Navigator ADCP/DVL Troubleshooting Guide

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RD Instruments
Acoustic Doppler Solutions

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Navigator Troubleshooting Guide

1 Introduction

Considering the complexity of the Navigator, 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.

Table 1: List of Least Replaceable Assemblies

LRA	Description
ADCP/DVL	The entire ADCP/DVL; includes the electronics, housing, transducer ceramic assemblies, and end-cap.
ADCP/DVL electronics	The spare boards kit Includes the PIO, CPU, and DSP boards.
End-Cap	Includes the end-cap, connector, and internal I/O cable.
I/O Cable	Connects the ADCP/DVL 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 17 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/DVL. 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, Navigator, 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 *BBTalk* 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 Navigator

Although the Navigator 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 20 to understand how the Navigator 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 power supply.

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

Navigator ADCP/DVLs 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 PIO board in the Navigator.

To successfully communicate, both the host computer and the Navigator 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 Navigator 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 Navigator again.

There are two types of communication failures; nothing happens at all when attempting to wake up the ADCP/DVL, 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 Navigator and the computer, or the Navigator may be set for RS-422 instead of RS-232. Check the RS-232/422 switch on the PIO card inside the Navigator. 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 Navigator and the computer).

Nothing Happens

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

a. Connect the Navigator to a computer according to the Navigator User’s Guide. Check that all cable connections are tight.

b. Is the Navigator AC power adapter working? Is the input voltage between 100 to 240 VAC? Is the output level 24 VDC?

c. If the Navigator is running from the optional external battery, check that the battery voltage is above 30 Volts DC. Navigator ADCP/DVLs 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 *BBTalk* 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/DVL is set for RS-422 or vice-versa. Check the RS-232/RS-422 switch on the PIO board (see the Maintenance guide).
- Sending a break causes “garbage” to appear on the screen. You can hear the ADCP/DVL “beep” when the break is sent. The “garbage” text does not keep scrolling. Check that the ADCP/DVL and computer are both using the same baud rate. See the CB-command in the Command and Output Data Format book.
- If the ADCP/DVL 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 boot code has been lost (see “ADCP/DVL Checks,” page 7). 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/DVL by measuring the voltage on the end of the cable that connects to the Navigator at Pins 3 and 7 (GND) (see “Navigator Cables,” page 17). The voltage should be +24 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 Navigator.

a. Disconnect both ends of the cable and measure the continuity using a DMM (see “Navigator Cables,” page 17 for the wiring diagram). Correct any problems found.

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

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

b. For RS-232 communications, short pins 1 and 2 together on the female 7-pin connector that was plugged into the Navigator (see “Navigator Cables,” page 17). 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 Navigator 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 Navigator. 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 “Navigator Cables,” page 17.

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/DVL Checks

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

Cold Start the ADCP/DVL

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

b. Remove *all* power to the ADCP/DVL.

CAUTION. Disconnect the power cables P1 and P2 on the PIO board to ensure that NO POWER is applied to the ADCP/DVL during the next step.

c. Short TP3 to TP4 on the PIO board for 10 seconds.

d. Remove the jumper.

e. Reconnect power cable P1 and P2.

f. Connect the computer and power to the ADCP/DVL. Send a break to the ADCP/DVL. This should start the ADCP/DVL in the “cold start” mode.

Fuse

Check the fuse on the PIO 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.

Boot Code Error

If the ADCP/DVL 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 boot 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/DVL 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 Navigator and you have ensured that the serial port on the computer, Navigator I/O Cable, and Navigator RS-232 to RS-422 converter (if applicable) are all working properly.
- Your Navigator 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 Navigator 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 Navigator fails when it is in water and air bubbles have been rubbed from the faces}

Sensor Tests:

H/W Operation {if the Navigator 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: RTC RAM ROM	CPU board failed
Recorder Tests: PC Card #0 Card Detect Communication DOS Structure Sector Test (short) PC Card #1 Card Detect Communication DOS Structure Sector Test (short)	PC card not plugged in PC card failed DSP board failed
DSP Tests: Timing RAM Demod RAM Demod REG FIFOs	DSP board failed
System Tests: XILINX Interrupts	DSP or CPU board failed
Receive Loop-Back	DSP or CPU board failed
Wide Bandwidth	Not in water External interference DSP or Receiver board failed
Narrow Bandwidth	
RSSI Filter	
Transmit	Not in water or PIO board failed
Sensor Tests: H/W Operation	PIO board failed Receiver board failed Pressure sensor failed ADCP/DVL laying on its' side

2.3.2 Installation of the Spare Board Kit

This Kit has been setup so that you will replace all three of the Navigator DVL/ADCP boards at once. This is done so that you do not have to risk damaging the individual boards while swapping in individual boards. The heading, pitch, and roll sensors have all been calibrated (the temperature sensor is an independent calibration and not changed by these new boards). Once you have replaced your original boards place them back in the Spare Board Kit box and contact RD Instruments Customer Service Department so that you can return them for repair.

CAUTION. Before handling either the Spare Board Kit or the original Board Set, always wear an earth-grounding static protection strap. The electronics in the Workhorse are very sensitive to static discharge. Static discharge can cause damage that will not be seen immediately and will result in early failure of electronic components.

We assume that a qualified technician or equivalent will perform all of the following work.

The Spare Boards Set will allow your system to perform to the same velocity specifications as your original set. There is, however, an offset error in the compass that can be as great as ±1.5 degrees. This error CANNOT be removed by doing the Field Calibration procedure (AF command) even though you MUST do this as part of the installation. The additional ±1.5 degrees can only be removed by RDI at the factory.

However, in most cases, the total compass error will still be within our original specification of ±5.0 degrees. The only way to be sure that you have smaller errors than this specification is to perform your own local compass verification and correct any errors you find during your post processing of the data.

2.3.3 Remove the Original Set of Boards

g. Remove the Transducer assembly from the pressure case. Use the Maintenance Guide for instructions.

h. With your earth-ground static protection strap on, use a 3mm Allen wrench, to remove the four bolts that secure the three original Workhorse boards to the Transducer assembly.

i. Note the orientation of the transmit cable connector as it is plugged into the PIO board and to the Receiver board (see Figure 1).

   This cable must be removed and it has a very tight fit. To remove this cable, lift straight up on the three boards and tilt slightly (no more than 2 cm) toward the cable. This should allow you enough slack to unplug the cable from the PIO board. If this is not possible you may unplug the cable from the Receiver board. Be sure to note its orientation before unplugging.

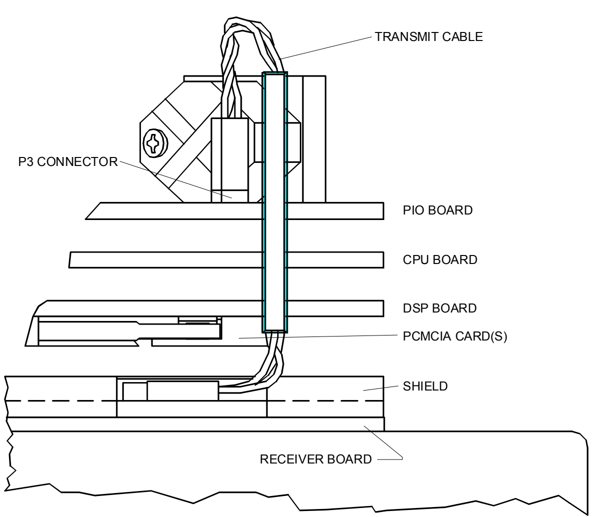

Figure 1. Transmit Cable

j. Once the transmit cable has been disconnected you may now remove the top three boards as a set by lifting the set straight up.

These top three boards are connected to each other via connectors and will remain as one piece (see Figure 2). The DSP board connects to the Receiver board through a 26-pin header. The 26-pin header is a series of male pins. The 26-pin header may or may not stay connected to the DSP board when you remove the top three boards. If you see that there are male pins sticking out of the DSP board when you finish removing the board set then the header has remained attached to the DSP board. If this happens remove it and place it into the Receiver board. To remove it, gently rock it back and forth while pulling it away from the DSP board. Once removed, align it with the connector on the Receiver board and press it into place.

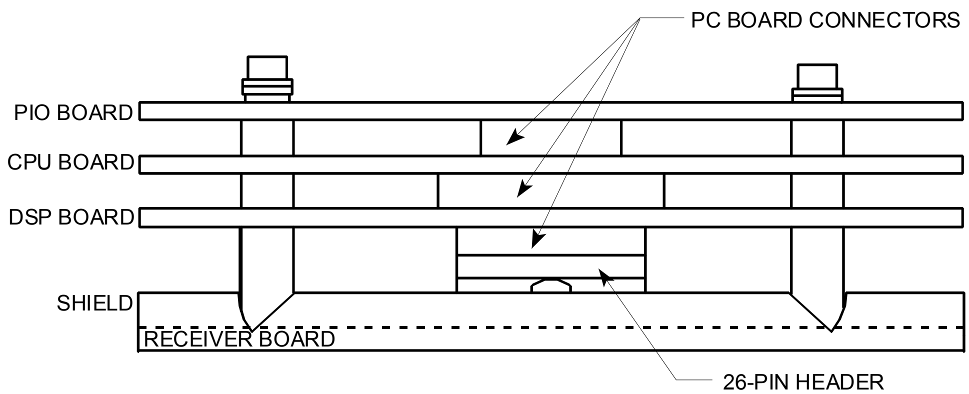

Figure 2. PC Board Connectors

k. Remove all PCMCIA card(s) from the original set of boards. These PCMCIA cards will be used again once you install your Spare Boards Set. The Spare Board set does NOT contain a PCMCIA card(s). The PCMCIA card(s) are located on the bottom of the DSP board. To remove the PCMCIA card(s) press the button(s) on the side of the PCMCIA card slot. As you press this button the PCMCIA card will slide out. You will have to pull the card(s) out the rest of the way once the button is depressed all the way in.

l. Set the original board set to the side for now.

2.3.4 Installing the Spare Board Kit

a. With your earth-ground static protection strap on, remove the Spare Board Kit from the anti-static bag.

b. Using a 3 mm Allen wrench and a 7mm wrench remove the nuts from the bolts that secure the Spare Boards together. You will be using these bolts to secure the spare set in your system. DO NOT change the position of any of the bolts. The bolt containing the felt washers and ground jumper must remain in the same position (see Figure 3).

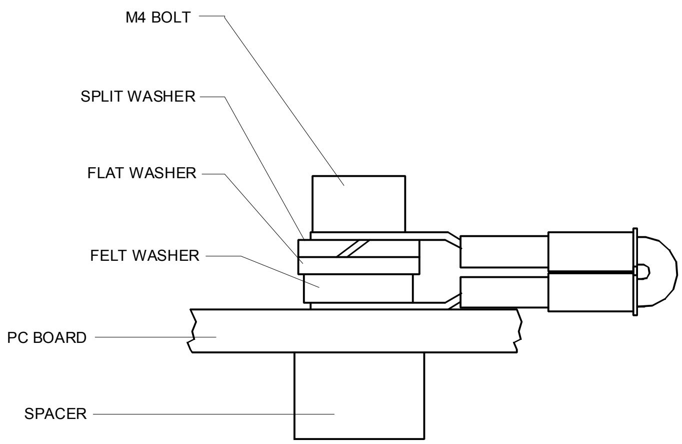

Figure 3. Ground Jumper

c. Place the nuts (just removed) on the four bolts of your original set of boards and place them into the anti-static bag. You will use the new set of bolts included in the Spare Board kit to secure them to the Transducer assembly.

d. Install all optional PCMCIA cards removed in "Remove the Original Set of Boards," page 11 step e into the PCMCIA card slots. The PCMCIA card is keyed and will only connect when it has been aligned correctly and slid all the way in. The PCMCIA card is installed with the label side pointing away from the DSP board.

e. Connect the Spare Board set to the Receiver board. Align the Spare Board set to the 26-pin header connected to the Receiver board. As you connect the Spare Board set, connect the transmit cable you removed in "Remove the Original Set of Boards," page 11 step c. Be sure to connect the cable in the same orientation as was installed on the original board set.

   To test that the transmit cable is connected properly, start *BBTalk* and run the PT4 test. The test failure example shown below is what you would see for a missing or improperly attached transmit cable.

```
[BREAK Wakeup A]
WorkHorse Broadband ADCP Version x.xx
RD Instruments (c) 1996-2002
All Rights Reserved.
>pt4

IXMT    =      0.0 Amps rms  [Data= 0h]
VXMT    =     19.3 Volts rms [Data=4ch]
   Z    =    999.9 Ohms
Transmit Test Results = $C0 ... FAIL
>
```

f. Insert the four new bolts and tighten to 4 Newton-pounds.

g. Install the Transducer into the Pressure Case. Use the Maintenance Guide for instructions.

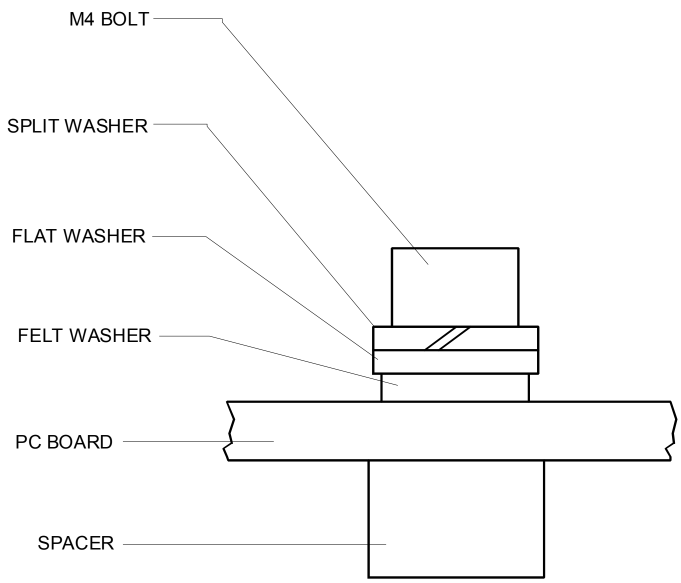

Figure 4. Mounting Hardware

2.3.5 Installing the Beam Cosine Matrix

The beam cosine matrix table corrects small transducer beam misalignment angles that occur during manufacturing.

a. Connect your Navigator DVL/ADCP as you would normally and apply power.

b. Start *BBTalk* and confirm that the Navigator DVL/ADCP is communicating normally and which communication port you are using (COM 1 or COM 2).

c. Place the Beam Cosine Matrix Disk into your computer's disk drive.

d. If your ADCP/DVL is connected to COM 1, press **<F2>** and run the script file *xxxx_1.scr* (where xxxx is your system serial number).

   If your ADCP/DVL is connected to COM 2, press **<F2>** and run the script file *xxxx_2.scr* (where xxxx is your system serial number).

   Your Beam Cosine Matrix table will automatically be updated in your ADCP and a file called SPRBD.LOG will be created. You can view the contents of this file to confirm that the data entered during the &V portion matches the contents in the PS3 results under the label Q14.

2.3.6 Testing the System

a. Install the Transducer in the Pressure Case.

b. Connect the cable and power as you normally do and test as Navigator DVL/ADCP as shown in the Test Guide. All PA tests should pass when run in water and the PC tests should pass out of water.

c. ***Perform a field calibration of your compass*.** Use the Maintenance Guide for instructions on running the AF command. Remember that there will be up to 1.5 degrees of offset error in the compass measurement. This error is not removed by the field calibration.

You have completed the Navigator DVL/ADCP Spare Board Installation. The original boards can be returned to RDI for repair. Please contact the RD Instruments Customer Service Department for return shipping instructions and repair costs at:

- EMAIL: rdifs@rdinstruments.com
- PHONE: 858-693-1178
- FAX: 858-578-4016

2.4 Troubleshooting a Beam Failure

If the beam continuity test fails, a bad DSP board, Receiver board, PIO board, or a bad beam may cause the failure. If replacing the DSP and PIO board (included with the spare boards kit) does not fix the problem, the ADCP/DVL 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/DVL 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 |          PIO 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 PIO board under the compass. The ADCP/DVL 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/DVL 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 *BBTalk*. Press the **End** key to wakeup the ADCP/DVL. Type the following commands: **CR1**, **FC**, **PA**, **FD**. The fault log will be displayed by the FD-command.

```
[BREAK Wakeup A]

WorkHorse Broadband ADCP/DVL 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

+33(0) 492-110-931

rdifs@rdieurope.com

Web: http://www.rdinstruments.com

http://www.dvlnav.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 Navigator Cables

This section has information on Navigator 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/DVL. If you feel there is a conflict, contact RDI for specific information about your system. The following figures show various Navigator cable locations, connectors, and pin-outs.

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

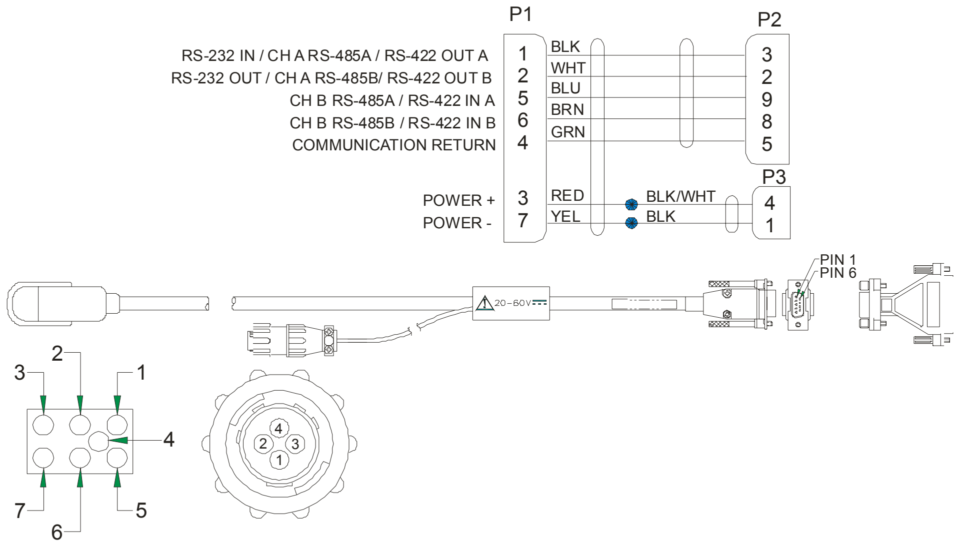

Figure 5. Navigator I/O Cable Wiring

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

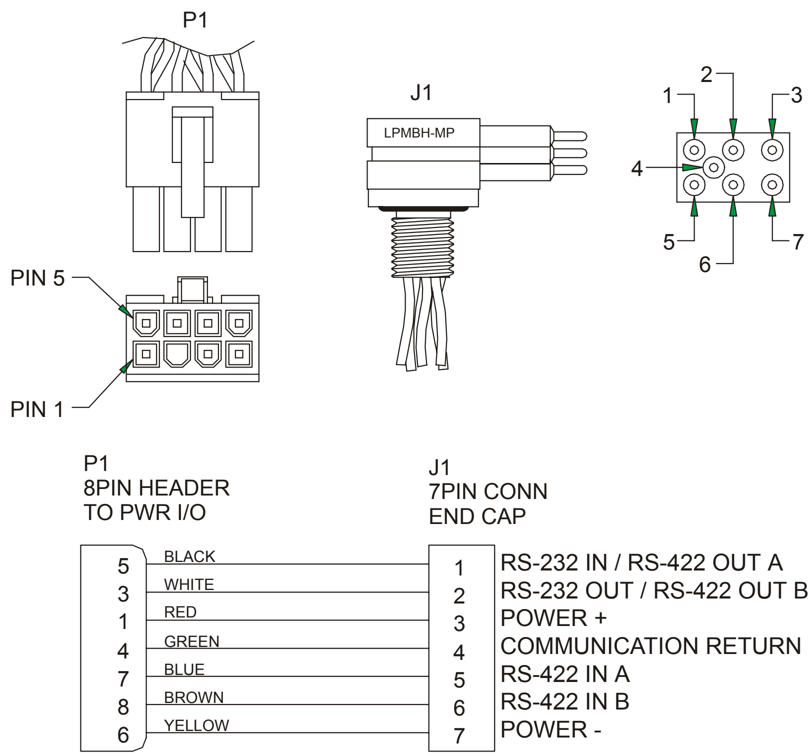

Figure 6. Navigator Internal I/O Cable (End-Cap to PIO Board) Wiring

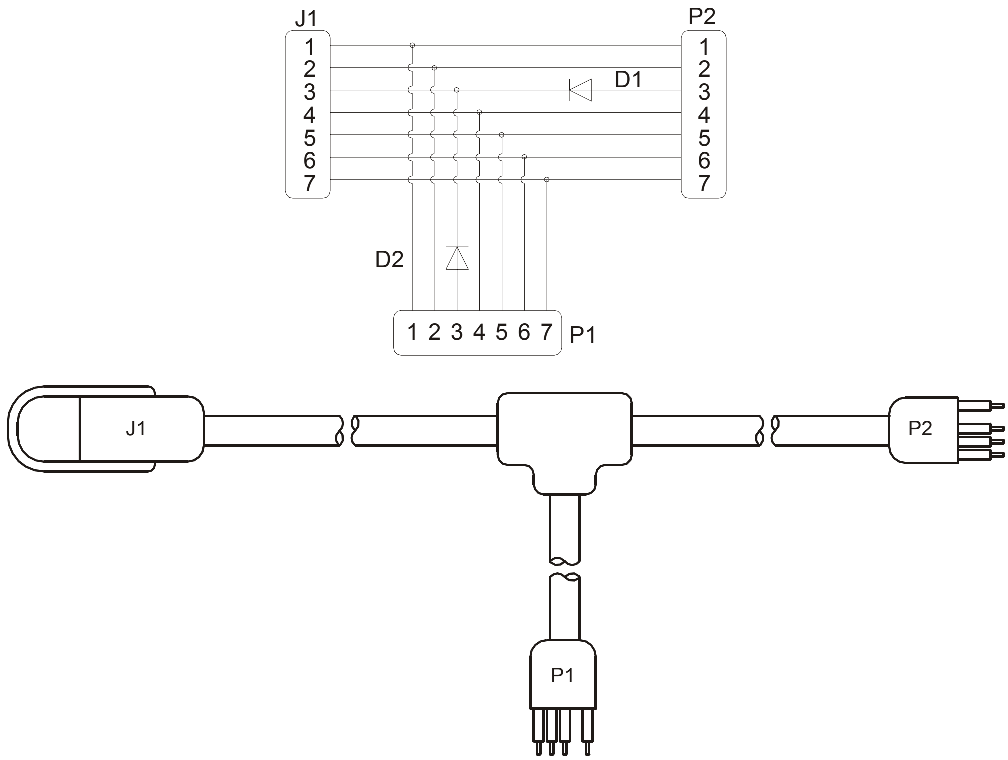

Figure 7. Optional External Battery Pack "Y" Cable

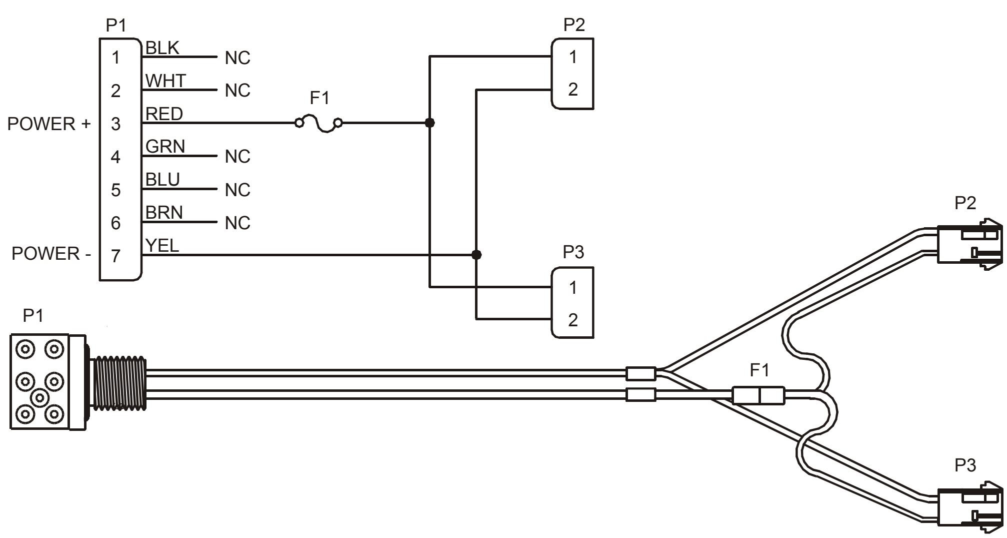

Figure 8. Optional External Battery Case Internal Wiring

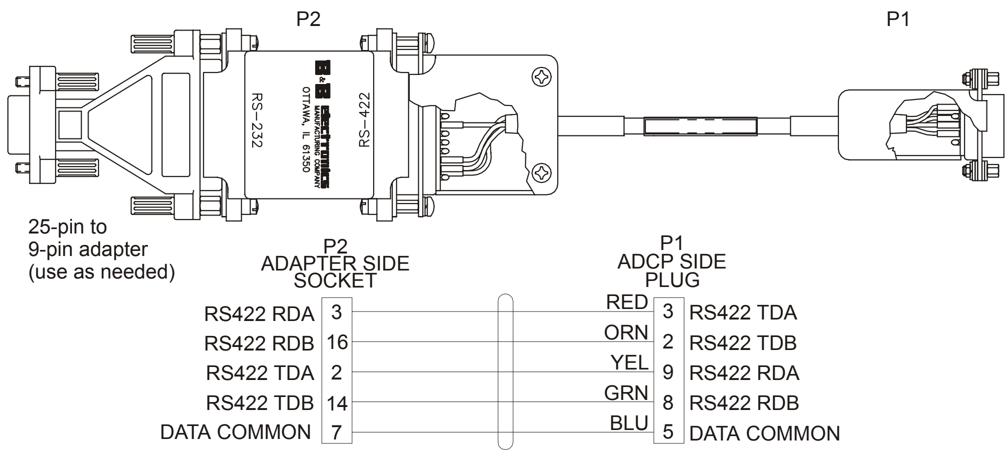

Figure 9. Optional RS232-to-RS422 Converter Wiring (25-Pin to 9-Pin)

4 System Overview

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

4.1 Operating Modes

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

4.1.1 Command Mode

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

- If the ADCP/DVL receives a BREAK, it will go to the command prompt and wait for a command. The ADCP/DVL 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/DVL will go to sleep.
- If the ADCP/DVL 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/DVL will go to sleep until the TF time occurs.

- If the ADCP/DVL does a COLD wakeup (i.e. an unknown state), it will go to the command prompt.
- If the ADCP/DVL 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/DVL goes back to sleep.

4.1.2 Ping Mode

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

- If the ADCP/DVL receives a BREAK, it will go to the command prompt, but stays in the ping mode. If a valid command is received, the ADCP/DVL 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/DVL will resume pinging.
- If you press the reset switch, and an alarm is currently set for the next ping, the ADCP/DVL 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/DVL will go to sleep until the TF time occurs.
- If the ADCP/DVL 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/DVL will go to sleep until the TF time occurs if the TF time is valid (i.e., not in the past).
- If the ADCP/DVL 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/DVL goes back to sleep and waits for the alarm. If no alarm is set, the ADCP/DVL will resume pinging immediately, or wait for the TF time (if valid), and then start pinging.

4.2 Overview of Normal Navigator Operation

Refer to Figure 10, page 25 through Figure 13, page 28. The following events occur during a typical data collection cycle.

a. The user or a controlling software program sends data collection parameters to the Navigator. 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 Navigator operation based on the commands received through the serial I/O cable.

   Figure 10, page 25 shows a flow chart of the wake-up logic used by the Navigator. The Navigator 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 PIO Board, the POWER REGULATOR circuit sends a transmit command to the POWER AMPLIFIER circuit. This tells the Navigator 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 Navigator 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 PIO Board sends pitch and roll from the TILT SENSOR and Navigator 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 Navigator operates and interacts with its modules. Refer to Figure 10, page 25 through Figure 13, page 28 throughout this description.

4.3.1 Input Power

The Navigator requires a DC supply between 20 volts and 60 volts. Either an external DC power supply or optional external battery pack can provide this power. Figure 11, page 26 shows the DC voltage power distribution path.

Power is applied to pins 3 (positive) and 7 (negative) on the external connector (see Figure 12, page 27). The power then goes through an electromagnetic interference (EMI) filter on the PIO Board. This filter reduces the chance that external noise sources associated with the external power source can disrupt Navigator operation.

4.3.2 Board Descriptions

PIO 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 Navigator use.
- Limits the in-rush of current to the Navigator 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 +60 VDC).
- Converts the operating power supply (filtered/isolated 20 to 60 VDC) in a DC-to-DC converter to the +5 VDC (Vcc) used to power all other Navigator circuits.
- Uses the Power Amplifier circuit on the PIO board to generate the high-amplitude pulse AC signal that drives the sonar transducers. The Power Amplifier sends the drive signal to the Receiver Board.
- RS-232/RS-422 switch.

CPU Board.

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

DSP Board.

- Contains the PCMCIA recorder slots.
- 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

4.3.3 Sensors

This section describes the standard Navigator sensors. The PIO 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 PIO board.

Compass - Determines the Beam 3 heading angle of the Navigator using a flux-gate compass. This sensor is located on the PIO 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/DVL is ±20° from vertical, the heading information is also limited to this range.

Attitude Sensor - Determines the tilt angles of the Navigator. This sensor is located on the PIO board. The attitude sensor uses a pitch and roll liquid-filled sensor. This sensor is functional to an angle of ±20° from vertical.

Pressure Sensor (optional) - Measures pressure at the Navigator 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.

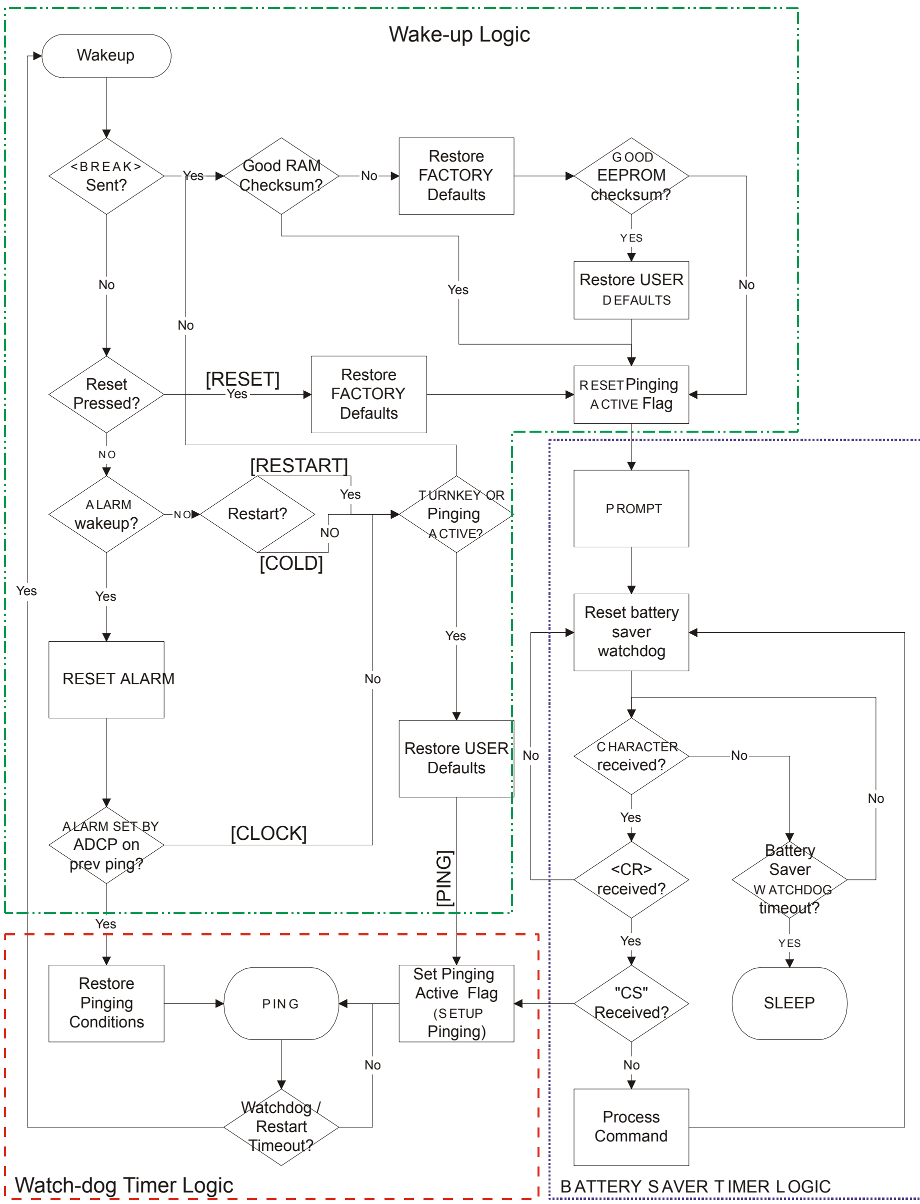

Figure 10. Navigator Wake-up and Timer Logic

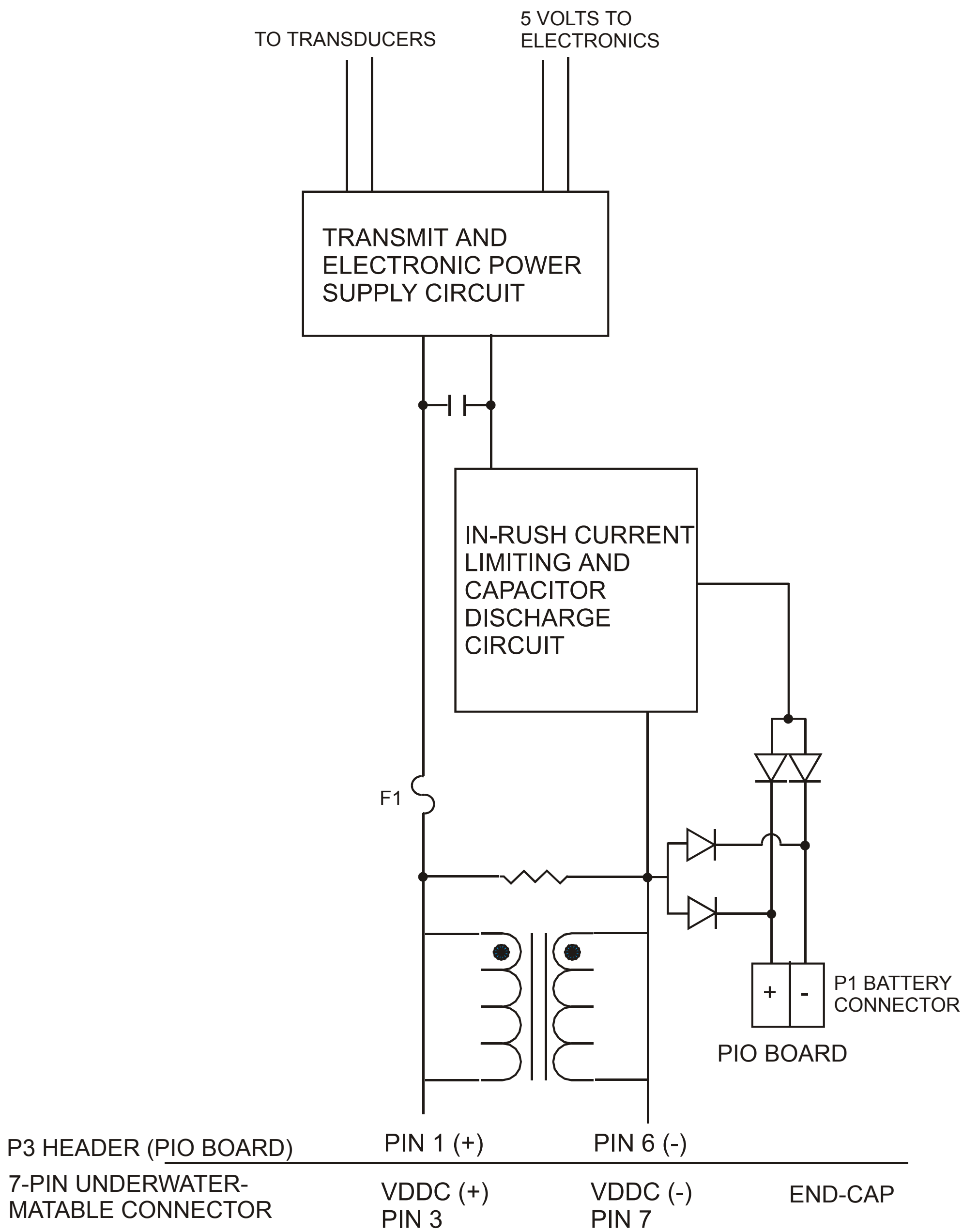

Figure 11. Navigator DC Power Path

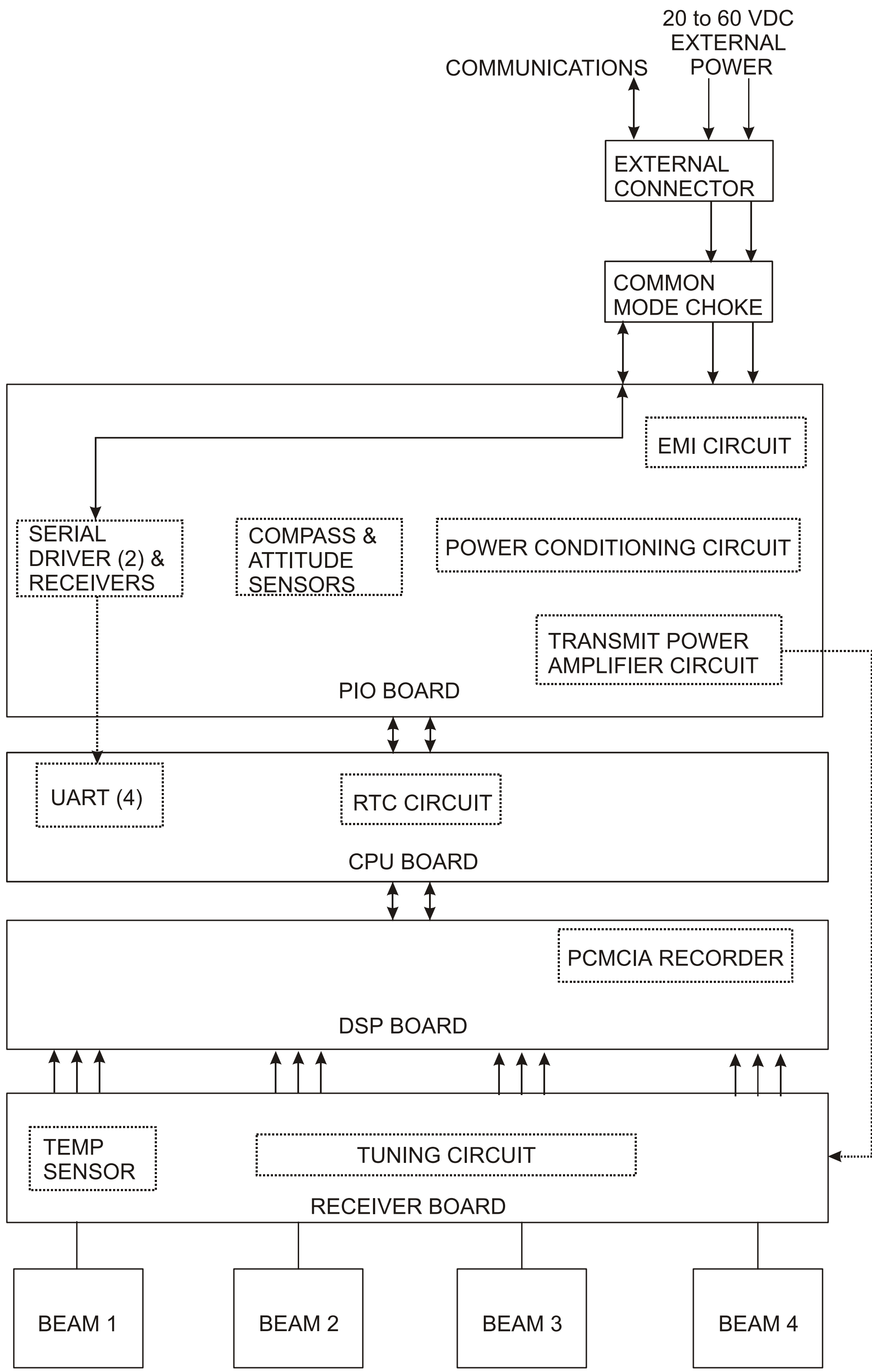

Figure 12. Navigator Block Diagram

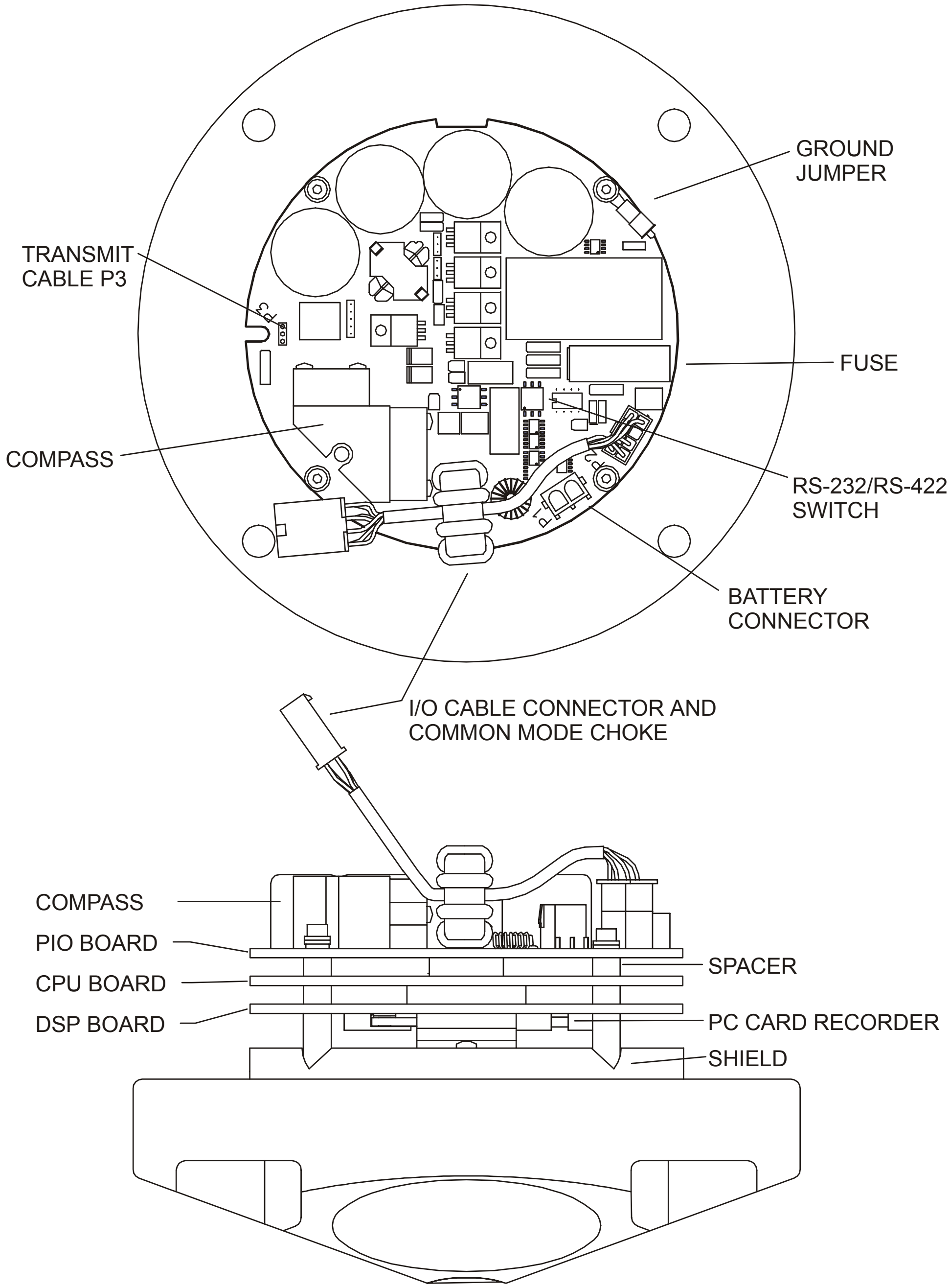

Figure 13. Navigator PC Board Locations

NOTES