INSTRUCTION MANUAL

CRS451V/CRS456V Submersible Water-Level Recording Sensor

Revision: 6/16

Limited Warranty

"Products manufactured by CSI are warranted by CSI to be free from defects in materials and workmanship under normal use and service for twelve months from the date of shipment unless otherwise specified in the corresponding product manual. (Product manuals are available for review online at *www.campbellsci.com*.) Products not manufactured by CSI, but that are resold by CSI, are warranted only to the limits extended by the original manufacturer. Batteries, fine-wire thermocouples, desiccant, and other consumables have no warranty. CSI's obligation under this warranty is limited to repairing or replacing (at CSI's option) defective Products, which shall be the sole and exclusive remedy under this warranty. The Customer assumes all costs of removing, reinstalling, and shipping defective Products to CSI. CSI will return such Products by surface carrier prepaid within the continental United States of America. To all other locations, CSI will return such Products best way CIP (port of entry) per Incoterms ® 2010. This warranty shall not apply to any Products which have been subjected to modification, misuse, neglect, improper service, accidents of nature, or shipping damage. This warranty is in lieu of all other warranties, expressed or implied. The warranty for installation services performed by CSI such as programming to customer specifications, electrical connections to Products manufactured by CSI, and Product specific training, is part of CSI's product warranty. **CSI EXPRESSLY DISCLAIMS AND EXCLUDES ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE**. **CSI hereby disclaims, to the fullest extent allowed by applicable law, any and all warranties and conditions with respect to the Products, whether express, implied or statutory, other than those expressly provided herein.**"

Assistance

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To obtain a Returned Materials Authorization (RMA), contact CAMPBELL SCIENTIFIC, INC., phone (435) 227-9000. Please write the issued RMA number clearly on the outside of the shipping container. Campbell Scientific's shipping address is:

CAMPBELL SCIENTIFIC, INC.
RMA#_____
815 West 1800 North
Logan, Utah 84321-1784

For all returns, the customer must fill out a "Statement of Product Cleanliness and Decontamination" form and comply with the requirements specified in it. The form is available from our website at *www.campbellsci.com/repair*. A completed form must be either emailed to *repair@campbellsci.com* or faxed to (435) 227-9106. Campbell Scientific is unable to process any returns until we receive this form. If the form is not received within three days of product receipt or is incomplete, the product will be returned to the customer at the customer's expense. Campbell Scientific reserves the right to refuse service on products that were exposed to contaminants that may cause health or safety concerns for our employees.

Safety

DANGER — MANY HAZARDS ARE ASSOCIATED WITH INSTALLING, USING, MAINTAINING, AND WORKING ON OR AROUND **TRIPODS, TOWERS, AND ANY ATTACHMENTS TO TRIPODS AND TOWERS SUCH AS SENSORS, CROSSARMS, ENCLOSURES, ANTENNAS, ETC**. FAILURE TO PROPERLY AND COMPLETELY ASSEMBLE, INSTALL, OPERATE, USE, AND MAINTAIN TRIPODS, TOWERS, AND ATTACHMENTS, AND FAILURE TO HEED WARNINGS, INCREASES THE RISK OF DEATH, ACCIDENT, SERIOUS INJURY, PROPERTY DAMAGE, AND PRODUCT FAILURE. TAKE ALL REASONABLE PRECAUTIONS TO AVOID THESE HAZARDS. CHECK WITH YOUR ORGANIZATION'S SAFETY COORDINATOR (OR POLICY) FOR PROCEDURES AND REQUIRED PROTECTIVE EQUIPMENT PRIOR TO PERFORMING ANY WORK.

Use tripods, towers, and attachments to tripods and towers only for purposes for which they are designed. Do not exceed design limits. Be familiar and comply with all instructions provided in product manuals. Manuals are available at www.campbellsci.com or by telephoning (435) 227-9000 (USA). You are responsible for conformance with governing codes and regulations, including safety regulations, and the integrity and location of structures or land to which towers, tripods, and any attachments are attached. Installation sites should be evaluated and approved by a qualified engineer. If questions or concerns arise regarding installation, use, or maintenance of tripods, towers, attachments, or electrical connections, consult with a licensed and qualified engineer or electrician.

General

- Prior to performing site or installation work, obtain required approvals and permits. Comply with all governing structure-height regulations, such as those of the FAA in the USA.
- Use only qualified personnel for installation, use, and maintenance of tripods and towers, and any attachments to tripods and towers. The use of licensed and qualified contractors is highly recommended.
- Read all applicable instructions carefully and understand procedures thoroughly before beginning work.
- Wear a **hardhat** and **eye protection**, and take **other appropriate safety precautions** while working on or around tripods and towers.
- **Do not climb** tripods or towers at any time, and prohibit climbing by other persons. Take reasonable precautions to secure tripod and tower sites from trespassers.
- Use only manufacturer recommended parts, materials, and tools.

Utility and Electrical

- **You can be killed** or sustain serious bodily injury if the tripod, tower, or attachments you are installing, constructing, using, or maintaining, or a tool, stake, or anchor, come in **contact with overhead or underground utility lines**.
- Maintain a distance of at least one-and-one-half times structure height, 20 feet, or the distance required by applicable law, **whichever is greater**, between overhead utility lines and the structure (tripod, tower, attachments, or tools).
- Prior to performing site or installation work, inform all utility companies and have all underground utilities marked.
- Comply with all electrical codes. Electrical equipment and related grounding devices should be installed by a licensed and qualified electrician.

Elevated Work and Weather

- Exercise extreme caution when performing elevated work.
- Use appropriate equipment and safety practices.
- During installation and maintenance, keep tower and tripod sites clear of un-trained or non-essential personnel. Take precautions to prevent elevated tools and objects from dropping.
- Do not perform any work in inclement weather, including wind, rain, snow, lightning, etc.

Maintenance

- Periodically (at least yearly) check for wear and damage, including corrosion, stress cracks, frayed cables, loose cable clamps, cable tightness, etc. and take necessary corrective actions.
- Periodically (at least yearly) check electrical ground connections.

WHILE EVERY ATTEMPT IS MADE TO EMBODY THE HIGHEST DEGREE OF SAFETY IN ALL CAMPBELL SCIENTIFIC PRODUCTS, THE CUSTOMER ASSUMES ALL RISK FROM ANY INJURY RESULTING FROM IMPROPER INSTALLATION, USE, OR MAINTENANCE OF TRIPODS, TOWERS, OR ATTACHMENTS TO TRIPODS AND TOWERS SUCH AS SENSORS, CROSSARMS, ENCLOSURES, ANTENNAS, ETC.

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CRS451V/CRS456V Submersible Water-Level Recording Sensor

1. Overview

The CRS451V/CRS456V consists of a water-level and water-temperature sensor that has its own time clock and memory to store the collected data, in a compact stainless steel or titanium case. This frees users to place the sensor in remote sites and let it collect data for long periods of time. The CRS451V/CRS456V supports standard time-based scanning and recording along with event-based recording based on water level change (Delta) or logarithmic time sequence for pump and slug tests. *HydroSci* software is included and supports test setup, data retrieval, and data display. Additionally, this sensor can be attached to a telemetry device (such as a cell phone modem) for remote data collection using *LoggerNet*.

The CRS451V has a 316L stainless steel case that can be submerged in most canals, wells, ponds, lakes, and streams. The CRS456V has a rugged titanium case that allows it to be used in saltwater or other harsh environments.

Before using the CRS451V/CRS456V, please study:

- Section 2, *Precautions* *(p. 1)*
- Section 3, *Initial Inspection and Handling Guidelines* *(p. 2)*
- Section 6, *Installation* *(p. 4)*

2. Precautions

- READ AND UNDERSTAND the *Safety* section at the front of this manual.
- The CRS451V/CRS456V will be damaged if deployed in frozen liquid (see Section 6.2, *Avoiding Freezing Conditions* *(p. 5)*, for more information).
- One of the most common modes of sensor failure is caused by the introduction of water into the vent tube. To prevent water from accumulating in the vent tube, it is necessary to terminate the cable in a dry environment. It is critical to exchange the desiccant when needed to keep the vent tube dry.
- Although the CRS451V/CRS456V is a rugged and reliable device, it is also a highly precise scientific instrument and should be handled as such.
- Dropping the instrument or allowing it to “free fall” down a well may damage the transducer.
- Confirm the compatibility of the instrument to non-water environments before installation.
- The CRS451V should not be used in harsh water applications, including salt water. Instead use the CRS456V, but confirm the compatibility of the instrument with the target environment.

3. Initial Inspection and Handling Guidelines

- Upon receipt of the CRS451V/CRS456V, inspect the packaging for any signs of shipping damage. File damage claims with the shipping company.
- Immediately check package contents against the shipping documentation (see Section 3.1, *Ships With (p. 2)*). Contact Campbell Scientific with any discrepancies.
- The model number and pressure range are etched on the housing. Check this information against the shipping documentation to ensure that the expected product was received.

3.1 Ships With

HydroSci configuration software on ResourceDVD

4. Overview

The CRS451V/CRS456V, *Submersible Water-Level Recording Sensor*, provides reliable, accurate pressure/level measurements that are fully temperature-compensated. The vented cable allows the sensor to remain in place when data is being retrieved; precludes the need for a separate barometric sensor to compensate for changes in atmospheric pressure; and provides you with the ability to attach the sensor directly to a cell phone or radio for remote data collection using *LoggerNet*.

The 24 bit A/D has simultaneous 50/60 Hz rejection and automatic calibration for each measurement. A number of additional advanced measurement techniques are employed to harness the best possible performance available from today's state-of-the-art pressure sensor technology. The CRS451V/CRS456V reverts to a low-power sleep state between measurements. A series of measurements are performed yielding temperature and pressure values. This measurement cycle can be as fast as 1 second.

The design features a piezoresistive sensor housed in a 316L stainless steel (CRS451V) or titanium (CRS456V) package to enhance reliability. The rugged construction makes the CRS451V/CRS456V suitable for water level measurement in irrigation applications, water wells, lakes, streams, and tanks. The titanium package of the CRS456V makes it ideal for salt water or other harsh environments.

The CRS451V/CRS456V has three nose cone options: Standard Nose (NS), Weighted Nose (WN), and NPT Fitting (NN). The weighted nose cone makes the transducer easier to submerge to depth. The NPT option allows the sensor to be mounted to a 1/4-inch fitting. The nose cones can be exchanged at a later time.

Communicating with the CRS451V/CRS456V can be done using Campbell Scientific's *HydroSci*, *LoggerNet*, *PC400*, or *PC200W* software. When attached directly to a radio or cell modem, data can be collected remotely using *LoggerNet* or *PC400*. Configurable settings can be changed using Campbell Scientific's *HydroSci* software utility or *Device Configuration Utility*.

5. Specifications

Features:

- Field-replaceable batteries
- Campbell Scientific quality
- No additional datalogger, enclosure, and power supply required
- Can be wired directly to a radio or cell phone for remote data collection (in which case an enclosure and separate power supply are required)
- Free customer-friendly software for communication, configuration, data collection
- Large data storage capacity
- High accuracy
- Long battery life

Measurement Time: < 1 s typical

Output: RS-232

Internal Data Collection Memory: 4 MB

***HydroSci* Supported Operating Systems:** Windows XP, Windows Vista, Windows 7, Windows 8

Logging/Scanning Modes: Standard, Delta, Logarithmic

Power Requirements: Internal user-replaceable lithium battery

Battery Life: 5+ years when logging interval is once per hour

Power Consumption
Quiescent Current: < 80 µA
Measurement/ Communication Current: 4 mA for 1 s measurement

Measurement Ranges[1]:

Pressure (psig)	Pressure (kPa)	Meters of fresh water	Feet of fresh water
0 to 7.25	0 to 50	0 to 5.1	0 to 16.7
0 to 14.5	0 to 100	0 to 10.2	0 to 33.4
0 to 29	0 to 200	0 to 20.4	0 to 67
0 to 72.5	0 to 500	0 to 50.9	0 to 167
0 to 145	0 to 1000	0 to 102	0 to 334.5

Accuracy
- **Pressure Reading[2]:** 0.1% full-scale range TEB[3]
- **Temperature:** ±0.2 °C

Resolution: 0.0035% full-scale range

Overpressure: 2x pressure range

Dry Storage Temperature: –30 to 80 °C

Operating Temperature: 0 to 60 °C

CAUTION Freezing conditions may damage the CRS451V/CRS456V (see Section 6.2, *Avoiding Freezing Conditions* (p. 5), for more information).

Body Material
- **CRS451V:** 316L Stainless Steel
- **CRS456V:** Titanium

Element Material
- **CRS451V:** 316L Stainless Steel
- **CRS456V:** Hastelloy®

Nose Options
- **Standard:** Delrin®
- **Weighted**: Stainless Steel
- **NPT Nose:** 1/4 in NPT; Stainless Steel

Dimensions
- **Length:** 22.23 cm (8.75 in)
- **Diameter:** 2.22 cm (0.875 in)

Weight: 230 g (0.51 lb)

[1]The CRS451V is a gage sensor and should produce an output near 0 when not submerged. The CRS451V is calibrated at 9 pressures starting at 0.6 bar up to full scale referenced to 1 bar.

[2]The accuracy specification listed pertains to the level of accuracy that the CRS451V/CRS456V is able to measure pressure.

[3]Total Error Band (TEB) includes the combined errors due to nonlinearity, hysteresis, nonrepeatability, and thermal effects over the compensated temperature range, per ISA S51.1.

6. Installation

The CRS451V/CRS456V is designed for water level measurements. Typical applications include agricultural water level/flow, water wells, lakes, streams, and tanks. If the device is to be installed in a liquid other than water or in contaminated water, check the compatibility of the wetted material. The CRS456V should be used in harsh water applications, including salt water.

6.1 Appropriate Depth

The CRS451V/CRS456V must be installed below the water at a fixed depth. This depth should be chosen so that water pressure never exceeds the transducer's pressure range.

CAUTION The output reading will not be correct, and the transducer can be damaged if pressure is twice its pressure rating.

Pressure can be converted to feet of fresh water using the following simple equation:

1 psi = 2.31 feet of water

For example, the maximum depth with a pressure range of 0 to 7.25 psig is 16.748 feet of water.

6.2 Avoiding Freezing Conditions

Expansion of water due to freezing will irreparably damage the CRS451V/CRS456V. The CRS451V/CRS456V can be safely deployed in freezing conditions if the sensor is placed below the frost line. In a lake or channel of moving water, often the sensor can be placed deep enough to avoid freezing. In shallow conditions, where the water body is at risk of freezing solid, placing the sensor in a stilling well that extends below the frost line will protect the sensor from freezing water.

6.3 Dislodge Bubbles

While submersing the CRS451V/CRS456V, air bubbles may become trapped inside the nose cone, causing small, offset errors until the bubbles dissolve. Dislodge these bubbles by gently shaking the CRS451V/CRS456V while under water.

CAUTION Hitting the instrument against the well casing or other solid surface could damage the CRS451V/CRS456V.

CAUTION If the bubbles are not removed by rotation and shaking underwater (or bleeding out the air in a closed system), the CRS451V/CRS456V reading will drift lower by the distance of the gap as the air is slowly dissolved into the water over time.

6.4 Well Installation

Braided stainless steel cable (pn 29221-L) in tandem with cable grip (pn 25431) is used to lower the instrument to an appropriate depth and to suspend the CRS451V/CRS456V in a well. The cable grip can also be used without the cable for short lengths or if user wants to provide own cable.

With long drops, it may be necessary to use the weighted nose cone (option –WN).

For surface installations, the instrument's body can be strapped with tie wraps or tape. Campbell Scientific offers cable ties (pn 7364) to secure the cable. If installing in a well, fasten the cable to the well head.

6.5 Other Installations

The CRS451V/CRS456V can be installed in any position; however, when it leaves the factory, it is tested in the vertical position. There will be an offset error if not installed vertically; contact Campbell Scientific for more information. Strapping the transducer body with tie wraps or tape will not hurt it.

6.6 Battery Voltage Measurement

Internal Battery

The voltage of the lithium ion battery used in the CRS451V/CRS456V will abruptly decrease at the end of its useful life, which makes predicting remaining battery life difficult by measuring battery voltage alone. Therefore, the predicted remaining battery life displayed by *HydroSci* is the direct battery measurement adjusted for the total number of measurements since the battery was new. When a new battery is installed, the **Battery Status** function of *HydroSci* should be reset to accurately reflect the addition of this new battery. To reset **Battery Status**: establish a connection with the sensor through *HydroSci*, select **Monitor/View Status**.

External Batteries

The datalogger will consume power from the external power source and report its voltage, but in this case, the battery status indicator will typically underestimate the amount of battery power still available. The internal battery is only used when external power is interrupted or not sufficient. An external battery sized to meet long-term operational power requirements is required if the sensor is wired directly to a radio or cell modem for remote data collection.

6.7 Heyco Cable Grip

To protect your transducer during deployment, Campbell Scientific offers the 31648 Heyco cable grip (FIGURE 6-1) to clamp the transducer to the submerged end of a 1-inch PVC pipe (FIGURE 6-2). The PVC pipe will help protect the sensor and cable from debris and disturbances while also providing a more secure means of anchoring the sensor to minimize movement. The 31648 Heyco fitting is not meant to be watertight and water will likely fill the submerged pipe behind the fitting. A 1-inch female adapter socket with FPT threads is needed between the 31648 and 1-inch PVC pipe. This adapter socket is available at any store that sells PVC pipe.

FIGURE 6-1. 31648 Heyco Cable Grip

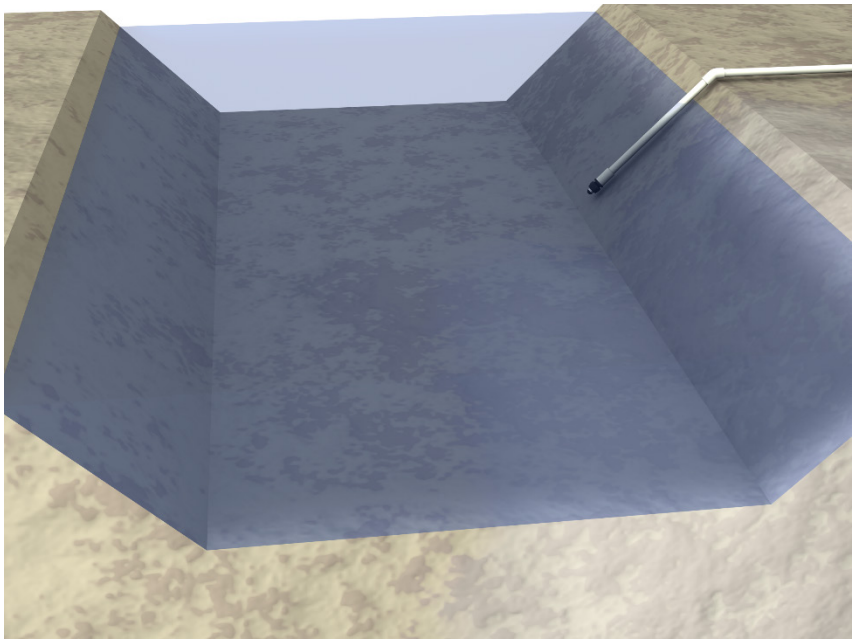


FIGURE 6-2. Transducer mounted in PVC pipe using the 31648 Heyco cable grip

7. Programming via *HydroSci* Software

Configure the CRS451V/CRS456V with the *HydroSci* software provided with the unit. A DVD containing *HydroSci* is shipped with the CRS451V/CRS456V.

Communicating with the CRS451V/CRS456V through a USB port requires Campbell Scientific's A200 Sensor to PC Interface (pn 25982). The A200 USB driver should be installed automatically when you plug the port into your computer, provided there is a working internet connection. If not, the driver can be installed from the Resource DVD or from *www.campbellsci.com/a200-support*. Communicating through a serial port requires a standard serial cable and a female DB9 terminal block, such as our pn 28841.

CAUTION If you are using a Windows XP operating system, please have the driver disc in the CD/DVD drive before plugging in the USB cord. A driver will need to be installed before the computer can connect with the sensor.

7.1 PC Connection Using the A200

The A200 or another device is required to connect the CRS451V/CRS456V to a PC. This allows sensor settings to be changed via *DevConfig*.

7.1.1 Driver Installation

If the A200 has not been previously plugged into your PC and your PC operating system is not Windows 7, the A200 driver needs to be loaded onto your PC.

NOTE Drivers should be loaded before plugging the A200 into the PC.

The A200 drivers can be downloaded, at no charge, from: *www.campbellsci.com/downloads*.

7.1.2 A200 Wiring

One end of the A200 has a terminal block while the other end has a type B female USB port. The terminal block provides 12V, G, TX, and RX terminals for connecting the sensor (see FIGURE 7-1 and TABLE 7-1). A data cable (pn 17648) ships with the A200. This cable has a USB type-A male connector that attaches to a PC's USB port, and a type B male connector that attaches to the A200's USB port.

FIGURE 7-1. A200 Sensor-to-PC Interface

TABLE 7-1. A200 Wiring		
Color	**Sensor Cable Label**	**A200 Terminal**
Red	12V	+12Vdc
Black	G	G
White	C	Tx
Blue	G	Rx
Yellow	G	G
Clear	Signal Ground	G

7.1.3 Powering the Sensor

The A200 provides power to the sensor when it is connected to a PC's USB port. An internal DC/DC converter boosts the 5 Vdc supply from the USB connection to a 12 Vdc output is required to power the sensor.

7.1.4 Determining which COM Port the A200 has been Assigned

When the A200 driver is loaded, the A200 is assigned a COM port number. This COM port number is needed when using *DevConfig* or a PC terminal software such as *HyperTerminal*.

Often, the assigned COM port will be the next port number that is free. However, if other devices have been installed in the past (some of which may no longer be plugged in), the A200 may be assigned a higher COM port number.

To check which COM port has been assigned to the A200, watch for the appearance of a new COM port in the list of COM ports offered in the software package (e.g., *LoggerNet*) before and after the installation, or look in the Windows Device Manager list under the ports section (access via the control panel).

7.2 Settings

Before connecting to the CRS451V/CRS456V, you can change the sensor name or the appearance of *HydroSci* screens by clicking on **Settings** at the upper right portion of the *HydroSci* screen.

Selecting **LoggerNet Communication Settings** will allow the user to change the PakBus address and baud rate at which the sensor communicates. If these settings are changed, be sure to make identical changes to the station settings in *LoggerNet* or future communications may fail.

7.3 Connect to the CRS451V/CRS456V

1. Select **CRS45X** from the left margin.
2. Select appropriate **COM Port**.
3. Click **Connect** button.

7.4 Configure CRS45XV for Measurements

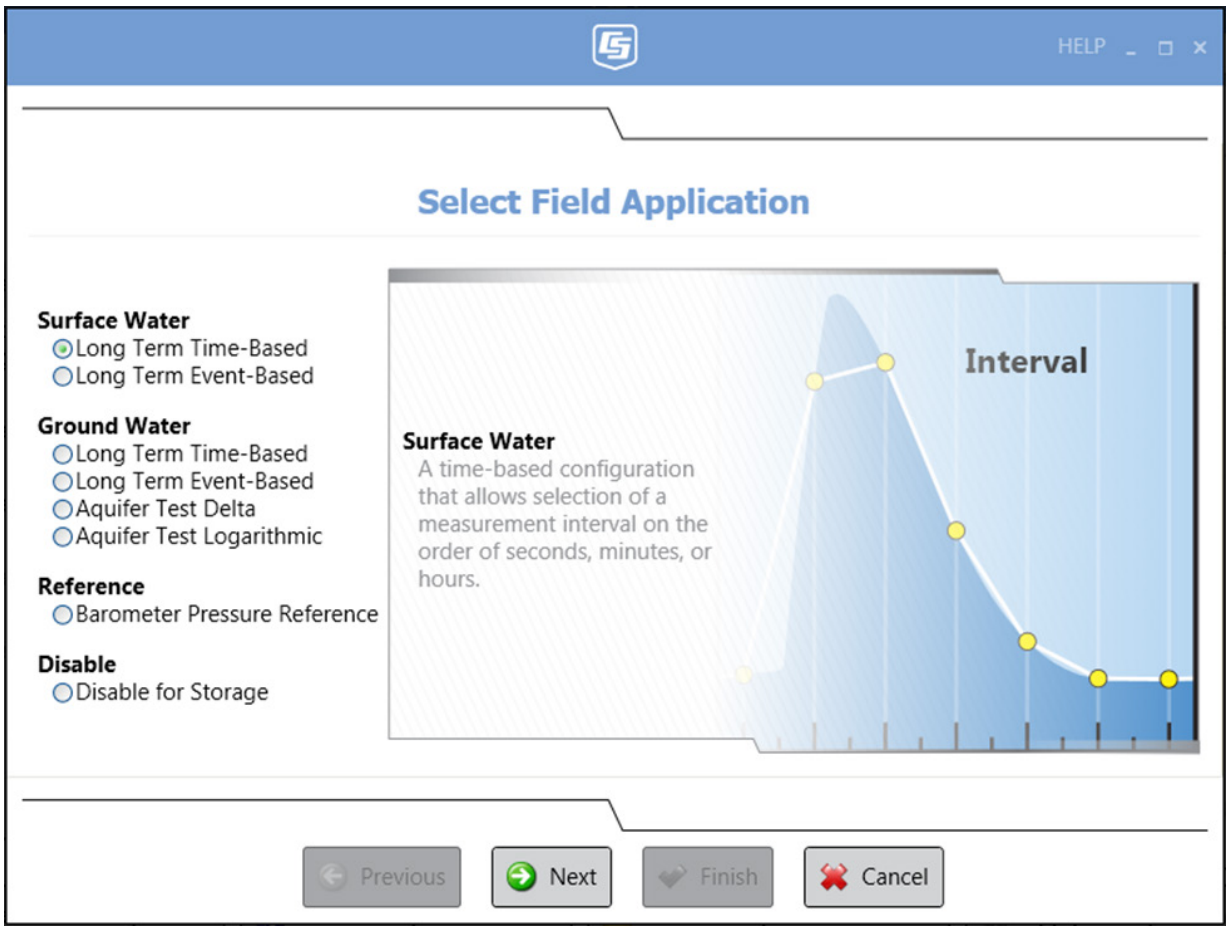
1. Click **Configuration**.

2. Select **Create New Configuration** button located at the lower left of the screen.

3. In the Select Field Application window, select the type of measurements you want to make.

   a) Do not select the Barometer Pressure Reference. This option is for other sensor models.

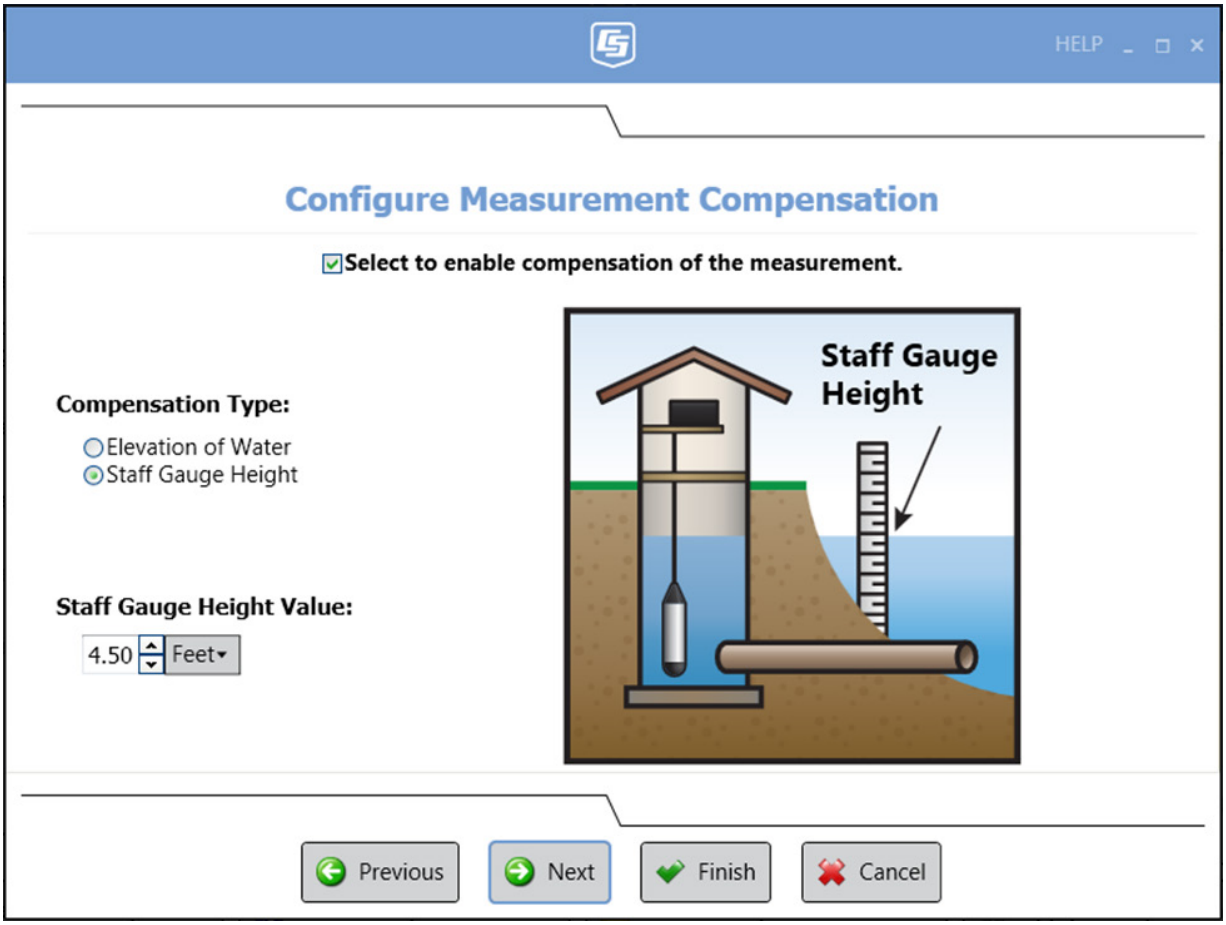
   b) Select Disable for Storage before storing the sensor. This pauses the program and preserves the battery when the sensor is not deployed and making measurements.



4. Add offset to relate water level measurements to a known datum or reference point. (Aquifer tests start at level 0.)

   a) This step is optional and not required.

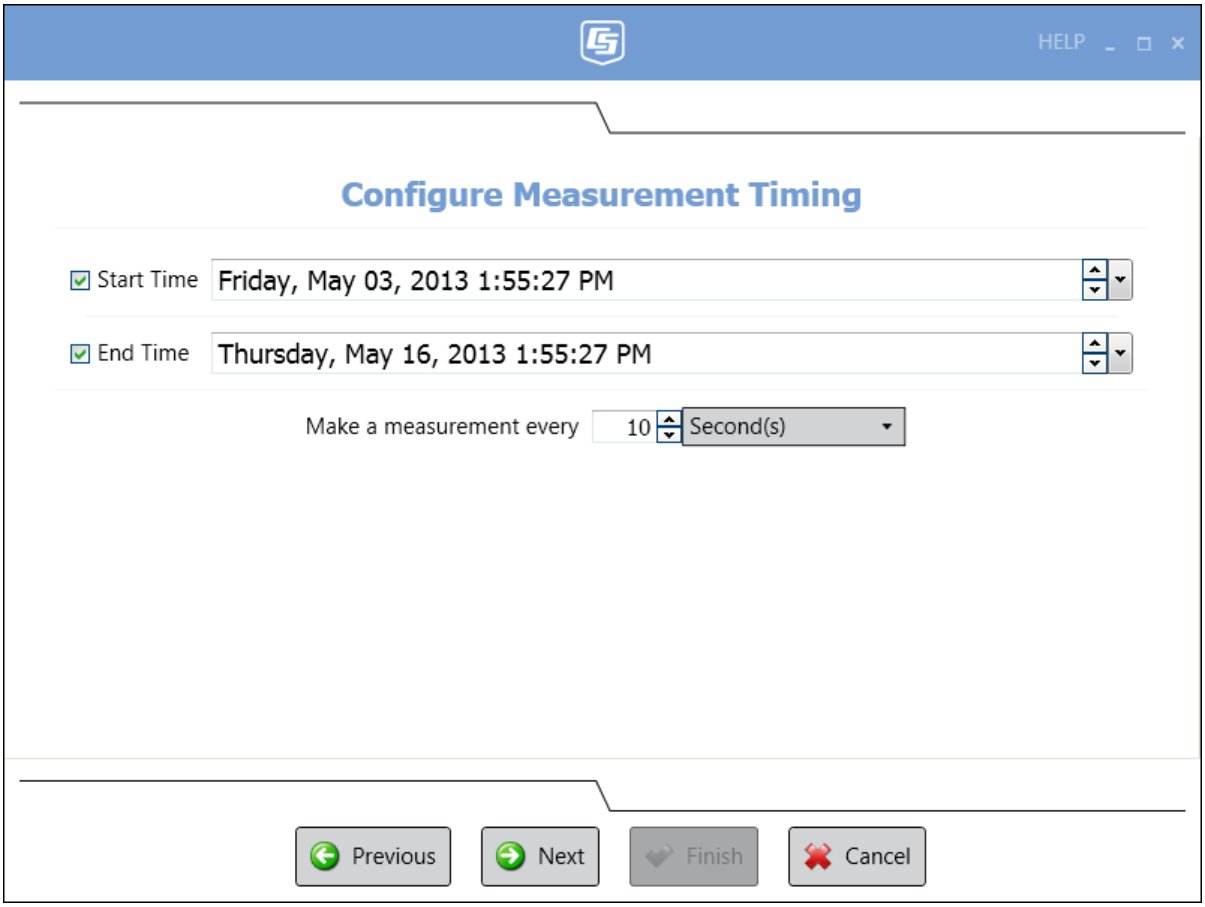
   b) This offset takes effect at the Start Time—which is set in a subsequent screen—so it is necessary that this sensor be in its permanent measurement position before the Start Time, otherwise the offset correction will be incorrect.



5. Select a **Start** and **Stop Time**.

   a) Select a time in the future when measurements should begin. Selecting a time in the past will force the sensor to begin making measurements immediately at the indicated frequency. If an offset calculation is needed, a Start Time must be selected far enough in the future that the sensor can be properly placed in its measurement position before measurements begin.

   b) If desired, select a time in future when measurements should cease.

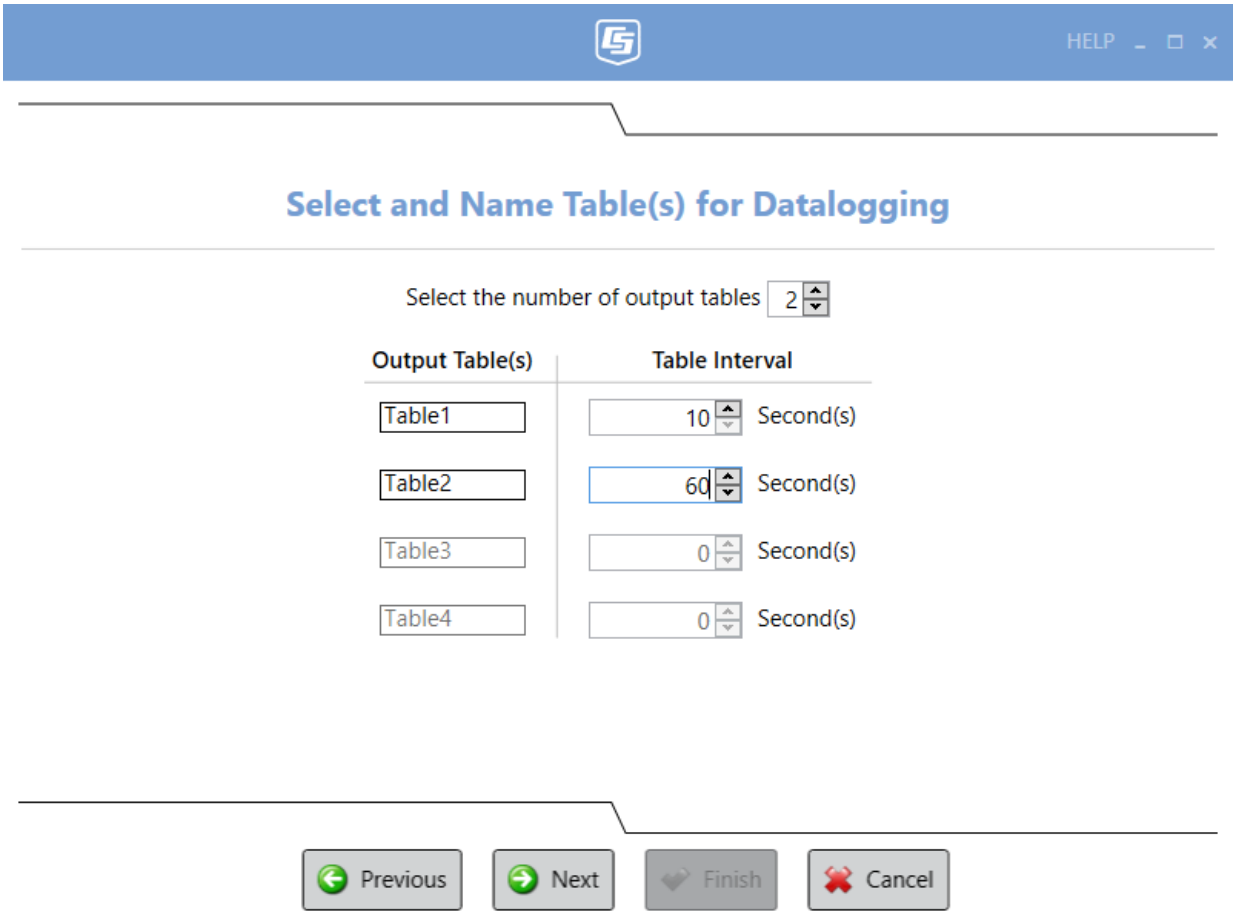


   c) Select the rate at which measurements will be made. This does not configure the sensor for data storage, only the rate at which measurements are made.

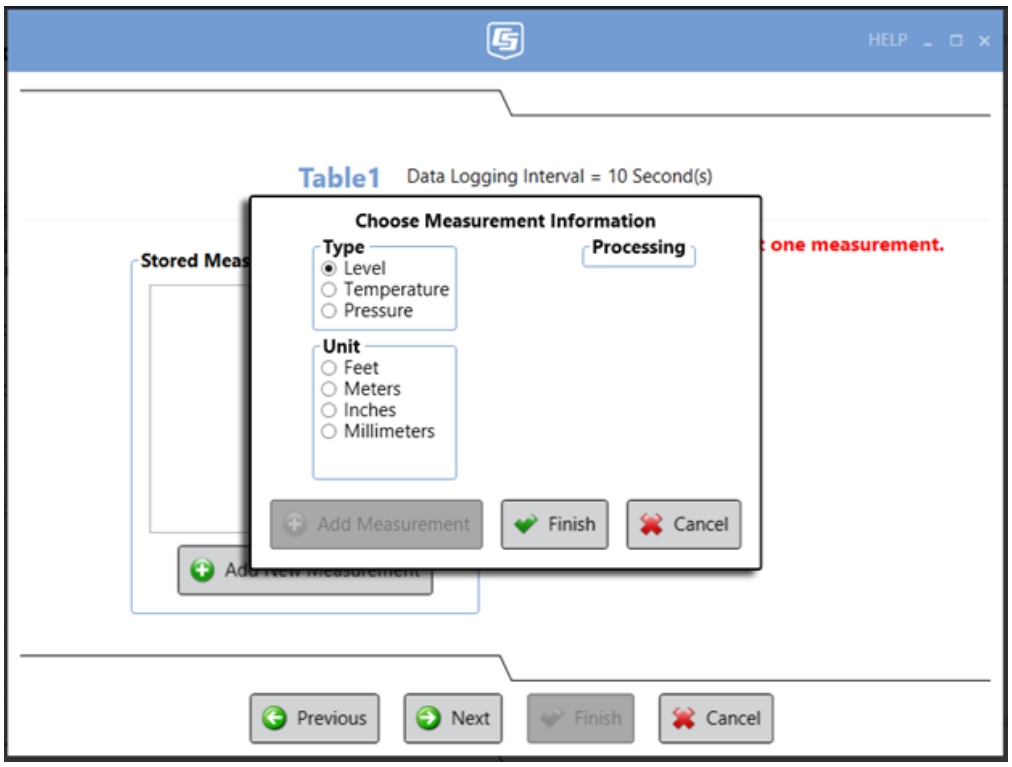
6. **Select and Name Tables for Datalogging**.

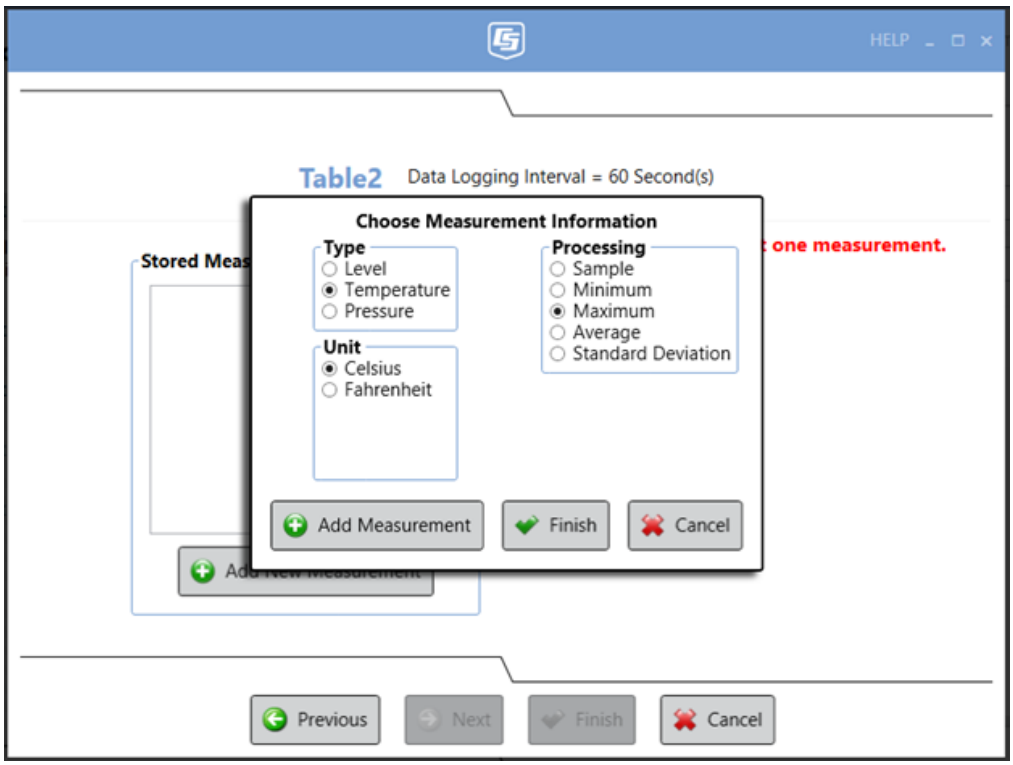
   a) Up to four different Tables can archive data at independent intervals with any combination of elements (samples, averages, maximum, etc.).

   b) Contents of the **Table** are selected in the next screen.



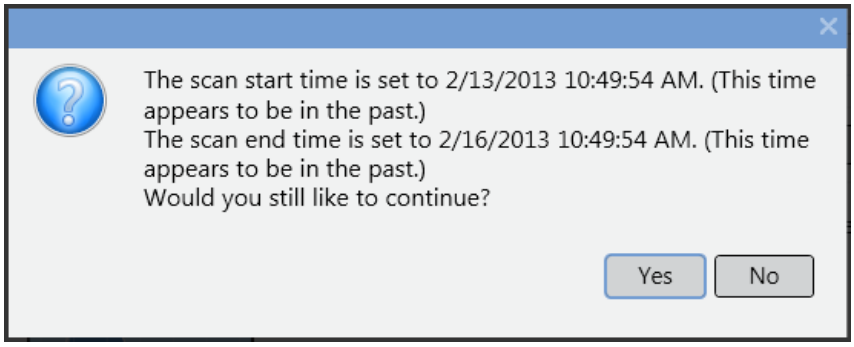
7. Select which data, in which format and unit of measurement, is to be included in each of the tables selected in the previous screen. The CRS451V/CRS456V is calibrated to pressure units in psi. TABLE B-1, *Conversion Factors* *(p. B-1)*, contains the conversion factors used to convert psi to depth of water.



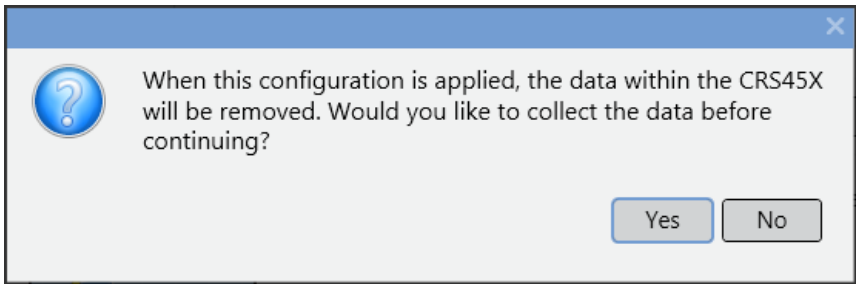


8. Once the **Tables** have been configured, the configuration process is complete and **Finish** can be selected.

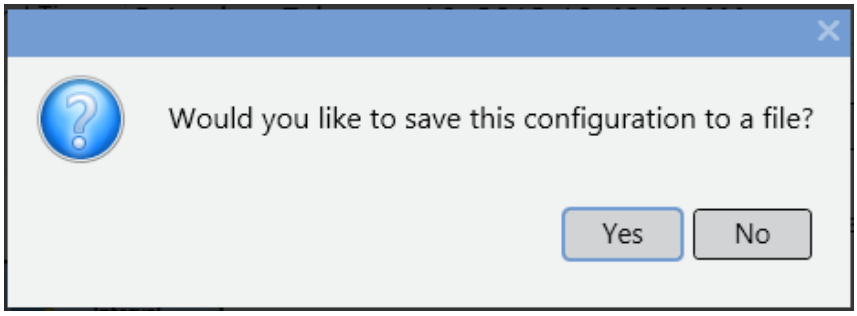
9. Once the configuration is complete, it must be copied to the CRS451V before it will take effect. Click on **Apply Configuration to CRS45X** to start this process.



Before sending the configuration file to the CRS451V/CRS456V, *HydroSci* will provide a warning if your start and/or stop time is earlier than the current time. If the **Start Time** is in the past, the CRS45X will immediately begin logging data but any offset you may have applied will not be effective. Also, if the **Stop Time** is in the past, no data will be logged.



Save data if you have not already done so. Archived data is purged from the CRS45X when a new configuration file is copied, so you will want to collect any data before sending the configuration file.



This option allows you to save the configuration file for future reference or for easy use in other similarly deployed sensors.

8. Maintenance

Campbell Scientific recommends that the CRS451V/CRS456V be factory recalibrated every 24 months. Before a CRS451V/CRS456V is sent to Campbell Scientific, the customer must get an RMA (returned material authorization) number and fill out the Declaration of Hazardous Material and Decontamination form.

Every visit:

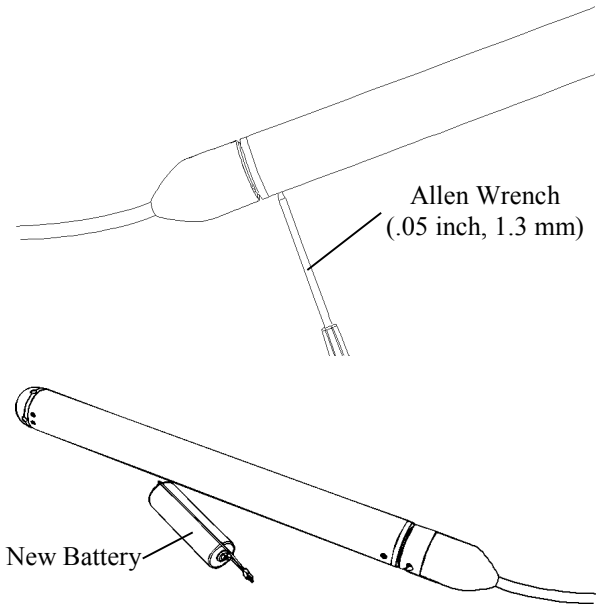
- Collect data.
- Visually inspect the physical condition of the sensor.
- Check battery condition by using *HydroSci* software to view the battery voltage (see Section 6.6, *Battery Voltage* *(p. 6)*). The battery replacement procedure is provided in Section 8.1, *Battery Replacement* *(p. 17)*.
- Check all readings; adjust offsets if necessary.
- Check recent data.

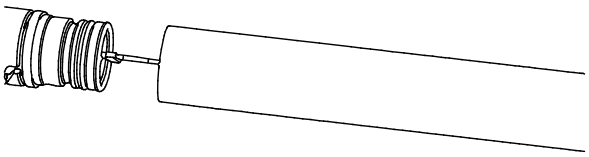
Every two to three years or on a rotating schedule:

- Send the CRS451V/CRS456V in for inspection and calibration.

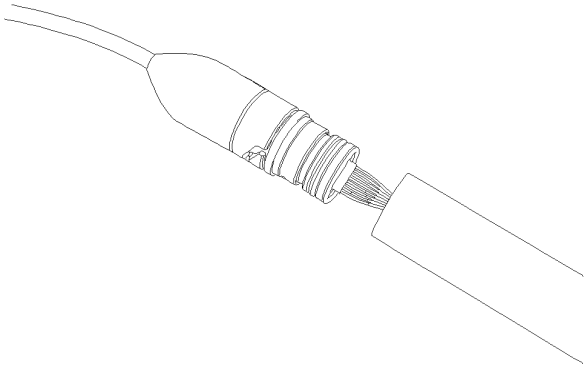
8.1 Battery Replacement

1. Remove the set screws on the cap end of the CRS451V/CRS456V.

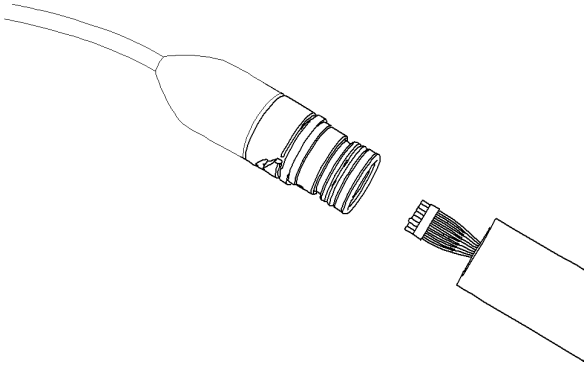




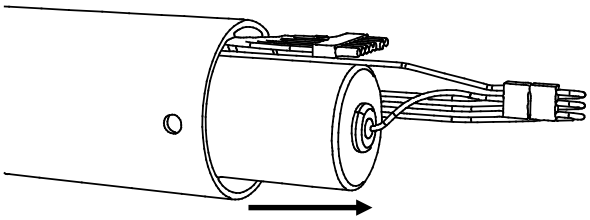
2. Gently pull the end out of the housing.



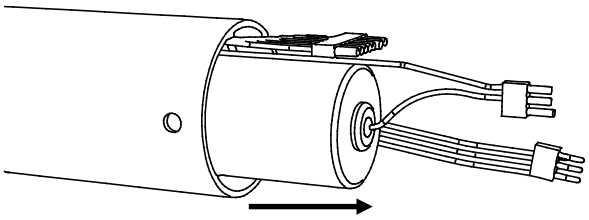
3. Unplug the connector.



4. Gently pull the battery out.

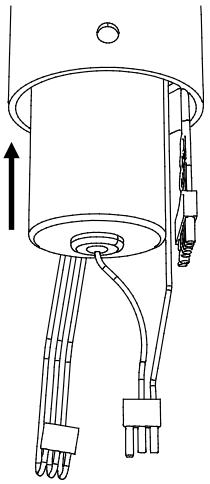


5. Disconnect the battery.

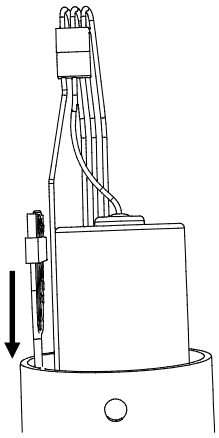


6. Remove the battery.

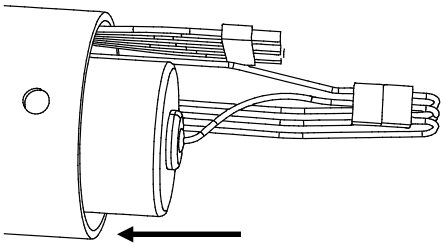
7. Slide in the new battery.



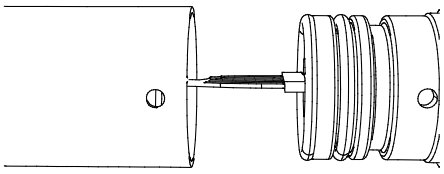
8. Plug in the new battery.



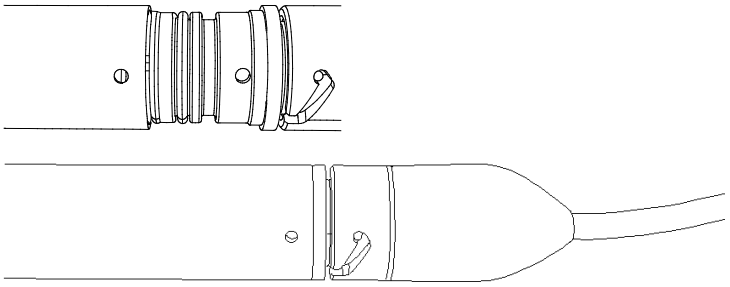
9. Slide the battery into the housing.



10. Reconnect the cable.

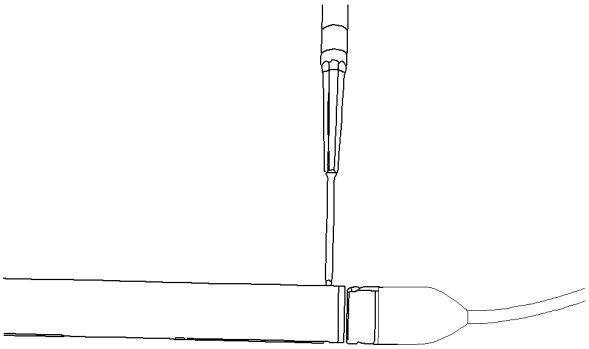


11. Gently slide the end piece with its O-rings into the housing.



NOTE Nicking the O-ring could result in a leak.

12. Line up the holes and insert the set screw. Do not over tighten the set screw.



9. Troubleshooting

The most common causes for erroneous pressure transducer data include:

- Low battery
- Moisture in vent tube
- Damaged CRS451V/CRS456V
  Water damage
  Damage to diaphragm due to excessive pressure or frozen water
  Damaged cable or restricted vent tube

Symptom: Unit will not respond when attempting USB communications.

- Replace battery.
- Correct COM port used for communication not selected in *HydroSci*.

Symptom: Cannot communicate with CRS451V/CRS456V through A200 when using *HydroSci*, *Device Configuration Utility*, *LoggerNet*, *PC400*, or *PC200W*.

- Verify that the sensor cable is attached correctly to the A200.
- Was the USB driver for the A200 installed?
- Have you selected the correct COM port assigned to the A200?
- Has your software been set for the correct baud rate?

Symptom: Cannot communicate with CRS451V/CRS456V via communication devices such as RF401A, RavenXTV modem, NL240, etc.

- Verify that sensor cable is attached correctly to the DB9 terminal adaptor:
  - White connects to Terminal # 3
  - Blue connects to Terminal # 2
- Verify that the sensor is being powered by 12 Vdc:
  - Red connects to +12Vdc
  - Black connects to Gnd
- Make sure the baud rates of both the telemetry device and the sensor are identical.
- Has the correct PakBus Address been used in *LoggerNet*?
- Try attaching a wire between the Gnd terminal (#10) on the DB9 terminal connector and Gnd terminal of power source.

Appendix A. Calibration Certificate

Each CRS451V/CRS456V has been calibrated to meet printed accuracy specification at multiple temperature and pressure ranges. If additional verification is required, a Calibration Certificate can be purchased for each CRS451V/CRS456V Water-Level Recording Sensor.

The Instrument Data Report provides a list of the pressure and temperature at which the sensor was tested.

Pressure [kPa] is the pressure applied (listed in kilopascals) to the sensor. **Temperature [°C]** is the temperature inside the test chamber at the time of testing. **Pressure After [kPa]** represents the resulting measurement output by the CRS451V/CRS456V at the given pressure and temperature. Finally, **Deviation After [%F.S.]** provides the difference between the actual pressure applied to the sensor and the pressure measurement output by the sensor. This value is listed as a percentage of the full scale range of the sensor.

When a CRS451V/CRS456V is returned to Campbell Scientific for calibration, the sensor will be returned with an Instrument Data Report. This report will include values in the **Pressure Before [kPa]** column. These values represent the measured pressure the sensor returns at the specified pressure and temperature, BEFORE calibration.

Appendix B. Conversion to Units of Measurement

TABLE B-1. Conversion Factors	
Unit of Measurement	**Factor of Conversion**
Feet	2.3066587369
Inches	27.679904843
Meters	0.1019716213
Millimeters	101.9716213

Appendix C. Using Device Configuration Utility with the CRS451V/CRS456V

The *Device Configuration Utility* (*DevConfig*) bundled with *LoggerNet*, *PC400*, and *PC200W* is typically used to configure Campbell Scientific hardware with specific settings. The CRS451V can likewise be accessed through *DevConfig* to change or view the following:

1. Communication Baud Rate
2. PakBus Address
3. Clock
4. Data
5. Upload Operating System (OS)

The CRS451V/CRS456V cannot be configured to make measurements and store data using *DevConfig*; this can only be done using *HydroSci*.

Appendix D. Connection to Radio or Cell Phone Modem for Remote Communication

One of the benefits of the imbedded datalogger is its ability to communicate via RS-232 protocol. Because of this, the sensor can be wired directly to a radio, cell phone modem, or other device as if it were a PakBus datalogger and data can then be viewed and retrieved remotely.

D.1 Configuring CRS451V/CRS456V

Sensor baud rate must match the baud rate of the communication device. Typical baud rates for telemetry products offered by Campbell Scientific are as follows:

TABLE D-1. Baud Rate

Communication Device	Baud Rate
RF401 Radio	9600 or 19200
RF401A Radio	9600 – 115200
RF450 Radio	9600 – 115200
Raven Cell Phone Modem	9600 – 115200
NL200 and NL240	9600 – 115200
MD485	9600 – 115200

CAUTION Long cable lengths may require slower baud rates.

D.2 Wiring

The CRS451V/CRS456V can connect to an RS-232 port on a radio, a cell phone modem, a Network Link, or an MD485 modem.

Wire sensor cable to DB9 Terminal Block (pn 28841) according to the following table:

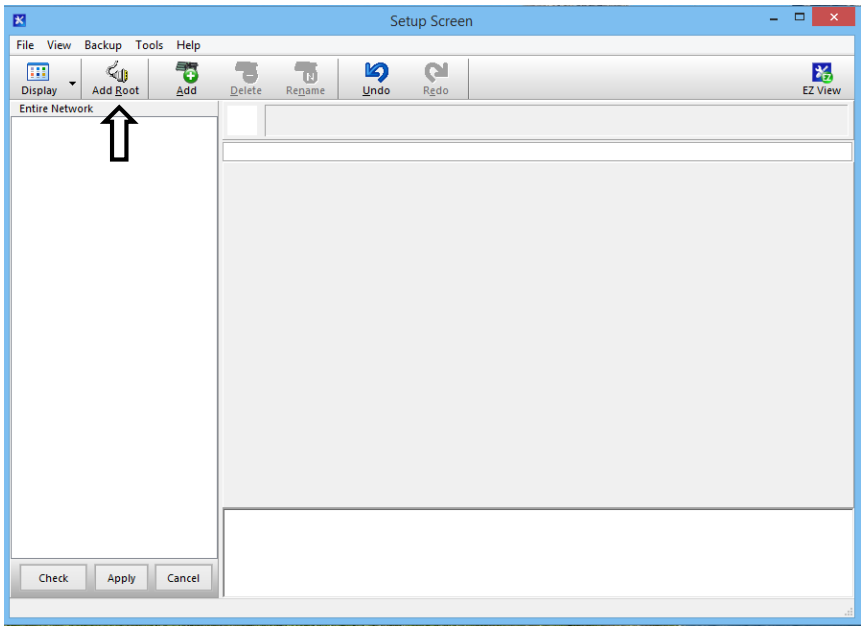
TABLE D-2. CRS451V/CRS456V Sensor Wiring

Sensor Wire	12 Vdc Power Supply	
Red	+12V	
Black	Ground	
	DB9 Terminal Block (pn 28841)	
Blue	Pin 2	
White	Pin 3	
	Pin 5	May need to tie to power supply ground using separate wire.

D.3 Software Configuration

Make sure your software is current. Visit *www.campbellsci.com/downloads* for software updates and patches.

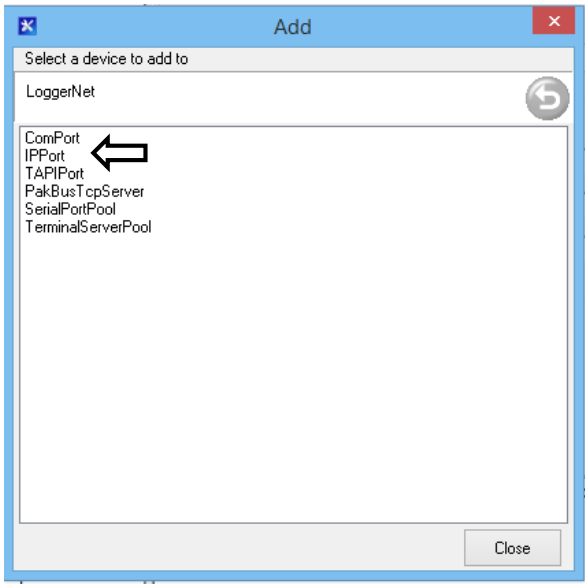
1. From the Standard View of the *LoggerNet Setup* screen, press **Add Root**.



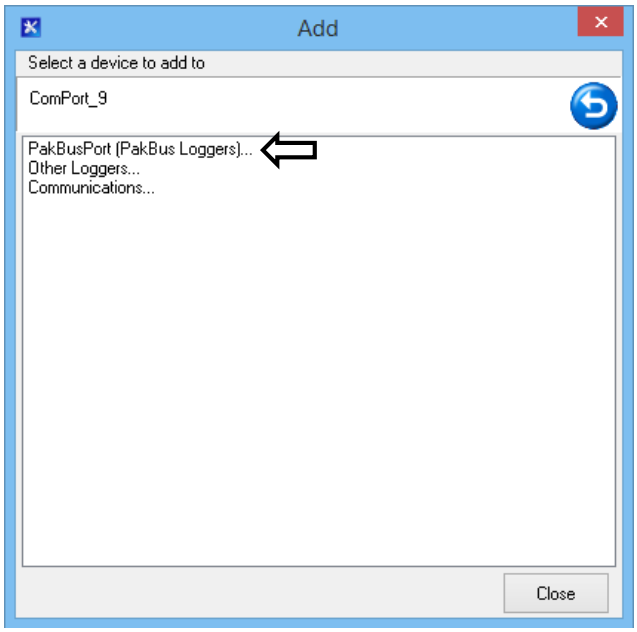
2. Select the proper communication root.

   a. Select **IP Port** for communication through cell phone or network link, such as NL240 or NL201.

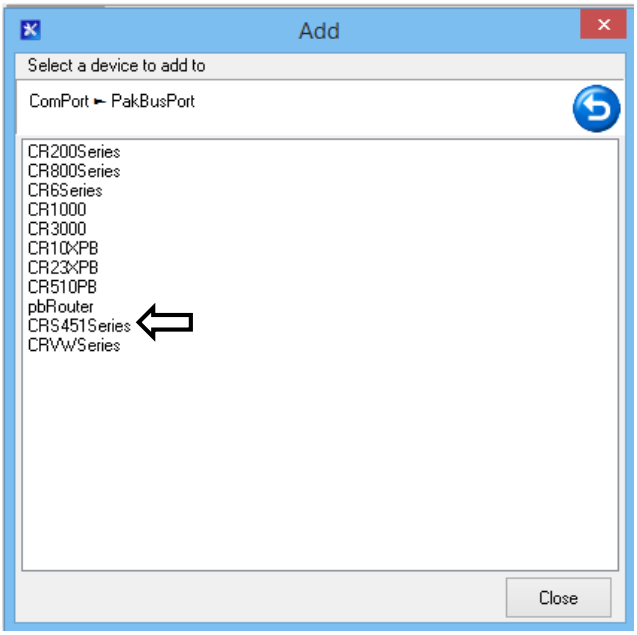
   b. Select **COM Port** for direct communication through the A200 or through RF450, RF401, or RF401A radios.



3. Select **PakBus Port** and attach it to the chosen root.

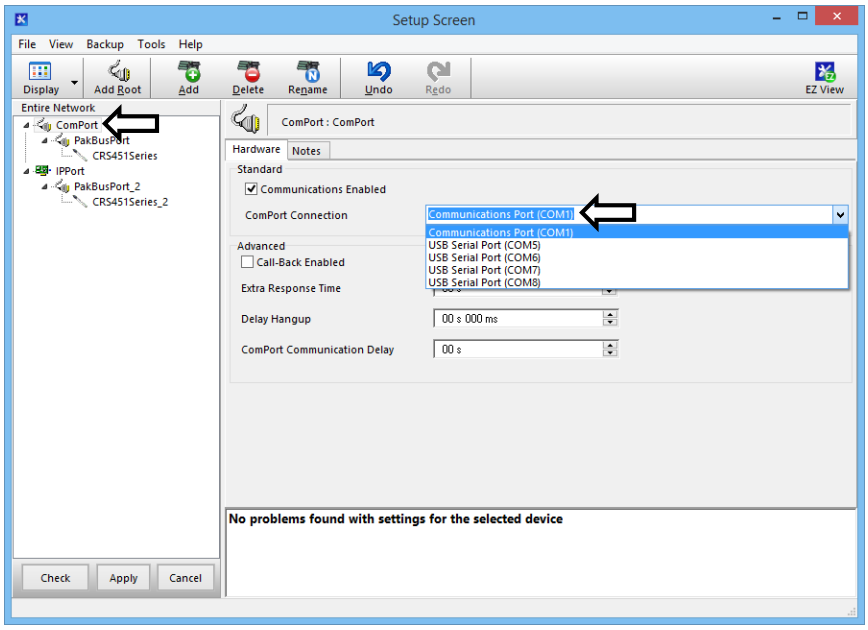


4. Select **CRS451**.

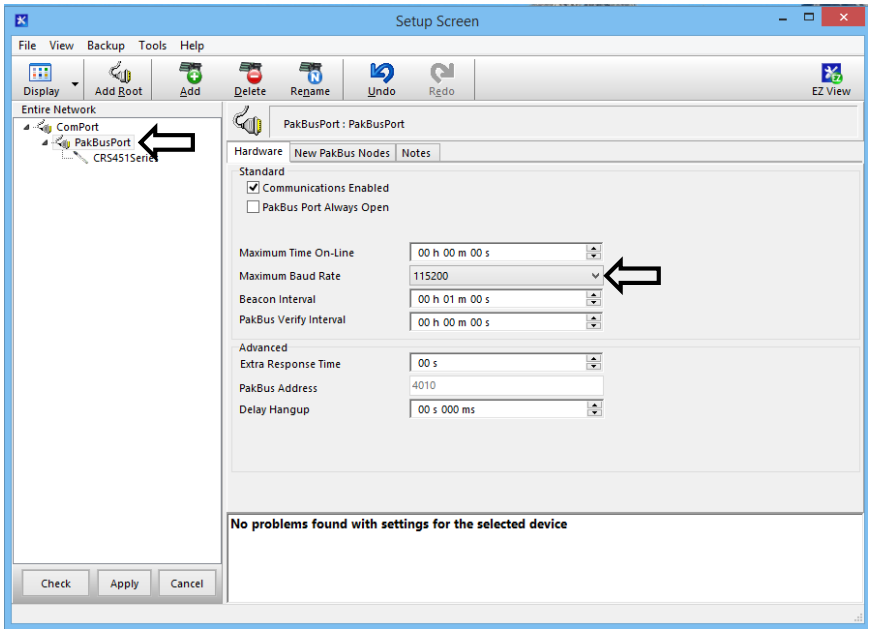


5. If using a **COM port**:

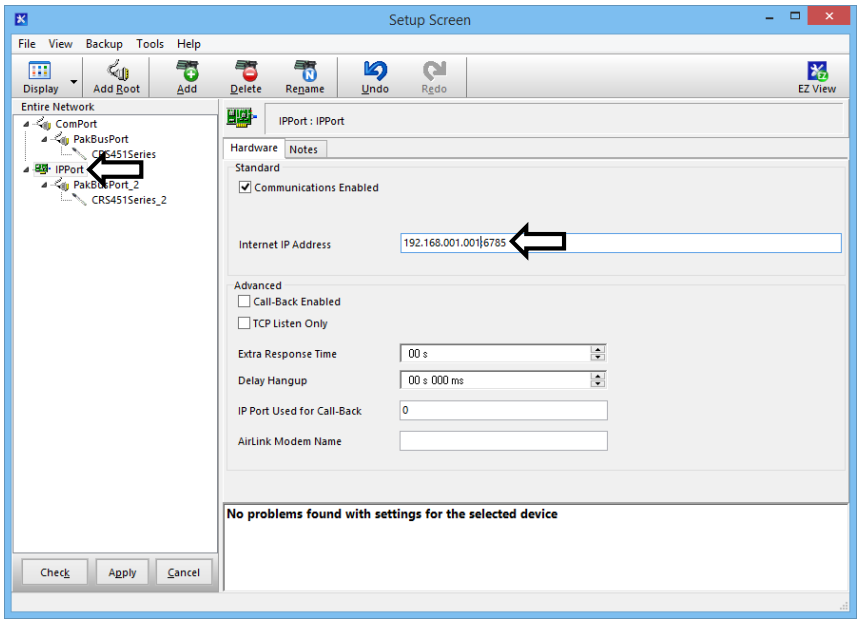
   a. Note which COM port *LoggerNet* assigns, and verify it is available for use.



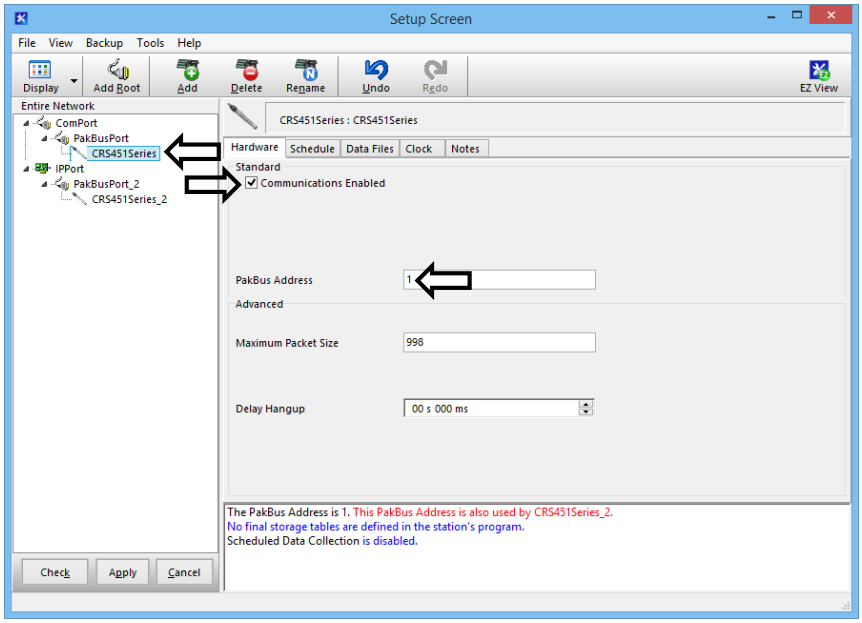
   b. Specify the **Maximum Baud Rate**. Ensure the baud rate entered is compatible with all communication devices. Refer to TABLE D-1.



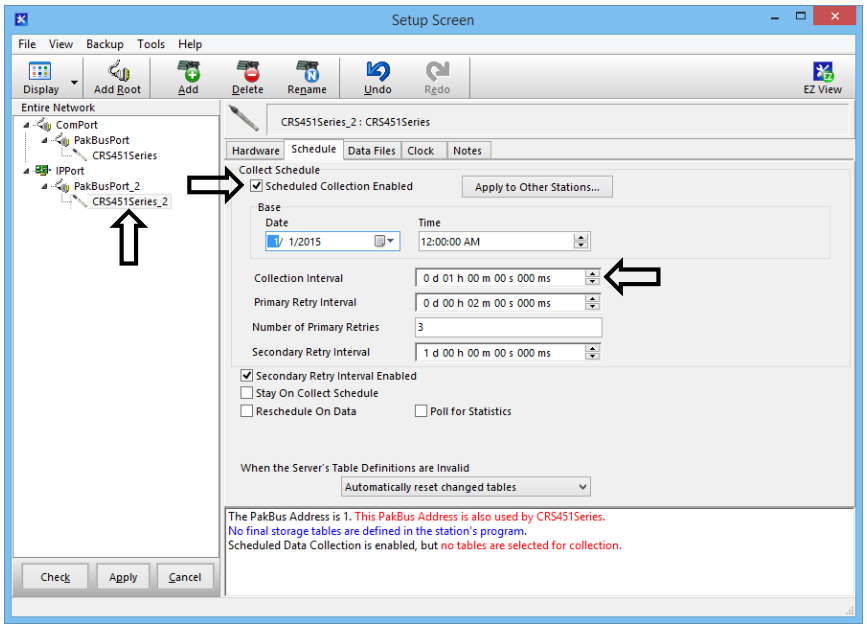
6. If using an **IP Port**, enter the IP address and port number of the cell modem, NL240, or NL201.



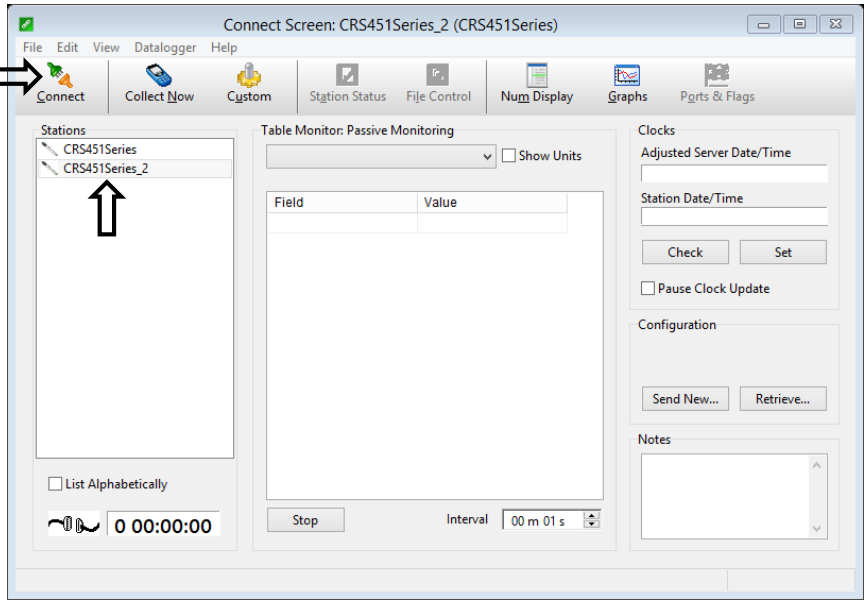
7. Enter the **PakBus Address** of this specific sensor. Communication will fail unless this is correct. To view or set the PakBus Address of the CRS451V/CRS456V, use *DevConfig* or select **LoggerNet Communication Settings** from the *Settings* window of *HydroSci*.



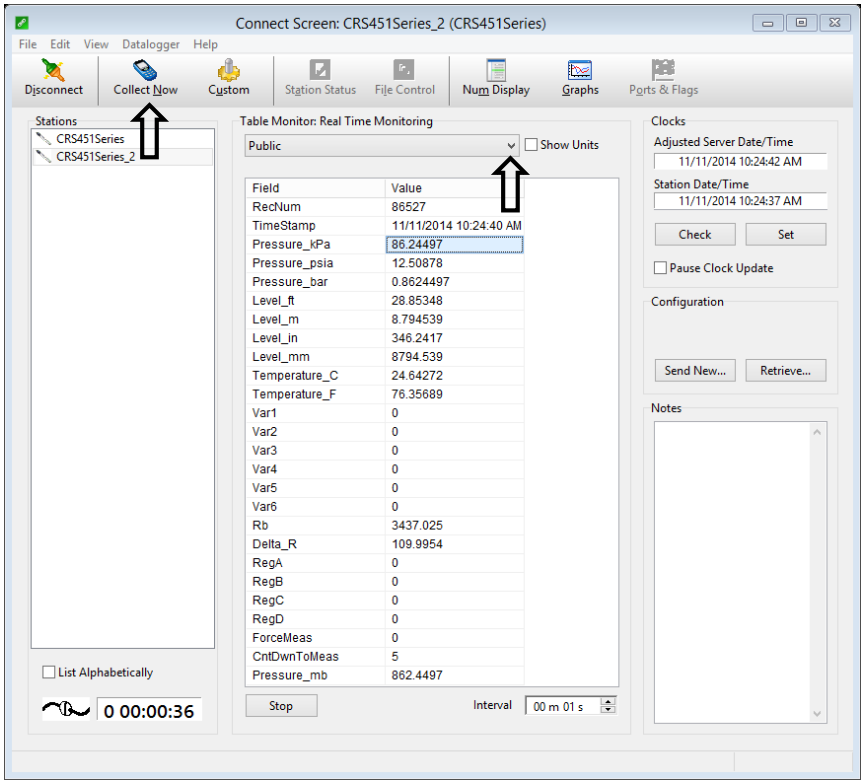
8. Automated data collection can be enabled for any type of communication. Click on **CRS451Series** and then on **Schedule** to access this screen. Check the Scheduled Collection Enabled box and then set up a collection schedule. In this example, *LoggerNet* will collect data every hour starting at midnight, January 1, 2015.



9. Once the station has been properly configured in *Setup*, communication between the computer and the sensor can be established in the *LoggerNet Connect* screen. In *Connect*, select the station of interest from the **Stations** list, and click the **Connect** button.



10. The icon at the bottom left of the screen indicates whether communication between the sensor and computer is active. Select **Public** from the **Table Monitor: Real Time Monitoring** drop-down menu to view real-time data. Click the **Collect Now** button to retrieve data from memory.



11. If communication fails, refer to Section 9, *Troubleshooting* *(p. 20)*, for tips.

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