DigiSTREAMER IAS Data Format Document

Procedure AS1050-600

Revision -1

1.0 About This Document

1.1 Purpose

The ION Data Format Document describes the ION SEG-D and SU tape and disk data formats used by the DigiSTREAMER Integrated Acquisition System (IAS).

1.2 Audience

This document is intended for seismic operators involved in marine seismic data acquisition and processing.

1.3 Scope

This document is limited in scope to a graphical overview of the ION SEG-D and SU recording formats and corresponding Header and Trace Data Blocks used with the DigiSTREAMER IAS.

2.0 Symbols Used in This Document

This symbol represents a note.

3.0 Reference Documents

The following documents provide supplemental information to this manual:

- ION Concept Systems *Header Outputs Reference User Manual*. Document Revision 11.2, December 2008.
- Society of Exploration Geophysicists, SEG-D, Rev 2.1 http://www.seg.org/resources/publications/misc/technical-standards, seg_d_rev2.1.pdf
- Society of Exploration Geophysicists, SEG-Y, Rev 0 http://www.seg.org/resources/publications/misc/technical-standards, seg_y_rev0.pdf

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4.0 Revision History

Revision Level	Revision Date	Details		Description of Change
		Page	Para.	
-1	Aug. 2011			Initial release

5.0 Definition of Acronyms

Table 1: Acronym Definitions

Term	Definition	Term	Definition
ASC	ASCII	FMT	Format
BCD	Binary Coded Decimal	HDR	Trace Header + Trace Header Extension
BIN	Unsigned Binary	IAS	Integrated Acquisition System
±BIN	2's complement signed binary	IEEE	The Institute of Electrical and Electronics Engineers.
BOT	Beginning of Tape.	ION	ION Geophysical Corporation
CRC	Cyclical Redundancy Check	SEG-D	Society of Exploration Geophysicists, Field Tape Standards, D-Format
DC	Direct Current	SEG-Y	Society of Exploration Geophysicists, Field Tape Standards, Y-Format
EOF	End of File (same as record)	SU	Seismic Unix
EOT	End of Tape	UTC	Universal Time Constant
FIT	IEEE single-precision floating point		

6.0 ION SEG-D Tape Format

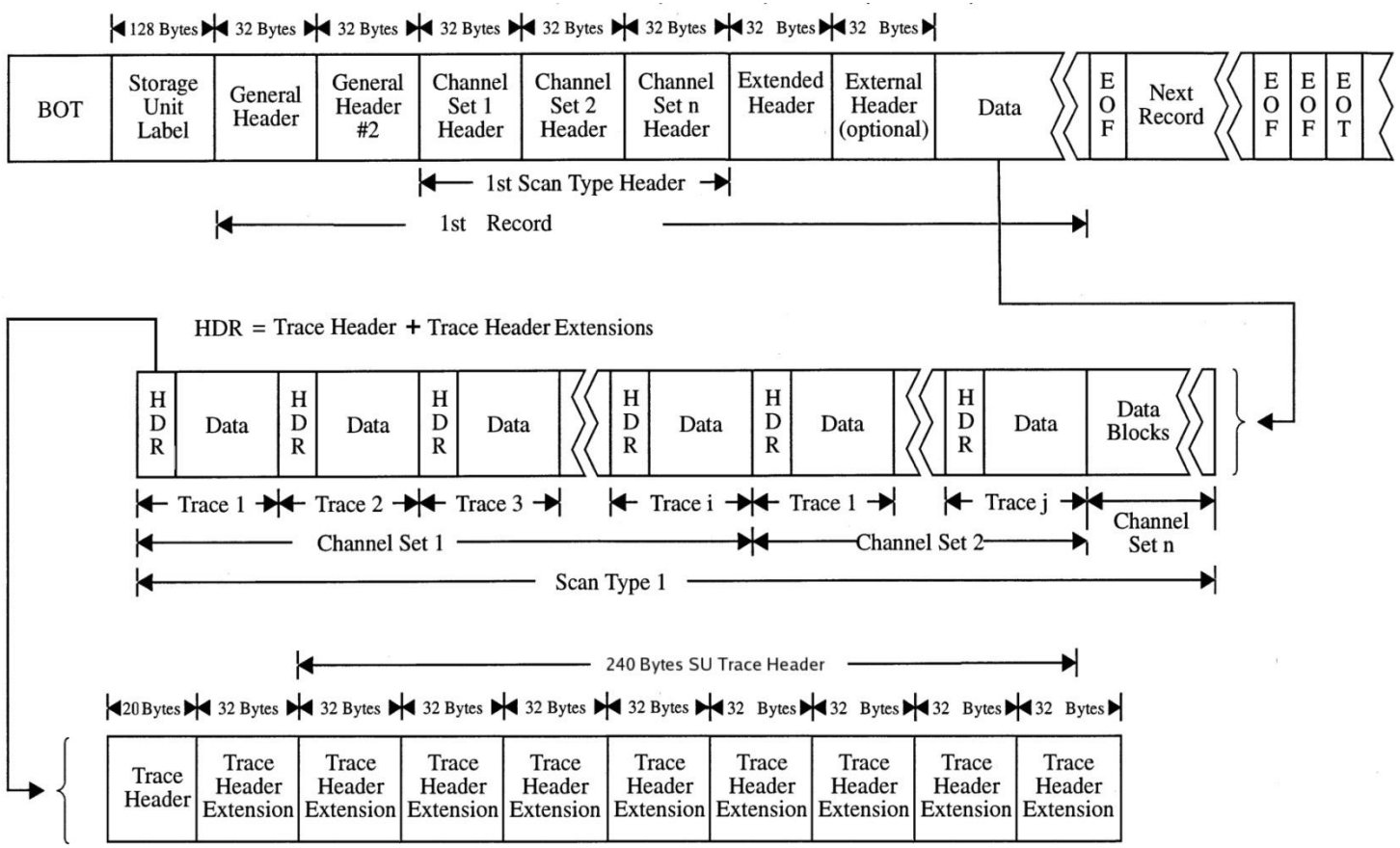


Figure 1: SEG-D Record Format

6.1 File Header Blocks

6.1.1 Storage Unit Label Block

Start - End Byte	Value	FMT	Description
1 - 4	All blanks	ASC	Storage unit sequence number
5 - 9	SD2.1	ASC	SEG-D Revision
10 - 15	RECORD	ASC	Storage unit structure (fixed or variable)
16 - 19	B2	ASC	Binding edition
20 - 29	2097152	ASC	Maximum block size
30 - 39	All blanks	ASC	API Producer organization code
40 - 50	dd-MMM-yyyy	ASC	Creation date
51 - 62	XXXXXX	ASC	Serial number (6 blanks followed by 6 digit reel number)
63 - 68	All blanks	ASC	Reserved
69 - 80	All blanks	ASC	Storage set identifier: External Label Name
81 - 104	ION	ASC	Storage set identifier: Recording Entity Name
105 - 118	All blanks	ASC	Storage set identifier: User defined
119 - 128	1	ASC	Storage set identifier: Max shot records per field record

6.1.2 General Header #1 Block

Start - End Byte	Value	FMT	Description
1 - 2	0xffff	BCD	File number (0-9999) if > 9999 set to 0xffff and expanded file number of GH2 is used
3 - 4	8058	BCD	Format code
5 - 10	0	BCD	General constants (not decoded)
11	XX	BCD	Year
12H	1	BCD	# of additional blocks in general extended headers
12L - 13	XXX	BCD	Day
14	XX	BCD	Hour
15	XX	BCD	Minute
16	XX	BCD	Second
17	18	BCD	Manufacturer s code
18 - 19	0	BCD	Manufacturer's serial number
20 - 22	0	BCD	Not Used
23	XXXX	BCD	Base scan interval in milliseconds times 16
24H	0	BCD	Polarity (Untested)
24L - 25	0	BCD	Not Used
26H	X	BCD	Record type (8=normal record, 2=all other types)
26L - 27	0xfff	BCD	Record length (if 0xfff refer to Extended Record Length GH2)
28	1	BCD	Num scan types
29	0xff	BCD	Channel sets per scan type ff (if 0xff refer to Extended Channel Sets/Scantype GH2)
30	0	BCD	Number of 32-bytes fields for sample skew (see trace headers for skew)
31	0xff	BCD	Extended header length (if 0xff refer to Extended Header Blocks GH2)
32	0xff	BCD	External header length (if 0xff refer to External Header Blocks GH2)

6.1.3 General Header #2 Block

Start - End Byte	Value	FMT	Description
1 - 3		BIN	Expanded file number
4 - 5		BIN	Extended channel sets/scantype
6 - 7		BIN	Extended header blocks, used for navigation data
8 - 9	0	BIN	External header blocks
10	0	BIN	Not Used
11	2	BIN	SEG-D major revision number
12	1	BIN	SEG-D minor revision number
13 - 14	0	BIN	General trailer blocks
15 - 17		BIN	Extended Record Length, milliseconds, divisible by the sample interval
18	0	BIN	Not Used
19	2	BIN	General Header Block Number
20	0	BIN	Not Used
21- 22		BIN	Line Sequence number
23 - 26		BIN	Start Time Remainder in micro seconds
27 - 30		±BIN	Time Break Delay in micro seconds, positive when TB is after Start
31 - 32	0		Not Used

6.1.4 Scan Type Header (Channel Set Descriptor) Block

Start - End Byte	Value	FMT	Description
1	1	BCD	Scan type number
2	XX	BCD	Channel set number
3 - 4	0	BIN	Channel set start time
5 - 6		BIN	Channel set end time, record length, in units of 2 milliseconds
7 - 8	0	±BIN	(Exponent of 2 needed to scale the data to millivolts) * 1024
9 -10	XXXX	BCD	Number of channels
11H	X	BCD	Channel type (1=Seis, 7=Aux)
12H	0	BCD	Subscans/channel
12L	3	BCD	Channel gain (3=fixed gain)
13 - 14	XXXX	BCD	Alias filter frequency [860 | 410 | 205 | 103] Hz
15L - 16	574	BCD	Alias filter slope, dB / octave
17 - 18	XXXX	BCD	Low cut filter frequency [2 | 3] Hz
19L - 20	XXX	BCD	Low cut filter slope [6 | 12] db/octave
21 - 22	0	BCD	First notch filter frequency
23 - 24	0	BCD	Second notch filter frequency
25 - 26	0	BCD	Third notch filter frequency
27 - 28		BIN	Extended channel set number = Channel set number
29H		BIN	Extended header flag
29L		BIN	Trace header extensions
30		BIN	Vertical stack
31		BIN	Streamer cable number
32	XX	BIN	Array forming

6.1.5 Extended Header Block

Start - End Byte	Value	FMT	Description
1 - n	1	ASC	Concatenation of information from shooting or navigation system

Refer to Section 10 and following for navigation data formats.

6.2 Trace Data Blocks

6.2.1 Demultiplexed Trace Header Block

Start - End Byte	Value	FMT	Description
1 - 2	XXXX	BCD	File Number
3	1	BCD	Scan Type Number
4	XX	BCD	Channel Set Number
5 - 6	XXXX	BCD	Trace Number
7 - 9	0	BIN	First Timing Word
10	9	BIN	Trace Header Extensions
11		BIN	Sample Skew
12	0	BIN	Trace Edit
13 - 15	0	BIN	Time Break Window
16 - 17		BIN	Extended Channel Set Number
18 -20		BIN	Extended File Number

6.2.2 Trace Header Extension Block #1

Start - End Byte	Value	FMT	Description
1 - 3		±BIN	receiver line number
4 - 6		±BIN	receiver point number
7	0	BIN	receiver point index
8 - 10		BIN	number samples per trace
11 -15		±BIN	extended receiver line number (three bytes integer, two bytes fractional)
16 - 20		±BIN	extended receiver point number (three bytes integer, two bytes fractional)
21		BIN	sensor type, 1 = hydrophone, 0 = not defined
22 - 32	0		Not Used

6.2.3 Trace Header Extention Block #2–9 [8x32 = 256 bytes]

Start - End Byte	Value	FMT	Description
1 - 240			SU Trace Header (big endean byte order in Release 3.1.2), See below
241 - 256	0	BIN	Not used

6.2.4 Trace Data

Start - End Byte	Value	FMT	Description
1 - N		FLT	N = 4 * number samples per trace from Trace Header Extention Block #1. The data format is 32 bit IEEE floating point. The data is in units of millivolts unless otherwise indicated by the attribute bits.

7.0 ION SU Tape Format

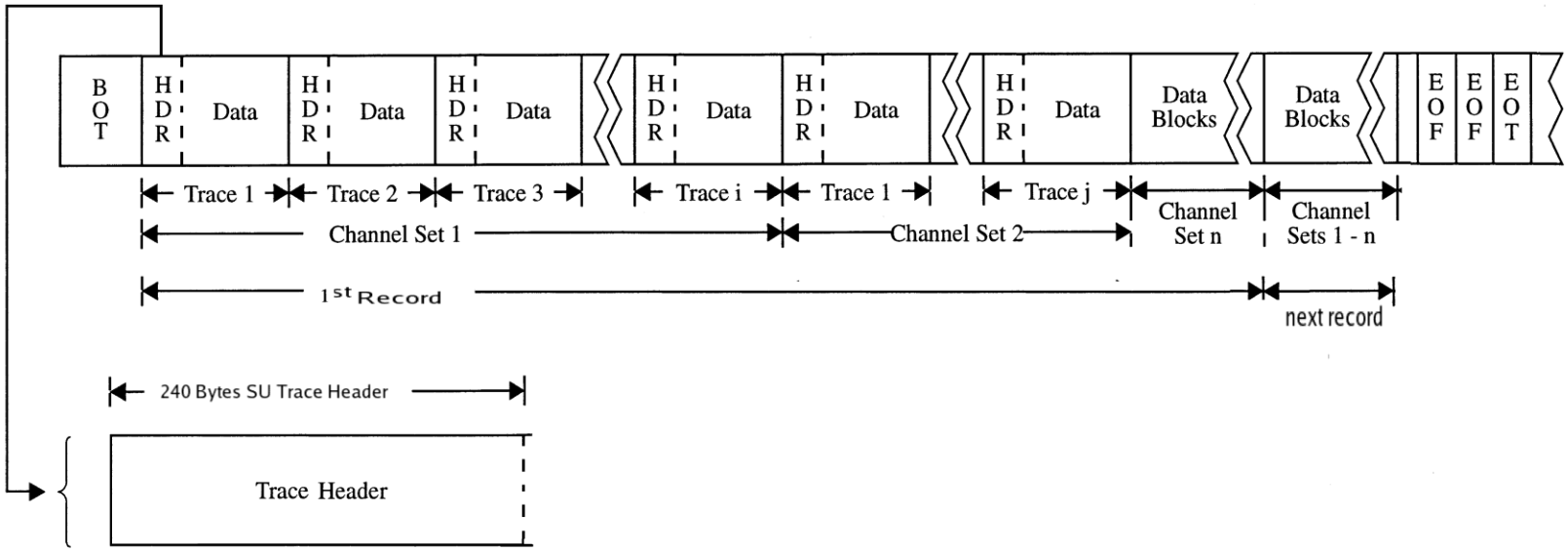


Figure 2. SU Record Format

7.1 Trace Data Blocks

7.1.1 ION IAS 240-Byte SU Trace Header

Start - End Byte	Value	FMT	Description
1 - 4		BIN	Trace Sequence Number within Line (start at 1)
5 - 8		BIN	Trace Sequence Number within Reel (start at 1)
9 - 12		BIN	File Number for Shot Ordered Data
13 - 16		BIN	Trace Number in Shot Record as currently written. (start at 1)
17 - 20		BIN	Energy Source Point = Gun Group Selection Number
21 - 24		BIN	Streamer Number (starts at 1)
25 - 28		BIN	Channel on Streamer (starts at 1)
29 - 30		BIN	Trace ID Code (1-Seis | 2-Dead trace | 200-Aux)
31 - 32	1	BIN	Number of Vertically Summed Traces (1)
33 - 34		BIN	Number of Horizontally Summed Traces (1 or 2)
35 - 36		BIN	Data Use Flag (1-Production | 2-Test)
37 - 104	0	BIN	Not Used
105 - 106		±BIN	Lag Time A, milliseconds, Start of record to time break delay
107 - 114	0		Not Used
115 - 116		BIN	Number of Samples This Trace
117 – 118		BIN	Sample Interval [500 | 1000 | 2000 | 4000] microseconds
119 - 120	1	BIN	Instrument Gain Type (1-Fixed)
121 - 122		BIN	Instrument Gain Constant [0 | 12 | 24 | 36] dB
123 - 124	0		Not Used
125 – 126	0	BIN	Data Type (0=Raw)
127 - 140	0		Not Used
141 – 142		BIN	Anti-Alias Filter Frequency [860 | 410 | 205 | 103] Hz
143 - 144	574	BIN	Anti-Alias Filter Slope dB/octave
145 - 148	0		Not Used
149 – 150		BIN	Low Cut Filter Frequency in Tenths [0 | 20 | 30] Tenths Hz (0=not used)
151 – 152	0		Not Used
153 - 154		BIN	Low Cut Filter Slope [0 | 6 | 12] dB/octave (0=not used)
155 – 156	0		Not Used
157 – 158		BIN	Year Recorded (4 digits)
158 – 160		BIN	Day of Year(start at 1)
161 – 162		BIN	Hour of Day (start at 0)
163 - 164		BIN	Minute of Hour(start at 0)
165 - 166		BIN	Second of Minute(start at 0)
167 - 168	4	BIN	Time Basis Code (4-UTC)
169 - 180	0		Not Used
181 – 182	1005	BIN	Revision Number of this Trace Header
183 - 184		±BIN	Lag Time AA, microseconds, remainder of start time to time break delay
185 - 188		BIN	Start Time Seconds, UTC time
189 - 192		BIN	Start Time Microseconds, UTC time

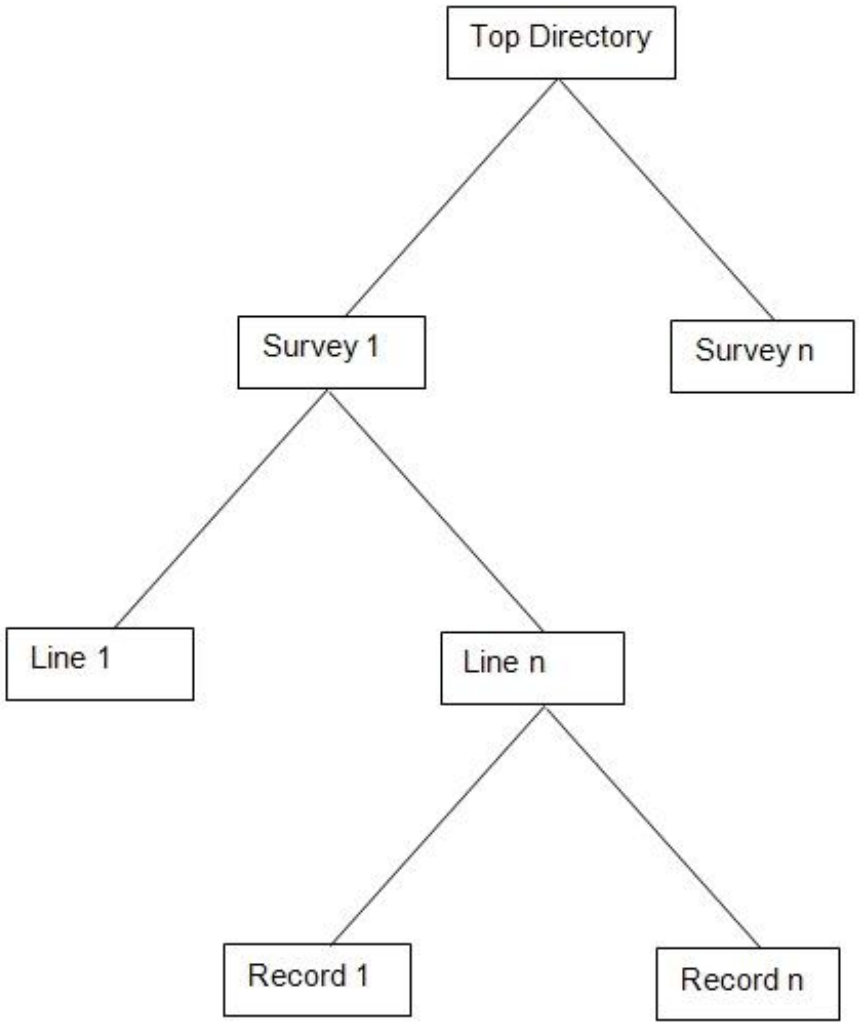
Start - End Byte	Value	FMT	Description
193 - 196	0		Not Used
197 - 200		±BIN	Shot Point Number
201 - 208	0		Not Used
209 - 212		±BIN	Line Number
213	42	BIN	Device Type
214 – 215	0	BIN	Not used
217		BIN	DC Cancel / Cal Mode [0 | 1 | 2]
218		BIN	Simulator Mode [0 | 1 |2 | 3]
219		BIN	Test Sig.Att.[3 | 15 | 27 | 39] dB
220		BIN	Test Mode [0x00 .. 0x0F], 0x00 = production, no test signal.
221 - 224			Module Id: 24 least significant bits: module serial number 8 most significant bits: 0x01 – load cell attached 0x08 – aux module
225 - 234	0		Not used.
235 - 236		BIN	CRC-16, CRC computed on trace data.
237 - 238	0	BIN	Parity Error Count, not used.
239 - 240		BIN	Attribute Flags: 0x0001 Scan substitution was enabled. (disabled) 0x0002 One or more parity error occurred. (disabled) 0x0004 Noisey, (RMS too high) 0x0008 Dead, (RMS too low) 0x0010 Spikes detected. 0x0020 Weak 0x0100 Data is scaled to millivolts 0x0200 Data is scaled to volts 0x0400 Amplifier gain has been removed

7.1.2 Trace Data

Start - End Byte	Value	FMT	Description
1 - N	X.X	FLT	N = 4 * number samples per trace from Byte 115-116 of Trace Header. The IAS SU data format is 32 bit IEEE floating point. The data is in units of millivolts unless otherwise indicated by the attribute bits. The byte order is the native byte order for the machine.

8.0 ION Data Disk Formats

The IAS disk formats consist of a top directory and a directory tree made of survey and line. Each line directory contains file made of one record. The record format is the same of that of the respective tape format. Please refer to the figures for record format



9.0 Trace Numbering in the SU Header

The following fields in the SU header are assigned values according to these rules.

Description	What to do
Trace Sequence Number within Line	When writing to the first tape of a line from the beginning: -Renumber starting at 1 with the first trace on tape. When appending to tape from EOT: -Read the last trace on the tape to get the last trace number and line number -If the line number matches, continue with the last trace number + 1 -If the line number does not match, continue with 1 for the next trace number to be written. When writing to a file, one shot record is written per file: For each Archiver session: -Renumber starting at 1. For successive traces written, increment by 1 for each trace until the line changes, then start numbering from 1. This applies for both line and disk cases.
Trace Sequence Number within Reel	When writing to tape from the beginning: -Renumber starting at 1 with the first trace on tape -Increment by 1 for each trace until the reel is unloaded. When appending to tape from the EOT: -Read the last trace on the tape to get the last trace number -Write the added traces starting with last trace number + 1. When writing to a file, one shot record is written per file: For each Archiver session: -Renumber starting at 1 -Increment by 1 for each trace.
Trace Number in Original Field Record	For each shot record: -Renumber starting at 1 -Increment by 1 for each trace.
Channel on Streamer	For each cable, renumber starting at 1. The aux channels are considered to be on the same cable.

10.0 Navigation Header Input Process

The Header Input Process srs_hdrinput receives headers from the navigation system and records shot information in the Session Index Database. When the navigation header indicates approach to a line, that line is made the active line; if it does not already exist in the Survey-wide database, then it is created.

The navigation data gets inserted into the SEG-D header. Refer to the Extended Header Block in Section 4.1.5. The navigation data format description follows.

For each shot, the navigation system sends information to the DigiSTREAMER recording system which is then written to the SEG-D 2.1 Extended Header. The content of this information is dependent on how the navigation system is set up. The following paragraphs describe the information content that is commonly found. For specific and special cases refer to the navigation system documentation.

The navigation system information typically includes:

- IAS Navigation Header (required)
- Navigation General Header (optional)
- Timing Section (optional)
- Gun Array Section (optional)
- Gun Sections (optional)
- Data from other interfaces (optional).

10.1 IAS Navigation Header Format

The header format is as follows
(a = any char, n = decimal digit, . = . , 6a = aaaaaa, b = blank space)

Start Byte Offset	Field	Format	Description
0	Header ID	aa	'$1'
2	Length	nnnn	Length of remainder of header after this field
6	Version	aaaa	Version number of header format
10	Line status	nn	01=Offline, 02=Approach, 03=Online, 04=Runout
12	Shot time	24a	
12	Hour	nn	
14	Minute	nn	
16	Second	nn	
18	Microseconds	.nnnnnn	A dot followed by 6 digits
25	Year	nnnn	
29	Month	nn	
31	Day	nn	
33	time ref	aaa	'UTC'
36	shot number	nnnnnn	
42	line name	16a	NB. IAS can have 32-char. line names, but lines created from Nav. headers will not be that long.
58	master latitude	nnnn.nnnnnn	degrees
69	master longitude	nnnn.nnnnnn	degrees
80	water depth	nnnn.n	degrees
86	source latitude	nnnn.nnnnnn	degrees
97	source longitude	nnnn.nnnnnn	degrees
108	master gyro	nnn.n	degrees
113	master cmg	nnn.n	degrees
118	master speed	nn.n	knots

Version				
!= 3	= 3			
	122	Orca vessel code	aaa	
122	125	FFID	nnnnnn	Initial or expected next Field File Identifier
128	131	shots to go	nnnnnn	shots remaining during approach
134	137	line type	nn	01=production 02=test 03=IQC
136	139	last ffid	nnnnnn	Last FFID
142	145	line_seq	nnnnnn	Line Sequence
148	151	line_heading	nnn.n	Line Heading
153	156	line params 1	nnnnnn	Spare, always 0
159	162	line params 2	nnnnnn	Spare, always 0
165	168	line params 3	nnnnnn	Spare, always 0
171	174	line params 4	nnnnnn	Spare, always 0

The total size of the above if the version is either 177 or 180 bytes depending on if the version number is 0002 or 0003.

10.2 Navigation General Header

This section is similar to and follows the previous section. There are many navigation setup parameters which control which fields are present in this section.

Start Byte Offset	Field	Format	Description
0	Header ID	aa	'$1'
2	Length	nnnn	Length of remainder of header after this field
6	Version	aaaa	[‘0002’ | ‘0003’], the only allowed values
10	Line status	nn	01=Offline, 02=Approach, 03=Online, 04=Runout
12	Shot time		
12	Hour	nn	
14	Minute	nn	
16	Second	nn	
18	Microseconds	.nnnnnn	Required field. Nav. system must include.
25	Year	nnnn	
29	Month	nn	
31	Day	nn	
33	time ref	aaa	'UTC'
36	shot number	nnnnnn	
42	line name	16a	NB. IAS can have 32-char line names, but lines created from Nav. headers will not be that long.
58	master latitude	nnnn.nnnnnn	degrees
69	master longitude	nnnn.nnnnnn	degrees
80	water depth	nnnn.n	degrees
86	source latitude	nnnn.nnnnnn	degrees
97	source longitude	nnnn.nnnnnn	degrees

108				master gyro	nnn.n	degrees
113				master cmg	nnn.n	degrees
118				master speed	nn.n	knots
Version						
2	3	5	7			
		122	122	sequence number	nnnn	Version = 0004 only
	122		126	Vessel ID	nnn	ID of the shooting vessel, Version = 0003 only

Total size of the Navigation section varies depending on the format version. Format versions 0001, 0004, and 0006 cannot be used because they do not include the microseconds part of the time. The current IAS software only allows Version 0001, 0002, and 0003.

Revision	Description	Total Size
0002	Default for Spectra and Gator	122
0003	Default for Orca , includes vessel ID	125
0005	Includes sequence number	126
0007	Orca, includes vessel ID and sequence number	129

10.3 Timing Section

Beginning the Timing Section one blank space is written. The Timing Section consists of a blank space plus Trigger Sections.

Start Byte Offset	Definition	Format	Description
0	blank space	b	

The following Trigger Section has a size of 20 characters and is repeated a minimum of six times up to a maximum of 10 times.

Start Byte Offset	Definition	Format	Description
0	Trigger Name	10a	Truncated to 10 characters
10	blank space	b	
11	Trigger firing time	8n	Time of trigger relative to the shot firing time – that is, trigger firing time minus actual shot time in microseconds.
19	blank space	b	

Triggers that fire after the shot have a positive time and triggers that fire before the shot have a negative time. A value of -9999999 appears if any of the following are true:

- No/invalid data is available for that trigger
- Data for that trigger is stale (it is an old shot)
- Shot time exceeds upper and lower limits of 99999999 and -9999999.

Total size of the Timing Section is 121 bytes, or up to 201 bytes if more than six triggers are specified.

10.4 Gun Array Section

Start Byte Offset		Definition	Format		Description
0		Gun String ID	aaaaaa		'*GCS90'
6		Length	nnnn		Length of gun section including this field and the 'Gun String ID' field
10		Line name	aaaaaa		
16		Shot number	nnnn		
20		Active Array mask	nn		
V1 Syntron	V2 Syntron				
	22	Trigger Mode	a		I = internal , E = external Only present with V2 Syntron gun data
22	23	Sequence number	nn		
	25	Number of subarrays	nnn		Only present with V2 Syntron
24	28	Number of guns	nnn		
37	31	Number of active guns	nnn		
30	34	Number of delta errors	nnn		
33	37	Number of autofires	nnn		
36	40	Number of misfires	nnn		
39	43	Delta Spread	nnn		
42	46	Volume Fired	nnnnnn		
			V1 Syntron	V2 Syntron	
48	52	Spare	22x'0'	nnnn	22 zeroes with V1 Syntron Gun Data, I4 with V2
	56	Manifold pressure	nnnn		Only present with V2 Syntron Gun Data
	60	Deep tow	nnnn		Only present with V2 Syntron Gun Data
	64	Subarray pressure	nnnn		Only present with V2 Syntron Gun Data. This field is repeated for the number of subarrays given above.

Total size of Gun Array Section is 70 bytes for V1 Syntron data and 68 bytes plus (number of subarrays x 4) bytes for V2 data.

The following Gun Section may be included and repeated for each gun in the array.

Refer to the *General Header/PSI Header/Syntrak Header* section of the ION Concept Systems *Header Outputs Reference User's Manual* for any additional navigation header information that may follow.

Start Byte Offset	Definition	Format	Description
0	Port number	nn	Physical Port (Gun) Number
2	Gun mode	a	'A' = auto 'M' = manual 'S' = spare 'O' = off
3	Detect mode	a	'P' = peak 'Z' = zero crossing
4	Sequence Number	n	
5	Autofire	a	'Y' = yes 'N' = No
6	Spare	a	' '
7	Static Offset	nnn	in tenths of milliseconds
10	Gun delay	nnn	in tenths of milliseconds
13	Fire time	nnn	in tenths of milliseconds
16	Delta error	nnn	in tenths of milliseconds
19	Depth	nnn	in tenths of meters

The size of the Gun Section above is 22 bytes.

10.5 Auxiliary Interface Section (Optional)

Data from another interface may be attached to the output header; for example, COMPASS data. Refer to the navigation system documentation.