



NEUROSOFT
Since 1992

NEURON-SPECTRUM SOFTWARE

**USER MANUAL
(VOLUME 1)**

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Neurosoft Ltd.

Address: 5, Voronin str, Ivanovo, 153032, Russia

Service Department: +7 (4932) 24-04-37 help@neurosoft.ru

Sales Department: +7 (4932) 24-04-34 com@neurosoft.ru

Fax: +7 (4932) 24-04-35

Internet: www.neurosoft.ru

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INTRODUCTION

We congratulate you on purchase of the **Neuron-Spectrum** digital EEG system. Before using it, please, read this manual carefully and keep it at hand as a reference guide.

We hope that our software will be helpful and enable you to solve problems of people health care more efficiently.

You can send your responses and recommendations to the following address:

P.O. Box 10, Ivanovo, 153000, Russia

or by e-mail:

com@neurosoft.ru.

You can find additional information on **Neurosoft** products in the Internet:

www.neurosoft.ru

You can also ask questions by phones:

+7 (4932) 24-04-37 (service department)

+7 (4932) 24-04-34

CHAPTER 1

LIST OF ABBREVIATIONS, DESIGNATIONS AND FONTS

We used following abbreviations, designations and fonts in this manual:

- *Italic font* – is used for the indication of selective alternatives, field meanings in a dialog box which are displayed on the monitor screen on the program work;
- **Bold font** – the names of dialog boxes, menu commands, names of keys and their combinations, manually given commands, file names;
- ***Bold italic font*** – is used for the italicizing of important text fragments that you should pay attention to;
- **[Key], [Key+Key]** – is used for the indication of keys and key combinations that you should press on the keyboard to fulfill some actions;
- **Menu, Menu|Command, Menu|Submenu|Command** is used for the indication of menu or menu commands that you should select to fulfill some action;
-  – is used for the indication of menu or menu commands that you should select to fulfill some action;
- “*Button*” – is used for the indication of the dialog box button, the click of which proceeds or ends the dialog.

CHAPTER 2

GUIDE TO WINDOWS ™ PROGRAMS OPERATING

Neuron-Spectrum EEG software runs in the Microsoft™ Windows™ 9x/ME/XP operating systems and uses friendly and handily arranged user interface. If you have some experience in working with Windows™ programs (for example, the Microsoft™ Word text editor), you will easily cope with our program as well. If you are working with Windows™ for the first time you should study this section carefully.

2.1. MOUSE

1. To work with the program you have to learn the main actions of operating the “mouse”. They include single and double clicks by the left mouse button, clicks by the right mouse button, highlighting, and “dragging”.
2. To point at an element move the mouse until its pointer (a small arm on the screen) is fixed on the element.
3. To click on an element fix the mouse pointer on it and then press and release the left button quickly.
4. To double click fix the mouse pointer on the element, then press and slacken the left button quickly two times, not moving the pointer between clicks.
5. To click on an element with the right button fix the mouse pointer on it and then press and release the right button quickly.
6. To highlight an element click on it. A highlighted element usually differs in color or frame presence.
7. To highlight a text item or an image fix the mouse cursor on the beginning of the text item, press the left mouse button, and move the cursor to the end of the item, not releasing the button. Then release the left mouse button. The highlighted item will be different in color.
8. To “drag” an element you should point at it with the mouse, press the left mouse button and move the element to the required place not slackening the button. After that you should slacken the button.

2.2. DESKTOP

1. The *desktop* is the image you can see on the screen when there are no programs (tasks) started or all the windows are minimized (Pic. 2.1).

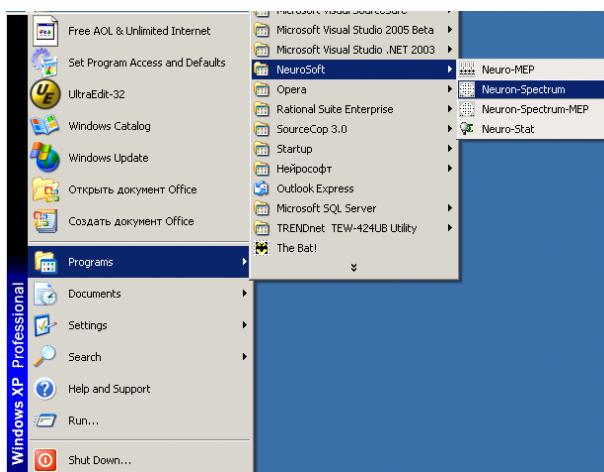


Pic. 2.1

2. On the desktop you can see the icons of the programs installed on your computer. A double click on the icon will start the program. At the bottom of the desktop you can see the Taskbar with the “*Start*” button of the main menu.

2.3. START MENU AND TASKBAR

1. Using menu *Start* is the fastest way to start programs that have no icons on the desktop. Click on the *Start* button, then select the **Programs** item of the pull down and as the menu of the following levels are being opened find the required program (Pic. 2.2).

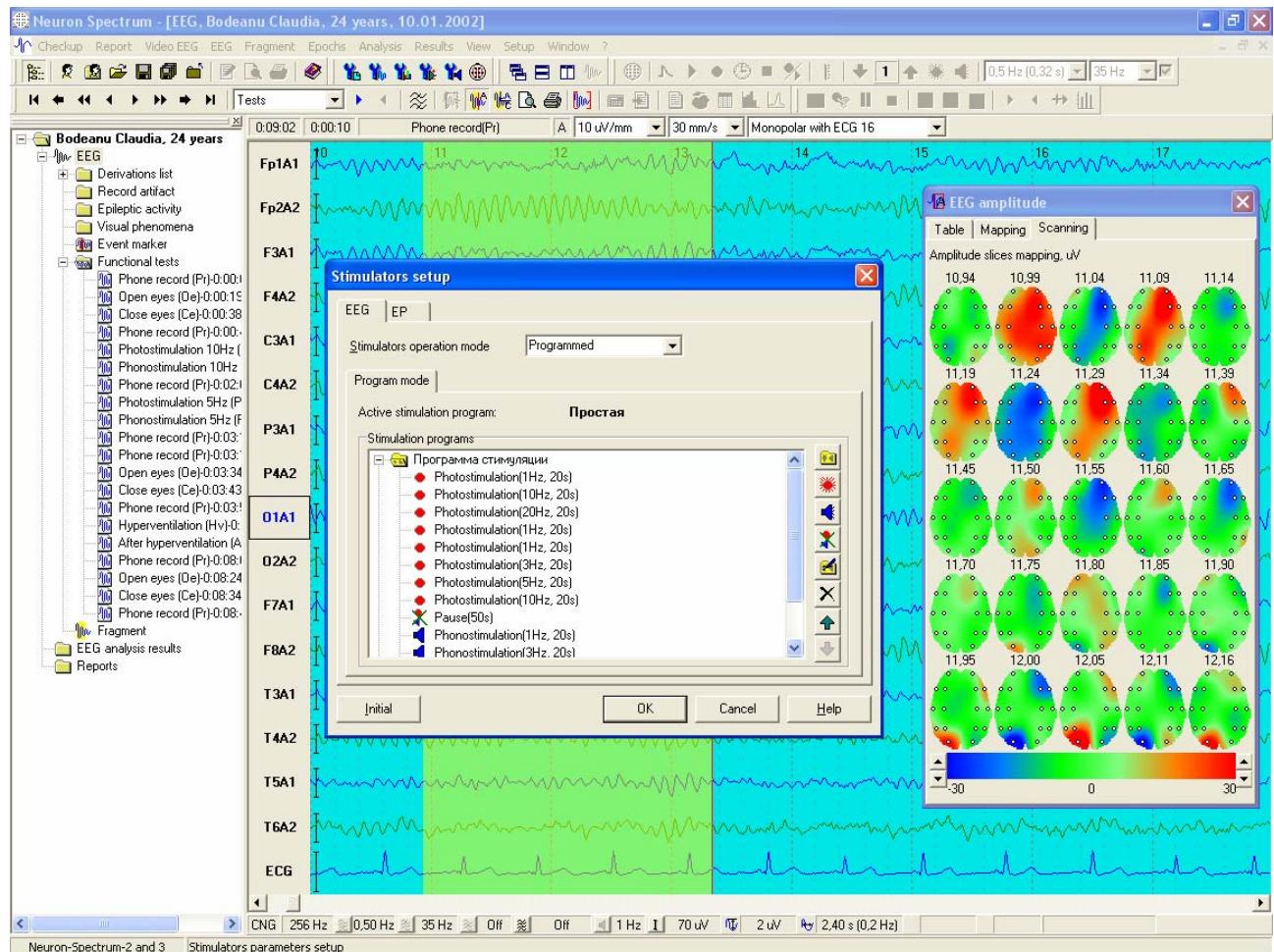


Pic. 2.2

2. On the Taskbar you can see buttons for activating working programs (Pic. 2.1). Click any of them to activate the window of this program.

2.4. PROGRAM WINDOW

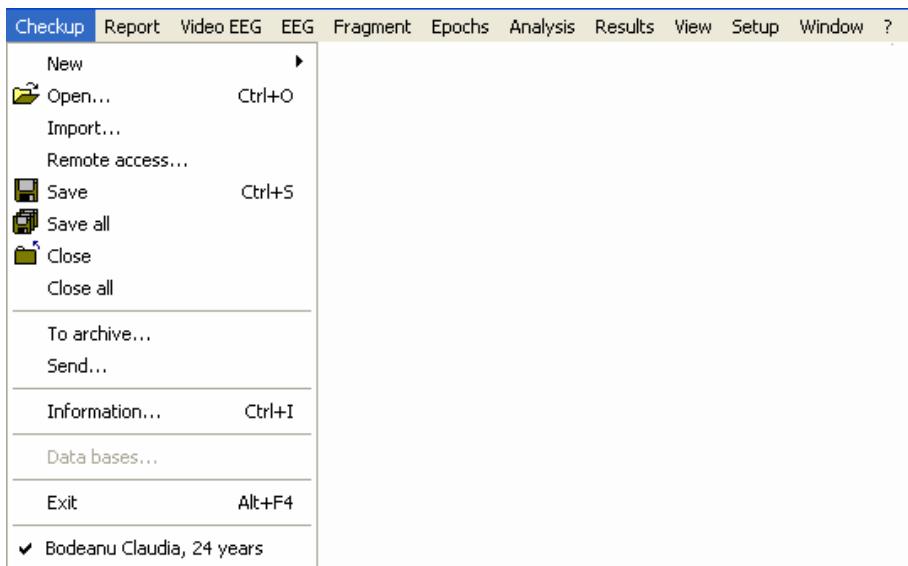
The programs running on your computer are displayed as windows. A *window* contains a title, a menu, a toolbar, a status line, an internal area, which in its turn may contain sub windows with dialog boxes, lists, bookmarks, buttons and flags (Pic. 2.3).



Pic. 2.3

2.5. MENU

1. *Menu* is the line at the top of the program window. Using the menu you can give the program commands to do some tasks. When you select a main menu item, a pull down will appear (Pic. 2.4).



Pic. 2.4

2. When you select a pull down item (menu command), the commands of this item (command) will be performed. To give a command from the menu use one of the following ways:

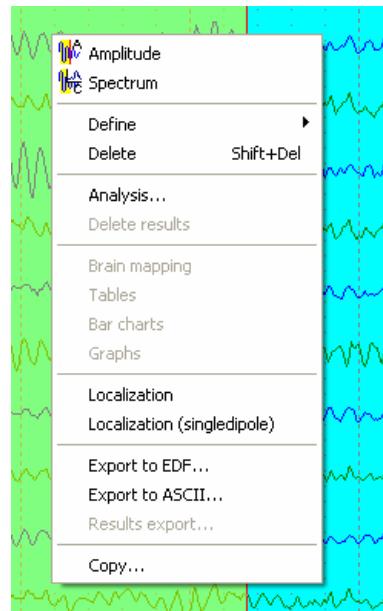
- press the button [F10] or [Alt], using cursor control keys (arrow-keys) select the required menu item and press [Enter];
- move the mouse pointer to the required menu item and press the left mouse button;
- use the [Alt+selected letter] key combination.

3. There are names of “hot” keys on the right of some menu items. Having pressed a “hot” key you can immediately start the command.

It is often necessary to press a key combination rather than a single key. For example, to press the [Alt+X] key combination you should keep [Alt] pressed and not release it until you press [X].

2.6. CONTEXT MENU

1. Right mouse button click evokes the so-called “*context menu*” (Pic. 2.5).



Pic. 2.5

2. Context menu contains the commands, which are typical for a certain object and can change its features (characteristics).

2.7. TOOLBARS

1. *Toolbar* is a bar containing buttons and placed under the menu (Pic. 2.6).



Pic. 2.6

2. The buttons on the toolbar duplicate the items of the main menu in order to speed up your work. To click on any button press the left mouse button.

2.8. STATUS LINE

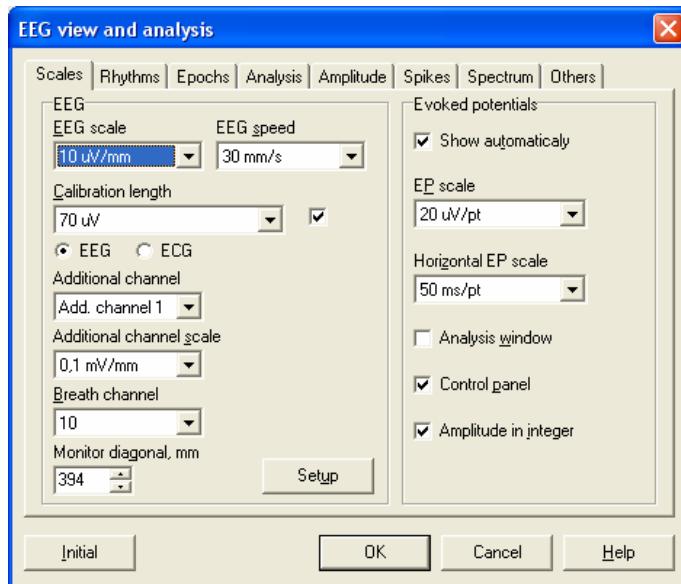
Status line is situated at the bottom of the program window. It contains brief information about the current status of the program and tips about the functions of the control elements active at the moment.

2.9. WINDOW

Window is a screen section that is separated on four sides by a window frame that has a title, a menu, fold, unfold and close buttons.

2.10. DIALOG BOX

1. A *dialog box* is a type of a common window (Pic. 2.7). It contains program interface and program management elements, for example, edit lines, lists, tabs, and buttons. The dialog panels enable to specify or modify some program parameters that will change the logic of the process. Dialog boxes appear when you select the menu item ended in dots.



Pic. 2.7

2. The main difference between a dialog box and a common window is that the dialog box is modal. It means that you can't refer to the other elements of the program (the menu, the toolbar, etc.) until the dialog box is closed.

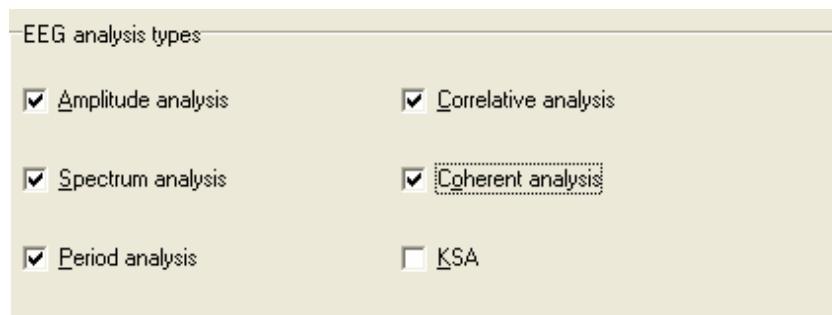
3. To close the dialog box you should do one of the following:

4. click “OK” if you want to save all the changes you made in the box;
 - click “Cancel” if you don’t want to save any changes;
 - click on the close button of the window or press [Esc]; in this case you will cancel all the changes.
5. Dialog boxes may contain various control elements:
 - **Edit lines** (Pic. 2.8) are used for the entering of textual or numerical information.



Pic. 2.8

- **Check-boxes** (Pic. 2.9) choose any number of elements or operation in the list of alternatives. Click the check-box to place it. If it is already set, click it once more to abort.



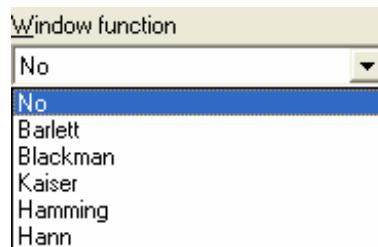
Pic. 2.9

- **Radio-buttons** (Pic. 2.10) choose only one element or operation in the list of alternatives. Click the button to check it.



Pic. 2.10

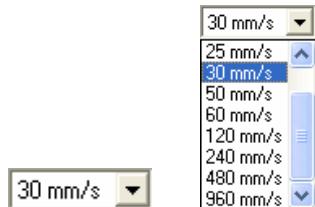
- **Lists** (Pic. 2.11) are used for the enumerating of possible alternatives and enabling you to select one or several of them. To select an element on the list you should click on it.



Pic. 2.11

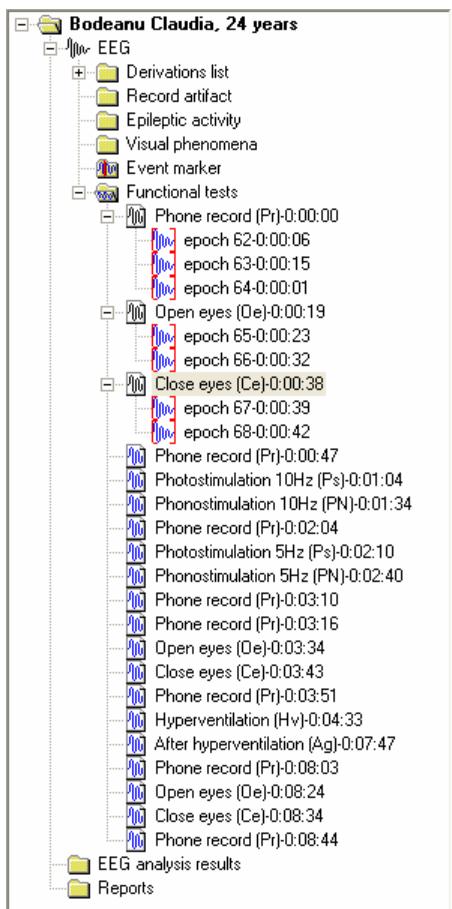
Neuron-Spectrum Program

- **Combo-boxes** (Pic. 2.12) – differs from the list only in one characteristic: in the combo box the possible alternatives list appears after you click on the button on the right of the list.



Pic. 2.12

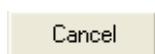
- **Tree views** (Pic. 2.13) differ from ordinary lists: each element has its own sub-elements.



Pic. 2.13

If the sub-elements are hidden, leftward of the main element you will see the **+** icon. If they are shown, the **-** icon will appear (Pic. 2.13). To show or hide the sub-elements, click on the icon on the left of the element.

- **Buttons** (Pic. 2.14) are used for commanding. To do a command you should click on the button. In that case we are going to use “click the button” term.



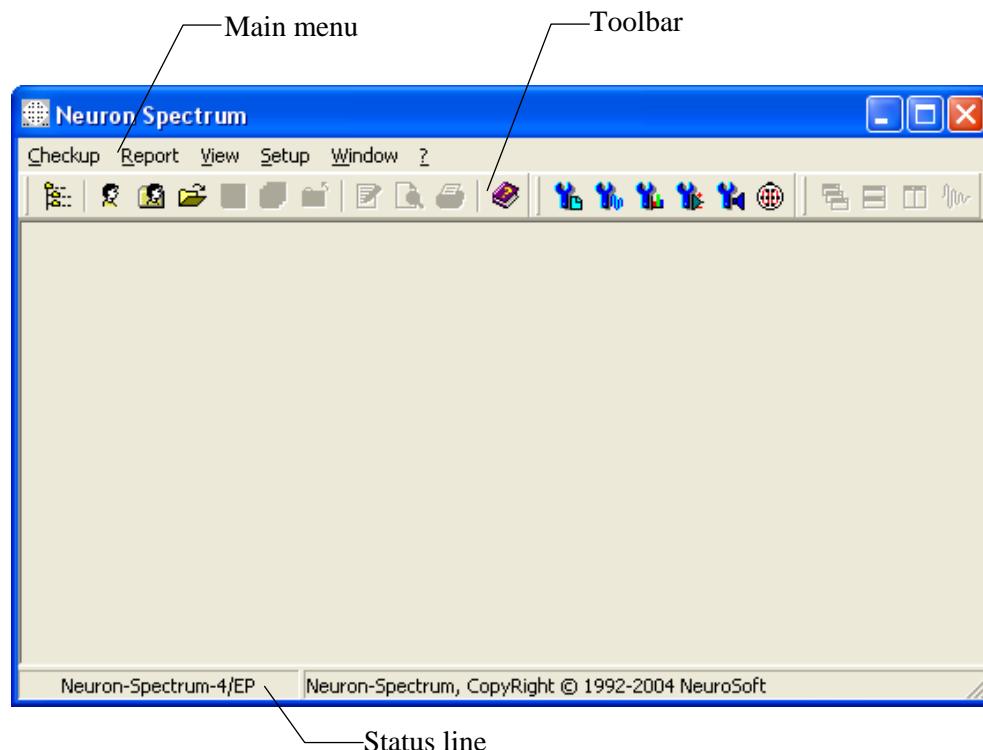
Pic. 2.14

CHAPTER 3

RUN AND EXIT OF NEURON-SPECTRUM SOFTWARE

1. To run the program **Neuron-Spectrum**, click on the “*Start*” button on the taskbar and choose **Programs|Neurosoft|Neuron-Spectrum**.

After the program has loaded, its main window will appear (Pic. 3.1). At the top of it you will see the menu items: **Checkup**, **Report**, etc. Below the menu there is a toolbar. At the bottom of the window you will find the status line.

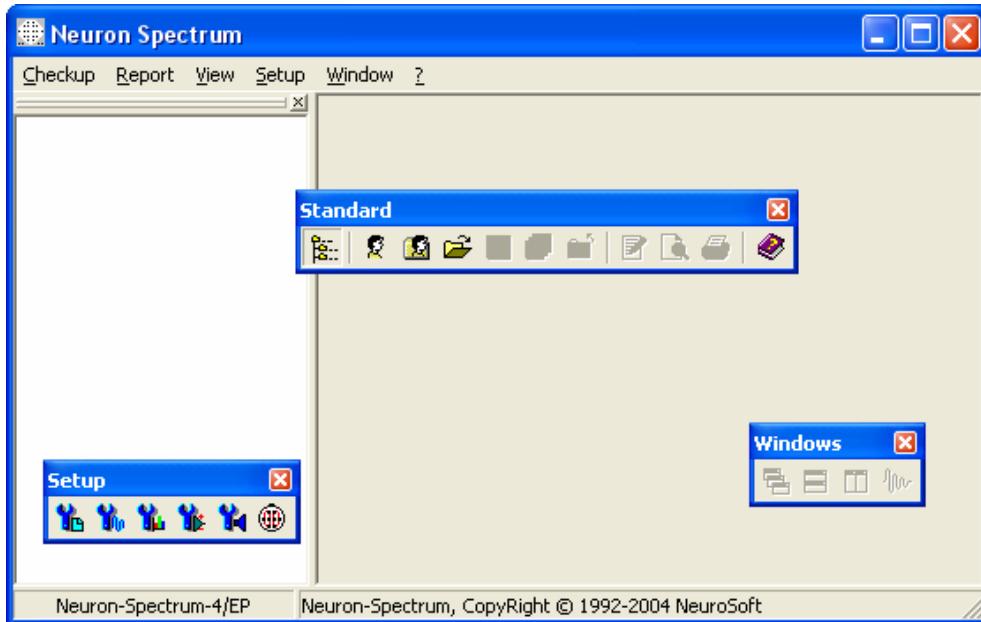


Pic. 3.1

2. To control program running, use the menu, more precisely, the choice of a menu item (command). The most frequently used menu commands are duplicated with the buttons on the toolbar.

Neuron-Spectrum Program

3. You may place the toolbars at the top of the window (under the menu) (Pic. 3.1), or “hang” them up in the center (Pic. 3.2). To do this, “catch” the bar by clicking its moving marker  and drag it to the required location.



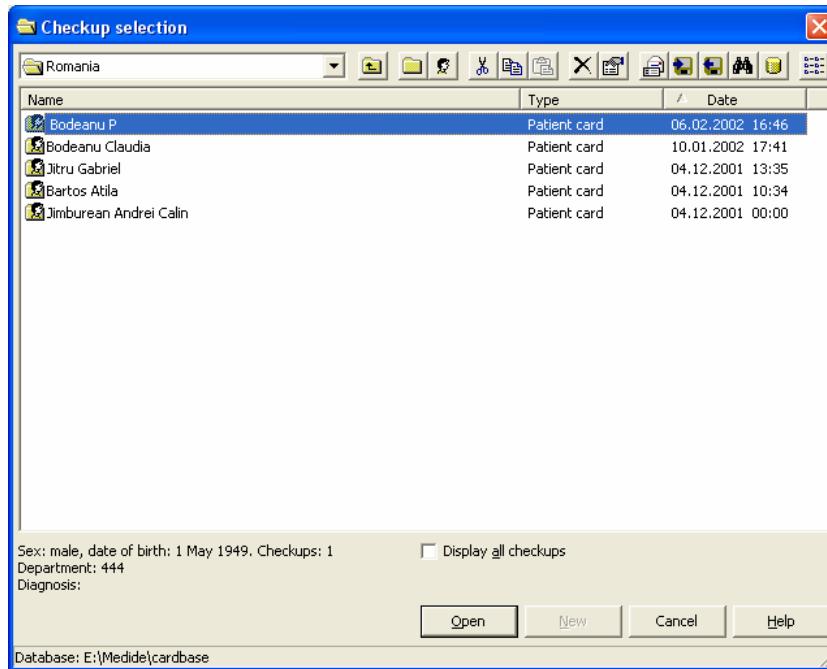
Pic. 3.2

4. The program is provided with a context-dependent help system. At any point you can look through a detailed reference by clicking [F1] or (if it is available) on the “Help” button.
5. When registering patients’ signal the program uses central processing unit (CPU) and system resources of your PC. For this reason we strongly recommend you not to start any other applications while the program is running.
6. To exit the program, use one of the following methods:
 - click **Exit** on the **Checkup** menu;
 - press **[Alt+F4]** (first press **[Alt]**, hold it down and press **[F4]**);
 - click on the close box  at the upper-right corner of the screen.

CHAPTER 4

NEUROSOFT DATABASE

1. All the **Neurosoft** programs installed in your PC work with the same database, which uses such terms as *catalogue (card file)*, *catalogue system (card-file system)*, *patient*, *patient card*, *checkup*.
2. *Checkup* is used here as data received during medical examination using the **Neuron-Spectrum** program. It contains information about the patient, the electroencephalogram (EEG traces) and the checkup report.
3. *Patient* is a person registered in the **Neuron-Spectrum** database. Each patient has a *patient card* with his surname, name, patronymic name, sex, date of birth, etc. The patient card can save a number of checkups held in different time by any **Neurosoft** devices.
4. *Patient cards* are saved in a catalogue that is a set of patient cards and checkups. Each catalogue has its own unique name and may contain sub-catalogues.
5. *Catalogue system (card-file system)* is a sum of all the catalogues. In other words, it is a *database* that saves all the **Neuron-Spectrum** information. Well-compiled catalogue system organizes the database and simplifies access to it.
6. You can work with database using the **Checkup selection** dialog box (Pic. 4.1). You can open it by clicking **Checkup|Open** of the main menu (the button  on the toolbar).



Pic. 4.1

At the top of the window there is a hierarchical pull-down list (combo-box) of card-files and patient cards of the current level as well as several buttons for creating, deleting, copying, properties editing and sending of card-files, patient cards and checkups by e-mail, working with archive and switching between databases.

The most part of the window is occupied by a list of enclosed card-files and patient cards of the chosen current card-file or by all the checkups of the current patient card.

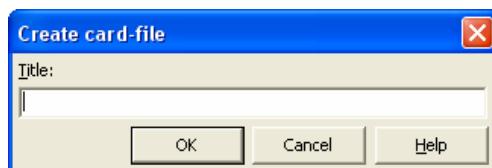
As a rule, operations with the window are carried out in the following way. At first, you should select *Card-files* on the pull-down list. It is the upper level of the card-file hierarchy. Then you should go down to the level of the required card-file each time double-clicking on the name of a card-file with the left mouse button. And finally after double-clicking on the required patient card with the left mouse button you will see his/her checkup list. Now you can either create a new checkup for this patient or open one of his previous checkups.

Working in this window you also can do the following:

- create, delete or rename a catalogue (card-file);
- create, delete or edit a patient card;
- copy or replace a card-file or a patient card from one catalogue (card-file) to another;
- save the data of one or several checkups into the archive file;
- restore the data from the archive files;
- make a complex search of a patient card;
- send a patient checkup, a catalogue (card-file) or a card by e-mail;
- work with data base administrator.

4.1. HOW TO CREATE NEW CATALOGUE (CARD-FILE)

To create a new card-file you should go down the hierarchy to the card-file where you want to create a sub-card-file. Then you should press the  button. The **Create card file** dialog box will appear on the screen (Pic. 4.2).



Pic. 4.2

In the *Title* edit line enter the name of a new card-file and press [Enter] key.

The principles of patient's layout within the card-files are entirely determined by your aims and objects.

Principles of patient's layout within the card-files are based on the basis of diagnoses, on the basis of the age or by any other sign.

4.2. HOW TO RENAME THE CARD-FILE

To rename a card-file select it on the list and press the  button. In the *Title* edit line of the **Card-file** dialog box appeared put down a new name of the card-file and press [**Enter**] key.

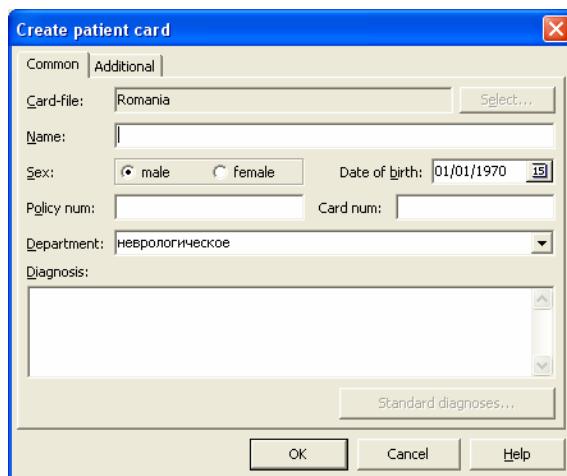
Note: It is possible to rename a card-file providing that all the checkups within it are closed. Otherwise, the card-file is considered to be booked and its deleting, copying and replacing are impossible.

4.3. HOW TO DELETE THE CARD-FILE

To delete a card-file you should select it on the list and press the  button or the [**Del**] key. A dialog box will appear on the screen asking for the confirmation of the card-file deleting. Click on the “Yes” button. The card-file will be deleted. After card-file deleting the enclosed card-files and information about all the patients registered in it are deleted automatically.

4.4. HOW TO CREATE A NEW PATIENT CARD

To create a new patient card in the database (to register a patient) press the  button. In the **Create patient card** (Pic. 4.3) dialog box appeared give all the registration information about the new patient: name, sex, date of birth. You may also enter a brief comment upon the reasons of consulting a doctor, preliminary diagnosis, etc.



Pic. 4.3

On the *Addition* page of the window you can enter the patient's address and phone number as well as a commentary containing the reason of the patient's appeal and other information about him/her.

4.5. HOW TO EDIT A PATIENT CARD

To change or supplement the information stored in a patient card you should press the  button and make necessary changes in the **Patient card** dialog box appeared.

4.6. HOW TO DELETE A PATIENT CARD

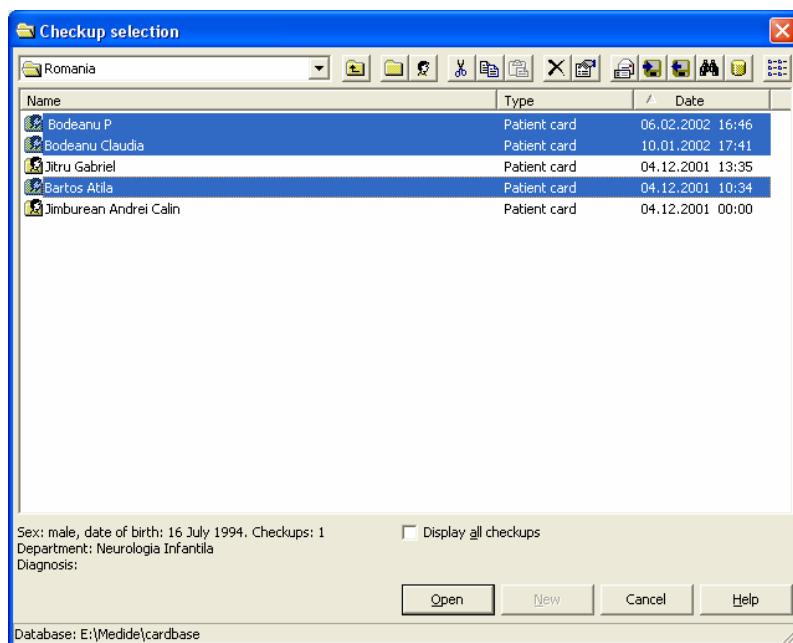
To delete a patient-card you should select it on the list and press the button . A dialog box will appear on the screen asking for the confirmation of the patient card deleting. Click on the “Yes” button. The patient card will be deleted.

Note: It is possible to delete a patient card from a card-file providing that all the checkups within the card-file are closed. Otherwise, the card is considered to be blocked.

4.7. HOW TO COPY AND MOVE A PATIENT CARD

To copy patient-card or card-file from one card-file to another:

- Select **Checkup|Open** menu command;
- In the **Checkup selection** dialog box select card-files or patient cards which should be copied, highlight them by a mouse. You can also copy and move patient cards using a multiple choice, i.e. in groups. A multiple choice implies successive clicking on several objects of a patients list while holding **[Ctrl]** or **[Shift]** down (Pic. 4.4).

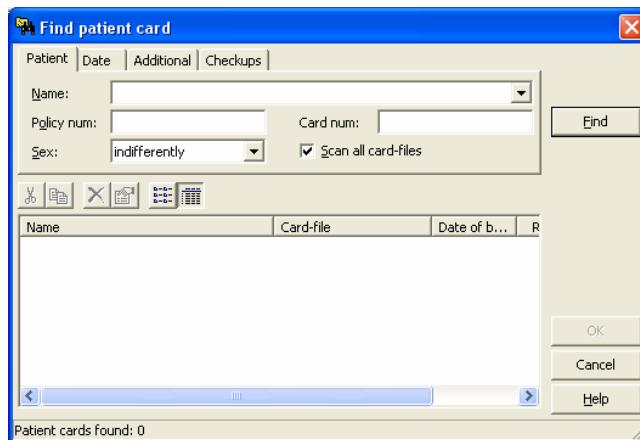


Pic. 4.4

- To copy highlighted objects into the clipboard click on the button. If you would like to move the objects into a new place, use the button.
- To paste into the card-file to which you would like to copy the selected object and press the button.

4.8. SEARCHING PATIENT CARDS

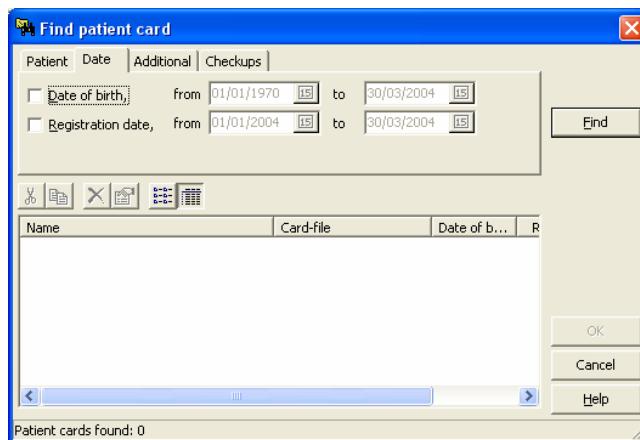
1. To organize a patient card search you should click on the button in the **Checkup selection** dialog box. The **Find patient card** dialog box will appear on the screen (Pic. 4.5).



Pic. 4.5

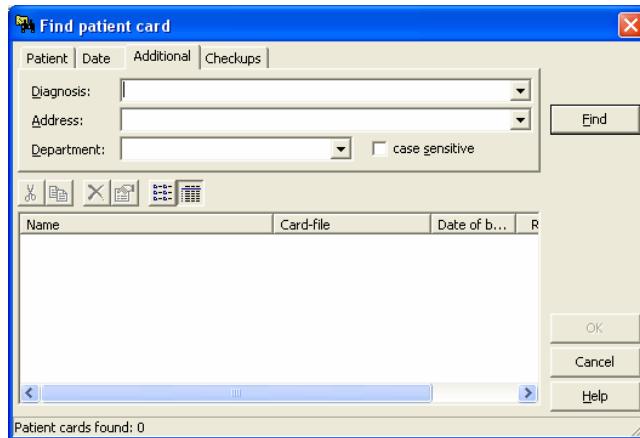
On the *Patient* page in the *Name* enter patient's name (several first letters of the name is enough). In the *Sex* combo-box indicate the sex of the patient. Set the insurance number. If you wish to organize the search in all the card-files check the *Scan all card-files* flag (if the flag is not activated the search will be organized only in the current card-file).

2. On the *Date* page you can input the range for a patient's date of birth and a registration date (Pic. 4.6).



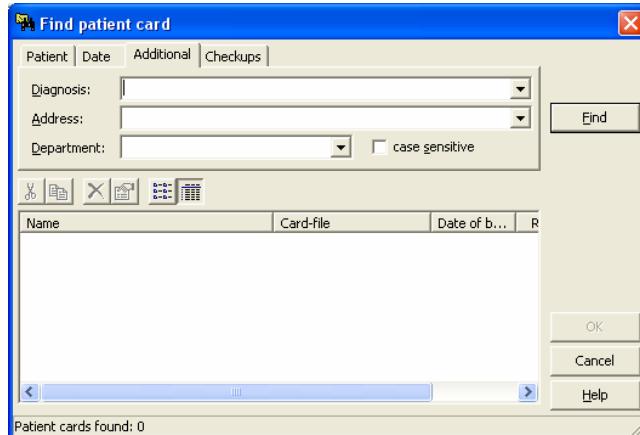
Pic. 4.6

3. On the *Additional* page you can input additional settings for patient card search (a line from the diagnosis, the address and the ward) (Pic. 4.7).



Pic. 4.7

4. On the *Checkups* page you can input the search settings for the cards with the checkups you specify (Pic. 4.8).



Pic. 4.8

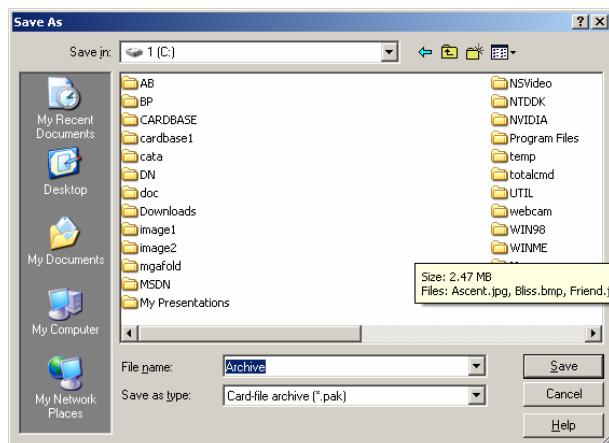
5. After setting all the necessary conditions click on the "Find" button. The program will organize the search of all the cards meeting the given conditions and will display them on the list at the bottom of the window. Status line will show their amount. You can switch over to any of the cards by double-clicking on it.

4.9. CHECKUP ARCHIVES

1. If you regularly need to transfer checkups from one computer to another long-term storage medium (CD, streamers, magneto-optic disks etc.), you need to master some checkup archiving techniques. You can add to archives one or several card-files, patient cards or checkups.

2. Using **Checkup|To Archive** menu command you can save the checkup opened in the program to the archive. To create archive of several checkups, cards or card-files, in the **Checkup selection** dialog box choose one or several card-file system objects enumerated above. You can choose several objects by successive clicking on them holding the **[Ctrl]** key down. After that press  button.

The **Save as** dialog box will appear on the screen (Pic. 4.9).

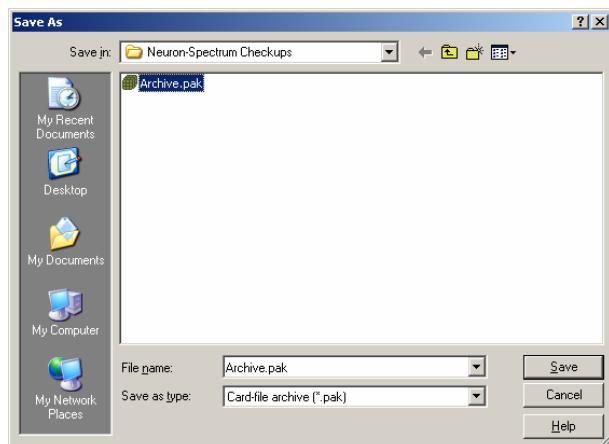


Pic. 4.9

In this box enter the folder to which you would like to record the archives and the name of the archives. Click on the “Save” button. The program will start archives recording to the given medium. If there is no more free space on the medium the program will suggest replacing it.

3. To extract checkups from the archives you should select in the **Checkup selection** dialog box (Pic. 4.4), a card-file to which you would like to extract the checkups and click on the  button.

The **Open** dialog box will appear on the screen (Pic. 4.10).



Pic. 4.10

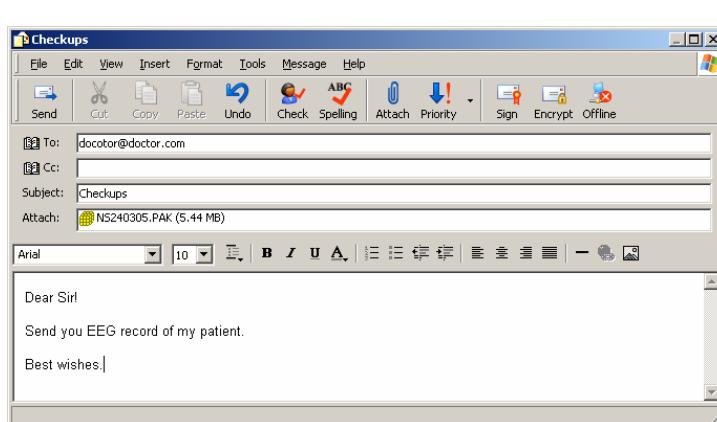
Input the archives file here and click “*Open*”. The program will extract the checkup and place it into the current card-file.

4.10. E-MAILING CARD-FILES, PATIENT CARDS AND CHECKUPS

You can e-mail checkup results providing the computer is connected to the internet. Using the **Checkup|Send** menu command, you can send the opened in the program checkup on the e-mail.

To e-mail one or several checkups:

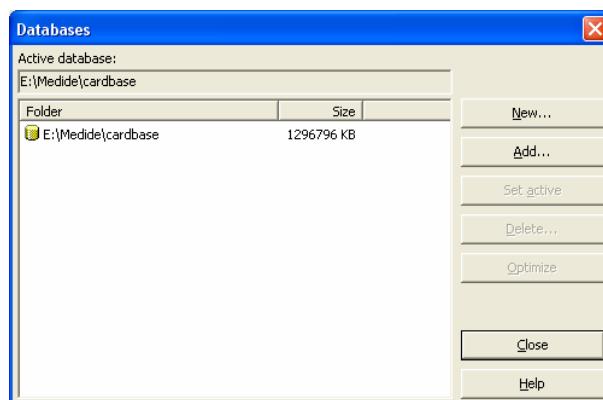
- In the **Checkup selection** dialog box (Pic. 4.4) select the required card-files, checkups or patient cards.
- Click . In the e-mail box appeared (Pic. 4.11) enter the address of the recipient and the message, if required. Then click .



Pic. 4.11

4.11. WORK WITH DATABASES

1. You can set up several databases in the program as required. They will be on local disks of PC or in the local net but you can work with one (active) base only. To work with database, chose **Checkups|Database** menu command or press the button in the **Checkup selection** dialog box (Pic. 4.4). The **Databases** dialogue box will appear on the screen (Pic. 4.12).



Pic. 4.12

2. The “*New*” button. New cards system (databases) creation. After you press that button, the dialog with the folder (catalog) request is appeared. The database can be created as in the existing folder as well as in a new one on the computer disc. The only restriction is that the folder should be empty. It is possible to create databases on any computer within the local net, for example on the general server of a hospital. The disc where the database is created should be open for the record.

3. The “*Add*” button. The database connection which is on the computer disc or in the net, but is not in the database list. The database is from the net disk or the local CD, for example. Net disk with the database *must be open for the record*.

4. The “*Set active*” button. To make active the selecteds database from the list, i.e. available to all **Neurosoft** programs.

5. The “*Delete*” button. To delete database selected in the list. The active database at the present moment can not be deleted.

6. The “*Optimize*” button. The database compression. Using the button you can make free space on the hard disk. The fact is, when you delete checkups from the database, the occupied place is not getting free in practical situation. You can make it free with the help of “compression” only. It is recommended to make that operation after the sizeable checkups deleting. And when there is lack of space on the hard disk. You should finish all the rest **Neurosoft** programs working with the card system before the optimization. The optimization time depends on the database volume and it can be quite long-continued. If the optimization process leads to the computer buzzing, then database contains outstanding units and can be restored with the help of “*New*” button.

4.12. CARD-FILES (DATABASES) CREATION ON CD OR PORTABLE DATA MEDIUM

1. As it is said above (see sec. 4.9), you can get a backup copy of any information from database by archiving. The lack of the approach is that you should restore the archive into the database completely in order to look through it. It is inconvenient if the archive volume is large.

You can copy the databases into the archive readable from the disc directly. To get such an archive, you should just copy (for example, with the help of **Windows Explorer**) the folder with all files of database to the disc for the archiving. The name of the folder (catalog) with database is in the lower edit-line of **Checkup selection** dialog box (Pic. 4.4).

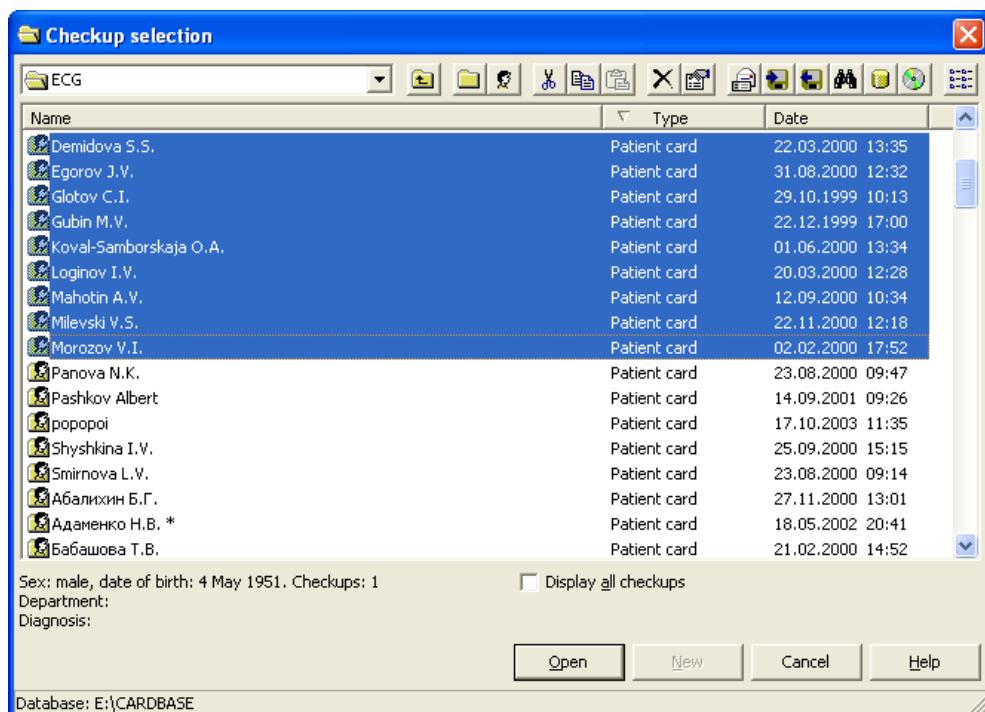
Later, to look through the archive, you should execute **Checkup|Database** menu command and connect archive card system (see sec. 4.11).

2. You can copy the database to any data medium (CD or DVD including). One should remember that on the following scanning of the database archive from the CD, it is possible to do from the local (not net) drive, i.e. the drive located on the same computer from which the execution program is initiated.

3. If you copy database from the CD to the hard disc conversely, you should remember, that the programs for the CD creation usually mark all files as “read only”. It makes impossible to edit them. Before connection of the database copied from the CD to the hard disc of computer, you should clear the “read only” flags in all database files by means of operating system. If the last phrase is not clear, please consult the experienced computer user in order to make the operation.

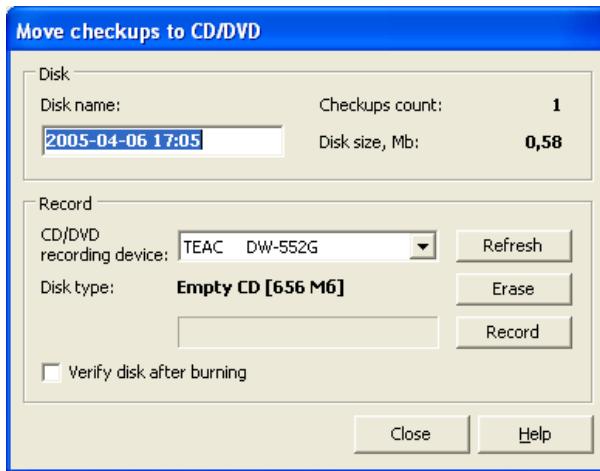
4.13. MOVE CHECKUPS TO CD

1. If the volume of checkup database becomes rather big, you can move the part of checkups to compact disc (CD or DVD). For this purpose your computer should have CD- or DVD- writer and also the **Windows XP** operation system. In the dialog box **Checkup selection** (**Checkup|Open** menu command) choose the card file (folder), patient card or checkup. You can apply multiple selection using the buttons **[Ctrl]** and **[Shift]**. The example is given on the Pic. 4.13.



Pic. 4.13

2. Having chosen the necessary checkups for moving, press the [F9] or the  button in the upper right part of the window. On the screen you will see the dialog box **Move checkups to CD/DVD** (Pic. 4.14).



Pic. 4.14

In the *Disk name* edit line it is necessary to set the name (mark) of the disc for its identification in future. By default the name of the disc composing of the current time and date will be offered to you, but you can name the disc as you wish.

In the *Checkups total* label, the quantity of checkups for moving is displayed.

In the *Disk volume* label the total size of data for moving is pointed. If it exceeds the compact disc size, the operation of moving will be impossible and you will have to reduce the size of data for moving or use the compact disc of bigger size.

If your computer has several CD- or DVD-writers, it is necessary to choose the drive for writing in the *CD/DVD recording device* combo-box.

The *Disk type* label gives the information about the presence of blank disc in the selected CD- or DVD-writer and its free volume.

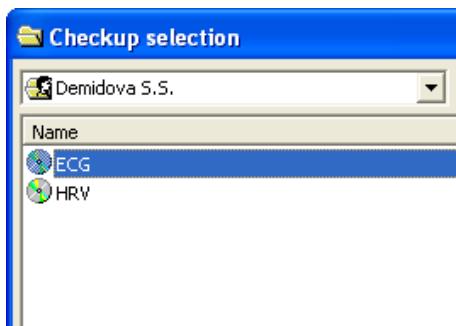
If you set the blank disc after the opening of this dialog box or changed the disc, press the button “*Refresh*” for refreshing the information about the disc.

If your CD- or DVD-writer supports the rewritable discs, you can clear the rewritable disc by pressing “*Erase*” button. The process of cleaning will take from 10 up to 30 seconds and after its finishing the program will inform you about that.

Verify disc after recording option indicates that after the disc recording, the verification of all moved files will be done. If the verification result will show that the recording is done with errors, the operation of moving will be annulated and you will be offered to use other disc.

3. To start the process of data moving, press the “*Record*” button. The indicator will show the recording process. The duration of the compact disc recording depends on the data volume, writer specifications and disc type. After the finishing of the recording, the verification of the disc will be done (if the option *Verify disc after recording* is set) and the message about the successful finishing of recording will appear on the screen.

4. After the moving process, all checkups transferred to CD, will be marked by the CD icon (Pic. 4.15). At that in spite of your seeing the checkup in the dialog box **Checkup selection**, it is not on the computer hard disc, and if you will try to open it, the corresponding compact disc will be demanded.



Pic. 4.15

5. There are several peculiarities when checkups moving and you should remember them:

- ***The moved checkups can be opened only for reading.*** If you want to make a copy to change it, than copy the required checkup in the other card file (the program will demand the compact disc with the moved checkup when copying).
- When checkup moving, only the part of checkup is copied to CD (DVD) that is why ***the removal of the moved checkup out of the database is the irreversible operation.***
- ***The checkups move to CD (DVD) discs is possible only using the Windows XP operation system.***
- ***For DVD discs recording it is necessary to install the “Nero Burning Rom” software with the version number not less than 5.5.9.9 (it is not included in the delivery set, produced by “Ahead Software AG” Company).***
- In case of “***Nero Burning Rom***” software absence, it is necessary to enable ***IMAPI CD-Burning COM Service***, in case this service is disabled. To enable this service, use **Administration/Services** from Windows **Control Panel**.

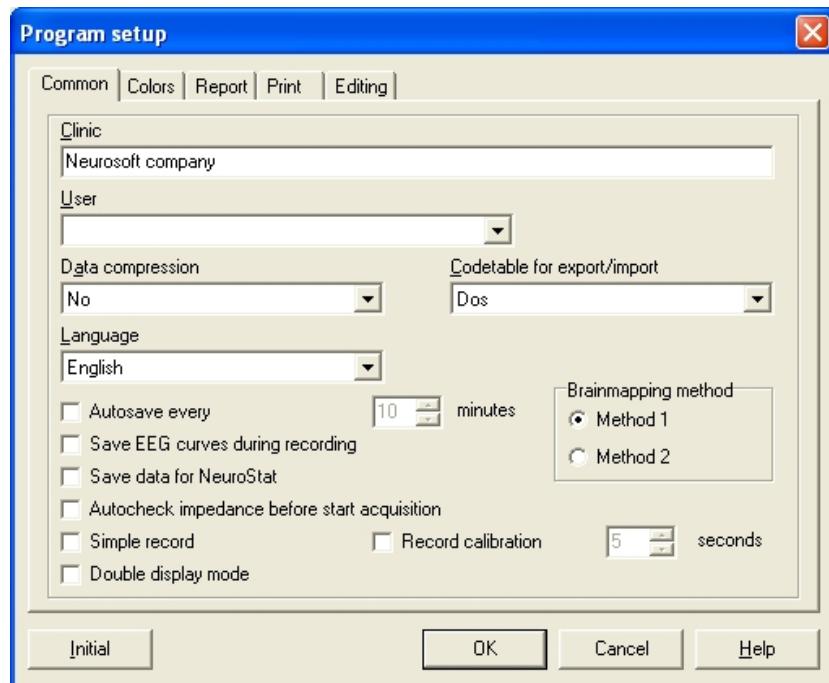
CHAPTER 5

SETUP OF SOFTWARE, HARDWARE AND PARAMETERS OF EEG REVIEW AND ANALYSIS

Before starting your work with the EEG system you will probably need to set up software and hardware parameters. In this case use the **Program...**, **Analysis...**, **Results...**, **Equipment...**, **Stimulators...** menu items in the **Setup** menu. The menu items are duplicated with  buttons on the **Setup** toolbar.

5.1. PROGRAM SETUP

1. To set up program parameters, click on the **Setup|Program** menu item or the  button of the **Setup** toolbar. The **Program setup** dialog box will appear on the screen (Pic. 5.1).



Pic. 5.1

2. *Common* page (Pic. 5.1).

Clinic. The name of your clinic. The name will be automatically inserted into the titles of all the documents you print.

User. User's (doctor) name.

Data compression. The data compression degree when saving checkups in database. High compression degree saves the hard disk space, but slows down checkup recording and reading.

Code table for export/import. The way of Russian text coding on exporting or importing checkups (electroencephalograms) to EDF and UDF formats. Select the coding according to the operating system import or export programs run under. Select "DOS" or "Windows". "Pseudo-Latin" means that Latin equivalents are substituted for Russian letters. For example, **Иванов** will be coded as **Ivanov**.

Language. The language of communication between the program and the user. This version of the program supports Russian, English, French languages.

Neuron-Spectrum Program

Autosave every... minutes. If the flag is checked, on the analysis and viewing process, the EEG program will save all checkup changes in the database automatically in a specified period of time.

Save EEG curves during recording. If the flag is checked, the software will save EEG-traces during recording in the database automatically when new functional probe is switched on.

Save data for NeuroStat. If the flag is checked, on finishing the work with checkup (and if you have performed EEG math analysis), the program will save the analysis results in the database, in order that the program of statistical treatment **NeuroStat** will be able to work with them. You should take into account that the saving of data can take much time.

Autocheck impedance before start aquisition. If this flag is checked, then before the monitoring or EEG recording mode is switched on for the first time, the impedance is automatically checked.

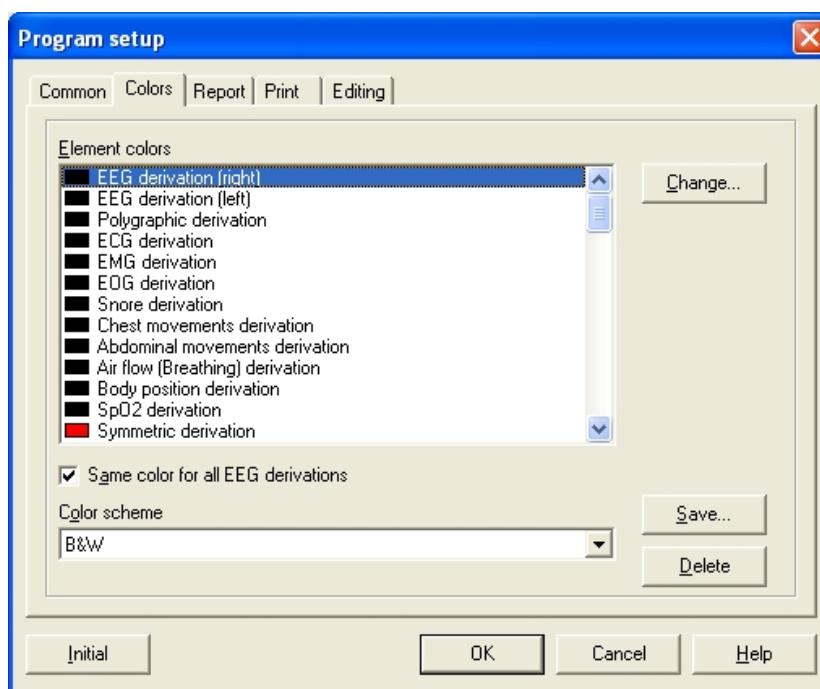
Simple record. If the flag is switched off, one can use the standard mode of EEG recording. If the flag is checked, the simple EEG record mode (without functional probe) is used. It is described in the section below.

Brain mapping method. There are two brain-mapping methods, which differ, by math methods of interpolation when mapping is got.

Record calibration. If the flag is initiated, in the beginning of the EEG registration the record of calibrating signal is performed within the period indicated in the edit line.

Double display mode. If this check box is checked, the special mode of operation is provided at the connection of two monitors to the computer. In this mode the first monitor displays always the electroencephalogram and the second one shows the windows with EEG analysis results, the report, etc.

3. The *Colors* page (Pic. 5.2).

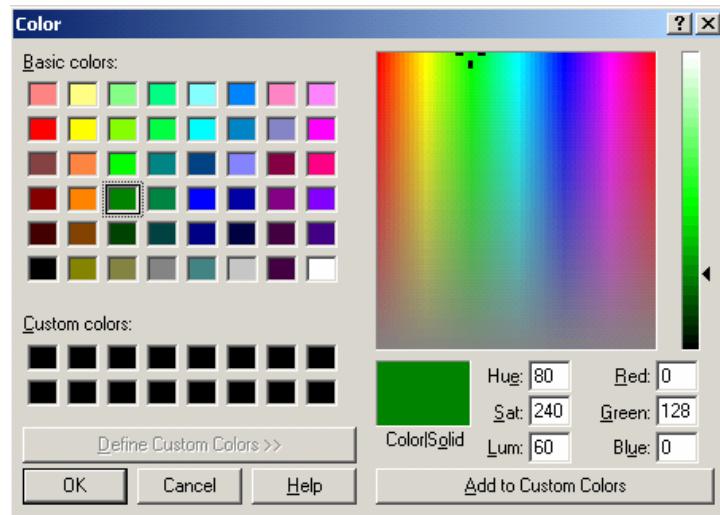


Pic. 5.2

You may set the colors of all the visible program elements.

Chapter 5. SOFTWARE, HARDWARE, EEG REVIEW AND ANALYSIS PARAMETERS SETUP

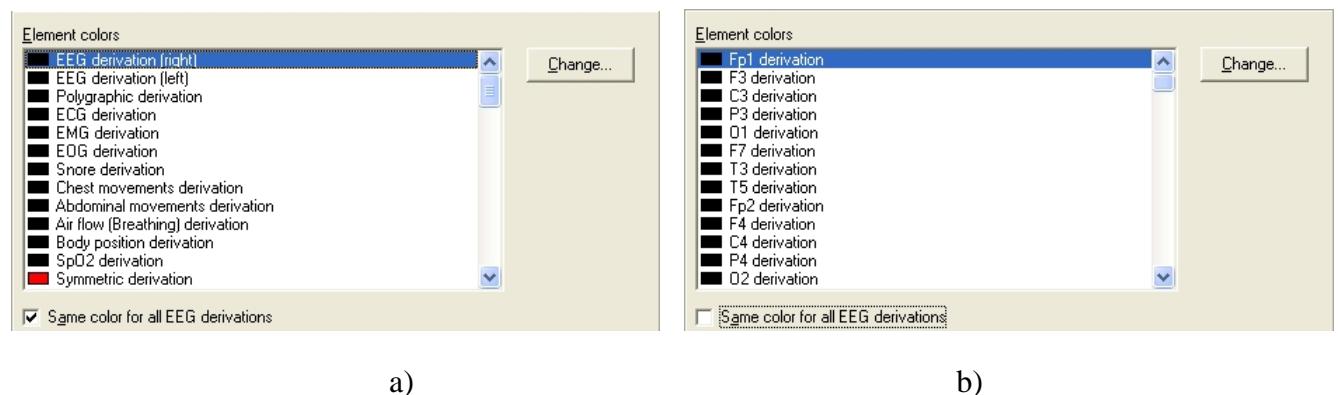
Element colors. The list of all the visible program elements and their colors. To change the color of an element, select the element and click on the “Change” button or double-click on the element. The standard **Color** dialog box will appear on the screen (Pic. 5.3).



Pic. 5.3

Select the required color in the basic palette or using the scale and click “OK”.

Same color for all EEG derivations. If the flag is checked, all the right side and left side EEG derivations are drawn the same color (Pic. 5.4a). If the flag is not active the *Element colors* list will contain the names of all the EEG derivations instead of the *EEG derivations (right side)* and *EEG derivations (left side)* items, and you will be able to set the unique color for each derivation (Pic. 5.4b).

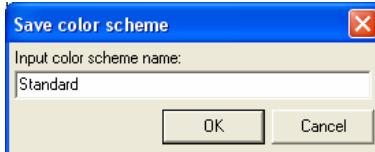


Pic. 5.4

Color scheme. To save the set of element colors use color schemes. The color scheme stores the colors of all the elements existing at its saving. At any time you can change the colors of all the elements at once by selecting one of the color schemes composed before. You can find the list of all the color schemes in the *Color scheme* combo box.

Neuron-Spectrum Program

To save the current element colors as a color scheme click on the “Save” button. The **Save color scheme** dialog box will appear on the screen (Pic. 5.5).

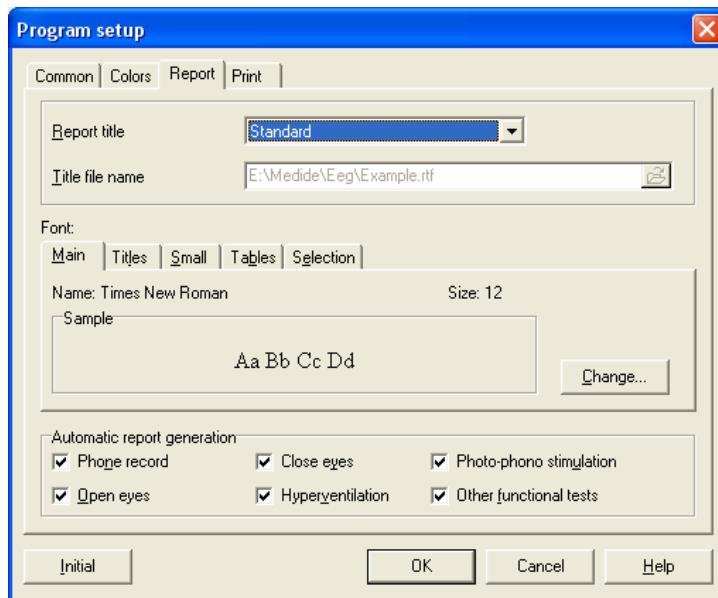


Pic. 5.5

Enter the scheme name in the *Input scheme name* edit line and click “OK”.

To change the colors of the elements according to one of the color schemes, select the required scheme in the *Color scheme* combo box. To delete color scheme push “Delete” button.

4. The *Report* page (Pic. 5.6).

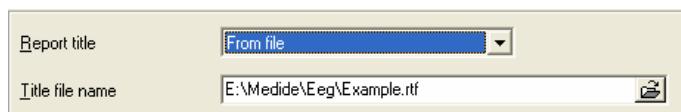


Pic. 5.6

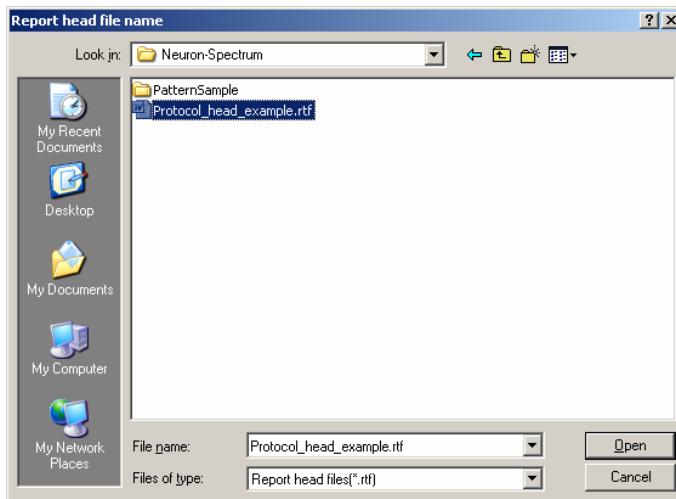
You can select the type of the report title in the *Report title* combo box.

If *Standard* is selected, the program automatically inserts the title, which is considered to be optimal.

If *From file* is selected the text from the external file in RTF format (Rich Text Format) will be inserted as a title. You can create such a file with the help of the WordPad text editor installed into the Windows operating system or the report editor installed into the program. This procedure is described below. You can select the name of the file with the title with the help of the *Title file name* browser by clicking the button (Pic. 5.7). Select the title file in the browser box appeared (Pic. 5.8) and click “Open”.



Pic. 5.7



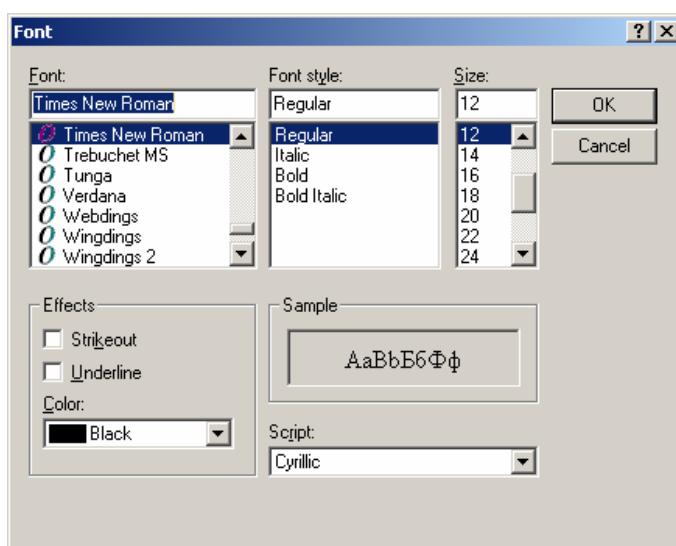
Pic. 5.8

If “*Do not use*” is selected the protocol will have no title.

If “*Do not use*” is selected the protocol will have no title.

With the help of the *Font* bookmarks you can set the style and size of the fonts used when creating a report. The following fonts are used:

- the main font (the *Main* bookmark) – is used for the basic text of the report;
- the titles font (the *Titles* bookmark) – is used for titles;
- the small font (the *Small* bookmark) – is used for the fragments of the report title;
- the table font (the *Tables* bookmark) – is used for the report tables;
- the important (selected) fragments font (the *Selection* bookmark) – is used for important semantic report fragments (Pic. 5.9).

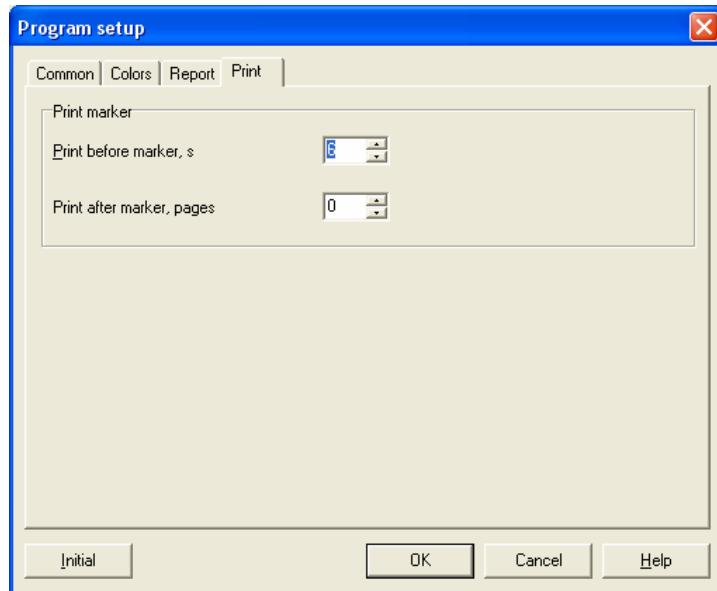


Pic. 5.9

Alter the font parameters and click “*OK*”.

The *Automatic report generation* set of flags enables you to include or exclude from the report the corresponding functional test descriptions.

5. The *Print* page (Pic. 5.10).



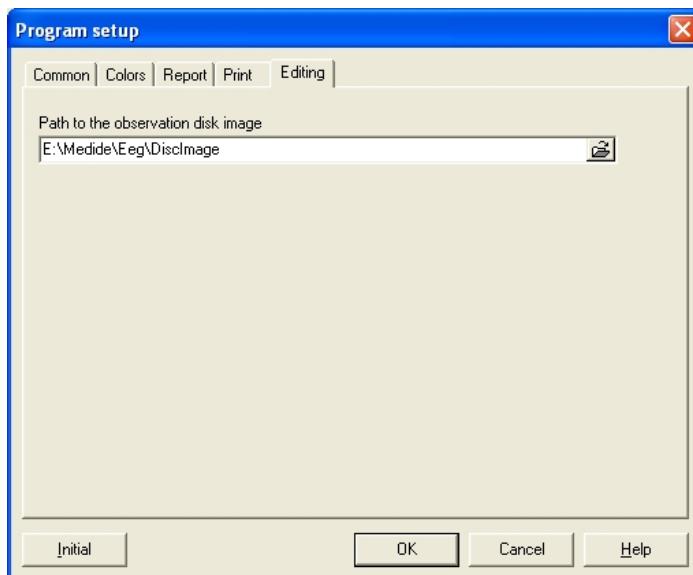
Pic. 5.10

Print marker – event marker, built-in the program. You can install it during EEG recording as well as during EEG reviewing by pressing the [P] key. The markers are indicated the EEG fragments which can be printed automatically immediately after stop EEG recording or any moment of EEG reviewing.

Print before marker, s. Number of seconds printed on the page before print marker.

Print after marker, pages. Number of pages, printed after the page where there is the print marker.

6. The *Editing* page (Pic. 5.11).



Pic. 5.11

Chapter 5. SOFTWARE, HARDWARE, EEG REVIEW AND ANALYSIS PARAMETERS SETUP

Path to the observation disk image. To burn the disk with the checkup and EEG review program which can be given to a patient and used for the review of the recorded EEG on any computer, it is necessary to create a folder on a hard disk. The image of the burned disk will be prepared in this folder. Indicate the pathway to this folder in the given field.

Attention! If you click the “Initial” button in the **Program setup** dialog box, all the current page parameters will be restored to the default values.

5.2. CREATING OF TITLE FILE TEMPLATES OF CHECKUP REPORTS

1. To create the title template file load any of the checkups. Select the **Report|New** menu item. In the **New report** dialog box appeared select the *Build in* item using the *Report type* radio button and click “*OK*”. In the report editor window you can enter any text of the report title with the so-called tags, or words of automatic substitution. Here is the list of possible tags and their description (Table 5.1).

Table 5.1

Name	Description
\$NAME	The patient's name and surname
\$AGE	Age
\$SEX	Sex
\$BDATE	The date of birth
\$REGDATE	The date of registration
\$CARDCOMMENT	Comments on the patient card
\$ADDRESS	The patient's address
\$PHOHE	The patient's phone number
\$DATE	Checkup date
\$LONGDATE	Checkup date (month in words)
\$SEPARATION	The department
\$COMMENT	Comments on the checkup
\$DIAGNOSIS	The diagnosis
\$CARDNAME	Card-file name
\$ORGANIZATION	The organization name
\$OBSERVATION	The checkup type (installed into the program)
\$©	The copyright string
\$DEVICE	The EEG system type
\$PROTONAME	The report name (entered when creating the report)
\$DOCTORNAME	The user's name
\$MONTAGE	EEG-montage

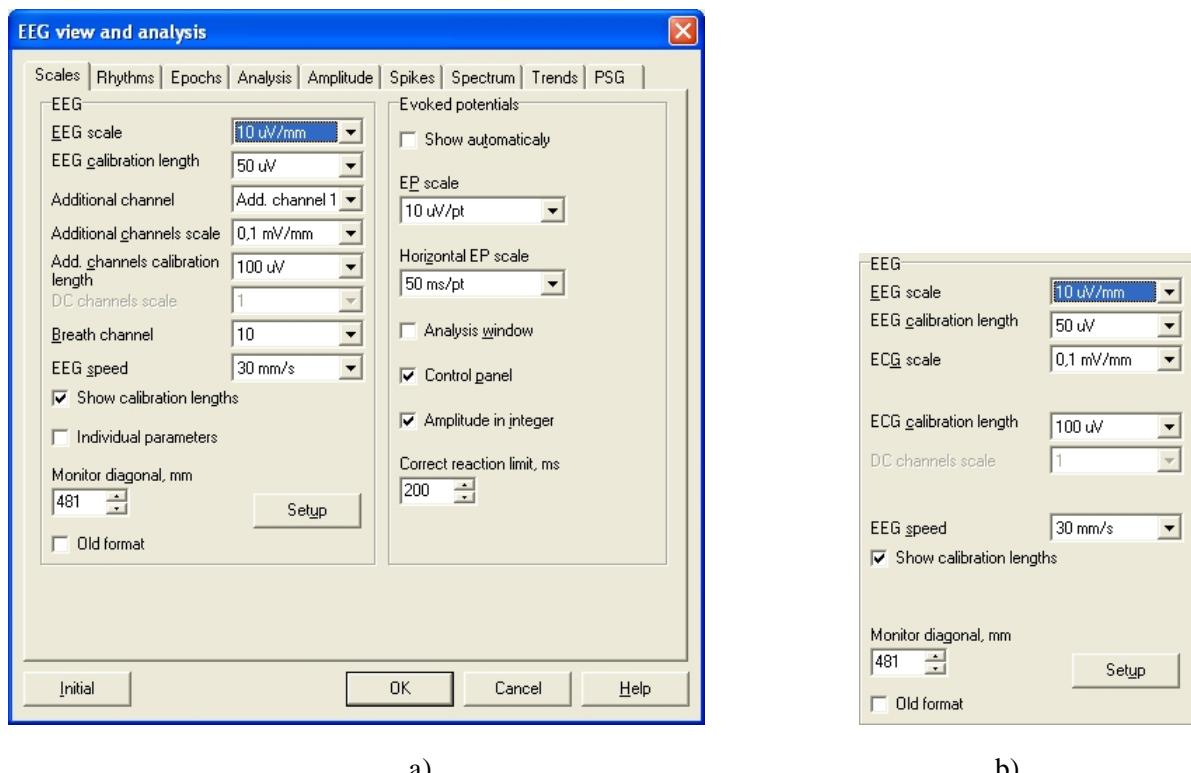
2. The algorithm of automatic tag substitution works in the following way. Each time you create a new report, the program opens the title template file you created and transmits the information to the new report. The corresponding tag value specific for the particular checkup is automatically substituted for the tag identified by the program. For example, the line: “Patient \$ NAME, \$AGE” for the checkup of I. Ivanov, 26 years old, will be written as “Patient: *I. Ivanov, 26 years old*”.

N.B. Mind that the font format is saved even after tag substitution. In the abovementioned example the tags \$NAME and \$AGE are written in Italic font. The substitute words are also Italic.

3. After you have created the required report title form, select the **Report|Export** menu command. In the **Save file** dialog box enter a template name. Click “Save”. To include the title template into the report, select the **Setup|Program** menu command. On the *Report* page (Pic. 5.6) in the *Report title* combo box select *From file*. Use browser (Pic. 5.8) to input the name of the template you created. You can find the example of the report title description template in the file named **Protocol_head_example.rtf**.

5.3. EEG REVIEW AND ANALYSIS PARAMETERS SETUP

1. To set up the EEG review and analysis parameters, select the **Setup|Analysis** menu command or click on the  button on the **Setup** toolbar. The **EEG view and analysis** dialog box will appear on the screen (Pic. 5.12).



Pic. 5.12

2. The *Scales* page (Pic. 5.12).

- a) for **Neuron-Spectrum-4 (v.1), 4/EP, 4/EPM, 4/P, 1, 2, 3, 4, 5** and b) for **Neuron-Spectrum-1, 2, 3 (v.1)**.

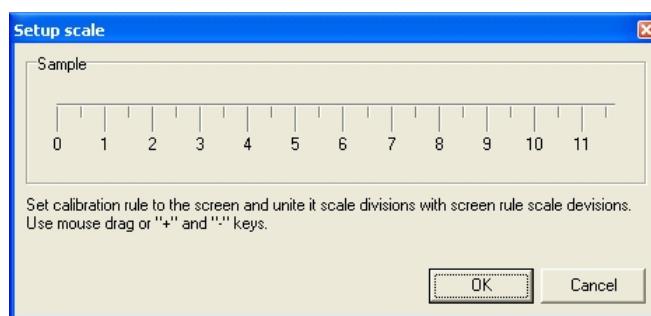
In the *EEG scale*, *EEG speed*, *ECG scale*, *EP scale*, *EP speed* combo boxes you can specify the values of the corresponding scales and “paper” speed of EEG, ECG, and EP curves on the screen. One should take into account that the group *Evoked potentials* will be displayed in the dialog box, if you have the **Neuron-Spectrum-LEP** program installed (see chapter 18).

If the *Individual parameters* check box is checked, you can set individual scale on every EEG derivation during EEG recording and reviewing. If the check box is unchecked, the same scale for every EEG derivation set in *EEG scale* combo box is used.

Using the combo boxes *EEG calibration length*, *Add. channels calibration length* and the check box *Show calibration lengths* you can control the size and the visibility of the calibration lengths on EEG, ECG and other polygraphic channels curves (the check box is checked – the lengths are visible)

Use the *Additional channel*, *Additional channel scale*, *DC channel scale* and *Breath channel* combo boxes to set the scale of the signal displayed on additional channels, DC channels and breath channel for **Neuron-Spectrum-4 (v.1), 4/EP, 4/EPM, 4/P, 1, 2, 3, 4, 5** digital EEG systems.

Monitor diagonal. The diagonal of the monitor used for the EEG displaying is set in millimeters. If the diagonal size is specified correctly, the curves are displayed on the screen accurately according to the specified scales. To set the size of the monitor diagonal correctly, press the “*Setup*” button. The dialog box of the monitor size setting **Setup scale** (Pic. 5. 13) will appear on the screen. Specify the ruler size on the screen according to the office ruler. After that the monitor diagonal sizes will be set automatically.



Pic. 5. 13

The *Old format* check box can be checked if your past checkups performed several years ago can not be downloaded from the database.

If the *Show automatically* check box in group of *Evoked potentials* is checked, in the presence of evoked potentials record (EP) in the checkup, the EP window is opened automatically and the first recorded EP test is displayed in it.

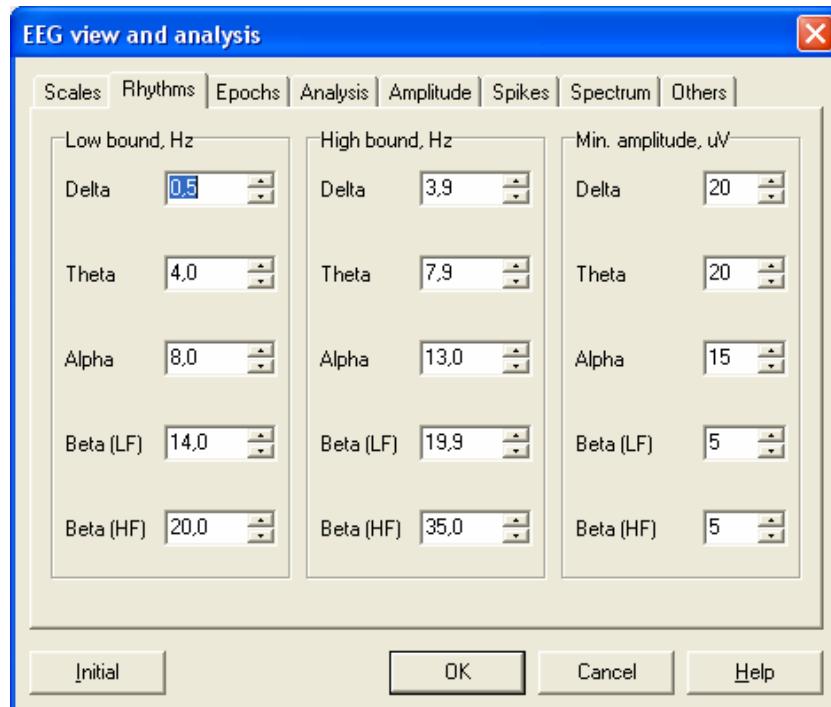
The *Analysis window* check box determines whether the window of EP analysis results is automatically displayed (the check box is checked) or not (the check box is not checked) after the EP test registration is finished.

The *Control panel* check box determines whether the control panel of EP curves and results is displayed automatically or not.

The *Amplitude in integer* determines how the meanings of EP component amplitudes are displayed in the tables (in integer or real numbers).

Correct reaction limit. The maximum response time (pressing of the patient button) for the cognitive EP. If the response time (pressing of the patient button) is lesser than this interval (after the stimulus supply), this pressing is considered to be incorrect.

3. The *Rhythms* page (Pic. 5.14).

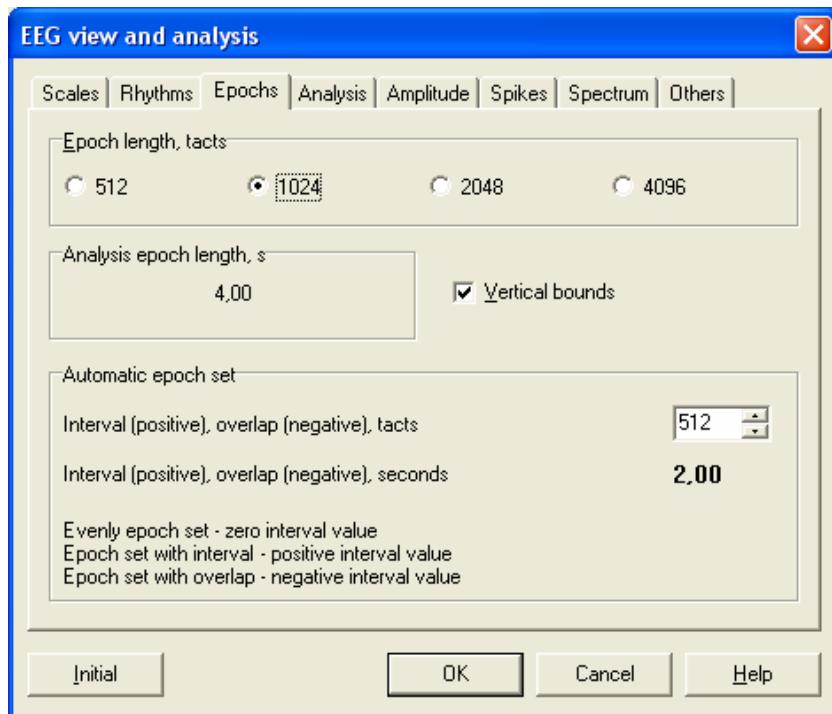


Pic. 5.14

The *Low bound, Hz* and *High bound, Hz* edit lines determine the limits of standard EEG-rhythms frequency ranges: Delta, Theta, Alpha, Beta (high frequency and low frequency ranges).

For each EEG-rhythm the *Min. amplitude, uV* edit line indicates the minimal amplitude used in EEG analysis and checkup report creating. If the amplitude of the corresponding rhythm is low that indicated, the amplitude meaning for the rhythm will be zero in the amplitude analysis results table.

4. The *Epochs* page (Pic. 5.15).



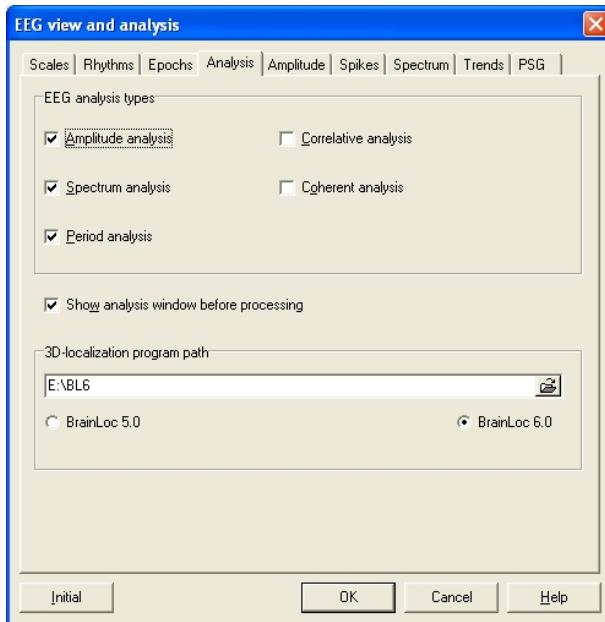
Pic. 5.15

The size of analysis epoch in quantization tacts is set with the *Epoch length, tacts* radio-buttons. The *Analysis epoch length, s* box indicates the analysis epoch duration in seconds. This value is calculated according to the current sampling rate. For example, at 200 Hz sampling rate and analysis epoch of 512 tacts the analysis epoch duration will be $512/200 = 2.56$ seconds.

Providing the *Vertical bounds* check box is checked vertical lines are displayed at the beginning and at the end of the analysis epoch.

For automatic setting of analysis epochs with an interval or overlap use *Interval (positive) overlap (negative), tacts* edit line. If you would like to get interval between setting epochs, set the positive value. If you need to get overlap between epochs, set the negative value. If you want to get evenly epochs, set zero value. Interval or overlap duration in seconds is indicated in the *Interval (positive) overlap (negative), seconds* box.

5. The Analysis page (Pic. 5.16).

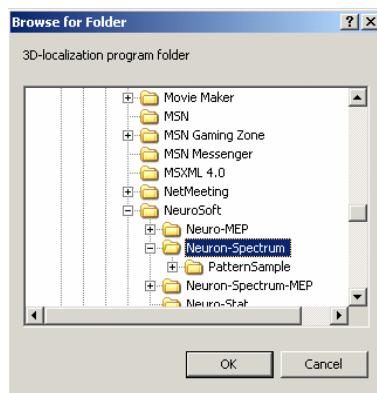


Pic. 5.16

The *EEG analysis types* check boxes indicate the types of EEG analysis being performed. If the check box is checked the corresponding type of analysis will be performed and the analysis results will be created.

If the *Show analysis window before processing* check box is checked, the program will show this window each time before starting EEG analysis. This enables you to change easily the EEG analysis types performed.

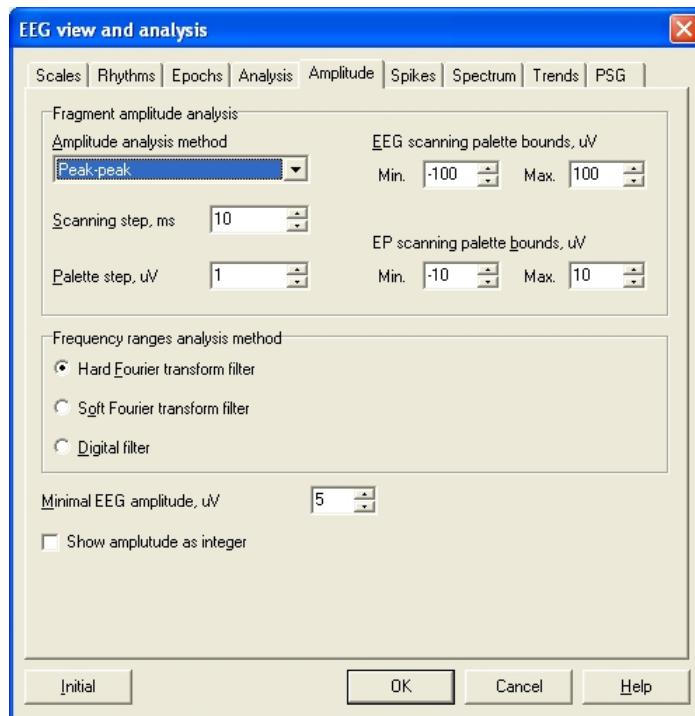
The *3D localization program path* edit line allows you to select the folder (the catalogue) with the program of three-dimensional localization of brain pathologic activity sources, in case you use the program. To select the folder, click . Select the required directory in browser (Pic. 5.17) and click “OK”.



Pic. 5.17

Chose the same version of used **BrainLoc** program: The **Neuro-Spectrum** program supports the fifth (*DOS*-version) and sixth (*Windows*-version) of the **BrainLoc** program.

6. The *Amplitude* page (Pic. 5.18) indicates the parameters of EEG or EP fragments amplitude analysis as well as the parameters of epochs EEG analysis.

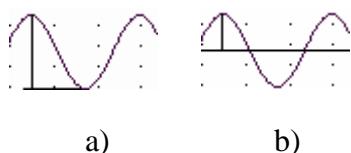


Pic. 5.18

Using the *Amplitude analysis method* combo box you can determine the EEG or EP waves amplitude method of measuring.

The *Peak-to-peak* method calculates wave amplitude from peak to peak (Pic. 5.19a).

The *Isoline-peak* method calculates wave amplitude from isoline to peak (Pic. 5.19b).



Pic. 5.19

The *Scanning step* edit line indicates the time interval (in milliseconds) for amplitude map scanning during the EEG and EP fragments amplitude analysis.

The *Palette step* edit line indicates the alteration step for maximum and minimum palette values during amplitude mapping of EEG or EP fragments.

The *Frequency ranges analysis method* radio buttons indicates the method of frequency ranges dedication during the amplitude analysis of EEG epochs.

If the *Hard Fourier transform filter* value is selected, the program will apply direct and inverse Fourier transform. To single out frequency ranges a “square” band-pass filter is used.

If the *Soft Fourier transform filter* value is selected, the program will apply direct and inverse Fourier transform. To single out frequency ranges, band-pass filter is used with 40 Db slope of a characteristic for a decade.

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If the *Digital filter* value is selected, the program will use a digital filter with adjustable frequency response rigidity. You can adjust the digital filter rigidity in the EEG view and analysis mode (the **EEG|Filtration** menu command).

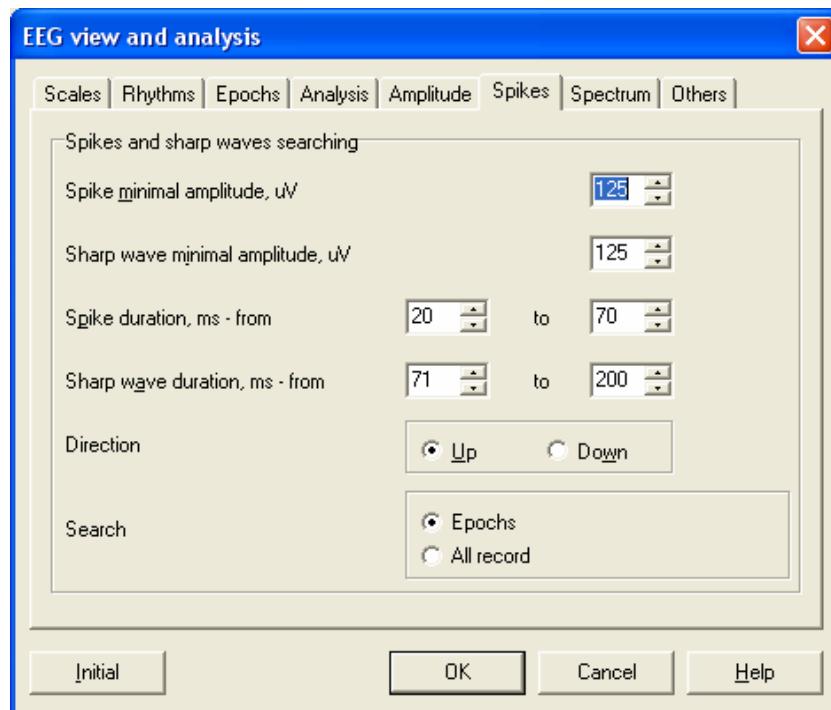
The *EEG scanning palette bounds, uV* edit lines indicate minimal and maximal values (the bounds) of the palette for the EEG fragments mapping in the amplitude analysis window.

The *EP scanning palette bounds, uV* edit lines indicate minimal and maximal values (the bounds) of the palette for the EP fragments mapping in the amplitude analysis window.

In the *Minimal EEG amplitude* edit line you can set minimal of bonding amplitude that considers by the program in the amplitude analysis process. The amplitude lower the indicated in the analysis process is taken as zero.

The *Show amplitude as integer* check box defines what number either integer or number with the floating-point represents the value of the signals amplitudes in the tables of the analysis results.

7. The *Spikes* page (Pic. 5.20) indicates the parameters of spikes and sharp waves search and singling out.



Pic. 5.20

The *Minimal amplitude* edit lines set the lower limit (threshold) of spikes and sharp waves amplitude.

The *Duration from...to* edit lines specify the time interval which is expected to contain the spikes and sharp waves duration.

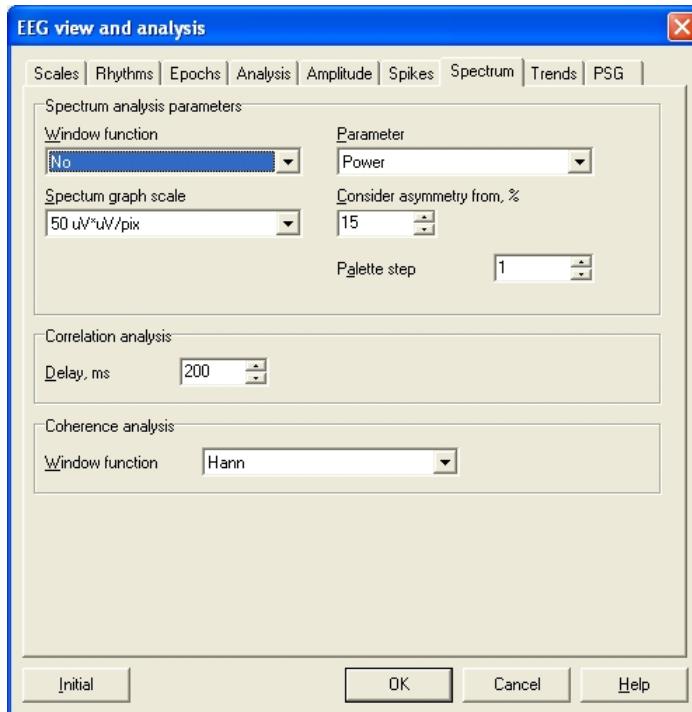
The *Direction* radio buttons specify the direction of spikes and sharp waves. If the *Up* value is set, the selection is organized only for upward waves. If the *Down* value is set, the selection is organized only for downward waves.

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The *Search* radio buttons specify the objects for the spikes and sharp waves search. If the *Epochs* value is set the search is organized only within the selected analysis epochs. If the *All record* value is set the search is organized within the whole EEG record.

In case the amplitude of both EEG-wave parts exceed the threshold, the wave duration fits the preset interval and the wave direction coincides with the preset one the wave is marked as a spike or a sharp wave.

8. The *Spectrum* page (Pic. 5.21) specifies the parameters of EEG spectrum analysis and parameters of trends and EEG spectrum panel.



Pic. 5.21

The *Window function* combo box indicates whether a window function is used for spectrum calculation (FFT) and if so, which one is used. The following window functions are available:

- Bartlett;
- Blackman;
- Kaiser;
- Hann;
- Hamming.

The *Parameter* combo box indicates in the EEG or EP fragments spectrum analysis window the parameter (amplitude or power) that will be displayed on the graphs and topographic maps.

The *Palette step* edit line indicates the alteration step for maximum and minimum palette values during spectrum mapping of EEG or EP fragments.

The *Spectrum graph scale* combo box indicates the scale of spectrum amplitude or power graphics.

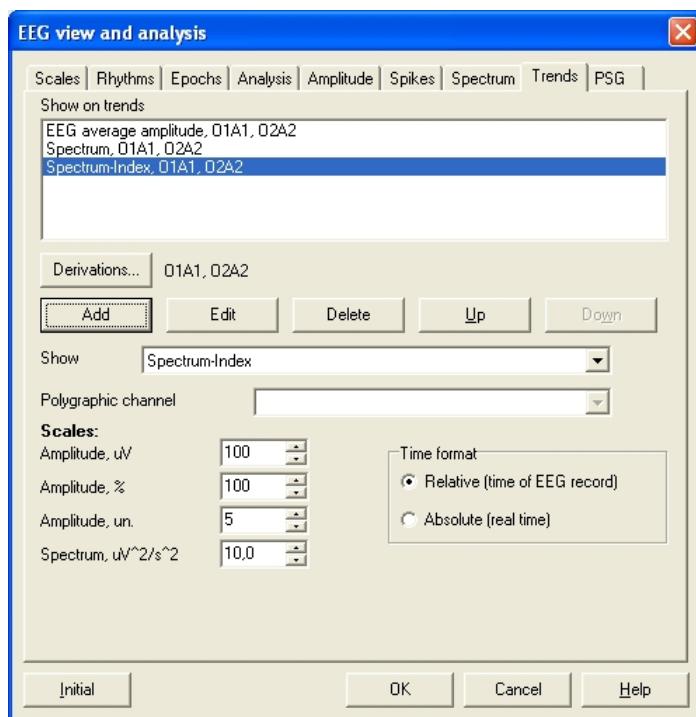
The *Consider asymmetry from, %* edit line specifies the bounder from which interhemispheric asymmetry is taken into account during asymmetry mapping of spectrum functions.

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The *Delay, ms* edit line in *Correlation analysis* group box defines the interval for the calculation of the correlation and the cross-correlation functions. If 200 ms value is set in the edit line, the correlation function is calculated within the interval from 0 up to 200 ms, and the cross-correlation one is calculated in the range from -200 up to 200 ms. Please take into consideration that the delay value should correlate with the analysis epoch value and mustn't be too large. In case of the ratio distortion, the error message box will appear on the screen after the closing of the dialog box.

The *Window function* combo box of the *Coherence analysis* group box specifies the window function used for the calculation of coherent spectrums.

9. The *Trends* page (Pic. 5.22) specifies the parameters of trends displaying.



Pic. 5.22

In the *Show on trends* list, all the trend graphs which should be displayed on the screen are listed.

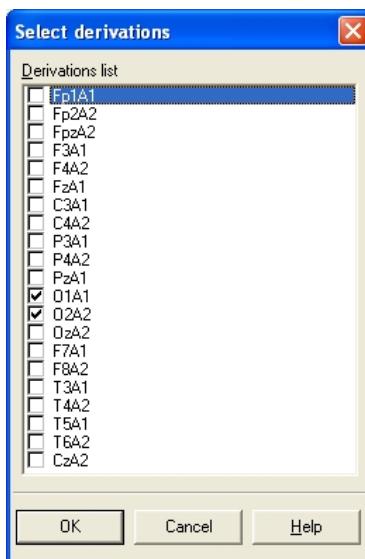
The *Show* combo box allows to choose the displayed trend. The following trends can be displayed as a trend:

- Pseudo 3D spectrum graph – graph which represents the current time on EEG by the abscissa axis, the frequency – by ordinate axis and by the color – (by vertical axis) – the spectrum power value.
- Trend of spikes and sharp waves amount.
- Trend of maximum amplitude of spikes and sharp waves.
- Trend with the displayed indices of delta-, theta-, alpha- and beta-rhythms marked by the different colors. It is named as *Spectrum-Index* in the combo-box.
- Trend of delta-, theta-, alpha- or beta-rhythm index.
- Trends of ratios of alpha to delta-rhythm indices and alpha to beta-rhythm ones.
- Trend of EEG average amplitude.
- Trend of EEG maximum amplitude.

- Trend of average amplitude of any polygraphic channel.
- Trend of maximum amplitude of any polygraphic channel.
- HR trend for ECG channel.

The *Polygraphic channel* combo box allows to select the polygraphic channel from the list of the ones available in the given montage at the displaying of the signal amplitude trends in a polygraphic derivation.

If you press the *Derivations* button, you can choose the derivations for the calculation of the selected parameter trend. The trend values are averaged through all the specified derivations. The derivations can be specified in the **Select derivations** dialog box (Pic. 5.23) which appears on the screen after the pressing of the “*Derivations*” button.

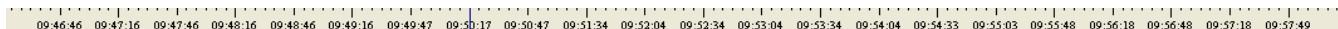


Pic. 5.23

The *Time format* radio button allows choosing the time format on the time scale of the trend graph. The relative format means the time displaying relative to EEG recording start (Pic. 5.24). The absolute format indicates the displaying of the absolute time (Pic. 5.25).



Pic. 5.24



Pic. 5.25

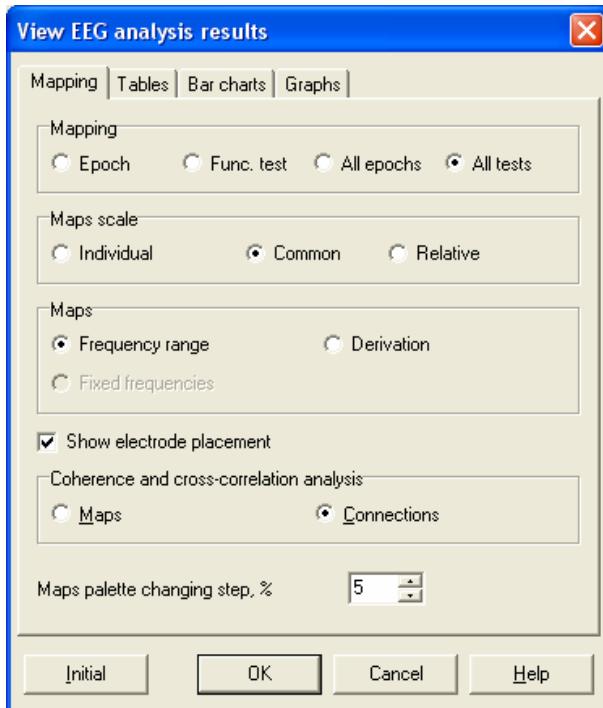
The *Scales* edit lines allow to specify the range of amplitude and spectrum trends displaying on the graph.

10. The description of the settings on *PSG* page is given in 21 chapter.

Attention! If you click “Initial” in the **EEG view and analysis** dialog box, all the values of the current page parameters will be restored to the default status.

5.4. SETUP OF PARAMETERS OF EEG ANALYSIS RESULTS DISPLAY

1. To set up EEG analysis results display parameters, select **Setup|Results** in the program main menu or click on the  button on the **Setup** toolbar. The **View EEG analysis results** dialog box will appear on the screen (Pic. 5.26).



Pic. 5.26

2. The *Mapping* page (Pic. 5.26) sets parameters for the topographic mapping of checkup analysis results

The *Mapping* radio buttons set the mapping mode (the map display mode) for: one epoch, one functional test, all epochs or all functional tests.

The *Maps scale* radio buttons set the scaling mode of topographic maps. If the *Individual* value is set, the individual scale is used for each frequency range (each EEG rhythm). If the *Common* value is set, the common scale is used for all the maps. If the *Relative* value is set, the maps will display the changes, in comparison with the selected epoch or functional test.

The *Maps* radio-buttons set the mapping methods.

If the *Frequency ranges* value is set, the selected parameter values will be mapped in standard frequency ranges (for example, the values of power spectrum in each standard frequency range Delta, Theta, Alpha, Beta high-frequency and low-frequency).

If the *Derivations* value is set, the values of the selected parameter are mapped in each derivation (for example, the dominant frequency or maximum amplitude of EEG).

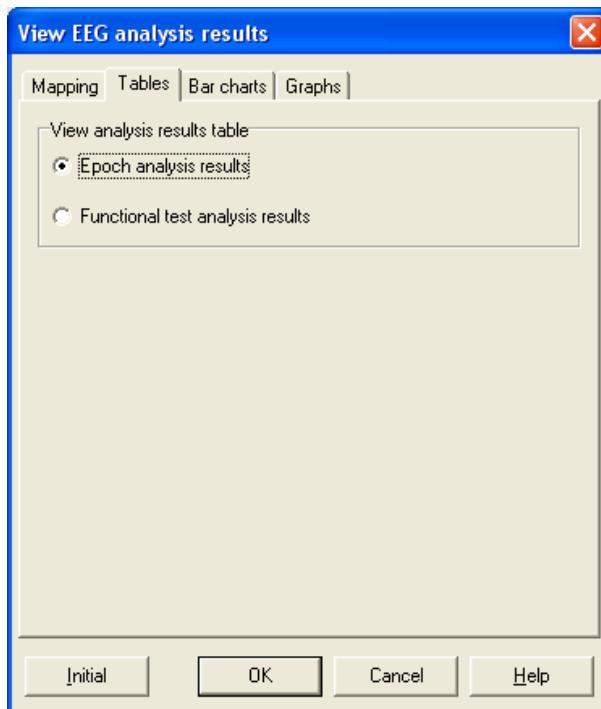
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If the *Fixed frequencies* value is set the values of the selected parameter are mapped in fixed frequency ranges 1 Hz wide (for example, power spectrum in 1..2 Hz, 2..3 Hz, 3..4 Hz and so on up to 19..20 Hz ranges).

The *Show electrode placement* check box indicates whether the electrode matching places for the selected EEG-montage are displayed on the maps.

The *Coherence and cross-correlation analysis* radio buttons indicates what will be shown on correlation and coherence analysis results mapping: topographical map (topograms) or diagrammatic representation of parameter analysis value for the corresponding couple in the form of connection

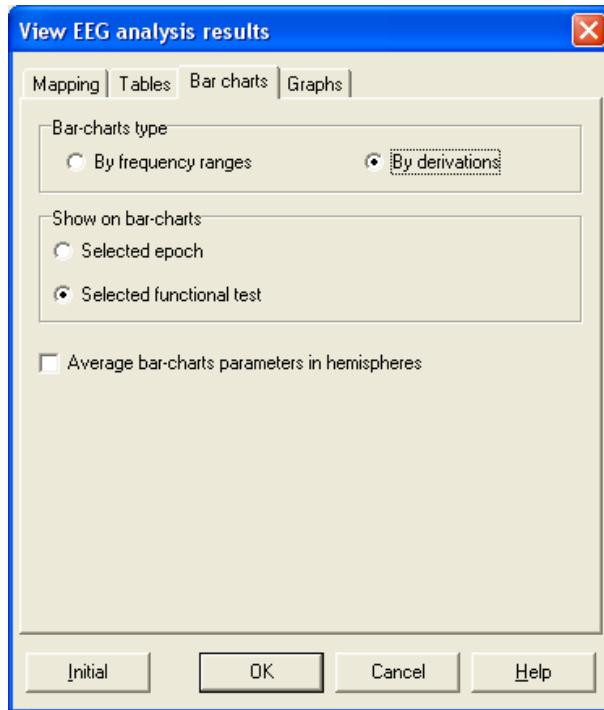
3. The *Tables* page (Pic. 5.27) sets the display parameters for the analysis results tables.



Pic. 5.27

The *View analysis results table* radio buttons sets the table view mode (either epoch analysis results, or functional tests analysis results).

4. The *Bar charts* page (Pic. 5.28) sets the display parameters for the analysis results bar charts.



Pic. 5.28

The *Bar charts type* radio buttons sets the bar chart display mode.

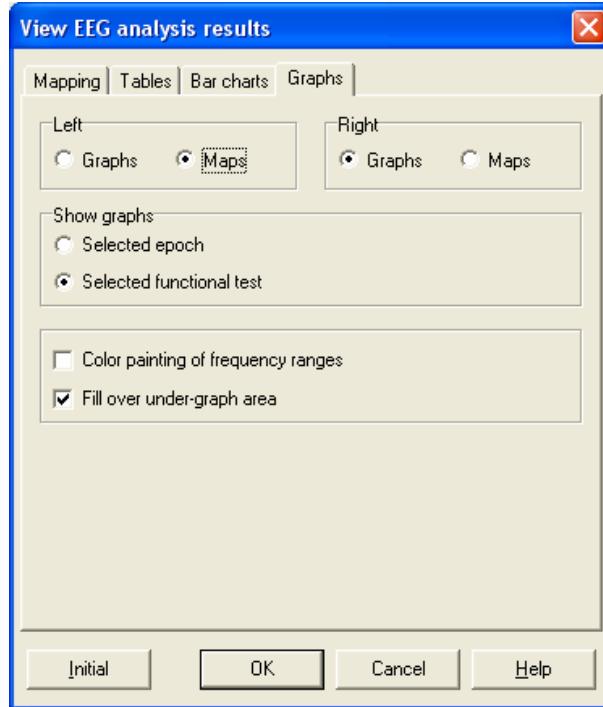
If the *By frequency ranges* value is selected, the individual bar chart is displayed for each standard frequency range. Such a bar chart reflects the selected parameter value in each derivation.

If the *By derivations* value is set, the individual bar chart is displayed for each derivation. Such a bar chart reflects the selected parameter value in each frequency range.

The *Show on bar charts* radio buttons set the mode of the analysis parameter values display on the bar charts (either epoch analysis results, or functional tests analysis results).

If the *Average bar charts parameters in hemispheres* checkbox is checked the bar charts will be displayed with hemisphere-averaged values of the selected analysis parameter.

5. The *Graphs* page (Pic. 5.29) sets the display parameters for the analysis results graphs.



Pic. 5.29

The *Left* and *Right* radio buttons indicate if maps or graphs will be displayed in left and right half of the graph window.

The *Show Graphs* radio buttons set the display mode of the analysis results parameter values (either epoch analysis results, or functional tests analysis results).

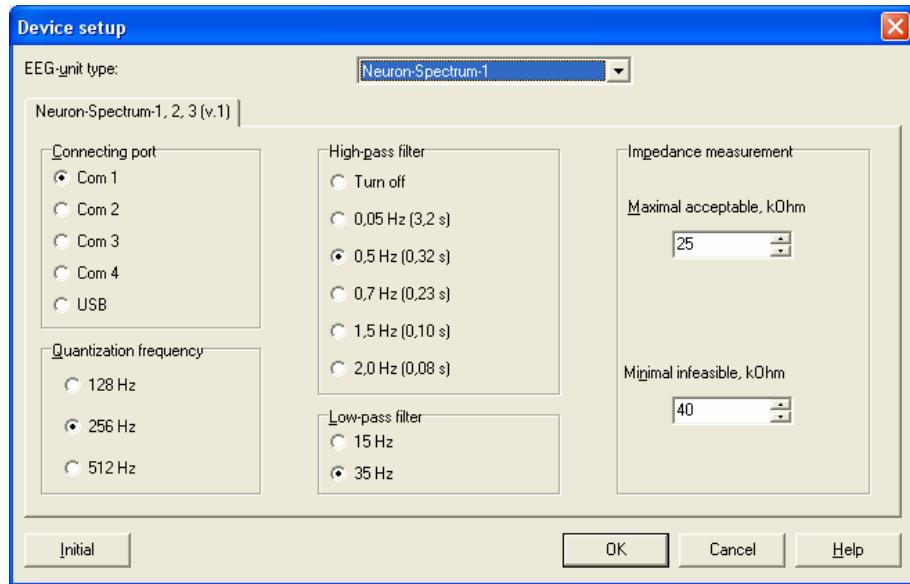
If the *Fill under-graph area* checkbox is checked, the area under the graph will be filled with color.

If the *Color painting of frequency ranges* checkbox is checked, each standard frequency range (EEG-rhythm) will be highlighted on the graphs with its own preset color.

Attention! If you click “Initial” in the **EEG view and analysis** dialog box, all the values of the current page parameters will be restored to the initial status set by default.

5.5. HARDWARE SETUP

1. To set up the equipment parameters click on the **Setup|Hardware** main menu command or on the  button on the *Setup* toolbar. The **Device setup** dialog box will appear on the screen (Pic. 5.30).



Pic. 5.30

2. The *EEG-unit type* combo box includes all types of EEG systems supported by **Neuron-Spectrum** software. Choose the type you use. Depending upon the selected device the tab of EEG system settings will vary.

3. The **Neuron-Spectrum-1 (v.1)** EEG system (Pic. 5.30).

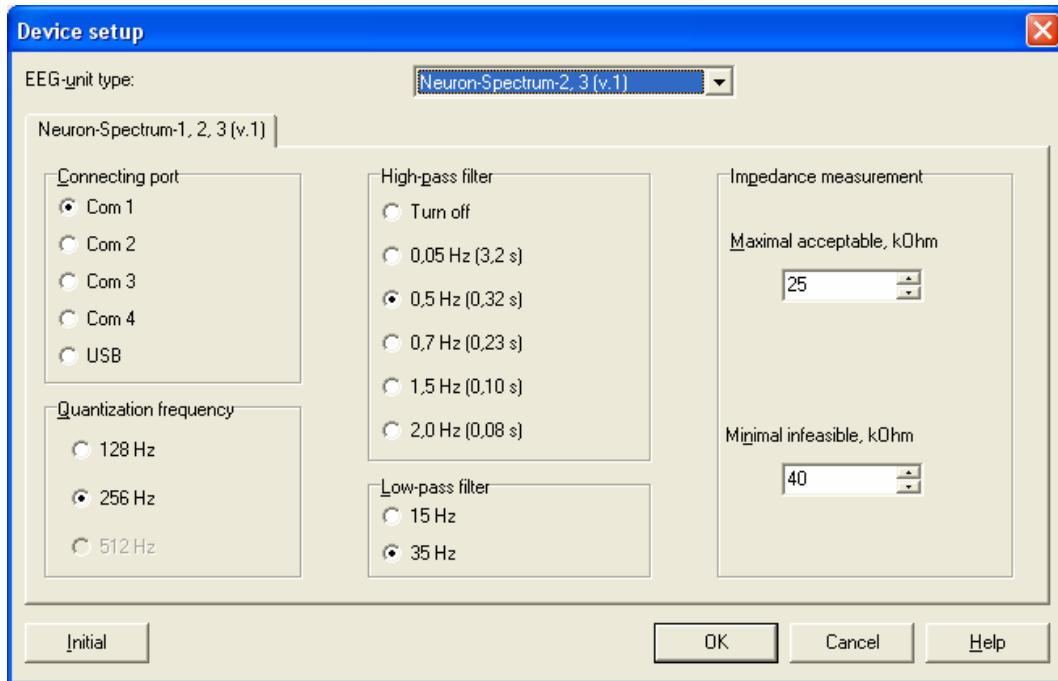
To indicate the number of the COM-port or USB-port, which your EEG system will be connected to, click one of the radio-buttons in the *Communication port* group.

To set the electroencephalogram sampling rate (digitization rate) use the *Quantization frequency* group.

To set the amplifier time constant (the lower cutoff frequency) during EEG recording use the *High-pass filter* group.

The *Maximal acceptable* and *Minimal infeasible* edit lines of the *Impedance measurement* group indicate the boarders of the under-electrode impedance, which enables you to register EEG. If impedance is less, than the maximum allowed value, the corresponding derivation button will be green-highlighted in the measurement mode. If impedance exceeds the minimum unallowable value, the derivation button will be red-highlighted. If impedance fits the limits, the derivation button will be yellow-highlighted.

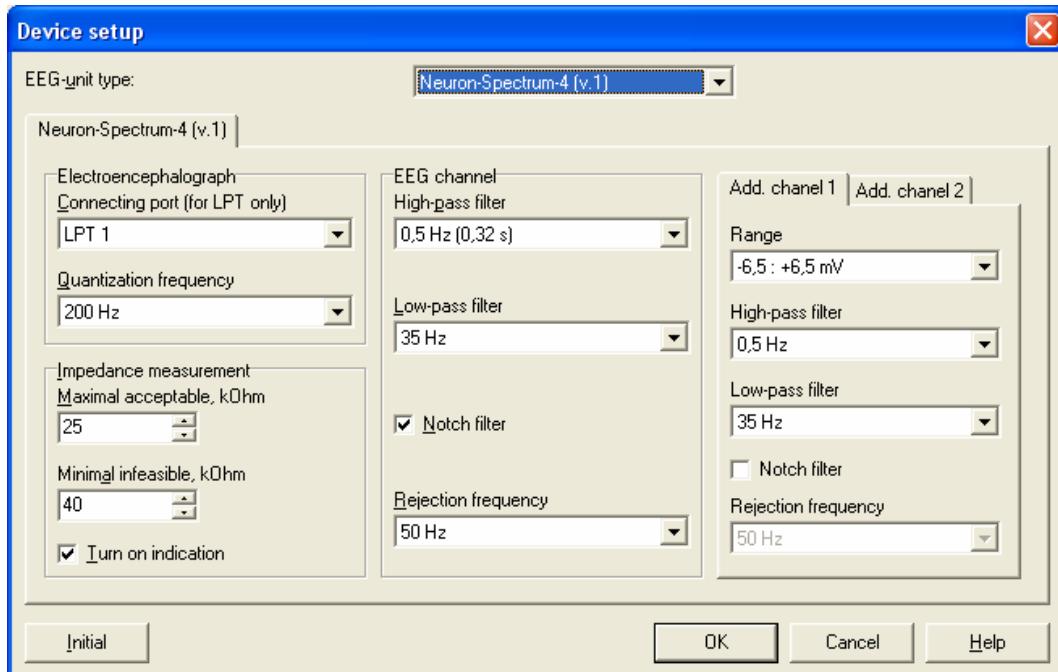
4. The Neuron-Spectrum-2 (v.1) and Neuron-Spectrum-3 (v.1) EEG systems (Pic. 5.31).



Pic. 5.31

All the fields of the **Neuron-Spectrum-2 (v.1)** and **Neuron-Spectrum-3 (v.1)** setup tab are identical with those of the **Neuron-Spectrum-1 (v.1)** one. The parameters to be set are also the same.

5. The Neuron-Spectrum-4 (v.1) EEG system (Pic. 5.32).



Pic. 5.32

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The *Connecting port* combo box sets the number of the LPT port, which your EEG systems will be connected to. For the EEG systems with USB-connection the number of the communication port is not important.

Select the EEG sampling rate (digitization rate) in the *Quantization frequency* combo-box.

To enter the boundary values of the under-electrode impedance use the *Maximal acceptable* and *Minimal infeasible* edit lines of the *Impedance measurement* group (see above the **Neuron-Spectrum-1** (v.1) setup).

To switch on and off the color indication of the electrode impedance at the EEG system front panel in the impedance measurement mode use the *Turn on indication* check box.

Use the *EEG Channels* group to set the parameters for the basic channels (EEG channels) filters setup.

The *High pass filter* combo box sets the amplifier time constant (lower cutoff frequency) during EEG recording.

The *Low pass filter* combo box sets the upper cutoff frequency of the amplifier low-pass filter.

The *Notch filter* check box activates the notch filter, and the *Rejection frequency* combo box sets the rejection frequency value: 50 or 60 Hz.

The *Additional channel 1* and *Additional channel 2* tabs set the values of parameters and filters for two extra poly channels.

The *Range* combo box sets the value of the amplifier input range for the additional channel selected.

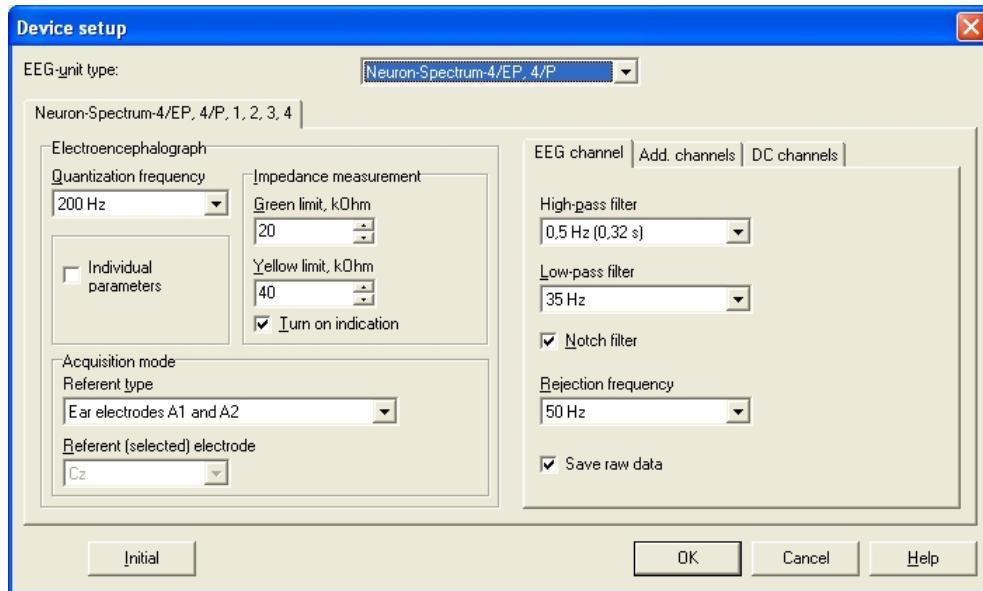
The *High pass* combo box sets the lower cutoff frequency of the amplifier high-pass filter during the signal registration by one of the extra channels.

The *Low pass filter* combo box sets the upper cutoff frequency of the amplifier low-pass filter during the signal registration by one of the extra channels.

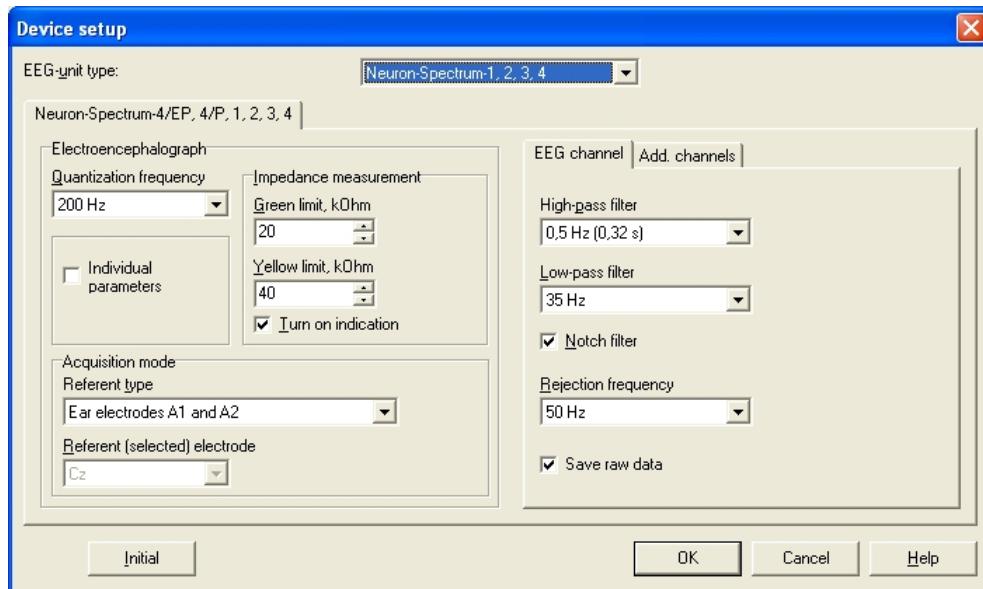
The *Notch filter* check box activates the notch filter, and the *Rejection frequency* combo box sets the rejection frequency value: 50 or 60 Hz.

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6. The **Neuron-Spectrum-4/EP, 4/P** and **Neuron-Spectrum-1, 2, 3, 4** EEG systems (Pic. 5.33, Pic. 5.34).



Pic. 5.33



Pic. 5.34

Select the EEG sampling rate (digitization rate) in the *Quantization frequency* combo box.

To enter the boundary values of the under-electrode impedance use the *Green limit* and *Yellow limit* edit lines (see above the **Neuron-Spectrum-1** parameters setup).

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To switch on and off the color indication of the electrode impedance at the EEG system front panel in the impedance measurement mode use the *Turn on indication* check box.

Use the *EEG Channels* tab to set the parameters for the EEG channels filters setup.

The *High pass filter* combo box sets the amplifier time constant (lower cutoff frequency) during EEG recording.

The *Low pass filter* combo box sets the upper cutoff frequency of the amplifier low-pass filter.

The *Notch filter* check box activates the notch filter, and the *Rejection frequency* combo box sets the rejection frequency value: 50 or 60 Hz.

If *Individual parameters* check box is checked, you can set individual parameters of High-pass, Low-pass and Notch filters on every EEG channel during EEG recording. If the check box is unchecked, the same scale filters parameters for each EEG channel, specified in the combo boxes of the *EEG channel* page, are used.

In *Referent type* combo box you can select referent electrode used during EEG recording. As referent electrodes, you can use ear electrodes A1 and A2, united ear electrode AA or arbitrary electrode. If you use arbitrary electrode as referent one, select the electrode in *Referent (selected) electrode* combo box. In this mode of recording you need not use ear electrodes. In this mode you must select montages which do not use ear electrodes.

The *Add. channels* page allows to set up the parameters of the additional polygraphic channels of EEG system.

The *Additional channel 1*, *Additional channel 2*, *Additional channel 3*, *Additional channel 4* (for **Neuron-Spectrum-4/EP, 4/P** device) and *Additional channel 1* (for **Neuron-Spectrum-1, 2, 3, 4**) pages set the values of parameters and filters for four or one extra poly channels correspondingly.

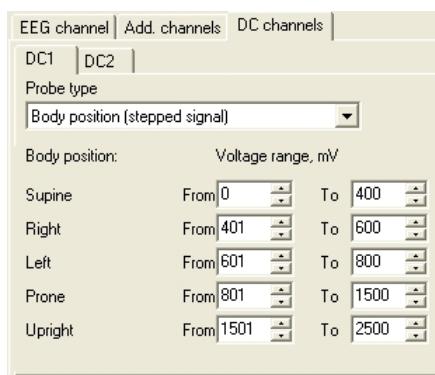
The *Range* combo box sets the value of the amplifier input range for the additional channel selected.

The *High pass filter* combo box sets the lower cutoff frequency of the amplifier high-pass filter during the signal registration by one of the extra channels.

The *Low pass filter* combo box sets the upper cutoff frequency of the amplifier low-pass filter during the signal registration by one of the extra channels.

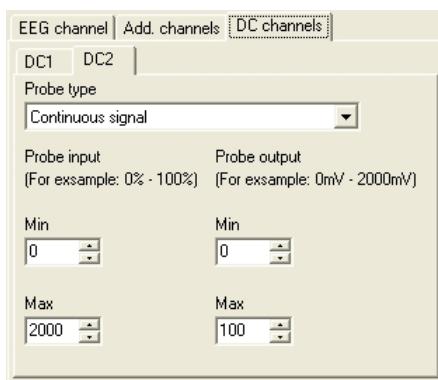
The *Notch filter* check box activates the notch filter, and the *Rejection frequency* combo box sets the rejection frequency value: 50 or 60 Hz.

The *DC channels* page allows to set up the parameters of the direct current channels of EEG system **Neuron-Spectrum-4/EP, 4/P** (Pic. 5.35, Pic. 5.36).



Pic. 5.35

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Pic. 5.36

The *Probe type* combo box defines the type of the used sensor. The program allows using the sensors of the stepwise signal such as body position sensors (Pic. 5.35) and the sensors of the continuous signal (Pic. 5.36).

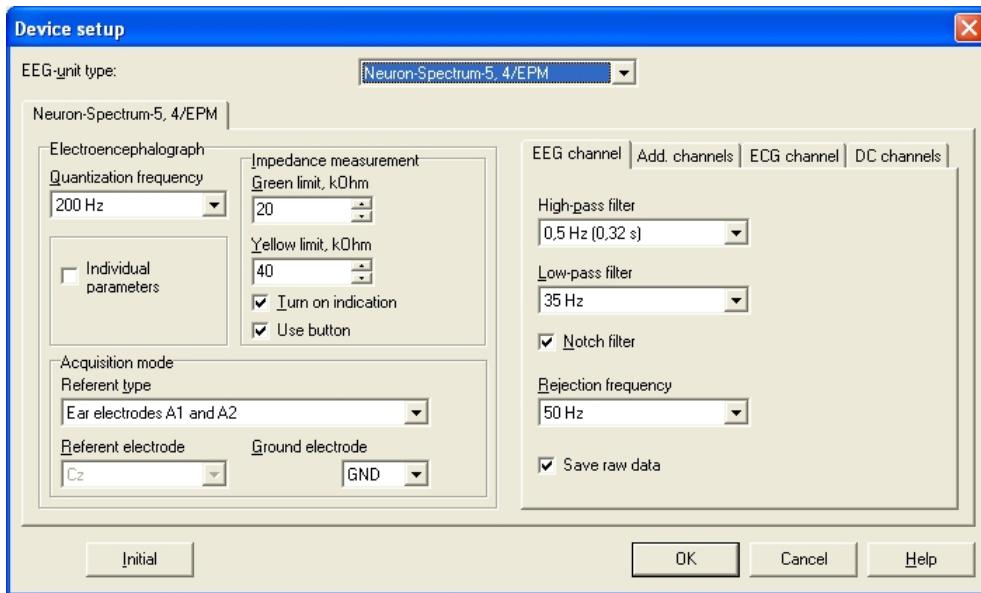
The following parameters are specified for the body position sensor:

- In the *Voltage range from, to* edit lines, the high and the low values of the output voltage of the sensor in millivolts are specified which correspond to the supine, right side, left side, prone and upright positions of a patient.

At the continuous output signal of sensor, the following parameters are specified:

- The *Probe input (Min., Max.)* and the *Probe output (Min., Max.)* edit lines define the voltage recalculations supplied from the sensor to the measurement units of the curve displayed on the screen.

7. The Neuron-Spectrum-5, 4/EPM EEG system (Pic. 5.37).



Pic. 5.37

The *Quantization frequency* combo-box defines the signal sampling rate used during EEG recording.

The *Green limit* and *Yellow limit* edit lines allow to specify the limit values of under-electrode impedance (see above the parameters setting of **Neuron-Spectrum-1 (v.1)**).

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The *Turn on indication* check box allows switching on and off the color indication of under-electrode impedance on the front panel of EEG system in impedance measurement mode.

The *Use button* check box provides the possibility to use the button on the device front panel to activate the impedance measurement and start monitoring.

The *EEG channels* page allows to specify the parameters of filters settings of main channels of EEG system (EEG channels).

The *High-pass filter* (time constant) combo-box determines the time constant (low cutoff frequency) of amplifier during EEG recording.

The *Low-pass filter* (cutoff frequency) combo-box determines the high cutoff frequency of amplifier low pass filter.

The *Notch filter* check box turns on the notch filter and the *Rejection frequency* combo-box defines the value of the rejection frequency – 50 or 60 Hz.

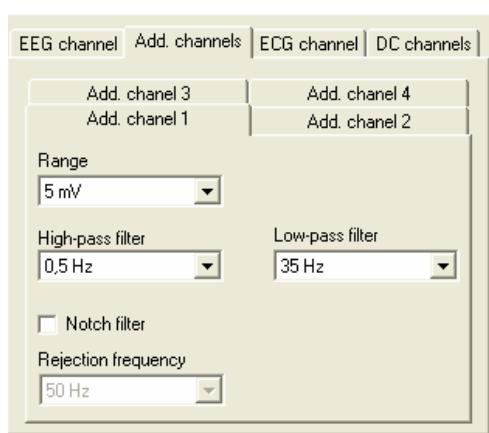
If the *Individual parameters* check box is checked, then you can specify your HPF, LPF and notch filter parameters for each channel during EEG recording. If the check box is unchecked, the same scale and filters parameters specified in the combo boxes of the *EEG channel* page are applied.

The *Referent type* combo-box allows choosing the referent electrode used during recording. As a referent electrode, the referent electrode **Ref** or selected electrode on the scalp can be used. If you want to use the selected electrode as a referent one, you should choose this electrode in the combo-box *Referent electrode*. In the acquisition mode with the selected referent electrode you can record without the ear electrodes. At that you should select the montages without ear electrodes.

As a ground electrode, you can use the electrode named **GND** or **DRL**. You can choose the electrode you want to use in the *Ground electrode* combo-box.

The *Add. channels* page allows specifying the parameters of additional polygraphic channels of EEG system.

The *Add. channel 1*, *Add. channel 2*, *Add. channel 3*, *Add. channel 4* tabs define the parameters values for four additional polygraphic channels correspondingly (Pic. 5.38).



Pic. 5.38

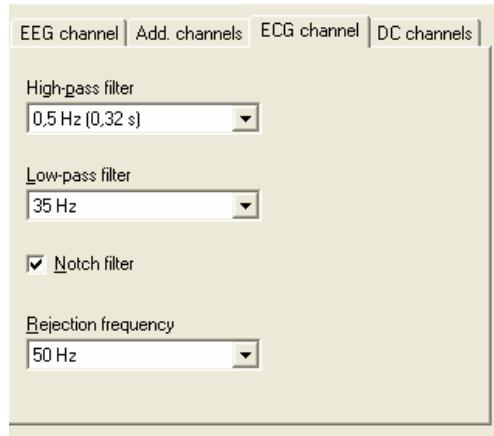
The *Range* combo-box defines the value of the amplifier input range for the selected additional channel.

The *High-pass filter* combo-box defines the low cutoff frequency of amplifier high pass filter during the signal recording by the selected additional channel.

The *Low pass filter* combo-box defines the high cutoff frequency of amplifier low pass filter during the signal recording by the selected additional channel.

The *Notch filter* combo box activates the notch filter and the *Rejection frequency* combo-box defines the rejection frequency value – 50 or 60 Hz – for the additional channels.

The *ECG channel* page (Pic. 5.39) allows to set up the parameters of the ECG channel. The channel parameters are analogous to EEG channels parameters (Pic. 5.37).



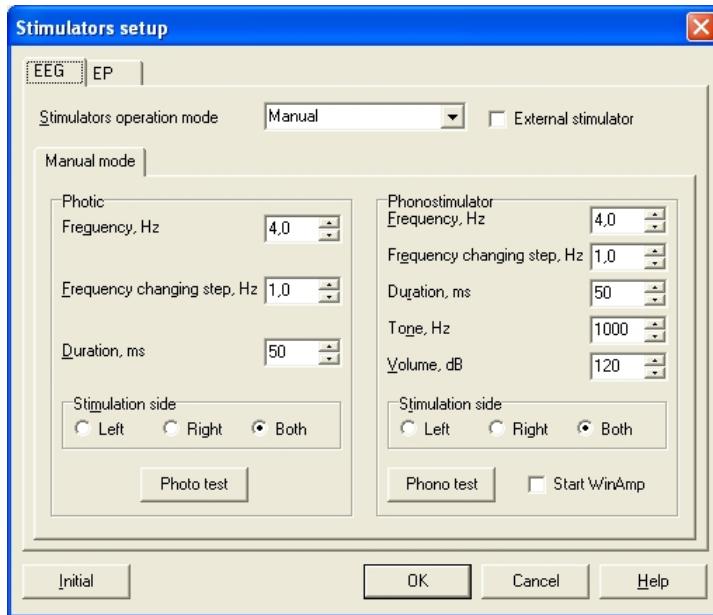
Pic. 5.39

The *DC channels* page allows specifying the parameters of the direct current channels of the **Neuron-Spectrum-5, 4/EPM** EEG system. The setting of the direct current channels parameters are analogous to the setting of the same channels of the **Neuron-Spectrum-4/EP, 4/P** EEG system (Pic. 5.35, Pic. 5.36).

Attention! If you click “Initial” in the *Device setup* dialog box, all the values of the current page parameters will be restored to the initial status set by default.

5.6. STIMULATORS SETUP

- To set up photic- and phono stimulators parameters click on the **Setup|Stimulators** main menu command or on the  button on the *Setup* toolbar. The **Stimulators setup** dialog box will appear on the screen (Pic. 5.40).



Pic. 5.40

- The *EEG* tab (Pic. 5.40). The stimulators can function either in manual or in program mode. If you select the manual mode of operation, you will have to control stimulation parameters (frequency, intensity, etc.) manually, via a keyboard or a mouse.

The program mode of operation allows presetting of all stimulation parameters in a special stimulation program. Then, during the recording, the program performs automatically without human interference.

You can select the required operation mode of the stimulators (program or manual) using the *Stimulators operation mode* combo box.

If the *External stimulator* check box is checked, the operation of the built-in stimulators is blocked and it is supposed that at the starting of the photic or auditory stimulation test, the stimulation is performed by the external stimulators. If the synchronization output of the external stimulator is connected to the synchronization input of the EEG system unit, the stimulation moments will be marked on the electroencephalogram as during the operation of the built-in stimulators.

- For **Neuron-Spectrum-1, 2, 3 (v.1)** EEG systems you can set the following photic stimulator parameters in the *Manual* mode:

- the initial photic frequency (the *Initial Frequency* edit line) – the stimulation frequency on activating photic;

- the step of photic frequency change (the *Frequency changing step* edit line) – determines the way photic frequency will change on issuing the command to increase or to decrease stimulation frequency via keyboard when carrying out a photo stimulation functional test in the manual mode;
- the duration of photic glow on each flare, measured in milliseconds (the *Duration* edit line).

You can test the adjusted parameters by clicking on the “*Photo test*” button.

In the *Phonostimulator* group you can set:

- the initial frequency of phono stimulation (the *Frequency* edit line);
- the step of phono stimulation frequency change (the *Frequency changing step* edit line).

You can test the adjusted parameters by clicking on the “*Phono test*” button.

4. For **Neuron-Spectrum-4 (v.1), 4/EP, 4/P, 1, 2, 3, 4, 5, 4/EPM** EEG systems you can set the following photic and phono stimulators parameters in the *Manual* mode of operation.

Photic:

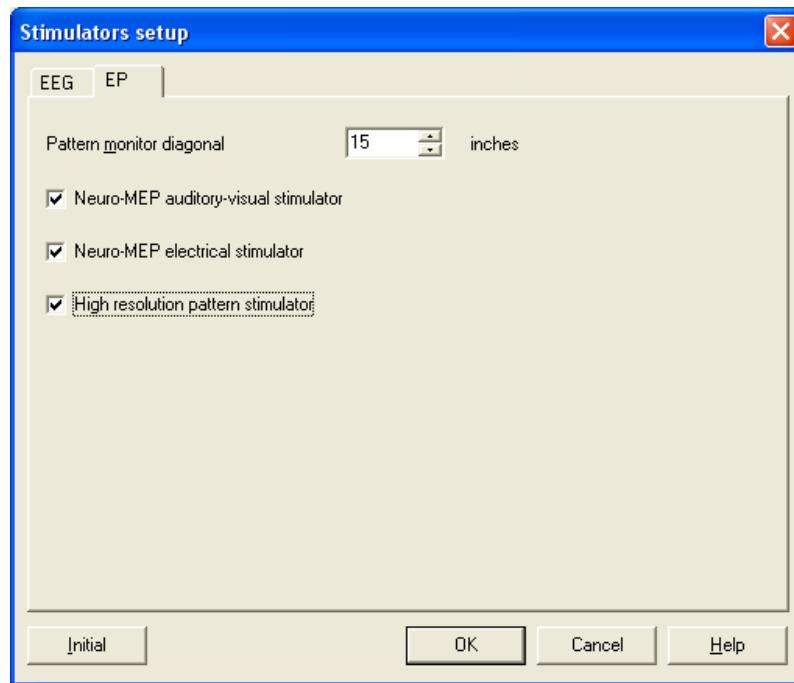
- the initial photic frequency (the *Frequency* edit line) – the stimulation frequency on activating photic;
- the step of photic frequency change (the *Frequency changing step* edit line) – determines the way photic frequency will change on issuing the command to increase or to decrease stimulation frequency via keyboard when carrying out a photo stimulation functional test in the manual mode;
- the duration of photic glow on each flare, measured in milliseconds (the *Duration* edit line);
- the stimulation side (the *Stimulation side* radio-buttons). The photic has two LEDs: left and right; you can choose between the LEDs or activate both.

Phono stimulator:

- the initial phono stimulation frequency (the *Frequency* edit line);
- the step of phono stimulation frequency change (the *Frequency changing step* edit line);
- the stimulus duration (the *Duration* edit line);
- the stimulus tone frequency (the *Tone* edit line);
- the stimulus intensity (volume) (the *Volume* edit line);
- the stimulation side (the *Stimulation side* radio-button) specifies, which of the phono stimulator earphones (left, right or both) will generate stimuli.

You may test all the settings by clicking “*Photo Test*” or “*Phono Test*” buttons.

5. The EP tab (Pic. 5.41).



Pic. 5.41

6. The *Pattern monitor diagonal* edit line allows you to set the monitor diagonal size in inches, which is used as a pattern-stimulator on visual EP registration on **Neuron-Spectrum-4 (v.1), 4/EP, 4/P, 1, 2, 3, 4, 5, 4/EPM** EEG systems.

When registration of the evoked potentials on EEG channels with the **Neuron-Spectrum-4 (v.1), 4/EP, 4/P, 1, 2, 3, 4, 5, 4/EPM** EEG systems, one can use an internal stimulators as well as external high-quality **Neuro-MEP** stimulators produced by the **Neurosoft** company. To use the external high-quality stimulators of **Neuro-MEP** EMG system as the stimulators for EP recording on EEG systems **Neuron-Spectrum-4 (v.1), 4/EP, 4/P, 1, 2, 3, 4, 5, 4/EPM**, one should check the *Neuro-MEP auditory- visual stimulator* or *Neuro-MEP electrical stimulator* check boxes.

If the *External stimulator* check box is checked, the operation of the built-in stimulators of EEG system is blocked, and the EP averaging is performed with the use of the external stimulators. For the correct operation of EP program, it is necessary to connect the synchronization output of the external stimulator to the synchronization input of the EEG system.

Attention! If you click “Initial” in the **Stimulators setup** dialog box, all the values of the current page parameters will be restored to the initial status set by default.

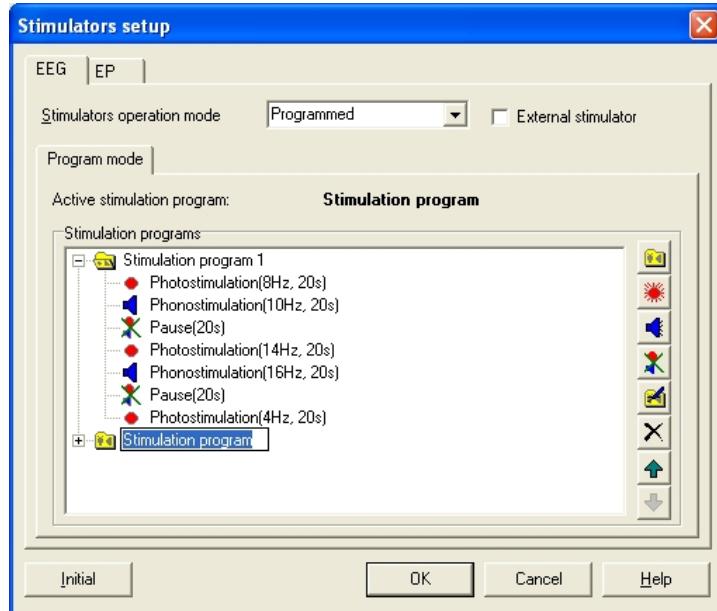
5.7. PHOTIC AND PHONO STIMULATORS PROGRAMMING

1. To get the photic and phono stimulators operating in the program mode select the mode in the setting parameters of the stimulators and prepare one or several stimulation programs. Stimulation program is a set of commands performed by a stimulator. Among them there are:

- photo stimulation command;
- phono stimulation command;
- pause (EEG is recorded without stimulation).

Each stimulation command sets certain operation time and parameters for the corresponding stimulator. One stimulation program can include an arbitrary number of commands.

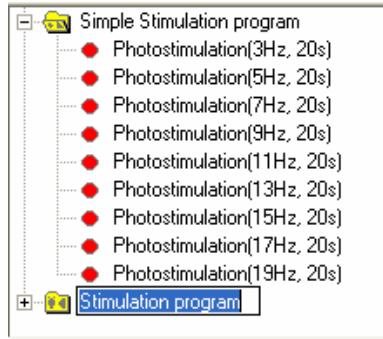
2. The program mode being chosen, the list of all created stimulation programs and a set of buttons for their creating and editing appear in the **Stimulators setup** dialog box (Pic. 5.42).



Pic. 5.42

3. Each stimulation program is displayed as a folder. If a folder is closed, the content of the program is not available. In this case the folder will have the “+” mark next to it. When a folder is open, the program stimulation commands appear on the list. In this case the folder will be marked with the “-” sign.

4. To create a new stimulation program, click on the  button. After this a new folder-node, a new stimulation program, will appear on the tree view list (Pic. 5.43). At first, it doesn't contain any commands. By default, it is named “*Stimulation program*”. Enter the program name (for example, “*My photo stimulation program*”) and press [Enter].

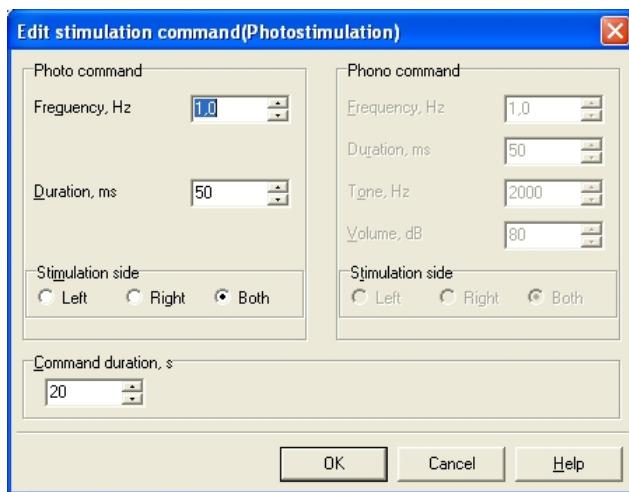


Pic. 5.43

You may add the following commands to your program:

- photo stimulation (the  button);
- phono stimulation (the  button);
- pause, i.e. registration without stimulation (the  button).

5. When you add a new photo stimulation command (by clicking on the  button), the **Edit stimulation command (Photostimulation)** dialog box appears on the screen (Pic. 5.44).

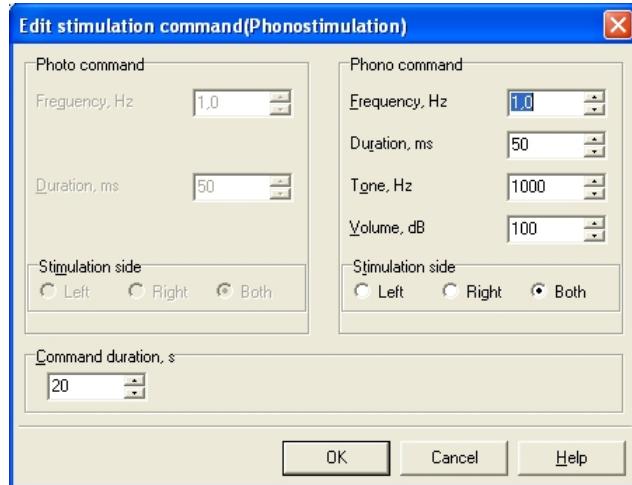


Pic. 5.44

Here you can set the following parameters:

- *stimulation frequency* in the *Frequency* edit line;
- *stimulus duration* in the *Duration* edit line;
- *stimulation side* (only for **Neuron-Spectrum-4 (v.1), 4/EP, 4/P, 1, 2, 3, 4, 5, 4/EPM**) with the *Stimulation side* radio-buttons;
- *stimulation time* in the *Command duration* edit line.

6. When you add a new phono stimulation command (by clicking on the  button), the **Edit stimulation command (Phonostimulation)** dialog box appears on the screen (Pic. 5.45).



Pic. 5.45

Here you can set the following parameters:

- *stimulation frequency* in the *Frequency* edit line;
- *stimulus duration* in the *Duration* edit line (only for **Neuron-Spectrum-4 (v.1), 4/EP, 4/P, 2, 3, 4, 5, 4/EPM**);
- *stimulus pitch* in the *Tone* edit line (only for **Neuron-Spectrum-4 (v.1), 4/EP, 4/P, 2, 3, 4, 5, 4/EPM**);
- *stimulus intensity (volume)* in the *Intensity* edit line (only for **Neuron-Spectrum-4 (v.1), 4/EP, 4/P, 2, 3, 4, 5, 4/EPM**);
- *stimulation side* (only for **Neuron-Spectrum-4 (v.1), 4/EP, 4/P, 2, 3, 4, 5, 4/EPM**) with the *Stimulation side* radio-buttons;
- stimulation time in the Command duration edit line.

7. When you add a new pause command (by clicking on the  button), the **Edit stimulation command (Pause)** dialog box appears on the screen the same as in the Pic. 5.44. Here you can set the command duration in the *Command duration* edit line.

8. To rename a stimulation program, highlight its name (click it) and click . To change stimulation command parameters, highlight the command (click it) and click . The **Edit stimulation command** dialog box (Pic. 5.44, Pic. 5.45) will appear on the screen. Enter the required parameters.

9. To delete a program or a stimulation command, highlight it (click it) and click on the  button.

10. To rearrange stimulation commands, select the required command and click on either the  button (one point upward), or the  button (one point downward).

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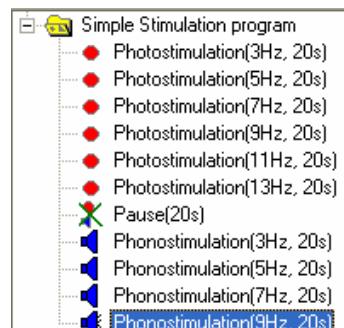
11. Let us take an example. You need to create a stimulation program, performing the following operations:

- Both eyes photo stimulation at the frequencies of 4, 6, 8, 10, 12, 14 Hz (20 sec.).
- Recording EEG without stimulation (60 sec.).
- Both ears phono stimulation at the frequencies of 4, 6, 8, 10, 12, 14 Hz (15 sec.).

To create the program, do the following:

- Select the program mode of stimulators operation.
- Create a new stimulation program folder (the  button) and name it (for example, “*Photo-phonostimulation program*”).
 - Successively add six photo stimulation commands by clicking on the  button. Set the parameters of stimulation frequency (4, 6, 8, 10, 12, 14 Hz); specify stimulation side (both) and stimulation time (20 sec.) for each command.
 - Add a pause command by clicking on the  button. Set its duration (60 sec.).
 - Successively add six phono stimulation commands by clicking on the  button. Set the parameters of stimulation frequency (4, 6, 8, 10, 12, 14 Hz); specify stimulation side (both) and stimulation time (15 sec.) for each command.

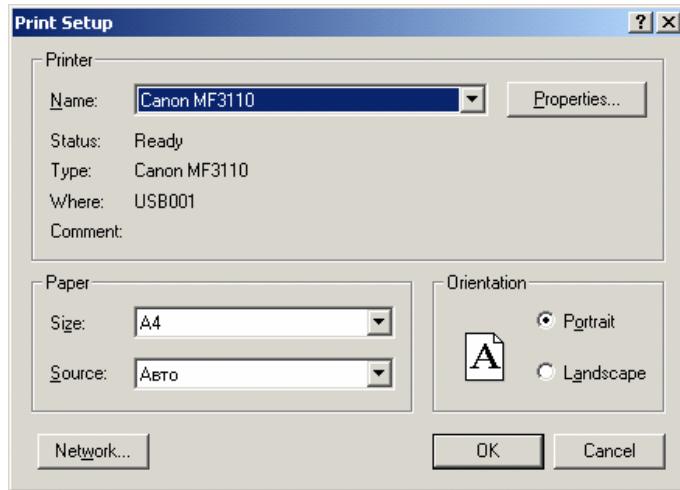
The stimulation program you get in the result of programming is given in the Pic. 5.46.



Pic. 5.46

5.8. PRINTER SETUP

1. To setup or change printer choose the **Setup|Printer**. The standard Windows dialog panel of printer setup and changing **Printer Setup** appear on the screen (Pic. 5.47).



Pic. 5.47

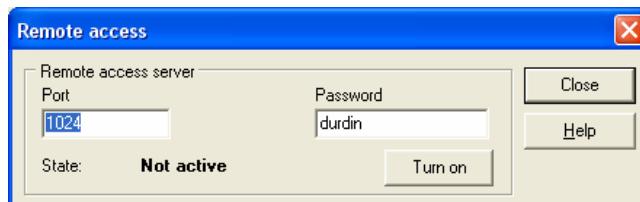
2. Combo box *Name* contains all setup printers in the system. Select the required printer from the list. To change the printer's characteristics, click the “*Properties*” button, which initiate the dialog panel of printer's characteristics changing. The panel view depends on the chosen printer type.

3. The *Size*, *Feed* combo box and *Orientation* radio buttons allow to select the size and the orientation of the used paper.

5.9. REMOTE ACCESS SETUP

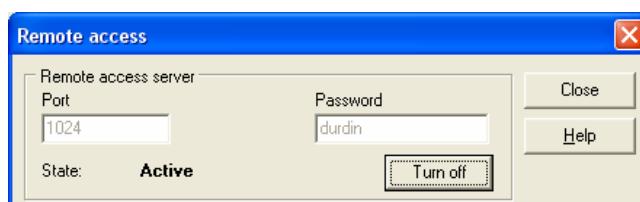
1. The **Neuron-Spectrum** program supports the network mode. So if there are several computers in local net with the **Neuron-Spectrum** program and one of them is connected with the EEG-unit, then one can observe the EEG registration mode. For example, if the EEG intraoperative monitoring is taking place and the computer from the operating-room is connected to the local net, one can follow the EEG monitored during the operation. The computer, to which the EEG-unit is connected, is called *server*, and computers with the **Neuron-Spectrum** program setup as well as without EEG-unit – *clients*.

2. To setup the remote access mode on computer-server, select the **Setup|Remote access** command. The **Remote access** dialog panel will appear on the screen (Pic. 5.48).



Pic. 5.48

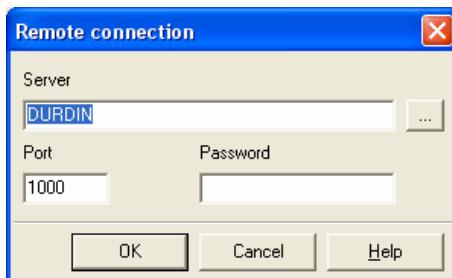
To activate remote access mode (other computers capability with local net (clients) to connect to the server to look EEG registration), supply random port number in the *Port* edit line and random password in the *Password* edit line. The password allows limiting the client access to the server. Then click “*Turn on*” key. If the remote access mode is successfully checked (switched on), the state will change from **Not active** to **Active**, and *Port* and *Password* edit lines will be inaccessible for data editing (Pic. 5.49). The server is ready for the work in the remote access mode. Click the “*Close*” button to finish the work with the dialog.



Pic. 5.49

To switch off the remote access mode, select the **Setup|Remote access** command and in the dialog panel (Pic. 5.49), click the “*Turn off*” button.

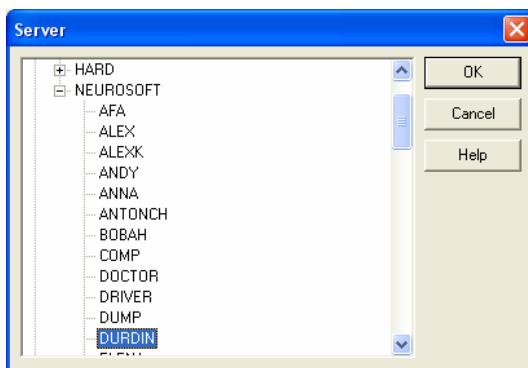
3. After the remote access mode activation on the computer-server, you can observe the EEG acquisition process on the computer-client. You should select **Checkup|Remote access** command on the computer-client. **Remote connection** dialog box will appear on the screen (Pic. 5.50).



Pic. 5.50

Enter the net address of the computer-server (*Server* edit line), the port number and the password (*Port* and *Password* edit lines) set in the server setup. After clicking the “OK” button, the computer-client will be connected to the computer-server and a new checkup will be opened on it. When choosing the *Monitoring* command, you can observe from the computer-client the EEG acquisition taking place on the computer-server.

You can also choose the computer-server directly in the browser list (Pic. 5.51) when press the button.



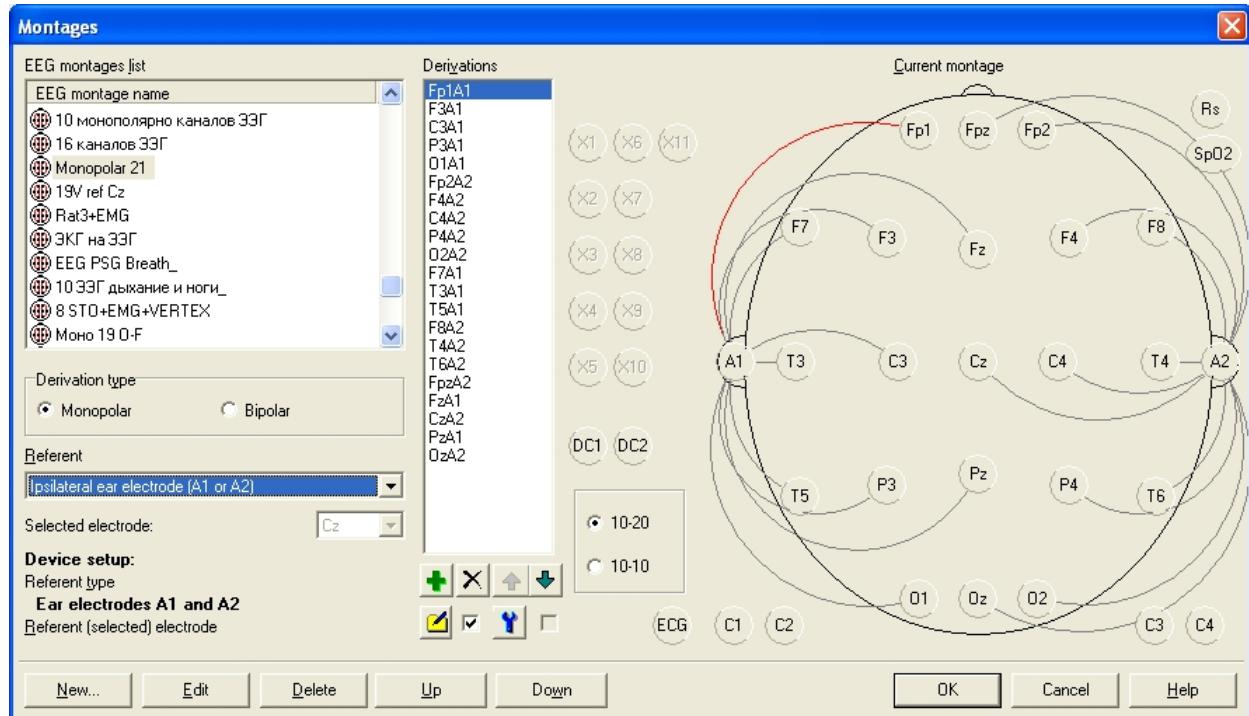
Pic. 5.51

5.10. EEG MONTAGES

One of the most significant advantages of computer EEG systems over paper ones is a possibility of getting an arbitrary set of mono- and bipolar recording variants out of one monopolar record. A set (number and type) and order of EEG-derivations traced on the screen or on the paper in the **Neuron-Spectrum** program, are called “montage”.

1. The program allows forming any number of montages and performing referent reconstruction of EEG-traces at any moment of EEG registration and analysis.

2. All montages are stored in a separate archive. To create, edit or select a montage, click **Setup|Montages** or on the  button on the *Setup* toolbar. The **Montages** dialog box will appear on the screen (Pic. 5.52).



Pic. 5.52

3. The *EEG montages list* shows all the EEG-montages formed in the program. Each montage has its own unique name, which is displayed on the list. The current montage is highlighted.

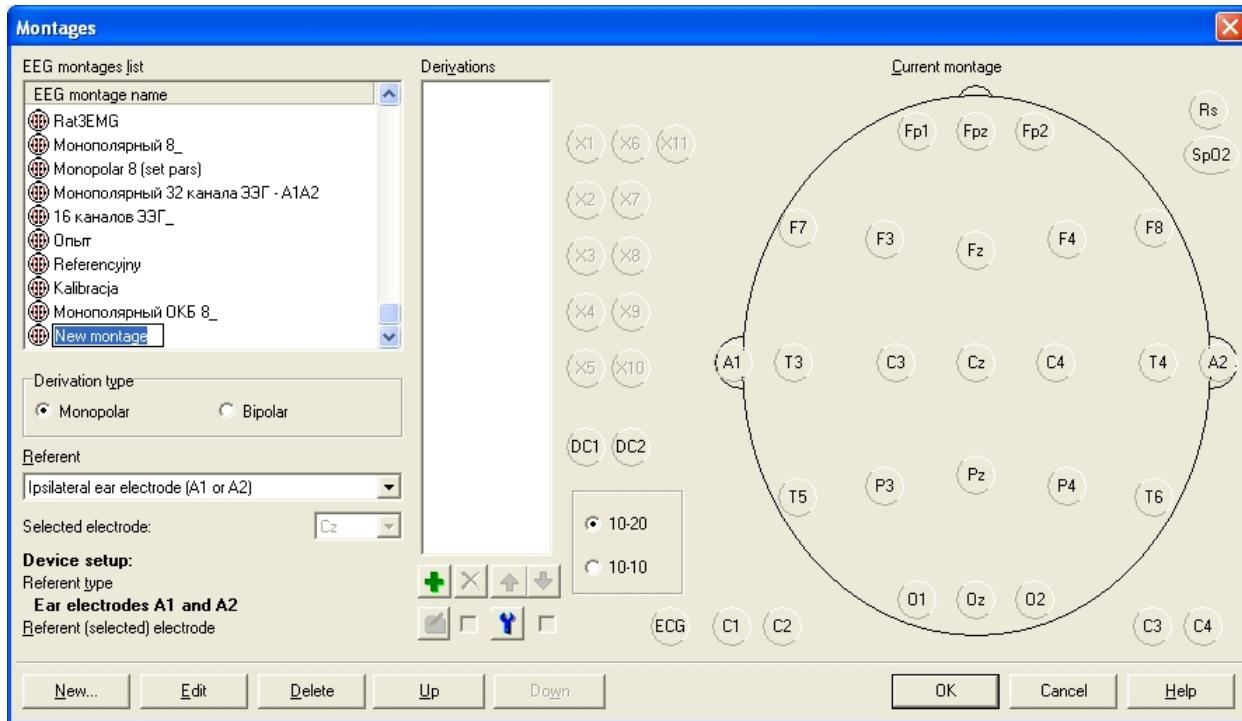
The *Derivations* list includes all the derivations of the chosen montage in the order of their appearance on the encephalogram. The *Current montage* scheme displays all the derivations schematically. The pointer being over the active electrode, the derivation is red-highlighted and marked out in the *Derivations* list. And vice versa, if you select any derivation in the *Derivations* list, the derivation will be marked on your scheme as well. The  and  buttons are used to replace the order of derivations in the *Derivations* list.

The *Derivation type* radio button specifies the type of the new derivation being created (added to the montage) – monopolar or bipolar.

In the *Referent* combo box you can specify the type of the referent electrode used for the creation (addition) of the next derivation to the montage or for the referent reconstruction of the electroencephalogram to the montage with the other referent.

The *Referent type* and *Referent (selected) electrode* lines inform you about the settings of these parameters during the hardware setup.

4. To create a new montage, click on the “New” button. A new montage named “*New montage*” will appear on the list of montages (Pic. 5.53).



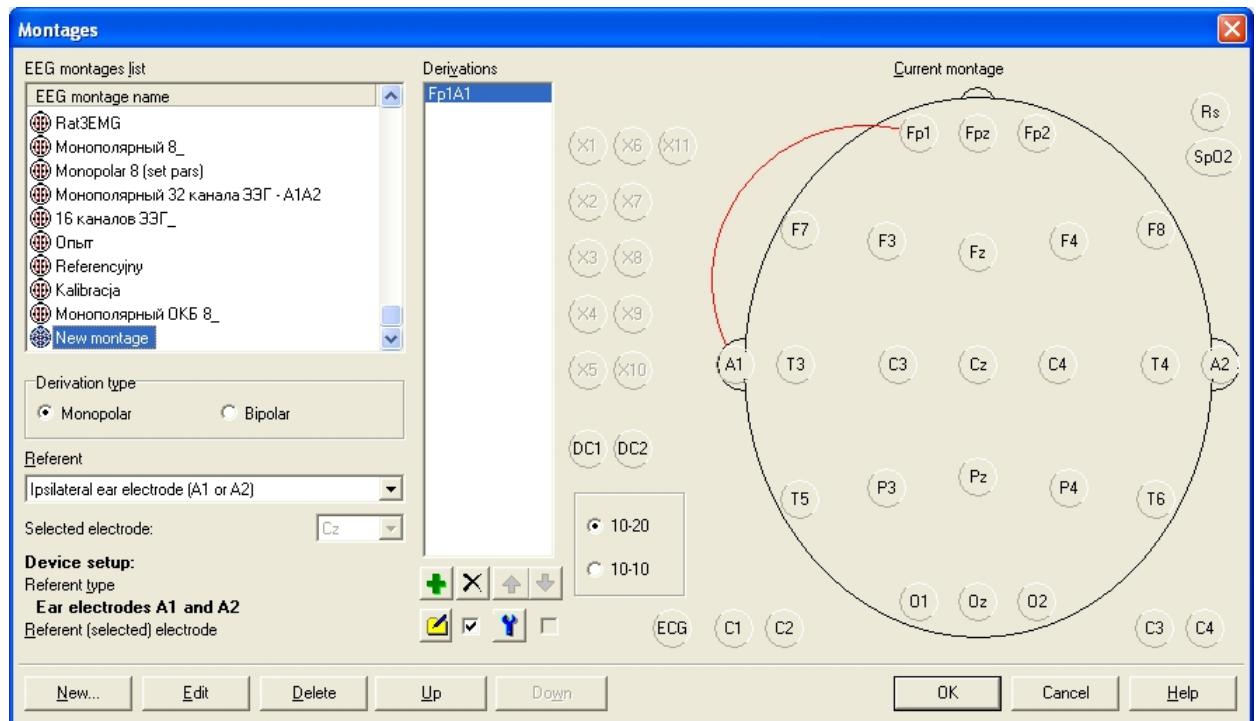
Pic. 5.53

Enter the montage name you wish and press [Enter]. A new montage has no derivations.

5. Select the type of the electrode for the first derivation *Monopolar* if you want to create a monopolar derivation or choose *Bipolar*, if you want to create a bipolar derivation (Pic. 5.53). One montage can include both monopolar and bipolar derivations.

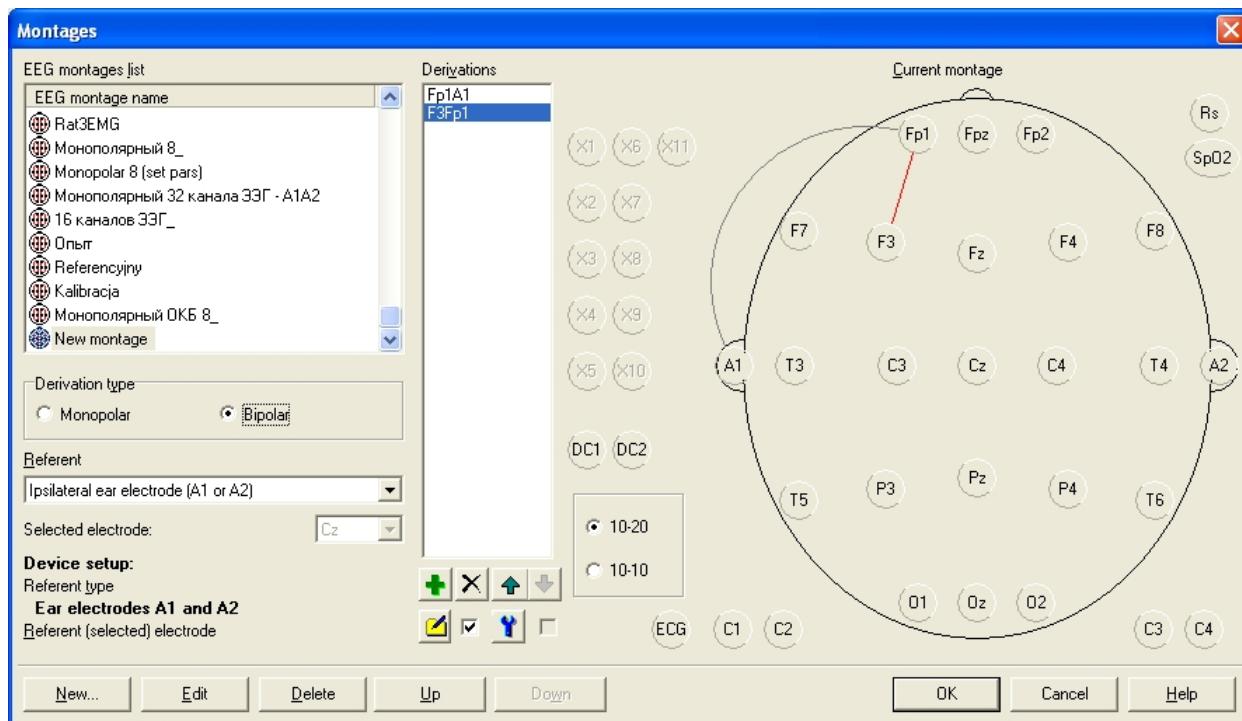
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6. To add a monopolar derivation into the montage, click on the active electrode button (Fp1 for example). The required derivation will be added into the montage (Pic. 5.54).



Pic. 5.54

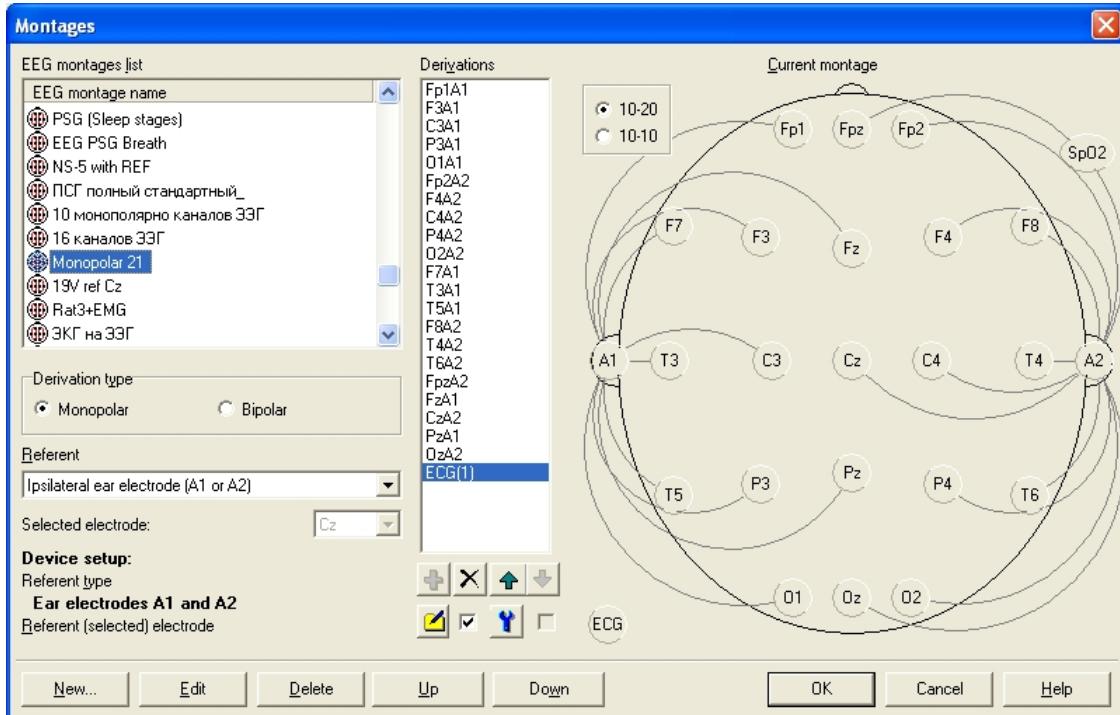
7. To add a bipolar derivation, set the *Derivation type* radio button into the *Bipolar* position. Click the active electrode with the left mouse button, move the cursor over the passive electrode with the button pressed and then release the button. For example, to add **Fp1F3** derivation, click the “*Fp1*” electrode button with the mouse, move cursor over the “*F3*” and release the mouse button. The **Fp1F3** derivation will be added into the montage (Pic. 5.55).



Pic. 5.55

8. To delete the selected derivation, click on button. To replace derivation in the list use and buttons. To control the visibility of the derivation in a montage, use the check box located under the button for the derivation removal. To rename a montage, click *Edit* button. To delete a montage, click on *Delete* button. To replace the montages in the list use *Up* and *Down* buttons.

9. **Neuron-Spectrum-1, 2, 3 (v.1)** EEG system are provided with ECG-channel. Generally ECG signal is registered in the second standard ECG lead. To make the registration of the ECG-channel possible, it must be added to the montage list by clicking on the ECG button on the “*Current Montage*” scheme. The ECG-derivation will be added into the montage (Pic. 5.56).



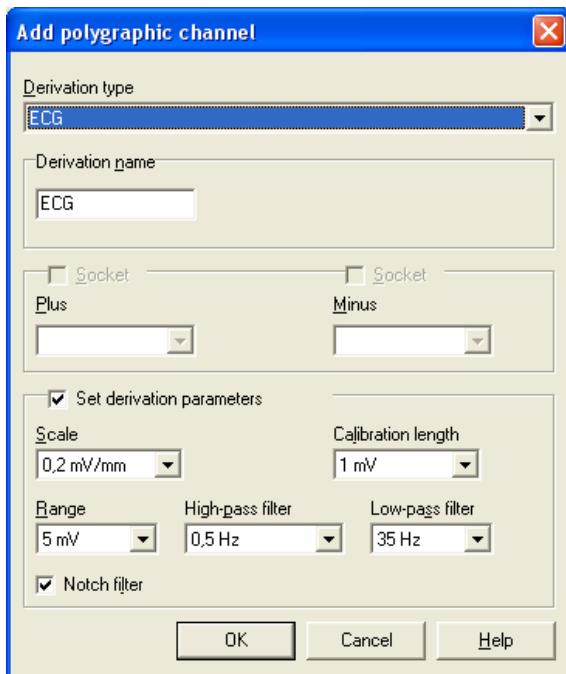
Pic. 5.56

10. **Neuron-Spectrum-4 (v.1), Neuron-Spectrum-4/EP, Neuron-Spectrum-4/P, Neuron-Spectrum-4/EPM** and **Neuron-Spectrum-5** EEG systems have three, seven, seven, seven and nine extra channels correspondingly. These are channels:

- breath;
- two or four extra high quality polygraphic channels;
- separate ECG channel for **Neuron-Spectrum-4/EPM** and **Neuron-Spectrum-5**;
- two direct current channels for **Neuron-Spectrum-4/EP**, **Neuron-Spectrum-4/P**, **Neuron-Spectrum-4/EPM** and **Neuron-Spectrum-5**;
- SpO_2 channel for **Neuron-Spectrum-5**.

Using these channels, you can record EMG, EOG, ECG and other electrophysiological signals, also including the channels from sensors providing the direct current signals (for example, body position sensors). To record the derivations by these channels, you have to add them to the montage list. When working with the montages of the **Neuron-Spectrum-4 (v.1), 4/EP, 4/P, 4/EPM, 5** EEG systems use “*K1*”, “*K2*” (“*K3*”, “*K4*”, “*ECG*”) or “*Rs*”, “*DC1*”, “*DC2*” and “*SpO2*” buttons on the *Current montage* scheme to add such derivations (Pic. 5.52, Pic. 5.55).

At first, select the channel by which the additional derivation is to be recorded (for example, “*KI*”) and click on the channel button. The dialog box for selecting the type of the derivation to be recorded by this channel will appear on the screen (Pic. 5.57).



Pic. 5.57

After selecting the *ECG*, *EMG*, *EOG* derivation type or the *Other* type, and entering the name of the derivation into the *Derivation name* edit line, you can add the selected derivation into the montage.

You can also specify the channel parameters: scale, calibration length, input range and filters parameters in the *Set derivation parameters* group by activating this check box.

In the same way you can add the direct current channel to montage by pressing the “*DC1*” or “*DC2*” button. The parameters of the direct current channel are defined by the channel hardware settings specified in the hardware setup dialog box.

The breath or *SpO₂* channels is added to montage by pressing the “*Rs*” or “*SpO₂*” button correspondingly.

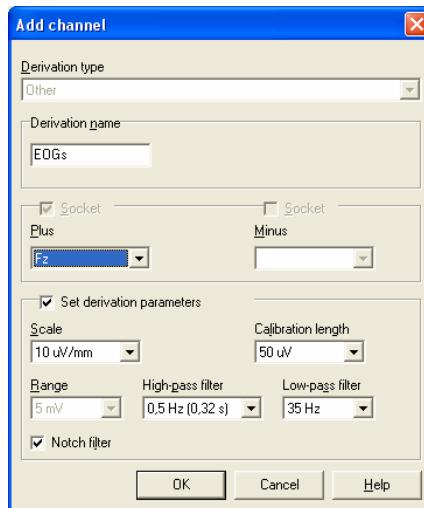
For example, to add ECG derivation on the first channel, click on the “*KI*” button. Select “*ECG*” in the dialog box appeared (Pic. 5.57) and click “*OK*”. ECG derivation to be registered by the first additional channel will appear in the in the montage (the channel number will be in brackets after derivation name).

In the “*Derivation name*” edit line, you can specify any derivation name.

11. Besides, you can register any signal on free EEG channels (are not involved in EEG recording). It is necessary to put such the derivation into the montage. To record, use one or two EEG sockets: one is positive and the other one is negative (referent electrode can be used as negative).

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To add the derivation into the montage, at first select one or two sockets will be used (select monopolar or bipolar derivation in *Referent electrode* radio buttons) and then press  button. The dialog box with the derivation type will appear on the screen (Pic. 5.58).



Pic. 5.58

In the *Derivation name* edit line set the derivation name, in the *Plus* and *Minus* combo boxes, set the sockets for plus and minus inputs if bipolar mode was selected. If you use the monopolar mode, select only plus socket. The referent electrode will be the minus one. The used sockets will be displayed in the brackets after the derivation name **EOGs(Fpz)**. Press “*OK*” and new derivation will be added into the montage. If you activate the *Set derivation parameters* check box, you can define the recording and new derivation displaying parameters.

12. In the montage the parameters can be set for each derivation. To do this, press  button. The **EEG channels parameters** dialog box will appear on the screen (Pic. 5.60).

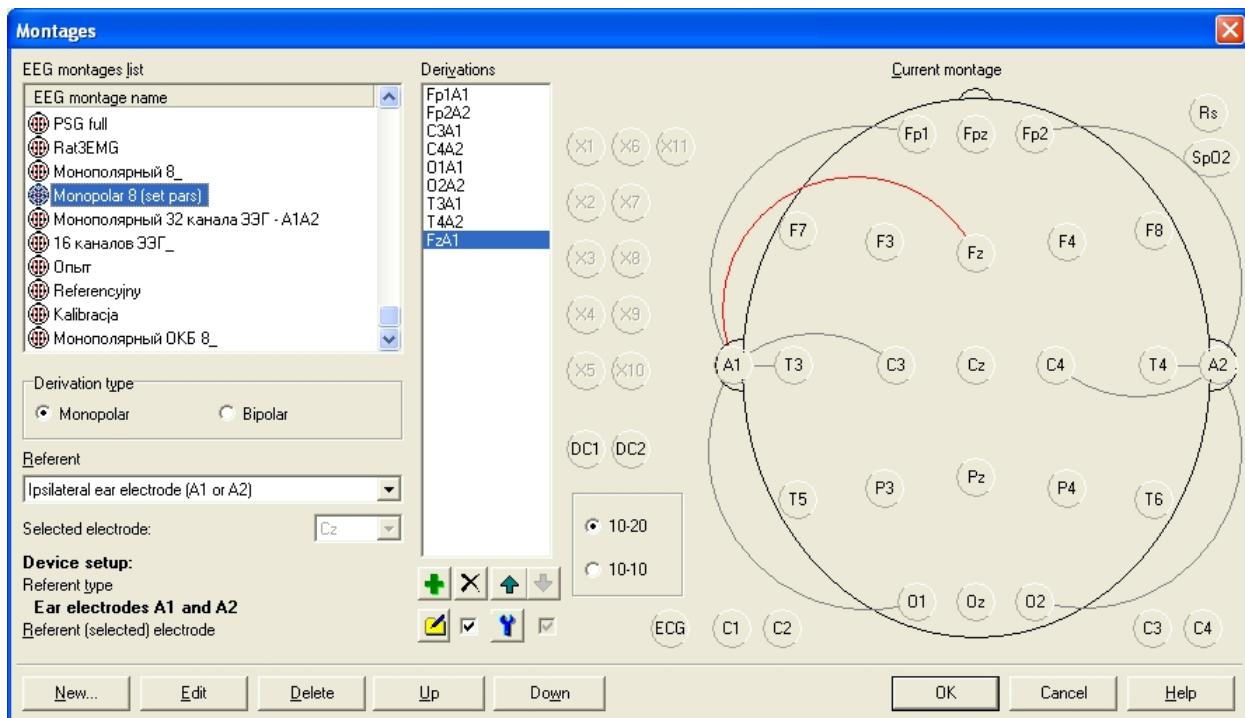
EEG channels parameters						
Derivations list	Scale	Length	High-pass filter	Low-pass filter	Notch	Range
Fp1A1	10 μ V/mm	50 μ V	0.5 Hz	35 Hz	Not set	
Fp2A2	10 μ V/mm	50 μ V	0.5 Hz	35 Hz	Not set	
T3A1	10 μ V/mm	50 μ V	0.5 Hz	35 Hz	Not set	
T4A2	10 μ V/mm	50 μ V	0.5 Hz	35 Hz	Not set	
T5A1	10 μ V/mm	50 μ V	0.5 Hz	35 Hz	Not set	
T6A2	10 μ V/mm	50 μ V	0.5 Hz	35 Hz	Not set	
C3A1	10 μ V/mm	50 μ V	0.5 Hz	35 Hz	Not set	
C4A2	10 μ V/mm	50 μ V	0.5 Hz	35 Hz	Not set	
O1A1	10 μ V/mm	50 μ V	0.5 Hz	35 Hz	Not set	
O2A2	10 μ V/mm	50 μ V	0.5 Hz	35 Hz	Not set	
EOG(P3A1)	50 μ V/mm	200 μ V	0.5 Hz	15 Hz	On	
EOG(F7A1)	50 μ V/mm	200 μ V	0.5 Hz	15 Hz	On	
Chin(F3A1)	10 μ V/mm	100 μ V	10 Hz	100 Hz	On	
Snore(F4A2)	10 μ V/mm	100 μ V	0.5 Hz	100 Hz	On	
Chest(3)	0.1 mV/mm	500 μ V	0.05 Hz	15 Hz	Off	2 mV
Abd(4)	0.1 mV/mm	500 μ V	0.05 Hz	15 Hz	Off	2 mV
Leg(1)	0.01 mV/mm	100 μ V	10 Hz	100 Hz	On	5 mV
Leg(2)	0.01 mV/mm	100 μ V	10 Hz	100 Hz	On	5 mV
ECG(P4A2)	20 μ V/mm	1 mV	0.5 Hz	35 Hz	On	

Pic. 5.59

All the derivations for the selected montage are given in the list of channels. You can arbitrary set the parameters for each channel. The parameters adjusted in this montage will be set for each derivation during EEG recording after the selection of this montage.

The check box to the right of the button is checked if the individual channels parameters were set in the current montage.

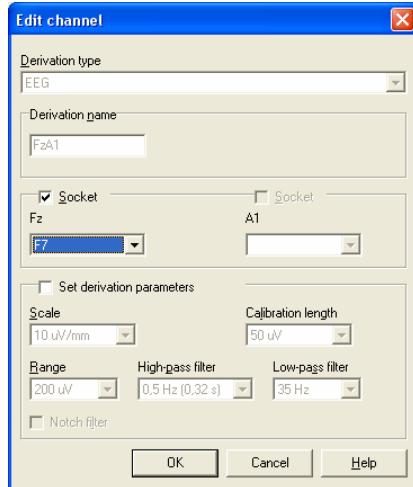
13. You can use the EEG channels which are not used during the acquisition for the recording of the arbitrary EEG derivations. So, you can record the central derivations on 16-channel digital EEG system. For example, you should record the derivation **FzA1** on 16-channel digital EEG system **Neuron-Spectrum-2** and you have free sockets: **F7** and **F8**. The socket **Fz** on 16-channel digital EEG system is not provided. You can solve this problem in the following way. Add the derivation **FzA1** in montage (Pic. 5.60).



Pic. 5.60

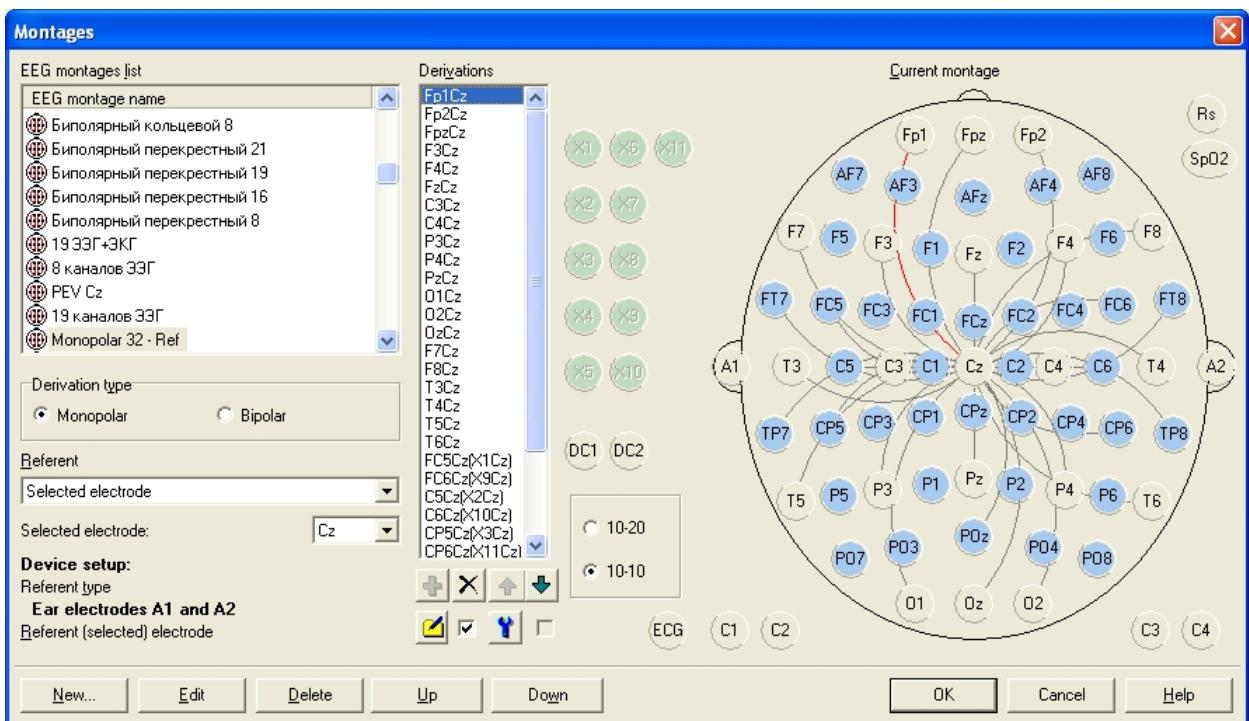
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Further, if you want to record this derivation physically from the socket **F7A1**, choose the added derivation **FzA1** in the *Derivations* list and press the  button to edit the derivation parameters. In the appeared dialog box activate the *Socket* check box and choose **F7** in the list (Pic. 5.60). So it indicates that the derivation **FzA1** will be physically recorded from the socket **F7**.



Pic. 5.61

14. If you want to add the derivations which are not included in the “10-20%” scheme (for example for recording of 32-channel EEG) to the montage, you can use the enlarged up to 64 derivations “10-10%” scheme. To activate the mode of 64 derivations displaying by the “10-10%” scheme, you should select “10-10” radio button instead of “10-20”.. All the 64 derivations of the “10-10” scheme will be displayed on the *Current montage*, moreover, the derivations which do not have physically the sockets on the EEG headbox, will be marked by the color (Pic. 5.62).

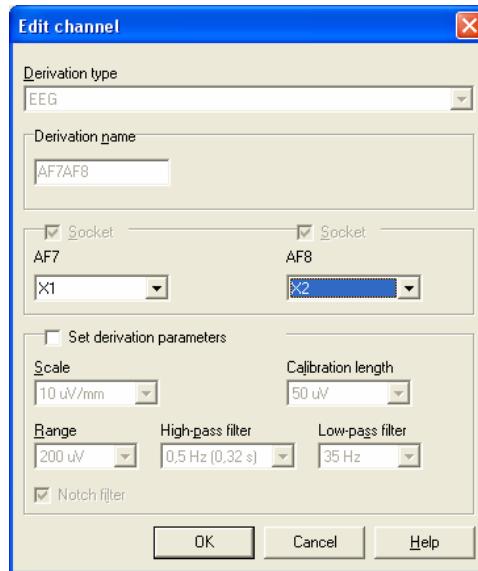


Pic. 5.62

Neuron-Spectrum Program

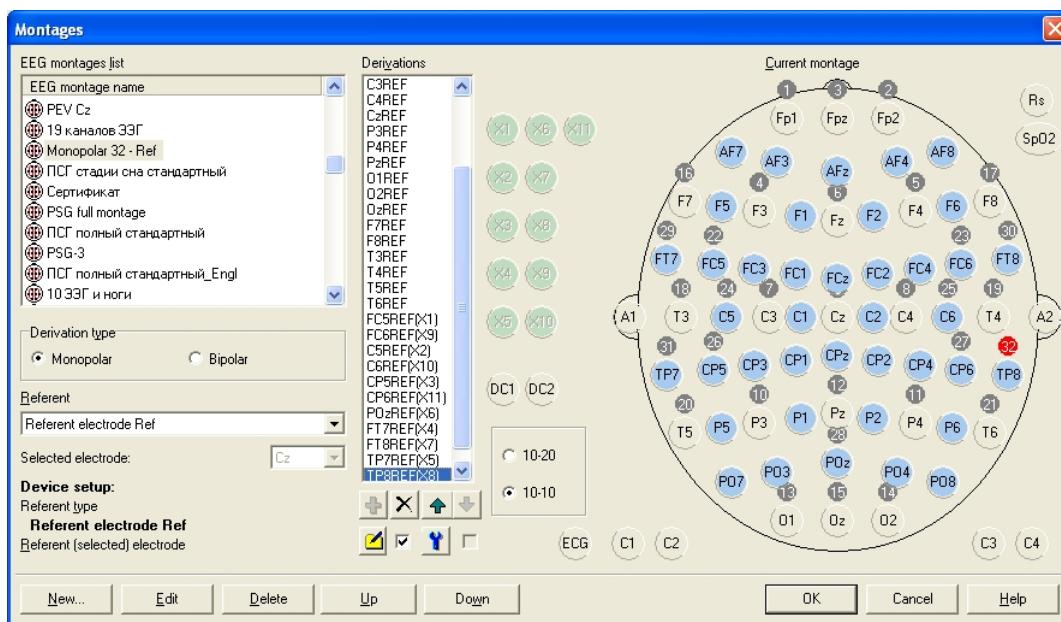
The addition of derivations from “10-10” scheme to montage is analogous to the addition of the derivations from the standard “10-20” scheme. The difference is that after the addition of derivation from the “10-10” scheme to montage, you should define at once the physical sockets for the recording of this derivation. At that you can use both the standard channels of “10-20” scheme and additional channels **X1,..., X11** (for **Neuron-Spectrum-5** EEG system).

Thus just after the addition of monopolar or bipolar channel containing the derivation from the “10-10” scheme to montage, the **Edit channel** dialog box (Pic. 5.63) for selection of physical sockets for the recording of derivation from the “10-10” scheme will automatically appear on the screen.



Pic. 5.63

On the picture (Pic. 5.64) you can see 32-channel montage for 32 channels EEG acquisition for **Neuron-Spectrum-5**. In this montage all the sockets of the “10-20” scheme and all additional channels **X1,..., X11** are used. The **Ref** derivation is used as a referent one.

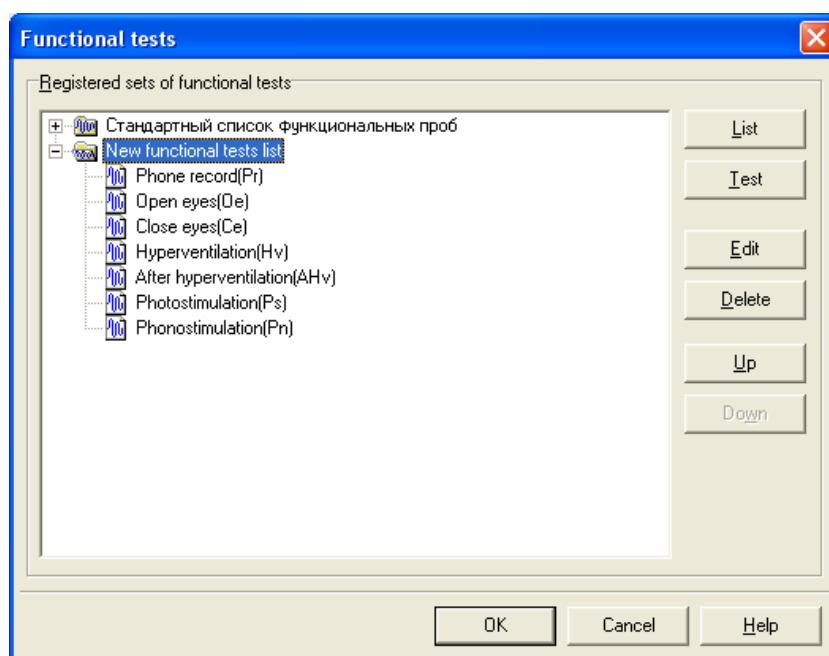


Pic. 5.64

5.11. LISTS OF FUNCTIONAL TESTS

1. **Neuron-Spectrum** EEG recording software allows to use a number of functional tests. The list of the tests may vary depending on test conditions: whether you perform ambulatory examination, intraoperative monitoring, or record EEG in a life-supporting ward. The program enables creating of any amount of the lists of functional tests. Each list must have its own unique name.

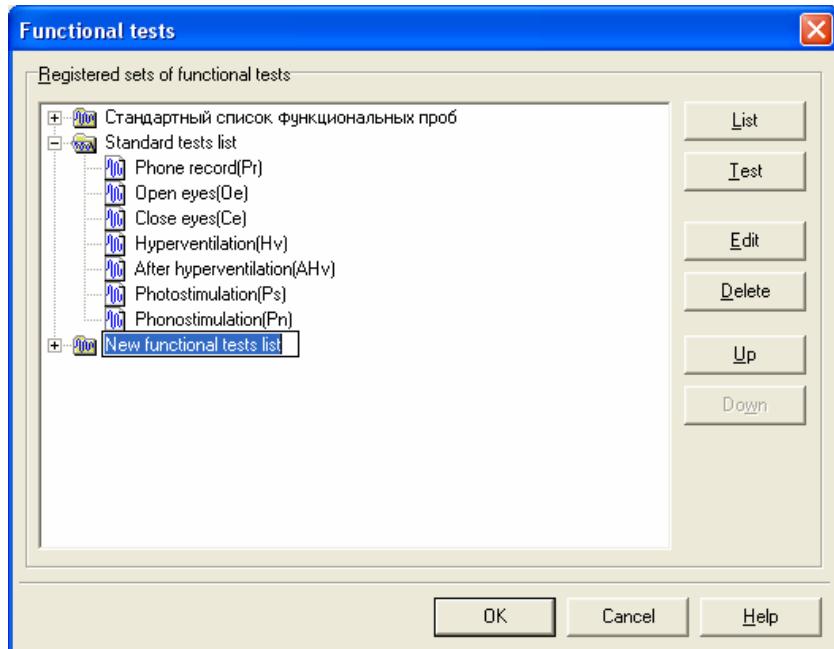
2. To create a new list of functional tests, to edit the lists that already exist or to select the test list to be used during EEG recording, use the **Setup|Functional tests** menu command. The **Functional tests** dialog box will appear on the screen (Pic. 5.65).



Pic. 5.65

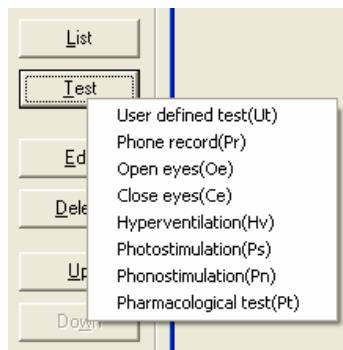
Each list of functional tests in the dialog box is a tree node, and the tests included into the list are the leaves of the node.

3. To create a new list of functional tests, click “List” button. A new line named **New functional tests list** will appear in the *Registered sets of functional tests* list (Pic. 5.66). Enter a new list name and press [Enter].



Pic. 5.66

4. To add a functional test to the new list, click on the “Test” button (Pic. 5.66). The list of all functional tests you may use will appear on the screen (Pic. 5.67).



Pic. 5.67

Neuron-Spectrum software uses the following standard functional tests:

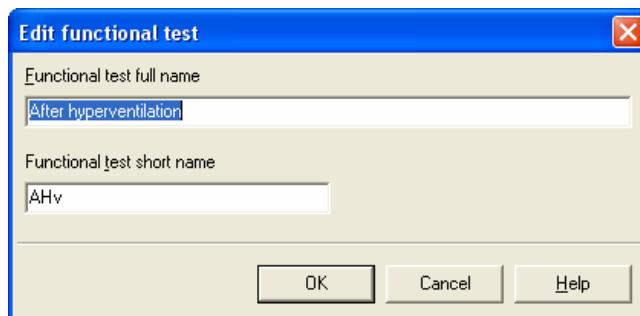
- Phone (background) record (Pr) – registration of background EEG.
- Open eyes (Oe) – reaction to the eyes opening.
- Close eyes (Ce) – reaction to the eyes closing.
- Hyperventilation (Hv) – deep breathe test.
- Photostimulation (Ps) – photostimulation test. Photostimulator can operate both in manual and automatic program mode. Program mode creates a separate photostimulation test for each stimulation command.

Chapter 5. SOFTWARE, HARDWARE, EEG REVIEW AND ANALYSIS PARAMETERS SETUP

• Phonostimulation (Pn) – phonostimulation test. Phonostimulator can operate both in manual and automatic program mode. Program mode creates a separate phonostimulation test for each stimulation command.

- Pharmacological test (Pt) – registration of reaction to drugs.

5. To register functional tests that do not belong to the standard list, you can use *User defined test* (Ut). Click on the “Edit” button to change full and short names of a user test providing the test is highlighted. The **Edit functional test** dialog box will appear on the screen (Pic. 5.68).



Pic. 5.68

Enter full and short names of a functional test and click “OK” or press [Enter].

6. To select the list of functional tests to be used for EEG recording, click on the name of the list, and then click “OK” or press [Enter].

7. During registration when selecting one of the functional tests, a functional test marker is set on the EEG record. Thus during EEG view and analysis you can identify different functional tests recorded fragments.

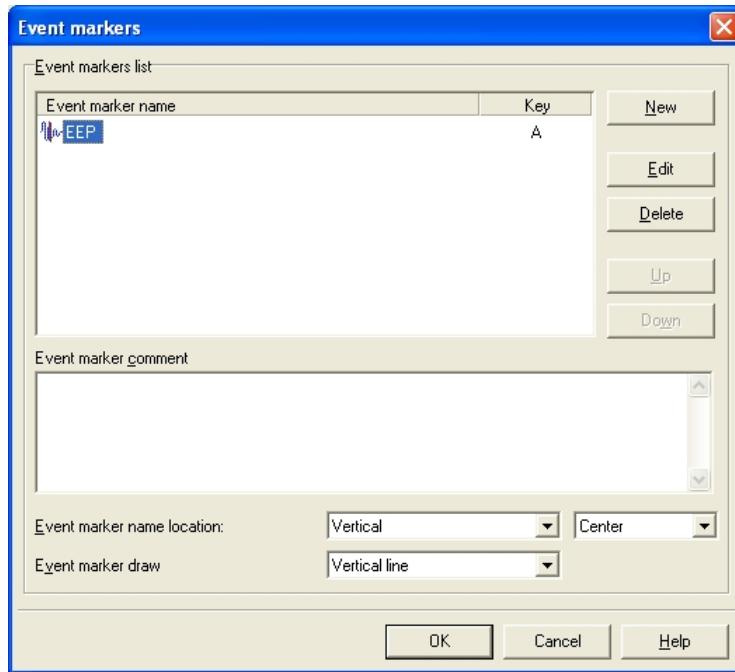
5.12. EVENT MARKERS

1. When recording EEG, you can mark any point of a record, so that you would have the opportunity to easily return to it. For this purpose, use special *event makers* and *comment markers*.

Neuron-Spectrum software allows compiling the list of markers beforehand, by associating them with certain keyboard keys that set markers during EEG recording at the moment of clicking.

Comment markers is not prepared beforehand and set during EEG recording process by selecting menu command (pressing the “hot” key). Marker’s name and comment are edited when marker is setting up.

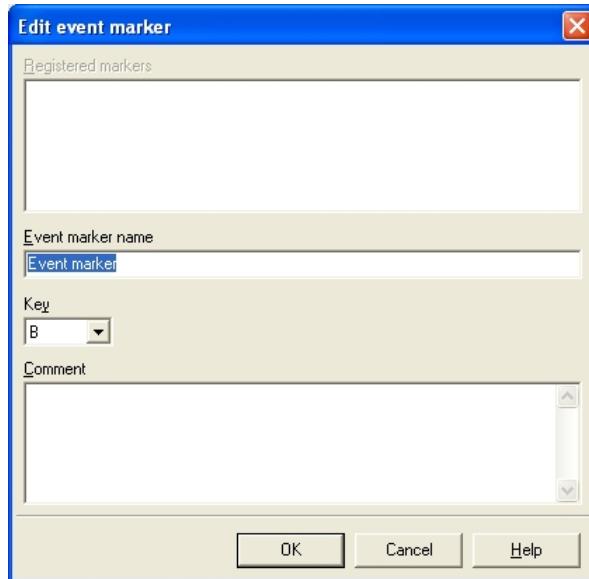
2. To compile and edit marker list, select **Setup|Markers**. The **Event markers** dialog box will appear on the screen (Pic. 5.69).



Pic. 5.69

In the *Event markers list* there are names of all registered event markers and the corresponding keys. To set a required marker during EEG recording, press the corresponding key.

3. To add a new marker, click “*New*” button. The **Edit event marker** dialog box will appear on the screen (Pic. 5.70).



Pic. 5.70

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Enter the new marker name in *Event marker name* edit line, select key for putting this marker during recording in *Key* combo box and press [Enter]. The new marker is registered. Also you can add a comment for event marker in the *Event marker comment* box.

You should take into account that “P” key is reserved after the so-called *printer marker*. It is an event marker, which indicates the EEG fragments to be printed after the record completed.

4. To rename a marker, select it in the list and click “Edit” button. The Edit event marker dialog box (Pic. 5.70) will appear. Enter a new name, select new key and press [Enter].

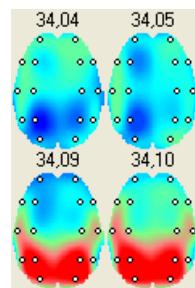
5. To delete a registered marker, select it in the list and click “Delete”. Confirm the deletion by clicking “Yes” or pressing [Enter].

6. To change a marker key, move the marker to the position with the corresponding letter by clicking on “Up” or “Down” buttons.

7. To change the way of marker representation on the electroencephalogram, you can use the combo boxes *Event marker name location* and *Event marker draw*. Choose where and how the event marker is displayed and where and how the marker name is located.

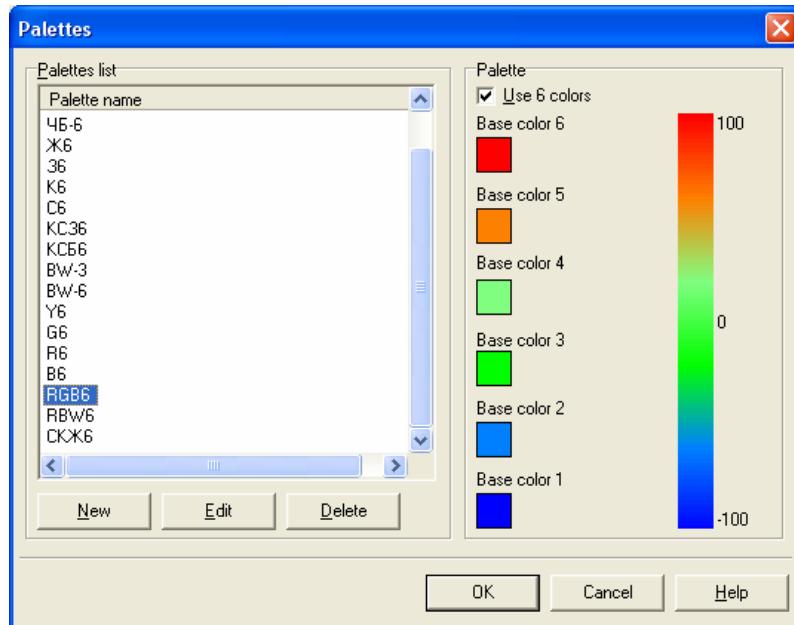
5.13. COLOR PALETTES OF TOPOGRAPHIC MAPS

1. *Palettes* are used for topographic maps display (Pic. 5.71). **Neuron-Spectrum** software allows creating your own palettes. Software distributive includes a set of various color and black-and-white palettes.



Pic. 5.71

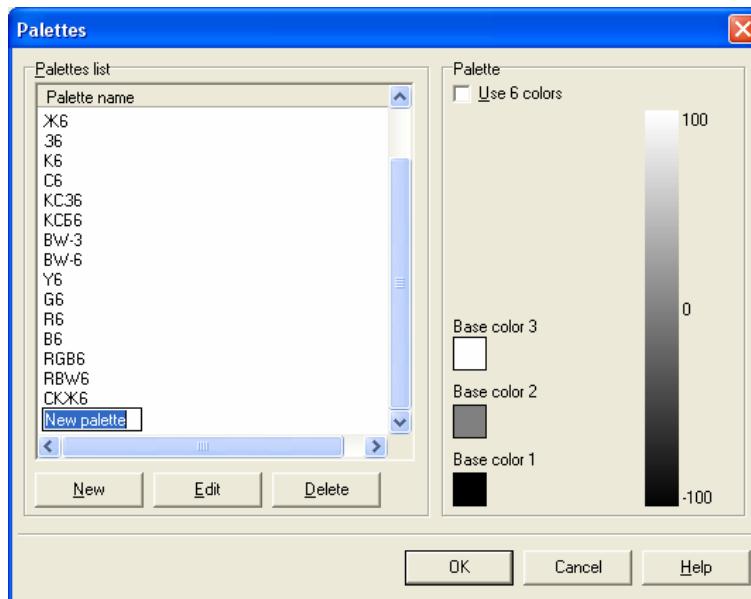
2. To create, edit or select a palette, use the **Setup|Palettes** menu command. The **Palettes** dialog box will appear on the screen (Pic. 5.72).



Pic. 5.72

3. The *Palette list* includes all the color palettes created in the program. The palette in use is highlighted. On the right in the **Palette** group the basic colors of palette are displayed. The palette can include three or five basic colors. The *Use 6 colors* check box sets their quantity. Basic colors of 3-color palette stand for minimum, maximum and averaged values. In 6-color palette they are evenly distributed between minimum and maximum (Pic. 5.72).

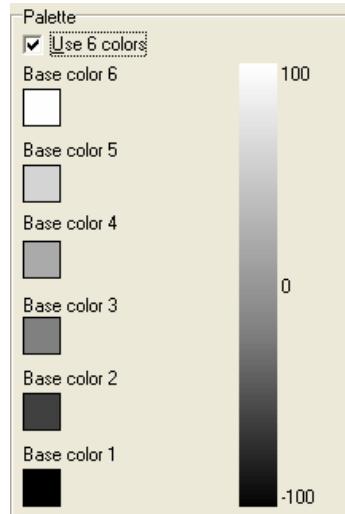
4. To create a new palette, click on the “*New*” button. A new line named *New Palette* will appear in the palette list (Pic. 5.73).



Pic. 5.73

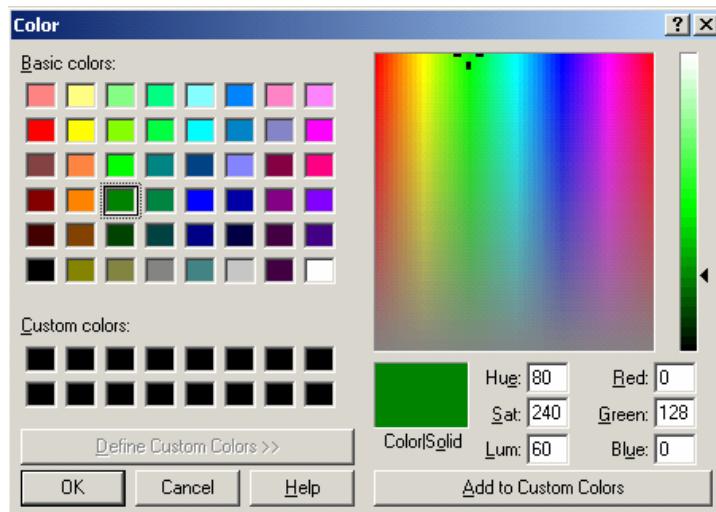
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Enter the required palette name and press [Enter]. By default, program sets 3-color mode and the palette is formed as black-and-white. If you wish to transform it into 6-color palette, check the *Use 6 colors* check box by clicking on it. The new palette will use six basic colors, but still remain black-and-white (Pic. 5.74).



Pic. 5.74

5. To change a basic color in the palette, double-click on the required color box. The **Color** dialog box will appear on the screen (Pic. 5.75). Select the required color and click “OK”.



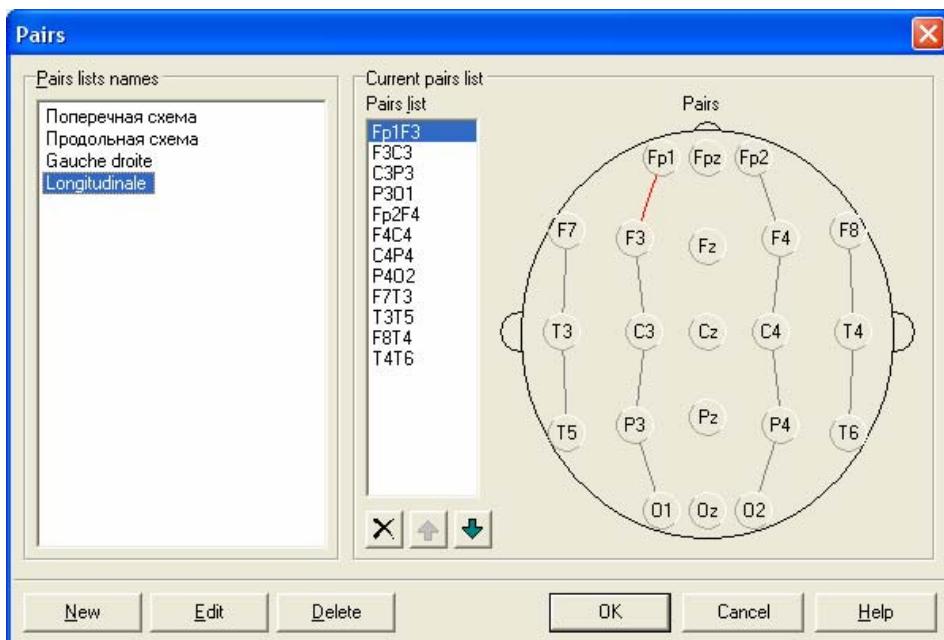
Pic. 5.75

Select all the basic colors in this way. New palette is now created and ready for use.

6. To change a palette name select it (click on the palette name) and then click “Edit” button. Enter a new name and press [Enter].
7. To delete a palette, click on the palette and then click “Delete” button.
8. To select a palette for further using, click on the palette name and then click “OK”. Click “OK” also to save changes if you added new palettes or edited the existing ones.

5.14. CREATING AND EDITING PAIRS FOR CORRELATION AND COHERENCE ANALYSIS

1. During EEG analysis some calculations (such as cross correlation and coherence) are done only for derivation pairs. To prepare such lists of pairs, for which the following calculations of cross correlation and coherence functions will be done, select **Setup|Pairs**. The **Pairs** dialog box will appear on the screen (Pic. 5.76).



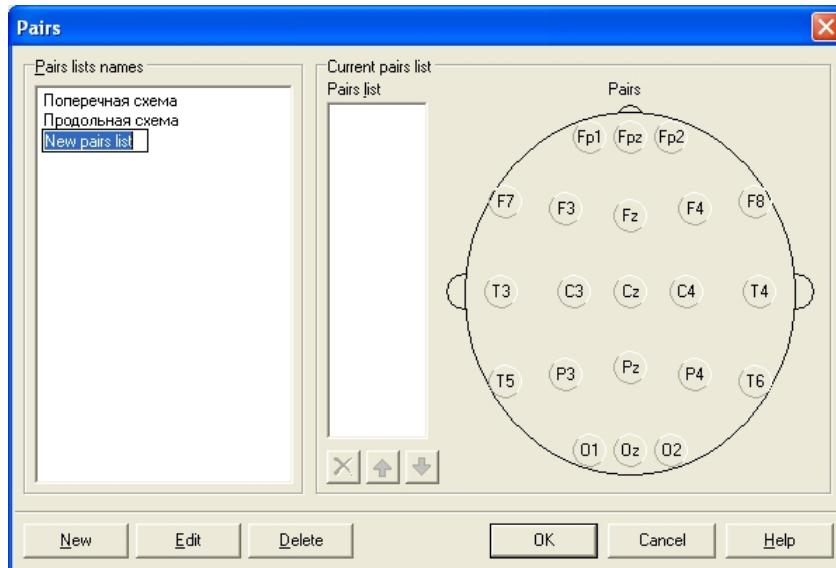
Pic. 5.76

2. The *Pair lists* names list contains already created and registered lists of derivation pairs. Every pair consists of two electrodes. You can include any number of pairs in every list. The *Current pairs list* group contains information on the current list of derivation pairs selected in the *Pair list names* list. The *Pairs* scheme displays all the derivation pairs in the current pair list.

3. To delete a pair select it in the *Pairs list* and click on the button. After entering all the pairs into the list and creating the required amount of pair lists click “OK” or press [Enter] to finish the dialog box work.

4. To change the reciprocal order of the pairs, use the and buttons. When pressing one button, the selected (hot) derivation will change its place with the next upper or lower one.

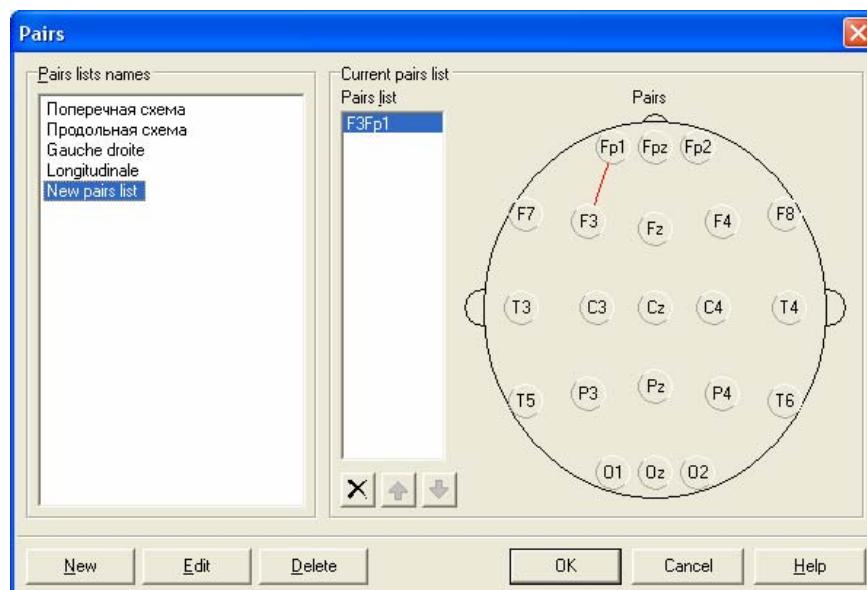
5. To create a new list of pairs, click on the “New” button. An empty list named “*New pairs list*” will appear in the *Pairs lists names* list (Pic. 5.77). Input your name and click [Enter].



Pic. 5.77

6. To edit the name of the current list of pairs click on the “Edit” button. Edit the name and press [Enter]. To delete the current list of pairs click on the “Delete” button.

7. To add a new pair into the list of pairs, click on the active electrode with the left mouse button, move the cursor over the passive electrode with the button pressed and release the button. For example, to add **Fp1F3** pair, click on “*Fp1*” electrode, move the cursor over “*F3*” with the mouse button pressed, and then release the button. The **Fp1F3** pair will be added into the *Pairs list* (Pic. 5.78). All the activities on the pair creating are the same as on bipolar derivations forming in EEG montage (see sec. 5.10).

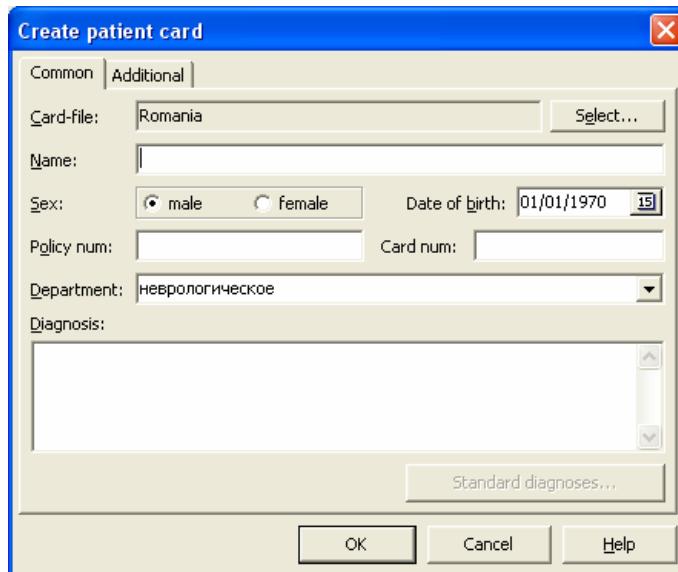


Pic. 5.78

CHAPTER 6

NEW CHECKUP (EEG RECORDING)

1. To record a new EEG (to start a new checkup) of a new patient, select **Checkup|New|New Patient**, click on the  button on the *Standard* toolbar or press the [**Ctrl+N**] key combination. The **Create patient card** dialog box will appear on the screen (Pic. 6.1).



Pic. 6.1

Set basic patient's data in the *Common* page (Pic. 6.1).

The *Card-file* edit line indicates the name of the database card file, where a new patient card will be created. If the card file offered does not meet your requirements, click on “*Select*” and choose another card file, or create a new one.

In the *Name* edit line enter the name, surname, patronymic name of your patient.

Select patient's sex using the *Sex* radio buttons.

Enter patient's date of birth in the *Date of Birth* field. If you click on the  button, the program will display a calendar, so that you will be able to select a date in a special date list.

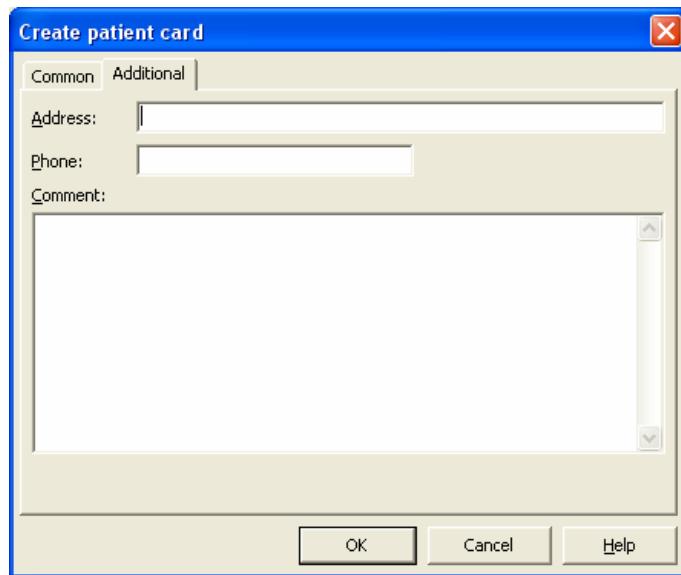
In the *Department* edit line type the name of a ward or clinic. If you click on , a list of names, already entered, will appear on the screen.

In the *Diagnosis* memo field enter preliminary diagnosis.

The *Department* and *Diagnosis* fields are optional.

Neuron-Spectrum Program

The *Additional* page (Pic. 6.2) includes additional (optional) data.



Pic. 6.2

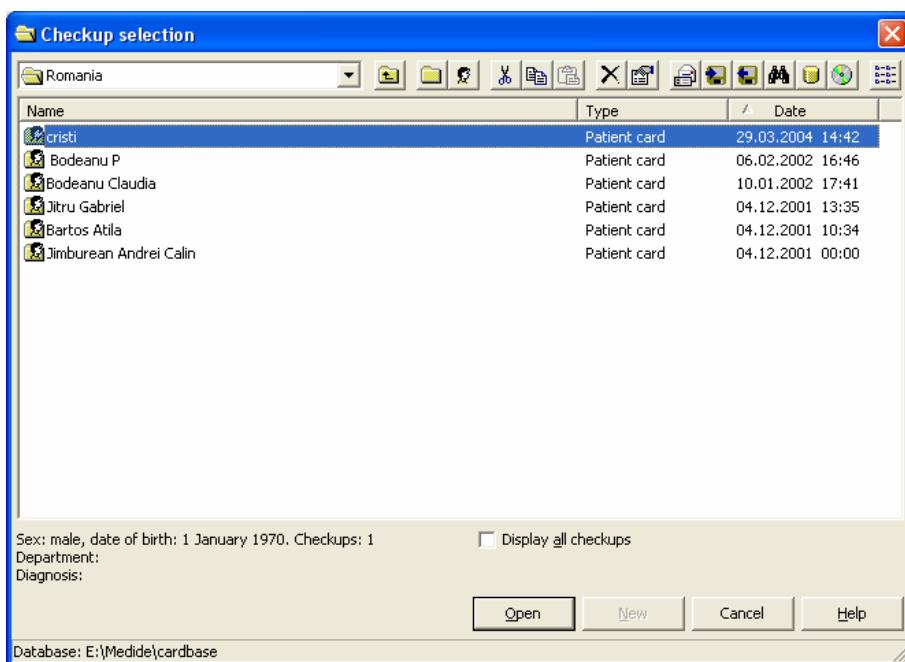
In the *Address* edit line enter the address of your patient.

In the *Phone* edit line enter his phone number.

The *Comments* field includes any text information to ease the search of a patient.

After you have filled the dialog box, click on "OK".

2. If the patient has already done checkups and the patient card already exists in the database, select **Checkup|New|Patient** or click on the button on the *Standard* toolbar. The **Patient Card selection** dialog box will appear on the screen (Pic. 6.3). In the following case six patient cards are stored in the *Romania* card-file.



Pic. 6.3

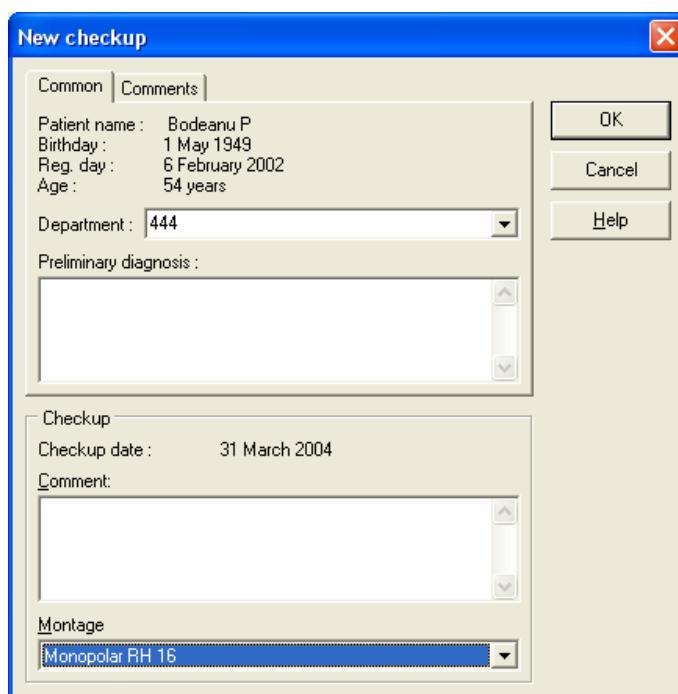
Click on the name of a patient with the left mouse button (you may also use arrow keys). Then click on “OK”.

If the patient’s card is stored in another card-file, close the current card-file by clicking on  button or pressing [Backspace]. To create a new card-file, click on .

To open a new card-file, double-click on its name, or click on it once, and then click on “Open”. Click on the  button to search for a required card if you have forgotten where it is stored. One patient may have several cards in different card-files.

To end the procedure, click on “OK”.

3. After you have registered a new patient or have chosen a patient card, the **New Checkup** dialog box will appear on the screen (Pic. 6.4).



Pic. 6.4

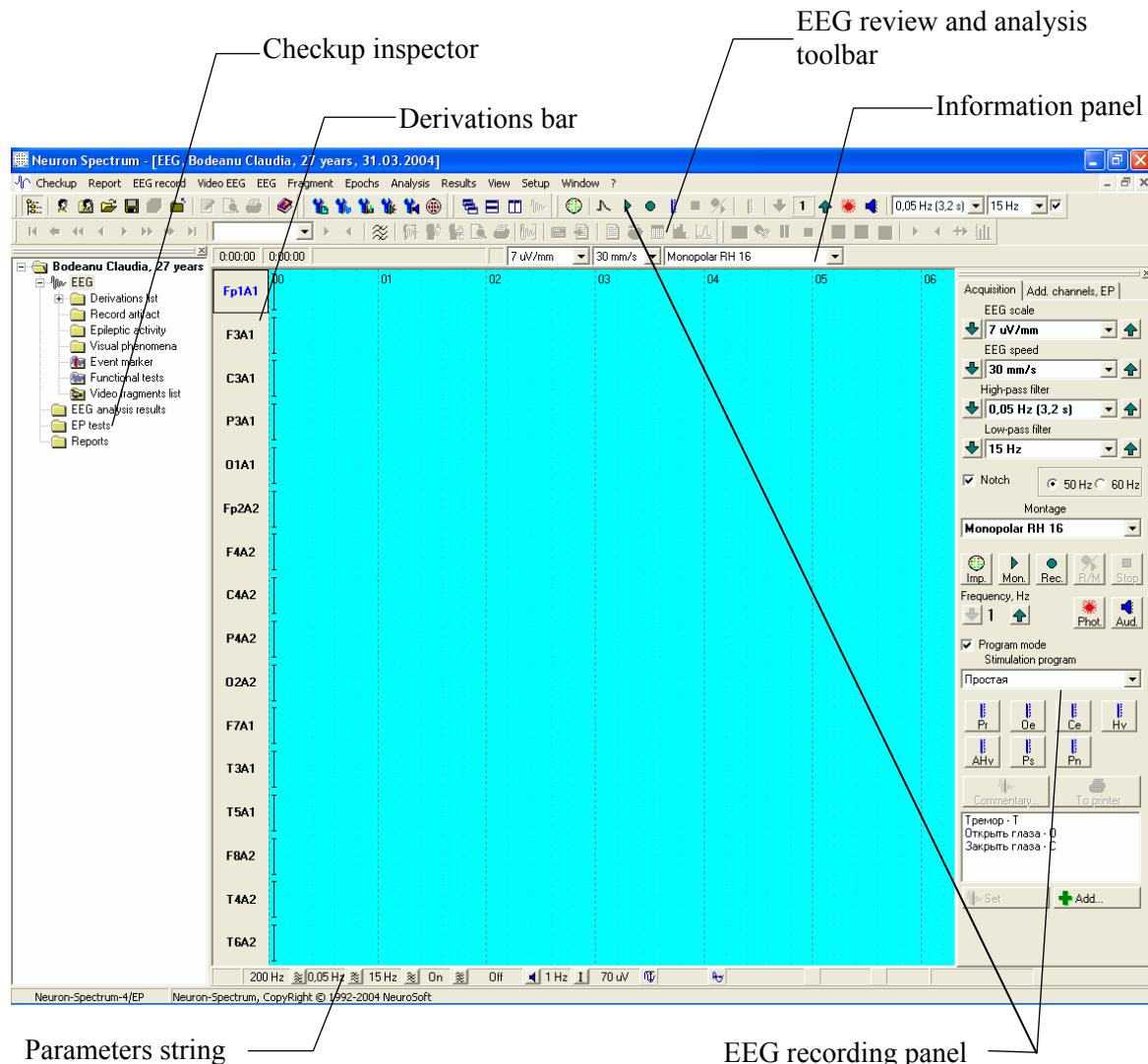
You may add your special comments in the *Comment* memo field.

Select the required EEG montage in the *Montage* combo box. By default, the dialog box displays the montage that was preset as current when adjusting EEG-montages or performing the last registration.

After all click on “OK”.

Neuron-Spectrum Program

4. **Neuron-Spectrum** software will create a new checkup and go over to the EEG recording mode. In standard recording mode (*Simple recording* check box in **Program setup** dialog box is unchecked) the view and registration window will appear on the screen (Pic. 6.5).



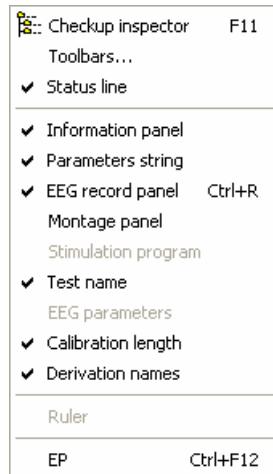
Pic. 6.5

The **Neuron-Spectrum** EEG registration mode window consists of:

- Menu;
- *Standard, Setup, Windows, EEG record* and *EEG view and analysis* toolbars;
- Checkup inspector (can be hide);
- EEG registration and review window, including derivations bar, information panel and EEG recording panels (can be hide).

Checkup inspector is a tree-view hierarchical list of all the checkup elements. It simplifies much the navigation. A detailed description of *Checkup inspector* is given below in the “**Checkup Inspector**” chapter. Note that you may hide *Checkup inspector* by clicking on **View|Checkup inspector** or on the  button, or pressing **[F11]**.

5. Many of program accessory elements (such as toolbars, recording bar, editor ruler, etc.) can be hidden with the help of **View** menu (Pic. 6.6).

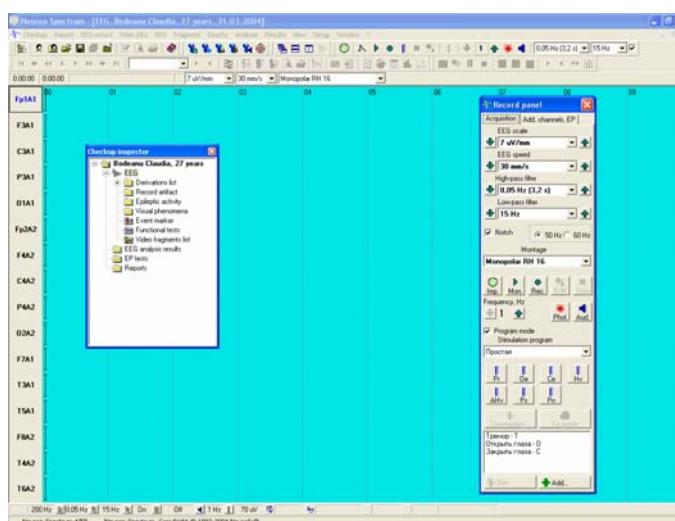


Pic. 6.6

General rules:

- if a **View** command is not enabled, grey-colored, you can not control the visibility of the corresponding element, it is not displayed on the screen (see **Ruler**, **EEG parameters** in the Pic. 6.6);
- if a command has a check mark before it, the element is activated and displayed on the screen (**Status line** in the Pic. 6.6);
- if there is no check mark before the command, the element is not displayed on the screen (**Montage panel** – Pic. 6.6);
- to change the visibility of an element, you should perform the corresponding command in the **View** menu.

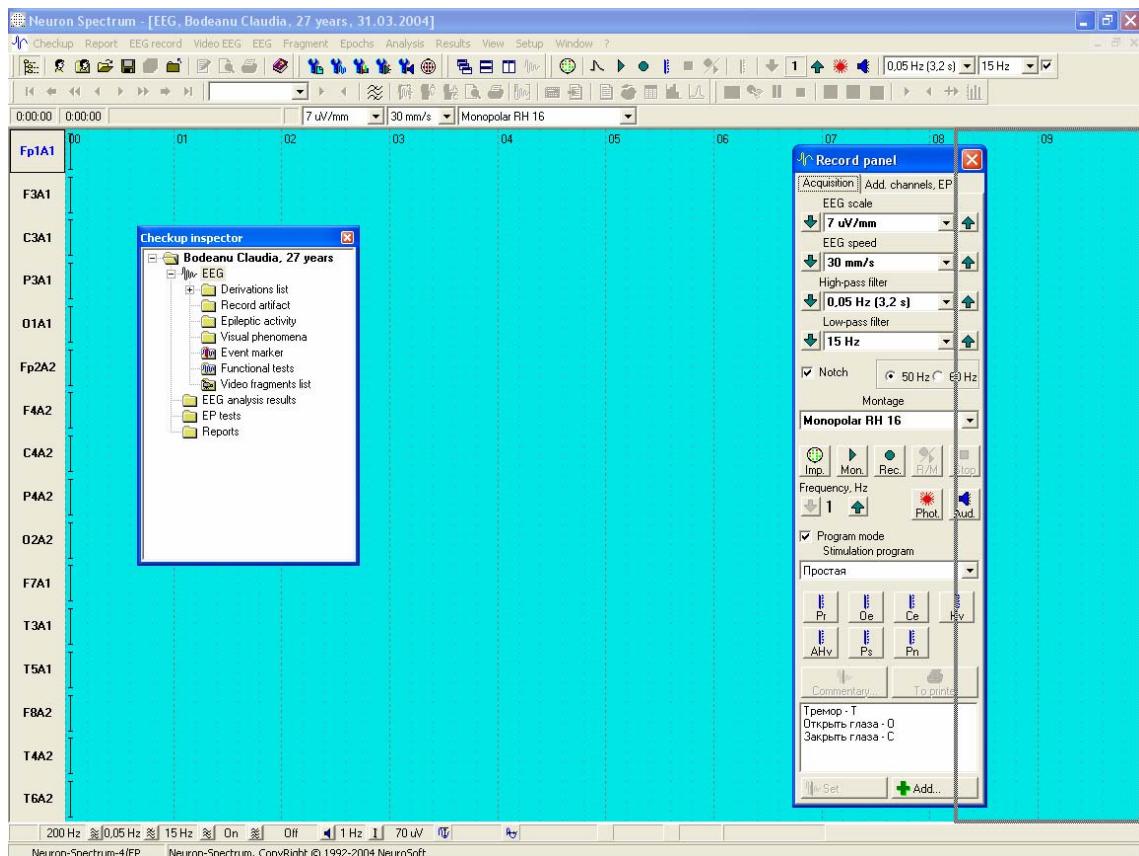
6. Such program elements as *Checkup inspector* and *Record panel* can operate both in undocked (“moving”) (Pic. 6.7) and docked (“fixed”) mode (Pic. 6.5).



Pic. 6.7

Neuron-Spectrum Program

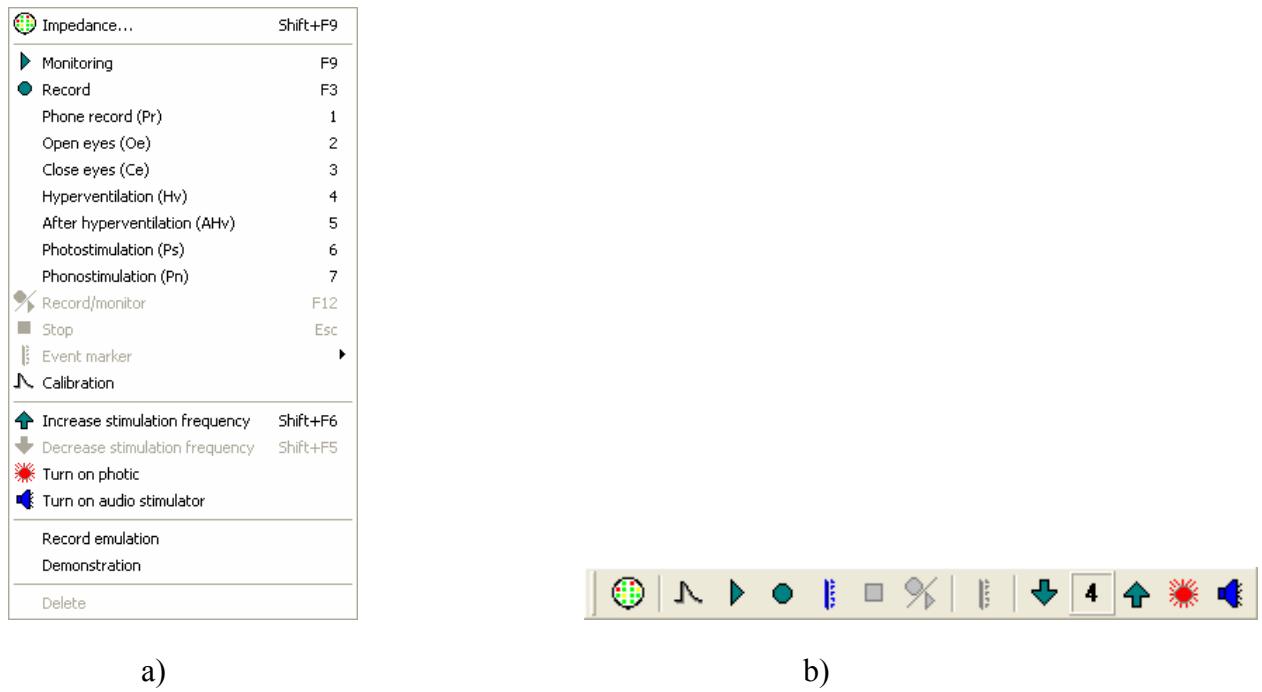
The undocked mode enables moving of panels easily on the screen, holding a box by its title. When moving a box, you move its frame. You may dock a “moving” box to any side of the program window moving it to the edge till the frame is fixed (Pic. 6.8). To do this, click it with the left mouse button and drag to the very edge of the window. Then release the mouse button. The box will be docked.



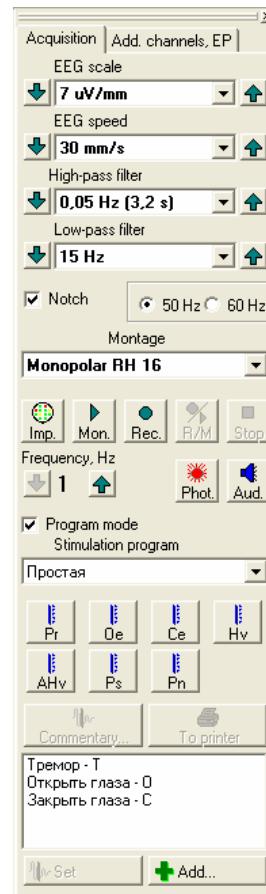
Pic. 6.8

To switch the docked panel to a “moving” state, drag it by the double line situated at the top of the window. Then release the mouse button; the box will be switched to a “moving” state.

7. To record EEG, use the **EEG record** menu (Pic. 6.9 a), or *EEG recording* toolbar (Pic. 6.9 b), or *Record panel*.



Pic. 6.9



Pic. 6.10

Neuron-Spectrum Program

The list of commands, used for EEG recording is given below (Table 6.1).

Table 6.1

Menu command	Button	Button in the Record panel	Shortcut keys	Description
Impedance			[Shift+F9]	Use to check electrode impedance
Monitoring			[F9]	Turn on EEG monitoring mode (EEG is registered without saving on the hard disk)
Record			[F3]	Use to turn on EEG recording on hard disk (turn on phone record functional test)
Functional test			[1]..[9]	Use to start selected functional test recording
Record/Monitoring			[F12]	Use to switch from recording to monitoring mode without changing or breaking functional test
Stop			[Esc]	Use to stop EEG recording
Event marker				Use to set an event marker
Calibration				Use to turn on the EEG calibration mode
Increase stimulation frequency			[Shift+F6]	Use to increase stimulation frequency by one step in manual operation mode
Decrease stimulation frequency			[Shift+F5]	Use to decrease stimulation frequency by one step in manual operation mode
Turn on photic			[BackSpace]	Turn on photic
Turn on audio stimulator				Turn on audio stimulator
Restart				Restart of EEG system after the failure
Record emulation				Use to turn on an emulation mode of recording (registration of sinusoidal signal at different frequencies in each derivation)
Demonstration				Use to activate a demonstration mode
Delete				Use to delete an EEG record (to empty a checkup)

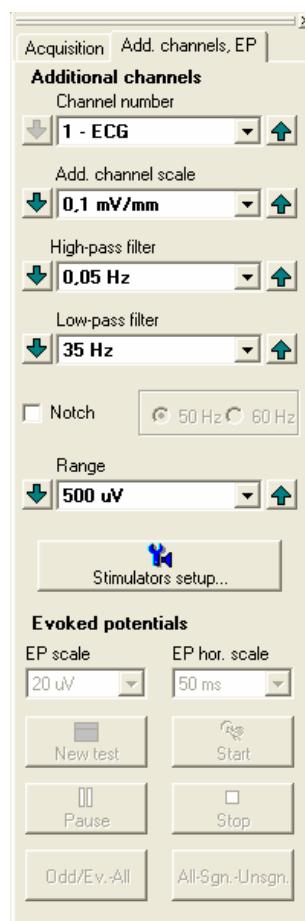
The basic commands of EEG recording are duplicated on the *EEG recording* toolbar (Pic. 6.9 b) and in the *EEG record* panel, which is placed on the right, if its visibility is turned on (Pic. 6.10).

Using the combo boxes on the information panel of EEG recording window, you can change EEG parameters values such as time constant (low cutoff frequency of HPF), high cutoff frequency of LPF and also enable or disable the notch filter (Pic. 6.11).



Pic. 6.11

8. You can control the EEG recording process from the *EEG Record panel* (Pic. 6.10). The *EEG Record panel* consists of two pages *Acquisition* (Pic. 6.10) and *Add. Channels, EP* (Pic. 6.12).



Pic. 6.12

There are some groups of control elements on the *Asquisition* page:

- *EEG Scale*, *EEG speed* combo boxes allow to control the EEG scale and “paper speed”. To change the value, you can select it from the list as well as using the arrow – buttons: decrease and increase the value on one step.
- To control EEG channel parameters use *High-pass filter (time constant)* combo box (in order to change the time constant); *Low-pass filter* – to change high cutoff frequency; *Notch* flag – to turn on and off the notch filter and radio buttons to select notch filter frequency. If the individual parameters

Neuron-Spectrum Program

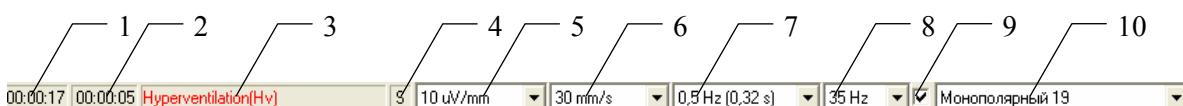
mode is activated, the EEG recording panel displays the parameters of the selected derivation, otherwise, it is done for all EEG channels. At that, if the value of any parameter for the given derivation differs from the common values (are given in the combo boxes of the parameters values on the information panel), this parameter is written by the italic type.

- *Montage* combo box allows selecting EEG montage.
- To control EEG recordinf, use the impedance measuring button ; the monitoring mode button ; the record functional test buttons , , ..., , turn on and off photic- and audio stimulators buttons , , stimulation frequency control buttons ; *Program mode* check box, temporary switching from recording to monitoring mode button , stopping of EEG registration button .
- To control events markers and print marker use the set comment-marker button , the printer market button , the list of registered event markers, the setup on EEG of chosen marker event from the list button , adding of a new marker event into the list .

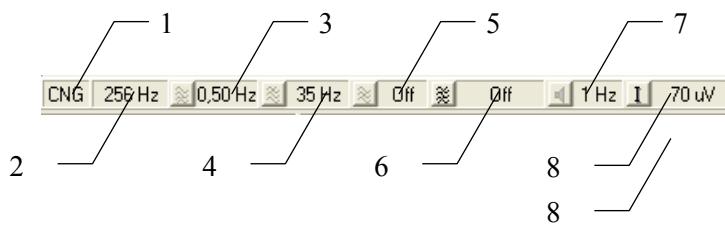
There are some groups of control elements on the *Add. channels, EP* page:

- To control additional channels parameters (not EEG channels parameters) use the combo box *Channel number* (in order to select an additional channel with changing parameters), combo boxes to setup parameters of the selected additional channel (scale, time constant, high cutoff frequency, turning on/off of the notch filter, input range) –*Add. channel scale*, *High-pass filter (time constant)*, *Low-pass filter*, *Notch* check box and notch filter frequency radio buttons, *Range* combo box.
- *Stimulators setup* – the button for dialog box of stimulators setting up.
- *Evoked potentials groups* – the controls for the brain evoked potentials registration.

9. *Information panel* (Pic. 6.13) and *Parameters string* (Pic. 6.14) at the top and at the bottom of the EEG recording window display the current state of EEG and the window.



Pic. 6.13



Pic. 6.14

Information panel displays:

- (1) – total duration of EEG record, saved on the hard disk;

- (2) – the duration of the current functional test, being recorded or monitored (is counted out from the very beginning each time when starting a new functional test recording or when switching from the record mode to the monitoring one);
- (3) – the name of the current functional test, being recorded (monitoring mode leaves the box blank);
- (4) – operation mode indicator can take the following values: “*M*” – monitoring mode; “*R*” – record mode; “*A*” – EEG analysis mode;
- (5) – the combo box with EEG channels scale (you may vary it selecting the appropriate values in the list);
- (6) – the combo box with EEG sweep speed (you may vary it by selecting the required speed);
- (7) – the combo box with the value of the HPF cutoff frequency on EEG channels (the cutoff frequency can be changed by selecting the corresponding value in the list);
- (8) – the combo box with the value of the LPF cutoff frequency on EEG channels (the cutoff frequency can be changed by selecting the corresponding value in the list);
- (9) – the check box of notch filter on/off on EEG channels;
- (10) – the combo box with EEG current montage (the montage can be changed by selecting the corresponding value in the list or using the key combination [**Shift+<Number of the montage in the list>**] for the first 9 montages).

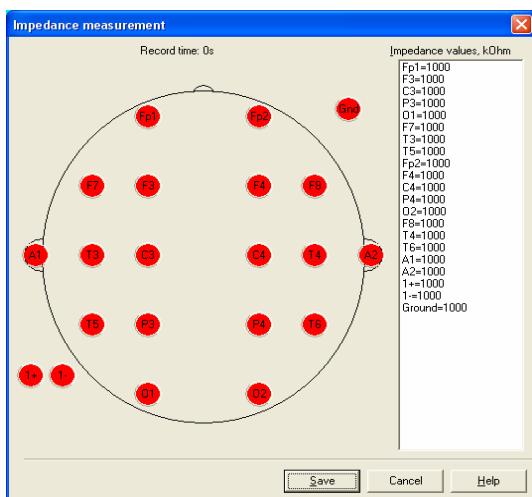
Parameters string displays:

- (1) – update indicator (when you change your data or parameters, indicator displays “CNG”);
- (2) – EEG sampling rate;
- (3) – lower cut-off frequency for EEG high-pass filter;
- (4) – upper cut-off frequency for EEG low-pass filter;
- (5) – the state of notch filter (“*Off*” – filter is off; “*50 Hz*” – rejection frequency is 50 Hz; “*60 Hz*” – rejection frequency is 60 Hz);
- (6) – the state of software band-pass filter, which can filtrate EEG displayed (“*Off*” – filter is off; “*F1 – F2Hz*” – frequency band is F1–F2);
- (7) – the state or frequency of photic- and audio stimulators (“*Off*” – stimulators are off; “*N Hz*” – frequency of stimulation is N Hz);
- (8) – value of calibration piece.

When the parameter has a button before it (for example:), it means that you can change the parameter by clicking on one of the buttons

6.1. STANDARD MODE OF EEG RECORDING

1. To record EEG, put electrodes on the patient's head and attach derivations cables.
2. Start the impedance measurement mode. Use the **EEG record|Impedance**,  button, or **[Shift+F9]**. You may also click on corresponding button  in the *Record panel*. The **Impedance measurement** window will appear on the screen (Pic. 6.15).



Pic. 6.15

In the left part of the **Impedance measurement** window measurement time in accordance with the EEG recording time and derivation buttons are displayed. The buttons are colored green, yellow or red, depending on the electrode impedance value. The right part of the **Impedance measurement** window presents numerical values of electrode impedance, including ear and ground electrodes.

Color borders are set in EEG device settings. If the impedance value is less or equal to the acceptable maximum (25 KOhm, by default), the button is colored green. If the impedance value is between the acceptable maximum and the unacceptable minimum (25 – 40 KOhm, by default), the button is colored yellow. If the impedance value is more than the unacceptable minimum, the button is colored red.

LEDs on the front panel of **Neuron-Spectrum-4 (v.1), 4/EP, 4/P, 1, 2, 3, 4, 5, 4/EPM** EEG headboxes indicate impedance values in this derivation. Besides, on the front panel of the **Neuron-Spectrum-5, 4/EPM** headbox you can see the button which allows to run the procedure of impedance measurement directly from the head box. The second pressing on this button terminates the impedance measurement and runs the EEG monitoring.

If impedance values are incorrect in all derivations, the ground electrode may have been set not properly. If there is difference between the impedance values of two hemispheres, one of the ear electrodes may have been set not properly. If in some of the derivations the impedance is high, derivation electrodes may have been set not properly. You may start EEG recording, only if you are sure that all the electrodes are set properly.

3. Change the electroencephalograph parameters if needed:

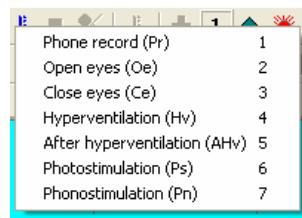
- set sampling rate (please take into account that after EEG recording is turn on, you can not change the sampling rate);
- set the time constant, upper cut-off frequency, turn on the notch filter if needed.

To change the parameters, select **Setup|Hardware** or click on the  button of the *Setup* toolbar.

If you use photic- or audio stimulator, select the stimulator operation mode. Click on the **Setup|Stimulators** menu command, or on the  button of the *Setup* toolbar, or “*Stimulators setup*” button of the *Record panel*. For the manual operation mode set the value of the initial frequency and the step of frequency change. For the program operation mode choose the stimulation program.

4. Start EEG monitoring clicking on the **EEG record|Monitoring** menu command, on the  button of the *EEG recording* toolbar, or pressing [**F9**]. You can also click on the corresponding button  on the *Record panel*. Obtain the required EEG registration quality. At the same time, in the EEG recording process, you can change the amplifier filters parameters.

5. Now you may start functional test recording. “*Phone record*” must be the first functional test. For starting functional test recording, press one of the [**1**]...[**9**] keys corresponding to the test. Select **EEG record|<Test name>**, click on the  button of the toolbar and select the required functional test (Pic. 6.16) or click on the test name button on the *Record panel* (, , , , , , ).

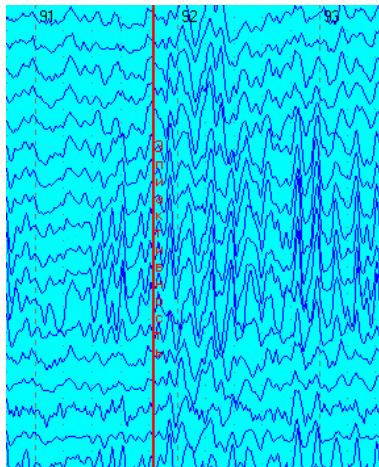


Pic. 6.16

6. While functional test recording you can temporarily turn off EEG saving to the hard disk. To turn off EEG saving, select **EEG record|Record/monitoring**, press [**F12**], click on the  button, or on the  button on the *Record panel*. The “*M*” (monitoring mode) sign will appear on the *Information panel 4* window (Pic. 6.13). To continue recording repeat the procedure: select **EEG record|Record/monitoring** or click [**F12**], , or  button on the *Record panel* (“*M*” sign will be replaced by “*R*” sign).

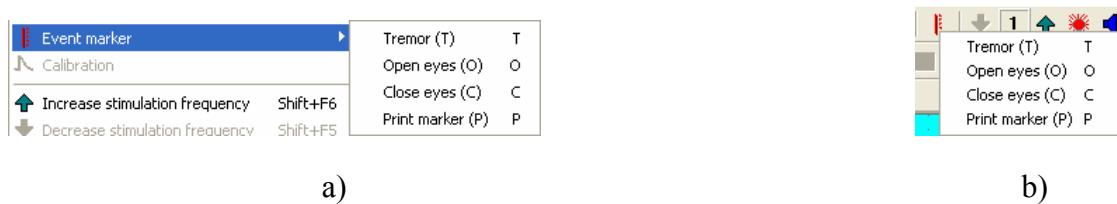
7. To stop monitoring or functional test recording, select **EEG record|Stop**, click on the  button, press [**Esc**] or  button on the *Record panel*. After performing any operation (for example, scale change or montage), monitoring or record can be continued. The recorded functional tests are saved.

8. While recording functional test, you can mark any EEG fragment with an event marker, providing the list of event markers is created beforehand. Later while viewing EEG you can easily switch to such a marker. It will be displayed on the EEG traces as a vertical line with an inscription (Pic. 6.17) or other way of the markers representation defined at the setup.



Pic. 6.17

To set a marker, press the corresponding key. You may also use the **EEG record|Event marker** menu command or the button. A pull down menu of marker names will appear on the screen. Select the required marker and it will be set on EEG (Pic. 6.18a). You can also use button on the EEG recording toolbar (Pic. 6.18b).



Pic. 6.18

In addition, you can set event marker using the *Acquisition* page of *Record panel* page. You should double click on the marker's name in the list in the bottom part of the page or select event marker from the list, by clicking it and press the button .

You can add new event markers to the list with the registered ones in the EEG recording window. When EEG recording is stopped, press the button on the *Acquisition* page on the *Record panel*. The **Edit event marker** dialog box will appear on the screen. Enter the event marker name and a comment (if needed) and click “OK” or press [Enter]. An event marker will be set on EEG.

In the record process, you can set EEG fragment that should be printed immediately after the registration stop. You should set *Print marker* on EEG during the process of recording. To set the marker, press the [P] key (marker of printing is connected with that button on default) or button on *Record panel*.

When the recording is stopped, the **Print EEG fragment** dialog box will appear on the screen, if there is at least one printer marker (Pic. 6.19)



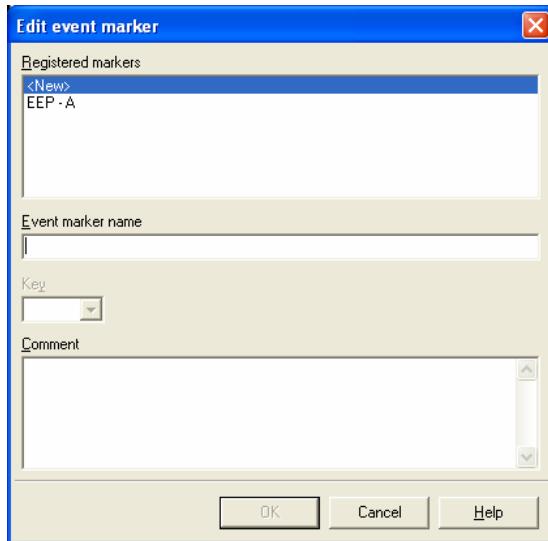
Pic. 6.19

If you press “*Print*” button, all marked fragments will be printed. If you press “*Preview*” button, you can view printing pages layout on the screen before printing. If you press “*Cancel*” button, the printing will be cancelled. The amount of EEG seconds printing before print marker, and number of pages printing after the page where the print marker is placed, are set in the **Program setup** dialog box on the *Print* page. For example: if the parameters values are “5” and “0”, then 5 seconds will be printed before the marker and one page will be printed (where the marker is placed) (Pic. 6.20).



Pic. 6.20

You can set *Comment marker* on EEG, using the **Epoch|Comment** menu command, [F7] “hot” key or  button on *Record panel*. The **Edit event marker** dialog box will appear on the screen (Pic. 6.21).



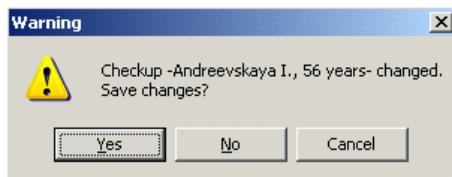
Pic. 6.21

Enter the commentary name and the commentary by itself and click “*OK*” or press [**Enter**] key. New Comment marker will be set on EEG traces.

9. Manual operation mode of photic- and audio stimulation tests enables varying of stimulation frequency. Use **EEG record|Increase stimulation frequency** and **EEG record|Decrease stimulation frequency**, the  and  buttons of the toolbar, the [Shift+F6] and [Shift+F5] key combinations, or the corresponding buttons of the *Record panel*. One click – one step frequency changed. New photo or audio stimulation functional test begins with new stimulation frequency.

If the patient feels bad in the process of stimulation in manual or program mode of stimulators, press [**Space**] key to stop it. The program of stimulation will be stopped and the EEG software will be turned to the *Phone record*, i.e. the EEG recording without the stimulation.

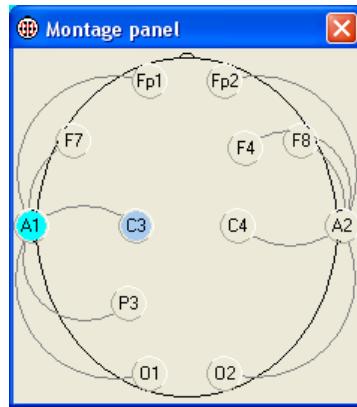
10. To stop recording and save results in a database, select **Checkup|Close**, click on the  button, or on the  button in the right upper corner of the EEG recording window. A confirmation box will appear on the screen (Pic. 6.22). If you wish to save the results in a database, click “*Yes*” or [**Enter**].



Pic. 6.22

11. After you have finished EEG recording, you can analyze the EEG traces. The procedure of EEG analysis and checkup protocol creation are described below.

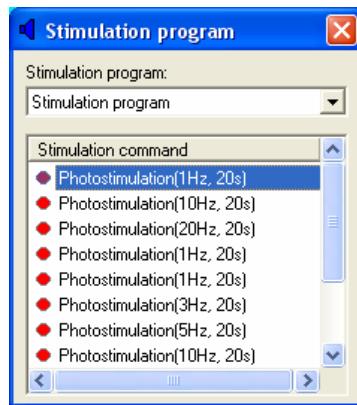
12. During EEG recording, review and analysis you can display a number of optional panels with the help of the **View** menu commands. These panels will simplify the program visual perception and control. The **View|Montage panel** main menu command displays the *Montage panel* which displays the EEG montage used during registration (Pic. 6.23).



Pic. 6.23

The selected EEG derivation is highlighted on the *Montage panel*. To select a derivation on the *Derivation panel*, click on the name of the derivation with the left mouse button. To select a derivation on the *Montage panel*, click on the derivation active electrode with the left mouse button.

13. To control and display stimulation program work process use the *Stimulation program* panel, which can be displayed by the **View|Stimulation program** menu command (Pic. 6.24).



Pic. 6.24

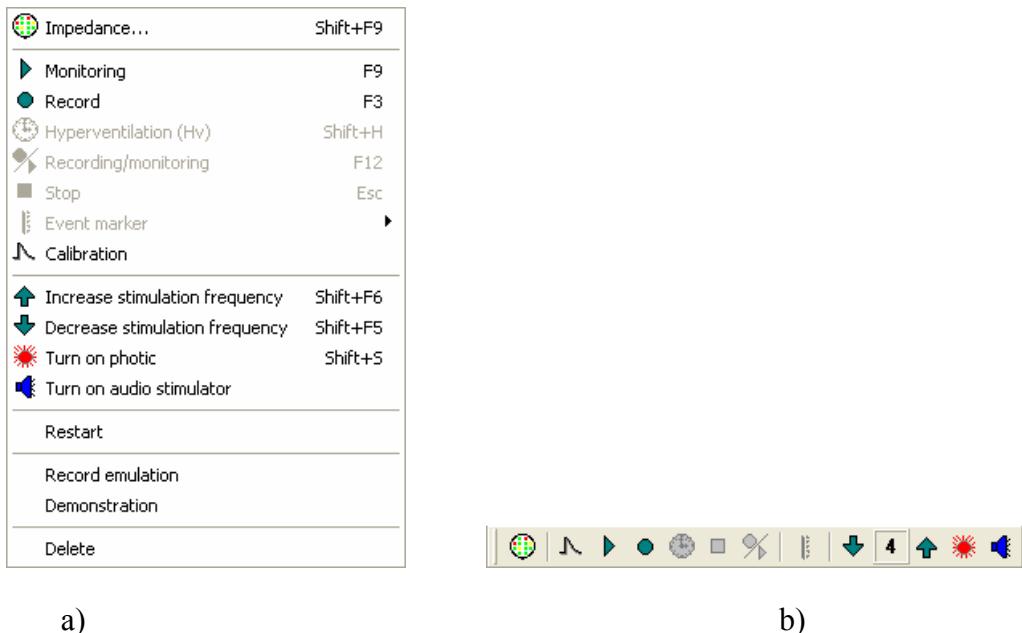
The *Stimulation program* combo box contains the list of all the stimulation programs you created. Select the stimulation program you want to perform.

The *Stimulation commands* list displays all stimulation commands of the current selected stimulation program. During the program running the current command is highlighted.

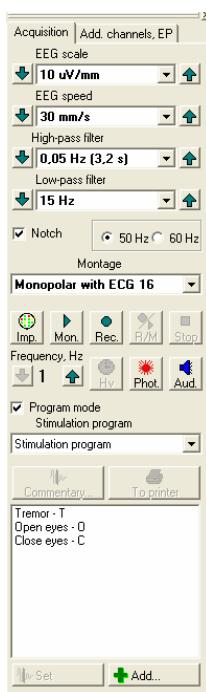
14. The **View|Test name** menu command displays on the EEG traces the name of the current test being recorded and the duration of the test recording or EEG monitoring. You can drag all these lines with the left mouse button. The **View|Calibration piece** menu command shows or hides calibration pieces at the left side of EEG curves.

6.2. EEG RECORDING IN THE SIMPLE MODE

1. To turn on/off the simple EEG recording, display **Setup program** dialog box (Pic. 5.1) (*Common* page), using for example **Setup|Program** menu command. Check *Simple record* check box.
2. The main difference of simple recording mode is that the functional tests are not set on EEG as it is in the standard recording mode. All events on EEG are marked by event markers. You should remember that when analyzing the simple record, the results of separate epoch are averaged on the whole record but not on the functional tests.
3. In the simple record mode the **EEG record** menu command set (Pic. 6.25) and *Acquisition* page on the *Record panel* (Pic. 6.26) are changed.



Pic. 6.25



Pic. 6.26

The list of command used in the simplified record mode is given below (Table 6.2)

Table 6.2

Menu command	Button	Button in the record panel	Shortcut keys	Description
Impedance		Imp.	[Shift+F9]	Use to check electrode impedance
Monitoring		Mon.	[F9]	Turn on EEG monitoring mode (EEG is registered without saving on the hard disk)
Record		Rec.	[F3]	Use to turn on EEG recording on hard disk
Record/Monitoring		R/M	[F12]	Use to switch from recording to monitoring mode
Stop		Stop	[Esc]	Use to stop EEG recording
Event marker		Set		Use to set an event marker
Calibration				Use to turn on the EEG calibration mode
Increase stimulation frequency			[Shift+F6]	Use to increase stimulation frequency by one step in manual operation mode
Decrease stimulation frequency			[Shift+F5]	Use to decrease stimulation frequency by one step in manual operation mode

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Hyperventilation				Turn on the hyperventilation
Turn on photic			[BackSpace]	Turn on photic
Turn on audio stimulator				Turn on audio stimulator
Restart				Restart of EEG system after the failure

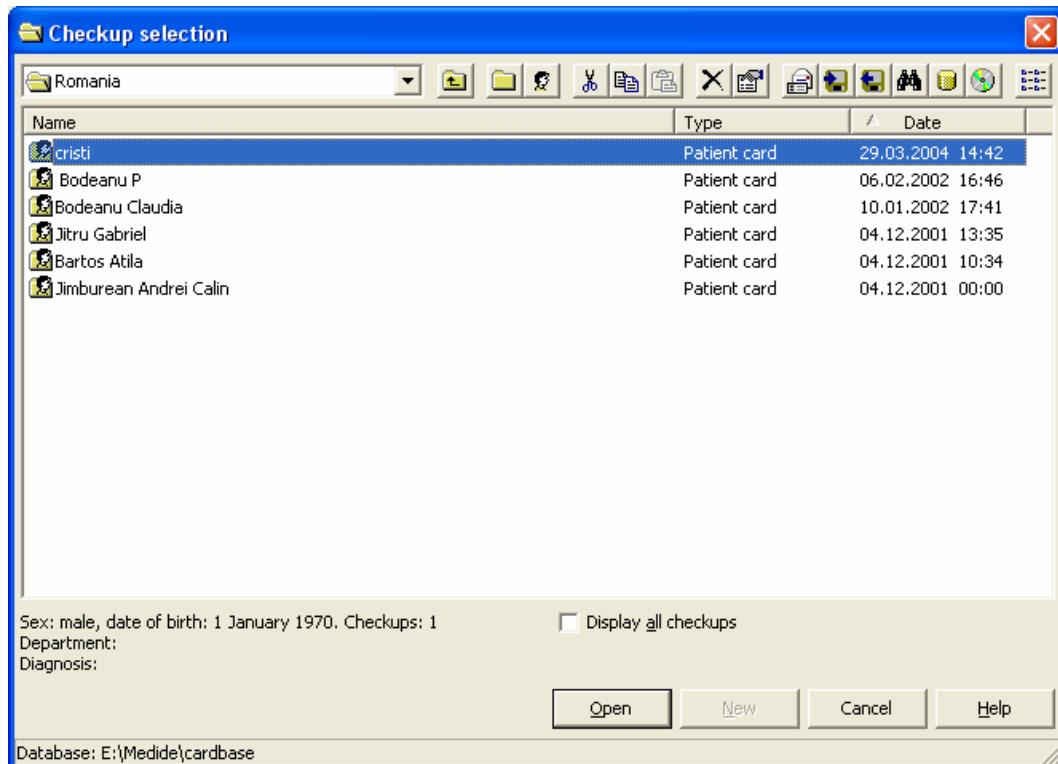
When turning on/ off the **Hyperventilation**, turn on photic, turn on audio stimulator, the event marker is setup automatically. The hyperventilation turning on command differs by cleaning the record time indication of the current functional test. It enables to see the hyperventilation time.

4. As for the rest, the simple record mode is similar to the standard record mode.

CHAPTER 7

EXTRACT OF RECORDED EEG FROM A DATABASE FOR REVIEW AND ANALYSIS

1. To review and analysis recorded EEG, select **Checkup|Open**, click on the  button, or press [Ctrl+O]. The **Checkup selection** dialog box will appear on the (Pic. 7.1).

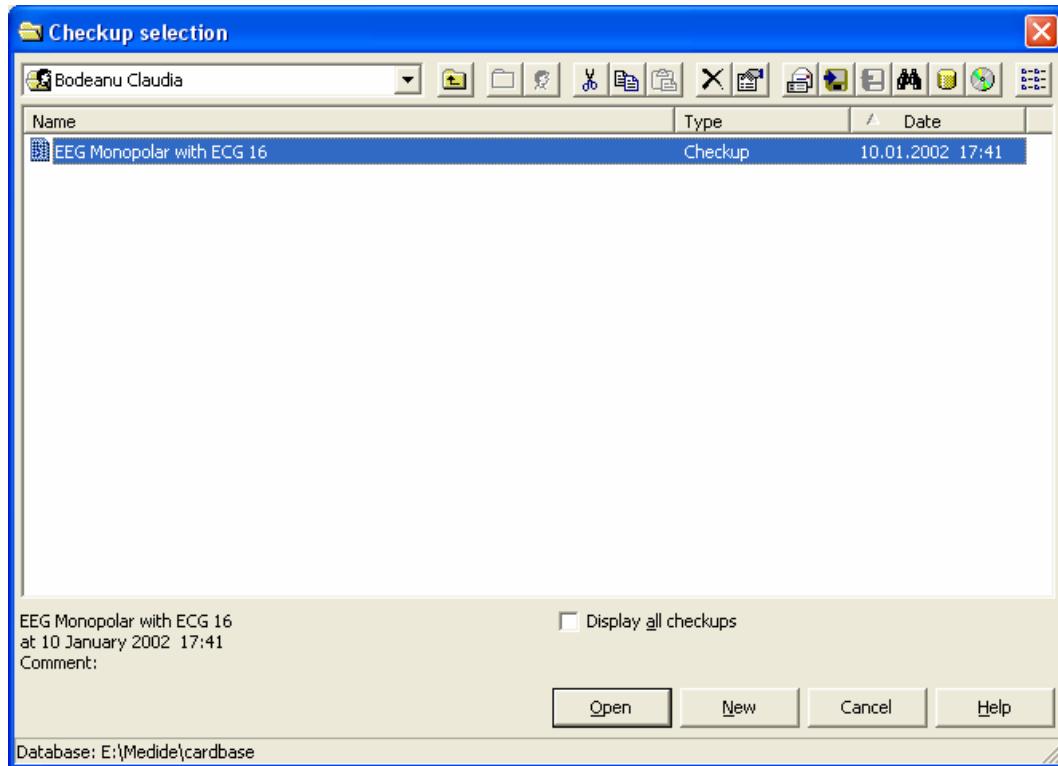


Pic. 7.1

To open a folder, double-click on it. To exit a catalogue, click on the  button or press [Back-space].

Neuron-Spectrum Program

2. To look through a patient's checkup list, you have to open his card double-clicking on it (Pic. 7.2). To exit a patient card, click on the  button or press [Backspace].



Pic. 7.2

To open the checkup selected, choose it in the list and click “*Open*” or double-click on it.

You can open the last checkup straight in the list of cards, without opening a patient card (Pic. 7.1). Press and hold down the [Alt]-key and double-click the required card.

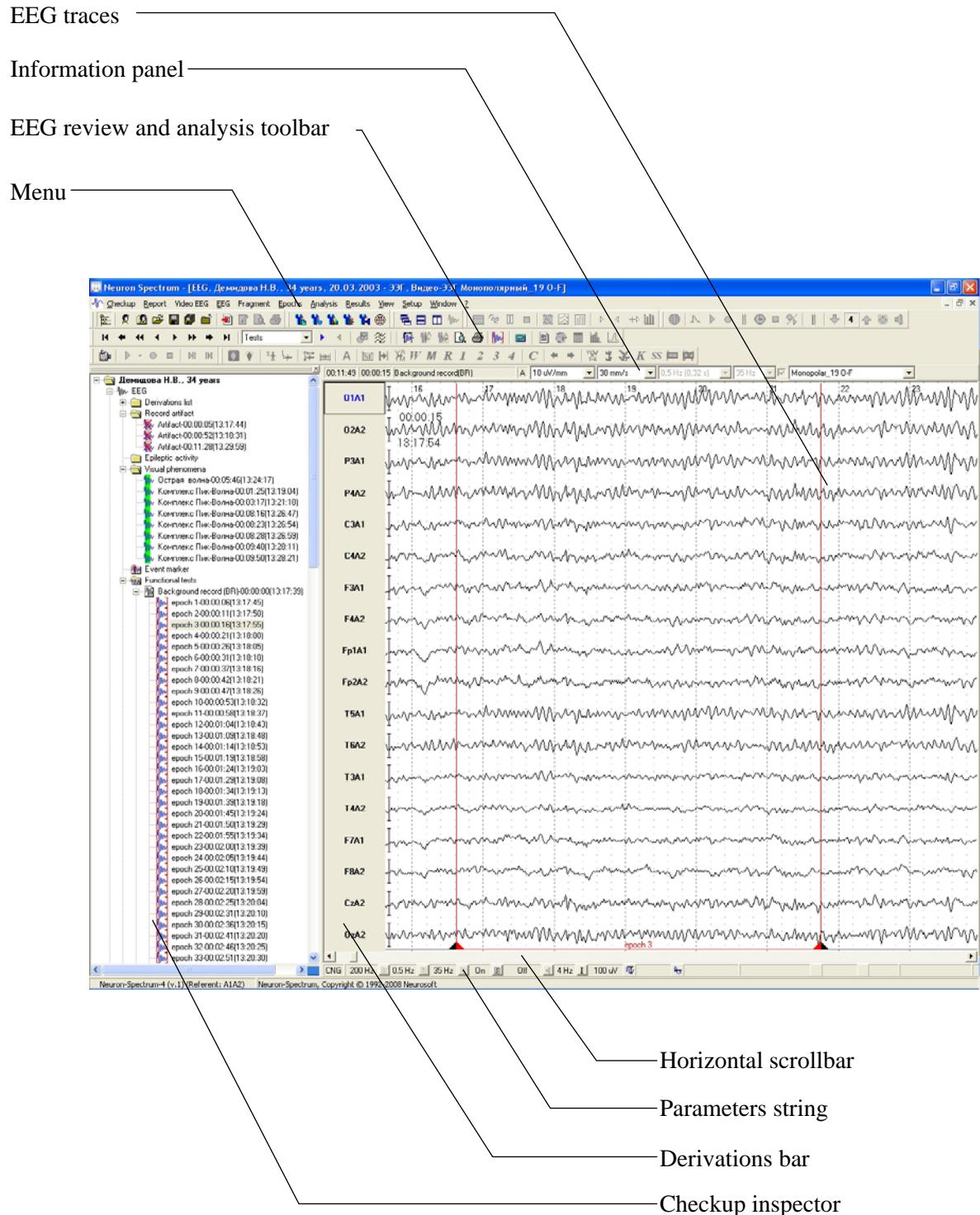
If you have forgotten what exact catalogue the patient card belongs to, apply the search function using the  button of the above-mentioned dialog box.

CHAPTER 8

EEG REVIEWING AND EDITING

8.1. EEG REVIEWING AND EDITING

- After checkup (EEG) opening, the EEG review and analysis window will appear on the screen (Pic. 8.1).



Pic. 8.1

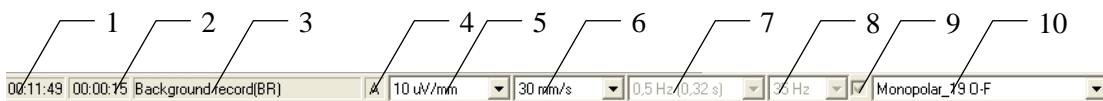
Neuron-Spectrum Program

The headline of the EEG review window displays the type of the window (EEG) as well as the patient's name and age.

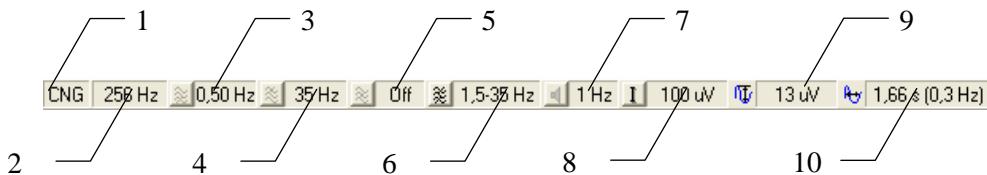
The EEG review and analysis window includes:

- program menu;
- the *Standard, Setup, Windows, EEG recording* (doesn't not work in review and analysis mode), *EEG review and analysis* toolbars;
- the EEG review and analysis window including derivations bar, information panel, parameters string, vertical and horizontal scrollbars (if required);
- checkup inspector.

2. The current state of the EEG review and analysis window and EEG information is displayed on the *Information panel* (Pic. 8.2) and in the *Parameters string* (Pic. 8.3).



Pic. 8.2



Pic. 8.3

The Information panel displays:

- (1) – duration of EEG record, in seconds;
- (2) – current time of EEG traces (window left border);
- (3) – the name of the current functional test (window left border);
- (4) – the review window working mode indicator (“A” means that the EEG review and analysis mode is activated);
- (5) – the combo box with the scale of EEG channels display (you can vary it by selecting the required value in the list). If the Individual channel scales mode is selected – the scale in current derivation is displayed in combo box (current derivation name is highlighted in *Derivations bar*)
- (6) – the combo box with the EEG sweep speed (you can vary it by selecting the required speed);
- (7) – the combo box with the value of the HPF cutoff frequency in EEG channels;
- (8) – the combo box with the value of the LPF cutoff frequency in EEG channels;
- (9) – the check box of notch filter on/off in EEG channels;

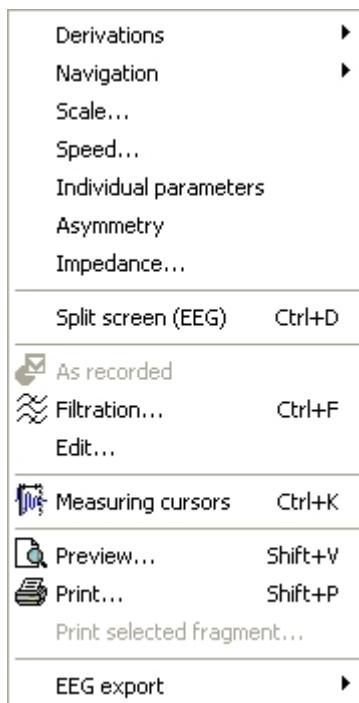
- (10) – the combo box with EEG current montage (the montage can be changed by selecting the corresponding value in the list or using the [Shift+<Number of the montage in the list>] key combination for the first 9 montages).

The *Parameters string* displays:

- (1) – the indicator of information update (when you change the data or parameters of the checkup, the indicator displays “CNG”);
- (2) – EEG sampling rate during recording;
- (3) – lower cut-off frequency for high-pass filter during recording;
- (4) – upper cut-off frequency for low-pass filter during recording;
- (5) – the state of notch filter during recording (“Off” – filter is off; “50 Hz” – rejection frequency is 50 Hz; “60 Hz” – rejection frequency is 60 Hz);
- (6) – the state of the band-pass program filter which can be applied to the EEG displayed (“Off” – filter is off; “F1 – F2Hz”- frequency band is F1-F2);
- (7) – the current frequency of photic- and audio stimulation (only for photic- and audio stimulation mode during recording);
- (8) – the value of a calibration pieces;
- (9) – EEG amplitude between markers (if they are activated) in a current derivation (the name is highlighted in the *Derivations bar*);
- (10) – the time interval between markers in seconds and hertz (when they are activated).

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3. To review and edit recorded EEG, use the **EEG** menu (Pic. 8.4a), buttons of the *EEG review and analysis* toolbar (Pic. 8.4b), or contextual menus of the window elements.



a)



b)

Pic. 8.4

In Table 8.1 there is the list of menu commands which are used for EEG review and analysis.

Table 8.1

Menu command	Button	Shortcut keys	Description
Derivations			Hide/show EEG derivations
Navigation			Set of EEG navigation menu commands
To begin		[Home]	Move to the beginning of EEG
To end		[End]	Move to the end of EEG
Next second		[→]	One-second shift to the end of EEG
Previous second		[←]	One-second shift to the beginning of EEG
Next page		[PgDn]	Shift to the one visible page to the end of EEG
Previous page		[PgUp]	Shift to the one visible page to the beginning of EEG
Automove to begin		[Ctrl+PgUp]	Automatic page-by-page shift to the beginning of electroencephalogram [PgUp], [PgDn] – changing of moving speed
Automove to end		[Ctrl+PgDn]	Automatic page-by-page shift to the end of electroencephalogram [PgUp], [PgDn] – changing of moving speed
To selected second			Shift to the selected second of EEG
To test		[Ctrl+F8]	Shift to the beginning of the functional test chosen
To event marker (commentary)		[Ctrl+F7]	Shift to the event marker chosen
To epoch		[Ctrl+F4]	Shift to the epoch chosen
Previous element		[Ctrl+←]	Shift to the previous selected visual element of EEG
Next element		[Ctrl+→]	Shift to the next selected visual element of EEG
Scale			EEG curves scale setting
		[Серый +]	Increase the EEG-traces scale
		[Shift + Серый +]	Increase the polygraph derivations scale
		[Серый -]	Decrease the EEG-traces scale
		[Shift + Серый -]	Decrease the polygraph derivations scale

Neuron-Spectrum Program

Continuation of Table 8.1

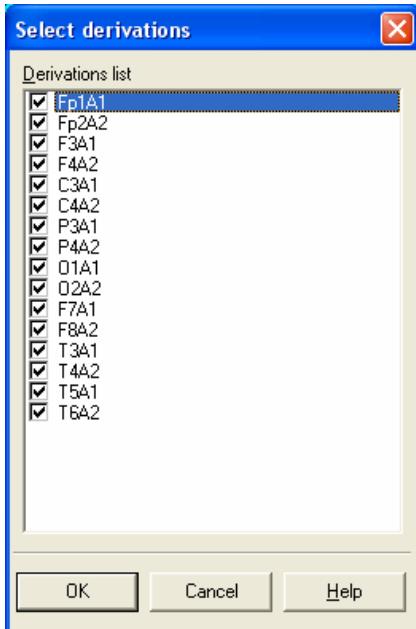
Menu command	Button	Shortcut keys	Description
Speed		[Серый *] [Серый /]	Setting the “paper” speed
			Increase the “paper” speed
			Decrease the “paper” speed
Individual parameters			Activate the individual parameters settings mode in EEG channels
Asymmetry			Display symmetrical EEG derivations marked with different colors on one isoline to provide asymmetry assessment
Impedance			Display the values of the electrode impedances measured and saved during recording
Split screen (EEG)		[Ctrl+D]	Split-screen to view different EEG fragments in every half of screen
Split screen (Results)		[Ctrl+S]	Split-screen to view EEG in one part and analysis results in another one
As recorded			View EEG-traces in “As recorded” mode – as you change EEG parameters during recording
Filtration		[Ctrl+F]	Select the arbitrary frequency bandpass on EEG (digital EEG bandpass filtering). Only for EEG channels
Edit			Edit EEG
Measuring cursors		[Ctrl+K]	Show/hide measuring marker
Preview			View the layout of the printing page with EEG
Print			Print the pages with EEG traces
Print selected fragments			Print EEG pages, where the print markers are set during recording
EEG export (ASCII format)			Export EEG in a separate file in the ASCII format
EEG export (EDF+ format)			Export EEG in the EDF+ format

4. **Neuron-Spectrum** software enables hiding and displaying of any derivation recorded. Hidden (invisible) derivations are not included into EEG analysis and, thus, do not influence its results. It is quite useful, when one or several derivations have irreducible and lasting record artifacts (for example, brake of electrode, etc.).

To control the visibility of derivations, select the **EEG|Derivations** menu command. The list of all the derivations of the selected EEG montage and the **Hide/Show** menu command will appear on the screen (Pic. 8.5). The **Hide/Show menu** command enables selecting of the derivations in the list of the **Select derivations** dialog box (Pic. 8.6).



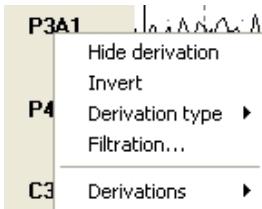
Pic. 8.5



Pic. 8.6

If the name of the derivation has a check mark before it, the derivation is visible, if not – the derivation is hide. To change the mode of derivation display, click on the derivation's name in the menu or on the flag in the dialog box.

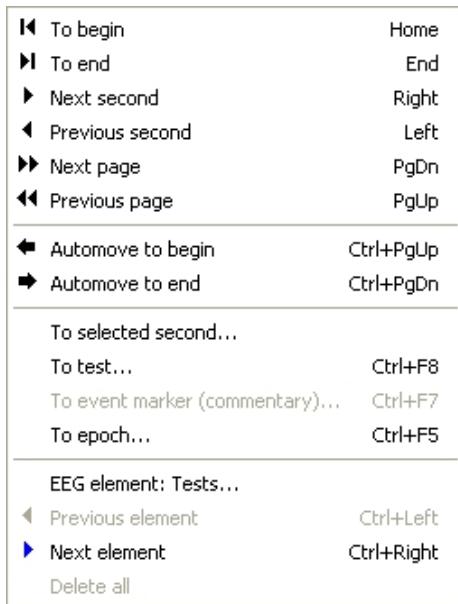
You can also use *Derivations bar* to hide/show the derivation by clicking on the name of the derivation with the right mouse button. The *Derivations* properties menu will appear on the screen (Pic. 8.7).



Pic. 8.7

If you click on the **Hide derivation** menu command, the derivation becomes invisible. If you click on the **Derivations** menu command, the list of montage derivations will be opened enabling you to change the visibility of any derivation.

5. If an EEG does not fit the review and analysis window, you have to scroll through the EEG traces. You may do this in different ways. The **EEG|Navigation** menu command displays a submenu menu for EEG navigation (Pic. 8.8).



Pic. 8.8

You can also use shortcut keys, buttons of the toolbar, mouse and vertical and horizontal scroll-bars to navigate through the EEG. Such EEG navigation (scrolling) commands as **To begin**, **To end**, **Next second**, **Previous second**, **Next page**, **Previous page** are duplicated by shortcut keys and buttons of the toolbar.

Commands of auto-shift to the beginning or the end of EEG (,) operate in the following way. When you select one of the commands through the menu, buttons on the toolbar or keys combination, you automatically start the process of page-by-page moving in this or that direction; at that the corresponding button of the toolbar will be dropped in. The pages alternate with the speed 1, 2, 4, 5, 10 pages per second. To change the speed press the right mouse button on the dropped button and select the required value in the menu. To stop this process, select the same command or click any key on the keyboard.

You can use scrollbars to navigate through the EEG. In the table below (Table 8.2) you will find the set of EEG-traces shift commands with the help of scrollbars.

Table 8.2

Menu command	Button	Shortcut key	Description
To begin		[Home]	 Press the left mouse button and drag the scroll-box to the beginning of the record with the mouse button pressed (extreme left position)
To end		[End]	 Press the left mouse button and drag the scroll-box to the end of the record (extreme right position)
Next second		[→]	
Previous second		[←]	
Next page		[PgDn]	
Previous page		[PgUp]	
Arbitrary position			Press the left mouse button and drag the scroll-box to the required fragment of the EEG record

The vertical scrollbar is used in the same way. It appears only if all the derivations of the montage chosen do not fit the EEG window.

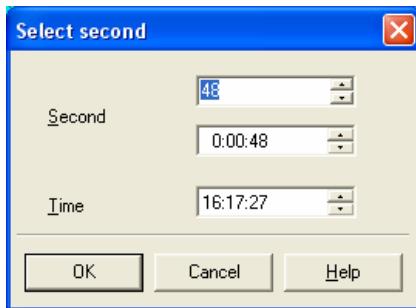
The size of the scroll-box depends on the size of the area being scrolled (across – on the total duration of the record). The longer the record is, the smaller the scroll-box will be.

If you have got an IntelliMouse you may horizontally scroll the EEG using its roller. Rolling “toward oneself”, you will move to the end of the record. Rolling “away from”, you will move to the beginning of it.

If the cursor is in the lower quarter of screen, then you may notice it's changing on moving along EEG. In the first quarter (the very left) of EEG it has shape , in the second – , in the third – , in the fourth (the very right) . When the cursor is in lower quarter of screen, you can scroll EEG, clicking the mouse on EEG. If the cursor is in the shape of “big” arrow, scrolling is performed in dependence of the cursor direction, on one page to the right () or to the left () ; if the cursor has got the “small” arrow shape – on a half of the page to the right () or to the left ().

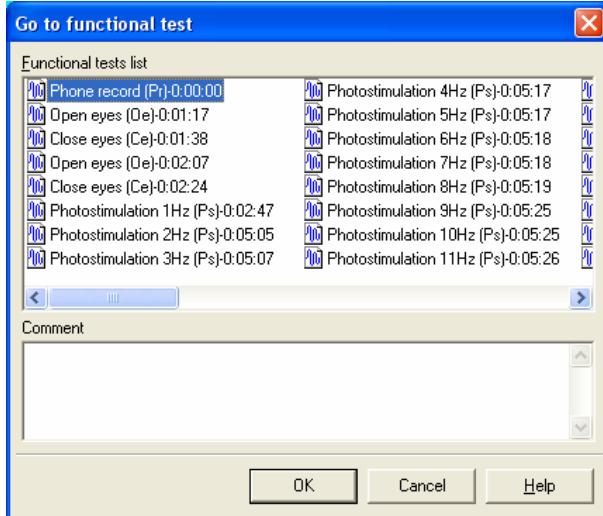
6. You can also perform a fast shift to a certain record fragment using the commands of fast-shift to the specified second, the beginning of a functional test, event marker, analysis epoch or the selected visual phenomenon.

To move to a certain second of the record, select the **EEG|Navigation|To selected second** menu command. The **Select second** dialog-box will appear on the screen (Pic. 8.9). Enter the required second in the format of integer number or time (HH:MM:SS) or enter a real time in the *Time* edit line and click “OK” or press [**Enter**]. Here a second is a definite second of the total recording time and record time is a real time when it is performed.



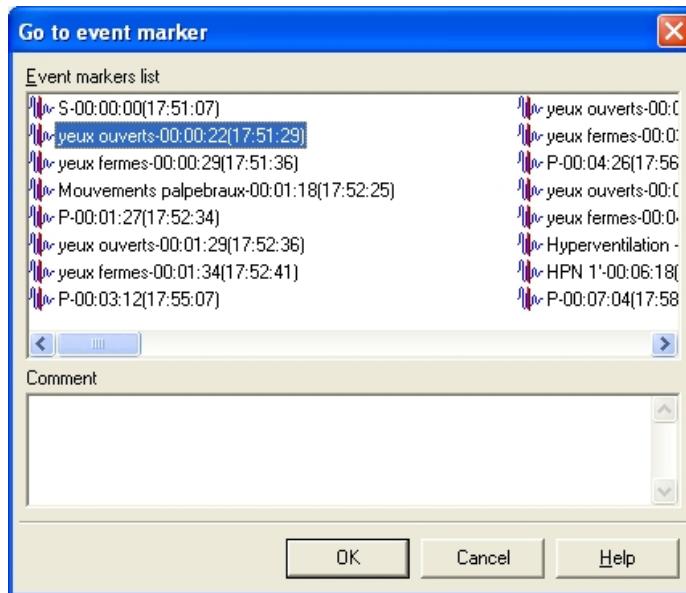
Pic. 8.9

To move to the beginning of a functional test, select **EEG|Navigation|To test** or press [**Ctrl+F8**]. The **Go to functional Test** dialog-box will appear on the screen. It contains the list of all the functional tests available (Pic. 8.10). Select the required functional test and click “*OK*” or press [**Enter**].



Pic. 8.10

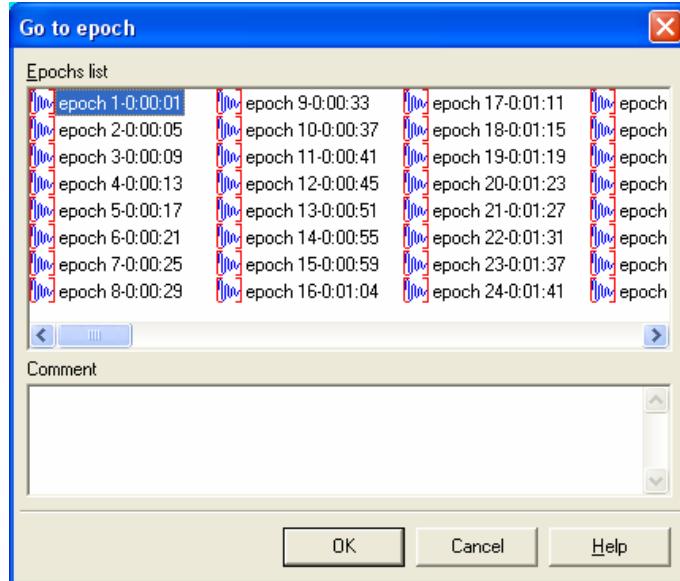
To move to a certain event marker, select **EEG|Navigation|To event marker** or press [**Ctrl+F7**]. The **Go to event marker** dialog-box will appear on the screen. It contains the list of all the event markers preset both during EEG recording and EEG review and analysis (Pic. 8.11). Select the required event marker and click “*OK*” or press [**Enter**].



Pic. 8.11

Remember that you can set the marker or commentary in any place of EEG record during its review and analysis using the **Epoch|Commentary** menu command or the hot key [**F7**].

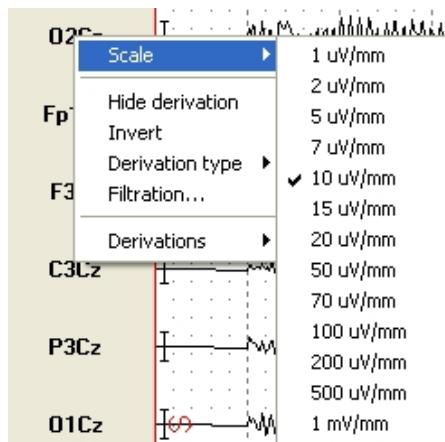
To move to a certain analysis epoch, select **EEG|Navigation|To epoch** or press the [**Ctrl+F5**] key combination. The **Go to epoch** dialog-box will appear on the screen (Pic. 8.12). It includes the list of all the epochs preset. Select the required one and click “**OK**” or press [**Enter**].



Pic. 8.12

7. For a step-by-step navigation through similar EEG elements (functional tests, event markers, analysis epochs, visual phenomena etc.) use the **EEG|Navigation|Previous element** or **EEG|Navigation|Next element** commands. The current element (the one for navigation) is indicated in the **EEG|Navigation|EEG element** menu. You can also use the *EEG review and analysis* toolbar. The current element is selected in the combo box. The and buttons correspond to the **Previous element** and **Next element** commands. For example, if the **Epoch** element is selected, you will navigate to the next or the previous epoch.

8. To change the scale and “paper” speed, use the **EEG|Scale** and **EEG|Speed** menu commands. You can also use shortcut keys or combo boxes (5) and (6) of the *Information panel*. The **EEG|Scale** command displays the **EEG view and analysis** dialog box on the *Scales* page (see sec. 5.3). To activate the mode of EEG review with the individual scales for each channel, choose the **EEG|Individual parameters** menu command. If you click the derivation name with right mouse button and choose the **Scales** menu, you can change the scale value of this EEG derivation (Pic. 8.13).



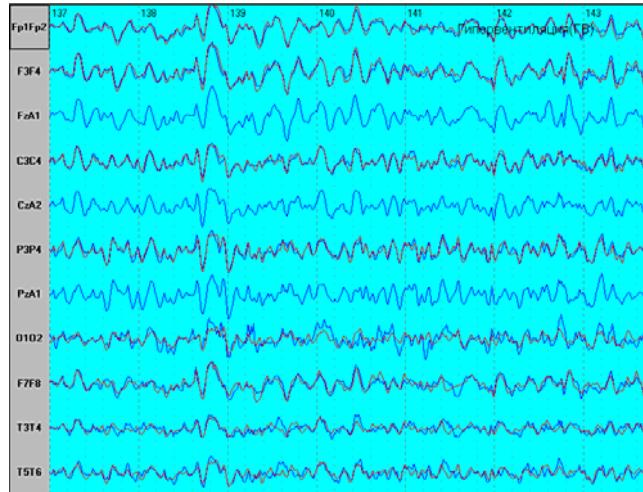
Pic. 8.13

You can change the EEG scale by selecting the required value in the combo box (5) of the *Information panel*. Thus the scale in all EEG channels is changed. If the reviewing mode of EEG with the individual parameters is set, the scale is changed in those EEG channels which scale corresponded to the one specified in this list. It means that if we change the scale from 10 μ V/mm to 7 μ V/mm, 7 μ V/mm scale will be set for all EEG channels which scale before was equal to 10 μ V/mm. If you have got the mouse with the scroll wheel, press the [**Shift**] key and vary the EEG scale with the mouse scroll wheel holding the key down. If individual channel scale mode in each derivation is specified, only the current (selected) derivation scale is changed.

If you select **EEG|Speed**, the **EEG view and analysis** dialog box will appear on the *Scale* page.

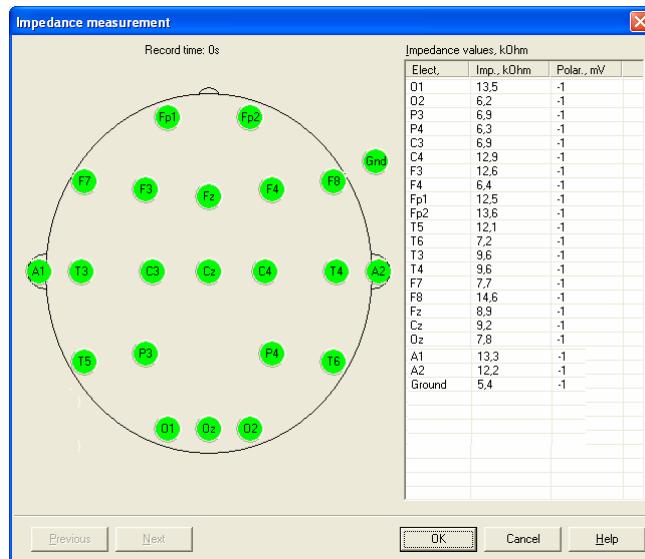
You can also change EEG speed by selecting the required value in the combo box (6) of the *Information panel*.

9. The **EEG|Asymmetry** menu command activates the mode of EEG display, which shows differently colored symmetrical EEG derivations on one isoline (for example, Fp1 and Fp2) (Pic. 8.14). The mode enables visualizing of electroencephalogram asymmetry within all the derivations. To return to the standard mode, select the **EEG|Asymmetry** command once more.



Pic. 8.14

10. To look through the values of the electrode impedances saved during EEG recording, use the **EEG|Impedance** menu command. The **Impedance measurement** dialog box will appear on the screen (Pic. 8.15).

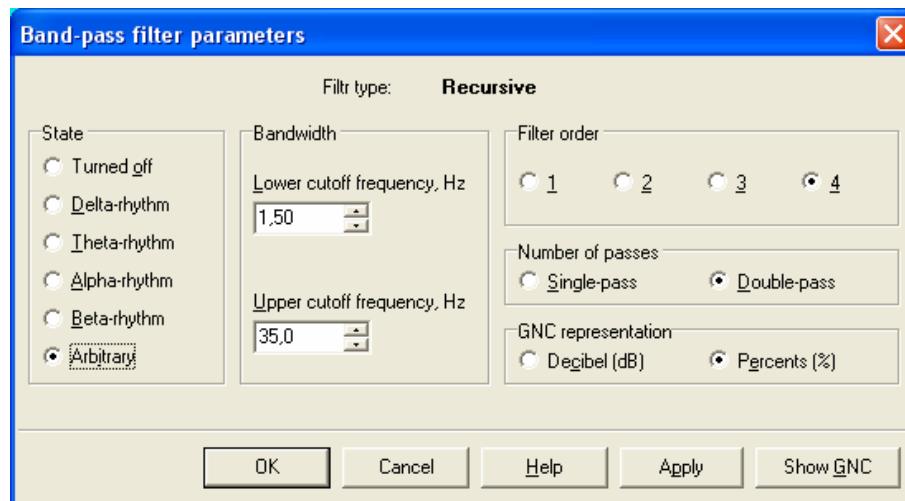


Pic. 8.15

The *Record time* line indicates the exact second of the measurement. The “*Previous*” and “*Next*” buttons display previous or next measurements, providing they were saved. The *Impedance values* list contains impedance values for each electrode, including ear and grounding electrodes.

11. Use “*As recorded*” reviewing mode to review EEG traces with all changes you did during recording (scales, montages, filters). This mode emulates paper recorded EEG as EEG has been re-recorded on a paper tape. To turn on the review in the mode “*As recorded*” use **EEG|As recorded** menu command or  tool button. You can’t change scales, speed, montages and other EEG reviewing parameters. During reviewing this parameters automatically changed as they changed during recording.

12. To filtrate EEG and to review frequency ranges of EEG traces, select the **EEG|Filtration** menu command, click on the  button or press [**Ctrl+F**]. The **Band-pass filter parameters** dialog box will appear on the screen (Pic. 8.16).



Pic. 8.16

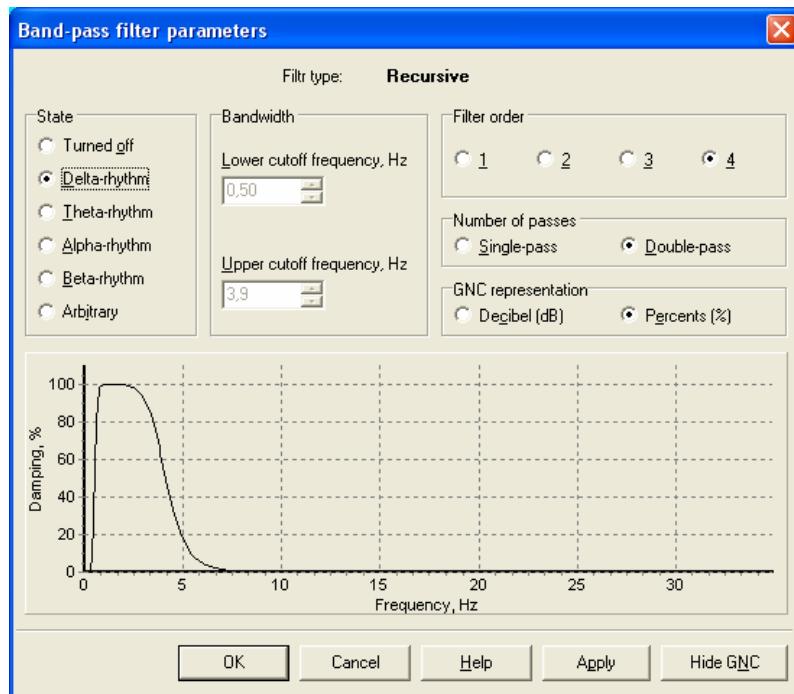
The *State* radio-buttons enables selecting of filter bandwidth. The *Turned off* radio-button switches the filter off. The *Delta*, *Alpha*, *Theta*, *Beta* buttons enable selection of standard frequency range. The *Arbitrary* button enables selection of frequency range in accordance with the values preset in the *Lower cut-off frequency* and *Upper cut-off frequency* edit lines.

The *Filter order* radio button sets the order of recursive filter. The higher the order is, the higher the filter quality will be; but at the same time the transient process becomes longer and the filter operates slower.

The *Number of passes* radio buttons sets the number of passes during filter processing – one or two. If the one-pass filter is set, a phase alignment of the mainframe signal appears in it. Using of two-pass filter can eliminate this alignment. Note that the two-pass filter works slower.

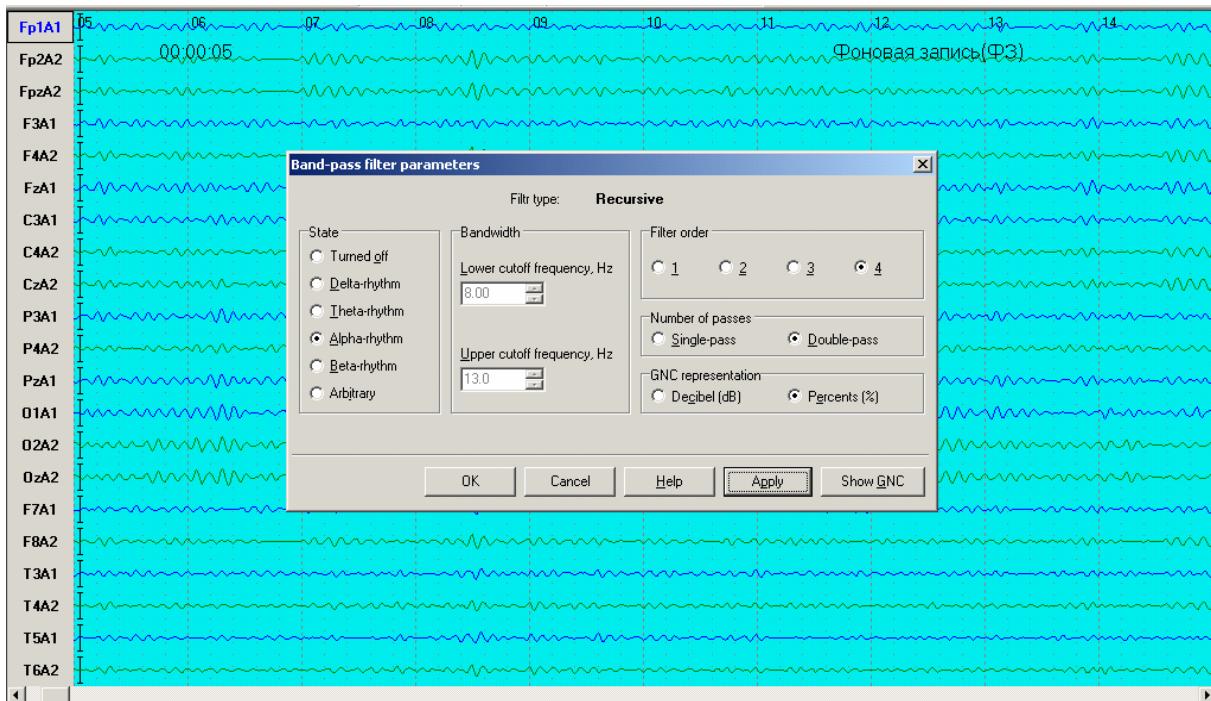
Neuron-Spectrum Program

The “*GNC representation*” radio-buttons sets the way of GNC display on the graph – in logarithmic scale or in the percentage wise of the amplitude value (Pic. 8.17).



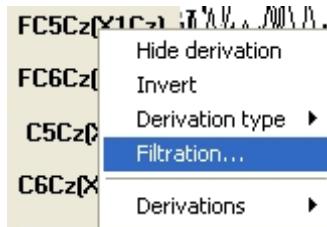
Pic. 8.17

When you press the “*Apply*” button in the dialog box, the result of filtration is displayed on the EEG traces (Pic. 8.18). Thus, you can view the results of filtration leaving the dialog box open.



Pic. 8.18

For the bandpass filtering in a selected channel (also not only in EEG derivation) use the menu of derivation properties (click the derivation name with the right mouse button). At that the menu of the derivation properties will appear on the screen (Pic. 8.19). Choose the **Filtration** command. The **Parameters of bandpass filter** dialog panel will appear on the screen (Pic. 8.16). Specify the required filter parameters and press the “OK” button. The selected derivation will be filtered according to the specified filter parameters.



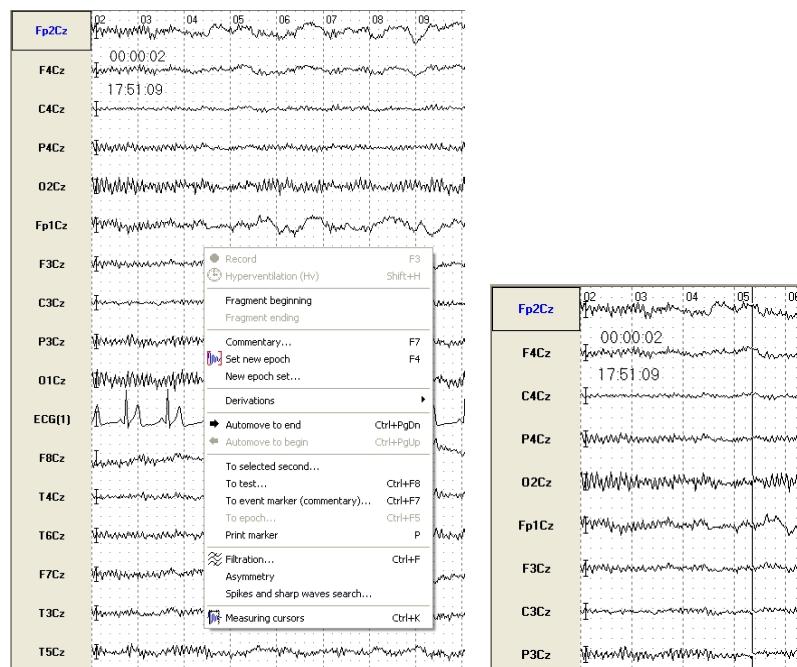
Pic. 8.19

13. The **Neuron-Spectrum** program allows EEG editing by saving only required marked fragments in the record. To edit EEG, you should first of all mark those record fragments which will be saved in the edited record. To mark EEG fragments remaining in the record, mark the required fragments sequentially and define them as fragments which should be saved at editing.

In the process of editing the program deletes all the results of EEG analysis, the analysis epochs selected earlier and automatically or manually marked fragments of epiphenomena. That is why it is advisable to perform editing before the EEG mathematical analysis.

To select the fragment it is most convenient to use the following sequence of operations:

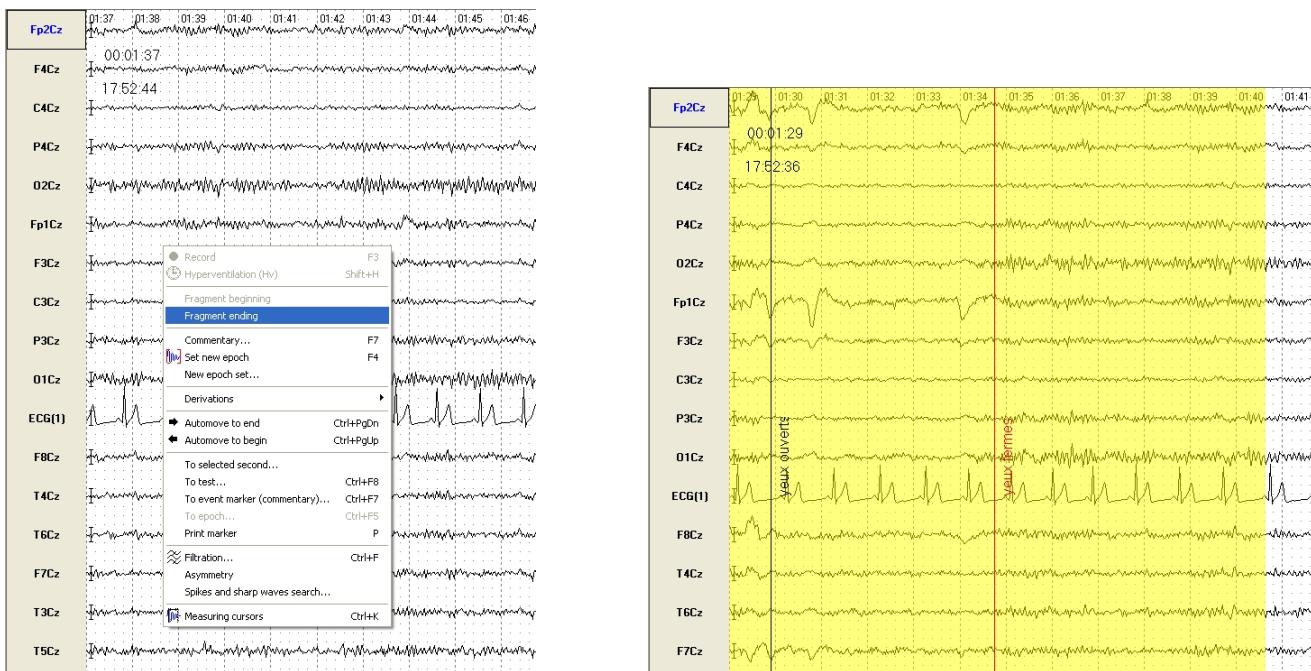
- Define the fragment onset, click this EEG point with the right mouse button and choose **Fragment beginning** command in the properties menu. The marker of the fragment onset will appear on the screen (Pic. 8.20).



Pic. 8.20

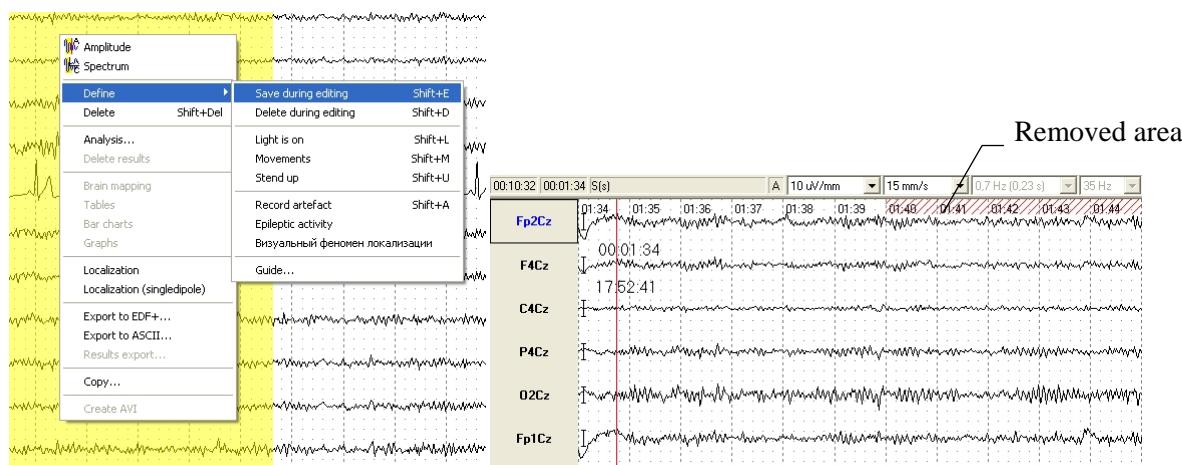
Neuron-Spectrum Program

- Shift to the end of the saved fragment, click this EEG point with the right mouse button and in the appeared properties menu choose the **Fragment ending** command. The fragment will be marked with the color (Pic. 8.21).



Pic. 8.21

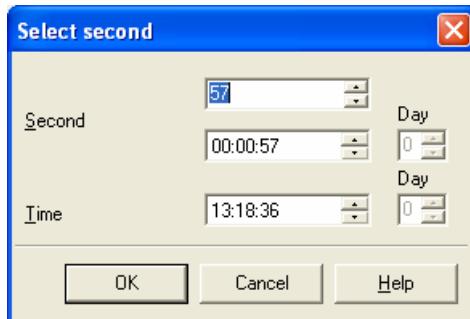
- Click the fragment with the right mouse button and in the appeared properties menu choose the **Define|Save during editing** command or use the [Shift+E] key combination. The saved fragment will not be marked in the top part of the electroencephalogram, all the rest part of EEG will be dashed what means that this marked area will be removed during the editing (Pic. 8.22).



Pic. 8.22

- In the same way mark those fragments that should remain in the record.

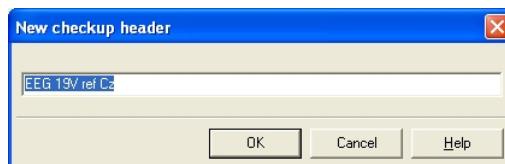
To perform the procedure of EEG editing, choose the **EEG>Edit** menu command. The **Edit EEG** dialog box should appear on the screen (Pic. 8.23).



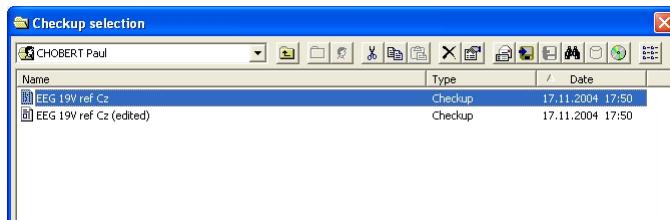
Pic. 8.23

The list of the saved fragments provides all the EEG fragments selected for the saving. Start the editing process by pressing “*Start*” button. After the termination of the process, the program will display the message box about the end of the editing process. You will get the edited EEG.

To save both edited and native (initial) EEG, use the **Checkup|Save as** menu command. At that, the **New checkup header** dialog box (Pic. 8.24) will appear on the screen. The checkup heading is the information showing in the checkups list in the database and identifying the checkup. Change this heading and your edited checkup will be saved with the new heading. It will allow you to distinguish between the initial checkup and the edited one at the checkup downloading from the database (Pic. 8.25). Thus you can save any number of edited copies of the initial checkup.



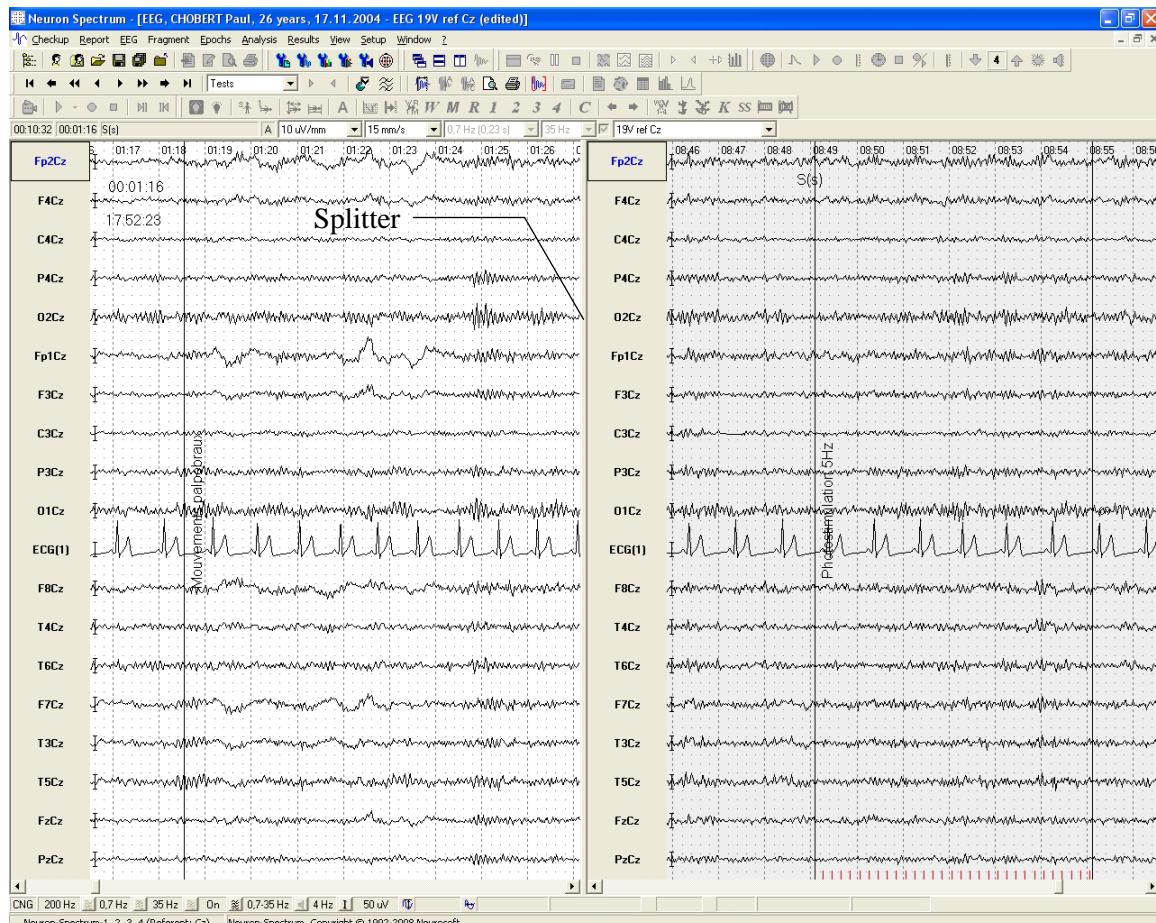
Pic. 8.24



Pic. 8.25

Neuron-Spectrum Program

14. To view two different EEG record fragments at the same time, use screen splitting. In that mode, the EEG review window is split into two parts. To turn on this mode, use the **EEG|Split screen (EEG)** menu command or [Ctrl+D] keys combination. The EEG review window will have the following type, shown in the Pic. 8.26.



Pic. 8.26

A special vertical line, called “splitter” is split the window into the two parts. You can move the line “hooked” by the mouse. All operations on EEG view with the **EEG|Navigation** menu command are performed with active part of the window. The part is selected by the mouse and marked by color.

“Splitting” mode of the screen is worked during the EEG recording. In the left part of the window you can view the EEG recording and in the right – view the recorded functional tests.

15. If during EEG recording or reviewing the print markers are set on EEG, you can print it in any moment, using **EEG|Print selected fragments** menu command. The EEG fragments printing mode using the print markers is described in details in the previous section

16. The EEG traces can be saved in the file of certain format. One of the standard international storage and exchange EEG data formats are EDF and EDF+ formats. You should use the **EEG|Export|EDF+ format** menu command. You can save EEG in the text format using **EEG|Export|ASCII format** menu command. The text file of EEG storage has the following structure (Pic. 8.27):

- some lines with “;”, symbol with the program name, sampling rate, exported EEG derivation and their names;
- further there are digital samples in each line – EEG signal value in each derivation.

```
;NeuroSoft EEG ASCII export file. Version 1.0
;Frequency: 200
;Derivations number: 19
;Derivation names: O1A1, O2A2, P3A1, P4A2, C3A1, C4A2, F3A1, F4A2, Fp1A1, Fp2A2, T5A1, T6A2, T3A1, T4A2, F7A1, F8A2, OzA2, CzA2, FpzA2
-25 -37 -3 4 11 10 2 8 0 10 2 4 8 10 -3 13 -34 0 -4
-23 -32 1 8 12 12 3 10 -2 12 3 7 8 11 -3 15 -30 1 -4
-18 -24 6 11 13 14 4 12 -2 12 6 9 9 11 -3 14 -22 6 -3
-11 -15 12 15 14 17 3 13 -4 12 9 13 10 11 -3 13 -12 -2 -2
-2 -5 17 21 15 22 1 13 -6 12 13 16 11 11 -3 12 1 10 1
9 7 23 28 16 28 1 15 -7 13 18 18 13 12 -4 11 14 15 3
20 18 28 35 17 34 0 16 -7 14 21 18 13 13 -4 12 27 23 5
28 28 30 38 16 37 -1 16 -8 14 21 16 12 14 -4 12 36 15 5
33 35 27 37 13 35 -3 14 -9 13 16 13 7 13 -7 11 42 19 2
34 40 22 32 9 29 -7 11 -12 9 10 10 2 11 -10 8 47 14 -3
34 42 18 26 7 23 -10 8 -17 5 4 8 -2 8 -14 5 48 13 -9
32 41 15 21 6 19 -13 7 -21 3 1 6 -4 7 -17 4 47 3 -13
28 33 13 17 7 19 -14 8 -22 4 -1 5 -4 6 -17 4 43 13 -14
21 22 11 16 8 22 -13 11 -21 7 -3 5 -3 7 -16 6 35 15 -11
11 9 8 16 8 25 -11 14 -18 10 -6 7 -3 8 -14 8 23 20 -7
0 -3 3 16 7 26 -8 16 -14 12 -10 7 -4 9 -12 9 10 9 -3
-9 -13 -1 13 7 26 -5 15 -10 12 -14 8 -4 8 -10 9 -3 13 -1
-17 -21 -5 10 8 23 -1 14 -5 12 -16 8 -3 8 -7 8 -15 11 -1
-22 -27 -7 7 10 20 2 14 0 10 -15 8 -1 7 -4 8 -24 13 -1
~~ ~~~ ~~~ ~~~ ~~~ ~~~ ~~~ ~~~ ~~~ ~~~ ~~~ ~~~ ~~~ ~~~ ~~~ ~~~ ~~~ ~~~ ~~~ ~~~ ~~~
```

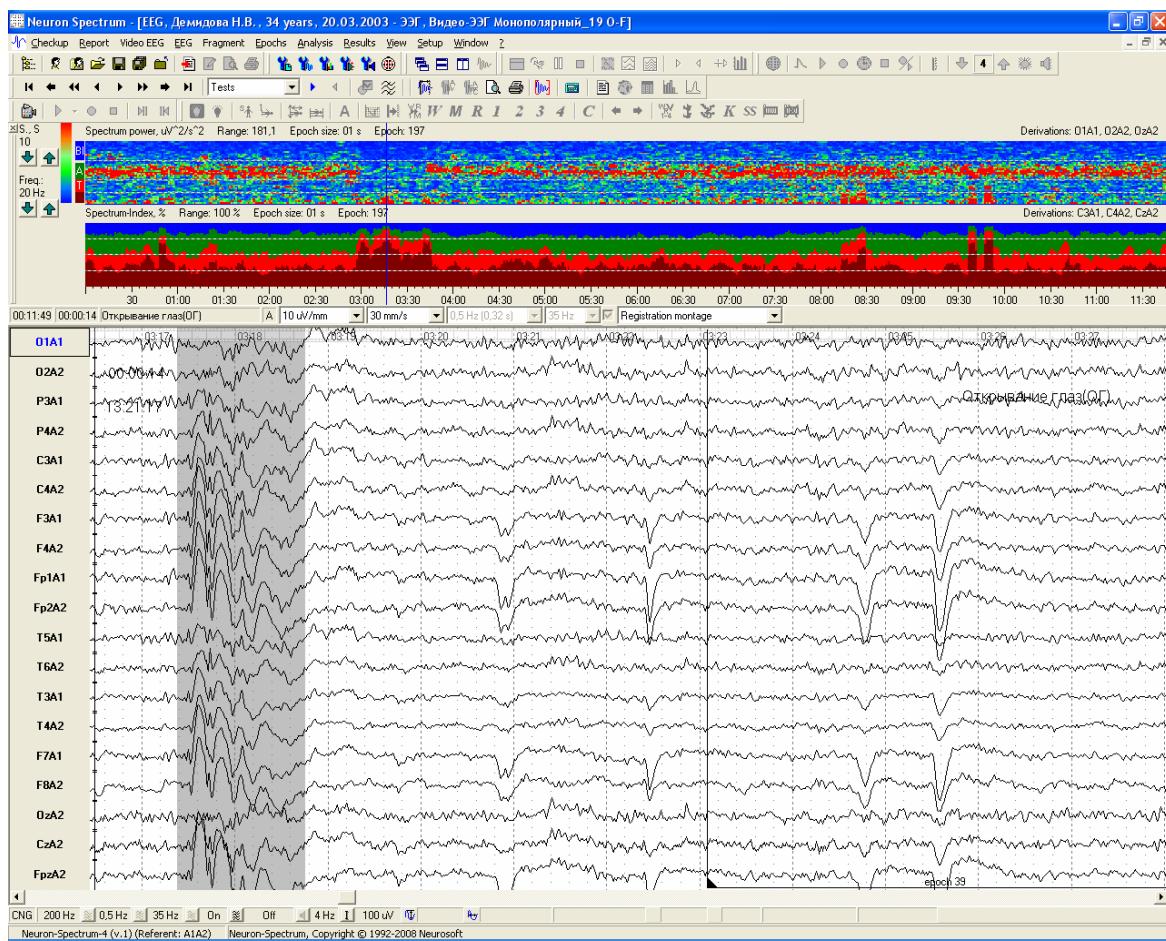
Pic. 8.27

EEG export into external file of different formats helps to exchange EEG data between different EEG analysis programs and use the data to analyze by different programs (for example MathLab, EEGLab or Excel).

17. EEG editing is described in detail in Chapter 19.

8.2. EEG COMPRESSED REPRESENTATION ON ONE SCREEN (TRENDS)

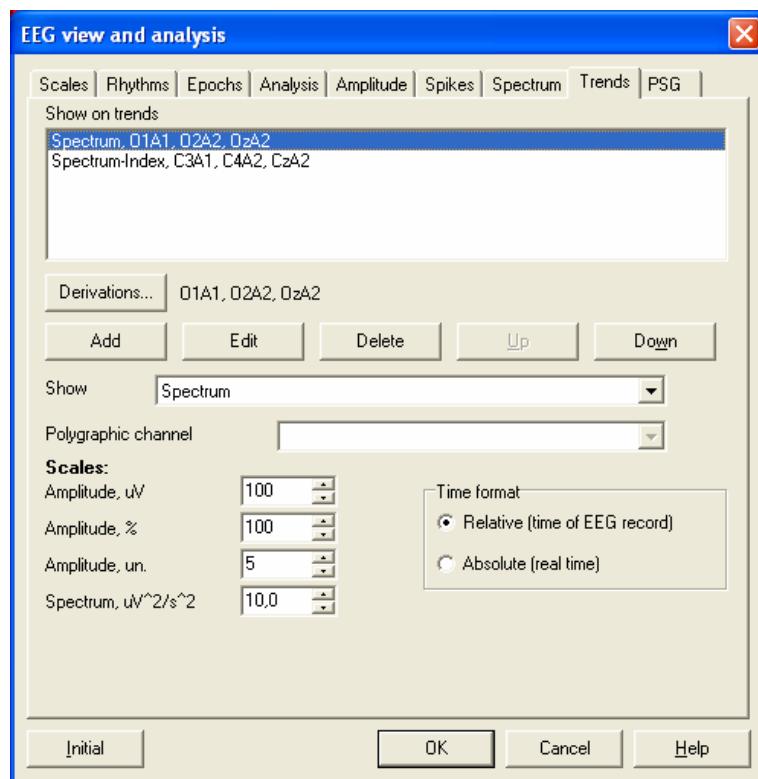
1. On one screen you can display the entire recorded electroencephalogram in the compressed form for the receiving of integrated information concerning the change of selected parameter by the entire EEG. Such a compressed EEG representation is called the trend. In **Neuron-Spectrum** program you can display up to six trends of different parameters (EEG spectrum, EEG amplitudes, EEG spectrum indices, polygraphic channels amplitudes, HR for ECG channel, amplitudes and number of spikes and sharp waves). To display the trend window of some parameter on the screen, choose the menu command **Analysis|Spectrum and trends panel**, and the panel with the trends of selected parameters will appear in the top part of the screen (Pic. 8.22).



Pic. 8.28

2. Each trend contains the heading line in which the trend parameters, trend graph area are presented. The bottom part of the window contains the time scale and the left one does the scales of the trend graphs displaying. The vertical line indicates the current fragment of EEG reviewed on the screen and is synchronized with the electroencephalogram. When you move EEG in the review window, the marker on the trend graphs also moves. If you move the marker on trend graphs, EEG on the screen is synchronized with the marker by time. To move the marker, drag it with the mouse and move to the required position. Besides, if you click the trend graph with the left mouse button, you can move the marker of EEG current position to the selected trend graph point.

3. The selection and setup of the parameters displayed on the trend graphs is done in **EEG view and analysis** dialog box on the *Trends* page (Pic. 8.29).



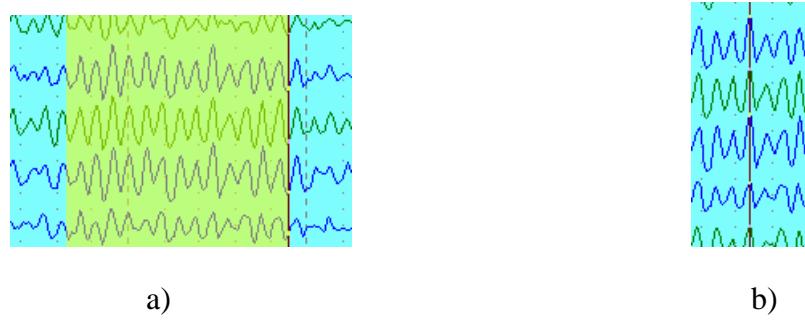
Pic. 8.29

The description of the operation with the dialog box is given in 6.3 chapter.

CHAPTER 9

OPERATING OF EEG FRAGMENTS

1. **Neuron-Spectrum** software enables selection of an EEG piece. Such a selected piece is called *fragment*. (Pic. 9.1a). You can set a vertical marker named “cursor” on the EEG Pic. 9.1b). In EEG fragments you can perform amplitude and spectral analysis the results of which are represented in tables, maps and graphs. Using EEG fragments you can mark artifacts and visual phenomena, which can be analyzed in groups (for example, to perform a 3-D localization procedure for all the selected identical phenomena).



Pic. 9.1

2. You can set the cursor or select a fragment using a mouse, shortcut keys, or the **Fragment** menu commands (Pic. 9.2).



Pic. 9.2

To set the cursor, press [**Shift**] and click on the required place of the EEG-traces holding the [**Shift**] key down. Use **Fragment|Set visir** menu command or the [**Shift+Ins**] key combination to set the cursor one second to the right of the left side of EEG review and analysis window.

To select EEG fragment, press [**Shift**] and position the mouse pointer at the beginning of the fragment being selected with the [**Shift**] button pressed. Press the left mouse button and drag the

pointer to the end of the fragment with the button pressed. The fragment will be highlighted. Release the mouse button. To select the fragment, you can also use the **Fragment|Mark fragment** menu command or the **[Shift+Alt+Ins]** key combination.

To select fragment of arbitrary length you can use mouse. Set mouse on the beginning of fragment. Push right mouse button and select **Fragment beginning** command in menu properties (Pic. 9.3).



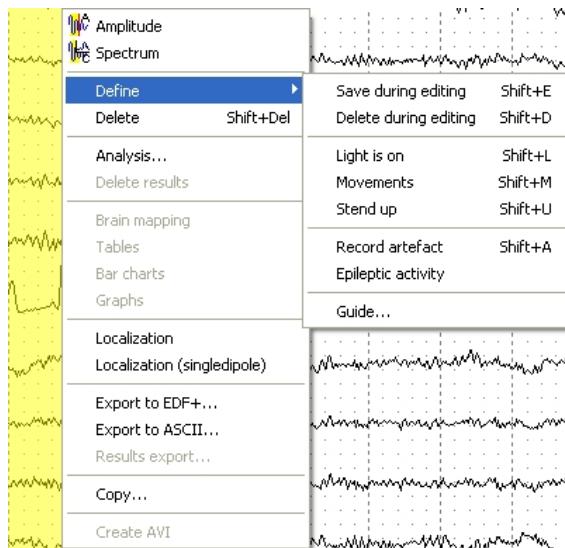
Pic. 9.3

After it position EEG to the end of the fragment. Set mouse to the end of fragment and push right mouse button. In menu properties (Pic. 9.3) select **Fragment ending** command. On EEG the fragment of selected length will be marked.

3. You can change the length of the fragment or move the cursor using the following commands of the **EEG|Fragment** menu: **Visir left**, **Visir right**, **Visir left quickly**, **Visir right quickly** or the corresponding **[Shift+→]**, **[Shift+←]**, **[Shift+Ctrl+→]**, **[Shift+Ctrl+←]** key combinations. The **Visir left** and **Visir right** commands move the cursor one step to the left or to the right. **Visir left quickly**, **Visir right quickly** move the cursor ten steps to the left or to the right.

4. To delete the cursor or the fragment, select **Fragment|Delete visir/fragment** or **[Shift+Del]**.

5. The cursor or fragment are used to measure EEG amplitude, to perform amplitude or spectral and frequency EEG analysis and 3D-localization, to select EEG fragments which will be saved during EEG editing, as well as to highlight various section and patterns of EEG-traces. To define EEG fragments, use **Define** command of fragment menu properties (you can see it by pushing right mouse button on fragment) (Pic. 9.4).

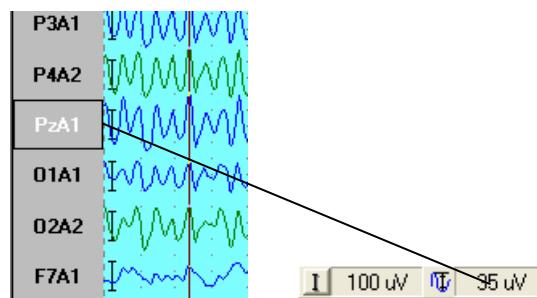


Pic. 9.4

6. To measure amplitudes at any point of any derivation, you have to (Pic. 9.5):

- set the cursor at the required point of EEG;
- choose and click on the name of the required derivation on the *Derivations bar*; the derivation will be activated and highlighted.

Panel (8) on the *Parameters string* of the EEG review and analysis window will display EEG amplitude at the given point of the given derivation.



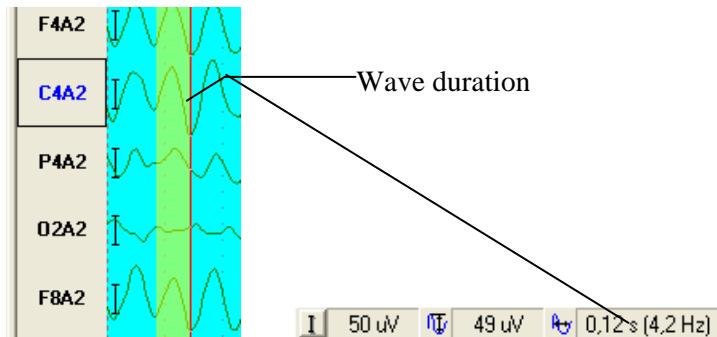
Pic. 9.5

7. To measure the amplitude and duration of a wave as well as to measure the amplitude and duration between two points using fragment selection, you have to (Pic. 9.6, Pic. 9.7):

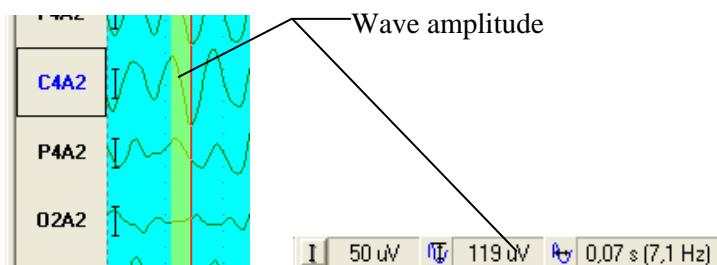
- select the fragment, the beginning and the end of which are situated in the required points;
- click on the name of the required derivation in the *Derivations bar*; the derivation will be activated and highlighted.

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Panels (8) and (9) on the *Parameters* string will display amplitude and duration of the wave in the derivation chosen.



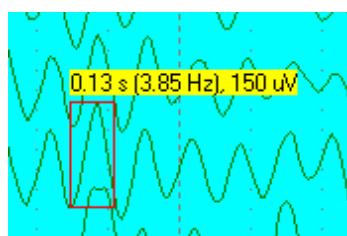
Pic. 9.6



Pic. 9.7

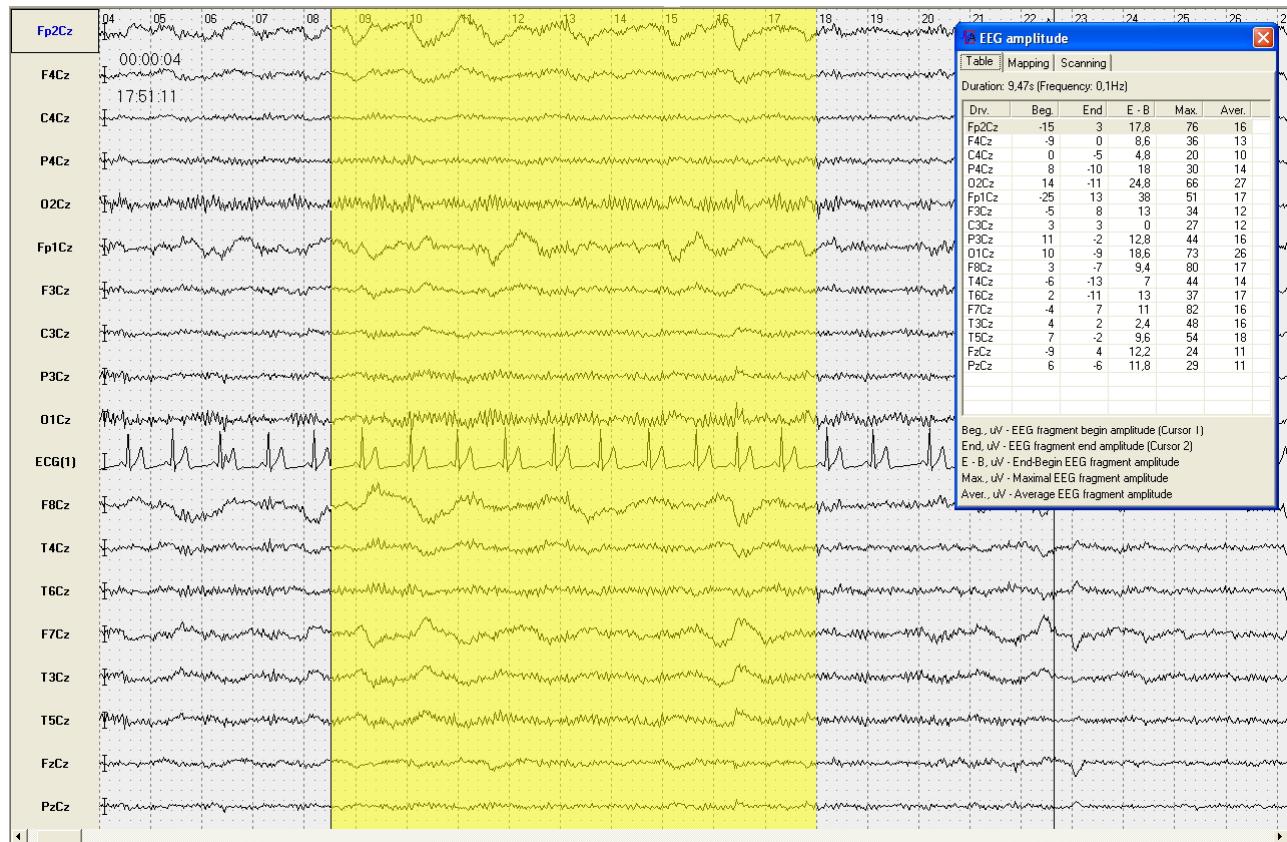
8. The amplitude and duration of EEG waves can also be measured in the following way:

- Press [Ctrl], the mouse cursor will turn into a cross $+$. Hold the key down.
- Press the left mouse button, hold it down as well. Drag the mouse. A red measuring rectangle following the cross will appear. Its height will be measured in microvolts, and length – in seconds. The values will be displayed in a yellow line atop.
- If you use the rectangle to outline the required wave, you will get its duration and amplitude (Pic. 9.8).



Pic. 9.8

9. To perform amplitude analysis in all derivations using the cursor or EEG fragment, select **Fragment|Amplitude** or click on the  button on the *EEG review and analysis* toolbar. In the right-hand corner of the screen the EEG amplitude analysis window will appear (Pic. 9.9).



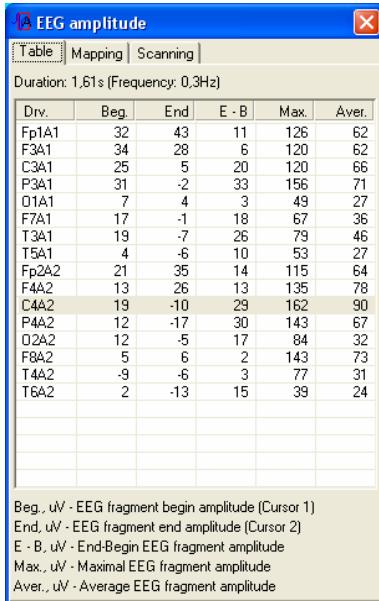
Pic. 9.9

By default the amplitude analysis window is “floating” in the right part of the EEG review and analysis window when appearing on the screen. If necessary, the window can be made “docked”.

The window has three pages: **Table**, **Mapping**, **Scanning**.

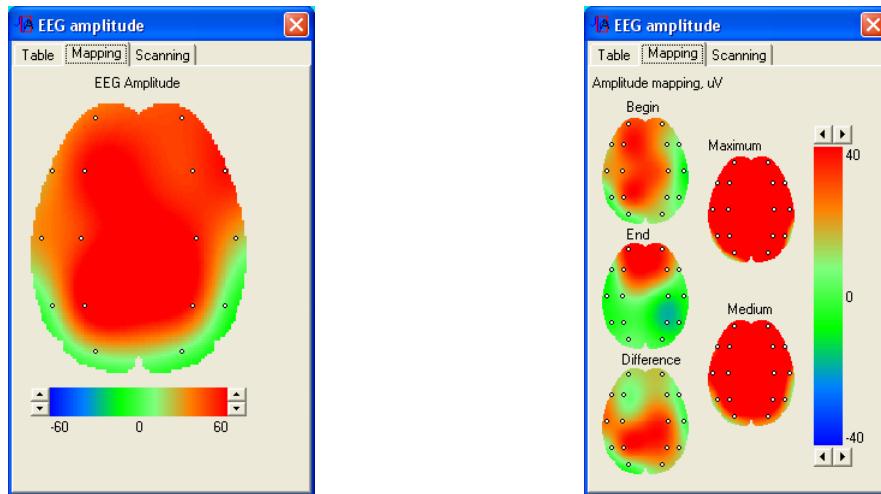
Neuron-Spectrum Program

The **Table** page displays momentary amplitude values in all the derivations at the points of their cursor or, momentary amplitude values of the beginning and the end of a fragment, the difference between them and the maximal and average amplitude in the fragment (Pic. 9.10). The current derivation is highlighted.



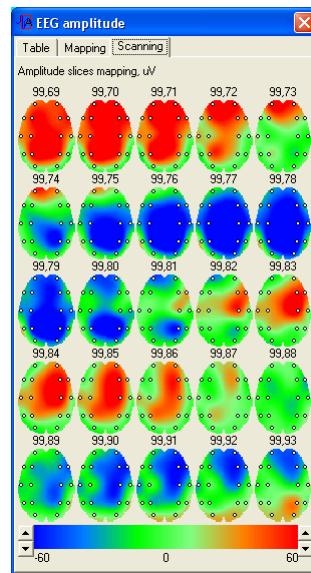
Pic. 9.10

The **Mapping** page, depending on whether you analyze the cursor or the fragment, displays one (for the cursor) or five (for the fragment) maps of momentary amplitude as well as maximal and medium amplitude of the fragment (Pic. 9.11).



Pic. 9.11

The **Scanning** page displays the sequence of topographic momentary amplitude maps, starting with the cursor or the beginning of the fragment with the preset time-step (Pic. 9.12).



Pic. 9.12



To change palette borders use buttons (Pic. 9.15), or [Add. +], [Add. -] for upper bound and [Ctrl+Add. +], [Ctrl+Add. -] for low bound.

The context menu of the EEG amplitude analysis window (activating by the right mouse button) (Pic. 9.13) enables setting of the parameters of analysis (**Setup**), changing palettes of topographic maps (**Palette**), and copying data to clipboard, report or printer (**Copy**). After coping to clipboard the table you can insert it in a Microsoft Excel™.



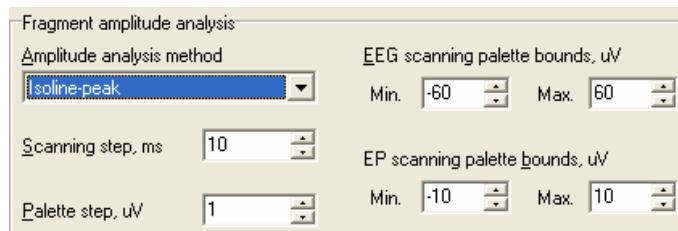
Pic. 9.13

The dialog box of parameters settings enables varying of the following (Pic. 9.14):

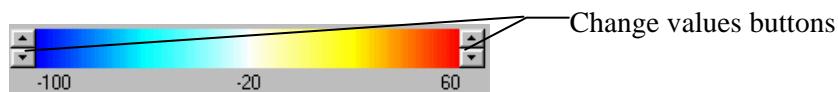
- The way of amplitude measuring when displaying sequence of maps on the **Scanning** page (*Amplitude analysis method* combo box). The *Isoline-peak* value is the absolute value of amplitude in each point. The *Peak-to-peak* value is the difference between amplitude value in the current point and amplitude value in the start point.
- Time-step between maps for the **Scanning** page (the *Scanning step* edit line).

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- Palette changing step for the **Mapping** and **Scanning** pages while using the buttons of maximal and minimal modification of the palette bounds (Pic. 9.15).
- Palette bounds (minimal and maximal value); i.e. boundary values of amplitude maps scale (the *EEG scanning palette bounds* edit lines).



Pic. 9.14



Pic. 9.15

10. Spectral and frequency analysis is applied only if an EEG fragment is not less than a second. To start the analysis, select **Fragment|Spectrum** or the button on the toolbar. The panel of spectral and frequency EEG analysis will appear in the right-hand corner of the EEG review and analysis window (Pic. 9.16).



Pic. 9.16

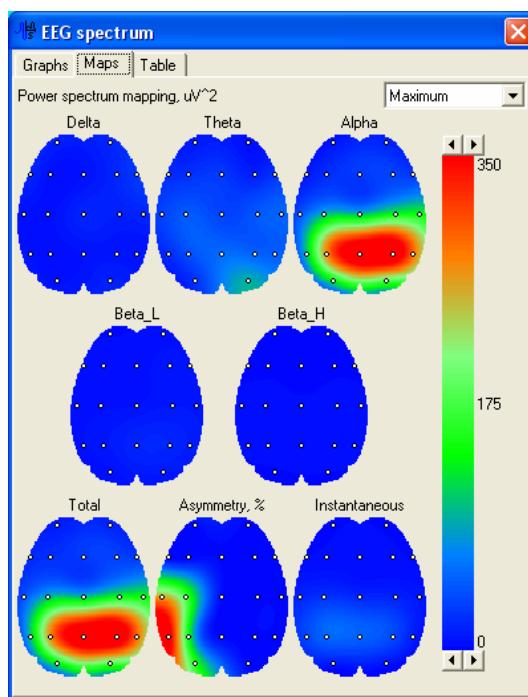
By default the spectral-frequency analysis window is “floating” in the right part of the EEG review and analysis window when appearing on the screen. If necessary, the window can be made “docked”.

The panel has three pages: **Graphs**, **Maps** and **Table**.

The **Graphs** page (Pic. 9.16) displays the graphs of spectrum power or amplitude in all the derivations. At the bottom of the window the bar of standard frequency bands (EEG-rhythms) will appear. There is a marker (a vertical line) moving along the graph. It enables marking of the frequency value. This value is displayed in the right upper corner of the panel. Momentary values of the spectrum in a marked point of each derivation are used in the other pages. The value of the spectrum power or amplitude of the current derivation (name marked with other color) is displayed in the right upper corner of the window. The current derivation of the graph is synchronized with the current derivation of the EEG traces window. You can select it by clicking with the left mouse button on its name.

The **Maps** page you can see brain mapping of (Pic. 9.17):

- the maximal, average and full spectrum power or amplitude in basic frequency ranges;
- the total value of the full spectrum power or amplitude in the whole derivation;
- the momentary spectrum power or amplitude value (in the cursor frequency);
- the momentary spectrum power or amplitude asymmetry.



Pic. 9.17

Neuron-Spectrum Program

The **Table** page displays the values of current, maximum, medium and full spectrum amplitude or power as well as dominating and medium frequencies of spectrum for each derivation (Pic. 9.18). The fragment duration is also included. Current derivation is highlighted.

The screenshot shows a software window titled "EEG spectrum". At the top, there are tabs for "Graphs", "Maps", and "Table", with "Table" being the active tab. Below the tabs, it says "Duration: 2s". The main area is a table with the following columns: Drv., Curr., Max., Medium, Full, Dom. frq., and Med. frq. The table lists 18 rows of data corresponding to different derivations (Fp1A1, Fp2A2, F3A1, F4A2, FzA1, C3A1, C4A2, CzA2, P3A1, P4A2, PzA1, O1A1, O2A2, F7A1, F8A2, T3A1, T4A2, T5A1, T6A2). The "Curr." column shows values like 1.39, 1.16, 3.09, etc. The "Max." column shows values like 11, 16, 23, etc. The "Medium" column shows values like 1.25, 1.64, 2.05, etc. The "Full" column shows values like 89, 116, 146, etc. The "Dom. frq." column shows values like 2, 2.5, 7.5, etc. The "Med. frq." column shows values like 9, 9, 9.5, etc. At the bottom of the table, there is a note: "Curr., Max., Medium, Full - uV^2" and "Dom. frq., Med. frq. - Hz".

Drv.	Curr.	Max.	Medium	Full	Dom. frq.	Med. frq.
Fp1A1	1.39	11	1.25	89	2	9
Fp2A2	1.16	16	1.64	116	2.5	9
F3A1	3.09	23	2.05	146	7.5	9.5
F4A2	2.73	33	2.86	203	10	9.5
FzA1	3.23	27	2.23	159	10.5	10
C3A1	24	100	5.27	374	10.5	10
C4A2	14	147	7.55	536	10.5	10
CzA2	18	109	5.98	424	10.5	10
P3A1	51	273	12	826	10.5	9.5
P4A2	35	384	15	1053	10.5	10
PzA1	49	389	15	1085	10.5	9.5
O1A1	8.75	126	6.66	473	10.5	9.5
O2A2	5.61	173	11	764	10.5	9.5
F7A1	2.10	20	1.72	122	7.5	9
F8A2	1.45	29	3.44	244	10	7.5
T3A1	16	43	3.72	264	9.5	9.5
T4A2	7.44	145	7.18	510	10.5	10
T5A1	35	106	6.06	430	9.5	9.5
T6A2	11	286	10	741	10.5	10

Pic. 9.18

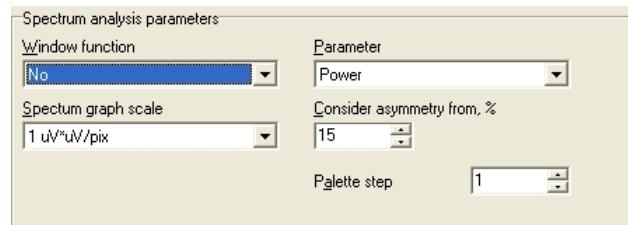
The properties menu of spectrum analysis panel (Pic. 9.19) enables:



Pic. 9.19

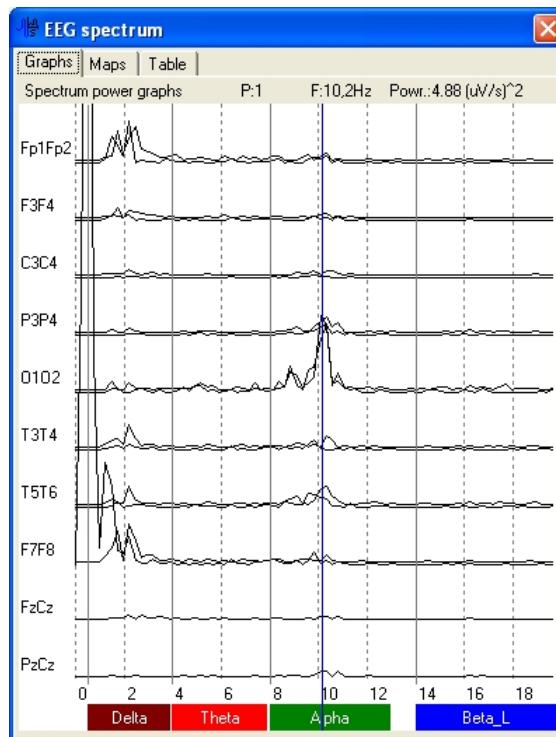
- Choosing of the spectrum amplitude or spectrum power (**Amplitude**, **Power**) to display. The current parameter is checked.

- Setting of the parameters of spectral analysis (the **Setup** menu command). The dialog box of parameters settings for spectral analysis appears on the screen (Pic. 9.20). It enables setting of several options. Among them are window function for spectrum calculations (the *Window function* combo box), the parameter displayed by default (amplitude or power) (the *Parameter* combo box), the step of palette change (the *Palette step* edit line), the scale for spectrum graphs (the *Spectrum graph scale* combo box) and the asymmetry bounds check (the *Consider asymmetry from* edit line).



Pic. 9.20

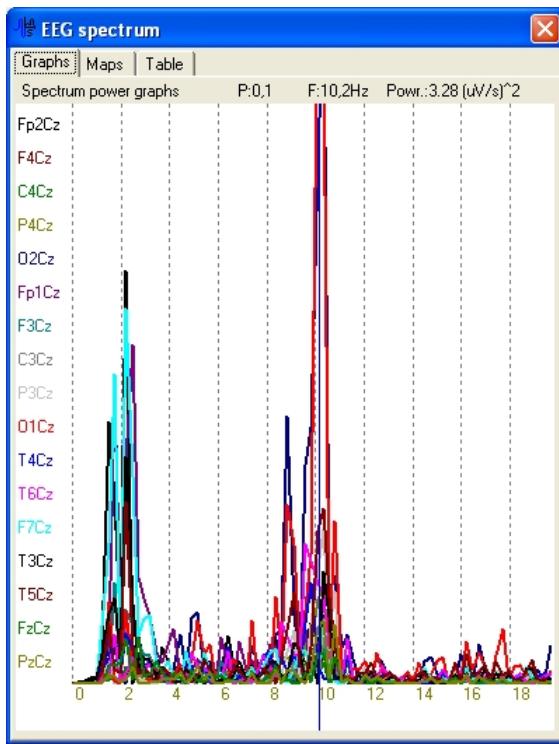
- Changing of topographic maps palette (the **Palette** command). You can change palette clicking buttons (Pic. 9.15) and using key combinations [Add. +], [Add. -] for upper bound and [Ctrl+Add. +], [Ctrl+Add. -] for low bound.
- Moving of the marker of momentary frequency to the left or to the right (the **Marker left**, **Marker right** menu commands or the [\leftarrow], [\rightarrow] keys). You can also drag marker with mouse. If you click left mouse button on graphs the frequency marker move to that position.
- Displaying of the graphs of power spectrum in pairs on one isoline for symmetrical derivations (Pic. 9.21) in order to measure spectrum asymmetry (the **Asymmetry** command).



Pic. 9.21

Neuron-Spectrum Program

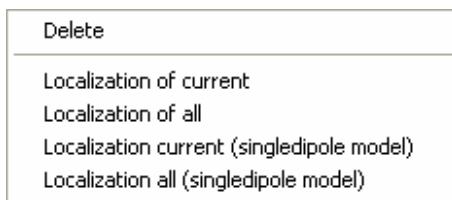
- Displaying of all graphs on one isoline (Pic. 9.22). Every graph has its own color (the **On one isoline** command).



Pic. 9.22

- Copying of data to the clipboard, report or printer (the **Copy** command). After coping to clipboard the table you can insert it in a Microsoft Excel™.

11. To highlight an artifact or pathologic pattern, choose the corresponding fragment and use the **Fragment|Define** menu command or the mouse. You can use these selected visual phenomena for processing in groups. If you mark several phenomena as visual ones and give them the same name, you can perform the 3-D localization of all the selected phenomena at once (Pic. 9.23) with the help of the properties menu of the phenomenon.



Pic. 9.23

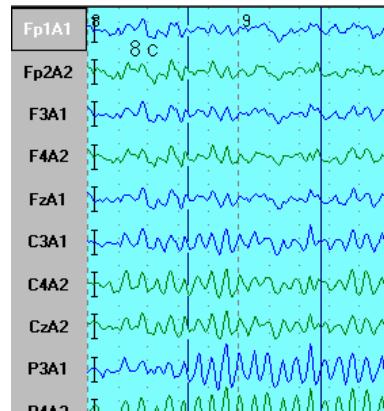
12. The group of commands of the **Fragment** menu, starting from **Analysis** to **Delete results**, enables performing of full mathematical analysis of EEG fragment with the following view of the results, using all the methods of **Neuron-Spectrum** software. Methods of results display and analysis will be discussed bellow.

13. If there is the **BrainLoc** three-dimensional localization software installed on your PC, you can perform three-dimensional localization of EEG fragment, using the **Fragment|Localization** command.
14. The **Fragment|Export to EDF+, Fragment|Export to ASCII** command exports EEG fragment into a separate file of international EDF format or ASCII text file (the ASCII-file is described earlier).
15. The **Fragment|Copy** command copies an EEG fragment into the clipboard, report or printer.
16. The **Fragment|Generate AVI** menu command is used for the generation of the video EEG fragments as a video film in AVI format to view these films on any computer. The order of actions for the video film generation is described in chapter 19.

CHAPTER 10

MEASURING MARKERS (CURSORS)

1. Measuring markers are two vertical lines of the EEG window, one of which is a firm line; the other is a dotted one (Pic. 10.1). You can move markers inside the window.



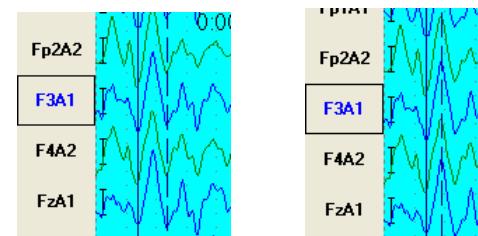
Pic. 10.1

2. The markers are used to measure amplitudes and time intervals of EEG waves, and to perform amplitude and spectral analysis of the fragment between the markers. Markers differ from EEG fragment. The latter is fixed to a certain part of EEG-traces and moves together with it. Markers do not change their position until you want them to.

3. To show or hide measuring markers, use the **EEG|Measuring cursors** command, the button or the **[Ctrl+K]** combination.

You can change their position with the mouse. If you move the pointer to the marker, the former will change from to . Press the left mouse button, hold it down and move the mouse in a required direction. Marker will follow the mouse.

4. The (8) and (9) bars of the *Parameters string* of the EEG review and analysis window show the duration (frequency) between the markers and the amplitude between cross-points of EEG waves and markers in the current derivation. Measuring markers allow fast measuring of amplitude (Pic. 10.2a) and duration (Pic. 10.2b) of EEG-waves.



18 μ V 0,20 s [2,6 Hz] 155 μ V 0,10 s [4,9 Hz]

a)

b)

Pic. 10.2

5. Amplitude and spectral analysis of EEG fragment between markers is similar to that of an ordinary EEG fragment.

CHAPTER 11

EEG ANALYSIS

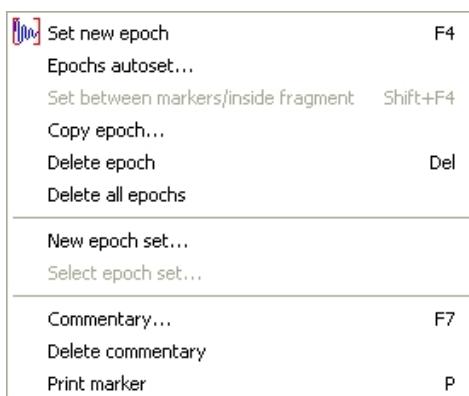
The **Neuron-Spectrum** program performs mathematical analysis of EEG in the following order:

- Select the EEG fragments for mathematical analysis. The fragments are called *analysis epochs*.
- Choose the necessary procedures of mathematical data processing (amplitude analysis, search of spikes and sharp waves, frequency and spectral analysis, correlation analysis, etc.).
- Software makes calculations for each analysis epoch and averages the results within every functional test.
- Now you can use various methods of results visualization as well as form automatically the description of the EEG based on the results.

Below we are giving a more detailed description of each EEG analysis step.

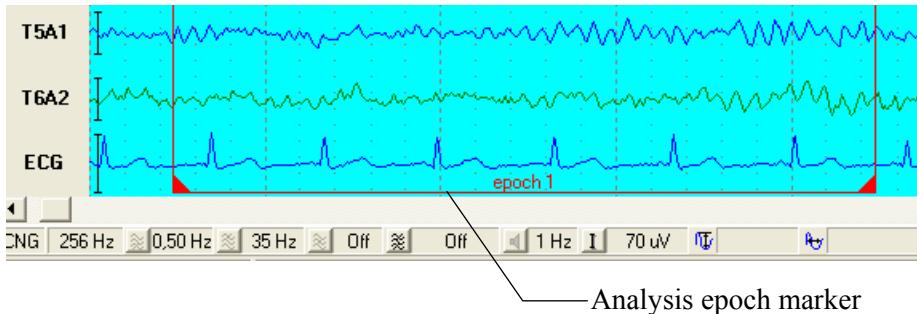
11.1. SETTING OF ANALYSIS EPOCHS

1. Analysis epoch is an EEG fragment of fixed duration, chosen for mathematical analysis. Its length is measured in quantization steps. It is divisible by two (for fast Fourier transformation during spectral and frequency analysis).
2. You can set the epoch length equal to 512, 1024, 2048, 4096, 8192 tact. Epoch duration is determined by sampling rate of EEG recording. For example, if sampling rate is equal to 256 Hz, 512 tact epoch runs on for 2 seconds; 1024 tact epoch – for 4 seconds; etc.
3. To operate with epochs, use the **Epochs** menu commands (Pic. 11.1).



Pic. 11.1

4. The **Neuron-Spectrum** software provides both manual and automatic mode of analysis epochs setting. To set an analysis epoch, select **Epochs|Set new epoch**, click on the  button or press **[F4]**. The marker of the set analysis epoch will appear in the left-hand corner of the window (Pic. 11.2). The length of the epoch is preset in the **EEG view and analysis** dialog box on *Epochs* page.

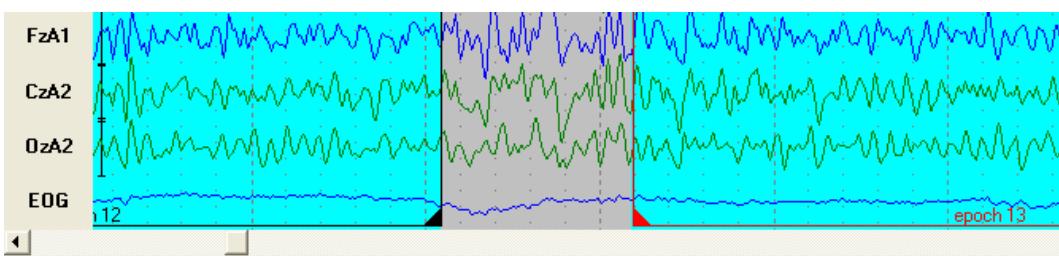


Pic. 11.2

5. You can move the marker of analysis epoch to any part of EEG traces. Move the mouse-pointer to one of the triangles on the edges of epoch marker  or , or to the vertical bound of the epoch. The pointer will change from  to . Press the left mouse button, hold it down and move the pointer. The marker will follow it. Release the mouse button.

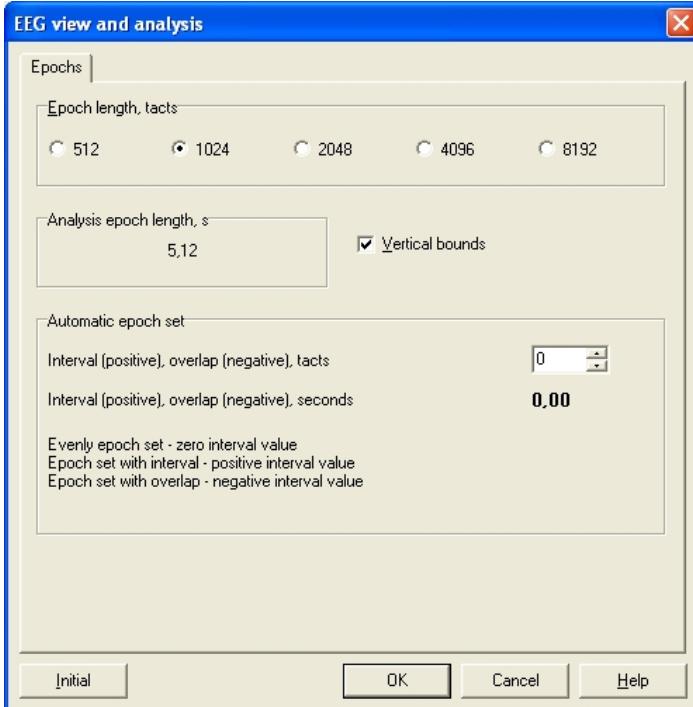
6. If there are several analysis epochs preset, one of them will be active (current). The active analysis epoch marker is marked with the color. All the operations are performed with the current epoch, it is highlighted in the dialog boxes of the epoch selection. To change the current epoch, click on the epoch you want to become active, or select it in the **Go to epoch** dialog box (the **EEG|Navigation|To epoch** menu command).

7. **Neuron-Spectrum** does not set an analysis epoch on a marked artifact. The artifact must be marked beforehand with the help of the fragment and defining of the fragment as an artifact. The artifact is highlighted by another color on the EEG (Pic. 11.3). During manual or automatic epochs setting the software avoids this marked artifact fragments.



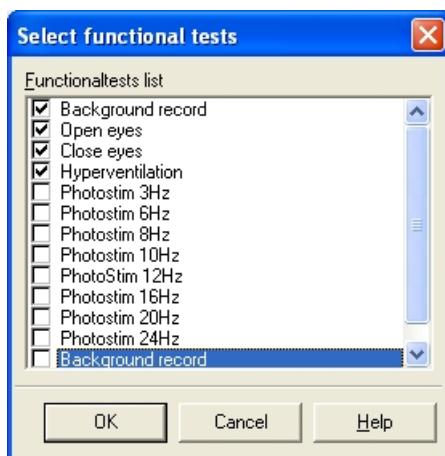
Pic. 11.3

8. Before automatic epoch setting review all the EEG-traces and mark all artifact fragments. Use the **Epochs|Epochs autoset** menu command for automatic epoch setting. The **EEG view and analysis** dialog box will be displayed on the **Epochs** page (Pic. 11.4). Select epoch length and interval or overlap duration.



Pic. 11.4

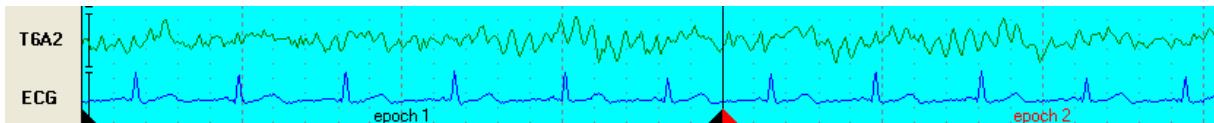
9. After it the **Select functional tests** dialog box appears on the screen. It contains the list of all functional tests in this record (Pic. 11.5). Select the functional tests in which you want to set epochs (check the check box).



Pic. 11.5

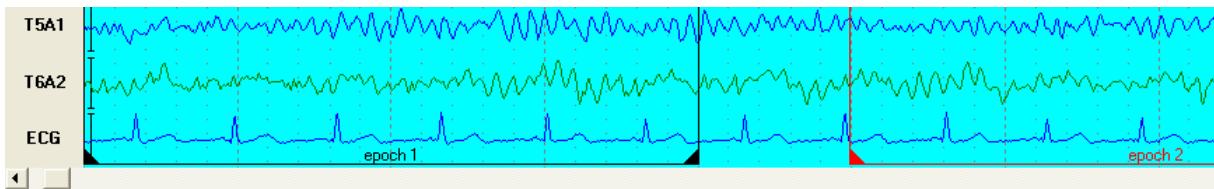
10. **Neuron-Spectrum** provides several methods of automatic epoch setting depending, on the value of interval (overlap) (Pic. 11.4):

- *Even* epoch setting (zero value of interval). The end of the previous epoch automatically becomes the beginning of the next one (Pic. 11.6). The positioning is performed from the beginning of each functional test. The marked artifacts are neglected; that is why epochs can cover each other.



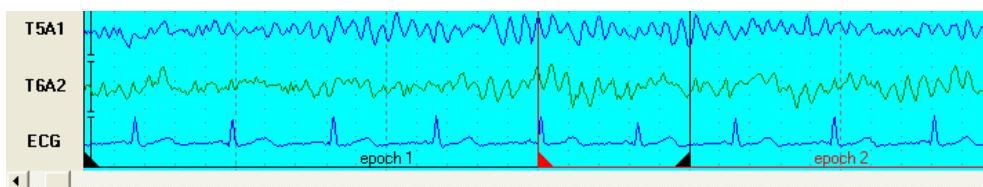
Pic. 11.6

- Epoch setting with *Interval* (positive interval value). The intervals between the markers are set in the parameters of EEG analysis. (Pic. 11.7). The positioning is performed from the beginning of each functional test. The marked artifacts are neglected; that is why the interval between epochs can be changed.



Pic. 11.7

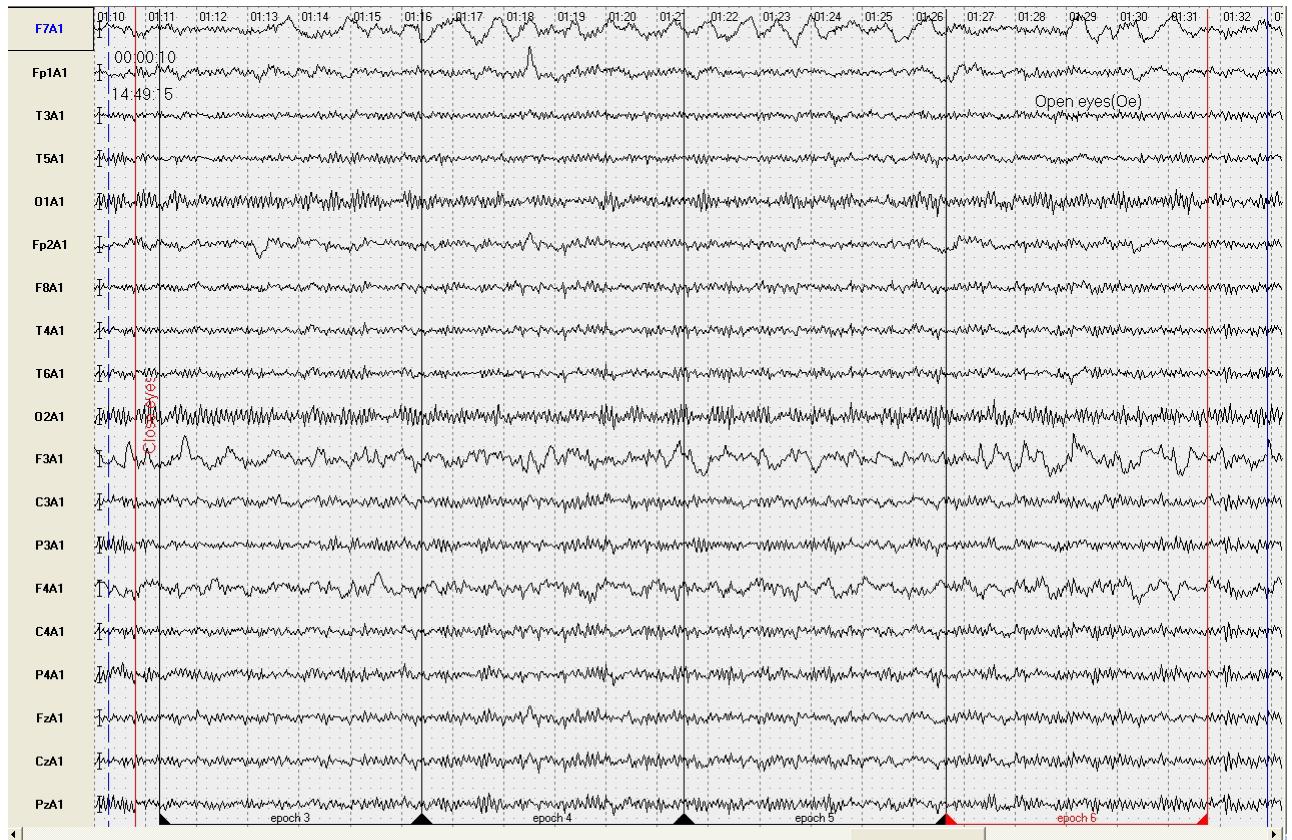
- Epoch setting with *Overlap* (negative interval value). The next epoch overlaps the previous one. Overlap interval is set in the parameters of EEG analysis. (Pic. 11.8). The positioning is performed from the beginning of each functional test. The marked artifacts are neglected; that is why the overlap interval can be changed.



Pic. 11.8

Note that automatic methods of epochs setting need previous marking of artifacts. This will reduce the possibility of mistakes during mathematical EEG analysis.

11. To perform the automatic setting of the epochs, use **Epochs|Set between markers/inside fragment** menu command ([**Shift+F4**] key combination). This command is enabled only if the measuring markers are visible or the fragment is selected. At that the epochs are automatically set only between markers or inside the selected fragment with interval (overlap) specified in the settings (Pic. 11.9).



Pic. 11.9

12. To delete an active epoch, select **Epochs>Delete epoch** or click [**Del**] and confirm the deletion.
13. To delete all preset epoch markers, select **Epochs>Delete all** and confirm the deletion.
14. The **Copy** epoch properties menu command (right mouse button click on the epoch marker) provides copying EEG traces of active epoch to the clipboard, report or printer.
15. **Neuron-Spectrum** enables saving and using of several variants of epoch settings. This appears to be quite useful, when you need to analyze several EEG fragments using different methods of analysis (for example, spectral and frequency analysis, analysis of spikes and sharp waves, analysis of background activity, analysis of pathologic patterns, etc.).

If you wish to add a new epoch setting to the one, that already exists, select **Epochs|New epoch set**. If the current variant was not saved, a saving message will appear on the screen (Pic. 11.10).



Pic. 11.10

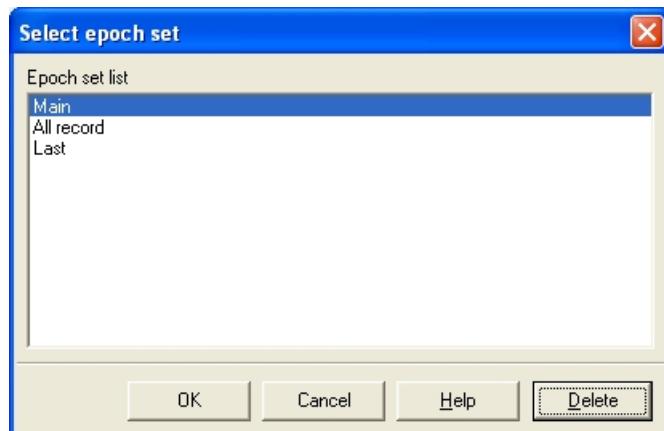
To save current epoch setting, click “*Yes*” or press [**Enter**]. If you click “*No*” or press [**Esc**], the current setting will not be saved.

When you save the epoch setting, there appears **Save current epoch-set** dialog box (Pic. 11.11). Enter the name of the scheme, click “*OK*” or press [**Enter**]. The current epoch setting is saved and can be restored later.



Pic. 11.11

16. To activate one of the epoch settings saved, select **Epochs>Select epoch set** menu command. If current setting is not saved, you will have to save it in **Save current epoch-set** dialog box (Pic. 11.10). Then the list of epoch settings will appear on the screen (Pic. 11.12).

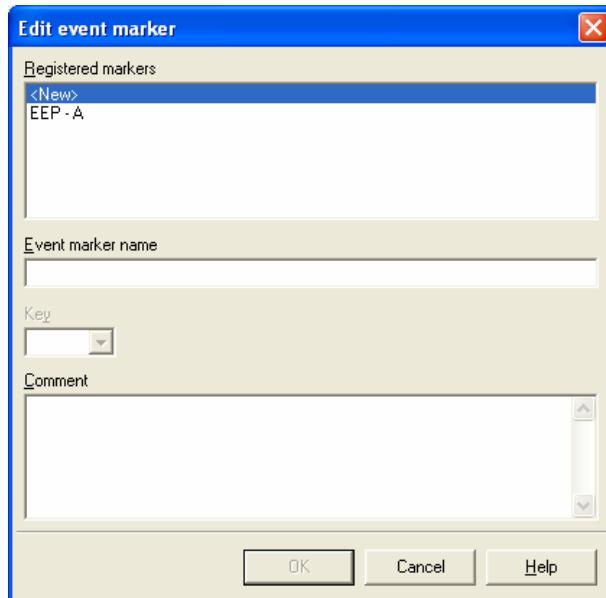


Pic. 11.12

The current setting is highlighted. Click the setting name you want to activate, than click “*OK*” or press [**Enter**]. The selected epoch setting will be displayed.

To delete the highlighted epoch setting, click “*Delete*”.

17. You can set the so called *Commentary* and *Print marker* on any part of EEG traces. *Commentary* is event marker. To set it use **Epochs|Commentary** menu command. The **Edit event marker** dialog box will appear (Pic. 11.13)



Pic. 11.13

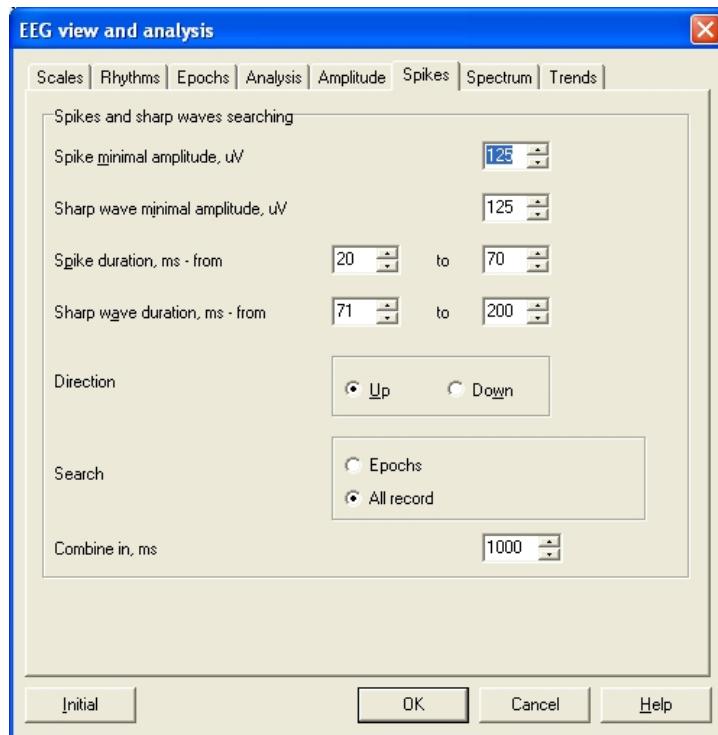
Input marker name and commentary and press “*OK*” or [*Enter*]. There will be a marker on the EEG traces. You can move it at any position.

Print marker is the event marker, which marked EEG fragments for printing. We described there setting and using during EEG recording early. To set *Print marker* during EEG reviewing, use **Epochs|Print marker** menu command or [**P**] key. After it Print marker will be set on EEG as much seconds righter the left EEG window border as set in **Program setup** dialog box on *Print* page. After setting you can arbitrarily position the *Print marker*. Printing procedure using print markers will described below.

11.2. SPIKES AND SHARP WAVES AUTOMATIC DETECTION

1. The **Neuron-Spectrum** software allows detecting spikes and sharp waves automatically within both the whole EEG record and set analysis epochs. The software detects spikes and sharp waves by the amplitude-and-time criterion. An EEG wave is considered a spike or a sharp wave when the amplitude of the wave half is more than the specified value and the wave duration is found in the specified range.

2. You can specify the amplitude and time criteria in the **EEG view and analysis** dialog-box on the **Spikes** page (Pic. 11.14). This dialog box can be displayed by the **Setup|Analysis** menu command.

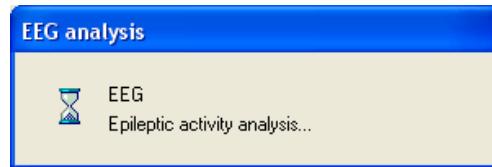


Pic. 11.14

In the *Spike minimal amplitude* and *Sharp wave minimal amplitude* edit lines enter the amplitude limit, the exceeding of which turns an EEG wave into a spike or a sharp wave. In the *Spike duration* and *Sharp wave duration* edit lines enter time ranges in milliseconds. The time ranges determine the EEG-wave duration and the amplitude of the wave halves that turn a wave into a spike or a sharp wave if the *Direction* radio-button shows the direction of the wave. The *Search* radio-button determines where spikes and sharp waves are sought – in all the record or in the set analysis epochs. The *Combine in* edit line specifies the time interval. In the range of this interval the separate identified spikes and sharp waves are combined into the blocks.

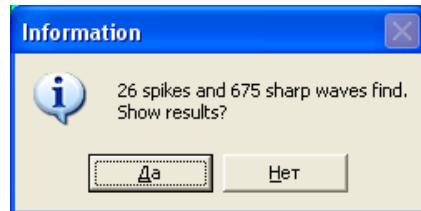
3. To start the automatic search of spikes and sharp waves select **Analysis|Spikes and SW search** menu command. There will appear the dialog-box for viewing and specification of the amplitude-and-time parameters of spikes and sharp waves (Pic. 11.14).

Enter the values if necessary and click “OK” or press [Enter]. The spikes and sharp waves search will begin. The information panel of the search mode will appear on the (Pic. 11.15).



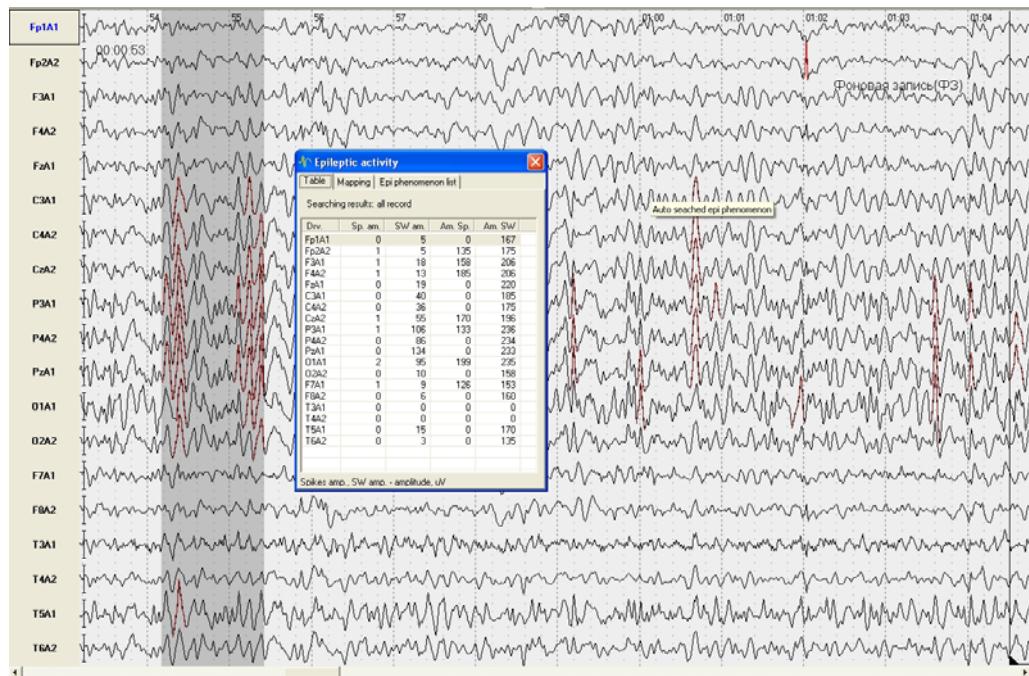
Pic. 11.15

4. After the search is finished the message box with the number of spikes and sharp waves found will appear on the screen (Pic. 11.16).



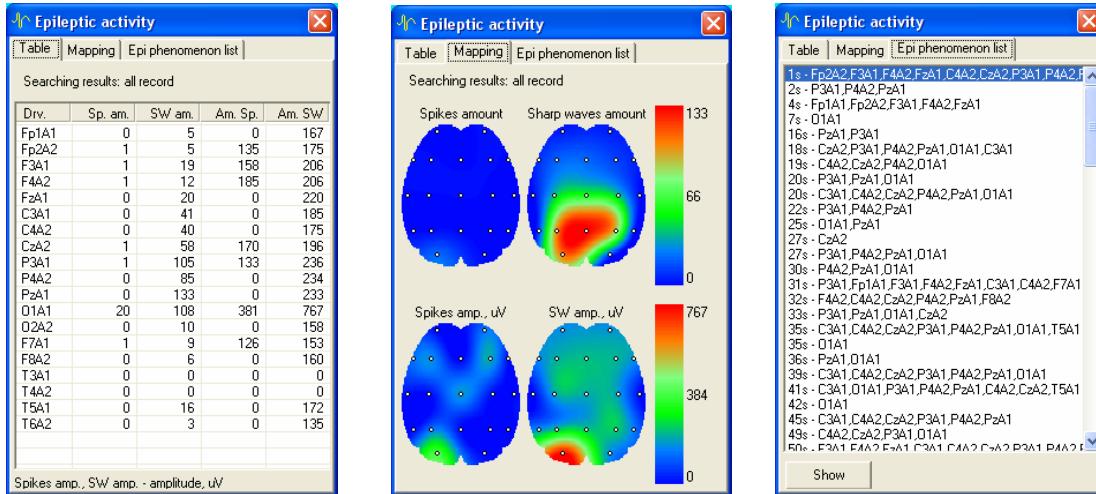
Pic. 11.16

All the spikes and sharp waves in each derivation will be highlighted. The EEG fragments spikes and sharp waves were detected in will be shown. If you click “Yes” button then search results window **Epileptic activity** will appear on the (Pic. 11.17).



Pic. 11.17

5. To look through the results of the spikes and sharp waves detection select **Results|Spikes and SW searching results** menu command. The window with results of search with the **Table**, **Mapping** and **Epiphenomenon list** pages will appear on the left of the EEG view and analysis window (Pic. 11.18).



Pic. 11.18

The **Table** contains the exact number of spikes and sharp waves in each derivation, their maximum and average amplitude (within the record, a functional test or selected phenomenon).

The **Mapping** page displays the topographic maps of spikes and sharp waves number and maximum amplitude (within the record, a functional test or selected phenomenon).

On the **Epiphenomenon list** page you can see the list of all epiphenomenon found (the same list you can find in *Observation inspector* in *Epileptic activity* folder). Double clicking on the list element you selecting this phenomena and positioning EEG traces window on this phenomena.

6. Using **Epileptic activity** window properties menu (Pic. 11.19) you can:

- select the searching results displayed: in entire record (**Entire record**), in selected functional test (**Test**) or in selected phenomena (**Selected epi-phenomena**);
- change mapping palette (**Palette**);
- copy searching results to clipboard, report or printer (**Copy**).



Pic. 11.19

7. To delete one phenomena click right mouse button on it and select **Delete** command from its properties menu.

8. To delete search results use **Results>Delete spikes and SW searching results**.

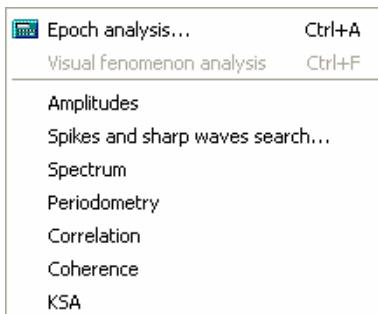
11.3. TYPES OF EEG MATHEMATICAL ANALYSIS

1. **Neuron-Spectrum** provides the following types of the EEG mathematical analysis (it is performed within chosen analysis epochs, the results are averaged for each functional test):
 - amplitude analysis;
 - frequency-spectral analysis;
 - periodometrical analysis;
 - correlation analysis;
 - coherent analysis.
2. The parameters calculated during the amplitude analysis are:
 - maximum and average EEG amplitudes in each derivation;
 - maximum and average EEG amplitudes for each standard frequency range (EEG-rhythm) in each derivation.
3. The parameters calculated during the frequency-spectral analysis with the help of fast Fourier transformation (FFT) are:
 - the graphs of spectrum power and amplitude for each derivation;
 - maximum, average and total spectrum power and amplitude for each derivation;
 - dominating and average spectrum frequency for each derivation;
 - maximum, average and total spectrum power and amplitude for each standard frequency range (EEG-rhythm) in each derivation;
 - dominating and average spectrum frequency for each standard frequency range (EEG-rhythm) in each derivation;
 - rhythm index for each standard frequency range (EEG-rhythm) in each derivation; it is calculated as a quotient of the total spectrum power within the frequency range of the derivation and the total spectrum power of the derivation.
4. The parameters calculated during the periodometrical analysis are:
 - for each derivation: waves amplitude distribution in amplitude ranges ($0\text{-}10 \mu\text{V}$, $10\text{-}20 \mu\text{V}$, $20\text{-}30 \mu\text{V}$, ... $90\text{-}100 \mu\text{V}$, more than $100 \mu\text{V}$);
 - for each derivation: waves frequency distribution in frequency ranges ($0\text{-}1 \text{ Hz}$, $1\text{-}2 \text{ Hz}$, $2\text{-}3 \text{ Hz}$, ... $19\text{-}20 \text{ Hz}$);
 - for each standard frequency range (EEG-rhythm) in each derivation: wave amplitude distribution in amplitude ranges and waves frequency distribution in frequency ranges;
 - for each standard frequency range (EEG-rhythm) in each derivation: rhythm index (percentage of the waves with amplitude exceeding the limit), average rhythm amplitude and frequency.

5. The parameters calculated during correlation analysis are:
 - autocorrelation functions for each derivation;
 - the average frequency of an autocorrelation function, the interval to the first concurrence of the autocorrelation function and the zero axis, the autocorrelation coefficient;
 - cross-correlation functions for selected derivation pairs;
 - average frequency, cross-correlation coefficient, lag values for each selected pair.
6. The parameters calculated during coherent analysis are:
 - coherence functions for selected derivation pairs;
 - maximum, average and total coherence as well as dominating and average coherence spectrum frequency for each derivation pair;
 - maximum, average and total coherence, dominating and average coherence spectrum frequency, index for each frequency range (EEG-rhythm) in each derivation pair.

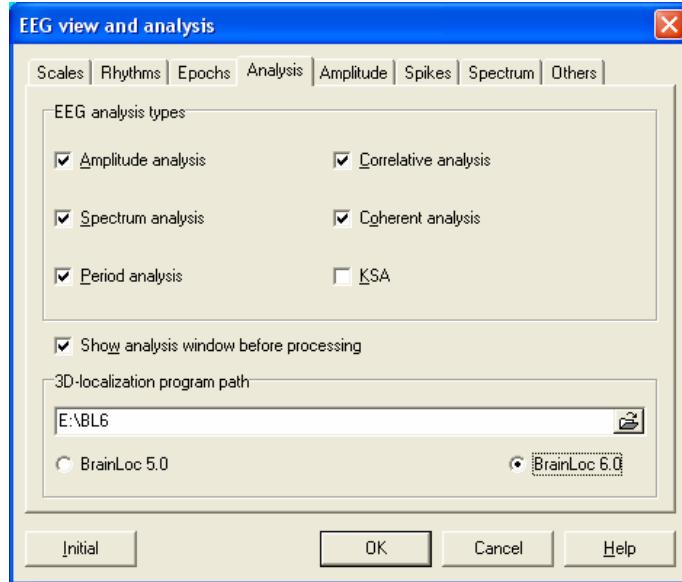
11.4. MATHEMATICAL EEG ANALYSIS IMPLEMENTATION

1. After you have positioned the epoch markers, start mathematical EEG analysis using the **Analysis** menu commands (Pic. 11.20).



Pic. 11.20

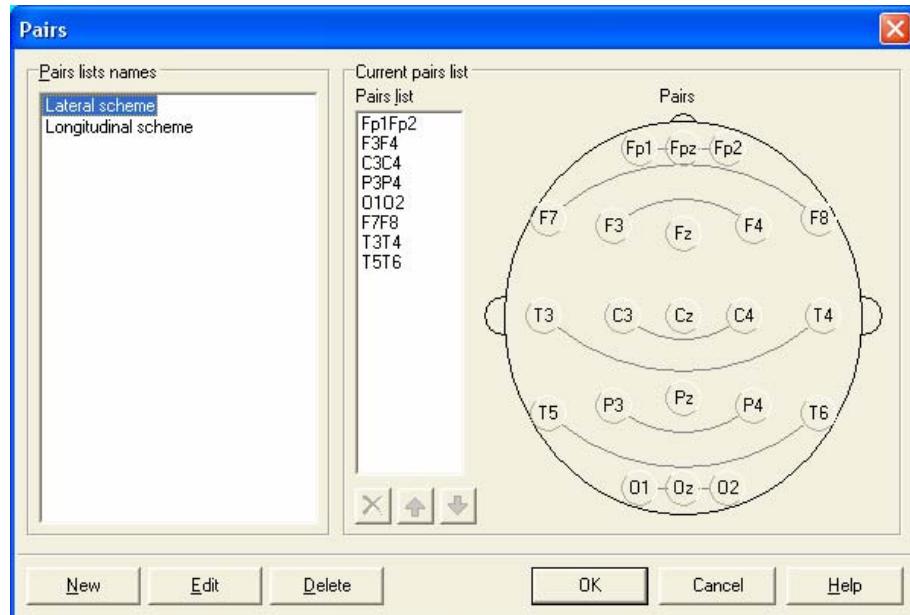
2. To perform all the types of analysis at the same time, use the **Analysis|Epoch analysis** command, the  button on the toolbar or the **[Ctrl+A]** key combination. If the “*Show analysis types before processing*” check box on the **Analysis** page in the **EEG view and analysis** dialog box is set up, the dialog box will appear on the screen every time before you start the (Pic. 11.21).



Pic. 11.21

Set the required analysis types flags and click “*OK*” or press **[Enter]**.

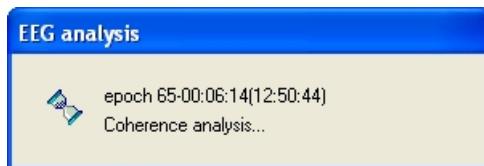
3. If the *Correlation* or *Coherent* analysis has been selected, there will appear a dialog panel where you can select the pairs for the cross-correlation and coherence functions calculations (Pic. 11.22).



Pic. 11.22

Select the required pair list or generate the new one, choose it and click “*OK*” button.

4. To perform single types of EEG analysis, select one of the **Analysis|Amplitudes...Analysis|Coherence** menu commands. The program will perform the selected EEG analysis method only.



Pic. 11. 23

5. If you select the **Analysis|Report creation** menu command, click the button on the toolbar or press the [Ctrl+P] key combination, the program will perform only the types of analysis that are necessary for automatic creation of an EEG description and will automatically form a new report with this EEG description.

11.5. THREE-DIMENSIONAL LOCALIZATION OF PATHOLOGIC ACTIVITY SOURCES

1. If the **BrainLoc** software of pathologic activity sources localization is installed on your computer, you can carry out localization procedures using the **Neuron-Spectrum** EEG records.

2. To connect the **BrainLoc** software, specify the path to the 3-D localization software folder in the **EEG view and analysis** dialog box (the **Setup|Analysis** menu command) on the **Analysis** page (Pic. 11.21). For that click the button in the *3D-localization program path* edit line and select the **BrainLoc** folder. Select the **BrainLoc** software version you use – *BrainLoc 5.0* or *BrainLoc 6.0*.

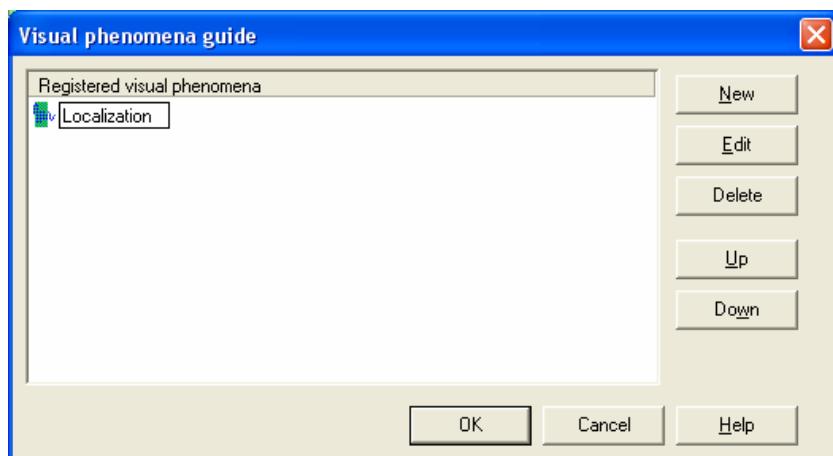
3. To perform three-dimensional localization, select a fragment of the EEG record. To start the **BrainLoc** program and transfer the selected fragment into it, use the **Fragment|Localization** menu command or select the **Localization** command in the fragment properties menu. The **BrainLoc** program will be started using the selected fragment as input data. If you select **Fragment|Localization (singledipole)** of fragment properties menu **Localization (singledipole)**, **BrainLoc** software starts and the single dipole localization in selected fragment will be performed.

4. If you want to analyze several EEG fragments simultaneously, do the following for each fragment:

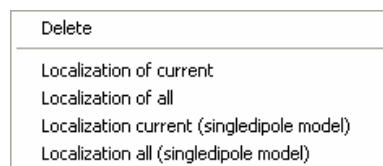
- Position the interesting you EEG fragment so that it can be found within the screen.
- Select it as an EEG fragment.
- Define the selected fragment as a visual phenomenon with a name (for example, “*BrainLoc localization*”). For that use the **Fragment|Define** menu command. If the fragment with this name is not determined, use the **Fragment|Define|Guide** menu item. In the **Visual phenomena guide** dialog panel appeared (Pic. 11.24) create a new visual phenomenon (for example, “*BrainLoc localization*”) using the “*New*” button and click “*OK*” or press **[Enter]**. Then select the phenomenon (the **Frag-**

ment|Define menu command). So you will define the selected EEG fragment as a visual phenomenon with the name “*BrainLoc localization*”.

- Carry out the actions enumerated above with other EEG fragments that you want to be localized.
- Select the **Localization of all** command using the visual phenomenon properties menu (Pic. 11.25), and all the fragments of the same name will be transferred to the **BrainLoc** software.



Pic. 11.24



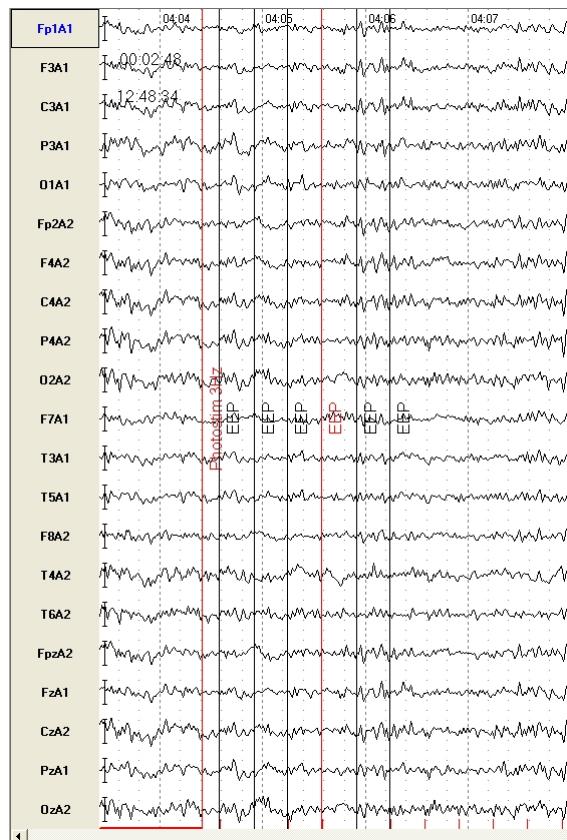
Pic. 11.25

5. After the localization is finished and you have exited the **BrainLoc** software you will return to the **Neuron-Spectrum**.

11.6. AVERAGING OF EEG FRAGMENTS CONNECTED WITH THE EVENTS (EVENT RELATED POTENTIALS)

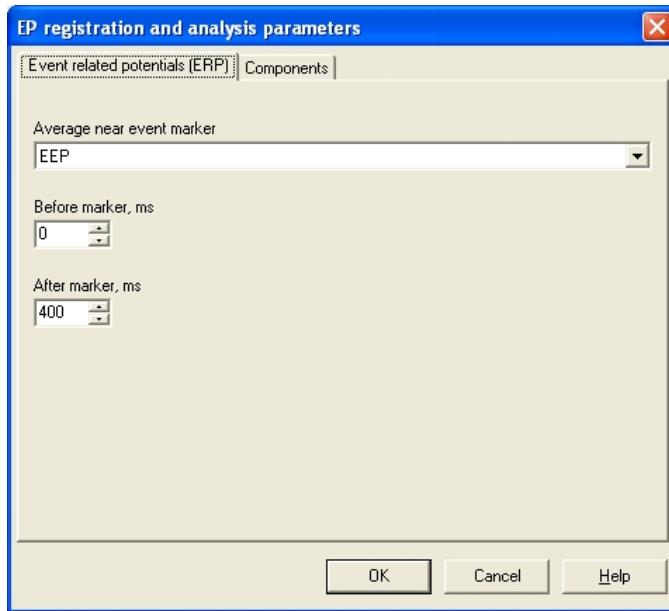
1. **Neuron-Spectrum** software (the **Neuron-Spectrum-LEP** additional software module should be available) allows averaging of EEG fragments connected with some events, i.e. the registration of the event related EP. To obtain the event related potential it is necessary to perform the following actions during EEG review and analysis:

- Set the event markers of the same type on all the events selected in the record. The averaging should be done relative to these record events. Such event can be the presence of the definite pattern on the selected record channel or the moment of the stimulus transfer of the definite nonstandard modality (for example, the magnetic pulse generated by the magnetic stimulator). For example, the Pic. 11.26 shows several event markers with EEP name set at the moments of the the photic stimulator stimulus.



Pic. 11.26

- After the setting of all the markers perform **Analysis|Averaging** menu command. The **EP registration and analysis parameters** (Pic. 11.27) dialog box will appear on the *Event related potentials (ERP)* page on the screen.

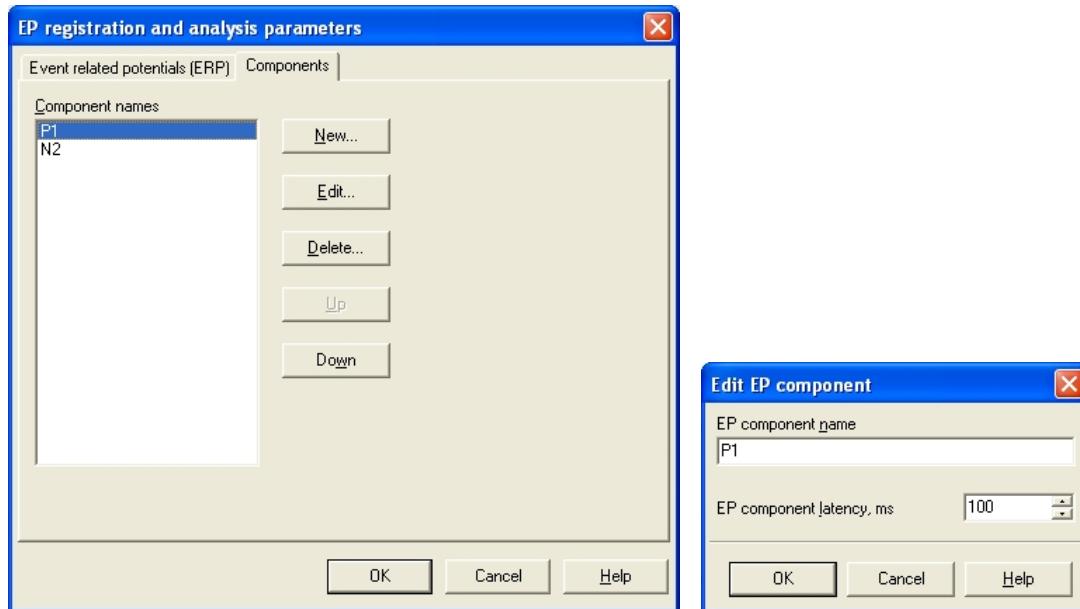


Pic. 11.27

- Choose the marker relative to which the averaging should be done in the *Average near event marker* list. In *Before marker* (the EEG fragment duration before the marker) and *After marker* (EEG fragment duration after the marker) edit lines, one can specify the time intervals. The averaging of EEG interval is performed within these time intervals.

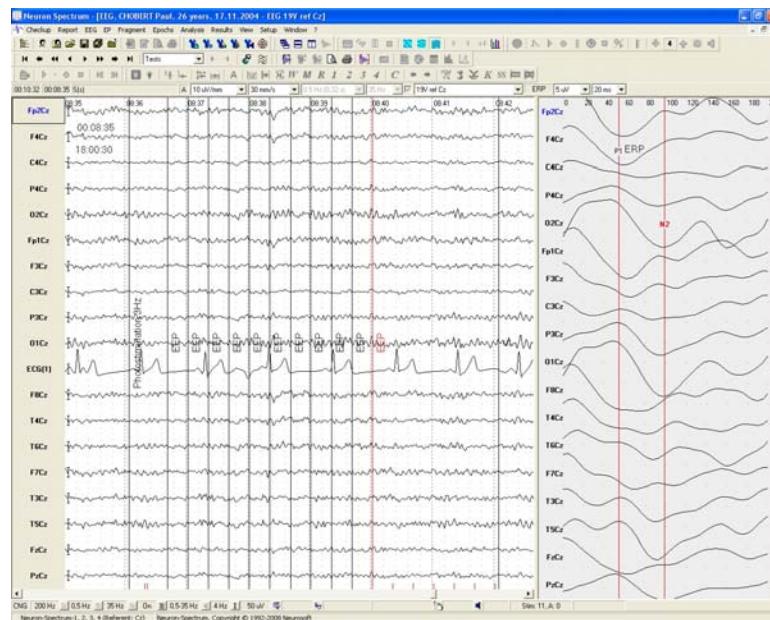
Neuron-Spectrum Program

- If after the averaging it is necessary to set the component markers on the got evoked potentials, make a list of components on the *Components* page (Pic. 11.28). To do this, use the “*New*” button and **Edit EP component** dialog box (Pic. 11.28).



Pic. 11.28

- To perform the averaging and getting of event related EP, press “*OK*” button. The dialog box with the event related potentials which are the result of the specified EEG fragments averaging relative to the set event markers (Pic. 11.29) will appear on the screen.



Pic. 11.29

2. The operation with the evoked potentials is described in details in the chapter devoted to the evoked potentials registration and analysis.

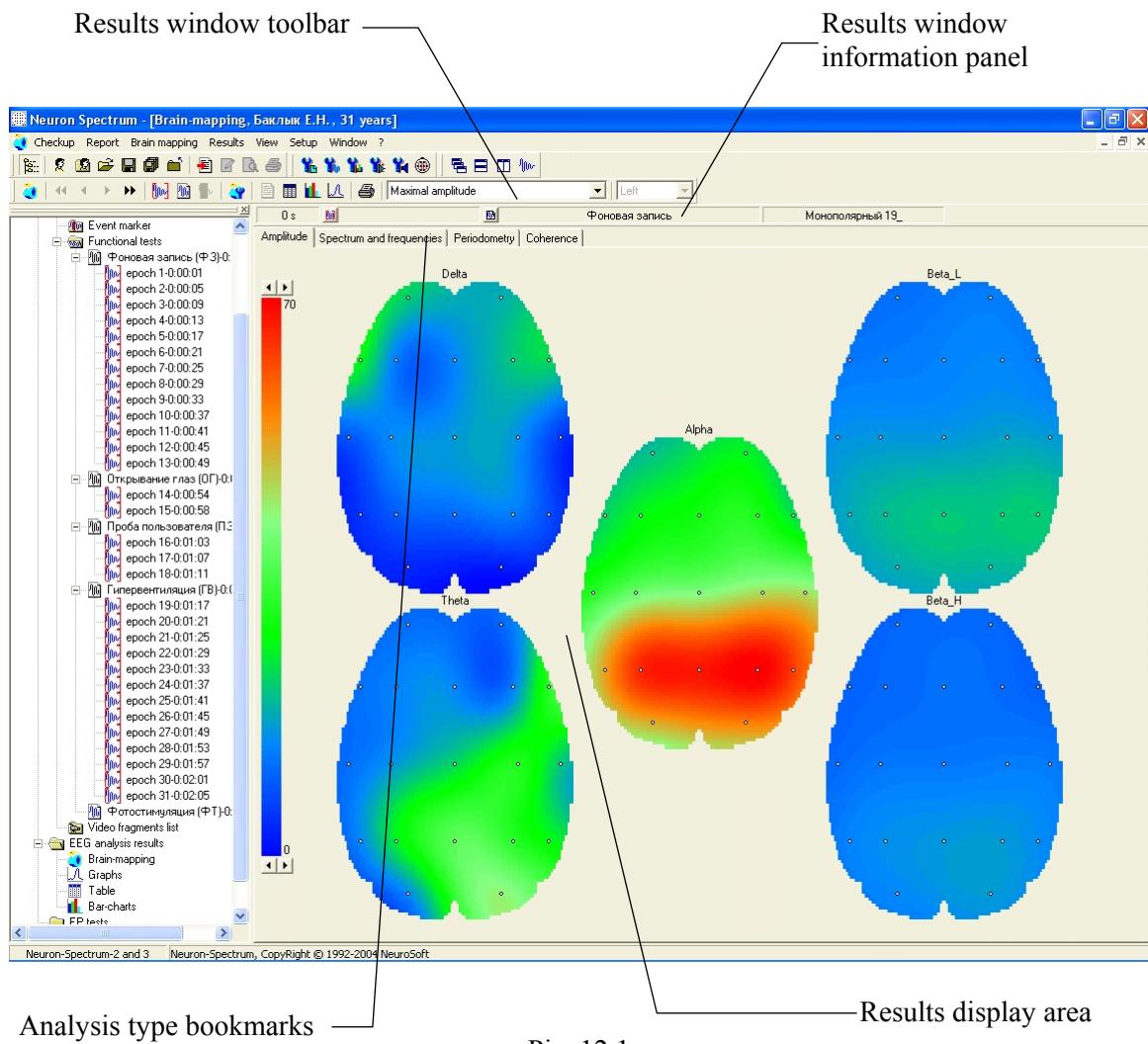
CHAPTER 12

PRESENTING AND VIEWING OF ANALYSIS RESULTS

1. The **Neuron-Spectrum** software presents the results of EEG analysis in tables, topographic maps, bar charts and graphs.

Tables, mapping, bar charts and graphs are displayed in results windows. Below you will find general information and general rules of working with analysis results windows.

2. Analysis results windows can be displayed only after EEG mathematical analysis is finished. Select **Results|Brain mapping**, **Results|Tables**, **Results|Bar charts**, **Results|Graphs**, click the corresponding buttons on the *Results* toolbar () or press the **[Alt+M]**, **[Alt+T]**, **[Alt+H]**, **[Alt+G]** key combinations. A results window will appear on the screen (Pic. 12.1).



Pic. 12.1

3. Each result window consists of:

- Analysis results display area that contains tables, topographic maps, bar charts and graphs.
- Bookmarks with the analysis results of the performed types.
- The toolbar and the analysis results window menu.
- The window *Information panel* that contains information about the analysis results displayed (the results of epoch analysis, functional test analysis, all epochs or all tests analysis, EEG montage).

4. Depending upon the types of analysis performed the bookmarks appear in the results windows. For example, the mapping window (Pic. 12.1) includes the **Amplitude, Spectrum and frequencies, Periodometry, Coherence** bookmarks. It means that the following types of analysis were performed:

- amplitude analysis;
- spectral and frequency analysis;
- periodometrical analysis;
- coherence analysis.

Each bookmark displays the results of the analysis type.

5. The window can display the results of analysis using different modes. The modes are:

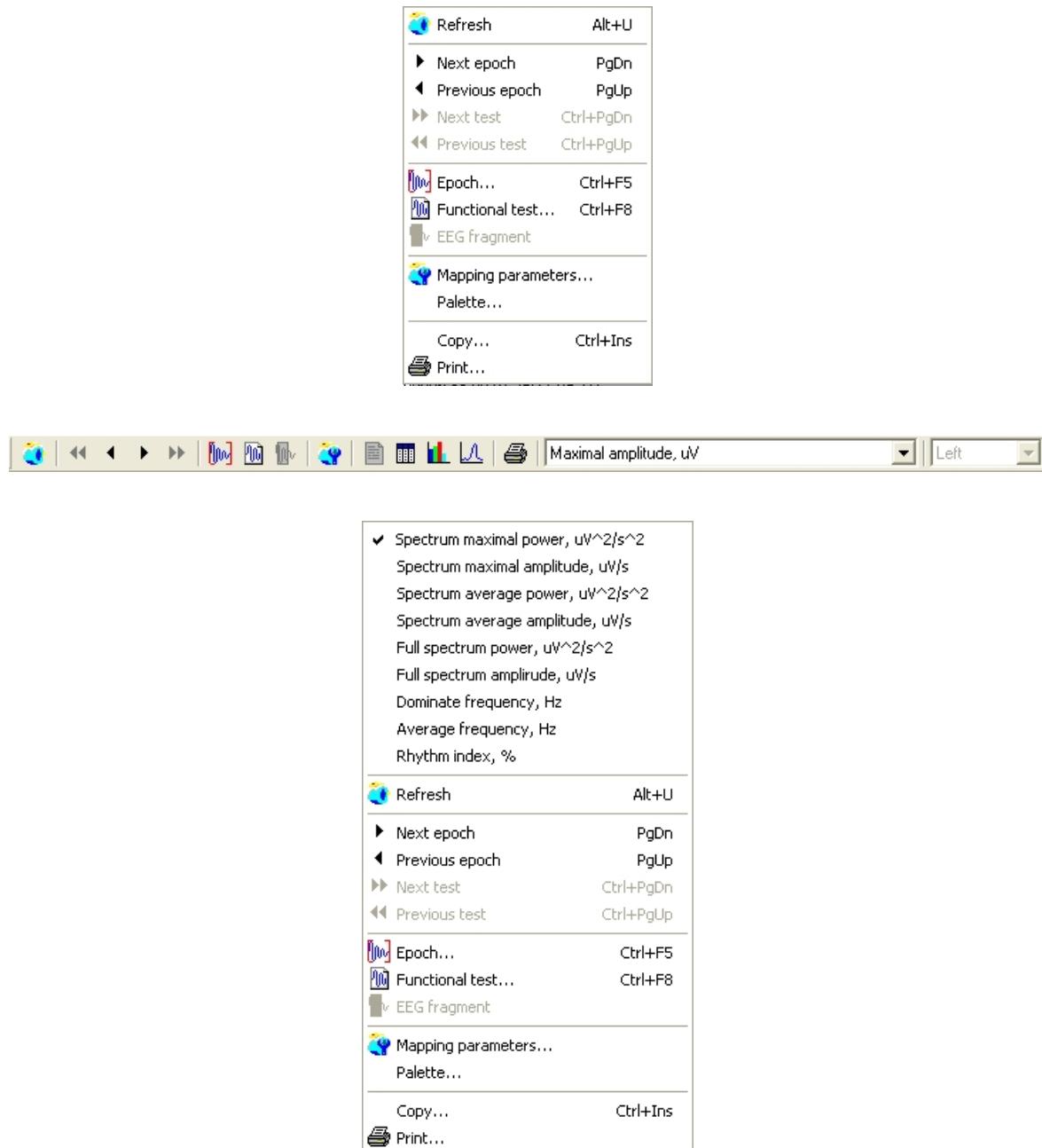
- the displaying of single epochs analysis results;
- the displaying of single functional tests analysis results;
- the displaying of all epochs analysis results;
- the displaying of all functional tests analysis results;
- the displaying of EEG fragment analysis results.

Besides the mode, each window has displaying parameters. They can be set in the **View EEG analysis results** dialog box of the **Setup** main menu. You may also use the commands of parameters settings in the analysis results window.

6. The window has its own menu named according to the information it contains. The tables window has the **Tables** menu, the mapping window has the **Brain mapping** menu, the bar charts window has the **Bar charts** menu, the **Graphs** menu is in the graphs window. The window has its own toolbar as well. The toolbar duplicates the most frequently used commands and includes the combo-box of analysis parameters displayed. For example, analyzing amplitude you may display maximum and average amplitudes (both in derivations and in single frequency ranges) on topographic maps. Also each window have properties menu.

Chapter 12. PRESENTING AND VIEWING OF ANALYSIS RESULTS

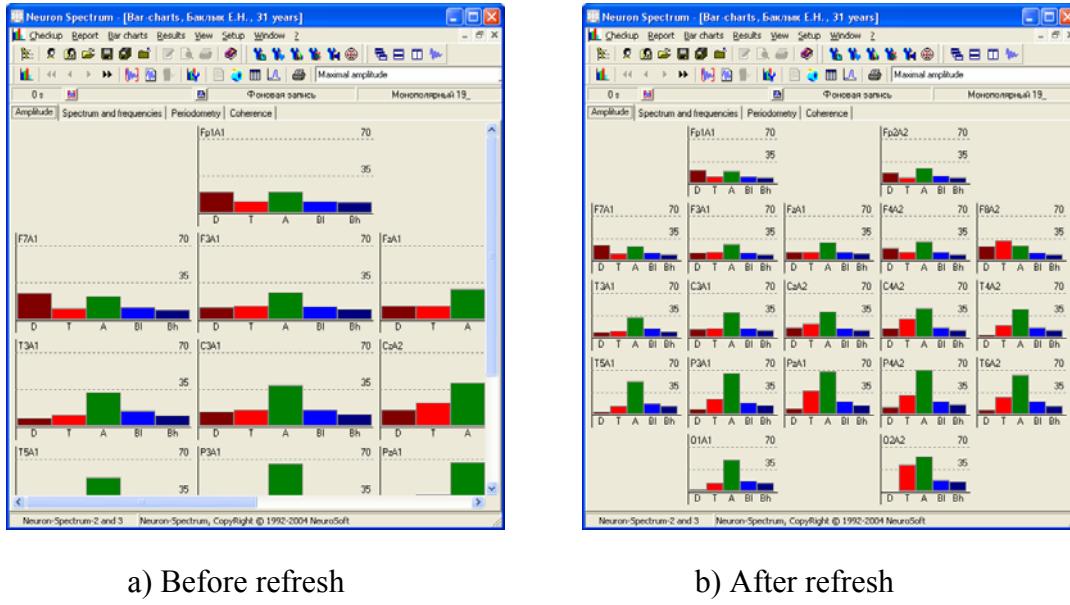
There are menu commands that are typical for all the analysis results windows. Below you will find the analysis results window menu and toolbar. The mapping window is set as an example (Pic. 12.2).



Pic. 12.2

7. With the help of upper part of the menu commands you can select the analysis parameter for showing. (for example maximal, average or full power and so on).

8. The **Refresh** command or the window show button (the [Alt+U] key combination) are used to update the analysis results (mapping, bar charts, graphs) windows after you have changed the screen size (Pic. 12.3a, b).



a) Before refresh

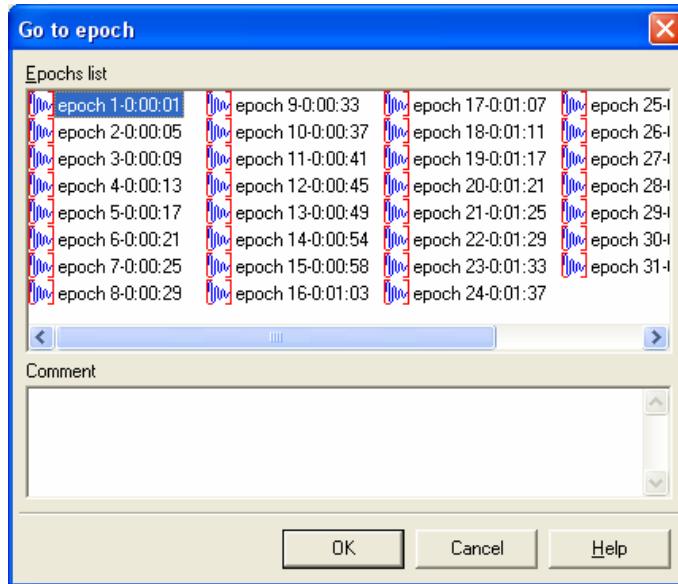
b) After refresh

Pic. 12.3

9. The **Next Epoch** (➡, [PgDn]) and **Previous Epoch** (⬅, [PgUp]) navigation commands display the analysis results of the next and previous epoch in the epoch's analysis results displaying mode.

The **Next Test** (➡, [Ctrl+PgDn]) and **Previous Test** (⬅, [Ctrl+PgUp]) navigation commands display the analysis results of the next and previous functional tests in the functional tests analysis results displaying mode. After the software has performed the above-mentioned commands, it automatically returns to the first epoch of the selected functional test. All the navigation commands can change a current epoch or functional test that memories in every results window.

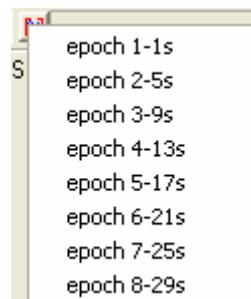
10. The **Epoch** ( [Ctrl+F6]) menu command enables you to select an epoch in the epochs or functional tests analysis results modes. When you select the command the **Go to epoch** dialog box will appear on the screen (Pic. 12.4).



Pic. 12.4

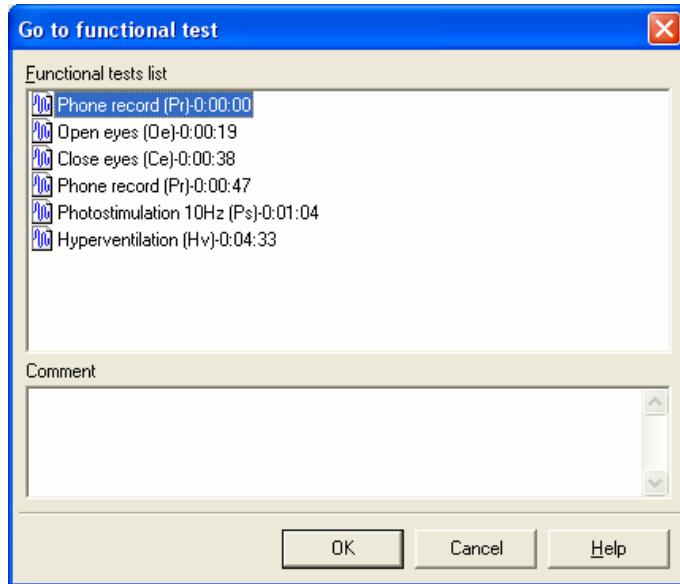
The current analysis epoch is highlighted. Select an epoch to display the analysis results, click “**OK**” or press **[Enter]**. If the window works in the functional tests analysis results displaying mode, it will be automatically changed over to the epochs analysis results displaying mode.

To the momentary transition into the epoch analysis results display mode and the epoch selection, press the  button and select the epoch from the list (Pic. 12.5). The window will be in epoch’s results display mode. To get the same result, you can double click the mouse on analysis epoch in *Checkups inspector*.



Pic. 12.5

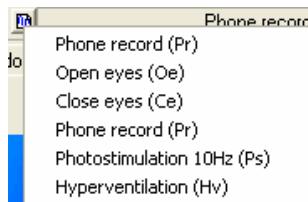
11. The **Functional test** (, [Ctrl+F8]) command enables you to select a functional test in the **Go to functional test** dialog box (Pic. 12.6).



Pic. 12.6

The current functional test is highlighted. Select a test to display the analysis results, click “*OK*” or press [Enter]. If the window works in the epoch’s analysis results displaying mode, it will be automatically changed over to the functional tests analysis results displaying mode.

To the momentary transition into the functional test analysis results display mode and the test selection, press the  button and select the test from the list (Pic. 12.8). The window will be in functional tests analysis results display mode. To get the same result, you can double click the mouse on functional test in *Checkups inspector*.



Pic. 12.7

12. The **EEG fragment** () command enables you to change the window over to the EEG fragment analysis results displaying mode. The window can be changed over only if it the fragment exists and have been analyzed. Otherwise, the menu command is not active. The mode of EEG fragment analysis results displaying is similar to that of epochs analysis results displaying.

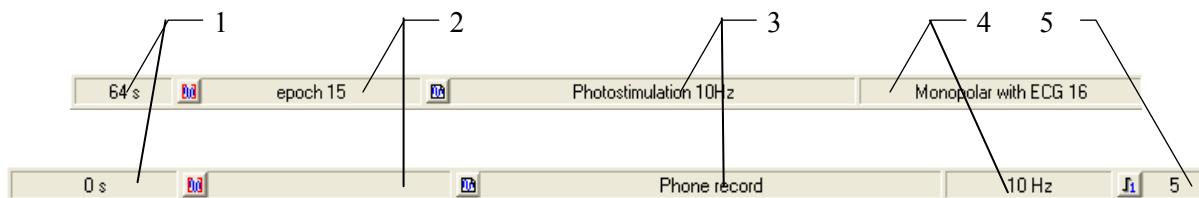
13. You can change the results displaying parameters using the ... **parameters** ... command. It is duplicated by a button with a “spanner” on the toolbar (, , , ). The command displays the corresponding page of the **View EEG analysis results** dialog box.

14. If the results can be displayed in both sides of the window, use the combo-box on the toolbar to set the side where all the navigation operations will be performed (Pic. 12.8). Clicking on the side by the left mouse button can also set the current side. The title of the current window half is highlighted.



Pic. 12.8

15. The results displaying window contains the *Information panel* (Pic. 12.9).

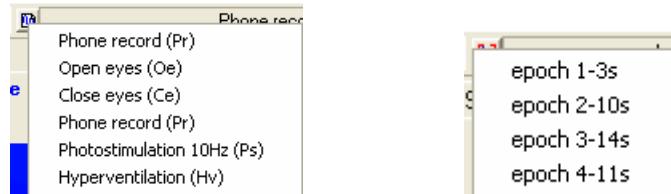


Pic. 12.9

The information panel displays:

- (1) – the start time of the analysis epoch, EEG fragment, functional test, or the start time of two analysis epochs, two functional tests if both window sides display the results (in the epochs, functional tests and fragment analysis results displaying modes only);
- (2) – the name of the analysis epoch, or two analysis epochs if both window sides display the results (in the epochs analysis results displaying modes only);
- (3) – the name of the functional test or the test containing the analysis epochs or EEG fragment (in the epochs, functional tests and fragment analysis results displaying modes only). In the other displaying modes the names of the modes are used (for example, “*Functional tests mapping*”). In the windows with two-sides displaying the information panels contain the names of the functional tests of both sides (functional tests results displaying mode) or the tests with the analysis epochs of both sides (epochs analysis displaying mode);
- (4) – the current EEG montage or the abscissa of instantaneous value markers (if the graphs of analysis results are being displayed);
- (5) – the scale of display (if the graphs of analysis results are being displayed).

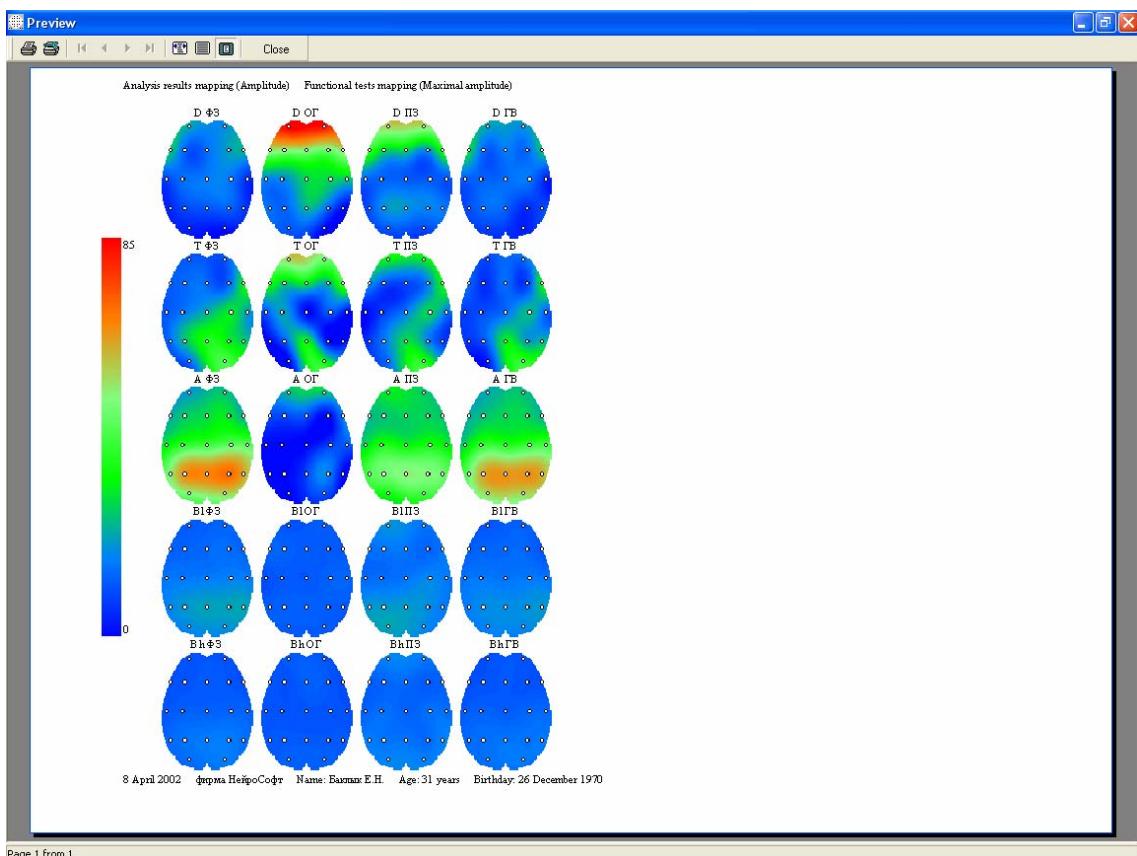
16. The and buttons on the information panel can be used to select an analysis epoch or a functional test for displaying the results. If you click the button, the list of epochs and functional tests analyzed will appear on the screen. (Pic. 12.10). If you choose the one you need, the window will be changed over to the corresponding mode and display it. To get the same result, you can double click the mouse on functional test in *Checkups inspector*.



Pic. 12.10

17. Use the **Copy** command to copy the data of the results window into the clipboard, report or to the printer. The more detailed description of the copying will be given below.

18. The displaying results can be printed. Use the **Print** menu command or the button on the toolbar. The preview window will be displayed (Pic. 12.11). To print it you should press the button.



Pic. 12.11

12.1. TABLES OF ANALYSIS RESULTS

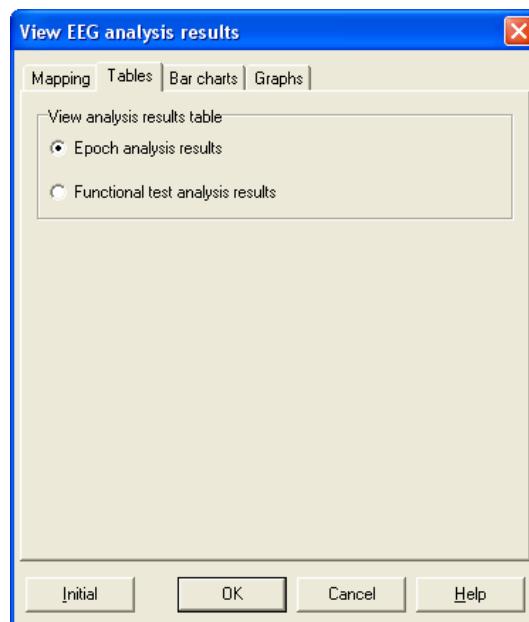
1. The window with the analysis results tables (Pic. 12.12) appears on the screen after selecting the **Results|Tables** ([Alt+T]) command in the EEG review and analysis window or in any window of EEG analysis results viewing.

The screenshot shows a software interface titled 'Neuron Spectrum - [Table, Бакылк Е.Н., 31 years]'. The menu bar includes 'Checkup', 'Report', 'Tables', 'Results', 'View', 'Setup', 'Window', and '?'. The toolbar has various icons for file operations. The main window displays a table of EEG analysis results for 'epoch 1' under 'Фоновая запись' (Background recording). The table has 14 columns: Drv, A max, A aver, A m(D), A av(D), A m(T), A av(T), A m(A), A av(A), A m(B), A av(B), A m(Bh), A av(Bh). The rows list electrode names (Fp1A1, Fp2A2, F3A1, F4A2, FzA1, C3A1, C4A2, CzA2, P3A1, P4A2, PzA1, O1A1, O2A2, F7A1, F8A2, T3A1, T4A2, T5A1, T6A2) and their corresponding amplitude values. A legend at the bottom indicates 'A - amplitude, uV'.

Drv.	A max	A aver	A m(D)	A av(D)	A m(T)	A av(T)	A m(A)	A av(A)	A m(B)	A av(B)	A m(Bh)	A av(Bh)
Fp1A1	23	12	0	0	0	0	0	0	12	4	7	3
Fp2A2	40	14	0	0	24	10	19	10	14	5	9	4
F3A1	29	14	0	0	21	10	17	9	15	5	8	4
F4A2	40	16	0	0	20	11	23	10	17	6	11	4
FzA1	33	14	0	0	20	11	19	9	16	6	9	4
C3A1	46	19	0	0	0	0	30	14	16	7	11	5
C4A2	46	20	0	0	24	13	39	17	18	7	13	5
CzA2	52	20	0	0	0	0	31	14	17	7	13	5
P3A1	83	35	0	0	0	0	75	32	20	9	17	6
P4A2	90	37	0	0	21	10	81	36	23	9	20	7
PzA1	90	36	0	0	27	15	73	32	20	9	19	6
O1A1	73	32	0	0	0	0	64	30	26	9	14	6
O2A2	90	40	0	0	36	24	63	32	24	10	18	7
F7A1	35	14	0	0	0	0	0	0	12	4	8	4
F8A2	40	23	29	14	27	18	16	9	14	6	10	4
T3A1	47	17	0	0	0	0	33	13	13	5	10	5
T4A2	55	20	0	0	0	0	45	16	17	7	13	5
T5A1	78	32	0	0	0	0	67	29	21	8	14	6
T6A2	84	38	0	0	0	0	70	34	20	9	17	6

Pic. 12.12

2. The **Tables|Setup** command and button on the toolbar display the dialog box of tables view parameters setup (Pic. 12.13).



Pic. 12.13

Neuron-Spectrum Program

The window of analysis results tables viewing can work either in epochs analysis results mode or in functional tests results mode. To select a mode, use the *View analysis results table* radio-buttons. You may also choose the epoch or functional test in the window (**Tables|Epoch**, **Tables|Functional test** commands; the  and  buttons on the toolbar, the key combinations or the  and  buttons on the *Information panel*).

To view the results of EEG fragment analysis, use the **Tables|EEG fragment** command or the  button on the toolbar.

3. If amplitude analysis has been carried out, the **Amplitude** page will contain the table of calculations results for every derivation (Pic. 12.14).

Drv.	A max	A aver	A m(D)	A av(D)	A m(T)	A av(T)	A m(A)	A av(A)	A m(BI)	A av(BI)	A m(Bh)	A av(Bh)
Fp1A1	23	12	0	0	0	0	0	0	12	4	7	3
Fp2A2	40	14	0	0	24	10	19	10	14	5	9	4
F3A1	29	14	0	0	21	10	17	9	15	5	8	4
F4A2	40	16	0	0	20	11	23	10	17	6	11	4
FzA1	33	14	0	0	20	11	19	9	16	6	9	4
C3A1	46	19	0	0	0	0	30	14	16	7	11	5
C4A2	46	20	0	0	24	13	39	17	18	7	13	5
CzA2	52	20	0	0	0	0	31	14	17	7	13	5
P3A1	83	35	0	0	0	0	75	32	20	9	17	6
P4A2	90	37	0	0	21	10	81	36	23	9	20	7
PzA1	90	36	0	0	27	15	73	32	20	9	19	6
O1A1	73	32	0	0	0	0	64	30	26	9	14	6
O2A2	90	40	0	0	36	24	63	32	24	10	18	7
F7A1	35	14	0	0	0	0	0	0	12	4	8	4
F8A2	40	23	29	14	27	18	16	9	14	6	10	4
T3A1	47	17	0	0	0	0	33	13	13	5	10	5
T4A2	55	20	0	0	0	0	45	16	17	7	13	5
T5A1	78	32	0	0	0	0	67	29	21	8	14	6
T6A2	84	38	0	0	0	0	70	34	20	9	17	6

Pic. 12.14

The following abbreviations are used in the table:

- Amax – maximal derivation amplitude;
- Aaver – average derivation amplitude;
- Am(D) – maximal derivation delta-rhythm amplitude;
- Aav(D) – average derivation delta-rhythm amplitude;
- Am(T) – maximal derivation theta-rhythm amplitude;
- Aav(T) – average derivation theta-rhythm amplitude;
- Am(A) – maximal derivation alpha-rhythm amplitude;
- Aav(A) – average derivation alpha-rhythm amplitude;
- Am(BI) – maximal amplitude of the derivation low-frequency beta-rhythm;
- Aav(BI) – average amplitude of the derivation low-frequency beta-rhythm;
- Am(Bh) – maximal amplitude of the derivation high-frequency beta-rhythm;
- Aav(Bh) – average amplitude of the derivation high -frequency beta-rhythm.

Program has minimal rhythm boundary amplitudes preset. If rhythm amplitude does not exceed the limit, its value is displayed in the table as equal to zero. Here are boundary amplitudes:

- delta-rhythm – 20 μ V;
- theta –rhythm – 20 μ V;
- alpha-rhythm – 15 μ V;
- beta-rhythm – 5 μ V.

Minimal amplitude is indicated in analysis setup (**EEG view and analysis** dialog box, **Amplitude** page, **Setup|Analysis** command *EEG minimal amplitude* edit line) and the system of amplitude analysis is distinguished it. If the amplitude between two adjacent curves peaks is less than the indicated one, it should not take into account and considered as zero.

4. If spectral and frequency analysis has been carried out, the **Spectrum and frequencies** page contains the table of spectrum and frequency analysis results in derivations (**Derivation** page (Pic. 12.15)), frequency ranges – EEG rhythms (**Delta,...Beta_H** pages (Pic. 12.16)), and frequency bands (**Band** page (Pic. 12.17)).

Drv.	A max	S max	A aver	S aver	A full	S full	F domin	F aver
Fp1A1	2.2	4.9	0.42	0.35	59	49	5	7
Fp2A2	2.6	6.9	0.56	0.56	78	79	5	7
F3A1	2.3	5.3	0.52	0.53	73	75	5	7
F4A2	2.9	8.3	0.63	0.72	88	100	2.5	7.3
FzA1	2.5	6.5	0.55	0.57	77	80	2.5	7
C3A1	4.2	17	0.67	0.96	93	135	10.5	10.3
C4A2	5.1	25	0.78	1.3	110	183	10.5	10
CzA2	3.9	15	0.75	1.1	105	149	11	10
P3A1	11	135	0.98	3.2	137	445	10.5	10.5
P4A2	13	173	1.0	3.8	147	535	10.5	10.5
PzA1	11	122	1.0	3.5	147	494	10.5	10.5
O1A1	11	127	0.91	2.7	127	376	10.5	10.5
O2A2	11	140	1.1	3.9	158	554	10.5	10.3
F7A1	3.6	13	0.54	0.64	75	90	2.5	4
F8A2	5.9	35	0.69	1.2	97	168	6.3	6.3
T3A1	3.6	12	0.59	0.77	83	107	10.5	10
T4A2	5.7	32	0.73	1.1	103	158	10.5	10.5
T5A1	10	113	0.89	2.5	126	353	10.5	10.5
T6A2	13	187	0.93	3.2	130	447	10.5	10.5

Pic. 12.15

Drv.	A max	S max	A aver	S aver	A full	S full	F domin	F aver	Index
Fp1A1	1.9	3.8	0.65	0.61	13	12	10.3	10.3	26
Fp2A2	1.7	3.0	0.88	1.0	18	21	10.3	10.3	27
F3A1	1.8	3.4	0.83	0.88	17	18	8	10	25
F4A2	2.6	6.7	0.98	1.3	20	26	8	9.8	27
FzA1	2.0	3.9	0.86	0.91	18	19	8	9.8	24
C3A1	4.2	17	1.3	2.8	28	59	10.5	10.5	44
C4A2	5.1	25	1.6	3.9	33	81	10.5	10.5	45
CzA2	3.9	15	1.4	3.0	30	63	11	10.5	43
P3A1	11	135	2.7	16	57	346	10.5	10.5	78
P4A2	13	173	2.9	20	61	424	10.5	10.5	79
PzA1	11	122	2.7	16	57	346	10.5	10.5	70
O1A1	11	127	2.4	13	51	292	10.5	10.5	78
O2A2	11	140	2.7	15	57	325	10.5	10.5	59
F7A1	1.3	1.7	0.75	0.67	15	14	9.8	10.3	15
F8A2	1.8	3.2	0.81	0.87	17	18	8	9.8	11
T3A1	3.6	12	1.3	2.4	26	50	10.5	10.5	46
T4A2	5.7	32	1.5	4.0	32	83	10.5	10.5	53
T5A1	10	113	2.5	12	52	270	10.5	10.5	77
T6A2	13	187	2.7	17	56	362	10.5	10.5	81

Pic. 12.16

Drv.	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20
Fp1A1	1.4	4.7	0.58	4.9	4.9	2.8	2.8	1.6	1.0	3.8	1.8	0.45	0.17	0.24	0.77	0.62	0.62	0.66	1.1
Fp2A2	2.4	5.4	0.92	6.9	6.9	3.6	2.9	2.9	2.7	3.0	1.9	1.6	1.1	1.7	0.81	0.72	0.24	0.38	0.50
F3A1	1.3	5.0	3.2	5.3	5.3	3.7	3.7	3.4	2.0	1.9	2.1	0.55	0.26	0.33	0.58	1.0	1.0	0.55	2.0
F4A2	2.0	8.3	1.4	5.0	5.0	3.7	6.7	6.7	2.6	3.1	3.1	1.7	1.5	1.4	1.1	1.0	0.47	0.54	1.1
FzA1	1.3	6.5	2.9	4.4	4.4	4.4	4.4	3.9	2.1	2.0	1.9	0.72	0.28	0.49	0.69	1.6	1.6	0.73	2.4
C3A1	2.3	5.4	6.4	3.5	4.0	3.8	3.8	2.9	4.7	17	10	1.2	0.39	0.71	0.84	1.4	2.3	1.4	2.2
C4A2	4.6	4.8	2.7	3.5	3.8	23	5.9	5.9	7.3	25	11	0.91	1.4	1.2	1.2	0.79	0.73	1.6	2.5
CzA2	3.1	6.2	5.1	4.4	4.4	4.9	4.9	4.8	6.2	15	15	0.98	1.7	1.3	1.3	1.3	0.87	1.1	2.3
P3A1	4.3	8.0	8.0	3.9	3.9	2.0	2.0	1.3	22	135	37	2.3	1.6	2.3	2.3	0	3.1	2.8	1.9
P4A2	4.8	5.0	5.7	3.9	3.5	2.6	2.7	1.5	30	173	48	23	2.3	2.7	2.7	1.7	2.1	3.7	3.7
PzA1	5.0	8.0	8.0	4.9	4.1	33	5.2	1.7	30	122	40	1.5	1.5	1.7	1.7	1.8	3.1	2.5	2.5
O1A1	3.1	4.0	5.2	2.0	2.0	2.0	0.61	1.5	18	127	24	1.9	1.9	4.8	4.8	2.4	1.3	3.7	0.60
O2A2	5.2	3.8	3.1	2.6	6.3	92	3.3	2.0	27	140	39	3.2	3.2	3.8	5.2	3.6	0	3.1	1.6
F7A1	1.5	13	4.3	4.5	2.8	2.4	2.2	1.0	1.7	1.2	1.5	0.56	0.30	0.22	0.65	0.49	0.49	0.56	1.2
F8A2	2.6	19	3.5	5.0	5.0	35	7.6	3.2	2.2	1.8	0.99	1.7	1.4	1.5	1.3	0.96	0.40	0.35	0.87
T3A1	2.9	5.1	4.8	3.0	3.0	3.5	3.5	3.0	6.0	12	7.8	1.6	0.48	0.69	0.69	0.61	1.5	0.76	1.1
T4A2	4.5	3.2	3.9	2.3	2.6	4.3	3.6	3.6	12	32	5.7	1.5	1.0	1.4	1.4	0.94	0.60	1.9	2.3
T5A1	3.9	6.6	6.6	3.3	3.3	1.6	2.8	2.8	11	113	22	2.8	1.5	2.3	2.3	0	1.7	2.3	1.6
T6A2	4.9	4.4	4.4	2.1	2.4	3.2	2.0	3.2	24	187	44	2.7	2.7	1.9	1.9	1.7	1.2	5.8	5.8

Pic. 12.17

Neuron-Spectrum Program

The table of derivations analysis results (Pic. 12.15) contains the following abbreviations:

- Amax – the maximal spectrum amplitude of the derivation;
- Smax – the maximal spectrum power of the derivation;
- Aaver – the average spectrum amplitude of the derivation;
- Saver – the average spectrum power of the derivation;
- Afull –the total spectrum amplitude of the derivation;
- Sfull – the total spectrum power of the derivation;
- Fdomin –the dominating spectrum frequency of the derivation;
- Faver – the average spectrum frequency of the derivation.

In the table of frequency bands (EEG-rhythms) analysis (Pic. 12.16) the same abbreviations are used. Besides, the program calculates a rhythm index for each EEG-rhythm in every derivation. The results are displayed in the *Index* column.

In the table of frequency bands analysis (Pic. 12.17) the displayed parameter for all the bands is selected from combo box.

5. If you have performed periodometric analysis, on the **Periodometry** page the tables of calculation results will appear on the screen. They are presented both in derivations (**Derivations** (Pic. 12.18) in combo box) and frequency ranges – EEG rhythms (**Delta,...Beta_B** (Pic. 12.19) in combo box).

Derivations											
	Amplitude distribution		Frequency distribution		Indexes						
Drv.	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	>100	
Fp1A1	58	7	0	0	0	0	0	0	0	0	
Fp2A2	57	14	1	1	0	0	0	0	0	0	
F3A1	55	18	0	0	0	0	0	0	0	0	
F4A2	54	20	3	1	0	0	0	0	0	0	
FzA1	56	16	1	0	0	0	0	0	0	0	
C3A1	40	30	12	1	0	0	0	0	0	0	
C4A2	34	28	14	4	0	0	0	0	0	0	
CzA2	41	33	8	2	1	0	0	0	0	0	
P3A1	27	15	14	14	15	5	3	2	0	0	
P4A2	17	18	13	8	14	6	8	2	1	0	
PzA1	20	15	19	15	10	6	3	2	1	0	
O1A1	23	17	26	15	5	5	3	0	0	0	
O2A2	10	20	18	20	7	13	0	3	2	0	
F7A1	62	14	1	0	0	0	0	0	0	0	
F8A2	27	30	25	3	0	0	0	0	0	0	
T3A1	50	29	4	1	0	0	0	0	0	0	
T4A2	43	26	11	3	1	0	0	0	0	0	
T5A1	27	14	25	16	4	6	1	0	0	0	
T6A2	6	31	21	16	9	10	1	2	0	0	

Pic. 12.18

Alpha-rhythm																			
	Amplitude distribution		Frequency distribution		Indexes														
Drv.	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20
Fp1A1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fp2A2	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0
F3A1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
F4A2	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0
FzA1	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
C3A1	0	0	0	0	0	0	0	0	0	2	27	13	0	0	0	0	0	0	0
C4A2	0	0	0	0	0	0	0	0	4	6	20	10	0	0	0	0	0	0	0
CzA2	0	0	0	0	0	0	0	0	0	5	24	8	0	0	0	0	0	0	0
P3A1	0	0	0	0	0	0	0	0	2	14	49	7	0	0	0	0	0	0	0
P4A2	0	0	0	0	0	0	0	0	2	15	59	7	0	0	0	0	0	0	0
PzA1	0	0	0	0	0	0	0	0	3	13	44	11	0	0	0	0	0	0	0
O1A1	0	0	0	0	0	0	0	0	2	12	51	6	0	0	0	0	0	0	0
O2A2	0	0	0	0	0	0	0	0	3	13	53	10	0	0	0	0	0	0	0
F7A1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F8A2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
T3A1	0	0	0	0	0	0	0	0	0	2	10	8	0	0	0	0	0	0	0
T4A2	0	0	0	0	0	0	0	0	1	8	25	7	0	0	0	0	0	0	0
T5A1	0	0	0	0	0	0	0	0	2	9	56	3	0	0	0	0	0	0	0
T6A2	0	0	0	0	0	0	0	2	18	61	7	0	0	0	0	0	0	0	0

Pic. 12.19

6. If you have performed correlation analysis, on the **Correlation** page, the tables of calculations will appear both for autocorrelation functions (the **Autocorrelation** page (Pic. 12.20)) and for crosscorrelation functions of the chosen derivation pairs (the **Crosscorreleation** page (Pic. 12.21)).

Autocorrelation		Crosscorrelation	
Drv.	Aver. freq.	Interval	Coef. AC
Fp1A1	10,4	46	0,18
Fp2A2	10,7	40	0,16
F3A1	10,9	49	0,15
F4A2	13,1	43	0,10
FzA1	10,9	50	0,15
C3A1	10,4	28	0,44
C4A2	10,7	28	0,38
CzA2	10,7	28	0,35
P3A1	10,4	24	1,65
P4A2	10,7	23	1,74
PzA1	10,7	25	1,25
O1A1	10,4	23	1,71
O2A2	10,7	26	0,90
F7A1	4,9	72	0,57
F8A2	6,4	49	0,73
T3A1	10,4	29	0,45
T4A2	10,4	26	0,56
T5A1	10,4	24	1,53
T6A2	10,7	24	1,90

Pic. 12.20

Autocorrelation		Crosscorrelation	
Pair	Aver. freq.	Delay	Coef. CC
Fp1Fp2	15,1	0	0,58
F3F4	11,9	0	0,75
C3C4	12,8	0	0,85
P3P4	10,8	0	0,88
O1O2	10,8	0	0,69
F7F8	8,3	-8	0,62
T3T4	12,5	-8	0,69
T5T6	10,7	0	0,79

Pic. 12.21

The tables contain the following abbreviations:

- Aver freq. – the average frequency of autocorrelation or cross correlation functions;
- Coef. AC – autocorrelation coefficient;
- Coef. CC – cross correlation coefficient;
- Interval – the first crossing time of the autocorrelation function with the zero line;
- Delay – time delay of the cross correlation function.

7. If you have performed coherence analysis, on the **Coherence** page there will be the tables of coherence analysis results in derivations (**Derivation** page (Pic. 12.22)), frequency ranges – EEG rhythms (the **Delta, ... Beta_B** pages (Pic. 12.23)), and frequency bands (the **Band** page (Pic. 12.24)).

Derivation	Delta	Theta	Alpha	Beta_L	Beta_H	Band
Pair	C aver	C max	C full	F domin	F aver	
Fp1Fp2	0,47	0,95	66,21	2,8	11,5	
F3F4	0,55	0,92	77,04	10,8	13,5	
C3C4	0,57	0,95	79,79	10,5	14,3	
P3P4	0,57	0,97	80,59	10,8	14,3	
O1O2	0,59	0,95	83,22	9,5	16,5	
F7F8	0,38	0,89	53,84	10,5	11,5	
T3T4	0,35	0,88	49,33	2,5	10,8	
T5T6	0,30	0,80	42,75	3,5	11	

Pic. 12.22

Derivation	Delta	Theta	Alpha	Beta_L	Beta_H	Band
Drv.	K aver	K max	K full	F domin	F aver	Index
Fp1Fp2	0,79	0,95	11,12	2,8	2,3	17
F3F4	0,72	0,92	10,05	2,8	2,3	13
C3C4	0,73	0,91	10,27	2,5	2,5	13
P3P4	0,69	0,84	9,71	3,5	2,5	12
O1O2	0,48	0,74	6,78	2,5	2,5	8
F7F8	0,59	0,83	8,28	3,5	2,5	15
T3T4	0,64	0,88	9,00	2,5	2,5	18
T5T6	0,53	0,80	7,45	3,5	2,5	17

Pic. 12.23

Derivation	Delta	Theta	Alpha	Beta_L	Beta_H	Band													
Drv.	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20
Fp1Fp2	0,78	0,87	0,89	0,81	0,68	0,53	0,70	0,78	0,81	0,81	0,53	0,49	0,35	0,42	0,33	0,47	0,44	0,31	0,38
F3F4	0,71	0,82	0,79	0,72	0,69	0,73	0,82	0,83	0,86	0,88	0,64	0,56	0,42	0,49	0,46	0,55	0,53	0,61	0,54
C3C4	0,71	0,88	0,81	0,69	0,72	0,58	0,88	0,84	0,88	0,93	0,70	0,54	0,44	0,44	0,37	0,57	0,51	0,63	0,63
P3P4	0,66	0,81	0,77	0,66	0,70	0,60	0,87	0,83	0,91	0,96	0,80	0,54	0,57	0,61	0,43	0,55	0,59	0,76	0,66
O1O2	0,34	0,68	0,62	0,60	0,57	0,46	0,84	0,83	0,89	0,90	0,71	0,59	0,61	0,65	0,63	0,54	0,63	0,66	0,68
F7F8	0,41	0,57	0,74	0,61	0,50	0,45	0,54	0,58	0,76	0,87	0,60	0,37	0,16	0,32	0,28	0,38	0,40	0,41	0,33
T3T4	0,58	0,85	0,72	0,52	0,52	0,31	0,63	0,58	0,69	0,75	0,31	0,24	0,16	0,24	0,14	0,20	0,15	0,28	0,25
T5T6	0,44	0,64	0,62	0,36	0,43	0,19	0,54	0,46	0,65	0,73	0,35	0,13	0,28	0,21	0,07	0,19	0,11	0,36	0,28

Pic. 12.24

The table of derivations analysis (Pic. 12.22) contains the following abbreviations:

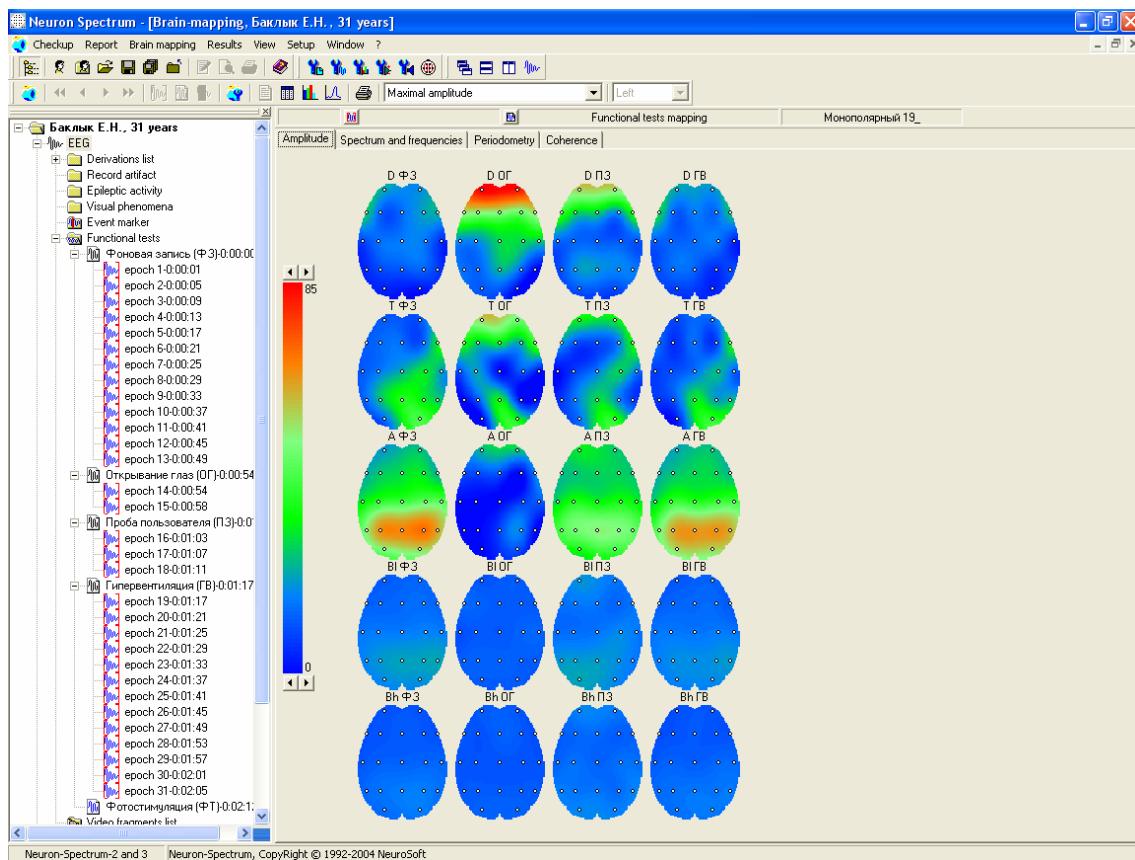
- Kmax – maximal coherence spectrum power in the derivation;
- Kaver – average coherence spectrum power in the derivation;
- Ktotal – total coherence spectrum power in the derivation;
- Fdomin – dominating coherence spectrum frequency in the derivation;
- Faver – average coherence spectrum frequency in the derivation.

In the table of frequency bands (EEG-rhythms) analysis (Pic. 12.23) the same abbreviations are used. Besides, the program calculates rhythm index for each EEG-rhythm in each derivation. The results are displayed in the *Index* column.

In the table of frequency bands analysis (Pic. 12.24) the parameter selected in combo box is displayed for all the bands.

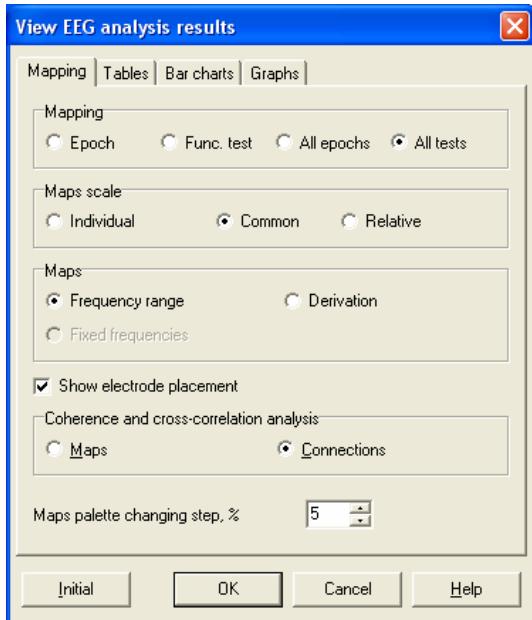
12.2. ANALYSIS RESULTS BRAIN MAPPING

1. To display the window of analysis results mapping, select the **Results|Brain mapping** command (, [Alt+M]) in the EEG review and analysis window or in any window of EEG analysis results viewing (Pic. 12.25). Analysis results mapping is available only for the montages consisting of monopolar derivations.



Pic. 12.25

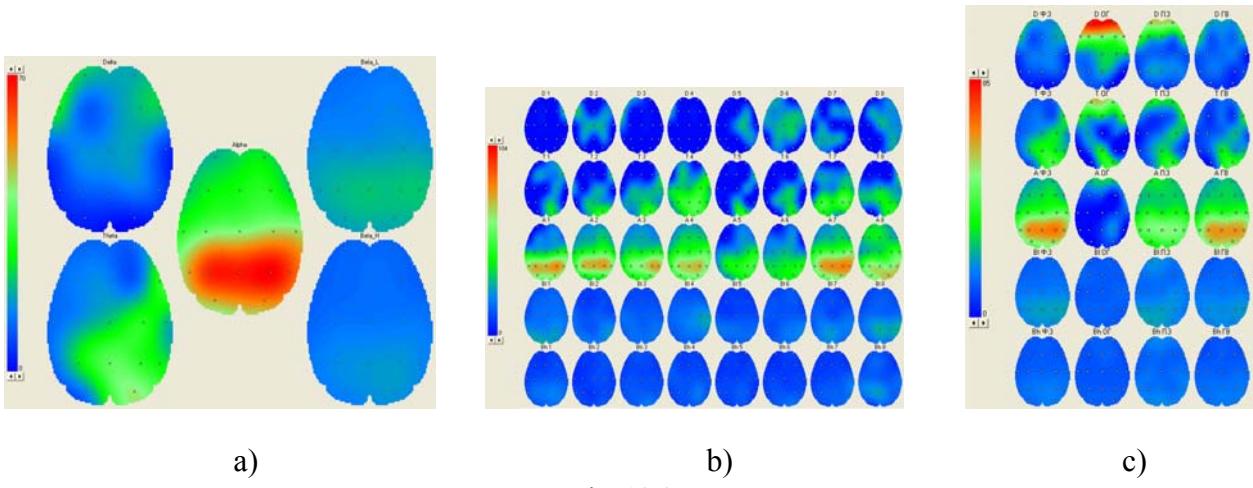
2. The **Mapping|Mapping parameters** command or the  button on the toolbar activate the dialog box of mapping parameters (Pic. 12.26).



Pic. 12.26

3. The mapping window operates in the following modes (the *Mapping* radio-buttons):

- mapping of epochs analysis results (Pic. 12.27a);
- mapping of functional tests analysis results (Pic. 12.27a);
- mapping of all the epochs analysis results (Pic. 12.27b);
- mapping of all the functional tests analysis results (Pic. 12.27c).

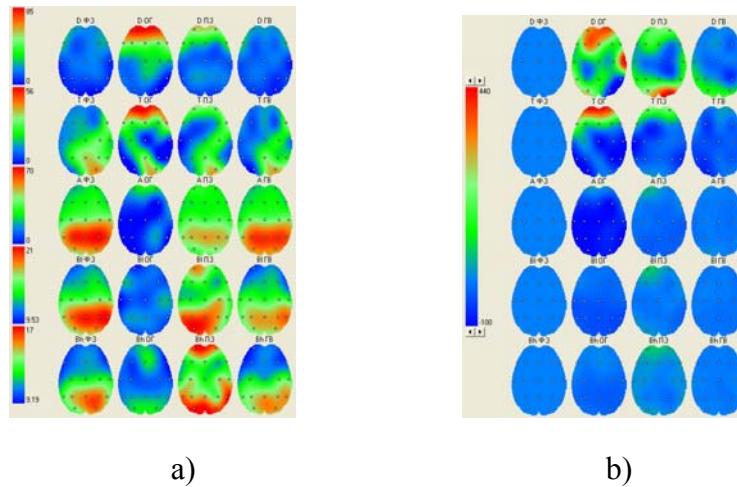


Pic. 12.27

In all the epochs and tests mapping modes the following abbreviations are used:

- D1, A2 – a rhythm name and an epoch number (Delta-rhythm epoch 1, Alpha-rhythm epoch 2).
- DPR, AHV – a rhythm name and a functional test short name (Delta-rhythm phone record, Alpha-rhythm hyperventilation).

4. When mapping you can use several map-scaling modes (the *Map scales* radio-buttons):
- individual scale – each map and each rhythm uses its own scale (Pic. 12.28a);
 - common scale – all the maps use one scale (Pic. 12.27);
 - relative scale (Pic. 12.28b) is used only for all the epochs and all the tests mapping. One test or epoch is assumed zero. Maps of the other tests and epochs display changes in comparison with the basic test or epoch. Current epoch or test is assumed basic.

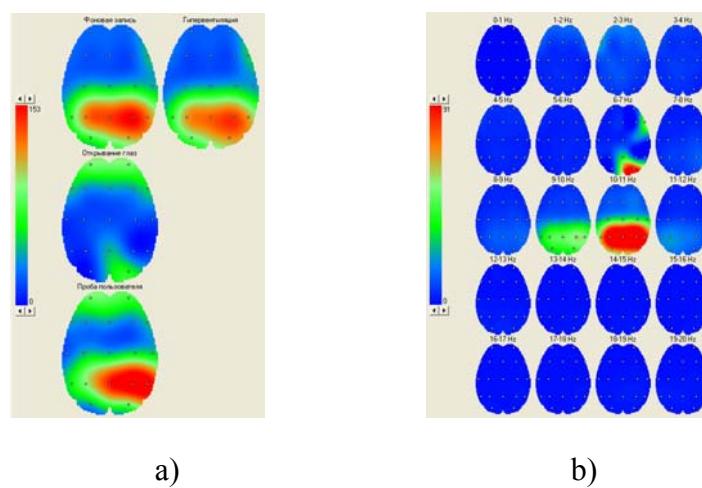


Pic. 12.28

If you have selected common scale, you can change maximal and minimal values of rule. Use the and buttons. The button extends the rule; the button shortens it in the amount of percent indicated in *Palette changes step* edit line of the dialog box (Pic. 12.26). To change low and upper border of the scale, you can use keyboard: [Gray +] and [Gray -] to extend and shorten upper border, and the same keys with holding down [Ctrl] to extend and shorten lower border.

5. **Neuron-Spectrum** software can display the following types of maps (the *Maps* radio-buttons):

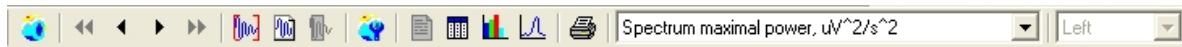
- brain maps for parameters values in frequency ranges (EEG-rhythms) (Pic. 12.27, Pic. 12.28);
- brain maps for parameters values in a hole derivations (Pic. 12.29a);
- brain maps for parameters values in frequency or amplitude bands (Pic. 12.29b).



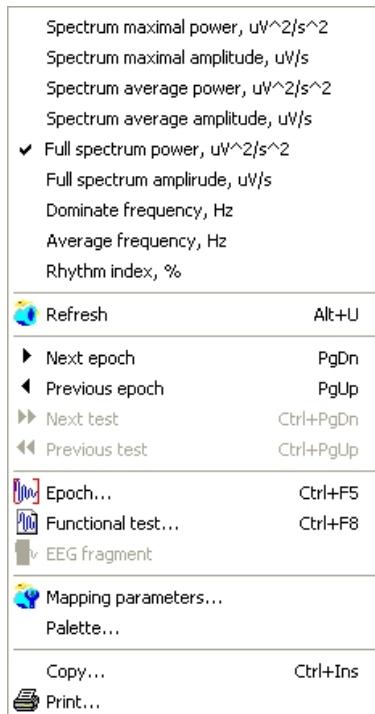
Pic. 12.29

Neuron-Spectrum Program

6. An analysis parameter can be selected in the combo box on the toolbar of the mapping window (Pic. 12.30) or with the help of the window's properties menu opened by the right mouse button (Pic. 12.31).



Pic. 12.30

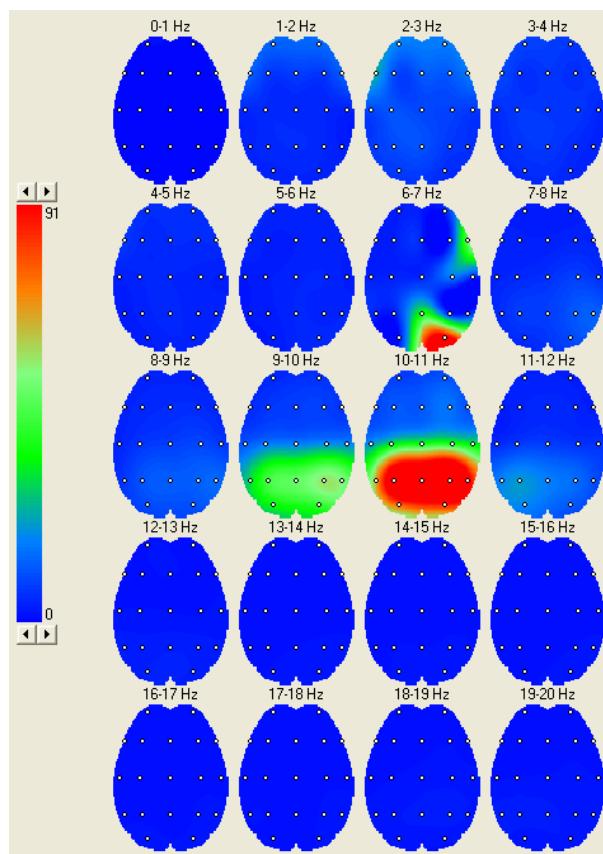


Pic. 12.31

7. If you have performed amplitude analysis, on the **Amplitude** page the maps both in derivations and in frequency ranges can be displayed. Mapping of the epoch analysis results, functional tests analysis results, all the epochs and all the functional tests analysis results is also possible. You can use common, individual or relative scale.

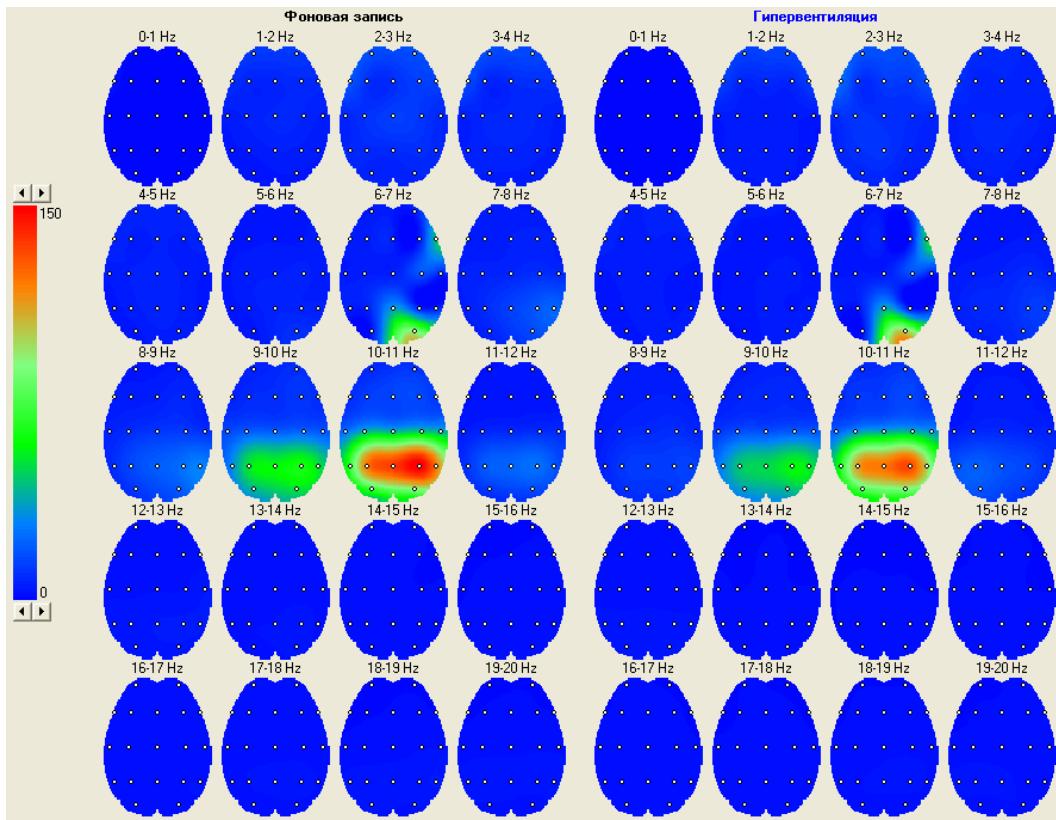
8. If you have performed frequency and spectral analysis, the **Spectrum and frequency** page displays the mapping of spectral and frequency parameters in derivations, frequency ranges (EEG-rhythms) and narrow frequency bands. Mapping of the epoch analysis results, functional tests analysis results, all the epochs and all the functional tests analysis results is also possible. You can use common, individual or relative scale.

When mapping of narrow frequency bands (of one epoch or functional test) is performed, and the *Fixed frequencies* mode is used, twenty 1-Hz band maps are displayed. Each of them corresponds to the frequency band of 1-2 Hz, 2-3Hz,...19-20 Hz (Pic. 12.32).

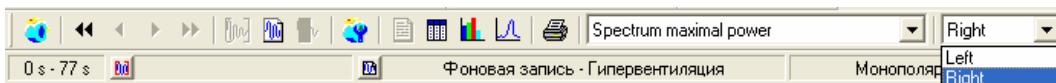


Pic. 12.32

When mapping of all epochs (functional tests) is performed, 20 maps in both parts of the screen are displayed for an epoch or test (Pic. 12.33). You can navigate both right and left half of window. The epoch or functional test name of active half is highlighted. To navigate within them, select the required part of the screen by clicking on it or using the **Left/Right** combo box on the toolbar (Pic. 12.34). For navigation use the **Brain mapping|Next epoch** (➡), **Brain mapping|Previous epoch** (⬅), **Brain mapping|Next test** (➡) and **Brain mapping|Previous test** (⬅) menu commands.



Pic. 12.33

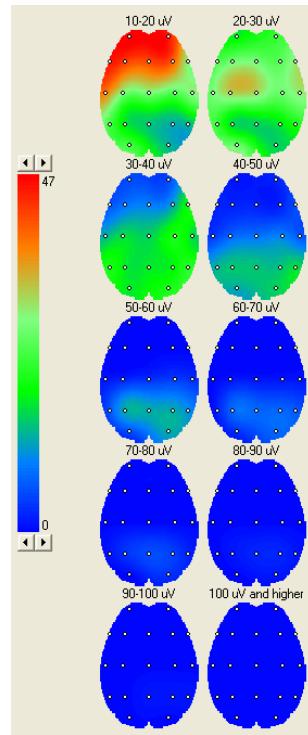


Pic. 12.34

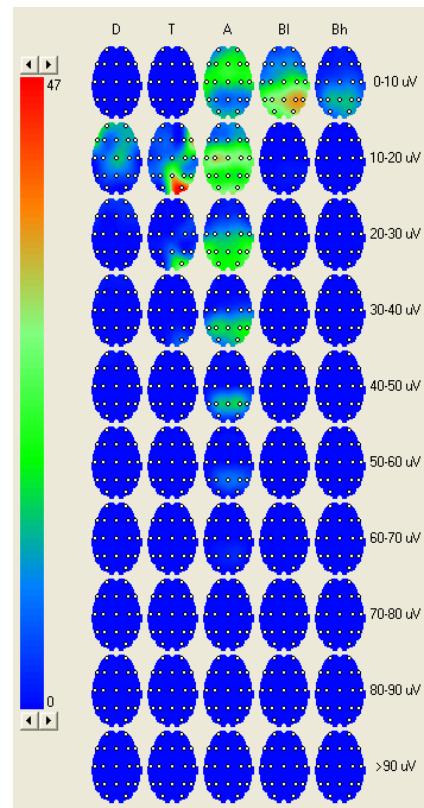
9. If you have performed periodometry analysis, the **Periodometry** page displays the mapping of rhythm indices, average frequencies and amplitudes (similar to mapping on the **Amplitude** page), as well as frequency and amplitudes distribution in ranges. The mapping is performed both for the results of separate epochs and functional tests analysis and for all the epochs and functional tests analysis.

Rhythm indexes, average amplitudes and frequencies mapping is then same as on **Amplitude** page.

If you are mapping amplitudes and frequencies distribution, you can use general scale only (Pic. 12.35). All the parameters are mapped for both derivations (Pic. 12.35) and frequency ranges (Pic. 12.36).



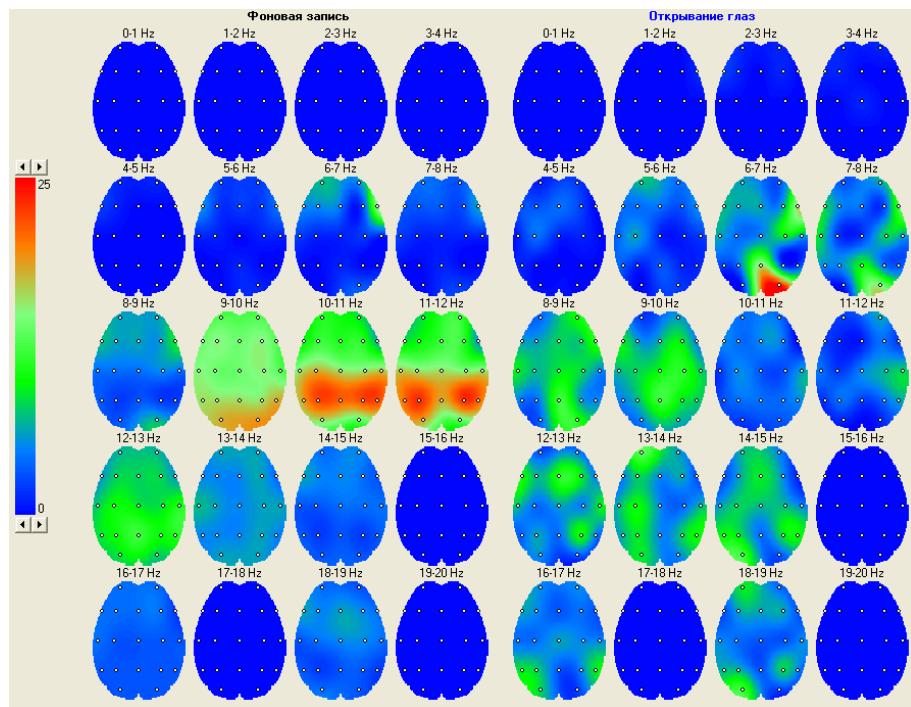
Pic. 12.35



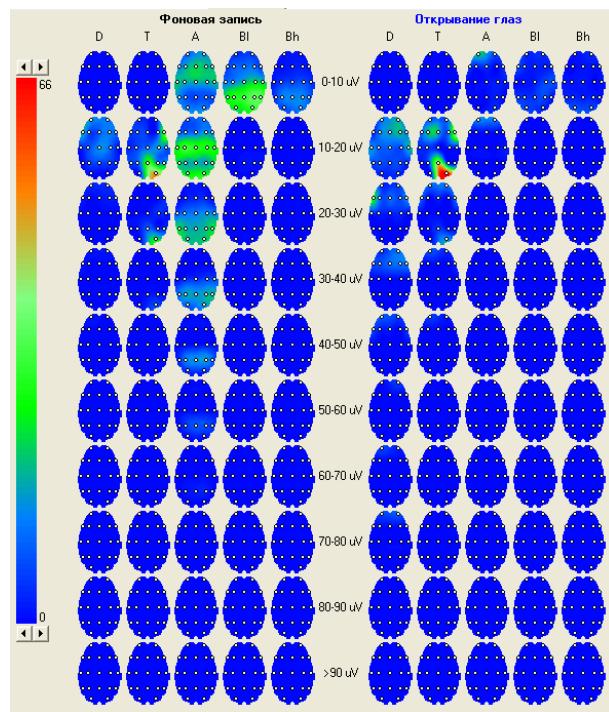
Pic. 12.36

Neuron-Spectrum Program

When mapping amplitudes and frequencies in the *All epochs* (*All functional tests*) mode is performed, two parts of the screen display maps for two epochs or functional tests (Pic. 12.37, Pic. 12.38). Navigation is similar to spectrum mapping in the *Fixed frequencies* mode.



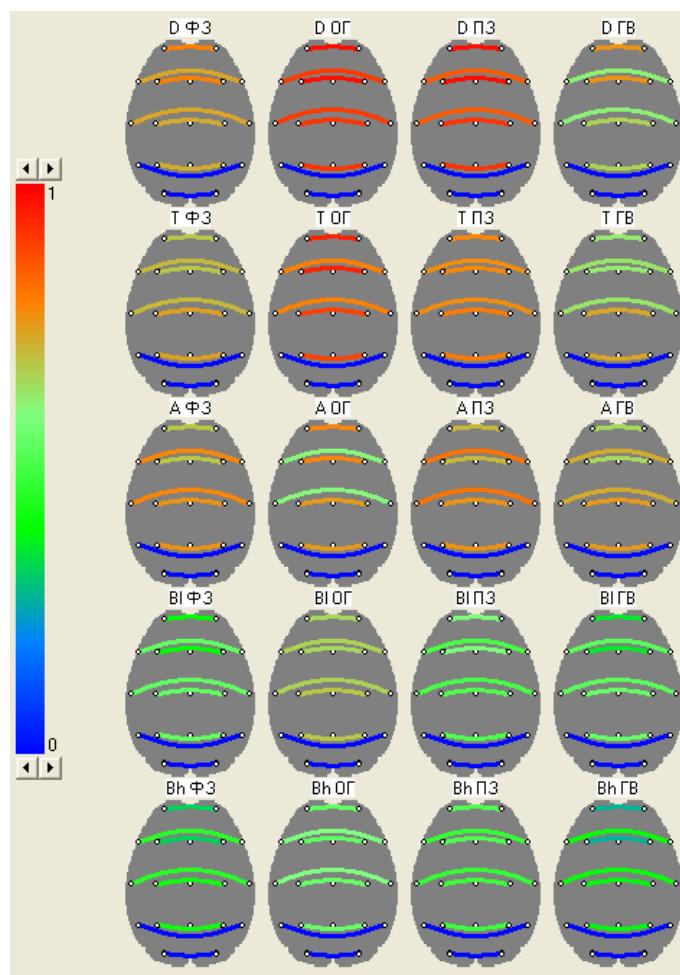
Pic. 12.37



Pic. 12.38

10. If you have performed coherence analysis, on the **Coherence** page you can see brain maps or connections diagrams of maximal, total, average coherence spectrum power values, dominate and average frequencies, and coherence index in a frequency range (for the frequency ranges mapping mode). Mapping is performed for the analysis results of single epochs, functional tests as well as all the epochs and functional tests. All the mapping modes are the same as on the **Spectrum and frequencies** page.

If in the **View EEG analysis results** dialog box (Pic. 12.26) on the **Mapping** page (the **Setup|Results** menu command) the *Coherence and cross-correlation analysis* radio-buttons are set to *Connections*, then instead of topograms you will see the values of coherence functions displayed as connection arcs, the color of an arc corresponds to a value of the function (Pic. 12.39). If you want to see brain maps set the radio buttons to *Maps*.

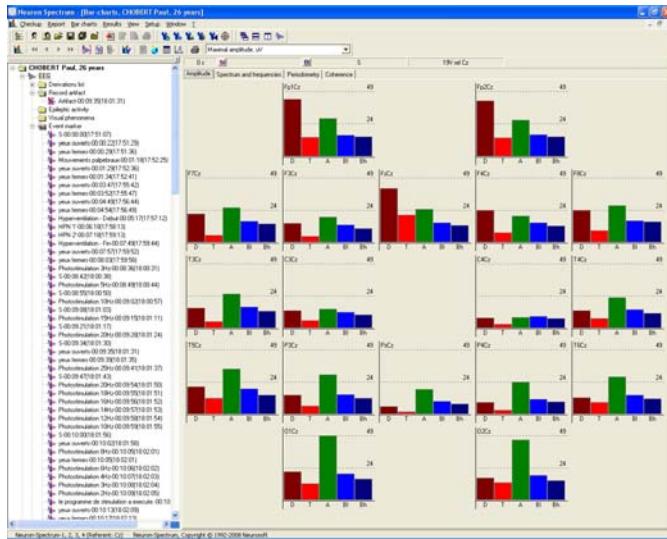


Pic. 12.39

11. To change the mapping palette, use the **Brain mapping|Palette** menu command

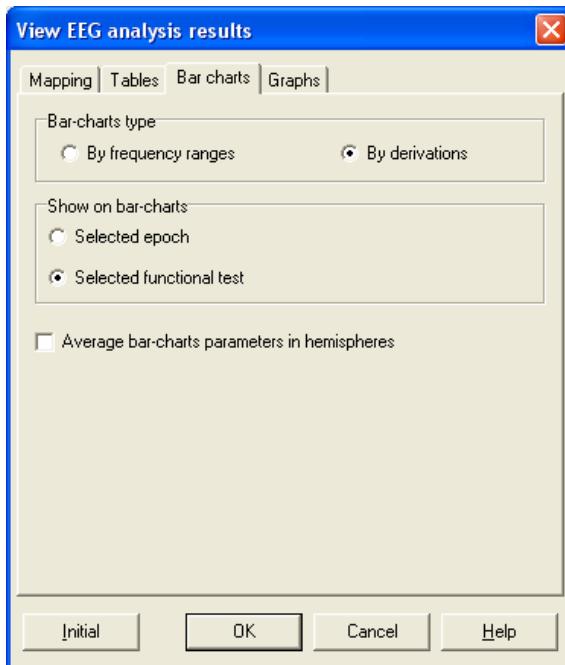
12.3. BAR CHARTS OF ANALYSIS RESULTS

1. The histogram (bar charts) window of analysis results appears when you use the **Results|Bar charts** menu command, the  button or [Alt+H] in the EEG review and analysis window or in any other window displaying EEG analysis results (Pic. 12.40).



Pic. 12.40

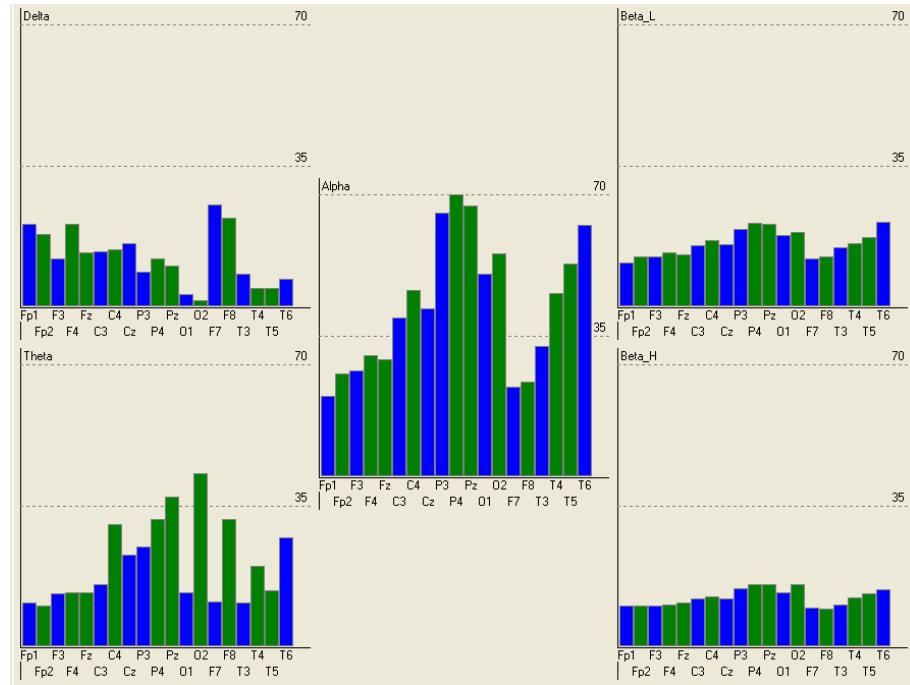
2. The **Bar charts|Bar charts parameters** menu command or the  button on the toolbar display the dialog box with bar chart viewing parameters (Pic. 12.41).



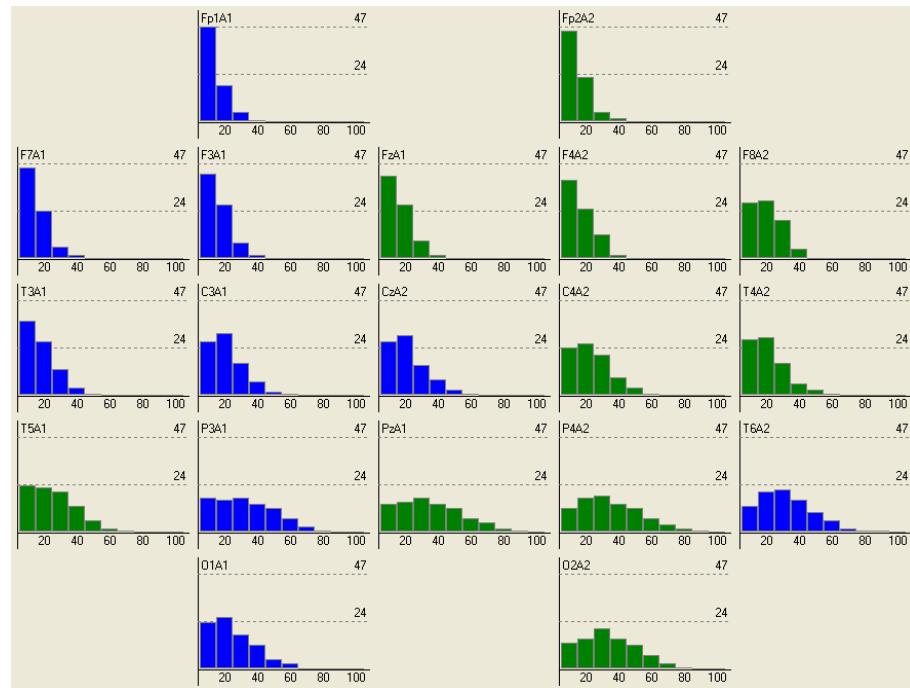
Pic. 12.41

3. The bar charts window displays the following types of histograms (the *Bar chart type* radio-buttons):

- *By frequency ranges* – in one axes are displayed the parameters of each derivation for one frequency range (EEG-rhythm (Pic. 12.42)).
- *By derivations* – in one axes are displayed the parameters of each frequency range (EEG-rhythm) or frequency (amplitude) band for one derivation (Pic. 12.40, Pic. 12.43).



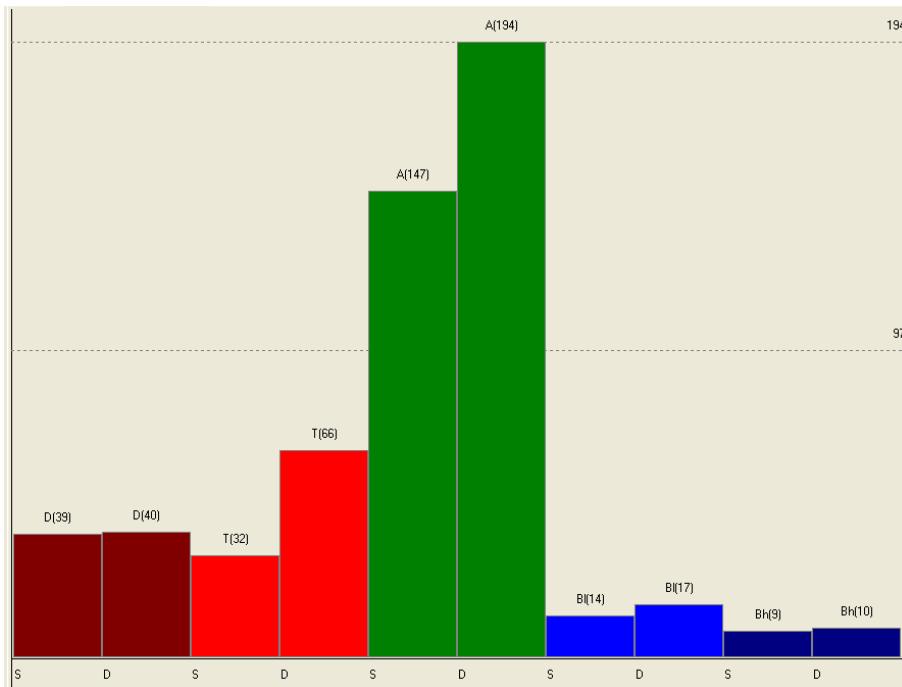
Pic. 12.42



Pic. 12.43

4. The window of analysis results bar charts displays either the results of epoch analysis or the results of functional tests analysis (the *Show on bar charts* radio-buttons).

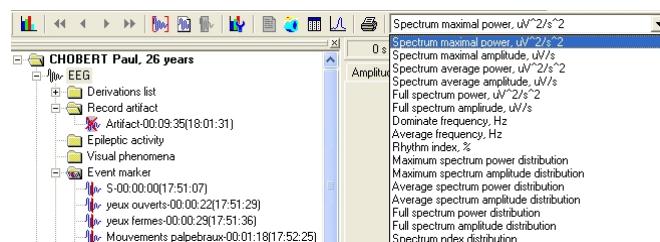
5. Any analysis parameter can be averaged in derivations of each hemisphere. Averaged values of each frequency range and each frequency (amplitude) band will be shown in the bar charts. To do this, check the *Average bar charts parameters in hemispheres* check box. The bar chart will display two columns for each frequency (amplitude) range: average parameter in left hemisphere and average parameter in right hemisphere (Pic. 12.44)



Pic. 12.44

6. If you have performed amplitude analysis, the **Amplitude** page will display the bar charts of amplitude distribution in frequency bands (EEG-rhythms). You may also view the bar charts with the results of epochs or functional tests analysis. It is possible to average the results of analysis for hemispheres and display the averaged bar charts of amplitude distribution.

7. If you have performed frequency and spectral analysis, the **Spectrum and frequencies** page will display the bar charts of EEG spectrum and frequency parameters. You can choose the required parameter in the combo box on the toolbar (Pic. 12.45) or in the properties menu of the window displayed by the right mouse button (Pic. 12.46).

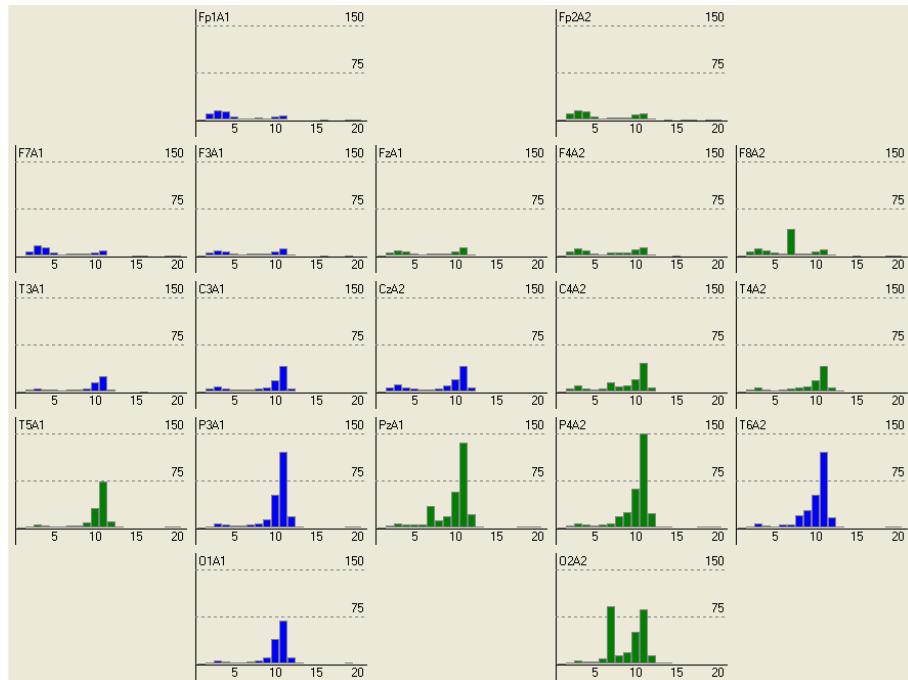


Pic. 12.45



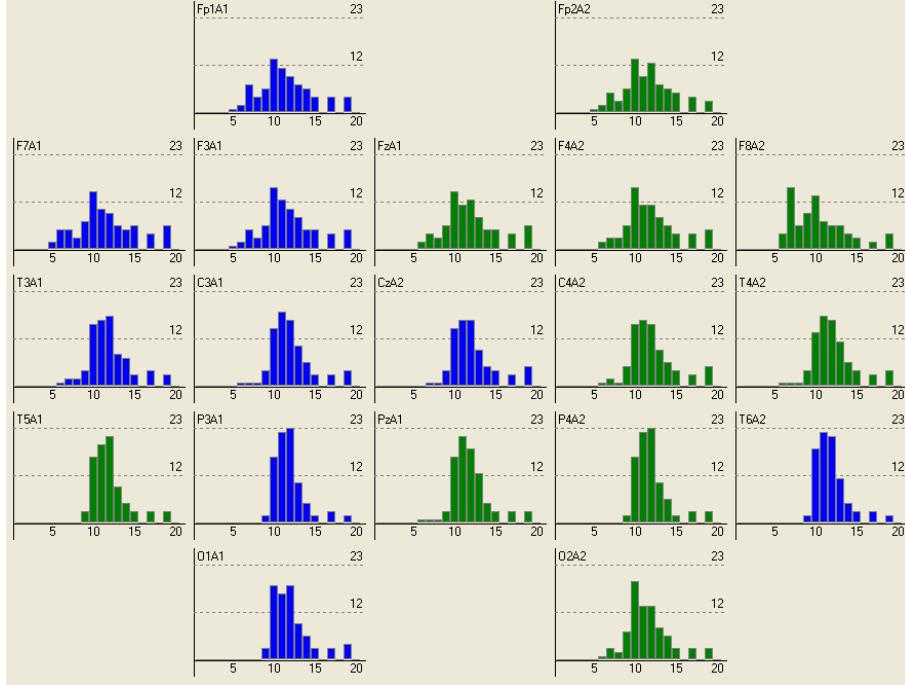
Pic. 12.46

If you display spectrum parameters distribution in narrow frequency ranges, you will see bar charts only by derivations (Pic. 12.47). There is a value of selected parameter on the bar chart for each band from 0 to 20 Hz.



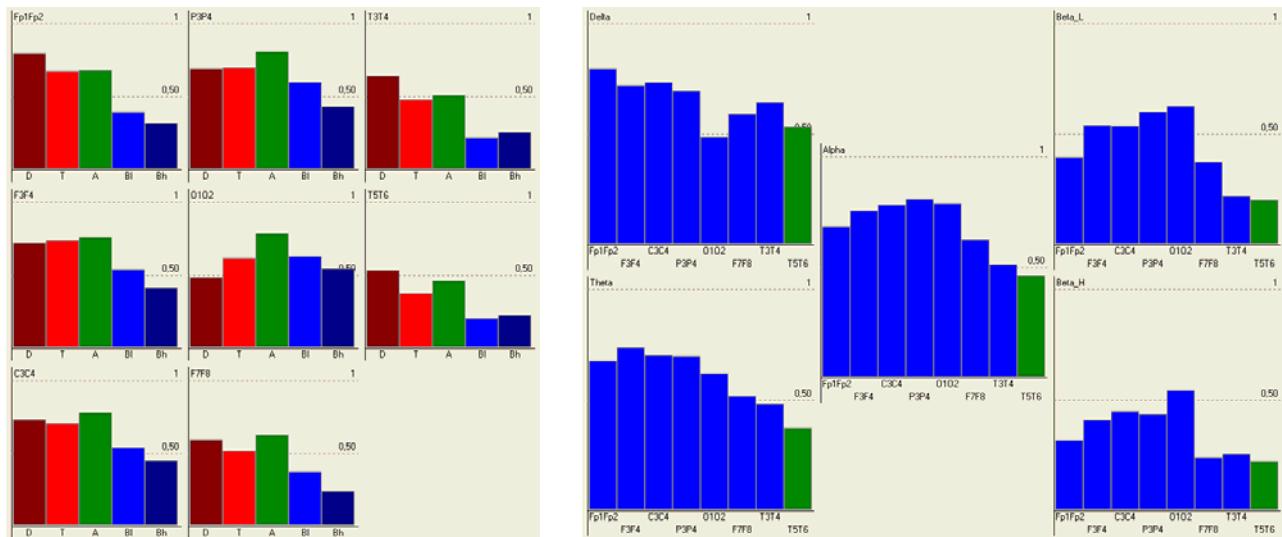
Pic. 12.47

8. If you have performed periodometry analysis, the **Periodometry** page will display the bar charts of the analysis results: rhythm indices, average frequencies and amplitudes as well as distribution of amplitudes and frequencies in ranges. Distribution bar charts are displayed by derivations only (Pic. 12.48).

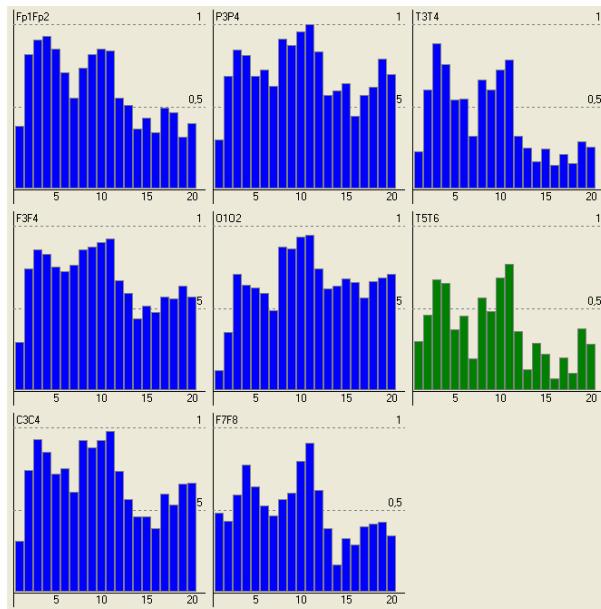


Pic. 12.48

9. If you have performed coherence analysis, the **Coherence** page will display bar charts of this analysis method results: maximal, average and total values of coherence functions, dominant and average frequencies of coherence power spectrum, rhythm indices, distribution of coherence function parameters in narrow frequencies bands (Pic. 12.49). Distribution bar charts can be displayed by derivations only (Pic. 12.50).



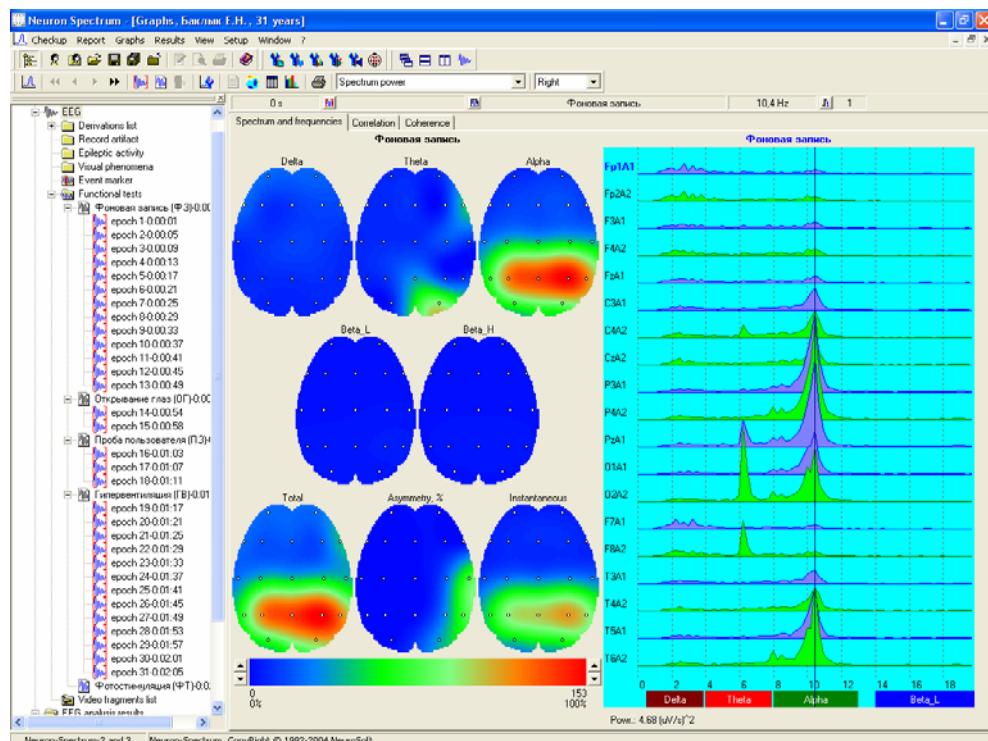
Pic. 12.49



Pic. 12.50

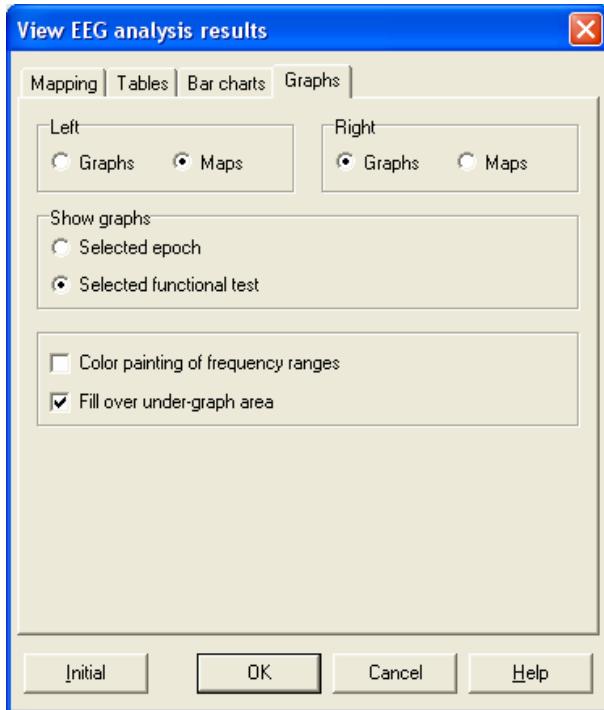
12.4. GRAPHS OF ANALYSIS RESULTS

1. To activate the analysis results graphs window, select the **Results|Graphs** menu command (the button, [Alt+G]) in the EEG review and analysis window or in any other window of EEG analysis results viewing (Pic. 12.51).



Pic. 12.51

2. The **Graphs|Graphs parameters** menu command or the  button on the toolbar activate the dialog box of graphs displaying and viewing parameters (Pic. 12.52).



Pic. 12.52

3. Graphs window consists of two panels (left and right). Each panel may display either graphs, or topographic maps of epoch or functional test analysis (the *Show graphs* radio-buttons). The displaying mode of each panel is set by the *Left* and *Right* radio-buttons of the **View EEG analysis results** dialog box on the *Graphs* page.

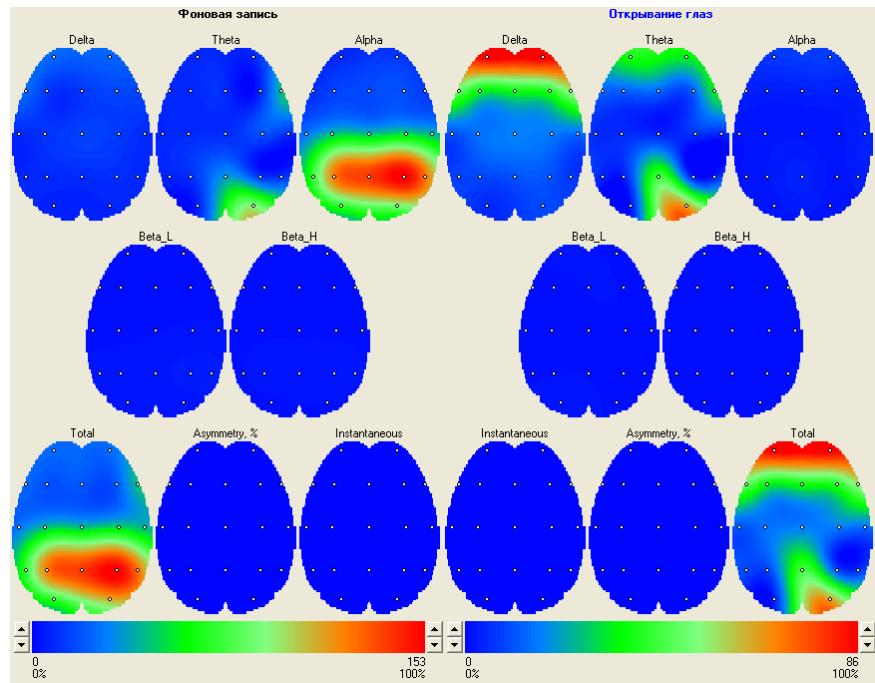
4. If you select the required epoch or functional test, using the **Graphs|Epoch** command (the  button or [Ctrl+F6]), the **Graphs|Functional test** command (the  button, [Ctrl+F8]) or  and  buttons on the toolbar, both window parts will display the same epoch or functional test. If you use **Next epoch** (, [PgDn]), **Previous epoch** (, [PgUp]), **Next test** (, [Ctrl+PgDn]), **Previous test** (, [Ctrl+PgUp]) navigation commands, the epoch or functional test will be changed only within one (current) panel. Current panel is selected in the Left/Right combo box on the toolbar (Pic. 12.53) or if you click on one of the panels.



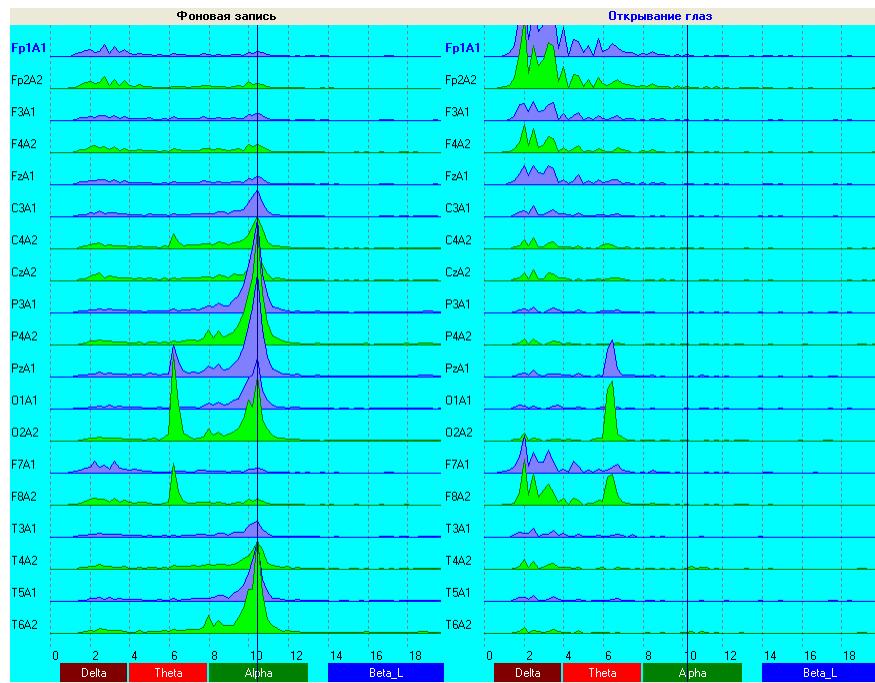
Pic. 12.53

Thus, if one pane displays graphs, while the other one shows maps (Pic. 12.51), it is reasonable to select the same epoch or functional test for both panes. If both panes display the same information – either graphs (Pic. 12.55) or maps (Pic. 12.54) – you can compare the analysis results of different ep-

ochs or functional tests. In this case it is better to select different epochs or functional tests for different panes.

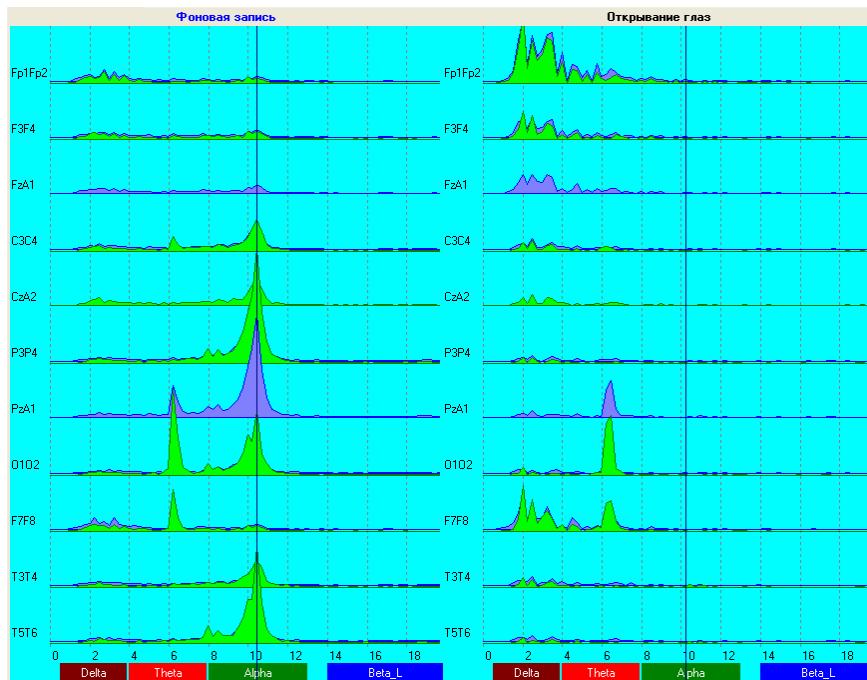


Pic. 12.54



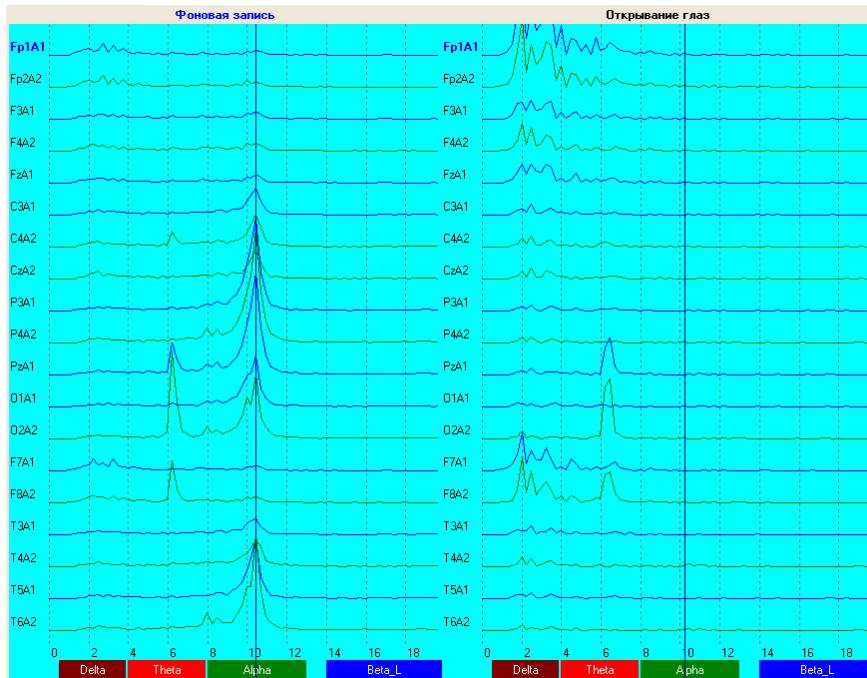
Pic. 12.55

5. Symmetrical derivations may be showed in the same isolines (Pic. 12.56). This mode enables better identifying of parameters distribution asymmetry. To start the mode, click on **Graphs|Asymmetry** menu command. Click on it again, and you will return to the previous mode.



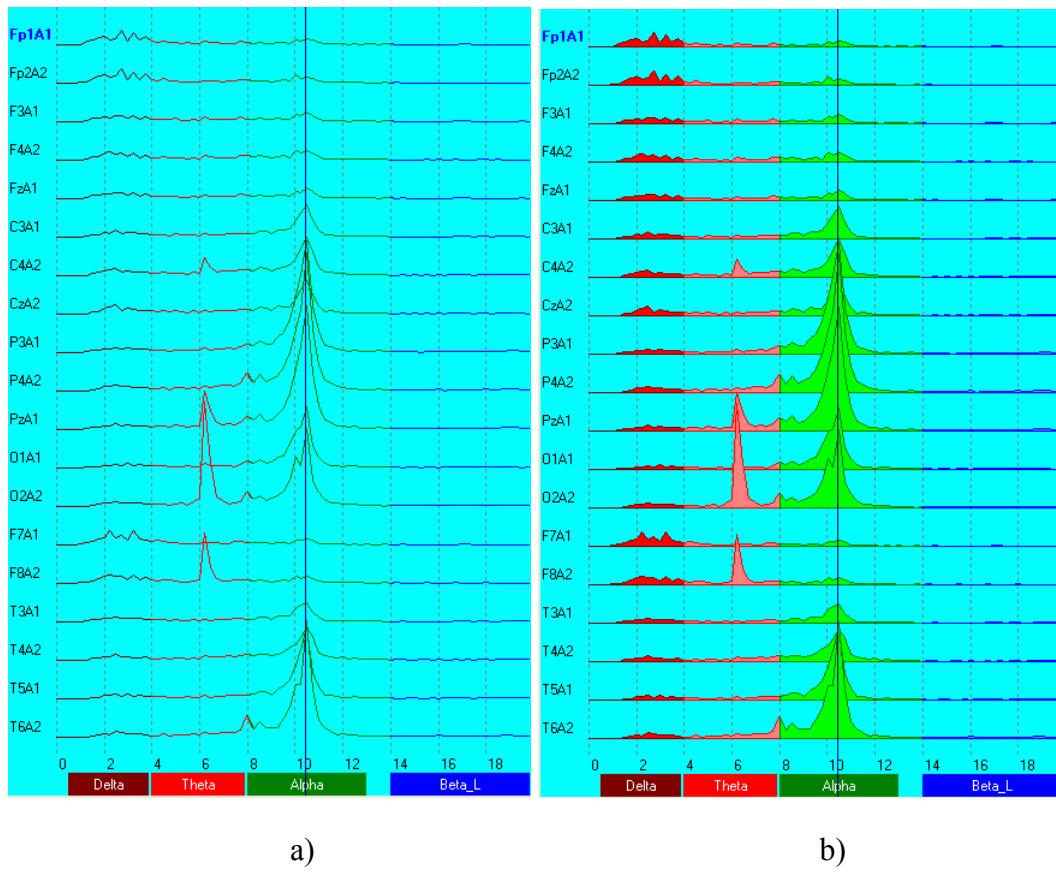
Pic. 12.56

6. If you want to fill the space between a graph and an isoline (Pic. 12.57), check the *Fill over under-graph area* check box in the parameters settings dialog box (Pic. 12.52).



Pic. 12.57

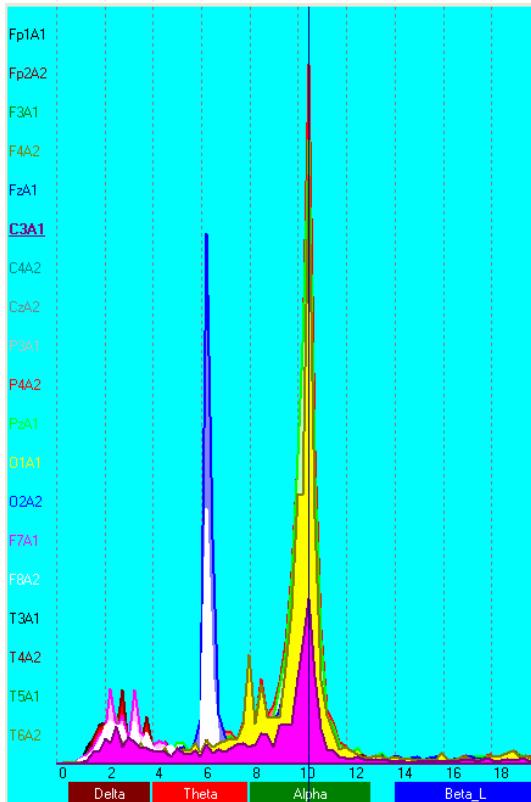
If you want the frequency ranges on the graph to be of different colors (Pic. 12.58a) and (Pic. 12.58b), check the *Color painting of frequency ranges* check box in the parameters settings dialog box (Pic. 12.52).



Pic. 12.58

7. If you click on the derivation name by the left mouse button, you make it current. The current derivation is highlighted. The derivation becomes current in all the other windows (EEG traces, analysis results tables etc.). The selection of the derivation in one window will select the same derivation in the other ones.

8. All the graphs can be located on the same isoline. In this case each graph has its own color, while the derivation name has the same color (Pic. 12.59). The current derivation is in the forefront. To set this mode select the **Graphs|On one isoline** menu command. To return to previous mode click this menu command again.



Pic. 12.59

You can turn on/off one-curve mode by double clicking on the name of the derivation.

9. There is a vertical (frequency) marker on graphs. The current position of the marker determines the abscissa value for the current derivation. This value is displayed in the left down corner of the graphs panel.

You can move the marker using the keyboard or the mouse. To move it one point to the left or to the right, press **[→]** or **[←]** keys. To move the marker using mouse point the marker with the cursor; the latter will be changed from to . Click on the marker with the left mouse button, and move the mouse in the required direction not releasing the button.

You can set the marker in any position by clicking on the left mouse button in this position.

If on both sides of graphs window the graphs are displayed, you can get markers to move synchronously on both sides. To do this use the **Graphs|Join markers** menu command.

10. To change the brain maps palette, use the **Graphs|Palette** menu command.

11. The graphs window is active only if you have performed frequency and spectral analysis. If you have performed other types of analysis, the graphs window is still available only after frequency and spectral one.

12. If the frequency and spectral analysis have been performed, the **Spectrum and frequencies** page will display the graphs of spectrum power or amplitude. The brain maps will show the values of the parameter being mapped for standard frequency ranges (EEG-rhythms) and maps of total (power and amplitude) and instantaneous values as well as instantaneous values asymmetry.

The vertical marker on the spectrum graph determines the brain map of power instantaneous values and its asymmetry. The parameter value in current derivation on marker frequency is displayed on the information panel of the window.

In the lower part of the graph there is a multi-colored bar of standard frequency ranges (EEG-rhythms).

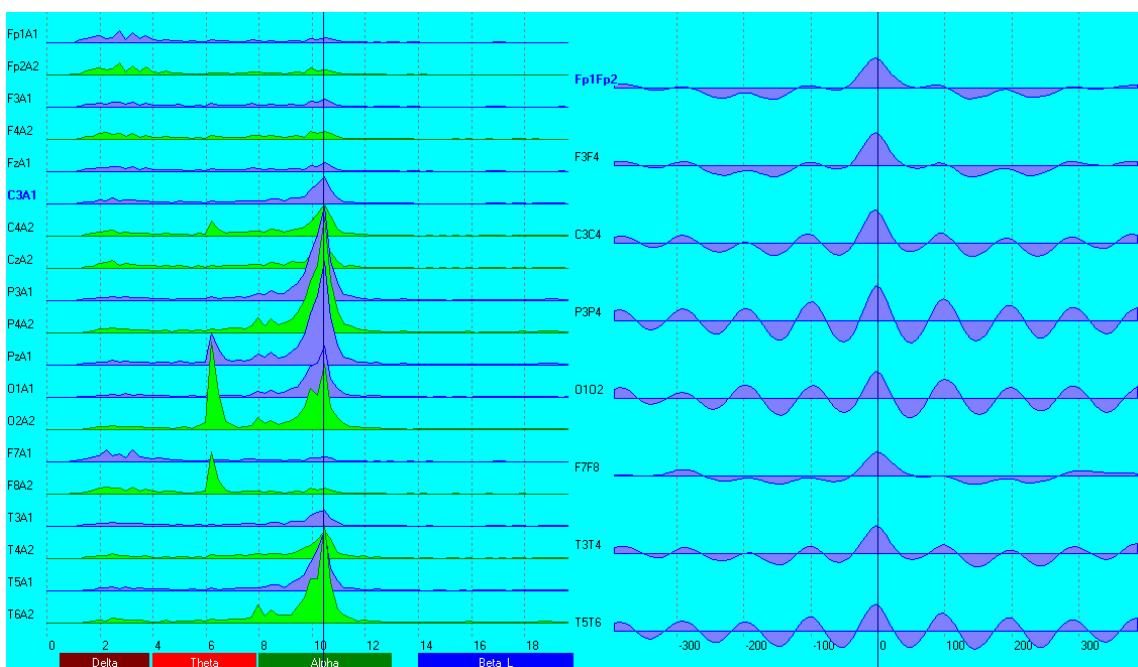
The value of the graphs scale is indicated on the information panel of the graph window. You can select it clicking on the button. To change the scale, use [**Grey +**] or [**Grey -**]. To change the horizontal graphs scale, use [**Grey ***] or [**Grey /**].

If you have got a mouse with roller, you may vary horizontal scale with its roller. To change the vertical scale, press and hold down [**Shift**] while using the roller.

You may change the maps scale rule using the keyboard or the mouse (the buttons). For active half of window use the following key combinations:

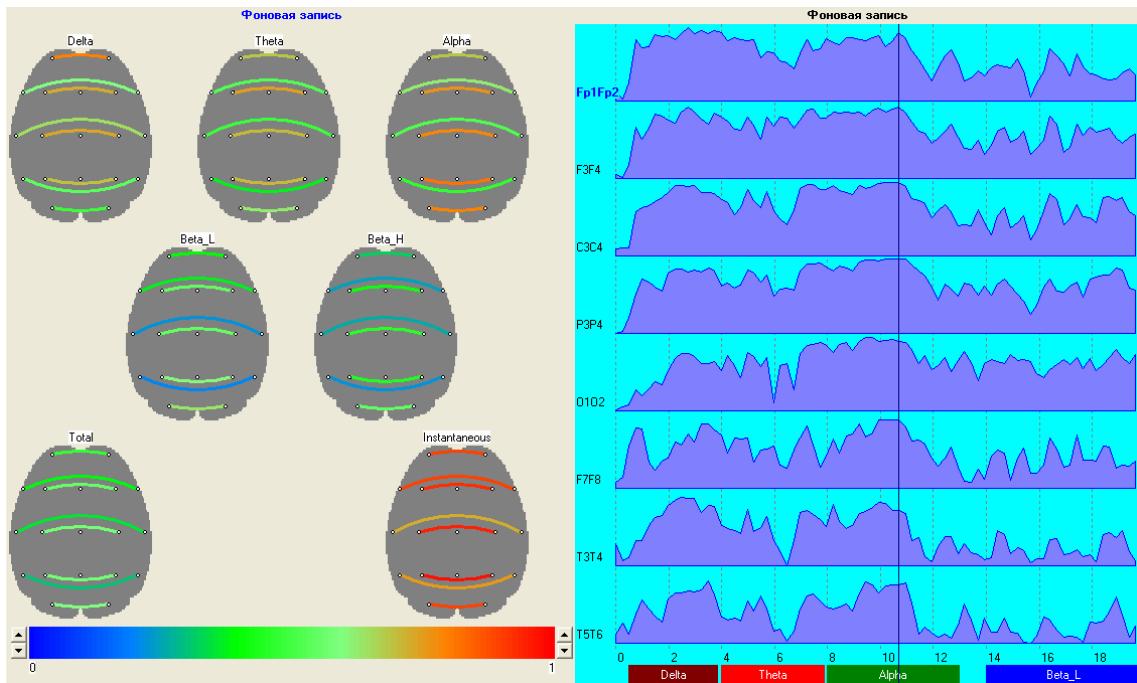
- [**Ctrl+“Grey +”**] – to extend lower scale limit;
- [**Ctrl+“Grey -”**] – to reduce lower scale limit;
- [**Grey +**] – to extend upper scale limit;
- [**Grey -**] – to reduce upper scale limit.

13. If you have performed correlation analysis, the **Correlation** page will display the graphs of auto- and cross correlation functions and graphs of spectrum amplitude and power. You can display correlation functions in one part and spectral functions in the other part of the window (Pic. 12.60). You can also mapped the results of auto and cross correlation analysis.



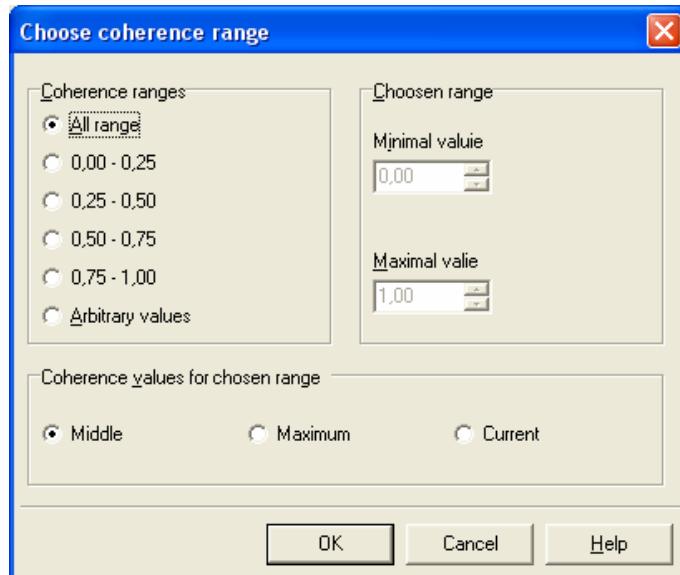
Pic. 12.60

14. If you have performed coherence analysis, the **Coherence** page will display the graphs of coherence power spectrum and graphs of spectrum amplitude and power. On the mapping half you can display brain maps or the connections diagrams of EEG coherence analysis results (Pic. 12.61).



Pic. 12.61

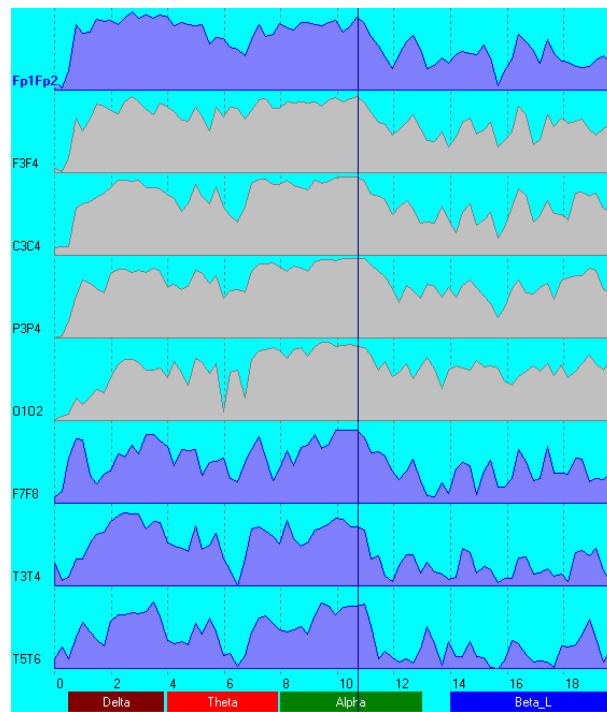
If you select **Graphs|Coherence levels** menu command, the dialog box **Choose coherence range** will be displayed on the screen (Pic. 12.62).



Pic. 12.62

The dialog box allows selecting the coherence graphs, parameters of which are in the selected range. As a parameter to select the range, you can use the average, maximal and momentary (indicated by the frequency marker on the graph) value of coherence function. For example, if you should select

derivations with the average coherence value in the range of 0,25-0,50, select the value by the *Coherence range* radio buttons. In the *Coherence values for chosen range*— select *Middle* value. After the pressing “OK” button on the graphs all derivations with the middle coherence values above the range will be displayed by “grey” (Pic. 12.63). To arbitrary range set, use the *Arbitrary values* switch and *Minimal value* and *Maximal value* edit lines.



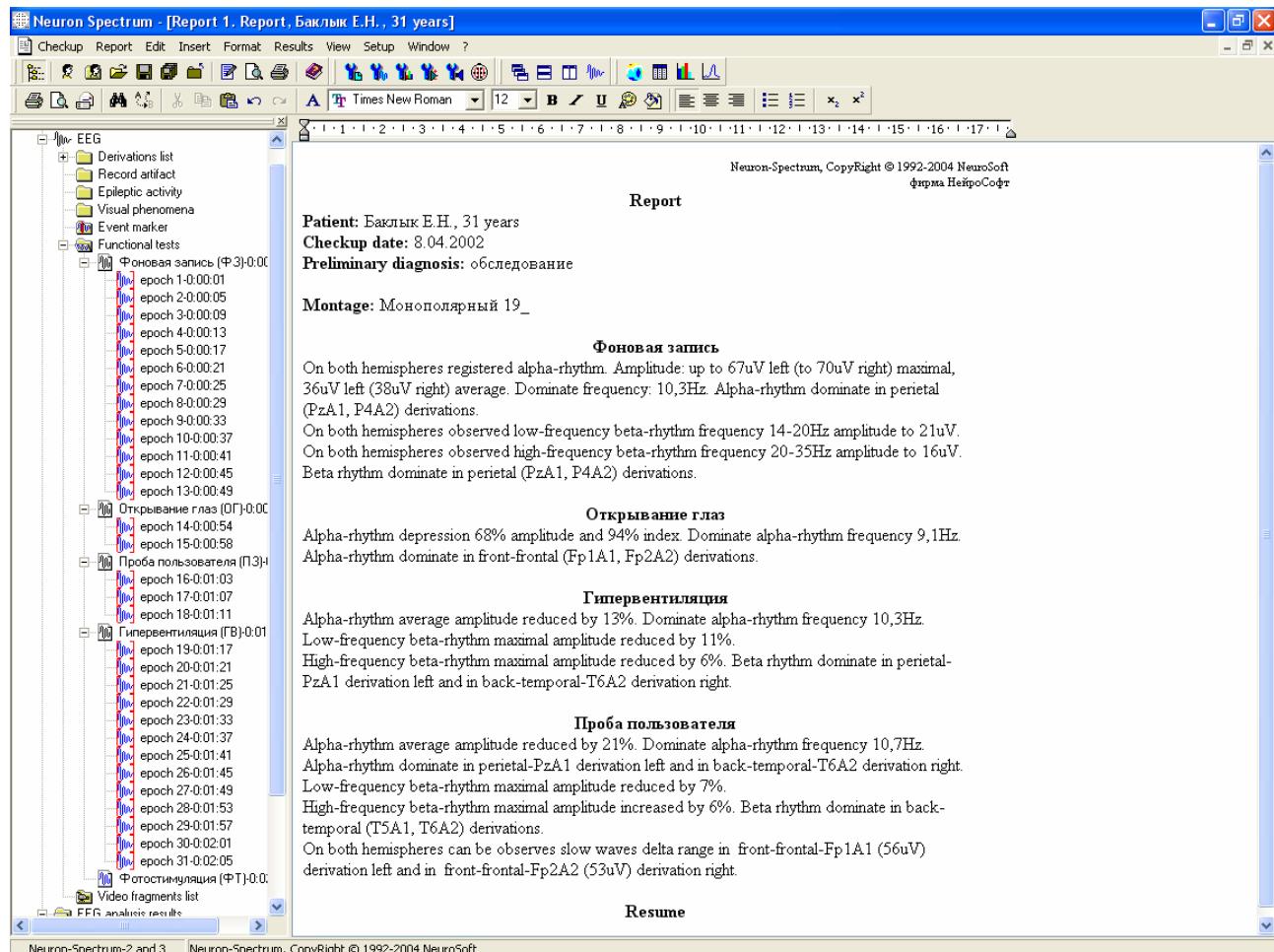
Pic. 12.63

CHAPTER 13

REPORT CREATING AND EDITING

1. Each checkup may include one or several reports. They are displayed in a separate window of text editor and contain text, tables, graphs and pictures. The software allows both automatic generating of a report and entering of information via the keyboard. The **Neuron-Spectrum** software can creates two types of reports: built-in and **Word 97/2000/2002/XP** format ones.

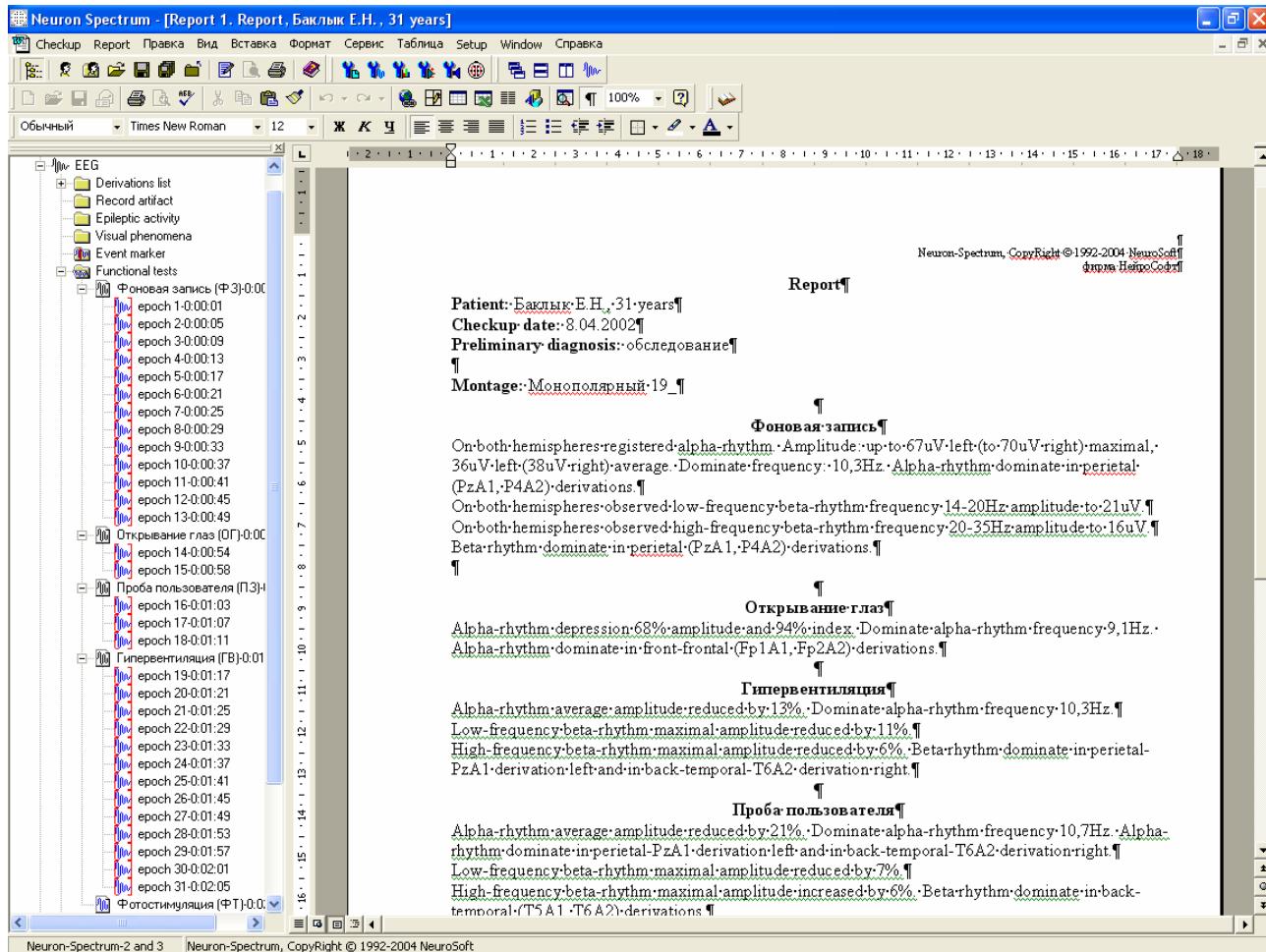
The editor of a built-in report is in many respects similar to the **WordPad** editor of the **Windows** operating system (Pic. 13.1). The merits of the editor are fast operation, and good report quality. Besides, there is no necessity of additional software. Among the disadvantages – poor tables forming and limited editing facilities.



Pic. 13.1

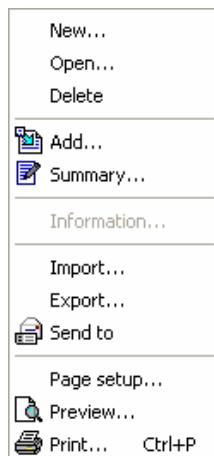
Neuron-Spectrum Program

The **Word 97/2000/2002/XP** fotrmat report (Pic. 13.2) uses all the facilities of **Microsoft Word 97/2000/2002/X.**



Pic. 13.2

2. To work with a report, use commands of the **Report** menu (Pic. 13.3): **Analysis|Report creation** and **Results|Report** in the EEG review and analysis window and **Results|Report** in the analysis results viewing windows.



Pic. 13.3

3. There are auto formed reports and reports formed manually in the **Neuron-Spectrum** software. There can be only one report formed automatically. It contains description of EEG has been analyzed. It can be edited and completed by any information. There can be a quantity of reports formed manually. The user forms their content.

4. There may be two methods of automatic report creation:

- If the EEG has not been analyzed yet, but the epochs have already been set, use the **Analysis|Report creation** menu command of the EEG review and analysis window, the  button on the toolbar or the [Ctrl+P] combination to start EEG analysis and automatic report generation.
- If the EEG has been analyzed, use the **Results|Report** command, click on the  button or press the [Alt+P] keys combination to start automatic report generation.
- Report is generated according to the parameters set in the **Program setup** dialog on the **Report** page.

5. To create a new report, use the **Report|New** menu command. The **New Report** dialog box will appear on the screen (Pic. 13.4). When automatic report generation the same dialog box is displayed.



Pic. 13.4

Report type – a built-in report or a report of **MS Word** format.

Report name is a short name of the report. The name is used just to make the report search easier.

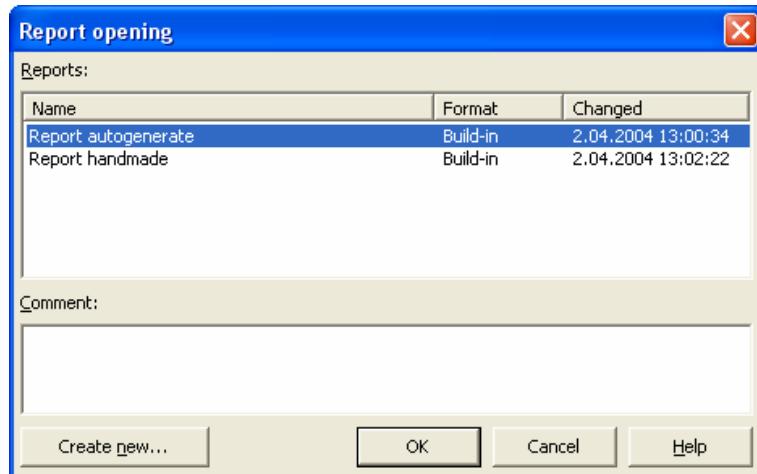
Comment is optional report description. It is not included into report data and is not printed. It is used to simplify the report identification

Input the necessary data and click “*OK*”. The editor window with the new report will appear on the screen.

Checkup and patient information are entered into a new report window automatically.

6. To look through the automatically generated checkup report, use the **Results|Report** command, the  button or the [Alt+P] keys combination in the EEG review and analysis window or any other results viewing window.

To look through other checkup reports that have already been created manually, use the **Report|Open** menu command. The **Report opening** dialog box will be displayed (Pic. 13.5).



Pic. 13.5

Reports – the list of all the reports created in the checkup.

Name – a short report name.

Format – the type of the report format: built-in or **Word**.

Changed – the date of the report creation or the last change.

Comment – report description.

To change comment of the report highlighted in the *Reports* list, you have to correct it in the *Comment* field.

If you click on the “*Create new*” button, a new report dialog box will appear on the screen.

To view and edit the report, highlight it, press [Enter] or click “*OK*”.

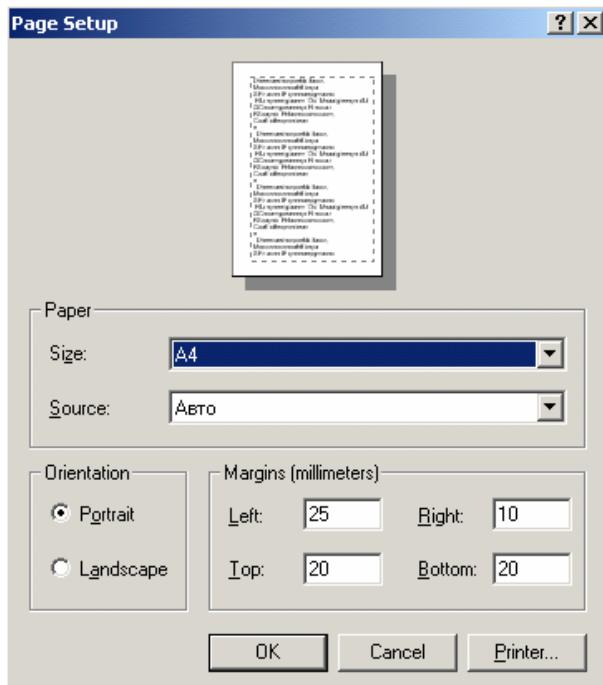
7. To delete the report, use the **Report|Delete** command. To look through the information about the report (its type, name and comment), use the **Report|Information** command. In the **New report** dialog box (Pic. 13.4) you can correct the name of the report and its comment.

8. You can save the report in an external file (*.RTF–file for built-in editor and *.DOC–file for **Word 97/2000/2002/XP**). To do it, use the **Report|Export** command. You can also e-mail your report.

Use the **Report|Send to** command or the  button on the toolbar of the editor window.

9. To print a report, use the **Report|Print** command or the  button on the toolbar.

10. You can set page parameters for a built-in report. To do it use the **Report|Page setup** command. Change the parameters in the **Page setup** dialog (Pic. 13.6).



Pic. 13.6

The upper part of the dialog box displays page layout with the setting parameters given below. The parameters alteration causes the automatic change of the layout.

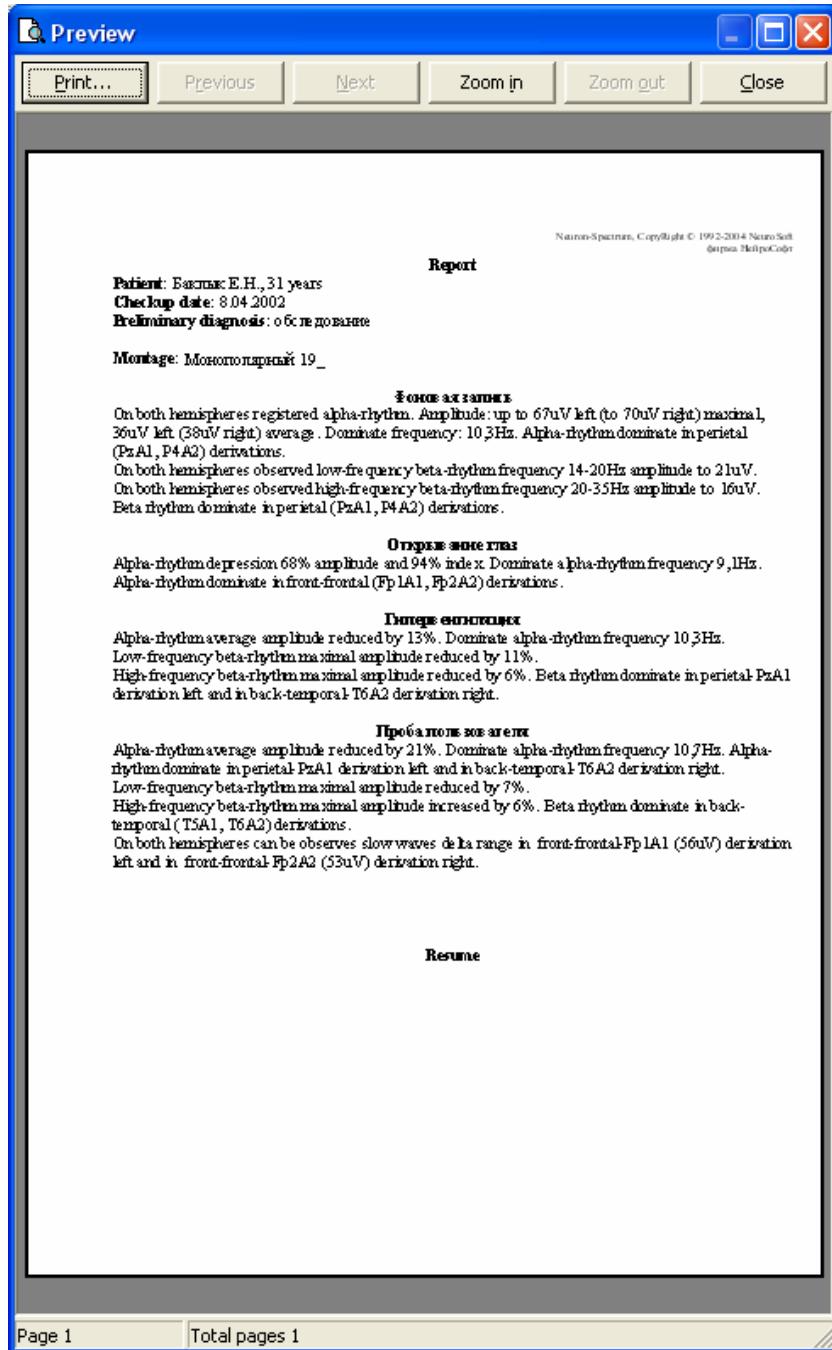
Size. Select the size of the paper used for printing.

Feed. Choose the paper source.

Alignment. “Portrait” or “Landscape” orientation of a paper list.

Margins. Text indents from the paper edges.

11. You can preview the layout of the report before printing. Use the **Report|Preview** command or the  button on the toolbar. A **Preview** dialog box with the report layout will appear on the screen (Pic. 13.7).

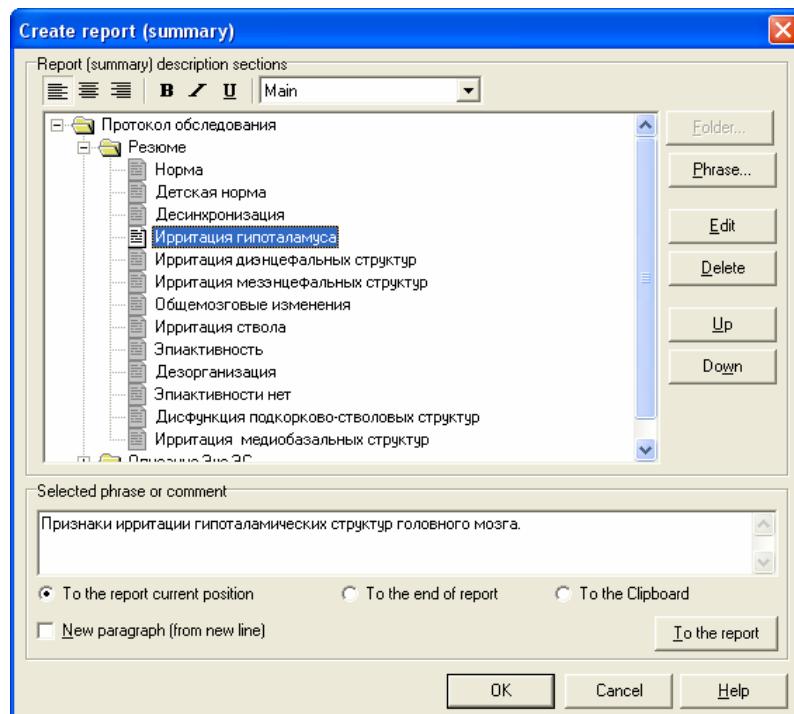


Pic. 13.7

To print the report, click on the “Print” button. To navigate within the report use the “Next” and “Previous” buttons. The “Zoom in” and “Zoom out” buttons are used to change the report size. To finish preview, click “Close”.

12. The report can be imported from the external file. Use the **Report|Import** menu command in the EEG review and analysis window. A new report will be created. Its content will be imported from external ***.RTF**-file.

13. The **Neuron-Spectrum** software enables creating of the arbitrary hierarchical list of standard phrases, which then can be copied to a report by single clicking on the button. To create the list and add the phrases to the report, use the **Report|Summary** command or the  button on the toolbar. The **Create report (Summary)** dialog box will appear on the screen (Pic. 13.8).



Pic. 13.8

The hierarchical list consists of *Folders* (sections) and *Phrases*.

Folder (section) is the element of the hierarchical list, which may contain other sub-sections and phrases. It cannot be added to the report and is used only for list structuring. The  icon shows that the section is closed, its content is hidden. The  icon shows that the section is open, its content is given in the list.

Phrase is the element, which can be added to the report. It does not include other sections or phrases. Phrases are marked by the  and  icons.

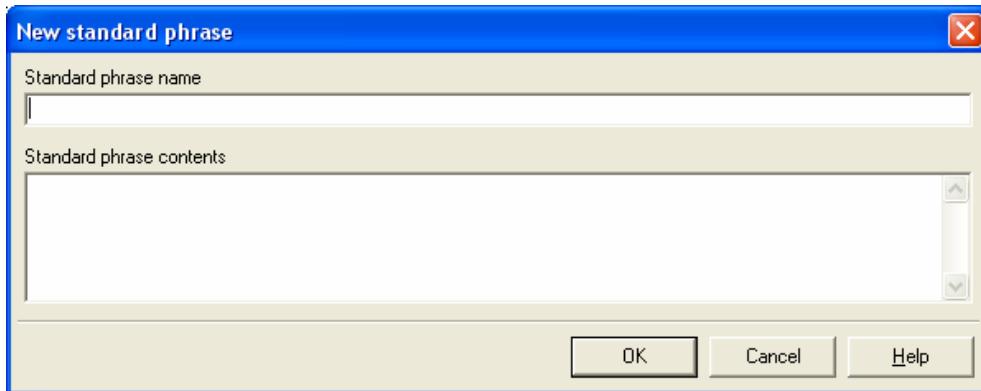
The list includes only the names of sections and phrases. The content of the phase selected is displayed in the *Selected phrase or comment* field. The *To the report current position*, *To the end of the report* and *To the Clipboard* radio buttons indicate the position, which the phrase will be inserted to. To copy the phrase, click on the “*To the report*” button.

To create a hierarchical list, use the buttons placed to the right of the list and the buttons of phrases forming.

The “*Folder*” button adds a new sub-section to the current section. The list always includes root (main) section: *Report*. To add sub-sections, click on the section in which you want to place it.

The “Phrase” button adds a new phrase to the current section.

When you create a new phrase or a new section, there appears the **New standard phrase** (Pic. 13.9) or **New section** dialog box.



Pic. 13.9

Enter the phrase or section name and phrase content (comment on the section). Click “OK” or press [Enter]. Phrase or section will be added to the list.

You can preset phrase formatting. Formatting specifies the appearance of the phrase (font, alignment, etc). To preset the formatting, use the buttons above the list. The buttons correspond to the standard buttons of paragraph formatting. The font is selected in the combo box. Font parameters are set in the **Setup program** dialog box on the *Protocol* page. There are 5 font types:

- Basic – is used for ordinary report phrases.
- Titles – is used for report titles.
- Tables – is used for report tables forming.
- Small – enables the displaying of some fragments in small print.
- Highlighting – to highlight the important words or fragments.

14. You can insert the content of any results window or EEG fragment to the report using the **Copy** menu command in any results window (see below).