Data Report

NBP0101

Leventer

January 30, 2001 – March 28, 2001

United States Antarctic Program

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Raytheon Polar Services Company

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TABLE OF CONTENTS

Introduction

The NBP data acquisition systems continuously log data from several instruments throughout the cruise. This document describes the format of that data and its location on the distribution DAT tapes. It also contains important information which 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.

The data is contained in a Unix tar archive called NBP0101.tar. All of the data has been compressed using Unix “gzip” compression. 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 Windows9X, WinZip, a shareware utility included on this CD (remember, it is shareware) will open these files.

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.
NBP0101.tar was created on an SGI using the following commands:

```
tar cvLf 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
```

The directories in the archive are structured in the following manner:

CD 1 of 3

NBP0101.GMT
NBP0101.MGD
NBP0101.TRK
NBP0101.ps
ADCP/
- 0101ADCP.tar
- 0101PING.zip

GEOPDATA/
- 0101BAT.tar
- 0101GRV.tar
- 0101JGOF.tar
- 0101KND.tar
- 0101MAG.tar
- 0101MGD.tar
- 0101NGL.tar
- 0101PCOD.tar
- 0101SB.tar
- 0101SIM.tar
- 0101TSG.tar

OCEAN/
- CTD/
  - 0101GRAPH.tar
  - 0101PROC.tar
  - 0101RAW.tar
  - 0101REPR.tar
- 0101PCO2.tar
- 0101TSGF.tar
- 0101XBT.tar

REPORT/
- 0101DATA.doc
- 0101DATA.htm
- 0101DATA.txt
- Jewel Cases
- CALIBRAT/
  - INSTRMNT.CNF

CD 1 of 3 continued

RVDAS/
- NAV/
  - 0101GP02.tar
  - 0101NGL.tar
- UW/
  - 0101BAR.tar
  - 0101BAT.tar
  - 0101KND.tar
  - 0101MAG.tar
  - 0101MET.tar
  - 0101PCO2.tar
  - 0101SIM.tar
  - 0101SVP.tar
  - 0101SWNC.tar
  - 0101TSG.tar

CD 2 of 3

RVDAS/
- NAV/
  - 01013DF.tar
  - 0101ADCP.tar
  - 0101GYR.tar
  - 0101PCOD.tar
- UW/
  - 0101GRV.tar

CD 3 of 3

ADDITION/
- BLNKLOGS.zip
- COREPHOT.zip
- DIATMSLD.zip
- DREDGEPX.zip
- DREDGES.zip
- FENCE.zip
- JGOF.zip
- MAGSUSC.zip
- PHYSPROP.zip
- SMPLINST.zip
- STNTABLS.zip
- 0101JPC.tar

IMAGES/
- 0101CWIF.tar

SUPPLEMT/
- GEOPDATA/
  - 0101BAT.tar
  - 0101GRV.tar
  - 0101JGOF.tar
  - 0101MAG.tar
  - 0101MGD.tar
  - 0101NGL.tar
  - 0101PCD.tar
  - 0101SB.tar
  - 0101TSG.tar
- OCEAN/
  - 0101PCO2.tar
  - 0101TSGF.tar
  - 0101XBT.tar
- RVDAS/
  - NAV/
    - 01013DF.tar
    - 0101ADCP.tar
    - 0101GP02.tar
    - 0101GYR.tar
    - 0101NGL.tar
    - 0101PCOD.tar
  - UW/
    - 0101BAR.tar
    - 0101BAT.tar
    - 0101GRV.tar
    - 0101MAG.tar
    - 0101MET.tar
    - 0101PCO2.tar
    - 0101TSG.tar

WINZIP

Distribution Contents

ADCP

The ADCP data set is broken up into files representing 24 hours of data collection. The files are named pingdata.xxx (xxx representing a day number). Note that these extensions do NOT represent Julian day numbers. Please refer to the file's creation date.

Some ADCP data is also transmitted to RVDAS. East and North vectors for ship's speed relative to the reference layer and ship's heading are archived in the navigational data section of RVDAS.

CTD

The ctd data and report have been placed in the tar file 0101ctd.tar, which contains the following structure:

ctdlist.txt (list of all ctd stations)
ctdsetup (batch files, cfg & con files)
0101Raw (raw datafiles)
0101Proc (processed data files)
seasoft (application for processing CTD data

Individual CTD casts are represented by a set of four files containing a bottle-firing file (.bl), a configuration file (.con), a data file (.dat) and a header file (.hdr). Casts are numbered according to the cruise id number (0101) followed by the number of the cast. For example; the raw files associated with the third cast on this cruise are: 0101003.bl, 0101003.con, 0101003.dat, 0101003.hdr. The raw and processed data files are in binary format. The 1 db bin averaged up and down traces have been converted to ASCII (.asc files).

SeaBird's SeaSoft software used to acquire the data is included in the CTD data distribution in the "Seasoft" directory. SeaSoft is a DOS-based software package, but can be run in a DOS window under the Windows9X operating systems for cast playback and data analysis. The software package used to process this data (version 4.234) is included on this CD in the directory **Seasoft**. The configuration files and processing scripts (written by Suzanne O'Hara for the standard processing of the SBE 9/11*plus*) are also included in the **Seasoft** directory under in the **ctdsetup** directory. The directory **report** contains the CTD data report with folder for all plots produced during the cruise. The directory **seacat** has a structure similar to the ctd directory and contains the data from the SeaCat CTD unit.

File extension definitions:

EXT	Description
ASC	The data portion of a .CNV converted data file written in ASCII by ASCIIOUT, or files written by TERM37.
BL	Created by SEASAVE when a bottle fire confirmation is received. Contains bottle sequence number, position, date, time, beginning and ending scan numbers.
BTL	Created by ROSSUM. This is a summary of the data in a .ROS file.
BSR	Bottle scan range file, used by DATCNV to create a .ROS file.
CFG	Used by SEASOFT modules to store the input filename, input data path, output data path, and other miscellaneous module specific parameters.
CTR	Density contour file generated by CONTOUR.
CNV	'Converted' engineering unit data file. An ASCII header precedes the data.
CON	Contains instrument configuration and calibration coefficients, used by SEACON, SEASAVE, and DATCNV
DAT	Raw binary data, optionally with header information (SBE 9/11, 11X, 9/11*plus*, and data files created with previous versions of SEASOFT).
DSP	Used by SEASAVE to store data acquisition and display parameters.
HDR	R. Header portion of a .CNV converted data file written by ASCIIOUT. 2) Header recorded when acquiring real time data or uploading archived data.
HEX	Raw HEX data with header information (SBE 16, 17, 19, 21, and 25)
MRK	Marker file created by SEASAVE during real time data acquisition.

PLT	Used by SEAPLOT to store display parameters
ROS	Scans marked with the bottle fire confirmation bit, or defined by a .BSR file, written by DATCNV.

*Note: This is a complete list of all file extensions. This data set may not contain ALL of the above extension files.

SEASOFT modules search the current directory for DSP, PLT, and CFG files. SEASOFT modules search the 'input data path' for CON, HEX, DAT, and CNV files. One exception is SEACON which searches the current directory for CON files.

For more information and updated software visit the web site at www.seabird.com; or contact (206) 643-9866, seabird@seabird.com, Sea-Bird Electronics 1808 – 136th Place NE Bellevue, WA 98005

Cruise Track

A Postscript cruise track file has been produced for this cruise called NBP0101.ps. It is a standard US Letter sized (8.5" x 11") plot. A GMT cruise track file (NBP0101.trk) is also included, which contains the longitude and latitude at one-minute intervals extracted from the NBP0101.gmt file.

NBP Data Products: MGD77 & JGOFS

NBP0101.mgd
NBP0101.gmt
/geopdata/JGOF
/geopdata/PROC

Two data products are created on each cruise of the NBP: JGOFS and MGD77.

JGOFS

The JGOFS data set consists of a single file produced each day named jgDDD.dat.gz where DDD is the Julian day the data was acquired. The ".gz" extension indicates that the individual files are compressed before archiving. The daily file consists of 20 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. For example, Course Made Good (CMG) and Speed Over Ground (SOG) are calculated from gyro and GPS inputs by the NGL software package. Similarly, the wind direction field is the vector sum of the separate X and Y inputs received from the wind instruments. The JGOFS data set was used to produce the daily data plots during the cruise. *Note: Null, unused, or unknown fields are filled with 9's in the JGOFS data. TSG data is processed by RVDAS.*

Field	Data	Units
01	GMT date	dd/mm/yy
02	GMT time	hh:mm:ss
03	NGL latitude (negative is South)	dd.dddd
04	NGL longitude (negative is West)	ddd.dddd
05	speed over ground	Knots
06	GPS HDOP	-
07	Gyro Heading	Degrees (azimuth)
08	course made good	Degrees (azimuth)
09	mast PAR	μEinsteins/meters^2 sec
10	sea surface temperature	°C
11	sea surface conductivity	siemens/meter
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	°C
17	relative humidity	%
18	barometric pressure	mBars

Field	Data	Units
19	sea surface fluorometry	volts (0-5 FSO)
20	not used	-

MGD77

The MGD77 data set is contained in a single file for the entire cruise named NBP0101.mgd, There is also a file named NBP0101.gmt. This file is the output of the mgd77togmt utility using NBP0101.mgd as input. The "gmt" file can be useful for plotting data using the GMT plotting package. The directory /geopdata/PROC contains a file from each day of data acquisition named: Dddd.fnl.gz, where ddd is the Julian day. These files contain all the data used to produce the "mgd" file, but in a space-delimited columnar format that may be more accessible for some purposes. In addition, these files contain data at one-second intervals rather than one minute and are individually "gzipped" to save space. Below is a detailed description of the MGD77 data set format.

All decimal points are implied. Leading zeros and blanks are equivalent. Unknown or unused fields are to be filled with 9's. All "corrections", such as time zone, diurnal magnetics, and Eotvos, are understood to be added.

Col	Len	Type	Description
1	1	int	DATA RECORD TYPE Set to "3" for data record.
2-9	8	char	SURVEY IDENTIFIER
10-14	5	int	TIME-ZONE CORRECTION: In hundredths of hours. Corrects time (in characters 13-27) to GMT when added: equals zero when time is GMT.
15-16	2	int	YEAR 2 digit year
17-18	2	int	MONTH (e.g. May is represented as 05)
19-20	2	int	DAY Day of month
21-22	2	int	HOUR
23-27	5	real	MINUTES X 1000
28-35	8	real	LATITUDE X 100000 + = North; - = South. (–9000000 to 9000000)
36-44	9	real	LONGITUDE X 100000 + = East; - = West. (–18000000 to 18000000)
45	1	int	POSITION TYPE CODE: 1=Observed fix; 3=Interpolated; 9=Unspecified
46-51	6	real	BATHYMETRY, 2- WAY TRAVELTIME: In 10,000th of seconds. Corrected for transducer depth and other such corrections
52-57	6	real	BATHYMETRY, CORRECTED DEPTH: In tenths of meters.
58-59	2	int	BATHYMETRIC CORRECTION CODE: This code details the procedure used for determining the sound velocity correction to depth
60	1	int	BATHYMETRIC TYPE CODE: 1 = Observed; 3 = Interpolated (Header Seq. 12); 9 = Unspecified
61-66	6	real	MAGNETICS TOTAL FIELD, 1ST SENSOR: In tenths of nanoteslas (gammas).
67-72	6	real	MAGNETICS TOTAL FIELD, 2ND SENSOR: In tenths of nanoteslas (gammas). For trailing sensor.
73-78	6	real	MAGNETICS RESIDUAL FIELD: In tenths of nanoteslas (gammas). The reference field used is in Header Seq. 13.
79	1	int	SENSOR FOR RESIDUAL FIELD 1 = 1st or leading sensor; 2 = 2nd or trailing sensor; 9 = Unspecified
80-84	5	real	MAGNETICS DIURNAL CORRECTION: In tenths of nanoteslas (gammas). (In nanoteslas) if 9-filled (i.e., set to "+9999"), total and residual fields are assumed to be uncorrected; if used, total and residuals are assumed to have been already corrected.
85-90	6	F6.0	DEPTH OR ALTITUDE OF MAGNETICS SENSOR: In meters. + = Below sea level 3 = Above sea level
91-9	7	real	OBSERVED GRAVITY: In 10th of mgals. Corrected for Eotvos, drift, tares.
98-10	6	real	EOTVOS CORRECTION: In tenths of mgals. E = 7.5 V cos phi sin alpha + 0.0042 V*V

Col	Len	Type	Description
104-108	5	real	FREE-AIR ANOMALY In tenths of milligals Free-air Anomaly = G(observed) – G(theoretical)
109-113	5	char	SEISMIC LINE NUMBER: Used for cross-referencing with seismic data.
114-119	6	char	SEISMIC SHOT-POINT NUMBER
120	1	int	QUALITY CODE FOR NAVIGATION: 5=Suspected, by the originating institution;6=Suspected, by the data center, 9=No identifiable problem found

RVDAS

rvdas/uw
rvdas/nav

Daily data processing of the RVDAS data is performed to convert values into usable units and as a check of the proper operation of the DAS. Both the raw and processed data sets from RVDAS are included in the data distribution. 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	met1	continuous	0.5 sec	R. M. young 41342C
Relative Humidity	met1	continuous	0.5 sec	Rotonics MP-101A-C4
Wind Speed/Direction	met1	continuous	0.5 sec	Belfort Model 5-122AHD
PIR (LW radiation)	met1	continuous	0.5 sec	Eppley PIR
PSP (SW radiation)	met1	continuous	0.5 sec	Eppley PSP
PhotoActive Radiation	met1	continuous	0.5 sec	BSI QSR-240
Barometer	bar1	continuous	9 sec	AIR-DB-3A

Navigational Data

Measurement	File ID	Collect. Status	Rate	Instrument
Attitude GPS	3df1	continuous	1 sec	Ashtec 12
P-Code GPS	PCOD	continuous	1 sec	Trimble 20636-00SM
Gyro	gyr1	continuous	0.2 sec	Yokogawa Gyro
NGL	ngl1	continuous	1 sec	NGL Processed Nav Data

Geophysical Data

Measurement	File ID	Collect. Status	Rate	Instrument
Gravimeter	grv1	continuous	1 sec	Lacoste & Romberg Gravity
Magnetometer	mag1	transit	15 sec	EG&G G-866
Bathymetry	bat1	continuous	varies	ODEC Bathy 2000
Bathymetry	sim1	depth < 2500 m	varies	Simrad EK200 Sonar

Oceanographic Data

Measurement	File ID	Collect. Status	Rate	Instrument
Conductivty	tsg1	continuous	15 sec	SeaBird 21
Salinity	tsgfl	continuous	15 sec	calculated from conductivity
Sea S Temperature	tsg1	continuous	15 sec	SeaBird 3-01/S
Fluorometry	flr1 & tsg1	continuous	15 sec	Turner 10-AU-005
pCO_2	pco2	continuous	70 sec	
ADCP	adcp	continuous	1 sec	RD Instruments

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 subdirectories exist under the top-level rvdas directory. The

instruments are broken down as shown. Each data file is gzipped 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: NBP[CruiseID][ChannelID].dDDD.

- The CruiseID is the numeric name of the cruise, for example: NBP0101.
- The FileID (aka Channel ID) is a 4-character code representing the system being logged, for example: met1 (for meteorology)
- DDD is the Julian day of the data collection

Underway Data	Channel ID
Barometer	bar1
Bathy 2000	bat1
Fluorometer	flr1
Gravimeter	grv1
Magnetometer	mag1
Meteorological	met1
Simrad	sim1
Thermosalinograph	tsg1
pCO_2	pco2

Navigation Data	Channel ID
Ashtech GPS	3df1
Trimble GPS (P-Code)	PCOD
Gyro Compass	gyr1
Furuno GPS	gp02
NGL	ngl1
ADCP course	adcp

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 fields separations are clearly understood. An example data file:

bar1

```
00+019:23:59:57.441  963.25
```

Field	Data	Units
1	Time Tag	
2	Pressure	mBar

bat1

```
00+019:23:59:53.901 ;I04485.3ME-23.0,I00000.0,-99.9, 0000@01/11/00,23:59:52.08 PW2 PF1 SF1 PL3
MO4 SB3 PO0 TX1 TR: GM5 1500 06.7 -72.1
```

Field	Data	Units
1	RVDAS Time Tag	
2	Flagged Low Freq. Chn. Depth w/ units ;FDDDDD.DUN F= V valid, I invalid	meters
3	Low Freq. Echo Strength EEE.EE	dB
4	Flagged High Freq. Chn. Depth – unused	
5	High Freq. Echo Strength – unused	
6	Signed Heave Data SHHHH	cm
7	Date	mm/dd/yy
8	Time	hh:mm:ss

Field	Data	Units
9	transmit pulse window type: PW1 Rectangular, PW2 Hamming, PW3 Cosine, PW4 Blackman	
10	Primary transmit frequency PF1 3.5 kHz, PF2 12.0 kHz	
11	Parametric mode secondary freq. SF1 3.5 kHz, SF2 12.0 kHz	
12	pulse length: PL1 200usec, PL2 500usec, PL3 1msec, PL4 2msec, PL5 5msec, PL6 10msec, PL7 25msec. If transmit mode is FM: PL1 25msec, PL2 50msec, PL3 100msec.	
13	Operating Mode: MO1 CW parametric, MO2 CW, MO3 FM parametric, MO4 FM	
14	Frequency sweep bandwidth: SB1 1 kHz, SB2 2 kHz, SB3 5 kHz	
15	power level: PO1 0dB, PO2 -6dB, PO3 -12dB, PO4 -18dB, PO5 -24dB, PO6 -30dB, PO6 -30 dB, PO7 -36dB, PO8 -42dB	
16	Transmit Mode: TX1 single ping active, TX2 pinger listen, TX3 multipinging TR, TX4 multipinging TR, TX5 multipinging TTRR, TX6 multipinging TTTTRRRR, TX7 multipinging TTTTTRRRRR	
17	Transmit Rate: TR3 4Hz, TR4 2Hz, TR5 1Hz, TR6 .5Hz, TR7 .33Hz, TR8 .25Hz, TR9 .20Hz, TR: = .10Hz, TR; = .05Hz	
18	System Gain Mode: GM0 hydrographic AGC, GM1 to GM9 hydrographic +3db to + 27db manual. GMA to GMD hydrographic + 30db through + 60db manual, GME to GMK sub-bottom 1 through sub-bottom 7	
19	speed of sound	m/sec
20	depth of sonar window below sea-level	meters
21	background noise level in fixed point reference	dB/V

flr1

```
00+019:23:59:58.061 0  0818 ::  1/19/00 17:23:17 = 0.983  (RAW)   1.2 (C)
```

Field	Data	Units
1	RVDAS Time Tag	
2	marker 0 to 8	
3	4-digit index	
4	date	mm/dd/yy
5	time	hh:mm:ss
6	signal	
7	signal units of measurement	
8	cell temperature	
9	temperature units	

grv1

```
99+099:00:18:19.775 your_line#1999 99 01818 9735.4
```

Field	Data	Units	Conversion
1	RVDAS Time Tag		
2	text string		
3	gravity device date	yyyyjjjhhmmss	
3	gravity count	count	mgal = count x 1.0047 + offset

mag1

```
99+099:00:00:23.203 %  0  98 235928    0?372453
```

Field	Data	Units
1	RVDAS Time Tag	
2	% 0 denotes G-866 magnetometer	
3	Julian Day	
4	Time	
5	0? denotes high noise condition	
6	Magnetic Data (last digit is 10^{th}'s place)	nT

met1

```
00+019:23:59:59.761 $MET:  0.84, 1.12, 0.76, 1.06, 4.98, 0.26, 1.49, 3.93, 8.94, 0.80, 0.01,
0.01, 0.01, 0.22, 0.02, 0.1,40.11,4.96
```

Field	Data	Units	Conversion
1	RVDAS Time Tag		
2	$MET		
3	starboard windbird north rel. speed vector voltage	V	m/s = 7.553 x voltage
4	starboard windbird east rel. speed vector voltage	V	m/s = 7.553 x voltage
5	Port windbird north rel. speed vector voltage	V	m/s = 7.553 x voltage
6	Port windbird east rel. speed vector voltage	V	m/s = 7.553 x voltage
7	Air temperature	V	°C = 10 x voltage - 50
8	PIR Eppley Pyrgeometer	V	W/m^2 = 923.87 x voltage
9	PSP Eppley Pyranometer	V	W/m^2 = 194.53 x voltage
10	Temperature at the Relative Humidity Sensor	V	°C = 10 x voltage – 40
11	Relative Humidity	V	%RH = 10 x voltage
12	PAR Irradiance	V	$\mu Ei/m^2s$ = 1662.24 x voltage
13-17	spare channels		
18	AC line voltage	V	VAC = 150 x voltage
19	uMac Temperature	C	
20	uMac DC Supply	V	

pCO_2

```
00+021:23:59:43.190 2000021.9992 2382.4 984.2 30.73 50.8 345.9 334.1 -1.70 -68.046 -144.446 Equil
```

Field	Data	Units
1	RVDAS Time Tag	
2	pCO_2 Time Tag (decimal is time of day)	yyyjdd.fod
3	raw voltage	mV
4	barometer	mBar
5	cell temperature	°C
6	flow rate	cm^3/min
7	concentration	ppm
8	pCO_2 pressure	microAtm
9	Equilibrated temperature	°C
10	Latitude	degrees
11	Longitude	degrees
12	Flow Source (Equil = pCO_2 measurement)	

sim1

```
00+005:00:00:52.388 D1,23583509,1479.6, 17,  1,  0
```

Field	Data	Units
1	RVDAS Time Tag	
2	Header	
3	Time Tag	hhmmss.sss
4	depth	m
5	bottom surface backscattering strength	dBar
6	transducer number (1 = 38 kHz)	
7		

tsg1

```
00+019:23:59:46.976 15A16CFC163F8C2C100
```

Field	Data	Units
1	RVDAS Time Tag	
2	Seabird Hex string (see notes on converting to real units)	

3df1

PBEN: Measurement Data

```
00+019:23:59:57.054 $PASHR,PBN,345609.00,-1695527.0,-1569301.4,-5925126.0,-068:49.6968,-
137:12.8448,00047.7,-000.69,000.67,-000.51,08,????,02,01,02,01*32
```

Field	Data	Units
1	RVDAS Time Tag $PASHR	
2	PBN	
3	GPS Time sec. of the week	seconds
4	Station Position: ECEF X	meters
5	Station Position: ECEF Y	meters
6	Station Position: ECEF Z	meters
7	Latitude (- = South)	deg:min
8	Longitude (- = West)	deg:min
9	altitude	meters
10	velocity in ECEF X	m/sec
11	velocity in ECEF Y	m/sec
12	velocity in ECEF Z	m/sec
13	number of satellites used	
14	site name	
15	PDOP	
16	HDOP	
17	VDOP	
18	TDOP	

ATTD: Attitude Data

```
00+019:23:59:57.854 $PASHR,ATT,345610.0,252.82,+000.52,+001.95,0.0011,0.0068,0
```

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	

GGA: GPS Position Fix – Geoid/Ellipsoid

```
00+019:23:59:57.134 $GPGGA,235956.00,6849.6968,S,13712.8448,W,1,08,01.0,+00048,M,,M,,
```

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

Field	Data	Units
14	age of diff. GPS data	
15	differential reference station ID	

gyr1

```
00+019:23:59:59.952 $HEHRC25034,-020*73
```

Field	Data	Units
1	RVDAS Time Tag	
2	$HEHRC	
3	Heading XXXXX = ddd.dd	degrees
4	Rate of Change SYYY S = +/-, YYY = r.rr	
5	Checksum	

ngl1

```
00+019:23:59:59.857 -68.82822,-137.21416,1.10,279.27,251.10,0.00,0.00,0,18.2587,1,1146973
```

Field	Data	Units
1	RVDAS Time Tag	
2	Latitude (south is negative)	degrees
3	Longitude (west is negative)	degrees
4	Ship Speed	knots
5	Course made good	degrees
6	Gyro Heading	degrees
7	PDOP	
8	HDOP	
9	quality	
10	GPS up	
11	Fix Number	

PCOD

GGA: GPS Position Fix – Geoid/Ellipsoid

```
00+019:23:59:59.301 $GPGGA,235958.409,6849.6944,S,13712.8472,W,1,06,1.2,092.4,M,047.3,M,,*67
```

Field	Data	Units
1	RVDAS Time Tag	
2	$GPGGA	
3	UTC time at position	hhmmss.sss
4	Latitude	ddmm.mmm
5	North (N) or South (S)	
6	Longitude	ddmm.mmm
7	East (E) or West (W)	
8	GPS quality (1=GPS 2=DGPS 3=P-CODE)	
9	Number of GPS satellites used	
10	HDOP	
11	Antenna Height	meters
12	M for Meters	
13	Geoidal height	meters
14	M for meters	
15	age of diff. GPS data	
16	differential reference station ID	
17	checksum	

GLL: GPS Latitude/Longitude

```
00+019:23:59:59.381 $GPGLL,6849.6944,S,13712.8472,W,235958.409,A*35
```

Field	Data	Units
1	RVDAS Time Tag	
2	$GPGLL	
3	Latitude	degrees
4	North or South	
5	Longitude	degrees
6	East or West	
7	UTC of position	hhmmss.sss
8	status of data (A = valid)	
9	checksum	

VTG: GPS Track and Ground Speed

```
00+019:23:59:59.382 $GPVTG,238.7,T,182.3,M,001.8,N,003.3,K*41
```

Field	Data	Units
1	RVDAS Time Tag	
2	$GPVTG	
3	heading	degrees
4	degrees True (T)	
5	heading	degrees
6	degrees magnetic (M)	
7	Ship speed	knots
8	N = knots	
9	speed	km/hr
10	K = km per hour	
11	checksum	

adcp

```
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, East vector	kn.
5	Ship Speed relative to reference layer, North vector	kn.
6	Ship heading	degrees

Ocean Data Files

ocean/

Some data files are “processed” into a slightly different form. The pCO_2 data is merged with data from other sources for ease of data analysis.

pCO2-merged

```
00+019:23:58:15.502 2000019.9983 2445.2 965.0 32.90 52.8 372.3 352.5 -1.27 -68.8285 -137.2080
Equil -68.8280 -137.2079 -1.58 33.60 0.97 9.06 307.23 50.0
```

Field	Data	Units
1	RVDAS Time Tag	
2	pCO_2 Time Tag (decimal is time of day)	yyyjdd.fod
3	raw voltage	mV
4	barometer	mBar
5	cell temperature	°C
6	flow rate	cm^3/min
7	concentration	ppm
8	pCO_2 pressure	microAtm

Field	Data	Units
9	Equilibrated temperature	°C
10	Flow Source (Equil = pCO_2 measurement)	
11	RVDAS latitude	degrees
12	RVDAS longitude	degrees
13	TSG external temperature	°C
14	TSG salinity	PSU
15	TSG fluorometry	V
16	RVDAS true wind speed	m/s
17	RVDAS true wind direction	degrees
18	RVDAS barometer	mBar
19	uncontaminated seawater pump flow rate	l/min
20	Ship's speed over ground	kn
21	Ship's course made good	°

PROCESSING RAW TSG DATA

Raw TSG data is stored as a hex string 20 bytes long.

Bytes	Data
1-4	Sensor Temperature
5-8	Conductivity
9-14	Remote Temperature
15-17	Fluorometer voltage
18-20	unused voltage

In all of the formulas listed below, the variables can be found in the TSGcal file.

Calculating Temperature

T = decimal equivalent of bytes 1-4

Temperature Frequency: f = T/19 +2100

q = ln(fo/f)

Temperature = 1/{a + b * q + c * q2 + d * q3} -273.15 (degrees C)

Calculating Conductivity

C = decimal equivalent of bytes 5-8

Conductivity Frequency f = sqrt(C*2100+6250000)

Conductivity = (afm +bf2 +c +dt)/[10(1+ep)] (siemens/meter)

note e = epsilon in the TSGcal file

Calculating Fluorometry Voltage

f = decimal equivalent of bytes 15-17

Fluorometry Voltage = f/819

Additional & Supplemental Files

Additional Files

Data volume 3 contains a directory called ADDITION. This directory contains data files that that were created by science groups on NBP0101. The files and their descriptions are as follows:

BLNKLOGS.zip	Blank log sheets
COREPHOT.zip	NBP0101 Core Photos DIATMSLD.zip Diatom Slides
DREDGEPX.zip	Dredge Pictures
DREDGES.zip	Dredges
FENCE.zip	Core Fence Diagrams
JGOF.zip	Spreadsheet of JGOF data and graphs of wind & temperature
MAGSUSC.zip	Magnetic Susceptibility
PHYSPROP.zip	Physical Properties
SMPLINST.zip	Sampling Instructions
STNTABLS.zip	NBP0101 Station Information Tables
0101JPC.tar	Processed winch logs from each jumbo piston core

(Note that the raw winch logs from the starboard trawl winch are in 0101SWNC.tar on volume 1)

Supplemental Files

Most of the data in this archive were collected on Julian days 030 through 079. That is from the start of the cruise until after the ship had left the Antarctic continental shelf for the last time. Those data are on volumes 1 & 2. RVDAS, Geophysical and Ocean data collected after that, from Julian days 080 through 084 are in the SUPPLEMT directory on Volume 3.

NBP0101 Sensors

Shipboard Sensors

Sensor	Description	Serial #	Cal. Date	Status
Port Anemometer	Belfort 5-122AHD	7957	4/1/99	collect
Stbd Anemometer	Belfort 5-122AHD	92-2133	6/23/98	collect
Barometer	Atmospheric Instr. AIR-DB-3A	7G3095	7/21/00	collect
Mast PRR	BSI PRR-610	9696	3/18/99	not collect
UW PRR	BSI PRR-600	9695	3/18/99	not collect
Rel. Hum./Air Temp	Rotronics MP-101A-C4	R45618	6/20/00	collect.
Mast PAR	BSI QSR-240	6357	1/4/01	collect
P-Code GPS	Trimble 20636-00 (SM)			PCD/CIV
Attitude GPS	Ashtech 12	700273F2114 FW 7B13-D1-C21		collect
Pyranometer	Eppley PSP	33090F3	11/7/00	collect
Pyrgeometer	Eppley PIR	33023F3	7/23/98	collect
Dry Air Temp	R. M. Young 41342C	2267	10/1/99	collect
TSG	SeaBird SBE21	218091-1390	11/20/99	collect
TSG Remote Temp	SeaBird 3-01/S	2593	01/03/01	collect
Fluorometer	Turner 10-AU-005 Lamp: daylight 10-045, reference filter: 10-052, emission filter: 10-051, excitation filter: 10-050.	5651 FRTD		collect
Magnetometer	EG&G G-866			off ship
Gravimeter	Lacoste & Romberg Gravity Meter			not collect
Bathymetry	Simrad EK200	3001	11/1/95	collect
Bathymetry	Bathy 2000			collect

0101 CTD Sensors:

Sensor	Description
CTD Fish	SeaBird model SBE 9+ SN 09510716-0377, w/Paroscientific model 410K-105 pressure sensor SN 58949
CTD Deck Unit	SeaBird model SBE 11+ SN 11P7536-0317
Primary Temperature Sensor	SeaBird model 3-02/F SN 2367. Last cal 05/17/00.
Secondary Temperature Sensor	SeaBird model 3-02/F SN 2299. Last cal 05/17/00.
Primary Conductivity Sensor	SeaBird model 4-02/0 SN 2069. Last cal 7/20/00.
Secondary Conductivity Sensor	SeaBird model 4C SN 1799. Last cal 06/27/00.
Dissolved Oxygen Sensor	SeaBird model 13-02-B SN 00501-40. Last cal 6/15/00.
Fluorometer	Chelsea model Mk III Aquatracka SN 088080. Last cal 6/2/00

Acquisition Problems and Events

This section lists all known problems with acquisition during this cruise including instrument failures, data acquisition system failures and any other factor affecting this data set. The format is jjj:hh:mm (jjj is Julian day, hh is hour, and mm is minute). All times are in GMT.

Start Time	End Time	Event
030		New Cruise NBP0101 – Australia 200 Mile Limit: Turn on all logging.
032		Changed CTD Dissolved Oxygen Sensor. Initial serial number 130327 replaced by serial number 130365.
036:23:53	021:01:40	Bathy-2000 not functioning correctly. Replaced PROMS and brought it back up.
079:04:00		Data logging ceases at Antarctic Continental Shelf.

084:11:59		Supplemental data logging turned off. SeaBeam turned off.

Calibrations

Barometer

VAISALA

CERTIFICATE OF CALIBRATION

Certificate Number: 0007171003

Customer:	RAYTHEON TECHNICAL SERVICE CO. RAYTHEON POLAR SERVICES CO. 61 INVERNESS DRIE EAST, STE 300 ENGLEWOOD, CO 80112

Model Number	Serial Number
AIR-DB-3A	7G3095

Calibration Expiration	JULY 21, 2001

Vaisala Inc. does hereby certify that the product listed above meets or exceeds all published specifications and has been calibrated using standards whose accuracy's are traceable to the National Institute of Standards and Technology, or have been derived from accepted values of natural physical constants. NIST test numbers on standards used are available upon request.

Certified by 7-21-00 Date

Vaisala Inc.
Boulder Operations
8401 Baseline Road
Boulder, CO 80303

Phone (303) 499-1701
Fax (303) 499-1767

Web http://www.vaisala.com

Pyranometer/PSP

THE EPPLEY LABORATORY, INC.
12 Sheffield Ave., P.O. Box 419, Newport, RI 02840 USA
Telephone: 401-847-1020 Fax: 401-847-1031

EPLAB
Scientific Instruments for Precision Measurements Since 1917

STANDARDIZATION OF EPPLEY PRECISION SPECTRAL PYRANOMETER Model PSP

Serial Number: 33090F3

Resistance: 699 Ω at 23 °C
Temperature Compensation Range: -20 to 40 °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). The adopted calibration temperature is 25 °C.

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

8.28 x 10^{-6} volts/watts meter^{-2}

5.77 millivolts/cal cm^{-2} min^{-1}

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 ± 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 Eighth International Pyrheliometric Comparisons (IPC VIII) at Davos, Switzerland in October 1995.

Useful conversion facts: 1 cal cm^{-2} min^{-1} = 697.3 watts meter^{-2}
1 BTU/ft^2-hr^{-1} = 3.153 watts meter^{-2}

Shipped to:
National Science Foundation
Port Heuneme, CA

Date of Test: November 7, 2000

In Charge of Test: R. T. Eppley

S.O. Number: 58282
Date: December 14, 2000

Reviewed by: Thomas D Kirk

Remarks:

Radiometer/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: eplab@mail.bbsnet.com Internet: www.eppleylab.com

EPLAB
Scientific Instruments
for Precision Measurements
Since 1917

STANDARDIZATION OF EPPLEY PRECISION INFRARED RADIOMETER Model PIR

Serial Number: 33023F3

Resistance: 764 Ω at 23 °C
Temperature Compensation Range: -20 to 40 °C

This pyrgeometer has been compared with Precision Infrared Radiometer, Serial Number 29326F3 in Eppley's Blackbody Calibration System under radiation intensities of approximately 200 watts meter^{-2} and an average ambient temperature of 28 °C.

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

$$3.95 \times 10^{-6} \text{ volts/watts meter}^{-2}$$

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 ±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.

Shipped to:
National Science Foundation
Port Hueneme, CA

S.O. Number: 58282
Date: December 14, 2000

Date of Test: June 23, 2000

In Charge of Test: R.T. Eppeman

Reviewed by: Thomas D Kirk

Remarks:

Gravity Tie

Gravity Tie Calculations

Hobart

The fields outlined in BOLD MUST BE FILLED IN for this spreadsheet to operate properly. The automatically calculated values show up in the shaded fields.

Date	1/27/01
Location	Hobart, Australia
Reference	Elizabeth Street Pier
Latitude	42 53 S
Longitude	147 20 E
Elevation	
Gravity	980450.52

Reference Code Numbers:
Station no. 6491.0260
ISGN no.

Station	Value	Time (GMT)	Temp	Date	OBS mgal, averaged
Ship measurement 1	4027.90	23:10	53.4	January 27, 2001	
Ship measurement 2	4027.91	23:14	53.4	January 27, 2001	3996.186
Ship measurement 3	4027.90	23:16	53.4	January 27, 2001	
Average	4027.903				
					OBS mgal, averaged
Elizabeth Street Pier 1	4027.16	23:37	53.4	January 27, 2001	
Elizabeth Street Pier 2	4027.16	23:49	53.4	January 27, 2001	3995.438
Elizabeth Street Pier 3	4027.13	23:53	53.4	January 27, 2001	
Average	4027.150				
					OBS mgal, averaged
Ship measurment 4	4027.86	0:20	53.5	January 28, 2001	
Ship measurment 5	4027.84	0:27	53.5	January 28, 2001	3996.133
Ship measurment 6	4027.85	0:33	53.5	January 28, 2001	
Average	4027.850				

Known Gravity at Elizabeth Street Pier	980450.520	Gravity offset from last tie	972428.10
		Drift since last tie	-0.035
Ship's meter averaged over period of the tie	7985.20		
Portable Gravimeter Correction Divisor	1.007937		
Ship's Gravimeter Correction Factor	1.0047		

OBS Differences		Comments
Eliz. St. Pier to Ship (1, 2, &3 averaged)	0.747	Gravity Tie done by: Fred Stuart & Jeff Otten & Walter Galligher
Eliz. St. Pier to Ship (4, 5, & 6 averaged)	0.694	
Averaged Differences	0.721	
Gravity at pier	980451.241	
Elevation of pier above gravimeter, meters	-1.500	
Earth differential gravity, mgal/meter	0.3	
Gravity at ship's gravimeter	980450.791	
Ship's relative gravity	8022.73044	
Gravity Offset	972428.061	

Mast Par

MAST PAR

DO NOT DISCARD
Biospherical Instruments Inc.
CALIBRATION DATA

Biospherical Instruments Inc.

CALIBRATION CERTIFICATE

Calibration Date	1/4/01
Model Number	QSR-240
Serial Number	6357
Operator	TPC
Standard Lamp	94532(03/13/98)
Probe Excitation Voltage Range:	5 to 18 VDC(+)
Output Polarity:	POSITIVE

Probe Conditions at Calibration(in air):

Calibration Voltage:	6	VDC(+)
Probe Current:	1.2	mA

Probe Output Voltage:

Probe Illuminated	80.1	mV
Probe Dark	0.3	mV
Probe Net Response	79.8	mV

Corrected Lamp Output:

Output In Air (same condition as calibration):

8.55E+15	quanta/cm²sec
0.014	uE/cm^{2}sec

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

Dry:	9.34E-18	V/(quanta/cm²sec)
	5.62E+00	V/(uE/cm^{2}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.

Thermosalinograph

Installed 12/14/99

TSG

SEA-BIRD ELECTRONICS, INC.
1808 136th Place N.E., Bellevue, Washington 98005 USA
Phone: (425) 643 - 9866 Fax: (425) 643 - 9954 Internet: seabird@seabird.com

SENSOR SERIAL NUMBER = 1390
CALIBRATION DATE: 20-Nov-99

CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

GHIJ COEFFICIENTS

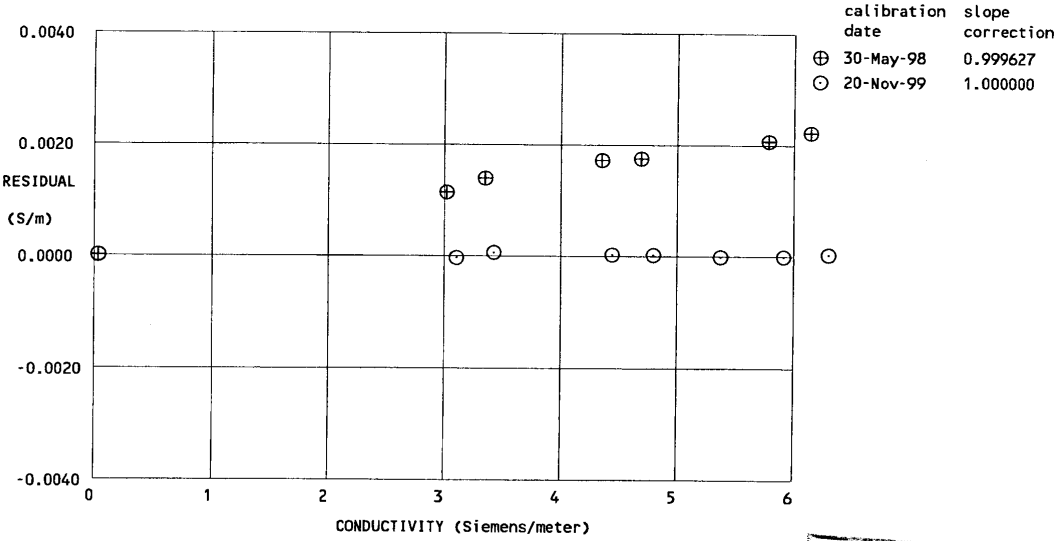
g = -3.93202500e+00
h = 4.70256307e-01
i = 7.32400918e-04
j = -1.40591115e-05
CPcor = -9.57e-08 (nominal)
CTcor = 3.25e-06 (nominal)

ABCDM COEFFICIENTS

a = 1.47556503e-02
b = 4.52645265e-01
c = -3.91849365e+00
d = -9.05554567e-05
m = 2.2
CPcor = -9.57e-08 (nominal)

BATH TEMP (ITS-90 °C)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2.88550	0.00000	0.00000
1.0000	36.0948	3.07458	8.53995	3.07454	-0.00004
4.5000	36.0923	3.39296	8.92178	3.39301	0.00005
15.0000	36.0872	4.41063	10.04412	4.41064	0.00001
18.4999	36.0860	4.76818	10.40948	4.76819	0.00001
23.9999	36.0835	5.34578	10.97375	5.34576	-0.00002
29.0000	36.0788	5.88528	11.47555	5.88526	-0.00002
32.5000	36.0722	6.26964	11.81996	6.26966	0.00002

Conductivity = $(g + hf^2 + if^3 + jf^4) / [10(1 + \delta t + \epsilon p)]$ Siemens/meter
Conductivity = $(af^m + bf^2 + c + dt) / [10(1 + \epsilon p)]$ Siemens/meter
t = temperaure [deg C]; p = pressure [decibars]; δ = CTcor; ϵ = CPcor;
Residual = (instrument conductivity - bath conductivity) using g, h, i, j coefficients



POST CRUISE CALIBRATION

TSG Internal

Installed 12/14/99

TSG Internal

SEA-BIRD ELECTRONICS, INC.
1808 136th Place N.E., Bellevue, Washington 98005 USA
Phone: (425) 643 - 9866 Fax: (425) 643 - 9954 Internet: seabird@seabird.com

SENSOR SERIAL NUMBER = 1390
CALIBRATION DATE: 20-Nov-99

TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS

g = 4.19943404e-03
h = 6.02868891e-04
i = 5.34296192e-06
j = -1.77943713e-06
f_0 = 1000.000

IPTS-68 COEFFICIENTS

a = 3.64763555e-03
b = 5.88552771e-04
c = 1.03072229e-05
d = -1.77889932e-06
f_0 = 2522.389

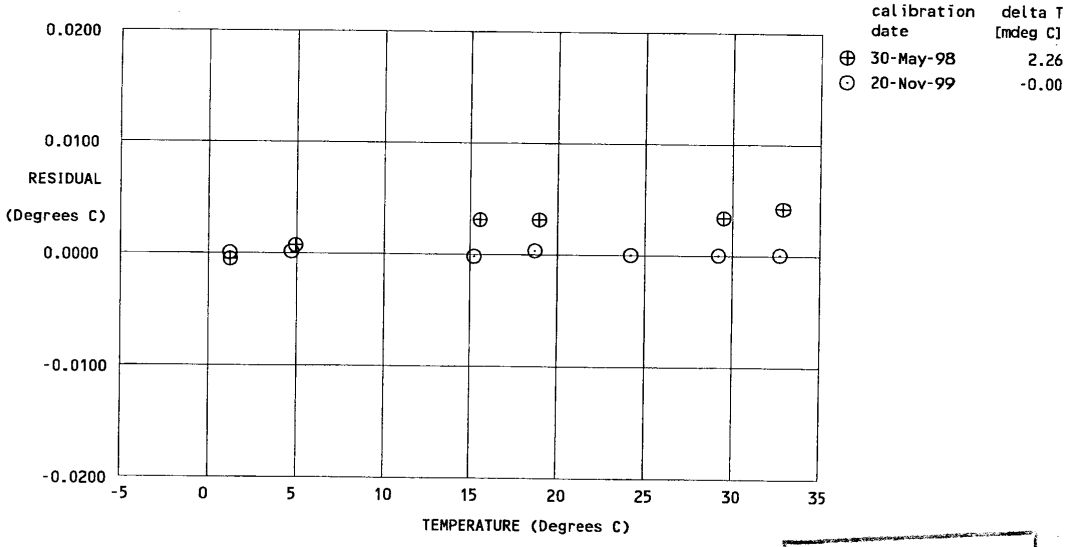
BATH TEMP (ITS-90 °C)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90 °C)	RESIDUAL (ITS-90 °C)
1.0000	2522.389	1.0000	-0.00004
4.5000	2727.711	4.5001	0.00009
15.0000	3414.661	14.9997	-0.00026
18.4999	3668.526	18.5002	0.00027
23.9999	4093.784	23.9998	-0.00005
29.0000	4509.404	29.0000	-0.00002
32.5000	4817.316	32.5000	0.00001

Temperature ITS-90 $= 1/\{g + h[\ell n(f_0/f)] + i[\ell n^2(f_0/f)] + j[\ell n^3(f_0/f)]\} - 273.15$ (°C)

Temperature IPTS-68 $= 1/\{a + b[\ell n(f_0/f)] + c[\ell n^2(f_0/f)] + d[\ell n^3(f_0/f)]\} - 273.15$ (°C)

Following the recommendation of JPOTS: T_{68} is assumed to be 1.00024 * T_{90} (-2 to 35 °C).

Residual = instrument temperature - bath temperature



POST CRUISE CALIBRATION

TSG External

TSG extended

SEA-BIRD ELECTRONICS, INC.
1808 136th Place N.E., Bellevue, Washington 98005 USA
Phone: (425) 643 - 9866 Fax: (425) 643 - 9954 Internet: seabird@seabird.com

SENSOR SERIAL NUMBER = 2593
CALIBRATION DATE: 03-Jan-01s

TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS

g = 4.27987204e-03
h = 6.19581534e-04
i = 2.06356990e-05
j = 1.60635055e-06
f_0 = 1000.000

IPTS-68 COEFFICIENTS

a = 3.67988692e-03
b = 5.83301097e-04
c = 1.58473443e-05
d = 1.60775530e-06
f_0 = 2715.661

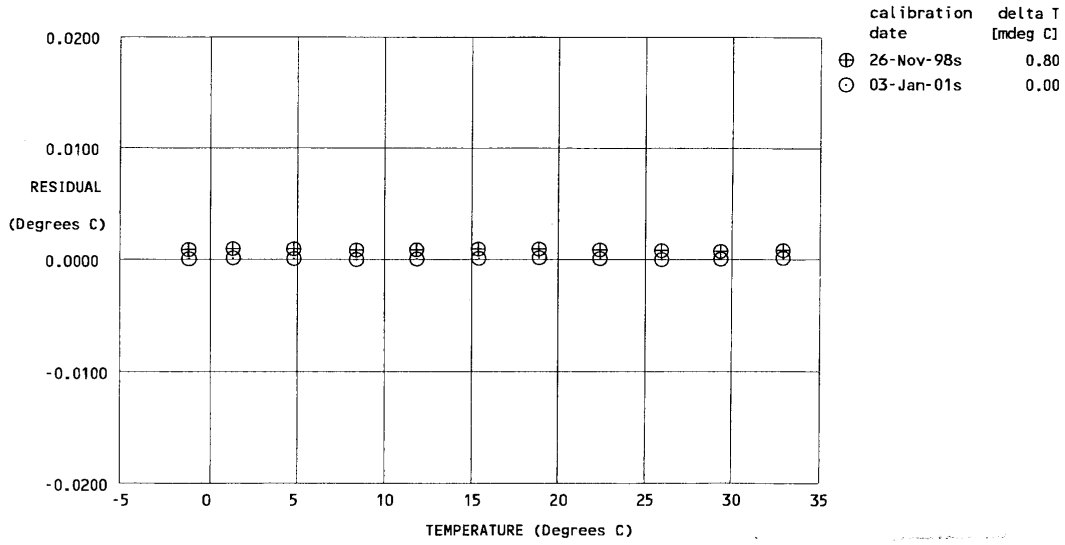
BATH TEMP (ITS-90 °C)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90 °C)	RESIDUAL (ITS-90 °C)
-1.4022	2715.661	-1.4022	-0.00002
1.1071	2877.328	1.1072	0.00005
4.5999	3113.969	4.5999	0.00001
8.1982	3372.323	8.1981	-0.00007
11.6315	3633.030	11.6314	-0.00003
15.1880	3918.156	15.1881	0.00003
18.6926	4214.514	18.6926	0.00008
22.1918	4526.070	22.1918	0.00002
25.7512	4859.455	25.7512	-0.00007
29.1661	5195.287	29.1660	-0.00004
32.6976	5559.429	32.6976	0.00005

Temperature ITS-90 $= 1/\{g + h[\ell n(f_0/f)] + i[\ell n^2(f_0/f)] + j[\ell n^3(f_0/f)]\} - 273.15$ (°C)

Temperature IPTS-68 $= 1/\{a + b[\ell n(f_0/f)] + c[\ell n^2(f_0/f)] + d[\ell n^3(f_0/f)]\} - 273.15$ (°C)

Following the recommendation of JPOTS: T_{68} is assumed to be 1.00024 * T_{90} (-2 to 35 °C).

Residual = instrument temperature - bath temperature



Temperature/Humidity Sensor

rotronic
instrument corp

160 E. Main Street, Huntington, NY 11743 • 516-427-3898 • FAX 516-427-3902 • 1-800-628-7101 • http://www.rotronic-usa.com

CERTIFICATE OF TEMPERATURE CALIBRATION

Model : MP101A
Serial # : 45618

In reference to the values published in standard DIN 43760, the manufacturer of the Pt100 RTD used in this instrument has specified a maximum tolerance of +/- 0.2 Deg. C, both at 0 and 100 Deg. C.

The measuring circuit of this instrument has been electronically tested with a Pt100 simulator with an accuracy of 0.1% in reference to the values of standard DIN 43760. This instrument was also placed in a ventilated tunnel having a minimum air velocity of 180 Ft/min. and calibrated against a certified thermometer traceable to the National Institute of Standards and Technology..

Based on the above procedure, the accuracy of this unit has been found to be as follows:

	Reference	Reading	Correction
Simulator :	-25.0	-25.0	0.0
	0.0	0.0	0.0
	25.0	25.0	0.0
	50.0	50.0	0.0
Thermometer :	29.5	29.1	0.4

Note: Temperatures Values in Deg.C

By: Date:6/20/2000

ROTRONIC Instrument Corp.

rotronic
instrument corp

160 E. Main Street, Huntington, NY 11743 • 516-427-3898 • FAX 516-427-3902 • 1-800-628-7101 • http://www.rotronic-usa.com

CERTIFICATE OF HUMIDITY CALIBRATION

Model : MP101A
Serial # : 45618

This instrument was placed in a ventilated tunnel having a minimum air velocity of 180 Ft/min. and calibrated against two reference instruments.

Calibration of the reference instruments was both with saturated salt solutions and with a certified chilled mirror instrument, traceable to the National Institute of Standards and Technology (NIST). A certified, traceable thermometer was used to monitor temperature. The %RH values of the saturated salt solutions were taken from the tables published by the National Bureau of Standards (now NIST), L. Greenspan, Journal of Research, Vol. 81A, January - February 1977. Details regarding calibration with saturated salt solutions may be found in ASTM standard E104-85.

Based on the above procedures, the accuracy of this instrument has been found to be as follows:

Reference	Reading	Correction
35.0	35.0	0.0
80.0	80.0	0.0
0.3	0.3	0.0

Note: Humidity Values in %RH.

By: _____ Date:6/20/2000

ROTRONIC Instrument Corp.

Belfort Wind Vector Transmitter

Belfort Wind Vector Transmitter Calibration

Serial # 7956
Calibration Date: 04/01/00
Calibration By: Craig Huhta

Comments: Original voltage measurements were 0.788, 1.805 and 3.55 volts prior to adjusting calibration screw.

Generator Outputs

Calibration Date: 04/01/00

Shaft Speed RPM	Theoretical Volts	Actual Volts	Error Volts	Tolerance Volts
140.5	0.81	0.815	0.00	+/-0.05
321.7	1.86	1.854	0.00	+/-0.05
634.9	3.66	3.65	0.01	+/-0.05
0	0.00	0	0.00	+/-0.05
0	0.00	0	0.00	+/-0.05

Used to convert RPM to Voltage		
	RPM	Voltage
High	1800	10.37
Low	180	1.04

Sine-Cosine Potentiometer Outputs

Reference Voltage Input: 5.18
Calibration Date: 04/01/00

Cosine Output Voltages

Azimuth Degrees	Theoretical Volts	Actual Volts	Error +/-0.13
0	2.59	2.58	0.01
15	2.5	2.57	-0.07
30	2.24	2.23	0.01
45	1.83	1.76	0.07
60	1.3	1.24	0.06
75	0.67	0.63	0.04
90	0	-0.05	0.05
105	-0.67	-0.73	0.06
120	-1.3	-1.34	0.04
135	-1.83	-1.9	0.07
150	-2.24	-2.26	0.02
165	-2.5	-2.49	-0.01
180	-2.59	-2.52	-0.07
195	-2.5	-2.5	0
210	-2.24	-2.22	-0.02
225	-1.83	-1.82	-0.01
240	-1.3	-1.29	-0.01
255	-0.67	-0.69	0.02
270	0	-0.07	0.07
285	0.67	0.64	0.03
300	1.3	1.28	0.02
315	1.83	1.83	0
330	2.24	2.25	-0.01
345	2.5	2.51	-0.01
Cosine RMS Error*			0.04113

***not to exceed 0.05v**

Sine Output Voltages

Azimuth Degrees	Theoretical Volts	Actual Volts	Error +/-0.13
0	0	-0.05	0.05
15	0.67	0.57	0.1
30	1.3	1.23	0.07
45	1.83	1.84	-0.01
60	2.24	2.27	-0.03
75	2.5	2.53	-0.03
90	2.59	2.58	0.01
105	2.5	2.52	-0.02
120	2.24	2.18	0.06
135	1.83	1.75	0.08
150	1.3	1.2	0.1
165	0.67	0.6	0.07
180	0	-0.06	0.06
195	-0.67	-0.75	0.08
210	-1.3	-1.34	0.04
225	-1.83	-1.82	-0.01
240	-2.24	-2.22	-0.02
255	-2.5	-2.47	-0.03
270	-2.59	-2.52	-0.07
285	-2.5	-2.52	0.02
300	-2.24	-2.27	0.03
315	-1.83	-1.89	0.06
330	-1.3	-1.35	0.05
345	-0.67	-0.69	0.02
Sine RMS Error*			

CTD Instruments

Transmissometer

25 cm TRANSMISSOMETER OPERATING INSTRUCTIONS

OPERATION & CALIBRATION:

First, connect a power source (9 to 30 VDC) to the instrument as shown on the connector wiring diagram, see figure 1. Observe polarity when connecting the power supply to the transmissometer, connect positive to pin 4 and negative to pin 1.

Use a voltmeter to measure the output voltage, pin 2 is the output and pin 3 is ground.

Block the light path to measure the zero output, it should be 0.00, +/- .01 VDC.

Clean the windows using kimwipes (or other non abrasive material), with a solution of dish washing liquid and water. When the windows are clean, the output voltage in air should be within +/- .02 VDC of the AIR CALIBRATION value listed below.

Perform the above procedure before each calibration and use of the instrument to measure transmission of water. The wavelength of the source is 660 nm, and at this wavelength the maximum value for light transmission in clean water with a 25 cm path length is 91.3% (4.565 VDC). Pure water absorption is 8.7% for a 25 cm path length at 660 nm.

MOUNTING INSTRUCTIONS:

A mounting bracket is provided with the transmissometer to simplify mounting the instrument on your system, see figure 2.

PRECAUTIONS:

DO NOT OPEN THE INSTRUMENT--this voids the warranty. If the instrument does not function properly, please consult the factory.

DO NOT LEAVE THE INSTRUMENT ON WHEN NOT IN USE. The LED is quite stable, but it will decrease in intensity, like most light sources, if left on for a long period of time.

DATA REDUCTION:

Air calibration may change with time. The LED light output can decrease approximately 1% in 1000 hours of operation. If the air calibration is measured frequently and the following correction is applied, then this change can be compensated for and will not affect the accuracy of the data.

$$V=(A/B) \cdot (X-Z) \quad \text{and} \quad \%\ \text{Transmission} = 20 \cdot V$$

V=Corrected output voltage, (≤ 4.565 VDC since 91.3% is pure water).
A=Air calibration value listed below.
B=Air calibration (present value).
X=Data value (output voltage measured in water).
Z=Zero offset with light path blocked.

The AIR CALIBRATION for SN- 207D was 4.644 VDC on 9/18/2000 .

The ZERO OFFSET with the light path blocked is -0.002 VDC

A = 20.834 } measured
B = 0 } 2/28/01

Underwater PAR Sensor

Biospherical Instruments Inc

CALIBRATION CERTIFICATE

UNDERWATER PAR SENSOR WITH LOG AMPLIFIER

DO NOT DESTROY
Biospherical Instruments Inc.
CALIBRATION DATA

Calibration Date: 06/07/00 **Job No.:** R7342
Model Number: QSP200L4S
Serial Number: 4361
Operator: TPC
Standard Lamp: 94532 (03/13/98)
Operating Voltage Range: 5 to 15 VDC (+)

Note: The QSP-200L uses a log amplifier to measure the detector signal current with V = log I (Amps) / IRef
To calculate irradiance, use this formula:

Irradiance = Calibration factor * (10^Light Signal Voltage - 10^Dark Voltage)

With the appropriate (solar corrected) Irradiance Calibration Factor:

Dry Calibration Factor:	**6.61E+12**	**quanta/cm² sec/"amps"**	**1.10E-05**	**µEinsteins/cm² sec/"amps"**
Wet Calibration Factor:	**1.11E+13**	**quanta/cm² sec/"amps"**	**1.85E-05**	**µEinsteins/cm² sec/"amps"**

Sensor Test Data and Results[4)]

Sensor Supply Current (Dark):	220.0	mA			
Supply Voltage:	6	Volts			
Lamp Integrated PAR Irradiance:	8.55E+15	quanta/cm² sec	0.01420	µEinsteins/cm²sec	
SC3 Immersion Coefficient:	0.594	Scalar Correction:	1	PAR Solar Correction:	1.0000

Nominal Filter OD	Calibrated Trans.	Sensor Voltage	Measured Trans.	Measured Signal (Amps)	Estimated Signal (Amps)	Calc. Output (Volts)	Error (Volts)	Error (%)	Test Irrad. (quanta/ cm² sec)
No Filter	100.00%	3.112	100.00%	1.29E-07	1.29E-07	3.112	0.000	0.0	8.55E+15
0.3	36.10%	2.674	36.42%	4.71E-08	4.67E-08	2.671	-0.003	-0.9	3.11E+15
0.5	27.60%	2.556	27.72%	3.59E-08	3.57E-08	2.555	-0.001	-0.4	2.37E+15
1	9.27%	2.095	9.52%	1.23E-08	1.20E-08	2.084	-0.011	-2.6	8.14E+14
2	1.11%	1.224	1.19%	1.54E-09	1.44E-09	1.197	-0.027	-6.6	1.02E+14
3	0.05%	0.387	0.08%	1.07E-10	6.91E-11	0.315	-0.072	-35.1	7.04E+12

Dark Before: 0.137 Volts
Light - No Filter Hldr.: 3.116 Volts
Dark After - NFH: 0.139 Volts
Average Dark 0.13775 Volts

I_{Ref} = 1.00E-10 Amps
I_{Dark} = 1.37E-10 Amps
10^{VDark} = 1.3732512 Amps

Notes:
1. Annual calibration is recommended.
2. There is increasing error associated with readings below zero.
3. The collector should be cleaned frequently with alcohol.
4) This section is for internal use and for more advanced analysis.

QSP-200L 12-98DG.xls

Fluorimeter

S/N 088080
Cal Date: June 2, 2000
MK III Aquatracka

Fluorimeter calibration readings

Ambient temperature 20°C

Output for detector mechanically blanked 0.1489 Volts

Output for pure water 0.2110 Volts

chlorophyll concentration in acetone (µg/l)	Output (volts)
Acetone (pure)	0.9361
0.1	1.1968
0.3	1.4471
1.0	1.8840
2.99	2.3265
9.9	2.8040
29.1	3.2574
90.9	3.7340

The uncertainty of the chlorophyll concentration is estimated not to exceed 3%. The uncertainty of output voltage measurement is estimated not to exceed 2mV.

Signed Date 2/6/00

Serial number 088080 Page 3 of 3

SBE 5T Submersible Pump Serial No: 050889

SEA-BIRD ELECTRONICS, INC.
1808 136th Place N.E., Bellevue, Washington 98005 USA
Telephone: (206) 643-9866 Telex: 292915 SBEI UR Fax: (206) 643-9954

SBE 5T SUBMERSIBLE PUMP CONFIGURATION SHEET

Operation Verified by Sea Bird 2/5/99

Serial No. : 050889

Job No : 7536

Customer : ANTARCTIC SUPPORT ASSOCIATES

Delivery Date : 20 January 1993

Single Connector Housing with Titanium screws

Pressure Case: 10,500 meters (titanium)

Pittman Motor Type:

P/N 3711B113, 18.2Ω nominal (Low power applications up to 2000 RPM MAX) _____

LOW POWER, low voltage input (jump P5 to P7) _____
(80681 assy / 3711B113 motor)

LOW POWER, standard voltage input (jump P5 to P6) _____
(80676 assy / 3711B113 motor)

P/N 3711B112, 7.4Ω nominal (High power applications up to 4500 RPM MAX) ✓

HIGH POWER, standard voltage input (jump P5 to P6) ✓
(80675 assy / 3711B112 motor)

Speed Adjustment Range:
Minimum : 894 RPM Maximum : 4887 RPM (≈12Vin/300mA load)

Final Speed Setting: 3000 RPM (TP1 = 100.06 Hz)

Motor speed at 6 Vin **with no load** = _____ RPM (TP1 = _____ Hz)

Motor speed at 6 Vin **w/200mA load** = _____ RPM (TP1 = _____ Hz)

Motor drop out voltage = _____ Vdc

Comments:

SBE 5T Submersible Pump Serial No:051265

SEA-BIRD ELECTRONICS, INC.
1808 136th Place N.E., Bellevue, Washington 98005 USA
Telephone: (206) 643-9866 Telex: 292915 SBEI UR Fax: (206) 643-9954

SBE 5T SUBMERSIBLE PUMP CONFIGURATION SHEET

Serial No. : 051265

Job No : 14893

Customer : ASA

Delivery Date : 20 Sep 96**

Operation Verified
By SeaBird
2/5/99

Single Connector Housing

Pressure Case: 10,500 meters (titanium)

Pittman Motor Type:

P/N 3711B112, 7.40Ω nominal (High power applications up to 4500 RPM MAX) ✓

HIGH POWER, standard voltage input (jump P5 to P6)
(80675 assy / 3711B112 motor) ✓

Speed Adjustment Range:
Minimum : 915 RPM Maximum : 4400 RPM **(≈12Vin/300mA load)**

Final Speed Setting: 3000 RPM (TP1 = 100 Hz)

Comments:

Pressure Sensor

Pressure Calibration Check

20 August 1999

pressure sensor model: Digiquartz 410K-105
sensor serial number: 58949
installed in: CTD 09P10716-0377

This pressure calibration is a check of the 'test' sensor against a stable reference pressure sensor. The reference pressure sensor is itself checked several times per year against a NIST-traceable pressure standard maintained at Paroscientific, Inc.. The circumstances of this pressure check introduce no more than 1.5 psia total error in 10,000 psi (0.015 %) in addition to the error resident in the Paroscientific site standard. The check offers a very high level certification of the health and proper operation of the 'test' sensor.

Input Pressure* [psia]	Sensor Output [hz]	Sensor Temperature [deg C]	Pressure Factory Coef [psia]	Pressure Corrected [psia]	Error [psia]
14.700	33360.38	23.6	13.985	14.564	-0.136
2014.828	34041.52	23.6	2014.307	2014.858	0.030
4014.722	34706.99	23.7	4014.205	4014.729	0.007
6014.534	35357.81	23.7	6014.023	6014.519	-0.015
8014.115	35994.74	23.8	8013.565	8014.033	-0.082
10013.720	36618.56	23.8	10012.995	10013.436	-0.284
8013.752	35994.72	23.9	8013.459	8013.927	0.175
6014.126	35357.77	23.9	6013.836	6014.331	0.205
4014.473	34707.00	24.0	4014.135	4014.658	0.185
2014.725	34041.53	24.0	2014.237	2014.788	0.063
14.717	33360.42	24.1	13.989	14.568	-0.149

Input pressure is generated with a Ruska model 5201 dead-weight tester, serial number 23330/380, and is determined by measurement with reference pressure sensor model Digiquartz 410K-000, serial number 73292.

Sensor Temperature: pressure sensor internal temperature.

Pressure Corrected: pressure computed with original factory coefficients and then corrected with a slope and offset to give the best linear agreement with the 'reference' Input pressure.

Error: Corrected pressure - Input pressure

A linear fit of this calibration data, between sensor pressure computed with factory coefficients and the Input pressure, yields correction coefficients:
Corrected pressure = psi_slope * Factory pressure + psi_offset [psia]
psi_slope = 0.99999 and psi_offset = +0.58 [psia]

These are converted to Slope and Offset in decibars for use in the SEASOFT programs by: Slope = psi_slope = 0.99999
Offset = C * (psi_offset - 14.7 * (1 - psi_slope)) = +0.3993 [dbars]
C = 0.689476 [dbar/psi]

Slope and Offset coefficients are entered into the pressure sensor calibration coefficient section of the <>.CON file using the program SEACON.

Digiquartz Coefficients:

C1 = -4.840395e+04
C2 = -2.017057e-03
C3 = 1.464810e-02
D1 = 3.990600e-02
D2 = 0.000000e+00
T1 = 2.998386e+01
T2 = -2.560542e-04
T3 = 3.869120e-06
T4 = 2.452640e-09

AD590 Pressure Temperature Coefficients:

AD590M = 0.01146
AD590B = -8.45734

Calibration Correction:

Slope = 0.99999
Offset = +0.3993

Dissolved Oxygen Sensor Serial No: 130327

Sea-Bird Electronics, Inc. FAX: (425) 643-9954
1808 136th Place NE, Bellevue, Washington 98005 USA Tel:(425)643-9866
Website: http://www.seabird.com Email: seabird@seabird.com

DISSOLVED OXYGEN SENSOR CALIBRATION: S/N 130327 15 June 2000

Sensor type:
Beckman, Module S/N 00501-40

Sensor Current

m = 2.4586 E-7
b = -4.6713 E-10

The use of these constants in a linear equation of the form
$I = mV + b$
will yield DO sensor membrane current as a function of sensor output voltage.

Sensor Compensation Temperature

k = 8.8802
c = -7.0722

The use of these constants in a linear equation of the form
$T = kV + c$
will yield membrane temperature as a function of temperature channel voltage with a maximum error of about 0.5 deg C. The correction to dissolved oxygen resulting from the use of this calibration should be sufficient to achieve the precision of which the sensor is capable.

SEASOFT Coefficients based on Oxfit Calibration Results

Soc	2.4938	
Boc	-0.0105	
tcor	-0.033	(nominal)
pcor	1.50e-4	(nominal)
tau	2.0	(for profiling applications only)
tau	0.0	(for moored applications only)
wt	0.67	(for Beckman type sensors)
wt	0.85	(for YSI type sensors)

barometer	=	1019.718	mB
Twater	=	6.031	deg C
Tcomp	=	5.733	deg C
Isat	=	0.496	uA
Iair	=	0.608	uA
Izero	=	0.004	uA

CALIBRATION AFTER MODIFICATIONS

Dissolved Oxygen Sensor Serial No: 130365

SBE
Sea-Bird Electronics, Inc. FAX: (425) 643-9954
1808 136th Place NE, Bellevue, Washington 98005 USA Tel:(425)643-9866
Website: http://www.seabird.com Email: seabird@seabird.com

DISSOLVED OXYGEN SENSOR CALIBRATION: S/N 130365 15 June 2000

Sensor type:

Beckman, Module S/N 00501-34

Sensor Current

m = 2.4585 E-7
b = -4.4006 E-10

The use of these constants in a linear equation of the form

$$I = mV + b$$

will yield DO sensor membrane current as a function of sensor output voltage.

Sensor Compensation Temperature

k = 9.0004
c = -6.8133

The use of these constants in a linear equation of the form

$$T = kV + c$$

will yield membrane temperature as a function of temperature channel voltage with a maximum error of about 0.5 deg C. The correction to dissolved oxygen resulting from the use of this calibration should be sufficient to achieve the precision of which the sensor is capable.

SEASOFT Coefficients based on Oxfit Calibration Results

Soc	2.4437	
Boc	-0.0073	
tcor	-0.033	(nominal)
pcor	1.50e-4	(nominal)
tau	2.0	(for profiling applications only)
tau	0.0	(for moored applications only)
wt	0.67	(for Beckman type sensors)
wt	0.85	(for YSI type sensors)

barometer	=	1020.018	mB
Twater	=	6.006	deg C
Tcomp	=	5.850	deg C
Isat	=	0.505	uA
Iair	=	0.593	uA
Izero	=	0.003	uA

CALIBRATION AFTER MODIFICATIONS

Conductivity Sensor (Primary)

C1

SEA-BIRD ELECTRONICS, INC.
1808 136th Place N.E., Bellevue, Washington 98005 USA
Phone: (425) 643 - 9866 Fax: (425) 643 - 9954 Internet: seabird@seabird.com

SENSOR SERIAL NUMBER = 2069
CALIBRATION DATE: 20-Jul-00s

CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

GHIJ COEFFICIENTS

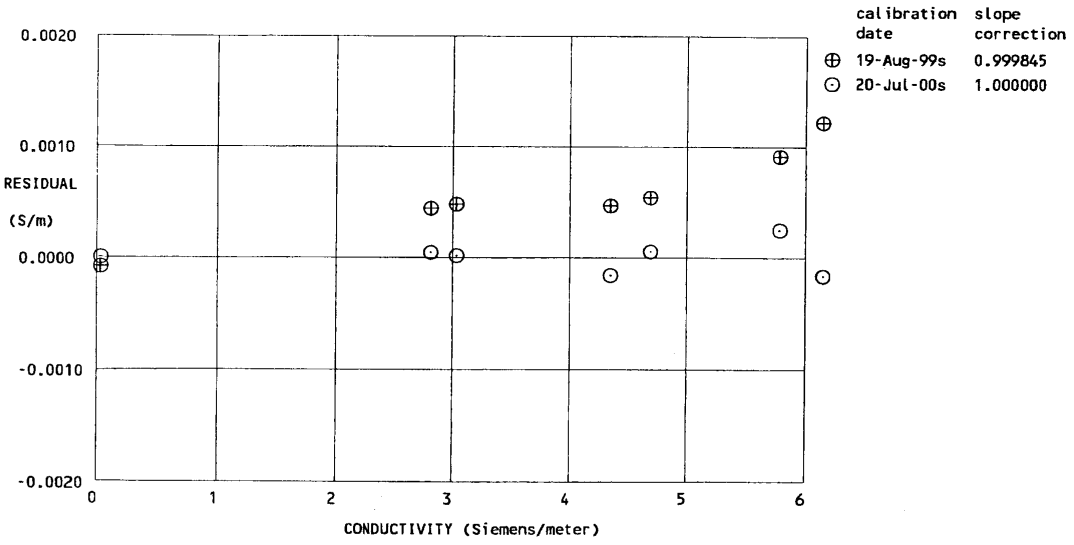
g = -1.04077910e+01
h = 1.45818332e+00
i = -6.50706333e-03
j = 5.48978386e-04
CPcor = -9.57e-08 (nominal)
CTcor = 3.25e-06 (nominal)

ABCDM COEFFICIENTS

a = 2.20517906e-13
b = 1.43713569e+00
c = -1.03516351e+01
d = -3.64579230e-05
m = 13.5
CPcor = -9.57e-08 (nominal)

BATH TEMP (IPTS-68 °C)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
0.0000	0.0000	0.00000	2.68407	-0.00000	-0.00000
-1.3758	34.9858	2.78507	5.15586	2.78511	0.00004
1.1631	34.9884	3.00345	5.30116	3.00346	0.00001
15.2830	34.9894	4.31808	6.10267	4.31791	-0.00017
18.7211	34.9868	4.66035	6.29457	4.66040	0.00005
29.2646	34.9845	5.75417	6.87114	5.75441	0.00024
32.7045	34.9801	6.12255	7.05426	6.12238	-0.00017

Conductivity = $(g + hf^2 + if^3 + jf^4) / [10(1 + \delta t + \epsilon p)]$ Siemens/meter
Conductivity = $(af^m + bf^2 + c + dt) / [10(1 + \epsilon p)]$ Siemens/meter
t = temperaure [deg C]; p = pressure [decibars]; δ = CTcor; ϵ = CPcor;
Residual = (instrument conductivity - bath conductivity) using g, h, i, j coefficients



Conductivity Sensor (Secondary)

SEA-BIRD ELECTRONICS, INC.
1808 136th Place N.E., Bellevue, Washington 98005 USA
Phone: (425) 643 - 9866 Fax: (425) 643 - 9954 Internet: seabird@seabird.com

SENSOR SERIAL NUMBER = 1799
CALIBRATION DATE: 27-Jun-00s

CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

GHIJ COEFFICIENTS

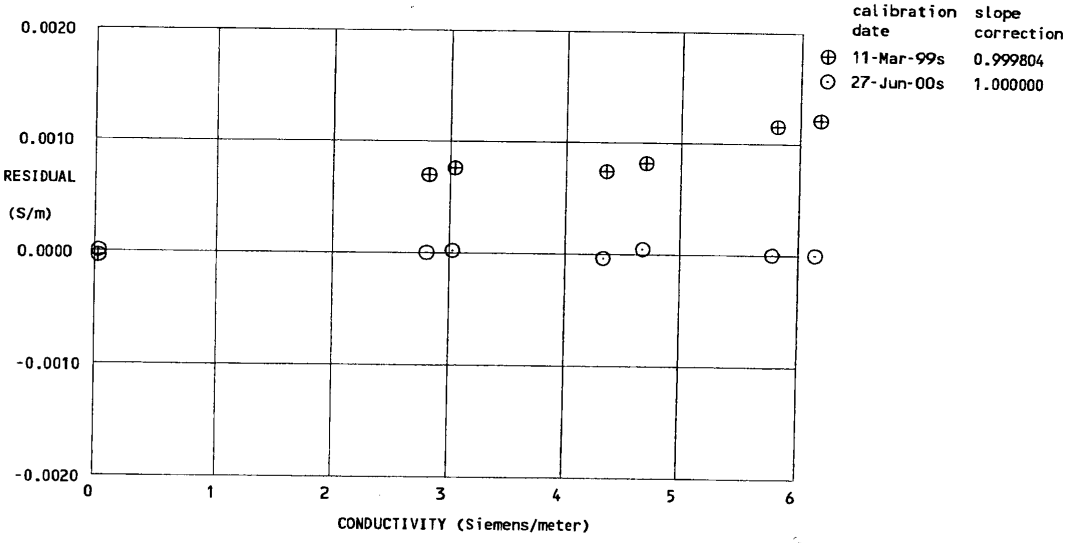
g = -4.35430860e+00
h = 5.28185259e-01
i = -8.02153803e-04
j = 6.56512680e-05
CPcor = -9.57e-08 (nominal)
CTcor = 3.25e-06 (nominal)

ABCDM COEFFICIENTS

a = 3.59299467e-07
b = 5.25167897e-01
c = -4.34339475e+00
d = -7.32162649e-05
m = 5.6
CPcor = -9.57e-08 (nominal)

BATH TEMP (IPTS-68 °C)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
0.0000	0.0000	0.00000	2.87603	-0.00000	-0.00000
-1.3747	34.9256	2.78081	7.82006	2.78080	-0.00001
1.1645	34.9262	2.99874	8.08023	2.99875	0.00001
15.2842	34.9264	4.31125	9.49530	4.31121	-0.00004
18.7220	34.9250	4.65310	9.82995	4.65314	0.00004
29.2656	34.9225	5.74524	10.82806	5.74524	-0.00000
32.7055	34.9178	6.11299	11.14346	6.11299	-0.00000

Conductivity = $(g + hf^2 + if^3 + jf^4) / [10(1 + \delta t + \epsilon p)]$ Siemens/meter
Conductivity = $(af^m + bf^2 + c + dt) / [10(1 + \epsilon p)]$ Siemens/meter
t = temperaure [deg C]; p = pressure [decibars]; δ = CTcor; ϵ = CPcor;
Residual = (instrument conductivity - bath conductivity) using g, h, i, j coefficients



Temperature Sensor (Primary)

T1

SEA-BIRD ELECTRONICS, INC.
1808 136th Place N.E., Bellevue, Washington 98005 USA
Phone: (425) 643 - 9866 Fax: (425) 643 - 9954 Internet: seabird@seabird.com

SENSOR SERIAL NUMBER = 2367
CALIBRATION DATE: 17-May-00s

TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS

g = 4.33448896e-03
h = 6.42724667e-04
i = 2.34768598e-05
j = 2.23916424e-06
f_0 = 1000.000

IPTS-68 COEFFICIENTS

a = 3.67992905e-03
b = 6.00811357e-04
c = 1.64175236e-05
d = 2.24073440e-06
f_0 = 2871.932

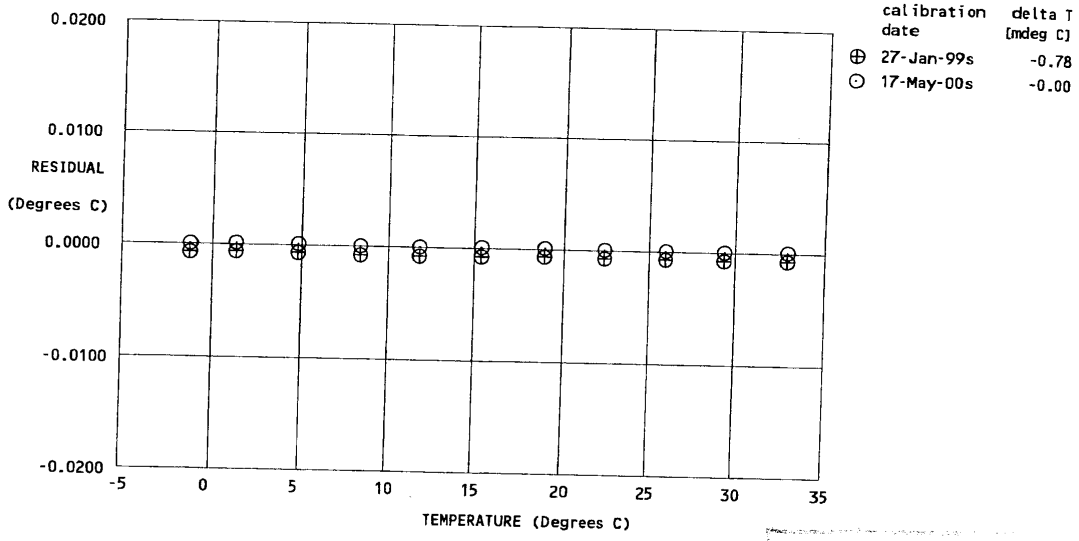
BATH TEMP (ITS-90 °C)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90 °C)	RESIDUAL (ITS-90 °C)
-1.4053	2871.932	-1.4053	-0.00003
1.1038	3037.762	1.1039	0.00005
4.5971	3280.044	4.5971	0.00004
8.1952	3543.832	8.1951	-0.00006
11.6294	3809.472	11.6293	-0.00003
15.1865	4099.250	15.1865	0.00002
18.6905	4399.622	18.6906	0.00004
22.1903	4714.737	22.1903	-0.00001
25.7498	5051.056	25.7498	0.00000
29.1653	5389.089	29.1653	-0.00002
32.6984	5754.849	32.6984	0.00001

Temperature ITS-90 $= 1/\{g + h[\ell n(f_0/f)] + i[\ell n^2(f_0/f)] + j[\ell n^3(f_0/f)]\} - 273.15$ (°C)

Temperature IPTS-68 $= 1/\{a + b[\ell n(f_0/f)] + c[\ell n^2(f_0/f)] + d[\ell n^3(f_0/f)]\} - 273.15$ (°C)

Following the recommendation of JPOTS: T_{68} is assumed to be 1.00024 * T_{90} (-2 to 35 °C).

Residual = instrument temperature - bath temperature



Temperature Sensor (Secondary)

T2

SEA-BIRD ELECTRONICS, INC.
1808 136th Place N.E., Bellevue, Washington 98005 USA
Phone: (425) 643 - 9866 Fax: (425) 643 - 9954 Internet: seabird@seabird.com

SENSOR SERIAL NUMBER = 2299
CALIBRATION DATE: 17-May-00s

TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS

g = 4.33162394e-03
h = 6.43156077e-04
i = 2.31350181e-05
j = 2.18787924e-06
f_0 = 1000.000

IPTS-68 COEFFICIENTS

a = 3.67992883e-03
b = 6.01989458e-04
c = 1.62777647e-05
d = 2.18943473e-06
f_0 = 2854.611

BATH TEMP (ITS-90 °C)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90 °C)	RESIDUAL (ITS-90 °C)
-1.4053	2854.611	-1.4053	-0.00002
1.1038	3019.104	1.1039	0.00003
4.5971	3259.393	4.5971	0.00002
8.1952	3520.959	8.1951	-0.00006
11.6294	3784.308	11.6293	-0.00003
15.1865	4071.531	15.1865	0.00001
18.6905	4369.203	18.6906	0.00008
22.1903	4681.424	22.1904	0.00003
25.7498	5014.582	25.7497	-0.00008
29.1653	5349.398	29.1653	-0.00003
32.6984	5711.614	32.6985	0.00004

Temperature ITS-90 $= 1/\{g + h[\ell n(f_0/f)] + i[\ell n^2(f_0/f)] + j[\ell n^3(f_0/f)]\} - 273.15$ (°C)

Temperature IPTS-68 $= 1/\{a + b[\ell n(f_0/f)] + c[\ell n^2(f_0/f)] + d[\ell n^3(f_0/f)]\} - 273.15$ (°C)

Following the recommendation of JPOTS: T_{68} is assumed to be 1.00024 * T_{90} (-2 to 35 °C).

Residual = instrument temperature - bath temperature