

| Brand           | Model                | Image   | Channels | Price              | Cons  | Pros  |
|-----------------|----------------------|---|----------|--------------------|---|---|
| <b>Emotive</b>  | Insight 5            |    | 5        | \$299.99           | Software isn't open source. No arduino connectivity. Devs dislike hacking |   |
|                 | Epoc+                |    | 14       | \$799.99           | Software isn't open source. No arduino connectivity. Devs dislike hacking |   |
| <b>OpenBCI</b>  | Ganglion             |    | 4        | \$199+<br>\$349.99 | headset<br>extra cost   | open source,<br>arduino<br>connection                     |
|                 | Cyton                |    | 8        | \$499+349.99       | headset<br>extra cost   | open source,<br>arduino<br>connection                     |
|                 | Cyton+Daisy          |  | 16       | \$949.99+349.99    | headset<br>extra cost   | open source,<br>arduino<br>connection                     |
| <b>Muse</b>     | Muse                 |  | 4        | \$179.99           | No "research support" yet   | Cheap,<br>hackable  |
| <b>Neurosky</b> | Mindwave             |  | 1        | \$99.99            | only one<br>channel   | Cheap   |
| <b>OpenEEG</b>  | ModularEEG           |  | 6        | \$200-400          | Totally DIY   | Totally DIY   |
|                 | Active<br>Electrodes |  | Na       | Na                 | Connects to<br>Modular EEG  | No skin<br>penetration                                    |
| <b>Necomimi</b> | Necomimi             |  | 1        | \$49.99            | Almost a<br>novelty toy   | Can be<br>hacked via<br>bluetooth<br>slave, very<br>cheap |

# Emotive

Mostly intended for gaming

## EPOC

<https://www.emotiv.com/epoc/>

14 channels (+2 reference)

9 axis motion sensors (for removal of motion artifacts)

Saline electrodes (no gel)

Bluetooth connection

800 USD or 53640 INR

## Insight

5 channels (+2 reference)

9 axis motion sensors

Long life semi-dry polymer electrodes

Bluetooth or custom wireless USB receiver

## Hackability:

<https://news.ycombinator.com/item?id=1687432>

<https://raphaelwimmer.wordpress.com/2010/09/13/emotiv-epoc-brain-computer-interface-cracked-open/>

“We strongly oppose this kind of action. It violates the end user license and seriously threatens our viability.” - Emotiv

## Bottom Line:

Not really hackable, company is making significant efforts to prevent it.

# MUSE

<http://www.choosemuse.com>

## Features:

<http://developer.choosemuse.com/technical-specifications>

Three axis accelerometer

4 channels (one reference)

“decent” output signal quality. For basic readings, it does the job.

## Hackability:

*Company encourages using it in novel ways*

<http://www.choosemuse.com/blog/3-hack-tacular-muse-modifications/>

*Seems to be the wearable to hack for a lot of people.*

<https://qz.com/900211/netflix-nflx-engineers-developed-a-hack-called-mindflix-with-a-muse-headband-that-turns-your-thoughts-into-a-remote-control/>

## Bottom Line:

Company is ambitious, open to new ideas. Seems like a lot of people have hacked it and turned it into something interesting. This includes music composition.

# Neurosky

## Mindwave

<http://neurosky.com/biosensors/eeg-sensor/biosensors/>

### Features:

1 channel (earlobe reference)

Very basic sensor

Dry electrode

uroSky eSense

A/D

amplification off head detection

noise filtering for 50/60Hz powerline interference

runs on single AAA battery (6-8 hours use time)

wireless pairing (Bluetooth?)

### Hackability:

Neurosky supports hacks on its website. It has a page dedicated to them. Furthermore, there are several tutorials available.

<http://www.instructables.com/id/The-Modifying-Course-of-MindWave-RF-to-MindWave-BL/>

Sparkfun has tutorial on it

<https://learn.sparkfun.com/tutorials/hackers-in-residence---hacking-mindwave-mobile/all.pdf>

<https://hackaday.com/tag/neurosky/>

<https://www.hackster.io/neurosky/projects>

<https://hackaday.io/project/11146-train-your-brain-with-neurofeedback>

<http://www.frontiernerds.com/brain-hack>

<http://developer.neurosky.com/docs/doku.php?id=projects>

<https://learn.sparkfun.com/tutorials/hackers-in-residence---hacking-mindwave-mobile>

## Necomimi

<https://store.necomimi.com/products/necomimi>

*Toy using neurosky's sensor. Easily hackable, but the cost is nearly half that of the mind wave.*

## **Hackability:**

<http://www.instructables.com/id/Necomimi-bluetooth-EEG-data-hack/>

<https://forum.arduino.cc/index.php?topic=422997.0>

<https://www.hackster.io/lmetomi/use-the-force-or-your-brainwaves-9e839b>

## **Bottom Line:**

Mindwave is very hackable. Seems to be the go to choice for people who want cheap EEG hacking options. Maybe the data is not as clear as you might want, but its the most basic option available. Furthermore, the manufacturers seem to embrace the idea of hacking.

Necomimi is probably even more rudimentary, output-wise. However, it is half the price and hackable. At only around 3500 rupees, its by far the cheapest option.

## **OpenBCI**

<http://openbci.com>

There isn't much to be said about this. Its clearly the most DIY option out there, and has lots of open source code that you can use, and has direct connections to arduino and other microcontrollers.

The readings are "research grade" according to the website, and several people recommend it in online forums.

An example of a project:

<http://eeghacker.blogspot.com>

## **OpenEEG**

<http://openeeg.sourceforge.net/doc/modeeg/modeeg.html>

This is the DIY version. Basically its a bunch of schematics online to build your own EEG sensor. However, the cost of all the parts racks up quite quickly, and can exceed \$200 depending on where you get it from.

Worth looking into as an option. However, it obviously demands significantly more time as you have to build and calibrate it, and its probably less useful than OpenBCI in the long run.

## **Extra Stuff**

<http://www.frontiernerds.com/brain-hack>