RV Langseth
Data Reduction Summary

MGL1206
Apra Harbor, Guam – Honolulu, HI

FINAL

V1.1, 2012-05-26
Lamont-Doherty Earth Observatory, Columbia University
### Wednesday Apr 15 2012 08:00:00L

<table>
<thead>
<tr>
<th>Date</th>
<th>Julian Date</th>
<th>Time</th>
<th>Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012-03-23</td>
<td>2012-083</td>
<td>2300 UTC, 0900L</td>
<td>Apra Harbor, Guam</td>
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<td>2012-04-17</td>
<td>2012-108</td>
<td>1800 UTC, 0800L</td>
<td>Honolulu, HI</td>
</tr>
</tbody>
</table>
Prepared by:
David Ng
IT/Nav
dng@ldeo.columbia.edu
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Please refer to the Langseth Data Report Supplement for information regarding data formats.
I. Background and Scientific Objectives

R/V *Marcus G. Langseth* MGL-1206 formed the major data acquisition phase of the NSF-funded project, "Geophysical Constraints on Mechanisms of Ocean Plateau Formation from Shatsky Rise, Northwest Pacific" (OCE-0926611). Deciphering the origins of large oceanic plateaus is a critical element for understanding mantle dynamics and its relation to terrestrial magmatism, and Shatsky Rise was chosen as a high-priority target because it provides a unique tectonic setting to distinguish between various models proposed for the formation of oceanic plateaus. The purpose of this survey was to provide critical missing information on (1) the thickness, velocity structure, and composition of the Shatsky Rise crust, and (2) the history of magmatic emplacement and later tectonic development of the Rise. This was planned to be achieved by acquiring seismic data along two refraction lines over the TAMU massif, which represents the early, most voluminous phase of the Rise construction, and over 3,000 km of reflection lines covering both the TAMU and ORI massifs, the latter of which corresponds to the intermediate phase of the plateau evolution.
Figure 1 – Cruise Track
Figure 2 – Cruise Track w/ XBT drops
Figure 3 – Northern Marianas/Shatsky Rise bathymetry and topography
Figure 4 – Northern Marianas/Shatsky Rise/Hawaii bathymetry and topography incl. Track-line

MGL1206 – Northern Marianas/Shatsky Rise/Hawaii Bathymetry & Topography
# II. Personnel

## Shipboard Technical Staff

<table>
<thead>
<tr>
<th></th>
<th>Name</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Robert Steinhaus</td>
<td>Chief Science Officer</td>
</tr>
<tr>
<td>2</td>
<td>Megan Meyer</td>
<td>Marine Tech</td>
</tr>
<tr>
<td>3</td>
<td>David Ng</td>
<td>Marine Tech</td>
</tr>
<tr>
<td>4</td>
<td>Bern McKiernan</td>
<td>Marine Tech</td>
</tr>
<tr>
<td>5</td>
<td>Mike Martello</td>
<td>Marine Tech</td>
</tr>
<tr>
<td>6</td>
<td>Chris Francis</td>
<td>Chief Sound Source Mechanic</td>
</tr>
<tr>
<td>7</td>
<td>Mike Tatro</td>
<td>Sound Source Mechanic</td>
</tr>
<tr>
<td>8</td>
<td>Carlos Gutierrez</td>
<td>Sound Source Mechanic</td>
</tr>
<tr>
<td>9</td>
<td>Weston Groves</td>
<td>Sound Source Mechanic</td>
</tr>
</tbody>
</table>

## Ship's Crew

<table>
<thead>
<tr>
<th></th>
<th>Name</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jim O'Loughlin</td>
<td>Captain</td>
</tr>
<tr>
<td>2</td>
<td>Lee Dortzbach</td>
<td>Chief Mate</td>
</tr>
<tr>
<td>3</td>
<td>Breckenridge Crum</td>
<td>2nd Mate</td>
</tr>
<tr>
<td>4</td>
<td>West Wilson</td>
<td>3rd Mate</td>
</tr>
<tr>
<td>5</td>
<td>Ricky Redito</td>
<td>Bosun</td>
</tr>
<tr>
<td>6</td>
<td>Inocencio Rimando</td>
<td>AB</td>
</tr>
<tr>
<td>7</td>
<td>Ben Nadler</td>
<td>AB</td>
</tr>
<tr>
<td>8</td>
<td>Glenice James</td>
<td>AB</td>
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<tr>
<td>9</td>
<td>Joshua Schaffner</td>
<td>OS</td>
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<tr>
<td>10</td>
<td>Joselyn White</td>
<td>OS</td>
</tr>
<tr>
<td>11</td>
<td>Al Karlyn</td>
<td>Chief Engineer</td>
</tr>
<tr>
<td>12</td>
<td>Matt Tucke</td>
<td>1st Asst. Engineer</td>
</tr>
<tr>
<td>13</td>
<td>Michael Romero</td>
<td>2nd Asst. Engineer</td>
</tr>
<tr>
<td>14</td>
<td>Ross Himebauch</td>
<td>3rd Asst. Engineer</td>
</tr>
<tr>
<td>15</td>
<td>Jack Schwartz</td>
<td>Electrician</td>
</tr>
<tr>
<td>16</td>
<td>Jack Billings</td>
<td>Oiler</td>
</tr>
<tr>
<td>17</td>
<td>Rudy Florendo</td>
<td>Oiler</td>
</tr>
<tr>
<td>18</td>
<td>Fernando Uribe</td>
<td>Oiler</td>
</tr>
<tr>
<td>19</td>
<td>Hervin Fuller</td>
<td>Steward</td>
</tr>
<tr>
<td>20</td>
<td>Leoncio Martires</td>
<td>Cook</td>
</tr>
</tbody>
</table>
## MMO

<table>
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<tr>
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<tbody>
<tr>
<td>1</td>
<td>Heidi Ingram</td>
<td>PSO</td>
</tr>
<tr>
<td>2</td>
<td>Meghan Piercy</td>
<td>PSO</td>
</tr>
<tr>
<td>3</td>
<td>Marina Olsen</td>
<td>PSO</td>
</tr>
<tr>
<td>4</td>
<td>Tatiana Moreno</td>
<td>PSO</td>
</tr>
<tr>
<td>5</td>
<td>Emily Ellis</td>
<td>PSO</td>
</tr>
</tbody>
</table>

## Science Party

<table>
<thead>
<tr>
<th></th>
<th>Name</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jun Korenaga</td>
<td>Chief Scientist</td>
</tr>
<tr>
<td>2</td>
<td>Tanya Blacic</td>
<td>Scientist</td>
</tr>
<tr>
<td>3</td>
<td>Cecilia Cadio</td>
<td>Scientist</td>
</tr>
<tr>
<td>4</td>
<td>Adria Melendez Catalan</td>
<td>Scientist</td>
</tr>
<tr>
<td>5</td>
<td>William Durkin</td>
<td>Scientist</td>
</tr>
<tr>
<td>6</td>
<td>Yanming Huang</td>
<td>Scientist</td>
</tr>
<tr>
<td>7</td>
<td>Heidi Reiter</td>
<td>Scientist</td>
</tr>
<tr>
<td>8</td>
<td>Theodore Them</td>
<td>Scientist</td>
</tr>
<tr>
<td>9</td>
<td>Patrick Young</td>
<td>Scientist</td>
</tr>
<tr>
<td>10</td>
<td>Jinchang Zhang</td>
<td>Scientist</td>
</tr>
</tbody>
</table>
III. Instrumentation Summary

All science instruments aboard the Langseth are listed below with data formats in section VII. Summary notes on operation during this cruise are listed below. Seismic equipment is not listed here; refer to Part IV for the seismic summary. Other instruments not listed were not in operation.

### Instrument Data Files

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Description</th>
<th>Data Set</th>
<th>Data Outputs</th>
<th>Files</th>
<th>Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>FE700</td>
<td>Furuno FE700 Echosounder</td>
<td>N/A</td>
<td>serial logs</td>
<td>MGL-bath01.*</td>
<td>1s</td>
</tr>
<tr>
<td>EM122</td>
<td>Kongsberg EM122 Multibeam Sonar</td>
<td>Full</td>
<td>raw output to file</td>
<td>See below</td>
<td>variable</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>centerbeam serial logs</td>
<td>MGL-bath02.*</td>
<td>variable</td>
</tr>
<tr>
<td>KNUDSEN</td>
<td>Knudsen Engineering 3260 Sub-bottom Profiler</td>
<td>Full</td>
<td>KEA, KEB, SEG-Y</td>
<td>See below</td>
<td>variable</td>
</tr>
<tr>
<td>DS50</td>
<td>Furuno DS50 Doppler Speedlog</td>
<td>Full</td>
<td>serial logs</td>
<td>MGL-slog01.*</td>
<td>1s</td>
</tr>
<tr>
<td>XBT/XCTD</td>
<td>Sippican MK21 XBT/XCTD Launcher</td>
<td>1 per drop</td>
<td>raw output to file</td>
<td>See below</td>
<td>n/a</td>
</tr>
<tr>
<td>WX1</td>
<td>RM Young 5103 Weather Bird and Analyzer</td>
<td>Full</td>
<td>serial logs</td>
<td>MGL-wx01.*</td>
<td>1s</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>mww conversion</td>
<td>MGL-mwv01.*</td>
<td>1s</td>
</tr>
<tr>
<td>TSG</td>
<td>SeaBird SBE45 Thermosalinograph</td>
<td>Full</td>
<td>raw serial logs</td>
<td>MGL-tsgraw.*</td>
<td>1s</td>
</tr>
<tr>
<td>CNAV</td>
<td>C&amp;C Tech. CNA V 2000 DGPS Receiver</td>
<td>Full</td>
<td>serial logs</td>
<td>MGL-cnav.*</td>
<td>1s</td>
</tr>
<tr>
<td>CNAV3050</td>
<td>C&amp;C Tech. CNA V 3050 DGPS Receiver</td>
<td>Full</td>
<td>raw serial logs</td>
<td>MGL-cnav3050all.*</td>
<td>1s</td>
</tr>
<tr>
<td>MAG01</td>
<td>GeoMetrics 882 Magnetometer</td>
<td>On Deploy</td>
<td>serial logs</td>
<td>MGL-mag01.*</td>
<td>1s</td>
</tr>
<tr>
<td>BGM</td>
<td>Bell Aerospace BGM-3 Gravimeter</td>
<td>Full</td>
<td>serial logs</td>
<td>MGL-vc01.*</td>
<td>1s</td>
</tr>
<tr>
<td>GYRO</td>
<td>Simrad GC80 Gyrocompass/AD100</td>
<td>Full</td>
<td>serial logs</td>
<td>MGL-gy01.*</td>
<td>1s</td>
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<tr>
<td>POSMV</td>
<td>Applanix POSMV Integrated Nav System</td>
<td>Full</td>
<td>serial logs</td>
<td>MGL-posmv.*</td>
<td>1s</td>
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<tr>
<td>SEAPATH</td>
<td>Kongsberg SeaPath Integrated Nav System</td>
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<td>serial logs</td>
<td>MGL-seapath.*</td>
<td>1s</td>
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<tr>
<td>STU</td>
<td>Sercel Streamer Tension</td>
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<td>serial logs</td>
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<td>MICROSV</td>
<td>Applied Microsystems Sound Velocity Pod Unit #1</td>
<td>Full</td>
<td>serial logs</td>
<td>MGL-svpod01.*</td>
<td>1s</td>
</tr>
<tr>
<td>MICROSV</td>
<td>Applied Microsystems Sound Velocity Pod Unit #2</td>
<td>Full</td>
<td>serial logs</td>
<td>MGL-svpod02.*</td>
<td>1s</td>
</tr>
<tr>
<td>SBE38</td>
<td>SeaBird SBE38 Pod Thermometer Pod Unit #1</td>
<td>Full</td>
<td>serial logs</td>
<td>MGL-temppod01.*</td>
<td>1s</td>
</tr>
<tr>
<td>SBE38</td>
<td>SeaBird SBE38 Pod Thermometer Pod Unit #2</td>
<td>Full</td>
<td>serial logs</td>
<td>MGL-temppod02.*</td>
<td>1s</td>
</tr>
<tr>
<td>PCO2</td>
<td>LDEO PCO2 System</td>
<td>Full</td>
<td>serial logs</td>
<td>MGL-pco2.*</td>
<td>~180s</td>
</tr>
</tbody>
</table>
All timestamps in this report are presented using UTC time and day of year in order to avoid confusion with local time changes.

Science Navigation Instrumentation

FE700

Logging interval: 1 second

File id: bath01

The FE700 only operated up to 800m depth. The echosounder is normally switched off before the unit goes out of depth.

*Interruptions greater than ten seconds are displayed in the following table.*

<table>
<thead>
<tr>
<th>Log Date</th>
<th>Event</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012:083:16:38:40.5855</td>
<td>Start</td>
<td>Logging officially started</td>
</tr>
</tbody>
</table>

bath01 data sample:

```
bath01 2008:220:13:45:42.0681 $SDDBT,,,,,,
bath01 2008:220:13:45:42.0690 $SDDBS,,,,,,
bath01 2008:220:13:45:42.0691 $SDDPT,,0006.6*49
bath01 2008:220:13:45:42.1482 $PFEC,Alarm,0,0*6F
bath01 2008:220:13:45:42.1483 $PFEC,xdr,FORE,050*79
```

EM-122 Mutibeam

The EM122 multibeam sonar was operated throughout the cruise. The system is designed for deeper water, and does not track ground well in less than 50m of water.

EM122 swath data is saved to the cruise archive under MGL1206/raw/multibeam. Center beam depth is recorded separately to serial log. The MicroSV (svpod01) probe in the pod supplied sound velocity to the EM122.

Logging interval: variable with water depth

File id: bath02

*Interruptions greater than one hundred and twenty seconds are displayed in the following table.*

<table>
<thead>
<tr>
<th>Log Date</th>
<th>Event</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Range</td>
<td>Status</td>
<td>Notes</td>
</tr>
<tr>
<td>------------</td>
<td>--------</td>
<td>-------</td>
</tr>
<tr>
<td>2012:084:03:53:15.888 - 2012:084:04:12:35.5967</td>
<td>Missing data</td>
<td>BIST Test</td>
</tr>
<tr>
<td>2012:084:04:12:35.5967 - 2012:084:04:14:56.7747</td>
<td>Missing data</td>
<td>Restarted d/t PU not online</td>
</tr>
<tr>
<td>2012:093:00:08:09.4000 - 2012:093:00:16:43.3177</td>
<td>Missing data</td>
<td>BIST Test</td>
</tr>
<tr>
<td>2012:094:00:10:20:07.53</td>
<td>Missing data</td>
<td>BIST Test</td>
</tr>
<tr>
<td>2012:095:00:07:58.8724 - 2012:095:00:15:51.1593</td>
<td>Missing data</td>
<td>BIST Test</td>
</tr>
<tr>
<td>2012:106:16:53:34.3180</td>
<td>End</td>
<td>Logging officially ended</td>
</tr>
</tbody>
</table>

bath02 data format:

```
bath02  2008:192:00:00:12.6663  $KGDP1,2938.25,0.0,12000.0*4a
bath02  2008:192:00:00:30.3301  $KGDP1,2954.08,0.0,12000.0*4f
```
Knudsen Engineering 3260 Sub-bottom Profiler

File id: n/a
Logging interval: Variable with water depth

The Knudsen 3260 is a chirp echosounder/sub-bottom profiler. It was in operation for the length of the cruise.

There are two sets of segy data recorded/processed this cruise. The segy set in the /raw/knudsen directory are generated by the knudsen software. The segy set in the /processed/knudsen directory are post-processed in the SEGY-Rev0 format.

DS50 Speedlog

File id: slog01
Logging interval: 1 second

The Furuno DS-50 is a Doppler speed log. It was in operation for the length of the cruise.

*Interruptions greater than ten seconds are displayed in the following table.*

<table>
<thead>
<tr>
<th>Log Date</th>
<th>Event</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012:083:00:00:01.6390</td>
<td>Start</td>
<td>Logging officially started</td>
</tr>
<tr>
<td>2012:106:18:39:15.9038</td>
<td>End</td>
<td>Logging officially ended</td>
</tr>
</tbody>
</table>

slog01 data format:

```
2008:231:00:00:00.0744 $VDVHW,,T,,M,09.68,N,17.93,K*4C
2008:231:00:00:00.1906 $VDVWK,009.68,000.09,A,009.68,000.09,V*46
2008:231:00:00:00.1908 $VDVLW,0005960.30,N,0005960.30,N*5F
```

RMYoung Integrated Weather

File id: wx01
Logging interval: 1 second

The weather station is used to log wind speed, direction, air temperature, and barometric pressure. The unit was functioning during the cruise. See also mwv01 below.

*Interruptions greater than ten seconds are displayed in the following table.*
The weather station is used to log wind speed, direction, air temperature, and barometric pressure. The wx01 strings are converted in real-time to produce mwv strings for the DP. The mwv output is strictly a derivative of the w01 output. See also the wx01 description above.

**Interruptions greater than ten seconds are displayed in the following table.**

### mwv01 data sample:

<table>
<thead>
<tr>
<th>Log Date</th>
<th>Event</th>
<th>Comment</th>
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<tbody>
<tr>
<td>2012:083:00:00:00.6749</td>
<td>Start</td>
<td>Logging officially started</td>
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</tbody>
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<table>
<thead>
<tr>
<th>mwv01</th>
<th>2008:231:00:00:00.5173</th>
<th>6.1 6.6 6.6 8.8 354 321 5 0.0 0.0 0.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0 355 355</td>
<td>0 ***** ***** ***** *****</td>
<td>8 8 8 1009.7</td>
</tr>
<tr>
<td>mwv01</td>
<td>2008:231:00:00:01.5172</td>
<td>5.9 6.6 6.6 8.8 353 321 5 0.0 0.0 0.0</td>
</tr>
<tr>
<td>0.0 355 355</td>
<td>0 ***** ***** ***** *****</td>
<td>8 8 8 1009.6</td>
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<tr>
<td>mwv01</td>
<td>2008:231:00:00:02.5190</td>
<td>6.3 6.6 6.6 8.8 354 321 5 0.0 0.0 0.0</td>
</tr>
<tr>
<td>0.0 355 355</td>
<td>0 ***** ***** ***** *****</td>
<td>8 8 8 1009.8</td>
</tr>
</tbody>
</table>

The C-NAV is a global satellite-based differential receiver. This was used as a secondary GPS system on the ship. This system was operational during the cruise.

**Interruptions greater than ten seconds are displayed in the following table.**

### CNAV2000

<table>
<thead>
<tr>
<th>Log Date</th>
<th>Event</th>
<th>Comment</th>
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</thead>
<tbody>
<tr>
<td>2012:083:00:00:00.6749</td>
<td>Start</td>
<td>Logging officially started</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CNAV2000</th>
<th>2008:231:00:00:00.5173</th>
<th>6.1 6.6 6.6 8.8 354 321 5 0.0 0.0 0.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0 355 355</td>
<td>0 ***** ***** ***** *****</td>
<td>8 8 8 1009.7</td>
</tr>
<tr>
<td>CNAV2000</td>
<td>2008:231:00:00:01.5172</td>
<td>5.9 6.6 6.6 8.8 353 321 5 0.0 0.0 0.0</td>
</tr>
<tr>
<td>0.0 355 355</td>
<td>0 ***** ***** ***** *****</td>
<td>8 8 8 1009.6</td>
</tr>
<tr>
<td>CNAV2000</td>
<td>2008:231:00:00:02.5190</td>
<td>6.3 6.6 6.6 8.8 354 321 5 0.0 0.0 0.0</td>
</tr>
<tr>
<td>0.0 355 355</td>
<td>0 ***** ***** ***** *****</td>
<td>8 8 8 1009.8</td>
</tr>
</tbody>
</table>
2012:083:00:00:00.0259   Start   Logging officially started

CNAV3050

File id: cnav3050

Logging interval: 1 second

The C-NAV 3050 is a global satellite-based differential receiver. This is the best individual receiver currently on the ship. This system was operational during the cruise.

Interruptions greater than ten seconds are displayed in the following table.

<table>
<thead>
<tr>
<th>Log Date</th>
<th>Event</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012:083:00:00:00.6329</td>
<td>Start</td>
<td>Logging officially started</td>
</tr>
</tbody>
</table>

cnav3050 data format:

```
cnav 2008:231:00:00:00.6936
$GPGGA,000000.00,1434.94372,N,10444.85748,W,2,8,1.1,15.52,M,-20.60,M,9.0108*65
```

```
cnav 2008:231:00:00:00.7137
$GPVTG,006.5,T,,M,9.64,N,17.85,K*53
```

GC80 Gyrocompass

The GC80 gyrocompass is installed on the bridge and used for ship and seismic navigation.

File id: gy01

Logging interval: 1 second

Interruptions greater than ten seconds are displayed in the following table.

<table>
<thead>
<tr>
<th>Log Date</th>
<th>Event</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012:083:00:00:00.0239</td>
<td>Start</td>
<td>Logging officially started</td>
</tr>
</tbody>
</table>

gy01 data format:

```
gy01 2008:231:00:00:00.4110
$PTKM,HEALM,0000,0,G1*09
```
POS MV Integrated Nav

The POS/MV is a receiver that uses CNAV input in addition to its own antennae, an inertial sensor and optional RTQ, WTC, or WAAS corrections and a Kalman filter to produce a smooth navigation output and very accurate heading.

Note that the PosMV was not operational (on but not outputting any good data) throughout the entire cruise and stopped functioning completely on Julian day 85.

File id: posmv
Logging interval: 1 second

Interruptions greater than ten seconds are displayed in the following table.

<table>
<thead>
<tr>
<th>Log Date</th>
<th>Event</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012:083:00:00:00.6979</td>
<td>Start</td>
<td>Logging officially started</td>
</tr>
<tr>
<td>2012:085:17:29:45.0239</td>
<td>End</td>
<td>Logging officially ended</td>
</tr>
</tbody>
</table>

posmv data format:

```
posmv 2008:231:00:00:00.6395 $HEHDT,005.8,T*22
posmv 2008:231:00:00:00.6396 $HEROT,-005.25,A*34
posmv 2008:231:00:00:01.6394 $HEHDT,005.7,T*2D
posmv 2008:231:00:00:01.6395 $HEROT,-004.53,A*34
```

SeaPath Integrated Nav

The Kongsberg Seapath is an integrated navigation system. It was in operation for the length of the cruise.

Logging interval: 1 second

File id: seapath

Interruptions greater than ten seconds are displayed in the following table.

```
posmv 2008:231:00:00:00.0885 $INGGA,235959.842,1434.95002,N,10444.85734,W,2,,1.1,12.71,M,,9.0,0108*2E
posmv 2008:231:00:00:00.0889 $INHDT,15.0,T*11
posmv 2008:231:00:00:00.2047 $INVTG,7.0,T,,M,9.7,N,17.9,K*46
posmv 2008:231:00:00:00.3208 $INGST,235959.842,,0.9,0.9,0.0,0.9,0.9,2.5*51
posmv 2008:231:00:00:00.4411 $PASHR,235959.842,15.05,T,-
0.58,0.48,0.15,0.069,0.069,0.045,2,0*05
posmv 2008:231:00:00:00.4412 $INZDA,235959.0000,17,08,2008,,*73
```
<table>
<thead>
<tr>
<th>Log Date</th>
<th>Event</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012:083:00:00:00.3939</td>
<td>Start</td>
<td>Logging officially started</td>
</tr>
</tbody>
</table>

**seapath data format:**

```
seapath 2008:231:00:00:00.0504 $INZDA,235959.99,17,08,2008,,*73
seapath 2008:231:00:00:00.1686 $INGGA,235959.99,1434.953109,N,10444.859147,W,2,08,1.1,=
16.30,M,,M,1.0,0291*70
seapath 2008:231:00:00:00.1687 $INVTG,5.97,T,,M,9.7,N,,K,D*03
seapath 2008:231:00:00:00.1688 $INHDT,5.82,T*1A
```

**Sercel Streamer Tension Unit**

The Sercel Streamer Tension Unit measures streamer tension in pounds. It was in operation while streamers were deployed.

**Logging interval:** 15 seconds

**File id:** stu1

*Data intermittent interruptions greater than thirty seconds are displayed in the following table.*

<table>
<thead>
<tr>
<th>Log Date</th>
<th>Event</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012:089:20:03:44.1402</td>
<td>Start</td>
<td>Logging officially started</td>
</tr>
<tr>
<td>2012:100:00:08:02.8965 - 2012:100:00:08:42.9692</td>
<td>Missing data</td>
<td>Reason not specified</td>
</tr>
<tr>
<td>2012:106:16:53:53.6708</td>
<td>End</td>
<td>Logging officially ended</td>
</tr>
</tbody>
</table>

**stu1 data format:**

```
stu1 2011:130:00:02:12.8968 111 129 22 0 49 1 0 3360 3472 179
33 1 1 3643 3643 -157 31 1 2 3964 3994 -157
34 1 3 3487 3584 -157 32
```

```
stu1 2011:130:00:02:27.8994 111 129 22 1 4 1 0 3375 3487 -164
33 1 1 3643 3793 -157 31 1 2 3950 4002 -164
34 1 3 3509 3606 -179 32
```

**Geometrics 882 Magnetometer**
The Geometrics 882 magnetometer is towed behind the ship. Raw serial output is logged using LDS. Deployment is dependent upon seismic operations. See the deployment notes below. For further information, see the elog files in docs/elog.

**Magnetometer Deployment Notes**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012:089:18:55:00.0000</td>
<td>Power up maggie and begin deployment</td>
</tr>
<tr>
<td>2012:089:19:04:00.0000</td>
<td>Maggie deployed and in position</td>
</tr>
<tr>
<td>2012:090:08:56:00.0000</td>
<td>Maggie stopped communicating and powered off</td>
</tr>
<tr>
<td>2012:090:08:58:00.0000</td>
<td>Recovering maggie</td>
</tr>
<tr>
<td>2012:090:09:03:00.0000</td>
<td>Maggie onboard</td>
</tr>
<tr>
<td>2012:090:09:09:00.0000</td>
<td>Powered maggie on; no comms</td>
</tr>
<tr>
<td>2012:090:10:28:00.0000</td>
<td>Maggie powered on; tow lead changed to new one; deploying maggie</td>
</tr>
<tr>
<td>2012:090:10:32:00.0000</td>
<td>Maggie in position</td>
</tr>
<tr>
<td>2012:091:21:44:00.0000</td>
<td>Begin retrieval</td>
</tr>
<tr>
<td>2012:091:21:48:00.0000</td>
<td>Maggie onboard</td>
</tr>
<tr>
<td>2012:092:19:22:00.0000</td>
<td>Beging deployment</td>
</tr>
<tr>
<td>2012:092:19:25:00.0000</td>
<td>Maggie in position and logging</td>
</tr>
<tr>
<td>2012:094:10:47:00.0000</td>
<td>Begin recovering maggie</td>
</tr>
<tr>
<td>2012:094:10:50:00.0000</td>
<td>Maggie onboard</td>
</tr>
<tr>
<td>2012:094:13:14:00.0000</td>
<td>Begin deploying maggie</td>
</tr>
<tr>
<td>2012:094:13:17:00.0000</td>
<td>Maggie in position</td>
</tr>
<tr>
<td>2012:095:09:04:00.0000</td>
<td>Power off maggie for retrieval d/t weather</td>
</tr>
<tr>
<td>2012:095:09:07:00.0000</td>
<td>Begin recovering maggie</td>
</tr>
<tr>
<td>2012:095:09:10:00.0000</td>
<td>Maggie onboard</td>
</tr>
<tr>
<td>2012:095:19:35:00.0000</td>
<td>Start deploying maggie</td>
</tr>
<tr>
<td>2012:095:19:39:00.0000</td>
<td>Maggie in position</td>
</tr>
<tr>
<td>2012:096:12:30:00.0000</td>
<td>Begin recovering maggie</td>
</tr>
<tr>
<td>2012:096:12:35:00.0000</td>
<td>Maggie on deck</td>
</tr>
<tr>
<td>2012:096:14:50:00.0000</td>
<td>Deploying maggie</td>
</tr>
<tr>
<td>2012:096:14:53:00.0000</td>
<td>Maggie in position</td>
</tr>
<tr>
<td>2012:097:15:31:00.0000</td>
<td>Begin recovering maggie</td>
</tr>
<tr>
<td>2012:097:15:36:00.0000</td>
<td>Maggie onboard</td>
</tr>
</tbody>
</table>
Logging interval: 1 second

File id: mag01

Interruptions greater than ten seconds are displayed in the following table.

<table>
<thead>
<tr>
<th>Log Date</th>
<th>Event</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012:089:18:56:36.6669</td>
<td>Start</td>
<td>Logging officially started</td>
</tr>
</tbody>
</table>

mag01 data sample:

| mag01 2008:185:09:45:58.1820 | $107714.673,0042,0024,0110,3533,1143 |
| mag01 2008:185:09:46:01.0333 | $ 63703.933,0042,0024,0110,3533,1143 |
| mag01 2008:185:09:46:04.0330 | $ 44031.029,0042,0027,0110,3533,1143 |

SBE-45 Thermosalinograph

The Seabird TSG output is logged by LDS to the “tsg” set.

File id: tsgraw

Logging interval: 1 second

Data intermittent interruptions greater than ten seconds are displayed in the following table.

<table>
<thead>
<tr>
<th>Log Date</th>
<th>Event</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012:084:01:19:27.7541</td>
<td>Start</td>
<td>Logging officially started</td>
</tr>
</tbody>
</table>
---|---|---

BGM-3 Gravimeter

The Bell Aerospace BGM-3 Gravimeter operated normally during the length of this cruise.

File id: vc01
Logging interval: 1 second

Interruptions greater than ten seconds are displayed in the following table.

<table>
<thead>
<tr>
<th>Log Date</th>
<th>Event</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012:083:00:00:00.9419</td>
<td>Start</td>
<td>Logging officially started</td>
</tr>
</tbody>
</table>

vc01 data format:

```
vc01 2011:130:00:00:08.2866 01:024436 00
vc01 2011:130:00:00:09.2926 01:024548 00
```

Applied Microsystems MicroSV Pod Unit #1

The Applied Microsystems MicroSV probe #1 in the pod was functional and logging during the length of the cruise.

File id: svpod01
Logging interval: 1 second

Interruptions greater than ten seconds are displayed in the following table.

<table>
<thead>
<tr>
<th>Log Date</th>
<th>Event</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012:083:00:00:00.3469</td>
<td>Start</td>
<td>Logging officially started</td>
</tr>
</tbody>
</table>

svpod01 data format:
Applied Microsystems MicroSV Pod Unit #2

The Applied Microsystems MicroSV probe #2 in the pod was functional and logging during the length of the cruise.

File id: svpod02
Logging interval: 1 second

Interruptions greater than ten seconds are displayed in the following table.

<table>
<thead>
<tr>
<th>Log Date</th>
<th>Event</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012:083:00:00:00.4629</td>
<td>Start</td>
<td>Logging officially started</td>
</tr>
</tbody>
</table>

svpod02 data format:

<table>
<thead>
<tr>
<th>svpod02</th>
<th>2011:130:00:00:08.0686</th>
<th>1541.87</th>
</tr>
</thead>
<tbody>
<tr>
<td>svpod02</td>
<td>2011:130:00:00:09.0746</td>
<td>1541.88</td>
</tr>
</tbody>
</table>

Seabird SBE38 Temperature Probe Pod Unit #1

The Seabird SBE38 temperature probe #1 in the pod was functional and logging during the length of the cruise.

File id: temppod01
Logging interval: 1 second

Interruptions greater than ten seconds are displayed in the following table.

<table>
<thead>
<tr>
<th>Log Date</th>
<th>Event</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012:083:00:00:00.2439</td>
<td>Start</td>
<td>Logging officially started</td>
</tr>
</tbody>
</table>

temppod01 data format:

<table>
<thead>
<tr>
<th>temppod01</th>
<th>2011:130:00:00:07.0855</th>
<th>29.4851</th>
</tr>
</thead>
<tbody>
<tr>
<td>temppod01</td>
<td>2011:130:00:00:07.9476</td>
<td>29.4850</td>
</tr>
</tbody>
</table>

Seabird SBE38 Temperature Probe Pod Unit #2
The Seabird SBE38 temperature probe #2 in the pod was functional and logging during the length of the cruise.

**File id:** temppod02  
**Logging interval:** 1 second

*Interruptions greater than ten seconds are displayed in the following table.*

<table>
<thead>
<tr>
<th>Log Date</th>
<th>Event</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012:083:00:00:00.8179</td>
<td>Start</td>
<td>Logging officially started</td>
</tr>
</tbody>
</table>

**temppod02 data format:**

```
temppod02 2011:130:00:00:07.2015 29.4884
temppod02 2011:130:00:00:08.0786 29.4883
```

**LDEO PCO2 System**

The LDEO PCO2 system output is logged by LDS to the “pco2” set.  
See below for more information.

**File id:** pco2  
**Logging interval:** ~180 seconds

*Interruptions greater than three hundred seconds are displayed in the following table.*

<table>
<thead>
<tr>
<th>Log Date</th>
<th>Event</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012:088:02:20:50.6694</td>
<td>Start</td>
<td>Logging officially started</td>
</tr>
<tr>
<td>2012:091:08:16:47.6809 - 2012:091:08:30:51.6197</td>
<td>Missing data</td>
<td>No serial data output</td>
</tr>
<tr>
<td>2012:106:15:51:08.0021</td>
<td>End</td>
<td>Logging officially ended</td>
</tr>
</tbody>
</table>

**pco2 data format:**

```
pco2 2011:130:00:27:11.9162 2011130.02002 2370.39 37.54 1007.07 404.51 28.42 386.9 5000.00 19 0
```

Equil
Mk21 XBT System

Files: *.RDF, *.EDF

Nineteen XBT drops (9x T-5 and 10x T-7) were made during this cruise. The data set is saved to the raw/XBT directory in the cruise archive. Refer to the MGL1206_Expendable_Drops.xls spreadsheet in the docs/operations directory of the cruise archive for more information.
### IV. Seismic Summary

#### A. Acquisition Parameter Table

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acquisition Parameter Table</strong></td>
<td></td>
</tr>
<tr>
<td>AcquisitionParameterID</td>
<td>MGL1206_Acq01</td>
</tr>
<tr>
<td>FieldActivityID</td>
<td>MGL1206</td>
</tr>
<tr>
<td>ReceiverType</td>
<td>Sentry Solid Streamer</td>
</tr>
<tr>
<td>SourceType</td>
<td>Airgun</td>
</tr>
<tr>
<td>Acquisition System Name</td>
<td>Sercel Syntrak 960</td>
</tr>
<tr>
<td>Acquisition System Type</td>
<td>MCS</td>
</tr>
<tr>
<td>Seismic Nav System</td>
<td>C-Nav 3050 primary</td>
</tr>
<tr>
<td>Survey Datum</td>
<td>WGS84</td>
</tr>
<tr>
<td>Navigation Reference Point</td>
<td>Fore/Aft+29.5 m, Stb/pt +0.00 m, vertical +16.9 m Keel, centerline, ~frame 42 (Seapath 200 calculated center of gravity) waterline</td>
</tr>
<tr>
<td>NRP to source</td>
<td>232.0 m</td>
</tr>
<tr>
<td>Source to Near Channel</td>
<td>152.70 m</td>
</tr>
<tr>
<td>Number of channels recorded</td>
<td>468</td>
</tr>
<tr>
<td>Number of cables</td>
<td>1</td>
</tr>
<tr>
<td>Number of channels each cable</td>
<td>468</td>
</tr>
<tr>
<td>Channel length</td>
<td>12.5 m</td>
</tr>
<tr>
<td>Cable length</td>
<td>6.0 km</td>
</tr>
<tr>
<td>Cable_spacing</td>
<td>N/A</td>
</tr>
<tr>
<td>Near Channel Number</td>
<td>N/A</td>
</tr>
<tr>
<td>Cable_depth</td>
<td>9.0 m</td>
</tr>
<tr>
<td>Number sources</td>
<td>1</td>
</tr>
<tr>
<td>Sub-arrays per source</td>
<td>4</td>
</tr>
<tr>
<td>Alternate Shooting</td>
<td>No</td>
</tr>
<tr>
<td>Source separation</td>
<td>N/A</td>
</tr>
<tr>
<td>Sub-array separation</td>
<td>8.0 m</td>
</tr>
<tr>
<td>Source volume</td>
<td>6600 cu in</td>
</tr>
<tr>
<td>Source pressure</td>
<td>2000 psi nominal</td>
</tr>
<tr>
<td>Source make, model</td>
<td>Bolt 1500LL &amp; 1900LL</td>
</tr>
<tr>
<td>Source number</td>
<td>36 + 4 spare</td>
</tr>
<tr>
<td>Source depth</td>
<td>9.0 m</td>
</tr>
<tr>
<td>Shot control</td>
<td>Distance</td>
</tr>
<tr>
<td>Shot_interval</td>
<td>50 m</td>
</tr>
<tr>
<td>Sample_interval</td>
<td>2ms</td>
</tr>
<tr>
<td>Record_length</td>
<td>16s</td>
</tr>
<tr>
<td>Compass birds</td>
<td>22 Digicourse 5011</td>
</tr>
<tr>
<td>Recording_delay</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Acquisition Parameter Table**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AcquisitionParameterID</td>
<td>MGL1206_Acq02</td>
</tr>
<tr>
<td>FieldActivityID</td>
<td>MGL1206</td>
</tr>
<tr>
<td><strong>ReceiverType</strong></td>
<td>Sentry Solid Streamer</td>
</tr>
<tr>
<td>------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td><strong>SourceType</strong></td>
<td>Airgun</td>
</tr>
<tr>
<td><strong>Acquisition System Name</strong></td>
<td>Sercel Syntrak 960</td>
</tr>
<tr>
<td><strong>Acquisition System Type</strong></td>
<td>MCS</td>
</tr>
<tr>
<td><strong>Seismic_Nav_System</strong></td>
<td>C-Nav 3050 primary</td>
</tr>
<tr>
<td><strong>Survey_datum</strong></td>
<td>WGS84</td>
</tr>
<tr>
<td><strong>Navigation Reference Point</strong></td>
<td>Fore/Aft+29.5 m, Stb/pt +0.00 m, vertical +16.9 m Keel, centerline, ~frame 42 (Seapath 200 calculated center of gravity) waterline</td>
</tr>
<tr>
<td><strong>NRP to source</strong></td>
<td>232.00 m</td>
</tr>
<tr>
<td><strong>Source_to_Near_Channel</strong></td>
<td>152.70 m</td>
</tr>
<tr>
<td><strong>Number_of_channels_recorded</strong></td>
<td>468</td>
</tr>
<tr>
<td><strong>Number_of_cables</strong></td>
<td>1</td>
</tr>
<tr>
<td><strong>Number_of_channels_each_cable</strong></td>
<td>468</td>
</tr>
<tr>
<td><strong>Channel_length</strong></td>
<td>12.5 m</td>
</tr>
<tr>
<td><strong>Cable_length</strong></td>
<td>6.0 km</td>
</tr>
<tr>
<td><strong>Cable_spacing</strong></td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Near_Channel_Number</strong></td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Cable_depth</strong></td>
<td>12.0 m</td>
</tr>
<tr>
<td><strong>Number_sources</strong></td>
<td>1</td>
</tr>
<tr>
<td><strong>Sub-arrays_per_source</strong></td>
<td>4</td>
</tr>
<tr>
<td><strong>Alternate_Shooting</strong></td>
<td>No</td>
</tr>
<tr>
<td><strong>Source_separation</strong></td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Sub-array_separation</strong></td>
<td>8.0 m</td>
</tr>
<tr>
<td><strong>Source_volume</strong></td>
<td>6600 cu in</td>
</tr>
<tr>
<td><strong>Source_pressure</strong></td>
<td>2000 psi nominal</td>
</tr>
<tr>
<td><strong>Source_make,model</strong></td>
<td>Bolt 1500LL &amp; 1900LL</td>
</tr>
<tr>
<td><strong>Source_number</strong></td>
<td>36 + 4 spare</td>
</tr>
<tr>
<td><strong>Source_depth</strong></td>
<td>9.0 m</td>
</tr>
<tr>
<td><strong>Shot_control</strong></td>
<td>Distance</td>
</tr>
<tr>
<td><strong>ShotInterval</strong></td>
<td>50 m</td>
</tr>
<tr>
<td><strong>Sample_interval</strong></td>
<td>2ms</td>
</tr>
<tr>
<td><strong>Record_length</strong></td>
<td>16s</td>
</tr>
<tr>
<td><strong>Compass_birds</strong></td>
<td>22 Digicourse 5011</td>
</tr>
<tr>
<td><strong>Recording_delay</strong></td>
<td>N/A</td>
</tr>
</tbody>
</table>

See the “MGL1206 Seismic Configuration by Sequence Acquired.xls” file in the MGL1206/docs/offsets directory for more information.

**B. Seismic Overview**

**Physical Configuration**
The towing configuration for the air guns and streamers is detailed in the document titled *MGL1206_Offsets.xls*.

**Offsets**
All antenna and in-water offset drawings are in the file *MGL1206_Offsets.xls*

**Spectra**
Spectra was used for all timing and navigation during the cruise. Shotlogs were generated from spectra header logs, P190 and P294 files using shotlog processing code contained on the archive in /supplemental/code/shotlog.
V. RV Langseth Gravity Tie Information

The Gravimeter was tied before and after the cruise at the tie point located at the pier in Kodiak.

<table>
<thead>
<tr>
<th>Date / Time</th>
<th>Ship Location</th>
<th>Reference Location</th>
<th>Mistie</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012-04-15T19:32</td>
<td>Honolulu, HI, UH Marine Center 21 18.9737 N 157 53.1742 W</td>
<td>Honolulu, HI, UH Marine Center UH Marine Center Pierside Tiepoint 21 18.962 N 157 53.180 W</td>
<td>Honolulu, HI, UH Marine Center 21 18.972 N 157 53.181 W</td>
</tr>
</tbody>
</table>

Please refer to the documents located under MGL1206/docs/gravity_tie for detailed records.
VI. Archive Contents

Key files are bolded.

<table>
<thead>
<tr>
<th>Directory Path</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MGL1206/docs</td>
<td>Cruise documents and logs</td>
</tr>
<tr>
<td>MGL1206/docs/config</td>
<td>Configuration archive</td>
</tr>
<tr>
<td>MGL1206/docs/elog</td>
<td>Cruise elog</td>
</tr>
<tr>
<td>MGL1206/docs/gravity_tie</td>
<td>Gravity Tie information</td>
</tr>
<tr>
<td>MGL1206/docs/map</td>
<td>Cruise maps, track map</td>
</tr>
<tr>
<td>MGL1206/docs/offsets</td>
<td>Vessel/sensor offsets</td>
</tr>
<tr>
<td>MGL1206/docs/operations/</td>
<td>Operations documents</td>
</tr>
<tr>
<td>MGL1206/docs/operations/Daily_Reports</td>
<td>Cruise Daily Reports from Chief Science Officer</td>
</tr>
<tr>
<td>MGL1206/docs/operations/NavLogs</td>
<td>Seismic navigation logs (spectra)</td>
</tr>
<tr>
<td>MGL1206/docs/operations/ObsLogs</td>
<td>Seismic acquisition logs (gun controller)</td>
</tr>
<tr>
<td>MGL1206/docs/operations/MGL1206_B15_line_log_multi_channel_seismics.xls</td>
<td>Master line log table</td>
</tr>
<tr>
<td>MGL1206/docs/permits</td>
<td>Clearance Documents</td>
</tr>
<tr>
<td>MGL1206/docs/waypoints</td>
<td>Waypoint files</td>
</tr>
<tr>
<td>MGL1206/docs/personnel</td>
<td>Personnel rosters, org chart, bunk and phone lists</td>
</tr>
<tr>
<td>MGL1206/docs/reports</td>
<td>Cruise Report and supplemental docs</td>
</tr>
<tr>
<td>MGL1206/docs/reports/MGL1206_DataReport_v1.0.doc</td>
<td>This file</td>
</tr>
<tr>
<td>MGL1206/docs/offsets/MGL1206_Offsets.xls</td>
<td>Vessel/sensor offsets</td>
</tr>
<tr>
<td>MGL1206/docs/scereencaps</td>
<td>Screen captures</td>
</tr>
<tr>
<td>MGL1206/processed</td>
<td>Processed data</td>
</tr>
<tr>
<td>MGL1206/processed/reflex (3D data-sets only, not applicable to OBS and 2D)</td>
<td>Spectra reflex files</td>
</tr>
<tr>
<td>MGL1206/processed/shotlogs</td>
<td>Shot log files</td>
</tr>
<tr>
<td>MGL1206/processed/sprint</td>
<td>Sprint files</td>
</tr>
<tr>
<td>MGL1206/processed/svp</td>
<td>Sound velocity profiles</td>
</tr>
<tr>
<td>MGL1206/raw</td>
<td>Raw data</td>
</tr>
<tr>
<td>MGL1206/raw/adcp</td>
<td>Raw ADCP data</td>
</tr>
<tr>
<td>MGL1206/raw/knudsen</td>
<td>Raw Knudsen sub-bottom profiler data</td>
</tr>
<tr>
<td>MGL1206/raw/multibeam</td>
<td>Raw EM122 data</td>
</tr>
<tr>
<td>MGL1206/raw/serial</td>
<td>Underway serial data: gps, tsg, weather, etc.</td>
</tr>
<tr>
<td>MGL1206/raw/spectra/P1</td>
<td>Spectra p190</td>
</tr>
<tr>
<td>MGL1206/raw/spectra/P2</td>
<td>Spectra p294</td>
</tr>
<tr>
<td>MGL1206/raw/XBT</td>
<td>Raw XBT data</td>
</tr>
</tbody>
</table>
VII. Data Formats

**Gravimeter data**
The gravimeter serial data is output in the following format:

01:025610 01

01:xxxxxx ff

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>output frequency</td>
<td>Hz</td>
</tr>
<tr>
<td>xxxx</td>
<td>raw counts</td>
<td>n/a</td>
</tr>
<tr>
<td>ff</td>
<td>sensor status</td>
<td>n/a</td>
</tr>
</tbody>
</table>
CNA GPS receiver data
CNA outputs data in NMEA 0183 compatible format. Currently* the following sentence types are enabled:

- $GPVTG-GPS Velocity, Track made good and Ground speed data (computed by the CNA GPS receiver).
- $GPGGA-Global Positioning System Fix data (computed by the CNA GPS receiver).

*Note: there are other sentence types available from CNA. Please consult the software manual for more options.

### $GPVTG, xxx.x, T,, M, m.mm, N, n.nn, K*hh

#### $GPVTG Sentence Fields

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>xxx.x</td>
<td>Course over ground (COG)</td>
<td>Degrees from True North</td>
</tr>
<tr>
<td>T</td>
<td>Indicates course relative to True North</td>
<td>n/a</td>
</tr>
<tr>
<td>M</td>
<td>COG</td>
<td>Degrees from Magnetic North</td>
</tr>
<tr>
<td>m.mm</td>
<td>Speed over ground (SOG)</td>
<td>Nautical miles per hour (knots)</td>
</tr>
<tr>
<td>N</td>
<td>Indicates that the speed over ground is in knots</td>
<td>n/a</td>
</tr>
<tr>
<td>n.nn</td>
<td>SOG</td>
<td>km/h</td>
</tr>
<tr>
<td>K</td>
<td>Indicates that the SOG is in km/h</td>
<td>n/a /td&gt;</td>
</tr>
<tr>
<td>*hh</td>
<td>Checksum (hexadecimal representation)</td>
<td>n/a</td>
</tr>
</tbody>
</table>

### $GPGGA,hhmmss.ss, ddmm.mmmmm, a, ddmm.mmmmm, a, x, xx, x.x, xx.xx, M, xx.xx, M, x.x, xyy*hh

#### $GPGGA Sentence Fields

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>hhmmss.ss</td>
<td>UTC time of position</td>
<td>Hours/Minutes/Seconds</td>
</tr>
<tr>
<td>ddmm.mmmmm</td>
<td>Latitude</td>
<td>Degrees/Minutes.decimal</td>
</tr>
<tr>
<td>a</td>
<td>Direction of Latitude</td>
<td>n/a</td>
</tr>
<tr>
<td>N</td>
<td>N = North</td>
<td>n/a</td>
</tr>
<tr>
<td>S</td>
<td>S = South</td>
<td>n/a</td>
</tr>
<tr>
<td>ddmm.mmmmm</td>
<td>Longitude</td>
<td>Degrees/Minutes.decimal</td>
</tr>
<tr>
<td>a</td>
<td>Direction of Longitude</td>
<td>n/a</td>
</tr>
<tr>
<td>E</td>
<td>E = East</td>
<td>n/a</td>
</tr>
<tr>
<td>W</td>
<td>W = West</td>
<td>n/a</td>
</tr>
<tr>
<td>x</td>
<td>GPS Quality indicator</td>
<td>n/a</td>
</tr>
<tr>
<td>0</td>
<td>fix not valid</td>
<td>n/a</td>
</tr>
<tr>
<td>1</td>
<td>GPS Autonomous fix</td>
<td>n/a</td>
</tr>
<tr>
<td>2</td>
<td>GcGPS Corrected Fix</td>
<td>n/a</td>
</tr>
<tr>
<td>xx</td>
<td>Number of GPS satellites used in solution fix</td>
<td>n/a</td>
</tr>
<tr>
<td>x.x</td>
<td>Horizontal Dilution of Precision (HDOP)</td>
<td>n/a</td>
</tr>
<tr>
<td>xx.xx</td>
<td>C-NAV GPS receiver antenna altitude reference to Mean Sea Level (MSL)</td>
<td>n/a</td>
</tr>
<tr>
<td>M</td>
<td>Altitude units--M indicates meters</td>
<td>n/a</td>
</tr>
<tr>
<td>xx.xx</td>
<td>WGS-84 Geoidal separation distance from MSL based on the NIMA/NASA EGM96 15-minute (Earth Gravity Model)</td>
<td>Meters</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Value</td>
</tr>
<tr>
<td>---</td>
<td>-----------------------------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>M</td>
<td>Geosoidal separation units--M indicates meters</td>
<td>n/a</td>
</tr>
<tr>
<td>x.x</td>
<td>Age of GcGPS corrections used in solution fix</td>
<td>n/a</td>
</tr>
<tr>
<td>xyy</td>
<td>C-NAV GPS receiver reference identification</td>
<td>x is downlink satellite beam in use, yy is the GPS correction mode/type being used</td>
</tr>
<tr>
<td>*hh</td>
<td>Checksum (hexadecimal representation) followed by CRLF terminator pair</td>
<td>n/a</td>
</tr>
</tbody>
</table>
CNA V 3050 GPS receiver data
CNA V 3050 outputs data in NMEA 0183 compatible format. Currently* the following sentence types are enabled:

- $GPVTG-GPS Velocity, Track made good and Ground speed data (computed by the CNA V GPS receiver).
- $GPGGA-Gobal Positioning System Fix data (computed by the CNA V GPS receiver).

*Note: there are other sentence types available from CNA V. Please consult the software manual for more options.

$GPVTG, xxx.x, T,, M, m.mm, N, n.nn, K*hh

$GPVTG Sentence Fields

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>xxx.x</td>
<td>Course over ground (COG)</td>
<td>Degrees from True North</td>
</tr>
<tr>
<td>T</td>
<td>Indicates course relative to True North</td>
<td>n/a</td>
</tr>
<tr>
<td>M</td>
<td>COG</td>
<td>Degrees from Magnetic North</td>
</tr>
<tr>
<td>m.mm</td>
<td>Speed over ground (SOG)</td>
<td>Nautical miles per hour (knots)</td>
</tr>
<tr>
<td>N</td>
<td>Indicates that the speed over ground is in knots</td>
<td>n/a</td>
</tr>
<tr>
<td>n.nn</td>
<td>SOG</td>
<td>km/h</td>
</tr>
<tr>
<td>K</td>
<td>Indicates that the SOG is in km/h</td>
<td>n/a /td&gt;</td>
</tr>
<tr>
<td>*hh</td>
<td>Checksum (hexadecimal representation)</td>
<td>n/a</td>
</tr>
</tbody>
</table>

$GPGGA, hhmmss.ss, ddmm.mmmmm, a, ddmm.mmmmm, a, x, xx, x.x, xx.xx, M, xx.xx, M, x.x, xyy*hh

$GPGGA Sentence Fields

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>hhmmss.ss</td>
<td>UTC time of position</td>
<td>Hours/Minutes/Seconds</td>
</tr>
<tr>
<td>ddmm.mmmmm</td>
<td>Latitude</td>
<td>Degrees/Minutes.Decimal</td>
</tr>
<tr>
<td>a</td>
<td>Direction of Latitude</td>
<td>n/a</td>
</tr>
<tr>
<td>N = North</td>
<td></td>
<td>n/a</td>
</tr>
<tr>
<td>S = South</td>
<td></td>
<td>n/a</td>
</tr>
<tr>
<td>ddmm.mmmmm</td>
<td>Longitude</td>
<td>Degrees/Minutes.Decimal</td>
</tr>
<tr>
<td>a</td>
<td>Direction of Longitude</td>
<td>n/a</td>
</tr>
<tr>
<td>E = East</td>
<td></td>
<td>n/a</td>
</tr>
<tr>
<td>W = West</td>
<td></td>
<td>n/a</td>
</tr>
<tr>
<td>x</td>
<td>GPS Quality indicator</td>
<td>n/a</td>
</tr>
<tr>
<td>0 = fix not valid</td>
<td></td>
<td>n/a</td>
</tr>
<tr>
<td>1 = GPS Autonomous fix</td>
<td></td>
<td>n/a</td>
</tr>
<tr>
<td>2 = GeGPS Corrected Fix</td>
<td></td>
<td>n/a</td>
</tr>
<tr>
<td>xx</td>
<td>Number of GPS satellites used in solution fix</td>
<td>n/a</td>
</tr>
<tr>
<td>x.x</td>
<td>Horizontal Dilution of Precision (HDOP)</td>
<td>n/a</td>
</tr>
<tr>
<td>xx.xx</td>
<td>C-NAV GPS receiver antenna altitude reference to Mean Sea Level (MSL)</td>
<td>n/a</td>
</tr>
<tr>
<td>M</td>
<td>Altitude units--M indicates meters</td>
<td>n/a</td>
</tr>
<tr>
<td>xx.xx</td>
<td>WGS-84 Geoidal separation distance from MSL based on the NIMA/NASA</td>
<td>Meters</td>
</tr>
<tr>
<td>EGM96 15-minute (Earth Gravity Model)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M  Geosoidal separation units--M indicates meters</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>x.x Age of GcGPS corrections used in solution fix</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>xyy C-NAV GPS receiver reference identification</td>
<td>x is downlink satellite beam in use yy is the GPS correction mode/type being used</td>
<td></td>
</tr>
<tr>
<td>*hh Checksum (hexadecimal representation) followed by CRLF terminator pair</td>
<td>n/a</td>
<td></td>
</tr>
</tbody>
</table>
**EM122 Center Beam Depth**

This page describes the EM122 centerbeam depth serial output, used for real-time depth display. For full multibeam data, please see the [multibeam](#) page.

The EM122 outputs serial data in the following formats:

- KIDPT - Depth below transducer

**SKIDBT,x.x,x.x,x.x,*hh**

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>x.x</td>
<td>Water depth</td>
<td>feet</td>
</tr>
<tr>
<td>x.x</td>
<td>Water depth</td>
<td>meters</td>
</tr>
<tr>
<td>x.x</td>
<td>Water depth</td>
<td>fathoms</td>
</tr>
<tr>
<td>*hh</td>
<td>Checksum</td>
<td>n/a</td>
</tr>
</tbody>
</table>

SDDBT sentence format
**FE700 Navigational Echosounder data**
The FE700 Navigational Echosounder outputs data in the following formats:

- $PFEC$ - unspecified
- $SDDBT$ - Depth Below Transducer
- $SDDBS$ - Depth Below Surface

**$PFEC$,aaaa,x,x*hF**

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>aaaa</td>
<td>unspecified</td>
<td>unspecified</td>
</tr>
<tr>
<td>x</td>
<td>unspecified</td>
<td>unspecified</td>
</tr>
<tr>
<td>x</td>
<td>unspecified</td>
<td>unspecified</td>
</tr>
<tr>
<td>*hF</td>
<td>unspecified</td>
<td>unspecified</td>
</tr>
</tbody>
</table>

**$SDDBT$,x.x,f,x.x,M,x.x,F*hh**

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>x.x</td>
<td>Water depth</td>
<td>feet</td>
</tr>
<tr>
<td>f</td>
<td>$f = \text{feet}$</td>
<td>n/a</td>
</tr>
<tr>
<td>x.x</td>
<td>Water depth</td>
<td>meters</td>
</tr>
<tr>
<td>M</td>
<td>$M = \text{meters}$</td>
<td>n/a</td>
</tr>
<tr>
<td>x.x</td>
<td>Water depth</td>
<td>fathoms</td>
</tr>
<tr>
<td>F</td>
<td>$F = \text{fathoms}$</td>
<td>n/a</td>
</tr>
<tr>
<td>*hh</td>
<td>Checksum</td>
<td>n/a</td>
</tr>
</tbody>
</table>

**$SDDBS$,x.x,f,x.x,M,x.x,F*hh**

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>x.x</td>
<td>Water depth</td>
<td>feet</td>
</tr>
<tr>
<td>f</td>
<td>$f = \text{feet}$</td>
<td>n/a</td>
</tr>
<tr>
<td>x.x</td>
<td>Water depth</td>
<td>meters</td>
</tr>
<tr>
<td>M</td>
<td>$M = \text{meters}$</td>
<td>n/a</td>
</tr>
<tr>
<td>x.x</td>
<td>Water depth</td>
<td>fathoms</td>
</tr>
<tr>
<td>F</td>
<td>$F = \text{fathoms}$</td>
<td>n/a</td>
</tr>
<tr>
<td>*hh</td>
<td>Checksum</td>
<td>n/a</td>
</tr>
</tbody>
</table>
**Gyroscope data**
The gyroscope serial data is output in the following sentence formats:

- PTKM,HEALM -- Unspecified
- HEHDT -- Heading - True
- HEROT -- Rate Of Turn

$PCICM,HEALM,xxxx,x,xx*hh

ALM sentence format

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>xxxx</td>
<td>unspecified</td>
<td>n/a</td>
</tr>
<tr>
<td>x</td>
<td>unspecified</td>
<td>n/a</td>
</tr>
<tr>
<td>*hh</td>
<td>unspecified</td>
<td>n/a</td>
</tr>
</tbody>
</table>

$HEHDT,xxx.x,T*hh

HDT sentence format

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>xxx.x</td>
<td>Heading true</td>
<td>degrees</td>
</tr>
<tr>
<td>T</td>
<td>T = true</td>
<td>n/a</td>
</tr>
<tr>
<td>*hh</td>
<td>Checksum</td>
<td>n/a</td>
</tr>
</tbody>
</table>

$HEROT,-xxx.x,A*hh

HEROT sentence format

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>xxxx.x</td>
<td>Rate of turn</td>
<td>Degrees per minute, Note: &quot;-&quot; means bow turns to port</td>
</tr>
<tr>
<td>A</td>
<td>A = data valid</td>
<td>n/a</td>
</tr>
<tr>
<td>*hh</td>
<td>Checksum</td>
<td>n/a</td>
</tr>
</tbody>
</table>
**Geometrics 882 Magnetometer Data**
The magnetometer serial data is output in the following format:

$ 53863.927,0652$

$ x x x x . x x , v v v v$

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>x x x x . x x</td>
<td>Magnetic field intensity</td>
<td>nT</td>
</tr>
<tr>
<td>v v v v</td>
<td>Reserved for future use</td>
<td>n/a</td>
</tr>
</tbody>
</table>
RM Young Meteorological Station Data
The meteorological data from the RMYoung integrated weather station is output in the following sentence format:

12.6 13.2 12.6 16.9 1 335 2 0.0 0.0 0.0 0.0 355 355 2 0.0 0.0 0.0 0.0 7.3 8 4 9 1006.9
aaa.a bbb.b ccc.c ddd.d eee fff ggg hhh.h iii.i jjj.j kkk.k lll mnn -oo.o -pp.p -qq.q -rr.r ss tt uu vvvv.v

Langseth WX station sentence format

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>aaa.a</td>
<td>bird 1 speed, instantaneous</td>
<td>knots</td>
</tr>
<tr>
<td>bbb.b</td>
<td>bird 1 speed, 60 second average</td>
<td>knots</td>
</tr>
<tr>
<td>ccc.c</td>
<td>bird 1 speed, 60 minute average</td>
<td>knots</td>
</tr>
<tr>
<td>ddd.d</td>
<td>bird 1 speed, 60 second peak</td>
<td>knots</td>
</tr>
<tr>
<td>eee</td>
<td>bird 1 direction, instantaneous</td>
<td>knots</td>
</tr>
<tr>
<td>fff</td>
<td>bird 1 direction, 60 second average</td>
<td>knots</td>
</tr>
<tr>
<td>ggg</td>
<td>bird 1 direction, 60 minute average</td>
<td>knots</td>
</tr>
<tr>
<td>hhh.h</td>
<td>bird 2 speed, instantaneous</td>
<td>knots</td>
</tr>
<tr>
<td>iii.i</td>
<td>bird 2 speed, 60 second average</td>
<td>knots</td>
</tr>
<tr>
<td>jjj.j</td>
<td>bird 2 speed, 60 minute average</td>
<td>knots</td>
</tr>
<tr>
<td>kkk.k</td>
<td>bird 2 speed, 60 second peak</td>
<td>knots</td>
</tr>
<tr>
<td>lll</td>
<td>bird 2 direction, instantaneous</td>
<td>knots</td>
</tr>
<tr>
<td>mmm</td>
<td>bird 2 direction, 60 second average</td>
<td>knots</td>
</tr>
<tr>
<td>nnn</td>
<td>bird 2 direction, 60 minute average</td>
<td>knots</td>
</tr>
<tr>
<td>ooo.o</td>
<td>temperature, instantaneous</td>
<td>Degrees C</td>
</tr>
<tr>
<td>ppp.p</td>
<td>temperature, 60 minute average</td>
<td>Degrees C</td>
</tr>
<tr>
<td>qqq.q</td>
<td>temperature, 60 minute low</td>
<td>Degrees C</td>
</tr>
<tr>
<td>rrr.r</td>
<td>temperature, 60 minute high</td>
<td>Degrees C</td>
</tr>
<tr>
<td>ss</td>
<td>relative humidity, instantaneous</td>
<td>%</td>
</tr>
<tr>
<td>tt</td>
<td>relative humidity, 60 minute low</td>
<td>%</td>
</tr>
<tr>
<td>uu</td>
<td>relative humidity, 60 minute high</td>
<td>%</td>
</tr>
<tr>
<td>vvvv.v</td>
<td>Barometer, instantaneous</td>
<td>knots</td>
</tr>
</tbody>
</table>
### OBSIP Shotlog Format
Each OBSIP shotlog contains a header followed by shot records:

```
#obsipshotfile v1.0
#shotnumbre date time sourceLat sourceLon shipLat shipLon waterDepth sciTag
0001280 2009-08-27 05:08:49.807873 48.495334 -129.201444 48.494097 -129.203017 2530.6 MGL0910_05
0001279 2009-08-27 05:12:33.961869 48.491860 -129.204474 48.490060 -129.205425 2526.4 MGL0910_05
0001278 2009-08-27 05:16:36.302883 48.488608 -129.204474 48.486807 -129.206944 2530.3 MGL0910_05
0001277 2009-08-27 05:19:51.053880 48.485157 -129.209212 48.483406 -129.209755 2526.1 MGL0910_05
0001276 2009-08-27 05:24:01.863875 48.480157 -129.212088 48.479293 -129.213152 2516.1 MGL0910_05
```

### Shot records are in the following format:

```
0001276 2009-08-27 05:24:01.863875 48.480813 -129.212088 48.479293 -129.213152 2516.1 MGL0910_05
```

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>sssss</td>
<td>shot number</td>
<td>n/a</td>
</tr>
<tr>
<td>yyyy-mm-dd</td>
<td>date</td>
<td>ISO8601 format</td>
</tr>
<tr>
<td>hh:mm:ss.sss</td>
<td>time</td>
<td>ISO8601 format</td>
</tr>
<tr>
<td>xx.xxxxx</td>
<td>source lat</td>
<td>degrees, WGS84</td>
</tr>
<tr>
<td>yy.yyyyy</td>
<td>source lon</td>
<td>degrees, WGS84</td>
</tr>
<tr>
<td>vv.vvvvvv</td>
<td>vessel lat</td>
<td>degrees, WGS84</td>
</tr>
<tr>
<td>ww.wwwwww</td>
<td>vessel lon</td>
<td>degrees, WGS84</td>
</tr>
<tr>
<td>dddd.d</td>
<td>depth</td>
<td>meters</td>
</tr>
<tr>
<td>llllllllllllll</td>
<td>linename</td>
<td>n/a</td>
</tr>
</tbody>
</table>
**LDEO PCO2 System**

PCO2 outputs data in the following sentence format:

`yyyyjjj.jjj aaaa.aa bb.bb cccc.cc ddd.dd e.ee fff.f gggg.gg hh i k`

**PCO2 Data**

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>yyyyjjj.jjj</td>
<td>pco2 Computer Date/Time</td>
<td>n/a</td>
<td>Year/Julian Day.decimal</td>
</tr>
<tr>
<td>aaaa.aa</td>
<td>CO2 Raw Signal</td>
<td>n/a</td>
<td>mVolts</td>
</tr>
<tr>
<td>bb.bb</td>
<td>CO2 Analyzer Cell Temperature</td>
<td>n/a</td>
<td>Celcius</td>
</tr>
<tr>
<td>cccc.cc</td>
<td>PCO2 Barometer</td>
<td>n/a</td>
<td>mbar</td>
</tr>
<tr>
<td>ddd.dd</td>
<td>VCO2</td>
<td>n/a</td>
<td>ppm</td>
</tr>
<tr>
<td>e.ee</td>
<td>Equilibrator Water Temp</td>
<td>n/a</td>
<td>Celcius</td>
</tr>
<tr>
<td>fff.f</td>
<td>pCO2</td>
<td>n/a</td>
<td>uatm</td>
</tr>
<tr>
<td>gggg.gg</td>
<td>Flow Controller</td>
<td>n/a</td>
<td>mVolts</td>
</tr>
<tr>
<td>hh</td>
<td>Flow Meter</td>
<td>n/a</td>
<td>cc/min</td>
</tr>
<tr>
<td>i</td>
<td>Sample ID #</td>
<td>0 to 16</td>
<td>integer</td>
</tr>
<tr>
<td>k</td>
<td>Sample ID</td>
<td>Equil, Atmos, Nitrogen, CC18798, CA07163, CC15551, or CC63668</td>
<td>alphanumeric</td>
</tr>
</tbody>
</table>
LDEO PCO2 + CNava + TSG + WX01 + SBE38 Systems

PCO2 merge is a combination of outputs of various serial data in the following sentence format:

\[yyyyjjj.jjj\ aaaa.aa\ bb.bb\ cccc.cc\ ddd.dd\ e.ee\ fffffff.gggg.gg\ \underline{hh}\ i\ k\ lllllllllm,\ nnnnn.nnnnno\ ppppp.pp,\ q.qq,\ r.rr,\ s.ss,\ t.t.t,\ uu.u,\ vvv,\ w.w,\ xxx.x,\ y.yy,\ zzz.z,\ @@.@@@@\]

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>yyyyjjj.jjj</td>
<td>pco2 Computer Date/Time</td>
<td>n/a</td>
</tr>
<tr>
<td>aaaa.aa</td>
<td>CO2 Raw Signal</td>
<td>n/a</td>
</tr>
<tr>
<td>bb.bb</td>
<td>CO2 Analyzer Cell Temperature</td>
<td>n/a</td>
</tr>
<tr>
<td>cccc.cc</td>
<td>PCO2 Barometer</td>
<td>n/a</td>
</tr>
<tr>
<td>ddd.dd</td>
<td>VCO2</td>
<td>n/a</td>
</tr>
<tr>
<td>e.ee</td>
<td>Equilibrator Water Temp</td>
<td>n/a</td>
</tr>
<tr>
<td>fff.f</td>
<td>pCO2</td>
<td>n/a</td>
</tr>
<tr>
<td>gggg.gg</td>
<td>Flow Controller</td>
<td>n/a</td>
</tr>
<tr>
<td>hh</td>
<td>Flow Meter</td>
<td>n/a</td>
</tr>
<tr>
<td>i</td>
<td>Sample ID #</td>
<td>0 to 16 integer</td>
</tr>
<tr>
<td>k</td>
<td>Sample ID</td>
<td>Equil, Atmos, Nitrogen, CC18798, CA07163, CC15551, or CC63668 alphanumeric</td>
</tr>
<tr>
<td>lllllllllm</td>
<td>CNav Latitude</td>
<td>0 to 90, N/S degrees/minutes</td>
</tr>
<tr>
<td>nnnnn.nnnnno</td>
<td>CNav Longitude</td>
<td>0 to 180, E/W degrees/minutes</td>
</tr>
<tr>
<td>ppppp.pp</td>
<td>TSG Speed of Sound</td>
<td>n/a</td>
</tr>
<tr>
<td>q.qq</td>
<td>TSG Internal Temperature</td>
<td>n/a</td>
</tr>
<tr>
<td>r.rr</td>
<td>TSG External Temperature</td>
<td>n/a</td>
</tr>
<tr>
<td>s.ss</td>
<td>TSG Conductivity</td>
<td>n/a</td>
</tr>
<tr>
<td>tt.tt</td>
<td>TSG Salinity</td>
<td>25 to 40 ppm</td>
</tr>
<tr>
<td>uu.u</td>
<td>WX01 Bird 1 Wind Speed 60 sec avg</td>
<td>n/a</td>
</tr>
<tr>
<td>vvv</td>
<td>WX01 Bird 1 Wind Direction 60 sec avg</td>
<td>0 to 360 degrees</td>
</tr>
<tr>
<td>w.w</td>
<td>WX01 Temperature Instantaneous</td>
<td>n/a</td>
</tr>
<tr>
<td>xxx.x</td>
<td>WX01 Ship Barometer Instantaneous</td>
<td>n/a</td>
</tr>
<tr>
<td>y.yy</td>
<td>CNav Speed Over Ground / Speed Made Good</td>
<td>0 to 15 knots</td>
</tr>
<tr>
<td>zzz.z</td>
<td>CNav Course Made Good</td>
<td>0 to 360 degrees</td>
</tr>
<tr>
<td>@@.@@@@@@@</td>
<td>SBE38 Temperature Probe</td>
<td>n/a</td>
</tr>
</tbody>
</table>

PCO2 Data
POS/MV Position and Orientation System for Marine Vessels
POS/MV outputs data using the NMEA 0183 format at rates of up to fifty sentences per second. The following seven different sentence formats are available.

- 1. $INGGA-Global System Position Fix Data
- 2. $INHDT-Heading - True data
- 3. $INVTG-Course over ground and Ground speed data
- 4. $INGST-GPS pseudorange noise statistics
- 6. $PRDID-Attitude data
- 7. $INZDA-Time and date

$INGGA, hhmmss.sss, llll.lllll, a, yyyyy.yyyyy, b, t, nn, v.v, x.x, M,,,c.c,rrrr*hh

$INGGA-Global System Position Fix Data

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$INGGA</td>
<td>Header</td>
<td>$INGGA</td>
<td>Hours/Minutes/Seconds.decimal. Two fixed digits of hours. Two fixed digits of minutes. Three digits for decimal fractions of a second.</td>
</tr>
<tr>
<td>hhmmss.sss</td>
<td>UTC time of position</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>llll.lllll</td>
<td>Latitude</td>
<td>-90 to +90</td>
<td>Degrees/Minutes.decimal. Two fixed digits of degrees. Two fixed digits of minutes. Five digits for decimal minutes.</td>
</tr>
<tr>
<td>a</td>
<td>N (north) or S (south)</td>
<td>N or S</td>
<td></td>
</tr>
<tr>
<td>yyyyy.yyyyy</td>
<td>Longitude</td>
<td>-180 to +180</td>
<td>E or W</td>
</tr>
<tr>
<td>b</td>
<td>E (east) or W (west)</td>
<td>E or W</td>
<td>0 = Fix not available or invalid</td>
</tr>
<tr>
<td>t</td>
<td>GPS Quality Indicator</td>
<td>0 = CIA standard GPS; fix valid. 1 = DGS mode; fix valid. 2 = PPP mode; fix valid. 3 = RTK fixed. 4 = RTK float 5 = free inertial</td>
<td></td>
</tr>
<tr>
<td>nn</td>
<td>Number of satellites used in fix</td>
<td>0 to 32</td>
<td></td>
</tr>
<tr>
<td>v.v</td>
<td>Horizontal dilution of precision</td>
<td>n/a</td>
<td>Metres</td>
</tr>
<tr>
<td>x.x</td>
<td>Altitude of the IMU above or below the mean sea level. A negative value</td>
<td>n/a</td>
<td>Metres</td>
</tr>
</tbody>
</table>
indicates below sea level.

M Units of measure = metres
Null Null
Null Null
c.c Age of differential corrections in records since last RTCM-104 message.
0 to 99.9 Seconds
rrr DGPS reference station identity
0000 to 1023
*hh Checksum
00 - FF
/CR/LF Carriage return and line feed

Note that, in the case of the HDOP, IMU altitude and age of differential connections, POS/MV adds leading digits as required (i.e. if the value exceeds 9.9). Also, note that commas separate all items, including null fields. The information is valid at the location of the vessel frame.

$INHDT, x.x, T*hh

$INHDT-Heading - True data

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$INHDT</td>
<td>Header</td>
<td>$INHDT</td>
<td></td>
</tr>
<tr>
<td>x.x</td>
<td>True vessel heading in the vessel frame</td>
<td>0 to 359.99 degrees</td>
<td></td>
</tr>
<tr>
<td>*hh</td>
<td>Checksum</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>/CR/LF</td>
<td>Carriage return and line feed</td>
<td>/CR/LF</td>
<td></td>
</tr>
</tbody>
</table>

$INVTG, x.x, T, M, n.n, N, k.k, K*hh

$INVTG-Course over ground and Ground speed data

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>%INVTG</td>
<td>Header</td>
<td>$INVTG</td>
<td></td>
</tr>
<tr>
<td>x.x</td>
<td>True vessel track in the vessel frame</td>
<td>0 to 359.99 degrees</td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>True</td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>null</td>
<td>Not supported</td>
<td>null</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>M</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>n.n</td>
<td>Speed in the vessel frame</td>
<td>n/a</td>
<td>Knots</td>
</tr>
<tr>
<td>N</td>
<td>Knots</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>k.k</td>
<td>Kilometres</td>
<td>K</td>
<td></td>
</tr>
<tr>
<td>*hh</td>
<td>Checksum</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>/CR/LF</td>
<td>Carriage return and line feed</td>
<td>/CR/LF</td>
<td></td>
</tr>
</tbody>
</table>

Note that, in the case of the track and the speed fields, POS/MV adds the leading digits as required (i.e. if the value exceeds 9.9). Also, note that commas separate all items in the including null fields.

$INGST, hhmmss.sss,,smjr.smjr,smnr.smnr, o.o, l.l, y.y, a.a *hh

$INGST-GPS pseudorange noise statistics

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$INGST</td>
<td>Header</td>
<td>$INGST</td>
<td></td>
</tr>
<tr>
<td>hhmmss.sss</td>
<td>UTC time of position</td>
<td>n/a</td>
<td>Hours/Minutes/Seconds.decimal.</td>
</tr>
</tbody>
</table>
null Not supported null

smjr.smjr Standard Deviation of semi-major axis of error ellipse n/a Metres

smnr.smnr Standard deviation of semi-minor axis of error ellipse n/a Metres

o.o Orientation of semi-major axis ellipse 0 to 359.9 Degrees from true north

l.l Standard deviation of latitude n/a Metres

y.y Standard deviation of longitude n/a Metres

a.a Standard deviation of Altitude n/a Metres

*hh Checksum n/a

/CR/LF Carriage return and line feed /CR/LF

Note that, in the case of all fields POS/MV adds leading digits as required (i.e. if the value exceeds 9.9).
Also, note that commas separate all items, including null fields. The information is valid at the location of the vessel frame.

Note that commas separate all items

Two attitude data strings are available. The strings are identical except for the definition of roll and pitch angles. One string uses Tate-Bryant angles and the other uses TSS angles. Use the POS/MV Controller program to set the required angle convention.

$PRDID, PPP.PP, RRR.RR, xxx.xx*hh

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$PRDID</td>
<td>Header</td>
<td>$PRDID</td>
<td></td>
</tr>
<tr>
<td>PPP.PP</td>
<td>Pitch</td>
<td>-90.00 to +90.00</td>
<td>Degrees</td>
</tr>
<tr>
<td>RRR.RR</td>
<td>Roll</td>
<td>-90.00 to +90.00</td>
<td>Degrees</td>
</tr>
<tr>
<td>xxx.xx</td>
<td>Sensor heading</td>
<td>0 to 359.99</td>
<td>Degrees</td>
</tr>
<tr>
<td>*hh</td>
<td>Checksum</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>/CR/LF</td>
<td>Carriage return and line feed</td>
<td>/CR/LF</td>
<td></td>
</tr>
</tbody>
</table>

Note that commas separate all items

Two attitude data strings are available. The strings are identical except for the definition of roll and pitch angles. One string uses Tate-Bryant angles and the other uses TSS angles. Use the POS/MV Controller program to set the required angle convention.

$INZDA, hhmmss.ss, DD, MM, YYYY,, *hh

$INZDA-Time and date

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$INZDA</td>
<td>Header</td>
<td>$INZDA</td>
<td></td>
</tr>
</tbody>
</table>
| hhmmss.sss | UTC time | n/a | Hours/Minutes/Seconds.decimal.  
|            |         |     | 2 fixed digits of hours  
|            |         |     | 2 fixed digits of minutes  
|            |         |     | 2 fixed digits of seconds  
|            |         |     | Three digits for decimal fractions of a second |
| DD         | Day of month | 01 to 31 |
| MM         | Month of year | 01 to 12 |
| YYYY       | Year |
| Null       | Null |
| Null       | Null |
| *hh        | Checksum | n/a | /CR/LF |
RM Young Rain Gauge & Eppley PSP data

RM Young Rain Gauge & Eppley PSP data is formatted in the following sentences:

*x.xxxxxx,y.y*

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Item</th>
<th>definition</th>
<th>units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eppley PSP</td>
<td>x.xxxxxx</td>
<td>voltage</td>
<td>mV</td>
</tr>
<tr>
<td>RM Young Rain Gauge</td>
<td>y.y</td>
<td>amount of rain</td>
<td>mm</td>
</tr>
</tbody>
</table>
**Seabird Thermosalinograph, Converted**

Data from the Seabird TSG is output in the following format:

```
2008:199:02:23:43.0914 AE9FC8F927F34AA7DAC1 1527.40 27.94 23.47 5.17 31.90
```

```
yyyy:ddd:hh:mm:ss.ssss ttttccccxxxxxxvvvvv aaaa.aa bb.bb cc.cc d.dd ee.ee
```

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>yyy</td>
<td>LDS Timestamp</td>
<td>year</td>
</tr>
<tr>
<td>ddd</td>
<td>LDS Timestamp</td>
<td>day of year</td>
</tr>
<tr>
<td>hh</td>
<td>LDS Timestamp</td>
<td>hour</td>
</tr>
<tr>
<td>mm</td>
<td>LDS Timestamp</td>
<td>minute</td>
</tr>
<tr>
<td>ss.sss</td>
<td>LDS Timestamp</td>
<td>second</td>
</tr>
<tr>
<td>tttt</td>
<td>Raw internal temperature sensor data</td>
<td>n/a</td>
</tr>
<tr>
<td>cccc</td>
<td>Raw conductivity sensor data</td>
<td>n/a</td>
</tr>
<tr>
<td>xxxxxx</td>
<td>Raw external temperature sensor data</td>
<td>n/a</td>
</tr>
<tr>
<td>aaaa.aa</td>
<td>Speed of sound</td>
<td>m/s</td>
</tr>
<tr>
<td>bb.bb</td>
<td>Internal temperature</td>
<td>Degrees C</td>
</tr>
<tr>
<td>cc.cc</td>
<td>External temperature</td>
<td>Degrees C</td>
</tr>
<tr>
<td>d.dd</td>
<td>Conductivity</td>
<td>S/m</td>
</tr>
<tr>
<td>ee.ee</td>
<td>Salinity</td>
<td>ppm</td>
</tr>
</tbody>
</table>
**Seabird SBE-45 Thermosalinograph Data**
Data from the SBE-45 TSG is output in the following format:

2012:050:06:02:01.0294     27.2958, 5.51684, 34.7768

```
yyyy:ddd:hh:mm:ss.ssss tttt, cccc, xxxx
```

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>yyyy</td>
<td>year</td>
<td>n/a</td>
</tr>
<tr>
<td>ddd</td>
<td>day of year</td>
<td>n/a</td>
</tr>
<tr>
<td>hh</td>
<td>hours</td>
<td>n/a</td>
</tr>
<tr>
<td>mm</td>
<td>minutes</td>
<td>n/a</td>
</tr>
<tr>
<td>ss.ssss</td>
<td>seconds</td>
<td>n/a</td>
</tr>
<tr>
<td>tttt</td>
<td>Raw internal temperature sensor data</td>
<td>n/a</td>
</tr>
<tr>
<td>cccc</td>
<td>Raw conductivity sensor data</td>
<td>n/a</td>
</tr>
<tr>
<td>xxxx</td>
<td>Raw salinity sensor data</td>
<td>n/a</td>
</tr>
</tbody>
</table>
SEAPATH 200 Inertial Navigation System

SEAPATH outputs data in NMEA format using the following sentence formats:

- 1. $INGGA - Global System Position Fix Data
- 2. $INHDT - Heading - True data
- 3. $INVTG - Course over ground and Ground speed data
- 4. $INZDA - Time and date

$INGGA, hhmmss.sss, llllllll, a, yyyyy.yyyyy, b, t, nn, v.v, x.x, M,,,c.c,rrrr*hh

SINGGA - Global System Position Fix Data

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$INGGA</td>
<td>Header</td>
<td>$INGGA</td>
<td>Hours/Minutes/Seconds.decimal.</td>
</tr>
<tr>
<td>hhmmss.sss</td>
<td>UTC time of position</td>
<td>n/a</td>
<td>Two fixed digits of hours. Two fixed digits of minutes. Two fixed digits of seconds. Three digits for decimal fractions of a second.</td>
</tr>
<tr>
<td>llllllll</td>
<td>Latitude</td>
<td>-90 to +90</td>
<td>Degrees/Minutes.decimal. Two fixed digits of degrees. Two fixed digits of minutes. Five digits for decimal minutes.</td>
</tr>
<tr>
<td>a</td>
<td>N (north) or S (south)</td>
<td>N or S</td>
<td>Degrees/Minutes.decimal.</td>
</tr>
<tr>
<td>yyyyy.yyyyy</td>
<td>Longitude</td>
<td>-180 to +180</td>
<td>Three fixed digits of degrees. Two fixed digits of minutes. Five digits for decimal minutes.</td>
</tr>
<tr>
<td>b</td>
<td>E (east) or W (west)</td>
<td>E or W</td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>GPS Quality Indicator</td>
<td>0 = Fix not available or invalid 1 = CIA standard GPS; fix valid. 2 = DGS mode; fix valid. 3 = PPP mode; fix valid. 4 = RTK fixed 5 = RTK float 6 = free inertial</td>
<td></td>
</tr>
<tr>
<td>nn</td>
<td>Number of satellites used in fix</td>
<td>0 to 32</td>
<td></td>
</tr>
<tr>
<td>v.v</td>
<td>Horizontal dilution of precision</td>
<td></td>
<td></td>
</tr>
<tr>
<td>x.x</td>
<td>Altitude of the IMU above or below the mean sea level. A negative value indicates below sea level.</td>
<td>n/a</td>
<td>Metres</td>
</tr>
<tr>
<td>M</td>
<td>Units of measure = metres</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>Null</td>
<td>Null</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Null</td>
<td>Null</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.c</td>
<td>Age of differential corrections in records since last RTCM-104 message.</td>
<td>0 to 99.9</td>
<td>Seconds</td>
</tr>
<tr>
<td>Item</td>
<td>Definition</td>
<td>Value</td>
<td>Units</td>
</tr>
<tr>
<td>--------</td>
<td>-----------------------------</td>
<td>-------</td>
<td>---------------</td>
</tr>
<tr>
<td>$INHDT</td>
<td>Header</td>
<td>$INHDT</td>
<td></td>
</tr>
<tr>
<td>x.x</td>
<td>True vessel heading in the vessel frame</td>
<td>0 to 359.99 degrees</td>
<td></td>
</tr>
<tr>
<td>*hh</td>
<td>Checksum</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>/CR/LF</td>
<td>Carriage return and line feed</td>
<td>/CR/LF</td>
<td></td>
</tr>
</tbody>
</table>

$INVTG, x.x, T,, M, n.n, N, k.k, K*hh

$INVTG-Course over ground and Ground speed data

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$INVTG</td>
<td>Header</td>
<td>$INVTG</td>
<td></td>
</tr>
<tr>
<td>x.x</td>
<td>True vessel track in the vessel frame</td>
<td>0 to 359.99 degrees</td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>True</td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>null</td>
<td>Not supported</td>
<td>null</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>M</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>n.n</td>
<td>Speed in the vessel frame</td>
<td>n/a</td>
<td>Knots</td>
</tr>
<tr>
<td>N</td>
<td>Knots</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>k.k</td>
<td>Kilometres</td>
<td>K</td>
<td></td>
</tr>
<tr>
<td>*hh</td>
<td>Checksum</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>/CR/LF</td>
<td>Carriage return and line feed</td>
<td>/CR/LF</td>
<td></td>
</tr>
</tbody>
</table>

$INZDA, hhmmss.ss, DD, MM, YYYY,, *hh

$INZDA-Time and date

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$INZDA</td>
<td>Header</td>
<td>$INZDA</td>
<td></td>
</tr>
<tr>
<td>hhmmss.ss</td>
<td>UTC time</td>
<td>n/a</td>
<td>Hours/Minutes/Seconds.decimal.</td>
</tr>
<tr>
<td>DD</td>
<td>Day of month</td>
<td>01 to 31</td>
<td>2 fixed digits of hours</td>
</tr>
<tr>
<td>MM</td>
<td>Month of year</td>
<td>01 to 12</td>
<td>2 fixed digits of minutes</td>
</tr>
<tr>
<td>YYYY</td>
<td>Year</td>
<td></td>
<td>2 fixed digits of seconds</td>
</tr>
<tr>
<td>Null</td>
<td>Null</td>
<td></td>
<td>Three digits for decimal fractions of a second</td>
</tr>
<tr>
<td>Null</td>
<td>Null</td>
<td></td>
<td></td>
</tr>
<tr>
<td>*hh</td>
<td>Checksum</td>
<td>n/a</td>
<td></td>
</tr>
</tbody>
</table>
**Langseth Shotlog Format**

Each Langseth shotlog contains shot records in the following format:

MGL1204MCS01 00924 2011:159:15:28:10.8208 152810.8208670 4059.5 565908.12N 1464326.41N 565906.79N 1464338.85N

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>linename</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>shot number</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>yyyy:mm:dd:hh:mm:sss</td>
<td>date/time</td>
<td>ISO8601 format</td>
</tr>
<tr>
<td>hhmmss.sssss</td>
<td>time</td>
<td>hh = hour, mm = minutes, ss = seconds, .ssss = decimal seconds</td>
</tr>
<tr>
<td>dddd.d</td>
<td>depth</td>
<td>meters</td>
</tr>
<tr>
<td>vv.vvvvvv</td>
<td>vessel lat</td>
<td>degrees, WGS84</td>
</tr>
<tr>
<td><a href="http://www.wwwwwww">www.wwwwwww</a></td>
<td>vessel lon</td>
<td>degrees, WGS84</td>
</tr>
<tr>
<td>xx.xxxxxx</td>
<td>source lat</td>
<td>degrees, WGS84</td>
</tr>
<tr>
<td>yyy.yyyyyy</td>
<td>source lon</td>
<td>degrees, WGS84</td>
</tr>
</tbody>
</table>
### Speed log data

Speed log data is formatted in the following sentences:

- **VHW** - Water speed and heading
- **VBW** - Dual Ground/Water Speed

#### $VHW, x.x, T, x.x, M, x.x, N, x.x, K*hh$

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>x.x</td>
<td>degrees true</td>
<td>?</td>
</tr>
<tr>
<td>T</td>
<td>T = true</td>
<td>n/a</td>
</tr>
<tr>
<td>x.x</td>
<td>degrees Magnetic</td>
<td>?</td>
</tr>
<tr>
<td>M</td>
<td>M = Magnetic</td>
<td>n/a</td>
</tr>
<tr>
<td>x.x</td>
<td>Speed of vessel relative to water</td>
<td>Knots/hour</td>
</tr>
<tr>
<td>N</td>
<td>N = Nots</td>
<td>n/a</td>
</tr>
<tr>
<td>x.x</td>
<td>Speed of vessel relative to water</td>
<td>Km/hour</td>
</tr>
<tr>
<td>K</td>
<td>K = Kilometers</td>
<td>n/a</td>
</tr>
<tr>
<td>*hh</td>
<td>Checksum</td>
<td>n/a</td>
</tr>
</tbody>
</table>

#### $VBW, x.x, x.x, A, x.x, x.x, A*hh$

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>x.x</td>
<td>Longitudinal water speed, &quot;-&quot; means astern</td>
<td>?</td>
</tr>
<tr>
<td>x.x</td>
<td>Transverse water speed, &quot;-&quot; means port</td>
<td>?</td>
</tr>
<tr>
<td>A</td>
<td>A = Data Valid</td>
<td>n/a</td>
</tr>
<tr>
<td>x.x</td>
<td>Longitudinal ground speed, &quot;-&quot; means astern</td>
<td>?</td>
</tr>
<tr>
<td>x.x</td>
<td>Transverse ground speed, &quot;-&quot; means port</td>
<td>?</td>
</tr>
<tr>
<td>A</td>
<td>A = data valid, V = data invalid</td>
<td>n/a</td>
</tr>
<tr>
<td>*hh</td>
<td>Checksum</td>
<td>n/a</td>
</tr>
</tbody>
</table>
**Streamer Tension Unit Data**

STU outputs data in the following sentence format:

```
aaa bbb cc dd ee f hhhh iiiii jjj jjj jkkk l m nnnn oooo pppp qqqq r s tttt uuuu vvvv wwwww x y zzzz !!!! @@@@ ####
```

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>aaa</td>
<td>na</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>bbb</td>
<td>Julian Day</td>
<td>1 to 366</td>
<td>day</td>
</tr>
<tr>
<td>cc</td>
<td>Hour</td>
<td>0 to 24</td>
<td>integer</td>
</tr>
<tr>
<td>dd</td>
<td>Minutes</td>
<td>0 to 60</td>
<td>integer</td>
</tr>
<tr>
<td>ee</td>
<td>Seconds</td>
<td>0 to 60</td>
<td>integer</td>
</tr>
<tr>
<td>f</td>
<td># 1 ID</td>
<td>1</td>
<td>integer</td>
</tr>
<tr>
<td>g</td>
<td># 1 Channel #</td>
<td>0</td>
<td>integer</td>
</tr>
<tr>
<td>hhhh</td>
<td># 1 Peak Tension</td>
<td>n/a</td>
<td>lbs</td>
</tr>
<tr>
<td>iiiii</td>
<td># 1 Average Tension</td>
<td>n/a</td>
<td>lbs</td>
</tr>
<tr>
<td>jjjjj</td>
<td># 1 Delta Tension</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>kkkk</td>
<td># 1 Temperature</td>
<td>n/a</td>
<td>Celcius</td>
</tr>
<tr>
<td>l</td>
<td># 2 ID</td>
<td>1</td>
<td>integer</td>
</tr>
<tr>
<td>m</td>
<td># 2 Channel #</td>
<td>1</td>
<td>integer</td>
</tr>
<tr>
<td>nnnn</td>
<td># 2 Peak Tension</td>
<td>n/a</td>
<td>lbs</td>
</tr>
<tr>
<td>oooo</td>
<td># 2 Average Tension</td>
<td>n/a</td>
<td>lbs</td>
</tr>
<tr>
<td>pppp</td>
<td># 2 Delta Tension</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>qqqq</td>
<td># 2 Temperature</td>
<td>n/a</td>
<td>Celcius</td>
</tr>
<tr>
<td>r</td>
<td># 3 ID</td>
<td>1</td>
<td>integer</td>
</tr>
<tr>
<td>s</td>
<td># 3 Channel #</td>
<td>2</td>
<td>integer</td>
</tr>
<tr>
<td>tttt</td>
<td># 3 Peak Tension</td>
<td>n/a</td>
<td>lbs</td>
</tr>
<tr>
<td>uuuu</td>
<td># 3 Average Tension</td>
<td>n/a</td>
<td>lbs</td>
</tr>
<tr>
<td>vvvv</td>
<td># 3 Delta Tension</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>wwwww</td>
<td># 3 Temperature</td>
<td>n/a</td>
<td>Celcius</td>
</tr>
<tr>
<td>x</td>
<td># 4 ID</td>
<td>1</td>
<td>integer</td>
</tr>
<tr>
<td>y</td>
<td># 4 Channel #</td>
<td>3</td>
<td>integer</td>
</tr>
<tr>
<td>zzzzz</td>
<td># 4 Peak Tension</td>
<td>n/a</td>
<td>lbs</td>
</tr>
<tr>
<td>!!!!!</td>
<td># 4 Average Tension</td>
<td>n/a</td>
<td>lbs</td>
</tr>
<tr>
<td>@@(@@@</td>
<td># 4 Delta Tension</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>######</td>
<td># 4 Temperature</td>
<td>n/a</td>
<td>Celcius</td>
</tr>
</tbody>
</table>
**Applied Microsystems Sound Velocity Probe Data**

The sound velocity probe serial data is output in the following format:

1479.35

xxxx.xx

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>xxxx.xx</td>
<td>Sound Velocity</td>
<td>m/s</td>
</tr>
</tbody>
</table>
### Seabird SBE38 Thermometer Probe Data

The sound velocity probe serial data is output in the following format:

8.2221

xx.xxxx

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>xx.xxxx</td>
<td>Temperature</td>
<td>Celcius</td>
</tr>
</tbody>
</table>
**Spectrum TM-4 time and frequency system data**

The TM-4 is used as an event logger to log shot times from digishot. The 'tagger' data set includes all output from the TM-4. The 'shot' data set includes only the event messages (message #62)

Spectra provides primary shot timing aboard Langseth. The TM-4 is used for qc and backup purposes.

<table>
<thead>
<tr>
<th>Message #</th>
<th>Type</th>
<th>Form</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>ACKNOWLEDGE</td>
<td>CRLF</td>
<td></td>
</tr>
<tr>
<td>51</td>
<td>DATE AND TIME</td>
<td>MMDDYYYY,HHMMSSCRLF</td>
<td>MMDDYYYY is UTC month, day, and year HHMMSS is UTC hours, minutes and seconds</td>
</tr>
</tbody>
</table>
| 52        | POSITION                              | WWWWW.WW,X,YYYYY.YY,Z,A,NCRLF            | W = latitude in DDMM.MM  
X = hemisphere N or S  
Y = longitude in DDMM.MM  
Z = hemisphere E or W  
A = GPS availability (0 = not available, 1 = available)  
N = number of satellites used (0-9, A[10], B[11], C[12]) |
| 53        | ALTITUDE                              | SXXXXX,MCRLF                              | S = sign (+ or -)  
X = altitude (5 digits)  
M = altitude units (meters) |
| 55        | MASK ANGLE AND MAP DATUM SETTING      | X,47CRLF                                  | X = 0 for 5 degrees  
X = 1 for 15 degrees  
X = 2 for 20 degrees  
47 = two digit map datum code (fixed at WGS84) |
| 56        | USER TIME BIAS                        | SXXXXXXCRLF                               | S = sign (+ or -)  
X = bias value (5 digits) |
| 57        | TIMING MODE                           | XCRLF                                     | X = 0 for Dynamic Timing Mode  
X = 1 for Static Timing Mode  
X = 3 for Auto Survey Mode |
| 59        | GEOMETRIC QUALITY AND ALMANAC STATUS  | X,YCRLF                                   | X = GQ (0-9)  
Y = 0 (Almanac OK)  
Y = 1 (no Almanac)  
Y = 2 (Almanac is old) |
| 60        | TIME PORT DATA RATE AND MULTIPLEXER #1 | X,YCRLF                                   | X = 0 (1200 baud)  
Y = 0 for 10 MHz output  
X = 1 (2400 baud)  
Y = 1 for 5 MHz output  
X = 2 (4800 baud)  
Y = 2 for 1 MHz output  
X = 3 (9600 baud)  
Y = 3 for 100 kHz output  
X = 4 (19200 baud)  
Y = 4 for 10 kHz output  
X = 5 (38400 baud)  
Y = 5 for 1 kHz output  
X = 6 (57600 baud)  
Y = 6 for IRIG output (if installed)  
X = 7 (115200 baud)  
Y = 7 for PPS output  
Y = 8 for OFF (newer TM-4's only) |
| 61 | TIMING STATUS | W,CRLF | W = 0 (time not valid)  
W = 1 (Time Valid) |
| 62 | EVENT TIME-TAG | MMDDYYYY,HHMMSS.SSSS,CRLF | MMDDYYYY = UTC date of event  
HHMMSS.SSSSSS = UTC time of event |
| 63 | POP/ETT STATUS | X,P,MMDDYYYY,HHMMSS.SSSSSSSS,RRRRRRRRRRR,CRLF | X = 0 for ETT/POP OFF  
X = 1 for POP One-Shot  
X = 2 for POP Repeat  
X = 3 for ETT  
P = + for positive polarity  
P = - for negative polarity  
P = 0 when POP/ETT Mode is OFF  
MMDDYYYY is the POP date (UTC)  
HHMMSS.SSSSSS is the POP time (UTC)  
RRRRRRRR is the POP repeat interval |
| 64 | OSCILLATOR TUNING MODE | XCRLF | X = 1 for Mode 1 (oscillator warm-up)  
X = 2 for Mode 2 (course adjust)  
X = 3 for Mode 3 (course adjust standby)  
X = 4 for Mode 4 (fine adjust)  
X = 5 for Mode 5 (fine adjust hold)  
Note: See OSCILLATOR MODES on page 11 of the Spectrum manual for an explanation of these Oscillator Tuning Modes. |
| 65 | ALARM STATUS | X,Y,ZCRLF | X = 0 for No Coast condition  
X = 1 for Coast Alarm condition See Message #79 for Coast Timer.  
Y = 0 for Antenna Good  
Y = 1 for Antenna Current Sense Fault condition  
Z = 0 for 10 MHz Frequency Output Good  
Z = 1 for 10 MHz Frequency Output Fault condition  
See HARDWARE FAULT MONITORING on page 14 of Spectrum manual for an explanation of Antenna Alarm. |
| 68 | MULTIPLEXER #2 STATUS | XCRLF | X = 0 for 10 MHz output  
X = 1 for Mux1 mirror  
X = 2 for PPS  
X = 3 for output option 1  
X = 4 for output option 2  
X = 5 for output option 3  
X = 6 for baseband IRIG (if installed)  
X = 7 for baseband NASA-36 (if installed)  
X = 8 for OFF (newer TM-4's only) |
| 69 | TRACKING CHANNEL STATUS | VV,W,X,Y,...,VV,W,X,Y,ZCRLF | VV = PRN of satellite being tracked  
W = constellation status:  
0 = not included in current constellation  
1 = included in current constellation  
X = tracking status: |
<table>
<thead>
<tr>
<th><strong>A</strong></th>
<th>acquisition/reacquisition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>S</strong></td>
<td>searching</td>
</tr>
<tr>
<td>0-9</td>
<td>SQ</td>
</tr>
<tr>
<td><strong>Y</strong></td>
<td>Ephemeris status:</td>
</tr>
<tr>
<td>0</td>
<td>not collected</td>
</tr>
<tr>
<td>1</td>
<td>collected</td>
</tr>
<tr>
<td><strong>Z</strong></td>
<td>receiver status:</td>
</tr>
<tr>
<td>2</td>
<td>search the sky</td>
</tr>
<tr>
<td>3</td>
<td>Almanac collect</td>
</tr>
<tr>
<td>4</td>
<td>Ephemeris collect</td>
</tr>
<tr>
<td>5</td>
<td>acquisition</td>
</tr>
<tr>
<td>6</td>
<td>position</td>
</tr>
<tr>
<td></td>
<td>NOTE: VV,W,X,Y repeats twelve times, corresponding to each of the twelve channels.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>70</strong></th>
<th>SERIAL TIME MESSAGE FORMAT</th>
<th><strong>XCRLF</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X = 0 for standard output</td>
<td></td>
</tr>
<tr>
<td></td>
<td>X = 1 for NTP output (optional)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>X = 2 for NMEA output</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>71</strong></th>
<th>SERIAL TIME CODE FORMAT</th>
<th><strong>XCRLF</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X = 0 for IRIG B output</td>
<td></td>
</tr>
<tr>
<td></td>
<td>X = 1 for NASA-36 output</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>72</strong></th>
<th>ETT PARAMETERS</th>
<th><strong>X,PCRLF</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X = 0 (ETT off)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>X = 1 (ETT on)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>74</strong></th>
<th>POP PARAMETERS (Simultaneous ETT/POP units)</th>
<th><strong>X,P,MMDDYYYY,HHMMSS,SSSSSSSS,RRRRRRRR,WCRLF</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X = 0 for POP Off</td>
<td></td>
</tr>
<tr>
<td></td>
<td>X = 1 for POP One-Shot</td>
<td></td>
</tr>
<tr>
<td></td>
<td>X = 2 for POP Repeat</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P = + for positive polarity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P = - for negative polarity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MMDDYYYY is the POP date (UTC)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HHMMSS.SSSSSSS is the POP time (UTC)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RRRRRRRRR is the POP repeat interval in milliseconds</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W = 0 for 1 ÅŽ¼s pulse width</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W = 1 for 10 ÅŽ¼s pulse width</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W = 2 for 100 ÅŽ¼s pulse width</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W = 3 for 1 ms pulse width</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W = 4 for 10 ms pulse width</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W = 5 for 50 ms pulse width</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W = 6 for 100 ms pulse width</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W = 7 for 250 ms pulse width</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W = 8 for Level Hold</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>75</strong></th>
<th>SPEED OVER LAND and HEADING</th>
<th><strong>SSS.SS,HHH.HCRLF</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SSS.SS indicates speed over land in meters/sec</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HHH.H indicates course in degrees decimal</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>76</strong></th>
<th>ADDITIONAL NMEA INFORMATION</th>
<th><strong>DDMM.MMNN,N,DDDMW,SAAAAAA.A,M,G,UU.PP.PZZ.ZZ,YYY.YCRLF</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DDMM.MMNN is latitude in degrees and decimal minutes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N is north or south (N, S)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DDDMM.MMNN is longitude in degrees and decimal minutes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W is west or east (W, E)</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>Field Description</td>
<td>Value Format</td>
</tr>
<tr>
<td>------</td>
<td>-------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>77</td>
<td>PHASE LOCK STATUS</td>
<td>X,CRLF</td>
</tr>
<tr>
<td>78</td>
<td>ADDITIONAL USER OPTION SETTINGS</td>
<td>A,B,C,D,E,F,CRLF</td>
</tr>
<tr>
<td>79</td>
<td>COAT TIMER</td>
<td>HHHHMNSSCRLF</td>
</tr>
<tr>
<td>80</td>
<td>PHASE LOCK STATUS</td>
<td>X, CRLF</td>
</tr>
<tr>
<td>81</td>
<td>LEAP SECONDS?GPS TIME</td>
<td>X,Y,Â±ZZCRLF</td>
</tr>
</tbody>
</table>

S is sign of altitude above or below sea level (+,-)  
AAAAA.A is altitude (in meters) (0-18000)  
M is altitude units (meters)  
G is GPS status (0=fix not valid, 1=fix valid)  
UU is number of satellites used in navigation solution (0-12)  
PP.P is estimated horizontal dilution of precision (0-99.9)  
ZZZ.ZZ is speed over ground in knots  
YYY.Y is course over ground in degrees

A = 0 for Antenna Alarm Disabled  
A = 1 for Antenna Alarm Enabled (default)  
B = 0 for PPS Source 0 (See Message #24 for definitions)  
B = 1 for PPS Source 1  
B = 2 for PPS Source 2  
B = 3 for PPS Source 3  
Fields C-F are reserved.

HHHHMMSS = Amount of time (Hours, Minutes, Seconds) that the unit has been in Coast (Mode 3 or Mode 5)

X = 0 for TM-4 operation in GPS Time (reserved for future feature, currently disabled)  
X = 1 for TM-4 operation in UTC Time (default)  
Y = 0 for Leap Second data not valid  
Y = 1 for Leap Second data valid  
Â±ZZ = UTC/GPS Time Offset, in whole seconds

The difference between UTC Time and GPS Time is the number of Leap Seconds that have been introduced to UTC Time since the beginning of GPS Time. (GPS Time is never adjusted for Leap Seconds.) The ÂƒÂ–UTC OffsetÂƒÂ® from GPS Time is in the information data stream broadcast by the GPS satellites. The TM-4 stores the previously known value, but until the TM-4 makes contact with satellites and downloads the current"UTC Offset", the data cannot be considered to be valid.
**RM Young Meteorological Station Data**

The meteorological data from the RMYoung integrated weather station is output in the following sentence format:

```
12.6 13.2 12.6 16.9 1335 2 0.0 0.0 0.0 0.0 355 355 0 -11.9 -23.8 ***** 7.3 8 4 9 1006.9
```

aaa.a bbb.b ccc.c ddd.d eee fff ggg hhh.h iii.i jjj.j kkk.k lll mmm nnn.o ooo.o ppp.p -qq.q -rr.r ss tt uu vvv.v

**Langseth WX station sentence format**

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>aaa.a</td>
<td>bird 1 speed, instantaneous</td>
<td>knots</td>
</tr>
<tr>
<td>bbb.b</td>
<td>bird 1 speed, 60 second average</td>
<td>knots</td>
</tr>
<tr>
<td>ccc.c</td>
<td>bird 1 speed, 60 minute average</td>
<td>knots</td>
</tr>
<tr>
<td>ddd.d</td>
<td>bird 1 speed, 60 second peak</td>
<td>knots</td>
</tr>
<tr>
<td>eee</td>
<td>bird 1 direction, instantaneous</td>
<td>knots</td>
</tr>
<tr>
<td>fff</td>
<td>bird 1 direction, 60 second average</td>
<td>knots</td>
</tr>
<tr>
<td>ggg</td>
<td>bird 1 direction, 60 minute average</td>
<td>knots</td>
</tr>
<tr>
<td>hhh.h</td>
<td>bird 2 speed, instantaneous</td>
<td>knots</td>
</tr>
<tr>
<td>iii.i</td>
<td>bird 2 speed, 60 second average</td>
<td>knots</td>
</tr>
<tr>
<td>jjj.j</td>
<td>bird 2 speed, 60 minute average</td>
<td>knots</td>
</tr>
<tr>
<td>kkk.k</td>
<td>bird 2 speed, 60 second peak</td>
<td>knots</td>
</tr>
<tr>
<td>lll</td>
<td>bird 2 direction, instantaneous</td>
<td>knots</td>
</tr>
<tr>
<td>mmm</td>
<td>bird 2 direction, 60 second average</td>
<td>knots</td>
</tr>
<tr>
<td>nnn</td>
<td>bird 2 direction, 60 minute average</td>
<td>knots</td>
</tr>
<tr>
<td>ooo.o</td>
<td>temperature, instantaneous</td>
<td>Degrees C</td>
</tr>
<tr>
<td>ppp.p</td>
<td>temperature, 60 minute average</td>
<td>Degrees C</td>
</tr>
<tr>
<td>qqq.q</td>
<td>temperature, 60 minute low</td>
<td>Degrees C</td>
</tr>
<tr>
<td>rrr.r</td>
<td>temperature, 60 minute high</td>
<td>Degrees C</td>
</tr>
<tr>
<td>ss</td>
<td>relative humidity, instantaneous</td>
<td>%</td>
</tr>
<tr>
<td>tt</td>
<td>relative humidity, 60 minute low</td>
<td>%</td>
</tr>
<tr>
<td>uu</td>
<td>relative humidity, 60 minute high</td>
<td>%</td>
</tr>
<tr>
<td>vvv.v</td>
<td>Barometer, instantaneous</td>
<td>knots</td>
</tr>
</tbody>
</table>