



WaveDroid

Quick Start Guide

Revision 3

For more information visit www.wavedroid.net or email info@wavedroid.net

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Introduction

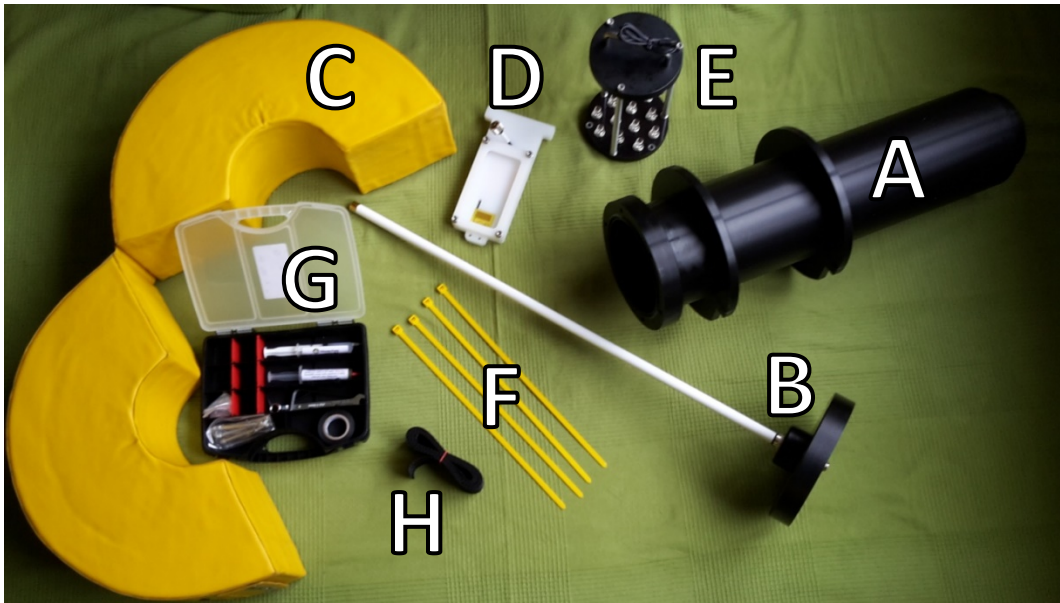
This Quick Start Guide aims to provide all the information necessary to prepare and deploy a WaveDroid Wave Measurement Buoy. If further assistance is required, please do not hesitate to visit our website or call us directly. We are here to make your wave measurement campaign a success.

Important Information

- Never deploy the anchor weight first. Always deploy the buoy and then the anchor.
- Make certain that there is no danger from entanglement in the mooring lines. Becoming caught in the mooring lines may result in injury or death.
- Ensure that the battery canister always remains dry and that no foreign object can make contact with the battery terminals. Moisture and foreign objects may result in a short-circuit leading to degassing and/or fire.
- Do NOT transport a full battery canister on an aircraft.
- Ensure that all batteries are placed in the battery pack in the correct orientation.
- Never hold the buoy upside down to prevent sliding of the battery canister, which may damage the usb connector, battery canister and phone tray.
- Whilst transporting the buoy, mooring and anchor, ensure that the load is correctly secured to prevent the load shifting.
- Do not use foreign magnetic materials in or around the buoy housing, as this may adversely influence the magnetic sensor readings.
- The provided cellular antenna is robust and fairly rigid under normal operating conditions. However care must be taken when handling your WaveDroid during transportation, deployment and recovery.



Packing List



Above: Overview of WaveDroid components

- A. HDPE Buoy Housing with Float Flanges.
- B. Top cap with secure Quad Band Cellular Antenna
- C. Closed Cell EVA Buoyancy Float
- D. Phone Holder with Passive Antenna Components
- E. Battery Pack (Quantity of 36 1.5v D-Cells) USB Cable Output: 5v
- F. Cable ties (Qty. 4)
- G. Tool kit
 - 1. M6X20 Cap Screws (Qty. 2 + 1 spare)
 - 2. M6X70 Cap Screws with Washers and Nyloc Nuts (Qty. 6 + 1 spare)
 - 3. Insulation Tape
 - 4. Silicon paste for the lubrication of O-Ring Seals
 - 5. Copper compound for anti-seize of bolts
 - 6. Size 10 Spanner
 - 7. Hex keys No.5 & No.6
- H. Shoulder strap
- I. Smartphone (not in picture)

Preparing For Deployment - Workflow

Steps to prepare the buoy for deployment:

1. Attach the phone tray to the top cap with the provided cap screws.
2. Insert a SIM card into the smartphone switch on, and choose your settings.
3. Prepare the battery pack.
4. Mount the smartphone in the buoy and connect the battery canister.
5. Start the measurement and close the buoy housing.
6. Calibrate the compass.
7. Secure the float.
8. Assemble the mooring line.
9. Deploy your WaveDroid.
10. Check data and adjust settings online.



IMPORTANT NOTICE REGARDING TIGHTENING OF BOLTS:

DO NOT APPLY EXTREME FORCE TO TIGHTEN BOLTS THAT ARE SCREWED INTO PLASTIC PARTS OF THE BUOY IN ORDER TO AVOID STRIPING OF THE THREADS!

Attaching the Phone Tray

Use the two provided M6X20 cap screws to secure the phone tray onto the top cap. Connect the antenna cable by tightening the metal plug. The result is shown in Figure 1.



Figure 1: Phone tray secured onto top cap

SIM Card

In order to establish a real-time data connection with the buoy, a SIM card with sufficient data credit should be arranged and inserted into the phone. When choosing a suitable SIM card, the following points are important to consider:

- Choose a provider with good network coverage at the deployment location. Network coverage may vary strongly between different providers. Most providers present a network coverage map on their website. For WaveDroid, only 2G coverage should be considered.
- The data load for WaveDroid is approximately 1 MB per day.
- The SIM card slot of the smartphone accepts one micro SIM card (middle size: standard > micro > nano)
- Generally, a prepaid SIM card is the best choice regarding flexibility and cost. It is important that additional prepaid credit can be purchased and loaded onto the SIM card online while the phone is at sea.
- Pay attention to the validity of the SIM card and data credit. Providers might restrict SIM card validity to only a few months, especially when selling to foreign customers.

Setting up the WaveDroid App.

Switch on the phone by pushing the power button and wait until the lock screen appears. Unlock the SIM card by entering the code, which has been provided to you by the SIM card provider. Unlock the screen by entering the unlock code, which has been provided to you by WaveDroid staff through personal communication. It is advised to set the SIM card unlock code equal to the screen unlock code.

The general settings of the smartphone have been configured correctly by WaveDroid staff. It is strongly advised not to change any of these general settings. Wifi should be switched off, GPS location should be switched on and the mobile connection should be set to 'GSM only' (3G or 4G tend to be less stable than 2G).

Launch the WaveDroid app by touching the WaveDroid icon on the Android home screen. You are now in WaveDroid's measurement screen (Figure 2, left panel). Touch the WaveDroid menu button in the top right corner ('...') and choose 'Settings'.

You are now in the settings menu (Figure 2, right panel). An overview of all options and their default values is presented in Table 1. The use of the GPS fence and calibration of the compass are explained in more detail in the associated sections of the manual.

Setting	Description	Default
Real-time data	Send real-time data	No (unchecked)
Log raw data	Log raw sensor values to phone memory (necessary for advanced measurement analysis by WaveDroid staff)	No
Real-time output parameters	Real-time bulk parameters and/or spectra (1D and 2D spectra)	Bulk
Logged output parameters	Bulk parameters and/or spectra logged in phone memory	Bulk and spectra
Number of initial 5 minute bursts	Number of 5-minute data bursts to start with (eventually, WaveDroid will measure in 30-minute bursts). Used to check buoy functioning after start of measurement.	5
Alert phone number	Domestic phone number to send SMS alerts to. Country code (+...) should be specified as part of the phone number.	
Daily SMS	Send a daily SMS text message to the alert phone number between 8h00 and 9h00 to notify the user that the WaveDroid is still functional. Useful in case mobile data connection is unreliable.	No
GPS fence	Send SMS alert when buoy is 500 m from deployment location	No
GPS latitude / longitude	Latitude and longitude of GPS fence reference location, specified in decimal degrees. Provide at least 6 decimals for sufficient accuracy.	0.0

Table 1: Settings overview

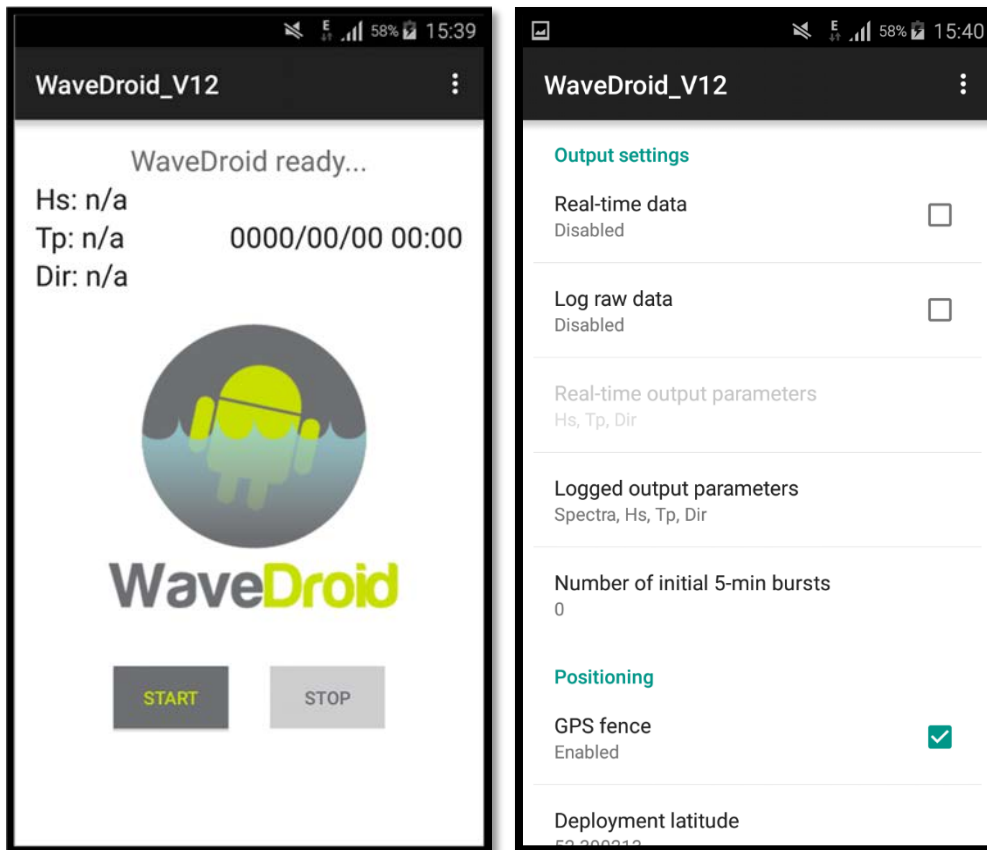


Figure 2: WaveDroid smartphone app screenshots

Preparing the Battery Pack

The battery pack should be filled with 36 alkaline D-cell batteries. Using batteries of a premium brand (Duracell, Varta, Energizer, etc.) will allow for 8 to 12 weeks of battery life. The steps needed to fill the battery canister are listed below.

1. Place 12 batteries in a hexagonal shape, with the + poles pointing upward (Figure 3a), put an elastic band around them (shown in the figure) and put tape around them (not shown in the figure).
2. Repeat step 1, place the new layer on top of the first layer and tape the two layers together (Figure 3b).
3. Repeat step 1, place the new layer on top of the second layer and tape the two layers together.
4. Make sure that all three layers are taped together properly, apply more tape if needed.
5. Place the batteries into the canister and close the lid, tighten the lid until full contact is made between the top cap and the aluminium rods. The aluminium rods act at the battery pack negative terminal (Figure 3c).
6. Do not pull or lift the battery pack by the USB cable, always use the provided handle.



Figure 3: Filling the battery canister. It is advised to apply tape around every single layer as well (not shown here) for larger stability of the battery pack.

Mounting the Smartphone

Remove the cap screws from the phone tray mounting bracket. Place the phone in the plastic bracket. Place the bracket (with the phone inside) on the plastic tray, making sure that the antenna board and cable are positioned inside the slots. Secure the bracket on the tray by tightening the cap screws.

GPS fence

Real-time GPS position feedback can be used to confirm that the buoy is still situated at its intended mooring location. If a recorded GPS position is more than 500 m away from the intended mooring location, an SMS message is sent to the specified emergency phone number.

The latitude and longitude of the intended mooring location can be specified in the app's settings menu, but also in the online settings menu on your WaveDroid's dedicated webpage. This allows you to adjust the specified mooring location after the buoy has been deployed, for example to correct for placement inaccuracy.

It is strongly advised to use a domestic emergency phone number, as sending text messages to foreign phone numbers could lead to high costs.

Starting the measurement

Make sure that the phone is fully charged. Plug in the battery pack. Sometimes the lightning-symbol will appear in the top right corner of the screen to indicate that the phone is charging, but this is not

necessarily the case if the phone is fully charged already. Touch the start button in the main screen of the app and confirm that the screen turns black after 15 seconds.

Closing the housing

Confirm that the rubber O-ring on the top flange is properly lubricated with silicone paste. Insert the battery pack into the buoy housing and then place the top cap on the top flange. Insert the bolts through the holes, apply washers and tighten the nuts. Do not completely tighten the nuts one-by-one, but iteratively twist every nut a several times to achieve equal pressure distribution over the rubber O-ring.

Compass calibration

The WaveDroid buoy measures wave directions with the help of a digital compass, which keeps track of the buoy's orientation. The compass is calibrated actively, continuously making use of buoy movements to update its centering.

However, reliable calibration is only possible if the buoy is rotated systematically into all possible 3-dimensional orientations. Therefore, a compass calibration routine should be completed by a group of 2 to 3 persons. Calibration is easiest if the yellow float is not secured around the housing yet.

Securing the float

Unscrew the two plastic float flanges, slide them over the housing into the slits and tighten the bolts. Place the float around the housing in between the flanges, apply force if needed. Fasten the float by looping the cable ties through the eyelets.

Mooring assembly

The WaveDroid buoy should be moored on a line with several in-line floats and weights. This avoids excessive mooring line tension and leads to optimal buoy dynamics. The general mooring design is shown in Figure 4. Table 2 gives the specifications of all components, partly depending on the expected maximum current speed, wave height and water depth. Further assistance on mooring design may be obtained from WaveDroid prior to deployment.

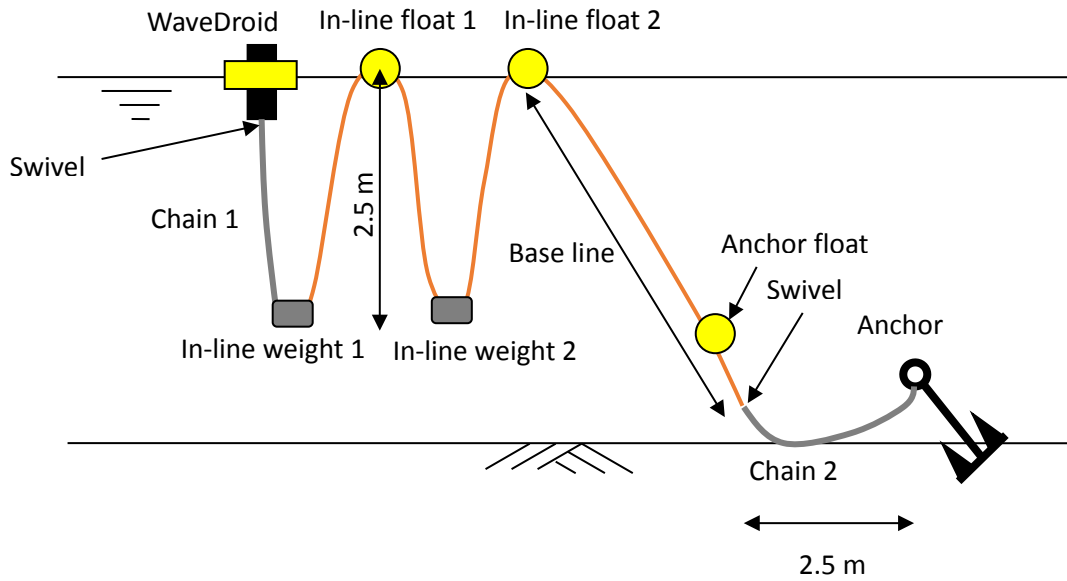


Figure 4: General mooring design

Component	Specification		
Base line	Diameter: min. 10 mm Length: Mean water depth + High Water level + Surge + 0.5 * maximum wave height + 2 meter margin (total line length = base length + 7.5 m)		
Chain 1 and 2	1 – 2 kg /m, seawater proof		
Anchor float	0.5 L		
Swivels	Stainless steel, min. 8 mm diameter		
	Currents max. 0.5 m/s	Currents 0.5 – 1 m/s*	Currents 1 – 1.5 m/s*
In-line float 1 and 2	5 L	10 L	15 L
In-line weight 1 and 2	1.5 kg	3 kg	5 kg
Anchor	15 kg	20 kg	30 kg

Table 2: Mooring specifications

Accessing the live data page

As a WaveDroid client, you will have access to a dedicated live data webpage. The URL of this webpage will be communicated to you by WaveDroid staff prior to deployment. Best performance of the webpage is achieved in Google Chrome. The webpage provides the following functionality:

- View interactive graphs of all bulk wave parameters (Figure 5).
- Download timeseries of bulk wave parameters and spectral parameters
- Download .png figures of daily bulk wave parameter graphs and 30-minute wave spectra (1D and 2D)
- Track the GPS position of your buoy(s) on a map

* The WaveDroid buoy functions optimally in currents < 0.5 m/s. Performance may be compromised at higher ambient flow velocities.

- View an event log (buoy online/offline, battery charged/empty, GPS alerts)
- Online configuration of a limited number of buoy settings during deployment

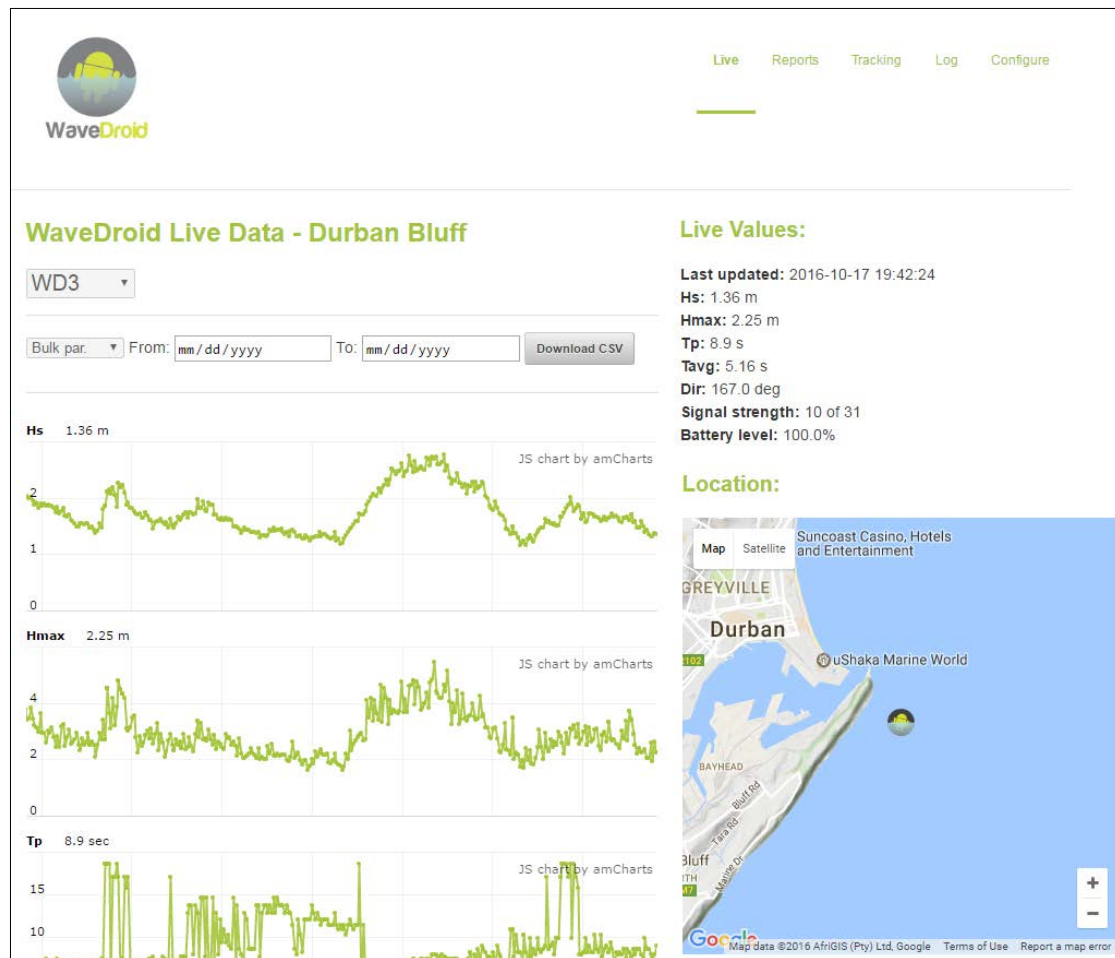


Figure 5: Live data webpage screenshot

Email alerts

The WaveDroid server runs automatic checks on the datastream at 30 minute intervals. Email alerts are sent in case of important changes of the buoy's status:

- Real-time data connection went online/offline
- Battery charged/empty
- GPS position OK/alert
- Wave height threshold OK/alert

Email addresses for alerts and wave height threshold (optional) can be set in the online configuration menu.

Accessing the logged data on the phone

The logged data (as specified in the 'logged output parameters' setting of the app) are accessible in the phone's internal memory after retrieval of the buoy.

Connect the phone to a computer using a micro USB cable. Enter the unlock code on the phone screen to gain access to the internal memory. The raw data files reside under 'Android/data/wavedroid_v12.wavedroid.eu.wavedroid_v12/files'. The following files are available:

- A bulk parameter file per measurement (a measurement being started by hitting the 'start' button in the app's main screen and being terminated by hitting the 'stop' button) named 'bulkparams_xxxx.txt'.
- A spectrum file containing the 1D and 2D spectral parameters per 30 minute burst. Timing is provide with an epoch timestamp (seconds since 1 January 1970 in UTC/GMT) in the filename '<epoch>_spectrum.txt'.
- An encrypted raw data file containing raw accelerometer, magnetometer and gyroscope data, for use by WaveDroid staff only.

General Specifications

The parameters returned by the WaveDroid buoy are listed below:

Parameter	Description
H_s [m]	Significant wave height (also known as H_{m0}). This is the most commonly used wave height statistic world-wide. It has been shown to closely match the visually estimated wave height by experienced human observers. Computed from the 1-dimensional wave spectrum.
H_{max} [m]	Maximum wave height. The wave height of the highest wave in one 30-minute record, based on a zero-crossing analysis.
T_p [s]	Peak wave period. The wave period that contains most energy in the 1-dimensional wave spectrum. The peak wave period is sometimes seen to alternate between different sea states (locally generated wind waves and distant swell).
T_{avg} [s]	Average wave period. The average wave period of all individual waves in one 30-minute record, based on a zero-crossing analysis.
T_{max} [s]	Period of the maximum wave. Wave period belonging to the highest wave in the 30-minute record, based on a zero-crossing analysis.
Dir_p [deg]	Peak wave direction. Wave direction (coming-from convention) that contains the most energy in the 2-dimensional wave spectrum. The peak wave direction is sometimes seen to alternate between different sea states. Ranging from -180 (South) through 0 (North) to +180 (South again) or 0 (North) through 180 (South) to 360 (North again).
Freq [Hz]	Frequencies of the 1D and 2D spectra.
P_{uu} [m ² /Hz]	Energy-density of the 1D spectrum.
θ_0 [rad]	Peak direction per wave frequency of the 2D spectrum. Ranging from $-\pi$ (South) through 0 (North) to $+\pi$ (South again).
m_1	Centred Fourier coefficient of $\cos(\theta)$ part of 2D spectrum.
m_2	Centred Fourier coefficient of $\cos(2\theta)$ part of 2D spectrum.
n_2	Centred Fourier coefficient of $\sin(2\theta)$ part of 2D spectrum.

Bat [%]	Battery percentage of the smartphone battery. Will remain 100% as long as the battery canister is still charging the smartphone. After the battery canister has drained, the smartphone battery will drop to 0% within approx. 12 hours.
Signal strength	Strength of the 2G network signal. Indicative of the stability of the internet connection. The value ranges between 1 (weak signal) and 31 (strong signal).