
LMG10-02

Palmer Station Logistics

Cruise Data Report

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Introduction

The LMG data acquisition systems continuously log data from a suite of instrumentation throughout the cruise. This document describes the format of that data and its location on the distribution CDs. It also contains important information that may affect how this data is processed such as instrument failures or other known problems with acquisition.

The data collected during this cruise is distributed on a CD-ROM written in ISO9660 level-1 format. This data format has very strict requirements on filenames and organization. However, it is readable by virtually every computing platform.

All of the data has been archived with the Unix "tar" command and/or compressed using Unix "gzip" compression. Tar files have a ".tar" extension and Gzipped files have a ".gz" extension. Tools are available on all platforms for uncompressing and de-archiving these formats. On Macintosh, Stuffit Expander with DropStuff will open a tar archive and uncompress gzipped and Unix compressed files. For Windows, WinZip, a shareware utility included on this CD (remember, it is shareware) will open these files.

In some cases to adhere to the ISO9660 format the .tar extension was removed. When we tarred the files then gzip the tar archive the name of the file became *File.tgz*. This name does not follow the 8.3 naming convention of the ISO9660 format. On Windows and Mac Platforms Winzip and Stuffit Expander handles this just fine. When they expand the *File.gz* the expanded file becomes *File.tar*, which both software packages can handle. On Unix platforms gunzip expands *File.tgz* but it does not append the .tar extension. So you may not recognize the file as a tar archive, but OS does recognize it as a tar archive. If you use the file command it will return saying it is a tar file. The below tar command will un-archive the file just fine.

IMPORTANT: Read the last section in this document, Acquisition Problems and Events, for important information that may affect the processing of this data.

Archive Data Extraction

It is often useful to know exactly how an archive was produced when expanding its contents. Tar files were created using the following commands:

```
tar cvf archive-file files-to-be-archived
```

To create a list of the files in the archive:

```
tar tvf archive-file > contents.list
```

To extract the files from the archive:

```
tar xvf archive-file file(s)-to-extract
```

G-zipped files will have a “.gz” extension on the filename. These files can be decompressed after de-archiving, using:

```
gunzip filename.gz
```

CD Directory Structure

| | | |
|---|---|--|
| <p>ADCP: ADCP.tar</p> <p>Cal: InstCoef.txt</p> <p>CTD: ctd.tar</p> <p>Imagery: Imag.tar</p> <p>Maps: (various)</p> <p>Process: JGOF.tar PCO2.tar PROC.tar QC.tar</p> <p>Report: Report.doc</p> <p>RVDAS: lmgnav.tar lmguw.tar</p> | <p>Salts:</p> <p>Science:</p> <p>TCO2:</p> <p>Utility: Acrobat Winzip</p> | |
|---|---|--|

Distribution Contents

ADCP

/Adcp/

This directory contains a tar file of gentoo's proc directory, which contains a database of the averaged ping data, Matlab m-files used in processing the data, and daily graphs of the currents. For more information contact Teri Chereskin at tchereskin@ucsd.edu. Processed data is usually available shortly after the cruise at <http://currents.soest.hawaii.edu>

Calibration

/Cal/

The tar files in the Cal directory contain images of calibration sheets for each of the following systems: Sound Velocity Probe (SVP_CALS.TAR), Meteorological System (MET_CALS.TAR), Underway System (UW_CALS.TAR), and CTD_CALS.pdf.

Refer to the InstCoef.txt file along with the specific instrument calibration sheets, both located in this directory, for information on how the RVDAS data was collected and processed.

CTD

CTD/

CTD/Scripts/

This directory contains the control files used for preliminary processing of the data. Processing performed by the vessel technicians is for *quality control purposes only*, as a check that the instruments are performing correctly.

CTD//raw

Contains the raw data from the instrument.

CTD/process

Contains the files generated as a result of the preliminary post processing. For more details, refer to the SBE Data Processing documentation available on the SeaBird website (<http://www.seabird.com>).

Ice Images

/ICE_IMAGE/

This directory contains .jpg files of Terrascan ice imagery sent to the ship from Palmer station to aid in navigation of the ship and science.

Isobar Charts

/Isobars/

This directory contains GIF and JPEG image files. The GIF's are an analysis of mean sea level pressure from the National Center for Environmental Prediction's Medium Range Forecast Model. They are updated every 6 hours. Naming the convention is as follows yyjjj.hh.gif where yy is the year, jjj is the day number, and hh is the hour.

Data and Science Report

/Report/

Copies of this report in MS Word, HTML, and text formats.

Sitrep

/Sitrep/

If this directory exists, it contains copies of the vessels Daily Situation Report.

XBT

/XBT/

If this directory exists, it contains data from Expendable Bathythermographic (XBT) “Deep Blue” probes were used to obtain water column temperature profiles. The dataset includes the following files:

| | |
|------------|--|
| dat.zip | The probe drop schedule and other configuration files. |
| efiles.zip | The edited data files. |
| log.zip | The log files for drop and GPS positioning. |
| nav.zip | The navigation files. |
| sfiles.zip | The raw data files. |
| *.pdf | Scanned images of the paper log sheets. |

XCTD

/XCTD/

If this directory exists, it contains data from Expendable Conductivity, Temperature, and Depth (XCTD) digital probes were used to obtain water column temperature and Salinity profiles. Two files are created for each drop .RDF files contain the raw data, and the .EDF contain the exported ascii data.

TCO2

/TCO2/

If this directory exists, it contains the log sheet for the TCO2 sample during the Drake Transect Sampling. For further information on this data, contact Tim Newberger at tnewberg@ldeo.columbia.edu

Salts

/SALT/

If this directory exists, it contains the log sheet for the Salt sample take during the Drake Transect Sampling, also a spreadsheet containing the Salt sample and TSG comparison. These samples are normally analyzed with a Guildline Autosalinometer.

Drifters

/DRIFTERS/

This directory contains the log sheet for the drifter buoys released during the Drake Transect.

Science

/Science/

If this directory is populated, it will contain various files, data, digital photos, and/or other information collected by the individual scientists.

Maps

/Maps/

If this directory is present, it contains maps generated by vessel staff or provided by the science party. Maps may be in any number of formats, some of which may be proprietary or vendor specific. Maps generated by the Marine Electronics and Instrument Specialists are typically JPEG images.

WAYPOINTS

/WAYPTS/

If this directory is present, it contains files in CSV format detailing various navigation waypoints.

QC Plots

/QC_PLOTS/

Postscript files of data stored each day on RVDAS for quality control analysis during the cruise. There are 3 types of files, named metXXX.ps, navXXX.ps, and oceanXXX.ps, where XXX represents the Julian day. Met files are a summary of the data from the meteorological instruments, Nav files are a summary of navigational data, and Ocean files are a summary of the underway seawater and bathymetry data.

JGOFS Data Set

/JGOF/

The JGOFS data set consists of a single file produced each day named jg<julian_day>.dat.gz where <julian_day> is the day the data was acquired. The “.gz” extension indicates that the individual files are compressed before archiving. The daily file consists of 22 separate columnar fields in text format, which are described below. The JGOFS data set is obtained primarily by applying calibrations to raw data and decimating to whole minute intervals. However, several fields are derived measurements from more than a single raw input. *Note: Null, unused, or unknown fields are filled with 9's in the JGOFS data.*

Additionally, 3 separate QC plots are generated daily by the ET using the JGOFS data set. These plots include TSG and Bathymetry data, meteorological data, and navigation data. The files are called ocean<julian_day>.ps, met<julian_day>.ps, and nav<julian_day>.ps respectively.

| Field | Data | Units |
|-------|---|--|
| 01 | GMT date | dd/mm/yy |
| 02 | GMT time | hh:mm:ss |
| 03 | PCOD latitude (negative is South) | Ddd.dddd |
| 04 | PCOD longitude (negative is West) | Ddd.dddd |
| 05 | Ships speed | Knots |
| 06 | GPS HDOP | - |
| 07 | Gyro Heading | Degrees (azimuth) |
| 08 | Course over ground | Degrees (azimuth) |
| 09 | Mast PAR | $\mu\text{Einsteins/meters}^2 \text{ sec}$ |
| 10 | Sea surface temperature | $^{\circ}\text{C}$ |
| 11 | Conductivity | S/m |
| 12 | Sea surface salinity | PSU |
| 13 | Sea depth (uncorrected, calc. sw sound vel. 1500 m/s) | meters |
| 14 | True wind speed (port windbird) | meters/sec |
| 15 | True wind direction (port windbird) | degrees (azimuth) |
| 16 | Ambient air temperature | $^{\circ}\text{C}$ |
| 17 | Relative humidity | % |
| 18 | Barometric pressure | mBars |
| 19 | Sea surface fluorometry | $\mu\text{g/l}$ |
| 20 | Transmissometer | Vols (0-5 FSO) |
| 21 | PSP | W/m^2 |
| 22 | PIR | W/m^2 |

RVDAS

/RVDAS/

RVDAS (Research Vessel Data Acquisition System) was developed at Lamont-Doherty Earth Observatory of Columbia University and has been used on the R/V Maurice Ewing for several years. It was adapted for use on the Nathaniel B. Palmer and her sister ship, the R/V Laurence M. Gould.

Below you will find detailed information on the data included. Be sure to read the "Significant Acquisition Events" section below for important information about data acquisition during this cruise.

Meteorological and Light Data

| Measurement | File ID | Collect. Status | Rate | Instrument |
|--|---------|-----------------|-------|-----------------------|
| Air Temperature | lmwx | continuous | 1 sec | R. M. young 41372VC |
| Relative Humidity | lmwx | continuous | 1 sec | R. M. young 41372VC |
| Wind Speed/Direction | lmwx | continuous | 1 sec | R. M. young 5106 |
| PAR, (Photosynthetically-Available Radiation) | lmwx | continuous | 1 sec | BSI QSR-240 |
| Barometer | lmwx | continuous | 1 sec | R. M. young 61201 |
| GUV & PUV | lguv | continuous | 1 sec | GUV2511 & PUV2510 |
| PIR (LW radiation) | lmwx | continuous | 1 sec | Eppler PIR |
| PSP (SW radiation) | lmwx | continuous | 1 sec | Eppler PSP |
| Port Ultrasonic Wind Speed/Direction | lmwx | continuous | 1 sec | Gill Wind Observer II |

Navigational Data

| Measurement | File ID | Collect. Status | Rate | Instrument |
|--------------|---------|-----------------|---------|--------------------|
| Attitude GPS | lash | continuous | 1 sec | Ashtec ADU-2 |
| Trimble GPS | tgps | civilian mode | 1 sec | Trimble 20636-00SM |
| Gyro | lgyr | continuous | 0.2 sec | Anschutz Gyro |
| Garmin GPS | lgar | continuous | 1 sec | Garmin 17 |

Geophysical Data

| Measurement | File ID | Collect. Status | Rate | Instrument |
|------------------|---------|-----------------|----------|----------------|
| Bathymetry | lknu | variable | Varies | Knudsen 320B/R |
| Net Depth Sensor | lnds | variable | ~1/3 sec | Omega PX-605 |
| DUSH 11 Winch | lwn1 | variable | varies | Markey DUSH 11 |
| DUSH 5 Winch | lwn1 | variable | varies | Markey DUSH 5 |
| DUSH 4 Winch | lwn1 | variable | varies | Markey DUSH 4 |

Oceanographic Data

| Measurement | File ID | Collect. Status | Rate | Instrument |
|-------------------------|---------|-----------------|---------|------------------|
| Salinity | utsg | continuous | 1 sec | SeaBird 45 |
| Sea Surface Temperature | lrtm | continuous | 1 sec | SeaBird 38 |
| Fluorometry (digital) | lflr | continuous | 1 sec | Turner 10-AU-005 |
| Fluorometry (digital) | ldfl | continuous | 1 sec | Wetlab ECO |
| ADCP, Speed Log | ladc | continuous | 1 sec | RD Instruments |
| Oxygen | loxy | continuous | 1 sec | |
| PCO2 | lpcO2 | continuous | 2.5 min | |
| | | | | |
| | | | | |

Data File Names and Structures

RVDAS data is divided into two broad categories, **Underway** and **Navigation**. The groups are abbreviated “uw” and “nav”. Thus, these two tar files, lmguw.tar and lmgnav.tar exist under the top-level rvdas directory. The instruments are broken down as shown. Each data file is g-zipped to save space on the distribution. Not all data types are collected everyday or on every cruise.

RVDAS data files are named following the convention: LMG[FileID].dDDD.

- The FileID is a 4-character code representing the system being logged, for example: lmet (for meteorology)
- DDD is the Julian day of the data collection

| Underway Data | File ID | Navigation Data | File ID |
|----------------------------|---------|------------------|---------|
| Meteorological - Cambell | lmwx | Gyro Compass | lgyr |
| Knudsen | lknu | P-CODE GPS | tgps |
| microTSG | utsg | Ashtech ADU2 GPS | lash |
| Digital Remote Temperature | lrtm | Garmin 17 GPS | lgar |
| Fluorometer - Turner | lflr | | |
| Fluorometer – Wetlab ECO | ldfl | | |
| ADCP | ladc | | |
| Sound Velocity Probe | lsvp | | |
| GUV & PUV | lguv | | |
| PCO2 System | lpco | | |
| Oxygen | loxy | | |
| Wet Wall Flows | lsea | | |
| Winches: Dush4,5,&11 | lwn1 | | |
| Net Depth Sensor | lnds | | |
| | | | |
| | | | |

Data is received by the RVDAS system via RS-232 serial connections. The data files that comprise the rvdas data set are described below. A time tag is added to each line of data received and the data is written to disk.

YY+DDD:HH:MM:SS.SSS [data stream from instrument]

Where, YY: two-digit year, DDD: Julian Day, HH: 2 digit hours, MM: 2 digit minutes SS.SSS: seconds. All times are UTC.

The delimiters used to separate fields in the raw data files are usually spaces and commas, but other delimiters are used (:, =, @) and occasionally there is no delimiter. Care should be taken when reprocessing the data that the field separations are clearly understood. An example data string is provided with each instrument section for your convenience, however it is always best to refer directly to the raw data.

Iknu – Knudsen Sonar

08+024:07:36:36.245 HF,00.00, 000,0,LF,448.9,-026,1

| Field | Data | Units |
|-------|-------------------------------------|--------|
| 1 | RVDAS Time Tag | |
| 2 | HF – high frequency header (12 kHz) | |
| 3 | HF - depth to surface | meters |
| 4 | HF - Echo Strength | |
| 5 | HF – Depth Valid Flag | |
| 6 | LF – low frequency header (3.5 kHz) | |
| 7 | LF - depth to surface | meters |
| 8 | LF - Echo Strength | |

| Field | Data | Units |
|-------|-----------------------|-------|
| 9 | LF – Depth Valid Flag | |

Inds – Net Depth Sensor

99+099:00:18:19.775 V01 00199.8

| Field | Data | Units |
|-------|----------------|--------|
| 1 | RVDAS Time Tag | |
| 2 | V01 – Sensor 1 | label |
| 3 | Depth | meters |

lwn1 - Winches

08+033:11:27:50.673 RD,DUSH-5,00111.63,00000000,-0000012,1938

| Field | Data | Units |
|-------|---|---------------|
| 1 | RVDAS Time Tag | |
| 2 | Record Identifier, RD=Remote Data | |
| 3 | Winch Identifier, DUSH-X where X is 4, 5, or 11 | |
| 4 | Tension | lbs |
| 5 | Speed | Meters/minute |
| 6 | Payout | meters |
| 7 | Checksum | |

Imwx - Campbell Meteorological DAS

08+034:13:52:14.216 SUS,A,356,002.15,M,+332.28,+000.97,60,08

| Field | Data | Units |
|-------|---|-------|
| 1 | RVDAS Time Tag | |
| 2 | SUS tag – Starboard UltraSonic Anemometer | |
| 3 | Unit Identification, A-Z | |
| 4 | Port Wind Direction, degrees relative to Bow | deg |
| 5 | Port Wind Speed | m/s |
| 6 | Units, M=meters per second | |
| 7 | Sound Speed | m/s |
| 8 | Sonic Temperature | °C |
| 9 | Status, 0=ok, 60=Heating Enabled & ok, Other value mean a fault | |
| 10 | Check Sum | |

08+034:13:52:14.216 PUS,A,356,002.15,M,+332.28,+000.97,60,08

| Field | Data | Units |
|-------|---|-------------|
| 1 | RVDAS Time Tag | |
| 2 | PUS tag – Port Anemometer | |
| 3 | Unit Identification, A-Z | |
| 4 | Port Wind Direction, degrees relative to Bow | deg |
| 5 | Port Wind Speed | m/s |
| 6 | Units, M=meters per second | |
| 7 | Sound Speed | meaningless |
| 8 | Sonic Temperature | meaningless |
| 9 | Status, 0=ok, 60=Heating Enabled & ok, Other value mean a fault | meaningless |
| 10 | Check Sum | meaningless |

08+034:13:52:14.454 MET,12.22322,44.25706,-75,-25,-363.6365,2.332982,-0.08215196,278.6845,279.2192,854.6198

| Field | Data | Units |
|-------|-----------------------------|--------|
| 1 | RVDAS Time Tag | |
| 2 | MET tag | |
| 3 | Power Supply Voltage | Volts |
| 4 | Enclosure Relative Humidity | % |
| 5 | Air Temp | °C |
| 6 | Air Relative Humidity | % |
| 7 | PAR | mVolts |
| 8 | PSP Thermopile | mVolts |
| 9 | PIR Thermopile | mVolts |
| 10 | PIR Case Temperature | °K |
| 11 | PIR Dome Temperature | °K |
| 12 | Barometer | mBars |
| | | |

utsg – microTSG, Thermosalinograph

For further information on this data, check on www.seabird.com on SBE 45 MicroTSG Thermosalinograph

08+037:13:45:57.596 2.6470, 3.03853, 33.8129, 1459.351

| Field | Data | Units |
|-------|----------------------------|-------|
| 1 | RVDAS Time Tag | |
| 2 | Internal water temperature | °C |
| 3 | Conductivity | S/m |
| 4 | Salinity | psu |
| 5 | Sound Velocity | m/s |

Irtm – digital Remote Temperature

For further information on this data, check on www.seabird.com on SBE38 Digital Thermometer

08+037:13:47:17.841 2.2527

| Field | Data | Units |
|-------|----------------------------|-------|
| 1 | RVDAS Time Tag | |
| 2 | External water temperature | °C |

Ifir – Fluorometer, Turner

04+107:16:48:02.342 0 5450 :: 4/16/04 09:44:17 = 0.632 (RAW)

| Field | Data | Units |
|-------|-------------------------------|----------|
| 1 | RVDAS Time Tag | |
| 2 | Zero Field | numeric |
| 3 | Sample Number | numeric |
| 4 | Fluorometer Date | mm/dd/yy |
| 5 | Fluorometer Time | hh:mm:ss |
| 6 | Digital output of fluorometer | Volts |
| 7 | (RAW) | |

Idfl – Fluorometer, Wetlab ECO

08+037:13:55:08.434 99/99/99 99:99:99 0.00 2585 73 543

| Field | Data | Units |
|-------|-----------------------------|----------|
| 1 | RVDAS Time Tag | |
| 2 | Fluorometer Date | mm/dd/yy |
| 3 | Fluorometer Time | hh:mm:ss |
| 4 | Chlorophyll Signal | µg/l |
| 5 | Reference | λq |
| 6 | Counts – Chlorophyll Signal | Count |
| 7 | Thermistor | |

loxy - Oxygen

For further information on this data, contact Tim Newberger at tnewberg@ldeo.columbia.edu

04+117:23:57:23.504 MEASUREMENT 3830 380 Oxygen: 309.95 Saturation:
83.48 Temperature: -1.35 DPhase: 33.41 BPhase: 32.22
RPhase: 0.00 BAmp: 262.09 BPot: 163.00 RAmp:
0.00 RawTem.: 694.92

| Field | Data | Units |
|-------|---|--------------|
| 1 | RVDAS Time Tag | |
| 2-4 | Measurement ID, Model Number, Serial Number | alphanumeric |
| 5 | Oxygen heading | text |
| 6 | Oxygen Reading | Raw numeric |
| 7 | Saturation heading | text |
| 8 | Saturation Reading | Raw numeric |
| 9 | Temperature heading | text |
| 10 | Water Temperature | °C |
| 11 | Dphase heading | text |
| 12 | Dphase | Raw numeric |
| 13 | Bphase heading | text |
| 14 | BPhase | Raw numeric |
| 15 | Rphase heading | text |
| 16 | Rphase | Raw numeric |
| 17 | Bamp heading | text |
| 18 | Bamp | Raw numeric |
| 19 | Bpot heading | text |
| 20 | Bpot | Raw numeric |
| 21 | Ramp heading | text |
| 22 | Ramp | Raw numeric |
| 23 | RawTem heading | text |
| 24 | RawTemp | Raw numeric |

IpcO – PCO₂ system

For further information on this data, contact Tim Newberger at tnewberg@ldeo.columbia.edu

02+319:23:59:13.748 2002319.99851 7154.27 26.49 1033.6 325.79 6.74 329.3
53.76 0 Equil

| Field | Data | Units |
|-------|--------------------------|-----------|
| 1 | RVDAS Time Tag | |
| 2 | Julian date file string | Julian |
| 3 | IR voltage reading | mV |
| 4 | Cell temperature | °C |
| 5 | Barometer | millibars |
| 6 | VCO ₂ | mL |
| 7 | Equilibrator temperature | °C |
| 8 | PCO ₂ | millibars |
| 9 | Gas flow | mL/min |
| 10 | Solenoid position ID | number |
| 11 | Valve Position ID | number |
| 12 | Measured gas | name |

Iguv – Biospherical GUV

08+037:14:17:59.211 020608 141758 -.000099 1.307E0 7.24E0 1.316E1 2.609E1 3.285E1 3.505E1 8.075E-
2 38.993 17.985

GUV only

| Field | Data | Units |
|-------|-------------------|-------------------------------------|
| 1 | RVDAS Time Tag | |
| 2 | GUV Computer Date | mmddyy |
| 3 | GUV Computer Time | hhmmss |
| 4 | Ed0Gnd - GUV | Volts |
| 5 | Ed0305 - GUV | $\mu\text{W}/\text{cm}^2\text{nm}$ |
| 6 | Ed0313 - GUV | $\mu\text{W}/\text{cm}^2\text{nm}$ |
| 7 | Ed0320 - GUV | $\mu\text{W}/\text{cm}^2\text{nm}$ |
| 8 | Ed0340 - GUV | $\mu\text{W}/\text{cm}^2\text{nm}$ |
| 9 | Ed0380 - GUV | $\mu\text{W}/\text{cm}^2\text{nm}$ |
| 10 | Ed0395 - GUV | $\mu\text{W}/\text{cm}^2\text{nm}$ |
| 11 | Ed0PAR - GUV | $\mu\text{E}/\text{cm}^2\text{sec}$ |
| 12 | Ed0Temp - GUV | °C |
| 13 | Ed0VIn | Volts |

GUV and PUV

| Field | Data | Units |
|-------|-------------------|--------------------------------------|
| 1 | RVDAS Time Tag | |
| 2 | GUV Computer Date | mmddyy |
| 3 | GUV Computer Time | hhmmss |
| 4 | EdZGnd -PUV | Volts |
| 5 | EdZ305 -PUV | $\mu\text{W}/\text{cm}^2\text{nm}$ |
| 6 | EdZ313 -PUV | $\mu\text{W}/\text{cm}^2\text{nm}$ |
| 7 | EdZ320 -PUV | $\mu\text{W}/\text{cm}^2\text{nm}$ |
| 8 | EdZ395 -PUV | $\mu\text{W}/\text{cm}^2\text{nm}$ |
| 9 | EdZ340 -PUV | $\mu\text{W}/\text{cm}^2\text{nm}$ |
| 10 | EdZPAR -PUV | $\mu\text{E}/\text{cm}^2\text{sec}$ |
| 11 | LuZChl -PUV | $\mu\text{E}/\text{srm}^2\text{sec}$ |
| 12 | EdZ380 -PUV | $\mu\text{W}/\text{cm}^2\text{nm}$ |
| 13 | WTemp -PUV | °C |
| 14 | Depth -PUV | m |
| 15 | EdZTemp -PUV | °C |
| 16 | LuZTemp -PUV | °C |
| 17 | Tilt -PUV | Degrees |
| 18 | Roll -PUV | Degrees |
| 19 | Ed0Gnd - GUV | Volts |
| 20 | Ed0305 - GUV | $\mu\text{W}/\text{cm}^2\text{nm}$ |
| 21 | Ed0313 - GUV | $\mu\text{W}/\text{cm}^2\text{nm}$ |
| 22 | Ed0320 - GUV | $\mu\text{W}/\text{cm}^2\text{nm}$ |
| 23 | Ed0340 - GUV | $\mu\text{W}/\text{cm}^2\text{nm}$ |
| 24 | Ed0380 - GUV | $\mu\text{W}/\text{cm}^2\text{nm}$ |
| 25 | Ed0395 - GUV | $\mu\text{W}/\text{cm}^2\text{nm}$ |
| 26 | Ed0PAR - GUV | $\mu\text{E}/\text{cm}^2\text{sec}$ |

| | | |
|----|---------------|-------|
| 27 | Ed0Temp - GUV | °C |
| 28 | Ed0VIn | Volts |

Isvp - Sound Velocity Probe in ADCP Transducer Well

00+348:01:59:52.128 1539.40

| Field | Data | Units |
|-------|----------------|-------|
| 1 | RVDAS Time Tag | |
| 2 | Sound velocity | m/s |

ladc – ADCP Speed Log

00+019:23:59:59.099 \$PUHAW,UVH,-1.48,-0.51,250.6

| Field | Data | Units |
|-------|--|---------|
| 1 | RVDAS Time Tag | |
| 2 | \$PUHAW | |
| 3 | UVH (E-W, N-S, Heading) | |
| 4 | Ship Speed relative to reference layer ¹ velocity ² , East vector | knots |
| 5 | Ship Speed relative to reference layer ¹ velocity ² , North vector | knots |
| 6 | Ship heading | degrees |

¹The reference layer is an average velocity measured in a number of depth “bins”. On the LMG, the bins are eight meters deep and bins 3-10 define the reference layer. Hence, the reference layer is the water column from 16-80 meters beneath the ship.

²The speed output is water velocity relative to the ship’s hull and is therefore opposite of the actual movement of the ship. For example, if the ship’s heading is due north, the North/South reference layer velocity is likely to be negative (southerly).

lash – Ashtech GPS

ATTD: Attitude Data

01+081:00:00:00.806 \$PASHR,ATT,345605.0,165.03,+001.86,-01.96,0.0018,0.0173,0*22

| Field | Data | Units |
|-------|------------------------------|---------|
| 1 | RVDAS Time Tag \$PASHR | |
| 2 | ATT | |
| 3 | GPS Time sec. of the week | seconds |
| 4 | heading (rel. to true North) | degrees |
| 5 | pitch | degrees |
| 6 | roll | degrees |
| 7 | Measurement RMS error | meters |
| 8 | Baseline RMS error | meters |
| 9 | attitude reset flag | |

01+081:00:00:00.966 \$GPGBGA,235952.00,6051.7937,S,06030.2175,W,1,08,01.0,+00068,M,,M,,*79

| Field | Data | Units |
|-------|-------------------------|-----------|
| 1 | RVDAS Time Tag \$GPGBGA | |
| 2 | UTC time at position | hhmmss.ss |
| 3 | Latitude | ddmm.mmm |

| Field | Data | Units |
|-------|-----------------------------------|----------|
| 4 | North (N) or South (S) | |
| 5 | Longitude | ddmm.mmm |
| 6 | East (E) or West (W) | |
| 7 | GPS quality (1=GPS 2=DGPS) | |
| 8 | Number of GPS satellites used | |
| 9 | HDOP | |
| 10 | Antenna Height | meters |
| 11 | M for Meters | |
| 12 | Geoidal height | meters |
| 13 | M for meters | |
| 14 | age of diff. GPS data | sss |
| 15 | differential reference station ID | aaaa |

Igyr - Gyro

02+315:23:59:58.194 \$PASVW,00.1,A*1D

02+315:23:59:58.414 \$IIVHW,287.7,T,,M,,N,,K*71

02+315:23:59:58.616 \$HEHDT,287.7,T*25

02+315:23:59:58.821 \$HEROT,001.6,A*2C

02+315:23:59:58.984 \$HCHDT,,T*07

HDT: True Heading

01+083:00:00:02.893 \$HEHDT,246.3,T*2C

| Field | Data | Units |
|-------|-----------------------------------|---------|
| 1 | RVDAS Time Tag \$HEHDT | |
| 2 | Heading XXXXX = ddd.d | degrees |
| 3 | T flag for true heading, checksum | |

ROT: Rate of Turn

01+083:00:00:03.093 \$HEROT,-006.3,A*03

| Field | Data | Units |
|-------|----------------------------------|-------------|
| 1 | RVDAS Time Tag \$HEROT | |
| 2 | Rate of turn | degrees/min |
| 3 | Status: A = data valid, checksum | |

Igar - Garmin GPS

GGA: Global Positioning Fix Data

08+034:12:26:06.131 \$GPGGA,122607,6446.4733,S,06403.4455,W,1,11,0.9,-193.4,M,9.7,M,,*5A

| Field | Data | Units |
|-------|---|-----------|
| 1 | RVDAS Time Tag | |
| 2 | \$GPGGA Tag | |
| 3 | UTC of position | hhmmss.ss |
| 4 | Latitude in degrees with decimal minutes | ddmm.mmm |
| 5 | North (N) or South (S) | |
| 6 | Longitude in degrees with decimal minutes | ddmm.mmm |
| 7 | East (E) or West (W) | |
| 8 | GPS quality (1=GPS 2=DGPS) | |

| Field | Data | Units |
|-------|--|--------|
| 9 | Number of GPS satellites used | |
| 10 | Horizontal dilution of precision (HDOP) | |
| 11 | Antenna height above/below mean-sea-level (geoid) | meters |
| 12 | Units for antenna height (M = Meters) | |
| 13 | Geoidal Separation ¹ | |
| 14 | Units for Geoidal Separation (M = Meters) | meters |
| 15 | Age of differential GPS data, number of seconds since last SC104 Type 1 or 9 | |
| 16 | Differential reference station ID | |

¹Geoidal Separation: the difference between the WGS-84 earth ellipsoid and mean-sea-level (geoid). A negative value represents mean-sea-level below ellipsoid.

RMC: Recommended Minimum Specific GNSS Data

08+034:13:17:26.627 \$GPRMC,131726.605,A,6446.4820,S,06403.3075,W,000.0,094.4,030208,16.3,E

| Field | Data | Units |
|-------|--|-----------|
| 1 | RVDAS Time Tag | |
| 2 | \$GPRMC Tag | |
| 3 | UTC of position | hhmmss.ss |
| 4 | Status A = Data Valid, V = Navigation Receiver Warning | |
| 5 | Latitude in degrees with decimal minutes | ddmm.mmm |
| 6 | North (N) or South (S) | |
| 7 | Longitude in degrees with decimal minutes | ddmm.mmm |
| 8 | East (E) or West (W) | |
| 9 | Speed Over Ground, knots | knots |
| 10 | Course Over Ground, degrees True | degrees |
| 11 | Date | ddmmyy |
| 12 | Magnetic Variation, degrees E/W | degrees |
| 13 | Mode Indicator E= Estimated Mode | |

VTG: Track Made Good and Speed over Ground

08+034:12:26:06.211 \$GPVTG,167,T,151,M,000.0,N,0000.0,K

| Field | Data | Units |
|-------|-------------------------|---------|
| 1 | RVDAS Time Tag | |
| 2 | \$GPVTG Tag | |
| 3 | Track, degrees true | degrees |
| 3 | T flag for True | |
| 4 | Track, degrees magnetic | degrees |
| 5 | M flag for Magnetic | |
| 6 | Speed over Ground | knots |
| 7 | N flag for Knots | |
| 8 | Speed over Ground | kmhr |
| 9 | K flag for km/hr | |

tgps – Trimble Centurion GPS

GGA: Global Positioning Fix Data

08+034:12:26:06.131 \$GPGGA,122607,6446.4733,S,06403.4455,W,1,11,0.9,-193.4,M,9.7,M,,*5A

| Field | Data | Units |
|-------|------|-------|
|-------|------|-------|

| Field | Data | Units |
|-------|--|-----------|
| 1 | RVDAS Time Tag | |
| 2 | \$GPGGA Tag | |
| 3 | UTC of position | hhmmss.ss |
| 4 | Latitude in degrees with decimal minutes | ddmm.mmm |
| 5 | North (N) or South (S) | |
| 6 | Longitude in degrees with decimal minutes | ddmm.mmm |
| 7 | East (E) or West (W) | |
| 8 | GPS quality (1=GPS 2=DGPS) | |
| 9 | Number of GPS satellites used | |
| 10 | Horizontal dilution of precision (HDOP) | |
| 11 | Antenna height above/below mean-sea-level (geoid) | meters |
| 12 | Units for antenna height (M = Meters) | |
| 13 | Geoidal Separation ¹ | |
| 14 | Units for Geoidal Separation (M = Meters) | meters |
| 15 | Age of differential GPS data, number of seconds since last SC104 Type 1 or 9 | |
| 16 | Differential reference station ID | |

¹Geoidal Separation: the difference between the WGS-84 earth ellipsoid and mean-sea-level (geoid). A negative value represents mean-sea-level below ellipsoid.

GLL: Geographic Position – Latitude/Logitude

08+034:12:26:06.211 \$GPGLL,6446.4733,S,06403.4455,W,122607,A

| Field | Data | Units |
|-------|---|-----------|
| 1 | RVDAS Time Tag | |
| 2 | \$GPGLL Tag | |
| 3 | Latitude | ddmm.mmm |
| 4 | North (N) or South (S) | |
| 5 | Logitude | ddmm.mmm |
| 6 | East (E) or West (W) | |
| 7 | UTC of position | hhmmss.ss |
| 8 | Status: A = Data Valid, V =Data Not Valid | |

VTG: Track Made Good and Speed over Ground

08+034:12:26:06.211 \$GPVTG,167,T,151,M,000.0,N,0000.0,K

| Field | Data | Units |
|-------|-------------------------|---------|
| 1 | RVDAS Time Tag | |
| 2 | \$GPVTG Tag | |
| 3 | Track, degrees true | degrees |
| 3 | T flag for True | |
| 4 | Track, degrees magnetic | degrees |
| 5 | M flag for Magnetic | |
| 6 | Speed over Ground | knots |
| 7 | N flag for Knots | |
| 8 | Speed over Ground | kmhr |
| 9 | K flag for km/hr | |

RMC: Recommended Minimum Specific GNSS Data

08+034:13:17:26.627 \$GPRMC,131726.605,A,6446.4820,S,06403.3075,W,000.0,094.4,030208,16.3,E

| Field | Data | Units |
|-------|--|-----------|
| 1 | RVDAS Time Tag | |
| 2 | \$GPRMC Tag | |
| 3 | UTC of position | hhmmss.ss |
| 4 | Status A = Data Valid, V = Navigation Receiver Warning | |
| 5 | Latitude in degrees with decimal minutes | ddmm.mmm |
| 6 | North (N) or South (S) | |
| 7 | Longitude in degrees with decimal minutes | ddmm.mmm |
| 8 | East (E) or West (W) | |
| 9 | Speed Over Ground, knots | knots |
| 10 | Course Over Ground, degrees True | degrees |
| 11 | Date | ddmmyy |
| 12 | Magnetic Variation, degrees E/W | degrees |
| 13 | Mode Indicator E= Estimated Mode | |

LMG Sensors

Shipboard Sensors

| Sensor | Description | Serial # | Cal. Date | Status |
|----------------------|----------------------------------|-------------|-------------|-----------|
| Port Anemometer | Gill Ultrasonic Wind Observer II | 840019 | | Collected |
| Starboard Anemometer | Gill Ultrasonic Wind Observer II | 71738 | | Collected |
| Barometer | R.M. Young 61201 | BP00873 | 10-Sep-2008 | Collected |
| Humidity/Wet Temp | RM Young 41372LC | 06133 | 8-May-2009 | Collected |
| PAR for Mast | Biosph. Inst. QSR-240P | 6393 | 7-Feb-2008 | Collected |
| PIR | Eppley PIR | 28903F3 | 30-Sep-2008 | Collected |
| PSP | Eppley PSP | 28933F3 | 24-Sep-2008 | Collected |
| GUV (Mast) | Biosph. Inst. GUV-2511 | 25110805127 | 02-Dec-2008 | Collected |
| Transmissometer | WET Labs C-Star 25 cm deep | CST-407DR | 13-Oct-2009 | Collected |
| Fluorometer | Turner 10AU-005-CE | 6592 RTX | | Collected |
| MicroTSG | Sea-Bird 45 | 243 | 21-Apr-2008 | Collected |
| Digital Remote Temp | Sea-Bird 38 | 262 | 07-Jan-2008 | Collected |
| Fluorometer | WET Labs ECO-FL | FLRTD-399 | 15-Sep-09 | Collected |
| | | | | |

Underway Calibration Sheets

Note: Embedded pdf files can be opened with a right-click, Acrobat Document Object, Open

Remote Temperature (SBE-38)

39

SEA-BIRD ELECTRONICS, INC.

1808 136th Place N.E., Bellevue, Washington, 98005 USA

Phone: (425) 643 - 9866 Fax (425) 643 - 9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 0262
CALIBRATION DATE: 07-Jan-08

SBE 38 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

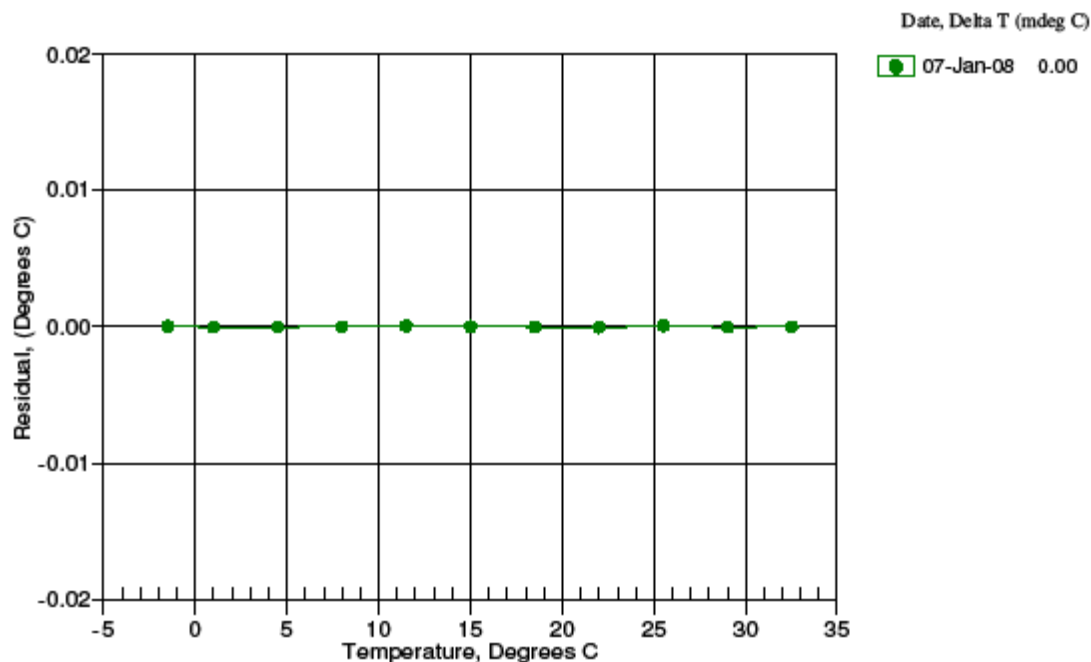
ITS-90 COEFFICIENTS

a0 = -2.602085e-005
a1 = 2.811337e-004
a2 = -2.667958e-006
a3 = 1.663429e-007

| BATH TEMP (ITS-90) | INSTRUMENT OUTPUT | INST TEMP (ITS-90) | RESIDUAL (ITS-90) |
|-----------------------|----------------------|-----------------------|----------------------|
| -1.50010 | 702896.2 | -1.50006 | 0.00004 |
| 0.99990 | 628320.9 | 0.99986 | -0.00004 |
| 4.49990 | 538544.5 | 4.49988 | -0.00002 |
| 7.99990 | 463090.7 | 7.99989 | -0.00001 |
| 11.49990 | 399460.2 | 11.49997 | 0.00007 |
| 14.99990 | 345627.5 | 14.99992 | 0.00002 |
| 18.50000 | 299936.1 | 18.49998 | -0.00002 |
| 22.00000 | 261037.3 | 21.99993 | -0.00007 |
| 25.49990 | 227819.7 | 25.49997 | 0.00007 |
| 28.99990 | 199372.5 | 28.99986 | -0.00004 |
| 32.49990 | 174939.0 | 32.49992 | 0.00002 |

Temperature ITS-90 = $1/[a_0 + a_1[\ln(n)] + a_2[\ln^2(n)] + a_3[\ln^3(n)]] - 273.15$ (°C)

Residual = instrument temperature - bath temperature



Transmissometer (Wetlabs C-Star)

PO Box 518
620 Applegate St.
Philomath, OR 97370



(541) 929-5650
Fax (541) 929-5277
www.wetlabs.com

C-Star Calibration

| | | | | | |
|--|------------------|------|---------------------|------------|-------|
| Date | October 13, 2009 | S/N# | CST-407DR | Pathlength | 25 cm |
| <hr/> | | | | | |
| | | | Analog meter | | |
| V_d | | | 0.059 V | | |
| V_{air} | | | 4.794 V | | |
| V_{ref} | | | 4.687 V | | |
| <hr/> | | | | | |
| Temperature of calibration water | | | | 22.6 °C | |
| Ambient temperature during calibration | | | | 22.0 °C | |

Relationship of transmittance (Tr) to beam attenuation coefficient (c), and pathlength (x , in meters): $Tr = e^{-cx}$

To determine beam transmittance: $Tr = (V_{sig} - V_{dark}) / (V_{ref} - V_{dark})$

To determine beam attenuation coefficient: $c = -1/x * \ln(Tr)$

V_d Meter output with the beam blocked. This is the offset.

V_{air} Meter output in air with a clear beam path.

V_{ref} Meter output with clean water in the path.

Temperature of calibration water: temperature of clean water used to obtain V_{ref} .

Ambient temperature: meter temperature in air during the calibration.

V_{sig} Measured signal output of meter.

Revision L

6/9/09

Fluorometer (Wetlabs ECO-FL)

PO Box 518
620 Applegate St.
Philomath, OR 97370



(541) 929-5650
Fax (541) 929-5277
www.wetlabs.com

ECO Chlorophyll Fluorometer Characterization Sheet

Date: 9/15/2009

S/N: FLRTD-399

Chlorophyll concentration expressed in $\mu\text{g/l}$ can be derived using the equation:

$$\text{CHL } (\mu\text{g/l}) = \text{Scale Factor} * (\text{Output} - \text{Dark Counts})$$

| | Analog Range 1 | Analog Range 2 | Analog Range 4 (default) | Digital |
|-------------------|-------------------|-------------------|--------------------------------|------------------------------|
| Dark Counts | 0.097 | 0.054 | 0.033 V | 68 counts |
| Scale Factor (SF) | 6 | 12 | 24 $\mu\text{g/l/V}$ | 0.0074 $\mu\text{g/l/count}$ |
| Maximum Output | 4.96 | 4.96 | 4.96 V | 16330 counts |
| Resolution | 0.7 | 0.7 | 0.7 mV | 1.0 counts |

Ambient temperature during characterization

22.3 °C

Analog Range: 1 (most sensitive, 0–4,000 counts), 2 (midrange, 0–8,000 counts), 4 (entire range, 0–16,000 counts).

Dark Counts: Signal output of the meter in clean water with black tape over detector.

SF: Determined using the following equation: $\text{SF} = x \div (\text{output} - \text{dark counts})$, where x is the concentration of the solution used during instrument characterization. SF is used to derive instrument output concentration from the raw signal output of the fluorometer.

Maximum Output: Maximum signal output the fluorometer is capable of.

Resolution: Standard deviation of 1 minute of collected data.

The relationship between fluorescence and chlorophyll-a concentrations *in-situ* is highly variable. The scale factor listed on this document was determined using a mono-culture of phytoplankton (*Thalassiosira weissflogii*). The population was assumed to be reasonably healthy and the concentration was determined by using the absorption method. To accurately determine chlorophyll concentration using a fluorometer, you must perform secondary measurements on the populations of interest. This is typically done using extraction-based measurement techniques on discrete samples. For additional information on determining chlorophyll concentration see "Standard Methods for the Examination of Water and Wastewater" part 10200 H, published jointly by the American Public Health Association, American Water Works Association, and the Water Environment Federation.

FLRTD-399_workbookj1.xls

Revision J

3/17/08

PSP (Eppley model PSP)**THE EPPLEY LABORATORY, INC.**

12 Sheffield Ave., P.O. Box 419, Newport, RI 02840 USA

Telephone: 401-847-1020

Fax: 401-847-1031

Email: info@eppleylab.com

Internet: www.eppleylab.com



Scientific Instruments
for Precision Measurements
Since 1917

**STANDARDIZATION OF
EPPLEY PRECISION SPECTRAL PYRANOMETER
Model PSP**

Serial Number: 28933F3

Resistance: 686 Ω at 23 $^{\circ}\text{C}$ Temperature Compensation Range: -20 to +40 $^{\circ}\text{C}$

This radiometer has been compared with Standard Precision Spectral Pyranometer, Serial Number 21231F3 in Eppley's Integrating Hemisphere under radiation intensities of approximately 700 watts meter⁻² (roughly one half a solar constant).

As a result of a series of comparisons, it has been found to have a sensitivity of:

$$8.04 \times 10^{-6} \text{ volts/watts meter}^{-2}$$

The calculation of this constant is based on the fact that the relationship between radiation intensity and emf is rectilinear to intensities of 1400 watts meter⁻². This radiometer is linear to within $\pm 0.5\%$ up to this intensity.

The calibration of this instrument is traceable to standard self-calibrating cavity pyrheliometers in terms of the Systems Internationale des Unites (SI units), which participated in the Tenth International Pyrheliometric Comparisons (IPC X) at Davos, Switzerland in September-October 2005.

Eppley recommends a minimum calibration cycle of five (5) years but encourages annual calibrations for highest measurement accuracy. Unless otherwise stated in the remarks section below or on the Sales Order, the results are "AS FOUND / AS LEFT".

Useful conversion facts: 1 cal cm⁻² min⁻¹ = 697.3 watts meter⁻²
1 BTU/ft²-hr⁻¹ = 3.153 watts meter⁻²

Shipped to: National Science Foundation Date of Test: Sept. 24, 2008
Port Hueneme, CA

S.O. Number: 61818

Date: Oct. 14, 2008

In Charge of Test:

R. Eggeman

Reviewed by:

Thomas D. Kurb

Remarks:

PIR (Eppley model PIR)**THE EPPLEY LABORATORY, INC.**

12 Sheffield Ave., P.O. Box 419, Newport, RI 02840 USA

Telephone: 401-847-1020

Fax: 401-847-1031

Email: info@eppleylab.com

Internet: www.eppleylab.com

Scientific Instruments
for Precision Measurements
Since 1917**STANDARDIZATION OF
EPPLEY PRECISION INFRARED RADIOMETER
Model PIR**

Serial Number: 28903F3

Resistance: 675 Ω at 23 $^{\circ}\text{C}$ Temperature Compensation Range: -20 to +40 $^{\circ}\text{C}$

This pyrgeometer has been compared against Eppley's Blackbody Calibration System under radiation intensities of approximately 200 watts meter⁻² and an average ambient temperature of 25 $^{\circ}\text{C}$ as measured by Standard Omega Temperature Probe, RTD#1.

As a result of a series of comparisons, it has been found to have a sensitivity of:

$$3.67 \times 10^{-6} \text{ volts/watts meter}^{-2}$$

The calculation of this constant is based on the fact that the relationship between radiation intensity and emf is rectilinear to intensities of 700 watts meter⁻². This radiometer is linear to within $\pm 1.0\%$ up to this intensity.

The calibration of this instrument is traceable to the International Practical Temperature Scale (IPTS) through a precision low-temperature blackbody.

Eppley recommends a minimum calibration cycle of five (5) years but encourages annual calibrations for highest measurement accuracy. Unless otherwise stated in the remarks section below or on the Sales Order, the results are "AS FOUND / AS LEFT".

Shipped to: National Science Foundation
Port Hueneme, CA

In Charge of Test: *R. Eggman*

S.O. Number: 61818

Date: Oct. 14, 2008

Reviewed by: *Thomas J. K...*

Remarks:

PAR (QSR-240P)**Biospherical Instruments Inc.**

CALIBRATION CERTIFICATE

Calibration Date 2/16/2008
 Model Number: QSR-240
 Serial Number 5393
 Operator TPC
 Standard Lamp 91537/10/25/2005
 Probe Excitation Voltage Range 6 to 18 VDC(+) 1000
 Output Polarity Positive

Probe Conditions at Calibration (in air):

Calibration Voltage: 6 VDC(+) 1000
 Probe Current: 1.3 mA

Probe Output Voltage:

Probe Illuminated 58.7 mV
 Probe Dark 0.8 mV
 Probe Net Response 87.9 mV
 RGT80 2.1 mV

Corrected Lamp Output:

Output In Air (same condition as calibration):

9.80E-15 quanta/cm²/sec
0.01487 μ E/cm²/sec

Calibration Scale Factor:

(To calculate irradiance, divide the net voltage reading in Volts by this value.)

Dry 9.04531E-18 V/(quanta/cm²/sec)
5.9897E+00 V/(μ E/cm²/sec)

Notes:

1. Annual calibration is recommended.
2. Calibration is performed using a Standard of Spectral Irradiance traceable to the National Institute of Standards and Technology (NIST).
3. The collector should be cleaned frequently with alcohol.
4. Calibration was performed with customer cable, when available.

QSR240R 05/24/05

Temperature/Relative Humidity (RMYoung model 41372LC)

R.M. Young Company
2801 Aero Park Drive
Traverse City, Michigan 49686 USA

CALIBRATION REPORT
Relative Humidity Sensor

Customer: *Raytheon Polar Services*

Test Number: 95082R
Test Date: 8 May 2009

Customer PO: RR44976-01
Sales Order: 0380

Test Sensor:

Model: 41372LC Serial Number: 6133
Description: Temperature/Relative Humidity Sensor

Report of calibration comparison of test relative humidity sensor with National Institute of Standards and Technology traceable standard relative humidity sensor at five humidity levels in the R.M. Young Company controlled humidity chamber facility. Calibration accuracy ± 2.0 %.

| Reference Humidity (%) | Current Output (milliamps) | Indicated (1) Humidity (%) |
|------------------------|----------------------------|----------------------------|
| 10.0 | 5.9 | 12.1 |
| 30.0 | 8.9 | 30.6 |
| 50.0 | 12.2 | 50.9 |
| 70.0 | 15.2 | 69.8 |
| 90.0 | 18.0 | 87.6 |

(1) Calculated from voltage output

All reference equipment used in this calibration procedure have been tested by comparison to traceable standards certified by the National Institute of Standards and Technology.

Reference Instrument

Vaisala Humidity Sensor Model 35AC
Fluke Multimeter Model 8060A

Serial # NIST Test Reference

N475040 TN 266152
4865407 234027

Tested By: EChernomy

M E T E O R O L O G I C A L I N S T R U M E N T S

Tel: 231-946-1980 Fax: 231-946-4772 Email: met.sales@youngusa.com Website: www.youngusa.com

Barometer (RMYoung model 61201)

R.M. Young Company
2801 Aero Park Drive
Traverse City, Michigan 49686 USA

CALIBRATION REPORT
Barometric Pressure Sensor

Customer: *Raytheon Technical Services Co LLC*

Test Number: 89101

Customer PO: RR42365-01

Test Date: 10 September 2008

Sales Order: 9955

| |
|---|
| <u>Test Sensor:</u> |
| Model: 61201 Serial Number: <i>BP00873</i> |
| Description: Barometric Pressure Sensor |

Report of calibration comparison of test barometric pressure sensor with National Institute of Standards and Technology traceable standard pressure calibrator at five pressures in the R.M. Young Company controlled pressure facility. Calibration accuracy ± 1.0 hPa.

| Reference Pressure (hPa) | Voltage Output (millivolts) | Indicated (1) Pressure (hPa) |
|--------------------------------|-----------------------------------|------------------------------------|
| 800.0 | 1 | 800.1 |
| 875.0 | 1251 | 875.1 |
| 950.0 | 2500 | 950.0 |
| 1025.0 | 3748 | 1024.9 |
| 1100.0 | 4994 | 1099.6 |

(1) Calculated from voltage output

All reference equipment used in this calibration procedure have been tested by comparison to traceable standards certified by the National Institute of Standards and Technology.

Reference Instrument

Druck Pressure Controller Model DPI515
Fluke Multimeter Model 8060A

Serial # NIST Test Reference

51500497 UKAS Lab 0221
4865407 234027

Tested By: *ECherny*

M E T E O R O L O G I C A L I N S T R U M E N T S

Tel: 231-946-3980 Fax: 231-946-4772 Email: met.sales@youngusa.com Website: www.youngusa.com

GUV (Biospherical Instruments 2511)



Biospherical Instruments Inc.

| GUV-2511 Calibration Certificate | | | | | | | | | | |
|----------------------------------|---------|---|--|--|--|-------------|---------------------------------|--------------|-----------------|--|
| System Serial Number | | 25110805127 | | | | | Date of Calibration | | 12/2/08 | |
| Calibration database | | 25110805127v3.mdb | | | | | Date of Certificate | | 12/4/2008 | |
| DASSN | | 0111 | | | | | Standard of Spectral Irradiance | | 91537(10/25/06) | |
| Microprocessor Tag Number | | 2 | | | | | Operator | | TC | |
| | | | | | | | | | | |
| Monochromatic Channels | | Wavelength | Responsivity | ScaleSmall | ScaleMedium | ScaleLarge | OffsetSmall | OffsetMedium | OffsetLarge | Measurement Units |
| Address | [nm] | [Amps per $\mu\text{W}/(\text{cm}^2\cdot\text{nm})$] | [Volts per $\mu\text{W}/(\text{cm}^2\cdot\text{nm})$] | [Volts per $\mu\text{W}/(\text{cm}^2\cdot\text{nm})$] | [Volts per $\mu\text{W}/(\text{cm}^2\cdot\text{nm})$] | [volts] | m [volts] | [volts] | | |
| Ed0305 | 2 | 305 | 3.8400E-11 | 3.9533E-06 | 1.1621E-03 | 3.5561E-01 | -3.1100E-04 | -3.1400E-04 | -3.2200E-04 | $\mu\text{W}/(\text{cm}^2\cdot\text{nm})$ |
| Ed0313 | 6 | 313 | 1.7300E-10 | 1.7613E-05 | 5.1598E-03 | 1.8121E+00 | 2.4700E-04 | 2.5200E-04 | 1.3090E-03 | $\mu\text{W}/(\text{cm}^2\cdot\text{nm})$ |
| Ed0320 | 8 | 320 | 2.5643E-10 | 2.6108E-05 | 7.6668E-03 | 2.5121E+00 | -1.6900E-04 | -1.6900E-04 | -3.6000E-05 | $\mu\text{W}/(\text{cm}^2\cdot\text{nm})$ |
| Ed0340 | 10 | 340 | 1.9390E-10 | 1.9792E-05 | 5.7828E-03 | 2.0723E+00 | 1.7900E-04 | 1.9300E-04 | 1.2780E-03 | $\mu\text{W}/(\text{cm}^2\cdot\text{nm})$ |
| Ed0380 | 12 | 380 | 7.3738E-11 | 7.5266E-06 | 2.2042E-03 | 7.5742E-01 | -1.5300E-04 | -1.4600E-04 | 1.3300E-04 | $\mu\text{W}/(\text{cm}^2\cdot\text{nm})$ |
| Ed0395 | 13 | 395 | 3.1478E-10 | 3.2257E-05 | 9.4259E-03 | 3.2088E+00 | -1.1700E-04 | -1.1400E-04 | -2.1000E-05 | $\mu\text{W}/(\text{cm}^2\cdot\text{nm})$ |
| | | | | | | | | | | |
| Broadband Channels | | Wavelength | Responsivity | ScaleSmall | ScaleMedium | ScaleLarge | OffsetSmall | OffsetMedium | OffsetLarge | Measurement Units |
| Address | [nm] | [Amps per $\mu\text{E}/(\text{cm}^2\cdot\text{s})$] | [Volts per $\mu\text{E}/(\text{cm}^2\cdot\text{s})$] | [Volts per $\mu\text{E}/(\text{cm}^2\cdot\text{s})$] | [Volts per $\mu\text{E}/(\text{cm}^2\cdot\text{s})$] | [volts] | m [volts] | [volts] | | |
| Ed0PAR | 18 | 400-700 | 1.6951E-05 | 1.7283E+00 | 5.0613E+02 | 1.6683E+05 | -2.0000E-06 | 0.0000E+00 | 7.9900E-04 | $\mu\text{E}/(\text{cm}^2\cdot\text{sec})$ |
| | | | | | | | | | | |
| Auxiliary Channels | Address | Wavelength | Responsivity | ScaleS | ScaleM | ScaleL | OffsetS | OffsetM | OffsetL | Measurement Units |
| Ed0Temp | 22 | 0 | 1.0000E+00 | 1.0000E-02 | 1.0000E-02 | 1.0000E-02 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | $^{\circ}\text{C}$ |
| Ed0Vin | 27 | 0 | 1.0000E+00 | -2.5000E-01 | -2.5000E-01 | -2.5000E-01 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | V |

Acquisition and Processing Information

Processing Specifics

Refer to the InstCoef.txt file along with the specific instrument calibration sheets, both located in the Cal/ directory of the data distribution, for information on how the RVDAS data was collected and processed.

Errors and Events

This section lists all significant events and known problems with acquisition during this cruise including instrument failures, data acquisition system failures, and other factors affecting this data set.

| Date (Julian) | Time (GMT) | Event | Location |
|---------------|------------|--|-----------------------|
| 045 | 0317 | Started data collection | @68W |
| 048 | 1657 | Paused sonars and seawater collection | @Palmer Station |
| 051 | 1826 | Resumed sonars and seawater | Depart Palmer Station |
| 062 | 1235 | Paused sonars and seawater collection | @Palmer Station |
| 064 | 1639 | Resumed sonars and seawater | Depart Palmer Station |
| 065 | 1210 | Noticed that calibration gas bottles were turned off on PCO2. Corrected. | |
| 078 | 1106 | Paused sonars and seawater collection | @Palmer Station |
| 080 | 1121 | Resumed sonars and seawater | Depart Palmer Station |
| | | | |
| | | | |