various additions, modification, corrections and clarifications which have been vetted and accepted by the PGHAC in the intervening years and published in the ICES Annual Reports of the Planning Group on the ***HAC*** data exchange format. Through the work of the PGHAC, many improvements have been made to the format, including the correction of errors and imprecisions in previously described tuples, the clarification of rules and definitions for tuple syntax, for allocating tuple numbers and for software compliance and compatibility, the addition of new tuples containing information for a new generation of echosounders, for additional auxiliary sensors and for the complete series of generic tuples for data exchange. The work of the PGHAC and the evolution of the ***HAC*** standard format will continue after the publication of this document and future modifications will continue to be published in the ***HAC*** Planning Group Annual Reports.

2 Introduction

Since 1999, when the ICES-Fisheries Acoustics Science and Technology Working Group (WGFAST) adopted the ***HAC*** (for ***h***ydro***ac***oustics) standard format (Simard *et al.*, 1997) for exchanging fisheries acoustics raw and edited data, the format has evolved considerably. At that time, a group of experts including WGFAST members and representatives of hardware and software manufacturers were assigned the responsibility of coordinating the development of the format by the WGFAST. This included the examination of proposals to introduce new information in the ***HAC*** environment and the definition of a generic set of tuples for echosounders that were not covered by the already defined tuples[1]. At the 2000 WGFAST (Haarlem, Netherlands), it was agreed that this was a major issue of importance to all members of the fisheries acoustic community and that a more permanent group should be set up. This was proposed at the ASC in Bruges, Belgium (September 2000) and was formally incorporated as an ICES ***HAC*** Planning Group (PGHAC, ICES Annual Report for 2000. Part 3. p. 256) "to oversee the evolution of the standard format in the ICES context". The terms of reference for PGHAC as agreed at the 2001 WGFAST (Seattle, USA) and approved at the September 2001 ICES Annual Conference (Oslo, Norway) were:

a) to continue to work on the ***HAC*** format in order to adapt it to the latest versions of equipment and to improve it;

b) to provide information on the changes in the format and its evolution;

c) to share information between manufacturers and users on the way acoustic data are processed and stored.

Since its inception, the PGHAC has met annually to introduce new tuples into the standard and to modify existing tuples either to correct inconsistencies and omissions or to clarify ambiguities (see Annex 1). The resulting standard is now recognised by most major scientific institutions as well as hardware and software developers (e.g. DFO, IFREMER, SIMRAD, SonarData) as the standard for data storage and/or exchange. This has lead to improved

[1] A tuple is a labelled group of bytes encapsulating related information forming the basic structure of the ***HAC*** format.

collaboration among scientists and facilitated data exchange as anticipated (ICES, 2003). The ***HAC*** is routinely specified as the prerequisite data format for internationally-funded collaborative acoustic research programs (i.e. the SIMFAMI project within the EU).

The purpose of the present report is to unite into one document the various additions and modifications made to the original version 1.0 (Simard *et al.*, 1997) which have been implemented and documented by the PGHAC in the intervening years (Table 1). Some of these updates include the addition of tuples, the modification of previously described tuples, and the clarification of definitions and descriptions of previously described fields and terms. As such, the present document includes only those tuple descriptions reviewed by the PGHAC and has precedence over any previous documents.

3 Tuple file structure

Information within a tuple data file is grouped into a series of packets of related data called *tuples*. A tuple is defined as a structured group of bytes labelled by a tag (Simard *et al.*, 1997). Tuples belong to families or classes grouping information by themes, which may or may not be related to each other in a hierarchical order. A "parent/child" relationship may exist between tuples where common information is separated from particular information to prevent redundancy, e.g. the Echosounder tuple, the Channel tuple, and the Ping tuple are hierarchically related by parent/child relationships (Figure 1). Unique numbers, ranging from 0 to 65535, identify each tuple (Table 1). The PGHAC allocates these numbers to prevent any "collisions" in tuple usage by various groups around the world and to agree on the definition of the various information fields they contain.

There are many advantages to the tuple structure. According to Simard *et al.* (1997):

> *A file could have as many tuple types as needed to code the information in extenso or only a few tuple types to represent a minimum of information. Further, a data access program may search only for the tuple types of interest for a particular application. The format structure thus allows forward and backward compatibility in time.* [...] *New versions of a program can always read the old tuple types; i.e. old files (backward compatibility). [The format structure] is therefore of great interest for the storage of raw fisheries hydroacoustic data at the acquisition step as well as for adding new information in subsequent processing steps, including [editing] commands or echo classifications resulting from various analyses. In this way, the raw data are kept unaltered and are always available to the scientist for new applications, while the data processing information that is required for proper interpretation remains attached to the file. The format is therefore useful for storing hydroacoustic data in large data banks as well as for data exchange at various levels of processing among the scientific community.*

Over the past five years, several new tuple types have been added to the ***HAC*** standard via the PGHAC to accommodate new instruments and applications, demonstrating the forward compatibility of the format structure.

4 Tuple syntax rules and definitions

All tuple types contain five required fields in the following order: (1) the tuple data size (total length of the data fields), (2) the tuple type code, or file tag, (3) the data fields, (4) the tuple attribute field (e.g. original tuple, edited tuple), and (5) the tuple backlink, which gives the tuple size (i.e. 10 bytes longer than the tuple data size). Apart from these five required fields, several additional rules and modifications affecting file structure and tuple content have been agreed upon by the PGHAC since version 1.0. They include (with the appropriate PGHAC annual report referenced):

- **Allowable values in fields** (ICES, 2001) – New values may be added to individual fields at any revision. The current lists of options may be added to and application code should be developed with the expectation of ANY permissible values.
- **Multiple channel tuples** (ICES, 2001) – More than one Channel tuple per channel are allowed within a file.
- **Start and End of run tuples** (ICES, 2001) – Start and End of run tuples are no longer compulsory in a file, but should they occur in a single file, they should always be paired. These tuple numbers have been removed from the basic tuple list (see ***HAC*** Compliance below).
- **Precision and "not applicable/not available/not known" data** (ICES, 2001) – LONG format data fields shall be used for continuous variables to allow a four-decimal place precision and a larger range of permitted values. Where possible, "not available/not known" will generally use the maximum permissible value for unsigned fields and the minimum permissible value for signed fields unless otherwise stated. Fields within a tuple that do not have applicable values for a specific situation will generally use the second highest permissible value for "not applicable" unless otherwise stated. For example, when translating data to one of the generic tuples, several fields may require data or parameters that are not applicable for the specific echosounder used.
- **Format of "char"** (ICES, 2002) – Data type "char" shall be 7-bit only. A number of formats are described in the literature for "char", the earliest being 7-bit. However, this does not allow for the coding of any non-English letters. An 8-bit char does allow for these, and a variety of other symbols; however, there is no single agreed international structure for 8-bit char, which could result in confusion between countries, developers, and software. In the light of this, the 7-bit char is specified to avoid confusion.
- **Big and little endian formatted files** (ICES, 2002) – Only "little endian" byte order (PC platform) shall be used for a file to be ***HAC*** compliant (see below). Originally, both big and little endian standards for byte order were permissible in the format to enhance platform independence (PC versus UNIX). However, in practice this was not necessary given that all known software developed for the ***HAC*** format at the time of the adoption of the format by ICES were on the PC platform.
- **Variable vs. fixed-length tuples** (ICES, 2002; 2003 and 2004) – Variable lengths are allowed for any new tuple and the actual length shall be specified in the Tuple Size field. The length of Remark fields will be of fixed dimension as specified in the present document. This modification was proposed to allow new fields to be added to existing tuples without major revision updates. Older software would simply not read the extra fields. The size of the tuple would remain in the first and last fields. Although variable lengths are desirable in principle, several problems can occur, e.g. the PG had also decided in 2001 to allow the use of variable length Remark fields. However, the combination resulted in tuples that are not easily readable by most software. This had generated some data problems with tuples 901 and 9001 (Generic echosounder and channel) and also in tuple 2002 (the patch tuple for the EK500 channel). To solve these ambiguities, it was decided to fix the Remark field lengths of tuples 901 and 9001 at 40 and 100 bytes, respectively, and at 20 bytes for tuple 2002. However, given the possibility of older, different-sized fixed-length tuples and newer, variable-length tuples, developers should always check tuple size when coding. Therefore, the use of variable-length tuples should be restricted to the following conditions:

  a) There would be no rewrite for existing tuples;

  b) New tuples will be variable in length and any software should read the tuple for length prior to use;

c) Where small modifications to existing fixed-length tuples are necessary, "patch tuples" will be used (see below). The original tuple to which the patch refers will indicate the presence of the patch using an entry in the "attribute" field.

- **Negative values in angle data tuples** (ICES, 2003) – "Two's complement" representation shall be used for storing all negative numbers. The format as originally defined did not specify whether the "two's complement" or the "sign + magnitude" method should be used to store negative numbers. Although "two's complement" is the general standard in software, "two's complement" had been used by some developers and "sign + magnitude" by others in the angle data tuples. The PG advises that programmers should implement code to allow for both in angle data tuples.
- **Completion of remark fields** (ICES, 2003) – All remark fields will be terminated with a "null" character and the rest of the field will be left untouched.
- **Angle coordinate variables** – All the descriptions for angle coordinate variables have been standardised (Annex 2) and are graphically presented in Figures 2–4 for clarity. An analysis of the treatment of angle coordinate variables showed various inconsistencies between tuples. It was noted that although coordinate systems for the various angle definitions (vessel motion, transducer installation and beam) were all right-handed, they did not all have the same reference for the x, y, and z direction. The modifications to the descriptions of angle variables affect channel tuples (1000, 1001, 2000, 2001, 9001) and platform attitude tuples (41, 42 10140, 10142).

5 Attribute codes

Attribute codes are used to label tuples according to certain qualitative characteristics necessary for the proper interpretation of the data contained within them, e.g. tuple data quality or state of processing. A grid of bit position codes has been developed to determine permissible entries for the attribute field (Annex 3). This grid allows for the addition of new attributes and combinations of attributes. Existing unique tuple attributes include:

- **original** (code 0): The tuple is as produced from the acquisition software.
- **edited** (bit 0 = 1): The basic concept of the ***HAC*** format is that data should be in its rawest possible form and that all information necessary for post-processing should be included within the file. However, there are many cases where "semi-processed" data are required for the proper interpretation of the raw data. This is most common when the data are to be exchanged between users of different software. An example of this would be the redrawing of the seabed. An "edited" value in the attribute field indicates that a tuple has been altered, however little. This can act as a warning to the user. The onus is then on the user to find out what has been changed.
- **temporary** (bit 1 = 1): Temporary (unofficial) tuple numbers are assigned specifically to allow developers to produce new software. They should not be used in shipped software until approval and adoption is finalised by the PGHAC.
- **patched** (bit 2 = 1): The tuple has been patched indicating that another tuple has been created with additional information which must be referred to this tuple.

By assigning these unique attributes to bit positions, the attribute code can be determined from Annex 3 by combining bit positions, e.g. to code a tuple as edited and patched, the bit positions 0 and 2 will be set to 1, resulting in a code = 5. Negative codes could be used for special cases.

6 The *HAC* standard format tuple types

6.1 *HAC* compliance

A data file is defined as ***HAC*** compliant if it contains tuples which conform to the ***HAC*** syntax rules, i.e. contains the minimum required ***HAC*** tuples using the exact tuple format described in this document.

- The **minimum tuple** types in a ***HAC*** file are: the ***HAC*** signature tuple, a Position tuple, an Echosounder tuple, a Channel tuple, Ping tuples, a Threshold tuple, and the End of file tuple.

Therefore a file (1) must start with the code 172 (=hexadecimal 0xAC, for ACoustics) stored in a ULONG[2] word in the ***HAC*** signature tuple, to identify the byte encoding mode of the computer platform, and (2) must contain at least the seven minimum tuple types. The first tuple in an ***HAC*** file must be the ***HAC*** signature tuple. The last tuple must be the End of file tuple.

Tuples that have been examined and accepted by the PGHAC comprise the ***HAC*** standard format and are described in Tables 2 – 31. Descriptions in these tables use a number of conventional terms (Annex 4) and follow the above described syntax rules. To ease the implementation of the ***HAC*** format by various software developers requiring the addition of new tuples and to facilitate the work of the PGHAC, the tuple classes have been divided in two groups. Any tuple to be added to the first group of basic tuple classes requires a thorough examination and a unanimous agreement by the PGHAC.

- The **basic tuple** classes are: Position tuples, Platform attitude tuples, Echosounder tuples, Channel tuples, Ping tuples, Threshold tuples, Environmental tuples for sound speed profiles, End of file tuples, and the ***HAC*** signature tuple.

A second group includes the optional tuple classes that concern auxiliary information or a secondary level of data analysis and completes the possible file content. Tuples within this group need not be approved by the PGHAC.

- The **optional tuple** classes are: Mission and project tuples, Navigation tuples, Event marker tuples, Edition tuples, Classification tuples, Environmental tuples except sound speed profiles, Start of run and End of run tuples, Private tuples, and Index tuples.

Since the initial definition of the ***HAC*** version 1.0, the following tuple numbers have been added to the list of defined tuples and may or may not be in use. Those in bold are part of the basic tuple types now accepted within the ***HAC*** standard:

- 30, 39, **41, 42, 210,** 220, 300, 301, **901, 1001, 2001, 2002, 2100,** 2200, 3000, 3001, **4000,** 4010, 5000, 5001, **9001, 10011**, 10039, 10090, 10119, **10140, 10142, 11000,** 12000, 12005, 12010, 12050, 12051, 12052, 12053, 12100, 13000, 13500, 14000, 65397, 65406.

The list of the tuples defined and described within the ***HAC*** standard format (or in use by the various groups in the acoustic community) as well as the reference to where these tuples were originally described and modified is presented in Table 1. In addition to the new tuples which have been added to the standard since the creation of the PGHAC, some discrepancies relative to the original defined standard version 1.0 (Simard *et al.*, 1997) were noted and have been corrected for the present version 1.6.

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[2] See definitions in Annex 4.

6.2 HAC compatibility

A software application is defined as ***HAC*** compatible if it can read and/or write, and use a minimum number of commonly used basic tuples following the ***HAC*** syntax rules as outlined in this document. These tuple numbers are:

- 20, 100, 200, 901, 1000, 2000, 2001, 2002, 9001, 10000, 10001, 10010, 10011, 10030, 10031, 10040, 10100, 65534, 65535.

7 Allocating tuple numbers and accepting new tuple definitions

The tuple type field is 16 bits long (USHORT), allowing for the definition of 65536 different tuple types (0 to 65535). The tuple type codes of the ***HAC*** standard format are given in Table 1. Tuple numbers for the basic tuple classes are allocated temporarily to the applicants during their definition and debugging period for a maximum of 14 months, after which time they are retired if the committee has not accepted their description. Temporary tuple numbers are assigned specifically to allow developers to produce new software. They should not be used in shipped software until approval and adoption is finalised by the PGHAC. Unless stated otherwise, new tuples will be considered provisional for two months after the current year's meeting to allow suggestions and objections to be made. Following that, and if no objections are raised, they will be accepted. For new tuples in the optional tuple classes, the PGHAC allocates tuple numbers at the request of the users, on presentation of a short justification and objectives of the tuple by the applicant.

8 Description of basic tuple classes

8.1 Position tuple

This tuple type stores the geographic position of the transducer deployment platform. The data collection rate of position data can be independent of the ping rate. [Reserved tuple type codes: 20 – 29].

8.2 Platform attitude tuple

This tuple type stores the attitude (i.e. pitch, roll, heave, and yaw) of the transducer deployment platform (i.e. ship, towed body, etc.). Tuples within this class have been designed to store data from both fixed and dynamic platforms. Fixed platforms have the attitude sensor at a fixed position relative to the transducer while dynamic platforms have a dynamic link between the attitude sensor and the transducer. Information on platform attitude is stored in either the platform attitude tuple class or the attitude sensor data tuple class. [Reserved tuple type codes: 40 – 49, 10140 – 10149].

8.3 Echosounder tuple

An echosounder is defined as a group of channels with a common configuration. Therefore the Echosounder tuple stores the information that is common to all channels of the group and is machine-specific. If several machines of a similar type are operated simultaneously, they may have the same Echosounder tuple. However, if several machines of different types are operated simultaneously, then one Echosounder tuple per machine type will exist. [Reserved tuple type codes: 100 – 999].

8.4 Channel tuple

The Channel tuple type is both machine- and channel-specific and is related to both the hardware and software channels, including virtual channels (e.g. an echo-classification channel combining the information from a number of existing channels). This tuple type stores the machine settings and calibration parameters specific to a given channel. This tuple type may also include single-target detection information. In addition to the five fields common to all tuples, this tuple type must also include the software channel identifier and the echosounder document identifier. [Reserved tuple type codes: 1000 – 9999].

8.5 Ping tuple

This tuple type stores a time-series of samples, either raw data or from processed information, depending on the specific tuple description. Samples may be encoded with many formats and several are described in this document, such as the U-32 for Sv or TS data or the C-32-16-angles for split-beam phase angle data. The Ping tuple formats should be chosen according to the desired resolution and their storage/recuperation efficiency. [Reserved tuple type codes: 10000 – 10099].

8.6 General threshold tuple

This tuple type stores the threshold used to filter samples during data acquisition. Algorithms used to define the filter presently include a constant threshold or a time-varied threshold (TVT). A given threshold applies to all pings collected subsequent to the time stamp of a given Threshold tuple, unless superseded by a new Threshold tuple. [Reserved tuple type codes: 10100 – 10109].

8.7 Environmental tuple (sound speed profile)

This tuple type stores the sound speed profile associated with the Echosounder tuple. If a fixed sound speed (independent of depth) was used, the value can be stored in the Echosounder tuple. [Reserved tuple type codes: 11000 – 11999].

8.8 End of file tuple

This tuple type identifies the end of the file and must be the last tuple in any tuple file. As such, it can be used to provide an error check for truncated files. [Reserved tuple type codes: 65526 – 65534].

8.9 *HAC* signature tuple

This tuple type stores the identification code confirming that the file is in the ***HAC*** standard hydroacoustic data format and should be the first tuple of the file. A program should first read this tuple to determine if it can interpret the file. [Reserved tuple type code: 65535].

9 Description of approved optional tuple classes

9.1 Private tuple

Temporary and private tuples as described in the ***HAC*** version 1.0 have been re-identified as the Private tuple class only, since Temporary tuples exist outside of this category, namely during the definition and debugging of the new tuples belonging to all other tuple classes (ICES, 2000).

Private tuples are used only to store software information that does not belong to the other tuple classes. However, this tuple class cannot be used to introduce proprietary formats inside the ***HAC*** standard data format. Consequently the space occupied by Private tuples within a ***HAC*** file will be very small in comparison to the other tuples within the data file. To introduce new types of data not already described in the ***HAC*** format, the abovementioned procedure to introduce new tuples must be followed (see Section 7 above). [Reserved tuple type codes: 65496 – 65505].

9.2 Temporary tuple

Temporary and provisional tuples are assigned specifically to encode information that is needed for a fixed and relatively short period of time to allow developers to produce new software. They should not be used in shipped software until approval and adoption is finalised by the PGHAC. The definition of the fields of these tuples is left to the users but must respect the ***HAC*** tuple syntax rules and required fields. [Reserved tuple type codes: assigned according to tuple class (Table 1)].

10 Acknowledgements

The authors wish to acknowledge the contributions of all PGHAC members past and present, as well as the participants of the original workshop held at the Maurice Lamontagne Institute on 12–14 December 1995, all of whom have been instrumental in the development and evolution of the ***HAC*** standard format. We particularly wish to thank Dr. Jon Preston who through his own initiative managed to greatly clarify the definitions of the various angle variables and their coordinate systems. Also, we especially wish to thank the various acoustic hardware and software developers involved in the definition and especially the implementation of the ***HAC*** standard format in their products, which transforms our efforts into very tangible results.

11 References

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12 Tuple Tables

Table 1. List of tuples and tuple classes described in the *HAC* standard format for raw and edited hydroacoustic data and the reference documents where they were first described and subsequently modified (bold = basic tuple class).

Tuple class		Tuple type		Description	Version	Reference			
Name	Range of codes	Name	Code			First described	Modified		
Mission and project tuples	10–19	Mission and project	10	General information on the mission, ship and research project.	1.0	(Simard *et al*., 1997)			
Position tuples	20–29	Position	20	Geographic and time references.	1.0	(Simard *et al*., 1997)			
Navigation tuples	30–39	Navigation	30	Platform navigation information (speed, heading).	1.0	(Simard *et al*., 1997)			
Platform attitude tuples	40–49	Platform attitude	40	Attitude (pitch, roll, and heave) of the platform (i.e. ship, towed body, AUV).	1.0	(Simard *et al*., 1997)			
		Platform attitude parameters	41	Parameters for the pitch, roll, heave, and yaw of the platform.	1.4	(ICES, 2002)			
		Dynamic platform position parameters	42	Offset calculation parameters and time-varied transducer position.	1.5	(ICES, 2003)			
Echosounder tuples	100–999	Biosonics 102	100	Biosonics Model 102 acquisition parameters with signal acquired via A/D or A/D-DSP boards. N.B. Could be used for similar analog echosounders.	1.0	(Simard *et al*., 1997)			
		Simrad EK500	200	Simrad EK500 (up to version 5.3) outputting simultaneously three-frequency split-beam digital data.	1.0	(Simard *et al*., 1997)	(ICES, 2001)		
		Simrad EK60	210	Simrad EK60 outputting multichannel split-beam digital data.	1.5	(ICES, 2003)	(ICES, 2004)		
		Generic echosounder	901	For echosounders that have not been described and will not be described by a specific echosounder tuple.	1.2	(ICES, 2000)	(ICES, 2003)		
Channel tuples	1000–9999	Biosonics 102	1000	Biosonics model 102 with signal acquired via an A/D-DSP board, or from similar analog echosounders.	1.0	(Simard *et al*., 1997)	This document		
		Biosonics 102	1001	Same as tuple 1000, except that the TVG field (offset byte 18) has been modified to be a multiplier rather than a code.	1.3	(ICES, 2001)	This document		
		Simrad EK500	2000	Simrad EK500 (up to version 5.3) outputting simultaneously three-frequency split-beam digital data.	1.0	(Simard *et al*., 1997)	This document		

Tuple class		Tuple type		Description	Version	Reference			
Name	Range of Codes	Name	Code			First described	Modified		
		Simrad EK500b	2001	Same as tuple 2000, except that (1) surface blanking range has been added, and (2) the angle offsets and 3dB beamwidth fields have been expanded to 2 dec.	1.3	(ICES, 2001)	(ICES, 2002)	(ICES, 2003)	This document
		Simrad EK500 channel patch	2002	Patches tuples 2000 and 2001 by specifying both EK500 transducer gains (Sv and TS) for a given transducer within a single channel tuple.	1.4	(ICES, 2002)	(ICES, 2003)		
		Simrad EK60	2100	Simrad EK60 outputting multichannel split-beam digital data.	1.5	(ICES, 2003)	(ICES, 2004)		
TS Parameters sub channel tuples	4000–4009	Simrad EK500 single target sub-channel	4000	Split-beam detected single-target parameters.	1.4	(ICES, 2002)			
		Generic channel	9001	For echosounder channels that have not been described and will not be described by a specific channel tuple.	1.2	(ICES, 2000)	(ICES, 2003)	This document	
Ping tuples	10000–10099	Ping U-32	10000	A time-series of sample values encoded using an uncompressed 32-bit sample format. N.B. The detected bottom range is put to -1 when the bottom is not detected (i.e. is missing).	1.0	(Simard *et al.*, 1997)			
		Ping U-32-16-angles	10001	A time-series of encoded off-axis electrical angles from raw split-beam sample phase data. The sample sequence is encoded using an uncompressed 32-bit format while the encoding of the two angles, with an uncompressed 16-bit format, requires 32 more bits.	1.0	(Simard *et al.*, 1997)	(ICES, 2001)	(ICES, 2003)	
		Ping C-32	10010	A time-series of sample values encoded using a compressed 32-bit format for the zero series.	1.0	(Simard *et al.*, 1997)	(ICES, 2001)	(ICES, 2003)	
		Ping C-32-16-angles	10011	A time-series of compressed split-beam off-axis angle sample data encoded using a compressed 16-bit format.	1.3	(ICES, 2001)			
		Ping U-16	10030	A time-series of samples using an uncompressed 16-bit sample format.	1.0	(Simard *et al.*, 1997)			
		Ping U-16-angles	10031	A time-series of encoded samples of split-beam off-axis phase angles. The sample sequence and the two angles are encoded using an uncompressed 16-bit format.	1.0	(Simard *et al.*, 1997)	(ICES, 2003)		
		Ping C-16	10040	A time-series of encoded samples using a compressed 16-bit format.	1.0	(Simard *et al.*, 1997)	(ICES, 2001)		
		Ping CE-16	10050	A time-series of samples using a compressed and encoded 16-bit format.	1.0	(Simard *et al.*, 1997)			

TUPLE CLASS		TUPLE TYPE		DESCRIPTION	VERSION	REFERENCE			
NAME	RANGE OF CODES	NAME	CODE			FIRST DESCRIBED	MODIFIED		
		Split-beam detected single target	10090	Ping tuple for detected single target.	1.4	(ICES, 2002)			
Threshold tuples	10100 – 10109	General threshold	10100	Constant and time-varied threshold (TVT) used during the acquisition to exclude samples. This threshold applies to the pings that are collected after the threshold setting time, until a subsequent threshold tuple updates the threshold information.	1.0	(Simard *et al.*, 1997)	(ICES, 2001)		
Event marker tuples	10110 – 10119	Event marker	10110	Time and text data used to mark events occurring during the acquisition or the edition at the user`s request.	1.0	(Simard *et al.*, 1997)			
Attitude sensor data tuples	10140 – 10149	Attitude sensor	10140	Pitch, roll, heave, and yaw of the transducer deployment platform.	1.4	(ICES, 2002)	(ICES, 2003)	This document	
		Platform position	10142	Recording of the attitude and relative position of an independent platform, e.g. a towed body or sounder mounted on a fishing net.	1.5	(ICES, 2003)	This document		
Environmental tuples	11000 – 11999	STD profile	11000	To store environmental variables describing the conditions in the study area. One tuple could be defined for each sensor type, e.g. salinity, temperature, depth, sound speed, light, meteorological information, refreshed at their own rate. Multi-variable sensors (e.g. CTD: conductivity, temperature, depth) should have only one tuple.	1.0	(Simard *et al.*, 1997)	(ICES, 2004)	This document	
Private tuples	65396 – 65405	Temporary tuple 1	65396	Temporary or testing tuples, or tuples specific to a particular or private application.	1.0	(Simard *et al.*, 1997)			
		Organisation	65397	Contains a code identifying the organization to which this private tuple belongs, that controls the format of the data section of the tuple and that has the definition of the fields it contains. It has the advantage of preventing possible collisions in non-concerted use of the private tuple by various groups.	1.2	(ICES, 2000)			
Opening and closing file tuples	65516 – 65525	Start of run	65516	To trace the file opening and appending steps (runs). New start of run tuples can be added each time data are appended to the file. These tuples are useful for selecting individual segments of a file such as acquisition runs.	1.0	(Simard *et al.*, 1997)			
		End of run	65517	To trace the file closing steps (runs). New end of run tuples can be added each time data acquisition is stopped (end of run). These tuples are useful for selecting individual segments of a file such as acquisition runs.	1.0	(Simard *et al.*, 1997)			

Tuple class		Tuple type		Description	Version	Reference			
Name	Range of Codes	Name	Code			First described	Modified		
End of file tuples	65526 – 65634	End of file	65534	Must be the last tuple of a ***HAC*** file.	1.0	(Simard *et al*., 1997)			
***HAC* signature tuple**	65635	***HAC*** signature	65535	***HAC*** file signature.	1.0	(Simard *et al*., 1997)	(ICES, 2000)		

The following tables describe the basic and optional tuples of the ***HAC*** standard format as defined by the PGHAC.

Table 2. Position tuple (20).

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
0	Tuple size	4	ULONG	Tuple data size: 26 bytes	byte	26
4	Tuple type	2	USHORT	Tuple type code: **20**	unitless	20
6	Time fraction	2	USHORT	Fraction of a second to add to the following CPU ANSI C time to get a time precision of 0.0001 s (Local time at which the position was taken by the positioning system).	0.0001 s	[0 – 6.5535 s] Practical range: [0 – 0.9999 s]
8	Time CPU ANSI C Standard time	4	ULONG	Local time at which the position was taken by the positioning system. ANSI C time given by the CPU clock, in seconds. Usually the CPU clock is set to local time. The difference with the GPS time gives the lag of the local time relative to the universal time.	s	[0 – 4294967295 s] i.e.: [up to year 2106]
12	GPS time (GMT)	4	ULONG	Universal time (GMT), given by the GPS, at which the position was taken by the positioning system. Absolute time, in seconds, elapsed since midnight (00:00:00) 1 January 1970.	s	[0 – 4294967295 s] i.e.: [up to year 2106]
16	Positioning system	2	USHORT	Positioning system used: 0 = Loran C 1 = GPS 2 = DGPS Other systems to be coded.	unitless	[0 – 65535] Presently: [0; 1; 2]
18	Space	2	USHORT	Space to allow the next field to be aligned on an address that is a multiple of 4.	unitless	0
20	Latitude	4	LONG	Latitude, in degrees. Negative values are in the southern hemisphere.	0.000001 deg precision: ~ 2 cm	[−214.7483648 – 214.7483647 deg] Practical range: [−90.000000 – 90.000000 deg]
24	Longitude	4	LONG	Longitude, in degrees. Negative values are western coordinates.	0.000001 deg precision: ~ 2 cm	[−214.7483648 – 214.7483647 deg] Practical range: [−180.000000 – 180.000000 deg]
28	Tuple attribute	4	LONG	Attribute of the tuple according to Annex 3. 0 = original 1 = edited 2 = temporary 3 = temporary + edited 4 = patched 5 = patched + edited …	unitless	[−2147483648 – 2147483647]
32	Backlink	4	ULONG	Tuple size: 36 bytes	byte	36

Table 3. Platform attitude parameters tuple (41).

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
0	Tuple size	4	ULONG	Tuple data size: 54 bytes	byte	54
4	Tuple type	2	USHORT	Tuple type code: **41**	unitless	41
6	Time fraction	2	USHORT	Fraction of a second to add to the following CPU ANSI C time to get a time precision of 0.0001 s (Local time at which the platform attitude reading was taken).	0.0001 s	[0 – 6.5535 s] Practical range: [0 – 0.9999 s]
8	Time CPU ANSI C Standard time	4	ULONG	Local time at which the platform attitude reading was taken. ANSI C time given by the CPU clock, in seconds. Usually the CPU clock is set to local time.	s	[[0 – 4294967295 s] i.e.: [up to year 2106]
12	Dependent attitude sensor identifier	2	USHORT	Unique identifier of the dependent attitude sensor.	unitless	[0 – 65535]
14	Transceiver channel number	2	USHORT	Transceiver channel number from the parent channel tuple to which these parameters refer.	unitless	[0 – 65535]
16	Platform type	2	USHORT	The platform type in which the attitude sensor is installed: 0 = ship 1 = towed body 1 2 = towed body 2 3 = AUV 4 = ROV 5 = pelagic trawl 6 = bottom trawl	unitless	[0 – 65535] Presently: [0; 1; 2; 3; 4; 5; 6]
18	Alongship offset	2	SHORT	Distance between the center of the transducer and the reference point of the attitude sensor in the fore and aft direction (X). Positive values are on the foreword side of the reference point of the attitude sensor.	0.01 m	[−327.68 – 327.67 m]
20	Athwartship offset	2	SHORT	Distance between the center of the transducer and the reference point of the attitude sensor in the starboard and port direction (Y). Positive values are on the port side of the reference point of the attitude sensor.	0.01 m	[−327.68 – 327.67 m]
22	Elevation offset	2	SHORT	Distance between the transducer face and the reference point of the attitude sensor in the vertical direction (Z). Positive values are below the reference point of the attitude sensor.	0.01 m	[−327.68 – 327.67 m]
24	Remarks	30	CHAR	Character string comment, up to 30 characters. This field could be used to store the sensor type and serial number.	ASCII char.	30 characters
54	Space	2	USHORT	Space to allow the next field to be aligned on an address that is a multiple of 4.	unitless	0

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
56	Tuple attribute	4	LONG	Attribute of the tuple according to Annex 3. 0 = original 1 = edited 2 = temporary 3 = temporary + edited 4 = patched 5 = patched + edited …	unitless	[−2147483648 – 2147483647]
60	Backlink	4	ULONG	Tuple size: 64 bytes	byte	64

Table 4. Dynamic platform position parameters tuple (42).

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
0	Tuple size	4	ULONG	Tuple data size: 62 bytes	byte	62
4	Tuple type	2	USHORT	Tuple type code: **42**.	unitless	42
6	Time fraction	2	USHORT	Fraction of a second to add to the following CPU ANSI C time to get a time precision of 0.0001 s (Local time at which the platform position reading was taken).	0.0001 s	[0 – 6.5535 s] Practical range: [0 – 0.9999 s]
8	Time CPU ANSI C Standard time	4	ULONG	Local time at which the platform position was taken. ANSI C time given by the CPU clock, in seconds. Usually the CPU clock is set to local time.	s	[0 – 4294967295 s] i.e.: [up to year 2106]
12	Dependent distance sensor identifier	2	USHORT	Unique identifier of the dependent sensor to which all distances (X and Y in tuple 10142) are referenced.	unitless	[0 - 65535]
14	Dependent depth sensor identifier	2	USHORT	Unique identifier of the dependent sensor to which all depths (Z in tuple 10142) are referenced.	unitless	[0 – 65535]
16	Transceiver channel identifier	2	USHORT	Transceiver channel identifier from the parent channel tuple to which these parameters refer.	unitless	[0 - 65535]
18	Platform type	2	USHORT	Platform type in which the transducer/echosounder is installed: 0 = ship 1 = towed body 1 2 = towed body 2 3 = AUV 4 = ROV 5 = Pelagic trawl 6 = Bottom trawl	unitless	[0 – 65535] Presently: [0, 1, 2, 3, 4, 5, 6]
20	Distance sensor type	2	USHORT	Distance sensor type: 0 = acoustic positioning 1 = cable length 2 = combining cable length and angle measurement 3 = other	unitless	[0 – 65535] Presently: [0, 1, 2, 3]
22	Depth sensor type	2	USHORT	Position sensor type: 0 = acoustic positioning (phase measurement) 1 = pressure sensor 2 = acoustic depth measurement 3 = acoustic bottom altitude measurement (including pinger) 4 = other	unitless	[0 – 65535] Presently: [0, 1, 2, 3, 4]
24	Alongship offset	2	SHORT	Distance between the position sensor and the attitude sensor in the fore and aft direction (X). Positive values are on the foreward side of the reference point of the attitude sensor.	0.01 m	[−327.68 – 327.67 m]
26	Athwartship offset	2	SHORT	Distance between the position sensor and the attitude sensor in the starboard and port direction (Y).	0.01 m	[−327.68 – 327.67 m]

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
				Positive values are on the starboard side of the reference point of the attitude sensor.		
28	Vertical offset	2	SHORT	Distance between the sea surface and the attitude sensor in the vertical direction (Z). Positive values are below the surface.	0.01 m	[−327.68 – 327.67 m]
30	Space	2	USHORT	Space to allow the next field to be aligned on an address that is a multiple of 4.	unitless	0
32	Remarks	30	CHAR	Character string comment, up to 30 characters. This field could be used to store the sensor type and serial number.	ASCII char.	30 characters
62	Space	2	USHORT	Space to allow the next field to be aligned on an address that is a multiple of 4.	unitless	0
64	Tuple attribute	4	LONG	Attribute of the tuple according to Annex 3. 0 = original 1 = edited 2 = temporary 3 = temporary + edited 4 = patched 5 = patched + edited …	unitless	[−2147483648 – 2147483647]
68	Backlink	4	ULONG	Tuple size: 72 bytes	byte	72

Table 5. Biosonics Model 102 Echosounder tuple (100).

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
0	Tuple size	4	ULONG	Tuple data size: 62 bytes	byte	62
4	Tuple type	2	USHORT	Tuple type code: **100**. This is the tuple type code for the Biosonics Model 102 echosounder. (Tuples 100 – 199 are reserved for Biosonics echosounders).	unitless	100
6	Number of software channels	2	USHORT	Number of software channels associated with this echosounder.	unitless	[1 – 65535]
8	Echosounder document identifier	4	ULONG	Unique identification number for the echosounder document (i.e. the group of channels). The channels are tied to the echosounder by the echosounder document identifier, which is repeated in the channel tuples.	unitless	[0 – 4294967295]
12	Sound speed	2	USHORT	Speed of sound. Note: Sound speed and sound speed profiles could also be computed from environmental tuples. 0.0 = profile used	0.1 m s^{-1}	[0 – 6553.5 m s^{-1}] In water: [1450.0 – 1550.0 m s^{-1}]
14	Ping interval	2	USHORT	Interval between 2 pings. In the multifrequency mode of the Biosonics 102, the acoustic frequency is alternating every ping.	0.01 s	[0 – 655.35 s] i.e.: [up to 10.92 min]
16	Transmitter attenuation setting	2	SHORT	The attenuation factor of the transmitter corresponding to the echosounder setting. This setting corresponds to a given source level recorded in the source level field of the channel tuple.	0.1 dB	[−3276.8 – 3276.7 dB] Biosonics 102 options: [−13, −10, −6, −3, 0 dB]
18	Multiplexing mode	2	USHORT	The operating transmitter mode of the echosounder. 0 = F1/X1 (frequency 1 on transducer 1) 1 = F2/X2 (frequency 2 on transducer 2) 2 = Ext. (transmitter and transducer controlled externally) 3 = F1/F2 multiplexed F1/X1 and F2/X2 4 = F1/X2 (frequency 1 on transducer 2) 5 = F2/X1 (frequency 2 on transducer 1)	unitless	[0 – 65535] Biosonics 102 options: [0, 1, 2, 3, 4, 5]
20	Blanking at TVG max. range	2	USHORT	The gain operating mode after the TVG max. range, from the blank at range switch. 0 = normal mode, the gain is maintained constant at the value reached at the TVG max. range. 1 = blank at range mode: the gain drops to zero at the TVG max. range.	unitless	[0 – 65535] Biosonics 102 options: [0, 1]

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
22	TVG max. range	2	USHORT	The range up to which the TVG is applied. Biosonics 102 echosounders normally apply TVG over the following two decade ranges: 1.25 – 125 m, 2.5 – 250 m, 5 – 500 m or 10 – 999.9 m, depending on hardware setting. TVG is computed from the transducer face and applied from the min. range up to the max. range. This max. range can, however, be limited to a smaller range by a range switch, whose setting would give the value of the present field. After this TVG max. range the gain is either maintained constant at the value reached at this range or dropped to zero if the TVG blank at range switch is on.	0.1 m	[0 – 6553.5 m] Biosonics 102 options: [0 – 999.9 m]
24	Blanking up to range	2	USHORT	Blanking range up to which the receiver output is blanked to zero. It is often set to the TVG min. range of either, 1.25, 2.5, 5.0 or 10.0 m. A blanking range of 0 sets the TVG off.	0.1 m	[0 – 6553.5 m] Biosonics 102 options: [0 – 999.9 m]
26	Calibrator signal	2	SHORT	Calibrator signal sent to the receiver from the echosounder setting: 0 = off, no calibrator signal is sent (This is the usual setting when echosounding).	dB	[−32768 – 32767 dB] Biosonics 102 options: [−40, −20, 0, 20 dB]
28	Calibrator mode	2	USHORT	Type of sound wave sent to the receiver: 0 = pulse, a pulse repeated at the interval given by the separation field below 1 = constant wave	unitless	[0 – 65535] Biosonics 102 options: [0, 1]
30	Calibrator separator	2	USHORT	Separation distance for the calibrator sound pulse when this mode is selected (previous field).	0.1 m	[0 – 6553.5 m] Biosonics 102 options: [0 – 99.9 m]
32	Remarks	30	CHAR	Character string comment, up to 30 characters. This field could be used to store the echosounder serial number.	ASCII char.	30 characters
62	Space	2	USHORT	Space to allow the next field to be aligned on an address that is a multiple of 4.	unitless	0
64	Tuple attribute	4	LONG	Attribute of the tuple according to Annex 3. 0 = original 1 = edited 2 = temporary 3 = temporary + edited 4 = patched 5 = patched + edited …	unitless	[−2147483648 – 2147483647]
68	Backlink	4	ULONG	Tuple size: 72 bytes	byte	72

Table 6. Simrad EK500 Echosounder tuple (200).

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
0	Tuple size	4	ULONG	Tuple data size: 70 bytes	byte	70
4	Tuple type	2	USHORT	Tuple type code: **200**. This is the tuple type code for the Simrad EK500. (Tuples 200 – 299 are reserved for Simrad echosounders).	unitless	200
6	Number of software channels	2	USHORT	Number of software channels associated with this echosounder.	unitless	[1 – 65535]
8	Echosounder document identifier	4	ULONG	Unique identification number for the echosounder document (i.e. the group of channels).	unitless	[0 – 4294967295]
12	Sound speed	2	USHORT	Speed of sound. Note: Sound speed and sound speed profiles could also be computed from environmental tuples. 0.0 = profile used	0.1 m s^{-1}	[0 – 6553.5 m s^{-1}] In water: [1450.0 m s^{-1} – 1550.0 m s^{-1}]
14	Ping mode	2	USHORT	Ping mode: 1 = normal 2 = external (trigged from an external source) 3 = synchronized	unitless	[0 – 65535] EK500 options: [0, 1, 2, 3]
16	Ping interval	2	USHORT	Interval between 2 pings. 0.00 = not known or variable	0.01 s	[0 – 655.35 s] i.e.: [up to 10.92 min]
18	Transmit power	2	USHORT	Nominal output power: 0 = normal 1 = reduced (The transmit power is reduced from its nominal value by 20 dB on all transceiver channels).	unitless	[0 – 65535] EK500 options: [0 or 1]
20	Noise margin	2	USHORT	The margin to add to the system noise to threshold out the samples.	dB	[0 – 65535 dB] EK500 options: [0 – 40 dB]
22	Sample range	2	USHORT	Range for the sample angle and sample power telegrams.	m	[0 m – 65535 m] EK500 options: [0 – 10000]
24	Super layer: Type	2	USHORT	Super layer type: 0 = off 1 = surface 2 = bottom 3 = pelagic (This layer type must be chosen to get values from the Ethernet port when the bottom is not found [e.g. for passive acoustics])	unitless	[0 – 65535] EK500 options: [0, 1, 2, 3]
26	Super layer: Number	2	USHORT	Layer number for the super layer.	unitless	[0 – 65535] EK500 options: [1– 10]
28	Super layer: Range	2	USHORT	Super layer thickness.	0.1 m	[0 – 6553.5 m]

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
						EK500 options: [0 – 1000.0 m]
30	Super layer: Start	4	LONG	Beginning depth of super layer relative to the transducer depth or the detected bottom. Negative values indicate starting depth below the reference depth.	0.1 m	[−214748364.8 – 214748364.7 m] EK500 options: [−10.0 – 9999.9 m]
34	Super layer: Margin	2	USHORT	Margin relative to the transducer depth or the bottom, to stop the super layer.	0.1 m	[0 – 6553.5 m] EK500 options: [0 – 10.0 m]
36	Super layer: Sv threshold	2	SHORT	Threshold to accept Sv samples.	dB	[−32768 – 32767 dB] EK500 options: [−100 – 0 dB]
38	EK500 version	4	ULONG	EK500 version number.	unitless	[0 – 42949672.95] Present range: [0 – 5.39]
42	Remarks	30	CHAR	Character string comment, up to 30 characters. This field could be used to store the echosounder serial number.	ASCII char.	30 characters
72	Tuple attribute	4	LONG	Attribute of the tuple according to Annex 3: 0 = original 1 = edited 2 = temporary 3 = temporary + edited 4 = patched 5 = patched + edited …	unitless	[−2147483648 – 2147483647]
76	Backlink	4	ULONG	Tuple size: 80 bytes	byte	80

Table 7. Simrad EK 60 Echosounder tuple (210).

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
0	Tuple size	4	ULONG	Tuple data size: 58 bytes	byte	58
4	Tuple type	2	USHORT	Tuple type code: **210.** Tuple type code for the Simrad EK 60.	unitless	210
6	Number of software channels	2	USHORT	Number of software channels associated with this sounder.	unitless	[1 – 65535]
8	Echo sounder document identifier	4	ULONG	Unique identification number for the echosounder document (i.e. the group of channels).	unitless	[0 – 4294967295]
12	Sound speed	2	USHORT	Mean speed of sound. 0.0 = Profile used	0.1 ms^{-1}	[0 – 6553.5 ms^{-1}] EK 60 range: [1400.0 – 1700.0 ms^{-1}]
14	Ping mode	2	USHORT	Ping mode. 1 = normal 2 = external	unitless	[0 – 65535]
16	Ping interval	2	USHORT	Interval between 2 pings. 0.00 = not known or variable	0.01 s	[0 – 655.35 s]
18	Space	2	USHORT	Space to allow the next field to be aligned on an address that is a multiple of 4.	unitless	
20	Remarks	40	CHAR	Software version (example: “1.2.34.5678”)	ASCII	40 characters
60	Tuple attribute	4	LONG	Attribute of the tuple according to Annex 3. 0 = original 1 = edited 2 = temporary 3 = temporary + edited 4 = patched 5 = patched + edited …	unitless	[−2147483648 – 2147483647]
64	Backlink	4	ULONG	Tuple size: 68 bytes	byte	68

Table 8. Generic Echosounder tuple (901) used with echosounders for which no Echosounder tuple has been described in the *HAC* standard data format.

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
0	Tuple size	4	ULONG	Tuple data size: 118 bytes	byte	118
4	Tuple type	2	USHORT	Tuple type code: **901**. This is the tuple type code for the generic echosounder.	unitless	901
6	Number of software channels	2	USHORT	Number of software channels associated with this echosounder.	unitless	[1 – 65535]
8	Echosounder document identifier	4	ULONG	Unique identification number for the echosounder document (i.e. the group of channels). The channels are tied to the echosounder by the echosounder document identifier, which is repeated in the channel tuples.	unitless	[0 – 4294967295]
12	Sound speed	2	USHORT	Mean sound speed used in the sounder. Mean sound speed should be calculated over the range of the sample data. 0.0 = profile used	0.1 m s^{-1}	[0 – 6553.5 m s^{-1}] In water: [1450.0–1550.0 m s^{-1}]
14	Ping interval	2	USHORT	Interval between 2 pings. If a multiplexing echosounder triggers the various transducers in sequence, the recorded ping interval is the master trigger interval. 0 = not known or variable (the interval can be obtained from the time difference between pings)	0.01 s	[0 – 655.35 s] i.e.: [up to 10.92 min]
16	Trigger mode	2	USHORT	The source characteristics of the trigger. 1 = normal 2 = external 3 = synchronized	unitless	[0 – 65535] Presently: [0, 1, 2, 3]
18	Space	2	USHORT	Space to allow the next field to be aligned on an address that is a multiple of 4.	unitless	0
20	Remarks	100	CHAR	Character string comment. This field could be used to store the echosounder brand, its properties and the serial number.	ASCII char.	100 characters
120	Tuple attribute	4	LONG	Attribute of the tuple according to Annex 3. 0 = original 1 = edited 2 = temporary 3 = temporary + edited 4 = patched 5 = patched + edited …	unitless	[–2147483648 – 2147483647]
124	Backlink	4	ULONG	Tuple size: 128 bytes	byte	128

Table 9. Biosonics Model 102 Channel tuple (1000).

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
0	Tuple size	4	ULONG	Tuple data size: 98 bytes.	byte	98
4	Tuple type	2	USHORT	Tuple type code: **1000.** This is the tuple type code for the Biosonics 102.	unitless	1000
6	Software channel identifier	2	USHORT	Unique identifier for this software data channel This identifier must be unique for the whole file in order to associate the pings to their proper parent channel. Note: This is not the hardware channel number.	unitless	[0 – 65535]
8	Echosounder document identifier	4	ULONG	Identification number for the parent echosounder document (i.e. the group of channels) to which this data channel belongs. It is the echosounder document identifier field of the echosounder tuple.	unitless	[0 – 4294967295]
12	Sampling rate	4	ULONG	Digitization rate for this channel.	sample s^{-1}	[0 – 4294967295 sample s^{-1}]
16	Type of data sample	2	USHORT	Type of data sample: 0 = volts 1 = Sv (Scattering volume in dB) 2 = TS (Target strength of single targets in dB) 3 = Offaxis mechanical angles of single targets Others to be defined.	unitless	[0 – 65535] Biosonics 102 options: [0, 1, 2, 3]
18	Time varied gain mode	2	USHORT	Time-varied gain (TVG) applied for this channel: 0 = 20 log R TVG 1 = 40 log R TVG Note: This TVG is applied from a min. range up to the TVG max. range field of the echosounder tuple. When this TVG max. range is null or smaller than the blanking up to range, or the blanking up to range is set to zero, no TVG is applied. See pertinent fields in Biosonics Model 102 Echosounder tuple.	unitless	[0 – 65535] Biosonics 102 options: [0, 1]
20	Transceiver channel number	2	USHORT	Hardware channel number from which the data are coming. It is convenient to use the same channel numbers as from the echosounder. The Biosonics 102 has the narrow-beam signal on channel 1, the wide-beam signal on channel 2, and the simultaneous 20 log R narrow-beam on channel 3. When the 40 log R TVG switch is on, channels 1 and 2 are the 40 log R signals. Note: This field is not the software channel number.	unitless	[0 – 65535] CH1 DSP-A/D options: [1, 2, 3]
22	Space	2	USHORT	Space to allow the next field to be aligned on an address that is a multiple of 4.	unitless	0
24	Acoustic frequency	4	ULONG	Acoustic frequency.	Hz	[0 – 4294967295 Hz] Fisheries acoustics range: [100 – 1000000 Hz]
28	Installation depth of transducer	4	ULONG	Installation depth of transducer relative to the sea surface.	0.01 m	[0 – 42949672.95 m] Working range: [0 – 999.99 m]
32	Alongship angle offset of the transducer face	2	SHORT	Mechanical offset angle of the transducer face relative to the horizontal in the alongship plane of the attitude sensor coordinate system (XY). Positive angles indicate the foreward side is above the horizontal.	0.1 deg	[–3276.8 – 3276.7 deg] Working range: [–360.0 – 360.0 deg]

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
34	Athwartship angle offset of the transducer face	2	SHORT	Mechanical offset angle of the transducer face relative to the horizontal in the athwartship plane of the attitude sensor coordinate system (YZ). Positive angles indicate the port side is above the horizontal.	0.1 deg	[−3276.8 – 3276.7 deg] Working range: [−360.0 – 360.0 deg]
36	Alongship angle offset of the main axis of the acoustic beam	2	SHORT	Mechanical offset angle of the main axis of the acoustic beam in the alongship plane relative to the perpendicular to the transducer face (XY). Zero (0) is perpendicular to the transducer face. Positive angles indicate the down-propagating sonar beam is oriented foreward.	0.1 deg	[−3276.8 – 3276.7 deg] Working range: [−20.0 – 20.0 deg]
38	Athwartship angle offset of the main axis of the acoustic beam	2	SHORT	Mechanical offset angle of the main axis of the acoustic beam in the athwartship plane relative to the perpendicular to the transducer face (YZ). Zero (0) is perpendicular to the transducer face. Positive angles indicate the down-propagating sonar beam is oriented to starboard.	0.1 deg	[−3276.8 – 3276.7 deg] Working range: [−20.0 – 20.0 deg]
40	Absorption of sound	2	USHORT	Absorption of sound (α) in the propagation medium.	0.01 dB km^{-1}	[0 – 655.35 dB km^{-1}] Practical range: [0 – 300.00 dB km^{-1}]
42	Pulse length	2	USHORT	Duration of the transmitted pulse.	0.1 ms	[0 – 6553.5 ms] Biosonics 102 range: [0.1 – 9.9 ms]
44	Bandwidth	2	USHORT	Transceiver specific bandwidth.	0.01 kHz	[0 – 655.35 kHz] Biosonics 102 options: [1.25, 2.50, 5.00, 10.00 kHz]
46	Calibration source level	2	USHORT	Source level (SL). Note: The attenuation factor of the transmitter, given in the echosounder tuple, is added to this field to get the effective source level.	0.01 dB µPa @ 1 m	[0 – 655.35 dB] Practical range: [150.00 – 250.00 dB]
48	3 dB beam width of the transducer beam	2	USHORT	Half power (3 dB) beam width of the transducer beam (narrow or wide).	0.1 deg	[0 – 6553.5 deg] Practical range: [1.0 – 50.0 deg]
50	Beam pattern	2	USHORT	Beam pattern factor (expected value of b^2) for this transducer beam (narrow or wide). (unitless). N. B. The directivity index (DI) in dB is 10 log the present field and 10 log ψ = -DI + 7.7 dB.	0.000001	[0 – 0.065535] Practical range: [0.000100 – 0.009000]
52	Wide-beam drop-off	2	USHORT	The wide-beam drop-off (d) is the factor relating the narrow-beam directivity in dB (Bn) to the difference between the narrow-beam and wide-beam (Bw) directivities in dB: Bn = d (Bn-Bw). It describes the decrease in wide-beam directivity over the angular range of the narrow beam.	0.0001	[0 – 6.5535] Practical range: [1.0000 – 1.5000]
54	Calibration receiving sensitivity	2	SHORT	Calibration receiving sensitivity of the transducer for this TVG-amplified data channel. Note: The receiver gain is included in the value of this field, which is the VR of the sonar equation.	0.01 dBv /µPa @ 1 m	[−327.68 – 327.67 dB] Practical range: [−200.00 – −100.00 dB]
56	Receiver gain	2	SHORT	Receiver gain of the echosounder. Note: The receiver gain is included in the receiving sensitivity value to get the VR of the sonar equation.	0.01 dB	[−327.68 – 327.67 dB] Biosonics 102 options: [−18, −12, −6, 0, 6, 12, 18, 24]

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
58	Bottom detection: minimum level	2	SHORT	Level for the bottom detection in the units selected in the above field "Type of sample data [0, 1 or 2]".	0.001 volts Sv and TS: 0.01 dB	For volts: [−32.768 – 32.767 volts] Practical range: [2.500 – 15.000 volts]; For Sv and TS: [−327.68 – 327.67 dB] Practical range: [−150.00 – 0.00 dB]
60	Bottom window min.	4	ULONG	Minimum depth for bottom detection window.	0.01 m	[0 – 42949672.95 m] Working range: [0 – 999.99 m]
64	Bottom window max.	4	ULONG	Maximum depth for bottom detection window in m. For the CH1 software this is also the maximum depth up to which data will be acquired.	0.01 m	[0 – 42949672.95 m] Working range: [0 – 999.99 m]
68	Remarks	30	CHAR	Character string comment, up to 30 characters. This field could be used to store the transducer serial number.	ASCII char.	30 characters
98	Space	2	USHORT	Space to allow the next field to be aligned on an address that is a multiple of 4.	unitless	0
100	Tuple attribute	4	LONG	Attribute of the tuple according to Annex 3. 0 = original 1 = edited 2 = temporary 3 = temporary + edited 4 = patched 5 = patched + edited …	unitless	[−2147483648 – 2147483647]
104	Backlink	4	ULONG	Tuple size: 108 bytes.	byte	108

Table 10. Biosonics Model 102 Channel tuple (1001).

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
0	Tuple size	4	ULONG	Tuple data size: 98 bytes.	byte	98
4	Tuple type	2	USHORT	Tuple type code: **1001.** This is the tuple type code for the Biosonics 102.	unitless	1001
6	Software channel identifier	2	USHORT	Unique identifier for this software data channel. This identifier must be unique for the whole file in order to associate the pings to their proper parent channel. Note: This is not the hardware channel number.	unitless	[0 – 65535]
8	Echosounder document identifier	4	ULONG	Identification number for the parent echosounder document (i.e. the group of channels) to which this data channel belongs. It is the echosounder document identifier field of the echosounder tuple.	unitless	[0 – 4294967295]
12	Sampling rate	4	ULONG	Digitization rate for this channel.	sample s^{-1}	[0 – 4294967295 sample s^{-1}]
16	Type of data sample	2	USHORT	Type of data sample: 0 = volts 1 = Sv (Scattering volume in dB) 2 = TS (Target strength of single targets in dB) 3 = Off-axis mechanical angles of single targets	unitless	[0 – 65535] Biosonics 102 options: [0, 1, 2, 3]
18	Time varied gain multiplier	2	USHORT	Time-varied gain (TVG) multiplier applied for this channel (e.g. a value of 28.00 = 28.00(log R) + 2αR). Note: This TVG is applied from the TVG minimum range up to the TVG maximum range field of the echosounder tuple. When the TVG maximum range is null or smaller than the blanking up to range, or the blanking up to range is set to 0, no TVG is applied. See pertinent fields in "Echosounder tuple for the Biosonics Model 102". Other components in the TVG (e.g. α) are dealt with elsewhere. 0.00 = no TVG applied	unitless 0.01	[0 – 655.35] Biosonics 102 options: [20.00, 40.00]
20	Transceiver channel number	2	USHORT	Hardware channel number from which the data are coming. It is convenient to use the same channel numbers as from the echosounder. The Biosonics 102 has the narrow-beam signal on channel 1, the wide-beam signal on channel 2, and the simultaneous 20 log R narrow-beam on channel 3. When the 40 log R TVG switch is on, channels 1 and 2 are the 40 log R signals. Note: This field is not the software channel number.	unitless	[0 – 65535] CH1 DSP-A/D options: [1, 2, 3]
22	Platform identifier	2	USHORT	Unique identifier of the installation platform of the transducer.	unitless	0 – 65535
24	Acoustic frequency	4	ULONG	Acoustic frequency.	Hz	[0 – 4294967295 Hz] Fisheries acoustics range: [100 – 1000000 Hz]
28	Installation depth of transducer	4	ULONG	Installation depth of transducer relative to the sea surface. 42949672.94 = dynamic platform	0.01 m	[0 – 42949672.95 m] Working range: [0 – 9999.99 m]
32	Alongship angle offset of the transducer face	2	SHORT	Mechanical offset angle of the transducer face relative to the horizontal in the alongship plane of the attitude sensor coordinate system (XY). Positive angles indicate the foreward side is above the horizontal.	0.1 deg	[−3276.8 – 3276.7 deg] Working range: [−360.0 – 360.0 deg]

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
34	Athwartship angle offset of the transducer face	2	SHORT	Mechanical offset angle of the transducer face relative to the horizontal in the athwartship plane of the attitude sensor coordinate system (YZ). Positive angles indicate the port side is above the horizontal.	0.1 deg	[−3276.8 – 3276.7 deg] Working range: [−360.0 – 360.0 deg]
36	Alongship angle offset of the main axis of the acoustic beam	2	SHORT	Mechanical offset angle of the main axis of the acoustic beam in the alongship plane relative to the perpendicular to the transducer face (XY). Zero (0) is perpendicular to the transducer face. Positive angles indicate the down-propagating sonar beam is oriented foreward.	0.1 deg	[−3276.8 – 3276.7 deg] Working range: [−20.0 – 20.0 deg]
38	Athwartship angle offset of the main axis of the acoustic beam	2	SHORT	Mechanical offset angle of the main axis of the acoustic beam in the athwartship plane relative to the perpendicular to the transducer face (YZ). Zero (0) is perpendicular to the transducer face. Positive angles indicate the down-propagating sonar beam is oriented to starboard.	0.1 deg	[−3276.8 – 3276.7 deg] Working range: [−20.0 – 20.0 deg]
40	Absorption of sound	2	USHORT	Absorption of sound (α) in the propagation medium used for TVG compensation.	0.01 dB km^{-1}	[0 – 655.35 dB km^{-1}] Practical range: [0 – 300.00 dB km^{-1}]
42	Pulse duration	2	USHORT	Duration of the transmitted pulse.	0.1 ms	[0 – 6553.5 ms] Biosonics 102 range: [0.1 – 9.9 ms]
44	Bandwidth	2	USHORT	Transceiver specific bandwidth.	0.01 kHz	[0 – 655.35 kHz] Biosonics 102 options: [1.25, 2.50, 5.00, 10.00 kHz]
46	Calibration source level	2	USHORT	Source level (SL). Note: The attenuation factor of the transmitter, given in the echosounder tuple, is added to this field to get the effective source level.	0.01 dB µPa @ 1 m	[0 – 655.35 dB] Practical range: [150.00 – 250.00 dB]
48	3 dB beam width of the transducer beam	2	USHORT	Half power (3 dB) beam width of the transducer beam (narrow or wide).	0.1 deg	[0 – 6553.5 deg] Practical range: [1.0 – 50.0 deg]
50	Beam pattern factor	2	USHORT	Beam pattern factor (expected value of b^2) for this transducer beam (see MacLennan and Simmonds, 1992, Section 2.3 for a definition of b). Note: The directivity index (DI) in dB is −10 log this field for a circular beam. For an asymmetric beam, DI = 10 log (2.5/ (sin(ß$_1$/2) * sin(ß$_2$/2))), where ß$_1$ and ß$_2$ are the longitudinal and transversal beam widths (radians), respectively.	unitless	[0 – 0.065535] Practical range: [0.000100 – 0.009000]
52	Transducer shape	2	USHORT	0 = other 1 = oval (which includes circular transducer) 2 = rectangular 3 = cross array 4 = ring	unitless	[0 – 65535] Presently: [0 – 4]

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
54	Wide-beam drop-off	2	USHORT	The wide-beam drop-off (d) is the factor relating the narrow-beam directivity in dB (Bn) to the difference between the narrow-beam and wide-beam (Bw) directivities in dB: Bn = d (Bn-Bw). It describes the decrease in wide-beam directivity over the angular range of the narrow beam.	0.0001	[0 – 6.5535] Practical range: [1.0000 – 1.5000]
56	Calibration receiving sensitivity	2	SHORT	Calibration receiving sensitivity of the transducer for this TVG-amplified data channel. Note: The receiver gain is included in the value of this field, which is the VR of the sonar equation.	0.01 dBv /µPa @ 1 m	[−327.68 – 327.67 dB] Practical range: [−200.00 – −100.00 dB]
58	Receiver gain	2	SHORT	Receiver gain of the echosounder. Note: The receiver gain is included in the receiving sensitivity value to get the VR of the sonar equation.	0.01 dB	[−327.68 – 327.67 dB] Biosonics 102 options: [−18, −12, −6, 0, 6, 12, 18, 24]
60	Bottom window minimum	4	ULONG	Minimum depth for bottom detection window.	0.01 m	[0 – 42949672.95 m] Working range: [0 – 999.99 m]
64	Bottom window maximum	4	ULONG	Maximum depth for bottom detection window in m. For the CH1 software this is also the maximum depth up to which data will be acquired.	0.01 m	[0 – 42949672.95 m] Working range: [0 – 999.99 m]
68	Bottom detection: minimum level	2	SHORT	Level for the bottom detection in the units selected in the above field "Type of sample data [0, 1 or 2]". For volts: −32.768 = not available For Sv or TS: −327.68 = not available	0.001 volts Sv or TS: 0.01 dB	For volts: [−32.768 – 32.767 volts] Practical range: [2.500 – 15.000 volts]; For Sv and TS: [−327.68 – 327.67 dB] Practical range: [−150.00 – 0.00 dB]
70	Remarks	30	CHAR	Character string comment, up to 30 characters. This field could be used to store the transducer serial number.	ASCII char.	30 characters
100	Tuple attribute	4	LONG	Attribute of the tuple according to Annex 3. 0 = original 1 = edited 2 = temporary 3 = temporary + edited 4 = patched 5 = patched + edited …	unitless	[−2147483648 – 2147483647]
104	Backlink	4	ULONG	Tuple size: 108 bytes.	byte	108

Table 11. Simrad EK500 Channel tuple (2000).

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
0	Tuple size	4	ULONG	Tuple data size: 98 bytes	BYTE	98
4	Tuple type	2	USHORT	Tuple type code: **2000**. This is the tuple type code for the Simard EK 500- raw data.	Unitless	2000
6	Software channel identified	2	USHORT	Unique identifier for this software data channel. This identifier must be unique for the whole file in order to associate the pings to their proper parent channel. Note: This is not the hardware channel number.	Unitless	[0–75535]
8	Echosounder document identifier	4	ULONG	Identification number for the parent echosounder document (i.e. the group of channels) to which this data channel belongs. It is the echosounder document identifier field of the echosounder tuple.	Unitless	[0–4294967295]
12	Sampling rate	4	ULONG	Digitization rate for this channel. Fixed according to acoustic frequency.	Sample s^{-1}	[0–4294967295 sample s^{-1}
16	Type of data sample	2	USHORT	Type of data sample: 0= electric phase angle from the split-beam analysis 1= power (raw Sv before the TVG) 2= Sv (Scattering volume) 3= TX (Target strength)	Unitless	[0–65535] Presently: [0, 1, 2, 3]
18	Transceiver channel number	2	USHORT	EK500 transceiver (1, 2 or 3).	Unitless	[0–65535] Presently: [1, 2, 3]
20	Acoustic frequency	4	ULONG	Acoustic frequency.	Hz	[0 – 4294967295 Hz] Fisheries acoustics range: [100 – 1000000 Hz]
24	Installation depth of transducer	4	ULONG	Installation depth of transducer relative to the sea surface.	0.01 m	[0 – 42949672.95 m] EK500 range: [0 – 999.99 m]
28	Alongship angle offset of the transducer face	2	SHORT	Mechanical offset angle of the transducer face relative to the horizontal in the alongship plane of the attitude sensor coordinate system (XY). Positive angles indicate the foreward side is above the horizontal.	0.1 deg	[−360.0 – 360.0 deg]
30	Athwartship angle offset of the transducer face	2	SHORT	Mechanical offset angle of the transducer face relative to the horizontal in the athwartship plane of the attitude sensor coordinate system (YZ). Positive angles indicate the port side is above the horizontal.	0.1 deg	[−3276.8 – 3276.7 deg] Working range: [−360.0 – 360.0 deg]
32	Alongship angle offset of the main axis of the acoustic beam	2	SHORT	Mechanical offset angle of the main axis of the acoustic beam in the alongship plane relative to the perpendicular to the transducer face (XY). Zero (0) is perpendicular to the transducer face. Positive angles indicate the down-propagating sonar beam is oriented foreward.	0.1 deg	[−3276.8 – 3276.7 deg] EK500 range: [−20.0 – 20.0 deg]

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
34	Athwartship angle offset of the main axis of the acoustic beam	2	SHORT	Mechanical offset angle of the main axis of the acoustic beam in the athwartship plane relative to the perpendicular to the transducer face (YZ). Zero (0) is perpendicular to the transducer face. Positive angles indicate the down-propagating sonar beam is oriented to starboard.	0.1 deg	[−3276.8 – 3276.7 deg] EK500 range: [−20.0 – 20.0 deg]
36	Absorption of sound	2	USHORT	Absorption of sound (α) in the propagation medium.	0.01 dB km^{-1}	[0 – 655.35 dB km^{-1}] Practical range: [0 – 300.00 dB km^{-1}]
38	Pulse length mode	2	USHORT	This field indicates the selected transceiver specific duration of the transmitted pulse: 0 = short 1 = medium 2 = long	unitless	[0 – 65535] EK500 options: [0, 1, 2]
40	Bandwidth mode	2	USHORT	This field indicates the selected transceiver specific bandwidth: 0 = narrow 1 = wide Note: The mode “auto” is not coded because the choice (narrow or wide) made by the EK500 is indicated in the EK500 telegram that the acquisition program reads.	unitless	[0 – 65535] EK500 options: [0, 1]
42	Max. power	2	USHORT	Transmit power referred to the transducer terminals.	watt	[0 – 65535] EK500 range: [1 watt – 10000 watt]
44	Alongship angle sensitivity	2	USHORT	The electrical phase angle in degrees for one mechanical phase angle in degrees in the fore-and-aft direction, specific to the split-beam transducer. A value of 1.0 indicates that the electrical angles are in units of mechanical angles.	unitless	[0 – 6553.5] EK500 range: [0 – 100.0]
46	Athwartship angle sensitivity	2	USHORT	The electrical phase angle in degrees for one mechanical phase angle in degrees in the starboard-and-port direction, specific to the split-beam transducer. A value of 1.0 indicates that the electrical angles are in units of mechanical angles.	unitless	[0 – 6553.5] EK500 range: [0 – 100.0]
48	Alongship 3 dB beam width of the transducer	2	USHORT	Half power (3dB) beam width of the transducer in the alongship plane.	0.1 deg	[0 – 6553.5 deg] EK500 range: [1.0 – 50.0 deg]
50	Athwartship 3 dB beam width of the transducer	2	USHORT	Half power (3dB) beam width off the transducer in the athwartship plane.	0.1 deg	[0 – 6553.5 deg] EK500 range: [1.0 – 50.0 deg]
52	Two-way beam angle	2	SHORT	Equivalent two-way beam opening solid angle: [=10 log (($\beta_1 * \beta_2$) / 5800)], where β_1 is the longitudinal beamwidth in degrees and β_2 is the transversal beam width in degrees). NB: Directivity index in dB: DI = 10 log (2.5/ (sin(β_1 / 2) * sin(β_2 / 2))). (see EK500 user manual).	0.01 dB	[−327.68 – 327.67 dB] EK500 range: [−99.90 – 0.00 dB]

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
54	Calibration transducer gain	2	USHORT	Peak transducer gain used during computation of the data sample corresponding to the above-selected “type of data sample” (either Sv or TS) (see EK500 user manual).	0.01 dB	[0 – 655.35 dB] EK500 range: [0 – 99.90 dB]
56	Bottom detection: minimum level	2	SHORT	Volume backscattering level for the bottom detector`s back search function.	0.01 dB	[−327.68 – 327.67 dB] EK500 range: [−80.00 – 0.00 dB]
58	Space	2	USHORT	Space to allow the next field to be aligned on an address that is a multiple of 4.	unitless	0
60	Bottom window min. depth	4	ULONG	Minimum depth for bottom detection window.	0.01 m	[0 – 42949672.95 m] EK500 range: [0 – 10000.00 m]
64	Bottom window max. depth	4	ULONG	Maximum depth for bottom detection window.	0.01 m	[0 – 42949672.95 m] EK500 range: [0 – 15000.00 m]
68	Remarks	30	CHAR	Character string comment, up to 30 characters. This field could be used to store the transducer serial number.	ASCII char.	30 characters
98	Space	2	USHORT	Space to allow the next field to be aligned on an address that is a multiple of 4.	unitless	0
100	Tuple attribute	4	LONG	Attribute of the tuple according to Annex 3. 0 = original 1 = edited 2 = temporary 3 = temporary + edited 4 = patched 5 = patched + edited …	unitless	[−2147483648 – 2147483647]
104	Backlink	4	ULONG	Tuple size: 108 bytes.	byte	108

Table 12. Simrad EK500 Channel tuple (2001).

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
0	Tuple size	4	ULONG	Tuple data size: 106 bytes.	byte	106
4	Tuple type	2	USHORT	Tuple type code: **2001**. This is the tuple type code for the Simrad EK500 raw data.	unitless	2001
6	Software channel identifier	2	USHORT	Unique identifier for this software data channel. This identifier must be unique for the whole file in order to associate the pings to their proper parent channel Note: This is not the hardware channel number.	unitless	[0 – 65535]
8	Echosounder document identifier	4	ULONG	Identification number for the parent echosounder document (i.e. the group of channels) to which this data channel belongs. It is the echosounder document identifier field of the echosounder tuple.	unitless	[0 – 4294967295]
12	Sampling interval	4	ULONG	Sampling interval for this channel. The nominal sampling rate can be derived from this field and the mean sound speed.	0.000001 m	[0 – 4294.967295 m]
16	Type of data sample	2	USHORT	Type of data sample: 0 = off-axis angles from the split-beam analysis 1 = power (raw Sv before the TVG) 2 = Sv (volume backscattering strength in dB) 3 = TS (point target strength in dB)	unitless	[0 – 65535] Presently: [0, 1, 2, 3]
18	Transceiver channel number	2	USHORT	EK500 transceiver (1, 2 or 3).	unitless	[0 – 65535] Presently: [1, 2, 3]
20	Acoustic frequency	4	ULONG	Acoustic frequency.	Hz	[0 – 4294967295 Hz] Fisheries acoustics range: [100 – 1000000 Hz]
24	Installation depth of transducer	4	ULONG	Installation depth of transducer relative to the sea surface. 42949672.94 = dynamic platform	0.01 m	[0 – 42949672.95 m] EK500 range: [0 – 9999.99 m]
28	Blanking range	4	ULONG	Blanking range from the transducer face up to which the receiver output is blanked to zero or the range at which the data started to be collected.	0.0001 m	[0 – 29496.7295 m]
32	Platform identifier	2	USHORT	Unique identifier of the installation platform of the transducer.	unitless	[0 – 65535]
34	Transducer shape	2	USHORT	0 = other 1 = oval (which includes circular transducer) 2 = rectangular 3 = cross array 4 = ring	unitless	[0 – 65535] Presently: [0 – 4]

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
36	Alongship angle offset of the transducer face	2	SHORT	Mechanical offset angle of the transducer face relative to the horizontal in the alongship plane of the attitude sensor coordinate system (XY). Positive angles indicate the foreward side is above the horizontal.	0.1 deg	[−3276.8 – 3276.7 deg] Working range: [−180.0 – 180.0 degree]
38	Athwartship angle offset of the transducer face	2	SHORT	Mechanical offset angle of the transducer face relative to the horizontal in the athwartship plane of the attitude sensor coordinate system (YZ). Positive angles indicate the port side is above the horizontal.	0.1 deg	[−3276.8 – 3276.7 deg] Working range: [−180.0 – 180.0 degree]
40	Rotation angle of transducer	2	SHORT	Mechanical angle of rotation of alongship axis of transducer relative to alongship axis of attitude sensor coordinate system. Positive angles are clockwise rotation (to starboard).	0.01 deg	[−327.68 – 327.67 deg] Working range: [−180.00 – 180.00 deg]
42	Alongship angle offset of the main axis of the acoustic beam	2	SHORT	Mechanical offset angle of the main axis of the acoustic beam in the alongship plane relative to the perpendicular to the transducer face (XY). Zero (0) is perpendicular to the transducer face. Positive angles indicate the down-propagating sonar beam is oriented foreward.	0.01 deg	[−327.68 – 327.67 deg] EK500 range: [−20.00 – 20.00 deg]
44	Athwartship angle offset of the main axis of the acoustic beam	2	SHORT	Mechanical offset angle of the main axis of the acoustic beam in the athwartship plane relative to the perpendicular to the transducer face (YZ). Zero (0) is perpendicular to the transducer face. Positive angles indicate the down-propagating sonar beam is oriented to starboard.	0.01 deg	[−327.68 – 327.67 deg] EK500 range: [−20.00 – 20.00 deg]
46	Absorption of sound	2	USHORT	Absorption of sound (alpha) in the propagation medium used for TVG compensation.	0.01 dB km^{-1}	[0 – 655.35 dB km^{-1}] Practical range: [0 – 300.00 dB km^{-1}]
48	Pulse length mode	2	USHORT	This field indicates the selected transceiver specific duration of the transmitted pulse: 0 = short 1 = medium 2 = long	unitless	[0 – 65535] EK500 options: [0, 1, 2]
50	Bandwidth mode	2	USHORT	This field indicates the selected transceiver specific bandwidth: 0 = narrow 1 = wide Note: the mode “auto” is not coded because the choice (narrow or wide) made by the EK500 is indicated in the EK500 telegram that the acquisition program reads.	unitless	[0 – 65535] EK500 options: [0, 1]
52	Maximum power	2	USHORT	Transmit power referred to the transducer terminals.	watt	[0 – 65535] EK500 range: [1 – 10000 watt]

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
54	Alongship angle sensitivity	2	USHORT	The electrical phase angle in degrees for one mechanical phase angle in degrees in the fore-and-aft direction, specific to the split-beam transducer. A value of 1.0 indicates that the electrical angles are in units of mechanical angles.	0.1	[0 – 6553.5] EK500 range: [0 – 100.0]
56	Athwartship angle sensitivity	2	USHORT	The electrical phase angle in degrees for one mechanical phase angle in degrees in the starboard-and-port direction, specific to the split-beam transducer. A value of 1.0 indicates that the electrical angles are in units of mechanical angles.	0.1	[0 – 6553.5] EK500 range: [0 – 100.0]
58	Alongship 3 dB beam width of the transducer	2	USHORT	Half power (3dB) beam width of the transducer in the alongship plane.	0.01 deg	[0 – 655.35 deg] EK500 range: [0 – 99.90 deg]
60	Athwartship 3 dB beam width of the transducer	2	USHORT	Half power (3dB) beam width of the transducer in the athwartship plane.	0.01 deg	[0 – 655.35 deg] EK500 range: [0 – 99.90 deg]
62	Two-way beam angle	2	SHORT	Equivalent two-way beam opening solid angle: [=10 log (($ß_1$*$ß_2$)/ 5800)], where $ß_1$ and $ß_2$ are the longitudinal and transversal beam width (degrees), respectively. Note: Directivity index in dB: DI = 10 log (2.5/(sin($ß_1$/2) * sin($ß_2$/2)). (See EK500 user manual).	0.01 dB	[–327.68 – 327.67 dB] EK500 range: [–99.90 – 0.00 dB]
64	Calibration transducer gain	2	USHORT	Peak transducer gain used during computation of the data sample corresponding to the above-selected “type of data sample” (either Sv or TS) (see EK500 user manual).	0.01 dB	[0 – 655.35 dB] EK500 range: [0 – 99.90 dB]
66	Bottom detection minimum level	2	SHORT	Volume backscattering level for the bottom detector`s back search function.	0.01 dB	[–327.68 to 327.67 dB] EK500 range: [–80.00 – 0.00 dB]
68	Bottom window minimum depth	4	ULONG	Minimum depth for bottom detection window.	0.01 m	[0 – 42949672.95 m] EK500 range: [0 – 9999.90 m]
72	Bottom window maximum depth	4	ULONG	Maximum depth for bottom detection window.	0.01 m	[0 – 42949672.95 m] EK500 range: [0 – 12000.00 m]
76	Remarks	30	CHAR	Character string comment, up to 30 characters. This field could be used to store the transducer serial number.	ASCII char.	30 characters
106	Space	2	USHORT	Space to allow the next field to be aligned on an address that is a multiple of 4.	unitless	0

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
108	Tuple attribute	4	LONG	Attribute of the tuple according to Annex 3. 0 = original 1 = edited 2 = temporary 3 = temporary + edited 4 = patched 5 = patched + edited …	unitless	[−2147483648 – 2147483647]
112	Backlink	4	ULONG	Tuple size: 116 bytes.	byte	116

Table 13. Simrad EK500 Channel patch tuple (2002).

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
0	Tuple size	4	ULONG	Tuple data size: 34 bytes	byte	34
4	Tuple type	2	USHORT	Tuple type code: **2002**.	unitless	2002
6	Software channel identifier	2	USHORT	Unique identifier for this software data channel. This identifier must be unique for the whole file in order to associate the pings to their proper parent channel. Note: This is not the hardware channel number.	unitless	[0 – 65535]
8	Echosounder document identifier	4	ULONG	Identification number for the parent echosounder document (i.e. the group of channels) to which this data channel belongs. It is the echosounder document identifier field of the echosounder tuple.	unitless	[0 – 4294967295]
12	Sv transducer gain	2	USHORT	Peak transducer gain used during computation of the Sv data sample.	0.01 dB	[0 – 655.35 dB] EK500 range: [0 – 99.90 dB]
14	TS transducer gain	2	USHORT	Peak transducer gain used during computation of the TS data sample.	0.01 dB	[0 – 655.35 dB] EK500 range: [0 – 99.90 dB]
16	Remarks	20	CHAR	Character string comment. The string must be space filled to the 4-byte boundary. The Remarks field can be missing if there are no comments.	ASCII char.	20 characters
36	Tuple attribute	4	LONG	Attribute of the tuple according to Annex 3. 0 = original 1 = edited 2 = temporary 3 = temporary + edited 4 = patched 5 = patched + edited …	unitless	[−2147483648 – 2147483647]
40	Backlink	4	ULONG	Tuple size: 44 bytes	byte	44

Table 14. Simrad EK60 Channel tuple (2100).

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
0	Tuple size	4	ULONG	Tuple data size: 258 bytes	byte	258
4	Tuple type	2	USHORT	Tuple type code: **2100.** Tuple type code for the Simrad EK 60.	unitless	2100
6	Software channel identifier	2	USHORT	Unique identifier for this software data channel.	unitless	[0 – 65535]
8	Echosounder document identifier	4	ULONG	Identification number for the parent echosounder document.	unitless	[0 – 4294967295]
12	Frequency channel name	48	CHAR	Example: "GPT 38 kHz 0090720171d3 1 ES38B"	ASCII	50 characters
60	Transceiver software version	30	CHAR	Example: "020221"	ASCII	30 characters
90	Transducer name	30	CHAR	Example: "ES38B"	ASCII	30 characters
120	Time sample interval	4	ULONG	Time between each sample.	µs	[0 – 4294967295 µs] EK 60 range:[1 – 65536 µs]
124	Data type	2	USHORT	Type of data sampled: 0 = Electrical phase angles [Units: 180/128 degree] 1 = Electrical power [Units: dB re 1W] 2 = Sv [Volume backscattering strength in dB] 3 = TS [point target strength in dB] 4 = Complex voltage [Complex voltage from split beam quadrants]	unitless	[0 – 65535]
126	Transducer beam type	2	USHORT	0 = single 1 = split	unitless	[0 – 65535]
128	Acoustic frequency	4	ULONG	Acoustic frequency.	Hz	[0 – 4294967295 Hz] EK 60 range: [1000 – 1000000 Hz]
132	Transducer installation depth	4	ULONG	Installation depth of transducer relative to the sea surface. 429496.7294 = dynamic platform	0.0001 m	[0 – 429496.7295 m] EK 60 range: [0 – 10000.0000 m]
136	Start sample	4	ULONG	Number of samples offset from transducer face. 0 = no offset	unitless	[0 – 4294967295]
140	Platform identifier	2	USHORT	Unique identifier of the installation platform of the transducer.	unitless	[0 – 65535]
…	Continued					

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
142	Transducer shape	2	USHORT	0 = other 1 = oval (which includes circular transducer) 2 = rectangular 3 = cross array 4 = ring	unitless	[0 – 65535] Presently: [0 – 4]
144	Transducer face alongship angle offset	4	LONG	Mechanical offset angle of the transducer face relative to the horizontal in the alongship plane of the attitude sensor coordinate system. Positive angles indicate the forward side is above the horizontal.	0.0001 deg	[−214748.3648 – 214748.3647 deg] EK 60 range: [−180.0000 – 180.0000 deg]
148	Transducer face athwartship angle offset	4	LONG	Mechanical offset angle of the transducer face relative to the horizontal in the athwartship plane of the attitude sensor coordinate system. Positive angles indicate the starboard side is above the horizontal.	0.0001 deg	[−214748.3648 – 214748.3647 deg] EK 60 range: [−180.0000 – 180.0000 deg]
152	Transducer rotation angle	4	LONG	Mechanical angle of rotation of alongship axis of transducer relative to alongship axis of attitude sensor coordinate system. Positive angles are clockwise rotation (to starboard).	0.0001 deg	[−214748.3648 – 214748.3647 deg] EK 60 range: [−180.0000 – 180.0000 deg]
156	Transducer main beam axis alongship angle offset	4	LONG	Mechanical offset angle of the main axis of the acoustic beam in the alongship plane relative to the perpendicular to the transducer face. Zero (0) is perpendicular to the transducer face. Positive angles indicate the down-propagating sonar beam is oriented forward.	0.0001 deg	[−214748.3648 – 214748.3647 deg] EK 60 range: [−180.0000 – 180.0000 deg]
160	Transducer main beam axis athwartship angle offset	4	LONG	Mechanical offset angle of the main axis of the acoustic beam in the athwartship plane relative to the perpendicular to the transducer face. Zero (0) is perpendicular to the transducer face. Positive angles indicate the down-propagating sonar beam is oriented to starboard.	0.0001 deg	[−214748.3648 – 214748.3647 deg] EK 60 range: [−180.0000 – 180.0000 deg]
164	Absorption coefficient	4	ULONG	Absorption of sound in the propagation medium.	0.0001 dB/km	[0 – 429496.7295 dB/km] EK 60 range: [0 – 300.0000 dB/km]
168	Pulse duration	4	ULONG	Duration of transmitted pulse.	µs	[0 – 4294967295 µs] EK 60 range: [0 – 65536 µs]
…	Continued					

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
172	Bandwidth	4	ULONG	Transceiver bandwidth.	Hz	[0 – 4294967295 Hz] EK 60 range: [100 – 100000 Hz]
176	Transmission power	4	ULONG	Transmit power referred to the transducer terminals.	W	[0 – 4294967295 W] EK 60 range: [0 – 10000 W]
180	Transducer alongship angle sensitivity	4	ULONG	Electrical phase angle in degrees for one mechanical angle in the alongship (fore-aft) direction.	0.0001 El./mec. deg	[0 –429496.7295 El./mec. deg] EK 60 range: [0 – 100.0000 El./mec. deg]
184	Transducer athwartship angle sensitivity	4	ULONG	Electrical phase angle in degrees for one mechanical angle in the athwartship (fore-aft) direction.	0.0001 El./mec. deg	[0 – 429496.7295 El./mec. deg] EK 60 range: [0 – 100.0000 El./mec. deg]
188	Transducer alongship 3 dB beam width	4	ULONG	Half power (3dB) beam width of the transducer in the alongship direction.	0.0001 deg	[0 – 429496.7295 deg] EK 60 range: [1.0000 – 99.9999 deg]
192	Transducer athwartship 3 dB beam width	4	ULONG	Half power (3dB) beam width of the transducer in the athwartship direction.	0.0001 deg	[0 – 429496.7295 deg] EK 60 range: [1.0000 – 99.9999 deg]
196	Transducer equivalent two-way beam angle	4	LONG	Equivalent two-way beam opening solid angle (See MacLennan and Simmonds, 1992; Section 2.3).	0.0001 dB	[−2147483648 – 2147483647 dB] EK 60 range: [−100.0000 – 0.0000 dB]
200	Transducer gain	4	ULONG	Transducer gain used in power budget calculations for calculation of TS.	0.0001 dB	[0 – 429496.7295 dB] EK 60 range: [0 – 99.9999 dB]
…	Continued					

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
204	Transducer sA correction	4	LONG	Correction to transducer gain to obtain transducer gain used in power budget calculations for calculation of Sv (and sA). Transducer Sv gain = Transducer gain + Transducer sA correction.	0.0001 dB	[−2147483648 – 2147483647 dB] EK 60 range: [−10.0000 – 10.0000 dB]
208	Bottom detection minimum depth	4	ULONG	Minimum depth required for bottom detection.	0.0001 m	[0 – 429496.7295 m] EK 60 range: [0 – 15000.0000 m]
212	Bottom detection maximum depth	4	ULONG	Maximum depth required for bottom detection.	0.0001 m	[0 – 429496.7295 m] EK 60 range: [0 – 15000.0000 m]
216	Bottom detection minimum level	4	LONG	Bottom detection minimum level used in the bottom detector function. Ref. EK60 manual	0.0001 dB	[−214748.3648 – 214748.3647 dB] EK 60 range: [−80.0000 – 0 dB]
220	Remarks	40	CHAR	Character string used for any comments to this channel.	ASCII	40 characters
260	Tuple attribute	4	LONG	Attribute of the tuple according to Annex 3. 0 = original 1 = edited 2 = temporary 3 = temporary + edited 4 = patched 5 = patched + edited …	unitless	[−2147483648 – 2147483647]
264	Backlink	4	ULONG	Tuple size: 268 bytes	byte	268

Table 15. Simrad EK500 Split-beam detected single target parameters sub-channel tuple (4000).

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
0	Tuple size	4	ULONG	Tuple data size: 54 bytes	byte	54
4	Tuple type	2	USHORT	Tuple type code: **4000**	unitless	4000
6	Time fraction	2	USHORT	Fraction of a second to add to the following CPU ANSI C time for a time precision of 0.0001 s (Local time at which the single-target TS logging was initiated).	0.0001 s	[0 – 6.5535 s] Practical range: [0 – 0.9999 s]
8	Time CPU ANSI C Standard time	4	ULONG	Local time at which the single-target TS logging was initiated. ANSI C time given by the CPU clock, in seconds. Usually the CPU clock is set to local time.	s	[0 – 4294967295 s] i.e.: [up to year 2106]
12	Parent software channel identifier	2	USHORT	Unique EK500 channel (tuple no. 2000 and 2001) identifier to which this TS parameter information applies. Note: This is not the hardware channel number.	unitless	[0 – 65535]
14	Detected single-target parameters sub-channel identifier	2	USHORT	Unique identifier for this software sub-channel tuple. Note: This is not the hardware channel number.	unitless	[0 – 65535]
16	Minimum value	2	SHORT	Threshold value (see EK500 TS-Detection menu).	0.01 dB	[−327.68 – 327.68 dB] Presently: [−100.00 – 0.00 dB]
18	Minimum echo length	2	USHORT	Minimum normalized echo length (see EK500 TS-Detection menu).	0.01 steps	[0 – 655.35 steps] Presently: [0 – 10.00 steps]
20	Maximum echo length	2	USHORT	Maximum normalized echo length (see EK500 TS-Detection menu).	0.01 steps	[0 – 655.35] Presently: [0 – 10.00]
22	Maximum gain compensation	2	USHORT	Maximum one-way gain compensation (see EK500 TS-Detection menu).	0.01 dB	[0 – 655.35 dB] Presently: [0 – 6.00 dB]
24	Maximum phase compensation	2	USHORT	Maximum standard phase deviation (see EK500 TS-Detection menu).	0.01 steps	[0 – 655.35] Presently: [0 – 10.00]
26	Remark	30	CHAR	Character string comment up to 30 characters.	ASCII char.	30 characters
56	Tuple attribute	4	LONG	Attribute of the tuple according to Annex 3. 0 = original 1 = edited 2 = temporary 3 = temporary + edited 4 = patched 5 = patched + edited …	unitless	[−2147483648 – 2147483647]
60	Backlink	4	ULONG	Tuple size: 64 bytes.	byte	64

Table 16. Generic Channel tuple (9001) for the generic echosounder.

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
0	Tuple size	4	ULONG	Tuple data size: 146 bytes	byte	146
4	Tuple type	2	USHORT	Tuple type code: **9001**. This is the tuple type code for the Generic Channel tuple.	unitless	9001
6	Software channel identifier	2	USHORT	Unique identifier for this software data channel. This identifier must be unique for the whole file in order to associate the pings to their proper parent channel. Note: This is not the hardware channel number.	unitless	[0 – 65535]
8	Echosounder document identifier	4	ULONG	Identification number for the parent echosounder document (i.e. the group of channels) to which this data channel belongs. It is the echosounder document identifier field of the echosounder tuple.	unitless	[0 – 4294967295]
12	Sampling rate	4	ULONG	Digitization rate for this channel. The nominal sampling interval can be derived from this field and the mean sound speed.	sample s^{-1}	[0 – 4294967295 sample s^{-1}]
16	Sampling interval	4	ULONG	Sampling interval for this channel. The nominal sampling rate can be derived from this field and the mean sound speed.	0.000001 m	[0 – 4294.967295 m]
20	Acoustic frequency	4	ULONG	Acoustic frequency.	Hz	[0 – 4294967295 Hz] Fisheries acoustics range: [100 – 1000000 Hz]
24	Transceiver channel number	2	USHORT	Hardware channel number from which the data are coming. It is convenient to use the same channel numbers as from the echosounder. Note: This field is not the software channel number.	unitless	[0 – 65535]
26	Type of data	2	USHORT	Type of data sampled: 0 = volts 1 = Sv (volume backscattering strength in dB) 2 = TS (point target strength in dB) 3 = Off axis mechanical angles of sample 4 = power in dB re 1 watt 5 = $volts^2$ 6 … the following codes are for data averaged over the sample interval to accommodate echosounders which do not output raw sample data: 10 = mean volts 11 = mean Sv (volume backscattering strength in dB)* 12 = mean TS (point target strength in dB)* 13 = Off-axis mechanical angles of samples 14 = mean power in dB re 1 watt* 15 = mean ($volts^2$) … *Note that the average must be computed in the linear domain.	unitless	[0 – 65535]
…	Continued					

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
28	Time-varied gain multiplier	2	USHORT	Time-varied gain (TVG) multiplier applied for this channel: XXX.XX (e.g. a value of 28.00 = 28.00(log R) + 2αR). Note: This TVG is applied from the TVG minimum range up to the TVG maximum range or for the sample range. Other components in the TVG (e.g. α) are dealt with elsewhere. 0.00 = no TVG applied	unitless	[0 – 655.35]
30	TVG blanking mode	2	USHORT	The gain operating mode before the TVG minimum range and after the TVG maximum range. 0 = normal mode: the gain is maintained constant at the minimum value before the TVG minimum range and at the value reached at the TVG maximum range after the TVG maximum range 1 = blank at range mode: the gain is zero before the TVG minimum range and after the TVG maximum range.	unitless	[0 – 65535]
32	TVG minimum range	2	USHORT	The range from which the TVG is applied. TVG is computed from the transducer face and applied from the TVG minimum range up to the TVG maximum range.	0.1 m	[0 – 6553.5 m]
34	TVG maximum range	2	USHORT	The range up to which the TVG is applied. TVG is computed from the transducer face and applied from the TVG minimum range up to the TVG maximum range. TVG maximum range must be greater than TVG minimum range.	0.1 m	[0.1 – 6553.5 m]
36	Blanking up to range	4	ULONG	Blanking range from the transducer face up to which the receiver output is blanked to zero or the range at which the data started to be collected.	0.0001 m	[0 – 29496.7295 m]
40	Sample range	4	ULONG	Range over which the echo sample data are output by the echosounder.	0.0001 m	[0 – 29496.7295 m]
44	Installation depth of transducer	4	ULONG	Installation depth of transducer relative to the sea surface. 429496.7294 = dynamic platform	0.0001 m	[0 – 429496.7295 m] Working range: [0 – 10000.0000 m]
48	Platform identifier	2	USHORT	Unique identifier of the installation platform of the transducer.	unitless	[0 – 65535]
50	Space	2	USHORT	Space to allow the next field to be aligned on an address that is a multiple of 4.	unitless	0
52	Alongship offset relative to the attitude sensor	4	LONG	Distance between the center of the transducer and the reference point of the attitude sensor in the fore and aft direction (X). Positive values are on the foreward side of the reference point of the attitude sensor. 214748.3647 = not available	0.0001 m	[−214748.3647 – 214748.3647 m] Working range: [−500.0000 – 500.0000 m]
56	Athwartship offset relative to the attitude sensor	4	LONG	Distance between the center of the transducer and the reference point of the attitude sensor in the starboard and port direction (Y). Positive values are on the starboard side of the reference point of the attitude sensor. 214748.3647 = not available	0.0001 m	[−214748.3647 – 214748.3647 m] Working range: [−500.0000 – 500.0000 m]
…	Continued					

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
60	Vertical offset relative to the attitude sensor	4	LONG	Distance between the transducer face and the reference point of the attitude sensor in the vertical direction (Z). Positive values are below the reference point of the attitude sensor. 214748.3647 = not available	0.0001 m	[−214748.3647 – 214748.3647 m] Working range: [−200.0000 – 200.0000 m]
64	Alongship angle offset of the transducer face	2	SHORT	Mechanical offset angle of the transducer face relative to the horizontal in the alongship plane of the attitude sensor coordinate system (XY). Positive angles indicate the foreward side is above the horizontal.	0.01 deg	[−327.68 – 327.67 deg] Working range: [−180.00 – 180.00 deg]
66	Athwartship angle offset of the transducer face	2	SHORT	Mechanical offset angle of the transducer face relative to the horizontal in the athwartship plane of the attitude sensor coordinate system (YZ). Positive angles indicate the port side is above the horizontal.	0.01 deg	[−327.68 – 327.67 deg] Working range: [−180.00 – 180.00 deg]
68	Rotation angle of transducer face	2	SHORT	Mechanical angle of rotation of alongship axis of transducer relative to alongship axis of attitude sensor coordinate system. Positive angles are clockwise rotation (to starboard).	0.01 deg	[−327.68 – 327.67 deg] Working range: [−180.00 – 180.00 deg]
70	Alongship angleoffset of the main axis of the acoustic beam	2	SHORT	Mechanical offset angle of the main axis of the acoustic beam in the alongship plane relative to the perpendicular to the transducer face (XY). Zero (0) is perpendicular to the transducer face. Positive angles indicate the down-propagating sonar beam is oriented foreward.	0.01 deg	[−327.68 – 327.67 deg] Working range: [−90.00 – 90.00 deg]
72	Athwartship angle offset of the main axis of the acoustic beam	2	SHORT	Mechanical offset angle of the main axis of the acoustic beam in the athwartship plane relative to the perpendicular to the transducer face (YZ). Zero (0) is perpendicular to the transducer face. Positive angles indicate the down-propagating sonar beam is oriented to starboard.	0.01 deg	[−327.68 – 327.67 deg] Working range: [−90.00 – 90.00 deg]
74	Absorption of sound	2	USHORT	Absorption of sound (α) in the propagation medium used for TVG compensation.	0.01 dB km^{-1}	[0 – 655.35 dB km^{-1}] Practical range: [0 – 300.00 dB km^{-1}]
76	Pulse duration	4	ULONG	Duration of the transmitted pulse.	0.0001 ms	[0 – 429496.7295 ms]
80	Pulse shape mode	2	USHORT	Shape of the transmitted pulse. 0 = other 1 = rectangular 2 = modulated 3 = chirp	unitless	[0 – 65535] Presently: [0.1.2.3]
82	Bandwidth	2	USHORT	Transceiver specific bandwidth.	0.01 kHz	[0 – 655.35 kHz]
84	Transducer shape mode	2	USHORT	Physical shape of the transducer element configuration. 0= other 1= oval (which includes circular transducer) 2= rectangular 3= cross array 4= ring	unitless	[0 – 65535] Presently: [0, 1, 2, 3, 4]
…	Continued					

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
86	3 dB alongship beamwidth of the transducer beam	2	USHORT	Half power (3 dB) beam width of the transducer beam in the alongship plane.	0.1 deg	[0 – 6553.5 deg] Practical range: [1.0 – 50.0 deg]
88	3 dB athwartship beam width of the transducer beam	2	USHORT	Half power (3 dB) beam width of the transducer beam in the athwartship plane.	0.1 deg	[0 – 6553.5 deg] Practical range: [1.0 – 50.0 deg]
90	Two-way beam angle	2	SHORT	Equivalent two-way solid beam angle: (1) = 10 log ψ, or (2) =10 log (($ß_1$ *$ß_2$)/5800), where $ß_1$ and $ß_2$ are the longitudinal and transversal beam widths (degrees), respectively, or (3) to derive this field from the beam pattern factor (b^2 (see Urick, 1983, and MacLennan and Simmonds, 1992, Section 2.3).	0.01 dB	[−327.68 – 327.67 dB] Practical range: [10.00 – 50.00 dB]
92	Calibration source level	2	USHORT	Source level (SL of the sonar equation).	0.01 dB re µPa @ 1 m	[0 – 655.35 dB] Practical range: [150.00 – 250.00 dB]
94	Calibration receiving sensitivity	2	SHORT	Calibration receiving sensitivity (VR of the sonar equation) of the transceiver. Note: This includes all through receiver gain.	0.01 dBv /µPa @ 1 m	[−327.68 – 327.67 dB] Practical range: [−200.00 – −100.00 dB]
96	SL+VR	2	SHORT	Sum of the calibration source level (SL of the sonar equation) and the receiving sensitivity (VR of the sonar equation). Note: This includes all through receiver gain. This field should be used when the values of SL and VR are not known separately.	0.01 dBv /µPa @ 1 m	[−327.68 – 327.67 dB] Practical range: [0 – 100.00 dB]
98	Bottom detection: minimum level	2	SHORT	Level for the bottom detection in the units selected in the above field “Type of data sampled”.	volts, $volts^2$, watts or dB	For all units: [−327.68 – 327.67] Practical range: [2.50 – 15.00 volts] [6.25 – 225.00 $volts^2$] [−150.00 to 0.00 dB]
100	Bottom window minimum	4	ULONG	Minimum depth for bottom detection window.	0.01 m	[0 – 42949672.95 m] Working range: [0 – 999.99 m]
104	Bottom window maximum	4	ULONG	Maximum depth for bottom detection window.	0.01 m	[0 – 42949672.95 m] Working range: [0 – 999.99 m]
108	Remarks	40	CHAR	Character string comment. This field could be used to store the transducer serial number. The string must be space filled to the 4-byte boundary. The Remarks field can be missing if there are no comments.	ASCII char.	40 characters
…	Continued					

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
148	Tuple attribute	4	LONG	Attribute of the tuple according to Annex 3. 0 = original 1 = edited 2 = temporary 3 = temporary + edited 4 = patched 5 = patched + edited …	unitless	[−2147483648 – 2147483647]
152	Backlink	4	ULONG	Tuple size: 156 bytes	byte	156

Table 17. Ping tuple U-32 (10000).

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
0	Tuple size	4	ULONG	Tuple data size: variable	byte	[30 – 4294967295]
4	Tuple type	2	USHORT	Tuple type code: **10000**	unitless	10000
6	Time fraction	2	USHORT	Time of the transmitted pulse. Fraction of a second to add to the CPU ANSI C time (next field) to get a time precision of 0.0001 s.	0.0001 s	[0 – 6.5535 s] Practical range: [0 – 0.9999 s]
8	Time CPU ANSI C Standard time	4	ULONG	Time of the transmitted pulse. ANSI C time given by the CPU clock, in seconds. Usually the CPU clock is set to local time.	s	[0 – 4294967295 s] i.e.: [up to year 2106]
12	Software channel identifier	2	USHORT	Unique identifier for this software data channel to which the ping data is associated.	unitless	[0 – 65535]
14	Transceiver mode	2	USHORT	Operating mode of the transmitter: 0 = active: the transceiver is transmitting and receiving a monotone pulse 1 = passive: the transceiver is receiving but not transmitting 2 = test: a calibration signal is injected in the sounder 3 = eavesdropping: the transceiver is receiving while another transceiver is transmitting	unitless	[0 – 65535] Presently: [0, 1, 2, 3]
16	Ping number	4	ULONG	Ping sequence number since the beginning of the file. This should be a permanent label of the pings that should not be altered in further processing steps, namely the edition steps.	unitless	[0 – 4294967295]
20	Detected bottom range	4	LONG	Positive values indicate the range from the transducer face where the bottom detection criteria were encountered, under the above active transmitter mode. The sound speed field of the echosounder tuple is used for conversion of time space. Negative values are reserved for future use. 2147483.647 = bottom not detected.	0.001 m	[−2147483.648 – 2147483.647 m] Practical range: [0 – 15000.000 m]
24	Sample sequence number	4	ULONG	Sample sequence number since the beginning of the ping (samples < threshold contribute to the sequence count).	unitless	[0 – 4294967295]
28	Sample value (> threshold)	4	LONG	Sample value on 32 bits. Encoded units and limit ranges depend on the “type of data sample” of the channel tuple. (For phase angles from the split-beam analysis, see Ping tuple U-32-16-angles)	0.000001 volts; Sv or TS: 0.000001 dB	For volts: [−2147.483648 – 2147.483647 volts] Practical range: [0 – 25.000000 volts]; For Sv or TS: [−2147.483648 – 2147.483647 dB] Practical range: [−150.000000 – 0.000000 dB]
…	Continued					

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
…	Sample sequence number	4	ULONG	idem		
…	Sample value (> threshold)	4	LONG	idem		
…	Tuple attribute	4	LONG	Attribute of the tuple according to Annex 3. 0 = original 1 = edited 2 = temporary 3 = temporary + edited 4 = patched 5 = patched + edited …	unitless	[−2147483648 – 2147483647]
…	Backlink	4	ULONG	Tuple size: variable (multiple of 4 bytes)	byte	[40 – 4294967295]

Table 18. Ping tuple U-32-16-angles (10001).

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
0	Tuple size	4	ULONG	Tuple data size: variable	byte	[30 – 4294967295]
4	Tuple type	2	USHORT	Tuple type code: **10001**	unitless	10001
6	Time fraction	2	USHORT	Time of the transmitted pulse. Fraction of a second to add to the CPU ANSI C time (next field) to get a time precision of 0.0001 s.	0.0001 s	[0 – 6.5535 s] Practical range: [0 – 0.9999 s]
8	Time CPU ANSI C Standard time	4	ULONG	Time of the transmitted pulse. CPU ANSI C time, in seconds. Usually the CPU clock is set to local time.	s	[0 – 4294967295 s] i.e.: [up to year 2106]
12	Software channel identifier	2	USHORT	Unique identifier for this software data channel to which the ping data is associated.	unitless	[0 – 65535]
14	Transceiver mode	2	USHORT	Operating mode of the transmitter: 0 = active: the transceiver is transmitting and receiving a monotone pulse 1 = passive: the transceiver is receiving but not transmitting 2 = test: a calibration signal is injected in the sounder 3 = eavesdropping: the transceiver is receiving while another transceiver is transmitting	unitless	[0 – 65535] Presently: [0, 1, 2, 3]
16	Ping number	4	ULONG	Ping sequence number since the beginning of the file. This should be a permanent label of the pings that should not be altered in further processing steps, namely the edition steps.	unitless	[0 – 4294967295]
20	Detected bottom range	4	LONG	Positive values indicate the range from the transducer face where the bottom detection criteria were encountered, under the above active transmitter mode. The sound speed field of the echosounder tuple is used for conversion of time to space. Negatives are reserved for future use. 2147483.647 = bottom not detected.	0.001 m	[−2147483.648 – 2147483.647 m] Practical range: [0 – 15000.000 m]
24	Sample sequence number	4	ULONG	Sample sequence number since the beginning of the ping (samples < threshold contribute to the sequence count).	unitless	[0 – 4294967295]
28	Sample value, alongship off-axis angle	2	SHORT	Alongship off-axis angle of the sample from the split-beam analysis. Zero (0) is the main axis of the transducer beam and positive is in the fore direction.	0.1 deg	[−3276.8 – 3276.7 deg] Practical range: [−180.0 – 180.0 deg]
30	Sample value, athwartship off-axis angle	2	SHORT	Athwartship off-axis angle of the sample from the split-beam analysis. Zero (0) is the main axis of the transducer beam and positive is in the starboard direction.	0.1 deg	[−3276.8 – 3276.7 deg] Practical range: [−180.0 – 180.0 deg]
...	Continued					

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
...	Sample sequence number	4	ULONG	idem		
...	Sample value, alongship electrical phase angle	2	SHORT	idem		
...	Sample value, athwartship electrical phase angle	2	SHORT	idem		
...	Tuple attribute	4	LONG	Attribute of the tuple according to Annex 3. 0 = original 1 = edited 2 = temporary 3 = temporary + edited 4 = patched 5 = patched + edited ...	unitless	[−2147483648 – 2147483647]
...	Backlink	4	ULONG	Tuple size: variable (multiple of 4 bytes).	byte	[40 – 4294967295]

Table 19. Ping tuple C-32 (10010).

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
0	Tuple size	4	ULONG	Tuple data size: variable	byte	[30 – 4294967295]
4	Tuple type	2	USHORT	Tuple type code: **10010**	unitless	10010
6	Time fraction	2	USHORT	Time of the transmitted pulse. Fraction of a second to add to the CPU ANSI C time (next field) to get a time precision of 0.0001 s.	0.0001 s	[0 – 6.5535 s] Practical range: [0 – 0.9999 s]
8	Time CPU ANSI C Standard time	4	ULONG	Time of the transmitted pulse. CPU ANSI C time, in seconds. Usually the CPU clock is set to local time.	s	[0 – 4294967295 s] i.e.: [up to year 2106]
12	Software channel identifier	2	USHORT	Unique identifier for this software data channel to which the ping data is associated.	unitless	[0 – 65535]
14	Transceiver mode	2	USHORT	Operating mode of the transmitter: 0 = active: the transceiver is transmitting and receiving a monotone pulse 1 = passive: the transceiver is receiving but not transmitting 2 = test: a calibration signal is injected in the sounder 3 = eavesdropping: the transceiver is receiving while another transceiver is transmitting	unitless	[0 – 65535] Presently: [0, 1, 2, 3]
16	Ping number	4	ULONG	Ping sequence number since the beginning of the file. This should be a permanent label of the pings that should not be altered in further processing steps, namely the edition steps.	unitless	[0 – 4294967295]
20	Detected bottom range	4	LONG	Positive values indicate the range from the transducer face where the bottom detection criteria were encountered under the above active transmitter mode. The sound speed field of the echosounder tuple is used for conversion of time to space. Negative values are reserved for future use. 2147483.647 = bottom not detected.	0.001 m	[−2147483.648 – 2147483.647 m] Practical range: [0 – 15000.000 m]
24	No. of samples (> threshold) in this ping	4	ULONG	No. of samples (> threshold) in this ping (This information can also be computed from the tuple size).	unitless	[0 – 4294967295]
…	Continued					

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
28	Sample value	4	LONG	Sample value on 31 bit or zero series (< threshold) compressed into RLE samples (the upper bit is set to 1 and the lower 31 bits indicate the number of zeros – 1; 2147483648 below threshold values can then be compressed into one RLE sample; no value smaller than −1073741825 or larger than 1073741824 can be encoded). Encoded units and limit ranges depend on the “type of data sample” of the channel tuple.	0.000001 volts Sv or TS: 0.000001 dB	For volts: [−1073.741825 – 1073.741824 volts] Practical range: [0 – 25.000000 volts] For Sv and TS: [−1073.741825 – 1073.741824 dB] Practical range: [−150.000000 – 0.000000 dB]
...	Sample value	4	LONG	idem		
...	Tuple attribute	4	LONG	Attribute of the tuple according to Annex 3. 0 = original 1 = edited 2 = temporary 3 = temporary + edited 4 = patched 5 = patched + edited …	unitless	[−2147483648 – 2147483647]
...	Backlink	4	ULONG	Tuple size: variable (multiple of 4 bytes).	byte	[40 – 4294967295]

Table 20. Ping tuple C-32-16-angles (10011).

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
0	Tuple size	4	ULONG	Tuple data size: variable	byte	[30 – 4294967295]
4	Tuple type	2	USHORT	Tuple type code: **10011**	unitless	10011
6	Time fraction	2	USHORT	Time of the transmitted pulse. Fraction of a second to add to the CPU ANSI C time (next field) to get a time precision of 0.0001 s.	0.0001 s	[0 – 6.5535 s] Practical range: [0 – 0.9999 s]
8	Time CPU ANSI C Standard time	4	ULONG	Time of the transmitted pulse. CPU ANSI C time, in seconds. Usually the CPU clock is set to local time.	s	[0 – 4294967295 s] i.e.: [up to year 2106]
12	Software channel identifier	2	USHORT	Unique identifier for this software data channel to which the ping data is associated.	unitless	[0 – 65535]
14	Transceiver mode	2	USHORT	Operating mode of the transmitter: 0 = active: the transceiver is transmitting and receiving a monotone pulse 1 = passive: the transceiver is receiving but not transmitting 2 = test: a calibration signal is injected in the sounder 3 = eavesdropping: the transceiver is receiving while another transceiver is transmitting	unitless	[0 – 65535] Presently: [0, 1, 2]
16	Ping number	4	ULONG	Ping sequence number since the beginning of the file. This should be a permanent label of the pings that should not be altered in further processing steps, namely the edition steps.	unitless	[0 – 4294967295]
20	Detected bottom range	4	LONG	Positive values indicate the range from the transducer face where the bottom detection criteria were encountered, under the above active transmitter mode. The sound speed field of the echosounder tuple is used for conversion of time to space. Negative values are reserved for future use. 2147483.647 = bottom not detected.	0.001 m	[−2147483.648 – 2147483.647 m] Practical range: [0 – 15000.000 m]
24	No. of samples (> threshold) in this ping	4	ULONG	No. of samples (> threshold) in this ping (This information can also be computed from the tuple size).	unitless	[0 – 4294967295]
28	Sample value	4	LONG	Sample values on 32 bit or zero series (< threshold) compressed into RLE samples (the upper bit is set to 1 and the lower 31 bit indicate the no. of zeros - 1; 2147483648 below threshold values can then be compressed into one RLE sample; alongship angle data are found in bits 16 to 30 while athwartship angle data are found in bits 0 to 15, thus the values are encompassed in the intervals [–16384, 16383] and [–32768, 32767], respectively.	0.1 deg	[−1638.4 – 1638.4 deg] Practical range: [−180.0 – 180.0 deg]; [−3276.8 – 3276.8 deg] Practical range: [−180.0 – 180.0 deg]
…	Continued					

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
...	Sample value	4	LONG	idem		
...	Tuple attribute	4	LONG	Attribute of the tuple according to Annex 3. 0 = original 1 = edited 2 = temporary 3 = temporary + edited 4 = patched 5 = patched + edited …	unitless	[−2147483648 – 2147483647]
...	Backlink	4	ULONG	Tuple size: variable (multiple of 4 bytes).	byte	[40 – 4294967295]

Table 21. Ping tuple U-16 (10030).

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
0	Tuple size	4	ULONG	Tuple data size: variable	byte	[26 – 4294967295]
4	Tuple type	2	USHORT	Tuple type code: **10030**	unitless	10030
6	Time fraction	2	USHORT	Time of the transmitted pulse. Fraction of a second to add to the CPU ANSI C time (next field) to get a time precision of 0.0001 s.	0.0001 s	[0 – 6.5535 s] Practical range: [0 – 0.9999 s]
8	Time CPU ANSI C Standard time	4	ULONG	Time of the transmitted pulse. CPU ANSI C time, in seconds. Usually the CPU clock is set to local time.	s	[0 – 4294967295 s] i.e.: [up to year 2106]
12	Software channel identifier	2	USHORT	Unique identifier for this software data channel to which the ping data is associated.	unitless	[0 – 65535]
14	Transceiver mode	2	USHORT	Operating mode of the transmitter: 0 = active: the transceiver is transmitting and receiving a monotone pulse 1 = passive: the transceiver is receiving but not transmitting 2 = test: a calibration signal is injected in the sounder 3 = eavesdropping: the transceiver is receiving while another transceiver is transmitting	unitless	[0 – 65535] Presently: [0, 1, 2, 3]
16	Ping number	4	ULONG	Ping sequence number since the beginning of the file. This should be a permanent label of the pings that should not be altered in further processing steps, namely the edition steps.	unitless	[0 – 4294967295]
20	Detected bottom range	4	LONG	Positive values indicate the range from the transducer face where the bottom detection criteria were encountered under the above active transmitter mode. The sound speed field of the echosounder tuple is used for conversion of time to space. Negative values are reserved for future use. 2147483.647 = bottom not detected.	0.001 m	[−2147483.648 – 2147483.647 m] Practical range: [0 – 15000.000 m]
24	Sample sequence number	2	USHORT	Sample sequence number since the beginning of the ping (samples < threshold contribute to the sequence count).	unitless	[0 – 65535]
26	Sample value (> threshold)	2	SHORT	Sample value on 16 bit. Encoded units and limit ranges depend on the “type of data sample” of the channel tuple.	0.001 volts SV or TS: 0.01 dB	For volts: [−32.767 – 32.767 volts] Practical range: [0–25.000 volts]; For Sv and TS: [−327.68–327.67 dB] Practical range: [−150.00–0.00 dB]
…	Sample sequence number	2	USHORT	Idem		
…	Continued					

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
…	Sample value (> threshold)	2	SHORT	Idem		
…	Tuple attribute	4	LONG	Attribute of the tuple according to Annex 3. 0= original 1= edited 2= temporary 3= temporary + edited 4= patched 5= patched + edited …	unitless	[–2147483648–2147483647]
…	Backlink	4	ULONG	Tuple size: variable (multiple of 4 bytes).	byte	[36–4294967295]

Table 22. Ping tuple U-16-angles (10031).

OFFSET BYTE	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
0	Tuple size	4	ULONG	Tuple data size: variable	byte	[30–4294967295]
4	Tuple type	2	USHORT	Tuple type code: **10031**	unitless	10031
6	Time fraction	2	USHORT	Time of the transmitted pulse. Fraction of a second to add to the CPU ANSI C time (next field) to get a time precision of 0.0001 s.	0.0001 s	[0 – 6.5535 s] Practical range: [0 – 0.9999 s]
8	Time CPU ANSI C Standard time	4	ULONG	Time of the transmitted pulse. CPU ANSI C time, in seconds. Usually the CPU clock is set to local time.	s	[0 – 4294967295 s] i.e.: [up to year 2106]
12	Software channel identifier	2	USHORT	Unique identifier for this software data channel to which the ping data is associated.	unitless	[0 – 65535]
14	Transceiver mode	2	USHORT	Operating mode of the transmitter: 0 = active: the transceiver is transmitting and receiving a monotone pulse 1 = passive: the transceiver is receiving but not transmitting 2 = test: a calibration signal is injected in the sounder 3 = eavesdropping: the transceiver is receiving while another transceiver is transmitting	unitless	[0 – 65535] Presently: [0, 1, 2, 3]
16	Ping number	4	ULONG	Ping sequence number since the beginning of the file. This should be a permanent label of the pings that should not be altered in further processing steps, namely the edition steps.	unitless	[0 – 4294967295]
20	Detected bottom range	4	LONG	Positive values indicate the range from the transducer face where the bottom detection criteria were encountered under the above active transmitter mode. The sound speed field of the echosounder tuple is used for conversion of time to space. Negative values are reserved for future use. 2147483.647 = bottom not detected.	0.001 m	[−2147483.648 – 2147483.647 m] Practical range: [0 – 15000.000 m]
24	Sample sequence number	2	USHORT	Sample sequence number since the beginning of the ping (samples < threshold contribute to the sequence count)	unitless	[0 – 65535]
26	Sample value, alongship electrical phase angle	2	SHORT	Alongship electrical phase angle of the sample from the split-beam analysis. Zero (0) is the main axis of the transducer beam and positive is in the fore direction. See “Alongship angle sensitivity” in Simrad EK500 Channel tuple for electrical to mechanical angle conversion (also see EK500 user manual).	0.1 deg	[−3276.8 – 3276.7 deg] Practical range: [−180.0 – 180.0 deg]
28	Sample value, athwartship electrical phase angle	2	SHORT	Athwartship electrical phase angle of the sample from the split-beam analysis. Zero (0) is the main axis of the transducer beam and positive is in the starboard direction. See “Athwartship angle sensitivity” in Simrad EK500 Channel tuple for electrical to mechanical angle conversion (also see EK500 user manual).	0.1 deg	[−3276.8 – 3276.7 deg] Practical range: [−180.0 – 180.0 deg]
…	Continued					

OFFSET BYTE	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
…	Sample sequence number	2	USHORT	idem		
…	Sample value, alongship electrical phase angle	2	SHORT	idem		
…	Sample value athwartship electrical phase angle	2	SHORT	idem		
…	Optional field: Space	2	USHORT	When needed: Space to allow the next field to be aligned on an address that is a multiple of 4.	unitless	0
…	Tuple attribute	4	LONG	Attribute of the tuple according to Annex 3. 0 = original 1 = edited 2 = temporary 3 = temporary + edited 4 = patched 5 = patched + edited …	unitless	[−2147483648 – 2147483647]
…	Backlink	4	ULONG	Tuple size: variable (multiple of 4 bytes).	byte	[40 – 4294967295]

Table 23. Ping tuple C-16 (10040).

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
0	Tuple size	4	ULONG	Tuple data size: variable	byte	[30 – 4294967295]
4	Tuple type	2	USHORT	Tuple type code: **10040**	unitless	10040
6	Time fraction	2	USHORT	Time of the transmitted pulse. Fraction of a second to add to the CPU ANSI C time (next field) to get a time precision of 0.0001 s.	0.0001 s	[0 – 6.5535 s] Practical range: [0 – 0.9999 s]
8	Time CPU ANSI C Standard time	4	ULONG	Time of the transmitted pulse. CPU ANSI C time, in seconds. Usually the CPU clock is set to local time.	s	[0 – 4294967295 s] i.e.: [up to year 2106]
12	Software channel identifier	2	USHORT	Unique identifier for this software data channel to which the ping data is associated.	unitless	[0 – 65535]
14	Transceiver mode	2	USHORT	Operating mode of the transmitter: 0 = active: the transceiver is transmitting and receiving a monotone pulse 1 = passive: the transceiver is receiving but not transmitting 2 = test: a calibration signal is injected in the sounder 3 = eavesdropping: the transceiver is receiving while another transceiver is transmitting	unitless	[0 – 65535] Presently: [0, 1, 2, 3]
16	Ping number	4	ULONG	Ping sequence number since the beginning of the file. This should be a permanent label of the pings that should not be altered in further processing steps, namely the edition steps.	unitless	[0 – 4294967295]
20	Detected bottom range	4	LONG	Positive values indicate the range from the transducer face where the bottom detection criteria were encountered under the above active transmitter mode. The sound speed field of the echosounder tuple is used for conversion of time to space. Negative values are reserved for future use. 2147483.647 = bottom not detected.	0.001 m	[−2147483.648 – 2147483.647 m] Practical range: [0 – 15000.000 m]
24	No. of samples (> threshold) in this ping	4	ULONG	No. of samples (> threshold) in this ping (This information can also be computed from the tuple size).	unitless	[0 – 4294967295]
28	Sample value	2	SHORT	Sample value on 16 bit or zero series (< threshold) compressed into RLE samples (the upper bit is set to 1 and the lower 15 bits indicate the no. of zeros - 1; 32768 below threshold values can then be compressed into one RLE sample; no value smaller than -16384 or larger than 16383 can be encoded). Encoded units and limit ranges depend on the "type of data sample" of the channel tuple.	0.001 volts; Sv or TS: 0.01 dB	For volts: [−16.384 – 16.383 volts] Practical range: [0 – 25.000 volts]; For Sv or TS: [−163.84 – 163.83 dB] Practical range: [−150.00 – 0.00 dB]
…	Continued					

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
…	Sample value	2	SHORT	idem		
…	Optional field: Space	2	USHORT	When needed: Space to allow the next field to be aligned on an address that is a multiple of 4.	unitless	0
…	Tuple attribute	4	LONG	Attribute of the tuple according to Annex 3. 0 = original 1 = edited 2 = temporary 3 = temporary + edited 4 = patched 5 = patched + edited …	unitless	[–2147483648 – 2147483647]
…	Backlink	4	ULONG	Tuple size: variable (multiple of 4 bytes).	byte	[40 – 4294967295]

Table 24. Split-beam detected single-target tuple (10090).

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
0	Tuple size	4	ULONG	Tuple data size: variable	byte	[58 – 4294967295]
4	Tuple type	2	USHORT	Tuple type code: **10090**	unitless	10090
6	Time fraction	2	USHORT	Fraction of a second to add to the following CPU ANSI C time for a time precision of 0.0001 s (Local time at which the single target detection was made). This should correspond to the raw ping tuple time fraction.	0.0001 s	[0 – 6.5535 s] Practical range: [0 – 0.9999 s]
8	Time CPU ANSI C Standard time	4	ULONG	Local time at which the single-target detection was made. ANSI C time given by the CPU clock, in seconds. Usually the CPU clock is set to local time. This should correspond to the raw ping tuple time.	s	[0 – 4294967295 s] i.e.: [up to year 2106]
12	Parent sub-channel identifier	2	USHORT	Split-beam detected single-target parameter sub-channel identifier to which this TS information applies.	unitless	[0 – 65535]
14	Space	2	USHORT	Space to allow the next field to be aligned on an address that is a multiple of 4.	unitless	0
16	Ping number	4	ULONG	Ping sequence number since the beginning of logging. This should be a permanent label, corresponding to the raw ping tuple, and should not be altered in subsequent processing.	unitless	[0 – 4294967295]
20	Search start range	4	ULONG	Range at which search for single targets started for this ping.	0.0001 m	[0 – 429496.7295]
24	Search end range	4	ULONG	Range at which search for single targets ended for this ping.	0.0001 m	[0 – 429496.7295]
28	Detected bottom range	4	LONG	Positive values indicate the range from the transducer face where the bottom detection criteria were encountered, under the above active transmitter mode. The sound speed field of the echosounder tuple is used for conversion of time to space. 214748.3647 = bottom not detected.	0.0001 m	[−214748.3648 – 214748.3647 m]
32	Number of detected single targets	4	ULONG	Number of single targets detected in this ping.	unitless	[1 – 4294967295]
36	Range (target #1)	4	LONG	Range of the first detected single target. Note: The Simrad EK500 and EK60 echosounders output “Depth” to the target relative to the surface, i.e. Range=Depth to the target–transducer depth–heave. The EK60 estimates the front edge of the echo (d), i.e. will seldom be an integer multiple of sample intervals, and is given by the equation: d=x–2*s, where s is the sample interval (and 2*s is half of a pulse length) and x is the centre of gravity of the target as estimated from the raw power samples (i.e. no TVG) according to the equation: $x=\Sigma(p_i*r_i)/\Sigma(p_i)$, where p_i is the linear power value of sample i and r_i is the range to sample i. i ranges from −2 to 2, where i=0 refers to the position of detected peak for the current single target. The closest TVG (40log) value is used to calculate the TS value.	0.0001 m	[−214748.3648 – 214748.3647]
40	Compensated TS (target #1)	2	SHORT	Target strength of detected single target after compensation for off-axis angle.	0.01 dB	[−327.68 – 327.67 dB] EK500 range: [−100.00 – 0.00 dB]
…	Continued					

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
42	Uncompensated TS (target #1)	2	SHORT	Raw target strength of detected single target uncompensated for off-axis angle.	0.01 dB	[−327.68 – 327.67 dB]] EK500 range: [−100.00 – 0.00 dB]
44	Alongship angle (target #1)	2	SHORT	Fore-and-aft off-axis angle of the detected single target.	0.01 deg.	[−327.68 – 327.67 dB]
46	Athwartship angle (target #1)	2	SHORT	Athwartship off-axis angle of the detected single target.	0.01 deg.	[−327.68 – 327.67 dB]
48	Range (target #2)	4	LONG	Range of the second detected single target.	0.0001 m	[−214748.3648 – 214748.3647]
52	Compensated TS (target #2)	2	SHORT	Target strength of detected single target after compensation for off-axis angle.	0.01 dB	[−327.68 – 327.67 dB] EK500 range: [−100.00 – 0.00 dB]
54	Uncompensated TS (target #2)	2	SHORT	Raw target strength of detected single target uncompensated for off-axis angle.	0.01 dB	[−327.68 – 327.67 dB] EK500 range: [−100.00 – 0.00 dB]
56	Alongship angle (target #2)	2	SHORT	Fore-and-aft off-axis angle of the detected single target.	0.01 deg.	[−327.68 – 327.67 dB]
58	Athwartship angle (target #2)	2	SHORT	Athwartship off-axis angle of the detected single target.	0.01 deg.	[−327.68 – 327.67 dB]
…	Tuple attribute	4	LONG	Attribute of the tuple according to Annex 3. 0 = original 1 = edited 2 = temporary 3 = temporary + edited 4 = patched 5 = patched + edited …	unitless	[−2147483648 – 2147483647]
…	Backlink	4	ULONG	Tuple size: variable (multiple of 4 bytes).	byte	[68 – 4294967295]

Table 25. General Threshold tuple (10100).

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
0	Tuple size	4	ULONG	Tuple data size: 34 bytes	byte	34
4	Tuple type	2	USHORT	Tuple type code: **10100**	unitless	10100
6	Time fraction	2	USHORT	Time of threshold setting. Fraction of a second to add to the CPU ANSI C time (next field) to get a time precision of 0.0001 s.	0.0001 s	[0 – 6.5535 s] Practical range: [0 – 0.9999 s]
8	Time CPU ANSI C Standard time	4	ULONG	Time of threshold setting. ANSI C time given by the CPU clock, in seconds. Usually the CPU clock is set to local time.	s	[0 – 4294967295 s] i.e.: [up to year 2106]
12	Software channel identifier	2	USHORT	Unique identifier for the software data channel to which this threshold tuple is associated. The equation used for the TVT evaluation should be dependent on channel data units (volts, Sv or TS, etc.). Some channels may not require any thresholding.	unitless	[0 – 65535]
14	TVG max. range	2	USHORT	Maximum range from the transducer on which the TVG is applied by the echosounder. This is the TVG maximum range field of the echosounder tuple (see Biosonics Model 102 Echosounder tuple).	0.1 m	[0 – 6553.5 m] Biosonics 102 options: [0 – 999.9 m]
16	TVG min. range	2	USHORT	Minimum range from which the TVG is applied by the echosounder. It is either the hardware determined TVG min. range (of either 1.25, 2.5, 5.0 or 10.0 m) or the value of the blank-at-range field of the echosounder tuple (see pertinent fields in Biosonics Model 102 Echosounder tuple).	0.1 m	[0 – 6553.5 m] Biosonics 102 options: [0 – 999.9 m]
18	TVT evaluation: Mode	2	USHORT	Time-varied threshold (TVT) evaluation mode: 0 = no TVT, a constant threshold is applied. When the mode is 0 and the “amplification field” is 0, the “offset field” specifies a constant threshold (which could be zero). When the offset is zero, no threshold is applied. 1 = manual (TVT is evaluated on the user`s request) 2 = automatic (TVT was evaluated at regular time intervals). 3 = manually set by user	unitless	[0 – 65535] Presently: [0, 1, 2]
20	TVT evaluation: Interval	2	USHORT	Time interval between two TVT evaluations under the automatic TVT evaluation mode of CH1 software.	s	[0 – 65535 s] i.e.: [up to 18.2 h]
22	TVT evaluation: No. of pings	2	USHORT	Number of pings over which the TVT is evaluated.	unitless	[0 – 65535]
24	TVT evaluation: Starting TVT ping number	4	ULONG	Starting TVT ping number of the ping series used for the TVT evaluation of this threshold tuple. The ending TVT ping number of the ping series is obtained by adding the above field “TVT evaluation: No. of pings” to the present field.	unitless	[0 – 4294967295]
…	Continued					

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
28	TVT offset parameter or constant threshold	4	LONG	Coefficient C of the TVT formula. This parameter becomes a constant threshold if the A coefficient =0. For volts (Note: not the energy, V^2), the 20 log R TVG = A_{20} R $e^{\beta R}$ + C_{20}; and the 40 log R TVG = A_{40} R^2 $e^{\beta R}$ + C_{40}; where R is the range, A and C are the estimated coefficients, and β is the sound absorption coefficient in nepers per m. For Sv or TS (dB), the formula for a 20 log R TVG = A(20 log(R) + 2αR) + C, and for a 40 log R TVG = A(40 log(R) + 2αR) + C, where R is the range, A and C are the estimated coefficients, and α is the sound absorption coefficient in dB/m. Note: β = α/10 log e. The curve is fitted for the range interval between TVG minimum and TVG maximum ranges or for the sample range.	0.000001	[−2147.483648 – 2147.483647]
32	TVT amplification parameter	4	ULONG	Coefficient A of the TVT formula. For volts (Note: not the energy, V^2), the 20 log R TVG = A_{20} R $e^{\beta R}$ + C_{20}; and the 40 log R TVG = A_{40} R^2 $e^{\beta R}$ + C_{40}; where R is the range, A and C are the estimated coefficients, and β is the sound absorption coefficient in nepers per m. For Sv or TS (dB), the formula for a 20 log R TVG = A(20 log(R) + 2αR) + C, and for a 40 log R TVG = A(40 log(R) + 2αR) + C, where R is the range, A and C are the estimated coefficients, and α is the sound absorption coefficient in dB/m. Note: β = α/10 log e. The curve is fitted for the range interval between TVG minimum and TVG maximum ranges or for the sample range.	0.000001	[0 – 4294.967295]
36	Tuple attribute	4	LONG	Attribute of the tuple according to Annex 3. 0 = original 1 = edited 2 = temporary 3 = temporary + edited 4 = patched 5 = patched + edited …	unitless	[−2147483648 – 2147483647]
40	Backlink	4	ULONG	Tuple size: 44 bytes	byte	44

Table 26. Attitude sensor tuple (10140).

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit Range
0	Tuple size	4	ULONG	Tuple data size: 22 bytes	byte	22
4	Tuple type	2	USHORT	Tuple type code: **10140**	unitless	10140
6	Time fraction	2	USHORT	Fraction of a second to add to the following CPU ANSI C time to get a time precision of 0.0001 s (Local time at which the platform attitude reading was taken).	0.0001 s	[0 – 6.5535 s] Practical range: [0 – 0.9999 s]
8	Time CPU ANSI C Standard time	4	ULONG	Local time at which the platform attitude reading was taken. ANSI C time given by the CPU clock, in seconds. Usually the CPU clock is set to local time.	s	[0 – 4294967295 s] i.e.: [up to year 2106]
12	Attitude sensor identifier	2	USHORT	Unique identifier for the attitude sensor providing the attitude information.	unitless	[0 – 65535]
14	Pitch	2	SHORT	Inclination of the platform relative to the horizontal plane in the fore-and-aft direction (X). Positive angles indicate bow up.	0.1 deg	[−3276.8 – 3276.7 deg] Practical range: [−90.0 – 90.0 deg]
16	Roll	2	SHORT	Inclination of the platform relative to the horizontal plane in the starboard-and-port direction (Y). Positive angles indicate port up.	0.1 deg	[−3276.8 – 3276.7 deg] Practical range: [−90.0 – 90.0 deg]
18	Heave	2	SHORT	Heave of the platform in the vertical direction (Z). Positive heave is downwards.	0.01 m	[−327.68 – 327.67 m]
20	Yaw	2	SHORT	Yaw of the platform. Positive angles indicate yaw to starboard.	0.1 deg	[−3276.8 – 3276.7 deg] Practical range: [−180.0 – 180.0 deg]
22	Space	2	USHORT	Space to allow the next field to be aligned on an address that is a multiple of 4.	unitless	0
24	Tuple attribute	4	LONG	Attribute of the tuple according to Annex 3. 0 = original 1 = edited 2 = temporary 3 = temporary + edited 4 = patched 5 = patched + edited …	unitless	[−2147483648 – 2147483647]
28	Backlink	4	ULONG	Tuple size: 32 bytes	byte	32

Table 27. Platform position tuple (10142).

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
0	Tuple size	4	ULONG	Tuple data size: 26 bytes	byte	26
4	Tuple type	2	USHORT	Tuple type code: **10142**	unitless	10142
6	Time fraction	2	USHORT	Fraction of a second to add to the following CPU ANSI C time to get a time precision of 0.0001 s (Local time at which the platform position reading was taken).	0.0001 s	[0 – 6.5535 s] Practical range : [0 – 0.9999 s]
8	Time CPU ANSI C Standard time	4	ULONG	Local time at which the platform position was taken ANSI C time given by the CPU clock, in seconds. Usually the CPU clock is set to local time.	S	[0–4294967295 s] i.e.: [up to year 2106]
12	Distance sensor identifier	2	USHORT	Unique identifier of the distance sensor providing the X and Y position information.	unitless	[0 - 65535]
14	Depth sensor identifier	2	USHORT	Unique identifier of the depth sensor providing the Z position information.	unitless	[0 – 65535]
16	Alongship distance (X)	4	LONG	Alongship distance between platform and reference point on vessel; negative values are on the aft side of the reference point.	0.0001 m	[−214748.3648 – 214748.3647 m]
20	Athwartship distance (Y)	4	LONG	Athwartship distance between platform and reference point on vessel; negative values are on the port side of the reference point.	0.0001 m	[−214748.3648 – 214748.3647 m]
24	Depth (Z)	4	LONG	Platform depth, referred to sea surface.	0.0001 m	[−214748.3648 – 214748.3647 m]
28	Tuple attribute	4	LONG	Attribute of the tuple according to Annex 3. 0 = original 1 = edited 2 = temporary 3 = temporary + edited 4 = patched 5 = patched + edited …	unitless	[−2147483648 – 2147483647]
32	Backlink	4	ULONG	Tuple size: 36 bytes	byte	36

Table 28. STD profile tuple (11000).

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
0	Tuple size	4	ULONG	Tuple data size: variable	Byte	[38–4294967295]
4	Tuple type	2	USHORT	Tuple type code: **11000**	unitless	11000
6	Time fraction	2	USHORT	Fraction of a second to add to the following CPU ANSI C time to get a time precision of 0.0001 s (Local time at which the STD profile started).	0.0001 s	[0 – 6.5535 s] Practical range: [0 – 0.9999 s]
8	Time CPU ANSI C Standard time	4	ULONG	Local time at which the STD profile started. ANSI C time given by the CPU clock, in seconds. Usually the CPU clock is set to local time.	s	[0 – 4294967295 s] i.e.: [up to year 2106]
12	Sensor type	2	USHORT	STD profiler used: 0 = XBT 1 = CTD 2 = XCTD 3 = Mobile sound velocity profiler	unitless	[0 – 65535]
14	Number of measurements	2	USHORT	Number of measurements in this profile.	unitless	[0 – 65535]
16	Pressure (record#1)	4	ULONG	Pressure.	0.001 Pa(dbar?)	[0 – 4294967.295 s] Practical range: [0 – 1000000.000 Pa]
20	Temperature (record #1)	4	LONG	Temperature.	0.0001°C	[−214748.3648 – 214748.3647°C] Practical range: [−5.000 – 50.0000 °C]
24	Conductivity (record #1)	2	USHORT	Conductivity.	0. 001S/m	[0 – 65.535 S/m] Practical range: [0 – 7.000 S/m]
26	Sound velocity (record #1)	2	USHORT	Speed of sound.	0.1 ms^{-1}	[0 – 6553.5 ms^{-1}] Practical range: [1400.0 – 1700.0 ms-1]
…	Continued					

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
28	Depth (record #1)	4	ULONG	Depth from surface.	0.0001 m	[0 – 429496.7295 m] Practical range: [0 – 10000.0000 m]
32	Salinity (record#1)	4	ULONG	Salinity.	0.001 psu	[0– 4294967.295 psu] Practical range: [0 – 42.000 psu]
36	Absorption (record #1)	4	ULONG	Absorption of sound in the propagation medium.	0.0001 dB/km	[0 – 429496.7295 dB/km] Practical range: [0 – 300.0000 dB/km]
40	Pressure (record#2)	4	ULONG	Pressure.	0.001 Pa(dbar ?)	[0 – 4294967.295 s] Practical range: [0 – 1000000.000 Pa]
44	Temperature (record #2)	4	LONG	Temperature.	0.0001°C	[−214748.3648 – 214748.3647°C] Practical range: [−5.000 – 50.0000 °C]
48	Conductivity (record #2)	2	USHORT	Conductivity.	0.001S/m	[0 – 65.535 S/m] Practical range: [0 – 7.000 S/m]
50	Sound velocity (record #2)	2	USHORT	Speed of sound.	0.1 ms^{-1}	[0 – 6553.5 ms^{-1}] Practical range: [1400.0 – 1700.0 ms^{-1}]
…	Continued					

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
52	Depth (record #2)	4	ULONG	Depth from the surface.	0.0001 m	[0 – 429496.7295 m] Practical range: [0 – 10000.0000 m]
56	Salinity (record#2)	4	ULONG	Salinity.	0.001 psu	[0 – 4294967.295 psu] Practical range: [0 – 42.000 psu]
60	Absorption(record #2)	4	ULONG	Absorption of sound in the propagation medium.	0.0001 dB/km	[0 – 429496.7295 dB/km] Practical range: [0 – 300.0000 dB/km]
	Tuple attribute	4	LONG	Attribute of the tuple according to Annex 3. 0 = original 1 = edited 2 = temporary 3 = temporary + edited 4 = patched 5 = patched + edited …	unitless	[−2147483648 – 2147483647]
...	Backlink	4	ULONG	Tuple size: variable (multiple of 4 bytes).	byte	[48 – 4294967295]

Table 29. Private tuple (65397).

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
0	Tuple Size	4	ULONG	Tuple data size: variable	bytes	[6 – 4294967295]
4	Tuple Type	2	USHORT	Tuple type code: **65397**	unitless	65397
6	Organization	2	USHORT	Code identifying the organization that controls the format of the data section of the tuple. Codes allocated by the ***HAC*** tuple coordination committee and described publicly. 1 = DFO-Maurice Lamontagne Institute 2 = BioSonics 3 = Simrad 4 = HTI 5 = IFREMER 6 = SonarData	unitless	[0 – 65535]
8	Data	multiple of 4 bytes		Space for data; structure to be determined by user with restriction that total length must be a multiple of 4 bytes.		
…	Tuple attribute	4	LONG	Attribute of the tuple according to Annex 3. 0 = original 1 = edited 2 = temporary 3 = temporary 4 = patched 5 = patched + edited …	unitless	[−2147483648 – 2147483647]
…	Backlink	4	ULONG	Tuple size: variable (multiple of 4 bytes)	byte	[16 – 4294967295]

Table 30. End of file tuple (65534).

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
0	Tuple size	4	ULONG	Tuple data size: variable	byte	[14 – 4294967295]
4	Tuple type	2	USHORT	Standard end of file tuple type code: **65534**	unitless	65534
6	Time fraction	2	USHORT	Fraction of a second to add to the following CPU ANSI C standard time to get a time precision of 0.0001 s (Local time at which the file was closed).	0.0001 s	[0 – 6.5535 s] Practical range: [0 – 0.9999 s]
8	Time CPU ANSI C standard time	4	ULONG	Local time at which the file was closed. ANSI C time given by the CPU clock, in seconds. Usually the CPU clock is set to local time.	s	[0 – 4294967295 s] i.e.: [up to year 2106]
12	Closing mode	2	USHORT	How the file was closed: 0 = closed manually by the operator command 1 = closed automatically by the program 2 = closed by the program while an error was detected.	unitless	[0 – 65535] Presently: [0, 1]
Space for possible data; structure if any, to be determined.						
...	Tuple attribute	4	LONG	Attribute of the tuple according to Annex 3. 0 = original 1 = edited 2 = temporary 3 = temporary + edited 4 = patched 5 = patched + edited …	unitless	[−2147483648 – 2147483647]
…	Backlink	4	ULONG	Tuple size: variable (multiple of 4 bytes).	byte	[24 – 4294967295]

Table 31. *HAC* Signature tuple (65535).

OFFSET (BYTE)	FIELD	LENGTH (BYTES)	FORMAT	CONTENT	ENCODED UNITS	LIMIT RANGE
0	Tuple size	4	ULONG	Tuple data size: 14	byte	14
4	Tuple type	2	USHORT	Tuple type code: **65535**	unitless	65535
6	***HAC*** identifier	2	USHORT	Unique code identifying the ***HAC*** tuple files. The chosen code was determined from the hexadecimal **0xACAC (decimal 44204**), the two first letters of ***AC***oustics).	unitless	44204
8	***HAC*** version	2	USHORT	***HAC*** format version.	0.00	[0 – 655.35]
10	Acquisition software version	2	USHORT	Version number of the acquisition software, e.g. 1.00.	0.00	[0 – 655.35] Practical range: [0 – 99.99]
12	Acquisition software identifier	4	ULONG	Unique code identifying the software used to acquire the tuple file. 1 = Echoview from SonarData 3741428908 = CH1 from DFO (hexadecimal 0xDF01ACAC) 4278234284 = MOVIES+ from IFREMER (hexadecimal 0xFF00ACAC).	unitless	[0 – 4294967295]
16	Tuple attribute	4	LONG	Attribute of the tuple according to Annex 3. 0 = original 1 = edited 2 = temporary 3 = temporary + edited 4 = patched 5 = patched + edited …	unitless	[−2147483648 – 2147483647]
20	Backlink	4	ULONG	Tuple size: 24 bytes	byte	24

13 Figures

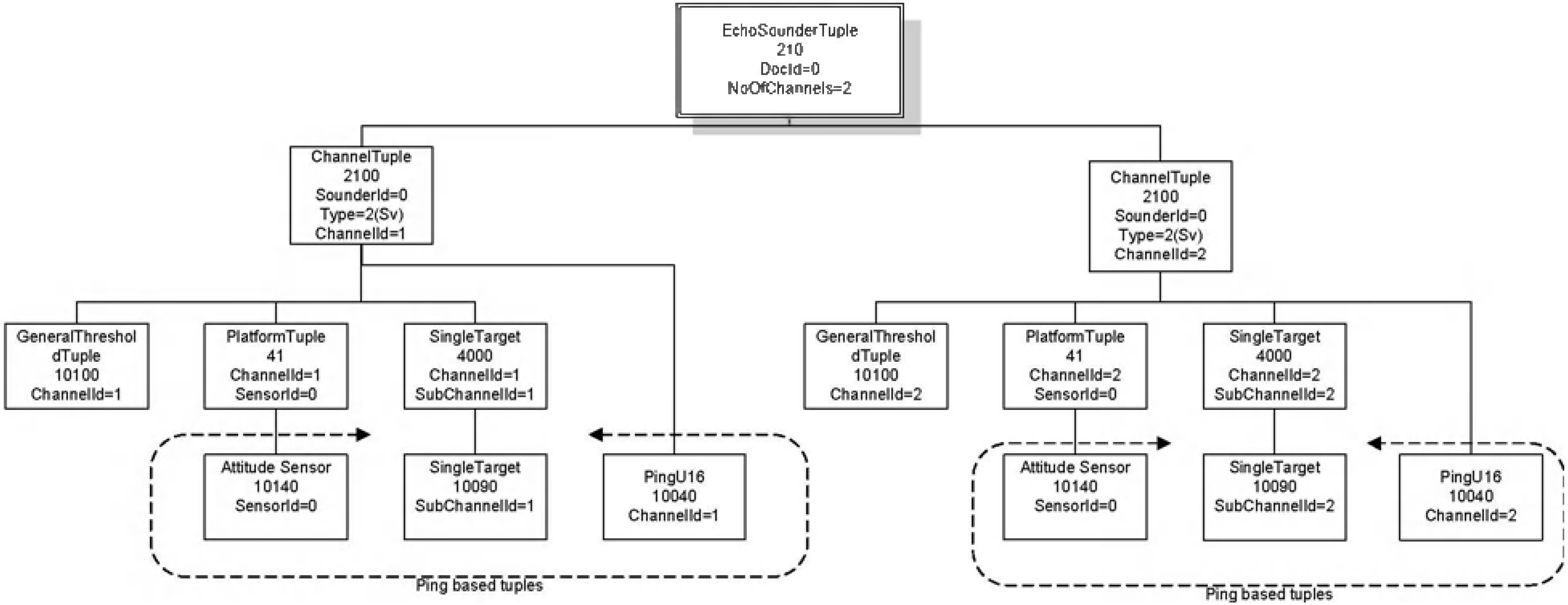

Figure 1. An example of a Tuple file structure with the parent/child hierarchical relationship.

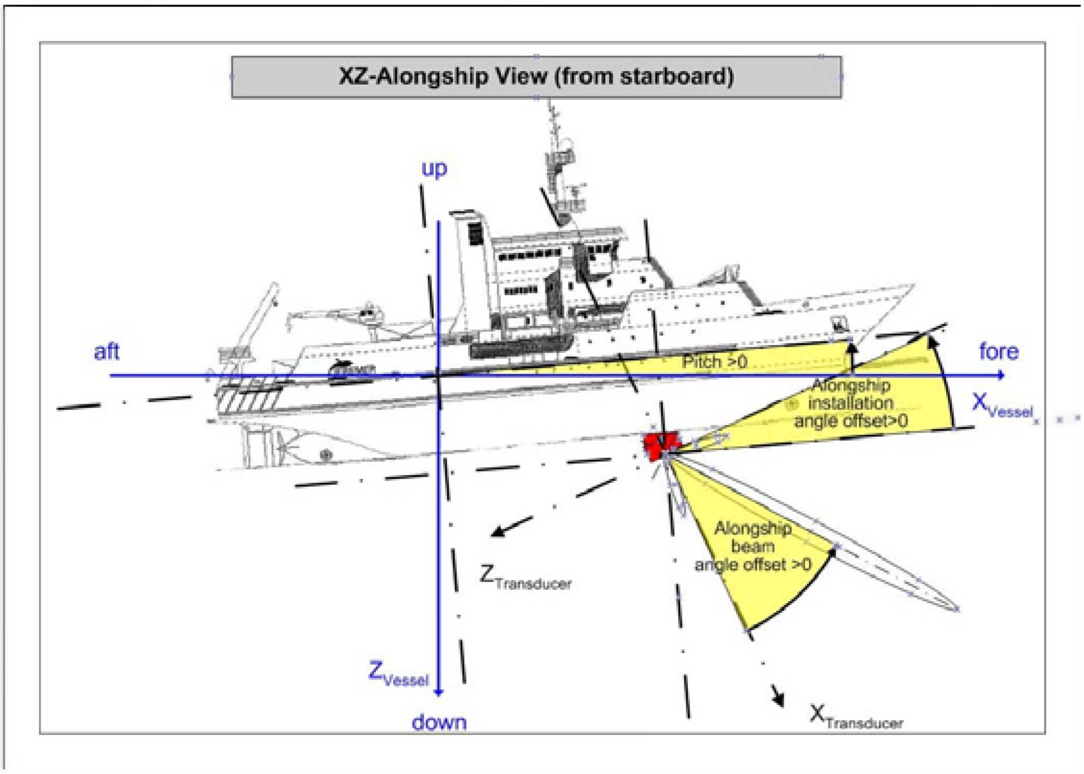

Figure 2. Schematic of the vessel, transducer and beam coordinate systems viewed relative to the alongship (XZ) axis.

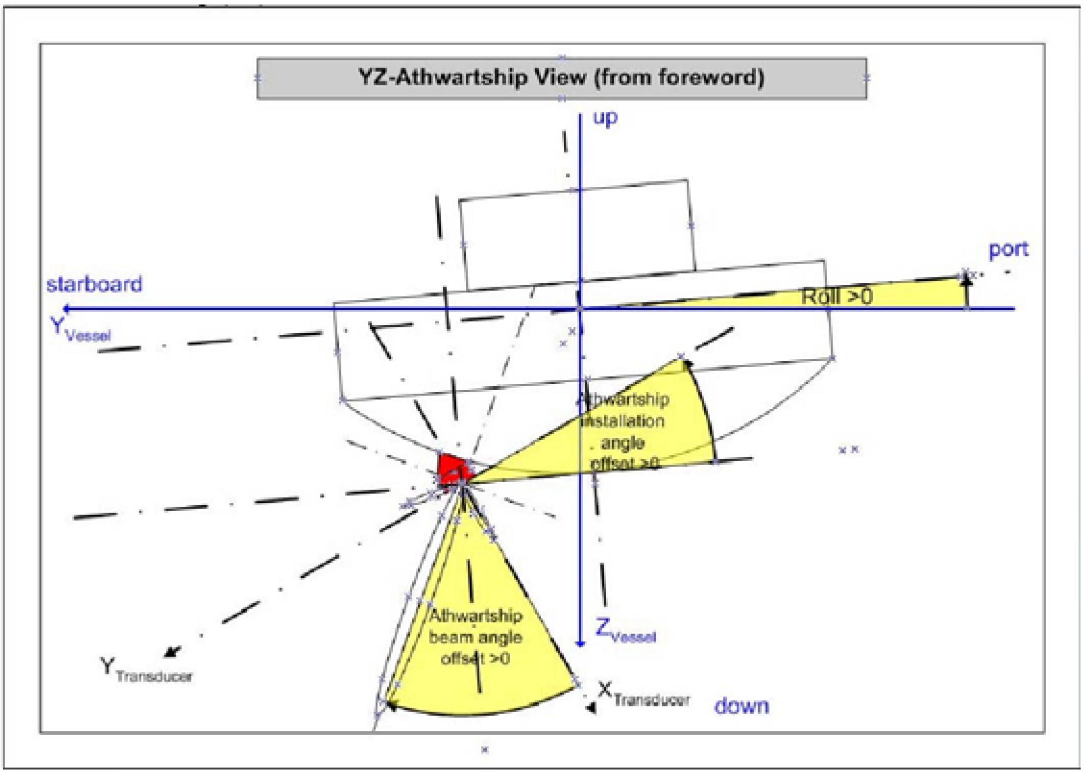

Figure 3. Schematic of the vessel, transducer and beam coordinate systems viewed relative to the athwartship (YZ) axis.

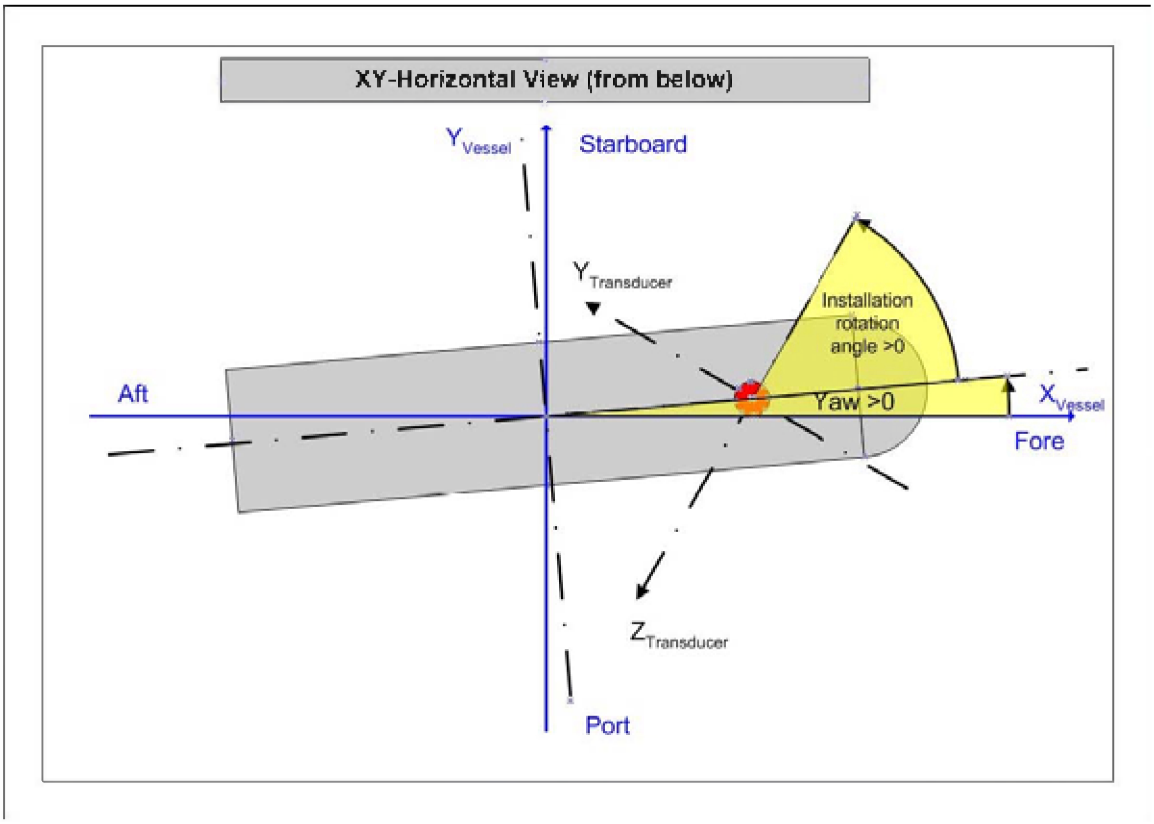

Figure 4. Schematic of the vessel and transducer coordinate systems viewed relative to the horizontal (XY) axis.

Annex 1: Additions and modifications to the *HAC* standard format since version 1.0

(Simard *et al.*, 1997). References refer to the PGHAC annual report describing the change

New Tuples

Platform attitude tuples (41, 10140) (ICES, 2002)

This group of tuples was designed to replace tuple 40 for storing platform motion information, mainly because tuple 40 lacked a field relating it to a particular channel. A parent/child structure was adopted, with a sub-channel tuple, containing the description and relationships of the attitude sensor system to the parent channel, and a "ping style" tuple, containing the data flowing from the sensor.

Independent platform attitude tuples (42, 10142) (ICES, 2003)

This group of tuples was designed to allow the recording of the attitude and relative position of an independent platform, e.g. a towed body or a sounder mounted on fishing net. The tuples describe the set-up for such a platform and its attitude recording systems (42) and a ping style tuple for recording continuous data (10142).

Simrad EK60 echosounder tuples (210, 2100) (ICES, 2003)

Revised versions for new sounder and channel tuples for the EK60 were presented at the 2003 meeting. In general the tuples met the requirements of the format. However, there were some problems that required correction before acceptance, and some agreements on approach.

Generic tuples (901, 9001) (ICES, 2000)

The ***HAC*** format philosophy is based on the identification of the attributes of specific echosounders by specific tuples mirroring the various settings offered by the manufacturer and to which the users are accustomed. However, to easily introduce data from various echosounders that have not already been defined by specific tuples in the ***HAC*** format, a set of tuples have been described that detail the common fields of information a "generic" echosounder should have. These generic tuples must only be used for the exchange of data collected from echosounders that are neither presently described nor will be described by specific tuples within the standard tuple classes. These tuples are not intended to be used to acquire new data in the ***HAC*** format from new scientific echosounders. If existing tuples are inadequate for this purpose, a new set of tuples must be defined for each new scientific echosounder. The generic tuples are:

- the generic echosounder tuple (901), to accommodate both analog and digital echosounders,
- the generic channel tuple (9001), associated with the generic echosounder tuple, according to the ***HAC*** rules,
- the standard ping tuple U-32 (10000). The "sample value" field has been upgraded by the definition of additional data ranges to use with the new types of data samples introduced in the generic channel tuple. The ping tuple U-32-16-angles (10001) is also associated with the generic echosounder and channel tuples for storing split-beam angle data.

Biosonics channel tuple (1001) (ICES, 2001)

The new tuple 1001, intended to replace 1000, includes a number of small changes in some fields and the addition of an attitude sensor identifier field and a transducer shape field.

Simrad EK500 channel tuple (2001) (ICES, 2001)

The new tuple 2001, intended to replace 2000, includes a number of small changes in some fields and the addition of a surface blanking range field, a sampling interval field, an attitude sensor identifier field, a transducer shape field, and a transducer rotation angle field.

Simrad EK500 channel patch tuple (2002) (ICES, 2002)

During the development of the single-target information tuples (see below), it was determined that there was no field available for the inclusion of the TS Gain in the EK500 channel tuple (2001). The EK500 channel patch tuple (2002) was therefore designed to include both TS and Sv gains.

Single-target information tuples (4000, 10090) (ICES, 2002)

This group of tuples was designed to contain single-target detection information, with the same parent/child structure as described for the platform attitude tuple group. Although at the time of the development of these tuples, only the SIMRAD EK500 was producing such data, these tuples were specifically designed to be "generic" and therefore to be suitable for all sources of single-target information independent of the acquiring hardware.

Modifications to Existing Tuples

Platform attitude parameters tuple (41) (ICES, 2003)

The term "transducer channel number" in tuple 41 was changed to match the term "transducer channel identifier" now used in tuple 42.

Simrad EK500 echosounder tuple (200) (ICES, 2001)

The "Ping Mode" field was changed to "Trigger Mode" and the "off" option has been eliminated. The maximum value for the field has been defined as "not available". The changes were not sufficient to merit a new tuple so the modifications were made to the existing tuple (200).

Simrad EK60 echosounder and channel tuples (210, 2100) (ICES, 2004)

The PG requested that the field order adopted by SIMRAD for the EK60 sounder and channel tuples be the same as that adopted for the EK500 tuples to avoid confusion. This request was carried out prior to final publication in the present document.

Generic echosounder tuple (901) (ICES, 2003)

The remark field was set to 100 bytes fixed length.

Simrad EK500 channel tuple (2001) (ICES, 2003)

Tuple size was originally given as 112 bytes (data size of 102 bytes). This should actually have read 116 bytes (data size of 106 bytes). There was also an addition to the attribute field to recognise the channel patch tuple 2002.

Simrad EK500 channel patch tuple (2002) (ICES, 2003)

The remark field was set to 20 bytes fixed length.

Generic channel tuple (9001) (ICES, 2003)

The remark field was set to 40 bytes fixed length.

Angle data tuples (10001, 10011, 10031) (ICES, 2003)

There are two accepted ways of storing negative values. These are either as "two's complement" or as "sign + magnitude". The format as it currently exists does not specify which method should be used to store negative numbers. "Two's complement" has been used by some developers and "sign + magnitude" by others in the angle data tuples. It was agreed that the format should recognise this and also that "two's complement" is the general standard in software. It was therefore decided that "two's complement" should be used from now on for storing all negative numbers, and that programmers should implement code to allow for both storing methods in angle data tuples.

Ping tuple U-32-16 angles (10001) (ICES, 2001)

Changes were made to the description of the sample value fields (offset byte 28 and 30).

Ping tuple C-32 (10010) (ICES, 2001)

The description of the sample value field (offset byte 28) has been clarified. The previously described compression methodology was potentially inefficient.

General threshold tuple (10100) (ICES, 2001)

A "Manually set by user" option was added to the TVT evaluation mode field (offset byte 18). The text in the TVT fields at offsets 28 and 32 was clarified and at offset 28 the format should be LONG, not ULONG.

Attitude sensor tuple (10140) (ICES, 2003)

There should have been a 2-byte space field after the "Yaw" field in the original description. However, the total number of bytes was correct in the description. This 2-byte space field has been added. Also, the "not available" value for offsets 14, 16, 18, and 20 was originally specified as the highest possible value (ICES, 2002) rather than the lowest possible value, i.e. + rather than –. The format generally specifies the lowest possible value for signed fields. This oversight may also occur in the documentation of other tuples. Therefore, programmers should pay particular attention to this issue.

Environmental tuple for sound speed profiles (11000)

The definition of this tuple has been detailed by DFO and IFREMER to include fields for vertical profiles of pressure, temperature, conductivity, sound velocity, depth, salinity, and absorption.

***HAC* Signature tuple (65535)** (ICES, 2000)

The codes for various ***HAC*** data production tools were added to the appropriate field of the ***HAC*** Signature tuple.

Annex 2: Standardized descriptions of angle coordinate variables

Field	Content
Alongship angle offset of the transducer face	Mechanical offset angle of the transducer face relative to the horizontal in the alongship plane of the attitude sensor coordinate system (XY). Positive angles indicate the foreward side is above the horizontal.
Athwartship angle offset of the transducer face	Mechanical offset angle of the transducer face relative to the horizontal in the athwartship plane of the attitude sensor coordinate system (YZ). Positive angles indicate the port side is above the horizontal.
Alongship angle offset of the main axis of the acoustic beam	Mechanical offset angle of the main axis of the acoustic beam in the alongship plane relative to the perpendicular to the transducer face (XY). Zero (0) is perpendicular to the transducer face. Positive angles indicate the down-propagating sonar beam is oriented foreward.
Athwartship angle offset of the main axis of the acoustic beam	Mechanical offset angle of the main axis of the acoustic beam in the athwartship plane relative to the perpendicular to the transducer face (YZ). Zero (0) is perpendicular to the transducer face. Positive angles indicate the down-propagating sonar beam is oriented to starboard.
Transducer rotation angle	Mechanical angle of rotation of alongship axis of transducer relative to the alongship axis of the attitude sensor coordinate system. Positive angles are clockwise rotation (to starboard).
Alongship offset	Distance between the center of the transducer and the reference point of the attitude sensor in the fore and aft direction (X). Positive values are on the foreward side of the reference point of the attitude sensor. Distance between the position sensor and the attitude sensor in the fore and aft direction (X). Positive values are on the foreward side of the reference point of the attitude sensor.
Athwartship offset	Distance between the center of the transducer and the reference point of the attitude sensor in the starboard and port direction (Y). Positive values are on the starboard side of the reference point of the attitude sensor. Distance between the position sensor and the attitude sensor in the starboard and port direction (Y). Positive values are on the starboard side of the reference point of the attitude sensor.
Elevation offset	Distance between the transducer face and the reference point of the attitude sensor in the vertical direction (Z). Positive values are below the reference point of the attitude sensor. Distance between the sea surface and the attitude sensor in the vertical direction (Z). Positive values are below the surface.
Pitch	Inclination of the platform relative to the horizontal plane in the fore-and-aft direction (X). Positive angles indicate bow up.
Roll	Inclination of the platform relative to the horizontal plane in the starboard-and-port direction (Y). Positive angles indicate port up.
Heave	Heave of the platform in the vertical direction (Z). Positive heave is downwards.
Yaw	Yaw of the platform. Positive angles indicate yaw to starboard.

Annex 3: Specifications of the attribute field

Content	Undefined																													Patched	Temporary	Edited	Value
Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Code
Original	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Edited	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Temporary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2
Temporary + Edited	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3
Patched	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	4
Patched + Edited	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	5
…																																	…
Bit 31 (2147483648)	Undefined																																

Annex 4: Data type and term definitions

DATA TYPE	SIZE	RANGE
DOUBLE	64 bit	Floating point
FLOAT	32 bit	Floating point
LONG	32 bit	Integer -2147483648 to 2147483647
ULONG	32 bit	Integer 0 to 4294967295
SHORT	16 bit	Integer -32768 to 32767
USHORT	16 bit	Integer 0 to 65535
CHAR	7 bit	Microsoft ASCII table for PC

Integer values are used to represent the encoded units presented in the tables.

TERM	DEFINITION
A/D	Analog to digital converter
ANSI C Standard time:	Time elapsed since midnight (00:00:00) 1 January 1970, in seconds
DSP	Digital signal processor
Hardware channel	Physical channel from which the data are coming
RLE	Run-Length Encoding method of data compression
Software channel	Virtual channel describing a particular type of data (see channel tuple)

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