RAW FILE FORMAT

1 Recorded Data Packet Format

Seismic data packets are encapsulated in one second sample period blocks. These data blocks are stored contiguously for each recording session on a “raw” disc device. The Ethernet connection will allow the “raw” data to be read from the DAR as a continuous image using either the Unix “dd “command or by a user application opening a “raw” disc device and reading continuous sectors.

The data packet format allows for different types of data packets within a recording session. Each data packet contains a 10 byte header which contains the second code, time occurrence, packet type and recording sequence of the packet. The time occurrence of the packet is the UTC time of the first data sample of the packet. The UTC time follows a unique code of 4 bytes that allows resynchronization of the second blocks in the event of corrupted data on the disc. Start log and end log data packets save recording parameter information at the beginning and end of the recorded seismic data packets. The start log packet will have the UTC time in the header set to the same value as in the first seismic data packet along with additional information for the recording session. The stop log packet will have the UTC time in the header set to the same value as in the last seismic data packet.

2 Data packet header

All data packets contain the following 10 byte header for packet synchronization and identification.

Byte	Description
0-3	Start of Second Code (0x12345678)
4-7	Current UTC Time (represented as time_t time)
8	Data Packet type
9	Recording sequence this packet belongs to

3 Start Log data packet

Byte	Description
0-3	Start of Second Code (0x12345678)
4-7	Current UTC Time (represented as time_t time)
8	Data Packet type (0x80)
9	Recording sequence (1 to 255)
10-13	Starting Disc Sector for this recording sequence.
14-17	Line Number Identification
18-21	Station Number Identification
22-23	Aux Chans (Binary xxxx xxxx xxxx xxxx – chans 0 to 15 , Off=0, On=1)
24-25	Aux Channel 0 Sample interval (in seconds)
26-27	Aux Channel 1 Sample interval (in seconds)
28-29	Aux Channel 2 Sample interval (in seconds)
30-31	Aux Channel 3 Sample interval (in seconds)
32-33	Aux Channel 4 Sample interval (in seconds)
34-35	Aux Channel 5 Sample interval (in seconds)
36-37	Aux Channel 6 Sample interval (in seconds)
38-39	Aux Channel 7 Sample interval (in seconds)
40-41	Aux Channel 8 Sample interval (in seconds)
42-43	Aux Channel 9 Sample interval (in seconds)
44-45	Aux Channel 10 Sample interval (in seconds)
46-47	Aux Channel 11 Sample interval (in seconds)
48-49	Aux Channel 12 Sample interval (in seconds)
50-51	Aux Channel 13 Sample interval (in seconds)
52-53	Aux Channel 14 Sample interval (in seconds)
54-55	Aux Channel 15 Sample interval (in seconds)
56	Data Channels @ 1 ms (Binary xxxx xxxx - chans 0 to 7, Off=0, On =1)
57	Data Channels @ 2 ms (Binary xxxx xxxx - chans 0 to 7, Off=0, On =1)
58	Data Channels @ 4 ms (Binary xxxx xxxx - chans 0 to 7, Off=0, On =1)
59	Data Channels @ 8 ms (Binary xxxx xxxx - chans 0 to 7, Off=0, On =1)
60-61	Minimum Battery Voltage Setting at start of recording (millivolts)
62-63	Battery Voltage at start of recording (millivolts)
64-65	Temperature at start of recording (signed degrees C)
66-67	X tilt offset (signed short)
68-69	Y tilt offset (signed short)
70-71	Z tilt offset (signed short)
72-73	X tilt scale (signed short)
74-75	Y tilt scale (signed short)
76-77	Z tilt scale (signed short)
78-79	X tilt at beginning of recording
80-81	Y tilt at beginning of recording
82-83	Z tilt at beginning of recording
84-85	Pressure at beginning of recording
86-89	Recorder Board Firmware Revision
90-93	Recorder Board FPGA #1 Revision
94-97	Recorder Board FPGA #2 Revision
98-101	Recorder Board Serial Number
102-105	Recorder Board Hardware Revision
106-109	Communication Board Firmware Revision
110-113	Communication Board Serial Number
114-117	Communication Board Hardware Revision
118	Clock Type
119	Recording Unit Type
120	Command used to start this recording
121	Phase Filter used on this recording 0 = Linear 1 = Minimum

122-255	Reserved (written as zero)
256-511	256 Character ASCII comment field. (Null terminated)

4 Stop Log data packet

Byte	Description
0-3	Start of Second Code (0x12345678)
4-7	Current UTC Time (represented as time_t time)
8	Data Packet type (0x81)
9	Recording sequence (1 to 255)
10-13	Ending Disc Sector for this recording sequence.
14-17	Line Number Identification
18-21	Station Number Identification
22-23	Aux Chans (Binary xxxx xxxx xxxx xxxx – chans 0 to 15 , On=1)
24-25	Aux Channel 0 Sample interval (in seconds)
26-27	Aux Channel 1 Sample interval (in seconds)
28-29	Aux Channel 2 Sample interval (in seconds)
30-31	Aux Channel 3 Sample interval (in seconds)
32-33	Aux Channel 4 Sample interval (in seconds)
34-35	Aux Channel 5 Sample interval (in seconds)
36-37	Aux Channel 6 Sample interval (in seconds)
38-39	Aux Channel 7 Sample interval (in seconds)
40-41	Aux Channel 8 Sample interval (in seconds)
42-43	Aux Channel 9 Sample interval (in seconds)
44-45	Aux Channel 10 Sample interval (in seconds)
46-47	Aux Channel 11 Sample interval (in seconds)
48-49	Aux Channel 12 Sample interval (in seconds)
50-51	Aux Channel 13 Sample interval (in seconds)
52-53	Aux Channel 14 Sample interval (in seconds)
54-55	Aux Channel 15 Sample interval (in seconds)
56	Data Channels @ 1 ms (Binary xxxx xxxx - chans 0 to 7, On =1)
57	Data Channels @ 2 ms (Binary xxxx xxxx - chans 0 to 7, On =1)
58	Data Channels @ 4 ms (Binary xxxx xxxx - chans 0 to 7, On =1)
59	Data Channels @ 8 ms (Binary xxxx xxxx - chans 0 to 7, On =1)
60-61	Minimum Battery Voltage Setting at start of recording (millivolts)
62-63	Battery Voltage at stop of recording (millivolts)
64-65	Temperature at stop of recording (signed degrees C)
66-67	X tilt offset (signed short)
68-69	Y tilt offset (signed short)
70-71	Z tilt offset (signed short)
72-73	X tilt scale (signed short)
74-75	Y tilt scale (signed short)
76-77	Z tilt scale (signed short)
78-79	X tilt at end of recording
80-81	Y tilt at end of recording
82-83	Z tilt at end of recording
84-85	Pressure at end of recording
86-89	Last Clock Set to GPS time (UTC) – written by download software
90-93	Last Skew Check to GPS time (UTC) – written by download software
94-97	Micro Second Skew Detected (signed integer) – written by download software
98-101	Last skew value in PPM (32 bit IEEE float) – written by download software
102	Stop cause
103	A1 Run errors
104	A2 Run Errors
105-511	Reserved (written as zero)

5 Seismic data packet

The seismic data packet contains both auxiliary and seismic data encapsulated in one second sample blocks. The auxiliary data is 4 bytes per sample. The upper byte specifies if the aux data is valid . The lower 3 bytes contain a signed 24 bit value of the aux data. The seismic data is 3 bytes per sample containing 24 bit signed seismic data.

The data portion of the seismic data packet will be written with all aux data for this second block immediately after the header. The aux data for all active aux channels is written for each second block. The upper byte of each aux data sample specifies if the sample is valid during this second period. Following the aux data, all seismic samples for the one second block will be written. The seismic data may be sampled at multiple rates. The data will be written in groups of active channels with all samples of the lowest active channel written first.

The total number of bytes of seismic data in a second block will be (10 + active aux channels *4 + (1000*1 ms channels) *3 + (500*2 ms channels)*3 + (250*4 ms channels)*3 + (125*8 ms channels)*3).

Following is a memory image of the seismic data packet using 4 active aux channels, 1 ms sampling data channels 0 & 1, 2 ms sampling data channel 2, 4 ms sampling data channel 3.

Byte	**Description**
0-3	Start of Second Code (0x12345678)
4-7	Current UTC Time (represented as time_t time)
8	Data Packet type (0x01)
9	Recording sequence (1 to 255)
10	Aux channel 0 sample valid code (0=no, 1=yes)
11-13	Aux channel 0 data (24 bit signed value)
14	Aux channel 1 sample valid code (0=no, 1=yes)
15-17	Aux channel 1 data (24 bit signed value)
18	Aux channel 2 sample valid code (0=no, 1=yes)
19-21	Aux channel 2 data (24 bit signed value)
22	Aux channel 3 sample valid code (0=no, 1=yes)
23-25	Aux channel 3 data (24 bit signed value)
26-3025	24 bit seis data channel 0 (all samples for channel 0)
3026-6025	24 bit seis data channel 1 (all samples for channel 1)
6026-7525	24 bit seis data channel 2 (all samples for channel 2)
7526-8275	24 bit seis data channel 3 (all samples for channel 3)

6 SD disc partition.

The SD disc contains 2 partitions, a boot code partition (type 0xBC) and a data partition (type 0xDD). The data partition is accessed as a "raw" device on sector boundaries. The first 512 sectors of the data partition are used for start and stop logs defining multiple recordings residing on the remainder of the data partition. Sector 0 and sector 256 are used for a running log of (TBD) recording information. Sectors 1 to 255 are used for start logs for recording sequences 1 to 255. Sectors 257 to 511 are used for stop logs for recording sequences 1 to 255. Sectors 512 - 1023 are reserved for future use. The following sector layout is used for the data partition.

NOTE: All sector values in the start and stop logs and the below table are relative to the starting sector of the data partition.

Sector	Description
0	Current recording information (updated each hour during a recording session)
1-255	Start Log for recordings 1 to 255 (one sector per recording)
256	Current recording information (updated each hour during a recording session)
257-511	Stop Log for recordings 1 to 255 (one sector per recording)
512-1023	Reserved for future use (written as zero)
1024-end	Seismic Data one second packets (up to 255 recordings)

7 Tilt angles

The uncalibrated values are written to the raw file.

	$\boldsymbol{k}_{[x]}$	$\boldsymbol{k}_{[y]}$	$\boldsymbol{k}_{[z]}$	$\boldsymbol{s}_{[x]}$	$\boldsymbol{s}_{[y]}$	$\boldsymbol{s}_{[z]}$
Bytes (Signed short)	66-67	68-69	70-71	72-73	74-75	76-77
	$a_{[x]}$	$a_{[y]}$	$a_{[z]}$	$c_{[x]}$	$c_{[y]}$	$c_{[z]}$
Bytes (Signed short)	AUX 5	AUX 6	AUX 7	724	724	1024

To derive calibrated data $\alpha_{[x,y,z]}$ use the following equation with the coefficients given in the table above:

$$\alpha_{[x,y,z]} = c_{[x,y,z]} \frac{\left(a_{[x,y,z]} - k_{[x,y,z]}\right)}{s_{[x,y,z]}}$$

Tilt for each axis $\vartheta_{[x,y,z]}$ can be computed as per

$$\vartheta_{[x,y,z]} = \sin^{-1}\left(\frac{\alpha_{[x,y,z]}}{\sqrt{\alpha_x^2 + \alpha_y^2 + \alpha_z^2}}\right)$$