

# **EPOC Flex User Manual**

# EPOC FLEX User Manual



EPOC Flex Saline Pre-Configured Kit

This document is intended to help you get started using the EPOC Flex. The EPOC Flex is a 32-channel, flexible EEG system. It was built on the award winning EPOC+ technology and is designed for researchers who would like to have a more flexible sensor placement and / or greater density of sensors. The reference sensors can be placed in any location on the head, or on the ears with included earclips. EmotivPRO v1.4+ is required for operation.

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

EPOC Flex

# Introduction



EPOC Flex Saline Kit Contents

This document is intended to help you get started using the EPOC Flex. The EPOC Flex is a 32-channel, flexible EEG system. It was built on the award winning EPOC+ technology and is designed for researchers who would like to have a more flexible sensor placement and / or greater density of sensors. The reference sensors can be placed in any location on the cap, and on the ears with included earclips (gel sensors only ). EmotivPRO v1.4+ is required for operation.

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

EMOTIV products are intended to be used for research applications and personal use only. Our products are not sold as Medical Devices as defined in EU directive 93/42/EEC. Our products are not designed or intended to be used for diagnosis or treatment of disease.

# Technical Specifications

Device	EPOC Flex
No. of Channels	32 (plus CMS/DRL references)
Channel names	Configurable on standard 72 channel international 10-20 locations.
Sampling method	Sequential sampling. Single ADC
Sampling rate	128 SPS (1024 Hz internal)
EEG Resolution	14 bits 1 LSB = $0.51\mu\text{V}$ (16 bit ADC, 2 bits instrumental noise floor discarded)
Max Slew Rate	32.64uV/sample (Compression required for BLE data transmission)
Bandwidth	0.2 - 45Hz, high attenuation at 50Hz and 60Hz
Filtering	Built in digital 5th order Sinc filter
Dynamic range (input referred)	$\pm 4.12 \text{ mV}$
Coupling mode	AC coupled
Connectivity	Proprietary 2.4GHz wireless, BLE(coming soon)
Battery Capacity.	LiPo battery 595mAh
Battery life (typical)	6-9 hours

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Impedance Measurement	Real-time contact quality using patented system
IMU Part	ICM-20948 3-axis Accelerometer, 3-axis Gyroscope, 3-axis Magnetometer. Data Output 10 channels Quaternions, (Q0, Q1, Q2,Q3), Acceleration (X,Y,Z) and Magnetometer (X,Y,Z)
Motion Sampling	16 Hz
Motion Resolution	8-bit Output
Sensor Material	Sintered Ag/AgCl (EPOC Flex Gel model) can be used with any EEG gel Electroplated Ag/AgCl (EPOC Flex Saline models) with replaceable polyester felt pads that can be sterilised and re-used (bulk pack available for separate purchase)

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# Safety Precautions

- EPOC Flex is a consumer product; it **is not** intended to be used as a medical device or in hazardous environments.
- EPOC Flex is designed for use at room temperature; rapid changes in temperature will affect the performance of the amplifiers and increase the noise floor.
- EPOC Flex uses saline based sensors. Every effort has been made to stop water entering the headset and protect the electronics inside. However, the headset is not waterproof. Do not submerge your headset in water.
- **WARNING:** EPOC Flex is powered by a lithium polymer battery that is rated for operation in <50°c environments. It **is not** user replaceable. If you suspect that there is a fault with the battery, please contact EMOTIV Support.
- **WARNING:** Do not open the headset enclosure. Doing so will void the warranty and can damage the headset.
- **WARNING:** Do not wear EPOC Flex while charging the device. If you want to operate while tethered EPOC Flex is compatible with Extender.

## Précautions de Sécurité

- EPOC Flex est un produit de consommation; il **n'est pas** destiné à être utilisé comme appareil médical ou dans des environnements dangereux.
- EPOC Flex est conçu pour une utilisation à température ambiante; des changements rapides de température affecteront les performances des amplificateurs et augmenteront le bruit de fond.
- EPOC Flex utilise des capteurs à base de solution saline. Tous les efforts ont été faits pour empêcher l'eau de pénétrer dans le casque et protéger l'électronique à l'intérieur. Cependant, le casque n'est pas étanche. Ne plongez pas votre casque dans l'eau.
- **AVERTISSEMENT:** EPOC Flex est alimenté par une batterie au lithium polymère conçue pour fonctionner dans des environnements <50°c. Il **n'est pas** remplaçable par l'utilisateur. Si vous pensez qu'il y a un problème avec la batterie, veuillez contacter le support EMOTIV.
- **AVERTISSEMENT:** n'ouvrez pas le boîtier du casque. Cela annulerait la garantie et pourrait endommager le casque.
- **AVERTISSEMENT:** ne chargez pas l'EPOC lorsque vous portez l'appareil. Si vous voulez fonctionner alors que l'EPOC Flex connecté est compatible avec Extender.

# Regulatory Compliance

**EMOTIV products are intended to be used for research applications and personal use only. Our products are not sold as Medical Devices as defined in EU directive 93/42/EEC. Our products are not designed or intended to be used for diagnosis or treatment of disease.**

FCC ID Number **2ADIH-FLEX01** and IC ID Number: **12769A-FLEX01**.

EMOTIV has undertaken testing and confirms:

This device complies with the radio equipment directive (2014/53/EU).

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or experienced person for help.

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

1. This device may not cause interference.
2. This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

1. L'appareil ne doit pas produire de brouillage;
2. L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

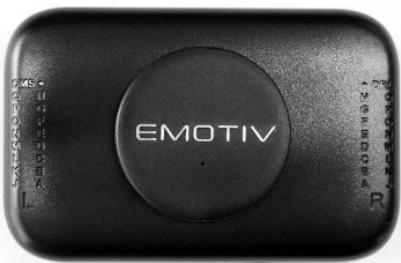
**Please Note: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.**

Section	Standards Tested
EMC and Telecom: Class B	ETSI EN 301 489-1 & 489-17
	ETSI EN 301 328 v2.1.1
	AS/NZS CISPR22 :2009
	AS/NZS 4268 :2012, BTLE 4.0
USA	FCC CFR 47 Part 15B & 15C
Canada	ISED RSS-247: Issue 2, IC RSS-102: Issue 5

Our USB dongle has FCC ID Number **XUE-USBD01**.

# Package Contents

EPOC Flex is designed to allow users to buy the components required to meet their research need. When you open the box, you will find the following:



Controller



Universal USB Receiver (included with Controller)



EasyCap(tm) Emotiv Custom Cap



Electrode Sensors - EPOC Flex Gel model



Micro-B to A USB charge cable



Earclips (included with Gel sensors only)

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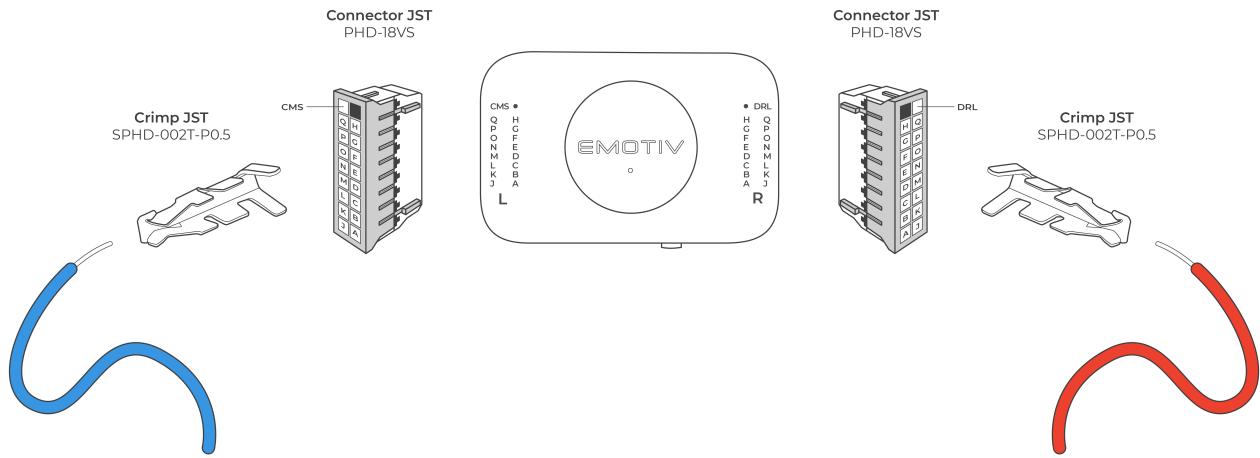
# Assembly Quick Start



After unboxing your EPOC Flex for the first time it is recommended to fully charge the controller unit before use. Please find the quick start guide for setting up your EPOC Flex here <https://www.emotiv.com/setup/flex/>

**Controller**

# Controller Details



The EPOC Flex controller pictured above has 16 channels on the left + CMS input and 16 channels on the right + DRL output. These channels are connected in two rows A-H and J-Q with the position above the CMS/DRL empty. The power switch is located next to the USB connector on the bottom edge of the unit, turn it to the right to turn on and left to turn it off. There is a multifunctional LED located below the logo to indicate charging or power on.

# Charging and LED Indicators

The EPOC Flex has a single RGB LED to indicate power on and charging as shown in the table below.

Action	LED Colour
Power OFF / Battery Flat	OFF
Powered On	BLUE
USB connected / Charging	ORANGE
Charge complete	GREEN
Firmware failure	Fade On - Fade Off Blue
USB connected / powered On	WHITE

It is recommended that your headset is fully charged prior to taking recordings. The charge time depends on the remaining capacity in the Lithium Polymer cell and can take up to four hours. If the EPOC Flex LED does not turn blue on power on it requires charging. Please use the provided USB Micro-B cable to recharge using any usb port.

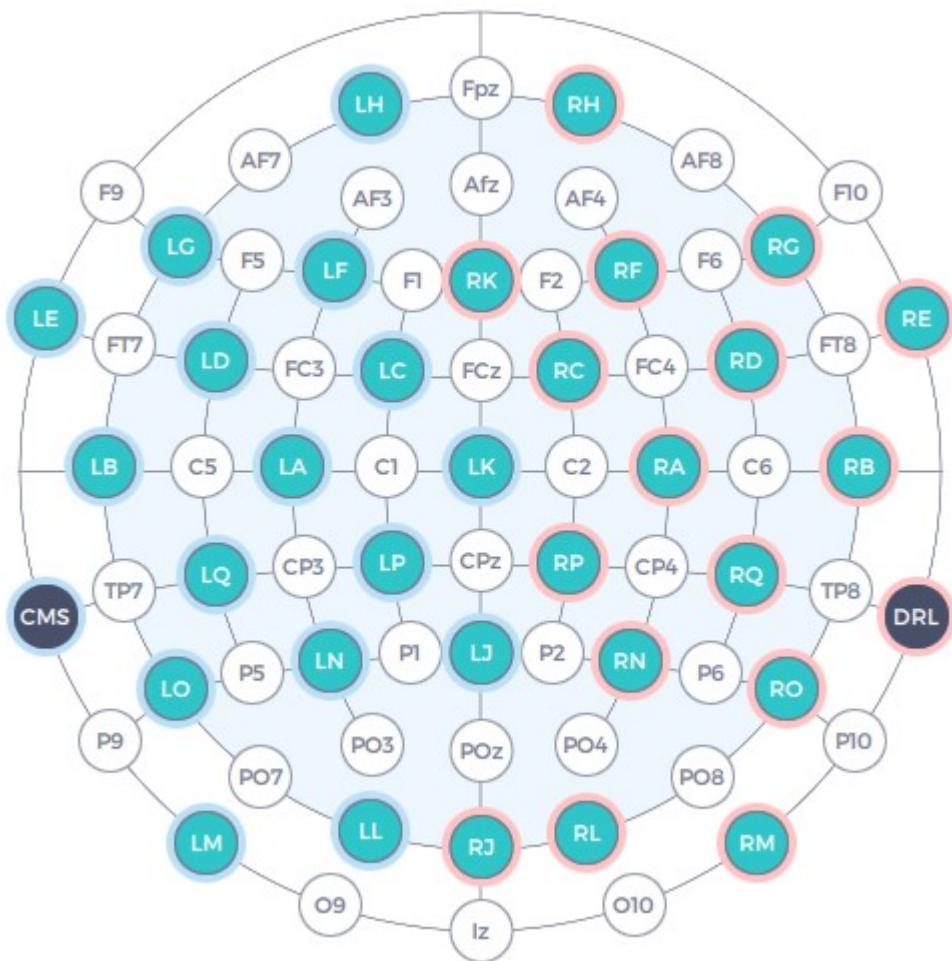
*Note 1: The headset will charge faster if connected to a dedicated USB port.*

*Note 2: If the headset it heavily depleted or hasn't been used for a few months, leave it connected for 24hrs.*

# Electrodes

# Example Sensor Placement (Montage)

Below is an example electrode placement for 32 channels with mastoid references, these can be moved to P9/P10 to be the same as EPOC+. The default configuration of EPOC Flex in EmotivPRO is as below. This placement gives good coverage of the entire head, with the pod fitted in the back pocket t Iz.



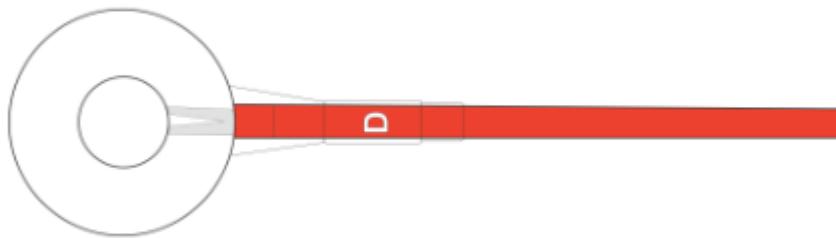
The EPOC Flex kits include 34 sensors connected to 16 red, 16 blue and 2 black wires, each wire is individually labeled with the channel letter it is connected to on the controller. The wire is crimped with a JST gold plated crimp to improve signal quality before inserting into the connector housing.

Sensor wires are colour coded, blue for left, red for right, and black for references. In addition, each sensor individually labeled with the channel name it is connected to the EPOC Flex. The aim of this colour coding is to simplify troubleshooting, because you can quickly identify channel name in the software and quickly find the electrode on the cap. For

example if contact quality is low on channel LA this corresponds with the blue A wire. The sensor wires are provided in two lengths to help to minimise the excess while allowing for any configuration, wires for channels A-G are 300mm and channel J-Q are 150mm.

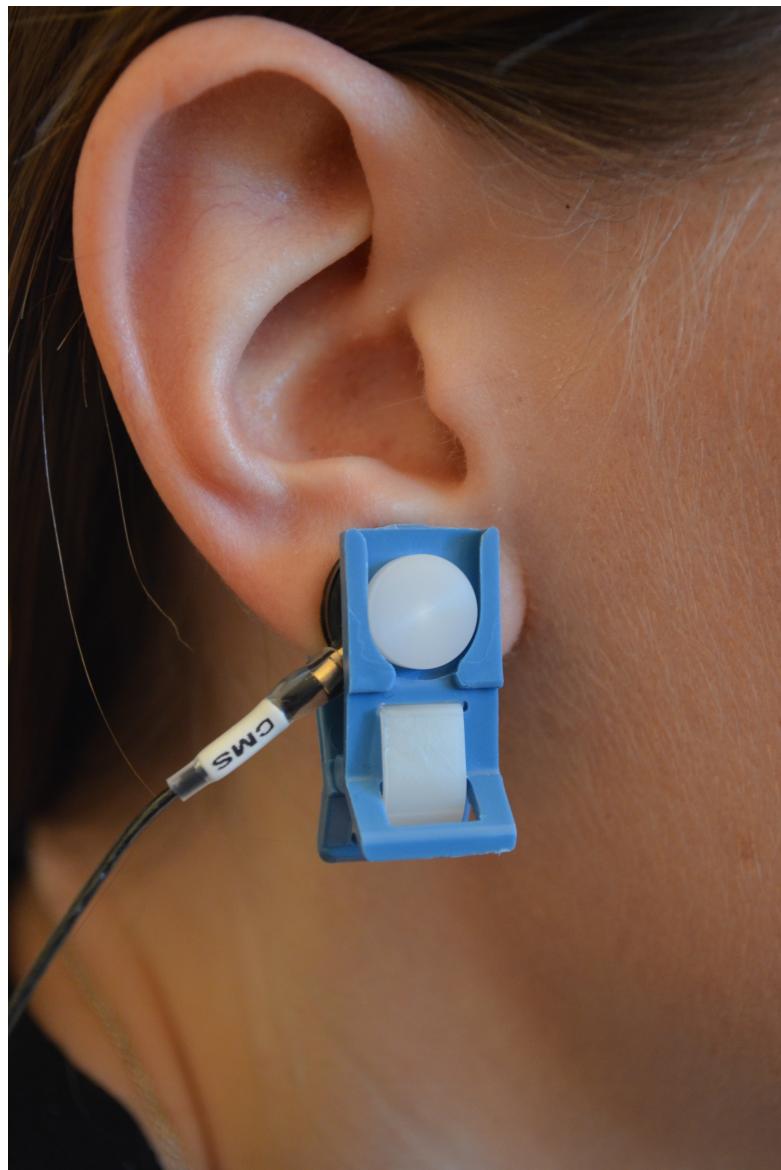
# Gel Sensors

The EPOC Flex gel kit includes 34 EasyCap multi-rode gel sensors that are crimped and fitted into the connector housing in the order they are labeled. The sensors are made from sintered Silver/SilverChloride to minimise the electrode impedance and fully compatible with gel electrolytes.



Easycap multi-rode gel sensor

We know that researchers can have different needs for references, so we have included ear clips in the kit and the gel sensors are compatible with adhesive pads. The included earclips are blue and fitting as shown below. The clip will hold the sensor onto the ear however can be removed once the gel has hardened.



# Saline Sensors

EMOTIV has developed our own saline sensors compatible with EPOC Flex available to purchase on their own or as a kit. These sensors use the same felt pads as EPOC+ but with are Silver / Silver Chloride plated electrode to grip the felt on the sides. Saline sensors start to dry out after 1-2hours and to enable easy topping up there is a refill hole to allow you re-wet the sensors without needing to take the cap off. To accommodate the existing felt size the saline sensors are bigger than the gel sensors but do still fit into the holes of the same cap.



Saline Sensor (Width 19 mm x Height 7.9 mm)

This length is designed to be long enough to reach any position on the cap. Sensor wires are colour coded, blue for left, red for right, and black for references. In addition, each sensor will be individually labeled with the channel name it is connected to the EPOC Flex. The aim of this colour coding is simple, when troubleshooting you can quickly identify the colour and channel name in the software and quickly find the sensor on the cap. For example, if contact quality is low on channel LA this corresponds with the blue channel A wire.

The sensor wires are in two lengths to help to minimise the excess but also allow for any configuration, channels A-G are 300mm and channel J-Q are 150mm. Once you have fitted all the sensors in place we recommend that you use the included tagger pins and tagger tool to tidy up the wiring (See [link](#)). Or we recommend that you place a cap over the top to

stop these wires catching. If your research involves minimising motion artifacts you should keep the excess wire secured.

EMOTIV now offers pre-configured Saline caps with all 32 channels fitted as per the default layout in PRO, the wires are cut to length and tied down. This means you can very quickly set up the cap and start recording.

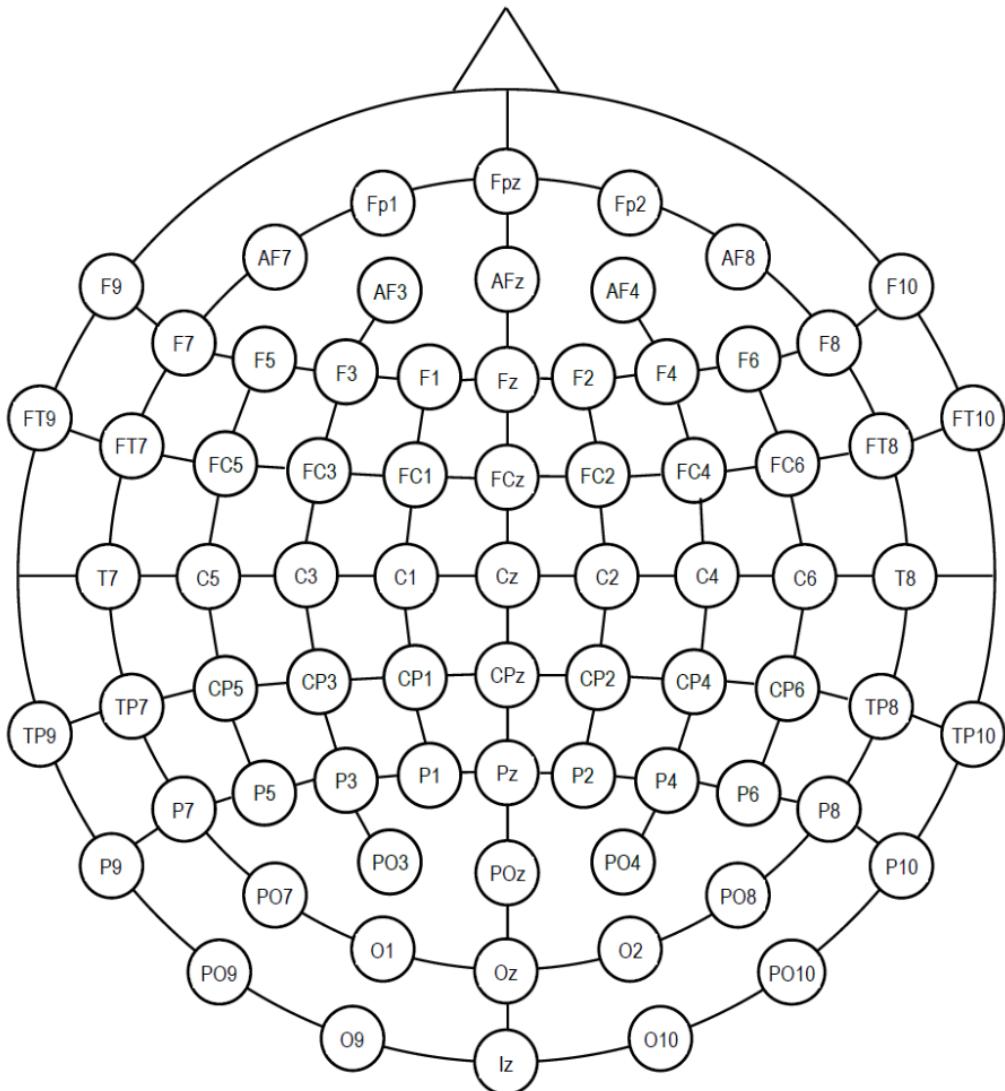
Cap

# EPOC Flex Cap



EPOC Flex Cap

The standard EPOC Flex cap follows the official 10-20 system and has 72 openings as shown below. The cap has two pockets for securing the controller into the cap, one is fitted below Cz and the other Iz.

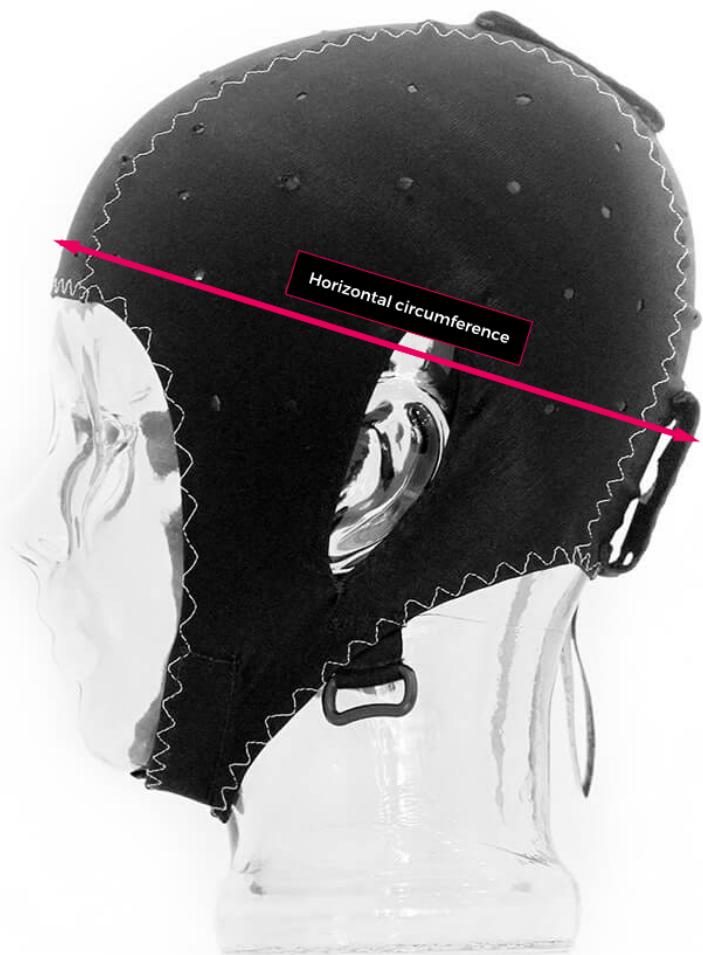


10-20 sensor map

The caps can be ordered in standard sizes are 54, 56 and 58 cm in a black high comfort material. Other sizes in 2cm increments, hole positions, materials and cuts are available please contact [online support](#) for further information.

# Choosing the Cap Size

Specifying the right cap size is critical for ensuring the sensors are in the right place when taking measurements. Our supplier recommends measuring the head diameter in the horizontal circumference as shown in the image below.

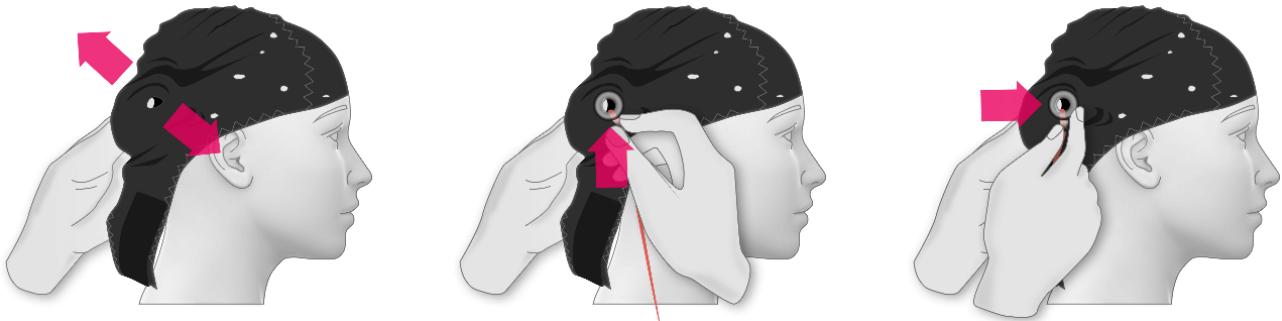


Once you have the measurement for your test subjects, specify the closest size to the ones available, for example 54.5cm → 54cm, 59cm → 58cm, etc. If you need larger or smaller sizes, please contact support.

# Setup

# Inserting the Sensors into the Cap

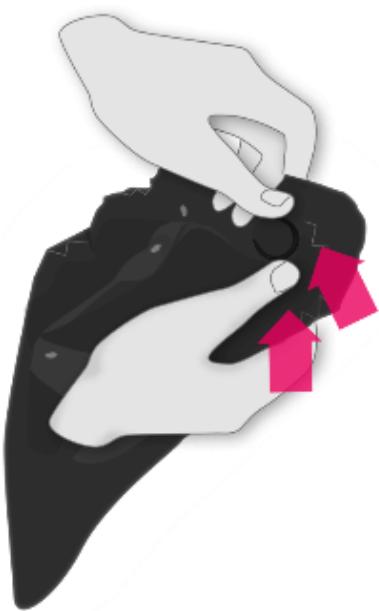
Hold the underside of the cap, stretch the material in all directions around the hole you intend to fit, then wedge the sensor into the hole. Push upwards first and then let the material move to fix the bottom half. Adjust the material until the sensor is fully fixed. Repeat this step for all the Sensors in your desired configuration.



Inserting the sensors

Since the Saline Sensors are a little larger than the Gel Sensors, it is easier to stretch the material of the cap around the Sensors than forcing the Sensor into the cap.

With the saline felt pad facing inwards, place it over the Sensor hole into which you wish to fit it. Flipping the Cap inside out, stretch the hole over the Sensor, let the material pop into place into the plastic groove. The majority of the Sensor should be on the outer side, while the felt should protrude towards the inside, where it will be resting against the scalp when the cap is in place. Repeat this step for all Sensors.

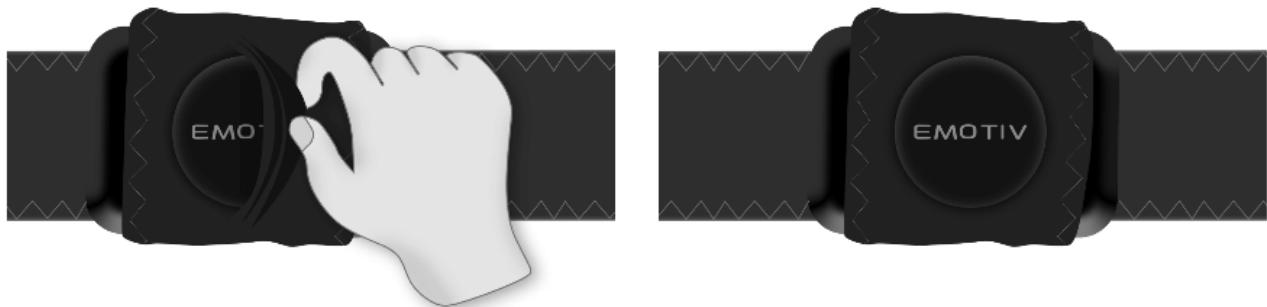


# Placing the Control Box



EPOC Flex Controller Fitted into cap

Place the control box in either the rear head position or the top position. The top position is recommended for those who research on people where headrests are required in a chair (in wheelchairs, for example), or in studies where people are lying down (sleep studies).

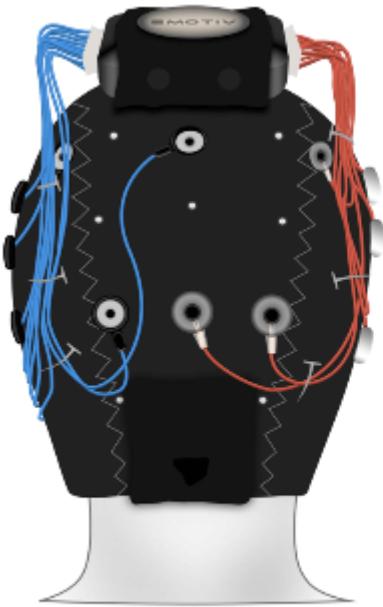


Positioning

With the EMOTIV logo facing outwards, stretch the fabric into the groove around the circular part of the control box securing the box in place.

# Positioning the Control Box

The Control Box should be positioned as shown below:



**Top Position of Control Box**

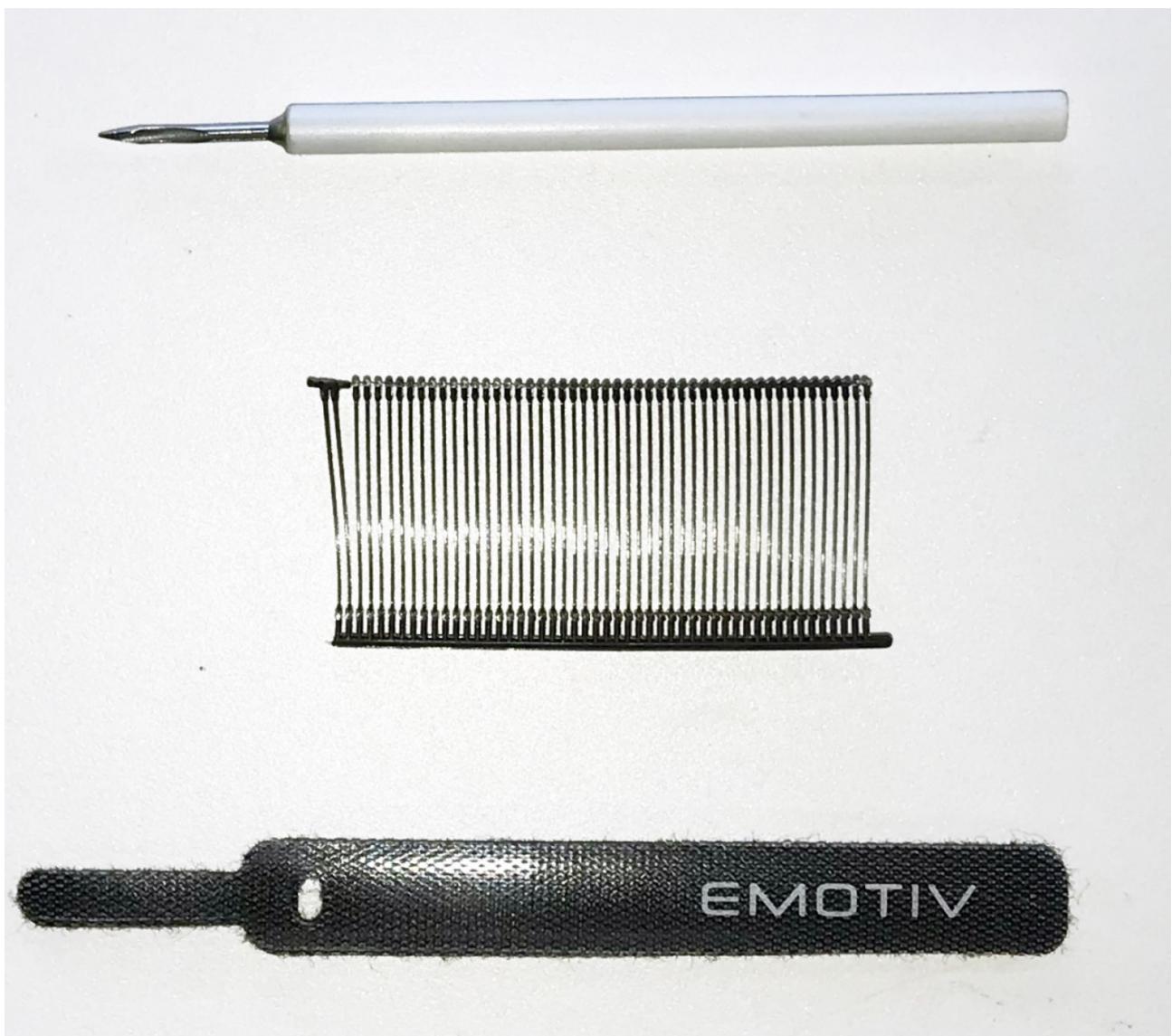


**Back Position of Control Box**

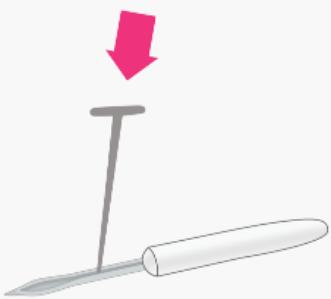
Positioning the Control Box

# Working with Wires

Once you have fitted all the sensors in place we recommend that you use the included tagger pins and tagger tool to tidy up the wiring. Or we recommend that you place a cap over the top to stop these wires catching. If your research involves minimising motion artifacts you should keep the excess wire secured. We have included two black wire wraps and a tagger tool and clothing tag pins to tie down your cables. This will help reduce wire movement being picked up by the sensor.

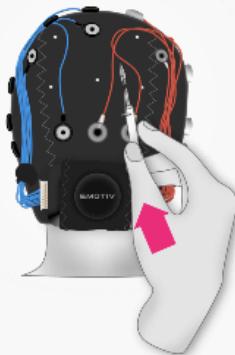


If you need to tidy up your wires, use the black cable ties and the needle provided to lock your cables down and prevent any unwanted movement. This is something similar to sewing the cables into the material.



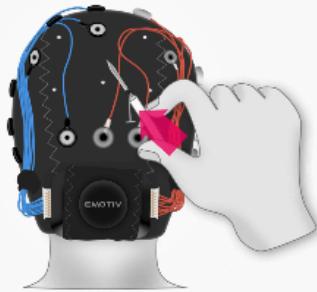
#### Threading

Thread the "T" Section of your cable tie through the threader in the needle as shown above.



#### Sticking the Needle

Through the bottom section of where you wish to tie the cables, stick the needle through 2 points of material



#### Pushing the Needle

Push the needle ALL the way thorough.

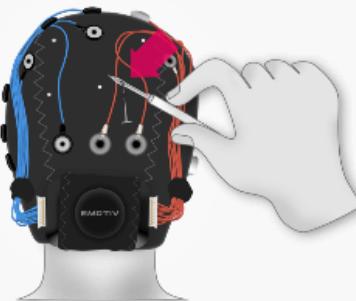
### Tidying up the wires

On the other side of the cables if you want to tie down:



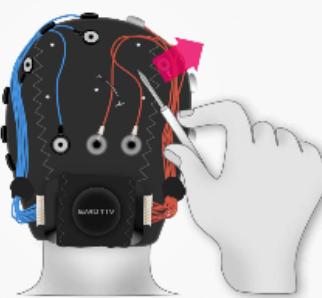
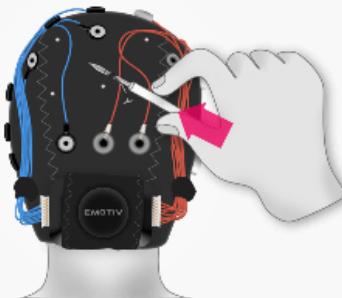
### Rethreading

Re-thread other "T" in the black cable into the tip of the needle



### Repeating the Process

Repeat the process as before, push the needle all the way through 2 layers of material:



### Pulling the Needle

Slowly, pull the needle back and out, the black "T" should begin to slide out of the needle, keep pulling the needle out until the cable is attached on both sides of the wires.

### Adjusting the Needle

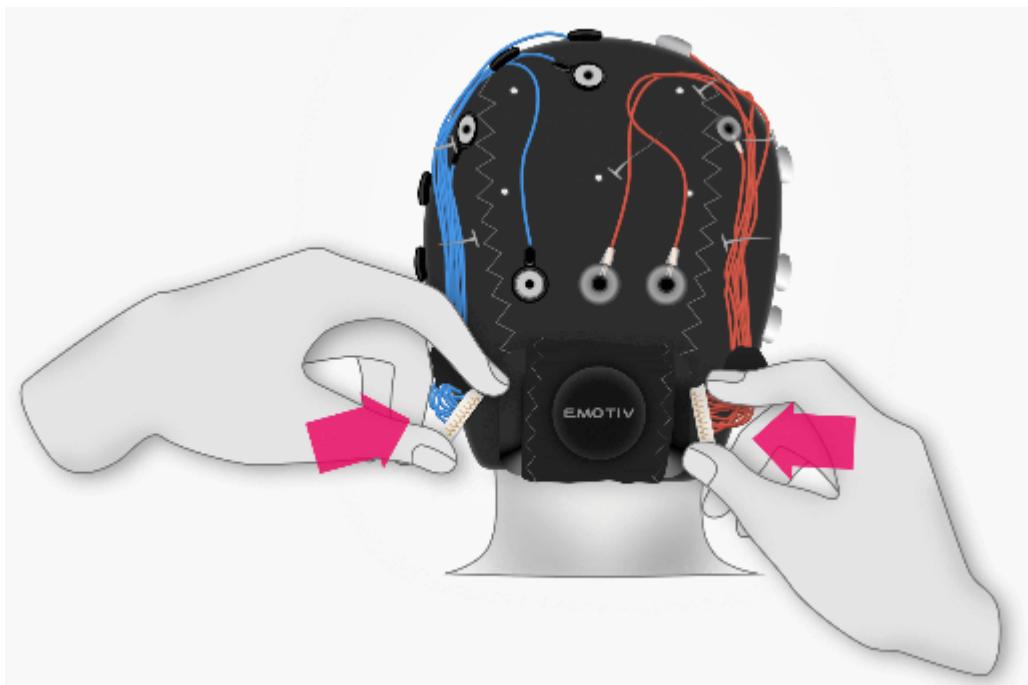
Adjust the needle to fit.

Tidying up the wires

# Plugging the Cables into the Control Box

Plug the white connector (attached to all your red cables) into the right hand side of the control box. The connector only fits in one way, so if it fits in, then you have successfully connected your control box! Repeat the process for the left side (blue cables).

Double check all your cables are in the right place – you are almost ready for recording!

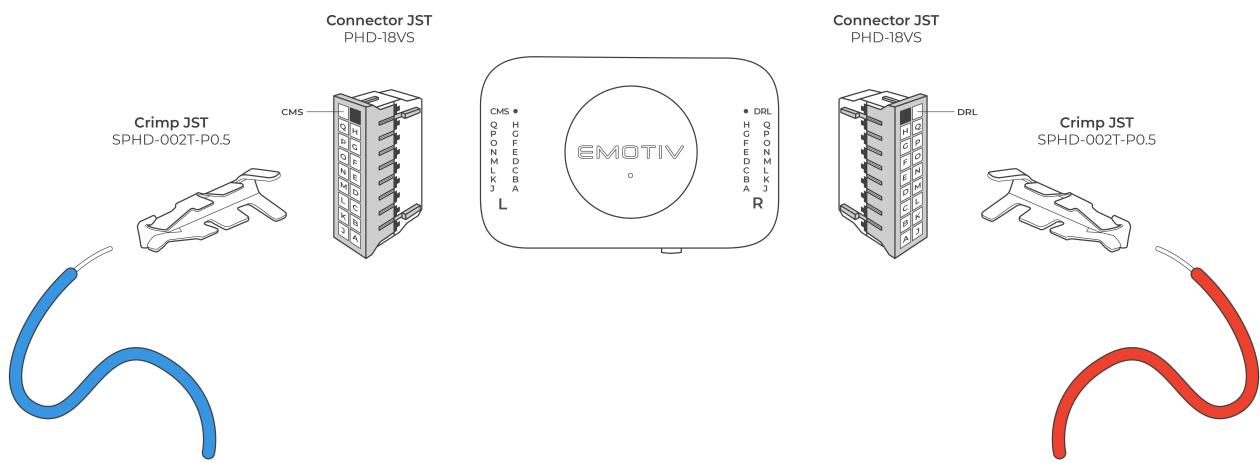


Plugging the cables



# Custom Sensor Wiring

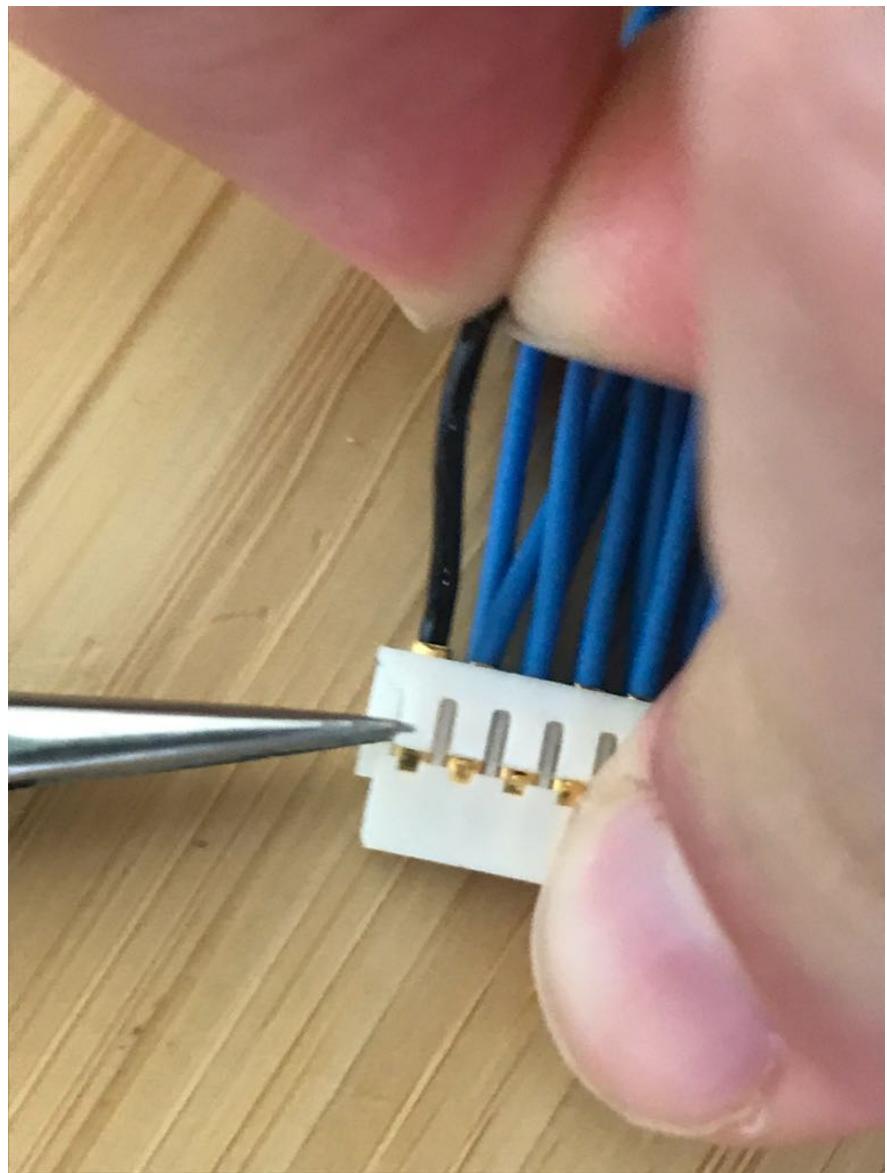
The EPOC Flex is flexible in wire position and number of sensors. By default all 32 sensors + 2 references are already fitted into the two connectors. As shown in the image below, 16 blue sensor wires + CMS a black wire is on the left. 16 red sensor wires + DRL a black sensor wire is on the right. The connector has one empty position above the references. EMOTIV has wired up the electrodes so that the electrode name A-Q matches the pin position shown below.



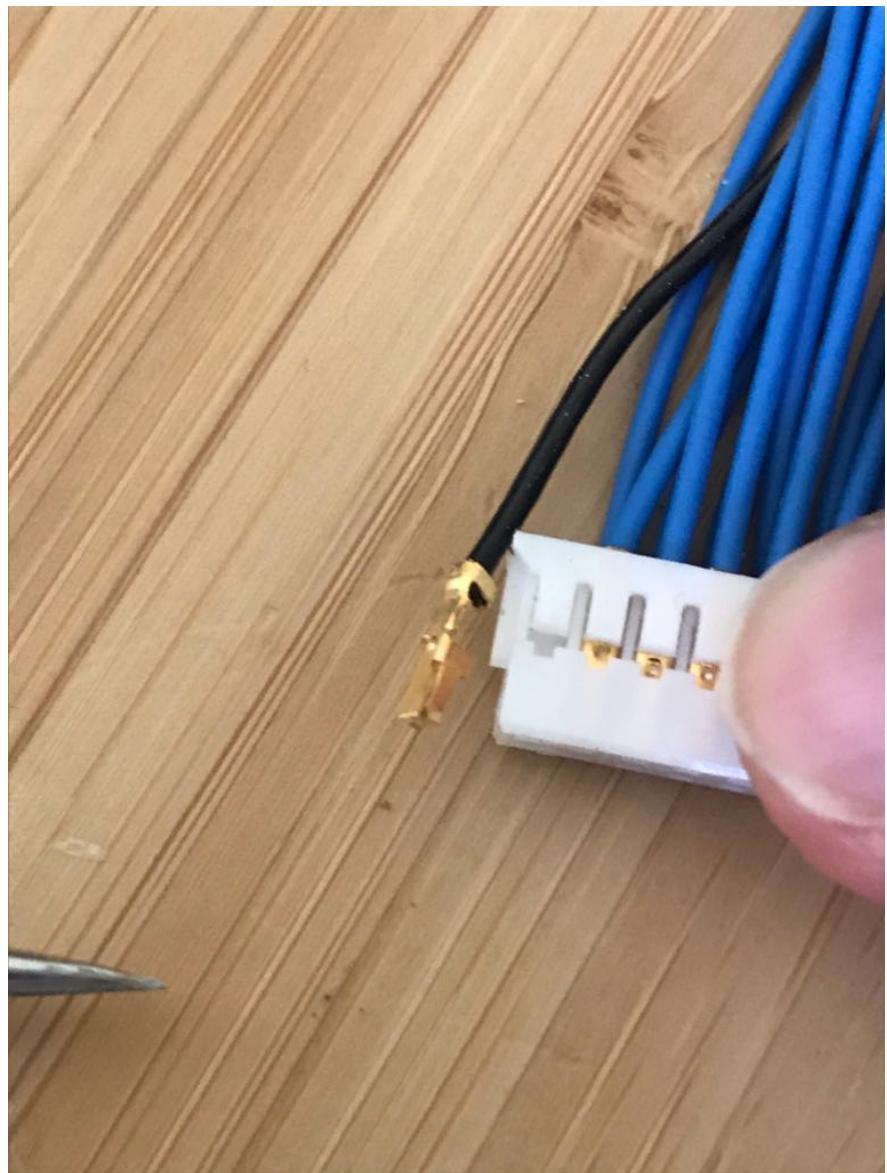
You can remove un-needed sensors if your experimental montage requires this. It is recommended to use a thin flat screwdriver or tweezers to lift up the plastic tab shown below.



Lifting this tab will release the crimp locking mechanism.



Pull on the wire until the gold of the crimp starts to be shown.



The reference wire shown above is removed.



Reinserting the wire into the connector make sure the crimp lock is facing upwards when inserting and pull on the wire to ensure it is locked in place.

# Gel Achieving high signal quality

To achieve great signal quality you need to minimise impedance between the gel sensor and the scalp. We recommend subjects should have their hair washed, but free from conditioner and other additives as these products can interfere with minimising impedances. It is recommended to have sufficient illumination when cleaning sensor positions and fitting the gel. The most effective method of achieving low impedance is to clean and abrade the skin under each electrode and then apply an electrolytic gel or paste. Any conductive gel can be used but some gels are better suited because of their viscosity or the EEG application for example in sleep studies it is important to use a gel that takes a long time to dry out.

The easycap multi-rodes can be used with both salty and salt-free electrolytes. Below are some of the available materials:

SuperVisc (clear, high-viscosity, salty)  
Lectron III-10(clear, medium-viscosity, salty)  
Abralyt HiCl(Abrasive, high-viscosity, salty)  
Abralyt 2000(Abrasive, high-viscosity, non-salty)  
Ten20 (Opaque, high-viscosity, salty)  
Nuprep Gel (Abrasive, high viscosity, non-salty)

Equipment required:

1. Wooden cotton swabs
2. Isopropyl alcohol >70%
3. Abrasive electrolyte gel such as Abralyt 2000
4. Conductive electrolyte gel such as SuperVisc or Ten20
5. Plastic syringe (20ml) without needle
6. tissues to remove excess gel

Please follow the outlined procedure below for all sensor locations, We recommend that you start this process with the reference sensors first before moving onto the other locations. You can fill the syringe ahead of time with the electrolyte gel, a 20ml syringe should contain enough gel for 30 electrodes.

## Clean the Skin

Using a wooden cotton swab move the hair below the sensor opening to get clear access to the scalp. Then using the isopropyl alcohol on a cotton swab rotate tip gently to degrease the skin.

## **Abrade the skin**

Using another cotton swab dip in the abrasive gel and again rotate in the sensor opening, be careful to not apply too much pressure to ensure this is painless and doesn't redden the skin.

## **Fill sensor with electrolyte**

Now fill completely the sensor opening with electrolyte gel using a syringe, ensuring you have made contact between the scalp and the electrode. Most electrolytes take a few minutes to permeate the skin.

## Cleaning & Troubleshooting

# Cleaning Gel Sensors & Cap

*For gel sensor users:* it is recommended to rinse the cap with the electrodes after each usage.

*Note: You can clean a configured EPOC Flex cap by soaking or rinsing in warm water as detailed below but (1) unplug and remove the EPOC Flex Controller from the cap and (2) make sure the connectors do not get wet (by putting them into a zip lock bag and sealing with a rubber band for protection against accidental splashes and hold them out of the water) while cleaning the cap and electrodes. This way you can keep the electrode arrangement without having to remove and re-install the sensors.*

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## Cap

The cap (without electrodes) can be cleaned in a washing machine at 30° Celsius, using a mild detergent and left to air dry. Please do not put in dryer or iron as this will reduce the life of the cap.

Under most circumstances, cleaning of caps and electrodes in mild detergent (such as children's shampoo) with a toothbrush will suffice. Afterward, rinse the cap with water and the electrodes with distilled water. Finally, remove the excess moisture with paper towel and leave to air dry.

*It is not recommended to use disinfectants with high than 20% alcohol, strong oxidisers or bleaching agents as they will reduce the life of the cap.*

*Note: Dishwasher detergents often leave a film and alter the electrode surface and disinfectants will react with the sensor material. Children's shampoo is a good choice for cleaning caps and electrodes.*

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## Gel Electrodes

Clean the electrodes immediately after each use, best before the electrolyte gel or paste starts to dry and rinse the rest of the gel out of the sensors under a running tap.

In case of dried gels, please soak the electrodes for a short while (30s) and rinse again, or use a soft toothbrush. In case of more persistent or greasy stains you may use a mild detergent, such as pure soap or baby shampoo, and clean your cap and electrodes in luke-warm soap water. Always rinse with water after cleaning and dry the electrodes with a tissue or towel.

*Note: Dried gel may reduce the capacity of the sensor to transduce signals and is a frequent reason for bad signals and impedance.*

The electrode manufacturer explicitly warns:

- Do Not to soak electrodes in saline solution or chloride them, as corrosion of connections will result.
  - Do Not to autoclave or use other hot sterilization methods as the wire insulation can be damaged.
- 

## Saline Electrodes

EMOTIV saline electrodes are only subjected to saltwater in use which should be rinsed with clean water after each use to prolong the life of the sensor.

The sensors are silver/silver chloride plated which can be easily scratched by other metal parts.

The cap will inevitably get saltwater on it and should also be rinsed and air-dried between users for hygiene and comfort reasons.

# **Storage**

## **Storage**

It is best is to store the cap and electrodes in a dry and dark place.

## **Handling and Maintenance**

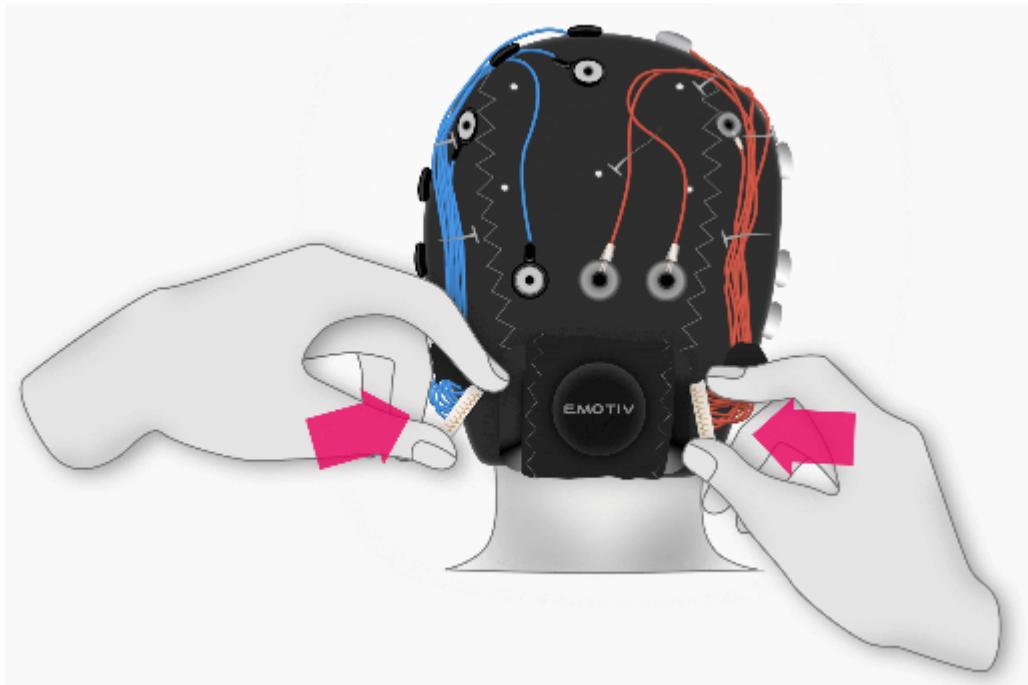
The lifespan of electrodes depends on the handling. The most critical spot for a gel electrode is where the cable enters into the solid electrode housing, and the crimp into the plug – please do never overstretch or overbend this section.

# Troubleshooting

The EPOC Flex is designed for expert users already comfortable with setup and use of EEG cap systems. Below is some easy troubleshooting steps we recommend following but for any further help please contact support via email or online chat.

## Error: Unable to get CQ on any channel

This could be due to not having plugged in the electrode trees into the cap please follow the steps outlined below. Or the references are not connected to the body please check the contact for both DRL and CMS.



Plugging the cables

## Error: Channel is always black

Please contact support and provide us with pictures of the electrode tree connectors, because the headsets are assembled by hand it is possible for mistakes to be made from time to time.