	<i>RESON Group</i>	Document Number:	11542	Rev:	E
		Document Title:	SeaBat 7k Data Format, Volume I		
DATA FORMAT DEFINITION DOCUMENT					


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DATA FORMAT DEFINITION DOCUMENT

SeaBat 7k Data Format, Volume I Version 1.00

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Revision History:

Date	ECO	Author	Rev	Description
05/11/2006		JM (MD)	E	Revision 1.00
11/8/2004	04551	MJF (MD)	D	Revision 0.54
10/6/2004	04422	MJF (MD)	C	Revision 0.53
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 & Overview

This document describes the data format used to log and transmit network data using the RESON Application titled 7kCenter. The 7kCenter is the primary interface to the sonar and provides auxiliary sensor support. It is included as standard software on all production units.

The 7k Data Format Definition document (DFD) defines record types relevant to the 7k series sonar. It also provides record definitions for generic sensors. This provides a robust, highly expandable generic wrapper format for sonar data in general, which includes all auxiliary sensors and information needed to completely describe data logged during a survey.

This record-based protocol encapsulates data using frames and headers. All records have a unique type identifier, and each record is wrapped within a frame that identifies and describes the content of the record.

A record's embedded synchronization pattern, combined with its checksum, is a powerful aid in real time record validation and recovery from file corruption.

The data format also defines 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 Data 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 (this document)
Heading	True heading.



Term	Definition
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 sonar systems, related software components and protocols.
VRP	Vessel Reference Point.
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, angles in radians and headings in degrees. 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	+	Distance above the VRP
	-	Distance below the VRP
Roll	+	Port Up
	-	Port Down
Pitch	+	Bow up
	-	Bow down
Yaw	+	Bow to Starboard
	-	Bow to Port
Heave	+	Up
	-	Down
Heading	+	Heading is always positive \square from 0 to 359.99°. It will never be a negative value.
Altitude	+	Up
	-	Down

Offset	Sign	Description
Depth	+	Up
	-	Down
Tide	+	High Tide (Height above a defined point)
	-	Low Tide (Height below a defined point)

2.3 Vessel Axes

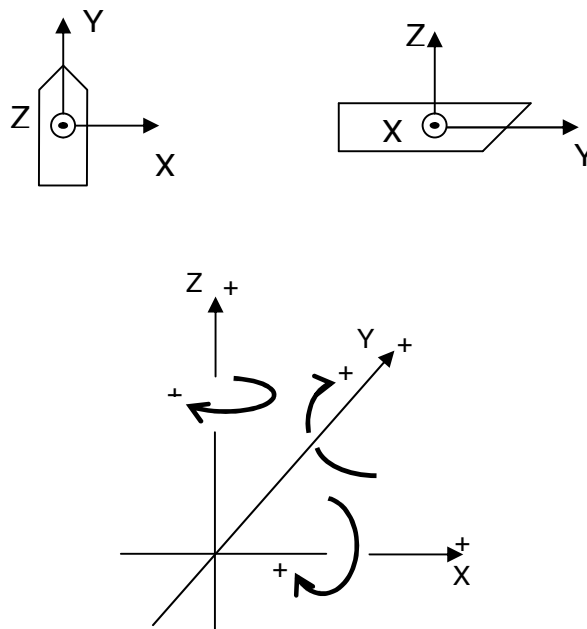


Figure 1: Vessel Axes

2.4 Beam Positions

In a standard installation, beam zero will represent the first beam on the port side of the sonar array. Some non-standard installations will require that the beam order be reversed in post-processing or using real time collection software that can account for this.

Setting the "Flip" in the UI does NOT reorder beams in the data output.

2.5 Data Type Definitions, Bit fields, and Byte Alignment

The following data type formats are defined by this document. Data shall be represented in little Endian (Intel) byte-order format unless stated otherwise.

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

Bit fields are frequently used in the data format. A bit field flag will indicate whether a feature is activated or deactivated, or in some cases a value.

All Record Type Headers are of static size and shall use `struct member alignment` of **1 byte** in memory, also called `Single Byte Alignment`.

2.6 Time Convention

Time tags shall be in UTC unless stated otherwise and use the following structure:

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

Also reference the 7KTIME definition in the Data Record Frame description as well as the general section regarding time stamping.

3 GETTING STARTED WITH 7KCENTER SOFTWARE

3.1 Establishing a Connection

Two communication methods are available to the 7kCenter: TCP/IP and UDP/IP. Before sending and receiving records to and from the 7kCenter, a socket must be created and a connection to the 7kCenter must be established.

A TCP socket must be connected in the sense that it negotiates an error-checking interaction with the socket in the 7kCenter. A UDP socket is simpler to create, however it has no error checking or guaranteed delivery. With UDP, a socket is created, and then a record is sent to the IP address and port for the 7kCenter to create a connection. TCP/IP is the recommended choice for communicating to the 7kCenter application.

The standard port used by the 7kCenter is 7000. All clients must initiate communication on this port.

3.2 Retrieving Data Records

When communicating to the 7kCenter, it is crucial that the Protocol field in the Data Record Frame and Network Frame be populated correctly. Refer to the Version Concordance shown below to identify the correct protocol version for your system.

Table 3: Version Concordance

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

There are two methods for retrieving data from the 7kCenter:

- 1) Request a single record.
- 2) Subscribe to records.

A single record request will result in one record being returned. These are not available for certain data records to prevent system overloading.

In contrast, subscription requests provide streaming data records from the 7kCenter for each ping or when newer data is available. For external sensor data, a subscription is updated when newer data is available from the source device or application.

The following list defines the most common single record requests:

- 1) Configuration Data (7001)
- 2) System State (7503)
- 3) Data Storage Status (7052)
- 4) 7k System Events (7050)

Though there are many records that can be subscribed to and requested. The following list provides some critical records needed for ping-to-ping logging and sonar data processing:

- 1) 7000 Sonar Settings
- 2) 7004 Beam Geometry
- 3) 7006 Bottom Detect Results (Bathymetric Data)
- 4) 7007 Side Scan Data
- 5) 7008 Beam formed data and snippets
- 6) 7018 Beam Formed Data Only
- 7) 7028 Snippets Only
- 8) 7051 7k System Event Messages

NOTE:

If there are multiple devices attached to the 7kCenter then you must subscribe to a specific set of records for each device using separate subscription requests.

3.3 Getting System State Information and Commanding

To obtain startup and system state information the client can request a single 7001. Because the requesting program is not expected to know what devices are attached until that record is received, the 7kCenter will accept a device ID of 7000 and system enumerator 0 in the DRF/NF for this request.

When the 7001 record has been received, a listing of attached devices can be extracted from that record. The most important information for communication to the 7kCenter is the Device ID (such as 7120 or 7125) and the System Enumerator (always zero if there is only one device attached).

Following this client synchronization, a 7000 or 7503 (System State) record can be requested to get current system info for each attached device.

Record 7500 is the primary means of changing sonar settings. A detailed description of this is given in Chapter 11 as well as the 7500 record definition section. When commanding the sonar, you must supply a valid device ID and enumerator in the 7500's Data Record Frame or the command will be rejected.

NOTE:

It is possible to bypass the configuration process and hard code the device ID values when deemed appropriate, for instance when simple data logging is needed with little commanding of the sonar.

3.4 Terminating Communication

The 7500/1053 command to the 7kCenter will stop all subscriptions that match the information provided in the command record. The 1053 command is specific for each device, so a separate 7500/1053 must be sent for each device. The 7500/1053 command should be sent so that the 7kCenter is in a well-known state and not still trying to send data to the requesting program. In the case of TCP, closing the socket will stop the data preparation; but UDP does not do so. **UDP links must be explicitly terminated** (see remote control definitions).

3.5 Record Fragmentation □ Special Considerations

The maximum size of packets sent by the 7kCenter has been set to 60,000 bytes. There are two reasons for this:

1. UDP packet sizes are limited to an implementation-dependent size, usually 64KB.
2. If the data is sent in a very large record, the error checking in TCP will require resending of the entire record should a transmission error occur.

For these reasons, the choice has been made to limit the size of packets in all cases. That means that the receiving program must reconstruct the full record from the fragments.

When a record is fragmented, each fragment is sent as a separate packet. The NETWORK_FRAME at the beginning of each data segment contains the information necessary to rebuild the record. Two separate numbering schemes are available for reconstruction.

NOTE:

The RECORD_FRAME for the record is not repeated for each packet. It is only present for the first packet of a record.

From record counts:

In each NETWORK_FRAME, there is a sequence_number field and a total_packets field. All that is necessary is to join the data parts of each packet to the data segments of the preceding packets, stopping when the sequence_number is one less than the total_packets value (the latter is the same in every packet of a record). (While total_packets is the actual number of packets, sequence_number is zero-based.)

The data portion of each packet begins at the location specified in the NETWORK_FRAME's offset field, which gives the position (in bytes) of the first data byte, relative to the beginning of the NETWORK_FRAME. Note that the size of each received packet is returned by the socket code that receives the packets, and the last packet will probably not be 60,000 bytes in length.

From accumulated packet sizes:

Reconstructing records from packet sizes is much like using record counts. The data sections are located and appended into a complete record as they are received. The accumulated data byte count is kept and compared to the total_size field of the NETWORK_FRAME (the same in each packet of a record). The record is complete when the accumulated size equals the total size.

Error checking:

Several error checks are possible on the incoming data. For TCP, there should be no transmission errors, but communications links could be dropped. For UDP, packets can be lost or appear out of order (but on small networks, that is extremely unlikely).

As each packet is received, the sequence numbers of the packets can be examined. Also, since all the packets except for the final one are of known size (data section 60,000 bytes less the size of the NETWORK_FRAME), the accumulated size that should be present for a given sequence number can be easily verified to see if packets have been lost.

These assume that the data are all present and are all in order and that no fragments of one fragmented record arrive interspersed between packets of



another fragmented record. While this is a reasonable assumption on a small network, it is not necessarily true in general.

4 TCP AND UDP

4.1 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.

5 RECORD DEFINITION

5.1 Overview

A 7k record consists of a data record frame, a record type header, an optional record data section and an optional data section for extra information. The Record Data section is considered optional because some remote controls commands consist only of the RTH

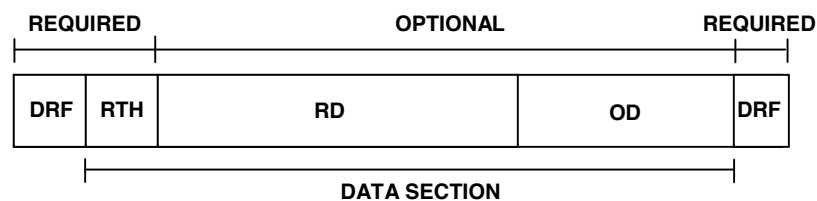
The optional data field typically holds sensor-specific data and 3rd party developer embedded data.

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

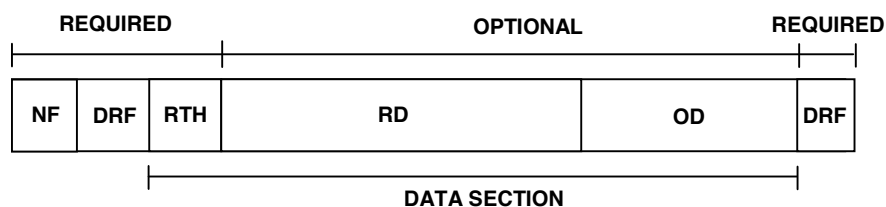
Please note that the Checksum is a required portion of the DRF which occurs as the last four bytes of every record.

7k RECORD

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



Network prepared with the Network Frame (NF).



6 DATA RECORD FRAME

6.1 Overview

The Data Record Frame (DRF) is the 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.

The frame is defined as follows:

Table 4: Data Record Frame

Name	Size	Description
Protocol Version	u16	Protocol Version of this frame (See the Protocol Version table in the front of this document.)
Offset	u16	Offset in bytes from the start of the sync pattern to the start of the Record Type Header (RTH). 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 Protocol version field to the end of the checksum field □ including any embedded data.
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	User Defined.
7KTIME	u8*10	Time tag indicating when data was produced.
Reserved	u16	Reserved.
Record Type Identifier	u32	Identifier for record type of embedded data.

Name	Size	Description
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.
Reserved	u32	Reserved.
Flags	u16	BITFIELD: Bit 0: Checksum 0 - Invalid checksum 1 - Valid checksum Bit 1: Reserved .
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 all byte values (treated as unsigned) 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 32 bit unsigned integer.

7 TCP AND UDP NETWORK FRAME

7.1 Overview

Records will be packetized using the following prefixed header for both the TCP and UDP/IP protocols. Packet sizes may not vary in a sequence, except for the last packet.

When using UDP protocol, each packet shall be less than or equal to 64K bytes, including the network header.

The following header shall prefix the network packet:

Table 5: Network Frame

Name	Size	Description
Protocol Version	u16	Protocol Version of this frame (See the Protocol Version table in the front of this document.)
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. (Always 1.)
Total Records	u16	Total number of records in network packets transmitted (helper field for parsing data). Max 128 records per transmission. (Always 1.)
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. (Always 1.)
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).



Name	Size	Description
Sequence Number	u32	Sequential packet number; allows correct ordering during reconstruction. 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.

8 LOGGING FILE FORMAT

8.1 Overview

A valid 7k data file shall be a binary file consisting of a series of data records conforming to the conventions and definitions in this document.

Records must be complete and without the network frame.

A file header record (7200) is recommended to be the first record in each file. This file describes the file's contents.

8.2 File Nomenclature

It is recommended that file names be based on the UTC date and time when they are created and utilize an `.s7k` extension as follows:

`YYYYMMDD_HHMMSS.s7k`

Where:

YYYY = Year.

MM = Month

DD = Day

HH = Hour

MM = Minutes

SS = Seconds

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

When using third party logging tools, multiple files created at the same time can 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`

The 7kCenter uses this convention, appending the frequency to the end of the file name.

For example, `20010516_102852_400kHz.s7k`

8.3 7kCenter Logged Files

The 7kCenter logs data in order it is received. In the case of sonar data this guarantees that the pings are logged in sequential (and therefore chronological) order. In general, however, the data in a log file cannot be guaranteed to be in chronological order.

Complete files generated using RESON 7kCenter software will always begin with a 7200 record, and will usually contain a 7300 record as the last record in the file. This record is for RESON diagnostic use only.

Incoming 7k Remote Controls (record 7500) are not logged in 7k files generated by the 7kCenter. Remote controls activity is stored in a separate log file. These files are for RESON diagnostic use only. Network Frames are also not logged.

The default extension for 7kCenter logged files is *.s7k, where the * represents the filename.



9 TIME TAGGING

Time tags reside in the DRF for each record. The time stamp is the time at which the data contained in the record was generated. It does not refer to the time that the record was formatted or sent.

For ping related records, the time stamp refers to the time when the sonar transmitter finishes a ping. For auxiliary sensors, it refers to the time at which the info was received from the sensor.

10 RECORD TYPE DEFINITIONS

10.1 Overview

The following table summarizes the allocated record type identifiers for the RESON 7k sonar and generic sensors. This table is not necessarily a complete listing of allocated or reserved record types.

Not all records show in this section are available for all systems. Availability of certain records will depend on the specific installation. In most cases, only SeaBat-relevant data is produced from the 7kCenter.

Table 6: 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

RECORD TYPE	DESCRIPTION
1050	Reserved for Generic Sensor Calibration Parameters
1200	Reserved for 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 Sonar Settings
7001	7k Configuration
7002	7k Match Filter
7004*	7k Beam Geometry
7005	7k Calibration Data
7006*	7k Bathymetric Data
7007*	7k Backscatter Imagery Data
7008*	7k Generic Data
7009	Vertical Depth
7010*	TVG Values
7011*	7k Image Data
7018*	Reserved for 7k Beam Data
7021	Reserved
7022	7kCenter Version
7028*	Reserved for 7k Snippet Data
7030	Sonar Installation Parameters
7038*	Reserved for 7k I & Q Data
7050	7k System Events
7051	7k System Event Message
7052	7k Data Storage Status Information

RECORD TYPE	DESCRIPTION
7060	Reserved for 7k Target Data
7200	7k File Header
7300	Reserved for RESON Diagnostic Use
7310	Reserved for 7k Trigger
7311	Reserved for 7k Trigger Sequence Setup
7312	Reserved for 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 for Maintenance Console Active
7515	Reserved
7600-7609	Reserved
7610	7k Sound Velocity
7611	7k Absorption Loss
7612	7k Spreading Loss
7900 □ 7999	Reserved
8100	Embedded 8100 Series Sonar Data

* These records are available by subscription only.

10.2 1000 Reference Point

Description: Reference Point Information

Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 7: 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.

10.3 1001 Sensor Offset Position

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

Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 8: 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.

NAME	SIZE	DESCRIPTION
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.

10.4 1002 Calibrated Sensor Offset Position

Description: Calibrated Sensor Offset Position information.

Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 9: 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.

10.5 1003 Position

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

Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 10: 1003 - Record Type Header

NAME	SIZE	DESCRIPTION
Datum Identifier	u32	0 <input type="checkbox"/> WGS84 >0 <input type="checkbox"/> 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 <input type="checkbox"/> Geographical coordinates 1 <input type="checkbox"/> Grid coordinates
UTM Zone	u8	UTM Zone
Quality Flag	u8	0 <input type="checkbox"/> Navigation Data 1 <input type="checkbox"/> Dead-Reckoning

NAME	SIZE	DESCRIPTION
Positioning Method	u8	0 <input type="checkbox"/> GPS 1 <input type="checkbox"/> DGPS 2 <input type="checkbox"/> Start of inertial positioning system from GPS 3 <input type="checkbox"/> Start of inertial positioning system from DGPS 4 <input type="checkbox"/> Start of inertial positioning system from bottom correlation 5 <input type="checkbox"/> Start of inertial positioning from bottom object 6 <input type="checkbox"/> Start of inertial positioning from inertial positioning 7 <input type="checkbox"/> Start of inertial positioning from optional data 8 <input type="checkbox"/> Stop of inertial positioning system to GPS 9 <input type="checkbox"/> Stop of inertial positioning system to DGPS 10 <input type="checkbox"/> Stop of inertial positioning system to bottom correlation 11 <input type="checkbox"/> Stop of inertial positioning to bottom object 12 <input type="checkbox"/> Start of inertial positioning to inertial positioning 13 <input type="checkbox"/> Start of inertial positioning to optional data 14 <input type="checkbox"/> User Defined

10.6 1004 Custom Attitude Information

Description: Attitude Data Record. The length of this record 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 11: 1004 - Record Type Header

NAME	SIZE	DESCRIPTION
Field Mask	u8	BITFIELD: Bit 0: 0/1 <input type="checkbox"/> No pitch/pitch in radians. Bit 1: 0/1 <input type="checkbox"/> No Roll/roll in radians. Bit 2: 0/1 <input type="checkbox"/> No heading/heading in radians. Bit 3: 0/1 <input type="checkbox"/> No heave/heave in meters. Bit 4: 0/1 <input type="checkbox"/> No pitch/pitch rate of change in radians per second. Bit 5: 0/1 <input type="checkbox"/> No roll rate/roll rate of change in radians per second. Bit 6: 0/1 <input type="checkbox"/> No heading rate/heading rate of change in radians per second. Bit 7: 0/1 <input type="checkbox"/> No heave rate/heave rate of change in meters per second.
Reserved	u8	Reserved.
N	u16	Number of repeated fields in the record.
Frequency	f32	Sample rate in samples / second (required if multiple samples are used per record).

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 12: 1004 - Record Data

NAME	SIZE	DESCRIPTION
FIELD 0	f32	Sensor data.
<input type="checkbox"/>	<input type="checkbox"/>	...
FIELD N-1	f32	Sensor data.

10.7 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 13: 1005 - Record Type Header

NAME	SIZE	DESCRIPTION
Tide	f32	Height correction above mean sea level in meters.
Source	u16	0 <input type="checkbox"/> Unspecified. 1 <input type="checkbox"/> Table (predicted) 2 <input type="checkbox"/> Measured (gauge).
Flags	u8	BITFIELD: Bit 0 <input type="checkbox"/> 0/1 for Gauge ID invalid/valid. Bit 1 <input type="checkbox"/> 0/1 for Position info invalid/valid.
Gauge Identifier	u16	User defined.
Datum identifier	u32	0 <input type="checkbox"/> WGS84 >0 <input type="checkbox"/> 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 <input type="checkbox"/> Geographical coordinates 1 <input type="checkbox"/> Grid coordinates

NAME	SIZE	DESCRIPTION
UTM Zone	u8	UTM zone

10.8 1006 Altitude

Description: Altitude data record.

Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 14: 1006 - Record Type Header

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

10.9 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 15: 1007 - Record Type Header

NAME	SIZE	DESCRIPTION
Flags	u8	BITFIELD: Bit 0: Speed in X, Y & Z directions (m/s); each an f32 if present. Bit 1: Acceleration in X, Y & Z directions (m/s ²); each an f32 if present. Bit 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.

NAME	SIZE	DESCRIPTION
N	u16	Number of Sensor Readings.
Frequency	f32	Sample rate in sensor readings per second.

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 16: 1007 - Record Data

NAME	SIZE	DESCRIPTION
Reading 0	Variable (3x f32 or 6x f32)	Motion Data
□	□	...
Reading N-1	variable (3x f32 or 6x f32)	Motion Data

10.10 1008 □ Depth

Description: Depth data record.

Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 17: 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.

10.11 1009 Sound Velocity Profile

Description: Sound velocity profile data record.

Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 18: 1009 - Record Type Header

NAME	SIZE	DESCRIPTION
Position flag	u8	0 <input type="checkbox"/> Invalid position fields. 1 <input type="checkbox"/> Valid position fields.
Reserved.	u8	Reserved.
Reserved.	u16	Reserved.
Latitude	f64	Latitude in radians (WGS84).
Longitude	f64	Longitude in radians (WGS84).
N	u32	Number of samples.

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 19: 1009 - Record Data

NAME	SIZE	DESCRIPTION
SAMPLE 0 Depth	f32	In meters.
SAMPLE 0 Sound velocity	f32	In meters / second.
<input type="checkbox"/>	<input type="checkbox"/>	...
SAMPLE N-1 Depth	f32	In meters.
SAMPLE N-1 Sound velocity	f32	In meters / second.

10.12 1010 CTD

Description: CTD Data Record

Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 20: 1010 - Record Type Header

NAME	SIZE	DESCRIPTION
Frequency	f32	Frequency
Sound velocity source flag	u8	0 <input type="checkbox"/> Not computed. 1 <input type="checkbox"/> CTD. 2 <input type="checkbox"/> User computed.
Sound velocity algorithm	u8	0 <input type="checkbox"/> Not computed. 1 <input type="checkbox"/> Chen Millero. 2 <input type="checkbox"/> Del Grosso.
Conductivity flag	u8	0 <input type="checkbox"/> Conductivity. 1 <input type="checkbox"/> Salinity.
Pressure flag	u8	0 <input type="checkbox"/> Pressure. 1 <input type="checkbox"/> Depth.
Position flag	u8	0 <input type="checkbox"/> Invalid position fields. 1 <input type="checkbox"/> Valid position fields.
Sample content validity	u8	BITFIELD: (Bit set means field is valid otherwise zero) 0 <input type="checkbox"/> Conductivity / Salinity 1 <input type="checkbox"/> Water Temperature 2 <input type="checkbox"/> Pressure / Depth 3 <input type="checkbox"/> Sound Velocity 4 <input type="checkbox"/> Absorption
Reserved.	u16	Reserved.
Latitude	f64	Latitude in radians (WGS84).
Longitude	f64	Longitude in radians (WGS84).
Sample rate	f32	Sample rate.

NAME	SIZE	DESCRIPTION
N	u32	Number of samples.

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 21: 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

10.13 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. The optional data portion of the record is used to contain custom projection parameters.

Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 22: 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.

NAME	SIZE	DESCRIPTION
Inverse flattening	f64	Inverse flattening in meters: e.g. 298.257223563 for WGS84.
Reserved 1	u8 * 16	Reserved
Datum name	u8 * 32	Datum name: e.g., <input type="checkbox"/> WGS84 <input type="checkbox"/>
Data calculation method	u32	<input type="checkbox"/> Molodensky <input type="checkbox"/> Bursa / Wolfe <input type="checkbox"/> DMA MRE <input type="checkbox"/> NADCON <input type="checkbox"/> HPGN <input type="checkbox"/> Canadian National Transformation V2
Number of parameters	u8	Three (3), Seven (7) and Eight (8) parameter transformation is supported.
DX	f64	X <input type="checkbox"/> Shift (m)
DY	f64	Y <input type="checkbox"/> Shift (m)
DZ	f64	Z <input type="checkbox"/> Shift (m)
RX	f64	X Rotation (radians)
RY	f64	Y Rotation (radians)
RZ	f64	Z Rotation (radians)
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., <input type="checkbox"/> UTM <input type="checkbox"/> (Refer to Appendix C)



NAME	SIZE	DESCRIPTION
Grid distance units	u8	<input type="checkbox"/> Meters <input type="checkbox"/> Feet <input type="checkbox"/> Yards <input type="checkbox"/> US Survey Feet <input type="checkbox"/> Kilometers <input type="checkbox"/> Miles <input type="checkbox"/> US Survey Miles <input type="checkbox"/> Nautical Miles <input type="checkbox"/> Chains <input type="checkbox"/> Links
Grid angular units	u8	<input type="checkbox"/> Radians <input type="checkbox"/> Degrees <input type="checkbox"/> Degrees, Minutes, seconds <input type="checkbox"/> Gradians <input type="checkbox"/> Arc-seconds
Latitude of Origin	f64	
Central Meridian	f64	
False Easting	f64	Meters.
False Northing	f64	Meters.
Central Scale Factor	f64	
Custom identifier	i32	Used to define projection specific parameters. -2 <input type="checkbox"/> Custom -1 <input type="checkbox"/> Not used (Refer to Appendix C
Reserved 3	u8 * 50	Reserved

Device Identifiers provides a list of currently reserved Custom Identifiers.

10.14 1012 Roll Pitch Heave

Description: Motion Data Record.

Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 23: 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

10.15 1013 Heading

Description: Vessel Heading Record.

Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 24: 1013 - Record Type Header

NAME	SIZE	DESCRIPTION
Heading	f32	Vessel Heading in radians

10.16 1014 Survey Line

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

Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 25: 1014 - Record Type Header

NAME	SIZE	DESCRIPTION
Waypoint Count (N)	u16	Number of points in the line / route.
Position Type	u16	0 = Latitude / Longitude 1 = Grid Coordinates
Radius	f32	Turn radius between line segments (meters, 0 = no curvature in turns).
Line Name	u8 * 64	Null terminated string <input type="checkbox"/> line name.

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 26: 1014 - Record Data

NAME	SIZE	DESCRIPTION
Latitude or Northing 0	f64	Latitude (Radians) or Northing (Meters) $-\pi/2$ to $\pi/2$, -south
Longitude or Easting 0	f64	Longitude (Radians) or Easting (Meters) $-\pi$ to π , -west
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Latitude or Northing N-1	f64	Latitude (Radians) or Northing (Meters)
Longitude or Easting N-1	f64	Longitude (Radians) or Easting (Meters)

10.17 1015 □ Navigation

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

Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 27: 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 $-\pi/2$ to $\pi/2$, -south
Longitude	f64	Longitude of vessel reference point in Radians $-\pi$ 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

10.18 1016 Attitude

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

Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 28: 1016 - Record Type Header

NAME	SIZE	DESCRIPTION
Number of attitude data sets	u8	Number of Data Sets

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 29: 1016 - Record Data

NAME	SIZE	DESCRIPTION
Time difference from record timestamp 0	u16	Time difference in seconds
Roll [0]	f32	Roll measured in radians
Pitch [0]	f32	Pitch measured in radians
Heave [0]	f32	Heave measured in meters
Heading [0]	f32	Heading of vessel in radians
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Time difference from record timestamp [N-1]	u16	Time difference in seconds
Roll [N-1]	f32	Roll measured in radians
Pitch [N-1]	f32	Pitch measured in radians
Heave [N-1]	f32	Heave measured in meters
Heading [N-1]	f32	Heading of vessel in radians

10.19 2000 □ XYZ Data

Description: XYZ data points on local grid.

Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 30: 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 31: 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.

10.20 7000 □ 7k Sonar Settings

Description: This record is produced by the SeaBat □ 7k sonar 7-P processor series. It contains the current sonar settings. The 7-P processor updates this record for each ping. This record is available by subscription only.

Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 32: 7000 - 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 is the sequence number of the ping in the multi-ping sequence.
Frequency	f32	Transmit frequency in Hertz.
Sample rate	f32	Sample rate in Hertz
Receiver bandwidth	f32	In Hertz.
Tx Pulse width	f32	In seconds.
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 1 μPa
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 identifier	u32	Projector selection.
Projector beam steering angle vertical	f32	In radians.
Projector beam steering angle horizontal	f32	In radians.
Projector beam \square 3dB beam width vertical	f32	In radians.
Projector beam \square 3dB beam width horizontal	f32	In radians.
Projector beam focal point	f32	In meters.
Projector beam weighting window type	u32	0 \square Rectangular 1 \square 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 identifier	u32	Hydrophone selection.
Receive beam weighting window	u32	0 \square Chebychev 1 \square Kaiser
Receive beam weighting parameter	f32	N/A

NAME	SIZE	DESCRIPTION
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 number of pings in the multi-ping sequence. 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.

10.21 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 34*). 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.

The dynamic data section for each device is encoded using XML. A sample is provided below.

Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 33: 7001 - Record Type Header

NAME	SIZE	DESCRIPTION
Sonar Id	u64	Sonar serial number
N	u32	Number of devices/sonars.

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 34: 7001 - Record Data

NAME	SIZE	DESCRIPTION
Device 0 identifier	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 identifier	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.

XML SAMPLE □ 7125

```
<?xml version="1.0" encoding="US-ASCII" ?>
= <SB7125HF>
  <Name deviceid="7125" subsystemid="1" enumerator="0">7125
    (200kHz)</Name>
  <SonarType type="0" unit="nb">Bathymetric sonar</SonarType>
  <ArrayType type="1" unit="nb">Flat array</ArrayType>
  <RxElements min="0" max="127" unit="nb">Receive
    ceramics.</RxElements>
```

```

<RxBeams min="0" max="108" unit="nb">Receive
  beams.</RxBeams>
<RxBeamSpacing uniform="yes" angles="0.022"
  unit="rad">Receiver beamspacing.</RxBeamSpacing>
<RxBeamWidth uniformacross="yes" uniformalong="yes"
  across="0.008726646" along="0.471238898"
  unit="rad">Receiver beamspacing.</RxBeamWidth>
<RxBeamPosition first="2.5" last="0.0" unit="rad">Receiver beam
  positions.</RxBeamPosition>
<RxBeamStabilization type="0" />
<TxBeams min="0" max="0" unit="nb">Transmit
  beams.</TxBeams>
<TxBeamSteering steerable="no" maxx="0.0" minx="0.0" maxz="0.0"
  minz="0.0" unit="rad">Transmit beam
  steering.</TxBeamSteering>
<TxBeamSpacing uniform="yes" angles="0.0" unit="rad">Transmit
  beamspacing.</TxBeamSpacing>
<TxBeamWidth variable="no" maxx="0.471238898"
  minx="0.471238898" maxz="2.094395102"
  minz="2.094395102" unit="rad">Transmit
  beamwidth.</TxBeamWidth>
<TxBeamStabilization type="0" />
<Frequency chirp="No" min="200000.0" max="200000.0"
  unit="hz">Transmit frequency.</Frequency>
<SampleRate rate="34482.75862" unit="hz">Receiver sample
  rate.</SampleRate>
<Power min="185.0" max="220.0" unit="dB//uPa">Transmit
  power.</Power>
<Gain min="0.0" max="83.0" unit="dB">Receiver gain.</Gain>
<TxPulseLength min="0.000010" max="0.000300"
  type="Rectangular" unit="s">Transmit pulse
  length.</TxPulseLength>
<Range min="5.0" max="500.0" unit="m">Operating
  range.</Range>
<PingRate min="0.0" max="20.0" unit="p/s">Ping rate.</PingRate>
</SB7125HF>

```

10.22 7002 □ 7k Match Filter

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

Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 35: 7002 - Record Type Header

NAME	SIZE	DESCRIPTION
Sonar Id	u64	Sonar serial number
Ping number	u32	Sequential number.
Operation	u32	0 <input type="checkbox"/> Off 1 <input type="checkbox"/> On
Start frequency	f32	Hz.
Stop frequency	f32	Hz.

10.23 7004 7k Beam Geometry

Description: This record is produced by the 7kCenter. It contains the receive beam widths and steering. The 7kCenter updates this record when any of the values have changed. This record is available by subscription only.

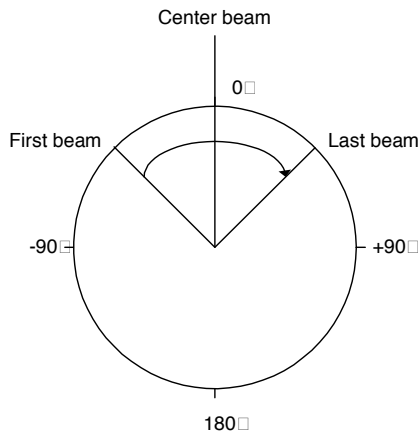


Figure 2: Sonar Beam Angle Convention

Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 36: 7004 - Record Type Header



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

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 37: 7004 - Record Data

NAME	SIZE	DESCRIPTION
Beam vertical direction angle[N]	f32*N	Angle in radians. The receiver beam steering angle (relative to nadir) applied in the along-track direction (typically 0).
Beam horizontal direction angle[N]	f32*N	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[N]	f32*N	Angle in radians. The receiver along-track beam width measured at the -3dB points (typically <30°).
-3dB Beam width X[N]	f32*N	Angle in radians. The receiver across-track beam width measured at the -3dB points (typically <5°).

10.24 7005 □ 7k Calibration Data

Description: This record is produced by the 7kCenter. It contains the receiver gain and phase offsets. The 7-P processor updates this data after receiver calibration operation. The record can be manually requested from the 7kCenter. This record is not available for subscription. For details about requesting records see record 7500 together with *Section 11, 7k Remote Control Definitions*.

Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 38: 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 39: 7005 - Record Data

NAME	SIZE	DESCRIPTION
Receiver gain [0]	f32	Receiver gain values relative to a nominal gain of 1.0.
□	□	□
Receiver phase [N-1]	f32	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.

10.25 7006 □ 7k Bathymetric Data

Description: This record is produced by the 7kCenter series. It contains the sonar bottom detection results. This record is typically not available in a forward looking sonar configuration. The 7kCenter updates this data for each ping. This record is available by subscription only.

Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 40: 7006 - 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	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 41: 7006 - Record Data

NAME	SIZE	DESCRIPTION
Range [N]	f32*N	Two way travel time in seconds

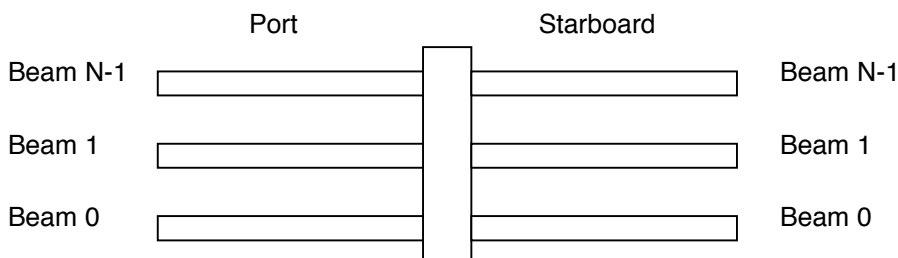
NAME	SIZE	DESCRIPTION
Quality [N]	u8*N	BITFIELD: Bit 0: Brightness: 1 = pass, 0 = fail Bit 1: Colinearity: 1 = pass, 0 = fail Bit 2: Bottom Detect Process (Magnitude): 1 = used, 0 = not used. Bit 3: Bottom Detect Process (Phase): 1 = used, 0 = not used. Bit 4-7: Reserved.
Intensity [N]	f32*N	Signal strength dB re 1 μ Pa. Value at bottom detect.
Min Filter Info	f32*N	Minimum 2-way travel time to filter point for each beam (minimum depth gate).
Max Filter Info	f32*N	Maximum 2-way travel time to filter point for each beam (maximum depth gate).

See PDS2000 Optional Data for information on Optional Data.

10.26 7007 7k Backscatter Imagery Data

Description: This record is produced by the 7kCenter. It contains the side scan sonar data. This record is typically not available in a forward looking sonar configuration. The 7kCenter updates this data for each ping. This record is available by subscription only.

Beam port and starboard numbering figure:



Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 42: 7007 □ 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.
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 per side (port / starboard).
Port -3dB beam width Y	f32	In radians.
Port -3dB beam width Z	f32	In radians.
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).



NAME	SIZE	DESCRIPTION
W	u8	Number of bytes per sample.
Data types	u8	BITFIELD: 0: Magnitude 1: Phase

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 43: 7007 Record Data

NAME	SIZE	DESCRIPTION
Port beams	W * S	Magnitude/Phase series. First sample represents range 0 meters. (Total bytes per side.)
Starboards beam	W * S	Magnitude/Phase series. First sample represents range 0 meters. (Total bytes per side.)

See PDS2000 Optional Data for information on Optional Data.

10.27 7008 □ 7k Generic Data

Description: This record is produced by the 7kCenter. It contains the sonar beam \square and \square or magnitude and phase data. The 7kCenter transmits this data for each ping. This record is available by subscription only.

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.

The Record Data portion is divided into two distinct parts:

1. Beam Descriptors
2. Sample Data

Beam Descriptors:

This part of the Record Data section contains each beam descriptor, followed by the beginning and ending sample numbers for that beam. For example:

b0 s1 s100 b2 s1 s100 b3 s1 s100 □

where b = Beam
s = sample

Sample Data

After all of the beams and their corresponding samples have been listed, the sample data will be output.

Sample data will be output in one of two ways:

1. All samples for a beam followed by all samples for the next beam (Row Column Flag = 0)
2. First sample for each beam followed by next sample for each beam (Row Column Flag = 1).

For example:

1. If the Row Column Flag = 0, the second part of the data would be:

sd_0 $\square \square \square \square \square$. sd_N	sd_0 $\square \square \square \square \square \square$ sd_N
(beam 1)	(beam 2)

where sd = sample data

2. If the Row Column Flag = 0, the second part of the data would be:



where b_x = sample data for each beam

Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 44: 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 beam descriptors 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 □ All samples for a beam, followed by all samples for the next beam. 1 □ Sample 1 for all beams, followed by Sample 2 for all beams, etc.
Reserved	u16	Reserved

NAME	SIZE	DESCRIPTION
Data sample type(s)	u32	<p>BITFIELD</p> <p>(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. Magnitude is a u4 with possible values in range 0 to 16)</p> <p>0-3 Magnitude:</p> <ul style="list-style-type: none"> 0 = No magnitude 1 = Reserved 2 = Magnitude (16 bits) 3 = Magnitude (32 bits) <p>4-7 Phase:</p> <ul style="list-style-type: none"> 0 = No phase 1 = Reserved 2 = Phase (16 bits) 3 = Phase (32 bits) <p>8-11 I and Q:</p> <ul style="list-style-type: none"> 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 <p>12 -14 Beam forming Flag:</p> <ul style="list-style-type: none"> 0 = Beam formed data 1 = Element data

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 45: 7008 Record Data (Part 1)

NAME	SIZE	DESCRIPTION
Descriptor 0	u16	First beam or element number.
First sample number	u32	First sample number in beam from transmitter and outward.
Last sample number	u32	Last sample number in beam from transmitter and outward.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Descriptor N-1	u16	Last beam or element number.

NAME	SIZE	DESCRIPTION
First sample number	u32	First sample number in beam from transmitter and outward
Last sample number	u32	Last sample number in beam from transmitter and outward.

Table 46: 7008 Record Data (Part 2)

NAME	SIZE	DESCRIPTION
First column / row	dynamic	First sample header + Magnitude/Phase series. Array is populated with samples from transmitter and outward, or beams from low beam number and increasing.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Last column / row	dynamic	Last Sample header + Magnitude/Phase series. Array is populated with samples from transmitter and outward, or beams from low beam number and increasing.

See PDS2000 Optional Data for information on Optional Data.

Additional SeaBat data settings (data reduction)

Beam limits, sample limits and SeaBat format types can be combined.

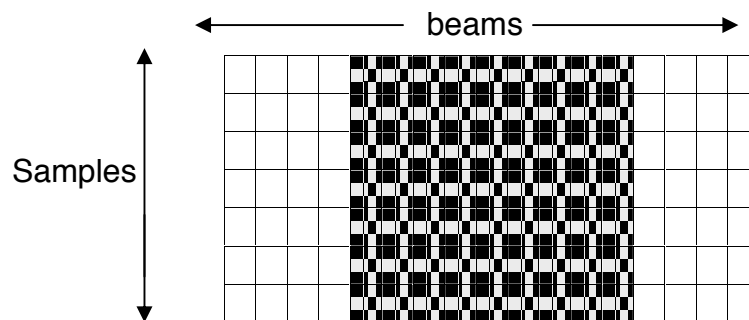


Figure 3: Beam Limits Set Min and Max Beam

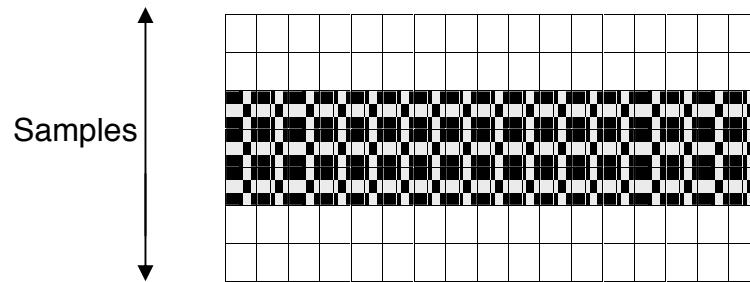


Figure 4: Sample Limits □ Set Min and Max Sample

10.28 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 47: 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 $-\pi/2$ 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
Along Track Distance	f32	Along track distance in vessel grid from reference point. Units = meters

NAME	SIZE	DESCRIPTION
Across Track Distance	f32	Across track distance in vessel grid from vessel reference point. Units = meters
Vertical Depth	f32	Vertical depth relative to chart datum (or relative to vessel if tidal data is unavailable). Units = meters

10.29 7010 □ TVG Gain Values

Description: This record provides the TVG Gain values, one for each sample in the ping.

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 48: 7010 - 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.
Reserved	u32	Reserved.
N	u32	Number of gain values to follow (1 float per sample). Also the number of samples per beam in the ping.

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 49: 7010 - Record Data

NAME	SIZE	DESCRIPTION
Sample [0]	u32	
□	□	□
Sample [N-1]	u32	

10.30 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. This record is available by subscription only.

The image data is arranged in bitmap format. The sample magnitude values sets the pixel intensities.

Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 50: 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.
W	u32	Image width in pixels.
H	u32	Image height in pixels.
Color depth	u16	Color depth (bits per pixel).
Reserved	u16	Reserved.
Compression algorithms	u16	Reserved for future use.
Samples	u32	Original samples prior to compression
Reserved1	u32*8	Reserved.

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 51: 7011 - Record Data

NAME	SIZE	DESCRIPTION
First row	Dynamic (1024 max)	All beams left to right
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Last row	Dynamic (1024 max)	All Beams left to right

10.31 7022 7kCenter Version

Description: This record provides the 7kCenter version as a NULL terminated string.

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 52: 7022 - Record Type Header

NAME	SIZE	DESCRIPTION
Version String	u8*32	ASCII string, max length 31 characters + null.

10.32 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:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

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]	

NAME	SIZE	DESCRIPTION
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.
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	Seconds
Position sensor X	f32	X offset in meters.
Position sensor Y	f32	Y offset in meters.
Position sensor Z	f32	Z offset in meters.

NAME	SIZE	DESCRIPTION
Position sensor time delay	u16	Seconds
Water line vertical offset	f32	Vertical offset from reference point to waterline in meters.

10.33 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 *Section 11, 7k Remote Control Definitions*.

Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 54: 7050 - Record Type Header

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

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 55: 7050 - Record Data

NAME	SIZE	DESCRIPTION
Event type 0	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 (or 7000 for system event).
System enumerator	u16	System enumerator for identical systems in one installation.



NAME	SIZE	DESCRIPTION
Event message length (L)	u16	Message length including termination character.
7KTIME	u8*10	Time tag.
Event message	u8*L	Fixed-width string.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Event type N-1	u16	0 <input type="checkbox"/> Success. 1 <input type="checkbox"/> Information. 2 <input type="checkbox"/> Warning. 3 <input type="checkbox"/> Error.
Event identifier	u16	0 <input type="checkbox"/> Not defined.
Device identifier	u32	Identifier of the device that this data pertains.
System enumerator	u16	System enumerator for identical systems in one installation.
Event message length (L)	u16	Message length including termination character.
7KTIME	u8*10	Time tag.
Event message	u8*L	Fixed-width string.

10.34 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 *Section 11, 7k Remote Control Definitions*.

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.

10.35 7052 7k Data Storage Status Information

Description: SeaBat 7k data storage status information. This record is generated at every 1% drop in disk capacity and on any start or stop of recording or playback,. 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 *Section 11, 7k Remote Control Definitions*.

Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 58: 7052 - Record Type Header

NAME	SIZE	DESCRIPTION
Position	u32	Seconds since start of recording.
Disk Free	u8	Percent of disk space free (0 100).
Mode	u8	0 = Stopped 1 = Recording 2 = Playing 3 = Deleting 4 = Reserved for FF
FileRecords	u32	Total number of records in file at the time the request is processed.
FileSize	u64	File size in bytes.
First 7KTIME	u8*10	Time tag first record time.
Last 7KTIME	u8*10	Time tag last record time.
Total Time	u32	Time span between first and last record (in seconds).
Directory Name	u8*256	Current Directory Name. Null-terminated ASCII string.
File Name	u8*256	Current file name. Null-terminated ASCII string.
Reserved	u32*8	Reserved

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 59: 7052 - Record Data

NAME	SIZE	DESCRIPTION
Threshold length (NT)	u32	Threshold Array Length
Threshold value array	u32*NT	Array of NT percentage threshold values.
Included Records (IR)	u32	Number of included records.
Included Records Array	u32*IR	Array of IR included records.
Excluded Records (ER)	u32	Number of excluded records.
Excluded Records Array	u32*ER	Array of ER excluded records.
Included Devices (ID)	u32	Number of included devices.
Included Devices Array	u32*ID	Array of ID Included Devices.
Excluded Devices (ED)	u32	Number of excluded devices.
Excluded Devices Array	u32*ED	Array of ED Excluded Devices.

10.36 7200 □ 7k File Header

Description: First record of 7k Data File.

Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 60: 7200 - Record Type Header

NAME	SIZE	DESCRIPTION
File identifier	u128	
Version number	u16	File format version number.

NAME	SIZE	DESCRIPTION
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 ($N \geq 0$).
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.

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 61: 7200 - Record Data

NAME	SIZE	DESCRIPTION
Device Identifier 0	u32	Identifier for record type of embedded data.
System enumerator 0	u16	Identifier for the device enumerator.
...
Device Identifier N-1	u32	Identifier for record type of embedded data.
System enumerator N-1	u16	Identifier for the device enumerator.

10.37 7400 Time Message

Description: This record is used to time-sync the 7kCenter. The leap second offset field can be used to flag for leap second inserts ahead of time. The current time is shown in the 7KTIME field of the DRF.

Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 62: 7400 - Record Type Header

NAME	SIZE	DESCRIPTION
Leap second offset	i8	-1, 0 or +1 second for midnight 31 Dec.
Pulse flag	u8	0 <input type="checkbox"/> Message is not associated with hardware pulse. 1 <input type="checkbox"/> Message preceding hardware pulse. 2 <input type="checkbox"/> 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.

10.38 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 *Section 10, Record Type Definitions*. 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 63: 7500 - Record Type Header

NAME	SIZE	DESCRIPTION
Remote control ID	u32	See separate remote control table for details. See <i>Section 10, Record Type Definitions</i> .
Ticket	u32	Ticket 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 64: 7500 - Record Data

NAME	SIZE	DESCRIPTION
Remote control data	variable	Value(s). See <i>Section 11 7k Remote Control Definitions</i> for descriptions.

10.39 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 65: 7501 - Record Type Header

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

10.40 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 66: 7502 - Record Type Header

NAME	SIZE	DESCRIPTION
Ticket	u32	Ticket number in record 7500.
Tracking number	u128	Unique number in record 7500.
Error code.	u32	See <i>Appendix D 7k Error Codes</i> for details.

10.41 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 Sections 10.38 7500 □ 7k Remote Control and 11 7k Remote Control Definitions.

Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 67: 7503 - Record Type Header

NAME	SIZE	DESCRIPTION
Sonar Id	u64	Sonar serial number.
Ping number	u32	Sequential number.
Frequency	f32	Center transmit frequency in Hertz.
Sample rate	f32	Sample 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/μPa
Gain selection	f32	Gain selection in dB.

NAME	SIZE	DESCRIPTION
Control flags	u32	BITFIELD: Bit 0-3: Auto range method. Bit 4-7: Auto bottom detect filter method. Bit 8: Bottom detect range filter enabled. Bit 9: Bottom detect depth filter enabled. Bit 10-14: Reserved for Auto receiver gain method. Bit 15-31: Reserved.
Projector identifier	u32	Projector selection.
Projector beam steering angle vertical	f32	In radians.
Projector beam steering angle horizontal	f32	In radians.
Projector beam \square 3dB beam width vertical	f32	In radians.
Projector beam \square 3dB beam width horizontal	f32	In radians.
Projector beam focal point	f32	In meters.
Projector beam weighting window type	u32	0 \square Rectangular 1 \square Chebychev
Projector beam weighting window parameter	f32	N/A
Transmit flags	u32	BITFIELD: Bit 0-3: Pitch stabilization method. Bit 4-7: Yaw stabilization method. Bit 8-31: Reserved.
Hydrophone identifier	u32	Hydrophone selection.
Receive beam weighting window	u32	0 \square Chebychev 1 \square Kaiser
Receive beam weighting parameter	f32	N/A

NAME	SIZE	DESCRIPTION
Receive flags	u32	BITFIELD: Bit 0-3: Roll stabilization method. Bit 4-7: Dynamic focusing method. Bit 8-11: Doppler compensation method. Bit 12-15: Match filtering method. Bit 16-19: TVG method. Bit 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. Bit 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 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



NAME	SIZE	DESCRIPTION
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
Data Sample Type(s)	u32	from Table 8
Projector Orientation	u8	0 = Down 1 = Up
Equiangle / Equidistant Mode	u16	1 = Equiangle 2 = Equidistant
7kCenter Mode	u16	0 = Normal 1 = Autopilot 2 = Calibration (IQ) 3+ = Reserved
Adaptive Gate Filter Information	f32	Min Depth (if Adaptive Gate depth filter is active)
Adaptive Gate Filter Information	u32	Max Depth (if Adaptive Gate depth filter is active)
Reserved	u16	Reserved
Reserved	u32 * 17	Reserved

10.42 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 *Section 11, 7k Remote Control Definitions*.

Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 68: 7610 - Record Type Header

NAME	SIZE	DESCRIPTION
Sound Velocity	f32	In meters / second.

10.43 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 *Section 11, 7k Remote Control Definitions*.

Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 69: 7611 - Record Type Header

NAME	SIZE	DESCRIPTION
Absorption Loss	f32	In dB / km.

10.44 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 *Section 11, 7k Remote Control Definitions*.

Data Definition:

DRF	RTH	RD	OD	DRF
-----	-----	----	----	-----

Table 70: 7612 - Record Type Header

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

10.45 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 71: 8100 - Record Type Header

NAME	SIZE	DESCRIPTION
Type	u8	0 <input type="checkbox"/> Unspecified 1 <input type="checkbox"/> R_THETA_DATA_VERY_OLD 2 <input type="checkbox"/> RI_THETA_DATA_VERY_OLD 3 <input type="checkbox"/> R_THETA_DATA_OLD 4 <input type="checkbox"/> RI_THETA_DATA_OLD 5 <input type="checkbox"/> R_THETA_DATA 6 <input type="checkbox"/> RI_THETA_DATA 7 <input type="checkbox"/> SIDESCAN_IMAGE 8 <input type="checkbox"/> RAW_DATA 9 <input type="checkbox"/> SONAR_STATUS 10 <input type="checkbox"/> SNIPPET >10 <input type="checkbox"/> Reserved.
Flags	u8	BITFIELD: 0: Embedded data format is 0 = big Endian 1 = little Endian. 1: Embedded checksums are: 1 = valid 0 = invalid 2 <input type="checkbox"/> 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

11 7K REMOTE CONTROL DEFINITIONS

This is a detailed discussion of the Record Data section of the 7500 record. The SeaBat 7k series system supports all commands or a subset of the below commands.

Table 72: 7k Remote Control Definitions

IDENTIFIER	DESCRIPTION	POSSIBLE RETURN RECORDS
1000	Shutdown	7501, 7502
1001	Reboot	7501, 7502
1002	Reserved for Calibrate	
1003	Range	7501, 7502
1004	Max Ping Rate	7501, 7502
1005	Transmit Power	7501, 7502
1006	Pulse Width	7501, 7502
1007	Pulse Type	7501, 7502
1008	Receiver Gain	7501, 7502
1009	Bottom Detection Mask	7501, 7502
1010	Bottom Detection Filter Info	7501, 7502
1011	Reserved	
1012	Reserved for Projector Stabilization	
1013	Reserved for Receive Beam Stabilization	
1014	7kCenter Mode Selection	7501, 7502
1015	Reserved for Hydrophone Selection.	
1016	Reserved	
1017	Reserved for Receiver Gain Type	
1018	Reserved for TVG Coefficients	
1019	Reserved for Auto Receiver Gain	
1020	Reserved for Transmit Pulse Envelope Identifier	
1021	Transmit Beam Steering	7501, 7502



IDENTIFIER	DESCRIPTION	POSSIBLE RETURN RECORDS
1022	Projector Beam Widths	7501, 7502
1023	Reserved for Projector Beam Focal Point	
1024	Reserved for Projector Beam Weighting	
1025	Reserved for Receive Beam Weighting	
1026	Reserved for Transmit Center Frequency	
1027	Transmit Frequencies For Chirps	7501, 7502
1028	Reserved for Head Tilt	
1029	Reserved for Tx Position Relative To Rx	
1030	Reserved for Projector Orientation	
1032	Reserved for Beam Spacing Mode	
1050	Single Record Request	7503, 7001, 7002, 7005, 7050, 7051, 7052, 7600, 7611, 7612
1051	Record Subscription	7503, 7000, 7001, 7002, 7004, 7006, 7007, 7008, 7011, 7018, 7028, 7038, 7050, 7051, 7052, 7500, 7610, 7611, 7612
1052	End All Subscriptions	7501, 7502
1053	Third Party Data Connection	7501, 7502
1054	Delete Third Party Data Connection	7501, 7502
1055	Data Feed, Range Of Records	7501, 7502, and all subscribed records
1056	Unsubscribe Records On Data Feed	7501, 7502
1057	Reserved for Subscriber Info	
1100	Start Pinging.	7501, 7502
1101	Stop Pinging.	7501, 7502
1102	Load Factory Parameters	7501, 7502
1103	Snippet Control	7501, 7502
1104	Beam Limit Control	7501, 7502



IDENTIFIER	DESCRIPTION	POSSIBLE RETURN RECORDS
1105	Data Sample Type	7501, 7502
1106	Reserved for Sonar Sequencer Control	
1107	Single Ping Request	7501, 7502
1108	Reserved for Load Factory Parameters, Specific Sonar	
1109	System Health Verification	7501, 7502
1111	Reserved for Set Multi-Ping Mode (On/Off)	
1200	Start Record	7501, 7502
1201	Stop	7501, 7502
1202	Start Playback	7501, 7502
1203	Reserved for DR Delete	
1204	DR Status	7501, 7502, 7052
1205	Reserved for Catalog	
1206	Set Warning Thresholds	7501, 7502
1207	Set Recording Directory	7501, 7502
1209	Set Filtering	7501
1300 □ 1305	Reserved	

11.1 1000 Shutdown

Description: Software and firmware halt followed by power shutdown to dry and wet hardware.

This command has no parameters.

11.2 1001 Reboot

Software and firmware reset.

This command has no parameters.

11.3 1003 - Range

Description: System Range Setting

Table 73: 7500 Record Data - Command 1003

NAME	SIZE	DESCRIPTION
Range	f32	Range setting in meters.

11.4 1004 Max Ping Rate

Description: Max ping setting

Table 74: 7500 Record Data - Command 1004

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

11.5 1005 Transmit Power

Description: System transmit power setting

Table 75: 7500 Record Data - Command 1005

NAME	SIZE	DESCRIPTION
Transmit Power	f32	Transmit power in dB re 1 μ Pa@1m

11.6 1006 Pulse Width

Description: System transmit pulse width setting

Table 76: 7500 Record Data - Command 1006

NAME	SIZE	DESCRIPTION
Transmit Pulse Width	f32	Transmit Pulse Width in seconds

11.7 1007 Pulse Type

Description: System transmit pulse type.

Table 77: 7500 Record Data - Command 1007

NAME	SIZE	DESCRIPTION
Transmit Pulse Type	u32	0 = CW 1 = Linear chirp

11.8 1008 Receiver Gain

Description: System receiver gain.

Table 78: 7500 Record Data - Command 1008

NAME	SIZE	DESCRIPTION
Receiver Gain	f32	Gain selection in dB.

11.9 1009 Bottom Detection Mask

Description: System bottom detection mask.

Table 79: 7500 Record Data - Command 1009

NAME	SIZE	DESCRIPTION
Bottom Detection Flag	u32	BITFIELD: 0-3: Reserved 4-7: Reserved for bottom detection method. 8: Range filter (1 = Enabled, 0 = Disabled) 9: Depth filter (1 = Enabled, 0 = Disabled) 10: Adaptive Gate (1 = Enabled, 0 = Disabled) 11: Adaptive Gate Depth Filter (1 = Enabled, 0 = Disabled) 12-31: Reserved

11.10 1010 Bottom Detection Filter Information

Description: System bottom detection filter information.

Table 80: 7500 Record Data - Command 1010

NAME	SIZE	DESCRIPTION
Min Range	f32	In meters.
Max Range	f32	In meters.
Min Depth	f32	In meters.
Max Depth	f32	In meters.

11.11 1014 7kCenter Mode Selection

Description: Set 7kCenter mode.

Table 81: 7500 Record Data - Command 1014

NAME	SIZE	DESCRIPTION
Mode	u16	0 = Normal 1 = Autopilot 2 = Calibration (IQ) 3 = Reserved
Auto Method	u16	Auto Range Method

11.12 1021 Projector Beam Steering

Description: Horizontal and vertical projector beam steering. *This command is only available for selected systems.*

Table 82: 7500 Record Data - Command 1021

NAME	SIZE	DESCRIPTION
Projector Beam Steering Horizontal	f32	In Radians
Projector Beam Steering Vertical	f32	In Radians

11.13 1022 Projector Beam Widths

Description: Horizontal and vertical projector beam widths. *This command is only available for selected systems.*

Table 83: 7500 Record Data - Command 1022

NAME	SIZE	DESCRIPTION
Horizontal projector beam <input type="checkbox"/> 3dB beam width	f32	In Radians.
Vertical projector beam <input type="checkbox"/> 3dB beam width	f32	In Radians.

11.14 1024 DR Status

Description: Returns status of Data Recorder (Record 7052).

This command has no parameters.

11.15 1027 - Transmit Frequencies For Chirps

Description: Transmit pulse start and stop frequencies.

Table 84: 7500 Record Data - Command 1027

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

11.16 1050 Single Record Request

Description: Request latest record.

Table 85: 7500 Record Data - Command 1050

NAME	SIZE	DESCRIPTION
Record type	u32	Possible Responses: <ul style="list-style-type: none"> 7501 followed by the requested record. Will be one of the following: 1002, 1003, 1004, 1005, 1006, 1007, 1008, 1009, 1010, 1011, 1012, 1013, 1014, 1015, 1016, 1050, 7001, 7002, 7004, 7005, 7022, 7050, 7052, 7400, 7503, 7610, 7611, 7612. 7502 (NACK)

11.17 1051 Record Subscription

Description: Subscribe to records. The host is responsible to keep this connection alive as well as re-establish a lost connection to the 7-P processor.

Table 86: 7500 Record Data - Command 1051

NAME	SIZE	DESCRIPTION
N	u32	Number of records.
Array of record numbers.	u32 * N	Possible Responses: <ul style="list-style-type: none"> 7501 followed by the subscribed record(s): Will be one or more of the following: 7503, 7000, 7002, 7004, 7006, 7007, 7008, 7011, 7050, 7051, 7052, 7055 7502 (NACK)

11.18 1052 End All Subscriptions

Description: Unsubscribe to all records.

This command has no parameters.

11.19 1053 Third Party Data Connection

Description: Add UDP or TCP connection to 7kCenter, with specification of records to subscribe to.

Table 87: 7500 Record Data - Command 1053

NAME	SIZE	DESCRIPTION
Address	u32	IP address (Host Byte Data Order).
Port	u16	Port number.
Type	u16	0 = UDP, 1 = TCP.
# Records	u32	Number records
Record list	u32*N	Array of record IDs. N = # Records

11.20 1054 Delete Third Party Data Connection

Description: Delete UDP or TCP connection to 7kCenter. All three parameters must match those provided in the 1053 record for the connection to be deleted.

Table 88: 7500 Record Data - Command 1054

NAME	SIZE	DESCRIPTION
Address	u32	IP address. (Host Byte Data Order)
Port	u16	Port number.
Type	u16	0 = UDP 1 = TCP.

11.21 1055 Data Feed, Range of Records

Description: Create 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.

Table 89: 7500 Record Data - Command 1055

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

11.22 1056 Unsubscribe Records On Data Feed

Description: Remove specified records from the subscription list of a connection. The subscription list is set via the 1051 or 1055 records. The feed will be stopped if no records are left in the subscription list after this record is sent.

Table 90: 7500 Record Data - Command 1056

NAME	SIZE	DESCRIPTION
N	u32	Number of records.
Array of record numbers	N*u32	Any records that are subscription-enabled for the current system.

11.23 1100 Start Pinging

Description: Start continuous pinging. (Pinging will not start if the Max Ping Rate is set to zero.)

This command has no parameters.

11.24 1101 Stop Pinging

Description: Stop pinging.

This command has no parameters.

11.25 1102 Load Factory Parameters

Description: Load Factory Parameters from disk.

This command has no parameters.

11.26 1103 Snippet Control

Description: Limit record 7008's sample range to a window around the bottom detection ranges.

Table 91: 7500 Record Data - Command 1103

NAME	SIZE	DESCRIPTION
Enable	u32	0 <input type="checkbox"/> Disable snippet sample limitation. 1 <input type="checkbox"/> Enable snippet sample limitation.
Window size	u32	Number of samples around bottom detection for each beam.

11.27 1104 Beam Limit Control

Description: Limit the number of beams in record 7008.

Table 92: 7500 Record Data - Command 1104

NAME	SIZE	DESCRIPTION
Min beam	u32	Minimum beam number. 0 to beams <input type="checkbox"/> 1
Max beam	u32	Maximum beam number. 0 to beams <input type="checkbox"/> 1

NOTE:

There are two ways to turn off beam limits:

1. Send 0,0 for the Min and Max beams.
2. Send 0,nbeams-1 for the Min and Max beams.

If either the Min Beam or the Max Beam is greater than nbeams-1, or if the Min Beam value is greater than the Max Beam value, the 7kCenter will return a NACK message (7502) and no action will be taken.

11.28 1105 □ Data Sample Type.

Description: Set the data sample type for record 7008, 7018, or 7028.

Table 93: 7500 Record Data - Command 1105

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

11.29 1107 □ Single Ping Request

Description: Request for a single ping.

NOTE:

This request will halt continuous pinging if it has been started.

This command has no parameters.

11.30 1109 □ System Health Verification

Description: Request Acknowledgement (Record 7501) from sonar

This command has no parameters.

11.31 1200 Start Recording

Description: Start Recording. The Directory (see ID 1207) and Filename combined must not exceed 256 characters.

Table 94: 7500 Record Data - Command 1200

NAME	SIZE	DESCRIPTION
Append Flag	u32	0 = Overwrite Existing File. 1 = Append to end of file.
Filename	u8*256	<p>Null terminated ASCII string. Maximum 256 characters, including null character.</p> <p>If the filename is NULL (empty), the file name is created according to <i>8.2 File Nomenclature</i> (ie: UTC time stamp). If the file name is not fully qualified (no drive and/or directory) or NULL, the file will be saved in the application directory, unless a different default directory has been selected with command 1207.</p> <p>If a fully qualified path name <input type="checkbox"/> including drive (or UNC network resource), directory, and filename <input type="checkbox"/> is supplied, it will be used. The directory must exist. It will not be created.</p> <p>The .s7k extension will be added to the filename. The file name length + the directory path length cannot exceed 256 characters.</p>

11.32 1201 Stop

Description: Stop recording or playback (whichever is in progress).

This command has no parameters.

11.33 1202 □ Start Playback

Description: Sets up playback mode and begins record output. A NACK is generated if the file name is NULL, or if the current state is PLAYBACK or RECORDING when this record is received.

Table 95: 7500 Record Data - Command 1202

NAME	SIZE	DESCRIPTION
Start flag	u16	1 = time in seconds. 2 = record number.
Start point	u32	Seconds or record number
Frequency	i32	Playback frequency: 0 = Real Time <0 = As fast as possible. >0 = Records per second.
File Name	u8 * 256	Null-terminated ASCII string. 256 Characters maximum, including null character. The full path (drive and directory) must be specified with the file name. (The directory specified in the 1207 command record will not be used.)

11.34 1206 □ Set Warning Threshold(s)

Description: Set the low-drive-space warning threshold values. The warning levels are specified as percentages. Whenever free drive space on the active volume drops from one level to another, a 7051 (System Event) record will be generated by the 7kCenter.

Table 96: 7500 Record Data - Command 1206

NAME	SIZE	DESCRIPTION
N	u16	Number of integer percentage threshold values to follow. Maximum number is 100.
Value array	u32*N	Array of N percentage threshold values. Must be in descending order.

11.35 1207 Set Recording Directory

Description: Set DR data file storage directory. The combined directory and file name cannot exceed 256 characters. Data cannot be recording or playing for this command to be accepted.

Table 97: 7500 Record Data - Command 1207

NAME	SIZE	DESCRIPTION
Directory	u8*256	<p>New directory pathname. Null-terminated ASCII string. A trailing backslash (\) will be appended if necessary.</p> <p>Network paths should be specified as (for example): \\server\directory</p> <p>In the event that the directory does not exist, it will be created (if possible).</p>

11.36 1209 Set Filtering

Description: Set playback mode OR record mode filtering. Allows for exclusionary or inclusionary record filtering during playback or recording. To turn filtering OFF for a particular type, you must send this record with N=0.

The 7k records available for recording are contained in Record 7052, which is available as a single record request or subscriptions. Currently, the following records are available: 1000, 1001, 1010, 1012, 7000, 7002, 7004, 7006, 7007, 7008, 7011, 7051, 7052, 7511, 7503.

The minimal record set should include 7000, 7004, and either 7006 (bathymetry) or 7008 (FLS).

Table 98: 7500 Record Data - Command 1209

NAME	SIZE	DESCRIPTION
Filter Type	u16	0 = by record, 1 = by device
Filter Method	u16	1 = all records will be included
N	u16	Number of record IDs (maximum 128) or device IDs (maximum 5)
Filter List	u32*N	List of N record IDs or device IDs for filtering to act upon.

APPENDIX A PDS2000 OPTIONAL DATA

The following tables show optional data that may be sent for compatibility with PDS2000.

DRF	RTH	RD	OD	DRF
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Table 99: 7006 - 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 - 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 (in radians) at transmit time
Pitch	f32	Pitch (in radians) at transmit time
Heave	f32	Heave (in radians) 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 <input type="checkbox"/> Depth	f32	Depth relative chart datum (or relative waterline if Height source = 0). Units = meters
Beam 0 <input type="checkbox"/> Along track distance	f32	Along track distance in vessel grid.

NAME	SIZE	DESCRIPTION
		Units = meters
Beam 0 <input type="checkbox"/> Across track distance	f32	Across track distance in vessel grid. Units = meters
Beam 0 <input type="checkbox"/> Pointing angle	f32	Beam pointing angle from vertical in radians
Beam 0 <input type="checkbox"/> Azimuth angle	f32	Beam azimuth angle in radians

Table 100: 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.

Table 101: 7008 and 7028 - 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
Following set of data items is repeated for each beam.		



NAME	SIZE	DESCRIPTION
Beam <input type="checkbox"/> Along track distance	f32	Along track distance in vessel grid. Units = meters
Beam <input type="checkbox"/> Across track distance	f32	Across track distance in vessel grid. Units = meters
Center sample number	u32	Sample number at detection point of beam.

APPENDIX B DEVICE IDENTIFIERS

The Data Record Frame (see *Table 4: Data Record Frame*) requires a Device Identifier parameter. The table below provides the list of valid Device Identifiers and their descriptions.

Table 102: Device Identifiers

DEVICE 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



DEVICE IDENTIFIER	VENDOR	DESCRIPTION
7125	RESON	SeaBat□ 7125
7128	RESON	SeaBat□ 7128
7150	RESON	SeaBat□ 7150
7160	RESON	SeaBat□ 7160
8100	RESON	SeaBat□ 8100
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
10200	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	lfremer	Techsas
12000	Simrad	Simrad RPT319

APPENDIX C 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 103: 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

CUSTOM IDENTIFIER	PROJECTION
20	Miller Cylindrical
21	Mollweide
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

APPENDIX D 7K ERROR CODES

Code	Description
0x7000 (28672)	SYSTEM_NOT_READY 7KSystem is not ready for task requested
0x7001 (28673)	PARAMETER_OUT_OF_RANGE Data for this function is not within range specification for this sonar
0x7002 (28674)	RECORD_NOT_AVAILABLE Requested record does not exist. Invalid record number
0x7003 (28675)	MEMORY_ALLOCATION_ERROR Required memory allocation for task failed.
0x7004 (28676)	FIRMWARE_NOT_AVAILABLE Failure with AlphaData/Prpmc. Software not loaded, failed, or hardware failed
0x7005 (28677)	EXTERNAL_RECORD_NOT_AVAILABLE 1000 series records must be recieved from external source
0x7006 (28678)	FEATURE_NOT_AVAILABLE Option not avaiable or under development
0x7007 (28679)	REMOTE_COMMAND_NOT_FOUND Not a valid command, ie an invalid 7500 ticket like 1483
0x7008 (28680)	INVALID_PARAMETER Data not within DFD specifications
0x7009 (28681)	INVALID_DEVICE_ID Invalid device Identifier

Code	Description
0x700A (28682)	RECORD_IS_SUBSCRIPTION_ONLY Record is only available though subscription
0x7050 (28752)	NETWORK_PROTOCOL_VERSION Invalid network protocol version
0x7051 (28753)	NETWORK_OFFSET Invalid network offset
0x7052 (28754)	DATA_PROTOCOL_VERSION Record frame protocol version not valid
0x7053 (28755)	DATA_SYNC_PATTERN Record frame sync pattern not valid
0x7054 (28756)	DATA_CHECKSUM Checksum invalid. Data or checksum corrupted
0x7055 (28757)	SYSTEM_EVENT_NOT_LOGGED Last system event did not get logged
0x7101 (28929)	RDR_BUSY RDR system is already recording or in playback.
0x7102 (28930)	RDR_STOPPED RDR is already stopped
0x7103 (28931)	RDR_MEMORY_ALLOCATION_ERROR RDR memory allocation failed
0x7104 (28932)	RDR_BUFFER_NULL RDR allocated a null buffer
0x7105 (28933)	RDR_BUFFER_TOO_SMALL RDR Buffer size is smaller than that needed

Code	Description
0x7106 (28934)	RDR_NO_FILENAME File name given to RDR is invalid or no longer exists.
0x7107 (28935)	RDR_INVALID_PARAMETER Parameter passed to RDR is not valid
0x7108 (28936)	RDR_BAD_RECORDFRAME RDR Data frame header not valid or corrupted
0x7109 (28937)	RDR_BAD_CHECKSUM RDR Checksum invalid. Data or checksum corrupted
0x710A (28938)	RDR_BAD_EOF End of file not reached
0x710B (28939)	RDR_FILE_CREATION_FAILED RDR failed to create new file
0x710C (28940)	RDR_FILE_OPEN_FAILED RDR unable to open requested file
0x710D (28941)	RDR_FILE_WRITE RDR unable to write to file
0x710E (28942)	RDR_FILE_READ RDR unable to read file
0x710F (28943)	RDR_FILE_DELETE RDR unable to delete file
0x7999 (31129)	UNKNOWN_ERROR An unknown error has occurred

APPENDIX E HEXADECIMAL RECORD ID VALUES

The following table contains the hexadecimal value for each of the unique 7k record numbers and remote control command IDs. It is provided as an easy reference for those who are coding values in Hex format, or reading data using binary editors.

Code	Hex Value	Code	Hex Value	Code	Hex Value
1000	0x03E8	1034	0x040A	1068	0x042C
1001	0x03E9	1035	0x040B	1069	0x042D
1002	0x03EA	1036	0x040C	1070	0x042E
1003	0x03EB	1037	0x040D	1071	0x042F
1004	0x03EC	1038	0x040E	1072	0x0430
1005	0x03ED	1039	0x040F	1073	0x0431
1006	0x03EE	1040	0x0410	1074	0x0432
1007	0x03EF	1041	0x0411	1075	0x0433
1008	0x03F0	1042	0x0412	1076	0x0434
1009	0x03F1	1043	0x0413	1077	0x0435
1010	0x03F2	1044	0x0414	1078	0x0436
1011	0x03F3	1045	0x0415	1079	0x0437
1012	0x03F4	1046	0x0416	1080	0x0438
1013	0x03F5	1047	0x0417	1081	0x0439
1014	0x03F6	1048	0x0418	1082	0x043A
1015	0x03F7	1049	0x0419	1083	0x043B
1016	0x03F8	1050	0x041A	1084	0x043C
1017	0x03F9	1051	0x041B	1085	0x043D
1018	0x03FA	1052	0x041C	1086	0x043E
1019	0x03FB	1053	0x041D	1087	0x043F
1020	0x03FC	1054	0x041E	1088	0x0440
1021	0x03FD	1055	0x041F	1089	0x0441

Code	Hex Value	Code	Hex Value	Code	Hex Value
1022	0x03FE	1056	0x0420	1090	0x0442
1023	0x03FF	1057	0x0421	1091	0x0443
1024	0x0400	1058	0x0422	1092	0x0444
1025	0x0401	1059	0x0423	1093	0x0445
1026	0x0402	1060	0x0424	1094	0x0446
1027	0x0403	1061	0x0425	1095	0x0447
1028	0x0404	1062	0x0426	1096	0x0448
1029	0x0405	1063	0x0427	1097	0x0449
1030	0x0406	1064	0x0428	1098	0x044A
1031	0x0407	1065	0x0429	1099	0x044B
1032	0x0408	1066	0x042A	1100	0x044C
1033	0x0409	1067	0x042B	1101	0x044D
1102	0x044E	7020	0x042E	7059	0x0423
1103	0x044F	7021	0x042F	7060	0x0424
1104	0x0450	7022	0x0430	7061	0x0425
1105	0x0451	7023	0x0431	7062	0x0426
1106	0x0452	7024	0x0432	7063	0x0427
1107	0x0453	7025	0x0433	7064	0x0428
1108	0x0454	7026	0x0434	7065	0x0429
1109	0x0455	7027	0x0435	7066	0x042A
1200	0x04B0	7028	0x0436	7067	0x042B
1201	0x04B1	7029	0x0437	7068	0x042C
1202	0x04B2	7030	0x0438	7069	0x042D
1203	0x04B3	7031	0x0439	7070	0x042E
1300	0x0514	7032	0x043A	7071	0x042F
1301	0x0515	7033	0x043B	7200	0x0431
1302	0x0516	7034	0x043C	7300	0x0432
1303	0x0517	7035	0x043D	7400	0x0433

Code	Hex Value	Code	Hex Value	Code	Hex Value
1304	0x0518	7036	0x043E	7500	0x0435
1305	0x0519	7037	0x043F	7501	0x0436
2000	0x07D0	7038	0x0440	7502	0x0437
7000	0x041A	7039	0x0441	7503	0x0438
7001	0x041B	7040	0x0442	7504	0x0439
7002	0x041C	7041	0x0443	7505	0x043A
7003	0x041D	7042	0x0444	7506	0x043B
7004	0x041E	7043	0x0445	7507	0x043C
7005	0x041F	7044	0x0446	7508	0x043D
7006	0x0420	7045	0x0447	7509	0x043E
7007	0x0421	7046	0x0448	7510	0x043F
7008	0x0422	7047	0x0449	7511	0x0440
7009	0x0423	7048	0x044A	7512	0x0441
7010	0x0424	7049	0x044B	7513	0x0442
7011	0x0425	7050	0x041A	7514	0x0443
7012	0x0426	7051	0x041B	7515	0x0444
7013	0x0427	7052	0x041C	7600	0x0446
7014	0x0428	7053	0x041D	7601	0x0447
7015	0x0429	7054	0x041E	7610	0x0448
7016	0x042A	7055	0x041F	7611	0x0449
7017	0x042B	7056	0x0420	7612	0x044A
7018	0x042C	7057	0x0421		
7019	0x042D	7058	0x0422		