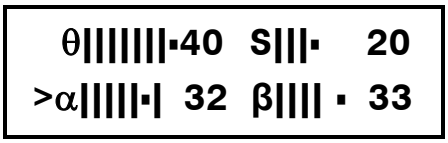
MONITOR protocol for Neurobit Lite device

This document describes new MONITOR protocol. Unlike protocols intended for neurofeedback training, it is rather intended for monitoring of general brain state. The protocol gives visual and audio information about brainwave relative amplitudes in basic EEG bands. General usage and most functions of Neurobit Lite device remain unchanged and are described in standard instruction manual for the product.

Screen view

The device's screen during MONITOR session is depicted below. It includes indicators of relative amplitudes in four frequency bands. The indicator for each band consists of a band sign, a bar of immediate amplitude (long strips) and filtered (averaged) amplitude (short strip), as well as a digital value of the filtered amplitude. A dominant band (with the highest filtered amplitude in a given moment) is marked with '**>**' sign on the left of a band sign.



The presented frequency bands:

Band sign	Band name	Frequencies [Hz]
θ	Theta	4-8
α	Alpha	8-12
S	SMR	12-15
β	Beta (Beta2, 3 & 4)	15-28

Percentage digital value on the screen is calculated as 100 (%) multiplied by an amplitude in a given band divided by the amplitude in the whole band of typical useful EEG signal (4-28Hz).

Range of amplitudes represented by bar indicators depends on the Protocol/Level setting.

Protocol/Level	Relative amplitude range [%]
Auto	auto-range, updated periodically
Beginner	0-40
Student	0-60
Advanced	0-80
Expert	0-100

Unlike for training protocols, for MONITOR protocol the level names do not reflect difficulty of the range achievement, just switch ranges of bar representation. Please also note that for Auto level a

lower range limit has not to be 0. The Protocol/Level option has no influence on displayed digital values.

If Session/Rounds option in on, every 4 minutes average round results are displayed on the screen. And when measurements are ended, average results of the whole session are shown. They are percentage amplitudes in the order of increasing band frequencies: θ, α, S, β.

Audio feedback

Audio signal in phones connected to the device enables continuous tracking of EEG changes even when watching the screen is not possible or is inconvenient. The amplitude in dominant band (in the range set for bar indicators, as described above) is mapped into sound pitch. Each band is attributed to a different instrument tone:

Band sign	Band name	Musical instrument
θ	Theta	Flute
α	Alpha	Guitar
S	SMR	Music Box
β	Beta (Beta2, 3 & 4)	Harp

Sound/Instrument and Sound/2nd instr. settings are not used for MONITOR protocol. All other sound options work as described in the instruction manual for the device.

Parameters

Default settings for MONITOR protocol:

Parameter	Value
Session/Level	Auto
Session/Duration	45 min.
Session/Rate	Medium
Session/Rounds	On
Sound/Tempo	4 per sec.
Sound/Pitch	1st octave
Sound/Range	2 octaves
Sound/Scale	Pentatonic
Sound/Direction	Upward
Sound/Play at	Note change

Those settings can be changed in the device's menu. All above parameters are set independently for each user (selected by System/User option of the menu).

Hints

- Digital values on the screen are relative values [%], and not absolute values [microvolts].
- In any moment the brain generates signals having components in many frequency bands. They fluctuate all the time, depending on current activity and unconscious processes.
- Proportions of brainwave amplitudes in individual EEG bands depend on several factors such as:
    - site of an EEG electrode(s) on the head (for example, Theta waves are typically higher in the front, whereas Alpha are higher in the rear);
    - eyes opened (more Beta on the back of the head) or closed (usually more Alpha in the back),
    - time of day ,
    - subject's age.
- Some interferences may have the frequencies overlapping with brainwaves, so they will raise presented amplitudes in concrete bands. Body motion artifacts and eye movement artifacts mainly influence Theta band, whereas muscle tension (or EMG signal) may be partially seen in Beta band. Avoid such interferences as far as possible to ensure that displayed values are connected only (or mainly) with brain activity.
- For complex and variable signals, such as EEG, amplitudes in individual frequency bands cannot be simply added to receive the signal amplitude in the whole frequency range. For this reason the sum of displayed percentage amplitudes is not equal 100 %.