ELECTRODES

| **Componente** | **Qué buscar / pedir** |
| --- | --- |
| Electrodos secos activos | “Active dry EEG electrodes standalone” |
| Compatibilidad | Que usen conectores estándar: snap, DIN o jack |
| Alimentación | Verifica si requieren 5V o ±2.5V para el buffer |
| Salida de señal | Idealmente salida diferencial (no single-ended) |
|  **Fp1 y Fp2** (frontal izquierda y derecha) – útiles para atención, meditación, emociones.   **TP9 y TP10** (detrás de las orejas) – se usan como referencia/masa en dispositivos como Muse.   |  |

A diagram of a human head

AI-generated content may be incorrect.

Electrodes on the front

<https://www.cgxsystems.com/patcheeg>

<https://www.gao.caltech.edu/uploads/2/6/7/2/26723767/advanced_materials_-_2021_-_heng_-_flexible_electronics_and_devices_as_human_machine_interfaces_for_medical_robotics.pdf>

<https://www.sciencedirect.com/science/article/abs/pii/S0924424725002602>

<https://www.st.com/resource/en/datasheet/cd00161566.pdf>

<https://ww1.microchip.com/downloads/en/DeviceDoc/Atmel-7810-Automotive-Microcontrollers-ATmega328P_Datasheet.pdf#page=6.07>

A screenshot of a computer

AI-generated content may be incorrect.

MUSE

FPZ is the reference

| **Electrodo** | **Ubicación** | **Función** |
| --- | --- | --- |
| TP9 | Detrás de la oreja izquierda |
| TP10 | Detrás de la oreja derecha |
| AF7 | Frontal izquierda | Activo (EEG) |
| AF8 | Frontal derecha | Activo (EEG) |
| 256 hz |  |  |

* EEG channels: 4 EEG channels + 2 amplified aux channels
* Sample rate: 256 Hz
* Sample resolution: 12 bit / sample
* Weight: 41 g
* Accelerometer: Three axes @ 52 Hz, 16-bit resolution, range +/- 4G
* PPG: 3 LEDs: IR, IR, red; 64 Hz sample rate; 16-bit resolution

<https://www.researchgate.net/publication/352019337_DETECTION_OF_DRIVER_DROWSINESS_FROM_EEG_SIGNALS_USING_WEARABLE_BRAIN_SENSING_HEADBAND#pf3>

 **Electrodos secos planos** tipo clip o personalizados (3D + Ag pintura)

 Posicionamiento en **AF7/AF8 + TP9/TP10**

 Amplificador ADS1299 + micro BLE (ESP32, Arduino Nano 33 BLE, etc.)

 Banda flexible con presión suave, tipo deportiva

<https://www.ti.com/product/ADS1299?utm_source=google&utm_medium=cpc&utm_campaign=asc-dc-null-44700045345909036_prodfolderdynamic-cpc-pf-google-eu_en_int&utm_content=prodfolddynamic&ds_k=DYNAMIC+SEARCH+ADS&gad_source=1&gclid=CjwKCAjwwe2_BhBEEiwAM1I7scx1kcd518M1zrQmqoUFjF5Zd1KxNd82bIGzmh5jUGg8ajXDRwFS9xoCQ88QAvD_BwE&gclsrc=aw.ds>

MUSE HEADBAND

<https://www.digikey.gr/en/maker/projects/muse-s-meditation-headband-teardown/1b6c27ebce0b461896ef80d0c91c2f32>

CYTON

* **Canales de acelerómetro (accel\_channels)**: canales 9, 10, 11.
* **Canales analógicos (analog\_channels)**: canales 19, 20, 21.
* **Canales de ECG (ecg\_channels)**: canales 1 a 8.
* **Canales de EEG (eeg\_channels)**: canales 1 a 8 (correspondientes a los nombres **Fp1, Fp2, C3, C4, P7, P8, O1, O2**).
* **Canales de EMG y EOG**: de manera similar, canales 1 a 8.
* **Canal de marcador**: canal 23.
* **Canal de tiempo**: canal 22.

OPENBCI

<https://docs.openbci.com/Cyton/CytonSpecs/>

A close-up of a diagram

AI-generated content may be incorrect.

Active electrodes think pulse

<https://drive.google.com/file/d/1Ri2UPmPH2SrTjYQ8Mj046ciWLGzRxCSl/view>

Description of electrodes openbci

* Conductive polymer that allows the bioelectric signal
* Active embebbed circuit which makes the impedance matching to avoid losing signal. Amplifying current before sending it
* Cable Dupont connector 2.54 mm, reduces EMC noise. Protects signal during its transmission
* Entry impedance 10 MΩ
* Circuit with op amp , two resistors ( protection and decoupling one to filter alimentation)

A close-up of a table

AI-generated content may be incorrect.

A table with text and numbers

AI-generated content may be incorrect.

Position electrodes

| **Active electrodes** | **Location** | **Function** |
| --- | --- | --- |
| Fp1, Fp2 | Prefrontal | Detección emocional (valencia, arousal) |
| AF7, AF8 | Frontal lateral | Atención, emociones, enfoque |
| TP9 | Left mastoid | **Referencia (REF)** |
| TP10 | Right mastoid | **Ground (GND)** |

POSITION REVIEW LITERATURE

Authentication: C3, C4, P3, P4, O1, O2

Emotion <https://www.sciencedirect.com/science/article/abs/pii/S0010482524015488>

Algorithms to work with for eeg selection

Minimum Redundancy Maximum Relevance

ReliefF

EMOTION

**INTEREST**

Try to diminish the length of the cables to reduce noise

Positioning the reference on the front

Signal to noise

* Electromagnetically isolated room. Use a Faraday cage if your institution has one.
* Remove or replace any electronics that use AC (alternating current) with equipment using a DC.
* Ensure your participants are in a comfortable resting position to reduce ECG noise.
* Eliminate EMG artifacts by removing tasks that require verbal responses or large movements.
* Minimize cable length. Each centimetre of cable that connects the electrodes to the amplifier may introduce motion artifacts. The less cable you use, the better.
* Reduce cable movement. You may be able to attach any moving cables to the EEG cap using velcro, putty, or similar. Ideally, your cables will not move when the participant moves.

<https://mentalab.com/reduce-noise-in-eeg-recordings/>

]

**SUMMARY- CONCLUSION**

* Reference and ground in mastoids
* Fp1 Fp2 AF8 AF7

Market products of interest

|  |  |  |  |
| --- | --- | --- | --- |
| PRODUCT | SPECS | LINK |  |
| Headband | 4 channels  Dry electrodes  Spiky electrodes golden spring  BLE connection  250 Hz | <https://brainbit.com/hardware-solutions/brainbit-headband/> | A white and orange bracelet with orange and blue triangles  AI-generated content may be incorrect. |
| Wearable sensing | Dry electrodes  Spring loaded  Ref in the ears | <https://wearablesensing.com/dsi-24/#features> |  |
| Emotiv | Semi dry poymer sensors  Wireless  5 channel  Ref mastoids  128 sampling rate  BLE conectivity | <https://www.emotiv.com/products/insight?srsltid=AfmBOor5F19eFbDBJE-C8q8fuahR9lpD3k07xa3u8nyh6wLnCAHFAm9t> |  |
| Focuscalm |  | <https://focuscalm.com/products/focuscalm-eeg-headband> | A close up of a bracelet  AI-generated content may be incorrect. |
| Mynd play | 3 dry sensors | <https://store.myndplay.com/products.php?prod=37> |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

TEST

**2. Check the impedance (if your system allows it)**  
Ideally <5 kΩ (for wet electrodes) or <50 kΩ (for active dry electrodes).

Some systems tolerate more, but high impedance = possible poor contact or noise.

**3. Observe the real-time signal (at rest)**  
Look for these things:

| **What to Check** | **Good Signal** | **Bad Signal** |
| --- | --- | --- |
| Alpha rhythm (8–12 Hz) | Present with eyes closed | Absent or full of noise |
| Zero crossings | Frequent | Flatline or extremely chaotic |
| Noise level | Low, stable | High, especially at 50/60 Hz |
| L/R symmetry | Left and right channels similar | Very different = possible fault |

**4. Run simple activation tests**

| **Test** | **What Should Happen** |
| --- | --- |
| Close eyes | Alpha rhythm increases in occipital region |
| Blink | Clear artifact in frontal channels |
| Move jaw | Muscle noise in temporal areas |
| Touch an electrode | Signal increases briefly |

**5. Repeat with another person or a dummy head**  
To make sure it’s not a physiological issue (like very dry skin, sweat, etc.).