

Replacing the WorkHorse DSP Board

This procedure details how to install the Spare DSP board on your WorkHorse ADCP. Once you have replaced the original board place it back in the Spare DSP board box/ESD envelope and contact Teledyne RD Instruments Customer Service Department so that you can return it for repair.

The DSP board is frequency specific: only install it on the same frequency system. Additionally, it is calibration specific, which means that once installed, you will have to reload the Beam Correction Matrix for the system you will be installing your Spare DSP board into. Contact Teledyne RD Instruments Customer Service Department and provide them with your system serial number in order to obtain the calibration data and loading procedure for your system.

The Beam Correction Matrix is created at the Teledyne RD Instruments factory to correct for any possible misalignment of each of the ADCP beam. If perfectly installed, the transformers should all be pointing exactly 20 degrees off of the vertical axis. If a beam is slightly off from that axis, TRDI will detect it with high precision and add correction in the Beam Correction Matrix to cancel its effect on the measured water velocity.

If the original system Beam Correction Matrix is not loaded, your system will use the default Matrix, which does not apply any corrections. If corrections were necessary for your system, this will cause bias in the Velocity measurements.



Figure 1. WorkHorse Electronics

Equipment Required

- WorkHorse Technical Manual
- ESD safe work space
- Soft pad (ESD Safe) to rest WorkHorse on while disassembling and reassembly
- Anti-static ground strap
- Hex wrenches and Phillips screwdriver
- O-rings and desiccant for ADCP
- Spare DSP board
- Beam Correction Matrix

Removing the Transducer Assembly

To remove the transducer assembly:

1. Remove all power to the WorkHorse.
2. Remove the I/O cable and place the dummy plug on the I/O cable connector.
3. Stand the WorkHorse on its end-cap.



Wear safety glasses and keep head and body clear of the transducer while opening. **Any system that was deployed may have pressure inside the housing.**

4. Inspect the transducer bolts for any signs of damage such as bending, stretched bolts, crushed or deformed bushings, etc. These signs may indicate that there is internal pressure inside the system.
5. To avoid any possible injury it is ALWAYS recommended that you loosen but do not remove the four transducer bolts to allow any internal pressure to be vented from the system. **Loosen the transducer bolts two turns each in a cross-pattern. Repeat until the face seal O-ring is not compressed and the system has the opportunity to vent.** If you note that the transducer moves as you loosen the bolts then this may indicate that internal pressure is present. Be sure to only loosen the bolts far enough to allow the system to vent.
6. Once all four bolts have been loosened and you are sure that there is no internal pressure, remove the bolts from the transducer.
7. Carefully lift the transducer assembly straight up and away from the housing until you can gain access to the connector jack on the common mode choke. Use care; the plastic mating surfaces scratch easily. Do not damage the mating surfaces.



The cable attached to the end cap is only long enough to disconnect the internal I/O cable. There is NOT enough cable to set the transducer down next to the housing assembly.

8. Squeeze the sides of the internal I/O cable connector to release it from the common mode choke jack. Set the housing/end-cap assembly aside. Set the transducer assembly (transducer face down) on a soft pad.
9. Clean the O-ring mating surfaces with a soft, lint-free cloth. Inspect the surfaces for damage.

Removing the Board Stack

To remove the board stack:

1. Attach an earth-grounded wrist strap.



Before handling any of the WorkHorse boards, you must be sure that you always wear an earth-grounding static protection strap. The electronics in the WorkHorse are very sensitive to electro-static discharge (ESD). **ESD can cause damage that will not be seen immediately and will result in early failure of electronic components.**

2. Loosen the four bolts holding the board stack onto the transducer.



During this operation it is tempting to remove the bolts for simplicity; it is advised to keep them in place. No matter what you do: **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 4).

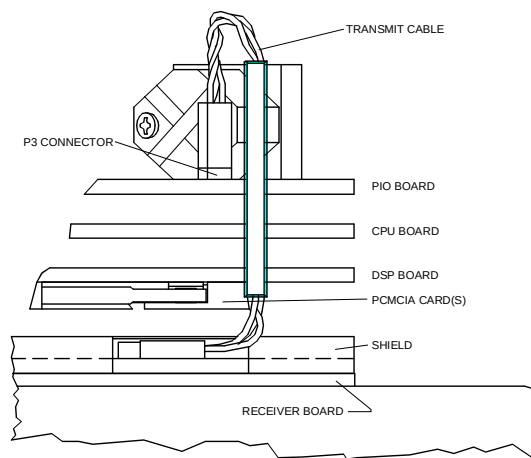


Figure 2. WorkHorse Board Stack

3. Disconnect the transmit cable from where the cable is plugged into the receiver board.



Note the orientation of the transmit cable connector as it is plugged into the Receiver board. **Do not attempt to remove the transmit cable from the PIO board.** The cable has a very tight fit.

4. Once the transmit cable has been disconnected, remove the top three boards as a set by lifting the board stack straight up.

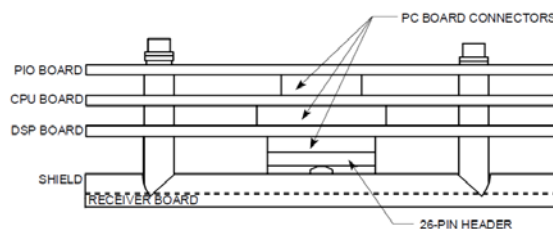


Figure 3. Board Stack Connectors



The top three boards (called the board stack) are connected to each other via connectors and will remain as one piece. The DSP board connects to the Receiver board through a 26-pin header (see Figure 3). The 26-pin header may or may not stay connected to the DSP board when you remove the board stack. If the 26-pin header is connected to the DSP board when you finish removing the board stack, remove it by gently rocking 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.

5. Remove the DSP board from the board stack.
6. Remove all PCMCIA card(s) from the original DSP board. These PCMCIA cards will be used again once you install your Spare DSP board. The Spare DSP board 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.
7. Set the original DSP board to the side for now.

Installing the Spare DSP Board

To install the Spare DSP board:

1. With your earth-ground static protection strap on, remove the Spare DSP board from the anti-static bag.
2. Install the Spare DSP at the bottom of the original two boards by connecting the DSP connector to the CPU board connector.



During this operation it is tempting to remove the bolts for simplicity; it is advised to keep them in place. No matter what you do: **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 4).

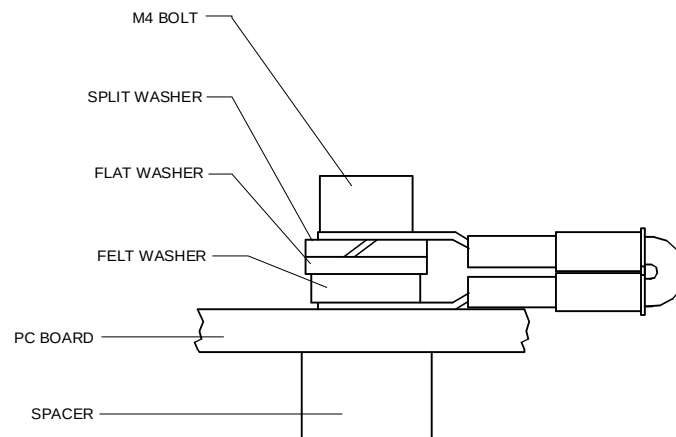


Figure 4. Ground Jumper

3. Install all PCMCIA cards into the PCMCIA card slots on the Spare DSP board. 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.

Installing the Electronics Board Stack

To install the board stack:

1. Connect the board stack to the Receiver board. Align the board stack to the 26-pin header connected to the Receiver board.
2. Connect the transmit cable to the Receiver board. Be sure to connect the cable in the same orientation as was installed.
3. Insert the four bolts and tighten to 0.45 Nm (4.0 Pound-Force Inch).

Installing the Transducer Assembly

To replace the transducer assembly:

1. Stand the WorkHorse housing/end-cap assembly on its end-cap.
2. Inspect, clean, and lubricate the O-ring. Apply a very thin coat of silicone lube on the O-rings.



TRDI recommends you use a new O-ring if you are preparing for a deployment.



Apply a very thin coat of silicone lube on the O-ring. Using too much silicone lube on the O-ring can be more harmful than using no O-ring lube at all.

3. Place the O-ring in the groove.
4. Connect the internal I/O connector to the plug on the common mode choke.
5. Place a fresh bag of desiccant in the housing.
6. Gently lower the transducer head/electronics assembly into the housing, aligning the mating holes and the beam 3 number embossed on the transducer head with the beam 3 number embossed on the end-cap. When mating the housing with the transducer head flange try to apply equal pressure to all parts of the O-rings. Make sure the face O-rings remain in the retaining grooves.



Check that no wires or any other object is pinched between the transducer head assembly and the housing. Use rubber bands to hold the wiring in place as necessary. **If the O-ring is not in the groove or if a wire or other object is pinched, the ADCP will flood.**

7. Examine the titanium transducer assembly nuts, bolts, and washers (8mm) for corrosion; replace if necessary. Figure 5 shows the assembly order of the transducer mounting hardware. All hardware items are needed to seal the WorkHorse properly.

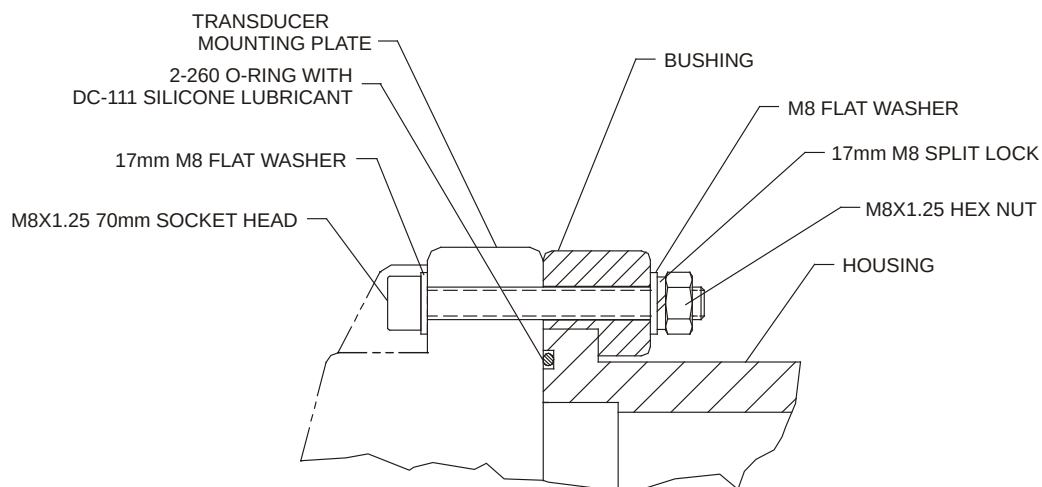


Figure 5. Transducer Mounting Hardware

8. Install all four sets of hardware until “finger tight.”

9. Tighten the bolts in small increments in a “cross” pattern until the split washer flattens out, and then tighten each bolt $\frac{1}{4}$ turn more to compress the face seal O-ring evenly. Tighten the bolts to the recommended torque value of 9.6 Nm (85 Pound-Force Inch). Do not deform the plastic bushings.



Apply equal pressure to the O-ring as you tighten the bolts. If one bolt is tightened more than the others, the O-ring can become pinched or torn. A damaged O-ring will cause the system to flood.



Do not over tighten the bolts that hold the transducer, housing, and end cap together. If you tighten too far, you can crack or break the plastic housing. On the other hand, leaving the bolts too loose can cause the system to flood.

Tighten the hardware to the recommended torque value of 9.6 Nm (85 Pound-Force Inch).

Installing the Beam Correction Matrix

The beam correction matrix table corrects small transducer beam misalignment angles that occur during manufacturing. Contact Teledyne RD Instruments Customer Service Department and provide them with your system serial number in order to obtain the calibration data and loading procedure for your system.

1. Connect your WorkHorse ADCP as you would normally and apply power.
2. Start *BBTalk* and confirm that the WorkHorse ADCP is communicating normally and what communication port you are using (COM 1 or COM 2).
3. Place the Beam Cosine Matrix Disk into your computer's disk drive.
4. If your ADCP 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 is connected to COM 2, press <F2> and run the script file *xxxx_2.scr* (where xxxx is your system serial number).

The Beam Correction 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.

Testing the System

To test the ADCP:

1. Connect the cable and power as you normally do and test the ADCP as shown in Testing the WorkHorse. All PA tests should pass when run in water and the PC tests should pass out of water.
2. Perform a field calibration of your compass. Use the WorkHorse Technical Manual for instructions on Compass Calibration and 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.
3. 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
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>pt4

IXMT   =      0.0 Amps rms [Data= 0h]
VXMT   =     19.3 Volts rms [Data=4ch]
Z      =     999.9 Ohms

Transmit Test Results = $C0 ... FAIL
>
```

Running the PC1 Test

The PC1 test is designed to measure the relative noise in the environment and then have you apply more noise by rubbing the ceramics with your hand. Sometimes your hand does not generate enough noise for the system to detect. This could be due to the environment you are in or for other reasons. A simple, safe, and easy to find material that works very well as a replacement to your hand is packaging material (a.k.a. bubble wrap). Using this instead of your hand will very likely provide enough relative frictional difference for the system to pass.

If the PC1 test fails, your system may still be okay. In this case deploy the ADCP into a bucket or container of water (preferably at least 0.5 meters deep). Record some data using *BBTalk* and the log file (**F3** key), or record data straight to the recorder card if your ADCP has one. Then look at the data using the *WinADCP* program and make sure that the echo amplitude counts in the 1st depth cell for all beams is between 128 and 192. If they are not, contact Field Service for further troubleshooting tips.

If the beam continuity test still fails and/or the echo amplitude indicates a problem, a bad DSP board, Receiver board, PIO board, or a bad beam may cause the failure. If replacing the DSP board did not fix the problem, the ADCP must be returned to TRDI 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		
Rub Beam 3 = PASS		
Rub Beam 4 = PASS		
>		

DSP Board
Receiver Board
PIO Board
Beam



This test must be performed with the ADCP out of water and preferably dry.

Running the PC2 Test

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 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



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

Using the Fault Log

To determine why a sensor failed, view the fault log. To view the fault log, start *BBTalk*. Press the **End** key to wake up the ADCP. Type the following commands: CR1, PA, FD, FC. The fault log will be displayed by the FD command and is cleared by the FC command.

[BREAK Wakeup A]

WorkHorse Broadband ADCP Version x.xx
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[BREAK Wakeup A]

>CR1

>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.

>FC

Return the Original Boards to TRDI

You have completed the WorkHorse Spare DSP Board Installation. The original boards can be returned to TRDI for repair. Please contact the Teledyne RD Instruments Customer Service Department for return shipping instructions and repair costs (see [Technical Support](#)).

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