Notice of Proprietary Rights

DATA FORMAT DEFINITION DOCUMENT

7k Data Format, Volume I

Version 2.43

Teledyne RESON A/S

Fabriksvangen 35

DK-3550 Slangerup

FOR PUBLIC USE

Revision History:

Date	Author	Rev	Description
26/10/2015	ALV	2.43	Record Type Definitions: 1003 – note added 7610 – text modified 7019 – text modified 7029 – record added 7042 – text modified 7058 – text modified 7503 – record type header modified (Added Applied frequency) 7504 – record type header modified (Added Tracker flags Bit 5 and Tracker max coverage) Remote Control Definitions: 1019 – text modified 1609 – added
29/08/2015	ALV	2.42	Record Type Definitions: 7000 – record type header modified 7042 – record type header modified 7058 – record type header modified – record type name changed – record type description changed – record data text modified 7503 – record type header modified 7610 – note modified Remote Control Definitions: 1044 – record data modified
17/08/2015	ALV	2.41	Record type definitions overview – Note added record 7006 and 7008 are depreciated. Added APPENDIX H Data Transformations (BlueView) Text - PDS2000 changed into Teledyne PDS Table 7 modified Table 8 modified: T50 added Table 192 modified – added BlueView identifier Remote Control Definitions: 1009 – record data modfied 1011 – record data & text modified 1118 – text modified 1040 – record data modified

Date	Author	Rev	Description
			7042 – record data modified 7614 - added Record Type Definitions: 1003 – record type header modified 2004 – text added 7000 – record type header modified 7001 – Sample XML MB2 and T20-P added 7002 – record type header modified 7006 – notes added 7041 – text modified 7042 – record type header and text modified 7052 – text modified 7058 – record type header and data modified 7503 – record type header modified 7504 – record type header and text modified BlueView: 7006 – record type header modified 5835 – record type header and text modified 5836 – record type header and text modified
24/03/2015	ALV	2.4	Table 8 modified Chapter 2.7 - note added Add chapter Sonar Reference Point Data record frame text modified Added 7K formats as used by the Odom MB2 Added appendix G - Wake On LAN Added chapter including BlueView record definitions Chapter 6, Data Record Frame, system enumerator modified. Record Type Definitions: 1020 – record type header modified 2004 – text modified 7000 – record type header & text modified 7004 – text modified 7006 – text modified (depreciated record) 7017 – text modified 7018 – text modified 7021 – record data & text modified 7027 – text modified 7031 – record added 7041 – record type header modified

Date	Author	Rev	Description
			7042 – record type header modified 7050 – record type header modified 7051 – record type header modified 7052 – record type header modified 7059 – record added 7503 – text and record type header modified 7504 – record type header & text modified Added Appendix F Handling 7027 record 7K Remote Control Definitions: 1100 – text modified 1115 - record data modified 1117 – removed 1046 – added 1047 – added 1211 – added 1600 – added 1601 – added 1602 – added 1603 – added 1604 – added 1605 – added 1606 – added 1607 – added 1608 – added 7042 – added 7041 – record data modified Appendix B – device identifier 7k logger added. Chapter 6 – text modified Chapter 7 – text modified
27/05/2014	ALV	2.33	Added appendix E – C++ source code example

Date	Author	Rev	Description
27/05/2014	ALV	2.32	*(Internal release.)* Record Type Definitions: 7504 – record type header modified 7021 – record type header modified 7503 – record type header modified 7000 – record type header modified 2004 – description modified (always 5) 7030 – description of this record added. Available records T20-P added Table 8 modified. (7500 valid for all types) 7504 - record type header modified 7K Remote Control Definitions: 1200 – description modified. 1118 – description modified. Appendix A – Teledyne PDS optional data text modified. Data Record frame: Device identifier T20-P added in device identifier overview. The T20-P has now a unique device identifier.
04/09/2013	HMS	2.31	Record Type Definitions: 7027 – record type header modified 7052 – record type header modified 7200 – optional data added 7300 – record data added 7503 – record type header modified 7k Remote Control Definitions: 1045 – added Appendix A – record 7400 modified

Date	Author	Rev	Description
05/07/2013	MHA / HMS	2.3	Chapter 10.1 – tables modified Record Type Definitions: 1020 – record type header modified 2004 – added 7017 – record data modified 7019 – added 7021 – record data modified 7027 – record data modified 7041 – record type header modified and record data modified 7050 – record data modified 7051 – record type header modified 7503 – record type header modified 7504 – record type header modified 7510 – text modified 7610 – text and record type header modified 7k Remote Control Definitions: 1002 – text and record data modified 1009 – record data modified 1019 – added 1040 – added 1041 – added 1038 – record data modified 1043 – added 1044 – added 1402 – added 7041 – record data modified Appendix A – record 7400 added
07/05/2012	MHA	2.22	Record Type Definitions: 7000 – record type header modified 7001 – record data modified 7021 – record data modified 7036 – removed 7052 – record type header modified 7503 – record type header modified 7510 – added 7k Remote Control Definitions: 1021 – record data modified 1022 – record data modified 1037 – record data modified 1099 – note removed 7610 – record data modified Appendix D – error code 28945 added

Date	Author	Rev	Description
09/01/2012	MHA	2.21	Chapter 9 – text modified Chapter 10.1 – table added Record Type Definitions: 7007 – record type header modified 7008 – record type header modified 7011 – record type header modified 7012 – record type header modified 7017 – record type header modified and record data modified 7027 – record type header modified and record data modified 7057 – record type header modified 7k Remote Control Definitions: 1028 – removed, use record type 1020 1029 – removed; use record type 1020
25/11/2011	MHA	2.20	Chapter 6 – data record frame modified Record Type Definitions: 1020 – record type header modified 7000 – record type header modified 7007 – record type header modified 7008 – record type header modified 7011 – record type header modified 7012 – record type header modified 7017 – record type header modified and record data modified 7027 – record type header modified and record data modified 7041 – added 7052 – record type header modified 7055 – record type header modified 7057 – record type header modified 7503 – record type header modified 7504 – record type header modified 7k Remote Control Definitions: 1002 – record data modified 1010 – record data modified 1033 – record data modified 1035 – record data modified 1037 – record data modified 1038 – added 1039 – added 1118 – text adjusted 7041 – added
17/06/2011	MHA	2.11	Record Type Definitions: 7005 – moved to Volume II 7018 – modified, 7018 7111/7150 removed 7026 – removed 7058 – is now implemented Chapter 9 – Time Tagging – Text modified

Date	Author	Rev	Description
26/05/2011	MHA	2.10	Record Type Definitions: 1016 – text adjusted 1020 – added 1209 – text and table modified 7018 – extra information added 7021 – table record data modified 7027 – text adjusted 7503 – table of record type header modified Teledyne PDS Optional Data: 7027 – added 7028 – modified 7058 – modified
13/09/2010	MHA	2.00	The information updated with the latest information. The text checked and all the formats are now in line with the latest code.
11/05/2006	JM (MD)	1.00	
08/11/2004	MJF (MD)	0.54	
06/10/2004	MJF (MD)	0.53	
19/07/2004	MJF (MD)	0.52	
11/03/2004	MD	Preliminary	

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

1.1 Purpose and Overview

This document describes the data format used to log and transmit network data using the RESON Application titled “7k Center.” The 7k Center 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.

Other Teledyne sonar brands as BlueView and Odom may use the 7K Data record formats as well. Currently this applies for the BlueView ProScan software and the Odom MB2 sonar. This document includes the Data record definitions in separate sections for these applications.

The 7k DFD 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.

Table 1: Terms and Acronyms

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
BITE	Built-In Test Environment
COG	Center of Gravity
Depth	Distance from the sea surface to the sensor
DFD	Data Format Definition (this document)
Heading	True heading
N/A	Not applicable
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
TPE	Total Propagated Error
VRP	Vessel Reference Point
Yaw	Rotation about the vertical (Z) axis

2 CONVENTIONS

2.1 Overview

This section describes the conventions and definitions used within this document.

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 3-D coordinate rotation is roll, pitch then yaw. The following sign conventions shall be used:

Table 2: 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 VRP44
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 – from 0 to 359.99˚ It will never be a negative value
Altitude	+ -	Up Down
Depth	+ -	Up Down
Tide	+ -	High Tide (Height above a defined point) Low Tide (Height below a defined point)
Projector steering	+ -	Steer forward Steer backward

2.3 Vessel Axes

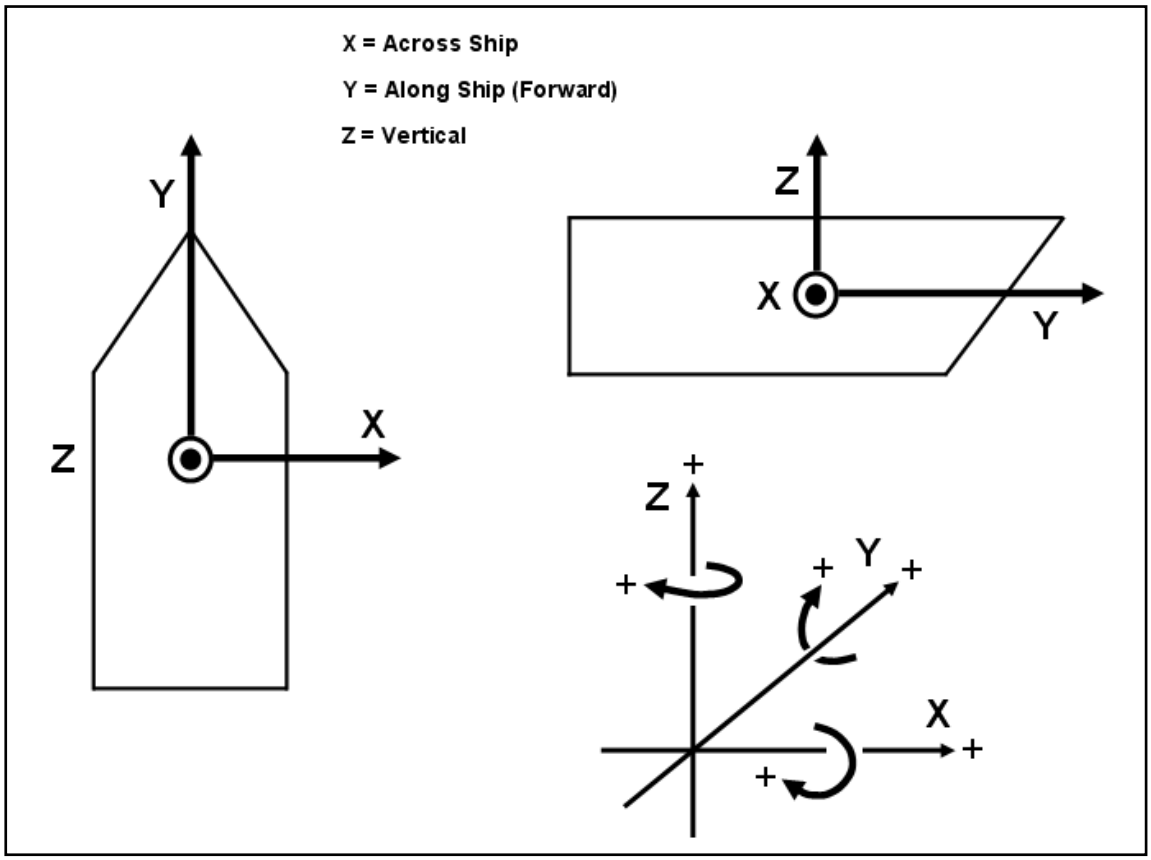


Figure 2-1: Vessel Axes

2.4 Sonar Reference Point

The following axis convention is applied for the sonar reference point convention:

X = across ship, points to starboard

Y= along ship points forward

Z = vertical, points up.

The sonar reference point is in the center of the receiver face in both X and Z directions and in the center of the projector in the Y direction.

The Tx offset is defined as the seperation of the projector (Tx) reference point from the Receiver (Rx) point.

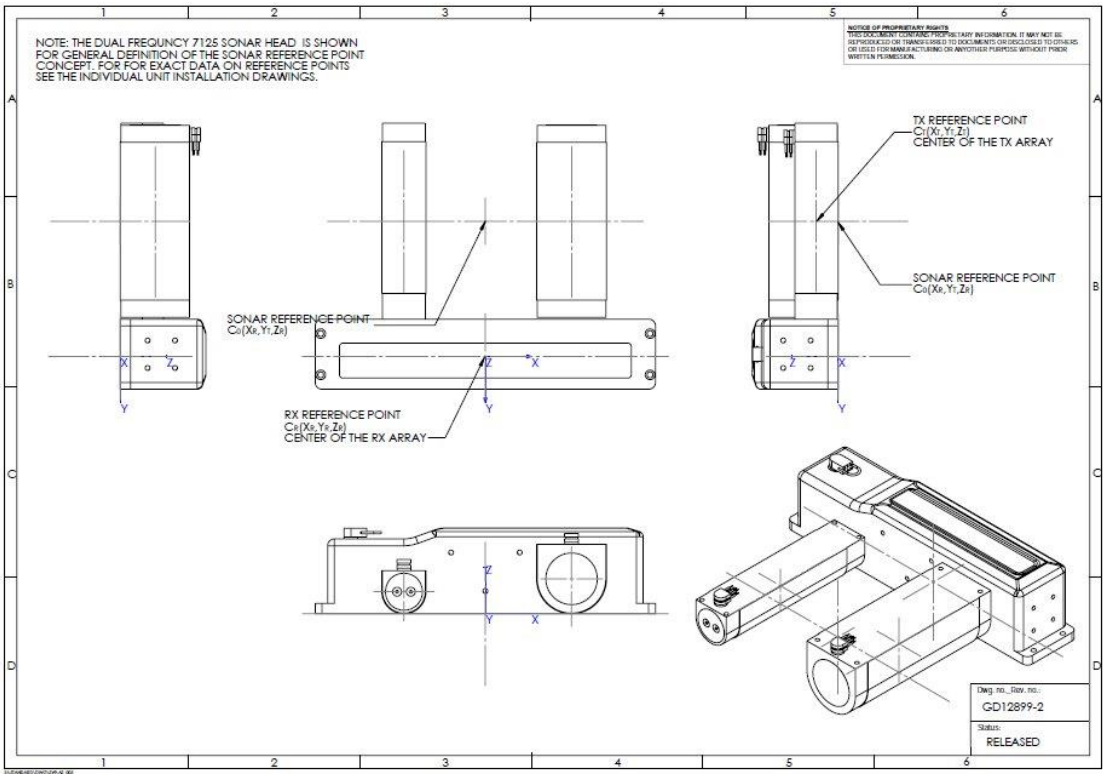


Figure 2-2: Sonar reference point (for reference only)

2.5 Beam Positions

In a standard installation, beam zero represents the first beam on the port side of the sonar array. A reversed head mount system require the beam order be reversed by post processing software and may not need to be done in the 7k software.

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

2.6 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 indicates 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”.

2.7 Time Convention

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

Table 3: 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

NOTE
If no time is available then all fields will be zero.

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 *Table 4: Version Concordance* to identify the correct protocol version for your system. Now only version 5 is used.

Table 4: 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:

- Request a single record
- 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:

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

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 (this is system and user dependent):

- **7000** – Sonar settings
- **7004** – Beam geometry
- **7006** – Bottom detection results (bathymetric data)
- **7007** – Side-scan data
- **7018** – Beamformed data and snippet
- **7027** – Raw Bathymetry
- **7028** – Snippet
- **7051** – 7k System event messages

NOTE
If there are multiple devices attached to the 7kCenter, 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 “7101” or “7125”) and the system enumerator (always zero if there is only one device attached).

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

Record 7500 is the primary means of changing sonar settings (for a definition of the 7500 record, see *section 0*

The record can contain optional data. For information on optional data, see APPENDIX A Teledyne PDS Optional Data

7500 – 7k Remote Control). For a detailed description, see *section 11 7k Remote Control Definitions*. 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 *section 11 7k 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:

- UDP packet sizes are limited to an implementation-dependent size, usually 64KB.
- 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.

3.5.1 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.

3.5.2 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.

3.5.3 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

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 7K RECORD DEFINITION

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.

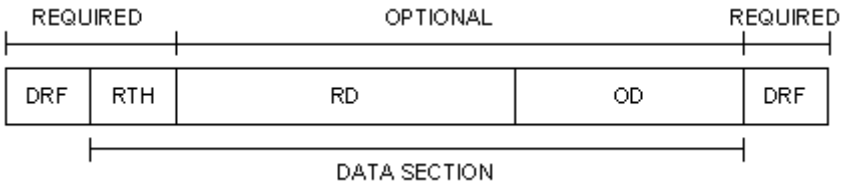
The optional data field typically holds sensor-specific data and third party developer embedded data.

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

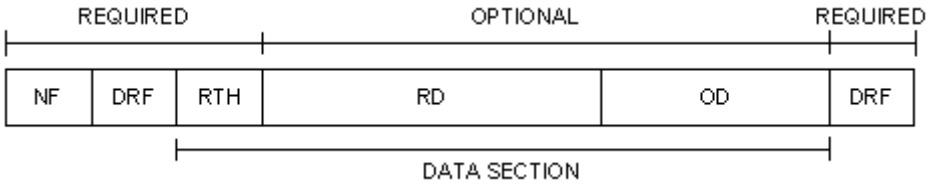
Please note that the Checksum is a required portion of the DRF, which occurs as the last four bytes of every record.

7k RECORD

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



Network prepared with the Network Frame (NF).



NOTE
When sonar software capabilities improve the need to modification / extension of the 7k protocol is mandatory. However, the 7k DFD will always be modified in such a way backwards compatibility is maintained as good as possible. This means reserved fields are used when available. When these are not available fields will always be added to the end of a record section. It is therefore important to read / parse the protocol using the record size.

6 DATA RECORD FRAME

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 5: Data Record Frame

Name	Size	Description
Protocol Version	u16	Protocol version of this frame (see *Table 4: Version Concordance*)
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
Record version	u16	Currently 1
Record type identifier	u32	Identifier for record type of embedded data
Device identifier	u32	Identifier of the device to which this data pertains. See appendix B for a overview.
Reserved	u16	Reserved
System enumerator	u16	The enumerator is used to differentiate between devices with the same device identifiers in one installation/system. For example, on 7125 200khz/400kHz dual-frequency systems, the enumerator will normally be zero (0) in 200khz mode, and one (1) in 400kHz mode.
Reserved	u32	Reserved

Name	Size	Description
Flags	u16	BIT FIELD: Bit 0: Checksum 0 – Invalid checksum 1 – Valid checksum Bit 1-14: Reserved (must be zero) Bit 15: 0 – Live data 1 – Recorded data
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

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 6: Network Frame

Name	Size	Description
Protocol version	u16	Protocol version of this frame (see *Table 4: Version Concordance*)
Offset	u16	Offset in bytes to the start of data from the start of this packet
Total packets	u32	Number of network packets for set of records transmitted
Total records	u16	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.
Packet size	u32	Size in bytes of this packet including the header and appended data
Total size	u32	Total size in bytes of all packets in transmission, excluding network frame(s)
Sequence number	u32	Sequential packet number; allows correct ordering during reconstruction. 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"

With:

YYYY = Year
MM = Month
DD = Day
HH = Hour
MM = Minutes
SS = Seconds

For example, 20100516_102852.s7k (Created May 16, 2010 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, 20100516_102852_0.s7k and 20100516_102852_1.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.

Record 7052 (7K Data Storage Status) can be used to determine which records are available and current record logging filters. Remote command 1209 (Set Filtering) is used to set the record logging filters.

Complete files generated using RESON 7kCenter software will always begin with a 7200 record and will usually be followed by a 7001 record and 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

Through the IO Module the time of the system has to be synced with a PPS and a time message from a GPS (for instance a ZDA message).

Time tags reside in the DRF for each record. The time stamp in the record is always 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.

The time stamping for messages received from a sensor depends on the selected driver in the IO Module. In general, the position will use time in message and other sensors use time of arrival of the first character. For some sensors (e.g POS MV), the time will be time in message; the time as is defined in the message string.

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.

Table 7: Record Type Definitions

Record Type	Description
1000 – 1999	Reserved for generic sensor records
1000	Reference point
1001	Sensor offset position
1002	Sensor offset position calibrated
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
1017	Pan tilt
1020	Sonar installation identifiers
1022	Reserved for IOP motion
1050	Reserved for generic sensor calibration
1200	Reserved for generic side-scan sonar
1500 – 1599	Reserved for future QC records
7000 – 7999	Reserved for SeaBat™ 7k records
7000[1]	7k sonar settings

[1] These records are available by subscription only.

Record Type	Description
7001	7k configuration
7002	7k match filter
7003	7k firmware and hardware configuration
7004	7k beam geometry
7005	Reserved for 7k calibration data
7006	7k bathymetric data Record 7006 is superseded by record 7027. The record is depreciated and will not be supported by latest 7k protocol based applications such as the Teledyne Odom MBCenter. It exists for backwards compatibility only.
7007[1]	7k side-scan data
7008[1]	7k generic water column data Record 7008 is superseded by 7018 and 7028. It is mutually exclusive. The record is depriciated and will not be supported by Teledyne RESON. It exists for backwards compatibility only.
7009	Reserved for vertical depth
7010[1]	TVG values
7011[1]	7k image data
7012[1]	7k ping motion data
7016	Reserved for extended bottom detect info
7017[1]	7k detection data setup
7018[1]	7k beamformed data
7021	7k built-in test environment data
7022	7kCenter version
7023	8k wet end version
7024	Reserved for license information
7026[1]	Reserved for 7k detection data
7027[1]	7k raw detection data
7028[1]	7k snippet data
7029	Vernier Processing Data (Filtered)
7030	Reserved for sonar installation parameters
7037	Reserved for raw I & Q data file header
7038[1]	Reserved for raw I & Q data
7040	Reserved for 7k Tx configuration files
7041[1]	Compressed Beamformed Magnitude Data

[1] These records are available by subscription only.

Record Type	Description
7042[1]	Compressed Watercolumn data
7048	7k calibrated beam data
7050	7k system events
7051	7k system event message
7052	RDR recording status
7053	7k subscriptions
7055	Normalization status
7057	Calibrated side-scan data
7058	Snippet Backscattering Strength
7059	MB2 specific status
7060	Reserved for 7k target data
7068[1]	Reserved
7200	7k file header
7300	7k file catalogue record
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	7P sensor settings
7505	Reserved
7510	SV Filtering
7511	System lock status
7515	Timestamp (not described in the documentation)
7610	7k sound velocity
7611	7k absorption loss
7612	7k spreading loss
7613	Reserved
7900 – 7999	Reserved
8012[1]	Pitch, yaw, heave flag (not described in the documentation)

[1] These records are available by subscription only.

Record Type	Description
8100	8k series sonar data (not described in the documentation)
11000 – 11299	Reserved
81000 – 87999	Reserved

Not all records shown 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.

The record types mentioned in the following table are the record types that are logged for the different 7k systems.

NOTE
✓: Record applies for specified 7K System. Empty field: This combination of 7K System and record is not supported by Teledyne RESON and thus it is not guaranteed that the data in the possible generated record is valid.

Table 8: Available Record Types per 7k System

Record Types	7k Systems																
	7100	7101	7111	7112	7122	7123	7125	7128	7130	7131	7150	8125H	T20-P	T20-S	MB2	BlueView	T50
1000	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
1001	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
1002	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
1003	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
1004	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
1005	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
1006	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
1007	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
1008	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
1009	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
1010	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
1011	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
1012	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
1013	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
1014	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
1015	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
1016	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
1017	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓

Record Types	7k Systems																
	7100	7101	7111	7112	7122	7123	7125	7128	7130	7131	7150	8125H	T20-P	T20-S	MB2	BlueView	T50
1020															✓		
1050	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
5835																✓	
5836																✓	
7000	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7001	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
7002	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓			✓
7004	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7006 (See note)	✓	✓	✓				✓				✓	✓	✓	✓		✓	✓
7007	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓			✓
7008 (See note)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
7010	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
7011	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
7012	✓	✓		✓			✓	✓	✓	✓		✓	✓	✓			✓
7017	✓	✓					✓	✓	✓	✓		✓	✓	✓	✓		✓
7018	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
7019									✓	✓							
7021	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
7022	✓	✓		✓			✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
7024															✓		
7027	✓	✓					✓	✓	✓	✓		✓	✓	✓	✓		✓
7028	✓	✓					✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
7029									✓	✓							
7038			✓		✓	✓					✓						
7039			✓		✓	✓											
7041			✓								✓						
7042													✓	✓	✓		✓
7048			✓		✓	✓	✓	✓			✓		✓	✓			✓
7052															✓		
7057			✓														
7058			✓								✓						✓
7059															✓		
7068					✓	✓											

Record Types	7k Systems																
	7100	7101	7111	7112	7122	7123	7125	7128	7130	7131	7150	8125H	T20-P	T20-S	MB2	BlueView	T50
7200	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
7300	✓	✓		✓	✓		✓	✓				✓	✓	✓			✓
7400											✓						
7500	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
7503	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
7504	✓	✓		✓			✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
7505					✓	✓											
7510							✓						✓	✓			✓
7511	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓			✓
7610	✓	✓					✓	✓	✓	✓		✓	✓	✓	✓		✓
7611	✓	✓					✓	✓	✓	✓		✓	✓	✓			✓
7612	✓	✓					✓	✓	✓	✓		✓	✓	✓			✓

NOTE

Record 7006 is superseded by record 7027. The record is depreciated and will not be supported by latest 7k protocol based applications such as the Teledyne Odom MBCenter. It exists for backwards compatibility only.

NOTE

Record 7008 is superseded by 7018 and 7028. It is mutually exclusive. The record is depriciated and will not be supported by Teledyne RESON. It exists for backwards compatibility only.

10.2 1000 – Reference Point

Description: Reference point Information.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 9: 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

Name	Size	Description
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 offset position information data (non-calibrated).

Data Definition:

DRF	RTH	RD	OD	DRF

Table 10: 1001 – Record Type Header

Name	Size	Description
Sensor position X offset	f32	X offset from vehicle reference point in meters
Sensor position Y offset	f32	Y offset from vehicle reference point in meters
Sensor position Z offset	f32	Z offset from vehicle reference point in meters
Sensor roll angle offset	f32	Roll angle offset in radians
Sensor pitch angle offset	f32	Pitch angle offset in radians
Sensor yaw angle offset	f32	Yaw angle offset in radians

10.4 1002 – Sensor Offset Position Calibrated

Description: Sensor offset position information data (calibrated).

Data Definition:

DRF	RTH	RD	OD	DRF

Table 11: 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 radian
Sensor yaw angle offset	f32	Yaw angle offset in radians

10.5 1003 – Position

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

NOTE
1003 record created by the 7kCenter is using the sensor (GPS) data. Teledyne PDS is using reference point data.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 12: 1003 – Record Type Header

Name	Size	Description
Datum identifier	u32	0 – WGS84 >0 – Reserved
Latency	f32	In seconds
Latitude or northing	f64	Latitude in radians or northing in meters
Longitude or easting	f64	Longitude in radians or easting in meters
Height relative to datum or height	f64	In meters
Position type flag	u8	0 – Geographical coordinates 1 – Grid coordinates
UTM zone	u8	UTM Zone
Quality flag	u8	0 – Navigation Data 1 – Dead-Reckoning

Name	Size	Description
Positioning method	u8	0 – GPS 1 – DGPS 2 – Start of inertial positioning system from GPS 3 – Start of inertial positioning system from DGPS 4 – Start of inertial positioning system from bottom correlation 5 – Start of inertial positioning from bottom object 6 – Start of inertial positioning from inertial positioning 7 – Start of inertial positioning from optional data 8 – Stop of inertial positioning system to GPS 9 – Stop of inertial positioning system to DGPS 10 – Stop of inertial positioning system to bottom correlation 11 – Stop of inertial positioning to bottom object 12 – Start of inertial positioning to inertial positioning 13 – Start of inertial positioning to optional data 14 – User defined 15 – RTK Fixed 16 – RTK Float
Number of Satellites	u8	Optional

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 determines 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 13: 1004 – Record Type Header

Name	Size	Description
Field mask	u8	BIT FIELD: Bit 0: 0 – No pitch 1 – Pitch in radians Bit 1: 0 – No roll 1 – Roll in radians Bit 2: 0 – No heading 1 – Heading in radians Bit 3: 0 – No heave 1 – Heave in meters Bit 4: 0 – No pitch 1 – Pitch rate of change in radians per second Bit 5: 0 – No roll rate 1 – Roll rate of change in radians per second Bit 6: 0 – No heading rate 1 – Heading ate of change in radians per second Bit 7: 0 – No heave rate 1 – 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 14: 1004 – Record Data

Name	Size	Description
FIELD 0	f32	Sensor data
…	…	...
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 15: 1005 – Record Type Header

Name	Size	Description
Tide	f32	Height correction above mean sea level in meters
Source	u16	0 – Unspecified 1 – Table (predicted) 2 – Measured (gauge)
Flags	u8	BIT FIELD: Bit 0: 0 – Gauge ID invalid 1 – Gauge ID valid Bit 1: 0 – Position info invalid 1 – Position info valid
Gauge identifier	u16	User defined
Datum identifier	u32	0 – WGS84 >0 – Reserved
Latency	f32	In seconds
Latitude or northing	f64	Latitude in radians or northing in meters
Longitude or easting	f64	Longitude in radians or easting in meters
Height relative to datum or height	f64	In meters
Position type flag	u8	0 – Geographical coordinates 1 – Grid coordinates

Name	Size	Description
UTM zone	u8	UTM zone

10.8 1006 – Altitude

Description: Altitude data record.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 16: 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 17: 1007 – Record Type Header

Name	Size	Description
Flags	u8	BIT FIELD: Bit 0: Speed in X, Y & Z directions (m/s); each an f32 if present Bit 1: Acceleration in X, Y & Z directions (m/s2); 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
N	u16	Number of sensor readings
Frequency	f32	Sample rate in sensor readings per second

DRF	RTH	RD	OD	DRF

Table 18: 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 19: 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 20: 1009 – Record Type Header

Name	Size	Description
Position flag	u8	0 – Invalid position fields 1 – 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 21: 1009 – Record Data

Name	Size	Description
SAMPLE 0 depth	f32	In meters
SAMPLE 0 sound velocity	f32	In meters/second
…	…	...
SAMPLE N-1 depth	f32	In meters
SAMPLE N-1 sound velocity	f32	In meters/second

10.12 1010 – CTD

Description: CTD Data Record

Data Definition:

DRF	RTH	RD	OD	DRF

Table 22: 1010 – Record Type Header

Name	Size	Description
Frequency	f32	Frequency
Sound velocity source flag	u8	0 – Not computed 1 – CTD 2 – User computed
Sound velocity algorithm	u8	0 – Not computed 1 – Chen Millero 2 – Del Grosso
Conductivity flag	u8	0 – Conductivity 1 – Salinity
Pressure flag	u8	0 – Pressure 1 – Depth
Position flag	u8	0 – Invalid position fields 1 – Valid position fields
Sample content validity	u8	BIT FIELD: (Bit set means field is valid otherwise zero) Bit 0: Conductivity/Salinity Bit 1: Water temperature Bit 2: Pressure/Depth Bit 3: Sound velocity Bit 4: Absorption
Reserved	u16	Reserved
Latitude	f64	Latitude in radians (WGS84)
Longitude	f64	Longitude in radians (WGS84)
Sample rate	f32	Sample rate
N	u32	Number of samples

DRF	RTH	RD	OD	DRF

Table 23: 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

Name	Size	Description
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:

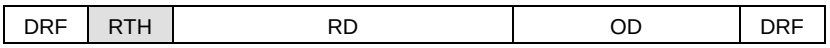


Table 24: 1011 – Record Type Header

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

Name	Size	Description
Scale	f64	Device scaling
Reserved 2	u8 * 35	Reserved for later extension to 9 parameter transformation
Grid name	u8 * 32	Name of grid system in use: e.g. “UTM” (see APPENDIX C)
Grid distance units	u8	0 – Meters 1 – Feet 2 – Yards 3 – US Survey Feet 4 – Kilometers 5 – Miles 6 – US Survey Miles 7 – Nautical Miles 8 – Chains 9 – Links
Grid angular units	u8	0 – Radians 1 – Degrees 2 – Degrees, minutes, seconds 3 – Gradians 4 – Arc-seconds
Latitude of origin	f64	
Central meridian	f64	
False easting	f64	Meters
False northing	f64	Meters
Central scale factor	f64	
Custom identifier	i32	Used to define projection specific parameters -2 – Custom -1 – Not used (Refer to APPENDIX C)
Reserved 3	u8 * 50	Reserved

For a list of currently reserved Custom Identifiers, see *APPENDIX* B *Device Identifiers*.

10.14 1012 – Roll Pitch Heave

Description: Motion Data Record.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 25: 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 26: 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 27: 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 – line name

DRF	RTH	RD	OD	DRF

Table 28: 1014 – Record Data

Name	Size	Description
Latitude or northing 0	f64	Latitude (radians) or northing (meters) -π/2 to π/2, -south
Longitude or easting 0	f64	Longitude (radians) or easting (meters) -π to π, -west
…	…	…
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 29: 1015 – Record Type Header

Name	Size	Description
Vertical reference	u8	1 – Ellipsoid 2 – Geoid 3 – Chart datum
Latitude	f64	Latitude of vessel reference point in radians -π/2 to π/2, -south
Longitude	f64	Longitude of vessel reference point in radians -π to π, -west
Horizontal position accuracy	f32	Position accuracy in meters
Vessel height	f32	Height of vessel reference point above vertical reference in meters
Height accuracy	f32	In meters
Speed over ground	f32	Speed over ground at position time in m/s
Course over ground	f32	Course over ground at position time in radians
Heading	f32	Heading of vessel at position time in radians

10.18 1016 – Attitude

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

Data Definition:

DRF	RTH	RD	OD	DRF

Table 30: 1016 – Record Type Header

Name	Size	Description
Number of attitude data sets	u8	Number of data sets

DRF	RTH	RD	OD	DRF

Table 31: 1016 – Record Data

Name	Size	Description
Time difference from record timestamp 0	u16	Time difference in milliseconds
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
…	…	…
Time difference from record timestamp [N-1]	u16	Time difference in milliseconds
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 1017 – Pan Tilt

Description: This record is the pan tilt input from an external source.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 32: 1017 – Record Type Header

Name	Size	Description
Pan	f32	Angle in radians
Tilt	f32	Angle in radians

10.20 1020 – Sonar Installation Identifiers

Description: This record gives the information on the MBES Linear and Angular Offsets and the wet-end configuration. XYZ offsets are measured from the Sonar Reference Point (SRP) to the acoustic center of the Tx array and to the acoustic center of the Rx array. The record can be manually requested or subscribed to from the 7kCenter. For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*

Data Definition:

DRF	RTH	RD	OD	DRF

Table 33: 1020 – Record Type Header

Name	Size	Description
System Identification Number	u32	Sonar ID
Transmitter Identification Number	u32	Tx Unit ID
Receiver Identification Number	u32	Rx Unit ID
Standard Configuration Options(*)	u32	0 = Custom Otherwise this specifies system dependant standard installation parameters and all installation defined parameters below are ignored.
Configuration Fixed Parameters(**)	u32	Defines configuration's defined parameters BIT FIELD, 1 = fixed: Bit 0-2: Tx to Rx XYZ Linear Offsets Bit 3-5: Tx to Reference XYZ Linear Offsets Bit 6-8: Tx to Rx Angular Offsets Bit 9-15: Reserved
Tx Length (Y)	f32	Measured values of Tx hardware, in meters. Flat arrays set to 0.
Tx Width (X)	f32	
Tx Height (Z)	f32	
Tx Radius	f32	
SRP to Tx X Linear Offset	f32	XYZ linear offsets from the SRP to the acoustic center of the transmitter, in meters.
SRP to Tx Y Linear Offset	f32	
SRP to Tx Z Linear Offset	f32	
Tx Roll Angular Offset	f32	Angular offsets are from array main axes to motion axes in Lagrange coordinates, in radians.
Tx Pitch Angular Offset	f32	
Tx Yaw Angular Offset	f32	

Name	Size	Description
Rx Length (Y)	f32	Measured values of Tx hardware, in meters. Flat arrays set to 0.
Rx Width (X)	f32	
Rx Height (Z)	f32	
Rx Radius	f32	
SRP to Rx X Linear Offset	f32	XYZ linear offsets from the SRP to the acoustic center of the receiver, in meters.
SRP to Rx Y Linear Offset	f32	
SRP to Rx Z Linear Offset	f32	
Rx to Rx Roll Angular Offset	f32	Angular offsets are from array main axes to motion axes in Lagrange coordinates, in radians.
Rx Pitch Angular Offset	f32	
Rx Yaw Angular Offset	f32	
Frequency	f32	System frequency
VRP to SRP Offset (X)	f32	XYZ linear offsets from the vessel reference to the sonar reference point, in meters.
VRP to SRP Offset (Y)	f32	
VRP to SRP Offset (Z)	f32	
Cable length	u32	Cable length in meters for DMPA systems. 0 when not set.
Reserved	u8 * 44	This field is reserved for system specific parameters and will be defined on per system basis.

(*) When this record is received by 7kCenter, all offset fields that are fixed for specified configuration are ignored and factory values are used. When this record is sent by 7kCenter, all offset fields are filled in with the offsets in use, and configuration is set to the last received. All standard configurations will be defined on per system basis.

(**) When this record is received by 7kCenter, this field is ignored. When this record is sent by 7kCenter, this field specifies which fields are fixed for the specified configuration.

10.21 2004 – Sonar Pipe Environment

Description: Sonar pipe environment from SeaBat UI Pipe Detection and Tracking system. This record is a five point description of a tracked pipe line. Pipe environment records are only available for finalized points of a tracked pipe line. The Cartesian coordinates are in sonar space and are for reference only. Points can be positioned between two sonar beams on the ping.

Due to the way of the pipe detection and tracking system works the five points records are outputted when the algorithm decides the pipe tracking is stable enough to have a proper five points output. That easy can be after a certain amount of pings.

Data Definition:

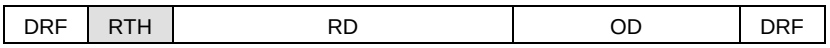


Table 34: 2004 – Record Type Header

Name	Size	Description
Pipe number	u32	Pipe identifier
Ping time	7kTime	Time
Ping number	u32	Sequential number
Multi-ping sequence	u32	Sub number
Pipe diameter	f32	Diameter of the pipe in meters
Sound velocity	f32	Sound velocity in m/s
Sample rate	f32	Sonar's sampling frequency in Hz
Finished	u8	0 – Pipe is still growing Otherwise – Pipe is finished
Number of points	u32	Number of point sub records. Always 5 (five).
Point sub record size	u32	Size of sub record
Reserved	u32*10	Reserved

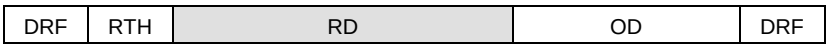


Table 35: 7001 – Record Data

Name	Size	Description
X	f32	X coordinate in sonar space in meters
Y	f32	Y coordinate in sonar space in ping number
Z	f32	Z coordinate in sonar space in meters
Angle	f32	Point angle in radians
Sample number	f32	Sample number

NOTE
The output is five in a sequence: seabed left, trench left, top, trench right and seabed right. (When multibeam X,Y,Z reference frame corresponds with vessel X,Y,Z reference frame.)

10.22 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 7kCenter updates this data for each ping. The record can be subscribed to from the 7kCenter. For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*

Data Definition:

DRF	RTH	RD	OD	DRF

Table 36: 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 (FM)
Tx pulse envelope identifier	u32	0 – Tapered rectangular 1 – Tukey
Tx pulse envelope parameter	f32	Some envelopes don't use this parameter
Tx pulse mode	u16	1 – Single ping 2 – Multi-ping 2 3 – Multi-ping 3 4 – Multi-ping 4
Tx pulse reserved	u16	Reserved
Max ping rate	f32	Maximum ping rate in pings per second
Ping period	f32	Seconds since last ping
Range selection	f32	Range selection in meters
Power selection	f32	Power selection in dB re 1μPa

Name	Size	Description
Gain selection	f32	Gain selection in dB
Control flags	u32	BIT FIELD: Bit 0-3: Auto range method Bit 4-7: Auto bottom detection filter method Bit 8: Bottom detection range filter enabled. Bit 9: Bottom detection depth filter enabled Bit 10: Receiver gain method Auto Gain Bit 11: Receiver gain method Fixed Gain Bit 12: Receiver gain method Reserved Bit 13: Reserved Bit 14: Trigger out High for entire RX duration 0 – Disabled 1 – Enabled Bit 15: 0 – System inactive 1 – Active Bit 16-19: Reserved for bottom detection Bit 20: Pipe gating filter 0 – Disabled 1 – Enabled Bit 21: Adaptive gate depth filter fixed 0 – Follow seafloor 1 – Fix depth Bit 22: Adaptive gate 0 – Disabled 1 – Enabled Bit 23: Adaptive gate depth filter 0 – Disabled 1 - Enabled Bit 24: Trigger out 0 – Disabled 1 – Enabled Bit 25: Trigger in edge 0 – Positive 1 – Negative Bit 26: PPS edge 0 – Positive 1 – Negative Bit 27-28: Timestamp State 0 – Timestamp not applicable 1 – Timestamp error / not valid

Name	Size	Description
		2 – Timestamp warning / use caution 3 – Timestamp ok / valid Bit 29: Depth filter follows seafloor 0 – Fix depth 1 – Follow seafloor Bit 30: Reduced coverage for constant spacing 0 – Always maintain swath coverage 1 – Allow swath coverage to be reduced Bit 31: 0 – 7K 1 – Simulator
Projector identifier	u32	Projector selection
Projector beam steering angle vertical	f32	In radians
Projector beam steering angle horizontal	f32	In radians
Projector beam -3dB beam width vertical	f32	In radians
Projector beam -3dB beam width horizontal	f32	In radians
Projector beam focal point	f32	In meters
Projector beam weighting window type	u32	0 – Rectangular 1 – Chebychev
Projector beam weighting window parameter	f32	N/A
Transmit flags	u32	BIT FIELD: 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 – Chebychev 1 – Kaiser
Receive beam weighting parameter	f32	N/A

Name	Size	Description
Receive flags	u32	BIT FIELD: Bit 0: Roll compensation indicator Bit 1: Reserved Bit 2: Heave compensation indicator Bit 3: Reserved 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
Receive beam width	f32	Angle in radians
Bottom detection filter info	f32	Min range (if range filter is active)
Bottom detection filter info	f32	Max range (if range filter is active)
Bottom detection filter info	f32	Min depth (if depth filter is active)
Bottom detection filter info	f32	Max depth (if depth filter is active)
Absorption	f32	Absorption in dB/km
Sound velocity	f32	Sound velocity in m/s
Spreading	f32	Spreading loss in dB
Reserved	u16	Reserved

NOTE
Pitch and yaw stabilization are not implemented. When the roll stabilization flag is not zero the beam pattern is roll stabilized; beam pattern is relative the vertical. Projector beam steering is pitch stabilization. Projector beam steering is not redundant when messages 7004 and 7006 are received; this value needs to take into account. (Unless the sonar does not have pitch steer capacity.)

10.23 7001 – 7k Configuration

Description: This record is produced by the SeaBat™ 7k sonar 7-P processor series. It contains the configuration information about the sonar capabilities. Each sonar configuration can be found in the record's module info section (see

Table 38). 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 and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*

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

Data Definition:

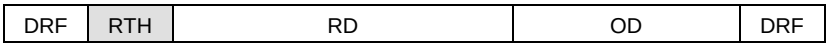


Table 37: 7001 – Record Type Header

Name	Size	Description
Sonar Id	u64	Sonar serial number
N	u32	Number of devices/sonar's

Table 38: 7001 – Record Data

Name	Size	Description
Device 0 identifier	u32	Unique identifier number
Device 0 description	u8 * 60	ASCII string
Device 0 AlphaData card	u32	Defines the type of the AlphaData card. 0x0400 – Virtex 2 card 0x0800 – Virtex 5 card 0x1000 – Virtex 6 card
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 * 60	ASCII string
Device N-1 AlphaData card	u32	Defines the type of the AlphaData card. 0x0400 – Virtex 2 card 0x0800 – Virtex 5 card 0x1000 – Virtex 6 card
Device N-1 serial number	u64	

Name	Size	Description
Device N-1 info length	u32	In bytes
Device N-1 info	dynamic	Varies with device type

A XML may differ depending of the sonar type.

Two samples of XML files are included in this document;

- XML sample T20-P
- XML sample MB2

XML SAMPLE – T20-P

<?xml version="1.0" encoding="US-ASCII"?>

-<T20P>

<Name version="2015-06-05" enumerator="0" deviceid="20">T20-P</Name>

<SystemInfo SystemTxDutyMax="3.0" name="T20-P" systemrelease="SV3" projectid="generic" auv="no">T20-P Sonar</SystemInfo>

<SonarType unit="nb" type="0">Bathymetric sonar</SonarType>

<ArrayType unit="nb" type="1" generation="2" number="7219">Flat array</ArrayType>

<RxElements unit="meters" spacing="0.0016" max="127" min="0">Receive ceramics</RxElements>

<RxBeamWidth unit="rad" along="0.471238898" across="0.019198622" uniformalong="yes" uniformacross="yes">Receiver beamspacing</RxBeamWidth>

-<RxBeamModeSet>

<RxBeamMode max_total_steering="85.0" min_grazing="15.0" max_coverage="140.0" min_coverage="45.0" std_coverage="130.0" beam_spacing="ED" max_beams="512" min_beams="10" std_beams="256">Equi-Distant</RxBeamMode>

<RxBeamMode max_total_steering="85.0" min_grazing="5.0" max_coverage="140.0" min_coverage="45.0" std_coverage="130.0" beam_spacing="ID" max_beams="512" min_beams="10" std_beams="256">Intermediate</RxBeamMode>

<RxBeamMode max_total_steering="85.0" min_grazing="5.0" max_coverage="165.0" min_coverage="45.0" std_coverage="130.0" beam_spacing="EA" max_beams="512" min_beams="10" std_beams="256">Equi-Angle</RxBeamMode>

<RxBeamMode max_total_steering="85.0" min_grazing="15.0" max_coverage="140.0" min_coverage="45.0" std_coverage="130.0" beam_spacing="FL" max_beams="512" min_beams="512" std_beams="512">FlexMode</RxBeamMode>

</RxBeamModeSet>

<RxBeamStabilization type="0">Receiver beam stabilization</RxBeamStabilization>

<RxBeamDistributionSettings CSSThresholdPercent="4.0">Beam distribution control options</RxBeamDistributionSettings>

<RxDelay unit="microseconds" rx_delay="1000">RX delay value</RxDelay>

<TxHardware name="TX1">Transmitter BITE board</TxHardware>

<TxType unit="nb" type="TC2181" number="2181">Standard</TxType>

<TxSetup relay_position="Y" CableComp="surface" Droop="disabled" TVR="enabled" P0="70" DMPA="yes">Tx Additional Configuration</TxSetup>

<TxBeams unit="nb" max="0" min="0">Transmit beams</TxBeams>

<TxBeamSteering unit="rad" minz="0.0" maxz="0.0" minx="0.0" maxx="0.0" steerable="no">Transmit beam steering</TxBeamSteering>

<TxBeamSpacing unit="rad" angles="0.0" uniform="yes">Transmit beamspacing</TxBeamSpacing>

<TxBeamWidth unit="rad" minz="2.094395102" maxz="2.094395102" minx="0.0174533" maxx="0.0174533" variable="no">Transmit beamwidth</TxBeamWidth>

<TxBeamStabilization type="0">Transmit beam stabilization</TxBeamStabilization>

<TxPulseEnvelope type="tukey" parameter="0.1"> TxPulseEnvelope </TxPulseEnvelope>

<TxDelay units="sec" transmitter="1048e-6" trigger="999e-6">Transmit Delay</TxDelay>

<Frequency unit="Hz" max="400000.0" min="200000.0" center="400000.0" chirp_V6="yes" chirp="no" stepcw="10000" maxcw="420000" mincw="190000" cw_variable="yes">Transmit frequency</Frequency>

<DualHead unit="Hz" SlaveStop="400000" SlaveStart="420000" MasterStop="400000" MasterStart="380000">Dual-Head FM frequencies</DualHead>

<FM_Parameters NegativeSweep="yes" CorrelationIndex="1.0" GuardBand_dB="3.0" KaiserLevel_dB="3">FM Tuning Paramters</FM_Parameters>

-<PingModeSet>

<PingMode mode="SP">Single Ping Mode</PingMode>

</PingModeSet>

-<SampleRateSet_1>

<SampleRate name="Standard (34k)" unit="hz" rate="34722.222222">Receiver sample rate</SampleRate>

<FWFilterFiles_V6 _3="999,bf_filter_34K_300uS_20141017.dat" _2="0.000299,bf_filter_34K_120uS_20141017.dat" _1="0.000119,bf_filter_34k_0uS_20141017.dat" size="3">Firmware Filter Sonar Specific Files</FWFilterFiles_V6>

<TxPulseLength unit="s" max="0.000300" min="0.000030" measured="1e-6" default_FM="0.001" max_FM="0.010" min_FM="0.000300" default="0.000060">Transmit pulse length</TxPulseLength>

<FM_Sweep max="30000" min="1000" units="Hz" default="30000" step="1000">FM Sweep Parameters</FM_Sweep>

</SampleRateSet_1>

<Power unit="dB//uPa" max="220.0" min="190.0" shared="no" tx_power_tweak="0.0">Transmit power</Power>

<Gain unit="dB" max="83.0" min="0.0" tvg_limit="83">Receiver gain</Gain>

<Range unit="m" max="600.0" min="5.0">Operating range</Range>

<RangeSet unit="m" _3="10" _2="7" _1="5" size="22" _22="600" _21="500" _20="400" _19="350" _18="300" _17="250" _16="200" _15="175" _14="150" _13="125" _12="100" _11="75" _10="50" _9="40" _8="35" _7="30" _6="25" _5="20" _4="15">Valid Range Set</RangeSet>

<PingRate unit="p/s" max="50.0" min="0.0" freerun="no" ratio="1.0">Ping rate</PingRate>

<Motion pitch_ON="no" roll_ON="no" heave="0" pitch="0" roll="1" heavable="no" pitchable="no" rollable="yes">Motion compensation factor</Motion>

<FWInfo type="single" IQShift="0" bf_upm_level="4" bite="new" pps="new">Firmware Info</FWInfo>

<FWFiles BITEfile="7K_Bite_T20-P.xml" bitfile_V6="v6_128_20140515.bit">Firmware Sonar Specific Files</FWFiles>

<FPGA _3="0" _2="0" _1="0" offset_size="T3" delay="150e-6" lo_if="00000.0">FPGA Sonar Specific Values</FPGA>

<DownLink remote="yes" register="yes">Downlink Commands</DownLink>

<RDR units="MB" buffer="10" format="short" maxsize="1024" defaultpath="">Raw data recording</RDR>

<StartState swiothrottlems="0" calibrate_delay="0.0" calibrate="yes" udp="on" selected="yes" pingmode="SP+CW" ping="yes" maxpower="0.0">Initial overwrite values</StartState>

<Install_Defaults MaxPingRate="50">Installation Default Settings</Install_Defaults>

<BottomDetection method="G2.5">BD Method (G1_Simple, G1_BlendFilt, G2, G2.5)</BottomDetection>

<Warnings IOM="error" PPS="fatal">Warning overrides</Warnings>

<GUIState wedgethrottlems="160">Initial overwrite values</GUIState>

<OutputBoost_dB Value="0">Beamformer Output Boost</OutputBoost_dB>

<InputAttenuation_dB Value="3">BF input attenuation setting.</InputAttenuation_dB>

<Display colordepth="1" bitshift="4">Display options</Display>

<CalibrationHistory maxdays="180"/>

<ComPorts time="COM1" motion="COM2" svp="COM3">Serial ports</ComPorts>

<Saturation max="25000" min="18">Saturation magnitude</Saturation>

<PingPong unit="seconds" delay="1.0e-3">Dual-head ping-pong delay</PingPong>

-<CopyrightSet>

<Copyright>This software includes the Armadillo library (http://arma.sourceforge.net) and LAPACK (http://www.netlib.org/lapack).</Copyright>

<Copyright>LAPACK Copyright (c) 1992-2013 The University of Tennessee and The University of Tennessee Research Foundation. All rights reserved.</Copyright>

<Copyright>LAPACK Copyright (c) 2000-2013 The University of California Berkeley. All rights reserved.</Copyright>

<Copyright>LAPACK Copyright (c) 2006-2013 The University of Colorado Denver. All rights reserved.</Copyright>

</CopyrightSet>

<DepthGate min_window="1.0" min_value="-5.0">Depth gate limits</DepthGate>

<RangeGate min_window="1.0" min_value="0.1">Range gate limits</RangeGate>

<NadirGate min_window="1.0" min_value="0.1">Nadir gate limits</NadirGate>

</T20P>

XML SAMPLE - MB2:

</RxBeamModeSet>

-<CopyrightSet>

<Copyright>The MBCenter.exe uses the Intel Math Kernel Library. MKL homepage: http://www.intel.com/software/products/mkl.</Copyright>

</CopyrightSet>

<TxPulseLength unit="s" measured="1e-6" max="0.001000" min="0.000020">Transmit pulse length</TxPulseLength>

<PulseLengthSlider Mode="Release">Pulse Length Slider</PulseLengthSlider>

<Frequency unit="Hz" Chirp="no" stepcw="10000" maxcw="420000" mincw="170000" cw_variable="yes">Transmit frequency</Frequency>

<FrequencySet _12="460" _11="435" _10="420" _9="400" _8="390" _7="360" _6="330" _5="300" _4="270" _3="245" _2="230" _1="200" size="12">Valid Frequency Set</FrequencySet>

<FrequencySlider Mode="Release">Frequency Slider</FrequencySlider>

<SampleRate unit="hz" rate="36000">Receiver sample rate</SampleRate>

<Power unit="" max="8" min="1" label="">Transmit power</Power>

<PowerSlider Mode="Release">Power Slider</PowerSlider>

<Range unit="m" max="250.0" min="2.0">Operating range</Range>

<RangeSet step="2.0">Valid Range Set</RangeSet>

<RecordableRecordSet _12="1011" _11="1010" _10="1009" _9="1008" _8="1007" _7="1006" _6="1005" _5="1004" _4="1003" _3="1002" _2="1001" _1="1000" size="37" _37="7613" _36="7612" _35="7611" _34="7610" _33="7511" _32="7504" _31="7503" _30="7042" _29="7028" _28="7027" _27="7021" _26="7017" _25="7012" _24="7010" _23="7004" _22="7002" _21="7001" _20="7000"

_19="1050" _18="1017" _17="1016" _16="1015" _15="1014" _14="1013" _13="1012">7k Records Available for Recording</RecordableRecordSet>

<RangeSlider Mode="Release">Power Slider</RangeSlider>

<PingRate unit="p/s" max="60.0" min="0.0" freerun="no" ratio="1.0">Ping rate</PingRate>

<PingRateSlider Mode="Release">Ping rate Slider</PingRateSlider>

<Motion pitch_ON="no" roll_ON="no" heave="0" pitch="0" roll="1" heavable="no" pitchable="no" rollable="yes">Motion compensation factor</Motion>

<RDR buffer="10" format="short" units="MB" maxsize="1024" defaultpath="C:\Data\">Raw data recording</RDR>

<StartState ping="yes" maxpower="0.0">Initial overwrite values</StartState>

<Saturation max="25000" min="100" indicator="off">Saturation magnitude</Saturation>

</MB2>

10.24 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 be manually requested for the last ping or subscribed to from the 7kCenter. For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*

Data Definition:

DRF	RTH	RD	OD	DRF

Table 39: 7002 – Record Type Header

Name	Size	Description
Sonar Id	u64	Sonar serial number
Ping number	u32	Sequential number
Operation	u32	0 – Off 1 – On
Start frequency	f32	Hz
Stop frequency	f32	Hz
Window type	u32	0 – Rectangular 1 – Kaiser 2 – Hamming 3 – Blackmann 4 – Triangular 5 – X (Taylor)
Shading value	f32	

Name	Size	Description
Effective Pulse Width	f32	Effective pulse width after FM compression (seconds) NOTE: Software versions prior to July 2015 (7kCenter 5.9.0.1 or older) do not calculate this value. In this case the value will be a very large negative number.
Reserved	u32 * 13	Filled with 0xFB

10.25 7003 – 7k Firmware and Hardware Configuration

Description: This record is produced by the 7kCenter series. It contains the configuration information about the sonar hardware and firmware. The record is created on system startup and does not change during operation. The record can be manually requested from the 7kCenter. This record is not available for subscription.

For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*

The dynamic data section is encoded using HTM. A sample is provided below.

Data Definition:

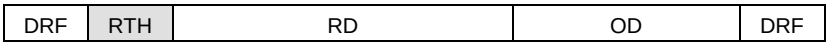


Table 40: 7003 – Record Type Header

Name	Size	Description
Devices	u32	Hardware device count
Info length	u32	Varies with device type

HTM SAMPLE – 7101

HARDWARE TABLE

Name	Hex Address	Frequency	Enumerator	UI	M2
SYS1 8101 Wet End	21	240000	N/A	8101	N/A
TX1	2A	240000	N/A	0	N/A
RX1	26	N/A	N/A	0	N/A
LM	30	N/A	N/A	7101	N/A

LM TABLE

Field	Bytes	Sensor Types	Name	Min	Max
1	2	0	Addresses Destination (MSB) Source (LSB)	0	0
2	2	0	Data Length	0	0
3	2	0	Type of Command	0	0
5	2	2	FPGA Die Temperature (°C)	-5.0	95.0

Field	Bytes	Sensor Types	Name	Min	Max
8	2	4	5V	4.5	5.5
9	2	4	2.5Vref	2.4	2.6
10	2	4	1.5V	1.3	1.7
12	2	4	3.3V	3.0	3.6
13	2	4	2.5V	2.2	2.8
14	2	4	1.0V	0.9	1.1
23	2	5	Controller CPLD	0	0
24	2	5	Controller FPGA	0	0
25	2	5	Controller DSP Boot	0	0
26	2	5	Controller DSP System	0	0
32	2	1	LM Downlink	0	65535
33	2	1	FPGA Status Field	0	65535
35	2	1	LM Uplink (from LM)	0	65535

SYS1 TABLE

Field	Bytes	Sensor Types	Name	Min	Max
1	2	0	Addresses Destination (MSB) Source (LSB)	0	0
2	2	0	Data Length	0	0
3	2	0	Type of Command	0	0
4	4	6	Head temperature (°C)	-20.0	70.0
5	4	7	Leak V	3.8	6.0
6	4	8	-5V	-5.5	-4.5
7	4	9	+12	11.0	13.0
8	4	9	-12	-13.0	-11.0
9	4	10	Dipswitch	0	0

10.26 7004 – 7k Beam Geometry

Description: This record is produced by the 7kCenter. It contains the receive beam widths and steering. The 7kCenter updates this data for each ping. The record can be manually requested for the last ping or subscribed to from the 7kCenter. For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*

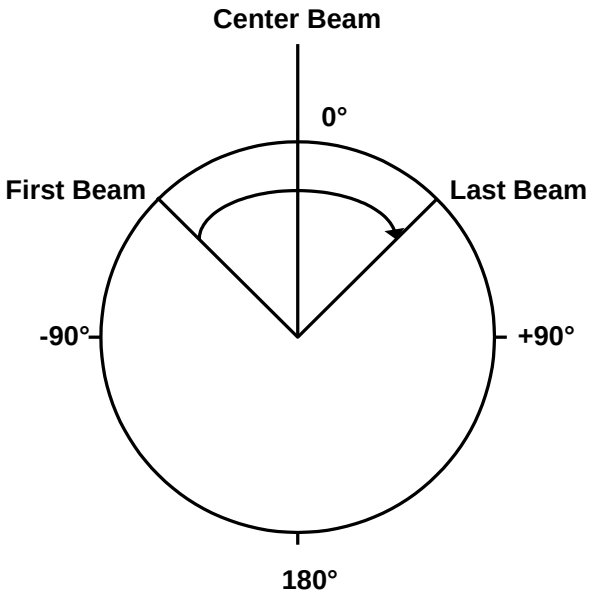


Figure 10-1: Sonar Beam Angle Convention

Data Definition:

DRF	RTH	RD	OD	DRF

Table 41: 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 42: 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-angular mode, steering angles will vary.

Name	Size	Description
-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°).

NOTE
Beam angles are relative sonar frame when beam stabilization is switched off. When enabled it will be relative the vertical. Beam vertical is always zero, angles are relative sonar frame..

10.27 7006 – 7k Bathymetric Data

NOTE
Record 7006 is superseded by record 7027. The record is depreciated and will not be supported by latest 7k protocol based applications such as the Teledyne Odom MBCenter. It exists backwards compatibility only.

Description: This record is produced by the 7kCenter series. It contains the sonar bottom detection results. The 7kCenter updates this data for each ping. The record can be subscribed to from the 7kCenter. For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*

Data Definition:

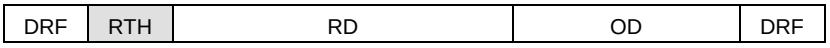


Table 43: 7006 – Record Type Header

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

Name	Size	Description
Flags	u8	BIT FIELD: Bit 0: Layer compensation 0 – Off 1 – On Bit 1: XYZ compensation 0 – Off 1 – On Bit 2-7: Reserved (always 0)
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

Table 44: 7006 – Record Data

Name	Size	Description
Range [N]	f32 * N	Two-way travel time in seconds
Quality [N]	u8 * N	BIT FIELD: Bit 0: Brightness 1 – Pass 0 – Fail Bit 1:Colinearity 1 – Pass 0 – Fail Bit 2: Bottom detection process (magnitude) 1 – Used 0 – Not used Bit 3: Bottom detection process (phase): 1 – Used 0 – Not used Bit 4: Used internally Bit 5: PDS nadir filter 1 – Fail 0 – Pass Bit 6-7: Reserved
Intensity [N]	f32 * N	Intensity: Bottom reflectivity. This is a relative value. (Not calibrated).
Min filter info	f32 * N	Minimum two-way travel time to filter point for each beam (minimum depth gate)

Name	Size	Description
Max filter info	f32 * N	Maximum two-way travel time to filter point for each beam (maximum depth gate)

For information on optional data, see APPENDIX A Teledyne PDS Optional Data.

NOTE
• *The compensation flag in the 7006 record is valid for all sonars, it does not compensate the conical intersection, it only correct the range. (conical intersection is required for sonars with projector steering)* • *7006 record flags if it is compensated for sonar geometry* • *You cannot do conical intersection correction svc of the 7006 record flagged XYZ compensated since this is already corrected for the tx-rx offset.* *The correction is required for 7027 record and 7006 flagged XYZ compensation off.*

10.28 7007 – 7k Side Scan Data

Description: This record is produced by the 7kCenter. It contains the non-calibrated side-scan type data. This record is typically not available in a forward-looking sonar configuration. The 7kCenter updates this data for each ping. The record can be subscribed to from the 7kCenter. For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*

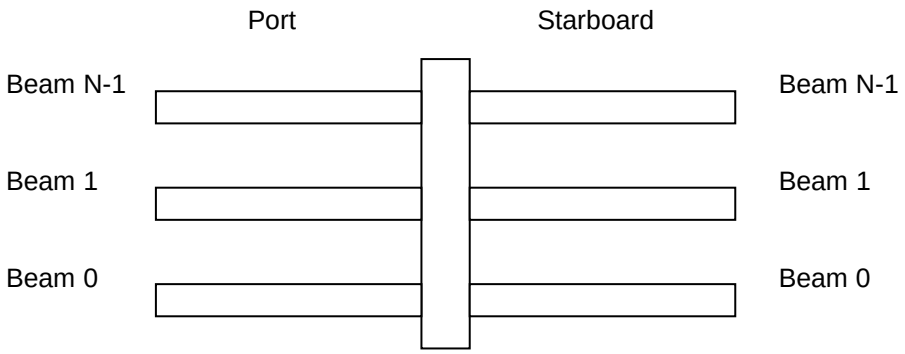


Figure 10-2: Beam Port and Starboard Numbering

Data Definition:

DRF	RTH	RD	OD	DRF

Table 45: 7007 – Record Type Header

Name	Size	Description
Sonar Id	u64	Sonar serial number
Ping number	u32	Sequential number

Name	Size	Description
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
Reserved	u32	BIT FIELD: Bit 0-31: Reserved
S	u32	Samples per side (port/starboard)
Reserved	f32 * 8	Reserved
N	u16	Number of beams per side
Current beam number	u16	Beam number of this record's data (0 to N-1)
W	u8	Number of bytes per sample
Data types	u8	BIT FIELD: Bit 0: Reserved (always 0) Bit 1-7: Reserved

Table 46: 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).

For information on optional data, see APPENDIX A Teledyne PDS Optional Data.

10.29 7008 – 7k Generic Water Column Data

NOTE
Record 7008 is superseded by 7018 and 7028. It is mutually exclusive. The record is depriciated and will not be supported by Teledyne RESON. It exists for backwards compatibility only.

Description: This record is produced by the 7kCenter. It contains the sonar beam "I" and "Q" 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:

- Beam Descriptors

- 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:

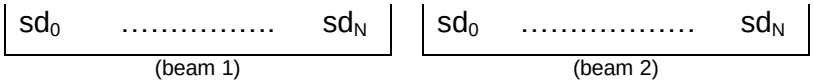
After all of the beams and their corresponding samples have been listed, the sample data will be output.

Sample data will be output in one of two ways:

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

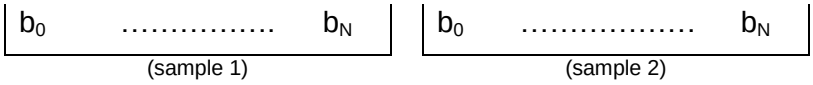
For example:

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



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:

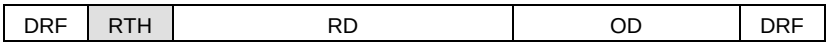


Table 47: 7008 – Record Type Header

Name	Size	Description
Sonar Id	u64	Sonar serial number
Ping number	u32	Sequential number
Multi-ping sequence	u16	Flag to indicate multi-ping sequence. Always 0 (zero) if not in multi-ping mode; otherwise this represents the sequence number of the ping in the multi-ping sequence.
N	u16	Total number of beam descriptors or elements in record
Reserved	u16	Reserved

Name	Size	Description
Samples	u32	Samples in ping. Only valid if all beams and samples are in record.
Record subset flag	u8	BIT FIELD: Bit 0: 0 – All beams and samples in ping 1 – Beam and/or sample ping subset Bit 1: 0 – Sample ping subset 1 – Beam 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
Data sample type(s)	u32	BIT FIELD: (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 an u4 with possible values in range 0 to 16.) Bit 0-3: Magnitude 0 – No magnitude 1 – Reserved 2 – Magnitude (16 bits) 3 – Magnitude (32 bits) Bit 4-7: Phase 0 – No phase 1 – Reserved 2 – Phase (16 bits) 3 – Phase (32 bits) Bit 8-11: I and Q 0 – No I and Q 1 – Signed 16 bit I and signed 16 bit Q 2 – Signed 32 bit I and signed 32 bit Q Bit 12-14: Beamforming flag 0 – Beam formed data 1 – Element data

DRF	RTH	RD	OD	DRF

Table 48: 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
…	…	…
Descriptor N-1	u16	Last 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

Table 49: 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.
…	…	…
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.

For information on optional data, see APPENDIX A Teledyne PDS Optional Data

Additional SeaBat™ data settings (data reduction).

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

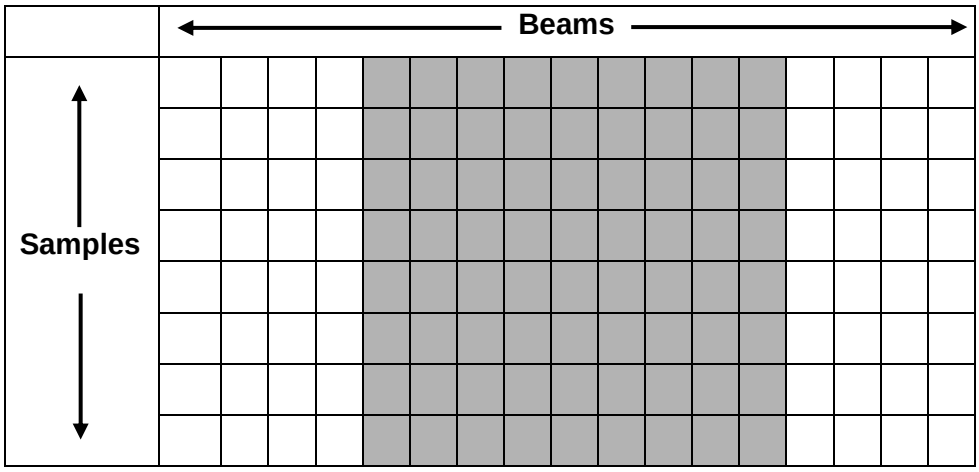


Figure 10-3: Beam Limits – Set Min and Max Beam

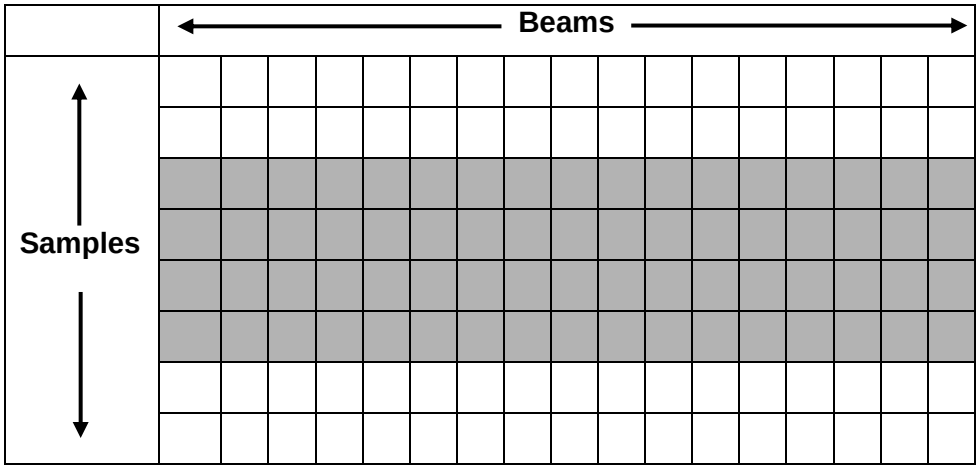


Figure 10-4: Sample Limits – Set Min and Max Sample

10.30 7010 – TVG Values

NOTE
This record requires the system to be calibrated. If calibration results are not available, all values are reported as -1.

Description: This record provides the TVG values, one for each sample in the ping. The 7kCenter updates this data for each ping. The record can be subscribed to from the 7kCenter. For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*

Data Definition:

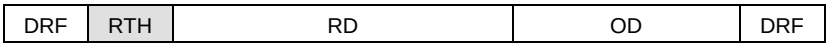


Table 50: 7010 – Record Type Header

Name	Size	Description
Sonar ID	u64	Sonar serial number
Ping number	u32	Sequential number
Multi-ping sequence	u16	Flag to indicate multi-ping sequence. Set to zero if not in multi-ping mode; otherwise, this represents the sequence number of the ping in the multi-ping sequence.
Samples (N)	u32	Number of gain values to follow (1 float per sample). Also the number of samples per beam in the ping.
Reserved	u32 * 8	Reserved

Table 51: 7010 – Record Data

Name	Size	Description
Gain value [1]	f32	Gain values – one per sample
…	…	…
Gain value [N]	f32	

10.31 7011 – 7k Image Data

Description: This record is produced by the SeaBat™ 7k sonar 7-P processor series. It contains the sonar image data. The image data is compressed RAW or beamformed magnitude / phase data. The 7kCenter updates this data for each ping. The record can be subscribed to from the 7kCenter. For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*

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

Data Definition:

DRF	RTH	RD	OD	DRF

Table 52: 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 (bytes 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 53: 7011 – Record Data

Name	Size	Description
First row	Dynamic (1024 max)	All beams left to right
…	…	…
Last row	Dynamic (1024 max)	All beams left to right

10.32 7012 – 7k Ping Motion Data

Description: This record is produced by the 7kCenter series. It contains the description of various parameters used in detection computations. The 7kCenter updates this data for each ping. The record can be subscribed to from the 7kCenter. For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*

NOTE
These are not actual steering angles. In order to get actual steering angles this data should be used in conjunction with base transmit and receive angles from record 7004 – 7k Beam Geometry.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 54: 7012 – Record Type Header

Name	Size	Description

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.
Samples (N)	u32	Number of samples
Flags	u16	BIT FIELD: Bit 0: Pitch stabilization applied/pitch field present Bit 1: Roll stabilization applied/roll field present Bit 2: Yaw stabilization applied/heading field present Bit 3: Heave stabilization applied/heave field present Bit 4-15: Reserved
Error flags	u32	BIT FIELD: Bit 0: PHINS reference 0 – Valid 1 – Invalid Bit 1-3: Reserved for PHINS Bit 4: Roll angle >15 degrees Bit 5: Roll angle >35 degrees Bit 6: Roll rate > 10 degrees per second Bit 7: 1 – External motion data not received (roll angle and rate are not reported) Bit 8-31: Reserved
Sampling rate	f32	Sampling frequency in Hz
Pitch	f32	Pitch value at the ping time in radians (see note below)
Roll	f32 * N	Roll value per sample in radians (see note below)
Heading	f32 * N	Heading value per sample in radians (see note below)
Heave	f32 * N	Heave value per sample in meters (see note below)

NOTE
The fields, Pitch, Roll, Heading, and Heave, are present only if corresponding flags are set. The new fields may be added (refer to the record size in the record header for the total size). For sign explanations, see *section 2.2 Sign Conventions*.

10.33 7017 – 7k Detection Data Setup

Description: This record is produced by the 7kCenter series. It contains the description of various parameters used in detection computations. The 7kCenter updates this data for each ping. The record can be subscribed to from the 7kCenter. For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*This record is available by subscription only.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 55: 7017 – 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 detection points
Data block size (S)	u32	Size of detection information block in bytes
Detection algorithm	u8	0 – G1_Simple 1 – G1_BlendFilt 2 – G2 3 – G3 4 – IF1 5-255 – Reserved for future use
Flags	u32	BIT FIELD: Bit 0: 1 – User-defined depth filter enabled Bit 1: 1 – User-defined range filter enabled Bit 2: 1 – Automatic filter enabled Bit 3: 1 – Nadir search limits enabled Bit 4: 1 – Automatic window limits enabled Bit 5: 1 – Quality filter enabled Bit 6: 1 – Multi-detection enabled Bits 7-31: Reserved for future use
Minimum depth	f32	Minimum depth for user-defined filter in meters

Name	Size	Description
Maximum depth	f32	Maximum depth for user-defined filter in meters
Minimum range	f32	Minimum range for user-defined filter in meters
Maximum range	f32	Maximum range for user-defined filter in meters
Minimum nadir search	f32	Minimum depth for automatic filter nadir search in meters
Maximum nadir search	f32	Maximum depth for automatic filter nadir search in meters
Automatic filter window	u8	Automatic filter window size in percent of the depth
Applied roll	f32	Roll value (in radians) applied to gates; zero if roll stabilization is ON
Depth gate tilt	f32	Angle in radians (positive to starboard)
Nadir depth	f32	Nadir depth used by MB2
Reserved	u32 * 13	Reserved for future use

NOTE
The following data section is repeated for each detection point as defined in RTH. The size of each field is always defined in RTH (S). If the size of this definition does not match the size specified in the record's header, the user must assume that there is an updated revision of this record and that new fields are added at the end.

Table 56: 7017 – Record Data

Name	Size	Description
Beam descriptor	u16	Beam number the detection is taken from
Detection point	f32	Non-corrected fractional sample number with reference to receiver's acoustic center with the zero sample at the transmit time

Name	Size	Description
Flags	u32	BIT FIELD: Bit 0: 1 – Automatic limits valid Bit 1: 1 – User-defined limits valid Bit 2-8: Quality type, defines the type of the quality field Bit 9: 1 – Quality passes user-defined criteria or no user-defined criteria was specified Bits 10-12: Detection type (1 or more of the following): Bit 10 : Magnitude detect used Bit 11 : Phase detect used Bit 12 : Reserved Bit 13-15: Reserved for future use Bit 16-19: Detection priority number for detections within the same beam (Multi-detect only). Value zero is highest priority.
Automatic limits minimum sample	f32	Minimum sample number for automatic limits
Automatic limits maximum sample	f32	Maximum sample number for automatic limits
User-defined limits minimum sample	f32	Minimum sample number for user-defined limits
User-defined limits maximum sample	f32	Maximum sample number for user-defined limits
Quality	32 bits	Detection quality, see *Table 57*
Uncertainty	f32	Detection uncertainty represented as an error normalized to the detection point

The quality field above should be treated as follows, according to the quality type specified in the record data's flags (bits 2-8):

Table 57: 7017 – Detection Quality

Name	Size	Description
0	u32	Quality is not available/not used
1	u32	BIT FIELD: Bit 0: 1 – Brightness filter passed Bit 1: 1 – Colinearity filter passed
2-31		Reserved for future use

10.34 7018 – 7k Beamformed Data

Description: This record is produced by the 7kCenter series. It contains the sonar beam magnitude and phase data. The 7kCenter updates this data for each ping. The record can be subscribed to from the 7kCenter. For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*

This record is available by subscription only.

Beams and samples are numbered from 0. Data is sample followed by beams.

First sample 0 of all beams then sample 1 of all beams etc. The sampling continues until the set range is reached. (Every beam will have the same number of samples)

Data rates:

Equation for no data reduction, beam limits, and all sonar settings:

beams * data format bits * sample rate * 10% (header overhead)

Example:

128 beams * 32 bits (sonar setting 6) * 34500 samples/s * 1.1 = 155.4432 Mbits/s

Data Definition:

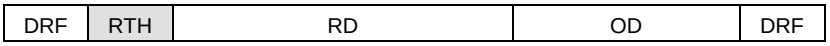


Table 58: 7018 – Record Type Header

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.
Beams (N)	u16	Total number of beams in ping record
Samples (S)	u32	Total number of samples per beam in ping record

Name	Size	Description
Reserved	u32 * 8	Reserved for future use

Table 59: 7018 – Record Data

Name	Size	Description
Sample 0, Beam 0, Amp	u16	Amplitude value for first sample, first beam (First sample represents range 0 meters)
Sample 0, Beam 0, Phs	i16	Phase value for first sample, first beam (First sample represents range 0 meters) (Phase values are in radians scaled by 10430)
…	…	…
Sample 0, Beam N-1, Amp	u16	Amplitude value for first sample, last beam
Sample 0, Beam N-1, Phs	i16	Phase value for first sample, last beam
…	…	…
Sample S-1, Beam N-1, Amp	u16	Amplitude value for last sample, last beam
Sample S-1, Beam N-1, Phs	i16	Phase value for last sample, last beam

10.35 7019 – Vernier Processing Data (Raw)

Description: This record is produced by the 7kCenter series. It contains the output of the custom vernier processing stage for multi-ping forward looking sonar systems (eg. 7130 and 7131). This record is not available on other system types. This record is available by subscription only.

Data Definition:

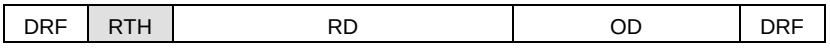


Table 60: 7019 – Record Type Header

Name	Size	Description
Sonar Id	u64	Sonar serial number
Ping number	u32	Sequential number
Multiping Sequence	u16	Multi-ping sequence number 0 – single ping
Reference Array	u8	Index of reference array
Pair 1, Array 2	u8	Index of second array for pair 1
Pair 2, Array 2	u8	Index of second array for pair 2
Decimation factor	u8	Data decimated by this factor, i.e. retain only 1 of X samples
Beams (N)	u16	Number of beams in record
Samples (S)	u32	Number of samples in source data (‘head samples’)

Name	Size	Description
Decimated samples (D)	u32	Number of samples in output angle data after filtering and decimation and clipping (where 'First Sample' > 0)
First sample	u32	Index of first sample (base-0)
Reserved	u32 * 2	Reserved for future use
Smoothing win type	u16	Smoothing window type: 0 – rectangular 1 – hamming 99 – None
Smoothing win length	u16	Smoothing window length [samples]
Reserved	u32 * 2	Reserved for future use
Magnitude threshold	f32	Magnitude threshold for determination of data quality
Min QF	f32	Minimum quality factor (QF), default 0.5
Max QF	f32	Maximum quality factor (QF), default 3.5
Min angle	f32	Lower limit on possible elevation angles, normally -45° (in radians)
Max angle	f32	Upper limit on possible elevation angles , normally +45° (in radians)
Elevation coverage	f32	Normally 90° (π/2) (in radians)
Reserved	u32 * 4	Reserved for future use

Table 61: 7019 – Record Data

Name	Size	Description
		Part 1
Sample 0, Beam 0, angle	i16	Vertical angle of arrival for first decimated sample, first beam (divide by *Angle scaling factor* to get radians)
Sample 0, Beam 1, angle	i16	Vertical angle for first sample, second beam
…	…	…
Sample 0, Beam N-1, angle	i16	Vertical angle for first sample, last beam
Sample 1, Beam 0, angle	i16	Vertical angle for second sample, first beam
…	…	…
Sample D-1, Beam N-1, angle	i16	Vertical angle for last sample, last beam
		Part 2
Sample 0, Beam 0, Mag	u16	Magnitude for first decimated sample, first beam.
Sample 0, Beam 1, Mag	u16	Magnitude for first sample, second beam

Name	Size	Description
…	…	…
Sample 0, Beam N-1, Mag	u16	Magnitude for first sample, last beam
Sample 1, Beam 0, Mag	u16	Magnitude for second sample, first beam
…	…	…
Sample D-1, Beam N-1, Mag	u16	Magnitude for last sample, last beam
		Part 3
Coherence	u16	Coherence data, following format above. Total size = D x N x 2 bytes
		Part 4
Cross Power	u16	Cross Power data, following format above. Total size = D x N x 2 bytes
		Part 5
Quality Factor	u16	Quality factor data, following format above. Total size = D x N x 2 bytes
		Part 6
Reserved field	u16	Reserved. Total size = D x N x 2 bytes

Part 1 of the Record Data (RD) contains the angle estimate raw values (RV). These are signed 16 bit values. To convert to radians, use the following formula:

Angle = (RV / 65536) * *Elevation coverage*

Part 5 of RD contains the quality factor (QF) for each angle estimate normalized such that QF values from min QF to max QF (as defined in the RTH) map to the interval 0 to 65535. After undoing the mapping, the radian vertical angle uncertainty (standard deviation) can be computed as $\sigma = 10^{-QF}$.

10.36 7021 – 7k Built-In Test Environment Data

Description: This record is produced by the SeaBat™ 7k Sonar 7-P processor. It contains both the Built-In Test Environment (BITE) data and board request data (uplink/downlink). The 7kCenter updates this record when any of the values have changed and publishes it every second. The record can be manually requested or subscribed to from the 7kCenter.

For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*

Data Definition:

DRF	RTH	RD	OD	DRF

Table 62: 7021 – Record Type Header

Name	Size	Description
N	u16	Number of boards reporting

DRF	RTH	RD	OD	DRF

Table 63: 7021 – Record Data for Each Device (N)

Name	Size	Description
Source name	u8 * 64	Null terminated ASCII string, e.g. “TX1”
Source address	u8	Source address
Reserved	f32	Reserved
Reserved	u16	Reserved
Downlink time sent	7kTime	Downlink time sent
Uplink time received	7kTime	Uplink time received
BITE time received	7kTime	BITE time received
Status	u8	BIT FIELD: Bit 0: 0 – Uplink OK 1 – Uplink Error Bit 1: 0 – Downlink OK 1 – Downlink Error Bit 2: 0 – Bite OK 1 – Bite Error Bit 3-4: 0 – OK 1 – Warning 2 – Error 3 - Fatal
NBF	u16	Number of valid bite fields (BF) for this board
BITE status bits	UINT64 * 4	BIT FIELD: Bit 0: 0 – BF #0 within range 1 – BF #0 out of range Bit 255: 0 – BF #255 within range 1 – BF #255 out of range
BF #0: Field	u16	Field Number (from Bite.htm file)
BF #0: Name	u8 * 64	Null terminated ASCII string, e.g. “3.3V”

Name	Size	Description
BF #0: Sensor Type	u8	1 – Error count 2 – FPGA die temperature 3 – Humidity 4 – Serial 8-channel ADC 5 – Firmware version 6 – Head Temp, 8K WetEnd 7 – Leak V, 8K WetEnd 8 – 5 Volt, 8K WetEnd 9 – 12 Volt, 8K WetEnd 10 – DipSwitch, 8K WetEnd 12 – Activity counter. Release an alarm if it increments too slowly. 13 – Error counter. Releases an alarm if it increments too much, too fast. 100 – Display 'Value' with 0 digits; scale 1 101 – Display 'Value' with 1 digit; scale 0.1 102 – Display 'Value' with 2 digits; scale 0.01 103 – Display 'Value' with 3 digits; scale 0.001 110 – Display as 4 hex digits 111 – Display as 8 bit Binary 112 – Display as Enumeration (literals defined in Bite.htm file) 200 – Display as part number 201 – Part revision High order 8 bits is the revision number, Low order 8 bit is an ASCII character. 250 – Display as positive number
BF #0: Minimum	f32	Minimum value for alarm
BF #0: Maximum	f32	Maximum value for alarm
BF #0: Value	f32	Current value
…..		
…..		
BF #NBF-1: Field	u16	Field Number (from Bite.htm file)
BF #NBF-1: Name	u8 * 64	Null terminated ASCII string, e.g. "3.3V"

Name	Size	Description
BF #NBF-1: Sensor Type	u8	1 – Error count 2 – FPGA die temperature 3 – Humidity 4 – Serial 8-channel ADC 5 – Firmware version 6 – Head Temp, 8K WetEnd 7 – Leak V, 8K WetEnd 8 – 5 Volt, 8K WetEnd 9 – 12 Volt, 8K WetEnd 10 – DipSwitch, 8K WetEnd 12 – Activity counter. Release an alarm if it increments too slowly. 13 – Error counter. Releases an alarm if it increments too much, too fast. 100 – Display 'Value' with 0 digits; scale 1 101 – Display 'Value' with 1 digit; scale 0.1 102 – Display 'Value' with 2 digits; scale 0.01 103 – Display 'Value' with 3 digits; scale 0.001 110 – Display as 4 hex digits 111 – Display as 8 bit Binary 112 – Display as Enumeration (literals defined in Bite.htm file) 200 – Display as part number 201 – Part revision High order 8 bits is the revision number, Low order 8 bit is an ASCII character. 250 – Display as positive number
BF #NBF-1: Minimum	f32	Minimum value for alarm
BF #NBF-1: Maximum	f32	Maximum value for alarm
BF #NBF-1: Value	f32	Current value
…..		

10.37 7022 – 7kCenter Version

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

Data Definition:

DRF	RTH	RD	OD	DRF

Table 64: 7022 – Record Type Header

Name	Size	Description
Version string	u8 * 32	ASCII string, max length 31 characters + null

10.38 7023 – 8k Wet End Version

Description: This record provides the 8k Wet End version as a NULL terminated string.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 65: 7023 – Record Type Header

Name	Size	Description
Version string	u8 * 32	ASCII string, max length 31 characters + null

10.39 7027 – 7k RAW Detection Data

Description: This record is produced by the 7kCenter series. It contains non-compensated detection results. The 7kCenter updates this record on every ping. This record is available by subscription only.

Refer to APPENDIX F on page 189 for a description of handling the 7027 record.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 66: 7027 – Record Type Header

Name	Size	Description
Sonar Id	u64	Sonar serial number
Ping number	u32	Sequential number
Multiping sequence	u16	Flag to indicate multiping sequence. Always 0 (zero) if not in multiping mode; otherwise this represents the sequence number of the ping in the multiping sequence.
N	u32	Number of detection points
Data field size (S)	u32	Size of detection information block in bytes

Name	Size	Description
Detection algorithm	u8	0 – G1_Simple 1 – G1_BlendFilt 2 – G2 3 – G3 4 – IF1 5-255 – Reserved for future use
Flags	u32	BIT FIELD: Bit 0-3: Uncertainty method 0 – Not calculated 1 – Rob Hare's method 2 – Ifremer's method 3-15 – Reserved for future use Bit 4: Multi-detection enabled Bit 5-31: Reserved for future use
Sampling rate	f32	Sonar's sampling frequency in Hz
Tx angle	f32	Applied transmitter steering angle, in radians
Reserved	u32 * 16	Reserved for future use

NOTE
The following data section is repeated for each detection point as defined in RTH. The size of each field is always defined in RTH. If the size of this definition does not match the size specified in the record's header, the user must assume that there is an updated revision of this record and that new fields are added at the end.

Table 67: 7027 – Record Data

Name	Size	Description
Beam descriptor	u16	Beam number the detection is taken from
Detection point	f32	Non-corrected fractional sample number with reference to receiver's acoustic center with the zero sample at the transmit time
Rx angle	f32	Beam steering angle with reference to receiver's acoustic center in the sonar reference frame, at the detection point; in radians

Name	Size	Description
Flags	u32	BIT FIELD: Bit 0: 1 – Magnitude based detection Bit 1: 1 – Phase based detection Bit 2-8: Quality type, defines the type of the quality field below Bits 9-12: Detection priority number for detections within the same beam (Multi-detect only). Value zero is highest priority. Bits 13-31: Reserved for future use
Quality	32 bits	Detection quality, see *Table 68*
Uncertainty	f32	Detection uncertainty represented as an error normalized to the detection point
Signal Strength	f32	Signal strength of detection point

For information on optional data, see APPENDIX A Teledyne PDS Optional Data.

NOTE
Transmit and receive steering angles provided in this record are total steering angles applied. Refer to record *7004 – 7k Beam Geometry* and/or record *7012 – 7k Ping Motion Data* in order to isolate steering components. For sign explanations, see *section 2.2 Sign Conventions*.

The quality field above should be treated as follows, according to the quality type specified in the record data's flags (bits 2-8):

Table 68: 7027 – Detection Quality

Name	Size	Description
0	u32	Quality is not available / not used
1	u32	BIT FIELD: Bit 0: 1 – Brightness filter passed Bit 1: 1 – Colinearity filter passed
2-31		Reserved for future use

10.40 7028 – 7k Snippet Data

Description: This record is produced by the SeaBat™ 7k sonar. It contains the sonar snippet imagery data. The 7kCenter updates this record on every ping. This record is available by subscription only. It is not available for forward-looking sonar.

For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*

For information on optional data, see APPENDIX A Teledyne PDS Optional Data

Beams and samples are numbered from 0. Data is beams followed by samples.

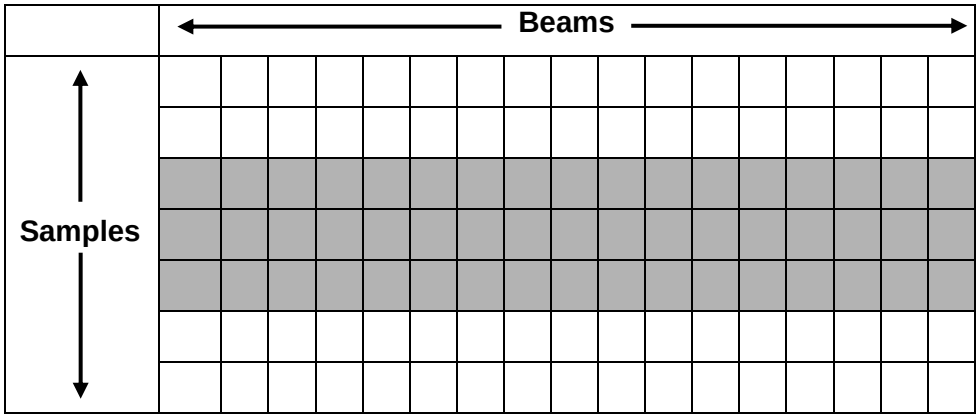


Figure 10-5: Sample Limits – Set Min and Max Sample

Data rates:

Equation for no data reduction, beam limits, and all sonar settings:

beams * data format bits * sample rate * 10% (header overhead)

Example:

128 beams * 32 bits (sonar setting 5) * 34500 samples/s * 1.1
= 155.4432 Mbits/s

Equation for sample limits:

beams * ping rate * samples * data format bits * 10%

Example:

128 beams * 7 ping/s * 3000 samples * 8 bits (sonar setting 1) * 1.1
= 23.6544 Mbits/s

Data Definition:

DRF	RTH	RD	OD	DRF

Table 69: 7028 – Record Type Header 7K and T-series sonar

Name	Size	Description
Sonar Id	u64	Sonar serial number
Ping number	u32	Sequential number

Name	Size	Description
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	Number of detection points
Error flag	u8	If *set*, record will not contain any data. Flag itself will indicate an error. 0 – OK 1-5 – Reserved 6 – Bottom detection failed (R7006) 7-255 – Reserved
Control flags	u8	Control settings from RC 1118 0 – Automatic snippet window is used 1 – Quality Filter enabled 2 – Minimum window size is required 3 – Maximum window size is required 4-7 – Reserved
Reserved	u32 * 7	Reserved for future use

Table 70: 7028 – Record Data

Name	Size	Description
Beam descriptor[1]	u16	Beam number
Snippet start[1]	u32	First sample included in the snippet
Detection sample[1]	u32	Detection point
Snippet End[1]	u32	Last sample included in the snippet
…	…	…
Beam descriptor[N]	u16	Beam number
Snippet start[N]	u32	First sample included in the snippet
Detection sample[N]	u32	Detection point
Snippet end[N]	u32	Last sample included in the snippet
First snippet	Dynamic, u16	Amplitude series for each sample. Array is populated with samples from the first sample to the last as defined above.
…	…	…
Last beam	Dynamic, u16	Amplitude series for each sample. Array is populated with samples from the first sample to the last as defined above.

For information on optional data, see APPENDIX A Teledyne PDS Optional Data.

10.41 7029 – Vernier Processing Data (Filtered)

Description: This record is produced by the 7kCenter series. It contains the *filtered* output of the vernier processing stage for multi-stave forward looking sonar systems (eg. 7130, 7131). This record is not available on other system types. This record is available by subscription only.

For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions*

Data Definition:

DRF	RTH	RD	OD	DRF

Table 71: 7029 – 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.
Soundings (S)	u16	Number of soundings. There may be several soundings per beam.
Min Angle	f32	Minimum elevation angle in all soundings (radians).
Max Angle	f32	Maximum elevation angle in all soundings (radians).
Repeat Size	u16	Size of sounding repeat blocks following (bytes).

DRF	RTH	RD	OD	DRF

Table 72: 7029 – Record Data

	Name	Size	Description
Sounding #1	Beam Angle	f32	Sounding horizontal angle (radians).
	Sample	u32	Sounding sample number (convert to range using sample rate and sound velocity).
	Elevation	f32	Sounding vertical angle (radians).
	Reserved	f32	Reserved (zero).
Sounding #2			
....			
Sounding #S			

10.42 7030 – Sonar Installation Parameters

NOTE
Teledyne RESON Sonars will NOT generate this record. This record could however be generated by third-party software such as Teledyne PDS.

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 73: 7030 – Record Type Header

Name	Size	Description
Frequency	f32	Frequency in Hz
Length of firmware version info	u16	Length in bytes
Firmware version info	u8 [128]	
Length of software version info	u16	Length in bytes
Software version info	u8 [128]	
Length of 7k software version info	u16	Length in bytes
7k software version info	u8 [128]	
Length of record protocol info	u16	Length in bytes
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

Name	Size	Description
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
Position sensor time delay	u16	Seconds
Water line vertical offset	f32	Vertical offset from reference point to waterline in meters

10.43 7031 – 7k Built-In Test Environment Data (Summary)

Description: This record is produced by the SeaBat™ 7k Sonar 7-P processor. It contains a summary of the Built-In Test Environment (BITE) warning, error and fatal level alert items. The 7kCenter updates this record when any of the values have changed and publishes it every two seconds. The record can be manually requested or subscribed to.

For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*

Data Definition:

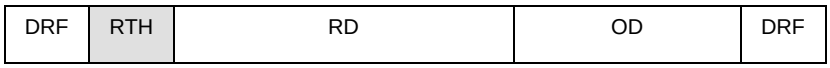


Table 74: 7031 – Record Type Header

Name	Size	Description
Total Items	u16	Total of all *warning*, *error* or *fatal* level BITE status items. If this field is not zero, then the following fields can be examined to determine severity and source of BITE alerts.
Warnings	u16*4	Index 0 = Overall number of warnings. Index 1 = Receiver related warnings. Index 2 = Transmitter related warnings. Index 3 = Other (system) related warnings.
Errors	u16*4	Index 0 = Overall number of errors. Index 1 = Receiver related errors. Index 2 = Transmitter related errors. Index 3 = Other (system) related errors.
Fatals	u16*4	Index 0 = Overall number of fatal status items. Index 1 = Receiver related fatal status items. Index 2 = Transmitter related fatal status items. Index 3 = Other (system) related fatal status items.
RESERVED	u32*2	Zero. Reserved for future use

10.44 7041 – Compressed Beamformed Magnitude Data

Description: This record is produced by the SeaBat™ 7k sonar 7-P processor series. It contains the compressed magnitude sonar beam data. The 7-P processor updates this record for each ping. The record can be subscribed to from the 7-P processor; it is not available by single request. For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*

NOTE
The 7041 record is deprecated by the new 7042 record. The 7041 record is supported only for 7111 and 7150 systems. All other systems should use the 7042 record.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 75: 7041 – 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.
Number of Beams (B)	u16	Total number of beams in ping record
Flags	u16	BIT FIELD: Bit 0-1: Reserved Always 1 for backward compatibility with 7111 systems Bit 2-4: Down –sampling method 0 – no down sampling 1 – nearest neighbor 2 – linear approximation 3-7 - reserved Bit 5-7: Filtering method 0 – no filtering 1-7 – reserved Bit 8: Beam identification method 0 – beam number (u16) 1 – beam angle (f32, in radians) Bit 9-15: Reserved
Sample Rate	f32	Sampling rate for the data
Reserved	4*u32	Reserved for future use

DRF	RTH	RD	OD	DRF

Table 76: 7041 – Record Data for Each Beam (B)

Name	Size	Description
Beam	var	Identification for the beam. (See “Beam identification method” above)
Number of Samples (S)	u32	Total number of samples recorded for this beam
Data	S*var	Data series for each sample. (See ‘Data Size’ above)

10.45 7042 - Compressed Watercolumn Data

Description: This record is produced by the 7kCenter series. It contains compressed watercolumn data. The 7kCenter updates this record on every ping. This record is available by subscription only. For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*

NOTE
Remote command 7500 sub7042 is used to configure this record.

The compressed watercolumn record allows for the reduction in record data size (vs. the standard 7018 full magnitude/phase record) via the several possible options listed here. “Downsampling” means that only 1 of N mag/phase samples are kept. Where ‘N’ is the “downsampling factor” value. The “downsampling type” controls how that 1 value is determined. The three choices are:

1. Middle of window:
   The 1 sample value kept is the middle one in each “window” (e.g. if N = 5, then we keep sample 3, 8, 13, 18, …)
2. Peak:
   The 1 sample value kept is the largest of each “window” of N samples.
3. Average:
   The 1 sample value kept is the average of all N samples in each “window”.

For example, if the “Remove phase data” option and the Downsampling option (with factor 5) are selected, then the resulting compressed watercolumn record will be 1/2 * 1/5 = 1/10 the size of corresponding 7018 mag+phase watercolumn record.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 77: 7042 - Record Type Header

Name	Size	Description
Sonar Id	u64	Sonar serial number.

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.
Beams (B)	u16	Number of beams.
Samples	u32	Number of samples (nominal, based on range)
Compressed Samples	u32	Number of samples (maximum over all beams if Flags bit 0 set [samples per beam varies]. Otherwise same as *Samples*)
Flags	u32	Bit field: Bit 0 : Use maximum bottom detection point *in each beam* to limit data. Data is included up to the bottom detection point + 10%. This flag has no effect on systems which do not perform bottom detection. Bit 1 : Include magnitude data only (strip phase) Bit 2 : Convert mag to dB, then compress from 16 bit to 8 bit by truncation of 8 lower bits. Phase compression simply truncates lower (least significant) byte of phase data. Bit 3 : Reserved. Bit 4-7 : Downsampling divisor. Value = (BITS >> 4). Only values 2-16 are valid. This field is ignored if downsampling is not enabled (type = “none”). Bit 8-11 : Downsampling type: 0x000 = None 0x100 = Middle value 0x200 = Peak value 0x300 = Average value
First Sample (F)	u32	First sample included for each beam. Normally zero, unless power saving mode “*Range Blank*” or absolute gate (bit 3) is in effect. See RC 1046 for details. Thus, the samples in each beam data section will run from F to F+N-1. Construction of a correct water column image must take this into account.
Sample Rate	f32	Effective sample rate after downsampling, if specified.
RESERVED	u32*2	Zero. Reserved for future use

NOTE
If downsampling is used (Flags bit 8-11), then the effective Sample Rate of the data is changed and is given by the sample rate field. To calculate the effective sample rate, the system sample rate (provided in the 7000 record) must be divided by the downsampling divisor factor specified in bits 4-7.

NOTE
The following data section is repeated for each beam (B) as defined in RTH. The size may vary for each beam if bottom detection truncation is in effect (Flags bit 0 is set). **IMPORTANT:** This is "reversed" compared to the data ordering in the standard 7018 watercolumn record!

DRF	RTH	RD	OD	DRF

Table 78: 7042 – Record Data

Name	Size	Description
Beam 0	u16	Beam Number for this data.
Samples (N)	u32	Number of samples included for this beam.
Sample 0	Variable	Each "Sample" may be one of the following, depending on the *Flags* bits: A) 16 bit Mag & 16bit Phase (32 bits total) B) 16 bit Mag (16 bits total, no phase) C) 8 bit Mag & 8 bit Phase (16 bits total) D) 8 bit Mag (8 bits total, no phase)
Sample 1	Variable	
…	Variable	
Sample N-1	Variable	
Beam 1	u16	
Samples (N)	u32	
Sample 0	Variable	
Sample 1	Variable	
…	Variable	
Sample N-1	Variable	
…..		
Beam B-1	u16	
Samples (N)	u32	
Sample 0	Variable	
Sample 1	Variable	
…	Variable	
Sample N-1	Variable	

10.46 7048 – 7k Calibrated Beam Data

NOTE
This record contains non-calibrated beam magnitude, if calibration is available but not run. (See Error flag in *Table 79: 7048 – Record Type Header*).

Description: This record is produced by the SeaBat™ 7k sonar series. It contains the calibrated sonar beam magnitude. The 7kCenter updates this record for each ping.

Beams and samples are numbered from 0. Data is sample followed by beams.

Additional SeaBat™ Data Settings (Data Reduction).

Both beam limits and SeaBat™ format types can be combined.

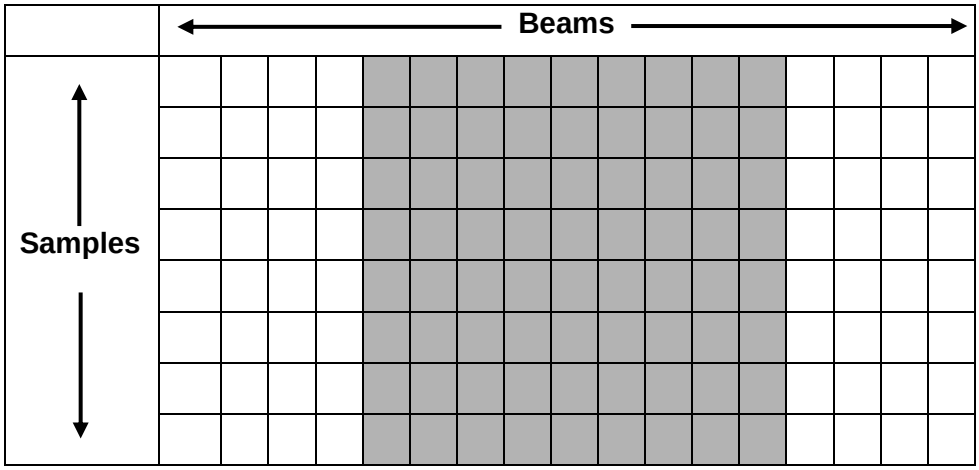


Figure 10-6: Beam Limits – Set Min and Max Beam

Data Definition:

DRF	RTH	RD	OD	DRF

Table 79: 7048 – 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
First beam	u16	Beam reduction initial beam
N	u16	Total number of beams in ping record
S	u32	Total number of samples in ping record
Forward-looking sonar	u8	FLS flag

Name	Size	Description
Error flag	u8	If *set*, record contains original non-calibrated beamformed data. Flag itself will indicate an error. 0 – OK 1 – No calibration 2 – TVG read error (R7010) 3 – CTD not available (R1010) 4 – Invalid or not available geometry (R7004) 5 – Invalid sonar specifications (XML) 6 – Bottom detection failed 7 – No power (Power is set to zero) 8 – No gain (Gain is too low) 128-254 – Reserved for internal errors 255 – System cannot be calibrated (c7k file missing)
Reserved	u32 * 8	Reserved for future use

Table 80: 7048 – Record Data

Name	Size	Description
First sample	N * f32	Amplitude series for each beam. First sample represents range 0 meters.
…	…	…
Last sample (S)	N * f32	Amplitude series for each beam

10.47 7050 – 7k System Events

Description: This record is produced by the SeaBat™ 7k sonar series. It contains the 7kCenter system events. The 7kCenter updates this record when any event is added or removed in the system. The record can be manually requested or subscribed to from the 7kCenter. For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*

Data Definition:

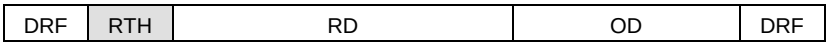


Table 81: 7050 – Record Type Header

Name	Size	Description
Sonar Id	u64	Sonar serial number
N	u32	Number of events

DRF	RTH	RD	OD	DRF

Table 82: 7050 – Record Data

Name	Size	Description
Event type 0	u16	0 - Success 1 – Information 2 – Warning 3 – Error 4 - Fatal
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
Event message length (L)	u16	Message length including termination character
7KTIME	u8 * 10	Time tag
Event message	u8 * L	Fixed-width string
…	…	…
Event type N-1	u16	0 - Success 1 – Information 2 – Warning 3 – Error 4 - Fatal
Event identifier	u16	0 – Not defined
Device identifier	u32	Identifier of the device that this data pertains
System enumerator	u16	System enumerator for identical systems in one installation
Event message length (L)	u16	Message length including termination character
7KTIME	u8 * 10	Time tag
Event message	u8 * L	Fixed-width string

10.48 7051 – 7k System Event Message

Description: This record is produced by the SeaBat™ 7k sonar series. It holds a single 7k event. The latest record can be manually requested or subscribed to from the 7kCenter. For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*

Data Definition:

DRF	RTH	RD	OD	DRF

Table 83: 7051 – Record Type Header

Name	Size	Description
Sonar Id	u64	Sonar serial number
Event Id	u16	0 - Success 1 – Information 2 – Warning 3 – Error 4 - Fatal
Message length	u16	Message length in bytes
Event identifier	u16	0 – Undefined

DRF	RTH	RD	OD	DRF

Table 84: 7051 – Record Data

Name	Size	Description
Event message	dynamic	Null terminated string.

10.49 7052 – RDR Recording Status

Description: This record is generated at every 1% drop in disk capacity and on any start or stop of recording or playback. The record can be manually requested or subscribed to from the 7kCenter. For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*

Data Definition:

DRF	RTH	RD	OD	DRF

Table 85: 7052 – Record Type Header

Name	Size	Description
Position	u32	Seconds since start of recording
Disk free	u8	Percentage of disk space free (0-100)

Name	Size	Description
Mode	u8	BIT FIELD: Bits 5-0: 0 – Stopped 1 – Recording 2 – Playing 3 – Deleting 4 – Stopping 5+ – Reserved
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.
Error	u32	Error code (see appendix D)
Logger Address	u32	IP address of stand alone 7K logger when connected
Single or multiple file	u8	Zero = Write logfiles of multiple 1GB files Non-zero = Write single 7K logfile
Ping data history	u8	Zero = No lead-in ping data Non-zero = Write 10 sec of lead-in ping data
Reserved	u16	Reserved
Reserved	u32 * 4	Reserved

Table 86: 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 (not used)
Excluded Records Array	u32 * ER	Array of ER excluded records (not used)
Included Devices (ID)	u32	Number of included devices (not used)
Included Devices Array	u32 * ID	Array of ID included devices (not used)

Name	Size	Description
Excluded Devices (ED)	u32	Number of excluded devices (not used)
Excluded Devices Array	u32 * ED	Array of ED excluded devices (not used)

10.50 7053 – 7k Subscriptions

Description: This record is produced by the SeaBat™ 7k sonar 7-P processor. It contains information about subscription connections and third-party data connections. The record can be manually requested or subscribed to from the 7-P processor. For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*

Data Definition:

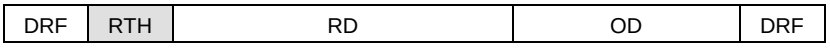


Table 87: 7053 – Record Type Header

Name	Size	Description
N	i32	Number of subscriptions

Table 88: 7053 – Record Data for Each Subscription (N)

Name	Size	Description
Address	u32	IP Address (host byte data order)
Port	u16	Port number
Type	u16	0 – UPD 1 – TCP
# records	u32	Number of records
Record list	u32 * 64	Array of records ID N – # of valid records
Reserved	u32 * 128	Reserved

10.51 7055 – Calibration Status

Description: This record is produced by the SeaBat™ 7k sonar series. It contains status of the system calibration. The record can be manually requested or subscribed to from the 7kCenter. For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*

Data Definition:

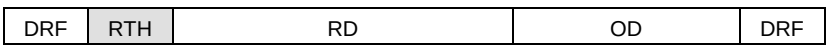


Table 89: 7055 – Record Type Header

Name	Size	Description
Sonar Id	u64	Sonar serial number

Name	Size	Description
Calibration status	u16	0 – Calibration is not available 1 – Calibration was not done 8 – Calibration is in progress 16 – Calibration completed >127 – Calibration failed
Percent complete	u16	If status is 8 (in progress) this field indicates percentage completed. If calibration status is 16 (completed) this field indicates the following. 0 – Results of previous calibration used without validation 1-99 – Results of previous calibration validated and used 100 – Full calibration performed
Calibration time	u8 * 10	Completion time of most recent calibration (zero if none). TIME_7K format (UTC). If calibration status is 1 (not done), calibration time other than zero indicates that previous calibration results are available but not validated.
Status message	u8 * 800	Status message text string (null terminated)
Sub status	u32	Status details 0 – Ok 1 – No license file 2 – License file corrupt 3 – Invalid version 10 – Failed – noise 11 – Failed – ceramics bad 12 – Failed – magnitude tolerance 13 – Failed – phase tolerance
Fields below apply only for FP2+ multi-frequency systems		
Calibration system	u8	Bitfield indicating which system(s) are being calibrated Bit 0: enum Bit 1: enum Etc
Calibration system done	u8	Bitfield indicating which ones are already done
Current calibration system	u8	Enum of system being calibrated
Start-up calibration	u8	Non zero if start-up calibration is in progress
Status	u16	Final status of each system calibrated
Reserved	u32 * 2	Reserved

10.52 7057 – Calibrated Side-Scan Data

Description: This record is produced by the 7kCenter. It contains the calibrated side-scan sonar data. This record is typically not available in a forward-looking sonar configuration. This record is not available for subscription, if calibration is not available for the system. This record contains non-calibrated side-scan data, if calibration is available but not run.

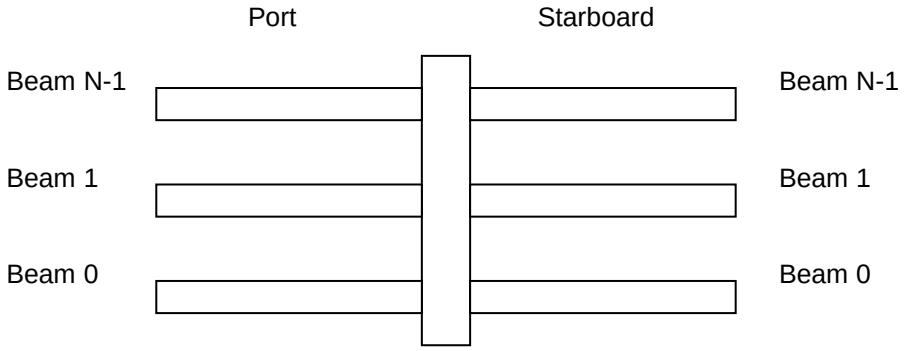


Figure 10-7: Beam Port and Starboard Numbering

Data Definition:

DRF	RTH	RD	OD	DRF

Table 90: 7057 – 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
Reserved	u32	Controls BIT FIELD: Bit 0-31: Reserved
S	u32	Samples per side (port/starboard)
Reserved	f32 * 8	Reserved
N	u16	Number of beams per side
Current beam number	u16	Beam number of this record's data (0 to N-1)
W	u8	Number of bytes per sample 4 – Single precision (u32)
Data types	u8	BIT FIELD: Bit 0: Reserved (always 0) Bit 1-7: Reserved

Name	Size	Description
Error flag	u8	If *set*, record contains original non-calibrated beamformed data. Flag itself will indicate an error. 0 – OK 1 – No calibration 2 – TVG read error (R7010) 3 – CTD not available (R1010) 4 – Invalid or not available geometry (R7004) 5 – Invalid sonar specifications (XML) 6 – Bottom detection failed 7 – No power (Power is set to zero) 8 – No gain (Gain is too low) 128-254 – Reserved for internal errors 255 – System cannot be calibrated (c7k file missing)

Table 91: 7057 – 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).
Port beams number	S * u16	Indicates the beam number corresponding value was taken from
Starboards beams number	S * u16	Indicates the beam number corresponding value was taken from

NOTE
Calibrated side-scan data is returned as floating point values, either single (W = 4 bytes) or double (W = 8 bytes) precision.

For information on optional data, see APPENDIX A Teledyne PDS Optional Data.

10.53 7058 – Snippet Backscattering Strength

NOTE
Snippet must be enabled in order to receive this record.

Description: This record is produced by the SeaBat™ 7k sonar. This record is available by subscription only, and is only available if normalized backscatter is licensed on the system. It contains snippet data where the reported backscattering strengths have been compensated for sonar system parameters, propagation losses, and geometric footprint as described in the record. Backscatter levels are reported in dB reference 1 µPa. The 7kCenter updates this record on every ping. Sonar system compensation can be based upon generic performance parameters for each component, or specific calibration parameters for individual units, as specified in the record.

Beams and samples are numbered from 0. Data is beams followed by samples.

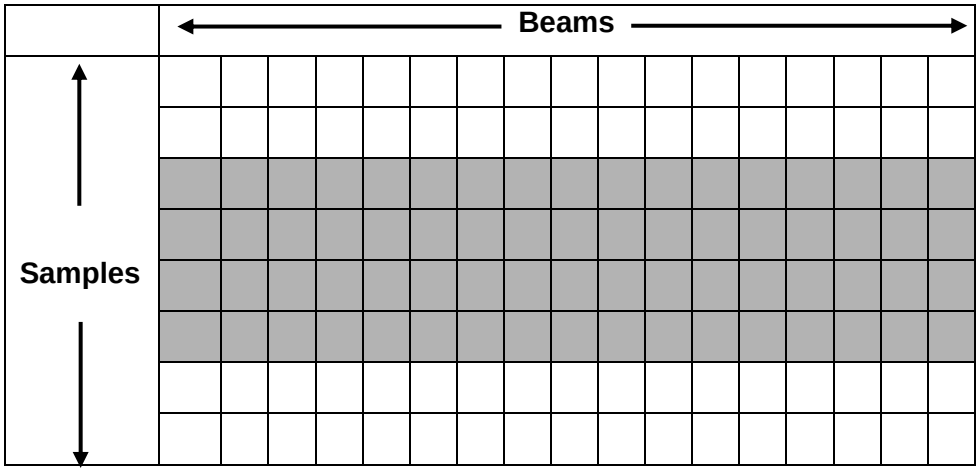


Figure 10-8: Sample Limits – Set in dB Around Bottom Detection Point

For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*

Data Definition:

DRF	RTH	RD	OD	DRF

Table 92: 7058 – 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.
Detections	u16	Number of detections

Name	Size	Description
Error flag	u8	If set, record contains original non-calibrated beamformed data. Flag itself will indicate an error. 0 – OK 1 – No calibration 2 – TVG read error (R7010) 3 – CTD not available (R1010) 4 – Invalid or not available geometry (R7004) 5 – Invalid sonar specifications (XML) 6 – Bottom detection failed (R7006) 7 – No power (Power is set to zero) 8 – No gain (Gain is too low) 128-254 – Reserved for internal errors 255 – System cannot be calibrated (c7k file missing)
Control flags	u32	Control settings Bit 0 – Brightness is required to pass Bit 1 – Colinearity is required to pass Bit 2 – Bottom detection results are used for snippet Bit 3 – Snippet display min. requirements are used Bit 4 – Minimum window size is required Bit 5 – Maximum window size is required Bit 6: - Footprint areas are included Bit 7: - Generic compensation (not per unit) Bit 8: - Single absorption value used for the whole ping. Otherwise a CTD profile is used Bit 9-31: - Reserved
Absorption	f32	Absorption value in dB/km. Only valid when control flag bit 8 is set.
Reserved	u32 * 6	Reserved for future use

Table 93: 7058 – Record Data

Name	Size	Description
Beam descriptor of first detection	u16	Beam number
Begin sample descriptor	u32	First sample number in beam from transmitter and outward
Bottom detection sample	u32	Bottom detection point in beam from transmitter and outward

Name	Size	Description
End sample descriptor	u32	Last sample number in beam from transmitter and outward
…	…	…
Beam descriptor of last detection	u16	Beam number
Begin sample descriptor	u32	First sample number in beam from transmitter and outward
Bottom detection sample	u32	Bottom detection point in beam from transmitter and outward
End sample descriptor	u32	Last sample number in beam from transmitter and outward
BS of first detection	Dynamic (E-B+1) * f32	Backscattering Strength (BS) for each sample, in dB re 1 µPa. Array is populated with samples from transmitter and outward.
…	…	…
BS of last detection	Dynamic (E-B+1) * f32	Backscattering Strength (BS) for each sample, in dB re 1 µPa. Array is populated with samples from transmitter and outward.
Footprints of first detection	Dynamic (E-B+1) * f32	Footprint area series for each sample in square meters. Only available when control flag bit 6 is set.
…	…	…
Footprints of last detection	Dynamic (E-B+1) * f32	Footprint area series for each sample in square meters. Only available when control flag bit 6 is set.

For information on optional data, see APPENDIX A Teledyne PDS Optional Data.

10.54 7059 – MB2 specific status

This record contain MB2 specific status information. This record can be retrieved by a single record request to obtain the initial value of the fields as requsted by the remote control definitions 1211, 1600, 1601, 1602, 1603, 1604 and 1605 For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*

Data Definition:

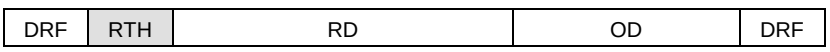


Table 94: 7059 Record Type Header

Name	Size	Description
Directory	u8 * 256	Full directory path name. Null terminated ASCII string. Maximum of 256 characters, including null character.
Header name	u8 * 256	Null terminated ASCII string. Maximum of 256 characters including null character.
Trailer name	u8 * 256	Null terminated ASCII string. Maximum of 256 characters including null character.
Prepend header	u8	When not zero: Prepend the file specified by the header name for each file.
Append trailer	u8	When not zero: Append the file specified by the trailer name for each record.
Storage	u8	When not zero: Enable custom recording.
Playback Path name	u8 * 256	Full directory path name. Null terminated ASCII string. Maximum of 256 characters, including null character.
Playback File name	u8 * 256	Null terminated ASCII string. Maximum of 256 characters including null character.
Playback Loop mode	u32	0 – Play file once 1 – Loop the file 2 – Advance to next file
Playback	u8	When not zero: Enable custom playback
RRIO address1	u8 * 256	RRIO IP address :port ASCII string, max length 255 characters + null.
RRIO address2	u8 * 256	RRIO IP address :port ASCII string, max length 255 characters + null.
RRIO address2	u8 * 256	RRIO IP address :port ASCII string, max length 255 characters + null.
Use build in HPR	u8	0 – Use HPR sensor connected to RTA 1 – Use the build in HPR sensor
Use attached SVP sensor	u8	0 – Use SVP sensor connected to RTA 1 – Use attached SVP sensor
Enable stacking	u8	0 – Disable stacking mode 1 – Enable stacking mode
Stacking value	u8	Number of results to stack min = 1, max = 9

Name	Size	Description
ZDA port baudrate	u8	0 – 1200 1 – 2400 2 – 4800 3 – 9600 4 – 14400 5 – 19200 6 – 28800 7 – 38400 8 – 56000 9 – 57600 10 - 115200
ZDA port parity	u8	0 – None 1 – Even 2 – Odd 3 – Space 4 - Mark
ZDA port data bits	u8	0 – 5 bits 1 – 6 bits 2 – 7 bits 3 – 8 bits
ZDA port stop bits	u8	0 – 1 bit 1 – 2 bits
GGA port baudrate	u8	0 – 1200 1 – 2400 2 – 4800 3 – 9600 4 – 14400 5 – 19200 6 – 28800 7 – 38400 8 – 56000 9 – 57600 10 - 115200
GGA port parity	u8	0 – None 1 – Even 2 – Odd 3 – Space 4 - Mark

Name	Size	Description
GGA port data bits	u8	0 – 5 bits 1 – 6 bits 2 – 7 bits 3 – 8 bits
GGA port stop bits	u8	0 – 1 bit 1 – 2 bits
SVP port baudrate	u8	0 – 1200 1 – 2400 2 – 4800 3 – 9600 4 – 14400 5 – 19200 6 – 28800 7 – 38400 8 – 56000 9 – 57600 10 - 115200
SVP port parity	u8	0 – None 1 – Even 2 – Odd 3 – Space 4 - Mark
SVP port data bits	u8	0 – 5 bits 1 – 6 bits 2 – 7 bits 3 – 8 bits
SVP port stop bits	u8	0 – 1 bit 1 – 2 bits
HPR port baud rate	u8	0 – 1200 1 – 2400 2 – 4800 3 – 9600 4 – 14400 5 – 19200 6 – 28800 7 – 38400 8 – 56000 9 – 57600 10 - 115200

Name	Size	Description
HPR port parity	u8	0 – None 1 – Even 2 – Odd 3 – Space 4 - Mark
HPR port data bits	u8	0 – 5 bits 1 – 6 bits 2 – 7 bits 3 – 8 bits
HPR port stop bits	u8	
HDT port baud rate	u8	0 – 1200 1 – 2400 2 – 4800 3 – 9600 4 – 14400 5 – 19200 6 – 28800 7 – 38400 8 – 56000 9 – 57600 10 - 115200
HDT port parity	u8	0 – None 1 – Even 2 – Odd 3 – Space 4 - Mark
HDT port data bits	u8	0 – 5 bits 1 – 6 bits 2 – 7 bits 3 – 8 bits
HDT port stop bits	u8	0 – 1 bit 1 – 2 bits
RRIO	u16	RRIO port used by SUI
Playback Time stamps	u8	0 – Set new timestamps 1 – Keep original timestamps when playing the file
Reserved	u8	Reserved
Reserved	u32	Reserved

10.55 7200 – 7k File Header

Description: First record of 7k data file.

Data Definition:

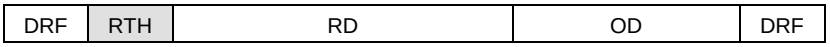


Table 95: 7200 – Record Type Header

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

Table 96: 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

This record may have optional data that contains information about the file catalog (7300 record) at the end of the log file. The optional data identifier (in the record frame) will be 7300.

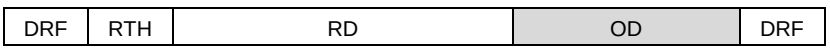


Table 97: 7200 – Optiona Data

Name	Size	Description
Size	u32	Size of the file catalog record

Offset	u64	File offset of the file catalog record

10.56 7300 – 7k File Catalog Record

Description: 7k file catalog record, placed at the end of log files.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 98: 7300 – Record Type Header

Name	Size	Description
Size	u32	Size of this record type header
Version	u16	1
Number of records	u32	Number of records in the file
Reserved	u32	Reserved

The file catalog contains one entry for each record in the log file, including the 7200 file header record, but excluding the 7300 file catalog record. The information corresponds to the record frame, plus the offset in the file.

DRF	RTH	RD	OD	DRF

Table 99: 7300 – Record Data

Name	Size	Description
Size	u32	Record size in bytes
Offset	u64	File offset
Record type	u16	Record type identifier
Device identifier	u16	Device identifier
System enumerator	u16	System enumerator
7KTIME	u8 * 10	Time
Record count	u32	Total records in fragmented data record set
Reserved	u16 * 8	Reserved

10.57 7400 – 7k 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 100: 7400 – Record Type Header

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

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

The record can contain optional data. For information on optional data, see APPENDIX A Teledyne PDS Optional Data

10.58 7500 – 7k Remote Control

Description: This record is used to remotely control SeaBat™ 7k sonar 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 7kCenter. 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.

NOTE
If a 7500 command is sent which requires no argument, an empty byte still needs to be packed into the command data.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 101: 7500 – Record Type Header

Name	Size	Description
Remote control ID	u32	See separate remote control table for details. See *section 10 Record Type Definitions*.
Ticket	u32	Ticket number. Set by client for control packet matching ACK or NAK packets.
Tracking number	u128	Unique number. Set by client for packet tracking.

DRF	RTH	RD	OD	DRF

Table 102: 7500 – Record Data

Name	Size	Description
Remote control data	variable	Value(s). See *section 11 7k Remote Control Definitions* for descriptions.

10.59 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 103: 7501 – Record Type Header

Name	Size	Description
Ticket	u32	Ticket number in record 7500
Tracking number	u128	Unique number in record 7500

10.60 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 was not accepted. This record cannot be manually requested or subscribed to.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 104: 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 APPENDIX D 7k Error Codes for details

10.61 7503 – Remote Control Sonar Settings

Description: This record is produced by the SeaBat™ 7k Sonar. It contains the remote control sonar settings. The 7kCenter updates this record for each ping. For multi-ping only one record is produced for the whole sequence .The record can be manually requested or subscribed to from the 7kCenter. For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*

.**Data Definition:**

DRF	RTH	RD	OD	DRF

Table 105: 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 rate in Hertz
Receiver bandwidth	f32	In Hertz
Tx pulse width	f32	Seconds of pulse
Tx pulse type identifier	u32	0 – CW 1 – Linear chirp (FM)
Tx pulse envelope identifier	u32	0 – Tapered rectangular 1 – Tukey
Tx pulse envelope parameter	f32	Pulse envelop shading. Some envelopes don't use this parameter.

Name	Size	Description
Tx pulse mode	u16	1 – Single ping 2 – Multi-ping 2 3 – Multi-ping3 4 – multi-ping 4
Tx pulse reserved	u16	Reserved
Max ping rate	f32	Maximum ping rate in pings per second
Ping period	f32	Seconds since last ping
Range selection	f32	Range selection in meters
Power selection	f32	Power selection in dB/μPa
Gain selection	f32	Gain selection in dB
Control flags	u32	BIT FIELD: Bit 0-3: Auto range method Bit 4-7: Auto bottom detection filter method Bit 8: Bottom detection range filter enabled. Bit 9: Bottom detection depth filter enabled Bit 10: Receiver gain method Auto Gain Bit 11: Receiver gain method Fixed Gain Bit 12: Receiver gain method Reserved Bit 13: Reserved Bit14: Trigger out HIGH for entire RX duration 0 – Disabled 1 - Enabled Bit 15: 0 – System inactive 1 – Active Bit 16-19: Reserved for bottom detection Bit 20: Pipe gating filter 0 – Disabled 1 – Enabled Bit 21: Adaptive gate depth filter fixed 0 – Follow seafloor 1 – Fix depth Bit 22: Adaptive gate 0 – Disabled 1 – Enabled Bit 23: Adaptive gate depth filter 0 – Disabled 1 - Enabled Bit 24: Trigger Out 0 – Disabled

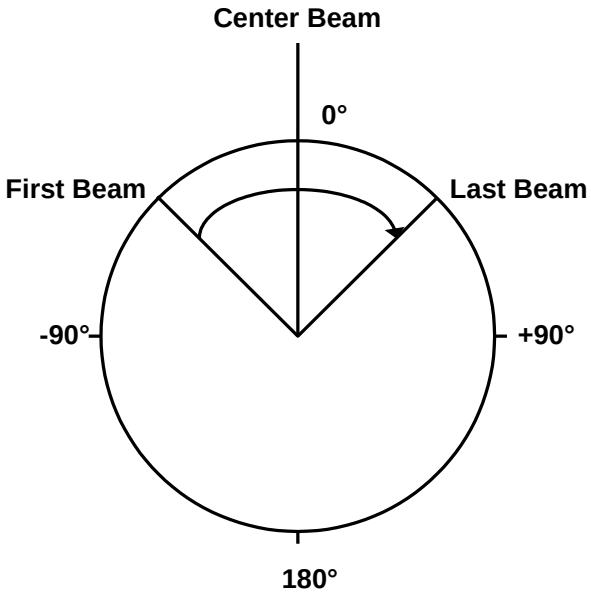
Name	Size	Description
		1 – Enabled Bit 25 Trigger In Edge 0 – Positive 1 – Negative Bit 26: PPS Edge 0 – Positive 1 – Negative Bit 27-28: Timestamp State 0 – Timestamp not applicable 1 – Timestamp error / not valid 2 – Timestamp warning / use caution 3 – Timestamp ok / valid Bit 29: Depth filter follows seafloor 0 – Fix depth 1 – Follow seafloor Bit 30: Reduced coverage for constant spacing 0 – Always maintain swath coverage 1 – Allow swath coverage to be reduced Bit 31: 0 – 7K 1 – Simulator
Projector identifier	u32	Projector selection
Projector beam steering angle vertical	f32	In radians
Projector beam steering angle horizontal	f32	In radians
Projector beam -3dB beam width vertical	f32	In radians
Projector beam -3dB beam width horizontal	f32	In radians
Projector beam focal point	f32	In meters
Projector beam weighting window type	u32	0 – Rectangular 1 – Chebychev
Projector beam weighting window parameter	f32	N/A
Transmit flags	u32	BIT FIELD: Bit 0-3: Pitch stabilization method Bit 4-7: Yaw stabilization method Bit 8-31: Reserved
Hydrophone identifier	u32	Hydrophone selection

Name	Size	Description
Receive beam weighting window	u32	0 – Chebychev 1 – Kaiser
Receive beam weighting parameter	f32	N/A
Receive flags	u32	BIT FIELD: Bit 0: Roll compensation indicator Bit 1: Reserved Bit 2: Heave compensation indicator Bit 3: Reserved 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	u8	Reserved
Automatic filter window	u8	Automatic filter window size in percent of the depth
Tx array position offset X	f32	Offset of the transmitter array in m, relative to the receiver array on the X axis, positive value is to the right, if the receiver faces forward Refer to chapter 2.4.
Tx array position offset Y	f32	Offset of the transmitter array in m, relative to the receiver array on the Y axis, positive value is forward, if the receiver faces forward Refer to chapter 2.4

Name	Size	Description
Tx array position offset Z	f32	Offset of the transmitter array in m, relative to the receiver array on the Z axis, positive value is up, if the receiver faces forward Refer to chapter 2.4
Head Tilt X	f32	Radians
Head Tilt Y	f32	Radians
Head Tilt Z	f32	Radians. Typically zero.
Ping state	u32	Ping state: 0 – Pinging disabled 1 – Pinging enabled 2 – External trigger
Beam spacing mode	u16	1 – Equiangle 2 – Equidistant 3 – Flex 4 – Intermediate
7kCenter mode	u16	0 –Normal 1 – Autopilot 2 – Calibration (IQ) 3+ – Reserved
Adaptive gate bottom filter information	f32	Min depth (if Adaptive Gate depth filter is active)
Adaptive gate bottom filter information	f32	Max depth (if Adaptive Gate depth filter is active)
Trigger out width	f64	Valid if control bit 24 is set
Trigger out offset	f64	Valid if control bit 24 is set
81xx series projector Selection	u16	0 – Stick 1 – Main Array 2 – Extended Range 3+ – Reserved
Reserved	u32 * 2	Reserved
81xx series alternate gain	f32	Gain in dB for Method not selected in Control flags bits 10 and 11
Vernier filter	u8	Vernier filter settings
Reserved	u8	Reserved
Custom beams	u16	Custom number of beams
Coverage angle	f32	Coverage angle in radians

Name	Size	Description
Coverage mode	u8	0 – Reduce Spacing 1 – Reduce Beams
Quality filter flags	u8	BIT FIELD: Bit 0: 0 – Quality filter disabled 1 – Quality filter enabled Bit 1-7: Reserved, must be zero
Horizontal receiver beam steering angle	f32	Steering angle in radians (positive to starboard)
Flex mode sector coverage	f32	Coverage sector in radians
Flex mode sector steering	f32	Steering angle in radians (positive to starboard)
Constant spacing	f32	Constant beam spacing on the seafloor in meters.
Beam mode selection	u16	Zero based index number corresponding with the available bean modes in the sonar XML
Depth gate tilt	f32	Angle in radians (positive to starboard)
Applied frequency	f32	Transmit frequency for UI slider. Will be different from center frequency in full-rate dual-head.
Reserved	u32	Reserved

NOTE
Head tilt uses same geometry as the beam numbering. This means port-up movement is negative and port down movement is positive.



10.62 7504 – 7P Common System Settings

Description: This record is produced by the SeaBat™ 7k sonar series. It contains additional sonar settings. The 7kCenter updates this record on change only. The record can be manually requested or subscribed to from the 7kCenter. For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*

Data Definition:

DRF	RTH	RD	OD	DRF

Table 106: 7504 – Record Type Header

Name	Size	Description
Sonar serial number	u64	Sonar serial number
Ping number	u32	Sequential number
Sound velocity	f32	Sound velocity in m/s
Absorption	f32	Absorption in dB/km
Spreading loss	f32	Spreading loss in dB
Sequencer control	u32	0 – Off 1 – On

Name	Size	Description
Motion sensor format	u8	0 – TSS1 1 – SIMRAD EM1000 2 – SIMRAD EM3000 3 – NMEA $PASHR 4 – OCTANS TAH 5+ – Reserved
Motion Sensor Baud Rate	u8	0 – 4800 1 – 9600 2 – 14400 3 – 19200 4 – 28800 5 – 38400 6 – 56000 7 – 57600 8 – 115200 9+ – Reserved
Motion Sensor Parity	u8	0 – None 1 – Even 2 – Odd 3 – Space 4 – Mark 5+ – Reserved
Motion Sensor Data Bits	u8	0 – 5 bits 1 – 6 bits 2 – 7 bits 3 – 8 bits 4+ – Reserved
Motion Sensor Stop Bits	u8	0 – 1 bit 1 – 2 bits 2+ – Reserved
Orientation	u8	0 – Port Up 1 – Port Down
Record Version	u8	Record revision number
Motion latency	f32	Motion sensor latency in seconds Valid range 0 – 0.050

Name	Size	Description
SVPFilter	u8	SVP Filter type 1 – No Filter 2 – Light Filter 3 – Normal Filter 4 – SVP70 Wizard
SV manual override	u8	Deprecated, use Sensor Manual Override flags field
Active enumerator	u16	Enumerator of pinging system
Active device ID	u32	Device ID of pinging system
System mode	u32	0 – Manual (normal) mode 1 – AutoPilot mode 2 – I&Q (normalization) mode 3 – Playback mode 4+ – Reserved
Master Slave Mode	u32	0 – Normal 1 – Master full (full rate) 2 – Slave 3 – Master half. Separate enumeration for ½ rate (“ping-pong”) mode vs. full rate.
Tracker flags	u32	Bit 0: Enable range control Bit 1: Enable power & gain control Bit 2: Enable pulse length control Bit 3: Enable coverage angle control Bit 4: Use fixed swath width Bit 5: Set maximum coverage angle
Tracker swath width	f32	Tracker swath width in meters
Multi-Detect Enable	u16	Zero = Multi-detect OFF. Non-zero = Multi-detect ON.

Name	Size	Description
Multi-Detect Object Size	u16	Range of 1 to 100. Controls the sensitivity of the algorithm to Object Size. This is a unit-less quantity. Note: Increasing this parameter results in more detections on smaller objects. Decreasing this parameter results in fewer detections and only on larger objects.
Multi-Detect Sensitivity	u16	Range of 1 to 100. Controls the sensitivity of the algorithm to Amplitude. This is a unit-less quantity. Note: Increasing this parameter causes more objects to be detected.
Multi-Detect Max Detections	u16	Range of 1 to 5. Limits the number of detections produced per beam. The maximum number of detections per beam is five. Note: If there are fewer clusters which are over the sensitivity threshold than the selected number of detections, only the number of valid detections shall be produced, i.e. detections will not be generated from clusters below the sensitivity threshold.
Multi-Detect Reserved	u16 * 2	Reserved, set to zero
Slave IP Address	u8 * 4	Slave IP V4 Address (e.g. 192.168.1.22) Only valid for record revision number 1 or greater.

Name	Size	Description
Snippet Control Flags	u32	BIT FIELD: (1 – Enabled) Bit 0: Use automatic snippet window Bit 1: Include at least samples around bottom detection (min. window size is valid) Bit 2: Include at most samples around bottom detection (max. window size is valid) Bit 3-31: Reserved
Snippet Control Min. Window	u32	Used as Minimum Window Size when bit 0 is set (automatic window) AND bit 1 is set. Used as Fixed Window Size when flags bit 0 is NOT set (fixed window).
Snippet Control Max. Window	u32	Max snippet window. Used when flags bit 2 is set.
Full Rate Dual Head Flag	u32	1 – Full-rate dual head enabled
Delay multiplier	f32	Master delay multiplier
Power Saving Mode	u8	0 : **None**. No power saving enabled at all. Can be used as reference. 1 : **Normal.** Components save power when possible. No effect on operation. 2 : **Range Blank**. Normal saving + "real" samples are not output from RX controller until X range is reached. X is controlled by the Flags and Range Blank Control fields. 3 : **Sleep.** Components will be put in sleep mode. Sleep mode has 0 to 50ms recovery time. All settings will be retained. NO DATA is produced in sleep mode. 4 : **Hibernate**. Components will be put in hibernate mode. Hibernate mode has 0 to 10 second recovery time. All settings will be retained. NO DATA is produced in hibernate mode.
Flags	u8	Bit 0 : Range blanking type 0 = fixed amount of meters. 1 = percent of range scale. Bits 1 – 7 : Reserved, zero.

Name	Size	Description
Range Blank Control	u16	Used only for power saving mode 2 ("*Range Blank" mode).* Controls size of range blanking interval. Ping data during this time interval will be zero. Only affects receiver component. If Flags bit 0 is not set (0), then this value gives a fixed range blanking interval in *meters*. If Flags bit 0 is set (1), then this value gives range blanking interval as a *percent of range scale* (0 – 100). The number of samples blanked will change with range settings in this case.
Startup Normalization	u8	Non-zero to enable normalization at startup.
Restore Ping Rate	u8	Non-zero to restore ping rate to previous setting (which was in effect when system was last shut down).
Restore Power	u8	Non-zero to restore power to previous setting. Otherwise system starts with power OFF.
SV Interlock	u8	Non-zero to enable Sound Velocity Interlock safety feature (for system with integrated SV probe only).
Ignore PPS Errors	u8	Non-zero to suppress error messages due to PPS signal errors. Proper functioning of the PPS signal is normally required for accurate data time-stamping in bathymetry systems.
RESERVED	u8*15	Reserved. Zero.
Compressed Watercolumn (7042) record control flags	u32	Bit field: Bit 0 : Use maximum bottom detection point *in each beam* to limit data. Data is included up to the bottom detection point + 10%. This flag has no effect on systems which do not perform bottom detection. Bit 1 : Include magnitude data only (strip phase). Bit 2 : Convert mag to dB, then compress from 16 bit to 8 bit. Phase compression simply truncates lower (least significant) byte of phase data. Bits 31 – 3 : Reserved.

Name	Size	Description
Deck Mode	u8	Deck mode Non zero: Sonar is in deck mode
Reserved	u8	Reserved
Power mode (of control Center PC) flags	u8	Bit field: Bit 0: Power mode supported by Control Center computer. Bit 1: Power mode status CPU throttled. Bit 2: Power mode status AC.
Power mode max	u8	Percentage on which the CPU is throttled between 0-100%.
Water Temperature	f32	Water Temperature (°C)
Sensor Manual Override	u8	Bit field: Bit 0: Manual override of sound velocity in effect. Bit 1: Manual override of temperature in effect.
Sensor Data Flags	u8	Bit field: Bit 0: Sound velocity sensor data stream detected. Bit 1: Temperature sensor data stream detected. (*Persistent* – bit set if sensor data stream was ever seen)
Sensor Active	u8	Bit field: Bit 0: Sound velocity sensor data stream active. Bit 1: Temperature sensor data stream active. (*Volatile* – bit set only if sensor input is active; timeout period = ~15 sec.)
Reserved	u8	Reserved
Tracker max coverage	f32	In radians
Reserved	u32 * 100	Reserved

10.63 7510 – SV Filtering

Description: This record is generated every time a surface sound velocity value is received by the 7kCenter either via record 7610 (see *section 10.65 7610 – 7k Sound Velocity*) or remote control command 7610 (see *section 11.77 7042 – compressed Watercolumn Data* Setup

Description: Allows configuration of compressed watercolumn record (7042). Note that the current value of these flags are reported in the 'Flags' field of the 7042 Compressed Watercolumn record. The settings are retained between executions of the 7kCenter.

NOTE
Apply until software updates are released for other systems, on the moment of writing only to the T-20-S.

Table 176: 7500 Record Data – Command 7042

Name	Size	Description
Flags	u32	Bit field: Bit 0 : Use maximum bottom detection point *in each beam* to limit data. Data is included up to the bottom detection point + 10%. This flag has no effect on systems which do not perform bottom detection. Bit 1 : Include magnitude data only (strip phase). Bit 2 : Convert mag to dB, then compress from 16 bit to 8 bit. Phase compression simply truncates lower (least significant) byte of phase data. Bit 3 : Exclude data outside of absolute gates. Only applicable if abolute gates in use. (UNSUPPORTED IN THIS RELEASE) Bit 4-7 : Downsampling divisor. Value = (BITS >> 4). Only values 2-16 are valid. This field is ignored if downsampling is not enabled (type = “none”). Bits 8-11 : . Downsampling type: 0x000 = None 0x100 = Middle value 0x200 = Peak value 0x300 = Average value

7610 – Manual Sound Velocity). A filtered sound velocity will be generated. If received via record 7610 and dispatcher is set for immediate broadcast, record 7510 will be broadcast immediately upon receiving record 7610, otherwise (throttled broadcast or receipt of remote control command 7610) it will be broadcast on dispatcher’s external records update.

For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*

Data Definition:

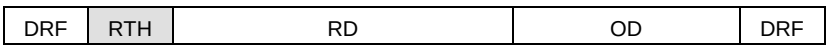


Table 107: 7510 – Record Type Header

Name	Size	Description
Sensor SV	f32	Surface sound velocity reported by sensor If ‘Filter’ value is either 0 (no value) or 128 (manual), Sensor SV is set to 0 (zero).
Filtered SV	f32	Filtered sound velocity value used

Name	Size	Description
Filter	u8	0 – No value; no sound velocity value was received by the 7kCenter 1 – Transparent; no filtering 2 – Light filter 3 – Normal filter 4 – SVP70 Wizard 5-127 – Reserved 128 – Manual input

NOTE
Record 7510 is not generated if surface sound velocity value is received via record 7610 while 7kCenter is in manual overwrite mode.

NOTE
SV Filter is now reset every time a manual value is received via the remote control command 7610. Manual values are never filtered.

10.64 7511 – System Lock Status

Description: This record informs the clients about SeaBat™ 7k being used exclusively by single client. No other client will be able to change any parameters of the system while it is locked. The remote control commands will be not acknowledged with the error code 0x700B (Remote Command Denied). The 7kCenter updates and publishes this record when the status has changed. The record can be manually requested or subscribed to from the 7kCenter. For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*

Data Definition:

DRF	RTH	RD	OD	DRF

Table 108: 7511 – Record Type Header

Name	Size	Description
System lock	u16	0 – System is not locked 1 – System is locked
Client IP	u32	IP Address of the client that has exclusive control of the system. 127.0.0.1 (0x7F000001) is reported for local clients (those that are running on the same host as 7kCenter) regardless of the type of the connection (TCP or Shared Memory). This field is not valid if system is not locked.
Reserved	u32 * 8	Reserved for future use

NOTE
This record is unidirectional. See remote command 1503 in *section 11 7k Remote Control Definitions* for how to gain exclusive control of the system.

10.65 7610 – 7k Sound Velocity

Description: This record can be used to set the SeaBat™ 7k sonar series systems current sound velocity value. The record can be manually requested or subscribed to from the 7kCenter. For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*

Data Definition:

DRF	RTH	RD	OD	DRF

Table 109: 7610 – Record Type Header

Name	Size	Description
Sound velocity	f32	In meters/second
Temperature	f32	Kelvin (optional)
Pressure	f32	Pascal (optional)

NOTE
The Pressure field is for information only. It is not used in the 7kCenter. The 7kCenter simply passes the record along to subscribers and raw data recording with no source code changes. The field is not present with a version of the IO Module older than V4.0.0.8. When the value is zero it is not valid.

NOTE
If filtering is enabled in record 7510 (see *section 10.63 7510 – SV Filtering*), record 7610 will contain filtered values used by 7kCenter when broadcasted by 7kCenter, except when in manual overwrite mode.

NOTE
Record 7610 is updated for single request, but not broadcast when manual value is received via remote control command 7610. Record 7610 is generated every time surface sound velocity value is received via record 7610 even if 7kCenter is in manual overwrite mode and the value was ignored. In this case, returned sound velocity value will be unfiltered.

10.66 7611 – 7k Absorption Loss

Description: This record can be used to set the SeaBat™ 7k sonar series systems current absorption loss value. The record can be manually requested or subscribed to from the 7kCenter. For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*

Data Definition:

DRF	RTH	RD	OD	DRF

Table 110: 7611 – Record Type Header

Name	Size	Description
Absorption loss	f32	In dB/km

10.67 7612 – 7k Spreading Loss

Description: This record can be used to set the SeaBat™ 7k sonar 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 be manually requested or subscribed to from the 7kCenter. For details about requesting and subscribing to records, see section *10.58 7500 – 7k Remote Control* together with *section 11 7k Remote Control Definitions.*

Data Definition:

DRF	RTH	RD	OD	DRF

Table 111: 7612 – Record Type Header

Name	Size	Description
Spreading loss	f32	In dB (0.0-60.0)

11 7K REMOTE CONTROL DEFINITIONS

11.1 Overview

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 112: 7k Remote Control Definitions

Identifier	Description	Possible Return Records
1000	Shutdown	7501, 7502
1001	Reboot	7501, 7502
1002	Calibrate	7501, 7502
1003	Range	7501, 7502
1004	Max ping rate	7501, 7502
1005	Transmit power	7501, 7502
1006	Pulse length	7501, 7502
1007	Pulse type	7501, 7502
1008	Receiver gain	7501, 7502
1009	Bottom detection mask	7501, 7502
1010	Bottom detection filter information	7501, 7502
1011	Projector selection	7501, 7502
1012	Reserved for projector beam stabilization	
1013	Reserved for receive beam stabilization	
1014	Reserved for 7kCenter mode selection	
1015	Reserved for hydrophone selection	
1016	Bottom detection adaptive gate window and filters	
1017	Receiver gain type	
1020	Transmit pulse envelope identifier	
1021	Projector beam steering	7501, 7502
1022	Projector beam widths	7501, 7502
1023	Reserved for projector beam focal point	
1024	Reserved for projector beam weighting	
1025	Reserved for receiver beam weighting	
1026	Reserved for system center frequency	7501, 7502
1027	Transmit frequencies for chirps	7501, 7502
1028	Head tilt	
1029	Projector position relative to receiver	7501, 7502

Identifier	Description	Possible Return Records
1032	Reserved for beam spacing mode	
1033	Motion compensation	
1034	Match filter parameters	
1035	Coverage sector	
1036	Coverage mode	
1037	Motion sensor configuration	
1038	Flex mode parameters	
1039	Beam mode selection	
1040	Sample rate parameters	
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, 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
1099	Stop 7kCenter	7501, 7502
1100	Start pinging	7501, 7502
1101	Stop pinging	7501, 7502
1102	Load factory parameters	7501, 7502
1103	Snippet control	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	Multi-ping control enable	
1112	Reserved for multi-ping projector focusing	
1113	Calibrated snippet control	
1114	External trigger	
1115	Trigger out	

Identifier	Description	Possible Return Records
1116	PPS edge control	
1117	Reserved for Quality filter settings	
1118	Snippet control	
1138	Element limit control	
1200	Start recording	7501, 7502
1201	Stop recording/playback	7501, 7502
1202	Start playback	7501, 7502
1203	Reserved for data storage delete	
1204	Data storage status request	
1205	Reserved for get catalog	7502
1206	Set warning thresholds	7501, 7502
1207	Set recording directory	7501, 7502
1209	Set filtering	7501
1211	7k Logging settings	7501, 7502
1300-1305	Reserved	
1400	Autopilot table update	
1401	Autopilot algorithm parameters update (not described in the documentation)	7501, 7502
1503	Reserved for system lock	
1509	System health check (not described in the documentation)	7501, 7502
1600	Custom recording control	7501, 7502
1601	Custom playback control	7501, 7502
1602	Custom sensors	7501, 7502
1603	Stacking	7501, 7502
1604	Serial ports	7501, 7502
1605	RRIO addresses	7501, 7502
1606	Custom recording quick info	7501, 7502
1607	Head tilt angle	7501, 7502
1608	Deck mode	7501, 7502
7041	R7041 setup	
7042	Compressed Water column record options	7501, 7502
7610	Manual sound velocity	

11.2 1000 – Shutdown

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

This command has no parameters.

11.3 1001 – Reboot

Software and firmware reset.

This command has no parameters.

11.4 1002 – 7kCenter Calibration Control

Description: Initiate system calibration, cancel calibration, control various aspects of calibration process, etc.. Record 7055 (7K Calibration Status Information) will indicate the ongoing calibration status and Record 7005 will be available when calibration is complete.

Table 113: 7500 Record Data – Command 1002

Name	Size	Description
Calibration Command	u16	0 – Start calibration process 1 – Cancel any calibration that's in progress 2 – Use results of last calibration (ignored if no calibration has been done) 3 – Verify existing calibration 4 – Revert to previous 5 – Clear to "not calibrated" state 6-10 – Reserved / internal 11 – Start calibration (Cal-tone OFF) 12 – Set Cal-tone frequency. *Optional Data* is 32 bit float specifying frequency in Hz. 13 – Manual Cal-tone control (on/off). *Optional Data* is 16 bit Boolean flag (0 = OFF, non-zero = ON) 14 – EM7218 amplitude and waveform control ('D' command) 15 – Manual Tx shading control (on/off). *Optional Data* is 16 bit Boolean flag (0 = OFF, non-zero = ON)
Optional Data	variable	Depends on Calibration Commands

11.5 1003 – Range

Description: System Range Setting

Table 114: 7500 Record Data – Command 1003

Name	Size	Description
Range	f32	Range setting in meters

11.6 1004 – Max Ping Rate

Description: Max ping setting

Table 115: 7500 Record Data – Command 1004

Name	Size	Description
Max ping rate	f32	Max ping rate setting in pings per second

11.7 1005 – Transmit Power

Description: System transmit power setting

Table 116: 7500 Record Data – Command 1005

Name	Size	Description
Transmit power	f32	Transmit power in dB re 1µPa@1m

11.8 1006 – Pulse Length

Description: System transmitter pulse length setting

Table 117: 7500 Record Data – Command 1006

Name	Size	Description
Transmit pulse width	f32	Transmit pulse length in seconds

11.9 1007 – Pulse Type

Description: System transmitter pulse type.

***This command is only available for selected systems*.**

Table 118: 7500 Record Data – Command 1007

Name	Size	Description
Transmit pulse type	u32	0 – CW 1 – Linear chirp

11.10 1008 – Receiver Gain

Description: System receiver gain.

Table 119: 7500 Record Data – Command 1008

Name	Size	Description
Receiver gain	f32	Gain selection in dB

11.11 1009 – Bottom Detection Mask

Description: System bottom detection mask.

Table 120: 7500 Record Data – Command 1009

Name	Size	Description
Bottom detection flag	u32	BIT FIELD: Bit 0-3: Reserved Bit 4-7: Reserved for bottom detection method Bit 8: Range filter 0 – Disabled 1 – Enabled Bit 9: Depth filter 0 – Disabled 1 – Enabled Bit 10: Adaptive gate 0 – Disabled 1 – Enabled Bit 11: Adaptive gate depth filter 0 – Disabled 1 – Enabled Bit 12: Adaptive gate depth filter fixed 0 – Follow seafloor 1 – Fix depth Bit 13: Depth filter follows seafloor 0 – Fix depth 1 – Follow seafloor Bit 14-31: Reserved

11.12 1010 – Bottom Detection Filter Information

Description: System bottom detection filter information. The minimum and maximum must differ by at least 2 meters.

Table 121: 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
Depth gate tilt	f32	Angle in radians (positive to starboard)

11.13 1011 – Projector / Frequency Selection

Description: Selects an active projector (8k systems) or active frequency (7k systems). This command does not apply to T-Series sonars with variable CW capability.

NOTE
8k systems or 8125-H only: If any other transmitter is pinging (even if Max Ping Rate is zero), this command will fail. 1101 – Stop Pinging – should be issued prior to issuing this command. Reselecting current transmitter always succeeds regardless of pinging state.

Table 122: 7500 Record Data – Command 1011

Name	Size	Description
Command	u32	8K wet ends – projector selection: 0 – Stick 1 – Main array 2 – Extended range 3+ – Reserved If set to -1 (0xffff) the projector selection will be forced, by issuing stop pinging command to all other projectors 7k systems: For multi-frequency systems where each XML configuration file defines operating parameters for one frequency, selects the active frequency configuration by system enumerator value. 0 – Enumerator 0 (e.g. 7125 400kHz) 1 – Enumerator 1 (e.g. 7125 200kHz). 2 – Enumerator 2 (e.g. 7131 635kHz) 3 – Enumerator 3 4+ - Reserved

11.14 1016 – Bottom Detection Adaptive Gate Window and Filters

Description: Controls the bottom detection adaptive gate operation. The nadir search minimum and maximum values are used only if the Adaptive Gate Depth Filter option is enabled (See *section 11.11 1009 – Bottom Detection Mask*). The minimum and maximum must differ by at least 2 meters.

Table 123: 7500 Record Data – Command 1016

Name	Size	Description
Window size	i32	Bottom detection gate size as a percentage of the approximate nadir depth. Valid range is 1-100.
Search minimum	f32	Minimum depth for initial bottom detection on nadir beam (meters)
Search maximum	f32	Maximum depth for initial bottom detection on nadir beam (meters)

11.15 1017 – Receiver Gain Type

Description: Sets the receiver gain type.

***This command is only available for selected systems*.**

Table 124: 7500 Record Data – Command 1016

Name	Size	Description
Gain type	u32	0 – TVG 1 – Reserved for auto gain 2 – Fixed 3+ – Reserved
Reserved	u32 * 4	Reserved

11.16 1019 – Vernier Processing Parameters

Description: Sets parameters that control the vernier processing, which is output in the 7019 record. The command applies only to the 200kHz 7130 system and the 200kHz 7131 system at this time.

Table 125: 7500 Record Data – Command 1019

Name	Size	Description
Field flags	u16	Bitfield indicating which parameters are to be applied by this command. Bit 0: Operational mode Bit 1: Decimation Bit 2: First sample Bit 3: Smoothing window type Bit 4: Smoothing window length Bit 5: Reference array Bit 6-15: Reserved
Operational mode	u32	0 – Vernier 1 – Single array Mag & Phase (power reduction - *TBA*) 3 – Triple array Mag & Phase (3 sets of records generated for each ping – one for each stave)
Decimation factor	u8	Data decimated by this factor, i.e. retain only 1 of X samples)
First sample	u32	Index of first sample to include in output record. Allows for reduction of 7019 record size via elimination of near range data.
Smoothing window type	u32	0 – Rectangular 2 – Hamming 99 – None
Smoothing window length	u16	Smoothing window length [samples]. Range = 3 to 63. Value must be odd.

Name	Size	Description
Reference array	u8	When *Operational Mode* is “Vernier” (0), this selects which array to use as reference array in Vernier processing. When *Operation Mode* is “Single array” (1), this selects which of the three 200kHz arrays is to be active. Valid values are 0, 1, or 2 in both cases. (*TBA - unsupported at this time*)
Reserved	4*u32	Reserved for future use

11.17 1020 – Transmit Pulse Envelope Identifier

Description: Sets the Transmit Pulse Envelope.

***This command is only available for selected systems*.**

Table 126: 7500 Record Data – Command 1020

Name	Size	Description
Envelope type	u32	0 – Rectangular 1 – Tukey 2 – FFFFFFFFFF - Reserved
Shading value	f32	Window shading value Tukey (0.0-1.0)
Reserved	u32 * 4	Reserved

11.18 1021 – Projector Beam Steering

Description: Horizontal and vertical projector beam steering.

This command is only available for selected systems.

Table 127: 7500 Record Data – Command 1021

Name	Size	Description
Projector beam steering angle vertical	f32	In radians
Projector beam steering angle horizontal	f32	In radians

11.19 1022 – Projector Beam Widths

Description: Horizontal and vertical projector beam widths.

This command is only available for selected systems.

Table 128: 7500 Record Data – Command 1022

Name	Size	Description
Projector beam –3dB beam width vertical	f32	In radians
Projector beam –3dB beam width horizontal	f32	In radians

11.20 1027 – Transmit Frequencies for Chirps

Description: Transmit pulse start and stop frequencies.

***This command is only available for selected systems*.**

Table 129: 7500 Record Data – Command 1027

Name	Size	Description
Start frequency	f32	In Hz
Stop frequency	f32	In Hz

11.21 1033 – Motion Compensation

Description: Sets motion compensation options. Roll compensation status is reported for each ping in the receive flags field of the 7000 and 7503 records. Pitch compensation status is reported for each ping in the transmit flags field of the 7000 and 7503 records. Motion compensation capability varies depending on system type.

Table 130: 7500 Record Data – Command 1033

Name	Size	Description
Roll	u8	0 – OFF >0 – ON
Pitch	u8	0 – OFF >0 – ON
Heave	u8	N/A
Speed	u8	N/A
Reserved	u8 * 8	Reserved

11.22 1034 – Match Filter Parameters

Description: Sets the match filter parameters.

This command is only available for selected systems.

Table 131: 7500 Record Data – Command 1034

Name	Size	Description
Window type	u32	0 – Rectangular 1 – Kaiser 2 – Reserved for Hamming 3 – Reserved for Blackmann 4 – Reserved for Triangular 5 – Reserved for X (Taylor) 6 – FFFFFFFFFF – Reserved
Shading value	f32	Window shading value
Reserved	u32 * 4	Reserved

11.23 1035 – Coverage Sector

Description: Sets the current coverage sector.

***This command is only available for selected systems*.**

Table 132: 7500 Record Data – Command 1035

Name	Size	Description
Coverage sector	f32	Coverage sector in radians
Horizontal receiver beam steering angle	f32	Steering angle in radians (positive to starboard)

11.24 1036 – Coverage Mode

Description: Sets the current coverage mode.

***This command is only available for selected systems*.**

Table 133: 7500 Record Data – Command 1036

Name	Size	Description
Coverage mode	u8	0 – Reduce spacing 1 – Reduce beams

11.25 1037 – Motion Sensor Configuration

Description: Sets the motion sensor configuration.

***This command is only available for selected systems*.**

Table 134: 7500 Record Data – Command 1037

Name	Size	Description
Format	u8	0 – TSS1 1 – SIMRAD EM1000 2 – SIMRAD EM3000 3 – NMEA $PASHR 4 – OCTANS TAH
Baud	u8	0 – 4800 1 – 9600 2 – 14400 3 – 19200 4 – 28800 5 – 38400 6 – 56000 7 – 57600 8 – 115200
Parity	u8	0 – None 1 – Even 2 – Odd 3 – Space 4 – Mark
Data Bits	u8	0 – 5 bits 1 – 6 bits 2 – 7 bits 3 – 8 bits
Stop Bits	u8	0 – 1 bit 1 – 2 bits
Orientation	u8	0 – Port Up 1 – Port Down
Reserved	u8	Reserved
Motion Latency	f32	Motion latency in seconds Valid range is 0 – 0.050
Reserved	u8 * 20	Reserved

11.26 1038 – Flex Mode Parameters

Description: Set the flex mode parameters.

Table 135: 7500 Record Data – Command 1038

Name	Size	Description
Flex mode sector coverage	f32	Coverage sector in radians
Flex mode sector steering	f32	Sector steering angle in radians (positive to starboard)

11.27 1039 – Beam Mode Selection

Description: Set the beam mode selection.

Table 136: 7500 Record Data – Command 1039

Name	Size	Description
Beam mode selection	u16	Zero based index number corresponding with the available beam modes in the sonar XML

11.28 1040 – System Sample Rate

Description: Sets system sample rate parameters. Applicable only for systems using the EM7218 receiver.

Table 137: 7500 Record Data – Command 1040

Name	Size	Description
IQ Rate	u32	0 – SR17K 1 – SR34K 2 – SR50K 3 – SR60K 4 – SR80K 5 – SR100K

11.29 1041 – Manual IMUX Control

Description: Sets IMUX bits manually, overriding the value which is normally supplied in the system configuration XML file. Applicable only for systems using the EM7218 receiver.

Table 138: 7500 Record Data – Command 1041

Name	Size	Description
IMUX	u32	The valid range is 0 - 7. NOTE: During normalization/calibration process the IMUX value is set to 4, regardless of any previous setting via this command.
Reserved	u32*2	Reserved, set to zero

11.30 1043 – Custom Beams

Description: Set the number of beams for the beamformer.

Table 139: 7500 Record Data – Command 1043

Name	Size	Description
Custom beams	u16	Custom number of beams. Zero for default.

11.31 1044 – Constant Spacing

Description: Set the constant beam spacing value on the seafloor in meters.

Table 140: 7500 Record Data – Command 1044

Name	Size	Description
Constant spacing	f32	Constant beam spacing on the seafloor in meters. Used for equi-distant and flex modes. The number of beams will vary depending on the seafloor depth. Setting this to zero will always use all beams.
Flags	u32	Bit1:Reduce coverage 0 – Always maintain swath coverage 1 – Allow swath coverage to be reduced

11.32 1045 – Multi-Detect Parameters

Description: Sets parameters that control the Multi-Detect bottom detection processing. Multi-detect allows for *up to five* detections for each beam. The command affects the output of the 7017 and 7027 bathymetry records. Multi-detect is a licensed feature. If the license is not present, then this command will produce a "NACK" response.

NOTE
Multi-Detect currently use a version of the "G2" bottom detection algorithm as its basis. This may change in the future.

Table 141: 7500 Record Data – Command 1045

Name	Size	Description
Enable	u16	Zero = Multi-detect OFF. Non-zero = Multi-detect ON.

Name	Size	Description
Object Size	u16	Range of 1 to 100. Controls the sensitivity of the algorithm to Object Size. This is a unit-less quantity. *Note: Increasing this parameter results in more detections on smaller objects. Decreasing this parameter results in fewer detections and only on larger objects.*
Sensitivity	u16	Range of 1 to 100. Controls the sensitivity of the algorithm to Amplitude. This is a unit-less quantity. *Note: Increasing this parameter causes more objects to be detected.*
Max Detections	u16	Range of 1 to 5. Limits the number of detections produced per beam. The maximum number of detections per beam is five. *Note: If there are fewer clusters which are over the sensitivity threshold than the selected number of detections, only the number of valid detections shall be produced, i.e. detections will not be generated from clusters below the sensitivity threshold.*
Reserved	u16*2	Reserved, set to zero

11.33 1046 – Power Saving

Description: Sets overall system power saving mode. Only components which support power saving modes are affected by this command.

NOTE
Apply on the moment of writing to the T-20-S only until software updates are released for other systems.

Table 142: 7500 Record data – Command 1046

Name	Size	Description
Mode	u8	0 : **None**. No power saving enabled at all. Can be used as reference. 1 : **Normal.** Components save power when possible. No effect on operation. 2 : **Range Blank**. Normal saving + “real” samples are not output from RX controller until X range is reached. X is controlled by the Flags and Range Blank Control fields. 3 : **Sleep.** Components will be put in sleep mode. Sleep mode has 0 to 50ms recovery time. All settings

Name	Size	Description
		will be retained. NO DATA is produced in sleep mode. 4 : **Hibernate**. Components will be put in hibernate mode. Hibernate mode has 0 to 10 second recovery time. All settings will be retained. NO DATA is produced in hibernate mode.
Flags	u8	Bit 0 : Range blanking type 0 = fixed amount of meters. 1 = percent of range scale. Bits 1 – 7 : Reserved, zero.
Range Blank Control	u16	Used only for power saving mode 2 (“*Range Blank” mode).* Controls size of range blanking interval. Ping data during this time interval will be zero. Only affects receiver component. If Flags bit 0 is not set (0), then this value gives a fixed range blanking interval in *meters*. If Flags bit 0 is set (1), then this value gives range blanking interval as a *percent of range scale* (0 – 100). The number of samples blanked will change with range settings in this case.

11.34 1047 – AUV Configuration Options

Description: Allows control of AUV / ROV focused system features. The initial (installation default) value for these options is determined by the system XML file. Thereafter the settings are remembered in the system parameter file, and changed via this remote command.

NOTE
Apply on the moment of writing to the T-20-S only until software updates are released for other systems.

Table 143: 7500 Record Data – Command 1047

Name	Size	Description
Startup Normalization	u8	Non-zero to enable normalization at startup.
Restore Ping Rate	u8	Non-zero to restore ping rate to previous setting (which was in effect when system was last shut down).
Restore Power	u8	Non-zero to restore power to previous setting. Otherwise system starts with power OFF.
SV Interlock	u8	Non-zero to enable Sound Velocity Interlock safety feature (for system with integrated SV probe only).

Name	Size	Description
Ignore PPS Errors	u8	Non-zero to suppress error messages due to PPS signal errors. Proper functioning of the PPS signal is normally required for accurate data time-stamping in bathymetry systems.
RESERVED	u8*15	Reserved. Zero.

11.35 1050 – Single Record Request

Description: Request latest record.

Table 144: 7500 Record Data – Command 1050

Name	Size	Description
Record type	u32	Possible responses: 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)

11.36 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 145: 7500 Record Data – Command 1051

Name	Size	Description
N	u32	Number of records
Array of record numbers	u32 * N	Possible responses: 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)

11.37 1052 – End All Subscriptions

Description: Unsubscribe to all records.

This command has no parameters.

11.38 1053 – Third Party Data Connection

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

Table 146: 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

11.39 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 147: 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

11.40 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 148: 7500 Record Data – Command 1055

Name	Size	Description
Start record ID	u32	Start record ID
End record ID	u32	End record ID

11.41 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 149: 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

11.42 1099 – Stop 7kCenter

Description: Causes 7kCenter process to stop. Should always be acknowledged.

This command has no parameters.

11.43 1100 – Start Pinging

Description: Start continuous pinging.

(Pinging will not start if the Max Ping Rate is set to zero.)

(This command will change the triggering configuration of the sonar to internal; external triggering overruled)

This command has no parameters.

11.44 1101 – Stop Pinging

Description: Stop pinging.

This command has no parameters.

11.45 1102 – Load Factory Parameters

Description: Load Factory Parameters from disk.

This command has no parameters.

11.46 1103 – Snippet Control

Description: Limit record 7028's sample range to a window around the bottom detection ranges.

NOTE
Have the same working as 7008 record (i.e. obsolete and will cause undefined behavior if used in conjunction with 7028 record).

Table 150: 7500 Record Data – Command 1103

Name	Size	Description
Enable	u32	0 – Disable snippet sample limitation 1 – Enable snippet sample limitation
Window size	u32	Number of samples around bottom detection for each beam

11.47 1107 – Single Ping Request

Description: Request for a single ping.

This command has no parameters.

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

11.48 1109 – System Health Verification

Description: Request System Health snapshot text file to be created. The file name is created according to *section 8.2 File Nomenclature* with a .txt extension.

File is named “7kSystemHealth. The file will be created in the 7kCenter executable directory. For remote connections (UDP/TCP) with the SeaBat UI, an additional file will be created in the SeaBat executable directory.

This command has no parameters.

11.49 1111 – Multi-ping Control Enable

Description: Set multi-ping control parameters. Note that if the number of pings field is 0 or 1, then multi-ping mode is turned OFF, and the begin frequency and spacing fields are ignored. Multi-ping capability varies depending on system type.

Table 151: 7500 Record Data – Command 1111

Name	Size	Description
Number of pings in sequence	u16	0, 1 – Single ping mode (default) 2 – 2 pings 4 – 4 pings
Begin frequency	u32	First ping frequency (Hz)
Spacing	i32	Frequency spacing (Hz, may be negative)

NOTE
Currently the Begin Frequency and Spacing fields are not used. Each ping in the multi-ping sequence is spaced evenly about the base (center) frequency, and the spacing is not adjustable. E.g. for 2 ping mode, frequency for ping #1 = center frequency – (fixed spacing / 2); frequency for ping #2 = center frequency + (fixed spacing / 2). For instance, the center frequency is 400kHz, the spacing is set at 30kHz then ping#1 is 385kHz and ping#2 is 415kHz. The actual frequency value for each ping is reported in the 7000 record, which is generated for each ping in the multi-ping sequence.

11.50 1113 – Calibrated Snippet Control

Description: Limit record 7058's sample range to a window around the bottom detection ranges.

Table 152: 7500 Record Data – Command 1113

Name	Size	Description
Enable	u16	0 – Disable snippet sample limitation 1 – Enable snippet sample limitation
Window size	f32	Number of samples around bottom detection for each beam
Flags	u32	BIT FIELD: Bit 0: Bottom detection window selected Bit 1: Snippet display window selected Bit 2: Quality control Bit 3: Minimum window size is required Bit 4: Maximum window size is required Bit 6-31: Reserved
Flag	u8	BIT FIELD: Bit 0: Require brightness quality to pass Bit 1: Require colinearity quality to pass Bit 2-7: Reserved
Minimum window size	u32	Minimum number of samples around bottom detection for each beam
Maximum window size	u32	Maximum number of samples around bottom detection for each beam

11.51 1114 – External Trigger

Description: Starts pinging on external trigger. Should always be acknowledged.

This command has no parameters.

11.52 1115 – Trigger Out

Description: Sets output trigger on ping command.

Table 153: 7500 Record Data – Command 1115

Name	Size	Description
State	u32	BIT FIELDS: Bit 0: 1 – Enabled 0 – Disabled Bit 1: 1 - Trigger for entire Rx duration (depends on range setting) Length field is ignored. Not supported on all systems. 0 – Fixed length trigger, defined by *Length* field Bit 2-31: Reserved (must be zero)
Length	f64	Trigger length (in seconds)
Offset	f64	Trigger delay after ping command (in seconds)

11.53 1116 – PPS Edge Control

Description: Sets PPS input edge control.

Table 154: 7500 Record Data – Command 1116

Name	Size	Description
PPS Edge	u32	BIT FIELD: Bit 0: 0 – Rising 1 – Falling Bit 1-31: Reserved

11.54 1118 – Snippet Control

Description: Limits snippet sample range.

NOTE
This command may affect old 7008 record's format.

Table 155: 7500 Record Data – Command 1118

Name	Size	Description
Snippet Control Flags	u32	BIT FIELD: (1 – Enabled) Bit 0: Use automatic snippet window Bit 1: Include at least samples around bottom detection (min. window size is valid) Bit 2: Include at most samples around bottom detection (max. window size is valid) Bit 3-31: Reserved
Snippet Control Min. Window	u32	Used as Minimum Window Size when bit 0 is set (*automatic window*) AND bit 1 is set. Used as Fixed Window Size when flags bit 0 is NOT set (*fixed window*).
Snippet Control Max. Window	u32	Max snippet window. Used when flags bit 2 is set.

Automatic snippet window, if enabled, is constructed to allow 3dB overlap between beams.

In snippet control command at least one of the three control flags has to be enabled; but they can be used all three together.

11.55 1138 – Element Limit Control

Description: Limit the number of elements and/or samples in record 7038.

Table 156: 7500 Record Data – Command 1138

Name	Size	Description
Sample type	u16	16, 12 or 8 bits
Min sample	u32	Start sample number. 0 to samples – 1
Max sample	u32	Stop sample number. 0 to samples – 1 0xffffffff
Number of elements (E)	u16	0 – All elements 0xffff – If calibration is available, only “good” elements will be included. Otherwise, all elements are included. Otherwise, number of elements to follow
Elements	u16 * E	List of elements to include. Element numbers are zero based.

11.56 1200 – Start Recording

Description: Start recording. The directory (see ID 1207) and file name combined must not exceed 256 characters. The string should be of the form <filename in u8></0><0 in u8 to fill to a total length of 256>

Table 157: 7500 Record Data – Command 1200

Name	Size	Description
Reserved	u32	Reserved – must be 0
Filename	u8 * 256	Null terminated ASCII string. Maximum 256 characters, including null character. If the filename is NULL (empty), the file name is created according to *section 8.2 File Nomenclature* (i.e., 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. If a fully qualified path name – including drive (or UNC network resource), directory, and filename – is supplied, it will be used. The directory must exist. It will not be created. The .s7k extension will be added to the filename. The file name length + the directory path length cannot exceed 256 characters.

11.57 1201 – Stop Recording / Playback

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

This command has no parameters.

11.58 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 158: 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

Name	Size	Description
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.)

11.59 1204 – Data Storage Status Request

Description: Returns status of data recorder (Record 7052).

This command has no parameters.

11.60 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 159: 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.

11.61 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 160: 7500 Record Data – Command 1207

Name	Size	Description
Directory	u8 * 256	New directory pathname. Null-terminated ASCII string. A trailing backslash (‘\’) will be appended if necessary. Network paths should be specified as (for example): \\server\directory. In the event that the directory does not exist, it will be created (if possible).

11.62 1209 – Set Filtering

Description: Sets playback mode OR record mode filtering. Allows for inclusionary record filtering during playback or recording.

The 7k records available for recording are listed below:

1000	1001	1002	1003	1004	1005	1006	1007	1008	1009
1010	1011	1012	1013	1014	1015	1016	1017	1020	1050
7000	7002	7004	7006	7007	7008	7011	7012	7017	7018
7021	7026	7027	7028	7038	7039	7048	7057	7058	7068
7503	7504	7505	7511	7610	7611	7612	8012		

However, since new records are defined from time to time, and others may become obsolete, it is recommended to use the 7052 “recording status” record, which is available as a single record request or via subscription, in order to obtain the list of records supported by your version of the software. The 7052 record will contain the complete list of available records if the “Filter Method” field of the most recent 1209 command record is set to 0 (No filtering).

The minimal record set should include 7000, 7004, and either 7011 + 7027 (bathymetry) or 7018 (FLS). Full reprocessing of .s7k files requires water column data record 7018 or 7008 (obsolete). The SeaBat UI enforces this minimal set via the 1209 command records it sends to the 7kCenter.

Table 161: 7500 Record Data – Command 1209

Name	Size	Description
Filter type	u16	0 – By record
Filter method	u16	0 – None, all records will be included 1 – Inclusionary, ‘Filter List’ is the list of records for playback or recording
N	u16	Number of record IDs in ‘Filter List’ (maximum 128)
Filter list	u32 * N	List of N record IDs for filtering to act upon

11.63 1211 – Logging Settings

Description: Set the 7K logger settings; single or multiple log file, lead-in or none lead-in ping data.

Table 162: 7500 Record Data – Command 1211

Name	Size	Description
Single or multiple file	u8	Zero = Write logfiles of multiple 1GB files Non-zero = Write single 7K logfile
Ping data history	u8	Zero = No lead-in ping data Non-zero = Write 10 sec of lead-in ping data

11.64 1400 – Autopilot Table Update

Description: Autopilot table to be loaded.

Table 163: 7500 Record Data – Command 1400

Name	Size	Description
Size	i32	Table size
Version	i32	Table version: currently set at 3
Mode	u32	0 – Range based 1 – Depth based
Rows	i32	Number of rows in table, based on number of valid ranges/depth increments for sonar (Max 100)
Range[0] sonar type	u32	0 – 7101 1 – 7111 2 – 7125 200kHz 3 – 7125 400kHz 4 – 7150 5 – Default 6+ – Not valid
Range[0] Min power	i32	Min power for this range
Range[0] Max power	i32	Max power for this range
Range[0] Min gain	i32	Min gain for this range
Range[0] Max gain	i32	Max gain for this range
Range[0] Min pulse length	f32	Min pulse length for this range
Range[0] Max pulse length	f32	Max pulse length for this range
Range[0] Tuning	u16*8	Algorithm tuning parameters
Range[0] Reserved	u32*4	Reserved
.... Range[Rows-1]		Additional settings for each range/depth (row)
Row[0] Sonar type	u32	First row Sonar type (same as above)
Row[0] Bottom depth	f32	First row Depth
Row[0] Range	i32	First row Range
Row[0] Tx Power	i32	First row Power
Row[0] Gain	i32	First row Gain
Row[0] Spreading	i32	First row Spreading
Row[0] Absorption	i32	First row Absorption
Row[0] Tx Pulse length	i32	First row Pulse length
Row[0] Reserved	u32*4	First row Reserved
…. Row[Rows-1]		Last row Settings

11.65 1402 – Tracker Control

Description: Sets the state of the Tracker options.

Table 164: 7500 Record Data – Command 1402

Name	Size	Description
Tracker flags	u32	Bit 0: Enable range control Bit 1: Enable power & gain control Bit 2: Enable pulse length control Bit 3: Enable coverage angle control Bit 4: Use fixed swath width Bit 5: Set maximum coverage angle
Tracker swath width	f32	In meters
Tracker max coverage	f32	In radians

11.66 1600 – Custom Recording Control

Description: Set custom recording control parameters.

Table 165: 7500 Record Data – Command 1600

Name	Size	Description
Path name	u8 * 256	Full directory path name. Null terminated ASCII string. Maximum of 256 characters, including null character.
Header name	u8 * 256	Null terminated ASCII string. Maximum of 256 characters including null character.
Trailer name	u8 * 256	Null terminated ASCII string. Maximum of 256 characters including null character.
Prepend header	u8	When not zero: Prepend the file specified by the header name for each file.
Append trailer	u8	When not zero: Append the file specified by the trailer name for each record.
Record	u32	When not zero: Enable custom recording.

11.67 1601 – Custom Playback Control

Description: Set custom playback control parameters.

Table 166: 7500 Record Data – Command 1601

Name	Size	Description
Path name	u8 * 256	Full directory path name. Null terminated ASCII string. Maximum of 256 characters, including null character.
File name	u8 * 256	Null terminated ASCII string. Maximum of 256 characters including null character.

Name	Size	Description
Loop mode	u32	0 – Play file once 1 – Loop the file 2 – Advance to next file
Play	u8	When not zero: Enable custom playback
Time stamps	u8	0 – Set new timestamps 1 – Keep original timestamps when playing the file

11.68 1602 – Custom Sensors

Description: Set HPR (heading, pitch roll) and SVP (sound velocity) sensors. The HPR sensor can optionally installed in the RTA and a SVP optionally connected to the sonar head.

Table 167: 7500 Record Data – Command 1602

Name	Size	Description
Use build in HPR	u8	0 – Use HPR sensor connected to RTA 1 – Use the build in HPR sensor
Use attached SVP sensor	u8	0 – Use SVP sensor connected to RTA 1 – Use attached SVP sensor

11.69 1603 – Stacking

Description: Set stacking

Table 168: 7500 Record Data – Command 1603

Name	Size	Description
Enable stacking	u8	0 – Disable stacking mode 1 – Enable stacking mode
Stacking value	u8	Number of results to stack min = 1, max = 9

11.70 1604 – Serial Ports

Description: Set serial ports

Table 169: 7500 Record Data – Command 1604

Name	Size	Description
ZDA port baudrate	u8	0 – 1200 1 – 2400 2 – 4800 3 – 9600 4 – 14400 5 – 19200 6 – 28800 7 – 38400 8 – 56000 9 – 57600 10 - 115200
ZDA port parity	u8	0 – None 1 – Even 2 – Odd 3 – Space 4 - Mark
ZDA port data bits	u8	0 – 5 bits 1 – 6 bits 2 – 7 bits 3 – 8 bits
ZDA port stop bits	u8	0 – 1 bit 1 – 2 bits

Name	Size	Description
GGA port baudrate	u8	0 – 1200 1 – 2400 2 – 4800 3 – 9600 4 – 14400 5 – 19200 6 – 28800 7 – 38400 8 – 56000 9 – 57600 10 - 115200
GGA port parity	u8	0 – None 1 – Even 2 – Odd 3 – Space 4 - Mark
GGA port data bits	u8	0 – 5 bits 1 – 6 bits 2 – 7 bits 3 – 8 bits
GGA port stop bits	u8	0 – 1 bit 1 – 2 bits
SVP port baudrate	u8	0 – 1200 1 – 2400 2 – 4800 3 – 9600 4 – 14400 5 – 19200 6 – 28800 7 – 38400 8 – 56000 9 – 57600 10 - 115200
SVP port parity	u8	0 – None 1 – Even 2 – Odd 3 – Space 4 - Mark

Name	Size	Description
SVP port data bits	u8	0 – 5 bits 1 – 6 bits 2 – 7 bits 3 – 8 bits
SVP port stop bits	u8	0 – 1 bit 1 – 2 bits
HPR port baud rate	u8	0 – 1200 1 – 2400 2 – 4800 3 – 9600 4 – 14400 5 – 19200 6 – 28800 7 – 38400 8 – 56000 9 – 57600 10 - 115200
HPR port parity	u8	0 – None 1 – Even 2 – Odd 3 – Space 4 - Mark
HPR port data bits	u8	0 – 5 bits 1 – 6 bits 2 – 7 bits 3 – 8 bits
HPR port stop bits	u8	
HDT port baud rate	u8	0 – 1200 1 – 2400 2 – 4800 3 – 9600 4 – 14400 5 – 19200 6 – 28800 7 – 38400 8 – 56000 9 – 57600 10 - 115200

Name	Size	Description
HDT port parity	u8	0 – None 1 – Even 2 – Odd 3 – Space 4 - Mark
HDT port data bits	u8	0 – 5 bits 1 – 6 bits 2 – 7 bits 3 – 8 bits
HDT port stop bits	u8	0 – 1 bit 1 – 2 bits

11.71 1605 – RRIO Addresses

Description: Set RRIO addresses.

Table 170: 7500 Record Data – Command 1605

Name	Size	Description
RRIO address1	u8 * 256	RRIO IP address :port ASCII string, max length 255 characters + null.
RRIO address2	u8 * 256	RRIO IP address :port ASCII string, max length 255 characters + null.
RRIO address2	u8 * 256	RRIO IP address :port ASCII string, max length 255 characters + null.

11.72 1606 – Custom Recording Quick Info

Description: Custom recording quick status information.

Table 171: 7500 Record Data – Command 1606

Name	Size	Description
Disk free	u16	Percentage free disk space
Number	u32	Number of records written
Size	u64	Size of recorded file
Record	u32	Non zero when recording is active
File name	u8 * 256	Nameo f current file being recorded ASCII string, max length 255 character + null
Error	u32	RDR error
Reserved	u32 * 30	Reserved

11.73 1607 – Head Tilt Angle

Description: Set Head tilt mounting angle.

Table 172: 7500 Record Data – Command 1607

Name	Size	Description
Head tilt	f32	In radians

11.74 1608 – Deck Mode

Description: Set deck mode; sonar is in degraded operation.

Table 173: 7500 Record Data – Command 1608

Name	Size	Description
Mode	u32	Deck mode Non zero: Sonar is in deck mode

11.75 1609 – Power Mode

Description: Give (windows) power mode of the sonar (Control Center) PC.

Table 174: 7500 Record Data – Command 1609

Name	Size	Description
Flags	u8	Bit 0: – Power mode is supported Bit 1: – Power mode CPU throttled Bit 2: – Power mode AC
Mode max	u8	Percentage on which the CPU is throttled between 0 – 100%

11.76 7041 – R7041 Setup

Description:

Table 175: 7500 Record Data – Command 7041

Name	Size	Description	Startup
Down-sampling Method	u8	0 – No down-sampling No down-sampling is performed and magnitude is recorded unchanged 1 – Nearest neighbor For each new sample the nearest original sample within the same beam is picked 2 – Linear approximation Each new sample is calculated as linear approximation of two original neighboring samples 3 – Averaging Each new sample is an average of all original samples within half new sampling period	1
Filtering Method	u8	0 – No filtering	0
Flags	u16	BIT FIELD: Bit 0: - Discard data beyond absolute gates If absolute gates are enabled, data series will be recorded only to maximum depth or range gate, whichever is less Bit 1: - Reduction relative to pulse length New sample periods calculated as Pulse Length * Multiplier Bit 2: - Reduction relative to sample rate New sample period is calculated as *original Sample Period * Multiplier* Bit 3: - Absolute reduction New sample rate is adjusted such as total number of samples would not exceed specified value in Multiplier/Size field Bit 4-15: - Reserved (always zero) Only one of 1-3 bits could be set	3
Multiplier/Size	f32/u32	For relative reduction, this field contains floating point multiplier value For absolute reduction this field contains integer number for max samples	1.0

11.77 7042 – compressed Watercolumn Data Setup

Description: Allows configuration of compressed watercolumn record (7042). Note that the current value of these flags are reported in the 'Flags' field of the 7042 Compressed Watercolumn record. The settings are retained between executions of the 7kCenter.

NOTE
Apply until software updates are released for other systems, on the moment of writing only to the T-20-S.

Table 176: 7500 Record Data – Command 7042

Name	Size	Description
Flags	u32	Bit field: Bit 0 : Use maximum bottom detection point *in each beam* to limit data. Data is included up to the bottom detection point + 10%. This flag has no effect on systems which do not perform bottom detection. Bit 1 : Include magnitude data only (strip phase). Bit 2 : Convert mag to dB, then compress from 16 bit to 8 bit. Phase compression simply truncates lower (least significant) byte of phase data. Bit 3 : Exclude data outside of absolute gates. Only applicable if abolute gates in use. (UNSUPPORTED IN THIS RELEASE) Bit 4-7 : Downsampling divisor. Value = (BITS >> 4). Only values 2-16 are valid. This field is ignored if downsampling is not enabled (type = "none"). Bits 8-11 : . Downsampling type: 0x000 = None 0x100 = Middle value 0x200 = Peak value 0x300 = Average value

11.78 7610 – Manual Sound Velocity

Description: Set SVP filtering manual sound velocity value, with optional 'override' flag. If override flag is set, then 7610 records received by the 7KCenter from other clients (e.g. Teledyne PDS) will be ignored.

Table 177: 7500 Record Data – Command 7610

Name	Size	Description
Flags	w16	BIT FIELD: Bit 0: Manual Override If set any subsequent 7610 record will be ignored, otherwise any subsequent 7610 record will change the Sound Velocity value Bit 1: Settings Only If set the Sound Velocity value will not be updated and Sound Velocity field within this remote command will be ignored Bit 2: Filter Setting If set SVP Filter type will be changed, otherwise SVP Filter field within this remote command will be ignored Bit 3-15: Reserved, must be zeros
Sound velocity	f32	Sound velocity in m/s
SVP Filter	u8	SVP Filter type 1 – No Filter 2 – Light Filter 3 – Normal Filter 4 – SVP70 Wizard NOTE: to change the filter values Flags Bit 2 must be set
Reserved	u8*3	Reserved

11.79 7614 – Manual Temperature Control

Description: Set Temperature, with optional 'override' flag. If override flag is set, then 7614 records received by the 7KCenter from other clients (e.g. Teledyne PDS) will be ignored.

Table 178: 7500 Record Data – Command 7614

Name	Size	Description
Flags	u16	BIT FIELD: Bit 0: Manual Override If set any subsequent 7614 record will be ignored, otherwise any subsequent 7614 record will change the Temperature value. Bit 1: Settings Only If set the Temperature value will not be updated and Temperature field within this remote command will be ignored. Bit 2-15: Reserved, must be zeros
Temperature	f32	Temperature (°C)
Reserved	u16*2	Reserved. Set to zero.

12 BLUEVIEW DATA FORMAT DEFINITION

The BlueView ProScan software uses the RESON 7K data format with the definitions and conventions as specified earlier in this document.

There are five types of network data records provided by the MB Sonar/ProScan software system. They are the Sonar Configuration record, the Multibeam Configuration record, the Bathymetry record, the Pan/Tilt Configuration record, and the Pan/Tilt Position record.

NOTE
The record definitions defined in this DFD version applies for ProScan version 3.12 and higher. Refer to DFD version 2.40 for the definition of records which applies for ProScan version 3.11 or lower.

There are small differences for the network frame as specified in section 7 and the data record frame as specified in section 6 compared to BlueView.See the below sections for the BlueView frame specifications and the record definition.

12.1 BlueView Network Frame Format

The following table lays out the format for the Network Frame.

Name	Data Type	Description
Protocol version	u16	Identifies the version of this record.
Offset	u16	Offset in bytes to the start of the Data Type Header from the start of this Network Frame.
Reserved	u32	Reserved
Reserverd	u16	Reserved
Reserved	u16	Reserved
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).
Reserved	u32	Reserved
Reserved	u32	Reserved
Reserved	u16	Reserved
Reserved	u16	Reserved
Reserved	u32	Reserved

12.2 BlueView Data Record Frame

The following table lays out the format for the Data Record Frame

Name	Data Type	Description
Protocol version	u16	Identifies the version of this record.
Offset	u16	Offset in bytes from the start of the Sync Pattern to the start of the Data Container.
Sync Pattern	u32	0x0000FFFF
Data Size	u32	Size of the DTH and Data Container portion of the network record.
Reserved	u32	Reserved
Reserved	u32	Reserved
7KTIME	u8*10 (7K Time)	Timestamp indicating when data was generated.
Record version	u16	Version of the specified record
Record Type Identifier	u32	Identifies the kind of data stored in the Data Container. The legal values are: 7000: Sonar Configuration 7004: Multibeam Configuration 7006: Bathymetry 5835: Pan/Tilt Configuration 5836: Pan/Tilt Position
Device Identifier	u32	ProScan device identifier
Reserved	u16	Reserved
Reserved	u16	Reserved
Reserved	u32	Reserved
Flags	u16	BIT FIELD: Bit 0:Checksum 0 – Invalid checksum 1 – Valid checksum Bit 1-14: Reserved (must be zero) Bit 15: 0 – Live data 1 – Recorded data
Reserved	u16	Reserved
Reserved	u32	Reserved
Reserved	u32	Reserved
Reserved	u32	Reserved
DATA SECTION	Variable	Payload of the network record.

Name	Data Type	Description
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.

12.3 7000 Sonar Configuration Container format

Description: This record contains the current sonar settings. For every sonar ping, the Sonar Configuration record is transmitted.

Data Definition:

DRF	RTH	RD	OD	DRF

Table 179: 7000 – Record Type Header

Name	Data Type	Description
Sonar Serial Number	u64	Identifies sonar.
Ping Number	u32	Identifies a particular ping.
Reserved	u16	Reserved
Frequency	f32	Transmit frequency in Hertz
Reserved	f32	Reserved
Reserved	f32	Reserved
Reserved	f32	Reserved
Reserved	u32	Reserved
Reserved	u32	Reserved
Reserved	f32	Reserved
Reserved	u32	Reserved
Reserved	f32	Reserved
Reserved	f32	Reserved
Maximum Range	f32	Maximum Range setting in meters
Reserved	f32	Reserved
Reserved	f32	Reserved
Reserved	u32	Reserved
Reserved	u32	Reserved

Name	Data Type	Description
Reserved	f32	Reserved
Reserved	f32	Reserved
Reserved	f32	Reserved
Reserved	f32	Reserved
Reserved	f32	Reserved
Reserved	u32	Reserved
Reserved	f32	Reserved
Reserved	u32	Reserved
Reserved	u32	Reserved
Reserved	u32	Reserved
Reserved	f32	Reserved
Reserved	u32	Reserved
Reserved	f32	Reserved
Reserved	f32	Reserved
Reserved	f32	Reserved
Reserved	f32	Reserved
Reserved	f32	Reserved
Reserved	f32	Reserved
Reserved	f32	Reserved
Reserved	f32	Reserved
Reserved	u16	Reserved

12.4 7004 Multibeam Configuration Container Format

Description: This record contains the receive beam widths and steering. For every sonar ping, the Multibeam Configuration is transmitted.

Data definition:

DRF	RTH	RD	OD	DRF

Table 180: 7004 – Record Type Header

Name	Data Type	Description
Sonar Serial Number	u64	Identifies sonar.
Number of Beams	u32	Number of receiver beams.
Reserved	f32 * Number of Beams	Reserved
Beam Bearing Angle	f32 * Number of Beams	The bearing, in +/- radians, from the center of the sonar for each beam.
Reserved	f32 * Number of Beams	Reserved
Reserved	f32 * Number of Beams	Reserved

12.5 7006 Bathymetry Container Format

Description: This record contains the bottom detection results. For every sonar ping, the Bathymetry network record is transmitted.

Data definition:

DRF	RTH	RD	OD	DRF

Table 181: 7006 – Record Type Header

The following table lays out the format for the Bathymetry container.

Name	Data Type	Description
Sonar Serial Number	u64	Identifies sonar.
Ping Number	u32	Identifies a particular ping.
Mult-Ping Sequence	u16	If not zero, then this is the sequence number of the ping in the multi-ping sequence.
Number of Beams	u32	Number of receiver beams.
Reserved	u8	Reserved
Sound Velocity Source	u8	Identifies source of sound velocity. 0 = Measured 1 = Manually Entered
Sound Velocity	f32	Sound velocity in meters/second

Range	f32 * Number of Beams	Two-way travel time in seconds
Range Quality	u8 * Number of Beams	Indicates where ranges are valid. 0x07 = Valid 0x06 = Invalid
Reserved	f32 * Number of Beams	Reserved
Start Range Window	f32 * Number of Beams	Two-way travel time in seconds
Stop Range Window	f32 * Number of Beams	Two-way travel time in seconds

12.6 5835 Pan/Tilt Configuration Container Format

NOTE
Refer to APPENDIX H - Data Transformations (BlueView) - for a description of how to populate the function coefficients and arguments based on the values in the PanTilt Configuration record and the PanTilt Position record.

Description: This record contains the pan/tilt configuration parameters. For every sonar ping, the Pan/tilt Configuration record is transmitted.

Data definition:

DRF	RTH	RD	OD	DRF

Table 182: Record Type Header

The following table lays out the format for the Pan/Tilt Configuration container. The size of the complete record, i.e., Network Frame, Data record frame, and PanTiltCalibration, is 323 bytes.

Name	Size	Description
Version Number	u16	Version number of this record format.
Sonar ID	u64	Sonar Serial number
Head ID	u16	Specific Head on the sonar
Manufacturer	u8 * 80	Pan/Tilt Manufacturer
Model	u8 * 80	Pan/Tilt Model
Tilt Elbow Offset	f32	Length in meters from tilt axis to sonar central axis (See Figure 12-2: Pan/Tilt Offsets
Pan Arm Offset	f32	Length in meters from pan axis to sonar acoustic center (See Figure 12-2: Pan/Tilt Offsets

Name	Size	Description
Tilt Axis Offset	f32	Length in meters from Pan/Tilt unit base to tilt axis (See Figure 12-2: Pan/Tilt Offsets
Head Roll Orientation	f32	Roll angle in degrees of the head about P/T Base Y axis. In most cases, a guide pin directs the head to the0 degree roll angle.
Pan Calibration Position	f32	Raw degrees reported by the pan/tilt base motor at "calibrate" position
Tilt Calibration Position	f32	Raw degrees reported by the pan/tilt elbow motor at "calibrate" position
Is Scanning	u8	If the Pan/Tilt is performing a scan 0 = Stationary 1 = Scanning 2+ = Reserved If 1 the following 4 fields are valid:
Scan Pan start Raw Angle	f32	Raw degrees reported by the pan/tilt base
Scan Pan Stop Raw Angle	f32	raw degrees reported by the pan/tilt base
Scan Tilt Start Raw Angle	f32	If a spherical scan*, the first tilt angle to use raw degrees reported by the pan/tilt elbow
Scan Tilt Stop Raw Angle	f32	If a spherical scan*, the last tilt angle to use raw degrees reported by the pan/tilt elbow

*The start and stop angles tilt angles will be the same if this is a single (i.e., non-sperical) scan.

12.7 5836 Pan/Tilt Position Container Format

NOTE
Refer to APPENDIX H - Data Transformations (BlueView) - for a description of how to populate the function coefficients and arguments based on the values in the PanTilt Configuration record and the PanTilt Position record.

Description: This record contains the position readings of the pan/tilt unit. For every sonar ping, the Pan/tilt Position record is transmitted.

Data definition:

DRF	RTH	RD	OD	DRF

Table 183: Record Type Header

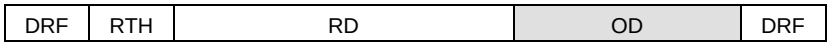
The following table lays out the format for the Pan/Tilt Position container. The size of the complete record, i.e., Network Frame, Data record frame, and Pan/Tilt Position, is 132 bytes.

Name	Size	Description
Version Number	u16	Version number of this record format.
Sonar ID	u64	Sonar Serial number
Head ID	u16	Specific Head on the sonar
Ping number	u32	
Pan Position	f32	Degrees about P/T Base Z-axis (right handed)
Tilt Position	f32	Degrees about P/T Base X-axis (right handed)
Reserved	f32	Reserved

APPENDIX A TELEDYNE PDS OPTIONAL DATA

The following tables show optional data created by Teledyne PDS when the S7K file is logged by, or exported from Teledyne PDS.

Use tables to maintain compatibility with Teledyne PDS.



Optional data 7006 record:

Table 184: 7006 – Optional Data

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

Optional data 7007 record:

Table 185: 7007 – Optional Data

Name	Size	Description
Frequency	f32	Ping Frequency in Hz
Latitude	f64	Latitude of vessel reference point in radians -π/2 to π/2, south negative
Longitude	f64	Longitude of vessel reference point in radians -π to π, west negative
Heading	f32	Heading of vessel at transmit time in radians
Depth	f32	Depth for slant range correction in meters

Optional data 7008 record:

Table 186: 7008 – Optional Data

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

Optional data 7027 record:

Table 187: 7027 – Optional Data

Name	Size	Description
Frequency	f32	Ping Frequency in Hz
Latitude	f64	Latitude of vessel reference point in radians -π/2 to π/2, south negative
Longitude	f64	Longitude of vessel reference point in radians -π to π, west negative
Heading	f32	Heading of vessel at transmit time in radians
Height source	u8	Method used to correct to chart datum. If height source = 1, then Tide = '0'. 0 – None 1 – RTK 2 – Tide

Name	Size	Description
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 meters
The following set of data items are repeated for each beam:		
Beam 0 – Depth	f32	Depth relative chart datum (or relative waterline if Height source = 0) (in meters)
Beam 0 – Along track distance	f32	Along track distance in vessel grid (in meters)
Beam 0 – Across track distance	f32	Across track distance in vessel grid (in meters)
Beam 0 – Pointing angle	f32	Beam pointing angle from vertical in radians
Beam 0 – Azimuth angle	f32	Beam azimuth angle in radians

Optional data 7028 record:

Table 188: 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:		
Beam – Along track distance	f32	Along track distance in vessel grid in meters
Beam – Across track distance	f32	Across track distance in vessel grid in meters
Center sample number	u32	Sample number at detection point of beam

Optional data 7057 record:

Table 189: 7057 – 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

Optional data 7058 record:

Table 190: 7058 – Optional Data

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

Optional data 7400 record:

Table 191: 7400 – Optional Data

Name	Size	Description
UTC time	f64	Time since midnight in HHMMSS.SS format
External time	f64	UTC Time in milliseconds since 1 Jan 1970
T0	f64	T Null Time in milliseconds since 1 Jan 1970
T1	f64	T One Time in milliseconds since 1 Jan 1970
Pulse length	f64	Pulse length in milliseconds
Difference	f64	Difference between computer clock and External time in milliseconds
IO Module status	u16	IO Module synchronization status

APPENDIX B DEVICE IDENTIFIERS

The Data Record Frame (see *Table 5: Data Record Frame*) requires a Device Identifier parameter. The table below provides the list of valid Device Identifiers and their descriptions.

Table 192: Device Identifiers

Identifier	Vendor	Description
20	RESON	SeaBat™ T20-P
100		Generic Position Sensor (e.g., GPS)
101		Generic Heading Sensor (e.g., Gyro)
102		Generic Attitude Sensor
103		Generic MBES
104		Generic Side-scan Sonar
105		Generic Sub-bottom Profiler
1000	Odom	Odom MB1
1001	TrueTime	PCISG
1002	Odom	Odom MB2
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	Teledyne PDS
7004	RESON	7k Logger
7005	BlueView	BlueView ProScan
7012	RESON	SeaBat™ 7012
7100	RESON	SeaBat™ 7100
7101	RESON	SeaBat™ 7101
7102	RESON	SeaBat™ 7102
7111	RESON	SeaBat™ 7111
7112	RESON	SeaBat™ 7112
7123	RESON	SeaBat™ 7123
7125	RESON	SeaBat™ 7125
7128	RESON	SeaBat™ 7128
7150	RESON	SeaBat™ 7150

Identifier	Vendor	Description
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	Ifremer	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 193: Projection Identifiers

Custom Identifier	Projection
-1	Not used
0	Universal Transverse Mercator (UTM)
1	Albers Equal-Area Conic
2	Azimuthal Equal Area
3	Azimuthal Equidistant
4	Bonne
5	Cassini
6	Double Stereographic
7	Equal-Area Cylindrical
8	Equidistant Conic
9	Equidistant Cylindrical
10	European Stereographic
11	Gnomic
12	Oblique Mercator (Rectified Skew Orthomorphic – with skew angle parameter)
13	Hotine
14	Hungarian National System (EOV)
15	Hungarian National System (EOV)
16	IMW Polyconic
17	Lambert Conformal Conic (1 parallel)
18	Lambert Conformal Conic (2 parallel)
19	Mercator
20	Miller Cylindrical
21	Mollweide
22	Orthographic
23	Polar Azimuthal
24	Equal Area
25	Polar Azimuthal Equidistant

Custom Identifier	Projection
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 received from external source
0x7006 (28678)	FEATURE_NOT_AVAILABLE Option not available or under development
0x7007 (28679)	REMOTE_COMMAND_NOT_FOUND Not a valid command, i.e. an invalid 7500 ticket like 1483
0x7008 (28680)	INVALID_PARAMETER Data not within DFD specifications
0x7009 (28681)	INVALID_DEVICE_ID Invalid device identifier
0x700A (28682)	RECORD_IS_SUBSCRIPTION_ONLY Record is only available though subscription
0x700B (28683)	PARAMETER_VALUE_CLIPPED Value passed has been clipped to stay within allowed range
0x700C (28684)	REMOTE_COMMAND_DENIED Valid command issued either under invalid condition or with insufficient permissions
0x700D (28685)	REMOTE_BROADCAST_DENIED Remote command cannot be broadcasted to multiple systems
0x700E (28686)	REMOTE_ILLEGAL_BROADCAST Broadcast notation is used with system identifier either zero or 7000
0x700F (28687)	REMOTE_BROADCAST_NO_SYSTEM Some or all enumerators in broadcast notation are not valid systems

Code	Description
0x704F (28751)	REMOTE_BROADCAST_FAILED While using RC Broadcast, several systems nacked with different error codes
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
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

Code	Description
0x710D (28941)	RDR_FILE_WRITE_ERROR RDR unable to write to file
0x710E (28942)	RDR_FILE_READ_ERROR RDR unable to read file
0x710F (28943)	RDR_FILE_DELETE_ERROR RDR unable to delete file
0x7110 (28944)	RDR_LOCK_FAILED System could not lock file for recording/playback
0x7111 (28945)	RDR FAILURE RDR system stopped, thus and future RDR related remote control commands will be rejected
0x7999 (31129)	UNKNOWN_ERROR An unknown error has occurred

APPENDIX E EXAMPLE C++ SOURCE CODE FOR INTERFACING WITH THE 7KCENTER USING THE TCP/IP PROTOCOL

This appendix contains an example of C++ source code for interfacing with the 7KCenter using the TCP/IP protocol. This example consists of two files: example7k.cpp and TCPsocket7k.cpp

```
// File: Example7k.cpp

#include "stdafx.h"
#include "Example7k.h"

#include <cstdio>
#include <cstdlib>
#include <cstring>

#include "7k.h"


namespace
{
    const char NAME_START[] = "<Name";
    const char DEVID_START[] = "deviceid=\"";
    const char ENUM_START[] = "enumerator=\"";

#pragma pack(push, 1)
    struct R7500_1050
    {
        R7500 r7500;
        DWORD record_type;
    };

    struct R7500_1051
    {
        R7500 r7500;
        DWORD record_count;
        DWORD record_types[1];
    };
#pragma pack(pop)
}


// The example connects to the sonar,
// request the XML configuration record (7001),
// subscribes to the raw detections record (7027),
// and prints the last detection of each ping

void Example7k::Run(const char* host)
{
    if (!ConnectToCenter(host))
        return;

    RequestConfig();
    ReceiveLoop();
}


bool Example7k::ConnectToCenter(const char* host)
{
    return m_socket.Create() && m_socket.Connect(host);
```

```
}


void Example7k::RequestConfig()
{
    R7500_1050 r7500_1050 = {};
    r7500_1050.r7500.rc_id = 1050;  // Single Record Request
    r7500_1050.record_type = 7001;  // Configuration

    m_socket.SendRecord(7000, 0, 7500, &r7500_1050, sizeof(r7500_1050));
}


bool Example7k::ReceiveLoop()
{
    std::vector<BYTE> recordData;
    while (m_socket.ReceiveRecord(recordData))
    {
        const RECORD_FRAME* pFrame = GetFramePtr(recordData);
        if (!pFrame)
            break;

        size_t dataSize = 0;
        const BYTE* pData = GetDataPtr(recordData, dataSize);

        switch (pFrame->record_type)
        {
        case 7001:
            HandleConfig(pData, dataSize);
            break;

        case 7027:
            HandleDetections(pData, dataSize);
            break;
        }
    }

    return true;
}


// Get device identifier and enumerator from the XML configuration,
// and subscribe to the raw detections (7027) record for each system
bool Example7k::HandleConfig(const BYTE* pData, size_t dataSize)
{
    const BYTE* ptr = pData;
    const BYTE* end = pData + dataSize;

    const R7001* pR7001 = reinterpret_cast<const R7001*>(ptr);
    ptr += sizeof(R7001);
    if (ptr > end)
        return false;

    for (DWORD i = 0; i < pR7001->systems; ++i)
    {
        const R7001MODULEINFO* pR7001Info =
            reinterpret_cast<const R7001MODULEINFO*>(ptr);
        ptr += sizeof(R7001MODULEINFO);
        if (ptr > end)
            return false;

        const char* pInfo = reinterpret_cast<const char*>(ptr);
        ptr += pR7001Info->info_length;
        if (ptr > end)
            return false;
```

```
        if (pInfo[pR7001Info->info_length - 1] != '\0')
            return false;

        // Get device id and enum from XML
        const char* pName = std::strstr(pInfo, NAME_START);
        if (!pName)
            continue;

        const char* pId = std::strstr(pName, DEVID_START);
        if (!pId)
            continue;
        DWORD deviceId = (DWORD) std::atoi(pId + sizeof(DEVID_START) - 1);

        const char* pEnum = std::strstr(pName, ENUM_START);
        if (!pEnum)
            continue;
        WORD enumerator = (WORD) std::atoi(pEnum + sizeof(ENUM_START) - 1);

        Subscribe(deviceId, enumerator);
    }

    return true;
}


void Example7k::Subscribe(DWORD deviceId, WORD enumerator)
{
    R7500_1051 r7500_1051 = {};
    r7500_1051.r7500.rc_id = 1051;  // Record Subscription
    r7500_1051.record_count = 1;
    r7500_1051.record_types[0] = 7027;  // Raw Detections

    m_socket.SendRecord(deviceId, enumerator, 7500, &r7500_1051,
        sizeof(r7500_1051));
}


bool Example7k::HandleDetections(const BYTE* pData, size_t dataSize)
{
    const BYTE* ptr = pData;
    const BYTE* end = pData + dataSize;

    // The size of the 7027 header part is fixed
    const R7027* p7027 = reinterpret_cast<const R7027*>(ptr);
    ptr += sizeof(R7027);
    if (ptr > end)
        return false;

    // The size of the 7027 data parts is specified in the header
    // so that fields may be added in the future
    // We have to be able to deal with shorter (older) versions,
    // and longer (newer) versions
    size_t r7027DataSize = p7027->data_size;
    size_t minSize = (std::min)(sizeof(R7027Data), r7027DataSize);

    R7027Data r7027Data = {};
    for (DWORD i = 0; i < p7027->detections; ++i)
    {
        const BYTE* p7027Data = ptr;
        ptr += r7027DataSize;
        if (ptr > end)
            return false;

        std::memcpy(&r7027Data, p7027Data, minSize);
    }
```

```
    // Print last detection of each ping
    std::printf("Ping %u, beam %u, sample %f\n",
        (unsigned) p7027->ping_number,
        (unsigned) r7027Data.beam_number,
        r7027Data.detection);

    return true;
}
```

```
// File: TcpSocket7k.cpp

#include "stdafx.h"
#include "TcpSocket7k.h"

#include <cassert>

#include "7k.h"


namespace
{
    const int TCP_PORT_7K = 7000;
    const DWORD MAX_PACKET_SIZE = 60000;
}


TcpSocket7k::TcpSocket7k()
    : m_socket()
    , m_nextTransmissionId(0)
{
}


bool TcpSocket7k::Create()
{
    return m_socket.Create(NetworkSocket::TYPE_TCP);
}


bool TcpSocket7k::Connect(const char* host)
{
    return m_socket.Connect(host, TCP_PORT_7K);
}


void TcpSocket7k::Close()
{
    m_socket.Close();
}


bool TcpSocket7k::SendRecord(DWORD deviceId, WORD enumerator, DWORD
recordType,
        const void* pData, size_t dataSize)
{
    DWORD recordSize = sizeof(RECORD_FRAME) + (DWORD) dataSize +
CHECKSUM_SIZE;
    DWORD totalPackets = 1;
    DWORD packetSize = sizeof(NETWORK_FRAME) + recordSize;

    // Splitting large records into multiple packets is not implemented here
    // because it is not needed for sending small commands
    assert(packetSize <= MAX_PACKET_SIZE);

    std::vector<BYTE> buffer(packetSize);
    BYTE* ptr = &buffer[0];

    NETWORK_FRAME* nf = reinterpret_cast<NETWORK_FRAME*>(ptr);
    nf->version = PROTOCOL_VERSION;
    nf->offset = sizeof(NETWORK_FRAME);
    nf->total_packets = totalPackets;
    nf->total_records = 1;
    nf->transmission_identifier = m_nextTransmissionId++;
    nf->packet_size = packetSize;
    nf->total_size = recordSize;
```

```
    nf->sequence_number = 0;
    nf->destination_device_identifier = 0;
    nf->destination_system_enumerator = 0;
    nf->source_system_enumerator = 0;
    nf->source_device_identifier = 0;
    ptr += sizeof(NETWORK_FRAME);

    RECORD_FRAME* rf = reinterpret_cast<RECORD_FRAME*>(ptr);
    rf->version = PROTOCOL_VERSION;
    rf->offset = sizeof(RECORD_FRAME) - SYNC_PATTERN_OFFSET;
    rf->sync_pattern = SYNC_PATTERN;
    rf->size = recordSize;
    rf->offset_optional = 0;
    rf->identifier_optional = 0;
    rf->time_stamp = TIME_7K();  // empty time stamp
    rf->records_version = RECORDS_VERSION;
    rf->record_type = recordType;
    rf->device_identifier = deviceId;
    rf->reserved2 = 0;
    rf->system_enumerator = enumerator;
    rf->record_count = 0;
    rf->flags = 0;  // no checksum
    rf->reserved3 = 0;
    rf->reserved4 = 0;
    rf->total_records = 0;
    rf->fragment_number = 0;
    ptr += sizeof(RECORD_FRAME);

    std::memcpy(ptr, pData, dataSize);
    ptr += dataSize;

    DWORD* pChecksum = reinterpret_cast<DWORD*>(ptr);
    *pChecksum = 0;

    ssize_t sentSize = m_socket.Send(&buffer[0], packetSize);
    return sentSize == (ssize_t) packetSize;
}


bool TcpSocket7k::ReceiveRecord(std::vector<BYTE>& recordData)
{
    NETWORK_FRAME nf;
    if (!ReceiveExact(&nf, sizeof(nf)))
        return false;

    if (nf.version != PROTOCOL_VERSION)
        return false;

    DWORD totalPackets = nf.total_packets;
    WORD transmissionId = nf.transmission_identifier;
    DWORD totalSize = nf.total_size;

    recordData.resize(totalSize);
    BYTE* pRecordData = !recordData.empty() ? &recordData[0] : 0;

    // Combine multiple packets into one large record
    size_t readSize = 0;
    for (DWORD sequenceNo = 0; sequenceNo < totalPackets; ++sequenceNo)
    {
        if (sequenceNo > 0)
        {
            if (!ReceiveExact(&nf, sizeof(nf)))
                return false;

            if (nf.version != PROTOCOL_VERSION
                || nf.total_packets != totalPackets
```

```
                || nf.transmission_identifier != transmissionId
                || nf.total_size != totalSize)
            {
                return false;
            }
        }

        if (nf.sequence_number != sequenceNo || nf.offset != sizeof(nf))
            return false;

        size_t payloadSize = nf.packet_size - nf.offset;
        if (payloadSize > totalSize - readSize)
            return false;

        if (!ReceiveExact(pRecordData + readSize, payloadSize))
            return false;

        readSize += payloadSize;
    }

    if (readSize != totalSize)
        return false;

    return true;
}


bool TcpSocket7k::ReceiveExact(void* pBuffer, size_t size)
{
    char* pInBuf = static_cast<char*>(pBuffer);
    size_t toDo = size;

    while (toDo > 0)
    {
        ssize_t done = m_socket.Receive(pInBuf, toDo);
        if (done <= 0)
            return false;

        pInBuf += done;
        toDo -= (size_t) done;
    }

    return true;
}


const RECORD_FRAME* GetFramePtr(const std::vector<BYTE>& recordData)
{
    if (recordData.size() < sizeof(RECORD_FRAME))
        return 0;

    const RECORD_FRAME* rf =
        reinterpret_cast<const RECORD_FRAME*>(&recordData[0]);
    if (rf->sync_pattern != SYNC_PATTERN)
        return 0;

    return rf;
}


const BYTE* GetDataPtr(const std::vector<BYTE>& recordData, size_t&
dataSize)
{
    const RECORD_FRAME* rf = GetFramePtr(recordData);

    WORD dataOffset = rf->offset;
```

```
    DWORD optionalOffset = rf->offset_optional;
    size_t recordSize = rf->size;

    size_t frameSize = SYNC_PATTERN_OFFSET + dataOffset;
    if (frameSize < sizeof(RECORD_FRAME))
        return 0;

    size_t optionalSize = 0;
    if (optionalOffset)
    {
        if (recordSize < optionalOffset - CHECKSUM_SIZE)
            return 0;
        optionalSize = recordSize - optionalOffset - CHECKSUM_SIZE;
    }

    if (recordSize < frameSize + optionalSize + CHECKSUM_SIZE)
        return 0;
    dataSize = recordSize - frameSize - optionalSize - CHECKSUM_SIZE;

    return &recordData[frameSize];
}
```

APPENDIX F HANDLING THE 7027 RECORD

USING THE 7K RAW DETECTION DATA

Refer to the 7027 record definition on page 74.

From sample number to range

The detection point is given as a sample number. Divide this value by the sampling rate to get the two way travel time from the sonar to the detection point. Use the applied soundvelocity for this ping (Record 7000 contains the sonar parameters) or a sv profile to convert the two way travel time to a range.

RX angle

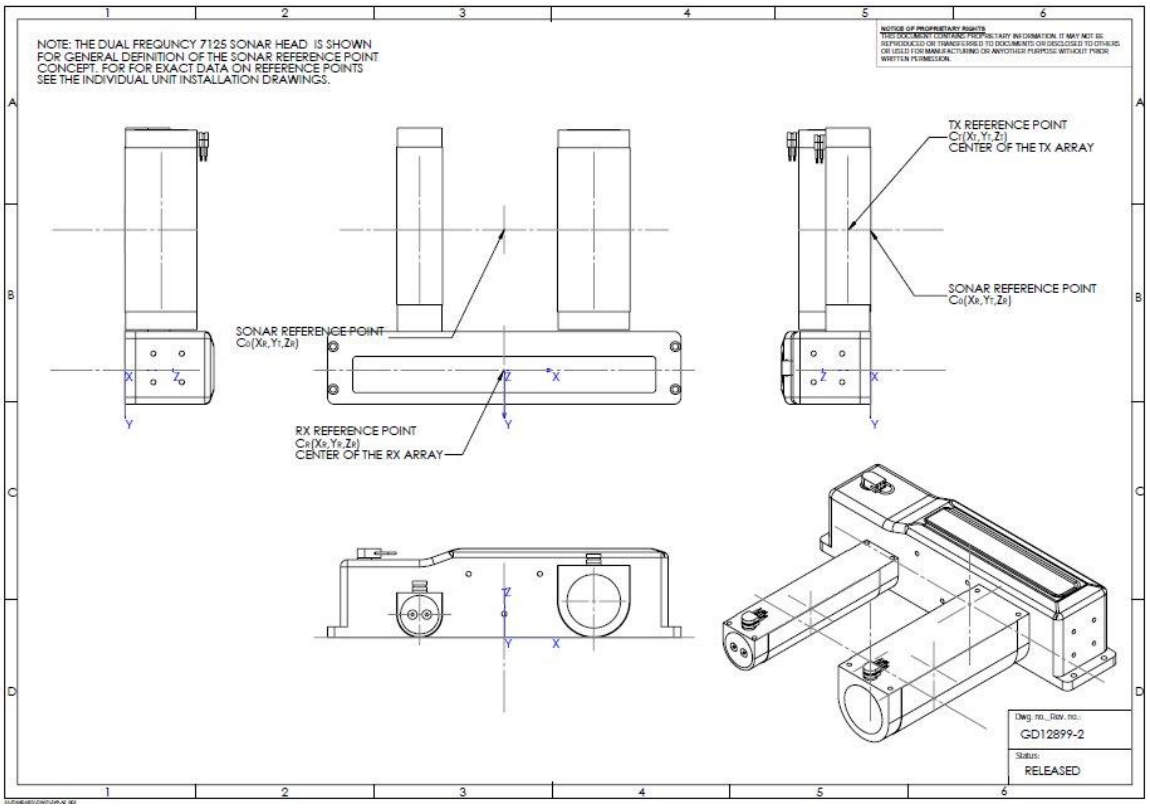
The receive steering angles are in the sonar reference frame and in that frame they represent the actual angle from the sonar reference point to the detection point. The steering applied for roll stabilization is included in the angle. This means that data processing software can use their ‘standard’ methods to convert the information to the vessel reference frame and subsequently to world coordinates. With standard methods referring to the handling of other RESON SeaBat systems outputting non roll stabilized data.

Beam uncertainty

This value is a real-time uncertainty and available per beam. These values can be used to feed into an error model instead of the a-priori error values typically used to compute a TPE. Will be available in MR7.2 release.

TX OFFSET CORRECTION

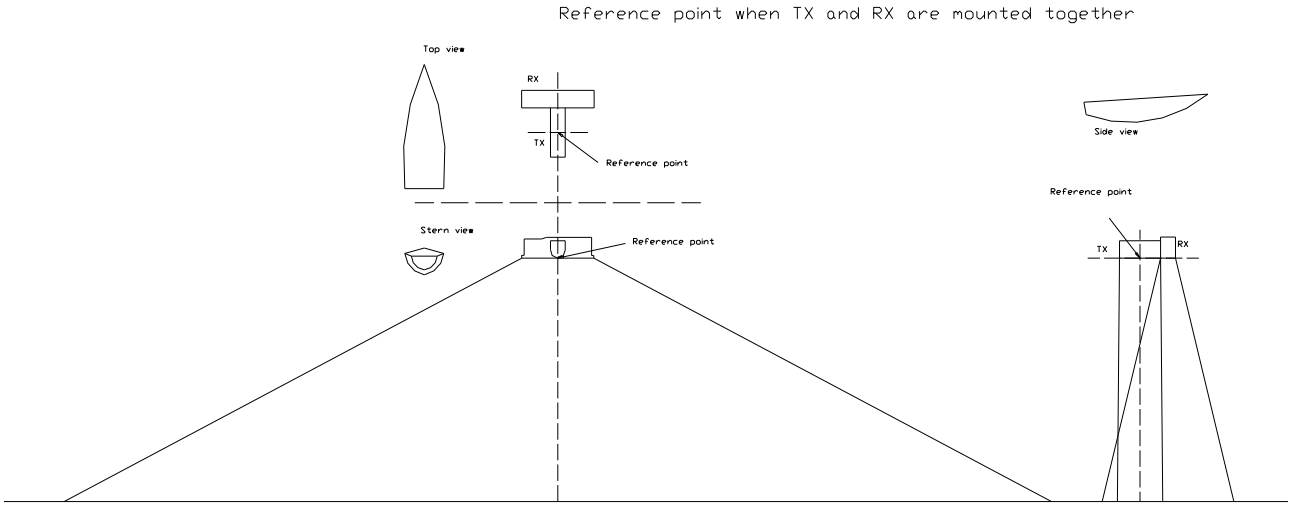
The sonar reference point is used to define the coordinate system to which sonar data is referred. The Sonar Reference Point X&Z coordinates are the same as the X&Z coordinates of the sonar receiver head reference point. The Y coordinate of the reference point is the same as the Y coordinate of the Tx array reference point. Thus the coordinates of the reference point of the sonar are C0(XR,YT,ZR).



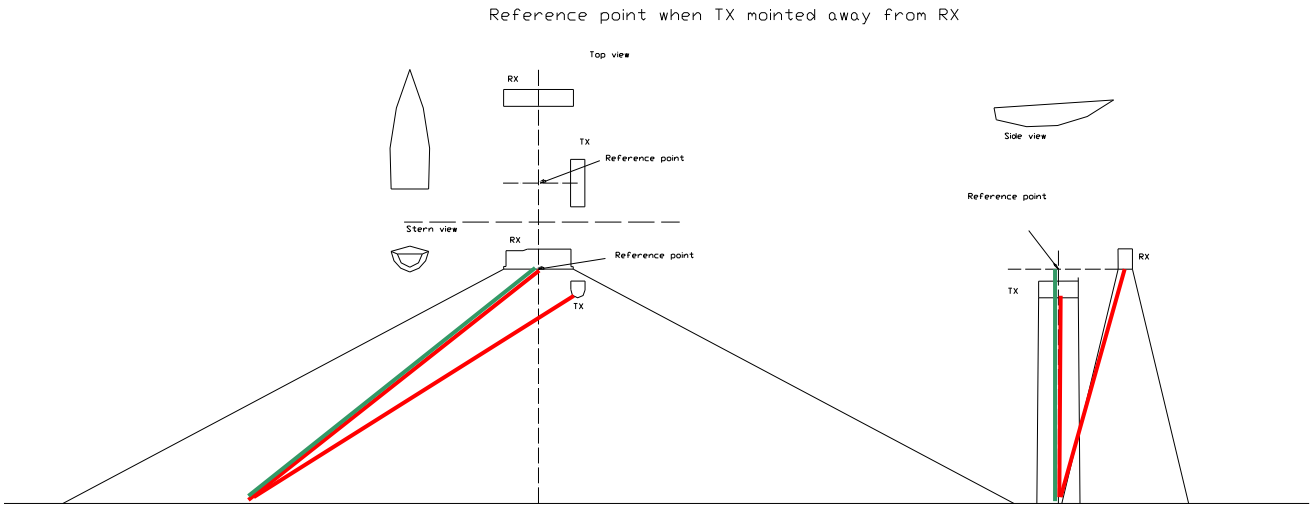
The Tx offset is defined as the separation of the projector (Tx) reference point from the receiver (Rx) reference point.

The Tx offset information is available from the sonar in a separate record (7503)

The along ship reference point (Y) of the sonar is determined by the Transmitter since this one illuminated the seafloor at the moment of the ping with a narrow across stripe of sound. The across (X) and height (Z) reference point is determined by the receiver because this one forms the narrow beam in a predetermined direction.



When we have a transducer configuration with separation between the RX and TX (bi-static configuration) we need to adjust the observed two-way travel time to the sonar reference point.

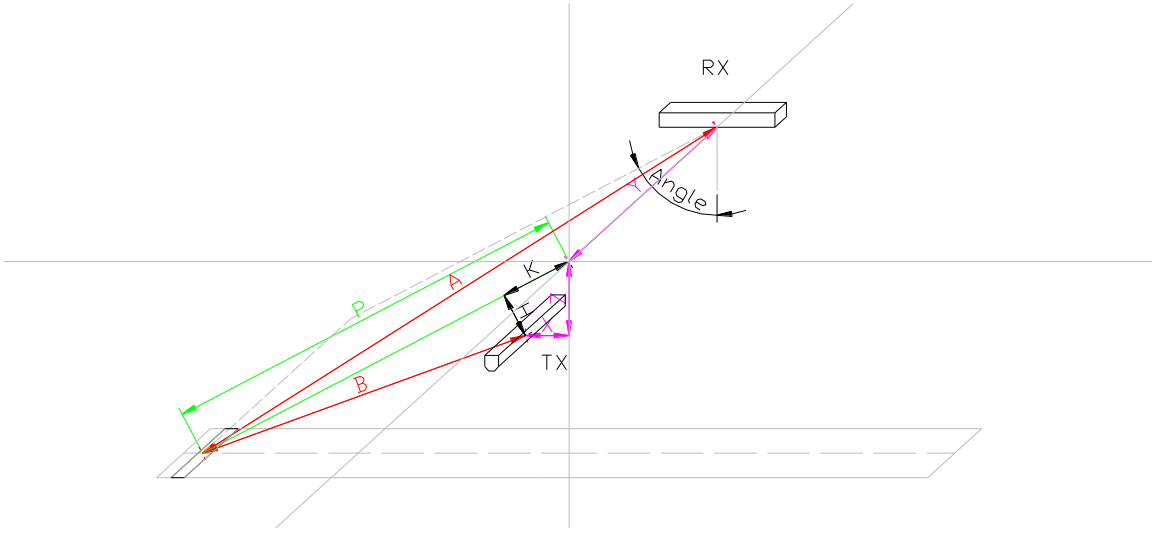


Red line: acoustic path of observation.

Green line: Reported two-way travel and beams angle relative reference point.

In the Teledyne PDS software the implementation of the Tx-offset correction is according the steps below.

- The Tx offset value is converted from sonar reference frame to vessel reference frame. Heave at transmit time is added.
- An Rx offset point in vessel reference frame is created using heave at receive time.
- From these two offset points a vector is created and split in a component in beam direction and a component perpendicular to the beam direction.
- An iteration method is used to compute a correction factor that is applied to the beam range (and two travel time).
- The iteration is illustrated in the diagram below



The algorithm description is based on range, and not two-way travel time.

Variable name	Description
X	X Offset of TX relative RX, positive when TX starboard of RX
Y	Y Offset of TX relative RX, positive when TX forward of RX
Z	Z Offset of TX relative RX, positive when TX above RX
Angle	Measured beam angle = 180 – 7K beam angle
R	Observed range (A+B)/2
A	RX to detection point
B	TX to detection point
K	Longitudinal offset of TX in beam direction relative ref.
H	Perpendicular offset of TX to beam
P	Corrected range

We want to compute the corrected range (P)

H = X*cos(angle)+Z*sin(angle)

K = X*sin(angle)-Z*cos(angle)

$\sqrt{(P^2 + Y^2)} + \sqrt{((P-K)^2 + H^2)} – 2*R = 0$

Since there is no direct solution to this equation we solve it with iteration.

The iteration will be started with best estimate

R = two-way travel time * Speed of sound / 2;

P=R

Only do the iteration when $\sqrt{(X^2+Y^2+Z^2)} < P$

D=0

Do

{

P = P-D/2

$$D = \sqrt{(P^2 + Y^2)} + \sqrt{((P-K)^2 + H^2)} - 2*R$$

}

While(|D| > 0.005)

Hereafter P will be the corrected range.

Corrected Two-way travel = P*2 / Speed of sound;

USING THE OPTIONAL DATA FROM 7027

The Optional data section of 7027 is the same as the optional data section of the 7006 record. The only difference being is that now only the valid beams are given.

The optional data is used in the CARIS version in use by Ifremer

The optional data is fully corrected for motion, sound velocity and Tx-offset. No additional corrections need to be applied to this data.

USING THE 'OLD' RECORDS WITH MR7

With the MR7 there is backwards compatibility for the 7006 bathymetry record. Third party software processing working according to SeaBat 7k DFD Version 0.54 will still be able to obtain that record.

Please be aware of the following:

- In case of roll stabilization it is not possible then to obtain the beam steering angles in the sonar reference frame. So the processing software should not perform a roll correction in that case. In situations where there is a sonar-IMU alignment error it will not be possible then to compensate for pitch induced roll.
- The Tx-offset correction also requires the beam steering angle in the sonar reference frame. The closest approximation is this situation is to apply the actual roll value to the beam angle based on the assumption that the sonar and the processing software work with the same roll values.

APPENDIX G WAKE ON LAN (WOL)

With wake on LAN (WOL), it is possible to switch on a remote computer by means of a special network package transmitted over a LAN network connection (not wireless). This package is known as ‘magic packet’.

The magic package consists of 102 bytes. It starts with 6 bytes of HEX 255 (FF FF FF FF FF FF) follows by 16 times the 48-bit MAC address of the remote computer.

The magic packet must be broadcasted.

The remote computer can be switched off; however, the network card should be ‘alive’ in order to wake up the computer.

Refer to external sources for more information about WOL such as Wikepedia. (http://en.wikipedia.org/wiki/Wake-on-LAN)

APPENDIX H DATA TRANSFORMATIONS (BLUEVIEW)

The Pan/Tilt base coordinate system, is the system that is used to report pan and tilt angles in record 5836. It is standardized on a right-handed coordinate system with a well-defined origin for this streaming spec. and for the pan/tilt SDK going forward.

Beam angles and detection ranges reported in the Multibeam Configuration record (7004) and the Bathymetric record (7006), respectively, are reported with respect to a two-dimensional polar axis system (i.e., R-Theta) fixed to the sonar head acoustic center. This axis system moves in space based on pan and tilt angle, vessel/tripod position and motion, sonar mounting configuration, and pan/tilt unit mounting configuration. The orientation contained in the PanTilt Configuration record and PanTilt Position record provides sufficient information to compute a function that maps a detection (beam angle and range) to a 3-dimensional point in an axis system fixed to the base of the pan/tilt unit. Once the transform function is produced, each detection may be mapped by a simple substitution of the detection's range and bearing into the function.

This section describes how to populate the function coefficients and arguments based on the values in the Pan/Tilt Configuration record and Pan/Tilt Position record. Note that the PanTilt Configuration record data entries are static throughout an entire scan, while the PanTilt Position record entries generally change per ping.

The following diagrams show the unit's base coordinate system and definition of lever arm offsets. In Figure 12-1, the sonar is oriented such that the Pan and Tilt positions would each be reported as 0° in the Pan/Tilt Position record

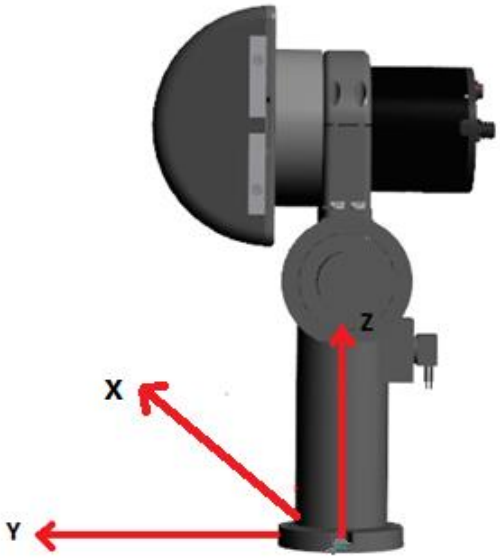


Figure 12-1: Pan/Tilt Unit Axes

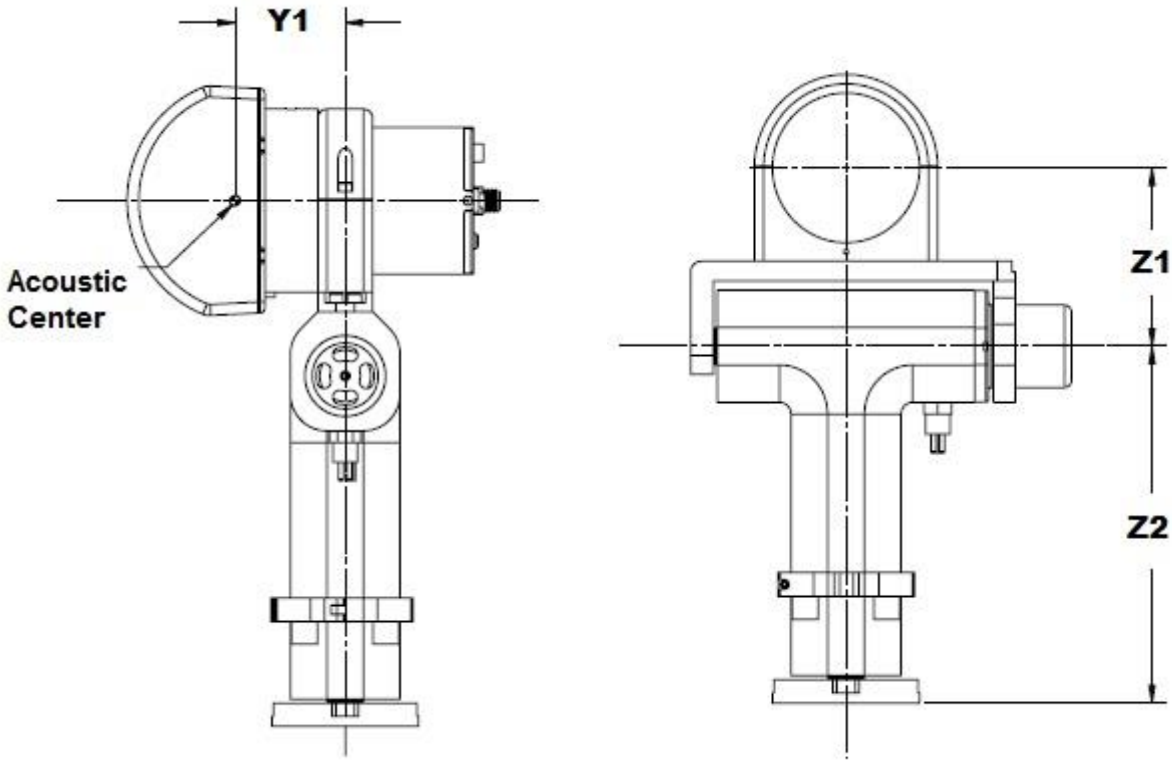


Figure 12-2: Pan/Tilt Offsets

NOTATION AND CONVENTIONS

The following table provides the notation and record data field names for all symbols in the output vector described below. All rotational axes have right-handed sign conventions with respect to the corresponding Pan/Tilt Base coordinate axes.

Table 194: Parameter Notation

Symbol	Description	Record ID	Record Field Name	Static/Dynamic over course of scan
c(·)	cosine	N/A	N/A	N/A
s(·)	sine	N/A	N/A	N/A
ϕ	Sonar head roll angle (typically 0° or 180°),	5835	Head Roll Orientation	Static
ψ_p	Pan angle	5836	Pan Position	Dynamic
ψ_t	Tilt angle	5836	Tilt Position	Dynamic
z_1	Length of tilt axis lever arm (see Figure 12-2)	5835	Tilt Elbow Offset	Static
z_2	Length from pan/tilt base to tilt axis (see Figure 12-2)	5835	Tilt Axis Offset	Static
y_1	Length of pan axis lever arm (see Figure 12-2)	5835	Pan Arm Offset	Static
r_i	Range to detection for beam *i*	7006	Range[i]	Dynamic
θ_i	Bearing to detection for beam *i*	7004	Beam Bearing Angle[i]	Static

DETECTION TRANSFORMATION EQUATION

The following equation provides a detection point in pan/tilt XYZ coordinates based on the static and dynamic geometric parameters provided in Table 194. The XYZ coordinate system is shown in Figure 12-1.

$$\begin{bmatrix} x_i \\ y_i \\ z_i \end{bmatrix} = \begin{bmatrix} c(\psi_t)s(\psi_p)(-r_i c(\theta_i) - y_1) + z_1 s(\psi_p)s(\psi_t) - r_i s(\theta_i)\big(s(\phi)s(\psi_p)s(\psi_t) - s(\phi)c(\psi_p)\big) \\ c(\psi_t)c(\psi_p)(r_i c(\theta_i) + y_1) - z_1 c(\psi_p)s(\psi_t) - r_i s(\theta_i)\big(c(\phi)c(\psi_p)s(\psi_t) - s(\phi)s(\psi_p)\big) \\ r_i(c(\theta_i)s(\psi_t) - c(\psi_t)c(\phi)s(\theta_i)) + z_1 c(\psi_t) + y_1 s(\psi_t) + z_2 \end{bmatrix}$$

Derivation details for the equation above are provided in the whitepaper *BlueView Pan/Tilt Kinematics*, which is available upon request.

COMPUTATIONAL EFFICIENCY

The vector equation above must be computed once for each detection in each ping, which quickly becomes a computational burden for systems with high ping rates and/or many detections per ping. Some simple optimizations can help computational efficiency to great effect. It is suggested that trigonometric functions of dynamic values are computed just once per sonar ping and cached as local variables since they each arise multiple times in the vector function. Similarly, multiplicative combinations appearing in many of the terms can be precomputed per ping for computational efficiency. Of course, the equation is executed in a loop over the entire set of detection ranges for a given ping, so it is a prime candidate for vectorization operations via a single-instruction-multiple-data (SIMD) coprocessor or similar parallelizing processor (e.g., GPU acceleration). Some combination of these types of optimization should allow real-time conversion capabilities on any modern hardware.

GEOREFERENCING DATA

Note that the transformation provided in the previous section places a detection point in a coordinate system fixed to the base of the pan/tilt unit. To georeference the detections, further transformation(s) are required, which take account of additional static and dynamic offsets, such as pan/tilt unit base axis offsets in the vessel coordinate system, vessel dynamic position, flexible mount points, etc. These additional transformations and any associated parameters are not provided by ProScan's network interface and are the responsibility of client applications.