

EmotivPRO v3.0

EmotivPRO

EmotivPRO is EMOTIV's end-to-end solution for neuroscience research. EmotivPRO enables you to build and publish neuroscience experiments; as well as acquire and analyze EEG data all in one integrated software environment.

EmotivPRO has five license options to choose from:

- Lite
- Student
- Standard
- Premium
- Team

To find out more about each licence , please visit the [EmotivPRO webpage](#).

The EmotivPRO user manual will help you get started with EmotivPRO and understand how to use its various features.

If you have any queries beyond the scope of this user manual, please get in touch with [EMOTIV Support](#), who will be happy to help you.

Getting started

System requirements

Learn more about [the system requirements for EmotivPRO](#).

Install EMOTIV Launcher

To install EmotivPRO, you must first download EMOTIV Launcher—EMOTIV’s centralized installer for its suite of applications.

For more information on installing EMOTIV Launcher on your computer, please refer to the [EMOTIV Launcher User Manual](#).

Installing EmotivPRO onto your PC or Mac

Installing EmotivPRO onto a Windows PC

1. Go to www.emotiv.com
2. Login to your Emotiv ID by clicking on Login at the top right-hand corner of the screen.
3. Go to My Account drop-down menu, at the top right-hand corner of the screen, and click on Downloads.
4. Find Emotiv-Installer-Win in the list of available downloads and click the Download button next to it.
5. Open the downloaded Emotiv-Installer-Win-x64.exe
6. Install EmotivPRO using the default path C:\Program Files (x86) or specify a different path. Click Continue.
7. Select the EmotivPRO from the applications list.
8. Accept the User License Agreement and click Continue
9. The installer will download EmotivPRO
10. Once installation is completed, click on Close to exit the installer.

Installing EmotivPRO onto a Mac

1. Go to www.emotiv.com
2. Login to your Emotiv ID by clicking on Login at the top right-hand corner of the screen.
3. Go to My Account drop-down menu, at the top right-hand corner of the screen, and click on Downloads.
4. Find Emotiv-Installer-Mac in the list of available downloads and click on the Download button next to it.
5. Open the downloaded Emotiv-Installer-Mac.dmg
6. Install EmotivPRO using the default path User/Applications/EmotivApps or specify a different path. Click Continue.
7. Select the EmotivPRO from the applications list.
8. Accept the User License Agreement and click Continue
9. The installer will download EmotivPRO.
10. Once installation is complete, click Close to exit the installer.

Please note: Your Mac may ask you to allow installation of apps from unidentified developers in order to run Emotiv Installer. To give Emotiv Installer permission to install on your Mac, right click on the installer and select Open from the menu. A pop up will appear on your screen asking for permission to open Emotiv Installer. Click on Open.

Updating EmotivPRO

Emotiv Launcher will notify you when an update for EmotivPRO is available. We recommend that you update EmotivPRO to the latest version when you're notified. Keeping EmotivPRO up-to-date means you benefit from new features, bug fixes, and continue its compatibility with other Emotiv applications.

Logging into EmotivPRO

To log in to EmotivPRO:

1. Open EMOTIV Launcher. To do this, go to your computer's system tray and click on the brain icon.
2. Log into EMOTIV Launcher using your EmotivID and password. You can also log in using your Facebook account (the same Facebook account you used when purchasing your EmotivPRO license).

Note: You need to be connected to the internet when trying to log in to EMOTIV Launcher for the first time. This will allow the application to confirm your subscription is active.

Creating an EmotivID and password

To create an EmotivID and password:

1. Open EMOTIV Launcher.
2. Click on Create Account.
3. Follow the instructions to create your EmotivID and password.

Forgotten password

If you forget your password:

1. Go to Emotiv Launcher
2. Click on the Forgot password link under the login fields.
3. Follow the instructions to reset your password.

Viewing your account information

To view your account information, change your password, or view your EmotivPRO license:

1. Go to the [account page](#) on the EMOTIV website.
2. Login to your account using your EmotivID and password.
3. The My Account page will open. Select the information you want to view about your account from the left-hand menu.

You can also view your account information from the EMOTIV Launcher:

1. Open EMOTIV Launcher. To do this, go to your computer's system tray and click on the brain icon.
2. Click on the Account tab.
3. Click on Manage Subscriptions. This will take you to the website [account page](#).

Logging out of EmotivPRO

To log out of your account:

1. Open EMOTIV Launcher
2. Click on Settings at the top right of the window.
3. Click on Log out.

Note: By logging out of the EMOTIV Launcher, you will be logged out of all EMOTIV applications.

EmotivPRO license options

Purchasing an EmotivPRO license

There are five different licenses to access EmotivPRO:

- Lite
- Student
- Standard
- Premium
- Team

For further information about each license, please visit the [EmotivPRO webpage](#).

Only one license is permitted per EmotivID.

Changing the number of seats in your license

If you want to upgrade or downgrade the number of seats in your EmotivPRO license, please get in touch with [EMOTIV Support](#).

Using EmotivPRO offline

Once you have logged in to EmotivPRO for the first time, you can use all of its features while offline. However, when you are using EmotivPRO offline, your data will not sync to EMOTIV Cloud, nor will it sync to other devices on your account.

Soft limit

When you reach the end of your monthly subscription cycle, EmotivPRO checks your subscription status to ensure that you have paid the monthly subscription fee and reauthorizes your license.

If you do not pay the monthly subscription fee on the due date, you have seven days in which to pay. You can still access and use EmotivPRO during the seven-day grace period.

EmotivPRO will notify you that the monthly subscription fee is due and how many days remain in the seven-day grace period before you lose access.

Hard limit

If you do not connect to the internet before your grace period expires (7 days) you will no longer be able to use the app for taking new recordings or to stream data. In order to continue using the app you will need to connect to the internet while launching the app. A message will appear on timeline UI to notify about the start of Hard limit. Please plan accordingly.

Note: You can still playback, delete and export your previously taken recordings when you have reached your hard limit or when your license has expired.

Cancelling your EmotivPRO license

To cancel your EmotivPRO license:

1. Login to your [EMOTIV account](#).
2. Click on Subscriptions.
3. Click on Cancel next to your EmotivPRO license and follow the instructions.

Note: Cancellation of a PRO license is subject to the terms and conditions of our [Subscription and Cancellation terms](#).

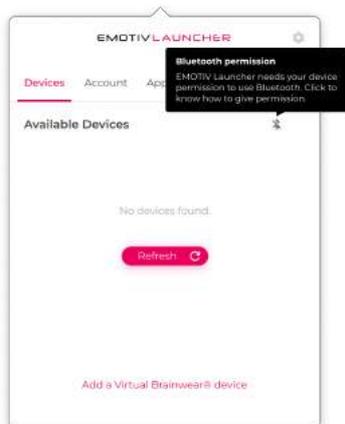
Connecting your headset to EmotivPRO and fitting your headset

Connecting your EEG headset to EmotivPRO via Bluetooth

MacOS

To connect your EEG headset to EmotivPRO via Bluetooth (BLE 4.0) on Mac OS:

1. Go to Bluetooth settings and turn Bluetooth on.
2. Open EMOTIV Launcher, click on the Bluetooth icon and follow the steps.



3. Turn your headset on.
4. Open EmotivPRO.
5. Click on the Connect Headset button at the top of the screen.
6. Choose your headset and click on Connect.
7. Follow the fitting instructions for your headset.
8. Once you've fitted your headset, click on Close.
9. Your headset is now connected to EmotivPRO.

Windows

There are two states for connecting your EMOTIV headset; "unpaired" or "paired". If you are having trouble connecting in the "unpaired" state, then you should try pairing the device to your computer.

Unpaired mode

1. Go to Settings and turn Bluetooth On.
2. Turn your headset on.
3. Open EmotivPRO.
4. Click on the Connect Headset button at the top of the screen.
5. Choose your headset and click on Connect.
6. Follow the fitting instructions for your headset.
7. Once you've fitted your headset, click on Close.
8. Your headset is now connected to EmotivPRO.

Paired mode

If you're having trouble connecting your headset, you should try pairing it to your computer:

1. Go to Settings and then Bluetooth and other devices.



2. Turn your headset on.

3. Turn Bluetooth On and click Add Bluetooth or other device.



4. Your headset should now appear on the list of available devices.

Bluetooth connection troubleshooting

- If your Windows PC does not have a BTLE driver built in, you will need a BTLE adaptor to connect your headset to your PC via Bluetooth.
- On Windows, when your headset is connected to Bluetooth it will show as connected in the Bluetooth settings window. It should then be available to connect to in EmotivPRO.
- If your headset is already paired to your computer, power cycle the headset to reconnect it to your device.
- If your headset is showing as connected to your device, but you still cannot connect it to EmotivPRO or Cortex API, remove the headset from the Bluetooth & other devices devices list, but keep your headset turned on.
- Make sure that your headset's battery is fully charged before connecting it via Bluetooth.
- Bluetooth shares a 2.4 GHz ISM band with other household devices, such as cordless telephones, wireless networks, baby monitors, and microwave ovens. Avoid using your headset near common sources of interference, such as power cables, microwave ovens, fluorescent lights, wireless video cameras, and cordless phones.
- If you are experiencing connection issues with your headset that you suspect might be due to frequency congestion, see [AirPort and Bluetooth: Potential sources of wireless interference](#) for further information.
- If your headset and Bluetooth are not connecting with each other, move them closer together to see if it improves the connection.

Pairing your EEG headset with a USB receiver dongle

If you're in an environment with high levels of Bluetooth interference, we recommend using a USB receiver dongle to pair with your headset.

To pair your headset with a USB receiver dongle:

1. Plug in the USB receiver dongle to your computer's USB port. The LED above the power symbol should start blinking (about once a second) to show that it is broadcasting.
2. Turn your headset on. When you turn your headset on, a second LED will light up, and the LED above the power symbol will become fainter and flicker more rapidly. When your USB receiver dongle does this, it is paired with your headset.
3. You can now connect your headset to EmotivPRO.

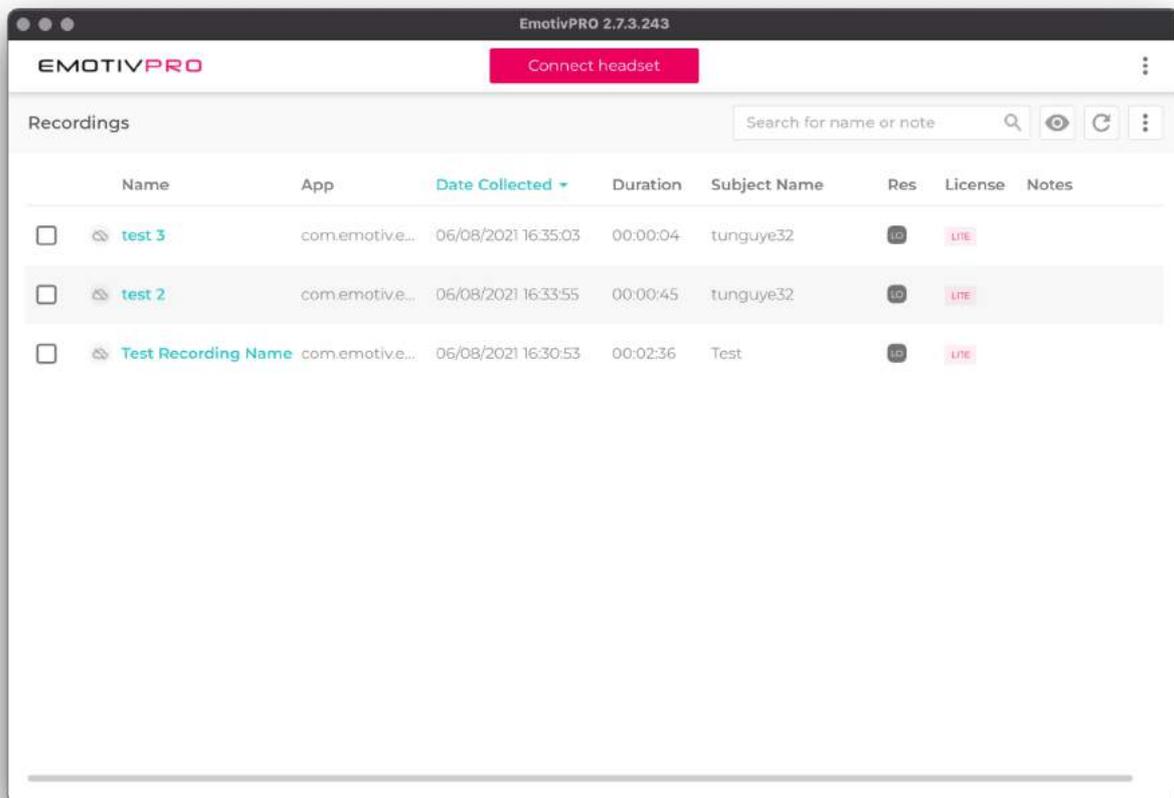
If you experience any issues when pairing your EEG headset with a USB receiver dongle, please refer to your headset's user manual.

Connecting your EEG headset to EmotivPRO

EmotivPRO is compatible with the following EMOTIV headsets: EPOC, EPOC+, EPOC X, EPOC Flex, and Insight.

To connect an EEG headset to EmotivPRO:

1. Turn your headset on.
2. Check that your headset's battery is fully charged before you try to connect it.
3. Click on the Connect Headset button at the top of the screen.
4. Choose your headset and click on Connect.
5. Follow the fitting instructions for your headset.
6. Once you've fitted your headset, click on Close.
7. Your headset is now connected to EmotivPRO.



Connect Headset button at the top of the EmotivPRO screen

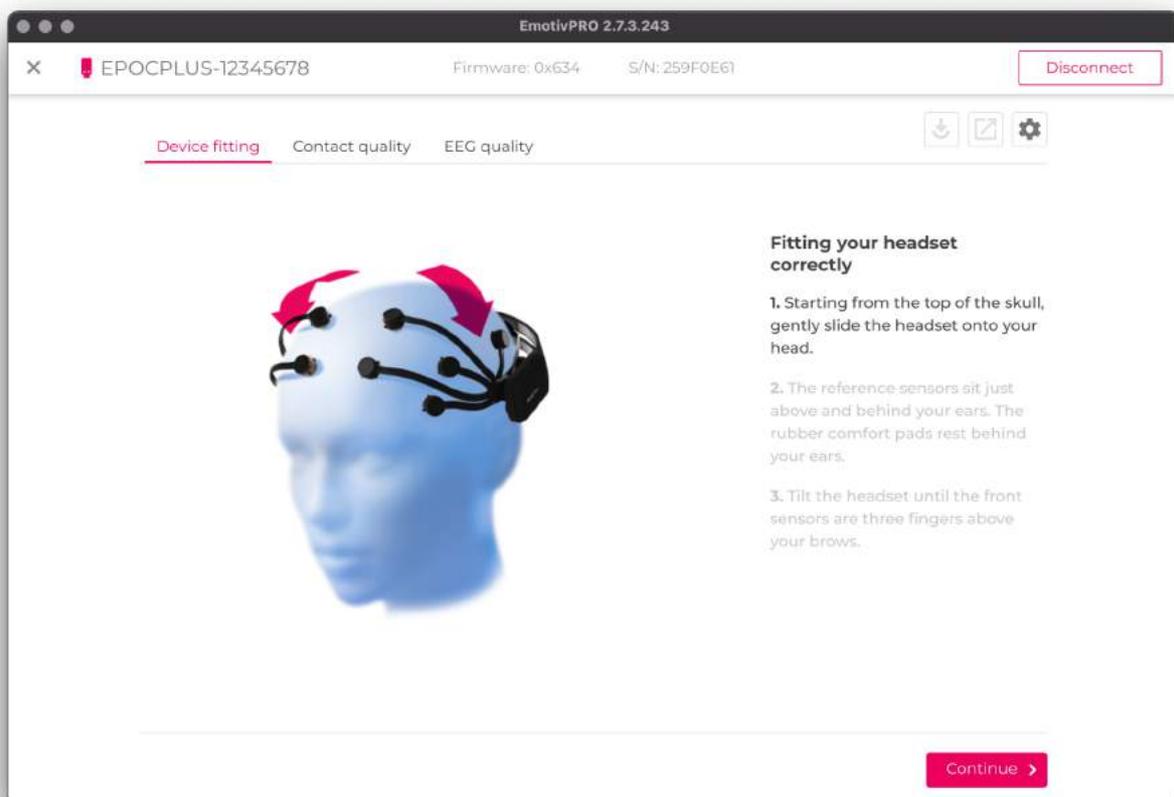
Disconnecting your EEG headset from EmotivPRO

To disconnect your headset from EmotivPRO, unplug the USB receiver dongle or turn your headset off. It can take up to 30 seconds for your headset to disconnect.

Fitting your EEG headset

When connecting your EEG headset to EmotivPRO, the Device Fitting screen will show you how to fit your headset (excluding EPOC Flex).

If you're connecting an EPOC Flex headset to EmotivPRO, please refer to the Assembly and Fitting guide which can be accessed via the link on the Device Fitting screen.



Contact quality map

Accurate EEG data collection depends on good sensor contact with the scalp and good EEG signal quality.

The contact quality map shows you a visual representation of the current contact quality at each individual sensor on your headset. Each sensor's contact quality status can be seen in real time, so you can adjust them (if needed) to achieve 100% contact quality.

The contact quality statuses are:

- Green - good
- Orange - moderate
- Red - poor
- Black - very poor

Please note: The contact quality map for EPOC Flex will only show the sensors that have been configured.

Contact Quality (CQ) vs. EEG Quality (EQ)

What is EEG Quality?

EEG Quality (EQ) has been built to give you an easy way to assess whether you are recording high quality brain signals or not. Basically, it is a scoring system for the quality of the signal in each sensor. Each sensor is given a black, red, orange, light green or dark green colour to indicate the quality of the EEG signal for that specific sensor.

Overall EEG Quality as displayed in your EMOTIV application is presented as a score of 0-100. This number makes it easy to understand the quality of your signal at a glance. How do we calculate it? See below.

How is EEG Quality Different to Contact Quality?

Contact Quality is a simple measurement of impedance of the channel. While this measurement is used widely in neuroscience and medical settings, it is really only a useful reading to a trained EEG professional and does not give the full picture on the quality of the signal. Signals that have low impedance are not necessarily brain signals - and you might have found that sitting your headset on the table can produce a false positive - leading the user to falsely believe they are recording high quality brain data.

Okay, but what actually is EQ?

EEG Quality is a machine-learning trained algorithm that automatically determines the quality of the signal based on multiple metrics. Each of these metrics are important in assessing whether the recording data accurately captures the underlying brain signal. These metrics include

- **Contact Quality (CQ) (as above)** - an impedance measurement that indicates the quality of the electrical signal passing through the sensors and the reference. It can be one of 4 values: 0 - very bad (black), 1 - bad (red), 2 - ok (orange) and 4 - good (green).

- **ML Signal Quality (SQ):** A machine learning algorithm trained on high quality EEG recordings that were assessed and collected by the EMOTIV Research team. The Signal Quality algorithm assess data over 2 seconds and is scored 0 - very bad (black), 1 - bad (red), 3 (light green) and 4 -good (dark green)
- **Signal Magnitude Quality (SMQ):** A measure of the signal amplitude. Sometimes, the above metrics i.e. CQ, SQ are good but the signal amplitude is very small and therefore small power fluctuations in the FFT would be undetectable. Often, this is due to poor sensor hydration or poor scalp contact. SMQ gives scores for the average signal magnitude within a 2 second epoch. The scores can be 0 - very low (black), 1 - low (red), 4 - ok (green).

Each of these metrics are important in determining the quality of the signal, therefore the sensor colour will not be dark green unless all of these metrics have a “good” score of 4. The “EQ Map” UI in your EMOTIV software displays the minimum score of any of these metrics. The resulting EQ Score for each channel can be 0,1,2,3,4 corresponding to the colours black, red, orange, light green and dark screen, respectively.

How is Overall EQ Calculated?

Overall EQ is calculated and displayed as a number out of 100 so you can see your EEG Quality for all channels at a glance. Overall EQ is calculated as the sum of the worst 3 channels divided by the sum of the maximum score of these 3 channels, as a percentage. The resulting mathematical formula is $(\text{min1} + \text{min2} + \text{min3} / 12) * 100$.

Using EmotivPRO

EmotivPRO home screen and menu

When you log in to EmotivPRO, the home screen displays a list of all your previous recordings (if you have any).

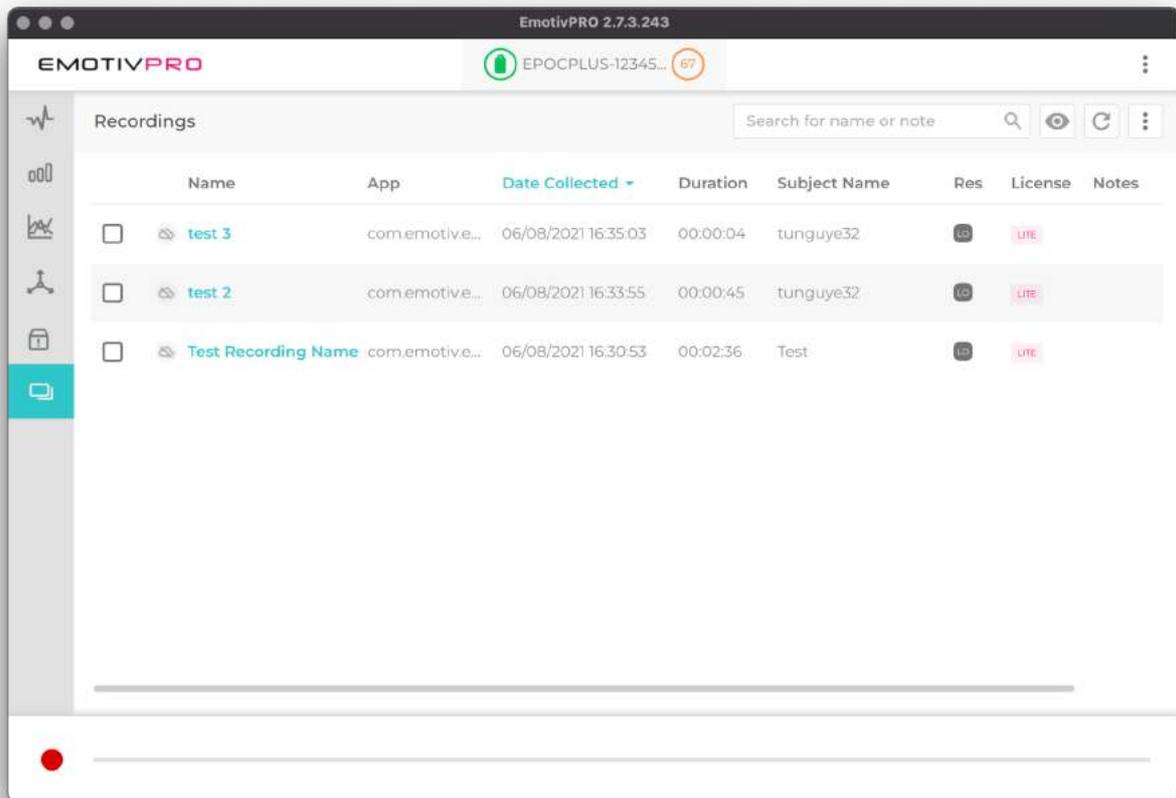
You can access the different views in EmotivPRO using the menu on the left-side of the screen.

The menu is always visible on high resolutions screens. If you're using a low resolution screen, you can access the menu by clicking on the menu icon at the top-left corner of EmotivPRO.

The menu includes the following features:

- **Raw EEG:** view a real time or recorded data stream from your headset's sensors (14 for EPOC, EPOC+ and EPOC X; 5 for Insight and up to 32 for EPOC Flex, depending on your configuration).
- **FFT/Band Power:** perform a frequency analysis on single channel EEG data in real time or on recorded data.
- **Performance Metrics:** view real time or recorded performance metrics for six cognitive states: Stress, Engagement, Interest, Excitement, Focus and Relaxation.
- **Motion Sensors:** view a real time or recorded data stream from your headset's digital motion sensors, with 7-channel quaternions and accelerometer data.*
- **Data packets:** view a real time or recorded data stream of packet loss and captured from your headset to your PC

*Older firmware versions of EPOC+ (Firmware version < 633) motion data will be presented as 9-channels.



EmotivPRO menu

EEG quality indicator

You can find the EEG quality indicator at the top of the EmotivPRO home screen, next to your headset's name.

The EEG quality indicator shows you, in real time, the overall EEG quality averaged across all the sensors on your headset. Red indicates poor EEG quality, orange is average EEG quality, and green indicates good EEG quality.



EEG headset contact quality indicator

Battery indicator

You can find the battery level indicator at the top of the EmotivPRO home screen, next to your headset's name.

The battery level indicator shows you the percentage of battery life remaining in your EEG headset.

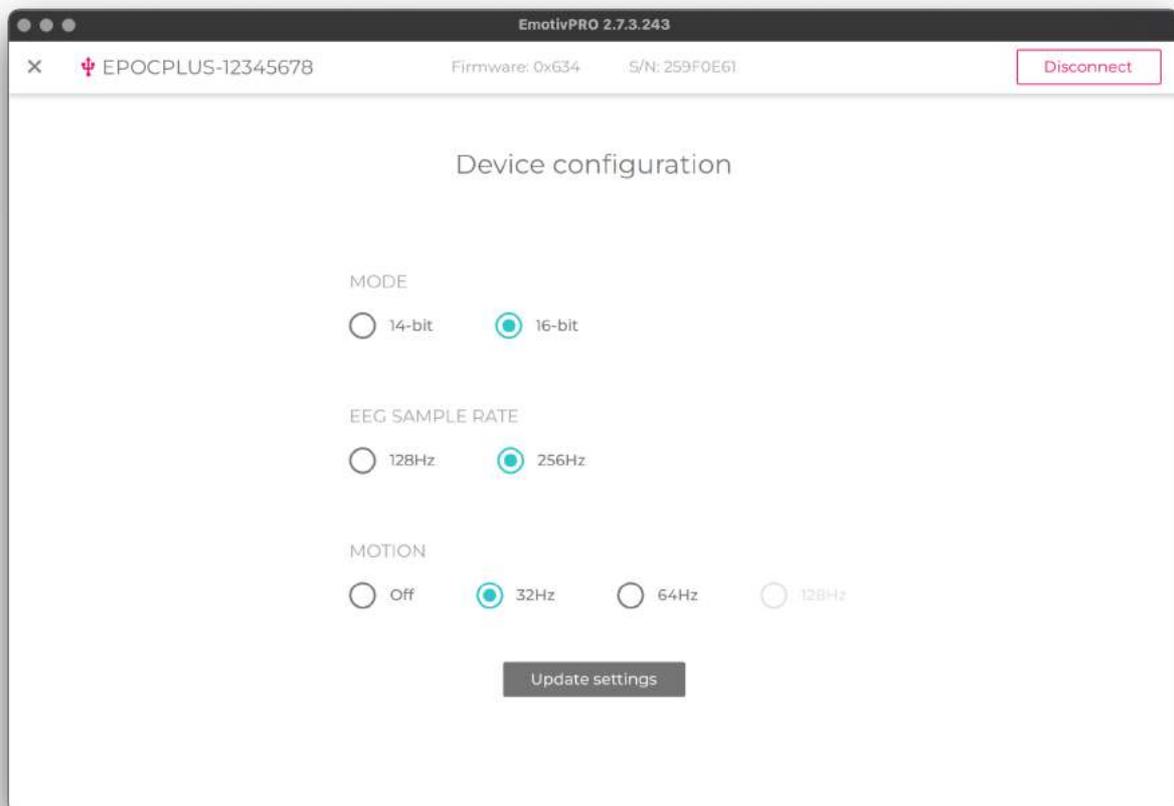


EEG headset battery level indicator

EPOC+ and EPOC X configurations

You can configure your EPOC+ and EPOC X's EEG sample rate, EEG resolution, motion data sample rate, and motion data resolution through EmotivPRO. .

There are no configuration settings for Emotiv's EPOC, EPOC Flex, and Insight headsets.



To configure your EPOC+ or EPOC X:

1. Connect your EPOC+ or EPOC X headset to your computer using the USB cable that came with it.
2. Open the EPOC+ or EPOC X configuration settings by clicking on the headset name at the top of the EmotivPRO home screen.
3. Select your configuration. Your headset will update as you make your selections.
4. Unplug your EPOC+ or EPOC X device from your computer

Please note:

- If your EPOC+ or EPOC X headset is connected to your computer via Bluetooth, then EEG can only run at 128 Hz and motion data can only run at 64 Hz.
- If you view the configuration menu during real time streaming, your headset settings will be shown even when your headset is not plugged in to your computer.

Data Streams

Real time data streams, recording, and playback

EmotivPRO allows you to view data streams and frequency analyses in real time whenever your headset is connected: both during a recording and when you're not recording. EmotivPRO also allows you to open and playback saved recordings, including all data streams and frequency analyses.

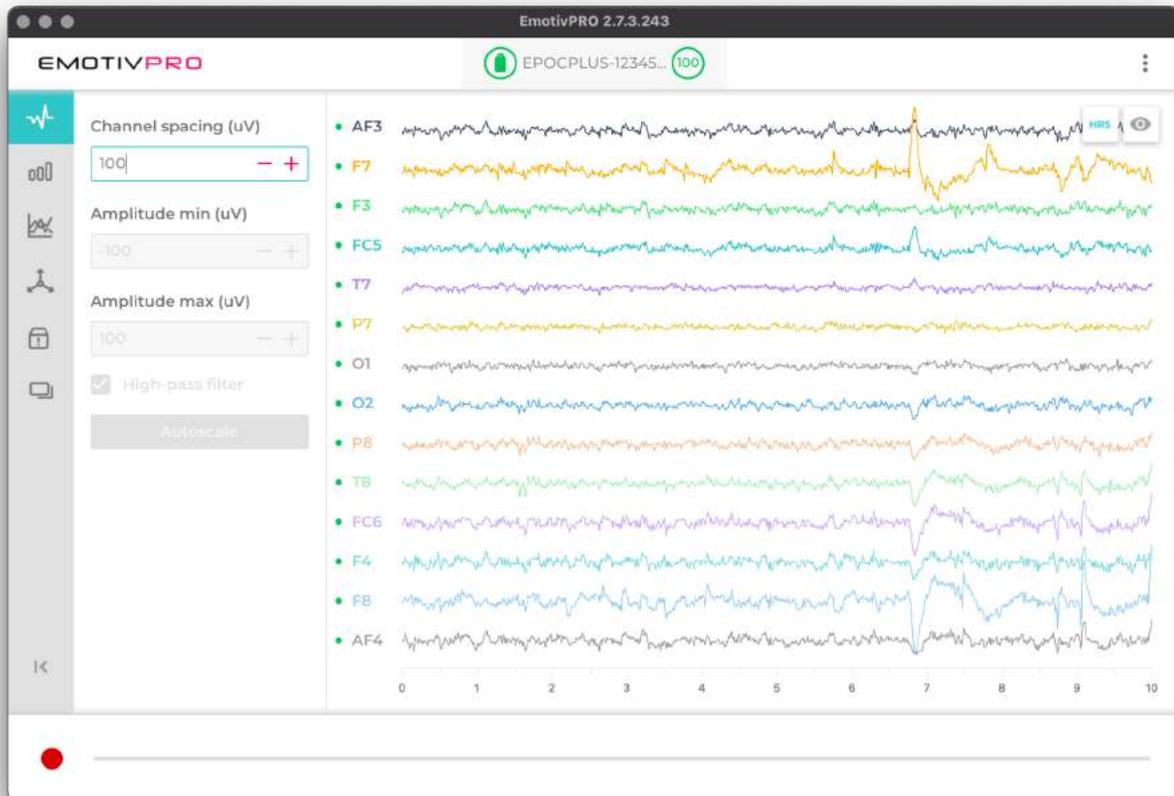
Note: EPOC Flex now supports Performance Metrics if you map the sensors in the EPOC X configuration.

Raw EEG

Raw EEG can be found in the menu on the left-hand side of the EmotivPRO screen.

Raw EEG displays the voltage fluctuations detected from each sensor on your headset.

Raw EEG graphs are displayed as uV per sample.



The channels shown include:

- EPOC, EPOC+ and EPOC X - 14 channels are shown.
- Insight - 5 channels are shown.
- EPOC Flex - up to 32 channels can be shown, depending on the configuration of the headset.

The resolutions shown include:

The resolution of raw EEG for Insight, EPOC and EPOC Flex headsets is 128 Hz and 14-bits. The resolution for EPOC+ and EPOC X is 16-bits and can be either 128 or 256 Hz depending on the headset's configuration. EPOC+ and EPOC X is 128 Hz when connected via Bluetooth.

How to turn channels on and off

So you can focus on the data you are interested in, you can turn individual channels on and off in the Raw EEG view.

To do this:

1. Click on the eye icon at the top-right hand corner of the screen.
2. The show/hide channel pop-up box will appear.
3. Select the channel(s) that you do not want to see.
4. To close the pop-up box, click anywhere outside of the box.



How to toggle all channels on and off

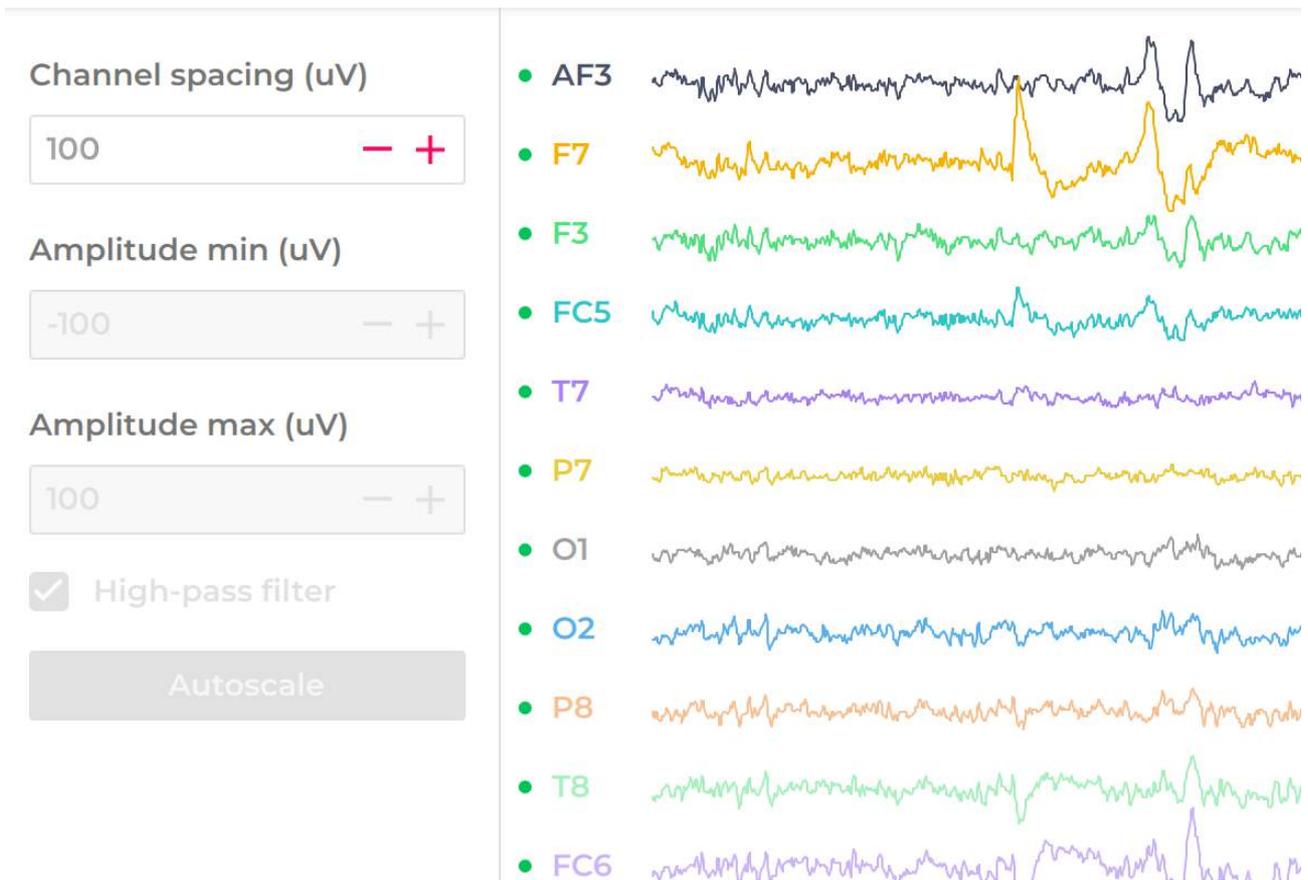
You can toggle all EEG channels on and off in the Raw EEG view.

To do this:

1. Click on the eye icon at the top-right-hand corner of the screen.
2. The show/hide channel pop-up box will appear.
3. Click on the **Toggle All** button in the pop-up.
4. To close the pop-up box, click anywhere outside of the box.
5. To view a single-channel, deselect all channels but the channel you want to see.

How to customize EEG graph scaling

Using the controls on the left-hand side of the Raw EEG view, you can configure the vertical scaling of your EEG graphs. You can do this for multiple channels and single channels. Your configurations will be saved locally for the next time you use EmotivPRO.



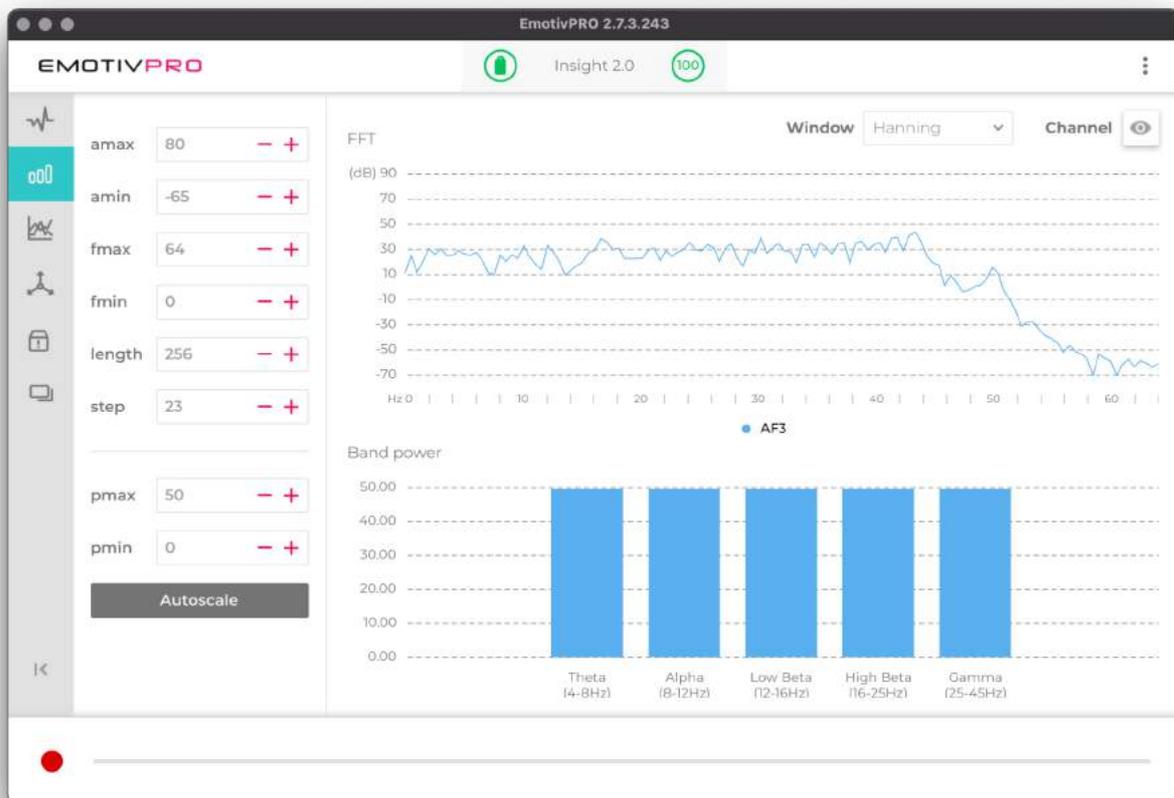
- **Channel Spacing** - Adjusts the height of the display area of a channel in the multi-channel display mode. This changes the vertical resolution of the display when more than one channel is selected.
- **Amplitude min** - Single channel display only. Defines the lower limit of the value displayed in single channel display mode.
- **Amplitude max** - Single channel display only. Defines the upper limit of the value displayed in single channel display mode.
- **Autoscale** - Single channel display only. Automatically aligns the upper and lower limit in line with the current channel values (lower limit is +/- 100 uV).
- **High-pass filter** - Removes the DC offset by applying a 0.16Hz high-pass filter and is activated by default. This filter can only be removed for single-channel display.

Frequency Bands

How to view frequency information

Frequency Analysis can be found in the menu on the left-hand side of the EmotivPRO screen.

The Frequency Analysis view allows you to see frequency information of a single EEG channel.



Selecting an EEG channel

To select an EEG channel:

1. Click on the eye icon, next to Channel, at the top-right-hand corner of the screen.

2. A pop-up box will open showing the channels you can select
3. Click on the channels you want to see.
4. To close the pop-up box, click anywhere outside of the box.

Selecting a window

To select a window:

1. Click on the drop-down menu next to Window at the top right-hand corner of the screen.
2. Select either:
 - Hanning,
 - Hamming,
 - Hann,
 - Blackman, or
 - Rectangle.



Fast Fourier Transform (FFT) graph

The graph at the top of the Frequency Information view displays an FFT analysis of the selected EEG channel as dB over frequency (Hz). You can adjust the parameters using the controls on the left-hand-side of the screen.

The parameters include:

- **amax, amin** - Adjust the maximum and minimum amplitude (dB) for the y-axis
- **fmax, fmin** - Adjust the maximum and minimum frequency (Hz) for the x-axis
- **length** - Adjust the transform length for the FFT analysis
- **step** - Adjust the step size for the FFT analysis

Band power graph

The bar graph at the bottom of the Frequency Information view displays the power of theta (4-8Hz), alpha (8-12Hz), low beta (12-16Hz), high beta (16-25Hz) and gamma (25-45Hz) frequencies for the channel selected.

You can adjust the parameters using the controls at the bottom left-hand-side of the screen.

The parameters include:

- **pmax, pmin** - Adjust the maximum and minimum amplitude for the y-axis
- **autoscale** - Automatically scale the data to fit the max value on the y-axis and update the y-axis appropriately

You can choose to export the time series values of these five frequency bands for each sensor on your headset when you export data. You can view the format of these files [here](#).

Performance Metrics

Performance Metrics can be found in the menu on the left-hand side of the EmotivPRO screen.

The Performance Metrics view displays the EMOTIV Performance Metrics algorithms.



Performance Metrics data is displayed in EmotivPRO on a scaled axis from 0 to 100. Exported data files for performance metrics contain both the scaled and unscaled versions of the data.

Please note: Performance Metrics for EPOC FLEX can only be supported when its sensors are mapped to the EPOC X sensor configuration.

Performance Metrics graphs include six metrics for Emotiv's Insight, EPOC+, EPOC X, and EPOC Flex (only when mapped to the EPOC X configuration) headsets.

The performance metrics include:

- **Stress (FRU)** measures how comfortable you are with a task. High stress can result from an inability to complete a difficult task, feeling overwhelmed, and fearing negative consequences for failing to satisfy the task requirements. Generally a low to moderate level of stress can improve productivity, whereas a higher level tends to be destructive and can have long term consequences for health and well-being.
- **Engagement (ENG)** is experienced as alertness and the conscious direction of attention towards task-relevant stimuli. It measures the level of immersion in the moment and is a mixture of attention and concentration and contrasts with boredom. Engagement is characterized by increased physiological arousal and beta waves along with attenuated alpha waves. The greater the attention, focus, and workload, the greater the output score reported by the detection.
- **Interest (VAL)** is the degree of attraction or aversion to the current stimuli, environment, or activity and is commonly referred to as Valence. Low interest scores indicate a strong aversion to the task, high interest indicates a strong affinity with the task while mid-range scores indicate you neither like nor dislike the activity.
- **Excitement (EXC)** is an awareness or feeling of physiological arousal with a positive value. It is characterized by activation in the sympathetic nervous system which results in a range of physiological responses including pupil dilation, eye widening, sweat gland stimulation, heart rate and muscle tension increases, blood diversion, and digestive inhibition. In general, the greater the increase in physiological arousal the greater the output score for the detection. Excitement detection is tuned to provide output scores that reflect short-term changes in excitement over time periods as short as several seconds.
- **Focus (FOC)** is a measure of fixed attention to one specific task. Focus measures the depth of attention as well as the frequency that attention switches between tasks. A high level of task switching is an indication of poor focus and distraction.
- **Relaxation (MED)** is a measure of an ability to switch off and and recover from intense concentration. Trained meditators can score extremely high relaxation scores.

Performance metrics are supplied at 0.1Hz for data export, playback, and preview in EmotivPRO.

How to turn performance metrics on and off

To focus on a particular performance metric, you can turn individual performance metrics on and off.

To select which performance metrics you want to focus on:

1. Click on the eye icon at the top-right-hand corner of the screen.
2. A pop-up box will open showing the performance metrics you can select.
3. Click on the performance metrics you want to see.
4. To close the pop-up box, click anywhere outside of the box.

How to toggle all performance metrics

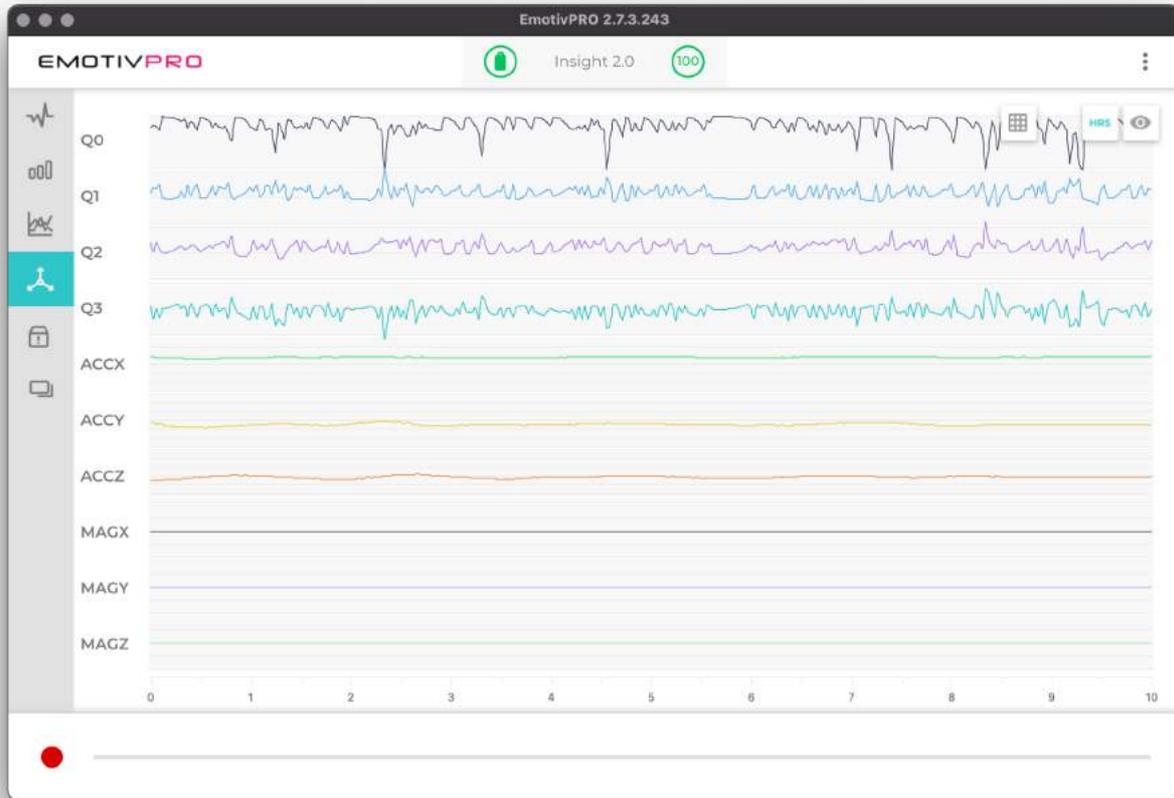
The toggle feature allows you to see all or none of the performance metrics.

To use the toggle feature, you need to:

1. Click on the eye icon at the top-right-hand corner of the screen.
2. A pop-up box will open showing the performance metrics you can select
3. Click on the Toggle button. This will either select or unselect all performance metrics.
4. To close the pop-up box, click anywhere outside of the box.

Motion

Motion can be found in the menu on the left-hand side of the EmotivPRO screen.



The Motion tab displays the motion sensor data. Motion sensor data shows your headset's position and orientation using a combination of absolute orientation (magnetometer), acceleration (accelerometer), and rotation vectors (quaternion) data in a ten-channel time series graph.

Please note: EPOC Flex does not support motion sensor data.

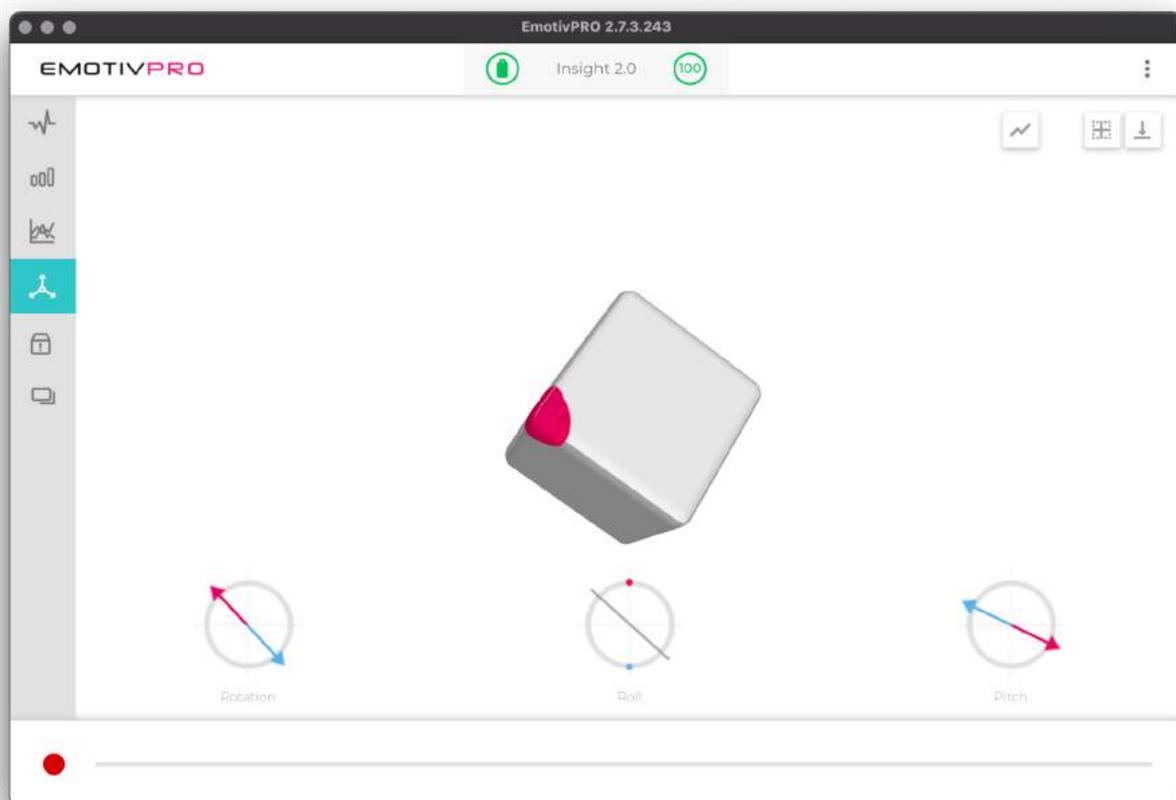
3D visualization

You can choose to view a 3D visualization of the motion sensor represented by a cube. The cube represents accurate rotation of the device along the X, Y and Z axes.

To calibrate the cube, turn your headset on and click the Calibrate button—this sets the cube to position 0.

The mirrored display is automatically selected so that the pink marker points towards you when your headset is worn correctly. If the mirrored option is not selected, the pink pointer will face away from you and the blue marker will point towards you.

Rotation, roll, and pitch of the cube



Rotation

The rotation gauge represents the cube's rotation along the Y axis (also known as pointing direction). Position 0 is set with the arrow in a vertical position on the gauge.

Roll

The roll gauge represents the cube's rotation along the Z axis. It can also be described as

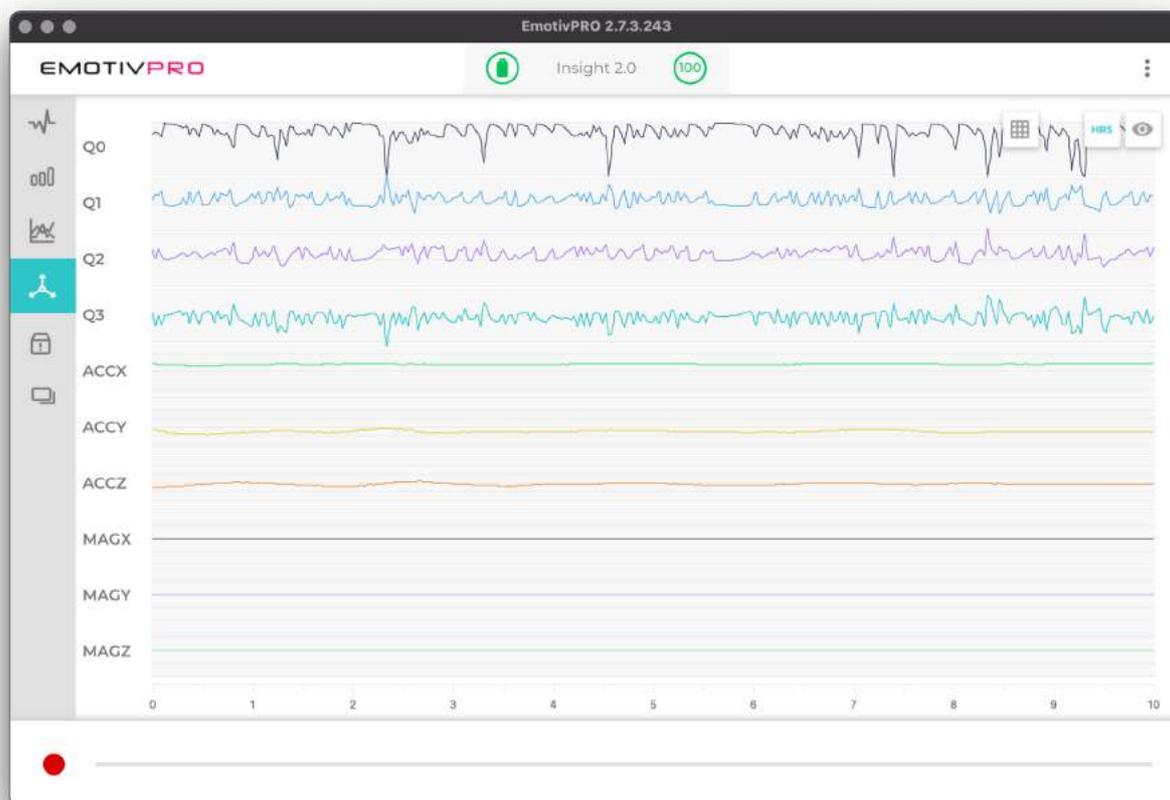
roll left or roll right. The pink and blue dots on the gauge stay in the fixed position. Position 0 is set in a horizontal position on the gauge.

Pitch

The pitch gauge represents the cube's rotation along the X axis. It can also be described as tilt up or tilt down. Position 0 is set in a horizontal position on the gauge.

Please note: For older EPOC+ headsets, (Firmware <0x633) motion sensors display data concerning your headset's position and orientation using a (gyroscope), acceleration (accelerometer) and absolute orientation (magnetometer) measurements.

Motion sensor graph



The motion tab window shows a graph of the connected headsets' various measured outputs. All headsets manufactured since 2018 feature the same 9-axis inertial measuring

unit the invensense ICM-20948. We chose this part because it has sensor fusion processing where the various sensors are measured and rotational vectors called quaternions (Q0-Q3) are calculated so it is easier for understanding head movement. We have also included the raw outputs from the accelerometer and magnetometer. The only exception is MN8 which does not have a magnetometer.

Older headsets (EPOC+ / INSIGHT 2015-2018) are still supported but output raw 9-axis data for acceleration, gyroscope and magnetometer which researchers will need to post-process. Original EPOC devices are also supported but only feature gyroscope X and Y channels.

The outputs shown on the window are also exported in the same order. They are:

- Quaternion 0, 1, 2, 3 - rotational vector representation of head position.
- AccX, AccY, AccZ - acceleration in X, Y, Z directions.
- MagX, MagY and MagZ - magnetometer in X, Y and Z directions
- GyroX, GyroY and GyroZ - gyroscope in X, Y and Z directions (Only older headsets have this output).

The resolution of motion sensor data for EPOC is 128 Hz and 12-bits, and for Insight headsets is 64 Hz and 14-bits. The resolution for EPOC+ and EPOC X is 16-bits and can be 32, or 64 (or OFF) depending on the headset's **configuration** and whether or not it is connected via Bluetooth. When EPOC+ or EPOC X is connected to EmotivPRO via Bluetooth, the rate is limited to 64 Hz. For EPOC Flex, the resolution of motion sensor data is 8 bits and the sampling rate is 16 Hz. EPOC headsets include GyroX and GyroY sensors only. Y-axis is samples.

Motion data resolution

EPOC - 128 Hz and 12-bits.

Insight - 64 Hz and 14-bits.

EPOC+ and EPOC X - 16-bits (but it can be 32 or 64 (or OFF)) depending on the headset's configuration and whether or not it is connected via Bluetooth. When EPOC+ or EPOC X is connected to EmotivPRO via Bluetooth, the rate is limited to 64 Hz.

EPOC Flex - 16 Hz and 8-bits.

How to turn channels on and off

You can turn individual channels on and off in the motion sensor view to focus on the data you are most interested in. To do this:

1. Click on the eye icon at the top-right-hand corner of the screen.
2. A pop-up box will open showing the channels you can select.
3. Select the channels that you want to see
4. To close the pop-up box, click anywhere outside of the box.

How to toggle all channels on and off

The toggle feature allows you to see all or none of the channels.

To use the toggle feature, you need to:

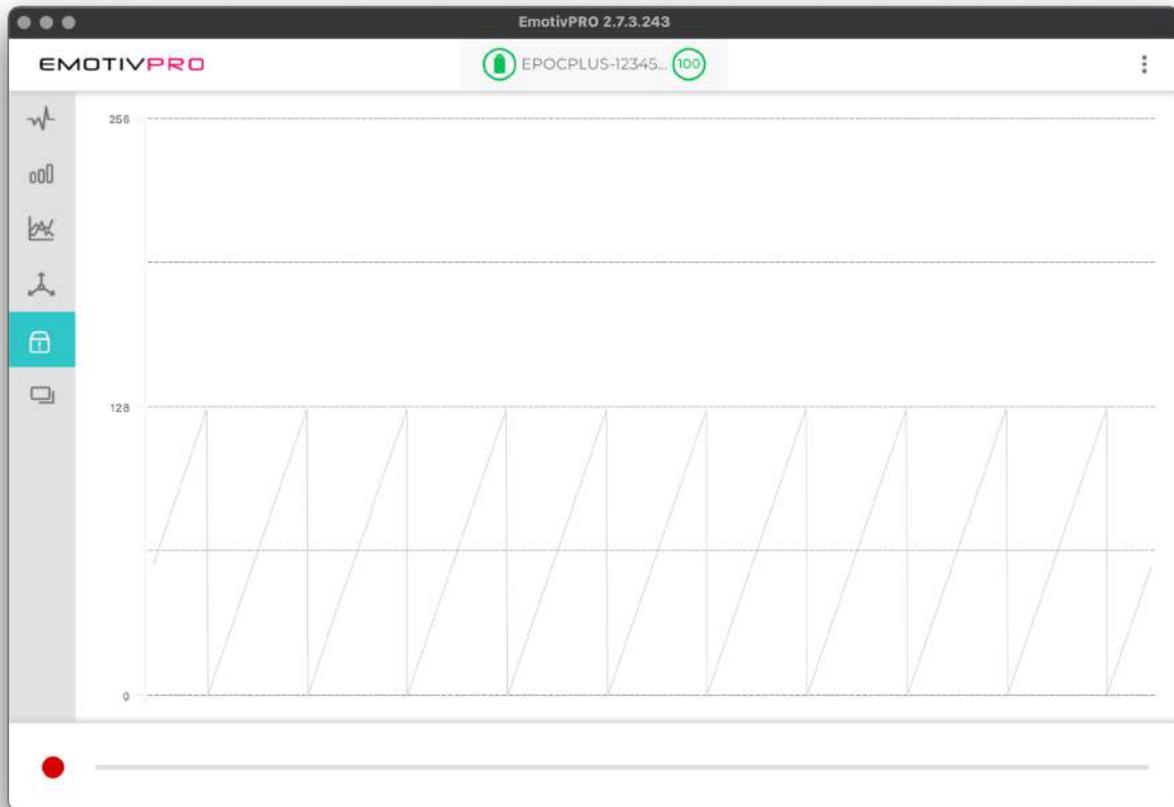
1. Click on the eye icon at the top-right-hand corner of the screen.
2. A pop-up box will open showing the performance metrics you can select
3. Click on the Toggle button. This will either select or unselect all performance metrics.
4. To close the pop-up box, click anywhere outside of the box.



Data Packets

Data Packets can be found in the menu on the left-hand side of the EmotivPRO screen.

Data Packets shows you the number of data packets that are successfully transferred from your headset's sensors to your computer and how many are dropped.



Gray sawtooth line(s) show a repeating one-second cycle of the data collected from your headset, at either 128 Hz or 256 Hz. The samples are drawn over time, depending on your headset's frequency rate. Evenly spaced sawtooth lines represent good data collection. Unevenly spaced sawtooth lines represent significant packet loss.

Pink vertical lines mark the times when data packets are dropped. The numbers under the pink lines indicate the number of data packets lost.

Data packet loss

If you are experiencing a high degree of packet loss:

- Try using a USB extender to connect your headset's dongle to your computer. Doing this can reduce interference from your computer's power supply. Keep the dongle at your line of sight and keep it away from other electronics (such as TVs, phones, routers), if possible.
- If you're connecting your headset to your computer via Bluetooth, try reducing the number of other Bluetooth devices connected to your computer.
- If you're using EPOC+ or EPOC X, you can try reducing the frequency rate of your headset.
- If you're using EPOC+ or EPOC X and you're losing data, try turning motion data off.

Recordings

About recordings

EmotivPRO allows you to take recordings of all data streams for playback, analysis and export.

You can take recordings in any of EmotivPRO's data stream views (Raw EEG, Performance Metrics, Motion Sensors, FFT/Band Power and Data Packets). You can view the EEG data streams while you're recording.

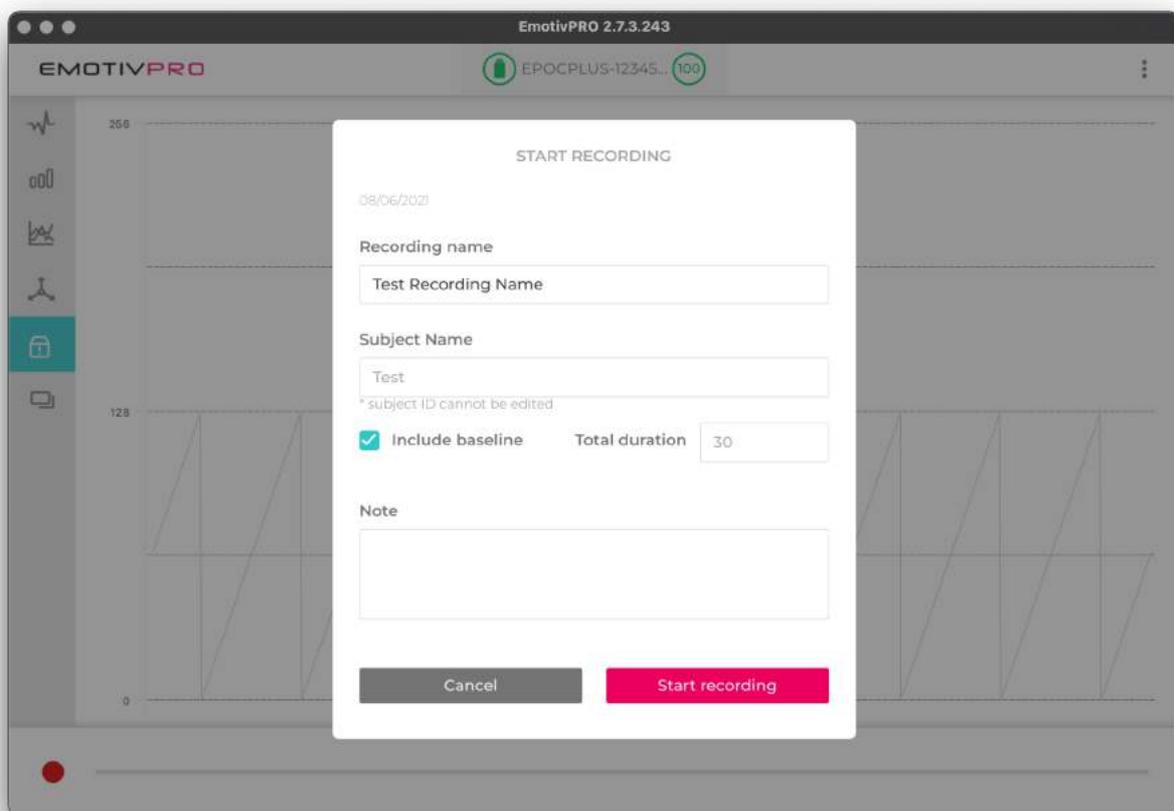
Starting and stopping a recording

1. Before you start a recording, check your headset's battery level and contact quality.
2. To start your recording, press the record button at the bottom left-hand corner of the screen.
3. A pop-up box will appear on the screen. Enter a name for your recording (required) and a SubjectID (required). Previously used Subject Id's will show up as a suggestion in the Subject ID field while you type.
4. Click on the Start Recording button and recording will begin.
5. To stop a recording, click on the stop button at the bottom left-hand corner of the screen.

Please note: EmotivPRO will not record data while your computer is in sleep mode. Disable your computer's sleep mode before you start a data recording.

Baseline recording

EmotivPRO gives you the option to take a baseline recording at the start of each recording session. A baseline recording is a short recording of the subject with their eyes open and with their eyes closed. This standardized recording provides a way to make comparisons across recordings from different people or across the same people on different days. Additionally, these recordings are stored by EMOTIV and may one day be used to provide insights into brain aging or other basic science.



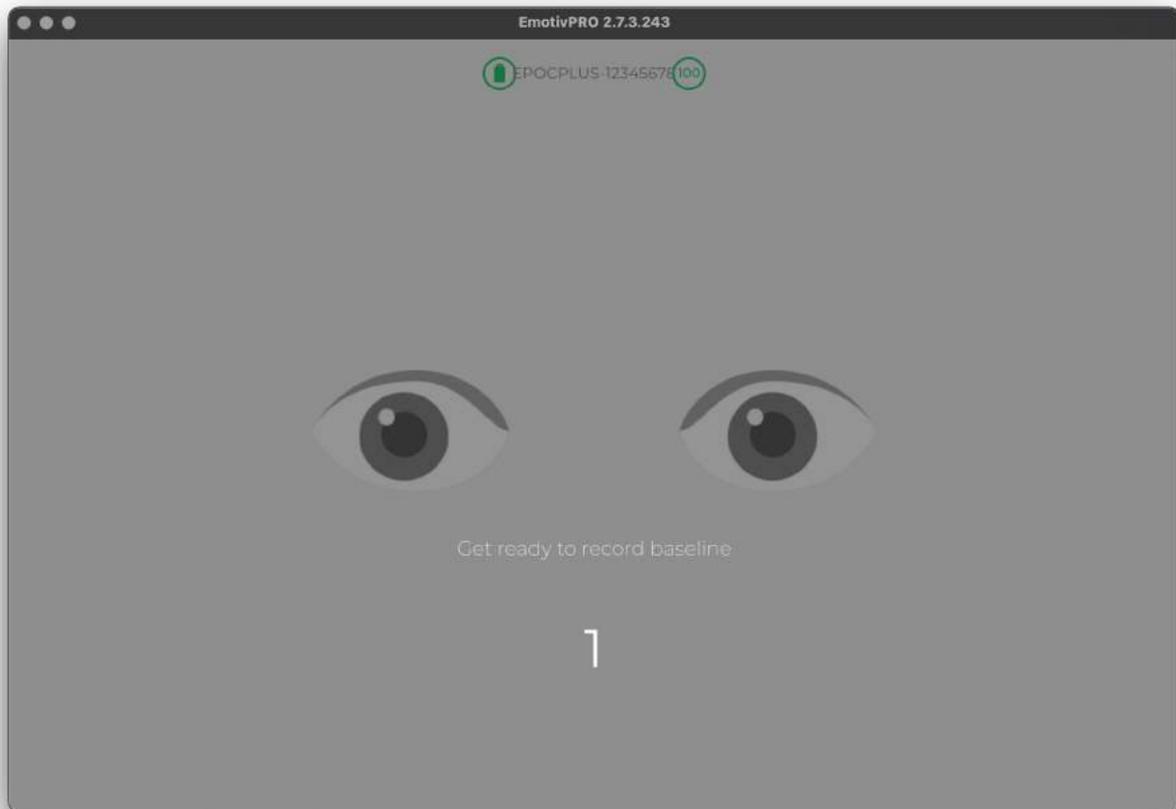
To enable baseline recording, select **Include baseline** in the Start Recording window. Baseline recording is automatically set to 30 seconds in duration.

Baseline protocol

Once you click on Start Recording, the baseline protocol will start. The baseline protocol involves six different states:

1. 3 seconds preparation time, with countdown.
2. 15 seconds eyes open recording, with countdown.
3. 2 seconds completion screen.
4. 3 seconds preparation time, with countdown.
5. 15 seconds eyes closed recording, with countdown.
6. 2 seconds completion screen.

At the beginning and end of the eyes open and eyes closed phases, you will hear an audio cue.

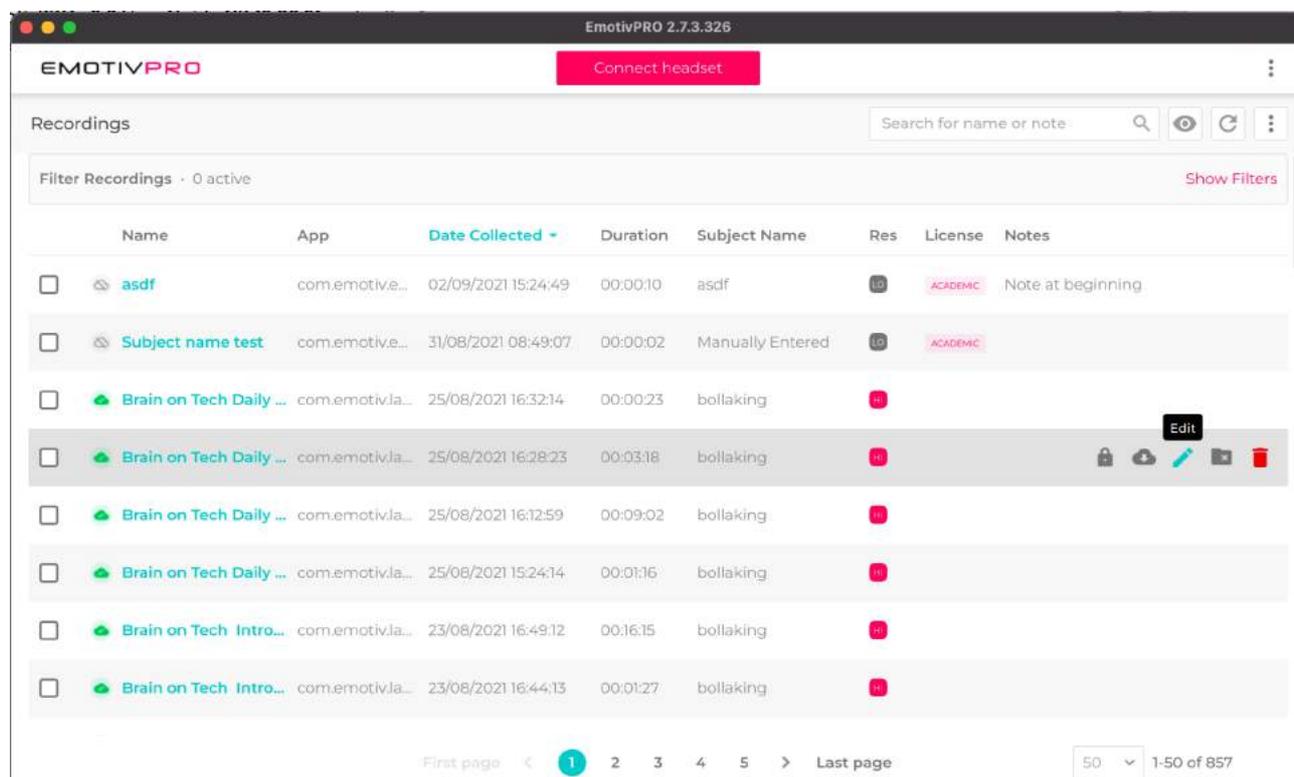


Once baseline recording is complete, your EEG data recording starts immediately.

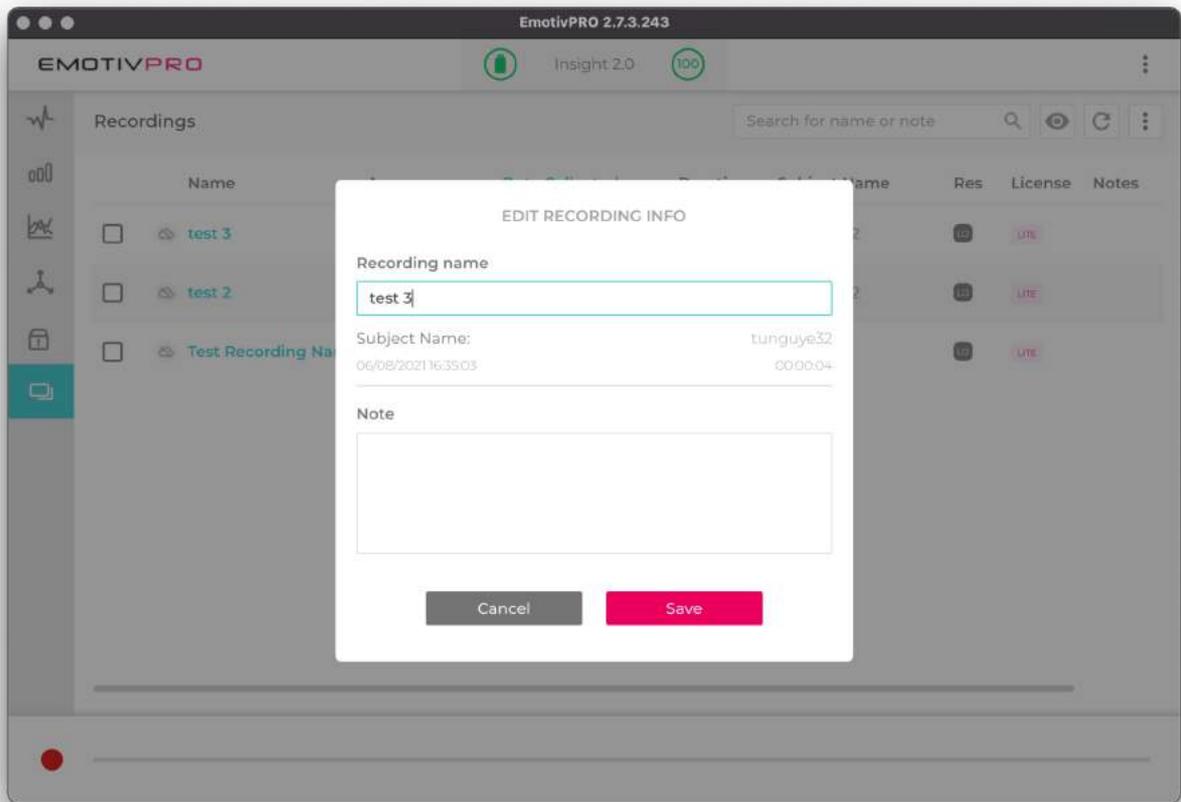
Adding a note to a recording

Once you stop an EEG data recording, you can add a note to it.

To do this:



1. Stop your recording in EmotivPRO. To do this, click on the stop button at the bottom left-hand corner of the screen.
2. Once the recording stops, a pop-up box will appear on screen.
3. Type a note about the recording into the dialog box. You can type up to 1000 characters into the dialog box.
4. Click on **Save** to save your note to the recording.
5. If you don't want to add a note to your recording, click on **Skip**.



Timer

The timer at the bottom of the EmotivPRO screen shows you the time elapsed during a recording. The time is shown in hours: minutes: seconds.



00:01:22



Event markers

About event markers

You can add event markers to specific events or areas of interest while recording your EEG data. Adding event markers means you can easily find events during playback or analysis.

EmotivPRO allows you to insert markers into the data stream manually via your computer's keyboard, or via to a serial port (or virtual serial port), USB port or Extender to allow other applications to present stimuli and mark the events automatically. Any marker entered will display in the data stream and on the recording timeline during playback and will be indicated alongside other data streams in the application's exported CSV files.

Baseline markers

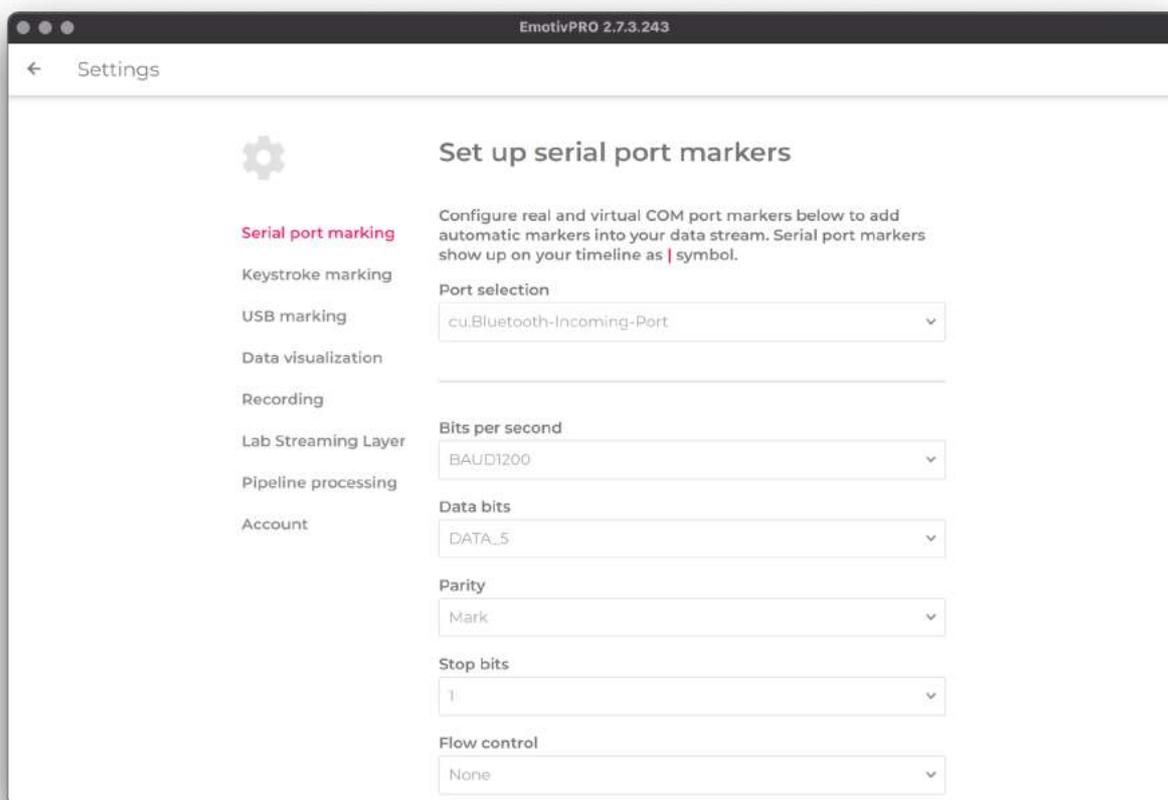
The beginning and end of the eyes open and eyes closed periods are recorded via markers in data stream as interval markers. An interval marker has a start time as well as a duration. The start times of all markers are shown as vertical pink lines in the EEG data recording shown in Raw EEG and Motion views. The exact location can be seen in the "markers" file that is exported with the data, if requested.

Serial port markers

EmotivPRO can receive automatic markers via serial ports (TTL and virtual), so that you can perform event-related experiments with high temporal precision.

To configure serial port markers using a real or virtual COM port:

1. Click on **Settings** which can be found at the top right-hand side of EmotivPRO.
2. Select **Serial port marking** from the menu on the left-hand side of the screen.
3. Select the configurations you need from each menu: COM port (real or virtual), bits per second (BAU), data bits, parity, stop bits, and flow control that are compatible with your sending device
4. Click on **Start** to save the configurations.
5. Click on the back arrow at the top left-hand corner of the screen to go back to the Recording screen.



You will see a vertical pink line in the data stream in Raw EEG, Performance Metrics and Motion Sensors views when a marker has been added successfully and will be able to view the markers in the recording timeline and exported data file.

Keystroke markers

Keystroke markers are an easy way to manually add event data into your data stream if high temporal precision of these markers is not a priority.

Keystroke marker settings are saved to your local device.

Adding a new keystroke marker

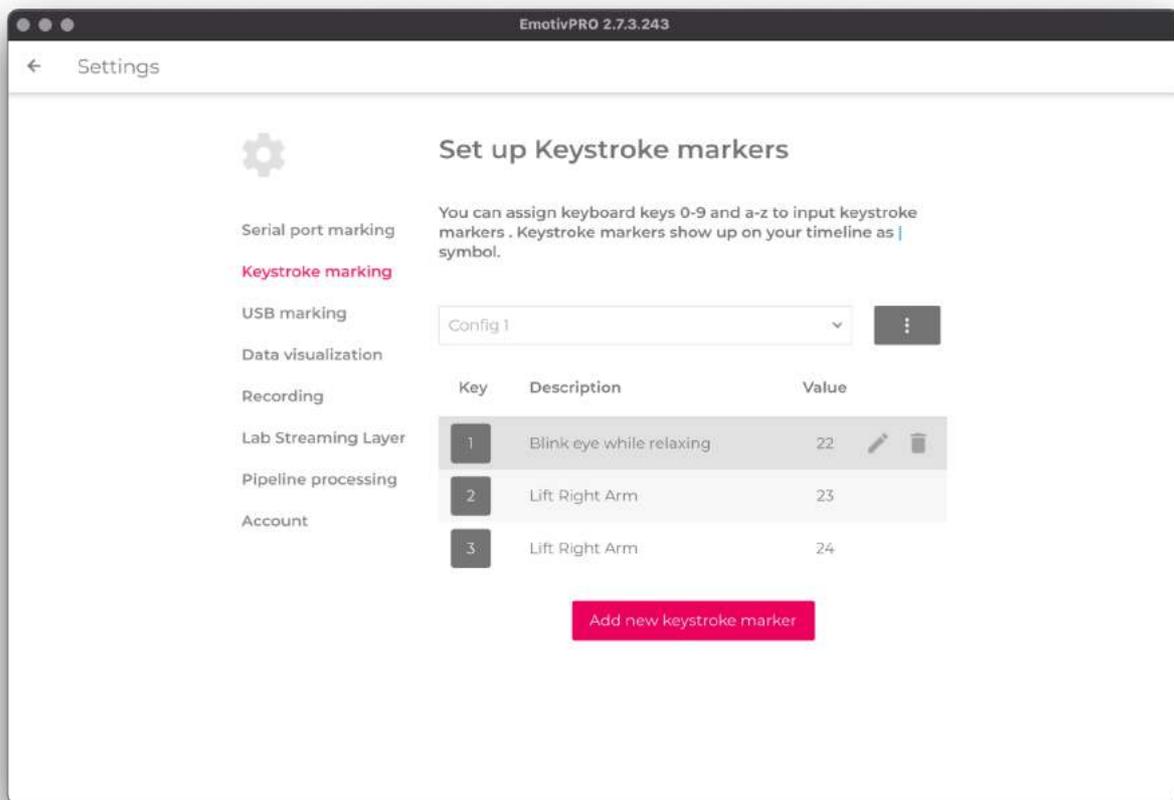
To add a new keystroke marker:

1. Click on **Settings** which can be found at the top right-hand side of EmotivPRO.
2. Click on **Keystroke marking** from the menu on the left-hand side of the screen
3. Click on **Add new keystroke marker**
4. Input values for:
 1. **Key** - the keystroke on your PC to activate the marker.
 2. **Description** - a summary or name for this marker.
 3. **Value** - a unique numeric value (integer between 0 and 255) that will represent this marker in the recording timeline and exported data file.
5. Click on **Add** to save your new keystroke marker.

Editing a keystroke marker

To edit a keystroke marker:

1. Hover your mouse over the keystroke marker you want to edit.
2. Click on the edit icon (pencil icon).
3. The Edit Keystroke Marker window will open. You can then edit the Keystroke, Label, and Value of your chosen keystroke marker.
4. Click on the Save button to save your changes.



Deleting a keystroke marker

To delete a keystroke marker:

1. Hover your mouse over the keystroke marker you want to delete.
2. Click on the trash can icon to delete the keystroke marker.

Keystroke marker configuration

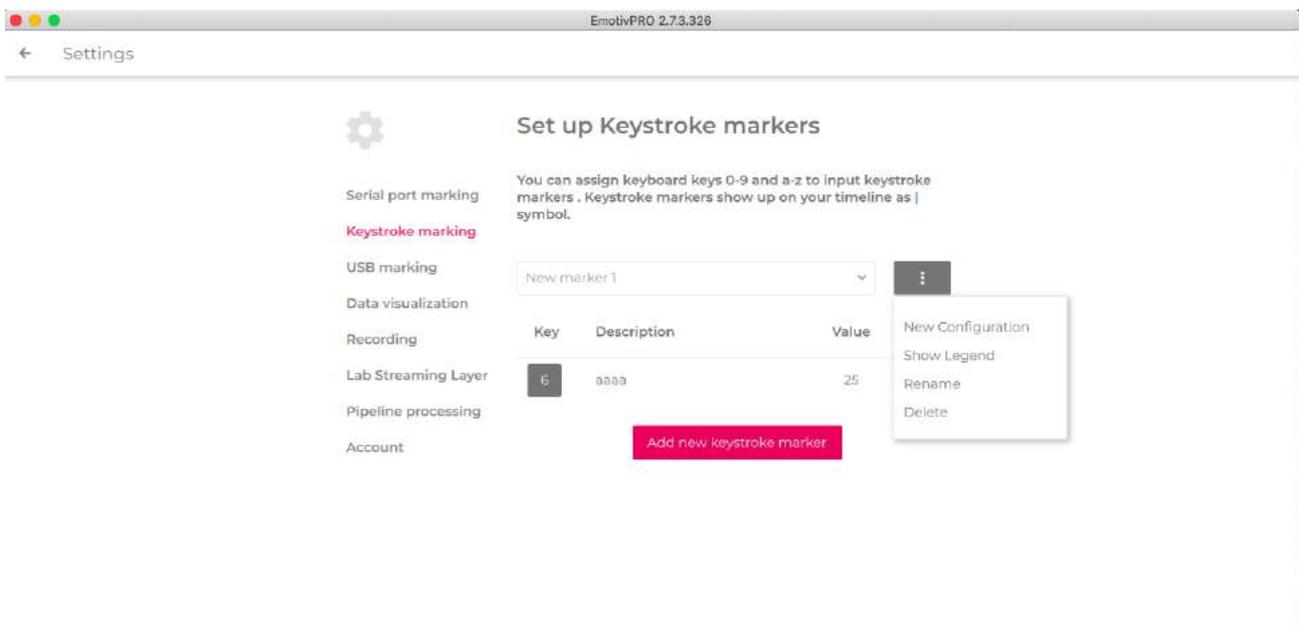
Keystroke marker configuration allows you to add your own keystroke marker settings to EmotivPRO and save them for future experiments.

Keystroke marker configurations are automatically saved to EMOTIV Cloud—so you can use them on any device with EmotivPRO.

Creating a new keystroke marker configuration

To create a new keystroke marker configuration:

1. Click on **Settings** which can be found at the top right-hand side of EmotivPRO.
2. Click on **Keystroke marking** from the menu on the left-hand side of the screen.
3. Click on the hamburger icon on the right-hand side of the screen.
4. Click on **New Configuration** at the top of the drop-down list.
5. Enter a name for your new keystroke marker configuration and click on **Create**.
6. Your new configuration will appear in the keystroke marker configuration drop-down list.



Selecting a keystroke marker configuration

To select a keystroke marker configuration:

1. Click on the keystroke marker configuration drop-down list
2. Then click on the keystroke marker configuration you need.

Renaming a keystroke marker configuration

To rename a keystroke marker configuration:

1. Go to the keystroke marker configuration drop-down list and click on the keystroke marker configuration you want to rename.
2. Click on the burger icon to the right-hand side of the list and click on **Rename**.
3. Enter a name for your new keystroke marker configuration and click on **Rename**.
4. The new name will appear in the drop-down list.

Deleting a keystroke marker configuration

1. Go to the keystroke marker configuration drop-down list and click on the keystroke marker configuration you want to delete.
2. Click on the burger icon to the right-hand side of the list and click on **Delete**.
3. A pop-up box will appear on screen asking you if you want to delete the keystroke marker configuration. Click on **Yes, delete!**
4. The keystroke marker configuration is now deleted.

How to open the keystroke marker configuration legend

The keystroke marker configuration legend can remind you of the keystrokes you need during an EEG data recording session. The legend opens in a separate window and can be placed anywhere on the screen.

To open the keystroke marker configuration legend:

1. Go to the keystroke marker configuration drop-down list and click on the keystroke marker configuration you want to see.
2. Click on the burger icon to the right-hand side of the list and click on **Show Legend**.
3. Once open, you can place the legend anywhere on the screen.

How to add markers to your EEG data stream while recording

There are two ways you can add event markers to an EEG data stream recording:

Typing the number associated with the event

To add markers to your EEG data stream while recording, type the number associated with the marker on your keyboard at the time of the event. When you type the number, a vertical pink line will appear in the data stream.

Adding a marker with a mouse click

To add a marker to an EEG data stream recording with a mouse click, you need to:

1. Open the keystroke marker configuration legend (to do this, see [How to open the keystroke marker configuration legend](#)).
2. Place the legend in a suitable place on the screen.
3. Each time you need to mark an event in an EEG data stream, click on the appropriate keystroke marker in the legend. You'll then see a pink vertical line appear in the data stream to mark the event.

You can add markers to Raw EEG, Performance Metrics, and Motion views, so you can easily see the event when you review the recorded EEG data.

USB markers

To configure markers sent by a USB device:

1. Click on **Settings** which can be found at the top right-hand side of EmotivPRO.
2. Click on **USB marking** from the menu on the left-hand side of the screen.
3. Go to the USB Device drop-down list and select the USB device you want to connect.
4. If you don't see the USB device you're looking for in the drop-down list, click on **Refresh device list**.
5. Once you've selected a USB device, click on **Start**.

Please note:

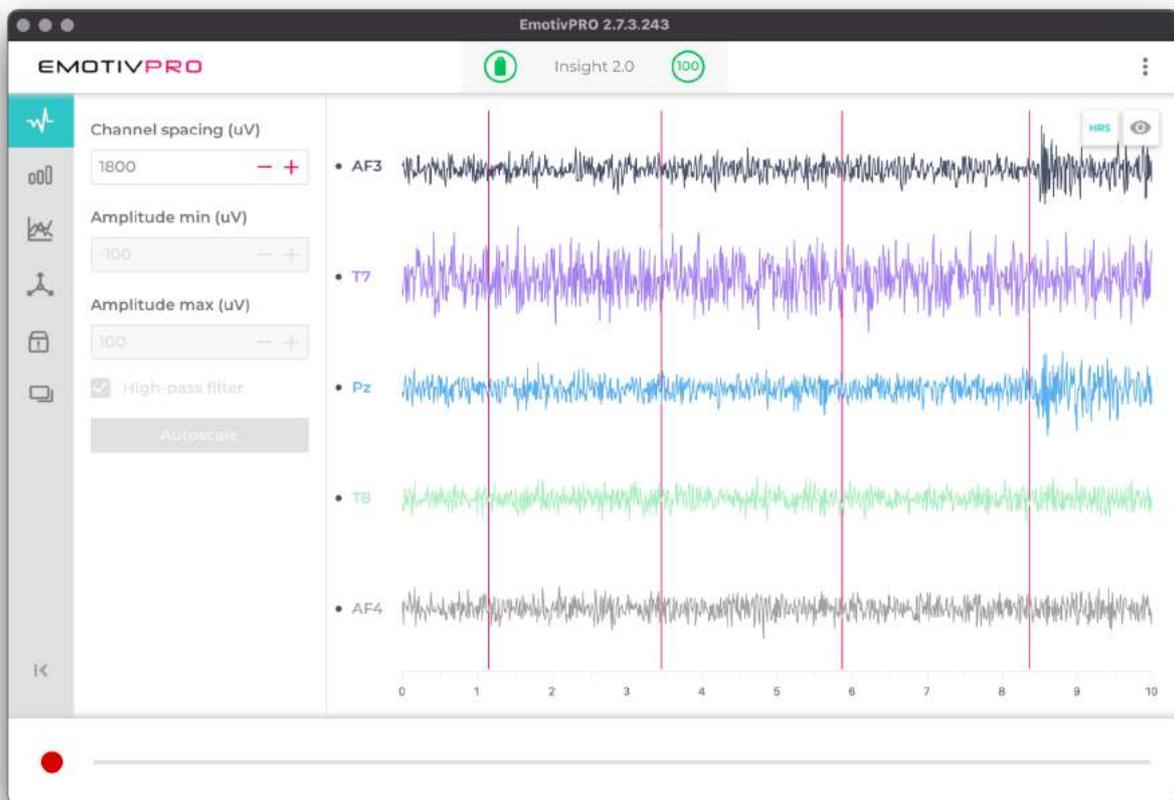
- USB mice and USB keyboards are not supported.
- Marker values from a USB port are in the range of 0 to 127.

You will see a vertical pink line in the data stream in Raw EEG, Performance Metrics and Motion Sensors views when a marker has been added successfully and will be able to view the markers in the session timeline and exported data file.

EMOTIV Extender triggering

EMOTIV Extender's hardware triggering feature allows you to mark external events for post-processing. The input trigger pulses are injected into a headset's data stream within +/-1 sample. There is a fixed 60ms delay between the trigger and the channel signal data which is due to the filter delay for the channels.

The trigger pulse is shown in EmotivPRO as a pink line and is also saved in the hardware column when exporting a file.



Every EMOTIV Extender comes with a 1m trigger cable. The cable has two tinned wires: red and black that can be connected to an external trigger source. The input polarity of the trigger is reversible and utilizes an opto-coupled photo transistor Vishay VOL628A (see [datasheet](#)). This component requires a minimum of 1mA forward current and maximum of 60mA. The input design has an internal limiting resistor of 1kOhm. The trigger input voltage needs to be between 2.5 and 15V, and can be driven directly from an Arduino or a parallel

port.

Please see the [Extender User Manual](#) for details.

Managing your EEG data recordings

Recordings history list

The recording history list shows you all of the EEG data recordings you have made while subscribing to your EmotivPRO license.

The list shows you the:

- name,
- Subject ID,
- date of recording,
- duration of recording, and
- recording notes

for each EEG data recording.

Sorting and searching your EEG data recordings

You can sort your EEG data recordings by:

- Name,
- Subject ID, or
- Duration.

To sort your EEG data recordings, click on the up/down arrows next to the category.

You can also search for an EEG data recording using the search box at the top right-hand corner of the screen.

Cloud synchronization

All EEG data recordings made in EmotivPRO are saved locally, so your computer does not need to be connected to the internet to access them after a recording.

You also have the option to save your EEG data recordings to EMOTIV Cloud automatically. When you choose to save your EEG data recordings to EMOTIV Cloud, you can also access them on other computers that share your EmotivPRO license (if applicable).

EEG data recordings that are **only** saved locally (you have opted out of cloud synchronization) cannot be accessed on other devices that share your EmotivPRO license.

Opting out of cloud synchronization

To opt out of your EEG data recordings being saved to EMOTIV Cloud:

1. Click on **Settings** which can be found at the top right-hand side of EmotivPRO
2. Click on **Recording** from the menu on the left-hand side of the screen.
3. Click on opt out to stop your EEG data recordings from being saved to EMOTIV Cloud.

Playing an EEG data recording

To play an EEG data recording:

1. Open the Recordings view in EmotivPRO. You will see a list of your saved EEG data recordings.
2. Find the EEG data recording you want to play from the recordings list.
3. Click on the EEG data recording you want to play.
4. The EEG data recording will start playing automatically.
5. To move to a particular time point in the recording, move the scrubber (the pink circle) left or right along the timeline. The time point of the scrubber is shown next to the recording duration at the bottom left-hand corner of the screen.
6. While a recording is playing you can pause it at any time.

You can play a recording for all data views – Raw EEG, Performance Metrics, Motion Sensors, Data Packets and FFT/Band Power – at 1x speed.

Recording timeline

When a recording is playing, you will see the recording timeline along the bottom of the screen.

At the top of the screen you will see information about your recording—name of the recording, date it was recorded, time, and headset used (including contact quality scoring).

Timeline markers

If you added markers to a recording, icons for the markers are placed on the recording timeline.

The markers include:

- Pink tags - serial port markers or USB markers
- Blue lines - keystroke markers

At the time of a marked event, you will also see vertical lines in the data stream. The vertical lines are shown in Raw EEG, Performance Metrics, and Motion Sensors streams.

Baseline recording playback

When playing an EEG data recording, the baseline recording in the data stream—15 seconds for eyes closed and 15 seconds for eyes open— is shown in the shaded area.



Deleting an EEG recording

To delete an EEG recording:

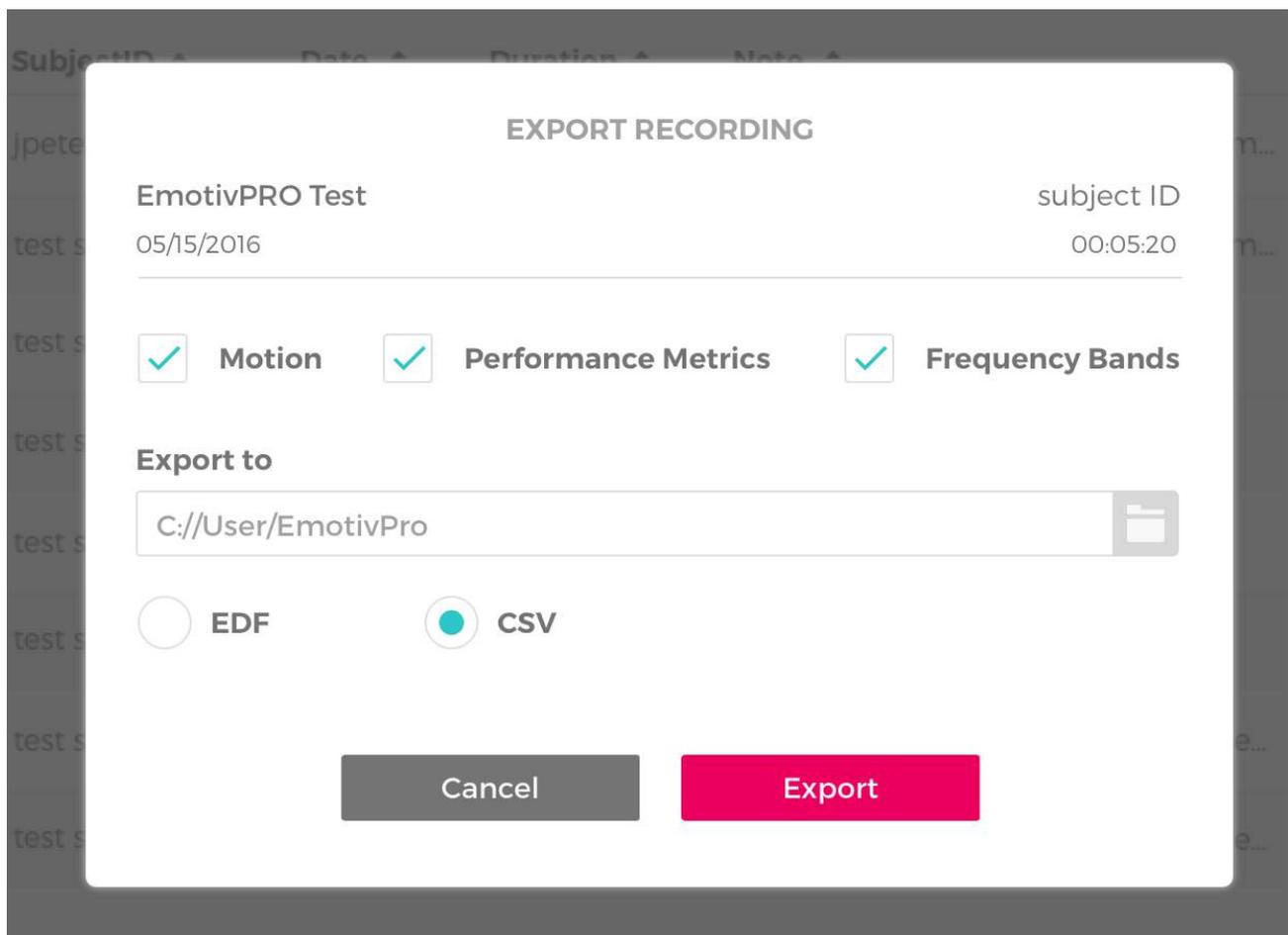
1. Go to the Recording view in EmotivPRO.
2. Find the EEG data recording you want to delete from the list.
3. Hover your mouse over the EEG data recording you want to delete.
4. To the right-hand side of your selected recording you will see a trash can. Click on the trash can.
5. A window will open asking you to confirm that you want to delete the recording. Click on Delete.
6. The recording is now deleted.

Please note: Deleting an EEG data recording will only remove it locally and from your Recordings list. Deleted recordings are still available to view on other computers that share the same EmotivPRO license.

Exporting an EEG data recording

To export an EEG data recording so you can analyse it in another software program:

1. Go to the Recording view in EmotivPRO.
2. Find the EEG data recording you want to export from the list.
3. Hover your mouse over the EEG data recording you want to export.
4. To the right-hand side of your selected recording you will see a cloud. Click on the cloud.
5. A window will open on the screen with different data export options. Select or unselect additional data streams you want to export (EEG data is always exported), choose a folder to export the EEG data recording to, and choose whether you want your data exported as a CSV or EDF file.
6. The EEG data will be exported to the chosen folder.



Exporting EEG data recordings containing keystroke markers

If the EEG data recording you're exporting contains keystroke markers, a JSON file is also exported. The JSON file contains the descriptions for the keystroke markers, their corresponding values in the EDF and CSV files.

For more information about formatting EDF and CSV files, visit the [Exported Data Files](#) section of this user guide.

Please note: EmotivPRO currently only supports Raw EEG and Frequency Analysis for EPOC Flex.

EDF files

EEG and motion data are stored by EmotivPRO in a standard binary format, EDF, which is compatible with many EEG analysis programs. Following the initial information line, each successive row in the data file corresponds to one data sample, or 1/32, 1/64, 1/128 or 1/256 second time slice of data (depending on your headset's frequency rate and if the data file is EEG or motion data). Successive rows correspond to successive time slices and each column of the data file corresponds to to an individual sensor location or other information tag.

Emotiv PRO exports your record in 2 separate EDF files:

- 1 file with the EEG data, the contact quality and the EEG quality
- 1 file with the motion data

These EDF files follow the [EDF specification](#).

Columns of the EEG file

The EEG file includes these columns:

Column name	Value
TIME_STAMP_s	See below for details
TIME_STAMP_ms	See below for details
COUNTER	Increment by 1 for each sample, reset to zero every second.
INTERPOLATED	0 if this EEG sample was received from the headset. Greater than 0 if this sample was interpolated by Cortex.
<sensor>	
Examples: AF3, T7, Pz, T8	For each EEG sensor, you get 1 value in microvolt.

BATTERY	The battery level of the headset, from 0 to 4.
BATTERY_PERCENT	The battery level of the headset, from 0 to 100. It has the same purpose as the column "Battery", but it is more precise.
MARKER_HARDWARE	1 if a hardware marker was received for this EEG sample. 0 otherwise. Hardware markers are created with the Extender .
CQ_<sensor> Examples: CQ_AF3, CQ_T7, CQ_Pz, CQ_T8	The contact quality of each EEG sensor, from 0 to 4.
CQ_OVERALL	The overall contact quality is a value from 0 to 100 that is calculated from the contact quality of all the EEG sensors.
EQ_<sensor> Examples: EQ_AF3, EQ_T7, EQ_Pz, EQ_T8	The EEG quality of each EEG sensor, from 0 to 4.
EQ_SampleRateQua	A float value from 0 to 1 that evaluates the actual sample rate of the EEG data coming from the headset. If the wireless connection between the headset and the computer is perfect (no data loss) then the sample rate quality is 1. If X percent of the EEG samples were lost over the last 2 seconds, then the SRQ is $(100 - X) / 100$. If we lost more than 300 ms of data over the last 2 seconds, then the SRQ takes the special value -1.
EQ_OVERALL	A value from 0 to 100 that is calculated from the EEG quality of all the EEG sensors.

Columns of the motion file

When you export a recording, you will also get an EDF file for the motion data (named "xxx.md.edf"), if that data was collected from your headset. This file is in the same format as the EEG file and with the same descriptive tags.

Column name	Value
TIME_STAMP_s	See below for details
TIME_STAMP_ms	See below for details
COUNTER_MEMS	Increment by 1 for each motion sample, reset to zero every second.
INTERPOLATED_MEM	0 if this motion sample was received from the headset. Greater than 0 if this sample was interpolated by Cortex.
Q0, Q1, Q2, Q3	Quaternions of the gyroscope (newer EMOTIV headsets)
GYROX, GYROY, GYROZ	X, Y, Z axis of the gyroscope (older EMOTIV headsets)
ACCX, ACCY, ACCZ	X, Y, Z axis of the accelerometer.
MAGX, MAGY, MAGZ	X, Y, Z axis of the magnetometer.

The timestamp columns

The EDF files includes 2 columns named "TIME_STAMP_s" and "TIME_STAMP_ms". You need to combine them in order to get a usable timestamp for each sample:

$$\text{RELATIVE_TIME} = \text{TIME_STAMP_s} + (\text{TIME_STAMP_ms} / 1000)$$

RELATIVE_TIME is the number of seconds elapsed since the beginning of the record. So it means that the first EEG sample of record has a relative timestamp of zero. The relative timestamp of the last EEG sample gives you the duration of the record.

To get the start date and time of the record, you can read the fields `startdate` and `starttime` from the **header of the EDF file**. However, the field `starttime` has a precision of 1 second, which is not enough to combine it with the relative timestamps.

Instead, you should read the field `reserved` of the EDF header. This field stores the start date and time of the record as a string, with a precision of 1 microsecond.

The format is `YYYY-MM-DDThh:mm:ss.mmmmmm+TIMEZONE`

Example: `2020-06-19T15:36:47.256794+07:00`

CSV files

Header

The CSV file has a header made of 2 lines. The first line contains information about the record and its data streams. The second line is a classic CSV header with the name of the columns.

First line

The first line of the CSV file is a comma separated list of key and value pairs. The key is separated from the value by a colon. It looks like

```
key1:value1, key2:value2, key3:value3
```

Here is the meaning of each key and value pair:

Key	Value
title	The title of the record
start timestamp	The timestamp of the first EEG sample of the record
stop timestamp	The timestamp of the last EEG sample of the record
headset type	The type of the headset used during this record. It can be INSIGHT, EPOC, EPOCPLUS, EPOCFLEX, EPOCX, MN8
headset serial	The serial number of the headset
headset firmware	The firmware version of the headset
channels	The number of columns in this CSV file
sampling rate	The sample rate of each data stream.
samples	The number of data samples in this CSV file.

Example:

```
title:foo, start timestamp:1623658701.491566, stop timestamp:1623658723.788441,
headset type:INSIGHT, headset serial:7AEC4253, headset firmware:931, channels:28,
sampling rate:128, samples:2855 , version:2.1,
```

Second line

The comma separated list of the column names of this CSV file.

Example:

```
Timestamp,EEG.Counter,EEG.Interpolated,EEG.AF3,EEG.T7,EEG.Pz,EEG.T8,EEG.AF4,EEG.
RawCq,EEG.Battery,EEG.BatteryPercent,MarkerIndex,MarkerType,MarkerValueInt,EEG.Mar
kerHardware,CQ.AF3,CQ.T7,CQ.Pz,CQ.T8,CQ.AF4,CQ.Overall,EQ.SampleRateQuality,EQ.OV
ERALL,EQ.AF3,EQ.T7,EQ.Pz,EQ.T8,EQ.AF4
```

Columns

The CSV file contains many columns. For clarity, we divide them into categories in this documentation. The exact content of your CSV file depends on the options you selected when you exported the record.

EEG and markers

Column name	Value
EEG.Counter	Increment by 1 for each sample, reset to zero every second.
EEG.Interpolated	0 if this EEG sample was received from the headset. Greater than 0 if this sample was interpolated by Cortex.
EEG.<sensor> Examples: EEG.AF3, EEG.T7, EEG.Pz, EEG.T8	For each EEG sensor, you get 1 value in microvolt.

EEG.Battery	The battery level of the headset, from 0 to 4.
EEG.BatteryPercent	The battery level of the headset, from 0 to 100. It has the same purpose as the column "Battery", but it is more precise.
EEG.MarkerHardware	1 if a hardware marker was received for this EEG sample. 0 otherwise. Hardware markers are created with the Extender

Motion

Column name	Value
MOT.CounterMems	Increment by 1 for each sample, reset to zero every second.
MOT.InterpolatedMems	0 if this motion sample was received from the headset. Greater than 0 if this sample was interpolated by Cortex.
MOT.Q0, MOT.Q1, MOT.Q2, MOT.Q3	Quaternions of the gyroscope (newer EMOTIV headsets)
MOT.GYROX, MOT.GYROY, MOT.GYROZ	X, Y, Z axis of the gyroscope (older EMOTIV headsets)
MOT.AccX, MOT.AccY, MOT.AccZ	X, Y, Z axis of the accelerometer.
MOT.MagX, MOT.MagY, MOT.MagZ	X, Y, Z axis of the magnetometer.

Contact quality

Column name	Value
CQ.Overall	The overall contact quality is a value from 0 to 100 that is calculated from the contact quality of all the EEG sensors.

CQ.<sensor>

Examples: CQ.AF3,
CQ.T7, CQ.Pz, CQ.T8,
CQ.AF4

The contact quality of each EEG sensor, from 0 to 4.

EEG quality

Column name	Value
EQ.SampleRateQuality	<p>A float value from 0 to 1 that evaluates the actual sample rate of the EEG data coming from the headset.</p> <p>If the wireless connection between the headset and the computer is perfect (no data loss) then the sample rate quality is 1. If X percent of the EEG samples were lost over the last 2 seconds, then the SRQ is $(100 - X) / 100$.</p> <p>If we lost more than 300 ms of data over the last 2 seconds, then the SRQ takes the special value -1.</p>
EQ.OVERALL	<p>A value from 0 to 100 that is calculated from the EEG quality of all the EEG sensors.</p>
EQ.<sensor>	<p>The EEG quality of each EEG sensor, from 0 to 4.</p>

Performance metrics

The name of the columns has the format PM.<name>.<value>

The <name> is the name of a performance metric. There are 6 possible values:

Engagement, Excitement, Stress, Relaxation, Interest, Focus.

The <value> can be IsActive, Scaled, Raw, Min, Max.

Examples: PM.Engagement.Min, PM.Stress.IsActive, PM.Relaxation.Scaled

Value	Meaning
IsActive	1 if the detection is running properly. It is 0 if the detection cannot run. This can happen if the EEG signal from the headset is of poor quality.
Scaled	The Scaled column shows the Raw value scaled to fit on a 0 to 1 scale to provide more context for each individual's scores. The scaling is based on a successive approximation of the mean and variance for each recording, calculated as the session progresses. The data file reflects this progressive scaling which usually stabilizes after a few minutes.
Raw	The Raw column shows the raw value outputted from our Performance Metrics algorithm, which can range from single digit negative numbers to single digit positive numbers. Different individuals can have non-overlapping ranges. These numbers are meaningful when looked at relatively.
Min, Max	Min and Max values set lower and upper bounds for the Scaled value and are calculated from the current mean and variance of the Raw value. Initial values of Min and Max are set based on population data. The current value is scaled so that Min maps to .05 and Max maps to .95 on the 0-1 scale. We use a logistic scale to prevent data cutoff at 0 and 1 boundaries; the range around the mean value (mapped to 0.5) is close to linear while the extremes get steadily more nonlinear.

To scale the Raw value post hoc for a given recording, you can use the Min and Max values at the end of the recording (where they are most stable) and the following equation:

```

1 AVERAGE = (MAX + MIN)/2.0;
2 RANGE = MAX - MIN;
3 scaled = 1.0 / (1 + exp( -5.0 * (raw - AVERAGE) / RANGE));

```

There is one additional column, named "PM.LongTermExcitement". **Long Term Excitement** is a metric derived from the Excitement metric. It is a better measurement of overall mood, rather than acute changes in mental arousal.

Mental commands

Column name	Value
MC.Action	A mental command action. See the meaning of each value below.
MC.ActionPower	The power of the action. It is a decimal number between 0 and 1, zero means "low power", 1 means "high power".
MC.IsActive	1 if the detection is running properly. It is 0 if the detection cannot run. This can happen if the EEG signal from the headset is of poor quality.

The possible values for MC.Action are:

MC.Action	Meaning
1	Neutral
2	Push
4	Pull
8	Lift
16	Drop
32	Left
64	Right
128	Rotate Left
256	Rotate Right
512	Rotate Clockwise
1024	Rotate Counter-Clockwise
2048	Rotate Forward
4096	Rotate Backward
8192	Disappear

Facial expressions

Column name	Value
FE.BlinkWink	10 for "Blink" 11 for "Wink Left" 12 for "Wink Right"
FE.HorizontalEyesDirection	-1 for "Look Left" 0 for "Neutral" 1 for "Look Right"
FE.UpperFaceAction	32 for "Raise Brows" 64 for "Furrow Brows"
FE.UpperFaceActionPower	The power of the upper face action. It is a decimal number between 0 and 1, zero means "low power", 1 means "high power".
FE.LowerFaceAction	128 for "Smile" 256 for "Clench Teeth" 512 for "Laugh" 1024 for "Smirk Left" 2048 for "Smirk Right"
FE.LowerFaceActionPower	The power of the lower face action. It is a decimal number between 0 and 1, zero means "low power", 1 means "high power".

Frequency band

The file contains 5 columns for each EEG sensor of the headset. The name of the columns has the format POW.<sensor>.<band>

The bands are:

- Theta: 4-8 Hertz
- Alpha: 8-12 Hertz

- BetaL: 12-16 Hertz
- BetaH: 16-25 Hertz
- Gamma: 25-45 Hertz

For example, for the EEG sensor AF3, the file has 5 columns: POW.AF3.Theta, POW.AF3.Alpha, POW.AF3.BetaL, POW.AF3.BetaH, POW.AF3.Gamma.

JSON files

If your recording contains keystroke markers, a JSON file will also be exported. This JSON file contains the descriptions of the keystroke markers used and their corresponding values in the EDF and CSV files.

A Baseline JSON file is created when baseline recording is enabled. The baseline markers and their corresponding values are:

- Eyes Opened Start : 1
- Eyes Opened End: 2
- Eyes Closed Start: 3
- Eyes Closed End: 4

```
{
  "Markers": [
    {
      "endDatetime": "2019-05-06T10:17:33.437177+07:00",
      "index": 1,
      "label": "Eyes Opened Start",
      "port": "Baseline EmotivPR0",
      "startDatetime": "2019-05-06T10:17:33.437177+07:00",
      "type": "instance",
      "uuid": "aa904f2c-9752-4664-ae6d-54b5da03d69e",
      "value": 1
    },
    {
      "endDatetime": "2019-05-06T10:17:48.439063+07:00",
      "index": 2,
      "label": "Eyes Opened End",
      "port": "Baseline EmotivPR0",
      "startDatetime": "2019-05-06T10:17:48.439063+07:00",
      "type": "instance",
      "uuid": "06e95a74-52ff-488e-b282-74f0cc622e73",
      "value": 2
    },
    {
      "endDatetime": "2019-05-06T10:17:53.447293+07:00",
      "index": 3,
      "label": "Eyes Closed Start",
      "port": "Baseline EmotivPR0",
      "startDatetime": "2019-05-06T10:17:53.447293+07:00",
      "type": "instance",
      "uuid": "cb9c102c-7579-48b6-8c73-6a21c1abe68d",
      "value": 3
    },
    {
      "endDatetime": "2019-05-06T10:18:08.446519+07:00",
      "index": 4,
      "label": "Eyes Closed End",
      "port": "Baseline EmotivPR0",
      "startDatetime": "2019-05-06T10:18:08.446519+07:00",
      "type": "instance",
      "uuid": "23b09eca-aad1-4185-a885-b72b575d2efa",
      "value": 4
    }
  ],
  "exportApp": "com.emotiv.emotivpro",
  "exportTime": "2019-05-09T15:10:30.172+07:00",
  "recordId": "cbe3cfd8-0667-4d71-a034-7e848dd74f68",
  "user": "11"
}
```

In case of EPOC Flex, a separate JSON file is created that outputs the mapping for channel names and sensor positions for the selected session. For e.g.:

"CMS": "Afz",

"DRL": "FCz",

"LA": "C3",

"LB": "T7",

"LC": "FC1",

"LD": "FC5",

"LE": "FT9",

"LF": "F3",

"LG": "F7",

"LH": "Fp1",

"LJ": "Pz",

"LK": "Cz",

"LL": "O1",

"LM": "TP9",

"LN": "P3",

"LO": "P7",

"LP": "CP1",

"LQ": "CP5",

"RA": "C4",

"RB": "T8",

"RC": "FC2",

"RD": "FC6",

"RE": "FT10",

"RF": "F4",

"RG": "F8",

"RH": "Fp2",

"RJ": "Oz",

"RK": "Fz",

"RL": "O2",

"RM": "TP10",

"RN": "P4",

"RO": "P8",

"RP": "CP2",

"RQ": "CP6"

Editing an EEG data recording note

To edit or add to a recording note:

1. Go to the Recording view in EmotivPRO.
2. Find the EEG data recording you want to edit from the list.
3. Hover your mouse over the EEG data recording you want to edit.
4. To the right-hand side of your selected recording you will see a pencil icon. Click on the pencil.
5. The Edit recording info window will open. Here you can edit or add more text to your recording note.
6. Once you've finished editing the note, click on Save.

Closing a recording

To close an opened recording and return to the recordings menu, click on the back arrow at the top left-hand side of the screen.

Lab Streaming Layer (LSL)

About LSL

LSL is a protocol that enables a streamlined and synchronized collection of time series measurements across multiple devices.

EmotivPRO's LSL feature:

- Supports research experiments that require sub-millisecond timing precision.
- Allows efficient, two-way communication between EmotivPRO and other third-party software and devices.
- Enables users to synchronize data streams across multiple devices.
- Allows real-time processing of raw EEG data in third- party applications.
- Allows you to send distinct markers (such as event markers) to different devices and synchronize those markers across devices.

To configure LSL in EmotivPRO:

1. Connect an EMOTIV headset to EmotivPRO.
2. Click on **Settings** at the top right-hand side of EmotivPRO.
3. Click on **Labs Streaming Layer** from the menu on the left-hand side of the screen.
4. You can then configure:
 - EMOTIV data streams that communicate with third-party devices or third-party software in LSL outlet mode, and
 - markers from third-party software to communicate with EmotivPRO.

Further information about LSL, can be read here - [EMOTIV Lab Streaming Layer Interface](#)

LSL Outlet

Use the LSL Outlet mode to configure EMOTIV data streams that can communicate with other devices or 3rd party software.

Configuration

SETTING DETAILS

Stream Name	Set the stream name for transmission
Device ID	This displays the Device ID for the selected device
Data Stream	Choose the data stream for transmission and select between EEG, Performance Metrics (PMs), Motion Data, Contact Quality (CQ) or EEG Quality (EQ).
Number of channels	This displays the number of channels available for transmission (note this correlates to the number of channels available for that headset type)
Sample rate	This displays the sampling rate of the selected data stream (note this correlates to the sampling rate available for that headset type)
Data format	Choose the Data format for transmission as either Double/Float. However, If you choose Float format, only data value in range -16777216 to 16777216 are represented accurately (LSL doc). The Timestamp is not accurate because out of range. But others are fine.
Transmit type	Set the transmission type by selecting between Sample or Chunk. For Chunk, you can set the Chunk size to be 4/16/32/64/128/256
Start	Click this button to start transmission



Stop Click this button to stop transmission

Stream Outlet Information

Stream type	Stream name	Channel name list
EEG	EmotivDataStream-EEG	["Timestamp", "Counter", "Interpolate", , "HardwareMarkers"]
		For newer EMOTIV headsets (support Quaternions): ["Timestamp", "Counter", "Interpolate", "Q0","Q1","Q2","Q3", "ACCX","ACCY","ACCZ", "MAGX","MAGY","MAGZ"]
Motion	EmotivDataStream-Motion	For older EMOTIV headsets: ["Timestamp", "Counter", "Interpolate", "GYROX","GYROY","GYROZ", "ACCX","ACCY","ACCZ", "MAGX","MAGY","MAGZ"]
Performance-Metrics	EmotivDataStream- <i>Performance-Metrics</i>	["Timestamp", "Engagement","Excitement","Focus","Intensity","Relaxation","Stress"]



Contact- Quality	EmotivDataStream- <i>Contact-Quality</i>	["Timestamp", "BatteryPercent", "Overall", "Signal", <E sensors>]
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EEG-Quality	EmotivDataStream- <i>EEG-Quality</i>	["Timestamp", "BatteryPercent", "Overall", "SampleRateC <EEG sensors>]
-------------	---	---

LSL Inlet

Use the LSL Inlet mode to inject markers from 3rd party software to EEG data stream via EmotivPRO.

LSL Inlet Configuration on EmotivPRO

SETTING	DETAILS
Marker Stream	Select the stream name that will allow 3rd party software to communicate and add markers into PRO. <i>Please note, we only support streams with channel count =1 or channel count = 3</i>
Device ID	This field displays the Device ID of the third party device that can communicate with PRO
Number of channels	This field displays the number of channels being transmitted to PRO
Transition time	This value displays the transmission time
Data Stream	This field displays the type of data stream that can communicate with PRO
Connect	This button initiates the third party connection
Disconnect	This button terminates the third party connection

LSL Outlet configuration on 3rd party software

Currently, We support Marker injection with 2 options:

Type	Stream Info	Channel name list	Description
Simple Marker	type = 'Markers' , <i>channel_count</i> = 1	["MarkerValue"]	"MarkerValue" is value of Marker and it is Integer type. You can put Double type but EmotivPRO will extract integer part only before injecting to data stream. EmotivPRO will get current Epoch time for Marker time.
Marker with time for time synchronization (*) You should use this type when inject Marker from another machine.	type = 'Markers' , <i>channel_count</i> = 3	["MarkerTime", "MarkerValue", "CurrentTime"]	"MarkerTime" is Double type. It is time of Marker event. EmotivPRO will adjust the time for synchronization before injecting to data stream. "MarkerValue" is value of Marker and it is Integer type. You can put Double type but EmotivPRO will extract integer part only before injecting to data stream. "CurrentTime": is current Epoch time when the marker is pushed to LSL stream. The time is used to synchronize time between 2 machines

Exported data files

Opening a locally saved EDF file

To open an EDF file locally that is not in your Recordings list in EmotivPRO:

1. Go to the Recording view in EmotivPRO.
2. Go to Options burger at the top-right corner of the screen and click on Open Recording.
3. Your computer's file explorer will open. Navigate to the EDF file you want to open.
4. Click on the EDF file. It will now open in EmotivPRO.

Please note:

- Selecting an EEG EDF file will also open the motion data EDF file of the same name, as long as it's in the same folder.
- EDFs files that you open locally are not saved to the Recordings list in EmotivPRO or synced to other shared devices.
- EmotivPRO currently only supports Raw EEG for EPOC Flex.

Converting EDF files to CSV files

To convert EDF files to CSV files:

1. Go to the Recording view in EmotivPRO.
2. Go to Options burger at the top-right corner of the screen and click on Convert to .csv.
3. Your computer's file explorer will open. Navigate to the EDF file you want to convert.
4. Wait for the EDF file to be converted. Once the file is converted, a verification message will appear on the screen.
5. The output CSV file will be in the same location as the source EDF file.

EmotivPRO Analyzer

Analyzing your EEG data with EmotivPRO Analyzer

EmotivPRO Analyzer (Analyzer) is a cloud-based batch processing tool for EEG data integrated with EMOTIVPro.

Using Emotiv Cloud, Analyzer allows users of EMOTIVPro to quickly and easily process a large amount of EEG data or process a number of EEG data recordings in a standardized way without doing any coding. The pipelines available include:

- Basic EEG processing;
- Basic EEG processing and band power transformation; or
- ERP experiment analysis.

To find out more about using EmotivPRO Analyzer, please visit the [EmotivPRO Analyzer User Manual](#).

EmotivPro Builder

Building experiments with EmotivPRO Builder

EmotivPRO Builder (Builder) is an online neuroscience experiment building platform designed for use with Emotiv's EEG headsets.

It's a simple, user-friendly platform that allows you to create neuroscience experiments from scratch by building phases: calibration, instruction, and stimuli phases.

Each phase is built by including different elements — like video, audio, and text — which you can upload from your computer. You can also customize the elements in an experiment so the participant(s) can see them in different ways: including randomizations and looping.

When you've finished building an experiment, you can publish it to EmotivPRO Player (privately) for use in-house or remotely, or publicly to LABS Citizen Science.

As a participant plays an experiment, a live EEG recording is collected, fully time-marked, and saved securely and anonymously in EMOTIV Cloud.

To find out more about using EmotivPRO Builder, please visit the [EmotivPRO Builder User Manual](#).

Release Notes

v3.0

Enhancements and features

- Windows 8 no longer supported.
- Created new EmotivPRO ecosystem model to incorporate all features together for a more sequential experience.
- UI changes for accessing Builder and Analyzer within EmotivPRO.
- Updated licensing to a more simplified model, with 5 licenses for different users (plus API licensing).
- Allow users to configure EPOC Flex headband position.

Bug fixes

- Minor bug fixes and UX improvements.