

ER-00016-RevA-Open-LIFU Water Tank Testing

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Change Approval History

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Open-LIFU Water Tank Testing

NOTE: Water tank setups vary so instructions may be different depending on the tank being used.

Overview

This document outlines water tank (**Onda AIMS III Water Tank and Soniq 5.3+ software**) testing procedures for acoustic verification of Open-LIFU transducers using the Open-LIFU Test Application. Designed for straightforward hardware validation and basic operational testing, the test application provides an intuitive, QML-based user interface to control the Open-LIFU system.

Unlike the advanced Verification Tank suite, which focuses on automated field mapping and complex acoustic characterization, this application is streamlined for end-users. It allows users to quickly verify basic hardware functionality, run test procedures on transducers, and load preset solutions without needing extensive Python programming experience or direct interaction with the underlying SDK.

To test the Open-LIFU device with a water tank, users may use any of the following tools:

- [Open-LIFU Test App](#) (recommended)
- [Open-LIFU Python](#)
- [Slicer Open-LIFU](#)
- [Open-LIFU Desktop](#)

NOTE: This document focuses specifically on the Open-LIFU Test App. Users wishing to use another application are encouraged to review the documentation found in the respectively linked repos.

NOTE: Users with a different water tank and software package setup may use this document as a guide while adapting the described workflow for their specific setup and application.

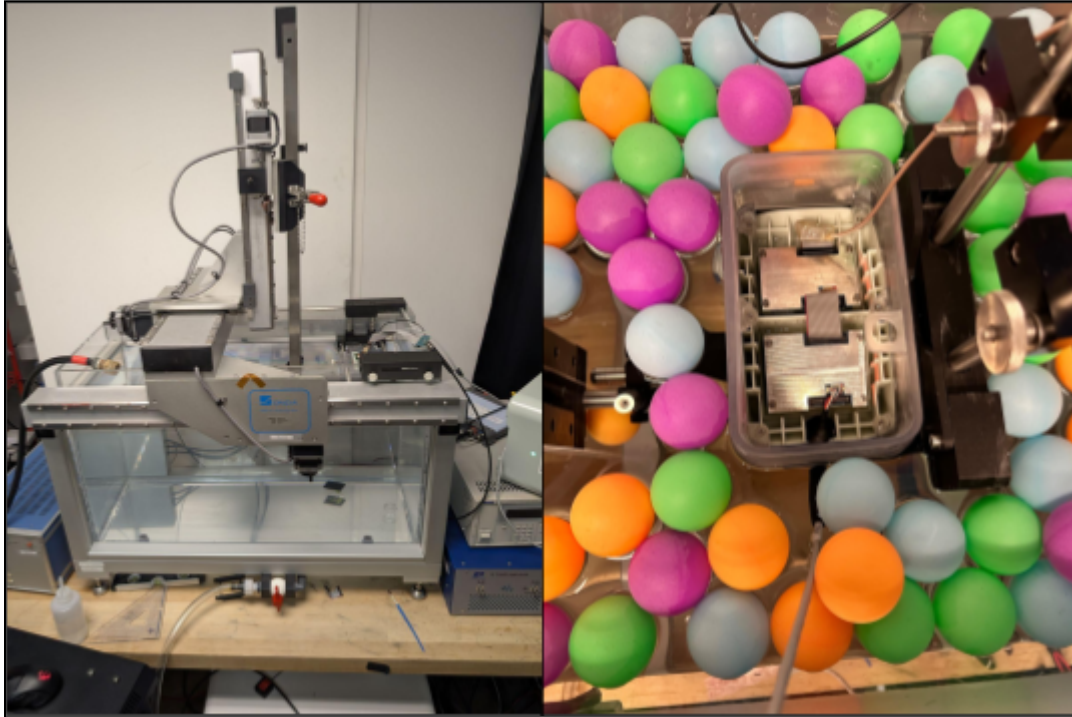


Figure 1: Demonstrates the Onda AIMS III water tank setup (left) described in this document along with the 2x transducer configuration partially submerged (top down) in the tank (right).

Device Compatibility

The Open-LIFU Test App v 1.0.15 is compatible with Open-LIFU hardware running:

- [Transmitter Firmware](#) v2.0.x
- [Console Firmware](#) v 1.2.x

Key Features

- Multi-instrument coordination: Seamless integration of transducer control, data acquisition, and power management
- Automated measurements: Built-in scanning, peak finding, and field mapping capabilities
- Calibrated pressure measurements: Support for calibrated hydrophones with frequency-dependent sensitivity
- High-speed data acquisition: Integration with PicoScope oscilloscopes for precision timing
- Flexible control: Programmable power supply control with voltage settling detection

System Components

Hardware

- Water Tank
 - **Onda AIMS III Water Tank:** Provides a controlled and repeatable acoustic environment for characterizing focused ultrasound transducers
 - **Calibrated Hydrophone:** Precision pressure sensor with tank positioning system
 - Testing with HNR-500 with extended frequency range calibration
 - **PicoScope 5000A Series:** High-speed USB oscilloscope for data acquisition
- OpenLIFU Transducer System:
 - Multi-element focused ultrasound transducer with beam steering
 - Trigger sync cable (ribbon to BNC)
 - Transducer fixture (holder)

Software

- Onda Soniq 5.3+ software: An industry-standard suite designed for acquiring, mapping, and analyzing acoustic fields in liquids, typically used with the AIMS III hydrophone scanning system
- Open-LIFU Software (Need one of the following)
 - **Test App (Recommended):** QML-based Python user interface
 - Load solution(s) into test app to run
 - **Python API:** Object-oriented interfaces for each system component
 - **Slicer Open-LIFU Extension (Advanced Users) and Open-LIFU Desktop:** Used as a graphical interface to plan and generate preconfigured sonication solutions, which can then be exported and loaded into the Test App

Water tank testing is performed to provide a controlled and repeatable acoustic environment for characterizing the performance of the Open-LIFU transducers. These tests help verify that transducers are functioning properly and operate within the designed performance specifications.

The transducer is designed to be cleanable, but is *not waterproof*. The cable entry and transmit modules have a watertight silicon seal with the transducer housing, but the patterned top lid does not form a watertight seal with the rest of the housing. To support water tank testing, the system must be temporarily modified to allow partial submersion in a water tank.

To scan beam plots, the transducer must be mounted face down (partially submerged in a **top down approach**¹) and the hydrophone should be attached to the translation stage.

¹ DO NOT fully submerge the transducer in the water tank. Doing so will damage the device and may result in injury.

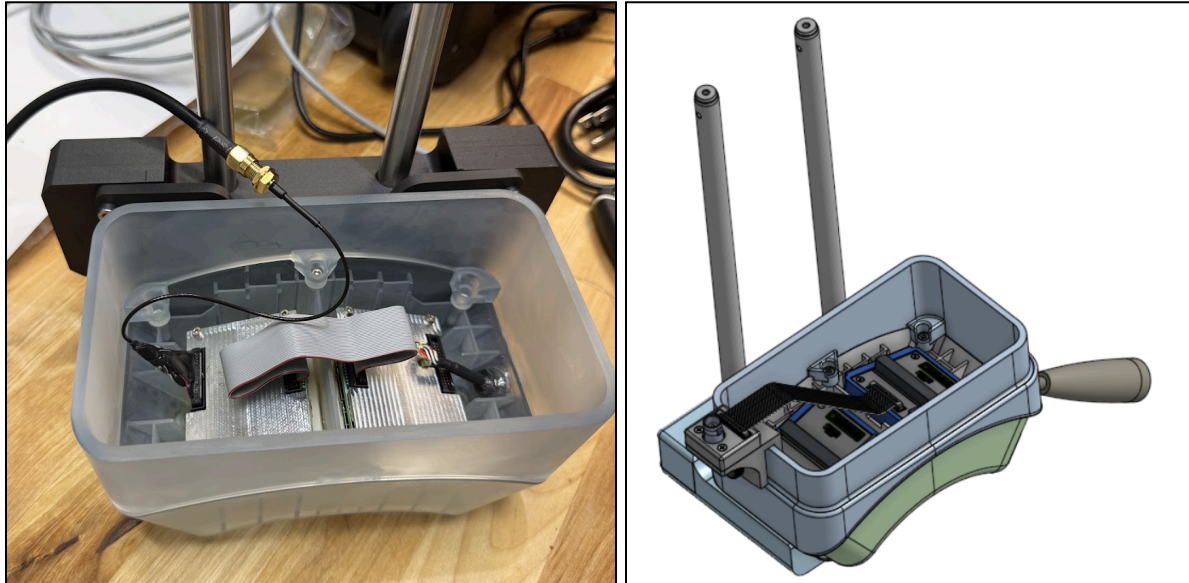


Figure 2: Shows the fully assembled transducer with water tank extender prior to placing it in the water tank.

Required Open-LIFU Water Tank Accessories

To support water tank testing, the following accessories are required²:

Wall Extender



A wall extender replaces the pressing lid and veneer, allowing more of the transducer to be submerged in a water tank without risking water spilling into the electronics. This part is sealed with a silicone rubber gasket.

² The Water Tank Accessories Kit (PN 900-00016) can be purchased by contacting your local sales representative. Alternatively, users may build their own by visiting Openwater's [openlifu-mechanical](https://openlifu-mechanical.com) repository.

Water Tank Holder

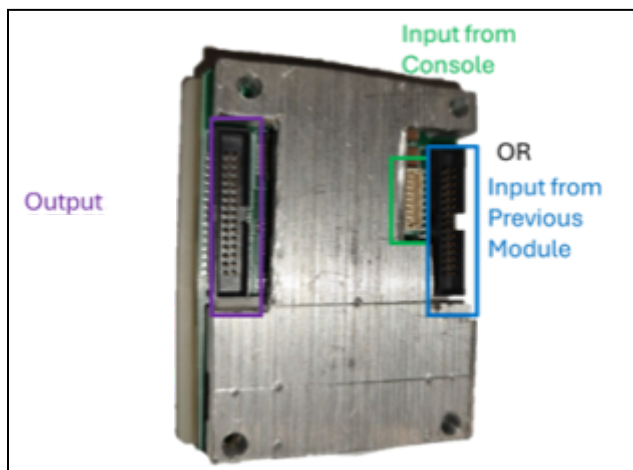


A dedicated fixture with two rods mount interface is provided to support the mounting of the 2X enclosure **with pre-attached (glued) transducers**. To install, remove two screws from the toggles, position the enclosure within the fixture, and align the toggle holes and cable notch accordingly. Once properly aligned, secure the enclosure to the fixture using the screws. This fixture allows the transducer to be positioned normal to the scanning tank axes.

Trigger Cable adapter



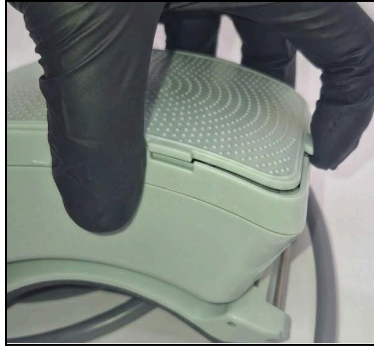
To synchronize the emission of ultrasound signals with an oscilloscope recording a hydrophone signal, a cable is provided that hooks into the *output* ribbon connector of the final transmit module and routes the trigger sync signal to an SMA connector.



Attaching the Extender

An extender is provided to extend the height of the transducer housing for partial submersion in a water tank.

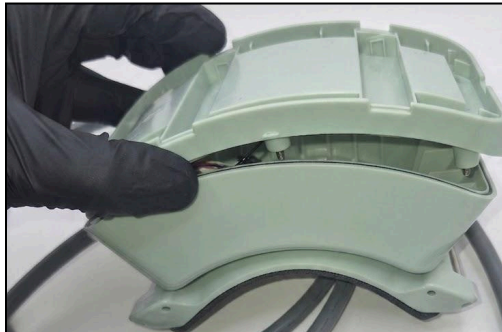
1. Remove the patterned lid (vener) by lifting the tab on the left side.



2. Using a 2.5mm hex screwdriver, loosen the 6 M3 screws holding the under-lid in place and remove them



3. Remove the under-lid (Pressing lid), exposing the trigger cable



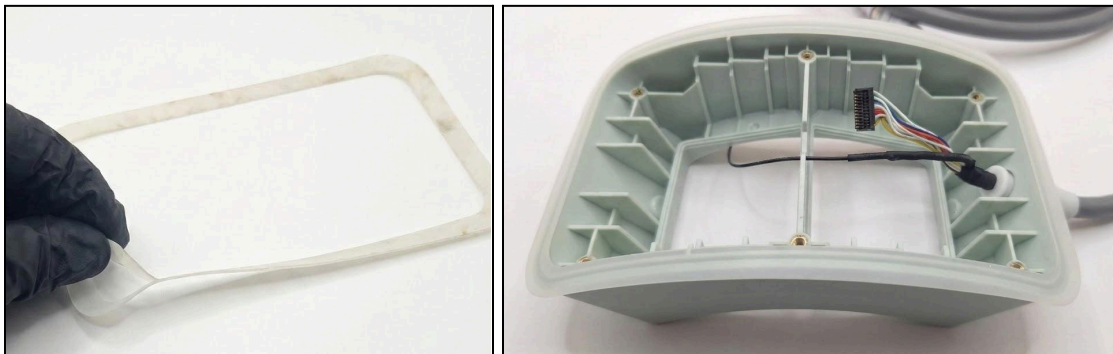
4. Remove the O-Ring gasket from the groove of the bottom enclosure.



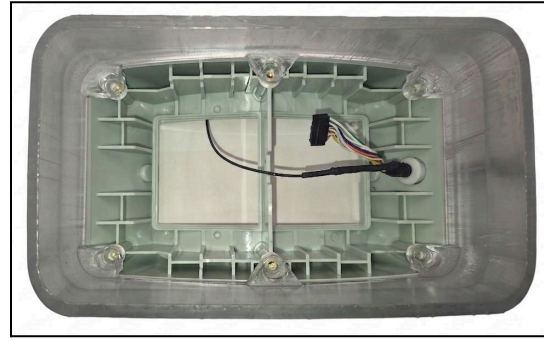
5. Using a 2.5mm hex screwdriver remove two M3 screws holding the enclosure bottom at the frame toggles.



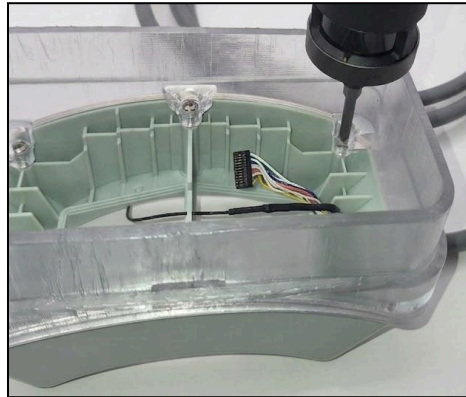
6. If the Extender gasket has a protective layer - remove it. Place the Extender gasket on the bottom enclosure,



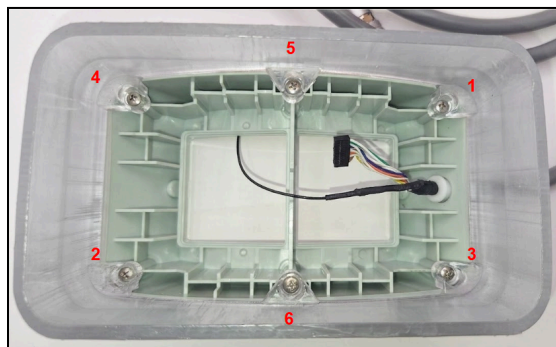
7. Place Wall Extender on top of the gasket.



8. Using the 2.5mm hex screwdriver, put the 6 M3, 8mm long screws in the holes inside the extender.



9. Tighten the screws to secure the extender in position and to compress the gasket. Begin by partially tightening each screw without fully securing them, ensuring that the gasket remains properly seated and uniformly aligned against the entire surface.
10. Proceed to tighten the screws gradually in a diagonal pattern, applying even pressure in multiple stages to achieve consistent compression.



11. Be careful not to over-tighten and damage the threaded inserts.

12. To work with a single transducer - carefully remove the Daisy Chain cable from the ribbon cable connector
13. Connect the trigger cable of the Ribbon to BNC adapter into the ribbon connector opposite the entry cable.
14. Place the enclosure to the mount, aligning the toggles mounting holes.



15. Using the 2.5 mm hex screwdriver screw two of M3, 8 mm long screws to fix the enclosure to the mount.

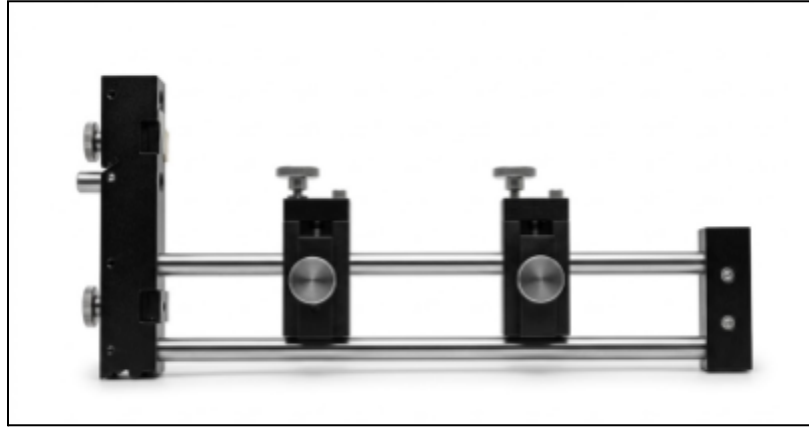


16. Partially submerge the housing in water, so that the sealed seam is below the water surface
17. Wait 4-6 hours and ensure that the seal is not leaking before powering on the system

Water Tank Holder Fixture

NOTE: The water tank holder fixture uses dual 12 mm rod interfaces for mounting the 2x transducer enclosure.

1. Openwater has created a water tank mount fixture that is compatible with the Onda AIMS III water tank for repeatable positioning against a corner of the big tank. The tank mount has two 12 mm rod interfaces as a standard. See image below:



2. Adjust height of the water tank holder to sink transducers at least 10 mm into the water and make sure the top of the wall extender edge is above the water level.
3. Remove all bubbles under the transducers with a soft brush and/or syringe.
4. Set up the hydrophone close to the best focus position.

Removing the Extender

1. Using a 2.5mm hex screwdriver, remove the 2 M3 screws holding the enclosure at the mount.
2. Using a 2.5mm hex screwdriver, remove the 6 M3 screws holding wall extender at the enclosure.
3. Carefully remove the separate trigger cable
4. Carefully place the Daisy Chain cable into the ribbon cable connector
5. Remove the Extender Gasket
6. Place O-Ring gasket into the groove at the enclosure bottom, make sure it is not twisted.
7. Seat the Pressing lid in the groove on the gasket
8. Using the 2.5mm hex screwdriver, insert the 6 M3 screws
9. Tighten the Pressing lid in place, being careful not to overtighten the bolts
10. Place the Veneer in place and press down to secure it
11. Using a 2.5mm hex screwdriver install 2 M3 screws to fix the enclosure bottom at the frame toggles.

Open-LIFU Test Application Download

1. Navigate to the [openlifufu-test-app](#) repo.
2. Click on the latest release and download the zip file.
3. Extract the files to a location on the local computer.

Running the Test App

If only measuring pressure output to make sure the Open-LIFU system is working as intended, it's recommended to use the [openlifu-test-app](#).

1. Navigate to where the files were extracted and double click on the executable file.
 - a. Acknowledge the Microsoft Defender SmartScreen warning and select Run anyway.



2. Refer to the [Controller User Guide - Pre-Release](#) to configure and run an arbitrary sonication.

Best Practices

WARNING: Failure to follow proper safe handling and operating procedures of the transducer may result in injury or damage to the equipment being tested.

- Use degassed water
- Leave high voltage on between scans if running multiple scans to avoid ramp up/down time
- Use shorter pulse if measuring pressure/ spatial scans
- When doing spatial beam scanning, changing some of the parameters from their therapeutic values can aid in fast and reliable scans while prolonging the life of your hydrophone:
 - Using a shorter pulse duration to capture steady-state amplitude (e.g. 200us)
 - Using a shorter pulse interval to allow for faster capture of signals (e.g. 20ms)
 - Using a lower pulse amplitude to reduce likelihood of cavitating air bubbles in the water tank (e.g. 40Vpp)
 - After performing spatial mapping, be sure to make appropriate measurements with the full therapeutic dose.