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Open-Motion*
Research User Manual

Openwater



Disclaimer

The Open-Motion platform is for research use only. Not for use in diagnostic or therapeutic procedures. All information contained herein, including but not limited to product features, specifications, and descriptions, is subject to change without notice.

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1. Introduction

1.1. Overview

This manual serves as a guide for trained users to operate Openwater's Open-Motion device, enabling them to take measurements safely.

Laser safety is enforced by a hardware interlock inside the Console, independently of this software.

1.2. Device Description

The Open-Motion device uses low-intensity near-infrared (NIR) light to measure blood flow and blood volume non-invasively in a research setting. Two forehead **Sensor Modules** (eight cameras each) and a **Console** containing a near-infrared laser use laser-speckle images to take measurements 40 times per second for every active camera:

- **BFI — Blood Flow Index**: a relative index of blood flow.
- **BVI — Blood Volume Index**: a relative index of blood volume.
- **Mean** and **Contrast**: the raw speckle-image statistics that BFI and BVI are derived from, available as an alternative display.

1.3. Indications for Use

The Open-Motion device is intended to be used by research professionals to measure changes in blood flow and blood volume for research purposes only. It is not intended for the diagnosis or treatment of any disease or medical condition.

1.4. Contraindications

Do not use the Open-Motion device on subjects with any of the following conditions:

- Open cuts, sores, or wounds within the contact area
- Head dressings, bandages, or gauze on or around the scan site
- Inability to remain stationary for the duration of the measurements

1.5. Research Use Only

Use of the device to perform pre-clinical and/or clinical research may be subject to various domestic and international laws and regulations. It is the responsibility of the operator to be aware of and comply with all applicable laws and regulations pertaining to their particular indication. While Openwater has endeavored to design the device with predictable performance and documented safety features, the device is provided as-is without warranty. The safety and efficacy of the device for any particular use are inherently subject to the specific requirements and risks of that application, and assessment and mitigation of such risks is the sole responsibility of the researcher.

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1.6. Definitions

Application: The executable software program for controlling the device

BFI: Blood Flow Index; a unitless index of regional cerebral blood flow

BVI: Blood Volume Index; a unitless index of regional cerebral blood volume

Console: Enclosure that houses the electronics used to control and power the laser, receive data from the camera sensors, and connect to the PC

Contrast: The fundamental physical metric measured by the P-SCOS sensors. Moving red blood cells cause the speckle pattern to fluctuate and blur, meaning lower contrast indicates higher blood flow, while higher contrast indicates slower or less blood flow

GUI: Graphical User Interface

Mean: The average light intensity captured by the sensor pixels over a given frame or exposure

NIR: Near infrared

Operator: The user operating and controlling the device

PC: Personal Computer

P-SCOS: Pulsed speckle contrast optical spectroscopy

Scan History: Chronological log or database of previously captured P-SCOS recordings, allowing operators to retrieve, compare, and analyze historical hemodynamic data from prior evaluations

Sensor Module: Part of the device that contacts the subject

Session: A single, contiguous period of data acquisition and monitoring within the Open-Motion software

Subject: The person, animal, or phantom being measured

System: The entire Open-Motion system, including hardware and software

TTL: Transistor-Transistor Logic

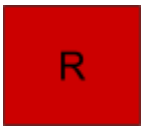
1.7. Symbols and Device Labels

Table 1: Open-Motion Device Labels and Symbols.

Label	Title	Description
	Class 1 laser radiation emitted from the device	Device-specific labeling symbol indicating that Class 1 laser radiation is emitted from the device during normal operation.
	Do not bend or damage cables	Device-specific handling symbol indicating that excessive bending force, kinking, or cable damage should be avoided.
	Caution	Indicates that caution is necessary when operating the device or when reviewing the associated labeling or instructions.

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Label	Title	Description
	Do not open or disassemble	Warning label indicating that there are no user-serviceable components inside and that opening or disassembling the device may expose individuals to hazardous internal laser radiation and can cause injury.
	Left Sensor Module identification	Used to identify the LEFT Sensor Module.
	Right Sensor Module identification	Used to identify the RIGHT Sensor Module.
	Output sync TTL digital synchronization	Device-specific connector marking identifying the output synchronization connection using TTL (Transistor-Transistor Logic) digital signaling.
	Input sync TTL digital synchronization	Device-specific connector marking identifying the input synchronization connection using TTL (Transistor-Transistor Logic) digital signaling. *This feature is not currently supported.*

2. Safety

2.1. Conformance Statement

Openwater is committed to meeting customer expectations by supplying safe and reliable products and services. The Open-Motion device has been designed to conform to the following regulatory and quality standards[1]:

ISO 13485 3rd Edition Quality management systems

ISO 14971:2019 Application of risk management to medical devices

IEC 62304:2006 Software Lifecycle

IEC 60601-1:2005+A1:2012+A2:2020 Medical electrical equipment — General requirements for basic safety and essential performance EDITION 3.0 & EDITION 3.2

IEC 60601-1-2:2014+A1:2020 Electromagnetic disturbances EDITION 4.1

[1] The Open-Motion platform is for Research Use Only. Not for use in diagnostic procedures.

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IEC 62366-1 Edition 1.1 Usability Engineering
IEC 60825-1:2014 Safety of Laser Products

2.2. General Safety, Warnings, and Precautions

Read this entire manual before operating the device, and always follow the instructions provided. Do not ignore warnings or precautions regarding safe operation and laser safety.

Position the device close to a wall outlet, or cover the power cable with a cable mat, to minimize tripping hazards.

Make sure the device is mounted securely on a flat surface such that it will not move during placement of the Sensor Modules or general operation of the device.

The Open-Motion device is intended to be used or serviced by suitably trained individuals. Untrained individuals wishing to operate or service the Open-Motion device should contact Openwater Support for assistance. Refer to the Service and Maintenance section of this manual for contact details.

2.3. Warnings

⚠ *Warning: If the fiber optic connections are disconnected or not properly secured to the Console, Class 3B laser energy may be emitted from open ports. This uncontrolled emission can cause serious eye injury. Ensure that all fiber optic connectors are properly attached and that any unused ports are properly covered before plugging in or operating the device.*

⚠ *Warning: Never use, place, or modify any optics or reflective surfaces in front of the device's laser beam. Use of unauthorized or user-supplied optical components to focus, redirect, or modify the laser output may increase the beam's intensity and result in unsafe laser radiation exposure. Directing a modified laser beam into the eyes can cause serious, potentially irreversible injury.*

⚠ *Warning: Failure to read and follow all warnings, cautions, product labeling, and instructions in the User Manual may result in serious injury, including eye injury. Intentionally directing the laser output from one or more Sensor Modules into the eye may expose the user to laser radiation levels that exceed Class 1 Accessible Emission Limits (AEL) and can result in serious eye injury. Users must review, understand, and comply with all labeling described in this User Manual before using the device.*

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⚠ *Warning: Operating the device without the delivery optic diffuser in contact with the subject's skin may result in laser radiation exposure to the eyes above Class 1 safety limits, causing potential eye injury. Always verify that the diffuser optic on the laser output of the Sensor Modules is present, intact, and in contact with skin before initiating a scan.*

⚠ *Warning: Unauthorized modification, disassembly, or alteration of the device may expose the user to electrical shock hazards and/or laser light. Service and maintenance must always be performed by trained technicians. Contact Openwater for all service and maintenance requests.*

⚠ *Warning: Opening the device enclosure while the unit is powered on may expose the user to laser radiation above safe exposure limits (MPE/AEL). Always power down the device and wear appropriate protective eyewear before servicing internal components.*

⚠ *Warning: Storing the device in high-temperature environments may cause sealed units to deform, leading to compromised seals and exposure of internal electronics. This damage may result in electrical shock to users. Always store the device within the recommended environmental conditions listed in this manual.*

⚠ *Warning: Failure to properly clean the device between subjects may result in transmission of pathogens. Always follow the validated cleaning instructions in this manual to prevent cross-contamination.*

⚠ *Warning: Storing subject information directly on the host computer may result in unauthorized access or data breach. Always follow institutional protocols for handling Protected Health Information (PHI) and avoid storing PHI on the host computer unless such use is explicitly secured and approved.*

⚠ *Warning: The Console power cable may present a trip hazard if routed across walkways. Tripping over the power cable may cause personal injury and may unplug the device, interrupting its usage. Always route the power cable to avoid foot traffic and secure it properly during use.*

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2.4. Precautions

Hair between the optodes and the skin can block light transmission or detection, resulting in inaccurate or ineffective measurements. Always ensure that the application site is free of hair, dirt, or other foreign objects and place the optodes directly on the skin.

Only use approved cleaning methods and cleaning agents to clean the device, allowing each component to dry completely before use. Always follow the cleaning instructions provided in this manual.

Movement of the device during scanning can cause motion artifacts, leading to inaccurate results. Secure the Console, cables, and Sensor Modules, ask the subject to stay still, and check Sensor Module alignment throughout the scan.

Running the device software on a computer without the specified operating system may cause software instability or device malfunction. Always use a computer configuration that meets the system requirements provided in this User Manual.

If the power cable is pulled and the Console shifts or falls, the attached Sensor Modules may be forcibly removed from the subject, potentially causing sprains, abrasions, or discomfort. Route cables to minimize trip hazards and prevent sudden pulling forces.

Allowing the Sensor Module to snap into place under spring tension may cause bruising or sudden impact injury to the subject. Always place the Sensor Module gently on the subject's skin or body surface.

The device will not function without AC power. In case of power loss, measurements will be interrupted until power is restored. Ensure reliable power before starting a procedure.

Excessive bending force or twisting of the Sensor Module and cables may degrade device performance and/or damage the unit. Handle all cables and Sensor Modules with care.

Storing the system in a moist environment may cause biofouling, odors, infection risks, or internal electrical damage. Store the device only under the recommended environmental conditions.

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Carefully read the User Manual and follow all product labeling and instructions prior to use. Failure to do so may lead to incorrect and/or unsafe operation.

2.5. Electrical Safety

In case of an emergency, flip the power switch on the back of the unit to the off position to turn off the device.

Always unplug the device from the wall outlet prior to performing any service or routine maintenance on the Console.

Ensure that the voltage for your AC mains supply is appropriate for the device (100-240 VAC, 50-60 Hz, 1.2 A) before connecting. The supply must include a ground connection.

The Console is equipped with protection circuitry to protect the unit and users from unexpected power surges.

Clean the Open-Motion device after each use according to Section 5.13, Cleaning the Open-Motion Device.

2.6. Laser Safety

In case of an emergency, flip the power switch on the back of the unit to the off position to turn off the device.

Use of controls or adjustments, or deviation from instructions and cautions specified herein, may result in hazardous laser radiation exposure, which may cause eye damage or burns.



Figure 1: Invisible laser label on the product.

During normal operation, the device uses a low-powered Class 1 laser. The Sensor Module emits Class 1 laser radiation when the diffuser optic is present, intact and in contact with the skin. Use the Sensor Module only as intended.

The Sensor Modules connect to the Console using embedded optical fibers carrying Class 3B laser radiation. Never bypass safety protocols or factory settings, and never modify the cables.

Do not apply excessive force to the Sensor Module cable, bend it sharply, or place heavy objects on it. Laser radiation exposure from the cable may occur if it is damaged, and any exposure to this laser radiation should be avoided. Disconnecting the Sensor Module fiber optic connections to the Console may also expose the user to laser radiation above Class 1. Always power down the Console and unplug it before disconnecting the Sensor Module cables.

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Figure 2: Warning label on the bottom of the Console.

3. System Specifications

3.1. Console

Table 2: Open-Motion Console Specifications.

Operating Voltage	100-240 VAC, 50-60 Hz, 1.2 A
Connections	1x USB-C (USB 2.0) 1x SMA trigger (input)[2] 1x SMA trigger (output) 2x electrical ports (left / right) 2x optical ports (left / right)
Device Status	LED indicator
Dimensions (w x h x d)	8.3 x 4.9 x 8.3 inches (210 x 125 x 210 mm)
Weight	5.5 lb (2.5 kg)

3.2. Sensor Module

Table 3: Specifications for a single Open-Motion Sensor Module. Each device uses two modules.

Image Sensors	1/3.52" CMOS
Resolution	1920 x 1280
Frame Rate	40 Hz
Pixel Size	2.2 µm x 2.2 µm
Dimensions (w x h x d)	2.1 x 1.6 x 2.5 inches (52.5 x 39.4 x 64.1 mm)
Cable Length	6.6 ft (2 m)
Weight	0.5 lb (0.2 kg)

[2] Not currently supported.

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3.3. Laser

Table 4: Open-Motion Laser Specifications.

Laser Classification	Class 1
Wavelength	795 nm
Pulse Duration	500-600 µs
Pulse Repetition Rate	40 Hz
Average Power	16 mW
Energy per Pulse (at the delivery fiber tip)	300-400 µJ

3.4. User-Provided Hardware

Table 5 lists the minimum recommended requirements for running the Open-Motion software:

Table 5: Recommended computer operating specifications.

Operating System	Windows 11+
CPU	2.0 GHz
Memory	8 GB of RAM
Storage	100 GB of free storage
Connections	1 USB-A port (at least USB 2.0) Internet connection (for SW/FW updates only)

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4. System Components

4.1. System Hardware



Figure 3: Open-Motion system and accessories. The adjustable straps include an arm, head, and torso strap to accommodate different research applications.

4.1.1. Console

The Console contains a laser, electronics, and optics, and has a power cable and an on/off switch on the back. The device is operated using the provided software running on a personal computer. Never open the Console; doing so could expose the user to harmful laser radiation and electrical hazards.

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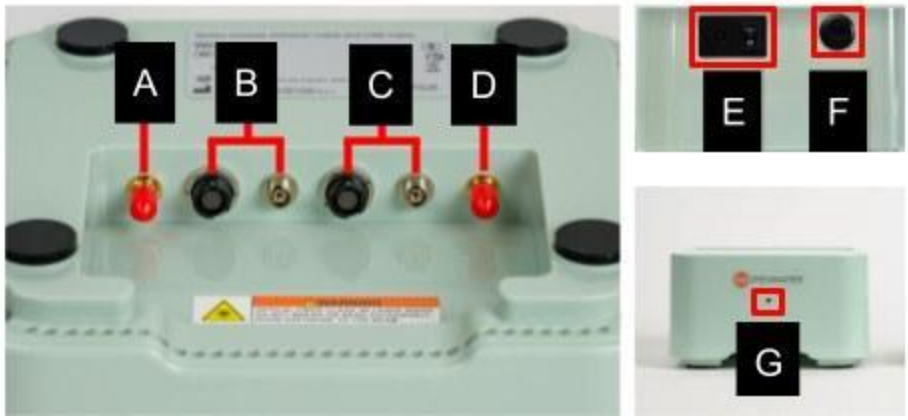


Figure 4: Parts of the Console: (A) SMA trigger output port for synchronizing other devices with Open-Motion data, (B) Left Sensor Module electrical and optical ports, (C) Right Sensor Module electrical and optical ports, (D) SMA trigger input port for synchronizing Open-Motion with other devices[3], (E) Power port and switch for the device, (F) USB port to connect to the computer, (G) Status LED on the front of the Console.

Table 6: Console status LED indicator.

Color	**Pattern**	**Meaning**
None	Off	System is off
Green	Solid	System is on and ready
Blue	Solid	The laser is active (during a check or a scan)
Blue	Pulsing	An error. The application shows an error dialog (see Section 7.2.3); the light returns to green once the dialog is dismissed. If the light pulses with no dialog in the application, power-cycle the Console.

4.1.2. Sensor Module

The Sensor Modules consist of optical components and fiber optics to deliver light to the target site being monitored and camera sensors to measure the reflected optical signals from the site on the subject being monitored.

[3] Not currently supported.

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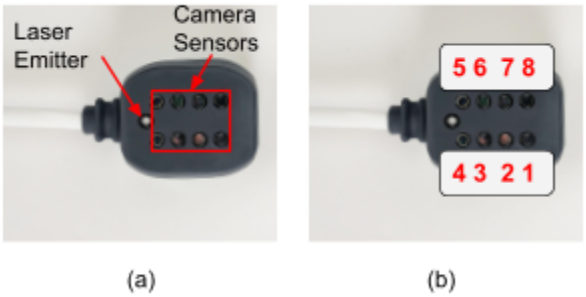


Figure 5: a) Parts of the Sensor Module. b) How the cameras are ordered in the software; note the orientation of the Sensor Module in this picture.

4.1.3. Storage and Handling of the Sensor Modules

The source cable and fiber transport the laser light to the sensor. It is important to treat this part of the device with care. Do not subject the cables connecting the Console to the Sensor Modules to excessive or undue bending force, as doing so may damage the optical fibers and electrical connections. Users must adhere to all warnings and precautions listed in this manual.

Replace the covers on the Sensor Modules after each use and loosely coil the cables prior to storage (see Figure 6).



Figure 6: The correct way to store the Sensor Modules.

5. Using Open-Motion

5.1. About the Software

Open-Motion Research is the research build of the Open-Motion application. It shows an orange BETA badge in the header and gives full control over acquisition: you choose which cameras to record, whether a scan is timed or continuous, and how the data is displayed, with one live plot per camera.

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5.2. Installing, Updating, and Starting the Application

5.2.1. Installing the Application

- Download the latest Open-Motion-Research setup file from the Open-Motion releases page on GitHub. The installer and the application are code-signed by Openwater.
- The installer installs the USB driver for the Sensor Modules, then the application, and offers a desktop shortcut. It needs administrator rights.
- Each Windows account has its own Scan History, settings, and logs (see Section 5.11).

5.2.2. Updating the Application

The application checks GitHub for new releases upon launch (this needs internet access). If one exists, a banner appears under the header: *"A new version is available: X.Y.Z"* with an **Update** button and a ✕ to hide it. The same status appears in Settings → About (see Section 5.10).

Pressing **Update** downloads the new installer (*"Downloading update…"*), checks that it carries a valid Openwater signature, then closes the application, installs the update, and starts the new version (*"Installing update…"*). Windows may ask for permission to install. An installer without a valid Openwater signature is refused and nothing is installed. You can always install a release manually instead (see Section 5.2.1).

5.2.3. Updating Device Firmware

When newer firmware is available for a connected device, a banner reads *"Device firmware update available"*. **View** opens Settings, where the device's row in the About card shows an **Update** button. Pressing it asks for confirmation:

> *"Console FW will reboot into DFU mode and be re-flashed. Do not unplug it until this is complete."*

Progress is shown under the firmware rows. Do not unplug or power off the device while it updates, and do not update firmware while a study is in progress.

NOTE: Interrupting power to the Sensor Module(s) before the firmware finishes installing may corrupt the system. If this occurs, contact Openwater Support.

5.2.4. Setting Up the Open-Motion Console and Connections

5.2.4.1. The Sensor Modules and cables come already connected to the Console.

5.2.4.2. Connect the included wall power cord and DC power supply to the Console, then plug it into the nearest wall outlet.

5.2.4.3. Connect the Console directly to a computer using the included USB-C to USB-A cable. Using a USB hub is not recommended.

5.2.4.4. To synchronize acquisitions with another device, see Section 5.14.

5.2.4.5. Turn on the power switch at the back of the Console.

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5.2.5. Assembling the Sensor Module Frame (Optional)

Follow these steps only if you are using the Sensor Module frame to hold the Sensor Modules during scans. Otherwise, continue with Section 5.2.6.

Tools needed: 2.0 mm Allen wrench (included).

5.2.5.1. Remove the Sensor Module frame from the package.

5.2.5.2. Locate the 2.0 mm Allen wrench.

5.2.5.3. Carefully lift and remove the strap cover plates from the Sensor Modules. No tools are necessary for this step (Figure 7).

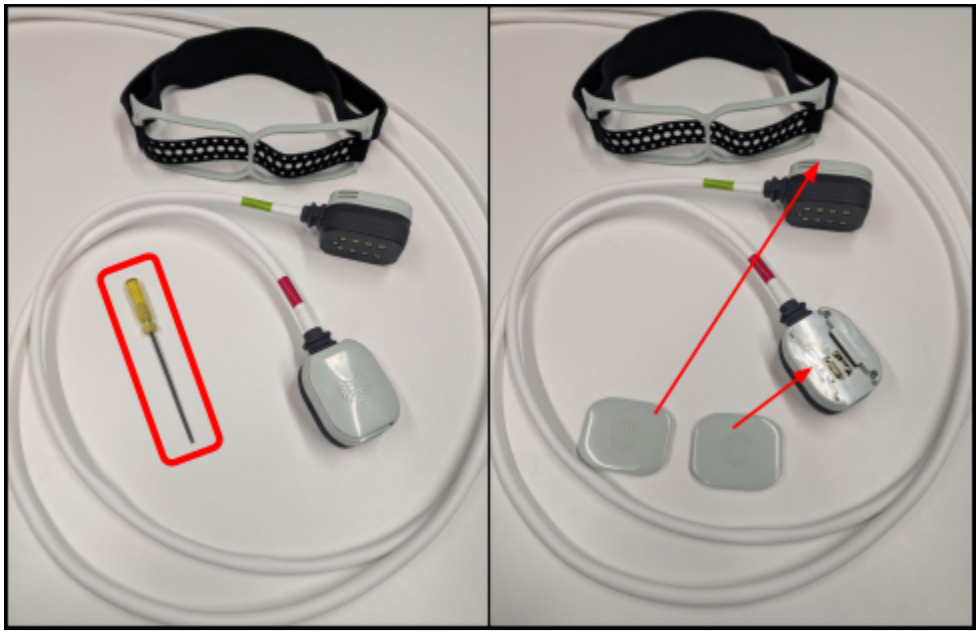


Figure 7: The Sensor Module frame kit with the 2.0 mm Allen wrench (left), and the Sensor Modules with their top cover plates removed (right).

5.2.5.4. Start by threading the neoprene strap through the opening for the strap on the frame from the inside-to-outside. Next, fold the strap back and secure the strap to itself (Figure 8).

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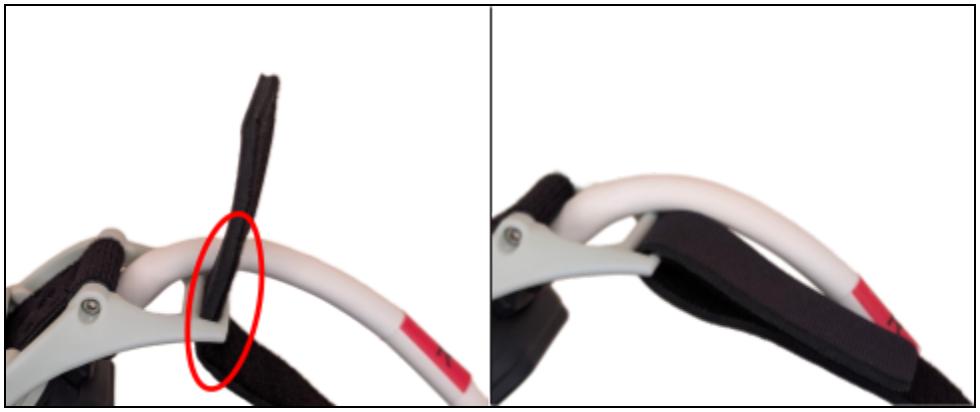


Figure 8: The neoprene strap is threaded through the frame (left), and then folded back and fastened to itself (right).

5.2.5.5. Using the 2.0 mm Allen wrench, unscrew the fasteners on the left and right sides of the frame (Figure 9). Set them aside in a safe place so they do not get lost.



Figure 9: Fastener on the side of the frame.

5.2.5.6. Gently push the left and right ends of the strap out of the frame.

5.2.5.7. Uncoil and straighten the left and right Sensor Module cables.

5.2.5.8. Thread the left and right Sensor Modules through the front side of the frame (Figure 10).

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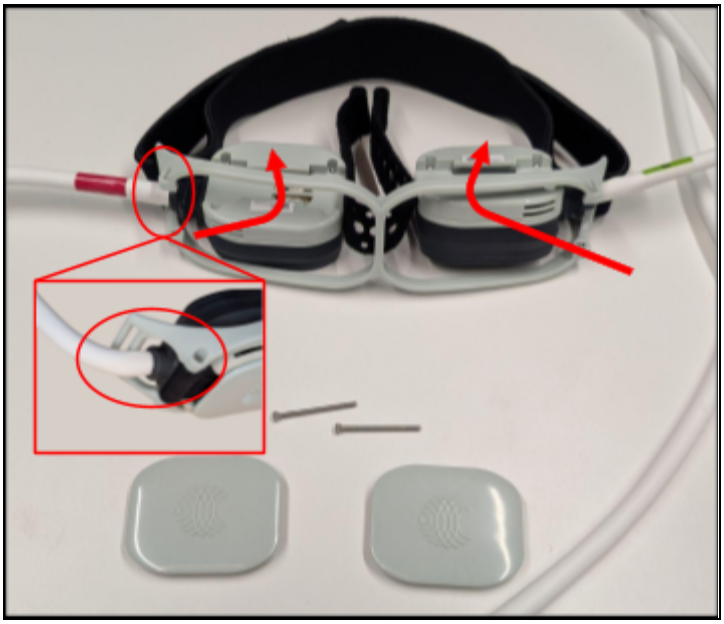


Figure 10: Threading the Sensor Modules through the front side of the frame.

5.2.5.9. Slide the strap on the frame under the grooves of each Sensor Module (see the arrows in Figure 11).

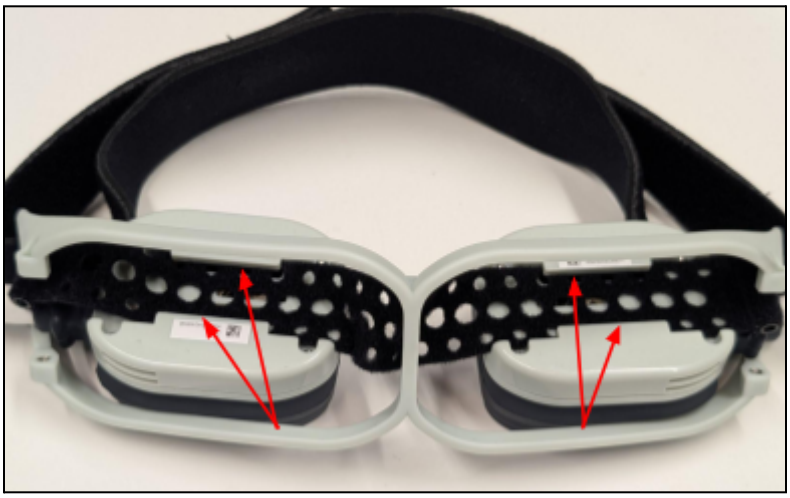


Figure 11: The frame strap under the grooves of each Sensor Module.

5.2.5.10. Replace the top cover plates on each Sensor Module.

5.2.5.11. Align and insert the threaded fasteners on the left and right sides of the frame.

5.2.5.12. Using the 2.0 mm Allen wrench, screw the fasteners in all the way until snug (Figure 12). **Do not overtighten**.

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Figure 12: Top cover plates replaced and fasteners inserted on both sides of the frame (circled).

5.2.5.13. When finished assembling the Sensor Module frame, place the assembly around the subject's head by adjusting the Velcro straps (Figure 13).



Figure 13: The assembled Sensor Module frame.

5.2.5.14. To disassemble the Sensor Module frame after use, simply reverse these steps and discard the frame and strap(s).

5.2.6. Securing the Sensor Modules to the Subject's Head

To ensure proper data capture:

- For optimal results, the laser and camera sensors must make direct contact with the skin below the hairline, with no hair or air gap between them (see Figure 15).
- The two Sensor Modules should be placed symmetrically left to right.
- The subject should remain stationary and avoid talking for the duration of the scan.

5.2.6.1. Ensure the left and right Sensor Modules are placed on the subject's left and right sides. Use the tags on the cables to identify them.

5.2.6.2. Set the strap length to a medium circumference by readjusting the Velcro end tabs.

5.2.6.3. Using a damp cloth or alcohol wipe, remove any topical or cosmetic products by wiping the surface of the skin where the Sensor Modules are to be placed.

5.2.6.4. Place both Sensor Modules on the forehead of the subject and then loop the strap behind their head.

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5.2.6.5. Tighten the straps by pulling them toward the back of the subject's head until the fit is snug and the Sensor Modules make good contact with the skin. It may be necessary to alternate between the left and right adjustment straps such that Sensor Modules are properly positioned on the head.

5.2.6.6. After snugging up the strap, it may be helpful to adjust the Sensor Modules themselves. Exact placement depends on the intended study; however, a good starting point is to place them close to midline and centered on the forehead vertically to avoid the hairline and eyebrows (see Figure 15).

5.2.6.7. Before operating the device, ensure there is no hair under any part of the Sensor Modules.



Figure 14: It is normal to see small markings from the Sensor Module. This indicates good contact between the sensors and skin.

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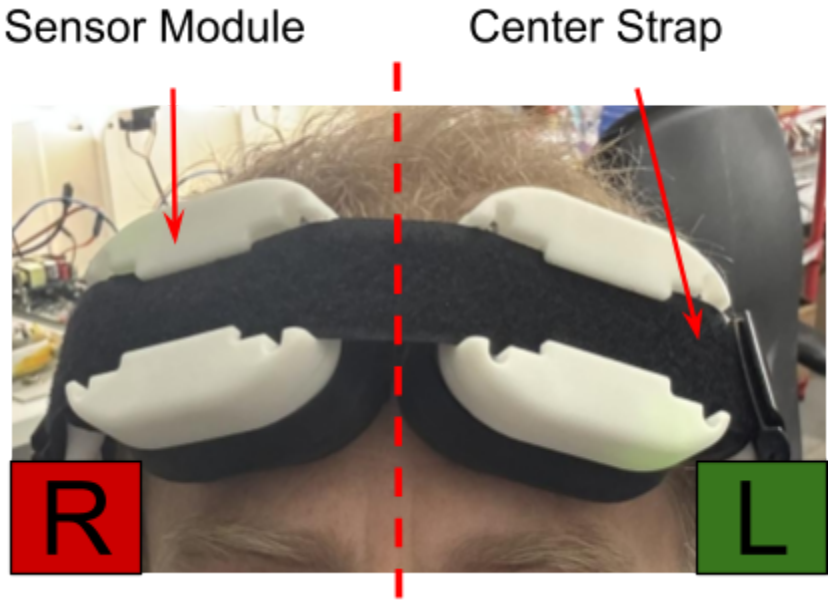


Figure 15: Place the Sensor Modules symmetrically about the midline on the subject's forehead while ensuring the sensors come into direct contact with the skin.

5.2.7. Securing the Sensor Modules to Other Areas of the Body

5.2.7.1. When scanning other areas of the body, e.g. torso or limbs, it may be necessary to remove each Sensor Module from the head frame, separate the sensor modules, and/or use a different Sensor Module strap.

5.2.7.2. Follow a similar procedure as outlined in 5.2.6, ensuring the Sensor Modules are located directly over the region(s) of interest.

5.2.8. Starting the Application

Launch **Open-Motion Research** from the Start menu or the desktop shortcut. The application is a single signed file that unpacks itself on launch, so the window takes a few seconds to appear.

- Only one copy of Open-Motion can run at a time. A second launch shows *"Another instance of the application is already running. Please close the existing instance before opening a new one."*
- The application connects to the Console and the Sensor Modules **automatically** whenever they are plugged in and powered on.
- Upon launch, the application checks for the Open-Motion Console. If a device is missing, a yellow message appears in the bottom-right corner:
    - *"Console not detected. Check the console USB cable and power, then reconnect."*
    - *"Sensor not detected. Check the sensor cable and power, then reconnect."*
    - *"System not found. Check that the console and sensor are connected and powered on."* (when nothing is found)

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- **Sample dataset:** if no device is connected at that point, a dialog titled *“No console detected”* offers to open a sample recording — *“You can explore real BFI/BVI traces without any hardware connected.”* Choose **Open sample dataset** to load it into the plot viewer, or **Not now**. The offer is made once per launch.
- After a Sensor Module connects, the system initializes it for a few seconds. The **Start** label stays dimmed and cannot be pressed until initialization finishes.

5.2.9. Connection States

The round badge at the top of the left toolbar shows the system state:

Table 7: Connection states shown by the badge at the top of the left toolbar (see also Figure 16 and Table 8).

Badge	Label	Meaning
Grey circle, chain-link icon	Disconnected	The Console or both Sensor Modules are not connected. Scanning is disabled.
Green circle, dimmed label	Start	Connected; a Sensor Module is still initializing. Wait a few seconds.
Green circle, play icon	Start	Ready to scan.
Yellow circle	Start	Start was pressed; the system is finishing the previous step before the scan begins (normally a few seconds).
Red circle, stop icon	Stop	A scan is running. Press to stop it.

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5.3. The Main Screen

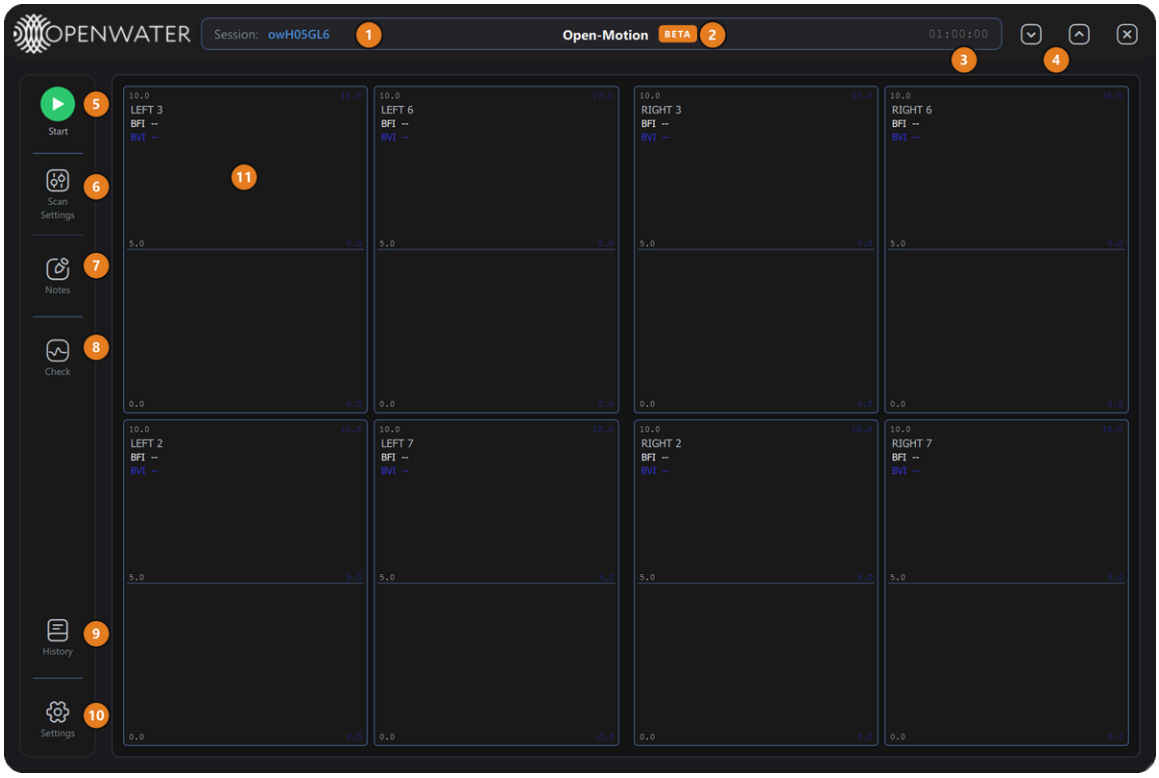


Figure 16: Annotated main screen of Open-Motion Research. This window displays a 4-camera configuration per left and right Sensor Module.

Table 8: Elements of the main screen (numbers refer to Figure 16).

#	Element	Description
1	Session	The session label (e.g. owH05GL6). A new label is generated at each launch; set your own in Scan Settings (see Section 5.4). Stored with every scan.
2	BETA	Software badge. Identifies the application as a Research build.
3	Scan clock	Idle: the configured scan length (e.g. 01:00:00) or Continuous. Scanning: elapsed / total in green, or Continuous and the elapsed time.
4		Minimize the window.
		Maximize/restore the window.

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#	Element	Description
		Close the application.
5		Start scanning.
		Stop scanning.
		Device not connected.
6		Open Scan Settings: session label, camera selection, and scan length (see Section 5.4). Disabled during a scan.
7		Open Session Notes (see Section 5.8). Always available.
8		Run a contact-quality check (see Section 5.5). Disabled during a scan.
9		Open Scan History: review, replay, export, or delete past scans (see Section 5.9). Disabled during a scan.
10		Open Settings (see Section 5.10). Disabled during a scan.
11	Plot grid	One plot per active camera, labeled LEFT n / RIGHT n (see Section 5.7), where “n” is the camera number.

Window behavior:

- **Move** the window by dragging the header bar.
- **Resize** with the diagonal grip in the bottom-right corner (minimum 800 × 600 pixels).

5.4. Scan Settings

Press **Scan Settings** to set up the next scan. Closing the dialog (✕, Esc, or clicking outside it) applies the settings.

NOTE: The user interface displays each Sensor Module as if it were being looked at from behind/above and the Sensor Module **face down** toward the subject.

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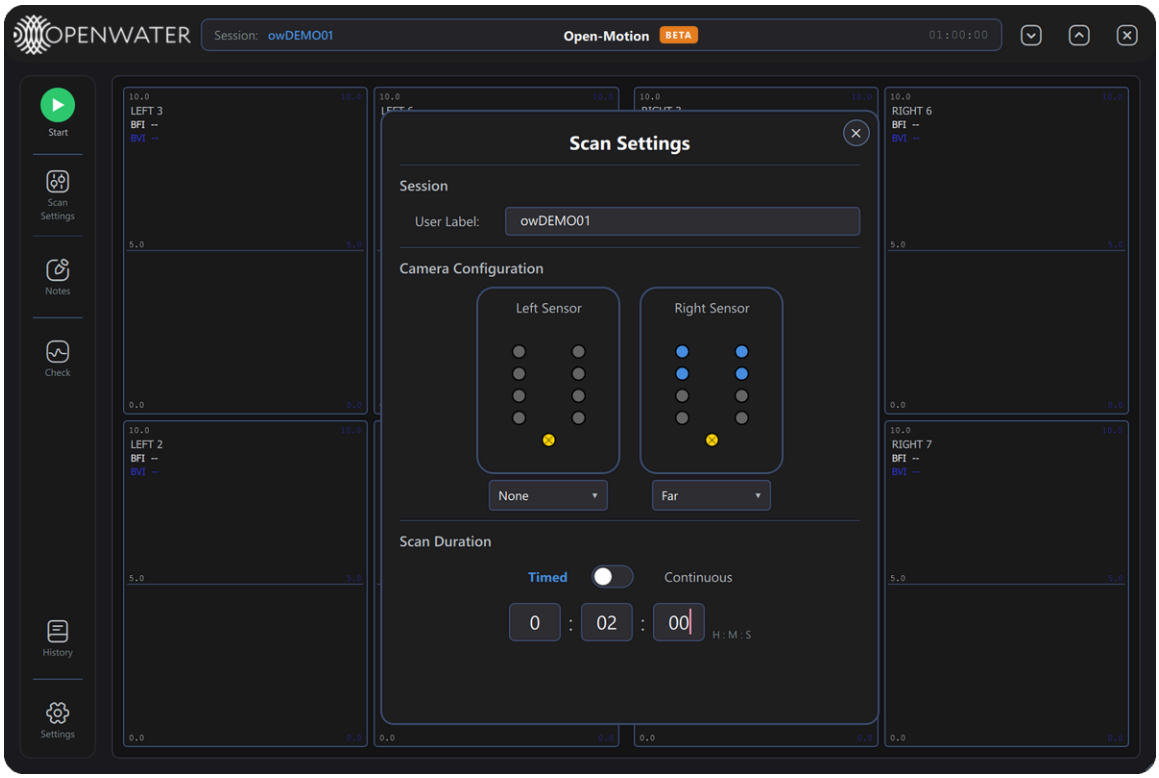


Figure 17: Scan Settings with the label DEMO01, no cameras on the left sensor, the Far pattern on the right sensor, and a 2-minute timed scan.

5.4.1. Session

User Label names the session. Letters and digits are kept, converted to uppercase, and prefixed with ow — typing demo01 gives owDEMO01. The label appears in the header, in Scan History, and in every scan's full label (e.g. 20260925_222432_owDEMO01, with the scan's start time in UTC). The label stays in effect until you change it or restart the application.

NOTE: Use a study or subject code, never a name or other subject-identifiable information.

5.4.2. Camera Configuration

Each sensor diagram shows the module's eight cameras: cameras 1 to 4 from top to bottom in the left column, cameras 8 to 5 from top to bottom in the right column, and the laser aperture (yellow ⊗) at the bottom. **Blue** cameras will be recorded; **grey** cameras will not. Hover over a camera to see its number. A disconnected sensor's diagram is dimmed and cannot be changed.

Choose a pattern for each sensor from the list under its diagram (Figure 18 and Table 9).

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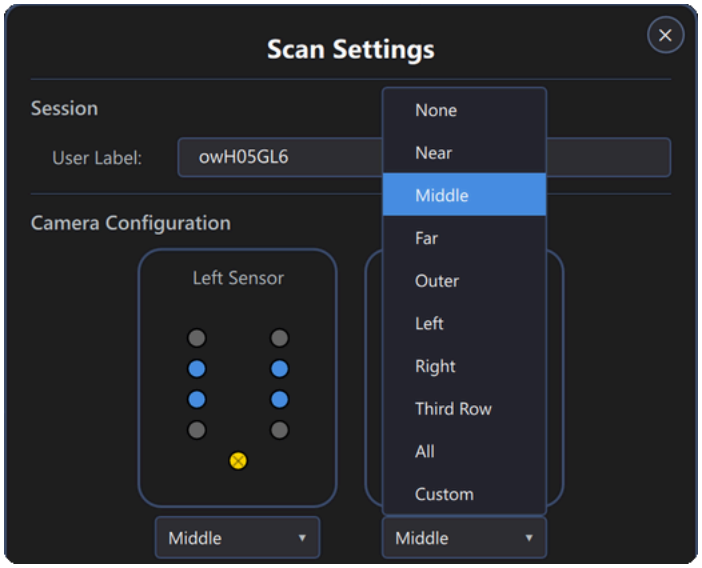


Figure 18: Camera pattern list under a sensor diagram.

Table 9: Camera patterns.

Pattern	**Cameras recorded**
None	None; the sensor is not used
Near	2, 4, 5, 7
Middle	2, 3, 6, 7 (default)
Far	1, 2, 7, 8
Outer	1, 4, 5, 8
Left	1, 2, 3, 4
Right	5, 6, 7, 8
Third Row	2, 7
All	All eight
Custom	Any combination (see below)

Custom: a ring appears around each camera, and clicking a camera turns it on or off. Custom starts from the cameras currently shown.

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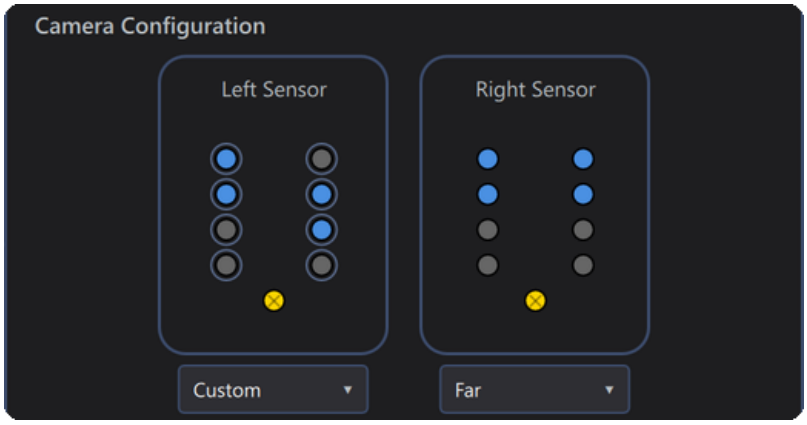


Figure 19: Custom mode on the left Sensor Module: each camera can be clicked to include or exclude it.

More cameras give more coverage but denser plots and larger recording files. The selection is kept if a sensor briefly disconnects and reconnects. The patterns selected when the application starts come from Settings → Default Camera Configuration (see Section 5.10).

5.4.3. Scan Duration

Table 10: Scan Duration controls.

Control	What it does
Timed / Continuous switch	Timed: the scan stops by itself after the set time. Continuous: the scan runs until you press Stop (“Scan will run indefinitely until stopped.”), up to a maximum of 12 hours.
H : M : S	The timed length (default 1:00:00, up to 99:59:59). A length of 0:00:00 is not allowed; it is reset to 1 minute with the message “Scan duration cannot be 0 seconds — reset to 1 minute.”

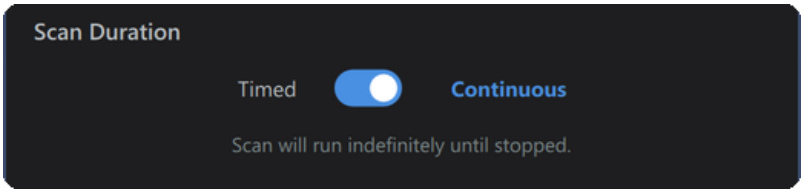


Figure 20: Scan Duration set to Continuous.

5.5. Checking Contact Quality

Press **Check** (not available during a scan) to check sensor contact without recording. The laser is on during the check, which takes about 10 seconds. The check tests **all eight cameras** on each connected sensor, regardless of the cameras selected in Scan Settings.

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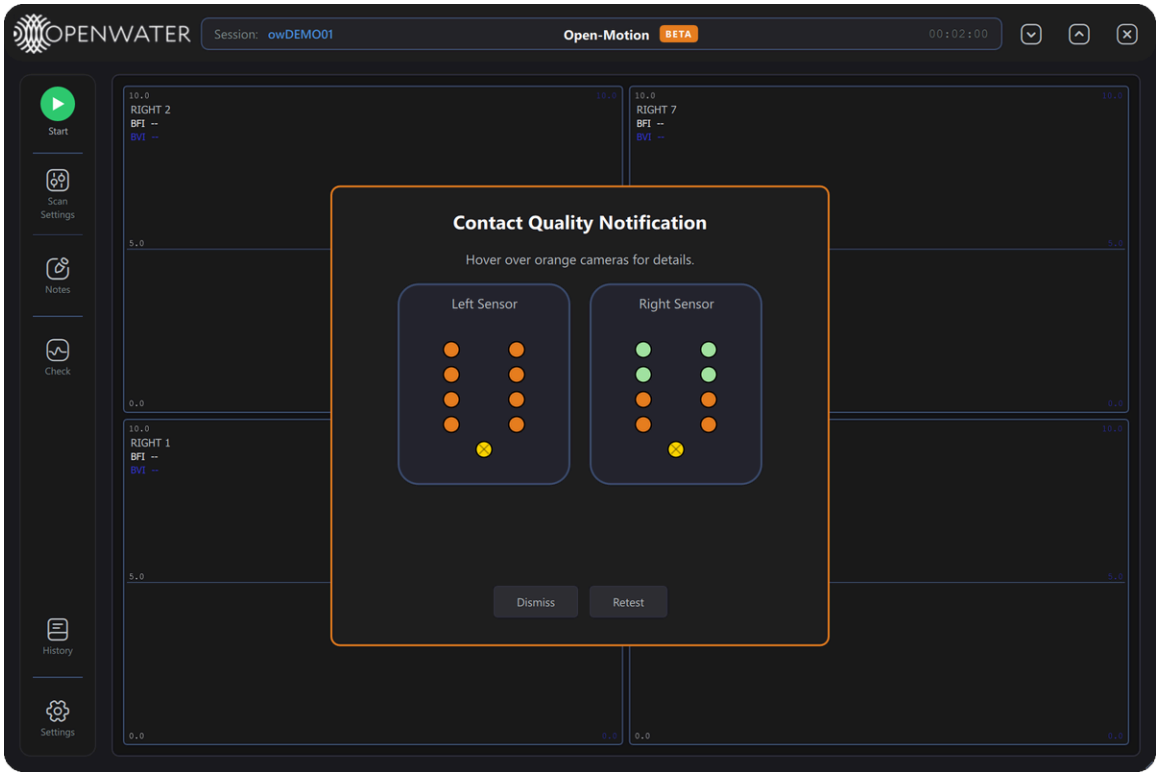


Figure 21: A check with problems: the left sensor was not in contact, and the right sensor had good contact on its top four cameras only.

Table 11: Contact-quality check results.

Border	Title	Meaning
Green	Good signal quality	All cameras report acceptable ambient light and contact levels.
Orange	Contact Quality Notification	One or more cameras have a problem. Hover over an orange camera for more context.
Red	Contact check failed	The check could not be completed; the reason is shown in red.

Camera dots: **green** = good contact · **orange** = problem · **grey** = not evaluated. Hovering over a camera shows its label (L = left, R = right, then the camera number) and the problem:

Table 12: Contact problems and what to do.

Reason	What to do
Poor sensor contact	The camera is not receiving enough light back from the skin. Re-seat the Sensor Module flat against the skin and check for hair or debris.

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Reason	What to do
Ambient light detected	Room light is reaching the camera. Improve the seal against the skin or shade the sensors.

Dismiss closes the dialog; **Retest** runs the check again after you adjust the sensors. A scan does not run the check for you — run it before pressing Start when contact matters.

5.6. Running a Scan

5.6.1. Set up the scan in **Scan Settings** (see Section 5.4). The defaults (Middle pattern, 1-hour timed scan) are a reasonable starting point.

5.6.2. Run **Check** (see Section 5.5) and re-seat the sensors until the cameras you plan to record are green.

5.6.3. Press **Start**. The scan starts immediately: the badge may turn yellow for a moment, then red (**Stop**), and the header clock starts counting.

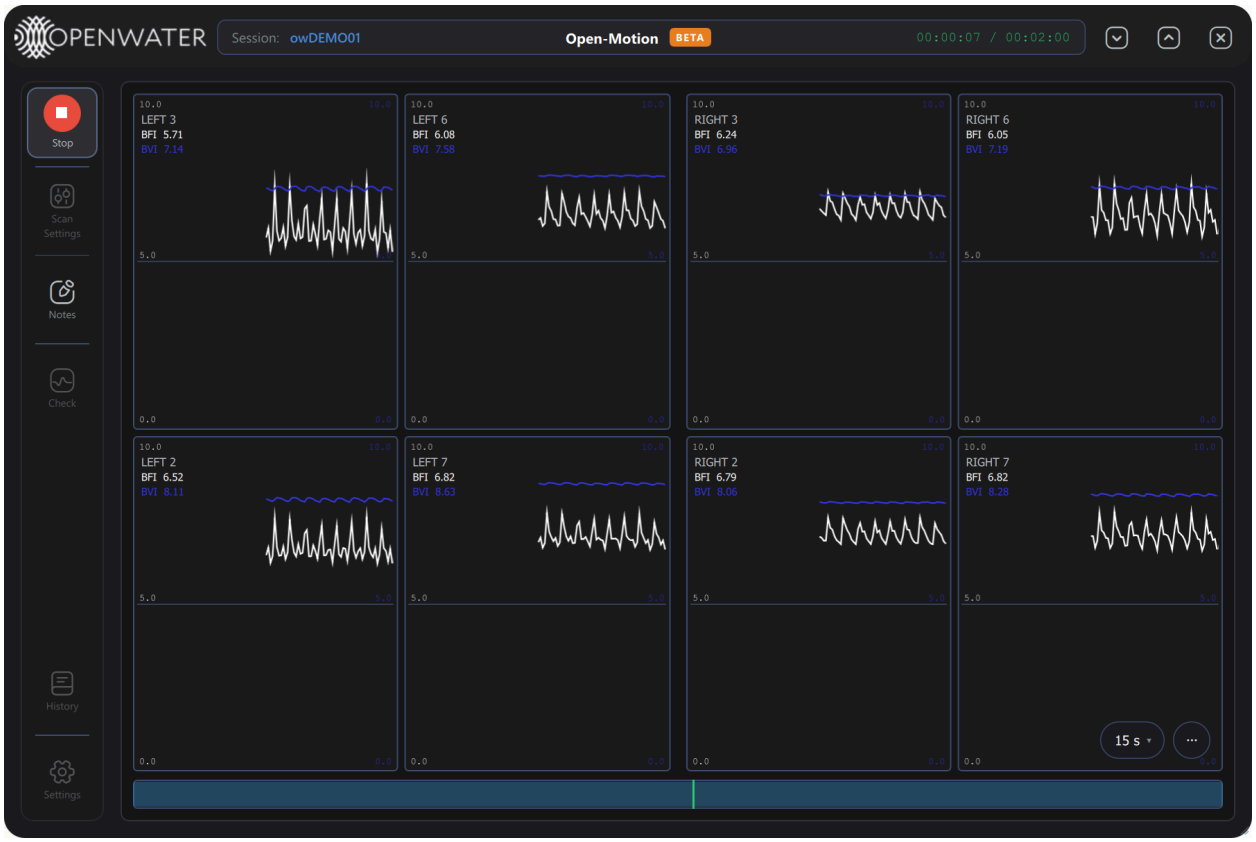


Figure 22: A 2-minute timed scan on four cameras using the left and right sensors.

During the scan:

- Each plot shows one camera's BFI (white) and BVI (blue) traces, with the latest values under its label (see Section 5.7).

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- **Scan Settings**, **Check**, **History,** and **Settings** are disabled. **Notes** stay available.
- Press **Space** to open Session Notes with a timestamp already inserted (Figure 23).



Figure 23: Space during a scan inserts a timestamp line, "[elapsed / clock time] - "; type the observation and close the window with ✕ to save it.

Contact warnings during a scan. If contact degrades on a recorded camera, the contact-quality dialog opens on top of the plots. Only the recorded cameras are evaluated; the others are grey. The scan keeps recording while the dialog is shown.

Table 13: Contact warning buttons during a scan.

Button	Action
Stop scan	End the scan now.
Continue	Return to the plots. Enabled only after every problem has stayed clear for a few seconds. Re-seat the sensor, then wait for the border to turn green and the message "All contact quality issues are currently inactive. You may dismiss." to appear.

Ending the scan. A timed scan stops by itself; otherwise press the red **Stop** badge (or **Stop scan** in a contact warning). After a few seconds, **Session Notes** opens with a closing line — *"Scan completed — duration: 00:02:00"* for a timed scan that ran to the end, *"Scan stopped — duration: …"* when stopped early.

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Figure 24: Session Notes after a scan, with the closing duration line.

- If gaps longer than 1 second were detected in the data, a *"Data gaps (>1.0s): …"* line is added.
- All scan data is saved automatically to the scan database (see Section 5.11); raw CSV files are also written if enabled in Settings (see Section 5.10), or exported individually (see Section 5.9.1).
- If a scan ends unexpectedly, a message reports what was kept:
  - *"Scan ended unexpectedly — partial data was saved. The final segment could not be dark-corrected and was discarded."* (yellow)
  - *"Scan ended unexpectedly and no data was recorded (the device may have disconnected mid-scan). This scan was not saved."* (red; stays on screen until dismissed)

5.7. Reading and Navigating the Plots

5.7.1. The Plot Grid

There is one plot per recorded camera. The grid mirrors the Sensor Modules: the left module's cameras on the left, the right module's on the right, and each row pairs the cameras that sit opposite each other — 4 and 5, 3 and 6, 2 and 7, 1 and 8 from top to bottom. Rows with no recorded camera are left out.

Each plot shows:

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- the camera label (LEFT 3, RIGHT 7, …) and its latest values under it;
- the traces: BFI (white) and BVI (blue), or Mean (green) and Contrast (purple);
- axis labels: the left scale belongs to the first trace (BFI or Mean), the right scale to the second (BVI or Contrast).

BFI and BVI values are limited to a 0–10 display range: a value below 0 shows as 0.00 and a value above 10 as 10.00. “--” means there is no valid reading.

5.7.2. Display Options

The ··· button at the bottom-right of the plots opens the display options (Figure 25 and Table 14).



Figure 25: Display options (··· menu).

Table 14: Display options.

Switch	**What it does**
BFI / BVI ↔ Mean / Contrast	Switches every plot between BFI/BVI and the raw Mean/Contrast statistics.
Autoscale	Fits the vertical axis to the data instead of using the Manual Plot Bounds from Settings.
Global scale ↔ Per-plot scale	Shown while Autoscale is on. Global: all plots share one range. Per-plot: each plot fits its own data.
Axis labels	Shows or hides the numbers on the vertical axes.

These switches are the same settings as in Settings → Realtime Plot Display and stay set across restarts.

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Figure 26: Autoscale on: each axis fits the data, so small changes become visible.

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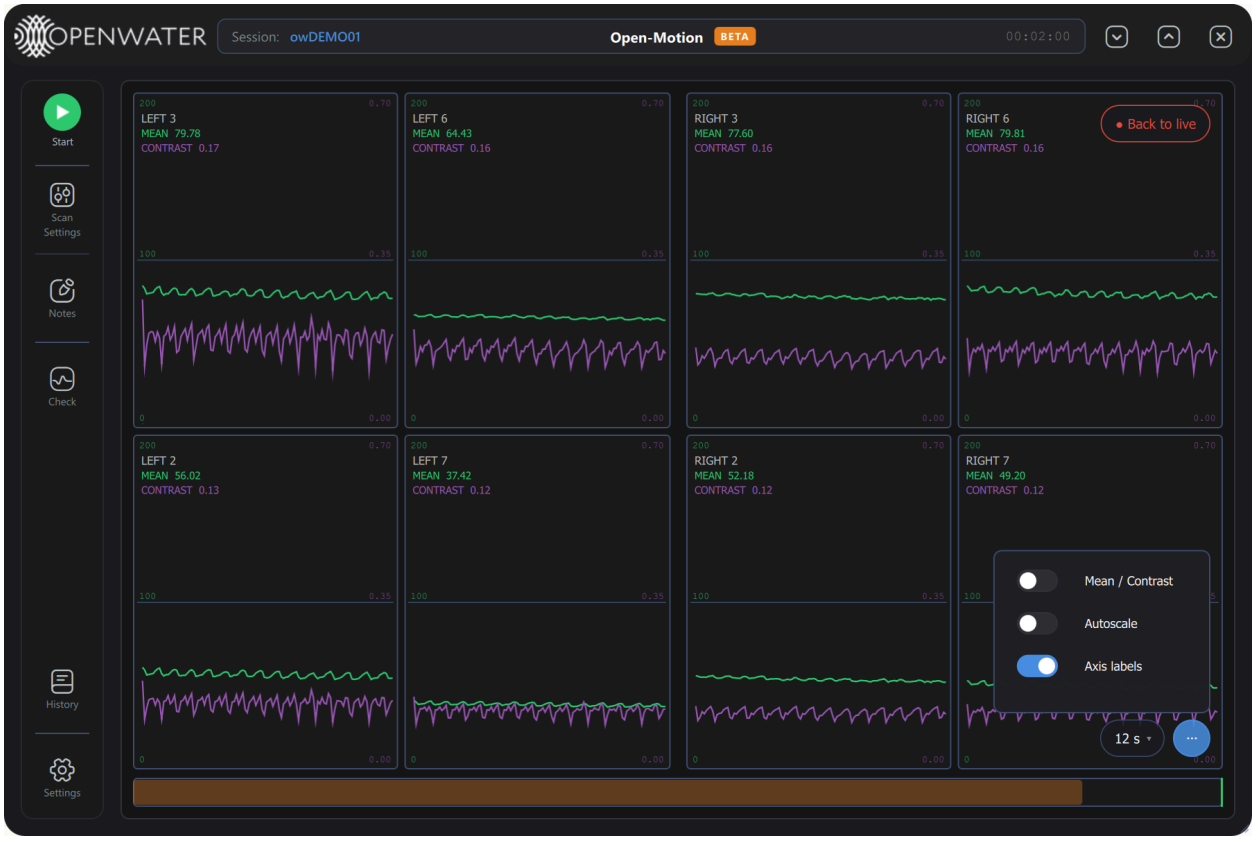


Figure 27: Mean / Contrast display: Mean (green) and speckle Contrast (purple) for each camera.

5.7.3. Navigation

The plot area works like a video recorder: you can rewind during or after a scan without losing the live recording.

Table 15: Plot navigation controls.

Control	Where	What it does
Window-length pill (e.g. 15 s ▾)	Bottom-right of the plots	Determines how much of a scan is visible on the display: 5 s, 15 s, 30 s, 1 min, or 5 min. The plots open at 15 s.
Timeline bar	Under the plots	Shows the whole scan. Drag the highlighted window to move through time, or click the bar to jump. Blue = following the live edge; orange = paused in the past.
Drag on a plot	Plot area	Pans back or forward in time (stops following live).
Mouse wheel on a plot	Plot area	Zooms the time window in or out around the pointer.

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Control	Where	What it does
Hover	Plot area	Shows a readout box (top-right) with the time and every camera's values under the pointer.
Back to live	Top-right of the plots	Appears when you have moved into the past during a scan. Click to return to the live edge.

Keyboard shortcuts (active when the plot area has keyboard focus — click a plot first):

Table 16: Plot keyboard shortcuts.

Key	Action
← / →	Pan 1 second back / forward (hold Shift to pan a full window)
+ or ↑	Zoom in
- or ↓	Zoom out
0	Reset the zoom and return to live
Home / End	Jump to the start of the scan / return to the live edge
Esc	Release keyboard focus from the plots
Space	Open Session Notes with a timestamp (during a scan)

5.8. Session Notes

- Open the notes with the **Notes** button at any time. They open automatically after every scan, and **Space** during a scan opens them with a timestamp line ([elapsed / clock time] -) ready for you to type after.
- Notes are attached to a scan. During a scan, they belong to that scan; after a scan, they belong to the scan just recorded. Each new scan starts with empty notes, so text typed before a session's first scan is cleared when that scan starts.
- Notes are saved when the window closes — with ✕, Esc, or by clicking outside the window. *"Note saved."* confirms it. **Always close the Notes window after typing** so the text is saved.
- Saved notes appear, read-only, in Scan History (see Section 5.9). They are kept in the scan database and are not included in exported CSV files.

NOTE: Do not enter subject-identifiable information in the notes. The same reminder is shown at the bottom of the Notes window.

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5.9. Scan History

Press **History** (available when no scan is running) to review past scans.

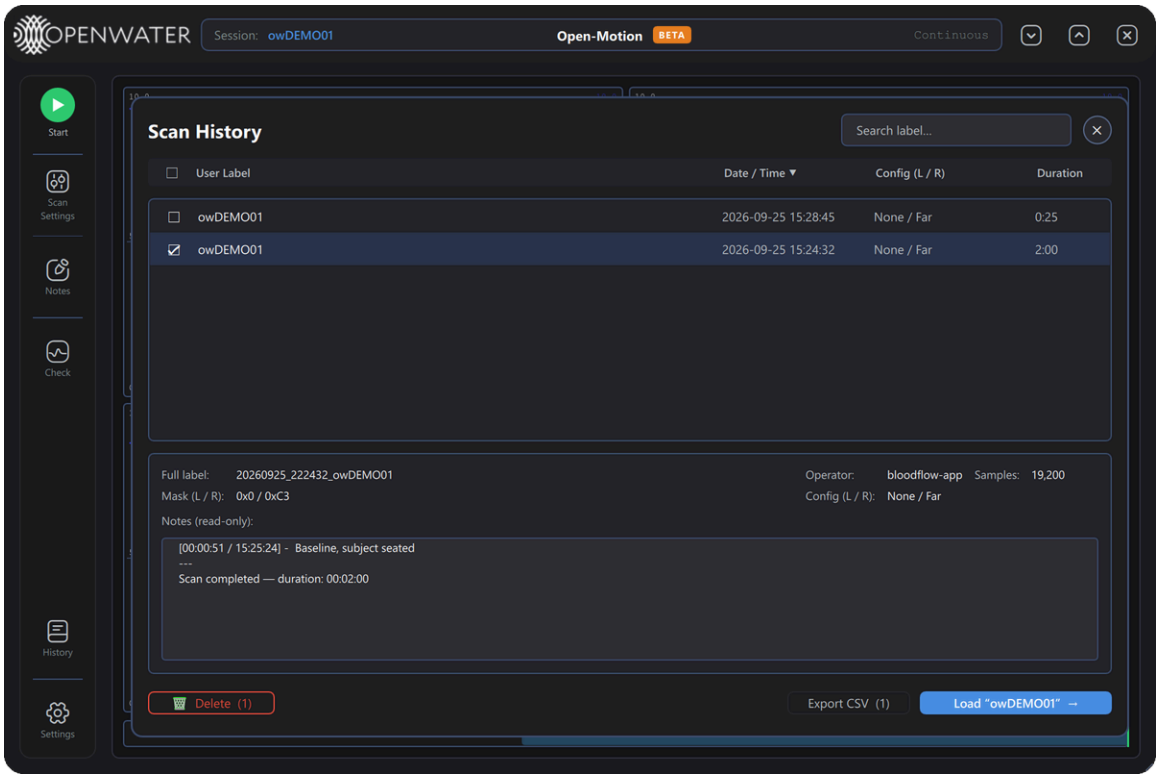


Figure 28: Scan History with a scan selected.

Table 17: Scan History columns and controls.

Column / control	What it shows or does
User Label	The session label the scan was recorded under. Scans from one session share a label; use the date and time to tell them apart.
Date / Time	When the scan started, in the computer's local time.
Config (L / R)	The camera pattern used on each side (None, Middle, Far, …). A Custom selection shows its camera mask in hexadecimal, e.g. 0x5B.
Duration	Scan length in minutes:seconds. "—" means the scan was interrupted and has no recorded end.
Search label…	Filters the list by label.
Column headers	Click to sort; click again to reverse (▲ / ▼).

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Column / control	What it shows or does
Row click	Selects the scan and shows its details: full label, operator, number of samples, camera masks (hexadecimal, left / right), configuration, and notes (read-only).
Checkboxes	Mark several scans for Delete or Export. The header checkbox selects all.
Export CSV (N)	Exports the checked scans to CSV (see Section 5.9.1).
Load “label” →	Opens the selected scan in the plot viewer for replay (see Section 5.9.3).
Delete (N)	Permanently deletes the checked scans (see Section 5.9.2).
×	Close History.

5.9.1. Exporting Scans

One checked scan opens a Save dialog (default name <full label>_export.csv); several ask for a destination folder and write one file per scan. Each file has one row per frame: the frame number, the time in seconds, and BFI, BVI, Mean, and Contrast for every recorded camera, plus a quality flag per camera. Notes are not included. Interrupted scans cannot be exported (*“Interrupted scans can’t be exported.”*). A message confirms the export (*“Exported to …”* or *“Exported N scan(s) to …”*).

5.9.2. Deleting Scans

Deleting is permanent: pressing **Delete** opens a *Confirm Delete* prompt, and the scans are permanently deleted. Once data has been deleted it is not recoverable.

5.9.3. Replaying a Scan

After **Load**, the plots show the recorded scan with a **Viewing** badge naming it (label · date and time). All plot features (see Section 5.7) work the same way on a replay. When it is shown, the red ← **Back to live scan** pill returns to the live view.

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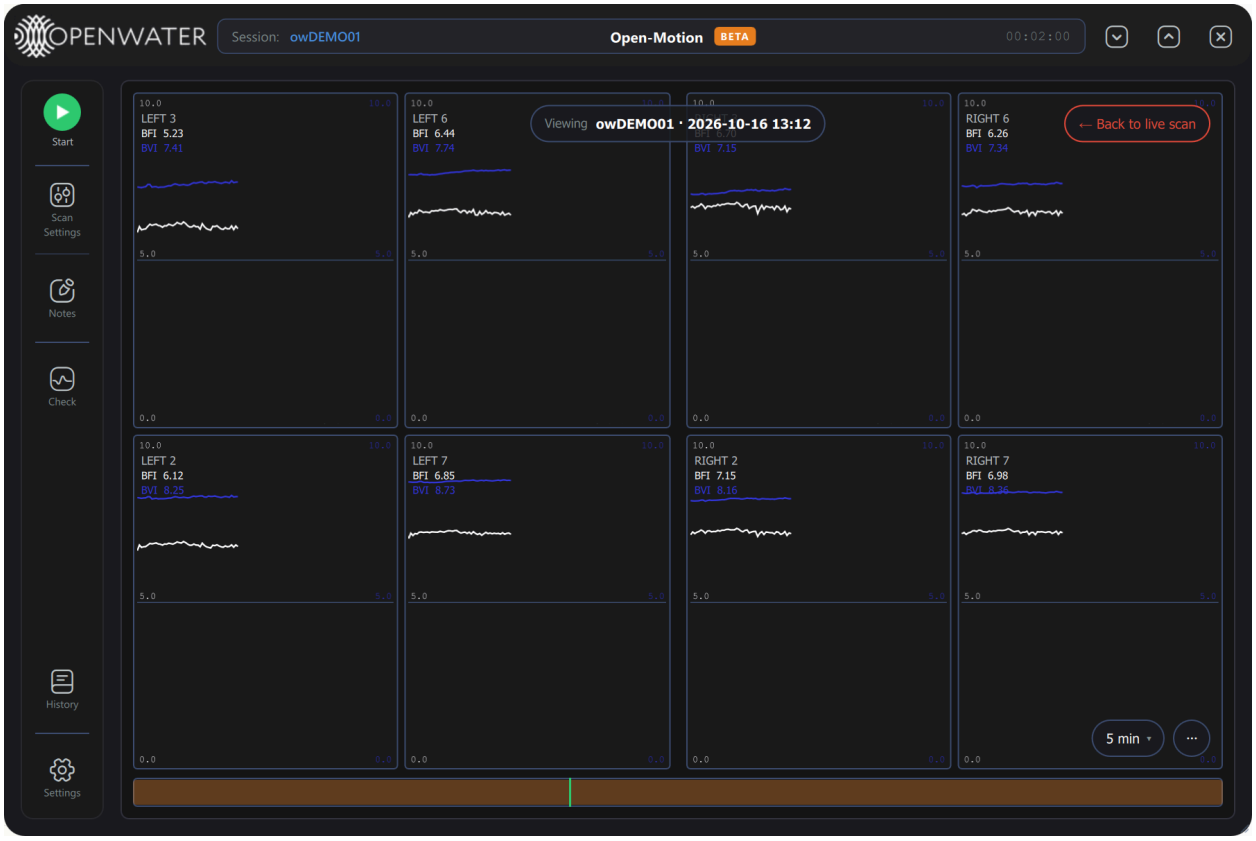


Figure 29: The 2-minute scan loaded from History, with the window set to 5 minutes so the whole scan fits.

5.10. Settings

Press **Settings** (available when no scan is running). Changes apply immediately and are saved when you close Settings with ✕, Esc, or by clicking outside it.

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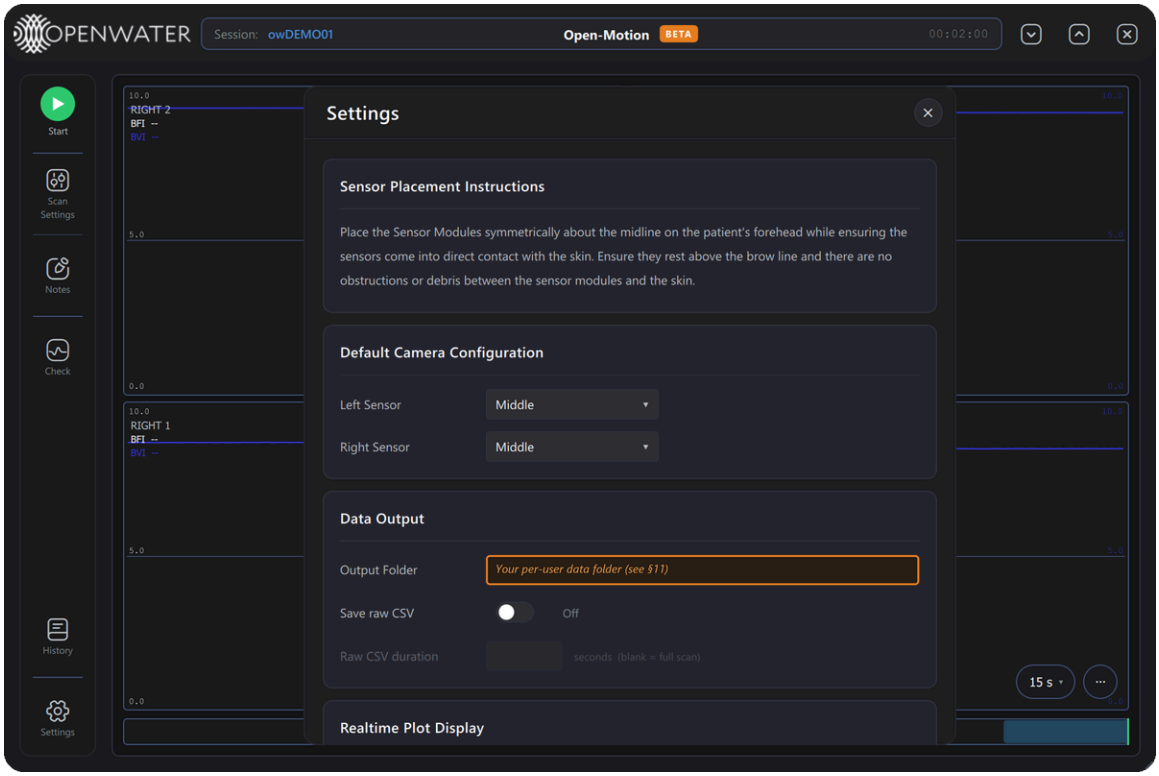


Figure 30: Settings, top. The Output Folder shows your data folder (see Section 5.11).

Table 18: Settings, top: Sensor Placement Instructions, Default Camera Configuration, and Data Output cards.

Card	**Contents**
Sensor Placement Instructions	Place the Sensor Modules symmetrically about the midline on the forehead, in direct contact with the skin, above the brow line, with no obstructions or debris.
Default Camera Configuration	The Left Sensor / Right Sensor patterns (see Section 5.4.2) selected when the application starts. Changes take effect at the next launch; Scan Settings changes the current session.
Data Output	Output Folder: this Windows account's data folder, for reference (it cannot be changed). Save raw CSV: also write the raw camera histograms of each scan to CSV files (see Section 5.11). Raw CSV duration: limit raw output to the first N seconds of each scan; leave blank for the whole scan.

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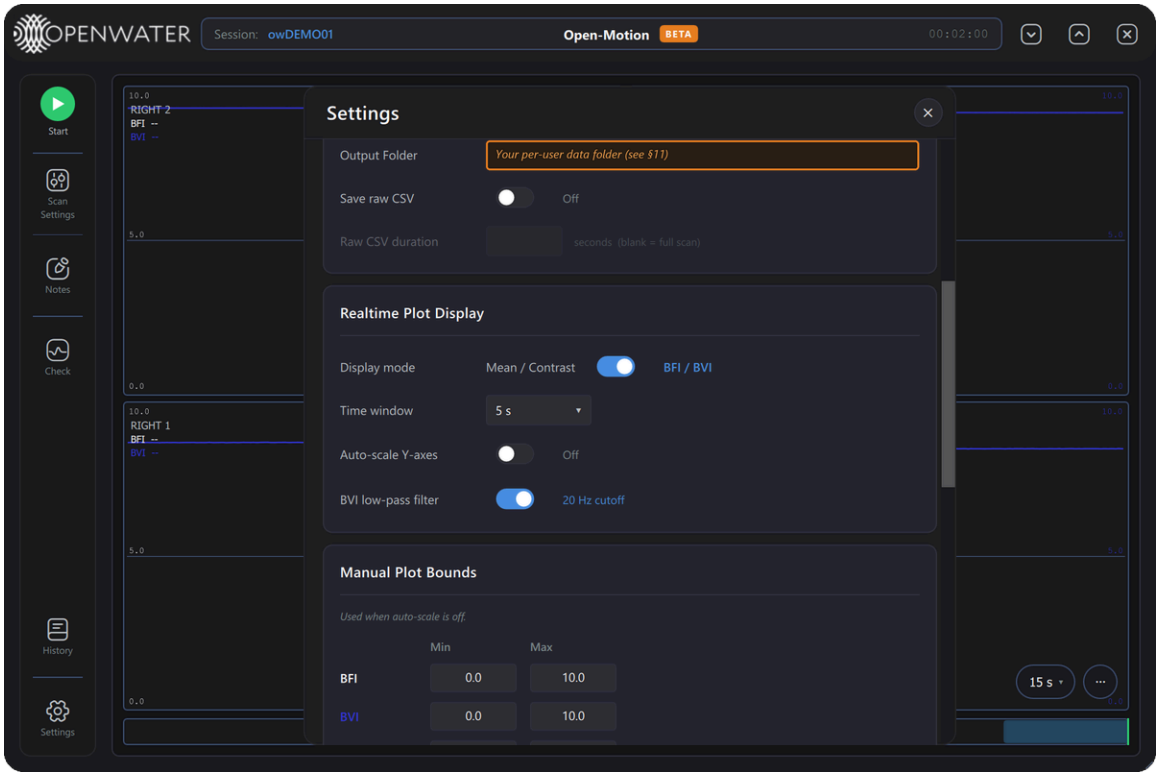


Figure 31: Settings, Realtime Plot Display.

Table 19: Settings, Realtime Plot Display card.

Card	Contents
Realtime Plot Display	Display mode (Mean / Contrast ↔ BFI / BVI) and Auto-scale Y-axes: the same switches as the ··· menu (see Section 5.7.2). Time window: 3, 5, 15, or 30 s; to change how much time the plots show, use the window-length pill (see Section 5.7.3). BVI low-pass filter: smooths the BVI trace (20 Hz cutoff, on by default); takes effect immediately, including during a scan.

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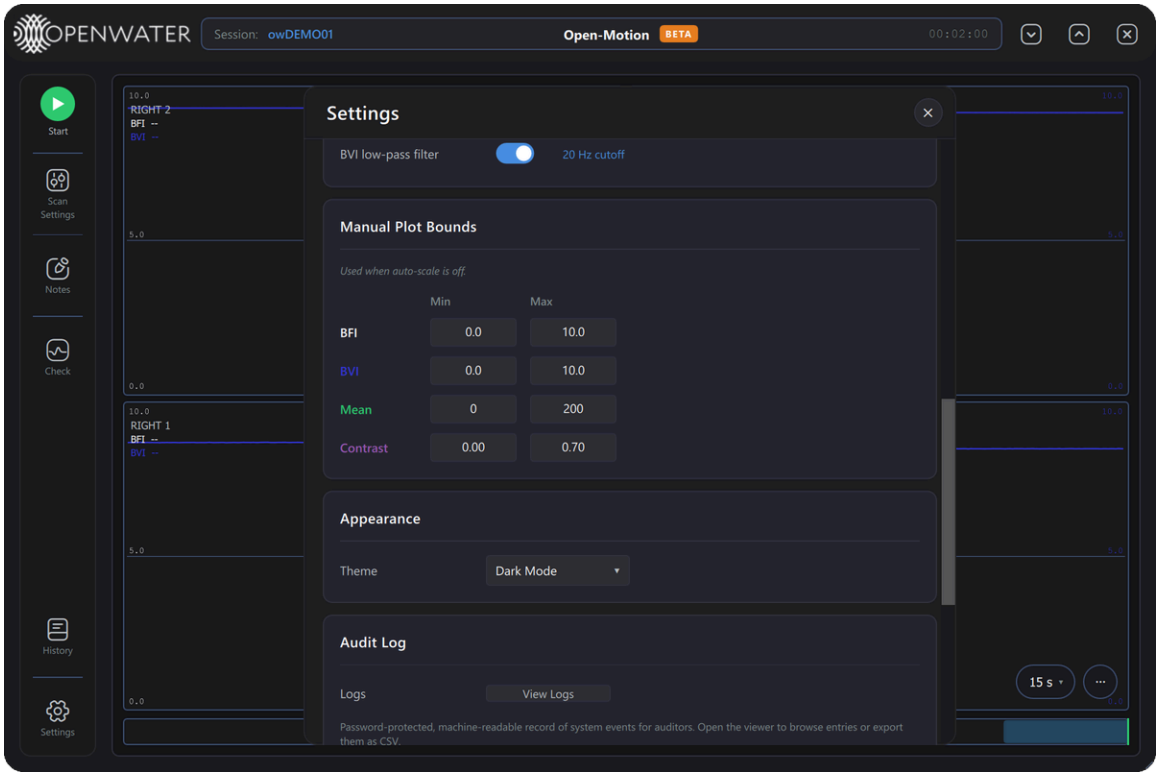


Figure 32: Settings, plot bounds and appearance.

Table 20: Settings, Manual Plot Bounds, Appearance, and Audit Log cards.

Card	Contents
Manual Plot Bounds	Fixed vertical ranges used when autoscale is off: Min and Max for BFI and BVI (0–10), Mean (0–1024), and Contrast (0–1). Min always stays below Max; out-of-range entries are corrected automatically.
Appearance	Theme: Dark Mode (default), Light Mode, or Liquid Glass. The interface re-themes immediately.
Audit Log	View Logs opens the audit log, a machine-readable record of system events for auditors. It asks for a password issued by Openwater; the viewer filters by event type, date range, and text, and exports CSV.

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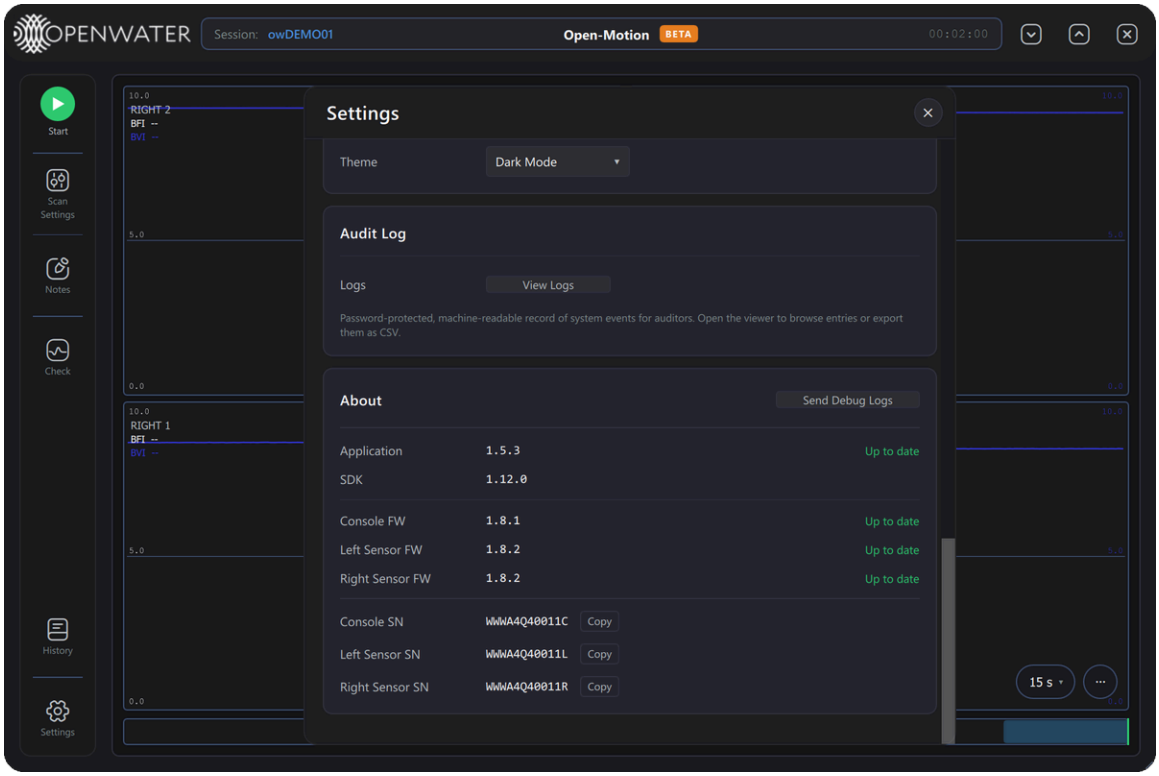


Figure 33: Settings, About.

The **About** card lists:

Table 21: Settings, About card.

Row	Meaning
Application	The application version, with Up to date, Check failed (no internet access or GitHub unreachable), or an Update button (see Section 5.2.2).
SDK	The version of the Open-Motion software library.
Console FW, Left Sensor FW, Right Sensor FW	Firmware version of each connected device (or Not connected), with Up to date or an Update button (see Section 5.2.3).
Console SN, Left Sensor SN, Right Sensor SN	Hardware serial numbers. Copy puts a serial number on the clipboard; include them when contacting support.
Send Debug Logs	Packages recent application logs for support (see Section 5.15).

5.11. Data Storage

Each Windows account keeps its own data in a private folder:

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C:\Users\<Windows user>\AppData\Local\Openwater

Table 22: Data storage locations.

Location	Contents
logs\	One application log file per launch (open-motion-<date>_<time>.log).
data\scans.db	The scan database: all scans, their notes, and your display preferences.
data\<full label>_left_mask<xx>_raw.csv, …_right_mask<xx>_raw.csv	Raw camera histograms, one file per sensor, only when Save raw CSV is on. These are large: several hundred megabytes per camera per hour.
data\debug-bundles\	Zip files created by Send Debug Logs.
data\updates\	Installers downloaded by the in-app updater.

- Scan data is kept automatically in the database. Processed CSV files are only created when you export from Scan History (see Section 5.9.1).
- In the Research build, the database is not encrypted. Protect the computer and any exported files according to your study's data-handling rules.

5.12. Shutting Down Open-Motion

5.12.1. If a scan is running, let a timed scan finish or press the red **Stop** badge to end it (see Section 5.6). When **Session Notes** opens, add any final observations and close the Notes window with ×, Esc, or by clicking outside it so the notes are saved (*"Note saved."*).

5.12.2. Close the application with the × button in the upper-right corner of the window. If a scan or contact-quality check is still running, the application does not exit; a yellow message such as *"Scan in progress. Click X again to cancel and exit."* appears. Press × again within 5 seconds only if you intend to abandon the work. On exit, the application stops any scan in progress, closes an open Notes window (saving its text), and disconnects from the Console and Sensor Modules.

5.12.3. Turn off the power switch on the back of the Console. The status LED on the front of the Console turns off.

5.12.4. Clean the Sensor Modules and Console as described in Section 5.13, then replace the Sensor Module covers and store them as described in Section 4.1.3.

5.13. Cleaning the Open-Motion Device

5.13.1. Cleaning the Sensor Modules

5.13.1.1. With the system powered off, clean the Sensor Modules with 70% Isopropyl Alcohol (IPA) and a lint-free cloth in accordance with your facility's protocols.

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5.13.1.2. When not in use, store Sensor Modules with the included protective covers on them to avoid damage to the camera sensors or laser emitters.

5.13.1.3. The disposable headband assembly (attachment frame and headband strap) is single-patient-use. After each patient use:

- Remove the disposable headband assembly from the reusable Sensor Modules.
- Discard the disposable headband assembly in accordance with facility policy.
- Do not clean, disinfect, reprocess, or reuse the disposable headband assembly.



Figure 34: Disposable headband assembly.

5.13.2. Cleaning the Console

5.13.2.1. With the system powered off, clean the Console with 70% Isopropyl Alcohol (IPA) and a lint-free cloth in accordance with your facility's protocols.

5.14. Sync Capabilities

5.14.1. The Open-Motion Console can be synchronized with compatible third-party devices by connecting the appropriate cable to the SMA trigger output port (see Figure 4, port A). Once connected, the Console provides an output frame sync signal that can be used to synchronize lighting, lasers, or other equipment. Refer to the Appendix for details on how to access the SMA port(s).

NOTE: Accessing the connection ports should only be done by trained individuals. Failure to adhere to strict guidelines may damage the device and/or void the manufacturer's warranty.

NOTE: Never operate the device while the bottom cover is removed. Doing so may expose users to laser light levels exceeding Class 1 limits. Always disconnect the wall power connection when the bottom cover is not in place.

5.15. Getting Help

5.15.1. Open **Settings** → **About** and press **Send Debug Logs**. The application packages the last 48 hours of application logs into a zip file under data\debug-bundles\, opens the folder with the file selected, and shows the file's location. The package contains application logs only — no scan data.

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5.15.2. Email the zip file to Openwater Support at **support@openwater.cc** with a description of the problem, the error code if there was one, and the serial numbers from Settings → About.

5.15.3. From an error dialog, **Contact Support** prepares the email for you (see Section 7.2.3).

5.16. Known Issues

Table 23: Known issues in Open-Motion Research 1.5.3.

Issue	Workaround
After changing the User Label between scans, the data file name of the next scan can still carry the previous label; it is correct from the scan after that.	Check the file names after changing the label.
The “Debug logs saved…” message names support@openwater.cc.	Send debug logs to the support address in Section 5.15.
Plot data loads slowly when zooming out to the beginning of a long scan.	Allow a moment for the plot to fill in.
A scan just under a whole minute can show a duration such as 0:60 in Scan History.	Read it as 1:00. The duration line in the scan’s notes is correct.
When the window is maximized, the restore button shows an incorrect icon.	The button still restores the window.

6. Service and Maintenance

Service and maintenance of the Open-Motion device should only be performed by suitably trained individuals. Contact Openwater Support using the contact information below or the details provided in your Service Agreement.

✉️: support@openwater.cc
📞: (415) 484-3776
🌎: www.openwater.health

7. Troubleshooting

At any point after the device starts up, if the system does not operate correctly or has any errors, restart the device and the application. Ensure that the device is fully powered on before starting the application. If problems persist after restarting the device, then refer to the information displayed on the GUI and take the recommended steps. For issues not covered in this manual, contact Openwater Support for assistance.

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7.1. Common Errors

The following are common errors with the recommended steps to correct them.

Table 24: Common errors and recommended solutions.

Issue	Potential cause	Recommended steps
Scans do not start	Sensor Modules too warm	Ensure that the device has been powered down for at least 5 minutes between scans
	Overheating	Turn off the Console when not in use to avoid overheating
Scan startup stalls	Error writing to cameras occurred	If software stalls and errors out, restart the application and power-cycle the hardware
	Previous error not cleared by software alone	
Poor or erratic data quality	Unintentional movement of the Console, cables, and/or Sensor Modules during measurement	Ensure the Console is placed where it will remain stationary, and prevent the cables from moving while measurements are being recorded
Scan data appears noisy	Sensor Modules may not have good contact with the subject's skin	Ensure the subject's skin is clean and free from hair or foreign debris, then reposition the Sensor Modules and restart the scan
Console connection status on the GUI is not green	Improper USB-C cable used	Use only the included USB-C cable to connect directly to the Console; do not use a USB hub
Console does not connect to the application or show any lights when switched on	Power cable not seated correctly	Make sure the power cable is fully plugged into the socket on the Console

7.2. Messages and Errors

7.2.1. Messages

Short messages appear in the bottom-right corner, color-coded: **green** = success, **yellow** = warning, **red** = error, **blue** = information. Most dismiss themselves after a few seconds (hovering over one pauses its countdown); those with an ✕ can be closed by hand. Up to five are shown at a time.

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Table 25: Messages.

Message	Meaning / action
“Note saved.”	Session Notes were saved.
“Console not detected…”, “Sensor not detected…”, “System not found…”	A device was not found at startup (see Section 5.2.7). Check cables and power.
“Left sensor disconnected” (or Right sensor, Console)	A device was unplugged or powered off while no scan was using it. Reconnect it.
“Could not start scan — the previous step is still finishing. Please press Start again.”	The system was still busy. Wait a few seconds and press Start again.
“Scan failed: …”	The scan could not start or run; the reason follows.
“Scan duration cannot be 0 seconds — reset to 1 minute.”	See Section 5.4.3.
“Scan ended unexpectedly …”	See Section 5.6.
“Laser safety warning detected. Please restart your console. If this error persists, please contact support.” (red, stays on screen)	The Console’s hardware laser-safety monitor reported a fault. Power-cycle the Console. Contact support if it recurs.
“Exported to …”, “Exported N scan(s) to …”	A CSV export finished.
“Interrupted scans can’t be exported.”	The selected scan was interrupted and has no exportable data.
“Console SN copied to clipboard.” (or Left / Right Sensor SN)	A serial number was copied from Settings → About.
“Preparing debug logs…”, “Debug logs saved to …”	See Section 5.15.

7.2.2. Closing While Busy

Pressing ✕ during a scan or check shows *“… in progress. Click X again to cancel and exit.”* Press ✕ again within 5 seconds only if you intend to abandon the work.

7.2.3. Error Dialog

Serious conditions raise a blocking **ERROR** dialog. It shows the error code (for example E-202), a title, an explanation, and a suggested action (→). While it is shown, the Console status LED pulses blue.

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Table 26: Error dialog controls.

Control	What it does
▸ Details	Expands technical detail, when available.
N more	Several errors are queued; they are shown one after another.
Copy details	Copies the error report to the clipboard.
Contact Support	Opens your email program with a pre-filled message to Openwater Support, copies the report to the clipboard, and opens the folder containing the application log with the file selected. Attach the log to the email before sending.
Dismiss	Closes the dialog (or shows the next queued error). Clicking outside the dialog or pressing Esc does the same.

Quote the error code when contacting support.

7.2.4. Error Code Reference

Table 27: Error codes.

Code	Title	Meaning	What to do
E-101	Sensor self-check failed	One or more of a Sensor Module's internal devices did not respond to its power-on self-check. The system cannot scan reliably.	Power-cycle the Sensor Module and reconnect. If it persists, the module needs service; contact support.
E-102	Sensor self-check unreadable	The Sensor Module connected but did not report its self-check result.	Power-cycle and reconnect. If it persists, update the sensor firmware or contact support.
E-103	Console initialization failed	The Console's laser-power configuration could not be applied.	Power-cycle the Console and reconnect. If it persists, contact support.
E-104	Console not detected	Startup check: no Console found (yellow message, not a dialog).	Check the Console USB cable and power. Use only the included USB-C cable to connect directly to the Console; do not use a USB hub.

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Code	Title	Meaning	What to do
E-105	Camera power-on failed	The Sensor Module could not power on its cameras.	Power-cycle the Sensor Module and reconnect. If it persists, the module may need service.
E-106	Sensor not detected	Startup check: no Sensor Module found (yellow message, not a dialog).	Check the sensor USB cable and power.
E-107	Storage almost full	The drive that stores scan data has less than 1 GB free. Scans cannot be started until space is freed.	Free up space on the data drive (or export and remove old scans) before starting a scan — no restart needed, Start re-checks. Contact support if the drive should not be full.
E-108	Scan storage inaccessible	The scan database in the data folder is not encrypted. This build stores patient data only in encrypted form, so it will not open that database and scans cannot be started.	Do not delete or move the data folder: it may hold patient data. Contact support with the session log attached.
E-201	Laser safety monitor unresponsive	Laser safety could not be confirmed, so the laser was shut off as a precaution.	Power-cycle the system and reconnect. Do not scan until this clears. Contact support if it persists.
E-202	Laser safety trip	The laser-safety monitor tripped during a scan. The laser was shut off and the scan stops about 5 seconds later.	Remove any obstruction, let the system settle, and start a new scan. If it trips repeatedly, stop and contact support.
E-203	Laser safety trip while no scan is running	The laser-safety monitor tripped while no scan was running and the laser was shut off. The safety interlock stays latched until the console is power-cycled.	Power-cycle the console and reconnect before starting a scan. If it trips again, stop and contact support.
E-301	Scan aborted before start	A check before the laser fired failed, so the scan did not start.	Resolve the reported problem (connection, safety, or configuration) and start again.

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Code	Title	Meaning	What to do
E-302	Scan could not start	The system refused a new scan, usually because the previous one is still finishing.	Wait a few seconds and try again. Reconnect if it stays busy.
E-303	Camera data lost during scan	Every camera stopped delivering data for about 3 seconds, so the scan was stopped. Data captured before the loss was saved.	Check the sensor cables and power, reconnect, and start a new scan.
E-304	Device disconnected during scan	The Console or a Sensor Module in use was disconnected during the scan, so the scan was stopped. Data captured before the disconnection may not have been saved.	Check the USB cables and power, reconnect, and start a new scan.
E-305	Not enough storage to start scan	The drive that stores scan data has less than 1 GB free, so the scan was not started.	Free up space on the data drive (or export and remove old scans), then start the scan again. Contact support if the drive should not be full.
E-306	Scan stopped, low storage	The drive that stores scan data dropped below 100 MB free during the scan, so the scan was stopped before the drive filled up. Data captured so far was saved.	Free up space on the data drive (or export and remove old scans) before starting another scan. Contact support if the drive should not be full.

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Appendix

Sensor Module Replacement

This appendix describes how to connect the hybrid cables of new or replacement Sensor Modules to the Console. Each hybrid cable has an optical fiber and a data cable, which connect to separate ports on the bottom of the Console.

> NOTE: Removing the Bottom Cover, disconnecting cables and fibers, or accessing the connection ports should only be done by trained individuals. Do not remove the optical fibers or data cables unless instructed to do so by Openwater. Failure to adhere to strict guidelines may damage the device and/or void the manufacturer's warranty.

Tools and Parts

The following tools and parts are needed (Figure 35):

- Bottom cover
- Retaining plank
- Screws (two)
- Plugs
- 2.5 mm Allen wrench
- Fiber connector cleaner (recommended)
- Sensor Modules with hybrid cables

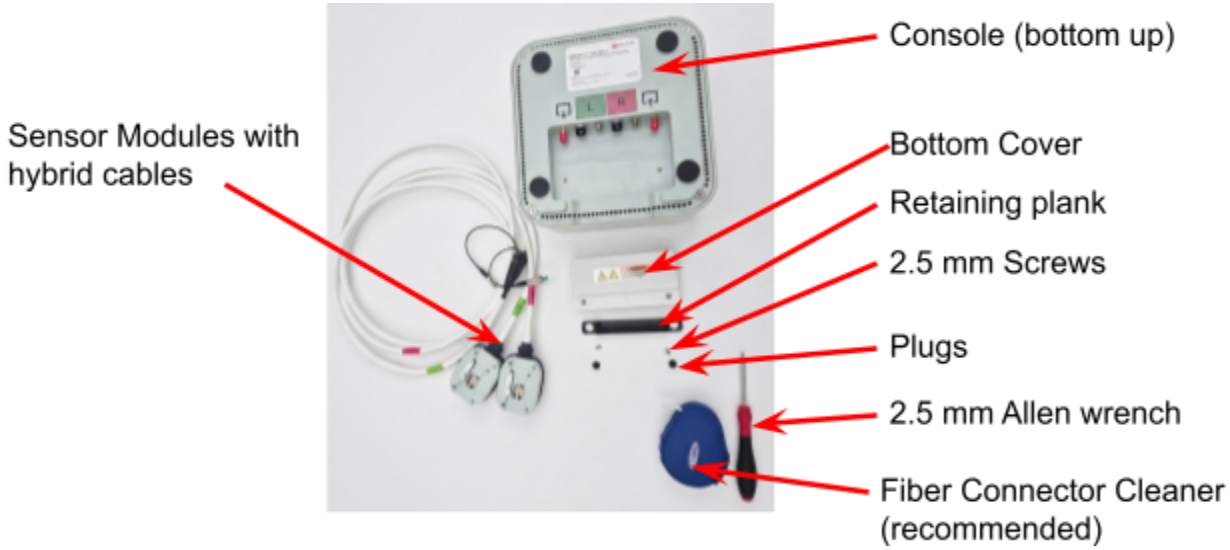


Figure 35: The Console (bottom up) with the tools and parts used to connect the Sensor Module hybrid cables.

Connecting the Hybrid Cables

1. Make sure the Console is unplugged.
2. Place the Console bottom up.

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3. Remove the two rubber plugs and then remove the two hex screws with the included 2.5 mm hex key (Figure 42).
4. If replacing a Sensor Module, disconnect the electrical cable by rotating the collar to the left and pulling back gently, and the fiber optic by unscrewing the collar fully and pulling back gently. It is recommended to cap the fiber optic to protect it from damage when not connected to the console.
5. To reconnect the Sensor Modules place the retaining plank on the Console with the foam side up. Make sure the foam is oriented as outlined in green in Figure 36.

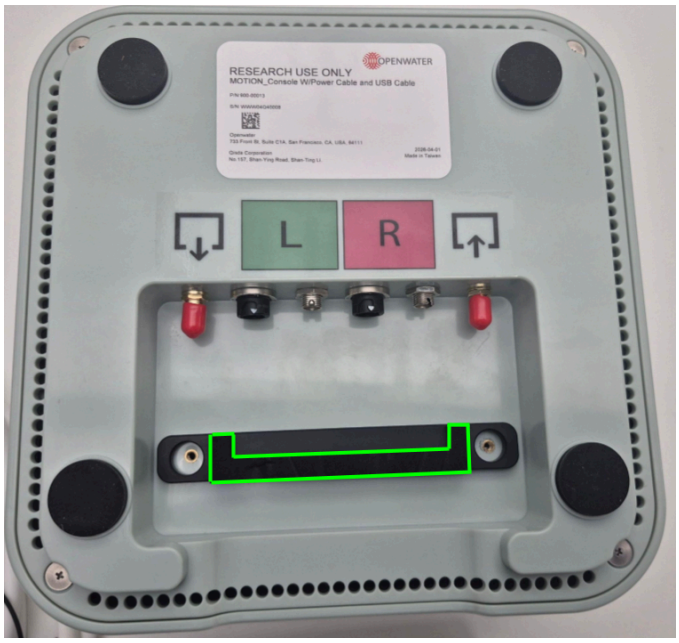


Figure 36: The retaining plank in place with the foam side up; the green outline shows the correct orientation of the foam (step 3).

6. Remove the protective cap from the fiber connector on the hybrid cable. Do not touch the fiber optic tip with anything except dedicated lint-free fiber cleaning material (Figure 37).

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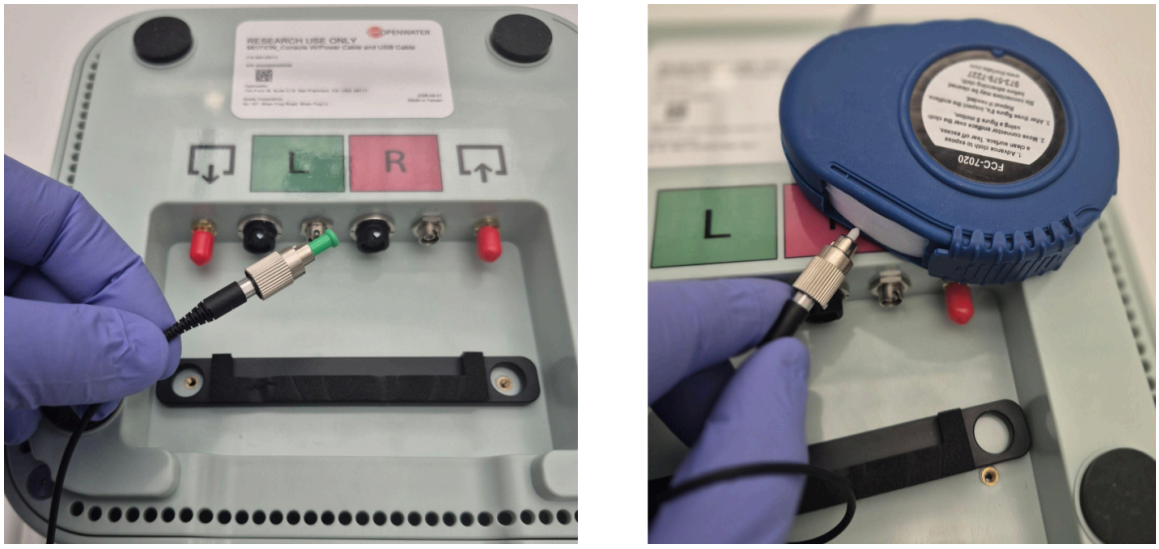


Figure 37: Removing the protective cap from the fiber connector (left) and the fiber connector cleaner in use (right) (step 4).

7. Connect the fiber cable to the matching connector on the Console (the left cable to the left connector). Align the key on the cable connector with the notch, then tighten the connector firmly (Figure 38).

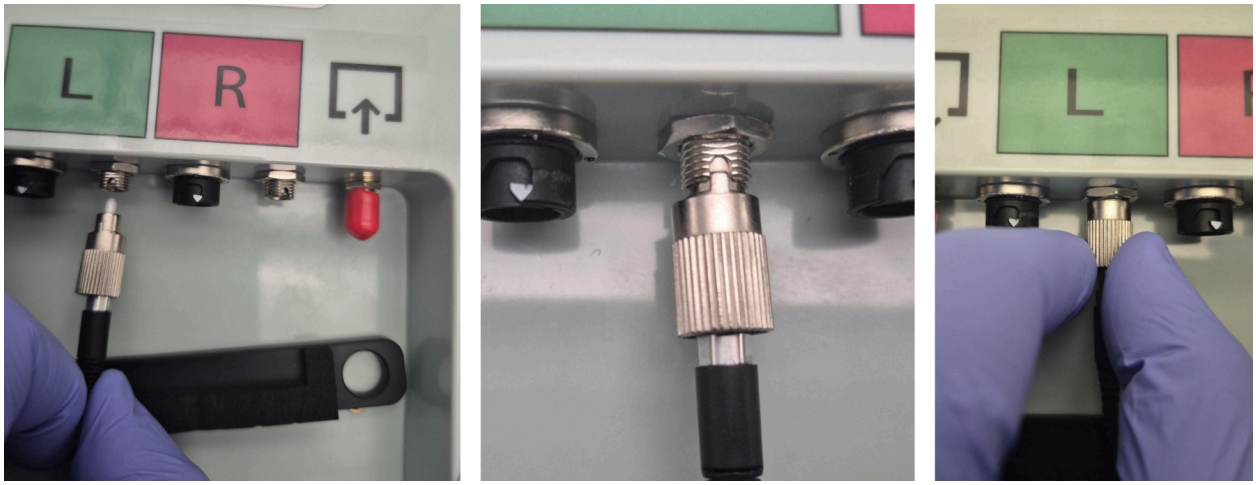


Figure 38: Connecting the fiber cable with the key aligned to the notch, and tightening the connector (step 5).

8. Align the white dot on the data cable connector with the white triangle on the mating connector, and insert the connector until it clicks. Pull back gently on the cable to confirm that it is locked in place (Figure 39).

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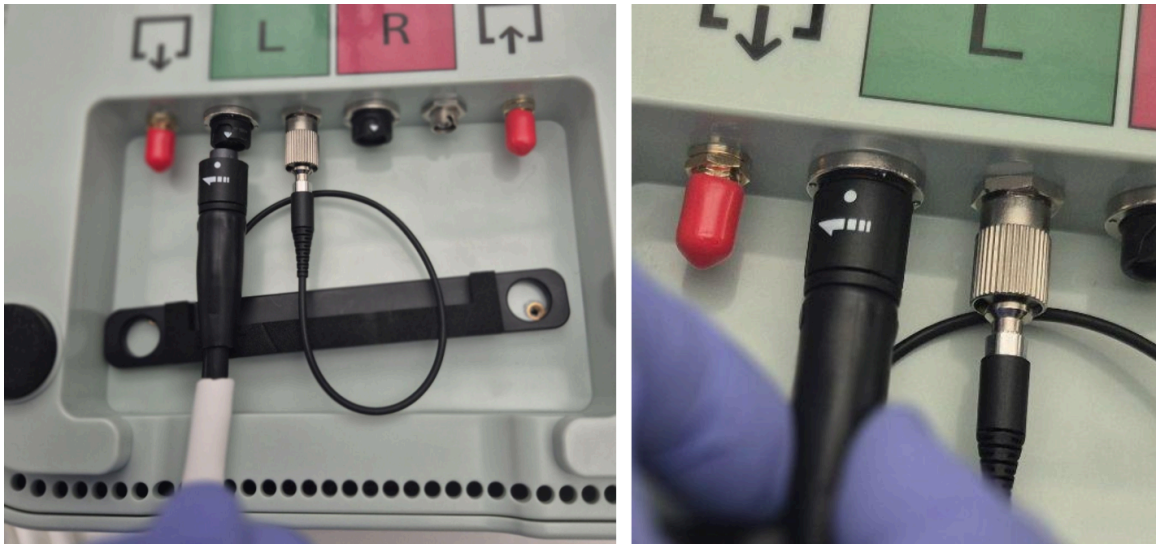


Figure 39: Connecting the data cable (step 6).

9. Repeat steps 4 to 6 for the second Sensor Module (Figure 40).



Figure 40: Both Sensor Modules connected to the Console (step 7).

NOTE: If the optical fiber in a hybrid cable is much longer than its data cable, route the extra fiber in a loop. The loop must pass beneath the connectors and extend toward the other cable (the left cable loops to the right and the right cable to the left) so that both loops sit in the center. The cables must not cross over each other on the surface of the plank.

NOTE: Before attaching the bottom cover, make sure the optical fiber is not on or near the regions highlighted in red in Figure 41. Fiber left in these regions can be permanently damaged.

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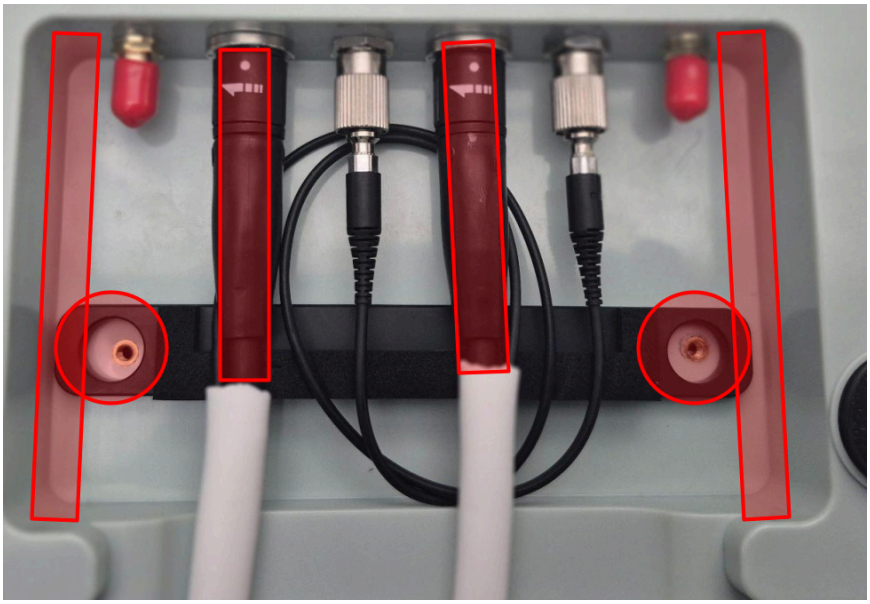


Figure 41: Regions highlighted in red, where the optical fiber must not be when the bottom cover is attached (steps 7 and 8).

10. Install the bottom cover. If it does not sit easily below the edge of the Console, do not force it; remove the cover and make sure the optical fibers are not in the way.
11. Check that no cables are crossed between the foam and that no cables are pinched or jammed by the cover.
12. Tighten the two screws, and seal the screw holes with the plugs (Figure 42).

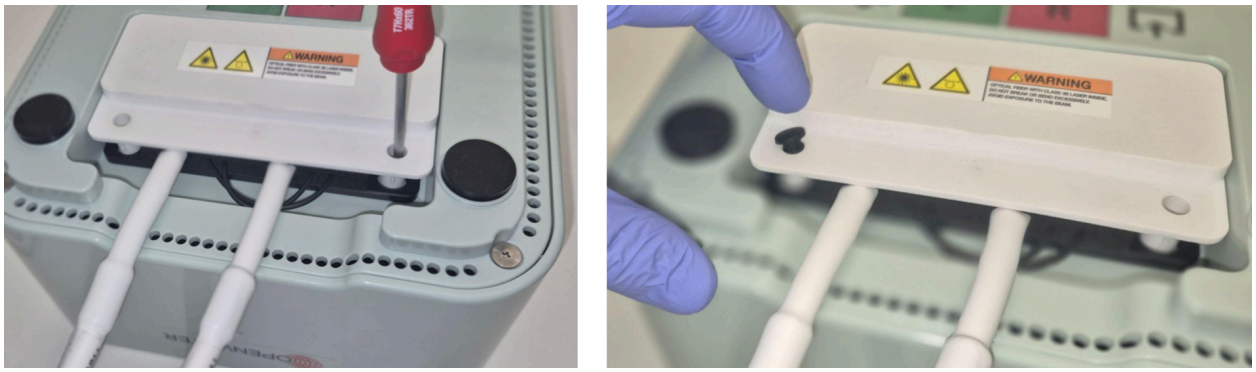


Figure 42: Tightening the bottom cover screws (left) and inserting a plug (right) (step 10).

Installation is complete (Figure 43).

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Figure 43: The Console with both Sensor Modules connected and the bottom cover installed.

NOTE: Any change(s) to a Sensor Module or its connections can alter the factory BFI and BVI calibration. Contact Openwater for additional details.

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