



**CGX** A Cognionics Company

# Mobile-128

This manual contains general operating instructions, precautionary measures, maintenance instructions, and information for use of the CGX Mobile-128.

Please read this manual carefully and familiarize yourself with the controls and accessories before using the product.

## **Note**

- This is an investigational device designed for research and development efforts.
- It is not an FDA-approved medical device.
- There are no known side effects from the use of this product.

## **Description**

The Mobile-128 is a wireless, high density gel EEG system.

The amplifier provides wireless acquisition of recorded EEG signals. Wireless technology allows the subject to move about while real-time data is collected and displayed. EEG channels are sampled at a time resolution of

500Hz and converted to digital data at 24 bits of resolution.

The Mobile-128 provides research grade signal quality and is ideally suited for high-density EEG and ERP research in laboratory and field environments.

## Warnings

**The Mobile-128 is intended to be used to acquire the electroencephalogram (EEG) and transmit it wirelessly to a computer.**

**This Device Is Intended For Research Only.**

**It Is Not Intended For The Following Uses:**

- monitoring of patients in a clinical environment
- use in medical diagnosis
- on subjects undergoing surgery
- use in sterile environments

**Do Not Use This Product In These Situations:**

- near high-frequency surgical equipment
- if exposed to ionizing radiation
- in oxygen-rich environments (concentration > 25% at 1 atm)
- in wet environments
- in the presence of flammable anesthetics or gases

**Precautions For The Practitioner**

- Do not drop the product.
- The Mobile-128 is not a diagnostic tool

- Any medical diagnosis related to the EEG should be derived by a certified physician.

**Subject Considerations**

- This device is intended for human use only.

**Follow These Advisories To Keep Your Mobile-128 In Good Working Order**

- Do not immerse in liquid.
- Do not expose to direct sunlight or heat source, moisture, vibration, mechanical shock, excessive dust, or humidity.
- Do not open, modify or disassemble the amplifier — this will void the warranty.
- Do not use if damaged.
- Do not use when wet.
- Do not use caustic or abrasive cleaners on the headset or sensors.

**Always Use Supplied Accessories**

Using accessories other than those supplied with your Mobile-128 system may result in damage or diminished efficacy of the system.

## Device Overview

### Mobile-128 Overview

EEG is the measurement — through the use of sensors and amplifiers — of scalp surface electrical potentials arising from activity in the cortex.

The Mobile-128 system includes a EEG Cap following the 10-5 standard for EEG. The 10-5 EEG Caps derive their name from measurements of 5% of the distance between landmarks on the head, specifically, the depression above the bridge of the nose (nasion), the bump at the back of the head (inion),

and the depressions in front of each ear (preauricular points).

Sensors are labeled with a combination of letters and numbers indicating their respective locations, with even numbers on the right and odd numbers on the left side of the head. Midline locations are marked with a “z” for “zero.” For instance, Fz sits on the frontal midline, while F3 sits left of and F4 sits right of Fz.

The Mobile-128 comes standard with caps at 54 cm, 56 cm, and 58 cm. Other sizes are available upon request.

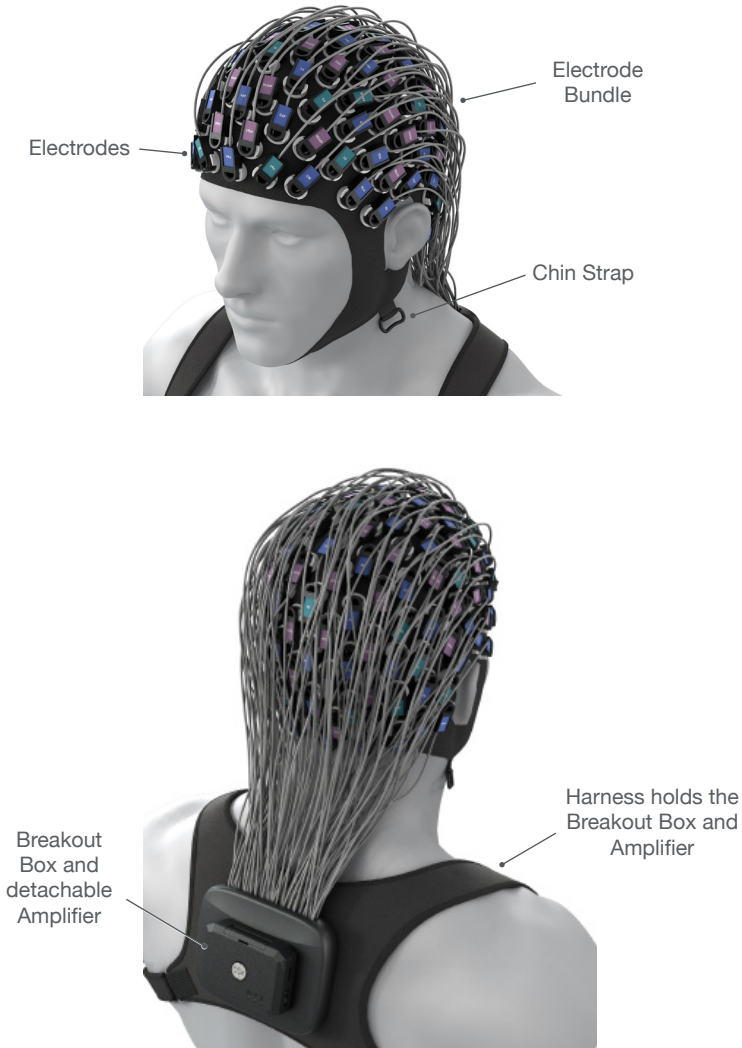
## Device Overview

### The Package Contains The Following Items

Mobile-128 Amplifier  
Mobile-128 Electrodes  
Mobile-128 Electrode Breakout Box  
3 EEG Caps (54 cm, 56 cm, 58 cm)  
Harness

Bluetooth Dongle  
2 Syringes  
3 Tubes EEG SignaGel  
2 Rechargeable Li-Ion Batteries  
1 Charger  
Carrying Case  
Manual

### Mobile-128 Headset



## Preparation

### 1. Install The Software

**Note: CGX Acquisition software runs on Windows only.**

- Navigate to [CGXSystems.com](http://CGXSystems.com)
- Select **Downloads** from the top navigation menu.
- Select **Click Here For Acquisition Software**
- Choose the latest version link under “Downloading and Installing the Software.”
- Extract the zipped file to your desktop.
- Run CGX Setup and follow the instructions.
- If you see a security warning, select **More Info** and **Run Anyway**
- The software will create a shortcut on your desktop.

Download the latest software from [CGXSystems.com](http://CGXSystems.com)

Downloads



Slide electrodes into housing until you hear a snap.

### 2. Attach Electrode Breakout Box To Harness

Use the velcro strips to hold the Electrode Breakout Box snug against the harness.

### 3. Attach Electrodes To The Cap

Slide electrodes into their housings. Use the montage map to locate each channel.

#### Electrode Color Guide







Green Electrodes: 20 channels in a traditional 10-20 montage.

Blue Electrodes: 48 additional channels creating a 10-10 64-channel montage.

Purple Electrodes: 64 additional channels creating a 10-5 128-channel montage.

See printed **Headmap Insert** for electrode locations.

#### Electrode Color Guide

|   |   |   |
|---|---|---|
|  |   | 20 Channel  |
|  |  | 64 Channel  |
|  |  |  128 Channel |

### 4. Charge and Insert the Batteries Into The Amplifier

Allow the batteries to fully charge before each use. Place batteries in the Amplifier.

### 5. Snap The Amplifier Onto The Breakout Box

Carefully push at the center of the Mobile-128 Amplifier when installing.



Slide batteries into compartment.



Attach Amplifier to Electrode Bundle Breakout Box.

## Preparation

### 6. Check Power Status, Trigger Status, and Battery Status Lights On The Amplifier

#### Power

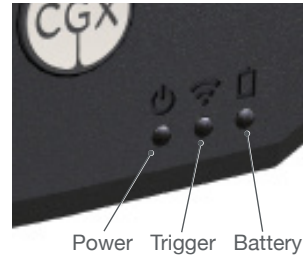
|               |  |
|---------------|--|
| <b>Off</b>    | Headset Off                                  |
| <b>Green</b>  | Headset On                                   |
| <b>Yellow</b> | Low Battery                                  |
| <b>Red</b>    | Critically Low Battery (replace immediately) |

#### Trigger

|                      |                      |
|----------------------|----------------------|
| <b>Off</b>           | Trigger Out Of Range |
| <b>Blue</b>          | Trigger In Range     |
| <b>Flashing Blue</b> | Triggers Received    |

#### Battery

|                     |                        |
|---------------------|------------------------|
| <b>Off</b>          | Battery OK             |
| <b>Red</b>          | Battery Low            |
| <b>Flashing Red</b> | Battery Critically Low |



### Indicator Lights On Dongle

**Green** Idling

**Purple** Searching For Device

**Blue** Device Found

**Flashing Blue** Data Transmission

### 7. Insert Bluetooth Dongle

Plug the dongle into your computer and Windows should automatically install the correct drivers. Verify driver installation by checking the Device Manager for problems, marked by a yellow exclamation mark.

- The dongle is specific to each headset.
- For best performance, ensure a clear line of sight between the dongle and the front of the headset.  
*If Windows did not successfully install the driver for the dongle, refer to the FTDI driver installation manual on our website.*

Each Mobile-128 is permanently paired to a receiver dongle. The pair automatically discover and initiate a connection when both are powered on and within a 10m range.

The light on the dongle indicates its current state:

|                      |                      |
|----------------------|----------------------|
| <b>Green</b>         | Power On, Not Paired |
| <b>Purple</b>        | Searching For Device |
| <b>Blue</b>          | Device Found         |
| <b>Flashing Blue</b> | Data Transmitting    |

### 8. Start The Acquisition Software

Once you've established a connection, data should begin to stream.

Double click on the CGX Acquisition software icon. You should see **CGX Mobile-128** under **Discovered Devices**.

*If you do not see the name CGX Mobile-128, remove and re-insert the dongle and restart the software.*

## Preparation

Click the device name in this window to select the Mobile-128 and click **Connect**.

You should now see the device configuration window.

*If you do not, double check to make sure the Mobile-128 is powered on.*

Click **Start Device**.

You will now see data streaming into the display. Click the **Channels** tab on the top right-hand side of the program. This will bring you to the impedance check. You are now ready to use the device.

### 9. Place The EEG Cap On The Subject's Head

- Pull the cap down onto the subject's head aligning with these head landmarks:  
Cz on the crown of the head  
Fp1/Fp2 ~1cm above browline  
Ears through cutouts in cap
- Ensure cap is centered on the head, with Fpz, Fz, FCz, down the midline.
- Connect straps under chin to keep headset securely in place.
- Apply a small amount of gel to Reference and Ground positions behind the ears and gently press these positions to activate impedance check. This will cause all channels to display red and only 3 ACC channels to appear in the main window.
- Apply a small amount of gel to each position on the head.

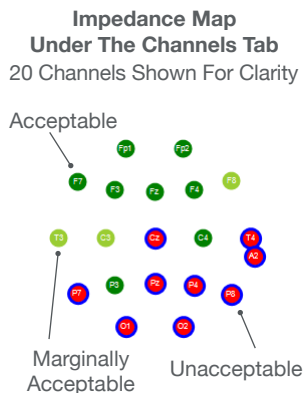
### 10. Optimize Sensor Contact

After properly positioning the headset on the subject, obtain direct contact on all sensors before recording.

Note: Gel may take up to a minute to warm up and soak through hair. Apply gel to all channels first. Gently press on locations that have not connected. If necessary, apply more gel, and gently rotate the applicator inside the sensor against the scalp to move hair.

Bring up the impedance check in the CGX Data Acquisition software under the Channels tab. The impedance check presents a color-coded map of the sensors on the device, corresponding to contact level:

|                    |   |
|--------------------|---|
| <b>Red</b>         | Impedance out of range (>100 k $\Omega$ default)            |
| <b>Light Green</b> | Impedance at top end of range (50 - 100 k $\Omega$ default) |
| <b>Dark Green</b>  | Impedance at bottom end of range (<50 k $\Omega$ default)   |



## Preparation

### 11. Adjust Electrodes If Required

- Use the impedance check to make sure impedances are within acceptable thresholds.
- If channels do not appear shortly after applying gel, check left ear (Ref) and AFz (Gnd) contact and add more gel if necessary.

### 12. Record An EEG

After you have acceptable impedance levels, click **Record** under the Device tab to begin your recording. To end the recording, under the same tab, click **Stop Recording**.

### 13. End The Session

Close out the current file in the software if one is active and exit the program. Press the power button once to turn off the device.

## Preventative Care To Maintain Safety And Effectiveness

To avoid cross-subject contamination, follow the cleaning instructions to clean sensors and headset after each use.

This device is not intended to be sterilized in an autoclave.

### Cleaning The Mobile-128 Amplifier

- Use hand sanitizer or alcohol wipes to the Mobile-128.

### Cleaning The Electrode Breakout Box

- Remove Amplifier from Electrode Breakout Box.
- Remove excess gel.
- Use hand sanitizer or alcohol wipes.

### Storage

- Always remove batteries when headset is not in use.
- Transport headset in the case.
- Store headset without the batteries.

### Do Not Let The Headset Come Into Contact With Liquid

Immediately take the batteries out and let the headset dry before resuming use.

### Keep Software Updated

Make sure software is up to date. Go to **CGXSystems.com** for latest updates.

### Disposal Instructions

To protect the environment, always follow local law, rules, and policies regarding electronic and battery disposal. You may also return the headset to CGX for proper disposal.

## Obtaining Clean EEG Data

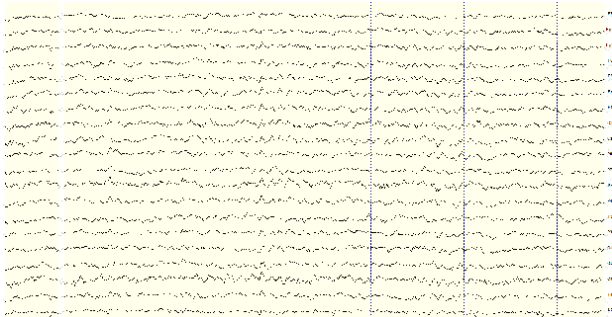
The most important aspect of EEG recording is that output data is only as good as the recording input. While algorithms exist to remove artifacts, poorly recorded data cannot be fixed in post processing.

Recording good EEG data requires preparation of the participant for optimal sensor contact:

1. Participants should have their hair recently washed and fully dried before recording. Wet hair, hair gel, conditioners, and hair spray may cause interference and degrade signal quality.
2. Clean each sensor location on the head with a cotton swab soaked with alcohol.
3. In the event of difficulty establishing good contact, apply a small amount of water between the sensor and scalp to create an electrical bridge.
4. It is important for subjects to reduce tension in the head, neck, and shoulders during readings.

Mobile-128 sensor locations lie within 1.0 centimeters on the vast majority of hand-measured 10-5 placements on heads sized from 52-62 centimeters.

## Typical Clean Data Recording

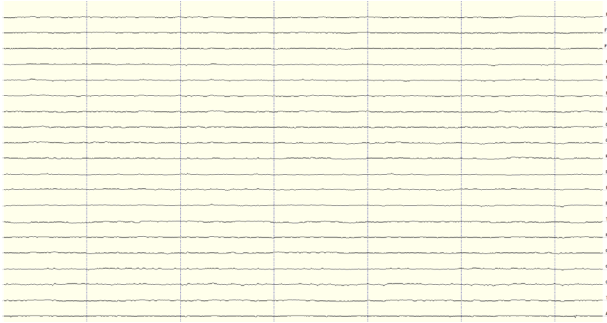


This is a representation of a clean data recording.



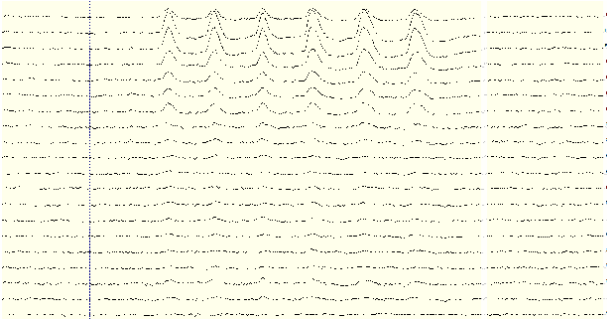
## Understanding Readings (20 Channels Shown For Clarity)

### Clean Data At Default Scale



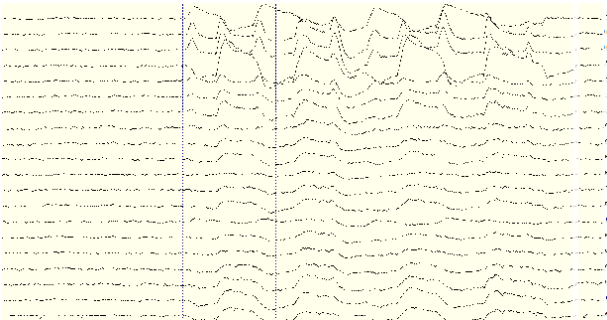
Traces are thin and deviate minimally from the axis.

### Blinks



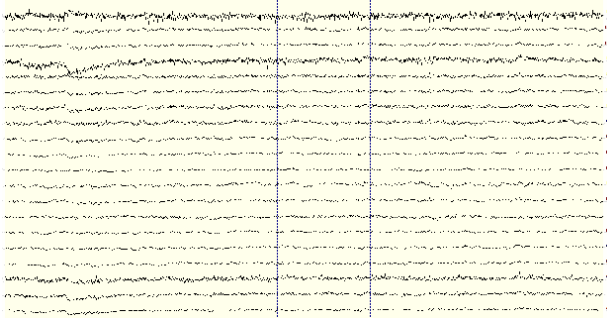
Eye blinks will generate muscle artifacts in the frontopolar locations (Fp1 and Fp2) and less so in frontal sensors (F3/F4, F7/F8), overshadowing brain activity in EEG recordings.

### Eye Movement



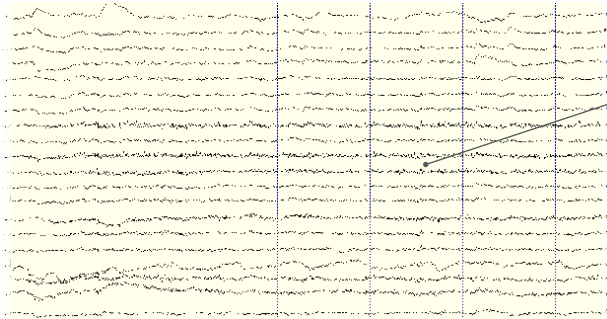
Moving the eyes will generate muscle artifact in the forehead and front of the head. A high concentration of neurons in the eyes generate strong electromagnetic fields, so eye movement causes disruptions in the EEG recording.

### Muscle Artifact: Jaw Clench



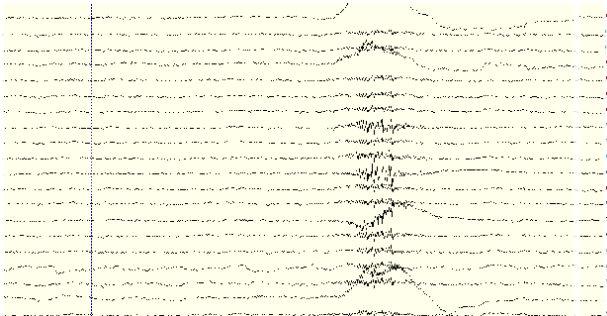
Jaw clenching may affect most or all channels, especially if clenching hard. Light jaw clenching or tightness can be observed in F7/F8, T3/T4. Take note of any temporomandibular joint disorders: these can cause artifact without typical clenching.

### Muscle Artifact: Tongue Movement



The tongue is a large polarized muscle, with the tongue's tip negative with respect to the base of the tongue. When the tongue moves around the mouth, it generates a moving field causing recording disruptions. Disruptions may be seen down the midline (Fz, Cz, Pz). Tongue movement during talking can be seen on many channels.

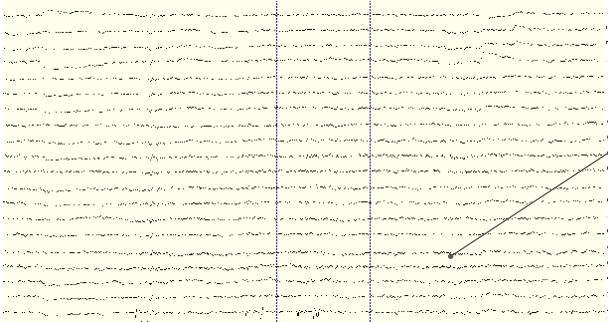
### Muscle Artifact: Swallowing



Swallowing invokes movement of several muscles in the mouth, including the tongue, causing disruption of many channels. Ignore swallowing if infrequent, but frequent swallowing may limit usable data.

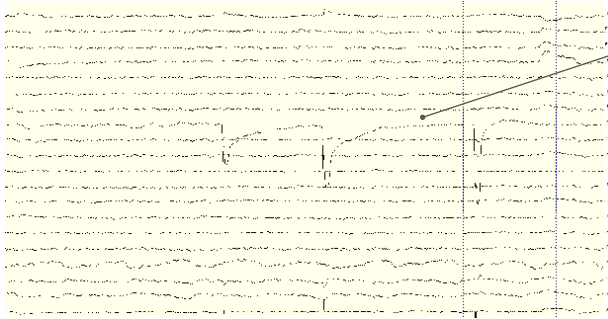
## Understanding Readings (20 Channels Shown For Clarity)

### Muscle Artifact: Neck Tension



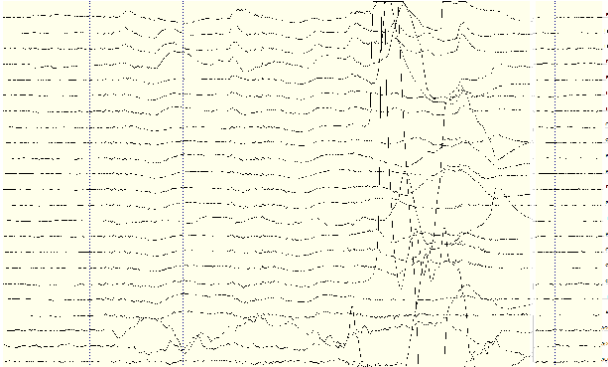
Neck tension may affect channels on the back of the head, predominantly O1/O2, but also in parietal sensors (Pz/P3/P4, P7/P8). Subjects should be comfortably seated, with appropriate bracing at the back and neck. Avoid slouching.

### Headset Or Electrode Disruptions: Sensor Pops



Brief disruptions in contact between sensor and scalp may cause “sensor pops” on recordings. Occasional pops can usually be ignored in processing, but if the problem persists, check the contact between the sensor and scalp. Wipe popping locations with a small amount of alcohol on the sensor.

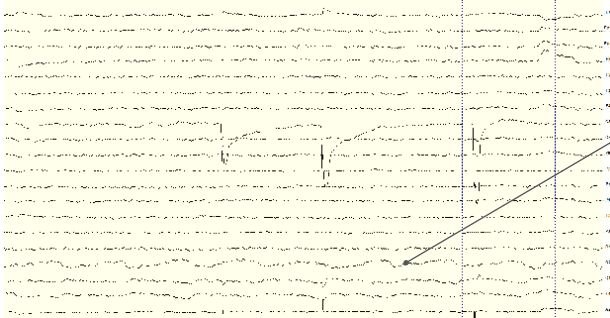
### Headset Or Electrode Disruptions: Head Movement



Excess or quick movement of the head may disrupt connection between sensors and scalp causing data artifacts as shown.

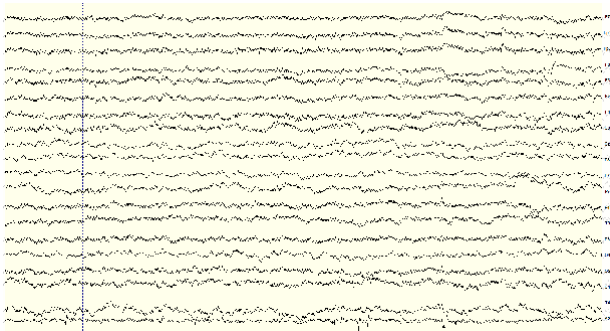
## Understanding Readings (20 Channels Shown For Clarity)

### Pulse Artifact



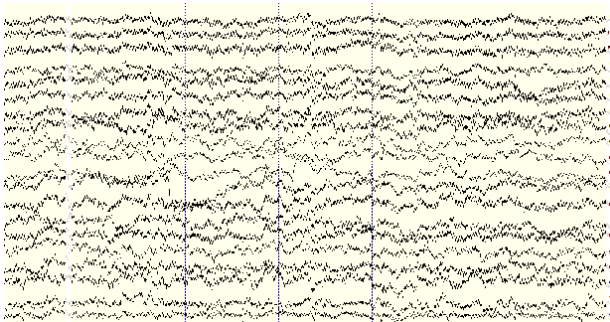
EEG sensors are sensitive enough to detect small electrical signals on the cortex. Occasionally, sensors may lie directly atop a blood vessel. When this occurs, sensors may detect the subject's pulse. Slightly move the sensors to reduce pulse artifacts.

### Mild Power Line Artifact



Power lines operate between 50 and 60 Hz. Unsecured power sources may leak electromagnetic frequencies. Because EEG records frequencies from 1hz to about 40hz, power line noise may negatively impact recordings on all channels. This is especially the case when connection between sensor and scalp is poor.

### Strong Power Line Artifact



To avoid power line artifacts, have subjects sitting at least 3 feet from power cords, plugged-in devices, and lighting or overhead fluorescent lights. The Mobile-128 shields the sensors from environmental noise, but issues can still occur with poor skin contact. If power line artifacts appear on all channels, lightly wet A1 Reference Drypad Ear Sensor.

### Improper Setup: No Connected Reference

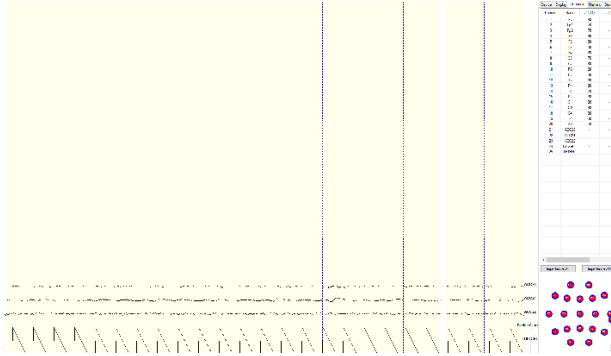


fig. 1

There are a multitude of recording errors when the A1 reference earclip is not connected to the subject.

The most common are:

- Impedances match or nearly match at a low value but do not appear on the display or in the impedance head map. (fig. 1)
- No traces appear and impedance values are zero. (fig. 2)
- No traces appear and impedance values are high. (fig. 3)

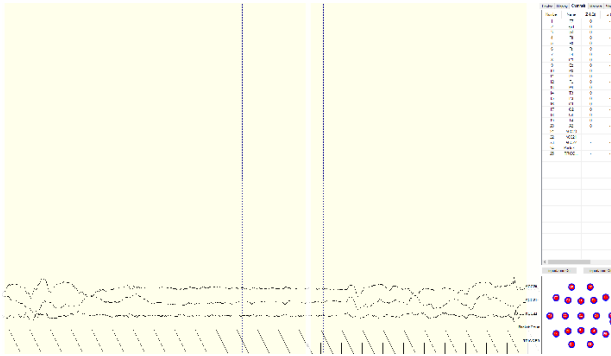


fig. 2

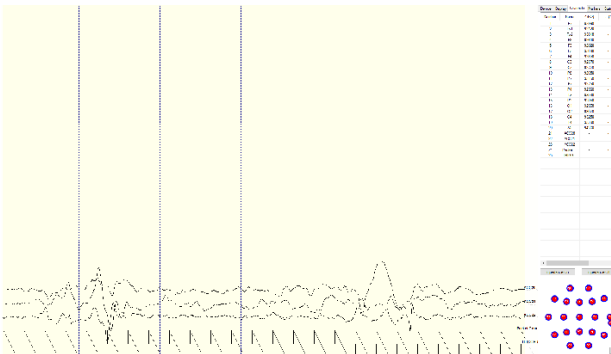
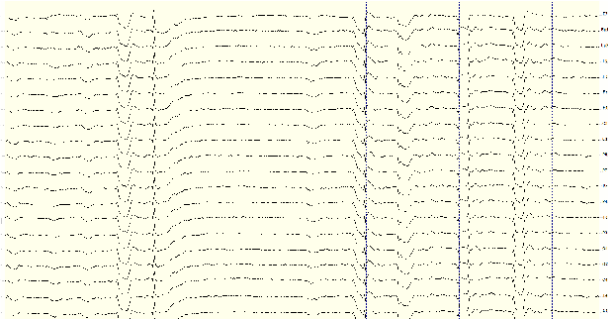


fig. 3

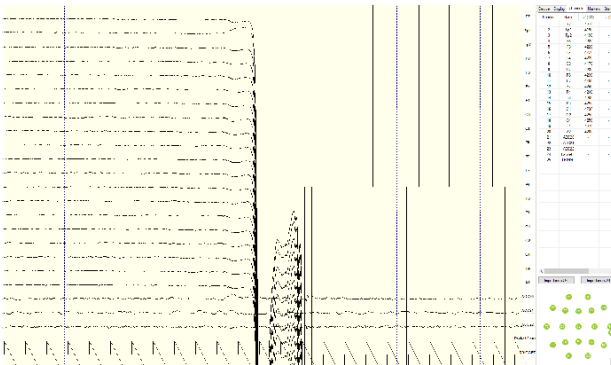
## Understanding Readings (20 Channels Shown For Clarity)

### Improper Setup: Reference Contact



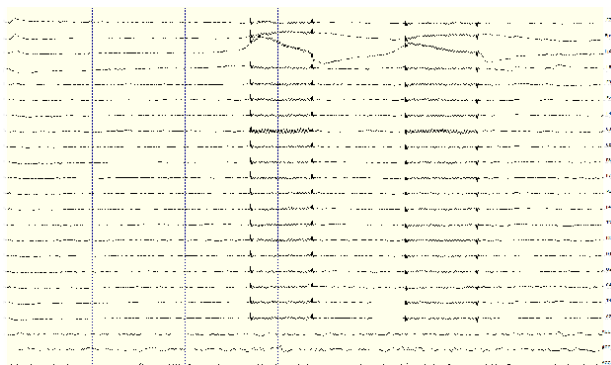
When the reference channel is touched or jostled, all channels will be affected. Avoid disrupting the A1 Reference earclip during use.

### Improper Setup: Reference Disruption



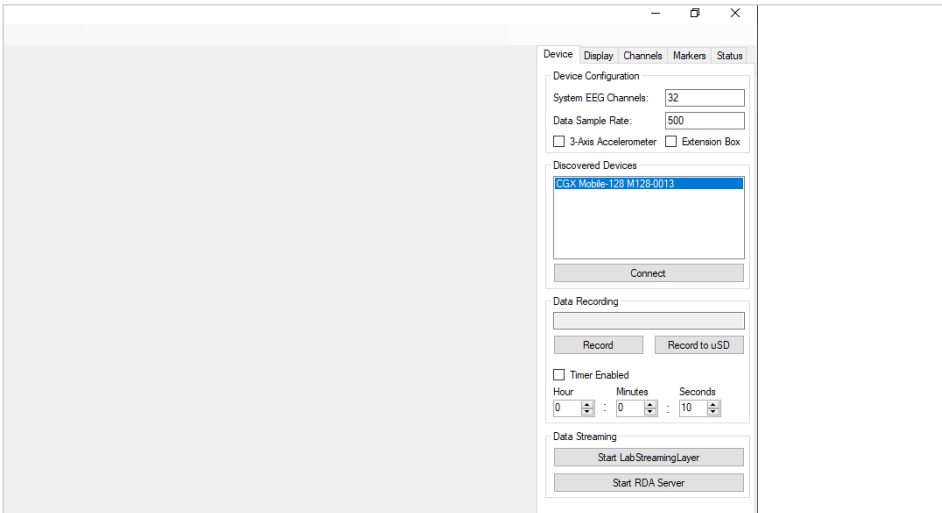
When the reference is disconnected, all channels will disconnect as well.

### Improper Setup: Ground Disruption



If the ground has poor contact, all channels will be impacted. Avoid disrupting the connection of the A1 Ground earclip during use. For best results, lightly wet A1 Reference Drypad Ear Sensor.

## Device Tab



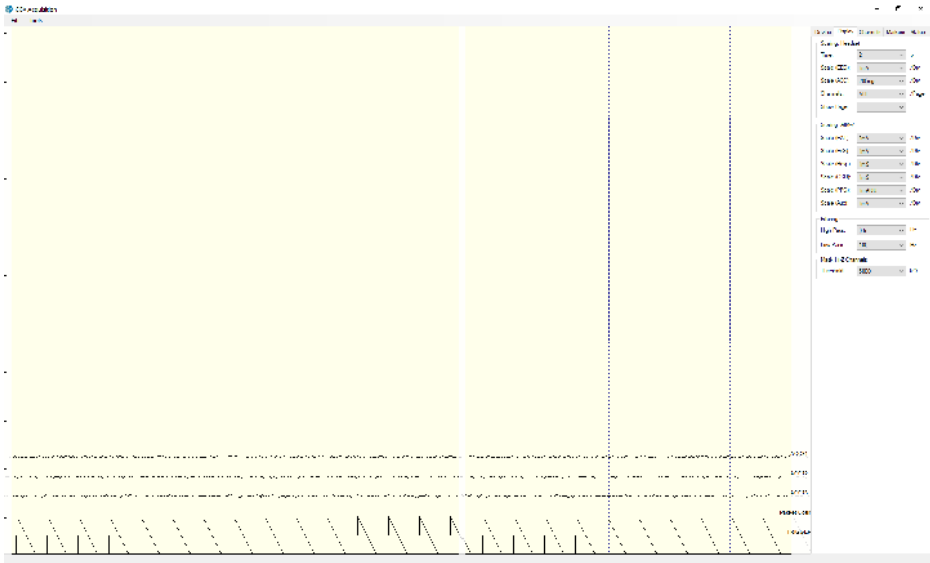
### Device Configuration

- **Discovered Devices** Connected dongles will be listed here. Select the device name of your system and hit **Connect**.
- The software automatically connects to your device to retrieve stored settings.
- The **Device Configuration** window is only for your information; changing the settings will not change the configuration of the device. If you need to change device configuration, contact support at CGX.

### Data Recording

- **Record** Click to open a file dialog. Select the desired location, file name, and file type. (CSV files have a time stamp built in). Recording begins when you press **OK**.
- **To Stop Recording** hit the button again. Elapsed time is shown in the box above the button.
- **Start LabStreamingLayer** Hit the **Start LabStreamingLayer** button.
- **Start RDA Server** To use the BCI2000 software with the Data Acquisition Software, click on this button. Then, connect to the application in BCI2000.
- **Timer** The timer allows you to limit file recording to a specific length.

## Display Tab



## Scaling: Headset

- **Time** sets the x axis time window. By default, it is set to 2 seconds.
- **Scale (EEG)** sets the y axis vertical gain for the EEG channels on the head.
- **Scale (ACC)** sets the y axis vertical gain for the accelerometer channels.
- **Channels** sets the maximum number of channels displayed per screen. To flip through the pages of channels, use the option below.
- **Show Page** switches between different pages of channels.

The display tab controls scaling and other viewing parameters for the signals.

## Scaling: AIM-2 (Optional)

## Filtering

- **High Pass** sets the floor (removes offsets and slow signals) corner frequency for the display.
- **Low pass** sets a ceiling (removes high frequency signals and noise) corner frequency for the display.
- Note: filtering is for display only. Data files are saved raw and unfiltered to preserve the maximum amount of information.

## Mask Hi-Z Channels

**Threshold** hides channels with sensor impedances above the specified threshold from the display.



## Channels Tab



The bottom half is a graphical map of sensor contact quality. Red circles indicate poor contact, whereas light green circles indicate acceptable contact. Dark green circles indicate ideal contact.

The threshold for this contact quality is, by default:

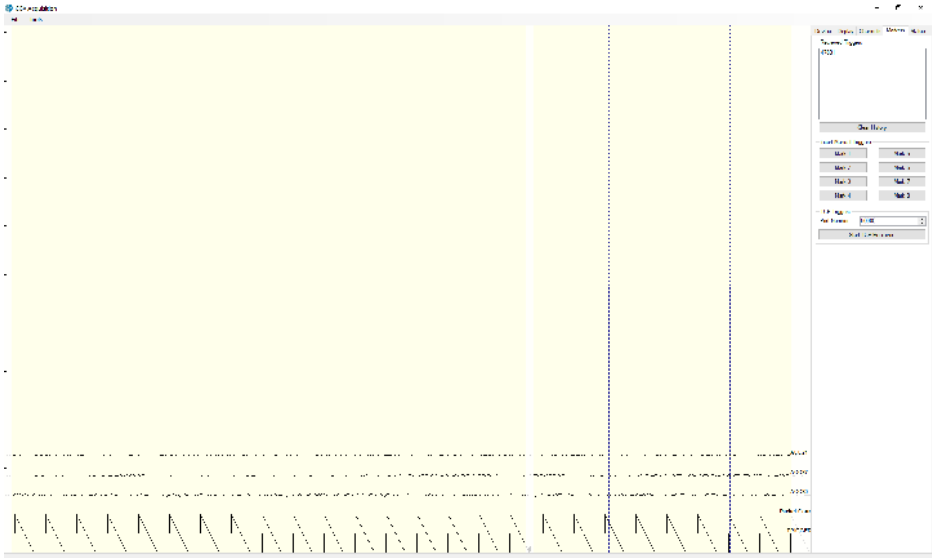
|                    |                              |
|--------------------|------------------------------|
| <b>Red</b>         | Above 5000 k $\Omega$        |
| <b>Light Green</b> | Between 2500-5000 k $\Omega$ |
| <b>Dark Green</b>  | Below 2500 k $\Omega$        |

The top half of the Channels tab contains a table displaying information about each channel in the system including its number, name, contact impedance ( $Z$  (k $\Omega$ )) and sensor offset (Off (mV)). The offset is calculated relative to the reference channel A1.

This threshold can be changed with the Mask Hi-Z menu on the display tab.

|                    |                                    |
|--------------------|------------------------------------|
| <b>Red</b>         | 100% or greater of Hi-Z threshold  |
| <b>Light Green</b> | Between 50%-100% of Hi-Z threshold |
| <b>Dark Green</b>  | Below 50% of Hi-Z threshold        |

## Markers Tab



### Received Triggers

- The box shows all of the received triggers chronologically.
- If no trigger is in range, value received will be 47831 (in hex: 0xBAD7).
- **Clear History** This button will clear all of the triggers in the box. It will not delete triggers from the recording itself.

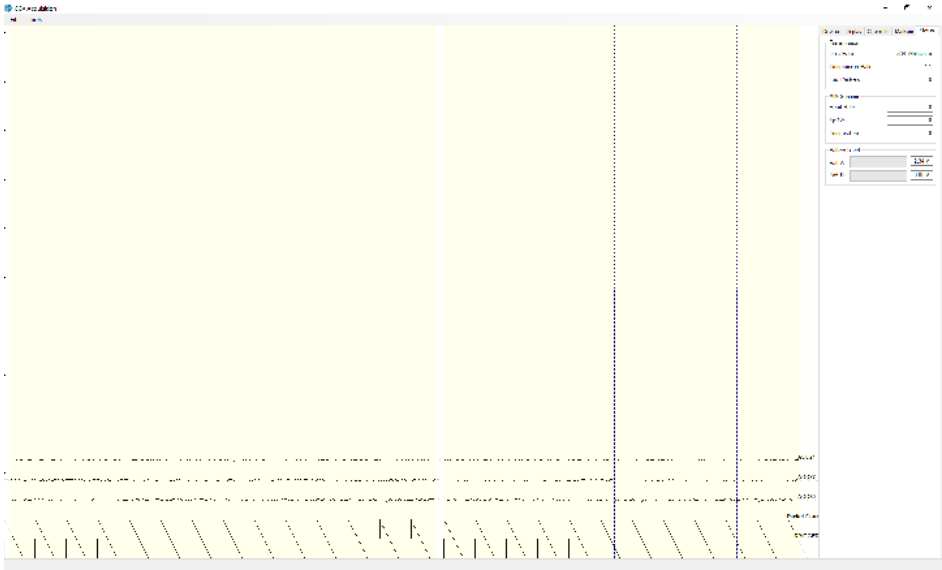
### Insert Manual Triggers

- You have the option to select any one of eight trigger codes to insert into the recording. These will be inserted in the same way as a normal trigger sent from our Wireless StimTrigger. However, we recommend only using the trigger for precision event marking, and to use these software triggers for general annotation.

### TCP Triggers

- **Port Number** Allows you to choose which port to receive triggers.
- **Start TCP Receiver** Starts the receiving service.
- Do not use for precision event marking.
- For general annotation only.

## Status Tab



## Transmission

- **Data Rate** Allows you to see the bandwidth being used for the data being sent.
- **Compression Ratio** Shows you the ratio at which data is being compressed and sent to the computer.
- **Lost Packets** Shows the amount of information dropped in communications between the headset and the computer, increasing as the headset moves away from the computer.
- **AIM Sensors** (not applicable)
- **Battery Level** Battery status is displayed at the bottom of this tab. The Mobile-128 only uses Batt: A.

## Specifications

|                        |  |
|------------------------|--|
| <b>A/D Resolution</b>  | 24-bit simultaneous sampling analog-to-digital converters                              |
| <b>Sampling Rate</b>   | 500 samples per second   |
| <b>Bandwidth</b>       | 0-131 Hz with true DC coupling   |
| <b>Accelerometer</b>   | 3-axis measures head motion  |
| <b>Range</b>           | 10 meters  |
| <b>Noise</b>           | <1.0 $\mu$ V RMS from 1-50 Hz, shorted inputs  |
| <b>Storage</b>         | microSD  |
| <b>Sensors</b>         | Active electrodes with sintered Ag/AgCl contacts,                                      |
| <b>Wireless Type</b>   | Bluetooth  |
| <b>API</b>             | Full access to raw data via real-time streaming API                                    |
| <b>Impedance Check</b> | Continuous impedance check, real-time monitoring of all channels simultaneous with EEG |

|                        |   |
|------------------------|---|
| <b>Export To</b>       | EDF, BDF, CSV   |
| <b>Compatible With</b> | NeuroPype, LabStreaming Layer, EEGLAB, BCILAB, MATLAB, BCI2000, OpenViBE, Neuroguide and more             |
| <b>Battery Type</b>    | Lithium-ion   |
| <b>Battery Life</b>    | 4 hours wireless<br>10 hours with microSD   |
| <b>Use With</b>        | CGX Wireless StimTrigger  |
| <b>Applied Part</b>    | Type BF   |
| <b>Weight</b>          | System: 1000g<br>Amplifier Only: 98g  |
| <b>Fits Heads</b>      | Includes 3 caps for heads sized 54, 56, and 58cm. Optional caps available for head sizes from 48 to 62cm. |
| <b>Dimensions</b>      | Amplifier: 9 x 6 x 2 cm   |



## Warranty and Service

### Mobile-128 Headset

3 year warranty on manufacturing defects.  
90 day warranty on accessories and disposable parts. Warranty is void if the device has been opened or tampered with.

### Returns

All units returned to CGX for repair must have an RA number issued by CGX.

CGX will pay outbound shipping costs only.  
Ship all returns with an RA number to:

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