# Long Ranger
# Troubleshooting Guide

P/N 957-6125-00 (October 2001)

RD Instruments
*Acoustic Doppler Solutions*

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# Long Ranger Troubleshooting Guide

## 1 Introduction

Considering the complexity of the Long Ranger, we have provided as much information as practical for field repair; *fault location to the component level is beyond the scope of these instructions*. The provided information assumes that faults are isolated with a large degree of certainty to a Least Replaceable Assembly (LRA) level only. The time to repair the system will be minimized if an entire replacement unit is available in the field. If time to repair is of essence, RD Instruments strongly advises the availability of the listed LRAs.

**NOTE.** When an addition or correction to the manual is needed, an Interim Change Notice will be posted to our web site on the Customer Service page (www.rdinstrument.com). Please check our web site often.

**Table 1: List of Least Replaceable Assemblies**

| LRA | Description |
|---|---|
| ADCP | The entire ADCP; includes the electronics, housing, transducer ceramic assemblies, and end-cap. |
| ADCP electronics | The spare boards kit Includes the High Power I/O, CPU, and DSP boards. |
| End-Cap | Includes the end-cap, connector, and internal I/O cable. |
| I/O Cable | Connects the ADCP to the Computer. |
| PC Card | Replaceable PC recorder card (optional). |

Since these Least Replaceable Assemblies are manufactured in different configurations, please contact RD Instruments (see "Technical Support," page 12 for contact information) to obtain the correct part number for your specific system configuration. When contacting RD Instruments about a replacement assembly, please provide the serial numbers of the ADCP. If

you want to replace the I/O Cable only, then please provide the cable length.

## 1.1 Equipment Required

Special test equipment is not needed for trouble shooting and fault isolation. The required equipment is listed in Table 2. Any equipment satisfying the critical specification listed may be used.

**Table 2: Required Test Equipment**

| Required Test Equipment | Critical Specification |
|---|---|
| DMM | Resolution: 3 ½ digit |
| | DC-Voltage Range: 200 mV, 2V, 20 V, 200V |
| | DC-Voltage Accuracy: ± 1% |
| | AC-Voltage Range: 200 V, 450 V |
| | AC-Voltage Accuracy: ± 2% |
| | Resistance Range: 200, 2 k, 20 k, 200 k, 20 MOhm |
| | Res.-Accuracy: ± 2% @ 200 Ohm to 200 kOhm |
| | Res.-Accuracy: ± 5% @ 20 Mohm |
| | Capacitance Range: 20 nF, 2 uF, 20 uF |
| | Capacitance Accuracy: ± 5% |
| Serial Data EIA Break-Out Box such as from International Data Sciences, Inc. 475 Jefferson Boulevard Warwick, RI 02886-1317 USA. | Model 60 or similar is recommended as it eases the troubleshooting of RS-232 communication problems significantly. Other manufacturers or models may be substituted. |

**NOTE.** The EIA Break-out Panel is not necessary, but eases RS-232 communication problems troubleshooting significantly.

## 1.2 Basic Steps in Troubleshooting

The first step in troubleshooting is determining what type of failure is occurring. There are four types of failures:

- Communication failure
- Built-In test failure
- Beam failure
- Sensor failure

***Communication failures*** can be the hardest problem to solve as the problem can be in any part of the system (i.e. the computer, Long Ranger, cable, or power). The symptoms include having the system not respond, or not responding in a recognizable manner (for example "garbled" text).

***Built-In test failures*** will appear when the system diagnostics are run. Use *DumbTerm* to identify the failing test.

***Beam failures*** can be identified when collecting data or during the user-interactive performance tests.

***Sensor failures*** can also be identified when collecting data or during the user-interactive performance tests. The sensor may send incorrect data, or not be identified by the system.

# 2 Troubleshooting the Long Ranger

Although the Long Ranger is designed for maximum reliability, it is possible for a fault to occur. This section explains how to troubleshoot and fault isolate problems to the Least Replaceable Assembly level (see Table 1, page 1). Before troubleshooting, review the procedures, figures, and tables in this guide. Also, read the "System Overview," page 15 to understand how the Long Ranger processes data.

**CAUTION.** Under all circumstances, follow the safety rules listed in the "Troubleshooting Safety," page 4.

## 2.1 Troubleshooting Safety

Follow all safety rules while troubleshooting.

**CAUTION.** Servicing instructions are for use by service-trained personnel. To avoid dangerous electric shock, do not perform any service unless qualified to do so.

**CAUTION.** Complete the ground path. **The power cord and the outlet used must have functional grounds.** The power plug on the AC power adapter must only be inserted in a socket outlet provided with a protective earth contact. The protective action must not be negated by the use of an extension cord (power cable) without a protective conductor (grounding). Grounding one conductor of a two-conductor outlet is not sufficient protection.

**CAUTION.** Any interruption of the earthing (grounding) conductor, inside or outside the instrument, or disconnecting the protective earth terminal will cause a potential shock hazard that could result in personal injury.

**CAUTION.** Only fuses with the required rated current, voltage, and specified type must be used. Do not repair fuses or short circuit fuse-holders. To do so could cause a shock or fire hazard.

**CAUTION.** Do not install substitute parts or perform any unauthorized modifications to the instrument.

**CAUTION.** Measurements described in the manual are performed with power supplied to the instrument while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

**CAUTION.** Do not attempt to open or service the AC power adapter.

**CAUTION.** Any maintenance and repair of the opened instrument under voltage should be avoided as much as possible, and when inevitable, should be carried out only by a skilled person who is aware of the hazard involved.

**CAUTION.** Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of power.

## 2.2 Troubleshooting a Communication Failure

Long Ranger ADCPs communicate by means of two serial communication channels. The user can choose between RS-232 and RS-422 classes of serial interfaces with a switch on the High Power I/O board in the Long Ranger.

To successfully communicate, both the host computer and the Long Ranger must communicate using the same class of serial interface. Standard serial interfaces in IBM compatible computers are also RS-232.

**NOTE.** If you have just received your Long Ranger from RDI, the standard configuration is RS-232.

**NOTE.** If you are using a high baud rate and/or a long I/O cable (greater then 50 meters), RS-232 may not work. Switch to RS-422 and try to wakeup the Long Ranger again. Your computer must have a RS422 adapter.

There are two types of communication failures; nothing happens at all when attempting to wake up the ADCP, or something happens, but not the correct wake up message is displayed.

***Incorrect Wakeup Message***

When you send a break and the data is garbled, you may have a baud rate or parity mismatch between the Long Ranger and the computer, or the Long Ranger may be set for RS-422 instead of RS-232. Check the RS-232/422 switch on the High Power I/O card inside the Long Ranger. See "Incorrect Wakeup Messages," page 6 for symptoms of garbled wakeup messages.

**NOTE.** Most communication problems are associated with incorrect cabling (i.e. the serial cable is connected to the wrong port) or data protocols (i.e. the wrong baud rate is set between the Long Ranger and the computer).

***Nothing Happens***

If you cannot talk to the Long Ranger (i.e., no wakeup message at all), you need to isolate the problem to a computer fault, power, cable failure, or a Long Ranger problem. Check the following items:

a. Connect the Long Ranger to a computer according to the Long Ranger User's Guide. Check that all cable connections are tight.

b. Is the Long Ranger AC power adapter working? Is the input voltage between 100 to 240 VAC? Is the output level 48 VDC?

c. If the Long Ranger is running from the internal batteries, check that the battery voltage is above 30 Volts DC. Long Ranger ADCPs will work at 20 volts; however, both lithium and alkaline battery packs with voltages

below 30 volts are at or near their end of life, and are approaching uselessness.

d. Is the computer hooked up properly? Does it have power?

e. Make sure that your computer and the *DumbTerm* program are set up to use the communication port the I/O cable is connected to on the computer.

### 2.2.1 Incorrect Wakeup Messages

The following conditions may indicate a communications mismatch or lost boot code.

- Sending a break causes "garbage" to appear on the screen. The "garbage" text may keep scrolling. This happens when the computer is using RS-232 and the ADCP is set for RS-422 or vice-versa. Check the RS-232/RS-422 switch on the High Power I/O board (see the Maintenance guide).
- Sending a break causes "garbage" to appear on the screen. You can hear the ADCP "beep" when the break is sent. The "garbage" text does not keep scrolling. Check that the ADCP and computer are both using the same baud rate. See the CB-command in the Command and Output Data Format book.
- If the ADCP gives a steady "beep" when power is applied, the ">" prompt appears on the screen, and a "X" appears when additional breaks are sent, this may indicate that the operating code has been lost (see "ADCP Checks," page 8). This can happen if you abort while downloading new firmware. Try downloading the firmware again.

### 2.2.2 Check the Power

The following test can be done with a voltmeter to check the power.

Check the power going into the ADCP by measuring the voltage on the end of the cable that connects to the Long Ranger at Pins 3 and 7 (GND) (see "Long Ranger Cables," page 13). The voltage should be +48 VDC (using the standard AC adapter). If not, check the voltage at the other end of the cable, and the AC adapter.

### 2.2.3 Check the I/O Cable

This test will check the communication between the computer and the Long Ranger.

a. Disconnect both ends of the cable and measure the continuity using a DMM (see "Long Ranger Cables," page 13 for the wiring diagram). Correct any problems found.

a. Reconnect the I/O cable to host computer.

a. Load *DumbTerm* on your computer. Select the proper communications port (see the RDI Tools User's Guide for help on using *DumbTerm*).

b. For RS-232 communications, short pins 1 and 2 together on the female 7-pin connector that was plugged into the Long Ranger (see "Long Ranger Cables," page 13). If you are using RS-422, connect a jumper between pin 2 to pin 6 and another jumper between pins 1 to pin 5 of the underwater connector at the Long Ranger end of the cable.

c. Type any characters on the keyboard. The keys you type should be echoed on the screen. If you see characters, but not correctly (garbage), the cable may be too long for the baud rate. Try a lower baud rate. If this works disconnect the jumper on pins 1 and 2 and then push any keys on the keyboard. You should NOT see anything you type.

d. If the keys are echoed correctly on the screen, the computer and the communication cable are good. Re-connect the I/O cable to the Long Ranger. The above loop-back test does not show if transmit and receive pairs are interchanged. Thus, it is important that you check the wiring diagrams provided in "Long Ranger Cables," page 13.

**NOTE.** A loop-back test does not show if transmit and receive wires or pairs are interchanged, even though characters may be displayed correctly.

## 2.2.4 ADCP Checks

Once you have eliminated possible problems with the power, I/O cable, communications settings, and the computer, that leaves the ADCP as the source of the problem. The following checks may help in some situations.

***Cold Start the ADCP***

a. Remove the housing to gain access to the PC boards.

b. Remove *all* power to the ADCP.

**CAUTION.** Disconnect the power cables P1 and P2 on the High Power I/O board to ensure that NO POWER is applied to the ADCP during the next step.

c. Short TP3 to TP4 on the High Power I/O board for 10 seconds.

d. Remove the jumper.

e. Reconnect power cable P1 and P2.

f. Connect the computer and power to the ADCP. Send a break to the ADCP. This should start the ADCP in the "cold start" mode.

***Fuse***

Check the fuse on the End-Cap Interface board is not blown (see the Maintenance Guide for fuse replacement procedures).

**CAUTION.** Only fuses with the required rated current, voltage, and specified type must be used. Do not repair fuses or short circuit fuse-holders. To do so could cause a shock or fire hazard.

***Operating Code Error***

If the ADCP gives a steady "beep" when power is applied, the ">" prompt appears on the screen, and a "*" appears when a break is sent or an "X" if Enter is pressed, this may indicate that the operating code has been lost. This can happen if you abort while downloading new firmware. Try downloading the firmware again.

## 2.3 Troubleshooting a Built-In Test Failure

The built-in diagnostic tests check the major ADCP modules and signal paths. The spare boards kit may be used to repair some failures.

### 2.3.1 When to use the Spare Boards Kit

Use this Kit whenever you have any of the following problems:

- Cannot communicate to the Long Ranger and you have ensured that the serial port on the computer, Long Ranger I/O Cable, and Long Ranger RS-232 to RS-422 converter (if applicable) are all working properly.
- Your Long Ranger fails any of the following PA tests at any time:

***CPU Tests***:

- RTC
- RAM
- ROM

***DSP Tests***:

- Timing RAM
- Demod RAM
- Demod REG
- FIFOs

***System Tests***:

- XILINK Interrupts
- Receive Loop Back Test

- Your Long Ranger fails any of the following PA tests provided the items indicated by {} have been checked:

***Recorder Tests***:

Any recorder tests fails {provided that the PC card(s) have been checked for proper installation, operation and they are DOS formatted; we STRONGLY recommend checking PC cards in a computer before replacing the boards}

***System Tests***:

Transmit {if the Long Ranger fails when it is in water and air bubbles have been rubbed from the faces}

***Sensor Tests***:

H/W Operation {if the Long Ranger fails when it is NOT sitting/resting on its side, or located near a large magnetic field like a motor in a boat}

**The spare boards kit will not correct any of the following failures:**

- A damaged beam or its urethane surface
- Damage to the transducer beam connections below the copper shield
- If it passes all PA tests and yet the data is all marked as bad
- Fails the following PA test:

***System Tests***:
Wide Bandwidth {bandwidth tests may fail due to external interference}

Narrow Bandwidth {bandwidth tests may fail due to external interference}

RSSI Filter

Transmit

**Table 3: Pre-deployment Test (PA) Possible Cause of Failures**

| PA Test Name | Possible Cause of Failure |
|---|---|
| Pre-Deployment Tests CPU Tests:<br>RTC<br>RAM<br>ROM | CPU board failed |
| Recorder Tests:<br>PC Card #0<br>Card Detect<br>Communication<br>DOS Structure<br>Sector Test (short)<br>PC Card #1<br>Card Detect<br>Communication<br>DOS Structure<br>Sector Test (short) | PC card not plugged in<br>PC card failed<br>DSP board failed |
| DSP Tests:<br>Timing RAM<br>Demod RAM<br>Demod REG<br>FIFOs | DSP board failed |
| System Tests:<br>XILINX Interrupts | DSP or CPU board failed |
| Receive Loop-Back | DSP or CPU board failed |
| Wide Bandwidth | Not in water<br>External interference<br>DSP or Receiver board failed |
| Narrow Bandwidth | |
| RSSI Filter | |
| Transmit | Not in water or High Power Amplifier board failed |
| Sensor Tests:<br>H/W Operation | High Power I/O board failed<br>Receiver board failed<br>Pressure sensor failed<br>ADCP laying on its' side |

## 2.4 Troubleshooting a Beam Failure

If the beam continuity test fails, a bad DSP board, Receiver board, High Power I/O board, or a bad beam may cause the failure. If replacing the DSP and High Power I/O board (included with the spare boards kit) does not fix the problem, the ADCP must be returned to RDI for repair.

```
>PC1

BEAM CONTINUITY TEST

When prompted to do so, vigorously rub the selected
beam's face.

If a beam does not PASS the test, send any character to
the ADCP to automatically select the next beam.

Collecting Statistical Data...
  41  46  45  43  41  46  45  43  41  46  45  42  41  46  44  42

Rub Beam 1 = PASS |   NOTE - Possible cause of failure
Rub Beam 2 = PASS |          DSP Board
Rub Beam 3 = PASS |          Receiver Board
Rub Beam 4 = PASS |          High Power Amplifier Board
>                 |          Beam
```

## 2.5 Troubleshooting a Sensor Failure

If the PA test fails the sensor test, run PC2 to isolate the problem. The ambient temperature sensor is mounted on the receiver board. This sensor is imbedded in the transducer head, and is used for water temperature reading. The attitude temperature sensor is located on the High Power I/O board under the compass. The ADCP will use the attitude temperature if the ambient temperature sensor fails.

If one of the temperature sensors fails, the PC2 test will show both sensors at the same value.

```
>PC2
Press any key to quit sensor display ...

Heading   Pitch    Roll   Up/Down    Attitude Temp   Ambient Temp   Pressure
301.01°  -7.42°  -0.73°     Up          24.35°C         22.97°C         0.0 kPa
300.87°  -7.60°  -0.95°     Up          24.36°C         22.97°C         0.0 kPa
300.95°  -7.60°  -0.99°     Up          24.37°C         22.97°C         0.0 kPa
300.71°  -7.61°  -0.96°     Up          24.37°C         22.98°C         0.0 kPa
300.69°  -7.61°  -0.96°     Up          24.35°C         22.98°C         0.0 kPa
300.76°  -7.60°  -0.98°     Up          24.38°C         22.97°C         0.0 kPa
>
```

**NOTE.** The PA test will fail if the ADCP is lying on its side or located near a large magnetic field.

**NOTE.** If the temperature sensor is bad, the data can still be collected with no effects to accuracy or quality. Contact RDI about scheduling a repair of the temperature sensor at your convenience.

### 2.5.1 Fault Log

To determine why a sensor failed, view the fault log. To view the fault log, start *DumbTerm*. Press the **End** key to wakeup the ADCP. Type the following commands: **CR1**, **FC**, **PA**, **FD**. The fault log will be displayed by the FD-command.

```
[BREAK Wakeup A]

WorkHorse Broadband ADCP Version x.xx
RD Instruments (c) 1996-1997
All rights reserved.
>CR1
>FC
>PA
|          (PA test results (not shown))
|
>FD
Total Unique Faults   =     2
Overflow Count        =     0
Time of first fault:   97/11/05,11:01:57.70
Time of last fault:    97/11/05,11:01:57.70
Fault Log:
Entry #  0 Code=0a08h  Count=    1  Delta=    0 Time=97/11/05,11:01:57.70
 Parameter = 00000000h
  Tilt axis X over range.
Entry #  1 Code=0a16h  Count=    1  Delta=    0 Time=97/11/05,11:01:57.70
 Parameter = 00000000h
  Tilt Y axis ADC under range.
End of fault log.
```

## 2.6 Technical Support

If you have technical problems with your instrument, contact our field service group in any of the following ways:


**RD Instruments**

9855 Businesspark Ave.

San Diego, California 92131

(858) 693-1178

FAX (858) 695-1459

rdifs@rdinstruments.com

**RD Instruments Europe**

5 Avenue Hector Pintus

06610 La Gaude, France

+33(0) 492-110-930

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rdifs@rdieurope.com

Web: http://www.rdinstruments.com


If your instrument works and you have questions involving a specific application, you may call either the field service group (above) or our sales/marketing staff.

# 3 Long Ranger Cables

This section has information on Long Ranger cabling. Special user-requests may cause changes to the basic wiring system and may not be shown here. We provide these drawings only as a guide in troubleshooting the ADCP. If you feel there is a conflict, contact RDI for specific information about your system. The following figures show various Long Ranger cable locations, connectors, and pin-outs.

**NOTE.** Where shown, the color code is for reference only; your cable may be different.

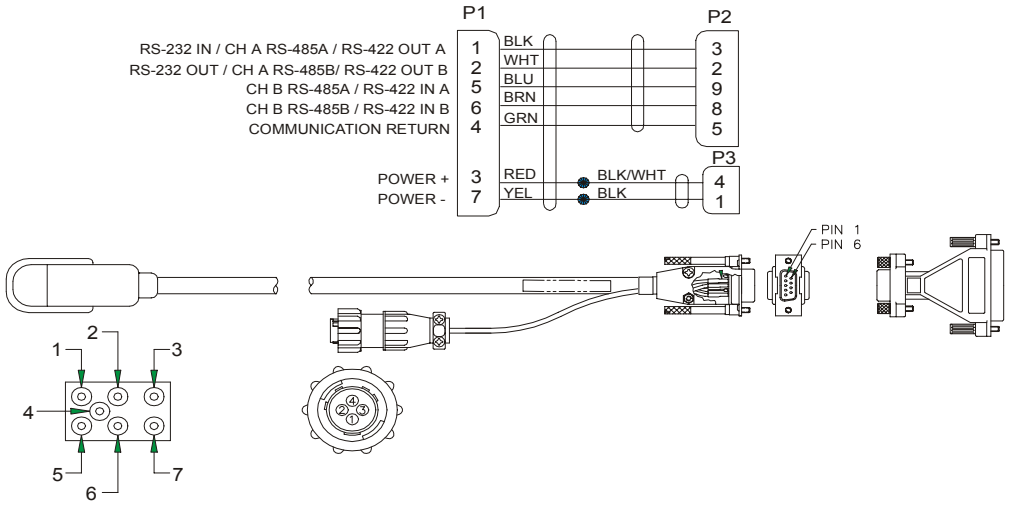


**Figure 1. Long Ranger I/O Cable Wiring**

**NOTE.** Where shown, IN refers to signals going into the ADCP and OUT refers to signals coming out of the ADCP.

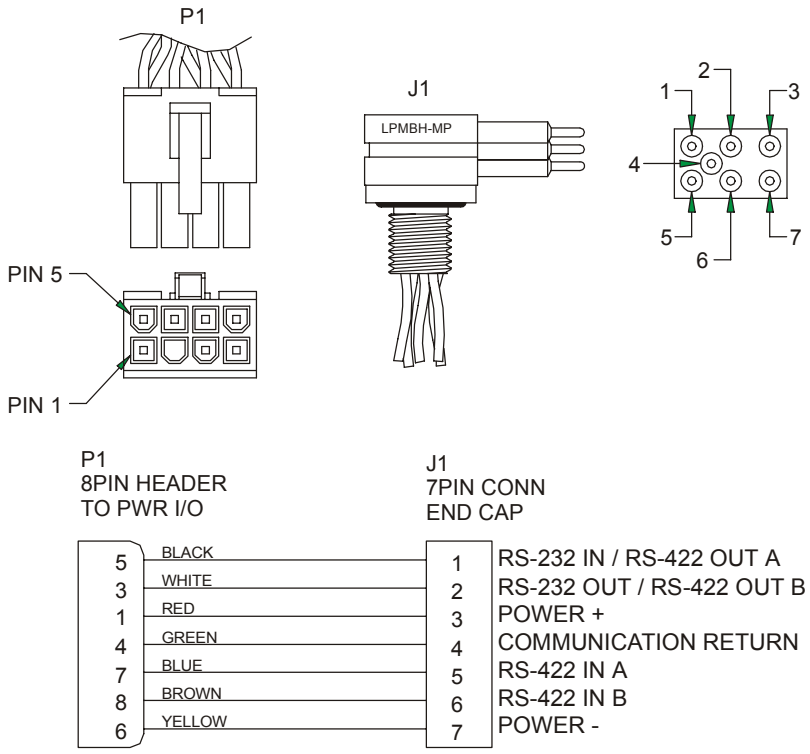


**Figure 2. Long Ranger Internal I/O Cable (End-Cap to Electronic Chassis) Wiring**

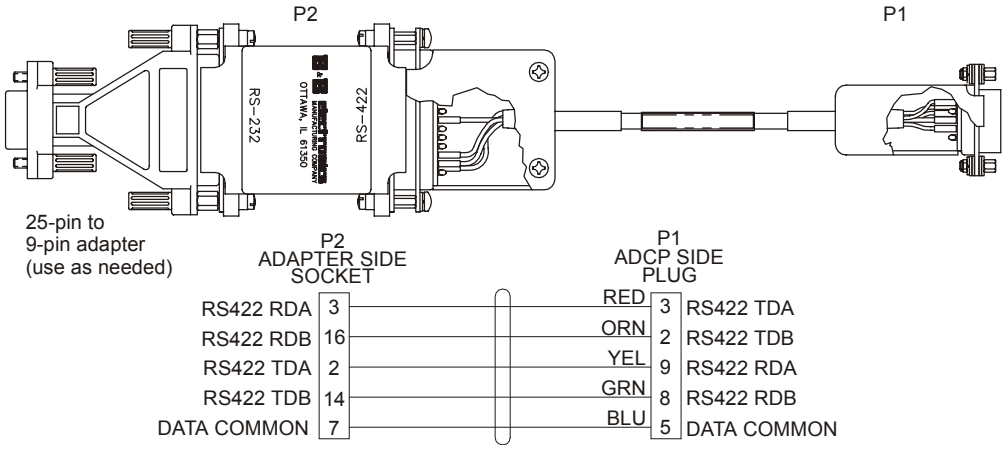


**Figure 3. Optional RS232-to-RS422 Converter Wiring (25-Pin to 9-Pin)**

# 4 System Overview

This section presents a functional description of Long Ranger operation using block diagrams.

## 4.1 Operating Modes

The Long Ranger has two modes of operation: *command mode*, and *ping mode* (also referred to as "Deployment Saver" Mode). Depending on what mode the ADCP is in; it will go either to sleep, or to resume pinging.

### 4.1.1 Command Mode

Whenever you wake up your Long Ranger, power dissipation increases from less than 1 mW to around 2.2 W. If you leave the Long Ranger in command mode without sending a command for more than 5 minutes, the Long Ranger automatically goes to sleep. This protects you from inadvertently depleting batteries.

- If the ADCP receives a BREAK, it will go to the command prompt and wait for a command. The ADCP will wait at the command prompt for five minutes. If no commands have been sent, it will go to sleep (also called "Battery Saver" mode).
- If you press the reset switch (located on the CPU board), the ADCP will go to sleep.
- If the ADCP receives a CS-command, it will go into the ping mode and begin pinging. If a TF-command (Time of First Ping) was sent prior to the CS-command, then the ADCP will go to sleep until the TF time occurs.
- If the ADCP does a COLD wakeup (i.e. an unknown state), it will go to the command prompt.
- If the ADCP is asleep for approximately nine hours, it wakes up to charge the capacitor used to maintain RAM. Once the capacitor is charged (this only takes a few seconds), the ADCP goes back to sleep.

### 4.1.2 Ping Mode

After you send commands to the Long Ranger that tells it to start collecting data, the Long Ranger goes into deployment saver mode. If power is somehow removed and later restored, the Long Ranger simply picks up where it left off and continues to collect data using the same setup.

- If the ADCP receives a BREAK, it will go to the command prompt, but stays in the ping mode. If a valid command is received, the ADCP will switch to the command mode. If no valid command is received, a warning will be displayed after four minutes, indicating that the system will self-deploy. After a total of five minutes with no input, the ADCP will resume pinging.
- If you press the reset switch, and an alarm is currently set for the next ping, the ADCP will go to sleep. If no alarm is set, the system will start a new deployment and starts pinging immediately unless a TF-command had been set after the last BREAK. In this case, the ADCP will go to sleep until the TF time occurs.
- If the ADCP does a COLD wakeup, the system will start a new deployment and starts pinging immediately unless a TF-command had been set after the last BREAK. In this case, the ADCP will go to sleep until the TF time occurs if the TF time is valid (i.e., not in the past).
- If the ADCP is asleep for approximately nine hours, it wakes up to charge the capacitor used to maintain RAM. Once the capacitor is charged, if a valid alarm is set for the next ping time, the ADCP goes back to sleep and waits for the alarm. If no alarm is set, the ADCP will resume pinging immediately, or wait for the TF time (if valid), and then start pinging.

## 4.2 Overview of Normal Long Ranger Operation

Refer to Figure 4, page 21 through Figure 6, page 23. The following events occur during a typical data collection cycle.

a. The user or a controlling software program sends data collection parameters to the Long Ranger. The user/program then sends a CS-command to start the data collection cycle. The firmware program stored in the CPU microprocessor takes control of Long Ranger operation based on the commands received through the serial I/O cable.

   Figure 4, page 21 shows a flow chart of the wake-up logic used by the Long Ranger. The Long Ranger determines what to do based on where the wake-up came from (a Break, CS-command, battery saver timer, or watchdog timer was detected).

b. On the High Power Amplifier Board, the power regulator circuit sends a transmit command to the power amplifier circuit. This tells the Long Ranger to start acoustic transmissions (pinging) on all transducers.

c. The transducers receive echoes from the backscatter. The receiver board amplifies and translates the echoes into a base-band frequency.

d. The CPU board processes the received echoes.

e. After echo reception, the Long Ranger injects a self-test signal into the receiver board and processes the signal as normal data for test purposes.

f. The Thermistor measures water temperature at the transducer head and sends it to the CPU via the DSP Board.

g. The High Power I/O Board sends pitch and roll from the tilt sensor and Long Ranger heading from the COMPASS to the DSP Board. The DSP Board digitizes this information and sends it to the CPU for processing.

h. The CPU repeats steps “b” through “g” for a user-defined number of pings. The CPU averages the data from each ping to produce an ensemble data set.

i. At the end of the ensemble (sampling) interval, the CPU sends the collected data to the serial I/O connector or PCMCIA recorder.

## 4.3 Functional Description of Operation

The following paragraphs describe how the Long Ranger operates and interacts with its modules. Refer to Figure 4, page 21 through Figure 6, page 23 throughout this description.

### 4.3.1 Input Power

The Long Ranger requires a DC supply between 20 and 50 volts. Either an external DC power supply or internal battery packs can provide this power. Figure 5, page 22 shows the DC voltage power distribution path.

***External DC Power Supply***. - With an external supply, power is applied to pins 3 (positive) and 7 (negative) on the external connector (see Figure 5, page 22). The power then goes through an electromagnetic interference (EMI) filter on the high power amplifier board. This filter reduces the chance that external noise sources associated with the external power source can disrupt Long Ranger operation.

***Internal Battery Packs***. - Each internal battery pack uses 28 alkaline "D" cells. Each pack supplies a nominal output voltage of 42 volts open circuit when fresh. The diode-isolated battery packs can only power the Long Ranger; they cannot "charge" each other.

### 4.3.2 Board Descriptions

***High Power Amplifier Board***.

- Receives the filtered/internal power.
- Uses a diode "OR" gate to determine which power source to use (external or internal). With both sources connected, the OR gate selects the "higher" voltage for Long Ranger use.
- Limits the in-rush of current to the Long Ranger and provides over and negative-voltage protection. Either condition will blow a protective fuse. However, damage could occur to other circuits before the fuse blows. Please ensure you apply only voltages within the specified range (+20 to +50 VDC).
- Uses the Power Amplifier circuit to generate the high-amplitude pulse AC signal that drives the sonar transducers. The Power Amplifier sends the drive signal to the Receiver Board.

***High Power IO Board***.

- Converts the operating power supply (filtered 20-50 VDC) in a DC-to-DC converter to the +5 VDC (Vcc) used to power all other Long Ranger circuits.
- Compass and attitude sensor circuits.
- RS-232/RS-422 switch.

***CPU Board***.

- Real time clock.
- Generates most of the timing and logic signals used by the Long Ranger.

***DSP Board***.

- Contains the Flash Memory card recorder.
- Analog to Digital converter.
- Digitizes information from sensors and sends sensor information to the CPU.

***Receiver Board***.

- Tuning functions.
- Receiver functions.
- Temperature sensor.
- Interface for pressure sensor.

***End-Cap Interface Board***.

- Feeds through communication and power to the high power amplifier board.
- Provides connectors for the internal I/O cable and battery packs.

### 4.3.3 Sensors

This section describes the standard Long Ranger sensors. The High Power I/O and DSP boards control the environmental sensors and contain unit-specific data. Sensors include:

***Temperature Sensor (Thermistor)*** - Used to measure the water temperature. The system uses this data to calculate the speed of sound. This sensor is embedded in the transducer head and is not field replaceable.

***Up/Down Sensor*** - Determines whether the transducer head is facing up or down. This sensor is located on the High Power I/O board.

***Compass*** - Determines the Beam 3 heading angle of the Long Ranger using a flux-gate compass. This sensor is located on the High Power I/O board. The flux-gate measured earth magnetic field vector together with the tilt sensor pitch and roll information is used to determine the heading. Since the tilt sensor data is only valid when the ADCP is ±15° from vertical, the heading information is also limited to this range.

***Attitude Sensor*** - Determines the tilt angles of the Long Ranger. This sensor is located on the High Power I/O board. The attitude sensor uses a pitch and roll liquid-filled sensor. This sensor is functional to an angle of ±15° from vertical.

***Pressure Sensor (optional)*** - Measures pressure at the Long Ranger transducer. This sensor is embedded in the transducer head and is not field replaceable.

The CPU microprocessor controls a multiplexed analog-to-digital converter to accept analog data from the sensors. Digital data are taken in directly. The pressure sensor incorporates a Wheatstone Bridge strain gage to measure the water pressure at the transducer faces. Depth is calculated from pressure, with water density adjusted by the salinity (ES) setting.

Calibration data for the sensors, a beam-angle correction matrix, and unit identification parameters (frequency, serial number, firmware version, etc.) are stored in ROM.

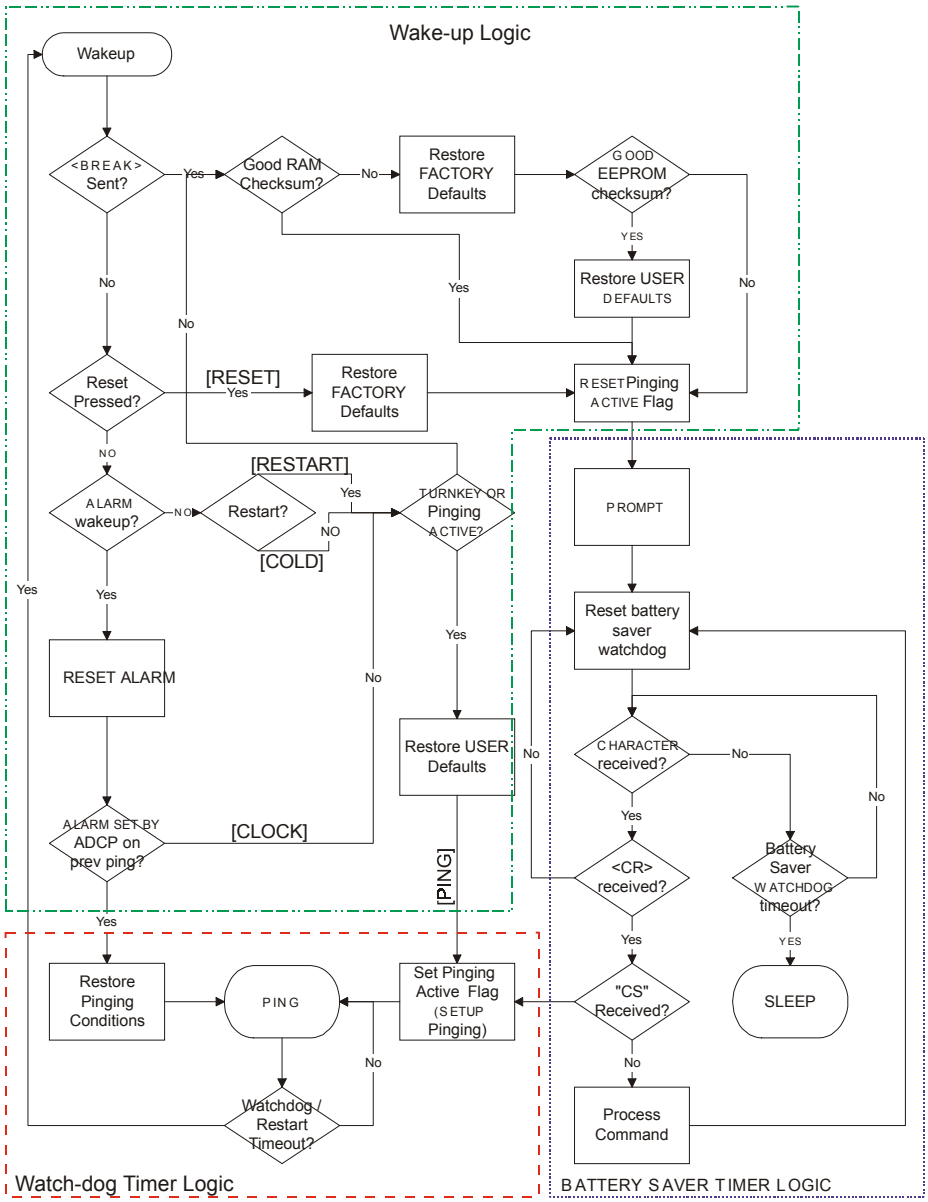


**Figure 4. Long Ranger Wake-up and Timer Logic**

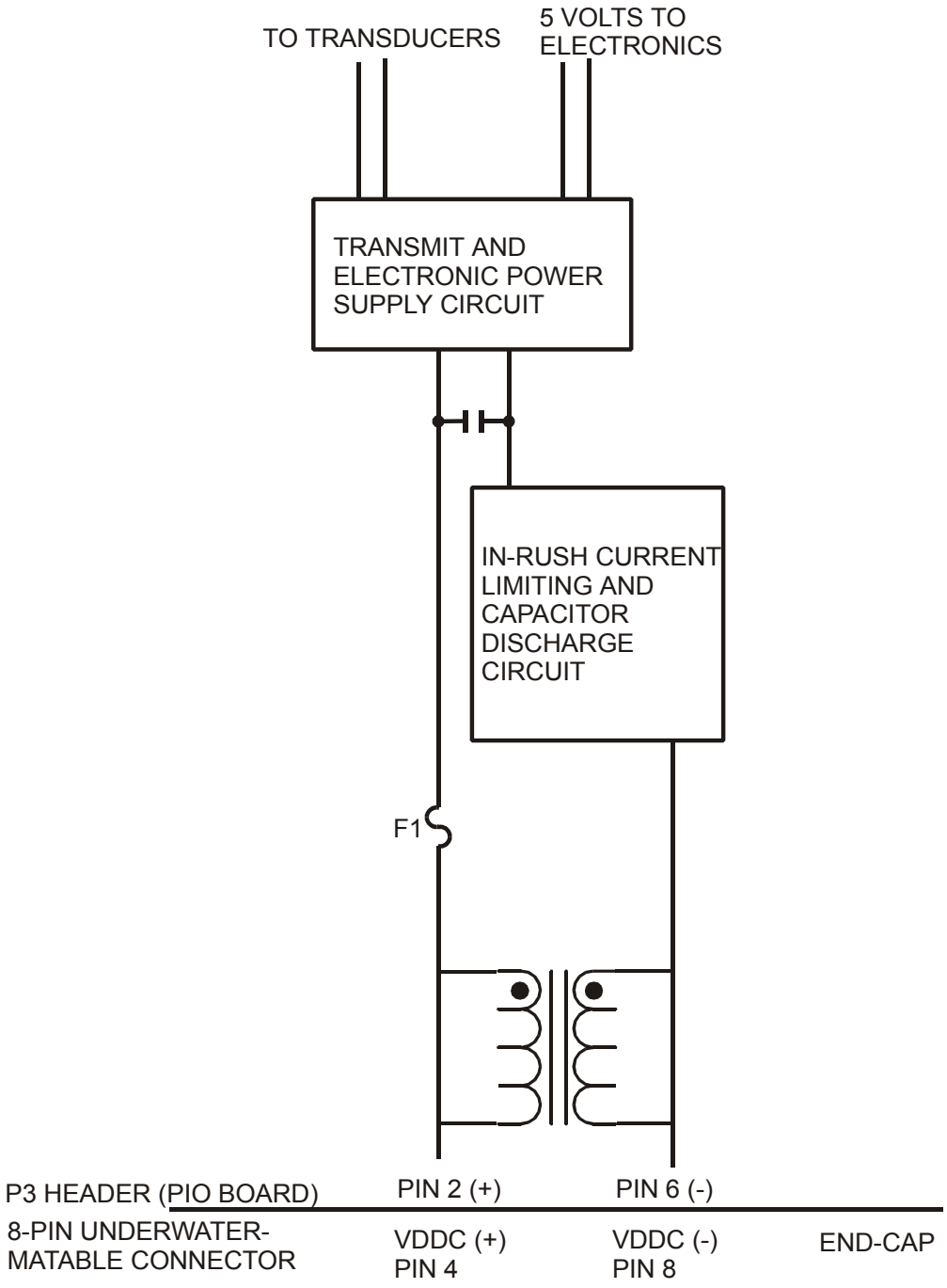


**Figure 5. Long Ranger DC Power Path**

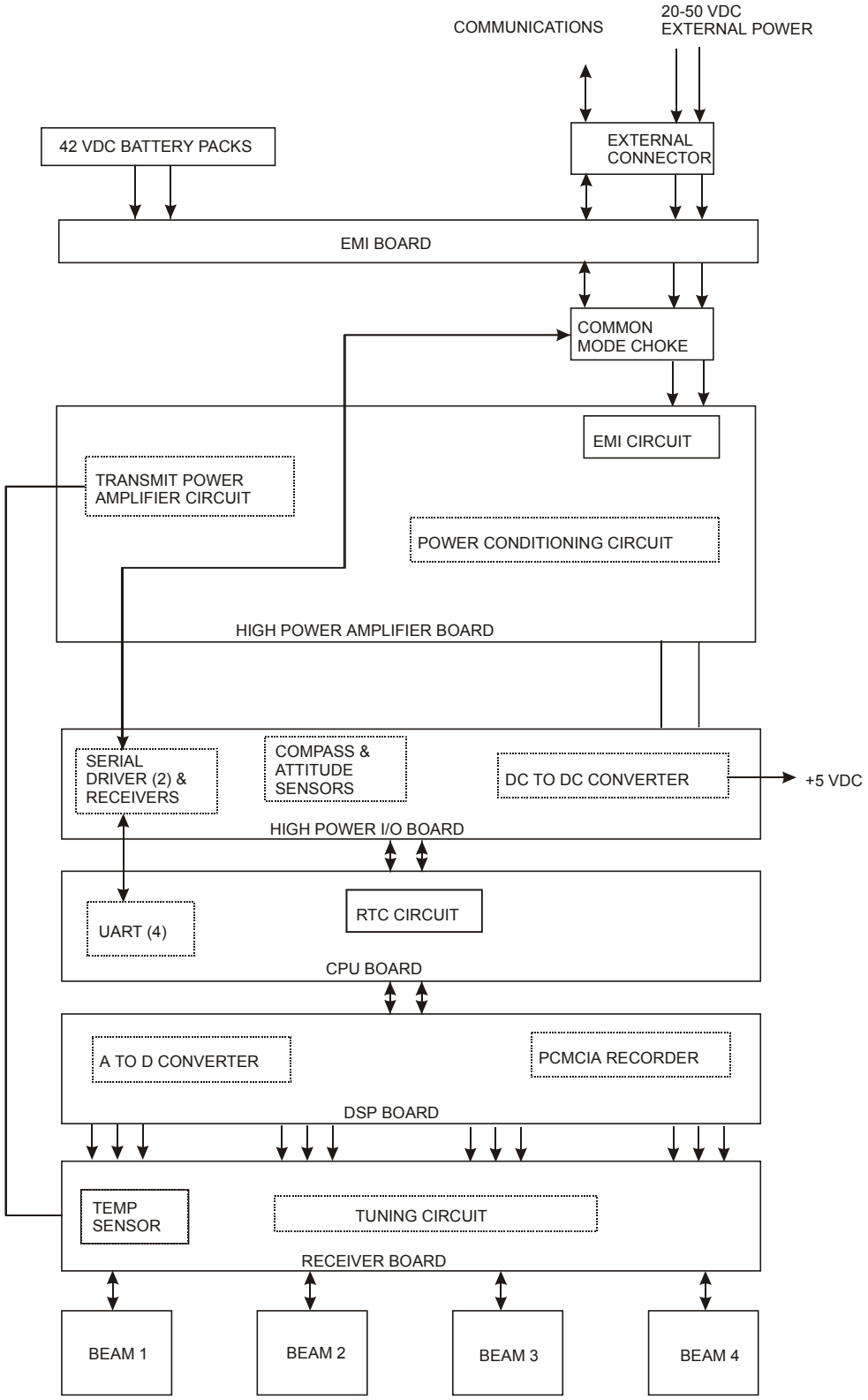


**Figure 6. Long Ranger Block Diagram**

# NOTES