EPOC X

User Manual

19/02/2020

Introduction

EMOTIV designs consumer Brainwear headsets which allow researchers, commercial companies or quantified selfers learn more about their brains. EPOC X is the latest iteration of the award winning EPOC brand. It is a 14 channel headset with saline soaked felt electrode designed to replace the current EPOC+ and address issues faced by our customers. EPOC X has a rotating headband, new electrode design and updated radio to improve connectivity. The electrode placement has not changed but now you are able to refill the sensors without removing the headset.

Product Highlights

Rotating Headband <IMAGE>
New Electrode Design <IMAGE>

Contents

1. Travel case + Sleeve
    a. Protect your headset when travelling and store all the accessories in the case.
2. EPOC X Headset
3. USB Dongle
4. Saline fluid sample 60ml
    a. The sample is contact lens solution
5. USB-C Charge Cable
    a. Reversible charge cable
6. Felt Pack - 80pcs
    a. EMOTIV has replaced the existing hydrator packs with standard a standard felt pack which contains 80pcs of felts that fit EPOC X and EPOC Flex. These are presented in a custom ziplock bag.

Technical Specification

Number of Channels	14 (plus CMS/DRL references, P3/P4 locations
10-20 positions	AF3, F7, F3, FC5, T7, P7, O1, O2, P8, T8, FC6, F4, F8, AF4
Sampling Method	Sequential sampling. Single ADC
Sampling Rate	128 SPS / 256 SPS (2048 Hz internal)
EEG Resolution	14 bits 1 LSB = 0.51μV (16 bit ADC, 2 bits instrumental noise floor is discarded), settings can be changed to 16-bit
Bandwidth	0.2 - 45Hz, digital notch filters at 50Hz and 60Hz
Filtering	Built-in digital 5th order Sinc filter
Dynamic Range (input referred)	8400 uV(pp)
Coupling Mode	AC coupled
Connectivity	Proprietary 2.4GHz wireless, BLE and USB (Extender only)
Battery Life	Upto 9 hours (LiPo)
Impedance Measurement	Real-time contact quality using patented system
Motion Sensor	ICM-20948
Accelerometer	3-axis +/-4g
Magnetometer	3-axis +/- 4900 uTesla
Motion Sampling	32 / 64 Hz
Motion Resolution	14 / 16-bit (User Defined)
Quanterion	Yes
Sensor Material	Ag/AgCl + Felt + Saline

Safety Precautions

- EPOC X is a consumer product; it is not intended to use for in-patient healthcare or in hazardous environments.
- EPOC X is designed for use at room temperature; rapid changes in temperature will affect the performance of the amplifiers and increase the noise floor.
- EPOC X uses saline based sensors and every effort has been made to protect the electronics from water ingress, however it is not waterproof. Please do not submerge your headset.
- *WARNING*: EPOC X is powered by a Lithium-Polymer battery that is rated for operation in <45C environments. It is not user replaceable, please contact support if you suspect a fault or have any questions.
- *WARNING*: Do not open the enclosure. Doing so will void the warranty and can damage the headset.
- *WARNING*: Do not charge EPOC X while wearing the device.

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-EPOC03** and IC ID Number: **12769A-EPOC03**.

EMOTIV has tested EPOC X 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.

Tested for safety and EMC/RF by Bay Area Compliance Laboratories (BACL) a registered NRTL.

EPOC X is fully compliant with the relevant standards for Europe / North America and Australia and has been tested to the following standards:

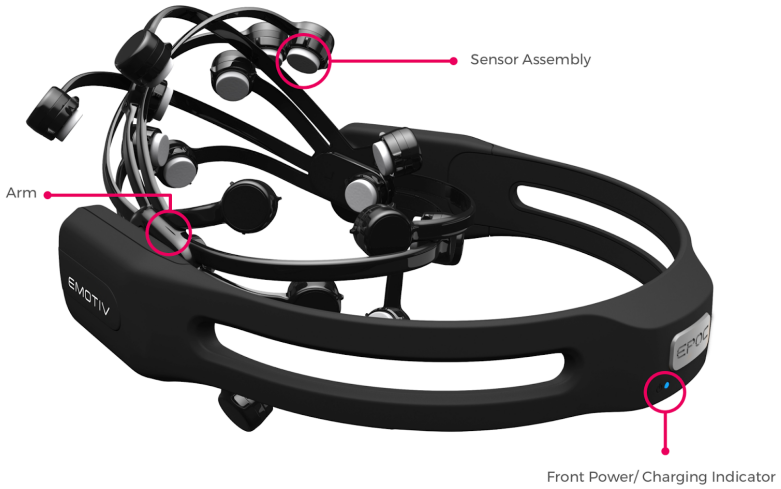
- SAFETY
  - UL/CSA/EN/IEC 62368-1 and has a CB certificate.
- EMC
  - FCC 15B / ICES-003 Class B
  - AS/NZ CISPR32:2015 Class B
  - EN301 489-1, EN301 489-17, EN55032:2012/AC:2013, EN55035:2017, EN61000-3-2, EN61000-3-3.
- RF
  - FCC 15.247 / ISED RSS-247 / EN300 328 V2.1.1
  - EN62479 RF Exposure Evaluation
  - AS/NZ 4268

Reports and certificates are here.

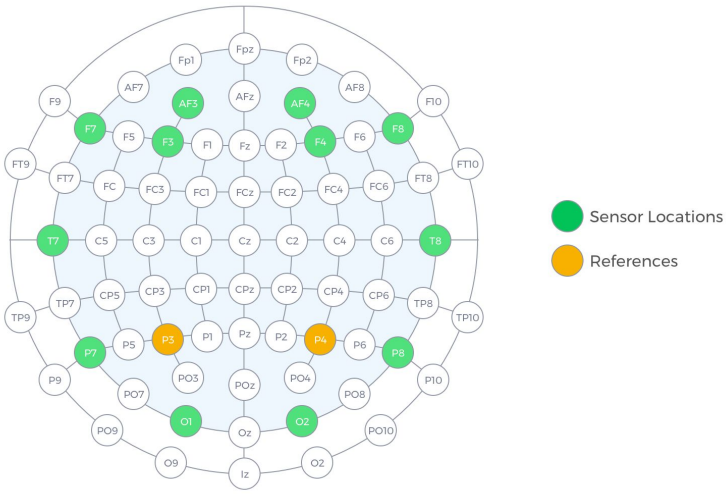
Getting Started

EMOTIV provides a quick start guide here. https://www.emotiv.com/setup/epoc-x/

Get to know your headset



The EPOC X has two electrode arms each containing 9 locations (7 sensors + 2 references). Two sensor locations (M1 / M2) already have comfort pads fitted because they are the alternative positions for the default references (P3 / P4).



The EPOC X is designed to provide good coverage of the frontal and prefrontal lobes and also provides coverage of the temporal, parietal and occipital lobes. The images shown above are the sensor locations for the EPOC+ using the international 10-20 system.

EPOC X has a new electrode design intended on reducing plastic waste by minimising potential areas of breakages. We are replaced the hydrator pack in EPOC+ with a retained sensor which

you can insert your felts. The arms now have decals marking their location if the primary reference location isn’t working for you, please try CMS2 (M2) / DRL2 (M1) to put the references at the mastoid.

User Interface

All interactions with the right side EPOC X. Here you will find located the LEDs, USB-C and buzzer. The table below outlines the action and expected output.

Action	Power LED	Charge LED	Buzzer	Image
Power OFF	OFF	OFF	OFF	
Power ON	WHITE	OFF	Beep	
USB Connected / Charging	OFF	ORANGE	OFF	
Charge Complete	OFF	GREEN	OFF	
Charge Failure	OFF	Flashing Red	OFF	
Firmware Updating	Fade On / Off	OFF	OFF	

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 two hours. If the power LED does not glow white when you turn it **ON**, your EPOC X requires charging. Please plug-in the provided USB-C cable into the headset.

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

USB Dongle

The universal USB receiver (dongle) uses a proprietary 2.4 GHz protocol to stream data from the headset. We recommend using this to connect to your headset on a PC or Laptop; once connected it remembers the serial number of the headset pairs to allow easy reconnection. The dongle pairing also allows multiple headsets to co-exist and provides a reliable high speed connection over Bluetooth Low Energy (BLE).

The headset supports BLE which allows connection to mobile devices (Android/iOS) and some computers. EmotivPRO does support the native BLE radio on MacOS devices (2015 or later). On PC's however the implementation of Bluetooth varies by manufacturer and it is not guaranteed to work and so we recommend using the dongle.

There are two green LED's on the top surface of the dongle and plastic lies at the bottom. The following table explains about LED's.

Action	LED Bottom (Power Icon)	LED Top
Looking for headsets	OFF	Slow Flashing
Connected no data	ON or slow flashing	ON
Connected and data	Fast Flashing	ON

Troubleshooting

If a sensor is not in green, please check that it is making a good contact with the scalp and the sensor is wet. If the subject has thick hair, try to work the sensor under the hair and add additional fluid using the refill opening from the rear. Bad positioning and dry sensors are the two most common reasons for poor contact quality.

If a sensor is persistently not making a good contact, you can test its functionality by tapping on the sensor and observe if anything appears in the EEG data steam. You can also try measuring your ECG by touching both references with one hand and the sensor with the other. You should be able to clearly see the QRS and T-wave.

If all of the channels are showing the same level of poor quality, the likely cause is the reference sensors are dry or the reference sensors are not making a good contact to the scalp. Before adjusting any of the recording electrodes, it is recommended that you have a good contact (green) for the reference sensors.

If the felt sensors are moistened for the first time, the sensors take time to absorb the fluid. The best solution is to apply a small amount onto each sensor and then top up each sensor so that they are wet. Wetting all felts in a cup and then squeezing out the excess before fitting into the headset.

For users with thick hair, skin contact can be improved by working the sensors through the hair to make a better contact onto the scalp

Further Saline Solution

Each headset is packed with a small bottle of multipurpose contact lens solution. When this is exhausted, you can purchase more from your local drug store or pharmacy. We recommend the use of contact lens solution if possible; but please do not use contact cleaning or sterilizing solutions. Multi-purpose solution contains non-allergenic anti-microbial agents which helps to keep your sensors fresh and prevent transfer of microbes between users.

A saline solution between 0.7% - 4% w-w sodium chloride can also be used, but we recommend adding a small quantity (< 4% by volume) of a household disinfectant such as 70% iso-propyl alcohol.

To reduce the rate of evaporation, add a couple of glycerin drops.

Storage

When the EPOC X is not in use, it is best to remove all the felt pads and leave them to dry. To keep the headset in optimum condition please rinse the sensors with sterile water after use to remove excess salt. Wet felts left in the sensors will corrode the electrodes over time. EPOC X electrodes are electro-plated and keeping them clean will minimise corrosion.

We provide replacement felt packs on our accessories page of the online store.