RIVERRAY

DEPLOYMENT GUIDE

https://www.teledynemarine.com

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HOW TO CONTACT TELEDYNE RD INSTRUMENTS

If you have technical issues or questions involving a specific application or measurement with your instrument, contact our Field Service group:

Teledyne RD Instruments	Teledyne RD Instruments Europe
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Phone +1 (858) 842-2600	Phone +33(0) 492-110-930
Sales – rdisales@teledyne.com	Sales – rdie@teledyne.com
Field Service – rdifs@teledyne.com	Field Service – rdiefs@teledyne.com

Client Services Administration – rdicsadmin@teledyne.com

Web: https://www.teledynemarine.com

For all your customer service needs including our emergency 24/7 technical support, call +1 (858) 842-2700

Self-Service Customer Portal

Use our online customer portal at https://www.teledynemarine.com/support/RDI/technical-manuals to download manuals or other Teledyne RDI documentation.

Teledyne Marine Software Portal

Teledyne RD Instruments Firmware, software, and Field Service Bulletins can be accessed only via our Teledyne Marine software portal.

To register, please go to https://tm-portal.force.com/TMsoftwareportal to set up your customer support account. After your account is approved, you will receive an e-mail with a link to set up your log in credentials to access the portal (this can take up to 24 hours).

Once you have secured an account, use the Teledyne Marine software portal to access this data with your unique username and password.

If you have an urgent need, please call our Technical Support hotline at +1-858-842-2700.

Preparing the ADCP

PREPARING THE ADCP INCLUDES THE FOLLOWING STEPS:

✔ Checking you have all the RiverRay parts

✔ Installing the documentation and software

Identifying what's in the Box

Included with the RiverRay system:

Part Number	Name		Description
RIVRAY600-I	RiverRay 600 kHz system		The RiverRay system includes the transducer, dummy plug, protective cap, tools, and mounting hardware for the mounting plate. When unpacking, use care to prevent physical damage to the transducer face and connector. Use a soft pad to protect the transducer.
71B-7007-xx	RiverRay Tethered Trimaran (optional)		Tri-hull Tethered Trimaran for tethered deployments (shown folded). Various GPS wiring configurations are available (optional).

Included with the RiverRay Accessories Kit (RIVRAY600-A):

	Part Number	Name	Description
	73B-6020-005	I/O cable	The I/O cable is used for serial communications.
	UK821	Shipping case	Shipping case with custom foam cutouts.
75BK6066-00 RIVERRAY DOCUMENTATION KIT	95Z-6007-00	Download instructions	This sheet has instructions for downloading the software and manuals.
		WinRiver II Software	TRDI's river and coastal data acquisition software package where the primary use is for discharge calculation. Although this is its primary function, it can be used for general coastal survey applications.
		TRDI Toolz Software	Utility and testing software package that can be used to test the ADCP.
		SxS Pro Software (optional)	Section-by-Section (SxS) Pro is a stationary ADCP discharge data collection and processing program. Registration code is required to collect data.
		Q-View Software (optional)	*Q-View* is designed for customers using *WinRiver II* software to have easy access to an evaluation of the quality of collected data while they are still in the field and back in the office.
	95B-6130-00	RiverRay Getting Started	A printed reference card showing how to get started with the RiverRay.
	SD1000U DAT5-G01R	USB Bluetooth device	USB Bluetooth device SD1000U and the Sena DAT5-G01R antenna.
	75BK6068-00	Spare parts and tools	Includes spare mounting hardware for the Tethered Trimaran mounting plate.

For instructions on using the USB Bluetooth device, see the WinRiver II Software User's Guide and the instructions included with the device on the Bluetooth driver CD. When WinRiver II is installed, shortcuts to the WinRiver II Software User's Guide and quick reference cards are added to the Windows Start menu.

Installing Documentation and Software

The RiverRay documentation and software are downloaded.

1. Follow the instruction sheet on downloading TRDI software and manuals.

2. Software is available on https://tm-portal.force.com/TMsoftwareportal. Install *WinRiver II* and *TRDI Toolz*, *SxS Pro* (optional), and *Q-View* (optional) software. Both *WinRiver II* and *TRDI Toolz* programs are needed to test and deploy the RiverRay system.

3. Use our online customer portal at https://www.teledynemarine.com/support/RDI/technical-manuals to download manuals or other Teledyne RDI documentation. Download the RiverRay Guide. PDF versions of all RiverRay documentation are available for download.

RiverRay Guide

Quick Review

✔ Check that you have all the RiverRay parts.	⊕ If you are missing parts, contact TRDI support rdifs@teledyne.com or call +1 (858) 842-2700.
✔ Check that the software and documentation is installed.	⊕ Install WinRiver II and TRDI Toolz.

Connecting to the ADCP

CONNECTING TO THE ADCP INCLUDES THE FOLLOWING STEPS:

✔ Connecting the cables and battery on the Boat

✔ Connecting to the system using WinRiver II

What type power does my system need?

The RiverRay ADCP requires a DC supply between 10.5 volts to 18 volts. Either an external DC power supply or battery can provide this power. The standard 12v 7 ah battery supplied with the Boat should power the ADCP for ~40 hours by itself, or ADCP + GPS for ~8 to 12 hours.

> Check that the battery voltage is above 10.5 Volts DC. RiverRay ADCPs will work at 10.5 VDC with at least 400 milli amps; however, batteries with voltages below 11 VDC are at or near their end of life and are approaching uselessness.

The power supply must be able to handle the inrush current as well. Inrush current is the current required to fully charge up the capacitors when power is applied to the RiverRay. The capacitors provide a store of energy for use during transmit. The inrush current is as high as three Amps rms. The RiverRay will draw this amperage until its capacitors are fully charged.

If the power supply limits the current or the power drop on the cable is significant, then the power on cycle will take longer. It can take up to one minute. If the power shuts down during the inrush current draw, this may not allow the RiverRay's electronics to start.

Using the Bluetooth Connection

> ⚠️ TRDI strongly recommends that users install the drivers and test communications in a location with internet access before proceeding to their measurement location.

Use a Bluetooth connection for a tethered boat deployment.
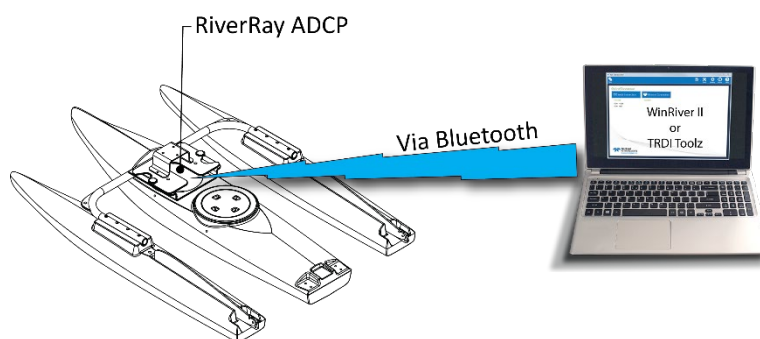
RiverRay Connections – Bluetooth Connection

> For instruction on using the SD1000U USB Bluetooth device, see the WinRiver II Software User's Guide, **SD1000U Quick Reference**, and the instructions and Bluetooth CD included with the device.

⚠️ Some Bluetooth devices may ask for a passkey, PIN code, Pair code, Pairing code, Security code, or Bluetooth code.

In all cases, the code is 0 or 0000 (zero, not the letter o).

The pin code is 0 for systems shipped prior to August 2017 and 0000 for systems shipped after August 2017. If your system is sent in for repair and the Bluetooth module is replaced, the pin code (if needed) will change from 0 to 0000.

⚠️ For RiverRay systems shipped after August 2017, the Microsoft® Bluetooth drivers work with *WinRiver II*. For best results, use the USB Bluetooth device with the driver supplied with the ADCP for *WinRiver II.*

To connect to a RiverRay ADCP using the Bluetooth port:

1. Attach the Boat's cable to the ADCP's connector and install the battery in the Boat. Turn on the Boat power switch. Verify that both the red and green LEDs light. After a few seconds, the red LED should go out and the green LED will blink twice and then stay on. This indicates that the RiverRay self-test has passed. If the red LED stays on, wait a few minutes, cycle the power off, and back on and check the LEDs again.

2. Plug in the SD1000U device to a USB port and determine the Com port used.

See the WinRiver II SD1000U Bluetooth Communication Setup Card for instructions.

3. Run the *ParaniWin* program and connect to the ADCP. With the Bluetooth modules used since August 2017 (or a repaired older unit where the Bluetooth module was replaced) you may need to use **Mode 0** and **Authentication** (not Encryption). The code is 0000 (four zeros) and click **Apply**.
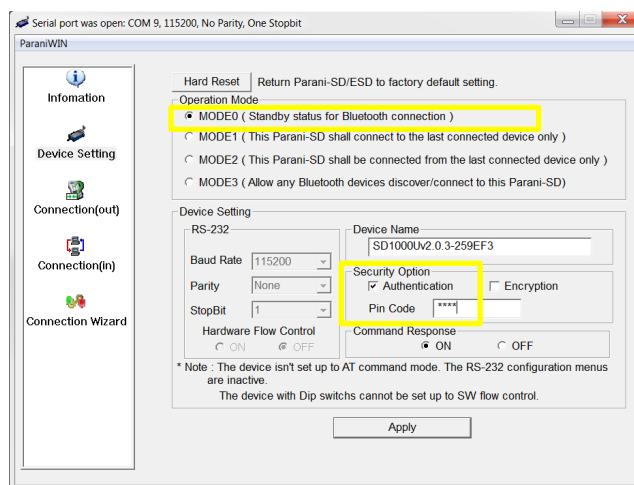

📌 You may need to use either **Authentication** or no authentication when using *ParaniWin* with an SD100U. Try one, and if does not work try the other. Use whichever one works going forward.

The selection of Mode 0 or Mode 1 is independent of Authentication/no Authentication:

- Mode 1 automatically reconnects to the ADCP but is otherwise identical to Mode 0.
- You must establish an outgoing connection before you can switch to Mode 1, but once in Mode 1 you can connect to a different ADCP without switching back to Mode 0.

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4. Exit the *ParaniWin* program.

5. Start *WinRiver II*.

6. On the **Configure** menu, select **Peripherals**.

7. Select **Port: ADCP Serial Port** and then click the **Configure** button.

8. Select the **Comm. Port** number as noted in step 2. The **Baudrate** must be set to 115200. Leave the **Databits**, **Parity**, and **Stopbits** as shown.

9. Click **OK** to close the Serial Communication Settings screen.
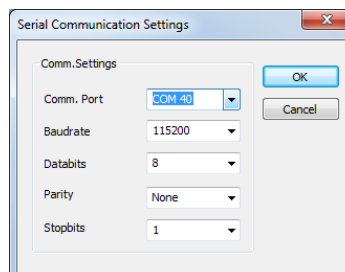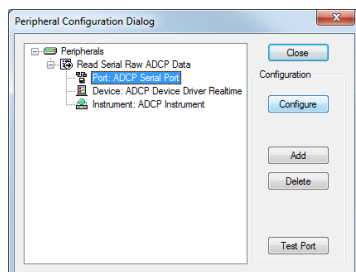
> 📌 Note it may take several seconds to accept the Comm. Port selection.
>
> In this example, the Comm. Port is set to Com Port 40.

10. Click the **Test Port** button. The RiverRay banner appears.

```
>break

RiverRay
Teledyne RD Instruments (c) 2015
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Firmware Version: 44.xx
>
```

11. Click the **Close** button to exit the Test Port Dialog.

12. Click the **Close** button once more to exit the Peripherals Configuration Dialog.

13. Start a new measurement in *WinRiver II*.

14. To use the RiverPro's vertical beam, check the **Vertical Beam Profile Ping** box.

15. On the **Configuration Dialog**, ensure the **ADCP** type matches the RiverRay and the indicator next to the RiverRay is green. Verify the blue LED on the RiverRay ADCP is on.

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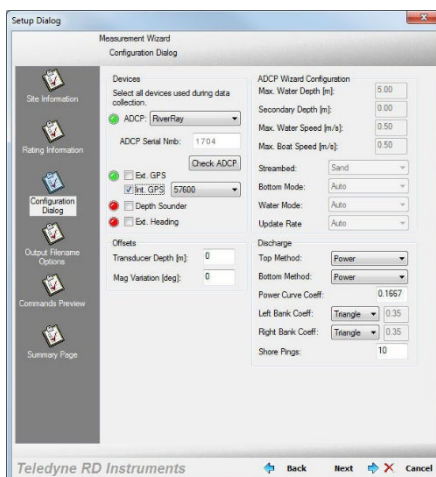
Serial Connection

Use a RS-232 Serial connection on a manned boat deployment.

> For more information on how to set up Serial communications with *WinRiver II*, see the **WinRiver II Serial Communications Setup Card** and Chapter 2 in the WinRiver II Software User's Guide.

To set up the Serial connection on a RiverRay ADCP:

1. The I/O cable connector must be lubricated before connecting. Connect the I/O cable to the RiverRay ADCP. Use a 3mm Allen Wrench to attach the strain relief.

> ⚠️ Always apply silicone lubricant before connecting the I/O cable.

2. Attach the I/O cable to the computer's communication port. The standard communications settings are RS-232, 115200-baud, no parity, 8 data bits and 1 stop bit.

RiverRay ADCP   **I/O CABLE** TO SERIAL PORT (COM1 OR COM2)   **12 VDC BATTERY**
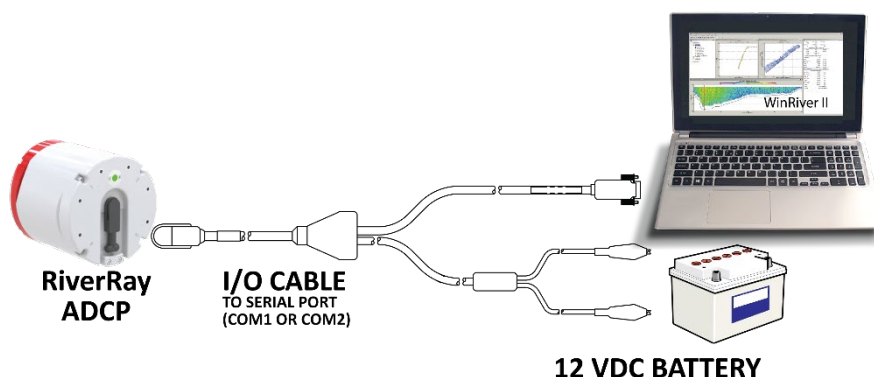
RiverRay Serial Connection

3. Connect a battery or DC power supply to the power connectors. Verify that both the red and green LEDs light. After a few seconds, the red LED should go out and the green LED will blink twice and then stay on. This indicates that the RiverRay self-test has passed. If the red LED stays on, wait a few minutes, cycle the power off, and back on and check the LEDs again.

4. Start *WinRiver II*.

5. On the **Configure** menu, select **Peripherals**.

6. Select **Port: ADCP Serial Port** and then click the **Configure** button.

7. Select the **Comm. Port** number the cable is connected to on the computer. The **Baudrate** must be set to 115200. Leave the **Databits**, **Parity**, and **Stopbits** as shown.

8. Click **OK** to close the Serial Communication Settings screen.
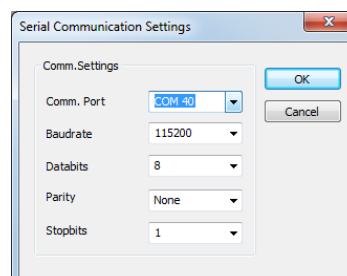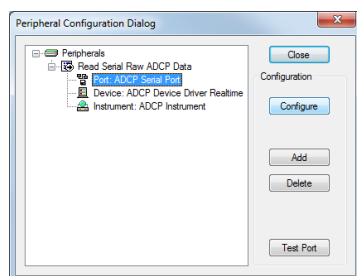
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> Note it may take several seconds to accept the Comm. Port selection.
>
> In this example, the Comm. Port is set to Com Port 40.

9. Click the **Test Port** button. The RiverRay banner appears.

```
>break

RiverRay
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Firmware Version: 44.xx
>
```

10. Click the **Close** button to exit the Test Port Dialog.

11. Click the **Close** button once more to exit the Peripherals Configuration Dialog.

12. Start a new measurement in *WinRiver II*.

13. On the **Configuration Dialog**, ensure the **ADCP** type matches the RiverRay and the indicator next to the RiverRay is green.

Quick Review

✔ Install the ADCP in the Boat or on a manned boat.	🌐 See the RiverRay ADCP Guide, Chapter 2.
✔ Connect to the ADCP using a Bluetooth connection (Boat)	🌐 For instruction on using the SD1000U USB Bluetooth device, see Chapter 2 in the WinRiver II Software User's Guide and the instructions and Bluetooth CD included with the device. 🌐 See the <u>WinRiver II SD1000U Bluetooth Communication Setup Card</u> for instructions. A PDF copy is installed with the WinRiver II software.
✔ Connect to the ADCP using a RS-232 Serial connection (Manned boat)	🌐 For more information on how to set up Serial communications with *WinRiver II*, see the <u>WinRiver II Serial Communications Setup Card</u> and Chapter 2 in the WinRiver II Software User's Guide.

Using GPS

Integrated GPS

The RiverRay ADCPs support integration of GPS data into the ADCP data stream. This approach minimizes the potential for latency in the GPS data and does not require a dedicated communications channel between the GPS receiver and the user's computer.

To integrate GPS data into the RiverRay ADCP:

Configure the GPS receiver for operation as desired. Note the baud rate used for NMEA 0183 output.

💡 The baud rate <u>must</u> be greater than 9600. The recommended baud rate is 57600 or 115,200.

Connect the GPS receiver to the RiverRay using the appropriate wiring harness and interconnect cable(s).

Mount the GPS antenna above the ADCP.

Apply power to the ADCP/GPS.

💡 Hemisphere V102 and the multipurpose GPS mount shown. Contact your local sales representative if you are interested in purchasing a GPS wiring/mounting kit or a complete GPS system.

Verifying the ADCP is Receiving GPS Data

Do not proceed to using *WinRiver II* if you want to use GPS data until you can see good GPS messages in *TRDI Toolz*. *WinRiver II* will only display properly formatted and fully populated messages.

```
CBREAK

RiverRay
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Firmware Version: 44.xx
>
>SF0
External NMEA status: NO DATA,  baud option 3
       Baud rate 4800(3)
Usage: SF <option>
Options:
  0    help
  1    status
  2    toggle diagnostics
  3-8  baud code; 3=4800, 4=9600, 5=19200, 6=38400,
7=57600, 8=115200
  9    enable baud detection
  10   detect baud now
  -1   disable
  11   enable
  20   message list sub-menu

>
```

To verify that the ADCP is receiving GPS data:

Open *TRDI Toolz* and connect to the ADCP. After sending a break type SF0 to show all the SF command settings.

If you know the baud rate, use the appropriate SF command SF3-8 and skip the next step.

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```
>sf9
External NMEA baud detection enabled (9)

>
```

If you do not know the GPS baud rate, type SF9 (enable baud detection).

```
>sf2
External NMEA diagnostics ON, pinging disabled

>NMEA External NMEA (3):  Rx Buffer:$GPGGA,090307.2
NMEA External NMEA (3):  Rx
Buffer:0,3237.182754,N,11713.812833,W,2,05,2.50,5.00
,M,0.00,M,000,0111*4A<CR><LF>$GPVTG,76.222,T,,,4.509,
N,8.350,K,D*70<CR><LF>$GPDB
T,23.083,f,7.036,M,138.498,F*31<CR><LF>$GPHDT,76.2,T*
06<CR><LF>
$GPGGA,090307.20,3237.182754,N,11713.812833,W,2,05,2.
50,5.00,M,0.00,M,000,0111*4A
$GPVTG,76.222,T,,,4.509,N,8.350,K,D*70
$GPDBT,23.083,f,7.036,M,138.498,F*31
$GPHDT,76.2,T*06
$GPGGA,090307.30,3237.182787,N,11713.812685,W,2,05,2.
50,5.00,M,0.00,M,000,0111*46
$GPVTG,75.202,T,,,4.679,N,8.665,K,D*76
$GPDBT,23.032,f,7.020,M,138.193,F*32
$GPHDT,75.2,T*05
$GPGGA,090307.40,3237.182822,N,11713.812539,W,2,05,2.
50,5.00,M,0.00,M,000,0111*45
```

Type SF2 to view the data coming from the GPS; This is an example of a working GPS that is outdoors providing fixes.

```
>sf2
External NMEA diagnostics ON, pinging disabled
$GPGGA,160832.989,,,,,0,0,,,M,,M,,*4E
$GPVTG,0.00,T,,M,0.00,N,0.00,K,N*32
```
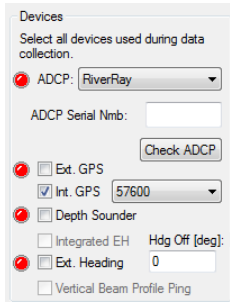
If your GPS is indoors, you will see the following NON-fully populated messages. However, they should have the correct format and the checksum (*XX) at the end.

```
>sf2
External NMEA diagnostics ON, pinging disabled
NMEA External NMEA (3):  Rx Buffer:$
<01>I<86><84>e<84><a6><a5><e5><a4><84>Z
NMEA External NMEA (3):  Rx
Buffer:fX<a4>X<c7>$<a4><c5><c1>*<84><a6>w<c4><e4>DF<
86>I<c4><c2>D<c4><84><84>g@<83><01><81><c1><85><e5><a
4>*<c0><c6><e4>]<c5>-<e6><c
6><c6><c3><e0><c4><02>$<ac><c1><86>9)<95><b1>9<d5><d1
><cb><a9><8d><a9>MN<f5><a4>
7<08>{V<ab><af><c0>k'<fe>
NMEA ERROR: Second end character(\n) NOT found f
```

If the baud rate is incorrect, you will **NOT** see the NMEA messages but instead the following error message.

If the GPS baud rate is not close to your SF baud rate setting, you may not even see this message.
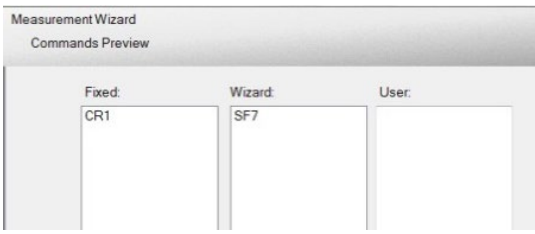
WinRiver II GPS Configuration

Start *WinRiver II*.

Using the **Measurement Wizard**, select the checkbox for **Int. GPS** and configure the baud rate to match that of the receiver.
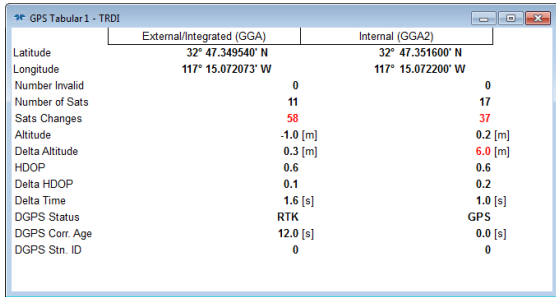
The baud rate <u>must</u> be greater than 9600. The recommended baud rate is 57600 or 115,200.

On the Commands **Preview** page, verify the SF command was added.

SF3 = 4800 baud
SF4 = 9600 baud
SF5 = 19200 baud
SF6 = 38400 baud
SF7 = 57600 baud
SF8 = 115200 baud

On the **Acquire** menu click **Start Pinging** or use the shortcut key **F4**.

The **GPS Tabular 1** screen will show the GPS data.

Quick Review

✔️	📖
✔ Use the GPS Tabular 1 display	↪ Read Chapters 3, 6, and 13 in the WinRiver II Users Guide.
✔ Use *TRDI Toolz* to verify that the ADCP is receiving GPS data	

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Prepare for Discharge Measurement

PREPARING FOR DISCHARGE MEASUREMENT INCLUDES THE FOLLOWING STEPS:

✔ **RUNNING THE WINRIVER II MEASUREMENT WIZARD**

✔ **RUN THE BUILT-IN TESTS ON THE ADCP**

✔ **RUN THE COMPASS CALIBRATION ON THE ADCP**

✔ **RUN THE MOVING BED TEST/SET THE CLOCK**

Prepare for Discharge Measurement

The Hydrologist arrives at the site with a RiverRay and all the ancillary equipment necessary to perform a discharge measurement.

- **Tethered boat w/ tagline** – The Hydrologist sets up a tagline/pulley system for the tethered boat and then proceeds to install the RiverRay in a standard RiverRay boat. Tethered boat measurements can also be performed from a bridge or other structure across the river. This tends to provide reduced control over the tethered boat motion in the water, as the bridle/line length is longer giving the Boat more freedom to move with the water currents. Measurements taken from bridges or other structures often encounter greater turbulence in the form of jets and eddies created by the structure or bridge piers.
- **Manned boat** – The RiverRay is attached to a Kentucky mount or equivalent mounting method.

> If the measurement site is expected to have significant moving bed conditions, the Hydrologist may decide to connect a portable GPS module to the RiverRay.

The RiverRay is connected to a 12V 7AHr gel-cell battery, and it automatically establishes a connection to external devices and begins to acquire a position via its internal GPS. Next, the Hydrologist powers on the laptop, opens the discharge measurement application *WinRiver II* and connects to the RiverRay with a wireless connection for a tethered boat or a wired connection using RS-232 for a manned boat.

Measurement Wizard

The Hydrologist selects to start a new measurement within the *WinRiver II* application. Once the Hydrologist enters all the background information on the site where the measurement will be performed, the software will then automatically detect whether an ADCP is connected and which ADCP type is connected.

Use the **Transducer Depth** field to set the depth from the water level to the center of the slant beam transducer faces.

Enter the **Magnetic Variation** for the site.

> See Chapter 3 Tutorials and Chapter 7 Using the Measurement Wizard in the WinRiver II User's Guide.

Run Built-In Tests

The RiverRay is commanded to perform a BIT test on power up, and flashes its LED lights to indicate the results of the test. It simultaneously transmits the results of the BIT test, the status of the internal GPS connection and any ancillary devices connected to it to the host computer. On the **Acquire** menu, click **Execute ADCP Test** to verify the ADCP is functioning properly.

> See Chapter 3 Tutorials and Chapter 9 QA/QC in the WinRiver II User's Guide.

Compass Calibration

Next, the Hydrologist performs a compass calibration. After ensuring that the system is well away from sources of magnetic interference, the Hydrologist starts the compass calibration within the application and then either: slowly rotates the RiverRay as suggested by the application (tethered boat/SxS) or slowly drives the boat in circle (manned boat). During the calibration process, feedback is provided to the user as to the quality of the collected magnetic field data at each partition of the 360° of rotation.

On the **Acquire** menu, click **Execute Compass Calibration**. When the calibration starts, select **No** for the **Use Pitch/Roll** selection. In normal river discharge circumstances, using the "No" Pitch and Roll selection is sufficient.
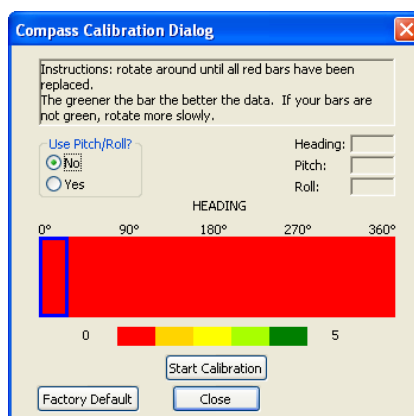

The no Pitch/Roll calibration (also called a single-tilt calibration) requires two rotations while the ADCP is on a flat, level surface.

Moving Bed Test/Set the Clock

At this point, the RiverRay should be tested and the compass calibration completed; once those steps are complete, it is ready to start the moving bed test. The RiverRay is placed in the water, and the Hydrologist enters the command to start it pinging using the **Acquire** menu and click **Start Pinging** or use the shortcut key **F4**. If this is the first measurement taken, *WinRiver II* will prompt for the clock to be set. Click the **Set Clock** button.

On the **Acquire** menu click **Select Moving Bed Test**. Select **Stationary** or **Loop Test** and click the **Start** button.
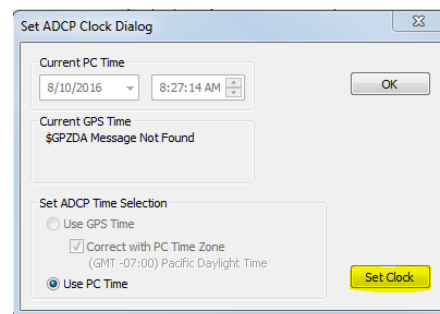
> ⚠ Only clicking the **OK** button will **NOT** set the clock. The user **MUST** click the **Set Clock** button.

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> If the RiverRay was left in the hot sun, its temperature can quickly rise to 35° C before use. When initially placed in the water, the thermal mass of the RiverRay housing near the temperature sensor initially affects the temperature measurement. Within five minutes it reaches equilibrium and the temperature is accurate within ± 1°C. If the temperature sensor is not allowed to sufficiently equilibrate within the body of water to be measured, it can impact Speed Of Sound, velocity, and discharge-measurement accuracy.

Tethered boat – The RiverRay is moved to the center of the river, and the stationary moving bed test is started. After five minutes, the moving bed test is stopped and the application displays the apparent moving bed velocity.

Manned boat – The Hydrologist begins a moving bed loop-test with the boat starting near the river bank. The boat is maneuvered across to the opposite bank and back again. The user stops the test, and the loop test results are displayed.

> Either type of moving bed test (stationary or loop) can be performed with either deployment method (tethered boat or manned boat).

Quick Review

✔ Run the Measurement Wizard	⊕ Read Chapter 7 in the WinRiver II Users Guide. ⊕ Set transducer depth and magnetic variation.
✔ Run the Built-in tests, compass calibration, and moving bed tests ✔ Set the clock	⊕ Read Chapter 9 in the WinRiver II Users Guide. ⊕ Click the **Set Clock** button.

Locating the Start & Stop Positions

LOCATING THE START AND STOP POSITIONS INCLUDES THE FOLLOWING STEPS:
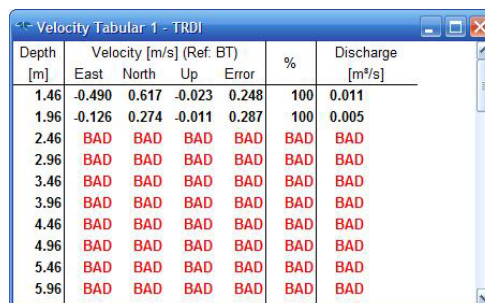
✔ Locating the Start and Stop Positions

Locating the Start and Stop Positions

While the RiverRay is pinging, the Hydrologist positions the boat until the application shows that the RiverRay is reliably collecting at least two bins of data and marks the position on the tagline for future reference. Measure the distance to the shore from the RiverRay. The RiverRay is positioned to the opposite bank where two bins of data are reliably collected. Again, the tagline is marked and the distance to the shore from the RiverRay is measured.

Depth	Velocity [m/s] (Ref: BT)				%	Discharge
[m]	East	North	Up	Error		[m³/s]
1.46	-0.490	0.617	-0.023	0.248	100	0.011
1.96	-0.126	0.274	-0.011	0.287	100	0.005
2.46	BAD	BAD	BAD	BAD	BAD	BAD
2.96	BAD	BAD	BAD	BAD	BAD	BAD
3.46	BAD	BAD	BAD	BAD	BAD	BAD
3.96	BAD	BAD	BAD	BAD	BAD	BAD
4.46	BAD	BAD	BAD	BAD	BAD	BAD
4.96	BAD	BAD	BAD	BAD	BAD	BAD
5.46	BAD	BAD	BAD	BAD	BAD	BAD
5.96	BAD	BAD	BAD	BAD	BAD	BAD

See Chapter 3 Tutorials and Chapter 10 Acquiring Discharge Data in the WinRiver II User's Guide.

Quick Review

✔	📖
✔ Locate the Start and Stop Positions	⊕ Read Chapter 3 and Chapter 10 in the WinRiver II Users Guide.
	⊕ Start/Stop distances from the center of the transducer to the shore should be measured as accurately as possible - at least to the nearest deci-meter.

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Discharge Measurements

Before starting a discharge measurement with a RiverRay ADCP using *WinRiver II*, the Hydrologist has:

1. Prepared the RiverRay, Boat or boat, and any external sensors being used
2. Configured the computer, communications link(s), and *WinRiver II* software for data collection using the RiverRay and any external sensors
3. Created a measurement file for the site
4. Ran the RiverRay Built-In tests
5. Performed the compass calibration procedure
6. Performed a moving bed test

The Hydrologist is now ready to start making the measurement.
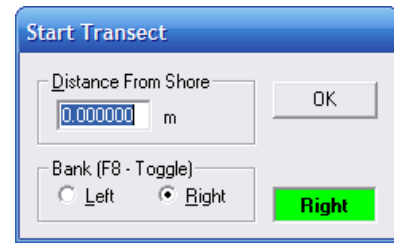
Discharge Measurement

A proper moving boat discharge measurement consists of multiple transects – passes across the measurement location from one bank to the other, collecting data continuously as they cross. For each transect, the Hydrologist must maneuver the RiverRay to the marked position at one bank of the measurement location (see Locating the Start and Stop Positions) and hold that position while they measure the distance to the shore from the RiverRay. Then, start a measurement transect and enter the starting edge bank and distance into the *WinRiver II* software. After collecting the required number of edge ensembles, the Hydrologist maneuvers the RiverRay towards the opposite bank of the measurement location in a smooth and steady manner, collecting data continuously as they travel across the river, and monitoring for data loss and quality issues. When the Hydrologist reaches the marked position at the other bank of the measurement location they hold that position while they collect the required number of edge ensembles, measure the distance to the bank, end the transect, and enter the ending edge distance in the *WinRiver II* software. After completing each transect, the Hydrologist performs a cursory review of the results and prepares to start the next transect.

The best practice for a moving boat discharge measurement is to collect discharge transects in reciprocal pairs (one transect in each direction across the measurement location) with some minimum number of total transects and/or minimum cumulative total duration for all transects. For locations with steady-state flow conditions, at least four transect that agree with each other within 5% of the mean of all the samples, and additional transects and/or cumulative transect duration may be required if that criteria is not met. The Hydrologist must make sure that the maximum permissible relative residual (MPRR) is met before leaving the site. A minimum of two good water profile bins above the sidelobe cutoff are desired for all ensembles in a transect to enable extrapolation of flow in the unmeasured top and bottom regions of the profile.

Once at least four transect that agree with each other within 5% of the mean of all the samples have been collected, the Hydrologist/team will perform a QA/QC review of the data. Primary indicators of high RiverRay data quality include a minimum loss of Bottom Track depth and velocity data, minimum loss of ensemble and individual bin water profile data, maximization of the measured Q as a percent of total Q, and consistency of the water velocity profile data between bins (vertically) and ensembles (horizontally) across the transect.

Step by Step Data Collection

1. Open or create a measurement file.

2. Press **F4** to start pinging.

3. At the start/stop position, press **F5** to start the transect.

4. Enter the starting distance from the shore.

5. Select Left or Right bank.

6. Wait for 10 shore ensembles.

7. Move across the river.

8. At the stop/start position, wait for 10 shore ensembles.

9. Press **F5** to end the transect.
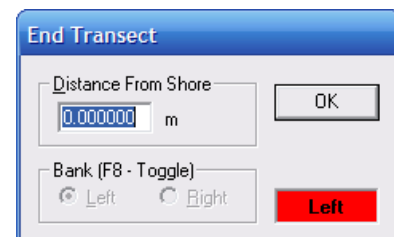
10. Enter the ending distance from the shore.
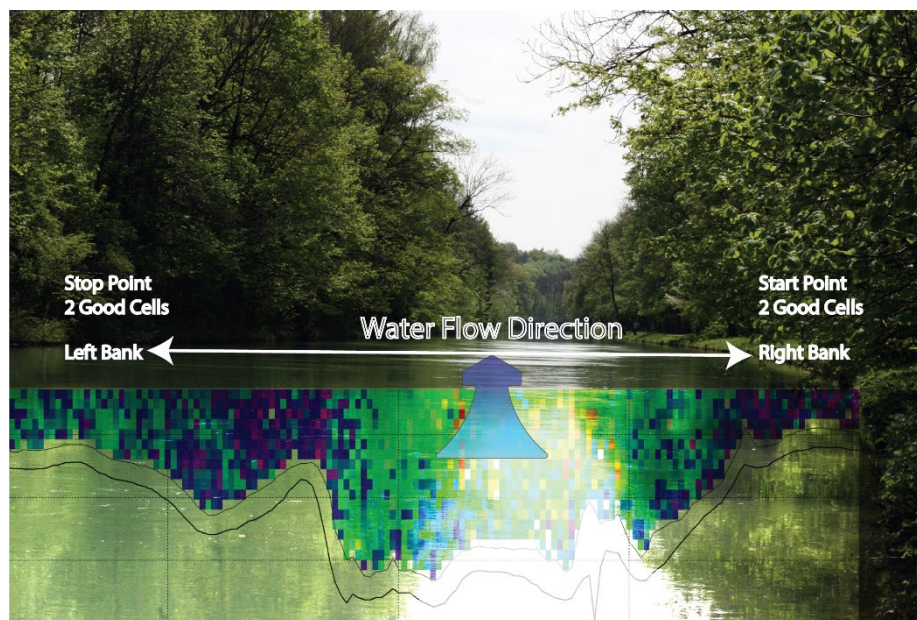
11. Repeat steps 3 through 10 to collect at least four transect that agree with each other within 5% of the mean of all the samples. The ADCP operator must make sure that the maximum permissible relative residual (MPRR) is met before leaving the site.

> See Dynamic Residual Analysis, Chapter 6 in the WinRiver II User's Guide.

Figure 1.   **Overview of Data Collection**

Data Collections Tips

- Locate the point where a solid two-depth cell measurement can be measured on both banks. Stake or otherwise mark these locations. They represent the starting and stopping points for the transects.

- Accurately measure and enter the **Distance from Shore** when prompted.

- Minimize the ADCP movement while Shore Ensembles are recorded.

- When departing from the edge, slowly accelerate the boat away from the edge and when approaching the other edge slowly reduce the speed such that the boat decelerates and does not overshoot the edge. The goal is to go from edge to edge and not overshoot at either edge. Doing so will allow you to obtain the most accurate measurements, in particular the area measurements.

- Move the ADCP at a slow steady pace in the water during transects.

- Collect a minimum of four transects that agree with each other to within 5% of the mean of all the samples. The ADCP operator must make sure that the maximum permissible relative residual (MPRR) is met before leaving the site (see Dynamic Residual Analysis, Chapter 6 in the WinRiver II User's Guide).

Quick Review

✔ Collect at least four transect that agree with each other within 5% of the mean of all the samples.	↻ Read Chapter 3 and Chapter 10 in the WinRiver II Users Guide.
✔ Verify the data before leaving the site.	↻ See Dynamic Residual Analysis, Chapter 6 in the WinRiver II User's Guide.

Glossary of Common Terms

Actors:

- Field hydrologist/Technician
- Data Analyst Expert (DAE)

Data Collection Terminology:

- Left/Right Bank – The Left bank is defined as the bank that would be on your left side if you were looking downstream.
- Transect – Data collection across the width of the river either from the Left bank to the Right bank or vice versa. (Sometimes referred to as a "Pass" across the river)
- Measurement – A collection (even number) of four or more Transects made of up of an equal number of Transects from Left to Right as Right to Left.
- Measured Discharge – The average of the discharges from the four (or more) transects.

Site/Measurement Conditions:

- Moving Bed/Moving Bottom – Movement downstream (typically) of near bed sediment. Moving Bed conditions will bias bottom-track velocities, which assume the streambed is stationary.
- Directional bias – This occurs when the discharges measured for transects from the left bank to the right bank are consistently either greater than or less than discharges measured for transects made from the right bank to the left bank.

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Conclusion

Congratulations! You have completed the RiverRay Deployment Guide. Read the following manuals for more detailed information.

RiverRay ADCP Guide

This manual contains all the details of RiverPro and RioPro maintenance, testing, trouble-shooting, commands, and data format description.

WinRiver II Software User's Guide

WinRiver II is TRDI's river and coastal data acquisition software package, where the primary use is for discharge calculation. Although this is its primary function, it can be used for general coastal survey applications.

WinRiver II Bluetooth Communications Setup Card

Quick reference card that shows instruction on using the SD1000U USB Bluetooth device.

WinRiver II Serial Communications Setup Card

Quick reference card that shows snap shots of the serial communications screens during setup.

SxSPro Software User's Guide

SxS Pro is a stationary ADCP discharge data collection and processing program for Teledyne RD Instrument's (TRDI) Rio Grande, StreamPro, RiverRay, and RiverPro/RioPro ADCP models. This program creates a measurement file, sends commands to the ADCP, lets the user collect data, visually displays the data, post-processes the data, and generates reports.

SxS Pro needs a Registration Code to enable data collection; however, data playback does not require a code. Please refer to the SxS Pro Quick Start Guide, Registration section for further details. Contact rdi.sales@teledyne.com to purchase an SxSPro license.

Q-View Software User's Guide

Q-View is Quality Assurance and Quality Control software for Water Resources discharge measurements using TRDI ADCP instrumentation. Q-View provides users with real-time feedback during ADCP data collection, or it can be implemented back in the lab during data review and analysis.

PDDecoder Library in C language

The Teledyne Marine PDDecoder library is an open-source library written in C language to decode the PD0 data formats that are commonly output by Teledyne Marine/Teledyne RD Instruments ADCPs.

Available for download from the Teledyne Marine portal: https://tm-portal.force.com/TMsoftwareportal

NOTES

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