CGX *A Cognionics Company*

CAMP Compact Amplifier

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

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 wireless CAMP Compact Amplifier pairs with conventional EEG caps for 20 channels of EEG data.

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 CAMP provides research-grade signal quality and is ideally suited for general-purpose EEG and ERP research in laboratory and field environments.

Warnings

The CAMP 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.
- Do not apply the device to a subject while the unit is charging.
- The CAMP 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 CAMP 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 the CAMP is damaged.
- Do not use when wet.
- Do not use caustic or abrasive cleaners on the enclosure.

Always Use Supplied Accessories

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

Device Overview

CAMP Overview

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

The CAMP system does not include an EEG cap. We recommend the E1 Series with ear inputs from Electro-Cap International (Electro-Cap.com).

For custom EEG caps refer to the diagram to the right. Pin 9 is Ground and Pin 11 is Reference. These must be wired at all times for any configuration.

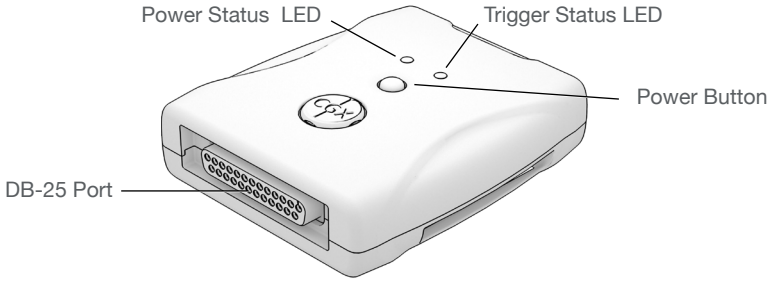
Cap must follow this DB-25 Pin-out

Device Overview

The Package Contains The Following Items

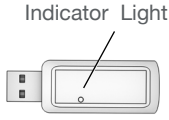
CAMP Amplifier
Bluetooth Dongle
USB Charging Cable
Wall Charger
Carrying Case
Manual

CAMP Compact Amplifier



Bluetooth Dongle

High-speed receiver dongle plugs into your computer's USB port.



Preparation

1. Install The Software

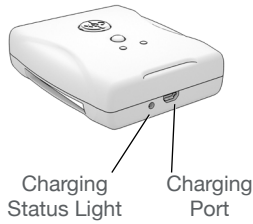
Note: CGX Acquisition software runs on Windows only.

- Navigate to 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

2. Charge The CAMP

Plug the microUSB Cable into the Charging Port and fully charge before using the CAMP. The CAMP can not be used when charging.



Charging

Off	USB Not Connected
Red/Orange	Charging
Green	Fully Charged

Red/Orange Charging
Green Fully Charged

3. Attach The EEG Cap

Confirm the EEG cap has the correct pin-out.

Push at the center of the DB-25 connector when installing.

4. Check Power Status and Trigger Status Lights On Top Of Amplifier

Power

Off	Power Off
Green	Power On
Yellow	Low Battery
Red/Orange	Critically Low Battery (replace immediately)

Green Power On
Yellow Low Battery
Red/Orange Critically Low Battery

Trigger

Off	Trigger Out Of Range
Blue	Trigger In Range
Flashing Blue	Triggers Received

Flashing Blue
Triggers Received

5. 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.

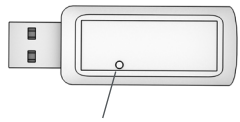
  If Windows did not successfully install the driver for the dongle, refer to the FTDI driver installation manual on our website.

Each CAMP 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:

Green	Power On, Not Paired
Purple	Searching For Device
Blue	Device Found
Flashing Blue	Data Transmitting

Dongle



Indicator light

Green Idling
Purple Searching For Device
Blue Device Found
Flashing Blue Data Transmission

Your package may come with either version of the dongle. They are functionally identical.

6. 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 CAMP** under **Discovered Devices.**

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

Click the device name in this window to select the CAMP and click **Connect.**

You should now see the device configuration window.

If you do not, double check to make sure the CAMP 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.

7. Place The EEG Cap On The Subject's Head

- Follow the instructions provided by your EEG Cap manufacturer.
- Apply Reference and Ground to activate the impedance check.

Donning Instructions

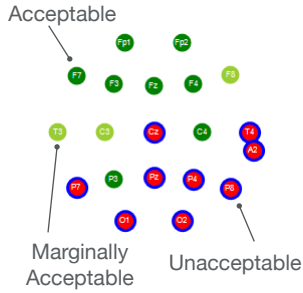
8. Optimize Sensor Contact

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

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:

Red	Impedance out of range (>100 kΩ default)
Light Green	Impedance at top end of range (50 - 100 kΩ default)
Dark Green	Impedance at bottom end of range (<50 kΩ default)

Impedance Map Under The Channels Tab



Reference and Ground earclips must be applied for impedance check to operate.

9. 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 (A1/Ref) and AFz (Gnd) contact and add more gel if necessary.

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**.

10. 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.

Cleaning And Maintenance

Follow the EEG cap manufacturer's cleaning instructions to clean sensors and headset after each use.

The CAMP is not intended to be sterilized in an autoclave.

Use the supplied carrying case when transporting the device.

Cleaning The CAMP

- Use hand sanitizer or alcohol wipes.

Cleaning The EEG Cap

- Follow the EEG cap manufacturer's cleaning instructions.

Disposal Instructions

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

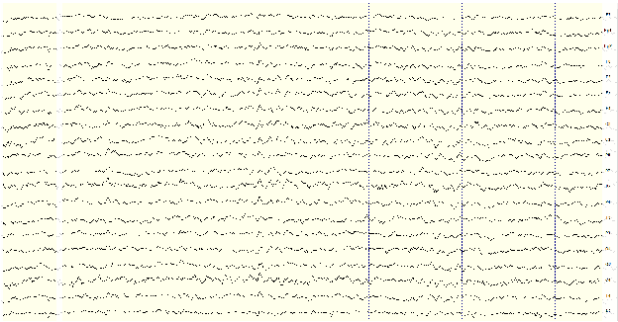
Obtaining Clean EEG Data

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 more gel 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.

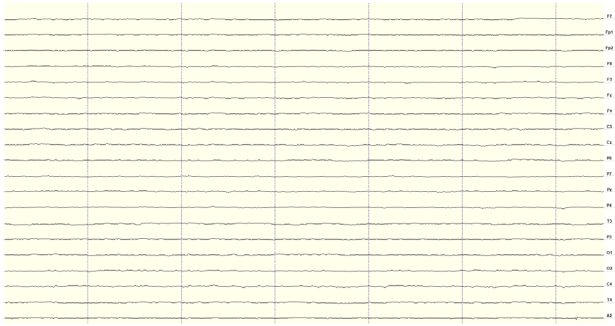
Typical Clean Data Recording



This is a representation of a clean data recording.

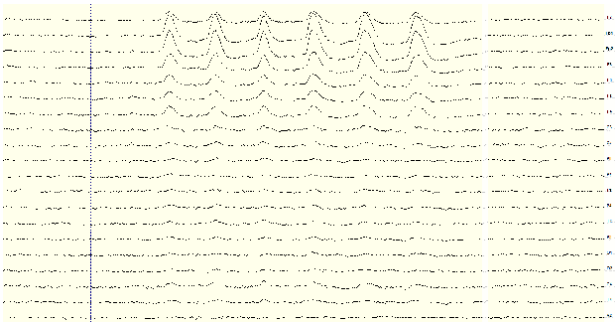
Understanding Readings

Clean Data At Default Scale



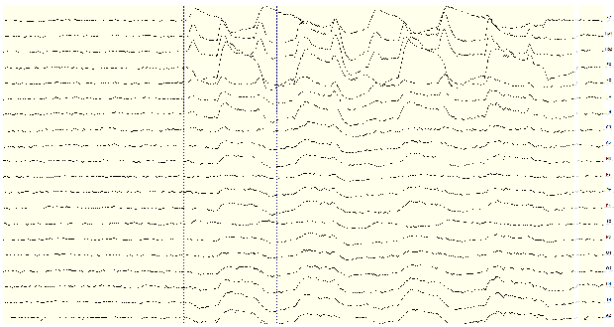
Traces are thin and deviate minimally from the axis.

Blinks



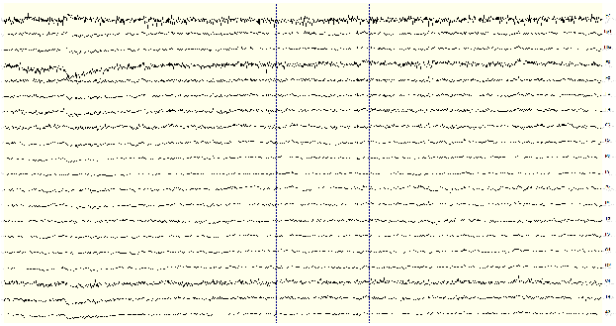
Eye blinks will generate muscle artifacts in the frontopolar locations (Fp1 and Fp2) and less so in frontal sensors (F3/F4, F7/F8), overshadowing brain activity in EEG recordings.

Eye Movement



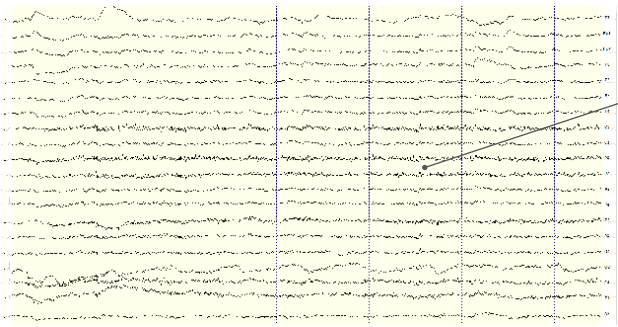
Moving the eyes will generate muscle artifact in the forehead and front of the head. A high concentration of neurons in the eyes generate strong electromagnetic fields, so eye movement causes disruptions in the EEG recording.

Muscle Artifact: Jaw Clench



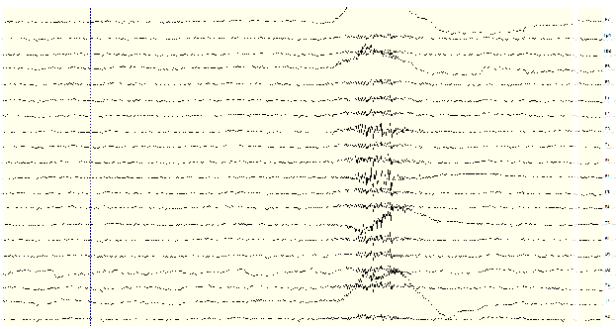
Jaw clenching may affect most or all channels, especially if clenching hard. Light jaw clenching or tightness can be observed in F7/F8, T3/T4. Take note of any temporomandibular joint disorders: these can cause artifact without typical clenching.

Muscle Artifact: Tongue Movement



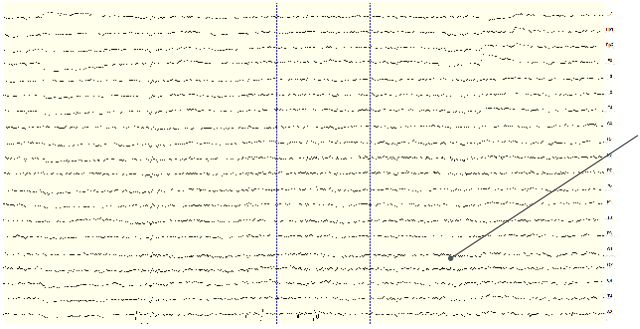
The tongue is a large polarized muscle, with the tongue's tip negative with respect to the base of the tongue. When the tongue moves around the mouth, it generates a moving field causing recording disruptions. Disruptions may be seen down the midline (Fz, Cz, Pz). Tongue movement during talking can be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

Muscle Artifact: Neck Tension

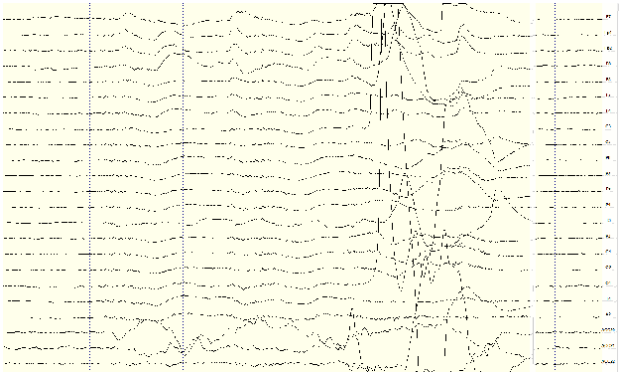


Neck tension may affect channels on the back of the head, predominantly O1/O2, but also in parietal sensors (Pz/P3/P4, P7/P8). Subjects should be comfortably seated, with appropriate bracing at the back and neck. Avoid slouching.

Headset Or Electrode Disruptions: Sensor Pops

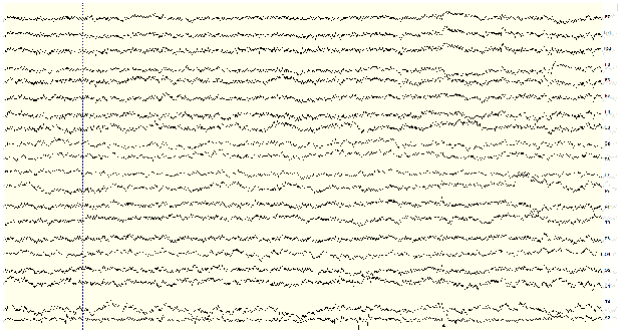
Brief disruptions in contact between sensor and scalp may cause “sensor pops” on recordings. Occasional pops can usually be ignored in processing, but if the problem persists, check the contact between the sensor and scalp.

Headset Or Electrode Disruptions: Head Movement



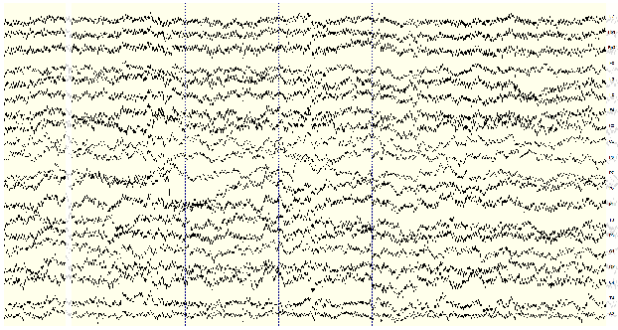
Excess or quick movement of the head may disrupt connection between sensors and scalp causing data artifacts as shown.

Mild Power Line Artifact



Power lines operate between 50 and 60 Hz. Unsecure 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. If power line artifacts appear on all channels, lightly gel the Reference Electrode.

Improper Setup: No Connected Reference

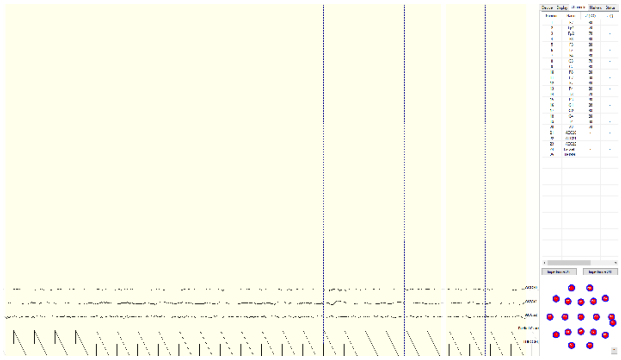


fig. 1

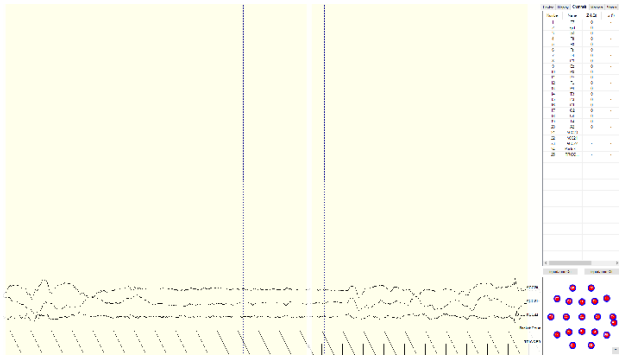


fig. 2

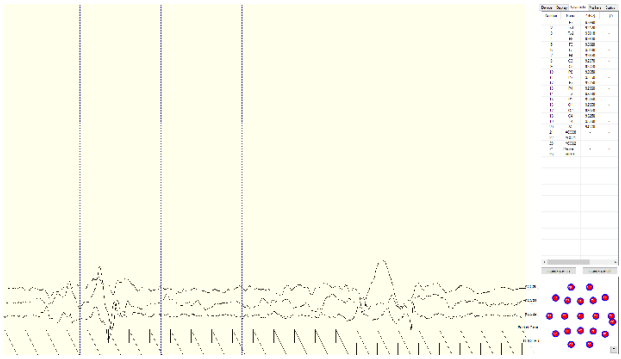


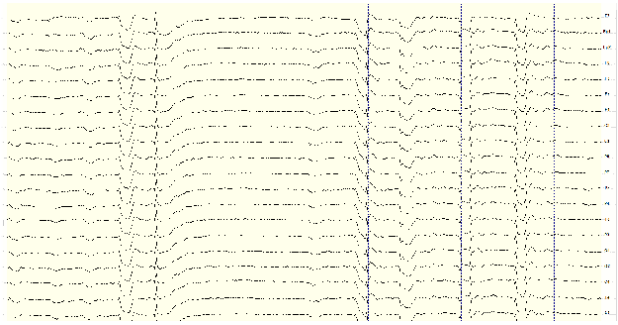
fig. 3

There are a multitude of recording errors when the Reference and Ground are not connected to the subject.

The most common are:

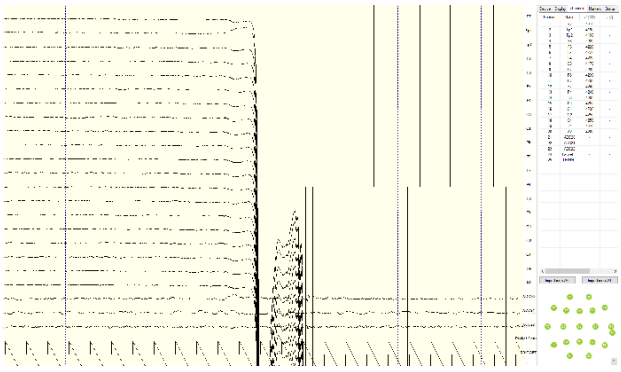
- Impedances match or nearly match at a low value but do not appear on the display or in the impedance head map. (fig. 1)
- No traces appear and impedance values are zero. (fig. 2)
- No traces appear and impedance values are high. (fig. 3)

Improper Setup: Reference Contact



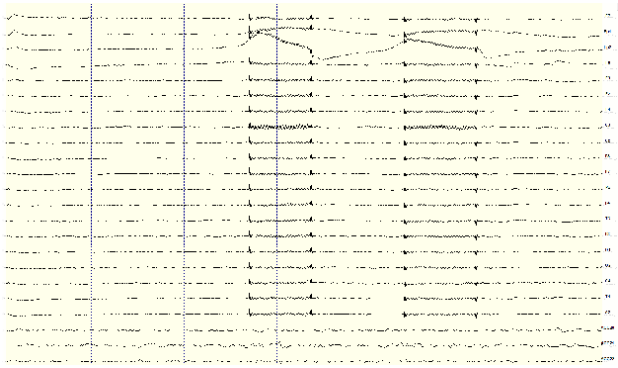
When the reference channel is touched or jostled, all channels will be affected. Avoid disrupting the Reference Electrode during use.

Improper Setup: Reference Disruption



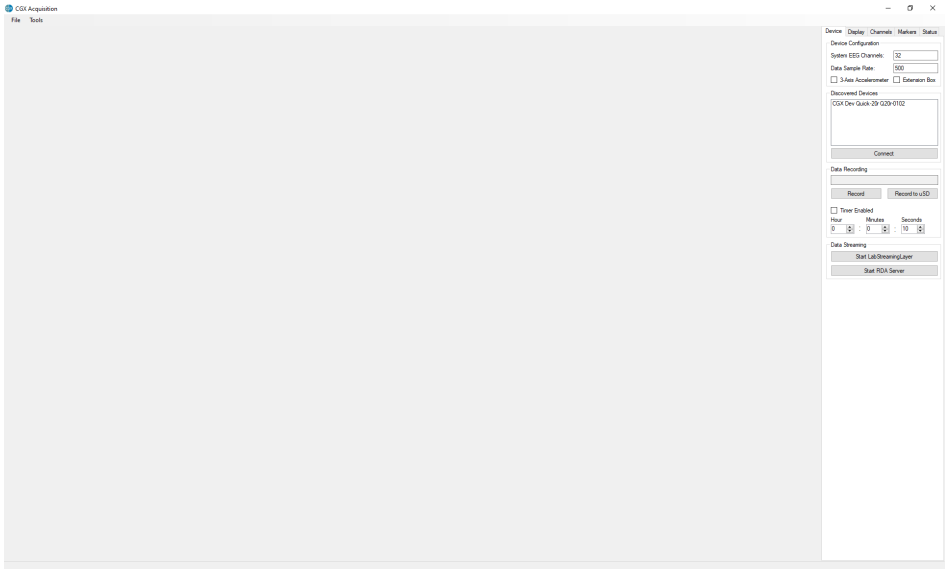
When the reference is disconnected, all channels will disconnect as well.

Improper Setup: Ground Disruption



If the ground has poor contact, all channels will be impacted. Avoid disrupting the connection of the Ground electrode during use.

Device Tab



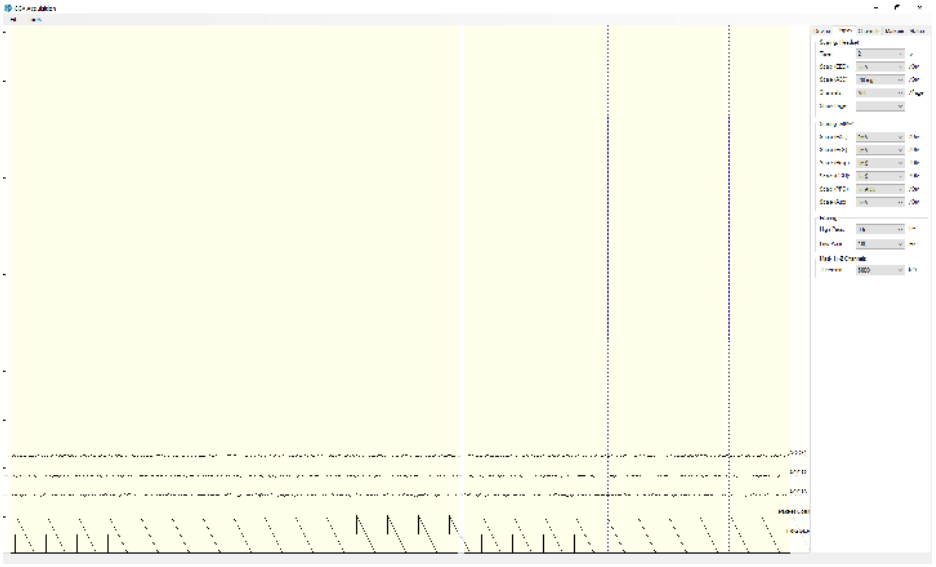
Device Configuration

- **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** press the button again. Elapsed time is shown in the box above the button.
- **Start LabStreamingLayer** Press **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



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

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.

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

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.

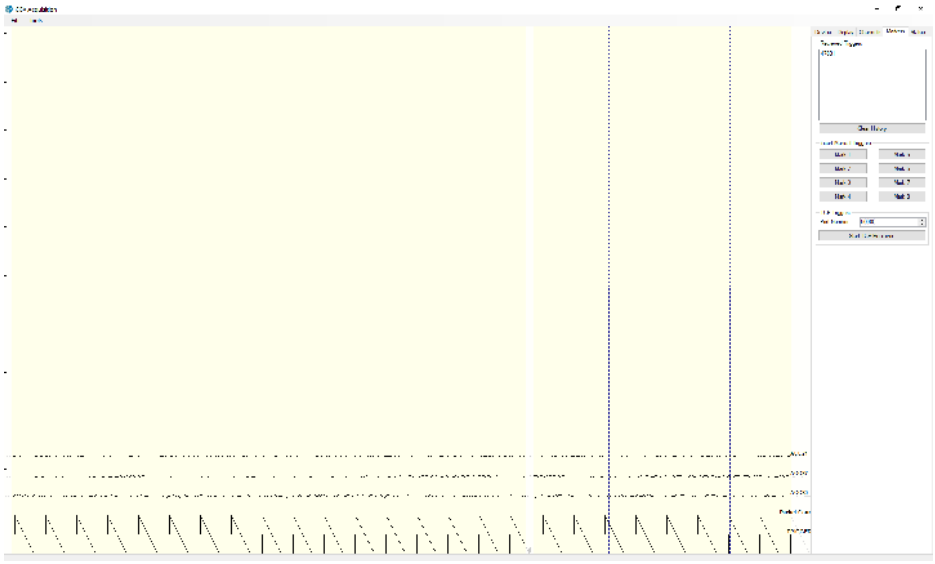
The threshold for this contact quality is, by default:

Red	Above 100 kΩ
Light Green	Between 50-100 kΩ
Dark Green	Below 50 kΩ

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

Red	100% or greater of Hi-Z threshold
Light Green	Between 50%-100% of Hi-Z threshold
Dark Green	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.

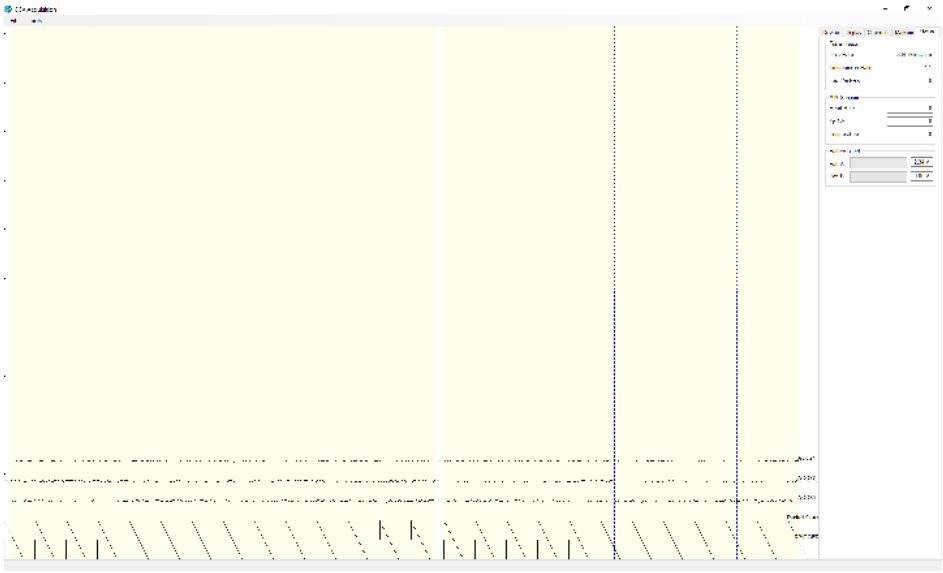
Insert Manual Triggers

- 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 CAMP only uses Batt: A.

Specifications

Specifications

Wireless Amplifier

A/D Resolution: 24-bit simultaneous sampling analog-to-digital converters

Sampling rate: 500 samples per second

Bandwidth: 0-131 Hz with true DC coupling

3-axis accelerometer measures head motion

Wireless Range: 10 meters

Noise: <1.0 µV RMS from 1-50 Hz, shorted inputs

Compatible with optional CGX Wireless StimTrigger.

Compatible with optional AIM.

Data Stream

Low-Energy Bluetooth

Full access to raw data via real-time streaming API

Continuous impedance check with real-time monitoring of all channels simultaneous with EEG

Export data to EDF, BDF, CSV, or BrainVision Analyzer

Compatible with NeuroPype, LabStreaming Layer, EEGLAB, BCILAB, MATLAB, BCI2000, Neuroguide and more

Power

Internal Li-Ion Battery: 8 hour battery life

General

Weight: 82g
Dimensions: 9 x 8 x 3 cm

CE UK CA

Warranty and Service

CAMP Compact Amplifier

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 and assessment must have an RA number issued by CGX.

CGX will pay outbound shipping costs only.

Ship all returns with an RA number to:

CGX
Attn: Service
8445 Camino Santa Fe, #213
San Diego, CA 92121

CGX *A Cognionics Company*

8445 Camino Santa Fe, #213
San Diego, CA 92121
858-864-9400
Sales@CGXSystems.com

Doc: CAMP011923