

Neurobit Optima

Instruction manual

for NO-2 and NO-4 models
with firmware ver. 1.0.1



In order to assure safe and effective operation we ask for a careful reading of chapters 1-3 of this manual before first use of the product.

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Neurobit Optima is the trademark of Neurobit Systems. Bluetooth jest the trademark of Bluetooth SIG, Inc. Ten20 is the trademark of Weaver & Co.

IMPORTANT NOTICE: Neurobit Optima equipment is not a medical product. It is intended for psychological training with methods of neurofeedback, biofeedback, as well as for scientific and high-tech applications.



This product is the subject to EU legal regulations for Waste Electrical and Electronic Equipment. For the sake of environmental protection and recycling, WEEE should be collected separately and not be mixed with unsorted municipal waste. Holders have important role in the collection process. They should return WEEE to civic amenity, recycling center or a retailer.

Neurobit Systems company reserves the right to introduce development changes in the product and its firmware & software without previous notification.

Important symbols used in this manual:



- requirements concerning safety,



- warnings connected with operation.

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1. Safety



- DO NOT CONNECT THIS DEVICE TO ANY EQUIPMENT NOT INTENDED FOR THAT PURPOSE BY THIS DEVICE'S MANUFACTURER.

PARTICULARLY, DO NOT CONNECT DEVICES POWERED FROM THE MAINS POWER NETWORK OR CONNECTED TO ANY SUCH DEVICES, FOR EXAMPLE POWER SUPPLY ADAPTOR, COMPUTER EQUIPMENT, MEASUREMENT EQUIPMENT.

- Do not connect measurement wires to any devices that are not intended for it.
- Do not use this product in industrial environment, or in means of transportation. It is intended for use in office environment and at home.
- Never use electrodes or conductive paste on damaged or irritated skin.
- Keep clean electrodes and other sensors applied to the skin.
- Do not use electrodes and other sensors with damaged wire insulation.
- Do not wrap the measurement wires around one's neck.
- In order to prevent cross-infections, the electrodes manufacturers recommend that electrodes used by persons with HIV, AIDS, Creutzfeldt-Jacob disease or comparable infections should not be used by any other people.
- Avoid eye contact with the electrode paste. If this happens, rinse the eyes with 0.9% saline solution. Avoid rubbing the eyes.
- Before application of electrode paste to persons prone to cosmetics allergies consultation with a doctor is required.
- Consult a doctor right away in the event of long-lasting redness, soreness, or swelling at the site of electrode paste application.
- Persons suffering from epilepsy, PTSD (posttraumatic stress disorder), depression or schizophrenia should use neurofeedback only under the supervision of a therapist.

2. Product characteristics

Neurobit Optima is an advanced, portable, versatile equipment for physiological measurements. It can be used in many applications, including:

- neurofeedback (EEG biofeedback),
- other types of biofeedback, e.g. sEMG, HRV, GSR, TEMP,
- scientific research,
- hi-tech user interfaces.

Neurobit Optima distinguishes, among other things, by multimodal measurement channels, which functions can be individually selected by a user.

Product highlights

- 4 versatile, low-noise channels enabling measurements of voltage, conductance, resistance and temperature signals. (NO-2 model has 2 channels.)
- a function of each channel is specified by a user (for example EEG + sEMG + GSR + TEMP, or 2 x EEG + 2 x sEMG etc.)
- built-in test of electrode-skin impedances and input circuit continuity,
- independent reference inputs for each channel,
- 16-bit resolution of measurements,
- 1% accuracy of voltage measurements,
- output sample rate up to 2000 sps,
- oversampling (primary sampling rate up to 8000 sps),
- selectable frequency characteristics enable to minimize signal delay or maximize frequency bandwidth,
- high immunity to electrical interferences,
- option of active shielding of sensor cables to reduce movement artifacts,
- configurable filter of power mains interferences (50/60 Hz or off),
- full galvanic isolation of the subject's body,
- wireless connection to a computer,
- real-time transmission of data to a computer,
- interoperation with many computer applications making possible flexible signal processing and visualization (also in real time), as well as storage in a computer,
- application programming interface (API),
- device extension with digital signal processor (DSP) executing client-defined algorithms (custom-made option),
- 2 AA battery powered,
- long work without battery replacement,
- indicators of battery, wireless link and measurement input states,
- small size and weight,
- belt clip enabling to wear the unit,
- remote firmware upgrade.



3. The basics of usage

Power

Neurobit Optima device is powered by 2 alkaline or rechargeable Ni-MH (nickel metal hydride) batteries of AA (R-6) size.



„Ordinary” (zinc-carbon) batteries should not be used, as they have low durability and threaten with the leakage of the electrolyte. Moreover, alkaline batteries should not be used after their use-by date.

In order to insert batteries, slightly press an arrow on battery compartment lid with the thumb and pull it out. Correct polarity is depicted with a sticker on the bottom of the compartment. Put in a battery with positive pole turned down, push it to metal contact in the enclosure, next squeeze in the negative pole end. When both batteries are inserted, draw the lid.

Fresh batteries suffice for a few dozen hours of work.

The device is turned on (or off) with short pressing of the **On/off** field on the front. After turning on the **Power** indicator should light green.

REMARK: When the device remains idle (no wireless connection to a computer), after 5 min. it automatically turns off in order to save batteries.

If the device will not be used for long time, batteries should be taken out.



The device cannot be powered by AC adapter or any other device connected to mains power network.

Bluetooth link

Neurobit Optima device communicates wirelessly with a computer, using Bluetooth standard of radio transmission (of low emission). It gives a subject ease of move within the limits of a room.

Most portable computers are equipped with built-in Bluetooth port. For desktop machines the Bluetooth adapter connected to USB port is used. Installation of a given adapter is carried out in accordance with an instruction attached to it.

HINT: a Bluetooth adapter or port should use Bluetooth drivers from Microsoft (available in the system) or from Widcomm/Broadcom. Drivers from other manufacturers (such as BlueSoleil by IVT Corporation) are not fully compatible with Microsoft software and do not allow connections with Neurobit Optima device.

Before use of Neurobit Optima device turn it on, place it near your computer (its Bluetooth port or adapter) and add the device to the list of Bluetooth devices, which can communicate with the computer. For example, in Windows Vista:

- click Bluetooth icon on the right side of system task bar and select the command „Add device” from its menu, or
- in system „Control panel” select the module „Bluetooth devices”, next click the link „Add wireless device” in upper bar of appearing window.

The list of devices detected in the computer neighborhood is shown on the screen in a while. Select the Bluetooth module of Neurobit Optima device, reported as "Serial Port Device". Pair the device with your computer. Required pairing code is 0000. You do not need to configure any services for the device. After adding the „Serial Port Device“ it should appear on the list of devices configured to work with your computer ("Control panel"/"Bluetooth devices").

Detailed information about a way of adding Bluetooth devices in a given operating system are available in its Help.

Signaling

Neurobit Optima is equipped with multilevel sound and visual signaling of operation states, giving high degree of control.

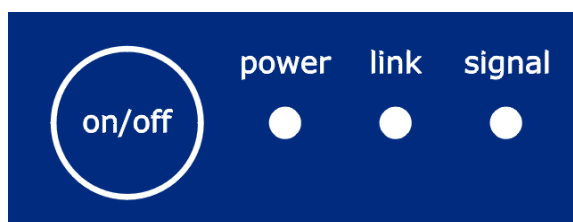
Sound signals

- single short sound - normal state change (e.g. turning on the power);
- a little longer single sound - warning of potential problem (e.g. measurement artifact or disturbed data link);
- triple sound repeated every 5 sec. - serious problem (e.g. lasting lack of connection to a computer or flat batteries);
- triple sound repeated every 2,5 sec. - failure.

HINT: Sound signaling during measurement session can be turned off in the device settings (see the option **Silent mode** on p. 15).

Device indicators

Further information about operational state is passed on by indicators on the device front plate:



- **Power** - status of batteries:
 - does not shine - the device is off,
 - green - the device is on, the status of batteries is correct,
 - continuous yellow - weak batteries,
 - flashing yellow - flat batteries.

The device will automatically turn off in a while. In order to avoid such situation it is recommended to replace batteries earlier - when the indicator continuously lights yellow.

- **Link** - status of wireless link:

- does not shine - link with a computer not established.

It is a normal state directly after turning the device on. The link is usually established only at measurement or test stage.

- green - link is established and correct,
- orange - link disrupted.

It usually indicates, that the device crosses a border of wireless communication range. If distance between the device and a computer decreases quickly, the link will recover and measurement session will continue. (When link pause exceeds 60s, the session ends.)

- orange flashing regularly - lasting link loss during data transmission. Turn off the device, place it closer to a computer and turn it on again. Measurement session should be restarted.

- **Signal** - status of measurement signals:

- does not shine - no measurement,
- green - correct measurement,
- orange - no signal.

This state is indicated, when signal level in at least one active measurement channel is many times lower than measurement range for long time.

For some signals such a situation may normally occur from time to time. However, if that state appears often or all the time, it may be caused by short circuit of electrodes connected to both inputs of a channel (e.g. with excessive amount of conductive gel). That state can also appear for correct electrode connection, when too high measurement range is selected for measured signal.

- red - signal exceeds the measurement range.

Signal in at least one measurement channel exceeds measurement range or common voltage interference is too high.

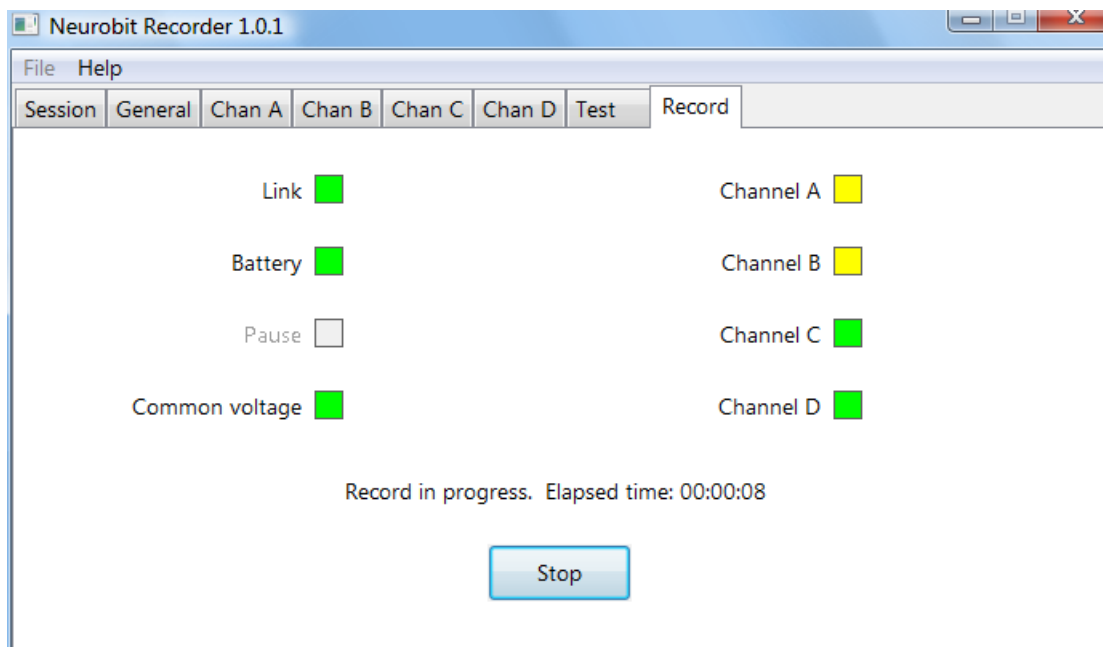
That state is usually caused by poor electrical contact of an electrode or high amplitude interference. It may also appear when too low measurement range is selected for measured signal.

- red flashing regularly - too wide data stream.

The sum of sampling rates in all active channels should not exceed the limit given in technical data (see p. 26).

Signaling on a computer

Detailed information about states of individual measurement channels and common voltage may be available on a computer screen (depending on used software). An example of signaling during data recording in Neurobit Recorder application is depicted below.



Measurement inputs

Depending on a model, Neurobit Optima has 2 or 4 identical, highly versatile channels. Each channel has two differential inputs marked as „+” and „-”. Apart from that the device has a **VG** socket (virtual ground). There is also **SH** socket for active shielding, reducing cable movement artifacts. **SH** socket connects shields of measurement cables (usually via special splitter). Sensors with shielded cables are available on special request. For common, non-shielded wires the **SH** port is not used.

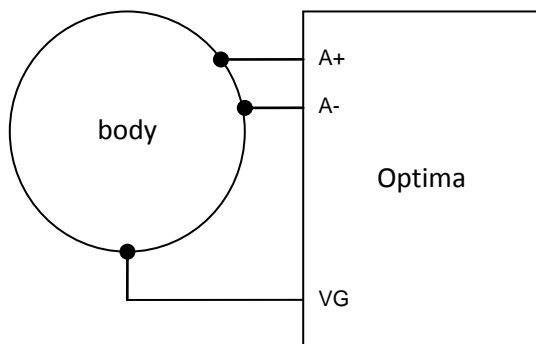
Measurement sockets are compatible with DIN 42802 (Touch-Proof) 1.5mm standard. Wires of electrodes and other sensors should be ended with plugs compatible with that standard.



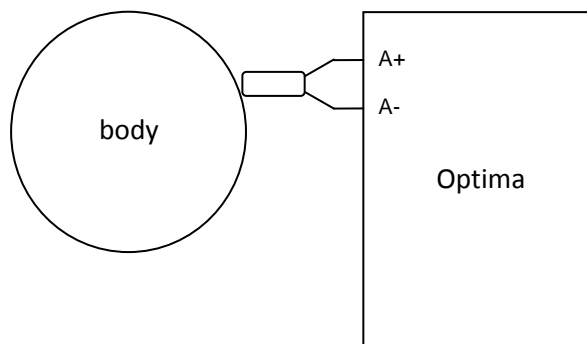
Connections

For measurements of electrophysiological signals (e.g. EEG, sEMG, HRV, GSR) „+” and „-” inputs of a channel are connected to two electrodes applied on the skin surface. Furthermore, a connection of the subject’s body to **VG** socket with a separate electrode is necessary.

Apart from electrophysiological signals Neurobit Optima can measure non-electrical quantities (for example temperature) with resistive sensors. They are connected between both inputs of a channel.



Connection of electrodes for measurement of electrophysiological signals

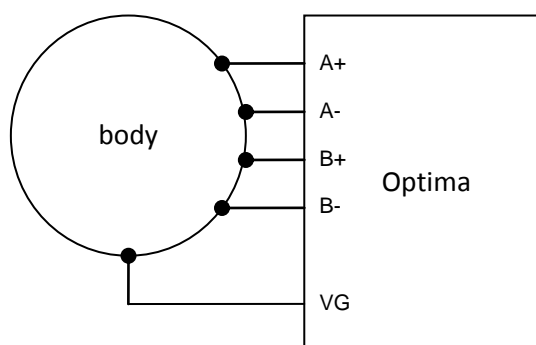


Connection of resistive sensor of non-electrical quantity

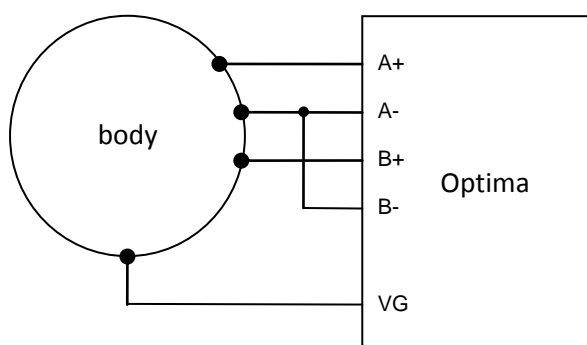
For electrophysiological measurements both main types of derivations (montages) can be used:

- bipolar (measurement of potential difference between two sites), and
- referential, also known as monopolar (measurement of voltages in reference to common electrode).

For referential derivations „-” inputs of used channels are connected to a single reference electrode with special splitter.



Bipolar derivations



Referential derivations

Simultaneous measurement of different physical quantities and types of signals in individual channels is possible (e.g. electrodes measuring EEG in A and B channels, electrodes measuring sEMG in C channel and a temperature sensor in D channel).

Information about configuration of measurement channels for various types of signals are included in chapter 4.

The following measurement rules should be obeyed:

1. All not used channels should be turned off (unchecked **Channel enable** option described on p. 16).
2. In all cases of measurement with electrodes on the skin (EEG, HRV, GSR etc.) the **VG** socket have to be connected to the body with a separate electrode.
3. When none of used channels is set to voltage measurement (**Channel function** not set to „Voltage”) and is not galvanically connected to the body (e.g. only temperature sensors are used), the **VG** socket is not used.
4. Measurements of impedance/resistance/conductance between electrodes on the skin (e.g. GSR) should be always bipolar, i.e. done with two separate electrodes for a given channel (none of its inputs should be connected to reference electrode common for a few channels).
5. Measurements of impedance/resistance/conductance of the skin should not be done simultaneously with measurement of voltage signals (ExG) on nearby (< about 30cm) electrodes (e.g. all electrodes placed on the head). (Otherwise test signal of frequency 31.25Hz, used for impedance measurement, might appear in voltage signals.)
6. When you connect sensors to the device, check if their plugs are inserted into full depth of measurement sockets. (Otherwise there may be no electrical contact.)
7. If at all possible, try not to touch sensors and their wires during measurements.
8. Control possible sources of artifacts, such as body movements, cell phones etc. It is especially important for measurements of subtle EEG signals (amplitudes of the order of microvolts). More information about various types of artifacts:

http://www.medicine.mcgill.ca/physio/vlab/biomed_signals/eeg_raw.htm,

<http://emedicine.medscape.com/article/1140247-overview>.



9. Measurement sockets cannot be connected to any devices powered from mains power network, to circuits, which may be connected to such devices or to equipment not intended for that.

Sockets of the device (including **VG**) cannot be connected to real electrical ground.

Sensors

For electrophysiological measurements (e.g. EEG, sEMG, HRV, GSR) virtually all electrodes routinely used for individual modalities (passive), ended with TP 1.5mm plugs or standard snaps, can be used. They may be both disposable and reusable electrodes, made of various materials (AgAgCl, Ag, Au, Sn). A user can also choose a method of their montage and a way to ensure electrical contact, e.g. with self-adhesive collars, caps, headbands etc., using adhesive-conductive paste (such as Ten20), gel or saline solution.

REMARK: Electrodes used on „+” and „-” inputs of a given measurement channel should be made of the same material.

REMARK: Dry electrodes can be used with Neurobit Optima device for GSR (skin conductance).

For measurements of non-electrical quantities special sensors delivered by the device manufacturer are required.

Clip

The device is equipped with a clip at the bottom of the enclosure. It enables to fasten the device on belt, pocket etc. in order to convenient wear.

Operational remarks



- **Do not open the device** (except for the battery compartment). **Do not remake it.** Incompetent intervention may cause damage and violate safety; it also causes loss of warranty.
- **Do not drop the device and do not expose it to strong bumps.** These may cause damage to the case and electronic components.
- **The device should always be dry.** Precipitation, high humidity or mineral solutions can disturb operation and cause corrosion of the electronic components.
- **Do not use or store the device in dirty or dusty places.** Accumulation of contaminants inside the device may disturb its operation.
- **Do not store the device at high temperatures. Do not leave it in direct sunlight for prolonged periods of time.** It shortens the life of batteries, electronic components and operational materials, and may warp the case.
- **Do not store the device at low temperatures.** It causes accumulation of moisture inside, which condenses after heating and may disrupt work of the equipment.
- **If the device will not be used for a long time, take the batteries out.** Leakage from outdated or dead batteries may cause corrosion of electronic components or defective operation of the device.
- **Do not use solvents or strong detergents for cleaning.** They may damage the case.
- Use a soft, dry cloth for cleaning the device. If necessary, use a soft pad moistened with isopropyl alcohol.
- Operational materials and accessories:
Electrodes, cables with TP 1.5mm plugs, electrode paste and similar accessories and materials can be purchased, among other things:
 - in internet shop <http://www.bio-medical.com> (USA; they also serve foreign orders),
 - from the device manufacturer: <http://www.neurobitsystems.com/contact.htm>.

Alcohol pads used for skin preparation and cleaning are available in drugstores.

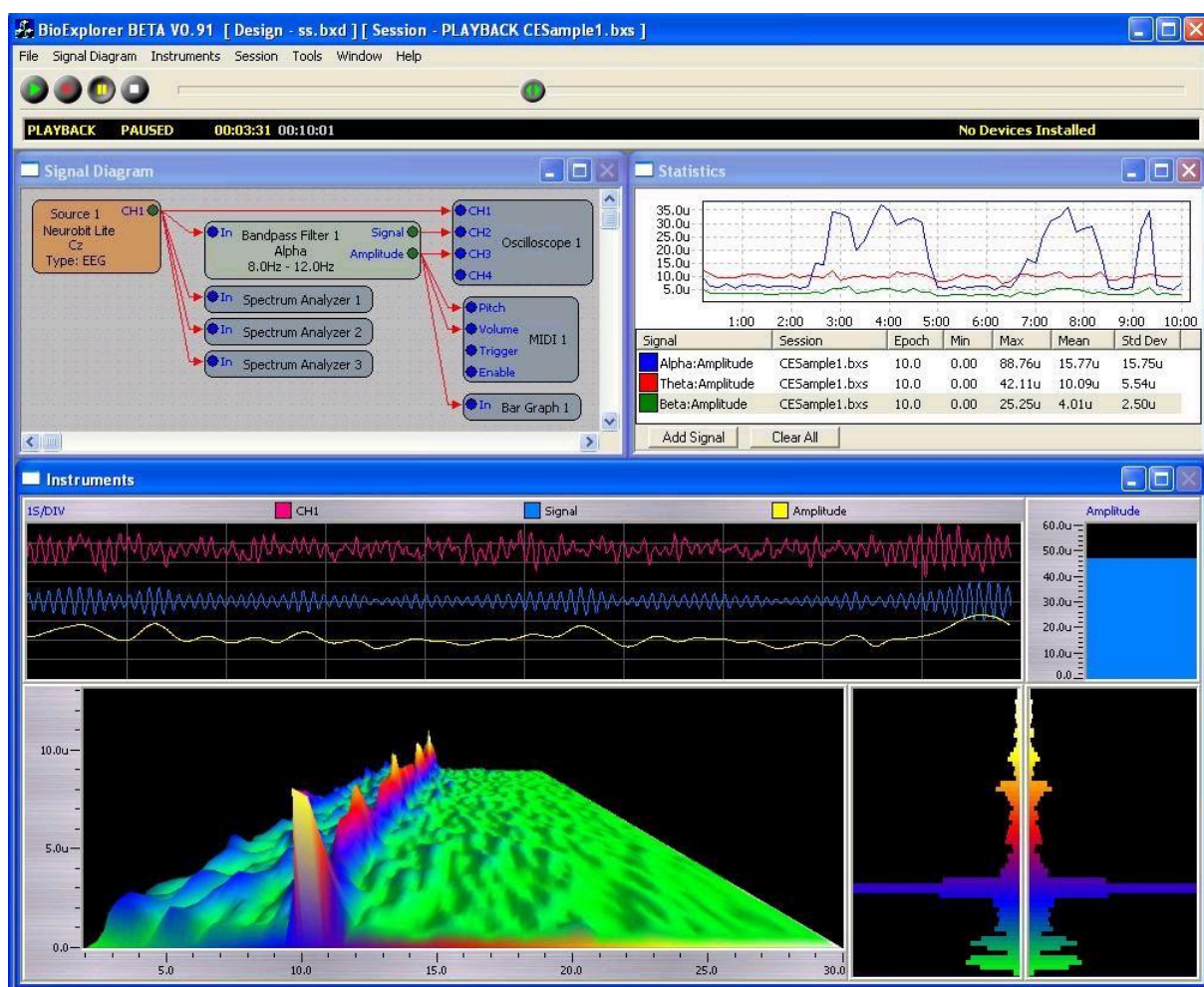
REMARK: electrodes used on „+“ and „-“ inputs of a given measurement channel should be made of the same material (for example both Ag).

4. Software

Computer applications

Neurobit Optima devices work with several computer applications from various manufacturers, among other things:

- **BioExplorer** – popular biofeedback software, enabling flexible configuration of signal processing and presentation, by CyberEvolution, Inc.,
- **BioEra** – versatile software for biofeedback and other signal processing, by Proatech, LLC,
- **eBioo** – sophisticated neurofeedback software by Soft-dynamics,
- **BrainBay** – open source biofeedback and bio-signal software,
- **Neurobit Recorder** – simple application recording physiological signals in EDF or text files,
- **BioPlay** – packages of traditional arcade games adapted to biofeedback by Itallis, working with BioExplorer application,
- **ParticleEditor, InnerTube** etc. – packages of games for biofeedback by SomaticVision, intended for interoperation with BioExplorer application.



Example of BioExplorer screen.

Moreover, measurement data recorded in EDF files by Neurobit Recorder or BioEra can be imported in many packages of physiological signal analysis, e.g. EEGLAB for Matlab.

Sources of information about features and usage of individual computer applications are given on p. 25.

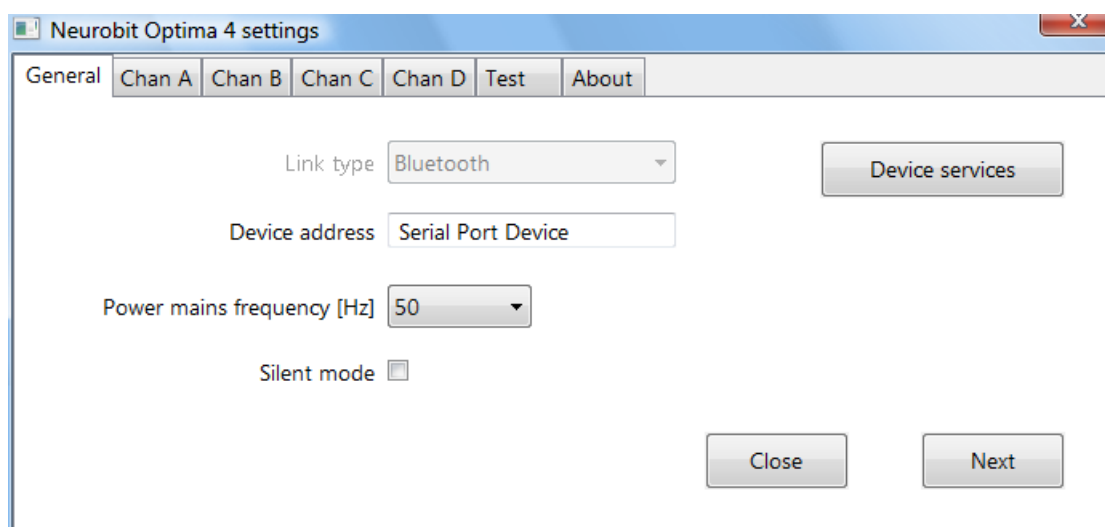
A user can also create his/her own computer programs directly receiving and processing data from Neurobit Optima equipment in real time, with the use of free application programming interface - **Neurobit API** (available on request).

Device settings

Computer applications interoperate with Neurobit Optima devices via **Neurobit Driver**. The device window created by the driver (the same for most of applications) enables configuration of the device, as well as test of electrode-skin impedance or input circuit continuity.

The device window is divided into several tabs, which can be selected in the upper bar or with Next button in lower right corner of the window. The tabs contain options depending on a selected device. These are a **General** tab with general device options and several tabs with settings for individual measurement channels. For Optima devices the window also includes **Test** tab. When required options are set or test is finished, the window is closed with **Close** button.

General tab



- **Link type**

Type of link used for communication with the device.

- **Device address**

Bluetooth address of Neurobit device (or name of its communication module).

If you have only one turned on Neurobit Optima device in the wireless communication range, you can usually leave the default value in this field. Otherwise it is recommended to set here a specific address of a given device. Addresses of Bluetooth devices seen by your computer can be listed in system "Control Panel"/"Bluetooth Devices" (location for Windows 7 and Vista systems).

- **Power mains frequency**

Setting of mains frequency used in your country, required for power interference filtering in the device.

For example, most European countries use 50 Hz mains, while 60 Hz is used in North America. If necessary, you can check local power frequency on the webpage

http://en.wikipedia.org/wiki/Mains_power_around_the_world.

- **Silent mode**

Option turning off sound signalization of events (artifacts etc.) in the device during measurements.

(The option is insignificant in devices without sound transducer.)

- **Device services**

Button opening the application of device service functions, for example firmware upgrade.

Chan X tab - Settings of measurement channel

The screenshot shows the 'Neurobit Optima 4 settings' window with the 'Chan A' tab selected. The window contains the following settings:

- Channel enable:** ☒
- Channel label:** EEG C3-A1
- Sensor info:** AgAgCl
- Channel profile:** User defined
- Channel function:** Voltage
- Frequency characteristic:** Linear phase sharp
- Measurement range [uV]:** 1000
- Range minimum [uV]:** -1000
- Sample rate [Hz]:** 125
- Power interference filter:** ☒
- Sum disconnected:** ☐

At the bottom right, there are two buttons: 'Close' and 'Next'.

A user can configure application and parameters of a measurement channel.

HINT: It should be taken into consideration, that appearance and available settings of some parameters (e.g. "Measurement range") may depend on other parameters (e.g. "Channel function"). When you change such superior parameter, all dependent parameters are set to defaults.

- **Channel enable**

Option enabling (or disabling) a measurement channel.

- **Channel label**

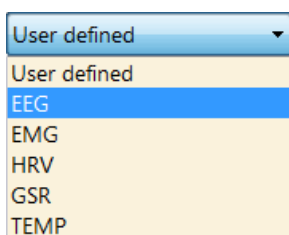
You can enter here your short label for the channel (e.g. "EEG FpzCz"), which may be used by an application. (The label is optional. It is limited to 16 characters.)

- **Sensor info**

You can enter here your short description of used transducer (e.g. "AgAgCl electrode"), which may be used by an application. (This description is optional. It is limited to 80 characters.)

- **Channel profile**

The profile enables to set in one step the default parameters for some basic types of physiological signals (fields of those parameters are locked then).

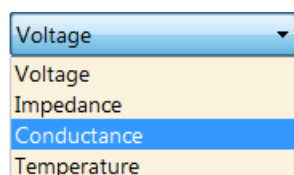


In order to freely set all parameters by yourself select "User defined" option. It unlocks rest of the parameters without their change.

(Thus if you would like to use default settings of most parameters for a specific profile (e.g. EEG) and set only one or two parameters on your own, you can first select that specific profile, next select "User defined" profile and do required minor changes.)

- **Channel function**

It enables to select measurement of voltage (default) or other physical quantity.



- **Frequency characteristic**

For voltage signals this option enables to minimize signal delay or maximize frequency bandwidth. E.g. for "Linear phase sharp" option the frequency bandwidth (in Hz) is 40% of sample rate, and signal delay of analog-to-digital conversion is 19 samples. For "Linear phase mild" characteristic the bandwidth is 30% of sample rate, with 11 samples delay.

This parameter is replaced with **Thermistor characteristic** for channel function set to Temperature.

- **Measurement range**

It selects upper limit of signal values, which can be measured. Higher range protects against clipping of high amplitude signals, while lower range makes measurement more sensitive, thus reduces quantization noise of analog-to-digital conversion.

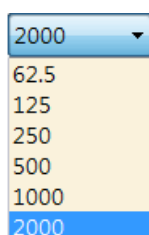
(Note for channel function set to conductance measurement: the unit 1uS (micro Siemens) equals 1micromhO used in electrophysiology.)

- **Range minimum**

Lower limit of measured signals (read only value depending on **Measurement range** setting).

- **Sample rate**

It selects number of output signal samples per second.



Higher sample rate enables to measure faster signals, whereas lower sample rate reduces high frequency noise, as well as computational load of a processor and size of recorded signal files.

- **Power interference filter**

It turns on or off device's filter of power mains interferences.

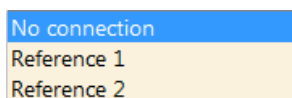
(Filter notch frequency is set by **Power mains frequency** option on **General** tab.)

- **Sum disconnected**

The option disconnecting sum voltage in channel from common voltage feedback amplifier (generating virtual ground potential). This option have to be cleared for channels galvanically connected to the body (measuring EEG, sEMG, GSR etc. signals on the skin surface). It is recommended to set the option for channels connected to transducers with asymmetric (two-wire) voltage output.

- **Common reference**

This option informs of external connection of "-" input of a given channel to a common reference electrode. Its suitable selection is required for correct results of electrode-skin impedance tests for such inputs. Up to two independent common references are supported.



(This setting does not cause any internal connections of inputs in the device. It also has no influence on regular measurements - apart from tests of electrode-skin impedances. It does not apply to channel functions different than "Voltage".)

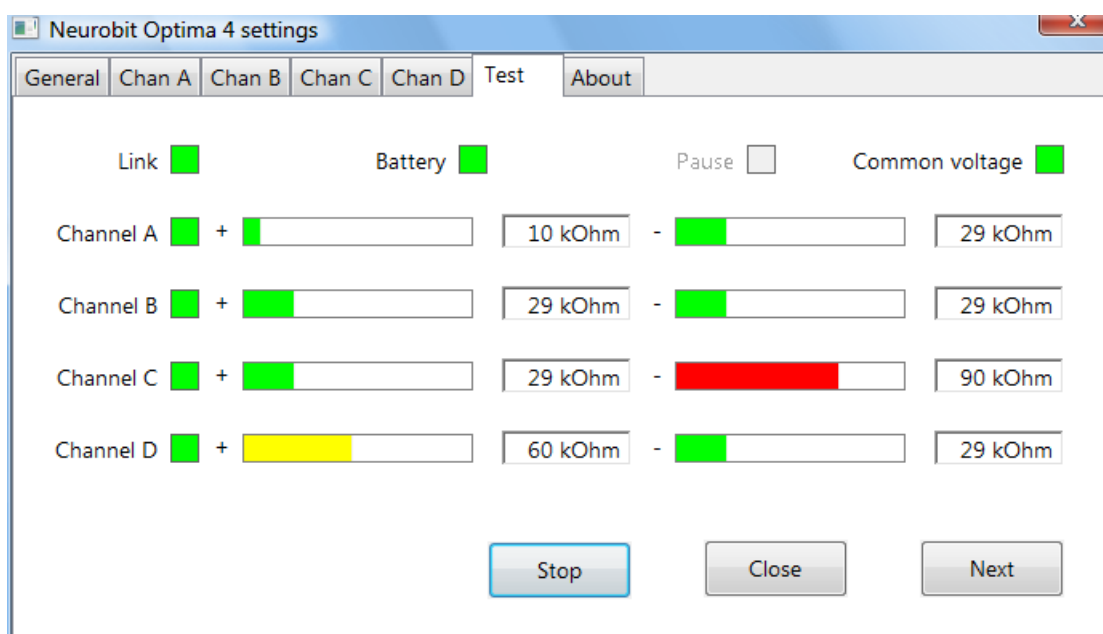
Test tab – Test of input circuit impedances

This tab enables to test input circuit connections and electrode-skin impedances for active channels before actual biofeedback or measurement session. Although optional, execution of the test is recommended.

Note: **Test** tab is not shown when the device window has been opened during regular measurement session.

State indicators shown on this tab can have up to four states:

- disabled - if the indicator does not apply to current configuration and state or corresponding measurement channel is disabled;
- green - correct state;
- yellow - warning (e.g. weak battery or no signal in channel);
- red - fault condition (e.g. battery flat or too high common voltage interferences).



Window contents:

- **Link** – state of wireless link between the device and computer.
It is red, if the link is lost. This condition usually appears when the device goes out of wireless communication range (typically 10 meters for Neurobit Optima). If the device will be quickly brought closer to a computer, link will be restored and session will continue. (If lack of communication is longer than about 60 seconds, the session will be ended.)
- **Battery** – state of batteries in the device.
If the indicator gets red (batteries flat), the device will turn off in a while. To avoid this situation it is recommended to replace batteries, when the indicator gets yellow (batteries become weak).
- **Pause** – not used for Neurobit Optima.

- **Common voltage** – indicator of common voltage interferences.

So called common voltage on inputs, which would strongly interfere with measurement of small electrophysiological signals, is almost totally removed by differential amplifiers.

However, it is true only as far as the common voltage is within dynamic range of the amplifier. To avoid uncontrolled conditions of poor signal quality, Neurobit Optima supervises common voltage and indicates when it is too high (the indicator becomes red).

In most cases the cause of that condition is lack of electrical contact between Virtual Ground (VG) line and examined subject's body.

- **Channel X** – state of signal in channel X.

At moments, when the signal goes beyond measurement range, this indicator gets red. It is usually caused by bad electrical contact of sensor or high amplitude interferences. This condition could also appear with correct connection and input signal, if too small measurement range was set for the channel.

The yellow indicator means lack of signal. This condition is detected when measured signal is many times lower than measurement range for long time (consult the equipment manual for specific limits). Depending on type of signal it may be normal from time to time. If the condition occurs frequently or all the time, it may be caused by short circuit of electrodes of both channel inputs (maybe with excessive amount of conductive gel). This condition may also occur with correct connections, as a result of too large measurement range set for the channel.

- Impedance indicators

For channels with voltage measurement setting there are two sets of indicators of electrode-skin impedances on inputs „+“ and „-“ of the differential channel. For channels with non-voltage measurement setting there is one set of indicators of connection resistance between + and - inputs of the channel. Indicators for disabled channels are inactive. Each set of indicators includes bar gauge and digital value of impedance (resistance).

Bar gauges for channels with voltage measurement setting change their colors depending on impedance level. For recommended low electrode-skin impedance they are green, when impedance goes higher to acceptable level, they become yellow. For unacceptably high impedances the gauges are red.

HINT: When signal state indicator for a given channel (or **Common voltage** indicator) is red (signal is invalid), impedance indicators are not updated.

- **Test** – button starting test.

When physical measurement starts, the indicators become active. During the test most of the configuration options are locked. The test can be ended with **Stop** button, which appears instead of **Test** button.

HINT: For multi-channel measurements of voltage signals (for example EEG), suitable settings of **Common reference** fields on individual channel tabs are necessary for correct electrode-skin impedance readings. For reference derivations (with common reference electrode) connection of „-“ inputs to that electrode should be selected ("Reference 1" option if single reference electrode is used). For bipolar derivations the **Common reference** fields should be set to "No connection" (it is the default).

Status tab

This tab is shown only when the device window has been opened during regular measurement session. It enables to check the session state, if not presented directly in an application window. The tab includes more detailed information than seen on the device, with separate indicators for individual measurement channels:

- **Link**
- **Battery**
- **Pause**
- **Common voltage**
- **Channel A**
- **Channel B**

Meaning and states of those indicators are described above in "Test tab" section.

About tab

Information about driver's manufacturer, its license and help are available here.

Neurobit Driver upgrade

Neurobit Driver and associated runtime files are distributed and installed along with applications supporting Neurobit devices. However, new versions of that runtime package may be released independently of the application releases. In such cases the driver used by an application can be upgraded. To do this download the latest **Neurobit Runtime** package from the webpage http://www.neurobitsystems.com/download/Neurobit_Runtime-versions.htm (or use Neurobit Runtime version delivered on CD-ROM with the device) and unpack it to a suitable subfolder of the used application:

- BrainBay\NeurobitRuntime,
- BioEraPro\drivers\neurobit,
- Neurobit\Recorder.

(If you have installed a few applications supporting Neurobit devices, such upgrade should be done for each of them.)

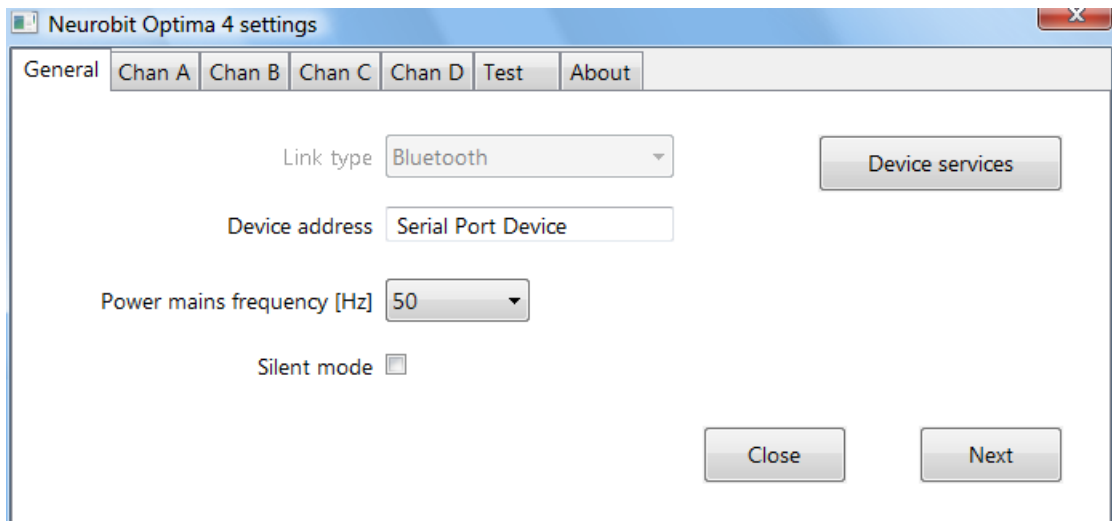
HINT: Right after installation of a third-party application supporting Neurobit devices it is recommended to check if it includes the latest Neurobit Driver version. The version number can be seen in device settings window, on **About** tab.

Firmware upgrade

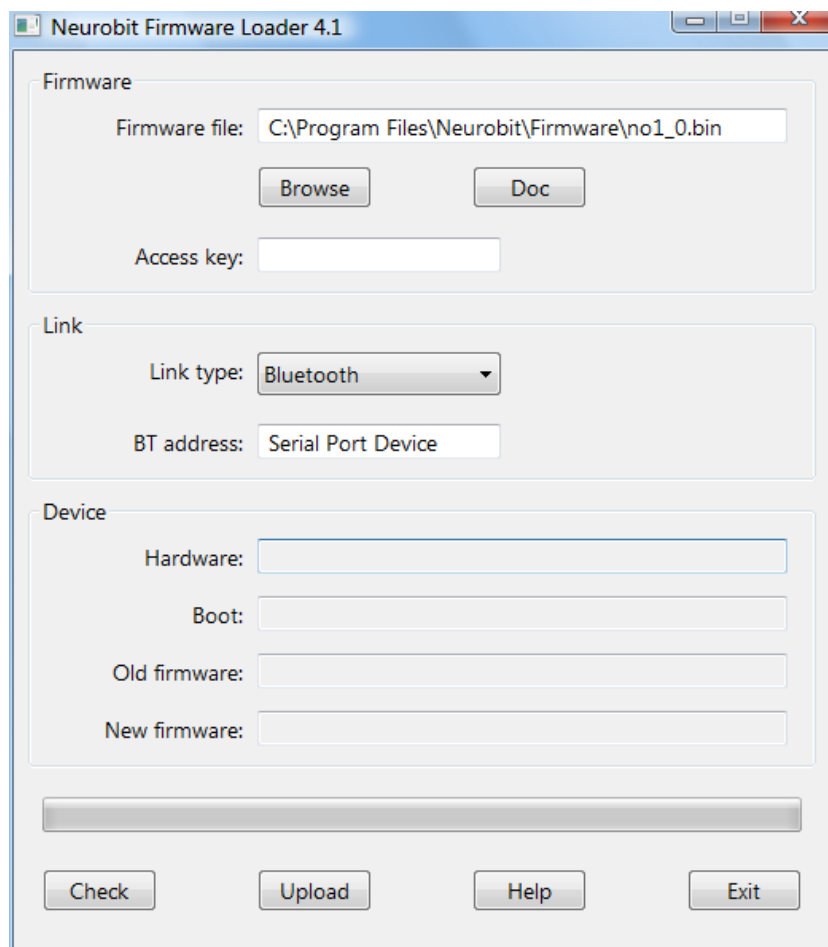
Neurobit Optima devices enable remote upgrade of the program controlling them (*firmware*).

The described procedure requires a computer with Microsoft Windows system (2000 or newer). It is assumed that Bluetooth adapter is correctly installed in the computer and connected to its USB port. Before use a Bluetooth device should be paired with your computer. One of applications supporting Neurobit Optima should be also installed.

1. Download the latest firmware file for your device model from the webpage http://www.neurobitsystems.com/download/Neurobit_Optima-firmware.htm and save it on disk, for example in "C:\Program Files\Neurobit\Firmware" folder.
2. Run an application interoperating with the device (for example BioExplorer). Open Neurobit device settings window (described on p. 14). If you do not know how, consult instructions for a given application.



On **General** tab click **Device services** button in order to open the loader application.



(If you have installed Neurobit Recorder, you can also directly run the loader file "C:\Program Files\Neurobit\Recorder\NeurobitServ.exe".)

3. In the loader window click **Browse** and select the downloaded firmware file.
4. Place Neurobit Optima device in the wireless communication range of the Bluetooth adapter (less than 10m).
5. Turn on the device and wait a few seconds.

If there are other Neurobit Optima devices nearby, it is recommended to turn them off. If they have to stay turned on, you should indicate an individual device for upload with its address in **BT address** field of the loader application. In order to list Bluetooth devices previously paired with your computer and their addresses click the Bluetooth icon on the right side of the system task bar and select the option "View Bluetooth devices". (You can select Properties of a given device and copy its address.)

6. Click **Upload** button at the bottom of the loader window.
7. Successful completion of the upload will be confirmed with a message on the computer screen. The new firmware will run automatically in the device. (In case of any fail start the upload process again with **Upload** button.)

If necessary, click **Help** button of the loader application to learn more about firmware upload.

5. Troubleshooting

Problem	Solution
The device does not turn on.	<ul style="list-style-type: none"> • Replace alkaline batteries or charge rechargeable batteries. • Check polarity of batteries in the device.
The device turns off unexpectedly.	<ul style="list-style-type: none"> • If the device is not wirelessly connected to a computer (Link indicator does not light green), it turns off automatically after 5 min. • If the device turned off during measurement, batteries are probably flat. The status of batteries is shown with Power indicator. However, if you use Ni-MH rechargeable batteries, you might not notice a change of the indicator's color, as voltage can drop very quickly when those batteries get flat.
Cannot establish Bluetooth connection to a computer when measurement or impedance test is started (Link indicator does not shine).	<ul style="list-style-type: none"> • Check if there is „Serial Port Device” on the list of Bluetooth devices configured to work with your computer. If not, add the Bluetooth device following hints in help of your operating system. Pairing code required to add the device is 0000. During that activity the device should be turned on and placed near the computer. • Check if your computer has built-in Bluetooth port or suitable adapter is connected to USB port. • Check if drivers of Bluetooth hardware have been correctly installed in the computer. Check if your computer is able to connect to other equipment having Bluetooth interface, e.g. cell phone (it may require configuration of such a device and the computer at the beginning).
Link indicator starts lighting orange during measurement or impedance test. Transmission of data to a computer is paused.	The device crossed the border of wireless communication range. Try to decrease the distance between the device and the computer (its Bluetooth port) quickly (within 1 min.)
Link indicator is regularly flashing orange. Data are not transmitted to a computer.	Lasting break of wireless connection ensued during data transmission, as the device has gone out of wireless communication range, interoperating computer application has not been closed correctly, computer has been turned off or due to other reasons. Turn off the device, place it closer to the computer and then turn it on again. Measurement session have to be restarted.

<p>Signal indicator lights red during measurement.</p>	<p>Check detailed statuses of individual channels and common voltage in used computer application (if it can show these information).</p> <ul style="list-style-type: none"> • If the application indicates exceeded acceptable level of common voltage, check if there is an electrode connected to VG socket and if it has good contact with skin. • If the application indicates exceeded measurement range of some channels, usually it is a result of incorrect electrical contact of those channels inputs (the device receives large interference in such a case). Check if corresponding electrodes have correct contact with skin and if plugs of sensors are inserted to full depth of appropriate sockets. For contact checking you can use impedance test available in device settings window of interoperating computer application. <p>In rare cases the cause of bad contact is a broken wire of a sensor (the defect may be invisible under insulation).</p> <ul style="list-style-type: none"> • Another cause of described indication may be setting of too small measurement range (e.g. ECG signal often exceeds 1000 μV range). • Check if not used (not connected) channels are turned off in device settings window. • Make sure that the sum of sample rates in active channels does not exceed maximum data stream given in technical data.
<p>Signal indicator is yellow during measurement.</p>	<p>The device detects lack of signal in one or more active channels.</p> <ul style="list-style-type: none"> • Check if there is no short circuit between electrodes, e.g. due to excessive amount of gel or paste. • Maybe a measured signal requires setting of lower (more sensitive) measurement range.
<p>Another problem with the device (or software of the equipment manufacturer).</p>	<p>Contact with technical support of the manufacturer: http://www.neurobitsystems.com/contact.htm.</p>
<p>A problem with software of another manufacturer.</p>	<p>If documentation of the software does not include the solution, search for it in a forum of that software users or contact technical support of the application manufacturer.</p>

6. Sources of additional information

1. Neurobit Systems website: <http://www.neurobitsystems.com/>
2. „Quick start with BioExplorer” tutorial:
http://www.neurobitsystems.com/download/BioExplorer_Quick_Start.pdf
3. „Quick start with BioEra” tutorial:
http://www.neurobitsystems.com/download/BioEra_Quick_Start.pdf
4. Application of EEG electrodes for typical neurofeedback protocols:
http://www.neurobitsystems.com/download/Application_of_EEG_electrodes.pdf
5. Documentation of Neurobit Recorder application:
http://www.neurobitsystems.com/download/Neurobit_Recorder.htm
6. Documentation of Neurobit Loader application:
http://www.neurobitsystems.com/download/Neurobit_Loader.htm
7. Website of CyberEvolution, Inc., the manufacturer of BioExplorer software:
<http://www.cyberevolution.com/>
8. Website of Proatech, LLC, the manufacturer of BioEra software: <http://www.bioera.net/>
9. Website of Soft-dynamics, the manufacturer of eBioo: <http://soft-dynamics.com/>
10. Website of BrainBay software: <http://www.shifz.org/brainbay/>
11. Website of Itallis Communications, the manufacturer of BioPlay package of biofeedback games: <http://www.itallis.com/>
12. Website of SomaticVision, Inc., the manufacturer of biofeedback gaming software:
<http://www.somaticvision.com/>
13. Technical support of the equipment manufacturer:
<http://www.neurobitsystems.com/contact.htm>

7. Technical data

Number of versatile measurement channels 4 (NO-4 model) or 2 (NO-2 model)

Resolution of ADC conversion 16 bits

Measurement capability:

Measured quantity	Application (measured signals)	Measurement ranges	Digital resolution	Measurement accuracy
Voltage	EEG, sEMG, HRV, EOG, ENG etc.	1000 μ V 8 mV	0.031 μ V 0.244 μ V	1 %
Resistance	Resistive sensors of non-electrical quantities	125 k Ω 1 M Ω	0.004 k Ω 0.030 k Ω	1 %
Conductivity	GSR (EDA) etc.	1..20 μ S (μ mho) 8..160 μ S (μ mho)	0.0006 μ S (μ mho) 0.005 μ S (μ mho)	
Temperature	TEMP	-18..120 $^{\circ}$ C	0.0037 $^{\circ}$ C	0.2 $^{\circ}$ C (from 0 to 70 $^{\circ}$ C)

Measurement sockets

Touch-Proof 1.5mm (DIN 42802)

Output sample rate
(set independently for each channel)

2000 | 1000 | 500 | 250 | 125 | 62.5 samples per sec. (15.625 for non-voltage measurements)

Maximum total sample stream

5000 samples per sec.

Passband:

- lower corner frequency (-3dB)
- upper corner frequency (-3dB)

0.3 Hz

up to 800 Hz (40% of the output sample rate)

Common mode rejection ratio (CMRR)

\geq 130 dB

Differential input impedance

100 G Ω typ. (DC)

Equivalent input noise
(EEG profile, 0.3..45 Hz band)

0.15 μ Vrms (1 μ Vpp)

Wireless data transmission

Bluetooth (2.4 GHz)

Wireless link range

10 m

Power supply

2 x AA – alkaline or rechargeable NiMH batteries

Battery life
(the device turned on and transmitting)

40 h typ.

Dimensions (L x W x D)

117 x 79 x 24 mm

Weight (with batteries)

200 g

Working temperature range

0..40 $^{\circ}$ C