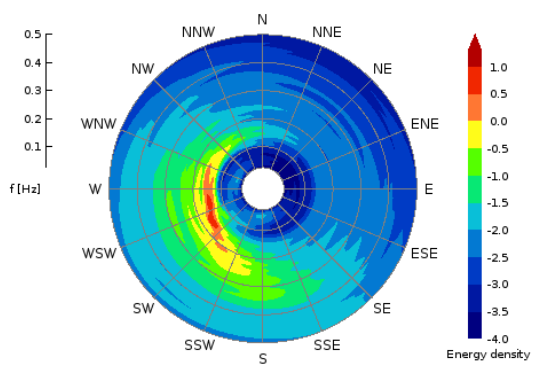


Datawell Waverider Installation Guide

DWR-MkIII, DWR-G, WR-SG
RX-D, RX-C, Waves4



MEM Spectrum - 2015-10-21 18:00





IMPORTANT

- **In case a transmitter is used within territorial waters a radio permit from the local authorities is obligatory.**
- **The transmitting frequency band 28.0 – 29.7 is reserved for amateur radio operators and needs to be avoided.**

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1 Introduction

Congratulations with your purchase of Datawell oceanographic equipment. You are building on over 40 years of oceanographic expertise. Over 4000 Datawell wave measurement buoys have been sold, providing high quality wave data of all oceans over the world. The oil industry, coastal engineers, governments, navies, harbour authorities, universities and scientific institutes all rely on our wave measuring equipment. Datawell buoys feature one of the highest up time scores, better than 99%. Our buoys are designed to withstand the extreme marine and meteorological conditions at sea, such as 40 m waves, 12 Bft winds, solar heating up to 50 °C, etc. Even under these conditions typical operational life is 10-15 years and 20 years are no exception.

The purpose of this Installation Guide is to help you set up the equipment as easy as possible, without going into all the details. By following the steps below you will be guided to set-up the equipment working on land first and later at your desired location at sea. At a later point in time you may want to refer to the Reference Manual of the Datawell products for details on maintenance, service, further options, etc.

2 Items required for wave measurement

In the purchasing phase Datawell Sales has collected all information necessary to provide you with the most suitable choice of instruments and options, including a tailor-made mooring (on request, based on your specified local conditions).

This document assumes you have a complete set of wave measuring equipment, consisting of the following items:

- Mooring, ready-made and fit to your local conditions, consisting of polypropylene rope, possible sinker weights, rubber cord(s), floats and terminals packed in a blue container and carton
- All shackles needed, with bolts, nuts and split pins, some spare split pins
- DWR-MkIII, DWR-G or WR-SG buoy including hatchcover, packed in a transport frame
- Argos or Orbcomm antennae are packed inside the buoy.
- Stabilizing chain including anodes and pre-mounted at the bottom end of the buoy hull (not for DWR-G4)
- separate HF/CAT4/LED flasher antenna including rubber sealing ring and 6 hexagon socket screws
- Receiving ground-plane antenna or portable antenna
- Antenna coaxial cable
- RX-C4 or RX-D (already tuned to your buoy frequency)
- This Installation Guide and Reference Manuals of the buoy and receiver

Datawell usually does not supply the following items, which you have to provide for yourself:

- Mooring weight; recommended is a scrap steel chain of 500 Kg for 0.9 m buoys and approximately 300 Kg for 0.7 m buoys
- Subsurface float if needed, at depth as communicated to Datawell Sales
- Receiving antenna mast
- PC or laptop
- Power cable for receiver

3 Dangers and warnings

Datawell distinguishes dangers, threatening your life and warnings, threatening your equipment. Below you will find a summary of dangers and warnings related to the present product.

3.1 Dangers

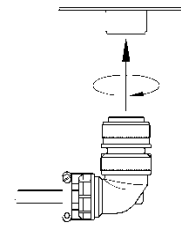
- Waverider buoys must be handled and serviced by qualified personnel only.
- Never deploy the anchor weight first, always deploy the buoy first followed by the mooring line, and finally deploy the anchor weight.
- Never stand within loops in the mooring line, never stand between mooring and the ship board. Lines may pull you overboard.
- Elongated rubber cords represent considerable elastic energy; do not stand in line with or near tense rubber cords. Snapping lines may cause injury.
- Prevent the batteries from being short-circuited. Despite the low voltage large currents may flow.
- While transporting the buoy either by car or by boat, tie it down firmly. A buoy moving uncontrolled is dangerous.
- Use Datawell supplied or recommended batteries (Datacell) only. Non-original batteries may produce hydrogen gas.
- A reversed battery in a series of cells produces hydrogen gas which constitutes a risk when servicing the Waverider. Strictly observe the battery replacement procedure in this manual. Ingression of water can also lead to gas formation through electrolysis. Handle your buoy with care. Delay manipulating electrical connections and do not allow any ignition source (sparks) until you have removed the hatchcover and allowed for 10 minutes of natural ventilation.
- Do not use empty batteries as ballast in the buoy. Dispose the empty batteries immediately after use.

3.2 Warnings

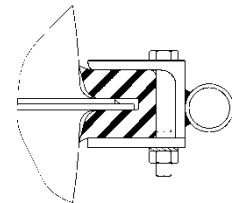
- Do not spin your DWR4 buoy more than 10 turns at once or faster than 1 turn/10 s. This may damage the motion sensor inside. Apply an anti-spin triangle if you expect vessels to graze along or against your buoy.
- Do not expose your DWR4 buoy to temperatures below $-5\text{ }^{\circ}\text{C}$ for longer periods, the fluid in the sensor could be permanently altered.
- Do not insert magnetic materials in the DWR4 buoy as this will affect the magnetic compass readings. Use original Datawell parts.
- Safeguard the GPS antenna from collisions, paint and dirt. GPS signals are shielded by certain types of paint, dirt, etc.
- Protect the rubber cords from being cut, leave them in their blue plastic containers whenever this is possible.
- Use of non-original mooring line parts may cause galvanic corrosion, early wear, etc. and may result in disruption of the mooring line and consequential buoy loss.
- Close the hatchcover whenever the buoy is not in use. Otherwise the bags of drying agent inside the buoy will take up moisture and become saturated. Particularly for a cold buoy (out of the water) placed in a humid environment, saturation will set in very fast.
- Avoid corrosion of your stainless steel buoy. Apply anodes.
- Always cover unused option ports with a blind flange and rubber sealing ring.
- Prolonged use of the Argos satellite communication unit without an Argos antenna may damage the unit.

4 Starting the buoy

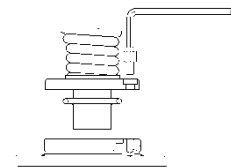
Before switching ON the buoy, unscrew the hatchcover from the hull, connect the plug at the end of the main hatchcover connector cable between the hull and the electronics unit as shown on the right and put the hatchcover back in place. In case of under-pressure in the hull use the lifting hole to open the hatchcover. Clean the o-ring groove beforehand. Take care that the rubber sealing ring completely resides in the circular groove otherwise water will enter the buoy. Fasten the 24 hexagon socket screws.



If you ordered an anti-spin triangle on your DWR-MKIII or WR-SG, you can apply it now. If you expect difficulties in transporting the buoy with the triangle in place, you may delay mounting it until the buoy is on board the ship. Lift the triangle over the buoy and lower it on to the fender. Use two screw bolts and one plate on all three touching sides to attach the triangle.



Place the HF/CAT4/LED flasher antenna on the port flange designated 'HF'. Clean the groove beforehand. Take care that the rubber sealing ring completely resides in the circular groove otherwise water will enter the buoy. Fasten the 6 hexagon socket screws.



Power the buoy by flicking the switch. Check if the buoy has started by observing the flash lights. An even better way is to set up the receiving equipment and to monitor the buoy output on your PC. Datawell has also developed the Buoy Tester application (only for DWR-MKIII) to check whether all sensors on your buoy are working properly.

4.1 Buoy tester application

In order to troubleshoot your DWR-MKIII before it is deployed we have developed the Buoy Tester application.

This application is free to download from the Datawell website:

<http://www.datawell.nl/Support/Download.aspx>

5 Receiving antenna installation

Datawell supplies standard GP (ground-plane) antennas to receive all its models of wave buoys. These antennas are able to withstand strong winds and are protected against corrosion. The user should provide for an antenna mast with the same properties. For optimum reception the antenna should overlook all surrounding buildings and have a direct view of the sea surface. Consult local companies for lightning protection. Feed the antenna signal to the RX-C4 or RX-D receiver through the high quality coax cable that is included in the GP antenna set. In less demanding circumstances a portable antenna can be used, especially in combination with a DWR-G4. The maximum range decreases to line of sight. It has a magnetic foot for easy fixation.

6 RX-C4 and RX-D buoy receiver

The RX-C4 and RX-D receive the following buoys: DWR-MkIII, DWR-G and WR-SG. Connect the antenna coax cable to the connector on the back panel. Once you have applied power, the receiver will inform you of the buoy readings on the LCD display. Datawell will tune the receiver to the transmitting frequency of the buoy.

7 Software

Datawell has designed its own software as part of a complete wave measuring system, called Waves4

7.1 Waves4

Waves4 is configured to your specific setting using the Waves4 configurator. The Waves4 configurator acquires the data which is sent from the buoy. The configurator corresponds to the Waves4 software which is the presentation part of the software.

Below description explains the installation and configuration of the Waves4 suite for two deployment scenarios:

7.1.1 A setup with one buoy and an HF-receiver

7.1.2 A site with several buoys using multiple HF receivers and satellite options.

7.1.1 Basic

This section describes the setup for the basic system as shown in the figure below



Example of a basic network

The network consists of:

Buoy The deployed DWR4 buoy using the HF-link.

Receiver An RX-C receiver using the Ethernet connection.

Computer The computer receives, processes, and displays the data of the Buoy. On this computer the following parts of the Waves4 suite are installed:

- buoyd
- waved
- Waves4 configurator
- Waves4

In this setup the user has only one buoy, but this can be scaled with multiple buoys.

7.1.2 Extended

The network consists of:

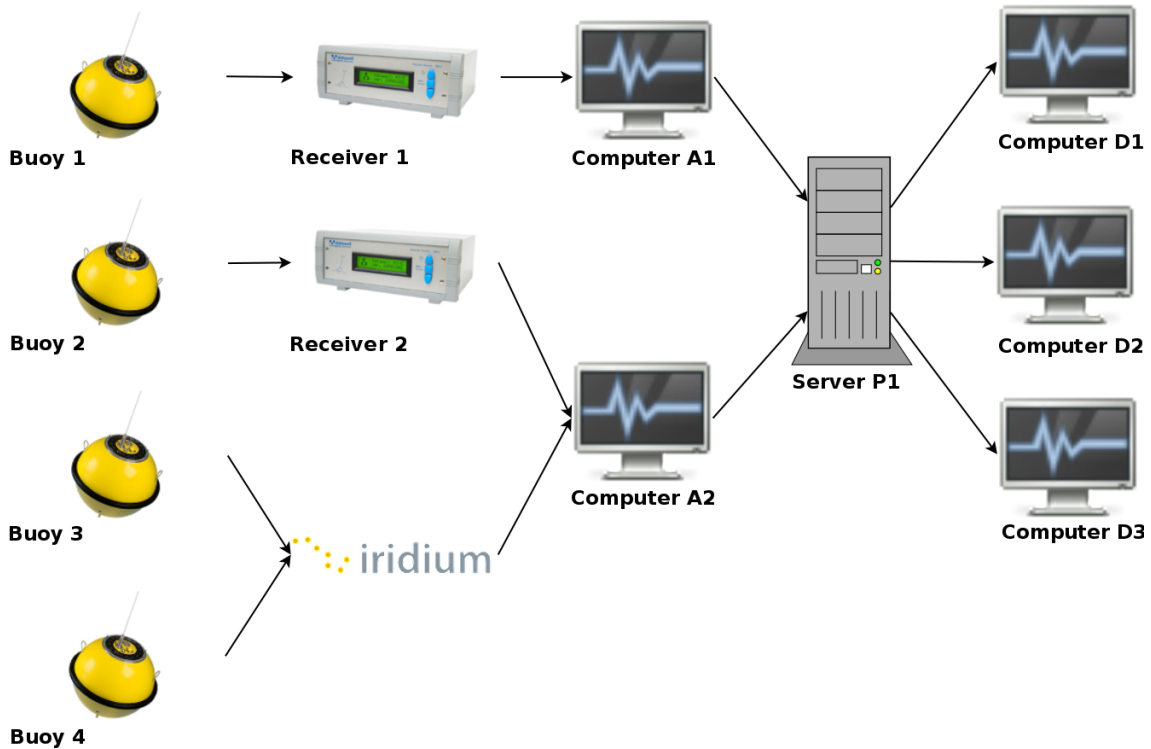
Buoys

Buoy 1 A deployed DWR4 buoy using the HF-link.

Buoy 2 A deployed DWR4 buoy using the HF-link.

Buoy 3 A deployed DWR4 buoy using the iBuoy communication option.

Buoy 4 A deployed DWR4 buoy using the iBuoy communication option.



Example of an extended network

Receivers

Receiver 1 An RX-C receiver using the serial connection.

Receiver 2 An RX-C receiver using the Ethernet connection.

Acquisition systems

Computer A1 The computer receives the data of Buoy 1. On this computer the following parts of the Waves4 suite are installed:

- buoyd, using the A1 as ID of the buoy instance.

Computer A2 The computer receives the data of Buoy 2, Buoy 3, and Buoy 4. On this computer the following parts of the Waves4 suite are installed:

- buoyd, using the A2 as ID of the buoy instance.

Processing systems

Server P1 The computer processes the data of Buoy 1, Buoy 2, Buoy 3, Buoy 4. On this computer the following parts of the Waves4 suite are installed:

- waved

Note there should be only one system running waved in a network.

Display systems

Computer D1 The computer displays the data of Buoy 1, Buoy 2, Buoy 3, Buoy 4. On this computer the following parts of the Waves4 suite are installed:

- Waves4

Computer D2 The computer displays the data of Buoy 1, Buoy 2, Buoy 3, Buoy 4. This system is also used by the operator of the Waves4 suite. This user configures the settings of the campaigns in buoyd and waved. On this computer the following parts of the Waves4 suite are installed:

- Waves4 configurator
- Waves4

Computer D3 The computer displays the data of Buoy 1, Buoy 2, Buoy 3, Buoy 4. On this computer the following parts of the Waves4 suite are installed:

- Waves4

In this example the HF-receivers are received with two systems. It is also possible to receive them on a single computer system with one buoyd service running. This depends on whether the RX-C4 receivers are at one or multiple physical locations. (With Ethernet it is possible to place the acquisition system at a different location as the RX-C4 receiver, but in case of network issues data will be lost.)

The system running the waved service is a separate server, it is also possible to put this on an acquisition machine. It would also be possible to install the Waves4-configurator on this machine.

For further information, please consult the Waves4 user and operator manual:
<http://www.datawell.nl/Support/Documentation/Manuals.aspx>

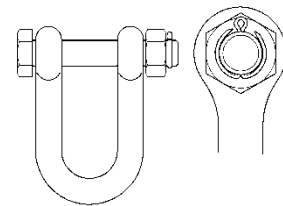
8 Mooring preparation (not for DWR-G4)

Even though the mooring is no sensor by itself, it is a crucial part of a wave measuring system. It solves the paradox of keeping the buoy on its location while at the same time allowing the buoy to follow the orbital wave motion.

Your mooring has been shipped to you pre-assembled as far as possible. The only things you have to do are:

- (1) adjust the Polypropylene line to the correct length and attach the yellow float according manual (page 70-73) and connect the terminals (page 64)
- (2) attach the sinker weight or chain to the P- rope according manual (page 70-73)
- (3) connect the P- rope end with the yellow float to the anchor weight using the 25 mm shackle provided and connect the other end to the rubber cord.
- (4) connect the rubber cord to the buoy chain
- (5) connect orange float(s) if required (only for mooring depth 8-34 m DWR or 8-17 WR)

After fastening the nut on the shackle bolt it must be secured from unscrewing by applying a split pin. Push both legs of the split pin through the hole in the bolt and bend them back, one leg round each side of the bolt. Bring a suitable pair of pliers and a few spare split pins (included).



To avoid entangling the mooring line, lay it out on the deck of the ship as a stack of 'eights'. To keep everything in place you may tie a rope around the waist, leaving one loop of the 'eight' on either side, and two ropes through the two loops itself. If you are taking off rope or wire from a reel, do not slide off loops on the side but unroll the reel. Sliding off line will build up a torque that may set the buoy spinning and damage the sensors of the WR-SG and DWR-MkIII.

In practice, all these actions will be taken when the ship has already left the port. However, to avoid problems at sea please inspect the mooring once before you actually deploy the buoy. If this is your first buoy deployment, lay out the mooring on land at ease as an exercise, study it and pack it into the blue containers again.

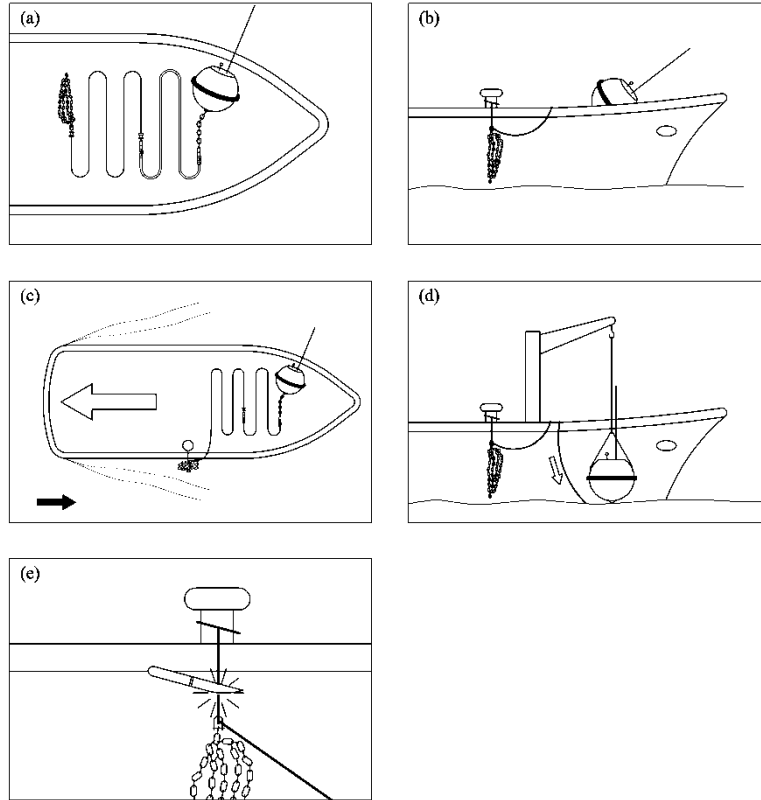
9 Buoy Deployment

Now that you have set up and checked the equipment on land, it's time to deploy the buoy. A safe and successful deployment requires the right equipment and a well-thought out procedure. Bring a few ropes and a knife, they always come in handy. Also bring a used car-tire to support the buoy while on deck. Still the buoy must be roped to the railing. If you have a Buoyfinder you can use it to monitor the buoys outputs. Alternatively you can radio contact your receiving station during deployment. The best time to do this is after the buoy is deployed on its location and before the ship will return to port. To handle the weight of the sinker, either a ship with a hoisting crane or U-frame or a ship with a removable railing should be chartered. For comfortable deployment a day with small waves is best waited for.

The procedure below, see pictures, is suggested for a small vessel with a hoisting crane or removable railing in the front. Users should adapt the procedure to size and outfit of their ship and according to their own experience. Before the actual deployment lay out the mooring line on deck and connect it to sinker and buoy using the shackles and split pins. Never stand inside the loops of the mooring line or between the mooring line and the ship sides. Hoist the sinker on the side of the ship and hang it overboard on a rope or push it towards the removable railing. Release the sinker weight from the hoisting crane and leave it hanging overboard. Once you are at the intended location steer the ship in reverse backing up slowly against the current. This manoeuvre will keep the mooring line out of the screw propeller. Deploy the buoy by hoisting or pushing it overboard. If you hoist the buoy use an extra piece of rope to keep the crane hook at a distance from the antennas and sensors mounted. To release, cut the rope. Feed the mooring

line loop by loop while the buoy drifts away from the ship and finally cut the rope that carries the sinker or push the sinker overboard. Continue to back up until the ship has gained enough distance to steer clear of the buoy and mooring line.

Should anything go wrong, do not recover the buoy by pulling on the rubber cords. This is dangerous. If you can reach the polypropylene rope, you may pull directly at this point. If you necessarily have to recover the buoy and you can only reach the rubber cords, cut the rubber cord.



10 Buoy Recovery

IMPORTANT – During the recovery process the most dangerous item is the rubber cord(s). Stretching the cord(s) increases the level of danger and should be avoided whenever possible.

There are several techniques for recovering a Waverider buoy. The most suitable method on any particular occasion will depend on the location, the weather, the sea state, the type/size of vessel being used, the availability of substitute equipment and, sometimes, operator experience/preference.

The general methodology is to recover the buoy first, then the rubber cord(s) and finally the clump weight, which should be lifted via the polypropylene rope. **Do not lift the mooring with the rubber cord(s).**

The rubber cord is a valuable item. Minimise the risk of damage after recovery by handling it carefully and stowed it away from operating areas as soon as practically possible.

(a) Method - Exchanging Waverider buoys at the same location

If the operating vessel has the ability to maintain its position in relationship to the Waverider mooring **without extending** the rubber cord during the recovery process, this is the quickest method of exchanging a buoy deployed at the same mooring:

Lift the buoy from the water using a rope bridal, connected between the two handles fitted to the upper half of the Waverider buoy hull. Steady or anti-spin lines can be attached to the safety triangle during the lifting procedure. Stow and secure the buoy on the vessel deck. Secure the mooring to the deck at the upper end of the Polypropylene rope.

Disconnect the mooring between the chain coupling of the buoy and the rubber cord terminal. Connect the mooring to the chain coupling of the replacement buoy, ensuring that the safety shackle is correctly fitted and securely locked with nut and split pin.

Free all securing lines to the mooring and the Waverider buoy, lift the buoy and lower back onto the water.

During the above operation a member of the recovery team, equipped with a knife, should be stationed close to the secured rubber cord. Should any sudden vessel movement increases the tension in the rubber cord and endanger the recovery personnel, the rubber cord must be severed.

It should be noted that this mode of operation may only be used where the ship is able to maintain its exact position within a couple of meters. Additionally this method does not allow all the mooring to be fully inspected (the rubber cord(s) for cuts and polypropylene rope for wear). If this method is regularly used, increased inspections of the complete mooring must be undertaken.

(b) Method - Recovery using a dummy buoy

Where there is no replacement Waverider buoy, a dummy buoy can be deployed to support the mooring thus avoiding the need to retrieve the complete mooring. An old Waverider equipped with an operating flashlight may be used as a dummy buoy. In this instance the exchange procedure described in a) above has to be applied twice.

(c) Method - Recovery using a small work boat, rib or dingy

The Waverider cannot be lifted onto a small workboat or rib. However, such a vessel may be used to tow the Waverider buoy to a larger vessel or ashore. Mooring recovery will be by hand, ensuring that no tension is placed on the rubber cord(s). Recovery of the mooring clump weight must only be achieved by using the polypropylene rope.

If the mooring clump weight cannot be recovered, the polypropylene rope may be cut below the rubber cord leaving the clump weight and residue rope on the seabed.

The Waverider should not be towed at speeds greater than 2 m/s (4 kn).

By using this recovery method, the cost of the loss of a section of mooring line and clump weight would be more than offset by the savings made in not chartering a ship.