

EMOTIVPRO

User Manual

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Introduction

This document is intended to help you get started using EmotivPRO and to understand how to use the various features that it offers.

If you have any queries beyond the scope of this document, please contact us through our [online support](#).

Getting started

System requirements

EmotivPRO is compatible with the following operating systems:

- Windows 7, 8, 10 (32 and 64-bit)
- Mac OSX 10.8 and higher

Note: Mac 10.8 and 10.9 require an EMOTIV USB dongle.

Installation

To install EmotivPRO on Windows:

1. Use the computer that you want to install EmotivPRO on
2. Login at www.emotiv.com
3. Go to the “MyAccount” page at www.emotiv.com/my-account/
4. Click on “Downloads” in the menu
5. Find **EmotivPRO Windows** in the list of available downloads and click on “Download” next to the listing
6. Open downloaded EmotivPRO Installer.exe

7. Install to the default C:\Program Files (x86) or specify the path where you would like to install the EmotivPRO. Click Continue.
8. Accept the User License Agreement and click Continue
9. Wait for the installer to download required files and install them
10. Click close to exit the installer.

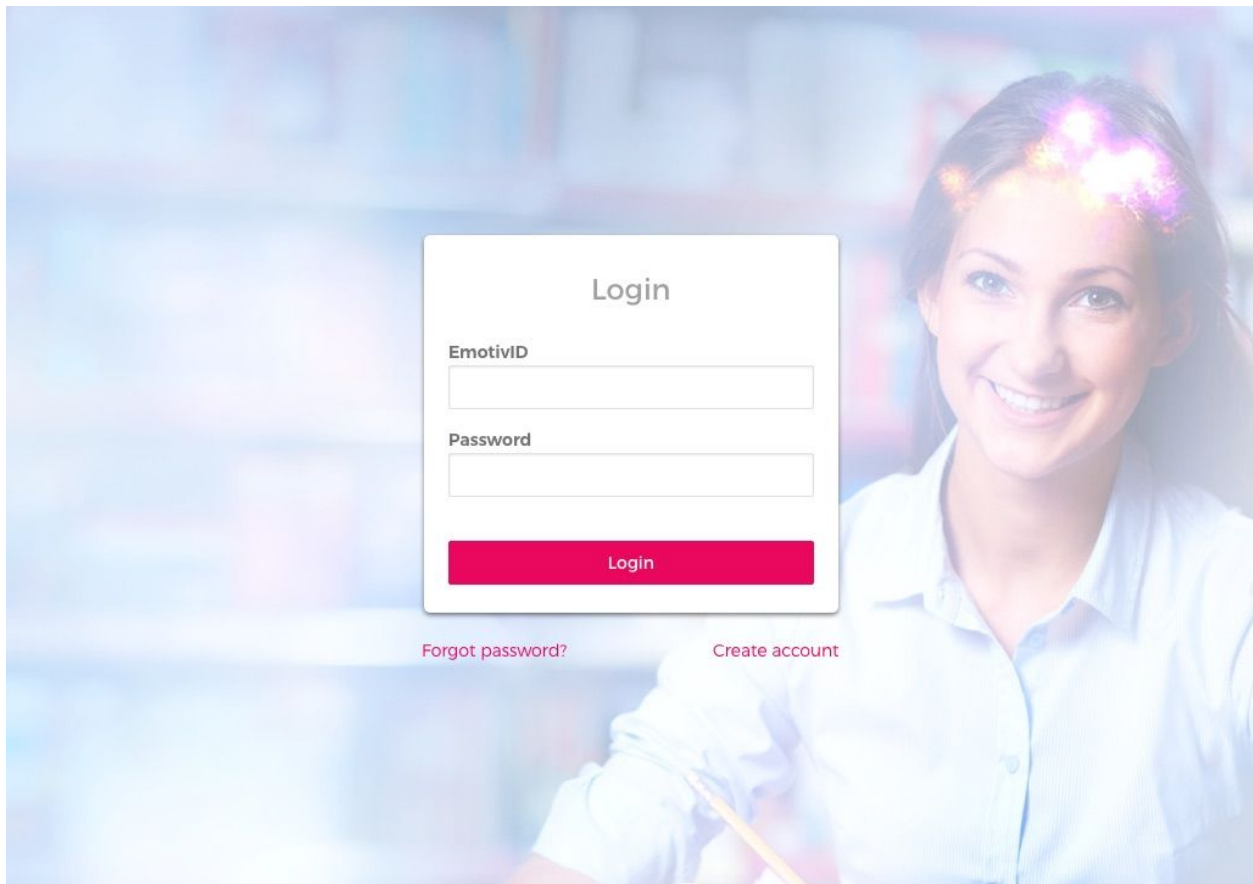
To install EmotivPRO on Mac:

1. Use the computer that you want to install EmotivPRO on
2. Login at www.emotiv.com
3. Go to the “MyAccount” page at www.emotiv.com/my-account/
4. Click on “Downloads” in the menu
5. Find **EmotivPRO Mac** in the list of available downloads and click on “Download” next to the listing
6. Open the downloaded EmotivPRO Installer.dmg (Note: You may need to allow installing apps from unidentified developers in order to run the installer. Please right click on the installer and select open from the right-click menu. You will then be prompted with a pop up asking for your permission to open the app, click Open.)
7. Install to the default User/Applications/EmotivPRO or specify the path where you would like to install the EmotivPRO. Click Continue.
8. Accept the User License Agreement and click Continue
9. Wait for the installer to download required files and install them
10. Click close to exit the installer.

If you do not see an EmotivPRO download available on your Account page, go to www.emotiv.com/emotiv-pro/ to purchase a license.

Logging in

When you open EmotivPRO, you will be asked to enter your EmotivID and password. Please enter the EmotivID or email address that was used when purchasing your EmotivPRO software license in the indicated fields. If you have an active EmotivPRO subscription associated with your EmotivID, you can get started right away.



Note: You need to be online the first time you login to EmotivPRO so that the application can confirm your subscription.

Your EmotivID will show in the top righthand corner of the application when you are logged in.

Create an account

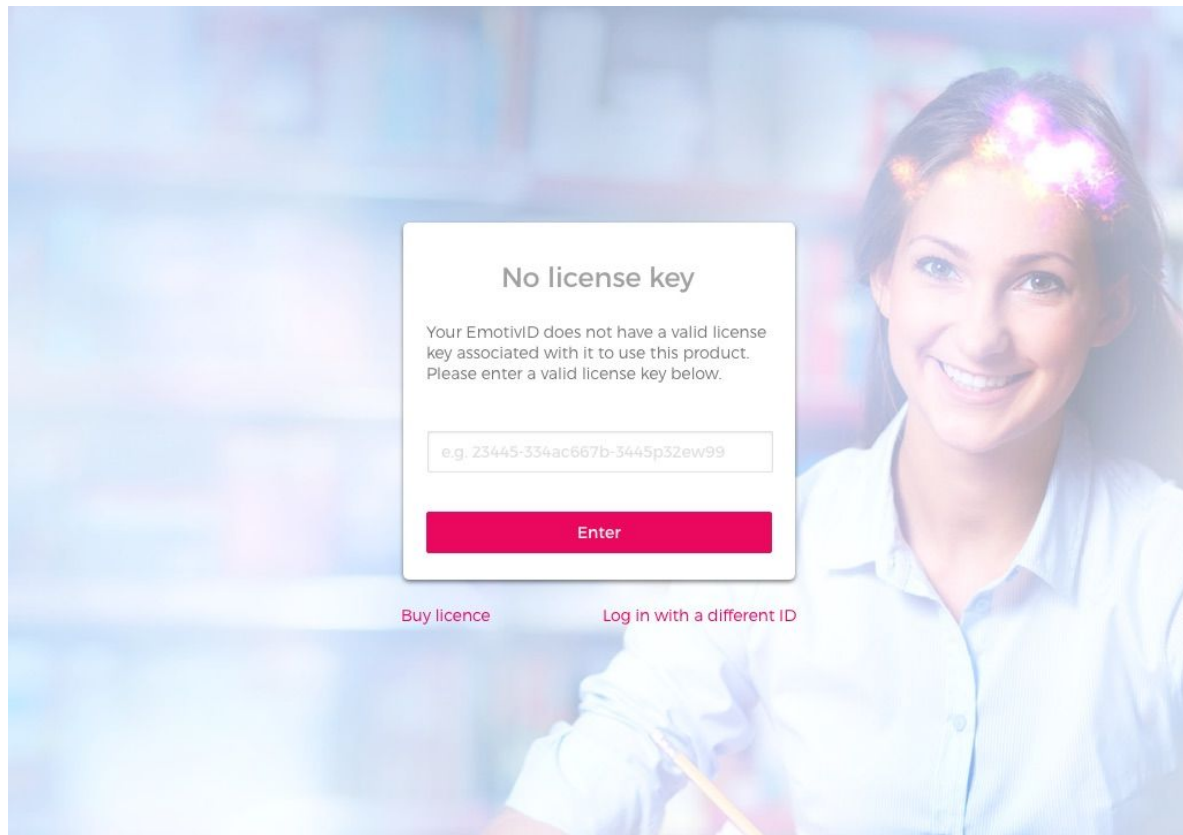
If you do not have an EmotivID, click on "Create Account" and follow the instructions on our website.

Forgot password

If you cannot remember your password, click on "Forgot Password" under the login fields to reset your password and follow the instructions provided.

Enter license key

If you are using a subscription that is associated with someone else's EmotivID, enter the license key for that subscription after you login. If that subscription is active and has not reached its device limit, you will be able to use the app right away.



Note: You need to be online the first time you enter a license key so that the application can confirm the subscription.

Purchase subscription

If you do not have an EmotivPRO subscription and would like to purchase one, click on "Purchase subscription" or visit our website at www.emotiv.com/emotiv-pro/. Licenses are sold as either monthly or annual subscriptions.

Access account

To view your account information, change your password, or view your subscriptions, visit your [Account page](#) on our website. To access this via the application:

1. Click on your username in the top righthand corner of the application
2. Click on “Account”



Logging out

To logout:

3. Click on your username in the top righthand corner of the application
4. Click on “Logout”



Subscriptions

Device limitations

One seat of EmotivPRO allows you to use the software on 3 different computers. Each additional seat allows access on 3 more computers.

To see how many seats you have in your EmotivPRO license, go to your [Account page](#) on our website and click on “Subscriptions”.

Offline use

You can use all features of EmotivPRO offline after you first login. However, if you are offline, your data will not be synced to other devices in your account.

Soft limit

When you reach the end of your monthly subscription cycle, the application needs to check the status of your subscription online to reauthorize your license. We recognize that our users may not be able to go online at all times conveniently, so we have built in a 7-day grace period where you can continue to use EmotivPRO as usual after the end of the current license period is reached. The application will inform you when this period is reached and how many days are remaining.

[Offline use: 7 days left](#)

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 recording new sessions 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.

	test subject 33	22/11/16	00:08:16	Cras finibus metus in ligula lorem...
g	test subject 44	22/11/16	00:08:16	Cras finibus metus in ligula consecte...

< 1 2 3 4 >

End of offline license period reached. Please connect to the internet to reactivate your subscription.

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

Changing the number of seats in your subscription

You can upgrade or downgrade the number of seats you have in your license at any time:

1. Go to www.emotiv.com/my-account/
2. Click on “Subscriptions”
3. Click “Change” next to your EmotivPRO license
4. Increase or decrease the number of seats
5. Click on “Update” to save your changes and follow the instructions

Increases in the number of seats will be reflected right away in your subscription. Decreases in the number of seats will be reflected in your next billing period.

Cancelling your subscription

To cancel your subscription:

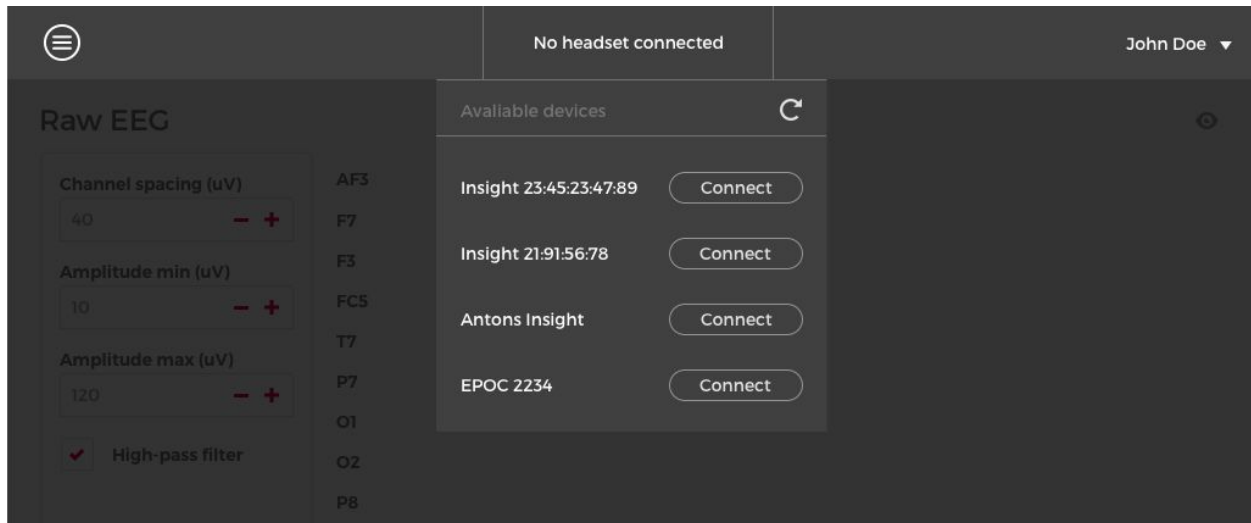
1. Go to www.emotiv.com/my-account/
2. Click on “Subscriptions”
3. Click “Cancel” next to your EmotivPRO license and follow the instructions

Note: you will not be able to take any new recordings or view real time data streams if you cancel your subscription.

Setting up your EEG device

Connecting your headset

EmotivPRO is compatible with all EMOTIV headsets: Epoc, Epoc+ and Insight.

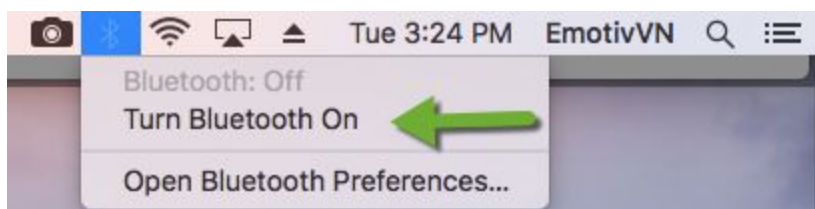


Before you connect your headset to EmotivPRO, make sure your device's battery is charged.

Bluetooth connection

To connect the software with your device using Bluetooth (BTLE 4.0) on Mac OS:

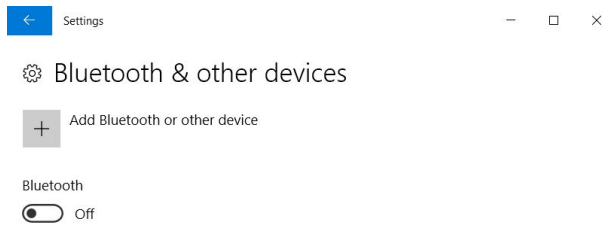
1. Turn on Bluetooth on MacOS



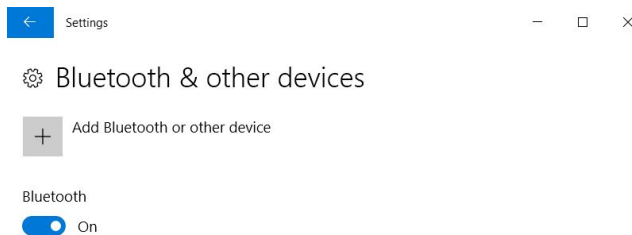
2. Turn on your headset.
3. Open EmotivPRO app and access the device list by touching on "No device connected" in the top middle of your application
4. You will see headset appear in the device list
5. Click on "Connect" next to the device you want to use to connect your device

To connect the software with you device using Bluetooth (BTLE 4.0) on Windows:

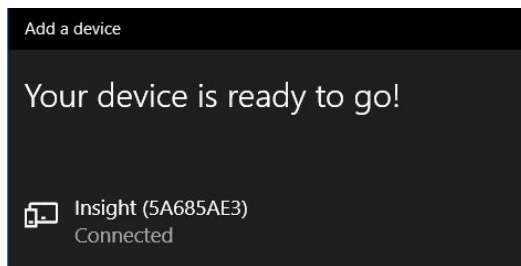
1. Open setting for “Bluetooth and other devices”



2. Turn on your headset
3. Turn on Bluetooth and click to “Add Bluetooth or other device”



4. Device should appear on the list of available devices and connect



5. Open EmotivPRO app and access the device list by touching on “No device connected” in the top middle of your application
6. You will see headset appear in the device list
7. Click on “Connect” next to the device you want to use to connect your device

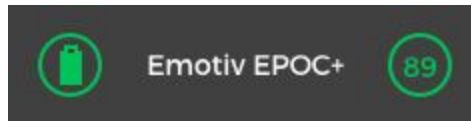
USB dongle connection

To connect the software with your device using one of our USB receivers (recommended if you are in an environment with high levels of Bluetooth interference):

1. Plug in the USB receiver to your computer’s USB port
2. Turn on your headset.

3. Open EmotivPRO app and access the device list by touching on “No device connected” in the top middle of your application
4. Click on “Connect” next to the device you want to use to connect your device

The top middle panel of the application shows you which headset you are connected to - “Epoc”, “Epoc+” or “Insight”.



Disconnecting your headset

To disconnect your headset from EmotivPRO:

1. Unplug the dongle or turn off the headset using power button on the device.
2. Disconnecting the device may take up to 30 seconds.

Fitting your headset

Follow the instructions provided in the application for how to fit your EMOTIV Epoc, Epoc+ or Insight headset. If you do not want to see these instructions every time you connect a device, just select “Do not show this again”.



Fitting your headset correctly

1. Starting from the top of the skull, gently slide the headset onto your head
2. The reference sensors sit just above and behind your ears. The rubber comfort pads rest behind your ears.
3. Tilt the headset until the front sensors are three fingers above your brows.

NEXT

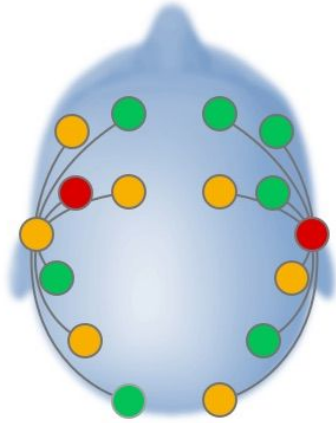


Do not show this again

Contact quality map

Accurate data collection depends on good sensor contact and EEG signal quality. The contact quality display is a visual representation of the current contact quality of the individual headset sensors. You can observe each sensor's status in real time to adjust sensors to optimize contact quality. The color coding is as follows:

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



Ensuring good contact quality

Work each sensor underneath hair to make contact with the scalp. If all sensors are black, first adjust the reference sensors (black circles) until they are green, and then adjust the other sensors.

You can access this screen at any time by clicking on the contact quality meter in the top middle of the application.

89%
CONTACT QUALITY

DONE

Contact quality indicator

The contact quality indicator shows you in real time your overall contact quality averaged across all sensors on your headset.



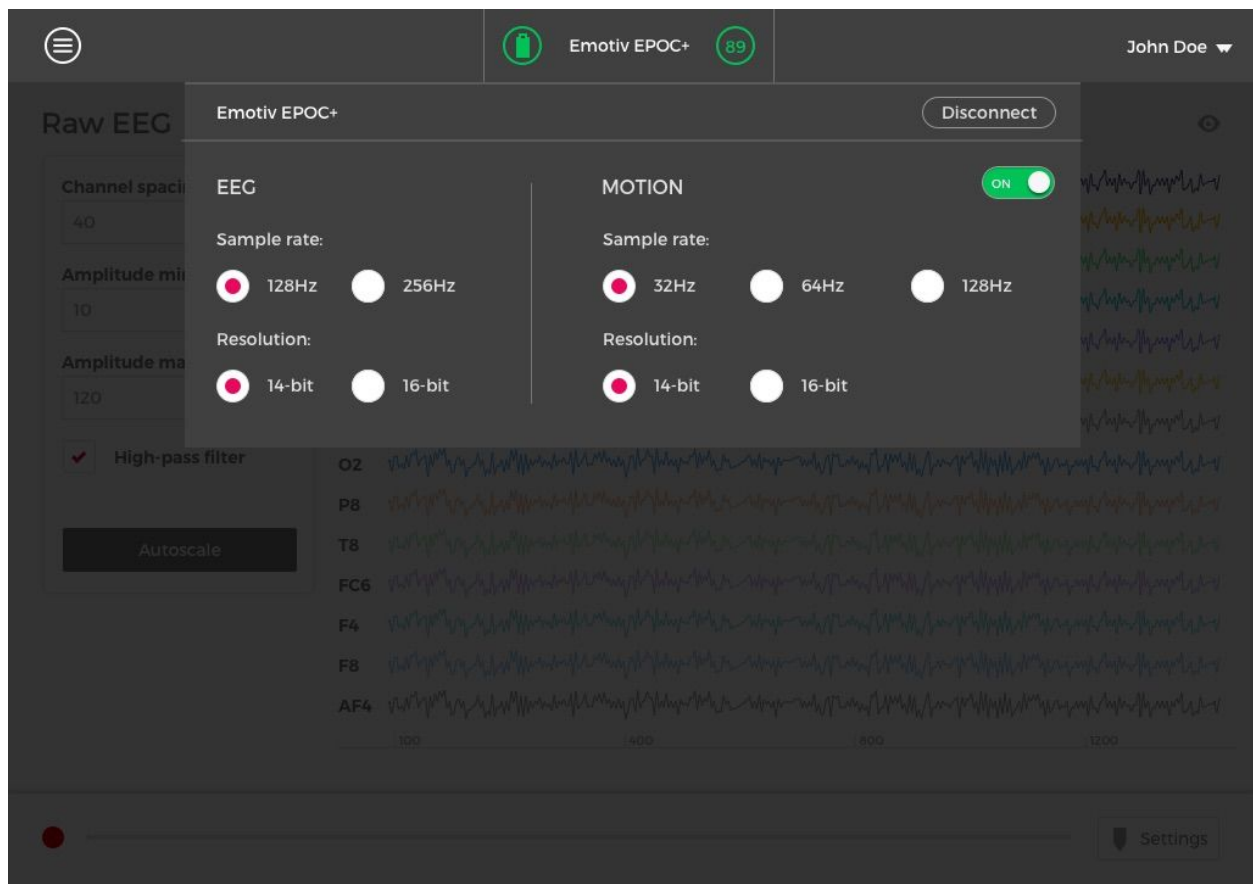
Battery indicator

Battery level shows you at all times and shows you the percentage of battery you have remaining in your headset.



Epoc+ configurations

You can configure your Epoc+'s EEG sample rate, EEG resolution, motion data sample rate, and motion data resolution through the EmotivPRO application. There are no configuration settings for Emotiv Epoc and Insight headsets.



To configure your Epoc+:

1. Plug in your Epoc+ device to your PC using the USB cable that came with your Epoc+ (unplug the USB cable from the mains plug)
2. Open the Epoc+ configuration settings by clicking on the headset name in the top center of the application
3. Select your configuration. Your headset will update as you make your selections

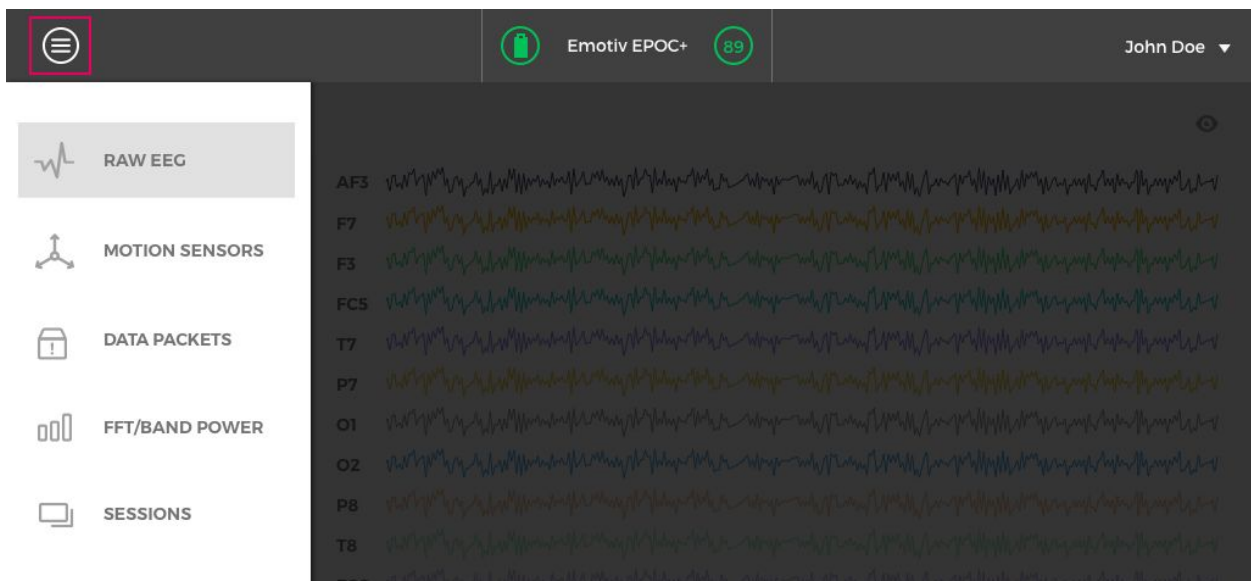
4. Unplug your Epoc+ device from your PC

Note: if you are connected to your computer via Bluetooth, the Epoc+ can only run at 128 Hz for EEG and a maximum of 64 Hz for motion data.

Viewing this configuration menu during real time streaming will show your current device settings even when your headset is not plugged in directly to your PC.

Menu and navigation

You can access the main screens of EmotivPRO using the left side menu. This menu is always visible on high resolutions screens. For low resolution screens, you can access this menu when needed by clicking on the menu icon in the top left corner of the application.



With this menu you can access the following features which will display in the main application display area:

- **Raw EEG:** view a real time or recorded data stream from your headset's electric sensors (14 for Epoc, Epoc+; 5 for Insight)

- **Motion Sensors:** view a real time or recorded data stream from your headset's 9-axis motion sensors
- **Data packets:** view a real time or recorded data stream of packet loss and capture from your device to your PC
- **FFT/Band Power:** perform a frequency analysis on single channel EEG data in real time or on recorded data
- **Sessions:** open or export previously recorded sessions

Data streams

Real time, recording and playback modes

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 are not recording.

EmotivPRO also allows you to open and playback saved recordings, which includes all data streams and frequency analyses.

The following describes the data streams and views available in EmotivPRO for real time, recording and playback modes.

Raw EEG

Raw EEG displays the voltage fluctuations detected from each sensor on your headset. Select "Raw EEG" in the left side menu to access this view.


Raw EEG graphs are displayed as uV per sample. For Epoc and Epoc+ devices, you will see 14 channels displayed, associated with each of the 14 channels on your headset. For Insight devices, you will see 5 channels.



The resolution of raw EEG for Insight and Epoc headsets is 128 Hz and 14-bits. The resolution for Epoc+ is 16-bits and can be either 128 or 256 Hz depending on the headset's [configuration](#). Epoc+ is 128 Hz when connected via Bluetooth.

Turn channels on/off

You can turn individual sensors on and off in the raw EEG view to focus on the data you are most interested in. To do this:

1. Click on the  eye icon in the top right corner of the EEG view
2. Deselect any channel that you do not want to see
3. Select any channel that you want to see
4. Click outside of the popup to close and return to the EEG view

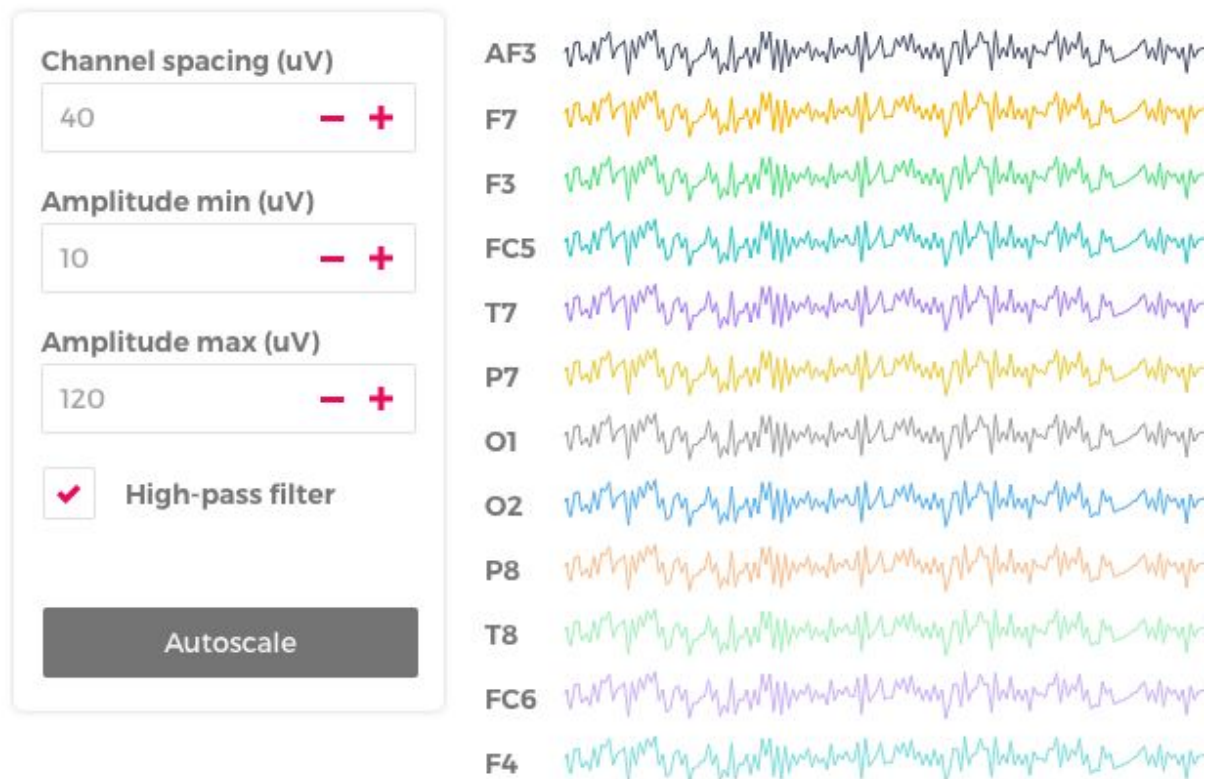


For single-channel display mode, deselect all channels but the channel of interest.

Customize the graph scaling

You can configure the vertical scaling of your EEG graphs using the controls on the left side of the EEG view for multi-channel and single channel display mode.

Raw EEG

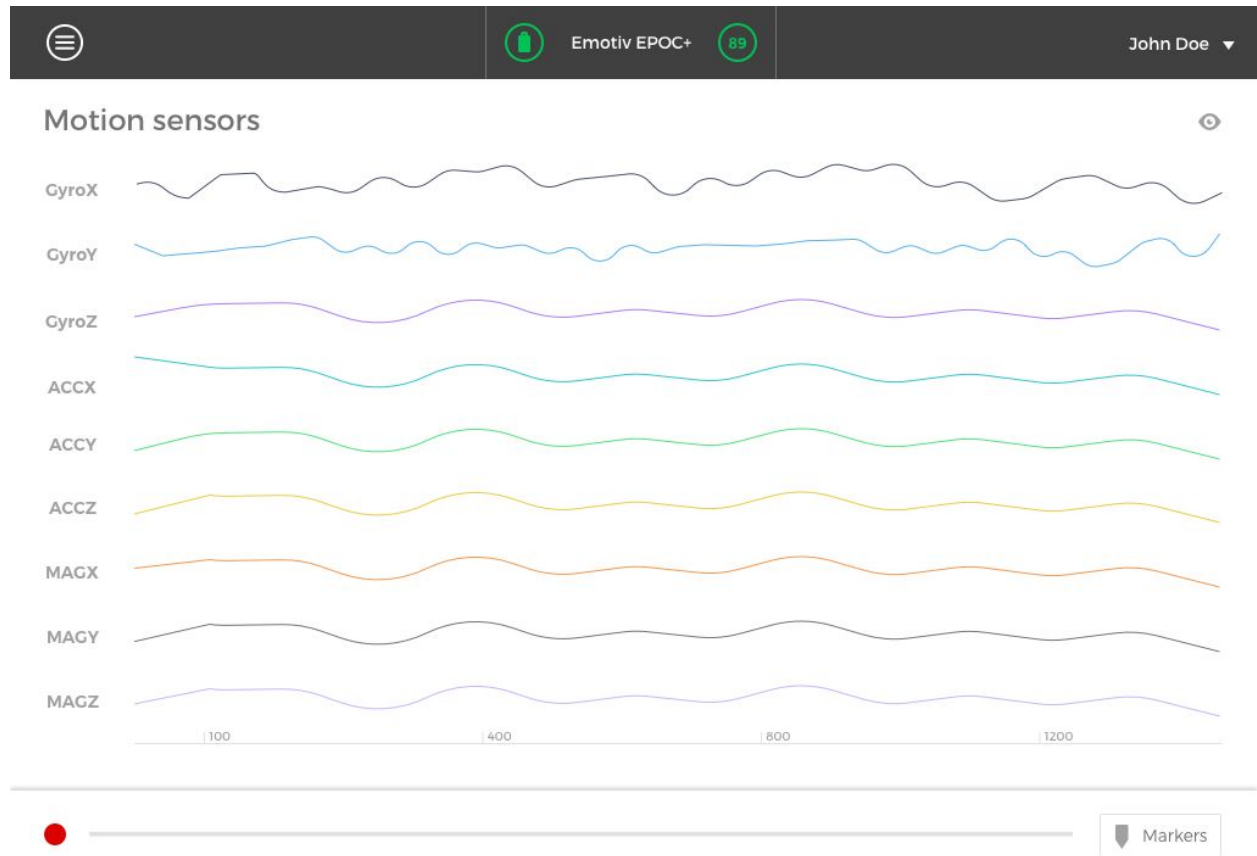


- **Channel Spacing** adjusts the height of the display area of a channel in the multi-channel display mode. This changes the vertical resolution of the display when more than one channel is selected.
- **Amplitude min** defines the lower limit of the value displayed in single channel display mode. Single channel display only
- **Amplitude max** defines the upper limit of the value displayed in single channel display mode. Single channel display only
- **Auto Scale** automatically aligns the upper and lower limit in line with the current channel values (lower limit is +/- 100 uV). Single channel display only
- **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.

Your configurations will be saved on your local device for the next time you use the application.

Motion sensors

Motion sensors display data concerning your headset's position and orientation using relative orientation (gyroscope), acceleration (accelerometer) and absolute orientation (magnetometer) measurements. Select "MOTION SENSORS" in the left side menu to access this view.



Motion sensor graphs include 9-axis motion sensors for Insight and EPOC+ headsets:


- GyroX, GyroY and GyroZ - gyroscope in X, Y and Z directions
- AccX, AccY and AccZ - accelerometer in X, Y and Z directions
- MagX, MagY and MagZ - magnetometer in X, Y and Z directions

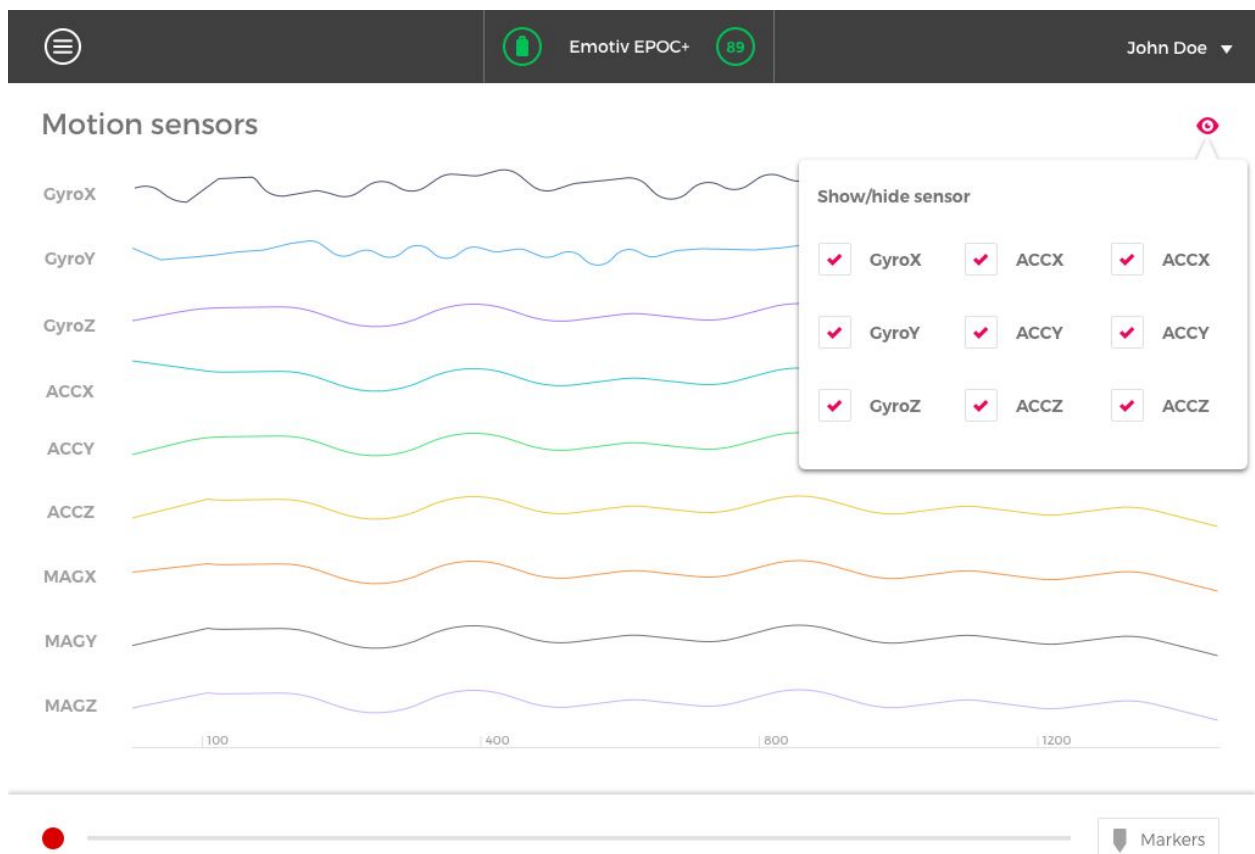
The resolution of motion sensor data for EPOC is 128 Hz and 12-bits, and for Insight headsets is 128 Hz and 14-bits. The resolution for EPOC+ is 16-bits and can be 32, 64 or 128 Hz (or OFF)

depending on the headset's [configuration](#) and whether or not it is connected via Bluetooth. When EPOC+ is connected to Bluetooth, the rate is limited to 64 Hz. EPOC headsets include GyroX and GyroY sensors only. Y-axis is samples.

Turn channels on/off

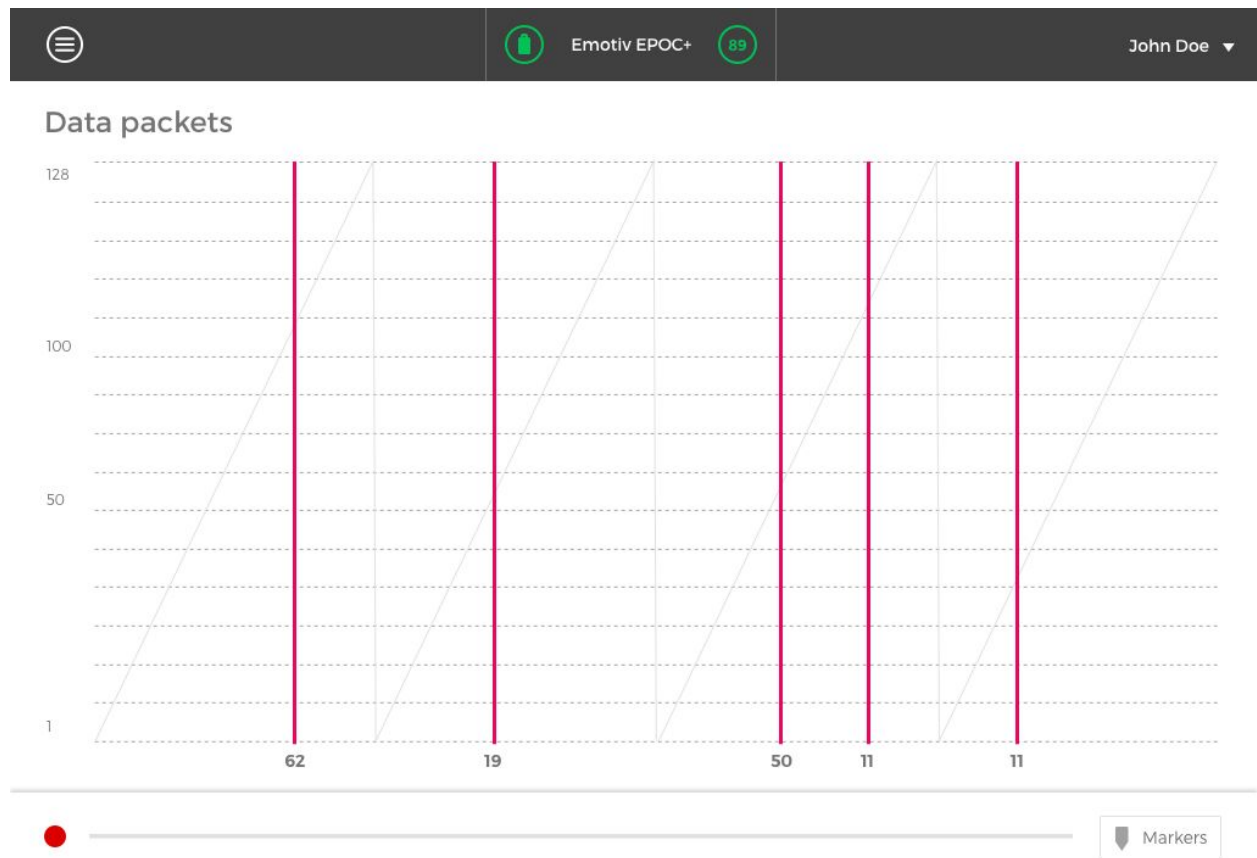
You can turn individual sensors on and off in the motion sensor view to focus on the data you are most interested in. To do this:

1. Click on the  eye icon in the top right corner of the EEG view
2. Deselect any channel that you do not want to see
3. Select any channel that you want to see
4. Click outside of the popup to close and return to the EEG view



Data packets

The data packet stream displays the number of data packets that are successfully transferred from the headset to the PC and how many are dropped. Select “DATA PACKETS” in the left side menu to access this view.



The gray sawtooth line displays a repeating 1 second cycle for your headset’s data collection at either 128 or 256 Hz and is drawn as samples over time depending on your headset’s frequency rate. An even sawtooth represents good data collection. A shifted sawtooth graph represents significant packet loss.

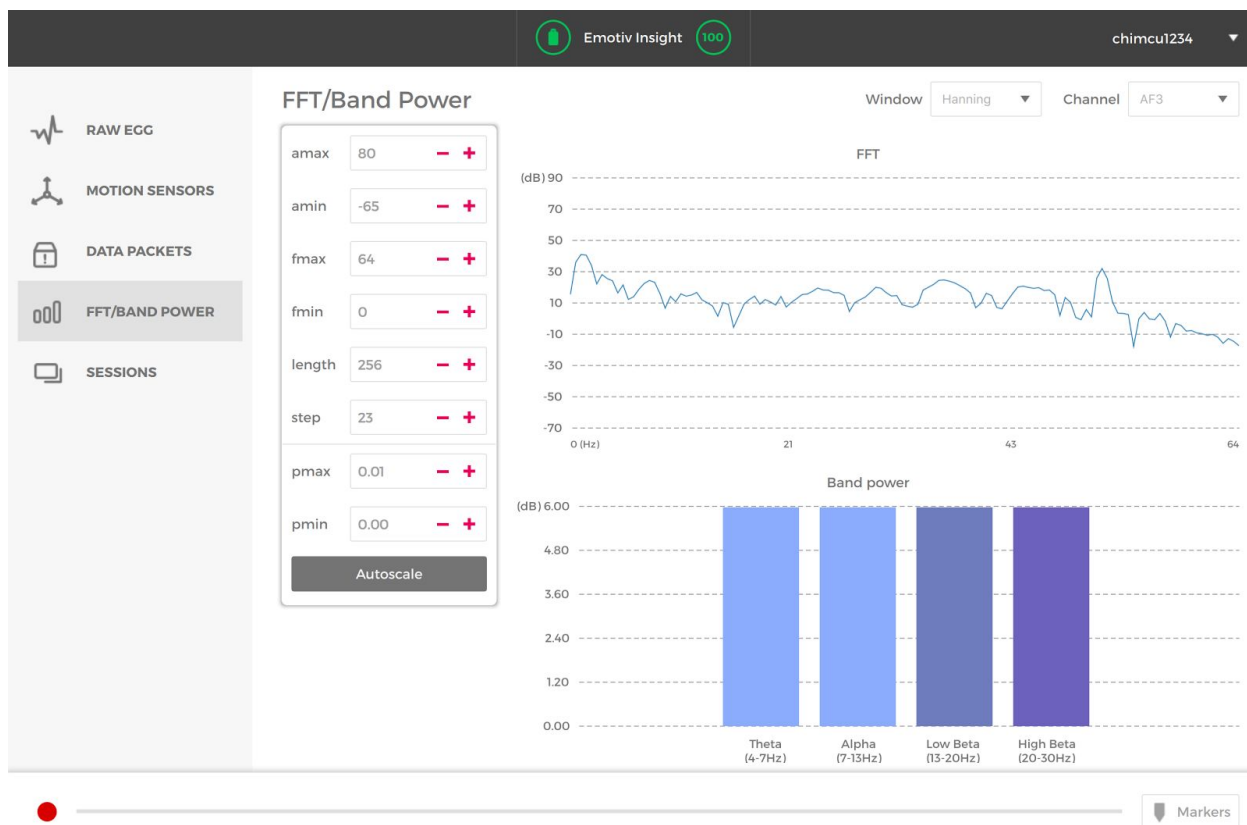
The vertical pink lines mark times when data packets are dropped with the number underneath the line indicating the number of packets lost in that chunk.

If you are experiencing a high degree of packet loss:

- Try using a USB extender to connect your dongle to your PC to reduce interference from your computer's power supply. Keep the dongle in the line of site of the headset and away from other electronics if possible.
- If you are connecting your headset to your computer via BTLE, try reducing the number of other BTLE devices connected to your PC or reduce the resolution or frequency rate on your headset if you are using an Epoc+ (see [Epoc+ configurations](#)).

Frequency analyses

The frequency analyses view allows you to view frequency information of a single EEG channel. Select "FFT/BAND POWER" in the left side menu to access this view.



Select channel

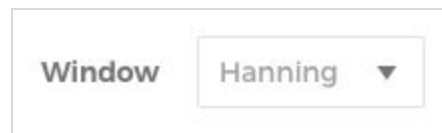
Select your EEG **channel** of interest using the drop down menu in the top right of the display.



A screenshot of a user interface element. It consists of a rectangular box with a light gray border. On the left side of the box, the word "Channel" is written in a bold, dark gray font. To the right of "Channel" is a smaller rectangular box containing the text "AF3" and a small downward-pointing triangle icon, indicating a dropdown menu.

Select windowing method

Select the **window** function used for both the FFT and power band graphs using the drop down menu in the top right of the display. You can choose from Hanning, Hamming, Hann, Blackman, and Rectangle.



A screenshot of a user interface element. It consists of a rectangular box with a light gray border. On the left side of the box, the word "Window" is written in a bold, dark gray font. To the right of "Window" is a smaller rectangular box containing the text "Hanning" and a small downward-pointing triangle icon, indicating a dropdown menu.

Fast Fourier Transform (FFT) graph

The top graph displays an FFT analysis of the selected EEG channel as dB over frequency (Hz). You can adjust the following parameters using the controls on the left top side of the display.

- **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 bottom graph is a bar graph that displays the power (in dB) of theta (4-7Hz), alpha (7-13Hz), low beta (13-20Hz), and high beta (20-30Hz) frequencies for the channel selected. You can adjust the following parameters using the controls on the left bottom side of the display.

- **pmax, pmin** - adjust the maximum and minimum amplitude (dB) for the y-axis
- **autoscale** - automatically scale the data to fit the max value on the y-axis and update the y-axis appropriately



Recording a session

EmotivPRO allows you to take recordings of all data streams for playback, analysis and export. An EmotivPRO license comes with unlimited session recordings and recordings can be done when you are both online and offline.



Start and stop a recording

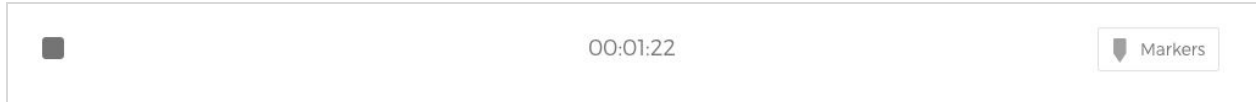
To record a session:

1. Check your device's battery level and contact quality
2. To begin your recording, hit the record button  in the bottom right corner of the application.
3. Enter the Name of your session (required) and your SubjectID (required).
4. Click on Save button and recording will begin.
5. To stop your recording, hit the stop button  in the bottom right corner of the application.

You can record a session while in any of the app main views (Raw EEG, Motion Sensors, Data Packets and FFT/Band Power) and view the data streams while the recording is taking place.

Timer

A timer at the bottom middle of the application displays the total length of time elapsed during the current recording in *hours : minutes : seconds*.



Event markers

Markers are used to indicate specific events or areas of interest in EEG files as they are recorded, so you can find the events later during playback or analysis. With EmotivPRO you can send markers manually via your computer's keyboard, or connect to a serial port (or virtual serial port), USB port or use our EMOTIV Extender peripheral to allow other applications to present stimuli and mark the events automatically. Any marker entered will display in the data stream and on the session timeline during playback and will be indicated alongside other data streams in the application's exported CSV files.

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.





Set up keystroke markers

Serial port marking

USB marking

Keystroke marking

You can assign keyboard keys 0-9 and a-z to input keystroke markers. Keystroke markers show up on your timeline as  symbol.



Key	Description	Value	
1	Blink eye while relaxing	22	 
2	Lift right arm	23	
3	Lift left arm	24	

Add new marker




Configure keystroke markers


To add a new keystroke marker:

1. Click on the “ Markers” button in the bottom right corner of the application
2. Click on “Keystroke marking” on the left menu
3. Click on “Add new marker”
4. Input values for:
 - a. **Key** - the keystroke on your PC to activate the marker
 - b. **Description** - a summary or name for this marker
 - c. **Value** - a unique numeric value (integer between 0 and 255) that will represent this marker in the [session timeline](#) and [exported data files](#)
5. Click on the “” check mark icon to save your changes

To edit a keystroke marker:

1. Hover over the marker you would like to edit with your mouse
2. Click on the  edit icon
3. Change the Key, Description or Value inputs
4. Click on the “ “ check mark icon to save your changes

To delete a keystroke marker:

1. Hover over the marker you would like to delete with your mouse
2. Click on the  trashcan icon

Manual marker settings will be saved on your local device for the next time you open the application.

Use keystroke markers

To add a keystroke marker to your data stream during a recording, touch the Key associated with the marker on your keyboard at the time of the event. You will see a vertical pink line in the data stream in Raw EEG 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 files](#).

Serial port markers (Windows only)

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

Set up serial port markers

Configure real and virtual COM port markers below to add automatic markers into your data stream. Serial port markers show up on your timeline as symbol.

Serial port marking

USB marking

Keystroke marking

Port selection

dev/cu.Bluetooth-Incoming-Port

Option 1

Option 2

Option 3

Data bits

Data_5

Parity

Mark

Stop bits

1

Flow control

None

Save

Markers

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


1. Click on the “ Markers” button in the bottom right corner of the application
2. Click on “Serial port marking” on the left menu
3. Select the configurations in the drop down menus for available 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 “Apply” to save configuration. Click on “Cancel” to cancel changes.
5. Click on “ Markers” to return to data views


You will see a vertical pink line in the data stream in Raw EEG 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 files](#).

The screenshot shows the 'Set up USB markers' configuration window. The top header includes a menu icon, 'Emotiv EPOC+' with a battery level indicator at 89%, and the user name 'John Doe'. The main content area has a gear icon and the title 'Set up USB markers'. Underneath, there are three marking options: 'Serial port marking', 'USB marking' (highlighted in pink), and 'Keystroke marking'. A descriptive text states: 'To mark events using a USB device, select from connected devices below. Markers sent via USB will show up on your timeline as ¶ symbol.' Below this is a 'USB device' dropdown menu currently showing 'usb port 2: Mouse'. At the bottom of the configuration area are two buttons: 'Refresh device list' and 'Start'. At the bottom right of the application window, there is a 'Markers' button with a pink shield icon.

USB markers

To configure markers sent by a USB device:

1. Click on the “ Markers” button in the bottom right corner of the application
2. Click on “USB marking” on the left menu

3. Select the USB device you want to connect to in the drop down menu of available devices.
4. If you do not see the device that you expect, click on “Refresh device list”
5. Click on “  Markers” to return to data views


Remarks for USB Marker:

- Currently USB mouse and keyboard are not supported.
- Marker values from the USB port is in the range of 0 to 127.

You will see a vertical pink line in the data stream in Raw EEG 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 files](#).

Managing your sessions

You can view your previously recorded sessions by selecting “Sessions” in the left side menu.

 Emotiv EPOC+ John Doe ▾

Sessions

Name ▾	SubjectID ▾	Date ▾	Duration ▾
EmotivPRO Test	jpeterson	05/15/16	00:05:20
Watching television	test subject	12/11/16	00:05:22
Yoga	test subject	22/11/16	00:08:16
Emotiv Commercial	test subject	22/11/16	00:08:16
Work Meeting	test subject 22	22/11/16	00:08:16
Browsing	test subject 33	22/11/16	00:08:16
Work Meeting	test subject 44	22/11/16	00:08:16

< 1 2 3 4 >

Markers

Sessions history list

Your sessions history list displays all sessions that have been recorded previously under your current license. In this view you can view each session's Name, SubjectID, the Date it was recorded and the Duration of the recording.

You can sort your recordings by Name, SubjectID, Date, or Duration by clicking on the up/down arrows next to each of these categories. You can also search for keywords in your sessions using the search box in the top right corner of the view.


Cloud synchronization




For your convenience, all recorded sessions are saved to your local PC, so that you do not need to be online to access your data, and to our cloud, so that you can access your sessions across all devices that share your EmotivPRO license.

You can [Delete](#) sessions from any of your local PCs while retaining them on your other devices.

Open a session


To Open a session for playback:

1. Go to the “Sessions” view in EmotivPRO
2. Hover over the session in your session history list
3. Click on the Play  icon on the right side of the entry

Name ↕	Date ↕	Duration ↕	Note ↕	
EmotivPRO Test	05/15/16	00:05:20	This is just a test pay full attention to it	  

Delete a session

To Delete a session:


1. Go to the “Sessions” view in EmotivPRO
2. Hover over the session in your session history list
3. Click on the Delete  icon on the right side of the entry
4. Confirm you would like to delete the session by clicking on “Yes, delete”

Deleting a session will remove this session from your local hard drive and history list.

Note: Deleted sessions will not be removed from other PCs sharing the same EmotivPRO license.

Export a session

To Export a session for analysis using other software programs:

1. Go to the “Sessions” view in EmotivPRO
2. Hover over the session in your session history list
3. Click on the Export  icon on the right side of the entry
4. Select the location on your PC where you would like to save your exported data by clicking on the folder icon
5. Select whether you would like your EEG data exported as a CSV or EDF file

Playback a session

To playback a previously recorded session, [Open](#) the session from your history list. Only one session can be opened at a time.

Session timeline

When a session is open, you will see a session timeline at the bottom of the application. The timeline will display the Name, Date and Duration of the open session.





Timeline markers

If you added markers to your recorded session, you will see icons for these markers placed on the session timeline. Pink tags represent serial port or USB markers and gray tags represent keystroke markers.

As you playback the recording, you will also see vertical lines in the Raw EEG and motion data streams at the time of the marked event.

Navigate a session

To playback a session, click on the play  button (forward arrow) in the bottom left of the application. Playback will replay your recorded session for all data views (Raw EEG, Motion Sensors, Data Packets and FFT/Power Bands) at 1x speed.

To stop the playback, click on the pause  button in the same location.

To quickly move to a time point in your recording, move the scrubber (pink circle) left or right along the session timeline. The current time point of the scrubber is displayed next to the total session duration on the bottom right of the timeline.

Close a session

To close an open session and return to real time mode, click on “Exit playback mode” in the top center of the application.



Opening another session will also close the current open session. Only one session can be open at a time.

Exported data files

EDF files

Data is 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.

Descriptive Tags

The exported EEG file consists of a single line containing reference information for the remainder of the file, arranged as information tags. Each tag consists of a tag name, a colon (:), and information separated by one whitespace character. There are seven tags whose format is shown in the following examples:

title:Demonstration

the title of the file as indicated at the time of saving

recorded:28.07.15 11.14.10

Date and time (Local time) when the recording was started, to the nearest second.

[Year]-[Month]-[Day] [Hours].[Minutes].[Seconds]

timestamp started: 2017-07-04T11:55:54.734969+07:00

ISO time when the session was started and the timestamps began, to the nearest millisecond.

[Year]-[Month]-[Day]T[Hours]:[Minutes]:[Seconds]+[hours from GMT]

Note: a session begins when the headset connects to the application, not when a recording begins

sampling:128

sampling rate in samples per second

subject:JaneDoe

Subject ID as indicated at the time of saving

For Epoc/Epoc+:

**labels: COUNTER INTERPOLATED AF3 F7 F3 FC5 T7 P7 O1 O2 P8 T8 FC6 F4 F8 AF4
RAW_CQ GYROX GYROY MARKER SYNC TIME_STAMP_s TIME_STAMP_ms CQ_AF3
CQ_F7 CQ_F3 CQ_FC5 CQ_T7 CQ_P7 CQ_O1 CQ_O2 CQ_P8 CQ_T8 CQ_FC6 CQ_F4
CQ_F8 CQ_AF4 CQ_CMS CQ_DRL**

headings for each data column (see below)

For Insight:

**labels: COUNTER INTERPOLATED AF3 T7 Pz T8 AF4 RAW_CQ GYROX GYROZ MARKER
SYNC TIME_STAMP_s TIME_STAMP_ms CQ_AF3 CQ_T7 CQ_Pz CQ_T8 CQ_AF4**

headings for each data column (see below)

chan:39

count of the total number of information columns in the remainder of the file (note - this includes all columns, not just EEG data)

units:emotiv

measurement units - one emotiv unit is almost exactly one microvolt

Column Headings

Each column of the EEG file, starting in row two, contains the following data over time.

COUNTER

“COUNTER” represents the packet counter and can be used as a timebase. The counter runs from 0 to 128 (note there are 129 counter values - it takes one sample longer than a second to cycle around the full count).

Note: the counter is not related to the sampling rate of your headset

INTERPOLATED

This column is a flag which shows if a packet was dropped (value = 1). FLAG=0 means the sample was good.

AF3...AF4

EEG channels associated with your EMOTIV headset

RAW_CQ

“Raw_CQ” is a multiplexed conductivity measurement used to derive the contact quality indicators in the application. It is possible to demultiplex this channel if more accurate conductivity measurements are required. The multiplexer cycles twice through the electrodes in each 129-sample cycle.

GYROX, GYRO

Horizontal and vertical difference readings since the previous sample.

MARKER

Actual value of the marker inserted. If no marker trigger was detected at the particular timing sample, a value of 0 is added into the file (except from Extender, see MARKER_HARDWARE). Otherwise the number associated with the marker trigger (positive number), or the byte value transmitted via the USB/COM port, will be inserted for that sample.

MARKER_HARDWARE

The index of device that has been used to trigger this marker. The value depends on order of devices (USB, serial, keyboard) when you use to send the marker. The first device will get an index of 1, the second will get 2, and vice versa.

A value of 0 indicates there is no event at that point.

If the trigger is sent via Extender, MARKER_HARDWARE will be 1 and MARKER will be 0.

Example:

	MARKER_HARDWARE	MARKER
1st marker from keyboard, with value 26	1	26
No event	0	0
2nd marker from USB, with value 8	2	8
3rd marker from keyboard, with value 99	1	99
4th marker from serial, with value 42	3	42

No event	0	0
5th marker from Extender	1	0
6th marker from USB, with value 27	2	27
7th marker from serial, with value 24	3	24

TIME_STAMP_s, TIME_STAMP_ms

The timestamp of EEG and motion sample in seconds (TIME_STAMP_s) and milliseconds (TIME_STAMP_ms), as related to the **timestamp started** value. The value explicitly related to the number of seconds (TIME_STAMP_s) and additional milliseconds (TIME_STAMP_ms) after the headset connected to the application that the sample was taken.

To get the actual time of a sample, you can add the timestamp values of a sample to the **timestamp started** value of the session:

REAL TIME = **timestamp started (ms)** + TIME_STAMP_s*1000 + TIME_STAMP_ms

CQ_AF3...CQ_AF4

These numbers show the colour of the CQ Map indicators, where 0=BLACK, 1 =RED, 2=ORANGE, 3=YELLOW, 4=GREEN.

CQ_CMS, CQ_DRL

These numbers show the contact of your headset's reference sensors. The colours for the the reference locations are either RED (1) or GREEN (4)

Motion data files

When you export a session, you will also receive an EDF file for the motion data (named "...md.edf"), if that data was collected from your headset (see [Epoc+ configurations](#)). This file is in the same format as the EEG file and with the same descriptive tags, but with only columns for

COUNTER, GYROX....MAGZ (9 motion sensor data streams), TIME_STAMPS, and TIME_STAMP_ms.

CSV files

Exported or converted CSV files contain the same descriptive tags and columns of data as the EDF files, but in CSV format. When exporting a session as a CSV file, you will get 2 files - one for EEG and one for motion data (named "...md.csv") if motion data was collected from your headset.

Notes on the data

DC Offset

EEG data is stored as floating point values directly converted from the unsigned 14 or 16-bit ADC output from the headset. This means that the (floating) DC level of the signal occurs at approximately 4200 μV , negative voltages are transmitted as positive values less than the average level, and positive voltages are transmitted as positive values greater than the average. In order to remove the DC offset, especially before performing any kind of analysis such as Fast Fourier Transform (FFT) it is necessary to apply some kind of DC offset removal. The simplest method is to subtract the average from the entire data channel, although this is the least accurate. Ideally you should apply a high-pass filter which matches the characteristics of the electronics - that is, you should use a 0.16Hz first order high-pass filter to remove the background signal (this also removes any longer term drift, which is not achieved by the average subtraction method). Another method is to use an IIR filter to track the background level and subtract it an example is shown below in Matlab pseudocode, assuming the first row has been removed from the array `input_data()`:

```
IIR_TC = 256;
```

2 second time constant- adjust as required

```
EEG_data = input_data( : ,3:16 );
```

select out only the EEG data

```
[rows columns]= size(EEG_data);
```

rows= number of data samples, columns= 14

```
AC_EEG_data = zeros(rows, columns);
```

reserve space for the output data file

```
back= EEG_data( 1, : );
```

copy the first row of data into the background file

```
for r = 2 : rows
```

```
back= (back* ( IIR_TC- 1 ) + EEG_data( r,:)) / IIR_TC;
```

```
AC_EEG_data = EEG_data( r,:)- back;
```

```
end
```

This demonstration code is not efficient in memory and assumes the entire file is available. It is quite straightforward to modify the code to replace the data in the source array rather than making a separate AC-coupled array, and also to run the IIR filter in open-ended form for processing in real time.

Note the vectorised form of the background recalculation at each iteration - each individual channel background average is retained in the relevant column of "back". At each step the running average is re-estimated using the new input value. Note also that the first IIR_TC samples are biased towards the initial value but this settles down after about $2 * IIR_TC$ samples.

It is very important to remove the background signal before performing an FFT - you should also apply a tapered window function such as a HANNING transform before executing the FFT to ensure there are no wrapping artefacts where the FFT treats the data as an infinitely repeating sequence, and any mismatch between the first and last samples appears as a STEP FUNCTION in the analysis, injecting noise across the spectrum.