«DINAMIKA», the research laboratory

SYSTEM OF COMPLEX COMPUTER-AIDED INSPECTION OF THE FUNCTIONAL CONDITION OF A HUMAN ORGANISM «DINAMIKA SPORT»

User's Manual

Saint-Petersburg, Russia

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www.dyn.ru

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1. INTRODUCTION

1.1. Common Info

“Dinamika Sport” - the digital analyzer of biorhythms – is a hardware-software complex, intended to analyze human heart and brain rhythms extracted from an electrocardiosignal in the broadband frequency. The system is based on a new information analysis technology of non-linear signals of a different physical nature – a so-called "Fractal Neurodynamics".

Designing the system, the latest achievements in theoretical and clinical medicine and physiology were used, and a number of new highly informative health evaluating indices are offered.

“Dinamika Sport” allows:

- in the screening mode - to estimate a level and reserves of a cardiovascular, vegetative and central regulation, and to evaluate deflections of these parameters from normal values;

- to estimate a level of indemnification and power resources of an organism at various levels of a regulation;

- in the “biological feedback” mode – to estimate capabilities of the self-regulation, to evaluate and forecast psycho-physical condition of a patient;

- in the dynamical monitoring mode - to monitor a functional condition of the patient and to estimate the effectiveness of various methods of therapy at realization of treatment-and-prophylactic measures;

- to create a medical report and give necessary recommendations as the results of a computer-aided analysis.

The “Dinamika Sport” system helps doctors of any field of medicine to monitor all parameters of the functional condition of a patient, to predict their changes, to estimate the organism's resources and to evaluate the effectiveness of the treatment. In cooperation traditional and non-traditional therapy, the hardware-software complex “Dinamika Sport” allows to create the unique diagnostically-therapeutic mini-studies with the completed cycle “diagnostics – therapy – monitoring – forecast” in various environmental conditions.

1.2. Application areas

- **The profile medical research institutes, hospitals, private clinics, first-aid posts of the industrial enterprises and establishments:**
  - dynamic observation over parameters of the functional condition of a patient during therapeutic treatment;
  - selecting schemes and optimization of the different methods of treatment;
  - multi-functional monitoring in surgeries, resuscitations and intensive care chambers;
  - monitoring and forecast of the functional condition parameters during an aftertreatment.

- **Polyclinics, centers of preventive medicine, studies of functional diagnostics, private medical studies:**
  - express-diagnostics of the functional and psychophysical condition of a patient with printing of a computer report by results of survey;
  - detection of the patients requiring for additional clinical survey at the doctors in profile medical establishments;
  - detection of the patients of an oncology types, including at early stages of disease;
  - evaluation of effectiveness of traditional and non-conventional methods of therapy during a treatment.

- **The specialized medical departments of atomic stations, airlines, police, banks etc.:**
  - selecting the staff for operating work with completing a personal database of physiological parameters;
  - screening and diagnostics during medical observations of staff;
  - monitoring and forecast of a psychophysical condition of operators, dispatchers, pilots, drivers, and other persons in requirements of a nervous-emotional strain and monotonic work;
  - individual choice of optimum agents of regeneration at overwork and chronic overstrain: vitamin balance, normalization of dream etc.;
  - detecting drug-users, including using drugs at a working place.

- **The scientific - practical centers of sports medicine, sports clubs, sports schools, health centers:**
  - Express - monitoring of acclimatization of the sportsman to exercise stresses training level and power resources estimation;
  - Evaluation of a level of a self-regulation in the “biological feedback” mode and monitoring of the psycho-emotional condition of a sportsman during competitions;
  - Dynamic observation over parameters of the sports form during post-trauma aftertreatment and during bolstering and corrective medicament and physiotherapeutic treatment.

1.3. System Capabilities

- ECG registration in any standard lead and real-time monitoring of the functional condition parameters.
- Blood pressure measuring while ECG registration.
- Self-regulation level estimating in the biological feedback mode.
- Screening and diagnostics of the functional condition of a patient.
- Dynamical monitoring of changes of the functional conditions parameters – health calendar and clock.
- Daily forecast of the psycho-physical activity in the “biological clock” mode.
- Estimation of the cardiovascular condition and neuro-humoral regulation according to the “golden section” on the ECG timing parameters.
- Estimation of the vegetative regulation parameters using statistic, time and spectral methods of heart rhythms analysis.
- Estimation of the central regulation parameters and the endocrine system by the methods of neurodynamics analysis of the human biological rhythms.
- Estimation of the psycho-physical condition o f the patient by the methods of the phase analysis and the brain biorhythms mappings.
- Estimation degree of a harmonization of biorhythms of an organism and evaluation of an information parameter of the immune status by the fractal analysis method.
- Controllable psycho-physiological therapy (“the dope effect”) in the biological feedback mode.
- Sequential 12-leads ECG registration with the visual monitoring of the recording quality.
- Automatic evaluation of the **PQRST** parameters with the ability of manual correction.
- Giving the complex medical report as the results of computer-aided analysis. Saving and printing the results of survey.
- Individual medical card-file of an ambulatory with a built-in database on 15000 diagnoses.
- Electronic patients file which can be exported, imported and archived.

1.4. System features

ECG registration at any standard lead during 5 minutes is completely enough to get all necessary information. A patient may sit or lay.

Brain rhythms are extracted from the ECG signal registered in a wide range of frequencies. No encephalogram is needed.

Monitoring of the parameters of the functional condition is implemented exactly during the ECG registration.

The “biological feedback” mode is applied to evaluate parameters of self-regulation and to correct psycho-emotional state of a patient.

Printed report of the observation can be completed with a patient’s photo (in case of using a digital camera).

Independent power supply allows examining patients in any environment and conditions.

1.5. What's new in current version

New type of the remote module of signal registration was developed for the "Dinamika Sport" complex. It is supplied with embedded blood pressure measurer. A new photon-coupled cable is used for transmitting an ECG signal. New model distinguishes:

- improved noise stability;

- high quality of a registered signal;

- reliability in maintenance;

- longer session of continuous work.

At development of the software the experience of five years' operation of system in medical establishments of Russia and abroad, and wishes and notes of the users was taken into account.

Software of the "Dinamika Sport" complex is designed for Windows 98 and uses all capabilities of modern operation system.

Modules of real-time monitoring, biological feedback, screening and diagnostics, 12-leads ECG registration and analysis were developed for the new version.

The electronic medical card-file of the patient ensuring an intrusion in medicine of paperless technology was designed.

A specially designed converter-program provides usage the medical database of the previous versions.

The system designers will appreciate any comments and recommendations on the software and documentation.

Due to constant up-dating of the software, this manual may differ to some extent from its later versions.

2. DELIVERY SETS

«Dinamika» Standard

- Dinamika.Medicine/Sport software;
- ECG module. Model DYN71;
- Cardiographic electrodes;
- USB cable;
- Medical bag.

«Dinamika» Express

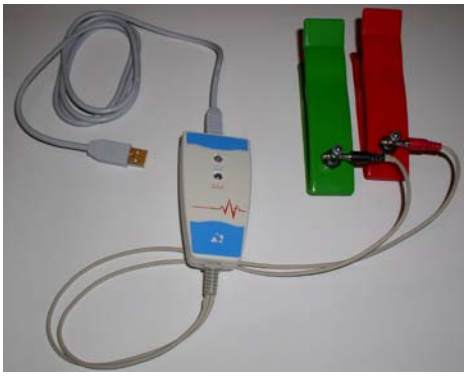
- Dinamika.Medicine/Sport.Express software;
- ECG module. Model DYN73 – 7 pcs.;
- Cardiographic electrodes – 14 pcs.;
- USB cable – 7 pcs;
- 7-port hi-speed usb hub;
- Medical bag.

«Dinamika» Pro

- Dinamika.Medicine/Sport.PRO software;
- ECG module. Model DYN71;
- Cardiographic electrodes;
- USB cable;
- Medical bag.
-
- ECG module. Model DYN73 – 7 pcs.;
- Cardiographic electrodes – 14 pcs.;
- USB cable – 7 pcs;
- 7-port hi-speed usb hub;
- Medical bag.

3. TECHNICAL DESCRIPTION

3.1. ECG registration module



Note: With some lap-top models, operating by means of outer source, not by means of accumulator, while writing the ECG some noise appears. To remove this noise it is recommended to turn off the alternating current adapter from the outer source and to use accumulator as a power supply for the lap-top. In case there is hum while using a desk computer, it is recommended to use ground connection.

Also the printer, connected via USB-interface, can be the origin of hum. To avoid the noise it is recommended to disconnect printer from the computer while recording the ECG.

3.2. Technical Features

Input voltage range .....0.03 - 5 mV

Input impedance not less than ..... 5 MΩ

Internal noise level not more .....10 mkV

Attenuation factor of co phased signals on 50 Hz frequency not less ..... 110 dB

Direct current in a chain of the patient, not more ..... 0.1 mkA

Bandwidth ..... 0.03 - 500 Hz

Stationary value of time .....3.2 sec.

Input signal sampling rate ..... 1000 Hz

Number of the discharges of quantization 12

Transmission rate on a sequential data link RS232C ..... 38 Kbod

Independent power supply voltage .....+ 5 V

Time of continuous operation without recharging ..... 20 hrs.

3.3. Requirements for a PC

	Recommended configuration
CPU	Intel Celeron M 1.7 ГГц
RAM	1024 Мб
Display Adapter	ATI Radeon 9000; nVidia GeForce 5200
Free disk space	over 200 Мб
Operating system	Windows XP, Windows Vista

Any windows-compatible printer device can be used for printing the results of an observation.

3.4. Warranty Statement

The warranty operational period is 36 months from installation. All warranty operations will be held in company's Service Center in Saint-Petersburg, Russia. Within the warranty period, in case of the system's malfunction, the Company provides a free replacement of the system either in part or in whole, in conformity with the delivery set checklist.

The Company will adapt the software to the Customer's working conditions. During the applicable warranty period, the Company will inform Customer of the upgraded software versions, and in case of interest, the Company will install them at a lower price.

4.GETTING STARTED

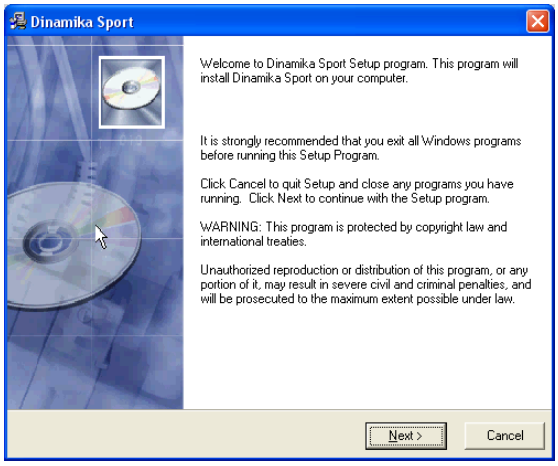
4.1. Software installation

1. Turn the PC on.

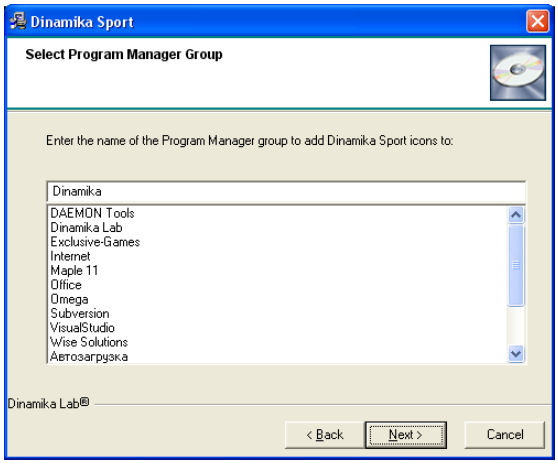
2. Insert the software CD.

3. Installation of the software will begin automatically, if it has not occured, start installation manually by means of file Setup.exe.

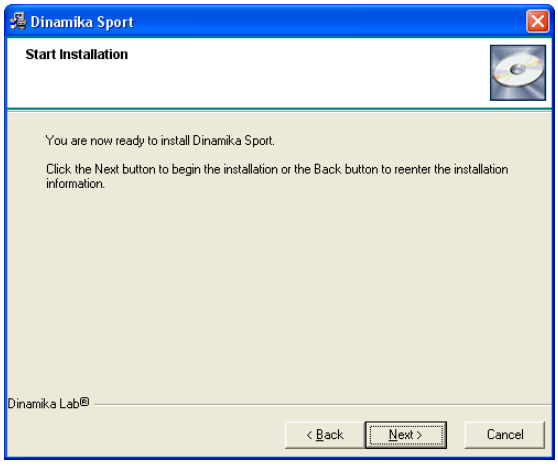
4. In the “Welcome” window press the “Next” button to begin the installation.



6. Select Program Manager Group



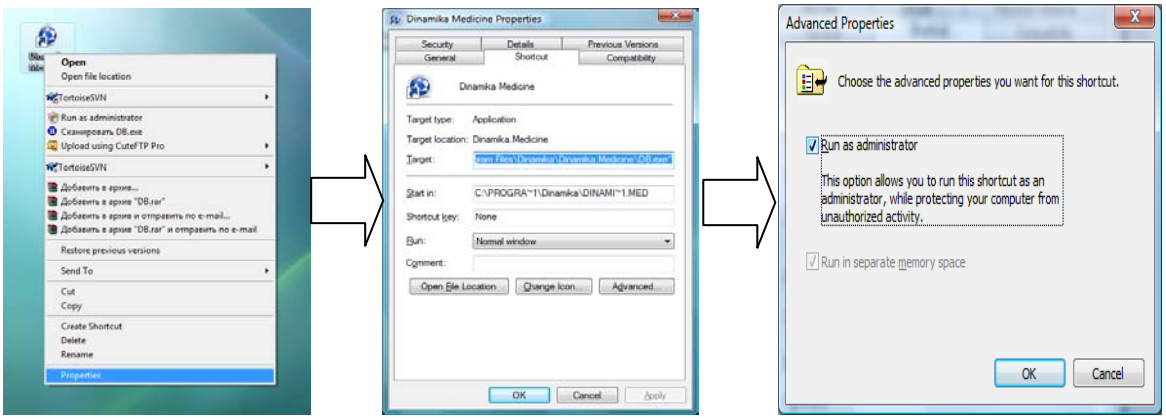
7. Press the “Next” button to start installation.



4.2. Preparation for the first start and the first start

4.2.1. For Windows Vista Users

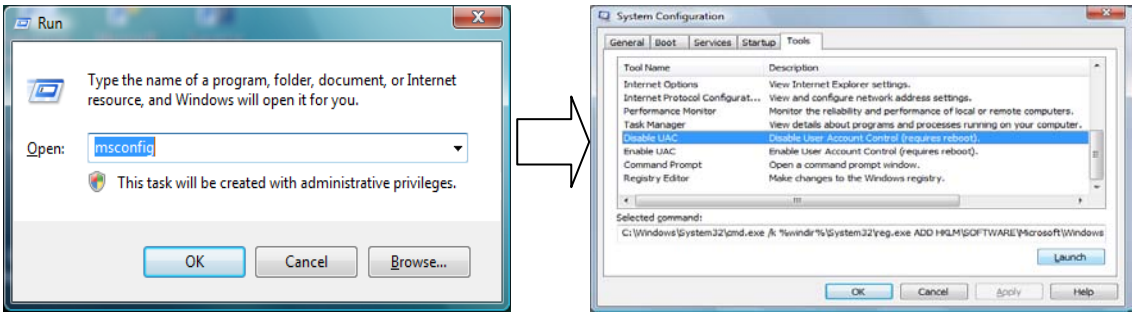
1. The program should be started with the administrator rights.For this purpose click the right mouse button on a program icon in the desktop and in the appeared menu choose "Property" item. Further, in the opened window first choose a "Shortcut" tab and then press button "Advanced".Check the item "Run as Administrator" in the appeared window and press button "OK".



2. Now you can go to 4.2.2.

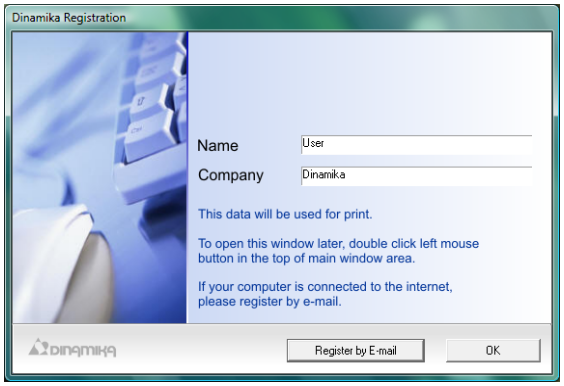
Note: Another way and also for more comfortable work in Windows Vista, it is possible to turn off the "User Account Control (UAC)".For that, press a combination of "WinKey + R" in the and type "msconfig" in the appeared window. In the opened window "System Configuration", press the "Tools" tab, choose the "Disable User Account Control" list item, press the "Start" button and restart the Windows. After switching-off of the "User Account Control" you can go to 4.2.2.

Remember, that the given action lowers safety of your computer!



4.2.2. First start Dinamika Sport software

1. Double-click on the “Dinamika Sport” icon on your desktop to run the program. Fill the registration form.

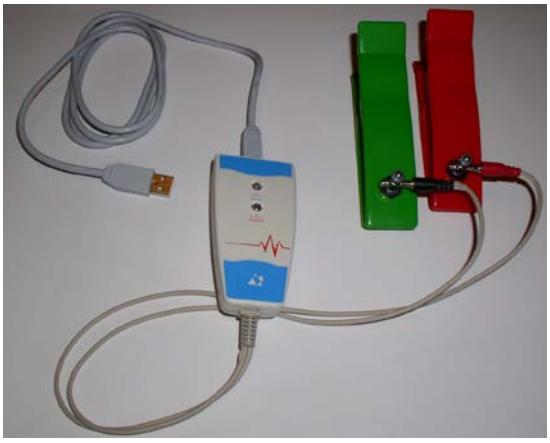


3. For continuation of work press «OK» if your computer is connected to the Internet, you can be registered having pressed the button «Register by E-mail».

4. Registration Complete.

4.3. Plugging the Remote Module

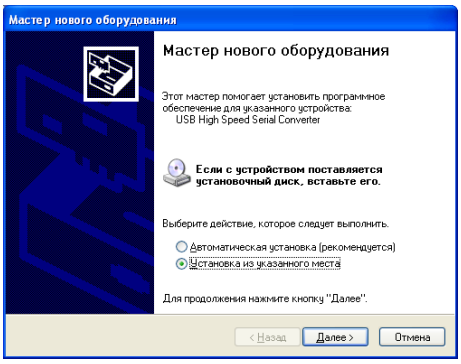
1. Connect electrodes to the lead-cable and fix them using screws.
2. Plug the interface cable to the USB port. Connect the cable and the remote module.
3. Complex is ready to work!



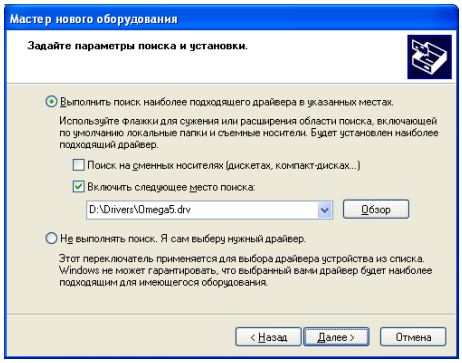
4.3.1. Installation the USB-device drivers.

After the connection of the remote module to the computer is done, the new device will be detected and new devices installing master will run.

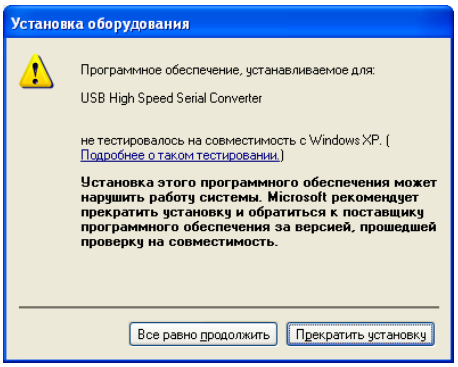
1.In appeared window check “Installation from current place” and push “Next” button.



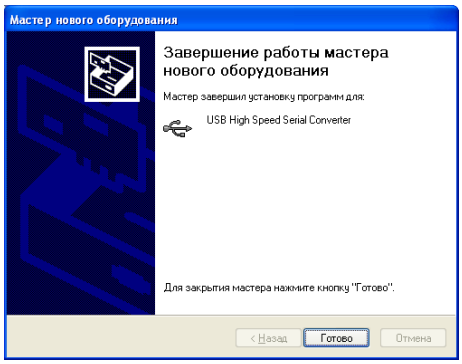
2. In the next window uncheck “Search on the portable sources” and check “Search in the following folder”. Press “Browse” button and choose “D:\Drivers\Omega5.drv” directory, then press “Next” button.



3. In the “Device installation” notifying window press “Continue” button.



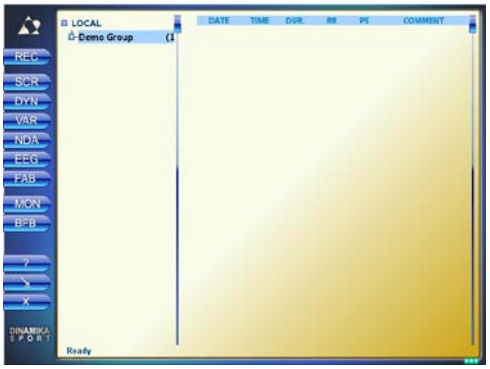
4. Press “Finish” to finish the installation.



5. OPERATION ORDER

5.1. Starting Software

1. Double-click the “Dinamika Sport” icon on your desktop to run the program.
2. The database window will appear.



Left part of the window will display the list of groups of patients.

The symbol means that the group is open – the list of the patients is shown.

The symbol means that the group is closed.

Double click on the name of group or single click on the / symbol to open/close the group.

The number of patients contained in the group is show to the right of the group name.

The group without any / symbol is empty.

The list of patients is alphabetically sorted alphabetically. The selected patient name is colored yellow.

The right part of the window represent the list of the ECG’s of the current patient, sorted by the date of observation.

All functional buttons are in the upper string of the window:

REC - ECG Registration

SCR - Screening-Diagnostics

DYN - Dynamic Observation and Forecast

VAR - Variation Analysis of Heart Rhythms

NDA - Neurodynamic Analysis

EEG - Charting of Brain Biorhythms

FAB - Fractal Analysis

MON - Monitoring

BFB - Biological Feedback

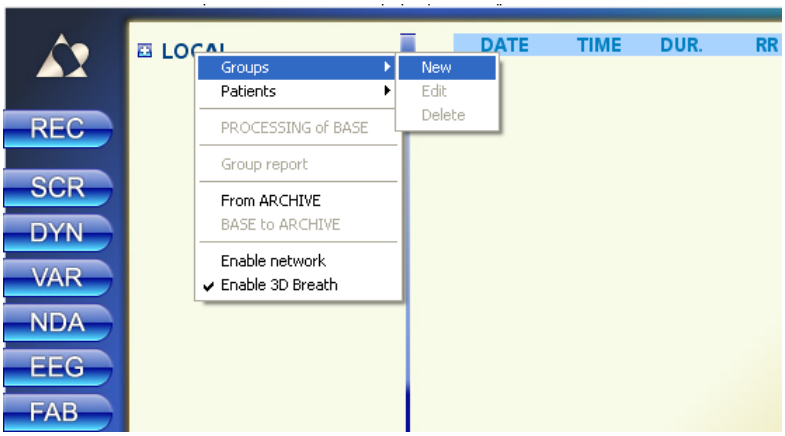
? - help

↘ - minimize

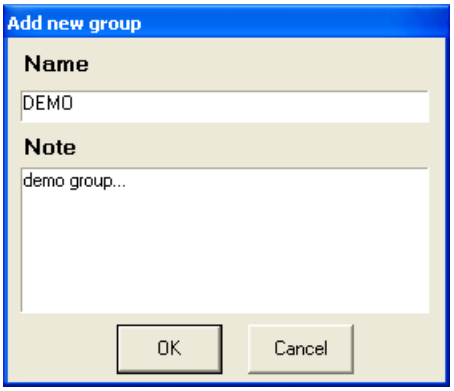
X - close

5.2. Creating a Group of Patients

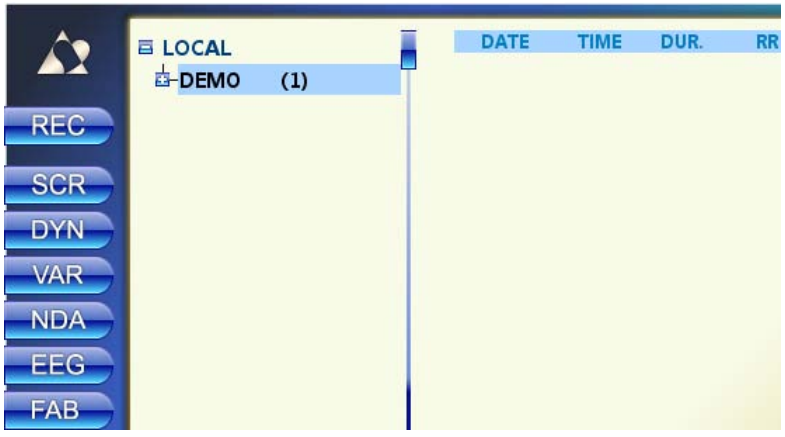
1. To create a group of patients right-click on the “Card-File” string in the left part of the window and choose the “Groups->New” item in the pop-up menu.



2. Fill the “New Group” form and press “OK” (“Notes” is an optional field).

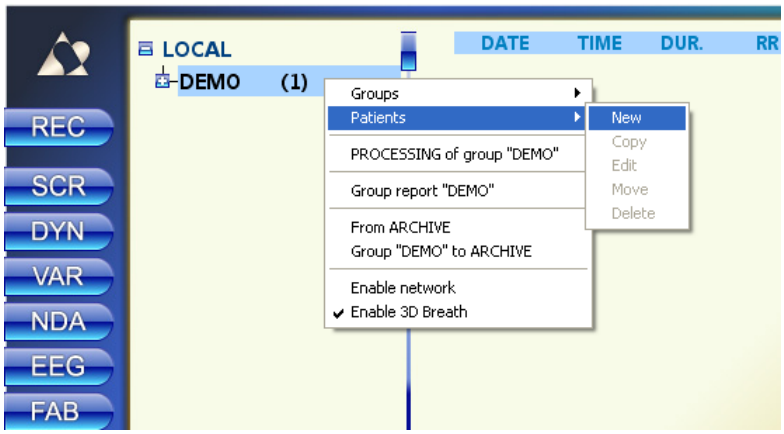


3. The new group will appear in the left part of the window.

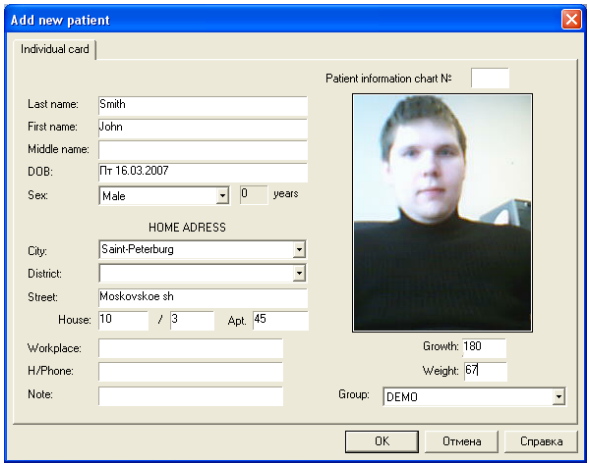


5.3. Adding a Patient into the Database

1. Click on the name of the group name to select a group. Right-clock to open a pop-up menu then select “Patients->New”.



2. Fill the “Add a new patient” form



Use “Tab” or “Shift+Tab” to switch between fields. Or use a mouse.

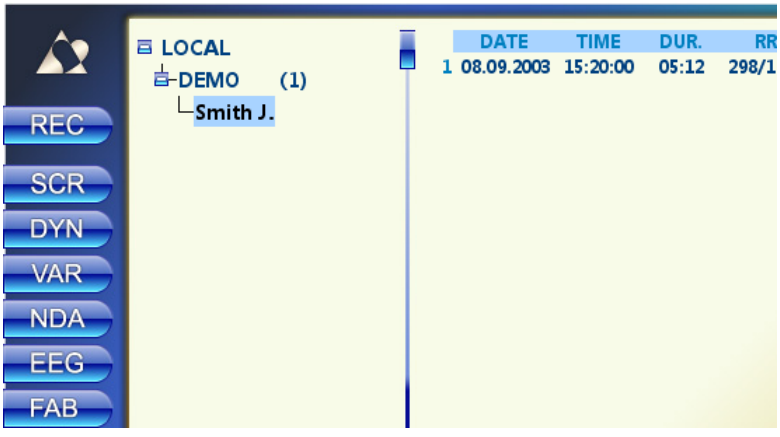
Fields “First Name”, “Second Name”, “Birth Date” and “Gender” are required.

Birth Date has to be entered in “DD.MM.YY” format (i.e. 17.01.45). You can also use a drop-down list.

To enter “Gender”, “City”, “Region”, "Group” please use drop-down list which are activated by button.

Click “OK” or press “Enter” when done.

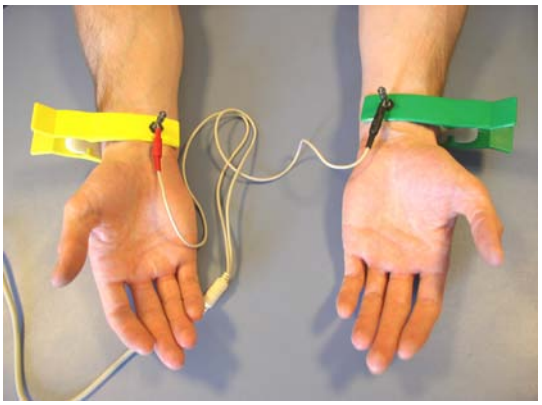
3. In the left part of the window the name of a new patient will appear.

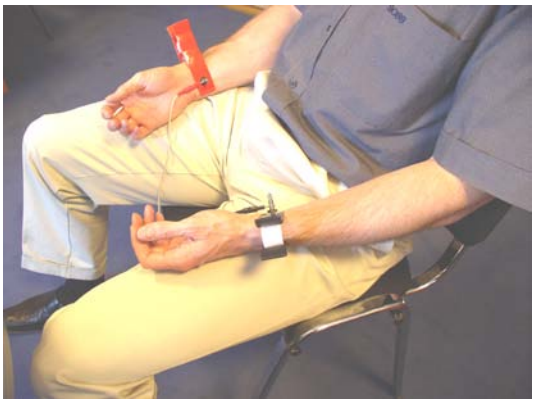


6. ECG REGISTRATION

6.1. Plugging the remote module of ECG registration

1. Place electrodes onto patient's wrists, contacts inside. It is also recommended to moisten the skin. A patient should sit or lay still. You do not have to observe polarity.





Note: Sometimes, when the amplitude of R-peaks is too low, the red electrode should be placed on the right wrist but the yellow one – on the left ankle, which also has to be moistened very well.

Attention! Please follow these reduce noise during the ECG registration:

a) patient's arms have to be relaxed and lay still.

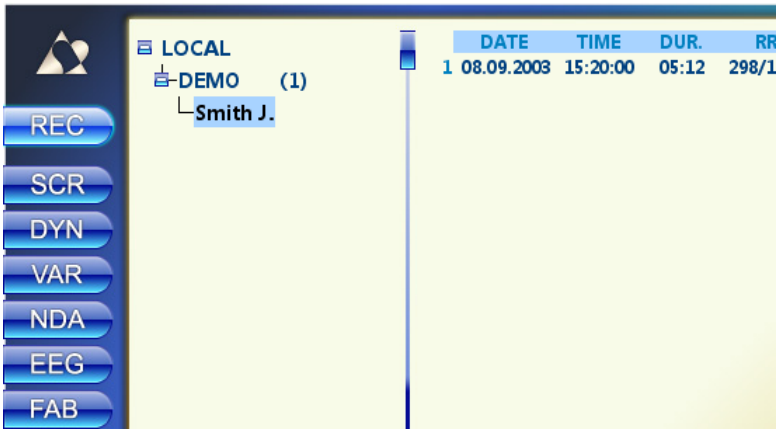
b) there should be nobody else in 1.5 – 2 meters around.

c) do not place the remote module near sources of magnetic and electrical fields (TV-Sets, old models of computer displays, etc.)

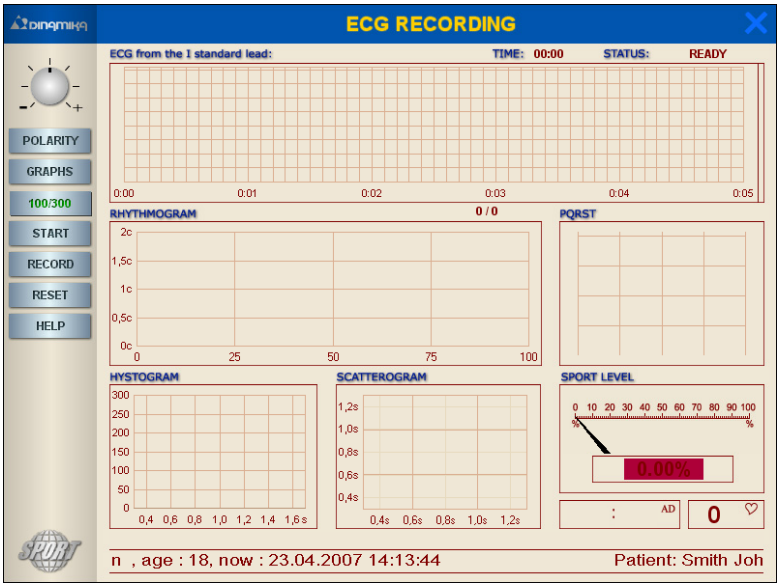
d) patient should try to be in most comfortable and relaxed position. It is NOT recommended to disturb a patient by talking or to demonstrate a computer display with ECG being recorded.

6.2. ECG Recording

1. Click to select a patient on the left panel. The selected patient's name will be colored yellow. Press the "REC" button to start recording the ECG.



2. The "ECG Registration window will open



3. Press "START" button. The ECG signal will appear in the upper window.

If no signal appears – see "TroubleShooting"

4. Before starting to record you have to achieve stable ECG signal in which precise R-peaks are marked with vertical markers. Follow these steps to do it:

a) Choose positive polarity of the ECG by pressing the "POLARITY" button

Positive polarity

Negative polarity

b) Establish appropriate scale by regulator

Source signal

Scaled signal

c) Remove all noises.

There are 3 types of noises:

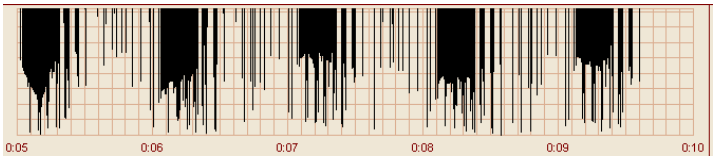
Some people are walking near – there should be nobody in 1.5-2 meters around.

Patient moves his hands – patient hand should be still.

Be contact between electrodes and patients skin – moist the skin and clean the electrode's contacts.

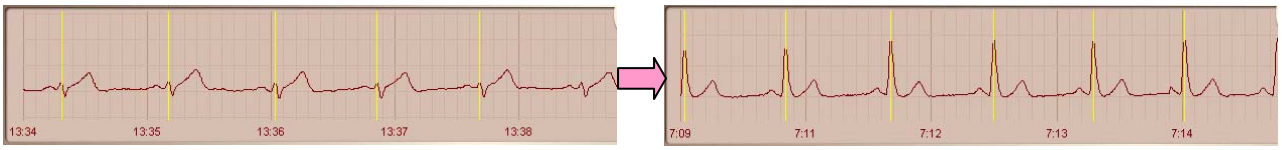
No contact between the electrodes and the remote module. Check the lead cable.

Remote module's batteries are off – charge the batteries.

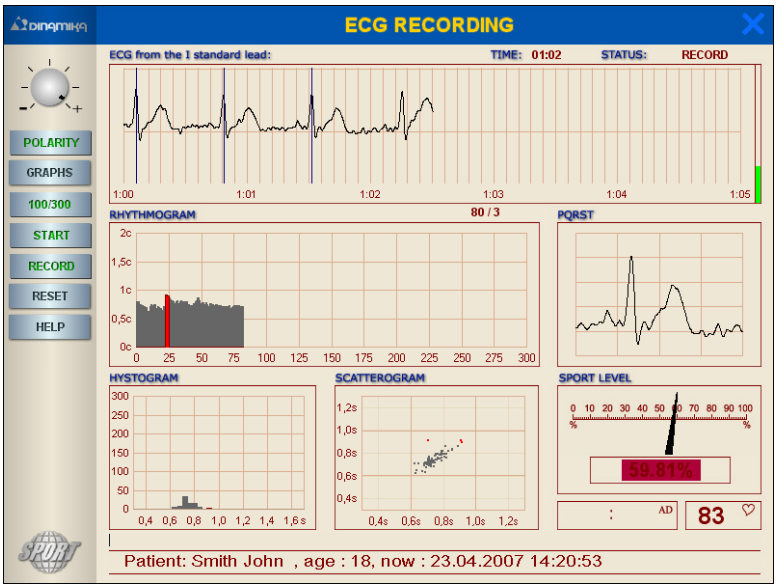


Incorrect device type selected. Please select "Omega 7.1" device (6.3.3).

Note: Sometimes, when the R-peaks amplitude is too low or contact between electrodes and a patient's skin is weak, the algorithms of R-peaks extraction may do not work properly. It is recommended to move the electrode from the left wrist to the left ankle – the 2nd lead. (see 7.1.4.1).



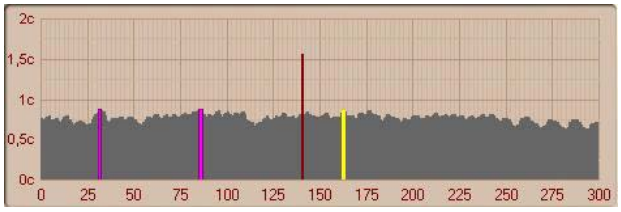
5. Press "RECORD" to start recording. The "PREPARE" mode will start and after 5 seconds of countdown the "RECORD" mode will begin working. All diagrams will be regenerated.



The “ECG” window

Time from the beginning of the record (in minutes and seconds) is shown along the abscissa axis. The axis of ordinates represents amplitude of ECG. Vertical lines are marking extracted R-peaks. By default, the scale of ECG is 25 mm/sec. To change the scale to “12.5 мм” – “25 мм” – “50 мм” please use the “SCALE” button. Use mouse to drag the graph along vertical and horizontal axes.

The “Rhythmogram” window

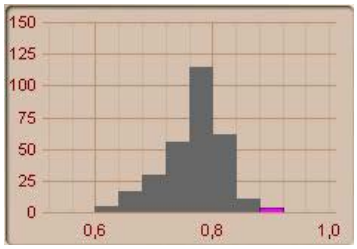


This window shows the dependence of the RR-interval duration from the number of the evaluation cycle. The artifacts are marked with red color. Along the abscissa axis the numbers of the evaluation cycles are shown. The time, in seconds, is along the ordinate axis. Rhythmogram can be represented in two modes: 300 and 100 cycles. The button “100/300” is used to switch between these modes.

The “PQRST” window

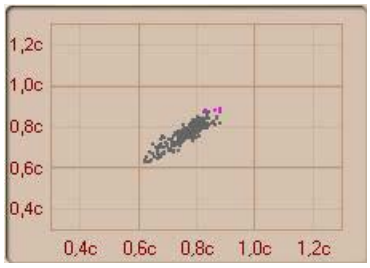
This window displays a cardio-complex, relevant to an RR-interval, selected on the rhythmogram. Blue marks are reflecting P, Q, R, S, & T peaks. Select (with the left mouse button) the necessary rectangle of the graph to zoom in. Click right mouse button to zoom back. Double-click left mouse button to switch to the manual measuring mode. For gauging amplitude-time parameters according to accepted standards it is necessary to place markers P and T of peaks on a beginning and an end P and T peaks accordingly.

The “Histogram” window



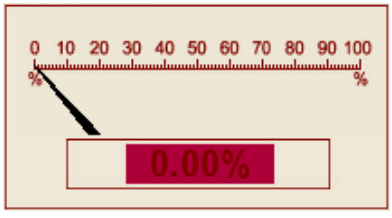
The histogram represents the chart of a relation of quantity of RR-intervals in different intervals of their duration. Duration of RR-intervals is shown along the abscissa axis. Axis of ordinates represents probability of their occurrence (i.e. number of RR-intervals in the relevant gamut). Artifacts are marked with red.

The “Scatterogram” window



R-R intervals scatterogram is a two-dimensional display of the heart rhythm, which allows receiving the so-called “mnemopictures” characteristic of the main types of the heart rhythm disturbances. Along the abscissa axis is the value of RR_i-interval in seconds. The ordinates axis represents the value of RR_{i+1}-interval in seconds. Artifacts are marked with red.

The “Sport level” window



This indicator displays the normalized value of the current integral index of the functional state of the patient. The first value of the index appears after 60 intervals of record and updates every 10 intervals.

The “Dynamics of indices of functional state” window

Click the 🗗 button to open this window. Colored graphs represent changes of current indices of physical state during the recording process: **A**, **B**, **C**, **D** & **Health**. The abscissa axis shows numbers of RR-intervals from 50 to 300. The first value of the index appears after 60 intervals of record and updates every 10 intervals. The first value of the index appears after 60 intervals of record and updates every 10 intervals.

A – level of acclimatization of cardiovascular system

B – index of a vegetative regulation

C – index of a central regulation

D – psycho-emotional state

Health – integral index of a sport level

6. You have to control quality of the ECG signal periodically. If any noises noticed – stop the record by pressing the “RECORD” button, figure out the reason of noises, press the “CLEAR” button to reset the record and repeat record by pressing “RECORD” button.

The duration of record is controlled by the number or RR-intervals indicator, which is upon the “Rhythmogram” window

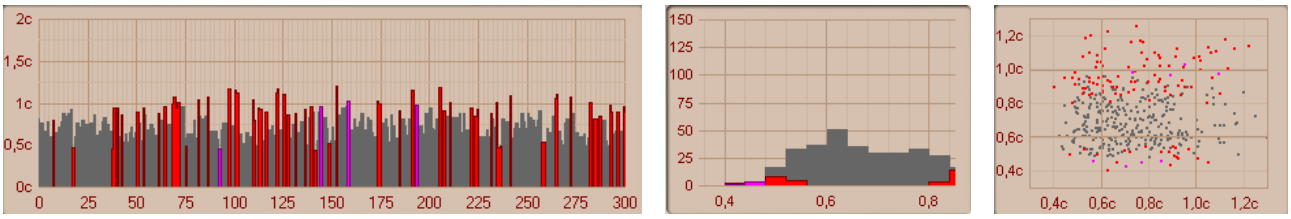
(the first value is the number of recorded RR-intervals, the second value is the number of artifacts). The record will stop automatically after 300 “clear” RR-intervals. You can interrupt the recording by pressing the “RECORD” button.

Attention!

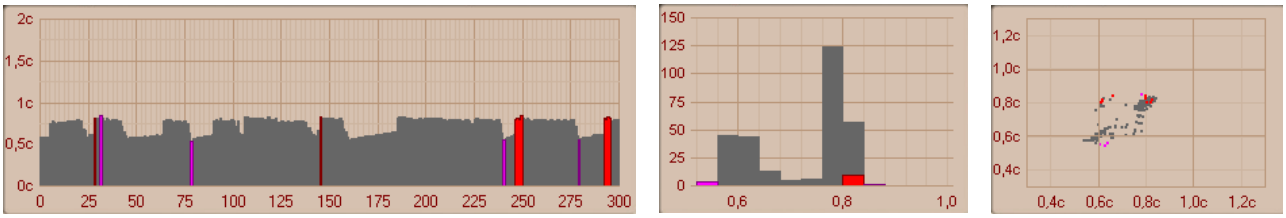
If a patient has obviously expressed violations of a cardiac rhythm, such as extrasystole and different sorts of arrhythmias the calculation of metrics of a functional state will be yielded incorrectly.

Estimation of the functional state metrics and processing an ECG in all modes can be done only if the patient does not have any violations of a cardiac rhythm!

Typical view of the “Rhytmogram”, “Histogram” and “Scatterogram” windows when the patient has cardiac rhythm violations are shown on the pictures below:



Fibrillation



Doubled rhythm.

7. You can leave any comments during the recording. Click mouse button on the comment string to edit it.

9. The following dialog box will appear after finishing the recording:

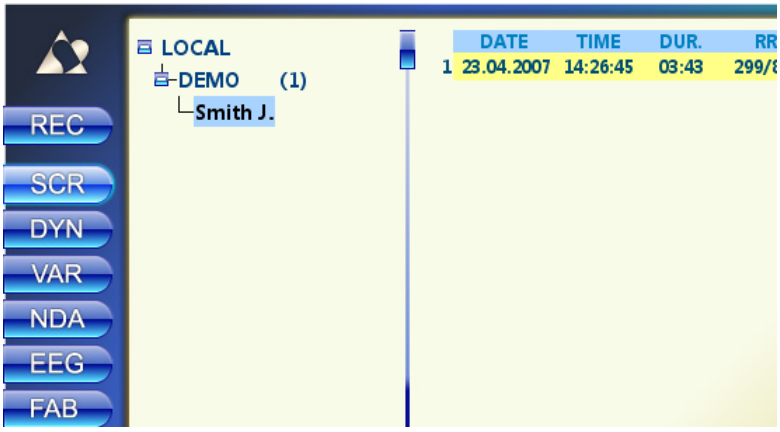
Press “Yes” to save the record.

10. Press “EXIT” to close the window.

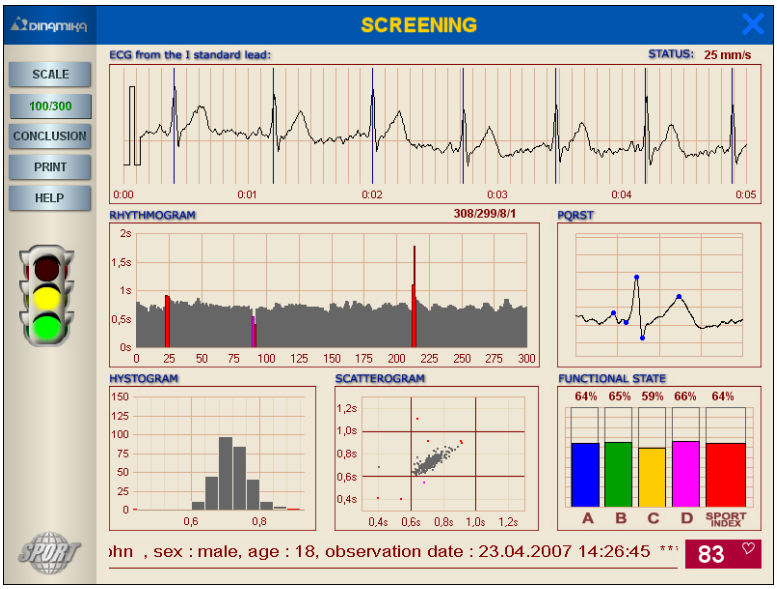
Note: to quit before the end of recording you have to press “RECORD” and “START” buttons sequentially and the press “EXIT”.

7.SCREENING AND DIAGNISTICS

Click left mouse button to select the patient's ECG record in the right part of the database window. The selected record will be colored yellow. Press the "SCR" button to run the "Screening-Diagnostics" module.



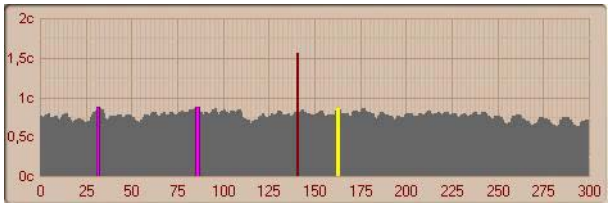
The "Screening-Diagnostics" window will appear.



1. The "ECG" window

Time from the beginning of the record (in minutes and seconds) is shown along the abscissa axis. The axis of ordinates represents amplitude of ECG. Vertical lines are marking extracted R-peaks. By default, the scale of ECG is 25 mm/sec. To change the scale to "12.5 мм" – "25 мм" – "50 мм" please use the "SCALE" button. Use mouse to drag the graph along vertical and horizontal axis.

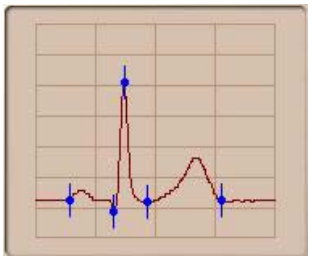
2. The “Rhythmogram” window



This window shows the dependence of the RR-interval duration from the number of the evaluation cycle. The artifacts are marked with red color. Along the abscissa axis the numbers of the evaluation cycles are shown. The time, in seconds, is along the ordinate axis. Rhythmogram can be represented in two modes: 300 and 100 cycles. The button “100/300” is used to switch between these modes. The RR-intervals counter is shown above the rhythmogram

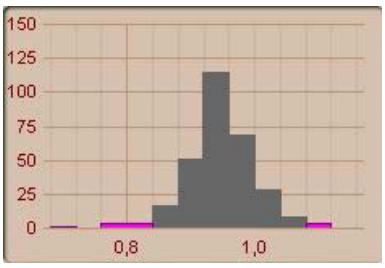
. It represents: total amount of recorded RR-intervals, number of “clear” intervals and number of artifacts. Click left mouse button to select an RR-interval. Selected interval will be colored yellow and the “ECG” window will display the corresponding part of a cardio signal.

3. The “PQRST” window

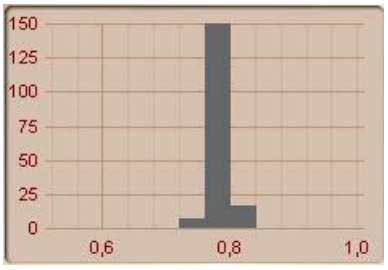


This window displays a cardio-complex, relevant to an RR-interval, selected on the rhythmogram. Blue marks are reflecting P, Q, R, S, & T peaks. Select (with the left mouse button) the necessary rectangle of the graph to zoom in. Click right mouse button to zoom back. Double-click left mouse button to switch to the manual measuring mode. For gauging amplitude-time parameters according to accepted standards it is necessary to place markers P and T of peaks on a beginning and an end P and T peaks accordingly.

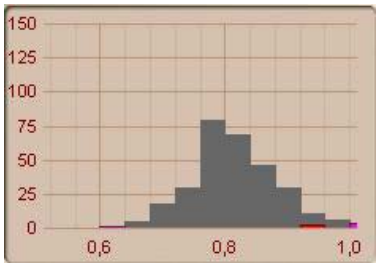
4. The “Histogram” window



A



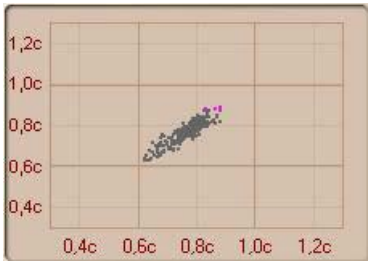
B



C

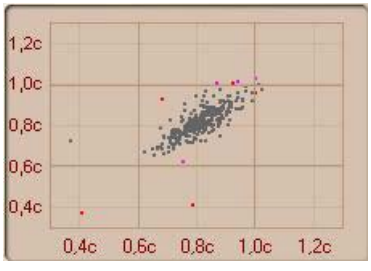
The histogram represents the chart of a relation of quantity of RR-intervals in different intervals of their duration. Duration of RR-intervals is shown along the abscissa axis. Axis of ordinates represents probability of their occurrence (i.e. number of RR-intervals in the relevant gamut). Artifacts are marked with red. Histogram's step is 0.04 sec. Gamut of the histogram's basement is between 0.32 & 1.64 sec. In the state of a vegetative equilibrium columns are centered and the highest one (Moda) is between 0.7-1.0 sec. (fig. A). Columns are essentially biased to the left and the histogram's basement is not so wide (fig. B) in case of influence of the sympathetic department of the vegetative nervous system. And vice-versa in case of para-sympathetic influence (fig. C).

5. The “Scatterogram” window



A

B



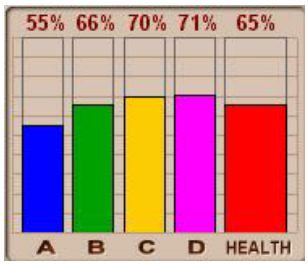
C

R-R intervals scatterogram is a two-dimensional display of the heart rhythm, which allows receiving the so-called “mnemopictures” characteristic of the main types of the heart rhythm disturbances. Along the abscissa axis is the value of RR_i-interval in seconds. Axis of ordinates represents the value of RR_{i+1}-interval in seconds. Artifacts are marked with red.

Uniform distribution (fig. A) means and equilibrium in the vegetative nervous system state. Higher density of the scatterogram “cloud” and it's biasing towards the bottom left corner (fig. B) means the predominance of the sympathetic department of the vegetative nervous system. And considerable straggling of points of scatterogram and biasing to the right (fig. C) speak about predominance of influences of a vagus nerve on a sine node.

6. The “FS Chart” window

This diagram show normalized values of index of a physical state.



A – level of acclimatization of cardiovascular system

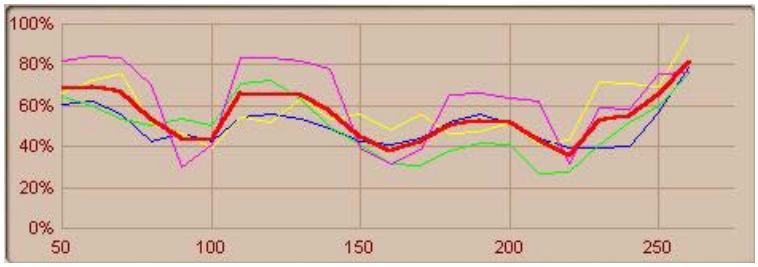
B – index of a vegetative regulation

C – index of a central regulation

D – psycho-emotional state

Health – integral index of a functional state

7. The “Dynamics of indices of functional state” window



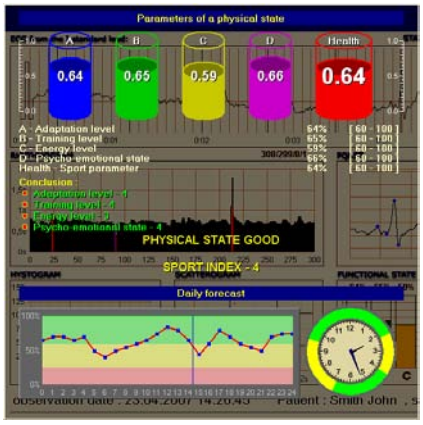
Double-click left mouse button upon the histogram graph to open this window. Colored graphs represent changes of current indices of physical state during the recording process: **A**, **B**, **C**, **D** & **Health**. The abscissa axis shows numbers of RR-intervals from 50 to 300.

8. “Semaphore”

Colors of the “semaphore” correspond to different levels of functional state:

	NORMAL FUNCTIONAL STATE. HIGHER ACTIVITY.
	NORMAL FUNCTIONAL STATE.
	INAPPRECIABLE DIVERSIONS OF A FUNCTIONAL STATE FROM A NORMAL STATE IT IS RECOMMENDED TO REPEAT THE OBSERVATION
	ABNORMAL FUNCTIONAL STATE. FURTHER OBSERVATION IS RECOMMENDED
	PRE-ILLNESS STATE. SIGNS OF PATHALOGICAL CHANGES. CLINICAL OBSERVATION IS STRONGLY RECOMMENDED

9. The “Conclusion” window

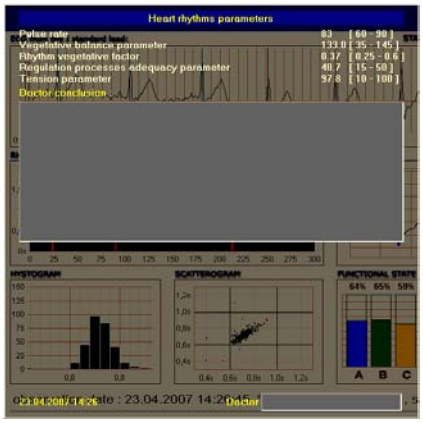


Indices of a physical state are shown in the upper part of the window. These parameters were calculated using unique methods of mathematical analysis of human biorhythms. All indices are in per cents. Computer conclusion is giver for each parameter separately and regarding an organism's condition in common.

24-hours forecast of changes of level of psycho-emotional and physical activity of a patient is given in the bottom part of a window.

“Green” – levels of psycho-emotional and physical activity are high; optimal adaptation;
“Yellow” – medium activity levels; normal adaptation;
“Red” – low activity levels; low adaptation;
Use ↓ cursor key or **PgDn** key to switch to the second page; use ↑ or **PgUp** to return to the first one.

Indices of a heart activity are shown on the second page of the window. These indices are calculated using standard methods of the variation analysis of the heart rhythms. Normal values of each parameter are shown to the right and a text conclusion regarding current state is shown below.



Coefficient of vegetative equilibrium (**AMo/ΔX**) shows relation between activity of the sympathetic and para-sympathetic departments of vegetative nervous system.

Index of adequacy of processes of a regulation (**AMo/Mo**) reflects correspondence between activity of a para-sympathetic department of vegetative nervous system and leading level of operation of the sinus node.

Vegetative Index of a Rhythm (**VIR=1/Mo*ΔX**) allows to evaluate vegetative balance from a point of view of an estimation of activity of an independent contour of a regulation. As this activity grows (VIR decreases), then the vegetative balance biases to the predominance of the para-sympathetic department of the vegetative nervous system.

Stain Index (**SI=AMo/2*ΔX*Mo**) of the regulation systems reflects a level of centralization of a control of the heart rhythm.

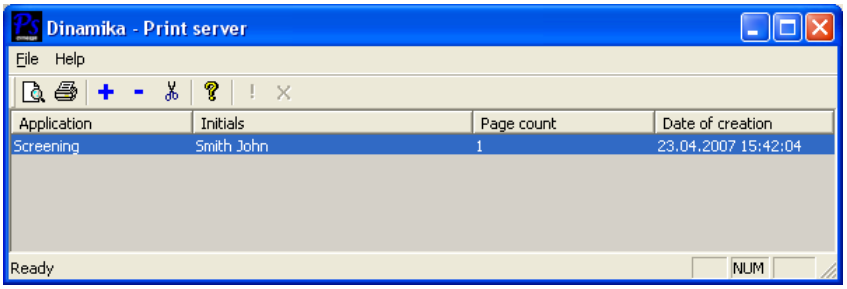
The central part of the window is intended for entering the medical conclusion and name of a doctor. Click on a field to enter the information. This data will be saved and used while printing the report.

Click left mouse button on any place of the window of hit “ECS” key to close the window.

10. The “Print” button

Pressing the “Print” buttons completes the full observation report which includes all current elements of window. Thus, it is recommended to choose the interesting ECG fragment, scale it, place all markers and calculate the PQRST-complex parameters before starting to print.

After completing the report, the window “Print Server” will appear.



Use “ZOOM” button to preview.

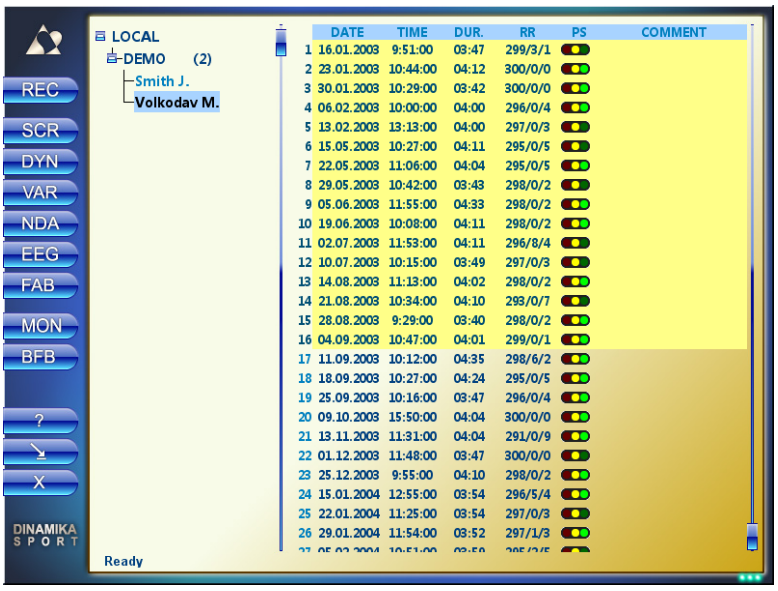
Use “PRINTER” button to start printing.

Use menu “File” -> “Printer Settings” to configure parameters.

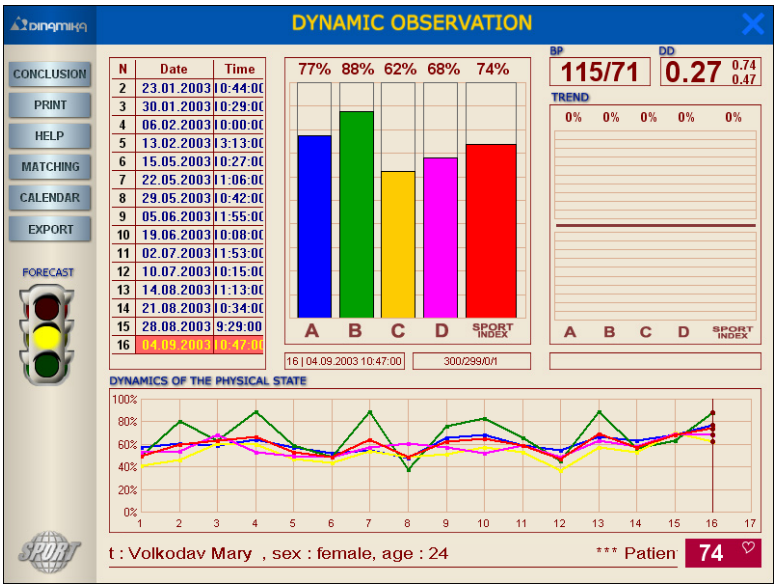
8. DYNAMICAL MONITORING AND FORECAST

The mode of dynamic observation is applied at nonsingular (two and more) surveys for comparison purposes of exponents of a physical state of the patient. In this mode all discharged records an ECG are handled (excluding artifacts), for which the pretreatment was yielded.

Choose a patient using mouse. The name of a selected person will be colored yellow. Select several ECG record in the right part of the database window. Press “DYN” button to run this module.



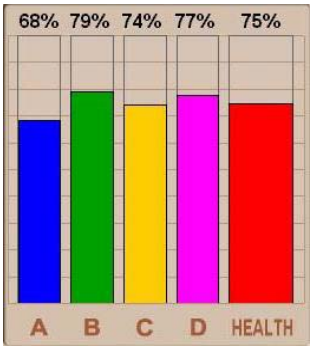
The “Dynamical Observation and Forecast” window will appear.



1. The "ECG records" window

In the upper-left window the list of patient's ECG records is shown. To move across this list please use **Home**, **End**, **PgUp**, **PgDn** buttons, or a mouse. The selected record is colored red. The last record in the list is selected by default.

2. The "FS Chart" window



Normalized values of the indices of functional state are represented on this diagram.

A – Cardiovascular system adaptation level

B – Vegetative regulation index

C – Central regulation index

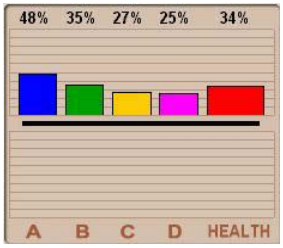
D – Psycho-emotional state

Health – integral functional state index

Blood pressure for the selected record.

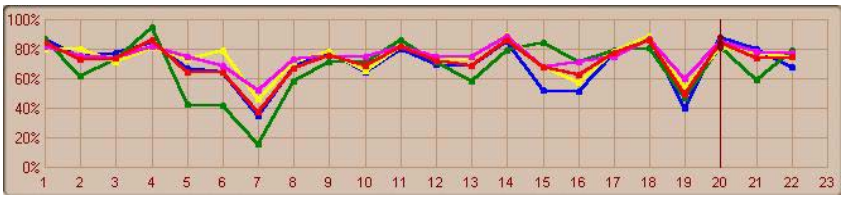
- Dynamic gamut (difference between maximum and minimum values of the integral index of the physical state).

3. The "Indices Trend" window



Press the "COMPARE" button to activate this window. It represents the difference between indices of two selected records. By default two latest records are selected. Selecting records to compare can be done in the "ECG records" window. During comparing previous record is subtracted from the next one.

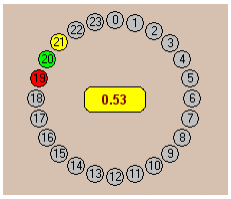
4. The "Dynamics of indices of a functional state" window



Graphs of corresponding colors represent normalized values of indices of a functional state: A, B, C, D & **Health**.

Id numbers of the ECG records are shown along the abscissa axis. Up to 26 records can be represented in one window simultaneously. The selected record is marked red. Moving along the graph can be done using cursor keys, **Home**, **End**, **PgUp**, **PgDn** keys, or using mouse.

5. The "Health calendar" and "Health clock" windows



These windows can be activated by pressing the "CALENDAR" button. Color marked dates on the calendar and time on the clock represent date and time of observations. The color corresponds to the health level. Digital value in the center of the clock shows the average value of the integral index of the functional state. By scrolling calendar to the left one can see the history of observations and by scrolling to the right - forecast for the next month.

6. EXPORT

This function allows to export all calculated indices to an Excel (*.xls) file.

7. Click “EXIT” button or hit “ESC” key to close the window.

9. SYSTEM ANALYSIS

System analysis includes four stages:

1. Variation analysis of heart rhythms – evaluation of the vegetative regulation indices using methods of statistic, time and spectral analysis of the heart rhythms;

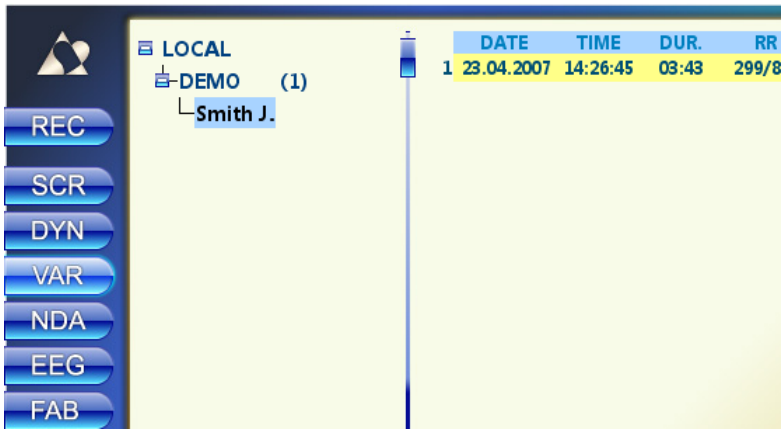
2. Neurodynamic analysis – evaluation of the central regulation indices and the endocrine system state using the neurodynamic analysis of the organism's biological rhythms;

3. Charting of brain biorhythms – evaluation of the patient's psycho-emotional condition using methods of phase analysis and of brain biorhythms charting;

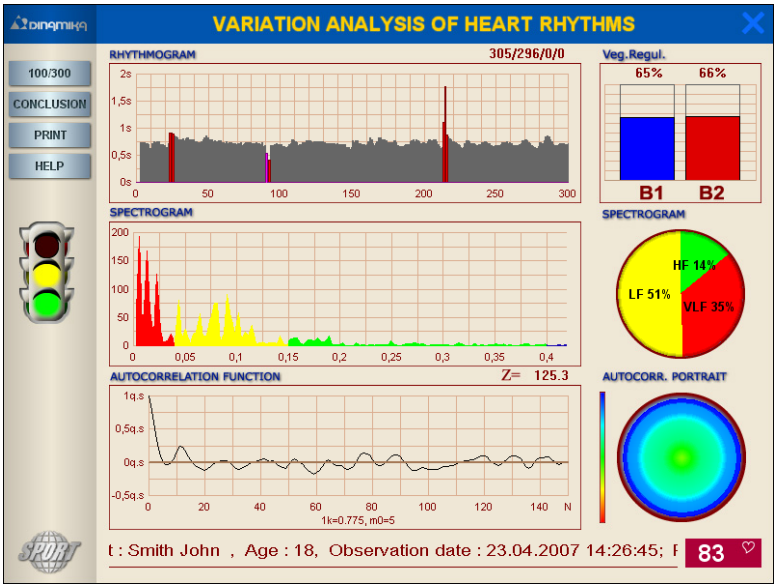
4. Fractal analysis – evaluation of the harmonization degree of organism's biorhythms and estimation of the immune status using methods of the fractal analysis.

9.1. Variation analysis of heart rhythms

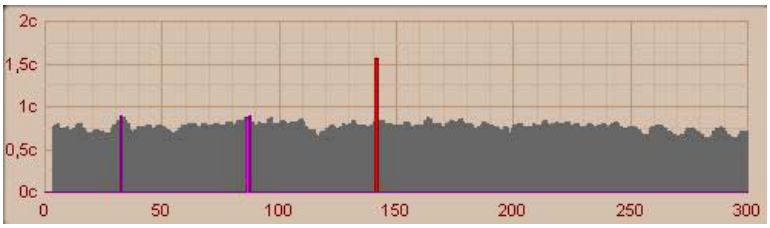
Click left mouse button to select a patient's EGC record in the right part of the window. The selected record will be colored yellow. Press "VAR" button to run the Variation Analysis module.



The "Variation analysis of heart rhythms" window will appear.



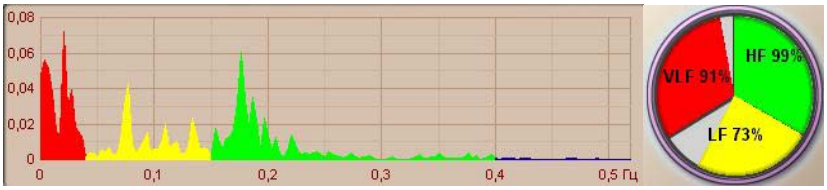
1. The "Rhythmogram" window



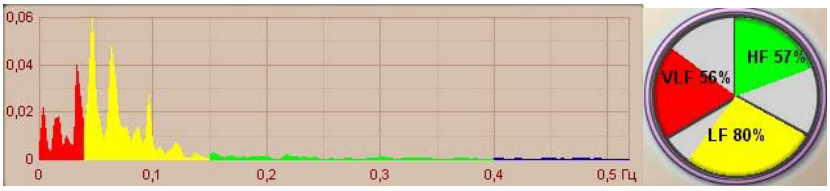
This window shows the dependence of the RR-interval duration from the number of the evaluation cycle. The artifacts are marked with red color. Along the abscissa axis the numbers of the evaluation cycles are shown. The time, in seconds, is along the ordinate axis. Rhythmogram can be represented in two modes: 300 and 100 cycles. The button **"100/300"** is used to switch between these modes. Above the rhythmogram the RR-intervals counter resides. This counter shows: the total amount of RR-intervals recorded, amount of clear RR-intervals, amount of RR-intervals filtered with 1st and 2nd level filters.

2. The "Spectrogram" window

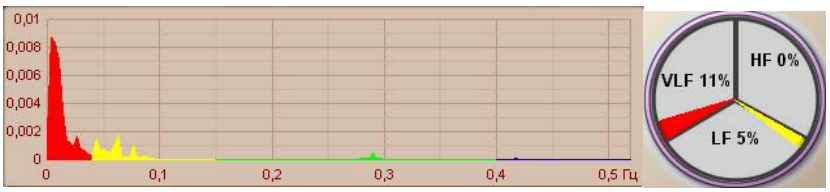
The spectral analysis is based on a physical transformation of the heart rhythm oscillations of the simple harmonic oscillations with various frequencies. Thus the sequence of cardiac cuttings is conversed to a spectrum of power of oscillations of duration of RR-intervals RR, frequencies, representing sequences describing dynamics of heart rhythms, to each of which there corresponds particular density (amplitude) of oscillations. As measure of an estimate the area, restricted curve of spectral power relevant to some particular frequency band is used.



a) Predominance of para-sympathetic activity



b) Predominance of sympathetic activity

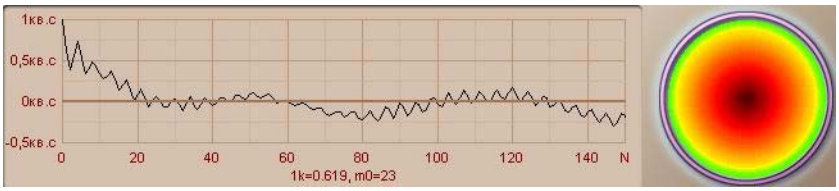


c) Predominance of cerebral ergotropic and/or humoral-metabolic influences

3. The “Autocorrelation function” window

Click 🗗 button to activate this function. The autocorrelation function diagram is built according to the values of a series of correlation factors between an initial dynamic series of RR-intervals and new series, obtained at sequential biases on one value. The steepness of wane of an autocorrelogram can be determined on value of a correlation factor after the first detrusion (lk). Besides the exponent **Mo** is entered which displays through how much of detrusions there is a first negative value of a correlation factor. At strong connection between central and independent contours a dynamic series RR is more organized, the autocorrelogram damps slowly and value lk and m0 above (fig. A). The prompt initial wane of the Autocorrelation function with the subsequent slow signal attenuation testifies to presence of confronting influences of an independent and central contour on a heart rhythm (fig. B).

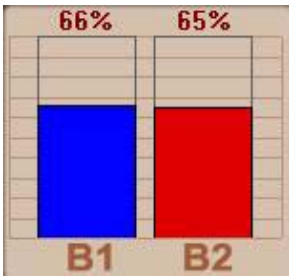
A – Predominance of the independent regulation contour



B - Predominance of the central regulation contour

C – Pathologic regulation

4. “VR indices”



This diagram shows normalized values of the integral indices of a vegetative regulation:

B1 – regulation level

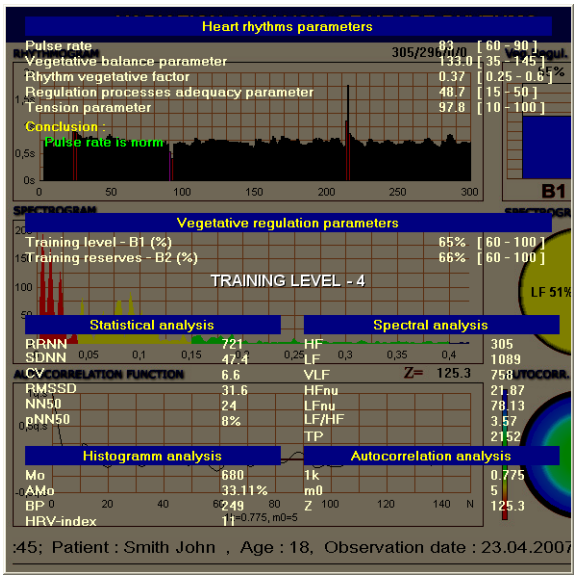
B2 – regulation resources

5. “Semaphore”

Colors of the “semaphore” correspond to different levels of vegetative nervous system:

	Normal vegetative regulation High function resources.	Minimal or optimal exertion of regulation systems. Good organism's adaptation to the environmental conditions.
	Moderate strain of the vegetative regulation system. Normal functional resources.	State of a physical strain manifested by mobilization of protective mechanisms, Raise of activity of the sympatho-adrenal system and the "pituitary bodies - paranephroses" system.
	Hard strain of the vegetative regulation system. Low functional resources.	Overstrain. Lack of adaptation and protective mechanisms. Disability to provide optimum proper response of an organism to action of environmental factors.
	Malfunction of the vegetative regulation system. Too low functional resources.	Malfunction of the adaptation mechanisms. Attrition of the regulation mechanisms. Predominance of the non-specific changes.
	Functional malfunctions of the vegetative regulation. No functional resources.	Premorbidal state with prevailing of particular changes.

6. The “Conclusion” window



Indices of a heart activity are shown in the upper part of the window. These indices are calculated using standard methods of the variation analysis of the heart rhythms. Normal values of each parameter are shown to the right and a text conclusion regarding current state is shown below.

Coefficient of vegetative equilibrium (**AMo/ΔX**) shows relation between activity of the sympathetic and parasympathetic departments of vegetative nervous system.

Index of adequacy of processes of a regulation (**AMo/Mo**) reflects correspondence between activity of a parasympathetic department of vegetative nervous system and leading level of operation of the sinus node.

Vegetative Index of a Rhythm (**VIR=1/Mo*ΔX**) allows to evaluate vegetative balance from a point of view of an estimation of activity of an independent contour of a regulation. As this activity grows (VIR decreases), then the vegetative balance biases to the predominance of the parasympathetic department of the vegetative nervous system. Stain Index (**SI=AMo/2*ΔX*Mo**) of the regulation systems reflects a level of centralization of a control of the heart rhythm. The normalized indices of the vegetative regulation are shown in the center of the window.

Computer conclusion regarding the vegetative regulation is blow. The results of different kinds of analysis of a variability of the heart rhythm are shown in the bottom of the window. All analysis meet “Standards of Measuring, physiologic interpretation and clinic usage of variability of the heart rhythm” by the Task Force of the European Society of Cardiology and the North American Society of Racing and Electrophysiology, 1996.

The medical-physiological interpretation is given below.

Statistic Analysis

RRNN – average duration of the R-R intervals. It reflects the final result of numerous regulation influences to a sinoatrial rhythm of the usual balance between para-sympathetic and sympathetic departments of vegetative nervous system;

SDNN – standard deviation of the NN interval. It is an integral index reflecting the variability of the heart rhythm in common. It depends of the influences of para-sympathetic and sympathetic departments of vegetative nervous system to a sinoatrial rhythm ; Increasing or decreasing of this index shows the biasing of the vegetative balance to one of the vegetative nervous system departments.

CV = SDNN/RRNN*100% – Coefficient of variation. It is very close to SDNN but also helps to take 'pulse rate' into account during analysis.

RMSSD – standard deviation of the subtraction of RR-intervals and their average value.

NN50 – amount of pairs of sequential RR-intervals which difference is more than 50 ms.

pNN50 – their percentage from the total amount of intervals being analyzed

Histogram Analysis

Moda (Mo) is the most frequent value of RR. It represents the dominant level of the sinoatrial node functioning. At sympathonia it is minimal, at vagotonia – maximal. Normal value of **Moda** is between 0.7 and 0.9.

Moda Amplitude (AMo) is a per cent relation of number of RR-intervals, which values are equal to Mo to the total number of intervals. This index reflects the degree of a rigidity of a rhythm. Its normal value is about 30-50%. The magnification AMo will testify to predominance of sympathetic influences on a sine knot and considerable rigidity of a rhythm. At vagotonia this index decreases.

Variation Total Amplitude (VTA) is a result of subtraction of maximum and minimum values of the RR-intervals (width of the histogram basement). VTA is a para-sympathetic index. As it is higher, the valal influence on a heart rhythm is more expressed. The normal values of the VTA are from 0.15 to 0.45.

HRV-index is calculated upon a histogram built with 8 ms interval, by division of the total number of analyzed RR-intervals to frequency of occurrence of RR-intervals, relevant to a Moda.

Spectrum analysis

HF – High Frequency: 0.15 – 0.40 Hz. Oscillations in the above frequency band are built by the para-sympathetic department of the vegetative nervous system. The power in this frequency band is incremented during respiration with particular frequency and depth, at cold influences. Sportsmen and well-trained people have higher power of HF than others. Their HF power is much more than low frequency power. Decreasing of this power means stain of the regulation heart systems, means over-training, though its excessive magnification speaks about danger of infringement of a sinoatrial rate.

Low Frequency – **LF**: 0.04 – 0.15 Hz. The physiological interpretation of this index is ambiguous. It is considered, that power in this frequency band is influenced by change of tone para-sympathetic and sympathetic departments of nervous system.

The relation between sympathetic and para-sympathetic influences is reflected by **LF/HF relation** When tone of a sympathetic department increases, this index increases rapidly. And vice-versa at vagotonia. Reciprocal changes in powers of LF and HF were observed in many cases. Essential increment of the LF power was also observed during orthostatic probe, psychological stress, and medium physical stain. Therefore point of view recently wide-spreads, that power in a gamut LF, as well as exponent LF/HF, can serve an exponent of activity of a sympathetic department of vegetative nervous system.

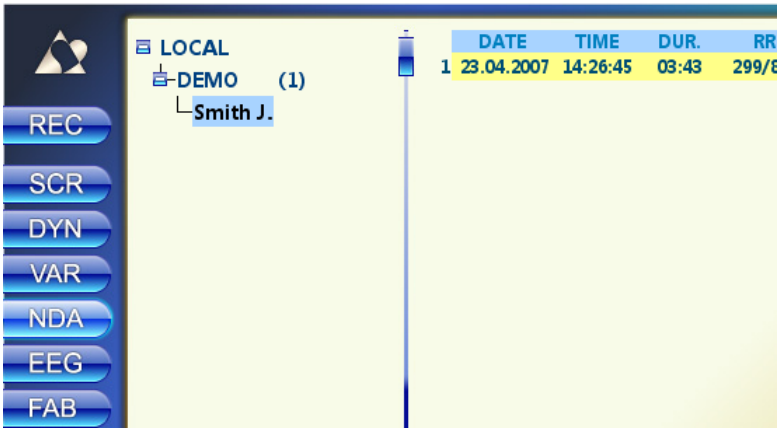
Very Low Frequency – **VLF**: 0,003 – 0, 04 Hz and Ultra Low Frequency – **ULF**: lower than 0,003 Hz. The physiological interpretation of this index is ambiguous. But there is an opinion, that the power of these frequencies essentially increases at attrition of an organism's regulation systems.

Complete frequency spectrum (Total) – less than 0.40 Hz. It is an integral index and reflects both para-sympathetic and sympathetic departments of an independent nervous system. Thus the intensifying of the sympathetic influences gives the decrease of the total power of a spectrum, and the activation of a vagus gives an inverse action. The given index is equivalent to a root-mean-square deviation and variation total amplitude.

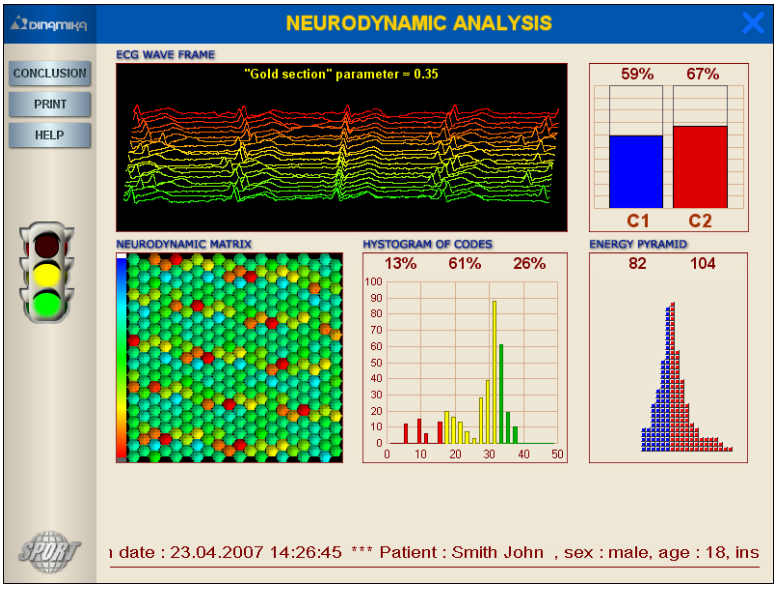
At interpreting data of the time analysis of dynamics of heart rhythms of the sportsmen it is necessary to take into account, that the considerable predominance of para-sympathetic influences to a sinoatrial rate is a normal appearance for them. Therefore, the adjusting of boundaries of norm of numerical values of statistics is necessary at holding survey of the sportsmen. Namely, it is necessary to expand boundary of norm to those in a state of a moderate vagotonia at the not trained people. At the same time, values close to moderate sympathonia will speak about the expressed infringement of system of a regulation of heart rhythm and drop of a reserve of acclimatization at the given sportsman.

9.2. Neurodynamic analysis

Click left mouse button to select a patient's EGC record in the right part of the window. The selected record will be colored yellow. Press "NDA" button to run the "Neurodynamic Analysis" module.

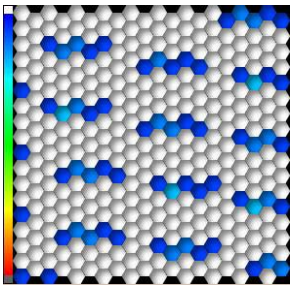


The "Neurodynamic analysis" window will appear.

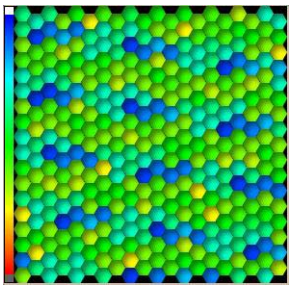


1. The "Wave frame of an EGC signal" window - allows estimating visually the variability of different rhythms from the **PQRST-complex**. In the upper-left corner the **"Golden Section"** parameter is shown, which is a relation of the duration of the whole complex to the period of the cardio-signal. The **"Golden Section"** parameter can vary from 0 to 0.62. Its normal value is more than 0.15. In pathology this value never exceeds 0.01.

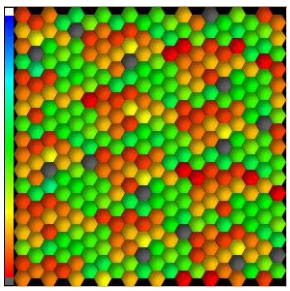
2. The "Neurodynamic Matrix" window characterizes the information interaction between the heart rhythms. Separate matrix elements correspond to different neurodynamic code exposition windows. The color of an element defines the failure degree of the code structure. The twelve grades of the color scale correspond to different degrees of the code structure failure, ranging from pathologic to optimal.



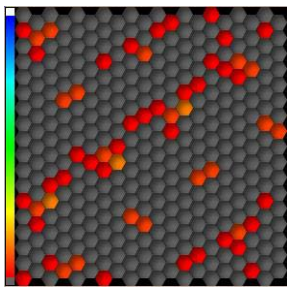
Norm
Hyper Activity



Norm
Hypo-activity

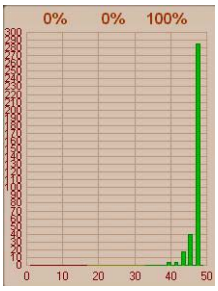


Functional disorders

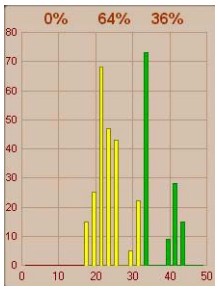


Pre-illness state

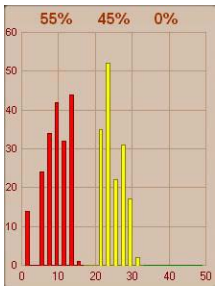
3. The “Codes Histogram” window represents the distribution of neurodynamic codes according to the degree of their structural failure. In the red field there are codes with defective structure, in the yellow field there are codes with modified structure, in the green area are the codes, whose structure corresponds to the normal functioning of the body.



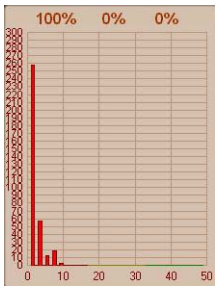
Norm
Hyper Activity



Norm
Hypo-activity

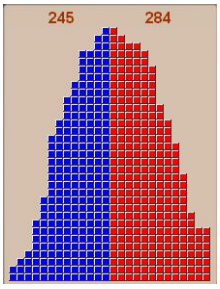


Functional disorders

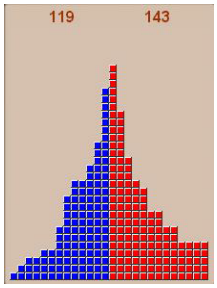


Pre-illness state

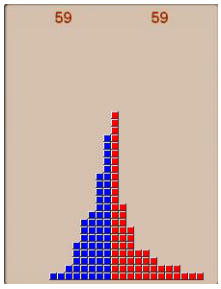
4. The “Energy Pyramid” window – the dynamic display of the energy balance in different control systems of the body. The correlation between the right and left parts of the pyramid characterizes the dynamics of anabolic and catabolic processes – the left part corresponds to the accumulation period, while the right one corresponds to the consumption period by different organs and systems of the organism. The energy pyramid is characterized by the following indices: the anabolism index, the energetic resource, the energetic balance, the catabolism index. Examples of “energy pyramids” corresponding to different states of the organism are shown in the picture below.



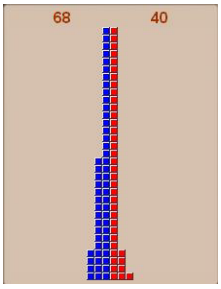
Optimal energy balance



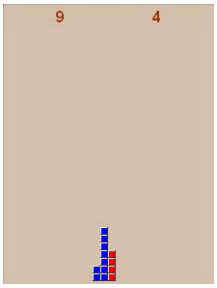
Norm



Lowered energy resources

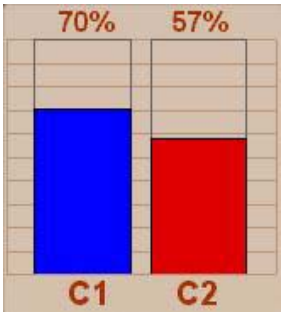


Signs of emaciation



Emaciation

5. The “CR Diagram” window

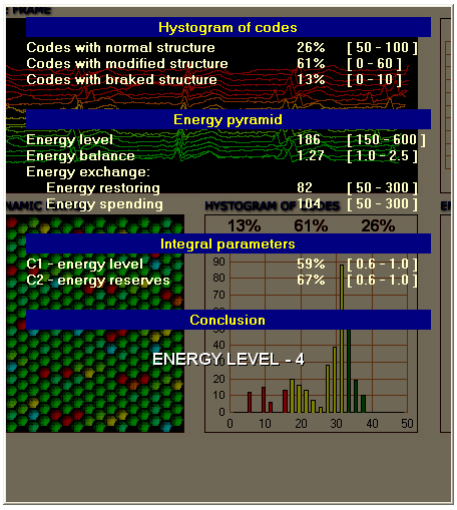


This diagram represents the normalized values of integral indices of the central regulation:

C1 – compensation level

C2 – compensation resources

6. The “Conclusion” window



In the upper part of the window you can see the relations between the neurodynamical codes and normal, changed or broken structure (normal limits are shown in the brackets).

The indices of the power resources are shown in the middle part of the window. The integral indices of the central regulation are below. All values are normalized and shown in per cents. Normal values are shown in brackets.

The conclusion regarding state of the central regulation mechanisms includes 5 variants:

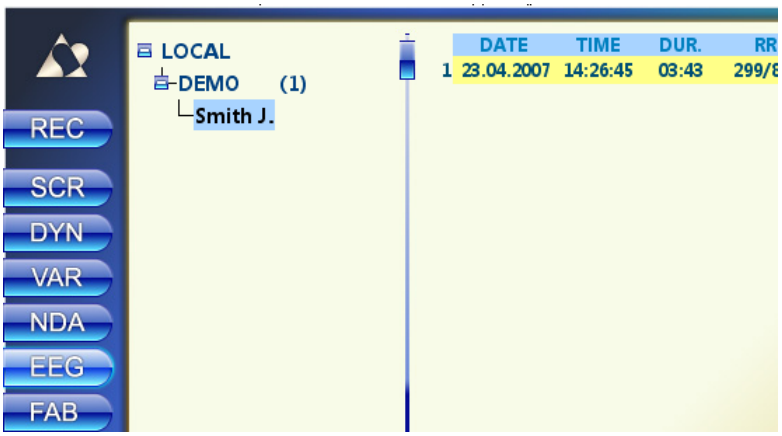
	NORMAL CENTRAL REGULATION. SUPERACTIVITY OF THE REGULATION SYSTEM.
	NORMAL CENTRAL REGULATION. NORMAL ACTIVITY OF THE REGULATION SYSTEM.
	NORMAL CENTRAL REGULATION. LOWER REGULATION ACTIVITY.
	SIGNS OF MALFUNCTION OF THE CENTRAL REGULATION MECHANISMS.
	MALFUNCTION OF THE CENTRAL REGULATION MECHANISMS.

Hit “ESC” key of left-click mouse button on any place on the “Conclusion” window to close it.

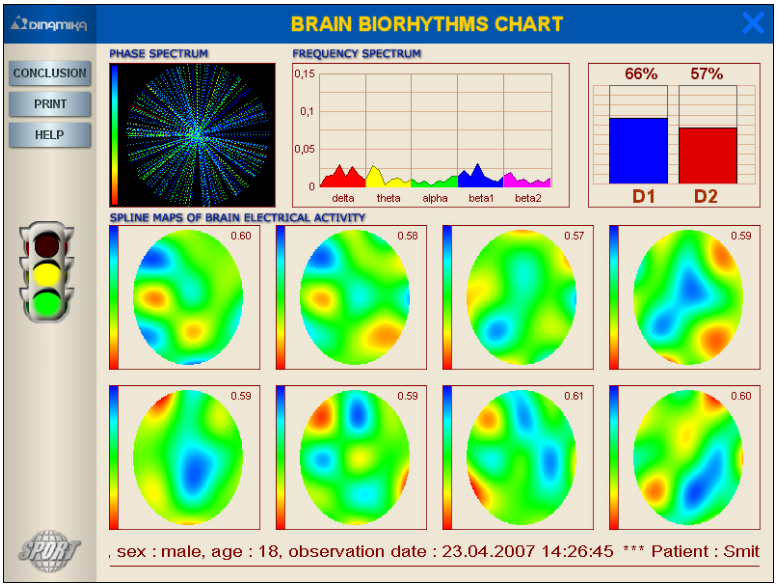
Press “EXIT” or hit “ESC” to close the “Neurodynamic Analysis” module.

9.3. Charting of brain biorhythms

Click left mouse button to select a patient's EGC record in the right part of the window. The selected record will be colored yellow. Press the "EEG" button to run the Brain Biorhythm Charting module.

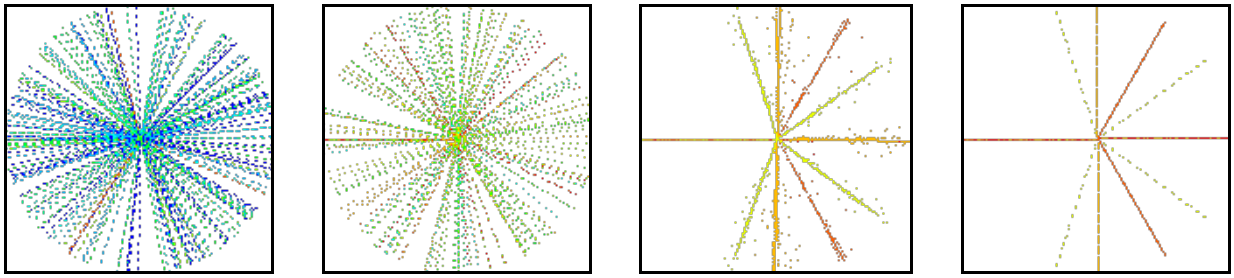


The "Brain Biorhythms chart" window will appear.



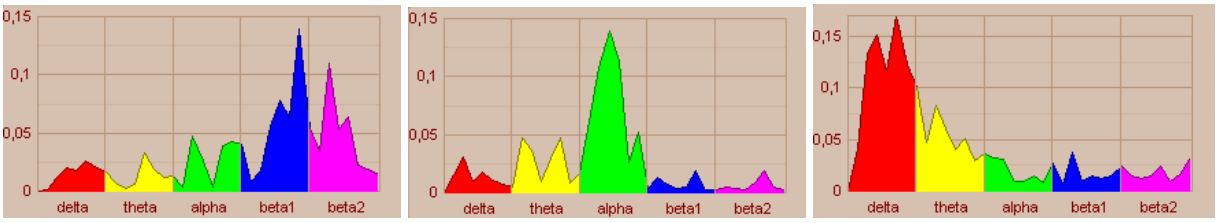
1. The "Phase Spectrum" window

Colors of the spectrum correspond to different rhythms. The width of sectors is defined according to the modulation indices of the correspondent parts of the spectrum. The maximum colors mean normal activity. In case of functional and pathologic malfunctions of an organism the level of phase portrait saturation decreases rapidly.



2. Frequency spectrum.

The spectral power is calculated for gamut a delta, theta, alpha, beta1- and beta2- rhythms.



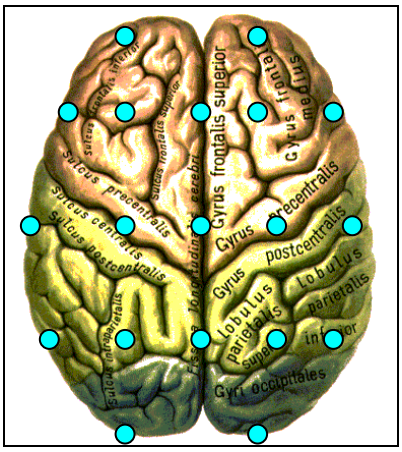
Hyper activity Normal activity Hypo-activity

3. Spline maps are two-dimensional representations of the central nervous system biorhythms in the functional spaces of the brain, and characterize integral activity of central nervous system in these spaces. The brain functional spaces are formed discreetly in the periodically repeated spans of time, and are built in the brain cellular structure by the neuron ensembles, which are activated at the moments defined by the periods of their refractivity.

The spline-map is built on results of an interpolation of the amplitude values of common brain rhythms compared to each other. These maps are templates of probabilities of shifting of basic rhythms in brain's space.

δ-δ	θ-δ	α-δ	β-δ
θ-δ	θ-θ	α-θ	β-θ
δ-α	θ-α	α-α	β-α
δ-β	θ-β	α-β	β-β

The following figure represents the topographic map of the shifting template which shows the probabilities of shifting of basic rhythms.

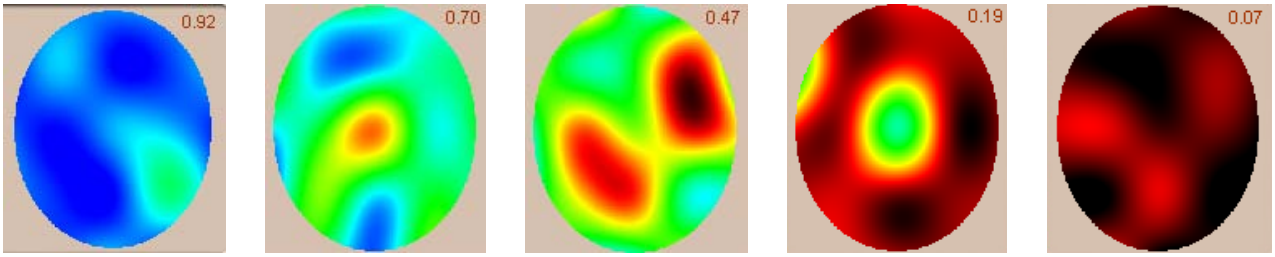


	Delta	Tetta	Alpha	Beta
Delta	8.3	5.4	3.2	9.1
Tetta	4.0	6.7	8.3	9.4
Alpha	5.9	6.9	6.2	7.1
Beta	8.2	6.8	9.0	11.2

Topographic map of the shifting template

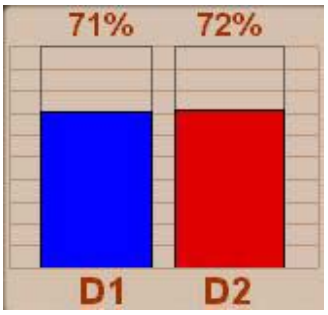
The charting mode is intended for monitoring and virtual visualization on the screen of the maps with power spectrums of the brain biorhythms. The set of spline cards completes the visual analysis of a recorded total bioelectric signal of the central nervous system, and enables one to evaluate the space changes in the brain biorhythms' activity on 8 maps of power spectrums simultaneously. This makes it possible to locate the beginning of the activity growth of any rhythm, observe solitary flashes of biorhythms' activity, generalized in different brain spaces, and to analyze the biorhythms' power and frequency asymmetry.

The consecutively completed set of the spline maps corresponds to different functional spaces of the brain, and their colors are conditioned by different levels of the electric activity in the brain. The color scale of activity is given on the right-hand side of the window.



Hyper Activity Normal Activity Hypo-activity Signs of depression Pathologic state

4. The “Control Diagram” window



This diagram shows normalized values of the integral parameters of control:

D1 – self-regulation level

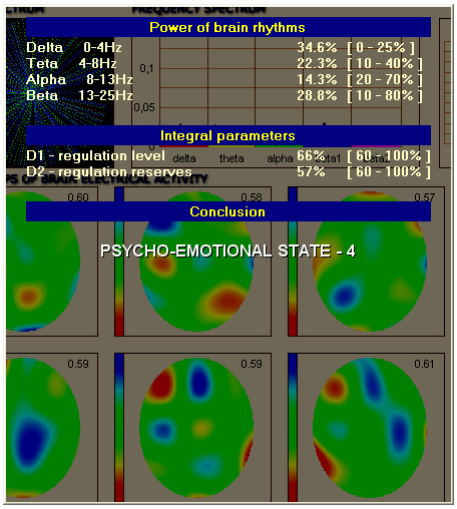
D2 – Self-regulation resources

5. “Semaphore”

Colors of the “semaphore” correspond to different levels of a psych-physical condition of an organism:

	PERFECT PSYCHO-EMOTIONAL STATE. HYPER ACTIVITY.
	GOOD PSYCHO-EMOTIONAL STATE. NORMAL ACTIVITY.
	NORMAL PSYCHO-EMOTIONAL STATE.
	NERVOUS STRAIN AND SIGNS OF WEAKNESS.
	NERVOUS STRESS AND SIGNS OF DEPRESSION.

6. Conclusion.



In the upper part of the window you can see the relations between the neurodynamical codes and normal, changed or broken structure (normal limits are shown in the brackets).

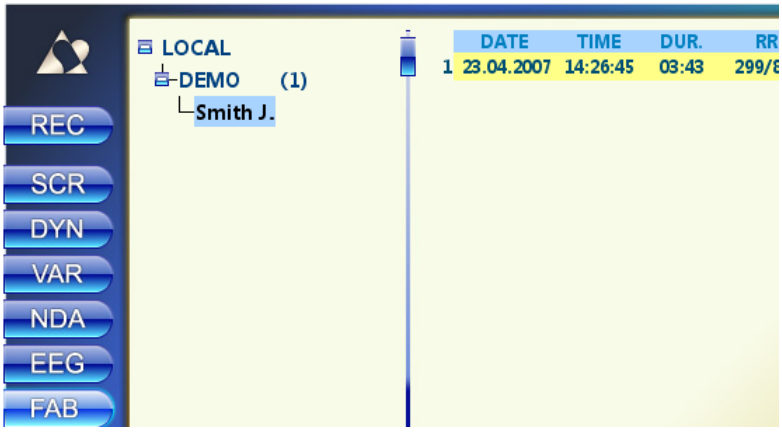
The indices of the power resources are shown in the middle part of the window. The integral indices of the central regulation are below. All values are normalized and shown in per cents. Normal values are shown in brackets.

Hit “ESC” key of left-click mouse button on any place on the “Conclusion” window to close it.

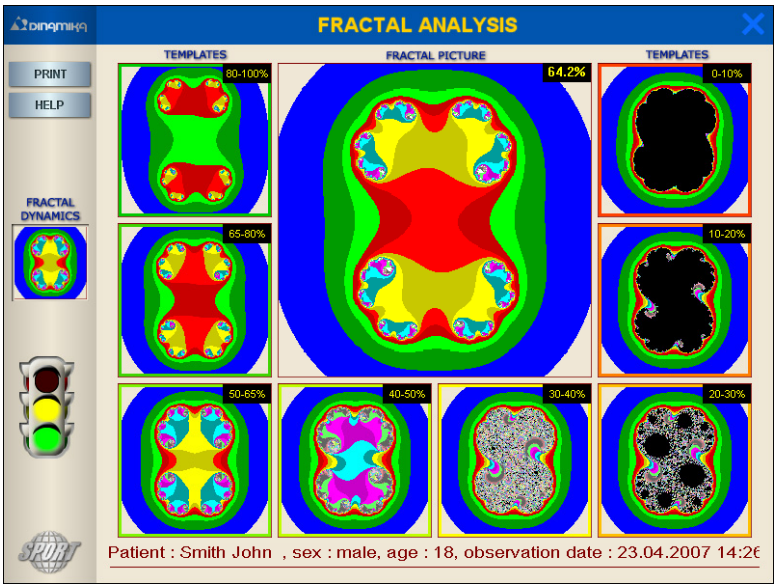
Press “EXIT” or hit “ESC” to close the “Brain biorhythm chart” module.

9.4. Fractal analysis of the organism's biorhythms

Click left mouse button to select a patient's record in the right pane of database window. The selected record will be colored yellow. Press the "FAB" button to run the "Fractal Analysis" program.



The "Fractal Analysis" window will appear.



The fractal analysis is intended for the evaluation of the harmonization degree of biorhythms at different control levels and for definition and forecast of sporting form index for a relatively long period (up to 10 days).

The fractal portrait – in the center – is formed by the biorhythms of an examined patient.

In windows [1] – [8] there are standards corresponding to different harmonization degrees of the biorhythms ranging from the maximum window [1] to the minimum window [8].

The harmony of biorhythms at all levels of control testifies to high energetic resources and an optimal energy balance, windows [1] – [2].

A partial disharmony in biorhythms at certain control levels is seen in fractal portraits [3] – [4].

A decrease of energy resources and changes in energy balance are characterized by the bio-rhythms' disharmony, windows [5] – [6].

A complete emaciation of energy resources is shown in the fractal portraits of windows [7] – [8].

If the fractal index is more than integral index in the "express-diagnostics" mode, then the health stat will improve, otherwise – it will be worse.

10. MONITORING

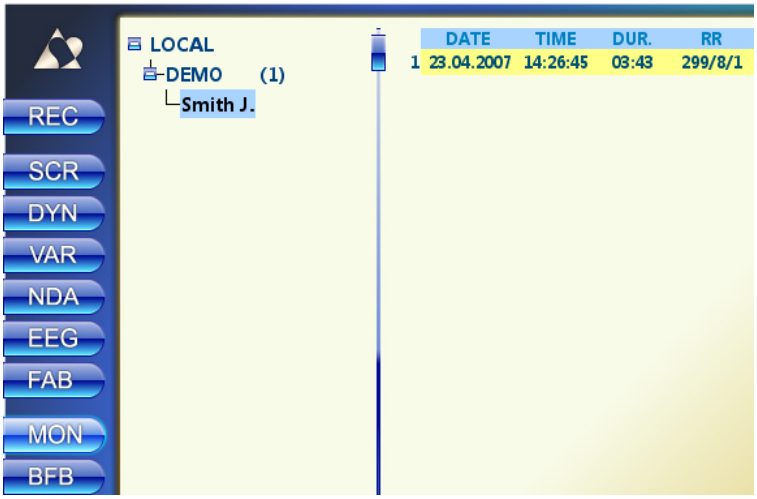
This mode is intended for ECG registration and real-time monitoring of the functional indices. Such monitoring can be very helpful for the express control of patient's condition in the following cases:

- evaluation of the anesthesia depth;
- evaluation of the effectiveness and dosage of physiotherapeutic procedures;
- express-control of any kind of non-traditional therapies: stylostixis, bioreverberatory therapy, etc.

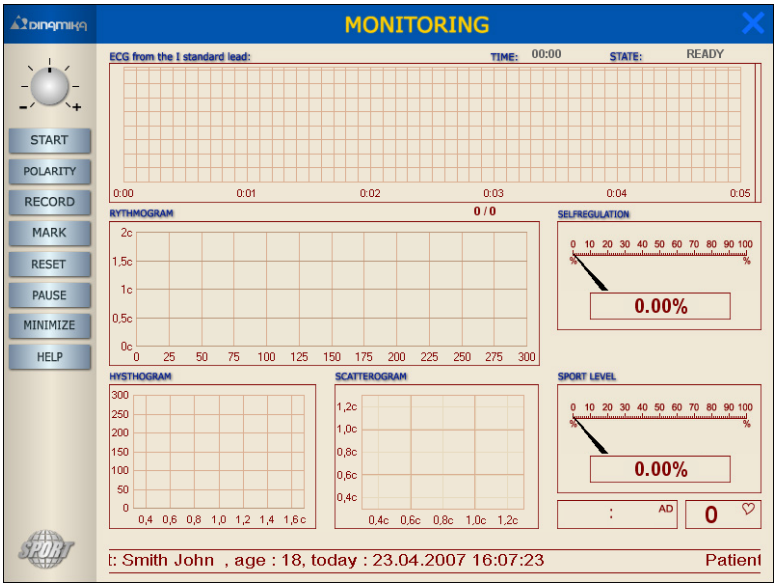
The only limiting factor is the condition of ainesia of the patient during a monitoring.

10.1. Recording

1. Left-click mouse button on the patient's name in the left window to select a patient. The patient's name will be colored yellow. Press the "MON" button to run the Monitoring program.



2. The "ECG Monitoring" window will appear.

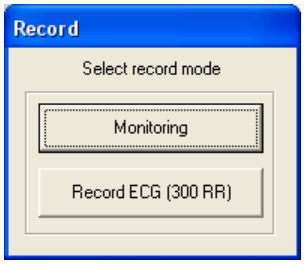


3. The "START" button. The ECG signal will appear in the upper window.

If no signal appears – see "TroubleShooting"

4. You have to achieve the steady signal before staring the recording. There must be clear R-peaks marked with vertical markers. *See 6.3.4.*

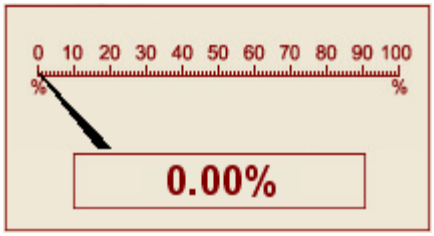
5. Press the “RECORD” button to start recording. The mode selecting dialog will appear.



The “Monitoring” mode is intended for permanent ECG registration. Only values of RR-intervals are recorded – the “Rhythmogram”. The cardio signal will not be saved. Use the special program “Analysis” to process results of recording. You can also place special markers to distinguish beginning and end of different procedures. Press the “PAUSE” button to stop recording temporary. Press it again to proceed recording. Duration of the “Analysis” program has no limitations.

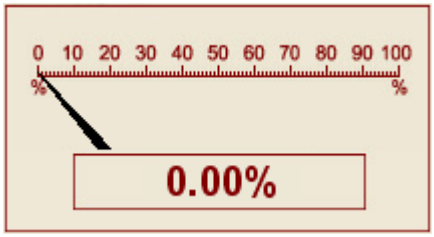
The “ECG Recording (300 RR)” mode – the ECG registration is also permanent, and the signal is saved in blocks of 300 RR-intervals, which allows recording several consequent blocks (one after another). Then recorded data can be researched using different system analysis methods.

The “Self-Regulation” window



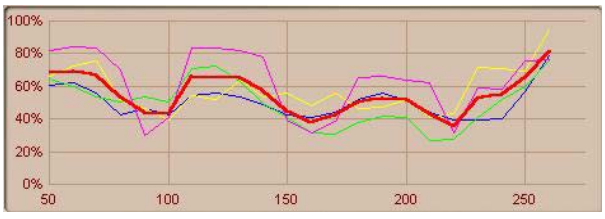
This indicator shows the normalized value of the self-regulation index. It represents the “Vegetative Homeostasis” – the organism’s ability to adapt to the environmental conditions.

The “Functional State” window



This indicator shows the normalized value of the current functional index. The first value is shown after 60 counts from start of the recording and is updated every 10 counts.

The “Dynamics of indices of functional state” window



Double-click left mouse button upon the histogram graph to open this window. Colored graphs represent changes of current indices of physical state during the recording process. The abscissa axis shows numbers of RR-intervals. The first value is shown after 60 counts from start of the recording and is updated every 10 counts.

6. You have to control quality of the ECG signal periodically. If any noises noticed – stop the record by pressing the “RECORD” button, figure out the reason of noises, press the “CLEAR” button to reset the record and repeat record by pressing “RECORD” button.

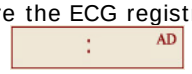
The duration of record is controlled by the number or RR-intervals indicator, which is upon the “Rhythmogram” window

(the first value is the number of recorded RR-intervals, the second value is the number of artifacts). The record will stop automatically after 300 “clear” RR-intervals. You can interrupt the recording by pressing the “RECORD” button.

Attention!

If a patient has obviously expressed violations of a cardiac rhythm, such as extrasystole and different sorts of arrhythmias the calculation of metrics of a functional state will be yielded incorrectly.

Estimation of the functional state metrics and processing an ECG in all modes can be done only if the patient does not have any violations of a cardiac rhythm! See 6.3.7.

7. If the patient's blood pressure was measured before the ECG registration – it can be entered in the conforming window in the right-bottom corner of the window: 

Click on the field to enter the values. Use "Tab" key to switch between fields.

8. You can leave any comments during the recording. Click mouse button on the comment string to edit it.

9. The following dialog box will appear after finishing the recording:

Press "Yes" to save the record.

10. Press "EXIT" to close the window.

Note: to quit before the end of recording you have to press "RECORD" and "START" buttons sequentially and the press "EXIT".

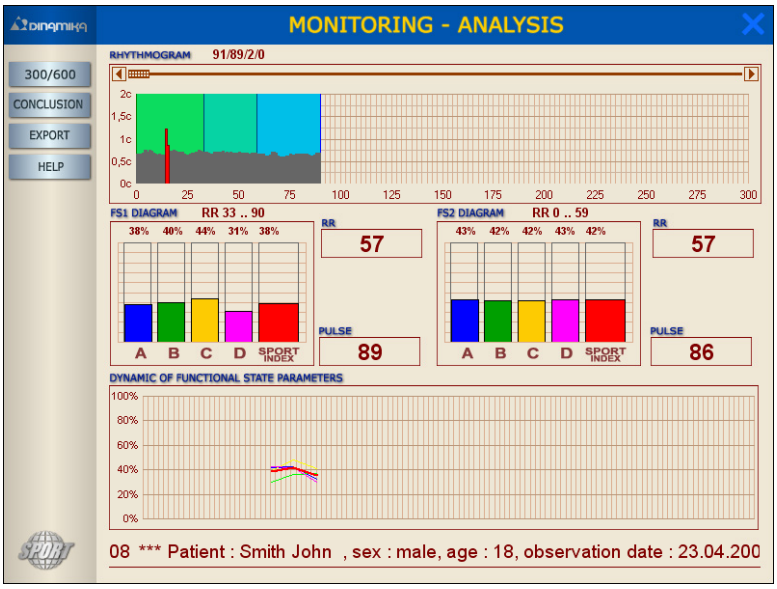
11. After closing the "Monitoring" window the right part of the display will contain the string with the number, date and duration of the saved record..

10.2. Analysis

This mode is intended for processing data recorded during the ECG registration in the "Monitoring" mode. It can also process records imported from the "Aelita" system.

Double-click on an ECG record to run the analysis program.

The "Monitoring-Analysis" window will appear.



Use the scroll bar in the upper part of the rhythmogram to choose the part of the ECG signal you a going to investigate. The diagram of the dynamics of the functional indices updates simultaneously.

You can select a part of the rhythmorgam by dragging a mouse. The length of the selection must be more than 57 RR-intervals. Release the mouse button to calculate all indices of the selected part. The diagram to the left will show the results of calculation.

11. CONTROLLED RESPIRATION IN THE “BILOGICAL FEEDBACK” MODE

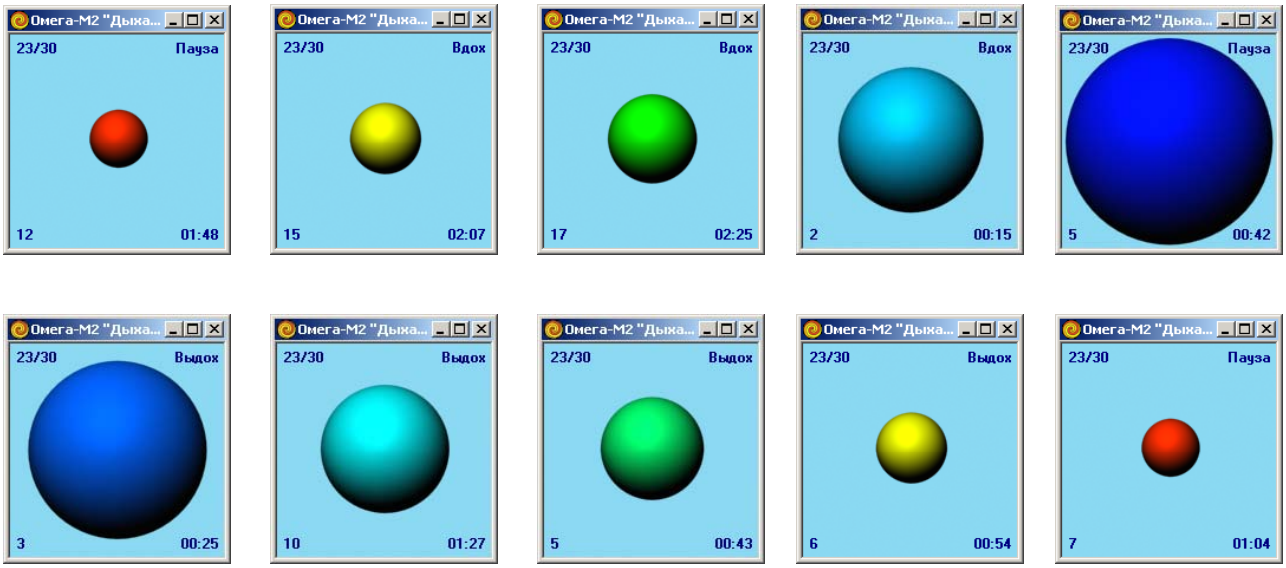
The program of controlling the respiration in the biological feed-back mode is used for correction psycho-emotional and physiological state after physical and mental loads, in stressful situations, at appearance of indications of fatigue, for rising efficacy of medicines and medical procedures. The regular respiratory gymnastics under this program allows essentially to increase the basic parameters of health and, first of all, energy resources of an organism and parameter of immunodefence.

Besides, the controlled respiration program can be used as an active test of organism’s functional resources. Please taka 5 min. pause before repeating the ECG registration after finishing the respiration session.

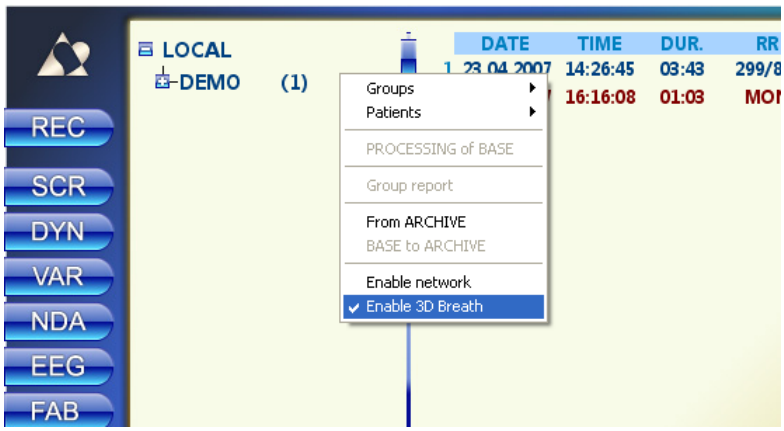
Order of work:

1. Complete a “background” ECG registration.
2. Left-click on the just made ECG record to select it and press “BFB” to run the “Controlled Respiration” program.
3. Breathe according the rhythm and the amplitude of the “breathing sphere” keeping all pauses precisely. The depth of respiration must correspond to the size of the sphere: the sphere is bigger – the inspiration is deeper, the sphere is smaller – the expiration is more completely. The duration of this session is about 5 minutes.

Caution! Each patient have to breathe according to his own, unique “breathing sphere” which is calculated based on the ECG, recorded exactly before the breathing session. The respiration controlled by another’s sphere or by sphere recorded earlier is strongly prohibited.

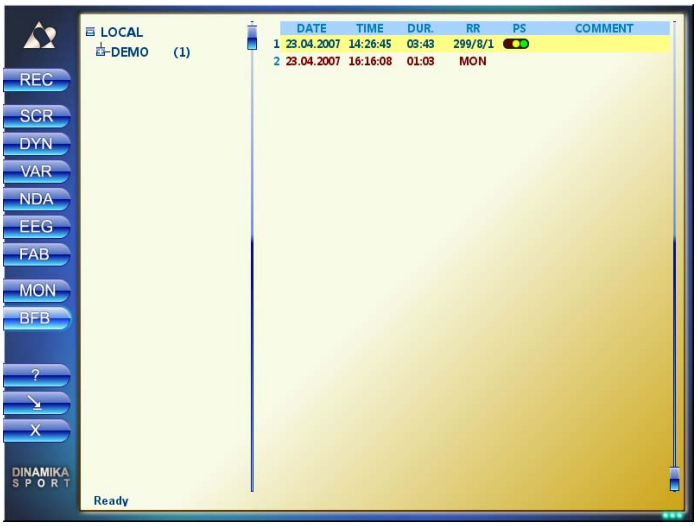


Note: to change the display mode of the sphere you have to right-click in the left database pane and switch on/off the “Enable 3D Breath” item.



12. WORKING WITH DATABASE

12.1. The “Card-Box” window



Left part of the window will display the list of groups of patients.

The symbol means that the group is open – the list of the patients is shown.

The symbol means that the group is closed.

Double click on the name of group or single click on the / symbol to open/close the group.

The number of patients contained in the group is show to the right of the group name.

The group without any / symbol is empty.

The list of patients is alphabetically sorted alphabetically. The selected patient name is colored yellow.

The right part of the window represents the list of the ECG’s of the current patient, sorted by the date of observation.

All functional buttons are in the upper string of the window:

REC - ECG Registration

SCR - Screening-Diagnostics

DYN - Dynamic Observation and Forecast

VAR - Variation Analysis of Heart Rhythms

NDA - Neurodynamic Analysis

EEG - Charting of Brain Biorhythms

FAB - Fractal Analysis

MON - Monitoring

BFB - Biological Feedback

? - help

- minimize

X - close

12.2. Working with groups

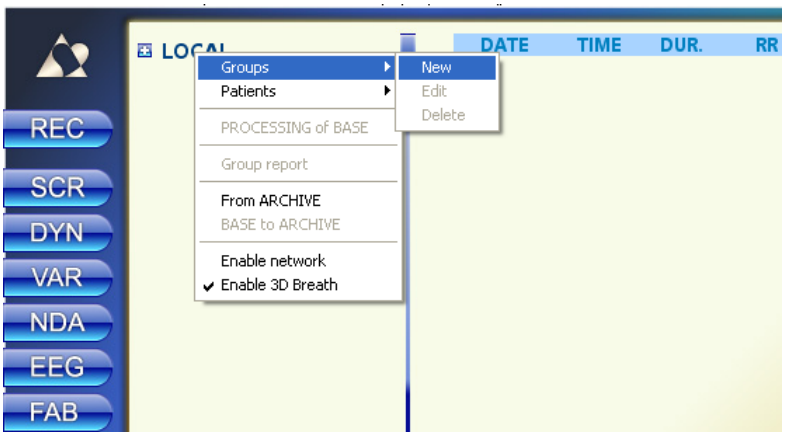
The “Dinamika Sport” system allows creating groups of patients. User can create any number of groups and use them to store patients’ file unite by any common feature. Number of patients in one group is not limited but too much patients in one group can reduce the speed of database response. It is recommended to store less than 100 patients’ files in one group.

The following commands are used to operate groups:

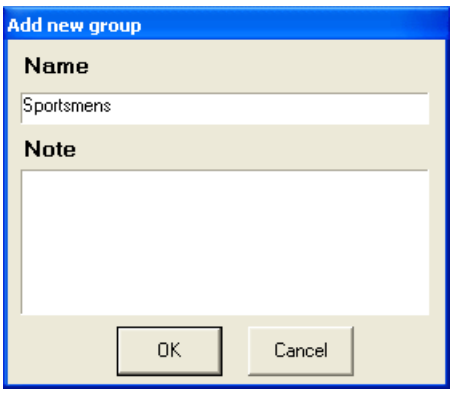
1. Create new group;
2. Edit;
3. Delete;
4. Process;
5. Group Report;
6. Into archive / From archive;
7. Group from network;

12.2.1. Creating a new group

Right click on the “Card-Box” string in the left pane of the database window. Choose “Groups” -> “New” in the pop-up menu.



Fill in the “Add new group” form and press “OK”.

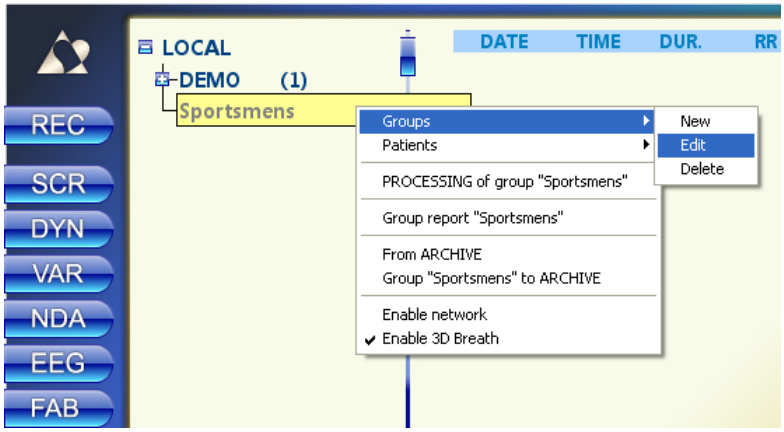


The “Notes” field is optional.

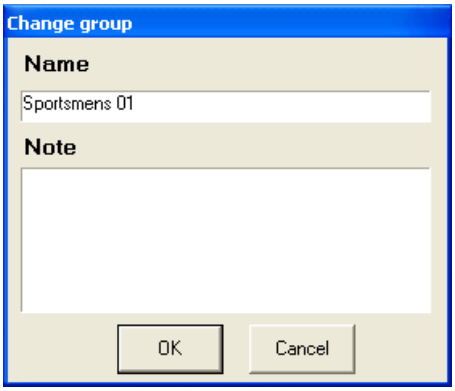
New group will appear in the left pane of the database window.

12.2.2. Editing

Click right mouse button on the group's name in the left pane of the database window to open a pop-up menu. Choose "Groups" -> "Edit" to change group's name and notes.

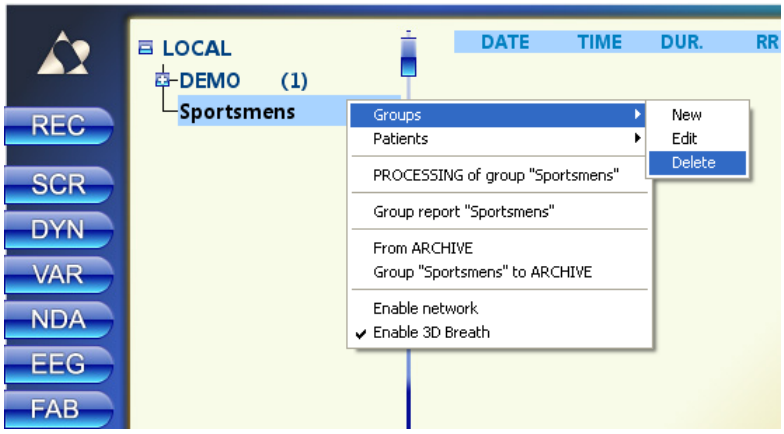


Fill in the "Editing Group Information" form and press "OK".



12.2.3. Deleting

Click right mouse button on the group's name in the left pane of the database window to open a pop-up menu. Choose "Groups" -> "Delete".



Confirm the operation by pressing "Yes" in the "Caution!" dialog.

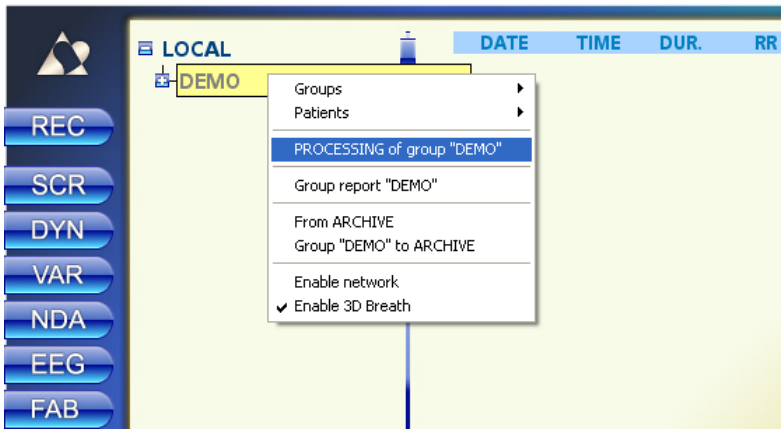
Note! All operations listed above can be done using keyboard:

«Ins» - create new group, «Enter» - edit, «Del» - delete.

12.2.4. Processing

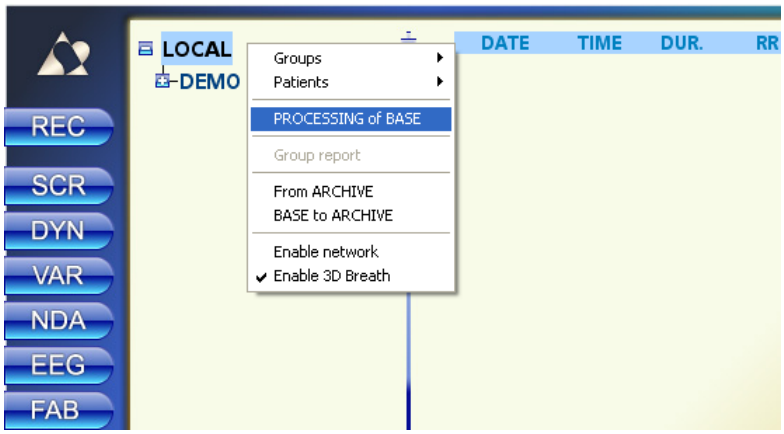
After observation of several users simultaneously in multi-channel mode of the ECG recording using the “CRAB” system, the processing of a group is commonly used. Such processing allows preparing the data for the group report.

Select the name of the imported group by clicking the left mouse button. Open the pop-up menu by clicking the right mouse button. Then left-click the item “PROCESSING of group “...”.



After finishing of the processing all data will be available for any system analysis mode.

You can process the whole database by running this option over “Card-Box” in common.

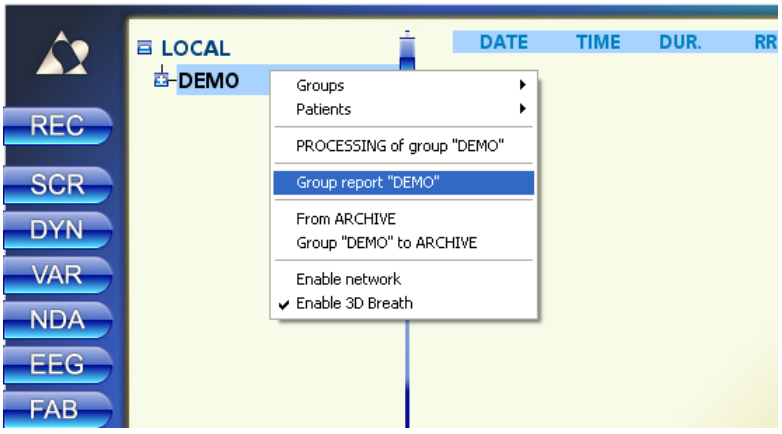


This will process all records from the database, even records, processed earlier.

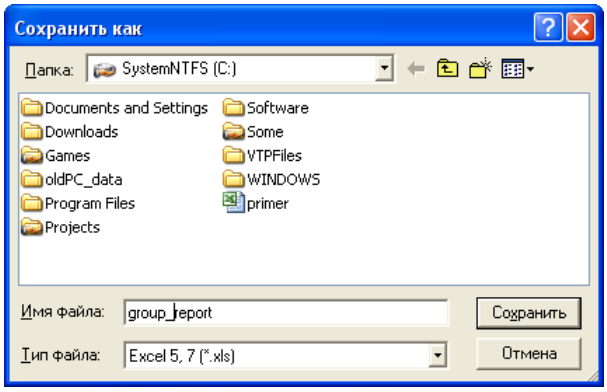
12.2.5. «Group Report»

The “Group report” is used to create tables containing the observation results of all patients of a group.

To run the report left-click to select the group name, right-click to open a pop-up menu and choose the item “Group report <group name>”.



In the “Save As…” window choose the folder and the filename of the future report and press “Save”:



Please select the period of creating records for the report and press “OK”

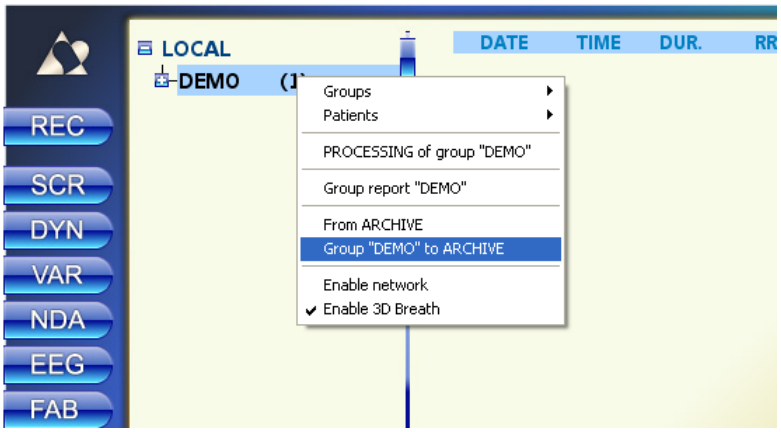
The Excel 5.7 (*.xls) file will be created. This file will contain: patient’s name, birth date, record number, record date, pulse rate, and indices of functional state for all patients of a group calculated upon the last record of the selected period.

Note! To include information from all records into the report (not only the last one), please check the “All Records” check-box.

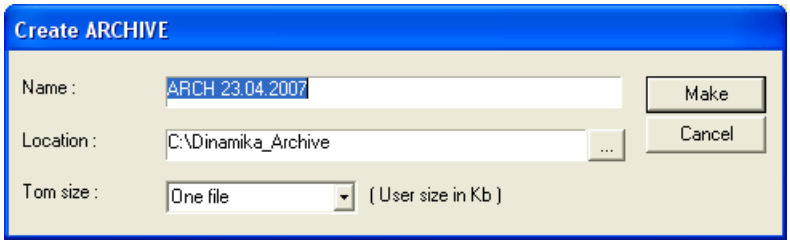
12.2.6. “Into Archive / From Archive »

The “Into archive / From Archive” operations are used to store data or to transfer it to another PC.

To add a group to the archive please do the following: click right mouse button on the group’s name to open a pop-up menu; choose “Group “…” to archive” to complete the operation.



The “New Archive” windows enter the name on new archive and in the “Path” field choose the folder where new archive should reside. Press ”OK” to create new archive.

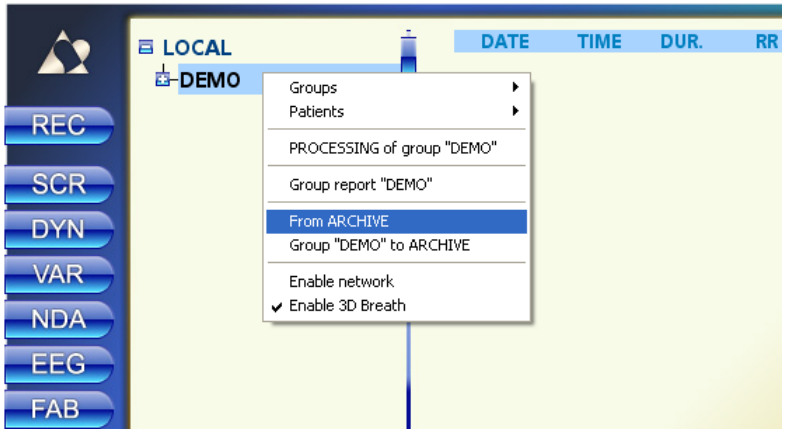


The default values of NAME and PATH are: “ARCH_<date>_<time>” and “C:\Dinamika_Archive”.

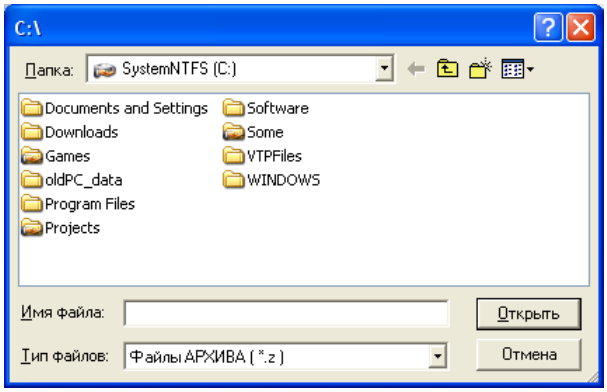
You can split the archive into 1.44Mb volumes in order to copy it on 3.5’’ diskettes.

You can add the whole database to archive by running this option over “Card-Box” in common.

To extract the group from archive do the following: click left mouse button on the “Card-Box” string to open a pop-up menu; choose “From archive” to complete the operation.

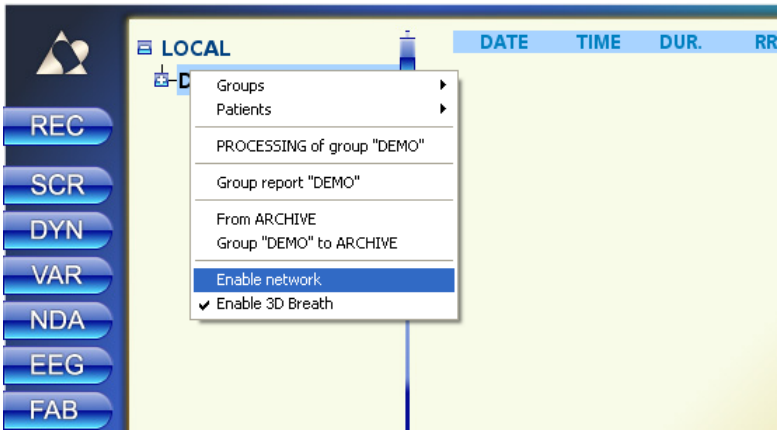


Select the folder containing the archive and press “OK”



12.2.7. Group from network

If there is another PC on the network on which “Dinamika Sport” software is installed you can browse the groups stored on this remote PC in the database window. To enable this opportunity you have to open the pop-up menu by right-clicking in the database window and switch on the “Enable network” item.



12.3. Working with patients' files

The following commands are used to operate patients' files:

1. Patient search;
2. Add new patient;
3. Edit patient's data;
4. Copy/Move to other group;
5. Delete;
6. Processing;
7. "Into archive /From archive";

12.3.1. Search Patient

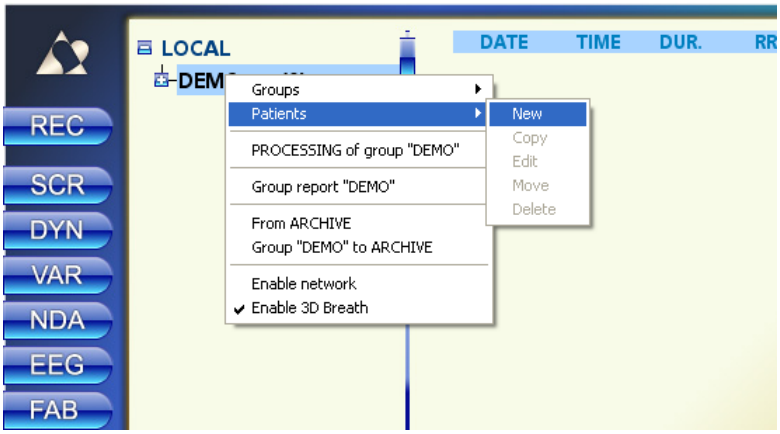
To find a patient you can look through all groups or use a quick search by the name of a patient.

To see the list of all patients of a group just click on the symbol near the name of the group or double-click on the group name. Look through the list to find a patient.

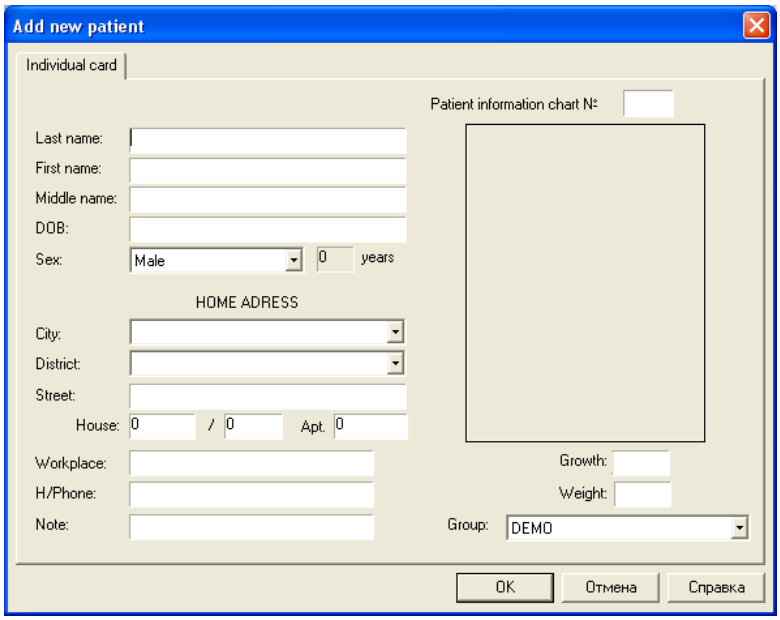
To use a quick search just click in the database pane (left side of the window) and type the name of a patient. Use Alt+Shift or Ctrl+Shift to switch between languages. Press and hold Shift for capital characters.

12.3.2. Adding new patient

To add new patient to a group do the following: click right mouse button on a group's name to open a pop-up menu; choose "Patients" -> "New".



Fill in the "Adding New Patient" form.



Use "Tab" or "Shift+Tab" to switch between fields. Or use a mouse.

Fields "First Name", "Second Name", "Birth Date" and "Gender" are required.

Birth Date has to be entered in "DD.MM.YY" format (i.e. 17.01.45). You can also use a drop-down list.

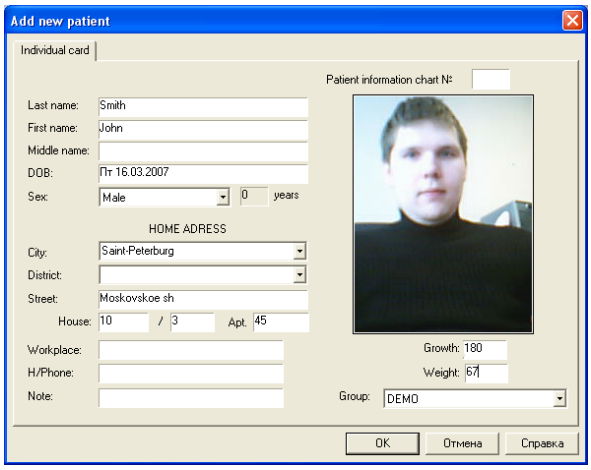
To enter "Gender", "City", "Region", "Group" please use drop-down list which are activated by button.

Note: Our system allows importing a photo into the patient's file. Double-click the square in the upper-right corner of the form and choose the file with a picture. Picture should be in BMP, JPG or GIF format.

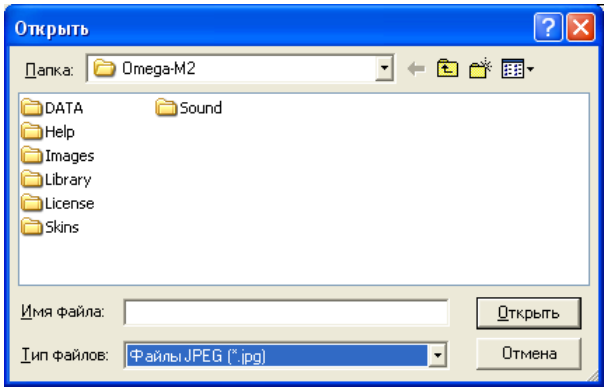
Click "OK" or press "Enter" when done.

You can also insert a patient's photo into the observation card:

1. If there is a Web-cam attached to the PC, the picture from the Web-cam will appear in the image area of the "Add new patient" window. Just click on this image to save it.



2. If there is no Web-cam attached to the PC you have to insert a photo from a file by double-clicking on the image area (in the upper-right corner of the window). Then just browse for the file containing patient's photo. BMP, JPG and GIF formats are supported.

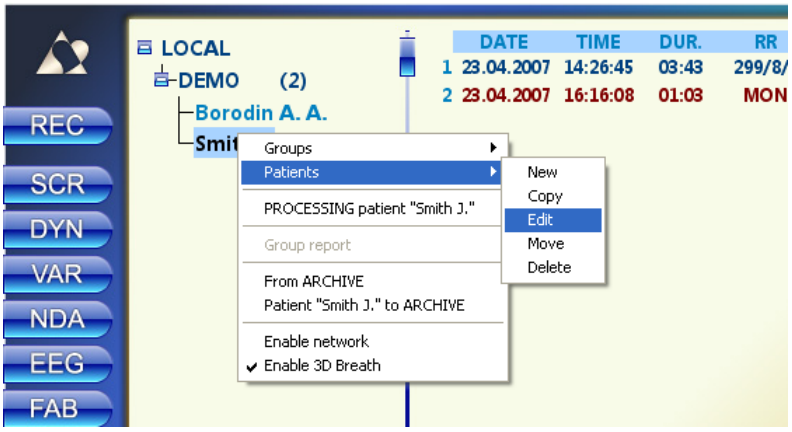


After filling in all required fields press "OK" and confirm entered information by pressing "Yes" in the dialog window.

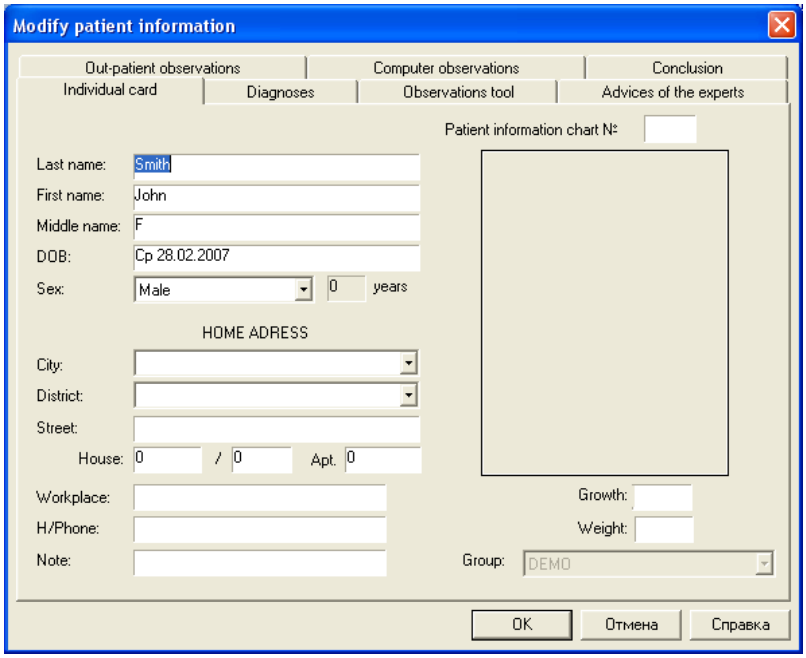
The string with the patient's name will appear on the database pane.

12.3.3. Editing Data

Click right mouse button on a patient's name to open a pop-up menu. Choose "Patients" -> "Edit".



The window "Modify patient information" will appear.



Besides the "Individual card" of the patient this window contains six additional tabs:

Diagnoses

Observations tool

Advices of the experts

Out-patient observations

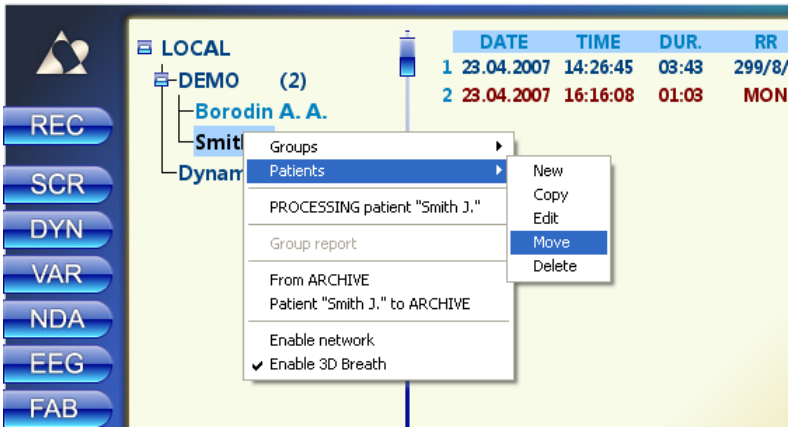
Computer observations

Conclusion

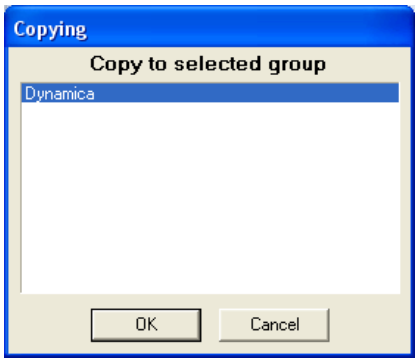
To switch to the desirable tab just click on its name.

12.3.4. Copying / Moving to other group

Click right mouse button on a patient's name to open a pop-up menu. Choose "Patient -> "Copy" (or "Move").



In the "Copy (Move)" dialog choose the new group name and press "OK".



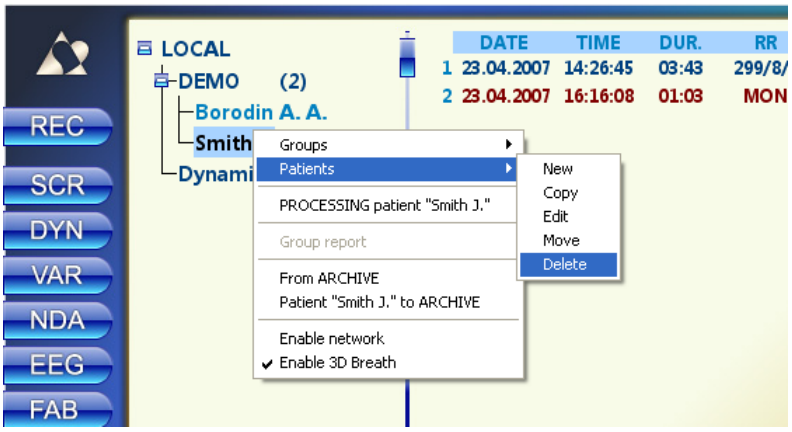
If such name already exists in a new group, the following dialog will appear:

You can either add new records to existing patient or create a new patient with the name entered in the field below.

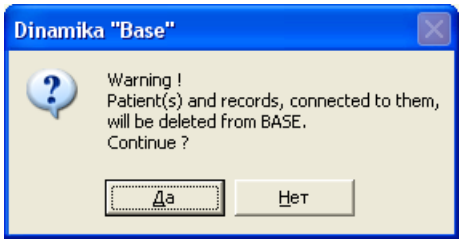
Press "OK" when done.

12.3.5. Deleting

Click right mouse button on a patient's name to open a pop-up menu. Choose "Patients" -> "Delete".



Confirm the operation by pressing "Yes" in the "Caution!" dialog.

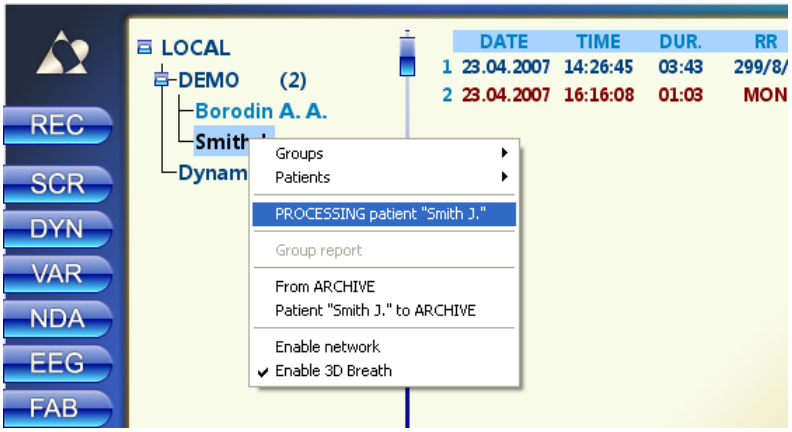


Note! All operations listed above can be done using keyboard:

«Ins» - create new group, «Enter» - edit, «Del» - delete.

12.3.6. PROCESSING

You have to implement the pre-processing of a patient's records after importing the data from the archive. Select the patient by left-clicking on his name and open the pop-up menu with the right click. Choose the item "PROCESSING Patient <patient name>"

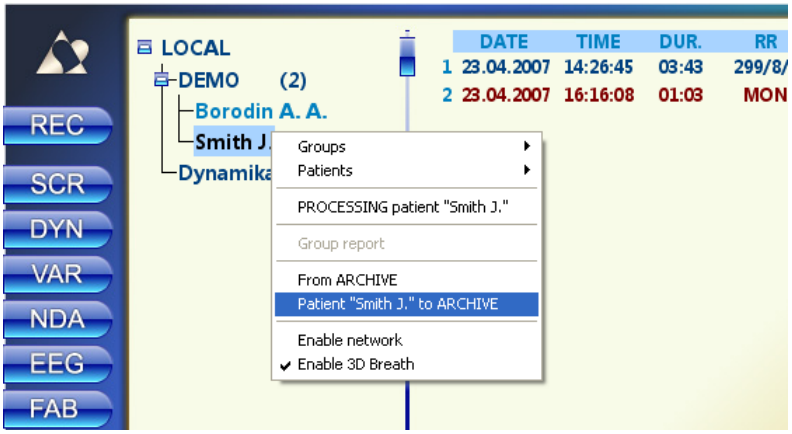


After finishing of the processing all data will be available for any system analysis mode.

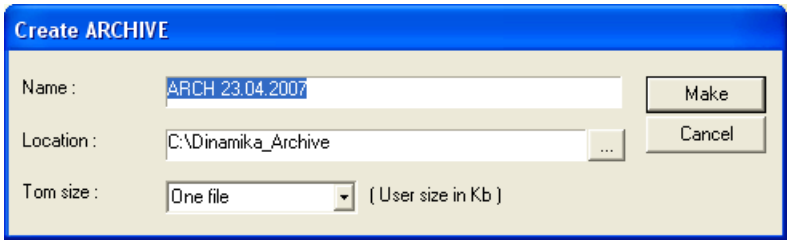
12.3.7. "Into Archive / From Archive"

The "Into archive / From Archive" operations are used to store data or to transfer it to another PC.

To add a group to the archive please do the following: click right mouse button on the patient's name to open a pop-up menu; choose "Patients "..." into archive" to complete the operation.



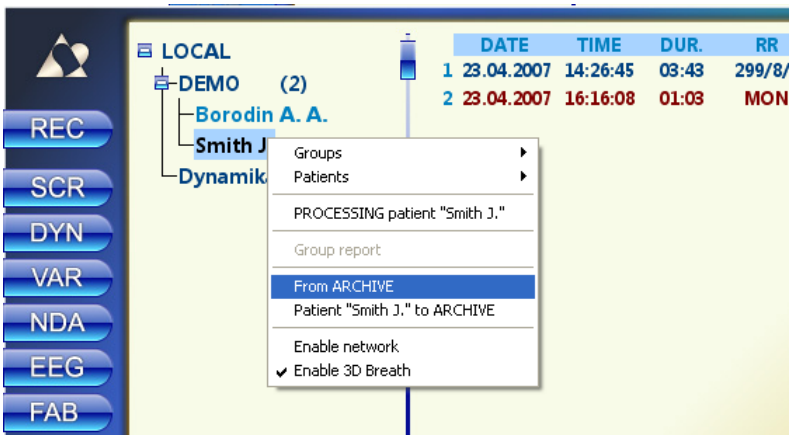
The "New Archive" windows enter the name of new archive and in the "Path" field choose the folder where new archive should reside. Press "OK" to create new archive.



The default values of NAME and PATH are: "ARCH_<date>_<time>" and "C:\Dinamika_Archive".

You can split the archive into 1.44Mb volumes in order to copy it on 3.5'' diskettes.

To extract the patient from archive do the following: click left mouse button on the group string to open a pop-up menu; choose "From archive" to complete the operation.



Choose the folder that contains the desired archive file (C:\DINAMIKA SPORT_Archive by default) and press "OK".

All operations listed above (copying, moving, deleting, processing, export/import, archive operations) can be applied on several patients at once. All you need is to select several patients. Selecting multiple items can be done by the following means:

- moving mouse pointer across the patients list with holding left mouse button pressed;

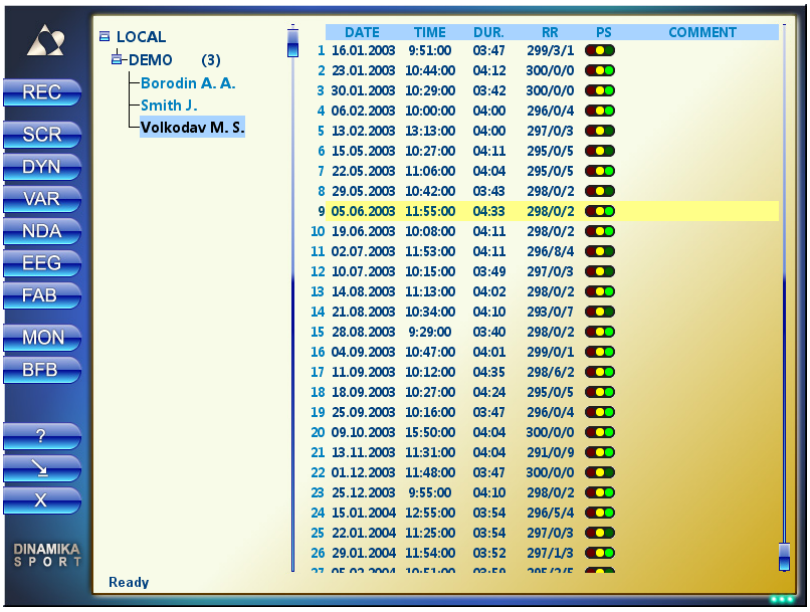
- clicking left mouse button with pressed "Ctrl" key on the keyboard;

- using cursor keys (↑ ↓ PgUp PgDn) with pressed "Shift" key.

Names of selected patients will be colored yellow.

12.4. Working with ECG Records

Click left mouse button to select patient's name. The right pane of the database window will represent the list of ECG registrations of the selected patient, sorted by the observation date (ascending).



The record string includes: number of a record, date and time of observation, duration of a record, number recorded of cardio cycles and number of artifacts. The "FS" column represents the level of functional state visually. Comments are given in the right part of the string.

Records that were not processed are colored light-gray. These records have no "RR" and "FS" information and can't be analyzed by the system.

Incorrect records are colored red. These are too short records or records with too much noise. You have to delete these records or to edit them by the "ECG Editor" program.

12-leads records are colored green. Such records can be analyzed only by the "ECG-12 Analysis" program.

Records made by the "BOS Monitoring" program are colored magenta. These records have no source ECG signal and can be analyzed only by the "Monitoring Analysis" program.

All other records are colored blue and can be processed by any kind of analysis.

Use cursor keys, PgUp, PgDn, Home, End key or mouse to navigate through the list of records. The selected record is colored yellow. Press functional buttons in the upper string of the window to run the corresponding analyzing method. The "Dynamical monitoring and Forecast" (the "DYN" button) analyzes all selected records.

To enter a comment – select a record and start entering a comment using keyboard.

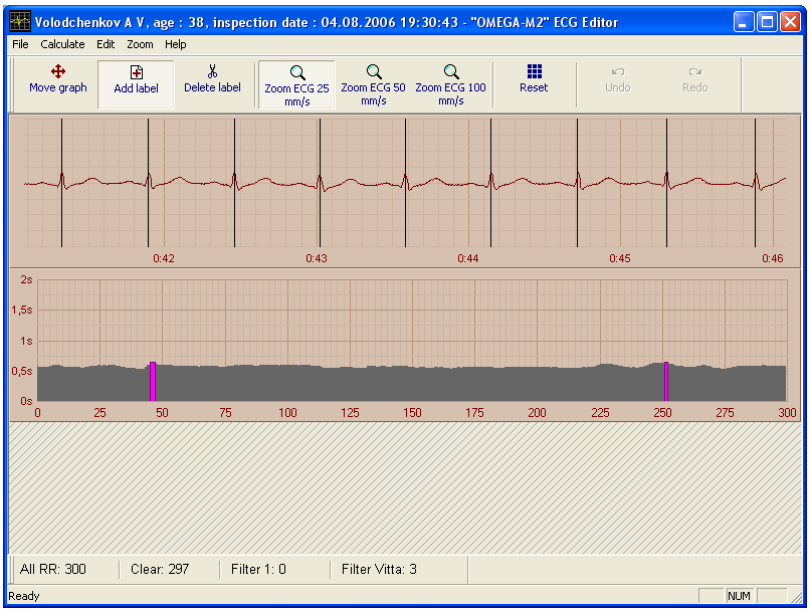
Double-click or press "Enter" on a selected record to start the "Screening and Diagnostics" program.

Besides, running any kind of analyzing method is available from the pop-up menu (click right mouse button on a record).

Use the "Del" key or "Delete" command from the pop-up menu to delete selected record.

13. ECG EDITOR

The “ECG Editor” program is intended for manual edition of the recorded ECG signal in case of too much noise in the signal, too much artifacts or extrasyslies. This program allows placing R-peaks markers manually. It can be started from the pop-up menu of the selected record.



The edition of the ECG record is as follow:

Click right mouse button on the part of rhythmogram colored red. The upper window will display the part of ECG needed to be corrected.

Drag incorrect markers to the exact maximum on the nearest R-peak.

You can also add markers by pressing “Add Marker”, if required. Press “Delete Marker” to erase the incorrect marker.

Move to the next “red” part of the rhythmogram and repeat the above operations.

You can use “Move Diagram” and “Scale” buttons.

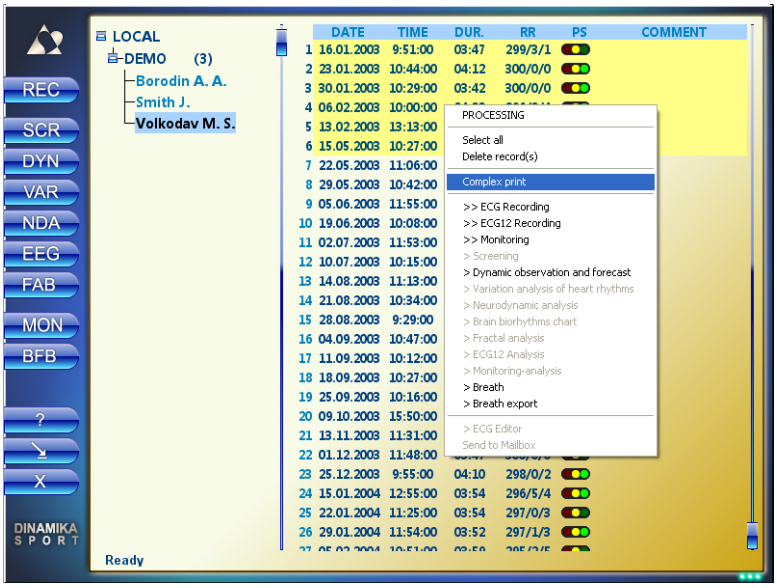
Save the record and close the window when done.

14. COMPLEX PRINT

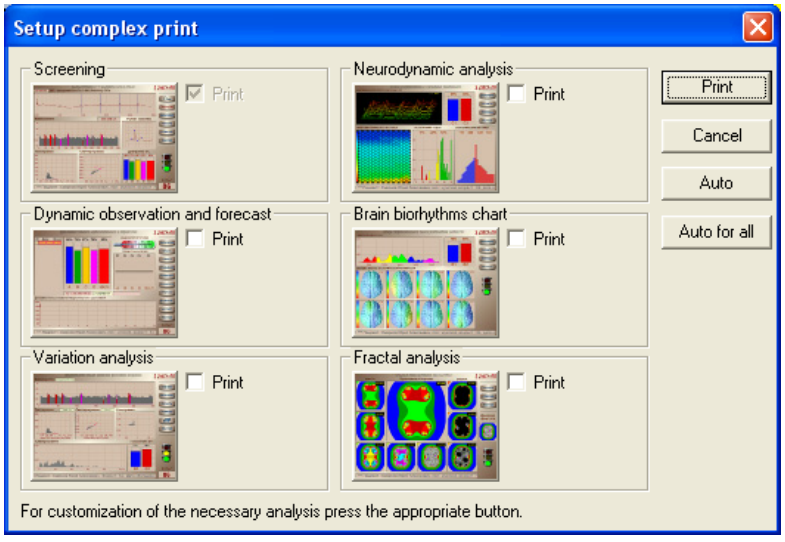
The “Complex print” program is intended for forming the complete observation card of a patient and printing via any printing device.

Click left mouse button to select a patient in the left pane of the database window. The selected patient will be colored yellow. If a patient has several records (in the right pane) select all of them in order to observe the dynamics of his indices. The observation card will be calculated according to the last record, but the dynamics diagram will use all selected records.

Right-click over selected records and choose “Complex print”.

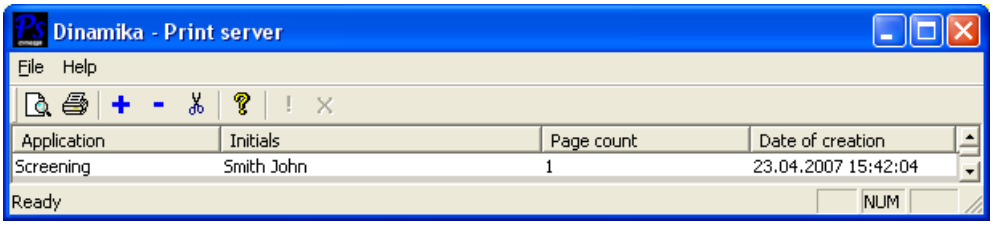


In the “Printing Settings” window press the “Auto All” button in order to form the report automatically. The report will contain all methods of analysis.



Different modes of analysis will appear on the screen sequentially. This process can take up to 2-3 minutes (which depends on the hardware capabilities).

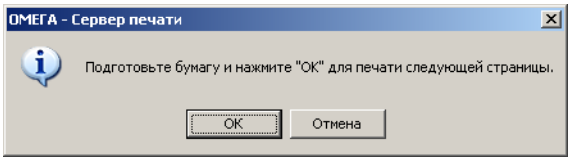
After completing the report “Print Server” window will appear.



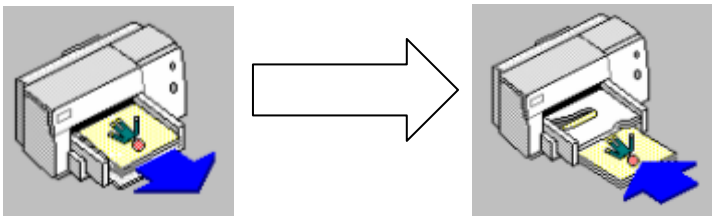
Press “Zoom” button for preview.

Use menu “File” -> “Printer Settings” to configure printing parameters.

Turn the printer on and press “PRINTER” button. The device will start printing and you will see the following window.



Please wait while printing the first page and move the paper from printer’s out box to inbox **without** inverting the paper.



Click “OK” or hit “Enter” to print the second page.

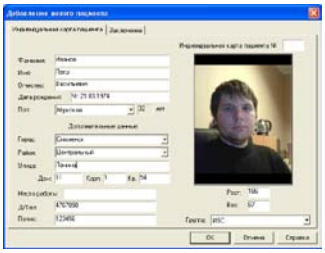
You can also form the printing report manually by pressing sequentially icons of all required analysis methods. Then press “Print” to send the report to the printer.

15. USEFUL FUNCTIONS

15.1. Search patient by name

You don't have to look through all groups to find a person. Just use a quick search by patient's name (or by it's part). See 12.3.1 "Search patient" for details.

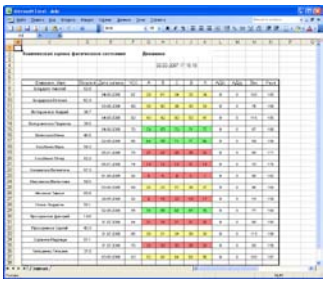
15.2. Web-cam usage



If a PC has a Web-cam attached you can insert a patient's photo into his individual card.

See 12.3.2 "Add new patient" for details.

15.3. Selective report



You can create a report for patients in a group containing basic indices of patient's health for the selected period of time.

See 12.2.5 "Group Report" for details.

15.4. Network support

If other PCs on the network have "Dinamika Sport" software installed there is an opportunity to browse the group stored on remote PCs from the database window.

See 12.2.7 "Group from network" for details.

16. TROUBLESHOOTING

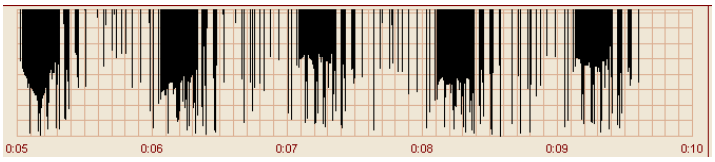
16.1. Problems with recording

The signal of the ECG record can be missing or can be displayed incorrectly because of one of the following reasons:

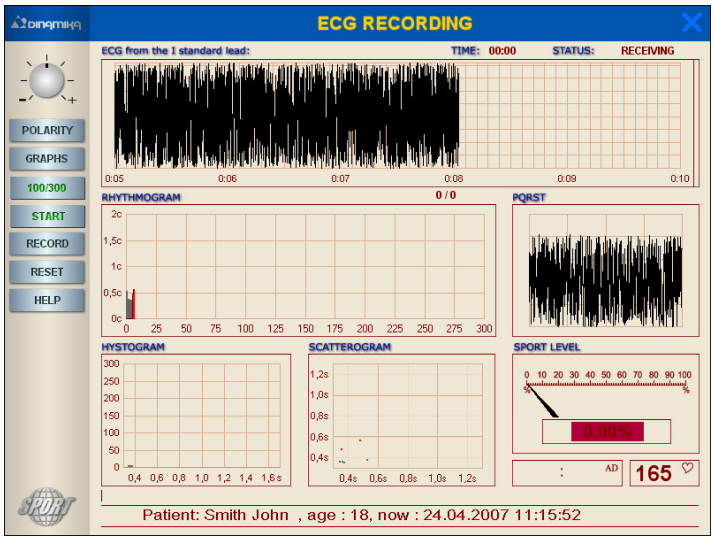
1. The selected device type is incorrect;
2. AC power noise;
3. Incorrect AC frequency is used;

16.1.1. The selected device type is incorrect

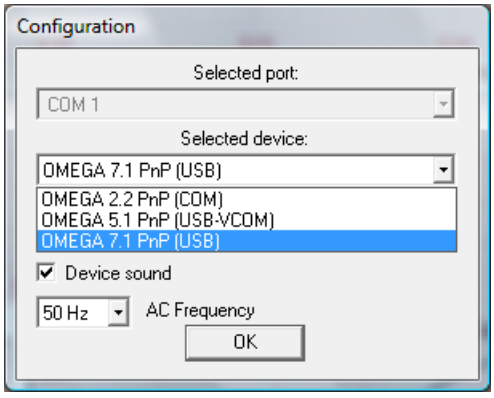
If a wrong device type is selected the signal looks like the following:



To solve this problem please double-click in the upper part “ECG Recording” window (in the caption area).

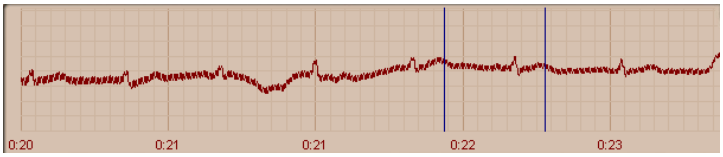


In the “Configuration” window select the device “OMEGA 7.1 PnP(USB)” and press OK.



16.1.2. AC power noise

If there are noises in power network the signal is as follows:

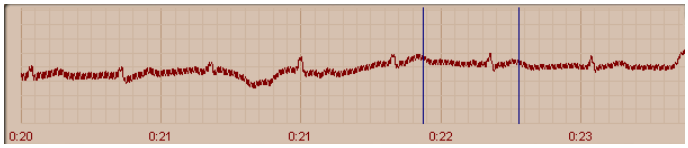


This problem occurs mostly when using a notebook plugged to an AC power. To solve the problem it's recommended to unplug the notebook from the AC power supply and continue the ECG recording using notebook's built-in batteries.

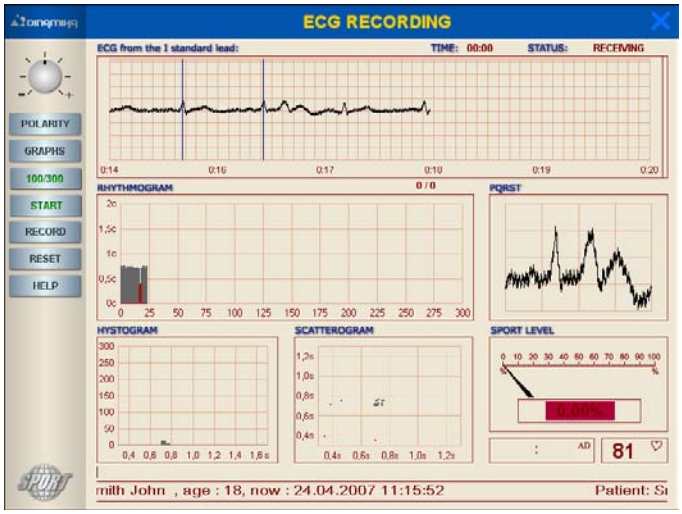
Note: If the problem occurs while using a desktop PC it's recommended to plug a PC through an AC filter or an UPS.

16.1.3. Incorrect AC frequency is used

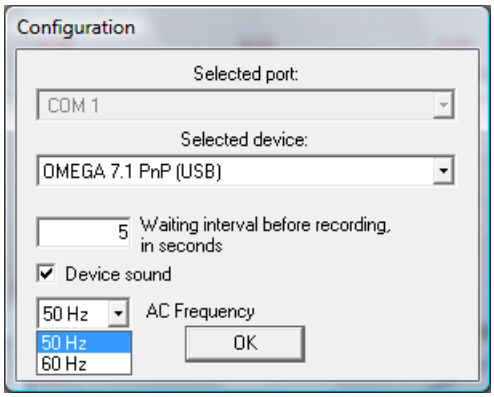
If the AC frequency is incorrect the signal is as follows:



To solve this problem please double-click in the upper part "ECG Recording" window (in the caption area).

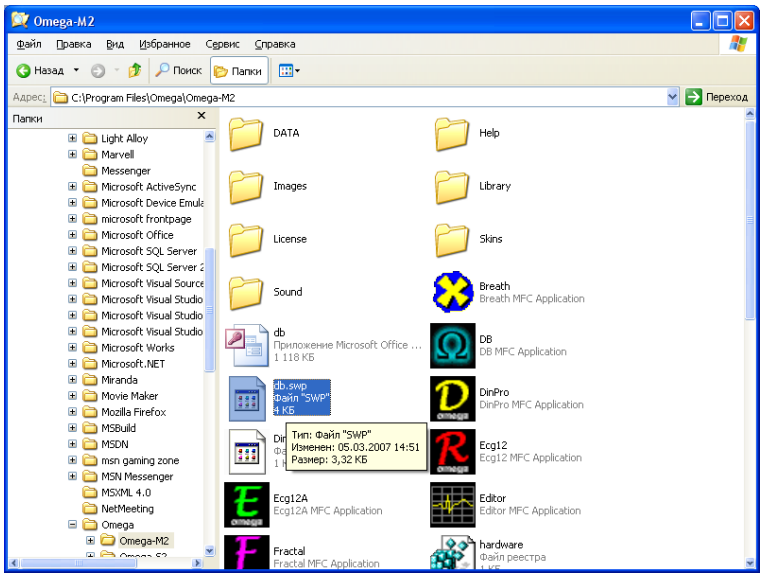


In the "Configuration" window select the AC frequency 50 Hz (for Europe and Russia) and press "OK"

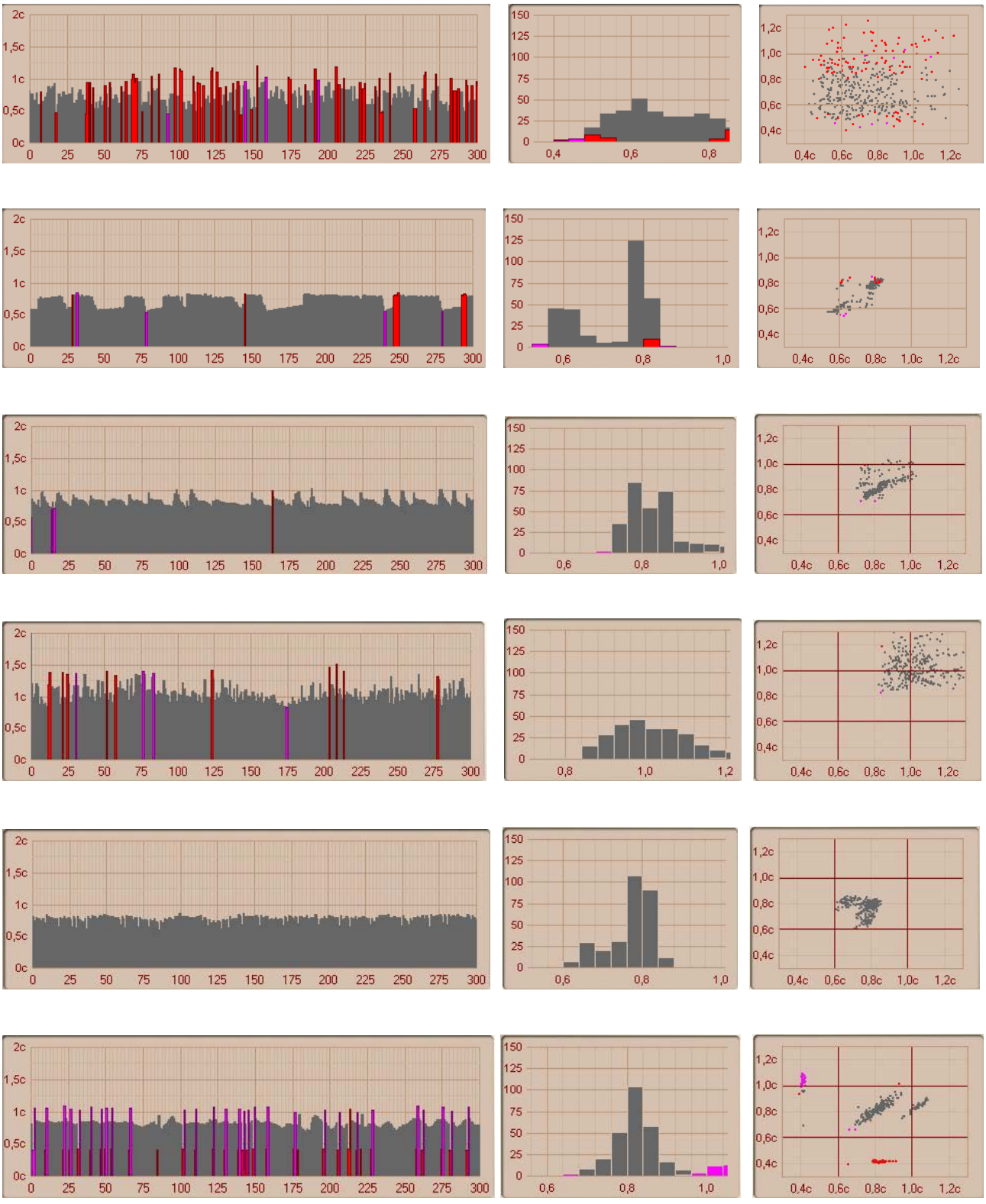


16.2. Database problems

If some patients or groups disappeared from your database you have to delete the file db.swp from the working folder of Dinamika Sport software (C:\Program Files\Dinamika\Dinamika.Sport\ by default)



17.EXAMPLES OF DISORDERS OF CARDIAC RHYTHM



18. MULTI-CHANNEL SYSTEM “CRAB” FOR SIMULTANEOUS OBSERVATION OF 7 PATIENTS

The system “CRAB” based on “Dinamika Medicine” device is designed for ECG recordings of up to 7 patients simultaneously.

18.1. Delivery package

ECG-recording module. “Omega-5.0 USB” ……..…..…… 7 pcs.

Cardiograph electrodes Skintact F 9024 …… 14 pcs.

USB-hub D-Link (USB2.0) for 7 ports ……..…... 1 unit.

Medical bag ……..…….. 2 шт.

18.2. PC hardware requirements

Recommended configuration	
CPU	Celeron M 1,7 GHz
RAM	1024 Mb
Operation System	Windows XP? Windows Vista

18.3. Plugging “CRAB” system to a PC

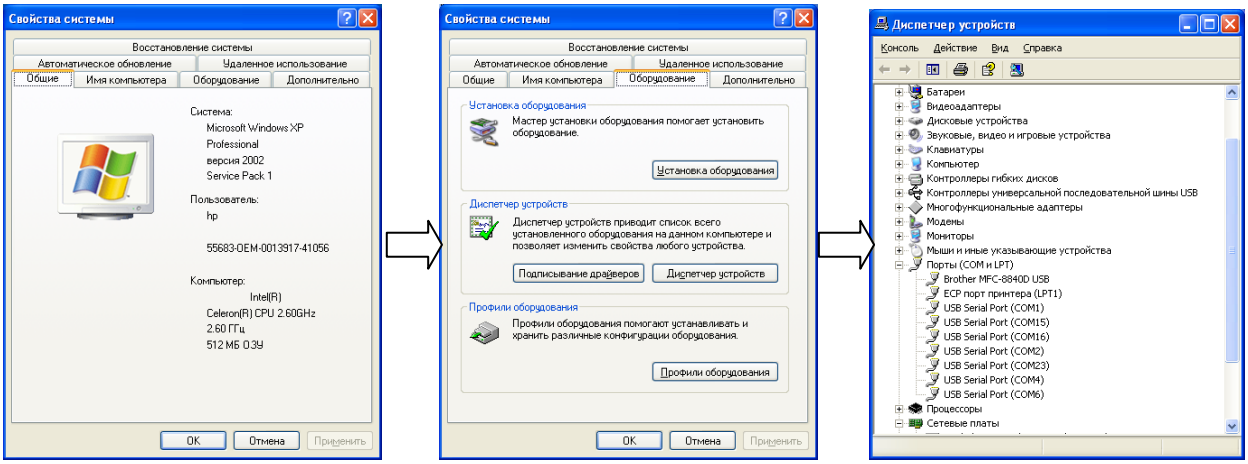
1. Plug USB-hub D-Link to any free USB port in your PC.

2. Plug the first ECG-recording module «Omega-5.0 USB» to the first port in USB-hub D-Link.

3. Install USB-device drivers (see 17.3.1 «USB-device driver installation»).

4. After installation of the driver repeat the procedure described in items 3 and 4 for each six remained units of registration of an electrocardiogram in ascending order of indexing

5. It is highly recommended to reboot a PC after drivers installation and check the “Device Manager” afterwards. Right-click on “My Computer” icon and select “Properties” in the pop-up menu. In the “System Properties” window switch to the tab “Hardware” and press the “Device Manager” button. Select “Ports (COM & LPT) from the list of hardware

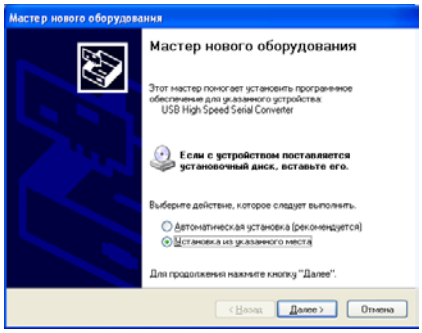


There should be 7 items named “USD Serial Port (COM)”. Make sure that all port numbers are unique and there are no yellow questions or exclamation marks

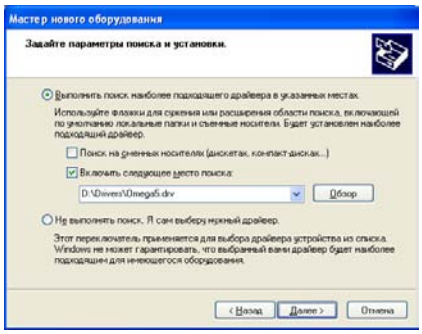
18.3.1. USB-device driver installation

When ECG-recording module «Omega-5.0 USB» is plugged for the first time the new device will be found by Windows and the “Add Hardware Wizard” will be started.

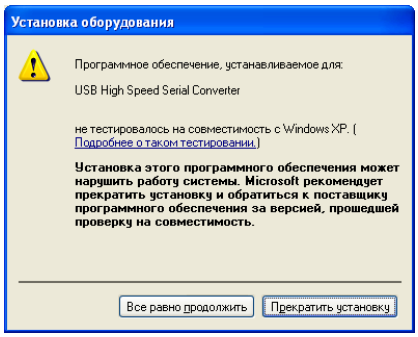
1. Select “Install from a specified location” and press “Next”



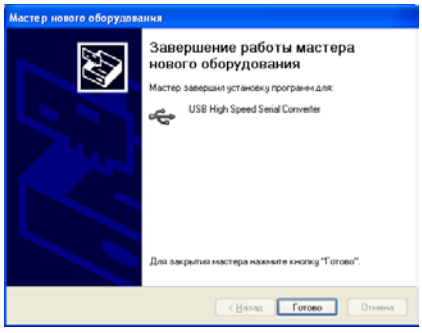
2. In the next window please deselect “Search on CD…” check-box and select “Search in the specified folder”. Browse to the folder D:\Drivers\Omega5.drv and press “Next”



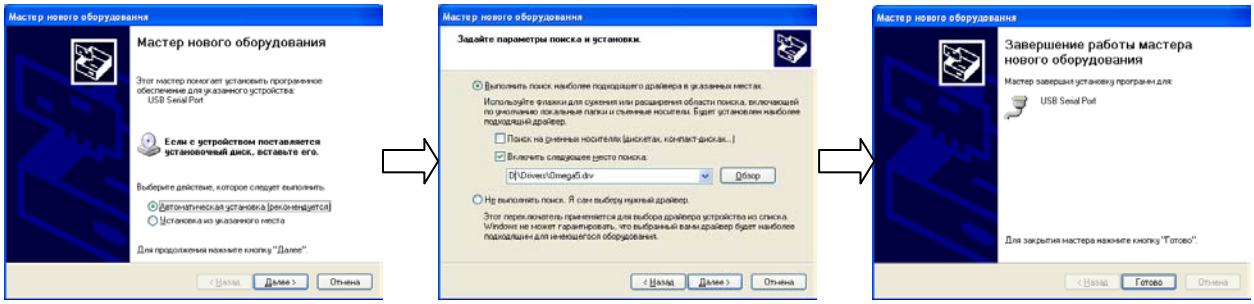
3. Press “Continue anyway” in the following warning window



4. Press “Finish”



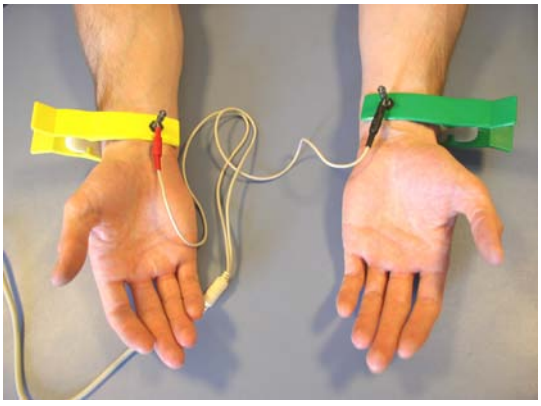
6. After installing USB device drivers the new device “USB Serial Port” will be found by the system. The procedure of driver installation is the same as the above.

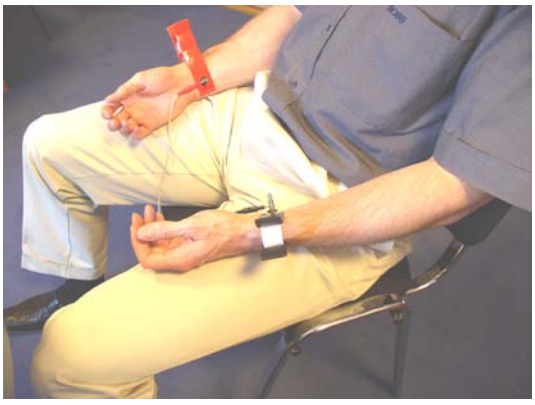


18.4. The “CRAB” system usage

18.4.1. Plugging the remote modules of ECG registration

Electrodes should be applied to patient’s wrists with the contact pads facing the inner side of the hand. The appropriate areas of patient’s skin should be vastly moistened with water or with physiologic saline. Patient can be sitting or laying and should be in a calm position. An electrode with the red connector attached should be applied to the right hand. An electrode with the black connector attached should be applied to the left hand of a patient.





Note: In some cases when the R-peak amplitude is too low, one electrode should be applied to the right wrist and the other – to the left ankle, vastly moistened as well

Important notice! To reduce the noise during ECG recording it is necessary to follow the below rules:

a) Patient’s hands should be still and relaxed. If a patient sits his hands should be placed over his lap. If a patient lays his hands should be placed along the body.

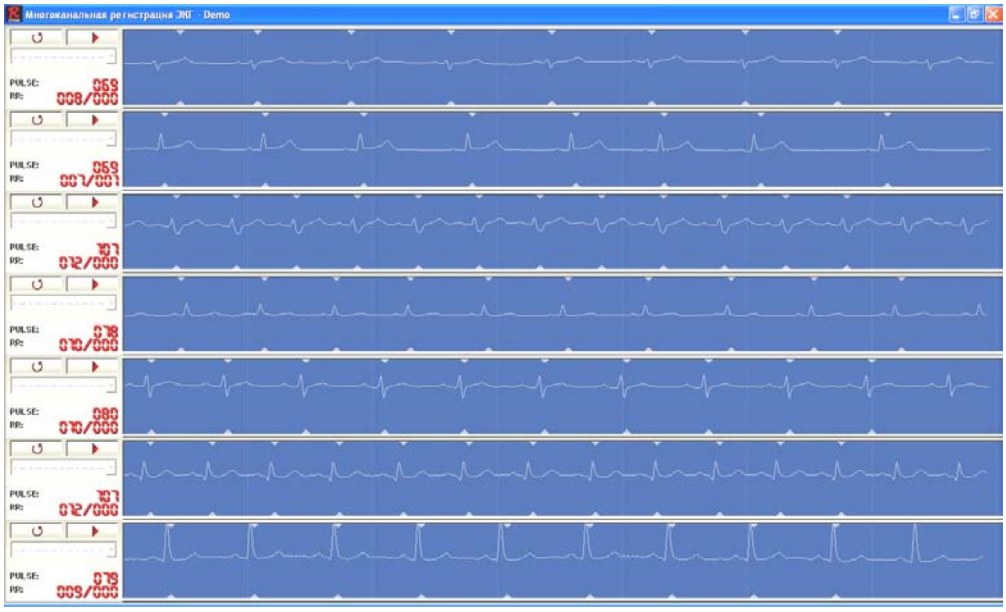
b) Unauthorized people should not walk within 1.5-2 meters around the patient.

c) During recording the ECG a patient has to be in a comfortable and relaxed state. A patient should NOT be disturbed by any talking or by demonstrating him the computer display with the ECG recording.

18.4.2. ECG recording

1. Select the group of patients in the left pane of the database window by left-clicking (the name of the group will be colored yellow). Press “REC” button to start recording ECG in multi-channel mode.

2. The window “Multi-channel ECG recording” will appear



3. Make sure that the ECG signal is stable for all patients before starting the recording process. R-peaks should be well-marked with triangle marks. To achieve this you have to:

a) Choose a positive polarity of the ECG signal by pressing the button

Positive polarity

Negative polarity

b) Make sure that there are no noises and eliminate them if any discovered.

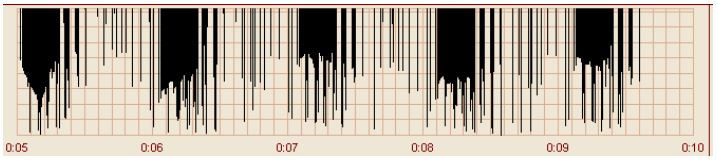
There can be several types of noises:

Some people are walking close to the patients – no one should walk in 1.5 – 2 meters distance from the patients

Patient is moving his hands – patient’s hands should be relaxed and still.

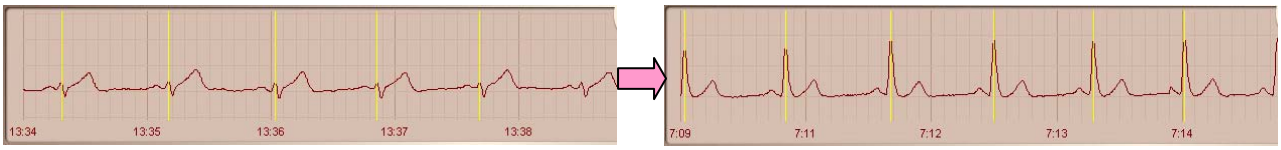
Bad contact between an electrode and patient’s skin – moisten patient’s skin and wash electrode’s contact pad.

There is no contact between electrodes and a remote module. Check the connection cable.

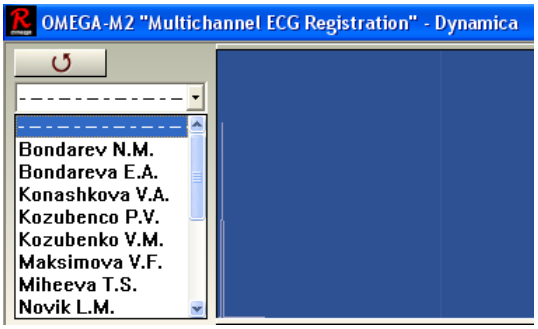


Decoding file is missing. Copy the file Hardware.id from the CD folder D:\Dinamika Medicine2.eng\Key\ into the working folder of the software C:\Program Files\Dinamika\Dinamica.Medicine\.

Note: Sometimes, if an amplitude of the R-peak is low or if the contact between electrode and patient's skin is weak, the algorithm of R-peaks extraction can generate errors. It's recommended to swap the electrode from patient's left wrist to his left foot - standard lead #2 (see 7.1.4.1 for details).



4. Click to open a drop-down list for selecting a patient's name. Connection cables are numbered from 1 to 7 for easy detection which channel is occupied by which patient.



Select patient's name for each channel being recorded.

The record will not be saved for the channel with no patient selected.

5. To start recording all channels simultaneously press the button in any window. The color of displayed signal will change and the countdown of recorded cardio-intervals in each channel will start.

6. The quality of the recorded signal should be controlled periodically during the ECG recording process. In case of noise in most of the channels simultaneously it's recommended to stop recording by pressing the button again. The recording will be stopped for all channels. Restart the recording after eliminating the reasons of noise. If noise is detected only in some channels it's recommended to wait until the end of recording in other channels.

Duration of the recording is controlled according to the counter of RR-intervals (the first number represents the total number of recorded intervals, the second number – number of artifacts). Recording will be stopped automatically upon achieving of 300 clean RR-intervals.

7. Duration of recording may vary for different channels. Depending on the patient's pulse rate it can take from 3 to 6 min to reach 300 cardio-intervals. After finishing the recording of the last channel the following window will be displayed.

Press "Yes" to save recorded signals.

From the very beginning and to the end of recording process all patients should stay on their places and should not disturb each other.

Caution!

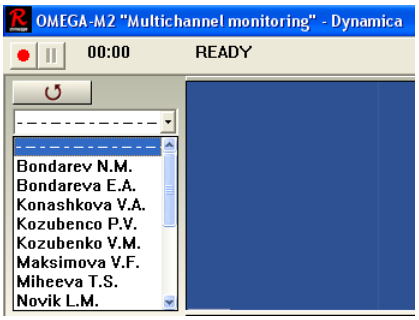
If a patient has a fibrillation or pronounced extrasystole the estimation of functional indices will be done incorrectly. Estimation of the functional state indices and the ECG processing in all modes can be carried out only if a patient has no disorders of heart rate!

8. To close the "Multi-channel ECG recording" mode just press the button .

18.4.3. Monitoring-recording

1. Select a group of patients in the left pane of the database windows. (The name of the group will be colored yellow). Press the button “MON” to start multi-channel monitoring of the ECG.

2. The window “Multi-channel monitoring” will appear.



Click , to open a drop-down list for selecting a patient’s name. Connection cables are numbered from 1 to 7 for easy detection which channel is occupied by which patient.

Select patient’s name for each channel being recorded.

The record will not be saved for the channel with no patient selected.

3. To start recording all channels simultaneously press the button .

4. To pause the recording press

5. To stop recording press once more. Recording will be stopped for all channels.