



X3 Environmental Data Logger

User Guide

Last Revision: 27 September 2024

Date Generated: 10 January 2025

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1. Introduction

X3 Environmental Data Logger Overview

The X3 is an all-in-one environmental data logger designed for both pole/wall mount and buoy-based applications. It automatically recognizes sensors and sends data to the [WQData LIVE web data center](#) via cellular or satellite telemetry. There, data is presented on a fully-featured and easy-to-use dashboard where remote, real-time communication with the logger is possible. The X3 includes three waterproof sensor ports that are compatible with most environmental sensors using SDI-12, RS-232 or RS-485. All connections are made with a simple thread-in connector, and the built-in sensor library automatically facilitates setup and configuration. Data is stored on common or independent schedules.

Power options include [SP-Series Solar Power Packs](#), [AC adapters](#), [battery backups](#), or external 12 VDC. Advanced power management combined with ultra-low sleep and run currents extend battery life and eliminate the need for multi-battery arrays or large solar charging systems. The X3 monitors itself while collecting environmental data – internal temperature, humidity, voltages, and currents are constantly recorded, and failure alerts can be sent automatically to a predefined list of contacts.

Using Bluetooth or a USB adapter with the NexSens CONNECT Software, users can configure the X3 Data Logger for deployment, view live data, change settings, or troubleshoot. Optional integrated 4G LTE cellular or Iridium satellite telemetry modules offer 2-way remote communications via the WQData LIVE.



Figure 1: NexSens X3 Environmental Data Logger.

Body Tag Identification

Each X3 logger has a *body tag* engraved into the exterior of the housing. The tag is located on the lower backside of the logger between the alignment screw and the green wire insert. The tag is incorporated into the default name of the device on WQData LIVE and is used for logger identification. A NexSens technical support specialist will request this tag for remote

troubleshooting or if NexSens-supplied data services require activation, suspension, or cancellation.

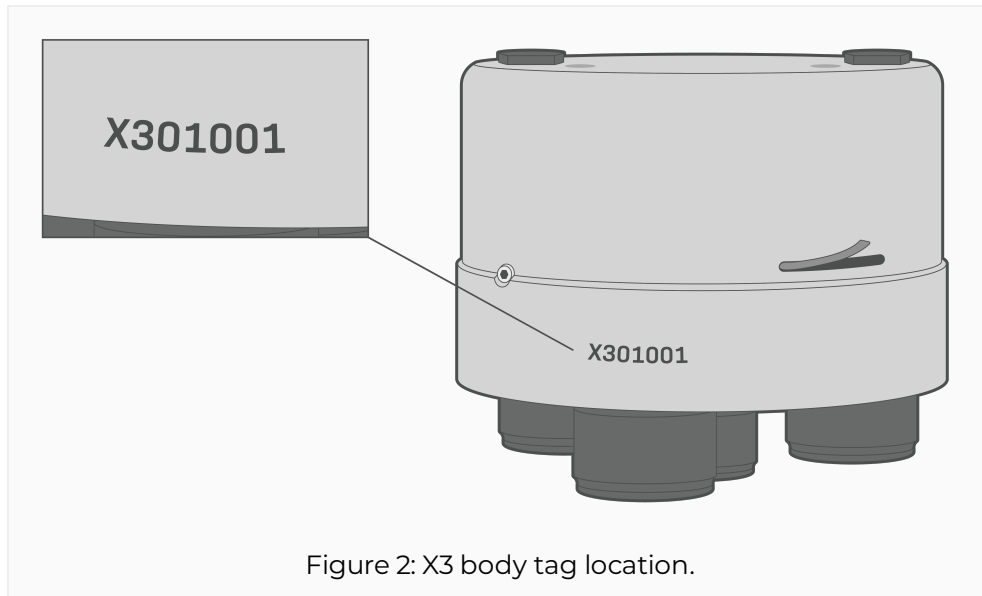


Figure 2: X3 body tag location.

Specifications

The X3 is fully sealed in a marine anodized aluminum housing. All sensor and power inputs utilize waterproof UW connectors, and antenna connections feature an O-ring seal. The unit is designed to work in extreme conditions, including underwater. A specially designed mounting bracket holds the X3 to a pole mast, and bolt holes on the top and bottom of the housing provide easy installation on NexSens CB-Series data buoys.

Housing

Operation

<ul style="list-style-type: none"> • Material: Marine anodized aluminum • Weight: 3.0 lbs. (1.36kg) • Dimensions: 4.9" (12.45cm) diameter x 4.15" (10.54cm) height • Rating: IP68 • Operating Temperature: -40°C to 70°C • Mount: (4) 5/16-18 top bolt holes, (3) 3/8-16 bottom bolt holes; Optional PM2 for pole/wall mounting • Antenna Port: SMA <p>Power</p>	<ul style="list-style-type: none"> • User Interface: Wireless Bluetooth or wired RS-485 via USB adapter to CONNECT Software; WQData LIVE Web Datacenter with optional wireless telemetry; Status beeps • Log Interval: User configurable from 1-minute (10-minute default)¹; Unique interval per sensor • Transmit Interval: User configurable from 5-minute (10-minute default) • Transmission Trigger: Time-based; Selective parameter upload option • Sensor Interfaces: RS-232 (3 Channels), SDI-12, RS-485, Pulse Count • Sensor Power: (2) independent switches from the input supply^{2,3} • Telemetry Options: 4G LTE global cellular; Iridium satellite; 4G LTE global cellular with Iridium fallback <p>Internal Features</p>
<ul style="list-style-type: none"> • Power Requirements: 10.7 to 16.8 VDC +/-5%; includes reverse polarity protection, over-voltage protection (OVP), and under voltage lockout (UVLO) protection • Current Draw (Typical @ 12VDC): Sleep: 450uA; Active: 55mA; Cellular transmitting: 300mA; Iridium satellite transmitting: 170mA • Peak Current: The power supply must be able to sustain a 500mA 1-second peak current (@ 12V) 	<ul style="list-style-type: none"> • Real-Time Clock (RTC): <30sec/month drift⁴; Auto-sync weekly⁵; Internal backup battery • Data Logging: 8 MB non-volatile flash memory; > 1-year storage with 20 parameters at 15-minute intervals; Max 200 parameters per log interval • Built-in Sensors: <ul style="list-style-type: none"> ◦ Temperature (-40° to 100°C, 0.016°C resolution, ±0.3°C accuracy) ◦ Humidity (0% to 100%, 0.03% resolution, ±4% accuracy from 5 to 95% RH) ◦ System voltage ◦ System current ◦ System power ◦ Real-time clock (RTC) battery voltage • Sensor Ports: (3) UW 8-pin for sensor interface (RS-232, SDI-12, RS-485, Pulse Count, Power, GND) • Power Port: (1) UW 6-pin for power and communication (primary/secondary/backup input, RS-485 host, GND)

¹Minimum log interval dependent on sensor limitations and processing time

²Cumulative concurrent current limit of all three channels is 2A

³Logger power supply must be able to support current requirements of sensors

⁴Assumes 25°C operating temperature

⁵Requires the X3 to be connected to the internet

What's Included & Accessories

All X3 data loggers come with product identifier information prominently displayed on the quick start guide, package exterior, and the data logger itself. These identifiers include the engraved body tag on the side of the X3 housing and the included Claim Code, which outlines ownership of the logger on WQData LIVE. Depending on the X3 model, the appropriate antenna will be included. Mounting hardware for the smaller (CB-150 to CB-450) and larger (CB-650 to CB-1250) buoys are included with each logger.

What's Included

Each data logger includes equipment for land-based and buoy-based applications. The quick start guide provides a step-by-step installation process for each type of mounting; however, note that not all equipment is necessary for use. The O-ring grease tube is included to grease all O-rings before deployment, and any time the O-rings are exposed for an extended period.

(1) X3 Environmental Data Logger

(2) Buoy mounting kits (small and large buoy kits)

(3) Sensor port plugs, spare o-rings

(1) Power port plug, spare o-ring

(1) O-ring grease tube

(1) Antenna (only included with telemetry models)

(1) Quick Start Guide



Accessories

Accessories for the X3 data logger include a specially designed pole mount, software communication adapters, antennas, solar power packs, power cables, and sensor interface cables.

Mounts	
PM2	Pole and wall mount kit for 1.5" to 2" pipe

MAST	Threaded aluminum pole assembly for hardware mounting, 2" NPT x 24" length
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Communication	
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UW6-USB-485P-DC	USB PC Adapter
A49	High Gain Cellular Antenna
A42	Iridium Satellite Antenna
A3x-SMA	RF extension cable, Type N male connector to SMA male connector (available in 2', 6' and 10' lengths)
A3x	RF extension cable, Type N male connector to Type N male connector (available in 2', 6', 10', 50' and 100' lengths)

Power	
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SP10	SP10 solar power pack with panel, regulator & 6 A-Hr battery in a weathertight enclosure, 10-watt
SP15	SP15 solar power pack with panel, regulator & 6 A-Hr battery in a weathertight enclosure, 15-watt
SP32	SP32 solar power pack with panel, regulator & 6 A-Hr battery in a weathertight enclosure, 32-watt
UW6-PW	UW 6-pin plug AC power adapter cable
UW6-BB	UW 6-pin plug battery backup with AC power adapter
UW6-2W	UW 6-pin plug 2-way power splitter, 1m
UW6-4W	UW 6-pin plug 4-way power splitter, 1m

Sensor Interface	
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UW-FWP	UW plug terminal for flying lead sensor interface
UW-FWP-V	UW plug terminal for vented flying lead sensor interface
UW-2W	UW plug 2-way sensor splitter, 1m
UW-4W	UW plug 4-way sensor splitter, 1m
A50	Sensor junction box, includes 4 entrance holes

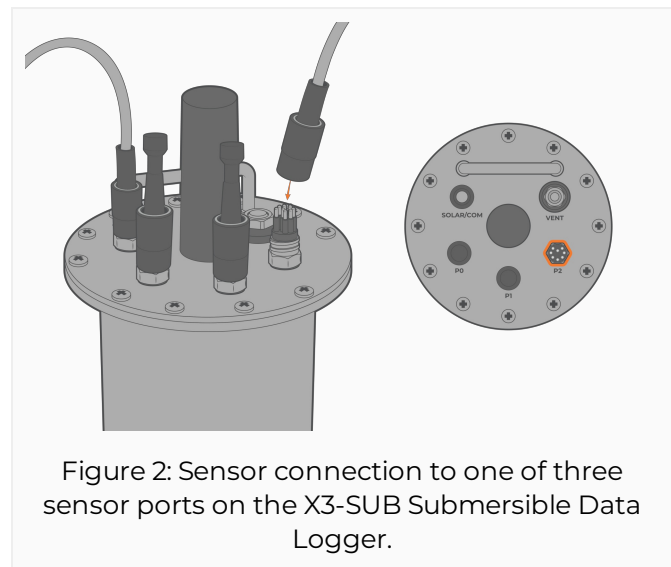
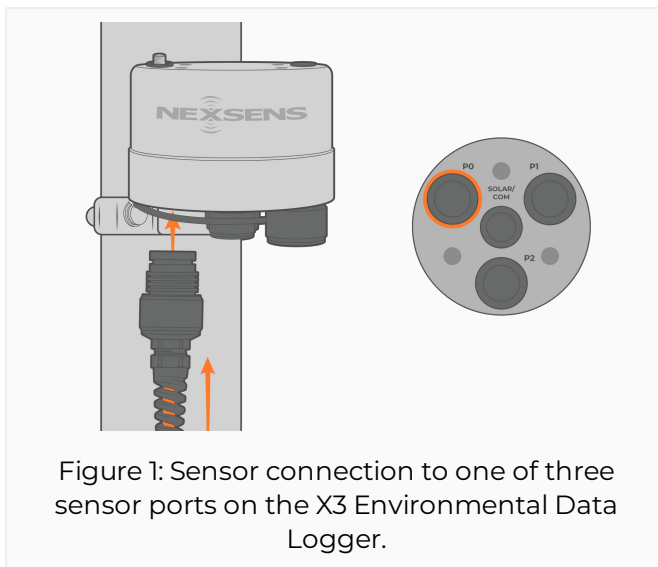
2. Data Logger Setup

X3 Data Logging Features

Configuring an environmental data logger has traditionally been a complex task requiring intricate programming software. Users were tasked with indicating all connected sensors' communication protocols, sensor addresses, measurement commands, data format, and power requirements. However, with NexSens X3 data loggers, this process is simplified through *sensor detection*. Using a built-in sensor library, X3 data loggers can recognize connected sensors and store their information in internal memory, such as the make and model, parameters, and the port to which it is connected. Once a sensor is detected, the logger provides power to the sensor and gathers measurements at a user-specified interval.

The X3 data logger includes (3) sensor ports that communicate with environmental sensors via the SDI-12, RS-485, and RS-232 digital communication protocols. Using these protocols, the logger interfaces with sensors through SDI-12, Modbus-RTU, NMEA0183, and a General Serial Interface (GSI). Sensor scripts not included in the base library can be created using script generator tools in the NexSens CONNECT software. Any sensors communicating via the mentioned sensor interfaces are compatible with NexSens X-Series data loggers.

Users will use the CONNECT software to enable the necessary scripts for sensor detection. Once enabled, the logger provides power to all sensor ports and saves information regarding each connected sensor. The sensor information and subsequent data are stored in its internal memory and transmitted to the WQData LIVE web data center in real-time.



Important Considerations

1. During sensor detection, only the *enabled* sensor scripts are processed.
 - a. Learn how to enable sensor scripts [here](#).
2. Only one RS-232 sensor can be connected to a single port.
3. Multiple SDI-12 and RS-485 sensors can be applied to a single port; however, each must

have a unique sensor address.

4. Most sensors require at least 12VDC power. During sensor detection, ensure the logger is connected to an adequate power source.
5. New sensor detections will erase any prior logger programming. Thus, any previously detected sensors that are physically disconnected or are experiencing communication disruptions at the time of a new detection will *not* be identified.
6. Port P0 will always use continuous power. Utilize this port for continuously powered sensors, such as rain gauges, weather stations, flow monitors, etc.

When to Run a Sensor Detection

Sensor detections can be performed in three separate ways:

1. If a logger has not been programmed, it automatically begins a sensor detection when power is applied or cycled.
2. WQData LIVE provides a remote sensor detection option, which is outlined [here](#).
3. In most instances, the NexSens CONNECT software will provide the safest and most efficient way to perform sensor detection. The sensor detection process via the CONNECT software is outlined [here](#).

Sensor detections should be performed in a controlled environment before a scheduled deployment date. The new programming should be thoroughly examined to ensure all sensors and parameters are shown, they output in the correct units, and the values are within the expected ranges. Systems should be tested for multiple hours before deployment to confirm functionality. NexSens strongly discourages using the remote WQData LIVE sensor detection process while the unit is in the field; however, the remote command is helpful in a controlled environment.

Buzzer Pattern Indicator

X3 Data Loggers include a built-in buzzer that outputs a distinctive pattern. The buzzer relays to the user the current processes being performed by the data logger. Upon power connection, the logger will beep once, indicating the system is powered. During a sensor detection, the logger will beep once every 3 seconds. Once the sensor detection is complete, the logger will continue this pattern as it gathers the first reading from the sensors. After collecting the measurements, the logger will automatically begin communicating with WQData LIVE. A “double-beep” pattern will be heard, which indicates the logger is setting up the cellular connection. When the connection has been established or if the connection failed, the logger will output two or three short beeps, respectively. If the connection is successful, the “double-beep” pattern will continue until all data is transmitted to the web.

Event	Beep Type	Status
Applying power	One short beep	System boot successful
Sensor detection/reading	One short beep every 3 seconds	Logger currently taking a reading or detecting sensors

Telemetry connection attempt	Double-beep every 3 seconds	Logger attempting to establish network connection
Telemetry connection successful	Two short beeps	Network connection established
Telemetry connection failed	Three short beeps	No signal/network connection failed

X3 Data Logger Programming

In many instances, applications scientists and engineers at NexSens will pre-program data loggers based on user specifications. The system will be ready for “plug-and-play” and will not require the subsequent steps below to be performed. If a system is pre-programmed, a System Integration Guide will be included with the order, with an overview of the next steps to get the system up and running. Review the System Integration Guide guide and skip to the WQData LIVE Setup section of the user guide (linked at the end of the article).

Note: It is recommended to download the CONNECT software (step 1) for future use.

1. CONNECT Software Download

The NexSens CONNECT Software enables users to communicate directly with any NexSens X-Series data logger using a [UW6-USB-485P-DC cable](#). It supports a growing number of diagnostic and configuration tools to facilitate system setup and troubleshooting. New systems should be completely configured with sensors and a telemetry connection in a nearby work area. It is recommended to operate the system for several hours to ensure correct sensor readings. Use this test run to become familiar with the features and functions of the logger, the CONNECT software, and the WQData LIVE web data center.

- Download the CONNECT software and establish a connection with the logger via Bluetooth or the direct connect USB cable.
 - [CONNECT Setup](#)
 - The 6-pin port on the X3 or X3-SUB provides power and communication through the CONNECT software. Connect the [UW6-USB-485P-DC cable](#) to the middle 6-pin port of the pole-mount X3 and the [MCIL6MP-USB-DC](#) to the SOLAR/COM port on the X3-SUB.
 - For sensor programming, ensure 12VDC is supplied to the system.

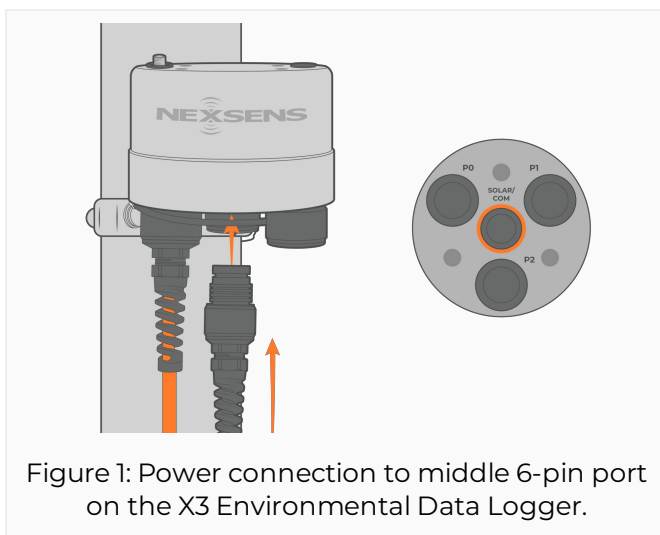


Figure 1: Power connection to middle 6-pin port on the X3 Environmental Data Logger.

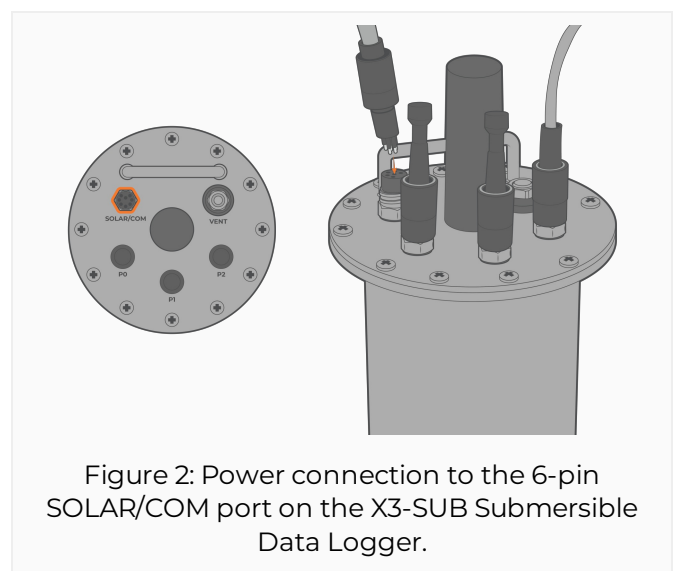


Figure 2: Power connection to the 6-pin SOLAR/COM port on the X3-SUB Submersible Data Logger.

2. Sensor Integration Guides

While the X3 data logger simplifies programming, most environmental sensors require their

own programming to communicate properly with the logger. NexSens application scientists and engineers created sensor integration guides to provide a step-by-step process for setting the appropriate communication settings on common environmental sensors for sensor detection.

- Review the sensor integration guides on the NexSens knowledge base to prepare the sensor(s) for the sensor detection.
 - [Sensor Integration Guides](#)
 - If a guide is unavailable, follow the links below to determine if a script for the sensor is available in the sensor library, or if a new script must be created.

3. Create and Enable Scripts

While the current sensor library on all X3 loggers is extensive and continuously growing, not all environmental sensors will be available. The sensor library can be reviewed in the CONNECT software following the link below to determine whether a sensor is available:

- [Configure Sensor Scripts](#)

For any scripts that are not available in the library, the CONNECT software provides an easy-to-use script generation tool for the X3's sensor interfaces. The user must review the sensor manufacturers' information regarding the appropriate protocol to choose. In many instances, a sensor will use multiple sensor interfaces, so it is imperative that the internal settings on the sensor are set to output in the proper interface.

Before creating a new script, below are a few important considerations to consider:

1. The sensor must be connected to the sensor port outlined in the script for proper communication. It is best to label the port with the sensor name after creating the script.
2. Only one RS-232 sensor can be connected to a single port.
3. Multiple SDI-12 and RS-485 sensors can be applied to a single port; however, they must each have a unique address.
4. Ensure the address selected in the script matches the address in the internal sensor settings.
5. Any scripts generated in the CONNECT software will automatically program onto the data logger, regardless of any confirmed communication with the sensor. Ensure to review the latest sensor readings to confirm the script is working. Below are articles to create specific scripts.
 - [Modbus Script](#)
 - [NMEA0183 Script](#)
 - [SDI-12 Script](#)
 - [GSI Script](#)

If there are any questions, contact NexSens technical support for assistance with new or existing scripts:

4. Automatic Sensor Detection

Once the appropriate scripts are created and enabled, connect sensor(s) to the (3) available sensor ports on the logger. Before running any new sensor detection, it is always recommended to erase the log data and erase any previous sensor programming:

- [Erase Log Data](#)
- [Erase Sensor Programming](#)
 - After the logger is reset, the data logger will begin the automatic detection process using the internal script library.

Depending on the number of scripts enabled, the process can take from 5 to 15 minutes. While waiting for the detection to complete, proceed to the [WQData LIVE Setup](#).

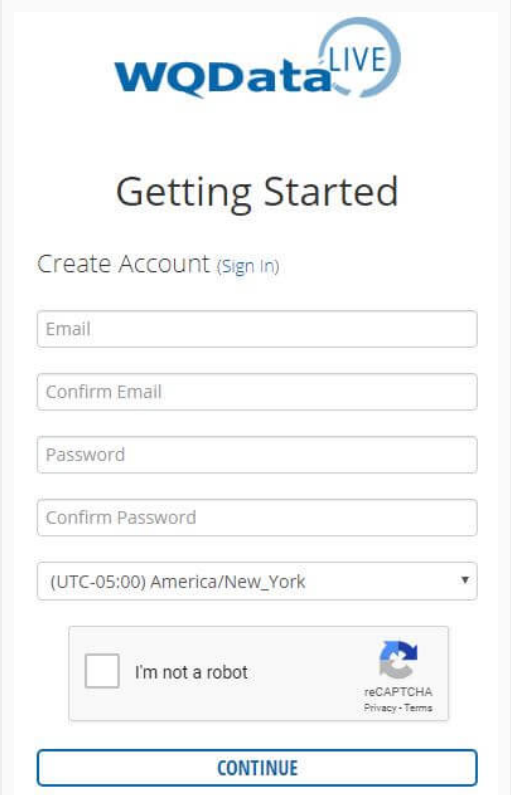
3. WQData LIVE Setup

Create a WQData LIVE Account

WQData LIVE is a web-based project management service that allows users to collect and manage data from NexSens data logging platforms. The *Basic* tier is free to use, while the *Advanced*, *Professional* and *Enterprise subscription tiers* offer an array of advanced project and data management features.

To get started with WQData LIVE, first, create an account:

1. Navigate to <https://www.wqdatalive.com/getting-started>
2. Fill out the form to create the account.
 - a. Select the proper time zone to ensure all dashboard data and reports display accurate timestamps.



The screenshot shows the 'Getting Started' page for WQData LIVE. At the top is the WQData LIVE logo. Below it is the heading 'Getting Started'. Underneath is the text 'Create Account (Sign In)'. The form consists of several input fields: 'Email', 'Confirm Email', 'Password', and 'Confirm Password'. Below these is a dropdown menu for time zone, currently set to '(UTC-05:00) America/New_York'. At the bottom of the form is a reCAPTCHA 'I'm not a robot' checkbox and a 'CONTINUE' button.

Figure 1: WQData LIVE Create Account form.

3. Select **Continue** when finished, and a success notification, along with an email verification request, will be shown.
4. Click the confirmation link in your email to complete the activation of the new WQData LIVE account.
5. The link will redirect to the account login menu. Signing in for the first time will take the user to the *Account Summary* menu, where settings such as the local time zone can be

configured.

The screenshot displays the 'Account Summary' settings page. At the top, it shows 'Account Summary' and 'Member Since 03/08/2022'. Below this is the 'User Information' section, which contains several input fields: email (info@nexsens.com), company name (NexSens Technology), address (2091 Exchange Court), city (Fairborn), state (Ohio), zip code (45324), country (United States), and time zone ((UTC-05:00) America/New_York). A 'Change Password' link is located below the time zone field. At the bottom of the form is a blue 'SAVE' button.

Figure 2: Account Summary settings.

6. Proceed to **create a WQData LIVE project** to continue the startup process.

Create a WQData LIVE Project/Site

Data loggers and measurement data are organized into projects and sites on WQData LIVE. Projects may contain one or more sites for further organization, and each site may contain one or more data loggers.

To create a project and site(s):

1. Sign in to an existing [WQData LIVE account](#).
2. Hover over the email in the upper right-hand corner of the page and select **PROJECTS** from the drop-down menu.

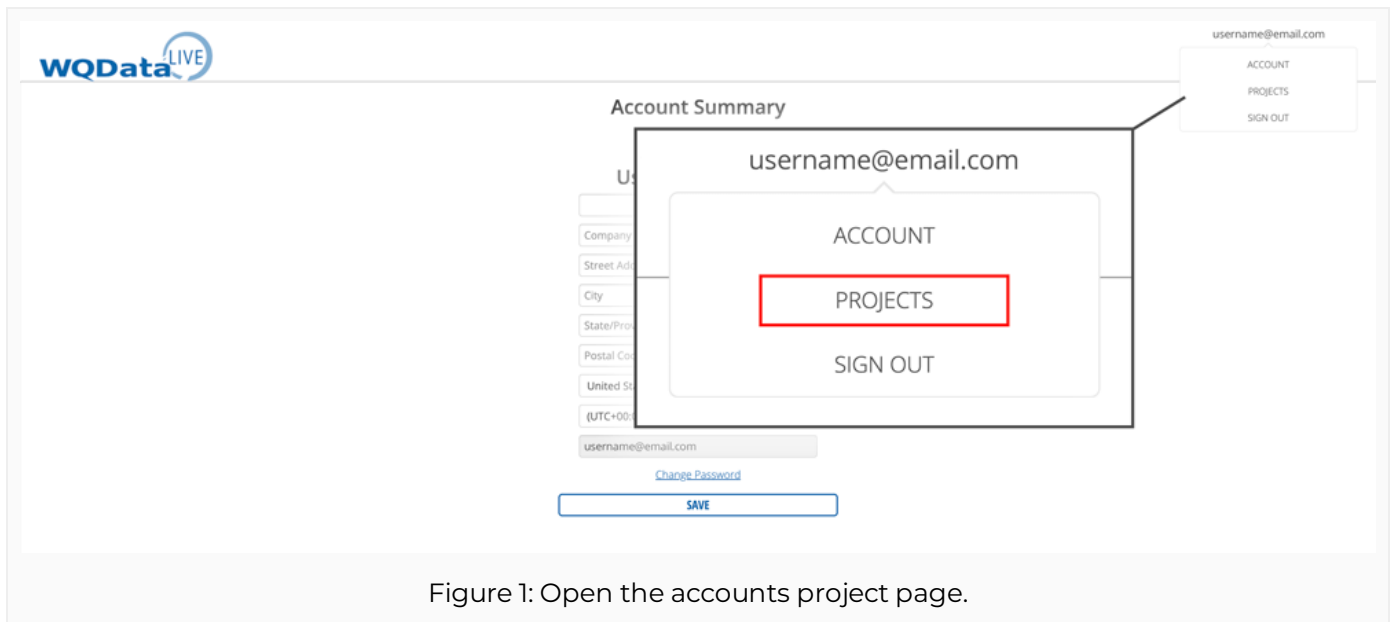


Figure 1: Open the accounts project page.

3. Select the tile labeled **Create New Project**.
4. Fill out the fields in the corresponding menu to title the project, and then click **CREATE PROJECT**.
5. The main *Project Dashboard* will appear. Access the administrator settings by going to **Admin | Settings** at the top.

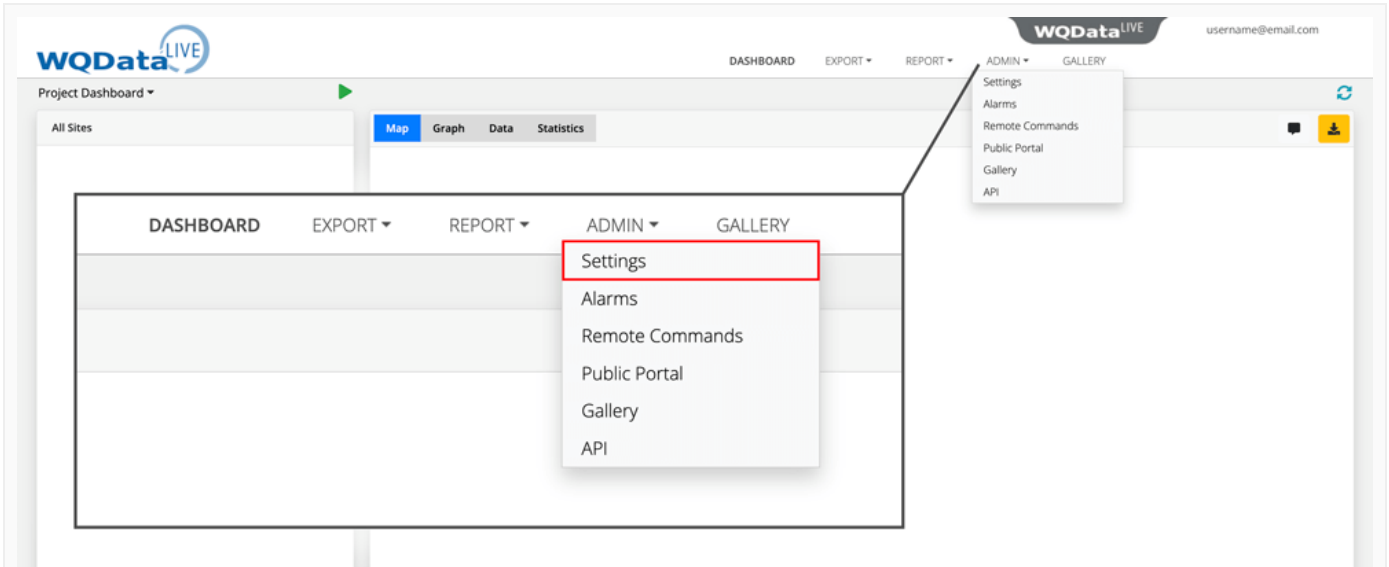


Figure 2: Access the administrator settings on the WQData LIVE project.

6. Select **Project/Site | Sites | +New Site**. Enter the site information in the spaces provided.
 - a. Upload a project/site image
 - b. Enter project/site coordinates

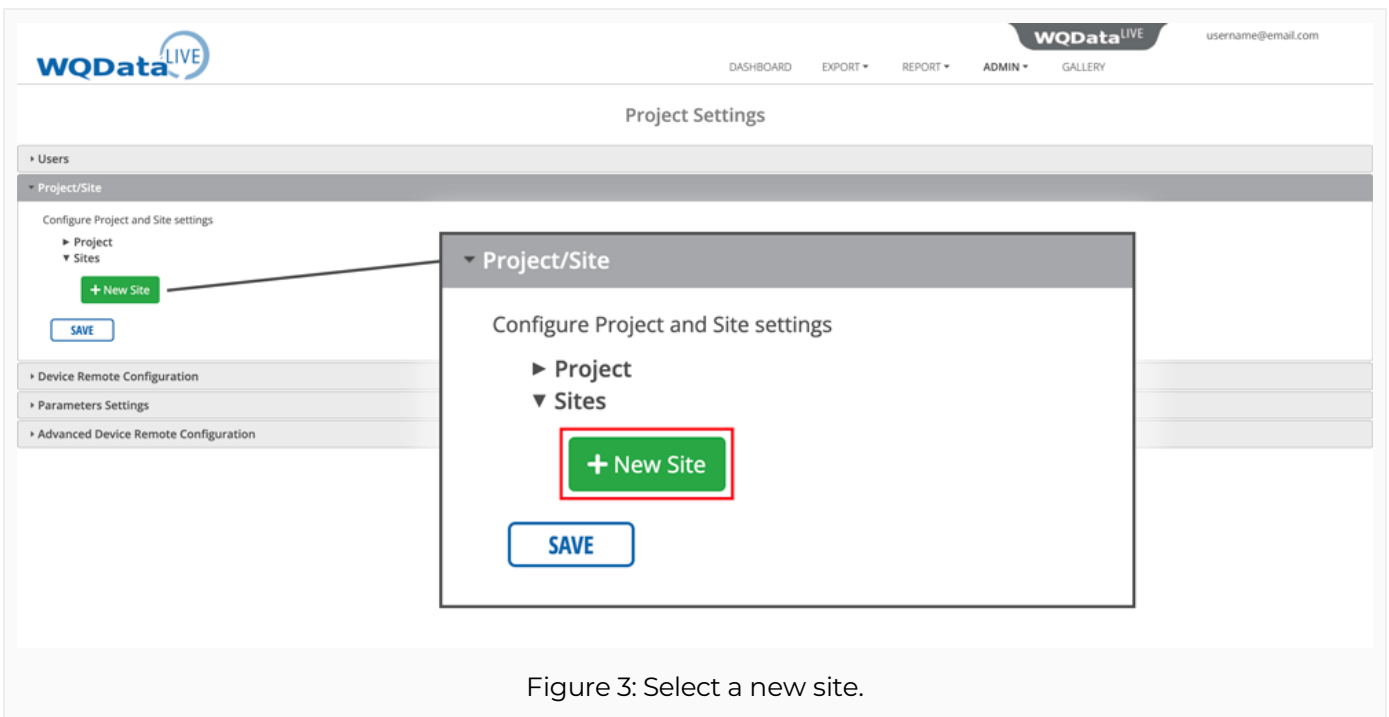


Figure 3: Select a new site.

7. Click **SAVE** when finished.
8. Proceed to [Add a data logger\(s\)](#) to each site to continue the startup process.

Add a Data Logger to a WQData LIVE Project

During first-time configuration, data loggers are added to WQData LIVE projects using a *Claim Code* supplied with each data logger.

To assign a data logger using a *Claim Code*:

1. Log in to WQData LIVE and find the username in the top right-hand corner of the page. Mouse over the username to reveal a drop-down menu, and click **PROJECTS**.

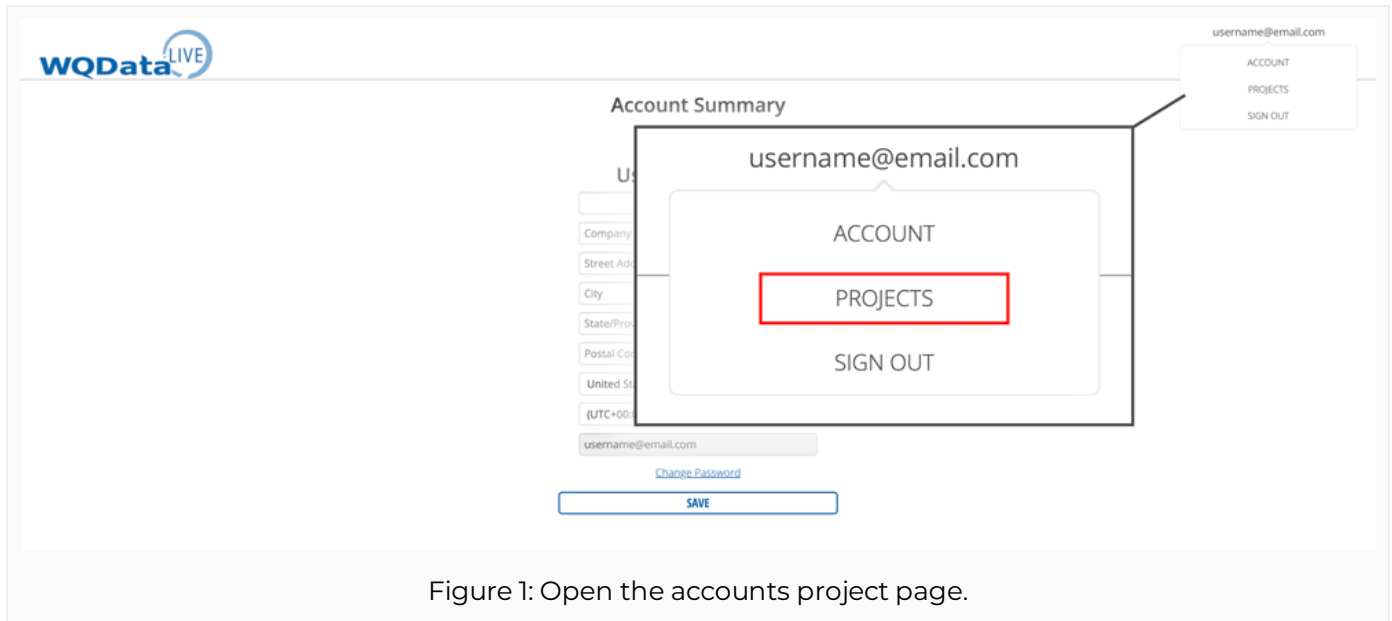


Figure 1: Open the accounts project page.

2. Choose an existing project or select **Create New Project**. Follow the link below for additional information on creating a new project.
 - a. [Creating a WQData LIVE Project](#)
3. After selecting or creating a project, click **ADMIN | Settings**, located at the top of the dashboard.

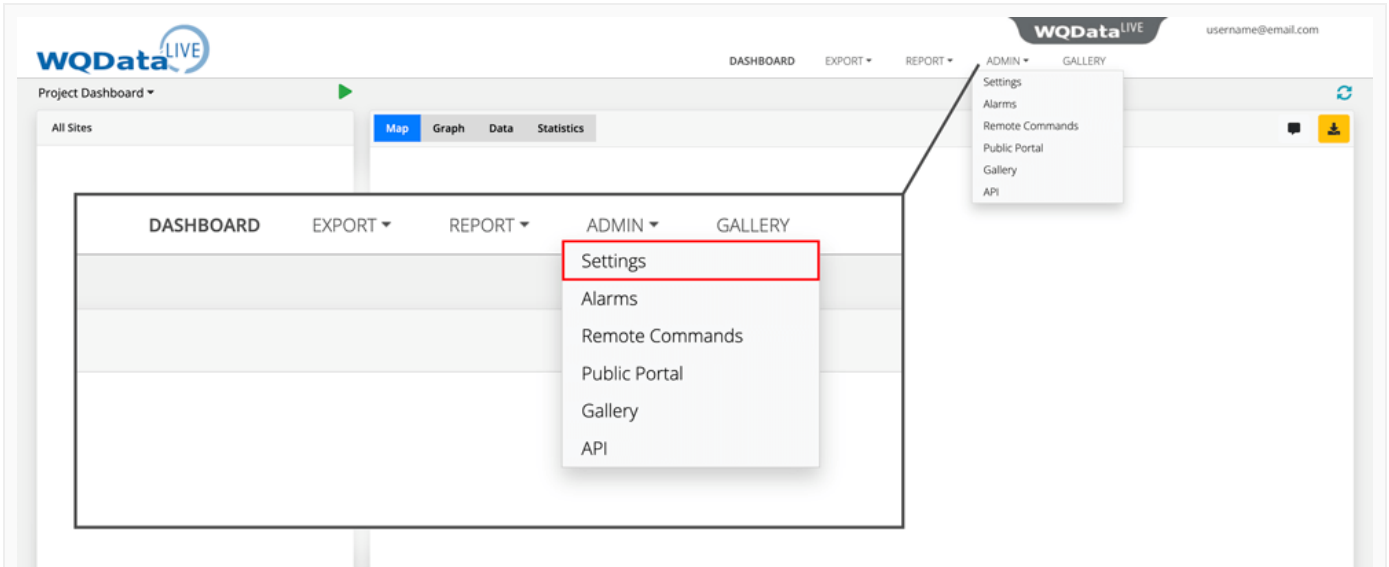


Figure 2: Access the administrator settings on the WQData LIVE project.

4. Click on the gray bar that says **Project/Site** to open a drop-down menu. Choose **Sites** to open a second drop-down menu.
5. The sites drop-down menu displays all of the current sites within the project. View the site settings by clicking on the name.
6. Locate the *Claim Code* on the serial label attached to the data logger's Quick Start Guide or System Integration Guide.

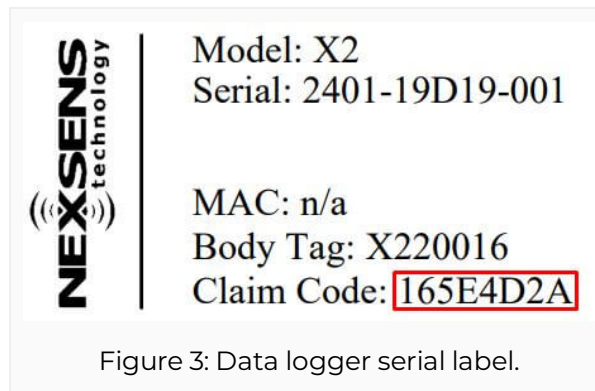


Figure 3: Data logger serial label.

7. Add a new logger by entering the *Claim Code* in the field near the bottom of the sites menu. Then click **Add Device**.

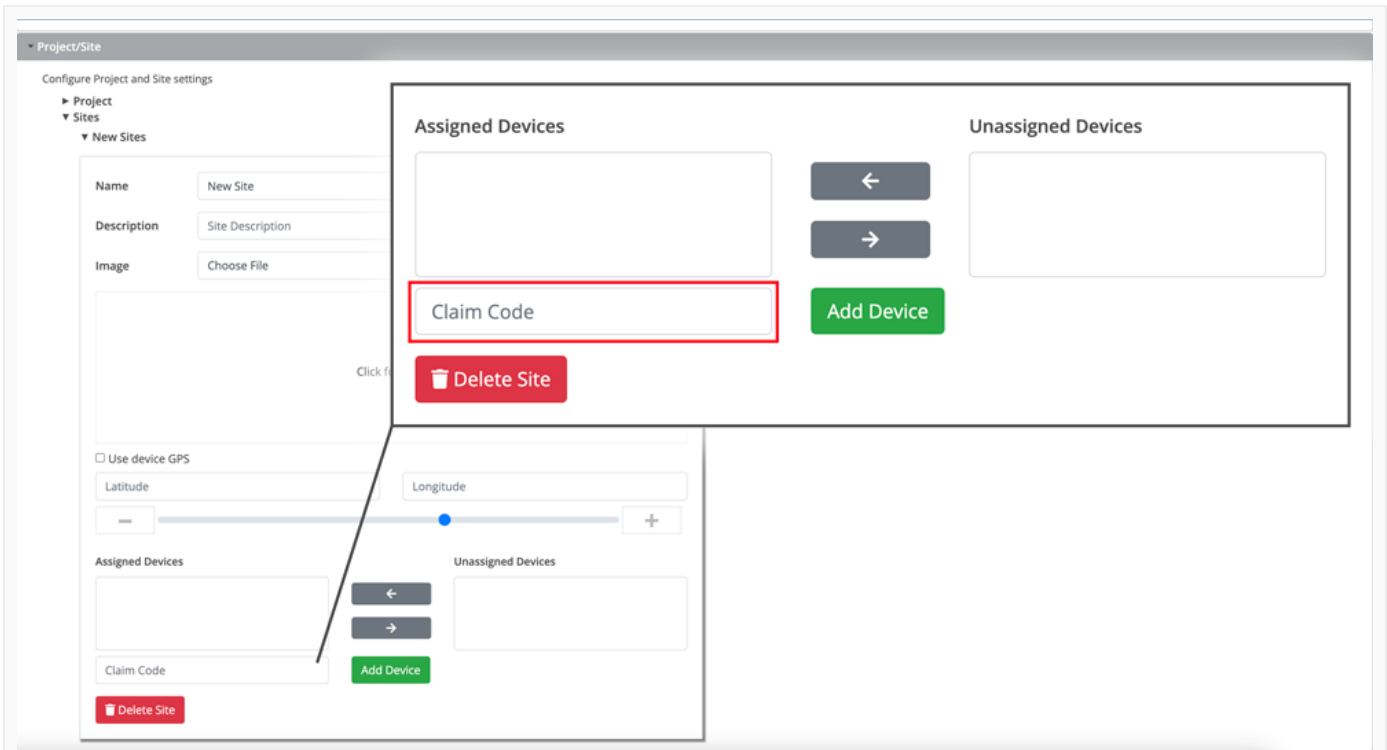


Figure 4: Enter the claim code in the space provided to add the data logger.

8. The device name will appear in the *Assigned Devices* box.
9. Click **SAVE** when finished.
 - a. All parameters and data for the logger will now be visible on the project and site dashboard.

4. Telemetry Setup

X-Series Logger Data Flow

NexSens X-Series data loggers have multiple options to access data collected by the logger. Communication options for the X3 data logger include cellular, satellite, Wi-Fi, Bluetooth, and a direct connection. The X2 data logger has an additional radio telemetry option. Telemetry models transmit data in real-time to the WQData LIVE web data center. All models include direct data download via Bluetooth (X3 only) or a direct cable. Direct data downloads are performed using the NexSens CONNECT software. The diagrams below outline how data is collected and transferred from the sensor to the user.

Note: X2 data loggers store data locally on a microSD card. X3 data loggers store data locally in internal memory.

Cellular

Modems and SIM cards in X-Series data loggers work with all major U.S. and international carriers. Cellular systems are best utilized near cities and areas with strong cellular coverage.

NexSens X-Series Data Flow: Cellular Logger to WQData LIVE

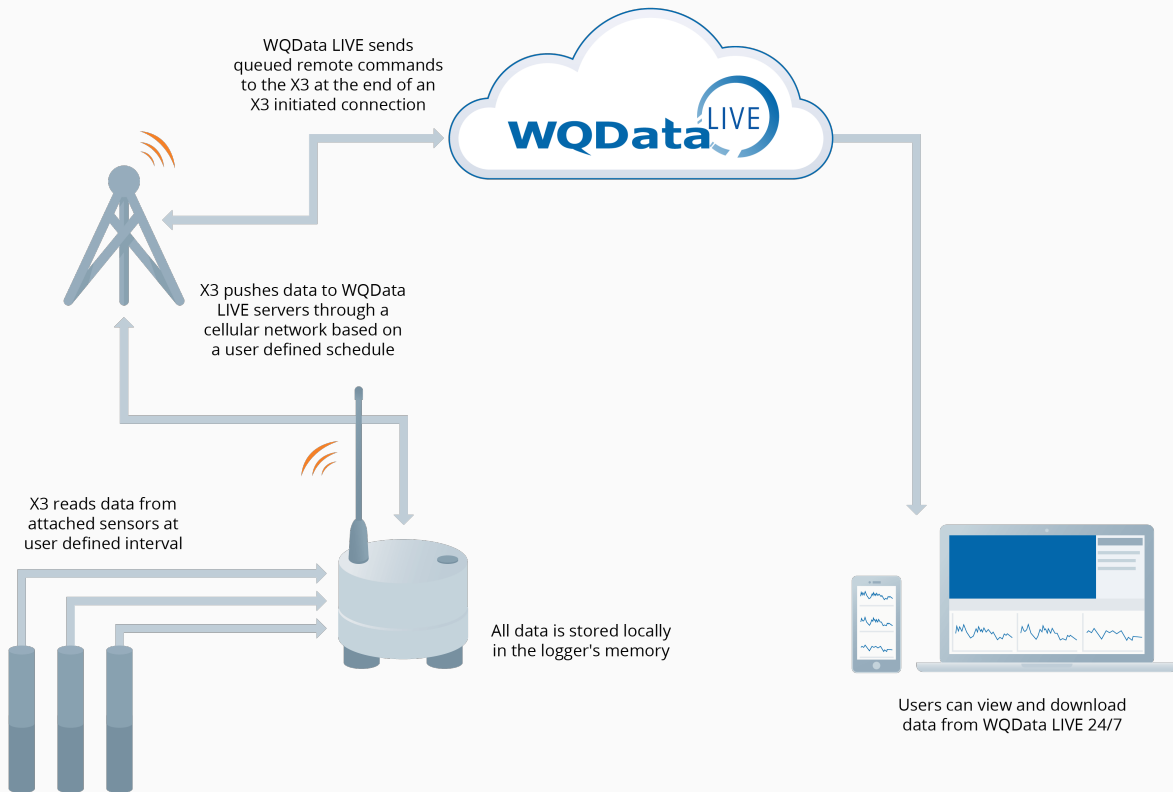


Figure 1: Cellular data flow to WQData LIVE.

Iridium

Iridium systems are best utilized in extremely remote locations that lack adequate cellular reception. These systems work globally as satellite coverage extends to nearly every location. X-Series loggers send iridium messages with measurement data to specified email servers, which are then collected and parsed by WQData LIVE every 5 minutes.

NexSens X-Series Data Flow: Iridium Logger to WQData LIVE

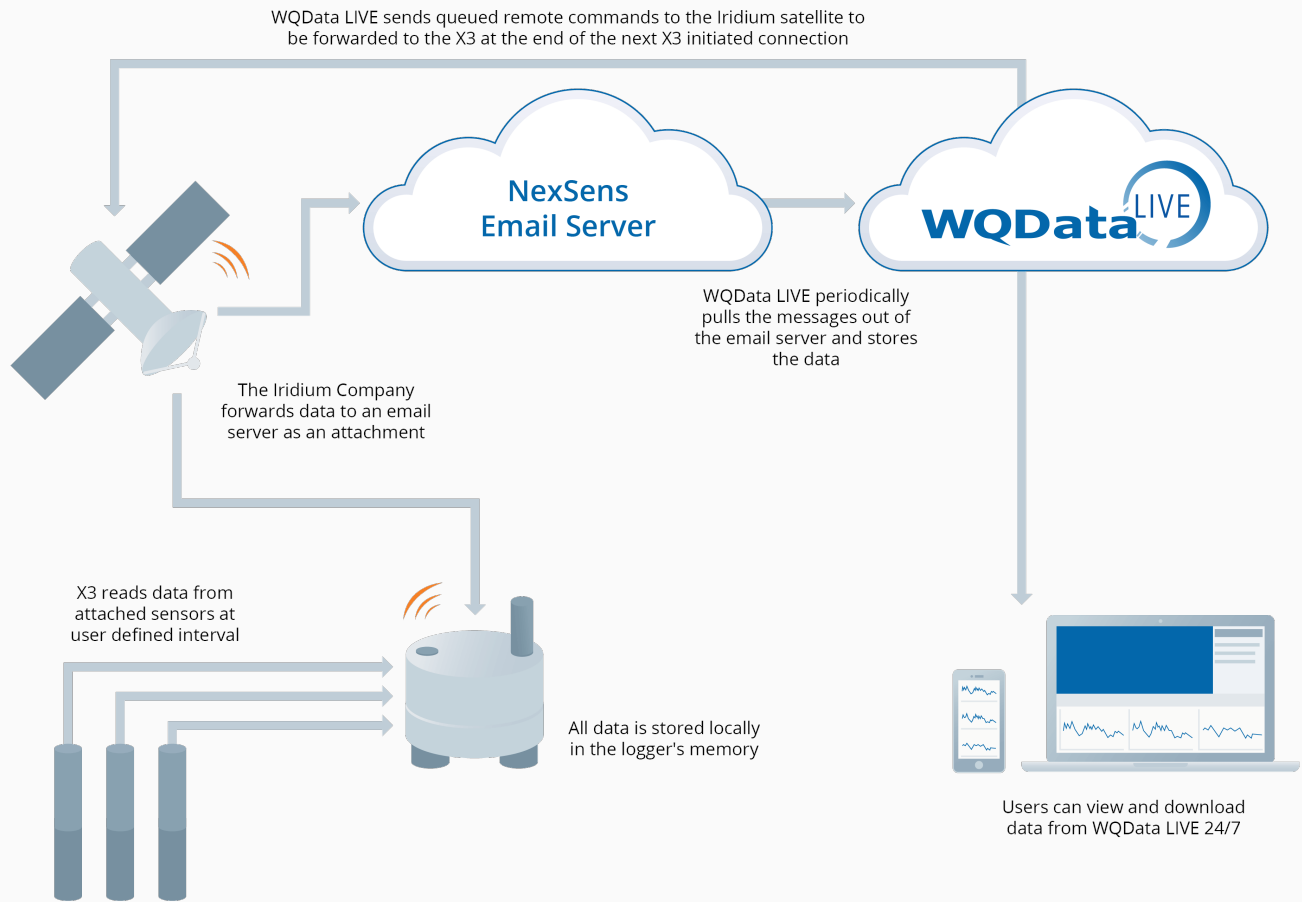


Figure 2: Iridium data flow to WQData LIVE.

Wi-Fi

Wi-Fi systems are best utilized if a local area network is on-site or within range of the deployment location. These systems save money on the annual costs of cellular or satellite services.

NexSens X-Series Data Flow: Wi-Fi Logger to WQData LIVE

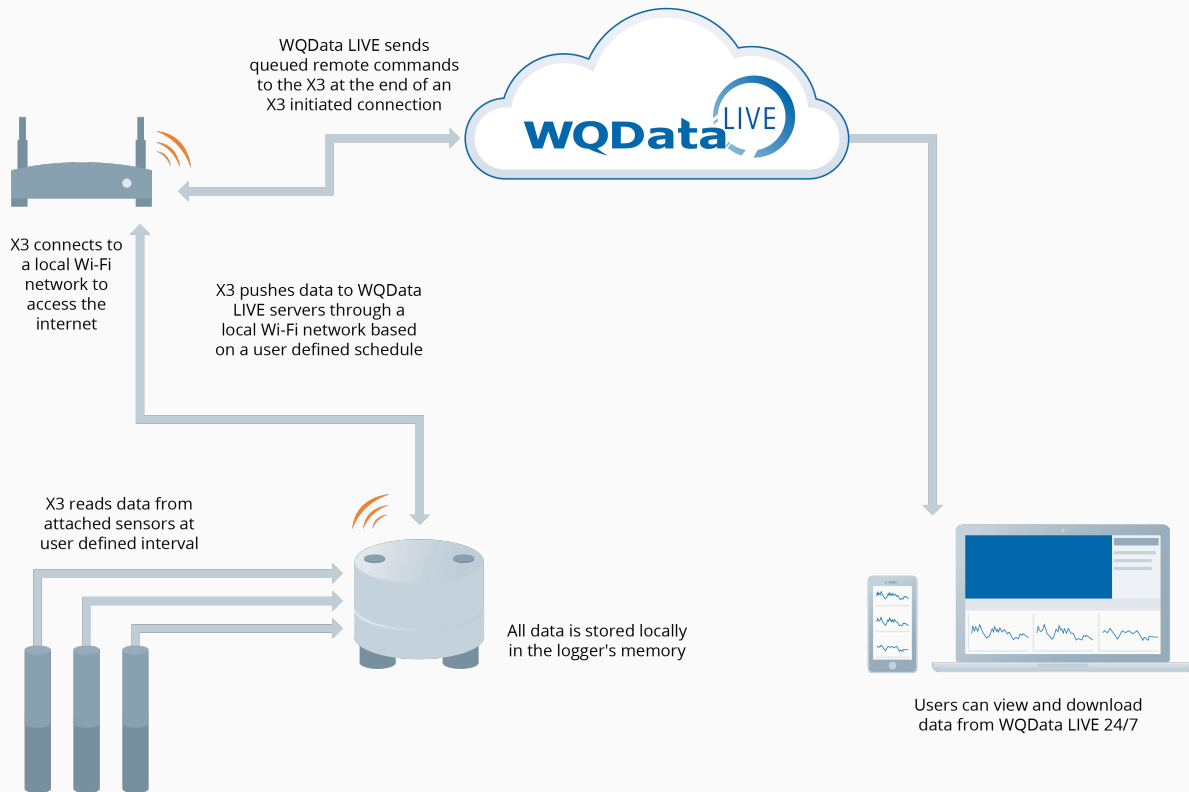


Figure 3: Wi-Fi data flow to WQData LIVE.

Bluetooth

The X3 Environmental Data Logger includes connectivity to Bluetooth-compatible (BLE 5.0) devices. Bluetooth capability removes the need for a direct connect cable and provides more seamless uploads and downloads via the NexSens CONNECT software. NexSens recommends the *tp-link Bluetooth 5.0 Nano USB Adapter* as an affordable Bluetooth adapter option.

NexSens X-Series Data Flow: Data Logger Bluetooth Connection to CONNECT Software



Figure 4: Bluetooth connectivity with the CONNECT software.

Direct Connection

All X-series data loggers have a 6-pin port for power and communication. Users can download logged data directly via the CONNECT software and a [UW6-USB-485P-DC cable](#).

NexSens X-Series Data Flow: Data Logger Direct Connect to CONNECT software

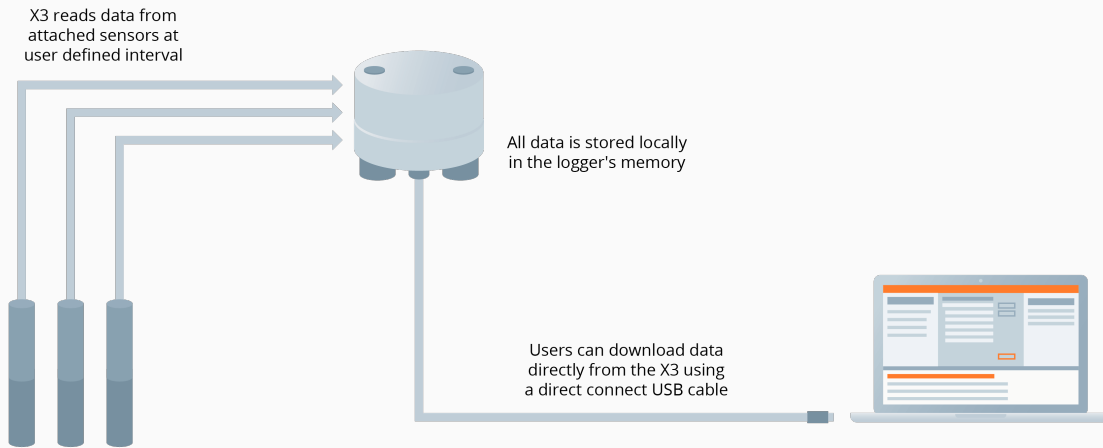


Figure 5: Direct connection via the CONNECT software.

Cellular

Set up a 4G Cellular Account for an X-Series Data Logger

While NexSens can provision and manage a cellular account for an X-Series Data Logger if desired, it may be preferred to set up and manage an account directly with a provider. The loggers' cellular telemetry requires a 4G-compatible SIM to operate. Please reference the following information for 4G cellular account setup:

Step 1) Verify cellular coverage

Prior to selecting a carrier, verify that the deployment location of the X-Series data logger has sufficient 4G data coverage. In addition to consulting a coverage map, confirm by visiting the deployment location with a 4G device operating on the carrier network, if possible. This is to ensure that the signal strength is not hindered by local obstructions.

Step 2) Receive the cellular module information from NexSens

In some cases, the cellular provider will request the device's International Mobile Equipment Identity (IMEI) number. NexSens will provide the IMEI number specific to each X-Series logger cellular module once assigned.

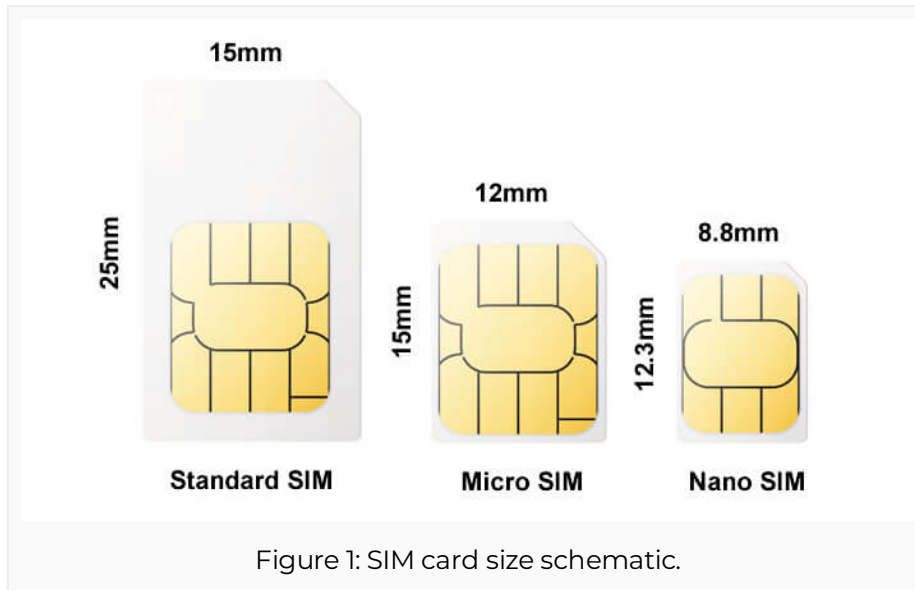
Step 3) Provide IMEI and data requirements to carrier and receive SIM card

Provide the 15-digit IMEI number to the carrier and request to assign this to a Micro SIM card (**3FF** size, 15mm x 12mm) for a *Machine-to-machine* data plan.

If asked about account monthly data plan size, note that most systems will require less than 25MB/month during deployment. Actual usage depends upon the number of recorded parameters, sampling frequency, and any over-the-air firmware updates. For a more precise estimate of system data usage, please contact NexSens.

A Static IP and Unrestricted Access are not required.

Note: For X-Series models produced before 2023, the SIM card size is a Mini (Standard) SIM card (2FF size, 25mm x 15mm). Before procuring a SIM card, confirm with NexSens by providing the model identification (i.e., body tag or serial number).



Step 4) Mail SIM card to NexSens Technology for installation and testing

Send the SIM card to NexSens for pre-shipment installation and testing (strongly recommended). Please ship the SIM card to:

NexSens Technology

2091 Exchange Court

Fairborn, OH 45324

X-Series Logger SIM Card Installation

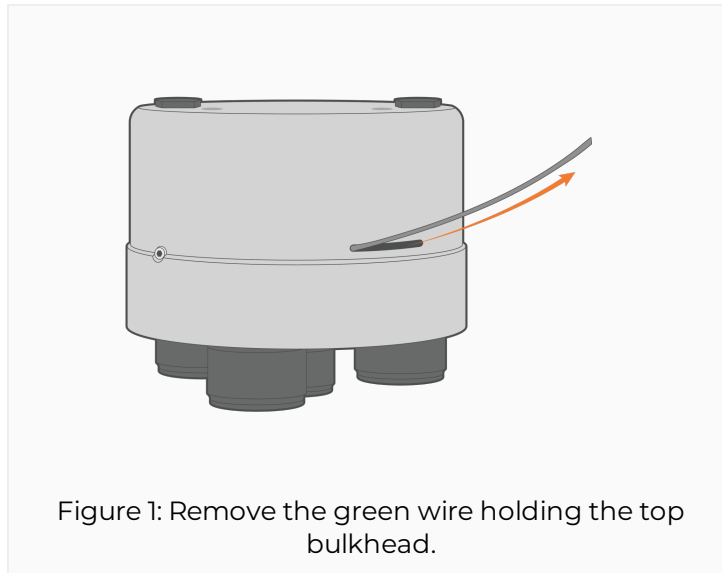
The cellular model of the X3 Environmental Data Logger contains an internal modem for cellular telemetry. The SIM card slot on the modem is compatible with 4G-capable SIM cards that are a 3FF SIM size (12 x 15 mm; Micro-SIM). Before purchasing or installing a SIM card, ensure the SIM is set up according to the article below:

- [Set up a 4G Cellular Account for an X-Series Data Logger](#)

Installation Instructions

Before installing a SIM card, ensure the logger is disconnected from all power sources. Statically ground yourself prior to and while contacting any of the electronics inside the logger. Failure to do so may result in a static discharge that can be harmful to the electronics.

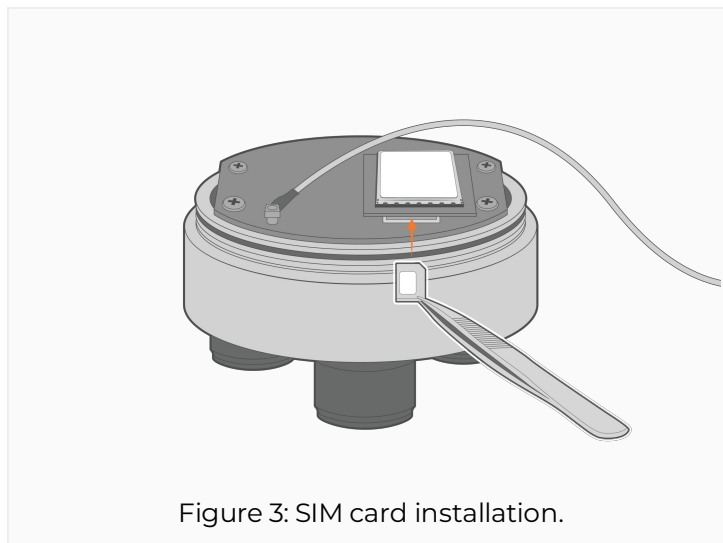
1. Remove the green wire from its track at the base of the data logger's aluminum housing.
 - a. Apply downward pressure on the top bulkhead while removing the wire, as air pressure inside the bulkhead may be pushing upward, making it difficult to remove. If needed, tweezers or needle-nosed pliers can be used.
 - b. The middle port plug can also be removed to relieve some of the built-up pressure.



2. Gently pull up on the top bulkhead to separate it from the data logger's base.
 - a. The data logger circuitry should now be exposed. Be cautious of the cables still connecting the top bulkhead and the electronics.



3. Locate the SIM card slot on the embedded modem at the back of the data logger.
 - a. Orient the SIM card with the electronic chip facing upward and the beveled edge in the top right.
 - b. Insert the SIM card until it is flush with the edge of the embedded modem.



4. Re-install the top bulkhead while aligning it with the blue set screw.
 - a. It is recommended to remove the middle port plug underneath the logger to push any air pressure out of the bulkhead during re-installation.
 - b. Be careful not to pinch any wires during re-installation.
 - c. If available, replace the desiccant and apply a light layer of O-ring grease.



Figure 4: Orient and re-install the top bulkhead.

5. Re-install the green wire while keeping slight downward pressure on the top bulkhead.
 - a. When fully installed, a small piece of the green wire should overlap the entry point for each access in the future.

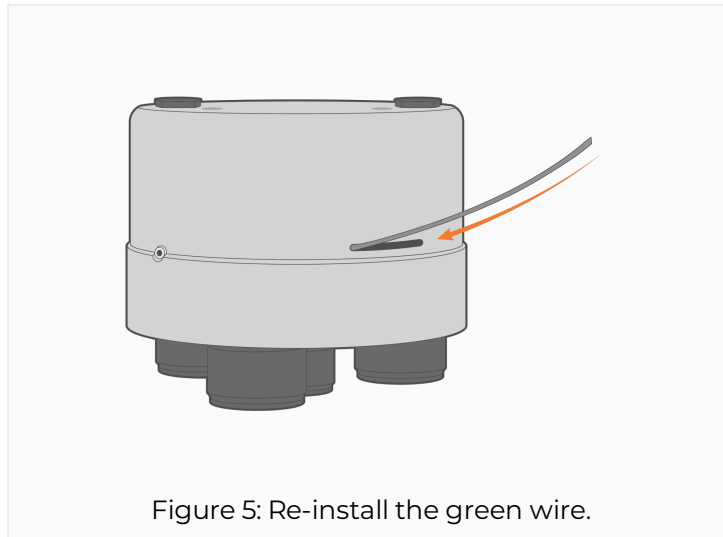


Figure 5: Re-install the green wire.

6. Follow the link below to set up the cellular telemetry on the X3-SUB:
 - a. [Enable Cellular Communication on an X-Series Data Logger](#)

Enable Cellular Communication on an X-Series Data Logger

To enable cellular communication on an X-Series data logger, the user must set the proper settings for the Packet Data Protocol (PDP) context in the CONNECT software. The PDP context involves the local context identification parameter (cid), the PDP type, and the Access Point Name (APN). Each of these settings specifies the local cellular carrier utilized by the modem and SIM card (e.g., Verizon, AT&T, T-Mobile, etc.) and provides a way to route data packets to the WQData LIVE Web Datacenter. For modems with multiple carrier options, multiple PDP contexts can be set; however, only one can be set to the “Active cid”. The process below outlines how to set the PDP context for cellular communication.

Note: All X3 data loggers will come with an active SIM card. If cellular service is purchased through NexSens, the card can be used for the duration of the active plan. No additional setup will be required. If cellular service is not purchased through NexSens, the SIM card will be active for a three-month trial period. The active SIM card can be used for initial testing and will not require the subsequent steps below. Only follow the steps below if a user-supplied SIM card is installed.

1) Power On the Modem

1. Connect the X-Series logger to a PC and launch the CONNECT software.
2. Navigate to **Tool | X2 RTU | Cellular** within CONNECT.
 - a. Wait for 30 seconds before powering on the RTU, as the X-Series data logger will conduct internal processes on powerup that will interfere with direct communication.

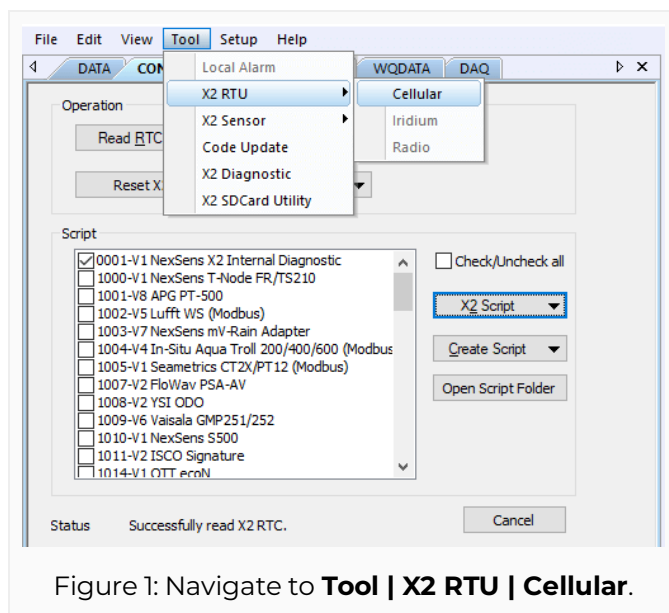


Figure 1: Navigate to **Tool | X2 RTU | Cellular**.

3. Select **Turn Power ON** to startup the loggers’s RTU board, which controls communication to the internal modem and SIM card.
 - a. Note that this process may take up to 30 seconds to complete.
 - b. A message will appear to confirm once RTU Power is successfully turned on.
 - o Note: The RTU will power down every 10 minutes or after completing a sensor reading. If this occurs, turn on the RTU again to continue direct communication.

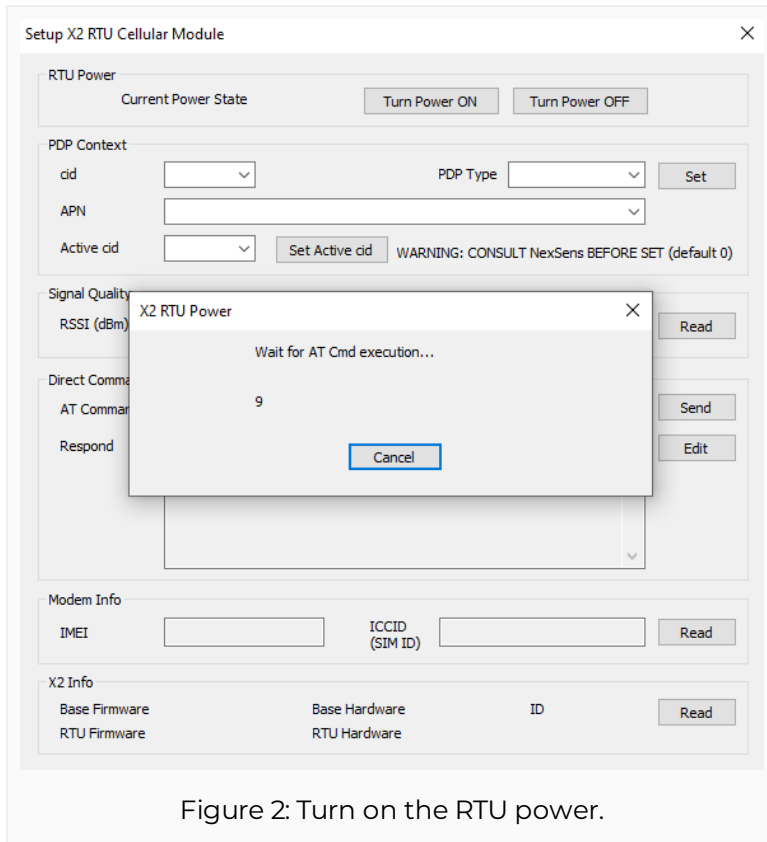


Figure 2: Turn on the RTU power.

2) Set the Network Configuration for the Local Cellular Carrier

Newer modem models (LE910C1-xx) available in X-Series data loggers can switch between multiple cellular carriers (e.g., AT&T, Verizon, T-Mobile, etc.). For proper communication, the carrier used at any given time must be specified and saved within the modem's internal settings. Begin by confirming the modem model and then setting the proper cellular carrier accordingly.

Note: All X3 Environmental Data Loggers will contain the LE910C1-WW4G modem, and the mode will be set to AT#FWSWTICH=40,1 (Global). If an X3 logger is purchased, users can skip to the next section.

1. Send the **AT#CGMM** to return the model name of the installed modem.
 - a. If the logger contains the LE910C1-xx model, continue to step 2.
 - b. If the logger contains a different modem model, continue to **Verify the Current APN Settings**.

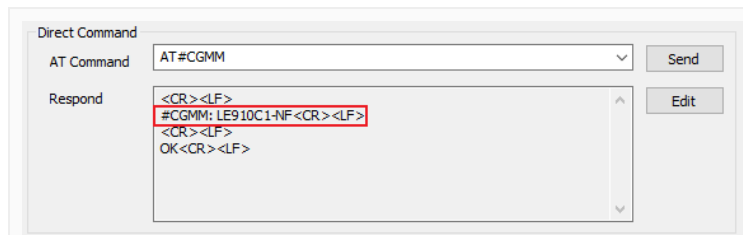


Figure 3: CONNECT view modem model command.

2. Check which mode the modem is currently in by entering: **AT#FWSWITCH?**

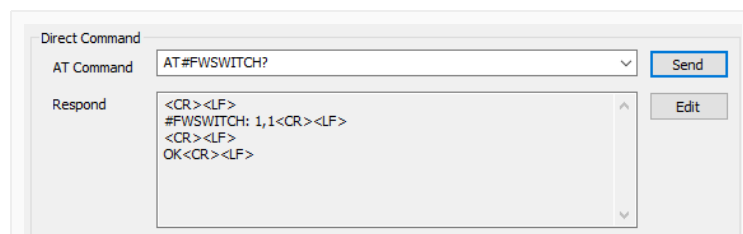


Figure 4: Check the current mode command. The current mode is Verizon.

3. Change the mode to the proper cellular carrier by entering any of the following commands:
 - a. **AT#FWSWITCH=0,1** (AT&T/International)
 - b. **AT#FWSWITCH=1,1** (Verizon)
 - c. **AT#FWSWITCH=3,1** (Bell)
 - d. **AT#FWSWITCH=4,1** (Telus)
 - e. **AT#FWSWITCH=40,1** (Global)
 - f. **AT#FWSWITCH=101,1** (T-Mobile Deutsche)
 - o After sending the command, wait ~30 seconds for the firmware change to complete.

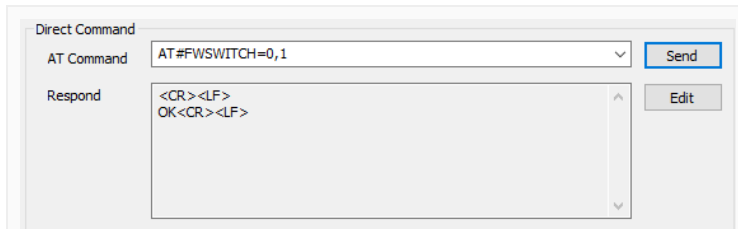


Figure 5: Change from cellular carrier mode.

4. Resend the **AT#FWSWITCH?** to ensure a successful change.

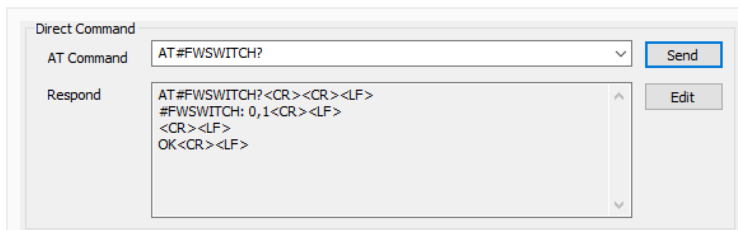


Figure 6: Confirm successful mode change.

5. Enter and send the following command (**AT+WS46=28**) to force the modem to only look for 4G networks.
 - a. By default, modems will look for available 2G and 3G networks, which are becoming obsolete. Limiting the connection to 4G networks substantially lowers the amount of time required for the modem to connect to a network.

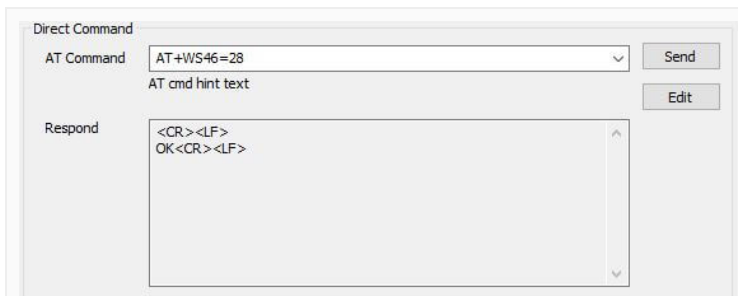
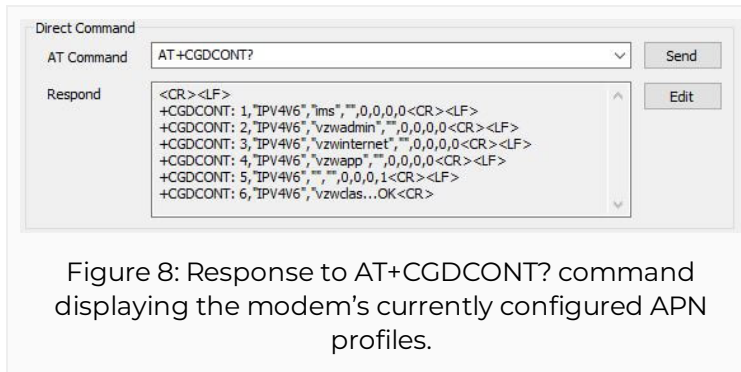


Figure 7: 4G-only cellular connectivity.

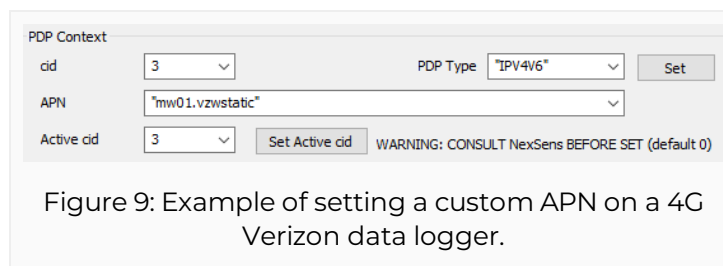
3) Verify and Configure the Current PDP Context Settings

New modem and SIM card combinations usually come with standard PDP context settings available in the list. The current PDP context settings can be verified before making any adjustments, if necessary.

1. To confirm the PDP Context settings, select and send the **AT+CGDCONT?** command from the *Direct Command* list.



2. In the *PDP Context* field of the menu, enter the following information:
 - a. *cid*
 - o Each cellular carrier has multiple cid's available for different purposes (e.g., IMS services, administrative, emergency, general internet connection, etc.). The cid necessary for communication with WQData LIVE is for general internet connections only.
 - 1 = AT&T, T-Mobile, or most International carriers
 - 3 = Verizon
 - b. *PDP Type* – (Type of IP address assigned to the PDP)
 - o **IPV4V6** typically works universally.
 - o KORE SIM cards provided by NexSens use the **IP** PDP type. If you are uncertain about the SIM card type, confirm it with NexSens.
 - c. *APN*
 - o Each cellular carrier has multiple APNs used for different purposes and corresponding to a specific cid. The most common APNs are available within the drop-down list.
 - o If the required APN is not on the list, which will often be the case, enter the proper APN enclosed in quotations.



3. After entering the values, click **Set**. Then, a prompt will appear indicating whether the command was successful.
4. Multiple PDP contexts with different cids can be set; however, the Active cid must be set for the carrier that is currently being utilized. Enter the appropriate cid and select **Set Active cid**.
5. It is recommended to read back the APN settings via the **AT+CGDCONT?** direct command following the change to verify they are properly listed on the modem.

4) Test Network Connection

After configuring the modem APN settings, test the modem's network connection.

1. Send the **AT+CMEE=2** command to turn on extended error codes.

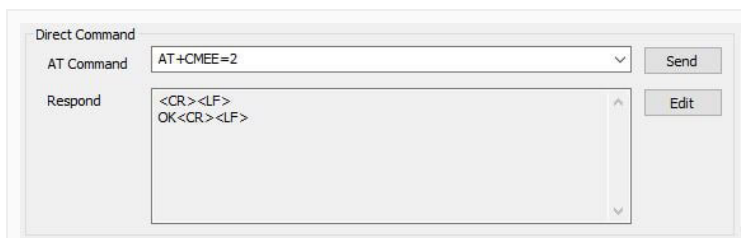


Figure 10: Turn on extended error code responses in the modem.

2. Read the *Signal Quality* of the system to verify it is within the -51 dBm to -90 dBm range.



Figure 11: Verify the signal strength is adequate.

3. Send the **Custom 1**, followed by the **Custom 2** command.
 - a. The Custom 1 command activates the modem and sets an HTTP connection to wqdatalive.com.
 - o Before sending the Custom 1 command, select *Edit* to ensure the **AT#SGACT** command is sending the correct information. For AT&T/International SIMs, the command should be **AT#SGACT=1,1**. For Verizon SIMs, the command should be **AT#SGACT=3,1**. The AT#SGACT command queries the modem, connects to the network, and resolves an IP address.
 - o Successful connections will display the IP address assigned to the modem during its connection request.
 - o Connections that fail will display one of many messages (facilitated by the extended error code activation in step 1). Some common ones are:
 - *SIM not inserted* – indicates a loose or improperly installed SIM card in the modem.
 - *Activation Failed* – generally a cellular account setup issue.
 - *Requested Service Option not subscribed* – generally a cellular account setup issue.
 - *Unspecified GPRS error* – typically a cellular account setup issue or an incompatibility between the network in use and the supported cell modem/antenna bands.
 - b. The Custom 2 command tests the communication with WQData LIVE by transmitting null data to wqdatalive.com and seeing if a timestamp is returned.
 - o If the Custom 1 command returns an error, the Custom 2 command should not be sent until the issue is resolved.

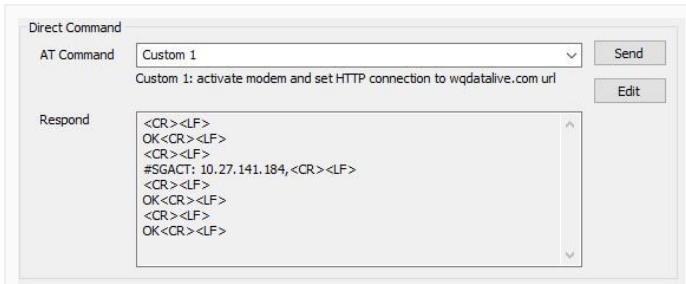


Figure 12: Successful Custom 1 command response.



Figure 13: Successful Custom 2 command response.

After successfully configuring the network connection, use the WQDATA tab in CONNECT to transfer data to WQData LIVE.

- [Communicate with WQData LIVE through CONNECT](#)

Iridium

Enable Iridium Communication on an X-Series Data Logger

Satellite/Iridium transmission is more expensive than other traditional forms of communication (e.g., cellular, radio, Wi-Fi). Therefore, it is imperative that the end-user only transmit the most useful diagnostic and sensor parameters. The CONNECT software can set these parameters and their log/transmission interval *before* the data logger transfers data to the web. Thus, outlining the proper sensor configuration through the CONNECT software will reduce overall data transfer.

If a sensor detection has not been performed, follow the included quick start guide to complete the detection process. It is recommended to disconnect the iridium antenna before performing the detection to ensure no communication is established with WQData LIVE. It is imperative that all internal logger settings are finalized before allowing the logger to send data to WQData LIVE.

1) Setup an Iridium Short-Burst Data (SBD) Account

All Iridium-enabled X-Series data loggers must have an active SBD account in order to send measurement data to WQData LIVE. *If iridium service is not purchased through NexSens*, follow the link below to find a 3rd party iridium service provider and set up an SBD account:

- [Setup an Iridium SBD Account](#)

2) Setup a Gmail Account for Iridium Messages

X-Series loggers with Iridium telemetry transmit data messages to a dedicated email server. The messages are then downloaded from the email server to the WQData LIVE web datacenter. NexSens hosts a secure Gmail account as a medium to store and upload data to WQData LIVE. Although this option is freely available to all customers who purchase an Iridium system, private Gmail accounts can be set up to achieve the same purpose. Follow the link below to set up a user-owned Gmail account to send Iridium data messages to WQData LIVE.

- [Setup Gmail Account for Iridium Messages](#)

3) Set Transmit Flags

Transmit flags control which parameter data is transmitted to WQData LIVE. Setting the transmit flags allows the user to control the amount of data that is transmitted to the web at each interval. It is important to review the iridium plan purchased through NexSens or a 3rd party provider to ensure the data size does not exceed the allowable limit.

- Follow the link below to set the appropriate transmit flags for the logger.
 - [Set Transmit Flags and Start Time/Interval](#)
 - It is advised to enable transmit flags for the following internal X2 parameters:
 1. Primary Power

2. Internal Humidity
3. Cell Signal Strength
4. Cell Status

4) Set Log/Selective Upload Interval(s)

The log interval controls the frequency at which parameter data is recorded, and the selective upload interval controls the frequency at which parameter data is transmitted. Users may set parameter data to log internally at a higher frequency while only transmitting a portion of the logged data. The selective upload feature allows Iridium users to limit their overall transmission size while still collecting data at a higher resolution. The logged data can then be downloaded directly at a later date.

- Follow the link below to set the appropriate log and selective upload intervals based on the Iridium data plan and the data collection requirements.
 - [Set Log and Selective Upload Intervals](#)
 - It is advised to set the selective upload interval for the internal X2 parameters to at least 6 hours; however, this will depend on the Iridium plan purchased for the logger.

5) Review & Begin WQData LIVE Setup

Review the final sensor configuration and gather multiple readings before continuing with the WQData LIVE setup. The Gmail account associated with the Iridium service must be entered into the advanced WQData LIVE settings for the data logger. These settings create the connection required for WQData LIVE to extract the Iridium messages. Follow the link below to set the appropriate settings on WQData LIVE:

- [Configure an Iridium Logger on WQData LIVE](#)
 - At the next transmit interval, the logger will push its sensor configuration to the email assigned to it during the Iridium account setup.
 - WQData LIVE will request messages from that email every 5 minutes. Once the emails are extracted, it will take ~2 additional minutes for processing before the configuration is visible on the web.

6) Update Logger's Binary Format

1. Once the configuration is visible, the user must send the "Update Binary Format" command from WQData LIVE.
 - The binary format command will provide the settings outlined in the CONNECT software.
 - **Note:** No data will transfer until the data logger provides an updated binary format to the web.

2. Navigate to the **ADMIN | Settings** tab at the top of the WQData LIVE *Project Dashboard*.

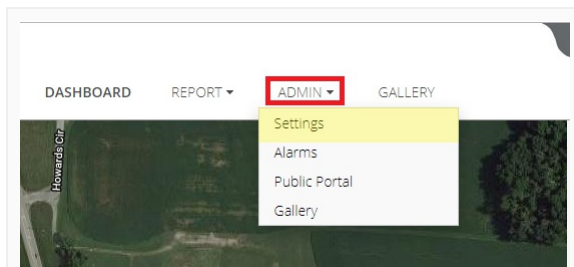


Figure 1: **ADMIN | Settings** tab.

3. Click on the **Advanced Device Remote Configuration** drop-down menu and choose the logger.
 - Enter code 'nexsens' when prompted.

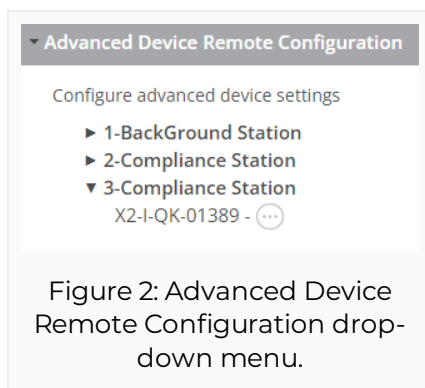


Figure 2: Advanced Device Remote Configuration drop-down menu.

4. Click the **UPDATE** button underneath *Update Binary Format*.
 - A prompt should display showing the command was sent successfully.
5. After the command is sent, three full transmission intervals will occur before data is pushed to the web.
 - The logger will pull this remote command from the email at the first transmit interval.
 - The logger will provide the updated format at the second transmit interval.
 - WQData LIVE will process this format and be able to parse the data that is pushed on the third transmit interval.

Iridium Transmission Delay

Compared to data loggers utilizing cellular, radio, or Wi-Fi telemetry, Iridium transmission systems have an additional step in the data upload process which may cause a delay in the time it takes from the logger recording a measurement to data being posted on WQData LIVE.

Data messages transmitted from the logger's satellite modem are first packaged as email attachments (SBD file). WQData LIVE must pull and process these data files from the associated Iridium email server before the data can be posted to the web.

Server-side restrictions limit the maximum frequency that polling of the Iridium mailbox can occur. Each device mailbox is checked once every 5 minutes. As a result, there will be at least a 5 minute delay between the scheduled Iridium transmission interval and posting of data to WQData LIVE. Systems which include sensors with long measurement acquisition times will experience even longer delays.

An example scenario:

- An Iridium X-Series logger is set to log and transmit its next reading at 08:00
- The reading is initiated and the last sensor completes its measurement at 08:06
- The logger records the new reading internally and signals the system to transmit the data
- The Iridium data message is delivered to the email server at 08:07
- WQData LIVE polls the mailbox and finds the new data message at 08:10
- The 08:00 reading is available to view on the WQData LIVE project shortly after 08:10

This process is illustrated in the diagram below.

NexSens X-Series Data Flow: Iridium Logger to WQData LIVE

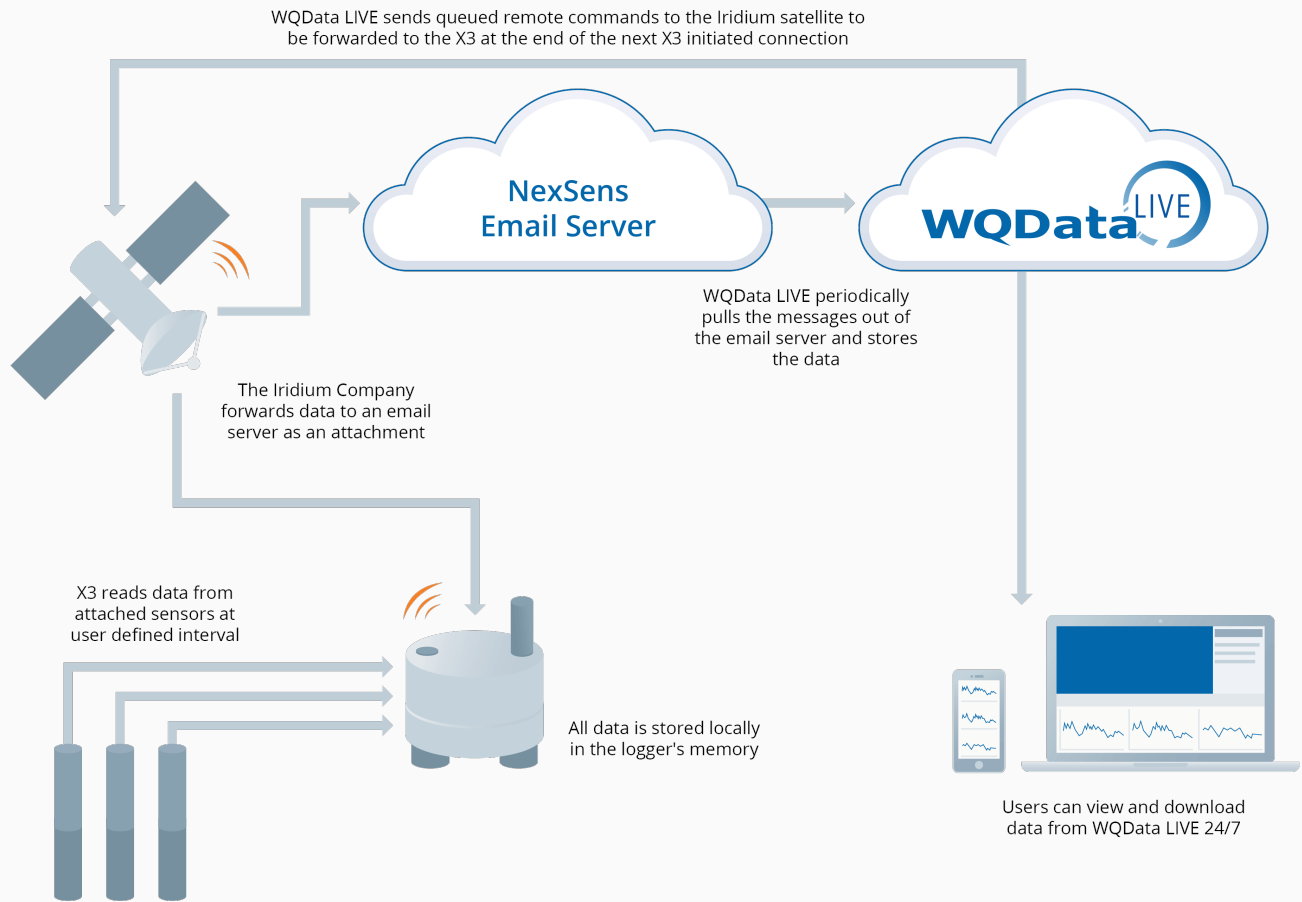


Figure 1: Iridium X-Series logger data flow.

5. Deployment

X-Series Data Logger Land-Based Installation

The [NexSens PM2 Data Logger Mounting Kit \(PM2\)](#) is a specially designed mounting kit for X-Series data loggers. It allows for wall mounting with user-supplied screws or pole mounting on a 1.5" to 2" (38 to 50 mm) pipe with other system components. The kit includes grounding hardware to protect the system from power surges or spikes.

Grounding a data logger is critically important to ensure measurement accuracy and prevent damage to a data logging system. Damage can either occur acutely or manifest through intermittent hardware problems that are difficult to diagnose and can eventually result in failure. While lightning strikes are an obvious source of power surges that can damage system components, other less commonly thought-of hazards include nearby machinery, other electrical systems, and electrostatic discharge (ESD). Regardless of the environment, measurement systems should always include proper grounding of a data logger and other electronics. Proper grounding helps reduce the risk of expensive damage to the system.

Instructions for installing the data logger are provided below. For more information on proper grounding procedures, please visit the article below:

- [Electrical Grounding, Surge and Lightning Protection](#)

Land-Based Installation Instructions

For wall mounting, the user must acquire the appropriate screws for the wall material. A 5/16" hex driver and 9/16" socket or wrench will be required to install the X-Series logger on the mount. For pole mounting, the user will need a 1/2" socket or wrench, along with the 5/16" hex driver and 9/16" socket or wrench for full installation. Before mounting the data logger in either scenario, ensure the locations of the power source and sensors are within range to connect directly with the logger. The locations should be in a close enough proximity that cables can connect without any strain.

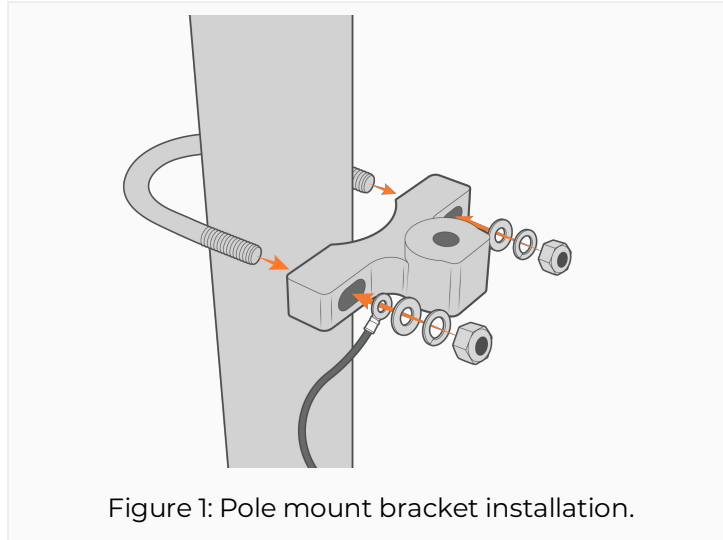
Included equipment:

- (1) Pole mount bracket
- (1) X3 Grounding kit (included with logger)
- (1) 5/16-18 x 2" U-bolt
- (1) 3/8-16 x 1-1/8" Socket head cap screw
- (2) 5/16" Split lock washers
- (2) 5/16" Flat washers
- (2) 5/16-18 Nuts

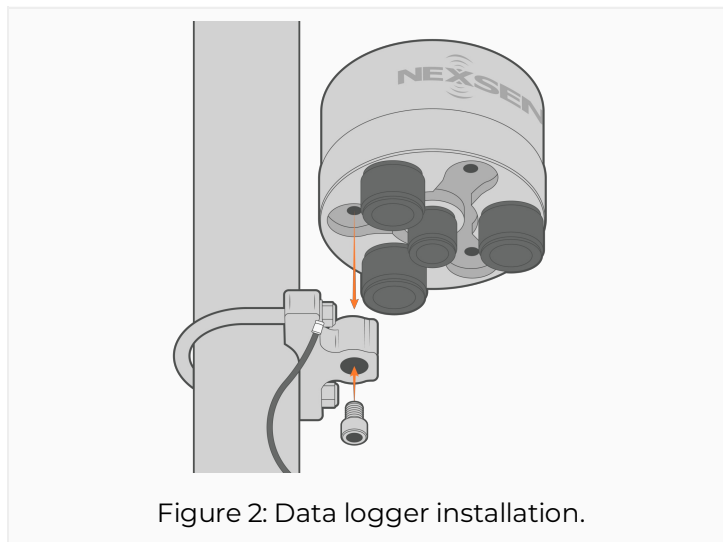
Required Tools:

- 9/16" socket or wrench
- 1/2" Socket or wrench
- 5/16" Hex driver

1. Gather the *PM2 pole mount hardware* and the *X3 Grounding Kit*. Attach the bracket to a wall with the appropriate screws or to a 1.5 to 2" pole using the included U-bolt, flat washers, lock washers, and nylon nuts.
 - a. Tighten the nylon nuts fully using a 1/2" socket or wrench.
 - b. Ensure the grounding cable contacts the bracket during installation.



2. Align one of the (3) threaded inserts on the bottom of the logger with the mount. It is best to mount the logger with the body tag visible. Insert the socket head cap screw and tighten using a 5/16" hex driver.
 - a. The bolt will sit flush within the mount.



3. Attach the other end of the grounding cable to one of the other threaded slots underneath the logger.
 - a. Ensure the grounding cable contacts the logger during installation.
 - b. Use a 9/16" socket to tighten until the lock washer is flattened.

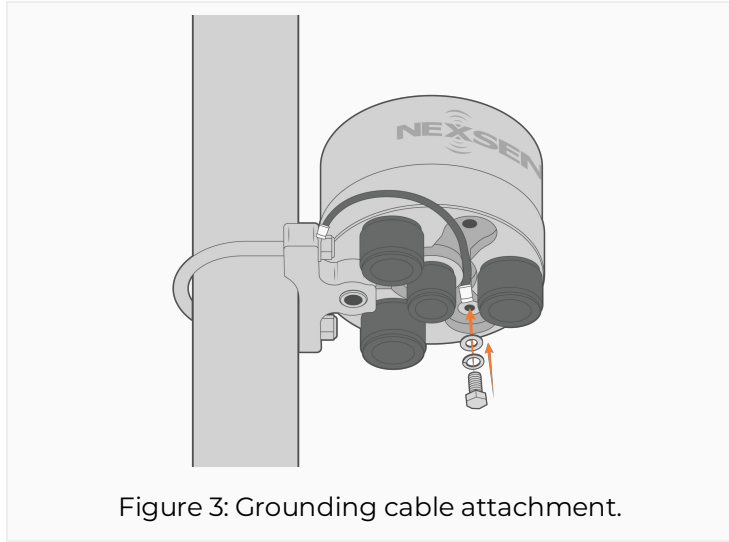


Figure 3: Grounding cable attachment.

X3 Data Logger Buoy-Based Installation

All X3 Data Loggers ship with multiple mounting equipment sets compatible with NexSens CB-Series data buoys. One set provides mounting equipment for the smaller buoy ranges (CB-150 to CB-450), and the other is used for the larger buoy ranges (CB-650 to CB-1250).

Engravings next to the antenna ports display the antenna type (i.e., CELL or SAT). For proper communication, match the appropriate antenna with the corresponding engraved antenna port. To avoid damage, remove all antennas before installation. Programming and testing the system before installation and labeling the ports with the sensor locations are also recommended. Once that is complete, follow the installation processes below for the specific buoy model.

Small Buoy Mounting Instructions (CB-150 to CB-450)

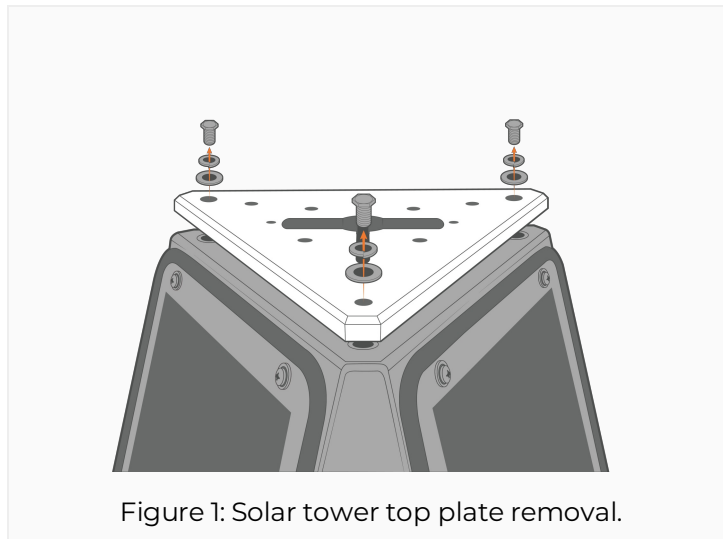
Included equipment:

- (4) 5/16-18 x 7/8" Hex head cap screws
- (4) 5/16" Split lock washers
- (4) 5/16" Flat washers

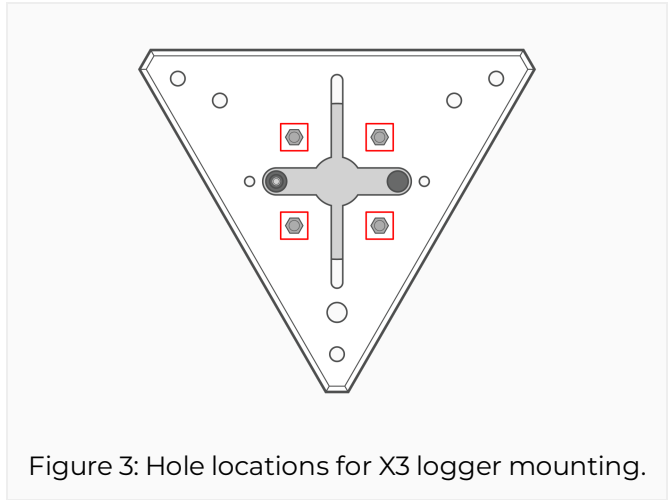
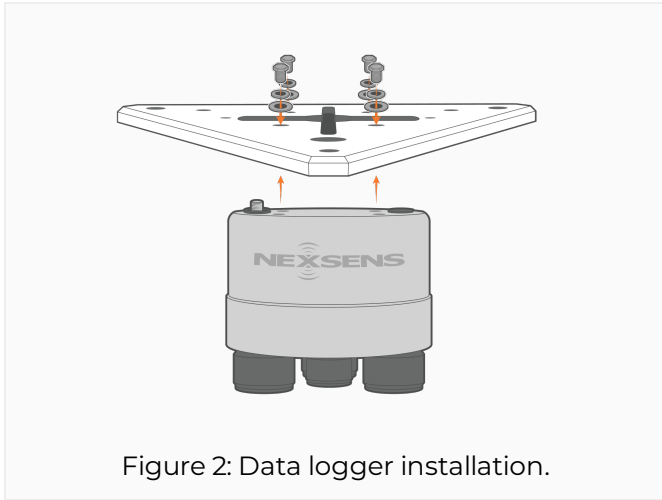
Required Tools:

- 9/16" Socket or wrench
- 1/2" Socket or wrench

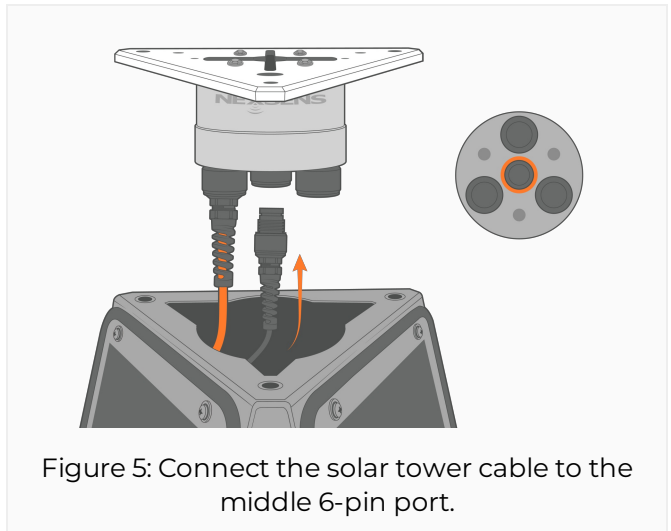
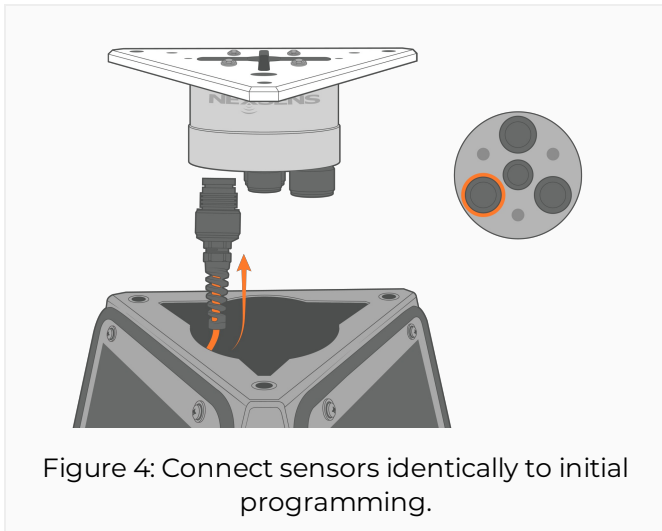
1. Gather the *CB-150-450 Mounting* equipment. Use a 9/16" socket or wrench to remove the white top plate from the buoy's solar tower.



2. Align the threaded slots on top of the logger with the (4) corresponding holes on the white plate.
 - a. Attach the logger using the (4) hex head cap screws, lock washers, and flat washers.
 - b. Tighten using a 1/2" socket or wrench.



3. Provide power to the middle 6-pin port on the data logger via the solar tower plug and connect the sensors to the outer 8-pin ports.
 - a. Ensure the sensors are connected in the same configuration as they were programmed.



4. Reattach the plate and install the antenna.
 - a. Install the antenna to the correctly labeled port (i.e., CELL or SAT).

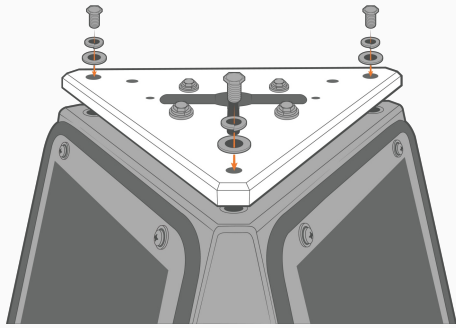


Figure 6: Re-install the top white plate with the X3 data logger attached.

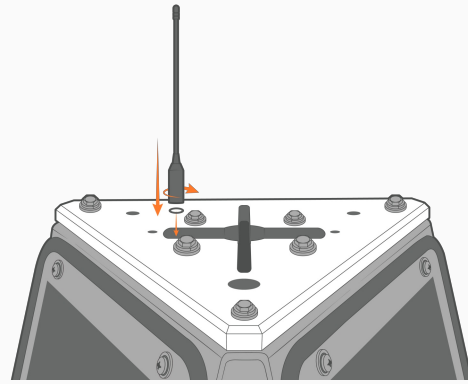


Figure 7: Install the antenna to the correctly labeled port (i.e., CELL or SAT).

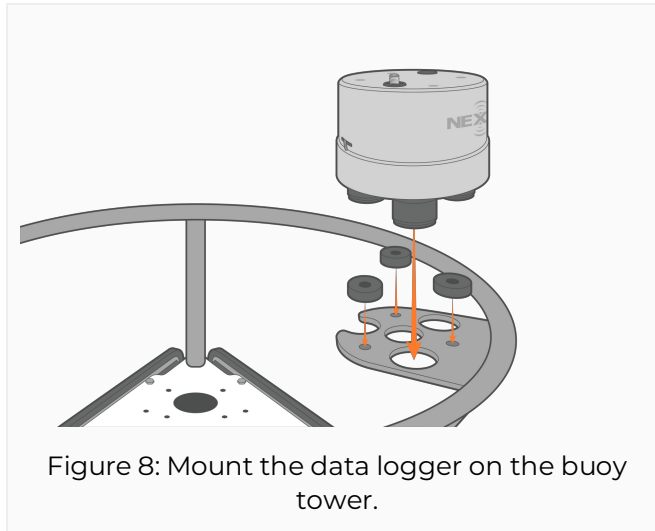
Large Buoy Mounting Instructions (CB-650 to CB-1250)

Included equipment:

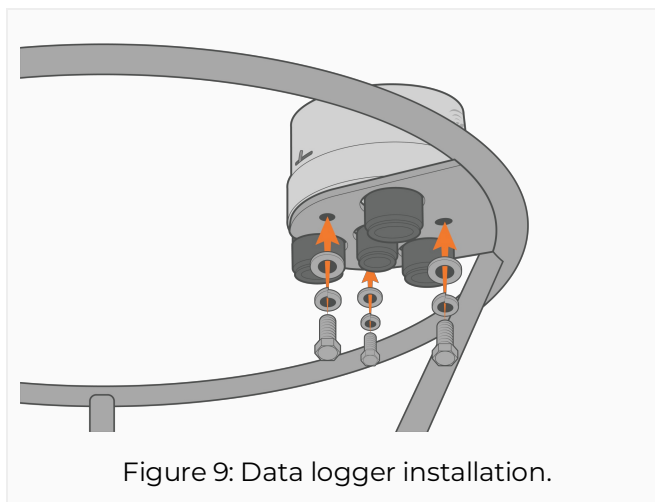
Required Tools:

- (3) 3/8-16 x 1" Hex head cap screws
- (3) 3/8" Split lock washers
- (3) 3/8" Flat washers
- (3) Isolation washers
- 9/16" Socket or wrench

1. Gather the *CB-650-1250 Mounting* equipment. Align the threaded inserts on the bottom of the data logger with the (3) black isolation washers and the smaller holes on the mount.
 - a. The data logger ports should align with the large openings on the mount.
 - b. **Note:** An intentional gap will exist between the mount and the data logger to avoid contact between the dissimilar metals.



2. Insert the (3) hex head cap screws, lock washers, and flat washers into the threaded inserts on the logger.
 - a. Tighten using a 9/16" socket or wrench.



3. Provide power to the middle 6-pin port on the data logger and connect the sensors to the outer 8-pin ports.
 - a. Ensure the sensors are connected in the same configuration as they were programmed.
 - b. For any connectors within or below the solar tower, it is best to tie a rope or string around each connector to pull them through the opening at the top of the solar tower.

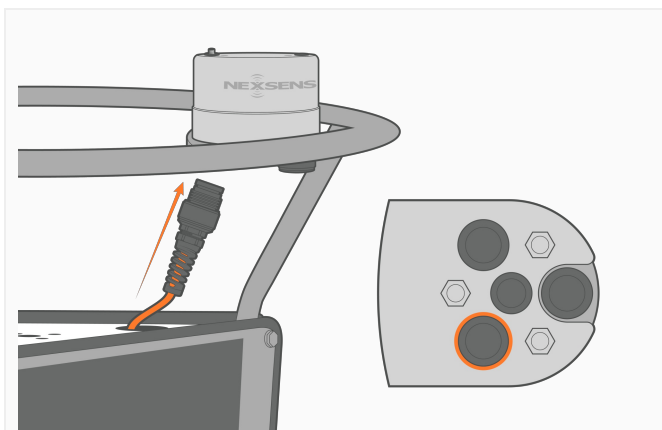


Figure 10: Connect sensors identically to initial programming.

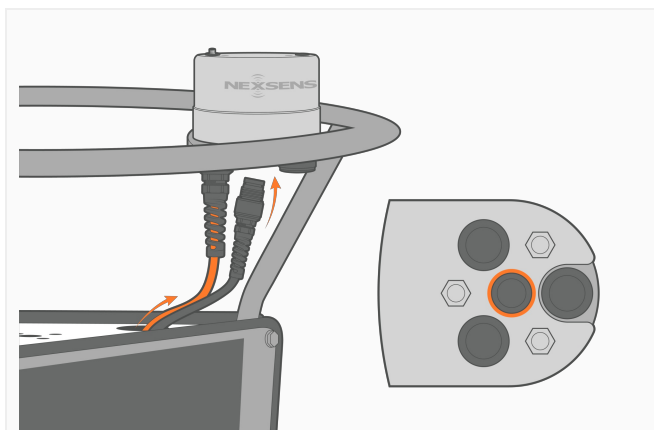


Figure 11: Connect the solar tower cable to the middle 6-pin port.

4. Install the antenna to the correctly labeled port (i.e., CELL or SAT).
 - a. Ensure the cellular antenna's O-ring is seated correctly and the antenna is making solid contact with it.

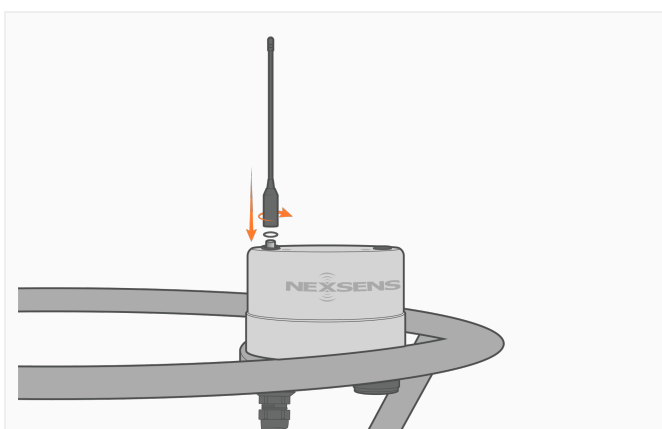


Figure 12: Cellular antenna installation.

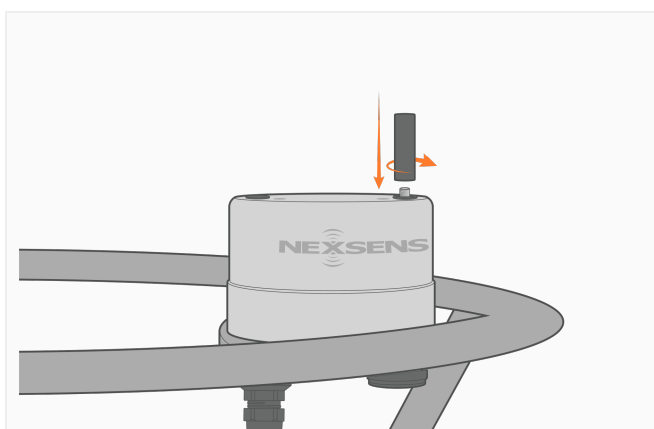


Figure 13: Satellite antenna installation.

6. Troubleshooting

Sensor(s) Not Found During X-Series Logger Auto-Detection

If an X-Series data logger fails to detect a connected sensor following the completion of the auto-detection process, verify the following:

1. Check for proper wiring of sensor signals and seating of all cable connections.
2. Verify that the **script for the sensor** has been developed, loaded onto the logger, and enabled to run.
3. Confirm the required configuration settings for each sensor.
 - a. Assign each SDI-12 or Modbus sensor a unique address to avoid conflicting with one another.
 - b. Connect each RS-232 sensor to a unique port to avoid conflicting with another RS-232 sensor (1 sensor to P0, 1 sensor to P1, 1 sensor to P2).
 - c. For multi-parameter sensors, confirm parameter outputs and/or the data formats using manufacturer software.
 - d. Many highly customizable sensors, such as a current profiler or wave sensor, require setting the instrument into a 'deployment mode' before external communications will work.
4. Verify sufficient 12VDC power supply to the logger.
 - a. The USB cable power, for example, may not provide enough current to properly power up certain sensors. This will, therefore, prevent them from responding during the detection process.
 - b. Old, damaged, or insufficiently charged SLA-type batteries may be unable to output the system current required for detection.

Once all of the above have been verified, **re-run sensor detection**. If the auto-detection still fails to identify any connected sensors, contact NexSens Technology for further assistance.

Phone: 937-426-2151

Email: info@nexsens.com

Running a Sensor Re-Detection

After running a sensor auto-detection during initial setup, WQData LIVE receives and parses the specific **XML data format** that outlines the logger's sensor configuration (i.e., sensor id, parameter ids, parameter units, etc.). Once the sensor configuration is received, it is saved on the backend of WQData LIVE and used to parse data for future transmissions from the logger.

When running a sensor **re-detection** to add or remove sensors/parameters, the XML data format of the sensor configuration changes, and WQData LIVE must be updated. If the new format is not saved via a *WQData setup* or *sync settings* command, data transmissions will be rejected as WQData LIVE cannot correctly parse the data. Additionally, the data logger relies on the latest timestamp from WQData LIVE to push up any backlogged data. Thus, the same parsing issues may arise if old data remains (gathered using the old sensor configuration) on the logger after running a new sensor detection.

Re-Detection Considerations

NexSens recommends running sensor re-detections while directly communicating with the data logger using the **NexSens CONNECT software**. CONNECT allows you to erase the log data and sensor programming, enable the proper scripts, run the sensor detection, and push the new configuration immediately to WQData LIVE. CONNECT will display the final sensor configuration that the user should confirm before transmitting the new sensor configuration.

- Ensure to consider the following for the sensors in the new detection:
 - All sensors are set up properly for communication with the data logger following their **X-Series integration guide**.
 - Only one RS-232 sensor is connected to a single port.
 - All SDI-12 and RS-485 sensors have unique addresses.
 - 12VDC power is connected during the detection process.

Re-Detection Process

1. Connect the sensors to the data logger.
 - a. If possible, connect the sensors used in the previous detection to the same port.
2. **Download and open the CONNECT software**. Establish a direct connection to the data logger using a **UW6-USB-485P communication cable**.
 - a. For buoy models, the internal battery will be used for power.
 - b. For pole-mount models, a DC adapter must be connected to the UW6-USB-485P cable.
 - c. For SDL models, (16) D-Cell batteries should be installed to provide adequate power.
3. Enable or create the proper sensor scripts for the connected sensors. NexSens recommends only enabling the necessary scripts.
 - a. **Configure Sensor Scripts**.
4. **Erase the log data**.

5. Erase the sensor programming.
6. Reset the logger.
 - a. The data logger will begin the automatic sensor detection process since its previous sensor configuration was erased.

Confirming the New Sensor Configuration

Depending on the number of scripts enabled, the sensor detection duration can be 2 to 15 minutes. The user must periodically check the sensor configuration in the CONNECT software to ensure the detection process is successful. Always gather a few sensor readings to confirm accuracy before moving further.

- **Read Sensor Configuration.**
 - If the new sensor configuration is incorrect, double-check the steps above.

Updating the Sensor Configuration on WQData LIVE

After a successful re-detection, the new sensor configuration must be sent to WQData LIVE. Depending on the extent of the changes, the user may need to contact a support specialist at NexSens Technology to re-create the device on the web.

- NexSens Technical Support Line: (+1) 937-426-2703
- Email: info@nexsens.com

Re-creating the device will make the original device obsolete on the web. All historical data, however, will still be available with the obsolete device. The new sensor configuration and all subsequent data transmissions will be uploaded to a separate location within the users' project/site. A new location is necessary to avoid overwriting the original device configuration, which may cause incorrect sensor/parameter labeling and create parsing issues on the web. A NexSens support specialist will walk you through this process, rename the old device, and ensure the new device is reading correctly.

7. Maintenance

Check SP-Series Solar Pack Voltage

In the event of insufficient or unstable battery voltage from an SP-series solar power pack, check the output voltage by measuring directly on the UW-6 plug. Test the pack both in and out of direct sunlight to fully assess the functionality of the solar panel.

Use a DC voltmeter or multimeter set to measure at least 20VDC. Measure the potential between Pins 1 (V+) and 3 (GND) of the pack's **UW-6 plug connector**.

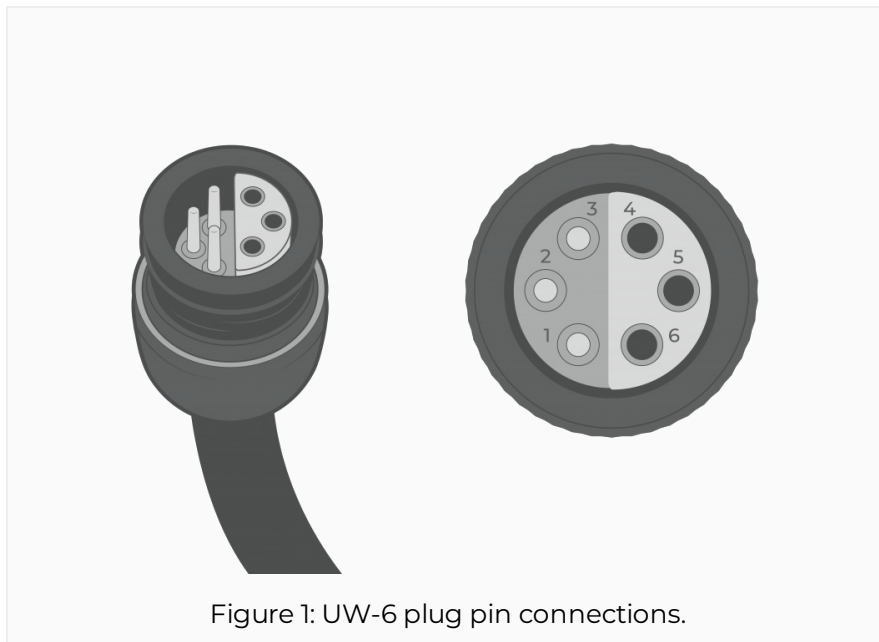


Figure 1: UW-6 plug pin connections.

Healthy operational pack voltages range from 12V to approximately 15.1V. The voltage depends on the amount of direct sunlight and the age/health of the installed battery.

Significantly lower observed voltage on the SP-Series solar power pack may warrant service. Normal service consists of a **battery replacement** (every 3-5 years standard) and/or **solar regulator replacement** (only in event of failure).

Verify Battery Voltage of a CB-Series Buoy

Use a DC volt/multimeter to verify the battery voltage of a CB-Series data buoy on the UW-6 (6-pin) **SOLAR** port on the data well top plate. This method works for both user-supplied battery systems with CB-PTL pass-through lid and NexSens-supplied CB-A01 and CB-A05 SLA battery systems.

Measure the voltage between pins 3 (V+) and 4 (GND) on the *SOLAR* port to verify battery voltage. Healthy SLA battery voltage is 12.0-14.9V.

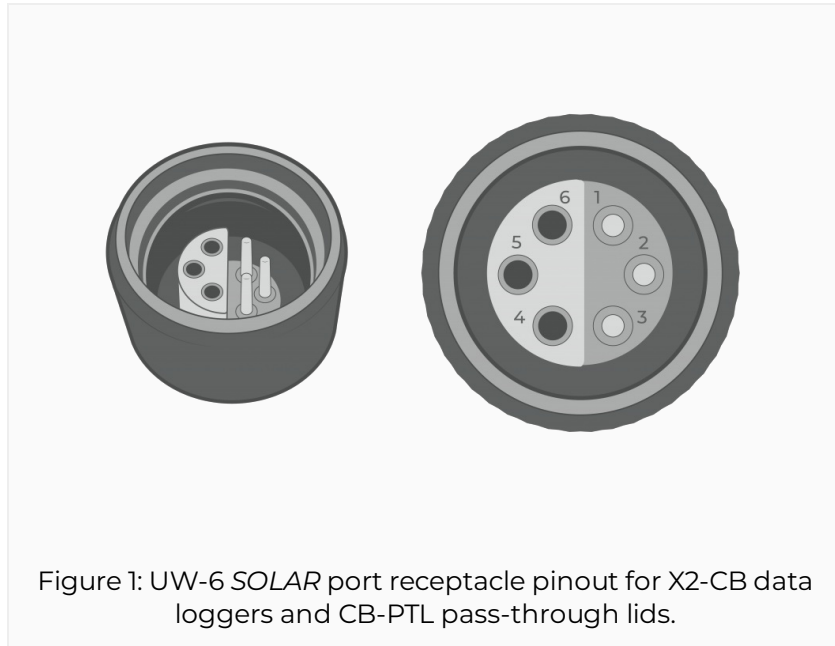


Figure 1: UW-6 *SOLAR* port receptacle pinout for X2-CB data loggers and CB-PTL pass-through lids.

SLA batteries which have fallen below ~10V **require replacement**. Batteries between 10-12V should be charged with a **float charger** or by connecting the buoy solar top and placing the buoy in the sun. Note that the system will be powered on when a cable is connected to the *SOLAR* port. Before charging batteries during long-term storage, be sure to review the **Data Buoy Storage Requirements**.

X3 Logger Desiccant Replacement

Each X3 Environmental Data Logger ships with a silica-gel desiccant pack mounted underneath the top enclosure. The desiccant is an important component in the logger enclosure to keep the internal humidity low. High humidity can adversely impact or damage the electronics. Replace desiccant packs any time the X3 enclosure is opened or if the internal humidity reading is greater than 50%.

For replacement, desiccant packs are available through NexSens or a local provider. NexSens uses [Silica Gel Desiccant Bags for 235 Cubic Inches](#) that are 2.8" L x 1" W.

Desiccant Replacement

Disconnect the logger from all power sources before replacing a desiccant pack. Statically ground yourself prior to and while contacting any of the electronics inside the logger. Failure to do so may result in a static discharge that can be harmful to the electronics.

1. Remove the green wire from its track at the base of the data logger's aluminum housing.
 - a. Apply downward pressure on the top bulkhead while removing the wire, as air pressure inside the bulkhead may be pushing upward, making it difficult to remove. If needed, tweezers or needle-nosed pliers can be used.
 - b. The middle port plug can also be removed to relieve some of the built-up pressure.

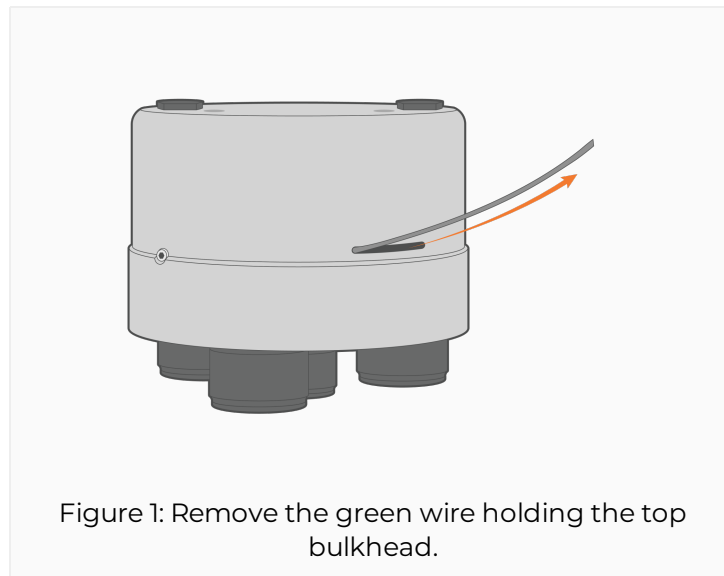
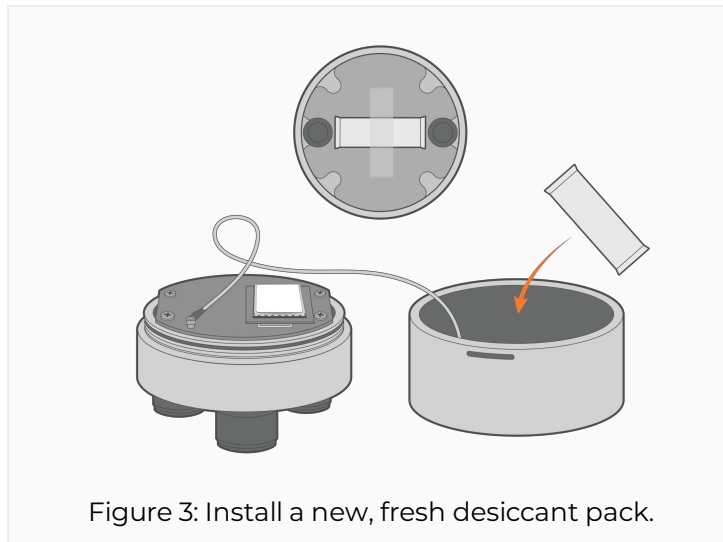


Figure 1: Remove the green wire holding the top bulkhead.

2. Gently pull up on the top bulkhead to separate it from the data logger's base.
 - a. The data logger circuitry should now be exposed. Be cautious of the cables still connecting the top bulkhead and the electronics.



3. Remove the current desiccant pack taped underneath the top bulkhead and replace it with the new desiccant in the same position.



4. Re-install the top bulkhead while aligning it with the blue set screw.
 - a. Remove the middle port plug underneath the logger to push any air pressure out of the bulkhead during re-installation.
 - b. Be careful not to pinch any wires during re-installation.
 - c. If available, apply a light layer of O-ring grease on the O-ring.



Figure 4: Orient and re-install the top bulkhead.

5. Re-install the green wire while keeping slight downward pressure on the top bulkhead.
 - a. When fully installed, a small piece of the green wire should overlap the entry point for easy access in the future.

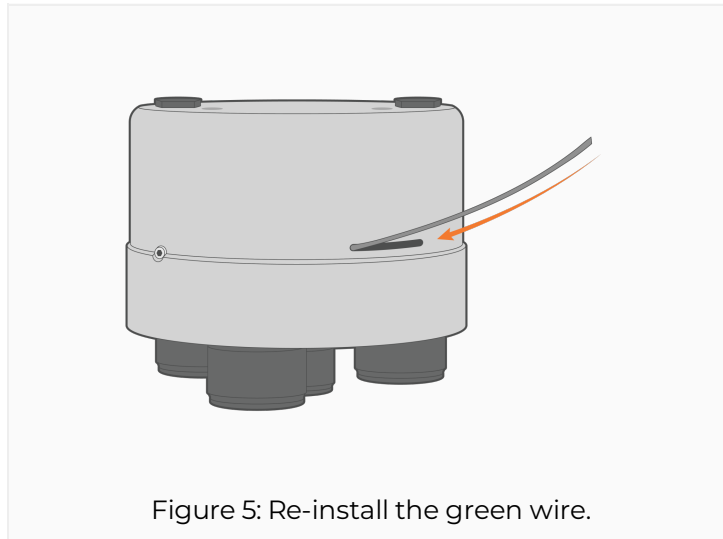


Figure 5: Re-install the green wire.

6. Review the internal humidity readings on WQData LIVE. Ideally, the internal humidity will stabilize under 20%; however, humidity levels will be dependent on the environmental conditions.

Replace a Battery in a CB-Series Data Buoy (CB-X3L Lid)

The 12V sealed lead acid (SLA) batteries installed in the data well of CB-Series buoys may require replacement when the charge falls below ~10V or every 2-3 years as their integrity declines with age. This guide shows the steps to replace the **A05 12V 28 A-Hr** battery commonly equipped in **harnesses with one to four A05 units** (depending on buoy capacity) on NexSens CB-Series data buoys.

Caution! While assembling the battery harness, insulate any loose battery leads, wrenches, or other tools with electrical tape to avoid shorting the batteries against the data well and potentially causing injury. Ensure the vent is clear of all obstructions, as a clogged vent can cause high-pressure combustible gas build-up in the well due to outgassing from the batteries. **DO NOT** use power tools to remove the plate.

Tools Required

- Electrical tape
- 9/16" socket wrench with extension
- 10mm socket wrench with extension
- Fully charged replacement battery
- Digital voltmeter/multimeter
- New desiccant (recommended)

Data Well Lid Removal

1. Disconnect the *PWR OUT* cable from the data logger and the *SOLAR IN* cable from the CB-X3L plate.
 - a. Cover all plugs and receptacles to prevent moisture and debris from the port pins and O-rings.
2. Remove the buoy's solar tower to gain access to the data well.
 - a. For the CB-150, CB-250, and CB-450: Remove the (6) bolts and lock washers holding the solar tower to the buoy using a 9/16" socket or wrench.
 - b. For the CB-650, CB-950, and CB-1250: Remove the three clevis pins securing the solar panel tower legs to the buoy hubs and carefully lift upwards to detach the assembly.

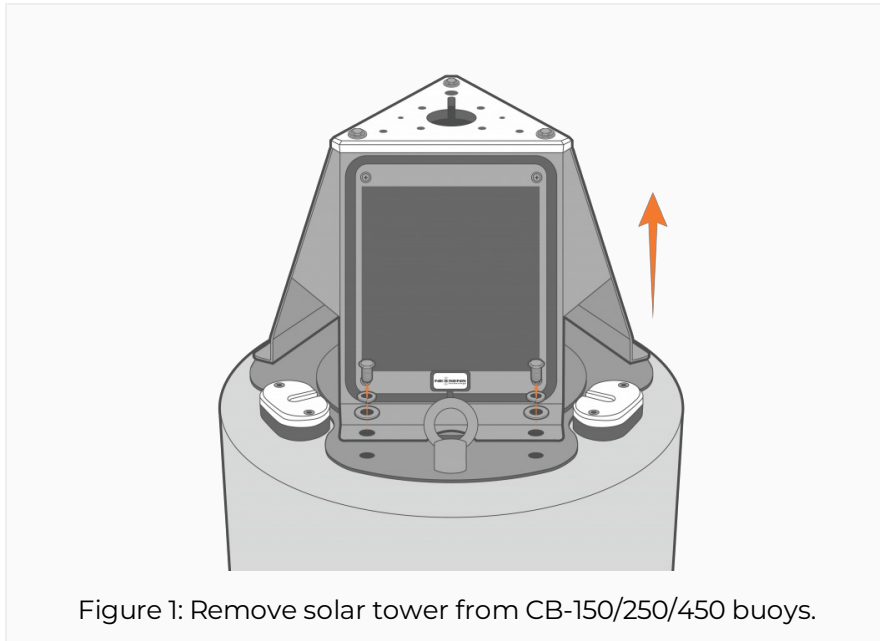


Figure 1: Remove solar tower from CB-150/250/450 buoys.

3. Remove the (8) bolts with lock washers from the buoy plate using a 9/16" socket or wrench.

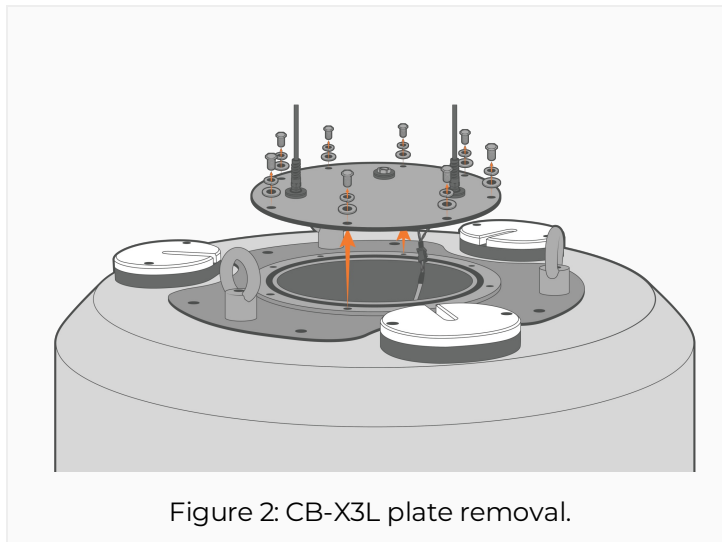


Figure 2: CB-X3L plate removal.

Battery Removal

1. Lift the buoy plate off the data well and disconnect the Molex connector running between the solar regulator and the CB-X3L plate.
 - a. This will expose the data well where the battery and solar regulator are installed.
2. Remove the foam coverings to expose the battery harness.
3. Remove the two nut, lock washer, and flat washer pairs securing the regulator bracket to the battery mount posts (threaded rod).
4. **Using caution to avoid short-circuiting the battery terminals to the walls of the buoy well**, remove the regulator's ring terminals from the battery using a 10 mm socket or wrench.
 - a. Set aside the terminal bolts for use later.

5. Lift the regulator bracket off of the threaded rod and remove it from the data well. The battery should now be accessible.

[Only for systems with 2 or more batteries]

1. Using a 10 mm socket or wrench, carefully remove one of the two ring terminal cables connected to the battery. **Immediately cover the loose cable end with electrical tape to prevent it from contacting the data well and short-circuiting.**
 - a. Repeat this step for the other battery terminal and cable, removing the old batteries one by one as they are disconnected.
2. Remove the used battery from the data well.
 - a. If it does not easily lift out, some of the wedged foam surrounding it may need to be removed.
3. Remove the ring terminal cables from the original battery terminals using a 10mm socket wrench.
 - a. Keep the terminal bolts and re-use them in the new battery.

New Battery Installation

[For systems with a single battery]

1. Lower the new battery into the data well.
 - a. It may be necessary to adjust the foam for a proper fit.
2. Skip ahead to **Step 3, “For All Systems”**

[Only for systems with 2 or more batteries]

1. Discard any pre-installed hardware on the new battery terminals. Using the original battery terminal bolts and a 10mm socket wrench, tighten the ring terminal cables to the new battery.
2. Make sure that the cables point toward the corners of the battery.
 - a. *Always insulate the detached cable leads to prevent short-circuiting the battery during installation.*
 - b. Ensure that the opposite ends of the ring terminal cables are still insulated with electrical tape.
 - c. All batteries except the battery on top of the stack should have neoprene strips adhered in line with the terminals to maintain spacing.
3. Lower the first battery into the bottom of the data well. Stack the second, then third and fourth batteries (if applicable), attaching the previous battery's ring terminal cable to the corresponding battery terminal above it each time.

[For all Systems]

1. Once the final battery is installed in the data well, orient the solar regulator bracket so that

the ring terminal connections to the topmost battery are on the same side.

2. Slide the solar regulator bracket back on to the threaded rod and lower it until it is resting on top of the new battery.
3. Using a 10 mm socket or wrench, tighten each ring terminal from the solar regulator to its corresponding battery terminal.
 - a. Ensure the leads face inwards toward the center of the battery.
4. Place the flat washer, followed by the lock washer and nut, over the threaded rod, and hand-tighten the regulator bracket to the top battery.
5. Using a 9/16" socket or wrench, tighten down the regulator bracket until it is snug and the lock washers are flattened.
 - a. Do not over-tighten, as this may bow or crack the regulator bracket.
6. Replace the foam inserts in the data well. Feed the Molex connector through the foam insert with the small-diameter hole.

Buoy Plate Re-installation

Note: It is recommended that a new desiccant be added and the large O-ring be cleaned with a lint-free wipe and lightly greased with O-ring grease.

1. Reconnect the Molex connector to the bottom of the CB-X3L plate.

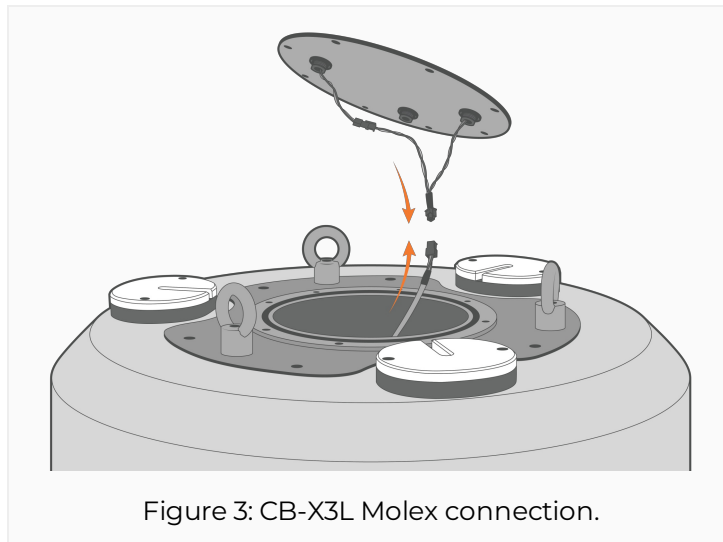


Figure 3: CB-X3L Molex connection.

2. Align the plate with the mounting holes on the buoy and verify that the large O-ring is in good condition, clear of debris, and lightly greased.
3. Reattach the plate using a 9/16" socket or wrench and the original set of bolts and lock washers.
 - a. Tighten in a cross pattern as shown below.

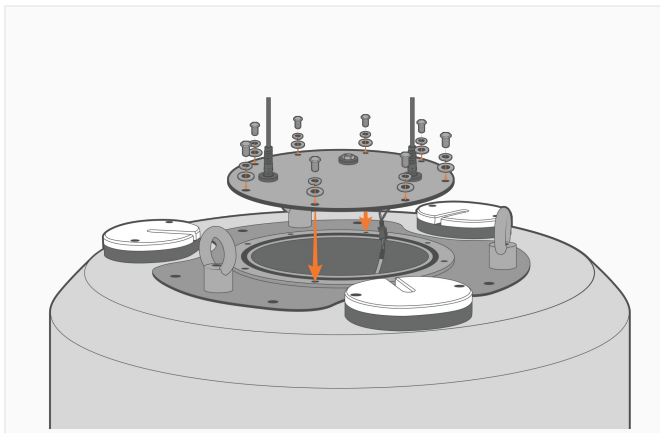


Figure 4: CB-X3L plate re-installation.

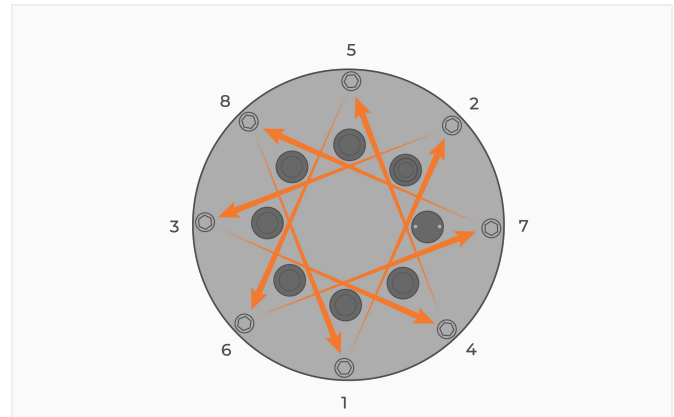


Figure 5: Bolt down the plate in a crisscross pattern

4. Re-attach the buoy's solar tower.
5. Using a voltmeter, measure the voltage between pins 3 (V+) and 4 (GND) of the *PWR OUT* cable. This should read close to the voltage of the new battery (~12V to 15V).

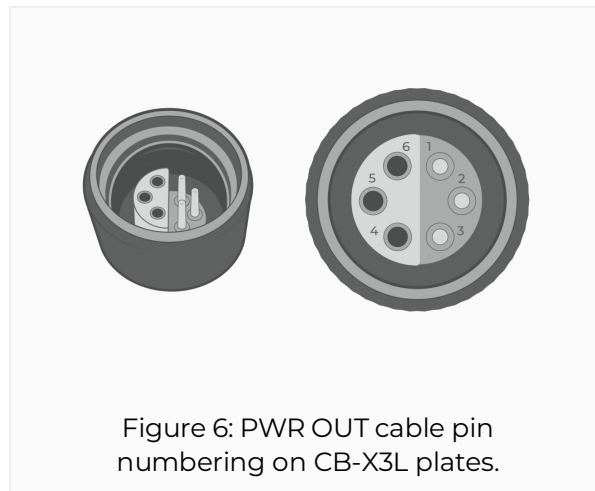


Figure 6: PWR OUT cable pin numbering on CB-X3L plates.

6. Once the voltage is confirmed, reconnect the solar tower cable to *SOLAR IN* and the *PWR OUT* cable to the data logger.
 - a. Place the entire system outside and review the *Primary Power* parameter from the data logger for multiple hours. On a clear, sunny day, the voltage should reach between 14 and 14.5V in a "charging state."

X-Series Logger Storage Requirements

The following practices should be carried out when storing an X-Series data logger for an extended period of time:

- Disconnect the solar tower cable, **SP-series solar power pack**, or **UW6-PW AC power adapter** cable from the center 6-pin port on the data logger.
 - Cap the 6-pin port with the blank plug included during shipment.
- Disconnect any telemetry antenna(s) to prevent any accidental damage resulting from field removal, transport, or storage.
- Protect all cable and port connections.
 - Inspect all sensor ports and cable connections ensuring there are no signs of moisture or damage.
 - Cover all logger or cable connectors with a dust cap or **UW-plug**.
 - Keep all system cable O-rings and connectors clean by covering them with the included red (8-pin) or yellow (6-pin) polymer caps. If these caps are no longer accessible, any means of shielding the connectors from debris is acceptable.
 - Use the O-ring grease included in the maintenance kit as needed to re-grease the cable/plug connector O-rings.
- Store the data logger, SP solar pack or AC adapter, and other logger accessories in a dry, climate-controlled environment.
- **Check the battery voltage** on any SP-series solar power packs monthly.
 - Ensure the voltage holds at or above 12V.
 - Place in the sun as needed (normally every 2-3 months) to keep the SLA battery inside topped off.

8. Warranty

NexSens Technology, Inc. warrants products against defects in materials or workmanship for a period of 12 months from the date of delivery to the original customer. This warranty is limited to the replacement or repair of such defects, without charge, when the product is returned to NexSens Technology, Inc. Damage due to accidents, misuse, tampering, lack of reasonable care, loss of parts, failure to perform prescribed maintenance, or accidents of nature are not covered. This warranty excludes all other warranties, express or implied, and is limited to a value not exceeding the purchase price of the instrument.

Limitation of Warranty

This warranty is not applicable to any NexSens Technology, Inc. product damage or failure caused by failure to install, operate or use the product in accordance with NexSens Technology, Inc. written instructions; abuse or misuse of the product; failure to maintain the product in accordance with NexSens Technology, Inc. written instructions; any improper customer repairs to the product; use by the customer of defective or improper components or parts in servicing or repairing the product; or customer modification of the product in any way not expressly authorized by NexSens Technology, Inc.

NexSens Technology, Inc. products are not authorized for use as critical components in any life support system where failure of the product may affect its safety or effectiveness.

Corporate Headquarters & Authorized Service Center

NexSens Technology, Inc.
2091 Exchange Court
Fairborn, OH 45324
Phone: 937.426.2703 | Fax: 937.426.1125
Email: support@nexsens.com

9. Service Request

Service Request

To return equipment for evaluation and repair, request Return Authorization (RA) at the following link:

[NexSens Return Authorization](#)

An email authorization receipt with a reference number will be sent to print and include with your shipment.

Products within the warranty period will be fixed at no charge. Initial evaluations are performed at no cost, and a quote will be provided if charges apply.

For additional support or inquiries, email support@nexsens.com.