Real Time Current Velocity System

Operations Manual

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INTRODUCTION

This document is meant to serve a range of users of Real Time Current Velocity (RTCV) systems, from managers and decision makers to on–site data users, and technicians that will be servicing RTCVs. RTCVs acquire and transmit data, primarily water currents and winds, for improving navigation safety, primarily at locks. RTCV data can also be used at other locations where currents make navigation difficult. This introductory material is meant for managers and decision makers. It provides basic concepts of where RTCVs are appropriate, and discusses the need and costs for site inspection, installation and maintenance. The remainder of the document contains information that is needed to help those using RTCVs in a more hands-on mode and includes the following information: instrumentation; equipment details and operation theory; installation; and diagnosing problems in the ACDP head, anemometer, and AtoN.

Support Requirements

The support sections of this document are divided into two sections, BASIC and ADVANCED. BASIC support can be undertaken by anyone comfortable with very simple technology, while the ADVANCED section will require an individual who is familiar with electronic systems, comfortable working with AC and DC power, and the use of a Digital Multi-meter.

Background

The RTCV System is an integrated set of components that, through the use of custom software, manages the collection of sensor data for the purposes of broadcasting current and wind data via the Automatic Identification System (AIS). The original challenge that brought about the development of the RTCV system is out-draft currents at lock approaches that increase the likelihood of accidents.

These RTCV data are to be received by commercial vessels that can utilize it as an aid to navigation. This document explains where an RTCV system can be used, how to install the system as well as maintain and troubleshoot an existing system.

The primary data types utilized by the RTCV are, obviously, that of water velocity and wind. The combination of water velocity and wind is the primary external factor effecting vessel navigation in a waterway. In an RCTV, an Acoustic Doppler Current Profiler (ADCP) is used to collect water current speed and direction and an anemometer is used to collect wind velocity.

Basic Requirements for a Successful RTCV System

In brief, a location that will allow for a successful RTCV application will have the following properties.

- **Depth.** The deployment location must have sufficient depth so the ADCP acoustic signal does not reach the bottom or the surface over the length for which it is collecting data. For application to shallow draft vessels, and a 100 m (330 ft) distance for data collection, the ADCP head would need to be mounted at a minimum depth of 3 m (10 ft) and the water depth would need to be at least 6 m (20 ft) over the entire length, i.e., no shoals less than the minimum depth.

- **Structure Requirements**. The ACDP head and above-water electronics must have a sturdy structure for mounting. In particular the ADCP head is very sensitive to motion, so the structure must be very stable. At locks, the ADCP head is generally mounted to a rail that is bolted to the lock bullnose. At more open water locations, the ADCP head can be attached to a substantial pile. The above-water electronics, antennas, and anemometer are often mounted to a railing structure. A 110 volt power supply is needed for the above-water electronics, though solar power is a viable option.
- **Interference from other structures or air.** The ADCP acoustic beam cannot impact a hard structure that is located in the area of measurement,. Also, large amounts of air in the water, for example the discharge of powerhouse spillway ship prop wash, or other source of air can severely disrupt the ADCP's acoustic signal.
- **Debris.** While more debris resistant mounting rails are being designed, excessive amounts of large debris that impact the ADCP head can be problem. If this is the case, then an RTCV may not be practical or a specially designed mounting system may be needed. In areas with considerable ice, the ADCP head and cable should be extracted prior to serious icing.

Site Investigation

Prior to making a decision to install an RTCV at a location, a site investigation is essential to insure the site is suitable for successful RTCV operation. The site investigation will determine if the water depth is sufficient to allow effective RTCV operation, a sturdy structure on which to mount the RTCV is available, if power is available (though solar power is a viable option), and check for the presence of other factors that would inhibit effective RTCV operations, e.g., excessive air in the water. ERDC staff is most knowledge about RTCVs and are strongly recommended to conduct the site inspection. Required prior to the visit are a recent, say within the last month, hydrographic survey of the area; photographs and drawing of the above-water portion of the facility where the above-water electronics will be mounted, and drawings of the structure below the water where the lower portion of the ADCP head mounting rail will be secured.

The estimated cost for an ERDC site inspection is approximately $12K.

INSTALLATION / OPERATIONS COST ESTIMATE

The RTCV is a system with both initial installation and ongoing support expenses. An estimate of installation expenses for a typical site might be as follows:

- Instrument: $15K
- RTCV System: $25K
- Instrument Rail: $7.5K
- Mounting: $2.5K
- Labor: $20K
- Total $70K

Note that the cost estimate does not include the cost of local support. When including the cost of local support, the cost of divers should be included. Because most sites require divers, the time when conditions are safe for diving needs to be considered when scheduling installation.

Cell Phone Requirement

To allow data downloading and system monitoring via the internet, an internal cell phone modem is included. For access, a cell phone contract with the local carrier is an absolute essential. These contracts typically are about $50/month, or $600/year. To date we have had better success with Verizon than AT&T.

After the system is up and running there is a need to keep the instrument clean and routinely check on the operation of the system. Below is an estimated amount of time and money that can be expected to invest in ongoing support. We assume the instrument maintenance and rail cleaning will be by District staff on site and that the systems and instrument support would be performed by ERDC staff.

- Instrument / Rail Cleaning: 12 man days yearly
- System / Instrument Support: $2.5K

EQUIPMENT DETAILS, OPERATION THEORY

Instrumentation

The RTCV system is capable of supporting a wide variety and number of field instruments, which will be discussed later. For the purposes of determining appropriate installation locations the current measuring device has the largest effect on the installation location of an RTCV. Currently, the only technology used by the RTCV to measure current is Acoustic Doppler Current Profilers (ADCP). It is important to understand the capabilities and limitations of ADCP devices to properly plan an RTCV installation.

Acoustic Doppler Current Profiler

The ADCP is the primary instrument used by the RTCV system to measure current velocity. An ADCP uses the Doppler Effect by transmitting sound at a fixed frequency and listening to backscattered sound in the water. It is important to understand the operational capabilities of an ADCP as these conditions are the primary determining factors in deciding where an RTCV system can be put to use.

ADCP instruments come in two configurations, horizontal and vertical (Figure 1); an RTCV system can utilize either configuration but is most commonly deployed with a horizontal instrument for various reasons that will be discussed. The unique circumstances where one or more vertical instruments may be appropriate will be discussed also.

Figure 1. Vertical ADCP head (left), horizontal ADCP head (right).

Horizontal ADCP Installation

A properly mounted horizontal ADCP can measure discreet current velocity and direction at up to 128 unique locations throughout its range (Figure 2). Any one of these values can be utilized by the RTCV for transmission. The image below gives a stylized representation of a horizontal installation.

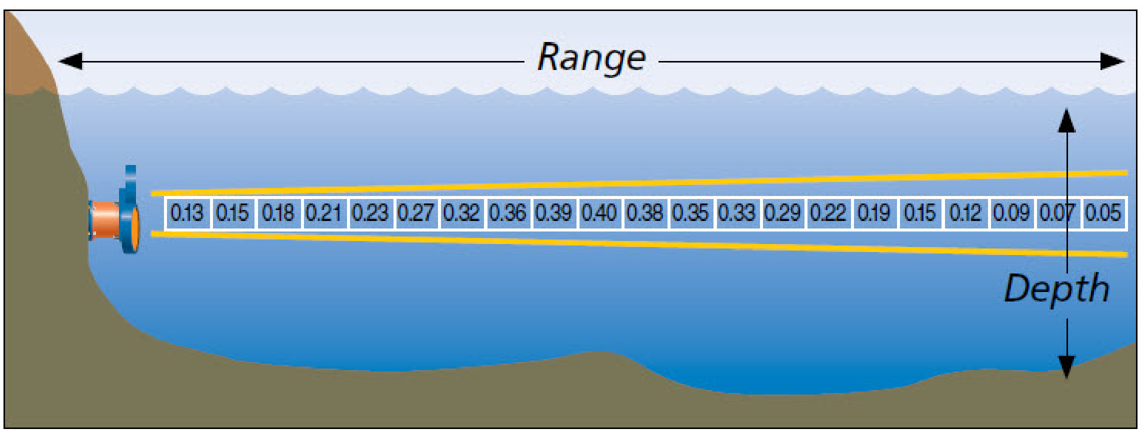


Figure 2. Location of individual bins for current measurements.

Please note that Figure 2 reflects the two primary factors associated with the installation of the ADCP, those of *Range* and *Depth*.

Range

All ADCP instruments have a maximum working range. Being able to find a mounting location for and an instrument that allows access to the desired measurement area, while offering easy access for service, and protection from vessel impacts and debris is the primary challenge in installing an RTCV system. The maximum range of the instrument is determined by the frequency of operation; the lower the frequency the longer the range. The instruments most often used by RTCV systems transmit in two frequency ranges, 300 KHz and 600 KHz. In actual working conditions, the 600 KHz instruments exhibit a maximum range of approximately

120 meters (360 ft), while certain 300KHz instruments can extend that to approximately 300 meters (1,000 ft).

This does not mean that the best instrument is always the one with the maximum range. Besides the obvious reason of increased cost, it is always advisable to use the smallest instrument that can acquire the desired data.

In installations with self-limited range, for example in man-made channels, possibly with concrete or steel pile linings, excess energy from the instrument can lead to skewing of readings from true and delays must be put in place between readings to allow this energy to dissipate. Also, lower frequency, or longer range, instruments have a data collection rate, or "ping" rate, that is slower due to obvious reasons. Both of these reasons limit the total amount of data that can be collected in any given amount of time.

Depth

Studying the image will give the understanding that, with a horizontal ADCP, all of the measurement locations are at the same depth. For the purposes of navigation safety, only currents in the depth range actually occupied by vessels are important. For example, if an RTCV installation is being considered in a channel where normal commercial traffic consists of barge tows, then maximum allowable draft is around four meters. The target depth, in this case, should be somewhat less than maximum, or three meters. Please note that Range and Depth are correlated in that the cone of sound transmitted by the instrument spreads as it travels thorough the water. The cone should not be allowed to be obstructed by either the water surface or the channel bottom. Therefore the instrument must be mounted deep enough to keep the beam from hitting the surface while still being at a depth that is navigationally significant. Three meters has proved to be a good depth, in actual installations, allowing the instruments to achieve maximum range.

In areas where deep draft vessels operate, it may be desired to take current readings deeper than for shallow draft vessels. Using commercial tow traffic as the low end, at around 3 meters normal draft, a transition can be made to container vessels which can draft as much as 15 meters. The obvious advantage of deeper instrument mounting depths is extended range and fewer worries about obstructions. Therefore, a recommended depth to mount the ADCP for deep draft vessel applications is 6 to 9 m (20 to 30 ft).

Installation

As mentioned previously, the primary challenge installing an RTCV is to be able to install the ADCP in a location that will allow access to the area that needs to be monitored while not subjecting the instrument to undue risk of damage from vessel strikes or debris. Luckily river locks, the primary intended market for the RTCV, have several features that make installing RTCV systems fairly straightforward. Because, as mentioned before, the primary application for the RTCV system is to help combat out-draft current at lock facilities, these systems will be installed normally on the up-river guard wall closest to the dam.

Figure 3 is a picture of the RTCV installation at Tom Bevill Lock on the Tenn-Tom waterway. This system is installed at the end of the upriver long wall. This picture displays clearly the ADCP, the ADCP mounting rail, as well as the control box mounted on the hand rail to the upper right of the ADCP. There are some observations that, while not obvious, make this a good installation that will be touched on later in this section.

The rest of this installation section applies to an out-draft application at a river lock facility.

NOTE ON SAFETY: While working over or near the water please observe all required safety precautions and wear required safety gear such as personal flotation devices, hard hats etc.

Figure 3. ADCP head and mounting rail at Tom Bevill Lock and Dam.

ADCP Rail Mounting

As noted above, in most cases, the ADCP will be installed at the end of the upstream wall closest to the damn. A typical mounting location is shown in Figure 3. The first thing to notice is that the instrument is not installed either parallel or perpendicular to the water flow; it is installed at an upstream angle. Being installed on the dead center of the bull nose would result in complete destruction of the instrument in the event of a barge strike. However, installment of the instrument at 90 degrees, or perpendicular to the water flow, is also not wanted.

The instrument rail mounting system is made up of three parts. The instrument hoist assembly, the instrument rail, and the instrument carrier assembly. Figure 4 shows the instrument hoist assembly mounted at the Smithland Lock and Dam on the Ohio River. Figure 5 shows the hand winch used to raise and lower the instrument for service. (NOTE: If for some reason the cable on the instrument hoist needs to be replaced use only high quality aircraft grade stainless steel cable.)

Figure 4. RTCV instrument hoist assembly at Smithland Lock and Dam.

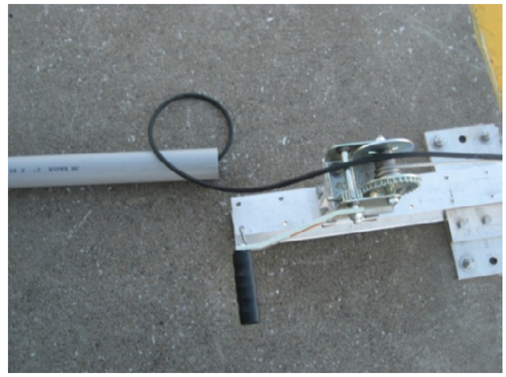


Figure 5. Hand winch for raising and lowering the RTCV head at Smithland Lock and Dam.

The rail is mounted to the structure with mounting plates. There are two types of mounting plates. These are aluminum plates designed to work with concrete anchor bolts, and steel plates designed to be welded directly to a steel pile wall or other steel outer covering.

In Figure 6, also at Smithland Lock and Dam, note the generous use of mounting plates (Red Arrows) all the way down the mounting rail to the water surface. This practice should extend below the water line as well. The blue arrow points to the junction between the rail head assembly and the first rail extension. It is important to point out that this junction must be smooth on both the outer flange surface as well as below the flange in the web area. If this area is not smooth, the instrument carrier will hang up on this area of the rail which will make servicing the instrument difficult.

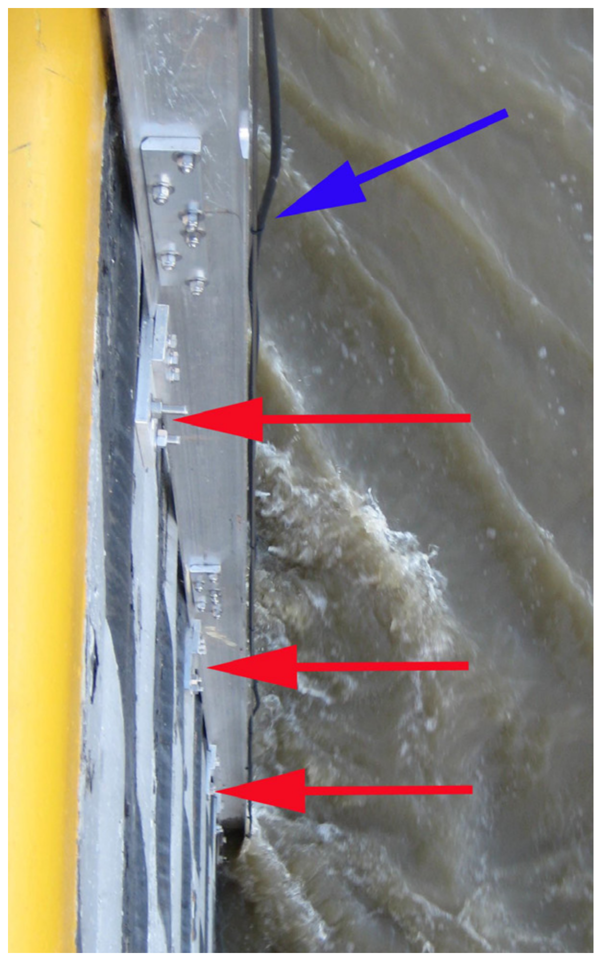


Figure 6. Mounting plates for ADCP deployment rail.

Ice Protection

If the system is to be installed in an area with regular ice buildup the rail will need protection. Ice can damage the rail by contact or though the buildup of ice around the rail that can then pull the rail from the mounting. In Figure 7, a steel box, a welded section of ½ inch plate on I-beam, has been built around the rail that extends three feet below the water line at L&D 22.

Please note that the protection structure allows room for the instrument mount to articulate and also allows easy access for cleaning and service.

Figure 7. Ice protection box for ADCP mounting rail.

Instrument Carrier

The instrument carrier assembly holds the instrument to the rail and allows some adjustments to be made concerning pitch, roll, and heading. The instrument carrier should be mounted in such a way that the heading adjustment swings upstream only.

The instrument is mounted to the carrier assembly using three 3" x 3/8" stainless steel bolts, in the locations shown in Figures 8 and 9. The instrument should be mounted as close to level with the mounting plate as possible. Later, once the instrument carrier is mounted to the rail, any required adjustment can be made to level the instrument relative to the water, if the rail was not installed plumb.

Figure 8. Three bolt mounting of ADCP to mounting plate.

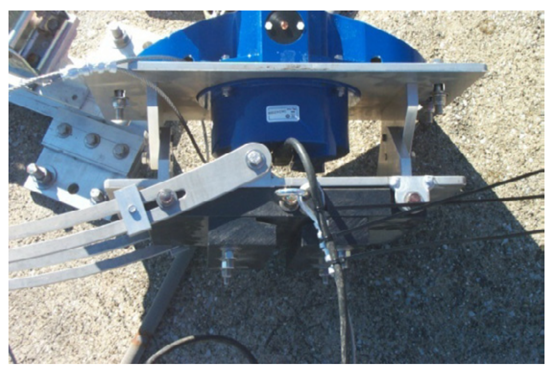


Figure 9. Second view of three bolt mounting.

The pitch of the instrument should be level to + two degrees. Again, mount and set the carrier as close to zero as possible before mounting to the rail and make final adjustments once the carrier is mounted to the rail.

Instrument Carrier Weight

Figure 10. Instrument Carrier Weight.

It can be beneficial to add additional weight to the instrument carrier assembly to ease the descent of the instrument down the rail and help keep tension on the hoist cable. An eye is provided on the bottom of the carrier, similar to the one on the top, where additional weight can be secured (Figure 10). Twenty to thirty pounds should be appropriate. If more weight is needed to get the instrument carrier to descend properly, check the carrier and rail for burrs or uneven spots that might be rubbing. Typically, a weight of twenty to twenty five pounds is sufficient.

Safety Cable

A safety cable should be attached to the instrument carrier in such a way that the cable runs though one of the ADCP mounting slots on the instrument as well as the instrument carrier. The cable should be run such that it cannot move in front of the "eyes" of the ADCP. This cable should be a quality stainless steel aircraft grade cable of at least 5 mm (3/16 inch) diameter. The cable should be secured topside to a secure mounting location DOWNSTREAM of the instrument with sufficient cable that if the instrument carrier was to be ripped from the rail it would swing away and down toward the bottom below the draft of the vessel to minimize possible harm to the instrument.

Figure 11. Safety cable attached to ADCP head.

Notice in Figure 11 that the safety cable runs though an unused mounting hole on the instrument as well as behind the mounting plate on the instrument carrier. This guarantees that the cable will not wander in front of the instrument or become detached from the instrument even if the instrument carrier is damaged.

Mounting the Instrument Carrier

Once the instrument is properly and securely mounted, all of the adjustment bolts on the carrier are secure, and the hoist as well as safety cables have been attached, the technician can begin mounting the carrier assembly to the rail. There is a notch, Figure 12, in the instrument rail assembly to allow mounting of the instrument carrier. The assembly should be picked up and over the front of the rail and lowered into place on the rail. With certain instrument combinations, the instrument carrier assembly along with the carrier weight can have a total weight of over two hundred pounds. Therefore, this activity would best be completed using a hoist or crane on a service vessel. **Please observe all proper safety precautions when working over the side of the safety railing.**

Figure 12. Instrument rail notch.

Once the instrument and its carrier are successfully mounted, it is time to attach the instrument data cable, Figure 13. The instrument end of the cable is a special seven (7) pin underwater connector with a locking strap.

Figure 13. Instrument data cable plugged into the instrument and secured with cable ties.

Note that once the cable is secure, a strain relief loop is left in the cable and it is securely wire tied to the instrument carrier assembly. After this, as the instrument carrier assembly is lowered into the water, **the data cable must be secured to the instrument hoist cable with a wire tie at least every two feet.** Without the data cable being secure, in this manner, the steel hoist cable will act as a fine-toothed saw and make quick work of the soft data cable and it will have to be replaced. The average cost for a replacement data cable is two thousand dollars, so please take these measures to protect it.

Control Box Mounting

The RTCV control box should be mounted as near as possible to the instrument mounting rail to reduce the distance required to run the data cable. Please choose a location that allows easy access for configuration and service while offering maximum protection from the elements. The enclosure is rated NMEA 4X and can be left directly in the elements with no problems, but the people that have to service such systems are not rated NMEA 4X and will greatly appreciate such actions (Figure 14).

Figure 14 shows the RTCV control box installed inside a control structure at the Smithland Lock and Damn. This is an ideal mounting location but not required. Figure 15 shows a close-up of the RTCV control box with the major components identified.

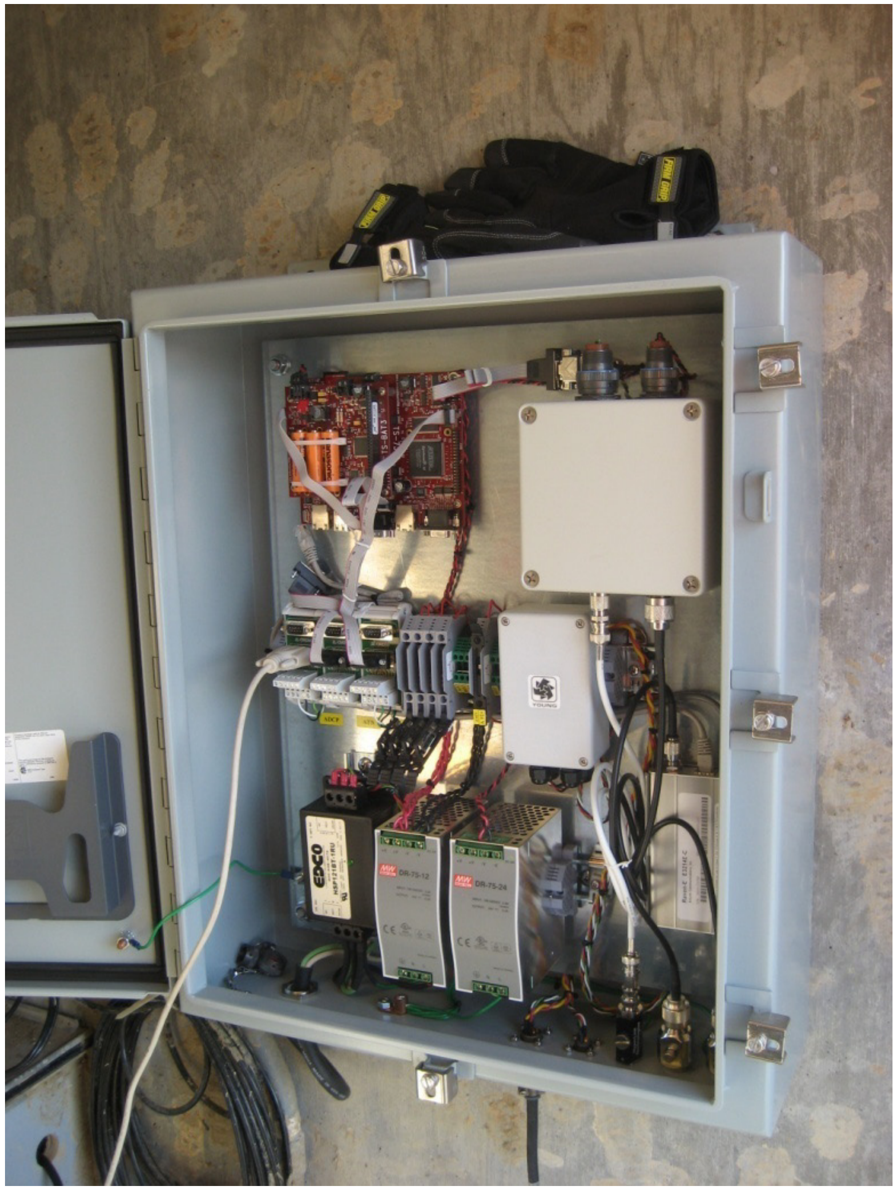


Figure 14. RTCV NMEA 4X enclosure.

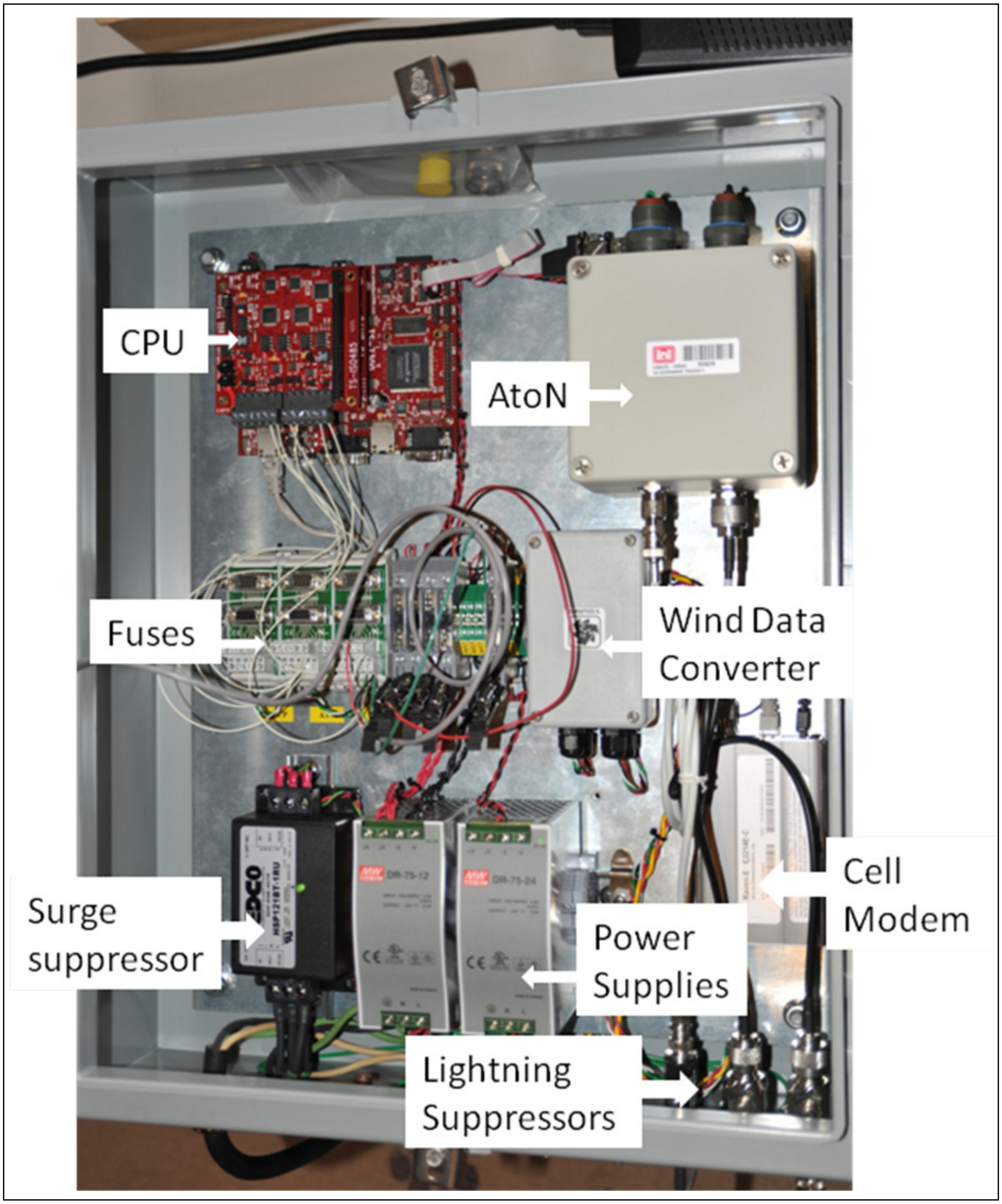


Figure 15. Major Components of the RTCV control box.

Running the ADCP Data Cable

The ADCP data cable should be run in a manner to afford maximum protection from damage due to traffic on the lock wall as well as from sunlight. Figures 16 and 17 show that the data cable runs in conduit to as close a proximity to the instrument as possible to afford maximum protection to the cable.

Figure 16. RTCV data cable in conduit

Figure 17. Second photo of RTCV data cable enclosed in conduit

Mounting Anemometer

The RTCV system captures wind speed and direction using a traditional prop and wing anemometer. The instrument must be mounted in a location that allows direct wiring to the RTCV control box within a distance of 30 m (98 ft). Because the wind data is reported via AIS for navigational purposes, the anemometer should be mounted in a location where it will report wind conditions near the water surface. For example, don't mount the anemometer on top of a 20 m pole or tower that will position the instrument well above the top of vessels traversing the facility, but rather mount it 3 m (10 ft) above the wall. Figures 18a and b show the instrument mounting as executed at Racine Locks and Dam.

Figures 18a and b. Anemometer mounting at Racine Lock and Dam.

The anemometer requires a 1 inch pipe (1” NPT) for mounting. The instrument must be mounted in a location that does not obstruct the free movement of the tail throughout a 360 degree arc. The instrument should also be mounted above head level for safety considerations.

Mounting the VHF Antenna

The VHF antenna is used by the AIS AToN unit to send and receive AIS transmissions. There are three things to consider when choosing a mounting location for the VHF antenna.

Figure 19. VHF antenna base mount.

- **Antenna Location**: The VHF antenna should be mounted in a location such that it is not shadowed either by structure, geography, or other RF equipment. Figure 19 shows the base of the 6 m (20 ft) antenna mounting structure erected at the Racine Lock & Dam for the purposes of mounting the VHF antenna for an RTCV installation. Not evident in the picture is that the antenna pole is located near the RTCV control box and provides a totally unobstructed field of view with a good height above water. The mount is simply a 6 m (20 ft)-long section of pipe with a sturdy tilt-down mount that allows for easy raising and lowering for installation and service.
- **Antenna Height**: The VHF antenna should be mounted as high as is practical in light of other considerations. Please be advised that the VHF and GPS antennas do not have to be in close proximity and this should not restrict the mounting location.
- **Cable Length:** With the type of cable provided, LMR-400, the length of the antenna should be kept to a limit of 150 feet. If the desired mounting location is in the 150-300 foot range, then an upgrade to LMR-600 is required. Be cautioned that LMR-600 is much larger (16 mm (5/8 inch) diameter), stiffer, and has a greater bend radius, making it much harder to install.

Mounting GPS Antenna

The GPS antenna is used by the AIS AtoN unit to establish time synchronization with the AIS system. Without a functioning GPS antenna connection the AIS AtoN cannot transmit. The same rules for the VHF antenna section apply regarding the un-shadowed location and cable length but antenna height is not a concern. Figure 20 shows the GPS antenna mount at the Racine Lock & Dam. Note that the sturdy mount is close to the RTCV box, limiting cable run length, thus improving signal.

Figure 20. GPS antenna mount and RTCV box.

Mounting the Cell Modem Antenna

Also shown in Figure 18 is the Cellular Modem Antenna mount. The length of the cable for the cellular antenna should be limited to what is delivered with the system. If the site has poor cellular coverage, an antenna with greater gain or even an active power booster could be used. Please contact the cellular service provider for advice.

Basic Troubleshooting

What follows is a step-by-step approach to troubleshooting an RTCV system. The messages presented below are seen on the laptop used for troubleshooting. Figure 21 shows a screen grab of the RTCV web interface.

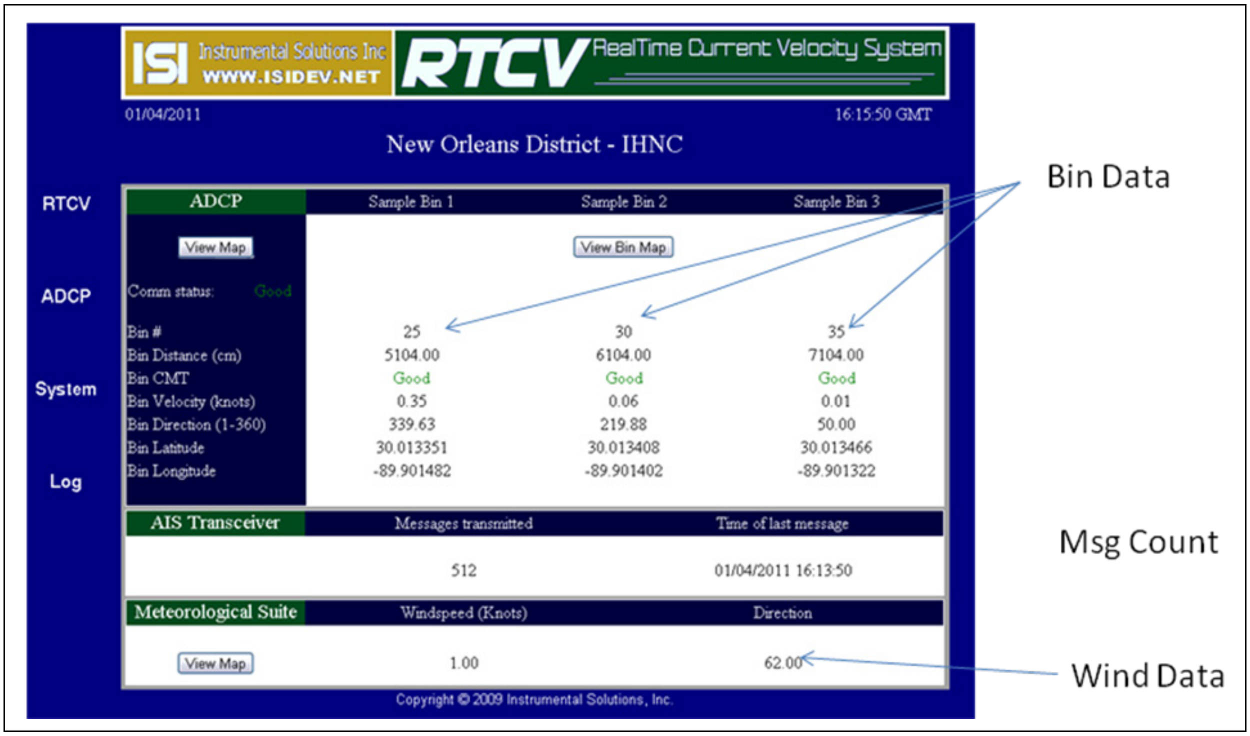


Figure 21. Screen grab of the RTCV web interface.

1. **Web interface not functional, no AIS messages being received:** This condition is the broadest indication of system failure. The first step is to verify system status, see **Check Status** below. See **Diagnose Power** below.
2. **No AIS messages being received**: Check to see if the RTCV web interface is functional. If both wind and current values are displayed on the web interface and the current values are above one foot per second there may be a problem with the AIS AtoN unit. See **Diagnose AtoN** below.
3. **Partial AIS messages are received**: If current messages are being received but not wind see section **Diagnose Anemometer** below.

Check System Status

To quickly check the status of the system, go to the electronics enclosure and open the door. On the microprocessor board, Figure 22, there should be seen at least two status lights during normal operation. If no LED indicators are active on the main processor board move on to **Verify Power**.

Otherwise, the first item to check is the main board indicator on the actual microprocessor board. This LED should be LIT SOLID **GREEN**. The next indicator to verify is the power LED on the battery backup board. It should indicate solid **GREEN** for a minute and then blink rapidly for a minute.

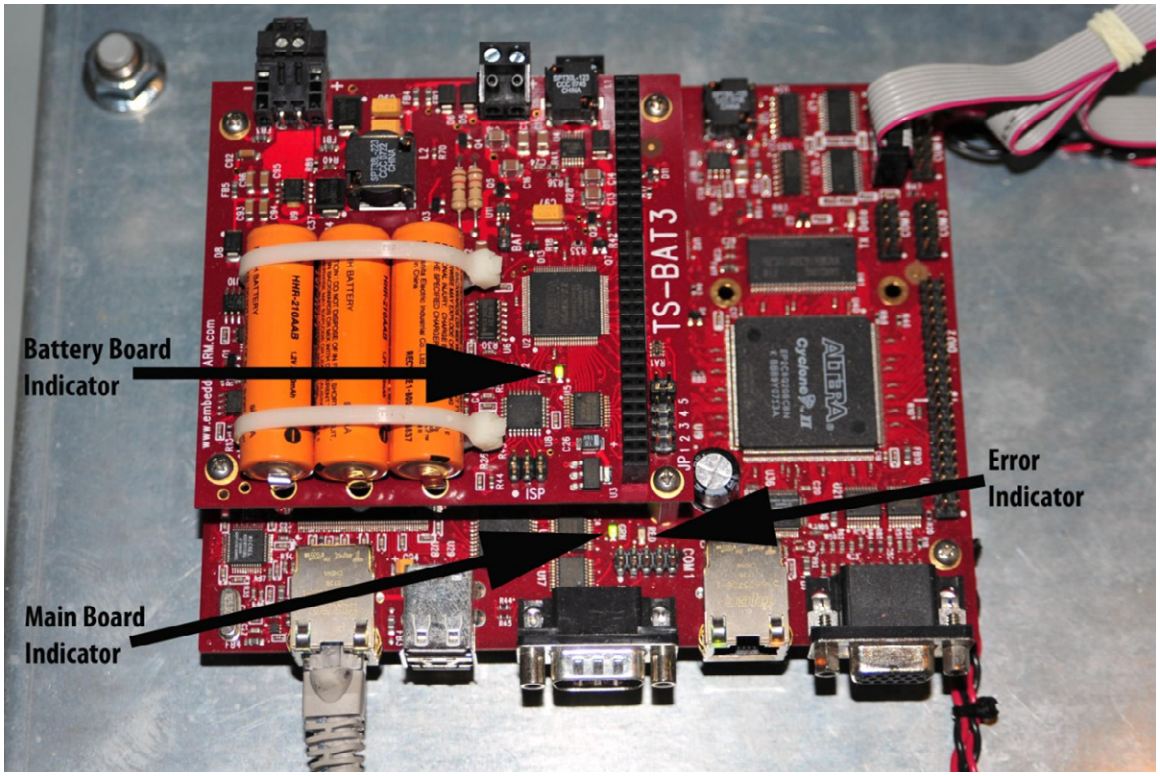


Figure 22. Microprocessor board found in the RTCV electronics enclosure.

Now check the **RED** system error indicator. Under normal working conditions this LED should be off. When an error condition warrants, it will blink out a number of blinks that indicate a type of error.

1 blink	=	ADCP read timeout
2 blinks	=	ADCP read error
3 blinks	=	Anemometer read timeout
4 blinks	=	Anemometer read error
5 blinks	=	Software License Error

If one or two blinks are seen, indicating ADCP read errors, see section **Diagnose ADCP**. If three or four blinks are seen, indicating an Anemometer read error, see section **Diagnose Anemometer**.

Once those two indicators are checked and are correct there exists two more indicators on the microprocessor board to verify data traffic. These are the TX data and RX data indicators. The RX data indicator is at the very top right of the main board (Figure 23) and should blink **GREEN** with a steady two hertz cycle, with the occasional burst of activity. The TX indicator should flash **RED** briefly when the system sends data to the AtoN for transmission. *(Serial cables removed for clarity)*

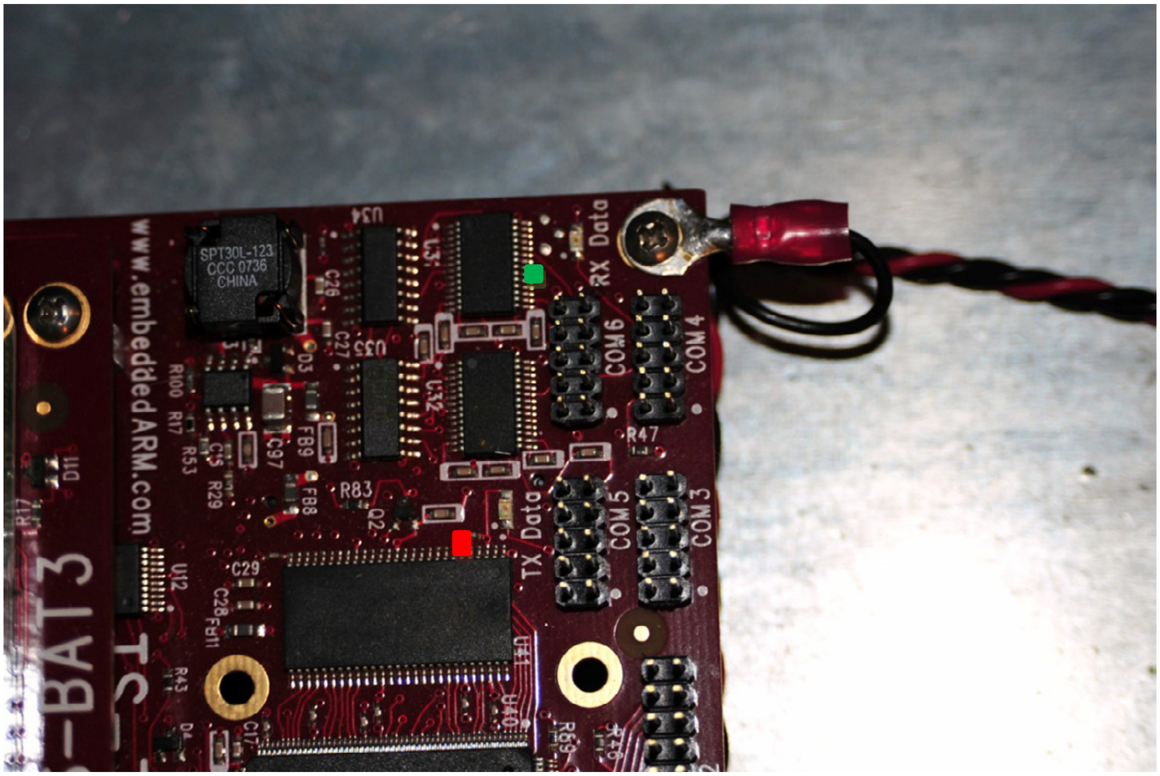


Figure 23. Top right of microprocessor board showing anemometer diagnostic lights.

If all of these conditions are present, the fact that the system is under power and receiving and sending data has been verified.

Diagnose Power

To verify system power, follow these steps after opening the electronics enclosure door. Please note that an individual will benefit from a general knowledge of electronics, AC, and DC power circuits to complete the following diagnostic procedures.

1. **Check Indicator Lights**: If these indicator lights, shown in Figure 24, are operational then system power is present.

   If one or more of the indicator lights is not operational, check the AC surge suppressor next; there should be a bright green indicator right in the middle, as shown in Figure 25.

Figure 24. System power indicator lights.

Figure 25. AC surge suppressor highlighting the power indicator light.

If there is not a green indicator light, the next thing to check is that main system voltage is present on both sides of the surge suppressor, as shown Figure 26.

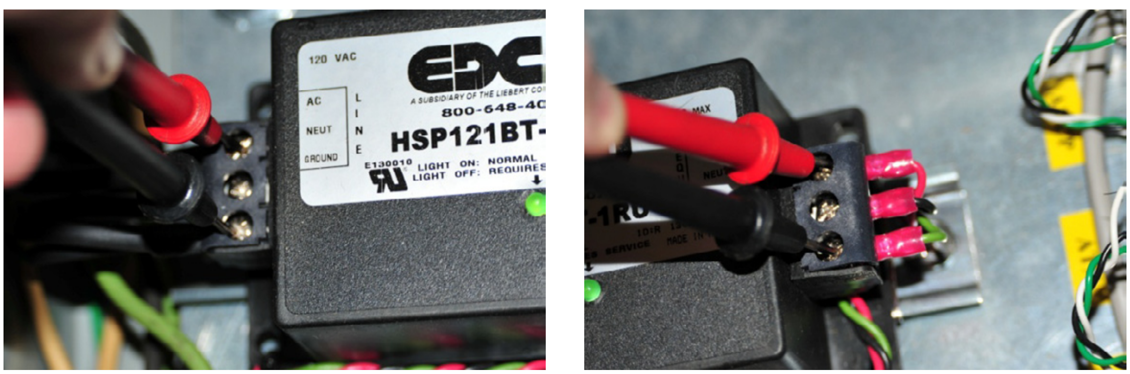


Figure 26. Checking for voltage on both sides of the AC surge surpressor.

If there is inbound voltage and none coming out of the suppressor, it will need to be replaced.

2. **Check DC Voltage:** If both indicator lights are operational, verify next the output voltage of the power supplies. One of the DC voltage power supplies is 12 volts dc while the other is 24 volts dc. If the voltage from one or more of the supplies do not check out, as shown in Figure 27, please remove AC power from the system and call ERDC for assistance. If either of the power supplies fails to produce voltage, they will need to be replaced.
3. **Check Fuses:** If the output voltage of both power supplies checks ok, it is time to check the system fuses. The system has five (5) fuses, as shown in Figure 28. They are for the Microprocessor, AtoN, ADCP, Cell Modem, and Anemometer.

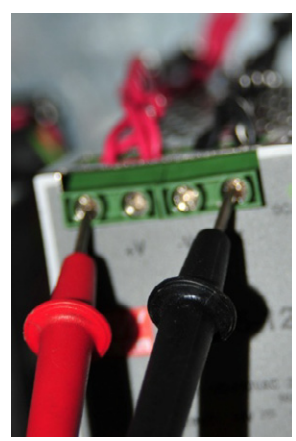


Figure 27. Checking voltage on the DC power supplies.

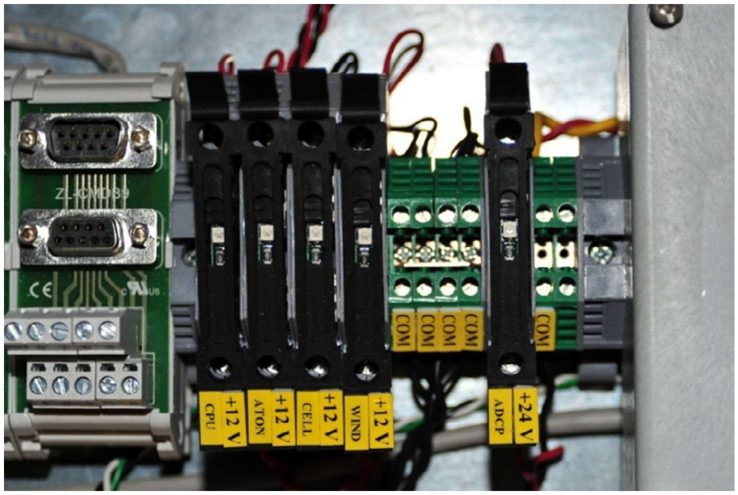


Figure 28. System fuses.

Check the output of any of these fuses, as shown in Figure 29, by testing for continuity with a VOM.

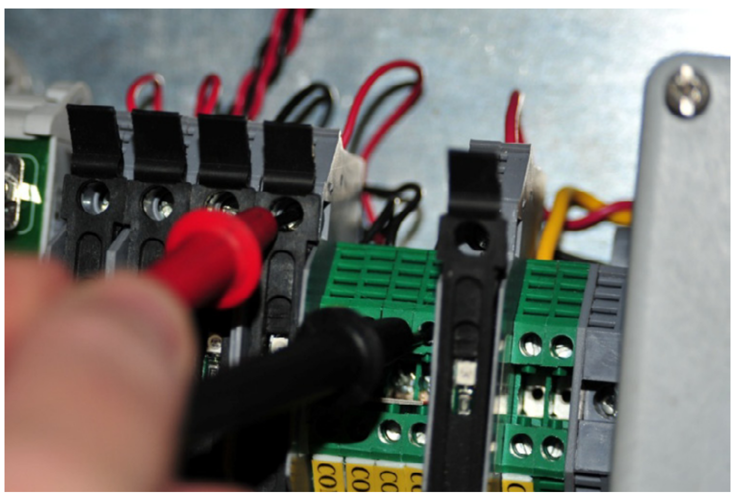


Figure 29. Checking system fuses.

If any of these fuses are blown, please replace them with standard ¼ inch glass fuses of these values.

- Microprocessor: 1 amp
- AtoN: 3 amp
- Anemometer: 1 amp
- Cell Modem: 1 amp
- ADCP: 3 amp

Diagnose ADCP

The first thing to check when suspecting a problem with the ADCP is instrument power. Please refer to **Diagnose Power** for instructions on how to debug the power system and, once that is complete, please return here.

Now that the power to the instrument has been verified let's diagnose a suspected faulty ADCP. We must now determine if the communications circuit between the Microprocessor board and the ADCP is functioning correctly. We will do this by checking voltages between the two devices. Take a voltmeter and, with it set to DC volts, check the voltage between pins 2 and 5 and pins 3 and 5 on the DB9 breakout box labeled ADCP. The proper way to do this check is demonstrated in Figures 30 and 31.

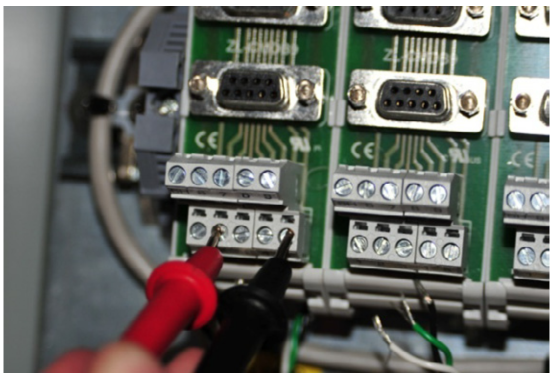


Figure 30. Checking DC voltage between pins 2 and 5.

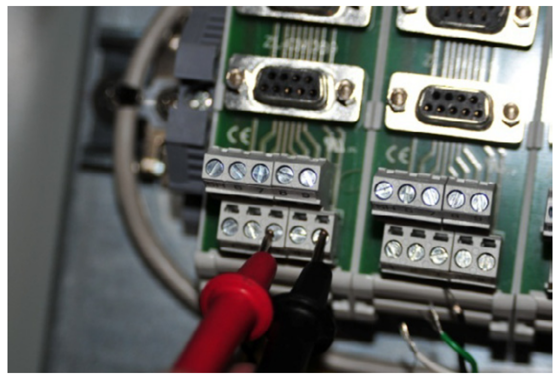


Figure 31. Checking DC voltage between pins 3 and 5.

If the communications circuit between the two devices is working properly, both of these voltages should read approximately -6 volts DC in an idle state.

Diagnose Anemometer

The wind instrument used on the RTCV systems is the RM Young model 05106 that, in conjunction with the Model 32400 RS-232 converter, provides the Microcontroller with a serial data stream from the wind instrument at a 2 hertz rate. If the system is operating and there are no wind data visible on the web interface nor are any AIS messages being displayed with wind data, follow these steps to diagnose the anemometer sub system. First, follow the steps in the Diagnose Power section to verify that power is present. Focus on the 12 Vdc supply and the fuse marked WIND. If power is present, check voltages between pins 2 and 5 and pins 3 and 5 on the DB-9 breakout box marked WIND. Please refer to the applicable photos in the diagnose ADCP.

The voltages should both read around -6 Vdc in an idle state. If there is voltage between pins 2 and 5 and not 3 and 5, loosen the screws under pins 2 and 3, remove the two wires and recheck those voltages on the DB-9 breakout box as before.

If voltage appears on pin 3, the problem is either with the RS232 converter box or a short in the wiring going to the converter box. Next, reverse the test by leaving the wires connected to pins 2 and 3 and disconnect the DB-9 cable from the breakout box. If there is power on pin 2 when there was no power before, the microcontroller, or the wiring to the microcontroller is at fault.

The only thing to check, in this case, is that the ten pin ribbon cable is good by first making sure that it is connected correctly to the processor board and breakout block. Please note that on the processor board connection, the bottom right connection in Figure 32, the red stripe on the cable is on the bottom of the connector.

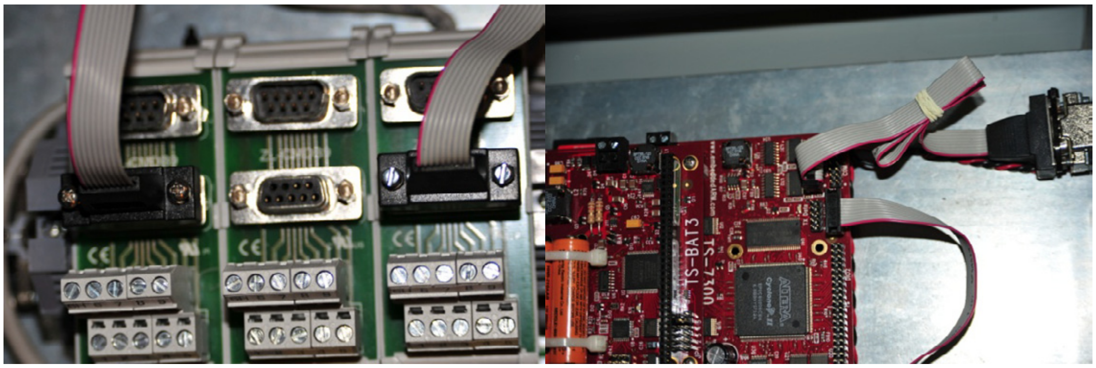


Figure 32. Processor board connection highlighting the ten pin ribbon cable at bottom right.

Lastly, pull back the black shield around the solder joints and inspect the wiring (Figure 33). If there is any damage replace the damaged connection.

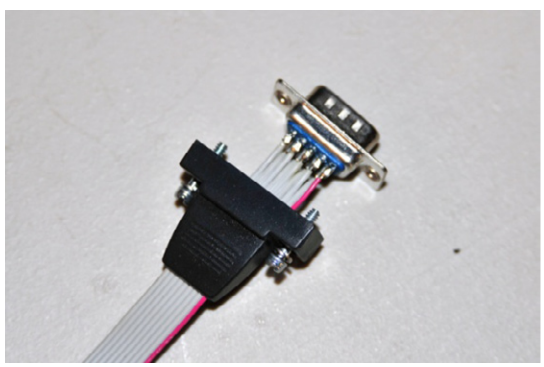


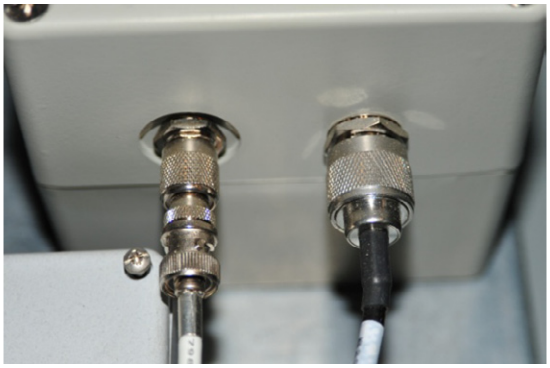
Figure 33. Exposed solder joints on anemometer ribbon cable

If all of these conditions are met, then a problem with the instrument or RS232 converter is indicated; please contact **ERDC**.

Diagnose AtoN

There are a limited number of things that can keep an AtoN from functioning.

The first thing to check on the AtoN is that all connections are tight. The four connections to the AtoN are Power, Data, UHF, and GPS (Figures 34 and 35). Make sure that all of the connections are good and that there is no visible damage to the associated cables.



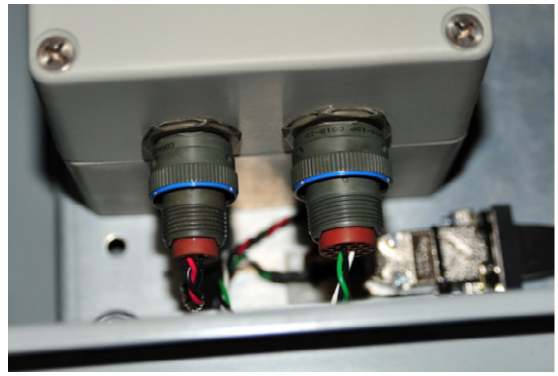


Figure 34. AtoN connections.

Figure 35. AtoN connections.

Next, verify that the data cable from the AtoN is connected properly to the Microprocessor, as shown in Figure 36. Note that the red stripe on the ribbon cable is oriented toward the bottom of the connector.

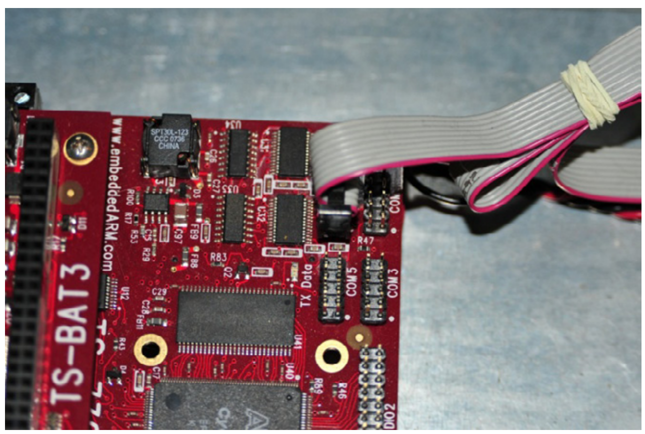


Figure 36. Data cable from AtoN connection to Microprocessor.

The next thing to check is power. Verify that the fuse marked AtoN is good; if not, replace it with a replacement fuse, 2 amp rating.

Once the connections to and from the AtoN are checked, and the power is verified, the only thing left to check is the GPS antenna. Without a proper GPS signal the AtoN cannot time sync its transmission to the AIS network and will not transmit. Verify that the cable to the GPS antenna is not damaged and that the antenna is also without damage. Make sure that the GPS antenna is not mounted flat to a piece of metal, forming a ground plane and that it is not positioned with other objects obstructing its view to the sky.