“HBI Database”

Version 2
(User Manual)

St-Petersburg, Russia
2007

1. Introduction

The HBI database was developed to help researchers perform both conventional and quantitative EEG and quantitative ERPs studies.

The HBI database is build in WinEEG software option but distributed separately. This allows any user of Mitsar-EEG systems upgrade it software by HBI database (the procedure of installation of HBI database see below). The description of WinEEG software (as PSYTASK software) can be downloaded from Mitsar site: http://www.mitsar-medical.com/printabledownloads.htm

The HBI database includes the results of processing more than 3000 EEG recordings collected from more than 1000 health subjects with age from 7 to 89 years old.

EEGs were recorded at 7 different conditions: Eye Opened, Eye Close tasks and during performing 5 different tasks using for ERP analysis such as Visual Continuous Performance Task (VCPT), Auditory Task, Reading Task, Mathematical Task and Missmath Negativity Task.

The HBI database includes the average spectra, average coherence, average event related potentials (ERPs) and their variance computed for three different referents: linked ears referent, average referent and weighted average referent. The next tables include the numbers of studies that were average for each condition and age.

1. Spectra for Eye opened and Eye closed condition

	Eye opened			Eye closed		
Age	Average referent	Weighted average referent	Linked ears referent	Average referent	Weighted average referent	Linked ears referent
7-9	40	40	32	43	43	28
10-11	49	48	40	49	49	37
12-13	65	63	51	61	62	50
14-15	50	50	49	47	46	43
16-17	59	58	58	59	59	59
18-19	62	61	62	64	63	64
20-21	61	61	61	56	56	56
22-23	44	44	45	43	44	42
24-25	56	54	55	52	53	50
26-30	34	36	35	33	33	33
31-35	24	26	26	25	26	26
36-40	37	38	38	38	38	38
41-45	57	59	59	59	58	57
46-50	52	52	52	52	52	52
51-55	57	56	56	54	54	54
56-60	39	39	39	39	39	39
61-65	25	25	24	25	25	24
66-70	38	38	38	38	38	38
71-80	36	36	37	37	37	37
81-90	10	10	10	10	10	10
Total	895	894	867	884	885	837

2. Spectra and ERPs for Visual Continuous Performance Task

	Spectra			ERPs		
Age	Average referent	Weighted average referent	Linked ears referent	Average referent	Weighted average referent	Linked ears referent
7-9	61	55	46	50	45	35
10-11	61	60	55	58	51	46
12-13	65	63	58	63	63	56
14-15	54	52	52	50	46	43
16-17	58	58	58	57	57	57
18-19	65	64	65	63	62	61
20-21	45	45	45	42	43	42
22-23	38	36	36	36	34	33
24-25	47	46	46	46	45	45
26-30	35	34	34	34	32	33
31-35	25	23	25	23	23	23
36-40	39	36	38	37	36	36
41-45	57	56	55	57	56	55
46-50	52	50	51	49	49	47
51-55	56	54	55	53	51	51
56-60	38	36	38	38	36	34
61-65	23	23	21	23	23	21
66-70	39	37	38	37	37	37
71-80	35	35	35	35	35	35
81-90	11	11	11	10	10	10
Total	904	874	862	861	834	800

3. Spectra and ERPs for Auditory Task

	Spectra			ERPs		
Age	Average referent	Weighted average referent	Linked ears referent	Average referent	Weighted average referent	Linked ears referent
7-9	44	42	31	12	13	10
10-11	49	49	44	40	40	34
12-13	61	62	53	54	57	43
14-15	51	51	50	42	42	40
16-17	58	57	57	55	56	56
18-20	64	64	63	64	63	62
21-30	58	58	59	58	58	59
31-40	47	48	51	48	48	48
41-50	91	94	95	91	93	91
51-60	82	85	82	82	84	81
61-70	57	57	57	55	57	55
71-90	38	40	38	36	36	34
Total	700	707	680	637	647	613

4. Spectra and ERPs for Mathematical Task

	Spectra			ERPs		
Age	Average referent	Weighted average referent	Linked ears referent	Average referent	Weighted average referent	Linked ears referent
7-9	26	26	25	25	24	18
10-11	43	42	40	41	40	33
12-13	55	54	50	55	54	45
14-15	40	40	40	40	39	38
16-21	30	27	30	30	27	30
22-46	24	23	23	24	23	23
Total	218	212	208	215	207	187

5. Spectra and ERPs for Reading Task

	Spectra			ERPs		
Age	Average referent	Weighted average referent	Linked ears referent	Average referent	Weighted average referent	Linked ears referent
7-9	42	41	33	27	26	21
10-11	52	51	49	40	38	31
12-13	61	61	53	48	46	35
14-16	57	55	55	50	49	42
Total	212	208	190	165	159	129

6. Spectra and ERPs for Reading Task

	Spectra			ERPs		
Age	Average referent	Weighted average referent	Linked ears referent	Average referent	Weighted average referent	Linked ears referent
15-17	45	45	45	44	45	44
18-20	56	56	56	55	55	55
21-40	54	54	54	54	54	54
41-50	44	44	44	44	44	44
51-84	53	52	51	52	51	51
Total	252	251	250	249	249	248

The HBI database includes optionally average ERP independent components. During this processing 19 channels ERPs for all subjects were processed and the decomposition of this ERPs to independent components was computed. Most important and ease explained components were selected and average by subjects for each group of age. Both average independent components of ERPs and matrixes of transformation from ERPs to components were included in HBI database.

2. Recording conditions

The EEG was recorded by Mitsar-EEG (21-channels) system. An electrode cap (produces by Electro-Cap International Inc.) containing tin electrodes was fitted, with continuous EEG recorded from 19 sites (Fp1, Fp2, F7, F3, Fz, F4, F8, T3, C3, Cz, C4, T4, T5, P3, Pz, P4, T6, O1 and O2) of the International 10–20 System (Jasper, 1958). The input signals referred to the linked ears were amplified (bandpass 0.3–70 Hz) and sampled at the rate of 250 Hz. The additional input was used for recording signal from special button during ERP studies. Further this signal was used for computing task performance parameters such as reaction time, omission and commission errors.

2.1. Eye opened and eye closed condition.

The EEG was recorded continuously during both Eyes opened and Eyes closed conditions. The duration of EEG recording for each condition was varied from 3 to 5 minutes.

2.2. Visual Continuous Performance Task

The EEG was recorded continuously during whole task. The tree types of visual stimuli are presented in this task: pictures with animals, pictures with plants and pictures with peoples. Stimuli are presented by pairs corresponding to trials. There are four different types of pairs: “Animal-Animal”, “Animal-Plant”, “Plant-Plant”, and “Plant-Human”. Trials are presented at random order with equal probability. The duration of stimuli is equal 100 ms. Inter-stimulus interval in a pair is equal to 1100 ms. Interval between trials is equal to 3100 ms. Subject has to press a button as soon as possible in case of presentation of Animal-Animal pairs and ignore other pairs of stimuli. The total number of trials is equal to 400. (This task is included in PSYTASK software used for stimuli presentation.)

2.3. Auditory Task

The EEG was recorded continuously during whole task. One of eight easily discriminated auditory stimuli – four short tones (duration is equal to 100 ms) with different frequency and four long tones (duration is equal to 400 ms) are presented every 1100 milliseconds. Inter-stimulus interval is equal to 1100 ms. Total number of stimuli is equal to 994. There are 7 different sequences of stimuli presented randomly with equal probability: 2 short 1 long, 3 short – 1 long, 4 short 1 long, 5 short 1 long, 6 short 1 long 7 short 1 long and 8 short 1 long. The frequency of presented tones is selected randomly. Subject has to press a button as soon as possible in respond to long tones. (This task is included in PSYTASK software used for stimuli presentation.)

2.4. Mathematical Task

The EEG was recorded continuously during whole task. The visual stimuli are presented by pairs corresponding to trials. The first stimulus is arithmetical equation, the second – integer number. There are two types of pairs: in the first the result of arithmetical equation is equal to second number, in the second – not equal. Subject has to press a button as soon as possible in respond to first type pairs, and ignore second type pairs. The duration of first stimulus in the pair is equal 400 ms, and second – 200 ms. Inter-stimulus interval in a pair is equal to 1100 ms. Interval between trials is equal to 3100 ms. The total number of trials is equal to 200. (This task is included in PSYTASK software used for stimuli presentation.)

2.5. Reading Task

The EEG was recorded continuously during whole task. The stimuli are presented by pairs corresponding to trials. The first stimulus is a word presented visually in the screen, and second – the same or another word presented auditory. There are two types of pairs: in the first presented words are the same, in the second are different. Subject has to press a button as soon as possible in respond to first type pairs, and ignore second type pairs. The duration of first stimulus in the pair is equal 200 ms, and second is about 700 ms. Inter-stimulus interval in a pair is equal to 1100 ms. Interval between trials is equal to 3100 ms. The total number of trials is equal to 200. (This task is included in PSYTASK software used for stimuli presentation.)

2.6. Missmatch Negativity Task

The EEG was recorded continuously during whole task. One of two easily discriminated auditory stimuli –the low frequency tone (1000 Hz) and the high frequency tone (1300 Hz), or one of twenty complex auditory stimuli (the combination of five short tones with the frequency 500, 1000, 1500, 2000, 2500 ms) – is randomly presented for 100 milliseconds every 850 milliseconds. Total number of stimuli is equal to 2000. The probability of the low frequency tone is equal to 0.8, the probability of the high frequency tone or complex tone is equal to 0.1. Subject has to ignore all stimuli and has to read a book or watch TV. (This task is included in PSYTASK software used for stimuli presentation.)

3. Installation

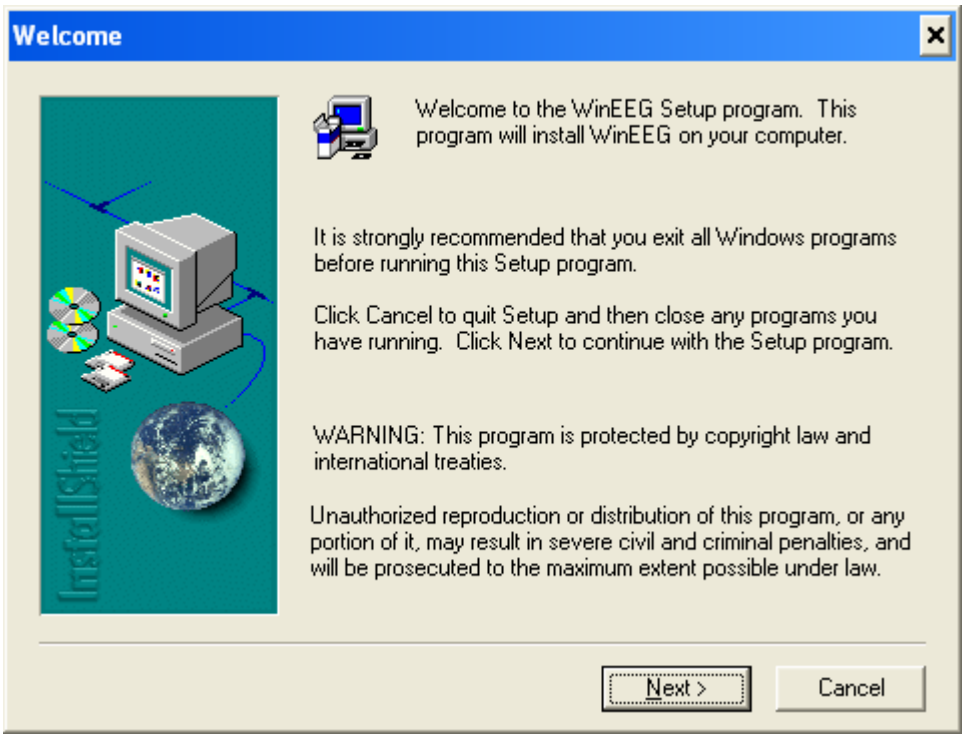
The HBI database installation consists of three important steps:

1. Installation of WinEEG software. WinEEG software (version 2.81.21 or later) should be installed. Latest version of WinEEG can be downloaded from Mitsar web-site: http://www.mitsar-medical.com
2. Installation of HBI database.
3. Installation of drivers for HBI database **dongle**.

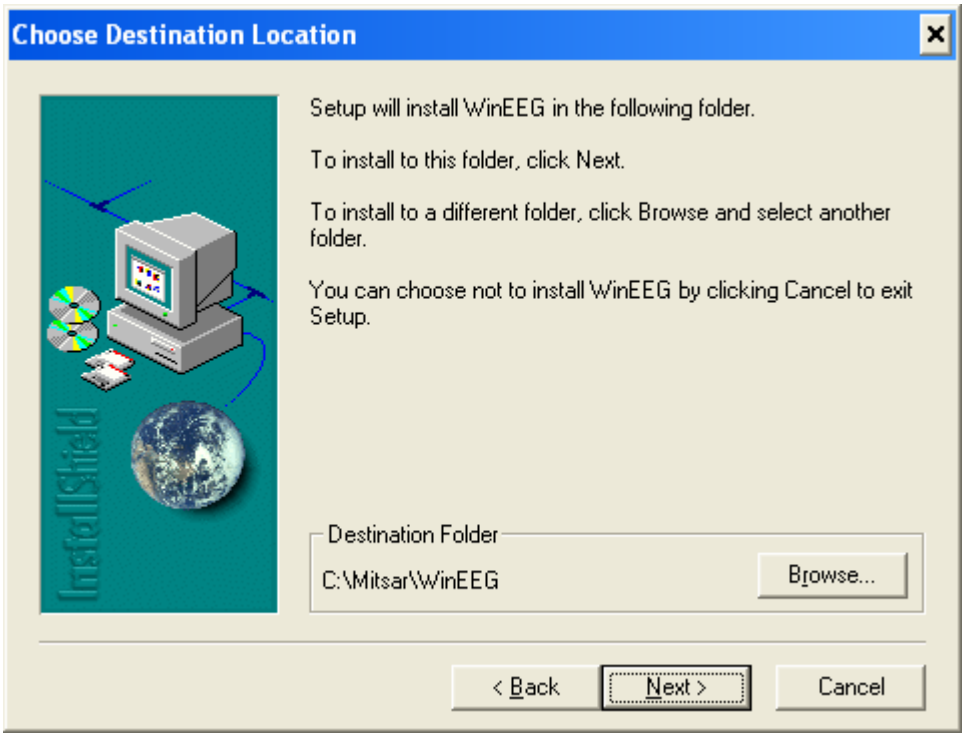
3.1. Installation of WinEEG software.

To install WinEEG program:

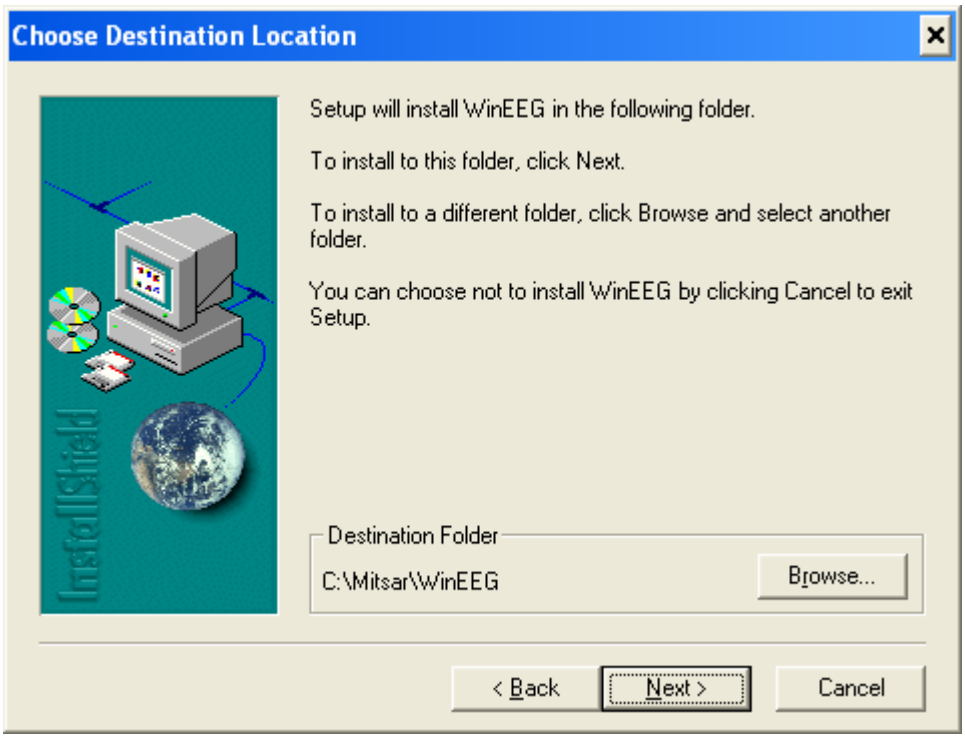
1. Insert the **CD** to the corresponding drive
2. Open folder with name "**WinEEG …**".
3. Run **SETUP.EXE** program.
4. Follow the instruction on the screen



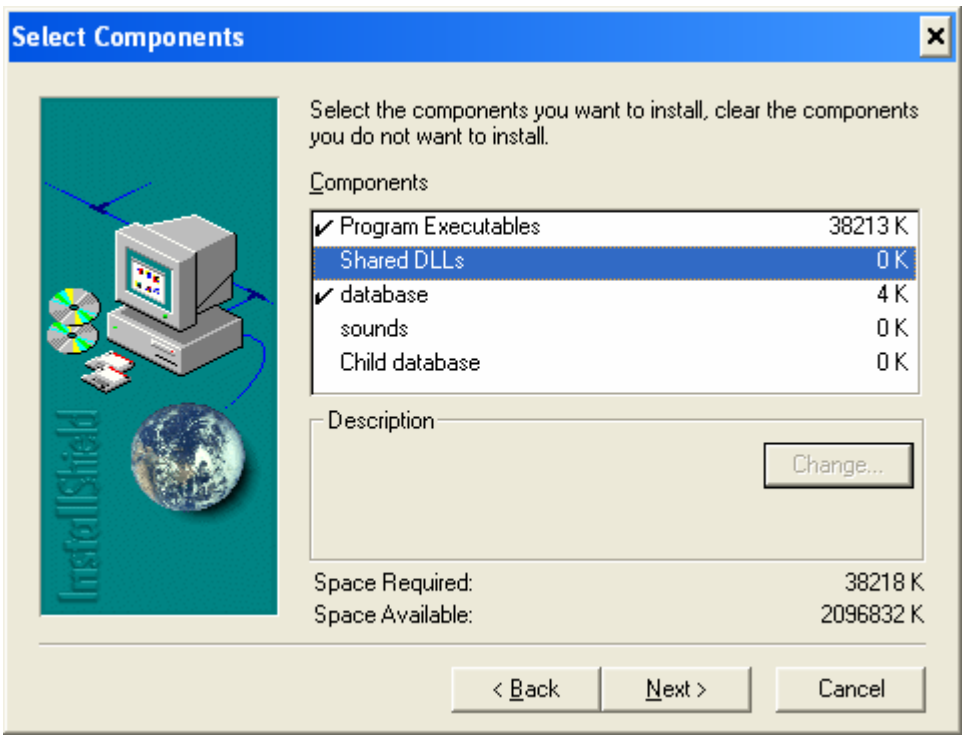
Press "**Next**" button to continue installation.



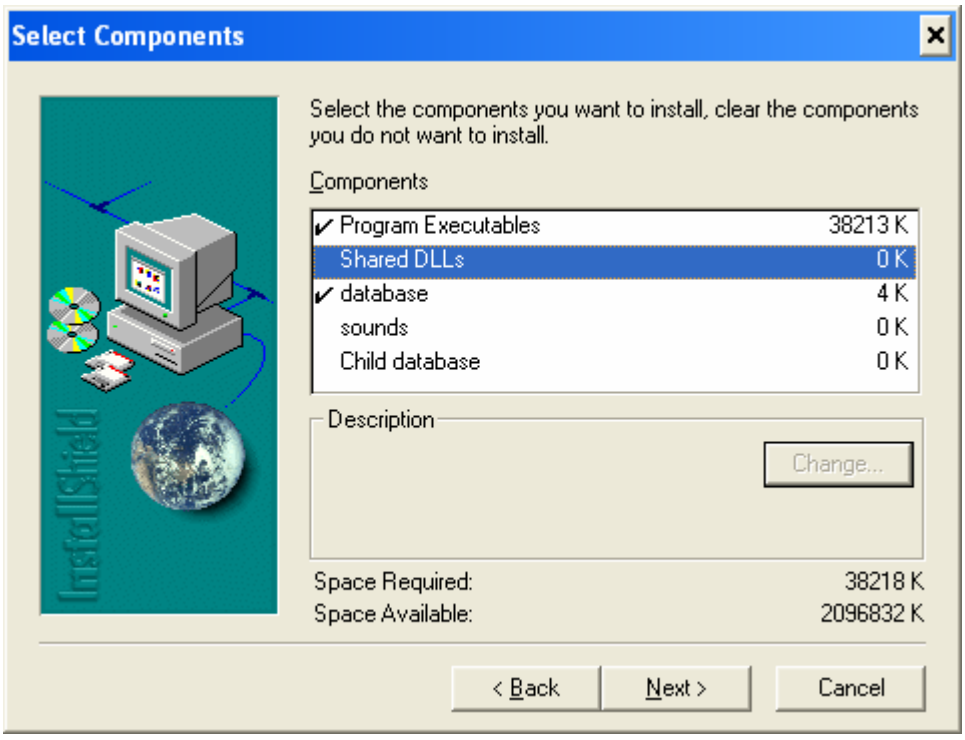
Press "**Browse**…" button if you would like to change location WinEEG program. Press "Next" button to continue installation.



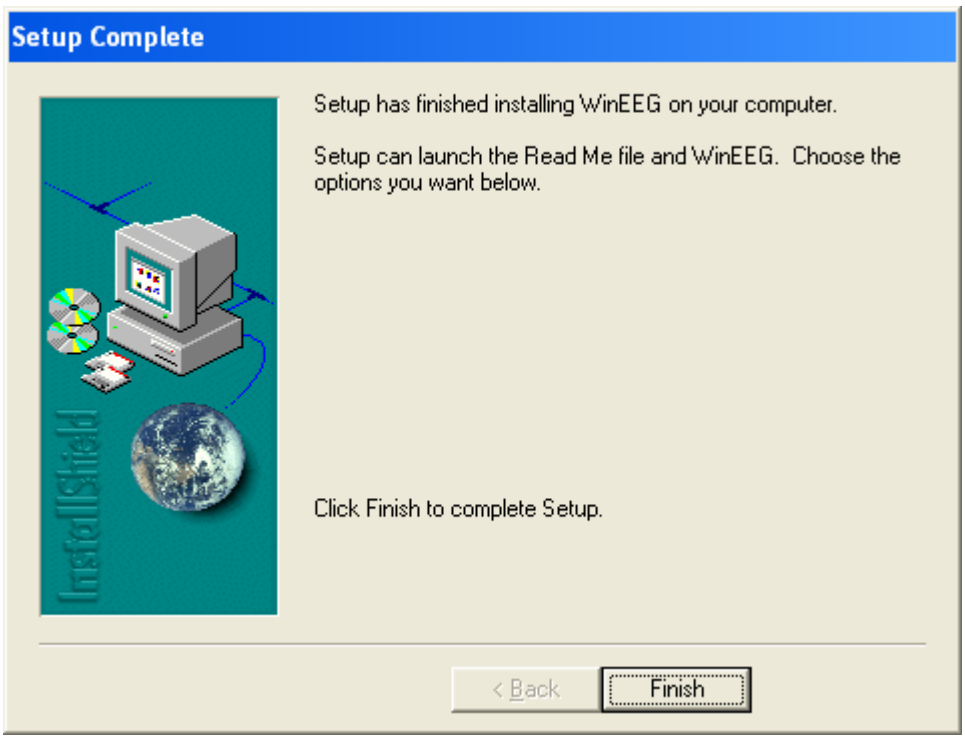
Select type of Setup you prefer. Press "**Next**" button to continue installation.



Select components you want to install. Don't install "**Sounds**. Don't install "**Child Database**". Press "**Next**" button to continue installation.



Type a new folder name if you want. Press "**Next**" button to continue installation.

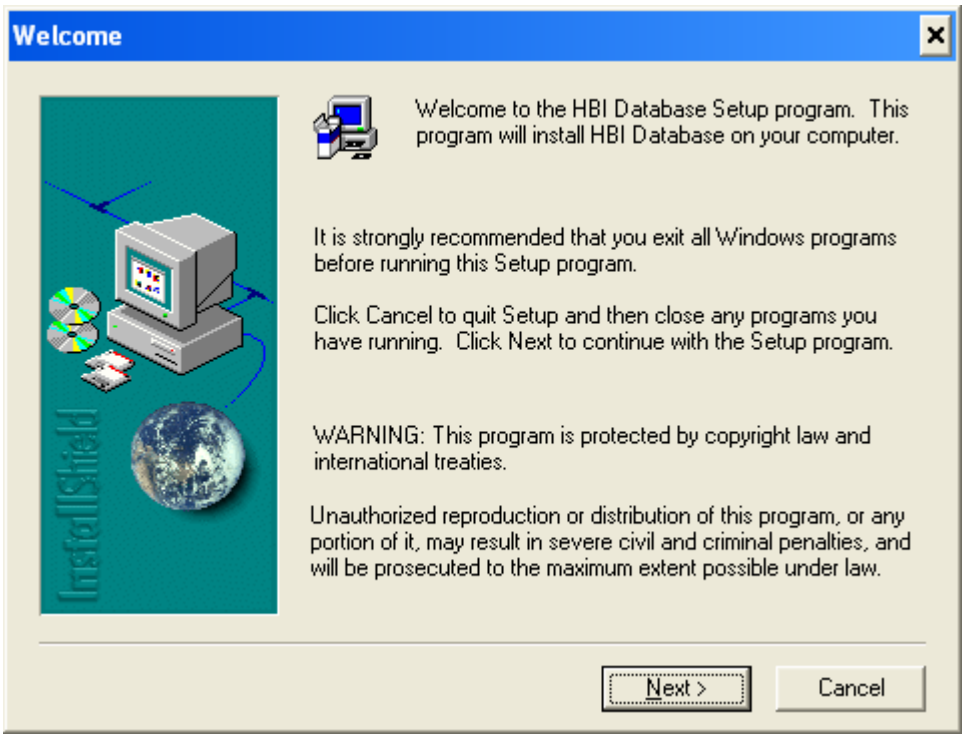


Press "**Finish**" button to complete Setup.

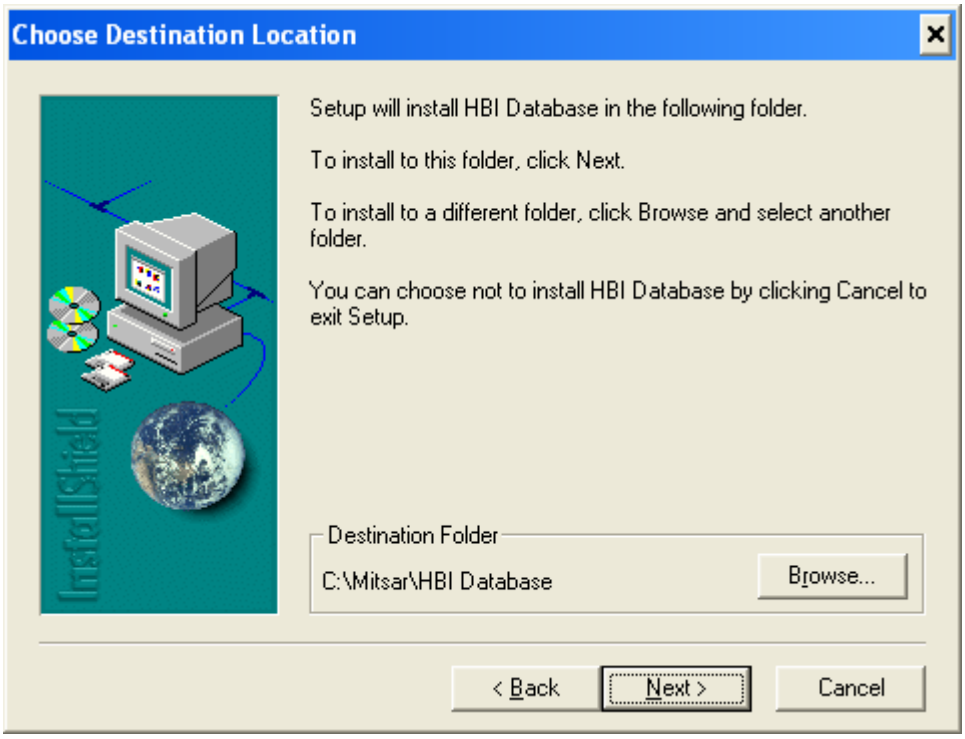
3.2. Installation of HBI database.

To install HBI database:

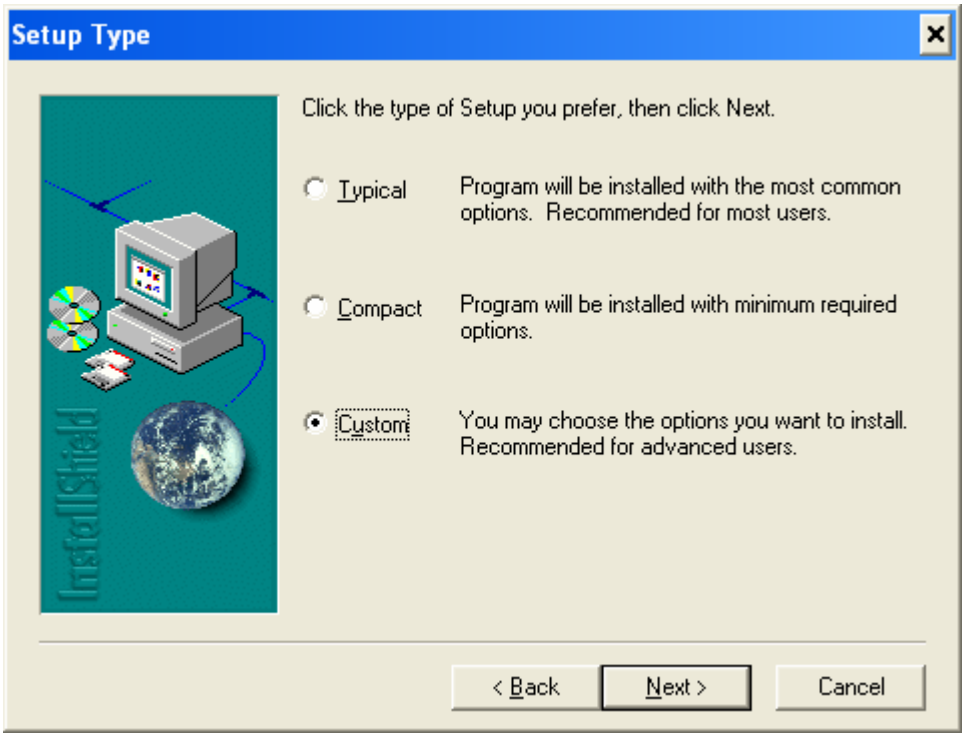
5. Insert the **CD** to the corresponding drive
6. Open folder with name "**HBI Database**".
7. Run **SETUP.EXE** program.
8. Follow the instruction on the screen



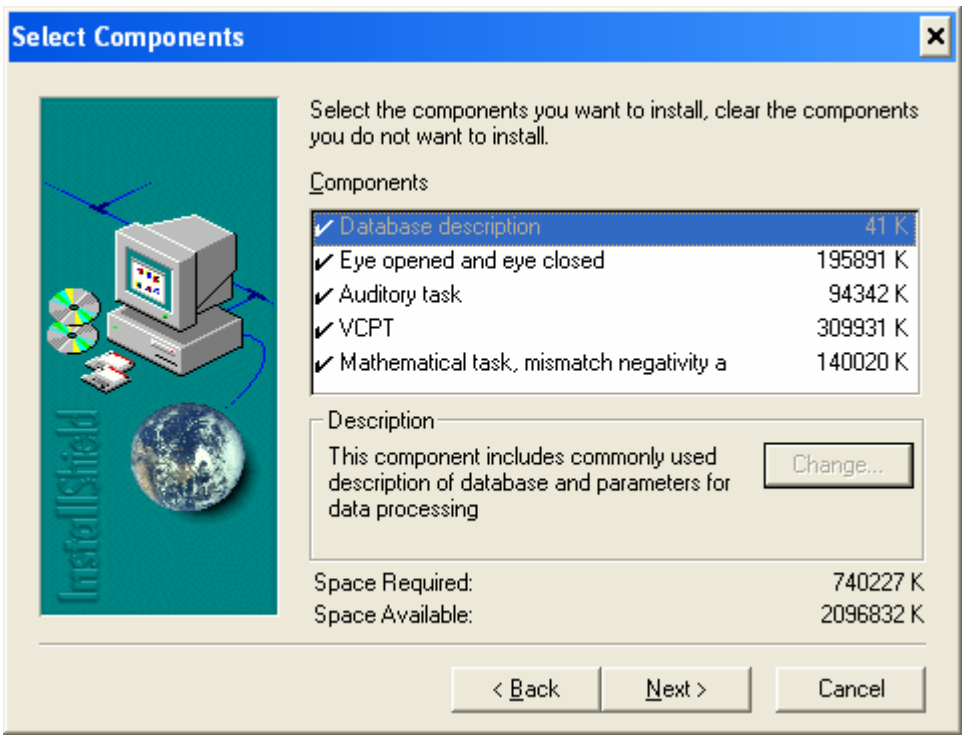
Press “**Next**” button to continue installation.



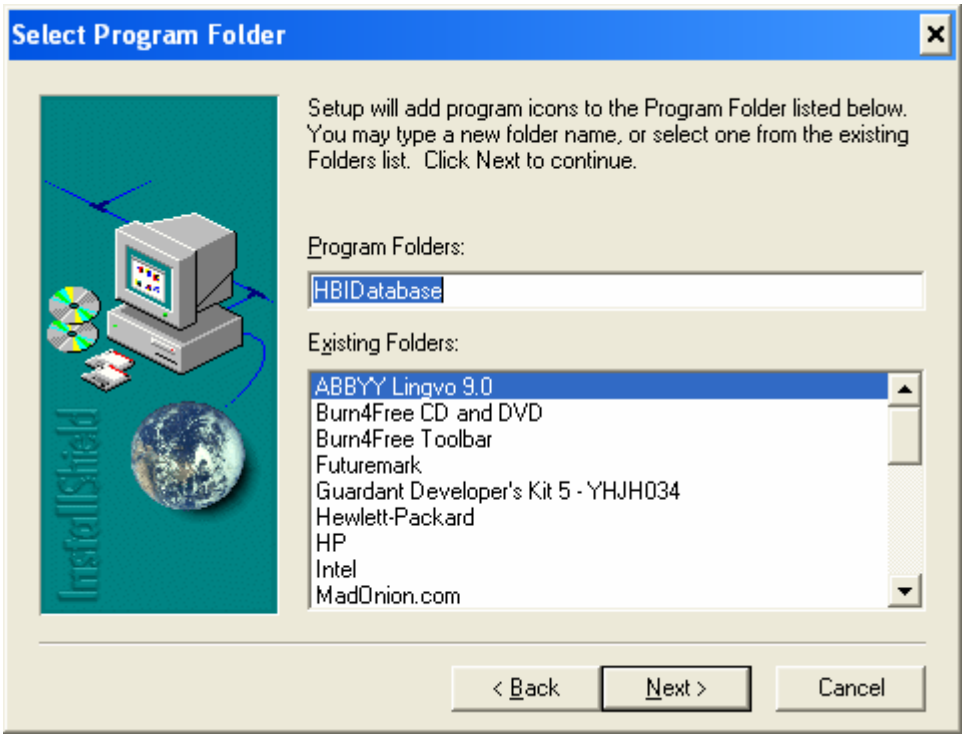
Press “**Browse**…” button if you would like to change location HBI database. Press “**Next**” button to continue installation.



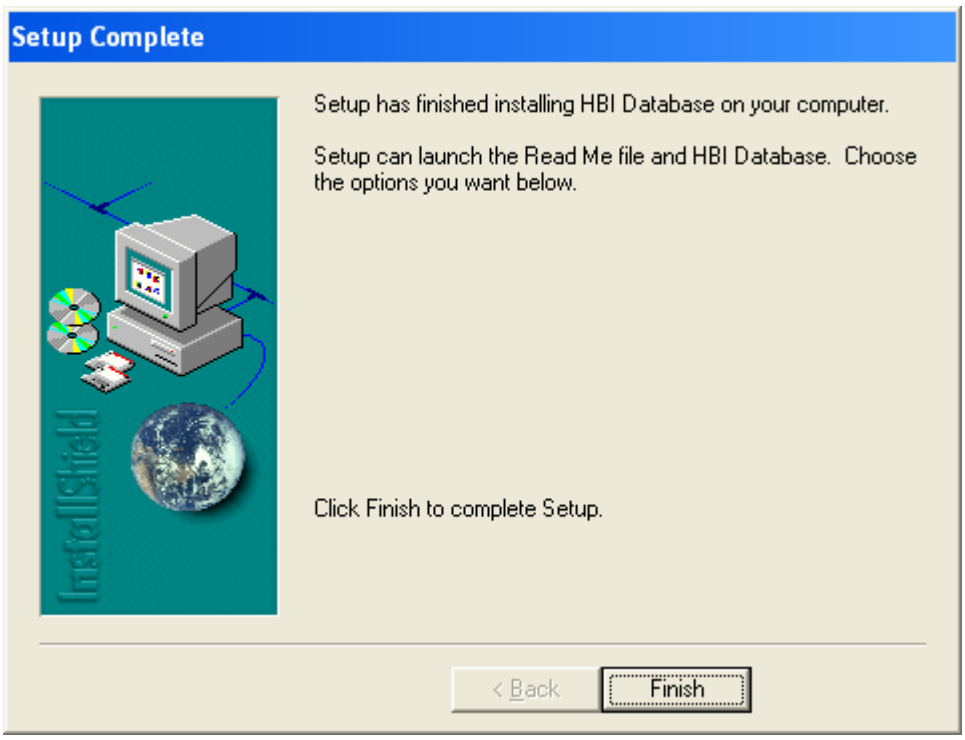
Select type of Setup you prefer. Press “**Next**” button to continue installation.



Select components you want to install. Press "**Next**" button to continue installation.



Type a new folder name if you want. Press "**Next**" button to continue installation.

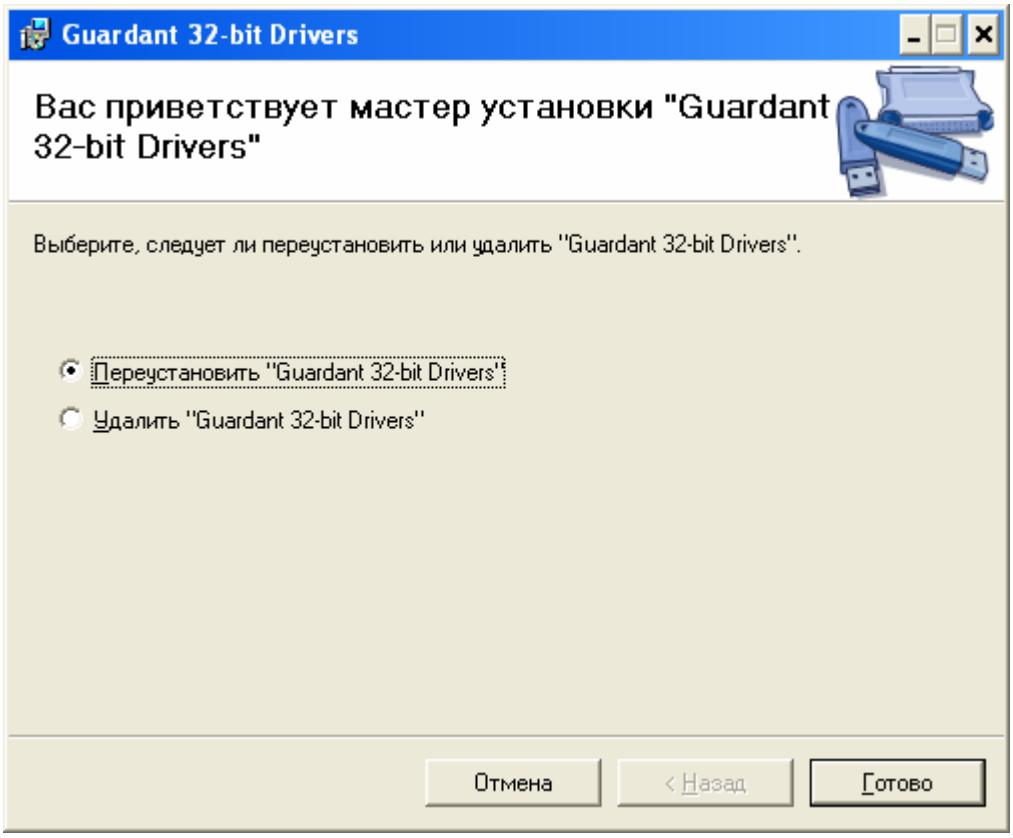


Press “**Finish**” button to complete Setup.

3.3. Installation drivers for HBI database dongle.

HBI database are protected by dongle (special electronic device) connected to USB. To open this function it is necessary to install driver for this device and to connect dongle to USB.

1. Insert the **CD** to the corresponding drive
2. Open the "**HBI Database dongle**" folder
3. Open "**Drivers**" subfolder
4. Run "**setup.exe**"



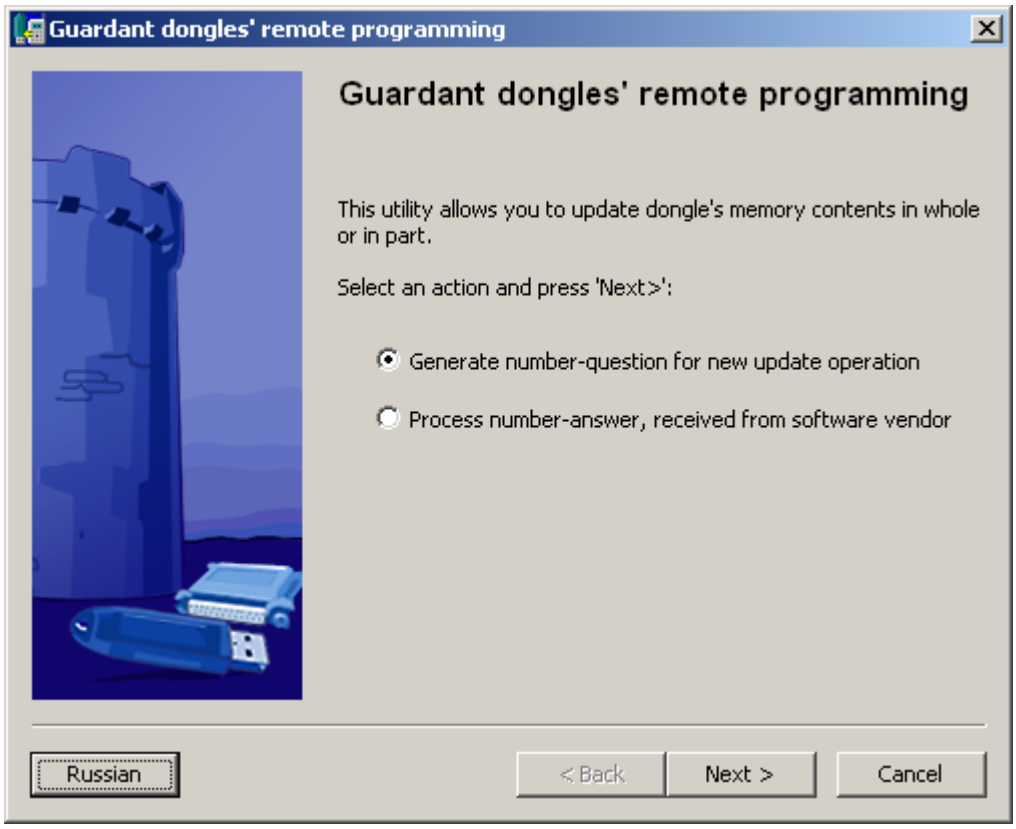
5. Press "**Finish**" («**Готово**») to install drivers (Right-Bottom Button).
6. Insert the **dongle** into the USB socket.
7. Windows will detect a **new hardware.**
8. Select **Automatic search** for corresponding driver and allow Windows to install it (press button "**Next**").
9. Sometimes you will need to reboot computer
10. Start **WinEEG** and work with HBI database.

3.4. Dongle remote programming.

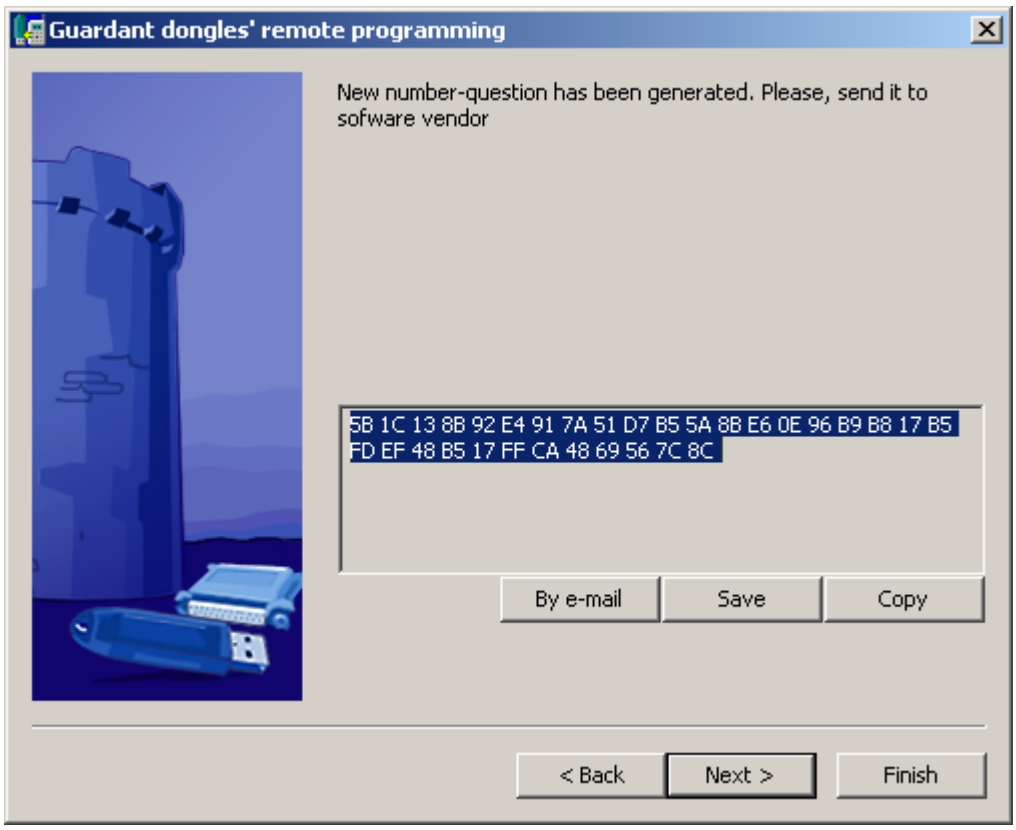
This chapter describes the procedure of remote programming of dongle. Do not read this chapter if you have dongle with unlimited number of comparisons with HBI database.

The remote programming of dongle consists of the next steps:

1. Insert the dongle to USB socket.
2. Run **gsremote.exe** utility placed in "**HBI Database dongle**" folder on CD. The next window will appear on the screen:

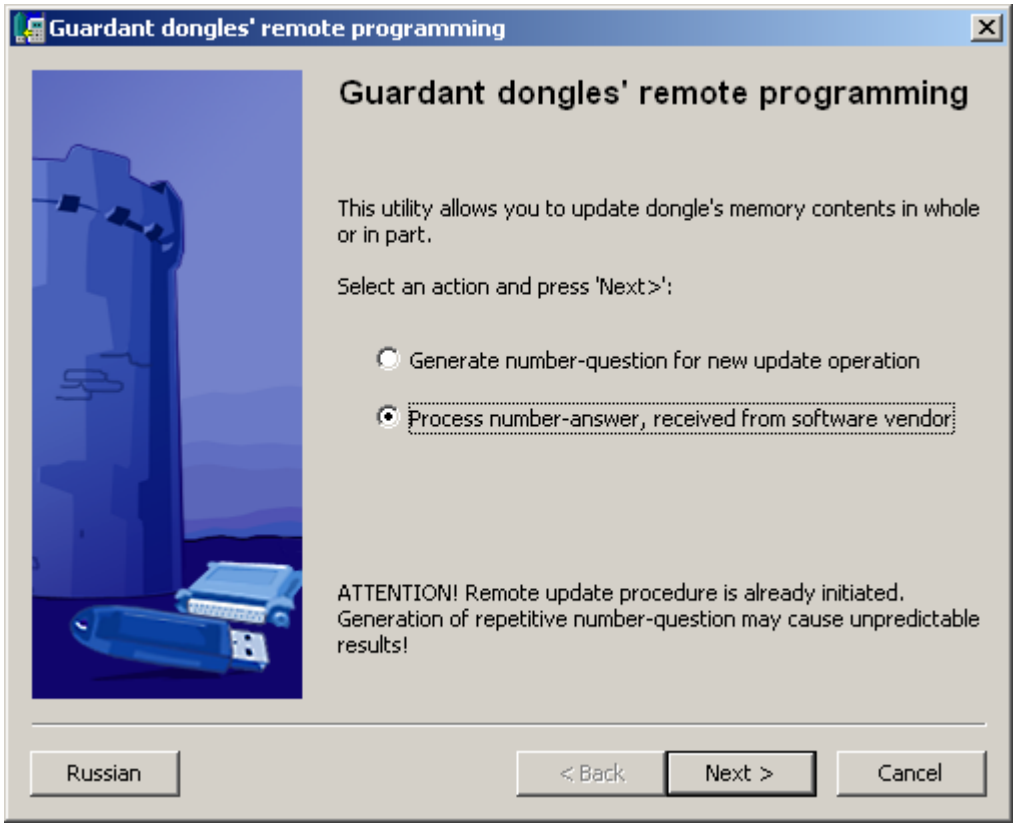


3. Select "**Generate number-question for new update operation**" and press "**Next**" button. The next window will appear on the screen:

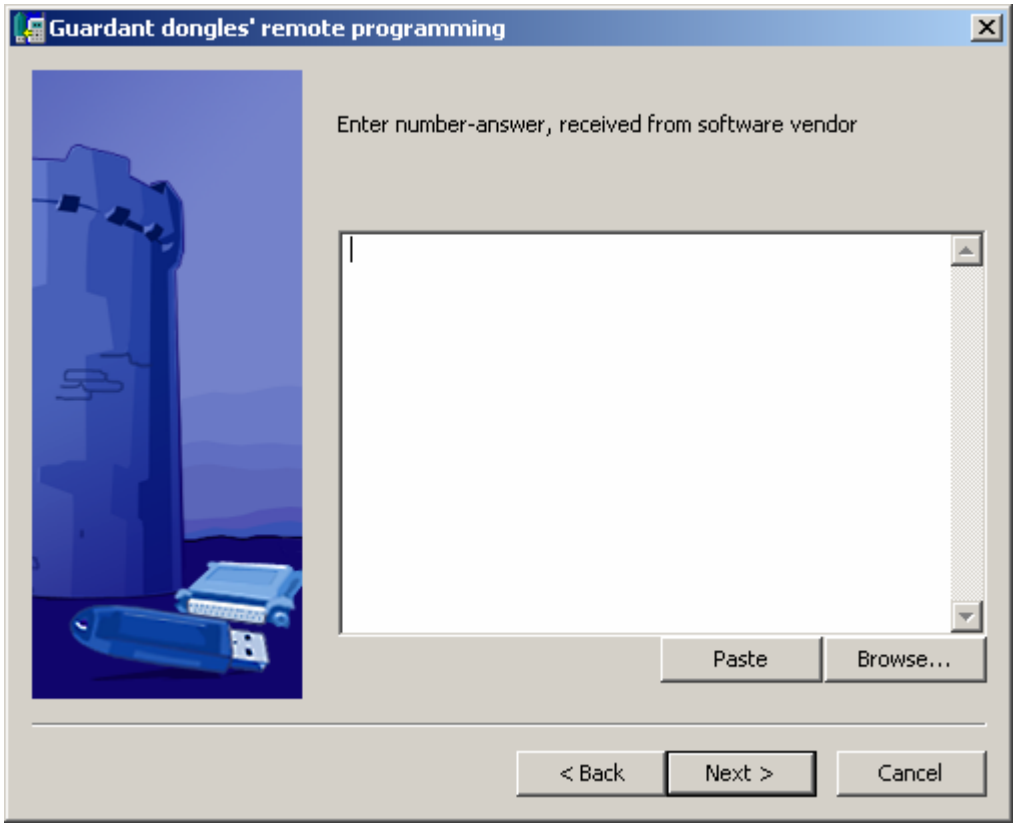


4. Press "**Save**" button to save the "**number-question**" into the file with name "**question.txt**" and press "**Cancel**" button to exit from **gsremote.exe** utility.
5. Send "**question.txt**" file to the software vendor by e-mail and wait for answer.
6. The vendor will send you the answer during a number of days. When you have received the answer save "update.txt" file to the hard disk and continue remote dongle update operation.

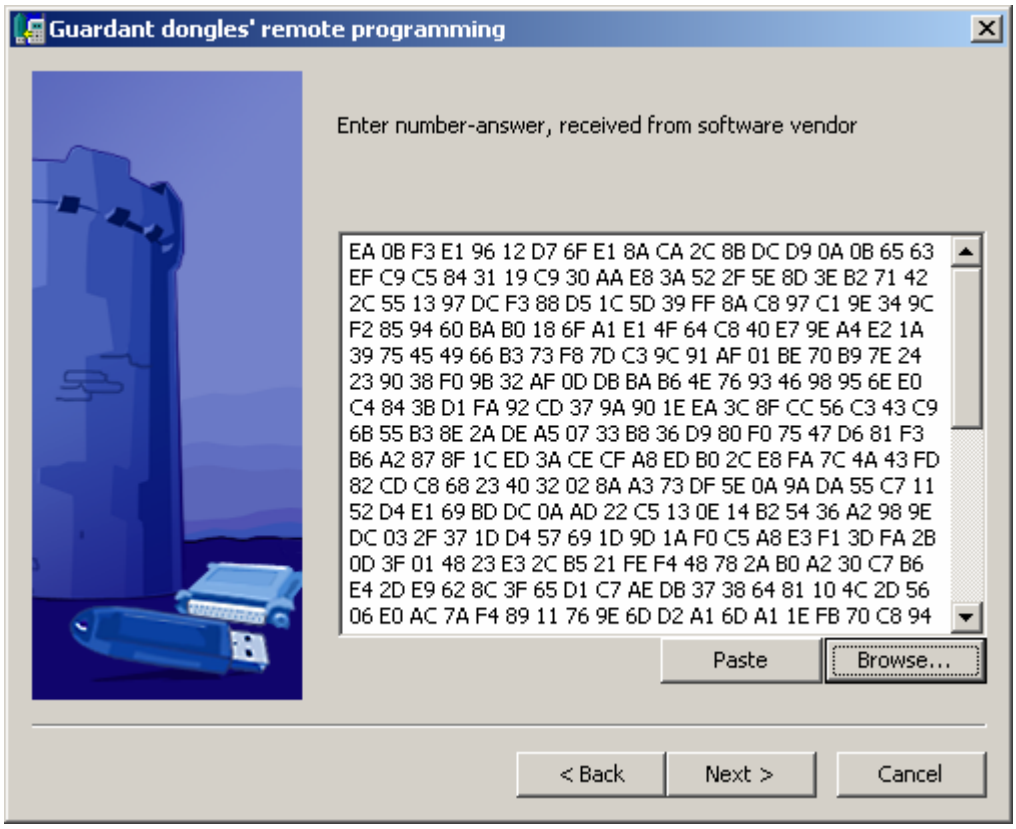
7. Insert the dongle to USB socket
8. Run **gsremote.exe** utility again. The next window will appear on the screen:



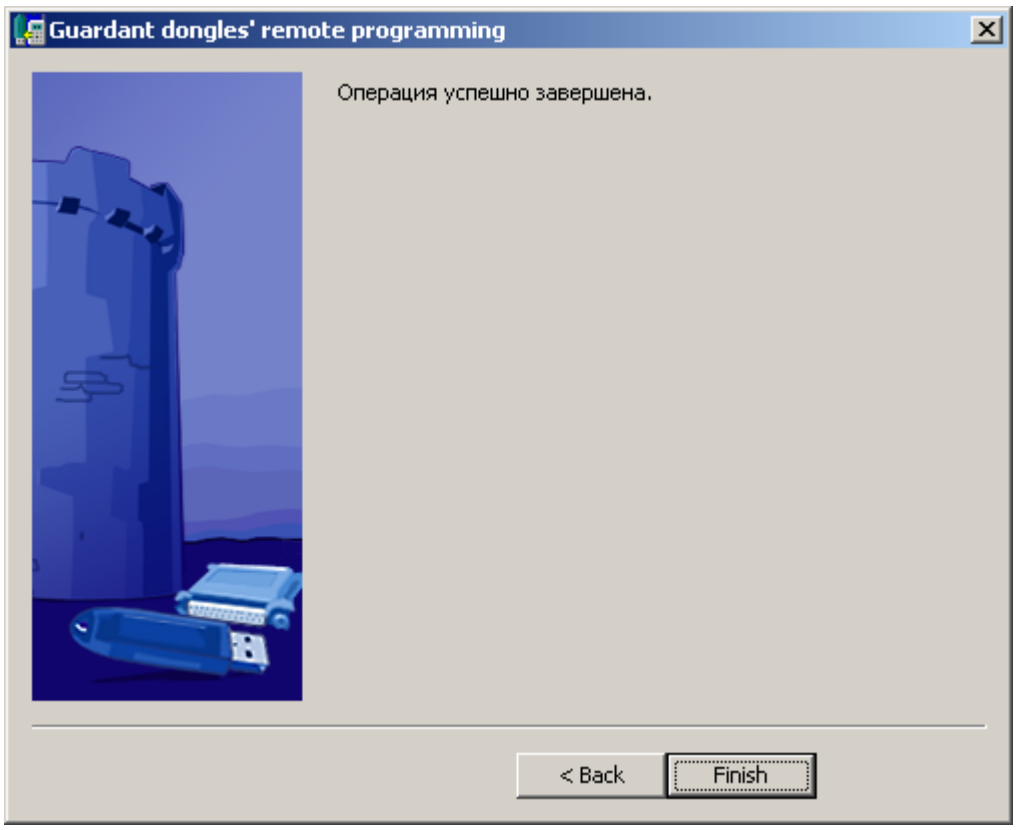
9. Select "**Process number-answer, received from software vendor**" and press "**Next**" button. The next window will appear on the screen:



10. Press “**Browse**” button to load the “**number-answer**” The name of file containing “**number-answer**” is “**update.txt**.



11. Press “**Next**” button to start dongle reprogramming. The next window will appear on the screen if reprogramming have completed successfully.



12. Press “Finish” button to exit from **gsremote.exe** utility.

Warning! Do not run **gsremote.exe** utility between “**Generate number-question for new update operation**” and “**Process number-answer, received from software vendor**” sessions. **This can result to “number-answer” will be invalid.**

Attention! You can use the dongle between “**Generate number-question for new update operation**” and “**Process number-answer, received from software vendor**” sessions for opening another WinEEG functions.

Attention! Use **GuarView.exe** to look at resting number of comparisons with HBI database.

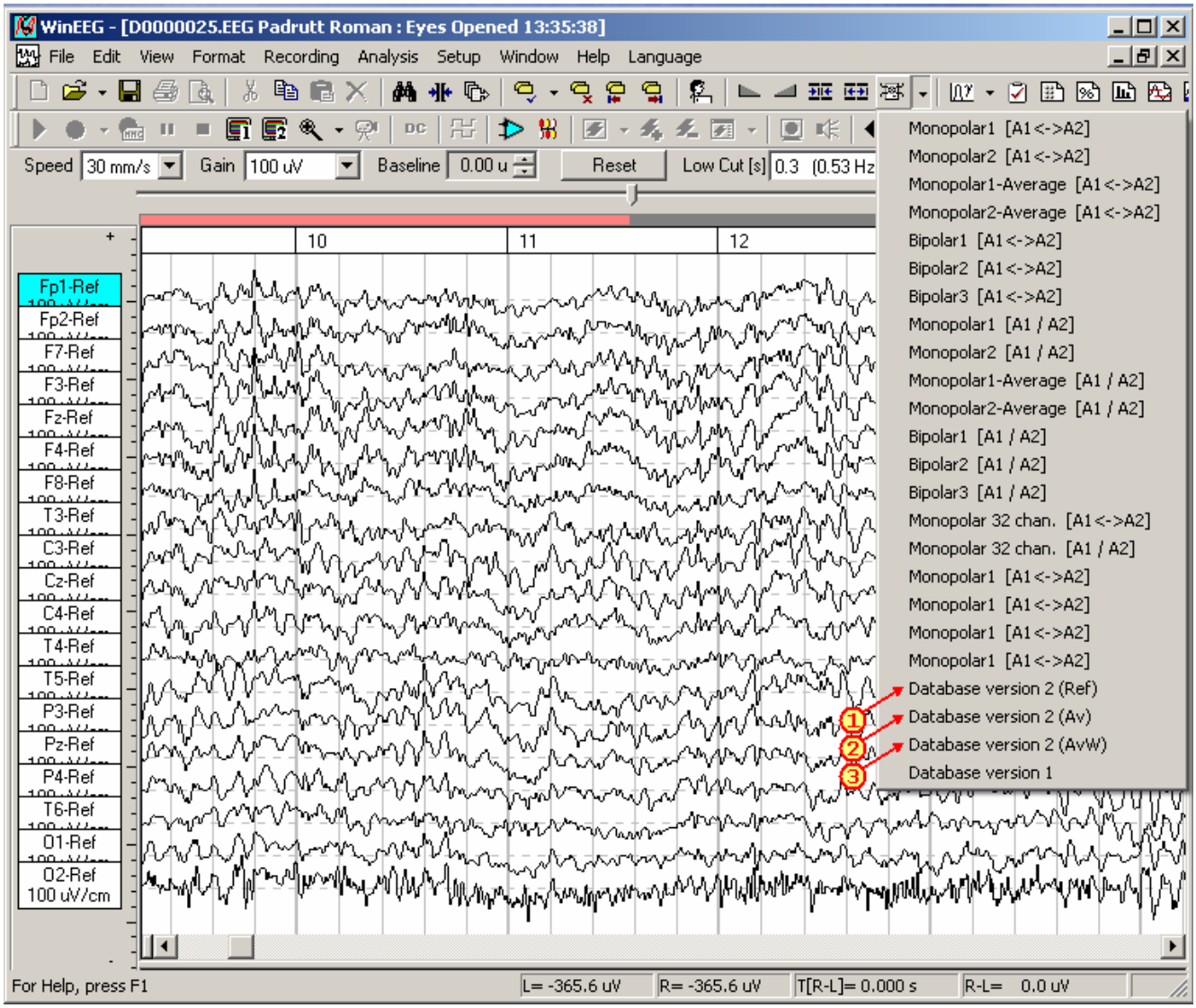
Warning! Resting number of comparisons with HBI database will be lost after reprogramming the dongle.

4. Using the HBI database.

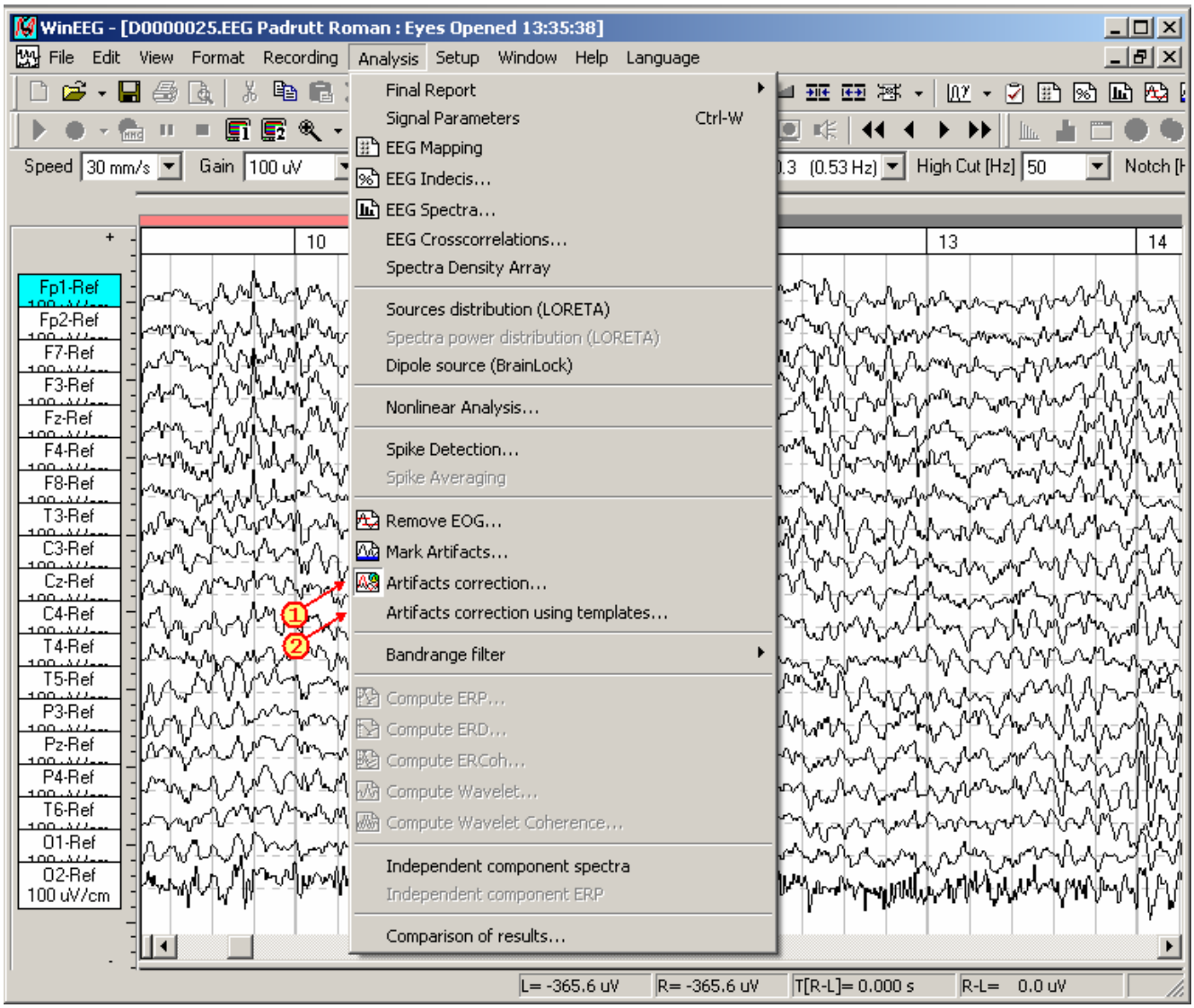
There are many ways to compute spectra and ERP using different additional parameters of processing. But there is only one way to compute spectra and ERP using correct parameters. WinEEG program includes a number of means helps to perform processing that is compatible with database. Each processing consists of a number of steps.

4.1. Spectra computation and comparison with average spectra database.

1. Open EEG file.
2. Change montage to “Database version 2 (Ref)” or Database version 2 (Av)” of Database version 2 (AvW)”. Montage “Database version 2 (Ref)” correspond to linked ears referent, Montage “Database version 2 (Av)” correspond to average referent and Montage “Database version 2 (AvW)” correspond to weighted average referent.



3. Perform eyes blink artifacts correction. Eyes blink artifacts correction can be done using one of commands of menu “Analysis”: “Artifacts correction…“ or “Artifacts correction using templates…“ commands. “Artifacts correction using templates…“ command allows correct artifacts automatically. This function works well enough in the case when it process long duration EEG recording (longer than 120 seconds) containing good expressed eyes blink artifacts. From the other hand “Artifacts correction…“ function is more flexible and can be used for any EEG recording.



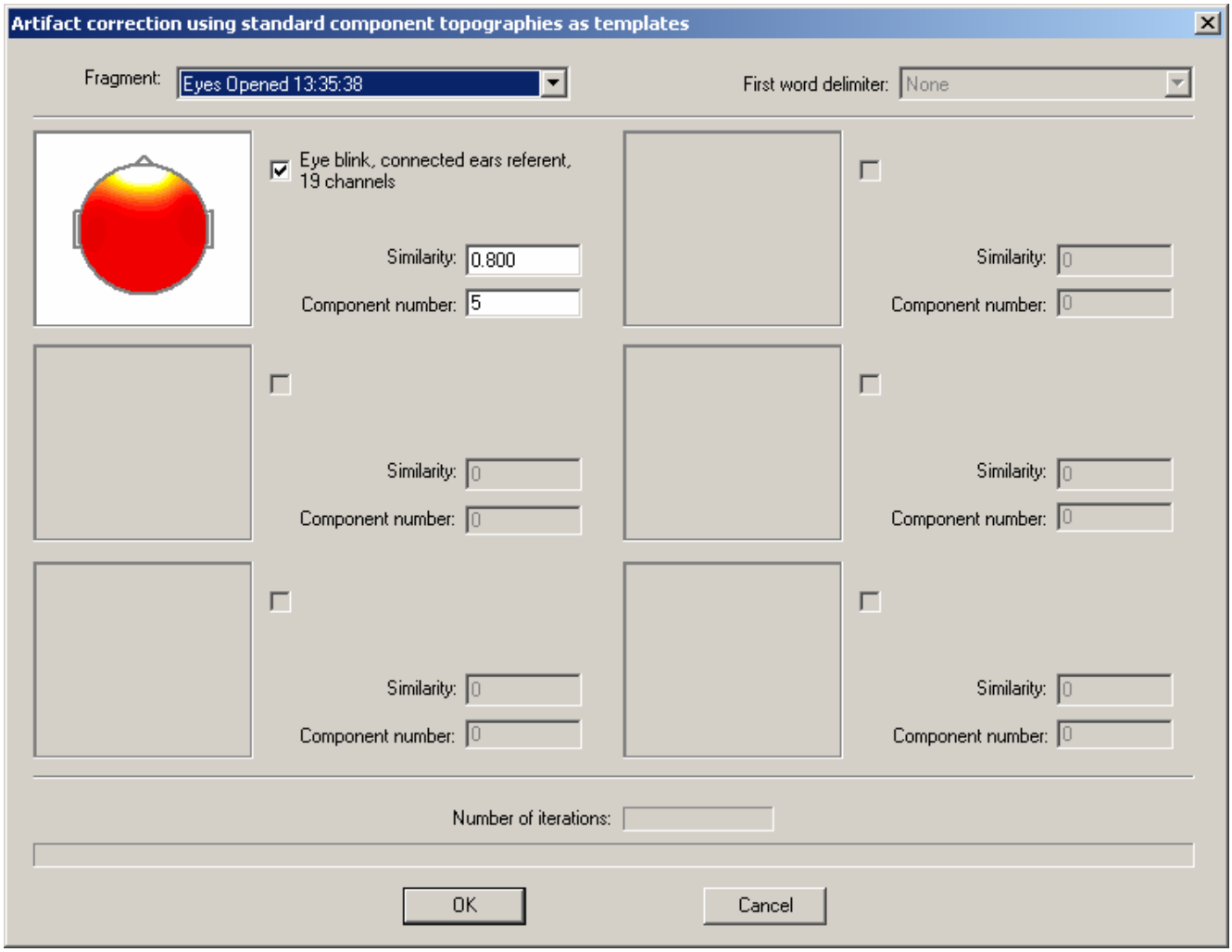
3.1. To correct eyes blink artifacts using “Artifacts correction using templates…“ the next steps should be done:

3.1.1. Run “Analysis-> Artifacts correction using templates” command. The “Artifact correction using standard component topographies as templates” dialog window will appear on the screen.

3.1.2. Select “Eyes opened” fragment from the list “Fragment”.

3.1.3. Select “Eyes blink” topography as template.

3.1.4. Press “OK” to start EEG processing. WinEEG program will automatically decompose multi channel EEG on independent components, find the component that topography is maximally similar to “Eyes blink” topography, calculate spatial filter (matrix) that will suppress eyes blink component and apply this spatial filter to whole EEG recording.



Attention! The selection of “Eyes opened” fragment is appropriate for “Eye opened” and “Eye closed” conditions EEG recording. If you want to process other EEG recording during “Visual Continuous Performance Task”, “Auditory Task”, “Reading Task”, “Mathematical Task” and “Missmatch Negativity Task” you should select “VCPT…”, “Auditory…”, “Reading…”, “Mathematical…” and “Missmatch Negativity…” fragments correspondingly.

Warning! Not all EEG recordings can be processed good enough using “Artifacts correction using templates”. Unacceptable results of eye blink artifacts correction will be observed from time to time (in approximate 3-5 percent of cases). That is why

the additional visual inspection of eye blink artifacts correction should be done. If the correction of eye blink artifacts is unacceptable use "Analysis->Artifact correction…" function to perform manual correction.

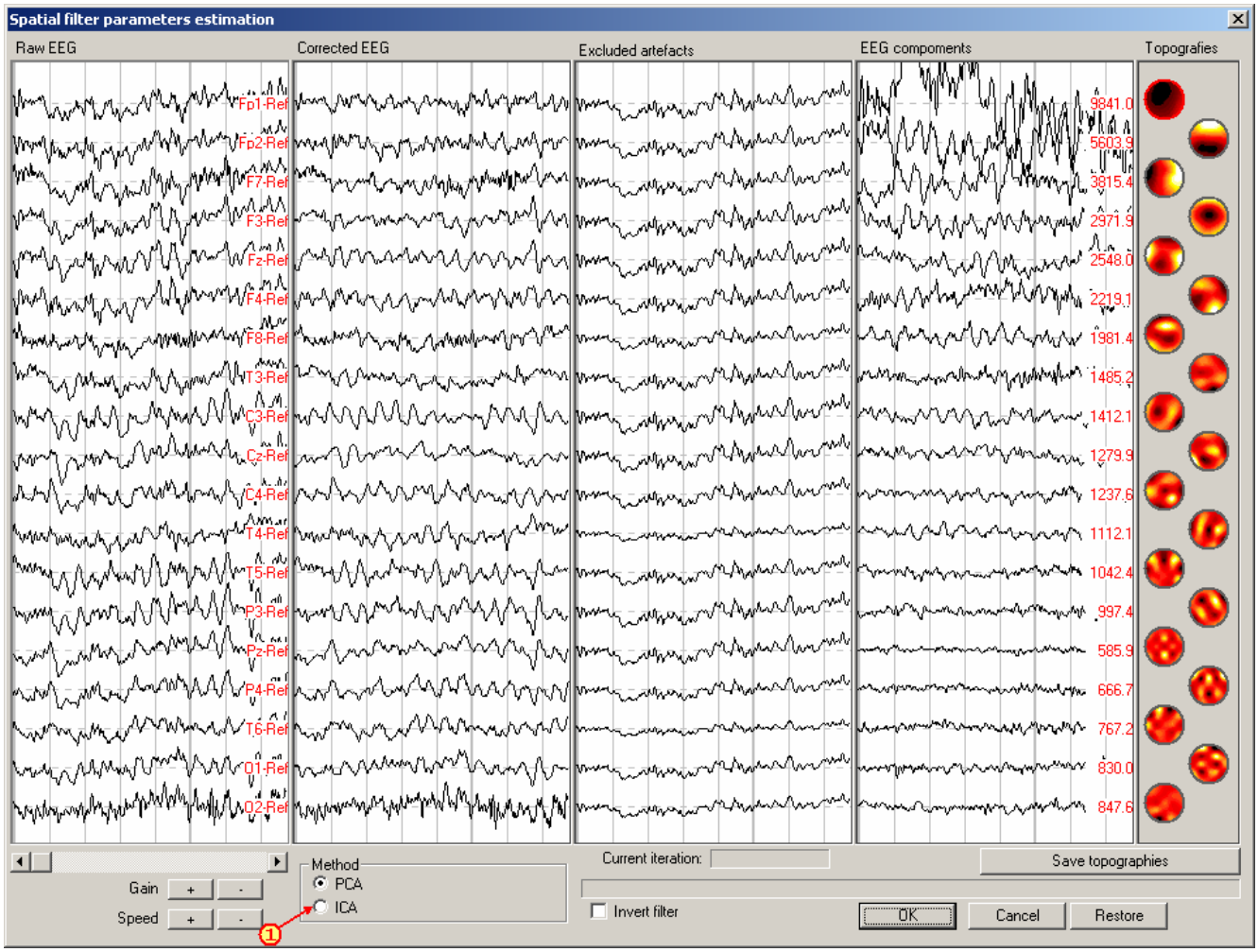
3.2. To correct eyes blink artifacts using "Artifacts correction …" the next steps should be done:

3.2.1. Select time interval by vertical markers including eyes blink artifacts. The duration is time interval should be longer than 100 seconds.

3.2.2. Run "Analysis-> Artifacts correction" command. The "Spatial filter parameters estimation" dialog window will appear on the screen.

3.2.3. Press "ICA" radio button including to "Method" radio buttons group. WinEEG program will compute independent components decomposition for selected multi channel EEG fragment. The raw (unfiltered) EEG waveforms are displayed on **Raw EEG** plot. The Corrected (filtered) EEG waveforms are displayed on **Corrected EEG** plot. The pure artifacts (filtered artifacts) waveforms are displayed on **Excluded Artifacts** plot. The waveforms of EEG signal components are displayed on **EEG components** plot. The amplitudes of these components are printed right to the waveforms. The topographies of EEG signal components are displayed by **Topographies** maps.

3.2.4. Click on **Map** of **topographies** to include (exclude) it to (from) the data set used for spatial filter estimation.



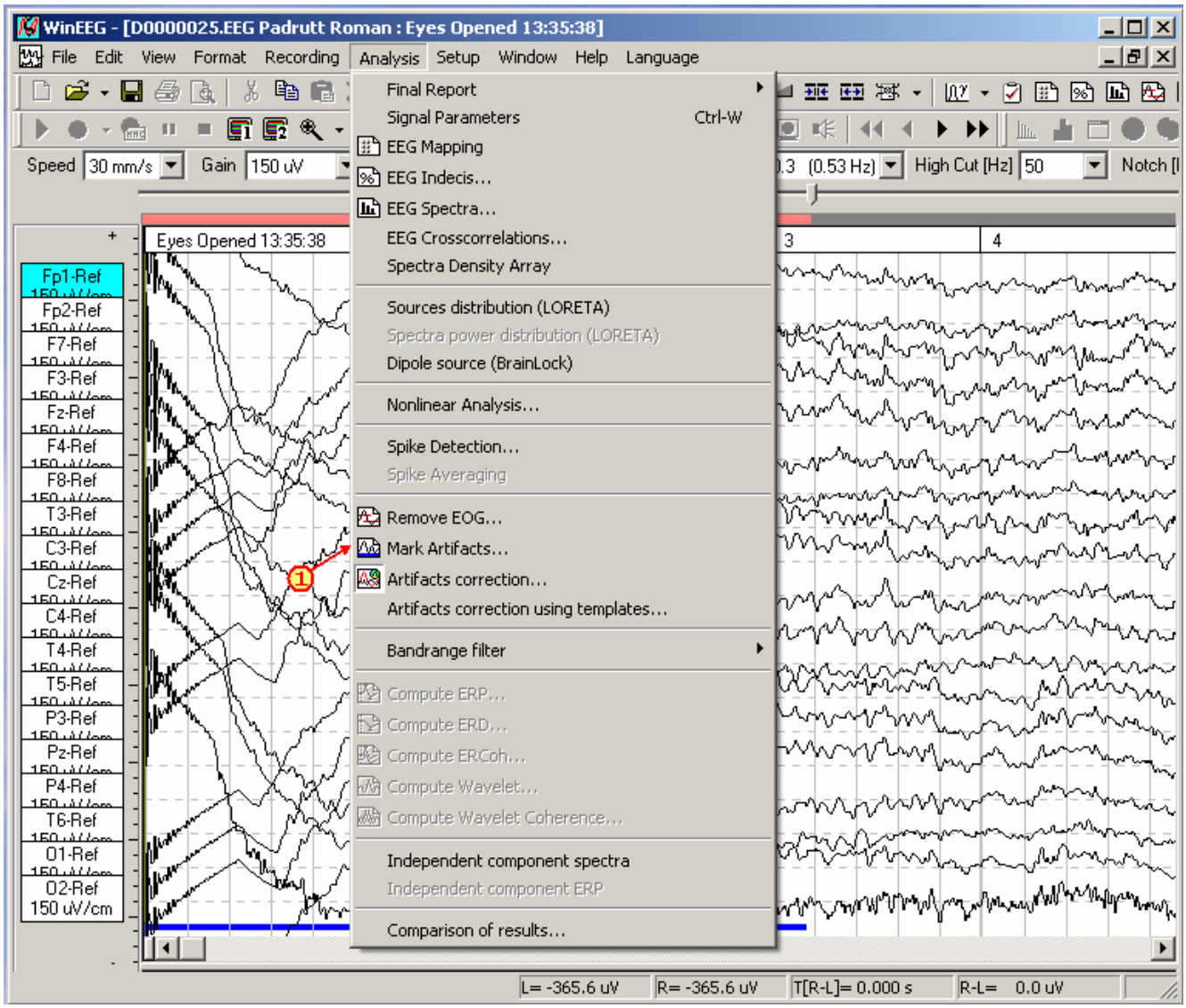
3.2.5. Press "**OK**" button to apply estimated spatial filter to whole EEG recording.

Click on **Map** of **topographies** to include (exclude) it to (from) the data set used for spatial filter estimation.

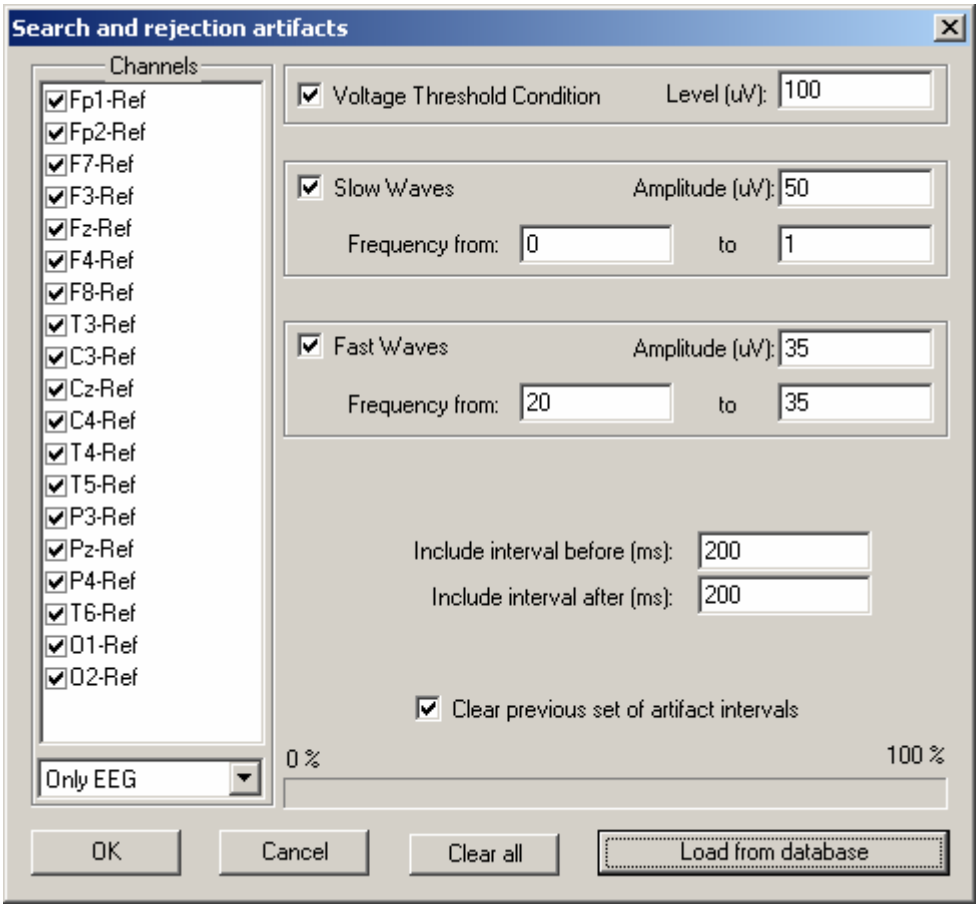
Warning! The algorithm of artifacts correction is not ideal. That is why the visual inspection of results of correction is necessary. If the results are not satisfied another time interval should be selected and analyzed.

Warning! In some cases there is no possibility to select time interval for processing from EEG record. In this case another procedure of artifact correction can be used. Select short time interval including well expressed eyes blink artifact. The duration of time interval should be approximately 500 milliseconds. Perform the steps 3.2.2-3.2.5 as described above excluding the step when “ICA” radio button is pressed. In this case the decomposition of EEG to the components will be done using singular values decomposition method. This is not so accurate approach but it is also acceptable for correction of eyes blink artifact.

4. Mark other artifacts by “Mark artifacts” command menu “Analysis. The “Search and rejection of artifacts” dialog window will appear on the screen.

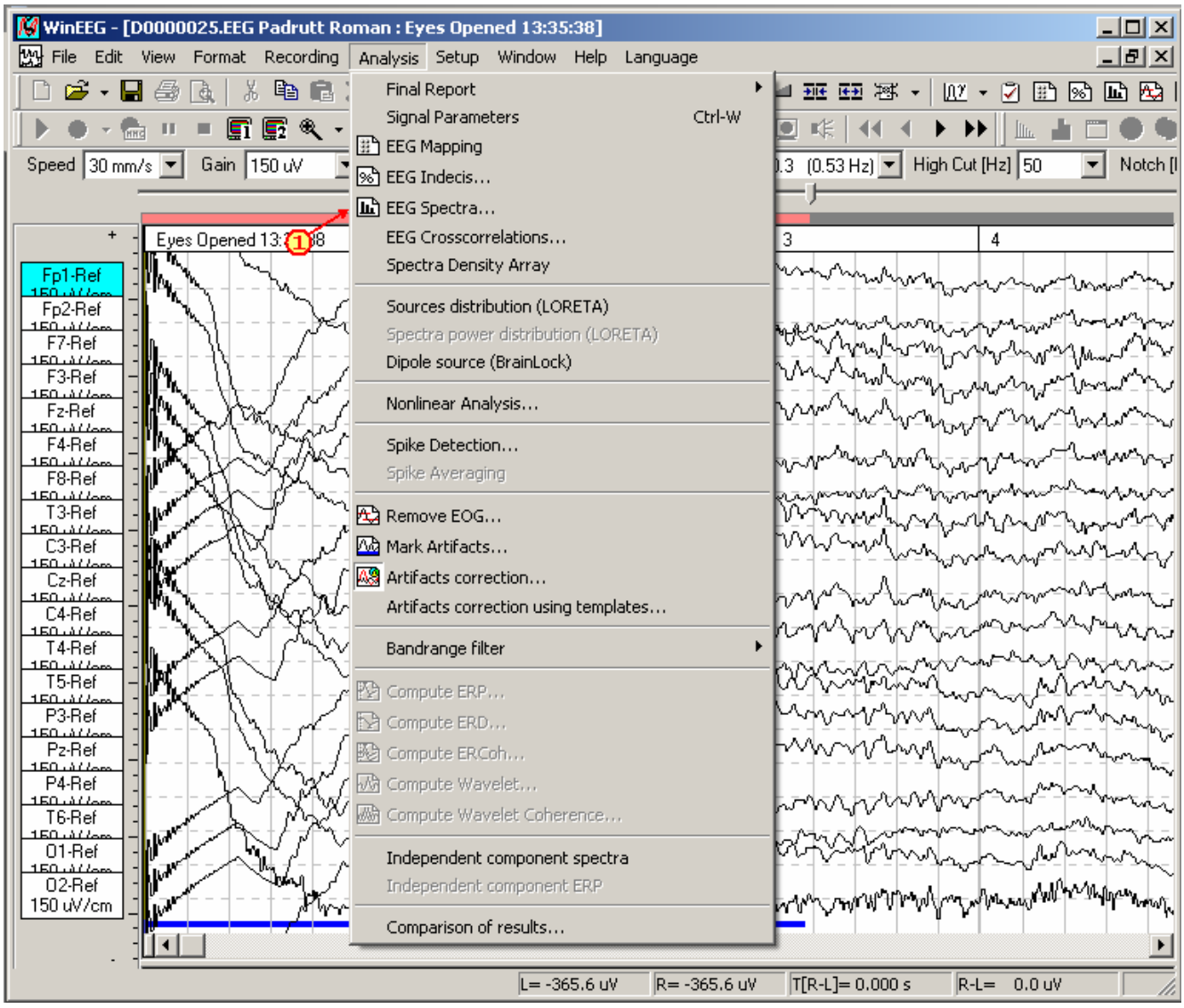


5. Define correct parameters pressing button “Load from database” and press button “OK” to start processing

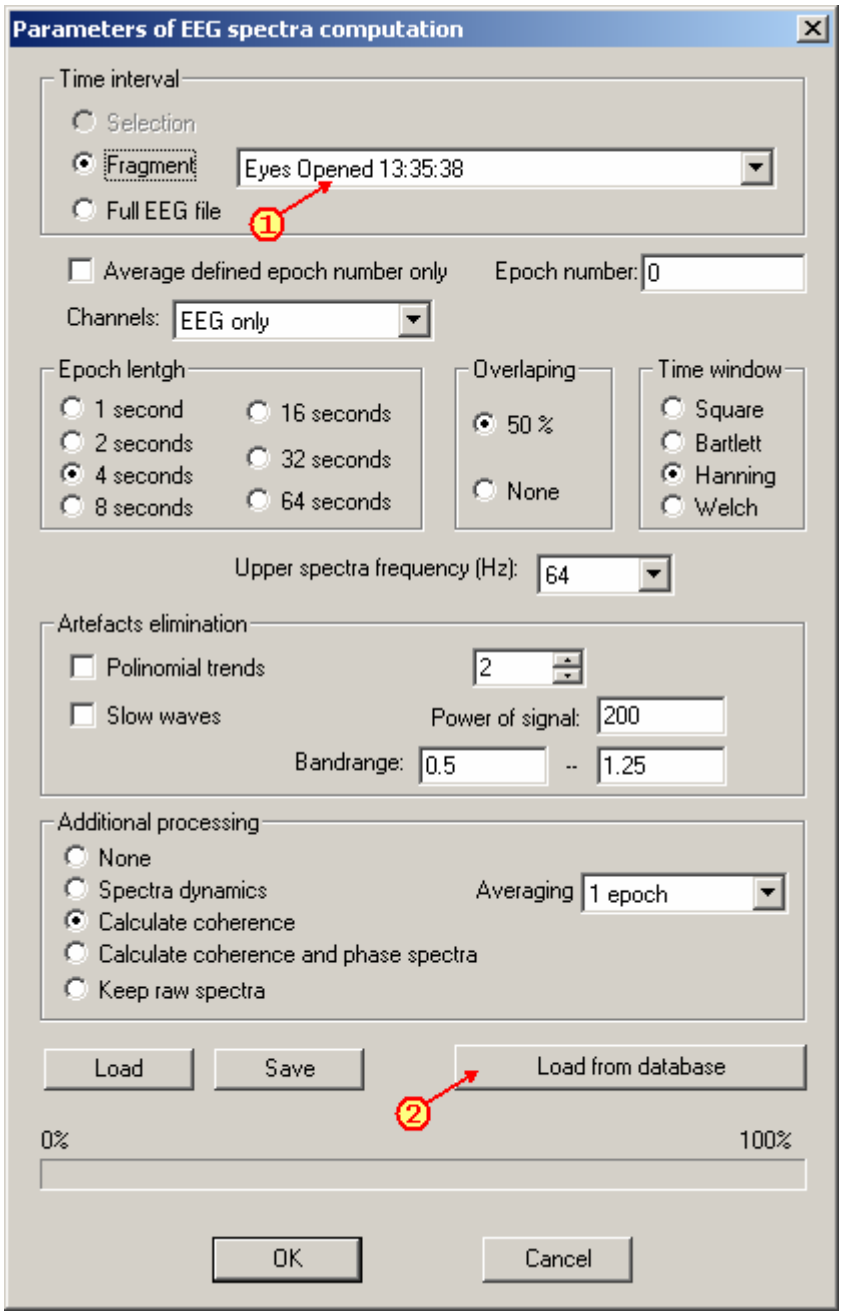


Attention! This procedure can not detect some artifacts. In this case other artifacts can be marked manually. To do this select corresponding time interval by vertical markers and perform command “Cut” menu “Edit”.

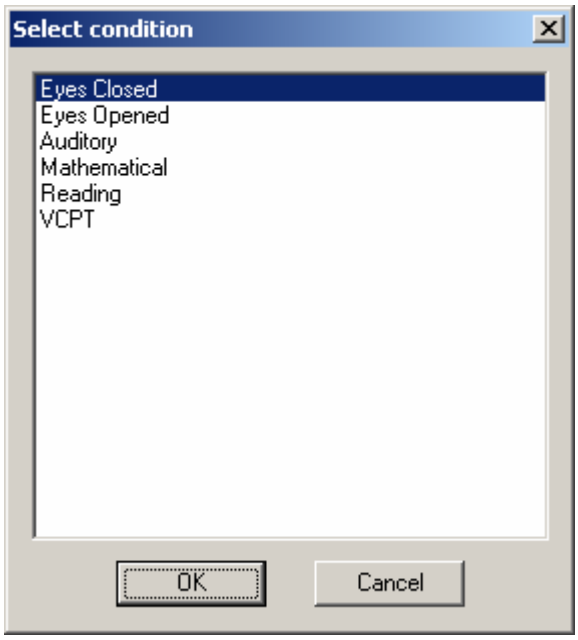
6. Compute spectra by command “EEG spectra” menu “Analysis”. The “Parameters of EEG spectra computation” dialog window will appear on the screen.



7. Press “Load from database” (arrow 2) button to define correct parameters for EEG power spectra calculation. The “Select condition” window will appear on the screen.

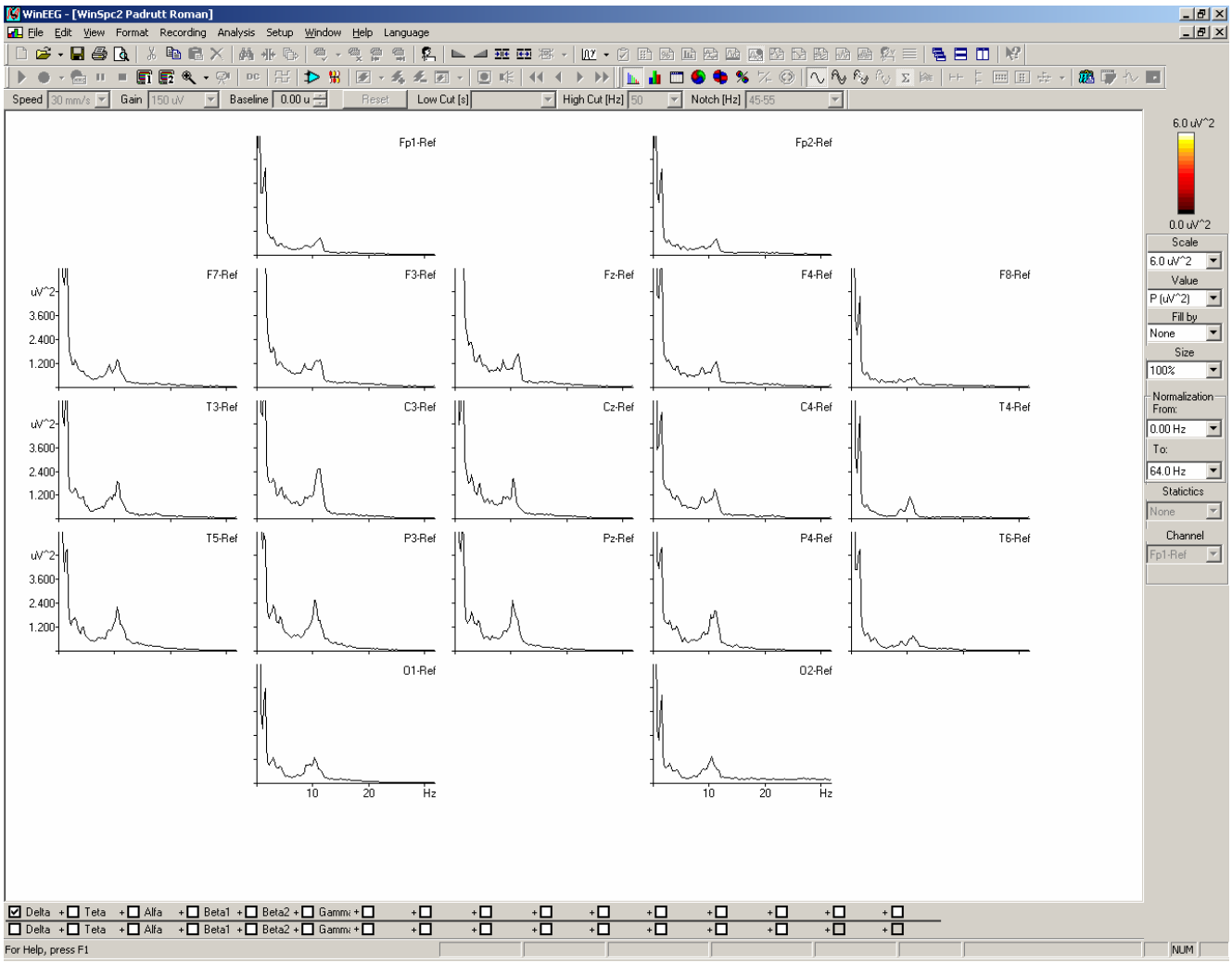


8. Select corresponding condition from the list of conditions and press “OK” button.



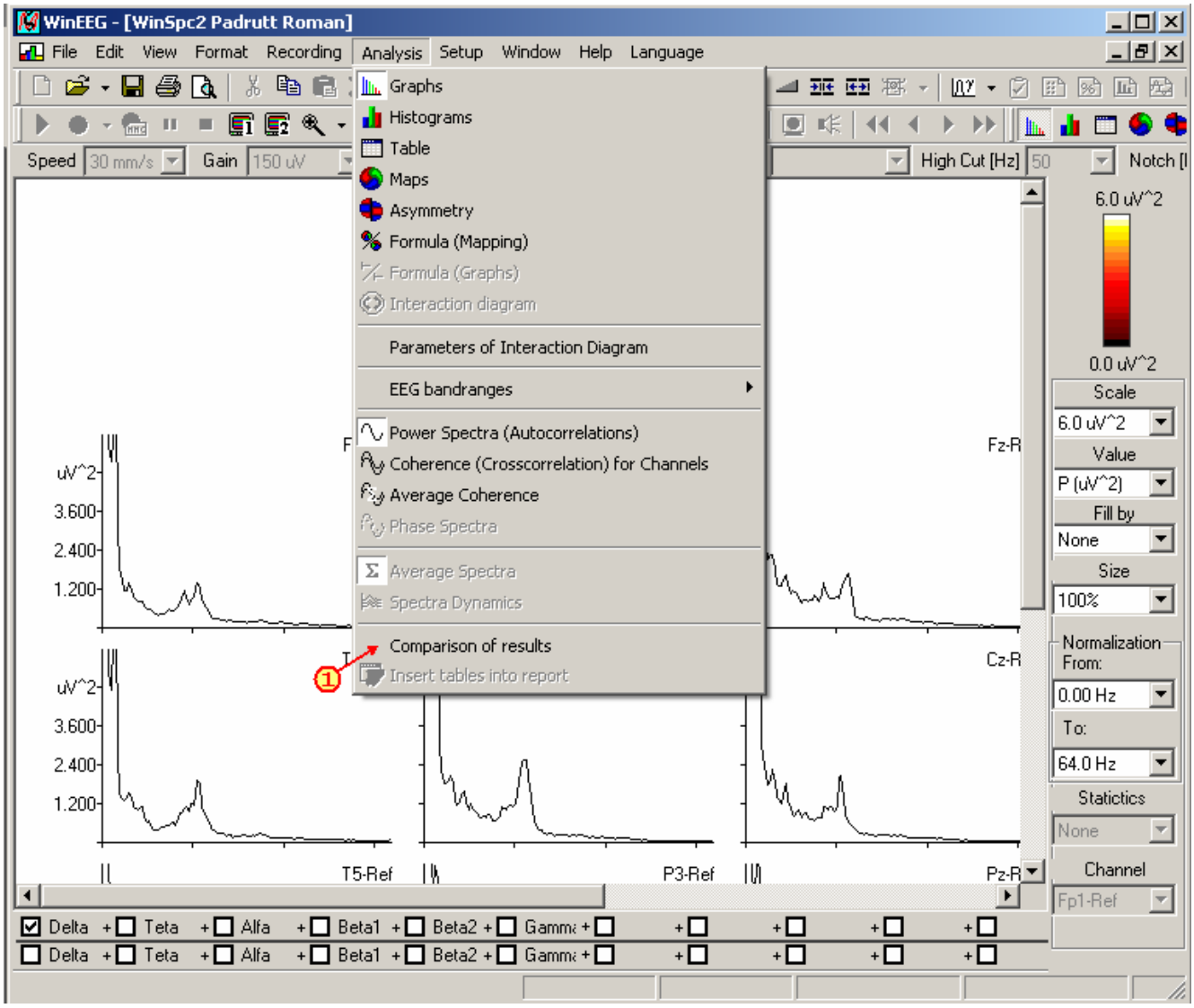
9. Select EEG fragment for that the power spectra will be calculated using “Fragment” field (arrow 1) and press “OK” button to start the processing. In dependence of the data and the goal of analysis different fragment should be selected: “Eyes opened” or “Eyes closed” for EEG recording, VCPT…”, “Auditory…”, “Reading…”, “Mathematical…” and “Missmatch Negativity…” for corresponding ERP studies.

10. Press “OK” button for beginning of data processing. The “Power spectra” window will appear on the screen after the end of processing.

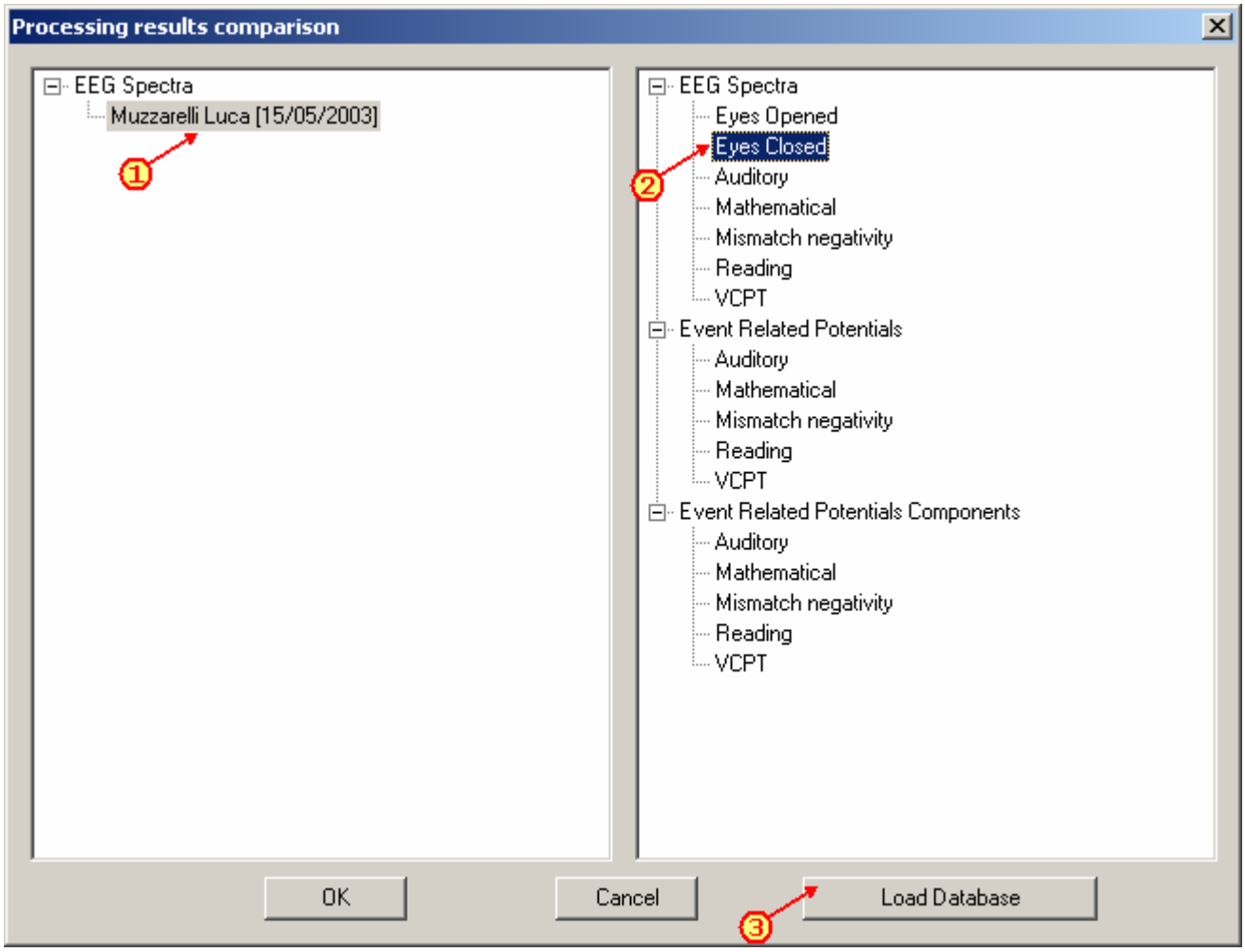


Attention! Power spectra can be displayed in “Power spectra window” in many different forms. The additional information about functions of “Power spectra window” can be found in “WinEEG User manual”.

11. Compare resulting spectra with database by command “Comparison of results” of menu “Analysis”. “Processing results comparison” window will appear on the screen.

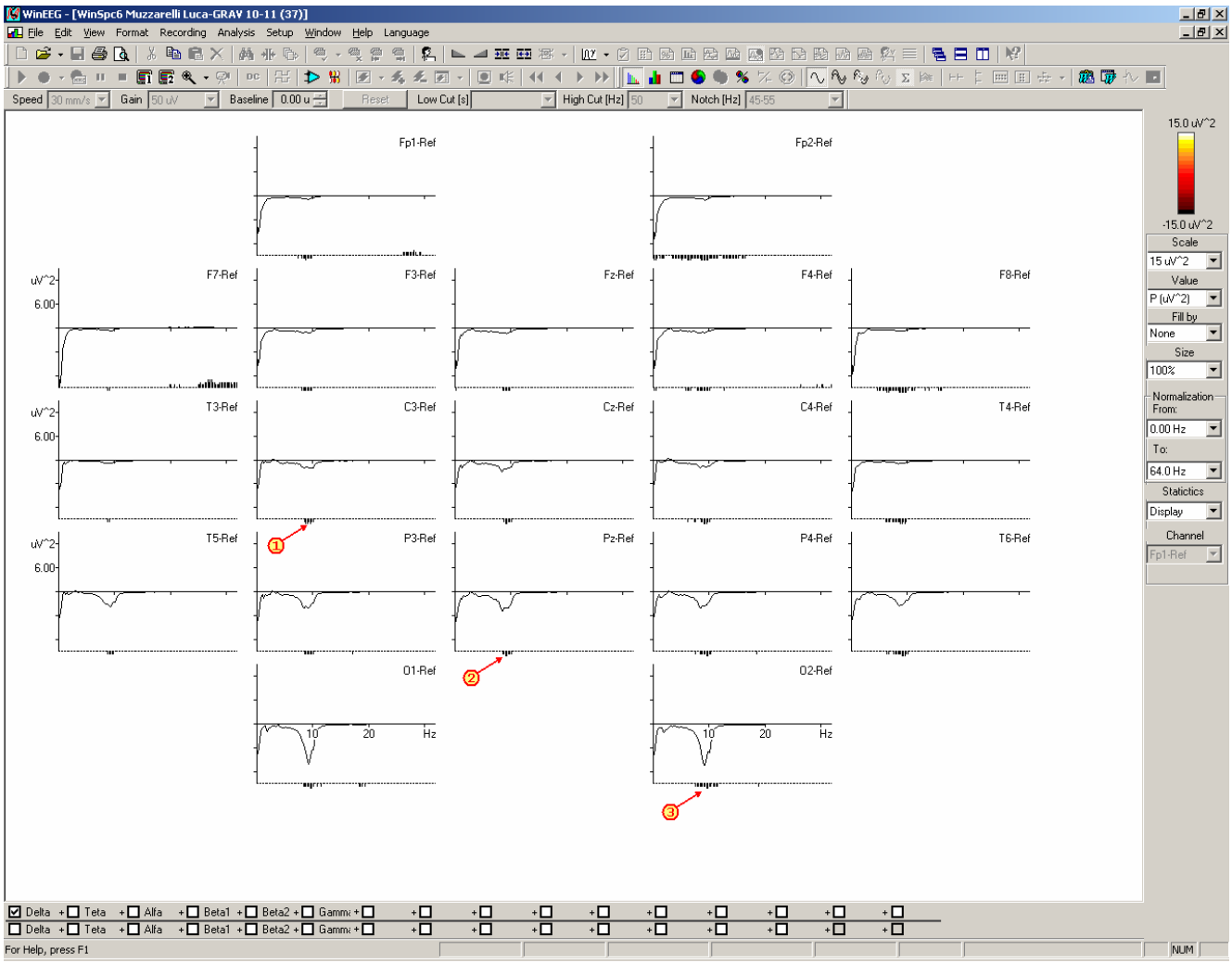


12. Select appropriate spectra at left panel of dialog window (arrow 1), press “Load database” button (arrow 2) to display content of database and select appropriate condition at right panel of dialog window (arrow 3).



13. Press “OK” button to do the comparison. Spectra window with differences of power spectra will appear on the screen (see below).

Warning! “Load Database” button will be disabled if dongle is not connected to computer or if dongle comparison counter is equal zero. The last condition is for limited access to HBI Database only.



The statistically significant differences of subject power spectra and corresponding HBI database spectra will be marked by vertical lines place below spectra plots. Some examples are marked by arrows 1, 2 and 3.

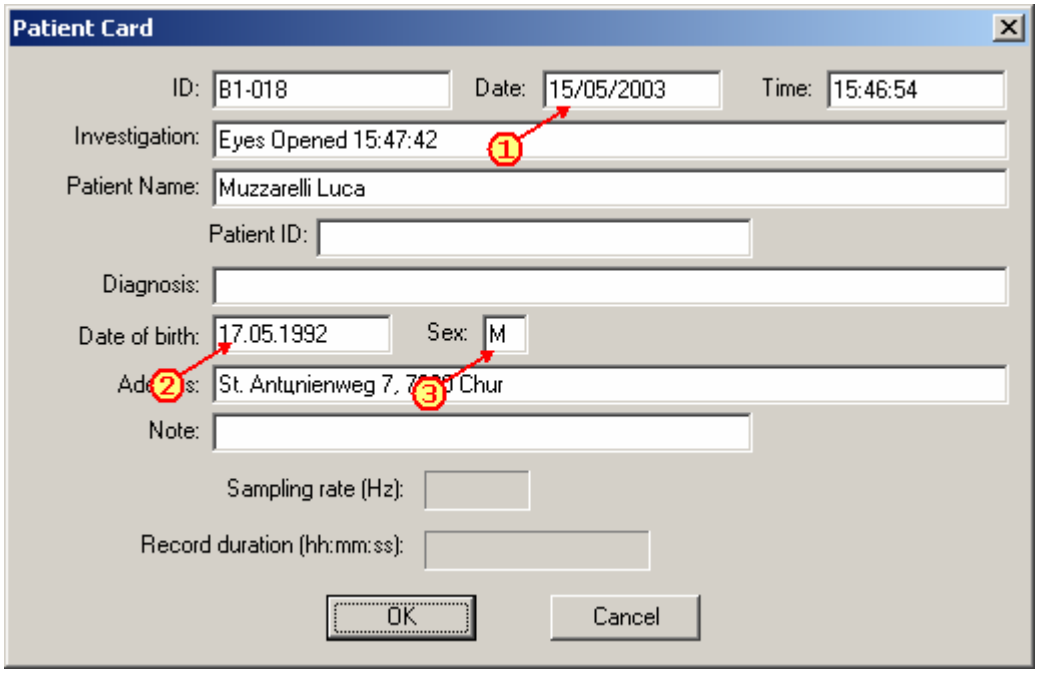
Warning! Any comparison with database is possible if Investigation date (arrow 1), Date of birth (arrow 2) and gender (arrow 3) are defined correctly only (See “Patient card” dialog window). It is absolutely necessary to use the next format for any date:

DD.MM.YYYY

Where DD is day, MM – month and YYYY year. For example

01.04.1995 or 25/12/1998

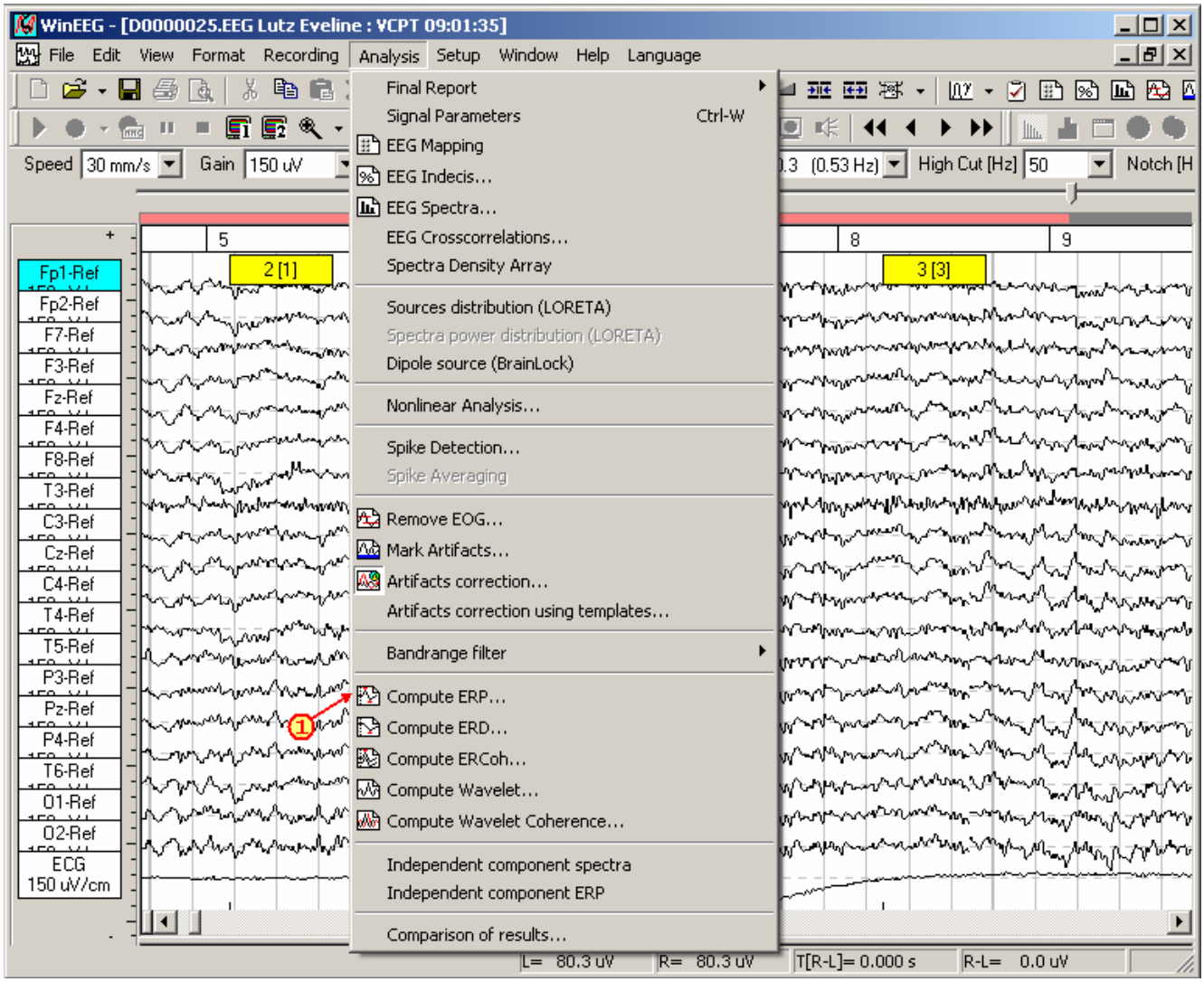
The gender should be “M” or “F”.



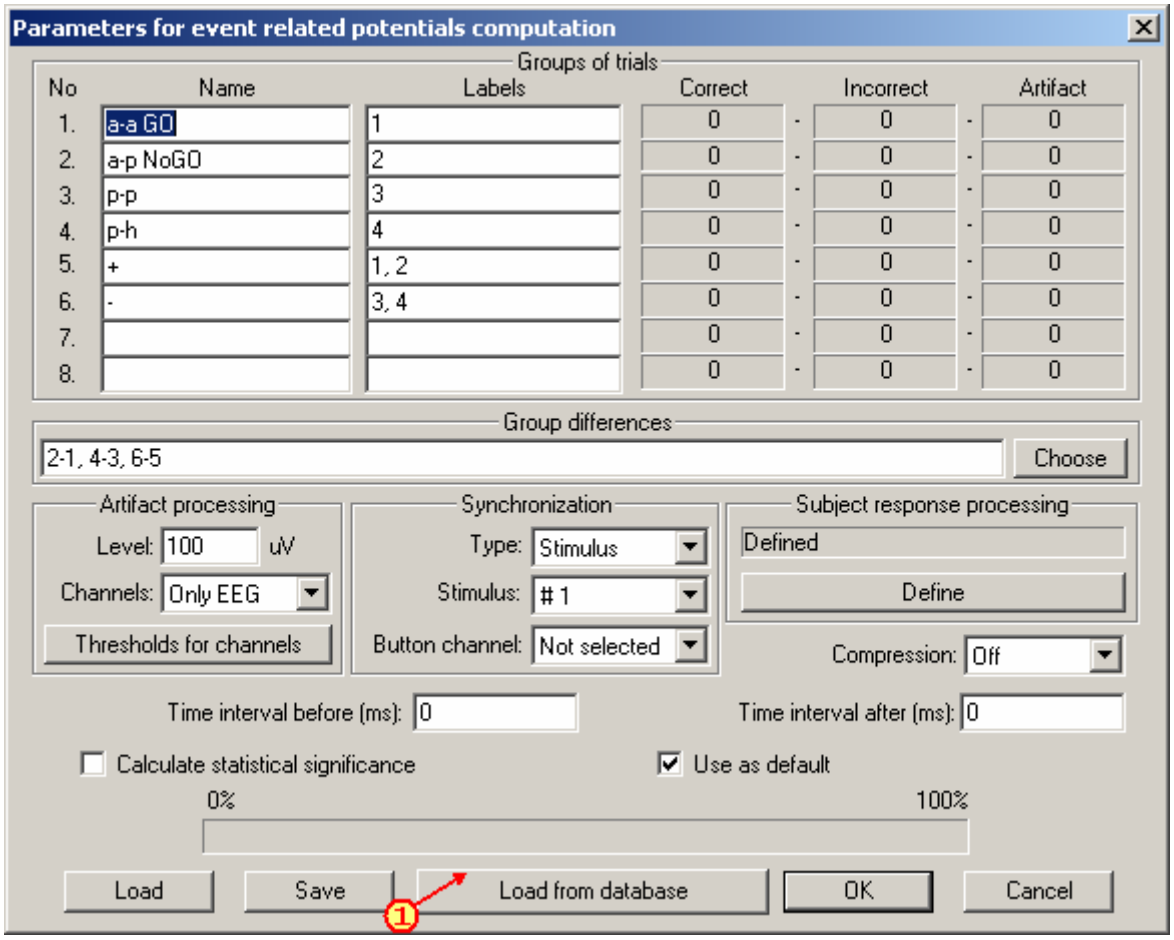
4.2. ERP computation and comparison with average ERPs database.

1. Perform 1-5 steps to reject artifacts similar to spectra computation

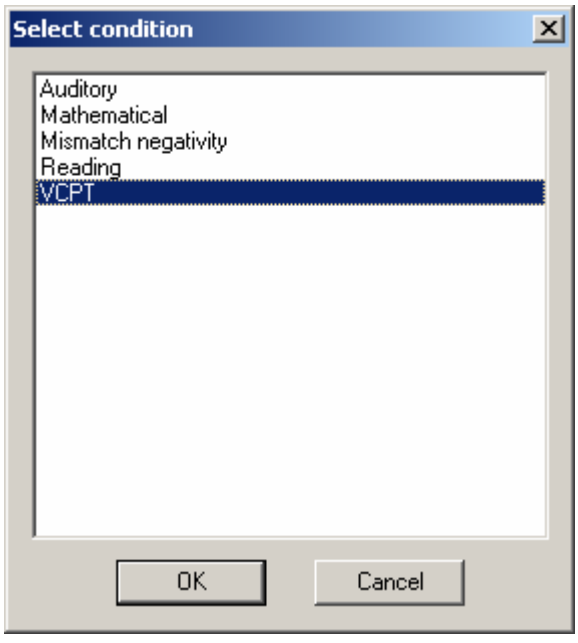
2. Compute ERP by command “Compute ERP” menu “Analysis”. The “Parameters for event related potentials computation” dialog window will appear on the screen.



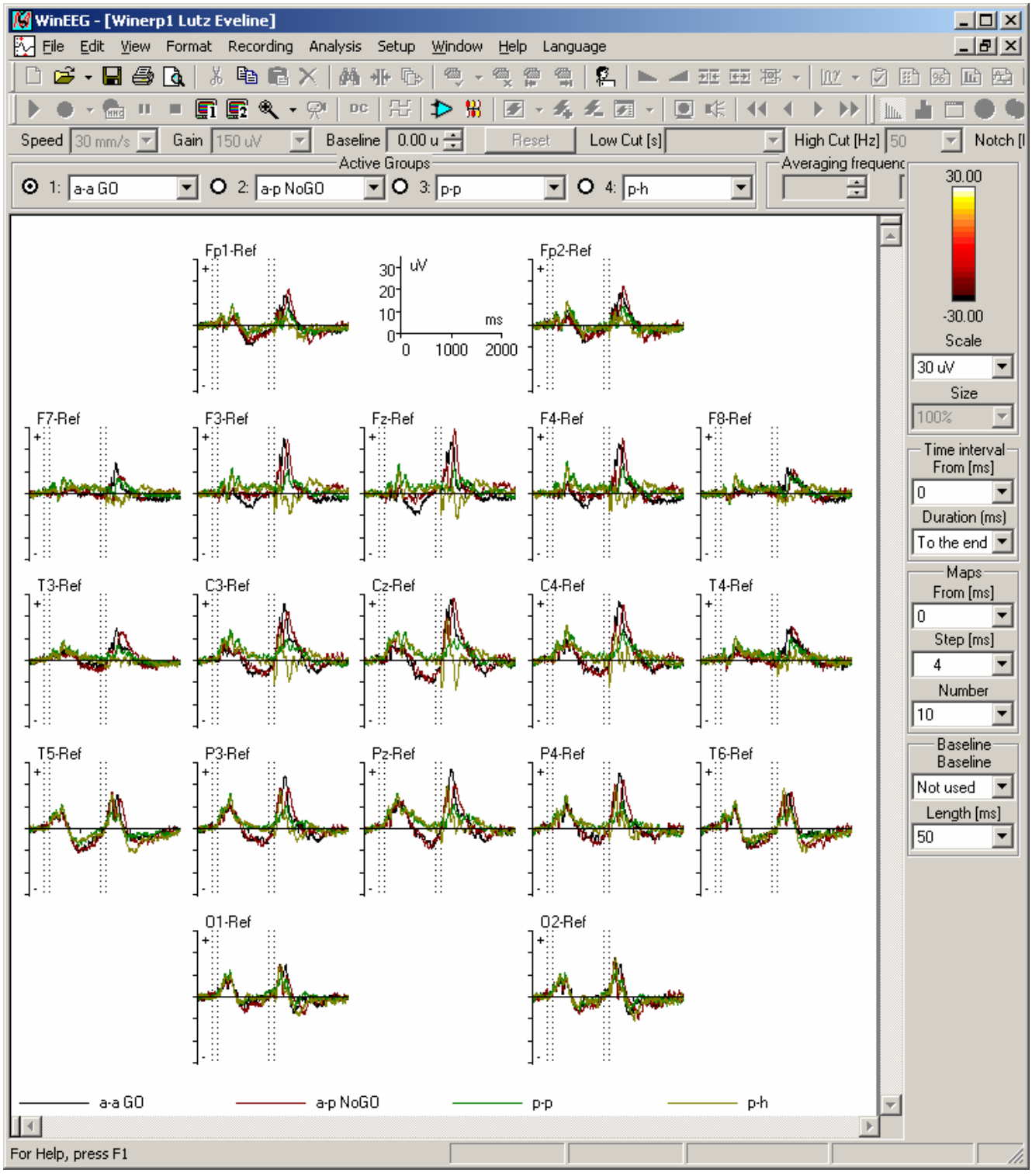
3. Press button “Load from database” to define correct parameters for event related potentials calculation. The “Parameters for event related potentials computation” dialog window will appear on the screen.



4. Select corresponding condition from the list of conditions (“Task name”) and press “OK” button.

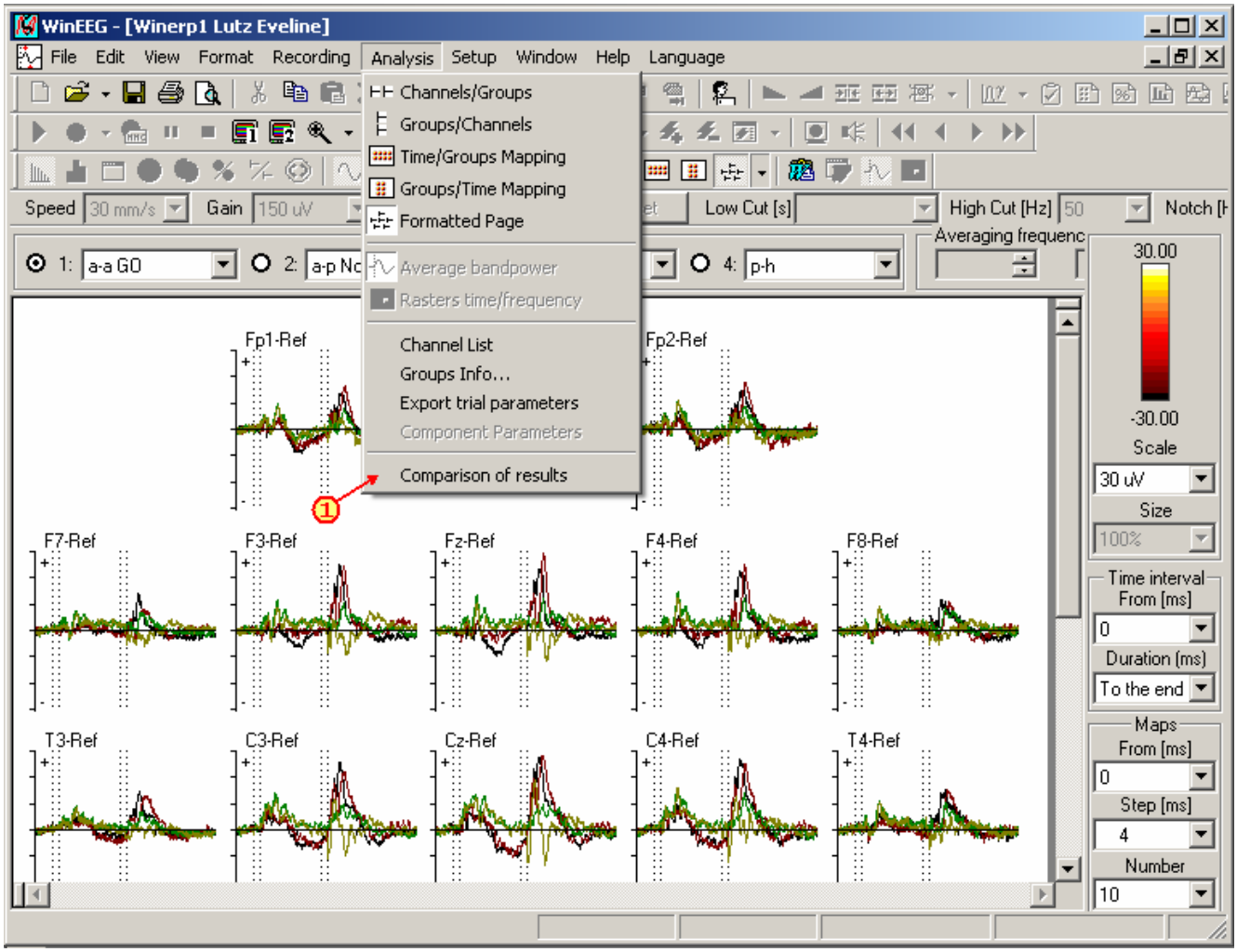


5. Press “OK” button for beginning of data processing. The “ERP” window will appear on the screen after the end of processing.

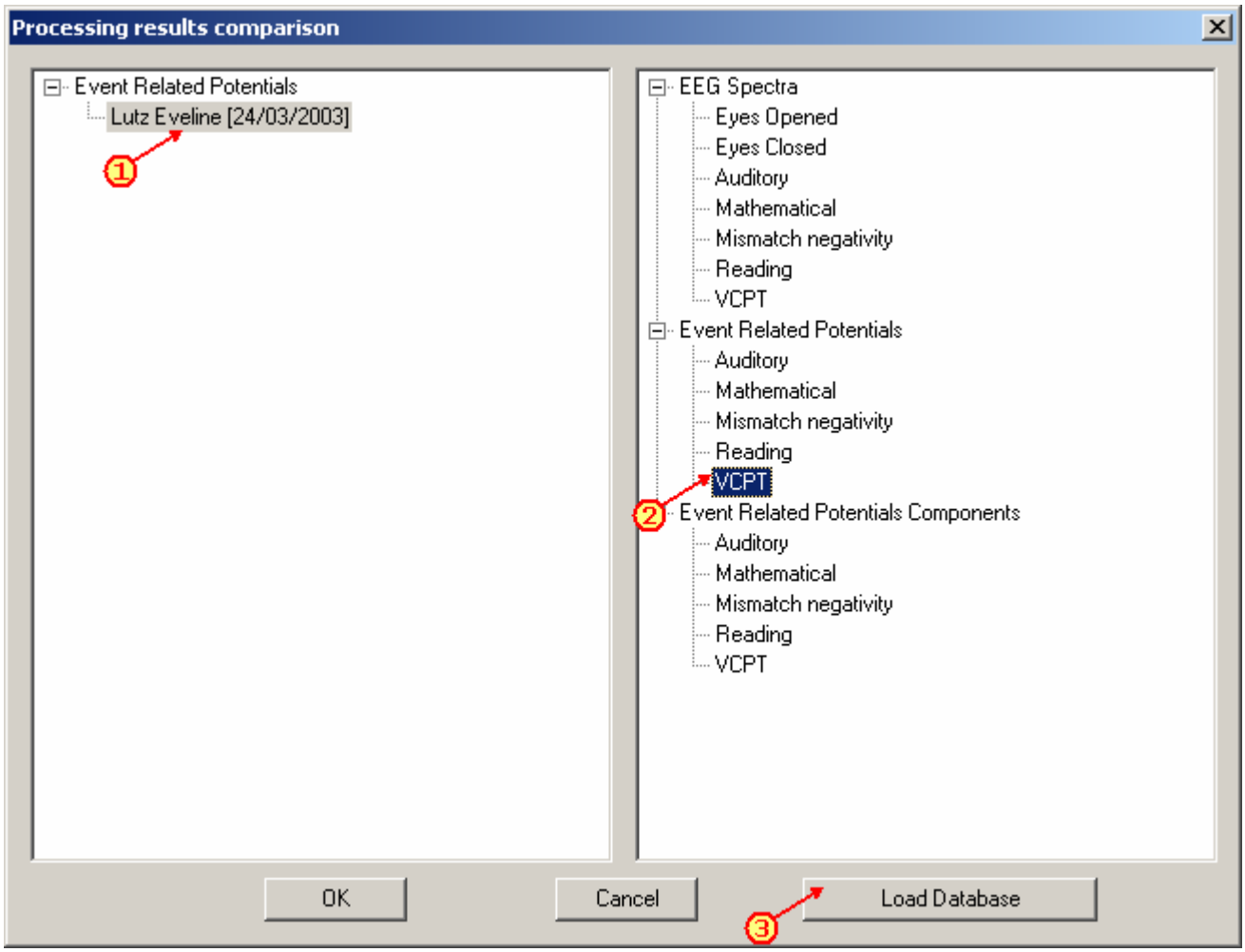


Attention! Event related potentials can be displayed in “ERP window” in many different forms. The additional information about functions of “ERspectra window” can be found in “WinEEG User manual”.

6. Compare resulting ERP with database by command “Comparison of results” menu “Analysis”. “Processing results comparison” window will appear on the screen.

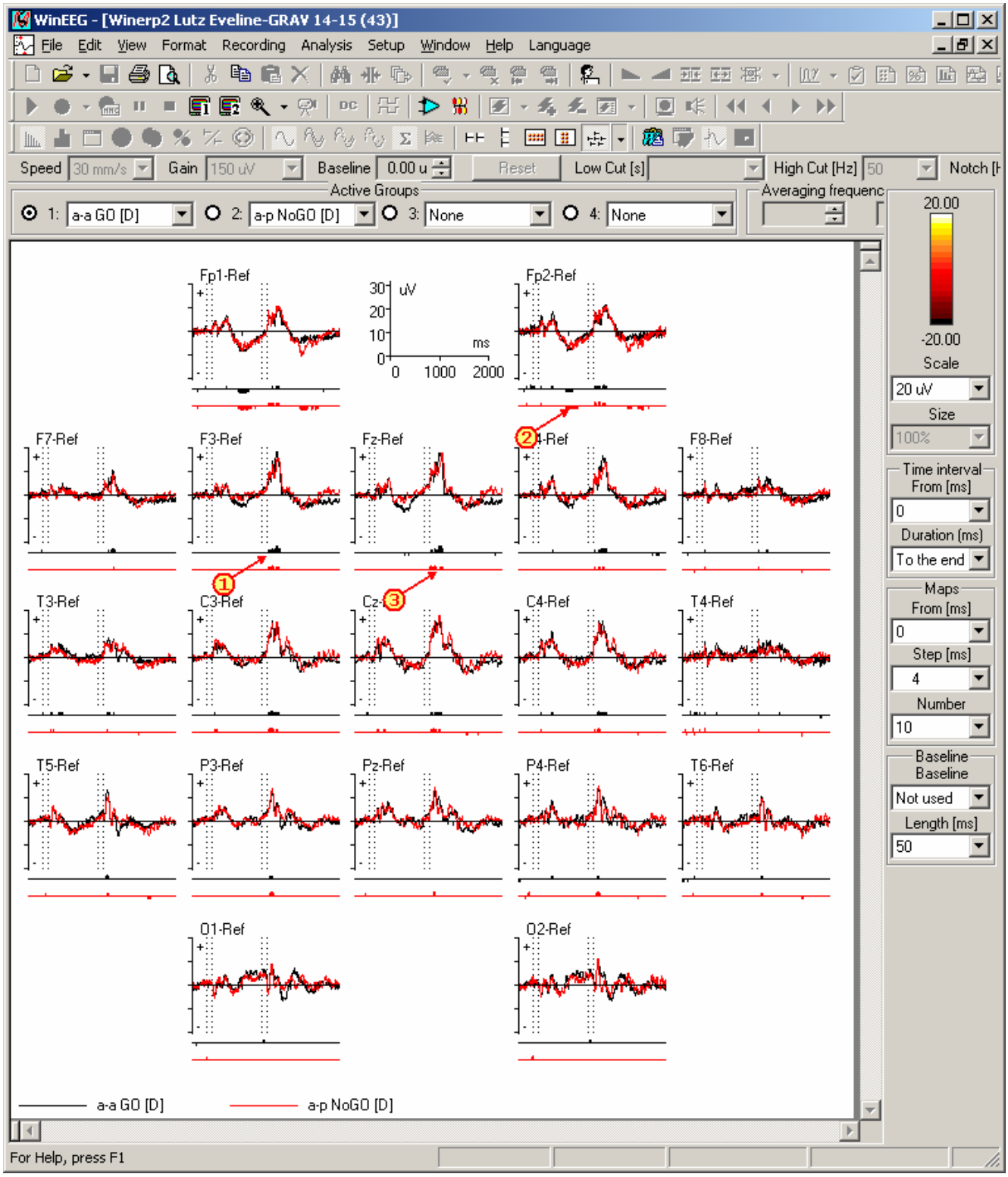


7. Select appropriate spectra at left panel of dialog window (arrow 1), press “Load database” button (arrow 3) to display content of database and select appropriate condition at right panel of dialog window (arrow 2). Press “OK” button to do the comparison. Spectra window with differences of power spectra will appear on the screen (see below).



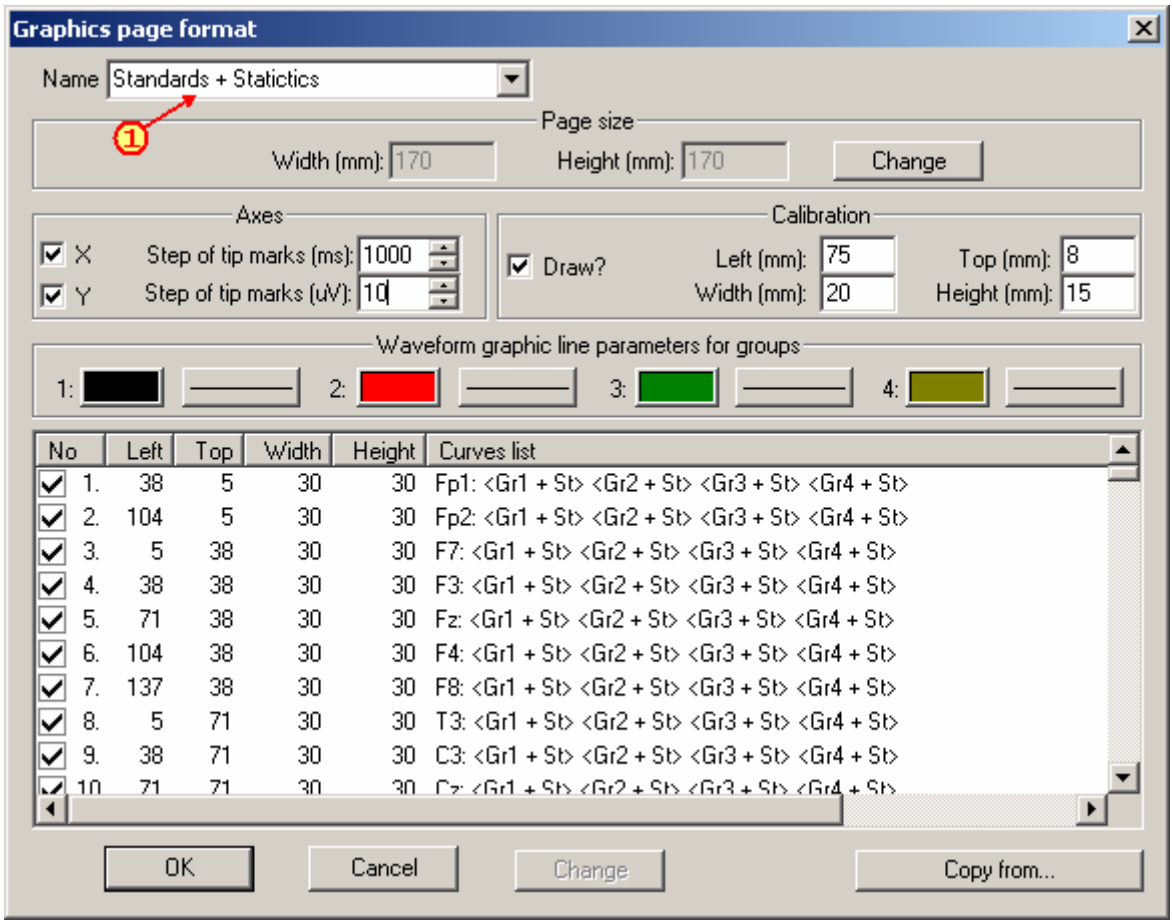
8. Press “OK” button to do the comparison. ERP window with differences of ERP waveforms will appear on the screen (see below).

Warning! “Load Database” button will be disabled if dongle is not connected to computer or if dongle comparison counter is equal zero. The last condition is for limited access to HBI Database only.

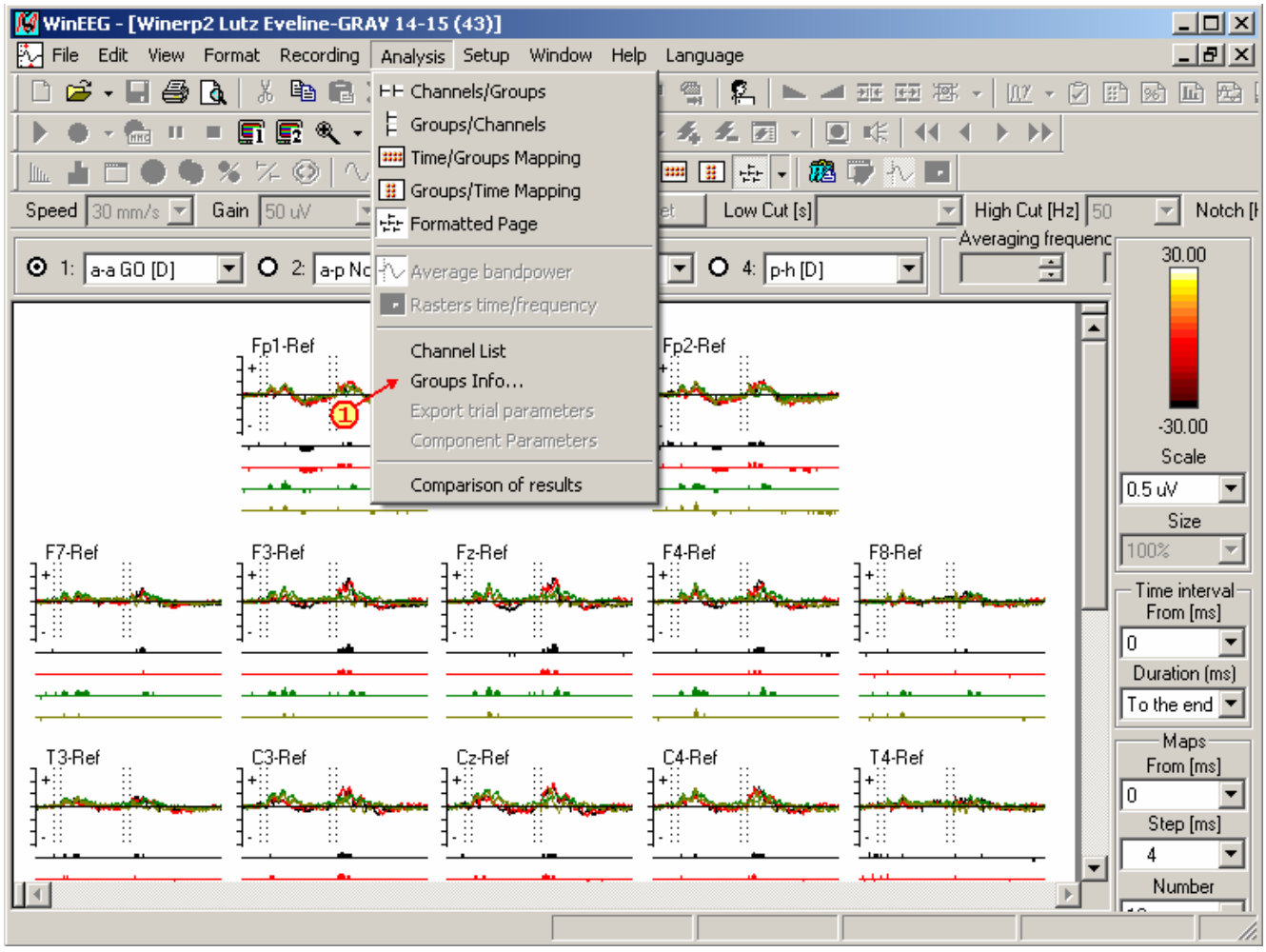


The statistically significant differences of subject ERPs and corresponding HBI database ERPs will be marked by vertical lines place below ERP waveform plots. Some examples are marked by arrows 1, 2 and 3.

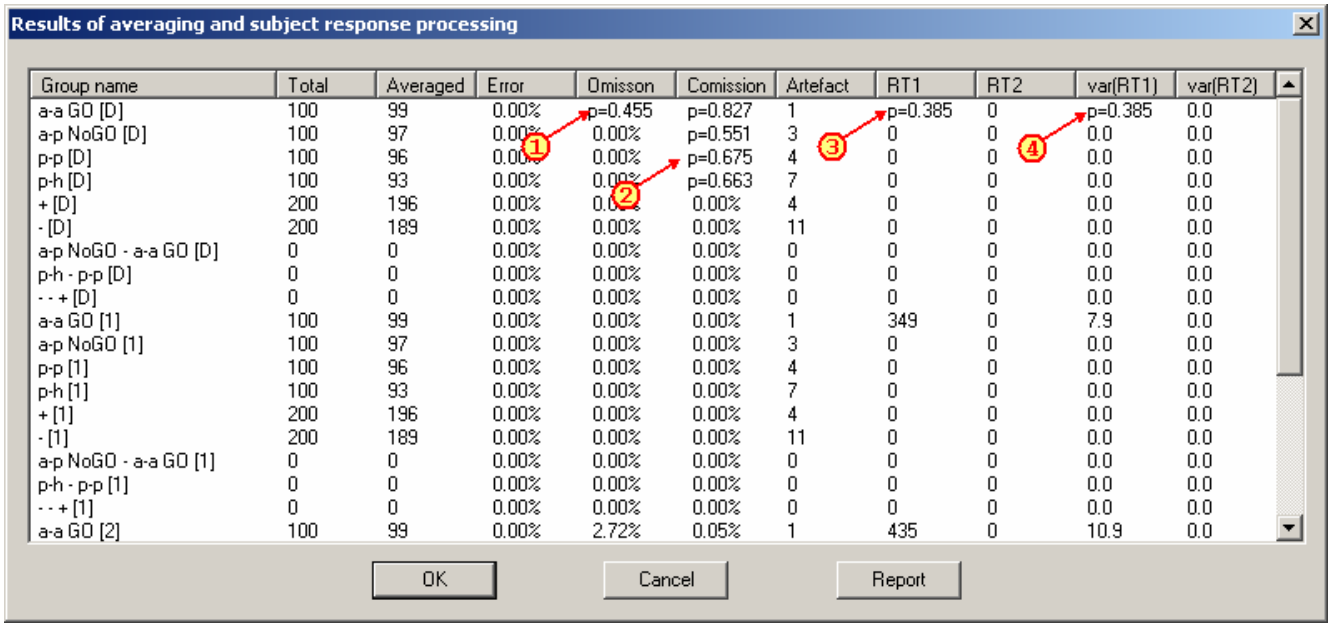
Attention! If vertical lines using for marking significant differences were not displayed below ERP waveform change ERP displaying format using “Setup->Graph Format” command. The “Graphics page format” dialog window will appear on the screen. Select “Standards +Statistics” format from the list (arrow 1) and press “OK” button.



9. Run “Analysis->Group Info” command to display results of statistical comparison of task performance parameters. “Results of averaging and subject response processing” dialog window will appear on the screen.



The statistical significance of differences for percent of omission errors (arrow 1), commission errors (arrow 2), reaction time (arrow 3) and standard error of reaction time (arrow 4) will be displayed in this dialog window.



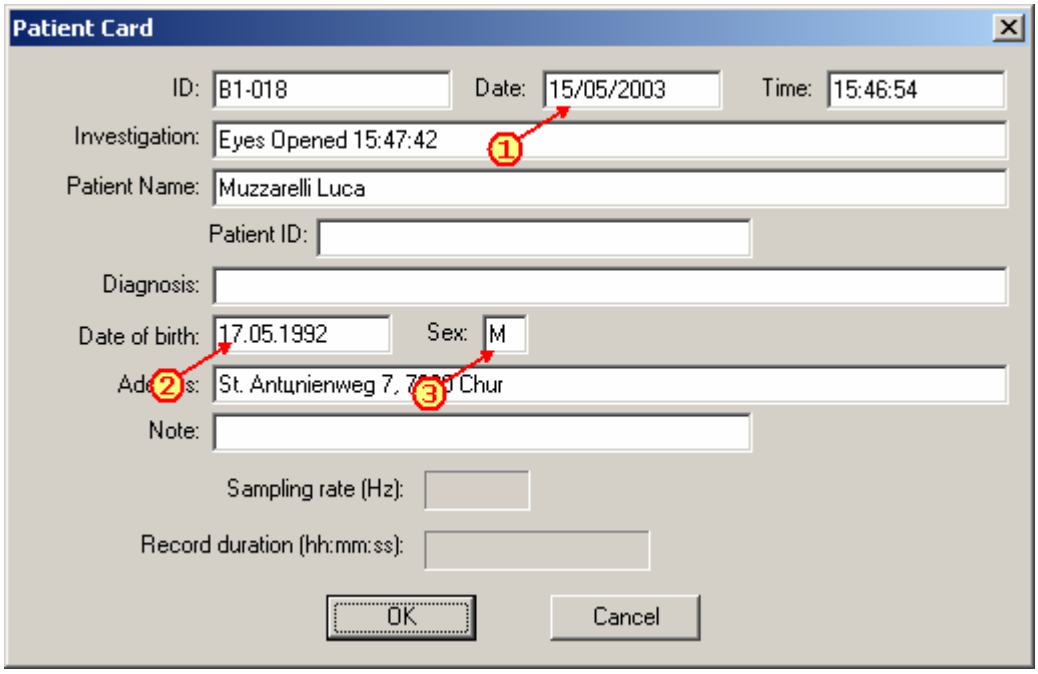
Warning! Any comparison with database is possible if Investigation date (arrow 1), Date of birth (arrow 2) and gender (arrow 3) are defined correctly only (See “Patient card” dialog window). It is absolutely necessary to use the next format for any date:

DD.MM.YYYY

Where DD is day, MM – month and YYYY year. For example

01.04.1995 or 25/12/1998

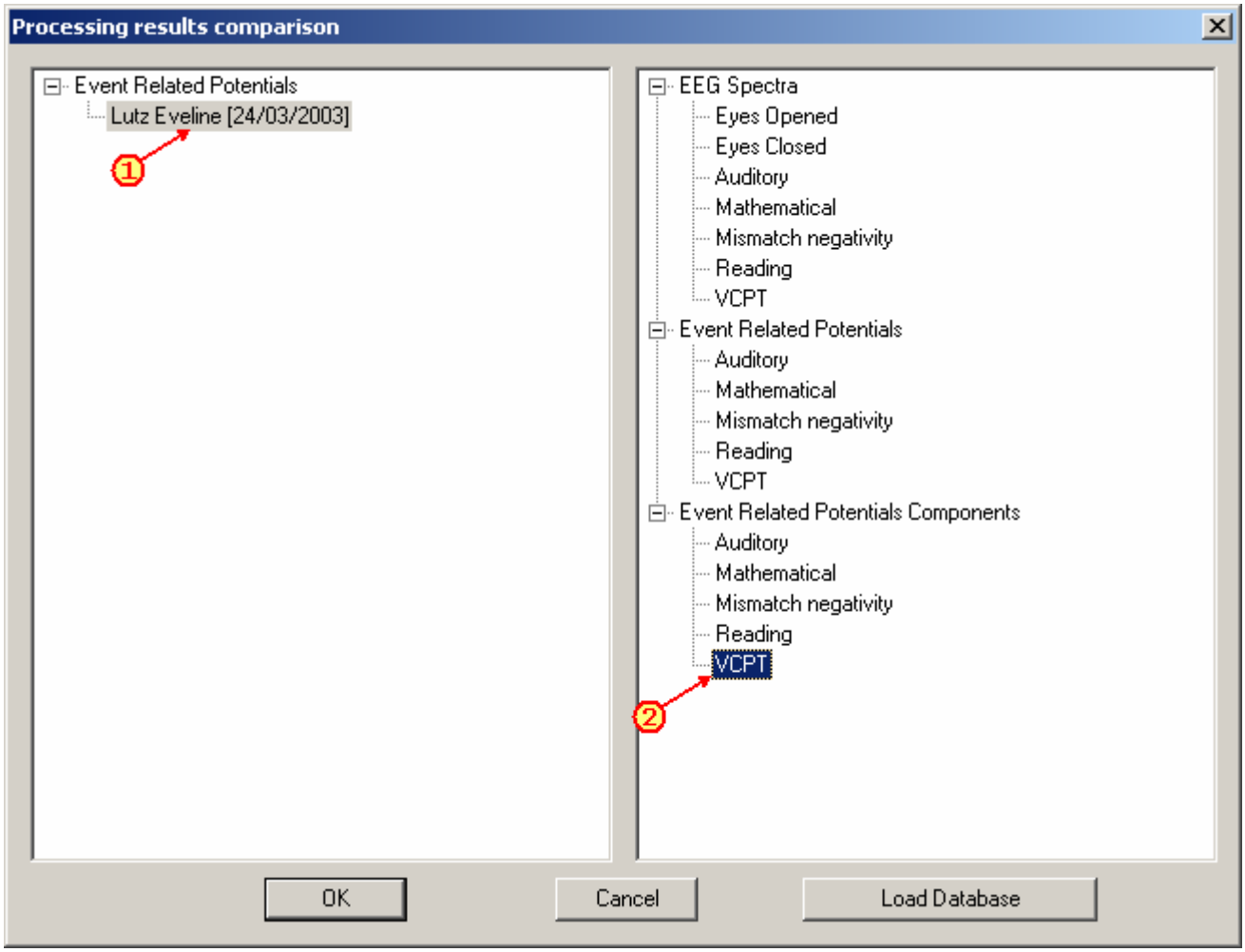
The gender should be “M” or “F”.



4.3. ERP computation and comparison with average ERP components database.

The procedure of comparison of ERPs with ERP components database is similar to the procedure of comparison of ERPs with ERP database except step 7.

The appropriate condition should be selected from the list of “Event Related Potentials Components” (see below).



The results of comparison individual ERPs with average ERP components are shown below.