

ATTACHMENT A

SEABAT™ 7100 DATA FORMAT AND TYPES

VERSION 1

INTRODUCTION

This document describes the data format used to log and transmit data with the SeaBat 7100 sonar system. It defines a standard record based protocol used to encapsulate sensor data by defining the record frame, file and TCP/UDP transmission formats along with individual sensor related records.

The generic format described herein also supports an enhanced data lookup mechanism to improve performance during file random access by utilizing an optional built-in record-indexing scheme.

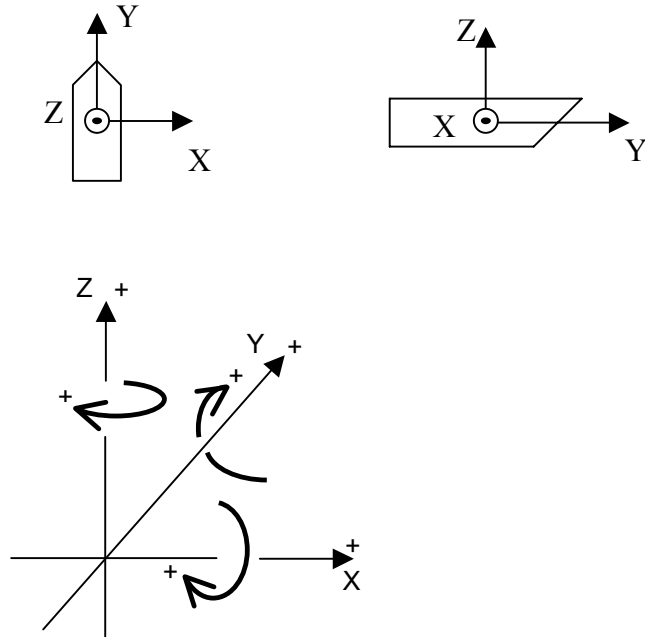
CONVENTIONS

Unless otherwise stated, all offset measurements shall be relative to the Vessel Reference Point (VRP). Distances shall be in meters and angles in decimal radians.

The following sign convention is used:

OFFSET	SIGN	DESCRIPTION
X	+	Starboard of the VRP
	-	Port of the VRP
Y	+	Forward of the VRP
	-	Astern of the VRP
Z	+	Height above the VRP
	-	Depth below the VRP
Roll	Port up is positive	Rotation about the along-ship (Y) axis
Pitch	Bow up is positive	Rotation about the across-ship (X) axis
Yaw	Bow right is positive	Rotation about the vertical (Z) axis
Heave	Positive up	
Heading	Positive clockwise	True heading
Altitude	Positive Up	distance from sea-bottom to the device
Depth	Positive Up	distance from sea surface to the device
Tide	Positive Up	High tide: positive height.
	Negative Down	Low tide: negative height.

Vessel Axes:



The following data type formats are defined by this document.

- Unsigned values – ‘uX’ is always an unsigned integer, X bits wide. E.g. u32 = unsigned 32 bits.
- Signed values – ‘iX’ is always a signed integer, X bits wide. E.g. i16 = signed 16 bits.
- Floating points – They are either f32 or f64 (IEEE 754-1985).

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

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

NAME	SIZE	DESCRIPTION
Year	u16	0 – 65535
Day	u16	1 – 366
Seconds	f32	0.000000 – 59.000000
Minutes	u8	0 – 59
Hours	u8	0 – 23

DATA RECORD FRAME (DRF)

The following data record frame is the generic wrapper in which all records (sensor data or otherwise) shall be embedded. The sync pattern combined with checksum makes it possible to recover records in corrupted files. The frame is defined thus:

NAME	SIZE	DESCRIPTION
Version	u16	Version of this frame (e.g.: 1, 2, ...)
Offset	u16	Offset in bytes from the start of the sync pattern to the start of the DATA SECTION. This allows for expansion of the header whilst maintaining backward compatibility.
Sync pattern	u32	0x0000FFFF
Size	u32	Size in bytes of this record from the start of the version field to the end of the checksum. It includes the embedded data size.
7KTIME	u8*10	UTC.
Record type	u32	Unique identifier of indicating the type of data embedded in this record.
Device identifier	u32	Identifier of the device that this data pertains.
Subsystem identifier	u32	Identifier for the device subsystem
Data set	u32	Data set number.
Record count	u32	Sequential record counter.
Previous record	i64	Pointer to the previous record of the same type (in bytes from start of file). This is an optional field for files and shall be -1 if not used.
Next record	i64	Pointer to the next record of the same type in bytes from start of file. This is an optional field for files and shall be -1 if not used.
Flags	u16	BIT FIELD Bit 1 – Valid checksum
DATA SECTION	Dynamic	Record type specific data.
Checksum	u32	Sum of bytes in data section (optional, depends on bit 1 of Flags field).

TCP AND UDP NETWORK FRAME

In order to facilitate network transport via the TCP - UDP/IP protocol, records will be packetized using the following header. In this scheme, a series of network packets may contain either a partial record or one or more data records depending upon the size boundary criterion. The packet size shall stay under 64k bytes and shall include this network header.

The following header shall prefix the network packet:

NAME	SIZE	DESCRIPTION
Total packets	u32	Number of network packets for set of records transmitted.
Packet size	u32	Size in bytes of this packet including the header and appended data.
Sequence number	u32	Sequential packet number; allows correct ordering during reconstruction. Range: 0 (zero) to N – 1 packets.
Version	u16	Version of this frame (e.g.: 1, 2, ...)
Offset	u16	Offset, in bytes, to the start of data from the start of this packet.
Data	Dynamic	Start of data section with either a partial or one or more records.

LOGGING FILE FORMAT

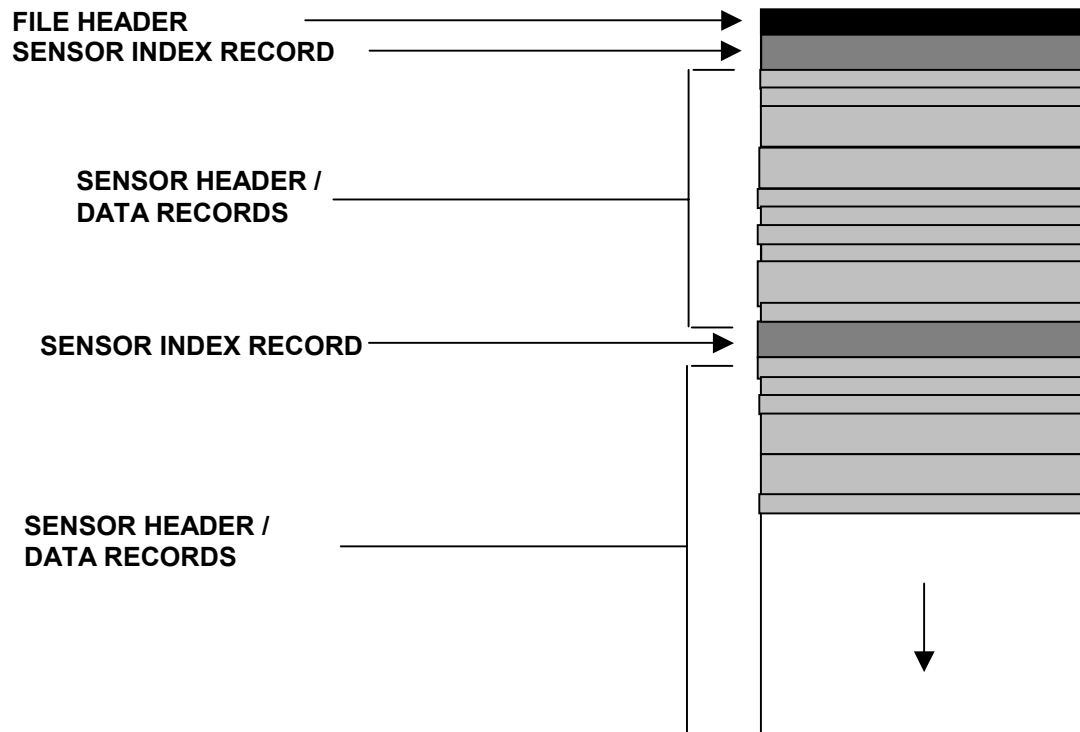
A valid 7k data file shall be a binary file consisting of a series of data records, as described by the Data Record Frame above.

The first record shall be a File Header Record, which shall include general file information.

Next there shall be a Sensor Index Record, that shall contain, in part, the Vehicle Reference Point position co-ordinates along with optional indexes into the file for quick reference to the first record of each sensor.

Any number of other record types may appear in the file thereafter, provided that a given Sensor Header Record appears before any other records for that sensor. The sensor header will contain, in part, the sensor's position and calibrated position offsets.

The following schematic shows the layout of a typical 7k file containing multiple data sets and records.



FILE NOMENCLATURE

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

“YYYYMMDD_HHMMSS.s7k”

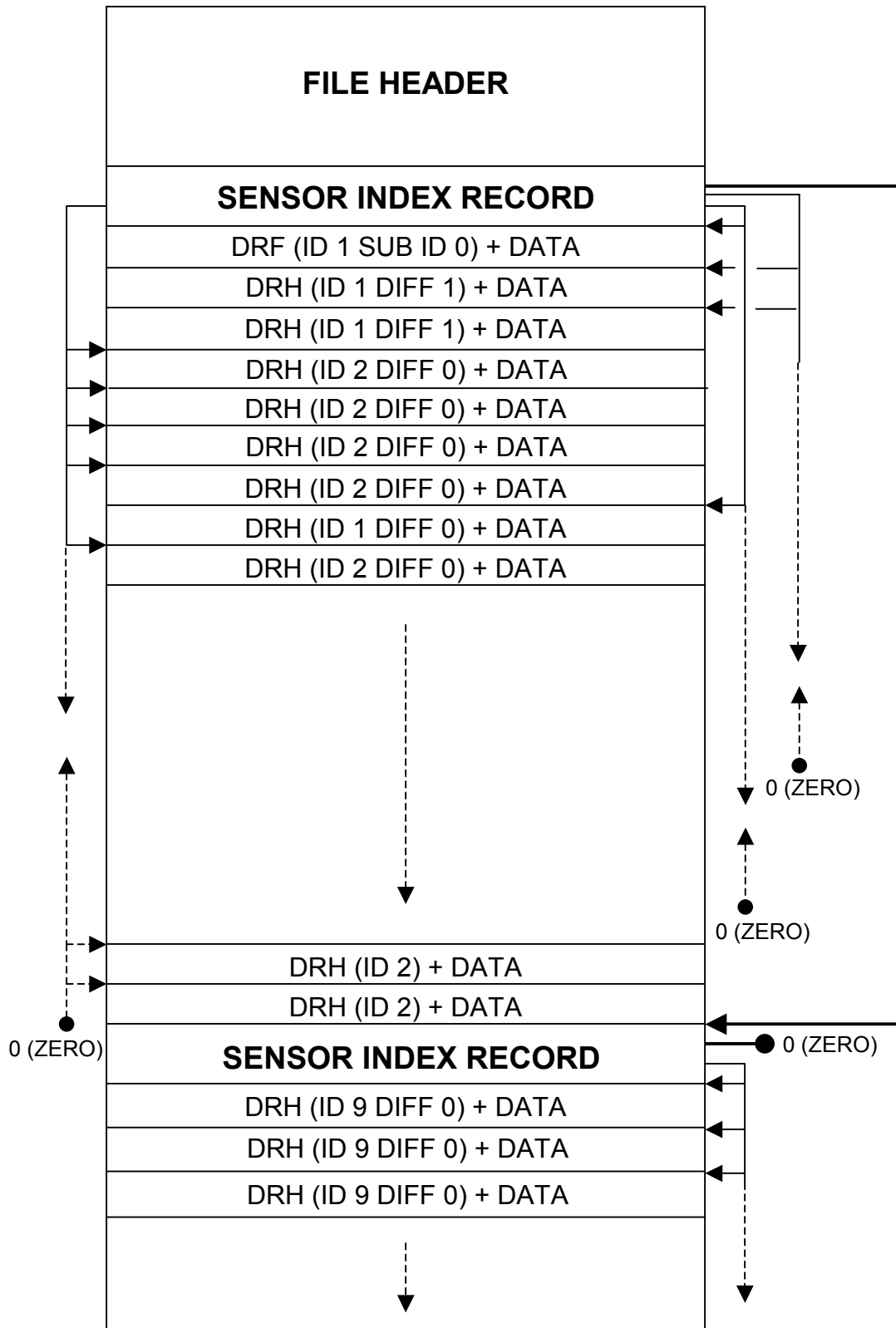
Where YYYYMMDD represents the date and HHMMSS the time.

For example, 20010516_102852.s7k

If many files are created at the same time append _X to the filename where X is an incrementing number.

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

FILE INDEX EXAMPLE GRAPH



RECORD TYPES

RECORD TYPE #1000 'Sensor offset position information'

DESCRIPTION:

Sensor position offset information data (non-calibrated).

DATA DEFINITION:

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.

RECORD TYPE #1001 'Calibrated sensor offset position information'

DESCRIPTION:

Calibrated sensor position offset information data.

DATA DEFINITION:

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.

RECORD TYPE #3000 'EdgeTech FS-Ax'**DESCRIPTION:**

EdgeTech system header and data.

DATA DEFINITION:

NAME	SIZE	DESCRIPTION
Ping number	u32	FS-AU supplied ping number.
Number of channels	u32	Number of channels in this record (N).
Format identifier	u32	EdgeTech defined format descriptor for channel data. 0 – Telemetry Format, SEG-Y 1 – Sidescan
Channel bytes	u32	Total number of bytes of channel data to follow (channel 0, 1, ... N-1)
DATA FIELDS	dynamic	Find definitions in SegyDefs.h and SidescanDefs.h

RECORD TYPE #7000 '7k Volatile sonar settings'**DESCRIPTION:**

SeaBat™ 7k volatile system settings for bathymetric, backscatter imagery and raw outputs.

DATA DEFINITION:

NAME	SIZE	DESCRIPTION
Ping number	u32	Sequential number.
Sonar Id	u64	Serial number, TBD
Sonar model[8]	u8*8	Descriptive name.
Frequency	f32	TBD.
Sample rate	f32	Sample in Hertz
Receiver bandwidth	f32	In Hertz.
Pulse width	f32	Seconds of pulse.
Pulse type	u32	Pulse type.
Pulse reserved	f32	Additional pulse information.
Ping period	f32	Seconds since last ping.
Range selection	f32	Range selection in meters.
Power selection	f32	Power selection in dB relative to TBD.
Gain selection	f32	Gain selection in dB relative to TBD.
Projector type	u16	Projector type. TBD
Projector mode	u16	Projector mode. TBD
Projector angle X	f32	Angle in radians.
Projector angle Y	f32	Angle in radians.
Auto Range	u16	BIT FIELD. Bit 1 – On / Off
Auto Filter	u16	BIT FIELD. Bit 1 – On / Off
Filter active flags	u16	Range and depth filter active. BIT FIELD Bit 1 – Range, on / off Bit 2 – Depth, on / off Bit 3 – TBD
Bottom detection filter info	f32	TBD.
Bottom detection filter info	f32	TBD.
Bottom detection filter info	f32	TBD.
Bottom detection filter info	f32	TBD.
Pitch compensation flags	u8	BITFIELD. TBD
Roll compensation flags	u8	BITFIELD. TBD.
Absorption	f32	Absorption in dB/km.
Sound velocity	f32	Sound Velocity in m/s
Spreading	f32	Spreading loss in dB.

RECORD TYPE #7001 '7k Configuration packet'**DESCRIPTION:**

SeaBat™ 7k configuration packet with serial numbers and other information, TBD. (ASCII table)

Data definition:

NAME	SIZE	DESCRIPTION
Sonar Id	u64	Sonar serial number
Sonar model[8]	u8*8	Descriptive name.
PCI board serial numbers	u64*?	TBD
Receiver boards serial number	u64*?	TBD
LCU serial numbers	u64*?	TBD
Transmitter serial numbers	u64*?	TBD
I/O-pod serial numbers	u64*?	TBD

RECORD TYPE #7002 '7k Pulse compression'**DESCRIPTION:**

SeaBat™ 7k pulse compression settings packet.

Data definition:

NAME	SIZE	DESCRIPTION
Ping number	u32	Sequential number.
Sonar Id	u64	Sonar serial number
Sonar model[8]	u8*8	Descriptive name.
TBD		

RECORD TYPE #7004 '7k beam position and type packet'**DESCRIPTION:**

SeaBat™ 7k beam position and size data excluding backscatter imagery beams.

STILL TO DO: **Add support for multiple projectors**

DATA DEFINITION:

NAME	SIZE	DESCRIPTION
Ping number	u32	Sequential number.
Sonar Id	u64	Sonar serial number
Sonar model[8]	u8*8	Descriptive name.
Projector angle X	f32	Angle in radians.
Projector angle Y	f32	Angle in radians.
Projector beam X width	f32	Angle in radians.
Projector beam Y width	f32	Angle in radians.
Rx Receiver Beams	u32	Beams = Rx
Rx Beam X angle position[Rx]	f32*Rx	Angle in radians.
Rx Beam Y angle position[Rx]	f32*Rx	Angle in radians.
Rx Beam width X[Rx]	f32*Rx	Angle in radians.
Rx Beam width Y[Rx]	f32*Rx	Angle in radians.

RECORD TYPE #7005'7k Calibration packet'**DESCRIPTION:**

SeaBat™ 7k calibration packet. (**TBD later**)

DATA DEFINITION:

NAME	SIZE	DESCRIPTION
Ping number	u32	Sequential number.
Sonar Id	u64	TBD
Sonar model[8]	u8*8	Descriptive name.
Uplink speed	f32	Hz.
Downlink speed	f32	Hz.

RECORD TYPE #7006'7k Bathymetric data packet'**DESCRIPTION:**

SeaBat™ 7k multibeam Bathymetric output data.

DATA DEFINITION:

NAME	SIZE	DESCRIPTION
Ping number	u32	Sequential number.
Sonar Id	u64	TBD
Sonar model[8]	u8*8	Descriptive name.
Rx Receiver Beams	u16	Beams = Rx
Range[Rx]	f32*Rx	Two way travel time in seconds.
Quality[Rx]	u8*Rx	TBD.
Intensity[Rx]	f32*Rx	Signal strength from signal return in dB to TDB.

RECORD TYPE #7007 '7k basic backscatter imagery data packet'**DESCRIPTION:**

SeaBat™ 7k backscatter imagery output data. One packet holds one beam per side, i.e. a system with multiple beams per side sends multiple packets.

DATA DEFINITION:

NAME	SIZE	DESCRIPTION
Ping number	u32	Sequential number.
Sonar Id	u64	TBD.
Sonar model[8]	u8*8	Descriptive name.
Beamforming types	u32	BITFIELD TBD.
Filter type	u32	TBD.
Samples	u32	Samples = S
Port beam width	f32	TBD.
Starboard beam width	f32	TBD.
Port beam angle	f32	TBD.
Starboard beam angle	f32	TBD.
Port side beams	u16	Number of beams for port side.
Starboard side beams	u16	Number of beams for starboard side.
Beam port number	u16	0 - N
Beam starboard number	u16	0 - N
Data types	u8	BIT FIELD Bit 1 – 16 bit Amplitude only Bit 2 – 16 bit Phase only Bit 3 – 16 bit Amplitude and 16 bit Phase
Port beam	u16/u32*S	Amplitude/Phase series. Array is populated with samples from transmitter and outward.
Starboard beam	u16/u32*S	Amplitude/Phase series. Array is populated with samples from transmitter and outward.

RECORD TYPE #7008 '7k RAW data packet'**DESCRIPTION:**

SeaBat™ 7k beam output data.

DATA DEFINITION:

NAME	SIZE	DESCRIPTION
Ping number	u32	Sequential number.
Sonar Id	u64	TBD
Sonar model[8]	u8*8	Descriptive name.
Region number	u16	0 – N.
Samples	u32	Samples = S
Beams	u16	Beams = N
First Beam	u16	First exported beam TBD
Last Beam	u16	Last exported beam TBD
First sample	u32	First exported sample from transmitter and outward.
Last sample	u32	Last exported sample from transmitter and outward.
Data types	u8	BIT FIELD Bit 1 – 16 bit Amplitude only Bit 2 – 16 bit Phase only Bit 3 – 16 bit Amplitude and 16 bit Phase
First Beam[S]	u16/u32*S	Amplitude/Phase series. Array is populated with samples from transmitter and outward.
...	...	...
Last Beam[S]	u16/u32*S	Amplitude/Phase series. Array is populated with samples from transmitter and outward.

RECORD TYPE #7009 '7k Snippet packet'**DESCRIPTION:**

SeaBat™ 7k beam snippet output data packet. (Absolute gain values TBD.)

DATA DEFINITION:

NAME	SIZE	DESCRIPTION
Ping number	u32	Sequential number.
Sonar Id	u64	TBD
Sonar model[8]	u8*8	Descriptive name.
Beams	u16	Beams = N
First Beam	u16	First exported beam TBD
Last Beam	u16	Last exported beam TBD
Data types	u8	BIT FIELD Bit 1 – 16 bit Amplitude only Bit 2 – 16 bit Phase only Bit 3 – 16 bit Amplitude and 16 bit Phase
First Sample		
Last Sample		
First Beam[S]	u16/u32*S	Amplitude/Phase series. Array is populated with samples from transmitter and outward.
...	...	...
First Sample		
Last Sample		
Last Beam[S]	u16/u32*S	Amplitude/Phase series. Array is populated with samples from transmitter and outward.

RECORD TYPE #7010 '7k RAW compressed data'**DESCRIPTION:**

SeaBat™ 7k beam output data. (TO DO: Add compression parameters)

DATA DEFINITION:

NAME	SIZE	DESCRIPTION
Ping number	u32	Sequential number.
Sonar Id	u64	TBD
Sonar model[8]	u8*8	Descriptive name.
Samples	u32	Samples = S
Beams	u16	Beams = N
First Beam	u16	First exported beam TBD
Last Beam	u16	Last exported beam TBD
First sample	u32	First exported sample from transmitter and outward.
Last sample	u32	Last exported sample from transmitter and outward.
Data types	u8	BIT FIELD Bit 1 – 16 bit Amplitude only Bit 2 – 16 bit Phase only Bit 3 – 16 bit Amplitude and 16 bit Phase
First Beam[S]	u16/u32*S	Amplitude/Phase series. Array is populated with samples from transmitter and outward.
...	...	...
Last Beam[S]	u16/u32*S	Amplitude/Phase series. Array is populated with samples from transmitter and outward.

RECORD TYPE #7051 '7k Alarm and status packet'

DESCRIPTION:

SeaBat™ 7k alarm and status information.

DATA DEFINITION:

NAME	SIZE	DESCRIPTION
TBD		

RECORD TYPE #7052 '7k Data storage status information'

DESCRIPTION:

SeaBat™ 7k data storage status information.

DATA DEFINITION:

NAME	SIZE	DESCRIPTION
TBD		

RECORD TYPE #7200 '7k File Header'

DESCRIPTION:

SeaBat™ 7k file header for RAW files. (dynamic section?)

The file identifier in this header improves file recognition for software application in various operating systems.

This document is describing file format version 1.

DATA DEFINITION:

NAME	SIZE	DESCRIPTION
File identifier	u64	'S' 'E' 'A' 'B' 'A' 'T' '7' 'k' 0x6b37544142414553
7KTIME	u8*10	UTC.
Version number	u16	File format version number (1 – N).

RECORD TYPE #7201 '7k Sensor Index Record'**DESCRIPTION:**

SeaBat™ 7k Data Set Header for 7k RAW files.

The Sensor Index Record (record id 7201) holds the offsets to the vehicle's center of gravity and provides the facility of optional record pointers to locate the first available record for the given sensors.

DATA DEFINITION:

NAME	SIZE	DESCRIPTION
Vehicle's X reference point to Center of Gravity	f32	X offset in meter
Vehicle's Y reference point to Center of Gravity	f32	Y offset in meter
Vehicle's Z reference point to Center of Gravity	f32	Z offset in meter
Water level Z	f32	Water level from reference point in meters.
File pointer to next set header	u64	File pointer to next data set header. 0 – If last (or single) data set in file.
Number of sensors	u32	Number of sensors in data set.
Dynamic section size	u32	Size in bytes for miscellaneous information.
Sensor 0 record file pointer	u64	File pointer to first sensor record in data set. 0 – if not yet indexed.
...	...	...
Sensor N record file pointer	u64	File pointer to first sensor record in data set. 0 – if not yet indexed.

RECORD TYPE #7202 '7k Sensor header record'**DESCRIPTION:**

Sensor header record for 7k RAW files.

This record holds general information about the sensor including its position offsets from the VRP. The subsystem is used to identify specific sensor types or configurations for the given sensor.

DATA DEFINITION:

NAME	SIZE	DESCRIPTION
Sensor identifier	u64	Unique identifier for the sensor.
Subsystem	u32	Unique identifier for the sensor's subsystem.
Number of records in data set.	i32	-1 if not yet counted or else the number of record in data set for this type.
POSITION RECORD	32 Bytes	The position offsets for this sensor. Record type number 1000.
CALIBRATED POSITION RECORD	32 Bytes	The calibrated offsets (if any) for this sensor. Record type number 1001.

RECORD TYPE #7300 '7k trigger packet'

DESCRIPTION:

SeaBat™ 7k software trigger packet.

DATA DEFINITION:

TBD

RECORD TYPE #7301 '7k trigger sequence setup packet'

DESCRIPTION:

SeaBat™ 7k trigger setup packet.

DATA DEFINITION:

TBD

RECORD TYPE #7302 '7k trigger sequence done packet'

DESCRIPTION:

SeaBat™ 7k trigger sequence done.

DATA DEFINITION:

TBD

RECORD TYPE #7400 '7k time messages'

DESCRIPTION:

SeaBat™ 7k time messages ranges from 7400 to 7450.

DATA DEFINITION:

TBD

RECORD TYPE #7500 '7k remote control packets'

DESCRIPTION: **TO DO: Add accepted message but not implemented scheme (not included within release 1)**

SeaBat™ 7k remote control packets ranges from number 7500 to 7999.

Single and simple commands are located inside record type 7500. This type is based on a variable length ASCII message that hold the new parameter(s). The message syntax is based on a prefix identifying the command, followed by a comma, the data and at the end <CR><LF>. If there aren't any parameters in the messages no comma is needed. Parameter numbers shall use "." for floating point representation. All messages are case sensitive.

COMMAND MESSAGES SYNTAX

<COMMAND NAME>,<PARAMETERS><CR><LF>

Some commands have a return message. These messages are being returned when the connection allows for it (serial or TCP / IP connection). Return messages can be either in ASCII format or binary format. The VERBOSE command toggles between those formats.

RETURN MESSAGES

<PARAMETERS><CR><LF>

The most commonly used return message are the STANDARD MESSAGES.

STANDARD MESSAGES

ASCII STRING	BINARY NUMBER	DESCRIPTION
REJECTED	0	Parameter(s) not accepted.
ACCEPTED	1	Parameter(s) accepted.
UNKNOWN COMMAND	2	Command not found.

Remote control types for larger and more complex messages can be found in higher than 7500 record types.

DATA DEFINITIONS:

The following commands are currently supported in the SeaBat 7k. (EXAMPLES
TODO: Complete list.)

COMMAND NAME – **VERBOSE**
DESCRIPTION – This message toggles between verbose and non-verbose return messages mode.
PARAMETERS – N/A.
RETURN VALUES – STANDARD MESSAGE
EXAMPLE – VERBOSE<CR><LF>

COMMAND NAME – **RANGE**
DESCRIPTION – This changes the current range setting to a new value.
PARAMETERS – <Range value>
RETURN VALUES – STANDARD MESSAGES.
EXAMPLE – RANGE,100.5<CR><LF>

COMMAND NAME – **BEGIN RECORD**
DESCRIPTION – This starts recording of pre-defined data sources in to the selected file.
PARAMETERS – N/A.
RETURN VALUES – STANDARD MESSAGES.
EXAMPLE – BEGIN RECORD<CR><LF>

COMMAND NAME – **OPEN RAW REGION**
DESCRIPTION – This opens a new raw beams region for network output or storage.
PARAMETERS – <Region #>, <first beam>, <last beam>, <first sample>, <last sample>
RETURN VALUES – STANDARD MESSAGES.
EXAMPLE – OPEN RAW REGION,0,0,10,50,100<CR><LF>

RECORD TYPE #7501 '7k remote control sonar settings'**DESCRIPTION:**

SeaBat™ 7k sonar control packet.

DATA DEFINITION:

NAME	SIZE	DESCRIPTION
Sonar Id	u64	Serial number, TBD
Pulse width	f32	Seconds of pulse.
Pulse type	u32	Pulse type.
Pulse reserved	f32	Additional pulse information.
Ping period	f32	Seconds since last ping.
Range selection	f32	Range selection in meters.
Power selection	f32	Power selection in dB relative to TBD.
Gain selection	f32	Gain selection in dB relative to TBD.
Projector mode	u16	Projector mode. TBD
Projector angle X	f32	Angle in radians.
Projector angle Y	f32	Angle in radians.
Auto Range	u16	BIT FIELD. Bit 1 – On / Off
Auto Filter	u16	BIT FIELD. Bit 1 – On / Off
Filter active flags	u16	Range and depth filter active. BIT FIELD Bit 1 – Range, on / off Bit 2 – Depth, on / off Bit 3 – TBD
Bottom detection filter info	f32	TBD.
Bottom detection filter info	f32	TBD.
Bottom detection filter info	f32	TBD.
Bottom detection filter info	f32	TBD.
Pitch compensation flags	u8	BITFIELD. TBD
Roll compensation flags	u8	BITFIELD. TBD.