DATA FORMAT DEFINITION DOCUMENT

SeaBat 7k Data Format, Volume I
Version 0.54

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Protocol Version History:

Protocol Version (DRF and NF)	DFD Version
5	0.54 +
4	0.51 – 0.53
3	0.48 – 0.50
2	0.32 – 0.47
1	0.1 – 0.31

Revision History:

Date	ECO	Author	Rev	Description
11/8/2004	04551	MJF (MD)	D	Revision 0.54
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07/19/04	04179	MJF (MD)	B	Revision 0.52
03/11/04		MD	A	Preliminary Release

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1 INTRODUCTION

1.1 Purpose

This document describes the data format used to log and transmit network data with the 7k series systems and to provide general sensor support. It defines record types for generic sensors and those relevant to the 7k series sonar.

This record-based protocol encapsulates data using frames and headers. A record can hold any type of data, and all records have a unique type identifier. Each record is wrapped within a frame that identifies and describes the content of the record. TCP/UDP transmission uses an additional preceding header to facilitate packet handling.

A built-in synchronization pattern, combined with the checksum, should aid record recovery in corrupted files.

The data format also defines set conventions pertaining to position, rotation, data types and time for consistent data handling.

1.2 Terms and Acronyms

The following table contains definitions of terms and acronyms used in this document.

Term	Definition
7k Format	A record-based data format defined for data logging and network transmission for use, in part, with the SeaBat™ 7k systems.
Altitude	Distance from the seafloor to the sensor.
COG	Center of Gravity
Depth	Distance from the sea surface to the sensor.
DFD	Data Format Definition
Heading	True heading.
ICD	Interface Control Document.
Pitch	Rotation about the across-ship (X) axis.
Roll	Rotation about the along-ship (Y) axis.
SeaBat™ 7k	Generic term used to describe the SeaBat™ 7000 series of

Term	Definition
	sonar systems, related software components and protocols.
VRP	Vessel Reference Point.
XTF	Extended Triton Format: an open binary data logging format created by Triton Elics International, Inc.
Yaw	Rotation about the vertical (Z) axis.

2 CONVENTIONS

2.1 Overview

This section describes sign conventions, data types and time definition used within this DFD.

2.2 Sign Conventions

Unless otherwise stated, all offset measurements shall be relative to the Vessel Reference Point (VRP). Distances shall be in meters and angles in radians. The convention used for 3D coordinate rotation is roll, pitch then yaw. The following sign convention shall be used:

Table 1: Sign Conventions

Offset	Sign	Description
X	+	Starboard of the VRP
	-	Port of the VRP
Y	+	Forward of the VRP
	-	Astern of the VRP
Z	+	Height above the VRP
	-	Depth below the VRP
Roll	+	Port Up
	-	Port Down
Pitch	+	Bow up
	-	Bow down
Yaw	+	Bow to Starboard
	-	Bow to Port
Heave	+	Up
	-	Down
Heading	+	Clockwise
	-	Counter-Clockwise
Altitude	+	Up
	-	Down
Depth	+	Up
	-	Down
Tide	+	High Tide (Height above a defined point)
	-	Low Tide (Height below a defined point)

2.3 Vessel Axes

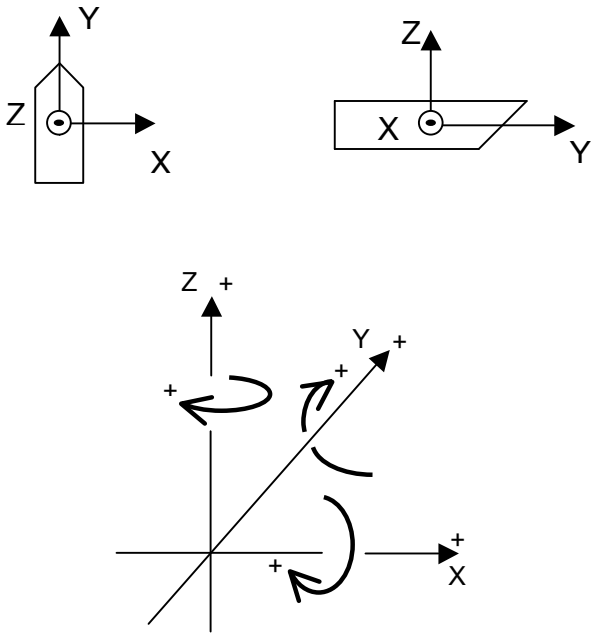


Figure 1: Vessel Axes

2.4 Beam Positions

Beam zero (first beam) is on the port (left) side of the vehicle when the array is installed with the projector facing down and pointing aft.

2.5 Data Types Definitions

The following data type formats are defined by this document.

- **Unsigned values:** 'uX' is an unsigned integer, X bits wide. (E.g. u32 = unsigned 32 bits.)
- **Signed values:** 'iX' is a signed integer, X bits wide. (.g. i16 = signed 16 bits.)
- **Floating points:** Either f32 or f64 (IEEE 1754-1994).

All headers are of static size unless stated otherwise and shall use "struct member alignment" of 1 byte (8 bits) in memory. Data shall be represented in little Endian (Intel) byte-order format unless stated otherwise.

A bit field flag will indicate whether a feature is activated or deactivated. Unless stated otherwise, a bit set to "1" will indicate the given feature is activated.

2.6 Time Definition

Time tags shall be in UTC unless stated otherwise and use the following structure (7KTIME):

Table 2: Time Definition

Name	Size	Description
Year	u16	0 - 65535, all four digits must be used (for example, "2004" rather than "04").
Day	u16	1 – 366
Seconds	f32	0.000000 - 59.999999
Hours	u8	0 - 23
Minutes	u8	0 - 59

3 TCP AND UDP

3.1 Overview

TCP sessions should conform to RFC 793 extensions. UDP session should conform to RFC 768 and later extensions.

Unless otherwise stated, TCP connections should not use the Nagle algorithm to minimize network latency.

Both source and destination port must be populated with a unique port number for TCP and UDP transmissions.

4 RECORD DEFINITION

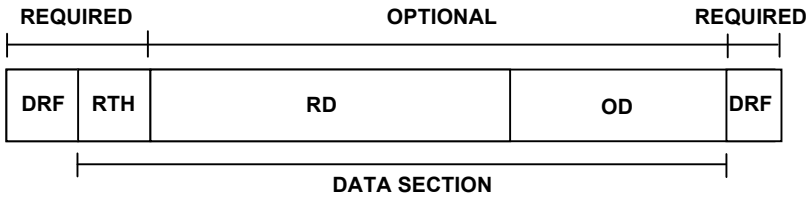
4.1 Overview

A 7k record consists of a data record frame (header and checksum), a record type header, an optional record data field and an optional data field for extra information. The optional data field typically holds sensor-specific data.

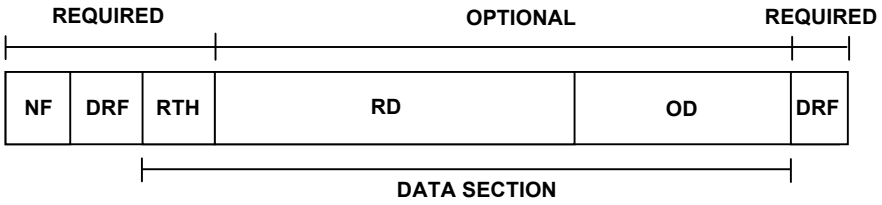
When 7k records are transmitted over a network, a network frame shall precede each record.

7k RECORD

- DRF – Data Record Frame.
- RTH – Record Type Header.
- RD – Record Data.
- OD – Optional Data.



Network prepared with the Network Frame (NF).



5 DATA RECORD FRAME

5.1 Overview

The Data Record Frame (DRF) is the generic wrapper in which all records (sensor data or otherwise) shall be embedded. The sync pattern combined with the checksum should aid recovery in the event a file becomes corrupted. A record frame shall always start with the version and offset fields and can be used to dynamically determine the protocol version, if necessary.

Size Limitation:

Although the format supports records of any length, a practical limitation of 8 MB is imposed on data records from the 7k sonar. Accordingly, if bit 2 of the Flags bit-field is set, the record is one in a sequence of multiple fragments. For the given sequence, the record's relative position in the sequence is given by the "Fragment number" field and the total number by the "Total records in fragment" field.

When a record is fragmented, subsequent Data Record Frames in the sequence shall be identical to the first in the sequence with the exception of the fragment fields. Furthermore, the Record Data fields of each fragmented component shall be a bit-wise segmentation from an equivalent record of the entire length up to and including its checksum.

Consumers of the data may re-constitute an entire record by removing the data record frames for all but the first record in the sequence then concatenating the components. The optional data field and checksum of the equivalently long record shall therefore be embedded in the data of the component records. No Optional Data fields in the record fragments are to be used.

NOTE:
"Fragment" nomenclature is used as opposed to sequence terminology used for the Network Frame (NF) — a similar concept.

The frame is defined as follows:

Table 3: Data Record Frame

Name	Size	Description
Protocol Version	u16	Protocol Version of this frame (e.g.: 1, 2, etc.)
Offset	u16	Offset in bytes from the start of the sync pattern to the start of the DATA SECTION. This allows for expansion of the header whilst maintaining backward compatibility.
Sync Pattern	u32	0x0000FFFF
Size	u32	Size in bytes of this record from the start of the version field to the end of the checksum field — that is, it includes the embedded data size.
Optional data offset	u32	Offset in bytes to optional data field from start of record. Zero (0) bytes implies no optional data.
Optional data identifier	u32	Identifier for optional field. Zero (0) if there is no optional field. This identifier is described with each record type.
7KTIME	u8*10	Time tag.
Record Version	u16	Version of Data Format used for record creation (e.g: 1, 2 etc.)
Record type identifier	u32	Identifier for record type of embedded data.
Device identifier	u32	Identifier of the device to which this data pertains.
Reserved	u16	Reserved.
System enumerator	u16	The enumerator is used to differentiate between devices with the same device identifiers in one installation / system. It is up to each application to decide what number to populate this field with.
Record count	u32	Sequential record counter
Flags	u16	BITFIELD: Bit 0: ChecksumReserved. 0 - Invalid checksum

Name	Size	Description
		1 - Valid checksum.Checksum. Bit 1: Reserved . Bit 2: Fragmentation 0 – Data Unfragmented 1 – Fragmented Sequence
Reserved	u16	Reserved.
Reserved	u32	Reserved.
Total records in fragmented data record set	u32	Total records in fragmented data record set. (If appropriate flag is set).
Fragment number	u32	Fragment number (if appropriate flag is set).
DATA SECTION	Dynamic	Data Section
Checksum	u32	Sum of the bytes in the record from the beginning of the version field to the end of the data section. The use of this field is optional and depends on bit 1 of the Flags field. The checksum should be computed as a 64 bit unsigned integer with the least significant 32 bits used to populate this field.

6 TCP AND UDP NETWORK FRAME

6.1 Overview

In order to facilitate network transport via both the TCP and UDP/IP protocols, records will be packetized using the following prefixed header. In this scheme, a series of network packets may contain a partial record or one or more data records, depending upon the boundary size criterion. A series of packets are allowed up to a maximum of 128 records.

When using UDP protocol, each packet shall be less than or equal to 64K bytes, including the network header. Packet sizes may not vary in a sequence except for the last packet.

The following header shall prefix the network packet:

Table 4: Network Frame

Name	Size	Description
Version	u16	Version of this frame (e.g.: 1, 2, etc.)
Offset	u16	Offset in bytes to the start of data from the start of this packet.
Total Packets	u32	Number of network packets for set of records transmitted.
Total Records	u16	Total number of records in network packets transmitted (helper field for parsing data). Max 128 records per transmission.
Transmission Identifier	u16	Transmission identifier (helper field for packet assembly). Must be the same number for each network packet in transmission. Adjacent transmissions in time from one source may not use the same identifier.
Packet Size	u32	Size in bytes of this packet including the header and appended data.
Total Size	u32	Total size in bytes of all packets in transmission, excluding network frame(s).
Sequence Number	u32	Sequential packet number; allows correct ordering during reconstruction.

Name	Size	Description
		Range = 0 to n-1 packets
Destination Device Identifier	u32	0 = Unspecified 0xFFFFFFFF = Not used. Any other number is a valid address.
Destination enumerator	u16	Destination enumerator unless destination device identifier is unspecified or not used.
Source Enumerator	u16	Source enumerator unless Source Device Identifier is unspecified or not used.
Source Device Identifier	u32	0 = Unspecified 0xFFFFFFFF = Not used. Any other number is a valid address.
Data	Dynamic	Start of data with either a partial record or one or more complete records.

7 LOGGING FILE FORMAT

7.1 Overview

A valid 7k data file shall be a binary file consisting of a series of data records.

Records must be complete and without the network frame. A file header record is recommended as the first record in each file thus describing the file's contents.

8 FILE NOMENCLATURE

To facilitate common file name parsing, it is recommended that file names be based on the UTC date and time when they are created and utilize a '.s7k' extension as follows:

"YYYYMMDD_HHMMSS.s7k"

Where YYYYMMDD represents the date and HHMMSS the time.

For example, 20010516_102852.s7k (Created May 16, 2001 at 10:28:52)

Multiple files created at the same time may be differentiated by appending _X to the filename (where "X" is an integer starting at zero and successively incremented for each file).

For example, 20010516_102852_0.s7k and 20010516_102852_1.s7k

9 RECORD TYPE DEFINITIONS

9.1 Overview

The following table summarizes the allocated record type identifiers pertaining to the RESON 7k sonar and generic sensors. This table is not necessarily a complete listing of allocated or reserved record types. Rather, it lists records that pertain specifically to, or are associated with, the RESON SeaBat™7k sonar.

Table 5: Record Type Definitions

RECORD TYPE	DESCRIPTION
1000-1999	Reserved for generic sensor records
1000	Reference point
1001	Sensor offset position
1002	Calibrated sensor offset position
1003	Position
1004	Custom Attitude Information
1005	Tide
1006	Altitude
1007	Motion over ground
1008	Depth
1009	Sound Velocity Profile
1010	CTD
1011	Geodesy
1012	Roll Pitch Heave
1013	Heading
1014	Survey Line
1015	Navigation
1016	Attitude
1050	Generic sensor calibration parameters
1200	Generic side-scan sonar
1201	Reserved for generic sub-bottom profiler
1202	Reserved for generic embedded device data
1500 – 1599	Reserved for future QC records
2000	XYZ Data
7000 – 7999	Reserved for SeaBat™ 7k records
7000	7k Volatile sonar settings
7001	7k Configuration
7002	7k Match Filter
7004	7k Beam geometry
7005	7k Calibration data
7006	7k Bathymetric data

RECORD TYPE	DESCRIPTION
7007	7k Backscatter image data
7008	7k Beam data
7009	Vertical Depth
7011	7k Image data
7021	Reserved
7022	Reserved
7030	Sonar Installation Parameters
7050	7k System events
7051	7k System event message
7052	7k Data storage status information
7060	7k Target Data
7200	7k File header
7300	Reserved
7310	7k Trigger
7311	7k Trigger Sequence Setup
7312	7k Trigger Sequence Done
7400	7k Time message
7401 – 7499	Reserved for future time messages
7500	7k Remote control
7501	7k Remote control acknowledge
7502	7k Remote control not acknowledge
7503	7k Remote control sonar settings
7504	Reserved
7511	Reserved
7515	Reserved
7600	7k Roll
7601	7k Pitch
7610	7k Sound Velocity
7611	7k Absorption loss
7612	7k Spreading loss
7900 – 7999	Reserved
8100	Embedded 8100 Series Sonar Data

9.2 1000 – Reference Point

Description: Reference Point Information

Data Definition:

DRF	RTH	RD	OD	DRF

Table 6: 1000: Record Type Header

NAME	SIZE	DESCRIPTION
Vehicle's X reference point to Center of Gravity	f32	X offset in meters.
Vehicle's Y reference point to Center of Gravity	f32	Y offset in meters.
Vehicle's Z reference point to Center of Gravity	f32	Z offset in meters.
Water level to Center of Gravity	f32	In meters.

NOTE:

For submersible vehicles, since the vertical offset from the COG to the water level is not fixed, the offsets should be set to zero. Typically the offsets to the depth sensor, combined with the reported depth at the sensor and the vehicle attitude would be used to determine the depth of the COG and reference point.

9.3 1001 – Sensor Offset Position

Description: Sensor position offset information data (non-calibrated).

Data Definition:

DRF	RTH	RD	OD	DRF

Table 7: 1001 - Record Type Header

NAME	SIZE	DESCRIPTION
Sensor position X offset	f32	X offset from vehicle reference point in meters.
Sensor position Y offset	f32	Y offset from vehicle reference point in meters.
Sensor position Z offset	f32	Z offset from vehicle reference point in meters.
Sensor roll angle offset	f32	Roll angle offset in radians.
Sensor pitch angle offset	f32	Pitch angle offset in radians.
Sensor yaw angle offset	f32	Yaw angle offset in radians.

9.4 1002 – Calibrated Sensor Offset Position

Description: Calibrated Sensor Position offset position information.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 8: 1002 - Record Type Header

NAME	SIZE	DESCRIPTION
Sensor position X offset	f32	X offset from vehicle reference point in meters.
Sensor position Y offset	f32	Y offset from vehicle reference point in meters.
Sensor position Z offset	f32	Z offset from vehicle reference point in meters.
Sensor roll angle offset	f32	Roll angle offset in radians.
Sensor pitch angle offset	f32	Pitch angle offset in radians.
Sensor yaw angle offset	f32	Yaw angle offset in radians.

9.5 1003 – Position

Description: Position Record used in conjunction with Record Type 1011.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 9: 1003 - Record Type Header

NAME	SIZE	DESCRIPTION
Datum Identifier	u32	0 – WGS84 >0 – Reserved.
Latency	f32	In seconds.
Latitude or Northing	f64	Latitude in radians or Northing in meters.
Longitude or Easting	f64	Longitude in radians or Easting in meters.
Height relative to Datum or Height	f64	In meters.
Position type flag	u8	0 – Geographical coordinates

NAME	SIZE	DESCRIPTION
		1 – Grid coordinates
UTM Zone	u8	UTM Zone
Quality Flag	u8	0 – Navigation Data 1 – Dead-Reckoning
Positioning Method	u8	0 – GPS 1 – DGPS 2 – Start of inertial positioning system from GPS 3 – Start of inertial positioning system from DGPS 4 – Start of inertial positioning system from bottom correlation 5 – Start of inertial positioning from bottom object 6 – Start of inertial positioning from inertial positioning 7 – Start of inertial positioning from optional data 8 – Stop of inertial positioning system to GPS 9 – Stop of inertial positioning system to DGPS 10 – Stop of inertial positioning system to bottom correlation 11 – Stop of inertial positioning to bottom object 12 – Start of inertial positioning to inertial positioning 13 – Start of inertial positioning to optional data 14 – Optional Data >14 – Reserved

9.6 1004 – Custom Attitude Information

Description: Attitude Data Record. The length of each data field is dynamic and is based on the field mask. The bit field mask will determine which elements make up a sample of fields in a given record. The number of samples (N) determines how many samples are repeated in a record at the specified sample rate (Frequency).

NOTE:

This is a custom field designed for advanced users who have specific needs. Normally, records 1012 and 1013 will be used.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 10: 1004 - Record Type Header

NAME	SIZE	DESCRIPTION
Field Mask	u8	BITFIELD: Bit 0: 0/1 – No pitch/pitch in radians. Bit 1: 0/1 – No Roll/roll in radians. Bit 2: 0/1 – No heading/heading in radians. Bit 3: 0/1 – No heave/heave in meters. Bit 4: 0/1 – No pitch/pitch rate of change in radians per second. Bit 5: 0/1 – No roll rate/roll rate of change in radians per second. Bit 6: 0/1 – No heading rate/heading rate of change in radians per second. Bit 7: 0/1 – No heave rate/heave rate of change in meters per second.
Reserved	u8	Reserved.
N	u16	Number of samples (repeated fields) in the record; data items therefore number of fields used x N.
Frequency	f32	Sample rate in samples / second (required if multiple samples are used per record).

DRF	RTH	RD	OD	DRF

Table 11: 1004 - Record Data

NAME	SIZE	DESCRIPTION
FIELD 0	variable	Sensor data.
…	…	...
FIELD N-1	variable	Sensor data.

9.7 1005 – Tide

Description: Tide Data Record. Supports either measured or predicted tide values.

NOTE:

Only the tide value and its source (the first two fields) in the RTH are mandatory; positional information is optional and may be set to zero.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 12: 1005 - Record Type Header

NAME	SIZE	DESCRIPTION
Tide	f32	Height correction above mean sea level in meters.
Source	u16	0 – Unspecified. 1 – Table (predicted) 2 – Measured (gauge).
Flags	u8	BITFIELD: Bit 0 – 0/1 for Gauge ID invalid/valid. Bit 1 – 0/1 for Position info invalid/valid.
Gauge Identifier	u16	Optional field to permit discrimination between different devices.
Datum identifier	u32	0 – WGS84 >0 – Reserved.
Latency	f32	In seconds.
Latitude or Northing	f64	Latitude in radians or Northing in meters.
Longitude or Easting	f64	Longitude in radians or Easting in meters.
Height relative to Datum or Height	f64	In meters.
Position type flag	u8	0 – Geographical coordinates 1 – Grid coordinates
UTM Zone	u8	UTM zone

9.8 1006 – Altitude

Description: Altitude data record.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 13: 1006 - Record Type Header

NAME	SIZE	DESCRIPTION
Distance	f32	Distance from seafloor in meters to sensor, positive up (0 at sea bottom).

9.9 1007 – Motion Over Ground

Description: Motion over ground record. The length of each data field is dynamic, based on the field mask.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 14: 1007 - Record Type Header

NAME	SIZE	DESCRIPTION
Field mask	u8	BITFIELD: 0: Speed in X, Y & Z directions (m/s);each an f32 if present. 1: Acceleration in X, Y & Z directions (m/s^2); each an f32 if present. 2-7: Reserved. Note: for bits 0 and 1, a set bit (1) indicates that the specified parameters are present in a field definition. If zero, then the field definition excludes the relevant parameters.
Reserved	u8	Reserved field.
N	u16	Number of fields.
Frequency	f32	Sample rate in samples / second.

DRF	RTH	RD	OD	DRF

Table 15: 1007 - Record Data

NAME	SIZE	DESCRIPTION
FIELD 0	Variable	Sensor data.
…	…	...
FIELD N-1	variable	Sensor data.

9.10 1008 – Depth

Description: Depth data record.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 16: 1008 - Record Type Header

NAME	SIZE	DESCRIPTION
Depth descriptor	u8	0 – Depth to sensor 1 – Water depth.
Correction flag	u8	0 – RAW depth (as measured). 1 – Corrected depth (relative to mean-sea level).
Reserved.	u16	Reserved.
Depth	f32	The deeper, the bigger (positive) this value becomes.

9.11 1009 – Sound Velocity Profile

Description: Sound velocity profile data record.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 17: 1009 - Record Type Header

NAME	SIZE	DESCRIPTION
Position flag	u8	0 – Invalid position fields. 1 – Valid position fields.
Reserved.	u8	Reserved.
Reserved.	u16	Reserved.

NAME	SIZE	DESCRIPTION
Latitude	f64	Latitude in radians (WGS84).
Longitude	f64	Longitude in radians (WGS84).
N	u32	Number of samples.

DRF	RTH	RD	OD	DRF

Table 18: 1009 - Record Data

NAME	SIZE	DESCRIPTION
SAMPLE 0 Depth	f32	In meters.
SAMPLE 0 Sound velocity	f32	In meters / second.
…	…	...
SAMPLE N-1 Depth	f32	In meters.
SAMPLE N-1 Sound velocity	f32	In meters / second.

9.12 1010 – CTD

Description: CTD Data Record

Data Definition:

DRF	RTH	RD	OD	DRF

Table 19: 1010 - Record Type Header

NAME	SIZE	DESCRIPTION
Frequency	f32	Frequency
Sound velocity source flag	u8	0 – Not computed. 1 – CTD. 2 – User computed.
Sound velocity algorithm	u8	0 – Not computed. 1 – Checn Millero. 2 – Del Grosso.
Conductivity flag	u8	0 – Conductivity. 1 – Salinity.
Pressure flag	u8	0 – Pressure. 1 – Depth.
Position flag	u8	0 – Invalid position fields. 1 – Valid position fields.

NAME	SIZE	DESCRIPTION
Sample content validity	u8	BITFIELD: (Bit set means field is valid otherwise zero) 0 – Conductivity / Salinity 1 – Water Temperature 2 – Pressure / Depth 3 – Sound Velocity 4 – Absorption
Reserved.	u16	Reserved.
Latitude	f64	Latitude in radians (WGS84).
Longitude	f64	Longitude in radians (WGS84).
Sample rate	f32	Sample rate.
N	u32	Number of samples.

DRF	RTH	RD	OD	DRF

Table 20: 1010 - Record Data

NAME	SIZE	DESCRIPTION
SAMPLE 0 Conductivity / Salinity	f32	In S/m or ppt.
SAMPLE 0 Water temperature	f32	In Celsius.
SAMPLE 0 Pressure / Depth	f32	In Pascal or meters.
SAMPLE 0 Sound velocity	f32	In meters / seconds.
SAMPLE 0 Absorption	f32	In dB / kilometer
…	…	...
SAMPLE N-1 Conductivity / Salinity	f32	In S/m or ppt.
SAMPLE N-1 Water temperature	f32	In Celsius.
SAMPLE N-1 Pressure / Depth	f32	In Pascal or meters.
SAMPLE N-1 Sound velocity	f32	In meters / seconds.
SAMPLE N-1 Absorption	f32	In dB / kilometer

9.13 1011 – Geodesy

Description: The Geodesy data record may be used to define the spheroid, datum and grid definitions for navigational data; each sequentially embedded within the RTH.

There are no dynamic data elements; the optional data portion of the record is used to contain custom projection parameters. The custom identifier field of the RTH identifies the various defined types. Moreover, this identifier may be -1 indicating that the optional data portion of the record contains user specific parameters.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 21: 1011 - Record Type Header

NAME	SIZE	DESCRIPTION
Spheroid name	u8 * 32	A short text description of the spheroid name: e.g., “WGS84”.
Semi-major axis	f64	Semi-major axis in meters: e.g., 6378137.0 for WGS84.
Inverse flattening	f64	Inverse flattening in meters: e.g. 298.257223563 for WGS84.
Reserved 1	u8 * 16	Reserved space; should be zeroed.
Datum name	u8 * 32	Datum name: e.g., “WGS84”
Data calculation method	u32	0 – Molodensky 1 – Bursa / Wolfe 2 – DMA MRE 3 – NADCON 4 – HPGN 5 – Canadian National Transformation V2
Number of parameters	u8	Three (3), Seven (7) and Eight (8) parameter transformation is supported.
DX	f64	X – Shift (m)
DY	f64	Y – Shift (m)
DZ	f64	Z – Shift (m)
RX	f64	X Rotation (degrees)

NAME	SIZE	DESCRIPTION
RY	f64	Y Rotation (degrees)
RZ	f64	Z Rotation (degrees)
Scale	f64	
Reserved 2	u8 * 35	Reserved for later extension to 9 parameter transformation
Grid name	u8 * 32	Name of grid system in use: e.g., “UTM”
Grid distance units	u8	0 – Meters 1 – Feet 2 – Yards 3 – US Survey Feet 4 - Kilometers 5 – Miles 6 – US Survey Miles 7 – Nautical Miles 8 – Chains 9 – Links
Grid angular units	u8	0 – Radians 1 – Degrees 2 – Degrees, Minutes, seconds 3 – Gradians 4 – Arc-seconds
Latitude of Origin	f64	
Central Meridian	f64	
False Easting	f64	Meters.
False Northing	f64	Meters.
Central Scale Factor	f64	
Custom identifier	i32	Identifier for optional field definition in 7k record. Used to define projection specific parameters. -2 – Custom -1 – Not used
Reserved 3	u8 * 50	Reserved

Appendix B provides a list of currently reserved Custom Identifiers.

9.14 1012 – Roll Pitch Heave

Description: Motion Data Record. The length of each data field is fixed.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 22: 1012 - Record Type Header

NAME	SIZE	DESCRIPTION
Roll	f32	Vessel Roll in radians
Pitch	f32	Vessel Pitch in radians
Heave	f32	Vessel Heave in meters

9.15 1013 – Heading

Description: Vessel Heading Record. The length of each data field is fixed.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 23: 1013 - Record Type Header

NAME	SIZE	DESCRIPTION
Heading	f32	Vessel Heading in radians

9.16 1014 – Survey Line

Description: This optional record describes the survey line or route associated with the data in this file.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 24: 1014 - Record Type Header

NAME	SIZE	DESCRIPTION
Waypoint Count (N)	u16	Number of points in the line / route.
Position Type	u16	0 = Latitude / Longitude

NAME	SIZE	DESCRIPTION
		1 = Grid Coordinates
Radius	f32	Turn radius between line segments (meters, 0 = no curvature in turns).
Line Name	u8 * 64	Null terminated string – line name.

DRF	RTH	RD	OD	DRF

Table 25: 1014 - Record Data

NAME	SIZE	DESCRIPTION
Latitude or Northing 0	f64	Latitude (Radians) -π/2 to π/2, -south
Longitude or Easting 0	f64	Longitude (Radians) -π to π, -west
…	…	…
Latitude or Northing N-1	f64	Northing (meters)
Longitude or Easting N-1	f64	Easting (meters)

9.17 1015 – Navigation

Description: This record will be output at the input navigation rate.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 26: 1015 - Record Type Header

NAME	SIZE	DESCRIPTION
Vertical reference	u8	1=Ellipsoid 2=Geoid 3=Chart datum
Latitude	f64	Latitude of vessel reference point in Radians -π/2 to π/2, -south
Longitude	f64	Longitude of vessel reference point in Radians -π to π, -west

Horizontal Position accuracy	f32	Position accuracy in meters.
Vessel height	f32	Height of vessel reference point above vertical reference in meters
Height accuracy	f32	In meters
Speed over ground	f32	Speed over ground at position time in m/s
Course over ground	f32	Course over ground at position time in radians
Heading	f32	Heading of vessel at position time in radians

9.18 1016 – Attitude

Description: This record will be output at the input motion sensor rate

Data Definition:

DRF	RTH	RD	OD	DRF

Table 27: 1016 - Record Type Header

NAME	SIZE	DESCRIPTION
Number of attitude data sets	u8	Number of Data Sets
For each attitude data set:		
Time difference with record timestamp	u16	Time difference in milliseconds
Roll	f32	Roll measured in radians
Pitch	f32	Pitch measured in radians
Heave	f32	Heave measured in meters
Heading	f32	Heading of vessel in radians
End loop		

9.19 1050 – Generic Sensor Calibration Parameters

Description: Sensor Calibration record.

Data Definition: The raw sensor calibration data is stored in the optional data (OD) field.

DRF	RTH	RD	OD	DRF

Table 28: 1050 - Record Type Header

NAME	SIZE	DESCRIPTION
Reserved.	u128	Reserved.

9.20 1200 – Generic SideScan Sonar

Description: Each side scan sonar imagery channel immediately follows the RTH and is prefixed with its own channel header structure. Port channels typically appear first then starboard. When multiple subsystems are combined in the same record (e.g. high and low frequency systems) the channels will typically be port 1, starboard 1, port 2, starboard 2.

Channel imagery is stored in ascending time order on a per channel basis.

The optional data field may be used by applications to contain application specific sundry sensor information that should be associated with this ping. The custom data descriptor field of the channel header is provided to permit discrimination on an application basis if “custom” type. Non-zero values are reserved for future expansion of standard types.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 29: 1200 - Record Type Header

NAME	SIZE	DESCRIPTION
Ping number	u32	Ping number as received from the side scan sonar
Number of channels	u32	Number of imagery channels to follow (typically 2).
Total bytes of channel data to follow	u32	Total bytes of channel data (and headers) to follow this record type

NAME	SIZE	DESCRIPTION
		header, including optional data).
Data type	u32	Format of sample time-series data contained herein, thus: 0 – Envelope 1 – I and Q (complex)

Table 30: 1200 - Channel Header

NAME	SIZE	DESCRIPTION
Channel number	u8	Channel number: 0 to Number of channels – 1.
Channel type	u8	0 - port 1 - starboard
Data type	u8	0 - slant range 1 - ground range
Polarity	u8	0 - bipolar, 1 - unipolar
Bytes per sample	u8	Bytes per sample of the imagery. Note: complex (I & Q) data can be thought of as being 2 x samples at each point in time on a per channel basis.
Reserved 1	u8 * 3	Reserved for future use.
Number of samples	u32	Number of samples in this channel.
Start time	u32	Start of first sample in microseconds relative to the ping time stamp in the DRF.
Sample interval	u32	Data sample interval in microseconds.
Range	f32	Slant range or ground range in meters; depends on the data type field above.
Voltage (FSD)	f32	Analogue maximum amplitude. Should be –1 if not used.
Name	u8 * 16	Channel name as a zero terminated character array.
Custom data descriptor	u16	Identifier allowing different optional data formats to be identified when the optional data field is used. 0, custom

NAME	SIZE	DESCRIPTION
Reserved 2	u8 * 18	> 0, reserved. Padding and reserved fields.

9.21 2000 – XYZ Data

Description: XYZ data points on local grid.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 31: 2000 - Record Type Header

NAME	SIZE	DESCRIPTION
Heading	f32	Instantaneous heading (in radians) that the frames pertain.
Frames in Data Record	u32	Number of data frames to follow

DRF	RTH	RD	OD	DRF

Table 32: 2000 - Record Data

NAME	SIZE	DESCRIPTION
7KTIME	u8 * 10	Time for which the point pertains.
X	f64	X in meters.
Y	f64	Y in meters.
Z	f64	Z in meters.
Tide	f32	Height in meters.
Height	f32	Height in meters.
Heave	f32	Heave in meters.
Reserved	u8 * 4	Reserved for future use and padding.

9.22 7000 – 7k Volatile Sonar Settings

Description: This record is produced by the SeaBat™ 7k sonar 7-P processor series. It contains the volatile sonar settings. The 7-P processor updates this record for each ping. The record can manually be requested or subscribed to from the 7-P processor. For details about requesting and subscribing to records see together with Appendix A.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 33: 7000 - Record Type Header

NAME	SIZE	DESCRIPTION
Sonar Id	u64	Serial number.
Ping number	u32	Sequential number.
Multi-Ping Sequence	u16	Flag to indicate Multi-Ping Sequence. Always 0 (zero) if not in Multi-Ping mode; otherwise this represents the sequence number of the ping in the multi-ping sequence.
Frequency	f32	Center transmit frequency in Hertz.
Sample rate	f32	Sample rate in Hertz
Receiver bandwidth	f32	In Hertz.
Tx Pulse width	f32	Seconds of pulse.
Tx Pulse type identifier	u32	0 – CW 1 – Linear chirp
Tx Pulse envelope identifier	u32	0 – Tapered rectangular 1 – Tukey
Tx Pulse envelope parameter	f32	Some envelopes don't use this parameter.
Tx Pulse reserved	u32	Additional pulse information.
Max ping rate	f32	Maximum ping rate in pings per second.
Ping period	f32	Seconds since last ping.
Range selection	f32	Range selection in meters.
Power selection	f32	Power selection in dB re 1μPa
Gain selection	f32	Gain selection in dB.

NAME	SIZE	DESCRIPTION
Control flags	u32	BITFIELD: 0-3: Auto range method. 4-7: Auto bottom detect filter method. 8: Bottom detect range filter. 9: Bottom detect depth filter. 10-14: Auto receiver gain method. 15-31: Reserved.
Projector magic number	u32	Projector selection.
Projector beam steering angle vertical	f32	In radians.
Projector beam steering angle horizontal	f32	In radians.
Projector beam –3dB beam width vertical	f32	In radians.
Projector beam –3dB beam width horizontal	f32	In radians.
Projector beam focal point	f32	In meters.
Projector beam weighting window type	u32	0 – Rectangular 1 – Chebychev
Projector beam weighting window parameter	f32	N/A
Transmit flags	u32	BITFIELD: 0-3: Pitch stabilization method. 4-7: Yaw stabilization method. 8-31: Reserved.
Hydrophone magic number	u32	Hydrophone selection.
Receive beam weighting window	u32	0 – Chebychev 1 – Kaiser
Receive beam weighting parameter	f32	N/A
Receive flags	u32	BITFIELD: 0-3: Roll stabilization method. 4-7: Dynamic focusing method. 8-11: Doppler compensation method. 12-15: Match filtering method. 16-19: TVG method. 20-23: Multi-Ping Mode. 0 = No Multi-Ping

NAME	SIZE	DESCRIPTION
		1 = Multi-Ping
		24-31: Reserved
Receive Beam Width	f32	Angle in radians
Bottom detection filter info	f32	Min range (if range filter active).
Bottom detection filter info	f32	Max range (if range filter active).
Bottom detection filter info	f32	Min depth (if depth filter active).
Bottom detection filter info	f32	Max depth (if depth filter active).
Absorption	f32	Absorption in dB/km.
Sound velocity	f32	Sound Velocity in m/s
Spreading	f32	Spreading loss in dB.
Reserved	u16	Reserved for future pulse shape description.

9.23 7001 – 7k Configuration

Description: This record is produced by the SeaBat™ 7k sonar 7-P processor series. It contains the configuration information about the sonar capabilities. Each sonar's configuration can be found in the record's Module info section (see *Table 35*). The record is created on system startup and does not change during operation. The record can be manually requested from the 7-P processor. This record is not available for subscription. For details about requesting records see record 7500 together with Appendix A.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 34: 7001 - Record Type Header

NAME	SIZE	DESCRIPTION
Sonar Id	u64	System processor serial number (7P)
N	u32	Number of devices/sonars.

DRF	RTH	RD	OD	DRF

Table 35: 7001 - Record Data

NAME	SIZE	DESCRIPTION
Device 0 magic number	u32	Unique identifier number.
Device 0 description	u8*64	ASCII string.
Device 0 serial number	u64	
Device 0 Info length	u32	In Bytes.
Device 0 info	dynamic	Varies with device type.
…	…	…
Device N-1 magic number	u32	Unique identifier number.
Device N-1 description	u8*64	ASCII string.
Device N-1 serial number	u64	
Device N-1 Info length	u32	In Bytes.
Device N-1 info	dynamic	Varies with device type.

9.24 7002 – 7k Match Filter

Description: This record is produced by the SeaBat™ 7k sonar 7-P processor series. It contains the sonar's receive match filter settings. The 7-P processor updates this record for each ping. The record can manually be requested or subscribed to from the 7-P processor. For details about requesting and subscribing to records see record 7500 together with Appendix A.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 36: 7002 - Record Type Header

NAME	SIZE	DESCRIPTION
Sonar Id	u64	Sonar serial number
Ping number	u32	Sequential number.
Operation	u32	0 – Off 1 – On
Start frequency	f32	Hz.
Stop frequency	f32	Hz.

9.25 7004 – 7k Beam Geometry

Description: This record is produced by the SeaBat™ 7k sonar 7-P processor series. It contains the receive beam widths and steering. The 7-P processor updates this record when any of the values have changed. The record can manually be requested or subscribed to from the 7-P processor. For details about requesting and subscribing to records see record 7500 together with Appendix A.

X represent across track beams and Y along track beams. This record does not take the sensor mounting location and where it is facing into account. The sensors mounting position and facing angle can for example instead be found in record #1001. In the case of a FLS, Y becomes Z and the definition of “nadir” changes accordingly.

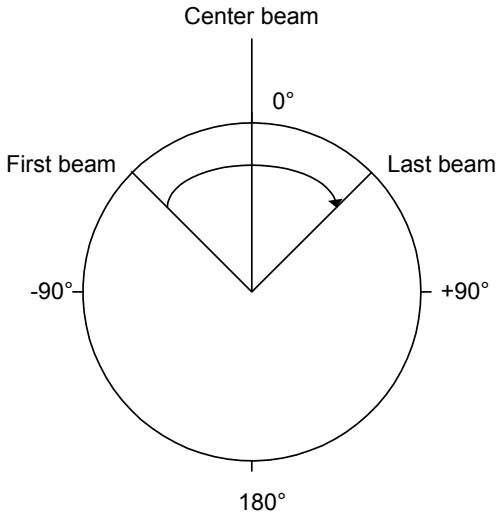


Figure 2: Sonar Beam Angle Convention

Data Definition:

DRF	RTH	RD	OD	DRF

Table 37: 7004 - Record Type Header

NAME	SIZE	DESCRIPTION
Sonar Id	u64	Sonar serial number
Rx	u32	Number of receiver beams.

DRF	RTH	RD	OD	DRF

Table 38: 7004 - Record Data

NAME	SIZE	DESCRIPTION
Beam vertical direction angle[Rx]	f32*Rx	Angle in radians. The receiver beam steering angle (relative to nadir) applied in the along-track direction (typically 0).
Beam horizontal direction angle[Rx]	f32*Rx	Angle in radians. The receiver beam steering angle (relative to nadir) applied in the across-track direction (varies according to beam number. Typically -75 to +75 degrees. In equi-distant mode, this will not change. In equi-angle mode, steering angles will vary.
-3dB Beam width Y[Rx]	f32*Rx	Angle in radians. The receiver along-track beam width measured at the -3dB points (typically <30°).
-3dB Beam width X[Rx]	f32*Rx	Angle in radians. The receiver across-track beam width measured at the -3dB points (typically <5°).

9.26 7005 – 7k Calibration Data

Description: This record is produced by the SeaBat™ 7k sonar 7-P processor series. It contains the receiver gain and phase offsets. The 7-P processor updates this record after receiver calibration operation. The record can be manually requested from the 7-P processor. This record is not available for

subscription. For details about requesting records see record 7500 together with Appendix A.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 39: 7005 - Record Type Header

NAME	SIZE	DESCRIPTION
Sonar Id	u64	Sonar serial number.
N	u16	Number of hydrophone receiver channels.

DRF	RTH	RD	OD	DRF

Table 40: 7005 - Record Data

NAME	SIZE	DESCRIPTION
Receiver gain [N]	f32	N receiver gain values relative to a nominal gain of 1.0.
…	…	…
Receiver phase [N]	f32	N receiver phase values relative to a nominal phase of 0.0 radians.

NOTE:

There are no units for Gain in this record, as the value is dimensionless. Since the value is relative to 1.0, it is simply a ratio.

9.27 7006 – 7k Bathymetric Data

Description: This record is produced by the SeaBat™ 7k sonar 7-P processor series. It contains the sonar bottom detection results. This record is typically not available in a forward looking sonar configuration. The 7-P processor updates this record for each ping. The record can manually be requested or subscribed to from the 7-P processor. For details about requesting and subscribing to records see record 7500 together with Appendix A.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 41: 7006 - Record Type Header

NAME	SIZE	DESCRIPTION
Sonar Id	u64	Serial number.
Ping number	u32	Sequential number.
Multi-Ping Sequence	u16	Flag to indicate Multi-Ping Sequence. Always 0 (zero) if not in Multi-Ping mode; otherwise this represents the sequence number of the ping in the multi-ping sequence.
N	u32	Number of receiver beams.
Layer Compensation Flag	u8	Flag indicating if the layer compensation is on or off 0 = Off 1 = On
Sound Velocity Flag	u8	Flag indicating if Sound Velocity is measured or manually entered 0 = Measured 1 = Manually Entered
Sound Velocity	f32	Sound Velocity at the sonar in meters/second

DRF	RTH	RD	OD	DRF

Table 42: 7006 - Record Data

NAME	SIZE	DESCRIPTION
Range [N]	f32	Two way travel time in seconds
Quality [N]	u8	BITFIELD: 0-3: Quality value (0 = bad 15 = best). 4-7: Bottom Detection Method for each Ping. 0 = Both Amplitude and Phase 1 = Amplitude Only 2 = Phase Only
Intensity [N]	f32	Signal strength dB re 1μPa. Value at bottom detect.

DRF	RTH	RD	OD	DRF

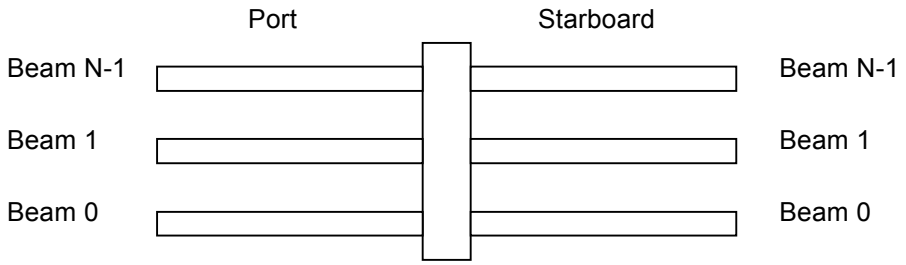
Table 43: 7006 - Optional Data

NAME	SIZE	DESCRIPTION
Frequency	f32	Ping Frequency in Hz.
Latitude	f64	Latitude of vessel reference point in radians -π/2 to π/2, south negative.
Longitude	f64	Longitude of vessel reference point in radians -π to π, west negative.
Heading	f32	Heading of vessel at transmit time in radians.
Height Source	u8	Method used to correct to chart datum. If height source = 1, then Tide = '0'. 0 = none 1 = RTK 2 = Tide
Tide	f32	In meters
Roll	f32	Roll at transmit time
Pitch	f32	Pitch at transmit time
Heave	f32	Heave at transmit time
Vehicle Depth	f32	Vehicle depth at transmit time in m.
The following set of data items are repeated for each beam:		
Beam 0 – Depth	f32	Depth relative chart datum (or relative waterline if Height source = 0). Resolution = meters
Beam 0 – Along track distance	f32	Along track distance in vessel grid. Resolution = meters
Beam 0 – Across track distance	f32	Across track distance in vessel grid. Resolution = meters
Beam 0 – Pointing angle	f32	Beam pointing angle from vertical in radians
Beam 0 – Azimuth angle	f32	Beam azimuth angle in radians

9.28 7007 – 7k Backscatter Imagery Data

Description: This record is produced by the SeaBat™ 7k sonar 7-P processor series. It contains the side scan sonar data. This record is typically not available in a forward looking sonar configuration. The 7-P processor updates this record for each ping. The record can manually be requested or subscribed to from the 7-P processor. For details about requesting and subscribing to records see record 7500 together with Appendix A.

Beam port and starboard numbering figure:



Data Definition:

DRF	RTH	RD	OD	DRF

Table 44: 7007 - Record Type Header

NAME	SIZE	DESCRIPTION
Sonar Id	u64	Serial number.
Ping number	u32	Sequential number.
Multi-Ping Sequence	u16	Flag to indicate Multi-Ping Sequence. Always 0 (zero) if not in Multi-Ping mode; otherwise this represents the sequence number of the ping in the multi-ping sequence.
Beam position	f32	Meters forward from position of beam 0.
Control flags	u32	BITFIELD: 0-3: Yaw stabilization method. 4-7: Beam forming method. 8-15: Calibration method. 16-31: Reserved.
S	u32	Samples.
Port -3dB beam width Y	f32	In radians.
Port -3dB beam width Z	f32	In radians.

NAME	SIZE	DESCRIPTION
Starboard -3dB beam width Y	f32	In radians.
Starboard -3dB beam width Z	f32	In radians.
Port beam steering angle Y	f32	In radians (typically positive).
Port beam steering angle Z	f32	In radians (typically pi).
Starboard beam steering angle Y	f32	In radians (typically positive).
Starboard beam steering angle Z	f32	In radians (typically zero).
N	u16	Number of beams per side.
Current beam number	u16	Beam number of this record's data (0 to N-1).
W	u8	Number of bytes per sample.
Data types	u8	BITFIELD: 0: Amplitude 1: Phase

Table 45: 7007 - Record Data

NAME	SIZE	DESCRIPTION
Port beam	W * S	Amplitude/Phase series. First sample represents range 0 meters.
Starboard beam	W * S	Amplitude/Phase series. First sample represents range 0 meters.

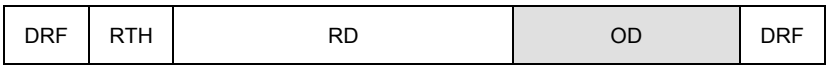


Table 46: 7007 - Optional Data

NAME	SIZE	DESCRIPTION
Frequency	f32	Ping Frequency in Hz.
Latitude	f64	Latitude of vessel reference point in radians $-\pi/2$ to $\pi/2$, south negative.
Longitude	f64	Longitude of vessel reference point in radians $-\pi$ to π, west negative.

Heading	f32	Heading of vessel at transmit time in radians.
Depth	f32	Depth for slant range correction in meters.

9.29 7008 – 7k Beam Data

Description: This record is produced by the SeaBat™ 7k sonar 7-P processor series. It contains the sonar beam "I" and "Q" or magnitude and phase data. The 7-P processor updates this record for each ping. The record can manually be requested or subscribed to from the 7-P processor. For details about requesting and subscribing to records see record 7500 together with Appendix A.

This record is used for snippet output as well. Beams and samples are numbered from 0. First beam to last beam fields are always enumerated from low to high numbers.

Available SeaBat™ format type settings

SONAR SETTING	MAGNITUDE (bits)	PHASE (bits)
1	8	None
2	16	None
3	32	None
4	8	8
5	16	8
6	16	16
7	32	32

SONAR SETTING	I (bits)	Q (bits)
8	16	16
9	32	32

Additional SeaBat™ data settings (data reduction)
Both beam limits, sample limits and SeaBat™ format types can be combined.

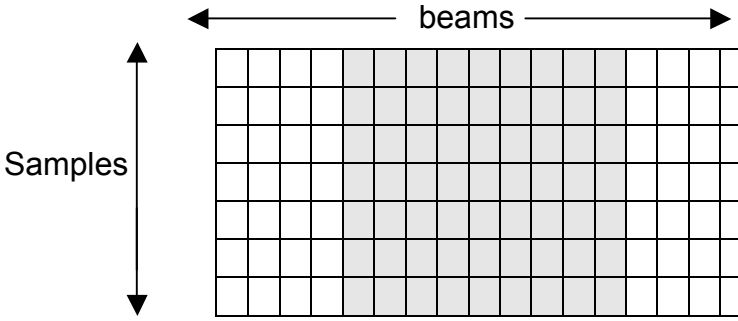


Figure 3: Beam Limits - Set Min and Max Beam

Figure 4: Beam limits – Set min and max beam.

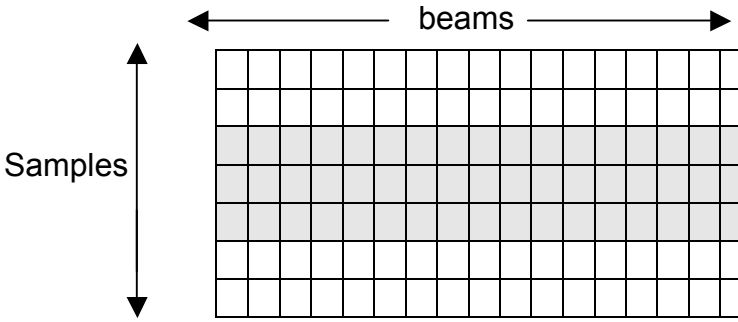


Figure 5: Sample Limits - Set Min and Max Sample

Figure 6: Sample limits – Set min and max sample.

Data rates:
Equation for no data reduction, beam limits and all sonar settings:
beams * data format bits * sample rate * 10% (header overhead)
E.g. 128 beams * 32 bits (sonar setting 5) * 34500 samples/s * 1.1 = 155.4432 Mbits/s

Equation for sample limits:
beams * pingrate * samples * data format bits * 10%
E.g. 128 beams * 7 ping / s * 3000 samples * 8 bits (sonar setting 1) * 1.1 = 23.6544 Mbits/s

Data Definition:

DRF	RTH	RD	OD	DRF

Table 47: 7008 - Record Type Header

NAME	SIZE	DESCRIPTION
Sonar Id	u64	Sonar serial number.
Ping number	u32	Sequential number.
Multi-Ping Sequence	u16	Flag to indicate Multi-Ping Sequence. Always 0 (zero) if not in Multi-Ping mode; otherwise this represents the sequence number of the ping in the multi-ping sequence.
N	u16	Total number of beams or elements in record.
Reserved	u16	Reserved.
Samples	u32	Samples in ping. Only valid if all beams and samples are in record.
Record subset flag	u8	0 – All beams and samples in ping. 1 – Beam and / or sample ping subset.
Row column flag	u8	0 – Beam followed by samples. 1 – Sample follows by beams.
Sample header Identifier	u16	0 – No sample header.
Data sample type(s)	u32	BITFIELD (Least significant bit corresponds to Bit 0. Each grouping of bits is to be treated as an unsigned integer of the specified width. E.g. Amplitude is a u4 with possible values in range 0 to 16) 0-3 Amplitude: 0 = No amplitude 1 = Amplitude (8 bits) 2 = Amplitude (16 bits) 3 = Amplitude (32 bits) 4-7 Phase: 0 = No phase 1 = Phase (8 bits) 2 = Phase (16 bits) 3 = Phase (32 bits)

NAME	SIZE	DESCRIPTION
		8-11 I and Q: 0 = No I and Q 1 = Signed 16 bit I and signed 16 bit Q 2 = Signed 32 bit I and signed 32 bit Q 12 -14 Beam forming Flag: 0 = Beam formed data 1 = Element data

DRF	RTH	RD	OD	DRF

Table 48: 7008 - Record Data

NAME	SIZE	DESCRIPTION
Beam descriptor	u16	Beam number.
Begin sample descriptor	u32	First sample number in beam from transmitter and outward.
End sample descriptor	u32	Last sample number in beam from transmitter and outward.
…	…	…
Beam descriptor	u16	Beam number.
Begin sample descriptor	u32	First sample number in beam from transmitter and outward
End sample descriptor	u32	Last sample number in beam from transmitter and outward.
First column / row	dynamic	Sample header + Amplitude/Phase series. Array is populated with samples from transmitter and outward, or beams from low beam number and increasing.
…	…	…
Last column / row	dynamic	Sample header + Amplitude/Phase series. Array is populated with samples from transmitter and outward, or beams from low beam number and increasing.

DRF	RTH	RD	OD	DRF

Table 49: 7008 - Optional Data

NAME	SIZE	DESCRIPTION

NAME	SIZE	DESCRIPTION
Frequency	f32	Ping frequency in Hz.
Latitude	f64	Latitude of vessel reference point in Radians -π/2 to π/2, south negative.
Longitude	f64	Longitude of vessel reference point in radians -π to π, west negative.
Heading	f32	Heading of vessel at transmit time in radians
Following set of data items is repeated for each beam.		
Beam – Along track distance	f32	Along track distance in vessel grid. Resolution = meters
Beam – Across track distance	f32	Across track distance in vessel grid. Resolution = meters
Center sample number	u32	Sample number at detection point of beam.

9.30 7009 – Vertical Depth

Description: This record provides vertical depth relative to chart datum or relative to the vessel if tidal data is unavailable.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 50: 7009 - Record Type Header

NAME	SIZE	DESCRIPTION
Frequency	f32	Ping frequency in Hz.
Ping Number	u32	Sequential number.
Multi-Ping Sequence	u16	Flag to indicate Multi-Ping Sequence. Always 0 (zero) if not in Multi-Ping mode; otherwise this represents the sequence number of the ping in the multi-ping sequence.
Latitude	f64	Latitude of vessel reference point in radians

NAME	SIZE	DESCRIPTION
		-π2 to π/2, south negative.
Longitude	f64	Longitude of vessel reference point in radians -π to π, west negative.
Heading	f32	Heading of vessel at transmit time in radians
Along Track Distance	f32	Along track distance in vessel grid from reference point. Resolution = meters
Across Track Distance	f32	Across track distance in vessel grid from vessel reference point. Resolution = meters
Vertical Depth	f32	Vertical depth relative to chart datum (or relative to vessel if tidal data is unavailable). Resolution = meters

9.31 7011 – 7k Image Data

Description: This record is produced by the SeaBat™ 7k sonar 7-P processor series. It contains the sonar image data. The image data is compressed RAW or beam formed magnitude / phase data. The 7-P processor updates this record for each ping. The record can manually be requested or subscribed to from the 7-P processor. For details about requesting and subscribing to records see record 7500 together with Appendix A.

The image represents range versus beams or beams versus range where the sample magnitude or phase values sets the pixel intensities.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 51: 7011 - Record Type Header

NAME	SIZE	DESCRIPTION
Ping number	u32	Sequential number.
Multi-Ping Sequence	u16	Flag to indicate Multi-Ping Sequence. Always 0 (zero) if not in Multi-Ping mode; otherwise this represents the sequence number of the ping in the multi-ping sequence.

NAME	SIZE	DESCRIPTION
W	u32	Image width in pixels.
H	u32	Image height in pixels.
Color depth	u16	Color depth per pixel.
Width height flag	u16	0 – Width followed by height. 1 – Height followed by width.
Compression algorithms	u16	Reserved for future use.

Table 52: 7011 - Record Data

NAME	SIZE	DESCRIPTION
First row / column	Dynamic	Populated from left to right or from top to bottom.
…	…	…
Last row / column	Dynamic	Populated from left to right or from top to bottom.

9.32 7030 – Sonar Installation Parameters

Description: This record is sent once when a client subscribes for the record and again when a parameter is changed.

Data Definition:

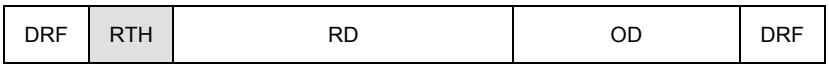


Table 53: 7030 - Record Type Header

NAME	SIZE	DESCRIPTION
Frequency	f32	Frequency in Hz.
Length of firmware version info	u16	Length in bytes.
Firmware version info	u8 [128]	
Length of software version info	u16	Length in bytes.
Software version info	u8 [128]	
Length of 7k software version info	u16	Length in bytes.
7k software version info	u8 [128]	
Length of record protocol info	u16	Length in bytes.

NAME	SIZE	DESCRIPTION
Record protocol version info	u8 [128]	
Transmit array X	f32	X offset in meters.
Transmit array Y	f32	Y offset in meters.
Transmit array Z	f32	Z offset in meters.
Transmit array roll	f32	Radians
Transmit array pitch	f32	Radians
Transmit array heading	f32	Radians
Receive array X	f32	X offset in meters.
Receive array Y	f32	Y offset in meters.
Receive array Z	f32	Z offset in meters.
Receive array roll	f32	Radians
Receive array pitch	f32	Radians
Receive array heading	f32	Radians
Motion sensor X	f32	X offset in meters.
Motion sensor Y	f32	Y offset in meters.
Motion sensor Z	f32	Z offset in meters.
Motion sensor roll calibration	f32	Radians
Motion sensor pitch calibration	f32	Radians
Motion sensor heading calibration	f32	Radians
Motion sensor time delay	u16	milliseconds
Position sensor X	f32	X offset in meters.
Position sensor Y	f32	Y offset in meters.
Position sensor Z	f32	Z offset in meters.
Position sensor time delay	u16	milliseconds
Water line vertical offset	f32	Vertical offset from reference point to waterline in meters.

9.33 7050 – 7k System Events

Description: This record is produced by the SeaBat™ 7k sonar 7-P processor series. It contains the 7-P processor system events. The 7-P processor updates this record when any event is added or removed in the system. The record can

manually be requested or subscribed to from the 7-P processor. For details about requesting and subscribing to records see record 7500 together with Appendix A.

The events in the Record Data (RD) section are located back to back.

Data Definition:

Table 54: 7050 - Record Type Header

NAME	SIZE	DESCRIPTION
Sonar Id	u64	Sonar serial number.
Events	u32	Number of events

Table 55: 7050 - Record Data

NAME	SIZE	DESCRIPTION
Event type	u16	0 – Success. 1 – Information. 2 – Warning. 3 – Error.
Event identifier	u16	0 – Not defined.
Device identifier	u32	Identifier of the device that this data pertains.
System enumerator	u16	System enumerator for identical systems in one installation. 0 – N.
Event message length	u16	Message length including termination character.
7KTIME	u8*10	Time tag.
Event message	dynamic	Null terminated string.

9.34 7051 – 7k System Event Message

Description: This record is produced by the SeaBat™ 7k sonar 7-P processor series. It holds a single 7-P processor event. The latest record can manually be requested or subscribed to from the 7-P processor. For details about requesting and subscribing to records see record 7500 together with Appendix A.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 56: 7051 - Record Type Header

NAME	SIZE	DESCRIPTION
Sonar Id	u64	Sonar serial number.
Event Id	u16	0 – Success. 1 – Information. 2 – Warning. 3 – Error.
Message length	u16	Message length in Bytes.
Event identifier	u16	0 – Undefined.

DRF	RTH	RD	OD	DRF

Table 57: 7051 - Record Data

NAME	SIZE	DESCRIPTION
Event message	dynamic	Null terminated string.

9.35 7052 – 7k Data Storage Status Information

Description: SeaBat™ 7k data storage status information.

Data Definition: TBD

9.36 7060 – 7k Target Data

Description: SeaBat™ 7k Target data information.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 58: 7060 - Record Type Header

NAME	SIZE	DESCRIPTION
Local track Identifier	u32	Unique within each sonar system
System track identifier	u32	Unique within each system
Time of Contact	u8*10	7k Time
Datum identifier	u16	0 – WGS84

NAME	SIZE	DESCRIPTION
		>0 – Reserved
Position latency	f32	In seconds
Latitude or Northing	f64	Latitude in radians or in meters
Longitude or Easting	f64	Longitude in radians or in meters
UTM Zone	u8	UTM Zone
Height relative to Datum or Height	f64	In meters
Position type flag	u16	0 – Position not used 1 – Geographical coordinates 2 – Grid coordinates
Classification type	u16	0 – Unknown 1 – Cursor marker (speed and heading always 0) 2 – MLO 3 – Submarine 4 – Surface Ship
Bearing to target	f32	In radians
Bearing flag	u32	0 – Relative to sonar array 1 – Absolute / north stabilized
Range to target	f32	Range from sonar array to target
Holding time	f32	In seconds. Negative value if not used
Detection method	u32	0 – Automatic, algorithm based 1 – Manual, operator selected 2 – Predicted, based on last known position, speed and direction
SNR	f32	Signal to Noise Ratio in dB
TS	f32	Target Strength in dB
Confidence value	u32	A value from 1 to 10 where 10 – Best confidence 1 – Worst confidence
Target altitude	f32	In meters, negative value if not used
Target depth	f32	In meters, value >100000.0 if not used
Target speed	f32	In meters / second
Target heading	f32	In radians

NAME	SIZE	DESCRIPTION
Reserved	u128	Reserved space
Target text information size	u32	Size of string in Bytes including termination character
Target text information	dynamic	Null terminated ASCII string

9.37 7200 – 7k File Header

Description: Optional data field can contain any customer specific information necessary to describe the file further.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 59: 7200 - Record Type Header

NAME	SIZE	DESCRIPTION
File identifier	u128	0xF3302F43CFB04d6fA93E2AEC33DF577D
Version number	u16	File format version number.
Reserved	u16	Reserved.
Session identifier	u128	User defined session identifier. Used to associate multiple files for a given session.
Record data size	u32	Size of record data. 0 if not present.
N	u32	Number of devices (N ≥ 0).

DRF	RTH	RD	OD	DRF

Table 60: 7200 - Record Data

NAME	SIZE	DESCRIPTION
Recording name	u8*64	Null terminated US-ASCII string.
Recording program version number	u8*16	Null terminated US-ASCII string.
User defined name	u8*64	Null terminated US-ASCII string.
Notes	u8*128	Null terminated US-ASCII string.
Device Identifier 0	u32	Identifier for record type of embedded data.
System enumerator 0	u16	Identifier for the device enumerator.

NAME	SIZE	DESCRIPTION
...	...	...
Device Identifier N-1	u32	Identifier for record type of embedded data.
System enumerator N-1	u16	Identifier for the device enumerator.

9.38 7400 – Time Message

Description: The time (7KTIME) in Data Record Frame represent the new time. This message can be used together with a PPS or equivalent. The leap second offset field can be used to flag for leap second inserts ahead of time.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 61: 7400 - Record Type Header

NAME	SIZE	DESCRIPTION
Leap second offset	i8	-1, 0 or +1 second for midnight 31 Dec.
Pulse flag	u8	0 – Message is not associated with hardware pulse. 1 – Message preceding hardware pulse. 2 – Message following hardware pulse.
Port identifier	u16	Port number identifier for pulse.
Reserved	u32	Reserved.
Reserved	u64	Reserved.

NOTE:

SeaBat 7k Time Records have a reserved number range from 7400 through 7499.

9.39 7500 – 7k Remote Control

Description: This record is used to remotely control SeaBat™ 7k sonar 7-P processor series. It contains the 7-P processor remote control commands. A remote control command is either acknowledged (record 7501) or not acknowledged (record 7502). The record can be subscribed to from the 7-P processor. For details about subscribing to records see Appendix A. All remote control commands shall be sent to TCP or UDP port 7000 on the 7-P processor.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 62: 7500 - Record Type Header

NAME	SIZE	DESCRIPTION
Remote control ID	u32	See separate remote control table for details. See Appendix A.
Ticket	u32	Ticker number. Set by client for control packet matching to ACK or NAK packets.
Tracking number	u128	Unique number. Set by client for packet tracking.

DRF	RTH	RD	OD	DRF

Table 63: 7500 - Record Data

NAME	SIZE	DESCRIPTION
Remote control data	dynamic	Value(s). See Appendix A for 7k Remote Control Descriptions.

NOTE:

SeaBat 7k Remote Control Records have a reserved number range from 7500 through 7550.

9.40 7501 – 7k Remote Control Acknowledge

Description: This record is produced by the SeaBat™ 7k sonar 7-P processor series as a reply to a successful remote control command (record 7500) and sent to the host. It contains a copy of the ticket and tracking number specified in record 7500. This record cannot be manually requested or subscribed to.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 64: 7501 - Record Type Header

NAME	SIZE	DESCRIPTION
Ticket	u32	Ticker number in record 7500.
Tracking number	u128	Unique number in record 7500.

9.41 7502 – 7k Remote Control Not Acknowledge

Description: This record is produced by the SeaBat™ 7k sonar 7-P processor series as a reply to a non-successful remote control command (record 7500) and sent to the host. It contains a copy of the ticket and tracking number specified in record 7500 as well as an error code to why the command wasn't accepted. This record cannot be manually requested or subscribed to.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 65: 7502 - Record Type Header

NAME	SIZE	DESCRIPTION
Ticket	u32	Ticker number in record 7500.
Tracking number	u128	Unique number in record 7500.
Error code.	u32	Error code 0 – Reserved 1 – Rejected command 2 – Unknown command

9.42 7503 – Remote Control Sonar Settings

Description: This record is produced by the SeaBat 7k Sonar 7-P Processor. It contains the remote control sonar settings. The 7-P Processor updates this record for each ping. The record can manually be requested or subscribed to from the 7-P Processor. For details about requesting and subscribing to records, see *9.39 7500 – 7k Remote Control* together with *Appendix A 7k Remote Control Definitions*.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 66: 7503 - Record Type Header

NAME	SIZE	DESCRIPTION
Sonar Id	u64	Serial number.
Ping number	u32	Sequential number.
Frequency	f32	Center transmit frequency in Hertz.
Sample rate	f32	Sample in Hertz

NAME	SIZE	DESCRIPTION
Receiver bandwidth	f32	In Hertz.
Tx Pulse width	f32	Seconds of pulse.
Tx Pulse type identifier	u32	0 – CW 1 – Linear chirp
Tx Pulse envelope identifier	u32	0 – Tapered rectangular 1 – Tukey
Tx Pulse envelope parameter	f32	Some envelopes don't use this parameter.
Tx Pulse reserved	u32	Additional pulse information.
Max ping rate	f32	Maximum ping rate in pings per second.
Ping period	f32	Seconds since last ping.
Range selection	f32	Range selection in meters.
Power selection	f32	Power selection in dB/μPa
Gain selection	f32	Gain selection in dB.
Control flags	u32	BITFIELD: 0-3: Auto range method. 4-7: Auto bottom detect filter method. 8: Bottom detect range filter. 9: Bottom detect depth filter. 10-14: Auto receiver gain method. 15-31: Reserved.
Projector magic number	u32	Projector selection.
Projector beam steering angle vertical	f32	In radians.
Projector beam steering angle horizontal	f32	In radians.
Projector beam –3dB beam width vertical	f32	In radians.
Projector beam –3dB beam width horizontal	f32	In radians.
Projector beam focal point	f32	In meters.
Projector beam weighting window type	u32	0 – Rectangular 1 – Chebychev
Projector beam weighting window parameter	f32	N/A

NAME	SIZE	DESCRIPTION
Transmit flags	u32	BITFIELD: 0-3: Pitch stabilization method. 4-7: Yaw stabilization method. 8-31: Reserved.
Hydrophone magic number	u32	Hydrophone selection.
Receive beam weighting window	u32	0 – Chebychev 1 – Kaiser
Receive beam weighting parameter	f32	N/A
Receive flags	u32	BITFIELD: 0-3: Roll stabilization method. 4-7: Dynamic focusing method. 8-11: Doppler compensation method. 12-15: Match filtering method. 16-19: TVG method. 20-23: Multi-Ping Mode. 0 = No multi-ping If non-zero, this represents the sequence number of the ping in the multi-ping sequence. 24-31: Reserved
Bottom detection filter info	f32	Min range (if range filter active).
Bottom detection filter info	f32	Max range (if range filter active).
Bottom detection filter info	f32	Min depth (if depth filter active).
Bottom detection filter info	f32	Max depth (if depth filter active).
Absorption	f32	Absorption in dB/km.
Sound velocity	f32	Sound Velocity in m/s
Spreading	f32	Spreading loss in dB.
Reserved	u16	Reserved for future pulse shape description.
Tx array position offset X	f32	Offset of the Transducer array in m, relative to the Receiver array on the X axis, positive value is to the right, if the receiver faces forward.
Tx array position offset Y	f32	Offset of the Transducer array in m, relative to the Receiver array on the Y axis, positive value is forward, if the

NAME	SIZE	DESCRIPTION
		receiver faces forward.
Tx array position offset Z	f32	Offset of the Transducer array in m, relative to the Receiver array on the Z axis, positive value is up, if the receiver faces forward.
Head Tilt X	f32	Radians
Head Tilt Y	f32	Radians
Head Tilt Z	f32	Radians. Typically zero.
Ping on/off	u32	Ping On/Off State, 0 = pinging disabled 1 = pinging enabled

9.43 7600 – 7k Roll

Description: This record can be used to set the SeaBat™ 7k sonar 7-P processor series systems current roll value. The record can manually be requested or subscribed to from the 7-P processor. For details about requesting and subscribing to records see record 7500 together with Appendix A.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 67: 7600 - Record Type Header

NAME	SIZE	DESCRIPTION
Roll	f32	In radians.

9.44 7601 – 7k Pitch

Description: This record can be used to set the SeaBat™ 7k sonar 7-P processor series systems current pitch value. The record can manually be requested or subscribed to from the 7-P processor. For details about requesting and subscribing to records see record 7500 together with Appendix A.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 68: 7601 - Record Type Header

NAME	SIZE	DESCRIPTION
Pitch	f32	In radians.

9.45 7610 – 7k Sound Velocity

Description: This record can be used to set the SeaBat™ 7k sonar 7-P processor series systems current sound velocity value. The record can manually be requested or subscribed to from the 7-P processor. For details about requesting and subscribing to records see record 7500 together with Appendix A.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 69: 7610 - Record Type Header

NAME	SIZE	DESCRIPTION
Sound Velocity	f32	In meters / second.

9.46 7611 – 7k Absorption Loss

Description: This record can be used to set the SeaBat™ 7k sonar 7-P processor series systems current absorption loss value. The record can manually be requested or subscribed to from the 7-P processor. For details about requesting and subscribing to records see record 7500 together with Appendix A.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 70: 7611 - Record Type Header

NAME	SIZE	DESCRIPTION
Absorption Loss	f32	In dB / km.

9.47 7612 – 7k Spreading Loss

Description: This record can be used to set the SeaBat™ 7k sonar 7-P processor series systems current spreading loss value. This coefficient value is used in conjunction with the absorption loss value to re-compute the TVG curve that will be applied to amplify the returned signal. The record can manually be requested or subscribed to from the 7-P processor. For details about requesting and subscribing to records see record 7500 together with Appendix A.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 71: 7612 - Record Type Header

NAME	SIZE	DESCRIPTION
Spreading Loss	f32	In dB (0.0 – 60.0).

9.48 8100 – Embedded 8100 Series Sonar Data

Description: This record is provided to allow SeaBat 8100 series sonar data records to be stored for backward compatibility. 8100 data records are embedded in their entirety within this record in either big Endian (Motorola) format (native from the sonar) or in little Endian (Intel) format thus accommodating Intel based hosts.

Where a given data type comprises multiple packets, the embedded Record Data field for a given record shall contain concatenated packets for that type. For example, data of type RAW_DATA.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 72: 8100 - Record Type Header

NAME	SIZE	DESCRIPTION
Type	u8	0 – Unspecified 1 – R_THETA_DATA_VERY_OLD 2 – RI_THETA_DATA_VERY_OLD 3 – R_THETA_DATA_OLD 4 – RI_THETA_DATA_OLD 5 – R_THETA_DATA 6 – RI_THETA_DATA 7 – SIDESCAN_IMAGE 8 – RAW_DATA 9 – SONAR_STATUS 10 – SNIPPET >10 – Reserved.
Flags	u8	BITFIELD: 0: Embedded data format is 0 = big Endian 1 = little Endian.

NAME	SIZE	DESCRIPTION
		1: Embedded checksums are: 1 = valid 0 = invalid 2 – 7: Reserved.
Data size	u16	Size in bytes of embedded data stream
Packets following header	u16	Specifies the number of data packets immediately following the embedded header. Only applies to Types RAW_DATA (8) and SNIPPET (10).
Reserved	u8 * 10	Reserved for future expansion and byte alignment

10 DEVICE IDENTIFIERS

Table 73: Device Identifiers

IDENTIFIER	VENDOR	DESCRIPTION
100		Generic Position Sensor (e.g., GPS)
101		Generic Heading Sensor (e.g., Gyro)
102		Generic Attitude Sensor.
103		Generic MBES.
104		Generic Sidescan Sonar.
105		Generic Subbottom Profiler.
1001	TrueTime	PCISG
2000	CDC	SMCG
2001	CDC	SPG
2002	Empire Magnetics	YS2000 Rotator
4013	RESON	TC4013
6000	RESON	DiverDat
7000	RESON	7kCenter
7001	RESON	7k User Interface
7003	RESON	PDS2000
7012	RESON	SeaBat™ 7012
7100	RESON	SeaBat™ 7100
7101	RESON	SeaBat™ 7101
7102	RESON	SeaBat™ 7102
7111	RESON	SeaBat™ 7111
7112	RESON	SeaBat™ 7112
7123	RESON	SeaBat™ 7123
7125	RESON	SeaBat™ 7125
7128	RESON	SeaBat™ 7128
7150	RESON	SeaBat™ 7150
7160	RESON	SeaBat™ 7160
8100	RESON	SeaBat™ 8100

IDENTIFIER	VENDOR	DESCRIPTION
8101	RESON	SeaBat™ 8101
8102	RESON	SeaBat™ 8102
8111	RESON	SeaBat™ 8111
8123	RESON	SeaBat™ 8123
8124	RESON	SeaBat™ 8124
8125	RESON	SeaBat™ 8125
8128	RESON	SeaBat™ 8128
8150	RESON	SeaBat™ 8150
8160	RESON	SeaBat™ 8160
10000	TSS	DMS 05
10001	TSS	335B
10002	TSS	332B
10010	SeaBird	SeaBird SBE37
10020	Litton	Litton 200
11000	EdgeTech	FS-DW Sub-bottom Profiler (SBP)
11001	EdgeTech	FS-DW Low frequency side-scan sonar (LFSSS)
11002	EdgeTech	FS-DW High frequency side-scan sonar (HFSSS)
11100	BlueFin	BlueFin vehicle controller
11200 12000	Ifremer Simrad	Techsas Simrad RPT319

APPENDIX A 7K REMOTE CONTROL DEFINITIONS

SeaBat™ 7k series system support all commands or a subset of the below commands.

Table 74: 7k Remote Control Definitions

IDENTIFIER	DESCRIPTION	POSSIBLE RETURN RECORDS
1000	Shutdown	7501, 7502
1001	Reboot	7501, 7502
1002	Calibrate	7501, 7502, 7005
1003	Range	7501, 7502
1004	Max ping rate	7501, 7502
1005	Transmit power	7501, 7502
1006	Transmit pulse width	7501, 7502
1007	Transmit pulse type	7501, 7502
1008	Receiver gain	7501, 7502
1009	Bottom detection method mask	7501, 7502
1010	Bottom detection filter info	7501, 7502
1011	Projector selection	7501, 7502
1012	Projector stabilization	7501, 7502
1013	Transmitter stabilization	7501, 7502
1014	Auto range	7501, 7502
1015	Hydrophone selection.	7501, 7502
1017	Receiver gain type	7501, 7502
1018	TVG Coefficients	7501, 7502
1019	Auto receiver gain	7501, 7502
1020	Transmit pulse envelope identifier	7501, 7502
1021	Transmit beam steering	7501, 7502
1022	Projector beam widths	7501, 7502
1023	Projector beam focal point	7501, 7502

IDENTIFIER	DESCRIPTION	POSSIBLE RETURN RECORDS
1024	Projector beam weighting	7501, 7502
1025	Receive beam weighting	7501, 7502
1027	Transmit frequencies for chirps	7501, 7502
1050	Single record request	7501, 7502, 7000, 7001, 7002, 7004, 7005, 7006, 7007, 7008, 7051, 7052
1051	Volatile (Subscription) data feed	7501, 7502, 7503, 7000, 7002, 7004, 7006, 7007, 7008, 7011, 7050, 7051, 7052
1052	Stop volatile data feed.	7501, 7502
1053	Persistent data feed.	7501, 7502
1054	Stop persistent data feed.	7501, 7502
1055	Volatile Data Feed, Range of Records	7501, 7502
1100	Start pinging.	7501, 7502
1101	Stop pinging.	7501, 7502
1102	Load parameters	7501, 7502
1103	Snippet control	7501, 7502
1104	7008 beam control	7501, 7502
1105	7008 data sample type	7501, 7502
1106	Sonar sequencer control	7501, 7502
1107	Single Ping Request	7501, 7502
1108	Load Factory Parameters, Specific Sonar	7501, 7502
1109	System Health Verification	7501, 7502
1200	Start record	7501, 7502
1201	Stop record	7501, 7502
1202	Start playback	7501, 7502
1203	Stop playback	7501, 7502
1300	Add port	7501, 7502
1301	Control port	7501, 7502
1302	Add trigger	7501, 7502

IDENTIFIER	DESCRIPTION	POSSIBLE RETURN RECORDS
1303	Control trigger	7501, 7502
1304	Add sequence	7501, 7502
1305	Control sequence	7501, 7502

IDENTIFIER: 1000
NAME: Shutdown
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Software and firmware halt followed by power shutdown to dry and wet hardware.
PARAMETERS: None.

IDENTIFIER: 1001
NAME: Reboot
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Software and firmware restart.
PARAMETERS: None.

IDENTIFIER: 1002
NAME: Calibrate
POSSIBLE RETURN RECORDS: 7501, 7502, 7005
DESCRIPTION: Initiate system calibration. Record 7005 is returned upon successful calibration.
PARAMETERS: None.

IDENTIFIER: 1003
NAME: Range
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: System range setting.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Range	f32	Range setting in meters.

IDENTIFIER: 1004
NAME: Max ping rate
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Max ping setting.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Max ping rate	f32	Max ping rate setting in ping per second.

IDENTIFIER: 1005
NAME: Transmit power
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: System transmit power setting.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Transmit power	f32	Transmit power in dB/uPa.

IDENTIFIER: 1006
NAME: Pulse width
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: System transmit pulse width setting.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Transmit pulse width	f32	Transmit pulse width in seconds.

IDENTIFIER: 1007
NAME: Pulse type
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: System transmit pulse type.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Transmit pulse type	u32	0 – CW 1 – Linear chirp

IDENTIFIER: 1008
NAME: Receiver gain
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: System receiver gain.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Receiver gain	f32	Gain selection in dB.

IDENTIFIER: 1009
NAME: Bottom detection mask
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: System bottom detection mask.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Bottom detection flag	u32	BITFIELD: 0-3: Reserved. 4-7: Bottom detection method. 8: Range filter (0n / Off). 9: Depth filter (0n / Off). 10-31: Reserved.

IDENTIFIER: 1010
NAME: Bottom detection filter info.
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: System bottom detection filter info.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Bottom detection filter info	f32	Min range (if range filter active).
Bottom detection filter info	f32	Max range (if range filter active).
Bottom detection filter info	f32	Min depth (if depth filter active).
Bottom detection filter info	f32	Max depth (if depth filter active).

IDENTIFIER: 1011
NAME: Projector selection.
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: System projector selection.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Projector's magic number	u32	Projector selection.

IDENTIFIER: 1012
NAME: Projector stabilization.
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: System projector stabilization setting.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Projector mask	u32	BITFIELD: 0-3: Pitch stabilization method. 4-7: Yaw stabilization method. 8-31: Reserved.

IDENTIFIER: 1013
NAME: Receive beam stabilization.
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Receive beam stabilization settings.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Receive mask	u32	BITFIELD: 0-3: Roll stabilization method. 4-31: Reserved.

IDENTIFIER: 1014
NAME: Auto range.
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: System automatic range method setting.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Auto range mask	u32	BITFIELD: 0-3: Auto range method. 4-31: Reserved.

IDENTIFIER: 1015
NAME: Hydrophone selection.
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: System hydrophone selection.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Hydrophone's magic number	u32	Hydrophone selection. TBD

IDENTIFIER: 1017
NAME: Receiver gain type.
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: System receiver gain type setting.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Receiver gain type	u32	TVG method.
Coefficients	TBD	TBD

IDENTIFIER: 1019
NAME: Auto receiver gain.
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: System automatic receiver gain setting.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Auto receiver gain flag	u32	0 – Off. 1 – On.

IDENTIFIER: 1020
NAME: Transmit pulse envelope identifier
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Identifies what envelope that shall be applied to the transmit pulse.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Transmit pulse envelope identifier	u32	0 – Tapered rectangular 1 – Tukey
Transmit pulse envelope parameter	f32	Different meaning for the different envelopes.

IDENTIFIER: 1021
NAME: Transmit beam steering.
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Horizontal and vertical projector beam steering.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Projector beam steering horizontal	f32	In Radians.
Projector beam steering vertical	f32	In Radians.

IDENTIFIER: 1022
NAME: Projector beam widths.
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Horizontal and vertical projector beam widths.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Horizontal projector beam –3dB beam width	f32	In Radians.
Vertical projector beam –3dB beam width	f32	In Radians.

IDENTIFIER: 1023
NAME: Projector beam focal point.
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Projector beam focal point.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Flag	u32	1 - Automatic focus 0 - Manual focus
Projector beam focal point	f32	In meters

IDENTIFIER: 1024
NAME: Projector beam weighting.
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Projector beam weighting window type.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Projector beam weighting window type	u32	0 – Rectangular 1 – Chebychev
Projector beam weighting window parameter	f32	N/A

IDENTIFIER: 1025
NAME: Receive beam weighting.
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Receive beam weighting window type.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Receive beam weighting window	u32	0 – Chebychev 1 – Kaiser
Receive beam weighting parameter	f32	N/A

IDENTIFIER: 1027
NAME: Transmit frequencies for chirps.
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Transmit pulse start and stop frequencies.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Start frequency	f32	In Hz.
Stop frequency	f32	In Hz.

IDENTIFIER: 1050
NAME: Single record request.
POSSIBLE RETURN RECORDS: 7501, 7502, 7503, 7000, 7001, 7002, 7004, 7005, 7006, 7007, 7008, 7011, 7051 and 7052, 7600, 7601, 7610, 7611, 7612.
DESCRIPTION: Request latest record.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Record type	u32	Possible Record Numbers: 7501, 7502, 7503, 7000, 7001, 7002, 7004, 7005, 7006, 7007, 7008, 7011, 7051 and 7052, 7600, 7601, 7610, 7611, 7612.

IDENTIFIER: 1051
NAME: Volatile data feed.
POSSIBLE RETURN RECORDS: 7501, 7502, 7503, 7000, 7001, 7002, 7004, 7005, 7006, 7007, 7008, 7011, 7051 and 7052, 7600, 7601, 7610, 7611, 7612.
DESCRIPTION: Create volatile data feed. The host is responsible to keep this connection alive as well as re-establish a lost connection to the 7-P processor.
PARAMETERS:

NAME	SIZE	DESCRIPTION
N	u32	Number of records.
Array of record numbers.	N*u32	Possible Record Numbers: 7501, 7502, 7503, 7000, 7001, 7002, 7004, 7005, 7006, 7007, 7008, 7011, 7051 and 7052, 7600, 7601, 7610, 7611, 7612.

IDENTIFIER: 1052
NAME: Stop volatile data feed.
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Stop volatile data feed.
PARAMETERS: None.

IDENTIFIER: 1055
NAME: Volatile Data Feed, Range of Records
POSSIBLE RETURN RECORDS: 7501, 7502, plus all records which may be subscribed to
DESCRIPTION: Create volatile data feed for a range of numerically continuous records. The host is responsible to keep this connection alive as well as to re-establish a lost connection to the 7-P processor. Subscribers are cautioned to choose reasonable ranges of defined records to avoid numerous log file messages for as yet undefined records
PARAMETERS:

NAME	SIZE	DESCRIPTION
Start Record ID	u32	Start Record ID
End Record ID	u32	End Record ID

IDENTIFIER: 1100
NAME: Start Pinging.
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Start continuous pinging.
PARAMETERS: None.

IDENTIFIER: 1101
NAME: Stop Pinging.
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Stop pinging.
PARAMETERS: None.

IDENTIFIER: 1102
NAME: Load Factory Parameters.
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Load Factory Parameters from disk.
PARAMETERS: None.

IDENTIFIER: 1103
NAME: Snippet control.
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Limit record 7008's sample range to a window around the bottom detection ranges.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Enable	u32	0 – Disable sample limitation. 1 – Enable sample limitation.
Window size	u32	Number of samples around bottom detection for each beam.

IDENTIFIER: 1104
NAME: 7008 beam control.
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Limit the number of beams in record 7008.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Min beam	u32	Minimum beam number. 0 to beams – 1
Max beam	u32	Maximum beam number. 0 to beams – 1

IDENTIFIER: 1105
NAME: 7008 data sample type.
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Set the data sample type for record 7008.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Data sample type	u32	BITFIELD (Least significant bit corresponds to Bit 0.) BIT 0-3 Amplitude: 0 = No amplitude 1 = Amplitude (8 bits) 2 = Amplitude (16 bits) 3 = Amplitude (32 bits) BIT 4-7 Phase: 0 = No phase 1 = Phase (8 bits) 2 = Phase (16 bits) 3 = Phase (32 bits) BIT 8-11 I and Q: 0 = No I and Q 1 = Signed 16 bit I and signed 16 bit Q 2 = Signed 32 bit I and signed 32 bit Q BIT 12 -14 Beam forming Flag: 0 = Beam formed data 1 = Element data

IDENTIFIER: 1106
NAME: Sonar sequencer control.
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Turn sequencer on or off with this command.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Flag	u32	0 – Sequencer off, ping rate based on range setting

NAME	SIZE	DESCRIPTION
		1 – Sequencer on, ping rate based on sequencer triggers

IDENTIFIER: 1107
NAME: Single Ping Request
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Request for a single ping, note that this request will halt continuous pinging if it has been started.
PARAMETERS: None.

IDENTIFIER: 1108
NAME: Load Factory Parameters, Specific Sonar
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Load factory parameters for a specific sonar when the 7P is controlling more than one sonar.
PARAMETERS: None

IDENTIFIER: 1109
NAME: System Health Verification
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Request Acknowledgement from sonar
PARAMETERS: None

IDENTIFIER: 1200
NAME: Start record.
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Start Recording.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Filename size	u32	In Bytes including termination character.
Filename	dynamic	Null terminated ASCII string.

IDENTIFIER: 1201
NAME: Stop record.
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Stop Recording.
PARAMETERS: None.

IDENTIFIER: 1202
NAME: Start playback.
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Start playback.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Filename size	u32	In Bytes including termination character.
Filename	dynamic	Null terminated ASCII string.

IDENTIFIER: 1203
NAME: Stop playback.
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Stop playback.
PARAMETERS: None

IDENTIFIER: 1300
NAME: Add port.
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Define and a port to the system.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Port ID	u32	Port identifier
Type	u32	Type identifier number 0 – Coaxial port 1 – Serial port 2 – Socket TCP 3 – Socket UDP
Address	u64	If IPv4, use lower 32 bits.
Port number	u32	Port index.

IDENTIFIER: 1301
NAME: Control port
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Control a physical or logical port.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Port ID	u32	Port identifier
Control flag	u8	0 – Delete port (only if it isn't used by a trigger) 1 – Enable port (default state) 2 – Disable port

IDENTIFIER: 1302
NAME: Add trigger.
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Define and map a trigger to one port.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Trigger ID	u32	Trigger identifier.
Port ID	u32	Defines the port the trigger is mapped to.
Trigger type	u16	0 – High Z 1 – TTL 2 – Software
Direction	u8	0 – IN 1 – OUT
Sense	u8	0 – Positive sense 1 – Negative sense
Pulse length	u32	Pulse length in microseconds.

IDENTIFIER: 1303
NAME: Control trigger.
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Control a defined trigger.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Trigger ID	u32	Trigger identifier.
Control flag	u8	0 – Delete trigger (only if it isn't used in a sequence) 1 – Enable trigger (default state) 2 – Disable trigger

IDENTIFIER: 1304
NAME: Add sequence.
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Control a defined trigger. A new defined sequence does not start to execute until remote control command 1305 has been issued.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Sequence ID	u32	Sequence identifier.
Steps	u16	Number of steps in sequence (0 – N).
Step Definition 0	u64	First step definition. See below.
…	…	…
Step Definition N-1	u64	Last step definition. See below.

Step definition:

NAME	SIZE	DESCRIPTION
Trigger ID	u32	Trigger ID.
Edge Trigger	u32	0 – Raising edge on previous pulse 1 – Falling edge on previous pulse
Delay	u32	Delay pulse in microseconds since trigger edge of previous pulse (only valid for OUT triggers).

IDENTIFIER: 1305
NAME: Control sequence.
POSSIBLE RETURN RECORDS: 7501, 7502
DESCRIPTION: Control a defined sequence.
PARAMETERS:

NAME	SIZE	DESCRIPTION
Sequence ID	u32	Sequence identifier.
Control flag	u8	0 – Delete sequence (stops sequence if running) 1 – Enable single sequence 2 – Enable repeat sequence 3 – Disable / stop sequence (default state)

APPENDIX B PROJECTION IDENTIFIERS

The following table defines the reserved values for the custom identifier field of the Geodesy record (record number 1011). Definitions of projection specific parameters are TBD.

Table 75: Projection Identifiers

CUSTOM IDENTIFIER	PROJECTION
-1	Not used.
0	Universal Transverse Mercator (UTM)
1	Albers Equal-Area Conic
2	Azimuthal Equal Area
3	Azimuthal Equidistant
4	Bonne
5	Cassini
6	Double Stereographic
7	Equal-Area Cylindrical
8	Equidistant Conic
9	Equidistant Cylindrical
10	European Stereographic
11	Gnomic
12	Oblique Mercator (Rectified Skew Orthomorphic - with Skew Angle parameter)
13	Hotine
14	Hungarian National System (EOV)
15	Hungarian National System (EOV)
16	IMW Polyconic
17	Lambert Conformal Conic (1 parallel)
18	Lambert Conformal Conic (2 parallel)
19	Mercator
20	Miller Cylindrical
21	Mollweide

CUSTOM IDENTIFIER	PROJECTION
22	Orthographic
23	Polar Azimuthal
24	Equal Area
25	Polar Azimuthal Equidistant
26	Polar Stereographic
27	Polyconic
28	Robinson
29	Sinusoidal
30	Space Oblique Mercator
31	Stereographic
32	Stereographic 70
33	Transverse Mercator (Gauss-Kruger)
34	Two-Point Fit (polynomial projection)
35	Van der Grinten 1