



# EMOTIV | EPOC Flex™

## User manual

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# 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-FLEX02** and IC ID Number **12769A-FLEX02**

EMOTIV has tested Flex 2 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.

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

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.

Radiation Exposure Statement: This equipment complies with the IC RSS-102 radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20 cm between the radiator and your body.

Énoncé d'exposition aux rayonnements: Cet équipement est conforme aux limites d'exposition aux rayonnements ioniques RSS-102 Pour un environnement incontrôlé. Cet équipement doit être installé et utilisé avec un Distance minimale de 20 cm entre le radiateur et votre corps.

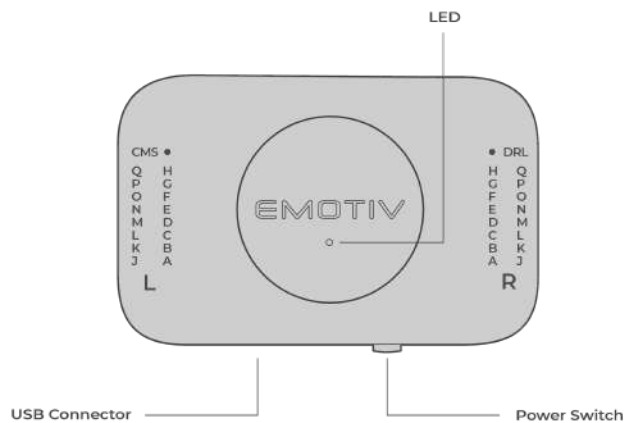
# EMOTIV | EPOC Flex™

Flex is a wireless control box ( Flex Controller) that works with EMOTIV's FlexCap system. It combines the wireless technology of EMOTIV's award-winning EPOC X headset, with the high-density and flexibility found in traditional EEG head-cap systems.

Flex has been designed for researchers who need flexible sensor placement and/or a greater density of sensors for their research. The sensors can be placed in any location on the head or the ears using the ear clips (gel sensor kit only).

Flex's features include:

- Up to 32-channels EEG — for high-density EEG coverage
- Choice of pre-configured\* or non-configured sensors — for easy set-up or flexible positioning
- Choice of gel or saline-based sensors — for optimal signal quality
- Wireless connectivity — connect to your PC or Mac
- Rechargeable — up to 9 hours of battery life
- Choice of cap sizes — for a perfect fit



For the EMOTIV MN8 Quick Start Guide, go to <https://www.emotiv.com/setup/flex/>

# Application compatibility

EMOTIV | EPOC Flex™

compatible with:

EMOTIVPRO

EMOTIVBCI

# Technical Specifications

Number 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	16 bits 1 LSB = 0.51 $\mu$ V (16 bit ADC, 2 bits instrumental noise floor is discarded)
Max Slew Rate	32.64uV/sample
Bandwidth	0.2 - 45Hz, digital notch filters at 50Hz and 60Hz
Filtering	Built-in digital 5th order Sinc filter
Dynamic Range (input referred)	+/- 4.12mV
Coupling Mode	AC coupled
Connectivity	Proprietary 2.4GHz wireless, BLE
Battery Capacity	LiPo battery 595mAh
Battery Life	Up to 9 hours
Impedance Measurement	Real-time contact quality using a 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 ( Flex gel kitl) can be used with any EEG gel Electroplated Ag/AgCl ( Flex saline kit) with replaceable polyester felt pads that can be sterilized and re-used (bulk pack available to buy from the EMOTIV store)



# Safety Precautions

- Flex is a consumer product; it **is not** intended to be used as a medical device or in hazardous environments.
- Flex is designed for use at room temperature; rapid changes in temperature will affect the performance of the amplifiers and increase the noise floor.
- **WARNING: Do not** submerge Flex in water. Every effort has been made to stop water entering Flex and protect the electronics inside. However, Flex is not waterproof.
- **WARNING:** 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 Flex enclosure. Doing so will void the warranty and can damage the headset.
- **WARNING: Do not** charge Flex while wearing the device. If you want to operate while tethered, we recommended using Flex with Extender.

# Précautions de Sécurité

- Flex est un produit de consommation; il **n'est pas** destiné à être utilisé comme appareil médical ou dans des environnements dangereux.
- 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.
- **AVERTISSEMENT: ne plongez pas** l' Flex dans l'eau. Tous les efforts ont été faits pour empêcher l'eau de pénétrer dans l' Flex et protéger l'électronique à l'intérieur. Cependant, Flex n'est pas étanche.
- **AVERTISSEMENT:** 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 l' Flex. Cela annulerait la garantie et pourrait endommager l' Flex.
- **AVERTISSEMENT:** ne chargez pas l' Flex lorsque vous portez l'appareil. Si vous souhaitez fonctionner en mode connecté, nous vous recommandons d'utiliser Flex avec Extender.

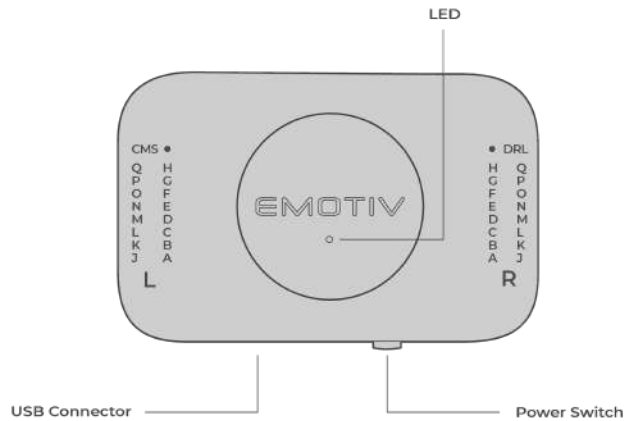
# Getting Started

## Package Contents

<Insert images for each kit - Flex Saline and Flex Gel>

- 1.

# Flex controller



Your Flex (Flex controller) has 16 channels on the left + CMS\* input. It has 16 channels on the right + DRL\* output. The channels are connected in two rows: rows A-H and J-Q, with an empty position above the CMS/DRL.

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.

\*CMS = common mode signal

DRL = driven right leg

# Charging your Flex

Your Flex is charged and tested before shipping — so you can start using it straight away.

## Charging the battery

To optimize the use of your Flex, we recommend that you fully charge it before making recordings.

If the ON/OFF LED is not blue when you turn your Flex on, it requires charging.

To charge the battery, plug the USB charging cable into the USB port located on the right-hand side of the headset.

Then, connect the other end of the USB charging cable to a power outlet or your PC/Mac.

The length of time it takes to fully recharge the Flex controller depends on the remaining capacity of the lithium polymer battery. Charging can take up to four hours. Charging the battery is faster if you connect your Flex to a dedicated USB port.

If your Flex is unused for a long period of time, the battery will become heavily depleted of charge. If this happens, you may need to charge your headset for 24-hours.

If you have any issues charging your Flex, please contact the [EMOTIV Support team](#).

## Flex Charging Behaviour

Charging	Charging Complete
<insert image showing behavior>	<insert image showing behavior>
When Flex is charging the orange LED is displayed.	When Flex is fully charged the LED turns green.

## Turning your Flex on

Power OFF	Power ON
<insert image showing behavior>	<insert image showing behavior>
When Flex is turned off the LED will not be illuminated.	To turn Flex on press the power button. When you do this, a blue LED next to the button will illuminate and the headset will beep.

# Flex Sensors and wires

## Wires

Your Flex kit includes 34 sensors; connected to 16 red wires, 16 blue wires and two black wires.

The wires are color-coded to make it easier to identify the channel name in EmotivPRO and find the corresponding sensor on the cap. For example, if the contact quality is low on channel LA, this will correspond with the blue A wire.

### Color coding key

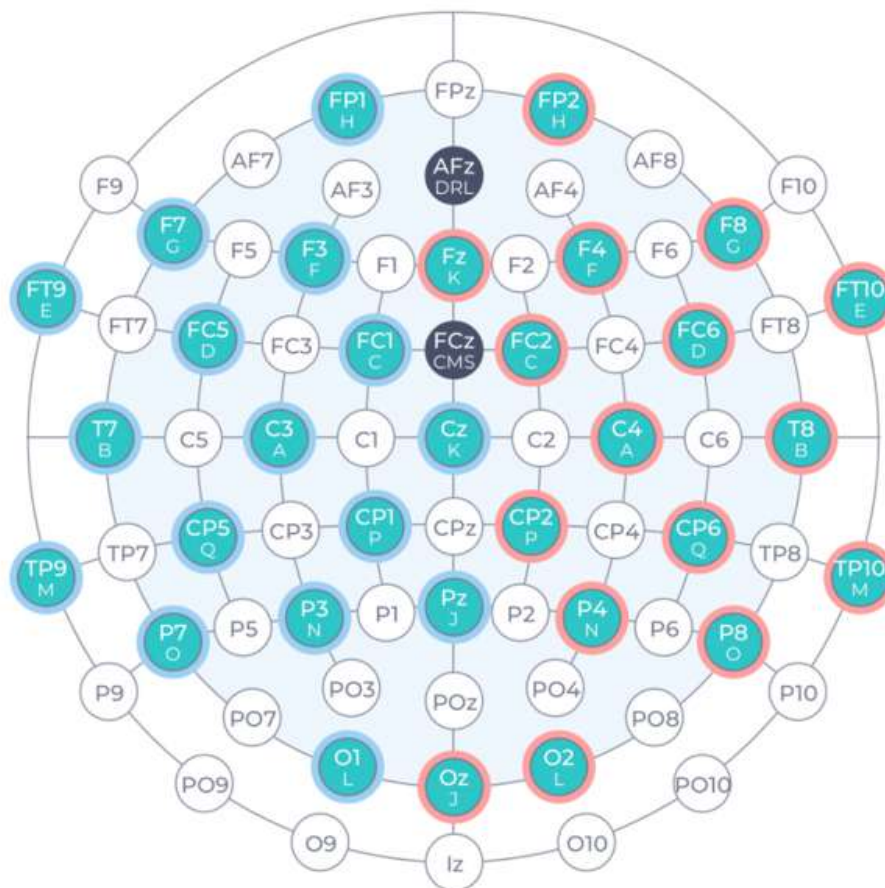
Wire color	Reason
Red	Right wires
Blue	Left wires
Black	References

Each wire is labeled with the channel letter it is connected to. All of the wires are crimped with a JST gold plated crimp. This improves the signal quality before the wires are connected to Flex.

The sensor wires included in your Flex kit come in two lengths —the wires for channels A-G (front of FlexCap) are 300mm in length, and the wires for channels J-Q (back of FlexCap) are 150mm. The different wire lengths minimize excess while allowing for any sensor configuration.

# Sensor montage

Below is the sensor montage for the pre-configured FlexCap. This montage matches the default configuration in EmotivPRO and provides good coverage across the head.





# Flex Gel Kit

The Flex gel kit includes 34 multi-rode gel sensors. The sensors are made from sintered Silver/Silver Chloride to minimize sensor impedance and ensure they are fully compatible



with gel electrolytes. Each sensor wire is crimped and fitted to the connector housing. The wires are labeled A-G and J-Q.

Multi-rode gel sensor

## Ear clips

The Flex Gel Kit includes two ear clips to hold the sensors in place on the ears. The clips can be removed once the gel has hardened on the ears.



## Keeping the wires tidy

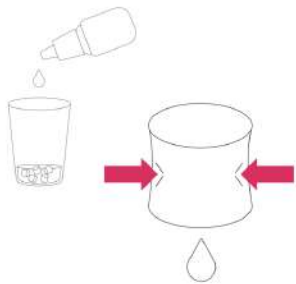
The sensor wires are designed to be long enough to reach any position on the Flex Cap. If your research involves minimizing motion artifacts, it's important to keep excess wires secured. Once all of the sensors are fitted to the FlexCap, we recommend using the tagger pins and tagger tool to tidy up the wiring.

Another option is to place a shower cap or swimming cap over the top of the FlexCap. This will also reduce wire movement.

# Flex Saline Kit

The Flex saline kit includes 34-saline sensors. Each sensor electrode is silver/silver chloride plated and has three prongs that grip the felt pad —the same way as EPOC X.

## Hydrating the sensors felts



To hydrate the sensor felts, place them in a glass then add the saline solution and soak. When the sensor felts are fully soaked, remove them from the glass and squeeze out the excess fluid. They are now ready to be inserted into the sensors.

## Rehydrating the sensors during an experiment

The saline sensors will start to dry out during an experiment. The length of time they take to dry out will depend on the environment you're working in. You will see in EmotivPRO that the contact quality will change from green to orange.

The saline sensors are designed to be refilled while they're in use. This can be done through an opening at the top of each sensor; this means your participant doesn't have to take the FlexCap off during the experiment.

We also recommend adding a few drops of glycerine to your saline solution. Doing this will slow down the time it takes for the sensor felts to dry out.

## Keeping the wires tidy

The sensor wires are designed to be long enough to reach any position on the Flex Cap. If your research involves minimizing motion artifacts, it's important to keep excess wires secured. Once all of the sensors are fitted to the FlexCap, we recommend using the tagger pins and tagger tool to tidy up the wiring.

Another option is to place a shower cap or swimming cap over the top of the FlexCap. This will also reduce wire movement.

## Pre-configured saline FlexCap

EMOTIV offers a pre-configured saline FlexCap, with all 32 sensors fitted — as per the default layout in EmotivPRO. The wires are cut to the right length and tied down. This means you can quickly set up the FlexCap and start taking recordings.

# FlexCap

The FlexCap follows the 10-20 system and has 72 positions. The cap has two pockets for securing Flex to the FlexCap — one is below Cz and the other is Iz.

The FlexCap is made from black high comfort material and is available in sizes 54cm, 56cm and 58cm. A pre-configured version of the FlexCap is also available in the 56cm size only.

If you need a different size, hole position, material or cut, please contact [EMOTIV Support](#).



## Choosing the right FlexCap

Choosing the right FlexCap for your study is essential for achieving the best measurements.

To choose the right size of FlexCap for your participant, measure their head circumference horizontally, as shown in the image below. Once you have their measurement, choose a FlexCap from the range of sizes available — 54cm, 56cm and 58cm sizes (whichever size is closest to their head circumference).



# Setting up the FlexCap

## Fitting the FlexCap to your participants head

The FlexCap can be fitted to your participant's head in the same way that you would fit a swimming cap.

Place the FlexCap over your participant's forehead, then stretch it to the back of their head. Make sure their ears are placed in the ear holes and the pocket for Flex is at the back of the head.

If your participant has long hair, make sure that it is spread out evenly across their head so that there are no thick sections. Your participant's hair must not be tied up during the experiment.

When the FlexCap is fitted to your participant's head, your participant should feel the pressure of each sensor against their scalp. If they do not feel pressure from the sensors on their scalp and there is not enough tension in the FlexCap, then try using a smaller FlexCap for your experiment or move the chin strap on their chin and not place it under it.

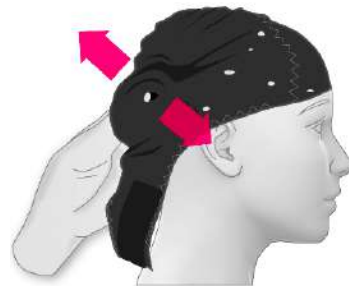
## Inserting the sensors into the FlexCap

To insert the sensors into the FlexCap, we recommend placing the FlexCap onto a mannequin head and inserting the sensors through the openings, before placing onto your participant's head.

It can take up to an hour to insert all of the sensors into the openings of your chosen sensor configuration.

### Step 1

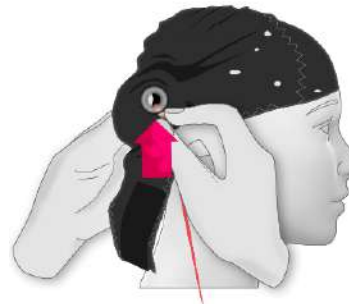
Hold the underside of the FlexCap and stretch the material around the hole you are going to insert the sensor into.



### Step 2

There are two ways to insert the sensors into the FlexCap. Always ensure that the felt pad of the sensor is facing inwards, towards the scalp, before inserting.

1. To insert the sensor, push it upwards through the hole, then release the tension in the material so that it fits around the bottom half of the sensor;  
or
2. Turn the FlexCap inside out, then stretch the hole over the sensor, then let the material retract into place, around the plastic groove of the sensor.



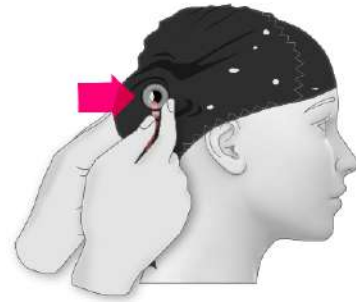


The majority of the sensor should be on the outside of the FlexCap and the felt pad should be on the inside where it will rest against your participant's scalp during your study.

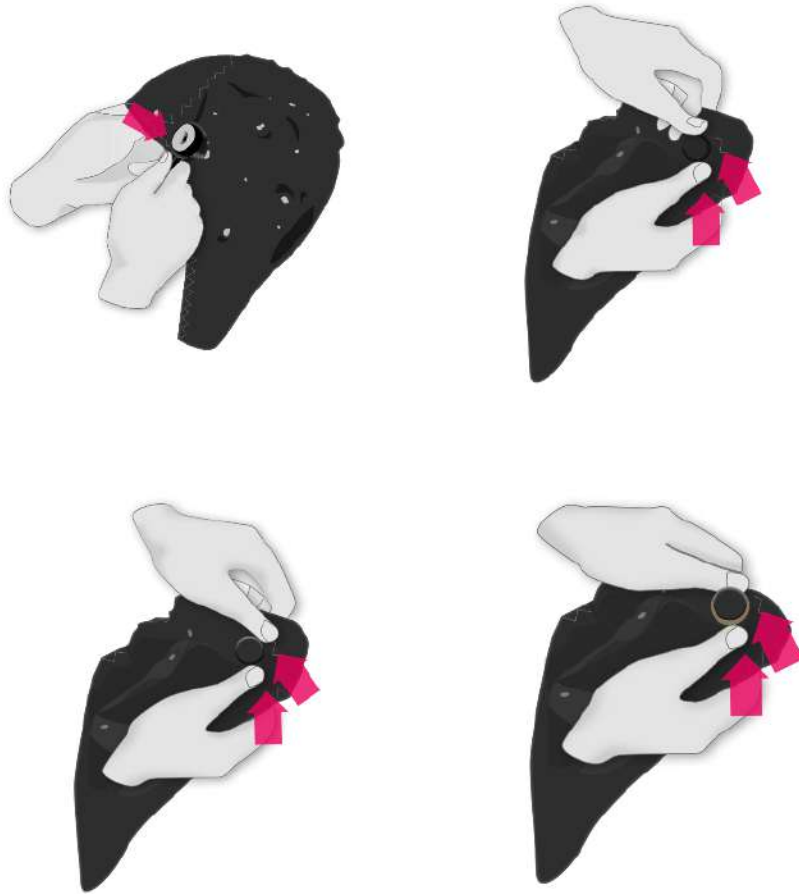
**Do not** force the sensor into the opening.

### Step 3

Adjust the material around the sensor until it is fully fixed in place.



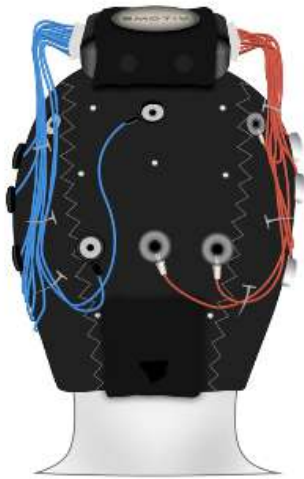
Repeat these three steps for all of the sensors in your chosen configuration.



## Positioning Flex on the FlexCap

There are two places on the FlexCap that Flex can be positioned — at the top (Cz) or at the rear of the FlexCap (see images below).

If you're doing a sleep study or your participant needs a headrest (e.g. they use a wheelchair), we recommend that you position Flex at the top of the FlexCap.



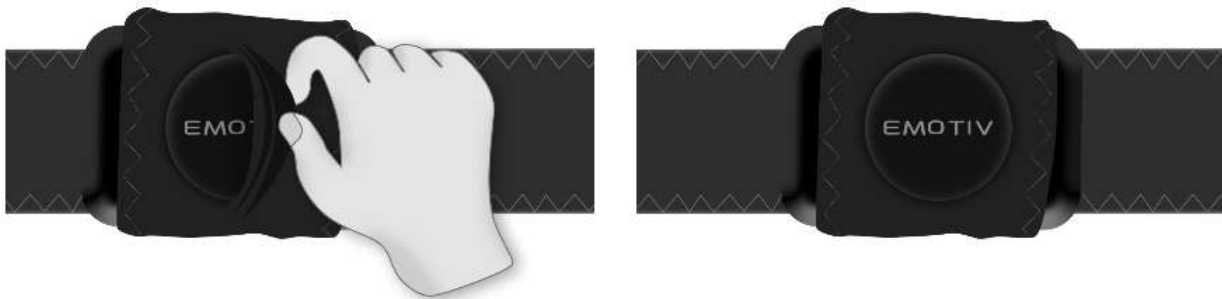
**Top Position of Control Box**



**Back Position of Control Box**

## How to fit Flex

1. Choose the position you want Flex to be in.
2. Place Flex in the pocket with the EMOTIV logo facing towards you.
3. Stretch the fabric of the FlexCap over Flex and around the edge of the EMOTIV logo (the circle).
4. Your Flex is now secured into place and ready to be used.



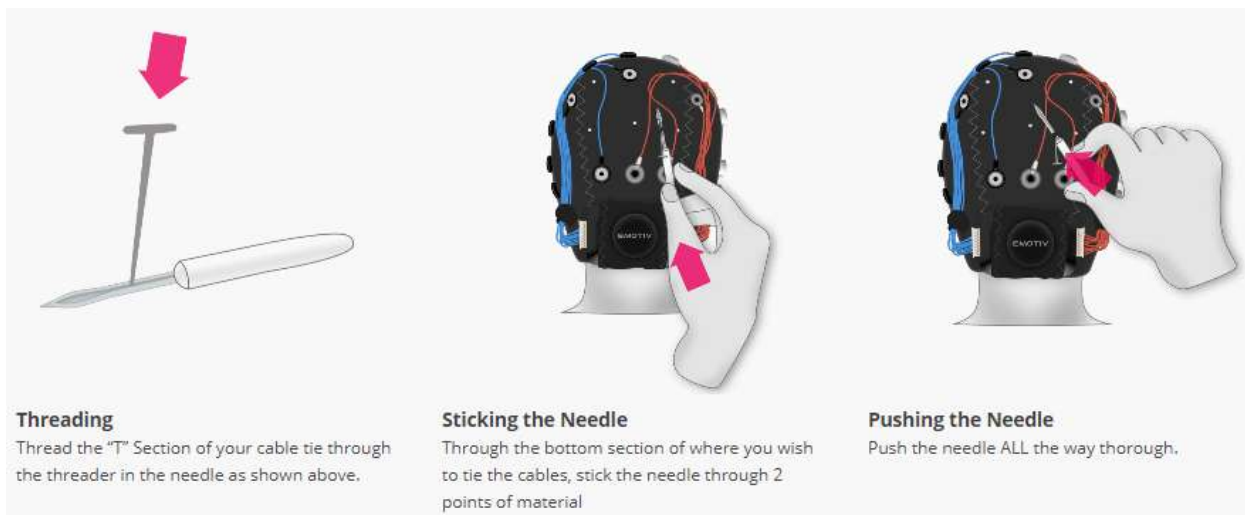
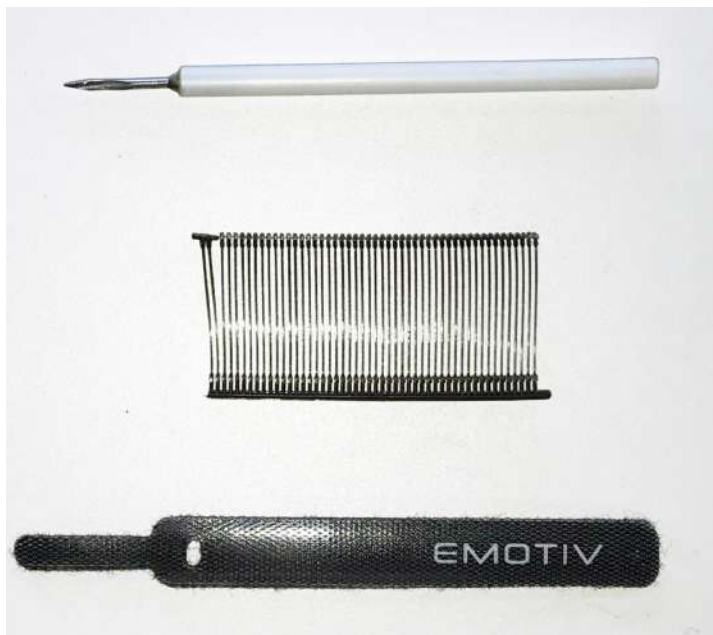
The FlexCap fabric being stretched over the Control Box to secure it into place.

# Tidying the sensor wires

Once you've inserted all of the sensors into the FlexCap, we recommend that you use the tagger pins and tagger tool, included with your Flex kit, to tidy up the wires by 'sewing' them into place.

Another option is to place the FlexCap over the top of the wires to keep them secure.

Securing the wires in place will reduce any movement from being picked up by the sensors.



## 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 through.



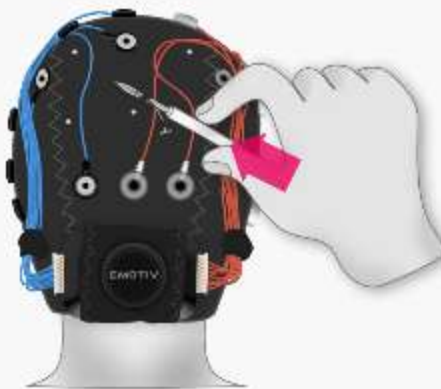
### Rethreading

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.



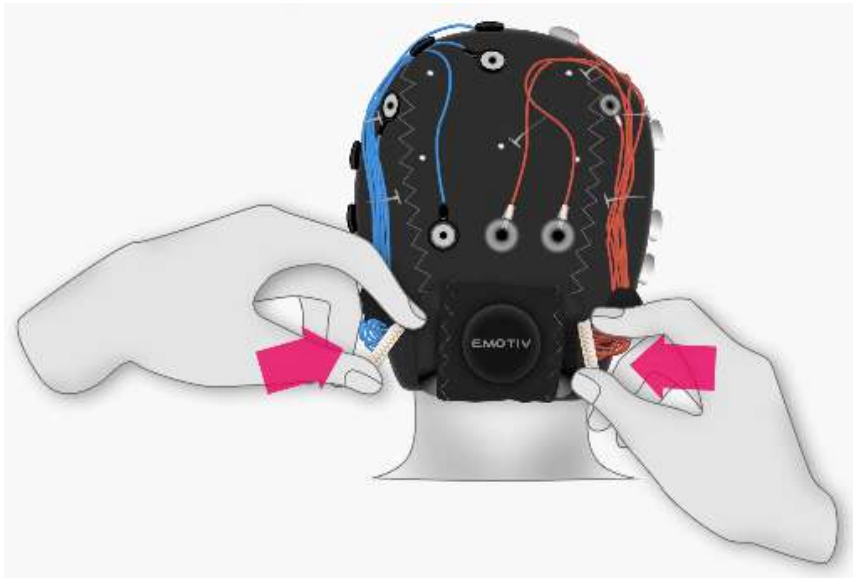
### Adjusting the Needle

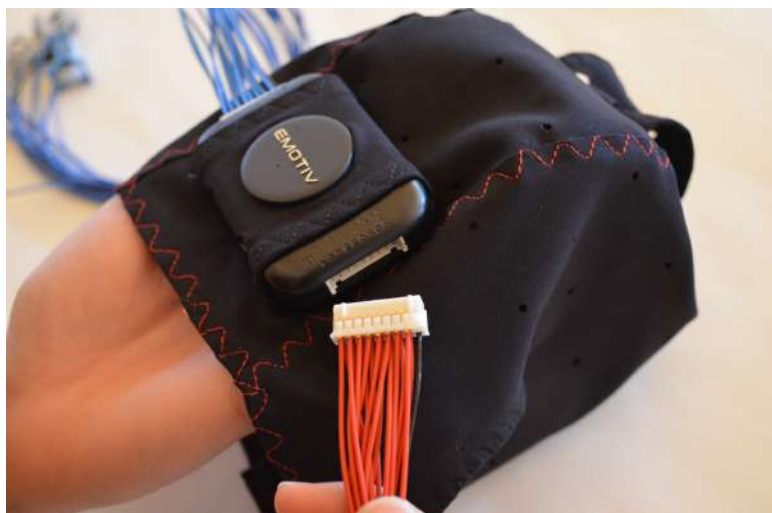
Adjust the needle to fit.

# Connecting the sensors to Flex

Take the white connector at the end of the red wires and plug it into the right-hand side of Flex. Repeat this process for the blue wires on the left-hand side.

Double-check that all of your wires are in the right place.





Connector and red wires on the right-hand side of the FlexCap



Connector and blue wires on the left-hand side of the FlexCap

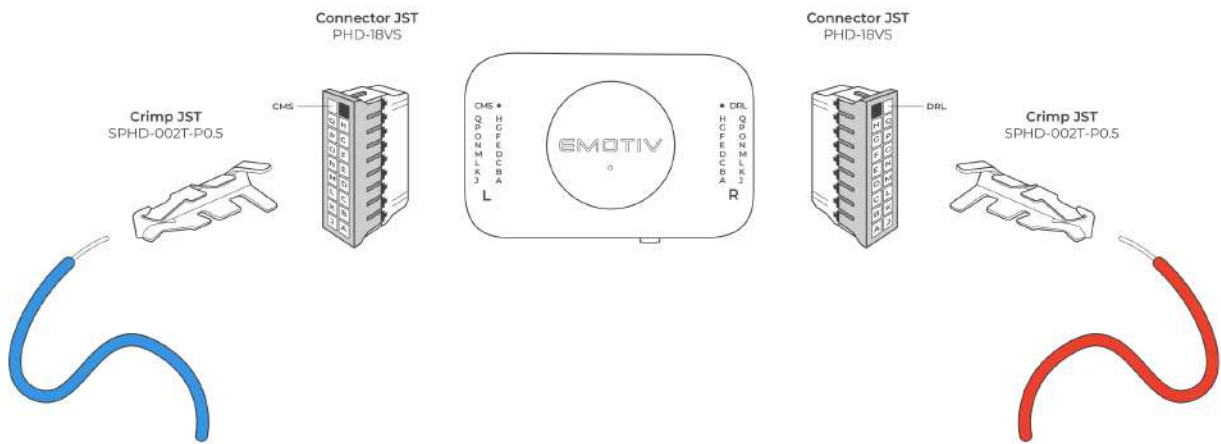


# Customizing the sensor wires

The number of sensors and wire positions for Flex is flexible. As a default, all 32 sensors + 2 references are fitted to the two connectors.

On the left-hand side are 16 blue sensor wires and the black CMS wire. On the right-hand side are 16 red sensor wires and the black DRL wire.

The sensor names (A-Q) match the pin positions (A-Q) on the connector, as shown below.



The connectors have an empty position above the black reference wires. This is because the connectors are standard 18 position connectors, but only 17 positions are loaded with wires for Flex. **Please do not insert the connector into the empty position.**

The connectors are standard 18 position connectors but only 17 positions are loaded with wires, this leaves one empty spot on each connector which is located above the black reference wire.

Sensors that you don't need for your experimental montage can be removed.

### **Removing unneeded sensors from the connector**

To remove unneeded sensors:

1. Use a thin-flat screwdriver or tweezers to lift up the plastic tab(s) on the connector. Lifting the tab will release the crimp locking mechanism.
2. Pull the wire until you see the gold color of the crimp.
3. Then remove the reference wire.

### **Inserting sensors into the connector**

To insert a sensor wire into the connector:

1. Place the crimp lock upwards,
2. Insert and then pull the wire to ensure it's locked in place.

# Achieving a high signal quality using gel sensors

To achieve a high signal quality, you need to minimize impedance between the gel sensors and the scalp. Here are some tips to help you achieve the best quality signal:

- Your participant should not use hair gel or other additives before fitting the sensors as these products can cause impedances.
- When you are cleaning the sensors or adding gel to the sensors, make sure you have enough light to see what you're doing.
- Clean and abrade the skin under each sensor, then apply the electrolytic gel.
- You can use any conductive gel on the sensors, but some gels are better suited due to their viscosity or for a particular experiment. For example, when conducting a sleep study, it's important to use a gel that takes a long time to dry out.

## Suitable electrolyte gels

The gel sensors can be used with salty or salt-free electrolytes. Here is a list of suitable products that you can use:

- 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)
- Nuprep Gel (abrasive, high viscosity, non-salty)
- Ten20 (opaque, high-viscosity, salty)

## Preparing the gel sensors for your experiment

When preparing gel sensors for your experiment, you will need the following items:

- Wooden cotton swabs,
- Isopropyl alcohol 70%,
- Abrasive electrolyte gel, such as Abralyt 2000,
- Conductive electrolyte gel, such as SuperVisc or Ten20,
- A plastic syringe without a needle (20ml), and
- Tissues to remove excess gel.

## Cleaning your participants skin

1. Move the hair below the sensor opening to one side, ensuring you have clear access to the scalp
2. Add isopropyl alcohol to a cotton swab
3. Gently rotate the tip of the cotton swab on your participants scalp to degrease the skin.

## Abrading your participants skin

1. Dip a cotton swab in abrasive gel.
2. Place the cotton swab into the sensor opening and rotate it gently on your participants scalp to abrade the skin. Do not apply too much pressure to your participants scalp. This process should be painless and should not irritate the skin.

## Filling the sensors with electrolyte gel

1. Open the sensor,
2. Fill a syringe with electrolyte gel,

3. Insert the syringe into the open sensor and then push the gel out of it. When you're doing this, ensure that you make contact between the scalp and the sensor. Most electrolyte gels take a few minutes to permeate the skin.

Check the signal quality in EmotivPRO after each sensor is prepared. The contact quality should be green.

# Achieving a high signal quality using saline sensors

To achieve the best quality signal, you need to minimize impedance between the saline sensors and the scalp. Here are some tips to help you achieve the best quality signal:

- Ensure that your participant has washed their hair before your experiment. They should not use hair conditioner, or add other additives, to their hair before the experiment as these products can cause impedances.
- When you are cleaning the sensors or adding the gel to the sensors, make sure you have enough light to see what you're doing.

# Cleaning the FlexCap and the sensors

## Cleaning the FlexCap

You can clean the FlexCap in a washing machine at 30°C using a mild detergent. When it's clean, allow it to air dry.

You can also hand wash the FlexCap with a mild detergent, such as children's shampoo. After handwashing it, rinse the FlexCap with clean water, then remove excess water with a paper towel and air dry.

**Do not** put the FlexCap in the dryer.

**Do not** iron the FlexCap.

**Do not** disinfect or bleach the FlexCap. Strong oxidizing agents or bleach can reduce the life of the FlexCap.

## Cleaning the FlexCap and gel sensors together

When you have finished your experiment, you can wash the FlexCap and sensors together to avoid removing and reinserting the sensors between experiments. To do this you need to:

- Remove the FlexCap, with the sensors attached, from your participant
- Unplug and remove the Flex Controller from the FlexCap and place to one side
- Put the connectors in a bag and seal it with a rubber band. Doing this will protect the connectors from accidental splashes whilst you're holding them out of the water.
- Handwash the FlexCap and sensors using a mild detergent, such as children's shampoo.
- Allow the FlexCap and sensors to air dry before your next experiment.

## Cleaning the gel sensors

After you've finished your experiment, you must clean the sensors immediately. Doing this will stop the electrolyte gel drying out. You can do this quickly by rinsing the sensors under a running tap to remove the gel residue. If you do not remove the gel from the sensors, it can impede the quality of the signals.

If the gel does dry out, soak the sensors in water for 30 seconds and then rinse again or rub with a soft toothbrush.

If the gel is difficult to remove, try soaking the sensors in water with a mild detergent (such as baby shampoo). After soaking, rinse the sensors under a running tap and dry the sensors with a towel or tissue.

**Do not** soak the gel sensors in saline solution or chloride. Doing this can result in the sensors becoming corroded.

**Do not** autoclave or use other hot sterilization methods as this can damage the wire insulation.

## Cleaning the saline sensors

Saline sensors should **only** be subjected to saltwater while they are in use. After use, you must rinse the sensors in clean water to remove the salty residue. Doing this will prolong the life of the sensors. After rinsing, dry the sensors with a towel or tissue.



# Storing your Flex

When your Flex is not in use, remove all the sensors from the FlexCap and ensure that everything is clean and dry before storing them.

**Do not** leave the sensor felts in the saline sensors. Leaving wet sensor felts in the saline sensors will corrode the sensors. Store used sensor felts separately to unused ones.

Replacement sensor felt packs can be purchased from the EMOTIV [online store](#)



# Troubleshooting

## Unable to get contact quality on any channel

There could be two reasons for this happening:

1. The sensor trees are not plugged into your Flex ; or
2. The references are not connected to your participant. Please make sure there is contact with both DRL and CMS.

## The input channel is always black

There could be two reasons for this happening:

1. There is no contact quality (see above); or
2. There could be an error with your Flex. If this is the case, please contact [EMOTIV Support](#).
- 3.

# Support

## EMOTIV Support

If you are encountering problems with your Flex, or have any technical questions, the EMOTIV Support team can assist you. Visit the [Contact Support](#) page of the EMOTIV website and submit your query.

## EMOTIV Knowledge Base

[EMOTIV Knowledge Base](#) provides useful information and solutions for common tasks related to EMOTIV's headsets, software and user accounts.

## FAQs

[EMOTIV's FAQs](#) provide answers to some of the most common questions asked by the EMOTIV community.

