SEA BEAM 2100
Multibeam Bathymetric
Survey Mapping System

External Interface Specifications

communications
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Revision H

Notice

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Warning

The SEA BEAM 2100 must be used only in accordance with the instructions contained in this document. Any other use could result in injury to the operator or others, and could cause damage to the system or vessel.

Table of Contents

1. Introduction to the Document

1.1. Overview of the Document

This document defines the baseline external inputs and outputs for the SEA BEAM 2100. Section 2.0 provides system AC power requirements. Section 3.0 presents various data outputs from the sonar system in table form. Section 4.0 provides tables on the format of the surface sound velocity, navigation, sound velocity profile, and VRU input. Section 5.0 provides a table on the timing interface to the sonar system. Section 6.0 discusses the signals used for synchronizing the SEA BEAM 2100 to other sonar systems.

1.2. About the Record Formats

The record formats in this document are specified using tables. All tables are comprised of the elements described below.

Item

The name of the field whose format is being specified, or the name given to a group of fields.

Units

The unit of measurement for the field.

Valid Range

The allowable content of the field; the range of allowable values. For a range, the minimum and maximum values are separated by a hyphen. For multiple single values, the values are separated by a comma. Literal values appear as they are expected. Entries in brackets are not literals, but commonly understood representations of a value, such as [LF] for line feed.

of Bytes

The number of bytes for the field.

Byte Offset

The first position for the field in the record, starting from the zero position for the record.

Coding

The data type for the field, either ASCII or binary.

Notes

Explanatory notes or additional specifications where needed.

Other Notes

Some notes in the table are referenced by number, e.g. (1) . The note itself is located immediately following the table.

1.3. Document History

The following table summarizes the changes made to this document.

Table 1-1: Document History

Rev.	Date	Changes
H	August 1999	• Added ship speed to Sub-Bottom Data Record • Added NMEA navigation input options • Added Applied Microsystems surface sound velocity input option • Clarified timing of 1PPS pulse and time message for external time input
G	October 1998	• Added carriage return/line feed to the end of the Vertical Depth message and documented that the message is sent both as a TCP/IP and a broadcast message • Added description of "waiting for ping" message that accompanies the Vertical Depth message • Added notation for Apparent Depth to Bathymetry record • Changed TSS model DMS-05 message format table • Merged all sections from all External Interface Specifications into a single document (henceforth, a list will be created for each ship, showing which parts of the new External Interface Specification apply to it)
F	September 1997	• Added AC Input Power Requirements section (Section 2) and changed the numbering of Sections 2 through 5 to Sections 3 through 6 • Updated text in Data Inputs introduction (Section 3), and moved the table in that section to Navigation Data Record (Section 4.2) • Added Vertical Depth Data Record section to Data Outputs (Section 3.6) • Updated Sound Velocity Data Record section (Section 4.1) • Added Surface Velocity Profile Data Record section (Section 4.3) • Added VRU Data Record section (Section 4.4) • Added Note (2) to Table 4-4 (Navigation Data Record)
E	June 1997	• Added information to Section 2.5 (Sub-Bottom Data Record)
D	October 1996	• Made formatting changes
C	February 1996	• Added Notes (2) and (3) to Table 2-3 • Added Note (2) to Table 2-4 • Added Note (1) to Table 3-3 • Modified the introductory text in Section 4 • Changed the baud rate and data bits values in Table 4-1 • Replaced Table 4-2 with a new table, notes, and example time message

Rev.	Date	Changes
B	May 1995	• Added ship's draft to sonar parameter record • Added range scale to sidescan record • Added decimeter scale to bathymetry and sidescan data • Added description of sonar key output • Changed timing in sonar synchronization signals • Clarified items in data outputs, data inputs, and sonar synchronization • Removed resolution column from all tables • Added and clarified examples in tables • Revised Notice page • New table formats with additional information • Aesthetic changes • Other content changes
A	July 1994	-

Notes:

2. AC Input Power Requirements

SEA BEAM 2112/2136/2112.360	
Voltage	117 V ±10%, 50 or 60 Hz ±3 Hz (110 or 220 V ±10% optional)
Current	35 A (20 A @ 220 V)

SEA BEAM Sub-Bottom Profiler	
Voltage	117 V ±10%, 50 or 60 Hz ±3 Hz (110 or 220 V ±10% optional)
Current	30 A (15 A @ 220 V)

Notes:

3. Data Outputs

Host data outputs are logged internally in TAR format to 8 mm tape, and are supplied over Ethernet using the TCP/IP socket protocol. The following conventions apply to all data in all data output records.

- All coding is in ASCII unless otherwise noted.
- All ASCII signed numeric quantities use "+" and "–" sign prefixes unless otherwise noted.
- All numeric fields are padded with leading 0's as necessary to fill the field.

3.1. Sonar Parameter Data Record

The sonar parameter record is sent over the data output channel. It provides a record of changes in the sound velocity profile (SVP), and provides a record of the roll and pitch bias. It is sent under the following conditions:

- At the start of data logging
- At the end of data logging
- Every 30 minutes
- When the SVP, roll bias, or pitch bias has changed

Table 3-1: Sonar Parameter Data Record

Item	Units	Valid Range	# of Bytes	Byte Offset	Cod-ing	Notes
Record Identifier						
Parameter record		SB2100PR	8	0	ASCII	
End of identifier		[CR][LF]	2	8	ASCII	
Record Header						
Year	years		4	10	ASCII	
Day	days	001 - 366	3	14	ASCII	day of year
Hour	hours	00 - 23	2	17	ASCII	
Minute	minutes	00 - 59	2	19	ASCII	
Milliseconds	milliseconds	00000 - 59999	5	21	ASCII	
Roll bias	thousandths of degrees	–05000 - +05000	6	26	ASCII	signed: + is port up; e.g., +04999 means +4.999°
Pitch bias	thousandths of degrees	–05000 - +05000	6	32	ASCII	signed: + is stern up; e.g., +04999 means +4.999°
Number of points in SVP		02 - 30	2	38	ASCII	

Item	Units	Valid Range	# of Bytes	Byte Offset	Cod-ing	Notes
Ship's draft	cm	0000000 - 0001000	7	40	ASCII	e.g. 0000999 means 9.99 m.
End of header		[CR][LF]	2	47	ASCII	
Per SVP Point - repeated for each point						
Depth	cm		7	49 (1)	ASCII	e.g. 0999999 means 9999.99 m.
Velocity	cm/sec.		6	56 (1)	ASCII	e.g. 149999 means 1499.99 m./sec.
End of point		[CR][LF]	2	62 (1)	ASCII	
End of Repeated Block						

Notes

(1) The byte offset shown is for the first sound velocity data set. Add 15 to the byte offset value for each successive data set.

3.2. Sonar Text Data Record

The sonar text record is sent when the operator enters text as commentary at the console. It is sent over the data output channel. The operator text is limited to 1920 characters. The format of the text is preserved.

Table 3-2: Sonar Text Data Record

Item	Units	Valid Range	# of Bytes	Byte Offset	Cod-ing	Notes
Record Identifier						
Text record		SB2100TR	8	0	ASCII	
End of identifier		[CR][LF]	2	8	ASCII	
Text Contents						
Year	years		4	10	ASCII	
Day	days	001 - 366	3	14	ASCII	day of year
Hour	hours	00 - 23	2	17	ASCII	
Minute	minutes	00 - 59	2	19	ASCII	
Milliseconds	milli-seconds	00000 - 59999	5	21	ASCII	
Text			variable	26	ASCII	maximum length = 1920 bytes
Message end		EOM	3	variable	ASCII	
End of record		[CR][LF]	2	variable	ASCII	

3.3. Bathymetry Data Record

The bathymetry data record is the primary system output. It contains per beam depth and crosstrack, and supporting data for every ping. Every beam is included, with missing beam records containing zeros. The record has two parts. The header contains all supporting data and is followed by the per beam data. The header and each beam are followed by both [CR] and [LF]. The entire record is in ASCII. It is transmitted via the data output channel.

Table 3-3: Bathymetry Data Record

Item	Units	Valid Range	# of Bytes	Byte Offset	Cod-ing	Notes
Record Identifier						
Data record		SB2100DR	8	0	ASCII	
End of identifier		[CR][LF]	2	8	ASCII	
Record Header						
Year	years		4	10	ASCII	
Day	days	001 - 366	3	14	ASCII	day of year
Hour	hours	00 - 23	2	17	ASCII	
Minute	minutes	00 - 59	2	19	ASCII	
Milliseconds	milliseconds	00000 - 59999	5	21	ASCII	
Latitude at ping (2)						
Hemisphere		N, S	1	26	ASCII	
Degrees	degrees	00 - 90	2	27	ASCII	
Minutes	minutes	00 - 59	2	29	ASCII	
Fraction of minute	ten-thousandths of minutes	0000 - 9999	4	31	ASCII	e.g. 9999 means .9999 min.
Longitude at Ping (2)						
Hemisphere		E, W	1	35	ASCII	
Degrees	degrees	000 - 180	3	36	ASCII	
Minutes	minutes	00 - 59	2	39	ASCII	
Fraction of minute	ten-thousandths of minutes	0000 - 9999	4	41	ASCII	e.g. 9999 means .9999 min.
Speed (2)	thousandths of knots	–999999 - +999999	7	45	ASCII	signed e.g. +0099999 means +9.999 knots
Number of beams		0001 - 0151	4	52	ASCII	total number of sounding fields for this record

Item	Units	Valid Range	# of Bytes	Byte Offset	Cod-ing	Notes
SVP correction		0, T, A	1	56	ASCII	0 = none T = true depth, true position A = apparent depth, true position
Frequency	kHz	LL, HH	2	57	ASCII	LL = 12 kHz HH = 36 kHz
Heave at ping	mm	–10000 - +10000	6	59	ASCII	signed: + is above mean level e.g. +09999 means +9.999 m.
Spare		[space]	2	65	ASCII	
Range scale		D, I, S	1	67	ASCII	D = meters I = decimeters S = centimeters
Surface sound velocity	cm/sec.	143500 - 156500	6	68	ASCII	e.g. 156499 means 1564.99 m./sec.
SSV source		V, M, T, E, U	1	74	ASCII	V = velocimeter M = manual T = temperature E = external U = unknown
Depth gate mode		A, M	1	75	ASCII	A = auto M = manual
Ping gain	dB	00 - 45	2	76	ASCII	
Ping pulse width	milliseconds	01 - 20	2	78	ASCII	
Transmitter attenuation	dB	00 - 18	2	80	ASCII	
Pitch at ping	thousandths of degrees	–10000 - +10000	6	82	ASCII	signed: + is stern up e.g. +09999 means +9.999°
Roll at ping	thousandths of degrees	–45000 - +45000	6	88	ASCII	signed: + is port up e.g. +44999 means +44.999°
Heading at ping (2)	thousandths of degrees	000000 - 359999	6	94	ASCII	e.g. 359999 means 359.999°
Number of algorithms		1 - 4	1	100	ASCII	number of algorithms per beam

Item	Units	Valid Range	# of Bytes	Byte Offset	Cod-ing	Notes
Algorithm order		[space], W, B	4	101	ASCII	if number of algorithms per beam = 1, field is a space W = WMT B = BDI currently undefined fields are for future expansion
End of header		[CR][LF]	2	105	ASCII	
Per Beam Data - repeated for each beam						
Data source		W, B	1	107 (1)	ASCII	W = WMT B = BDI
Range	msec	00000 - 99999	5	108 (1)	ASCII	raw round trip echo time
Angle from vertical	thousandths of degrees	–99999 - +99999	6	113 (1)	ASCII	e.g. +59999 means +59.999° signed: see Figure 3-1 and Figure 3-2 for meaning of signs
Angle forward	hundredths of degrees	–9999 - +9999	5	119 (1)	ASCII	e.g. +5999 means +59.99° signed: see Figure 3-1 and Figure 3-2 for meaning of signs
Depth	m., dm, or cm *	00000 - 99999	5	124 (1)	ASCII	* depends on range scale
Crosstrack	m., dm, or cm *	–99999 - +99999	6	129 (1)	ASCII	* depends on range scale signed: + is starboard
Along-track	m., dm, or cm *	–99999 - +99999	6	135 (1)	ASCII	* depends on range scale signed: + is forward
Signal amplitude	quarters of dB	000 - 400	3	141 (1)	ASCII	e.g. 400 means 100 dB
Signal to noise ratio	dB	00 - 99	2	144 (1)	ASCII	
Echo length		000 - 999	3	146 (1)	ASCII	number of samples
Signal quality		0, Q, [space]	1	149 (1)	ASCII	0 = no data (3) Q = poor quality a space otherwise
End of beam		[CR][LF]	2	150 (1)	ASCII	

Item	Units	Valid Range	# of Bytes	Byte Offset	Cod-ing	Notes
End of Repeated Block						

Notes

(1) The byte offset shown is for the first beam data set. Add 45 to the byte offset value for each successive data set.

(2) If navigation input is missing or corrupt, latitude at ping, longitude at ping, speed, and heading at ping are all set to 0 (ASCII '0's in all data characters).

(3) If signal quality = 0 (no data) on a beam, all data for that beam from data source to echo length inclusive are set to ASCII SPACE characters (20 hexadecimal).

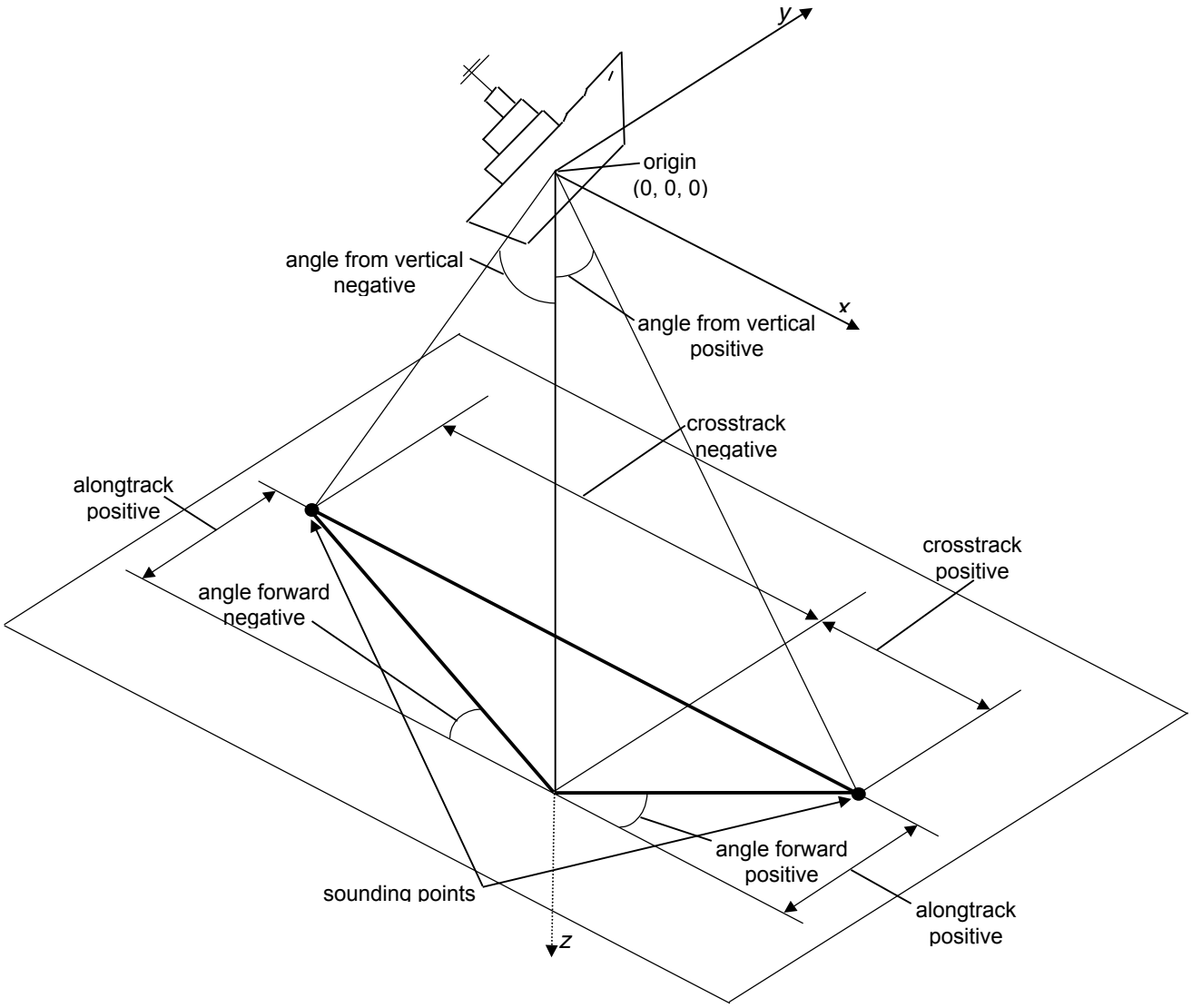

Figure 3-1: Signs for Bathymetry Record for Bow Up Position of Ship

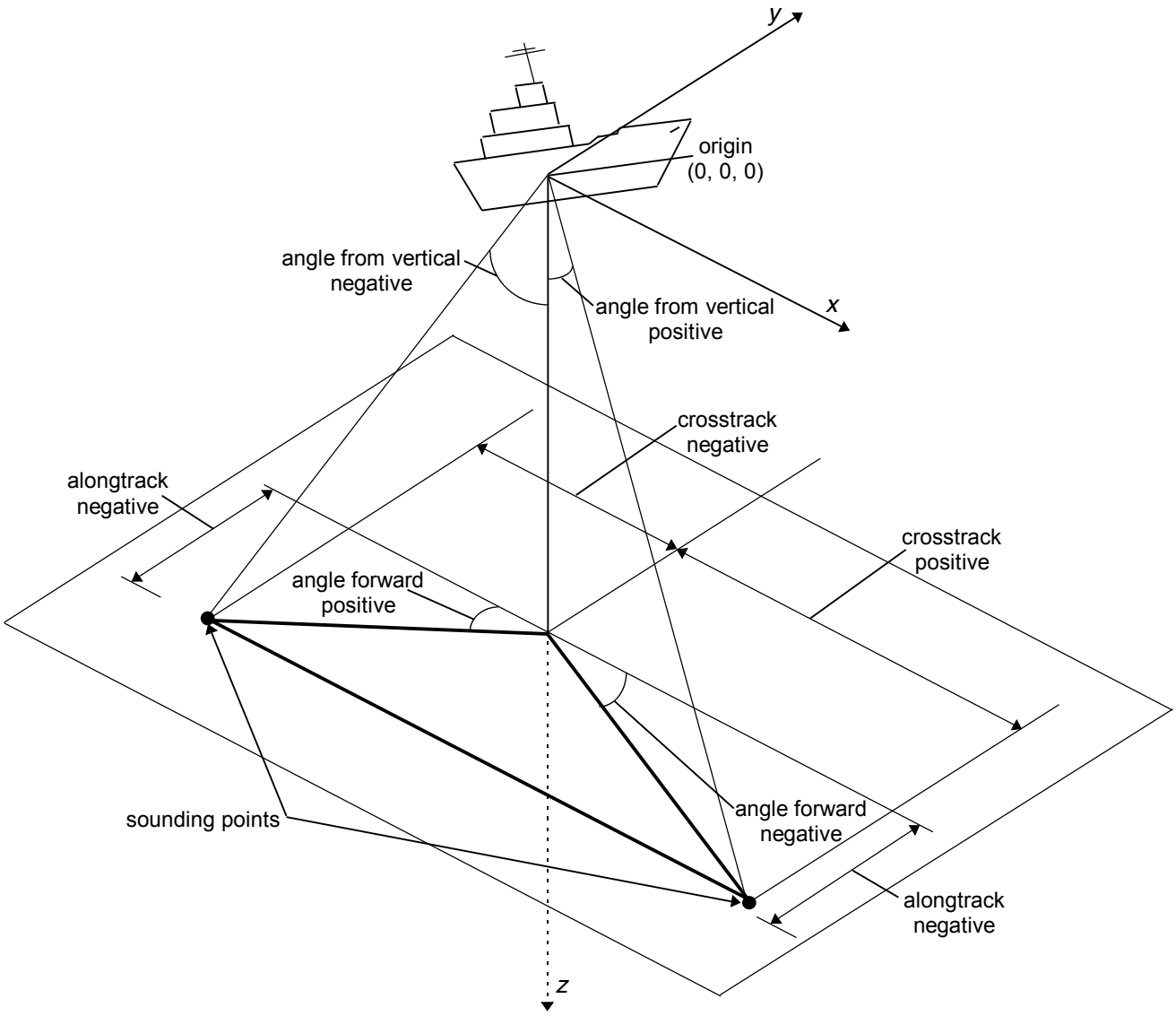

Figure 3-2: Signs for Bathymetry Record for Stern Up Position of the Ship

3.4. Sidescan Data Record

Sidescan output describes reflected intensity versus crosstrack. The sidescan record has two parts: the header contains all supporting data and is followed by the sidescan data. The header replicates some information in the bathymetry data record, allowing the two to be used independently. It is transmitted via the data output channel.

The sidescan record is in binary format and contains two streams for each pixel: amplitudes, and the along-track offset from the true vertical caused by the pitching motion of the ship. The length of each stream is equal to the number of pixels. Ship's vertical is at the center of the pixel array, and the across-track position of each pixel can be determined as

$$x = p\,[c - (N + 1)/2]$$

where p is the pixel size, and c equals the pixel number varying between 1 (port-most) and N (starboard-most).

Table 3-4: Sidescan Data Record

Item	Units	Valid Range	# of Bytes	Byte Offset	Cod-ing	Notes
Record Identifier						
Data record		SB2100SS	8	0		
End of identifier		[CR][LF]	2	8	ASCII	
Record Header						
Year	years		4	10	ASCII	
Day	days	001 - 366	3	14	ASCII	day of year
Hour	hours	00 - 23	2	17	ASCII	
Minute	minutes	00 - 59	2	19	ASCII	
Milliseconds	milliseconds	00000 - 59999	5	21	ASCII	
Latitude at ping (2)						
Hemisphere		N, S	1	26	ASCII	
Degrees	degrees	00 - 90	2	27	ASCII	
Minutes	minutes	00 - 59	2	29	ASCII	
Fraction of minute	ten-thousandths of minutes	0000 - 9999	4	31	ASCII	e.g. 9999 means .9999 min.
Longitude at ping (2)						
Hemisphere		E, W	1	35	ASCII	
Degrees	degrees	000 - 180	3	36	ASCII	
Minutes	minutes	00 - 59	2	39	ASCII	
Fraction of minute	ten-thousandths of minutes	0000 - 9999	4	41	ASCII	e.g. 9999 means .9999 min.

Item	Units	Valid Range	# of Bytes	Byte Offset	Cod-ing	Notes
Speed [2]	thousandths of knots	–999999 - +999999	7	45	ASCII	signed: e.g. +009999 means +9.999 knots
Record length	bytes		4	52	ASCII	total bytes of pixel data
SVP correction		0, T	1	56	ASCII	0 = none T = true depth, true position
Frequency	kHz	LL, HH	2	57	ASCII	LL = 12 kHz HH = 36 kHz
Heave at ping	mm	–10000 - +10000	6	59	ASCII	signed: + is above mean level e.g. +09999 means +9.999 m.
Range scale		D, I, S	1	65	ASCII	D = meters I = decimeters S = centimeters
Spare		[space]	1	66	ASCII	
Pixel size scale		D	1	67	ASCII	D = meters
Pixel intensity algorithm		D, L	1	68	ASCII	D = logarithm L = linear
Surface sound velocity	cm/sec.	143500 - 156500	6	69	ASCII	e.g. 156499 means 1564.99 m./sec.
SSV source		V, M, T, E, U	1	75	ASCII	V = velocimeter M = manual T = temperature E = external U = unknown
Depth gate mode		A, M	1	76	ASCII	A = auto M = manual
Number of pixels			4	77	ASCII	
Pixel size	m.	.125 to 20.0	4	81	ASCII	decimal point is included in field; e.g. .125 means .125 m.; 20.0 means 20 m.
Ping gain	dB	00 - 45	2	85	ASCII	
Ping pulse width	msec	01 - 20	2	87	ASCII	
Transmitter attenuation	dB	00 - 18	2	89	ASCII	
Pitch at ping	thousandths of degrees	–10000 - +10000	6	91	ASCII	signed: + is stern up e.g. +09999 means +9.999°

Item	Units	Valid Range	# of Bytes	Byte Offset	Cod-ing	Notes
Roll at ping	thousandths of degrees	–45000 - +45000	6	97	ASCII	signed: + is port up e.g. +44999 means +44.999°
Heading at ping (2)	thousandths of degrees	000000 - 359999	6	103	ASCII	e.g. 359999 means 359.999°
End of header		[CR][LF]	2	109	ASCII	
Per Pixel Data - repeated for each pixel						
Amplitude		0 - 65535	2	111 (1)	binary	unsigned integer
Along-track	m., dm, or cm *		2	113 (1)	binary	signed: + is forward * depends on range scale
End of Repeated Block						
End of record		[CR][LF]	2	variable	ASCII	

Notes

(1) The byte offset shown is for the first pixel. Add 4 to the byte offset value for each successive pixel.

(2) If navigation input is missing or corrupt, latitude at ping, longitude at ping, speed, and heading at ping are all set to 0 (ASCII '0's in all data characters).

3.5. Sub-Bottom Data Record

The identification and data records are the primary 4 kHz output. Their format follows the seismic SEG-Y standard for post-processing purposes. There is an identification header followed by a data record for each ping. Each data record consists of a trace identification header followed by sample data (one per time slice). All records are written to tape.

The tables in this section span two facing pages. (The "SEG-Y Description" column is repeated on each page.)

Table 3-5: Identification Header

SEG Y Description	Item Used by SBP	Units	Valid Range
Record 1			
Description of data	Identifier		SEA BEAM 2112.004
	User identifier		
Record 2			
Job identification number			0
Line number			0
Reel number	File number		$1 - 2^{31}$
Number of data traces per record	Trace per ping		1
Number of auxiliary traces per record			0
Sample interval (for this tape)	Sample interval	μsec	50
Sample interval (original data)	Sample interval	μsec	50
Number of samples per data trace (for this tape)			0
Number of samples per data trace (original data)			0
Data sample format code	Data type		6
CDP fold			0
Trace sorting code	Trace code		3
Vertical sum code	Sum code		1
Sweep frequency at start			0
Sweep frequency at end			0
Sweep length			0
Sweep type code			0

SEG Y Description	Item Used by SBP	Units	Valid Range
Trace number of sweep			0
Sweep trace taper length at start			0
Sweep trace taper length at end			0
Taper type			0
Correlated data traces			0
Binary gain recovered			0
Amplitude recovery method			0
Measurement system			0
Impulse signal polarity			0
Vibratory polarity code			0
Unassigned			0

SEG Y Description	# of Bytes	Byte Offset	Cod-ing	Notes
Record 1				
Description of data	17	0	ASCII	
	3183	16	ASCII	entered by user (future)
Record 2				
Job identification number	4	0	Binary	
Line number	4	4	Binary	
Reel number	4	8	Binary	
Number of data traces per record	2	12	Binary	
Number of auxiliary traces per record	2	14	Binary	
Sample interval (for this tape)	2	16	Binary	unsigned integer
Sample interval (original data)	2	18	Binary	unsigned integer
Number of samples per data trace (for this tape)	2	20	Binary	
Number of samples per data trace (original data)	2	22	Binary	
Data sample format code	2	24	Binary	IEEE floating point
CDP fold	2	26	Binary	
Trace sorting code	2	28	Binary	Single fold continuous profile
Vertical sum code	2	30	Binary	No sum
Sweep frequency at start	2	32	Binary	
Sweep frequency at end	2	34	Binary	
Sweep length	2	36	Binary	
Sweep type code	2	38	Binary	
Trace number of sweep	2	40	Binary	
Sweep trace taper length at start	2	42	Binary	
Sweep trace taper length at end	2	44	Binary	
Taper type	2	46	Binary	
Correlated data traces	2	48	Binary	
Binary gain recovered	2	50	Binary	
Amplitude recovery method	2	52	Binary	
Measurement system	2	54	Binary	
Impulse signal polarity	2	56	Binary	
Vibratory polarity code	2	58	Binary	
Unassigned	340	60	Binary	

Table 3-6: Data Record

SEG Y Description	Item Used by SBP	Units	Valid Range
Trace Identification Header			
Trace sequence number within line	Ping number		$1 - 2^{31}$
Trace sequence number within reel	Ping number		$1 - 2^{31}$
Original field record number	Ping number		$1 - 2^{31}$
Trace number within original field record	Trace number		1
Energy source point number	Ping number		$1 - 2^{31}$
CDP ensemble number			0
Trace number within CDP ensemble			0
Trace identification code	Ping code		1
Number of vertically summed traces			0
Number of horizontally stacked traces			0
Data use			0
Distance from source point to receiver group			0
Receiver group elevation	Neg. ship's draft	cm	–1000 - 0
Surface elevation at source			0
Source depth below surface	Ship's draft	cm	0 - 1000
Datum elevation at receiver group			0
Datum elevation at source			0
Water depth at source	Depth	m, dm, cm	1 - 99999
Water depth at group	Depth	m, dm, cm	1 - 99999
Scaler applied to elevations and depths	Range scale		1 or 10 or 100
Scaler to be applied to all coordinates	Coordinate scale		–100
Source coordinate - X	Longitude at ping	0.01 arc seconds	–64,800,000 to 64,800,000
Source coordinate - Y	Latitude at ping	0.01 arc seconds	–32,400,000 to 32,400,000

SEG Y Description	# of Bytes	Byte Offset	Cod-ing	Notes
Trace Identification Header				
Trace sequence number within line	4	0	Binary	unsigned
Trace sequence number within reel	4	4	Binary	unsigned
Original field record number	4	8	Binary	unsigned
Trace number within original field record	4	12	Binary	
Energy source point number	4	16	Binary	unsigned
CDP ensemble number	4	20	Binary	
Trace number within CDP ensemble	4	24	Binary	
Trace identification code	2	28	Binary	Seismic data
Number of vertically summed traces	2	30	Binary	
Number of horizontally stacked traces	2	32	Binary	
Data use	2	34	Binary	
Distance from source point to receiver group	4	36	Binary	
Receiver group elevation	4	40	Binary	e.g. – 999 means –9.99m
Surface elevation at source	4	44	Binary	
Source depth below surface	4	48	Binary	e.g. 999 means 9.99m
Datum elevation at receiver group	4	52	Binary	
Datum elevation at source	4	56	Binary	
Water depth at source	4	60	Binary	depends on range scale
Water depth at group	4	64	Binary	depends on range scale
Scaler applied to elevations and depths	2	68	Binary	specifies m, dm, or cm for depths
Scaler to be applied to all coordinates	2	70	Binary	0.01 arc seconds for latitude/longitude
Source coordinate - X	4	72	Binary	+ value indicates east of Greenwich meridian; – value indicates west
Source coordinate - Y	4	76	Binary	+ value indicates north of equator; – value indicates south

Table 3-6: Data Records *(continued)*

SEG Y Description	Item Used by SBP	Units	Valid Range
Group coordinate - X	Longitude at ping	0.01 arc seconds	–64,800,000 to 64,800,000
Group coordinate - Y	Latitude at ping	0.01 arc seconds	–32,400,000 to 32,400,000
Coordinate units	Latitude/longitude units		2
Weathering velocity			0
Subweathering velocity			0
Uphole time at source			0
Uphole time at group			0
Source static correction			0
Group static correction			0
Total static applied			0
Lag time A			0
Lag time B			0
Delay recording time	Time to first sample	msec	1 - 15000
Mute time - start			0
Mute time - end			0
Number of samples in this trace	Number of slices		1 - 4096
Sample interval for this trace	Sampling interval	μsec	50
Gain type of field instruments			0
Instrument gain constant	Receiver fixed gain	dB	24
Instrument initial gain	Receiver adjustable gain	dB	0 - 63
Correlated	Correlated		2
Sweep frequency at start	Frequency at start	Hz	2500 - 6500
Sweep frequency at end	Frequency at end	Hz	2500 - 6500
Sweep length	Sweep length	msec	5 - 100
Sweep type	Sweep type		1
Sweep trace taper length at start			0
Sweep trace taper length at end			0
Taper type			0
Alias filter frequency			0
Alias filter slope			0
Notch filter frequency			0
Notch filter slope			0

SEG Y Description	# of Bytes	Byte Offset	Cod-ing	Notes
Group coordinate - X	4	80	Binary	+ value indicates east of Greenwich meridian; – value indicates west
Group coordinate - Y	4	84	Binary	+ value indicates north of equator; – value indicates south
Coordinate units	2	88	Binary	seconds of arc
Weathering velocity	2	90	Binary	
Subweathering velocity	2	92	Binary	
Uphole time at source	2	94	Binary	
Uphole time at group	2	96	Binary	
Source static correction	2	98	Binary	
Group static correction	2	100	Binary	
Total static applied	2	102	Binary	
Lag time A	2	104	Binary	
Lag time B	2	106	Binary	
Delay recording time	2	108	Binary	
Mute time - start	2	110	Binary	
Mute time - end	2	112	Binary	
Number of samples in this trace	2	114	Binary	
Sample interval for this trace	2	116	Binary	
Gain type of field instruments	2	118	Binary	
Instrument gain constant	2	120	Binary	
Instrument initial gain	2	122	Binary	
Correlated	2	124	Binary	yes
Sweep frequency at start	2	126	Binary	
Sweep frequency at end	2	128	Binary	
Sweep length	2	130	Binary	
Sweep type	2	132	Binary	linear
Sweep trace taper length at start	2	134	Binary	
Sweep trace taper length at end	2	136	Binary	
Taper type	2	138	Binary	
Alias filter frequency	2	140	Binary	
Alias filter slope	2	142	Binary	
Notch filter frequency	2	144	Binary	
Notch filter slope	2	146	Binary	

Table 3-6: Data Records *(continued)*

SEG Y Description	Item Used by SBP	Units	Valid Range
Low cut frequency			0
High cut frequency			0
Low cut slope			0
High cut slope			0
Year data recorded	Year	years	1997 -
Day of year	Day	days	1 - 366
Hour of day	Hour	hours	0 - 23
Minute of hour	Minute	minutes	0 - 59
Second of minute	Second	seconds	0 - 59
Time basis code			0
Trace weighting factor			0
Geophone group number of roll switch position one			0
Geophone group number of trace number 1			0
Geophone group number of last trace			0
Gap size			0
Overtravel associated with taper			0
Unassigned	Fraction of second	msec	0 - 999
	Day of month		1 - 31
	Month		0 -11
	Heading	0.01 degrees	
	Pitch	0.01 degrees	
	Roll	0.01 degrees	
	Heave	cm	
	Transmitter attenuation	dB	-32 to 0
	Ship Speed	0.1 knots	
			0
Per sample data - repeated for each sample			
Sample	Time slice		≥ 0
End of repeated block			

SEG Y Description	# of Bytes	Byte Offset	Cod-ing	Notes
Low cut frequency	2	148	Binary	
High cut frequency	2	150	Binary	
Low cut slope	2	152	Binary	
High cut slope	2	154	Binary	
Year data recorded	2	156	Binary	
Day of year	2	158	Binary	
Hour of day	2	160	Binary	
Minute of hour	2	162	Binary	
Second of minute	2	164	Binary	
Time basis code	2	166	Binary	
Trace weighting factor	2	168	Binary	
Geophone group number of roll switch position one	2	170	Binary	
Geophone group number of trace number 1	2	172	Binary	
Geophone group number of last trace	2	174	Binary	
Gap size	2	176	Binary	
Overtravel associated with taper	2	178	Binary	
Unassigned	2	180	Binary	
	2	182	Binary	
	2	184	Binary	month since January
	2	186	Binary	
	2	188	Binary	+ is stern up
	2	190	Binary	+ is port up
	2	192	Binary	+ is above mean level
	2	194	Binary	
	2	196	Binary	
	42	198	Binary	
Per sample data - repeated for each sample				
Sample	4	240 (1)	IEEE 32 bit float	linear amplitude data from correlator output
End of repeated block				

Notes

(1) The byte offset shown is for the first sample data set. Add 4 to the byte offset value for each successive set data.

3.6. Vertical Depth Data Record

The vertical depth record is sent once per ping over the data output channel. It contains both true depth (corrected for sound velocity) and apparent depth (computed from round trip travel time assuming a 1500 meter per second sound velocity). The record also contains swath width and outer range gate information, for use by the SeaBeam Sonar Synchronizer.

This record is intended for immediate use by ancillary equipment, and is therefore output as quickly as possible, without delaying for digitally filtered heave compensation. It will generally be transmitted within two seconds from the end of the ping cycle for which it is valid. Although this record is not intended for data logging, the date and time at ping is included.

An ASCII text message containing the string `SB2100VD Waiting For Ping` is sent periodically to synchronize internal operations within the SEA BEAM 2100 system when it generates the Vertical Depth message. This message should be ignored by external equipment. This message and the Vertical Depth message are sent as UDO broadcast messages over the SEA BEAM 2100 subnet as well as TCP/IP messages. The broadcast messages are intended for use by the various components of the SEA BEAM 2100 system.

Table 3-7: Vertical Depth Data Record

Item	Units	Valid Range	# of Bytes	Byte Offset	Notes
Record Identifier					
Data record		'SB2100VD'	8	0	
End of identifier		[CR][LF]	2	8	
Record Contents					
Year		≥ 1997	4	10	
Day		001 - 366	3	14	Day of year
Hour		00 - 23	2	17	
Minute		00 - 59	2	19	
Milliseconds		00000 - 59999	5	21	
Delimiter		'T'	1	26	
True Depth	centimeters	0000000 - 1150000	7	27	Corrected for draft and sound velocity (zero means no data this ping)
Delimiter		'A'	1	34	
Apparent depth	centimeters	0000000 - 1150000	7	35	Not draft corrected, assumes 1500 m/s sound velocity (zero means no data this ping)
Delimiter		'R'	1	42	
Maximum Range	milliseconds	00100 - 23000	5	43	Time from ping to end of data reception
Delimiter		'B'	1	48	
Half Swath Angle	degrees	30 - 75	2	49	Maximum angle to either side of vertical

Item	Units	Valid Range	# of Bytes	Byte Offset	Notes
Delimiter		'Y'	1	51	
Half Swath Width	meters	00010 - 12000	5	52	Maximum crosstrack distance to either side of vertical
End of Record		[CR] [LF]	2	57	

4. Data Inputs

Data inputs are via serial RS-232 ports unless otherwise specified. No handshaking is used.

4.1. Surface Sound Velocity Data Record

In some cases, the SEA BEAM 2100 can receive surface sound velocity data from customer supplied equipment. Timing of this data is not critical. The message may be synthesized from any data source. However the measured sound velocity must be accurate to within ±0.6 meter per second.

The Surface Sound Velocity Data Record options, described in this section, are Generic, ODEC SV-5000, Falmouth Scientific and Applied Microsystems.

4.1.1. Generic

Port Parameters

Item	Value
Baud rate	9600
Data bits	8
Parity	none
Stop bits	1
Message interval	5 to 10 seconds

Table 4-1: Generic Surface Sound Velocity Message Format

Item	Units	Valid Range	# of Bytes	Byte Offset	Cod-ing	Notes
Data source		S, H, D, U, V	1	0	ASCII	S = thermo-salinograph H = human entry D = database U = other, unknown device V = velocimeter
Sound velocity	dm/sec.	14000 - 16000	5	1	ASCII	e.g. 15999 means 1599.9 m./sec.
Record terminator		[CR][LF]	2	6	ASCII	

4.1.2. ODEC SV-5000

Port Parameters

Item	Value
Baud rate	9600
Data bits	7
Parity	none
Stop bits	1
Message interval	10 seconds

Table Error! Style not defined.**-4-2: ODEC SV-5000 Surface Sound Velocity Message Format**

Item	Units	Valid Range	# of Bytes	Byte Offset	Notes
Measured sound velocity	meters/sec	1400.0 - 1600.0	6	0	Fifth character is ASCII decimal point
Delimiter		ASCII comma	1	6	
Space		ASCII space	1	7	
Temperature	degrees C	00.0 - 99.9	4	8	Third character is ASCII decimal point
Delimiter		ASCII comma	1	12	
Space		ASCII space	1	13	
Calculated sound velocity	meters/sec	1400.0 - 1600.0	6	14	Fifth character is ASCII decimal point
Delimiter		ASCII comma	1	20	
Flow indicator		‘0’ or ‘1’	1	21	‘0’ = normal water flow ‘1’ = poor water flow
Space		ASCII space	1	22	
Record terminator		[CR][LF]	2	23	

4.1.3. Falmouth Scientific

Port Parameters

Item	Value
Baud rate	9600
Data bits	8
Parity	none
Stop bits	1
Message interval	0.5 second

Figure 3: Falmouth Scientific Surface Sound Velocity Message Format

Item	Units	Valid Range	# of Bytes	Notes
Conductivity	mmho/cm	0 to 65	variable	Note 1
Delimiter		ASCII comma	1	
Temperature	degrees C	-2 to 32	variable	Note 1
Delimiter		ASCII comma	1	
Pressure	dBARs	0 to 35	variable	Note 1
Delimiter		ASCII comma	1	
Salinity	PSU	0 to 50	variable	Note 1
Delimiter		ASCII comma	1	
Surface Sound velocity	meters/sec	1400 - 1600	variable	Note 1
Record terminator		[CR][LF]	2	

Notes

(1) Numbers are expressed as a string of ASCII decimal digits. An ASCII decimal point separates the fractional portion of the number from the integer portion. Negative temperature values are preceded by an ASCII minus character. Examples are 0.0012,-1.907,1497.32.

4.1.4. Applied Microsystems

SEA BEAM 2100 interfaces to the Applied Microsystems Surface Sound Velocimeter in scan mode. It requests data approximately once per second. The interface format does not contain water pressure; the device must be configured without a pressure sensor. The data message returned by the velocimeter includes an echo of the command sent from SEA BEAM 2100, as well as a prompt character for the next command.

Port Parameters

Item	Value
Baud rate	9600
Data bits	8
Parity	none
Stop bits	1
Coding	ASCII
Message interval	1 second (approx.)

Table 4-3: Applied Microsystems Surface Sound Velocity Message Format

Item	Units	Valid Range	# of Bytes	Notes
Scan request		"S"	1	Echo of command sent by SEA BEAM 2100.
Request terminator		[CR][LF]	2	
Delimiter		ASCII space	1	
Surface sound velocity	meters / sec	1400.00 to 1550.00	7	Trailing zeroes required.
Delimiter		ASCII space	1	
Message terminator		[CR][LF]	2	
Prompt		">"	1	

4.2. Navigation Data Record

Navigation records are supplied at one-second intervals on the host computer serial port 3. Time sent in the record corresponds to the time of the position fix, *not* the time at which the record is transmitted. Fixes must be taken at integral seconds of the clock of the navigation source.

The navigation data record options described in this section are SeaBeam Composite and NMEA.

4.2.1. SeaBeam Composite

Port Parameters

Item	Value
Baud rate	9600
Data bits	8
Parity	none
Stop bits	1

Table 4-4: SeaBeam Composite Navigation Data Record

Item	Units	Valid Range	# of Bytes	Byte Offset	Cod-ing	Notes
Date						
Year	years	00 - 99	2	0	ASCII	
Month	months	01 - 12	2	2	ASCII	
Day	days	01 - 31	2	4	ASCII	
Delimiter		[space]	1	6	ASCII	
Time						
Hour	hours	00 - 23	2	7	ASCII	
Minute	minutes	00 - 59	2	9	ASCII	
Second	seconds	00 - 59	2	11	ASCII	
Delimiter		[space]	1	13	ASCII	
Latitude(2)						
Degrees	degrees	00 - 90	2	14	ASCII	
Delimiter		–	1	16	ASCII	
Minutes	minutes	00.0000 - 59.9999	7	17	ASCII	decimal point is included in field
Delimiter		[space]	1	24	ASCII	
Latitude direction		N, S	1	25	ASCII	
Delimiter		[space]	1	26	ASCII	
Longitude(2)						
Degrees	degrees	000 - 180	3	27	ASCII	
Delimiter		–	1	30	ASCII	
Minutes	minutes	00.0000 - 59.9999	7	31	ASCII	decimal point is included in field
Delimiter		[space]	1	38	ASCII	
Longitude direction		E, W	1	39	ASCII	
Delimiter		[space]	1	40	ASCII	
Speed over ground	knots	–99.9 - +99.9	5	41	ASCII	signed: - is reverse direction decimal point is included in field
Delimiter		[space]	1	46	ASCII	
Ship heading (1)	degrees	000.0 - 359.9	5	47	ASCII	decimal point is included in field
Record terminator		[CR][LF]	2	52	ASCII	

Notes

(1) Heading must be the true azimuth of the ship's keel, as measured by a gyrocompass or equivalent. Heading data supplied by standard GPS receivers is an estimate of course over ground, which may differ from keel azimuth by up to several degrees due to surface currents, wind and wave pressures.

(2) Latitude and Longitude must be offset to the location of the center of the SEA BEAM 2100 Projector Array. For multiple frequency systems, offset them to the center of the highest frequency array.

4.2.2. NMEA

The NMEA navigation sentences do not include the date. For this reason, they may only be used in systems configured for separate time synchronization. SEA BEAM 2100 requires position, speed over ground and ship azimuth through the navigation interface. These are provided in three separate NMEA sentences. The sentences must be sent once per second in the following order; position ($GLL or $GGA), speed ($VBW or $VTG) and azimuth ($HDT). The speed and azimuth data will be assumed valid at the time in the position sentence. Position and speed sentences may not be changed dynamically; the SEA BEAM 2100 software is compiled to work with one of each.

Port Parameters

Item	Value
Baud rate	4800
Data bits	8
Parity	none
Stop bits	1

Table 4-5: $GLL Sentence Format

Item	Valid Range	# of Bytes	Notes
Start character	$	1	NMEA message start character.
Talker	xx	2	Must be upper case alphabetic (from NMEA identifier list).
Sentence formatter	GLL	3	NMEA geographic position identifier.
Delimiter	,	1	See note 1.
Latitude			
Degrees	00 – 90	2	Leading zeroes required.
Minutes	00 – 59.99999	variable (minimum of 2)	Leading zeroes required; decimal point is included in field if needed.
Delimiter	,	1	See note 1.
Latitude direction	N, S	1	
Delimiter	,	1	See note 1.
Longitude			
Degrees	000 – 180	3	Leading zeroes required.
Minutes	00 – 59.99999	variable (minimum of 2)	Leading zeroes required; decimal point is included in field if needed.
Delimiter	,	1	See note 1.
Longitude direction	E, W	1	
Delimiter	,	1	See note 1.
UTC hours	00 - 23	2	Leading zeroes required.
UTC minutes	00 - 59	2	Leading zeroes required.

Item	Valid Range	# of Bytes	Notes
UTC seconds	00 - 60	2	Leading zeroes required.
UTC fraction of seconds	.xx	variable	Optional.
Delimiter	,	1	See note 1.
Status	A, V	1	A=valid data; V=invalid data
Delimiter	*	1	Optional - See note 2.
Checksum	cc	2	Optional - See note 2.
End of message	[CR][LF]	2	

Notes

(1) The comma delimiters must all be inserted whether or not optional fields are filled in. There must always be exactly six commas in this message. If one or more optional fields are not sent, commas separating the unused fields appear contiguously.

(2) If a checksum is sent, it must be preceded by an asterisk. If no checksum is sent, the asterisk must not be sent. The checksum is computed according to NMEA in the following description.

The checksum is the 8-bit exclusive OR of all characters in the sentence, including "," delimiters, between but not including the "$" and the "*" delimiters.

The hexadecimal value of the most significant and least significant 4 bits of the result are converted to two ASCII characters (0-9, A-F) for transmission. The most significant character is sent first.

4-6: $GGA Sentence Format

Item	Valid Range	# of Bytes	Notes
Start character	$	1	NMEA message start character.
Talker	xx	2	Must be upper case alphabetic (from NMEA identifier list).
Sentence formatter	GGA	3	NMEA GPS fix data identifier.
Delimiter	,	1	See note 1.
UTC hours	00 - 23	2	Leading zeroes required.
UTC minutes	00 - 59	2	Leading zeroes required.
UTC seconds	00 - 60	2	Leading zeroes required.
UTC fraction of seconds	.xx	variable	Optional.
Delimiter	,	1	See note 1.
Latitude			
Degrees	00 – 90	2	Leading zeroes required.
Minutes	00 – 59.99999	variable (minimum of 2)	Leading zeroes required; decimal point is included in field if needed.
Delimiter	,	1	See note 1.
Latitude direction	N, S	1	
Delimiter	,	1	See note 1.
Longitude			

Item	Valid Range	# of Bytes	Notes
Degrees	000 – 180	3	Leading zeroes required.
Minutes	00 – 59.99999	variable (minimum of 2)	Leading zeroes required; decimal point is included in field if needed.
Delimiter	,	1	See note 1.
Longitude direction	E, W	1	
Delimiter	,	1	See note 1.
GPS quality indicator	0, 1, 2	1	0=fix not available or invalid 1=GPS fix 2=differential GPS fix
Delimiter	,	1	See note 1.
Number of satellites in use	00 - 12	2	Leading zeroes required.
Delimiter	,	1	See note 1.
Horizontal dilution of precision	x.x	variable	Leading and trailing zeroes optional; decimal point is included in field if needed.
Delimiter	,	1	See note 1.
Antenna altitude above / below mean sea level (geoid)	x.x	variable	Leading and trailing zeroes optional; decimal point is included in field if needed.
Delimiter	,	1	See note 1.
Units of antenna altitude, meters	M	1	
Delimiter	,	1	See note 1.
Geoidal separation	x.x	variable	Leading and trailing zeroes optional; decimal point is included in field if needed; see note 2.
Delimiter	,	1	See note 1.
Units of geoidal separation, meters	M	1	
Delimiter	,	1	See note 1.
Age of differential GPS data	x.x	variable	Leading and trailing zeroes optional; decimal point is included in field if needed; see note 3.
Delimiter	,	1	See note 1.
Differential reference station ID	0000 - 1023	4	Leading zeroes required.
Delimiter	*	1	Optional - See note 4.
Checksum	cc	2	Optional - See note 4.
End of message	[CR][LF]	2	

Notes

(1) The comma delimiters must all be inserted whether or not optional fields are filled in. There must always be exactly 14 commas in this message. If one or more optional fields are not sent, commas separating the unused fields appear contiguously.

(2) The difference between the WGS-84 earth ellipsoid and mean sea level (geoid), "-" = mean sea level below ellipsoid.

(3) Time in seconds since last SC104 Type 1 or 9 update, null field when DGPS is not used.

(4) If a checksum is sent, it must be preceded by an asterisk. If no checksum is sent, the asterisk must not be sent. The checksum is computed according to NMEA in the following description.

The checksum is the 8-bit exclusive OR of all characters in the sentence, including "," delimiters, between but not including the "$" and the "*" delimiters.

The hexadecimal value of the most significant and least significant 4 bits of the result are converted to two ASCII characters (0-9, A-F) for transmission. The most significant character is sent first.

4-7: $VBW Sentence Format

Item	Valid Range	# of Bytes	Notes
Start character	$	1	NMEA message start character.
Talker	xx	2	Must be upper case alphabetic (from NMEA identifier list).
Sentence formatter	VBW	3	NMEA bottom and water speed identifier.
Delimiter	,	1	See note 1.
Fore / aft water speed	numeric	variable	Speed in knots; leading and trailing zeroes optional; decimal point is included in field if needed.
Delimiter	,	1	See note 1.
Port / starboard water speed	numeric	variable	Speed in knots; leading and trailing zeroes optional; decimal point is included in field if needed; negative value is port.
Delimiter	,	1	See note 1.
Status	A, V	1	A=valid data; V=invalid data
Delimiter	,	1	See note 1.
Fore / aft bottom speed	numeric	variable	Speed in knots; leading and trailing zeroes optional; decimal point is included in field if needed.
Delimiter	,	1	See note 1.
Port / starboard bottom speed	numeric	variable	Speed in knots; leading and trailing zeroes optional; decimal point is included in field if needed; negative value is port.
Delimiter	,	1	See note 1.
Status	A, V	1	A=valid data; V=invalid data
Delimiter	*	1	Optional - See note 2.
Checksum	cc	2	Optional - See note 2.
End of message	[CR][LF]	2	

Notes

(1) The comma delimiters must all be inserted whether or not optional fields are filled in. There must always be exactly six commas in this message. If one or more optional fields are not sent, commas separating the unused fields appear contiguously.

(2) If a checksum is sent, it must be preceded by an asterisk. If no checksum is sent, the asterisk must not be sent. The checksum is computed according to NMEA in the following description.

The checksum is the 8-bit exclusive OR of all characters in the sentence, including "," delimiters, between but not including the "$" and the "*" delimiters.

The hexadecimal value of the most significant and least significant 4 bits of the result are converted to two ASCII characters (0-9, A-F) for transmission. The most significant character is sent first.

Table 4-8: $VTG Sentence Format

Item	Valid Range	# of Bytes	Notes
Start character	$	1	NMEA message start character.
Talker	xx	2	Must be upper case alphabetic (from NMEA identifier list).
Sentence formatter	VTG	3	NMEA track made good and ground speed identifier.
Delimiter	,	1	See note 1.
Track, degrees	x.x	variable	True track; leading and trailing zeroes optional; decimal point is included in field if needed.
Delimiter	,	1	See note 1.
True track indicator	T	1	
Delimiter	,	1	See note 1.
Track, degrees	x.x	variable	Magnetic track; leading and trailing zeroes optional; decimal point is included in field if needed.
Delimiter	,	1	See note 1.
Magnetic track indicator	M	1	
Delimiter	,	1	See note 1.
Speed	x.x	variable	Speed in knots; leading and trailing zeroes optional; decimal point is included in field if needed.
Delimiter	,	1	See note 1.
Knots indicator	N		
Delimiter	,	1	See note 1.
Speed	x.x	variable	Speed in km/hr; leading and trailing zeroes optional; decimal point is included in field if needed.
Delimiter	,	1	See note 1.
km/hr indicator	K		
Delimiter	*	1	Optional - See note 2.
Checksum	cc	2	Optional - See note 2.
End of message	[CR][LF]	2	

Notes

(1) The comma delimiters must all be inserted whether or not optional fields are filled in. There must always be exactly eight commas in this message. If one or more optional fields are not sent, commas separating the unused fields appear contiguously.

(2) If a checksum is sent, it must be preceded by an asterisk. If no checksum is sent, the asterisk must not be sent. The checksum is computed according to NMEA in the following description.

The checksum is the 8-bit exclusive OR of all characters in the sentence, including "," delimiters, between but not including the "$" and the "*" delimiters.

The hexadecimal value of the most significant and least significant 4 bits of the result are converted to two ASCII characters (0-9, A-F) for transmission. The most significant character is sent first.

Table 4-9: $HDT Sentence Format

Item	Valid Range	# of Bytes	Notes
Start character	$	1	NMEA message start character.
Talker	xx	2	Must be upper case alphabetic (from NMEA identifier list).
Sentence formatter	HDT	3	NMEA true heading identifier.
Delimiter	,	1	See note 1.
Heading	0 - 360	variable	Heading in degrees; leading and trailing zeroes optional; decimal point is included in field if needed.
Delimiter	,	1	See note 1.
True heading indicator	T	1	
Delimiter	*	1	Optional - See note 2.
Checksum	cc	2	Optional - See note 2.
End of message	[CR][LF]	2	

Notes

(1) The comma delimiters must all be inserted whether or not optional fields are filled in. There must always be exactly two commas in this message. If one or more optional fields are not sent, commas separating the unused fields appear contiguously.

(2) If a checksum is sent, it must be preceded by an asterisk. If no checksum is sent, the asterisk must not be sent. The checksum is computed according to NMEA in the following description.

The checksum is the 8-bit exclusive OR of all characters in the sentence, including "," delimiters, between but not including the "$" and the "*" delimiters.

The hexadecimal value of the most significant and least significant 4 bits of the result are converted to two ASCII characters (0-9, A-F) for transmission. The most significant character is sent first.

4.3. Sound Velocity Profile Data Record

Sound velocity profile (SVP) data may be sent to SEA BEAM 2100 using ftp over Ethernet. The procedure for transferring SVP data files is described in the SEA BEAM 2100 Operator's Manual. The format for the data files is described below.

- ASCII file
- Each line contains one depth, an ASCII space, the sound velocity for that depth, and [CR][LF]
- First line must have depth ≤ the ship's draft. All other lines must have depth > the ship's draft
- Depths must be in increasing order
- Depths are in meters, with a maximum of 7 characters including a decimal point
- Sound velocities are in meters/sec, with a maximum of 7 characters including a decimal point
- Maximum of 30 lines

Following is an example SVP file:

```
0.0 1500.0
1000.0 1498.7
11000.0 1510.3
```

4.4. VRU Data Record

In some cases, SEA BEAM 2100 can receive ship attitude data from customer supplied Vertical Reference Units (VRUs). SEA BEAM 2100 time tags each VRU input as it is received. VRU data timing is critical for roll data in wide swath systems. For this reason, only hardware buffering of the actual VRU data stream (as opposed to software reformatting and retransmission of data) is acceptable as input to SEA BEAM 2100.

Compatible devices and data formats supported are listed below. If the device allows a lever arm to be set, the lever arm should either be set to zero, or a fixed value must be entered and conveyed to SBI so that we may enter the effective location of heave data into our software.

The VRU Data Record options, described in this section, are Seatex MRU-6 and TSS Model DMS-05 or POS-MV.

4.4.1. Seatex MRU-6

Port Parameters

Item	Value
Baud rate	38,400
Data bits	8
Parity	none
Stop bits	1
Message interval	44 milliseconds (auto transmit interval = 2)

Table 4-10: Seatex MRU-6 VRU Message Format

Item	Units	Valid Range	# of Bytes	Byte Offset	Notes
Record header		'q'	1	0	
Token		$0D_{16}$	1	1	
Message length		$0E_{16}$	1	2	Length in bytes of rest of message including this byte
Roll	radians	$-\pi/2$ to $+\pi/2$	4		IEEE 32 bit floating point number, MSB first Positive = port side up
Pitch	radians	$-\pi/2$ to $+\pi/2$	4		IEEE 32 bit floating point number, MSB first Positive = stern down
Heave	meters		4		IEEE 32 bit floating point number, MSB first Positive = below mean level
Checksum		00_{16} to FF_{16}	1		Bytewise sum of Message length through Heave, discarding overflow

4.4.2. TSS Model DMS-05 or POS-MV

Port Parameters

Item	Value
Baud rate	9600
Data bits	8
Parity	none
Stop bits	2

Table 4-11: TSS Model DMS-05 or POS-MV VRU Message Format (Format TSS1)

Item	Units	Valid Range	# of Bytes	Byte Offset	Notes
Record header		':'	1	0	
Horizontal acceleration	7.664 cm/s^2	00_{16} to FF_{16} (2 ASCII chars)	2	1	Range = -9.81 to 9.73 m/s^2
Vertical acceleration	0.125 cm/s^2	0000_{16} to $FFFF_{16}$ (4 ASCII chars)	4	3	Range = -40.96 to 40.96 m/s^2
Blank		ASCII space	1	7	
Heave sign		ASCII space or minus	1	8	– is below mean level
Heave magnitude	centimeters	0000 to 9900	4	9	
Status flag		'u', 'U', 'g', 'G', 'h', 'H', 'f', 'F'	1	13	
Roll sign		ASCII space or minus	1	14	– is port side down
Roll magnitude	hundredths of degree	0000 to 9000	4	15	
Blank		ASCII space	1	19	
Pitch sign		ASCII space or minus	1	20	– is stern up
Pitch magnitude	hundredths of degree	-9000 to 9000	4	21	
Record terminator		[CR][LF]	2	25	

5. External Time Synchronization

A once-per-second TTL pulse is used in conjunction with an RS-232 serial time message to synchronize to the navigation clock. The TTL pulse is positive going, and must drive a 1-Kohm load. The pulse duration must be between 100 microseconds and 500 milliseconds (square wave). The time message must end between 1 millisecond and 100 milliseconds after the low-to-high transition of its associated pulse.The time message is input on the host computer serial port 2. The serial port setup and message format conform to the NMEA specification.

Table 5-1: Serial Port Setup for External Time Synchronization

Item	Value
Baud rate	4800
Data bits	8 (d7 = 0 always)
Parity	none
Stop bits	1

Table 5-2 contains the message format for external time synchronization. All characters are ASCII, and with the exception of the carriage return and line feed at the end of message, all are printable. The record is variable length, so byte offsets are not given. Maximum message length is 82 bytes. Lowercase letters in 'Valid Range' are filled in as explained in the notes.

Table 5-2: External Time Synchronization Message Format

Item	Valid Range	# of Bytes	Notes
Start character	$	1	NMEA message start character
Talker	xx	2	Must be upper case alphanumeric
Sentence formatter	ZDA	3	NMEA time and date message identifier
Delimiter	,	1	See note 1.
UTC hours	00 to 23	2	Must be 2 characters - use leading zeroes as req'd.
UTC minutes	00 to 59	2	Must be 2 characters - use leading zeroes as req'd.
UTC seconds	00 to 59	2	Must be 2 characters - use leading zeroes as req'd.
UTC fraction of seconds	.xx	variable	Optional - see note 2.
Delimiter	,	1	See note 1.
Day of month	01 to 31	variable	Leading zero(es) are optional
Delimiter	,	1	See note 1.
Month	01 to 12	variable	Leading zero(es) are optional
Delimiter	,	1	See note 1.
Year	yyyy	variable	Must be at least 4 characters, e. g. 1996 Leading zero(es) are optional
Delimiter	,	1	See note 1.

Item	Valid Range	# of Bytes	Notes
Local zone hours	00 to ±13	variable	Optional - see note 3
Delimiter	,	1	See note 1.
Local zone minutes	00 to ±59	variable	Optional - see note 3
Delimiter	*	1	Optional - see note 4
Checksum	cc	2	Optional - see note 4
End of message	[CR][LF]	2	

Notes

(1) The comma delimiters must all be inserted whether or not optional fields are filled in. There must always be exactly six commas in this message. If one or more optional fields are not sent, commas separating the unused fields appear contiguously, as in the example below.

(2) If time is always sent at exact second boundaries of UTC, this field may be omitted entirely, including the decimal point. If a fractional second is sent, it must be preceded by the decimal point and may have any number of digits following the decimal point.

(3) Hour and minute offsets between local time and UTC are optional. If sent, they are ignored by SEA BEAM 2100. NMEA specifies that the sign of minutes be the same as that of hours, but SEA BEAM 2100 does no validation on these fields.

(4) If a checksum is sent, it must be preceded by an asterisk. If no checksum is sent, the asterisk must not be sent. The checksum is computed according to NMEA in the following description.

The checksum is the 8-bit exclusive OR (no start or stop bits) of all characters in the sentence, including "," delimiters, between but not including the "$" and the "*" delimiters.

The hexadecimal value of the most significant and least significant 4 bits of the result are converted to two ASCII characters (0-9, A-F) for transmission. The most significant character is transmitted first.

Example Time Message

$GPZDA,031708,3,06,1996,,*77[CR][LF]

The time is 03:17:08 UTC. (No fraction of second was sent, since the clock sends messages on even second boundaries. This need not be the case.) The date is June 3, 1996. (Real clocks would probably be consistent in applying or omitting leading zeroes, but consistency is not required.) Offsets to local time were not sent. If they were, they are ignored by the SEA BEAM 2100. A checksum was sent. SEA BEAM 2100 validates checksums if sent.

6. Sonar Synchronization Signals

SEA BEAM 2100 provides two interface signals to synchronize to other sonars. The operation of the sonar synchronization signals is enabled via a selection in the Data Output window. Their operation, when enabled, is described below.

OTHER CAN PING is a differential TTL output (26LS31). It is activated following the echo detection of a ping cycle, and negated either after SEABEAM CAN PING is activated or at the beginning of the next ping cycle.

SEABEAM CAN PING is an opto-isolated input (HCPL2211). It requires a minimum of 2.6 volts at 3.2 ma, and draws 8 ma at 5 volts. It is read not less than 100 milliseconds after activating OTHER CAN PING. If it is activated, the system pings again as soon as possible. If it is negated, the system waits until the transition SEABEAM CAN PING from inactive to active, and ping as soon as possible after that.

The figure below is a timing diagram showing the SEA BEAM 2100 synchronized with another sonar. OTHER CAN PING is activated by the SEA BEAM 2100 following echo detection (A). The other sonar should detect this transition and negate SEABEAM CAN PING within 100 ms (B). SEA BEAM 2100 system detects the negation of SEABEAM CAN PING and inhibit pinging. When the other sonar pings and allows at least sufficient time for the second echo return, it activates SEABEAM CAN PING (C). The SEA BEAM 2100 detects this transition and negate OTHER CAN PING within 100 ms (D). The other sonar should inhibit pinging for at least 100 ms after activating SEABEAM CAN PING.

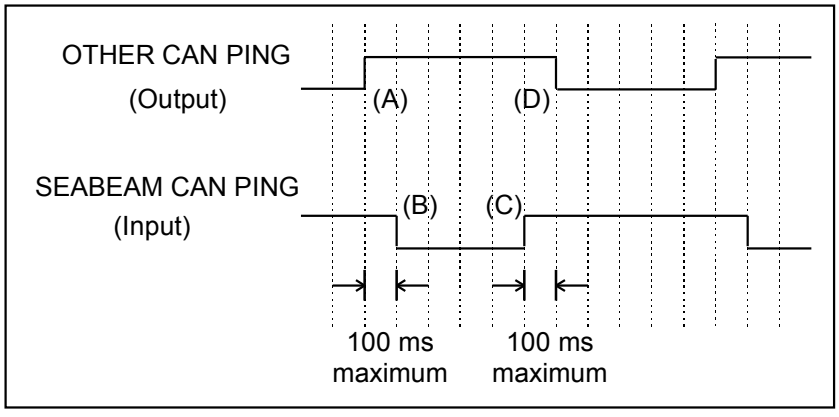

Figure 6-1: Timing Diagram for Sonar Synchronization

If sonar synchronization is disabled, SEA BEAM 2100 ignores SEABEAM CAN PING, and pings repeatedly at its maximum rate.

In addition to the two synchronization signals described above, a SONAR KEY output is always available, whether sonar synchronization is enabled or not. SONAR KEY is a differential TTL pulse output (26LS31), lasting about 7 microseconds. It coincides with the start of the SEA BEAM 2100 transmit pulse and can be used to slave other sonars to ping coincidentally with SEA BEAM 2100.