



SPECTRUM-C23

HARDWARE

Instruction manual

functional near-infrared
spectroscopy (fNIRS)



CORTIVISION

Cortivision sp. z o.o.
ul. Tomasza Zana 11a
20-601 Lublin
+48 606 723 359
support@cortivision.com
www.cortivision.com

version 2025.1.3



Table of Contents

<i>Product information</i>	3
<i>Safety information</i>	5
<i>Environmental protection</i>	6
<i>1. Description of the set.....</i>	7
1.1. Amplifier	8
1.2. LED status	9
1.3. Detectors and emitters	10
1.4. Caps	11
1.5. Accessories	11
<i>2. Preparing the system for startup</i>	18
2.1. Transport and storage	18
2.2 Preparation for first use	18
2.3. Connecting elements of the set	18
2.4 Connecting/disconnecting the amplifier with the optode bundle.	19
2.5 Installation of the memory card.	22
<i>3. Description of operation</i>	23
3.1. Research environment	23
3.2. Preparation of the participant	23
3.3. Disinfection and maintenance	28
<i>4. Support</i>	28
4.1. Online support	28
4.2. Warranty Coverage Information	28



Product information

Product name: **SPECTRUM Model: C23**

Manufacturer: **Cortivision sp. z o. o.** based in Lublin (address: ul. Tomasza Zana 11a, 20-601 Lublin) entered into the Register of Entrepreneurs kept by the Lublin-Wschód District Court, 6th Commercial Division of the National Court Register, under the number KRS 0000778384, REGON 382891891, NIP 7123384349.

Device parameters:

- Technology: near-infrared spectroscopy of solid light using the modified Beer-Lambert law.
- Light sources per each optode bundle: 12 LEDs with 760 nm and 850 nm wavelengths.
- Light detectors per each optode bundle: 8 SiPD detectors.
- Max. number of optode bundles connected to the amplifier: 2
- Sampling frequency: variable, up to 250 Hz (depending on the number of channels).
- Battery operation: approximately 6 hours.
- Communication with the recording device: Wireless communication protocol (WiFi)

As part of product improvement, we reserve the right to change its design and appearance.

Compliance with the CE declaration:

The CortiVision SPECTRUM device is CE marked, which means that it complies with the following requirements of the acts of the Union harmonization legislation:

- *DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL 2011/65/EU of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment*

- *DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL 2014/53 / EU of 16 April 2014 on the harmonization of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5 / EC*



SPECTRUM model C23 also meets the requirements of the following standards:

-EN 55032:2015/AC:2016/A1:2020/A11:2020

- EN 55035:2017/A11:2020

- EN IEC 61000-3-2:2019/A1:2021

- EN 61000-3-3:2013/A1:2019/A2:2021/AC:2022

- ETSI EN 301 489-1 V2.2.3 2019

- ETSI EN 301 489-17 V3.2.4 2020

- ETSI EN 300 328 V2.2.2 2019-07

Cortivision sp. z o. o. hereby declares that the radio device SPECTRUM type C23 conforms with the directives 2011/65/UE and 2014/53/UE. The full text of the EU Declaration of Conformity is available at the following address: www.cortivision.com/certification.



Safety information

Before starting work with the device, please read the instructions carefully. If you have any questions, please contact Cortivision sp. z o. o. (support@cortivision.com).

Cortivision sp. z o. o. is not responsible for any loss or damage resulting from failure to comply with the following rules and failure to comply with the operating instructions.

Safety tips:

1. Before use, make sure that all components of the device are connected following the operating instructions.
2. The device may only be operated by adults who have read the manual beforehand.
3. In the event of damage to the device components, it is necessary to turn off the power supply and contact Cortivision sp. z o. o.
4. The device and its accessories should be protected against the action of water and other liquids, the possibility of mechanical damage, and the influence of extreme weather conditions.
5. The device is not adapted to work in a high magnetic field, e.g. in the immediate vicinity of magnetic resonance imaging (MRI).
6. The device and accessories should be maintained and cleaned following the information provided in the user manual. Do not use chemicals with a composition other than that specified in the manual.
7. Elements in contact with the body of the tested person should be disinfected before each subsequent use (according to the information contained in the instructions).
8. Elements of the device that come into contact with the body of the tested person (e.g. optodes, cap) should be applied carefully and gently to avoid the possibility of scratching or injury.
9. Do not repair the device yourself, open its casing, or replace any element with parts other than those provided by Cortivision sp. z o. o.
10. This product is not authorized for use as a critical component in life support systems nor for diagnosis or medical use purposes. The manufacturer designed this product for research purposes only.



Environmental protection

Each user makes a significant contribution to the protection of the environment. The product and its packaging contain materials that should be reused. The reprocessing of waste reduces its quantity and contributes to the protection of the natural environment. It is possible only with the involvement of users who will hand over waste equipment for recovery and reuse.

The **packaging** should be disposed of following the principles of waste segregation. Local options for separate collection of waste should be used.



Marked with this symbol must not be disposed of with ordinary household waste. The SPECTRUM C23 device, including accessories, should not be mixed with household waste. Elements of the SPECTRUM C23 system should be disposed of according to national regulations for the management of used electronic equipment.

Cortivision sp. z o. o. at the customer's request, accepts the return of used devices and accessories, and takes care of their disposal. For this purpose, a request for the collection of waste equipment should be submitted by sending a message to info@cortivision.com.

The user may independently hand over the device for disposal at a selective electronic waste collection point. Information on collection points accepting waste equipment free of charge can be obtained from the local government administration.



1. Description of the set

Cortivision SPECTRUM C23 is a wireless near-infrared spectroscopy (NIRS) for the functional measurement of the brain's hemodynamic response. The device enables non-invasive monitoring of oxy-, and deoxyhemoglobin levels in selected areas of the cerebral cortex, thanks to a set of infrared light emitters and detectors. The set, depending on the chosen configuration, may include:

1. Amplifier with a wireless communication module (Fig. 1).
2. Optode bundle with infrared light emitters and detectors (Fig. 2).
3. Caps for attaching the optodes in the 10-5 standard (Fig. 3).
4. Wires (Fig. 4 and Fig. 5).
5. Transport case (Fig. 6).
6. Phantom (Fig. 7).
7. Light blocking overlay (Fig. 8)
8. Harness (Fig. 9) or stationary arm (Fig. 13)
9. Stationary (Fig. 11) or portable (Fig. 14) WiFi router

The individual elements of the set and additional accessories are presented in subchapter 1.5. Please note that the colors of some elements may vary slightly from those in the photos.



1.1. Amplifier

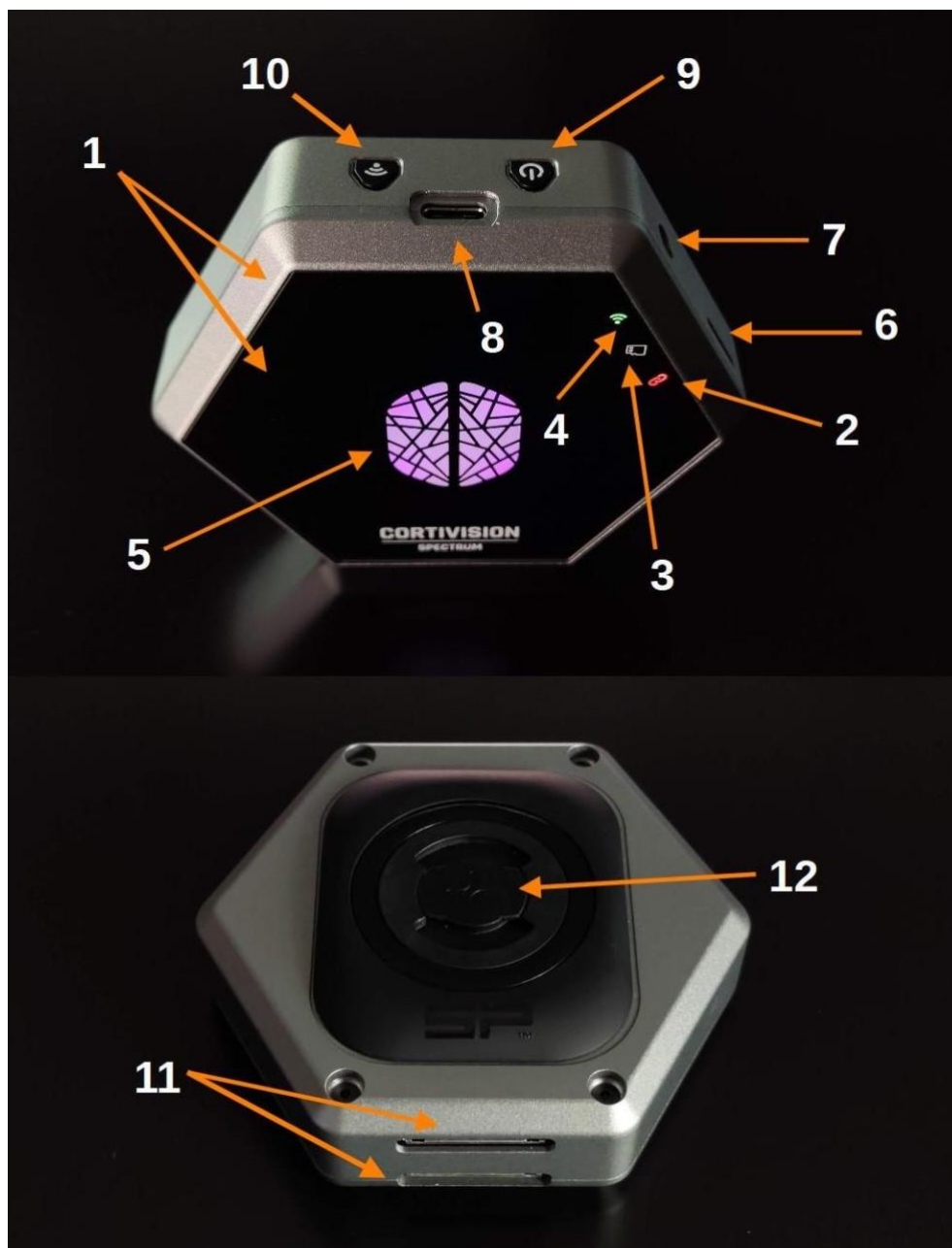


Fig. 1. The SPECTRUM amplifier (PN: SPE-MU): 1. Aluminum casing with glass front panel, 2. Software connection status diode , 3. Memory card status diode , 4. WiFi status diode , 5 Charging status diode , 6. Memory card slot, 7. Auxiliary input, 8.USB socket, 9. Power button, 10. User button, 11. Optode bundle inputs, 12. Mount interface.



1.2. LED status



Red - Disconnected.

Orange - Active CortiView 2 has been detected but is not yet connected.

Green - Connected.

Blue - Data stream/recording.



No backlight - No memory card in slot.

Green - Memory card detected in slot.

Blue - Recording on a memory card.

Flashing red - Memory card error, e.g., memory card not detected during the recording.

Yellow - MicroSD card space is low.



Yellow - Trying to connect.

Green - Connected.

Violet - Configuring a connection (access point mode).



Violet - The device is switched on and ready to use.

Orange - Charging mode.

Green - Fully charged.

Blue (flashing) - Firmware update in progress.

Red - Incorrect connection of optode bundles to the amplifier, e.g., bundles connected inconsistently with the marks on the housing and connector (see Fig. 16).

White - Tandem mode (see 2.7)

The Cortivision SPECTRUM C23 amplifier shown in Fig. 1 allows the connect infrared light emitters and detectors (see 1.3) and sends the processed signal via a wireless communication protocol to the recording software (CortiView2). The amplifier contains a built-in lithium-ion battery with a capacity of 2000 mAh (7.4V), powered by the charging socket (Fig. 4). The device status is communicated using four LEDs (see 1.2) informing about the current battery charging mode, software connection status, establishing wireless communication and data recording/streaming status. An interface on the back of the device allows it to be mounted on the harness (Fig. 9) and other holders (Fig. 13).



1.3. Detectors and emitters



Fig. 2. Optode bundle (PN: SPE-021): 1. Infrared light detectors, 2. Dual-band infrared light emitters (LEDs), 3. IMU module (Accelerometer and gyroscope sensors), 4. Breakout module, 5. Cable, 6. Connector.

SPECTRUM C23 enables the connection of an optode bundle consisting of infrared light detectors (Fig. 2.1.) and emitters (Fig. 2.2) in the form of LEDs emitting light with a length of 760 nm and 850 nm. The bundle also includes an IMU (inertial measurement unit) module with an accelerometer and a gyroscope (Fig 2.3). The optodes and IMU sensors are connected to the amplifier through a breakout module (Fig. 2.4), cable (Fig. 2.5), and connector (Fig. 2.6).



1.4. Caps



Fig. 3. Textile Cap (PN: SPE-CAP): 1. Holes for mounting optodes, 2. Optode mount for single emitter/detector, 3. Double optode mount detector and short-channel emitter.

Cortivision SPECTRUM uses the so-called “10-5 system”¹, which is an extension of the EEG electrode positioning standards known as the “10-20 system”² and the “10-10 array”³. In the 10-5 system, the distance between the 128 possible optode localization points corresponds to 10 or 5 percent of the distance between the imaginary extreme points on the skull. Emitters and detectors should be placed in predetermined holes (Fig. 3.1) using the holders included in the kit (Fig. 10.1 and Fig. 10.2). The cap size is selected individually based on the examined person's head circumference, and the chinstrap can be secured against displacement during signal recording.

1.5. Accessories

The SPECTRUM system uses two types of cables: a battery charging cable (Fig. 4.1) and a cable to connect the optode breakout with the amplifier (Fig. 5). The kit also includes an

¹ Oostenveld, R., Praamstra, P. (2001). The five percent electrode system for high-resolution EEG and ERP measurements. *Clinical neurophysiology*, 112(4), 713-719.

² Jasper, H. H. (1958). The ten-twenty electrode system of the International Federation. *Electroencephalogr. Clinical neurophysiology.*, 10, 370-375.

³ Chatrian, G. E., Lettich, E., Nelson, P. L. (1985). Ten percent electrode system for topographic studies of spontaneous and evoked EEG activities. *American Journal of EEG technology*, 25(2), 83-92.



optical phantom for optode validation (Fig. 7), powerbank (Fig. 14) and a light-blocking overlay (Fig. 8). The SPECTRUM C23's communication with the signal acquisition software (CortiView 2) passes through a stationary (Fig. 11) or portable (Fig. 14) WiFi modem. As an alternative to wireless synchronization, the system offers hardware connection via TTL cables (Fig. 12).



Fig. 4. (1) Battery charging USB-C cable (PN: SPE-USB); (2) Charger (PN: SPE-BAT1)



Fig. 5. A cable with a connector to the socket on the amplifier.



Fig. 6. Transport case (PN: G-TRCA2) with data acquisition PC 14" (PN: G-ACQ).



Fig. 7. Phantom (PN: PHT-C23)



Fig. 8. PCAP-LB light blocking overlay.



(1)



(2)

Fig. 9. Harness (PN: SPE-HM1) for attaching the amplifier (1) and cable management (2).



(1)



(2)

Fig. 10. Optodes holders (PN: SPE-H24A; SPE-H24B for (1) single emitter or detector; (2) detector and short-channel emitter.



(1)



(2)

Fig. 11. (1) Stationary WiFi router (PN: SPE-WFS) and (2) Portable WiFi router (PN: SPE-WFP).



(1)



(2)

Fig. 12. TTL cables: (1) LabJack version; (2) LPT version.



Fig. 13. Arm for stationary setup (PN: G-M4ARM)

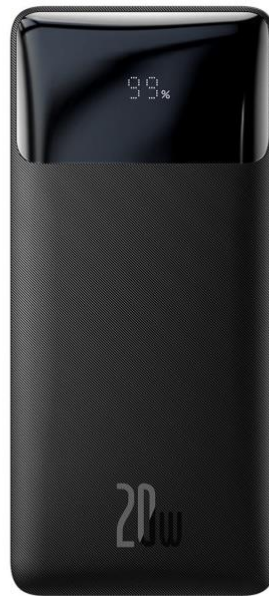


Fig. 14. Powerbank (PN: SPE-PWR3).



2. Preparing the system for startup

2.1. Transport and storage

The SPECTRUM C23 System should be transported in a protective case (Fig. 6) attached to the set and protected against the effects of extreme environmental conditions. The device is not waterproof and is not adapted to work in conditions of high sun exposure, dust, high humidity, and temperatures below 0°C (32 °F) and above 40°C (104°F).

When the device is not used intensively, it is best to store the system components in a protective case, away from heat sources (e.g. heaters) and the possibility of contamination or damage.

2.2 Preparation for first use

Before first use, you must charge the amplifier by plugging the charger cable. (Fig. 4). The

LED  will be orange while in charging mode. It takes approximately 2 hours to charge the battery fully. Before each subsequent use, check the battery level in the CortiView 2 program ("CortiView 2 - user manual"). The battery in the amplifier's housing enables uninterrupted operation in mobile mode for about 6 hours. The battery is not interchangeable. This time can be extended by connecting a power bank in place of a wall charger during operation.

2.3. Connecting elements of the set

Step 1. Using the cable (Fig. 5) connect the optode breakout with the amplifier.

Step 2. The previously charged amplifier is turned on by holding the power button for 3-5

seconds (Fig. 1.9). The LED  will turn violet on the amplifier's housing.

Step 3. (During first-time use) On the computer on which the signal will be recorded, install the CortiView2 application, configure wireless communication, connect the device to the software, and check if the device name is displayed in the program window (see: "CortiView2 - user manual").

Step 4. On the computer where the signal will be recorded, start the CortiView 2 application. The LED  will turn green on the amplifier housing.

Step 5. SPECTRUM C23 is ready to start recording.



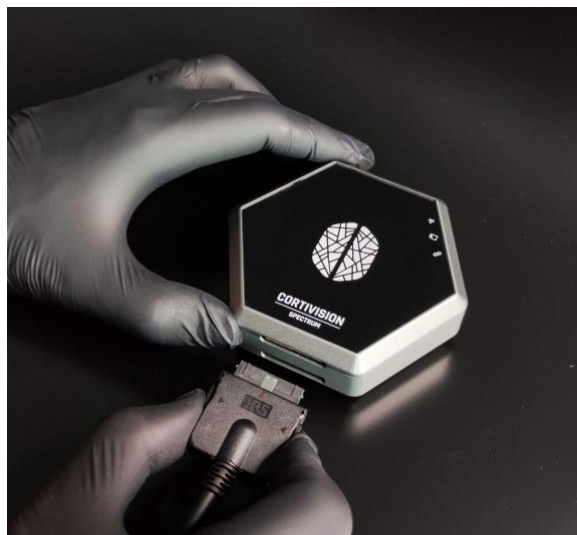
2.4 Connecting/disconnecting the amplifier with the optode bundle.

Step 1. Turn off the device.

Step 2. Detach the cable by squeezing the connector from the sides, then pull the connector (Fig. 15).



(1)



(2)

Fig. 15. Detaching the connector.

Step 3. To attach the connector, localize the cable marking “A” - for the first optode and “B” for the second optode bundle. The same markings are next to the connector sockets on the amplifier housing (Fig. 16). In the case of connecting two amplifiers (see Tandem Mode), the second amplifier will have sockets marked “C” and “D” dedicated to the third and fourth optod bundles.



(1)



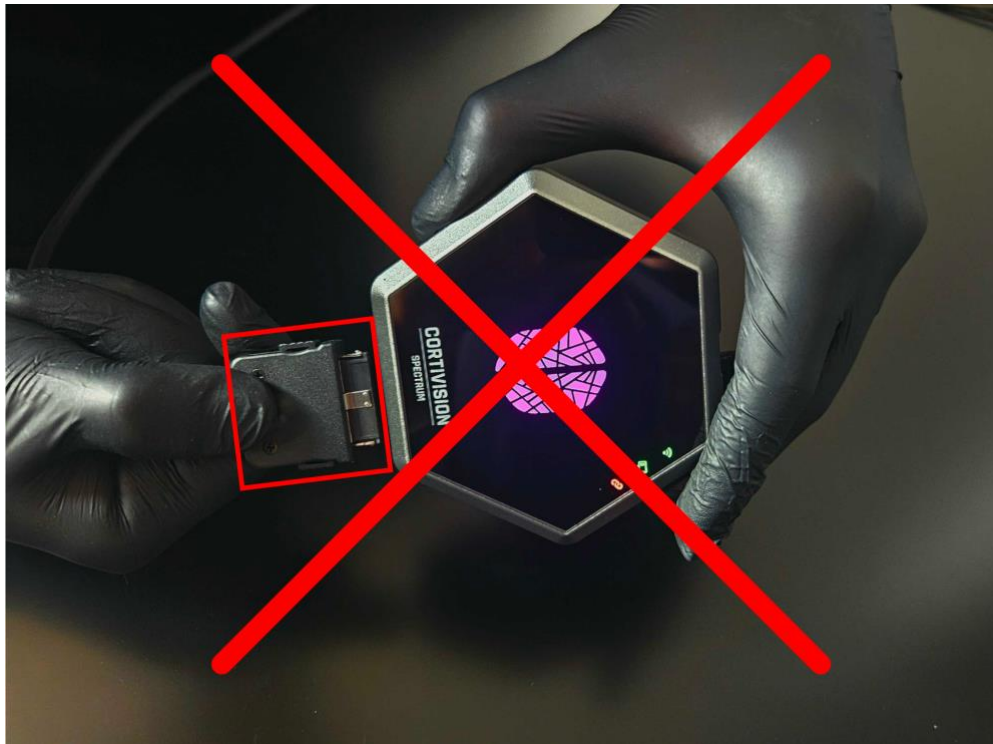
(2)

Fig. 16. Marks on the housing and connector (1). The red LED on the housing indicates incorrect connection of optode bundles to the amplifier (2).

Warning! There is only one way to attach the connector. Do not attach it differently!



Step 4. Grab a connector by squeezing it from the sides and attaching it to the device, but do not push it yet. The signs “A” or “B” should be pointing up. Ensure the connector is aligned in parallel with the receptacle and perpendicular to the device (Fig. 15). The star icon on the right side of the connector must match the star icon on the amplifier housing (Fig. 16).



(1)



(2)



Fig. 17. The following should be avoided: (1) plug in the connector "upside down"; (2) plug in the connector in other than a horizontal position.

Step 5. Push the connector forward until you hear a clicking sound.

2.5 Installation of the memory card.

Step 1. Find the memory card slot (Fig. 18).





Fig. 18. Memory card slot.

Step 2. Gently grasp the sides of the card and carefully push it inside with the contact pins up (Fig. 19).

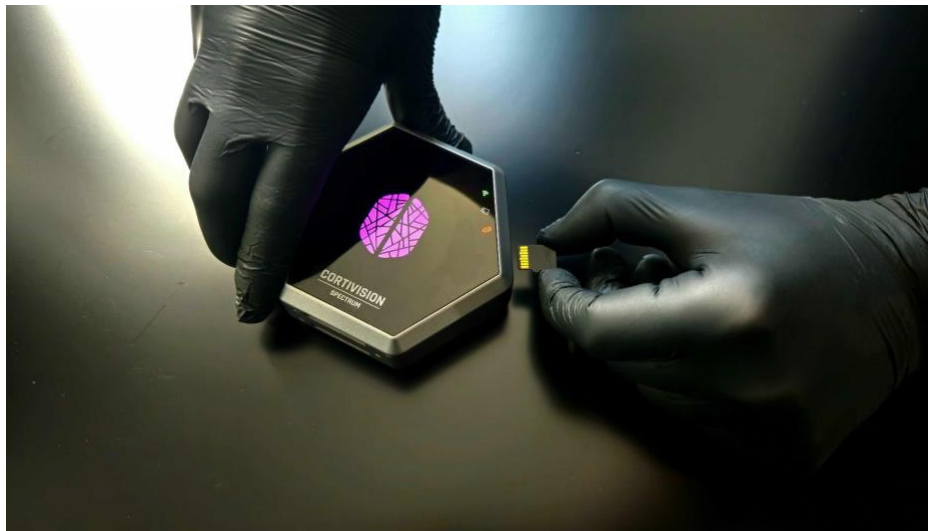


Fig. 19. The correct position of the memory card before placing it in the slot.

Step 3. To remove the memory card, grasp it on the sides and carefully remove it from the slot. **DO NOT PUSH IT** so that it comes out (Fig. 20).

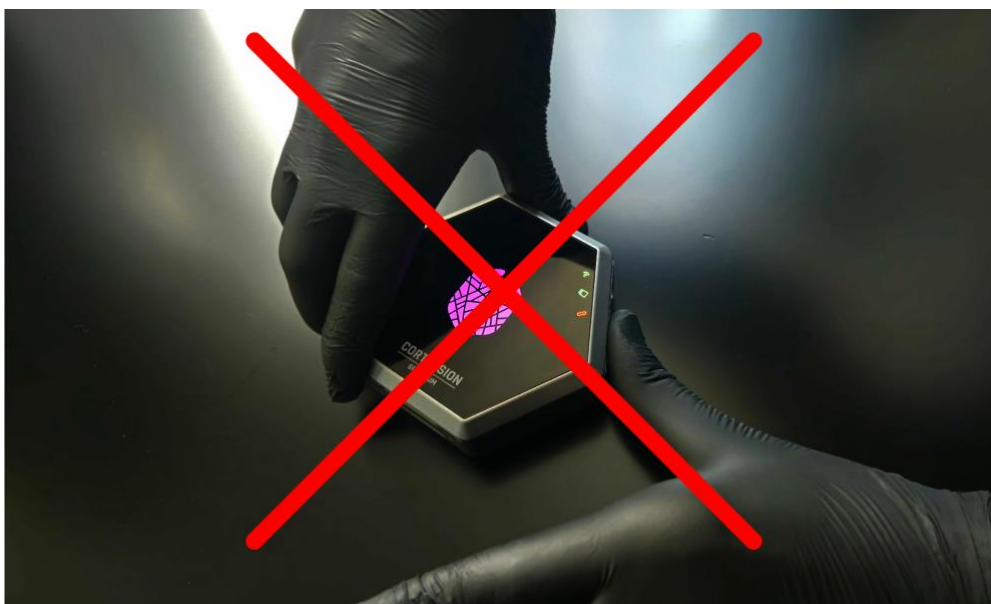


Fig. 20. Avoid pushing the memory card into the slot.



2.6 Hardware Triggers

2.6.1 Auxiliary input

The auxiliary input port (Figure 1.7) allows you to record external markers, alongside your data. These markers are crucial for synchronizing your recordings with specific experimental events.

Cable Compatibility

Cortivision provides ready-made cables to connect the auxiliary input to the following outputs:

- LabJack U3 DB15 (Figure 12.1)
- PC LPT DB25 Parallel Port (Figure 12.2)

The pinout for the auxiliary input port is detailed in Figure 21.

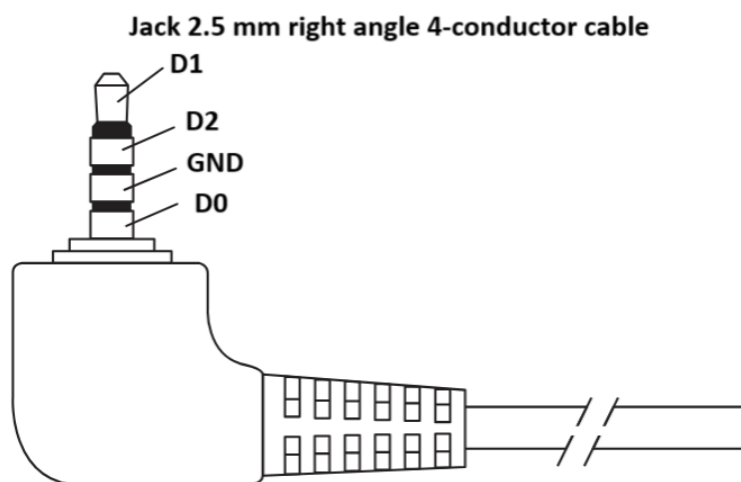


Fig. 21. The pinout of the input.

Triggering

Every positive pulse received by the auxiliary input that is longer than a single sample-to-sample interval will be recorded as a marker. This marker will be saved to your SNIRF file and, if enabled, to the SD card.

Recommendation for Pulse Duration:

To ensure reliable marker detection, we recommend using a pulse duration of 100 ms. If your sampling frequency is below 10 Hz, consider extending the pulse duration to 200 ms.



TTL Port Logic

The TTL port uses bit logic to generate markers with specific values. By changing the binary state of lines D0 to D2, you can create markers with decimal values from 1 to 7.

- Default State:

When all lines (D0-D2) are at a logical zero, no marker is generated. This is the default, inactive state of the input.

- Marker Values:

D0 only high: Marker value 1
D1 only high: Marker value 2
D0 and D1 high: Marker value 3
D2 only high: Marker value 4

... and so on, up to 7, based on the binary combination of D0, D1, and D2.

2.6.2 User Button Marker

The physical User Button  located on the amplifier (Figure 1.10) also functions as a marker generator.

- Action: Pressing the user button once.
- Marker Value: Generates a marker with a value of 128.

2.7 Tandem Mode

Two Spectrum C23 amplifiers can be connected to achieve the maximum number of optodes, i.e. 32 emitters and 48 detectors. The connected devices will maintain full synchronization via a single software interface and unified LSL or TTL streams. CortiView 2 software recognizes two devices connected in Tandem Mode as a single device.

Tandem mode configuration



Step 1. Connect all optode bundles to both amplifiers according to the instructions described in section 2.4.

Warning! Make sure that the labels (A, B, C, and D) on the bundle connectors match those on the amplifier sockets.

Step 2. Press the power buttons on both amplifiers to turn them on. The  LED on the housing should be violet (Fig. 22). Please note that the red backlight may indicate an incorrect connection between the bundles and the amplifiers.



Fig. 22. Two amplifiers working separately.

Step 3. Connect the amplifiers using the provided USB-C cable. The  LED backlight of both devices should change its colour to white (Fig. 23).



Fig. 23. Devices operating in Tandem mode.

Step 4. Start CortiView 2 and proceed to the connect(Fig. 24). The serial numbers of both amplifiers should be visible in the device list, separated by a plus sign (+). After clicking the Select button, the following stages described in the Calibration and Measurement sections of the "CortiView 2 - user manual" can be performed.

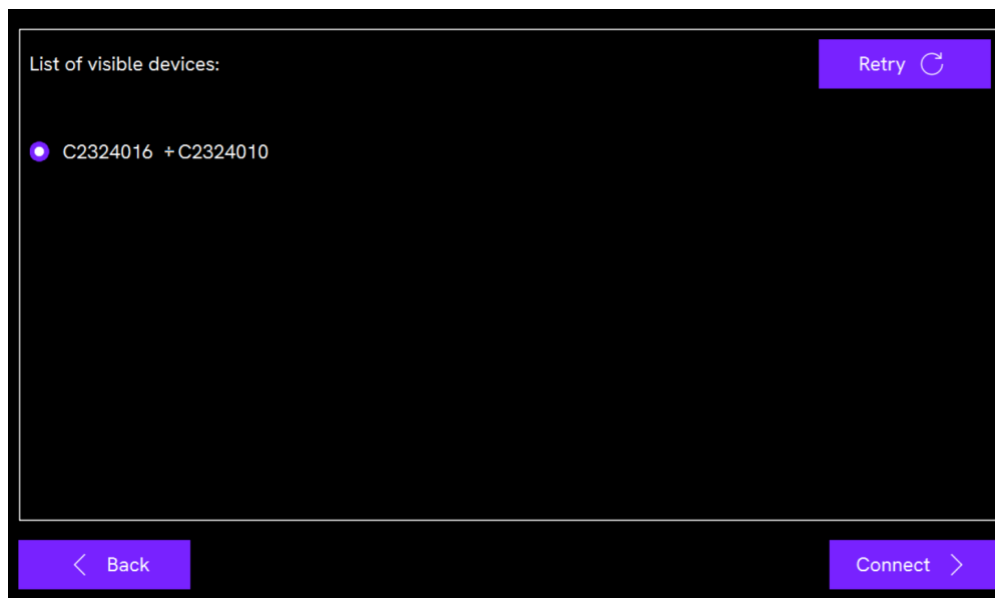


Fig. 24. List of the visible devices in CortiView 2 software.



3. Description of operation

3.1. Research environment

An intense natural or artificial light may cause infrared radiation to penetrate the device's detectors and cause disturbances in the recorded signal. For this reason, it is best to record with the lights off, the windows covered, and away from devices emitting infrared light (e.g. infrared radiators or industrial cameras). If the location where the tests will be conducted does not allow for removing the factors mentioned above, you should use the PCAP-LB light blocking insert (see Fig. 8) and/or additional shields to prevent outside light from reaching the detectors on the subject's head..

The SPECTRUM C23 amplifier connects to the CortiView 2 software via WiFi communication. Ensure that the distance between the amplifier and the computer used to record the signal does not exceed the range of the WiFi connection, i.e. about 10 m (32 feet).

3.2. Preparation of the participant

Step 1. First, choose a cap, the size of which corresponds to the circumference of the person's head. The head circumference is measured using a tailor's tape measure, drawing a line low over the ears, eyebrows, and the bone thickening on the edge of the occipital bone of the skull (Fig. 25). Before deciding to choose a cap, we ask the participant to put it on his head. After fastening the chin, the cap must not move loosely on the head or compress the scalp. The ears should pass freely through the openings on the sides.

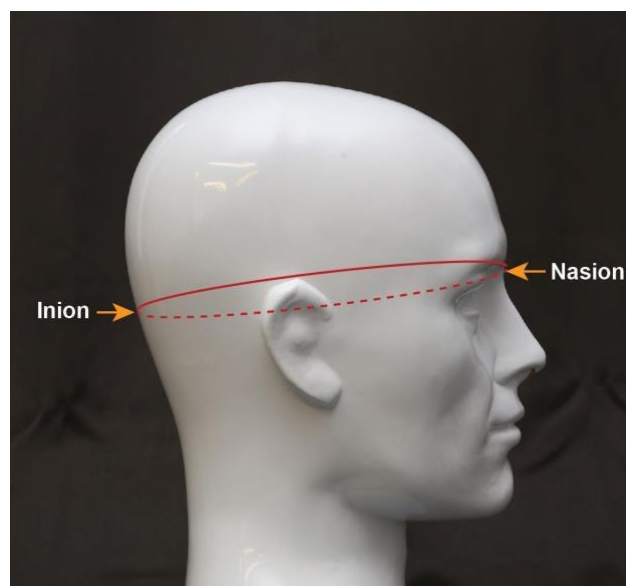




Fig. 25. Place of measuring the head circumference of the participant.

Step 2. In the selected cap, install holders for emitters and detectors at the locations where brain activity will be recorded. There are several methods to determine the optimal placement of optodes. One effective approach is to use software to aid in identifying the specific structures listed in widely-recognized brain atlases. Once determined, place the optodes into the mounted holders (see Fig. 26).



Fig. 26. Placing optodes in appropriate holders.

Step 3. The position of the optode in the holder can be adjusted by changing the insertion depth (Fig 27.1, Fig. 23.2). In hairless areas (e.g., on the forehead), it is recommended that the optode does not extend beyond the bottom edge of the mount (Fig. 23.3). With this position, the pressure of the optode on the subject's skin is minimized. In hair-covered areas, inserting the optode deeper into the holder is helpful so that its surface extends beyond the outline of the optode's lower edge (Fig. 23.4). Thus, reaching the skin's surface through the hair layer is easier.

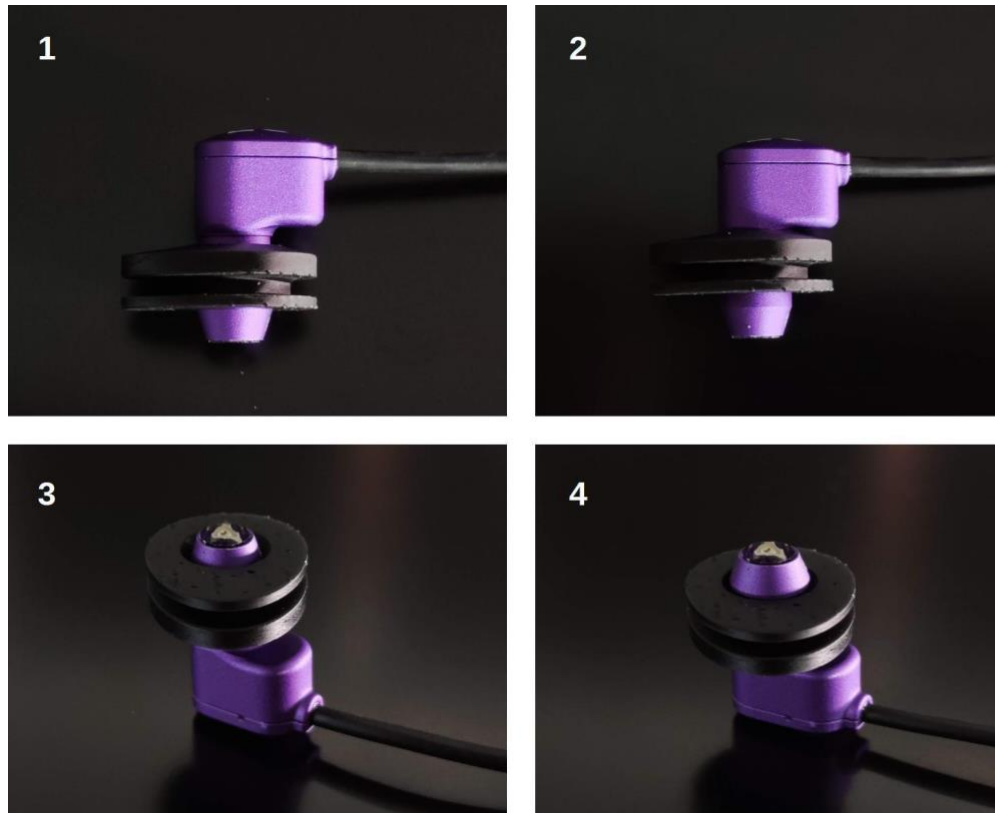


Fig. 27. Different positions of the optode in the holder, seen from the top (1, 2) and the bottom (3, 4).

Using a tailor's measuring tape, measure the distance from the point between the eyebrows of the test subject (nasion) and the farthest point of the back of the skull (inion). Divide the obtained value by 10 and measure, using the same measuring tape, from the point of the nasion, towards the centre of the head (Fig. 28). For example, if the distance through the centre of the subject's head was 35 cm, then we measure a distance of 3.5 cm from the point between the eyebrows, towards the centre of the head. We mark the measured point with a dermatograph, as a reference point.

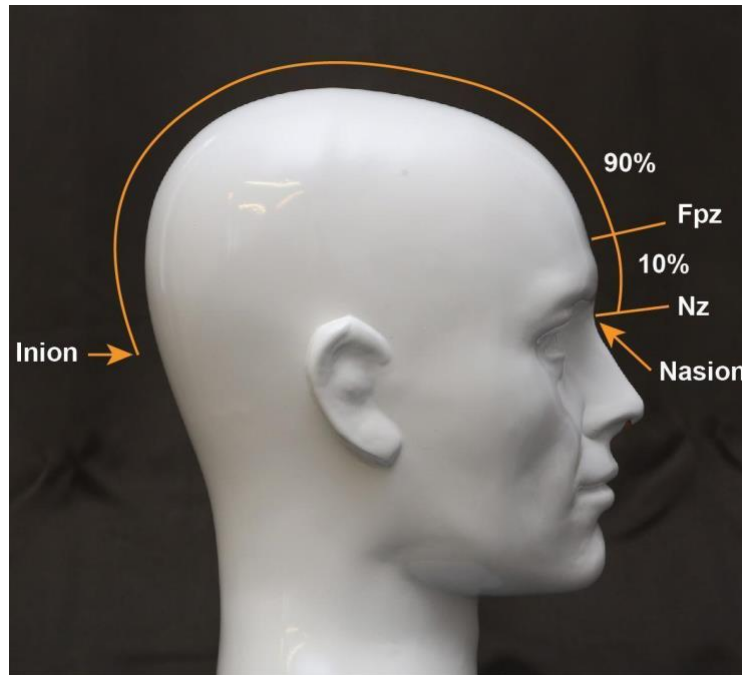


Fig. 28. Determining the reference point on the subject's head (FPz).

Step 4. The cap with mounted optodes and the IMU sensor is put on the head of the participant in such a way that the point marked as FPz coincides with the point marked in Step 3. Then, fasten the chinstrap in such a way as to prevent the cap from moving on the head. Using, for example, cotton buds or hair management tool, carefully brush the hair from under each optode so that it touches the skin on the head. At this stage, you can also change the insertion depth of the optode in the holder.

Caution:

- If the EEG signal is simultaneously recorded during fNIRS recording, ensure the applied gel, paste, or conductive fluid does not come into direct contact with the optodes.
- If virtual reality (VR) goggles are used to present stimuli during fNIRS recording, it should be checked that no part of the goggles causes the optodes to shift or tighten during the test.

Step 5. Use the CortiView software to control the signal quality on individual channels ("CortiView 2 - user manual"). If the signal quality is unsatisfactory, check whether the optodes accurately touch the scalp. Additionally, the cap with optodes can be fitted with the PCAP-LB light blocking cap (Fig. 8.) to improve the fit of the cap to the head and reduce the influence of external lighting.

Step 6. We start and end the recording of the signal using the CortiView 2 program ("CortiView 2 - user manual").



Step 7. After completing the signal recording, hold the power button for 3-5 seconds to turn off the device, disconnect the breakout and amplifier, and remove the cap with optodes from the subject's head. Parts that were in direct contact with the body of the tested person should be cleaned before the next use (Subsection 3.3. Disinfection and maintenance).

3.3. Disinfection and maintenance

After removing the optodes and holders, the cap can be hand washed with the addition of ECOLAB® Sekuspet® Plus liquid according to the manufacturer's instructions.

Parts of the optodes that were in contact with the scalp should be disinfected by wiping with a cotton pad soaked in the ECOLAB® Sekuspet® Plus liquid solution according to the manufacturer's instructions.

Clean the other elements of the SPECTRUM C23 set by wiping their surface with a dry cloth.

4. Support

4.1. Online support

Any issues or difficulties should be reported directly to the manufacturer, Cortivision sp. z o. o. using the e-mail address:

support@cortivision.com.

4.2. Warranty Coverage Information

1. Cortivision sp. z o. o. (hereinafter referred to as the Manufacturer) grants a time-limited warranty for each device, the warranty period starts from the moment the device is delivered to the Buyer and ends according to the General Guarantee Terms available at <https://www.cortivision.com/ggt/> .
2. The Manufacturer undertakes to remove the defects arising during the warranty period and recognized by the Manufacturer free of charge within the shortest possible time, but not longer than 30 days from the date of notification by the Buyer of the defect. In the event of a defect, the removal time of which will require a longer period, the Manufacturer will agree with the Buyer to a longer period of defect removal.



3. The Buyer is responsible for reporting the defect within 7 business days from defect detection in writing or, for example, by sending an email to the Manufacturer's e-mail address. info@cortivision.com
4. The warranty period of a given device, if the Manufacturer recognizes a significant defect, shall be extended by the time required to correct the reported defect. The warranty period for parts and components replaced or repaired during service is listed in the Article 2 of the General Guarantee Terms.
10. Liability under this warranty covers physical and legal defects arising from causes inherent in the device and only on the condition that the device is used following its intended purpose and the operating conditions specified in the manual.
11. The warranty does not cover defects arising from:
 - a) improper maintenance, operation, storage of the device,
 - b) mechanical, chemical, and thermal damage resulting from improper use of the device or deliberate damage to the device by the Buyer or third parties and causing a defect in the device or any of its parts,
 - c) damage to the device resulting from random events, force majeure factors, e.g. fire, flood, lightning strike,
 - d) defects caused by the Buyer's or User's actions or neglect
12. Please review all the details of the warranty service described in the General Guarantee Terms available at <https://www.cortivision.com/ggt/>