



# M20 EEG System Operational Instructions

\*\*\*Investigational use only. Exclusively for approved clinical investigations.\*\*\*

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## 1. M20 System Overview

The M20 System is comprised of three main components:

- A. EEG,
- B. Stimulus [psychological tasks software],
- C. Data input and storage: Questionnaires, Data Collection Portal and Cloud Storage.

### 1.1 EEG

The EEG is comprised of four main components:

- A. Headset, which consists of an adapter and sensor strip pair,
- B. Headset accessories: textile caps, sensors, and ear clips/stickers,

- C. Bioamplifier (bioamp),
- D. Collect [visualization software].



*Image shows: Bioamp, connected via a USB cable to a Visualizer laptop, and an adapter plugged into the bioamp attached via a cable to the cap that holds sensors onto the scalp.*

Assembly of the headset, bioamp, and accessories is discussed in Section 2.1.

Collect is the EEG visualization software included in the M20 system. The software runs on a provided Windows 10 laptop referred to as the Visualizer laptop. Operation of Collect is discussed in Section 2.2.

## 1.2 Stimulus

Stimulus is a piece of software designed to walk study participants through a series of psychological tasks as part of the M20 system. The software runs on a provided Windows 10 laptop referred to as the Stimulus laptop. For all tasks, the participant should be seated on a chair at a comfortable distance from the laptop and asked to remain as still as possible. Depending on the specific study involved, a participant might be asked to complete different combinations of tasks. The tasks are discussed in greater detail in Section 3.1.

## 1.3 Data Input and Storage

The M20 system ingests and stores data in 3 ways: questionnaires, a data collection portal, and cloud storage.

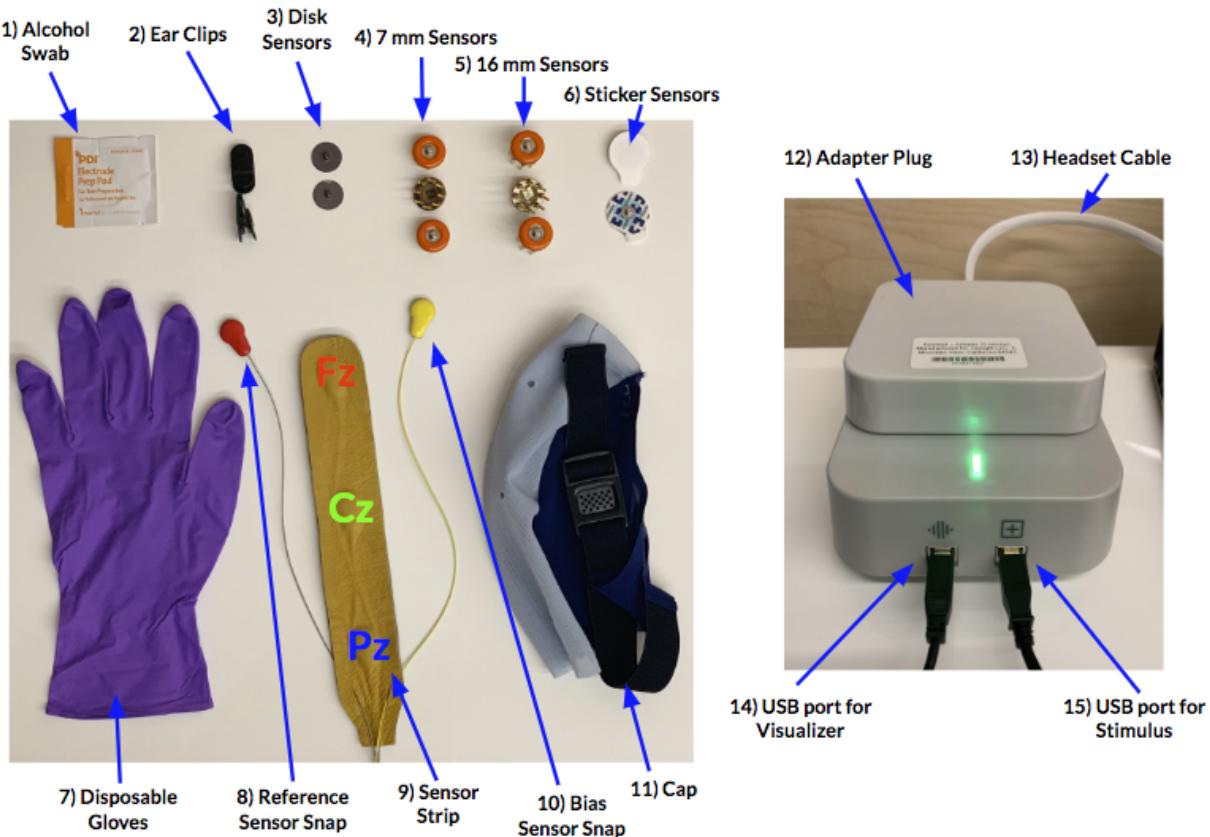
A series of questionnaires are used to collect data from participants as well as study staff, such as the technician operating the M20 EEG system. The data collection portal is used to upload relevant study data files, such as the EEG files Collect produces, to cloud storage where they will be stored.

# 2. EEG Details

## 2.1 Setting up the EEG

### 2.1.1 Headset and bioamplifier parts

Before attempting to set up the M20 EEG, please take a few moments to familiarize yourself with the various components of the system.



- 1) **PDI+ Alcohol swab (orange):** Used to prep skin for sensor contact (earlobes or mastoids if using sticker sensors)
- 2) **Ear Clips:** Used to affix disk sensors to earlobes
- 3) **Disk sensors:** Used to affix reference (red/blue) and bias (yellow) sensor snaps to earlobes
- 4) **7 mm sensors (short prong):** Sit on the scalp, to connect Fz, Cz, Pz, and, when needed, Oz electrodes
- 5) **16 mm sensors (long prong):** Sit on the scalp, to connect Fz, Cz, Pz, and, when needed, Oz electrodes
- 6) **Sticker sensors:** Connects reference (red/blue) and bias (yellow) sensor snaps to mastoids (optional, use only if ear clips are not feasible)
- 7) **Disposable gloves:** These are for the lab technician to wear while administering the EEG and cleaning the M20 system.

- 8) **Reference sensor snap:** Red/blue sensor to be placed on the left ear. This sensor is pictured as red above, but might be either blue or red on a specific device.
- 9) **Sensor Strip:** Holds the Fz, Cz, Pz, and, when needed, Oz electrodes in place on the participant's head
- 10) **Bias sensor snap:** Yellow sensor to be placed on the right ear
- 11) **Cap:** Holds the sensor strip in place on the participant's head. The back of the cap is indicated by markings.
- 12) **Adapter Plug:** Connects the EEG headset to the bioamp
- 13) **Headset Cable:** Contains wires connecting the sensor strip electrodes to the adapter plug
- 14) **USB port for Visualizer:** Connects the bioamp to the Visualizer laptop
- 15) **USB port for Stimulus:** Connects the bioamp to the Stimulus laptop

### 2.1.2 Assembling the EEG headset

The M20 system includes a bioamp and a headset. To connect the headset and the bioamp, place the bioamp on a solid surface and insert the adapter plug into the indentation on the top of the bioamp. Orient the adapter plug such that the headset cable points away from the LED light and USB ports. The exposed connections on the headset adapter and the bioamp should now be lined up with each other. Once the headset is connected to the bioamp, give a firm press on the top of the adapter plug to ensure it is seated well.

Next, connect the bioamp to the Stimulus and Visualizer laptops. The USB ports on the bioamp are labeled with images to indicate which connects to the Stimulus laptop and which connects to the Visualizer laptop. Plug the appropriate ends of the two provided USB cables into the ports on the bioamp. Connect the USB cable attached to the Stimulus port to a USB port on the Stimulus laptop. Connect the USB cable attached to the Visualizer port to a USB port on the Visualizer laptop. Please refer to 14 & 15 in Section 2.1.1 for assistance in determining the Stimulus & Visualizer ports.

**Note:** Please power down the bioamp before detaching or attaching the adapter plug. To power down the bioamp, unplug both USB cables from the device.

### 2.1.3 Putting the EEG headset on the participant's head

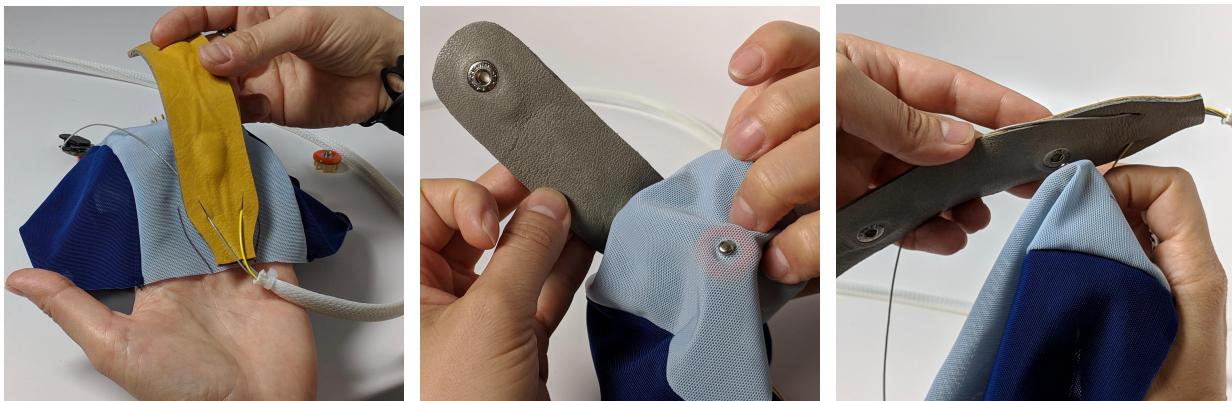
If a participant is wearing earrings in their earlobes, the earrings will need to be removed. Only earrings which might touch the ear clips need to be removed, not all earrings. If the participant is not wearing earrings or the earrings can easily be removed, please use the **Standard instructions** below. If the earrings cannot be removed or the earlobes are otherwise unable to support the ear clips, please use the **Alternate instructions** below.

#### **Standard instructions:**

1. Ask the participant to remove any earrings in their earlobes.
2. Vigorously clean the earlobes using PDI+ Alcohol swabs.
3. Ensure both disk sensors are set into the ear clips. Then, snap the ear clips into the red/blue and yellow sensor snaps.

**Alternate instructions:**

1. Confirm the participant's earrings cannot easily be removed from their earlobes or the earlobes are otherwise unable to support the ear clips.
2. Vigorously clean the mastoids using PDI+ Alcohol swabs.
3. Snap sticker sensors into the red/blue and yellow sensor snaps.
4. Select 7mm or 16mm sensors. Generally, 7mm sensors are used. If a participant has a hair texture / thickness that makes the 7mm sensors untenable for good skin contact, then the 16mm sensors should be used. Do not use 16mm sensors on participants without sufficient hair, as these can cause discomfort without the additional hair cushion.
5. Snap the sensor strip into the cap aligning the headset cable of the sensor strip with the placement markings on the back of the cap and ensuring that the seams are on the inside of the cap (touching the head) and the sensor strip is on the outside of the cap (not touching the head). Note that it's easier to insert the male end of the snap through the cap and bring the sensor strip to it rather than vice versa. Depending on the



configuration of your M20 system, you may have either 3 or 4 sensors to snap into the cap.



6. With the buckle unclipped, place the cap on the participant's head such that the headset cable is in the back and that the second sensor is in the Cz position (centered over the ears at the top of the head).



7. Ask the participant to pass the strap under their chin, clip the buckle, and pull on the strap end to tighten until the cap is snug but not uncomfortable.



8. Make sure the fabric is not folded under at the edges and that the cap is centered with the sensor strip running down the midline.



9. Attach the ear clip with the yellow sensor snap to the participant's right ear or place the sticker on the participant's right mastoid.
10. Ensure the disk sensor in the earclip is pressed firmly into the snap socket of the yellow (bias) sensor and red (ref) sensor. See below.



11. Attach the ear clip with the red/blue sensor snap to the participant's left ear or place the sticker on the participant's left mastoid.



12. Attach the ear clip with the red/blue sensor snap to the participant's left ear or place the sticker on the participant's left mastoid.



13. Applying light downward pressure, gently wiggle the sensors along the cap midline to ensure that the sensors are making good contact with the skin and don't have hair between them and the skin.
14. Check that all sensors are making good contact by looking at the EEG data in the Collect software and confirming it looks as expected.
15. (Optional) Once Steps 1-14 are completed, an additional, RF shielding cap (silver color) can be placed on top of the blue EEG cap & sensor strip. This cap will greatly reduce any 60 Hz (or other) line noise which may be present in the room. In addition, the application of the RF shielding cap will ensure a snug fit of the sensors, helping to hold the sensor strip below it firmly in place, securing the sensors against the scalp more firmly. Please ensure that the RF shielding cap is pulled down snugly to sufficiently cover both ear clips and as much of the head surface area as possible(see below):

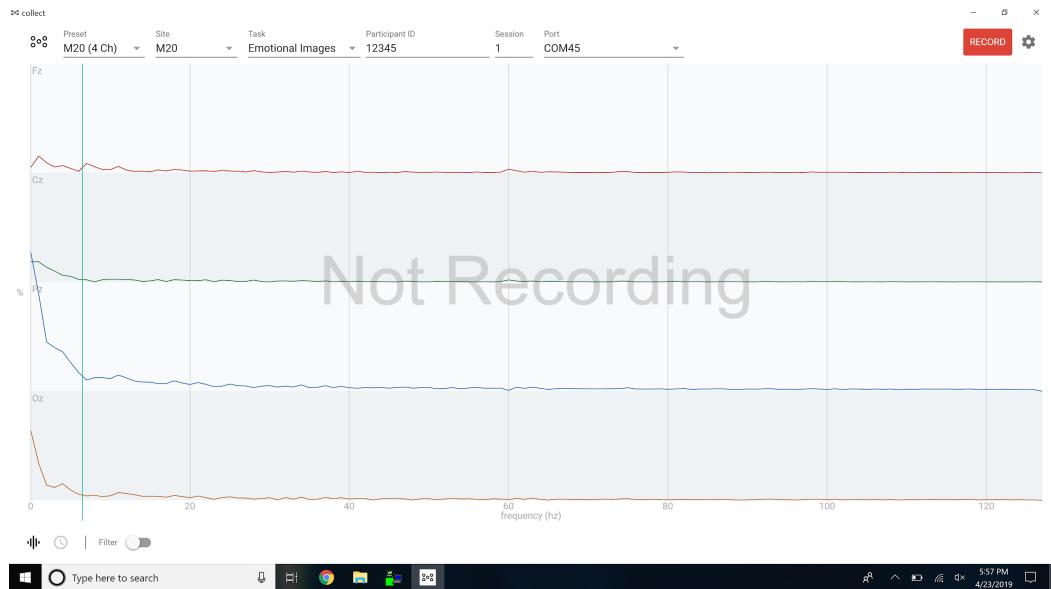


*Above image shows RF shielding cap worn to reduce noise in the EEG system, and is pulled down snugly to sufficiently cover both ear clips.*

## 2.2 Operating Collect

Collect is the EEG visualization software included in the M20 system. To utilize Collect, log into the Visualizer laptop and double click on the Collect icon on the desktop to launch the program.

**Note:** Make sure to complete Section 2.1.2 to connect the bioamp to the Visualizer laptop BEFORE opening Collect. Failure to do so will result in the program having trouble connecting to the bioamp.



**Step 1:** Select the appropriate options from the drop down menus at the top of the window as follows -

Preset: which channels are being viewed. Please select either M20 (3-channel) or M20 (4-channel) depending on whether the 5 sensor system configuration (3-channel) or the 6 sensor system configuration (4-channel) is being used.

Site: the site at which the system is being operated.

Task: the task the participant is performing. Please see Section 3.1 for a description of the task options.

Participant ID: unique deidentified participant id.

Session: the number of the session being recorded for this participant and task. Generally this value is 1. If the M20 is being used for a longitudinal study or a participant is being rerun on a given task due to a previous device malfunction, then the session number should be incremented accordingly.

Port: the connected bioamp. This field should only offer one option, as only one bioamp should be connected to the Visualizer laptop at a time.

**Step 2:** Verify the signal looks clean.

Please adjust the view settings according to your preferences. These adjustments will not affect the quality or content of the recording. We recommend enabling a low pass and a high pass filter with the following parameters:

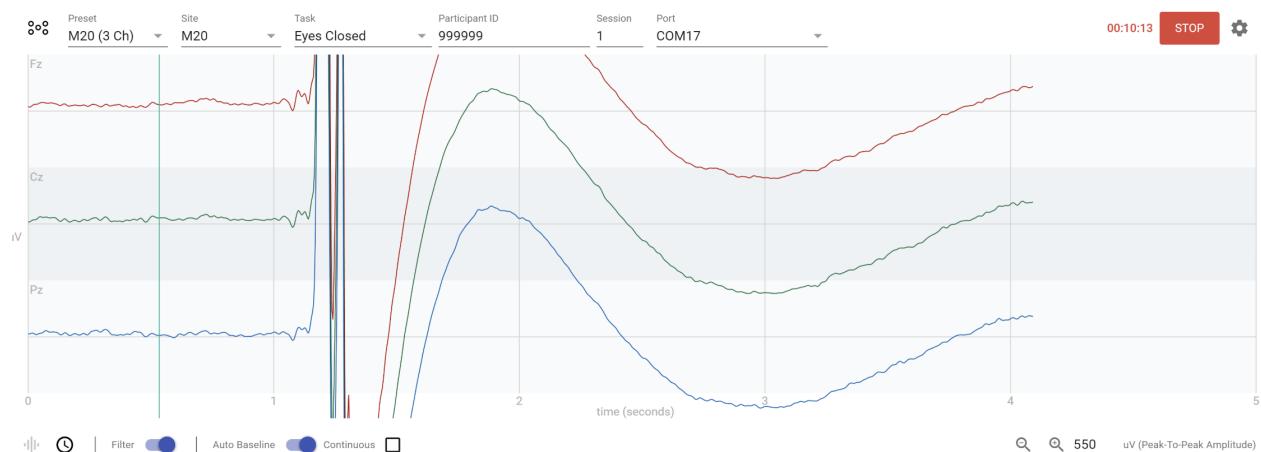
Enable Low Pass

Low Pass Order 8  
Low Pass Hz 40

Enable High Pass

High Pass Order 2  
High Pass Hz .1

Filter parameters with higher orders may induce filter artifacts, particularly following movement artifacts, as shown below. If you observe these filter artifacts, try turning the filter on and off, or lowering the order of the filter. Again, please note that this filter is designed purely for visualization purposes and in no way affects the data that is being digitized and stored on the local computer.



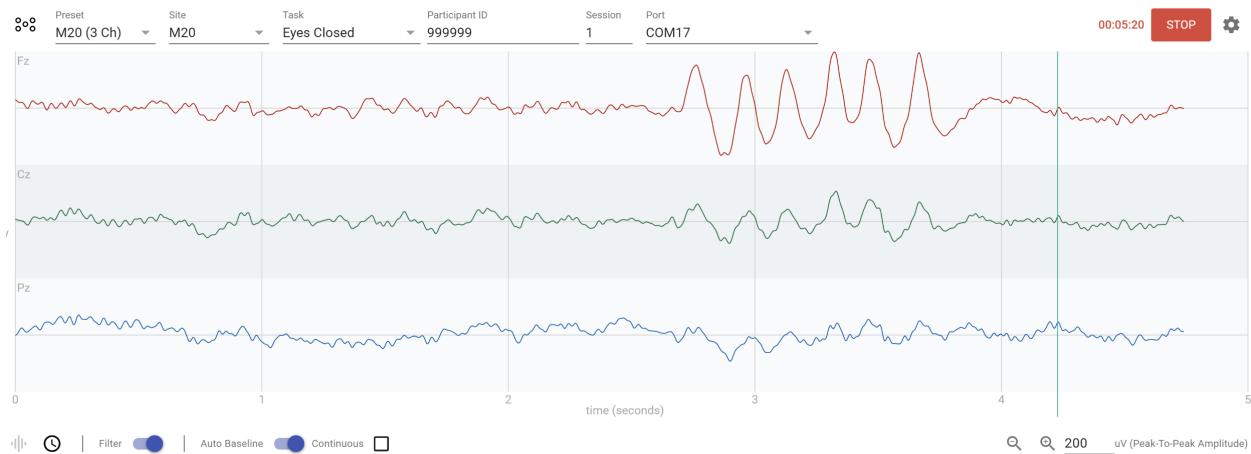
Amplitude: at the bottom right of the window, the peak-to-peak amplitude of the incoming waves can be adjusted by clicking the arrows or typing in a desired setting. The recommended amplitude setting for viewing clean data is 200  $\mu$ V. If the amplitude is much larger than 200  $\mu$ V, please wait about 30 seconds while the participant sits still to see if the signal settles. If it does not, please follow the troubleshooting steps outlined below.

Auto-baseline: checking and unchecking the “auto-baseline” box will toggle between viewing the waves on an absolute microvolt scale or adjusted so that their midline is in the center of the viewfield.

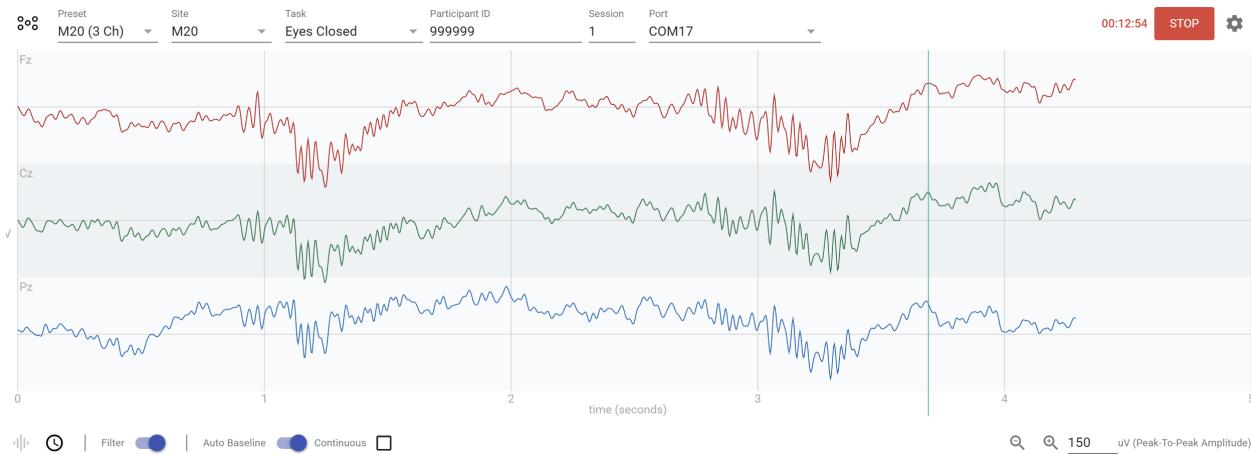
Below are the recommended baseline settings:



Before you start a recording, please ensure that you can see a clean signal on all 3 channels. The recommended checks are to ask the participant to blink a few times (e.g., six blinks are shown below). Make sure the blink signal is strongest on Fz, but you can view it on Cz and Pz, as seen below:

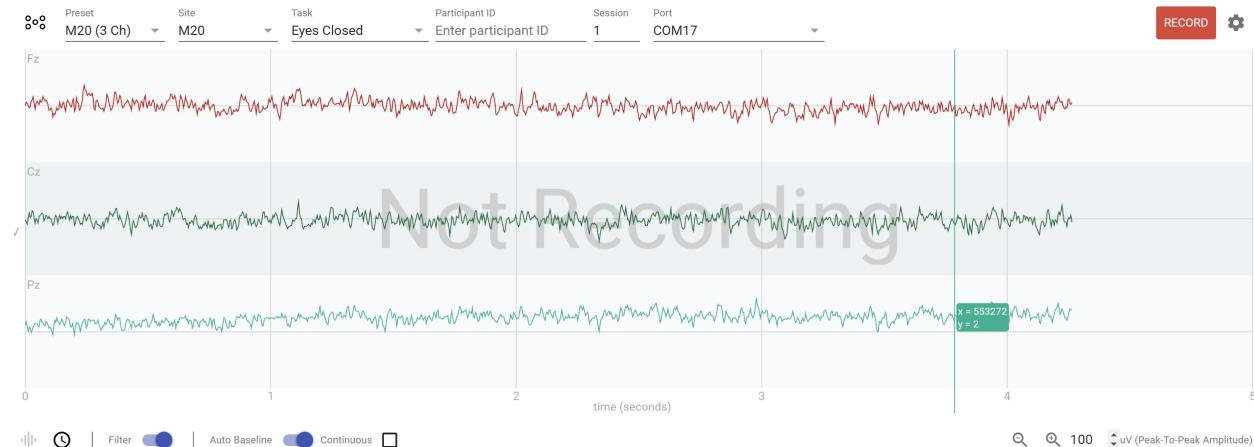


Another recommended check is to ask the participant to briefly clench their jaw. The EMG from this movement should appear as high frequency bursts, as shown below. Ensure these bursts are observed on all channels.



If the headset adapter becomes disconnected from the bioamplifier, the signal may look relatively noisy and flat, as shown below. If this is the case, the eye blinks and jaw clenches will

not be visible in the signal. If you observe this issue, just press the headset adapter into the bioamplifier to ensure a good connection.



**Step 3:** Press “RECORD.” A window will pop up asking where the recording should be saved. Verify the system is pointing to the Recordings folder [“> This PC > Desktop > Recordings”]. Click “Select Folder” to save the file.

**Note:** Before asking the participant to begin a task, confirm the watermark “Not Recording” has disappeared.

**Step 4:** Once the participant has completed a task, click “STOP” to finish recording. Doing so will open a dialogue box identifying what the filename is for the new recording. The filename will be in the form “Site-Task\_Name-ParticipantID-Session.csv”. Click “Ok” to dismiss the box.

To view the recorded files afterwards, please open the Recordings folder on the desktop.

**Note:** Please remember to change the Task preset to reflect the new task before starting the same participant on another task. Failing to do so will result in an error as Collect will not record a new file using an existing filename. Collect will launch a pop-up window alerting the user to the conflict and return to non-recording mode.

## 2.3 Safety Symbols Descriptions

The following symbols are used on the identification stickers for the bioamp and the headset:

Symbol	Description
	Non sterile

<b>SN</b>	Serial number
<b>REF</b>	Part number
	Type BF applied part
<b>QTY</b>	Quantity
	Manufacturer
	manual

### 3. Stimulus Details

Stimulus is a piece of software designed to walk study participants through a series of psychological tasks as part of the M20 system. Depending on the specific study involved, a participant might be asked to complete different combinations of tasks.

#### 3.1 Overview of Stimulus Tasks

##### 3.1.1 Eyes Closed Task (Baseline)

The Eyes Closed Task involves the participant sitting relaxed on a chair in front of a black screen for two minutes. The participant must be still and keep their eyes closed for the duration of the task. The EEG technician can use this task to baseline the participant's data and ensure the system is operating as expected.

This task lasts exactly 2 minutes.

##### 3.1.2 Hot Button Task

The Hot Button Task involves challenging the participant to press specific buttons on a keyboard as quickly as possible to win points through a series of trials. The software asks the participant which is their dominant hand and then walks them through the rules of the game. For each trial, the participant can select either an Easy or Hard option:

- Easy trial: The participant will use the index finger of their dominant hand to try to press a designated key 30 times in 7 seconds.
- Hard trial: The participant will use the pinky finger of their non-dominant hand to try to press a designated key 100 times in 21 seconds.

Successfully completing a trial earns the participant between 0 and 500 points, depending on which option is chosen, how many points that option is worth for this trial, and a randomized dice roll where the system decides if any points should be awarded. If participants do not successfully complete the trial, they will earn 0 points.

This task lasts exactly 20 minutes, with the number of trials varying depending on which option is chosen each trial.

### 3.1.3 Emotional Images Task

The Emotional Images Task involves the participant viewing a randomized set of images. Each image will be either unpleasant, neutral, or pleasant. Between images, the participant will see a fixation screen displaying a + for approx 2 seconds. Participants are asked to blink during the fixation screen and refrain from blinking during the images.

This task will take approximately 8 minutes.

### 3.1.4 Self-Referential Encoding [SRET] Task

The Self-Referential Encoding [SRET] Task asks the participant to indicate whether a displayed word describes themselves or not. Both pleasant and negative words will be randomly displayed to the participant. The participant indicates agreement by pressing one key on the keyboard and disagreement by pressing another. In between words, the participant sees a fixation screen with a white dot.

This task will take approximately 3 minutes.

### 3.1.5 Eriksen Flanker Task

The Eriksen Flanker Task displays a black screen with five arrows to the participant. The arrows may point to the right or the left. During each trial, the system will randomly select a single direction for the outer 4 arrows to point. The middle arrow can either point in the same direction

as all the others (congruent) or in the opposite direction (discongruent). The participant watches the center arrow and indicates for each trial whether it is facing to the left or the right by pressing defined keys on the keyboard. Between trials, the participant will see a fixation screen with a white dot. If the system gauges a participant is not responding quickly enough, they will be prompted to speed up.

This task will take approximately 12 minutes.

### 3.1.6 Steady State Visually Evoked Potential [SSVEP] Task

The Steady State Visually Evoked Potential Task involves a participant viewing rapid streams of images. The participant will view a variety of pleasant, unpleasant, and neutral images. The participant is asked to minimize blinking.

The task will take approximately 20 minutes.

### 3.1.7 Oddball Task, Doors Task, and Latency Test

Two other tasks are included in the Stimulus software - Oddball Task and Doors Task - but they are not for general use. The system similarly supports a latency test feature which is used for troubleshooting only.

## 3.2 Operating Stimulus

To utilize Stimulus, log into the Stimulus laptop and double click on the Stimulus icon on the desktop to launch the program.

**Note:** Make sure to complete Section 2.1.2 to connect the bioamp to the Stimulus laptop BEFORE opening Stimulus. Failure to do so will result in the program having trouble connecting to the bioamp.

Step 1: On launch, Stimulus will prompt to select a port. Please select port 2 by pressing "2" on the keyboard. Port options 1 & 3 are not required for general use.

Step 2: Stimulus will display a list of the available tasks. Please press "0"- "9" on the keyboard to select the appropriate task for this session. Task descriptions are listed in Section 3.1.

**Note:** It is recommended to provide the participant with written or verbal instructions on how to complete the task before launching it. Likewise, please make sure Collect is running on the Visualizer laptop and data is being recorded before proceeding further.

Step 2: Once chosen, the task will initiate immediately. The Eyes Closed Task begins automatically. For all other tasks, Stimulus will display a preparation screen that can hold indefinitely as the participant is prepared for the task.

Step 3: Once the chosen task has completed running, Stimulus will return to the main task menu.

Step 4: Stop the Collect recording. If you need to run an additional task, please repeat Steps 1-3 until all required tasks have been completed. Please make sure to update the Task preset in Collect for each new task run.

Step 5: Press Control-C to exit Stimulus.

**Note:** In order to utilize another bioamp, please exit Stimulus, plug in the new bioamp, and then relaunch Stimulus.

## 4. Data Input and Storage

The M20 system ingests and stores data in 3 ways: questionnaires, a data collection portal, and cloud storage.

### 4.1 Overview of Questionnaires

The M20 system uses a series of questionnaires to collect data from participants as well as study staff, such as the technician operating the M20 EEG. Different information will need to be collected depending on the specifics of the study being conducted. Study designers are expected to align their questionnaires with their protocol. The M20 system provides only the capability to create questionnaires, but no pre-built templates.

In particular, it is recommended a study's questionnaires include: Stimulus version, Collect version, serial numbers for the bioamp and headset, participant demographic information, the same participant id used in Collect, participant opt-out tracking, and inclusion/exclusion criteria for the study.

Please make sure that each questionnaire is completed for each participant. If an error is entered and needs to be corrected after submission, please email [M20System@google.com](mailto:M20System@google.com) with the subject line "data entry error correction" and explain the issue.

### 4.2 Overview of Data collection portal

The data collection portal is used to upload relevant study data files, such as the EEG files Collect produces, to cloud storage where they will be stored.

Medfield College

Upload

Task LPP Data Type EEG

Drag files here...

Or...

Choose Files No file chosen Submit

Opt out

Participant ID User has opted out

If you've made a mistake, please click [here](#).

To use:

1. Access the data collection portal using Chrome browser on the Visualizer laptop:  
<https://fluctusexedo.appspot.com/upload.html>.
2. Follow the steps for authentication using your login credentials.
3. Choose your site from the drop down menu in the top left corner.
4. Use the “Data Type” drop down menu in the Upload box to select the type of data to be uploaded (for example, EEG data). Likewise use the “Task” drop down menu to select the task associated with the file.
5. Select the files to be uploaded in either of the following ways:
  - a. Drag and drop the file into the grey box labeled “Drag files here...”.
  - b. Click on “Choose Files” and select from the menu that pops up.
6. Click “Submit”.

**Note:** The “Opt out” field in the data collection portal is deprecated. Please track participant opt-outs via the questionnaires.

### 4.3 Overview of Cloud storage space

Once data has been collected, either via data collection portal upload or via questionnaires, it is stored in a cloud-based storage space. Access to data is restricted and tied to your login credentials. Study staff will be able to view the data submitted but will not be able to make manual changes.

If an error is detected and needs to be corrected, please email [M20System@google.com](mailto:M20System@google.com) with the subject line “data entry error correction” and explain the issue.

## 5. Care, Maintenance, and Troubleshooting

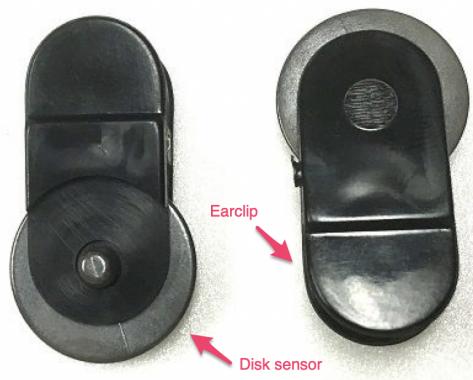
## 5.1 Cleaning instructions

Please remember to clean all parts of the M20 system between participants.

### 5.1.1 Cleaning the sensors

To clean the sensors, unsnap the 7mm (or 16mm) sensors from the sensor strip and the disk sensors from the earclips. Wipe both sets of sensors clean using a non-abrasive PDI electrode prep pad, making sure to get alcohol on all crevices. Let these sensors dry completely and then reattach the sensors to their respective locations on the headset. If using sticker sensors instead of ear clips, remove the sensors from their snaps and discard.

Dispose of and replace all 7mm sensors and 16mm sensors after approximately 500 uses (Fz, Cz, Pz, Oz). Dispose of and replace all disk sensors after approximately 20 uses (from the ear clips) or when there is any visual sign of discoloration or corrosion. Replace all earclips if there is damage or the spring has broken.



*Above image differentiates between the disk sensor and the earclip*

### 5.1.2 Cleaning the cap

To clean the cap:

STANDARD CLEANING PROCEDURE: to be used for typical EEG cap usage between site participant visits

1. Ensure the cap is disconnected from sensor strip. Make sure all detachable sensors are removed.



2. Fill a bucket with lukewarm water and a squirt of Johnson's baby shampoo.

3. Submerge the dirty EEG caps in the solution and let them soak for 3 minutes, then use your hands to swirl around the caps 7-10 times.
4. Transfer the EEG caps to a clean bucket, and fill with lukewarm water. Rinse until the caps are free from soap residue.
5. Squeeze as much water out of the caps, but do not wring, stretch or tear the fabric.
6. Hang caps to dry. If needed for immediate use, EEG caps can be dried for 15 minutes using a blowdryer on a cool setting for approximately 15 minutes.

DEEP CLEANING : As desired, at the discretion of the lab tech, for deep cleaning purposes (for example, if there is a patient with open head wounds or clear signs of lice), [Control III Disinfectant](#) can be used to disinfect. Note that this will degrade the caps more quickly and is not recommended for every EEG use.

1. Mix 1oz of Control III Disinfectant solution in 1 gallon of distilled water.
2. Soak the caps for 8-10 minutes. (Do not leave soaking for longer than necessary).
3. Rinse the caps with lukewarm water. Deionized water is recommended.
4. Reuse the disinfectant solution for up to 14 days.
5. Hang cap until completely dry.

### 5.1.3 Cleaning the hardware

Gently wipe down the bioamp, sensor strip, and Stimulus and Visualizer laptops with a soft, dry cloth as needed.

## 5.2 Avoiding certain risks with the use of EEG

### WARNINGS AND PRECAUTIONS

IMPORTANT: additional warnings and precautions may appear in preceding sections.

- Do not use the device except in accordance with an approved study protocol.
- Do not expose the bioamp, adapter plug, or laptops to water or other liquids.
- 
- Avoid dropping the device.
- Never try to open or repair the device.
- This device is not indicated for concurrent use with fMRI.
- This device should not be used in a high magnetic field (e.g., that of an MRI).
- This device may cause light skin irritation at sensor sites.
- This device may cause light skin irritation under the chin where the strap is tightened.
- This device should not be used on participants with open head wounds or skin parasites such as lice.
- This device should not be used with participants who have a personal or family history of photic seizures and/or epilepsy.
- This device should not be used with participants who have any active electrical implants (e.g., pacemakers, cochlear implants).

- This device should not be used with participants who are currently pregnant.

### 5.3 Risks of reciprocal interference

To ensure clean, usable EEG data is produced, please adhere to the following best practices:

- Keep the M20 system away from high power RF transmitters (e.g. military radar installations, base stations for radio telephones and land mobile radios, amateur radio, AM and FM radio broadcast, and TV broadcast).
- Avoid usage of the M20 system adjacent to or stacked with other equipment as it can result in improper operation. If such use is necessary, the M20 system and the other equipment should be observed to verify that they are operating normally.
- Do not use portable Radio Frequency (RF) communications equipment (including peripherals such as antenna cables and 27/34 external antennas) closer than 30 cm to any part of the M20 system, including the supplied USB cable.
- Do not use accessories, transducers, and cables other than those provided. This could result in increased electromagnetic emissions or decreased electromagnetic immunity and result in improper operation of the M20 system.

### 5.4 In the event of damage to the M20 EEG System

Please follow the below guidance in the event the M20 EEG system is damaged:

- If a device is damaged or malfunctioning, please refer to Section 5.5 for possible solutions. If this does not work, the malfunctioning device should be returned to the manufacturer.
- If a device is not performing as expected, please refer to Section 5.5 for possible solutions. If this does not work, the malfunctioning device should be returned to the manufacturer.
- Please direct questions about damage or malfunction to [M20Support@google.com](mailto:M20Support@google.com).

### 5.5 Troubleshooting guide for the M20 System

#### 5.5.1 Poor or Noisy EEG signal

If poor or noisy EEG signal quality is observed in Collect ...

**Validate the M20 is set-up correctly:** Ensure the adapter plug is fully seated on the bioamp by pressing down firmly on the adapter plug. Check reference and bias sensor snaps for proper contact. Try gently adjusting the prong sensors on the participant's head with the intention of increasing contact with the skin. Sometimes hair gets in the way and needs to be gently moved aside. Consider swapping the 7mm sensors for the 16mm sensors if it appears the prongs are too short to reach the scalp through the hair (if hair is thicker than 2cm).

**Remove electrical interference:** Unplug any electronic devices from the wall in the room, including cords which themselves are not plugged into anything else (for example, laptop chargers not plugged into laptops). Remove any cellular devices which might be sending or receiving signals from the immediate vicinity of the equipment.

**Remove noise:** Have the participant relax by taking deep breaths and request they sit as still as they are able and close their eyes. Sit still yourself and do not speak. Try to limit any other sources of noise or motion in the range of the participant.

**Verify good contact:** Make sure that the sensors have been thoroughly cleaned with a non-abrasive alcohol swab before applying them to the participant. Additionally, make sure that the earlobes (or other area of the skin) that the reference or bias sensor snaps are in contact with have been cleaned thoroughly with a slightly abrasive alcohol wipe.

**Be still:** Have the participant run through the Eyes Closed Task without recording data. Sometimes sitting still without moving for a 2 full minutes makes a big difference in the signal quality.

### 5.5.2 No incoming signal

If Collect is not registering any incoming signal ...

**Reset:** Try closing Collect, unplugging the bioamp from both laptops, replugging the bioamp in, and then restarting Collect.

### 5.5.3 Sudden signal changes

If you are used to seeing the signal look a particular way and it suddenly seems much more or less noisy ...

**Check the visualization settings:** What is the amplitude set to? Is Auto Baseline on? Was a filter applied to the data? Sometimes unexpected changes in view settings can make normal data look unfamiliar. Verify Collect is set for the correct preset for the hardware being used: M20 (3-channel) for the 5 sensor system configuration or M20 (4-channel) for the 6 sensor system configuration.



### 5.5.4 Stimulus crashes

If you try to select a task in Stimulus and the program suddenly closes ...

**New hardware:** Stimulus closes unexpectedly when a new bioamp has been attached to the Stimulus laptop without restarting the application. Please restart Stimulus and proceed with the task as normal.

### 5.5.5 General Troubleshooting

Issue	Recommended Solution
One channel shows no data, or looks bad or noisy	<ul style="list-style-type: none"> <li>Identify channel that shows poor or no data. Check electrode and sensor connections contact to scalp.</li> <li>Confirm the prong sensor is firmly snapped to the sensor strip.</li> <li>Remove the prong sensor out of the sensor snap and replace it back in the mating snap of the sensor strip.</li> <li>Twist the sensor around in the snap on the sensor strip.</li> <li>Replace the sensor with a new one.</li> <li>Restart the visualizer. Ensure that the Preset dropdown in Collect is set to the correct preset (M20 3-channel or M20 4-channel).</li> <li>Confirm Auto Baseline is turned on.</li> </ul>
All channels look bad	<ul style="list-style-type: none"> <li>When there is an artifact on all channels, it is usually caused by problems with reference or bias sensor snaps. So: <ul style="list-style-type: none"> <li>Make sure the ear clips are snapped into the reference and bias sensor snaps and making good contact with the skin.</li> <li>Exfoliate under the ear clips / sticker sensors again.</li> <li>Swap ear clip disk sensor for a new disk sensor.</li> </ul> </li> <li>Rearrange ear clips on the earlobes to ensure proper skin contact</li> <li>Make sure the ear clip attached to the reference sensor snap is not touching any other metal (ie an earring).</li> <li>Make sure the adapter plug is fully seated in the bioamp.</li> <li>Try powering down the bioamp by unplugging the USB cables, then unplugging and replugging the adapter. Press firmly down to ensure it's seated fully.</li> </ul>

Marks are not appearing in Collect	<ul style="list-style-type: none"> <li>Check each USB connection on the bioamp stim USB port.</li> <li>Check each laptop has a USB cable plugged in tightly.</li> <li>Check the USB cable from the Stimulus port is connected to the Stimulus laptop and the USB cable from the Visualizer port is connected to the Visualizer laptop.</li> <li>Restart the task.</li> <li>Restart the Visualizer laptop and bioamp.</li> </ul>
Collect cannot connect to the bioamp	<ul style="list-style-type: none"> <li>Restart Collect.</li> <li>Ensure the USB cable is fully connected to the Visualizer laptop and bioamp.</li> <li>Restart the Visualizer laptop and the bioamp.</li> </ul>
Another unexpected issue	<ul style="list-style-type: none"> <li>Restart the bioamp and Visualizer laptop.</li> <li>Restart Collect.</li> <li>Make sure the prong sensors are snapped into the sensor strip tightly.</li> <li>Make sure the reference and bias sensor snaps are contacting skin with good pressure, either through the ear clips or the sticker sensors.</li> <li>Make sure all the USB cables are connected to the bioamp and computer, and that the bioamp is turned on (indicated by the green light).</li> </ul>
Changing bioamps	<ul style="list-style-type: none"> <li>If a new bioamp is used, restart both the Stimulus program and the Visualizer program.</li> <li>If the COM ports are not recognized, check Device Manager, COM ports to identify and confirm the correct COM port used. Set the</li> </ul>

	<p>appropriate COM port on each computer manually in the application.</p> <ul style="list-style-type: none"> <li>○ On the Stimulus laptop, select the correct COM port by pressing the number 2 on your keyboard on the first menu screen.</li> <li>○ On the Visualizer laptop, change the COM port under the “Port, Choose a port” menu setting.</li> </ul>
Bioamp or computer does not power on, OR Green power indicator on bioamp not lit	<ul style="list-style-type: none"> <li>● Make sure both laptops have sufficient power as the batteries may be depleted. The bioamp is powered by the laptops.</li> <li>● Unplug and replug the USB cables from both bioamp USB ports.</li> <li>● Try plugging in both laptops to their power adapters and charging them for at least 1 hour.</li> <li>● Make sure the USB connections to the bioamp are properly plugged in.</li> </ul>