single channel biosignal acquisition tool-kit for advanced research applications

user manual

ATTENTION
please read this manual before using your
biosignalsplux product

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Please check your system after receiving and before using it the first time, to confirm if it contains all the ordered sensors, accessories and other components. Contact our customer support if there are any variations from your original order.

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1 Your biosignalsplux Solo Kit

Figure 1: OpenBAN – single channel acquisition device of the biosignalsplux Solo kit.

The *biosignalsplux Solo* system is designed for applications where the usage of a single biosignal sensor is required and comes with several accessories for you to take full advantage of its functionalities.

We recommend you to check and confirm the content of your kit after receiving it and before using it the first time, to identify missing or wrongly shipped components or sensors that vary from your original order. Contact our support if there are any variations from your original order.

biosignalsplux Solo kit content:

- 1x OpenBAN single channel acquisition device
- 1x Professional sensor of your choice
- 24x Pre-gelled & disposable electrodes
- 1x Bluetooth Dongle
- 1x Micro USB charging cable

2 OpenBAN - Signal Acquisition Device

Figure 2: OpenBAN.

The *OpenBAN* is the single channel device of the *biosignalsplux Solo* kit that collects and digitizes all signals from a single biosignal sensor and transmits them via Bluetooth to the computer, where they are recorded and visualized in real-time. The *OpenBAN* supports sampling resolutions of up to 16-bit and 1000Hz sampling frequency.

OpenBAN is compatible with most available *biosignalsplux* sensors, although the usage of some sensors is restricted due to the limited amount of sensor inputs (see chapter *3 Sensors* for more detailed information about this topic).

Additionally, the *OpenBAN* has integrated sensors such as an triaxial accelerometer, triaxial magnetometer and a microphone.

Features
> Designed for advanced biosignal research
> Medical-grade raw data acquisition
> Ready to use in- & out-of-the-lab
> Sensor auto-detection
> Bluetooth streaming capability for online acquisitions
> Internal memory for offline acquisitions

Intended Use for Research Applications
> Life sciences studies
> Biomedical research
> Human-Computer-Interaction
> Sports sciences
> Robotics & Cybernetics
> biomechanics
> Ergonomics
> Rehabilitation sciences

2.1 Specifications

The *OpenBAN* comes with integrated triaxial accelerometer, triaxial magnetometer, and microphone and with an additional port to connect an analog *biosignalsplux* sensor. This device allows data acquisition using a single sensor and wireless transmission of the acquired data to your computer via Bluetooth.

For detailed specifications check the table below and the *OpenBan's* datasheet.

Specifications

Analog Inputs:	1
Digital Ports:	none
Reference Electrode:	virtual ground for compatible sensors (e.g. EMG)
Integrated Sensors:	triaxial accelerometer; triaxial magnetometer; microphone
Sampling Rate:	up to 1000Hz
Sampling Resolution:	up to 16-bit
Communication:	Bluetooth 2.0+EDR (Class II); USB cable to download stored data from memory (optional extra)
Bluetooth Range:	up to ~10m (in line of sight)
Battery:	720mAh 3.7V LiPo rechargeable (up to 16h in continuous streaming)
Device Size:	54x35x15mm (without cloth clip)
Weight:	45g

2.2 Ports and Peripheries

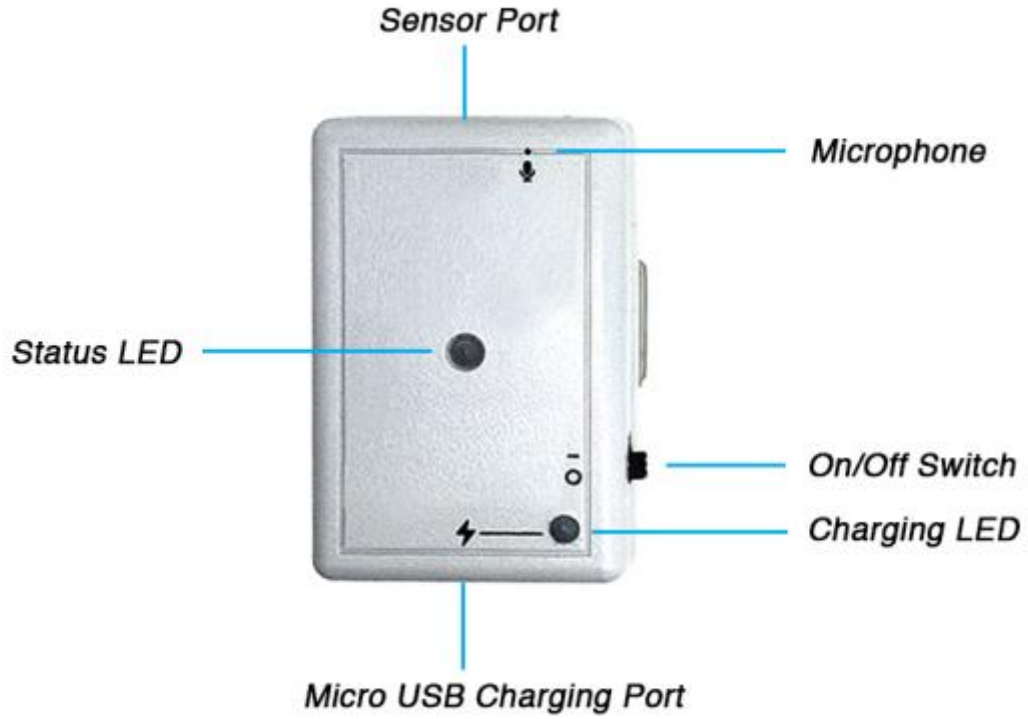

Figure 3: OpenBAN ports, LED, microphone placement & on/off switch.

2.2.1 On/Off Switch – Turning the Device On and Off

In order for the device to work, it must be turned on. Turning on the device can be done by sliding the on/off switch which is placed at the right side of the device into the on position (*I-position*). After being turned on, the LED status light will blink once per second (green).

Sliding the switch into the off-position (*O-position*) will turn off the device.

2.2.2 Sensor Port – Connecting and Disconnecting Sensors

WARNING
Do not use damaged sensors, devices or components, as this can cause serious injuries and device damages. Contact PLUX's Technical Assistance to report such issues and report malfunctioning devices or sensors without hesitation.

The *OpenBAN* has only a single sensor port where *biosignalsplux* sensors can be connected to the device.

Do not try to connect the sensor into the micro USB charging port as this might damage the equipment and harm the user. Also, when connecting the sensors, pay attention to where the cables go to avoid device damages or disrupting the user's movements.

Disconnect the sensors according to the recommendations displayed below, to avoid damaging the *biosignalsplux* device or the sensors:

- don't twist the sensor while disconnecting
- don't apply upward force or pull the cable
- use minimal force to disconnect
- hold the plug firmly and pull it out
- don't pull the cable

2.2.3 Micro USB Charging Port & Charging LED – How to Charge the OpenBAN

WARNING
Do not use the *OpenBAN* device during the charging process.

NOTE
Follow the indications on how to correctly charge your device to prevent any damage of your system or of the *OpenBAN* user(s).

OpenBAN has a battery lifetime of up to 16 hours in continuous usage. Note, that the lifetime might vary depending on the number of active sensors (incl. built-in sensors). The built-in LED will light up red if the battery is running low until the device stops working.

To recharge, turn off your *OpenBAN* by sliding the on/off switch into *O-position* (see *Figure 3*) and use the micro USB cable which comes with your kit by connecting the USB-A connector to an USB port of your computer and the micro USB connector to the micro USB charging port of your *OpenBAN* (see *Figure 3*). The charging process will take approximately 2 ½ hours to fully charge the battery.

WARNING
Make sure your device is turned off in order to charge it. If the device is turned on during the charging process, the charging LED will turn red and the device will not be charged.

If the charging process is being done correctly, the charging LED will turn purple.

If the charging LED turns red during the charging process, even when the device is turned off, disconnect the micro USB cable from your *OpenBAN* and contact PLUX's Technical Assistance.

The suitable room temperature when charging the device must be between 10°C and 35°C to prevent device or user related damages during the charging process.

WARNING
Unplug the charger from your computer if the battery/device overheats (reaching 60°C) and immediately get in contact with PLUX's Technical Assistance.

2.3 Status LED

The status LED at the centre of the *OpenBAN* provides basic visual information about the current device state (e.g., green blinking with 1Hz frequency → device is in idle mode, green blinking with 2Hz frequency → device is streaming data). Please check the *OpenBAN's* datasheet for more detailed information about the status LED and the device states.

2.4 Microphone

The microphone allows you to record sound during acquisitions. Make sure the microphone is not covered during acquisition to be able to record any useful audio data.

2.5 Communication

The communication with *OpenBAN* devices is done via Bluetooth Class II only. Bluetooth is used to configure the device, to acquire and transmit sensor signals in real-time to the computer and upload new firmware versions to your device.

Since most internal Bluetooth modules are not designed to support high transfer rates as those are needed when acquiring and streaming signals using *OpenBAN*, we strongly recommend using the PLUX Bluetooth dongle (which comes with your *biosignalsplux Solo* kit) to prevent any communication issues or connection losses. These dongles have been tested and verified by PLUX to work properly with any *biosignalsplux* device.

The Bluetooth dongle can be found in our store if several dongles are needed (e.g. to use *biosignalsplux Solo* on several computers without having to change the Bluetooth dongle every time another computer is being used[1]).

https://store.plux.info/biosignalsplux-accessories/368-bitalino-proven-bluetooth-dongle-820201511.html

Instructions on how to connect the *OpenBAN* device via Bluetooth to the computer can be found in the 4 *Bluetooth Setup* section.

If you're experiencing a great number of connection loss events, reconnection problems, missing samples or similar problems, your internal Bluetooth module might be being used for data transmission or your Bluetooth dongle might be configured to use the wrong Bluetooth stack. Instructions to set up the correct Bluetooth stack and to solve such problems can be found in the *6.1* Bluetooth section of this manual

See the table on the following page for detailed Bluetooth specifications of the internal Bluetooth module of *biosignalsplux* devices (incl. *OpenBAN*).

Operating frequency range	2400 – 2483.5 MHz ISM Band
Modulation method	GFSK (1 Mbps) P/4 DQPSK (2Mbps)
Hopping	1600 hops/s, 1 MHz channel space
Transmission power	Min: -11 dBm Max: +3 dBm
Antenna peak gain (XZ-V)	0.5dBi typical
Average antenna gain (XZ-V)	-0.5 dBi typical
Antenna VSWR	2 max
Certifications	Bluetooth, CE, FCC, IC, Japan and South Korea

Table 1: Specifications of biosignalsplux devices' internal Bluetooth modules.

[1] biosignalsplux can only be connected to one computer at a time

3 Sensors

biosignalsplux has a large variety of compatible professional and advanced sensors.

The entire updated list of *biosignalsplux* sensors can be accessed via the following link:

http://biosignalsplux.com/index.php/en/products/sensors

WARNING
Do not use damaged sensors, devices or components, as this can cause serious injuries and device damages. Contact PLUX's Technical Assistance to report such issues and report malfunctioning devices or sensors.

NOTE
Please review the sensor datasheets (see annexes) for more detailed specifications.

NOTE
The sensor configuration for *biosignalsplux* devices are demonstrated by using PLUX's *OpenSignals (r)evolution* software. Please review the software manual for more detailed information about how to configure your device when using *OpenSignals*.

3.1 Integrated Sensors

The *OpenBAN* has integrated sensors which are pre-wired and pre-configured inside *OpenSignals (r)evolution*, which are a triaxial accelerometer, a triaxial magnetometer and a microphone. The default configuration of the *OpenBAN* is displayed in *Table 2*.

CHANNEL	SENSOR	CHANNEL TYPE
1	Microphone	MICRO
2	biosignalsplux sensor	[DEPENDS ON CONNECTED SENSOR]
3	Accelerometer – X-Axis	ACC_X
4	Accelerometer – Y-Axis	ACC_Y
5	Accelerometer – Z-Axis	ACC_Z
6	Magnetometer – X-Axis	MAG_X
7	Magnetometer – Y-Axis	MAG_Y
8	Magnetometer – Z-Axis	MAG_Z

Table 2: Default configuration of the OpenBAN.

Note that this configuration is linked to the internal connections between integrated sensors and circuits of the *OpenBAN*, with the only exception of channel 2, which needs to be configured according to the connected *biosignalsplux* sensor at the *OpenBAN's* sensor port. Changing the channel configuration (e.g. channel type) of the pre-wired internal sensors will lead to false conversions of the acquired raw data.

The default configuration of an *OpenBAN* device should be as displayed in Figure 4 (with the exemption of channel 2).

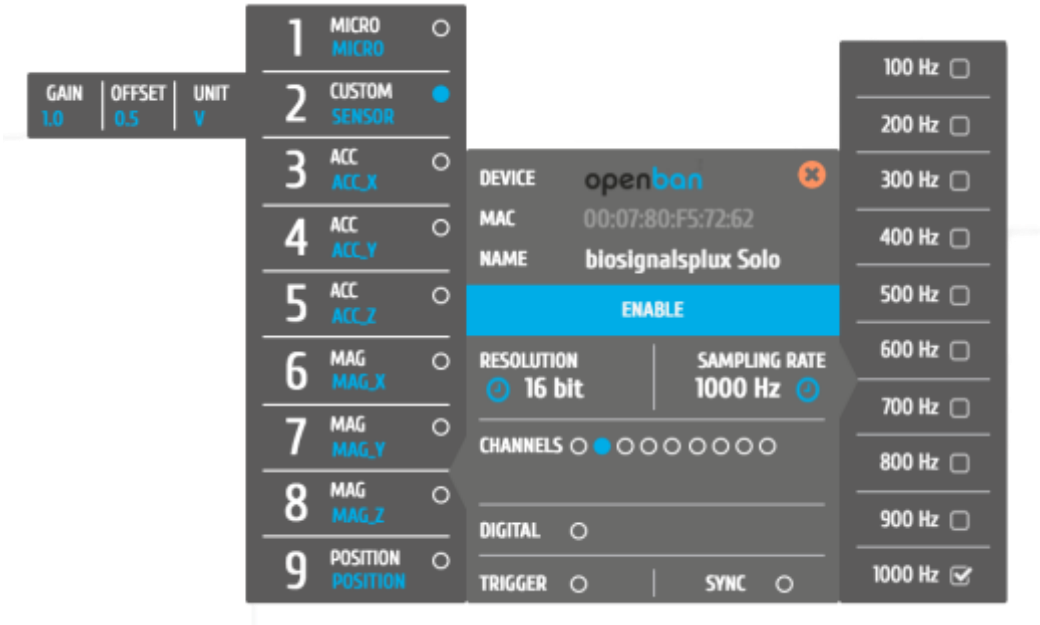

Figure 4: Default configuration of the OpenBAN in OpenSignals (r)evolution.

Channel 2 needs to be configured according to the sensor which is connected to the *OpenBan*. Please check the following chapters *3.2 Professional Sensors* and *3.3 Advanced Sensors* to learn how to correctly configure the *OpenBAN* and your sensor.

3.2 Professional Sensors

3.2.1 Electromyography (EMG)

Our low-noise ECG local differential triode configuration enables fast application and unobtrusive data acquisition (although custom electrode cable configurations are available). The state-of-the-art design of the analog frontend on this sensor is specifically targeted at analyzing minutiae in the data. Together with the Heart Rate Variability (HRV) plugin on our OpenSignals software, one can easily record and extract meaningful information.

Figure 5: EMG sensor.

Electrode cables & sleeves

The electrode cables of this sensor can be connected to electrodes with integrated stud connectors. The colored plastic sleeves on each electrode cable indicate which electrode must be connected to the positive or negative electrode cable (see Table 3).

Electrode Cable	+	-
Sleeve Color	Red	Black

Table 3: Color coding of the electrode cable sleeves.

How to configure your sensor in OpenSignals (r)evolution

Open the *OpenSignals (r)evolution* device manager and select the device you have your EMG sensor connected to. Select the channel of your EMG sensor and select *EMG* out of the dropdown menu (click on the arrow in the channel's field that appears when you hover over the channel's field). No additional set up is needed for the reference electrode inside *OpenSignals (r)evolution*.

Activate this channel for signal acquisition by clicking on the circle in the channel field (must be blue).

An example configuration is displayed in *Figure 6* (here: EMG connected to channel 1).

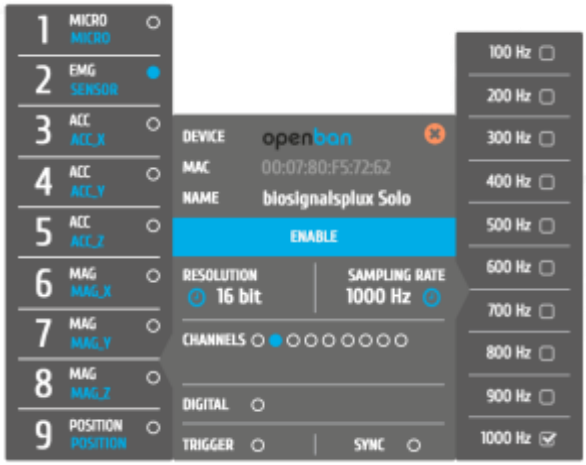

Figure 6: EMG configuration in OpenSignals.

If configured correctly, your acquired signals should be similar to the signal displayed in *Figure 7*.

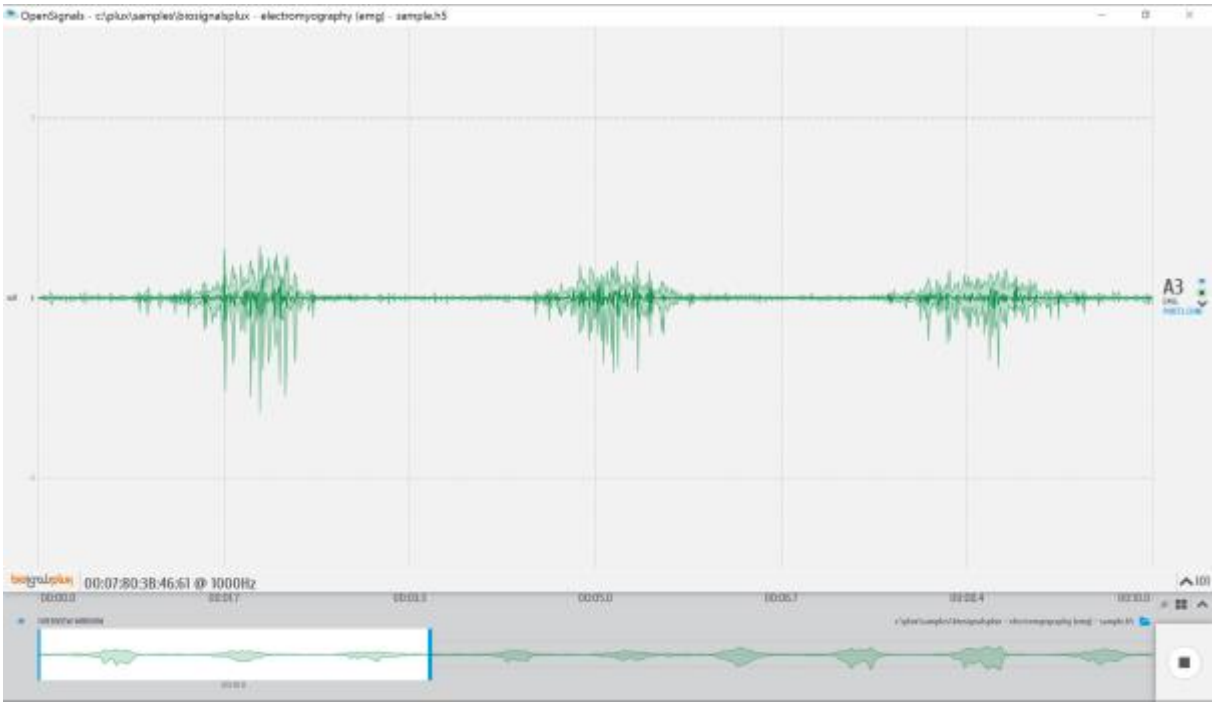

Figure 7: biosignalsplux EMG sensor sample.

OpenSignals (r)evolution Add-On: Electromyography Analysis

The *Electromyography Analysis* add-on is able to extract useful statistical information from EMG data acquired with this EMG sensor. This add-ons' automatic onset detection algorithm enables the analysis of each individual muscle action even, in addition to the overall analysis of the recording session. Timings analysis is also done for each activation to a reference muscle.

Please visit the following website for more information about this add-on:

http://www.biosignalsplux.com/index.php/en/software/add-ons

Sensor specifications

Please read the datasheet of the EMG sensor carefully before using it the first time. The datasheet can be downloaded here:

http://biosignalsplux.com/datasheets/EMG_Sensor_Datasheet.pdf

3.2.2 Electrocardiography (ECG)

Our low-noise ECG local differential triode configuration enables fast application and unobtrusive data acquisition (although custom electrode cable configurations are available). The state-of-the-art design of the analog frontend on this sensor is specifically targeted at analyzing minutiae in the data. Together with the Heart Rate Variability (HRV) plugin on our OpenSignals software, one can easily record and extract meaningful information.

Figure 8: ECG sensor.

Electrode cables & sleeves

The electrode cables of this sensor can be connected to electrodes with integrated stud connectors. The colored plastic sleeves on each electrode cable indicate which electrode must be connected to the positive, negative or reference electrode cable (see Table 4).

Electrode Cable	+	-	Reference
Sleeve Color	Red	Black	White

Table 4: Color coding of the electrode cable sleeves.

How to configure your sensor in OpenSignals (r)evolution

Open the *OpenSignals (r)evolution* device manager and select the device you have your ECG sensor connected to. Select the channel of your ECG sensor and select *ECG* out of the dropdown menu (click on the arrow in the channel's field that appears when you hover over the channel's field). No additional set up is needed for the reference electrode inside *OpenSignals (r)evolution*.

Activate this channel for signal acquisition by clicking on the circle in the channel field (must be blue).

An example configuration is displayed in *Figure 9* (here: ECG connected to channel 1).

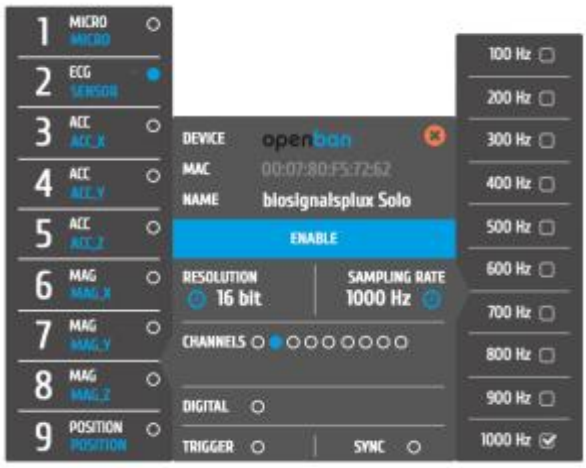

Figure 9: ECG configuration in OpenSignals.

If configured correctly, your acquired signals should be similar to the signal displayed in *Figure 10*.

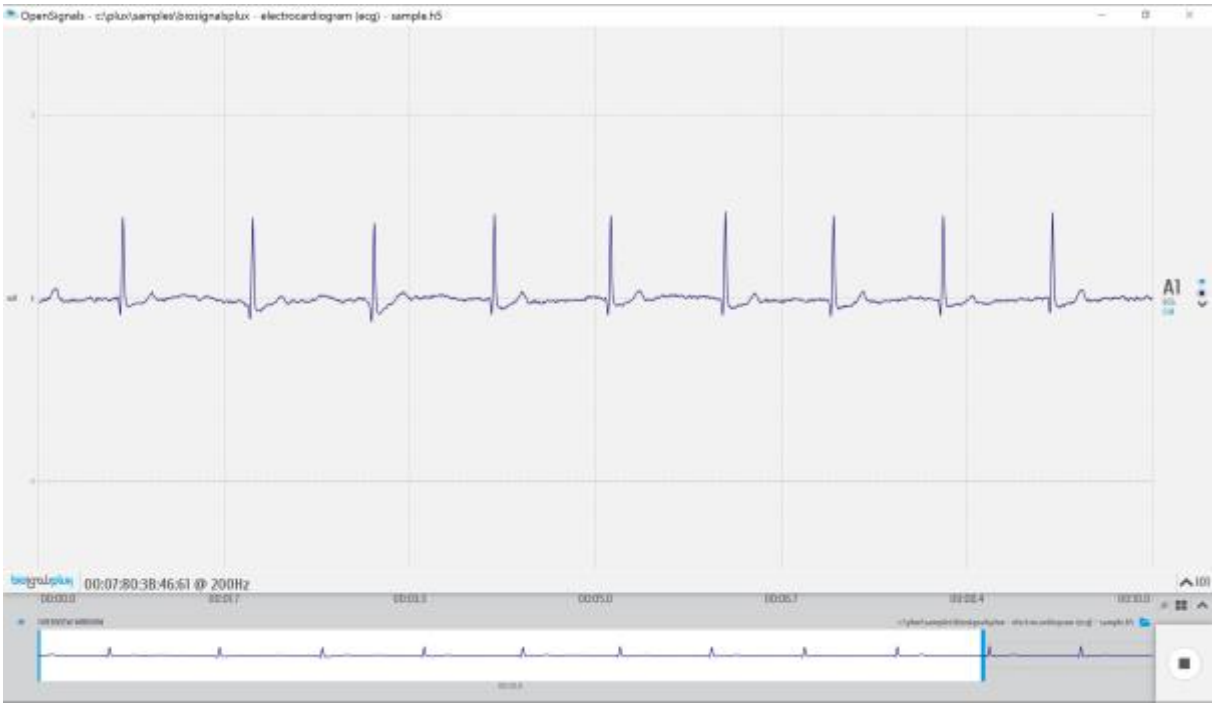

Figure 10: biosignalsplux ECG sensor sample.

OpenSignals (r)evolution Add-On: Heart Rate Variability

The *Heart Rate Variability* add-on provides important quantitative markers related with the sympathetic or vagal activity. This plugin enables the seamless extraction and analysis of temporal, spectral, and non-linear parameters from sensor data acquired with this ECG sensor (or the blood volume pulse sensor; see *3.3.5 Blood Volume Pulse* (BVP)).

Please visit the following website for more information about this add-on:

http://www.biosignalsplux.com/index.php/en/software/add-ons

Sensor specifications

Please read the datasheet of the ECG sensor carefully before using it the first time. The datasheet can be downloaded here:

http://biosignalsplux.com/datasheets/ECG_Sensor_Datasheet.pdf

3.2.3 Electrodermal Activity (EDA)

Our EDA sensor is capable of accurately measuring the skin activity with high sensitivity in a miniaturized form factor. The low-noise signal conditioning and amplification circuit design provides optimal performance in the detection of even the most feeble electrodermal skin response

Figure 11: EDA sensor.

How to configure your sensor in OpenSignals (r)evolution
Open the *OpenSignals (r)evolution* device manager and select the device you have your EDA sensor connected to. Select the channel of your EDA sensor and activate this channel for signal acquisition by clicking on the circle in the channel field (must be blue).

OpenSignals (r)evolution offers two modes that are designed for different applications for EDA sensors that can be selected in the dropdown menu which can be accessed via the channel field (click on the arrow in the channel's field that appears when you hover over the channel's field).

The *EDA* option is designed to work with applications where the EDA sensor is placed, for example, on the hand of the subject. If you plan to use the EDA sensor on the arm of a subject, we recommend selecting the *EDA.ARM* configuration to ensure high quality data acquisition.

Activate this channel for signal acquisition by clicking on the circle in the channel field (must be blue).

An example configuration is displayed in *Figure 12* (here: EDA connected to channel 1 and EDA on arm configuration connected to channel 2).

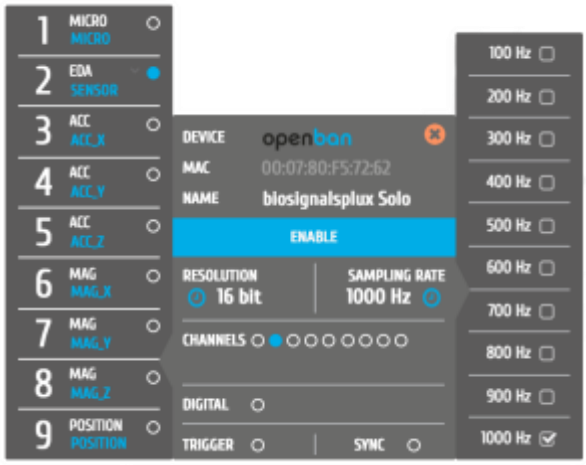

Figure 12: EDA configuration in OpenSignals.

If configured correctly, your acquired signals should be similar to the signal displayed in *Figure 13*.

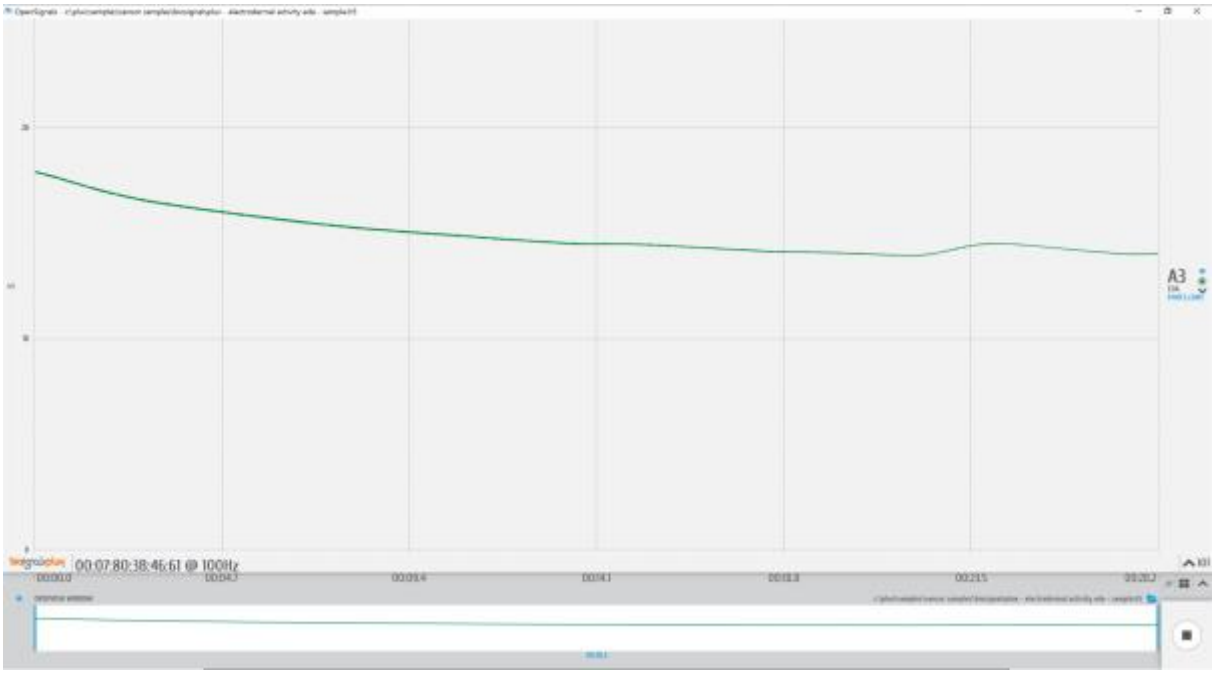

Figure 13: biosignalsplux EDA sensor sample.

OpenSignals (r)evolution Add-On: Electrodermal Activity Events

The *Electrodermal Activity Events* add-on has been designed to compute overall statistics, basic spectral analysis, and extract typical event-related phasic features from sensor data acquired with this EDA sensor.

Please visit the following website for more information about this add-on:

http://www.biosignalsplux.com/index.php/en/software/add-ons

Sensor specifications

Please read the datasheet of the EDA sensor carefully before using it the first time. The datasheet can be downloaded here:

http://biosignalsplux.com/datasheets/EDA_Sensor_Datasheet.pdf

3.2.4 Electroencephalography (EEG)

Our low-noise ECG local differential triode configuration enables fast application and unobtrusive data acquisition (although custom electrode cable configurations are available). The state-of-the-art design of the analog frontend on this sensor is specifically targeted at analyzing minutiae in the data. Together with the Heart Rate Variability (HRV) plugin on our OpenSignals software, one can easily record and extract meaningful information.

Figure 14: EEG sensor.

Electrode cables & sleeves

The electrode cables of this sensor can be connected to electrodes with integrated stud connectors. The colored plastic sleeves on each electrode cable indicate which electrode must be connected to the positive, negative or reference electrode cable (see Table 5).

Electrode Cable	+	-	Reference
Sleeve Color	Red	Black	White

Table 5: Color coding of the electrode cable sleeves.

How to configure your sensor in OpenSignals (r)evolution

Open the *OpenSignals (r)evolution* device manager and select the device you have your EEG sensor connected to. Select the channel of your EEG sensor and select *EEG* out of the dropdown menu (click on the arrow in the channel's field that appears when you hover over the channel's field). No additional set up is needed for the reference electrode inside *OpenSignals (r)evolution*.

Activate this channel for signal acquisition by clicking on the circle in the channel field (must be blue).

An example configuration is displayed in *Figure 15* (here: EEG connected to channel 1).

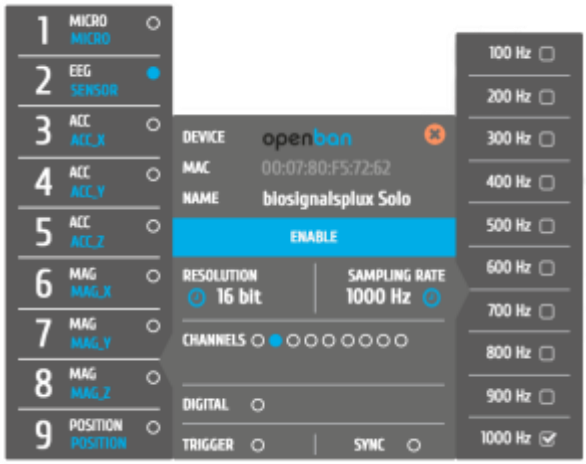

Figure 15: EEG configuration in OpenSignals.

If configured correctly, your acquired signals should be similar to the signal displayed in *Figure 16*.

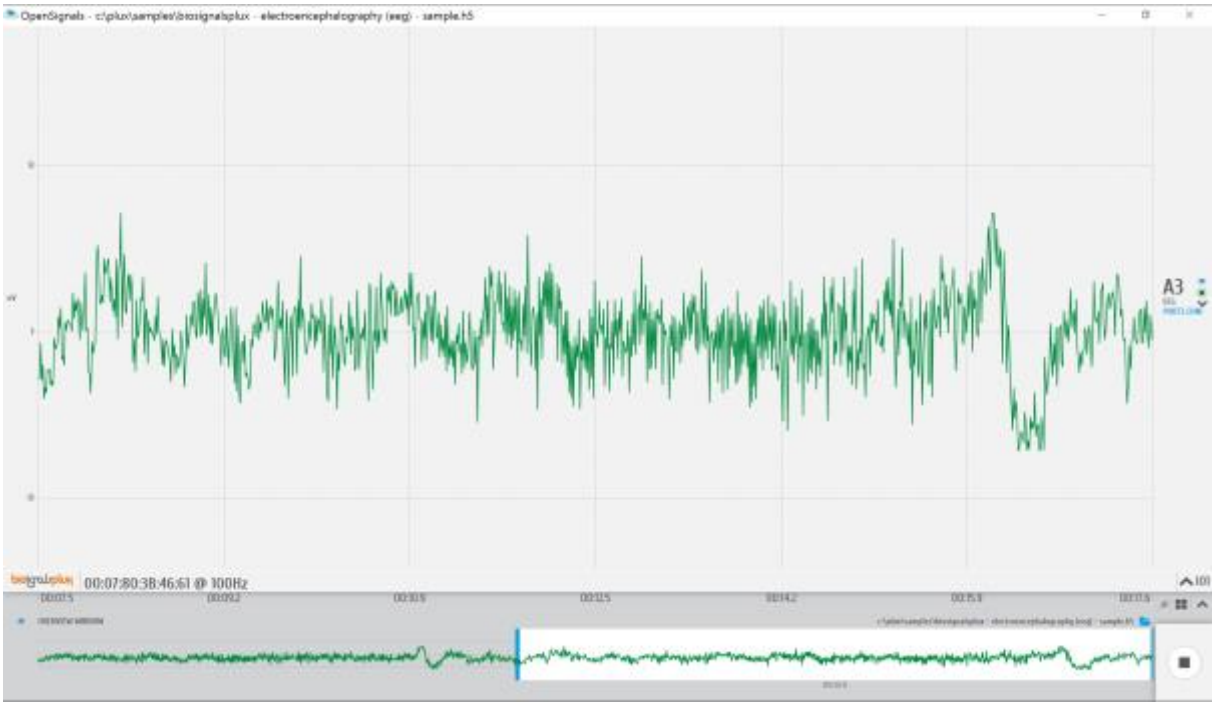

Figure 16: biosignalsplux EEG sensor sample.

Sensor specifications

Please read the datasheet of the EEG sensor carefully before using it the first time. The datasheet can be downloaded here:

http://biosignalsplux.com/datasheets/EEG_Sensor_Datasheet.pdf

3.2.5 Temperature (TMP)

Our high performance NTC sensors have been specifically developed for biomedical applications and are meant to be used on a range of temperatures suitable for body sensing. These sensors produce a robust, stable, and accurate output with low tolerance values. The geometry and rapid response are also of added value for even the most demanding applications.

Figure 17: Temperature sensor.

How to configure your sensor in OpenSignals (r)evolution

Open the *OpenSignals (r)evolution* device manager and select the device you have your temperature sensor connected to. Select the channel of your temperature sensor and select *TEMP* out of the dropdown menu (click on the arrow in the channel's field that appears when you hover over the channel's field).

Activate this channel for signal acquisition by clicking on the circle in the channel field (must be blue).

An example configuration is displayed in *Figure 18* (here: temperature sensor connected to channel 1).

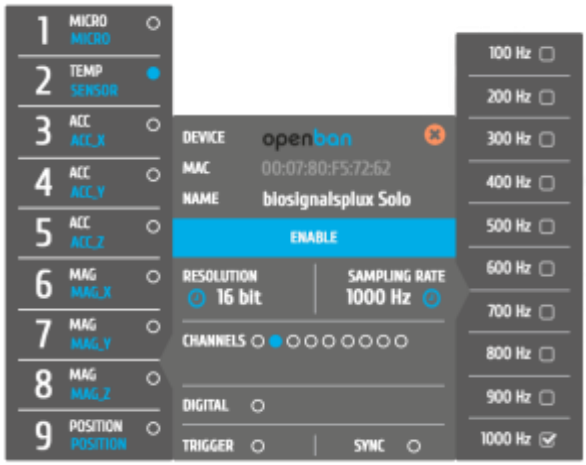

Figure 18: TMP configuration in OpenSignals.

If configured correctly, you should be able to acquire signals similar to the signal displayed in *Figure 19*.

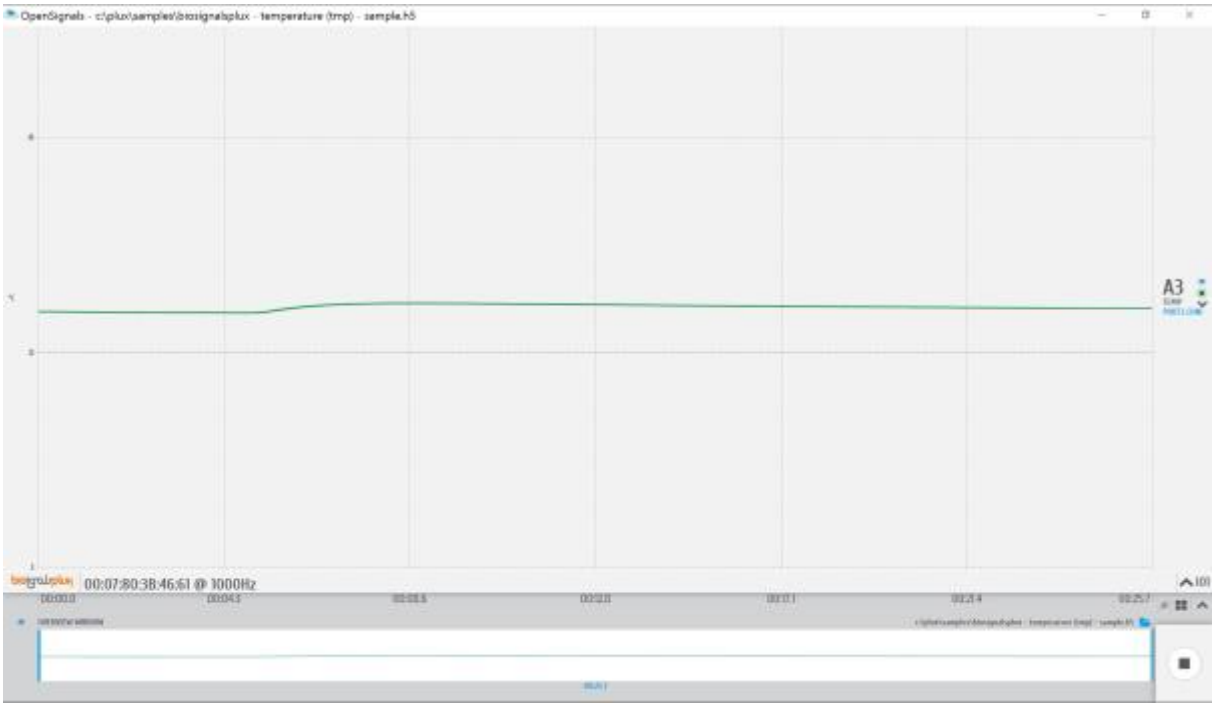

Figure 19: biosignalsplux temperature (TMP) sensor sample.

3.2.6 Respiration (PZT)

Our piezoelectric respiration sensor is an entry-level affordable option for respiratory analysis in a wide range of applications. It has a localized sensing element that measures displacement variations induced by inhaling or exhaling. The elastic strap is provided with the sensor to secure it in place, and can be adjusted in length, enabling the sensor to be applied in different anatomies (e.g. male and/or female) and body locations (e.g. thorax and/or abdomen).

Figure 20: PZT sensor.

How to configure your sensor in OpenSignals (r)evolution

Open the *OpenSignals (r)evolution* device manager and select the device you have your respiration sensor connected to. Select the channel of your respiration sensor and select *RESP* from the dropdown menu (click on the arrow in the channel's field that appears when you hover over the channel's field).

Activate the respiration sensor's channel for signal acquisition by clicking on the circle in the channel field (must be blue).

An example configuration is displayed in *Figure 21* (here: respiration sensor connected to channel 1).

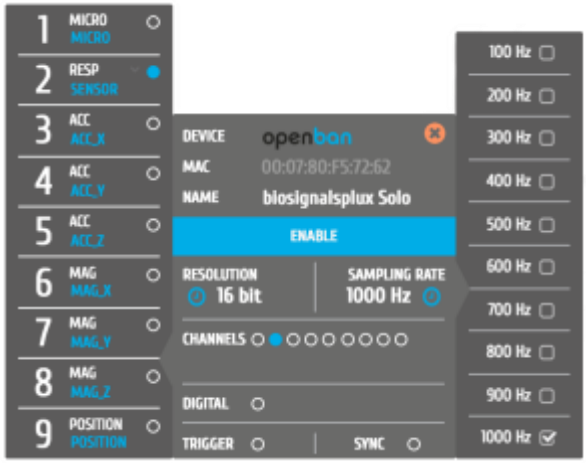

Figure 21: Respiration (PZT) configuration in OpenSignals.

If configured correctly, your acquired signals should be similar to the signal displayed in *Figure 22*.

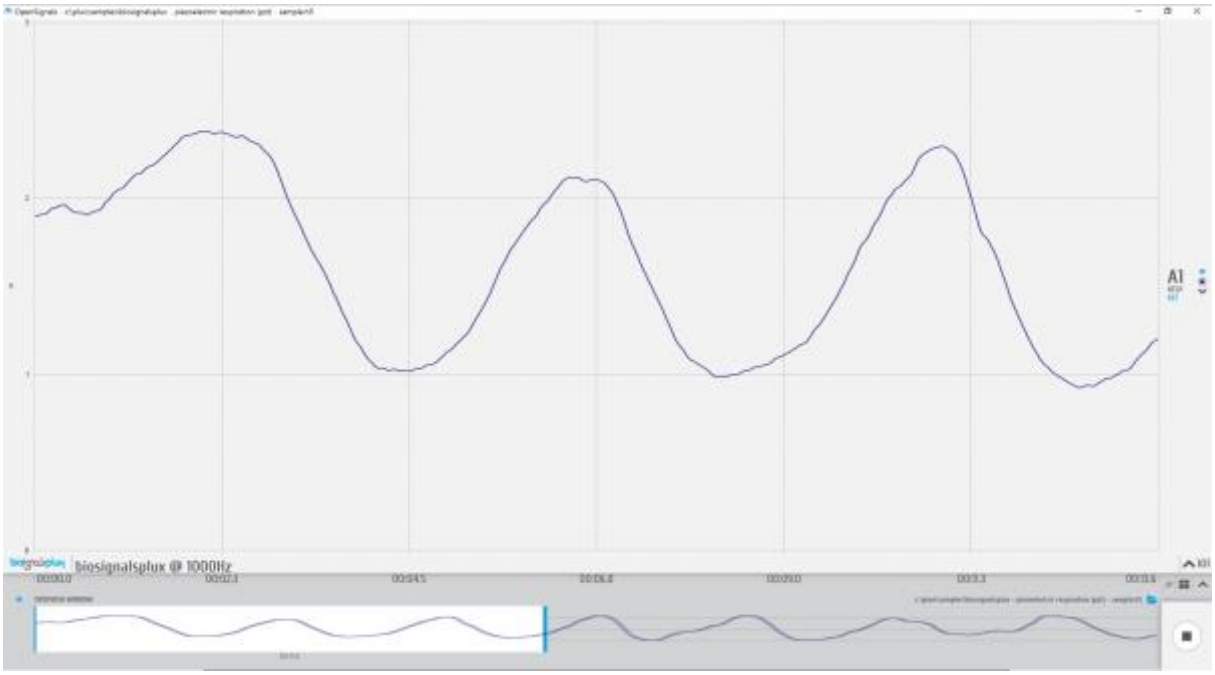

Figure 22: biosignalsplux respiration (PZT) sensor sample.

OpenSignals (r)evolution Add-On: Respiration Analysis

The *Respiration Analysis* add-on add-on is a convenient way to determine respiratory rate and other useful temporal and statistical parameters associated with the respiratory cycles and to provide useful information about the breathing dynamics. It is designed to work with sensor data acquired with this piezoelectric respiration sensor (PZT) (or with the inductive respiration sensor (RIP); see *3.3.1 Respiration (RIP)*).

Please visit the following website for more information about this add-on:
http://www.biosignalsplux.com/index.php/en/software/add-ons

Sensor specifications

Please read the datasheet of the respiration sensor carefully before using it the first time. The datasheet can be downloaded here:

http://biosignalsplux.com/datasheets/PZT_Sensor_Datasheet.pdf

3.2.7 Force (FSR)

From reaction time measurement to load distribution in shoe insoles, our thin film force sensors offer uncompromised performance in the most demanding applications. The low profile membrane and miniaturized signal conditioning circuitry are ideal for minimally intrusive setups. Multiple sensing area dimensions and measurement ranges are available.

Figure 23: Force sensor.

How to configure your sensor in OpenSignals (r)evolution

Open the *OpenSignals (r)evolution* device manager and select the device you have your force sensor connected to. Select the channel of your force sensor and select *CUSTOM* from the dropdown menu (click on the arrow in the channel's field that appears when you hover over the channel's field). In the custom field of your channel, adjust the *GAIN* and *OFFSET* that fits best to your application. Testing and readjustments of this parameters might be needed to find the configuration that fits best your needs.

Activate this channel for signal acquisition by clicking on the circle in the channel field (must be blue).

An example configuration is displayed in *Figure 24* (here: force sensor connected to channel 1).

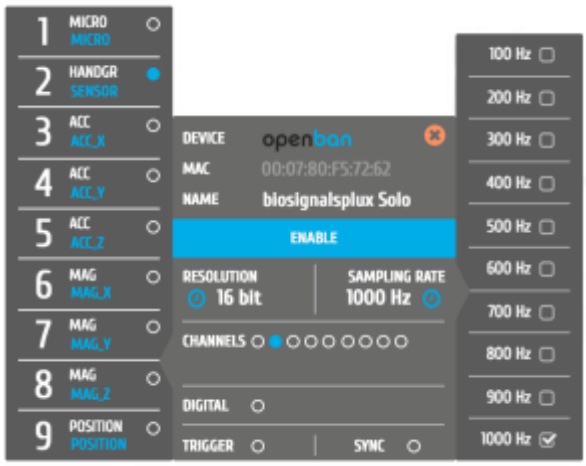

Figure 24: Force sensor configuration in OpenSignals.

If configured correctly, your acquired signals should be similar to the signal displayed in *Figure 25*.

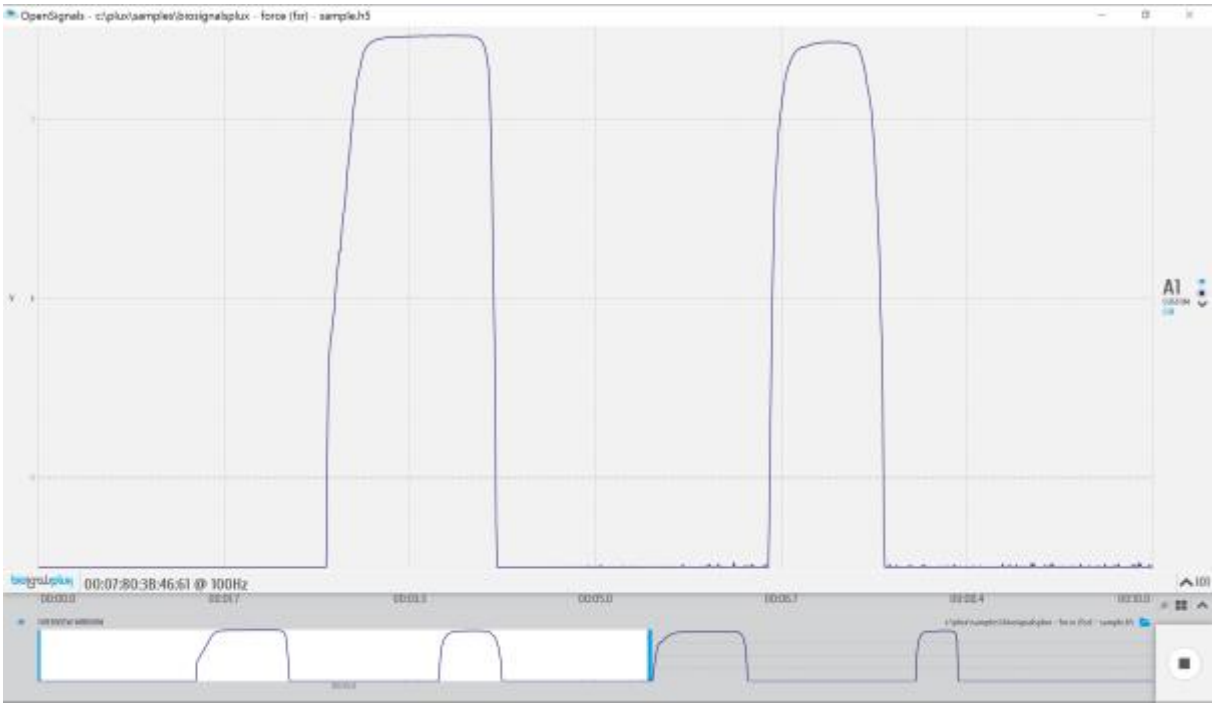

Figure 25: biosignalsplux force (FSR) sensor sample.

3.2.8 Light (LUX)

Figure 26: Light sensor.

A common need when working with biosignals is the synchronization of the recorded data with external sources (e.g. a computer screen for visual evoked potentials). If applied to the computer screen, our LUX sensor can be used to detect chromatic changes in the stimuli, hence providing a synchronization source. The LUX sensor can also be useful for optical synchronization with third-party devices (provided that the third-party device can trigger an LED), in applications where it is important to have electrical decoupling between devices.

How to configure your sensor in OpenSignals (r)evolution

Note, that the signal you are acquiring with this light sensor is affected by the ambient light and other light sources that are available at your experiment setup. Therefore, it is needed to adjust the acquired signal to fit to your application and setup.

For this, open the *OpenSignals (r)evolution* device manager and select the device you have your light sensor connected to. Select the channel of your light sensor and select *CUSTOM* from the dropdown menu (click on the arrow in the channel's field that appears when you hover over the channel's field). In the custom field of your channel, adjust the *GAIN* and *OFFSET* that fits best to your application. Testing and readjustments of this parameters might be needed to find the configuration that fits best your needs.

Activate the light sensor channel for signal acquisition by clicking on the circle in the channel field (must be blue).

An example configuration is displayed in *Figure 27* (here: light sensor connected to channel 1).

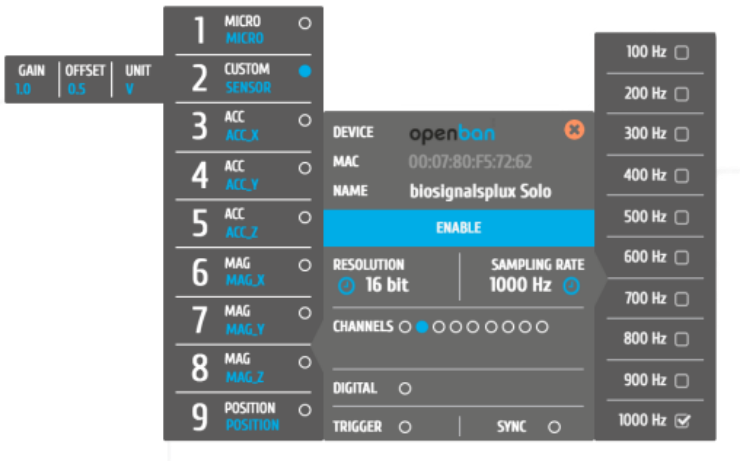

Figure 27: Light sensor configuration in OpenSignals.

If configured correctly, your acquired signals should be similar to the signal displayed in *Figure 28*.

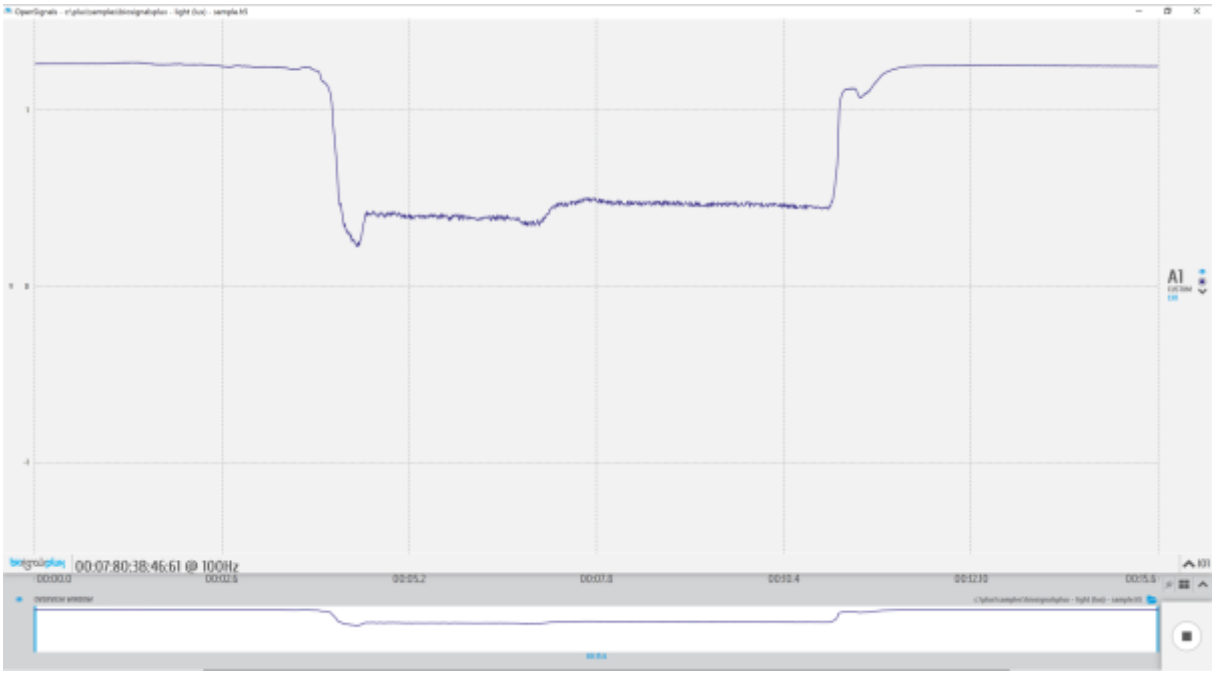

Figure 28: biosignalsplux light (LUX) sensor sample.

OpenSignals (r)evolution Add-On: Video Synchronization

The *Video Synchronization* add-on has been designed for research applications which involve recording data from sources other than the biosignal acquisition hardware devices (e.g. video camera). Given that the biosignal hardware and the camera are independent recording sources, a common problem when replaying the recording session is the synchronization of both. This plugin was created to provide an easy way to replay biosignal data synchronously with video using this light sensor.

Please visit the following website for more information about this add-on:

http://www.biosignalsplux.com/index.php/en/software/add-ons

Sensor specifications

Please read the datasheet of the EMG sensor carefully before using it the first time. The datasheet can be downloaded here:

http://biosignalsplux.com/datasheets/LUX_Sensor_Datasheet.pdf

3.3 Advanced Sensors

3.3.1 Respiration (RIP)

This high-performance inductive respiration sensor has been specifically designed having dynamic conditions in mind (e.g. ambulatory sensing). The sensing element is embedded in the chest strap fabric, and spans its full length. Unlike our affordable piezoelectric (PZT) sensor (which only measures the displacement in a localized manner), the RIP option measures the overall displacement of the thorax or abdomen, making it more immune to motion-induced artefacts.

Figure 29: Respiration (RIP) sensor.

How to configure your sensor in OpenSignals (r)evolution

Open the *OpenSignals (r)evolution* device manager and select the device you have your respiration sensor connected to. Select the channel of your respiration sensor and select *RESP* from the dropdown menu (click on the arrow in the channel's field that appears when you hover over the channel's field).

Activate the respiration sensor's channel for signal acquisition by clicking on the circle in the channel field (must be blue).

An example configuration is displayed in *Figure 30* (here: respiration sensor connected to channel 1).

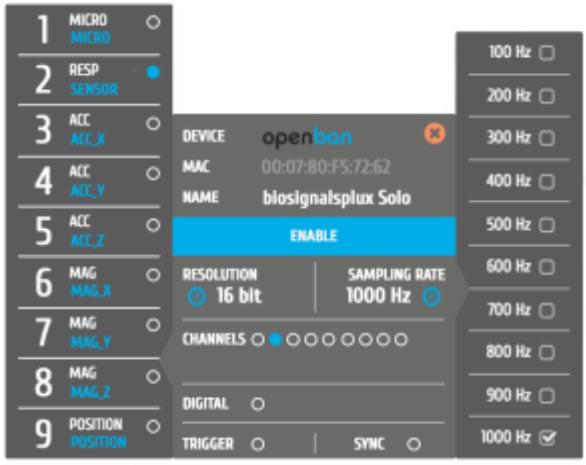

Figure 30: Respiration (RIP) configuration in OpenSignals.

OpenSignals (r)evolution Add-On: Respiration Analysis

The *Respiration Analysis* add-on add-on is a convenient way to determine respiratory rate and other useful temporal and statistical parameters associated with the respiratory cycles and to provide useful information about the breathing dynamics. It is designed to work with sensor data acquired with this inductive respiration sensor (RIP) (or with the piezoelectric respiration sensor (PZT); see *3.2.6 Respiration (PZT)*).

Please visit the following website for more information about this add-on:
http://www.biosignalsplux.com/index.php/en/software/add-ons

Sensor specifications

Please read the datasheet of the respiration sensor carefully before using it the first time. The datasheet can be downloaded here:

http://biosignalsplux.com/datasheets/RIP_Sensor_Datasheet.pdf

3.3.2 Load Cell

This single-axis load cell is particularly suitable for handgrip, traction/compression, and similar applications. Its sturdy design and accessories enable force measurement in many different settings. The plug & play design provides maximum flexibility for use with our biosignal acquisition kits.

Figure 31: Load cell.

How to configure your sensor in OpenSignals (r)evolution

Open the *OpenSignals (r)evolution* device manager and select the device you have your load cell connected to. Select the channel of your load cell and select *HANDGR* from the dropdown menu (click on the arrow in the channel's field that appears when you hover over the channel's field).

Activate the respiration sensor's channel for signal acquisition by clicking on the circle in the channel field (must be blue).

An example configuration is displayed in *Figure 32* (here: load cell connected to channel 1).

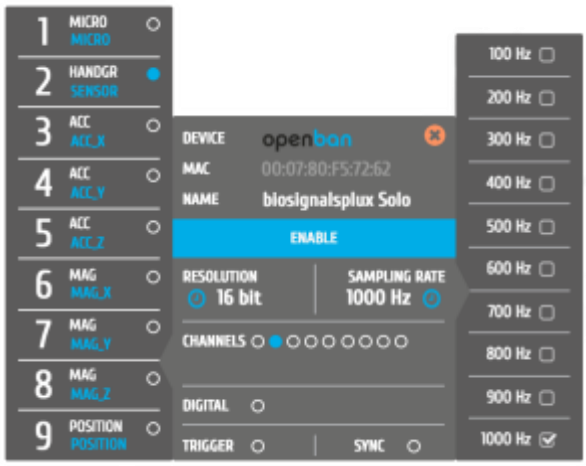

Figure 32: Load cell configuration in OpenSignals.

OpenSignals (r)evolution Add-On: Center of Mass Analysis

The *Center of Mass Analysis* add-on can be used for several applications using 4 of these sensors with the *biosignalsplux Force Platform*. Center of gravity distribution, jump analysis, weight assessment and force production capacity are just some of applications. This plugin allows you to observe, in real-time, the center of gravity and the force produced in each moment.

Please visit the following website for more information about this add-on:

http://www.biosignalsplux.com/index.php/en/software/add-ons

Sensor specifications

Please read the datasheet of the load cell carefully before using it the first time. The datasheet can be downloaded here:

http://biosignalsplux.com/datasheets/Load_Cell_Datasheet.pdf

3.3.3 Vaginal Probe (Pelvic EMG Sensor)

This sensor is especially designed for high performance pelvic floor EMG data acquisition. The bipolar configuration is ideal for uncompromised low-noise data acquisition, and the raw data output provides medical-grade data enabling it to be used for advanced and highly accurate electrophysiology research.

Figure 33: Vaginal probe.

How to configure your sensor in OpenSignals (r)evolution

Open the *OpenSignals (r)evolution* device manager and select the device you have your EMG sensor connected to. Select the channel of your EMG sensor and select *EMG* out of the dropdown menu (click on the arrow in the channel's field that appears when you hover over the channel's field). No additional set up is needed for the reference electrode inside *OpenSignals (r)evolution*.

Activate this sensor's channel for signal acquisition by clicking on the circle in the channel field (must be blue).

An example configuration is displayed *Figure 34* (here: vaginal probe connected to channel 1).

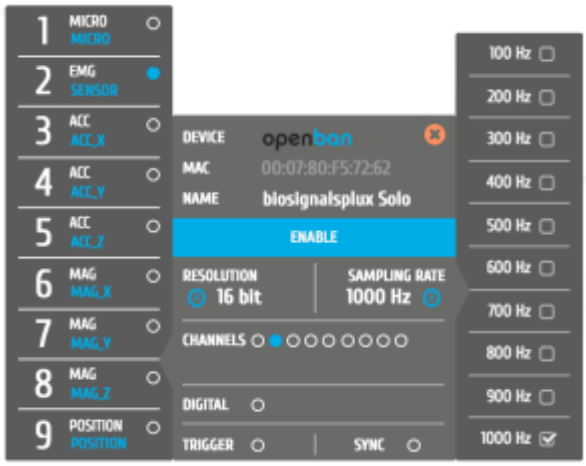

Figure 34: Vaginal probe configuration in OpenSignals.

Sensor specifications

Please read the datasheet of the EMG sensor carefully before using it the first time. The datasheet can be downloaded here:

http://biosignalsplux.com/datasheets/EMG_Sensor_Datasheet.pdf

3.3.4 RFID Sensor

This sensor is useful for synchronous recording of biosignal data and ID-mappable events. Usage examples include token detection and reaction time analysis in object manipulation tasks, and also differentiated event annotation.

Figure 35: RFID sensor.

How to configure your sensor in OpenSignals (r)evolution

Open the *OpenSignals (r)evolution* device manager and select the device you have your RFID sensor connected to. Select the channel of your RFID sensor and select *CUSTOM* from the dropdown menu (click on the arrow in the channel's field that appears when you hover over the channel's field). In the custom field of your channel, adjust the *GAIN* and *OFFSET* that fits best to your application. Testing and readjustments of this parameters might be needed to find the configuration that fits best your needs.

Alternatively, you can also use the *RAW* option, which will display the raw digital signals that are received from the *biosignalsplux.*

Activate this channel for signal acquisition by clicking on the circle in the channel field (must be blue).

An example configuration is displayed in *Figure 36* (here: RFID sensor connected to channel 1).

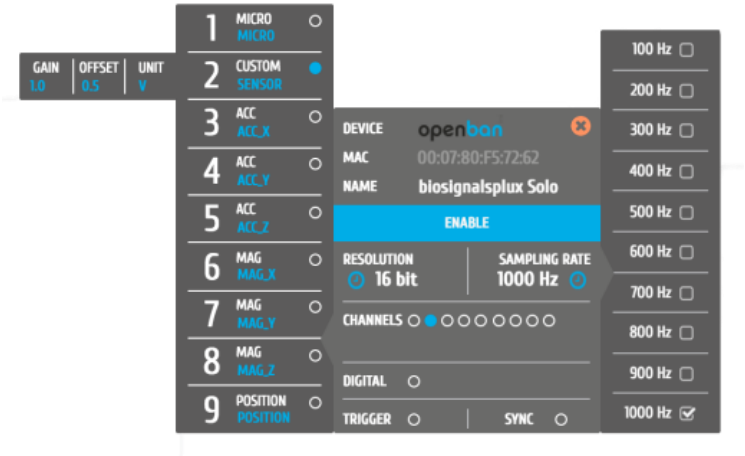

Figure 36: Load cell configuration in OpenSignals.

Sensor specifications

Please read the datasheet of the RFID sensor carefully before using it the first time. The datasheet can be downloaded here:

http://biosignalsplux.com/datasheets/RFID_Sensor_Datasheet.pdf

3.3.5 Blood Volume Pulse (BVP)

This Blood Volume Pulse (BVP) sensor is an optical, non-invasive sensor that measures cardiovascular dynamics by detecting changes in the arterial translucency. When the heart pumps blood the arteries become more opaque, allowing less light to pass from the emitter on the sensor through to the receiver. The BVP sensor has a plastic clip-on housing for placement on the finger, which houses the light emitter and detector, and also minimizes interferences from external light sources.

Figure 37: BVP sensor.

How to configure your sensor in OpenSignals (r)evolution

Open the *OpenSignals (r)evolution* device manager and select the device you have your blood volume pulse sensor connected to. Select the channels of your sensor and select *BVP* for the channel from of the dropdown menu (click on the arrow in the channel's field that appears when you hover over the channel's field).

Activate this channel for signal acquisition by clicking on the circle in the channel field (must be blue).

An example configuration is displayed in *Figure 38* (here: blood volume pulse sensor connected to channel 1).

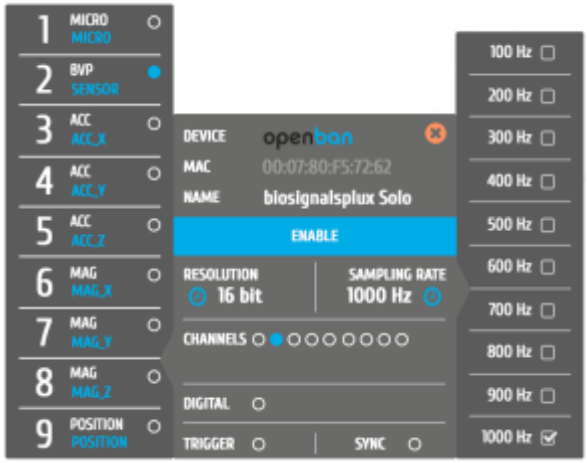

Figure 38: Blood volume pulse sensor configuration in OpenSignals.

If configured correctly, your acquired signals should be similar to the signal displayed in *Figure 39*.

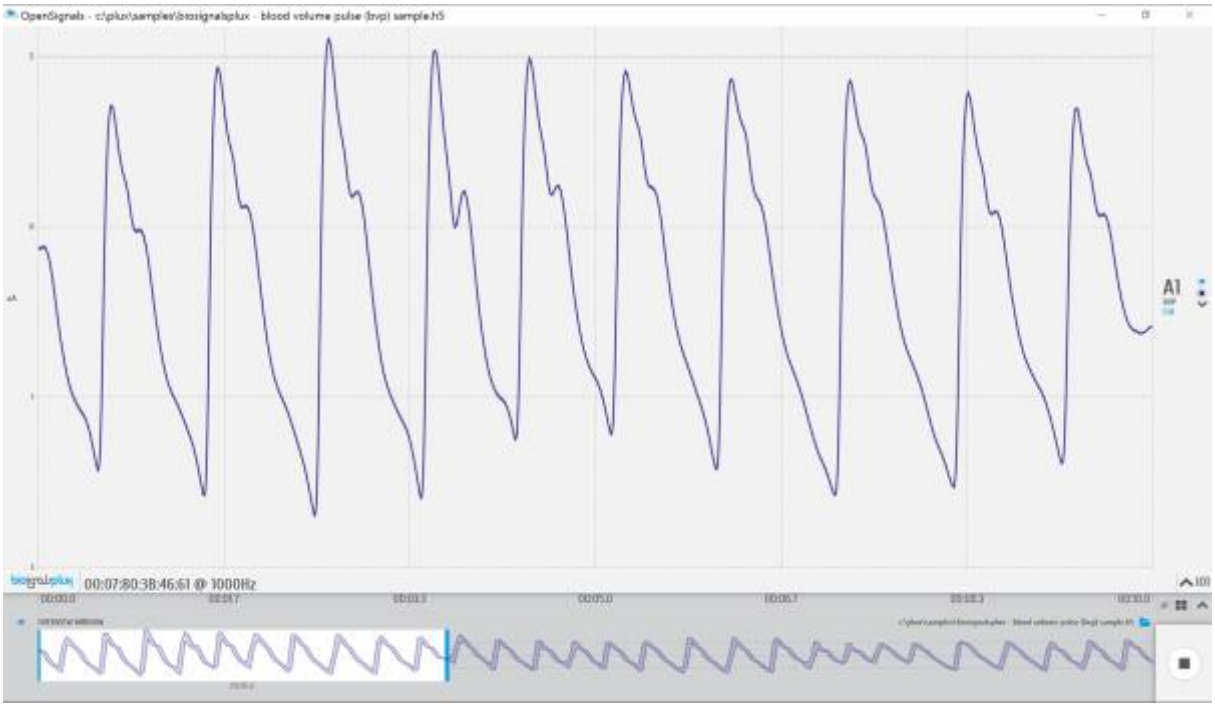

Figure 39: biosignalsplux blood volume pulse (BVP) sensor sample.

OpenSignals (r)evolution Add-On: Heart Rate Variability

The *Heart Rate Variability* add-on provides important quantitative markers related with the sympathetic or vagal activity. This plugin enables the seamless extraction and analysis of temporal, spectral, and non-linear parameters from sensor data acquired with this BVP sensor (or the ECG sensor; see *3.2.2 Electrocardiography* (ECG)).

http://www.biosignalsplux.com/index.php/en/software/add-ons

Sensor specifications

Please read the datasheet of the blood volume pulse sensor carefully before using it the first time. The datasheet can be downloaded here:

http://biosignalsplux.com/datasheets/BVP_Sensor_Datasheet.pdf

4 Bluetooth Setup

When connecting the device, you first need to enable Bluetooth on your computer or need to plugin the Bluetooth dongle to your USB port, if Bluetooth is not built in or reliable for your computer. Follow the instructions for your operating system that are displayed on the following pages to connect your *OpenBAN* to your computer.

4.1 Windows 7

To connect your device to your computer via Bluetooth, click on the start button at the right lower part of the Windows taskbar and click on *Control Panel* to access the control panel of your computer.

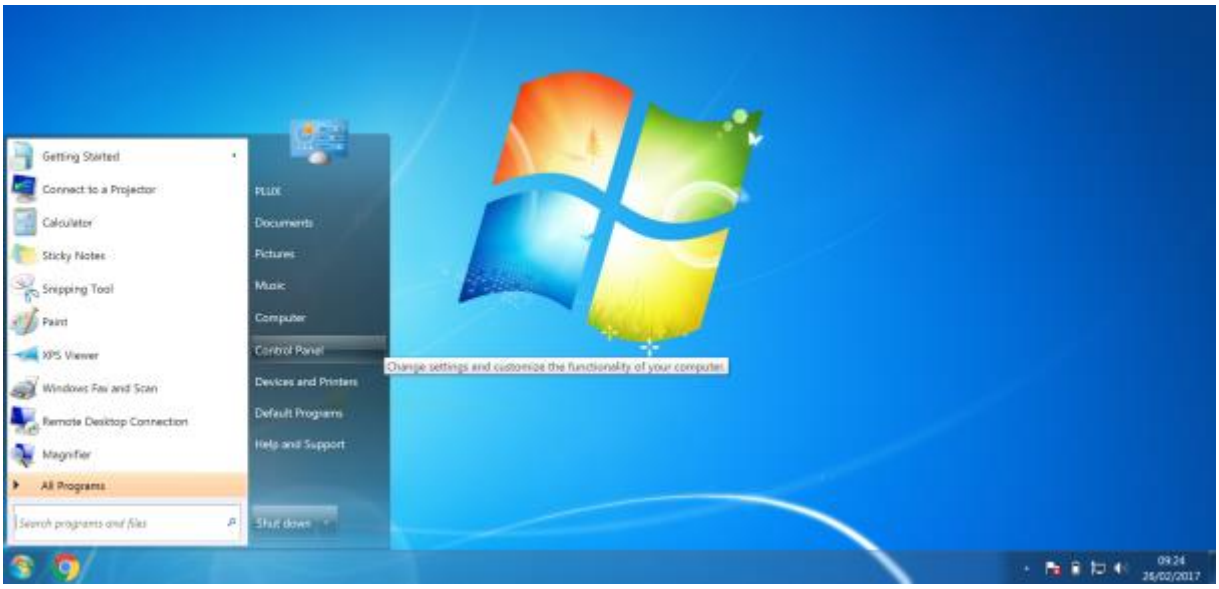

Figure 40: Access the Windows 7 control panel.

In the control panel, select the *Add a device* option in the *Hardware and Sound* section to add your device.

Figure 41: Select Add a device in the Hardware and Sound section.

At this point, turn on your *OpenBAN* (if not done before) and wait until it appears in the list available devices. When your device has been found (here: *biosignalsplux*), click on the device and click on *Next* at the lower right corner of the *Add a device* window.

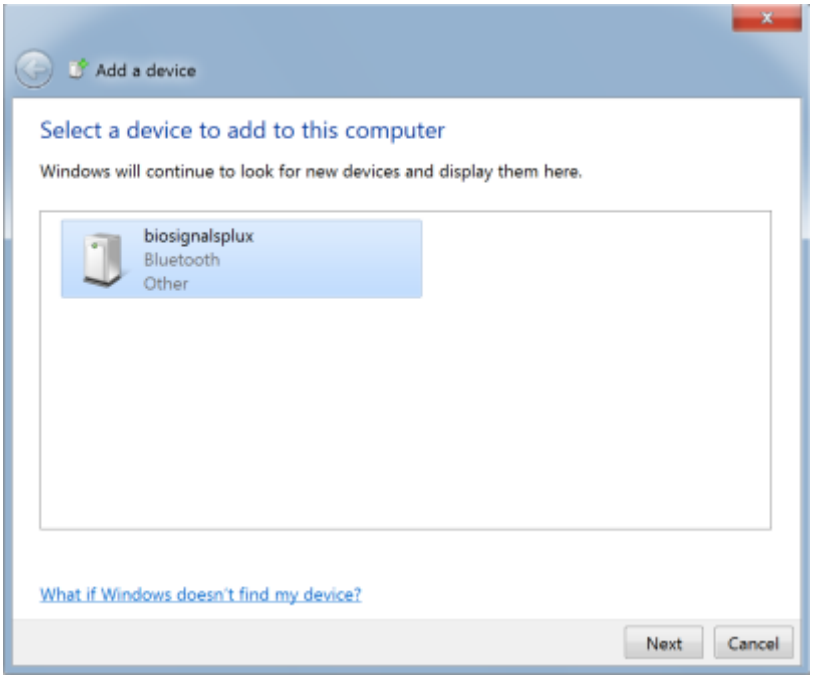

Figure 42: Select your device to add it to your computer.

Click on *Enter the device's pairing code* and click on *Next* at the lower right corner of the window to proceed.

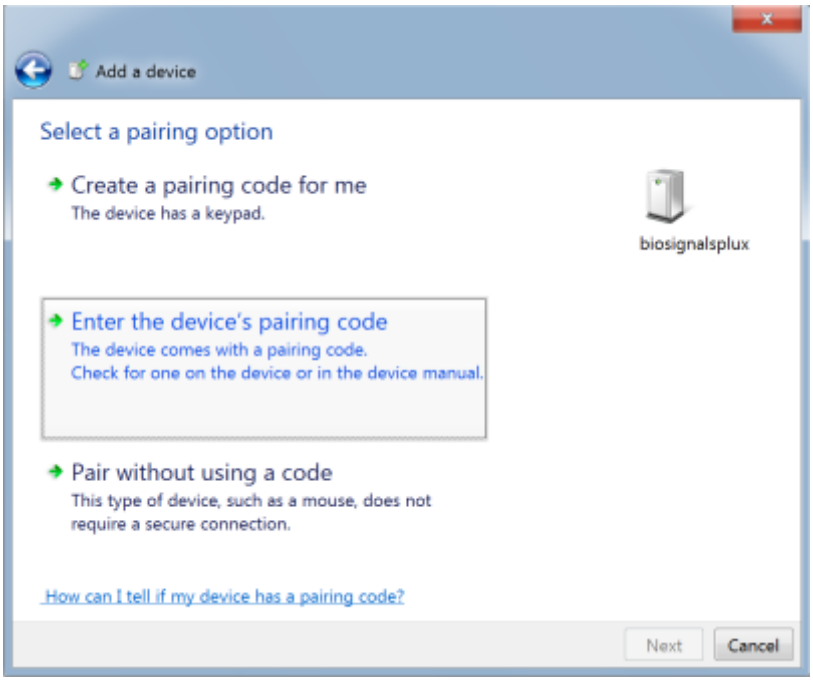

Figure 43: Select Enter the device's pairing code.

For *biosignalsplux* devices enter 123 and click on *Next* to connect to your device

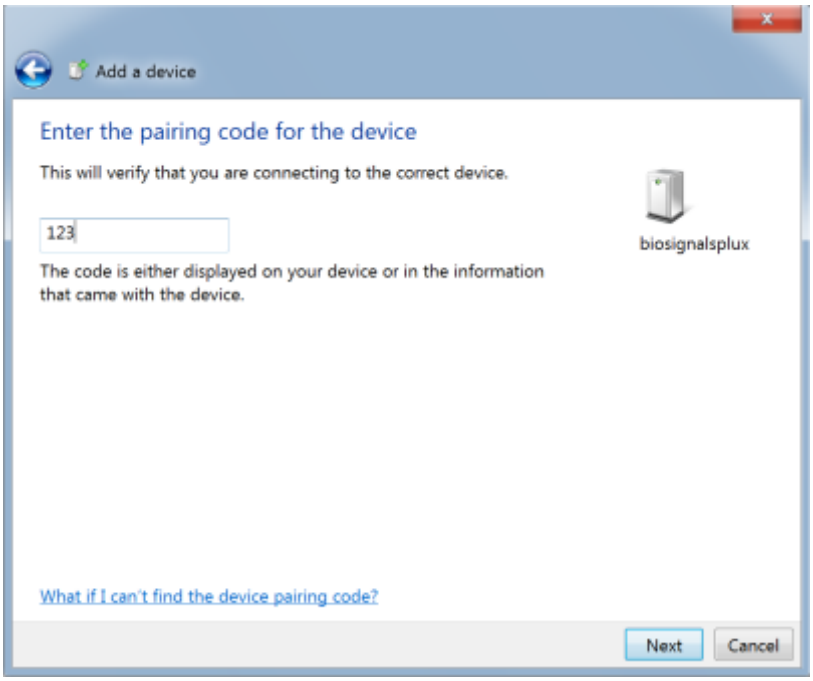

Figure 44: Enter the pairing code to connect to your device.

If Windows confirms that your device has been successfully added to your computer, the connection has been successfully established.

Figure 45: Windows confirmation if the device has been successfully added.

4.2 Windows 8

To connect your *OpenBAN* device to your computer via Bluetooth, click on the start button at the right lower part of the Windows taskbar, click on the triangle symbol and click on the Bluetooth icon to open the Bluetooth settings panel.

Figure 46: Access to the Bluetooth settings panel in Windows 8.

At this point, turn on your *OpenBAN* (if not done before) and wait until it appears in the list of Bluetooth devices. When your *OpenBAN* device has been found, click on the device and click on *Pair* to connect to your device (may appear as *biosignalsplux*).

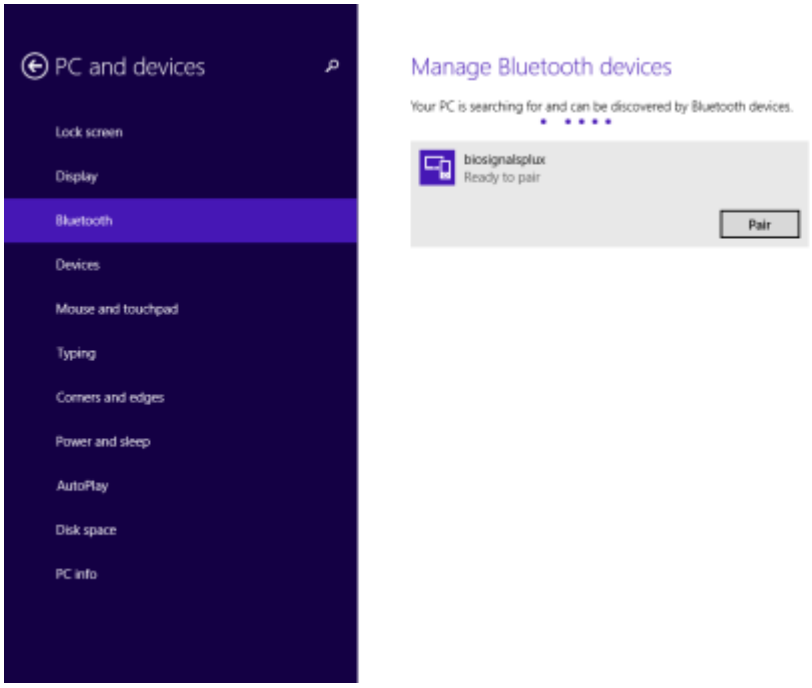

Figure 47: Bluetooth settings panel.

Windows will now try to connect to your device and pop up a window requesting you to enter the passcode (pin) of your device. Enter 123 and click on *Next* to connect to *OpenBAN*.

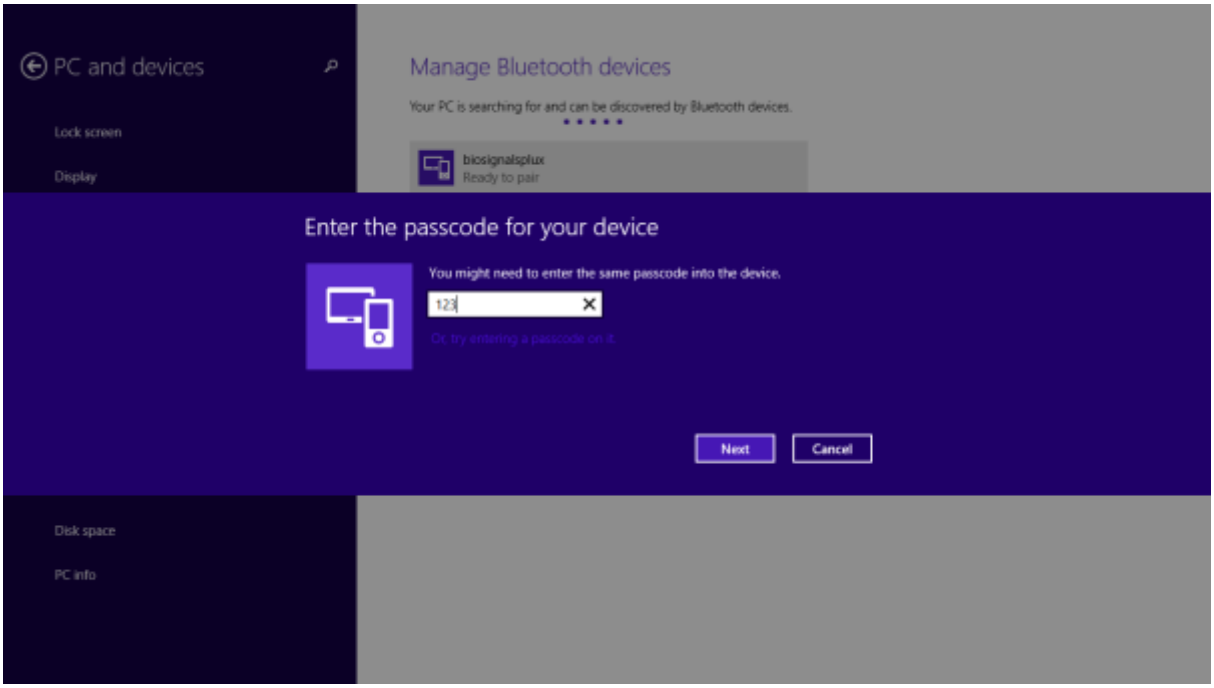

Figure 48: Requesting biosignalsplux' passcode (123).

If *Connected* is displayed under the name of your *OpenBAN* device in the Bluetooth settings panel, the connection has been successfully established.

4.3 Windows 10

To connect your *OpenBAN* device to your computer via Bluetooth, click on the start button at the left lower corner in Windows 10 to open the start menu. Click on the gear symbol to open the settings panel of your operating system as can be seen below.

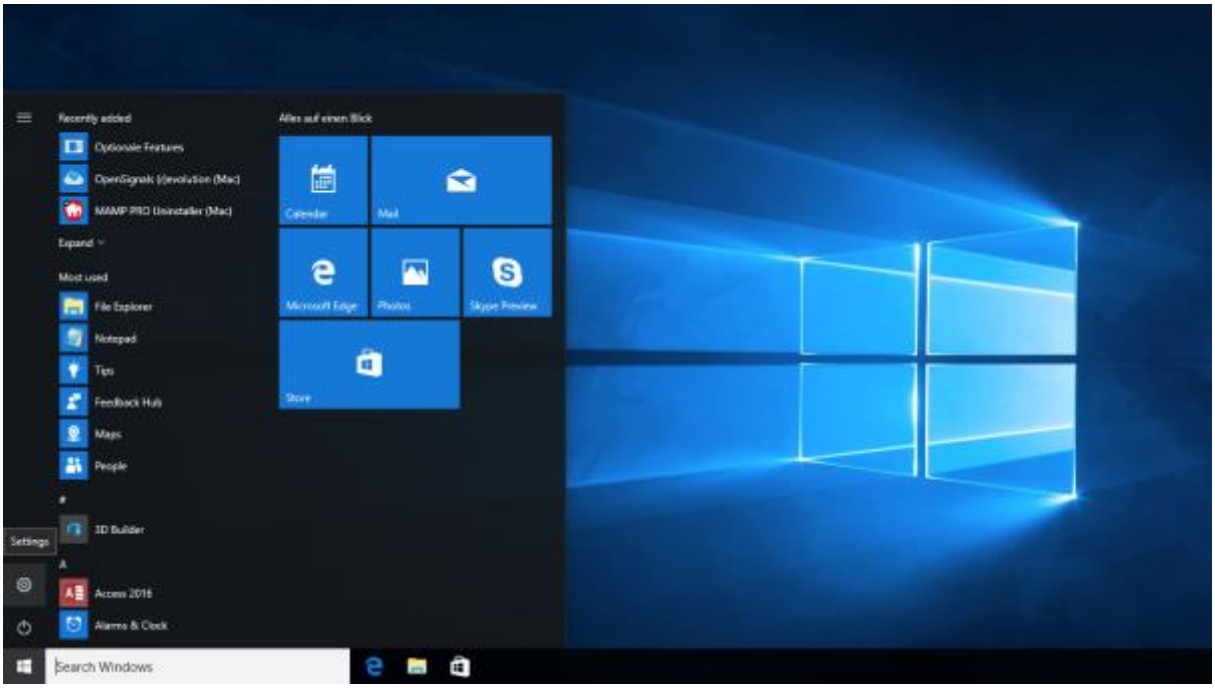

Figure 49: Access to the settings panel in Windows 10.

In the settings panel, click on the *Devices Bluetooth, printers, mouse* field to open the device configurations of your system.

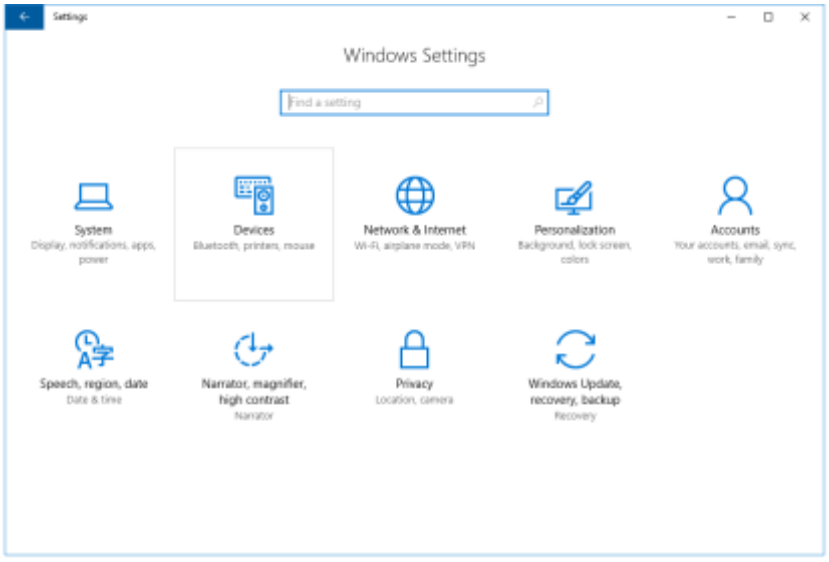

Figure 50: Windows 10 settings panel.

Select *Bluetooth* from the list which is displayed on the left side of your settings window. Note, that in some versions the Bluetooth option might not be available and that Bluetooth devices might be listed under *Other devices* as seen in *Figure 51*.

At this point, turn on your *OpenBAN* (if not done before) and wait until it appears in the list of Bluetooth devices. When your *OpenBAN* device has been found, click on the device and click on *Ready to pair* to connect to your device (may appear as *biosignalsplux*).

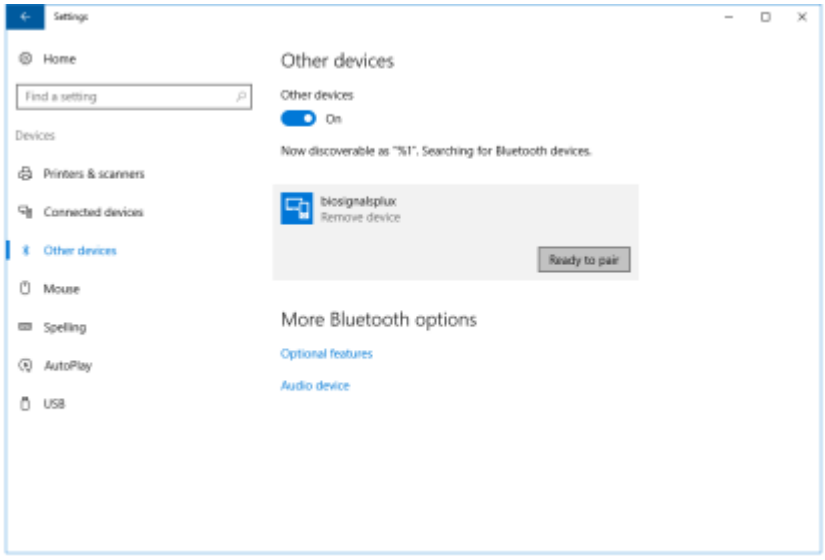

Figure 51: Bluetooth settings panel.

Windows will now try to connect to your device and pop up a window requesting you to enter the passcode (pin) of your device. Enter 123 and click on next to connect to *bios OpenBAN*.

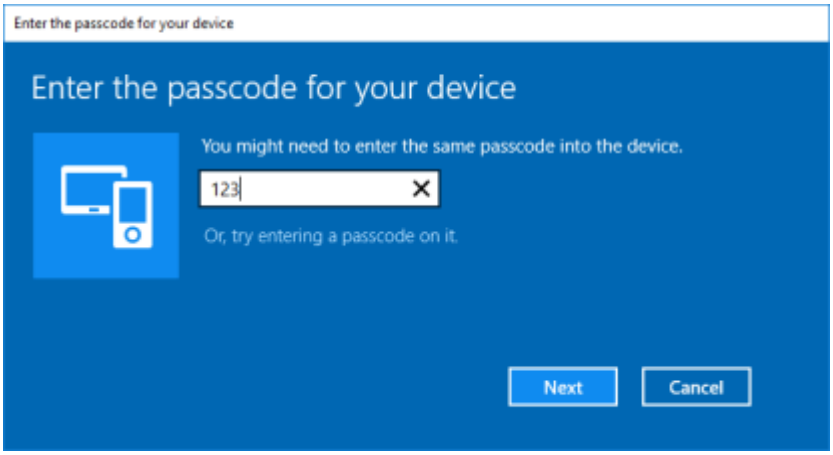

Figure 52: Requesting passcode (123).

If *Pair* is displayed under the name of your *OpenBAN* device in the Bluetooth settings panel, the connection has been successfully established.

4.4 Linux

Ubuntu offers two options on how to connect your devices via Bluetooth to your computer. The first option allows you to connect the device via Ubuntu's system settings and the graphical interface. The second option allows you to connect the device via the terminal. However, the second option is recommended for advanced users only.

4.4.1 Connecting via System Settings

To connect your device to your computer via Bluetooth, click on the wheel in the top right corner of the display and click on *System Settings..* to access the settings panel of your computer.

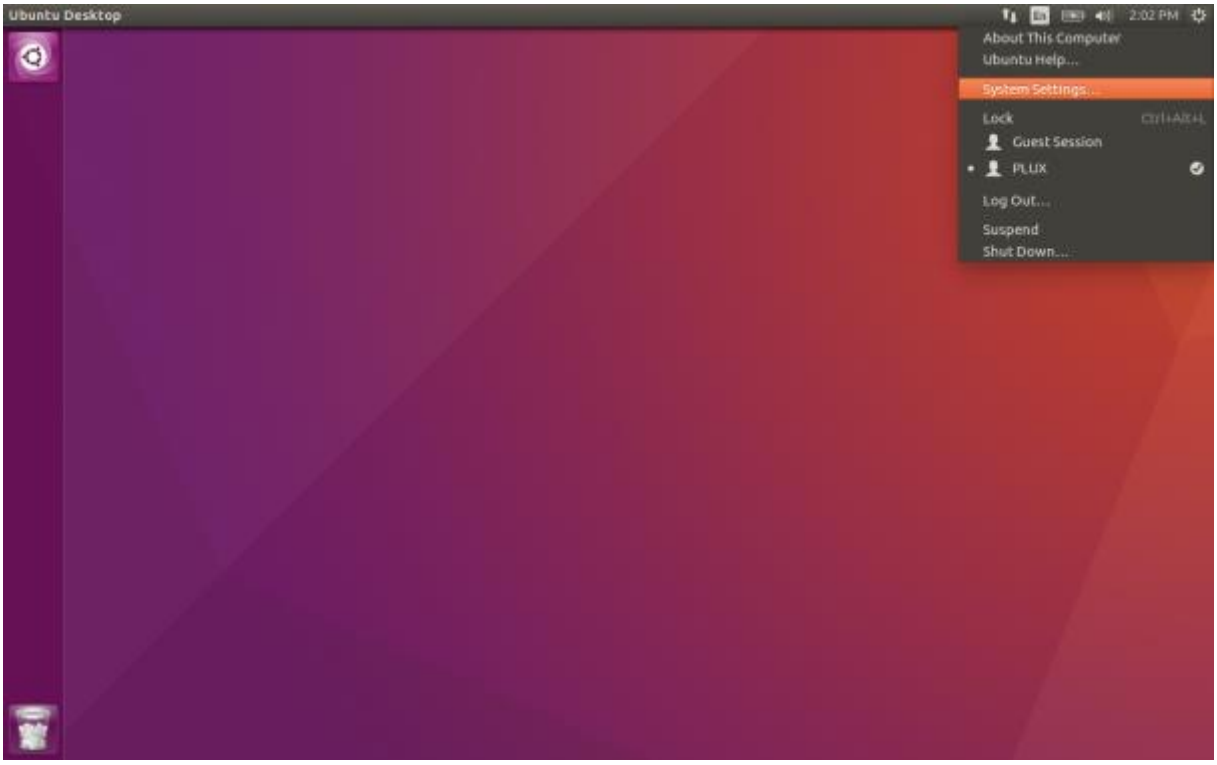

Figure 53: Access the system settings in Ubuntu.

In the settings panel, click on the Bluetooth logo to access the Bluetooth settings panel.

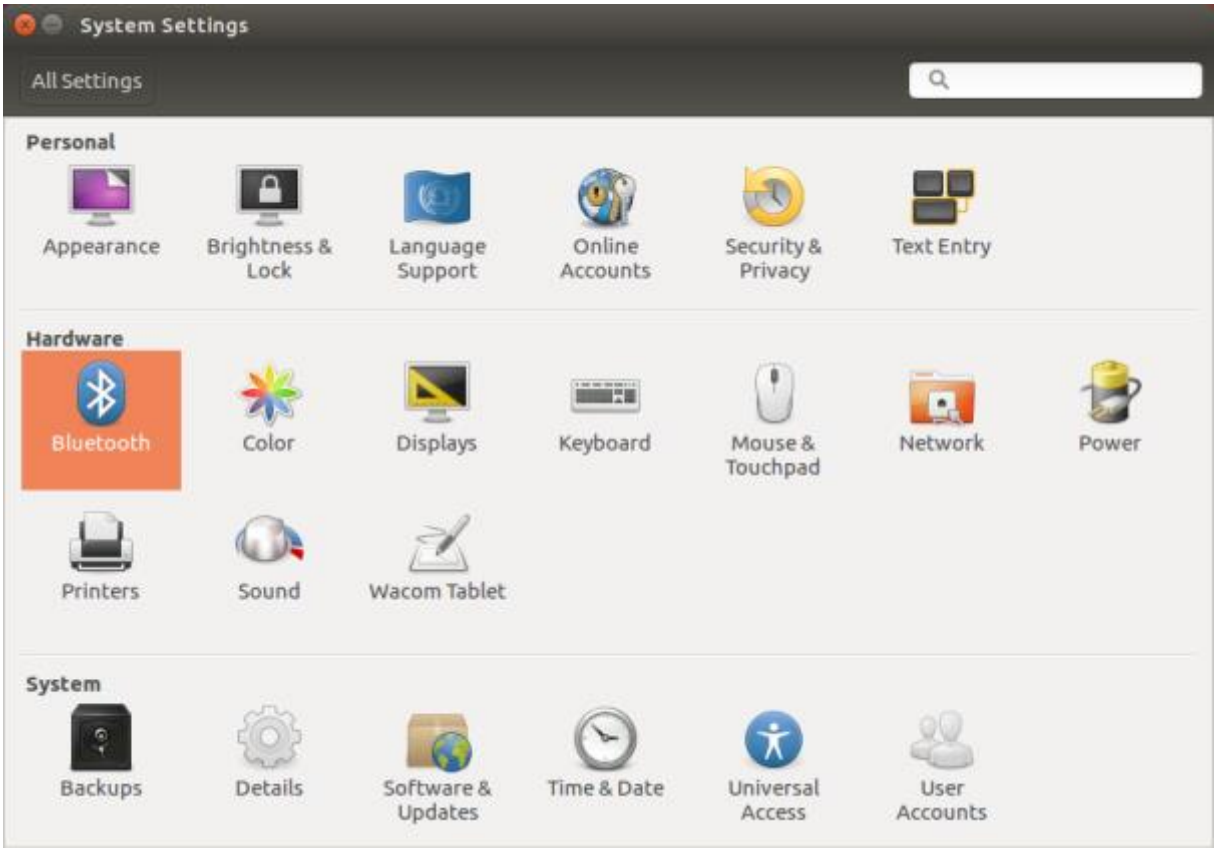

Figure 54: Click on the Bluetooth logo to access the Bluetooth settings.

At this point, turn on your *OpenBAN* (if not done before) and wait until it appears in the list available devices. When your device has been found (here: *biosignalsplux*), it will be listed in the *Device Search* window. Click on the device and select *PIN options…* to enter the device's PIN to proceed.

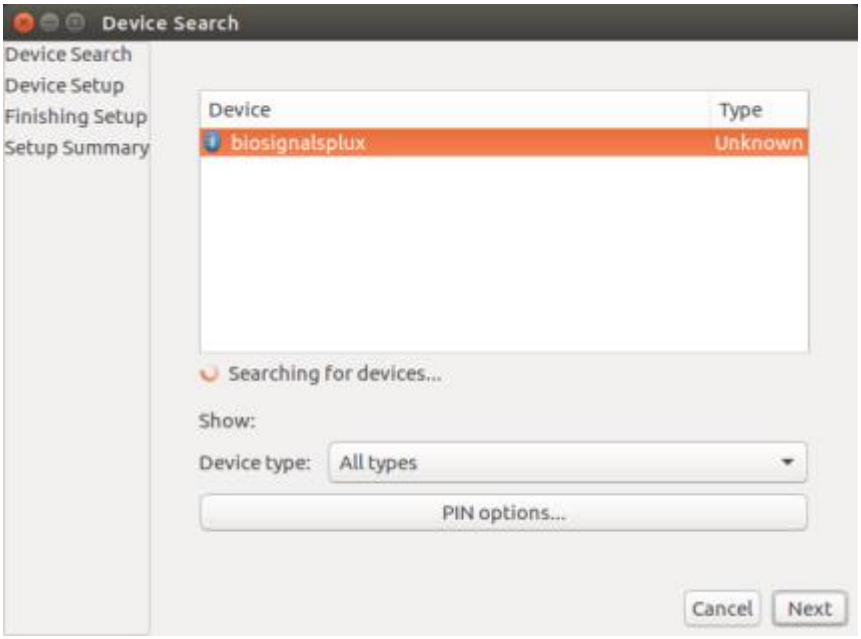

Figure 55: Select your device to add it to your computer.

In the new *PIN* Options window click on *Custom PIN* and enter the device's PIN to connect to your device. For *OpenBAN* devices enter 123 and click on *Next* to connect to your device.

NOTE
If the *Custom PIN* option is not available in this window, follow up with the instructions in *Connecting via Terminal* to connect your device to your computer using the terminal instead of proceeding with the configuration via the system settings.

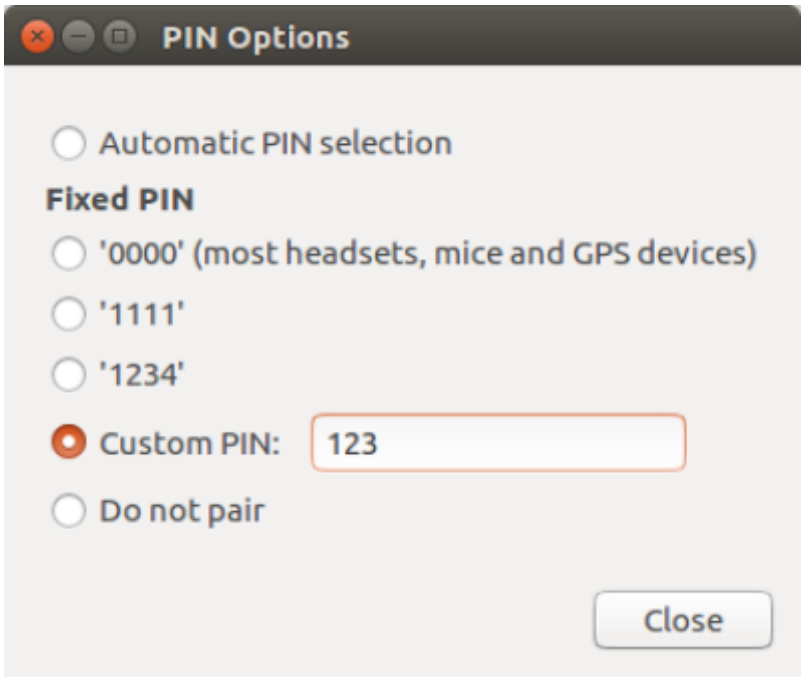

Figure 56: Enter the device's pin to pair.

Click on *Close* to close this window and click on *Next* on the *Device Search* window to connect to your device.

Click on your device in the *Devices* list. If paired is confirmed *(Paired Yes*) your device has been successfully connected to your computer[2].

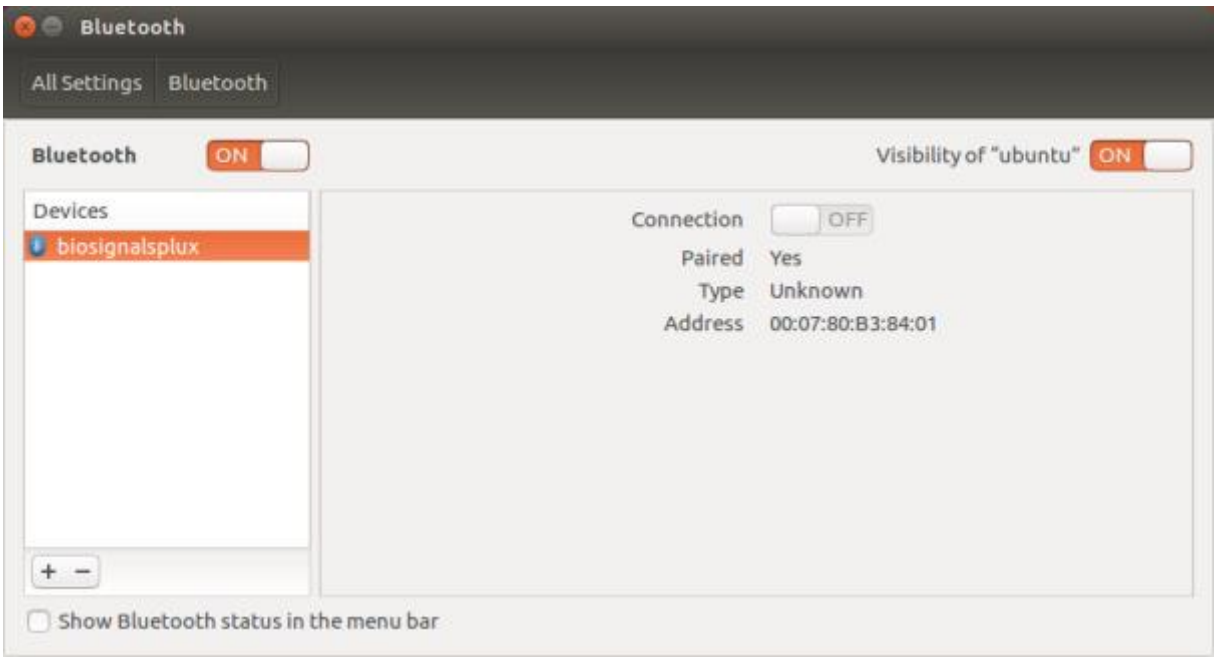

Figure 57: Successfully paired biosignalsplux.

[2] Do not worry if the connection is set off. It will automatically switch to on when connecting to your device using *OpenSignals* or other custom software for *biosignalsplux*.

4.4.2 Connecting via Terminal

NOTE
Using the terminal may harm your computer if it is not done correctly. Therefore, this method is recommended for advanced users only and following this method is done at your own risk.

To connect your device to your computer via Bluetooth, click on the *Unity Dash* logo in the toolbar on the left to your desktop open the search function. In the search bar, enter terminal (or Terminal) and click on the terminal logo to open the *Terminal*.

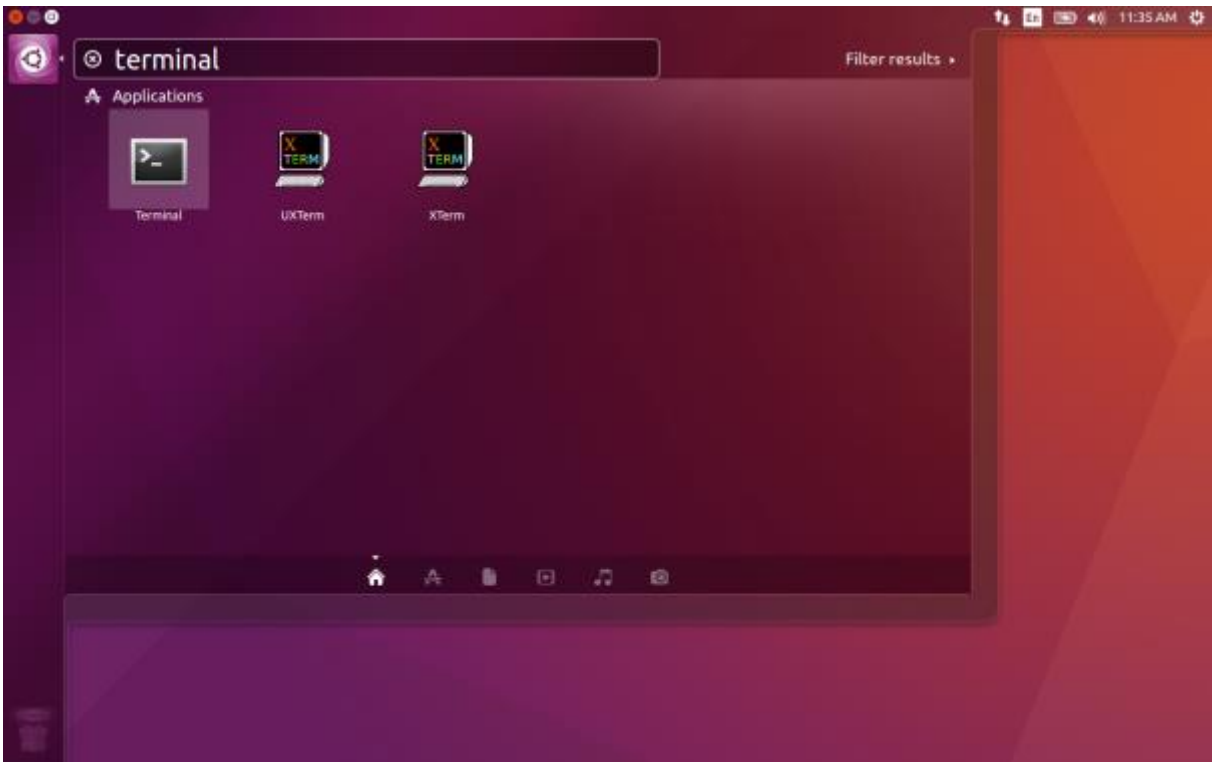

Figure 58: Access the terminal using the search function in Ubuntu.

Enter *bluetoothctl* into the terminal window (without the $). Terminal should answer to this command with the a line displaying the MAC address of your internal Bluetooth adapter. The response should be similar to this (with AA:BB:CC:DD:EE:FF being replaced with your MAC address):

```
$ bluetoothhctl
[NEW] Controller AA:BB:CC:DD:EE:FF ubuntu [default]
[bluetooth]#
```

Next, enter turn on your internal Bluetooth module on (if not done before) by entering *power on* into the Bluetooth prompt line. The response should be similar to this (again, with AA:BB:CC:DD:EE:FF being replaced with your MAC address):

```
[bluetooth]# power on
Changing power on succeeded
[CHG] Controller AA:BB:CC:DD:EE:FF Powered: yes
```

Next, it is needed to turn on a Bluetooth agent. The Bluetooth agents manages the transmission of pin codes (or pairing codes) between devices and is needed here to send the pairing code to the device you want to connect. To do this, enter *agent on*. The terminal response should be similar to this:

```
[bluetooth]# agent on
Agent registered
```

Set up the *default-agent* to proceed with the pairing process.

```
[bluetooth]# default-agent
Default agent request successful
```

At this point, turn on your device (if not done before) and enter *scan on* into the terminal to search for available Bluetooth devices and wait until your device's MAC address appears in the list (here: biosignalsplux, 00:07:80:B3:84:01). Your device's MAC address can be found at the back of the device.

```
[bluetooth]# scan on
Discovery started
[CHG] Controller AA:BB:CC:DD:EE:FF Powered: yes
[NEW] Device 00:07:80:B3:84:01 biosignalsplux
```

If your device is listed, enter *pair* followed by the MAC address of your device to start the pairing process which will be respond with requesting the PIN code of your device. For *OpenBAN* devices enter 123 and click on *Next* to connect to your device.

```
[bluetooth]# pair 00:07:80:B3:84:01
Attempting to pair with 00:07:80:B3:84:01
Request PIN code
[agent] Enter PIN code: 123
[CHG] Device 00:07:80:B3:84:01 Connected: yes
[CHG] Device 00:07:80:B3:84:01 Modalias: bluetooth
[CHG] Device 00:07:80:B3:84:01 UUIDs: (device specific ID)
[CHG] Device 00:07:80:B3:84:01 UUIDs: (device specific ID)
[CHG] Device 00:07:80:B3:84:01 Paired: yes
Pairing successful
[biosignalsplux]
```

If the terminal outputs *Pairing successful* your device has been successfully paired to your computer.

The entire text of your terminal should now be similar to the following:

```
$ bluetoothhctl
[NEW] Controller AA:BB:CC:DD:EE:FF ubuntu [default]
[bluetooth]#
[bluetooth]# power on
Changing power on succeeded
[CHG] Controller AA:BB:CC:DD:EE:FF Powered: yes
[bluetooth]# agent on
Agent registered
[bluetooth]# default-agent
Default agent request successful
[bluetooth]# default-agent
Default agent request successful
Discovery started
[CHG] Controller AA:BB:CC:DD:EE:FF Powered: yes
[NEW] Device 00:07:80:B3:84:01 biosignalsplux
[bluetooth]# pair 00:07:80:B3:84:01
Attempting to pair with 00:07:80:B3:84:01
Request PIN code
[agent] Enter PIN code: 123
[CHG] Device 00:07:80:B3:84:01 Connected: yes
[CHG] Device 00:07:80:B3:84:01 Modalias: bluetooth
[CHG] Device 00:07:80:B3:84:01 UUIDs: (device specific ID)
[CHG] Device 00:07:80:B3:84:01 UUIDs: (device specific ID)
[CHG] Device 00:07:80:B3:84:01 Paired: yes
Pairing successful
[biosignalsplux]
```

4.5 Mac OS X

To connect your *biosignalsplux* device to your computer via Bluetooth, click on the Apple symbol at the top left corner of your display and select *System Preferences…*

In the system preferences window click on the Bluetooth symbol to open the Bluetooth settings.

Figure 59: Mac OS X system preferences window.

At this point, turn on your *biosignalsplux* (if not done before) and wait until it appears in the list of Bluetooth devices. When your *biosignalsplux* device has been found, click on the device and click on *Pair* to connect to your device.

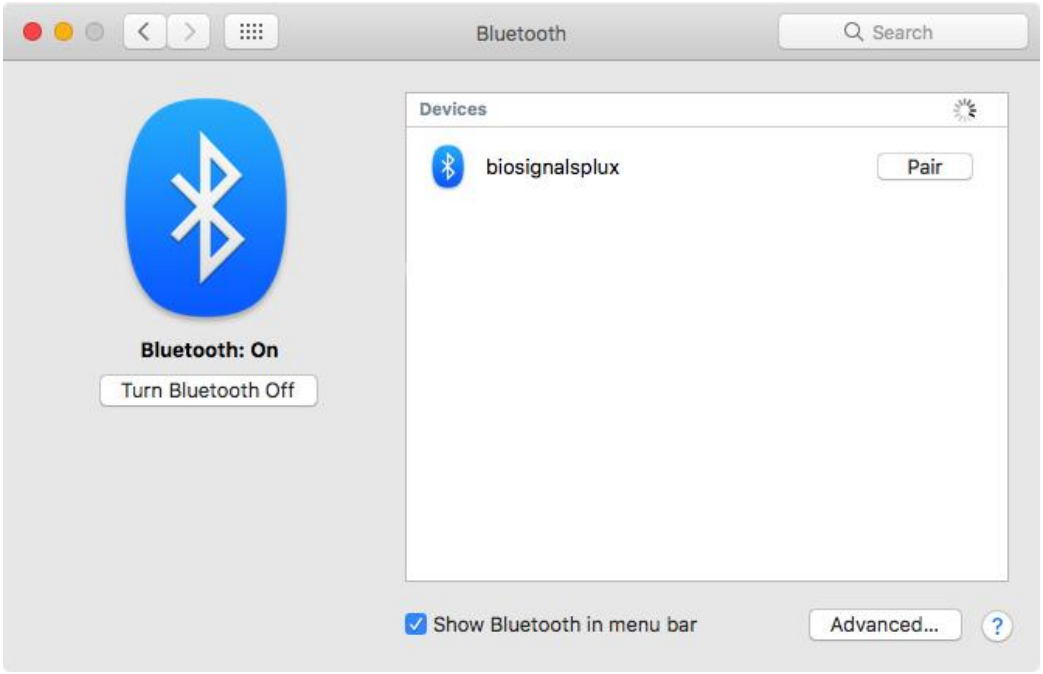

Figure 60: Click on Pair to connect to the biosignalsplux.

An error will occur indicating that the connection could not be established due to a mismatching passkey. Click on *Options…* to enter the passkey (pairing code).

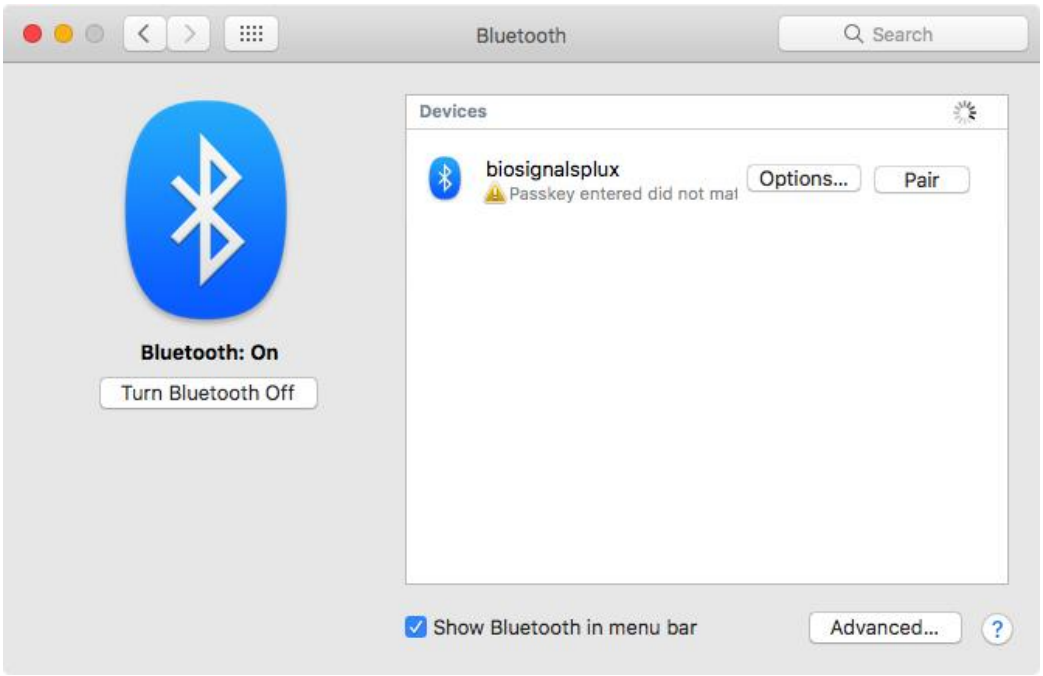

Figure 61: Click on Options… to enter the passkey.

Mac OS X will now try to connect to your device and pop up a window requesting you to enter the passcode (pin) of your device. Enter 123 and click on *Pair* to connect to *biosignalsplux*.

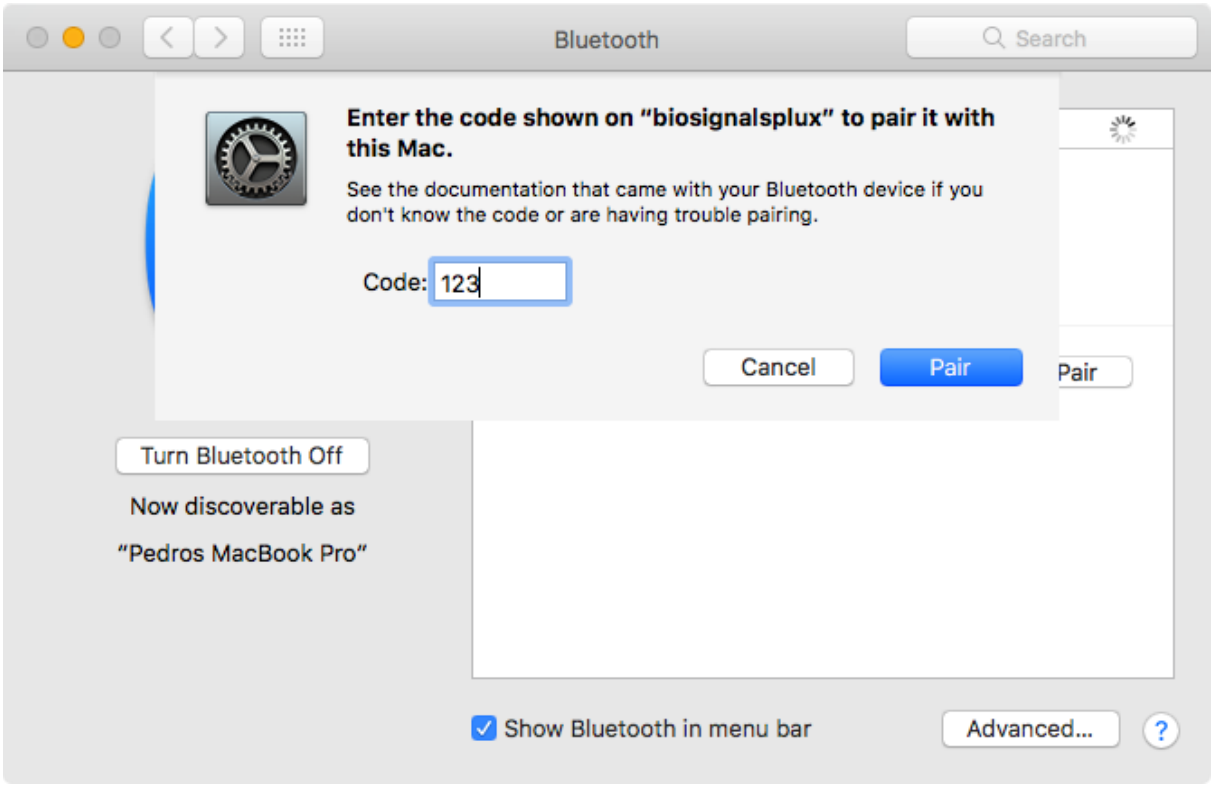

Figure 62: Enter the pairing code

If *Connected* is displayed under the name of your *biosignalsplux* device in the Bluetooth settings panel, the connection has been successfully established.

5 Software & APIs

5.1 OpenSignals (r)evolution

OpenSignals is our easy-to-use, versatile, and scalable software for real-time biosignals visualization, capable of direct interaction with all PLUX devices.

Core functionality includes sensor data acquisition from multiple channels and devices, data visualization and recording, as well as loading of pre-recorded signals. OpenSignals is also a Python-powered web-based software framework, targeted at rapid application development; a bare bone code base is available on GitHub

In addition, OpenSignals has a suite of data analysis add-ons to create reports from the recorded data and extract features directly from the signals without having to do any coding. *biosignalsplux* Research and Professional lab kits already include some or all of the add-ons upon purchase, although add-ons can also be purchased individually in our web store.

You can download the newest version of OpenSignals (r)evolution here:

http://biosignalsplux.com/index.php/en/software/opensignals

5.2 OpenSignals Mobile

OpenSignals Mobile is a slimmed down version of *OpenSignals (r)evolution* specifically designed to run on Android® mobile phones or tablets (iOS coming soon), while preserving the ease-of-use and performance for real-time sensor data visualization and recording.

OpenSignals Mobile is currently in development. However, if you are interested in being one of the first few users to get your hands on a beta version of this app, visit our *OpenSignals* website and fill in the form to subscribe for the early access beta version.

http://biosignalsplux.com/index.php/en/software/opensignals

5.3 APIs

It is possible to connect the devices to third party applications including your own custom software. The needed toolkits to start your own biosignal software are delivered by PLUX for free. All the functionalities and features of our high-end research devices can be accessed by developers to integrate PLUX systems in custom and third-party applications.

Visit the official *biosignalsplux* API website to check the list of the available APIs:

http://biosignalsplux.com/index.php/en/development/apis

6 Troubleshooting

6.1 Bluetooth

Most internal Bluetooth adapters are compatible with PLUX devices. However, if you're experiencing a great number of connection loss events, reconnection problems, missing samples or similar problems, your internal Bluetooth module might not have enough performance to deal with the data throughput of the device you are using. In this case, reducing the sampling frequency or the sample resolution might solve this issue, if a change of these parameters is possible.

For this reason, PLUX has identified Bluetooth dongles that have been tested and are known to work with our devices. We recommend that you use one of these PLUX-tested Bluetooth dongles, which are either already shipped with your device (e.g. in the case of *biosignalsplux* kits) or can be purchased separately from our store. These dongles are compatible to work with data rates up to 24 Mbps.

The solution is to exchange the internal Bluetooth Adapter for an **external Bluetooth USB dongle that uses the Windows native Bluetooth stack**. For this, you'll need to install the Bluetooth dongle properly, as described in the following steps, which are explained in more detail throughout the next pages for the supported operating systems:

Step 1:	Removing already paired devices from your operating system
Step 2:	Installing PLUX-proven Bluetooth dongle
Step 3:	Changing Bluetooth Stack to Microsoft's native Bluetooth stack

NOTE
If you're already using PLUX devices with the old Bluetooth stack, please remove your device(s) from your computer **before** changing the Bluetooth drivers/changing to Microsoft Bluetooth Stack.

NOTE
We recommend going through all the following steps to set up your Bluetooth dongle correctly, even if Windows may automatically install and set up your dongle.

NOTE
Installing the Bluetooth dongle and changing the Bluetooth stack is only required for Windows computers only. Computers with a Mac OS X operating system do not need to go through these steps and use the internal Bluetooth adapter instead.

6.1.1 Windows 7 & Windows 8

Step 1: Removing already paired devices from your operating system
To remove Bluetooth devices, it is needed to access the *Device Manager* on your computer and view the list of connected devices. The device list can be found following these steps:

Start Button > Control Panel > Hardware and Sound > View devices and printers

In the *Device and Printers* window, PLUX devices can be found in the *Unspecified* section. Right-click on the device you want to remove and select *Remove device* (see *Figure 63*)

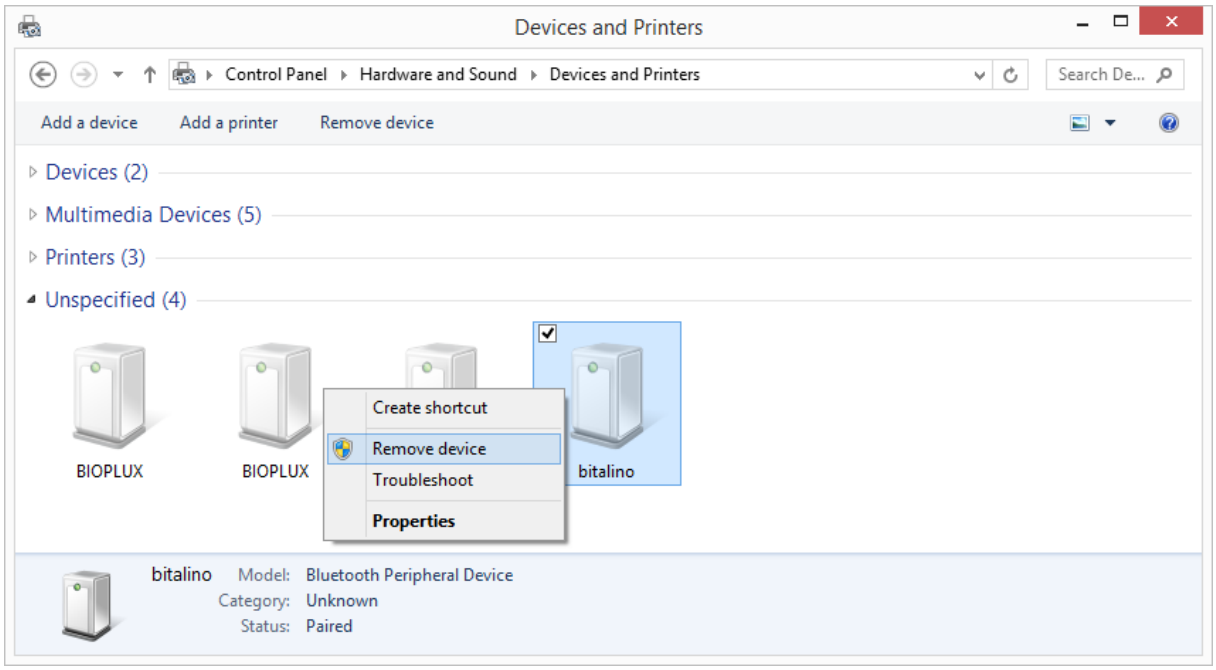

Figure 63: Windows 7 "Devices and Printers" window.

If the device is not listed under *Unspecified* anymore, it has been successfully removed from your system.

Step 2: Installing PLUX-proven Bluetooth dongle
To install the PLUX-proven Bluetooth dongle, plug it in and install all the necessary drivers for the Bluetooth dongle to work (an Internet connection is advisable). Windows should display the window below.

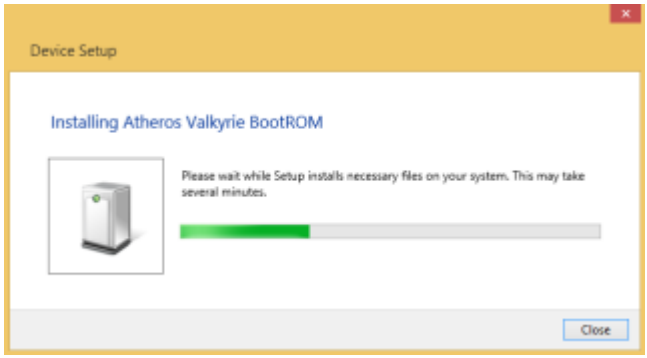

Figure 64: Wait for Windows to install your Bluetooth dongle.

Make sure you wait until your Bluetooth Dongle is installed. Windows will issue a notification and you'll be ready to configure the correct Bluetooth stack following the next step.

Step 3: Changing Bluetooth Stack to Microsoft's native Bluetooth stack

To configure the Bluetooth stack of the Bluetooth dongle, you have to connect your Bluetooth dongle to your computer and access the *Device Manager* on your computer. The device manager can be found following these steps:

Start Button > Control Panel > System and Maintenance > Device Manager

In the device manager, the Bluetooth dongle should be listed as *Generic Bluetooth Adapter* (see *Figure 65*). If your machine already has an internal Bluetooth Adapter and you have just plugged in the PLUX-proven Bluetooth Dongle, keep in mind that the last one will be automatically disabled by Windows. This is why one of your Bluetooth adapters under Bluetooth in the device manager shows a yellow warning icon (⚠) stating: *Code 10 - This device cannot start*.

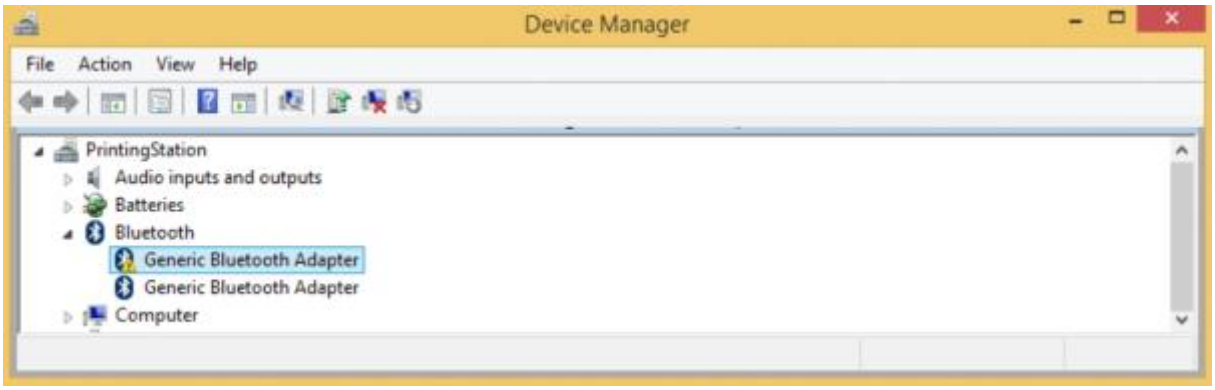

Figure 65: Bluetooth dongle listed in the device manager.

If your Bluetooth dongle is the one disabled, you can manually disable your internal Bluetooth adapter by right-clicking on it in the device manager and selecting *Disable*. This action will enable your Bluetooth dongle by default.

If, after this action, your Bluetooth Dongle continues to display a yellow warning icon (⚠) , it means that it is not installed correctly and you should try to update the drivers by right-clicking on it and selecting *Update Driver Software...* or fix the problem displayed under *Device Status* in the device properties (right-click the Bluetooth device and select Properties; see screenshot below).

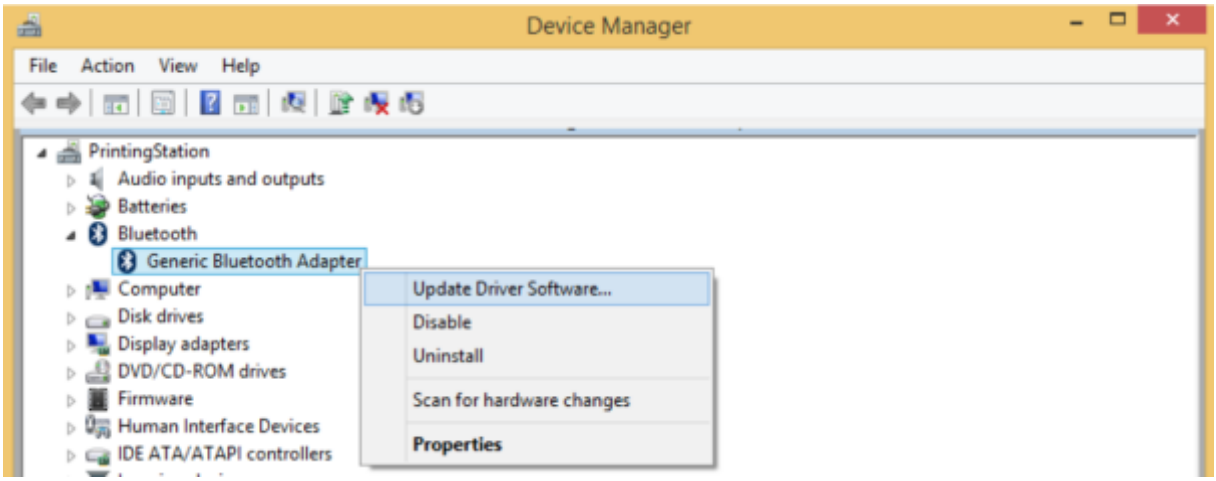

Figure 66: First step to update the driver of the Bluetooth dongle.

Select *Browse my computer for driver software* from the new window.

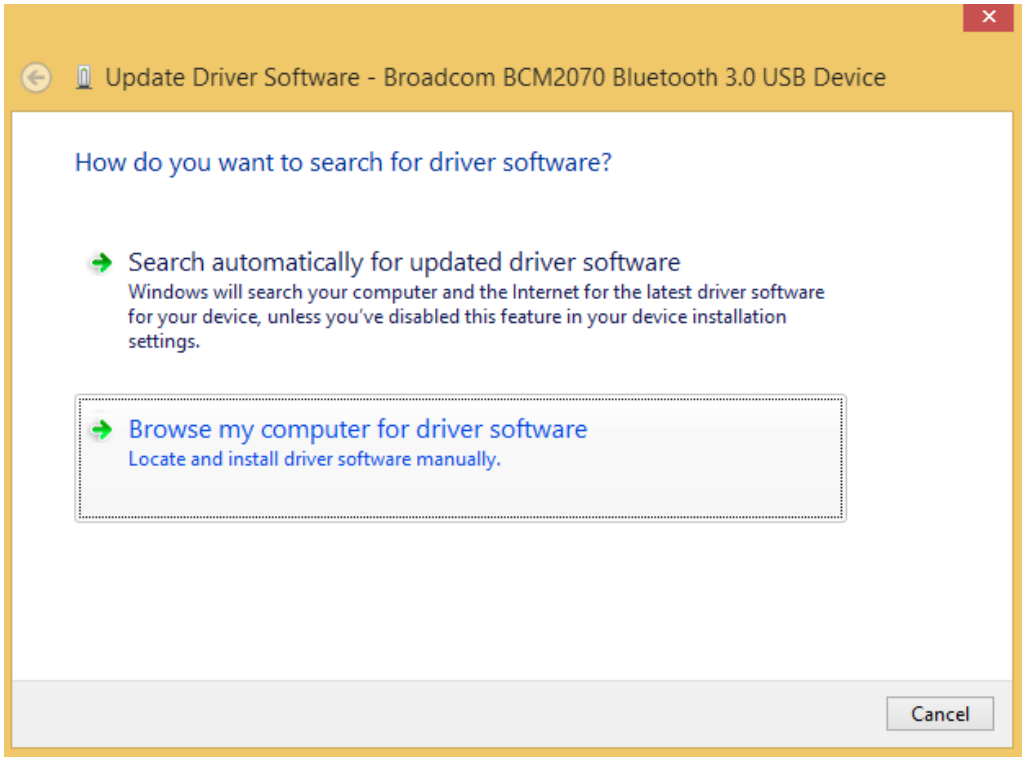

Figure 67: Browse for driver software.

Select *Let me pick from a list of device drivers on my computer*.

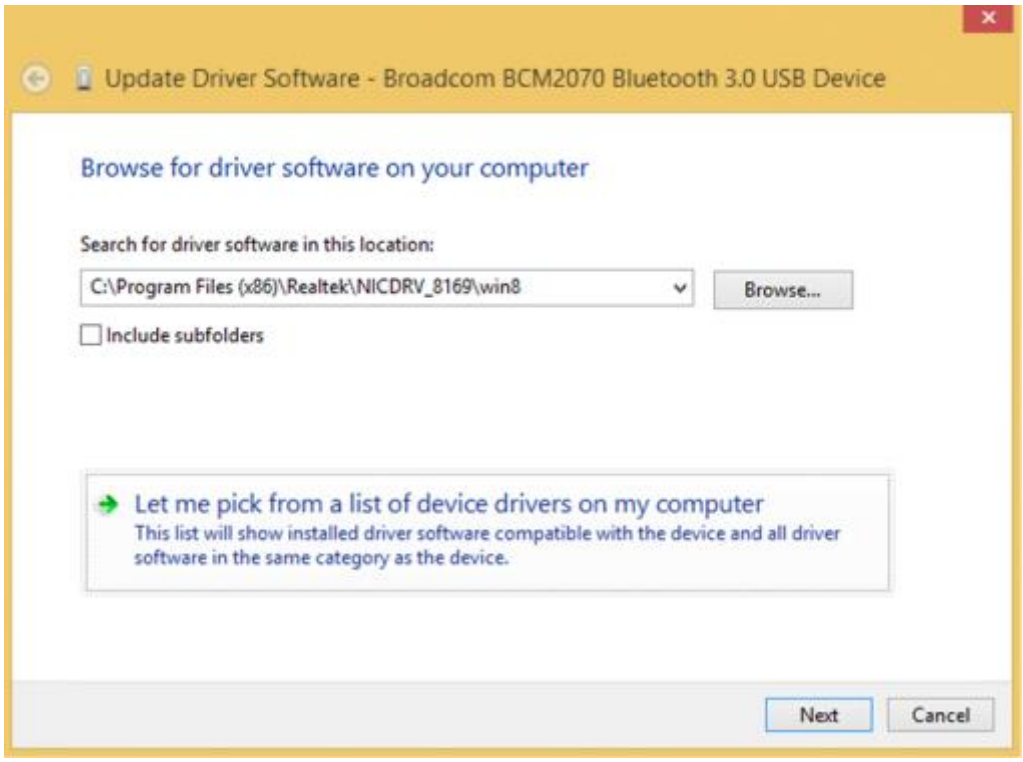

Figure 68: Pick driver from list of device drivers on the computer.

Select *Generic Bluetooth Adapter* and click on *Next* to install the Microsoft Bluetooth Stack. Of several models of *Generic Bluetooth Adapter* are available you can select any of them. It will not make any difference.

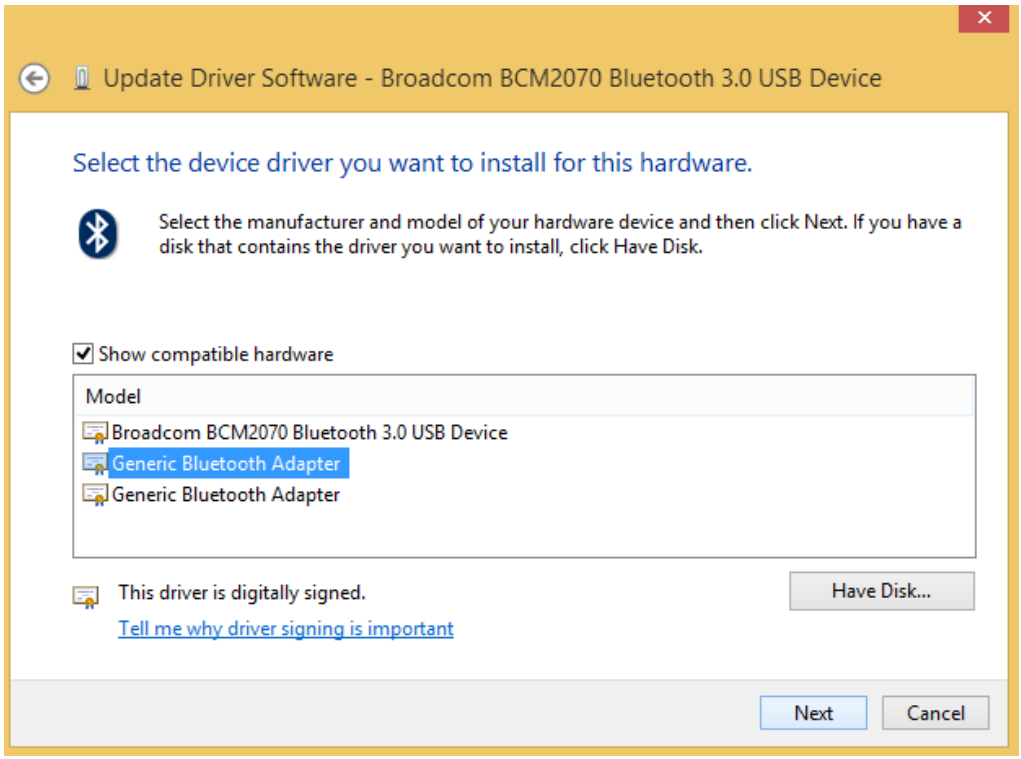

Figure 69: Select Generic Bluetooth Adapter

Your device should now be configured properly and have no warning sign or error message in the device manager. Rebuild the connection with your *biosignalsplux* device (see *Bluetooth Setup Windows 7*) and test your device by recording signals with the *OpenSignals (r)evolution* software. If, after all these steps, you keep experiencing the same issues, contact our support

6.1.2 Windows 10

Step 1: Removing already paired devices from your operating system
To remove Bluetooth devices, it is needed to access the Bluetooth configuration of your operating system. Click on the start button at the left lower corner in of your desktop to open the start menu. Click on the gear symbol to open the settings panel of your operating system as can be seen below.

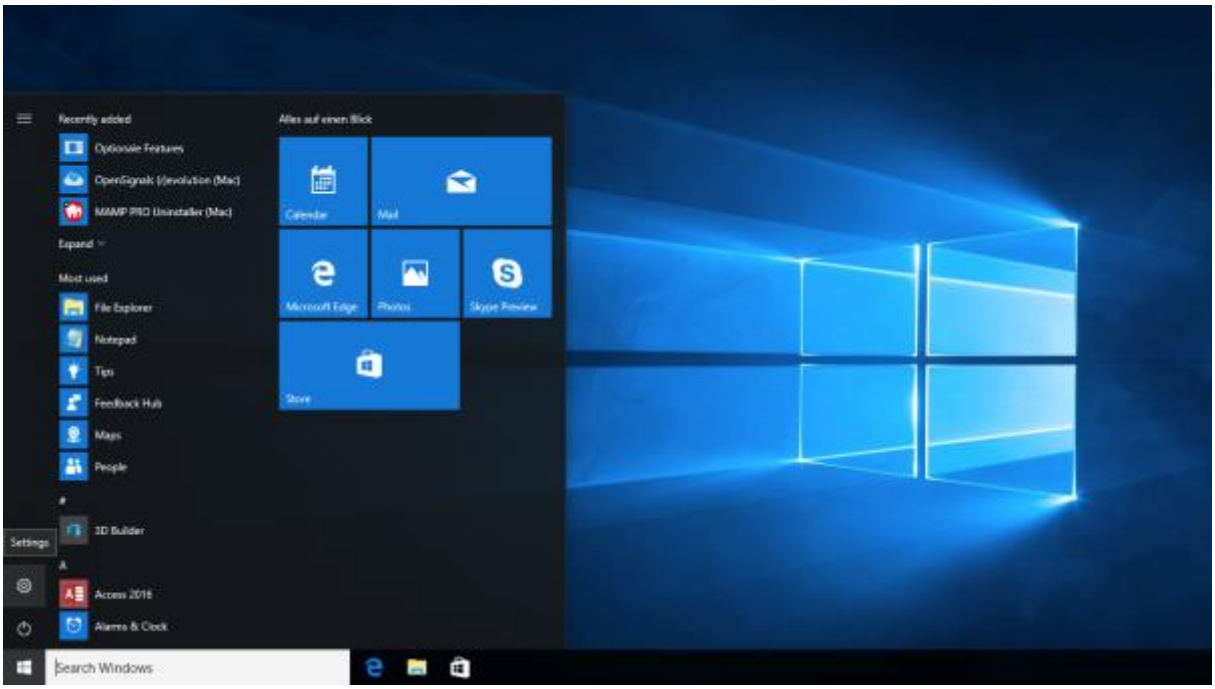

Figure 70: Access to the settings panel in Windows 10.

In the settings panel, click on the *Devices Bluetooth, printers, mouse* field to open the device configurations of your system.

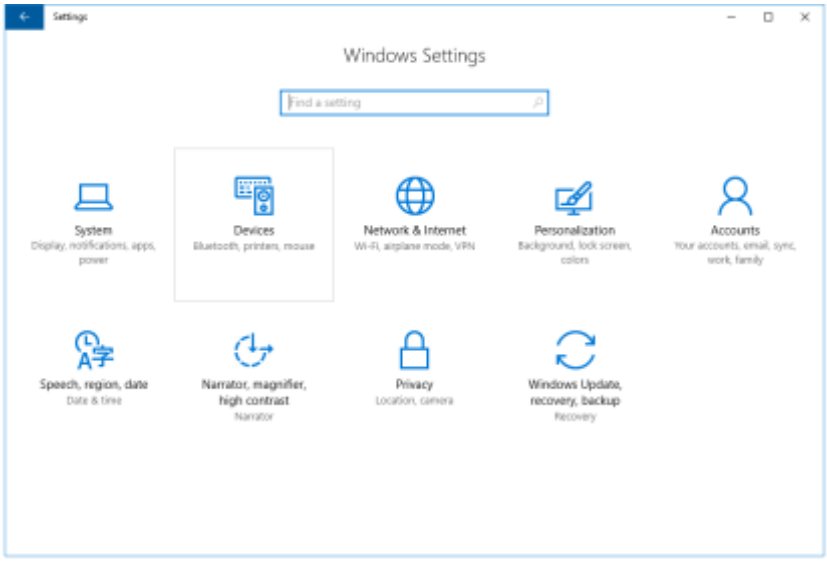

Figure 71: Windows 10 settings panel.

Select *Bluetooth* from the list which is displayed on the left side of your settings window. Note, that in some versions the Bluetooth option might not be available and that Bluetooth devices might be listed under *Other devices.*

Click on your *biosignalsplux* and click on *Remove device* to remove this Bluetooth connection from your computer and confirm the *Are you sure you want to remove this device?* message that will be shown on your screen. Repeat this step with every *biosignalsplux* if you're using several devices.

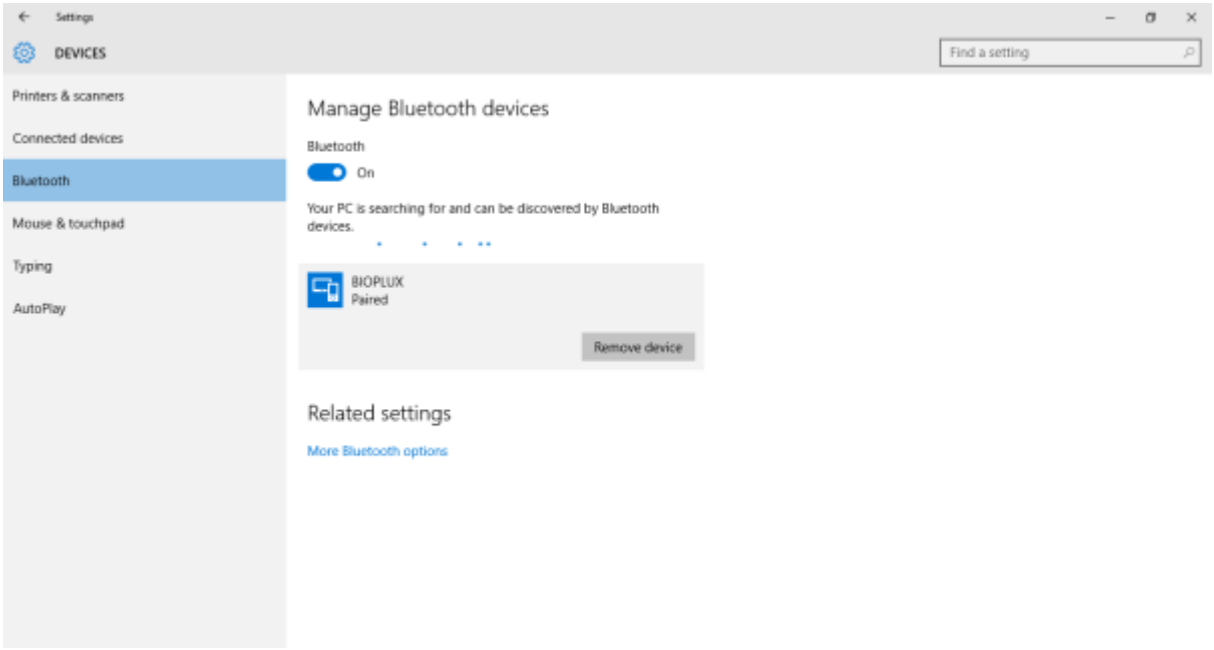

Figure 72: Windows 10 Bluetooth devices

If, after this step, your device is not listed in the list of Bluetooth devices anymore, the device has been successfully removed.

Step 2: Installing PLUX-proven Bluetooth dongle

To install the PLUX-proven Bluetooth dongle, plug it into your computer. Windows will install the Bluetooth dongle and display the window below.

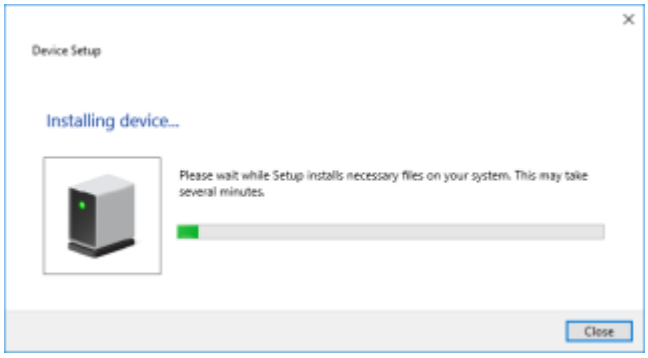

Figure 73: Wait for Windows to install your Bluetooth dongle.

Make sure you wait until your Bluetooth Dongle is installed. Windows will issue a notification and you'll be ready to configure the correct Bluetooth stack following the next step. Note, that this step might require a restart of your system. Make sure to close all your open work and programs properly before restarting the system to prevent data losses or other issues.

Step 3: Changing Bluetooth Stack to Microsoft's native Bluetooth stack

To configure the Bluetooth stack of the Bluetooth dongle, you have to connect your Bluetooth dongle to your computer and access the *Device Manager* on your computer. Enter *Device Manager* into the search field of your taskbar and click on the listed device manager.

In the device manager, the Bluetooth dongle should be listed as *Generic Bluetooth Adapter* (see). If your machine already has an internal Bluetooth Adapter and you have just plugged in the PLUX-proven Bluetooth Dongle, keep in mind that the last one will be automatically disabled by Windows. This is why one of your Bluetooth adapters under Bluetooth in the device manager shows a yellow warning icon (⚠) stating: *Code 10 - This device cannot start*.

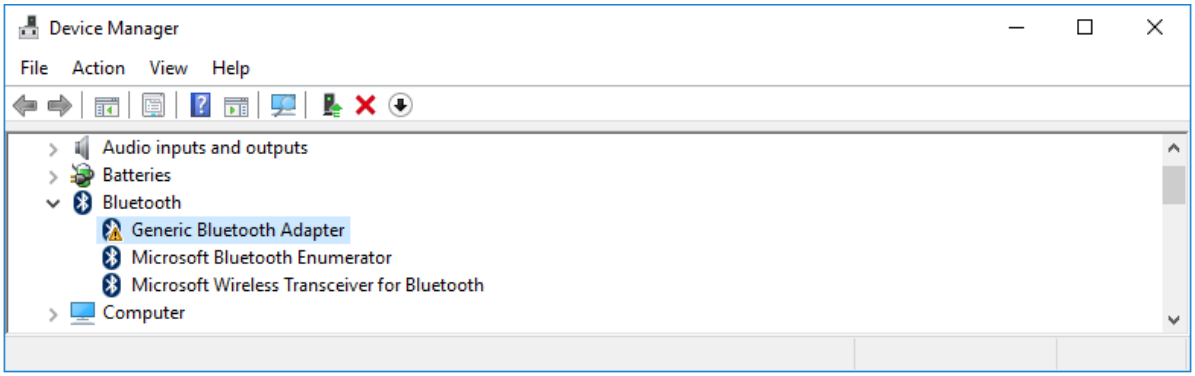

Figure 74: Bluetooth dongle listed in the device manager.

If, after this action, your Bluetooth Dongle continues to display a yellow warning icon (⚠), it means that it is not installed correctly and you should try to update the drivers by right-clicking on it and selecting *Update Driver Software...* or fix the problem displayed under *Device Status* in the device properties (right-click the Bluetooth device and select Properties; see screenshot below).

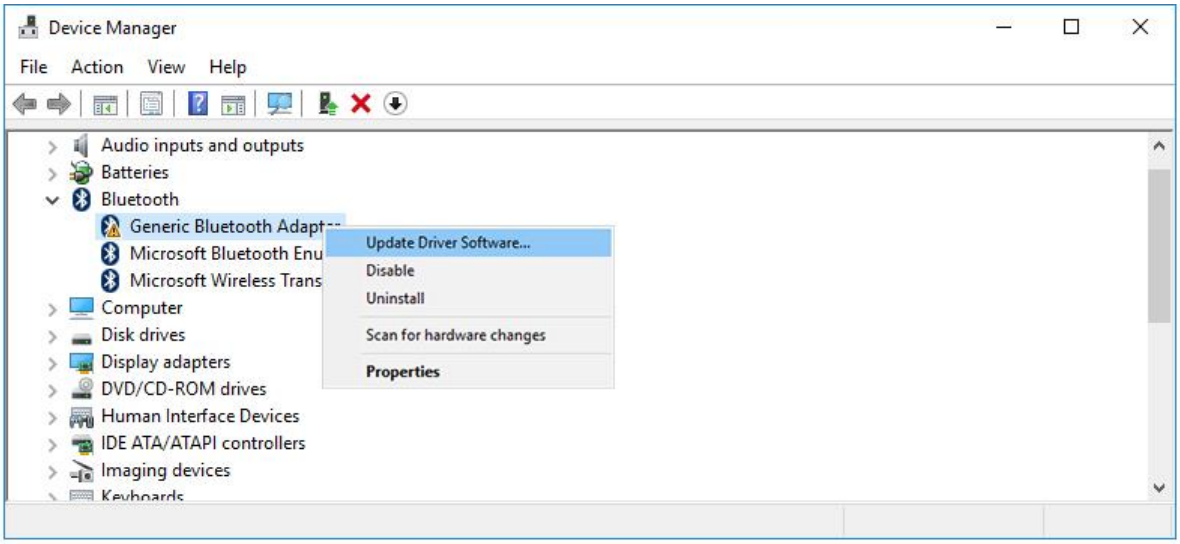

Figure 75: First step to update the driver of the Bluetooth dongle.

Select *Browse my computer for driver software* from the new window.

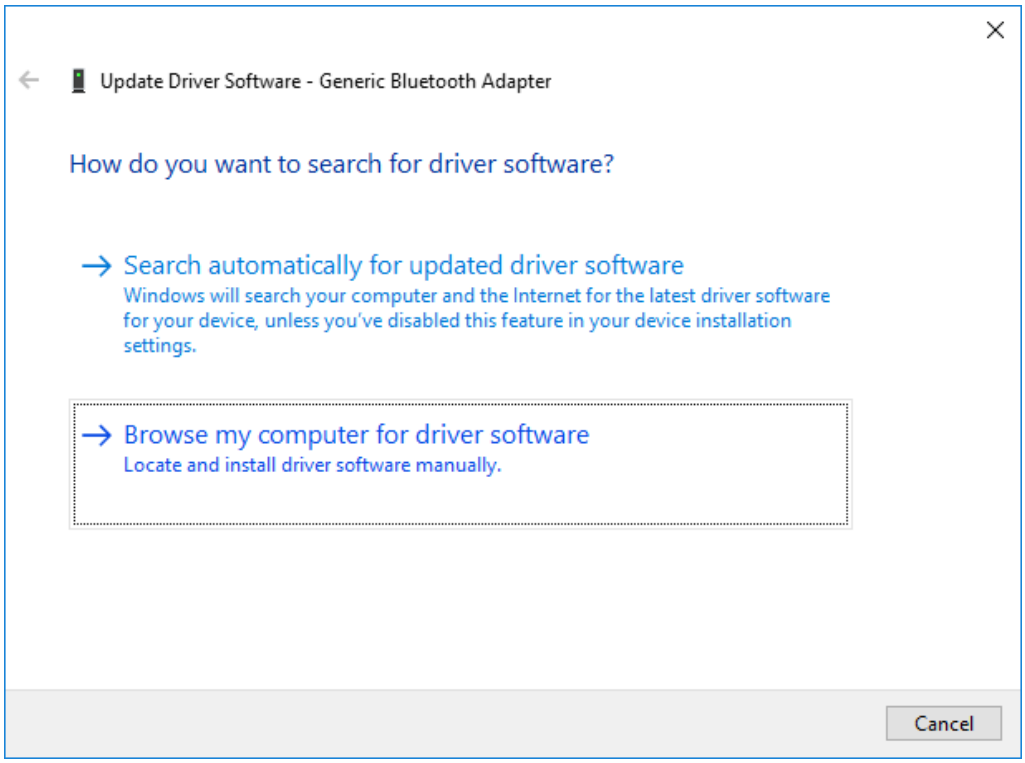

Figure 76: Browse for driver software.

Select *Let me pick from a list of device drivers on my computer*.

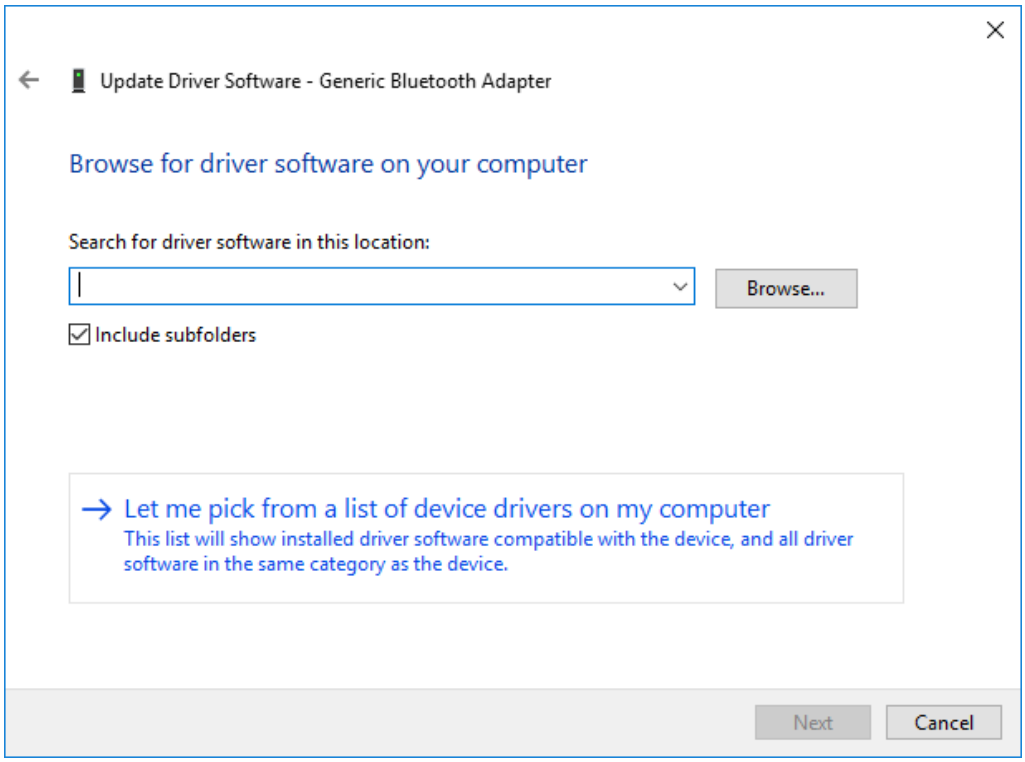

Figure 77: Pick driver from list of device drivers on the computer.

Select *Generic Bluetooth Adapter* and click on *Next* to install the Microsoft Bluetooth Stack. Of several models of *Generic Bluetooth Adapter* are available you can select any of them. It will not make any difference.

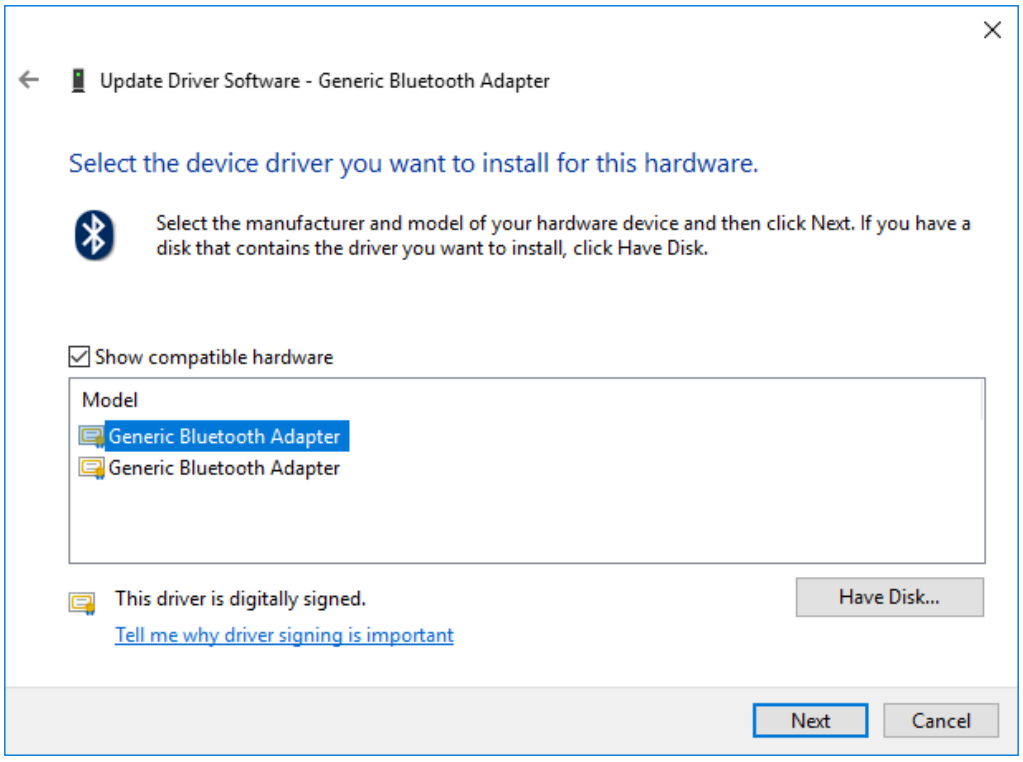

Figure 78: Select Generic Bluetooth Adapter

Your device should now be configured properly and have no warning sign or error message in the device manager. Rebuild the connection with your *biosignalsplux* device (see *Bluetooth Setup* Windows 10) and test your device by recording signals with the *OpenSignals (r)evolution* software. If, after all these steps, you keep experiencing the same issues, contact our support

7 Safety & Maintenance

Please read the following safety instructions **before** using your *biosignalsplux* system to prevent any damages or problems with the user, test persons and/or *biosignalsplux* devices. Violations of these instructions can lead to inferior signal quality and/or damages to the *biosignalsplux* system and user.

- ! The user should always keep the device and its accessories dry.
- ! The user must turn off the *biosignalsplux* device and contact Technical Support if the system or accessories reach uncomfortable temperatures.
- ! The user should not use the *biosignalsplux* device in noisy environments (environments with microwaves and other similar equipment). Doing so will lead to noise increase in the acquired signals and Bluetooth connectivity issues.
- ! The user must not use the device near the fire or in potentially explosive atmospheres, such as atmospheres with flammable gas.
- ! The user should only use the detection surfaces or other approved accessories purchased from PLUX or by a PLUX agent.
- ! The user should inspect the sensors on a regular basis to ensure that they remain in good working order.
- ! The user should stop using the *biosignalsplux* device if experience any kind of discomfort or skin irritation.
- ! The user should not use the *biosignalsplux* device continuously for periods of time above 60 minutes. Do not use the system on persons with allergies to silver.
- ! The user should dispose detection surfaces after using the *biosignalsplux* device. Detection sur- faces are single-user and disposable. Reusable electrodes should be reused by the same user. Do not use reusable electrodes on several users.
- ! The user must not place the device in the microwave.
- ! The user must not insert objects into the holes of the device.
- ! The user should not open the *biosignalsplux* device or its accessories. The repair of the same should be only done by properly authorized PLUX personnel.
- ! The user should make sure the cables do not obstruct the passage of people.
- ! The user should use the sensor cables with extreme caution to avoid risk of strangulation.

! The user should keep a safe distance between the *biosignalsplux* device and other devices to ensure their proper functioning.

! The user should only send the device to repair to qualified PLUX personnel.

! The user should not immerse the sensors or the *biosignalsplux* device, nor clean with liquid or abrasives.

! The user should handle the *biosignalsplux* device with caution and not expose the device or accessories to high accelerations and vibrations.

! *biosignalsplux* devices should not be used in patients with implanted electronic devices of any kind, including pace-makers, electronic infusion pumps, stimulators, defibrillators or similar.

! Do not apply electrodes over damaged or irritated skin.

! Do not use your device while charging its internal battery.

7.1 Maintenance Recommendations

7.1.1 Transportation and Storage

Please follow these recommendations to ensure safe transportation and storage of your *biosignalsplux* equipment and sensors to prevent any damaging of your system.

- The *biosignalsplux* equipment and sensors should be stored in the original box in a dry place when those are not being used.
    - Relative humidity: up to 95% with no condensation
    - Ambient temperature: 10°C to 30°C
    - Atmospheric pressure between 500hPa and 1060hPa

- Whenever the equipment needs to be transported, it should be placed in the original box, since this was designed and tested to ensure the equipment and accessories are securely stored.

- Take care while handling the bac and avoid dropping it, since the device is not shock-proof and should not be placed under stress or sudden acceleration.

7.1.2 Cleaning

Please follow these cleaning instructions to prevent any damage of the system or the user because of conducting cleaning methods that may cause any damage.

- The *biosignalsplux* and sensors should be visually checked before each use and cleaning process to ensure that no mechanical damage occurred.

- The *biosignalsplux* equipment and sensors (including the cables) should be cleaned with a slightly damp cloth or suitable absorbent paper, ensuring no liquid enters the equipment of sensors. Do not use detergent or any type of cleaning liquid as these may damage your equipment and/or sensor.

- Do not clean or re-use detection surfaces (electrodes). They are only suitable for single use, and should be disposed of after usage except indicated otherwise.

8 Regulatory & Legal Information

8.1 Disclaimer

***biosignalsplux* products are intended for use in life science education and research applications only; *biosignalsplux* products are not medical device**s, nor medical software solutions, nor are they intended for medical diagnosis, cure, mitigation, treatment or prevention of disease and is provided to you "as is".

We expressly disclaim any liability whatsoever for any direct, indirect, consequential, incidental or special damages, including, without limitation, lost revenues, lost profits, losses resulting from business interruption or loss of data, regardless of the form of action or legal theory under which the liability may be asserted, even if advised of the possibility of such damages.

8.2 Guarantee of Quality & Warranty

The *biosignalsplux* acquisition system has a two years quality guarantee from the date of purchase. *biosignalsplux* sensors have three months quality guarantee from the date of purchase. PLUX guarantees that the system, sensors and accessories will be free from material or manufacturing defects for the mentioned time periods following date of purchase.

If PLUX receives notification of any such defects within the guarantee period, it will repair or substitute with the same unit\model, any products with proven defects at no cost to the client. During the repair period PLUX promises to provide a temporary replacement under the same specification. Repairs will be carried out at PLUX's premises after the equipment has been received.

8.2.1 Warranty Voidance

Usage of the device that is not in accordance with the handling instructions indicated in the manual, or use with accessories other than those manufactured by PLUX will invalidate the warranty of your devices.

Be careful when connecting your *biosignalsplux* devices, sensors and/or accessories to any third party device including the usage of the 3rd party connection components that are available for *biosignalsplux* systems as **the usage of these components will void the electrical warranty of your *biosignalsplux* device** and sensors and, if not indicated otherwise, the warranty of the 3rd party system you're connecting to the device. Check the electrical specifications of both systems you want to connect to prevent any damage of the user(s) or the systems.

In the case of warranty voidance, the same applies that we expressly disclaim any liability whatsoever for any direct, indirect, consequential, incidental or special damages, including, without limitation, lost revenues, lost profits, losses resulting from business interruption or loss of data, regardless of the form of action or legal theory under which the liability may be asserted, even if advised of the possibility of such damages.

8.3 Contact & Support

Contact us if you're experiencing any problems that cannot be solved with the information given in the *biosignalsplux* or OpenSignals (r)evolution manual. We'll get back to you as soon as possible to find the best solution for your problem.

Please send us an e-mail with precise information about the error occurrence, device configuration, and, if possible, screenshots of the problem to support@plux.info.

9 Datasheets

The information displayed in this manual is taken from the official *biosignalsplux* datasheets. Please read the datasheets of your hub, sensors, and/or accessories before using them. The datasheets can be accessed via the links below.

OpenBAN
http://www.biosignalsplux.com/datasheets/OpenBAN_datasheet_v1.0.pdf

Accelerometer (ACC)
http://biosignalsplux.com/datasheets/ACC_Sensor_Datasheet.pdf

Blood Volume Pulse (BVP)
http://biosignalsplux.com/datasheets/BVP_Sensor_Datasheet.pdf

Breakout Cable
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Electrodermal Activity (EDA)
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Electroencephalography (EEG)
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Electromyography (EMG)
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