

Mindful Mobile System

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Contents

| | |
|---|----|
| 1. Safety Precautions | 4 |
| 1.1 Use Conditions | 4 |
| 1.1.1 Research Use Only | 4 |
| 1.1.2 Environmental Conditions | 4 |
| 1.1.3 Power Requirements | 4 |
| 1.1.4 Electrical Safety | 4 |
| 1.1.5 Setup and Training | 5 |
| 1.2 Storage Conditions | 5 |
| 1.2.1 Clean and Healthy Environment | 5 |
| 1.2.2 Temperature and Humidity | 5 |
| 1.2.3 Regular Inspections | 5 |
| 1.3 Waste Disposal Details | 6 |
| 1.3.1 Electrodes and Accessories | 6 |
| 1.3.2 Electronic Components | 6 |
| 1.3.3 Battery Disposal | 6 |
| 1.3.4 Packaging Materials | 6 |
| 1.4 Wireless Conditions | 6 |
| 2. Mindful Mobile Introduction | 7 |
| 2.1 Overview | 7 |
| 2.2 Components | 9 |
| 2.2.1 Amplifier | 9 |
| 2.2.2 Triggerbox | 10 |
| 2.2.3 EEG Cap | 11 |
| 2.2.4 Router | 12 |
| 2.2.5 Accessories | 12 |
| 2.2.5.1 Triggerbox package | 12 |
| 2.2.5.2 EEG Cap package | 13 |
| 2.2.5.3 Charger and battery | 13 |
| 2.2.5.4 Video camera | 14 |
| 2.2.5.5 Computer | 14 |
| 3. Setup of Mindful Mobile system | 14 |
| 3.1 Prepare to a local area network | 14 |
| 3.2 Start amplifier | 15 |

| | |
|--|----|
| 3.3 Connect triggerbox if necessary | 16 |
| 3.4 Donning the EEG Cap | 17 |
| 3.5 Establish communication between Mindful Mobile and Collect | 17 |
| 3.6 Minimize the impedance | 18 |
| 3.7 Inspecting signal quality and recording raw data | 19 |
| 3.8 Remove and turn off devices | 19 |
| 3.9 Clean EEG Cap..... | 20 |
| 4. Clean and Maintenance | 20 |
| 4.1 Exterior Cleaning..... | 20 |
| 4.2 Electrode and Cap Cleaning | 20 |
| 4.3 Battery Maintenance..... | 21 |
| 4.4 Software and Firmware Updates | 21 |
| 4.5 Regular Inspections | 21 |
| 5. Warranty and Repair..... | 21 |
| 5.1 Warranty..... | 21 |
| 5.2 Repair or Replacement Support..... | 22 |
| 6. FCC Statement | 22 |

1. Safety Precautions

The use and storage conditions for an EEG system typically involve the following guidelines to ensure optimal performance and longevity.

1.1 Use Conditions

1.1.1 Research Use Only

- The Mindful Mobile system is not intended for the diagnosis or treatment of any disease or condition. It is a scientific research instrument designed for performing measurements and acquiring data. Neuracle Neuroscience makes no representation regarding the suitability of this instrument for any particular research study.

1.1.2 Environmental Conditions

- Operate the EEG system in a controlled environment with stable temperature and humidity levels to prevent fluctuations that could affect signal quality.
- Avoid direct sunlight and exposure to extreme temperatures, as these conditions can impact electronic components:
 - 1) Ambient temperature: +5°C ~ +40°C
 - 2) Relative humidity: 30% ~ 75% (no condensation)
 - 3) Atmospheric pressure: 700 hpa ~ 1060 hpa

1.1.3 Power Requirements

- Power requirements: 3.6 V lithium battery
- Use the provided power adapters and cables that are compatible with the EEG system to ensure proper voltage and current supply.
- Follow the manufacturer's guidelines for charging and handling rechargeable batteries.
- Use only approved batteries and chargers specified by the manufacturer.
- Do not expose batteries to extreme temperatures or direct sunlight, as this may cause overheating or damage.

1.1.4 Electrical Safety

- If a broken or cracked wire is detected, operation of the equipment is prohibited. Please contact after-sales support for maintenance and repair promptly.

- The inflow of conductive liquid into an active circuit part of the product may cause a short circuit.

1.1.5 Setup and Training

- Set up the EEG system according to the manufacturer's instructions, ensuring all electrodes are properly positioned and secured on the subject's scalp.
- Monitor signal quality during recording sessions to ensure proper electrode contact and minimal artifacts.
- Follow protocols for data acquisition and ensure proper synchronization with any auxiliary equipment or stimuli presentation systems.

1.2 Storage Conditions

1.2.1 Clean and Healthy Environment

- Store the EEG system in a clean, dry environment to prevent dust accumulation and potential damage to sensitive components.
- Use protective cases or covers to shield the system from physical impacts or accidental spills.
- Protect the EEG system from direct sunlight, exposure to water or liquids, and chemical fumes that could corrode or damage electronic components.
- If applicable, store rechargeable batteries separately from the EEG system according to manufacturer instructions to prevent discharge or damage.

1.2.2 Temperature and Humidity

- Store the system within recommended temperature and humidity ranges specified by the manufacturer to prevent condensation or moisture buildup. Avoid storage in areas prone to extreme temperatures or humidity fluctuations:
 - 1) Temperature: $-20^{\circ}\text{C} \sim 55^{\circ}\text{C}$
 - 2) Relative humidity: $\leq 90\%$
 - 3) Atmospheric pressure: $700\text{hPa} \sim 1060\text{hPa}$
- The warehouse should be well ventilated and free of corrosive gases

1.2.3 Regular Inspections

- Periodically inspect the system for signs of wear, corrosion, or malfunction during storage.
- Follow any recommended maintenance procedures provided by the manufacturer to ensure readiness for future use.

1.3 Waste Disposal Details

The waste disposal details for Mindful Mobile system typically involve considerations for the disposal of components such as electrodes, cables, and electronic devices etc. Here are the general guidelines.

1.3.1 Electrodes and Accessories

- Dispose of electrodes, electrode caps, and other accessories according to local regulations for electronic waste (e-waste).
- Separate any disposable components from reusable parts and discard them in accordance with applicable recycling programs or guidelines.

1.3.2 Electronic Components

- Dispose of electronic components, such as amplifiers or signal processing units, in accordance with local e-waste disposal regulations. Contact the manufacturer or authorized service centers for guidance on proper disposal of specific EEG system components.
- Contact local authorities or recycling facilities that specialize in electronic waste to ensure proper recycling and disposal procedures.

1.3.3 Battery Disposal

- Dispose of rechargeable batteries according to local regulations for battery recycling.

1.3.4 Packaging Materials

- Dispose of packaging materials, such as cardboard boxes or plastic wraps, in recycling bins or according to local waste disposal guidelines.
- Whenever possible, reuse or recycle packaging materials to minimize environmental impact.

By adhering to these waste disposal details, users can responsibly manage the disposal of EEG system components while minimizing environmental impact and ensuring compliance with applicable regulations. Always consult local authorities or recycling facilities for specific guidelines on electronic waste disposal in your area.

1.4 Wireless Conditions

Mindful Mobile is a wireless system consisting of two main components: amplifier and triggerbox. It operates in the 5GHz Industrial, Scientific, and Medical (ISM) band, connecting to computer software via a wireless link with the triggerbox for synchronized signals. The standard operating distance is less than 10 meters. Below are the technical specifications.

- **Wireless Specifications of Amplifier:**

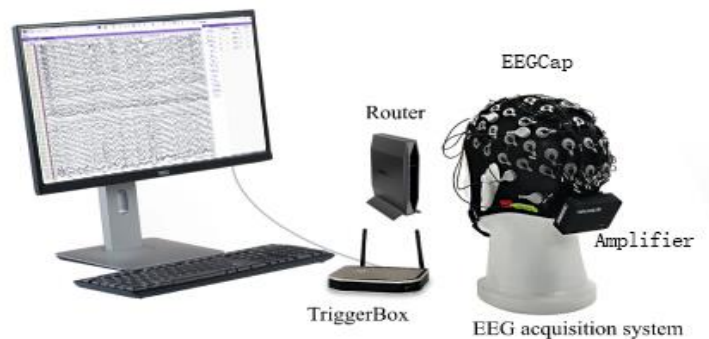
- 1) Wi-Fi: IEEE 802.11a/n-HT20/n-HT40
Operating frequency band: from 5.150 to 5.850 GHz
- 2) SRD: Operating frequency: 433.42MHz (RX)

- **Wireless Specifications of Triggerbox:**

- 1) SRD: Operating frequency: 433.42MHz (TX)
- 2) Wi-Fi: IEEE 802.11a/n-HT20/n-HT40
Operating frequency band: from 5.150 to 5.850 GHz

2. Mindful Mobile Introduction

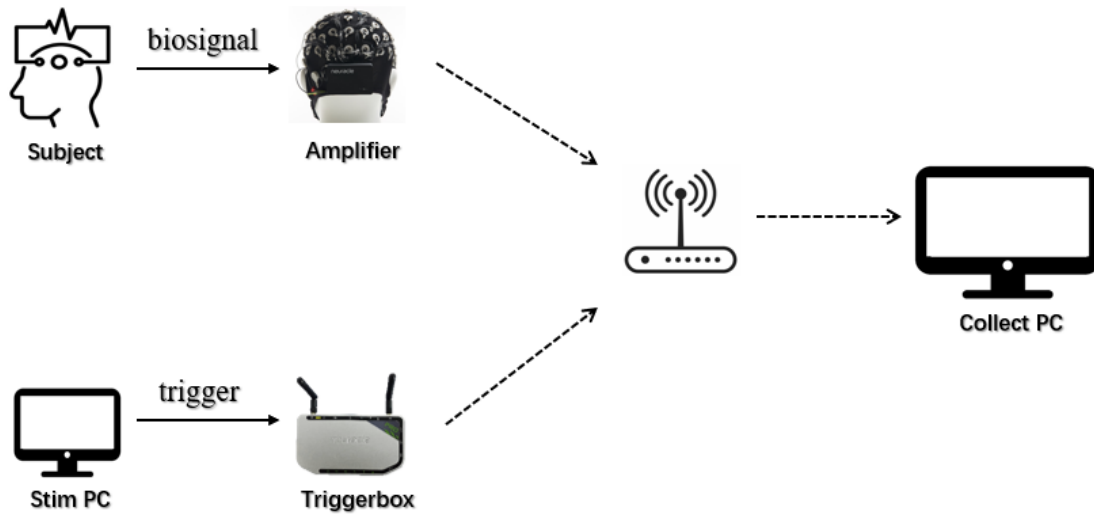
The Mindful Mobile EEG acquisition system represents a new generation of wireless EEG technology, developed using the latest and most innovative advancements. The signal quality of the wireless Mindful Mobile series rivals that of traditional wired EEG equipment. Additionally, the system is highly portable and incorporates advanced shielding technology to maximize signal stability.



2.1 Overview

The triggerbox, amplifier, and Collect software work together within an assigned local area network. The Stim PC sends triggers to the triggerbox who is using patented data communication protocols, with all triggers input through appropriate cables. This signal is then amplified by an amplifier before being transmitted wirelessly via Wi-Fi to a Collect PC.

The Collect PC serves as the central hub of this system, receiving the biosignal from the amplifier and trigger signals from the triggerbox. The Stim PC is responsible for presenting stimuli to the subject during the experiment, while the triggerbox records the timing of these stimuli in relation to the collected biosignal. As illustrated in the figure below.



Mindful Mobile is available in various configurations, offering different numbers of channels and types of electrodes/caps. The differences are as follows:

| Model \ Cap | | Flat Cap | Cup cap | Saline Net cap | Gelfree cap |
|---------------|-------------|----------|---------|----------------|-------------|
| NRW364 | 64 channels | Yes | Yes | Yes | No |
| NRW332 | 32 channels | Yes | Yes | Yes | Yes |
| NRW316 | 16 channels | Yes | Yes | Yes | Yes |
| NRW308 | 8 channels | Yes | Yes | Yes | Yes |

Mindful Mobile utilizes the 5 GHz band for wireless transmission, effectively avoiding packet loss and signal interference. Up to 64 analog-to-digital converters perform simultaneous sampling. Below is the specification table:

Specifications

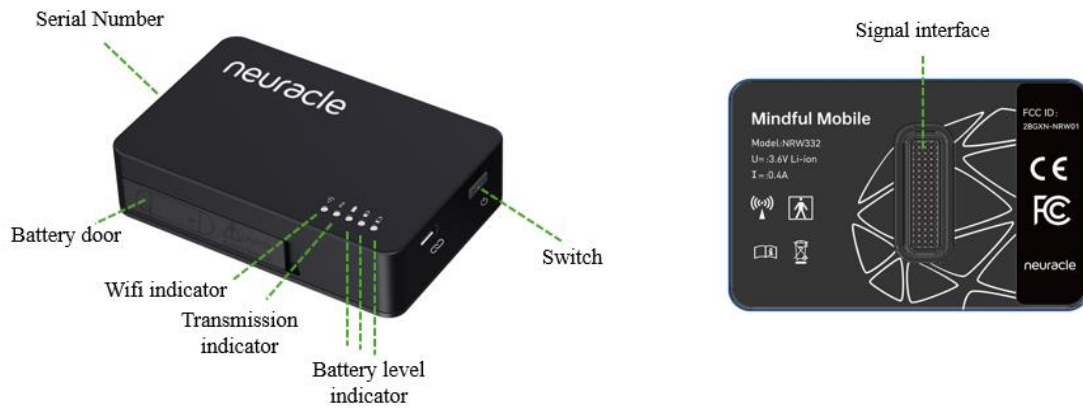
| | |
|------------------------------------|--------------------------------------|
| Maximum number of channels | 64 |
| Sampling rate | 250/500/1000/2000Hz |
| A/D resolution | 24bit |
| Common mode rejection ratio | > 120 dB |
| Data transmission | Wi-Fi frequency band: 5 GHz |
| Input noise | < 0.4uVrms (0.016-70Hz) |
| Input range | ±375mVpp |
| Input impedance (10Hz) | > 1GΩ |
| Trigger jitter | < 1ms |
| Maximum bandwidth | 16kHz: DC up to 4,000Hz |
| Power supply | rechargeable lithium battery |
| Run time | 2-4 hours |
| Dimensions (L×W×H) | Approx. 74x49x18 mm |
| Weight | Approx. 62g (without battery) |


2.2 Components

2.2.1 Amplifier

The Mindful Mobile system features a lightweight, compact, and flexible wireless amplifier that magnetically attaches to the EEG cap connector. It is powered by a rechargeable lithium battery. The device can acquire data with 24-bit resolution and a sampling rate of 250/500/1000/2000 Hz (2000 Hz is available only for 8, 16, and 32 channel systems). It has a wide dynamic range with a DC-coupled amplifier, which prevents saturation by electrode offset voltage or artifacts.

The system includes a built-in, fully calibrated 9-axis inertial measurement unit (IMU) containing three accelerometer, three magnetometers, and three gyroscopes for head movement monitoring. Mindful Mobile is robust for ambulatory use in naturalistic environments and compatible with VR/AR scenarios. It can be controlled via various software solutions (MATLAB/Python API, LSL, etc.). Please refer to the corresponding software manuals for further details.



| Components | Description |
|---|---|
| Switch | Turn on/off the amplifier |
| Serial number | Unique identifier assigned to an amplifier |
| Battery door | Designed to be easily setup for convenient battery replacement |
| Wi-Fi indicator | Determining whether an amplifier is on the network |
| Transmission indicator | Flashing in streaming period |
|  Battery level indicator | Indicates 100%, 60% and 30% of remaining power respectively; 3 rd indicator flashes quickly in per second when lack of power |
| Signal interface | 72 Pin, adsorbed to the EEG cap |

2.2.2 Triggerbox

The triggerbox serves as a critical auxiliary device for precise synchronization within the Mindful Mobile system. Capable of receiving various trigger types—including serial port, parallel port, audio, and optic—it ensures minimal trigger jitter (less than 1 millisecond), forming a crucial foundation for subsequent data analysis.

Patented for synchronized interbrain ERP hyper-scanning, it supports seamless integration with third-party platforms like EMG, eye tracking, and other multimodal systems, fostering expanded research and development opportunities. The trigger output voltage of 3.3 V is ample to drive standard device trigger inputs effectively.



| Components | Description |
|--------------------------|---|
| Switch | Turn on/off the triggerbox |
| Serial number | Unique identifier assigned to a triggerbox |
| Power connector | Supply for the triggerbox with 5 DC voltage |
| Wi-Fi indicator | Determining whether a triggerbox is on the network |
| Trigger indicator | Flashing during trigger input, and corresponding to different trigger methods |
| DAC output | Analog output, 3.3 v |
| Trigger IN/OUT | DB 25 Pin (female & male), customized port is available |
| Micro USB | Serial port trigger input |
| Line IN | Audio trigger input, 3.5 mm jack |
| Mic IN | Audio trigger input, 3.5 mm jack with microphone |
| Light IN | Flashing visual trigger input |

2.2.3 EEG Cap

Mindful Mobile is compatible with various cap types, including flat caps, cup caps, saline caps, and more. The system utilizes sintered electrodes made from powdered Ag/AgCl, known for their low-frequency noise characteristics, excellent signal quality, high signal-to-noise ratio, and robust anti-interference performance. Designed with a magnetic connector, it ensures stability during ambulation.

Using saline as a conductive medium eliminates the need for conductive gel, enabling immediate data collection upon wearing. The electrode cap is user-friendly, easy to clean, and dries quickly after washing, optimizing its usability.



2.2.4 Router




The router is essential for the Mindful Mobile system, providing Wi-Fi connectivity to the network. It automatically assigns IP addresses to the amplifier and triggerbox within the network. Utilizing 5 GHz Wi-Fi for data transmission helps prevent packet loss and signal interference, ensuring reliable communication.








2.2.5 Accessories

2.2.5.1 Triggerbox package

| Triggerbox Package | | |
|--------------------|--|--------------------------|
| Power adapter | | Triggerbox power supply |
| Micro USB cable | | Send serial port trigger |

| | | |
|-----------------------------|---|--|
| Trigger IN/OUT cable |  | Send TTL trigger: Standard Trigger I/O cable is for parallel port trigger Customized Trigger I/O cables are available (BNC etc.) |
| Line IN cable |  | Send audio trigger |
| Light IN cable |  | Send optic trigger |

2.2.5.2 EEG Cap package

| <i>EEG Cap Package</i> | | |
|-----------------------------|---|--|
| Conductive Gel |  | For wet EEG Cap |
| Syringe |  | Utility tool for gel |
| Tape rule |  | Measurement of head size |
| Cleaning brush |  | Clean the EEG Cap |
| Impedance check tool |  | Short circuit test for electrodes and cables |

2.2.5.3 Charger and battery

Battery capacity variations by model. Despite the differences in capacity, both types of batteries operate at a voltage of 3.6 volts (V).

64-channel /32-channel /16-channel /8-channel amplifiers (NRW364/ NRW332/ NRW316/ NRW308): These models use batteries with a capacity of 1240 milliampere-hours (mAh). This higher capacity supports the increased power demands of managing more channels.



2.2.5.4 Video camera

If your system includes an optional video camera, it connects via Ethernet to the system computer and is controlled through the Collect software. Alternatively, you can select a USB camera of your choice or use a laptop camera for video capture.



2.2.5.5 Computer

The Mindful Mobile system is wirelessly connected to the computer through the router. The computer needs to run the Collect software with basic configuration requirements. Here is Minimum configuration recommendations.

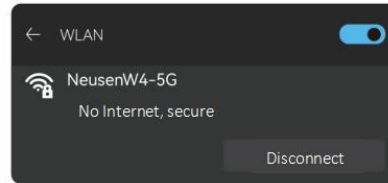
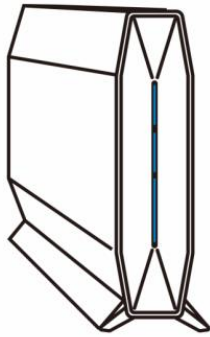
| | |
|----------------------|----------------------|
| Operating System | Windows 10 and above |
| Process | 2 GHz and above |
| RAM | 16 GB |
| Hard Disk Size | 1000 GB |
| Graphics Coprocessor | NVIDIA GTX 1060 |
| Screen Resolution | 1920 x 1080 |

3. Setup of Mindful Mobile system

Installation of Mindful Mobile is very easy. Here is a summary of the installation steps.

3.1 Prepare to a local area network

Power on the router to establish a stable Wi-Fi LAN environment for all components, which is crucial for seamless operation. The default SSID is **NeusenW4-5G** with the login password **neuracle0519**. All components will automatically connect to the LAN within seconds.



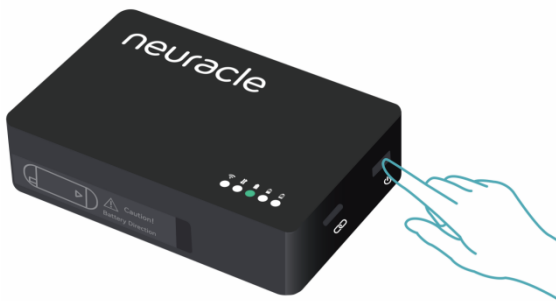
Warning

- Ensure not to confuse the adapter for the router (12V) with that of the triggerbox (5V)!
- Using a 12V adapter poses a risk of damaging the triggerbox.

3.2 Start amplifier

The batteries may be partly discharged upon delivery. Charge them fully until the charger indicator turns off.

Open the battery compartment and insert the batteries. Press and hold the power button until the amplifier vibrates slightly. The Wi-Fi indicator will remain lit when the amplifier is connected to the network.



Attention

- Pay attention to the battery orientation!
- A fully charged battery can operate for approximately 3-4 hours at most. Monitor the remaining battery level closely during your experiment.



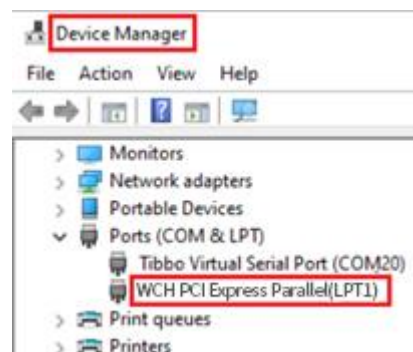
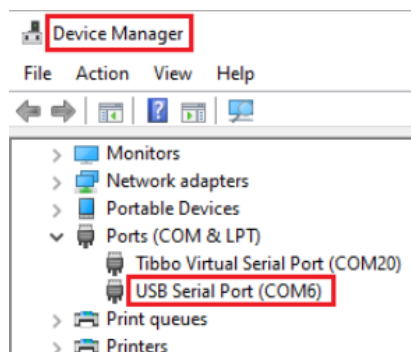
3.3 Connect triggerbox if necessary

Connect the triggerbox to its power source and ensure it is securely plugged in. Wait until the Wi-Fi indicator shows a steady light, indicating it is connected to the network. Choose the desired trigger cable and connect it to the Stim computer. These steps will properly initialize the triggerbox and prepare it for use in your setup.



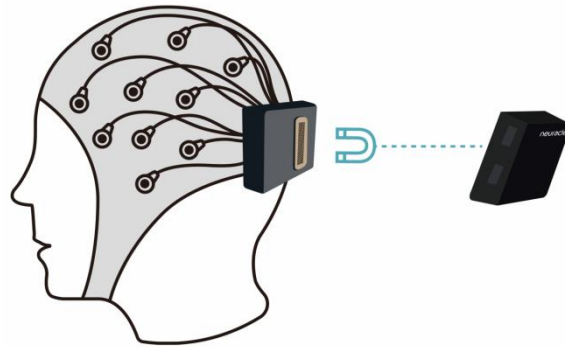
Attention

- Ensure that the port drivers are installed on the PC first.
- Open the Device Manager and navigate to Ports (COM & LPT) to verify their availability.



3.4 Donning the EEG Cap

Position the headset on the subject's head to align the electrodes according to the international 10/20 electrode system. To ensure precise placement of the electrode cap, measure the distance from the nasion (bridge of the nose) to the inion (prominent bump at the back of the skull), and from the left preauricular point (just in front of the ear) to the right preauricular point. The point where these measurements marks the vertex, or Cz position, on the scalp. For further details, refer to the EEG Cap Manual. Attach the amplifier to the EEG cap.

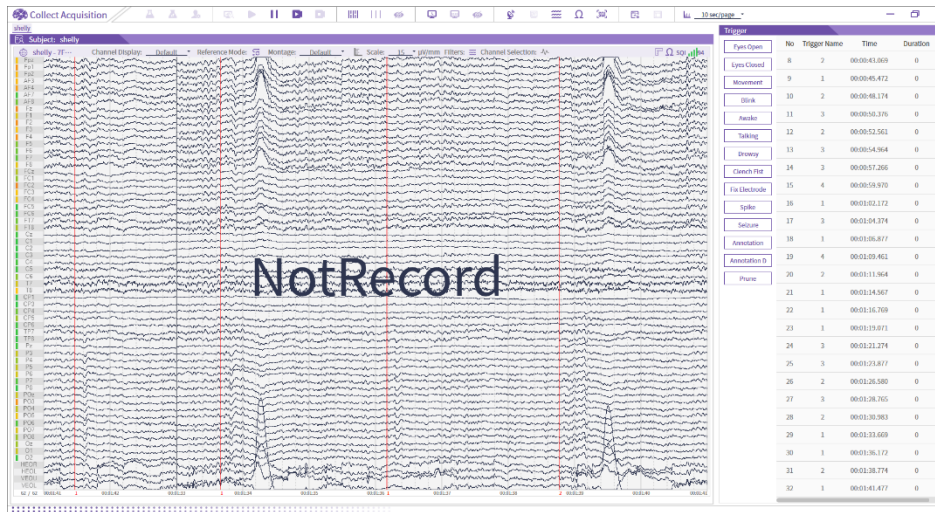


Warning

- Ensure the EEG cap and electrodes are clean and in good condition before use.
- Neuracle's standard 64-channel caps include 59 EEG channels and 5 auxiliary channels. Auxiliary channels are designated for VEOU, VEOL, HEOR, HEOL, and ECG signals.

3.5 Establish communication between Mindful Mobile and Collect

Locate and connect to the designated network **NeusenW4-5G** on your computer, entering the password **neuracle0519**. Open Collect and navigate to the preview screen. Once data streaming begins through the software, the transmission LED will continuously blink throughout the communication process. Refer to the Collect User Manual for more details.



Warning

- Disable all defender firewalls, including those for domain, private, and public networks!
- Prevent automatic network switching by disabling automatic connection modes for other networks on your computer!

3.6 Minimize the impedance

To ensure quality contact, measure the contact impedance between each electrode and the skin using the software, which provides direct feedback through color bars and numerical values. Refer to the Collect User Manual for detailed instructions.

Fill all electrodes with conductive gel. Coat around 1 cm² of skin under each electrode and completely fill the electrode with gel using a syringe. Insert the syringe tip into the electrode, ensuring it reaches the skin. Gently press the syringe and move the tip around on the skin with slight pressure to evenly distribute the gel. Carefully fill each electrode, ensuring the gel completely fills the gap between the skin and the electrode surface. Avoid using excessive gel to prevent short circuits between electrodes.

Impedance typically decrease gradually within the first 5-10 minutes after placing the electrodes on the scalp.

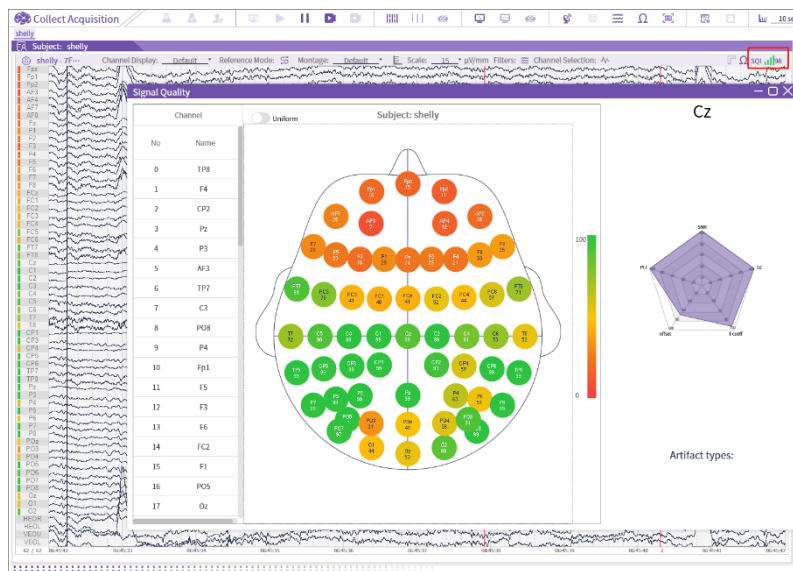
Attention

- Conduct a short circuit test to verify the integrity of electrodes and cables. More details are in the Collect User Manual.

3.7 Inspecting signal quality and recording raw data

This system allows for ongoing, detailed assessment of EEG signal quality, facilitating immediate corrections and ensuring accurate data collection. The quality of the EEG signals is continuously monitored in real-time by the Signal Quality Index (SQI) module. This module assesses the integrity and reliability of the recorded signals, ensuring they are free from noise and artifacts.

The signal quality is depicted through a radar map, which provides a visual representation of the data. This radar map evaluates signal quality across five distinct dimensions, offering a comprehensive overview of the signal's condition. Each dimension on the radar map represents a different aspect of signal quality, helping to identify potential issues and areas needing adjustment. More details are in the Collect User Manual.



3.8 Remove and turn off devices

Once the data acquisition is complete, follow these steps:

Close the Software: Shut down the software used for recording and monitoring the EEG signals to ensure that all data is properly saved and the system is securely closed.

Turn Off Devices: Power down all the equipment involved in the EEG recording process, including the amplifier and triggerbox, to ensure they are safely turned off.

Gently Remove the Cap: Carefully take the EEG cap off the subject's head to avoid causing any discomfort or pulling on their hair. Be gentle to ensure the subject's comfort and to maintain the integrity of the cap and electrodes.

Get out the Battery: Open the battery compartment and carefully remove the battery from the device. This helps prevent any power-related issues and prepares the device for storage or the next use.

3.9 Clean EEG Cap

To clean an EEG cap that has been used with conductive gel, follow these steps:

Preparation: Ensure the cap is disconnected from any hardware component. Prepare room-temperature cleaning water and a soft cleaning brush.

Remove Excess Gel: Use mild water to wash away excess gel from the electrodes and cap surface. Be careful not to rub too hard to avoid damaging the electrodes. Avoid using harsh chemicals or abrasive cleaners.

Cleaning Process: Gently wipe the electrodes and the surface of the EEG cap to remove residual gel and dirt. Rinse the cap thoroughly with clean water to remove any remaining gel.

Drying: Pat the cap dried with a clean towel or allow it to air dry completely before storing or reusing. Avoid outdoor exposure or drying with hot air.

Storage: Store the EEG cap in a clean and dry environment, ensuring it is protected from dust and moisture.

Maintenance: Regularly inspect the cap for any signs of wear or damage. Follow manufacturer guidelines for periodic deep cleaning or maintenance.

By following these steps, you can effectively clean an EEG cap that has been used with gel, maintaining its performance and longevity.

4. Clean and Maintenance

Cleaning and maintaining a Mindful Mobile system, typically involves the following steps to ensure optimal performance and longevity:

4.1 Exterior Cleaning

Use a soft, dry cloth to wipe down the exterior of the amplifier and other components to remove dust and debris. Avoid using abrasive materials that could scratch the surface.

4.2 Electrode and Cap Cleaning

If using a saline EEG Caps:

Rinse the cap under warm running water to remove any visible debris. Gently clean the cap to remove stains or residues. Rinse thoroughly with clean water and allow it to air dry completely before storage.

If using gel-based electrodes:

Clean the electrodes using a soft brush recommended by the manufacturer. Rinse thoroughly with water and allow them to air dry completely.

4.3 Battery Maintenance

Regularly check the battery status and recharge as needed to maintain optimal performance.

4.4 Software and Firmware Updates

Periodically check for and install any software or firmware updates provided by the manufacturer to ensure the system operates with the latest features and security enhancements.

4.5 Regular Inspections

Conduct regular inspections of the system components for signs of wear, damage, or malfunction. Address any issues promptly by contacting the manufacturer's support or service team.

5. Warranty and Repair

5.1 Warranty

The hardware of Mindful Mobile system has a warranty period of one year. If a quality issue occurs within one year from the date of sale, Neuracle will be responsible for resolving various problems, including repair materials and equipment performance. Purchasing additional parts and accessories from our company will not extend the warranty period. Unauthorized changes to the product's service, technology, or performance by anyone other than Neuracle or its authorized agents may invalidate this warranty.

The one-year warranty period applies under normal use of the equipment. This warranty does not cover the following situations:

- ✓ Damage caused by external objects, equipment being dropped, or liquid spills/soaking.
- ✓ Damage caused by fire, flood, hurricane, earthquake, or lightning.
- ✓ Replacement or removal of the original Neuracle serial number label or manufacturing mark.
- ✓ Damage caused by an improper operating environment.

- ✓ Damage resulting from operating the hardware system beyond its design specifications.
- ✓ Damage due to unauthorized maintenance and repairs.
- ✓ Damage caused by incorrect power connections.
- ✓ Damage resulting from misuse and abuse in violation of operating procedures.

5.2 Repair or Replacement Support

If repair or replacement is required, users can obtain support via web, email, or other communication methods. Please provide the product model and number (as marked on the label and packing list) along with a description of the fault. After approval by the customer service department, if the equipment needs to be shipped back to Neuracle or its authorized agent, the user is responsible for the freight charges (including customs fees).

| | |
|-----------------------|---|
| Email | info@neuracle-neuro.com |
| Website | https://www.neuracle-neuro.com/ |
| Business Address | New Hope PA 18938, USA |
| Manufacturing Address | Room 202, No.10, Intelligent Digital Industry Innovation Park, Changzhou Science and Education Town, Wujin, Changzhou, Jiangsu, China |

6. FCC Statement

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) This device must accept any interference received, including interference that may cause undesired operation.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

—Reorient or relocate the receiving antenna.

- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

RF Exposure Statement:

For Amplifier:

This device meets the government's requirements for exposure to radio waves. This device is designed and manufactured not to exceed the emission limits for exposure to radio frequency (RF) energy set by the Federal Communications Commission of the U.S. Government.

The exposure standard for wireless devices employs a unit of measurement known as the Specific Absorption Rate, or SAR. The SAR limit set by the FCC is 1.6 W/kg. *Tests for SAR are conducted using standard operating positions accepted by the FCC with the device transmitting at its highest certified power level in all tested frequency bands. Although the SAR is determined at the highest certified power level, the actual SAR level of the device while operating can be well below the maximum value.

For body worn operation, this device has been tested and meets the FCC RF exposure limits .

The FCC has granted an Equipment Authorization for this device with all reported SAR levels evaluated as in compliance with the FCC RF exposure guidelines. SAR information on this device is on file with the FCC and can be found under the Display Grant section of <http://www.fcc.gov/oet/fccid> after searching on FCC ID: 2BGXN-NRW01.

For Triggerbox :

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment .This equipment should be installed and operated with minimum distance 20cm between the radiator& your body.