SBE 44

Underwater Inductive Modem (UIM)

With RS-232 Interface for Serial Instrument

Note: NEW ADDRESS
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User's Manual

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Manual Version #018, 01/27/10
UIM Firmware Version 1.9a & later
SIM Firmware Version 3.0a & later

Limited Liability Statement

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Table of Contents

Section 1: Introduction

This section includes contact information, Quick Start procedure, photos of a standard SBE 44 Underwater Inductive Modem (UIM) shipment, and shipping precautions.

About this Manual

This manual is to be used with the SBE 44 UIM.

It is organized to guide the user from installation through operation. We've 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 contact us with any comments or suggestions (seabird@seabird.com or 425-643-9866). Our business hours are Monday through Friday, 0800 to 1700 Pacific Standard Time (1600 to 0100 Universal Time) in winter and 0800 to 1700 Pacific Daylight Time (1500 to 0000 Universal Time) the rest of the year.

Quick Start

Follow these steps to get a Quick Start using the UIM.
The manual provides step-by-step details for performing each task:

1. Perform pre-check (*Section 3: Preparing UIM for Deployment*):
   A. Install batteries.
   B. Test power and communications, and set UIM ID.

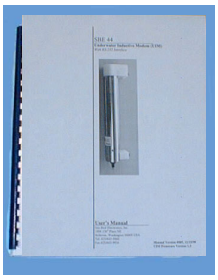
2. Deploy UIM (*Section 4: Deploying and Operating UIM*):
   A. Install new batteries if necessary.
   B. Input system operating parameters.
   C. Deploying multiple UIMs: verify UIM set to *Prompt ID*.
   D. Install cable connecting UIM to serial instrument.
   E. Install UIM on mooring cable.
   F. Install Inductive Cable Coupler (optional) on mooring cable.
   G. Wire system.

Unpacking UIM

Shown below is a typical UIM shipment.

UIM

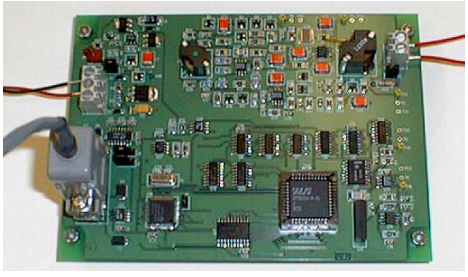
Spare parts (hardware and o-rings) kit



User Manual

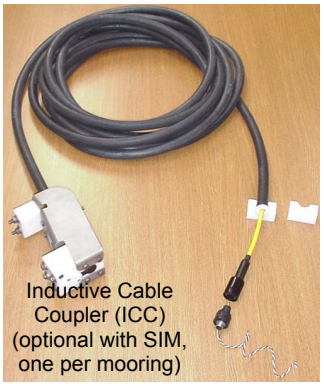
Software, and Electronic Copies of Software Manuals and User Manual

Serial Test Cable – connects UIM to computer to test serial communications through UIM's RS-232 bulkhead connector



Surface Inductive Modem (SIM) PCB (one per mooring, optional)

I/O Cable (included with SIM)



Inductive Cable Coupler (ICC) (optional with SIM, one per mooring)

Shipping Precautions

Batteries packed in heat-sealed plastic (above). Sea-Bird then places batteries in bubble-wrap outer sleeve and strong packaging for shipment (below).

For its main power supply, the UIM uses twelve 3.6-volt AA lithium batteries (Saft LS14500). The UIM was shipped from the factory with the batteries packaged separately within the shipping box (not inside the UIM). When packaged in the manner shown and described at left, the batteries are **not** considered Dangerous/Hazardous Goods, and may be shipped via commercial aircraft (those governed by DOT or IATA, including passenger airlines, or cargo carriers such as FedEx, DHL, UPS, etc.) if no more than the number of batteries required to operate the instrument are included in the shipment (i.e., no spares are included).

Assembled battery pack

WARNING!
Do not ship assembled battery pack by commercial aircraft.

IMPORTANT NOTE:
Do not ship the assembled battery pack by commercial aircraft. Refer to *Lithium Battery Shipping Guidelines* for background information on the applicable regulations as well as Sea-Bird's interpretation of those regulations, how they apply to the batteries in our equipment, and how we package and label our equipment.

Before attempting to communicate with the UIM, the batteries must be installed following the instructions in *Section 3: Preparing UIM for Deployment*.

Note:
Remove the batteries before returning the UIM to Sea-Bird. Do not return used batteries to Sea-Bird when shipping the UIM for repair. All setup information is preserved in EEPROM when the batteries are removed.

If you will re-ship the UIM by commercial aircraft after you have finished testing:

1. Remove the battery pack assembly from the UIM.
2. Remove the batteries from the battery pack assembly.
3. Pack the batteries separately as described in *Lithium Battery Shipping Guidelines*.

Section 2: Description of UIM

This section describes the functions and features of the UIM, including specifications, dimensions, and mooring requirements.

System Description

Note:
For detailed information on inductive modem systems, see *Real-Time Oceanography with Inductive Moorings*, at www.seabird.com under *Technical Papers*.

Note:
Half-duplex communication is **one-direction** at a time (i.e., you cannot send commands and receive data at the same time). For example, if the SIM commands a UIM to upload data from the serial instrument, nothing else can be done while the data is being sent – the data upload cannot be stopped, and commands cannot be sent to other UIMs on the line.

The SBE 44 Underwater Inductive Modem (UIM) makes it possible to integrate current meters, Doppler profilers, or other instruments having standard serial interfaces with MicroCATs or other instruments that communicate via Sea-Bird's inductive modem telemetry system. The UIM has a built-in inductive cable coupler (split toroid) and cable clamp, providing data communications without the need for electrical connections, and an easy and secure attachment to any point on a jacketed mooring wire. An underwater bulkhead connector on the end cap provides the serial data connection, an optional control line, and optional switched power out. Designed for moorings and other long duration, fixed-site deployments, UIMs have non-corroding titanium housings rated for operation to 7000 meters (23,000 feet).

When using the UIM, all that is required to link a computer or data logger to a serial instrument is a Surface Inductive Modem (SIM) PCB and a jacketed mooring wire. Communication between the PC or data logger and the SIM is full-duplex RS-232C (RS-485 optional). Commands and data are transmitted half-duplex between the SIM and the UIM. The UIM interprets the commands, relays correctly addressed commands to the serial instrument, and transmits replies from the instrument to the SIM.

The UIM transmits data over any insulated wire. Communication on a mooring is typically via the jacketed mooring wire. Cables up to 7000 meters (23,000 feet) long can be used. The superiority of the DPSK telemetry system provides a high degree of immunity from *fishbite* or other cable degradation. Laboratory bench testing may be performed by simply looping any insulated wire through the inductive core and connecting the ends of the wire to the SIM PCB.

Each UIM has a unique programmable address (ID), allowing up to 100 UIMs (or other instruments compatible with the Sea-Bird inductive modem) to be attached to a single mooring cable. Upon power up or receipt of the global wakeup command, the SIM sends a tone for two seconds, waking all UIMs on the cable. When the UIM receives a command containing its unique ID, it relays the command to the serial instrument and then transmits the reply over the inductive link. A 30 Kbyte FIFO buffer allows the UIM to interface to a serial instrument at 300, 600, 1200, 2400, 4800, 9600, or 19200 baud while transmitting data at 1200 baud over the inductive modem link. Programmable setup parameters stored in EEPROM include timeout values, control signal logic, and sensor response termination logic, allowing the UIM to interface to a wide variety of instruments without requiring custom programming. A global power-off command returns all UIMs to a quiescent (sleep) stand-by state. The UIM automatically returns to quiescent state if there is no line activity for a user-specified length of time.

Data can be requested and transmitted from the serial instrument in several ways, including:

Note:
Characters sent **from** the serial instrument **to** the UIM must be greater than 09 decimal (09 Hex) and less than 123 decimal (7B Hex). Additionally, the @ symbol (64 decimal or 40 Hex) cannot be sent.

- **Relay command** – sends a user-defined command string, character, or break recognizable by the serial instrument. This command is sent to a specific UIM, which transmits the character string / break to the serial instrument. The serial instrument replies to the UIM, which immediately transmits the reply to the SIM and computer/controller. Use a Relay command when you want data from a particular serial instrument, and do not want to synchronize with data from other serial instruments.

- **Get Data command** – sends a user-defined character string recognizable by the serial instrument. Get Data can be global (sent to all UIMs on the cable) or local (sent to a specific UIM). The UIM transmits the character string to the serial instrument. The serial instrument replies to the UIM, which holds the reply in a buffer. Another command gets the reply from a specific UIM and transmits it to the SIM and computer/controller. Use the global Get Data command when you want synchronized data from each UIM (and attached serial instrument) on the cable.

The UIM's internal battery uses twelve AA lithium cells. The UIM can be externally powered, and can provide power to the serial instrument from either the external source or its internal battery pack, via the switched power output pin on the bulkhead connector.

Note:
Help files provide detailed information on SEATERM.

The UIM is supplied with a powerful Win 2000/XP software package, SEASOFT V2, which includes:

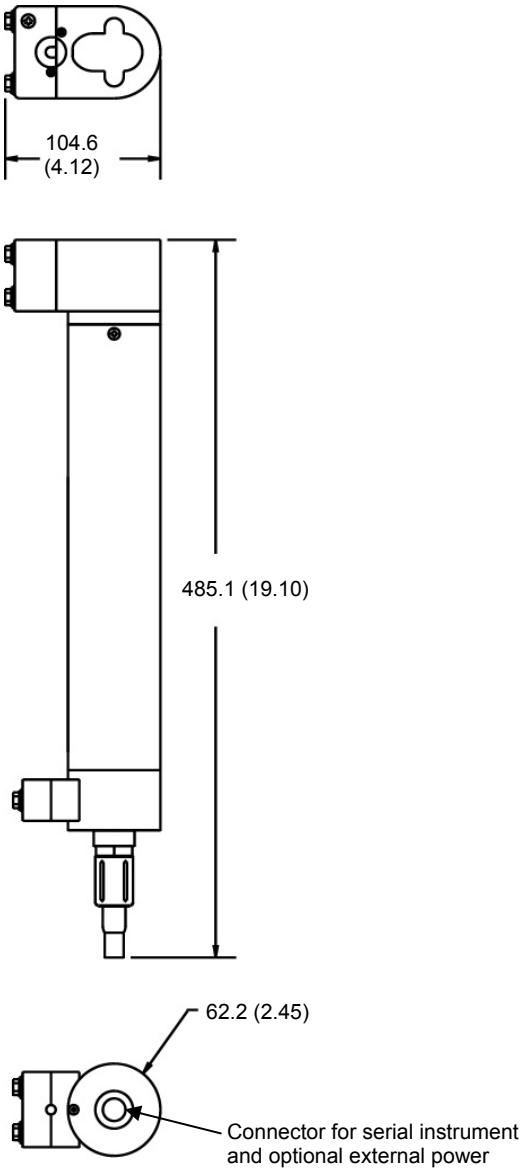
- **SEATERM** - terminal program for easy communication with the UIM (via the SIM) and data retrieval.

Specifications

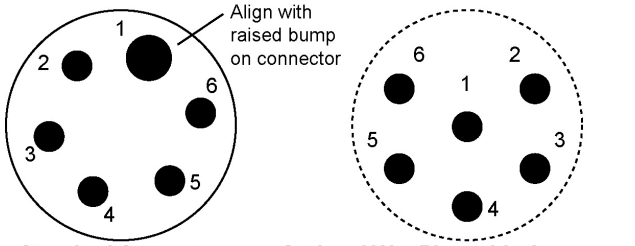
Internal Batteries	Nominal 10.6 Amp-hour pack consisting of 12 AA Saft LS 14500 lithium batteries (3.6 V and 2.45 Amp-hours each). See *Battery Endurance* for example calculation. See *Shipping Precautions* in *Section 1: Introduction*. Note: Saft batteries can be purchased from Sea-Bird or other sources. See Saft's website for suppliers (www.saftbatteries.com). Alternatively, substitute either of the following: - Tadiran TL-4903, AA (3.6 V and 2.4 Amp-hours each) (www.tadiran.com) - Electrochem 3B0064/BCX85, AA (3.9 V and 2.0 Amp-hours each) (www.electrochemsolutions.com)
Current	Quiescent Current: < 100 microAmps Operating Current: 10 milliAmps Maximum Current to serial instrument: 1.5 Amps (see *Battery Endurance* for length of deployment)
Materials	Titanium pressure case rated at 7000 meters (23,000 feet)
Serial Instrument Interface	RS-232 standard
Weight	*In water:* 2.1 kg (4.7 lbs) *In air:* 3.2 kg (7.1 lbs)

Dimensions and Bulkhead Connector

Dimensions in millimeters (inches).



Note:
See *Appendix V: UIM Interface PCB Configuration* for required jumper settings for switched power out and control signal.



Standard Connector
AG-306-HP

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

Pin	Description
1	Common
2	RS-232C Receive from serial instrument
3	RS-232C Transmit to serial instrument
4	Switched power out (optional)
5	Control signal (optional)
6	External power in (10-20 VDC) (optional)

External Power (optional)

The UIM can be powered from an external source through pin 6 on the bulkhead connector. The UIM's internal battery pack is diode-OR'd with the external source, so **power for the UIM** is drawn from whichever voltage source is higher. The UIM can also be operated from the external supply without having the lithium batteries installed.

Power for the serial instrument (if connecting to pin 4, switched power out, on the bulkhead connector) is drawn from the UIM's battery pack or from the external power source, depending on the setting of jumper J2 on the UIM Interface PCB (see *Appendix V: UIM Interface PCB Configuration*).

Battery Endurance

Note:
Sea-Bird recommends using the capacity value of 8.8 Amp-hours for the Saft batteries as well as for the alternate battery types (Tadiran TL-4903 and Electrochem 3B0064/BCX85 AA).

The battery pack has a nominal capacity of 10.6 Amp-hours. This is lower than the Saft factory capacity rating (2.45 Amp-hours * 6 = 14.7 Amp-hours), because the battery holder includes voltage up-conversion circuitry that consumes some battery capacity. For planning purposes, to account for the UIM's current consumption patterns and for environmental conditions affecting battery performance, **Sea-Bird recommends using a conservative value of 8.8 Amp-hours**.

Current consumption is as follows:

- UIM operating current is 10 mA. Operating current is drawn during each of these stages of operation:
  1. Sampling - While the serial instrument is sampling, including any delays programmed into the system.
  2. Communication - While the UIM is transmitting data from its buffer to the SIM. Assuming the fastest practical interrogation scheme (wake all UIMs on mooring, send **GData**, send **Dataii** to each UIM, and power off all UIMs), the operating current is drawn for approximately 0.5 seconds **per UIM on the mooring**. Each UIM draws this current while any of the UIMs are being queried to transmit data. Other interrogation schemes require more time.
- Optional power for the serial instrument (if connecting serial instrument to pin 4, switched power out, on the bulkhead connector, and J2 on the UIM Interface PCB is set to pins 1 and 2) can be up to 1.5 Amps.
- Quiescent current is less than 100 microAmps (0.9 AH per year).

So, battery endurance is highly dependent on the user-programmed sampling scheme. An example is shown below for one sampling scheme.

Example:
10 UIMs are deployed on a mooring, and each is powering a serial instrument that draws 50 mA for 3 seconds every time it samples. Every 10 minutes, simultaneous data is requested using **GData**, and then data is transmitted sequentially from each UIM using **Dataii**. How long can the instruments be deployed?

Power to serial instrument = 50 mA * 3 second sampling time = 0.150 Amp-sec/sample
UIM operating current while powering serial instrument = 10 mA * 3 seconds sampling time = 0.030 Amp-sec/sample
In 1 hour, sampling consumption = 6 samples * (0.150 + 0.030 Amp-sec/sample) = **1.08 Amp-seconds/hour**

Communication current = 10 mA * 0.5 seconds/UIM to be queried * 10 UIMs on mooring = 0.05 Amp-seconds/query
In 1 hour, communication current = 6 queries * 0.05 Amp-seconds/query = **0.30 Amp-seconds/hour**

Quiescent current = 100 microAmps = 0.1 mA
In 1 hour, quiescent current consumption ≈ 0.1 mA * 3600 seconds/hour = **0.36 Amp-seconds/hour**

In 1 hour, the current consumption is:
Total current consumption / hour = 1.08 + 0.30 + 0.36 = **1.74 Amp-sec**

Capacity = (8.8 Amp-hours * 3600 seconds/hr) / (1.74 Amp-sec/hour) = 18,200 hours = 758 days = 2.0 years

Surface Inductive Modem (SIM)

A Surface Inductive Modem (SIM) PCB is required for communication with the UIM. The SIM must be supplied with 7 to 25 volts DC power. The SIM's operating current is approximately 30 milliAmps.

The user's computer or buoy controller can be interfaced via RS-232 (optional RS-485) serial port to the SIM. The standard interface protocol between the user's computer/controller and SIM is 1200, 2400, 4800, or 9600 baud (user-selectable); 8 data bits; no parity; RS-232C; with echoing of characters.

The SIM impresses (*modulates*) the mooring cable with a DPSK signal that is encoded with commands received from the computer/controller. The encoded signals are *demodulated* by UIMs coupled to the mooring cable. Replies from UIMs are similarly coupled to the mooring cable and *demodulated* by the SIM.

The DPSK communication link between the SIM and UIM(s) is half-duplex, so talking and listening is sequential only (cannot send and receive at the same time). Although the data link between the SIM and computer/controller is established at 1200, 2400, 4800, or 9600 baud, the DPSK modem communication between SIM and UIMs always operates at 1200 baud. Communication between the UIM and serial instrument is user-selectable at 300, 600, 1200, 2400, 4800, 9600, or 19200 baud.

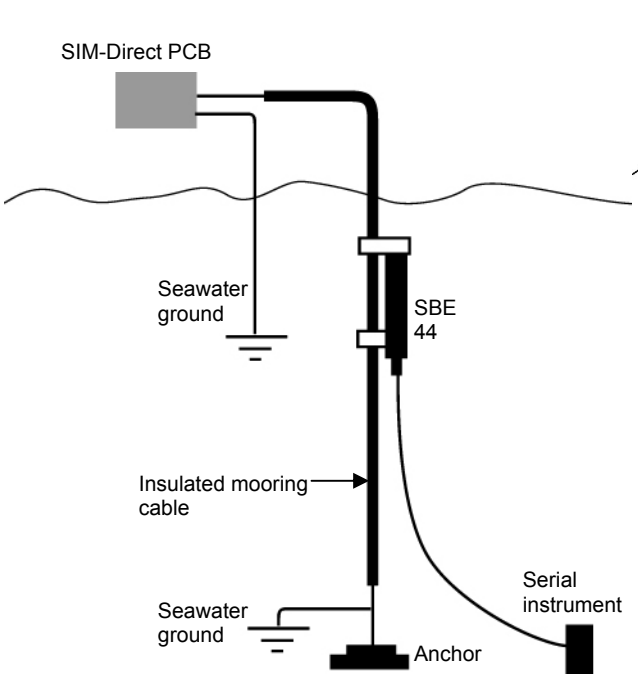
Mooring Cable and Wiring Requirements

Notes:
- See *Appendix IV: SIM Hookup and Configuration* for wiring details.
- See *Appendix VI: Using UIM with Tone Detect Board* for a schematic of that specialized application.

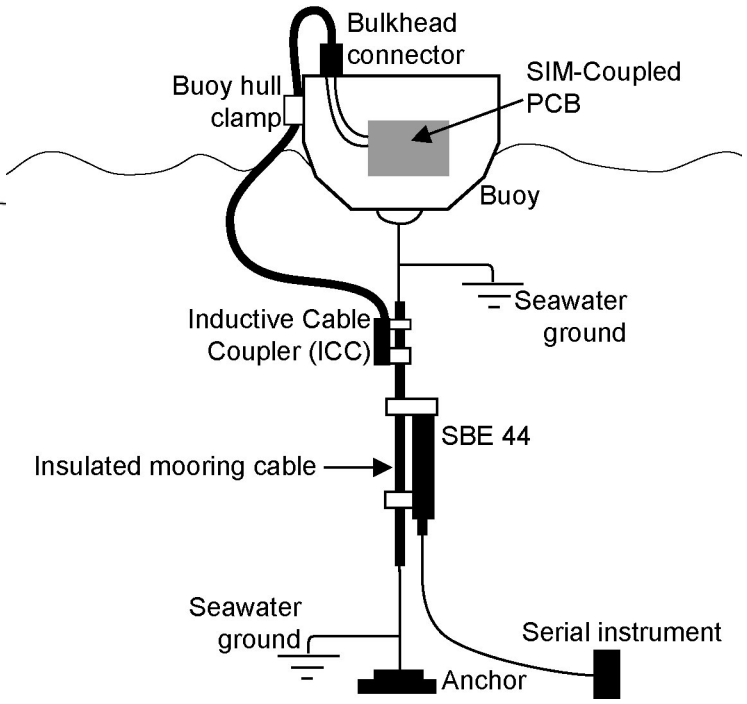
The UIM can mechanically accommodate mooring cables up to 16 mm (0.63 inches) in diameter. Clamps for specific cable diameters are available, or can be supplied on a custom basis. Suitable mooring cables use steel wire rope with a polypropylene or polyethylene insulating jacket. The SIM operates without data errors using up to 7000 meters (23,000 feet) of 3 mm (0.12 inches) or larger cable.

The mooring cable must provide connection to seawater ground below the deepest UIM. This connection is readily provided by leaving a section of cable uninsulated, or terminating it with a metallic rigging terminal, thimble, or clevis.

The mooring cable must also provide for connection to the SIM:
- In a direct connection (typical cable-to-shore applications), the bottom end of the wire is grounded to seawater, and the top end remains insulated to the connection to the SIM. A second wire from the SIM connects to seawater ground, completing the circuit.
- In typical surface buoys it is often preferable to connect the jacketed mooring wire to the buoy with a length of chain, grounding the jacketed wire to seawater at each end. An Inductive Cable Coupler (ICC) connects the SIM to the jacketed wire above the uppermost UIM and below the point where the wire is grounded.



Direct Connection



Connection with ICC

Note:
These illustrations are schematic only. The serial instrument, shown on the ocean floor, is usually clamped to the insulated mooring cable at the desired depth.

Section 3: Preparing UIM for Deployment

This section describes installation of the battery pack, installation of software, testing power and communications, and setting the UIM ID.

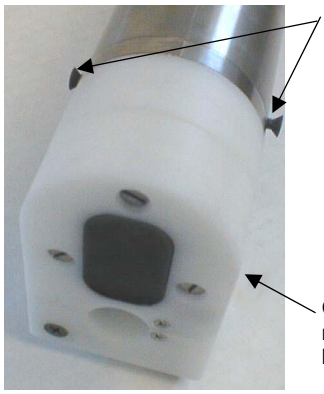
Battery Installation

WARNING!
Do not air-ship the UIM with batteries installed.
See *Shipping Precautions* in *Section 1: Introduction*.

Description of Batteries and Battery Pack

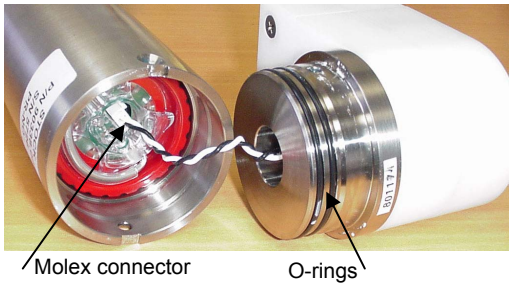
Sea-Bird supplies twelve 3.6-volt AA lithium batteries, shipped with the UIM in a heat-sealed plastic bag placed in bubble wrap and a cardboard box. The empty battery holder is installed inside the UIM for shipment.

No soldering is required when assembling the battery pack.

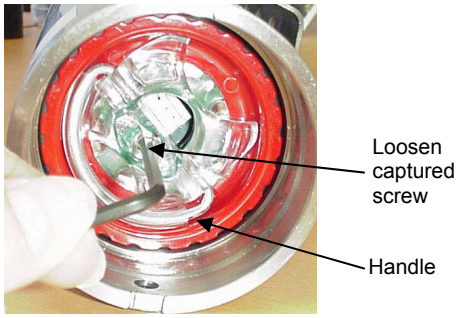


Installing Batteries

1. Remove the modem end cap:
   A. Wipe the outside of the modem end cap and housing dry, being careful to remove any water at the seam between them.
   B. Remove the 2 flat Phillips-head titanium machine screws. Do not remove any other screws from the housing.
   C. Remove the end cap by pulling firmly and steadily on the plastic cable mounting bracket/inductive coupler. It may be necessary to twist or rock the end cap back and forth or use a non-marring tool on the edge of the cap to loosen it.
   D. The end cap is electrically connected to the electronics with a 3-pin Molex connector. Holding the wire cluster near the connector, pull gently to detach the female end of the connector from the pins.
   E. Remove any water from the O-ring mating surfaces inside the housing with a lint-free cloth or tissue.
   F. Put the end cap aside, being careful to protect the O-rings from damage or contamination.



2. Remove the battery pack assembly from the housing:
   A. Loosen the captured screw from the battery cover plate, using the 7/64-inch Allen wrench included with the shipment.
   B. Lift the battery pack assembly straight out of the housing, using the handle.

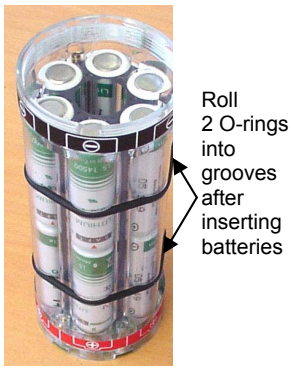


3. Keep the handle in an upright position. Holding the edge of the red* cover plate, unscrew the cover plate from the battery pack assembly. (*Note: Color may vary.)

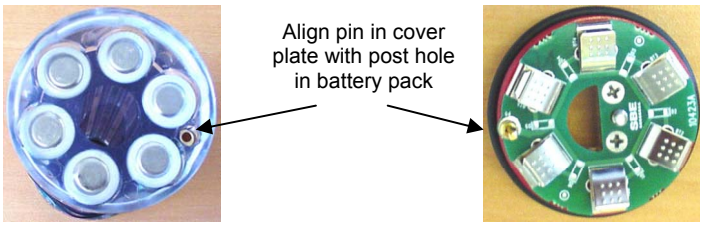
4. Roll the 2 O-rings on the outside of the battery pack out of their grooves.

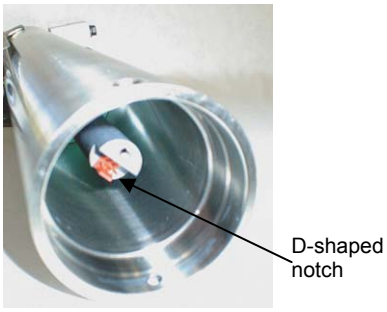
5. Insert each battery into the pack, **positive end (+) first**.

6. Roll the 2 O-rings on the outside of the battery pack into place in the grooves. The O-rings compress the side of the battery pack and hold the batteries tightly in place in the pack.



7. Reinstall the battery pack cover plate:
   A. Align the pin on the battery cover plate PCB with the post hole in the battery pack housing.
   B. Place the handle in an upright position. Screw the red cover plate onto the battery pack assembly. Ensure the cover is tightly screwed on to provide a reliable electrical contact.





8. Replace the battery pack assembly in the housing:
   A. Align the D-shaped opening in the cover plate with the D-shaped notch on the shaft. Lower the assembly slowly into the housing, and once aligned, push gently to mate the banana plugs on the battery compartment bulkhead with the lower PCB. A post at the bottom of the battery compartment mates with a hole in the battery pack's lower PCB to prevent improper alignment.
   B. Secure the assembly to the shaft with the captured screw, using the 7/64-inch Allen wrench. Ensure the screw is tight to provide a reliable electrical contact.

9. Reinstall the modem end cap:
   A. Remove any water from the O-rings and mating surfaces in the housing with a lint-free cloth or tissue. Inspect the O-rings and mating surfaces for dirt, nicks, and cuts. Clean as necessary. Apply a light coat of O-ring lubricant (Parker Super O Lube) to the O-rings and mating surfaces.
   B. Plug the female end of the 3-pin Molex connector onto the pins, with the flat portion of the female end against the flat portion of the 'D' cutout. Verify the connector is properly aligned – a backward connection will prevent communication with the computer.
   C. Carefully fit the end cap into the housing until the O-rings are fully seated.
   D. Reinstall the 2 flat Phillips-head titanium screws to secure the end cap.

Software Installation

Notes:
- Help files provide detailed information on the software.
- It is possible to use the UIM without the SEATERM terminal program by sending direct commands from a dumb terminal or terminal emulator, such as Windows HyperTerminal.
- Sea-Bird supplies the current version of our software when you purchase an instrument. As software revisions occur, we post the revised software on our FTP site. See our website (www.seabird.com) for the latest software version number, a description of the software changes, and instructions for downloading the software from the FTP site.

Sea-Bird recommends the following minimum system requirements for installing the software: Windows 2000 or later, 500 MHz processor, 256 MB RAM, and 90 MB free disk space for installation. Although SEASOFT V2 was designed to work with a PC running Win 2000/XP; extensive testing has not shown any compatibility problems when using the software with a PC running Windows Vista.

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

1. Insert the CD in your CD drive.

2. Install software: Double click on **SeasoftV2_*date*.exe** (*date* is the date that version of the software was created). Follow the dialog box directions to install the software. The installation program allows you to install the desired components. Install all the components, or just install SEATERM (terminal program).

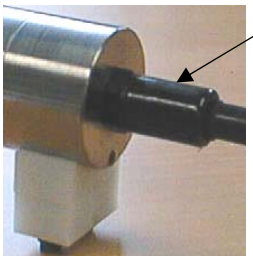
The default location for the software is c:\Program Files\Sea-Bird. Within that folder is a sub-directory for each program. Install all the components, or just install SEATERM for now.

Power and Communications Test and Setting UIM IDs

Note:
You can also simulate the serial instrument using only one computer, if the computer has a spare COM port. Test instructions below are written assuming you are using a second computer.

Note:
For testing and setup, an ICC is not required, even if using SIM-Coupled.

Notes:
- **If more than one IM instrument is on-line when you set the ID, all IM instruments will be set to the same ID.** The inductive modem receivers in IM instruments are very sensitive; two IM instruments that are side-by-side will take the same ID, even if one of them is not on the IM loop. **Therefore, separate IM instruments by at least 2 meters when setting IDs.**
- **Important! For Normal Deployed operation, reinstall the jumper across J5.**



The power and communications test will verify that the system works, prior to deployment. It requires a computer (*Computer #1*) to send commands to the SIM, and connection of the UIM's bulkhead connector to one of the following:
- to the serial instrument you intend to use when deployed, **or**
- to a second computer to simulate the serial instrument (*Computer #2*) – an optional serial instrument test cable can be supplied by Sea-Bird.

Test Setup

1. Loop insulated wire through the UIM's modem coupling core to simulate a mooring cable. Connect the test wire ends to the SIM's mooring cable terminals (JP4) (see *Appendix IV: SIM Hookup and Configuration*).

2. On the SIM, remove the J5 jumper (see *Appendix IV*). This inserts a 1K resistor in series with the inductive loop and reduces signal amplitude, preventing UIMs that are near, but not attached to, the inductive loop from responding to commands (especially important when sending ***ID=** command).

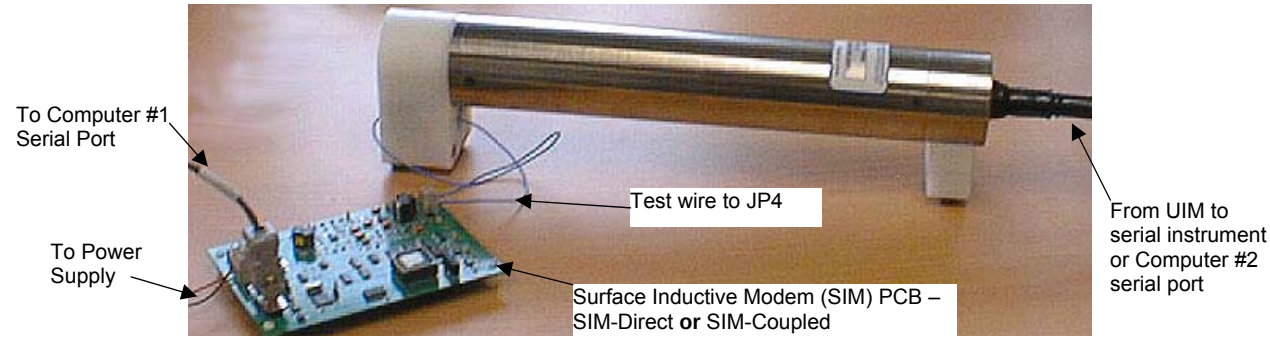
3. Connect the SIM to a 7-25 VDC power supply. Approximately 30 milliAmps are required. **Do not turn on the power supply yet**.

4. Connect the SIM to Computer #1's serial port using the 9-pin to 9-pin cable supplied with the SIM.

5. If a dummy plug and locking sleeve is installed on the connector: By hand, unscrew the locking sleeve from the UIM's bulkhead connector. **If you must use a wrench or pliers, be careful not to loosen the bulkhead connector instead of the locking sleeve**. Remove the dummy plug from the UIM's bulkhead connector by pulling the plug firmly away from the connector.

6. Install the serial instrument cable or the test cable: **Standard Connector -** align the raised bump on the side of the connector with the large pin (pin 1 - ground) on the UIM. **OR** **MCBH Connector** – align the pins with the pins on the UIM.

7. Connect the other end of the serial instrument cable or test cable to the desired instrument or to Computer #2.



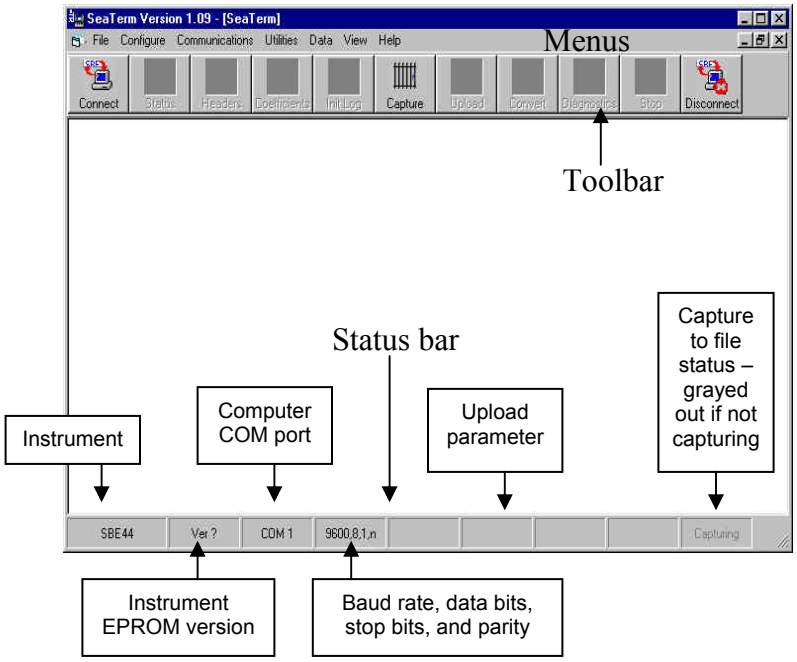
Test and Set UIM ID

Note:
See SEATERM's help files for detailed information on the use of the program.

1. **On Computer #1** - Double click on SeaTerm.exe. If this is the first time the program is used, the setup dialog box may appear:

Select the instrument type (SBE 44) and the computer COM port for communication with the SBE 44. Click OK.

2. The main screen looks like this:



- 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. The instrument must be *awake* for it to respond to a command (use Connect 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.

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 connected (Steps 3 through 5 below), to update the Status bar:
- on the Toolbar, click Status; or
- from the Utilities menu, select Instrument Status.

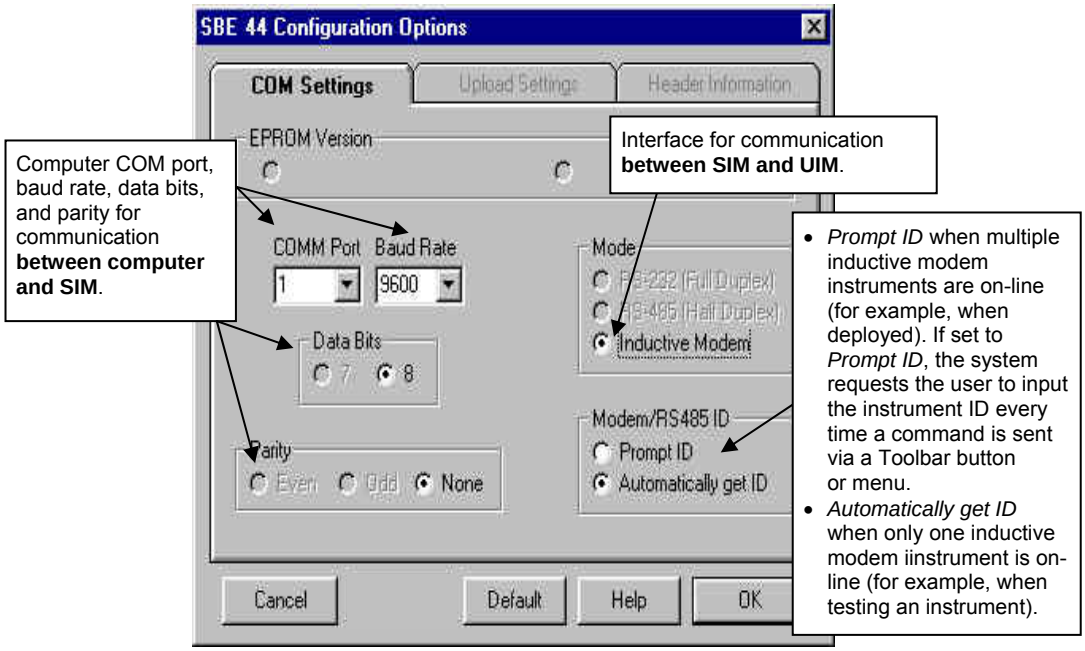
SEATERM sends the status command, which displays in the Command/Data Echo Area, and updates the Status bar.

Following are the Toolbar buttons applicable to the UIM:

Toolbar Buttons	Description	Equivalent Command*
Connect	Re-establish communications by sending wakeup tone to **all** UIMs. Computer responds with S> prompt. UIMs *go to sleep* after user-programmable timeout (**!iiTimeOut** – default is 120 seconds) without communication from computer have elapsed.	**PwrOn**
Status	Display instrument setup status (timeout settings, power-up settings, etc.).	**!iiDS**
Capture	Capture instrument responses on screen to file. File has .cap extension. Press Capture again to turn off capture. Capture status displays in Status bar.	—
Disconnect	Free computer COM port used to communicate with UIM. COM port can then be used by another program.	—

*See *Command Descriptions* in *Section 4: Deploying and Operating UIM*.

3. In the Configure menu, select SBE 44. The dialog box looks like this:



Notes:
- SEATERM's baud rate must be the same as the SIM baud rate (set with **Baud=**). Baud is factory-set to 9600, but can be changed by the user (see *Command Descriptions* in *Section 4: Deploying and Operating UIM*).
- When you click OK, SEATERM saves the Configuration Options settings to the SeaTerm.ini file in your Windows directory. SeaTerm.ini contains the last saved settings for each instrument (SBE 37, 44, etc.). When you open SEATERM and select the desired instrument in the Configure menu, the Configuration Options dialog box shows the last saved settings for that instrument.
- When deploying on a mooring cable with multiple UIMs, change **Modem/RS485 ID** to **Prompt ID** after testing is complete.

Make the selections in the Configuration Options dialog box:
- **COMM Port**: COM 1 through COM 10, as applicable
- **Baud Rate**: 1200, 2400, 4800, or 9600, as applicable
- **Data Bits**: 8
- **Parity**: None
- **Mode**: Inductive Modem
- **Modem/RS485 ID**: Automatically get I.D.

Click OK to save the settings.

Note:
The display shows *37* because the SIM was originally developed for the SBE 37-IM MicroCAT.

4. Turn on the SIM power supply (if already on, turn it off and then on again). The display looks like this:

```
37 SURFACE MODEM V 3.0
S>
Sending wake up tone, wait 4 seconds
S>
```

This shows that correct communications between the computer and the SIM has been established, and the SIM has sent the wake-up signal to the UIM.

If the system does not respond as shown above:

- Click Connect on the Toolbar.
- Verify the correct instrument was selected in the Configure menu and the settings were entered correctly in the Configuration Options dialog box. The baud rate is documented on the Configuration Sheet.
- Check cabling between the computer, the SIM, and the UIM.

5. Click Connect on the Toolbar. This allows the system to use the *Automatically get ID* feature when using the Toolbar keys or menus.

Note:
The SIM and UIM have timeout algorithms designed to:

- restore control to the computer if an illegal command is sent
- conserve battery energy if too much time elapses between commands

If the system does not respond, see *Timeout Descriptions* in *Section 4: Deploying and Operating UIM*.

6. Confirm the UIM has responded to the wake-up signal by typing **ID?** and pressing the Enter key. The display looks like this:

```
id=01
```

where 01 is the number set at the factory or by the previous user. See the Configuration Sheet for the factory-set identification (ID) number. The ID is stored in the UIM's EEPROM and can be changed so that multiple UIMs on a single mooring each have a unique ID.

Press the Enter key to get the S> prompt.

7. Display UIM status information by typing **!iiDS** (ii=UIM ID) and pressing the Enter key. The display looks like this:

```
SBE 44 UNDERWATER MODEM V 1.9a
sensor baud rate = 9600
break character length = 500 milliseconds
time out after 30 seconds without receiving a valid command
termination character is 62, char =>
Relay Command Settings:
  relay termination characters = <CR><LF>
  total time for response = 15 seconds
  wait 0 milliseconds before sending the command
  halt relay after a gap of 1000 milliseconds between characters
GDATA Command Settings:
  total time for response = 30 seconds
  wait 0 milliseconds before sending the command
  halt acquisition after a gap of 1000 milliseconds between characters
  GDATA command string = NO STRING
include gdata reply delay in datann reply
do not enable control line on power up
enable control line before relaying command
enable control line before sending GDATA command
do not switch power to sensor on power up
switch power to sensor before relaying command
switch power to sensor before sending GDATA command
```

Press the Enter key to get the S> prompt.

Note:
Steps 8 through 10 apply if you are connected to a second computer for testing purposes. If you are connected to the sensor (serial instrument), test the system using the commands described in *Command Descriptions* in *Section 4: Deploying and Operating UIM*.

8. **On Computer #2** – Set up Computer #2 as if it was an SBE 37 communicating with RS-232:
   A. Double click on SeaTerm.exe.
   B. If the setup dialog box appears, select the instrument type (**SBE 37**) and the computer COM port for communication with the SBE 37. Click OK.
   C. In the main screen's Configure menu, select **SBE 37**.
   D. Make the selections in the Configuration Options dialog box:
      - **COMM Port**: COM 1 through COM 10, as applicable
      - **Baud Rate**: (baud rate reported as **sensor baud rate** from Computer #1 in Step 7)
      - **Data Bits**: 8
      - **Parity**: None
      - **Mode**: RS-232 (Full Duplex)
      - **Modem/RS485 ID**: (not applicable)

      Click OK to save the settings.

9. **On Computer #1** – Type **#iiSENSORTEST** (ii=UIM ID).

Note:
Characters sent **from** the serial instrument (or from Computer #2) **to** the UIM must be greater than 09 decimal (09 Hex) and less than 123 decimal (7B Hex). Additionally, the @ symbol (64 decimal or 40 Hex) cannot be sent.

10. **On Computer #2** – Display should show **SENSORTEST**. Immediately begin typing on Computer #2. The characters will echo on Computer #1, until one of the following end-of-relay conditions are met:
    - SIM times out (default for **RelayMax**, total time allowed for reply, is 20 seconds)
    - UIM times out (default for **!iiRTotalMax**, total time allowed for reply, is 15 seconds)
    - UIM receives a termination character (default for **!iiTermChar**, sensor reply termination character, is >)
    - UIM detects a gap between received characters in the reply, which acts as a termination character (default for **!iiRTermMax**, maximum gap between characters in reply, is 1000 milliseconds)

The remaining steps refer to commands on **Computer #1**.

Note:
If more than one IM instrument is on-line when you set the ID, all IM instruments will be set to the same ID. The inductive modem receivers in IM instruments are very sensitive; two IM instruments that are side-by-side will take the same ID, even if one of them is not on the IM loop. **Therefore, separate IM instruments by at least 2 meters when setting IDs.**

11. Each UIM on a mooring must have a unique ID for communicating with the SIM and computer:
    A. Set the UIM ID by typing ***ID=ii** (ii= user-assigned ID number) and pressing the Enter key.
    B. The computer responds by requesting verification, requiring you to again type ***ID=ii** and press the Enter key.
    C. Record the ID for future reference.
    D. Press the Enter key to get the S> prompt.
    E. Click Connect on the Toolbar. This allows the system to use the *Automatically get I.D.* feature when using the Toolbar keys or menus.

12. Command the UIM to go to sleep (quiescent state) by typing **PwrOff** and pressing the Enter key.

The UIM is ready for deployment.

Important! When testing and ID setting is complete for all the UIMs, reinstall the J5 jumper on the SIM PCB. The jumper must be installed for Normal Deployed operation.

Section 4: Deploying and Operating UIM

This section includes system operation, example command sets, command descriptions, and instructions for deploying and recovering the UIM.

Operation Description

Commands sent to the SIM can be directed to the SIM, UIM, or serial instrument (sensor). A command prefix that includes the UIM ID (ii) directs commands to a specific UIM or to the serial instrument connected to it. Global commands are recognized by all UIMs on the same inductive cable.

Command prefixes determine which part of the system decodes the commands. The table below shows the general form of the commands; see *Command Descriptions* for detailed information:

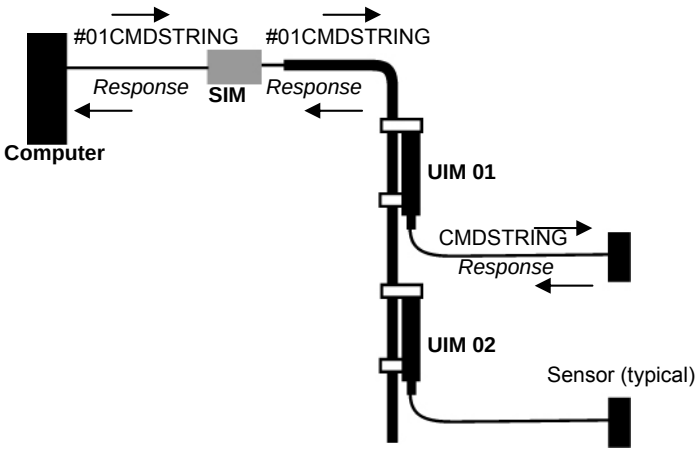
Command Form	Response
String	*String* is decoded by SIM.
!iiString	*String* is decoded by UIM with ID=ii.
#iiString	*String* is decoded by serial instrument connected to UIM with ID=ii. **ASCII** reply from serial instrument is transmitted through UIM to SIM and computer/controller.
BiiString	*String* is decoded by serial instrument connected to UIM with ID=ii. **Binary** reply from serial instrument is transmitted through UIM to SIM and computer/controller. **Note:** The SBE 44's binary data capability is intended for use on a system with only one inductive modem instrument online. A binary data reply ***could*** inadvertently include the equivalent of a valid command for other inductive modem instruments on line, causing other instruments to respond and thereby corrupting the data stream. **Sea-Bird strongly recommends that you do not use the binary data capability with multiple inductive modem instruments online.**
GData	Commands all UIMs to send pre-defined string to sensors. Each UIM holds sensor reply in buffer until receiving Dataii.
Dataii	Directs UIM with ID=ii to transmit data in its buffer to SIM and computer/controller.

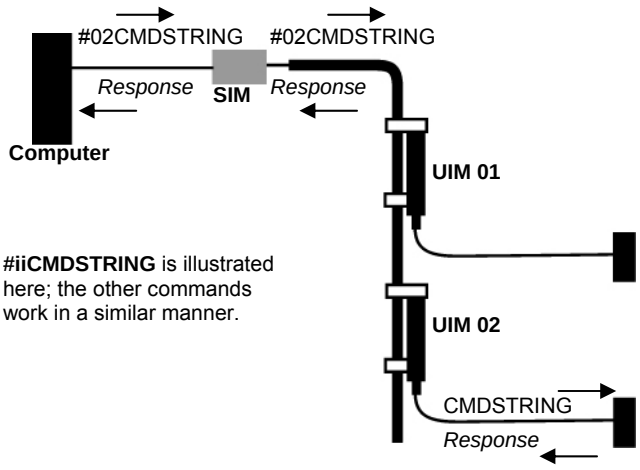
The UIM has a 30 Kbyte FIFO buffer, so the serial instrument response to any command is limited to 30,000 bytes.

Note:
Characters sent **from** the serial instrument **to** the UIM must be greater than 09 decimal (09 Hex) and less than 123 decimal (7B Hex). Additionally, the @ symbol (64 decimal or 40 Hex) cannot be sent. These limitations are not applicable to binary replies from the serial instrument.

Data can be requested and transmitted in several ways:

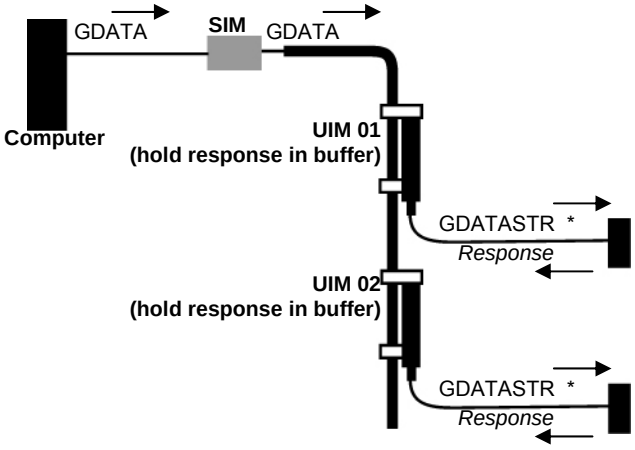
- A Relay command sends a user-defined command recognizable by the sensor. This command is sent to a specific UIM, which transmits the character string/break to the sensor. The sensor replies to the UIM, which immediately transmits the reply to the SIM and computer. Use a Relay command when you want data from a particular sensor at a particular time, and do not need to synchronize with data from other sensors. Relay commands include **#iiCmdString** (command string), **!iiSendCharW=x** (decimal value of character), **!iiSendBreak** (break character), and **BiiCmdString** (command string requesting a binary reply).

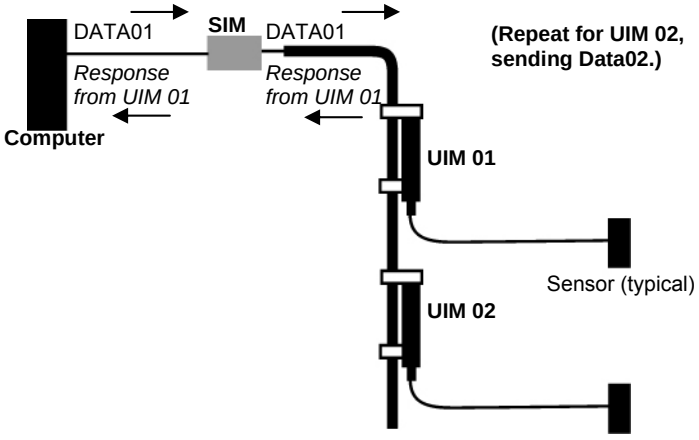




#iiCMDSTRING is illustrated here; the other commands work in a similar manner.

- A Get Data command sends a pre-defined character string recognizable by the sensor. A different character string can be pre-defined for each UIM (and associated sensor). Get Data can be global (for all UIMs on the cable) or local (for a specific UIM). The UIM transmits the character string to the sensor; the sensor replies to the UIM, which holds the reply in a buffer. **Dataii** gets the reply from a specific UIM and transmits it to the SIM and computer. Use **GData**, the global Get Data command, when you want synchronized data from each UIM on the cable.





* GDATASTR is pre-defined by **!iiGDataSTR=** for each UIM. Note that a different string can be defined for each UIM.

Operating Modes

Note:
See *Appendix V: UIM Interface PCB Configuration* for jumper settings for standard, switched power out, and control signal modes.

The UIM has three basic operating modes that affect how power is provided to the serial instrument:

- **Standard –** The serial instrument is powered independent of the UIM. The instrument can be set up for continuous logging (if applicable), or intermittent commands to take samples can be sent through the UIM.

- **Optional Switched Power Out (pin 4 on bulkhead connector) –** The serial instrument is powered by the UIM's internal batteries or by optional external power input to the UIM (pin 6). In this mode, power is applied to the instrument in one of the following ways:
  - On command (when **!iiSwPwrOn** command sent),
  - Automatically when UIM powers on (if **!iiAutoSwPwrPOn=Y**), **or**
  - Automatically when a
    Relay command (if **!iiAutoSwPwrRelay=Y**) or
    Get Data command (if **!iiAutoSwPwrGData=Y**) is sent.

  This mode is not compatible with continuous logging by the instrument, because power is removed from the instrument when the UIM enters the quiescent (sleep) state.

- **Optional Control Signal (pin 5 on bulkhead connector) –** The control signal can be 0 to 5 Volt or open collector, and is used to turn the serial instrument power on and off. In this mode, the control signal is enabled in one of the following ways:
  - On command (when **!iiCntlOn** command sent),
  - Automatically when UIM powers on (if **!iiAutoCntlOn=Y**), **or**
  - Automatically when a
    Relay command (if **!iiAutoCntlRelay=Y**) or
    Get Data command (if **!iiAutoCntlGData=Y**) is sent.

  This mode is not compatible with continuous logging by the instrument, because the control line is disabled when the UIM enters the quiescent (sleep) state.

For each mode, data stored in the serial instrument's memory can be uploaded through the UIM and SIM. Uploading data may require temporarily resetting system timeouts, to allow sufficient time for data transfer.

Commands can be used in various combinations to provide a high degree of operating flexibility. Review the operating modes, the examples, and the commands described in *Command Descriptions* before setting up your system.

Relay Command Operation

Action	Response		
	Standard Mode	**Optional Switched Power**	**Optional Control Signal**
1. UIM powers on	-	If **!iiAutoSwPwrPOn=Y**, apply power to sensor.	If **!iiAutoCntlPOn=Y**, enable control line to sensor.
2. UIM receives a command with its ID to be sent to sensor (#iiCmdString, where CmdString is command recognizable by sensor)	-	If **!iiAutoSwPwrRelay=Y**, apply power to sensor.	If **!iiAutoCntlRelay=Y**, enable control line to sensor.
	Wait **!iiRStartWait** milliseconds. Send command to sensor. Send reply to SIM until a Relay timeout condition is met.		
	-	If **!iiAutoSwPwrRelay=Y**, remove power from sensor.	If **!iiAutoCntlRelay=Y**, disable control line to sensor
3. UIM powers down	-	If power not already removed from sensor, remove power from sensor.	If control line not already disabled, disable control line.

Get Data Command Operation

Action	Response		
	Standard Mode	**Optional Switched Power**	**Optional Control Signal**
1. UIM powers on	-	If **!iiAutoSwPwrPOn=Y**, apply power to sensor.	If **!iiAutoCntlPOn=Y**, enable control line to sensor.
2. UIM receives a global Get Data command (GData) or a Get Data command with its ID (!iiGData)	-	If **!iiAutoSwPwrGData=Y**, apply power to sensor.	If **!iiAutoCntlGData=Y**, enable control line to sensor.
	Wait **!iiGStartWait** milliseconds. Send command to sensor (as defined by **!iiGDataStr=S**). Accept reply until a Get Data timeout condition is met. Store reply in UIM buffer.		
	-	If **!iiAutoSwPwrGData=Y**, remove power from sensor.	If **!iiAutoCntlGData=Y**, disable control line to sensor
3. UIM receives Dataii command	Send data held in UIM buffer. Data in buffer is erased when UIM powers down.		
4. UIM powers down	-	If power not already removed from sensor, remove power from sensor.	If control line not already disabled, disable control line.

Examples

Shown below are examples of the three basic operating modes for a system with two UIMs (IDs 01 and 02) on a mooring cable. The UIM's response to each command is not shown in the examples.

Example: ***Standard Operating Mode*** (user input in bold)

Example 1: Get Data Operation

Send wakeup tone to all UIMs. Pre-define data string to be sent to sensor when Get Data command is used. Data string can be any command understood by sensor (in example, TS is shown for sensor connected to UIM 01; SL is shown for sensor connected to UIM 02). Send power-off command to all UIMs.

S>**PWRON**
S>**!01GDATASTR=TS**
S>**!02GDATASTR=SL**
S>**PWROFF**

Send wakeup tone to all UIMs. Get data from each sensor using the global Get Data command, and store sensor reply in each UIM's buffer. Send data from each UIM to SIM and computer/controller. Send power-off command to all UIMs.

S>**PWRON**
S>**GDATA**
S>**DATA01**
S>**DATA02**
S>**PWROFF**

Example 2: Relay Command Operation

Send wakeup tone to all UIMs. Define data string to be sent to sensor now. Data string can be any command understood by sensor (in example, TS is shown for sensor connected to UIM 01; SL is shown for sensor connected to UIM 02). Sensor reply is sent to SIM and computer/controller. Send power-off command to all UIMs.

S>**PWRON**
S>**#01TS**
S>**#02SL**
S>**PWROFF**

Example: ***Switched Power Mode*** (user input in bold)

Note: Switched power mode requires connection of serial instrument to pin 4 on UIM bulkhead connector.

Example 1: Get Data Operation

Send wakeup tone to all UIMs. Pre-define data string to be sent to sensor when Get Data command is used. Data string can be any command understood by the sensor (in example, TS is shown for sensor connected to UIM 01; SL is shown for sensor connected to UIM 02). Set up each UIM to switch power on to sensor automatically before relaying Get Data command string. Send power-off command to all UIMs.

S>**PWRON**
S>**!01GDATASTR=TS**
S>**!02GDATASTR=SL**
S>**!01AUTOSWPWRGDATA=Y**
S>**!02AUTOSWPWRGDATA=Y**
S>**PWROFF**

Send wakeup tone to all UIMs. Get data from each sensor using global Get Data command, and store sensor reply in each UIM's buffer. Send data from each UIM to SIM and computer/controller. Send power-off command to all UIMs.

S>**PWRON**
S>**GDATA**
S>**DATA01**
S>**DATA02**
S>**PWROFF**

Example 2: Relay Command Operation

Send wakeup tone to all UIMs. Set up each UIM to switch power on to sensor automatically before sending a Relay command. Send power-off command to all UIMs.

S>**PWRON**
S>**!01AUTOSWPWRRELAY=Y**
S>**!02AUTOSWPWRRELAY=Y**
S>**PWROFF**

Send wakeup tone to all UIMs. Define data string to be sent to sensor now. Data string can be any command understood by the sensor (in example, TS is shown for sensor connected to UIM 01; SL is shown for sensor connected to UIM 02). Sensor reply is sent to SIM and computer/controller. Send power-off command to all UIMs.

S>**PWRON**
S>**#01TS**
S>**#02SL**
S>**PWROFF**

Example: ***Control Line Mode*** (user input in bold)

Note: Control line mode requires connection of serial instrument to pin 5 on UIM bulkhead connector

Example 1: Get Data Operation

Send wakeup tone to all UIMs. Pre-define data string to be sent to sensor when Get Data command is used. Data string can be any command understood by the sensor (in example, TS is shown for sensor connected to UIM 01; SL is shown for sensor connected to UIM 02). Set up each UIM to enable control line automatically before relaying Get Data command string. Send power-off command to all UIMs.

S>**PWRON**
S>**!01GDATASTR=TS**
S>**!02GDATASTR=SL**
S>**!01AUTOCNTLGDATA=Y**
S>**!02AUTOCNTLGDATA=Y**
S>**PWROFF**

Send wakeup tone to all UIMs. Get data from each sensor using global Get Data command, and store sensor reply in each UIM's buffer. Send data from each UIM to SIM and computer/controller. Send power-off command to all UIMs.

S>**PWRON**
S>**GDATA**
S>**DATA01**
S>**DATA02**
S>**PWROFF**

Example 2: Relay Command Operation

Send wakeup tone to all UIMs. Set up each UIM to enable control line automatically before sending a Relay command. Send power-off command to all UIMs.

S>**PWRON**
S>**!01AUTOCNTLRELAY=Y**
S>**!02AUTOCNTLRELAY=Y**
S>**PWROFF**

Send wakeup tone to all UIMs. Define data string to be sent to sensor now. Data string can be any command understood by the sensor (in example, TS is shown for sensor connected to UIM 01; SL is shown for sensor connected to UIM 02). Sensor reply is sent to SIM and computer/controller. Send power-off command to all UIMs.

S>**PWRON**
S>**#01TS**
S>**#02SL**
S>**PWROFF**

Timeout Descriptions

Both the SIM and UIM have timeout algorithms. Set the user-programmable timeouts to allow proper operation of your serial instrument while minimizing the time the system is tied-up waiting for a response.

SIM Timeouts

SIM timeouts restore control to the computer if no reply is received from the UIM (for example, upon sending an illegal command) within a specified length of time, thereby allowing new commands to be sent:

- **DataNNMax** – timeout that applies to **Dataii** only. Default is 1000 milliseconds.
- **RelayMax** –timeout that applies to all other commands. Default is 20 seconds.
- **BinaryGap** – termination timeout that applies to commands requesting binary response (**BiiCmdString**). Gap of **BinaryGap** since last byte received acts as termination character. Bytes sent after gap are ignored; control is returned to computer and other commands can be sent. Default is 1000 milliseconds.

Note:
For proper system operation when transmitting binary data, **BinaryGap** in the SIM must be less than **!iiRTermMax** in the UIM. Sea-Bird recommends **iiRTermMax** ≥ **BinaryGap**+1000 msec.

When using RS-232 between the SIM and computer, control of the SIM can be re-established sooner than the timeout by pressing the Esc key and then the Enter key. When the S> prompt is displayed, new commands can be sent.

UIM Timeouts

UIM Power Down Timeout

If the UIM does not receive a command for **!iiTimeOut** (default 120 seconds), the UIM communication circuits power down to prevent battery exhaustion. To re-establish control, send **PwrOn** or click Connect on the Toolbar.

Note:
ii = UIM ID.

Relay Command (Send Command String, Character, or Break) Timeouts

Relay command timeouts are used to determine when the sensor reply to a Relay command is complete:

- **!iiTermChar** – If the UIM receives a termination character, it ignores any additional characters received. Default is 62 (‘>’).
- **!iiRTermMax** – If the UIM detects a gap between received characters in the reply, it is interpreted as a termination character, and the UIM ignores any additional characters received. Default is 1000 milliseconds.
- **!iiRTotalMax** – After a total of **!iiRTotalMax** seconds, the UIM ignores any additional characters received. Default is 15 seconds.

Notes:
- **!iiTermChar=** is not applicable for binary sensor replies (replies to **BiiCmdString**).
- When transmitting binary data, set **!iiRTermMax** ≥**BinaryGap**+1000 msec for proper system operation.

Get Data Command Timeouts

Get Data timeouts are used to determine when the sensor reply to a Get Data command is complete. These are applicable to the global Get Data (**GData**) and the Get Data sent to a specific UIM (**!iiGData**):

- **!iiTermChar** – If the UIM receives a termination character, it ignores any additional characters received. Default is 62 (‘>’).
- **!iiGTermMax** – If the UIM detects a gap between received characters in the reply, it is interpreted as a termination character, and the UIM ignores any additional characters received. Default is 1000 milliseconds.
- **!iiGTotalMax** – After a total of **!iiGTotalMax** seconds, the UIM ignores any additional characters received. Default is 15 seconds.

Command Descriptions

This section describes commands and provides sample outputs.
See *Appendix III: Command Summary* for a summarized command list.

When entering commands:

- Input commands to the UIM in upper or lower case letters and register commands by pressing the Enter key.
- The UIM sends `? CMD` if an invalid command is entered.
- If the system does not return an `S>` prompt after executing a command, press the Enter key to get the `S>` prompt.
- If a new command is not received within **!iiTimeOut** (default 120 seconds) after the completion of a command, the UIM returns to the quiescent (sleep) state.
- If in quiescent state, re-establish communications by clicking Connect on the Toolbar or entering **PwrOn** to get an `S>` prompt.

SIM Commands

SIM commands are directed to the Surface Inductive Modem, to set it up for operation with the Underwater Inductive Modem.

PwrOn — Send wakeup tone to **all** IM instruments on-line. Equivalent to Connect on Toolbar.

PwrOff — Send power-off command to **all** IM instruments on-line. Main power turned off and IM instruments placed in quiescent (sleep) state. Any data in UIM buffer is erased.

DS — Display SIM firmware version and status. Example includes command used to modify parameter [in parentheses].

Note:
The **DS** response shows *SBE 37* because the SIM was originally developed for the SBE 37-IM MicroCAT.

Example: (user input in bold)

```
S>DS
SBE 37 SURFACE MODEM V 3.0
wait time for dataNN response = 1000 msec              [DataNNMax=]
wait time for relay command response = 20 seconds      [RelayMax=]
binary relay character timeout = 1000 msec             [BinaryGap-]
echo = yes                                             [EchoOn or EchoOff]
execute pwron command on powerup = yes                 [AutoPwrOn=]
```

Baud=x — **x**= baud rate between SIM and computer / controller (1200, 2400, 4800, or 9600). Default 9600.

Note:
The SIM's baud rate (set with **Baud=**) must be the same as SEATERM's baud rate (set in the Configure menu).

SIM Commands continued

DataNNMax=x	**x=** timeout (0-32767 milliseconds; SIM rounds down to nearest 50 milliseconds) that applies to **Dataii** only. If no reply received within **DataNNMax**, control returned to computer and other commands can be sent. Default 1000 milliseconds.
RelayMax=x	**x=** timeout (0-3276 seconds) that applies to all other commands. If no reply received within **RelayMax**, control returned to computer and other commands can be sent. Default 20 seconds.
BinaryGap=x	**x=** termination timeout (0 – 65535 milliseconds) for commands requesting binary data (**BiiCmdString**). Gap of **BinaryGap** since last byte received acts as termination character. Bytes sent after gap ignored; control returned to computer and other commands can be sent. Default 1000 milliseconds.
EchoOn	Echo characters received from computer (default) - computer monitor will show entered commands as you type.
EchoOff	Do not echo characters.
AutoPwrOn=x	**x=Y** (default): Automatically send **PwrOn** to IM instruments on-line when power applied to SIM. This wakes up all IM instruments on-line. **x=N**: Do not send **PwrOn** when power applied to SIM.

Note:
Set
!iiRTermMax ≥ **BinaryGap**+1000 msec for proper system operation when transmitting binary data.

Note:
AutoPwrOn=N is typically used only with a *Tone Detect* board system; see *Appendix VI: Using UIM with Tone Detect Board*.

ID Commands

Note:
If more than one IM instrument is on-line when you set the ID, all IM instruments will be set to the same ID. The inductive modem receivers in IM instruments are very sensitive; two IM instruments that are side-by-side will take the same ID, even if one of them is not on the IM loop. **Therefore, separate IM instruments by at least 2 meters when setting IDs.**

Only one IM instrument can be on-line when sending these commands.

ID? Display UIM ID (ID = ii, where ii= 0-99).

***ID=ii** Set UIM ID to ii, where ii= 0-99. Must be sent twice, because verification reequested. **If more than one IM instrument is on-line, all IM instruments will be set to same ID**.

UIM and Sensor Commands

UIM Status Commands

UIM Status commands are preceded by **!ii** (ii = UIM ID).

!iiDS Display UIM firmware version and setup parameters.
Equivalent to Status on Toolbar.

Example includes command used to modify parameter [in parentheses]:

Example: (user input in bold)

```
S>!01DS
SBE 44 UNDERWATER MODEM V 1.9a
sensor baud rate = 9600                                                    [!iiBaud=]
break character length = 500 milliseconds                                 [!iiBreakLen=]
time out after 30 seconds without receiving a valid command                [!iiTimeOut=]
termination character is 62, char=>                                        [!iiTermChar=]
Relay Command Settings:
  relay termination characters =  <CR><LF>                                 [!iiRelayTermChar=]
  total time for response = 15 seconds                                     [!iiRTotalMax=]
  wait 0 milliseconds before sending the command                           [!iiRStartWait=]
  halt relay after a gap of 1000 milliseconds between characters           [!iiRTermMax=]
GDATA Command Settings:
  total time for response = 30 seconds                                     [!iiGTotalMax=]
  wait 0 milliseconds before sending the command                           [!iiGStartWait=]
  halt acquisition after a gap of 1000 milliseconds between characters     [!iiGTermMax=]
  GDATA command string = NO STRING                                         [!iiGDataStr=]
include gdata reply delay in datann reply                                  [!iiIncGDataDelay=]
do not enable control line on power up                                     [!iiAutoCntlPOn=]
enable control line before relaying command                                [!iiAutoCntlRelay=]
enable control line before sending GDATA command                           [!iiAutoCntlGData=]
do not switch power to sensor on power up                                  [!iiAutoSwPwrPOn=]
switch power to sensor before relaying command                             [!iiAutoSwPwrRelay=]
switch power to sensor before sending GDATA command                        [!iiAutoSwPwrGData=]
send tone on powerup                                  [!iiPOnTone=; this line appears only if !iiPOnTone=Y]
```

!ii*EETest Test UIM's EEPROM, and reset all parameters to default values. **Before performing test, record all parameters, so they can be reentered after test if desired.**

UIM General Setup Commands

All UIM General Setup commands are preceded by **!ii** (ii = UIM ID).

Note:
The following parameters for communication between the UIM and sensor cannot be modified:
- Data bits – 8
- Stop bits – 1
- Parity – none

!iiBaud=x

x= baud rate for serial communication **between UIM and sensor** (300, 600, 1200, 2400, 4800, 9600, or 19200). Default 9600.

!iiRelayTermChar=x

x= decimal value (0-255) of **command termination character**. This allows user to specify what is appended to sensor command string for both Send Command String and Get Data commands. See *Appendix VII: Character Map and Values* for characters and decimal values.
If **x=CRLF** (default), UIM appends carriage return and line feed to relayed string.
If **x=NONE**, UIM does not append anything to relayed string.

Examples: (user input in bold)

```
S>!01RELAYTERMCHAR=CRLF
relay termination characters=<CR><LF>

S>!01RELAYTERMCHAR=100
relay termination character set to 100, char = d

S>!01RELAYTERMCHAR=NONE
no relay termination character
```

Note:
If the sensor is transmitting binary data in response to **BiiCmdString**, the UIM ignores **!iiTermChar**.

!iiTermChar=x

x= decimal value (11-122) of **sensor reply termination character**. If UIM receives a termination character, it ignores any additional characters received from sensor. Default is 62 (decimal value for '>'). See *Appendix VII: Character Map and Values* for characters and decimal values. If **!iiTermChar=NONE**, termination character checking is disabled.

!iiTimeOut=x

x= UIM timeout (30-1800 seconds). If no commands or replies are received for **!iiTimeOut**, UIM automatically enters quiescent (sleep) state. **When UIM enters quiescent state, any data held in its buffer is erased**. Default 120 seconds.

Relay Commands

These commands set up the controls for and send commands relayed from the UIM to the sensor. A Send Command String, Send Character, or Send Break command is sent to one UIM, which transmits it to the connected sensor. Unlike a Get Data command, the sensor response to these commands is sent immediately to the UIM, SIM, and computer/controller. Use a Relay command when you want to obtain data from a particular instrument at a particular time, and are not interested in synchronizing with data from other instruments.

Relay Setup Commands

These setup parameters apply to Send Command String, Send Character, and Send Break commands. Relay setup commands are preceded by **!ii** (ii = UIM ID).

!iiRStartWait=x — **x=** command transmission delay after setting control line or switched power (0-32767 milliseconds). Delaying transmission allows sensor to wake up before relaying command if **!iiAutoSwPwrRelay=Y** or **!iiAutoCntlRelay=Y**. Default 0.

!iiRTermMax=x — **x=** termination timeout for sensor reply (0-32767 milliseconds). Gap of **!iiRTermMax** after 2 characters have been received acts as termination character – characters sent by sensor after gap are ignored. Default 1000 milliseconds.

Note:
Set **!iiRTermMax** ≥ **BinaryGap**+1000 msec for proper system operation when transmitting binary data.

!iiRTotalMax=x — **x=** total time allowed for sensor reply (0-600 seconds). Characters sent by sensor after **!iiRTotalMax** are ignored. Default 15 seconds.

Send Command String Commands

#iiCmdString — Command UIM to send character string defined by **CmdString** to sensor. **CmdString** can be any character string recognized by sensor. UIM can append carriage return and line feed or character (defined by **!iiRelayTermChar**) to **CmdString**. Response is sent through UIM to SIM and computer/controller.

BiiCmdString — Command UIM to send character string defined by **CmdString** to sensor. **CmdString** can be any character string recognized by sensor that requests a **binary** response. UIM can append carriage return and line feed or character (defined by **!iiRelayTermChar**) to **CmdString**. Binary response is sent through UIM to SIM and computer/controller; any reply termination characters (defined by **!iiTermChar**) are ignored.

Note:
The SBE 44's binary data capability is intended for use on a system with only one inductive modem instrument online. A binary data reply ***could*** inadvertently include the equivalent of a valid command for other inductive modem instruments on line, causing other instruments to respond and thereby corrupting the data stream. **Sea-Bird strongly recommends that you do not use the binary data capability with multiple inductive modem instruments online.**

Send Character Commands

Send Character commands allow you to send a single character (including a *non-printing* character) to a sensor. These commands are preceded by **!ii** (ii = UIM ID). Termination character parameter **!iiRelayTermChar** does not apply to these commands.

!iiSendCharW=x — Command UIM to send character defined by decimal value **x** to sensor. Character can be any command recognized by sensor. Response is sent through UIM to SIM and computer/controller.

!iiSendChar=x — Command UIM to send character defined by decimal value **x** to sensor. Character can be any command recognized by sensor. **Command should be one that does not require response; UIM does not accept any response from sensor, and is immediately ready to accept another command.**

Examples: (user input in bold)
S>**!01SENDCHARW=101**
(send lower case e; wait for a reply from sensor)

S>**!01SENDCHAR=100**
(send lower case d; do not wait for reply from sensor)

Send Break Commands

These commands set up and send a break character, which may be a signal to some types of sensors to send data. These commands are preceded by **!ii** (ii = UIM ID).

!iiBreakLen=x — **x=** length of break character (0-32750 milliseconds). Default 1000 milliseconds.

!iiSendBreak — Command UIM to send break character, as defined by **!iiBreakLen**, to sensor. Termination character parameter **!iiRelayTermChar** does not apply to this command. Response is sent through UIM to SIM and computer/controller.

Get Data Commands

These commands set up controls for and transmit Get Data commands. **GData** or **!iiGData** sends the command pre-defined by **!iiGDataStr=** from the UIM to the sensor. The sensor reply is held in the UIM buffer until **Dataii** is sent. Use the global Get Data (**GData**) to obtain synchronized data from all sensors connected to UIMs on the mooring cable.

Get Data Setup Commands

Get Data Setup commands are preceded by **!ii** (ii = UIM ID).

!iiGStartWait=x
x= command transmission delay (after setting control line or switched power) (0-32767 milliseconds). Delaying transmission allows sensor to wake up before relaying command if **!iiAutoSwPwrGData=Y** or **!iiAutoCntlGData=Y**. Default 0.

!iiGTermMax=x
x= termination timeout for sensor reply (0-32767 milliseconds). Gap of **!iiGTermMax** after 2 characters received acts as termination character – characters sent by sensor after gap ignored. Default 1000 milliseconds.

!iiGTotalMax=x
x= total time allowed for sensor reply (0-600 seconds). Characters sent by sensor after **!iiGTotalMax** ignored.
Default 30 seconds.

!iiIncGDataDelay=x
x=Y (default): In **Dataii** reply, include number of 0.1-second ticks received while waiting for **GData** or **!iiGData** reply. May be helpful in verifying sensor / buoy controller clock synchronization.

x=N: Do not include number of ticks.

!iiGDataStr=S
S= character string sent to sensor (can be any command recognized by sensor) in response to **GData** or **!iiGData**. UIM can append carriage return and line feed or a character (defined by **!iiRelayTermChar**) to string. **!iiGDataStr=** followed by Enter key disables sending string. Default no string (disabled).

Get Data Commands

Note:
Data in the UIM buffer is erased when the UIM enters quiescent (sleep) state. Always send **Dataii** to transmit data in the buffer before the UIM timeout (**!iiTimeOut**) automatically puts the UIM to sleep and before sending **PwrOff** to put the UIM to sleep.

GData
Command **all** UIMs to send character string defined by **!iiGDataStr** to sensor. Each UIM holds sensor reply in buffer until receiving **Dataii**.

!iiGData
Command UIM with ID=**ii** to send character string defined by **!iiGDataStr** to sensor. UIM holds sensor reply in buffer until receiving **Dataii**.

Dataii
Get data obtained with **GData** or **!iiGData** from buffer of UIM with ID = **ii**. Response sent to SIM and computer/controller.

Switched Power Setup Commands

Note:
See *Appendix V: UIM Interface PCB Configuration* for required jumper settings on the UIM's Interface PCB.

These commands set up the controls for optional switched power operation (pin 4 on bulkhead connector). All Switched Power Setup commands are preceded by **!ii** (ii = UIM ID).

!iiSwPwrOn — Switch power on to sensor now. Power to sensor remains on while UIM remains awake. When UIM enters quiescent (sleep) state, power to sensor switches off.

!iiSwPwrOff — Switch power off to sensor now.

!iiAutoSwPwrPOn=x — **x=Y**: Switch power on to sensor automatically each time UIM powers on. When UIM enters quiescent (sleep) state, power to sensor switches off automatically. Entering this command **does not** switch power on now.

x=N (default): Do not switch power on to sensor automatically each time UIM powers on.

!iiAutoSwPwrGData=x — **x=Y**: Switch power on to sensor automatically before sending Get Data command string (**!iiGDataStr**) to sensor. Power to sensor switches off automatically when sensor response ends.

x=N (default): Do not switch power on to sensor automatically before sending Get Data command to sensor.

!iiAutoSwPwrRelay=x — **x=Y**: Switch power on to sensor automatically before sending Relay command (**#iiCmdString**, **!iiSendCharW=**, **!iiSendChar=**, or **!iiSendBreak**) to sensor. Power to sensor switches off automatically when sensor response ends.

x=N (default): Do not switch power on to sensor automatically before sending Relay command to sensor.

Note:
See *Appendix V: UIM Interface PCB Configuration* for required jumper settings on the UIM's Interface PCB.

Control Line Setup Commands

These commands set up the controls for optional control line operation (pin 5 on bulkhead connector). All Control Line Setup commands are preceded by **!ii** (ii = UIM ID).

!iiCntlOn
Enable control line to sensor now. Control line to sensor remains enabled while UIM remains awake. When UIM enters quiescent (sleep) state, control line to sensor is disabled.

!iiCntlROff
Disable control line to sensor now.

!iiAutoCntlPOn=x
x=Y: Enable control line to sensor automatically each time UIM powers on. When UIM enters quiescent (sleep) state, control line to sensor disables automatically. Entering this command **does not** enable control line now.

x=N (default): Do not enable control line to sensor automatically each time UIM powers on.

!iiAutoCntlGData=x
x=Y: Enable control line to sensor automatically before sending Get Data command string (**!iiGDataStr**) to sensor. Control line to sensor disables automatically when sensor response ends.

x=N (default): Do not enable control line to sensor automatically before sending Get Data command string to sensor.

!iiAutoCntlRelay=x
x=Y: Enable control line to sensor automatically before sending Relay command (**#iiCmdString**, **!iiSendCharW=**, **!iiSendChar=**, or **!iiSendBreak**) to sensor. Control line to sensor disables automatically when sensor response ends.

x=N (default): Do not enable control line to sensor automatically before sending Relay command to sensor.

Surface Tone Detect Commands

Note:
A surface *Tone Detect* board can be supplied by Sea-Bird. See *Appendix VI: Using UIM with Tone Detect Board*.

This command sets up the controls for when the system is used with a surface *Tone Detect* board to signal the surface controller electronics. A typical use is for a system where the serial instrument needs to indicate that it has completed sampling and is ready to transmit data:

1. When it has completed sampling, the serial instrument pulls the detect line low on the UIM, powering the UIM on.
2. The UIM waits 2.5 seconds, enables its transmitter, transmits a 4800 Hz tone for 2.5 seconds, and then turns off its transmitter.
3. The 4800 Hz tone is received by the surface *Tone Detect* board, which then signals the computer/controller.
4. The computer/controller sends the appropriate commands through the SIM to the UIM to get the data from the serial instrument.

!iiPOnTone=x

x=Y: Enable surface tone detect. After powering on, UIM waits 2.5 seconds, enables its transmitter, transmits 4800 Hz tone for 2.5 seconds, and then turns off its transmitter.

x=N: Do not enable surface tone detect; do not send a tone on power up. Default.

Setup for Deployment

1. Install new batteries or ensure the existing battery pack has enough capacity to cover the intended deployment (see *Replacing Batteries* in *Section 5: Routine Maintenance*).

2. Program the UIM for the intended deployment (*see Section 3: Preparing UIM for Deployment* for connection information; see information in this section on operation and commands):
   A. Establish the system operating parameters.
   B. If the system will have multiple underwater inductive modems on the mooring cable (SBE 44 UIMs and/or SBE 37-IM or -IMP MicroCATs, 39-IMs, 16/16*plus*-IM, 16*plus*-IM V2 SEACATs), verify the UIM is set to *Prompt ID* to allow use of the Toolbar buttons and Menus:
      1) In the Configure menu, select SBE 44.
      2) Click on the COM Settings tab.
      3) For Modem/RS485 ID, click on *Prompt ID*.
      4) Click OK.

UIM Deployment

Note:
See *Application Note 85: Handling of Ferrite Core on Instruments with Inductive Modem Telemetry* for more detailed information on handling and installation.

Mounting guide / inductive modem coupler – contains modem coupling toroid core. Cable goes through here but is **not clamped**, to avoid putting through tension on end cap (which could pull off end cap).

For both mounting brackets – loosen hardware to separate bracket halves and mount on mooring cable

Mounting clamp, with opening sized to specified cable diameter – cable **clamped** by this bracket.

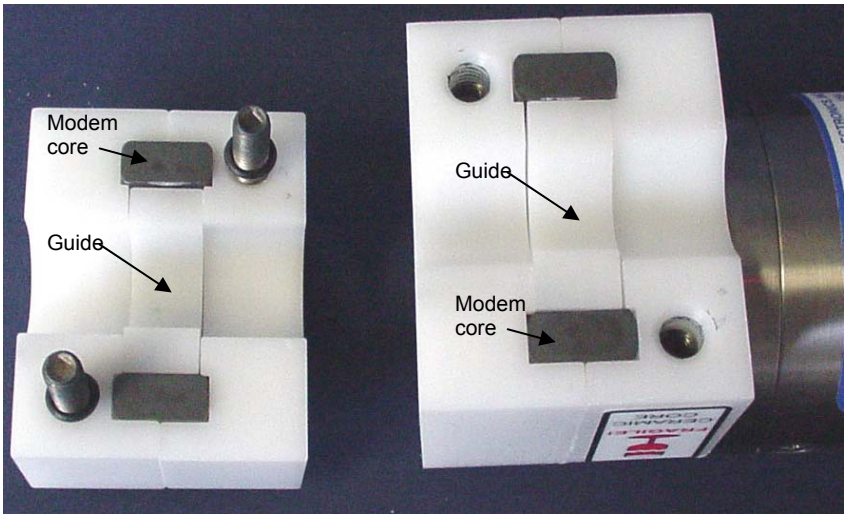
Note: Installing clamps on larger cable than specified may cause damage to cable and/or modem and prevent IM communications.

For proper communications, 2 halves of modem coupling toroid core must mate, with no gaps

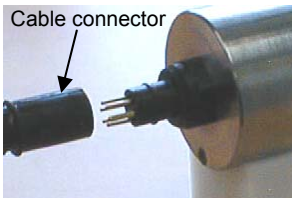
The UIM comes with pre-installed Sea-Bird mounting brackets.

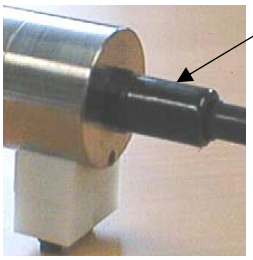
1. Attach the mounting brackets to the insulated mooring cable:
   A. Open each mounting bracket by unthreading the two large titanium hex bolts.
   B. Place the insulated mooring cable inside the brackets' grooves.
   C. Reinstall each bracket half with the hex bolts.
   D. Verify that the two halves of the modem coupling toroid have come together evenly, and that the mounting clamp is secure.

Mounting guide / Inductive Modem Coupler Detail
Guide is sized ***slightly*** bigger than specified cable diameter, to allow cable to pass through freely but limit vibration of UIM on cable



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





2. Verify that the hardware and external fittings are secure.

3. Install the serial instrument cable on the UIM:
   A. Lightly lubricate the inside of the cable connector with silicone grease (DC-4 or equivalent).
   B. **Standard Connector** (shown in photos) - Install the cable connector, aligning the raised bump on the side of the connector with the large pin (pin 1 - ground) on the UIM. Remove any trapped air by *burping* or gently squeezing the plug/connector near the top and moving your fingers toward the end cap. **OR**
   MCBH Connector – Install the cable connector, aligning the pins
   C. 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.**

4. Attach the other end of the cable to the serial instrument.

5. Deploy the UIM.

System Installation and Wiring

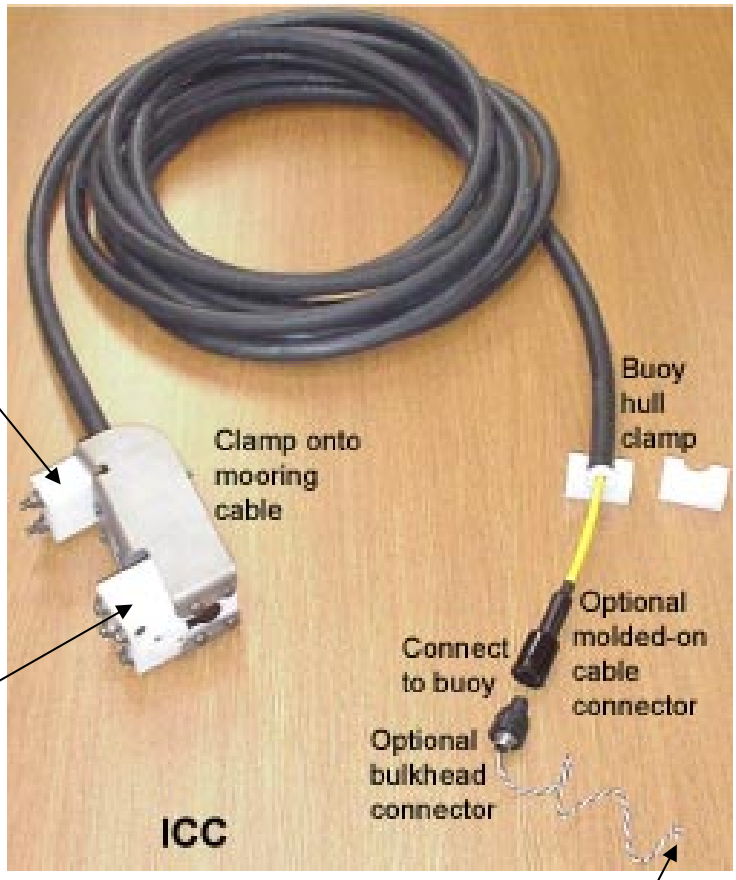
For system installation and wiring details, refer to:

- *Mooring Cable and Wiring Requirements* in *Section 2: Description of UIM.*
- *Appendix IV: SIM Hookup and Configuration*.
- *Appendix V: UIM Interface PCB Configuration.*
- *Appendix VI: Using UIM with Tone Detect Board.*

Installing Optional Inductive Cable Coupler (ICC)

1. Loosen the titanium hex head bolts connecting the two halves of each of the ICC brackets. Pull the halves apart.
2. Place the insulated mooring cable inside the brackets' grooves.
3. Reinstall each bracket half with the hex bolts.
4. Verify that the two halves of the modem coupling toroid have come together evenly, and that the mounting clamp is secure.

Note:
See *Application Note 85: Handling of Ferrite Core on Instruments with Inductive Modem Telemetry* for more detailed information on handling and installation.



Mounting clamp, with opening sized to specified cable diameter – cable **clamped** by this bracket.

Note: Installing clamps on larger cable than specified may cause damage to cable and/or modem and prevent IM communications.

Mounting guide / inductive modem coupler – contains modem coupling toroid. Cable goes through here but is **not clamped**, to avoid putting through tension on end cap (which could pull off end cap). **Detail of guide and core is similar to shown above for the UIM guide and core.**

Wiring to SIM PCB

Recovery

WARNING!
If the UIM stops working while underwater, is unresponsive to commands, or shows other signs of flooding or damage, carefully secure it 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 UIM is flooded, point it in a safe direction away from people, and loosen the 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.

1. Rinse the UIM with fresh water.

2. If immediate redeployment is not required:

   - Remove the UIM's batteries (all setup parameters will be saved in EEPROM), **or**

   - Leave the UIM with batteries in place and in a quiescent state (**PwrOff**). Because the quiescent current required is less than 100 microAmps, the batteries can be left in place without significant loss of capacity (less than 20% loss per year).

3. If immediate redeployment is required and the batteries are exhausted, install new batteries. See *Section 5: Routine Maintenance* for battery replacement.

Section 5: Routine Maintenance

This section reviews corrosion precautions, battery replacement, and connector mating and maintenance.

Corrosion Precautions

All exposed metal is titanium; other materials are plastic. No corrosion precautions are required, but avoid direct electrical connection of the UIM housing to mooring or other dissimilar metal hardware. Rinse the UIM with fresh water after use and prior to storage.

Replacing Batteries

Notes:
- For details and photos, see *Installing Batteries* in *Section 3: Preparing UIM for Deployment*.
- Battery pack cover plate color may vary.
- Batteries must be removed before returning the UIM to Sea-Bird. Do not return used batteries to Sea-Bird when shipping the UIM for repair.

1. Remove the 2 screws holding the modem end cap to the UIM housing, and remove the end cap.
2. Loosen the captured screw holding the battery pack in the housing, and remove the battery pack from the housing.
3. Place the handle in an upright position. Unscrew the red cover plate from the top of the battery pack assembly.
4. Roll the 2 O-rings on the outside of the pack out of their grooves.
5. Remove the existing batteries. Install new batteries, positive end (+) first.
6. Roll the O-rings into place in the grooves on the side of the battery pack.
7. Place the handle in an upright position. Reinstall the battery pack cover plate.
8. Replace the battery pack assembly in the housing, and secure the assembly with the captured screw. Plug in the Molex connector, and reinstall the UIM end cap.

Connector Mating and Maintenance

Note:
See *Application Note 57: Connector Care and Cable Installation*.

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

Clean and inspect the connectors, cable, and dummy plug before every deployment and as part of your yearly equipment maintenance. Inspect connectors that are unmated for signs of corrosion product around the pins, and for cuts, nicks or other flaws that may compromise the seal.

When remating:
1. Lightly lubricate the inside of the dummy plug/cable connector with silicone grease (DC-4 or equivalent).
2. **Standard Connector** - Install the plug/cable connector, aligning the raised bump on the side of the plug/cable connector with the large pin (pin 1 - ground) on the UIM. Remove any trapped air by *burping* or gently squeezing the plug/connector near the top and moving your fingers toward the end cap. **OR**
   MCBH Connector – Install the plug/cable connector, aligning the pins.
3. Place the locking sleeve over the plug/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 is installed before deployment.

Section 6: Troubleshooting

This section reviews common problems in operating the UIM, and provides the most common causes and solutions.

Problem 1: Unable to Communicate with UIM

The S> prompt indicates that communications between the UIM and computer have been established. Before proceeding with troubleshooting, attempt to establish communications again by clicking Connect on SEATERM's toolbar or pressing the Enter key several times.

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

Cause/Solution 2: The instrument type and/or its communication settings may not have been entered correctly in SEATERM. Select the *SBE 44* in the Configure menu and verify the settings in the Configuration Options dialog box. The settings should match those on the instrument Configuration Sheet.

Cause/Solution 3: The I/O cable between the SIM and computer may not be the correct one. The I/O cable supplied with the SIM permits connection to standard 9-pin RS-232 interfaces.

Cause/Solution 4: The modem core in the UIM (and/or the ICC, if applicable) may have a gap, be misaligned, or be damaged. See *Application Note 85: Handling of Ferrite Core in Instruments with Inductive Modem Telemetry* for details on inspecting the modem core and proper installation of the UIM and the ICC (if applicable) on the cable.

Glossary

Battery pack – 12 AA lithium batteries in a battery holder that connects 2 cells in series and each series string in parallel. Battery pack uses:
- Saft LS 14500, AA, 3.6 V and 2.45 Amp-hours each (www.saftbatteries.com) (**recommended**),
- Tadiran TL-4903, AA, 3.6 V and 2.4 Amp-hours each (www.tadiran.com), or
- Electrochem 3B0064/BCX85, AA, 3.9 V and 2.0 Amp-hours each (www.electrochemsolutions.com)

Character String - A group or sequence of characters, with no internal spaces. Letters of the alphabet, numbers, and punctuation symbols are characters.

ICC – Inductive Cable Coupler, which clamps to the insulated mooring cable and transfers the inductive signal on the wire to the SIM PCB installed inside the buoy or elsewhere.

PCB – Printed Circuit Board.

Scan – One data sample.

SEASOFT V2 – Sea-Bird's complete Win 2000/XP software package, which includes software for communication, real-time data acquisition, and data analysis and display. SEASOFT V2 includes **SEATERM**, SeatermAF, Seasave, SBE Data Processing, and Plot39.

SEATERM - Sea-Bird's Win 95/98/NT/2000/XP software used to communicate with the UIM through the SIM.

Sensor – See Serial Instrument.

Serial Instrument – An instrument connected serially to the UIM. Typical instruments with standard serial interfaces that are used with the UIM include current meters and Doppler profilers.

SIM - Surface Inductive Modem PCB, used to interface between the computer serial port and UIMs or other compatible sensors (such as the SBE 37-IM or 37-IMP MicroCAT, 39-IM Temperature Recorder, or 16*plus*-IM or 16*plus*-IM V2 SEACAT).

Super O-Lube – Silicone lubricant used to lubricate O-rings and O-ring mating surfaces. Super O-Lube can be ordered from Sea-Bird, but should also be available locally from distributors. Super O-Lube is manufactured by Parker Hannifin (www.parker.com/ead/cm2.asp?cmid=3956).

UIM - SBE 44 Underwater Inductive Modem.

Appendix I: Functional Description

Sea-Bird's Inductive Modem telemetry system uses a DPSK data transmission method that overcomes most of the disadvantages of Frequency Shift Keyed (FSK) transmission, resulting in superior transmission efficiency and much lower error rates. The Sea-Bird system uses a carrier frequency of 4800 Hz, permitting four cycles of carrier frequency during the time allotted to each data bit (i.e., 1200 baud).

The encoding scheme is straightforward: if the next bit is a one, the phase of the carrier is inverted (shifted 180 degrees); if the next bit is a zero, the carrier phase does not change. With DPSK, both the modulation and demodulation hardware are extremely simple. Modulation requires only an OR gate and flip-flop, and demodulation is inherently coherent (bit energy is averaged rather than spot-sampled) using minimal hard logic, a shift register implementing a one-bit delay being the principle component. Further advantages are that the transmission of all zeros creates a single coherent frequency (4800 Hz) that is readily detected in IM instruments as the *wake up* signal, and that - unlike FSK - the connection polarity of the transformers used for coupling does not matter.

Appendix II: Electronics Disassembly/Reassembly

Disassembly

1. Remove the modem end cap and battery pack following instructions in *Installing Batteries* in *Section 3: Preparing UIM for Deployment*.

2. The electronics are on a sandwich of three rectangular PCBs. These PCBs are assembled to a bulkhead that can be seen at the bottom of the battery compartment. To remove the PCB assembly:
   A. Use a long screwdriver (#1 screwdriver) to remove the Phillips-head screw at the bottom of the battery compartment. The Phillips-head screw is a 198mm (7.8 in.) threaded rod with Phillips-head.
   B. Pull out the PCB assembly using the PVC pylon post. The assembly will pull away from the 10-position edge connector used to connect to the sensors.

Reassembly

1. Sight down into the UIM housing to find the hole into which the Phillips-head screw threads. The hole is at the bottom of the housing, next to the edge connector. The small-diameter brass sleeve between two of the PCBs guides the screw into the hole. Align this sleeve with the hole.

2. Guide the PCB assembly into the housing and push the assembly until the edge connector is fully inserted. A gentle resistance can be felt during the last 3 mm (1/8 inch) of insertion as the PCB assembly mates to the edge connector.

3. Drop the Phillips-head screw into the hole and tighten gently.

4. If it is difficult to align the cards, obtain a 305mm (12 in.) length of 6-32 threaded rod.
   A. Thread the end of this rod into the hole at the bottom of the housing (next to the edge connector).
   B. Slide the PCB assembly's small diameter brass sleeve down the rod. The rod will help guide the assembly into the proper position.
   C. Push the assembly until the edge connector is fully inserted. After the PCB assembly has been fully inserted, remove the rod.
   D. Drop the Phillips-head screw into the hole and tighten gently.

5. Reinstall the battery pack and modem end cap following instructions in *Installing Batteries* in *Section 3: Preparing UIM for Deployment*.

Note:
If the rod will not tighten, the PCBs have not fully mated or are mated in reverse.

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.

Opening the battery compartment does not affect desiccation of the electronics.

Appendix III: Command Summary

FUNCTION	CATEGORY	COMMAND	DESCRIPTION
SIM Commands	-	**PwrOn**	Send wakeup tone to **all** IMs.
		PwrOff	Send power off command to **all** IMs, turn off transmitter. IMs enter quiescent (sleep) state. Any data in UIM buffer is erased.
		DS	Display SIM firmware version and status.
		Baud=x	**x=** baud rate between SIM and computer/controller (1200, 2400, 4800, or 9600). Default 9600.
		DataNNMax=x	**x=** timeout (0-32767 milliseconds) that applies to **Dataii** only. If no reply received within **DataNNMax**, control returned to computer and other commands can be sent. Default 1000 msec.
		RelayMax=x	**x=** timeout (0-3276 seconds) that applies to all other commands. If no reply received within **RelayMax**, control returned to computer and other commands can be sent. Default 20 sec.
		BinaryGap=x	**x=** termination timeout (0 – 65535 milliseconds) that applies to commands requesting binary response (**BiiCmdString**). Gap of **BinaryGap** since last byte received acts as termination character. Bytes sent after gap are ignored; control is returned to computer and other commands can be sent. Default 1000 msec. Must set **BinaryGap < !iiRTermMax**.
		EchoOn	Echo characters received from computer (default).
		EchoOff	Do not echo characters.
		AutoPwrOn=x	**x=Y** (default): Send **PwrOn** to IMs when power applied to SIM. This wakes up all IMs on line. **x=N**: Do not send **PwrOn** to IMs when power applied to SIM.

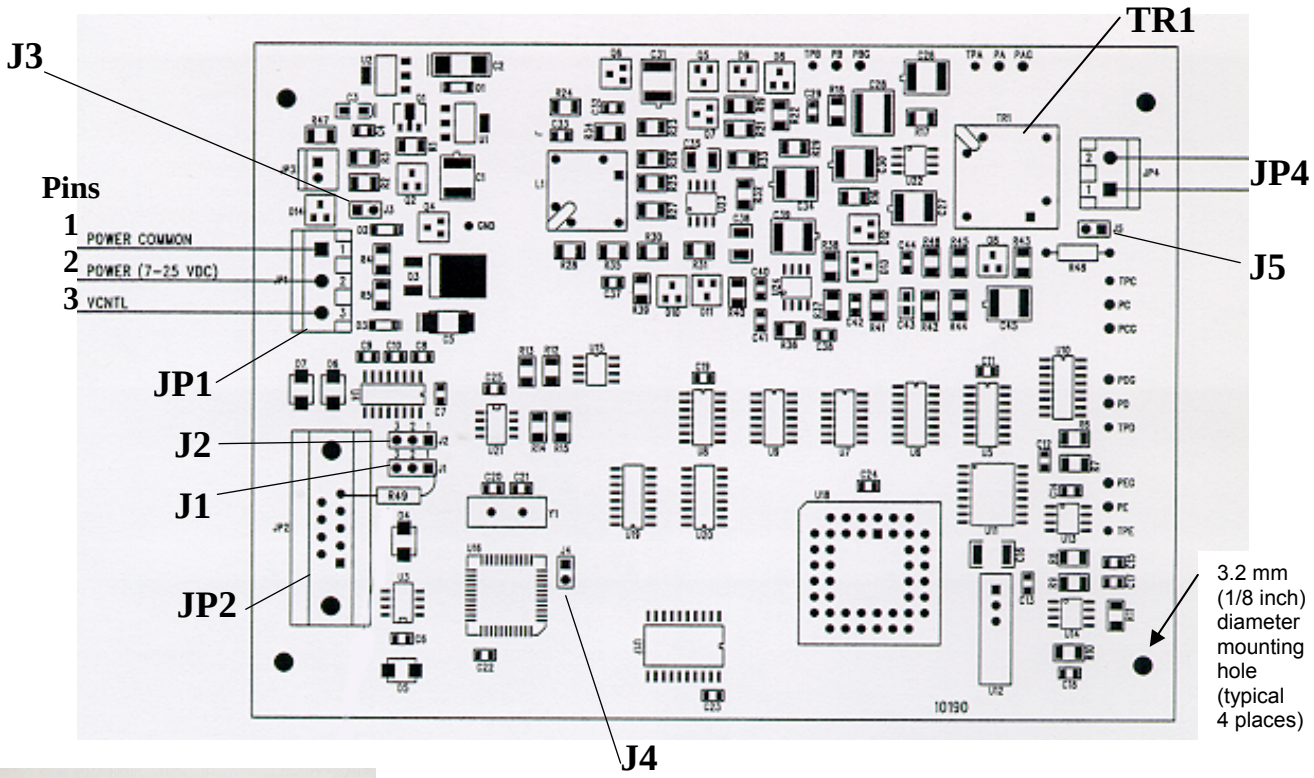
FUNCTION	CATEGORY	COMMAND	DESCRIPTION
ID Commands	**UIM ID** Only 1 UIM can be on line when sending these commands.	**ID?**	Display UIM ID (ID=ii, where ii=0-99)
		***ID=ii** If more than 1 UIM on line when setting ID, all UIMs will have same ID.	Set UIM ID to ii, where ii=0-99. Command must be sent twice, because verification requested.
UIM and Sensor Commands	**UIM Status** Commands preceded by **!ii** (ii=UIM ID).	**!iiDS**	Display firmware version and system setup information.
		!ii*EETest	Test UIM's EEPROM as a troubleshooting tool, and reset all parameters to default values.
	UIM General Setup Commands preceded by **!ii** (ii=UIM ID).	**!iiBaud=x**	**x=** baud rate for serial communication between UIM and sensor (300, 600, 1200, 2400, 4800, 9600, or 19200). Default 9600.
		!iiRelayTermChar=x	**x=** decimal value (0-255) of command termination character to specify what is appended to sensor character string for Send Command String and Get Data commands. If **x=CRLF** (default), appends carriage return and line feed. If **x=NONE**, appends nothing.
		!iiTermChar=x	**x=** decimal value (11-122) of sensor reply termination character. If UIM receives termination character, ignores any additional characters. If **x**=**NONE**, termination character checking disabled. Default 62 (>).
		!iiTimeOut=x	**x=** UIM timeout (30-1800 seconds). If no commands or replies received for **x**, UIM enters quiescent (sleep) state. Any data in UIM buffer erased. Default 120 seconds.

FUNCTION	CATEGORY	COMMAND	DESCRIPTION
UIM and Sensor Commands (continued)	**Relay Commands:** ***Relay Setup*** Commands preceded by **!ii** (ii=UIM ID).	**!iiRStartWait=x**	**x=** command transmission delay after setting control line or switched power (0-32767 milliseconds). Default 0 msec.
		!iiRTermMax=x	**x=** termination timeout for sensor reply (0-32767 milliseconds). Gap of **!iiRTermMax** after 2 characters received acts as termination character. Default 1000 msec.
		!iiRTotalMax=x	**x=** total time allowed for sensor reply to (0-600 seconds). Default 15 seconds.
	Relay Commands: ***Send Command String*** Command preceded by **#ii** (ii=UIM ID).	**#iiCmdString**	Command UIM to send character string defined by **CmdString** to sensor. **CmdString** can be any command recognized by sensor. UIM can append carriage return and line feed or character to string (see **!iiRelayTermChar=**). Response sent through UIM to SIM and computer/controller.
		BiiCmdString	Command UIM to send character string defined by **CmdString** to sensor. **CmdString** can be any character string recognized by sensor that requests a ***binary*** response. Binary response is sent through UIM to SIM and computer/controller; any termination characters are ignored.
	Relay Commands: ***Send Character*** Commands preceded by **!ii** (ii=UIM ID). **!iiRelayTermChar** does not apply to these commands.	**!iiSendCharW=x**	Command UIM to send character defined by decimal value **x** to sensor. Character can be any command recognized by sensor. Response sent through UIM to SIM and computer/controller.
		!iiSendChar=x	Command UIM to send character defined by decimal value **x** to sensor. Character can be any command recognized by sensor. **UIM does not accept any response from sensor.**
	Relay Commands: ***Send Break*** Commands preceded by **!ii** (ii=UIM ID). **iiRelayTermChar** does not apply to these commands.	**!iiBreakLen=x**	**x=** break character length (0-32750 milliseconds). Default 1000 msec.
		!iiSendBreak	Command UIM to send break character (defined by **!iiBreakLen=**) to sensor. Response sent through UIM to SIM and computer/controller.

FUNCTION	CATEGORY	COMMAND	DESCRIPTION
UIM and Sensor Commands (continued)	**Get Data Commands:** ***Setup*** Commands preceded by **!ii** (ii=UIM ID). Set up controls and timeouts for Get Data (**GData** or **!iiGData**) commands. Get Data commands cause sensor command pre-defined by **!iiGDataStr=S** to be sent to sensor. Sensor reply held in UIM buffer.	**!iiGStartWait=x**	**x=** command transmission delay after setting control line or switched power (0-32767 milliseconds). Default 0 msec.
		!iiGTermMax=x	**x=** termination timeout for sensor reply (0-32767 milliseconds). Gap of **!iiGTermMax** after 2 characters received acts as termination character. Default 1000 msec.
		!iiGTotalMax=x	**x=** total time allowed for sensor reply (0-600 seconds). Default 30 seconds.
		!iiIncGDataDelay=x	**x=Y**: In **Dataii** reply, include number of 0.1-second ticks received while waiting for **GData** or **!iiGData** reply. **x=N**: Do not include number of ticks.
		!iiGDataStr=S	**S=** character string sent to sensor in response to **GData** or **!iiGData**. Character string can be any command recognized by sensor. UIM can append carriage return and line feed or character to string (see **!iiRelayTermChar**).
	Get Data Commands ***Get Data***	**GData** Global command to all UIMs.	Command all UIMs to get data from sensors. Each UIM holds data in buffer until receiving **Dataii**.
		!iiGData Command to UIM with ID=ii (ii=0-99).	Command UIM to get data from sensor. UIM holds data in buffer until receiving **Dataii**.
		Dataii Command to UIM with ID=ii (0-99).	Get data obtained with **GData** or **!iiGData** from buffer of UIM with ID=ii. Data sent to SIM and computer/controller.
	Switched Power Setup Commands preceded by **!ii** (ii=UIM ID). Set up controls for optional switched power operation (pin 4 on connector).	**!iiSwPwrOn**	Switch power on to sensor now. Power remains on while UIM awake. When UIM enters quiescent (sleep) state, power to sensor switches off.
		!iiSwPwrOff	Switch power off to sensor now.
		!iiAutoSwPwrPOn=x	**x=Y**: Switch power on to sensor each time UIM powers on. When UIM enters quiescent (sleep) state, power to sensor switches off. **x=N** (default): Do not switch power on to sensor when UIM powers on.
		!iiAutoSwPwrGData=x	**x=Y**: Switch power on to sensor before sending Get Data command string (**!iiGDataStr**) to sensor. Power to sensor switches off when sensor response ends. **x=N** (default): Do not switch power on to sensor before sending Get Data command string.
		!iiAutoSwPwrRelay=x	**x=Y**: Switch power on to sensor before sending Relay command (**#iiCmdString**, **!iiSendCharW=x**, **!iiSendChar=x**, or **!iiSendBreak**) to sensor. Power to sensor switches off when sensor response ends. **x=N** (default): Do not switch power on to sensor before sending Relay command string.

FUNCTION	CATEGORY	COMMAND	DESCRIPTION
UIM and Sensor Commands (continued)	**Control Line Setup** All commands preceded by **!ii** (ii=UIM ID). Set up controls for optional control line operation (pin 5 on connector).	**!iiCntlOn**	Enable control line to sensor now. Control line remains enabled while UIM awake. When UIM enters quiescent (sleep) state, control line disabled.
		!iiCntlOff	Disable control line to sensor now.
		!iiAutoCntlPOn=x	**x=Y**: Enable control line to sensor each time UIM powers on. When UIM enters quiescent (sleep) state, control line disabled. **x=N**: Do not enable control line to sensor when UIM powers on.
		!iiAutoCntlGData=x	**x=Y**: Enable control line to sensor before sending Get Data command string (**!iiGDataStr**) to sensor. Control line disabled when sensor response ends. **x=N**: Do not enable control line to sensor before sending Get Data command string.
		!iiAutoCntlRelay=x	**x=Y**: Enable control line to sensor before sending Relay command (**#iiCmdString**, **!iiSendCharW=**, **!iiSendChar=**, or **!iiSendBreak**) to sensor. Control line disabled when sensor response ends. **x=N**: Do not enable control line to sensor before sending Relay command string.
	Surface Tone Detect Commands	**!iiPOnTone=x**	**x=Y**: Enable surface tone detect. After powering on, UIM waits 2.5 seconds, enables its transmitter, transmits 4800 Hz tone for 2.5 seconds, and then turns off its transmitter. **x=N**: Do not enable surface tone detect. Default.

Appendix IV:
SIM Hookup and Configuration



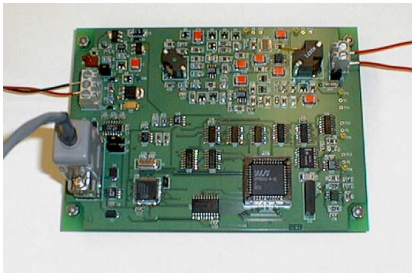


Photo shows SIM-Direct for use without Inductive Cable Coupler. SIM-Coupled for use with Inductive Cable Coupler is similar, but does not include TR1.

Dimensions:
PCB: 109 mm x 147.5 mm (4 1/4 x 5 3/4 inches)
Mounting holes: 90.5 mm x 138.1 mm (3 9/16 x 5 7/16 inches)

Power Connection

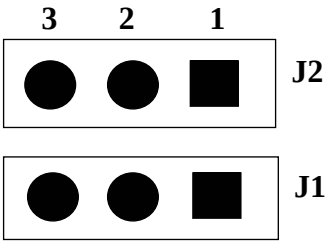
The SIM can be configured to power up in either of the following two modes:

- **Normal Power Switching (factory setting)** – The SIM runs when power is applied. Set up the SIM as follows:
  1. Connect Power Common to JP1 pin 1.
  2. Connect 7-25 VDC to JP1 pin 2.
  3. Verify there is no connection to JP1 pin 3.
  4. Verify jumper is across J3.

- **Logic Level Controlled Power Switching** – Power is always applied to JP1, pins 1 and 2. Voltage applied to JP1 pin 3 (VCNTL) switches power to the SIM. Set up the SIM as follows:
  1. Connect Power Common to JP1 pin 1.
  2. Connect 7-25 VDC to JP1 pin 2.
  3. Remove jumper on J3.

Note:
If VCNTL < 1 volt, SIM is Off (consuming < 100 microAmps).
If VCNTL > 2 volts, SIM is On.

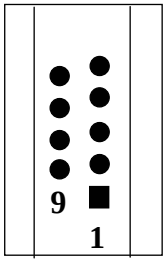
Interface Option Connection (J1, J2, and J4)



The SIM can be configured to accept RS-232 or RS-485:

- **RS-232 (factory setting)**
  1. Verify jumper is on J1 pins 2 and 3.
  2. Verify jumper is on J2 pins 2 and 3.
  3. Remove jumper on J4.
- **RS-485**
  1. Install jumper on J1 pins 1 and 2.
  2. Install jumper on J2 pins 1 and 2.
  3. Install jumper on J4.

I/O Connection (JP2)



Connect wires to JP2 as follows:

- **RS-232**
  1. **Pin 2** – RS-232 transmit from SIM to computer
  2. **Pin 3** – RS-232 transmit from computer to SIM
  3. **Pin 5** – Power Common
- **RS-485**
  1. **Pin 4** – RS-485 'A'
  2. **Pin 5** – Power Common
  3. **Pin 6** – RS-485 'B'

Inductive Mooring Cable Connection (JP4)

Note:
ICC version 4 may have 3 wires in the cable. If you ordered the ICC with a pigtail termination, solder the white and white/black wires together and attach to 1 terminal of JP4. Attach the white/red wire to the other terminal.

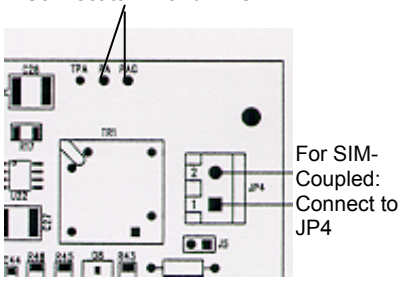
- **UIM installed with Inductive Cable Coupler (ICC)** - Connect wires from the ICC to JP4 on SIM-Coupled.
- **UIM installed without Inductive Cable Coupler** - Connect wires from the mooring cable and seawater ground to JP4 on SIM-Direct.

Normal Deployed Operation (J5)

Note:
If more than one IM instrument is on-line when you set the ID, all IM instruments will be set to the same ID. The inductive modem receivers in IM instruments are very sensitive; two IM instruments that are side-by-side will take the same ID, even if one of them is not on the IM loop. **Therefore, separate IM instruments by at least 2 meters when setting IDs.**

- **Normal Deployed Operation** – Ensure jumper on J5 is installed.
- **Instrument Setup and Lab Testing** - Remove jumper on J5. Removing the jumper on J5 inserts a 1K resistor in series with the inductive loop, reducing the signal amplitude. This prevents the UIMs in close proximity from responding to commands, which is especially important when sending the ***ID=** command.

Tone Detect Board Connection



A surface *Tone Detect* board is used for specialized applications. See *Appendix VI: Using UIM with Tone Detect Board* for a detailed description.

- **UIM installed without Inductive Cable Coupler (using SIM-Direct)** – Connect wires from the *Tone Detect* board to PA and PAG.
- **UIM installed with Inductive Cable Coupler (using SIM-Coupled)** – Connect wires from the *Tone Detect* board to JP4, or solder wires to wires connecting to JP4.

Appendix V:
UIM Interface PCB Configuration

This appendix describes the jumper configuration on the **UIM's Interface PCB** (labeled 10219). See *Appendix II: Electronics Disassembly/Reassembly* to access the Interface PCB.

Standard Setup (no optional control signal or optional switched power out)

For standard configuration, Sea-Bird recommends that you remove the J1 and J2 jumpers.

Optional Control Signal (jumper J1 on Interface PCB)

The optional control signal (pin 5 on bulkhead connector) can be configured in either of the following modes:

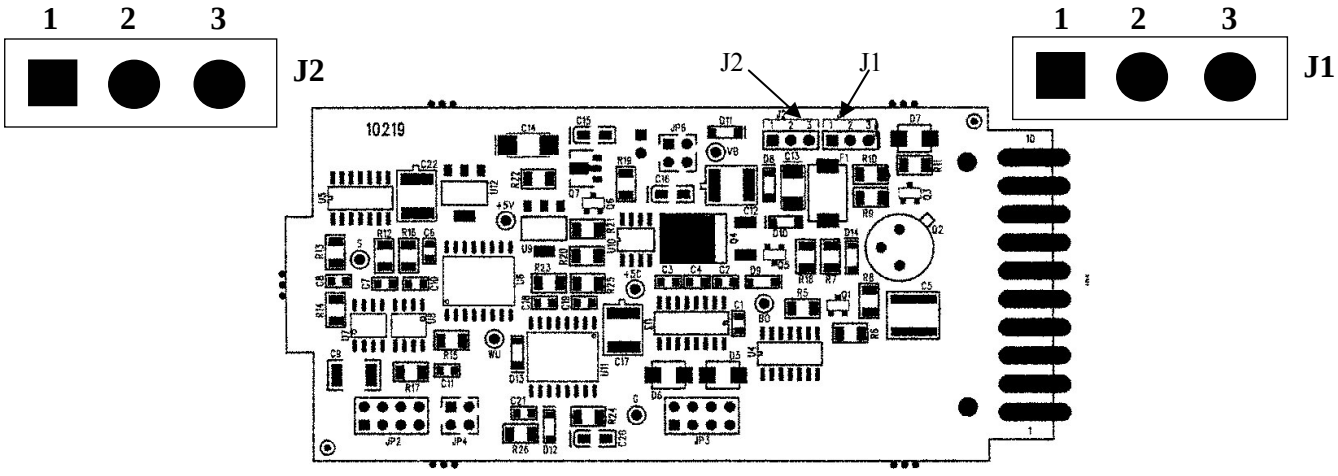
- **5 Volt logic** – jumper J1 pins 1 and 2
- **Open Collector logic** – jumper J1 pins 2 and 3

Optional Switched Power Out (jumper J2 on Interface PCB)

The optional switched power out (pin 4 on bulkhead connector) can be configured to power the serial instrument in either of the following modes:

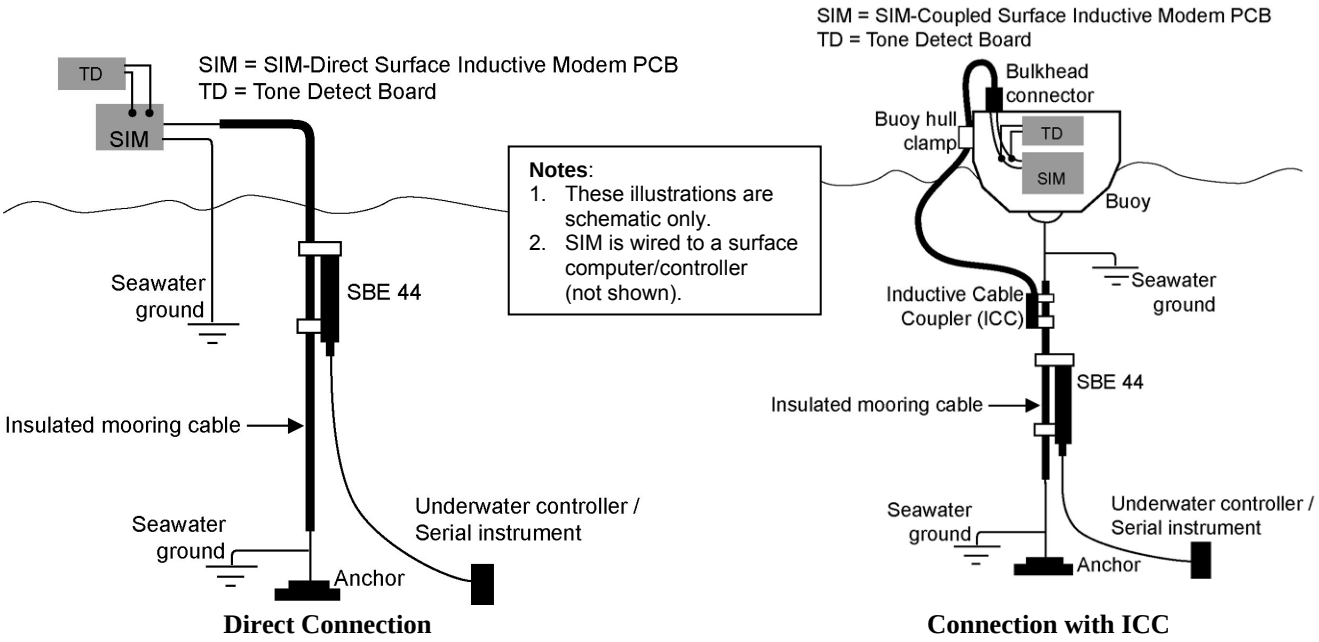
- Power serial instrument **from UIM battery pack or external voltage** (draw power from whichever voltage source is higher) – jumper J2 **pins 1 and 2**
- Power serial instrument **from external voltage only** (regardless of which voltage source is higher) – jumper J2 **pins 2 and 3**

Note:
External voltage (optional) is supplied to the UIM through pin 6 on the bulkhead connector.



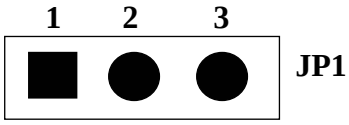
Appendix VI:
Using UIM with Tone Detect Board

A surface *Tone Detect* board can be supplied by Sea-Bird. Typically, a UIM system with a *Tone Detect* board is used when the serial instrument needs to indicate that it has completed sampling and is ready to transmit data. System schematics are shown below:

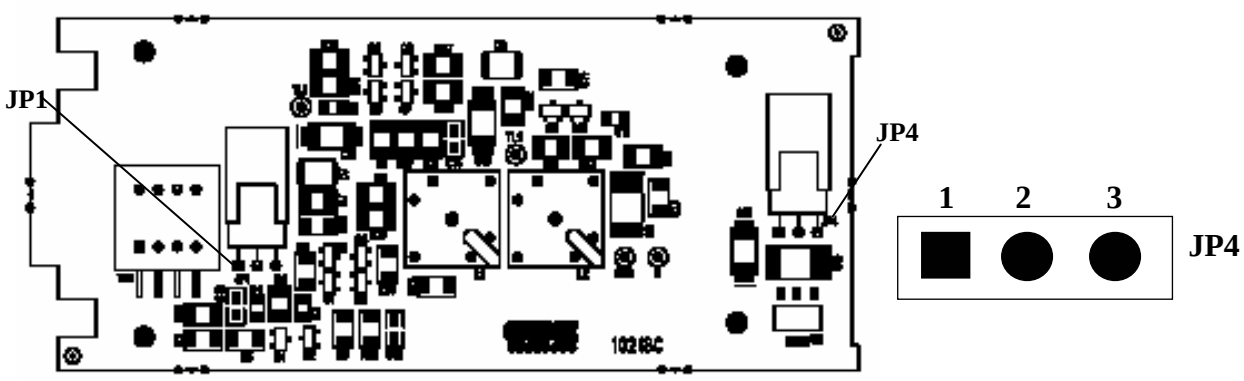


Direct Connection **Connection with ICC**

Wiring



- **Tone Detect Board JP1**
  Pin 1: connect to SIM-Coupled JP4 pin 1 or SIM-Direct PA
  Pin 2: connect to SIM-Coupled JP4 pin 2 or SIM-Direct PAG
- **Tone Detect Board JP4**
  Pin 1: ground
  Pin 2: tone detect output, PNP transistor emitter is pulled to ground when tone is detected
  pin 3: 6 – 20 VDC in (150 microAmps when waiting for tone)



The impedance of the inductive link must be 500 ohms or less at 4800 Hz for reliable operation. A mooring cable on a spool may have considerable impedance, and may need to be unspooled before using the inductive link.

The inductance of a spooled cable can be estimated by:

$$L \text{ (Henries)} = 1.0 \times 10^{-6} * 0.8 * a^2 * n^2 / (6 * a + 9 * b + 10 * c)$$

where
a = average radius of windings (inches)
b = length of the coil (inches)
c = difference between outer and inner radii of coil (inches)
n = number of windings on spool

The impedance at 4800 Hz is:

$$\text{Impedance (ohms)} = 1 / (2.0 * \pi * 4800 * L)$$

where
L = inductance (Henries)

Operation

To use the tone detect:

- Set up your underwater controller/serial instrument to pull the detect line low on the UIM when it has completed sampling.
- Set up your surface computer/controller to send the appropriate commands to get the data from the underwater controller/serial instrument, when it is signaled by the surface *Tone Detect* board.
- Set **!iiPOnTone=Y** to enable the tone detect in the UIM.

Note:
Transmission of the 4800 Hz tone by the UIM *wakes up* all other inductive modem instruments (such as other 44s as well as 37-IM, 37-IMP, 39-IM, 16*plus*-IM, 16*plus*-IM V2) on the mooring cable. These other instruments will draw their communications current (varies; see appropriate instrument manual) from their batteries while awake. They will go back to sleep after 2 minutes, or sooner if you send the **PwrOff** command. If you will be using the tone detect frequently, you should consider this effect on the power budget for the other IM instruments on the mooring.

When the underwater controller/serial instrument has completed sampling, the system responds as follows:

1. The underwater controller/serial instrument pulls the detect line low on the UIM, powering the UIM on.
2. The UIM waits 2.5 seconds, enables its transmitter, transmits a 4800 Hz tone for 2.5 seconds, and then turns off its transmitter.
3. The 4800 Hz tone is received by the surface *Tone Detect* board, which then signals the surface computer/controller.
4. The surface computer/controller sends the appropriate commands through the SIM to the UIM to get the data from the underwater controller/ serial instrument.

Shown below are two example command sets for a tone detect board system. The UIM's response to each command is not shown in the examples.

Example: ***System with Tone Detect Board and Multiple Inductive Modem Instruments*** (user input in bold)

Assume the following system: An underwater controller/sensor (call this UC) is sampling, and needs to upload the last sample data through the UIM after each sample is taken. UC is programmed to pull detect line low on UIM when sampling is complete. UC command set includes **SL** (send last data sample taken by UC).

Define SIM operation for entire system, and then verify SIM setup.

S>**AUTOPWRON=N** (do not automatically send **PWRON** to UIMs when power applied to SIM)
S>**RELAYMAX=20** (set total time allowed for sensor reply in SIM to 20 seconds)
S>**ECHOOFF** (do not echo characters to surface controller)
S>**DS** (verify SIM setup)

With (only) UIM 01 on-line: Send wakeup tone to UIM, and display UIM ID to verify ID. Set baud, termination characters, and timeouts, and enable the surface tone detect. Verify UIM setup, and send power-off command.

S>**PWRON** (wake up UIM; wait at least 10 seconds before proceeding to ensure UIM is awake)
S>**ID?** (verify UIM ID)
S>**!01BAUD=9600** (set baud between UIM and underwater controller/sensor to 9600)
S>**!01TIMEOUT=120** (set UIM main timeout to 120 seconds = 2 minutes)
S>**!01RELAYTERMCHAR=crlf** (append carriage return and line feed to commands relayed to underwater controller/sensor)
S>**!01TERMCHAR=x** (application dependent reply termination character)
S>**!01RSTARTWAIT=x** (application dependent)
S>**!01RTERMMAX=2000** (set sensor reply gap timeout in UIM to 2000 msec = 2 seconds)
S>**!01RTOTALMAX=20** (set total time allowed for sensor reply in UIM to 20 seconds)
S>**!01PONTONE=Y** (enable surface tone detect)
S>**!01DS** (verify UIM setup)
S>**PWROFF** (place UIM in sleep state)

Disconnect UIM 01 from SIM.
For each UIM that will be incorporated in system: connect UIM to SIM, and repeat **PWRON** through **PWROFF** using appropriate UIM ID.

Deploy system. When UC has completed sampling and is ready to transmit data, it pulls detect line low on UIM, powering UIM. UIM waits 2.5 seconds, enables its transmitter, transmits a 4800 Hz tone for 2.5 seconds, and then turns off its transmitter. Tone is received by surface *Tone Detect* board, which then signals SC to apply power to SIM. Wait at least 5 seconds to ensure UIM is listening for commands.

S>**#01SL** (SC sends command to send last sample taken by UC)
S>**PWROFF** (SC sends command to power down all UIMs)
(SC powers down SIM and SC)

Example: ***System with Tone Detect Board and1 Instrument with Binary Data*** (user input in bold)

Assume the following system: An underwater controller/sensor (call this UC) is sampling, and needs to upload binary data through the UIM after each sampling session is complete. UC is programmed to pull detect line low on UIM when sampling is complete. UC command set includes **status** (transmit status of instrument, including number of bytes in memory) and **sendb,e** (upload data in binary, from byte **b** to byte **e**). Surface computer/controller (call this SC) is programmed to interpret UC status response, and then send appropriate command(s) to upload data, limiting data transfer to 30,000 bytes at a time because of UIM's 30 Kbyte buffer.

Note: The SBE 44's binary data capability is intended for use on a system with only one inductive modem instrument online. A binary data reply ***could*** inadvertently include the equivalent of a valid command for other inductive modem instruments on line, causing other instruments to respond and thereby corrupting the data stream. **Sea-Bird strongly recommends that you do not use the binary data capability with multiple inductive modem instruments online.**

Define SIM operation, and then verify SIM setup.

S>**AUTOPWRON=N** (do not automatically send **PWRON** to UIMs when power applied to SIM)
S>**RELAYMAX=600** (set total time allowed for sensor reply in SIM to 600 seconds = 10 minutes)
S>**BINARYGAP=1000** (set sensor binary reply gap detect timeout in SIM to 1000 milliseconds = 1 second)
S>**ECHOOFF** (do not echo characters to surface controller)
S>**DS** (verify SIM setup)

With (only) UIM 01 on-line: Send wakeup tone to UIM, and display UIM ID to verify ID. Set baud, termination characters, and timeouts, and enable the surface tone detect. Verify UIM setup, and send power-off command.

S>**PWRON** (wake up UIM; wait at least 10 seconds before proceeding to ensure UIM is awake)
S>**ID?** (verify UIM ID)
S>**!01BAUD=9600** (set baud between UIM and underwater controller/sensor to 9600)
S>**!01TIMEOUT=120** (set UIM main timeout to 120 seconds = 2 minutes)
S>**!01RELAYTERMCHAR=crlf** (append carriage return and line feed to commands relayed to underwater controller/sensor)
S>**!01TERMCHAR=x** (application dependent reply termination character; not applicable to binary reply)
S>**!01RSTARTWAIT=x** (application dependent)
S>**!01RTERMMAX=2000** (set sensor reply gap timeout in UIM to 2000 msec = 2 seconds)
S>**!01RTOTALMAX=600** (set total time allowed for sensor reply in UIM to 600 seconds = 10 minutes)
S>**!01PONTONE=Y** (enable surface tone detect)
S>**!01DS** (verify UIM setup)
S>**PWROFF** (place UIM in sleep state)
Disconnect UIM 01 from SIM.

Deploy system. When UC has completed sampling and is ready to transmit data, it pulls detect line low on UIM, powering UIM. UIM waits 2.5 seconds, enables its transmitter, transmits a 4800 Hz tone for 2.5 seconds, and then turns off its transmitter. Tone is received by surface *Tone Detect* board, which then signals SC to apply power to SIM. Wait at least 5 seconds to ensure UIM is listening for commands.

S>**#01status** (SC sends status command to UC connected to UIM 01; assume status command shows that there are 45,000 bytes)
S>**b01send1,30000** (SC sends command to upload bytes 1 - 30,000 in binary to UC connected to UIM 01)
S>**b01send30001,45000** (SC sends command to upload bytes 30,001 – 45,000 in binary to UC connected to UIM 01)
S>**PWROFF** (SC sends command to power down all UIMs)
(SC powers down SIM and SC)

Appendix VII: Character Map and Values

The character map is used to set the sensor reply termination character (**!iiTermChar**), as described in *Section 4: Deploying and Operating UIM*.

Screen Codes

Dec.	Hex	Sym.	Dec.	Hex	Sym.
0	00		32	20	
1	01	☺	33	21	!
2	02	☻	34	22	"
3	03	♥	35	23	#
4	04	♦	36	24	$
5	05	♣	37	25	%
6	06	♠	38	26	&
7	07	•	39	27	'
8	08	◘	40	28	(
9	09	○	41	29	)
10	0A	■	42	2A	*
11	0B	♂	43	2B	+
12	0C	♀	44	2C	,
13	0D	♪	45	2D	-
14	0E	♫	46	2E	.
15	0F	☼	47	2F	/
16	10	►	48	30	0
17	11	◄	49	31	1
18	12	↕	50	32	2
19	13	‼	51	33	3
20	14	¶	52	34	4
21	15	§	53	35	5
22	16	▬	54	36	6
23	17	↨	55	37	7
24	18	↑	56	38	8
25	19	↓	57	39	9
26	1A	→	58	3A	:
27	1B	←	59	3B	;
28	1C	∟	60	3C	<
29	1D	↔	61	3D	=
30	1E	▲	62	3E	>
31	1F	▼	63	3F	?

Screen Codes (cont.)

Dec.	Hex	Sym.	Dec.	Hex	Sym.
64	40	@	96	60	`
65	41	A	97	61	a
66	42	B	98	62	b
67	43	C	99	63	c
68	44	D	100	64	d
69	45	E	101	65	e
70	46	F	102	66	f
71	47	G	103	67	g
72	48	H	104	68	h
73	49	I	105	69	i
74	4A	J	106	6A	j
75	4B	K	107	6B	k
76	4C	L	108	6C	l
77	4D	M	109	6D	m
78	4E	N	110	6E	n
79	4F	O	111	6F	o
80	50	P	112	70	p
81	51	Q	113	71	q
82	52	R	114	72	r
83	53	S	115	73	s
84	54	T	116	74	t
85	55	U	117	75	u
86	56	V	118	76	v
87	57	W	119	77	w
88	58	X	120	78	x
89	59	Y	121	79	y
90	5A	Z	122	7A	z
91	5B	[	123	7B	{
92	5C	\	124	7C	|
93	5D	]	125	7D	}
94	5E	^	126	7E	~
95	5F	_	127	7F	▒

Appendix VIII: Replacement Parts

Part Number	Part	Application Description	Quantity in UIM
50243 / 50243.1	Lithium battery set (6 sticks)	Power UIM	1
171887	9-pin DB-9P to 9-pin DB-9S I/O cable, 3 m (10 ft) long	From SIM to computer	1
171888	25-pin DB-25S to 9-pin DB-9P cable adapter	For use with computer with DB-25 connector	-
801434 *	6-pin AG-206 to 9-pin DB-9S serial test cable, 2.4 m (8 ft) long	Connects UIM connector to computer for lab testing	-
17047.1 *	6-pin AG-206 dummy plug with locking sleeve	For storage	-
17043 *	Locking sleeve *	Locks cable or dummy plug in place	
801450	6-pin (wet-pluggable) MCIL-6FS to 9-pin DB-9S serial test cable, 2.4 m (8 ft) long	Connects UIM connector to computer for lab testing	
171498.1	6-pin MCDC-6F dummy plug with locking sleeve	For storage	
171192	Locking sleeve	Locks cable or dummy plug in place	
41247	Surface *Tone Detect* board	For specialized applications	-
60050	Spare hardware/ O-ring kit	Assorted hardware and O-rings, including: • 30900 Bolt, 1/4-20 x 2" hex head, titanium (secures mounting clamp) • 30633 Washer, 1/4" split ring lock, titanium (for 30900) • 30634 Washer 1/4" flat, titanium (for 30900) • 31019 O-ring 2-008 N674-70 (for 30900) • 30857 Parker 2-033E515-80 O-ring (modem end cap and connector end cap o-ring) • 30859 Machine screw, 8-32 x 3/8" FH, titanium (secures housing to end caps) • 31749 Hex key, 7/64 inch, long arm (secures battery pack in housing with captured screw) • 31322 O-ring 2-130 N674-70 (for grooves on side of battery pack) • 30858 O-ring 2-133 N674-70 (for battery pack cover plate)	-

* For standard Impulse glass-reinforced epoxy connector

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