Fisheries Technology Committee **ICES CM 2001/B:03**

Report of the

Planning Group on the HAC Data Exchange Format

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TABLE OF CONTENTS

1 OPENING OF THE MEETING

The meeting was chaired by D. Reid, (UK, Scotland) who also acted as Rapporteur. A full list of participants is attached as Annex 1.

2 BACKGROUND

The terms of reference for Planning Group on HAC Data Exchange Format (PGHAC) as agreed at the FAST meeting (Haarlem, Netherlands, April 2000) and approved at the ICES Statutory Meeting, Bruges, Belgium, September 2000 were:

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

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

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

The planning group reported to the April 2001 meeting of Working Group on Fisheries Acoustics Science and Technology (Seattle, USA, April 24–27) and will report to the Fish Capture Committee at the 2001 Statutory meeting.

3 INTRODUCTION

In 1999 the Working Group on Fisheries Acoustics Science and Technology (Working Group on Fisheries Acoustics Science and Technology) meeting in St. John's, Newfoundland, Canada adopted the ***HAC*** standard data format for raw and edited hydroacoustic data (Simard *et al*. 1997, 1999) as the common format for exchanging fisheries acoustics data and for comparing processing algorithms within the ICES community (ICES-CM 1999/B:2: Section 10.3, p. 12). A group of experts including FAST members and representatives of hardware and software manufacturers was assigned the responsibility of coordinating the development of the format. 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[*] of this upgradable format. At the Working Group on Fisheries Acoustics Science and Technology in 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 Statutory Meeting in Bruges, Belgium (September 2000) and was formally incorporated as an ICES Planning Group (PGHAC, ICES Annual Report for 2000. Part 3. p. 256).

4 SUBJECTS ADDRESSED

The PG discussed the following main issues:

- A generic set of tuples for undefined echosounders.
- Modifications to existing tuples.
- New tuples to be included in the standard by July 1.
- New proposed tuple descriptions for testing.
- The allocation of a new set of tuples for the Simrad EK60 echosounder.
- General changes and improvements.

The new tuples and changes to existing tuples are detailed in the annex and are only described briefly here. For more detail please see Annex 2

[*] Tuple: a labelled group of bytes encapsulating special type of information in the ***HAC*** format, which forms the basic structure of this format and that gives the format its upgradability and versatility property. Tuples belongs to tuple families or classes that groups the information by themes. Unique numbers, varying from 0 to 65535, identify each tuple. The ***HAC*** co-ordinating committee has to allocate these numbers to prevent any "collision" in the tuple usage by various groups around the world and to agree on the definition of the various fields of information they contain.

5 A GENERIC SET OF TUPLES FOR UNDEFINED ECHOSOUNDERS

The PG had previously agreed to define a generic set of tuples to allow the easy introduction and exchange of data from various echosounders that have not been specifically defined in the ***HAC*** format. In the last report it was stressed that these generic tuples must only be used for the exchange of data collected from echosounders that are not presently described by tuples that are accepted by the Committee and from echosounders that will not be described by specific tuples. 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, a new set of tuples must be defined for each new scientific echosounder for this purpose. A new group of tuples was provisionally defined at the 2000 meeting. These were not intended to be used in shipped software, prior to confirmation by PGHAC. However, due to a misunderstanding this did occur, and therefore, a new set of generic tuples were defined at this meeting. The new tuples and changes are:

- A provisional Generic echosounder tuple (tuple no. 901) has been defined to accommodate both analogue and digital echosounders. It has an added value in the sound speed profile field, and the trigger mode field has been modified.
- A Generic channel tuple (tuple no. 9001) to be associated with the Generic echosounder tuple, according to the ***HAC*** rules, has also been defined. A series of small changes from 9000 have been made to this tuple. Most of the changes were clarifications in the text description. It was agreed and adopted as a general rule that fields should allow "not available" and "not used", and that these should be the highest or lowest available value where appropriate. It was also agreed that a number of fields should be changed from SHORT to ULONG or LONG to allow higher precision and range. Generally precision should be to four decimal places (field offsets 36, 40, 52–60, & 76).

The ping tuple associated to the Generic channel tuple that was chosen by the committee (see below) is the Standard ping tuple U-32 (tuple no. 10001) defined in the ***HAC*** version 1.0 (Simard *et. al.* 1997). 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. "Not available" has been added as an option in "Transceiver mode". **The Ping tuple U-32–16-angles (tuple no. 10001) was also chosen by the committee for storing split-beam angle data associated with the Generic echosounder and channel tuples.**

Modifications to Existing Tuples

A number of proposals were made for minor changes to existing tuples. The initial proposal was for the modification of a sounder and two channel tuples (200 & 1000, 2000).

EK500 Echosounder Tuple (200).

- "Ping mode" changed to "Trigger Mode", with no "off" option. The maximum value for the field has been defined as "not available". The group felt the changes were not sufficient to merit a new tuple and minor modifications were made to the existing tuple (200).

Biosonics Channel tuple (1001)

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

EK500 Channel tuple (2001)

- The new tuple 2001, intended to replace 2000, included 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.

Ping Tuple C-32 (10010)

- The description of the sample value field (offset byte 28) has been clarified. The previously described compression methodology was felt by the group to be potentially inefficient.

Ping Tuple U-32–16 angles (10001)

- Changes have been made to the text in sample value fields (offset byte 28 and 30).

General threshold tuple (10100)

- 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 & 32 was clarified and at offset 28 the format should be LONG not ULONG.

6 NEW TUPLES TO BE INCLUDED IN THE STANDARD

Ping Tuple C-32–16 angles (10011)

- This is a new compressed ping tuple for raw angle data.

Platform attitude tuple (41)

- A number of problems were identified in the operation of this tuple. Most importantly, it was impossible to relate this tuple to a particular channel. It was proposed that there should be a platform or attitude sensor ID field included in all channel tuples and to include "not available" & "not known" values. A temporary tuple number (no. 41) was assigned for developers to work on, and this subject will be reconsidered at the next meeting of PGHAC.

Single target information tuple (4000, 10090)

- The need for a tuple structure for single target detection data was recognised by the group. It was proposed that this should constitute a new "family" of "processed data" tuples. One tuple would be at the channel level (possibly a "sub-channel") to hold general information. A second tuple would be for each detected single target and include layer start and end range. This second tuple would be at the same "level" as the ping tuples.

7 GENERAL ITEMS

- **Temporary and provisional tuples** – These 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 Committee.
- **New tuples** – Unless stated otherwise new tuples will be considered provisional for two months after the meeting to allow suggestions and objections to be made. Following that, and if no objections are raised, they will be accepted.
- **Allowable items in fields** – All programmers should be aware that new values might be added at any revision to individual fields. The current lists of options may be added to and code should be developed with the expectation of ANY permissible values.
- **Compulsory General Threshold Tuple** – It was suggested that this tuple was not relevant to EK500 data, however, the group felt it did have wider application and should stay compulsory.
- **Version Numbering** – The current release will be entitled HAC 1.3. two months after the Seattle meeting (i.e., end of June 2001). New releases will be incremented in the first decimal after each annual meeting as required.
- **Multiple Channel Tuples** – More than one channel tuple per channel are allowed – the text of the HAC description will be modified to reflect this.
- **Start and end of run tuples** – The question of why start and end of run tuples were compulsory in a file was raised. It was agreed that they need not be, but that they should always be paired in a single file where they occur.
- **Big v. little endian formats** – These are both permissible in the format to enhance platform independence. It was proposed and agreed that this was probably not necessary given that all known software developed for the HAC format are on the PC platform. Therefore it should only be necessary for software to read or write in little endian format (PC platform) to be ***HAC*** compliant. DFO and IFREMER will investigate consequences of this change, and this will be discussed at PGHAC in 2002.
- **Precision and "unavailable/not known" data** – From now on, and where possible, LONG format data fields will be used to allow a four decimal place precision, and a larger range of permitted values. Where possible, "unavailable/not known" will generally use the maximum permissible value for unsigned fields and the minimum permissible value for signed fields.
- **Variable length tuples** – It was proposed that at the next revision ALL tuples should have a variable rather than a fixed length. This would 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. This will be examined by DFO and others and discussed at PGHAC in 2002.

- **Definitions and updates on the web** – It was agreed that it would be very useful if the full format document was available on the web (e.g., the FAST site). This could include any updates made. As the FAST web site is not yet finalised and as there are copyright questions on the format document, this will set up once these issues have been clarified.
- A proposal for 7 bit "Char" was also made.

8 NEW SIMRAD EK60 TUPLES

Simrad were assigned tuples 210 & 2100 for echosounder and channel for the development of HAC output from the new EK60 sounder.

9 TUPLE ALLOCATION RULES

The following is reprinted from the last report and is included here for the guidance of users and developers.

The rules for allocating tuple numbers and accepting new tuple definitions: the basic tuples and the optional tuples of the common data format:

*To ease the use of the **HAC** format by various software developers requiring the addition of new tuples, and to facilitate the work of the coordinating Committee, the tuple classes were divided in two groups. A first group is the basic tuples classes for which any tuple addition will require a thorough examination and a unanimous agreement by the coordinating committee. Tuple numbers will be allocated temporarily to the applicants during their definition and debugging period for a maximum of 14 months, after which they will be retired if the committee has not accepted their description. (See below; the Committee will meet annually to resolve outstanding issues). A second group is the optional tuple classes that concern auxiliary information or secondary level of data analysis. For these classes, the committee will allocate tuple numbers at the request of the users, on presentation of a short justification and objectives of the tuple by the applicant. In addition there is a need to define the minimum tuples required to define the minimum needs of a **HAC** compliant file.*

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

***The Optional tuple classes are:** Mission and project tuples, Event marker tuples, Edition tuples, Classification tuples, Environmental tuples except sound speed profiles, Private tuples, and Index tuples.*

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

10 NEW OR RECENTLY ADDED TUPLE NUMBERS

Since the initial definition of the ***HAC*** version 1.0, the following tuples numbers were added to the list of defined tuples or in use: 39, **41, 210**, 300, 301, **901, 1001, 2001, 2100**, 3000, 3001, **4000,** 5000, 5001, **9001**, **10011,** 10039, **10090,** 10119, 12000, 12005, 12010, 12050, 12051, 12052, 12053, 12100, 13000, 13500, 14000, 65397, 65406. *Numbers in bold represent those tuples added at the 2000 meeting.*

11 *HAC* COMPLIANCE AND *HAC* COMPATIBILITY

A data file is defined as ***HAC*** compliant if it conforms to the ***HAC*** syntax rules, contains the minimum required ***HAC*** tuples described above using the exact tuple format described (Simard *et al*. 1997 or subsequent updates).

A software application tool is defined as ***HAC*** compatible if it can read and/or write, and use a minimum number of commonly used basic tuples, in the little endian format used by PC platforms. These tuple numbers are: 20, 100, 200, 901, 1000, 2000, 2001, 9001, 10000, 10001, 10100, 65534 and 65535. Tuples 900 and 9000 have been replaced by 901 and 9001, respectively. Tuples 65516 and 65517 (start and end of run) are no longer required for ***HAC*** compatibility.

This represents an update on the published definitions in last year's report.

The following table represents the ability of some of the currently available data acquisition software to read and write the above list of tuples and therefore their HAC compatibility.

	Data Acquisition/Processing Software			
Tuple number	**CH1(ver. 3.1)**	**CH2(ver 2.1)**	**Echoview (ver 2.1)**	**Movies+ (ver. 3.2)**
20	W	R	RW	RW
100	W	R	R*	R*
200	W	R	R	R*W*
901	N/A	W*	R*W*	R*
1000	W	R	R*	R*
2000	W	R	R	R*W*
2001	W	R	R*	R*W*
9001	N/A	W*	R*W*	R*
10000	W	R	RW	R*W*
10001	W	R	R*W*	R*W*
10010	W	RW		
10011	W	RW		
10100	WW	R	W*	R*W*
65534	W	R	RW	R*W*
65535		R	RW	R*W*

* Represents implementation planned for 2001/2002

12 RECOMMENDATIONS

It was agreed that the group should meet again at the same time as the FAST meeting in April 2002 with D. Reid continuing as Chair. The Terms of Reference should remain the same as for the present meeting.

13 REFERENCES

Simard, Y., McQuinn, I., Diner, N., and Marchalot, C. 1999. The world according to ***HAC***: summary of this hydroacoustic standard data format and examples of its application under diverse configurations with various echosounders and data acquisition software. ICES-Fisheries Acoustics Sciences and Technology meeting, St. John's, Newfoundland, Canada, 20–22 April 1999, Working paper. 14 pp.

Simard, Y., McQuinn, I., Montminy, M., Lang, C., Miller, D., Stevens, C., Wiggins, D., and Marchalot, C. 1997. Description of the ***HAC*** standard format for raw and edited hydroacoustic data, version 1.0. Can. Tech. Rep. Fish. Aquat. Sci. 2174: vii + 65 pp.

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ANNEX 2 – MODIFICATIONS TO EXISTING TUPLES AND PROPOSED NEW TUPLES

The following tables outline changes to existing tuples and define new provisional tuples. Where a tuple has been modified by the PG the changes are in **bold** and only those fields which have been changed are included, all other fields remain as previously described. The new tuples are provisional and will be reviewed by PGHAC in 2002 for acceptance into the standard. Software developers are reminded that these should not be shipped in any new software prior to this approval.

Table 1. Definitions

Data Type		**Range**
DOUBLE	64 bit	Floating point
FLOAT	32 bit	Floating point
LONG	32 bit	Integer -2147483647 to 2147483647
ULONG	32 bit	Integer 0 to 4294967295
SHORT	16 bit	Integer -32767 to 32767
USHORT	16 bit	Integer 0 to 65535
CHAR	8 bit	Microsoft ASCII table for PC

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

Modifications to existing tuples:

Table 2. Echosounder tuple for the Simrad EK500 (tuple code 200). This is a three-frequency split-beam digital echosounder that transmits on all frequencies at the same time. The following tuple applies to the different versions of the Simrad EK500, up to version 5.2.

Offset (byte)	**Field**	**Length (bytes)**	**Format**	**Content**	**Encoded units**	**Limit range**
14	**Ping mode**	**2**	**USHORT**	**Ping mode:** **1 = normal** **2 = external (trigged from an external source)** **3 = synchronized** **…** **65635 = not available**	**unitless**	**[0 – 65535]** **EK500 options:** **[0, 1, 2, 3]**
38	EK500 version	4	ULONG	EK500 version number.	0.00	**[0.00 – 42949672.95]** Present range: [0.00 – 5.20]

Table 3. Ping tuple U-32–16-angles (tuple code 10001).

Offset (byte)	**Field**	**Length (bytes)**	**Format**	**Content**	**Encoded units**	**Limit range**
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 degree	[-3276.8 to 3276.7 degree] Practical range: [-180.0 to 180.0 degree]
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 degree	[-3276.8 to 3276.7 degree] Practical range: [-180.0 to 180.0 degree]

Table 4. Ping tuple C-32 (tuple code. 10010).

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).**	depending on the "type of data sample" of the channel tuple: 0.000001 volts or 0.000001 dB, for Sv or TS	For volts: [-1073.741825 to 1073.741824 volts] Practical range: [0.000000 to 25.000000 volts]; For Sv and TS: [-1073.741825 to 1073.741824 dB] Practical range: [-150.000000 to 0.000000 dB]

Table 5. General threshold tuple (tuple code 10100).

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit Range
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** **…** **65535 = not available**	unitless	[0 – 65535] Presently: [0, 1, 2]
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 (N.B. 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 =**	0.000001	**[-2147.483648 to 2147.483647]**

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit Range
				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. N.B. 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. **-2147.483648 = not available**		
32	TVT amplification parameter	4	ULONG	**Coefficient A of the TVT formula. For volts (N.B. 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. N.B. 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.** **4294.967295 = not available**	0.000001	[0.000000 – 4294.967295]
36	Tuple attribute	4	LONG	Attribute of the tuple: 0 = original tuple, e.g., nothing special to mention 1 = edited tuple **2 = temporary** **3 = converted from a previously used equation** Other attributes could be labelled by a code (e.g., tuple data quality). Negative codes should be used for special cases.	unitless	[-2147483648 to 2147483647]

New tuples included in the standard:

Table 6. New channel tuple for the Biosonics Model 102 (tuple code 1001) with signal acquired via an A/D-DSP boards with the acquisition software CH1 of DFO/NHP/DAT. This tuple type template could be used for similar analogue echosounders.

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. (Tuple type codes 1000 – 1999 are reserved for Biosonics echosounders).	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. **N.B.** 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	Digitisation 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] Presently for the Biosonics 102: [0, 1, 2, 3]
18	**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).** **N.B.** 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 "Echosounser tuple for the Biosonics Model 102". **Other components in the TVG (e.g., α) are dealt with elsewhere.** **0.00 = no TVG applied** **655.34 = not applicable** **655.35 = not available**	**unitless 0.01**	**[0 – 655.35]** Presently for the Biosonics 102: [20.00 or 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 & 2 are	unitless	[0 – 65535] Presently for the CH1 DSP-A/D: [1, 2, 3]

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
				the 40 log R signals. **N.B.** This field is not the software channel number.		
22	**Attitude sensor identifier**	**2**	**USHORT**	**Unique identifier of the attitude sensor of the installation platform of the transducer** **65535 = unavailable**	**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** **42949672.95 = not available**	0.01 m	[0.00 – 42949672.95 m] Working range: [0.00 – 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. Negative is below the horizontal and 0 degree is in the fore direction. **-3276.7 = not available**	0.1 degree	[-3276.8 to 3276.7 degree] Working range: [-360.0 to 360.0 degree]
34	Athwartship angle offset of the transducer face	2	SHORT	Mechanical offset angle of the transducer face relative to the horizontal in the athwartgship plane. Negative is below the horizontal and 0 degree is in the starboard direction. **-3276.7 = not available**	0.1 degree	[-3276.8 to 3276.7 degree] Working range: [-360.0 to 360.0 degree]
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 of the transducer relative to the vertical in the alongship plane. Negative is in the aft direction. Zero (0) is perpendicular to the transducer face. **-3276.7 = not available**	0.1 degree	[-3276.8 to 3276.7 degree] Working range: [-20.0 to 20.0 degree]
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 of the transducer relative to the vertical in the athwartship plane. Negative is in the port direction below the horizontal. Zero (0) is perpendicular to the transducer face. **-3276.7 = not available**	0.1 degree	[-3276.8 to 3276.7 degree] Working range: [-20.0 to 20.0 degree]
40	Absorption of sound	2	USHORT	Absorption of sound (α) in the propagation medium used for TVG compensation. **655.35 = not available**	0.01 dB km^{-1}	[0.00 – 655.35 dB km^{-1} Practical range: [0.00 – 300.00 dB km^{-1}]
42	Pulse **duration**	2	USHORT	Duration of the transmitted pulse. **6553.5 = not available**	0.1 ms	[0.0 ms – 6553.5 ms] Biosonics 102 range [0.1 ms – 9.9 ms]
44	Bandwidth	2	USHORT	Transceiver specific bandwidth.	0.01 kHz	[0.00 – 655.35 kHz]

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
						Biosonics 102 options: [1.25, 2.50, 5.00, 10.0 kHz]
46	Calibration source level	2	USHORT	Source level (SL). **N.B.** 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	[0.00 to 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 degree	[0.0 – 6553.5 degree] Practical range: [1.0 to 50.0 degree]
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). N.B. 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 0.000001	[0.000000 to 0.065535] Practical range: [0.000100 to 0.009000]
52	**Transducer**	**2**	**USHORT**	**0= other 1= oval (which includes circular transducer) 2= rectangular 3= cross array 4= ring … 65535= not available**	**unitless**	**[0 – 65535] Presently: [0 – 4]**
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	[0.0000 – 6.5535] Practical range: [1.0000 to 1.5000]
56	Calibration receiving sensitivity	2	SHORT	Calibration receiving sensitivity of the transducer for this TVG-amplified data channel. **N.B.** The receiver gain **is included** in the value of this field, which is the VR of the sonar equation.	0.01 dB v /µPa @ 1 m	[-327.68 to 327.67 dB] Practical range: [-200.00 to -100.00 dB]
58	Receiver gain	2	SHORT	Receiver gain of the echosounder. **N.B.** The receiver gain **is included** in the receiving sensitivity value to get the VR of the sonar equation.	0.01 dB	[-327.68 to 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. **42949672.95 = not available**	0.01 m	[0.00 – 42949672.95 m] Working range: [0.00 –

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
						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. **42949672.95 = not available**	0.01 m	[0.00 – 42949672.95 m] Working range: [0.00 – 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 and TS:** **-327.68 = not available**	0.001 volts, Sv and TS in 0.01 dB	For volts: [-32.768 to 32.767 volts] Practical range: [2.500 to 15.000 volts]; For Sv and TS: [-327.68 to 327.67 dB] Practical range: [-150.00 to 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: 0 = original tuple, e.g., nothing special to mention 1 = edited tuple **2 = temporary** … Negative codes should be used for special cases.	unitless	[-2147483648 to 2147483647]
104	Backlink	4	ULONG	Tuple size: 108 bytes.	byte	**108**

Table 7. New channel tuple for the Simrad model EK500 (tuple code 2001).

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
0	Tuple size	4	ULONG	Tuple data size: **102** bytes.	byte	**102**
4	Tuple type	2	USHORT	Tuple type code: **2001**. This is the tuple type code for the Simrad EK500 raw data. (Tuples 2000 – 2999 are reserved for Simrad echosounders).	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 N.B. 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.** **4294.967294 = not applicable** **4294.967295 = not available**	**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 = **S_v (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** **42949672.95 = not available**	0.01 m	[0.00 – 42949672.95 m] EK500 range: [0.00 – 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.** **429496.7294 = not applicable**	**0.0001 m**	**[0.0000 – 429496.7295m]**

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
				429496.7295 = not available		
32	**Attitude sensor identifier**	**2**	**USHORT**	**Unique identifier of the attitude sensor of the installation platform of the transducer** **65535 = unavailable**	**unitless**	**[0 – 65535]**
34	**Transducer shape**	**2**	**USHORT**	**0= other** **1= oval (which includes circular transducer)** **2= rectangular** **3= cross array** **4= ring** **…** **65535= not available**	**unitless**	**[0 – 65535]** **Presently: [0 – 4]**
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. Negative is below the horizontal and 0 degree is in the fore direction. **-3276.7 = not available**	0.1 degree	[-3276.8 to 3276.7 degree] **Working range: [-180.0 to 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. Negative is below the horizontal and 0 degree is in the starboard direction. **-3276.7 = not available**	0.1 degree	[-3276.8 to 3276.7 degree] **Working range: [-180.0 to 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 co-ordinate system. Negative angles are clockwise rotation.** **-327.68 = not available.**	**0.01 degree**	**[-327.68 to 327.67 degree]** **Working range: [-180.00 to 180.00 degree]**
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 of the transducer relative to the vertical in the alongship plane. Negative is in the aft direction. 0 = perpendicular to the transducer face **-327.67 = not available**	**0.01 degree**	**[-327.68 to 327.67 degree]** **EK500 range: [-20.00 to 20.00 degree]**
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 of the transducer relative to the vertical in the athwartship direction. Negative is in the port direction. 0 = perpendicular to the transducer face **-327.67 = not available**	**0.01 degree**	**[-327.68 to 327.67 degree]** **EK500 range: [-20.00 to 20.00 degree]**

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
46	Absorption of sound	2	USHORT	**Absorption of sound (alpha) in the propagation medium used for TVG compensation.** **655.35 = not available**	0.01 dB km^{-1}	[0.00 – 655.35 dB km^{-1}] Practical range: [0.00 - 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 N.B. Auto: this mode 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 watt – 10000 watt]
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	[0.0 – 6553.5] EK500 range: [0.0 – 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	[0.0 – 6553.5] EK500 range: [0.0 – 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 degree**	**[0.00 – 655.35 degree] EK500 range: [0.00 to 99.90 degree]**
60	Athwartship 3 dB beam width of the transducer	2	USHORT	Half power (3dB) beam width off the transducer in the athwartship plane.	**0.01 degree**	**[0.00 – 655.35 degree] EK500 range: [0.00 to 99.90 degree]**

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
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. N.B.: 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 to 327.67 dB] EK500 range: [-99.90 to 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	[0.00 dB – 655.35 dB] EK500 range: [0.00 to 99.90 dB]
66	Bottom detection minimum level	2	SHORT	Volume backscattering level for the bottom detector's back search function. **-327.68 = not available**	0.01 dB	[-327.68 to 327.67 dB] EK500 range: [-80.00 to 0.00 dB]
68	Bottom window minimum depth	4	ULONG	Minimum depth for bottom detection window. **42949672.95 = not available**	0.01 m	[0.00 – 42949672.95 m] EK500 range: [0.00 – 9999.90 m]
72	Bottom window maximum depth	4	ULONG	Maximum depth for bottom detection window. **42949672.95 = not available**	0.01 m	[0.00 – 42949672.95 m] EK500 range: [0.00 – 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
96	Space	2	USHORT	Space to allow the next field to be aligned on an address that is a multiple of 4.	unitless	0
104	Tuple attribute	4	LONG	Attribute of the tuple: 0 = original tuple, e.g., nothing special to mention 1 = edited tuple **2 = temporary** Other attributes could be labelled by a code (e.g., tuple data quality). Negative codes should be used for special cases.	unitless	[-2147483648 to 2147483647]
108	Backlink	4	ULONG	Tuple size: 112 bytes.	byte	112

Table 8. New ping tuple C-32–16-angles (tuple code 10011). This ping tuple is for the encoding in a compressed 32-bit format of the alongship and athwartship off-axis angles of sample data from a split-beam transceiver.

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
0	Tuple size	4	ULONG	Tuple data size: variable	byte	[30 - 4 giga]
4	Tuple type	2	USHORT	Tuple type code: **10011**	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] (= 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	Transmitter 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 to 2147483.647 m] Practical range: [0.000 - 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 0	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	0.1 degree	[-1638.4 to 1638.4 degree] Practical range:

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
				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.**		[-180.0 to 180.0 degree]; [-3276.8 to 3276.8 degree] Practical range: [-180.0 to 180.0 degree]
...	Sample value	4	LONG	idem		
...	continued					
...	Tuple attribute	4	LONG	Attribute of the tuple: **0 =** original tuple, e.g., nothing special to mention **1** = edited tuple Other attributes could be labelled by a code (e.g., tuple data quality). Negative codes should be used for special cases.	unitless	[-2147483648 to +2147483647]
...	Backlink	4	ULONG	Tuple size: variable (multiple of 4 bytes).	byte	[40 - 4 giga]

Proposed new tuples:

Table 9. Platform attitude tuple (tuple code 41).

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: **41**	unitless	40
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] (= up to year 2106)
12	**Attitude sensor identifier**	**2**	**USHORT**	**Unique attitude sensor identifier to which this attitude information applies**	**unitless**	**[0 – 65535]**
14	Platform referred to	2	USHORT	The platform to which the attitude information is referring: 0 = ship 1 = towed body 1 2 = towed body 2 **3 = AUV** **…**	unitless	[0 – 65535] Presently: [0; 1; 2]
16	Alongship offset	2	SHORT	Distance between the transducer and the reference point of the attitude sensor in the fore and aft direction. Negative values are on the aft side of the reference point of the attitude sensor.	0.01 m	[-327.68 to 327.67 m]
18	Athwartship offset	2	SHORT	Distance between the transducer and the reference point of the attitude sensor in the starboard and port direction. Negative values are on the port side of the reference point of the attitude sensor.	0.01 m	[-327.68 to 327.67 m]
20	Pitch	2	SHORT	Inclination of the platform relative to the horizontal plane in the fore-and-aft direction. Negative angles are below the horizontal and positive above. **3276.7 = unavailable**	0.1 degree	[-3276.8 to 3276.7 degree] Practical range: [-90.0 to 90.0 degree]
22	Roll	2	SHORT	Inclination of the platform relative to the horizontal plane in the starboard-and-port direction. Negative angles are below the horizontal and positive above. **3276.7 = unavailable**	0.1 degree	[-3276.8 to 3276.7 degree] Practical range: [-90.0 to 90.0 degree]
24	Heave	2	SHORT	Heave of the platform. **3276.7 = unavailable**	0.01 m	[-327.68 to 327.67 m]

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
26	**Yaw**	**2**	**SHORT**	**Yaw of the platform.** **3276.7 = unavailable**	**0.1 degree**	**[-3276.8 to 3276.7 degree]** **Practical range: [-180.0 to 180.0 degree]**
28	Tuple attribute	4	LONG	Attribute of the tuple: **0 =** original tuple, e.g., nothing special to mention **1** = edited tuple **…** Negative codes should be used for special cases.	unitless	[-2147483648 to 2147483647]
32	Backlink	4	ULONG	Tuple size: 36 bytes	byte	36 bytes

Table 10. Simrad EK500 split-beam detected single target parameters sub-channel tuple (tuple code 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.	1 s	[0 – 4294967295 s] (= 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. **N.B.** 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. **N.B.** This is not the hardware channel number.	unitless	[0 – 65535]
16	Minimum value	2	SHORT	Threshold value (see EK500 TS-Detection menu)	1 dB	[-327.68 – 327.68] Presently: [-100.00 – 0.00]
18	Minimum echo length	2	USHORT	Minimum normalized echo length (see EK500 TS-Detection menu)	0.01 steps	[0.00 – 655.35] Presently: [0.00 – 10.00]
20	Maximum echo length	2	USHORT	Maximum normalized echo length (see EK500 TS-Detection menu)	0.01 steps	[0.00 – 655.35] Presently: [0.00 – 10.00]
22	Maximum gain compensation	2	USHORT	Maximum one-way gain compensation (see EK500 TS-Detection menu)	0.01 dB	[0.00 – 655.35] Presently: [0.00 – 6.00]
24	Maximum phase compensation	2	USHORT	Maximum standard phase deviation (see EK500 TS-Detection menu)	0.01 steps	[0.00 – 655.35] Presently: [0.00 – 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 0 = original	unitless	[-2147483648 – 2147483648]

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
				1 = edited …		
60	Backlink	4	ULONG	Tuple size: 64 bytes.	byte	64

Table 11. Split-beam detected single-target tuple (tuple code 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.	1 s	[0 – 4294967295 s] (= 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 to 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	0.0001 m	[-214748.3648 – 214748.3648]
40	Compensated TS (target #1)	2	SHORT	Target strength of detected single target after compensation for off-axis angle.	0.01 dB	[-327.68 to 327.67 dB] EK500 range: [-100.00 to 0.00 dB]
42	Uncompensated TS (target	2	SHORT	Raw target strength of detected single target uncompensated for off-axis angle.	0.01 dB	[-327.68 to 327.67 dB] EK500 range: [-100.00

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
	#1)					to 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 to 327.67 dB]
46	Athwartship angle (target #1)	2	SHORT	Athwartship off-axis angle of the detected single target.	0.01 deg.	[-327.68 to 327.67 dB]
48	Range (target #2)	4	LONG	Range of the second detected single target	0.0001 m	[-214748.3648 – 214748.3648]
52	Compensated TS (target #2)	2	SHORT	Target strength of detected single target after compensation for off-axis angle.	0.01 dB	[-327.68 to 327.67 dB] EK500 range: [-100.00 to 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 to 327.67 dB] EK500 range: [-100.00 to 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 to 327.67 dB]
58	Athwartship angle (target #2)	2	SHORT	Athwartship off-axis angle of the detected single target.	0.01 deg.	[-327.68 to 327.67 dB]
…	continued					
…	Tuple attribute	4	LONG	Attribute of the Tuple 0 = original 1 = edited	unitless	[-2147483648 – 2147483648]
…	Backlink	4	ULONG	Tuple size: variable (multiple of 4 bytes).	byte	[68 – 4294967295]

Generic tuples:

GENERIC Echosounder tuple

Table 12. Generic Echosounder tuple used with echosounders for which no Echosounder tuple has been described in the ***HAC*** standard data format. Echosounder tuple for echosounders that do not fit in the already described echosounder tuples of the ***HAC*** standard data format, version 1.3 (Simard et al. 1997), or subsequent approved updates.

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
0	Tuple size	4	ULONG	Tuple data size: variable	byte	[…– 4 giga]
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 – 4294967296]
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** **6553. 5 = not available**	0.1 m s^{-1}	[0.0 - 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	[0.00 - 655.35 s] (= up to 10.92 min)
16	**Trigger mode**	**2**	**USHORT**	**The source characteristics of the trigger** **1 = normal** **2 = external** **3 = synchronized** **…** **65535 = not available**	**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	X4	CHAR	Character string comment. This field could be used to store the echosounder brand, its properties and the serial number.	ASCII char.	variable
…	Tuple attribute	4	LONG	Attribute of the tuple: 0 = original tuple, e.g., nothing special to mention	unitless	[-2147483648 to 2147483647]

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
				1 = edited tuple … Other attributes could be labelled by a code (e.g., tuple data quality). Negative codes should be used for special cases.		
…	Backlink	4	ULONG	Tuple size: variable (X4) bytes	byte	[… – 4 giga]

GENERIC Channel tuple

Table 13. Generic channel tuple for the Generic Echosounder. Do not use this Channel tuple for any other described Echosounder tuples (tuples no 100, 200, 300 and 301) of the HAC standard data format, version 1.3, or subsequent approved updates.

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
0	Tuple size	4	ULONG	Tuple data size: variable	byte	[… – 4 giga]
4	Tuple type	2	USHORT	Tuple type code: **9001.** This is the tuple type code for the Generic Channel tuple.	unitless	9000
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. **N.B.** 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	Digitisation rate for this channel. **The nominal sampling interval can be derived from this field and the mean sound speed.** **4294967294= not applicable** **4294967295= not available**	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.** **4294.967294 = not applicable** **4294.967295 = not available**	0.000001 m	[0 – 4294.967295 m]
20	Acoustic frequency	4	ULONG	Acoustic frequency. **4294967295= not available.**	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. **N.B.** This field is not the software channel number. **65535 = not available.**	unitless	[0 – 65535]
26	Type of data	2	USHORT	Type of data sampled: **0** = Volts **1** = S_v (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** = $Volts^2$	unitless	[0 – 65535]

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
				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 S_v (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.		
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).** **N.B. 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** **655.34 = not applicable** **655.35 = not available**	**Unitless 0.01**	**[0 – 655.35]**
30	**TVG blanking mode**	2	SHORT	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 … 65534 = not applicable 65535 = not available	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. **6553.4 = not applicable** **6553.5 = not available**	0.1 m	[0.0 – 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.** **6553.4 = not applicable**	0.1 m	**[0.1 –** 6553.5 m]

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
				6553.5 = not available		
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. **429496.7294 = not applicable** **429496.7295 = not available**	**0.0001 m**	**[0.0000 – 429496.7295m]**
40	**Sample range**	**4**	**ULONG**	**Range over which the echo sample data are output by the echosounder.** **429496.7295 = not available**	**0.0001 m**	**[0.0000 – 429496.7295m]**
44	Installation depth of transducer	4	ULONG	Installation depth of transducer relative to the sea surface. 429496.7294 = dynamic platform 429496.7295 = not available	0.0001 m	[0.0000 – 429496.7295 m] Working range: [0.0000 – 10000.0000 m]
48	**Attitude sensor identifier**	**2**	**USHORT**	**Unique identifier of the attitude sensor of the installation platform of the transducer.** **65535 = unavailable**	**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	Alongship distance between the center of the transducer face and the reference point of the attitude sensor in the fore and aft direction of the attitude sensor co-ordinate system. Negative values are on the aft side of the reference point of the attitude sensor. **214748.3647m = not available**	0.0001 m	**[-214748.3647to214748.3647m]** **Working range: [-500.0000 to500.0000 m]**
56	Athwartship offset relative to the attitude sensor	4	LONG	Athwartship distance between the center of the transducer face and the reference point of the attitude sensor in the fore and aft direction of the attitude sensor co-ordinate system. Negative values are on the port side of the reference point of the attitude sensor. **214748.3647m = not available**	0.0001 m	**[-214748.3647to214748.3647m]** **Working range: [-500.0000 to 500.0000 m]**
60	Vertical offset relative to the attitude sensor	4	LONG	Vertical distance between the center of the transducer face and the reference point of the attitude **sensor when the platform is horizontal**. Negative values are below the reference point of the attitude sensor. **214748.3647m = not available**	0.0001 m	[-214748.3647to 214748.3647m] Working range: [-200.0000 to 200.0000 m]
64	Alongship angle offset of the transducer	2	SHORT	**Angle of the transducer face relative to the horizontal in the alongship plane of the attitude sensor co-ordinate system. Negative is below the horizontal and 0 degree is in the fore direction.**	0.01 degree	[-327.68 to 327.67 degree] Working range: [-180.00 to

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
	face			**-327.68 = not available**		180.00 degree]
66	Athwartship angle offset of the transducer face	2	SHORT	Angle of the transducer face relative to the horizontal in the athwartgship plane of the attitude sensor co-ordinate system. Negative is below the horizontal and 0 degree is in the starboard direction. **-327.68 = not available**	0.01 degree	[-327.68 to 327.67 degree] Working range: [-180.00 to 180.00 degree]
68	Rotation angle of transducer face	2	SHORT	**Angle of rotation of alongship axis of transducer relative to alongship axis of attitude sensor co-ordinate system. Negative angles are clockwise rotation.** **-327.68 = not available**	0.01 degree	[-327.68 to 327.67 degree] Working range: [-180.00 to 180.00 degree]
70	Alongship angle offset of the main axis of the acoustic beam	2	SHORT	Offset angle of the main axis of the acoustic beam in the alongship plane and perpendicular to the transducer face. Negative is in the aft direction below the horizontal. 0 = perpendicular to the transducer face. **-327.68 = not available**	0.01 degree	[-327.68 to 327.67 degree] Working range: [-90.00 to 90.00 degree]
72	Athwartship angle offset of the main axis of the acoustic beam	2	SHORT	Offset angle of the main axis of the acoustic beam in the athwartship plane and perpendicular to the transducer face. Negative is in the port direction below the horizontal. 0 = perpendicular to the transducer face. **-327.68 = not available**	0.01 degree	[-327.68 to 327.67 degree] Working range: [-90.00 to 90.00 degree]
74	Absorption of sound	2	USHORT	Absorption of sound (α) in the propagation medium used for TVG compensation. **655.35 = not available**	0.01 dB km^{-1}	[0.00 – 655.35 dB km^{-1} Practical range: [0.00 – 300.00 dB km^{-1}]
76	**Pulse duration**	**4**	**ULONG**	**Duration of the transmitted pulse.** **429496.7295 = not available.**	**0.0001 ms**	**[[0.0000 – 429496.7295 ms]**
80	**Pulse shape mode**	**2**	**USHORT**	**Shape of the transmitted pulse.** **0 = other** **1 = rectangular** **2 = modulated** **3 = chirp** **…** **65535 = not available**	**unitless**	**[0 – 65535]** **Presently: [0,1,2,3]**
82	**Bandwidth**	**2**	**USHORT**	**Transceiver specific bandwidth.** **655.35 = not available**	**0.01 kHz**	**[0.00 – 655.35 kHz]**
84	**Transducer le**	**2**	**USHORT**	**0= other** **1= oval (which includes circular transducer)** **2= rectangular** **3= cross array**	**unitless**	**[0 – 65535]** **Presently:** **[0, 1, 2, 3, 4]**

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
				4= ring **…** **65534= not applicable** **65535= not available**		
86	3 dB alongship beam width of the transducer beam	2	USHORT	Half power (3 dB) beam width of the transducer beam in the alongship plane. **6553.5 = not available**	0.1 degree	[0.0 – 6553.5 degree] Practical range: [1.0 – 50.0 degree]
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. **6553.5 = not available**	0.1 degree	[0.0 – 6553.5 degree] Practical range: [1.0 – 50.0 degree]
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.** **-327.67 = not available**	**0.01 dB**	**[-327.68 to 327.67 dB] Practical range: [10.00 – 50.00 dB]**
92	Calibration source level	2	USHORT	Source level (SL of the sonar equation). **655.35 = not available**	0.01 dB μPa @ 1 m	[0.00 – 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**. **N.B.** This includes all through receiver gain. **-327.68 = not available**	0.01 dB v /μPa @ 1 m	[-327.68 to 327.67 dB] Practical range: [-200.00 to -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). **N.B.** This includes all through receiver gain. This field should be used when the values of SL and VR are not known separately. **-327.68 = not available**	0.01 dB v /μPa @ 1 m	[-327.68 to 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". **-327.68 = not available**	0.01 volts, (volts)^2, Watts or dB	For all units: [-327.68 to 327.67] Practical range: [2.50 – 15.00 volts] [6.25 – 225.00 (volts)^2] [-150.00 to 0.00 dB]
100	Bottom	4	ULONG	Minimum depth for bottom detection window.	0.01 m	[0.00 – 42949672.95

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
	window minimum			**42949672.95 = not available**		m] Working range: [0.00 – 999.99 m]
104	Bottom window maximum	4	ULONG	Maximum depth for bottom detection window. **42949672.95 = not available**	0.01 m	[0.00 – 42949672.95 m] Working range: [0.00 – 999.99 m]
108	Remarks	X4	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.	variable
…	Tuple attribute	4	LONG	Attribute of the tuple: 0 = original tuple, e.g., nothing special to mention 1 = edited tuple … Other attributes could be labelled by a code (e.g., tuple data quality). Negative codes should be used for special cases.	unitless	[-2147483648 to 2147483647]
…	Backlink	4	ULONG	Tuple size: ?+ X4 bytes	byte	[… – 4 giga]

STANDARD PING TUPLE U-32

Table 14. Standard ping tuple U32.

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
0	Tuple size	4	ULONG	Tuple data size: variable	byte	[30 – 4 giga]
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[2]	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] (= 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**	2	USHORT	Operating mode of the transceiver: **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** **…** **65535 = not available**	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. **2147483.647 = not detected** Negative values are reserved for future use.	0.001 m	[-2147483.648 m to 2147483.647 m] Practical range: [0.000 – 15000.000 m]
24	Sample	4	ULONG	Sample sequence number since the beginning of the ping (samples <	unitless	[0 – 4294967295]

[2] To not use FLOATS , the time, which could be stored with precision by a DOUBLE, is divided here in two fields, s-integer (ANSI C standard time) and s-fraction (to the 0.1 ms). There are other ways of encoding time that require less space but we have chosen this way for clarity and safety.

Offset (byte)	Field	Length (bytes)	Format	Content	Encoded units	Limit range
	sequence number			threshold contribute to the sequence count).		
28	Sample value (> threshold)	4	LONG	Sample value on 32 bits. (For phase angles from the split-beam analysis, see Ping tuple U-32–16-angles, table 19)	depending on the "type of data sample" of the channel tuple: 0.000001 volts, or 0.000001 dB, for Sv or TS	For volts: [-2147.483648 to 2147.483647 volts] Practical range: [0.000000 to 25.000000 volts]; for Sv and TS: [-2147.483648 to 2147.483647 dB] Practical range: [-150.000000 to 0.000000 dB];
...	continued					
...	Sample sequence number	4	ULONG	idem		
...	Sample value (> threshold)	4	LONG	idem		
...	Tuple attribute	4	LONG	Attribute of the tuple: 0 = original tuple, e.g., nothing special to mention 1 = edited tuple … Other attributes could be labelled by a code (e.g., tuple data quality). Negative codes should be used for special cases.	unitless	[-2147483648 to 2147483647]
...	Backlink	4	ULONG	Tuple size: variable (multiple of 4 bytes)	byte	[40 – 4 giga]