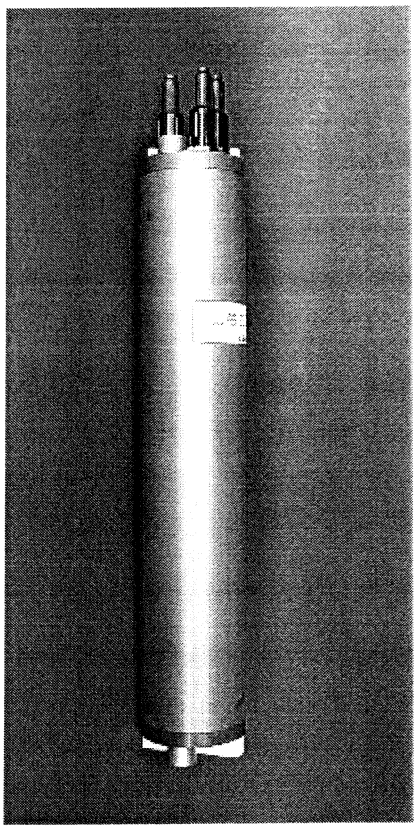
CAROUSEL
AUTO FIRE MODULE (AFM)



Serial Number: 0118

User Manual, Version 009

Sea-Bird Electronics, Inc.
1808 136th Place NE
Bellevue, Washington 98005 USA
Tel: 425/643-9866
Fax:425/643-9954

This page Intentionally Left Blank.

PN 90208 AFM OPERATING AND REPAIR MANUAL

TABLE OF CONTENTS

Manual Generation Date..... 1

Limited Liability Statement..... 2

Warning..... 4

AFM Manual - Version 009..... 5

AFM Reference Sheet - Version 003..... 63

AFM Specifications..... 65

AFM Pressure Test Certificate - S/N 0118..... 67

Appnote 68 USB Ports..... 68

Appnote 71 Desiccant Use and Regeneration..... 69

Drawings..... 75

Warranty..... 92

Service Request Form..... 94

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

Manual Generation Date: 10 March 2008

LIMITED LIABILITY STATEMENT

Extreme care should be exercised when using or servicing this equipment. It should be used or serviced only by personnel with knowledge of and training in the use and maintenance of oceanographic electronic equipment.

SEA-BIRD ELECTRONICS, INC. disclaims all product liability risks arising from the use or servicing of this system. SEA-BIRD ELECTRONICS, INC. has no way of controlling the use of this equipment or of choosing the personnel to operate it, and therefore cannot take steps to comply with laws pertaining to product liability, including laws which impose a duty to warn the user of any dangers involved in operating this equipment. Therefore, acceptance of this system by the customer shall be conclusively deemed to include a covenant by the customer to defend, indemnify, and hold SEA-BIRD ELECTRONICS, INC. harmless from all product liability claims arising from the use of servicing of this system.

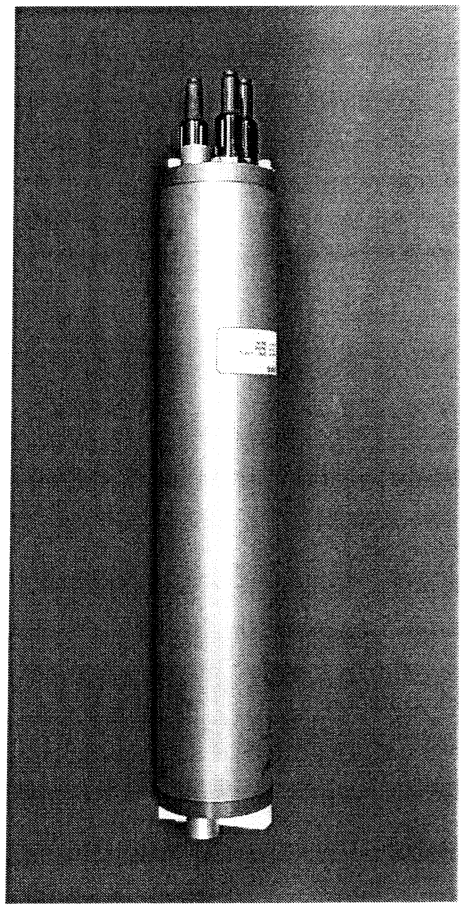
This page intentionally left blank.

WARNING !!

Do not submerge this instrument (S/N 0118)
beyond the depth rating of the lowest rated component listed below!

Main Housing (Aluminum)	**6800 meters**

Carousel Auto Fire Module (AFM)



User's Manual

Sea-Bird Electronics, Inc.
1808 136th Place NE
Bellevue, Washington 98005 USA
Telephone: 425-643-9866
Fax: 425-643-9954
E-mail: seabird@seabird.com
Website: www.seabird.com

Manual Version #009, 05-25-07
Firmware Version 1.2

Limited Liability Statement

Extreme care should be exercised when using or servicing this equipment. It should be used or serviced only by personnel with knowledge of and training in the use and maintenance of oceanographic electronic equipment.

SEA-BIRD ELECTRONICS, INC. disclaims all product liability risks arising from the use or servicing of this system. SEA-BIRD ELECTRONICS, INC. has no way of controlling the use of this equipment or of choosing the personnel to operate it, and therefore cannot take steps to comply with laws pertaining to product liability, including laws which impose a duty to warn the user of any dangers involved in operating this equipment. Therefore, acceptance of this system by the customer shall be conclusively deemed to include a covenant by the customer to defend, indemnify, and hold SEA-BIRD ELECTRONICS, INC. harmless from all product liability claims arising from the use or servicing of this system.

Table of Contents

Section 1: Introduction **5**
About this Manual 5
How to Contact Sea-Bird 5
Quick Start 5
Unpacking AFM 6

Section 2: Description of AFM **7**
System Description 7
Specifications 9
Dimensions and End Cap Connectors 10

Section 3: Deploying and Operating System **11**
Installing Software 11
Installing System 11
Testing and Setting Up System 12
Using SeatermAF 13
Testing and Setting Up AFM and CTD 16
Bottle Closure Setup Parameters 21
Close on Downcast 21
Close on Upcast 23
Close when Stationary 25
Close on Elapsed Time - Record or Do Not Record CTD Data 26
Deploying System 27
Recovery 29
Physical Handling 29
Uploading Data 30
AFM Command Descriptions 35
Commands Not Typically Sent by User 39

Section 4: Processing Uploaded Data **42**
AFM Data Output Formats 42
CTD Data Output Formats 43
Processing .afm Files from AFM and
.hex Files from SBE 19, 19*plus*, and 25 43
Data Conversion 44
Bottle Summary 46
Other Processing Modules 46
Processing .afm Files from AFM when Used with SBE 50 47

Section 5: Routine Maintenance **48**
Corrosion Precautions 48
Connector Mating and Maintenance 48
Replacing/Recharging Batteries 49
Replacing Alkaline Batteries 49
Recharging/Replacing Ni-Cad Batteries 50

Section 6: Troubleshooting **51**
Problem 1: Unable to Communicate with AFM 51
Problem 2: Unable to Communicate with CTD through AFM 51
Problem 3: No Bottles Closed / No Data Recorded in AFM 52
Problem 4: Nonsense or Unreasonable CTD Data 52
Problem 5: Program Corrupted 52

Glossary **53**

Appendix I: Functional Description **54**
Battery Wiring and Power Supply 54
Analog PCB 54
Digital PCB 54
Real-Time Clock 54
Memory 54
Appendix II: Electronics Disassembly/Reassembly **55**
Appendix III: Replacement Parts **56**
Index **58**

Section 1: Introduction

This section includes contact information, Quick Start procedure, and photos of a standard Auto Fire Module (AFM) shipment.

About this Manual

This manual is to be used with the AFM. It is organized to guide the user from installation through operation, data collection, and basic data processing. We have included detailed specifications, command descriptions, maintenance information, and helpful notes throughout the manual.

Sea-Bird welcomes suggestions for new features and enhancements of our products and/or documentation. Please e-mail any comments or suggestions to seabird@seabird.com.

How to Contact Sea-Bird

Sea-Bird Electronics, Inc.
1808 136th Place Northeast
Bellevue, Washington 98005 USA

Telephone: 425-643-9866 Fax: 425-643-9954
E-mail: seabird@seabird.com Website: http://www.seabird.com

Business hours:
Monday-Friday, 0800 to 1700 Pacific Standard Time
(1600 to 0100 Universal Time)
Except from April to October, when we are on *summer time*
(1500 to 0000 Universal Time)

Quick Start

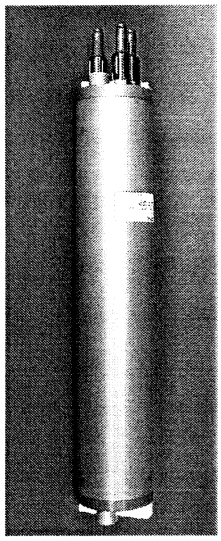
Follow these steps to get a Quick Start using the AFM. The manual provides details for performing each task in *Section 3: Deploying and Operating System*:

1. Install AFM and CTD on SBE 32 Carousel Water Sampler.
2. Connect AFM's data I/O cable to computer.
3. Set up AFM and CTD using SeatermAF software:
   A. Select AFM with applicable CTD in Configure menu. Enter AFM and CTD communication settings, bottle closure logic, and bottle closure pressures/times. Save settings.
   B. Click Connect AFM to communicate with AFM. Set AFM date and time with **ST**. Click Program to send bottle closure parameters to AFM.
   C. Click Connect CTD to communicate with CTD. Send commands to CTD to change instrument setup. Send **QS** to put CTD in quiescent (sleep) state (not applicable to SBE 50).
4. Arm AFM and deploy system:
   A. Click Connect AFM to communicate with AFM. Click ARM.
   B. Disconnect AFM's I/O cable; replace with dummy plug and locking sleeve.
   C. Turn on CTD's magnetic switch (if applicable) to start logging.
   D. Deploy system.

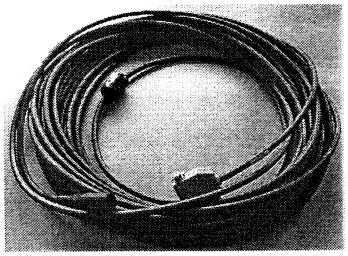
Note:
You must upload data from the AFM before redeploying. On redeployment, the AFM overwrites any data in its memory.

Unpacking AFM

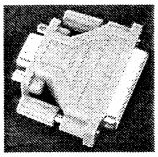
Shown below is a typical AFM shipment.



AFM



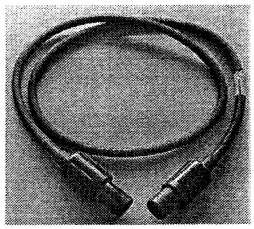
Data I/O Cable (4 pin JB3 on AFM)



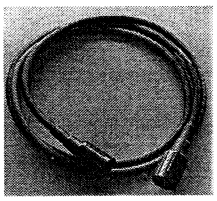
25-pin to 9-pin adapter
(for use with computer with DB-25 connector)

Note:
Typical shipment includes cable to Carousel and cable to SBE 19, 19*plus*, or 25, **OR** Y-cable to Carousel and SBE 50.

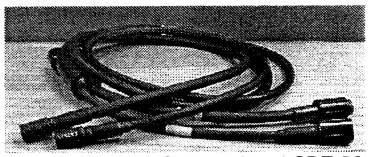
CTD / Carousel Cables



Cable to SBE 32 Carousel Water Sampler
(from 6-pin JB2 on AFM)

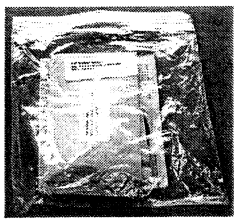


Cable to CTD -
SBE 19, 19*plus*, or 25
(from 3-pin JB1 on AFM)



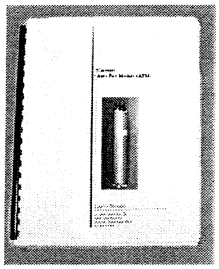
Double Y-Cable to Carousel and SBE 50
(from 6-pin JB2 and 3-pin JB1 on AFM)

Jackscrew Kit



Spare o-ring and hardware kit

AFM Mount Kit for SBE 32 Carousel (optional) - photo not available



AFM User Manual

Software, and Electronics Copies of Software Manuals and User Manual

Section 2: Description of AFM

This section describes the functions and features of the AFM, including system description, specifications, dimensions, and end cap connectors.

System Description

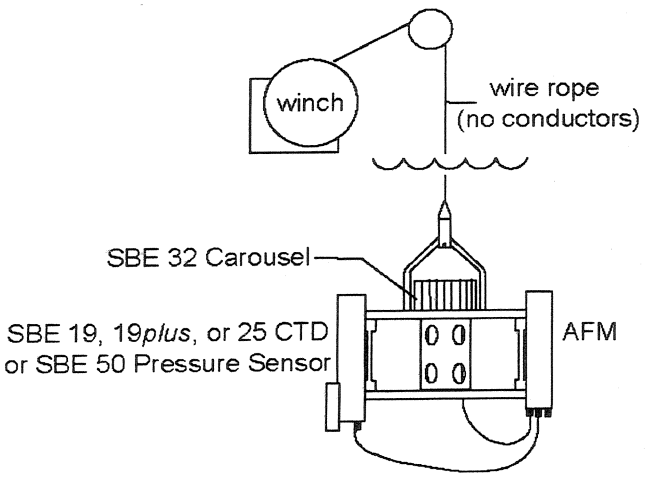
The Carousel Auto-Fire Module (AFM) allows the SBE 32 Carousel Water Sampler to operate autonomously on non-conducting cables. The AFM includes a microprocessor, solid-state memory, RS-232 interface, and battery power that supply the operating voltage, logic, and control commands to operate the Carousel.

Notes:
- The term *Carousel* or *SBE 32 Carousel* applies to all Carousel models: SBE 32 (full size), 32C (compact), and 32SC (sub-compact).
- Except where noted, the term *CTD* refers to the SBE 19, 19*plus*, and 25 CTD *as well as* to the SBE 50 Digital Oceanographic Pressure Sensor.
- The AFM provides power for the SBE 50 Pressure Sensor, which has no internal power supply.
- The SBE 19, 19*plus*, and 25 simultaneously record data (including pressure) in memory while transmitting pressure data in real-time to the AFM. The SBE 50 does not have an internal memory.

When the Carousel is used without a CTD, the AFM is programmed to fire bottles at predefined intervals of elapsed time after receipt of the **Arm** command. The point at which samples are taken can be determined (approximately) by monitoring the paid out cable length and elapsed time. The AFM records bottle sequence and number, date and time, and firing confirmation for each bottle fired. At the end of a cast, the bottle data (.afm) file is uploaded from the AFM.

When the Carousel is used with a CTD (SBE 19 or 19*plus* SEACAT Profiler, SBE 25 SEALOGGER CTD, or SBE 50 Pressure Sensor), the AFM:
- Monitors the pressure data transmitted in real-time by the SBE 19, 19*plus*, 25, or 50,
- Fires bottles at predefined pressures (depths), on upcast, downcast, or whenever the Carousel is stationary for a specified period of time, and
- Records bottle sequence and number, time, firing confirmation, and five scans of CTD data in AFM memory for each bottle fired.

At the end of a cast, the SBE 19, 19*plus*, or 25 CTD data is uploaded from the CTD (through the AFM), and the bottle data is uploaded from the AFM. SBE Data Processing's Data Conversion module converts the raw data and creates a .cnv data file from the uploaded CTD data and a .ros bottle file from the uploaded AFM data.



The AFM is powered by 9 alkaline D-size cells (Duracell MN1300, LR20), which provide approximately 40 hours of operation. Optionally, the AFM can be powered by rechargeable Ni-Cad batteries. Battery endurance is predominantly a function of the amount of time the AFM is powered and armed; the number of bottles fired has little impact. Setup, checkout, and data extraction are performed (without opening the housing) with our SeatermAF terminal program.

A standard AFM (PN 90208) is supplied with:

- Anodized aluminum housing rated to 6800 meters (22,300 feet)
- Impulse glass-reinforced epoxy bulkhead connectors for the CTD, Carousel, and Data I/O (RS-232) mounted on the housing end cap
- Cables from AFM to Carousel and CTD

As an option, the AFM (PN 90491) is supplied with wet-pluggable (MCBH) connectors and compatible cables in place of standard glass-reinforced epoxy connectors.

The AFM is typically installed on the Carousel, using the same mounting bracket used to mount a SEACAT, and hangs vertically between the upper and lower adapter plates.

Notes:

- Help files provide detailed information on the use of SeatermAF and SBE Data Processing.
- A separate software manual on CD-ROM contains detailed information on the setup and use of SBE Data Processing.

The AFM is supplied with a powerful Win 2000/XP software package, SEASOFT-Win32, which includes:

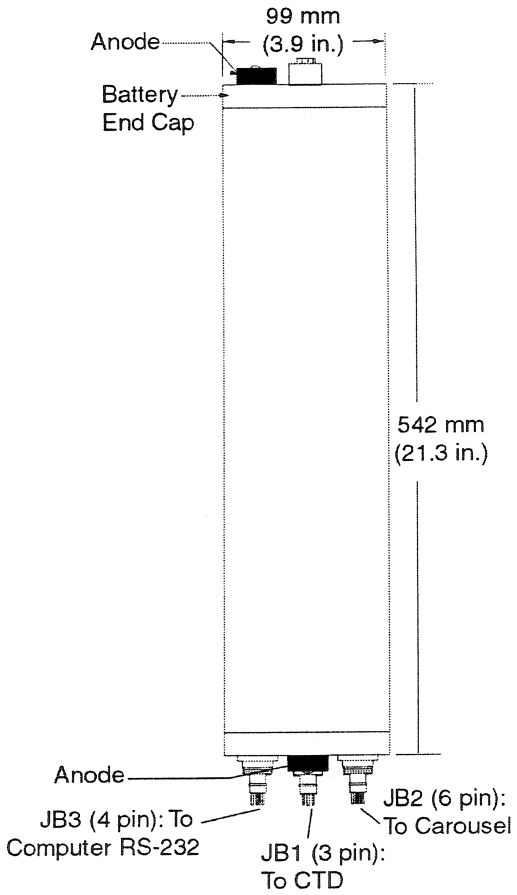
- **SeatermAF** - terminal program for easy communication and data retrieval.
- **SBE Data Processing** - program for calculation, display, and plotting of temperature, conductivity, pressure, auxiliary sensor data, and derived variables such as salinity and sound velocity.

Specifications

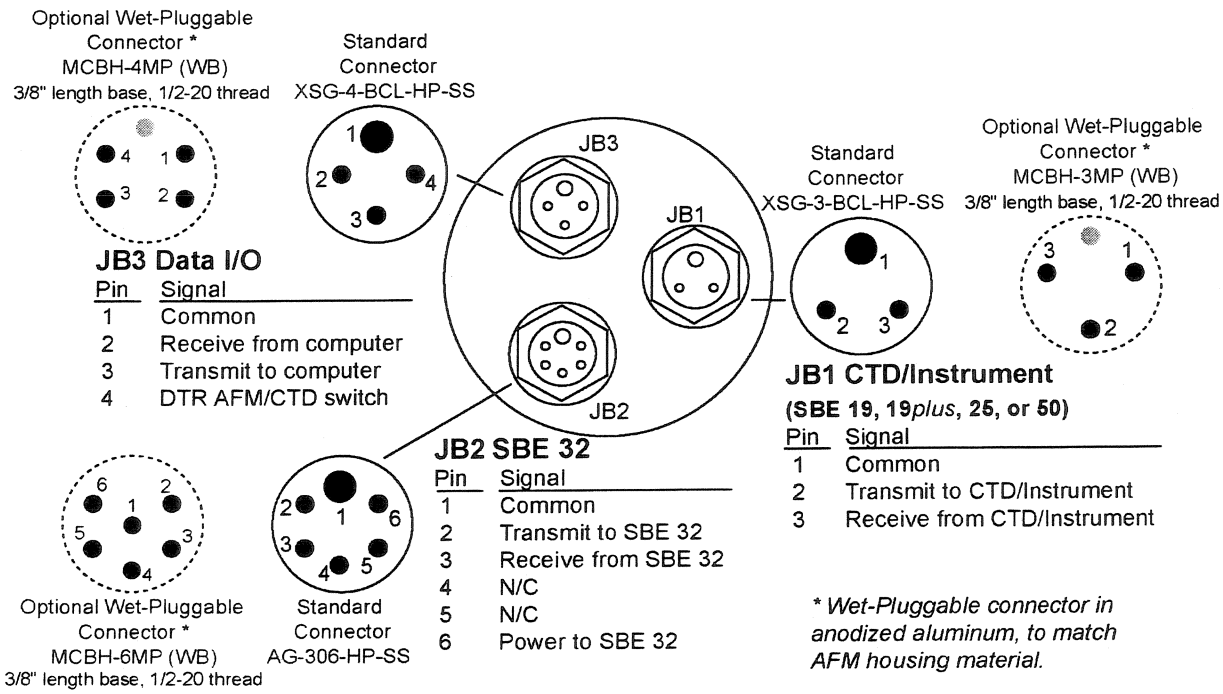
Note:
In response to low battery voltage, the AFM turns off power (goes to sleep). For **Ni-Cads**, the AFM turns off power when voltage drops below 7.3 volts or is less than 10 volts and voltage drop is greater than 1 volt/minute. This reduces battery load to quiescent current once the first cell in the battery pack is exhausted. For **alkalines**, the AFM turns off power when voltage drops below 7.3 volts.

Memory and Data Storage	64K byte static RAM memory. Memory space for 1 cast (36 bottles maximum). AFM memory records for each bottle fired: • Bottle sequence and number, date and time, firing confirmation, battery voltage, scan number of first of 5 CTD scans, and 5 scans of CTD data, or • (if used without a CTD) Bottle sequence and number, date and time, firing confirmation, and battery voltage
Real-Time Clock	Watch-crystal type
Internal Batteries	*Standard*: 9 alkaline D-size batteries (Duracell MN1300, LR20) *Optional*: 9 Ni-Cad D-size batteries
Current	*Quiescent Current*: 60 microamps *Operating Current*: Not armed - 35 milliamps Armed, Carousel capacitor charged - 175 milliamps Armed, Carousel capacitor charging - 250 milliamps
Battery Endurance	Approximately 40 hours for alkaline batteries and 17 hours for Ni-Cad batteries.
Materials	Anodized aluminum housing rated at 6800 meters (22,300 feet)
Weight	In air: 8.1 kg (18 lbs) In water: 4.1 kg (9 lbs)

Dimensions and End Cap Connectors



Notes:
- JB1 to CTD's 4-pin data I/O connector
- JB2 to SBE 32 Carousel's 6-pin modem connector
- When used with an SBE 50, a double Y-cable connects to JB1 and JB2, and to the SBE 50 and 32. This provides power to the SBE 50, which does not have an internal power supply.



JB3 Data I/O

Pin	Signal
1	Common
2	Receive from computer
3	Transmit to computer
4	DTR AFM/CTD switch

JB2 SBE 32

Pin	Signal
1	Common
2	Transmit to SBE 32
3	Receive from SBE 32
4	N/C
5	N/C
6	Power to SBE 32

JB1 CTD/Instrument
(SBE 19, 19*plus*, 25, or 50)

Pin	Signal
1	Common
2	Transmit to CTD/Instrument
3	Receive from CTD/Instrument

** Wet-Pluggable connector in anodized aluminum, to match AFM housing material.*

Section 3: Deploying and Operating System

This section describes the procedures for installing software; installing, setting up, and deploying the system; and uploading data.

Installing Software

Note:
It is possible to use the AFM without SeatermAF by sending direct commands from a dumb terminal or terminal emulator, such as Windows HyperTerminal.

Recommended minimum system requirements for running SEASOFT-Win32: Windows 2000 or later, 500 MHz processor, and 256 MB RAM.

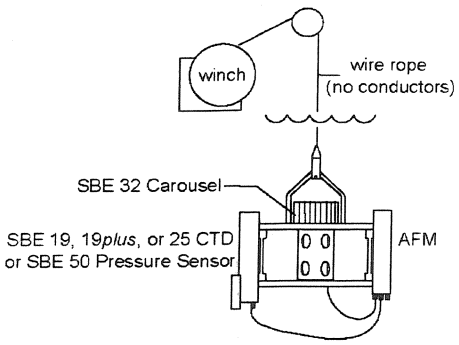
If not already installed, install SeatermAF and other Sea-Bird software programs on your computer using the supplied software CD:

1. Insert the CD in your CD drive.
2. Double click on **SEASOFT-Win32.exe**.
3. Follow the dialog box directions to install the software.

The default location for the software is c:/Program Files/Sea-Bird. Within that folder is a sub-directory for each program. The installation program allows you to install the desired components. Install all the components, or just install SeatermAF (terminal program) and SBE Data Processing.

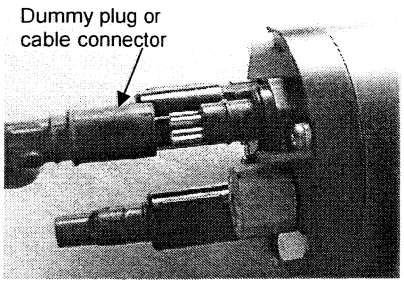
Installing System

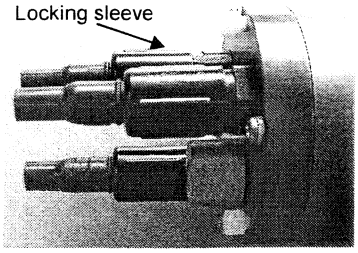
Note:
If you order the AFM, Carousel, and CTD as a package, the AFM and CTD may be factory-installed on the Carousel, depending on the Carousel model.



1. Install the AFM and CTD on the Carousel Water Sampler (see the instructions provided with the Mount Kit):
   A. Put a layer of Teflon tape on the inside of the steel clamps to provide electrical isolation between the clamps and the AFM's aluminum housing.
   B. Attach the AFM to the mounting bracket using the clamps.
   C. Install the mounting bracket on the Carousel in place of a sample bottle. (On some Carousels, extra mounting positions have been provided to mount the AFM and CTD, in addition to the full number of bottles).
   D. Repeat Steps A through C for the CTD.
2. Install the cables connecting the AFM to the CTD and Carousel:
   - **No CTD** - AFM's 6-pin **JB2** to Carousel's 6-pin modem connector.
   - **SBE 19, 19*plus*, or 25 CTD** - AFM's 6-pin **JB2** to Carousel's 6-pin modem connector and AFM's 3-pin **JB1** to CTD's 4-pin data I/O connector.
     Note: SBE 19s and 25s configured with a pump have a 6-pin data I/O - pump connector. These CTDs are supplied with a Y-cable (6-pin to SBE 19/25, 4-pin data I/O, 2-pin pump); connect the AFM's 3-pin JB1 to the 4-pin data I/O connector on the Y-cable.
   - **SBE 50** – Double Y-cable from AFM's 6-pin JB2 and 3-pin JB1 to Carousel's 6-pin modem connector and SBE 50's 4-pin data I/O connector.

CAUTION:
Do not use WD-40 or other petroleum-based lubricants, as they will damage the connector.





For each cable connector:

A. Remove dummy plug (if installed).
   (1) By hand, unscrew the locking sleeve from the connector. **If you must use a wrench or pliers, be careful not to loosen the bulkhead connector instead of the locking sleeve.**
   (2) Remove the dummy plug from the connector by pulling the plug firmly away from the connector.

B. Lightly lubricate the inside of the cable connector with silicone grease (DC-4 or equivalent).

C. **Standard Connector** - Install the cable connector, aligning the raised bump on the side of the connector with the large pin (pin 1 - ground) on the instrument. Remove any trapped air by *burping* or gently squeezing the connector near the top and moving your fingers toward the end cap. **OR**
MCBH Connector – Install the cable connector, aligning the pins.

D. Place the locking sleeve over the connector. Tighten the locking sleeve finger tight only. **Do not overtighten the locking sleeve and do not use a wrench or pliers.**

Testing and Setting Up System

1. Connect the AFM's 4-pin **JB3** to your computer's serial port using the supplied cable. This cable (with blue tape on both ends) uses the Data Terminal Ready (DTR) line from the computer to control internal switches in the AFM. These switches allow the terminal program (SeatermAF) to communicate with the AFM or CTD without switching cables or COM ports (SeatermAF sets the DTR line high to select the AFM and low to select the CTD). **The CTD's data I/O cable is not able to communicate with the AFM.**

   A. If there is a dummy plug on the connector, remove as follows:
      (1) By hand, unscrew the locking sleeve from the connector. **If you must use a wrench or pliers, be careful not to loosen the bulkhead connector instead of the locking sleeve.**
      (2) Remove the dummy plug from the connector by pulling the plug firmly away from the connector.

   B. **Standard Connector** - Install the cable connector, aligning the raised bump on the side of the connector with the large pin (pin 1 - ground) on the AFM. **OR**
   MCBH Connector – Install the cable connector, aligning the pins.

   C. Connect the 9-pin end to your computer's serial port.

Using SeatermAF

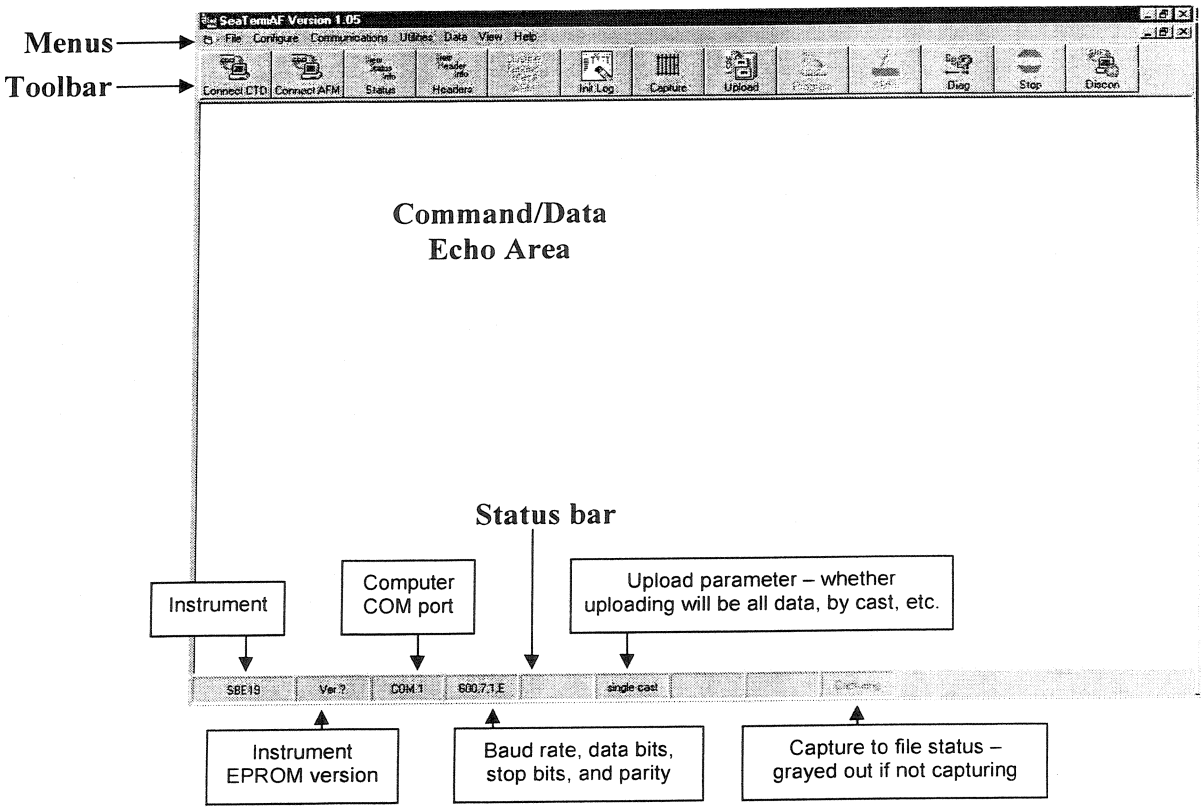
Proceed as follows:

Notes:
- SeatermAF's initialization file, SeaTermAF.ini, includes information on the last instrument used when the program was closed, and the location of that instrument's settings (.ini) file. As a default, the instrument's .ini file is saved to the same directory as SeatermAF.exe.
- See SeatermAF's Help files.

1. Double click on SeatermAF.exe. If this is the first time the program is used, the setup dialog box appears:

Select the instrument type (*AFM with SBE 19*, *AFM with SBE 19plus*, *AFM with SBE 25*, *AFM with SBE 50*, or *AFM with no CTD*) and computer COM port for communication with the AFM. Click OK.

2. The main screen looks like this:



Note:
There is at least one way, and as many as three ways, to enter a command:
- Manually type a command in Command/Data Echo Area
- Use a menu to automatically generate a command
- Use a Toolbar button to automatically generate a command

Note:
Once the system is configured and the computer is communicating with the AFM or CTD, to update the Status bar:
- on the Toolbar, click Status; or
- from the Utilities menu, select Instrument Status.

SeatermAF sends the status command, which displays in the Command/Data Echo Area, and updates the Status bar.

Description of SeatermAF main screen:
- Menus – Contains tasks and frequently executed instrument commands.
- Toolbar – Contains buttons for frequently executed tasks and instrument commands. All tasks and commands accessed through the Toolbar are also available in the Menus. To display or hide the Toolbar, select View Toolbar in the View menu. Grayed out Toolbar buttons are not applicable.
- Command/Data Echo Area – Echoes a command executed using a Menu or Toolbar button, as well as the instrument's response. Additionally, a command can be manually typed in this area, from the available commands for the instrument. Note that the instrument must be *awake* for it to respond to a command (use Connect AFM or Connect CTD on the Toolbar to wake up the instrument).
- Status bar – Provides status information. To display or hide the Status bar, select View Status Bar in the View menu.

You must test and set up both the AFM and the CTD. The Status bar indicates which instrument is active.
- Menus, toolbar buttons, and manually typed commands associated with the AFM are only applicable when the AFM is *connected* (use Connect AFM on the Toolbar).
- Menus, toolbar buttons, and manually typed commands associated with the CTD are only applicable when the CTD is *connected* (use Connect CTD on the Toolbar).

Following are the Toolbar buttons applicable to the AFM and/or CTD (some apply to both, others apply to only the AFM or only the CTD):

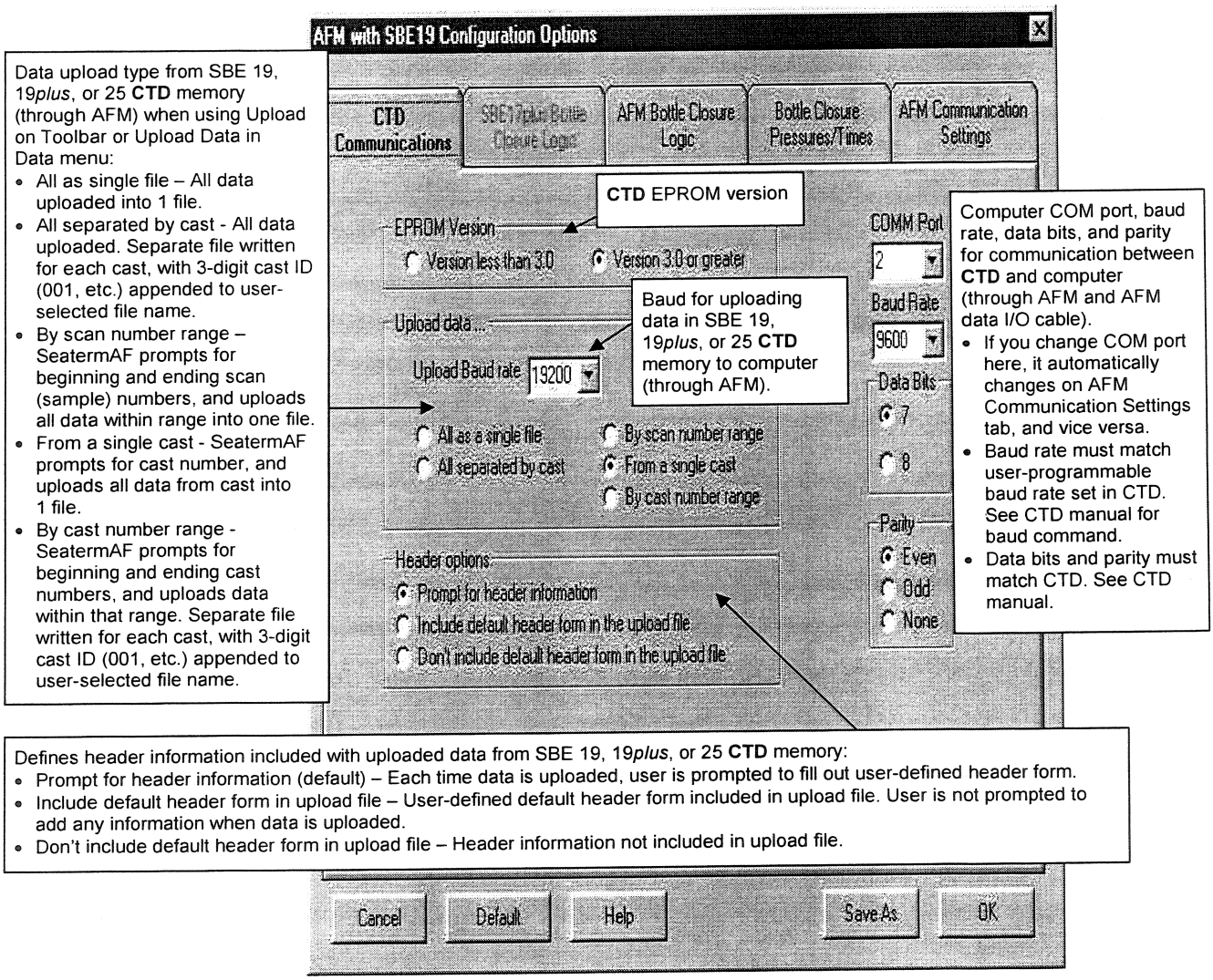
Note:
You have only 2 minutes to communicate with the SBE 50 before the AFM goes to sleep and shuts off power to the SBE 50. If you need more time to perform SBE 50 setup, follow this procedure:
1. Click Connect AFM.
2. Send **UE** to override the AFM's timeout.
3. Click Connect CTD to connect to SBE 50.
4. Perform desired setup of SBE 50.
5. Click Connect AFM to reconnect to AFM.
6. Send **UD** to disable timeout override, to avoid running down the AFM batteries.

Toolbar Buttons	Description	Equivalent Command*
Connect CTD	Re-establish communications with **CTD** (SBE 19, 19*plus*, 25, or 50). Computer responds with S> prompt. SBE 19, 19*plus*, or 25 *goes to sleep* after 2 minutes without communication from computer have elapsed.	—
Connect AFM	Re-establish communications with **AFM**. Computer responds with A> prompt. AFM *goes to sleep* after 2 minutes without communication from computer have elapsed.	—
Status	Display **AFM or CTD** instrument status — provide information on instrument setup and current status.	**DS**
Headers	View SBE 19, 19*plus*, or 25 **CTD** data headers (cast number, date and time, number of samples in cast, etc.). A new header is generated for each CTD cast.	**DH**
Closure Parameters AFM	Display all auto fire parameters and auto fire status for **AFM**.	**CP**
Init Log	Reset data pointers and cast numbers for SBE 19, 19*plus*, or 25 **CTD**. This should be performed after existing data has been uploaded from CTD and prior to recording new data.	SBE 19 or 25: **IL** SBE 19*plus*: **InitLogging**
Capture	Capture instrument (**AFM or CTD**) responses on screen to file; may be useful for diagnostics. File has .cap extension. Press Capture again to turn off capture. Capture status displays in Status bar.	—
Upload	Upload data from **AFM or CTD** (SBE 19, 19*plus*, or 25), in format post-processing software can use. Before using upload: • CTD: Stop logging. • Configure upload and header parameters in Configure menu.	AFM or SBE 19, 19*plus*, or 25 CTD: **DD**
Program	Send auto fire information input in Configure menu to **AFM**. Must send this information before deployment for auto fire capability to function.	—
ARM	Enable **AFM's** auto fire algorithm to close bottles. Must arm AFM before deployment for auto fire capability to function. AFM will automatically disarm itself and enter the quiescent (sleep) state after 24 hours.	**Arm**
Diag	Perform one or more diagnostic tests on **CTD**. Diagnostic test(s) accessed in this manner are non-destructive – they do not write over any existing instrument settings.	SBE 19 or 25: **DS, J, VR, FR** SBE 19*plus*: **DS, DCal, TS, TSR** SBE 50: (not applicable)
Stop	Halt current command for **AFM or CTD**.	(press Esc key or Ctrl C)
Disconnect	Free computer COM port used to communicate with **AFM or CTD**. COM port can then be used by another program.	—

*See *AFM Command Descriptions* and the applicable CTD manual for detailed command descriptions.

Testing and Setting Up AFM and CTD

3. In SeatermAF's Configure menu, select the AFM with the applicable CTD. The dialog box looks like this for the AFM with SBE 19 (others are similar):



Data upload type from SBE 19, 19*plus*, or 25 **CTD** memory (through AFM) when using Upload on Toolbar or Upload Data in Data menu:

- All as single file – All data uploaded into 1 file.
- All separated by cast - All data uploaded. Separate file written for each cast, with 3-digit cast ID (001, etc.) appended to user-selected file name.
- By scan number range – SeatermAF prompts for beginning and ending scan (sample) numbers, and uploads all data within range into one file.
- From a single cast - SeatermAF prompts for cast number, and uploads all data from cast into 1 file.
- By cast number range - SeatermAF prompts for beginning and ending cast numbers, and uploads data within that range. Separate file written for each cast, with 3-digit cast ID (001, etc.) appended to user-selected file name.

Baud for uploading data in SBE 19, 19*plus*, or 25 **CTD** memory to computer (through AFM).

Computer COM port, baud rate, data bits, and parity for communication between **CTD** and computer (through AFM and AFM data I/O cable).

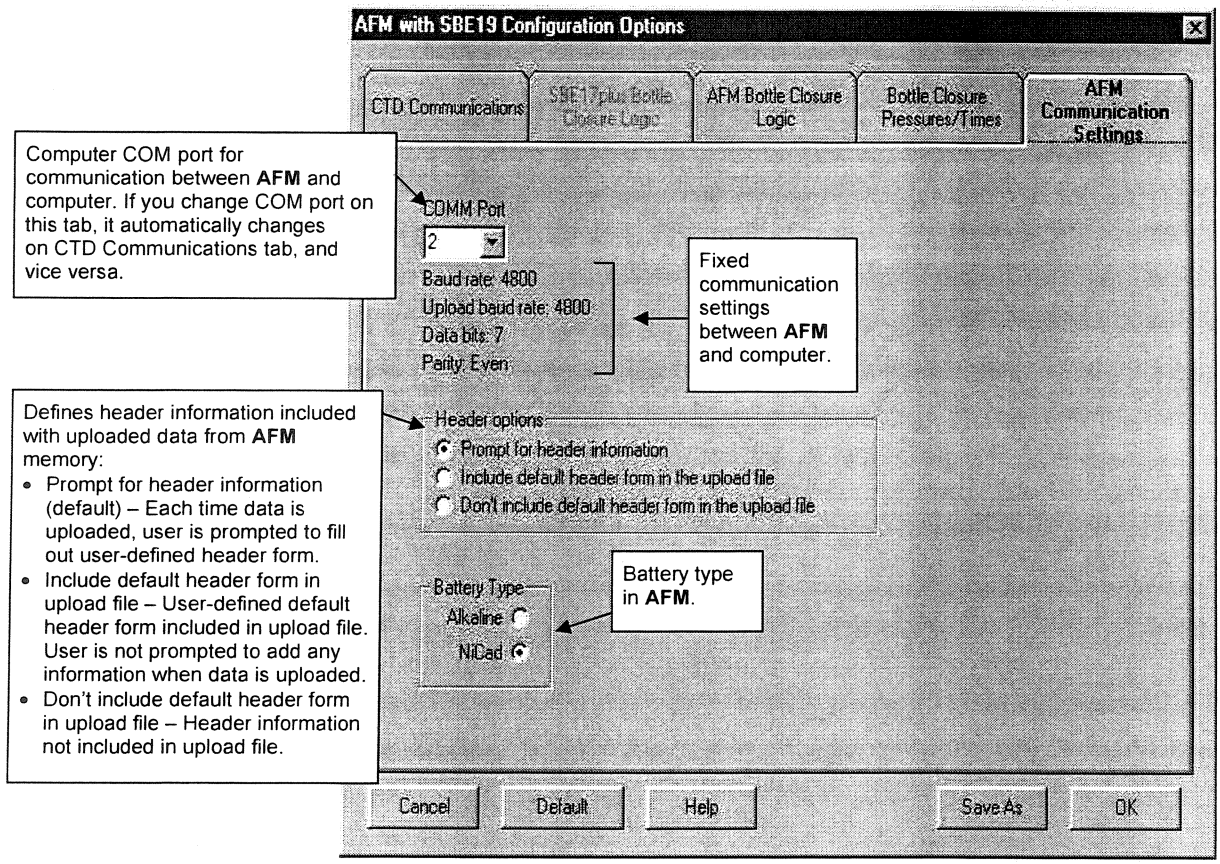
- If you change COM port here, it automatically changes on AFM Communication Settings tab, and vice versa.
- Baud rate must match user-programmable baud rate set in CTD. See CTD manual for baud command.
- Data bits and parity must match CTD. See CTD manual.

Defines header information included with uploaded data from SBE 19, 19*plus*, or 25 **CTD** memory:

- Prompt for header information (default) – Each time data is uploaded, user is prompted to fill out user-defined header form.
- Include default header form in upload file – User-defined default header form included in upload file. User is not prompted to add any information when data is uploaded.
- Don't include default header form in upload file – Header information not included in upload file.

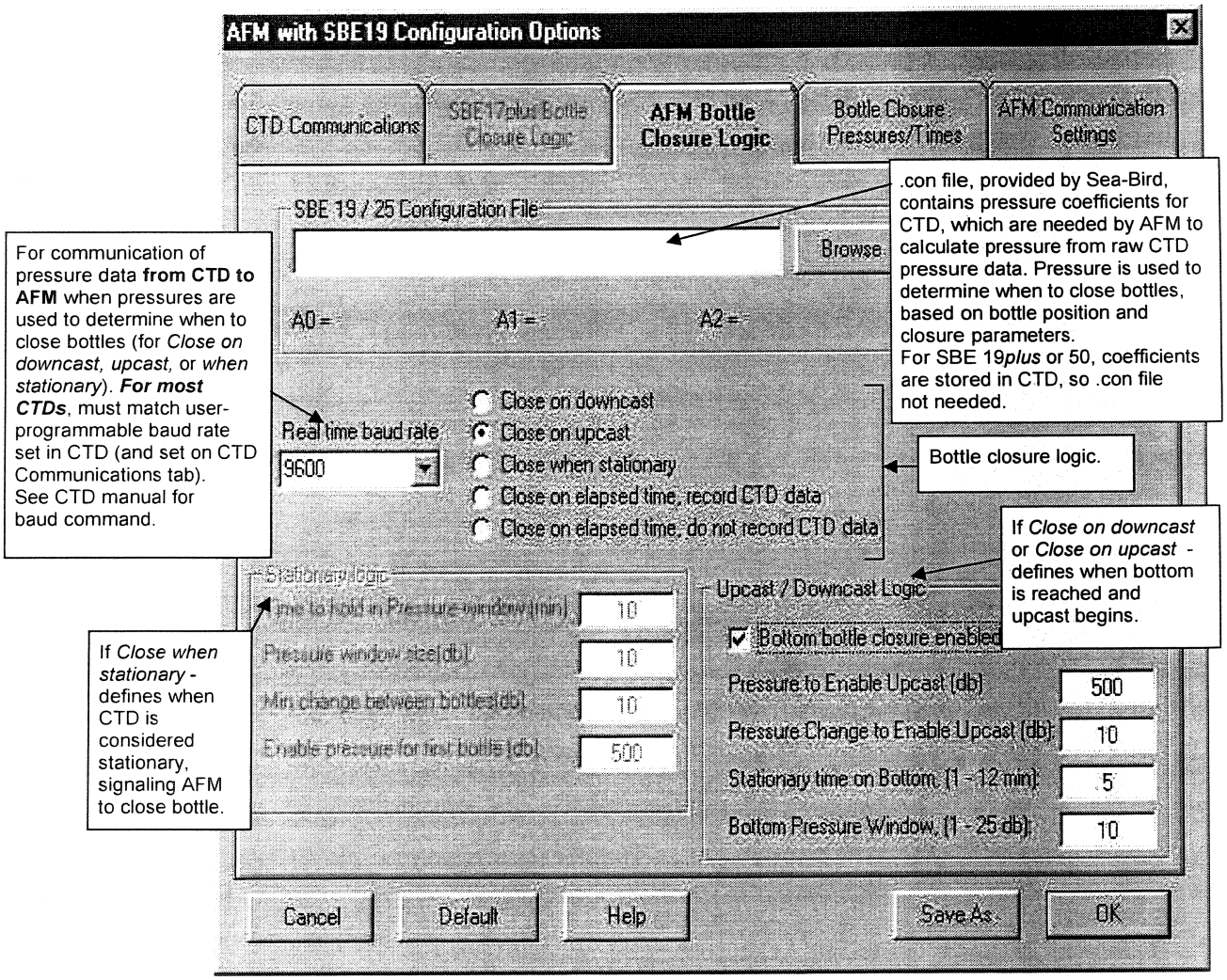
Make the selections on the CTD Communications tab (see CTD manual for communication parameters for your instrument).
Note that selections for uploading data and header options can be made now or when you are ready to upload data from memory after deployment - they have no effect on system operation.

4. Click on the AFM Communication Settings tab. The dialog box looks like this:



Make the selections on the AFM Communication Settings tab. Note that the selection for header options can be made now or when you are ready to upload data after deployment - it has no effect on system operation.

5. Click on the AFM Bottle Closure Logic tab. The dialog box looks like this:



.con file, provided by Sea-Bird, contains pressure coefficients for CTD, which are needed by AFM to calculate pressure from raw CTD pressure data. Pressure is used to determine when to close bottles, based on bottle position and closure parameters.
For SBE 19*plus* or 50, coefficients are stored in CTD, so .con file not needed.

For communication of pressure data **from CTD to AFM** when pressures are used to determine when to close bottles (for *Close on downcast, upcast,* or *when stationary*). ***For most CTDs***, must match user-programmable baud rate set in CTD (and set on CTD Communications tab). See CTD manual for baud command.

Bottle closure logic.

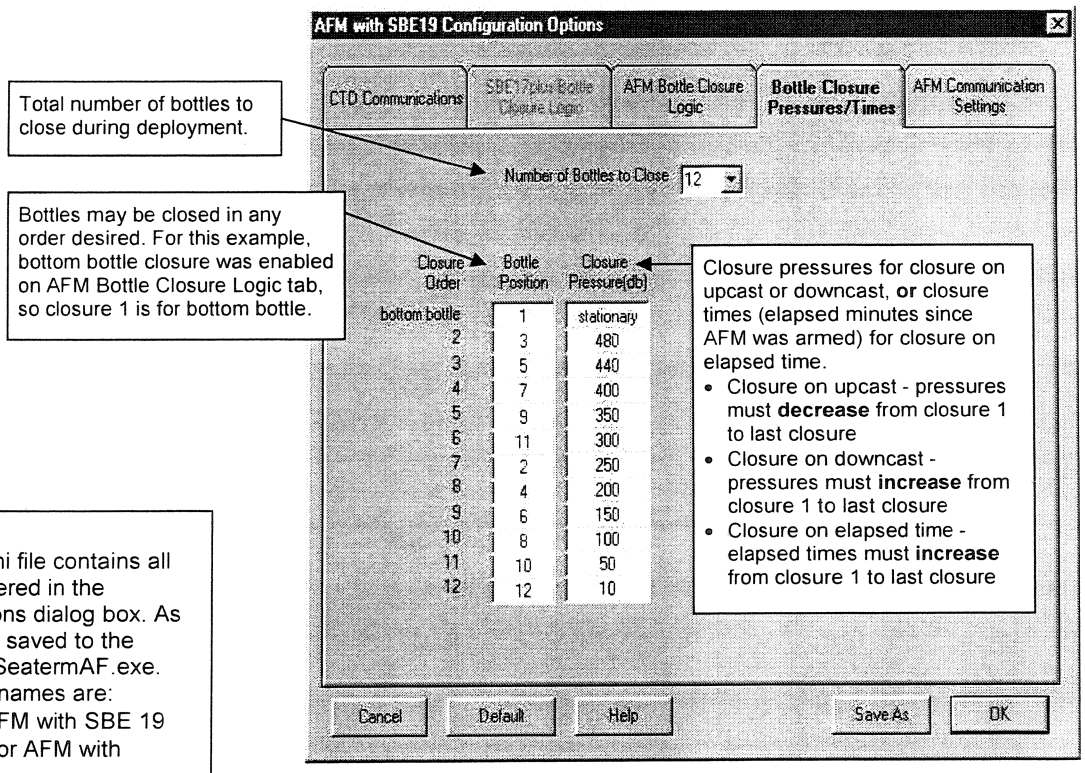
If *Close on downcast* or *Close on upcast* - defines when bottom is reached and upcast begins.

If *Close when stationary* - defines when CTD is considered stationary, signaling AFM to close bottle.

Note:
When we ship a new instrument, we include a .con file that reflects the current instrument configuration *as we know it*. The .con file is named with the instrument serial number, followed with the .con extension. For example, for an instrument with serial number 2375, we name the .con file *2375.con*. You may rename the .con file if desired; this will not affect the results.

Make the selections on the AFM Bottle Closure Logic tab (see *Bottle Closure Setup Parameters*).

6. Click on the Bottle Closure Pressures/Times tab. The dialog box looks like this if *Close on upcast* was selected:



Notes:
The instrument's .ini file contains all the information entered in the Configuration Options dialog box. As a default, this file is saved to the same directory as SeatermAF.exe. The default .ini file names are:
- SBE19.ini - for AFM with SBE 19
- SBE19plus.ini - for AFM with SBE 19*plus*
- SBE25.ini - for AFM with SBE 25
- SBE 50.ini – for AFM with SBE 50
- AFMonly.ini - for AFM with no CTD

You may want to save .ini files with unique names or in unique directories for reuse in future deployments.

Make the selections on the Bottle Closure Pressures/Times tab (see *Bottle Closure Setup Parameters*). Click OK to overwrite an existing instrument settings (.ini) file, or click Save As to save the settings as a new filename.

7. Click Connect AFM on the Toolbar. The display looks like this:

```
Power up
A>
```

This shows that correct communications between the computer and AFM have been established.
If the system does not respond as shown above:
- Click Connect AFM again.
- Verify the COM port is correct on the AFM Communication Settings tab in the Configuration Options dialog box.
- Check cabling between the computer and AFM.
- Check the AFM battery voltage - see *Replacing/Recharging Batteries* in *Section 5: Routine Maintenance*

Notes:
- *90208* in the status reply is the part number of a standard AFM (aluminum housing and glass-reinforced epoxy connectors); the 90491 AFM (aluminum housing and wet-pluggable connectors) uses the same firmware, and has the same status reply.
- The AFM has a 2-minute timeout algorithm designed to conserve battery energy if too much time elapses between commands. If the system does not appear to respond, click Connect AFM on the Toolbar to reestablish communications.
- The AFM's response to low voltage varies, depending on battery type. For **Ni-Cads**, the AFM turns off power when voltage drops below 7.3 volts or is less than 10 volts and voltage drop is greater than 1 volt/minute. This reduces battery load to quiescent current once the first cell in the battery pack is exhausted. For **alkalines**, the AFM turns off power when voltage drops below 7.3 volts.

8. Display AFM status information by clicking Status on the Toolbar. The display looks like this:

```
SBE 90208 Auto Fire Module V1.2 30 Aug 2005 08:49:08
Vmain = 13.3, vlith = 6.6
Auto Fire Module is NOT ARMED
```

Looking at the status display, verify the following:
- Battery voltage is sufficient (Vmain > 10.2 volts) - If not, replace/recharge the batteries before proceeding (see *Replacing/Recharging Batteries* in *Section 5: Routine Maintenance*).
- Date and time are correct - If not, type **ST** and press the Enter key. The AFM responds by requesting the new date and time.
- AFM is not armed - If it is armed, type **DA** (disarm) and press the Enter key before proceeding. The AFM must be disarmed before it accepts the bottle closure information you input in the Configuration Options dialog box.

9. Click Program on the Toolbar to send all the bottle closure information from the Configuration Options dialog box to the AFM. SeatermAF sends a number of commands to the AFM, transmitting the bottle closure parameters in the format required by the AFM.

10. Click Connect CTD on the Toolbar. The display looks like this:

```
Connected successfully . . .
S>
```

This shows that correct communications between the computer and CTD (through the AFM) have been established.
If the system does not respond as shown above:
- Click Connect CTD again.
- Verify the correct CTD was selected in the Configure menu and the CTD communication settings were entered correctly on the CTD Communications tab in the Configuration Options dialog box.
- Check cabling between the computer, AFM, and CTD.
- Check the SBE 19, 19*plus*, or 25 CTD battery voltage.

Notes:
- **AFM with SBE 25:** If you want to close bottles on upcast, verify that the SBE 25 configuration entered with **CC** is *Stop CTD on upcast (y/n)? = NO*.
- **AFM with SBE 19*plus*:** SeatermAF automatically sets **OutputFormat=4** in the SBE 19*plus* when you program the AFM (click Program on Toolbar or select Program Auto Fire in Utilities menu). This is the data format required for real-time communication of pressure data to the AFM.
- **AFM with SBE 50:** SeatermAF automatically sets **AutoRun=Y**, **NAvg=16**, and **OutputFormat=7** in the SBE 50 when you arm the AFM (click Arm on Toolbar or select Arm Auto Fire in Utilities menu). These parameters are required for real-time communication of pressure data to the AFM. It then sends **Start** to the SBE 50, to start sampling.

11. Display CTD status information by clicking Status on the Toolbar. The display looks like this for an SBE 19*plus*:

```
SeacatPlus V 1.5  SERIAL NO. 4000    30 Aug 2005  14:02:13
vbatt = 9.6, vlith = 8.6, ioper = 61.2 ma, ipump = 25.5 ma,
iext01 = 76.2 ma
status = not logging
number of scans to average = 1
samples = 5000, free = 376300, casts = 1
mode = profile, minimum cond freq = 3000, pump delay = 60 sec
autorun = no, ignore magnetic switch = no
battery type = ALKALINE, battery cutoff = 7.3 volts
pressure sensor = strain gauge, range = 1000.0
SBE 38=no, Gas Tension Device = no
Ext Volt 0=yes, Ext Volt 1=no, Ext Volt 2=no, Ext Volt 3=no
echo commands = yes
output format = converted decimal
output salinity = no, output sound velocity = no
```

12. Review the information in the status display. As desired, send commands to the CTD to change the instrument setup (see CTD manual).

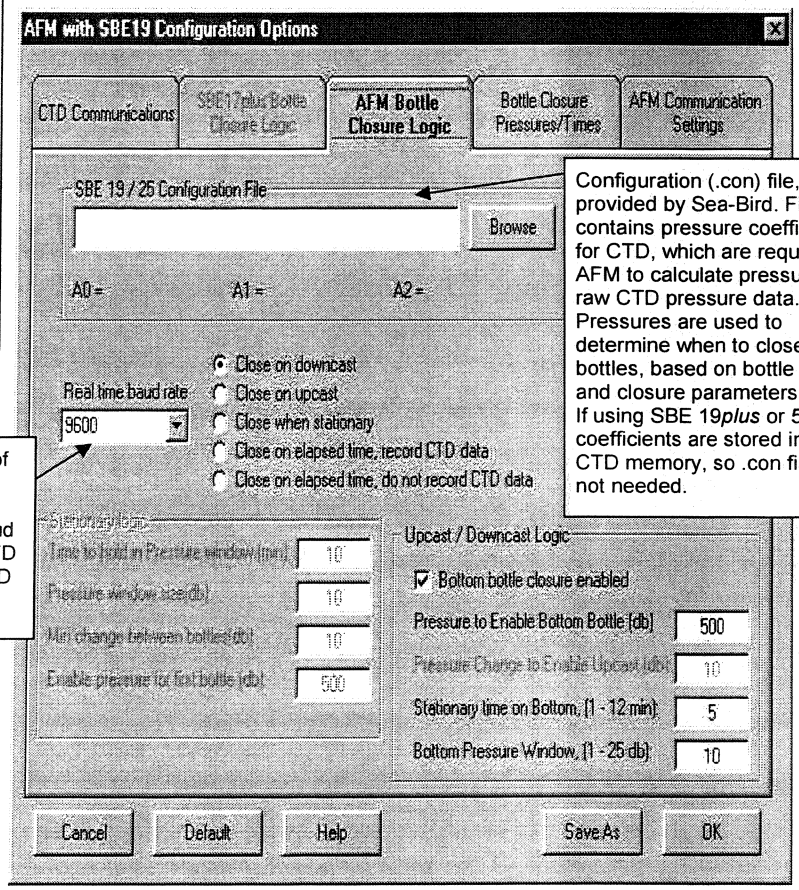
Bottle Closure Setup Parameters

Notes:
- After entering and saving information in the Configuration Options dialog box, you must *program* the AFM to send the bottle closure information to the AFM. With the AFM *connected*, click Program on the Toolbar; SeatermAF sends a number of commands to the AFM, transmitting the required information.
- When we ship a new instrument, we include a .con file that reflects the current instrument configuration *as we know it*. The .con file is named with the instrument serial number, followed with the .con extension. For example, for an instrument with serial number 2375, we name the .con file *2375.con*. You may rename the .con file if desired; this will not affect the results.

The AFM closes bottles on downcast, on upcast, when stationary, or based on elapsed time. Descriptions of each closure type follow.

Close on Downcast

If you select *Close on downcast* on the AFM Bottle Closure Logic tab, the AFM closes bottles on downcast only. Upcast/Downcast Logic parameters on the AFM Bottle Closure Logic tab define the conditions of pressure and time that indicate that the bottom has been reached and upcast has begun, allowing closure of a *bottom* bottle if desired.



Configuration (.con) file, provided by Sea-Bird. File contains pressure coefficients for CTD, which are required for AFM to calculate pressure from raw CTD pressure data. Pressures are used to determine when to close bottles, based on bottle position and closure parameters. If using SBE 19*plus* or 50, coefficients are stored in CTD memory, so .con file not needed.

Baud rate for communication of pressure data **from CTD to AFM**. ***For most CTDs***, must match user-programmable baud rate set in CTD (and set on CTD Communications tab). See CTD manual for baud command.

Bottom Bottle Closure not Enabled
The Upcast/Downcast Logic parameters are not applicable.

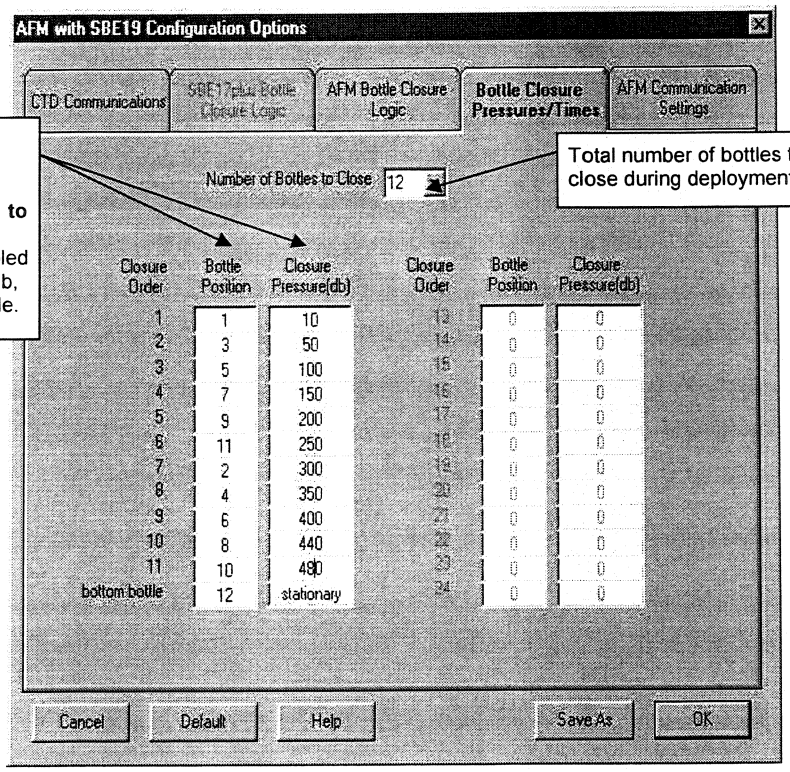
Bottom Bottle Closure Enabled
The bottom bottle closes when the AFM determines that the bottom of the cast has been reached. This occurs when the pressure is at least *Pressure to Enable Bottom Bottle*, **and** the pressure remains within *Bottom Pressure Window* for *Stationary Time on Bottom*.

Surface

Bottom Pressure Window - bottom bottle closes if pressure remains within this window for *Stationary Time on Bottom* after *Pressure to Enable Bottom Bottle* is reached. Set *Bottom Pressure Window* greater than peak-to-peak ship heave.

Pressure to Enable Bottom Bottle - set close to expected maximum cast depth

The Bottle Closure Pressures/Times tab defines the number of bottles to close, closure order, and closure pressures.



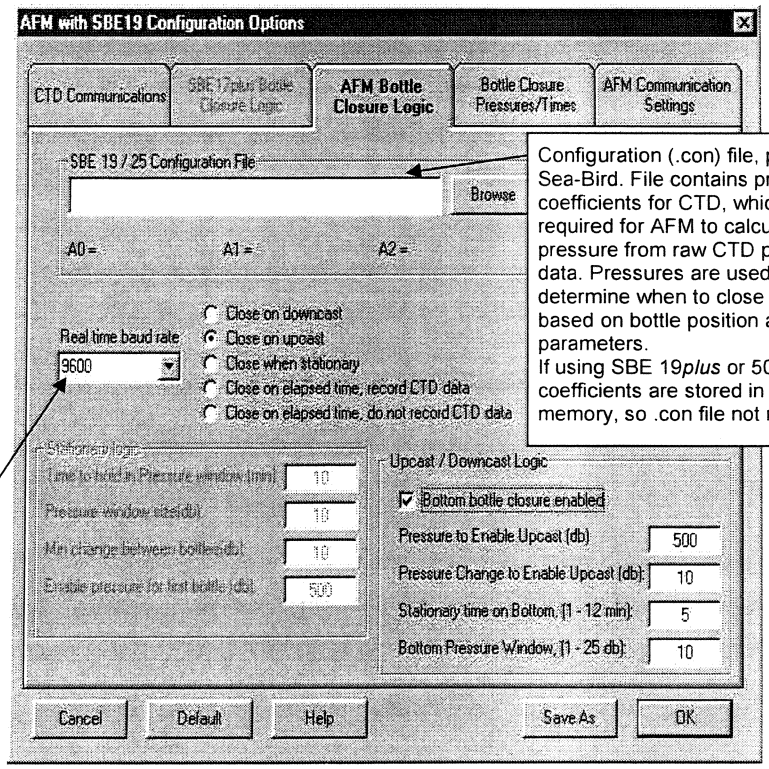
Bottles may be closed in any order desired. **For closure on downcast, closure pressure must increase from closure 1 to last closure**. For this example, bottom bottle closure was enabled on AFM Bottle Closure Logic tab, so closure 12 is for bottom bottle.

Total number of bottles to close during deployment.

Note:
AFM with SBE 25: If you want to close bottles on upcast, verify that the SBE 25 configuration entered with **CC** is *Stop CTD on upcast (y/n)? = NO*.

Close on Upcast

If you select *Close on upcast* on the AFM Bottle Closure Logic tab, the AFM closes bottles on upcast only; it does not begin to close bottles until it determines that upcast has begun. Upcast/Downcast Logic parameters on the AFM Bottle Closure Logic tab define the conditions of pressure and time that indicate that the bottom has been reached and upcast has begun.

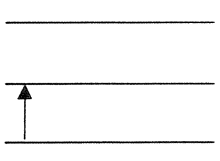


Configuration (.con) file, provided by Sea-Bird. File contains pressure coefficients for CTD, which are required for AFM to calculate pressure from raw CTD pressure data. Pressures are used to determine when to close bottles, based on bottle position and closure parameters.
If using SBE 19*plus* or 50, coefficients are stored in CTD memory, so .con file not needed.

Baud rate for communication of pressure data **from CTD to AFM**. ***For most CTDs***, must match user-programmable baud rate set in CTD (and set on CTD Communications tab). See CTD manual for baud command.

Bottom Bottle Closure not Enabled

Upcast is enabled (has begun) when the pressure is greater than *Pressure to Enable Upcast*. If the CTD never meets this criterion, upcast is enabled when the pressure decreases more than *Pressure Change to Enable Upcast*. This ensures that water samples are taken, even if the CTD did not go as deep as anticipated. The AFM does not close a *bottom* bottle when upcast is enabled.



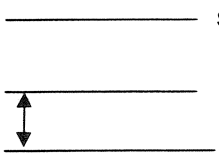
Pressure Change to Enable Upcast - upcast is enabled if pressure decrease exceeds this value. Set greater than peak-to-peak ship heave, to avoid closing bottles before upcast actually begins.

Pressure to Enable Upcast - set close to expected maximum cast depth

Bottom Bottle Closure Enabled

Upcast is enabled **and** the bottom bottle closes when the AFM determines that the bottom of the cast has been reached.

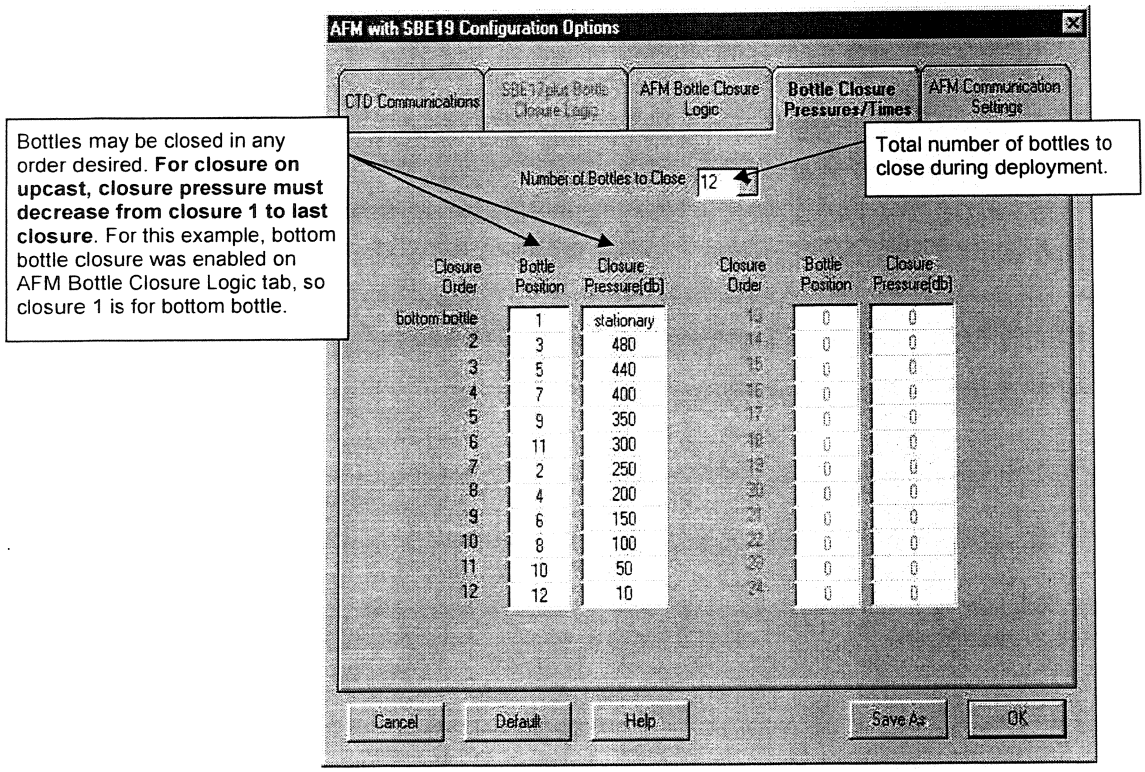
- The AFM enables upcast when the pressure is at least *Pressure to Enable Upcast*, **and** the pressure remains within *Bottom Pressure Window* for *Stationary Time on Bottom*.
- If the instrument never meets the above criteria, the AFM enables upcast when the pressure decreases by *Pressure Change to Enable Upcast*.



Bottom Pressure Window - bottom bottle closes if pressure remains within this window for *Stationary Time on Bottom* after *Pressure to Enable Upcast* is reached. Set *Bottom Pressure Window* greater than peak-to-peak ship heave.

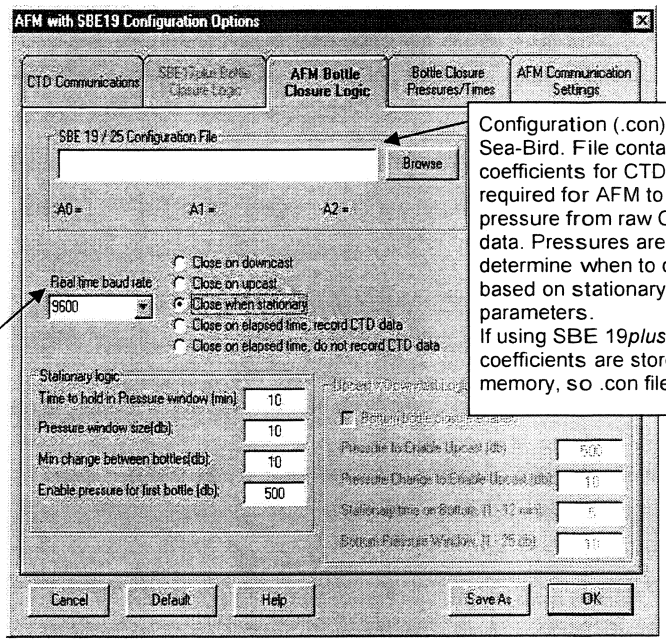
Pressure to Enable Upcast- set close to expected maximum cast depth

The Bottle Closure Pressures/Times tab defines the number of bottles to close, closure order, and closure pressures.



Close when Stationary

If you select *Close when stationary* on the AFM Bottle Closure Logic tab, Stationary Logic parameters on the AFM Bottle Closure Logic tab define when the CTD is considered stationary, signaling the AFM to close a bottle. The AFM closes bottles **on upcast** when using stationary logic.



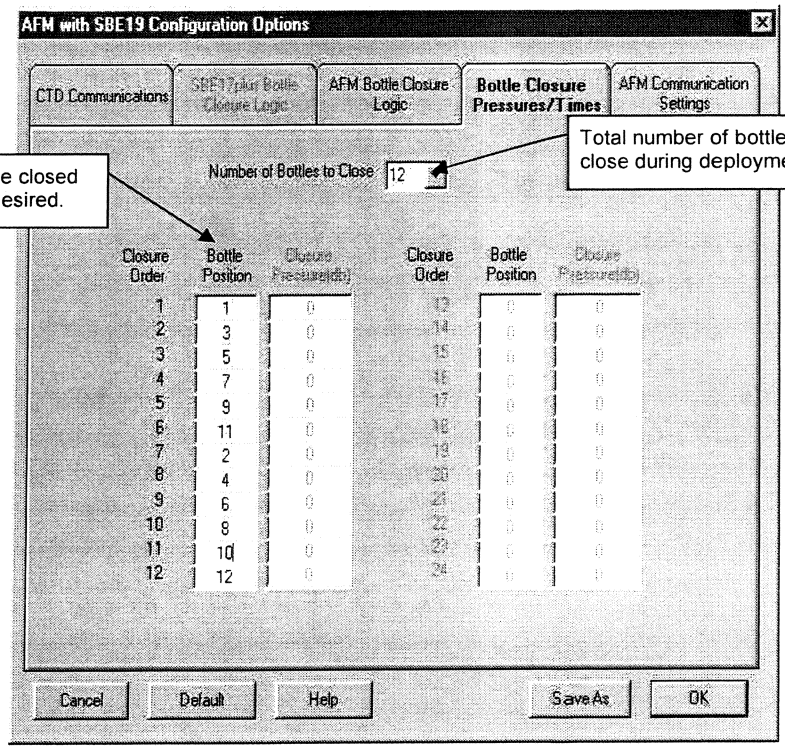
Configuration (.con) file, provided by Sea-Bird. File contains pressure coefficients for CTD, which are required for AFM to calculate pressure from raw CTD pressure data. Pressures are used to determine when to close bottles, based on stationary logic parameters.
If using SBE 19*plus* or 50, coefficients are stored in CTD memory, so .con file not needed.

Baud rate for communication of pressure data **from CTD to AFM**. ***For most CTDs***, must match user-programmable baud rate set in CTD (and set on CTD Communications tab). See CTD manual for baud command.

- Once the CTD reaches *Enable pressure for first bottle*, a bottle is closed each time the pressure remains within *Pressure window size* for *Time to hold in Pressure window*.
- *Min change between bottles* is the minimum pressure change between two consecutive bottles to enable the next bottle closing. This prevents the AFM from closing multiple bottles at approximately the same pressure.

Note:
If *Min change between bottles* is 0 (i.e., you **want** to close all bottles at the same pressure), there is a delay of approximately 15 seconds between each bottle closing to ensure the Carousel capacitor has enough time to recharge between bottle closings.

The Bottle Closure Pressures/Times tab defines the number of bottles to close and the bottle closure sequence.

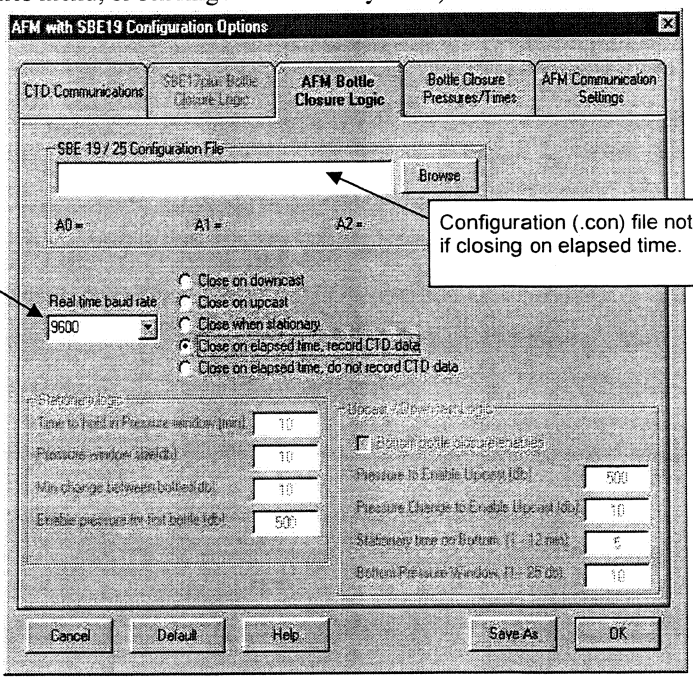


Total number of bottles to close during deployment.

Bottles may be closed in any order desired.

Close on Elapsed Time - Record or Do Not Record CTD Data

If you select *Close on elapsed time* on the AFM Bottle Closure Logic tab, the AFM closes bottles based on the elapsed time from when the AFM is armed (AFM is armed by pressing ARM on Toolbar, selecting ARM Auto Fire in Utilities menu, or sending **Arm** from keyboard).



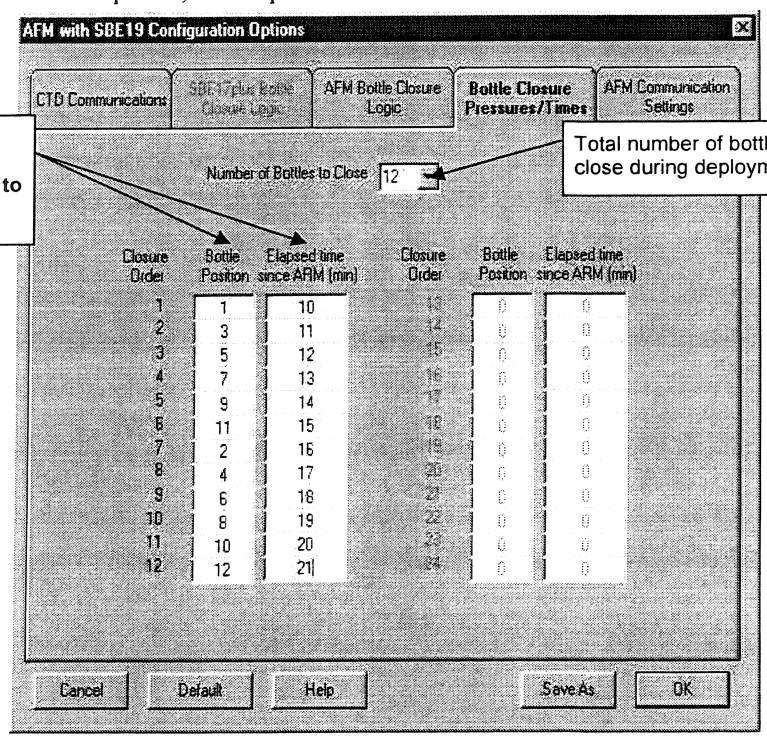
Baud rate for communication of pressure data **from CTD to AFM** if AFM recording 5 scans of CTD data each time a bottle is closed. ***For most CTDs***, must match user-programmable baud rate set in CTD (and set on CTD Communications tab). See CTD manual for baud command.

Configuration (.con) file not needed if closing on elapsed time.

Note:
If you selected *AFM with no CTD* in the Configure menu, the AFM Bottle Closure Logic tab is grayed out, because bottle closure logic is automatically set to *Close on elapsed time, do not record CTD data*.

- Close on elapsed time, **record CTD data** - The AFM records 5 scans of CTD data each time a bottle is closed, to provide a CTD record for each water sample.
- Close on elapsed time, **do not record CTD data** - The AFM does not record any CTD data. This option is most often used for an AFM and water sampler system operating without a CTD.

The Bottle Closure Pressures/Times tab defines the number of bottles to close, closure sequence, and elapsed time for each bottle.



Bottles may be closed in any order desired. **Elapsed time must increase from closure 1 to last closure.**

Total number of bottles to close during deployment.

Deploying System

Notes:

- **Upload existing data from the AFM before redeploying**. On redeployment, the AFM overwrites any data in its memory.
- The AFM automatically disarms itself after 24 hours.
- **AFM with SBE 19*plus*:** SeatermAF automatically sets **OutputFormat=4** in the SBE 19*plus* when you program the AFM (click Program on Toolbar or select Program Auto Fire in Utilities menu). This is the data format required for real-time communication of pressure data to the AFM.
- **AFM with SBE 50:** SeatermAF automatically sets **AutoRun=Y**, **NAvg=16**, and **OutputFormat=7** in the SBE 50 when you arm the AFM (click Arm on Toolbar or select Arm Auto Fire in Utilities menu). These parameters are required for real-time communication of pressure data to the AFM. It then sends **Start** to the SBE 50, to start sampling.

1. Double click on SeatermAF.exe. The main screen appears.

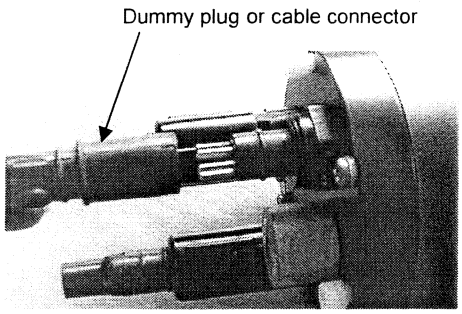
2. Ready the **AFM** for deployment by programming and arming it:
   A. In the File menu, select Open Instrument Configuration. In the dialog box, select the previously saved settings (.ini) file.
   B. Click Connect AFM to establish communications with the **AFM.**
   C. Click Program, sending the input closure parameters to the **AFM**.
   D. Click ARM, enabling the **AFM** to close bottles.

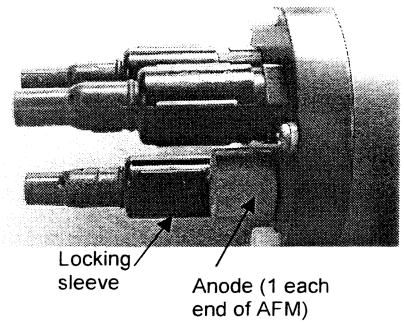
3. Ready the **CTD** for deployment:
   A. Click Connect CTD to establish communications with the **CTD**.

4. Deployment **starting the CTD with its magnetic switch** (SBE 19, 19*plus*, or 25):
   A. Verify the CTD's magnetic switch is in the Off position.
   B. Send **QS** to put the CTD in quiescent (sleep) state.
   C. Exit SeatermAF.
   D. Disconnect the I/O cable from the **AFM**. Place the dummy plug and locking sleeve on the AFM's bulkhead connector (see Step 6).
   E. Turn on the CTD's magnetic switch to start logging. Data will be recorded after existing data in the CTD.

5. Deployment **starting the CTD with a computer command**:
   A. Start sampling/logging -
      - SBE 19 and 25: Turn on the CTD's magnetic switch, and then send **GL** (overwrite existing data in CTD) or **RL** (do not overwrite existing data in CTD).
      - SBE 19*plus*: Send **StartNow** (do not overwrite existing data in CTD).
      - SBE 50: Do not send any commands. SeatermAF automatically sent a command to the SBE 50 to start sampling when you armed the AFM.
   B. Click Connect AFM to establish communications with the **AFM**.
   C. Verify that pressure numbers from each CTD scan are displaying on the screen (see the CTD manual for data format details).
      - SBE 19 and 25: displayed pressures are raw values. For SBE 19, the first pressure number is not displayed until reference scans are received.
      - SBE 19*plus*: AFM automatically set SBE 19*plus* to **OutputFormat=4**; displayed pressures are decibars.
      - SBE 50: AFM automatically set SBE 50 to **OutputFormat**=7; displayed pressures are decibars.
   D. Exit SeatermAF.
   E. Disconnect the I/O cable from the AFM. Place the dummy plug and locking sleeve on the AFM's bulkhead connector (see Step 6).

CAUTION:
Do not use WD-40 or other petroleum-based lubricants, as they will damage the connectors.





6. Verify that a cable connector or dummy plug is installed for every connector on the AFM, CTD, and Carousel:
   A. Lightly lubricate the inside of the cable connector or dummy plug with silicone grease (DC-4 or equivalent).
   B. **Standard Connector** - Install the cable connector/plug, aligning the raised bump on the side of the connector/plug with the large pin (pin 1 - ground) on the instrument. Remove any trapped air by burping or gently squeezing the connector/plug near the top and moving your fingers toward the end cap. **OR**
   MCBH Connector – Install the cable connector/plug, aligning the pins.
   C. Place the locking sleeve over the connector/plug. Tighten the locking sleeve finger tight only. Do not overtighten the locking sleeve and do not use a wrench or pliers.
7. Verify that the anodes have not eroded away.
8. Verify that the hardware and external fittings are secure.
9. Deploy the system.

Recovery

WARNING!
If the AFM, CTD, or Carousel stop working while underwater, are unresponsive to commands, or show other signs of flooding or damage, carefully secure the instruments away from people until you have determined that abnormal internal pressure does not exist or has been relieved. Pressure housings may flood under pressure due to dirty or damaged o-rings, or other failed seals. When a sealed pressure housing floods at great depths and is subsequently raised to the surface, water may be trapped at the pressure at which it entered the housing, presenting a danger if the housing is opened before relieving the internal pressure. Instances of such flooding are rare. However, a housing that floods at 5000 meters depth holds an internal pressure of more than 7000 psia, and has the potential to eject the end cap with lethal force. A housing that floods at 50 meters holds an internal pressure of more then 85 psia; this force could still cause injury.
If you suspect the AFM is flooded, point the AFM in a safe direction away from people, and loosen the 4 screws on the connector end cap about ½ turn. If there is internal pressure, the end cap will *follow* the screws out, and the screws will not become easier to turn. In this event, loosen 1 bulkhead connector very slowly, at least 1 turn. This opens an o-ring seal under the connector. Look for signs of internal pressure (hissing or water leak). If internal pressure is detected, let it bleed off slowly past the connector o-ring. Then, you can safely remove the end cap.

Physical Handling

Rinse the CTD and auxiliary sensors, AFM, and Carousel Water Sampler with fresh water, and dry thoroughly.

Uploading Data

Note:
You must upload data from the AFM before redeploying. On redeployment, the AFM overwrites any data in its memory.

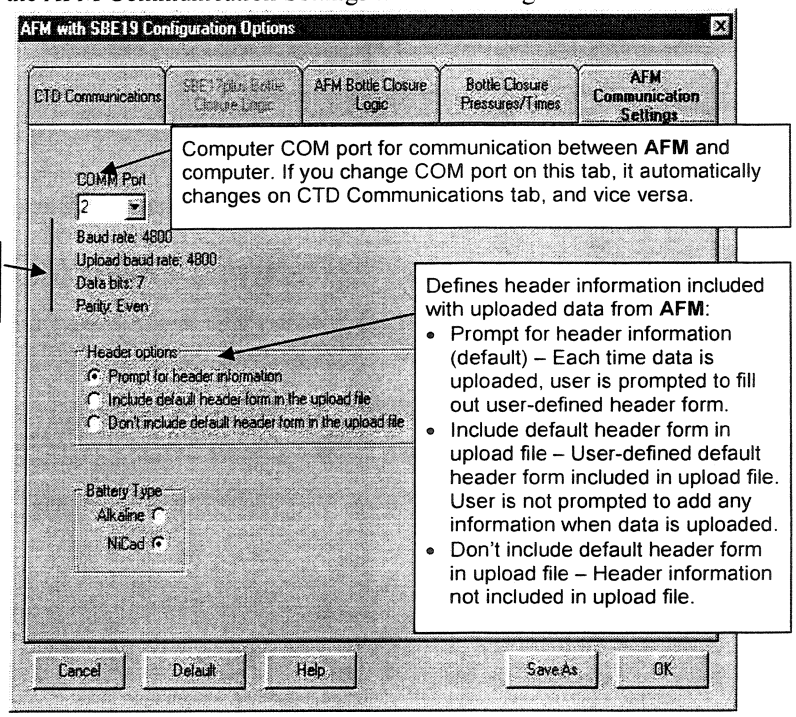
1. If you have not already done so, stop CTD logging/sampling:
   - SBE 19 or 25: Move the magnetic switch to the Off position.
   - SBE *19plus*:
     Move the magnetic switch to the Off position. **OR**
     If set up to start and stop logging on command and ignore the magnetic switch position - connect the AFM to the computer, establish communications with the SBE 19*plus* through the AFM, and send **Stop** to stop logging.
   - SBE 50: Connect the AFM to the computer, establish communications with the SBE 50 through the AFM, and send **Stop** to stop sampling.

2. If you have not already done so, connect the AFM to computer:
   A. By hand, unscrew the locking sleeve from the AFM's I/O connector. **If you must use a wrench or pliers, be careful not to loosen the bulkhead connector instead of the locking sleeve.**
   B. Remove the dummy plug from the AFM's I/O connector by pulling the plug firmly away from the connector.
   C. **Standard Connector** - Install the I/O cable connector, aligning the raised bump on the side of the connector with the large pin (pin 1 - ground) on the AFM. **OR**
   MCBH Connector – Install the I/O cable connector, aligning the pins.
   D. Connect the I/O cable connector to your computer's serial port.

3. In SeatermAF's File menu, select Open Instrument Configuration. In the dialog box, select the settings (.ini) file you previously saved.

Note:
Set up **Header options** and **Upload data options** for the AFM and CTD (Steps 4 and 5):
- The first time you upload data, and
- If you want to change header or upload parameters.

4. In the Configure menu, select the AFM with the applicable CTD. Click on the AFM Communication Settings tab. The dialog box looks like this:

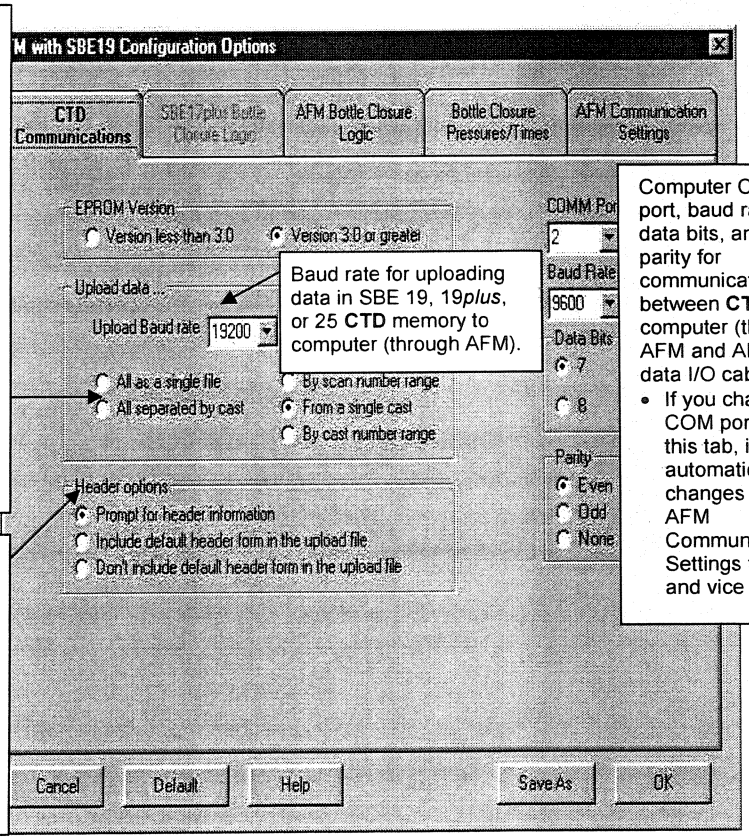


Make the selection for Header options. Skip to Step 6 if you are using the AFM with no CTD or with an SBE 50.

5. Click on the CTD Communications tab. The dialog box looks like this:

Data upload type from SBE 19, 19*plus*, or 25 **CTD** memory (through AFM) when using Upload on Toolbar or Upload Data in Data menu:
- All as single file – All data uploaded into 1 file.
- All separated by cast - All data uploaded. Separate file written for each cast, with 3-digit cast ID (001, etc.) appended to user-selected file name
- By scan number range – SeatermAF prompts for beginning and ending scan (sample) numbers, and uploads all data within range into 1 file.
- From a single cast - SeatermAF prompts for cast number, and uploads all data from that cast into 1 file.
- By cast number range - SeatermAF prompts for beginning and ending cast numbers, and uploads data within that range. Separate file written for each cast, with 3-digit cast ID (001, etc.) appended to user-selected file name.

Defines header information included with uploaded data from SBE 19, 19*plus*, or 25 **CTD**:
- Prompt for header information (default) – Each time data is uploaded, user is prompted to fill out user-defined header form.
- Include default header form in upload file – User-defined default header form included in upload file. User is not prompted to add any information when data is uploaded.
- Don't include default header form in upload file – Header information not included in upload file.



Baud rate for uploading data in SBE 19, 19*plus*, or 25 **CTD** memory to computer (through AFM).

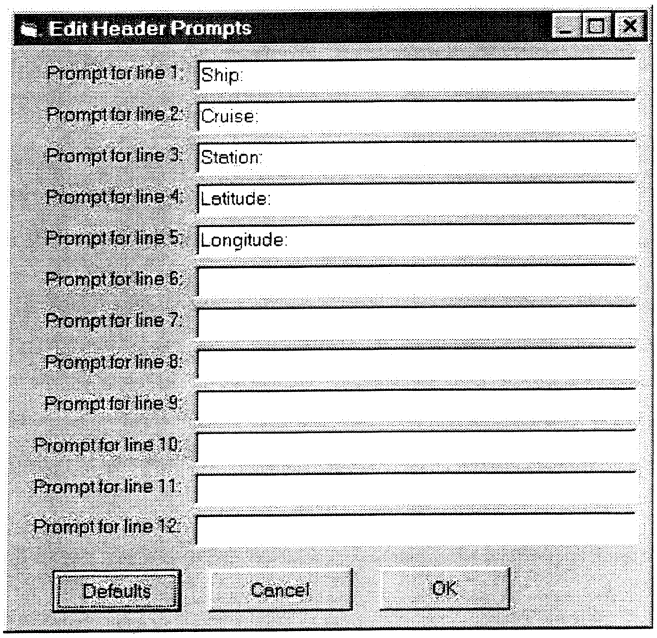
Computer COM port, baud rate, data bits, and parity for communication between **CTD** and computer (through AFM and AFM data I/O cable).
- If you change COM port on this tab, it automatically changes on AFM Communication Settings tab, and vice versa.

Make the selection for Upload data and Header options.

6. Click OK to overwrite an existing settings (.ini) file, or click Save As to save the settings as a new filename.

Upload Data from AFM

7. In the Configure menu, select Header Form to customize the header for the AFM. The dialog box looks like this (default prompts are shown):



The entries are free form, 0 to 12 lines long. This dialog box establishes:
- header prompts that appear for the user to fill in when uploading data, if *Prompt for header information* was selected on the AFM Communication Settings tab in the Configuration Options dialog box (Step 4)
- header included with the uploaded data, if *Include default header form in upload file* was selected on the AFM Communication Settings tab in the Configuration Options dialog box (Step 4)

Enter the desired header/header prompts. Click OK.

8. Click Connect AFM on the Toolbar to begin communications with the AFM. The display looks like this:

```
Power up
A>
```

This shows that correct communications between the computer and AFM have been established.
If the system does not respond as shown above:
- Click Connect AFM again.
- Verify the COM port is correct on the AFM Communication Settings tab in the Configuration Options dialog box.
- Check cabling between the computer and AFM.
- Check the AFM battery voltage - see *Replacing/Recharging Batteries* in *Section 5: Routine Maintenance*.

9. Disarm the AFM by sending **DA** (the AFM responds with `#A>` if it is already disarmed).

Note:
90208 in the status reply is the part number of a standard AFM (aluminum housing and glass-reinforced epoxy connectors); the 90491 AFM (aluminum housing and wet-pluggable connectors) uses the same firmware, and has the same status reply.

10. Display AFM status information by clicking Status on the Toolbar. The display looks like this:

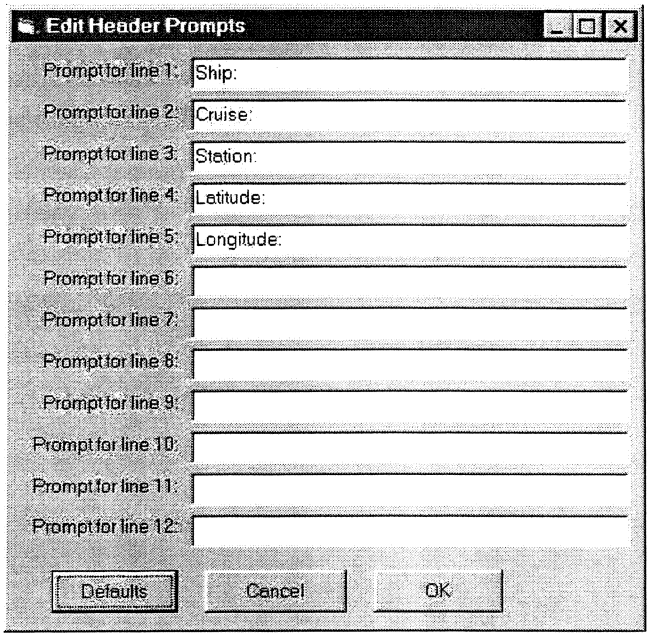
```
SBE 90208 Auto Fire Module V1.2 30 Aug 2005 08:49:08
Vmain = 13.3, vlith = 6.6
Auto Fire Module is NOT ARMED
```

11. Click Upload on the Toolbar to upload data from the AFM. SeatermAF responds as follows:
    A. SeatermAF sends **DS**, displays the status response, and writes the command and response to the upload file.
    B. **If you selected *Prompt for header information* on the AFM Communication Settings tab in the Configuration Options dialog box (Step 4)** – a dialog box with the header form appears. Enter the desired header information, and click OK.
    C. In the Open dialog box, enter the desired upload file name and click OK. SeatermAF automatically adds the .afm file extension.
    D. SeatermAF sends **UE** to enable the timeout override. This prevents the AFM from automatically entering the quiescent (sleep) state after 2 minutes, so the AFM will not go to sleep during the data upload.
    E. SeatermAF sends the data upload command (**DD**), and writes the response to the upload file.
    F. SeatermAF sends **UD** to disable the timeout override. The AFM will enter quiescent (sleep) state after 2 minutes elapse without transmission of a command or reply.

Notes:
- If `Warning: Low Battery Voltage` displays while uploading data, replace or recharge the batteries before proceeding (see *Replacing/Recharging Batteries* in *Section 5: Routine Maintenance*).
- Uploaded data files from the AFM and CTD must have the same name (different extensions) and be in the same directory for processing by SBE Data Processing.

Upload Data from CTD (not applicable to SBE 50)

12. In the Configure menu, select Header Form to customize the header for the CTD. The dialog box looks like this (default prompts are shown):



The entries are free form, 0 to 12 lines long. This dialog box establishes:

- header prompts that appear for the user to fill in when uploading data, if *Prompt for header information* was selected on the CTD Communications tab in the Configuration Options dialog box (Step 5)
- header included with the uploaded data, if *Include default header form in upload file* was selected on the CTD Communications tab in the Configuration Options dialog box (Step 5)

Enter the desired header/header prompts. Click OK.

13. Click Connect CTD on the Toolbar to begin communications with the CTD. The display looks like this:

```
Connected successfully . . .
S>
```

This shows that correct communications between the computer and CTD has been established.

If the system does not respond as shown above:

- Click Connect CTD again.
- Verify the correct **CTD** was selected in the Configure menu and the CTD communication settings were entered correctly in the Configuration Options dialog box.
- Check cabling between the computer, AFM, and CTD.

Notes:
- If `Warning: Low Battery Voltage` displays while uploading data, replace or recharge the batteries before proceeding. See *Section 5: Routine Maintenance* for replacement / recharging of AFM batteries; see CTD manual for replacement / recharging of CTD batteries.
- Uploaded data files from the AFM and CTD must have the same name (different extensions) and be in the same directory for processing by SBE Data Processing.

14. Click Upload on the Toolbar to upload data from the CTD. SeatermAF responds as follows:
    A. SeatermAF sends the status (**DS**) and header (**DH**) commands, displays the responses, and writes the commands and responses to the upload file. These commands provide information regarding the instrument setup, number of samples in memory, cast number, etc.
    B. **If you selected *By scan number range*, *From a single cast*, or *By cast number range* on the CTD Communications tab in the Configuration Options dialog box** (Step 5) – a dialog box requests the range/cast number. Enter the desired value(s), and click OK.
    C. SBE 19*plus* only: SeatermAF sends **OutputFormat=0** to the 19*plus*. This sets the 19*plus* format to raw hexadecimal data, which is required for data that will be processed with SBE Data Processing.
    D. **If you selected *Prompt for header information* on the CTD Communications tab in the Configuration Options dialog box (Step 5)** – a dialog box with the header form appears. Enter the desired header information, and click OK.
    E. In the Open dialog box, enter the desired upload file name and click OK. SeatermAF automatically adds the .hex file extension.
    F. SeatermAF sends **UE** to the AFM to enable the timeout override. This prevents the AFM from automatically entering the quiescent (sleep) state after 2 minutes, so the AFM will not go to sleep during the data upload from the CTD.
    G. SeatermAF sends the data upload command (**DDb,e**) to the CTD through the AFM, and writes the response to the upload file.
    H. SeatermAF sends **UD** to the AFM to disable the timeout override. The AFM will enter quiescent (sleep) state after 2 minutes elapse without transmission of a command or reply.
    I. SBE 19*plus* only: SeatermAF sends **OutputFormat=4** to the 19*plus*. This sets the 19*plus* format back to pressure in decibars, so it is ready to provide real-time pressure data to the AFM for the next deployment.

Notes:
After sending **UD**, the AFM will enter quiescent (sleep) state after 2 minutes without a command have elapsed. Leave the AFM with the batteries in place to retain the date and time. The quiescent current is only 60 microamps, so the batteries can be left in place without significant loss of capacity.

Review Data from AFM and CTD

15. Ensure all data has been uploaded from the **AFM** and **CTD** by reviewing the data. Use **SBE Data Processing** to process the files; see *Section 4: Processing Uploaded Data.*

AFM Command Descriptions

Notes:
- When connected to the **AFM**, SeatermAF displays an A> prompt. When connected to the **CTD through the AFM**, SeatermAF displays an S> prompt.
- For CTD command descriptions, see the applicable CTD manual.

When entering commands for the **AFM**:

- **Verify that the computer is talking to the AFM, not the CTD** (check the left side of the status bar at the bottom of SeatermAF's window). If it is not, click Connect AFM on the Toolbar.
- Input commands to the AFM in upper or lower case letters and register commands by pressing the Enter key.
- The AFM sends # if an invalid command is entered.
- If the system does not return an A> prompt after executing a command, press the Enter key to get the A> prompt.
- If a new command is not received within 2 minutes after completion of a command, the Command/Data Echo Area indicates **time out** and the AFM returns to quiescent (sleep) state to prevent battery exhaustion. **Exception**: If you send **UE**, the AFM will not time out, allowing you to upload data or to set up an SBE 50 connected to the AFM (SBE 50 requires power from the AFM; when the AFM times out, power to the SBE 50 is removed, preventing further setup). Send **UD** to restore the automatic timeout, to avoid draining the batteries.
- If in quiescent state, re-establish communications by clicking Connect AFM on the Toolbar to get an A> prompt.

Note:
90208 in the status reply is the part number of a standard AFM (aluminum housing and glass-reinforced epoxy connectors); the 90491 AFM (aluminum housing and wet-pluggable connectors) uses the same firmware, and has the same status reply.

Status Commands

DS

Display operating status and setup parameters. List below includes, where applicable, command used to modify parameter:
- firmware version, date and time [**ST**]
- main and back-up lithium battery voltage
- AFM armed status [**Arm** or **DA**]

Equivalent to Status on Toolbar.

Example: (user input in bold)

```
A>DS
SBE 90208 Auto Fire Module V1.2 30 Aug 2005 08:49:08          [ST]
Vmain = 13.3, vlith = 6.6
Auto Fire Module is NOT ARMED                                 [DA]

or

A>DS
ARMED                                                         [Arm]
```

Status Commands *(continued)*

DC

Display bottle closure parameters.

- number of bottles to fire
- bottle closure sequence
- bottle closure pressure
- bottle closure elapsed time
- closure mode - downcast (0), upcast (1), elapsed time with no CTD data (2), stationary (3), elapsed time with CTD data (4)
- bottom bottle enabled
- stationary time on bottom
- bottom pressure window
- stationary logic - minimum time to hold in pressure window to enable bottle closure
- stationary logic - enable pressure for first bottle
- stationary logic - pressure window size
- stationary logic - minimum change in pressure between bottles to enable next bottle closing
- pressure to enable upcast
- pressure change to enable upcast
- battery type
- CTD type
- CTD pressure sensor type
- CTD baud rate

Equivalent to Closure Parameters AFM on Toolbar.

Example: (user input in bold).

```
A>DC
Number of bottles to fire = 12
Ba(1) = 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1, 0
Pa() = 3600, 3350, 3100, 2850, 2600, 2350, 2100, 1850, 1600, 1350, 1100, 850
Ta() = 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60
Fmode = 1
Get bottom = 1
Bottom time = 1
Bottom window = 500
Stationary time = 2
Stationary minimum pressure = 0
Stop window = 500
Go window = 500
Upcast min press = 0
Upcast min change = 100
Battery type = 0
Ctdtype = 0
Pressure sensor type = 0
CTD baud rate = 600
```

Note:
If the AFM battery has been removed, date and time must be reset.

Date and Time Command

ST Set real-time clock time and date.

Example: Set date and time to 10 August 2004 12:15:33 (user input in bold).

```
A>ST
Date (MMDDYY) = 081004    (press Enter key after typing date)
Time (HHMMSS) = 121533    (press Enter key after typing time)
```

Auto Fire: *Arm/Disarm* Commands

Arm before deploying to enable the Carousel to take water samples. Disarm to disable the Carousel from taking water samples; the CTD (SBE 19, 19*plus*, or 25) can still log data.

Arm Arm (enable) auto fire to close bottles. AFM automatically disarms after 24 hours. Equivalent to ARM on Toolbar.

DA Disarm (disable) auto fire to close bottles.

Notes:
- **Use Upload on the Toolbar or Upload Data in the Data menu to upload data that will be processed by SBE Data Processing.** Manually entering the data upload command does not produce data with the required header information for processing by our software. These commands are included here for reference for users who are writing their own software.
- To save data to a file, click Capture on the Toolbar before entering **DD**.
- See *AFM Data Output Formats* in *Section 4: Processing Uploaded Data*.

Data Upload Command

Stop CTD logging/sampling before uploading data.

DD Upload raw data from **AFM**. For each bottle fired:
- Bottle sequence and number, date and time, firing confirmation, battery voltage, scan number of first of 5 CTD scans, and 5 scans of CTD data, or
- (if used without a CTD) Bottle sequence and number, date and time, firing confirmation, and battery voltage.

Timeout Override Command

Ux

x=E: Enable AFM timeout override. Do not timeout/enter quiescent (sleep) state automatically. Use **UE**:

- Before uploading data from CTD or AFM, to prevent system from going to sleep during data upload.
- Before setting up SBE 50 connected to AFM, to prevent AFM from going to sleep and shutting off power to SBE 50 while you are trying to send setup commands to SBE 50.

x=D: Disable AFM timeout override. AFM enters quiescent (sleep) state if 2 minutes elapse without transmission of a command or reply. Use **UD** to restore automatic timeout, to avoid running down AFM batteries.

Note:
If you use Upload on the Toolbar or Upload Data in the Data menu to upload data from the **AFM** or **CTD**, SeatermAF automatically sends **UE** before the data upload command (**DD**), and then sends **UD** after data upload is complete.

Example: Upload data from AFM (user input in bold).
(Click Capture on Toolbar and enter desired filename in dialog box.)

```
A>UE
A>DD
A>UD
```

Commands Not Typically Sent by User

The user does not typically send the remaining commands, which are included here for reference only. These involve:

- Turning on power to an SBE 50 Pressure Sensor.
- Setting up auto fire parameters, which are more easily set up in the Configuration Options dialog box (select the AFM with the applicable CTD in the Configure menu). SeatermAF automatically sends many of these commands (with **calculated** values based on entries in the dialog box) to the AFM when the user clicks on the Toolbar's Program button. **Sea-Bird highly recommends using the Configuration Options dialog box to set up the AFM** instead of using these commands.

Note:
You have only 2 minutes to communicate with the SBE 50 before the AFM goes to sleep and shuts off power to the SBE 50. If you need more time to perform SBE 50 setup, follow this procedure:
1. Click Connect AFM.
2. Send **UE** to override the AFM's timeout.
3. Click Connect CTD to connect to SBE 50.
4. Perform desired setup of SBE 50.
5. Click Connect AFM to reconnect to AFM.
6. Send **UD** to disable timeout override, to avoid running down the AFM batteries.

Power On Command

POn	Switch on power to Carousel and SBE 50, which are powered from same pin. (If you selected *AFM with SBE 50* in Configure menu) When you click Connect CTD on Toolbar, SeatermAF automatically: 1. Connects to AFM. 2. Sends **POn** to AFM to provide power to SBE 50. 3. Connects to SBE 50.

General Setup Commands

BTx	Select AFM battery type: **x=0**: Nickel-Cadmium (Ni-Cad). **x=1**: Alkaline.
ITx	Select CTD: **x=0**: SBE 19 **x=1**: SBE 25 with firmware version < 2.0 **x=2**: SBE 25 with firmware version ≥ 2.0 **x=3**: SBE 19*plus* or 50
BRx	**x**= 76800 / (CTD real-time data baud rate) (see CTD configuration sheet for baud rate).

Notes:
- n = sequence, single character = (sequence number - 1) + '0'
- m = bottle number, single character = (bottle number - 1) + '0'
- t = time in minutes, long integer value between 0 and 2,147,483,648
- p = raw pressure sensor pressure number, integer value between -4095 and +4095. SeatermAF computes p using the calibration coefficients in the specified configuration (.con) file.

Auto Fire: *General Setup* Commands

BLx — Set bottle closure logic:
x=0: Close on downcast.
x=1: Close on upcast.
x=2: Close on elapsed time, and do not record CTD data in AFM.
x=3: Close when stationary.
x=4: Close on elapsed time, and record CTD data in AFM.

BNx — x= total number of bottles to be closed.

BAnm — AFM allows bottles to be fired out of numerical sequence. Bottle closure **n** closes bottle number **m**. Repeat for each bottle.

PTx — Select pressure polarity (see configuration sheet for CTD - SBE 19 or SBE 25 - used with AFM):
x=0: Negative polarity (increasing pressures give decreasing pressure numbers)
x=1: Positive polarity (increasing pressures give increasing pressure numbers)

Auto Fire: *Downcast and Upcast Logic Setup* Commands

These commands set up closure parameters for closure on downcast or upcast (applicable if **BL0** or **BL1** was sent)

BBx — **x=Y:** Enable bottom bottle closure - close a bottle when pressure remains within **BBP** for **BBT**.
x=N: Disable bottom bottle closure.

BBPp — p= bottom bottle pressure window size.

BBTt — t= bottom bottle time.

BUPp — p= pressure to signal upcast.

BUDp — p= pressure decrease from maximum to signal upcast.

PAnp — Perform bottle closure **n** at pressure **p**. Repeat for each bottle.

Auto Fire: ***Time-Based Logic Setup*** Commands

These commands set up closure parameters for closure based on elapsed time (applicable if **BL2** or **BL4** was sent).

TAnt	Perform bottle closure **n** at elapsed time **t**. Repeat for each bottle.

Auto Fire: ***Stationary Logic Setup*** Commands

These commands set up closure parameters for closure based on elapsed time (applicable if **BL3** was sent).

BSTt	**t**= time to hold in pressure window.
BSPp	**p**= pressure window size.
BSGp	**p**= change in pressure to switch from stop to go.
BSMp	**p**= minimum pressure to enable first bottle.

Section 4: Processing Uploaded Data

This section covers data output formats, and provides information on how to process the data files.

AFM Data Output Formats

When data is uploaded from the AFM using Upload on the Toolbar or Upload in the Data menu, the data is written to a file with a .afm extension. The data consists of:

Note:
Each line of the AFM header starts with *.

- Header providing the .afm file name, SeatermAF software version, upload time, and AFM status
- For each bottle that was *fired*:
  - bottle closing information, in the following format -
    a b mm/dd/yy hh:mm:ss.s xxxxxxxxx cc.c dd
    where

Parameter	Description
a	Bottle sequence
b	Bottle position
mm/dd/yy	Date
hh:mm:ss.s	Time
xxxxxxxxx	Closure confirmation message: • confirmed = OK • user cmd = disarm command received • low volt = low battery voltage • cell fail = battery failure • no confirm = current through latch magnet not sufficient • invalid bn = bottle number received was invalid • no reply = no reply from Carousel
cc.c	Battery voltage
dd	Scan number of first of 5 CTD scans recorded with this bottle, **counting scans from when AFM was armed**. May not correspond to scan number in CTD file, where scan number is number of scans since last time memory pointer was reset to beginning of memory. dd is 1 if no CTD was used.

  - (if used with a CTD) 5 scans of CTD data in hex format (see CTD manual for data format details; the parameters included and the order of the parameters varies for each type of CTD).
    - SBE 19 and 25: The AFM records the entire data scan from the CTD, including any auxiliary sensor data.
    - SBE 19*plus* and 50: The AFM records only the pressure and scan number, ppppssssss, *where*
    pressure [decibars] = pppp (converted from hex to decimal) – 100; ssssss = scan number (converted from hex to decimal).

Note:
SBE 19*plus* and 50: The first scan number dd for each bottle may not match the scan number ssssss because of differences in how scans are counted. dd is the number of scans counted by the AFM since the AFM was armed.

- SBE 19*plus*: ssssss is the number of scans counted by the 19*plus* since the last time **InitLogging** or **SampleNumber=0** was sent to the 19*plus* to reset logging to the beginning of memory.
- SBE 50: ssssss is the number of scans counted by the SBE 50 since power was applied and sampling began. See *Processing .afm Files from AFM when Used with SBE 50.*

Shown below is an example .afm file for an AFM used with an SBE 25 CTD; two bottles were closed.

Note:
90208 in the status reply is the part number of a standard AFM (aluminum housing and glass-reinforced epoxy connectors); the 90491 AFM (aluminum housing and wet-pluggable connectors) uses the same firmware, and has the same status reply.

```
* Sea-Bird SBE 25 Data File:
* FileName = \JOBS\J9\9498\25test.AFM
* Software Version 1.17
* System UpLoad Time = Aug 30 2005 16:34:06
* ds
* SBE 90208 Auto Fire Module V 1.2   08/30/05   16:30:50.0
* vmain = 13.2 , vlith = 6.5
* Auto Fire Module is NOT ARMED
* A>

*END*

dd
1  1  08/30/05  16:23:02.7  confirmed   13.0  65
     25F0D40B300B0D991C90B806005E0000000FFF
     25F2A40B30080D971CB0B806105E0000000FFF
     25F49E0B300B0D971CC0B806005E0000000FFF
     25F6540B30130D951CE0B806005E0000000FFF
     25F7A00B30100D951CF0B806005E0000000FFF
2  2  08/30/05  16:23:25.7  confirmed   12.9  88
     2607A80B30130C6D1E80B906005C0000000FFF
     2608410B300E0C561E90B806005C0000000FFF
     2609040B300A0C341EA0B906005C0000000FFF
     2609CA0B300A0C2C1EC0B806005C0000000FFF
     260A930B300B0C2C1ED0B906005C0000000FFF
```

CTD Data Output Formats

Note:
Each line of the CTD header starts with *.

When data is uploaded from the CTD (either through the AFM or directly from the CTD) using Upload on the Toolbar or Upload in the Data menu, the data is written in hex format to a file with a .hex extension. The data consists of a header and the CTD data. See the CTD (SBE 19, 19*plus*, or 25) manual for details on the CTD data output format.

Processing .afm Files from AFM and .hex Files from SBE 19, 19*plus*, and 25

Notes:
- **These instructions do not apply to the SBE 50.** See *Processing .afm Files from AFM when Used with SBE 50.*
- *Basic* instructions are provided for processing the data using SBE Data Processing. See the SBE Data Processing manual / Help files.

The AFM's .afm file is processed in SBE Data Processing in two steps:

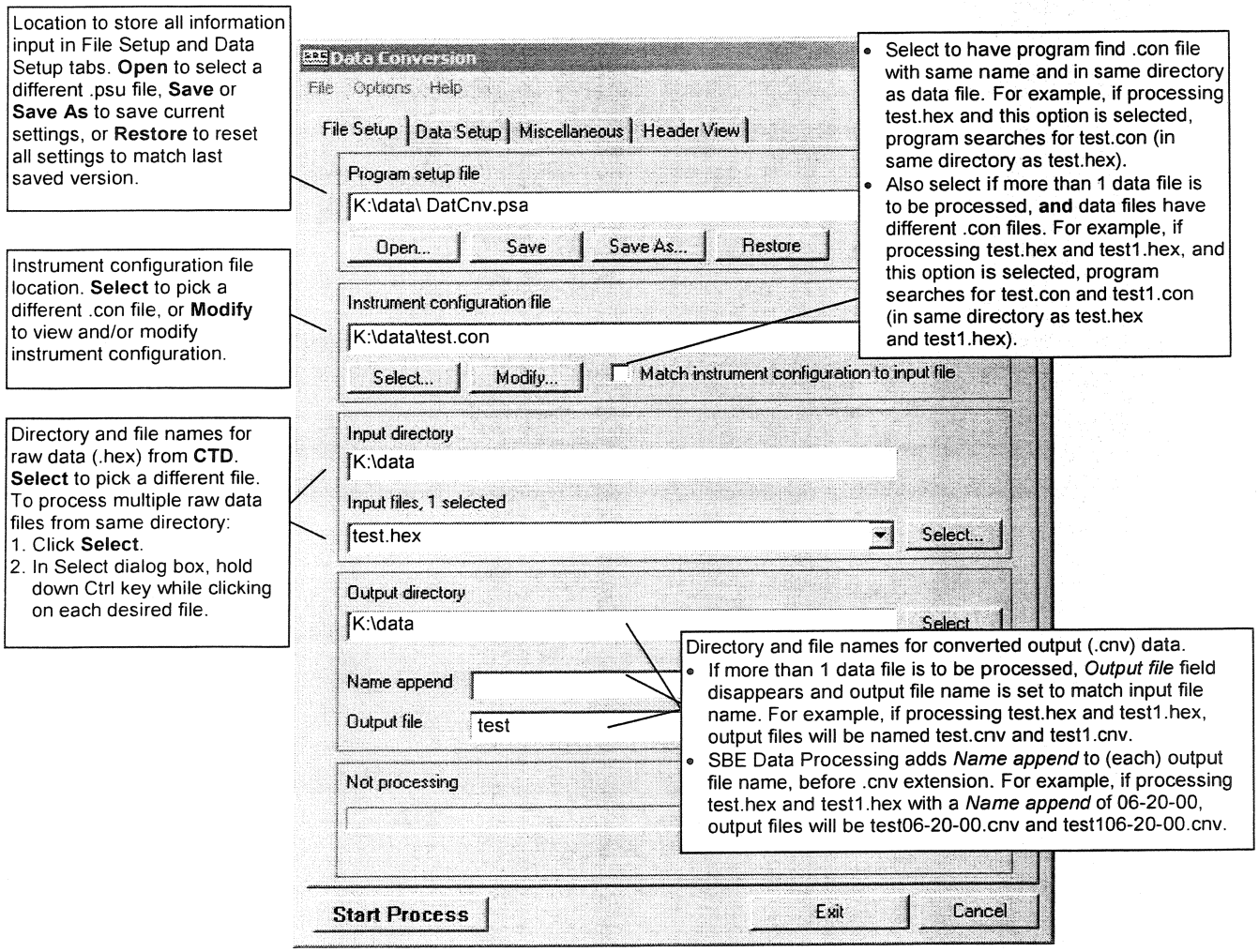
1. **Data Conversion** module - The .hex file from the CTD and .afm file from the AFM are processed at the same time by Data Conversion. Data Conversion creates:
   - .cnv file (from .hex file) - CTD data converted from raw hexadecimal to engineering units.
   - .ros water bottle file (from .hex and .afm files) - data converted from raw hexadecimal to engineering units. The .ros file contains the CTD data for the 5 scans associated with each bottle firing as well as additional data for a user-selected range of scans before and after each bottle firing.

2. **Bottle Summary** module - The .ros file created by Data Conversion is processed by Bottle Summary, which creates a bottle data summary .btl file. The .btl file includes:
   - Bottle position, optional bottle serial number, and date and time.
   - User-selected derived variables, computed for each bottle from mean values of input variables (temperature, pressure, conductivity, etc.).
   - User-selected averaged variables, computed for each bottle from input variables.

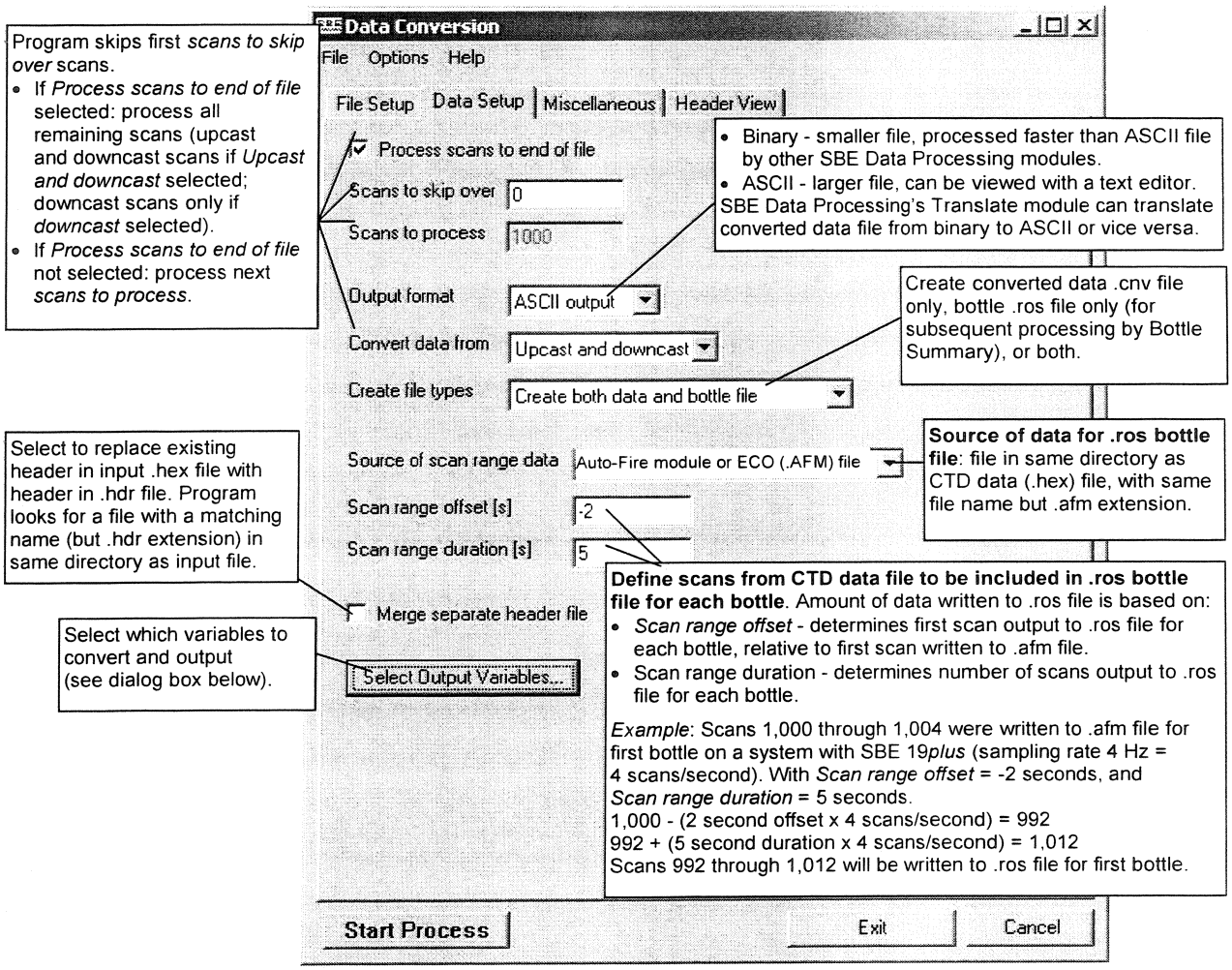
The use of Data Conversion and Bottle Summary is described below (see the SBE Data Processing manual/Help files for details).

Data Conversion

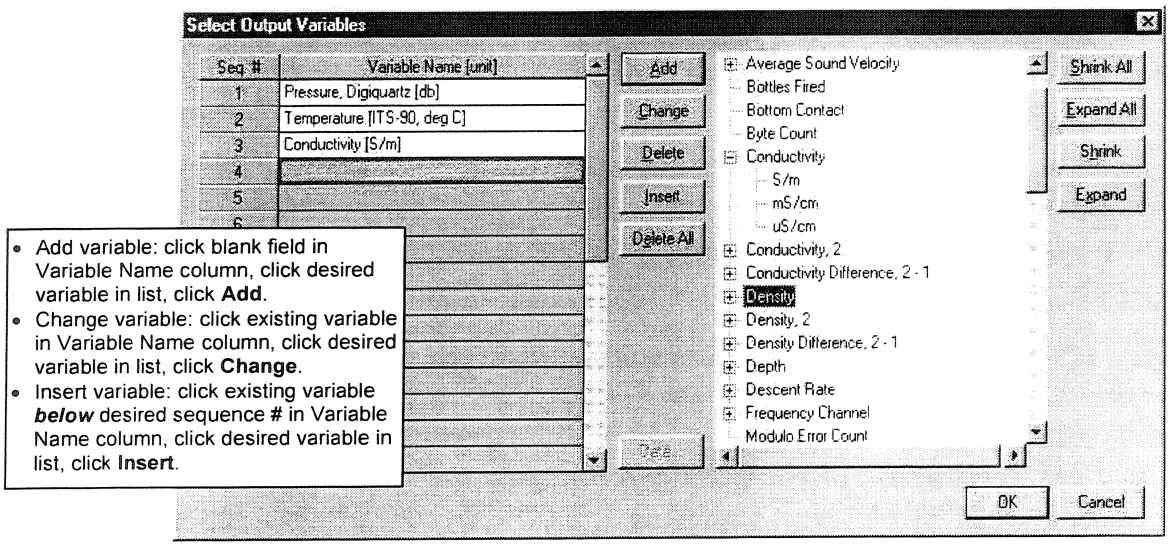
In SBE Data Processing's Run menu, select Data Conversion. The input files for Data Conversion are the .afm file from the AFM, the .hex file from the CTD, and the CTD configuration .con file. The File Setup tab in the dialog box looks like this:



The Data Setup tab in the dialog box looks like this:



The Select Output Variables dialog box (which appears when you click **Select Output Variables** on the Data Setup tab) looks like this:



Output variables selected here will be put in both the .cnv and .ros files.

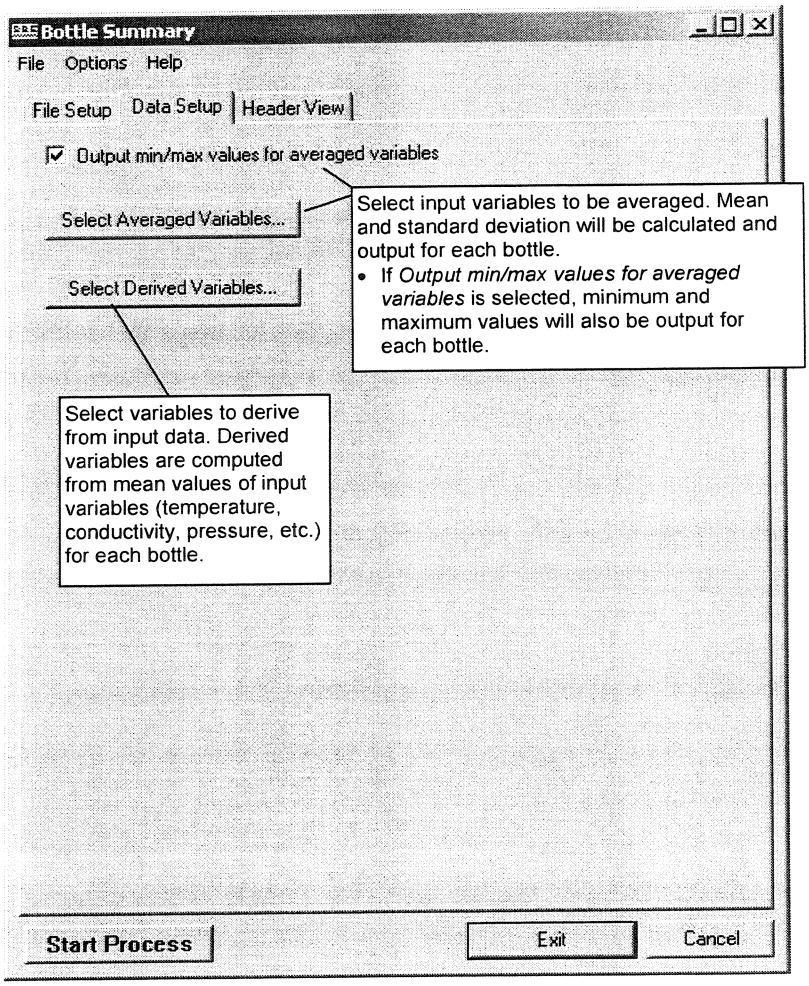
Bottle Summary

In SBE Data Processing's Run menu, select Bottle Summary. The File Setup tab in the dialog box is similar to the one shown and described for Data Conversion above. The input files for Bottle Summary are the .ros file (created in Data Conversion) and the CTD configuration .con file.

Note:
You can create a .sn file in a text editor.

- Additionally, if a .sn file (same name as input .ros file, with .sn extension) is found in the input file directory, bottle serial numbers are inserted between the bottle position and date/time columns in the .btl file output. The format for the .sn file is:
  Bottle position, serial number (with a comma separating the two fields)

The Data Setup tab in the dialog box looks like this:



Other Processing Modules

See the SBE Data Processing manual/Help files for information on additional processing that can be performed on the converted CTD data (.cnv). file.

Processing .afm Files from AFM when Used with SBE 50

Notes:
- **These instructions do not apply to the SBE 19, 19*plus*, or 25.** See *Processing .afm Files from AFM and .hex Files from SBE 19, 19plus, and 25.*
- *90208* in the status reply is the part number of a standard AFM (aluminum housing and glass-reinforced epoxy connectors); the 90491 AFM (aluminum housing and wet-pluggable connectors) uses the same firmware, and has the same status reply.

Sea-Bird software cannot be used to process data from the AFM when it is used with the SBE 50. See *AFM Data Output Formats* above for a description of each line. An example .afm data file for an SBE 50 and AFM is shown below (two bottles were closed) along with an example calculation of pressure and scan number, to assist you in automating any data processing.

```
* Sea-Bird SBE50 Data File:
* FileName = H:\jobs\J36\36695\AFM-0084\afm1.afm
* Software Version 1.17
* Temperature SN =
* Conductivity SN =
* System UpLoad Time = Aug 30 2005 12:36:49
* SBE 90208 Auto Fire Module V 1.2  08/30/05  12:36:36.1
* vmain = 14.0 , vlith = 6.0
* Auto Fire Module is NOT ARMED

*
* S>

*END*

1  1  08/30/05  10:17:23.4  confirmed   13.7  481
   0063000436
   0063000437
   0063000438
   0063000439
   006300043A
2  3  08/30/05  10:18:23.4  confirmed   13.7  577
   0063000496
   0063000497
   0063000498
   0063000499
   006300049A
```

Example: Calculate pressure and scan number for first scan recorded with first bottle firing in example data file.
First scan is 0063000436 = ppppssssss.

Pressure = pppp = 0063 (99 decimal)
pressure (decibars) = 99 - 100 = -1 decibars

Scan number = ssssss = 000436 (1078 decimal)
scan number = 1078 (see note)

Note:
In the example, the scan number *1078* from the SBE 50 hex data does not match the scan number *481* in the line above it. The scan number in the first line is the **number of scans counted by the AFM since the AFM was armed**. The scan number from the SBE 50 hex data is the **number of scans counted by the SBE 50 since power was applied to the SBE 50**. These may differ, but the offset (in this example, 1078 – 481 = 597) is constant for each bottle firing.
Checking the second bottle firing,
496 hex = 1174 decimal;
1174 – 577 (first line for 2nd bottle) = 597.

Note that the calculated pressures may be off by as much as 1 decibar from the actual measured value, because of truncation. See the example below:

Example: SBE 50 measures pressure as -0.01 db. When outputting with **OutputFormat=7** (for use with AFM), SBE 50 adds 100 to measured pressure, then truncates result and converts it to hex before transmitting data to AFM (i.e., -0.01 + 100 = 99.99, truncated to 99, converted to 63 Hex). Looking at result in .afm file, you convert 63 hex to 99 decimal, and subtract 100 to get -1 db (shown in example above). Therefore, for this example, actual measured pressure is -0.01 db, but calculated pressure from .afm file is -1 db.

Section 5: Routine Maintenance

This section reviews corrosion precautions, connector mating and maintenance, and replacement/recharging of the batteries.

Corrosion Precautions

Rinse the AFM with fresh water after use and prior to storage. Periodically (yearly), remove the AFM from the mounting clamps to rinse the entire housing surface with fresh water.

Avoid direct attachment of metal objects to the AFM housing to prevent corrosion. **Insulate the stainless steel clamps used with the AFM's mounting bracket with Teflon tape.**

All stainless steel screws that are exposed to salt water have been generously lubricated at the factory with Blue Moly™. After each cruise, remove these screws and re-lubricate them. **This compound is electrically conductive, so use care to ensure it does not get on circuit boards.**

A large zinc anode is screwed in each end cap. Check the anodes periodically to verify that they are securely fastened and have not been eaten away.

Connector Mating and Maintenance

CAUTION:
Do not use WD-40 or other petroleum-based lubricants, as they will damage the connector.

Mated connectors do not require periodic disassembly or other attention. Inspect a connector that is unmated for signs of corrosion product around the pins. When remating:

1. Lightly lubricate the inside of the cable connector with silicone grease (DC-4 or equivalent).
2. **Standard Connector** - Install the cable connector, aligning the raised bump on the side of the cable connector with the large pin (pin 1 - ground) on the AFM. Remove any trapped air by *burping* or gently squeezing the connector near the top and moving your fingers toward the end cap. **OR**
   MCBH Connector – Install the cable connector, aligning the pins.
3. Place the locking sleeve over the cable connector. Tighten the locking sleeve finger tight only. **Do not overtighten the locking sleeve and do not use a wrench or pliers.**

Verify that a cable or dummy plug is installed for each connector on the system before deployment.

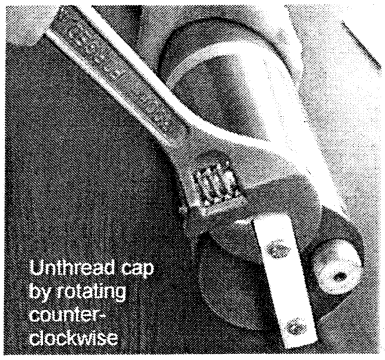
Replacing/Recharging Batteries

Leave the batteries in place when storing the AFM to prevent depletion of the back-up lithium batteries by the real-time clock. Even *exhausted* main batteries will power the clock (60 microamps) almost indefinitely. If the AFM is to be stored for long periods, leave the batteries in place and replace them yearly.

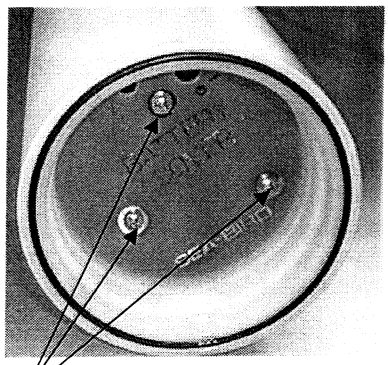
Alkaline D-cell
(MN1300, LR20)

Replacing Alkaline Batteries

1. Remove the battery end cap (end cap without connectors):
   A. Wipe the outside of the end cap and housing dry, being careful to remove any water at the seam between them.
   B. Unthread the end cap by rotating counter-clockwise (use a wrench on the white plastic bar if necessary).
   C. Remove any water from the O-ring mating surfaces inside the housing with a lint-free cloth or tissue.
   D. Put the end cap aside, being careful to protect the O-ring from damage or contamination.



2. Remove the battery cover plate from the housing:
   A. Remove the three Phillips-head screws and washers from the battery cover plate inside the housing.
   B. The battery cover plate will pop out. Put it aside.



Remove Phillips-head
screws and washers

3. Turn the AFM over and remove the batteries.

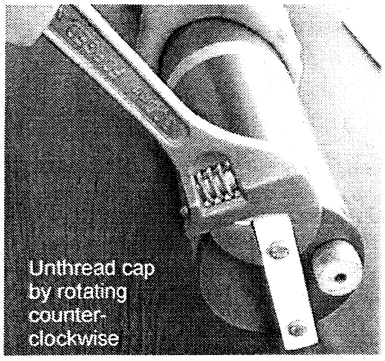
4. Install the new batteries, with the + terminals against the flat battery contacts and the - terminals against the spring contacts.

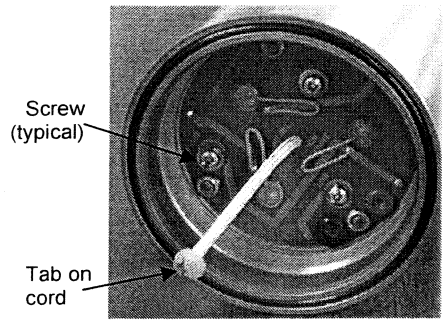
5. Reinstall the battery cover plate in the housing:
   A. Align the battery cover plate with the housing. The posts inside the housing are not placed symmetrically, so the cover plate fits into the housing only one way. Looking at the cover plate, note that one screw hole is closer to the edge than the others, corresponding to the post that is closest to the housing.
   B. Reinstall the three Phillips-head screws and washers, while pushing hard on the battery cover plate to depress the spring contacts at the bottom of the battery compartment. **The screws must be fully tightened, or battery power to the circuitry will be intermittent.**

6. Check the battery voltage at BAT + and BAT - on the battery cover plate. It should be approximately 13.5 volts with fresh batteries.

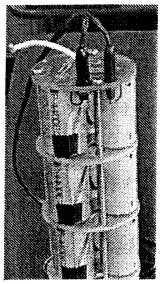
7. Reinstall the battery end cap:
   A. Remove any water from the O-rings and mating surfaces with a lint-free cloth or tissue. Inspect the O-rings and mating surfaces for dirt, nicks, and cuts. Clean or replace as necessary. Apply a light coat of O-ring lubricant (Parker Super O Lube) to O-rings and mating surfaces.
   B. Carefully fit the end cap into the housing and rethread the end cap into place. Use a wrench on the white plastic bar to ensure the end cap is tightly secured.

Recharging/Replacing Ni-Cad Batteries





CAUTION:
Do not recharge the battery pack while it is in the housing. If you do so, you may damage the AFM electronics.



Recharging Ni-Cad Batteries

1. Remove the battery end cap (end cap without connectors):
   A. Wipe the outside of the end cap and housing dry, being careful to remove any water at the seam between them.
   B. Unthread the end cap by rotating counter-clockwise (use a wrench on the white plastic bar if necessary).
   C. Remove any water from the O-ring mating surfaces inside the housing with a lint-free cloth or tissue.
   D. Put the end cap aside, being careful to protect the O-ring from damage or contamination.

2. Remove the battery pack from the housing:
   A. Remove the three Phillips-head screws and washers from the battery cover plate inside the housing.
   B. Pull on the plastic tab on the center cord to remove the battery pack from the housing.

3. Recharge the batteries:
   A. Connect the battery charger leads to the battery cover pin jacks, matching black-to-black and red-to-red (the pin jacks are different sizes to prevent cross-wiring).
   B. Plug the battery charger into a suitable AC mains power source.
   C. The red **Charge** LED on the charger comes on. Recharging takes approximately 15 hours. When recharging is complete, the yellow **Trickle** LED comes on, indicating the charger is providing a maintenance level charge.
   D. Disconnect the battery pack from the charger and the charger from the power source.
   E. Check the voltage at BAT + and BAT – on the battery cover plate. It should be approximately 10.8 volts.

4. Reinstall the battery pack in the housing:
   A. Align the battery pack with the housing. The posts inside the housing are not placed symmetrically, so the battery pack fits into the housing only one way. Looking at the battery bottom cover plate, note that one circular cutout is closer to the edge than the others, corresponding to the post that is closest to the housing.
   B. Reinstall the three Phillips-head screws and washers, while pushing hard on the top of the battery pack to depress the spring contacts at the bottom of the compartment. **The screws must be fully tightened, or the battery power to the circuitry will be intermittent.**

5. Reinstall the battery end cap:
   A. Remove any water from the O-rings and mating surfaces with a lint-free cloth or tissue. Inspect the O-rings and mating surfaces for dirt, nicks, and cuts. Clean or replace as necessary. Apply a light coat of O-ring lubricant (Parker Super O Lube) to O-rings and mating surfaces.
   B. Carefully fit the end cap into the housing and rethread the end cap into place. Use a wrench on the white plastic bar to ensure the end cap is tightly secured.

Replacing Ni-Cad Battery Pack

Follow Steps 1, 2, 4, and 5 in *Recharging Ni-Cad Batteries* above to access the battery compartment and remove and replace the battery pack.

Section 6: Troubleshooting

This section reviews common problems in operating the AFM/Carousel/CTD system, and provides the most likely causes and solutions.

Problem 1: Unable to Communicate with AFM

The A> prompt indicates that communications between the AFM and computer have been established. Before proceeding, try to establish communications again by clicking Connect AFM on SeatermAF's toolbar.

Cause/Solution 1: The I/O cable connection may be loose. Check the cabling between the AFM and computer for a loose connection.

Cause/Solution 2: The instrument type and/or communication settings may not have been entered correctly in SeatermAF. Select the AFM with the applicable CTD in the Configure menu and verify the AFM communication settings in the Configuration Options dialog box.

Cause/Solution 3: The I/O cable may not be the correct one. The I/O cable supplied with the AFM (with blue tape on both ends) uses the Data Terminal Ready (DTR) line from the computer to control internal switches in the AFM. These switches allow the terminal program (SeatermAF) to communicate with the AFM or CTD without switching cables or COM ports (SeatermAF sets the DTR line high to select the AFM and low to select the CTD). This I/O cable permits connection to the DB-9P input connectors used on standard RS-232 interfaces.

Problem 2: Unable to Communicate with CTD through AFM

The S> prompt indicates that communications between the CTD and computer (through the AFM) have been established. Before proceeding, try to establish communications again by clicking Connect CTD on SeatermAF's toolbar. The steps below are based on the assumption that you are able to communicate with the AFM from the computer. If not, see Problem 1 above.

Cause/Solution 1: The cable connection may be loose. Check the cabling between the AFM and CTD for a loose connection.

Cause/Solution 2: The instrument type and/or communication settings may not have been entered correctly in SeatermAF. Select the AFM with the applicable CTD in the Configure menu and verify the CTD communication settings in the Configuration Options dialog box. The CTD settings should match those on the CTD Configuration Sheet.

Cause/Solution 3: The cable from the AFM to the CTD may not be the correct one.

Problem 3: No Bottles Closed / No Data Recorded in AFM

Cause/Solution 1: The AFM may not have been *armed* before it was deployed. After you set up the AFM and CTD, you must:

1. Connect to the AFM by clicking Connect AFM on the Toolbar.
2. Program the AFM by clicking Program on the Toolbar (this *sends* all the bottle closure setup parameters to the AFM).
3. Arm the AFM by clicking ARM on the Toolbar.

Verify that the AFM is armed by sending **DS** (Status on Toolbar).

Problem 4: Nonsense or Unreasonable CTD Data

Note:
Each CTD (SBE 19, 19*plus*, or 25) is shipped with a configuration (.con) file that matches the instrument configuration (number and type of auxiliary sensors, etc.) and includes the instrument calibration coefficients.

The symptom of this problem is an uploaded file that contains nonsense values (for example, 9999.999) or unreasonable values (for example, values that are outside the expected range of the data).

Cause/Solution 1: An uploaded data file with nonsense values may be caused by incorrect instrument configuration in the .con file. Verify that the settings in the instrument .con file match the CTD Configuration Sheet.

Cause/Solution 2: An uploaded data file with unreasonable (i.e., out of the expected range) values for temperature, conductivity, etc. may be caused by incorrect calibration coefficients in the instrument .con file. Verify the calibration coefficients in the instrument .con file match the CTD Calibration Certificates.

Problem 5: Program Corrupted

Note:
Using the reset switch erases the AFM's memory (data in memory as well as user-programmable parameter values). Reenter all user-programmable parameters after using the reset switch.

Cause/Solution 1: In rare cases, the program that controls the AFM's microprocessor can be corrupted by a severe static shock or other problem. This program can be initialized by using the reset switch. Proceed as follows to initialize:

1. Open the battery end cap and remove the batteries (see *Replacing/Recharging Batteries* in *Section 5: Routine Maintenance*).
2. There is a small, two-position switch on the battery compartment bulkhead, which is visible after the main batteries are removed. The switch is used to disconnect the internal lithium batteries from the electronics. Move the switch to the reset position and leave it there for 5 minutes, allowing several capacitors to drain. Then move the switch back to the on position.
3. Reinstall or replace the main batteries, and close the battery end cap.
4. Establish communications with the AFM (see *Section 3: Deploying and Operating System*). Reenter all user-programmable parameters.

Glossary

AFM – Carousel Auto Fire Module. The AFM is available in two models:
- PN 90208 with standard aluminum housing and standard glass-reinforced epoxy connectors
- PN 90491 with standard aluminum housing and optional wet-pluggable (MCBH) connectors

Battery – nine alkaline or Ni-Cad D-size cells

Carousel Water Sampler – Sea-Bird's SBE 32.
The AFM is compatible with the SBE 32 (full-size), SBE 32C (compact), or SBE 32SC (sub-compact) Carousel.

CTD – profiling instrument for measuring Conductivity, Temperature, and Depth (pressure); some CTDs can be integrated with auxiliary sensors to measure oxygen, pH, etc. The AFM is compatible with the SBE 19 SEACAT CTD, SBE 19*plus* SEACAT CTD, and SBE 25 SEALOGGER CTD as well as the SBE 50 Digital Oceanographic Pressure Sensor.

PCB – Printed Circuit Board

SBE Data Processing – Sea-Bird's Win 2000/XP data processing software, which calculates and plots temperature, conductivity, pressure, auxiliary sensor parameters, and derived variables such as salinity and sound velocity.

Scan – One data sample containing (for example) temperature, conductivity, pressure, and optional auxiliary sensor data.

SEASOFT-Win32 –Sea-Bird's complete Win 2000/XP software package, which includes software for communication, real-time data acquisition, and data analysis and display. SEASOFT-Win32 includes ***SeatermAF*** and ***SBE Data Processing***.

SeatermAF – Sea-Bird's Win 95/98/NT/2000/XP software used to communicate with the AFM and with a CTD (SBE 19, 19*plus*, or 25 CTD or SBE 50 Pressure Sensor) connected to the AFM.

Appendix I: Functional Description

Battery Wiring and Power Supply

The AFM's main battery is a series connection of D-cells that drop into the battery compartment as a cluster of three end-to-end pairs. The positive battery connections are contact areas on double-thick printed circuit disks that form the internal bulkhead and battery retainer plates. Battery negative contacts are heavy beryllium-copper springs. The three cell pairs are aligned by plastic insulated aluminum spacers which also serve as electrical interconnects. The battery - circuit card connection is via a Molex-type PCB connector.

The Analog PCB contains two series-connected lithium cells (Panasonic BR 2/3 A non-hazardous) that are diode OR'd with the main battery. The lithium supply is capable of maintaining data in memory, and permits orderly shut-down in the event of a failed or exhausted main battery.

Analog PCB

- U2 provides continuous 5 volts to power the RAM, real-time clock, and wake-up circuitry.
- Q1 switches power to the main 5 volt logic.
- Q6 switches power to the DC/DC converter (U3 and TR1) that powers the Carousel Water Sampler.

Digital PCB

- U11 is the RS-232 interface. U15 is a multiplexer:
  If DTRPC (Data Terminal Ready line from the PC) is greater than 2 volts, the PC is connected to the AFM. If DTRPC is less than 1 volt, the PC is connected to the CTD (SBE 19, 19*plus*, 25, or 50).
- U16 and U17 are the UARTS; U12 and U13 form a watchdog timer.
- U14 is the real-time clock. It generates pulses every 0.5 seconds while the AFM is armed and powered.

Real-Time Clock

To minimize battery current drain, a low power *watch* crystal is used as the real-time-clock frequency source.

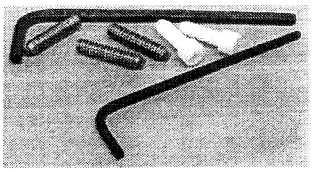
Memory

The AFM has a 64 KB static RAM memory for data storage. The on-board lithium cells maintain data in memory even if the main battery runs down or is removed. If power is completely removed by performing a reset (removes power from both main battery and lithium cells), data in memory will be lost. If power is completely removed by performing a reset, the clock resets to 1 January 1980. Upon power restoration, the clock resumes normal operation.

Appendix II: Electronics Disassembly/Reassembly

Disassembly

Jackscrew kit

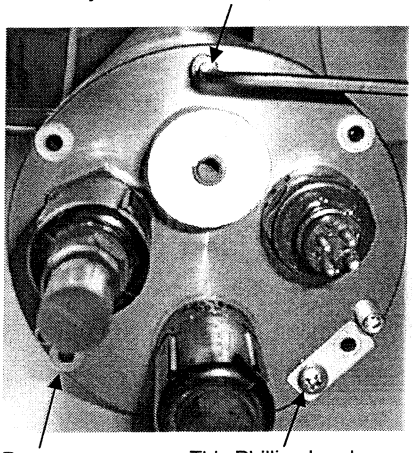


Sea-Bird provides a jackscrew kit with the AFM, to assist in removal of the connector end cap. The kit contains:

- 2 Allen wrenches
- 3 jackscrews
- 2 spare plastic socket hex-head screws

Remove the connector end cap and attached electronics PCB assembly as follows:

Remove plastic hex head screws and install jackscrews in their place



Remove 4 Phillips-head screws

This Phillips-head screw does not connect to housing - do not remove

1. Wipe the outside of the end cap and housing dry, being careful to remove any water at the seam between them.
2. Remove the four Phillips-head screws securing the end cap to the housing.
3. Remove the three plastic hex head screws from the end cap using the larger Allen wrench. Insert the three jackscrews in these three holes in the end cap. When you begin to feel resistance, use the smaller Allen wrench to continue turning the screws. Turn each screw 1/2 turn at a time. As you turn the jackscrews, the end cap will push away from the housing. When the end cap is loosened, pull it and the PCB assembly out of the housing.
4. Remove any water from the O-ring mating surfaces inside the housing with a lint-free cloth or tissue.
5. Disconnect the Molex connector connecting the PCB assembly to the AFM.
6. Remove the jackscrews from the end cap.

Reassembly

Note:
Before delivery, a desiccant package is inserted in the housing and the electronics chamber is filled with dry Argon gas. These measures help prevent condensation. To ensure proper functioning:

1. Install a new desiccant bag each time you open the electronics chamber. If a new bag is not available, see *Application Note 71: Desiccant Use and Regeneration (drying)*.
2. If possible, dry gas backfill each time you open the housing. If you cannot, wait at least 24 hours before redeploying, to allow the desiccant to remove any moisture from the housing.

Note that opening the battery compartment does not affect desiccation of the electronics.

1. Remove any water from the O-ring and mating surfaces with a lint-free cloth or tissue. Inspect the O-ring and mating surfaces for dirt, nicks, and cuts. Clean or replace as necessary. Apply a light coat of O-ring lubricant (Parker Super O Lube) to O-ring and mating surfaces.
2. Reconnect the Molex connector to the PCB assembly.
3. Carefully fit the PCB assembly into the housing, aligning the holes in the end cap and housing
4. Reinstall the 4 Phillips-head screws to secure the end cap to the housing.
5. Reinstall the 3 plastic hex head screws in the end cap.

Appendix III: Replacement Parts

Part Number	Part	Application Description	Quantity in AFM
22018	Alkaline D-cell battery, Duracell MN 1300	Power AFM	9
41124B	Battery cover plate	For alkaline batteries	1
80256	Ni-Cad battery pack	Rechargeable 9-battery pack	1
90226	Ni-Cad battery charger (90/240 VAC)	Charging Ni-Cad battery pack	-
22009	Panasonic BR 2/3 A back-up lithium batteries	Permits orderly shut-down in event of failed or exhausted main battery	2
60021	Spare battery end cap hardware and o-ring kit	O-rings and hardware, including: • 30145 Screw, 6-32 x 1/2" Phillips-head, stainless steel (secures battery cover plate to battery posts for alkaline batteries; secures battery pack to battery rods for Ni-Cad battery pack) • 30242 Washer, #6 flat, stainless steel (for screw 30145) • 30816 Parker 2-234E603-70 (battery end cap to housing piston seal) • 30090 Parker 2-153N674-70 (battery end cap to housing face seal)	-
30164	Screw, 8-32 x 1 1/8" Phillips-head, stainless steel	Secures connector end cap to housing	4
50121	SEACAT Mount Kit	For mounting AFM or CTD (SBE 19, 19*plus*, or 25) to Carousel	1
50092	SBE 16/19 Jackscrew Kit	For removing AFM connector end cap	1
17821 or 17884	RMG-4FS to RMG-3FS, 1.2 m (4 ft) or 1.8 m (6 ft) *	From AFM (3-pin) to SBE 19, 19*plus*, or 25 data I/O connector (4-pin)	1
171846	MCIL-4FS to MCIL-3FS, 1.8 m (6 ft)	From AFM (3-pin) to SBE 19, 19*plus*, or 25 data I/O connector (4-pin) with wet-pluggable connectors	1
171730	RMG-3FS and AG-206 to AG-206 and RMG-4FS *	Double Y-cable (AFM 3-pin and 6-pin to Carousel 6-pin and SBE 50 4-pin)	1
171991	MCIL-3FS and MCIL-6FS to MCIL-6FS and MCIL-4FS	Double Y-cable (AFM 3-pin and 6-pin to Carousel 6-pin and SBE 50 4-pin) for wet-pluggable connectors on SBE 50, SBE 32, and AFM	1
17168 or 17198	AG-206 to AG-206, 1.1 m (3.7 ft) or 2 m (6.6 ft) *	From AFM to Carousel	1
171798 or 171741	MCIL-6FS to MCIL-6FS, 1.0 m (3.3 ft) or 2 m (6.6 ft)	From AFM to Carousel for wet-pluggable connectors	1
801436	RMG-4FS to DB-9S I/O, 20 m (66 ft) *	AFM to computer	1
801460	MCIL-4FS to DB-9S I/O, 20 m (66 ft)	AFM with wet-pluggable connectors to computer	1
171888	DB-25S to DB-9P cable adapter	For use with computer with DB-25 connector	1

Continued on next page

Note:
SBE 19s and 25s configured with a pump have a 6-pin data I/O - pump connector. These 19s and 25s are supplied with a Y-cable (6-pin to SBE 19/25, 4-pin data I/O, 2-pin pump); connect the AFM-SBE 19/25 cable (17821, 17884, or 171846) to the 4-pin data I/O connector on the Y-cable.

Continued from previous page

Part Number	Part	Application Description	Quantity in AFM
171220	6-pin AG-206 to 6-pin AG-206 to 6-pin AG-206 Y-cable *	From SBE 35 to AFM and SBE 32 Carousel Water Sampler	-
171995	6-pin MCIL-6FS to 6-pin MCIL-6FS to 6-pin MCIL-6FS Y-cable	From SBE 35 to AFM and SBE 32 Carousel Water Sampler (all with wet-pluggable connectors)	-
17045.1	3-pin RMG-3FSD dummy plug with locking sleeve *	Connector protection for 3-pin connector	1
17046.1	4-pin RMG-4FSD dummy plug with locking sleeve *	Connector protection for 4-pin connector	1
17047.1	6-pin AG-206 dummy plug with locking sleeve *	Connector protection for 6-pin connector	1
17043	Locking sleeve *	Locks cable / dummy plug in place	3
171500.1	3-pin MCDC-3-F dummy plug with locking sleeve	Connector protection for 3-pin wet-pluggable connector	1
171398.1	4-pin MCDC-4-F dummy plug with locking sleeve	Connector protection for 4-pin wet-pluggable connector	1
171498.1	6-pin MCDC-6-F dummy plug with locking sleeve	Connector protection for 6-pin wet-pluggable connector	1
171192	Locking sleeve	Locks cable / dummy plug in place for wet-pluggable connectors	3
30044	Anode, 1 inch diameter	For AFM end caps (for corrosion prevention)	2

* *For standard connectors.*

Index

.

.afm file · 42, 43, 44, 47
.btl file · 46
.cnv file · 44, 46
.con file · 18, 21, 23, 25, 26, 44
.hex file · 43, 44
.ini file · 13, 19
.ros file · 44, 46

A

About Sea-Bird · 5
Analog PCB · 54

B

Batteries
  recharging · 49
  replacing · 49
Battery · 9, 54
Bottle closure setup · 21

C

Clock · 9, 54
Close on downcast · 21
Close on elapsed time · 26
Close on upcast · 23
Close when stationary · 25
Commands
  Auto Fire arm/disarm · 37
  Auto Fire downcast and upcast logic setup · 40
  Auto Fire general setup · 40
  Auto Fire stationary logic setup · 41
  Auto Fire time-based logic setup · 41
  data upload · 37
  date and time · 37
  descriptions · 35
  general setup · 39
  power on · 39
  status · 35, 36
  timeout override · 38
Communication defaults · 16
Connector · 48
Connectors · 10
Corrosion precautions · 48

D

Data output formats · 42, 43
Data processing · 43, 47
Deployment · 27
  preparing for · 11
Description · 7
Digital PCB · 54
Dimensions · 10
Downcast · 21

E

Elapsed time · 26
Electrical connections · 10
Electronics disassembly/reassembly · 55
End cap · 48

F

Format
  data output · 42, 43
Functional description · 54

G

Glossary · 53

I

Installation · 11

L

Limited liability statement · 2

M

Maintenance · 48
Memory · 9, 54

P

Parts
  replacement · 56
Power supply · 54
Processing data · 43, 47

Q

Quick start · 5

R

Recovery
  physical handling · 29
  uploading data · 30
Replacement parts · 56
Reset · 52, 54

S

SBE Data Processing · 8, 11, 34, 43
SEASOFT-Win32 · 8, 11
SeatermAF · 8, 11, 12, 13
  main screen · 13
  toolbar buttons · 15
Setup · 12
Software · 8
Software installation · 11
Specifications · 9
Stationary · 25
System description · 7

T

Terminal program
  installation · 11
Testing · 12
Troubleshooting · 51

U

Unpacking AFM · 6
Upcast · 23
Uploading data · 30

Auto Fire Module (AFM) Reference Sheet

(see AFM User's Manual for complete details)

System Setup and Deployment

Note: Except where noted otherwise, the term *CTD* refers to the SBE 19, 19*plus*, and 25 CTD as well as the SBE 50 Pressure Sensor.

1. Install AFM and CTD on SBE 32 Carousel Water Sampler.
2. Connect AFM's data I/O cable to computer.
3. Set up AFM and CTD:
   A. Select AFM with applicable CTD in SeatermAF's Configure menu.
   B. Configure Options dialog box appears. On CTD Communications tab, input/select:
      - CTD Eprom version
      - Com port, baud rate, data bits, and parity for communication between CTD and computer (through AFM)
      - Upload baud rate, upload type, and header options - these selections can be made now or when you are ready to upload data after deployment (they have no effect on system operation)

   C. On AFM Communication Settings tab, input/select:
      - Com port for communication between AFM and computer
      - Battery type in AFM
      - Header options - this selection can be made now or when you are ready to upload data after deployment (they have no effect on system operation)

   D. On AFM Bottle Closure Logic tab, input/select:
      - Configuration (.con) file - needed for SBE 19 or 25 only
      - Baud rate for communication of pressure data from CTD to AFM, for *close on downcast*, *upcast* or *when stationary*, pressures are used to determine when to close bottles.
      - Closure type - on downcast, on upcast, when stationary, or on elapsed time (can record or not record CTD data)
      - Stationary logic, for close when stationary
      - Upcast/downcast logic, for close on downcast or upcast

   E. On Bottle Closure Pressures/Times tab, input:
      - Number of bottles to close during deployment
      - Bottle closure order
      - Closure pressures for closure on upcast or downcast, **or** closure times (elapsed minutes since AFM was armed) for closure on elapsed time.
        For closure on downcast, pressures must **increase** from closure 1 to last closure.
        For closure on upcast, pressures must **decrease** from closure 1 to last closure.
        For closure on elapsed time, elapsed times must **increase** from closure to last closure.

      Click OK to overwrite existing settings (.ini) file, or click Save As to save settings as a new filename.

   F. Click Connect AFM button to communicate with AFM.
   G. Set date and time for AFM with **ST**.
   H. Click Program button to send bottle closure parameters to AFM.
   I. Click Connect CTD button to communicate with CTD.
   J. Send desired commands to CTD to change instrument setup. Send **QS** to put CTD in quiescent (sleep) state (not applicable to SBE 50).
      Notes:
      If using **AFM with SBE 25** and you want to close bottles on upcast, verify that SBE 25 configuration entered with **CC** command is *Stop CTD on upcast (y/n)? = NO*.
4. Arm AFM and deploy system:
   A. Click Connect AFM button to communicate with AFM.
   B. Click ARM button.
   C. Disconnect I/O cable from AFM and replace with dummy plug and locking sleeve.
   D. SBE 19, 19*plus*, or 25: Turn on CTD's magnetic switch to start logging.
      SBBE 50: SeatermAF automatically sent **START** to SBE 50 to start sampling when you armed the AFM.
   E. Deploy system.

AFM Commands

- **Verify that computer is talking to AFM (shows A>), not CTD (shows S>).** If not, click Connect AFM on Toolbar.
- Input commands to AFM in upper or lower case letters and register commands by pressing Enter key.
- AFM sends # if invalid command is entered.
- If system does not return A> prompt after executing a command, press Enter key to get A> prompt.
- If new command is not received within 2 minutes after completion of a command, AFM returns to quiescent (sleep) state. **Exception:** If you send **UE** command, AFM will not time out. Make sure to send **UD** command to restore automatic timeout, to avoid running down batteries.
- If in quiescent (sleep) state, re-establish communications by clicking Connect AFM on Toolbar to get A> prompt.

Shown below are the commands used most commonly in the field. See the Manual for complete listing and detailed descriptions.

CATEGORY	COMMAND	DESCRIPTION
Status	**DS**	Display status.
	DC	Display bottle closure parameters.
Date / Time	**ST**	Set clock date (mmddyy) and time (hhmmss).
Arm / Disarm	**ARM**	Arm (enable) auto fire to close bottles. AFM automatically disarms after 24 hours.
	DA	Disarm (disable) auto fire to close bottles.
Data Upload	**DD**	Upload raw data from AFM (5 scans of CTD or SBE 50 data recorded in AFM memory for each bottle fired). Use Upload button on Toolbar if will be processing data with SBE Data Processing.
Timeout Override	**Ux**	**x=E:** Enable timeout override for AFM. Do not timeout / enter quiescent (sleep) state automatically. Use command: • Before uploading data from CTD (SBE 19, 19*plus*, or 25), to prevent system from going to sleep during data upload. • Before setting up SBE 50 connected to AFM, to prevent AFM from going to sleep and shutting off power to SBE 50 while you are trying to send setup commands to SBE 50. **x=D:** Disable timeout override. AFM enters quiescent state if 2 minutes elapse without transmission of a command or reply. Use to restore automatic timeout, to avoid running down batteries.

CTD Commands

- **Verify that computer is talking to CTD (shows S>), not AFM (shows A>).**
  If not, click Connect CTD on Toolbar.

See the instrument manual (SBE 19, 19*plus*, 25, or 50) for command details.

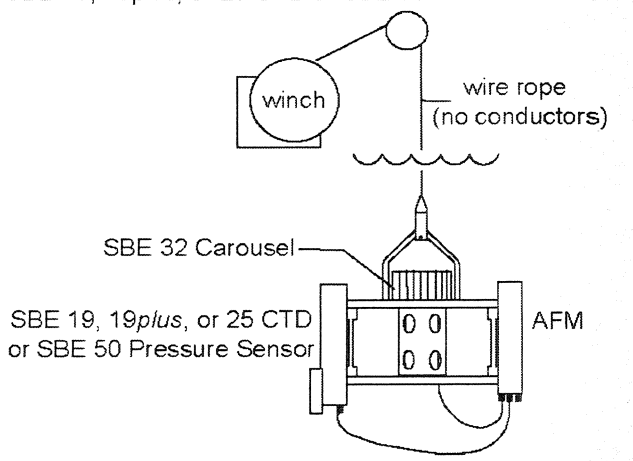
Carousel Auto Fire Module

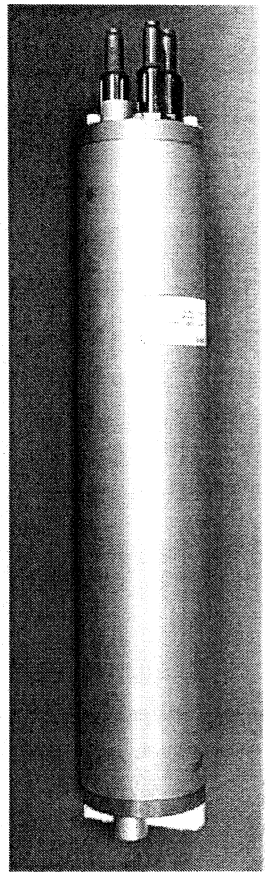
AFM

The Carousel Auto-Fire Module (AFM) allows the SBE 32 Carousel Water Sampler to operate autonomously on non-conducting cables. The AFM includes a microprocessor, solid-state memory, RS-232 interface, and battery power that supply the operating voltage, logic, and control commands to operate the Carousel.

When the Carousel is used without a CTD, the AFM fires bottles at pre-defined intervals of elapsed time after receipt of the *Arm* command. The point at which samples are taken can be determined (approximately) by monitoring cable length paid out and elapsed time. The AFM records bottle number, date, time, and firing confirmation for each bottle fired. At the end of a cast, the bottle data (.afm) file is uploaded from the AFM.

Auto Fire Module (AFM) with SBE 32 and SBE 19, 19plus, or 25 CTD or SBE 50 Pressure Sensor





When the Carousel is used with a CTD (SBE 19 or 19*plus* SEACAT Profiler or SBE 25 SEALOGGER CTD) **or SBE 50 Pressure Sensor**, the AFM:

- Monitors the pressure data recorded by the CTD (or transmitted by the SBE 50) in real-time,
- Fires bottles at predefined pressures (depths), on upcast, downcast, or when the Carousel is stationary for a specified period of time, and
- Records bottle number, date and time, firing confirmation, and five scans of CTD or SBE 50 data in AFM memory for each bottle fired

Setup, checkout, and data extraction are performed (without opening the housing) with our SeatermAF terminal program. At the end of a cast, CTD data is uploaded from the CTD (through the AFM) and bottle data is uploaded from the AFM. SBE Data Processing's Data Conversion module converts the raw CTD data and creates a .cnv CTD data file and .ros bottle data file.

MECHANICAL

The AFM has an anodized aluminum housing rated to 6800 meters (22,300 feet). Bulkhead connectors for the CTD, Carousel, and Data I/O (RS-232) are mounted on the housing end cap. The AFM is typically installed on the Carousel, using the same mounting bracket used to mount a SEACAT, and hangs vertically between the upper and lower adapter plates.

BATTERY ENDURANCE

The AFM is powered by 9 alkaline D-size cells, which provide approximately 40 hours of operation. Optionally, the AFM can be powered by rechargeable Ni-Cad batteries. Battery endurance is predominantly a function of the amount of time the AFM is powered up and armed; the number of bottles fired has little impact.

SOFTWARE

The AFM is supplied with a powerful Windows 2000/XP software package, SEASOFT®-Win32, which includes:

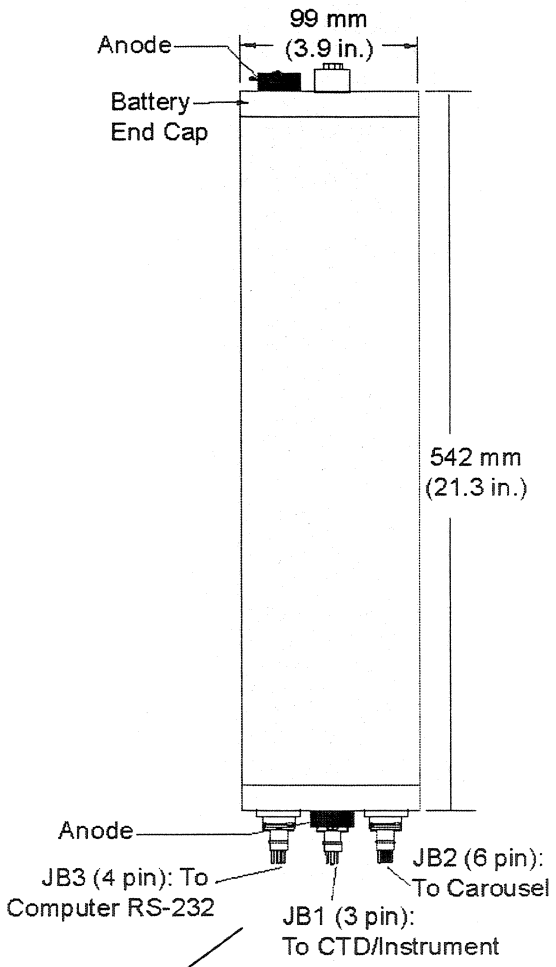
- **SeatermAF** — terminal program for easy communication and data retrieval.
- **SBE Data Processing-Win32** — modules for calculation, display, and plotting of temperature, conductivity, pressure, auxiliary sensor data, and derived variables such as salinity and sound velocity.

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

Carousel Auto Fire Module (AFM)

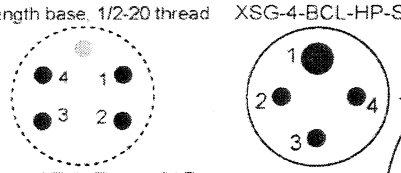
SPECIFICATIONS

Memory	64K byte static RAM memory
Data Storage	Memory space for 1 cast (36 bottles maximum). AFM memory records for each bottle fired: — (if used with a CTD) Bottle sequence and number, date and time, firing confirmation, battery voltage, scan number of first of 5 CTD scans, and 5 scans of CTD data — (if used without a CTD) Bottle sequence and number, date and time, firing confirmation, and battery voltage
Real-Time Clock	Watch-crystal type
Internal Batteries	
Standard:	9 alkaline D-size batteries (Duracell MN1300, LR20)
Optional:	9 Ni-Cad D-size batteries
Current	
Quiescent Current:	60 microamps
Operating Current:	Not armed - 35 milliamps Armed, Carousel capacitor charged - 175 milliamps Armed, Carousel capacitor charging - 250 milliamps
Battery Endurance	Approximately 40 hours for alkalines and 17 hours for Ni-Cads.
Materials	Anodized aluminum housing rated at 6800 meters (22,300 feet), with zinc anode protection
Weight	
In air:	8.1 kg (18 lbs)
In water:	4.1 kg (9 lbs)



Optional Wet-Pluggable Connector * MCBH-4MP (WB) 3/8" length base, 1/2-20 thread

Standard Connector XSG-4-BCL-HP-SS



JB3 Data I/O

Pin	Signal
1	Common
2	Receive from computer
3	Transmit to computer
4	DTR AFM/CTD switch

Standard Connector XSG-3-BCL-HP-SS

Optional Wet-Pluggable Connector * MCBH-3MP (WB) 3/8" length base, 1/2-20 thread

JB1 CTD/Instrument
(SBE 19, 19*plus*, 25, or 50)

Pin	Signal
1	Common
2	Transmit to CTD/Instrument
3	Receive from CTD/Instrument

Optional Wet-Pluggable Connector * MCBH-6MP (WB) 3/8" length base, 1/2-20 thread

Standard Connector AG-306-HP-SS

JB2 SBE 32

Pin	Signal
1	Common
2	Transmit to SBE 32
3	Receive from SBE 32
4	N/C
5	N/C
6	Power to SBE 32

** Wet-Pluggable connector in anodized aluminum, to match AFM housing material.*

05/07

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

Sea-Bird Electronics, Inc.
1808 136th Place NE, Bellevue, Washington 98005 USA
Website: http://www.seabird.com

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

SBE Pressure Test Certificate

Test Date: **11/1/2007** Description **Auto Fire Module**

Job Number: **49707** Customer Name **TDI-BROOKS**

SBE Sensor Information:

Model Number: **AFM**
Serial Number: **0118**

Pressure Sensor Information:

Sensor Type: **None**
Sensor Serial Number: **None**
Sensor Rating: **0**

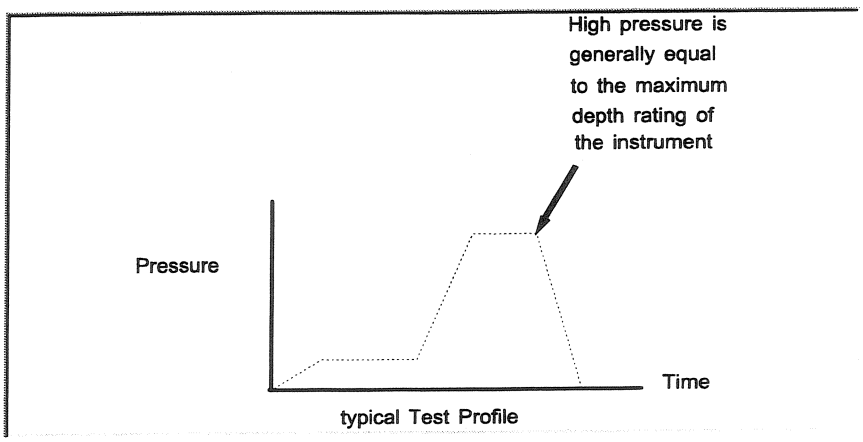
Pressure Test Protocol:

Low Pressure Test: **40** PSI Held For **15** Minutes

High Pressure Test: **10000** PSI Held For **15** Minutes

Passed Test: ☑

Tested By: nd



Sea-Bird Electronics, Inc.
1808 136th Place NE
Bellevue, WA 98005
USA

Phone: (425) 643-9866
Fax: (425) 643-9954
E-mail: seabird@seabird.com
Web: www.seabird.com

APPLICATION NOTE NO. 68

Revised **November 2006**

Using USB Ports to Communicate with Sea-Bird Instruments

Most Sea-Bird instruments use the RS-232 protocol for transmitting setup commands to the instrument and receiving data from the instrument. However, many newer PCs and laptop computers have USB port(s) instead of RS-232 serial port(s).

USB serial adapters are available commercially. These adapters plug into the USB port, and allow one or more serial devices to be connected through the adapter. Sea-Bird tested USB serial adapters from three manufacturers on desktop computers at Sea-Bird, and verified compatibility with our instruments. These manufacturers and the tested adapters are:

- **IOGEAR** (www.iogear.com) –
  USB 1.1 to Serial Converter Cable (model # GUC232A).
  Note: This adapter can also be purchased from Sea-Bird, as Sea-Bird part # 20163.

- **Keyspan** (www.keyspan.com) -
  USB 4-Port Serial Adapter (part # USA-49WLC, replacing part # USA-49W)

- **Edgeport** (www.ionetworks.com) -
  Standard Serial Converter Edgeport/2 (part # 301-1000-02)

Other USB adapters from these manufacturers, and adapters from other manufacturers, **may** also be compatible with Sea-Bird instruments.

We have one report from a customer that he could not communicate with his instrument using a notebook computer and the Keyspan adapter listed above. He was able to successfully communicate with the instrument using an XH8290 DSE Serial USB Adapter (www.dse.co.nz).

We recommend testing any adapters, *including those listed above*, with the instrument and the computer you will use it with before deployment, to verify that there is no problem.

Sea-Bird Electronics, Inc.
1808 136th Place NE
Bellevue, WA 98005
USA

Phone: (425) 643-9866
Fax: (425) 643-9954
E-mail: seabird@seabird.com
Web: www.seabird.com

APPLICATION NOTE NO. 71

Revised July 2005

Desiccant Use and Regeneration (drying)

This application note applies to all Sea-Bird instruments intended for underwater use. The application note covers:

- When to replace desiccant
- Storage and handling of desiccant
- Regeneration (drying) of desiccant
- Material Safety Data Sheet (MSDS) for desiccant

When to Replace Desiccant Bags

Before delivery of the instrument, a desiccant package is placed in the housing, and the electronics chamber is filled with dry Argon. These measures help prevent condensation. To ensure proper functioning:

1. Install a new desiccant bag each time you open the housing and expose the electronics.
2. If possible, dry gas backfill each time you open the housing and expose the electronics. If you cannot, wait at least 24 hours before redeploying, to allow the desiccant to remove any moisture from the chamber.

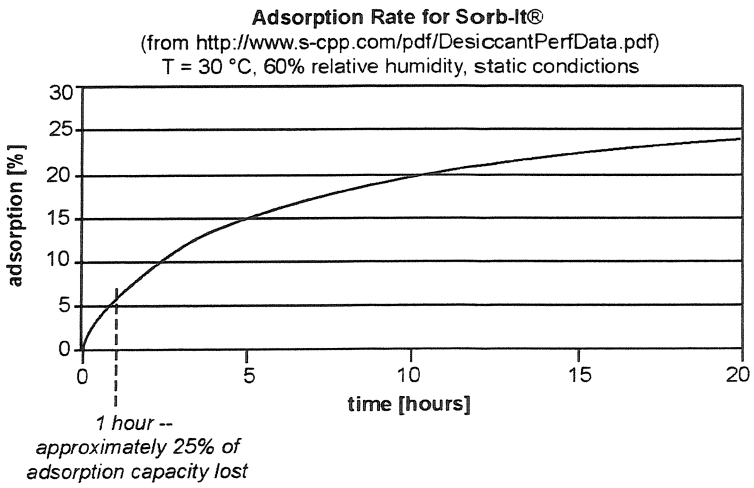
What do we mean by *expose the electronics*?

- For most battery-powered Sea-Bird instruments (such as SBE 16, 16*plus*, 16*plus*-IM, 17*plus*, 19, 19*plus*, 25, 26, 26*plus*, 37-SM, 37-SMP, 37-IM, 37-IMP, 44, 53; Auto Fire Module [AFM]), there is a bulkhead between the battery and electronics compartments. Battery replacement does not affect desiccation of the electronics, as the batteries are removed without removing the electronics and no significant gas exchange is possible through the bulkhead. Therefore, opening the battery compartment to replace the batteries does not expose the electronics; you do not need to install a new desiccant bag in the electronics compartment each time you open the battery compartment. For these instruments, install a new desiccant bag if you open the electronics compartment to access the printed circuit boards.
- For the SBE 39, 39-IM, and 48, the electronics must be removed or exposed to access the battery. Therefore, install a new desiccant bag each time you open the housing to replace a battery.

Storage and Handling

Testing by Süd-Chemie (desiccant's manufacturer) at 60% relative humidity and 30 °C shows that approximately 25% of the desiccant's adsorbing capacity is used up after only 1 hour of exposure to a constantly replenished supply of moisture in the air. In other words, if you take a bag out of a container and leave it out on a workbench for 1 hour, one-fourth of its capacity is gone before you ever install it in the instrument. Therefore:

- Keep desiccant bags in a tightly sealed, impermeable container until you are ready to use them. Open the container, remove a bag, and quickly close the container again.
- Once you remove the bag(s) from the sealed container, rapidly install the bag(s) in the instrument housing and close the housing. **Do not use the desiccant bag(s) if exposed to air for more than a total of 30 minutes.**



Regeneration (drying) of Desiccant

Replacement desiccant bags are available from Sea-Bird:

- PN 60039 is a metal can containing 25 1-gram desiccant bags and 1 humidity indicator card. The 1-gram bags are used in our smaller diameter housings, such as the SBE 3 (*plus*, F, and S), 4 (M and C), 5T, 37 (-SI, -SIP, -SM, -SMP, -IM, and –IMP), 38, 39, 39-IM, 43, 44, 45, 48, 49, and 50.
- PN 31180 is a 1/3-ounce desiccant bag, used in our SBE 16*plus*, 16*plus*-IM, 19*plus*, 21, and 52-MP.
- PN 30051 is a 1-ounce desiccant bag. The 1-ounce bags are used in our larger diameter housings, such as the SBE 9*plus*, 16, 17*plus*, 19, 25, 26, 26*plus*, 32, 53 BPR, AFM, and PDIM.

However, if you run out of bags, you can regenerate your existing bags using the following procedure provided by the manufacturer (Süd-Chemie Performance Packaging, a Division of United Catalysts, Inc.):

MIL-D-3464 Desiccant Regeneration Procedure

Regeneration of the United Desiccants' Tyvek Desi Pak® or Sorb-It® bags or United Desiccants' X-Crepe Desi Pak® or Sorb-It® bags can be accomplished by the following method:

1. Arrange the bags on a wire tray in a single layer to allow for adequate air flow around the bags during the drying process. The oven's inside temperature should be room or ambient temperature (25 – 29.4 °C [77 – 85 °F]). **A convection, circulating, forced-air type oven is recommended for this regeneration process. Seal failures may occur if any other type of heating unit or appliance is used.**

2. When placed in forced air, circulating air, or convection oven, allow a minimum of 3.8 to 5.1 cm (1.5 to 2.0 inches) of air space between the top of the bags and the next metal tray above the bags. If placed in a radiating exposed infrared-element type oven, shield the bags from direct exposure to the heating element, giving the closest bags a minimum of 40.6 cm (16 inches) clearance from the heat shield. Excessive surface film temperature due to infrared radiation will cause the Tyvek material to melt and/or the seals to fail. Seal failure may also occur if the temperature is allowed to increase rapidly. This is due to the fact that the water vapor is not given sufficient time to diffuse through the Tyvek material, thus creating internal pressure within the bag, resulting in a seal rupture. Temperature should not increase faster than 0.14 to 0.28 °C (0.25 to 0.50 °F) per minute.

3. Set the temperature of the oven to 118.3 °C (245 °F), and allow the bags of desiccant to reach equilibrium temperature. **WARNING**: Tyvek has a melt temperature of 121.1 – 126.7 °C (250 – 260 °F) (Non MIL-D-3464E activation or reactivation of both silica gel and Bentonite clay can be achieved at temperatures of 104.4 °C [220 °F]).

4. Desiccant bags should be allowed to remain in the oven at the assigned temperature for 24 hours. At the end of the time period, the bags should be immediately removed and placed in a desiccator jar or dry (0% relative humidity) airtight container for cooling. If this procedure is not followed precisely, any water vapor driven off during reactivation may be re-adsorbed during cooling and/or handling.

5. After the bags of desiccant have been allowed to cool in an airtight desiccator, they may be removed and placed in either an appropriate type polyliner tightly sealed to prevent moisture adsorption, or a container that prevents moisture from coming into contact with the regenerated desiccant.

NOTE: Use only a metal or glass container with a tight fitting metal or glass lid to store the regenerated desiccant. Keep the container lid **closed tightly** to preserve adsorption properties of the desiccant.

SÜD-CHEMIE
Creating Performance Technology
ISO 9002 CERTIFIED

Sud-Chemie Performance Packaging
101 Christine Dr.
Belen, New Mexico 87002
Phone: (505) 864-6691
Fax: (505) 864-9296

MATERIAL SAFETY DATA SHEET – August 13, 2002
SORB-IT®
Packaged Desiccant

SECTION I -- PRODUCT IDENTIFICATION

Trade Name and Synonyms:	Silica Gel, Synthetic Amorphous Silica, Silicon, Dioxide
Chemical Family:	Synthetic Amorphous Silica
Formula:	$SiO_2.x\ H_2O$

SECTION II -- HAZARDOUS INGREDIENTS

Components in the Solid Mixture

COMPONENT	CAS No	%	ACGIH/TLV (PPM)	OSHA-(PEL)
Amorphous Silica	63231-67-4	>99	PEL - 20 (RESPIRABLE), TLV – 5	LIMIT – NONE, HAZARD - IRRITANT

Synthetic amorphous silica is not to be confused with crystalline silica such as quartz, cristobalite or tridymite or with diatomaceous earth or other naturally occurring forms of amorphous silica that frequently contain crystalline forms.

This product is in granular form and packed in bags for use as a desiccant. Therefore, no exposure to the product is anticipated under normal use of this product. Avoid inhaling desiccant dust.

SECTION III -- PHYSICAL DATA

Appearance and Odor:	White granules; odorless.
Melting Point:	>1600 Deg C; >2900 Deg F
Solubility in Water:	Insoluble.
Bulk Density:	>40 lbs./cu. ft.
Percent Volatile by Weight @ 1750 Deg F:	<10%.

SÜD-CHEMIE
Creating Performance Technology
ISO 9002 CERTIFIED

Sud-Chemie Performance
Packaging
101 Christine Dr.
Belen, New Mexico 87002
Phone: (505) 864-6691
Fax: (505) 864-9296

MATERIAL SAFETY DATA SHEET – August 13, 2002
SORB-IT®
Packaged Desiccant

SECTION IV -- FIRE EXPLOSION DATA

Fire and Explosion Hazard - Negligible fire and explosion hazard when exposed to heat or flame by reaction with incompatible substances.

Flash Point - Nonflammable.

Firefighting Media - Dry chemical, water spray, or foam. For larger fires, use water spray fog or foam.

Firefighting - Nonflammable solids, liquids, or gases: Cool containers that are exposed to flames with water from the side until well after fire is out. For massive fire in enclosed area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of the tank due to fire.

SECTION V -- HEALTH HAZARD DATA

Health hazards may arise from inhalation, ingestion, and/or contact with the skin and/or eyes. Ingestion may result in damage to throat and esophagus and/or gastrointestinal disorders. Inhalation may cause burning to the upper respiratory tract and/or temporary or permanent lung damage. Prolonged or repeated contact with the skin, in absence of proper hygiene, may cause dryness, irritation, and/or dermatitis. Contact with eye tissue may result in irritation, burns, or conjunctivitis.

First Aid (Inhalation) - Remove to fresh air immediately. If breathing has stopped, give artificial respiration. Keep affected person warm and at rest. Get medical attention immediately.

First Aid (Ingestion) - If large amounts have been ingested, give emetics to cause vomiting. Stomach siphon may be applied as well. Milk and fatty acids should be avoided. Get medical attention immediately.

First Aid (Eyes) - Wash eyes immediately and carefully for 30 minutes with running water, lifting upper and lower eyelids occasionally. Get prompt medical attention.

First Aid (Skin) - Wash with soap and water.

SÜD-CHEMIE
Creating Performance Technology
ISO 9002 CERTIFIED

Sud-Chemie Performance Packaging
101 Christine Dr.
Belen, New Mexico 87002
Phone: (505) 864-6691
Fax: (505) 864-9296

MATERIAL SAFETY DATA SHEET – August 13, 2002
SORB-IT®
Packaged Desiccant

NOTE TO PHYSICIAN: This product is a desiccant and generates heat as it adsorbs water. The used product can contain material of hazardous nature. Identify that material and treat accordingly.

SECTION VI -- REACTIVITY DATA

Reactivity - Silica gel is stable under normal temperatures and pressures in sealed containers. Moisture can cause a rise in temperature which may result in a burn.

SECTION VII --SPILL OR LEAK PROCEDURES

Notify safety personnel of spills or leaks. Clean-up personnel need protection against inhalation of dusts or fumes. Eye protection is required. Vacuuming and/or wet methods of cleanup are preferred. Place in appropriate containers for disposal, keeping airborne particulates at a minimum.

SECTION VIII -- SPECIAL PROTECTION INFORMATION

Respiratory Protection - Provide a NIOSH/MSHA jointly approved respirator in the absence of proper environmental control. Contact your safety equipment supplier for proper mask type.

Ventilation - Provide general and/or local exhaust ventilation to keep exposures below the TLV. Ventilation used must be designed to prevent spots of dust accumulation or recycling of dusts.

Protective Clothing - Wear protective clothing, including long sleeves and gloves, to prevent repeated or prolonged skin contact.

Eye Protection - Chemical splash goggles designed in compliance with OSHA regulations are recommended. Consult your safety equipment supplier.

SECTION IX -- SPECIAL PRECAUTIONS

Avoid breathing dust and prolonged contact with skin. Silica gel dust causes eye irritation and breathing dust may be harmful.

SÜD-CHEMIE
Creating Performance Technology
ISO 9002 CERTIFIED

Sud-Chemie Performance Packaging
101 Christine Dr.
Belen, New Mexico 87002
Phone: (505) 864-6691
Fax: (505) 864-9296

MATERIAL SAFETY DATA SHEET – August 13, 2002
SORB-IT®
Packaged Desiccant

* No Information Available

HMIS (Hazardous Materials Identification System) for this product is as follows:

Health Hazard	0
Flammability	0
Reactivity	0
Personal Protection	HMIS assigns choice of personal protective equipment to the customer, as the raw material supplier is unfamiliar with the condition of use.

The information contained herein is based upon data considered true and accurate. However, United Desiccants makes no warranties expressed or implied, as to the accuracy or adequacy of the information contained herein or the results to be obtained from the use thereof. This information is offered solely for the user's consideration, investigation and verification. Since the use and conditions of use of this information and the material described herein are not within the control of United Desiccants, United Desiccants assumes no responsibility for injury to the user or third persons. The material described herein is sold only pursuant to United Desiccants' Terms and Conditions of Sale, including those limiting warranties and remedies contained therein. It is the responsibility of the user to determine whether any use of the data and information is in accordance with applicable federal, state or local laws and regulations.

DRAWINGS

31936 AFM PN 90208 Block Diagram..... 1

31684a Cable, RMG-4FS to DB-9S, AFM I/O, 20m, PN 801436..... 2

30568 Cable, AG-206 to AG-206, AFM to SBE 32, 98", PN 17198..... 3

31670 Cable, RMG-3FS to RMG-4FS, AFM to SBE 19/25, 72", PN 17884..... 4

50114 End Cap Connector..... 5

31687 End Cap Connector Internal Wiring..... 6

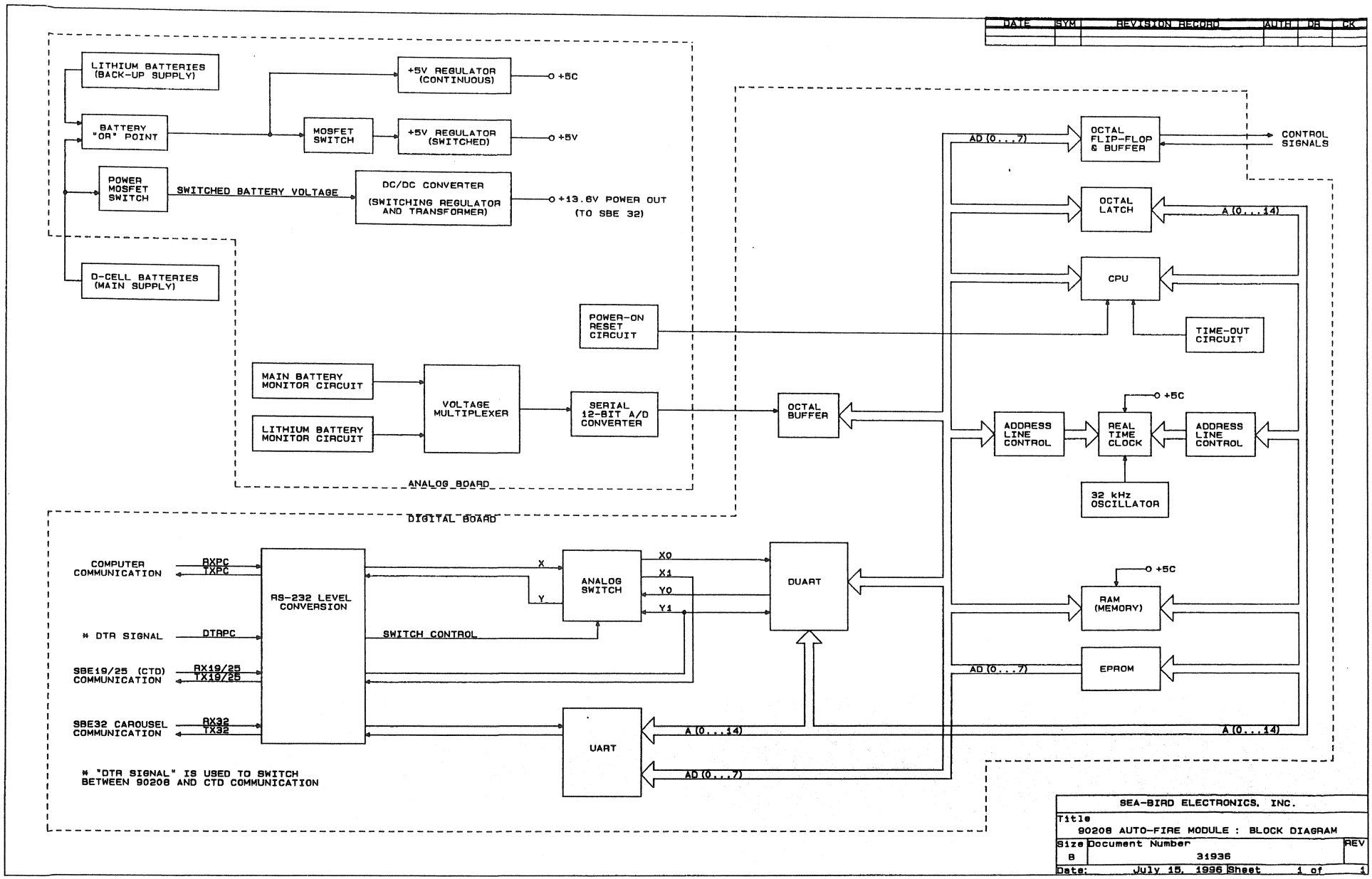
30712 Batery wiring - Reset Switch..... 7

31640b Analog Board Schematic..... 8

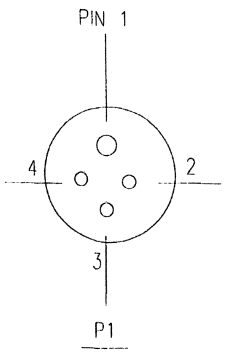
40708D Analog Board Assembly..... 10

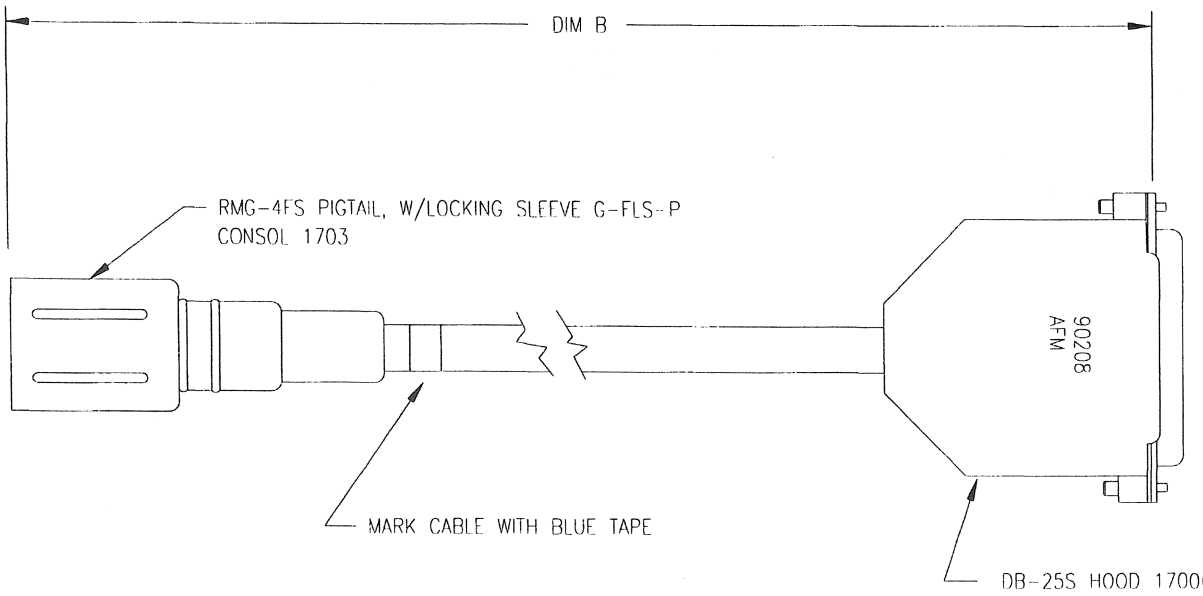
31641b Digital Board Schematic..... 12

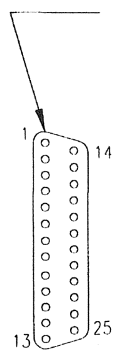
40709B Digital Board Assembly..... 15


DATE | SYM | REVISION RECORD | AUTH | DR | CK
LITHIUM BATTERIES (BACK-UP SUPPLY)
BATTERY "OR" POINT
+5V REGULATOR (CONTINUOUS)
+5C
MOSFET SWITCH
+5V REGULATOR (SWITCHED)
+5V
POWER MOSFET SWITCH
SWITCHED BATTERY VOLTAGE
DC/DC CONVERTER (SWITCHING REGULATOR AND TRANSFORMER)
+13.6V POWER OUT (TO SBE 32)
D-CELL BATTERIES (MAIN SUPPLY)
POWER-ON RESET CIRCUIT
MAIN BATTERY MONITOR CIRCUIT
LITHIUM BATTERY MONITOR CIRCUIT
VOLTAGE MULTIPLEXER
SERIAL 12-BIT A/D CONVERTER
OCTAL BUFFER
ANALOG BOARD
DIGITAL BOARD
AD(0...7)
OCTAL FLIP-FLOP & BUFFER
CONTROL SIGNALS
OCTAL LATCH
A(0...14)
CPU
TIME-OUT CIRCUIT
+5C
ADDRESS LINE CONTROL
REAL TIME CLOCK
ADDRESS LINE CONTROL
32 kHz OSCILLATOR
COMPUTER COMMUNICATION
RXPC
TXPC
RS-232 LEVEL CONVERSION
X
Y
ANALOG SWITCH
X0
X1
Y0
Y1
DUART
* DTR SIGNAL
DTRPC
SWITCH CONTROL
SBE19/25 (CTD) COMMUNICATION
RX19/25
TX19/25
SBE32 CAROUSEL COMMUNICATION
RX32
TX32
UART
+5C
RAM (MEMORY)
EPROM
AD(0...7)
A(0...14)
A(0...14)
AD(0...7)
* "DTR SIGNAL" IS USED TO SWITCH BETWEEN 90208 AND CTD COMMUNICATION
SEA-BIRD ELECTRONICS, INC.
Title
90208 AUTO-FIRE MODULE : BLOCK DIAGRAM
Size B
Document Number 31936
REV
Date: July 15, 1996 Sheet 1 of 1

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.
03/30/01	A	Added P/N 801273		LRG	







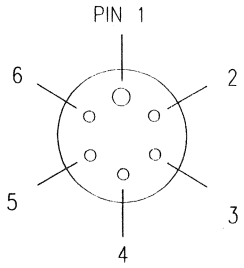
RMG-4FS TO DB-25S CABLE ASSEMBLIES			
SHIELDED ASSY P/N	PIGTAIL P/N	LENGTH 'B' (FT)	LENGTH 'B' (m)
80802	17831	8	2.5
80803	17221	66	20
801071	17183	83	25
A 801273	17204	33	10

P1 RMG-4FS	COLOR	P2 DB-25S
PIN 1	SHIELD	PIN 7
PIN 2	BLACK	PIN 2
PIN 3	WHITE	PIN 3
PIN 4	RED	PIN 20

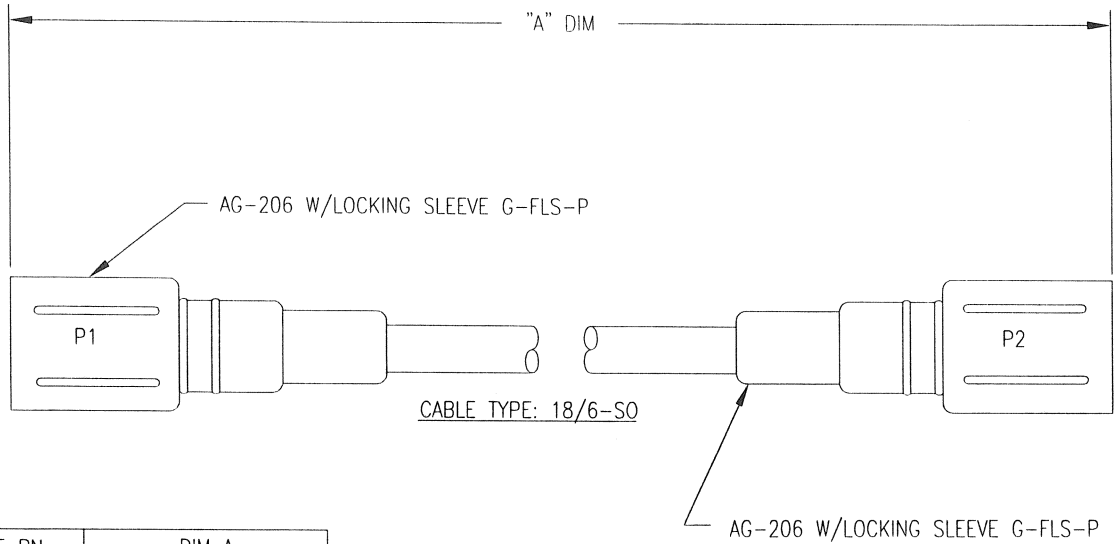
PIGTAILS ARE PURCHASED PER DWG 30585

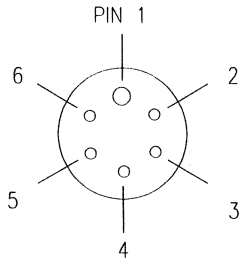
TOLERANCES	SEA-BIRD ELECTRONICS, INC		
FRACTIONAL	P/N SEE TABLE	SCALE 1:1	DRAWN BY BMC APPROVED BY
DECIMAL	TITLE 90208 DATA I/O CABLE		
ANGULAR	DATE 7/94	DRAWING NUMBER 31684	REV A

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.



P1





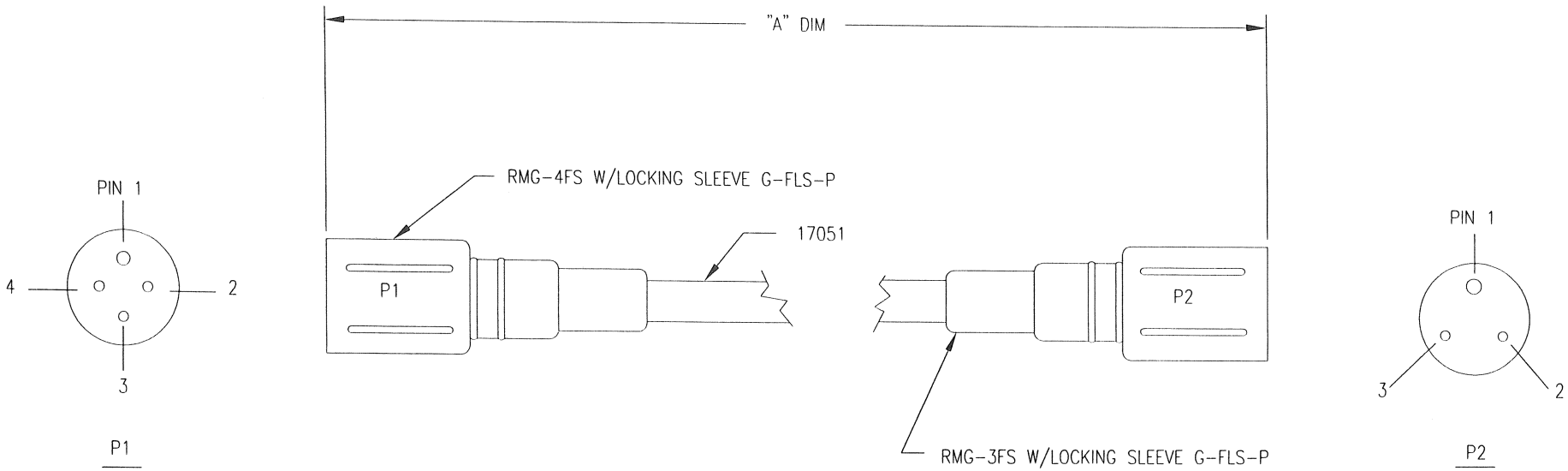
P2

SBE PN	DIM A	
17033	36 IN	----
17132	13 IN	----
17162	30 FT	----
17168	44 IN	----
17197	98 IN	----
17198	79 IN	2 m
17260	120 IN	3 m
17368	30 IN	----
17597	20 IN	----
17607	50 IN	----
17950	60 IN	1.5 m
17954	17 FT	5.5 m
171097	27 FT	8 m
171098	40 FT	12 m
171745	33 FT	10 m
172181	158 IN	4 m
172238	197 IN	5 m

P1	P2
PIN 1	PIN 1
PIN 2	PIN 2
PIN 3	PIN 3
PIN 4	PIN 4
PIN 5	PIN 5
PIN 6	PIN 6

TOLERANCES	SEA-BIRD ELECTRONICS, INC		
FRACTIONAL	P/N SEE TABLE	SCALE 1:1	DRAWN BY JEB APPROVED BY
DECIMAL	TITLE CABLE, 6 PIN/ 6 PIN AG-206 + LS		
ANGULAR	DATE 4/19/96	DRAWING NUMBER 30568	REV

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.



SBE PART NO	A DIM
17821	48 IN
17884	72 IN
171979	36 IN
172014	24 IN

P1	P2
PIN 1	PIN 1
PIN 2	PIN 2
PIN 3	PIN 3
PIN 4	N/C

TOLERANCES	SEA-BIRD ELECTRONICS, INC		
FRACTIONAL	P/N SEE TABLE	SCALE 1:1	DRAWN BY BMC APPROVED BY
DECIMAL	TITLE CABLE, 4 PIN / 3 PIN RMG-4FS TO RMG-3FS		
ANGULAR	DATE 6/6/94	DRAWING NUMBER 31670	REV

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.

DATA I/O

RETURN
1
2 RX (FROM PC)
4 DTR 90208/CTD SWITCH
3 TX (TO PC)

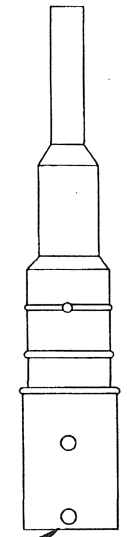
SBE 19/25 CTD

RETURN
1
2 TX (TO CTD)
3 RX (FROM CTD)

JB3
JB1
JB2
ANODE

SBE 32 CAROUSEL

RETURN
1
2 TX (TO SBE 32)
6 +13.6V
3 RX (FROM SBE 32)
5 N/C
4 N/C



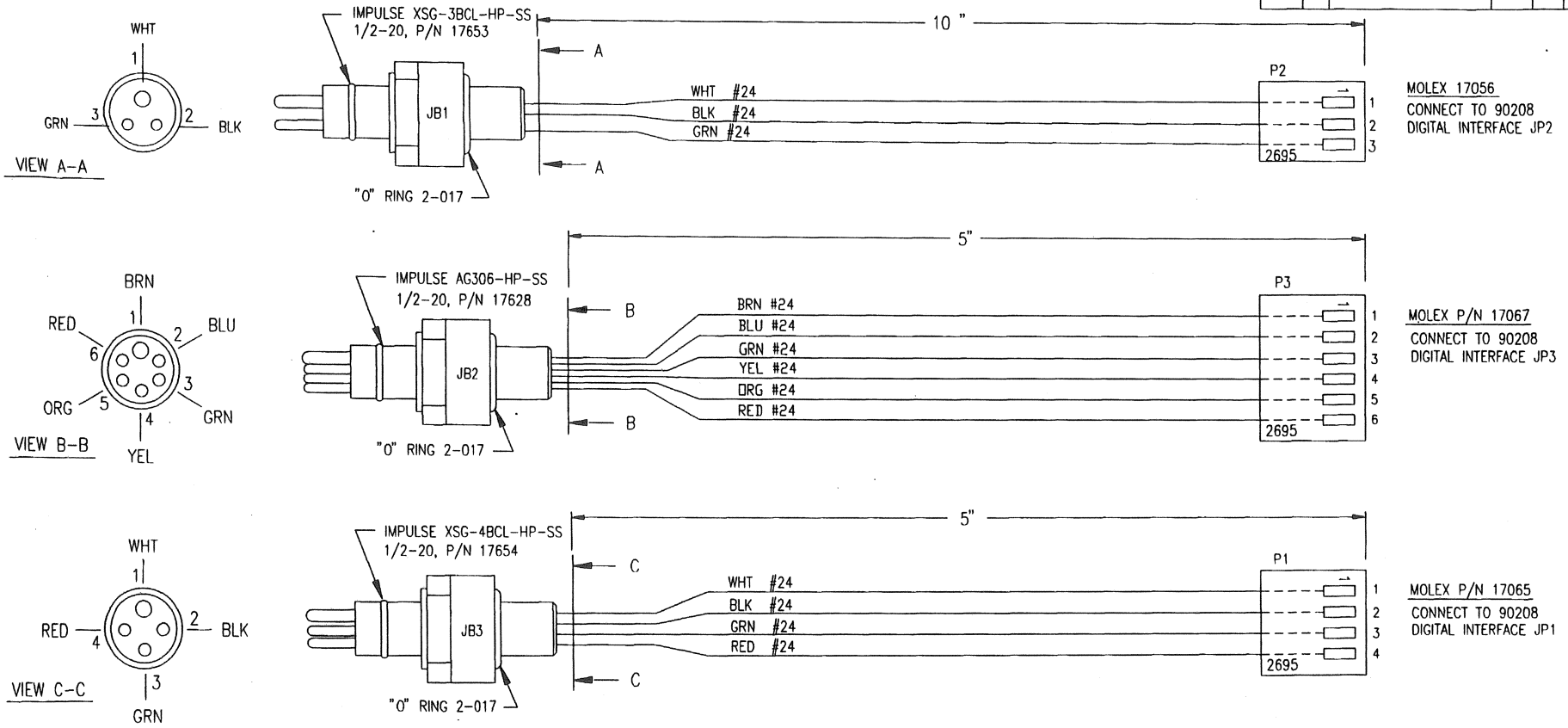
ALIGNED WITH LARGE PIN (PIN 1)

EXTERNAL VIEW

NOTE: INSTALL CONNECTORS RELATIVE TO END CAP MOUNTING HOLES.

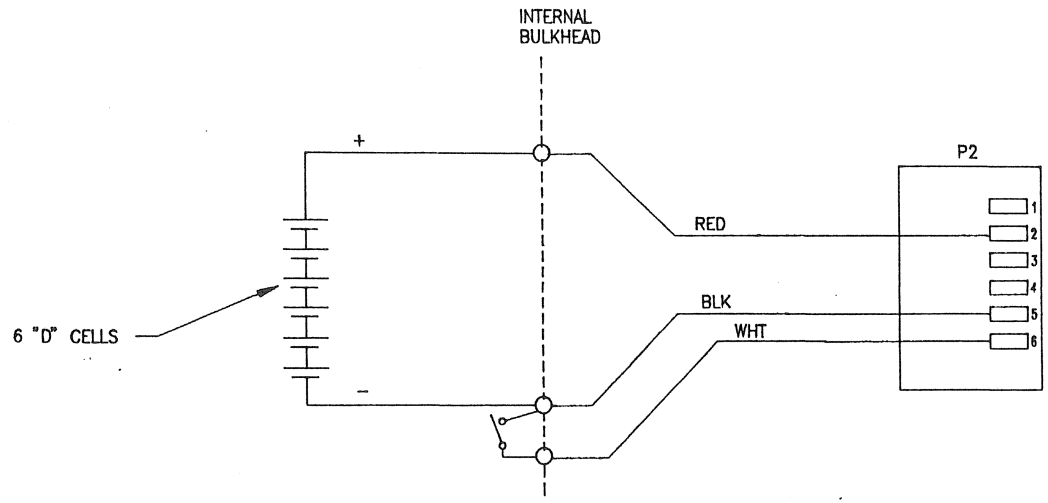
TOLERANCES	SEA-BIRD ELECTRONICS, INC			
FRACTIONAL	P/N 90208	SCALE –	DRAWN BY BMc APPROVED BY	
DECIMAL	TITLE AUTO-FIRE MODULE ENDCAP CONNECTORS			
ANGULAR	DATE 7/6/94	DRAWING NUMBER 50114		REV

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.



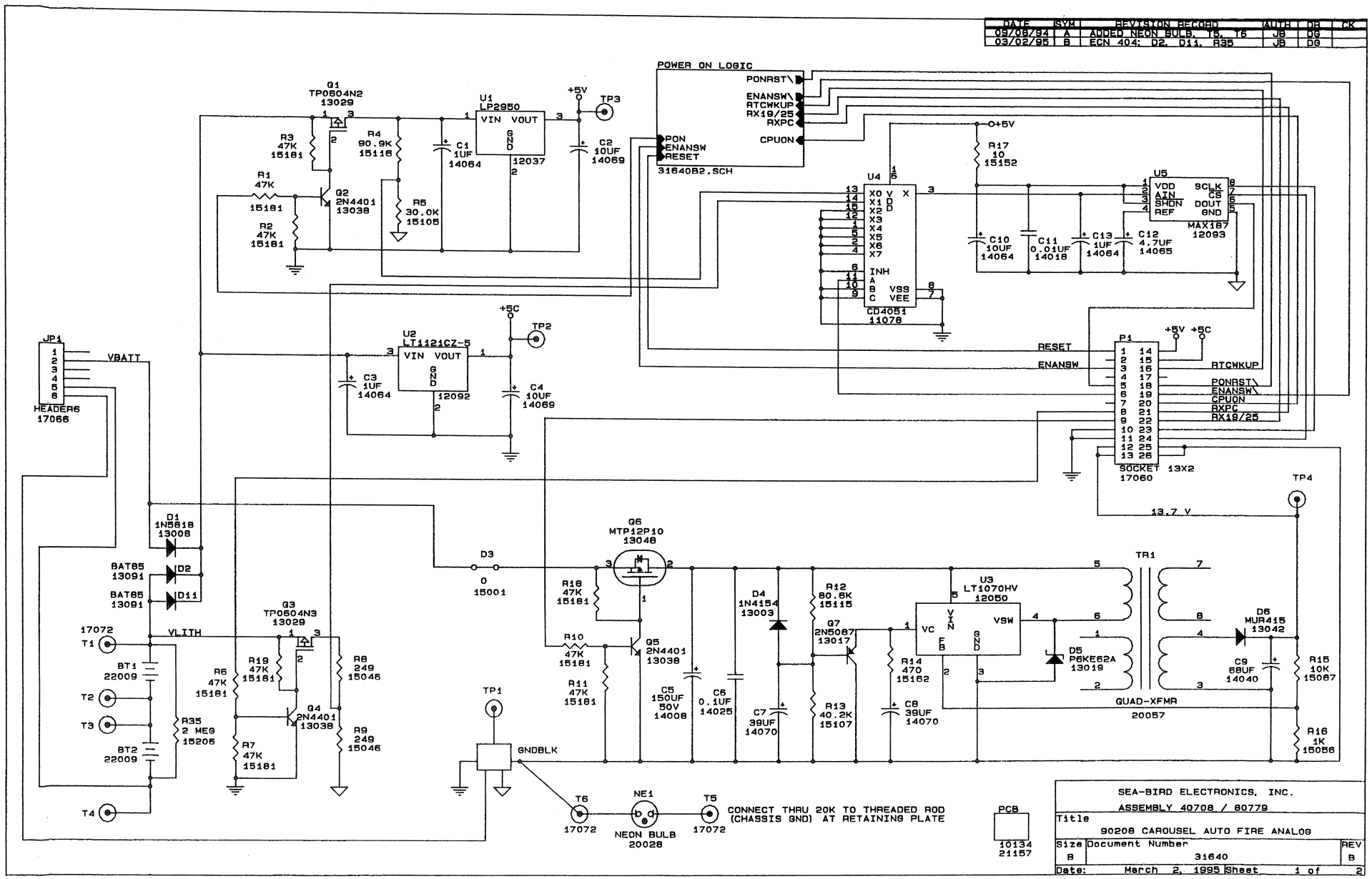
TOLERANCES	SEA-BIRD ELECTRONICS, INC		
FRACTIONAL	P/N 90208	SCALE –	DRAWN BY BMc APPROVED BY
DECIMAL	TITLE AUTO FIRE MODULE ENDCAP INTERNAL WIRING		
ANGULAR	DATE 7/6/94	DWG NO. 31687	REV

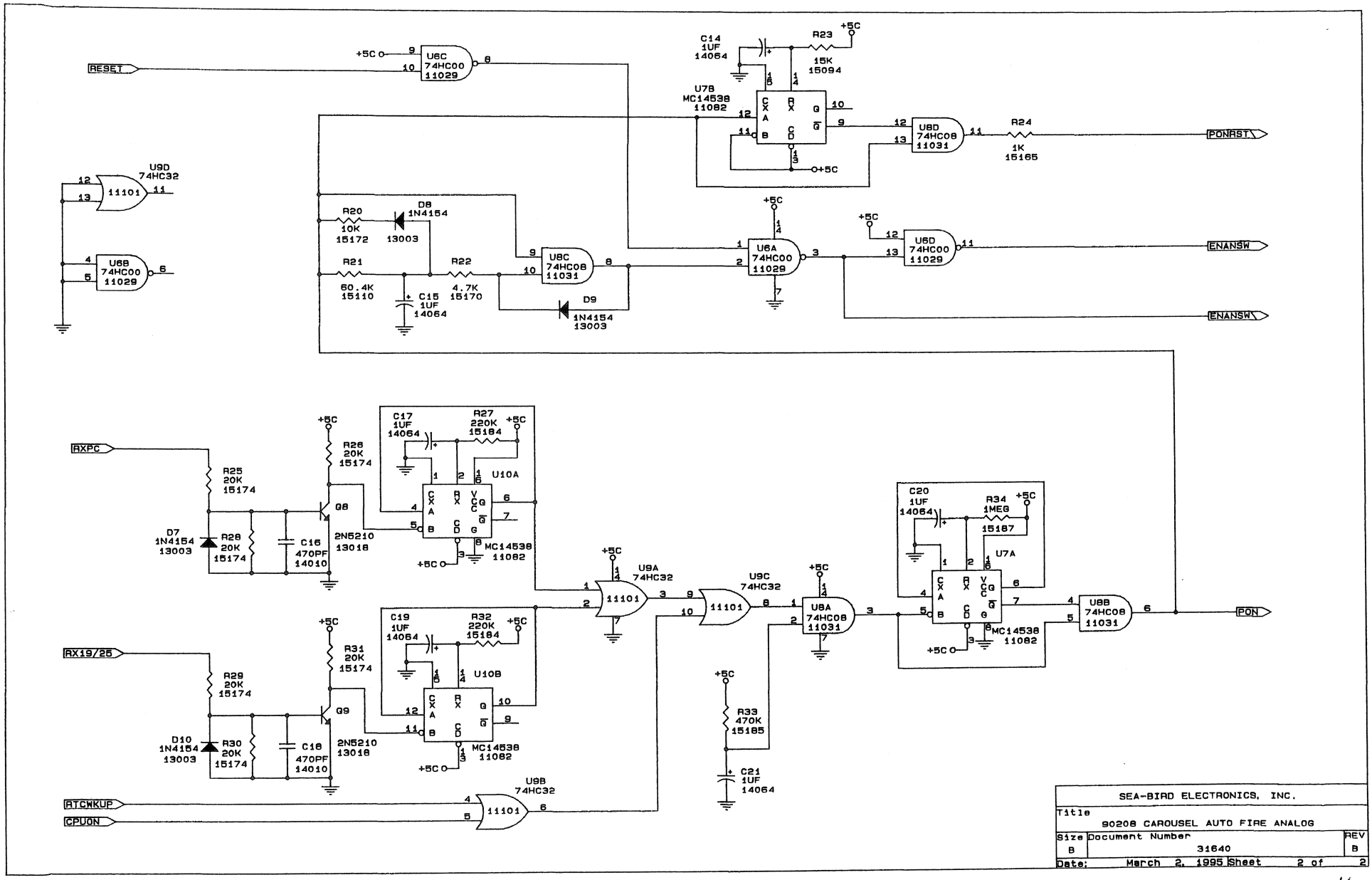
DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.



TOLERANCES	SEA-BIRD ELECTRONICS, INC			
FRACTIONAL	P/N	SCALE –	DRAWN BY BMC APPROVED BY	
DECIMAL	TITLE SEACAT BATTERY WIRING WITH RESET SWITCH			
ANGULAR	DATE 9/14/89	DRAWING NUMBER 30712		REV

REDRAWN ON ACAD NO CHG 10/26/92


REVISION RECORD
DATE | SYM | REVISION RECORD | AUTH | DR | CK
09/08/94 | A | ADDED NEON BULB, T5, T6 | JB | DG
03/02/95 | B | ECN 404: D2, D11, R35 | JB | DG
POWER ON LOGIC
PONRST\
ENANSW\
RTCWKUP
RX19/25
RXPC
CPUON
PON
ENANSW
RESET
31640B2.SCH
Q1 TP0604N2 13029
U1 LP2950
VIN VOUT GND
TP3
+5V
R3 47K 15181
R4 90.9K 15116
C1 1UF 14064
12037
C2 10UF 14069
R1 47K 15181
Q2 2N4401 13038
R2 47K 15181
R5 30.0K 15105
U4 CD4051 11078
R17 10 15152
U5 MAX187 12093
VDD SCLK AIN CS SHDN DOUT REF GND
C10 10UF 14064
C11 0.01UF 14018
C13 1UF 14064
C12 4.7UF 14065
JP1 HEADER6 17066
VBATT
U2 LT1121CZ-5 12092
C3 1UF 14064
C4 10UF 14069
TP2
P1 SOCKET 13X2 17060
RESET
ENANSW
RTCWKUP
PONRST\
ENANSW\
CPUON
RXPC
RX19/25
TP4
13.7 V
D1 1N5818 13008
BAT85 13091 D2
BAT85 13091 D11
D3 0 15001
Q6 MTP12P10 13048
R18 47K 15181
R10 47K 15181
Q5 2N4401 13038
R11 47K 15181
C5 150UF 50V 14008
C6 0.1UF 14025
D4 1N4154 13003
C7 39UF 14070
R12 80.6K 15115
Q7 2N5087 13017
R13 40.2K 15107
U3 LT1070HV 12050
VC VIN VSW FB GND
R14 470 15162
C8 39UF 14070
D5 P6KE62A 13019
TR1 QUAD-XFMR 20057
D6 MUR415 13042
C9 68UF 14040
R15 10K 15067
R16 1K 15056
17072
T1
T2
T3
T4
BT1 22009
BT2 22009
R35 2 MEG 15206
VLITH
Q3 TP0604N3 13029
R6 47K 15181
R19 47K 15181
R7 47K 15181
Q4 2N4401 13038
R8 249 15046
R9 249 15046
TP1
GNDBLK
T6
NE1 NEON BULB 20028
T5
17072
CONNECT THRU 20K TO THREADED ROD (CHASSIS GND) AT RETAINING PLATE
PCB 10134 21157
SEA-BIRD ELECTRONICS, INC.
ASSEMBLY 40708 / 80779
Title
90208 CAROUSEL AUTO FIRE ANALOG
Size B
Document Number 31640
REV B
Date: March 2, 1995 Sheet 1 of 2


RESET
U6C 74HC00 11029
C14 1UF 14064
R23 15K 15094
U7B MC14538 11082
U8D 74HC08 11031
R24 1K 15165
PONRST
U9D 74HC32 11101
U6B 74HC00 11029
R20 10K 15172
D8 1N4154 13003
R21 60.4K 15110
R22 4.7K 15170
C15 1UF 14064
U8C 74HC08 11031
D9 1N4154 13003
U6A 74HC00 11029
U6D 74HC00 11029
ENANSW
ENANSW
AXPC
R25 20K 15174
R26 20K 15174
C17 1UF 14064
R27 220K 15184
U10A
Q8
2N5210 13018
D7 1N4154 13003
R28 20K 15174
C16 470PF 14010
MC14538 11082
RX19/25
R29 20K 15174
R31 20K 15174
C19 1UF 14064
R32 220K 15184
U10B
Q9
2N5210 13018
D10 1N4154 13003
R30 20K 15174
C18 470PF 14010
MC14538 11082
U9A 74HC32
U9C 74HC32
U8A 74HC08 11031
C20 1UF 14064
R34 1MEG 15187
U7A
MC14538 11082
U8B 74HC08 11031
PON
R33 470K 15185
C21 1UF 14064
U9B 74HC32
RTCWKUP
CPUON
SEA-BIRD ELECTRONICS, INC.
Title
90208 CAROUSEL AUTO FIRE ANALOG
Size B
Document Number 31640
REV B
Date: March 2, 1995 Sheet 2 of 2

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.
9/94	A	ADDED NE1, T5, T6	JB	DL	
3/95	B	ECN 404: CHG D2, ADD D11	JB	DL	
5/95	C	ECN 404: R35 ADDED		DL	
6/95	D	PCB REWORKED TO REFLECT ABOVE CHANGES	DM	BM	

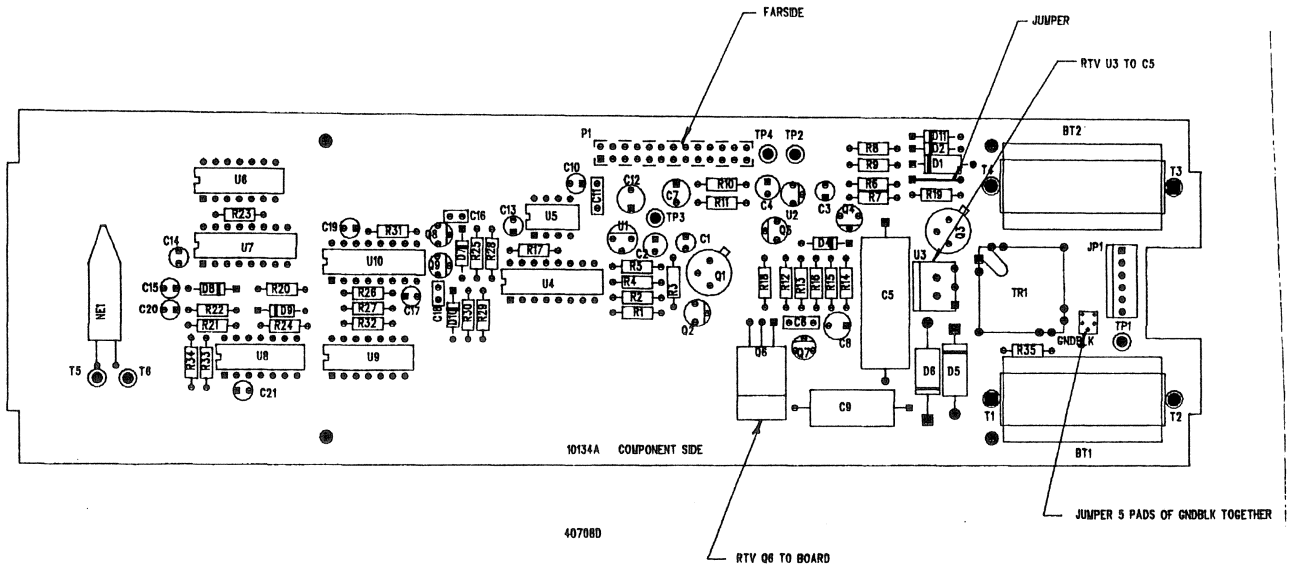
SLB PRINTED ON 13:22:19 06 MAR 1995

PART NUMBER.	DESCRIPTION	QPA	ITM REF DESIG NBR
80779	CAROUSEL AUTO FIRE ANALOG ASSY / 40708		
11029	IC, 74HC00N, QUAD 2-INPUT NAND	1.0000	U6
11031	IC, 74HC08N, QUAD 2-INPUT AND	1.0000	U8
11078	IC, CD4051BE	1.0000	U4
11082	IC, MC14538BCP, PREC DUAL SS	2.0000	U7 U10
11101	IC, 74HC32AN QUAD OR GATE	1.0000	U9
12037	IC, LP2950ACZ-5.0, 5 VOLT REGULATOR	1.0000	U1
12050	IC, LT1070HVCT, SW. REGULATOR	1.0000	U3
12092	IC, LT1121CZ-5 5V REGULATOR, LINEAR TECH	1.0000	U2
12093	IC, MAX187BCPA 12 BIT A/D CONV, MAXIM	1.0000	U5
13003	DIODE, 1N4154, UNITRODE	5.0000	D4 D7 D8 D9 D10
13008	DIODE, 1N5818, SCHOTKEY	1.0000	D1
13017	XISTOR, 2N5087, MOTOROLA	1.0000	Q7
13018	XISTOR, 2N5210, MOTOROLA	2.0000	Q8 Q9
13019	DIODE, P6KE62A, 62 V TRANS-SORB	1.0000	D5
13029	FET, TP0604N2, SUPERTEX, PWR.	2.0000	Q1 Q3
13038	XISTOR, 2N4401	3.0000	Q2 Q4 Q5
13042	DIODE, MUR 415, FAST RECOVERY	1.0000	D6
13048	FET, MTP12P10, MOTOROLA / IRF9530 SILICONIX	1.0000	Q6
13091	DIODE, PHILIPS BAT85-AMO	2.0000	D2 D11
14008	CAP, 150 uf, 50V AL ELECT, TVA1311	1.0000	C5
14010	CAP, 470 pf, 100V CER, SR151A471JAA, NPO	2.0000	C16 C18
14018	CAP, .01 uf, 100V CER, SR211C103KAA, X7R	1.0000	C11
14025	CAP, .1 uf, 100V CER, SR211C104KAA, X7R	1.0000	C6
14040	CAP, 68 uf, 15V TANT, CSR13D686KP	1.0000	C9
14064	CAP, 1 uf, 35V DIPPED TANT. T350A105K035AS	10.0000	C1 C3 C10 C13 C14 C15 C17 C19 C20 C21
14065	CAP, 4.7 uf, 25V DIPPED TANT, T350C475K025AS	1.0000	C12
14069	CAP, 10 uf, 20V DIPPED TANT, T350E106K020AS	2.0000	C2 C4
14070	CAP, 39 uf, 10V DIPPED TANT, 199D396X9010DA2	2.0000	C7 C8
15001	JUMPER WIRE	1.0000	D3
15046	RES, 249 OHM, 1%, 1/4 W	2.0000	R8 R9
15056	RES, 1K OHM, 1%, 1/4 W	1.0000	R16
15087	RES, 10K OHM, 1%, 1/4 W	1.0000	R15
15094	RES, 15K OHM, 1%, 1/4 W	1.0000	R23
15105	RES, 30.1K OHM, 1%, 1/4 W	1.0000	R5
15107	RES, 40.2K OHM, 1%, 1/4 W	1.0000	R13

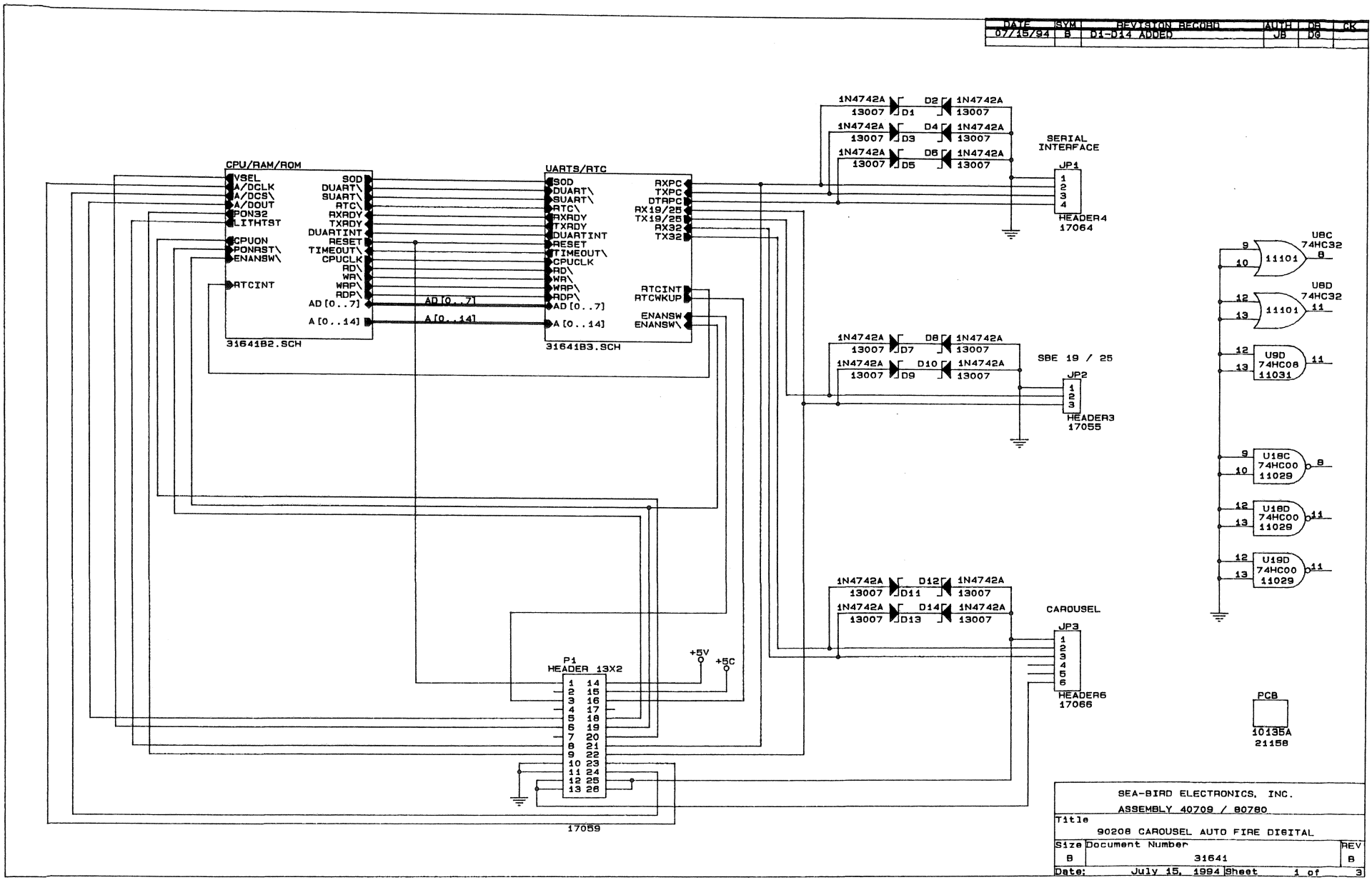
PART NUMBER.	DESCRIPTION	QPA	ITM REF DESIG NBR
15110	RES, 60.4K OHM, 1%, 1/4 W	1.0000	R21
15115	RES, 80.6K OHM, 1%, 1/4 W	1.0000	R12
15116	RES, 90.9K OHM, 1%, 1/4 W	1.0000	R4
15152	RES, 10 OHM, 5%, 1/4 W	1.0000	R17
15162	RES, 470 OHM, 5%, 1/4 W	1.0000	R14
15165	RES, 1K OHM, 5%, 1/4 W	1.0000	R24
15170	RES, 4.7K OHM, 5%, 1/4 W	1.0000	R22
15172	RES, 10K OHM, 5%, 1/4 W	1.0000	R20
15174	RES, 20K OHM, 5%, 1/4 W	6.0000	R25 R26 R28 R29 R30 R31
15181	RES, 47K OHM, 5%, 1/4 W	9.0000	R1 R2 R3 R6 R7 R10 R11 R18 R19
15184	RES, 220K OHM, 5%, 1/4 W	2.0000	R27 R32
15185	RES, 470K OHM, 5%, 1/4 W	1.0000	R33
15187	RES, 1 MEG OHM, 5%, 1/4 W	1.0000	R34
15206	RES, 2 MEG OHM, 1%,1/4W CMF55	1.0000	R35
17060	SOCKET, 26 PIN, 2 ROW, SAMTEK SD113G2	1.0000	P1
17066	HEADER, 6 PIN, MOLEX 6373-22-11-2062	1.0000	JP1
17072	TERMINAL, PCB, 1/16", USECO 2520B-1	10.0000	TP1 T1 TP2 T2 TP3 T3 TP4 T4 T5 T6
20028	NEON BULB, ALCO NE-211	1.0000	NE1
20057	SBE 25 ANAL. INTRFCE XFMR, QUAD, /DWG 40316	1.0000	TR1
21157	PCB, CAROUSEL AUTOFIRE ANAL BD, /10134	1.0000	PCB
22009	LITHIUM BATTERY, BR 2/3 A-T2SP	2.0000	BT1 BT2

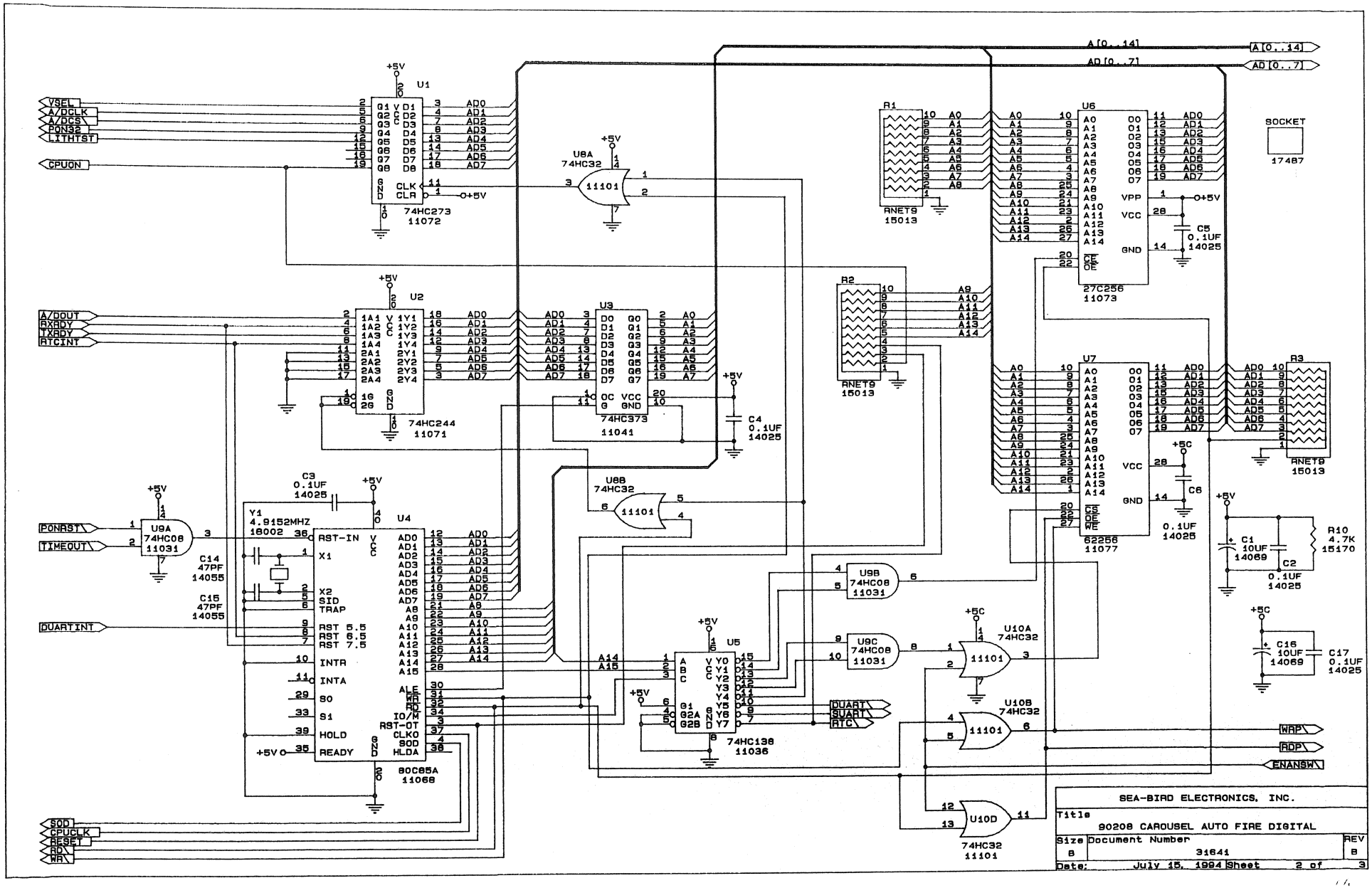
***

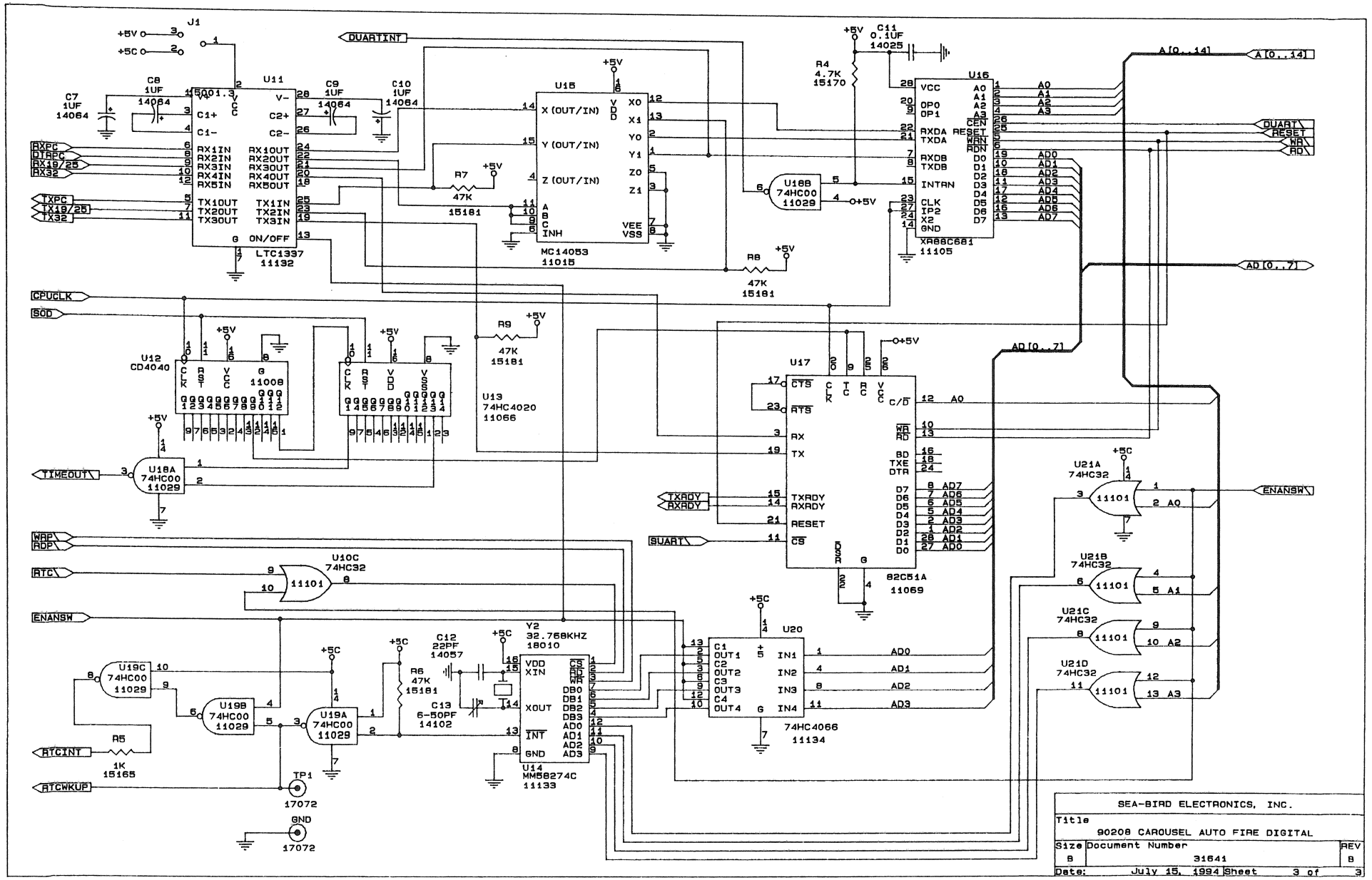
TOLERANCES	SEA-BIRD ELECTRONICS, INC		
DECIMAL .XX .02 .XXX .010	P/N 31640	SCALE 1X	DRAWN BY BM
FRACTIONAL ±	TITLE CAROUSEL AUTO FIRE ANALOG ASSY		APPROVED BY
ANGULAR ±	DATE 6/20/94	DRAWING NUMBER SH 1 OF 2 40708	REV D



DWG NO	REV
SH 2 OF 2 40708	D


DATE | SYM | REVISION RECORD | AUTH | DR | CK
07/15/94 | B | D1-D14 ADDED | JB | DG
CPU/RAM/ROM
VSEL
A/DCLK
A/DCS\
A/DOUT
PON32
LITHTST
CPUON
PONRST\
ENANSW\
RTCINT
SOD
DUART\
SUART\
RTC\
RXRDY
TXRDY
DUARTINT
RESET
TIMEOUT\
CPUCLK
RD\
WR\
WRP\
RDP\
AD[0..7]
A[0..14]
31641B2.SCH
UARTS/RTC
SOD
DUART\
SUART\
RTC\
RXRDY
TXRDY
DUARTINT
RESET
TIMEOUT\
CPUCLK
RD\
WR\
WRP\
RDP\
AD[0..7]
A[0..14]
RXPC
TXPC
DTRPC
RX19/25
TX19/25
RX32
TX32
RTCINT
RTCWKUP
ENANSW
ENANSW\
31641B3.SCH
1N4742A 13007 D1
1N4742A 13007 D2
1N4742A 13007 D3
1N4742A 13007 D4
1N4742A 13007 D5
1N4742A 13007 D6
SERIAL INTERFACE
JP1
HEADER4
17064
1N4742A 13007 D7
1N4742A 13007 D8
1N4742A 13007 D9
1N4742A 13007 D10
SBE 19 / 25
JP2
HEADER3
17055
1N4742A 13007 D11
1N4742A 13007 D12
1N4742A 13007 D13
1N4742A 13007 D14
CAROUSEL
JP3
HEADER6
17066
P1
HEADER 13X2
17059
+5V
+5C
U8C 74HC32 8
U8D 74HC32 11
U9D 74HC08 11
11031
U16C 74HC00 8
U16D 74HC00 11
U19D 74HC00 11
11029
PCB
10135A
21158
SEA-BIRD ELECTRONICS, INC.
ASSEMBLY 40709 / 80780
Title
90208 CAROUSEL AUTO FIRE DIGITAL
Size B
Document Number 31641
REV B
Date: July 15, 1994 Sheet 1 of 3


A[0..14]
AD[0..7]
VSEL
A/DCLK
A/DCS
PON32
LITHTST
CPUON
U1
74HC273
11072
U8A
74HC32
11101
R1
RNET9
15013
U6
27C256
11073
SOCKET
17487
C5
0.1UF
14025
A/DOUT
RXRDY
TXRDY
RTCINT
U2
74HC244
11071
U3
74HC373
11041
R2
C4
0.1UF
14025
U7
62256
11077
R3
C6
0.1UF
14025
PONRST
TIMEOUT
U9A
74HC08
11031
C3
0.1UF
14025
Y1
4.9152MHZ
18002
U4
80C85A
11068
C14
47PF
14055
C15
47PF
14055
U8B
74HC32
11101
U9B
74HC08
11031
U9C
74HC08
11031
U10A
74HC32
11101
U10B
74HC32
11101
U10D
74HC32
11101
U5
74HC138
11036
C1
10UF
14069
C2
0.1UF
14025
R10
4.7K
15170
C16
10UF
14069
C17
0.1UF
14025
DUARTINT
DUART
SUART
RTC
WRP
RDP
ENANSW
SOD
CPUCLK
RESET
RD
WR
SEA-BIRD ELECTRONICS, INC.
Title
90208 CAROUSEL AUTO FIRE DIGITAL
Size
B
Document Number
31641
REV
B
Date: July 15, 1994 Sheet 2 of 3


J1
DUARTINT
U11
LTC1337
11132
U15
MC14053
11015
U16
XR88C681
11105
U18B
74HC00
11029
U12
CD4040
11008
U13
74HC4020
11066
U17
82C51A
11069
U18A
74HC00
11029
U10C
74HC32
11101
U20
74HC4066
11134
U19C
74HC00
11029
U19B
74HC00
11029
U19A
74HC00
11029
U14
MM58274C
11133
U21A
74HC32
11101
U21B
74HC32
11101
U21C
74HC32
11101
U21D
74HC32
11101
Y2
32.768KHZ
18010
TP1
17072
GND
17072
CPUCLK
SOD
TIMEOUT
WRP
RDP
RTC
ENANSW
RTCINT
RTCWKUP
TXRDY
RXRDY
SUART
A[0..14]
AD[0..7]
DUART
RESET
WR
RD
SEA-BIRD ELECTRONICS, INC.
Title
90208 CAROUSEL AUTO FIRE DIGITAL
Size B
Document Number 31641
REV B
Date: July 15, 1994 Sheet 3 of 3

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.
7/94	B	REVISED PCB-REVB	JB	BMC	

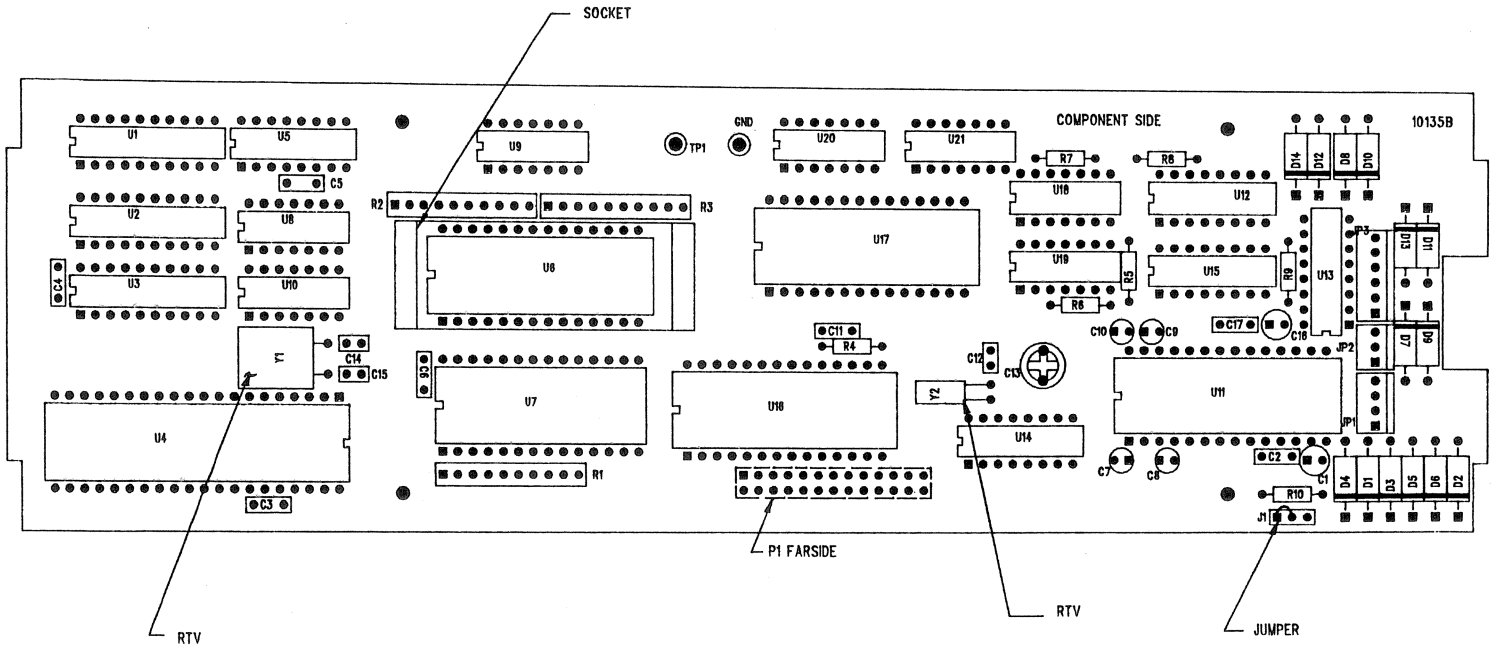
SLB PRINTED ON 06:56:27 18 JUL 1994

PART NUMBER.	DESCRIPTION.....	QPA.....	ITM NBR	REF DESIG.....
80780	CAROUSEL AUTO FIRE DIGITAL ASSY, / 40709A			
11008	IC, 74HC4040N, HC RIPPLE CTR.	1.0000		U12
11015	IC, CD4053BE	1.0000		U15
11029	IC, 74HC00N, QUAD 2-INPUT NAND	2.0000		U18 U19
11031	IC, 74HC08N, QUAD 2-INPUT AND	1.0000		U9
11036	IC, 74HC138N, 3-TO-8 DECODER	1.0000		U5
11041	IC, 74HC373N, OCTAL LATCH	1.0000		U3
11066	IC, 74HC4020N	1.0000		U13
11068	IC, MSM80C85ARS, CMOS CPU	1.0000		U4
11069	IC, MSM82C51ARS, CMOS UART	1.0000		U17
11071	IC, 74HC244, OCTAL BUFFER	1.0000		U2
11072	IC, 74HC273N, OCTAL FLIP-FLOPS	1.0000		U1
11073	IC, TMS27C256-2JL EPROM	1.0000		U6
11077	IC, HM62256ALP-12, 32K X 8 CMOS LO PWR	1.0000		U7
11101	IC, 74HC32AN QUAD OR GATE	3.0000		U8 U10 U21
11105	IC, XR-88C681CP/28 CMOS DUART	1.0000		U16
11132	IC, LTC1337CN 3DRVRS/5RCVRS RS232, LIN TECH	1.0000		U11
11133	IC, MM58274CN REAL TIME CLK, NATIONAL	1.0000		U14
11134	IC, MC74HC4066AN, MOTOROLA	1.0000		U20
13007	ZENER, 1N4742A, 12 VOLT	14.0000		D1-D14
14025	CAP, .1 uf, 100V CER, SR211C104KAA, X7R	7.0000		C2 C3 C4 C5 C6 C11 C17
14055	CAP, 47 pf, 100V CER, SR151A470KAA, NPO	2.0000		C14 C15
14057	CAP, 22 pf, 100V CER, SR151A220KAA, NPO	1.0000		C12
14064	CAP, 1 uf, 35V DIPPED TANT. T350A105K035AS	4.0000		C7 C8 C9 C10
14069	CAP, 10 uf, 20V DIPPED TANT, T350E106K020AS	2.0000		C1 C16
14102	CAP, TRIMMER 6 TO 50pf, TZ03Z500ER169	1.0000		C13
15001.3	JUMPER WIRE, 3 POSITION	1.0000		J1
15013	RES-NET, 100K OHM SIP, 4310R-101-104	3.0000		R1 R2 R3
15165	RES, 1K OHM, 5%, 1/4 W	1.0000		R5
15170	RES, 4.7K OHM, 5%, 1/4 W	2.0000		R10 R4
15181	RES, 47K OHM, 5%, 1/4 W	4.0000		R6 R7 R8 R9
17055	HEADER, 3 PIN, MOLEX 6373-22-11-2032	1.0000		JP2
17059	HEADER, 26 PIN, 2 ROW, SAMTEK BBD-113GB	1.0000		P1
17064	HEADER, 4 PIN, MOLEX 6373-22-11-2042	1.0000		JP1
17066	HEADER, 6 PIN, MOLEX 6373-22-11-2062	1.0000		JP3
17072	TERMINAL, PCB, 1/16", USECO 2520B-1	2.0000		TP1 GND

PART NUMBER.	DESCRIPTION.....	QPA.....	ITM NBR	REF DESIG...
17487	SOCKET, 28 PIN ARIES 28-C182-10	1.0000		SOCKET
18002	XTAL, 4.9152 MHZ, FOX 049/SVF49152	1.0000		Y1
18010	XTAL, WATCH, 32.768 KHZ, FOX NC-38	1.0000		Y2
21158	PCB, AUTOFIRE DIGITAL BD, /DWG 10135A	1.0000		PCB

***

TOLERANCES	SEA-BIRD ELECTRONICS, INC		
FRACTIONAL	P/N 31641	SCALE 5:4	DRAWN BY BMC
			APPROVED BY
DECIMAL	TITLE CAROSEL AUTO FIRE DIGITAL-PCB ASSY		
ANGULAR	DATE 7/18/94	DRAWING NUMBER SH 1 OF 2 40709	REV B



SH 2 OF 2	40709	B

WARRANTY POLICY 2006

5-YEAR LIMITED WARRANTY (NEW PRODUCTS)

For a period of five years after the date of original shipment from our factory, products manufactured by Sea-Bird are warranted to function properly and be free of defects in materials and workmanship. Should a Sea-Bird instrument fail during the warranty period, return it freight pre-paid to our factory. We will repair it (or at our option, replace it) at no charge, and pay the cost of shipping it back to you. Certain products and components have modified coverage under this warranty as described below.

LIMITED WARRANTY ON SERVICE & REPAIRS

Service work, repairs, replacement parts and modifications are warranted to be free of defects in materials or workmanship for the remainder of the original 5-year warranty or one year from the date of shipment from our factory after repair or service, which ever is longer. Certain products and components have modified coverage under this warranty as described below.

MODIFICATIONS / EXCEPTIONS / EXCLUSIONS

1. The SBE 43 DO sensor is warranted to function properly for 5 years. Under normal use however, the electrolyte in an SBE 43 DO sensor will require replenishment after about 3 years. Purchase of an SBE 43 includes one free electrolyte replenishment (as necessitated by chemical depletion of electrolyte) anytime during the warranty period. To obtain the replenishment, return the sensor freight pre-paid to our factory. We will refurbish it for free (electrolyte refill, membrane replacement, and recalibration) and pay the cost of shipping it back to you. Membrane damage or depletion of electrolyte caused by membrane damage is not covered by this warranty.

2. Because pH and other dissolved oxygen (DO) electrodes have a limited life caused by the depletion of their chemical constituents during normal storage and use, our warranty applies differently to such electrodes. Electrodes in SBE 13Y and 23Y DO sensors, SBE 18 pH sensors, and SBE 27 pH/ORP sensors are covered under warranty for the first 90 days only. Other components of the sensor are covered for 5 years.

3. Equipment manufactured by other companies (e.g., fluorometers, transmissometers, PAR, optical backscatter sensors, altimeters, etc.) are warranted only to the limit of the warranties provided by their original manufacturers (typically 1 year).

4. Batteries, zinc anodes or other consumable/expendable items are not covered under this warranty.

5. Electrical cables and dummy plugs are warranted to function properly and be free of defects in materials and workmanship for 1 year.

6. This warranty is void if in our opinion the instrument has been damaged by accident, mishandled, altered, improperly serviced, or repaired by the customer where such treatment has affected its performance or reliability. In the event of such misuse/abuse by the customer, costs for repairs plus two-way freight costs will be borne by the customer. Instruments found defective should be returned to the factory carefully packed, as the customer will be responsible for freight damage.

7. Incidental or consequential damages or costs incurred as a result of product malfunction are not the responsibility of SEA-BIRD ELECTRONICS, INC

Warranty Administration Policy

Sea-Bird Electronics, Inc. and its authorized representatives or resellers provide warranty support only to the original purchaser. Warranty claims, requests for information or other support, and orders for post-warranty repair and service, by end-users that did not purchase directly from Sea-Bird or an authorized representative or reseller, must be made through the original purchaser. The intent and explanation of our warranty policy follows:

1. Warranty repairs are only performed by Sea-Bird.

2. Repairs or attempts to repair Sea-Bird products performed by customers (owners) shall be called *owner repairs*.

3. Our products are designed to be maintained by competent owners. Owner repairs of Sea-Bird products will NOT void the warranty coverage (as stated above) simply as a consequence of their being performed.

4. Owners may make repairs of any part or assembly, or replace defective parts or assemblies with Sea-Bird manufactured spares or authorized substitutes without voiding warranty coverage of the entire product, or parts thereof. Defective parts or assemblies removed by the owner may be returned to Sea-Bird for repair or replacement within the terms of the warranty, without the necessity to return the entire instrument. If the owner makes a successful repair, the repaired part will continue to be covered under the original warranty, as if it had never failed. Sea-Bird is not responsible for any costs incurred as a result of owner repairs or equipment downtime.

5. We reserve the right to refuse warranty coverage *on a claim by claim basis* based on our judgment and discretion. We will not honor a warranty claim if in our opinion the instrument, assembly, or part has been damaged by accident, mishandled, altered, or repaired by the customer *where such treatment has affected its performance or reliability*.

6. For example, if the CTD pressure housing is opened, a PC board is replaced, the housing is resealed, and then it floods on deployment, we do not automatically assume that the owner is to blame. We will consider a claim for warranty repair of a flooded unit, subject to our inspection and analysis. If there is no evidence of a fault in materials (e.g., improper or damaged o-ring, or seal surfaces) or workmanship (e.g., pinched o-ring due to improper seating of end cap), we would cover the flood damage under warranty.

7. In a different example, a defective PC board is replaced with a spare and the defective PC board is sent to Sea-Bird. We will repair or replace the defective PC board under warranty. The repaired part as well as the instrument it came from will continue to be covered under the original warranty.

8. As another example, suppose an owner attempts a repair of a PC board, but solders a component in backwards, causing the board to fail and damage other PC boards in the system. In this case, the evidence of the backwards component will be cause for our refusal to repair the damage under warranty. However, this incident will NOT void future coverage under warranty.

9. If an owner's technician attempts a repair, we assume his/her qualifications have been deemed acceptable to the owner. The equipment owner is free to use his/her judgment about who is assigned to repair equipment, and is also responsible for the outcome. The decision about what repairs are attempted and by whom is entirely up to the owner.

Service Request Form

To return your instrument for calibration or other service, please take a few moments to provide us with the information we need, so we can serve you better.

PLEASE:

1. **Get a Returned Material Authorization (RMA) number from Sea-Bird (*phone 425-643-9866, fax 425-643-9954, or email seabird@seabird.com*). Reference the RMA number on this form, on the outside shipping label for the equipment, and in all correspondence related to this service request.**
2. **Fill out 1 form for each type (model) of instrument.**
3. **Include this form when shipping the instrument to Sea-Bird for servicing.**
4. **Fax us a copy of this form on the day you ship.** ***FAX: (425) 643-9954***

RETURNED MATERIAL AUTHORIZATION (RMA) NUMBER: _____

DATE EQUIPMENT REQUIRED BY: _____

DO YOU REQUIRE A WRITTEN QUOTE? _____

CONTACT INFORMATION

Your name: _____

Institution/Organization/Company: _____

Shipping/Delivery address for packages: _____

_____

_____

Telephone: _____ Fax: _____

e-mail: _____

SERVICE INFORMATION

Date Shipped: _____

Sea-Bird Model Number (for example, SBE 37-SM): _____

Quantity: _____

Serial Numbers: _____

_____

_____

(**Note**: **Specify instrument serial numbers below** if specific services are required for some instruments. For example, if 10 instruments are being returned for calibration, and 1 of the 10 also requires repairs, specify the serial number for the instrument requiring repairs in the appropriate section of the form.)

SEASOFT Version you have been using with this instrument(s): _____

[ ] Calibration Services:

____Calibration (includes basic diagnostic):

___Temperature ___Conductivity ___Pressure ___DO ___pH

(Please allow a minimum of 3 weeks after we receive the instrument(s) to complete calibration.)

____Other (specify): _____

_____

[ ] Internal Inspection and O-Ring Replacement (includes hydrostatic pressure test):

Additional charges may apply.

_____

_____

[ ] System Upgrade or Conversion:

Specify (include instrument serial number if multiple instruments are part of shipment): _____

_____

_____

[ ] Diagnose and Repair Operational Faults:

Please send a disk containing the raw data (.hex or .dat files) that shows the problems you describe. Also send the .con files you used to acquire or display the data.

Problem Description (continue on additional pages if needed; include instrument serial number if multiple instruments are part of shipment): _____

_____

_____

_____

PAYMENT/BILLING INFORMATION

Credit Card: Sea-Bird accepts payment by VISA, MasterCard, or American Express.

[ ] MasterCard [ ] Visa [ ] American Express

Account Number: _____ Expiration Date: _____

Credit Card Holder Name (printed or typed): _____

Credit Card Holder Signature: _____

Credit Card Billing Address (if different than shipping address):

_____

_____

_____

Invoice/Purchase Order: If you prefer us to invoice you, please complete the following or enclose a copy of your Purchase Order:

Purchase Order Number: _____

Billing Address (if different than shipping address):

_____

_____

_____

Instructions for Returning Goods to Sea-Bird

1. **Domestic Shipments (USA) - Ship prepaid** (via UPS, FedEx, DHL, etc.) directly to:
   Sea-Bird Electronics, Inc.
   1808 136th Place NE
   Bellevue, WA 98005, USA
   Telephone: (425) 643-9866 Fax: (425) 643-9954
2. **International Shipments** –
   Option A. Ship via **PREPAID AIRFREIGHT to SEA-TAC International Airport (IATA Code "SEA"):**
   Sea-Bird Electronics, Inc.
   1808 136th Place NE
   Bellevue, WA 98005, USA
   Telephone: (425) 643-9866 Fax: (425) 643-9954 E-mail: seabird@seabird.com

   Notify: MTI Worldwide Logistics for Customs Clearance
   Seattle, WA, USA
   Telephone: (206) 431-4366 Fax: (206) 431-4374 E-mail: bill.keebler@mti-worldwide.com

   E-mail flight details and airway bill number to seabird@seabird.com and bill.keebler@mti-worldwide.com when your shipment is en-route. Include your RMA number in the e-mail.

   Option B. Ship via **EXPRESS COURIER directly to Sea-Bird Electronics**:
   If you choose this option, **we recommend shipping via UPS, FedEx, or DHL**. Their service is door-to-door, including customs clearance. It is not necessary to notify our customs agent, MTI Worldwide, if you ship using a courier service.

   E-mail the airway bill / tracking number to seabird@seabird.com when your shipment is en-route. Include your RMA number in the e-mail.

   For All International Shipments:
   Include a **commercial invoice** showing the description of the instruments, and **Value for Customs purposes only**. Include the following statement:
   "U.S. Goods Returned for Repair/Calibration. Country of Origin: USA. Customs Code: 9801001012."
   Failure to include this statement in your invoice will result in US Customs assessing duties on the shipment, which we will in turn pass on to the customer/shipper.

Note: Due to changes in regulations, if Sea-Bird receives an instrument from outside the U.S. in a crate containing non-approved (i.e., non-heat-treated) wood, we will return the instrument in a new crate that meets the requirements of ISPM 15 (see http://www.seabird.com/customer_support/retgoods.htm for details). We will charge for the replacement crate based on the dimensions of the crate we receive, determined as follows:

1. Multiply the crate length x width x height in centimeters (overall volume in cm^3, not internal volume).
2. Determine the price based on your calculated overall volume and the following chart:

Overall Volume (cm^3)	< 52,000	52,000 to < 65,000	65,000 to < 240,000	> 240,000
Example Instrument	37-SM MicroCAT	SEACAT, no cage	CTD in cage	--
Price (USD)	$45	$70	$125	consult factory

These prices are valid only for crate replacement required in conjunction with return of a customer's instrument after servicing, and only when the instrument was shipped in a crate originally supplied by Sea-Bird.