CB-250 Data Buoy

User Guide

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1. General

CB-250 Data Buoy Overview

The CB-250 data buoy strikes a balance between compact and easy to deploy, yet buoyant and powerful enough to be deployed in larger water bodies including lakes, rivers, coastal waters, harbors, estuaries and other freshwater or marine environments. Like all solar-powered NexSens CB-Series data buoys, it is a highly customizable platform that may be configured with NexSens or user-supplied electronics. It supports a wide variety of topside and subsurface sensors and measurement instruments.

Figure 1: CB-250 data buoy.

Key Components and Definitions

Buoy Hull

Constructed of cross-linked polyethylene foam with a durable polymer outer layer and rugged stainless steel frame providing a net buoyancy of 250 lb (114 kg). Three 2” pass-through holes with female NPT bottom threads allow for quick connection of instrument deployment pipes and custom sensor mounts.

Data Well

The waterproof compartment located in the center of the buoy hull for placement of system electronics such as batteries and data loggers. On the CB-250 model, the data well has a 10.3” (26.2 cm) diameter and 19.5″ (49.5 cm) height.

For complete NexSens systems, the data well is fitted with a CB-A01-2 or CB-A05 battery harness and the X2-CB data logger, which has (5) waterproof UW sensor ports supporting common standards such as SDI-12, RS-232 and RS-485. Waterproof sensor connection is achieved by factory installation of sealed UW connectors on sensor cables.

For users supplying their own electronics, the CB-250 is delivered as an open platform with empty data well or with battery only. A data well top plate can be supplied in many configurations, for example:

1. A standard CB-PTL Pass Through Lid for passing of instrument cables through gland fittings
2. A CB-PTL lid with UW8-BULK sensor bulkhead cable assemblies
3. A CB-MCL Wet-Mate Lid for use with marine-grade bulkhead connectors
4. A blank lid with only UW6-BULK power cable assembly and vent that users may drill their own holes and install connectors into
5. No lid, only a drawing showing bolt hole locations for users who want to machine their own lid

Figure 2: Buoy data well and pass-through holes.

Figure 3: Data well top plate.

Solar Tower

Three 15W solar panels capture sunlight from any direction and charge batteries located inside the data well. The tower also supports the mounting of an M550 solar marine light for nighttime visibility. Aside from regular cleaning to ensure solar panels are unobstructed from receiving maximum sunlight, there is little to no maintenance required. However, solar assemblies may be function tested if any performance issue is suspected by placing in the sun and measuring output on the UW-6 (6-pin) port plug.

Figure 4: CB-250 solar tower.

Buoy Frame

The skeleton of the buoy is comprised of 316 stainless steel with topside lifting eyes and subsurface mooring eyes for single and multi-point moorings. The frame supports attachment of an instrument cage for secure connection of subsurface sensors and additional ballast weight for stability.

Figure 5: CB-250 buoy frame with instrument cage installed.

Key Specifications

The key specifications of the CB-250 buoy are given below:

- **Hull Outer Diameter**: 30.0” (76.2cm)
- **Hull Height**: 20.0” (50.8cm)
- **Data Well Inner Diameter**: 10.3” (26.2cm)
- **Data Well Height**: 19.5″ (49.5cm)
- **Pass-Through Hole Diameter**: 2.0″ (5.1cm)
- **Tower Height**: 20.0” (50.80cm)

- **Solar Panels**: 3x 15-watts
- **Weight**: 115 lb (52kg)
- **Net Buoyancy**: 250 lb (114kg)
- **Hull Material**: Cross-linked polyethylene foam with polyurea coating & stainless steel deck
- **Hardware Material**: 316 stainless steel
- **Mooring Attachments**: 3x 3/4” eyenuts

CB-Series Data Buoy Planning & Precautions

Buoy deployments are usually complex operations that involve many elements including sensors, data loggers, mounting hardware, and mooring equipment. Careful planning and precautions are essential to the success of a buoy project, not only for system operation and data collection but also to ensure the safety of project personnel and minimize the risk of damage to expensive system components. When planning a buoy deployment, be sure to give careful consideration to the following aspects:

Buoy sizing and power budget

Buoys come in various physical sizes with differing battery and solar charge capacities. A buoy must be adequately sized to tolerate the site environmental conditions while providing sufficient power for continuous system operation. A *power budget* should be analyzed to ensure the system can meet the demand for sensor measurements and data transmission.

Buoy ballast

Proper ballast of a buoy is critical to buoy stability when it is deployed in the water. Be sure to review the ballast weight and stability guide when designing a buoy system. Some experimentation may be required before final deployment.

Buoy mooring

Mooring systems come in many forms depending on the location, water depth, and environmental conditions to which a buoy will be exposed. As a starting point, the mooring data buoys guide provides an overview of common mooring strategies. However, NexSens does not endorse any particular mooring strategy, and systems should be designed and executed based on careful consideration and local knowledge of the deployment site.

Electrical connections

Many NexSens buoy systems utilize UW connectors for connection of power and sensor cables. Data loggers such as the X2-CB have UW receptacle ports to receive sensor cables fitted with UW plug connectors. UW connectors provide a double O-ring seal, with one O-ring inside the receptacle and one around the plug. In order to ensure waterproof connection, check the following each time a UW connection is made:

1. The O-ring inside the receptacle is present (has not fallen out)
2. The receptacle and plug are clean, dry and free of debris
3. The O-ring on the plug is lightly greased
4. Connection is tight, secure and fully seated
5. Unused receptacle ports are fitted with UW port plugs

Connections may be periodically inspected and maintained with O-ring grease, at a minimum before each buoy deployment.

CB-Series data buoys contain a waterproof data well constructed of stainless steel where batteries are mounted. Whenever installing or maintaining battery systems, use caution to avoid short-circuiting of battery poles to the metal walls of the data well. Gloves and tools with rubber grips are recommended, and any exposed connections should always be covered with electrical tape or other suitable coverings.

Safe deployment

Above all else, safety is the most critical consideration to take during the planning and precautions of a buoy deployment. Any time a buoy system is deployed, there are countless hazards, including, but not limited to, working on/near water and lifting of heavy equipment. Important factors to consider for personnel safety are:

- Use of safety equipment (i.e., life jackets, gloves, steel toed boots, etc.,)
- Proper lifting and mooring techniques
- Awareness of on-site and surrounding weather conditions and advisories

Despite careful planning and precautions, unforeseen situations are always still a possibility. Buoy deployments are an at-risk operation, and the user assumes liability for any injury or damages that may occur.

2. Buoy Assembly

Using NexSens Electronics in CB-Series Data Buoys

Although users may provide their own electronics, including data loggers, modems, and batteries, many CB-Series data buoys are delivered as complete, plug-and-play system packages with a NexSens data logger as the central component of the system.

Data Loggers

NexSens offers four different data logging systems for buoy deployment, all of which are based on the central processing unit of the X2 environmental data logger:

1. **X2-SDL Submersible Data Logger** – fully submersible unit designed for standalone operation or installed in the CB-50 platform
2. **X2-SDLMC Submersible Data Logger** – fully submersible unit with topside wet-mate sensor connectors for standalone operation or installed in the CB-25 platform
3. **X2-CB Buoy-Mounted Data Logger** – waterproof, lid-mounted package for integration on CB-Series data buoys with data well and solar charging (model CB-150 and larger)
4. **X2-CBMC Buoy-Mounted Data Logger** – lid-mounted package with wet-mate connectors for use on CB-Series data buoys in challenging environments such as offshore, typical on model CB-650 and larger

Figure 1: X2-SDL data logger

Figure 2: X2-SDLMC data logger

Figure 3: X2-CB data logger

Figure 4: X2-CBMC data logger

Reference the *Data Loggers* section of the NexSens Knowledge Base for resources including Quick Start and User Guides to install, configure and operate NexSens data logger electronics with CB-Series data buoys. Data logger user guides include detailed instructions on interfacing with sensors and setting up transmission of data to the WQData LIVE web datacenter.

Battery Packs

X2-SDL and X2-SDLMC data loggers rely on internal batteries to supply power. X2-CB and X2-CBMC data loggers are designed for use on CB-Series data buoys with solar charging (model CB-150 and larger). These buoys have a data well for installation of battery packs, and the data logger serves as the top plate to provide a waterproof seal on the data well.

NexSens offers two standard types of battery harnesses, which include sealed lead acid (SLA) batteries, solar regulator, mounting bracket and data logger connection cable pigtail (UW-6 connector):

1. **CB-A01-2** – contains two 8.5 A-hr batteries (CB-150 only)
2. **CB-A05-x** – contains one to four 28 A-Hr batteries (depending on buoy capacity – see table below)

The following table shows what battery harness models each CB-Series data buoy model has capacity for in the data well. However, what model is selected should be based on a complete power budget analysis that includes system power demand, solar charge capacity (panel size) and available sunlight based on deployment location to aid in determining how much reserve battery power is needed.

See CB-Series Buoy Battery Capacities for additional relevant specifications and capacity information for the battery harnesses.

	CB-A01-2	**CB-A05-1**	**CB-A05-2**	**CB-A05-3**	**CB-A05-4**
					
CB-150	x	x			
CB-250	x	x	x		
CB-450	x	x	x		
CB-650		x	x	x	
CB-950		x	x	x	
CB-1250		x	x	x	x

NexSens battery harnesses are typically shipped pre-installed in CB-Series data buoys. However, in cases where batteries need to be installed or replaced, detailed instructions can be found here.

Accessories

Many optional accessories are available for CB-Series data buoys with NexSens electronics. In some cases, certain accessories are strongly recommended, such as the addition of sacrificial zinc anodes for use in saltwater. The table below lists the most common accessories with explanation of when each should be used.

In addition to accessories, a list of available top-side and subsurface sensor mounts is available here.

Part (link)	Description	Use Cases
 **M550-F-Y**	Solar marine light with flange mount & 1-3 nautical mile range, 15 flashes per minute, yellow	For nighttime visibility on CB-150, CB-250 and CB-450 buoys
 **M650H-Y**	Solar marine light with 4 nautical mile range, 15 flashes per minute, yellow	For nighttime visibility on CB-650, CB-950 and CB-1250 buoys
 **CB-RR**	Radar reflector for CB-Series data buoys	For visibility on ship radar screens, mounts to CB-650, CB-950 and CB-1250 buoys
 **CB-CCA**	Cage anti-rotation collar for CB-Series data buoys	For strengthening connection of instrument cage on CB-150, CB-250 and CB-450 buoys (included with CB-650 and larger)
 **CB-ZA**	Sacrificial zinc anode for CB-Series data buoys	For protection of stainless steel frame when used in saltwater, recommended two per buoy, requires periodic replacement
 **CB-PW-AC-30W**	Battery float charger for CB-A01-2 battery harness, UW 6-pin plug to AC adapter, 30W	For charging CB-A01-2 battery pack without opening the buoy data well
 **CB-PW-AC-60W**	Battery float charger for CB-A05-X battery harness, UW 6-pin plug to AC adapter, 60W	For charging CB-A05-X battery pack without opening the buoy data well
 **BALxx**	Ballast weight for CB-Series data buoys, 25 – 150 lb. (11.3 – 68 kg)	For adding counter-ballast to buoys, see recommended ballast weights by buoy model
91xM	Deployment pipe assembly with stop bolt & threaded male adapter, schedule 80 PVC, 32″ length	For secure, near-surface instrument deployment with topside access for maintenance

Creating a Parts List

To obtain a complete parts list including recommended accessories and pricing for a CB-Series system based on the above components, fill out and submit the NexSens Buoy Configurator form.

Custom Data Buoy Configuration Guide

While many NexSens data buoys are delivered as turnkey systems featuring a NexSens X2-CB or X2-CBMC buoy-mounted data logger, they are also designed to support custom integration of user-supplied, third-party electronics. The CB-Series data buoys from the CB-150 and larger are designed with an open data well in the center of the hull to facilitate such deployments.

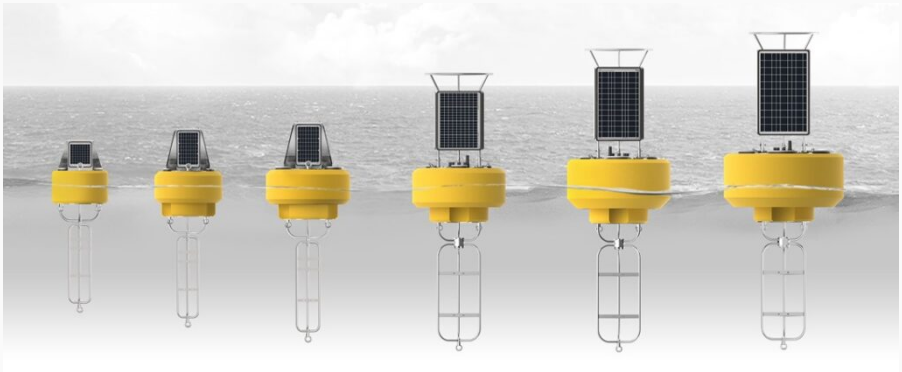

Figure 1: From left to right, CB-150, CB-250, CB-450, CB-650, CB-950 and CB-1250 data buoys.

The aim of this guide is to describe the options and design process for configuring a custom system using the CB-Series data buoy platforms. The topics considered are (click to jump to a section):

Selecting a Buoy Platform

The first step in designing a custom buoy system is to choose a buoy platform. The CB-Series data buoys range in size from the small and portable CB-150 with 150 lb (68 kg) net buoyancy and 24” (61 cm) hull diameter to the large and powerful CB-1250 with 1250 lb (567 kg) net buoyancy and 48” (122 cm) hull diameter. An overview of the complete line of buoys is available in the CB-Series comparison chart.

Buoyancy, power supply, physical space in the watertight data well for mounting user-

supplied electronics, and mounting options for specific sensor types are the main criteria used to determine which platform is best suited for a particular application. These factors are discussed in more detail in the following sections.

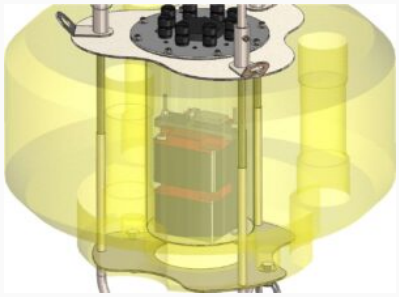

Figure 2: Buoy hull X-ray view showing data well with battery harness, data well lid, and instrument pass-through holes.

Buoyancy Requirements

Determining minimum required buoyancy is a fairly straightforward process. Calculate the total in-water weight of the sensor payload and mooring hardware to be used. Compare this to the net buoyancy of the platform(s) under consideration, keeping in mind that the value listed in the datasheet is the absolute maximum the buoy can safely handle. Allowing a minimum 25% margin is recommended. Remember to account for potential changes during the deployment of the buoy system, such as weight added due to biological growth on the buoy hull, frame and mooring system.

In many cases, a weight to net buoyancy calculation is not the only buoyancy-related consideration. Any deployment location subject to substantial waves, currents and/or periodic rough conditions may be hazardous for smaller platforms. Although watertight, **buoys should not be submerged** for best performance. A factor of 100% surplus buoyancy or more may be desirable.

For more information on buoy buoyancy and stability, see CB-Series Data Buoy Ballast Weight & Stability.

Power Requirements

Power supply is the second primary factor that drives buoy selection, and very often the controlling factor. The size of solar panels varies by buoy model, as does the height of the data well where battery packs are mounted. Proper sizing of a power system requires calculation of the combined demand of the data logger, sensors and other electrical components of the system and determination of the estimated solar insolation at the geographic location where the buoy will be deployed.

To aid with system power analysis, NexSens has developed a power budget calculator that factors in the system variables and allows for custom inputs. This tool is available from

NexSens upon request.

Battery packs are available from NexSens or can be user-supplied. NexSens CB-A01-2 and CB-A05-X battery harnesses include a solar regulator, sealed lead acid (SLA) batteries, and mounting bracket for secure installation in the buoy data well. The compatible battery harnesses by buoy model are as follows:

	CB-A01-2	**CB-A05-1**	**CB-A05-2**	**CB-A05-3**	**CB-A05-4**
					
CB-150	**x**	**x**			
CB-250	**x**	**x**	**x**		
CB-450	**x**	**x**	**x**		
CB-650		**x**	**x**	**x**	
CB-950		**x**	**x**	**x**	
CB-1250		**x**	**x**	**x**	**x**

For additional relevant specifications and capacity information for the battery harnesses, see CB-Series Buoy Battery Capacities.

For user-supplied battery packs, there are two threaded hubs in the bottom of the data well spaced 7-¾” (19.7 cm) apart (note minor variation may be possible due to welding process). These allow connection of 3/8″-16 threaded rod which can be locally sourced or supplied by NexSens (part number N11149). A predesigned bracket like what is used in the CB-Series battery harnesses can optionally be supplied as well (part number CB0468).

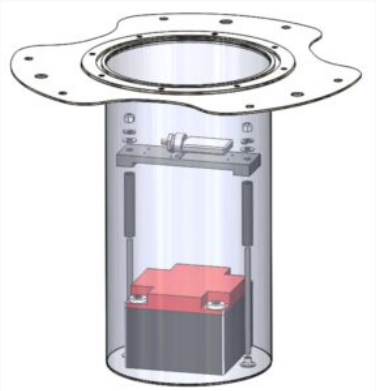

Figure 3: Data well internal view with optional battery mount hardware pictured.

Aside from the threaded hubs, there are no built-in connection points inside of the data

well. However, wedge-shaped and round foam inserts sized for the data well can also be provided to help secure mounted electronics and prevent items from moving inside the data well. Part numbers are:

- CB0161 – wedge-shaped for packing batteries and other sqaure-shaped items
- CB0162 – round with small center hole cutout
- CB0163 – round with large center hole cutout

Warning! The data well is constructed entirely of 316 stainless steel. Use extreme caution when installing or replacing any batteries in the data well. Any contact between the walls of the data well and battery poles can cause short-circuiting. This includes through metallic tools used to tighten connections. Always use tools with rubber grips when handling batteries.

Data Well Size Requirements

Adequate physical space in the data well is necessary for placing any electronics that must be kept free from moisture. All CB-Series data buoys have the same data well **inner diameter of 10.3” (26.2 cm)**. The height of the data well varies based on buoy model:

Model	Data Well Height (in)	Data Well Height (cm)
CB-150	13.5″	34.2 cm
CB-250	19.5″	49.5 cm
CB-450	19.5″	49.5 cm
CB-650	21.5″	54.6 cm
CB-950	25.5″	64.8 cm
CB-1250	27.5″	69.9 cm

The drawing sets in the Knowledge Base show how much space remains in the data well of each buoy model with a battery harness installed. The below examples show a cutaway view of the data well of the CB-150 with CB-A01-2 and CB-A05-1 battery harnesses, respectively. The given dimension is in inches.

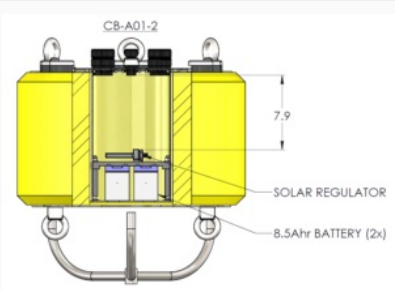

Figure 4: CB-150 with CB-A01-2 Battery Harness.

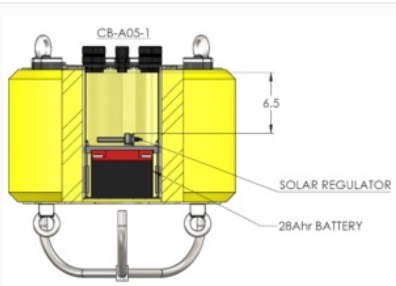

Figure 5: CB-150 with CB-A05-1 Battery Harness.

Sensor Mount Requirements

Both standard and sensor-specific mounting hardware is available for the CB-Series data buoys.

A common feature of all buoy hulls is a set of three pass-through holes for routing instrument cables from the data well to below the water surface while keeping them well protected. The pass-through holes vary from 2” on the CB-150 and CB-250 to 8” on the CB-1250.

Model	Pass-Through Hole Diameter (in)	Pass-Through Hole Diameter (cm)
CB-150	2.0″	5.1 cm
CB-250	2.0″	5.1 cm
CB-450	4.0″	10.2 cm
CB-650	4.0″	10.2 cm
CB-950	6.0″	15.2 cm
CB-1250	8.0″	20.3 cm

Optional 91xM deployment pipes can thread directly into the bottom of the pass-through ports to provide for secure placement of sensors with topside access for maintenance without having to remove the buoy from the water. This is sometimes a preferred solution compared to fixing sensors onto the instrument cage below the buoy. In such cases, the pass-through port size may be a determining factor for buoy selection. For example, although the CB-250 and CB-450 models provide the exact same power capacity, the CB-450 with its 4” pass-through ports would be a better option to deploy a water quality sonde with 4” diameter.

Figure 6: CB-450 view showing 4″ pass-through holes.

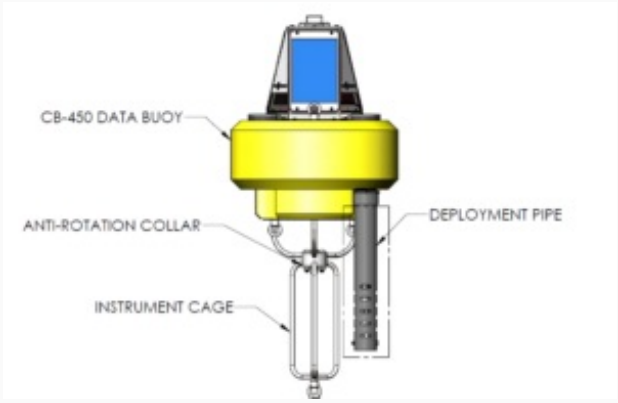

Figure 7: CB-450 with 914M instrument deployment pipe.

Some mounting hardware is designed for a specific buoy model. For example, the Nortek Aquadopp ADCP Buoy Mount fits only into the 6” pass-through port of the CB-950 or the 12” pass-through port of the CB-1250.

A list of top-side and subsurface sensor mounting accessories is available here.

In the design process, consider what instruments will be mounted onto the buoy and how well-suited the selected buoy is for accommodating them.

Selecting a Data Well Lid

Once the buoy platform is selected, the data well lid is the next component to determine.

There are four alternatives for data well lid. The selection criteria are given below, and the standard and optional parts are listed for each lid type. Those marked with a [1] are included standard with the respective lid, and those marked with [2] are options that must be ordered separately.

1. The **CB-PTL Pass Through Lid** is the simplest and most common lid type for deployments in freshwater and some marine environments where full buoy submersion is not a high risk. It features gland fittings for passing through cables with bare leads, which are tightened around the cable jacket to create a seal. For pluggable connections, sensor and RF bulkhead adapters are available. Contents and options:
   a. UW6-BULK Power Bulkhead Cable Assembly[1]
   b. Standard pressure release valve[1]
   c. (6) sensor port openings
      i. Set of (6) sensor port plugs[1] (for unused ports)
      ii. Set of (6) gland fittings[1]
   d. Spare O-rings and grease[1]
   e. RF-BULK RF Bulkhead Connector Assembly[2]
   f. UW-BULK Sensor Bulkhead Connector Assembly[2] (requires UW-CON connectorization of sensor cable)
   g. SA1352 CB-Series battery harness cable adapter[2] (connects UW6-BULK to a CB-A01-2/CB-A05-X battery harness)

Figure 8: CB-PTL with all standard parts included.

Figure 9: RF-BULK RF Bulkhead Connector Assembly.

Figure 10: UW-BULK Sensor Bulkhead Connector Assembly.

Figure 11: SA1352 Battery harness connector assembly.

2. The **CB-MCL wet-mate Marine Connector Lid** incorporates all marine-grade wet-mate connectors and a 5 psi UW-PRV Pressure Relief Valve. It is ideal for harsher marine environments where occasional full buoy submersion is a concern. Contents and options:
   a. CB-MCL Solar Connector with UW6 Solar/COM port adapter[1]
   b. UW-PRV Pressure Release Valve[1]
   c. Bushing connector[1]
      i. Can optionally be replaced with RF-BULK RF Bulkhead Connector Assembly[2]
   d. (5) sensor port openings
      i. (5) MCBH Connector Port Plugs[1] (for unused ports)
      ii. MCBH Male Bulkhead Connectors[2] (4-pin, 5-pin, 6-pin or 8-pin, use with MCDC Female Dummy Plugs[2])
      iii. MCBH Female Bulkhead Connectors[2] (4-pin, 5-pin, 6-pin or 8-pin, use with MCDC Male Dummy Plugs[2])

Figure 12: CB-MCL with all standard parts included.

Figure 13: RF-BULK RF Bulkhead Connector Assembly.

Figure 14: MCBH Male Wet-Mate Bulkhead Connectors.

Figure 15: MCBH Female Wet-Mate Bulkhead Connectors.

3. SA1304 blank plates are available for users who want to start with a blank plate and drill their own holes.
   a. SA1304-C1: Custom plate with bolt holes and power/vent only (UW6-BULK Power Bulkhead Cable Assembly[1])
   b. SA1304-C2: Custom plate with bolt holes only

4. No lid provided. User can machine own plate using dimensional drawing with bolt hole locations provided by NexSens.

Selecting Accessories

Besides sensor mounts previously mentioned, there are many accessories that can be added to CB-Series buoy systems. In many cases these are optional, but in some cases they are strongly recommended, such as the addition of sacrificial zinc anodes for use in saltwater. The table below lists the most common accessories with description of the use cases.

Part (link)	Description	Use Cases
 **M550-F-Y**	Solar marine light with flange mount & 1-3 nautical mile range, 15 flashes per minute, yellow	For nighttime visibility on CB-150, CB-250 and CB-450 buoys
 **M650H-Y**	Solar marine light with 4 nautical mile range, 15 flashes per minute, yellow	For nighttime visibility on CB-650, CB-950 and CB-1250 buoys
 **CB-RR**	Radar reflector for CB-Series data buoys	For visibility on ship radar screens, mounts to CB-650, CB-950 and CB-1250 buoys
 **CB-CCA**	Cage anti-rotation collar for CB-Series data buoys	For strengthening connection of instrument cage on CB-150, CB-250 and CB-450 buoys (included with CB-650 and larger)
 **CB-ZA**	Sacrificial zinc anode for CB-Series data buoys	For protection of stainless steel frame when used in saltwater, recommended two per buoy, requires periodic replacement
 **CB-PW-AC-30W**	Battery float charger for CB-A01-2 battery harness, UW 6-pin plug to AC adapter, 30W	For charging CB-A01-2 battery pack without opening the buoy data well
 **CB-PW-AC-60W**	Battery float charger for CB-A05-X battery harness, UW 6-pin plug to AC adapter, 60W	For charging CB-A05-X battery pack without opening the buoy data well
 **BALxx**	Ballast weight for CB-Series data buoys, 25 – 150 lb. (11.3 – 68 kg)	For adding counter-ballast to buoys, see recommended ballast weights by buoy model
91xM	Deployment pipe assembly with stop bolt & threaded male adapter, schedule 80 PVC, 32″ length	For secure, near-surface instrument deployment with topside access for maintenance

Creating a Parts List

By following the design process described above, a parts list for the custom buoy system can be developed. To further simplify the process and to receive pricing for a custom system, fill out and submit the Custom Buoy Configurator form.

Installing User-Supplied Electronics in CB-Series Data Buoys

NexSens CB-Series data buoys are flexible platforms that allow for use with both NexSens and user-supplied electronics. For user-supplied electronics, several accessories are available to facilitate installation inside the watertight data well.

Common Accessories

Battery mounts – While user-supplied electronics on CB-Series data buoys may receive power from NexSens-issued CB-A01-2 and CB-A05-x battery harnesses, users may also supply and install their battery and solar regulator systems in the data well. The bottom of the data well has two welded standoffs for connection of battery mount posts, and hardware for securing user-supplied batteries, including mounting posts, brackets, and foam inserts can be provided. Consult a NexSens Applications Engineer for available parts or the custom data buoy configuration guide.

Data well plates – Buoys may be delivered with various data well top plate options:

- CB-PTL pass-through lid with gland fittings for running user-supplied flying lead cables into the data well, also compatible with bulkhead cable assemblies
- CB-MCL wet-mate lid for use with MCBH wet-mate connectors in marine and other harsh environments
- Blank plate with only bolt holes for users to drill custom hole patterns
- No plate, user may machine custom plate using bolt hole pattern from NexSens

In most cases, the CB-PTL or CB-MCL is delivered with the buoy as these prefabricated lids offer both flexibility and ease of use.

Figure 1: CB-PTL pass through lid.

Figure 2: CB-MCL wet-mate lid.

Bulkhead cable assemblies – Ports on a CB-PTL may be interchanged with bulkhead cable assemblies for power, RF signals and sensor data cables. The following options are available:

- UW6-BULK – 6-pin power cables for connection of batteries, solar panels and regulator (included)
- RF-BULK – N-style female to SMA male RF cable assembly for use with modems placed inside data well
- UW-BULK – 8-pin sensor receptacle for use with sensor cables with factory-installed UW plug connector; allows for external waterproof connection of user-supplied sensors

Instructions for installation and use of these bulkhead connector cables is available here.

Figure 3: UW6-BULK power cable assembly.

Figure 4: RF-BULK antenna cable assembly.

Figure 5: UW-BULK sensor cable assembly.

Ports on a CB-MCL may receive blank plugs (CB0981), an RF-BULK adapter, and MCBH bulkhead cable assemblies:

- MCBH Male – Male 4-pin, 5-pin, 6-pin or 8-pin wet mateable bulkhead connectors
- MCBH Female – Female 4-pin, 5-pin, 6-pin or 8-pin wet mateable bulkhead connectors

Figure 6: MCBH Male Bulkhead Connectors

Figure 7: MCBH Female Bulkhead Connectors

Additional information on the connector types and other custom options is available here.

Securing Data Well Plate

When re-installing the plate, first verify that the large O-ring is in good condition, clear of debris, and lightly greased. Align the plate with the bolt holes on the buoy and place the provided bolts with lock washer. Tighten incrementally using a 9/16″ socket wrench in a cross-pattern as shown below (2-3 passes recommended) to ensure even load distribution and proper seal of the data well.

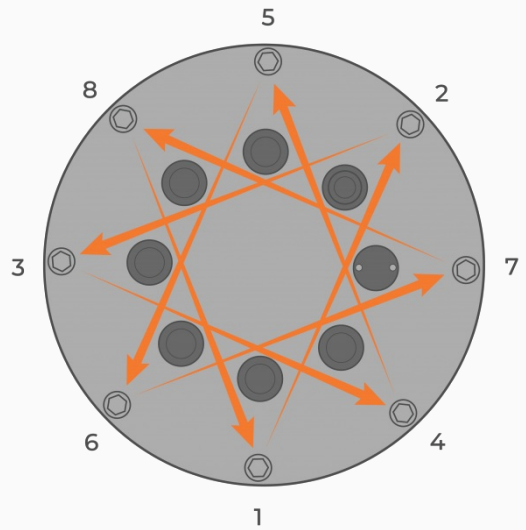

Figure 8: Tighten bolts in a cross-pattern to seal properly.

CB-PTL Bulkhead Connector Assembly Installation

The NexSens CB-PTL Pass-Through Lid is used on NexSens CB-Series data buoys for custom integrations of user-supplied electronics. NexSens CB-Series data buoys with CB-PTL pass-through lids have optional bulkhead accessories for providing power, sensor connections, and telemetry to internal electronics. The pass-through lid includes (6) ports for sensor cables, a solar tower connection port, and a battery vent.

Figure 1: NexSens CB-Series Data Buoy Pass-Through Lid

Connector Types

UW6 Power Bulkhead Connector Assembly

Figure 2: UW6 Power Bulkhead Connector Assembly

The CB-PTL comes standard with a UW-6 power bulkhead cable assembly (UW6-BULK) pre-installed. Wiring instructions for the connection of this cable to user-supplied electronics are available here.

RF Bulkhead Connector Assembly

Figure 3: RF Bulkhead Connector Assembly

The RF bulkhead connector assembly (RF-BULK) allows third-party modems to be integrated inside CB-Series buoy data wells capped with CB-PTL pass-through lids. It consists of an N-style female connector integrated on the bulkhead for external antenna connection. Additionally, it contains a 1m pigtail cable with SMA male connector for connection to a modem placed inside the watertight data well. Installation instructions for an RF-BULK cable assembly can be found here.

UW Sensor Bulkhead Connector Assembly

Figure 4: UW Sensor Bulkhead Connector Assembly

UW sensor bulkhead connector assemblies (UW-BULK) allow for pluggable, watertight connection of sensor cables to user-supplied electronics in the data well. Sensor cables must have a factory-installed UW connector for connection to the UW-BULK bulkhead receptacle. Installation instructions for a UW-BULK cable assembly can be found here.

UW-6 Power Bulkhead Connector Assembly Wiring

CB-Series Buoys supplied with a CB-PTL Pass-Through Lid for integration of user-supplied electronics include a UW-6 power bulkhead connector (UW6-BULK) port on the lid. The UW6-BULK connects to the solar tower on the outside of the buoy and has bare wires with Molex connector on the inside of the data well. Information regarding the port pinout and different options for wiring power to user-supplied electronics is supplied below. For installation instructions, follow the guide here.

Figure 1: NexSens UW6-BULK power bulkhead connector.

UW6-BULK Pinout

The diagram and table below show the pinout of the UW-BULK cable assembly.

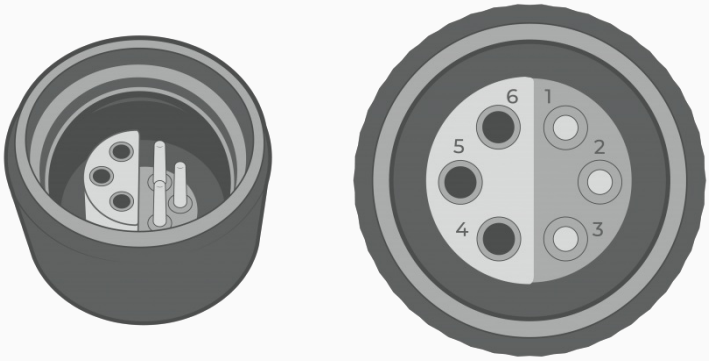

Figure 2: UW6-BULK pinout.

UW6-Bulk Pin #	Molex Wire Color[1]	Flying Lead Wire Color[2]	Notes
1	–	–	
2	–	–	
3	Red	–	Solar Connector Jumps to Pin 6
4	Black	Black	
5	Yellow	–	
6	Orange	Red	Solar Connector Jumps to Pin 3

[1]Molex connector is designed to interface with a NexSens CB-A01-2 or CB-A05-X battery harness. If this accessory was not ordered, connector can be cut off to wire to user-supplied components.

[2]The Red and Black flying lead wires are intended to supply power to user-supplied electronics.

Wiring Options

Solar Charged Battery [most commonly used]

If power to the buoy electronics is to be maintained by a solar-charged battery and the buoy was not delivered with a CB-A05-X or CB-A01-2 battery harness, a solar regulator and battery must be sourced locally.

Molex Wire	Solar Regulator Connection	Battery Terminal Connection
Yellow	Solar +	–
Black	Common/GND	Negative (GND)
Orange	Battery +	–
Red	–	Positive (V+)

The internal jumper inside the solar panel connector disconnects battery power from on-board electronics when the solar panel plug is removed from the UW6-BULK port. This simplifies system storage as the data well does not need to be opened to manually disconnect the battery.

Battery ONLY

If solar charging is not required for the application, a user may source a standalone battery to supply power to on-board electronics. The following wiring will direct battery power to the Red and Black flying lead wires of the UW6-BULK.

Molex Wire	Battery Terminal Connection
Orange	Positive (V+)
Black	Negative (GND)

Solar Panel ONLY

If the unregulated solar panel output is solely required to power instrumentation, connect:

Molex Wire	Electronics Connection
Yellow	V+
Black	GND

CB-MCL Bulkhead Connector Installation

The NexSens CB-MCL Wet-Mate Lid is used on NexSens CB-Series data buoys for custom integrations of user-supplied electronics with marine-grade connectors on the outside of the lid. MCBH wet-mate bulkhead connectors provide power and sensor connections, while an RF bulkhead adapter facilitates integration of telemetry modems installed in the data well. The CB-MCL wet-mate lid includes (5) holes for sensor cables, (1) hole for optional RF adapter, a power connection port with solar tower pigtail adapter, and a 5 psi pressure relief valve.

Figure 1: CB-Series Data Buoy Wet-Mate Lid

Connector Types

RF Bulkhead Connector Assembly

Figure 2: RF Bulkhead Connector Assembly

The CB-MCL wet-mate lid has a single port which can optionally be fitted with an RF bulkhead connector assembly (RF-BULK) for integration of third-party modems inside CB-Series buoy data wells. The RF-BULK adapter consists of an N-style female connector integrated on the bulkhead for external antenna connection. Additionally, it contains a 1m pigtail cable with SMA male connector for modem connection inside the watertight data

well. Installation instructions for an RF-BULK cable assembly can be found here.

MCBH Bulkhead Connectors

Figure 3: MCBH Male Bulkhead Connectors

Figure 4: MCBH Female Bulkhead Connectors

Wet mateable MCBH bulkhead connectors are used on the (5) holes on the CB-MCL for connection of sensors and other devices. MCBH bulkhead connectors are available in 4-pin, 5-pin, 6-pin and 8-pin versions with either male or female pin styles. These are purchased separately and added to the CB-MCL plate, while any unused ports can be plugged.

The SOLAR port on the CB-MCL wet-mate lid includes a 6-pin female MCBH connector as standard, along with a UW6 pigtail cable for connection to the solar tower of a CB-Series buoy. On the inside of the data well, there is a 4-pin Molex connector with red (+V) and black (GND) power leads. NexSens-supplied CB-A01-2 or CB-A05-X battery harnesses can be connected to the Molex connecctor for 12V supply on the power leads using an SA1352 CB-Series battery harness cable adapter.

Installation instructions for MCBH connectors, pinouts for device connections and solar connector wiring information are all available in the CB-MCL quick start guide. For proper cable connection and connector maintenance, see MCBH & MCIL Connector Operation & Maintenance.

M550 Beacon for CB-Series Data Buoys

The NexSens M550 Solar Marine Light is a common accessory added to NexSens CB-Series data buoys up to and including the CB-450. Depending on the configuration, it has a 1-3 nautical mile range and is normally delivered with flange mount hardware, yellow color and default 15 flash/minute pattern (Model *M550-F-Y*).

Figure 1: M550 Solar Marine Light.

Installation

While it typically comes pre-installed, the M550 can easily be removed and/or installed by the user. Reference the M550 Installation Instructions for guidance with the standard flange mount version. The pole mount option can be similarly fixed to the buoy top plate using the provided hardware and one of the pre-drilled holes on the top plate.

Figure 2: M550 pole mount option.

Figure 3: Mounted to top plate.

Operation

The M550 is controlled using an IR programmer that is normally provided with the beacon.

Figure 4: IR programming remote.

The IR programmer can be used to perform the following functions:

- Turn beacon on and off
- Check the battery pack charge status
- Change the flash pattern
- Change the flash intensity

CB-Series Data Buoy Instrument Cage Installation

The NexSens buoy instrument cage attaches to the bottom of CB-Series buoys for water sensor deployments while simultaneously lowering the center of gravity and increasing stability.

Model number CAGE is 39″ (99 cm) in length and is normally used with the CB-50, CB-150, CB-250, and CB-450 buoys. It is an optional accessory for the CB-50 and comes standard with the others.

Model number CAGE-L is 44″ (112 cm) in length and has a wider profile. It comes standard with CB-650, CB-950, and CB-1250 buoys.

Figure 1: Model CAGE instrument cage.

Figure 2: Model CAGE-L instrument cage.

The cage is a critical component of the ballast weight of a data buoy and provides a mounting location for additional ballast weight to be added as needed.

Attachment to the internal frame of a data buoy is simple using the provided hardware.

1. Use the provided bolt, lock washer and castle nut to attach the cage to the buoy frame.

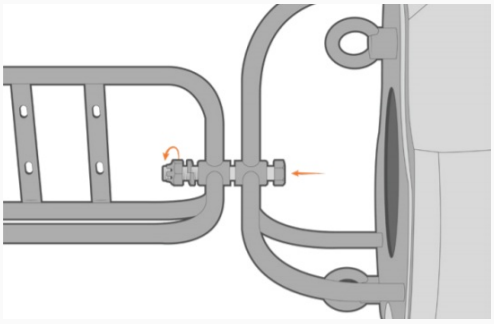

Figure 3: Bolt installation and cage connection.

2. Tighten firmly with a pair of 1-1/8” wrenches such that the lock washer is flattened and the bolt hole is aligned with a notch on the castle nut.

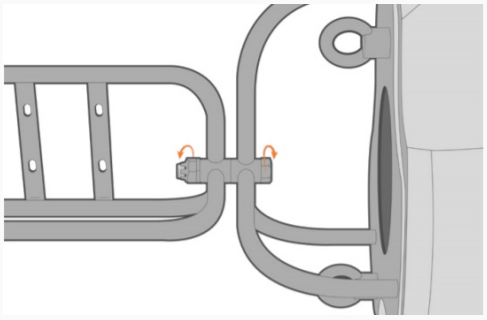

Figure 4: Secured cage.

3. Place the cotter pin through the bolt hole and bend the long leg of the pin.

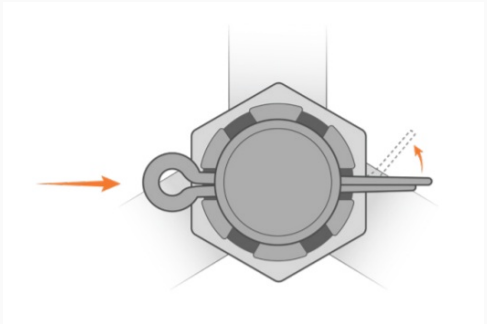

Figure 5: Cotter pin with bent leg for security.

CB-CCA Anti-Rotation Collar

The single bolt connection is sufficient for small buoys in calm waters. However, a CB-CCA Buoy Cage Anti-Rotation Collar may be used for added security in rough waters or when suspending sensor strings from the cage. *It is included standard and should always be used with buoy models CB-650 and larger* that come with the CAGE-L. For installation instructions, see the CB-CCA installation guide.

Figure 6: CB-CCA collar.

Use of Sacrificial Anodes on CB-Series Data Buoys

Sacrificial zinc anodes are recommended for use on CB-Series data buoys any time they will be used in saltwater environments. This helps to prevent corrosion on the stainless steel frame, as zinc is a more active metal that will be consumed while protecting the stainless steel.

NexSens Sacrificial Anodes

Anodes sourced from NexSens are sized specifically for installation onto buoy frames and instrument cages using a pair of screws provided with the anode. They will typically need to be replaced approximately every 6 months, though this may vary depending on factors such as the temperature and salinity of the saltwater environment. Buoys should be regularly inspected and anodes replaced any time it appears they will be consumed before the next scheduled maintenance. It is often a good idea to have two anodes installed onto a buoy – one on the frame and one on the cage – and replace them intermittently to ensure that there is always sufficient protection for the stainless steel. Anode replacement will require a 4-mm Allen wrench to remove the pair of screws connecting the two anode halves.

Figure 1: Sacrificial zinc anodes.

Zinc as Anode Material

Zinc is chosen for the anode material because it is a readily-available metal with a lower reduction potential (-0.76V) than the steel of the buoy frame. This offers the steel what is known as cathodic protection, where oxidation reactions are transferred away from the steel to the zinc when placed in highly ionic environments such as saltwater in the case of a buoy. The zinc is slowly consumed by the process, hence the term sacrificial anode.

In theory, other materials besides zinc can be used as the anode as long as they rank lower on the reduction potential scale than the stainless steel. Generally speaking, the larger the difference between the metals on the scale, the faster the rate of the oxidation-reduction reaction. Materials with lower reduction potential than zinc may therefore be consumed more rapidly and require more frequent changes. Regardless of anode material chosen,

frequent inspection and replacement of anodes as needed can extend the life of a data buoy significantly in saltwater.

Sacrificial anodes are normally not necessary for buoys used in freshwater except in special circumstances. It is therefore generally recommended only to order anodes with buoys intended for use in brackish or saltwater.

CB-Series Data Buoy Instrument Mounts

CB-Series data buoys support a wide range of topside and subsurface instruments with uniquely designed buoy instrument mounts. Mounting accessories are available for many of the most commonly-used sensors and instruments. Click on each accessory name for product information and instructions for use.

Topside Buoy Instrument Mounts

GPS Receiver – Mounts for GPS positioning devices:

- Garmin GPS 24xd Receiver

Radar Reflector – For passive reflection of radar waves and visibility:

- CB-Series Buoy Radar Reflector

Weather Sensors – Mounts for many of the most common meteorological sensors deployed on buoys:

- Airmar WX-Series Weather Sensors
- Gill MaxiMet Weather Sensors
- LI-COR Terrestrial Light Sensors
- Lufft WS-Series Weather Sensors
- METER ATMOS Weather Sensors
- Vaisala WXT-Series Weather Sensors

Miscellaneous Mounts – Other mounting brackets:

- CB-150/CB-250/CB-450 Instrument Offset Mount

Subsurface Buoy Instrument Mounts

Data Logger/Battery Pack Mounts – For mounting of NexSens X2-SDL data logger or SBP500 extra/reserve battery packs to instrument cage:

- X2-SDL Instrument Cage Mount

Instrument Deployment Pipes – For instrument installation and topside access using buoy pass through ports:

- 912M – 2″ diameter for use with CB-150 and CB-250 buoys
- 914M – 4″ diameter for use with CB-450 and CB-650 buoys

- 916M – 6″ diameter for use with CB-950 buoy
- 918M – 8″ diameter for use with CB-1250 buoy
- 918M-PO4 – 8″ diameter for use HydroCycle PO4 sensor on CB-1250 buoy

Click for product information and instructions for use.

Miscellaneous Instrument Mounts – Mounting hardware for some commonly used sensors:

- Airmar SS510 Sonar Sensor Mount
- MC-600 Instrument Mooring Clamp
- Underwater PAR Sensor Mounting Arm
- YSI EXO Sonde Mooring Clamps

Profiling Instrument Mounts – Mounting brackets for commonly used current meters and profiler (ADCP) instruments:

- Nortek Aquadopp Buoy Instrument Hole Mount – variants for mounting on CB-950 and CB-1250 buoys
- Nortek Aquadopp Mooring Cages – variants for Aquadopp current meters and current profilers
- Nortek Signature1000 ADCP Instrument Cage

A complete list of data buoy accessories is available here.

3. Deployment

CB-Series Data Buoy Ballast Weight & Stability

Ballast weight may be needed to prevent overturning a CB-series buoy system and ensure stability in the water. The center of gravity of NexSens CB-Series buoys is near the water surface *without instruments connected*. Therefore, any top-side weight added above the water's surface (e.g., sensors, sensor mounts) must be appropriately counterbalanced by ballast weight below the surface (e.g., instrument cage, chain, anchors, etc.). Before deploying a buoy system, some experimentation may be required to balance the system properly.

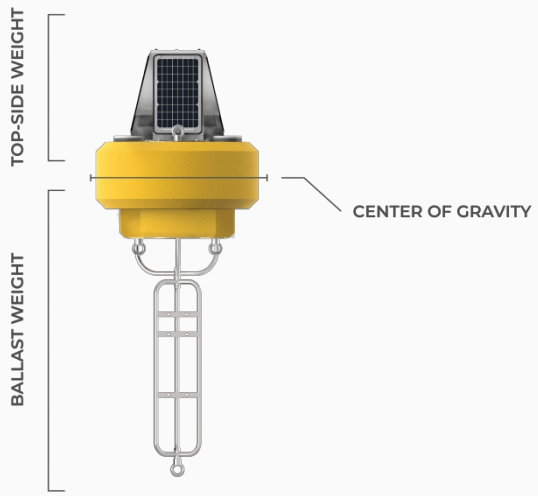

Figure 1: NexSens CB-450 buoyancy diagram.

Top-Side Weight

Top-side weight is any weight mounted on the buoy above the water surface or the buoy's center of gravity. Weight located further from the buoy's center of gravity will cause greater instability of the buoy. For example, suppose a weather sensor is mounted 36″ above the water surface *(Figure 2)*. In that instance, the sensor mount will cause more buoy instability than mounted 24″ above the surface *(Figure 3)*. As a result, the buoy would require more subsurface ballast weight to counterbalance.

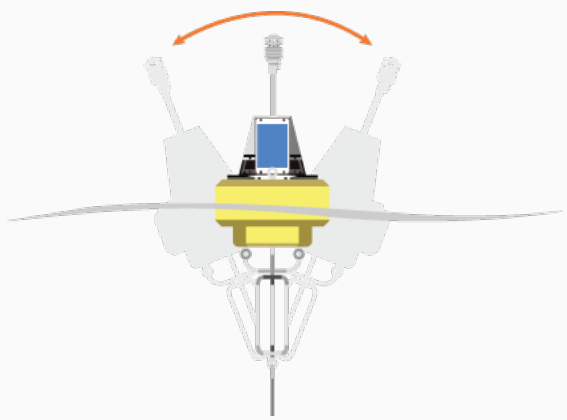

Figure 2: Top-side weight mounted higher causes greater buoy instability.

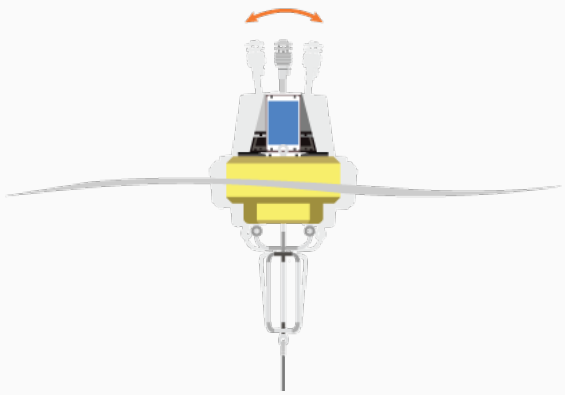

Figure 3: Top-side weight mounted closer to the water surface provides more stability.

Ballast Weight

Ballast weight is any weight mounted on the buoy below the water surface or the buoy's center of gravity. Contrary to top-side weight, a ballast weight added further below the surface *(Figure 4)* will provide a more significant stabilizing effect than the same size weight mounted closer to the surface *(Figure 5)*. An instrument cage mounted to the buoy frame helps stabilize the buoy and provides a deeper location for mounting additional weight. For single-point mooring configurations, mooring chains and lines connected to the bottom of the cage may provide adequate ballast. For multi-point configurations, the mooring hardware does not contribute to the ballast weight. If needed, add ½ inch galvanized chain (~2.3lb/ft) to the bottom of the cage, or utilize NexSens ballast weights that can be added to the cage in specific applications.

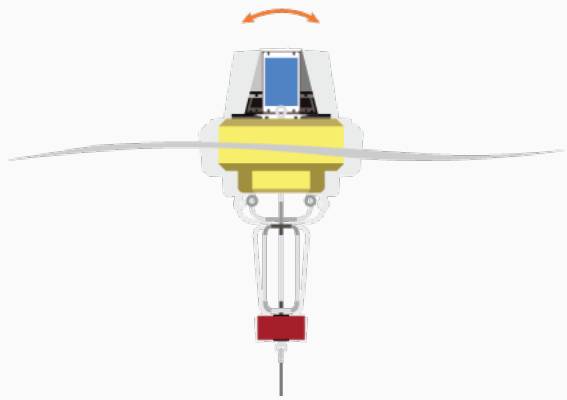

Figure 4: Ballast weight mounted deeper below the surface provides greater buoy stability.

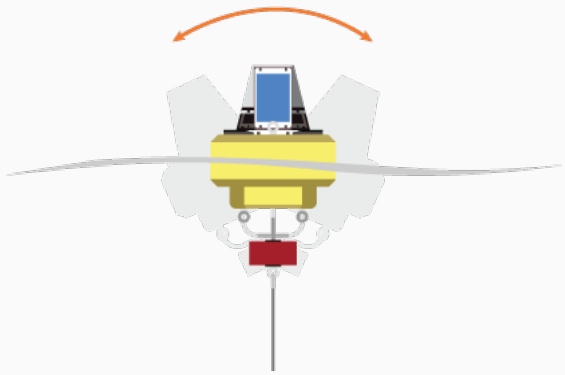

Figure 5: Ballast weight mounted closer to the surface causes greater buoy instability.

NexSens CB-series buoy data wells are not rated for submersion, so proper ballast weight is critical to ensure that the buoy does not overturn, including when subjected to additional loading (e.g., high wind/waves, periodic snow/ice loads, etc.).

For information on NexSens CB-Series buoy ballast weight recommendations, follow the link below.

NexSens CB-Series Buoy Ballast Weights

Buoy Ballast Weights

The table below indicates the minimum recommended buoy ballast weights for each CB-Series data buoy, assuming no additional topside weight and calm environmental conditions. Included instrument cages mounted to the buoy frame helps stabilize the buoy and provides a deeper location for mounting additional weight. The small model instrument cage (10 lbs.) is included with the purchase of CB-150, CB-250, & CB-450 buoy models and is an optional purchase for the CB-50. The large model instrument cage (26 lbs.) is included with the purchase of CB-650, CB-950, & CB-1250 buoy models. Typically, no additional ballast weight is necessary for the CB-25-SVS, CB-25, CB-40, CB-75-SVS, & CB-75 models as each buoy comes standard with either 1/2″ galvanized chain (CB-25, CB-25-SVS, CB-75, & CB-75-SVS) or an installed steel instrument pipe (CB-40) for ballast.

Model	Buoyancy (lbs.)	Minimum Recommended Ballast Weight (lbs.)[1]
CB-25-SVS[2]	25	—
CB-25[2]	25	—
CB-40[2]	40	—
CB-50	50	—
CB-75-SVS	75	—
CB-75	75	—
CB-150	150	—
CB-250	250	—
CB-450	450	—
CB-650	650	50
CB-950	950	100
CB-1250	1250	150

[1]Minimum recommended ballast weight incorporates the weight of the included or optionally purchased instrument cage.

[2]Discontinued models

Important: *To effectively provide adequate ballast weight, a variety of application-specific criteria (sensor weight and positioning, water level fluctuations, wave and current action, external loading, etc.) must be thoroughly reviewed prior to deployment. NexSens does not endorse using these specific buoy ballast weights for all applications.*

For more information regarding buoy ballast weight and stability, please refer to the following article:

CB-Series Data Buoy Ballast Weight & Stability

Mooring Data Buoys

This article contains only general information on the available mooring options for NexSens data buoys. Developing an effective mooring strategy requires reviewing various application-specific criteria (water level fluctuations, currents and wave action, debris loads, etc.) before deployment. This document is intended to provide a starting place for mooring design and is by no means comprehensive. Good mooring design is often developed through years of experience with various deployment scenarios. For first-time mooring designers, it is best to include an experienced marine engineer.

NexSens Technology supplies mooring hardware to support user-designed systems but does not endorse any particular mooring strategy for any specific application and does not take responsibility for mooring performance or damage resulting from mooring failure.

Buoy Ballast

Buoy ballast is best handled by adding weight to the bottom of the buoy and not relying on the mooring weight to act as ballast. Additionally, the weight associated with biofouling growth can impact the buoy buoyancy and mooring performance. Minimum recommended ballast weights for NexSens Technology data buoys can be reviewed at the link below.

NexSens Technology Buoy Ballast Weights

More information on buoy ballast can also be found at the link below.

CB-Series Data Buoy Ballast Weight & Stability

Mooring Eye Lifting

All NexSens CB-Series buoy models have three topside mooring eyes located around the solar tower. These are sufficiently strong that a buoy can be lifted from a single top-facing eye nut via crane or winch for removal or deployment when required. Care should always be taken to avoid damaging any solar panels, topside sensor mounts and sensors connected to the instrument cage when lifting and moving a buoy.

Data Buoy Mooring Types

There are three commonly used mooring types for data buoy applications:

1. Catenary moorings
2. Semi-taut two point moorings
3. Inverse-catenary (S-shape) moorings

1. Catenary Moorings

For shallow deployments with minimal wind, wave and current loading, most data buoys utilize catenary moorings. Shallow deployments can be designed with all chain or a combination of heavy bottom chain and light water column chain. Deeper water moorings may need to use a combination of chain and rope.

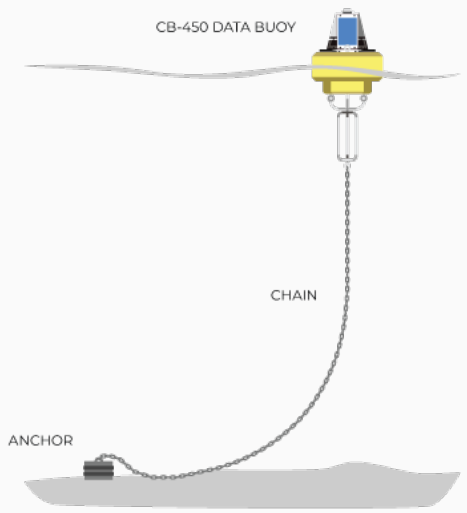

Figure 1: Example catenary mooring deployment with single chain for shallow waters.

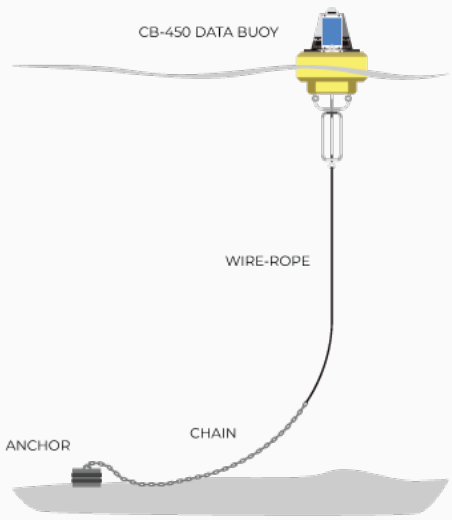

Figure 2: Example catenary mooring with combination of rope and chain for deeper waters.

Small-buoy catenary moorings

Additional surface or subsurface floatation may be required for smaller buoyancy buoy applications where the floatation may not be adequate to support the mooring weight. Extra floatation can also free motion for wave measurement applications or offer additional resistance to horizontal loading.

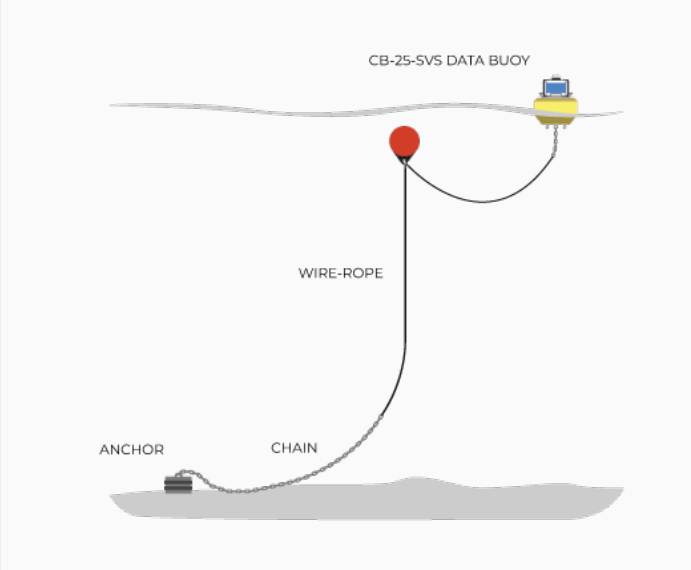

Figure 3: Example small-buoy catenary mooring with subsurface flotation.

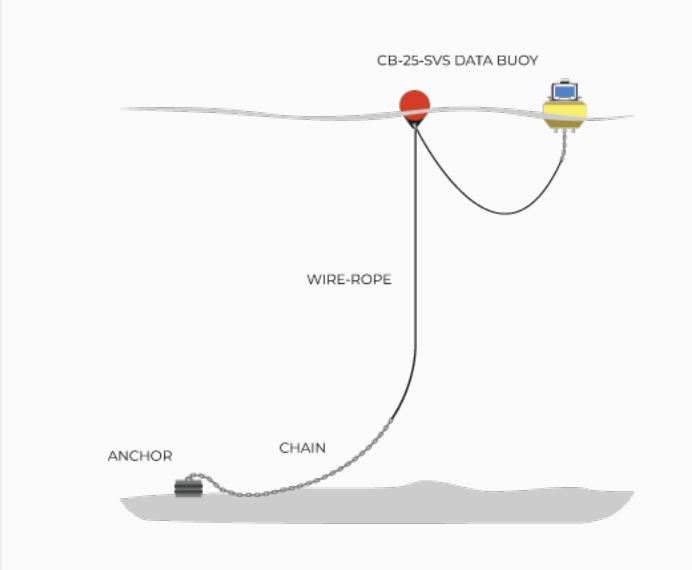

Figure 4: Example small-buoy catenary mooring with surface flotation.

Horizontal Loading

As wind, wave and current loads increase, the buoy is driven away from the anchor and mooring can be pulled taut resulting in the buoy listing to one side. Damage can result with topside equipment and solar panels becoming submerged. Additional surface or subsurface floatation may be required.

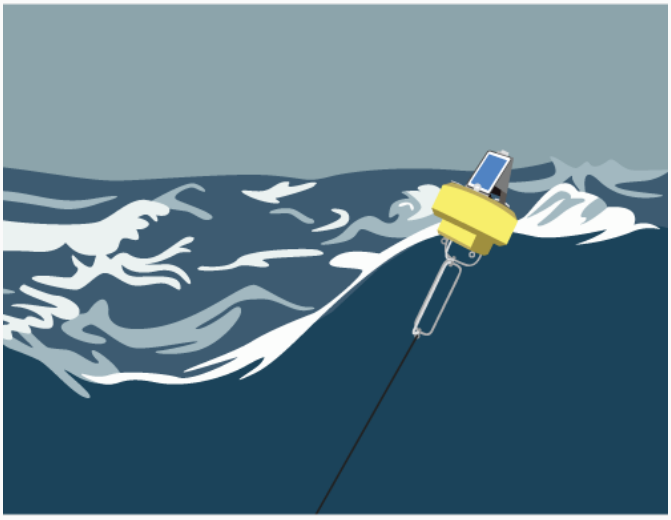

Figure 5: Depiction of horizontal loading resulting in buoy listing to one side.

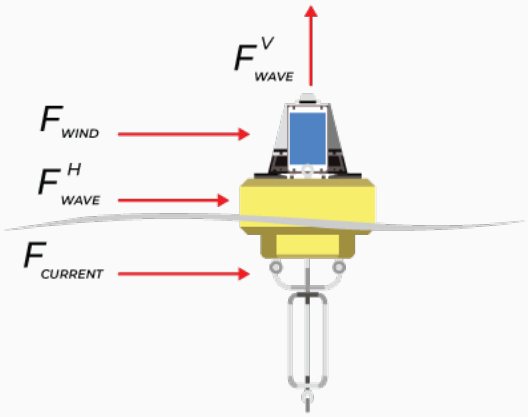

Figure 6: Force diagram representing external forces acting on buoys in natural environments.

2. Semi-taut two point moorings

For calm, shallow water with limited horizontal loading, semi-taut two point moorings can be utilized. These moorings are useful for suspending sensor lines by pulling the mooring lines free and clear. Rough water, shifting bottom or horizontal loads can tangle two point moorings and lead to chafing and cable failure. Use this mooring type only in controlled and calm applications.

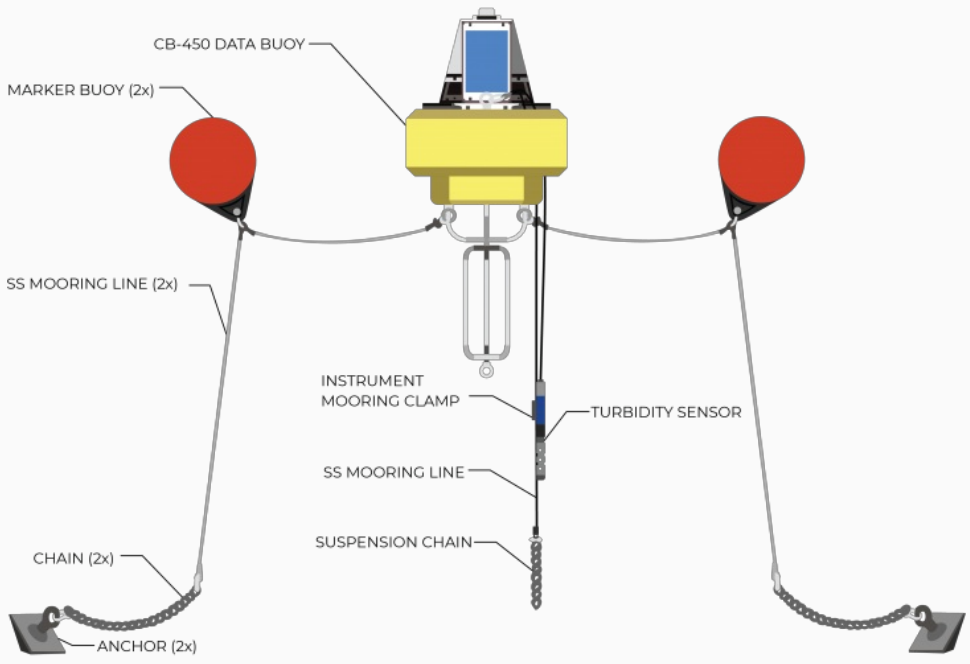

Figure 7: CB-450 data buoy with semi-taut two-point mooring setup.

3. Inverse-catenary (S-shape) moorings

Inverse-catenary moorings are often referred to as S-shaped moorings. Floats and weights on the mooring lines create an S-shape, which provides spring action in the water column. Waves and water level changes are easily managed. This mooring type is most common on deep water deployments but has utility in shallow rough water applications.

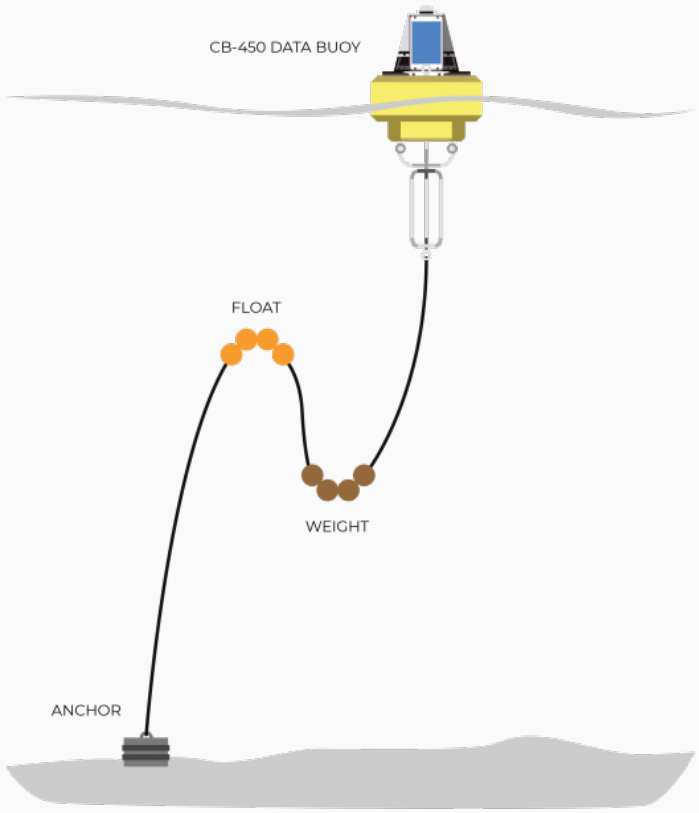

Figure 8: Inverse catenary (S-shaped) mooring diagram.

CB-Series Data Buoy Deployment Tips

NexSens Technology supplies mooring hardware to support user-designed systems but does not endorse any particular mooring strategy for any specific application and does not take responsibility for mooring performance or damage resulting from mooring failure.

NexSens CB-Series Data Buoys

The NexSens CB-series data buoys contain several mooring eyes on the underside of the buoy hull to accommodate single-point, two-point, and three-point mooring configurations. For two- and three-point moorings, use the mooring eyes located on the bottom of the hull. For single-point, use the mooring eye at the bottom of the buoy frame or instrument cage. Refer to the articles below to learn more about CB-Series buoy characteristics before deployment:

- Buoy Ballast Weight & Stability
- NexSens CB-Series Buoy Ballast Weights
- Mooring Data Buoys

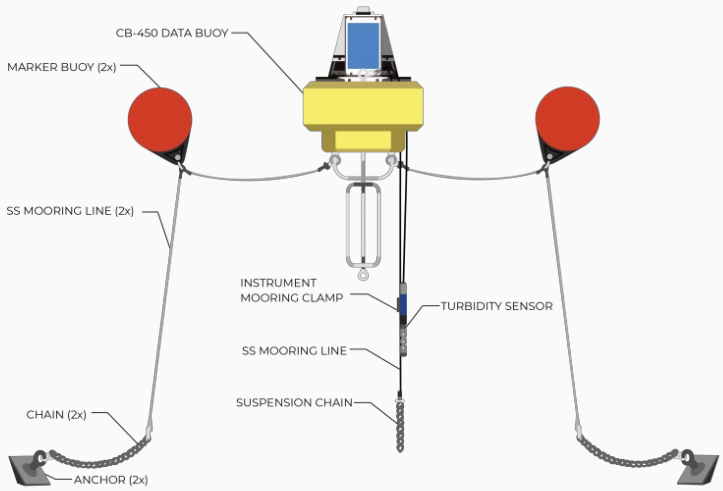

Figure 1: Two-point mooring system on CB-450 data buoy.

Connecting Mooring Hardware

For NexSens-supplied mooring systems, stainless steel bow shackles connect the various mooring components (i.e., mooring lines, marker buoys, chains, and anchors) together and to the CB-series buoy. 1/2” bow shackles connect mooring lines to the CB-series buoy eyes and 1/2” bottom chains. Larger, 5/8” bow shackles connect to the marker buoys and anchors.

Note: Shackle sizes are dependent on the thickness of the bottom chain. Shackles shown in the images below are used for 1/2″ galvanized chain, which is standard in most applications.

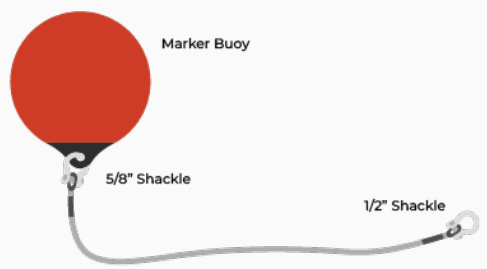

Figure 2: Shackle connections between the buoy tether line and marker buoy.

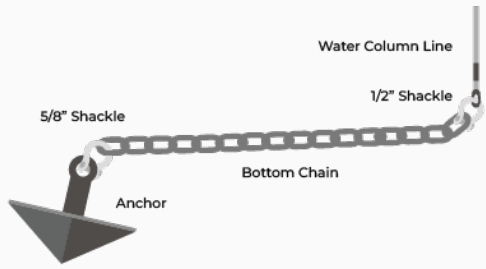

Figure 3: Shackle connections between the anchor, chain, and water column line.

Bow shackles must be properly connected and secured to prevent loosening, especially in rough water conditions. To attach a mooring line, remove the pin from the shackle and run it through the thimble of the mooring line (left image below). Hand-tighten the shackle pin, then use a crescent wrench to tighten the connection. Insert a cable tie into the hole on the shackle pin and run it through the shackle loop (right image below). Pull tightly to secure, and trim the excess.

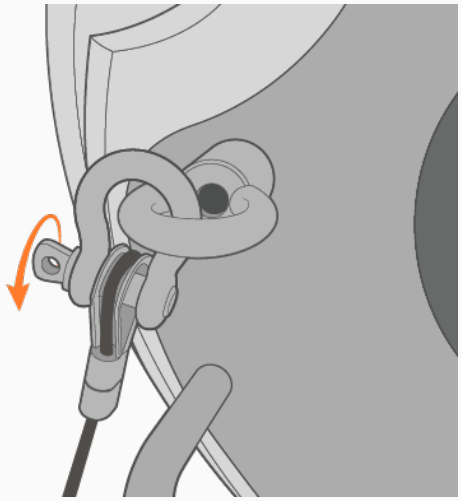

Figure 4: Tighten bow shackle.

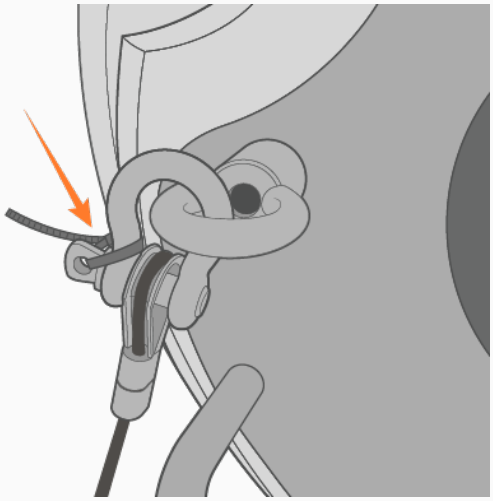

Figure 5: Secure shackle with cable tie.

Buoy Deployments

Personnel safety is the number one priority when deploying a data buoy. Using proper

equipment (e.g., workboat, lifting rig for heavier systems, gloves, safety footwear, etc.) is essential to deploy any buoy system safely. Buoy systems are heavy, and personnel can quickly become entangled with mooring lines and anchors. Safety and flotation gear should be worn at all times when working on or near the water.

Remember to perform a complete system test onshore before buoy deployments. Learning the system's nuances is better handled onshore or in a lab rather than in the field.

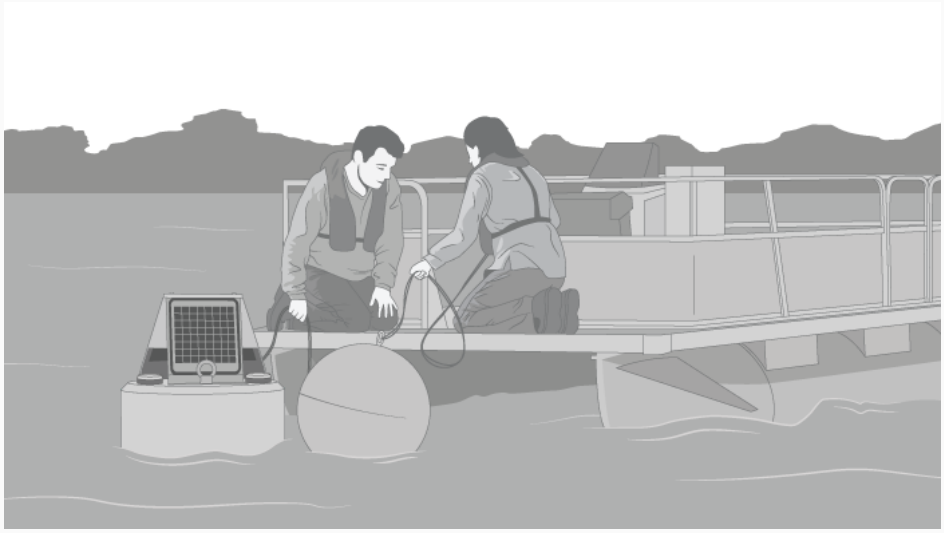

Figure 6: Safe deployment of a buoy system.

Single-Point Mooring Buoy Deployments

1. With the buoy in the boat, begin by connecting all mooring hardware, including the mooring line's connection to the bottom eye of the CB-series buoy.
2. Lift the anchor over the side of the boat and release it in to the water at the chosen deployment location. *Be sure that the mooring line and bottom chain assembly are long enough that dropping the anchor does not pull the buoy over the side of the boat.* Pay out the mooring line so that it does not become entangled.
3. Finalize any sensor connections and apply power, then lift the buoy over the side of the boat and carefully set it in the water.

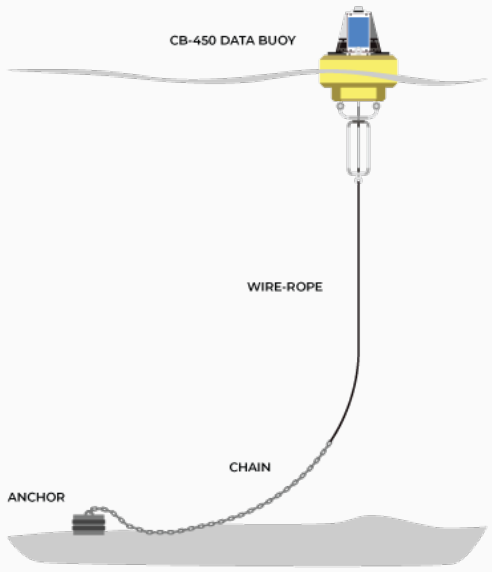

Figure 7: Single-point mooring system on CB-450 data buoy.

Two-Point and Three-Point Mooring Buoy Deployments

1. Connect all mooring components inside the boat. Stage the components so that they can be lifted over the side of the boat and laid out without becoming entangled.
2. Navigate to the chosen location for the first anchor. The distance from the anchor location to the location of the data buoy is best determined by drawing out a diagram of the mooring system and calculating the horizontal distance, taking into account the lengths of the mooring lines and the current water level.
3. Lift the anchor over the side of the boat and place it into the water. Pay out the mooring line as the anchor sinks, using extreme caution to avoid entanglement of the line with personnel and equipment. Place the connected marker buoy in the water.
4. Move to the desired location of the data buoy. Pay out the mooring line from the first marker buoy to the data buoy as the boat is moved.
5. Finalize sensor connections and apply power, then lift the buoy over the side of the boat and set it in the water.
6. Move onward to the location of the second anchor as the mooring line connecting to the second marker buoy is paid out.
7. Drop the marker buoy in the water and continue to the calculated location for the second anchor.
8. Lift the anchor over the side of the boat and lower it into the water.
    a. Again, pay out the mooring line as the anchor sinks, using extreme caution to avoid entanglement of the mooring line and especially to avoid entanglement of personnel with the mooring line.

9. Repeat this process if a third mooring point is to be used.

Planning a Medium-Deep Water Mooring for Small Data Buoys

Note: NexSens Technology supplies mooring hardware to support user-designed systems but does not endorse any particular mooring strategy for any specific application and does not take responsibility for mooring performance or damage resulting from mooring failure.

Medium-Deep Water Deployment Considerations

While many medium-deep water (>100m depth up to approx. 1000m depth) monitoring projects require large buoy platforms due to sensor loads and corresponding power requirements, there may be some cases where a smaller buoy platform is desirable. This can facilitate measurements from a small package of power-efficient sensors where only near-surface (<50m) measurements are required and provide a solution that is easier to lift and handle by project personnel.

By small data buoys, we are generally referring to CB-Series buoys up to and including the CB-450 model. While these are small and light enough to lift manually by 1-2 persons depending on the model, a medium-deep water mooring system will generally have a sizable anchor weight. As such, a suitable vessel equipped with winch and crane is strongly recommended for lifting and controlled release of equipment to avoid injury to personnel or damage to equipment.

Mooring Configuration

Whereas two-point moorings with suspended sensor lines are often a viable option for shallower applications, medium-deep water moorings will typically be single-point due to the required mooring line length. This means that suspended sensors will be mounted along the primary mooring line, and special care must be taken in the design to ensure that twisting or stretching of data cables does not take place, as this can lead to failure even within a short timeframe.

Some general suggestions and points for consideration when planning this type of deployment are described in the following sections:

Mooring Line Length and Drift Radius

Chains for Controlled Movement vs. Ballast Weight

System Maintenance

Mooring Hardware Materials

Deployment

Mooring Line Length and Drift Radius

In order to determine the appropriate mooring line length, it is first necessary to have a fairly accurate water depth measurement at the deployment site and overview of the expected water level changes. In most applications, mooring line lengths should be ~50% greater than the median water depth to account for water level fluctuations.

The potential drift radius of the buoy, determined by the water depth and mooring line length, is important to calculate to understand if the mooring line will work for the application. The maximum drift radius can be theoretically calculated using Pythagorean theorem as illustrated in the diagram below and using the following formula:

$$r = \sqrt{l^2 - d^2}$$

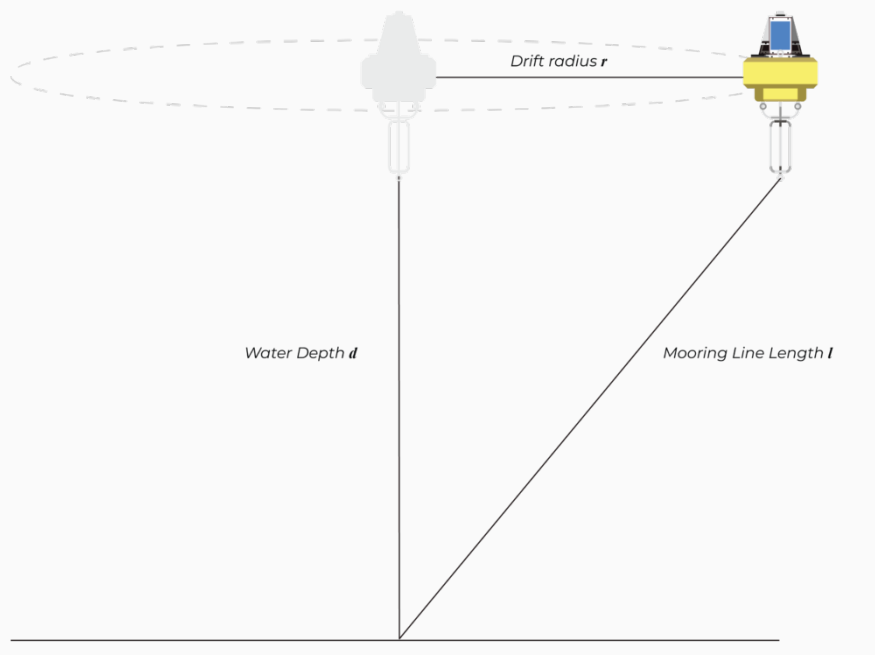

Figure 1: Determination of drift radius *r*

While this is only a theoretical calculation which may vary in an actual deployment, especially depending on the physical properties of the mooring line, it can serve as a basis for determining the total mooring line length (also see **Mooring Hardware Materials**). Too large of a drift radius may result in the buoy coming into conflict with the shore, infrastructure such as docks, or ship traffic. However, a mooring line that is too short can put the buoy at risk of submersion from horizontal loading during high wave and current conditions. The diagrams below illustrate this effect.

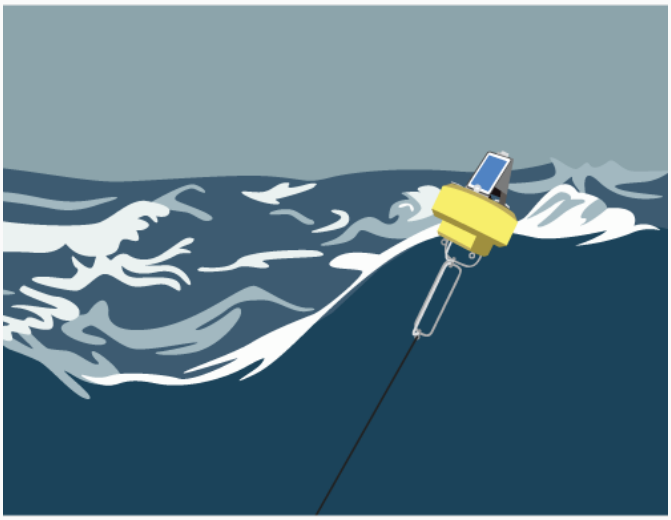

Figure 2: Depiction of horizontal loading resulting in buoy listing to one side.

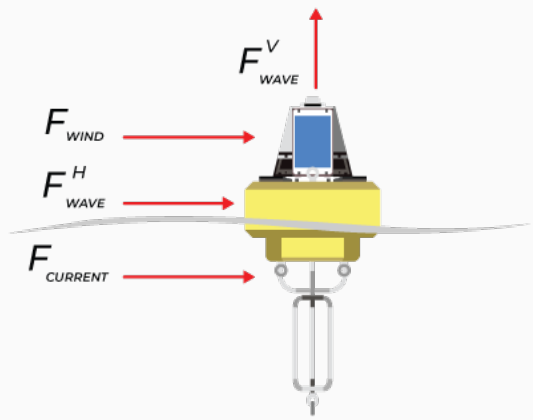

Figure 3: Force diagram representing external forces acting on buoys in natural environments.

A general principle is that the buoy should be allowed to move somewhat freely with waves and currents rather than attempting to firmly hold it in place at an exact point. How much drift radius can be tolerated must first be determined, and then the total mooring line length can be calculated.

Chains for Controlled Movement vs. Ballast Weight

One strategy to provide an adequate potential mooring line length but provide some limitation on the buoy's free movement is to use a heavy bottom chain as a part of the mooring system. The idea of the heavy bottom chain is that it can be lifted up from the seafloor as the buoy is pushed away from its centerline during rough conditions, yet provide enough resistance to dampen this effect.

However, the total buoyancy of the buoy must be carefully considered at this stage, as the chain cannot be too heavy such that it contributes to submersion of the buoy if it becomes fully drawn up from the seafloor. A method for slightly reducing the chain weight while simultaneously preventing it from becoming caught on objects on the seafloor is to install trawl floats at the terminus of the chain, at the location where the primary mooring line is connected. The buoyancy provided by these floats can help to maintain a segment of the chain in suspension as illustrated in Figure 4.

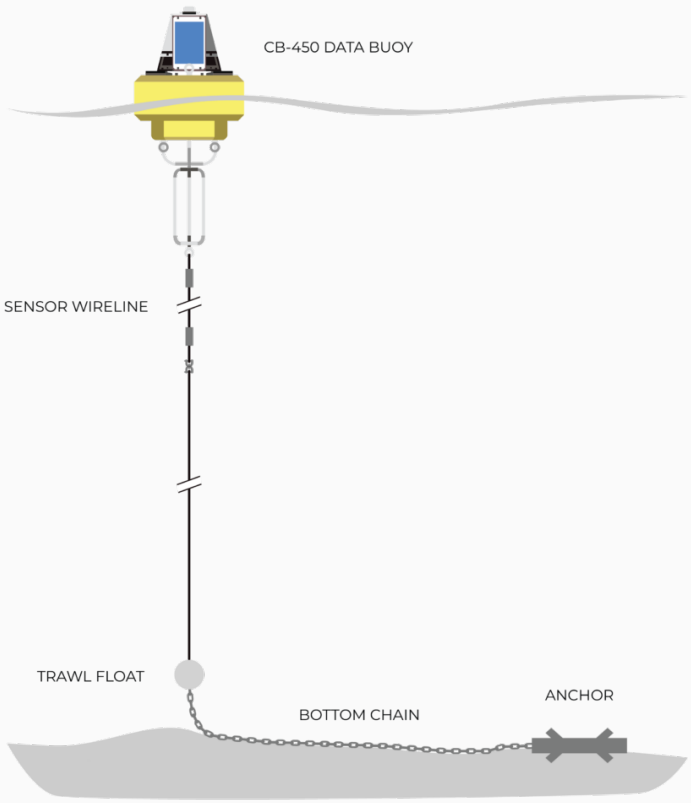

Figure 4: Mooring system overview with trawl float supporting bottom chain.

System Maintenance

A secondary consideration in calculation of mooring line length is serviceability of the instruments deployed. For practicality, it may be desirable to be able to access sensors mounted along the mooring line without having to lift the entire anchor system from its placement. This additionally helps to ensure that the buoy remains stationed at precisely the same location both before and after service.

Depending on sensor depths, this may or may not be achievable, but it will be theoretically possible any time the sensor depth is less than the drift radius, provided that maintenance is carried out under low and/or calm water conditions. Heavy chain connected to the anchor can also contribute to facilitating this, since it normally rests on the seafloor and contributes to anchor weight but may be lifted up during maintenance (preferably with the assistance of a winch or crane on the service vessel).

The diagram in the previous section illustrates an example where placement of the two sensors is less than the drift radius when accounting for the bottom chain length, so it should be possible to access the sensors for maintenance without disturbing the anchor placement.

Mooring Hardware Materials

Mooring Lines

A wide range of hardware options are available, and these can largely be selected based on site conditions, but there are a few critical points which should be considered.

Sensors suspended below the buoy frame can optionally be mounted onto NexSens-issued stainless steel mooring lines. Sensors can be securely mounted using MC-600 mooring clamps specifically designed for use with these mooring lines.

Buoyancy Control

Due to the weight of such wirelines, it is often preferable to use a neutral-buoyancy or even net positive buoyancy mooring rope with sufficient strength to perform well in the site conditions, for example Superdan® 8-strand or 12-strand ropes. Mooring lines with elastic properties may also help to reduce the total line length required and thereby reduce the drift radius as well.

If a positive buoyancy rope is used, this may result in some slack in the mooring line especially during calm conditions, thus forming a so-called S-shaped mooring as pictured in the diagram below. A potential issue with this is rope floating up and coming into contact with sensors, which can cause measurement interference, particularly on optical sensors. Rope floating all the way to near the surface can also present a risk of being snagged by passing boat/ship traffic. For those reasons, some weight should be added to limit the amount of flotation that can occur, similar to what is illustrated in the figure. However, it is important to keep in mind that this will count against the net buoyancy provided by the buoy.

Biofouling resulting in growth on mooring lines can also contribute additional weight during a deployment, so buoys and mooring lines should be periodically inspected and cleaned to ensure there are no issues. Any visual change to the way the buoy sits on the water surface during calm conditions (e.g. listing or sitting lower than normal) should immediately be inspected.

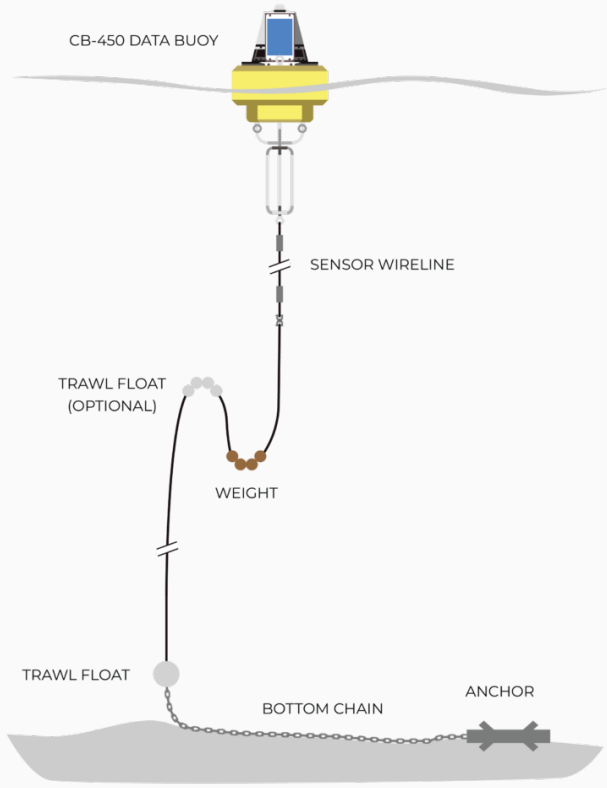

Figure 5: S-shaped mooring with weight applied to avoid mooring rope coming into contact with sensors.

Mooring Connections

To connect mooring components together, various shackle types may be used. Here, it is important to consider the materials of construction. The internal frame of CB-Series buoys is constructed of Type 316 stainless steel. Thus, to avoid mixing metals, any shackles connected directly to the buoy should also be made of 316 stainless steel.

At the seafloor, galvanized steel shackles, bottom chain and anchors may be used, provided there is consistency of materials. To guard against corrosion in saltwater environments, the buoy frame should be equipped with zinc anodes (NexSens part number CB-ZA).

Sensor Cable Protection

For protection of sensor data cables, it is recommended to secure the cable using cable ties at many points along the sensor wireline (or equivalent mooring line). This is to ensure that there is plenty of slack in the data cable and that all loads are carried by the wireline/mooring line and NOT the data cable. Twisting in the wireline should be reduced as much as possible. This can, in some cases, be achieved by using a stainless steel swivel at the point where the wireline connects to the primarily buoy mooring line. A swivel should NOT be used directly at the connection to the buoy frame, as this will allow the buoy to

rotate around the mooring line connection. An exception to this would be if no sensors are suspended below the depth of the buoy's internal frame.

Deployment

Due to the size and total weight of medium-deep water moorings, it is strongly recommended to deploy using an appropriately-sized vessel equipped with a crane and winch for controlled lifting and release of the mooring system and buoy. The following describes the process for a typical deployment.

1. Lay out the buoy and mooring hardware on the vessel's deck such that all connections can be made and the mooring line can be paid out without risk of tangling.

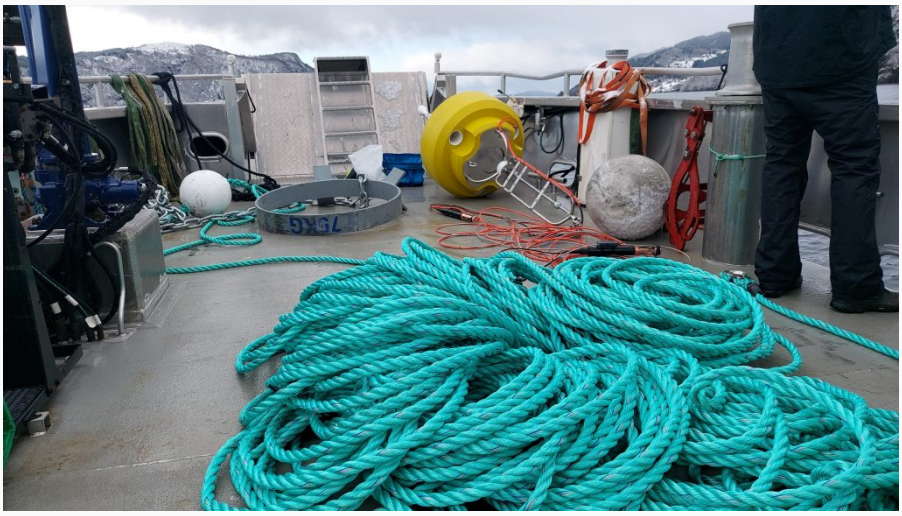

Figure 6: Buoy mooring hardware carefully arranged on deck to avoid tangling.

2. Use the crane to lift the heavy anchor and carefully lower it over the side of the vessel at the deployment site. Use the winch to hold the mooring rope such that the release is controlled throughout.
   a. Tip: To pay out the anchor and bottom chain without having to run the chain through the winch, an off-load hook (e.g. from Henriksen or equivalent) is a handy helping device. Commonly used with lifeboats, these hooks have an automatic self-open function that causes the hook to release when the load is released. Using the winch to support the rope connected to the chain, lower the anchor into the water deep enough that the anchor load begins to be carried by the chain connected to the winch-supported rope rather than the crane, and the anchor will be released in a very controlled manner.

Figure 7: Anchor supported by off-load hook.

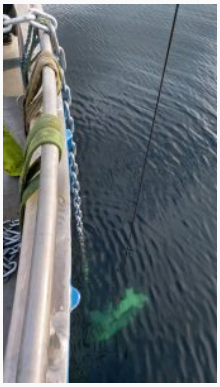

Figure 8: Anchor being lowered into water with crane.

3. After drawing the wire of the crane back to its original parked position, begin slowly paying out the mooring line using the winch. Before the anchor touches the seafloor, there is the possibility to make fine adjustments to the mooring location by carefully navigating the vessel, being sure to avoid tangling of the mooring line with the motor.

Figure 9: Paying out the mooring line using the winch.

4. Once the entirety of the mooring line is paid out, be sure to double check all sensor connections and that the buoy and LED beacon are powered up. Then, carefully place the buoy in the water. This can either be done by lifting it and placing it with the crane and off-load hook as with the anchor, or by placing it into the water through a bow gate

if the vessel is equipped with one.

Once deployed, observe the buoy’s movement to ensure it appears to be stable. If the buoy is equipped with a GPS device, track the coordinates for a few days to ensure it is staying within the desired drift radius, and consider configuring a geofence alarm to provide notice if the buoy moves outside the desired boundaries.

4. Troubleshooting and Maintenance

General Data Buoy Maintenance

The following practices should be carried out for general CB-Series data buoy maintenance during normal operation. As a general practice, measurement data should regularly be inspected, and Quick Alerts or Alarms should be configured in WQData LIVE to detect any anomalies which may indicate that maintenance is required.

Immediate Steps for Buoy Maintenance

1. Monitor the battery voltage and charge or replace as needed.
   a. Battery voltage is reported as a standard metaparameter in WQData LIVE. Alarms can be configured to monitor the charge.
   b. If the charge of 12V sealed lead acid (SLA) batteries provided by NexSens (CB-A01/A05-X battery packs) falls below ~10V, batteries should be charged or replaced.
      i. Use a CB-Series battery float charger kit for recharging (30W for CB-A01-2 packs, 60W for CB-A05-X packs).

Figure 1: NexSens CB-Series Battery Float Charger Kit

      ii. Battery replacement instructions are available here.

   c. Batteries repeatedly falling below 10V should be replaced.

2. Monitor the internal humidity and replace desiccant as needed.
   a. *Internal Humidity* is reported as a standard metaparameter in WQData LIVE. Alarms can be configured to monitor the status.
   b. If the humidity rises above 50%, the desiccant should be replaced.
      i. Use the NexSens A71 Desiccant Kit or a suitable locally-sourced desiccant for replacement.
      ii. Desiccant replacement instructions are available here.

Figure 2: NexSens A71 Desiccant Kit

3. Carefully clean the buoy and connected devices as needed.
   a. Clean off the solar panels with a soft towel using caution not to scratch the surface. Water is normally sufficient for this, but a mild cleaning agent may be used if necessary. Do not use any harsh or corrosive chemicals.
   b. Ensure the vent on the data logger/data well lid is clear of all obstructions to avoid buildup of high pressure gases in the data well from charging.
   c. Inspect mooring lines and remove buildup from biofouling, especially if it is beginning to add significant weight that is causing the buoy to sit low in the water. Replace any components which are showing significant signs of wear.
   d. Consult manufacturer's instructions for cleaning of sensors and other connected devices.

4. If the buoy is deployed in saltwater, inspect the sacrificial zinc anodes and replace as needed.
   a. Replacement part number CB-ZA.

Figure 3: NexSens CB-ZA Sacrificial Zinc Anode

Preparing for Re-deployment

1. Inspect sensor cables and calibrate instruments per manufacturer's recommendations.
    a. Before disconnecting any sensor cables, it is recommended to remove power from the buoy by disconnecting the UW-6 pin plug from the *SOLAR* port on the data logger/data well lid.
        i. Make sure to protect the plug with a cap and the port with a port plug to avoid water intrusion while disconnected.

    b. Carefully disconnect and inspect any UW or MCIL connectors.
        i. Follow the article below for proper connector operation and maintenance.
            - MCBH & MCIL Connector Operation & Maintenance

2. Be sure to reconnect the UW-6 plug in the *SOLAR* port when finished.
    a. For systems with a NexSens data logger, an audible beep indicates that the logger is powering up.

    b. Allow time for a measurement cycle and check readings on WQData LIVE before leaving the site to make sure everything is in working order.

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.

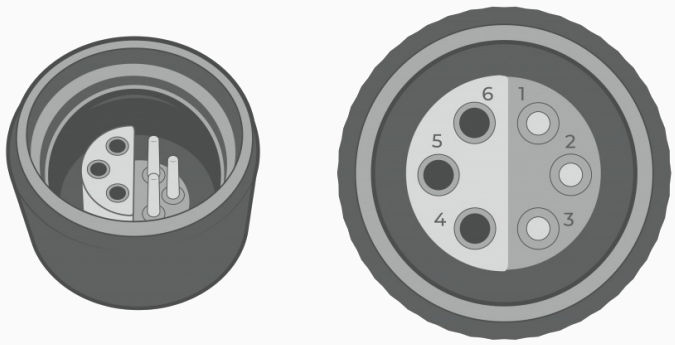

Figure 1: UW-6 *SOLAR* port receptacle pinout for X2-CB data loggers and CB-PTL pass-through lids.

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.

Replace a Battery in a CB-Series Data Buoy

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. This process may similarly be followed to replace the A01 batteries of a CB-A01-2 battery harness in a CB-150 buoy.

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 6-pin solar panel cable from the X2-CB's SOLAR port to remove power to the data logger.
   a. Cover the plug and receptacle 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 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.

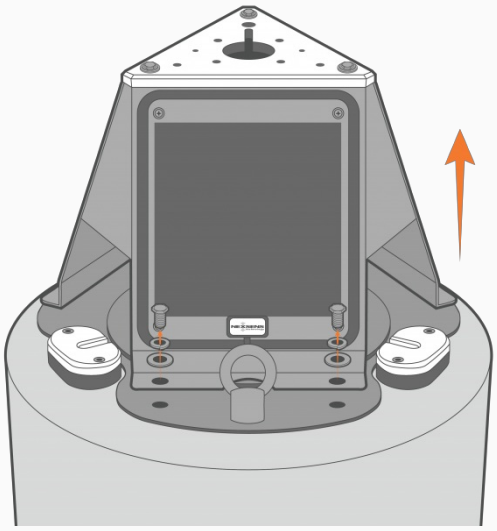

Figure 1: Remove solar tower from CB-150/250/450 buoys.

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

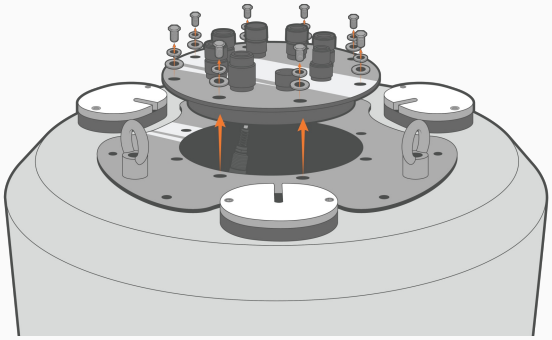

Figure 2: X2-CB removal from CB-150/250/450 buoys.

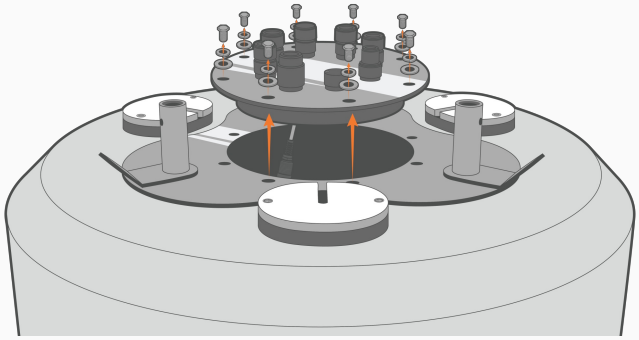

Figure 3: X2-CB removal from CB-650/950/1250 buoys.

Battery Removal

1. Lift the buoy plate off of the data well. Disconnect the 6-pin UW-plug running between the solar regulator and the X2-CB and protect the connectors.
   a. This will expose the data well where the battery and solar regulator are installed.

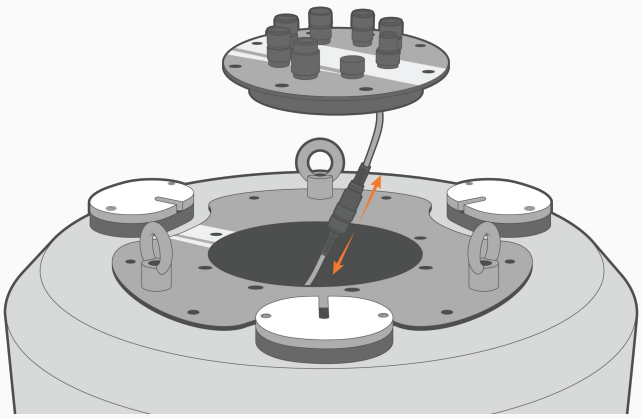

Figure 4: Unplug X2-CB in CB-150/250/450 buoys.

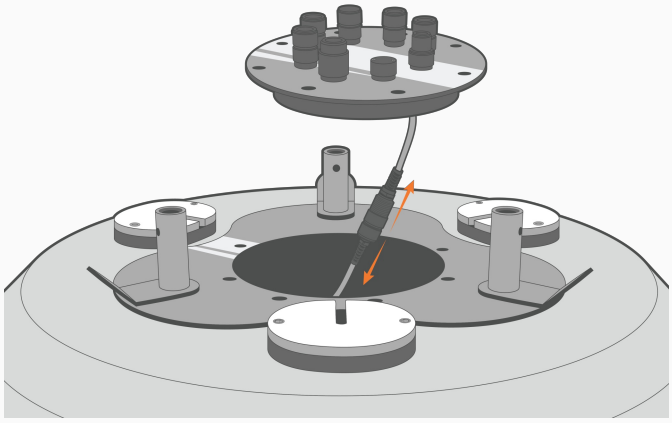

Figure 5: Unplug X2-CB in CB-650/950/1250 buoys.

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**, use a 10mm socket wrench to remove the regulator's ring terminals from the battery.
   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. Carefully remove one of the two ring terminal cables connected to the battery using a 10mm socket wrench. **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 freed.

2. Remove the used battery from the data well.
   a. It may be necessary to remove some of the wedged foam surrounding it in the event it does not easily lift out.

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 top-most 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. Tighten down each ring terminal from the solar regulator to its corresponding battery terminal using a 10mm socket wrench.
   a. Ensure the leads face inwards towards 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 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 to the data well. Feed the 6-pin solar plug through foam insert with the small diameter hole.

Buoy Plate Re-installation

Note: It is recommended that new desiccant be added at this point in the process.

1. Reconnect the solar plug to the receptacle at the bottom of the X2-CB.

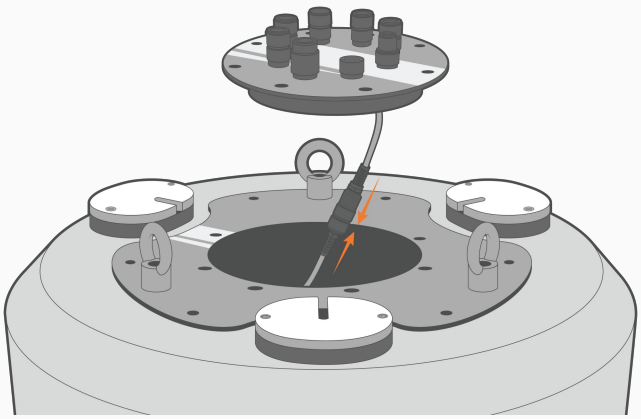

Figure 6: Re-connect the data well 6-pin cable connection.

2. Align the X2-CB or pass-through 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 wrench and the original set of bolts and lock washers, tightening in a cross-pattern as shown below.

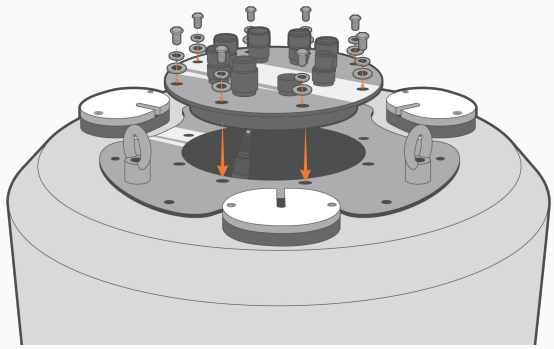

Figure 7: Bolt down the X2-CB/X2-CBMC.

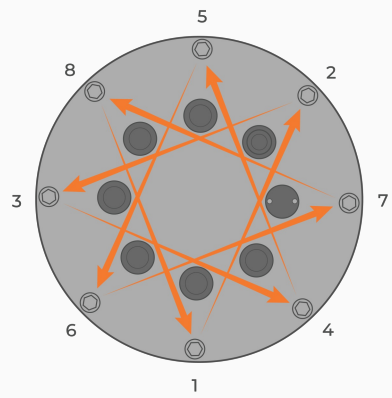

Figure 8: Bolt down the logger in a crisscross pattern.

4. Re-attach the buoy solar panel.
5. Using a voltmeter, measure the voltage between pins 3 (V+) and 4 (GND) of the X2-CB *SOLAR* port. This should read close to the voltage of the new battery (~12V to 15V).

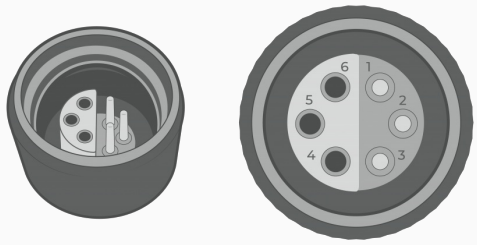

Figure 9: UW-6 *SOLAR* port receptacle pinout for X2-CB data loggers and CB-PTL pass-through lids.

6. Connect the 6-pin solar panel plug to the buoy's *SOLAR* port to reapply power to the data logger.

Test a CB-Series Buoy Solar Tower

Due to prolonged submersion, corrosion, UV exposure, or physical damage, a CB-Series buoy solar tower may need to be manually tested to confirm proper functionality. This testing process applies to all CB-Series buoy solar towers from the CB-150 up to the CB-1250. If a panel or entire tower is found to be faulty, contact NexSens to purchase a panel replacement.

1. 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 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.

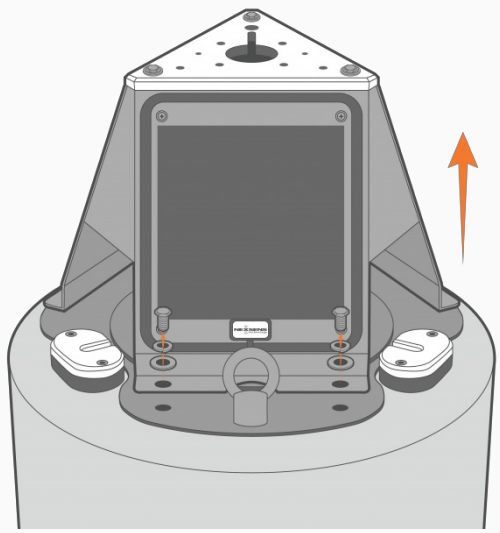

Figure 1: Remove solar tower from CB-150/250/450 buoys.

2. Use cardboard or cloth to shade two of the three solar panels on the buoy and move the tower into direct sunlight.
3. Record the DC voltage observed between Pins 2 (V+) and 3 (GND) of the solar tower's UW-6 plug cable. Typical panel output in direct sunlight for all buoys is *18-22VDC*.

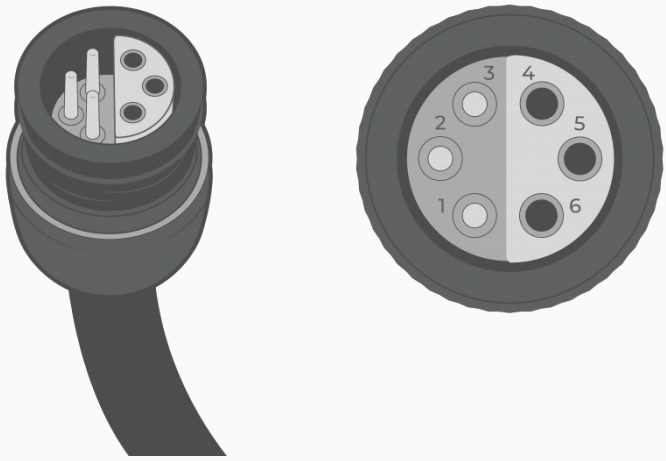

Figure 2: Solar Tower UW6 plug pinout.

4. Repeat this process two more times, rotating the cardboard/cloth around until all three panels have been isolated and tested.
5. Switch the positive voltmeter lead over to the **10A** port and change the setting to measure DC Amps.
6. Measuring again between Pin 2 (V+) and Pin 3 (GND), record the current output of each isolated panel. The expected output for each size panel *in full sun* and in a *horizontal orientation* is listed below. *Note that the observed output will normally be somewhat lower due to the angle at which each panel is mounted to the tower and atmospheric conditions.*

Data Buoy	Panel Size (Watts)	Expected Amperage Output (Amps)
CB-150	10	0.37-0.46
CB-250	15	0.59-0.72
CB-450	15	0.59-0.72
CB-650	32	1.36-1.67
CB-950	46	2.00-2.40
CB-1250	71	2.59-3.17

7. If one or more of the three panels show lower than expected voltage or current output, inspect the surface of the panel for visible damage.
8. If a panel needs replacement contact NexSens and follow the link below:
   a. CB-Series Panel Replacement Instructions

Data Buoy Storage Requirements

The following buoy storage requirements are required when storing a CB-Series data buoy with an X2-CB data logger:

Storage Requirements

1. Store the buoy in a dry environment that is kept above freezing. A climate-controlled location may be necessary.
   a. Extremely cold temperatures can negatively impact the performance of the batteries.
   b. Cold or excessively fluctuating storage temperatures can weaken the PVC joints of the deployment pipes.

2. Ensure the vent is clear of all obstructions.
   a. If the vent is clogged, high-pressure combustible gas can build up within the data well due to outgassing from the batteries.
   b. If planning to remove the plate from the data well, **DO NOT use power tools**.

3. **Disconnect the 6-pin solar panel plug from the buoy's *SOLAR* port** as soon as the buoy is removed from service.
   a. The solar panel cable plug has an internal jumper that acts as a switch to supply onboard electronics with power.
      - **If the solar panel cable is left connected during storage, the batteries inside the data well will die and require replacement**.

4. **Power OFF any LED beacons** that are affixed to the buoy solar tower.
   a. The included IR beacon remote can be used to accomplish this according to the commands listed in the M550 or M650H Quick Start Guides.
   b. If a remote is not available, remove the beacon and place it outdoors where it can receive consistent sun to maintain charge.

Figure 1: M550 Solar Marine Light

Figure 2: M650 Solar Marine Light

5. Check the voltage of the SLA batteries in the buoy data well monthly and ensure they remain above 12V. Follow the link below for proper guidance.
   a. Verify Battery Voltage of a CB-Series Buoy

Preparing for Re-Deployment

1. Top off the charge of the buoy batteries every 2-3 months by:
   a. Connecting a NexSens CB-Series Battery Float Charger Kit*
   b. Reconnecting the solar panel and moving the buoy outdoors into the sun.*

Figure 3: NexSens CB-Series Battery Float Charger Kit

*While charging, the data logger will be running. It is recommended that:

- All sensors be disconnected from the buoy.
- The X2-CB transmit interval and sensor log intervals are reduced to minimize telemetry data usage and power consumption.

2. Protect all cable and port connections.
   a. Inspect all sensor ports and cable connections ensuring all O-rings are present and there are no signs of moisture or damage.
   b. Cover all logger or cable receptacle ports with a UW-plug to keep moisture out.
   c. 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 that does not damage the O-rings is acceptable.
   d. Use the O-ring grease included in the maintenance kit as needed to re-grease the cable/plug connector O-rings.

5. 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.

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Fairborn, OH 45324
Phone: 937.426.2703 | Fax: 937.426.1125
Email: support@nexsens.com

6. 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.