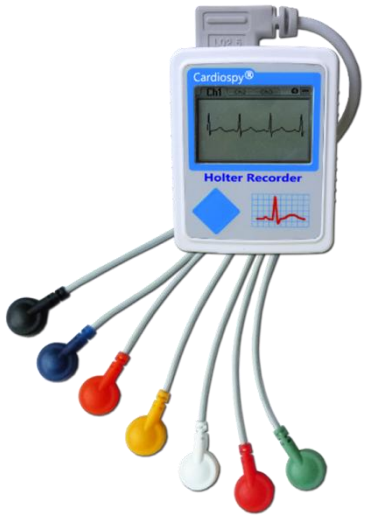
EC-2-3-12H Holter ECG System

Technical specification



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TECHNICAL SPECIFICATIONS OF DIFFERENT HOLTER SYSTEMS			
Type of Holter Recorders	**EC-2H**	**EC-3H**	**EC-12H**
Bipolar ECG Channels	1, 2	1, 2, 3	1, 2, 3
Other ECG Channels	-	+PM, Nehb	+PM Standard 12 CH, Nehb
Respiration	-	Yes	Yes
Number of snap type Leads	3, 5	3, 4, 5, 7	3, 4, 5, 7, 10
Recording duration maximum (without battery changing)	48h	48h	24h
The battery can be changed during recording	Yes		
Recording duration maximum (with battery changing)	336h		
Dynamic Bandwidth	±20 mV		
DC Offset Range	±600 mV		
Frequency Response maximum	0.05 Hz … 150Hz		
Sampling Rate	125 Hz, 250 Hz, 500 Hz, 1000 Hz		
Recording Rate	125 Hz, 250 Hz, 500 Hz, 1000 Hz		
Common Mode Rejection Ratio	120dB		
A/D Resolution	16 bit		
Input impedance	>100 MΩ		
Power Source	1x1.2 V AAA NiMH (or 1x1.5 V AAA alkaline)		
Battery Life	min. 24 h, up to 48 h using a high-capacity battery		
Storage Card Capacity	built-in 8GB (microSD)		
Internal Voltage (max)	3.3 V		
Display	LCD (Grey Scale 160x100 pixels)		
Movement detection-3D	Yes		
Patient Event button	Yes		
Monitoring ECG	On PC via Bluetooth and on LCD as well		
Reading Record	via USB cable		
International Protection Rating Against Water: IPX0	Yes		
Size	53 x 67.5 x 18.5 mm		
Weight	~ 50 g		

BASIC FUNCTIONS OF SOFTWARE

DATABASE FUNCTIONS		
• Common database for all Labtech system	• Record recycle bin function	• Search records
• Acquire Patient ID from barcode reader	• System log	• Local database, Network database: Microsoft SQL Server database, SQLite database
• Acquire Patient ID using magnetic card reader	• Filter records	• Different date format
• Medical record for patients	• Import – export records	• Password protected software starting
• Access control	• Import – export records by date	
BASIC FUNCTIONS		
• Automatic update	• Normal and MSI install	• Full screen mode
• HIS integrations: GDT, DICOM MODALITY WORKLIST, Cardiospy SDK	• Two display mode	• Cubios HRV export
• FTP integration	• Email function	• AHA / IEC electrode placement
PRINT AND EXPORT FUNCTIONS		
• Report printing and exporting	• Automatic print	• Selectable reports
• Color and Black and white reports	• Contrast settings	• Resizable resolution
• Customizable company logo	• Automatic diagnosis	• Custom report
• Adjustable paper speed and amplitude	• Import /Export settings	• Export ECG data to CSV, SCP, Dat format
• Export QRS data	• Export N-N intervals	• Export R-R intervals

HOLTER SOFTWARE FUNCTIONS

• Make new record using PC or recorder display	• Raw ECG visualization after reading to PC	• Visualization of evaluated record on PC
• Store the Indication and medication of the patient	• Awake, Asleep and special time	• Smoothing, baseline, mains filters
• Event Viewer	• Colour-coded event marking	• ST level/ST slope diagrams
• QT – QTc – QT% diagrams	• QRS – PQ diagrams	• Atrial fibrillation and atrial flutter screen
• Battery status	• Noise detection and editor	• Lead off warnings
• Detailed ECG Visualization	• QRS Detection	• Adjustable parameters for analysis
• HR and ST Graphs	• Arrhythmia Analysis (N,S,V)	• Full ECG Visualization
• Measuring possibility on the ECG	• Insert and delete QRS	• Rename QRS
• Mark noisy intervals	• Delete single/group events	• Patient event view
• Sleep apnea detection		

ADDITIONAL FUNCTIONS OF DIFFERENT HOLTER SYSTEMS

	EC-2H	EC-3H	EC-12H
P-wave detection	+	+	+
Motion Detection	+	+	+
QRS Template Classification	+	+	+
QT Analysis	+	+	+
HRV Time Domain	+	+	+
AV block I-II-III Analysis	+	+	+
Atrial Fibrillation & Flutter Analyis		+	+
HRV Frequency Domain		+	+
Pacemaker Analysis		+	+
Vector cardiography		+	+
T Alternant			+
HR Turbulence Analysis			+
Respiration		+	+

SOFTWARE MINIMUM CONFIGURATION

Processor	minimum: Intel® Core™ i3 recommended: Intel® Core™ i5 or better (Sandy Bridge or newer architecture)
RAM	minimum: 4 GB; recommended: 8 GB
Graphics card	DirectX 10 compatible, min. 128 MB video memory
Display	minimum: min. 1280x800 resolution recommended: 22” monitor 1920 x 1080 resolution (Full HD)
HDD	500 GB (SATA II or newer recommended)
Interface	1 USB port for the EC-2H/3H/12H/ABP recorder 1 USB port for the USB-02 key 1 USB port for the printer
Printer	Laser (printing speed: 15-20 page/min, color printer recommended)
Operating system	Windows 7, Windows 8, Windows 8.1, Windows 10 (32-bit or 64-bit versions)

*Windows XP is no longer supported by Microsoft. Labtech provides only limited support for previously installed systems.

ECG Holter System

Cardiospy® User Manual

For EC-2H; EC-3H; EC-12H; EC-3H/ABP recorder

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Quality certifications

The CE mark indicates that the product meets the essential requirements of European Council Directive 93/42/EEC concerning medical devices.

Labtech Ltd. also operates a quality system certified to ISO 13485:2016. Made in Hungary by Labtech Ltd.

We wish you success in the use of our ECG Holter System!

Release date: 26-06-2012
Revision date: 17-01-2019
Version number: v6.6

If you have any questions, ideas, partnership suggestions please contact us.

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1 Introduction

Dear Customer!

Thank you for purchasing our Cardiospy ECG Holter System. We sincerely hope that our product will help you with your diagnostic and therapeutic work. To be able to use Holter System and computer programs appropriately, please read the manuals carefully. A basic knowledge of computers and Windows based applications are required. We appreciate any comment you might have on the use of the System. Please, turn to us with confidence: our colleagues and representatives will be pleased to help you, even in person if need be.

What is a Holter?

A Holter is a non-invasive, long-term ambulatory ECG device that is capable of recording up to 24 (or even 48-72) hours of ECG signals.

How to use Holter monitoring?

The Holter recorder is worn by the patient for 24 hours, and records during normal daily activities, including sleep periods. After 24 hours, the readings are downloaded to a computer for analysis, where a qualified expert reviews and, if necessary, edits the data.

What is the main idea of Holter Monitoring?

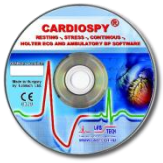
Holter monitoring is a tool in the evaluation of patients with symptoms of various forms of heart disease, or in situations where the physician suspects cardiac pathology in the absence of symptoms. Holter monitoring is an ideal test because the patient assumes normal daily activities, increasing the likelihood that he or she will experience the precise situations that can trigger symptoms or cardiac events. This allows correlation of any rhythm problems or abnormalities with activities and/or symptoms. In the opposite sense, Holter monitoring can also be used to "rule out" cardiac causes of patients' symptoms.

2 Preparations for using the Holter System

NOTE: BEFORE STARTING TO USE THE HOLTER SYSTEM YOU ARE EXPECTED TO FOLLOW LABTECH LTD.'S **INSTALLATION AND UPDATE GUIDE,** WHICH PROVIDES GUIDANCE ON THE INSTALLATION OF THE SYSTEM.

2.1 List of accessories for EC-2H; EC-3H; EC-12H *

Please check the listed units and accessories before installing the ECG Holter System

Code No.	Specification	Qa.	EC-2H	EC-3H	EC-12H	Picture
CAS-00000-01	Case for holding the systems	1	x	x	x	
ACC-0SWCD-01	CD with installation software	1	x	x	x	
DEV-0USBB-02	USB-02 Bluetooth interface unit	1	x	x	x	
DEV-02HLC-05	EC-2H ECG Holter Recorder	1	x			
DEV-03HLC-05	EC-3H ECG Holter Recorder	1		x		
DEV-12HLC-05	EC-12H ECG Holter recorder	1			x	

Code No.	Specification	Qa.	EC-2H	EC-3H	EC-12H	Picture
BAG-0012H-01	Recorder bag (EC-2-3-12H V5, attachable to patient's waistbelt)	1	x	x	x	
BAG-0012H-02	Recorder bag (EC-2-3-12H V5, attachable to patient's neck)	1	x	x	x	
CHA-0002X-01	Battery charger MINI	1	x	x	x	
BAT-00000-01	1.2V Rechargeable batteries (AAA)	2	x	x	x	
CAB-00L02-06	2 CH bipolar patient cable (HDMI-Snap, 45cm)	1	x			

Code No.	Specification	Qa.	EC-2H	EC-3H	EC-12H	Picture
CAB-00L03-06	3 CH bipolar patient cable (HDMI-Snap, 45cm)	1		x		
CAB-00L12-05	12 CH standard patient cable (HDMI-Snap connector)	1			x	
CAB-00LNE-06	NEHB patient cable (HDMI-Snap, 45cm)	1			x	
CAB-00USB-01	Extension cable for USB-02	1	x	x	x	
CAB-00REC-05	Data transfer cable (USB A - HDMI)	1	x	x	x	
USR-00000-01	Installation and Update Guide	1	x	x	x	

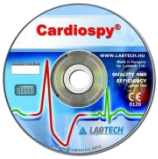
Code No.	Specification	Qa.	EC-2H	EC-3H	EC-12H	Picture
USR-00000-02	User manual for Holter recorders	1	x	x	x	
ELE-00000-01	Single-use electrodes (1 pack / 30 pcs)	1	x	x	x	

NOTE: PLEASE REFER TO THE CODE NUMBER ABOVE WHEN PLACING AN ORDER.

*The manufacturer reserves the right to change prices at any time.

**The accessories highlighted in grey in the chart will be given as accessories for the recorders as well.

2.2 List of accessories for EC-3H/ABP

Code No.	Specification	Qa.	EC-3H/ABP	Picture
CAS-00ABP-01	Case for holding the recorder and accessories	1	x	
ACC-0SWCD-01	CD with installation software	1	x	

Code No.	Specification	Qa.	EC-3H/ABP	Picture
DEV-0USBB-02	USB-02/B Bluetooth Interface Unit (monitoring and evaluation)	1	x	
DEV-3HABP-05	EC-3H/ABP ECG and ABPM Recorder	1	x	
BAG-3HABP-02	Recorder bag (EC-ABP V5, EC-3H/ABP V5, attachable to patient's waistbelt)	1	x	
CHA-0004X-01	Battery charger MAXI	1	x	
BAT-00000-02	1.2V Rechargeable batteries (AA)	4	x	
CAB-00L03-06	3 CH bipolar patient cable (HDMI-Snap, 45cm)	1	x	

Code No.	Specification	Qa.	EC-3H/ABP	Picture
CAB-00USB-01	Extension cable for USB-02	1	x	
CAB-00REC-05	Data transfer cable (USB A - HDMI)	1	x	
USR-00000-01	Installation and Update Guide	1	x	
USR-00000-02	User manual for Holter recorders	1	x	
ELE-00000-01	Single-use electrodes (1 pack / 30 pcs)	1	x	
ELE-00000-02	Single-use electrodes for cuff fixing	1	x	
BEL-00000-01	Waist belt	1	x	

Code No.	Specification	Qa.	EC-3H/ABP	Picture
CUF-00LOC-31	BP cuff, Adult (23-33cm)	1	x	

***The manufacturer reserves the right to change prices at any time.**

****The accessories highlighted in grey in the chart will be given as accessories for the recorders as well.**

NOTE: *PLEASE REFER TO THE CODE NUMBER ABOVE WHEN PLACING AN ORDER.*

2.3 Principles of Operation

Holter monitoring is a tool in the evaluation of patients with symptoms of various forms of heart disease, or in situations where the physician suspects cardiac pathology in the absence of symptoms. Symptoms such as lightheadedness, palpitations, or fainting may be caused by disturbances in the electrical signals that control the heart muscle contractions. These disturbances can be random, spontaneous, sleep-related, emotion- or stress-induced.

Holter monitoring is an ideal test because the patient assumes normal daily activities, increasing the likelihood that he or she will experience the precise situations that can trigger symptoms or cardiac events. This allows correlation of any rhythm problems or abnormalities with activities and/or symptoms. In the opposite sense, Holter monitoring can also be used to "rule out" cardiac causes of patients' symptoms.

Symbols:

This equipment meets the requirements of Directive 93/42/EEC Annex II (excluding section 4).

Do not dispose of this product and batteries as unsorted municipal waste. Prepare this product for reuse or separate collection as specified by Directive 2002/96/EC of the European Parliament and the Council of the European Union on Waste Electronic and Electrical Equipment (WEEE).

MDD IIa

MDD classification IIa. EMC class B. EMC group 1.

Bluetooth Wireless Communication Technology
Not ionizing radiation – Device including Bluetooth based RF transmitter.

Pay special attention to the part, marked with the exclamation mark.

CF type side of patient

Year of manufacture

Manufacturer

Operating instruction

2.4 Warnings and Contraindications of using Holter System

⚠ Never use the recorder:

- in wet conditions (the recorder is not waterproof)
- in strong heat
- in explosive surroundings
- in strong electrostatic field
- in the presence of flammable anaesthetics and oxygen rich environment.
- Do NOT remove recorder covers
- Do NOT immerse the recorder in any fluid
- the Holter is not defibrillator-protected, do not use with not-implanted defibrillator

⚠ Usage with other devices:

Holters may be used safely in patients with pacemakers, Implanted Cardiac Defibrillator (ICD) or other implanted devices. The implanted devices will not disrupt or be influenced by the operation of the recorder, as well as the recorder will not be influenced by the operation of the above devices.

The recorder may be used simultaneously with a high frequency surgical device, in this case make sure that the ECG electrodes are placed as far as possible away from the surgical field.

Do not use the recorder in MRI environment or in an excessive electromagnetic field.

⚠ Environmental conditions of storage and operation:

Temperature-range: -10-50°C

Relative humidity: 10-95% non-condensing

Air pressure-range: 700-1060 hPa

To achieve good and safe connection, to take care of the patient's skin and to avoid infection use only good quality single-use electrodes that are marked with the CE sign. Do not use electrodes with expired warranty or dry or used ones from old, previously opened packages because it will result in bad recording quality.

As in all Holter systems, noise and artefact may produce false positive ECG events. Therefore, patient data must be reviewed and edited by a qualified technician. You can find more information about evaluation in CHAPTER 4.2.4.

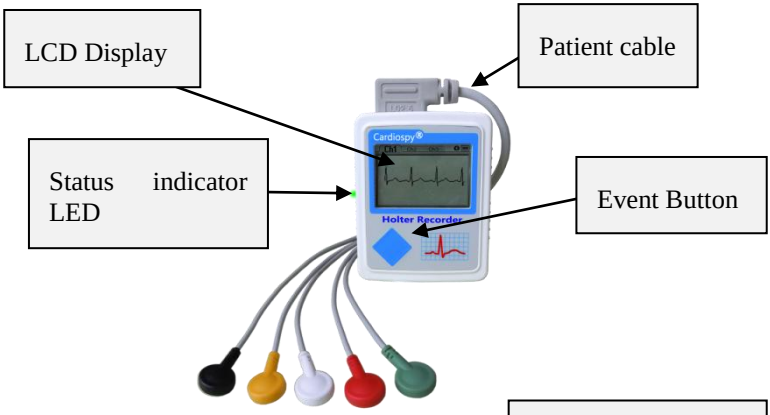
Opening the enclosure by unauthorized person may invalidate warranty. Modification of the ME equipment can only be performed by the manufacturer. In case of problems contact a professional repair shop.

NOTE: IF ANY ABNORMALITY OCCURS IN THE UNIT, SUSPEND THE OPERATION IMMEDIATELY AND DISCONNECT THE UNIT FROM THE PATIENT.

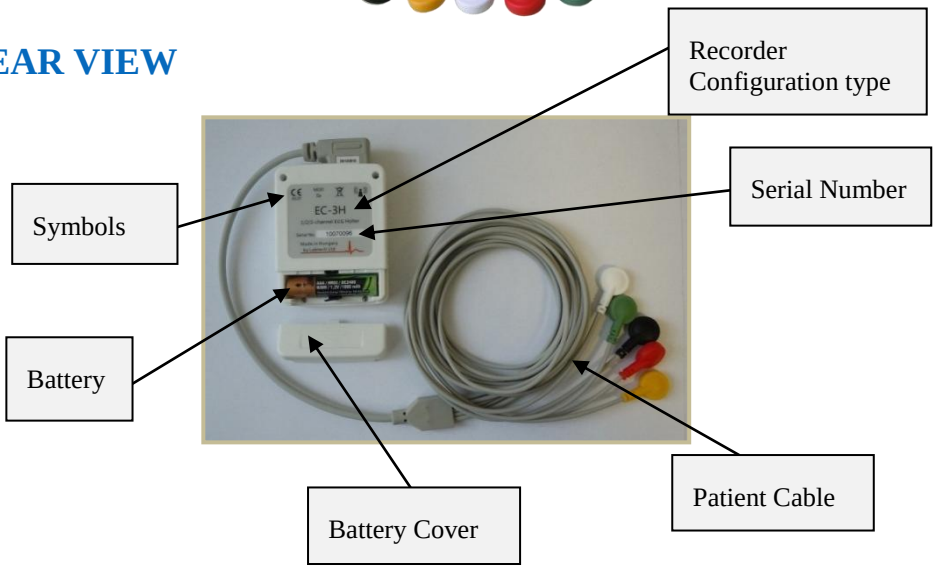
3 Instructions for starting Holter Monitoring

3.1 Main parts and functions of the Holter (EC-2H; EC-3H; EC-12H)

FRONT VIEW

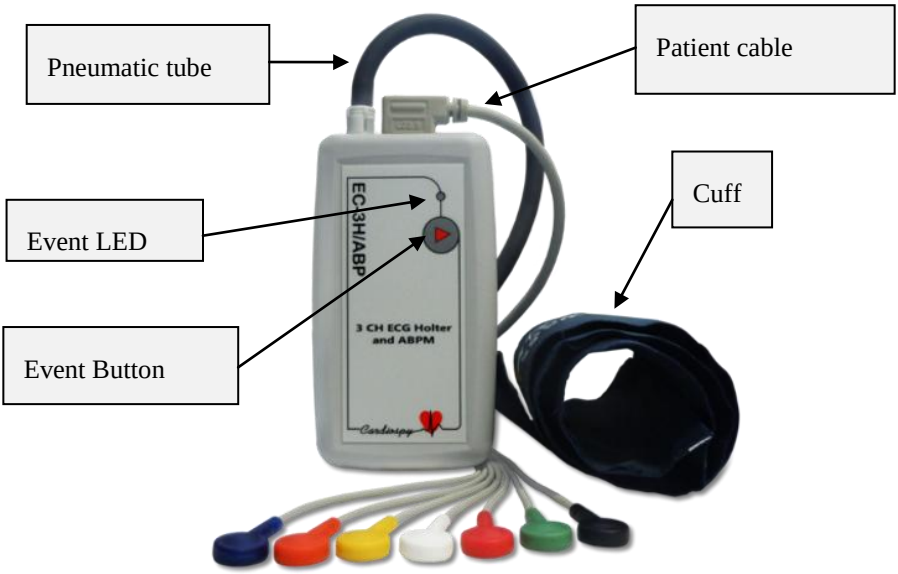


REAR VIEW



3.2 Main parts and functions of the Combined device

FRONT VIEW



3.2.1 Signs and alarms of EC-3H/ABP

The recorder contains a single RGB LED with which you can indicate several colours and hues.

Light signal	Description	What should we do?
The LED light is red.	Hardware error	After detecting the hardware error it waits a few seconds and restarts automatically. If it's not then you should restart the recorder by replacing the batteries. If the problem still occurs it requires repairing.
The LED is red and flashing.	The battery has run out.	Battery exchange required.
The LED light is green.	The recorder connects to the PC through the USB data transfer cable and it works properly.	-
The green LED light flashes quickly.	The recorder connects to the PC through the USB data transfer cable and and there is data transfer between the PC and the recorder. The rythm of the flashing is syncronized with the rythm of data transfer.	-
The green LED seldom flashes	The recorder is ready to start recording (doesn't contain any unread records, the self-test and initialization was successfully completed).	-

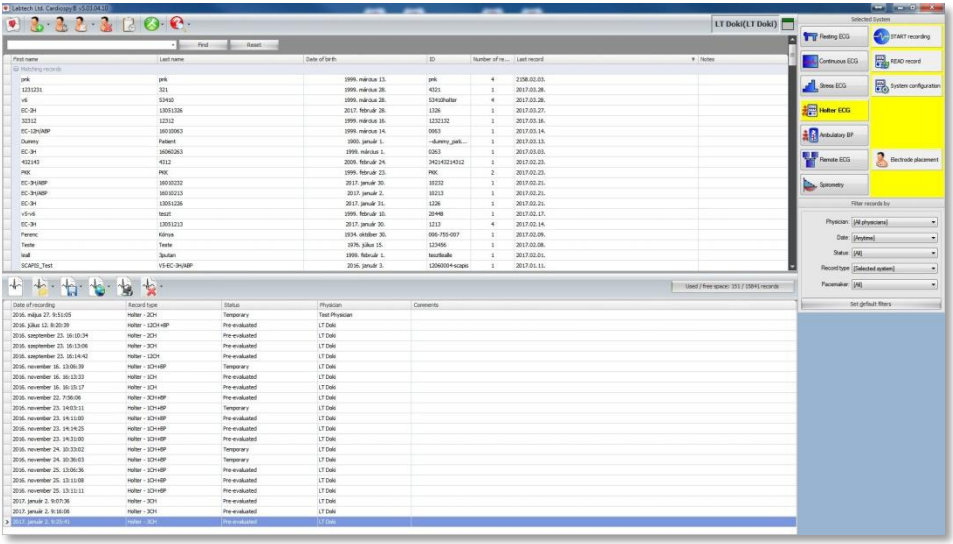
Light signal	Description	What should we do?
The yellow LED flashes.	The device is recording.	-
A crimson LED flashes	The recorder contains unread record.	You should read the last record from the recorder, otherwise you cannot start the next record and the device won't turn on the Bluetooth modul.
Blue LED seldom flashes	There is Bluetooth connection between the PC and recorder.	-
Blue LED flashes quickly	There is data transfer between the PC and recorder.	-

The recorders include a buzzer which can operate in different frequencies. By this the recorders are able to display the different statuses and errors.

Signal	Rhythm, tune	Status description
One high-pitched short beep	•	Push-button event on the recorder or on the PC (Start/Stop BP).
One short beep in deep voice	○	The device was removed from the USB.
One high-pitched long beep	●	Start of recording.
		Stop of recording.
The recorder beeps for some seconds on a high-pitched voice.		Hardware error.

Signal	Rhythm, tune	Status description
Two high-pitched short beep	••	Cannot start recording (no patient data).
		Push-button event, but there is no function related to pushing the Push-button in the current state of the recorder (for example: the recorder connects to the USB).
Two short beep in deep voice	○○	The device was connected to USB.
Two short beep with rising melody	○•	Bluetooth connection was created.
Two short beep with descending melody	•○	Bluetooth connection was broken.
Three high-pitched short beep	•••	After the battery was put in the initialization, selftest was successfully completed.
Four high-pitched short beep	••••	Discharged battery.

3.3 Database management interface

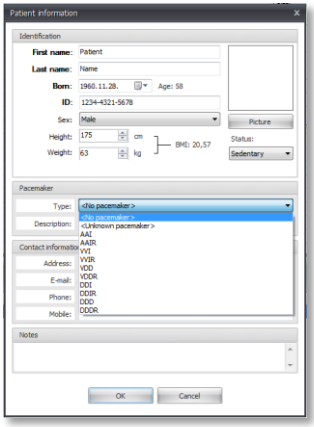


The database management interface enables us to add physicians and patients by name and ID number (e.g., social security number), which can be sorted and filtered according to different criteria. The interface also offers a search option by name or ID. The database management interface displays the list of patients and the pertaining number of records. Here we can view previous records and start new recordings as well.

3.4 Toolbar

The toolbar contains different buttons which provide access to the most often used functions in the software.

New patient: Here you can add new patients to the list. Patient's first and last names, date of birth and patient IDs are fields which need to be filled in. The software allows only unique patient IDs to be entered into the database, which is the reason why it is recommended to use this field for entering the social security number of each patient (or any other code which uniquely identifies a person). Entering address, weight and height is optional when registering a patient.



If the patient has pacemaker, you can also select it's type here, with a short description. Besides, contact information and even notes can be entered.

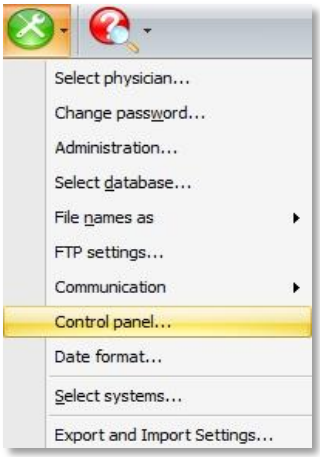
Modify: Patient data can be edited by clicking on the Modify button. The interface allows every field to be edited except patient ID (social security number)

Since it is possible that a patient without pacemaker was examined with our system previously (has record in the database), but after that a pacemaker was implanted, you can modify the pacemaker type as well. In this case, the existing records will be kept without pacemaker detection, but new records will be analyzed with detecting pacemaker spikes. For more information, please read CHAPTER 5.5.5.

Medical record: This function gives a summary about the medical record. This summary can be edited and we can also add explanations and observations.

Delete: Click on the Delete button for deleting patients. When patient is deleted, all of its corresponding records are deleted as well. After deleting, there is only one way to restore data. If the “Move deleted records to recycle bin” option is turned on (Settings/Administration/Settings) you can restore the deleted record from the “Record recycle bin”.

DICOM Modality Worklist: The software gets in contact with the DICOM Modality Worklist and receives a list of the patients for whom examination is required. For more information about its settings, please check the **Cardiospy Installation and Update Guide**.



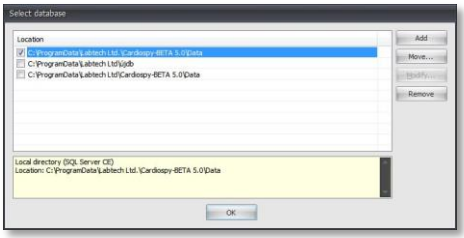
3.4.1 Settings:

- **Select physician:** In this menu the physician, who is performing the current test, can login to the software and also select to view the records of other physicians whose records are not password protected.

- **Change password:** By selecting this option, the physician, who is performing the current test, can change his/her password.

- **Administration:** Here, we can manage the users and also the security settings and administrator rights can be set under this menu point. Further information on modifying user authorization can be found in **Cardiospy Installation and Update Guide.**

- **Select database:** In this menu, you can choose to create a new database or to use a different one. These databases operate independently of each other, so a patient who is created in one of them does not appear in another. The software always uses the database set for the previous operation.



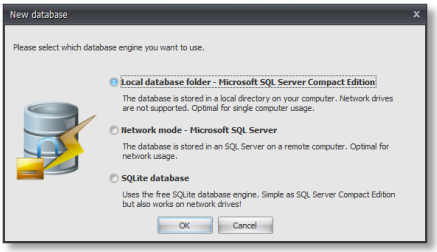
Clicking on the “Add” button creates a new database.

If you need to work with a different one, then select it and click on “OK”.

You can move a database to a different location with the “Move...” function.

There are three possible ways to create a database:

1. Local database
2. Network mode - Microsoft SQL Server
3. SQLite database



Local database:

The database is stored in a local directory on your computer. Network drives are not supported.

It is optimal for single computer usage. Select the directory for the database and it is ready.

Network mode - Microsoft SQL Server:

Please ask for help from your administrator.

SQLite database:

You can find its description in the **Cardiospy Installation and Update Guide**.

- File names as: The order of first and last name can be set in this menu.

- FTP settings: You can find its description in the **Cardiospy Installation and Update Guide**.

- Communication: You are able to communicate through HL7 between Cardiospy and external software. To do this, ask your local distributor and administrator.

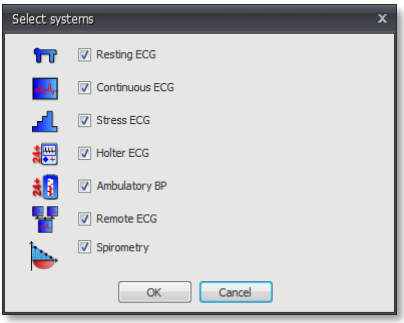
- Control Panel: In this menu, you can find the general settings of the software. You can read more about it's option in the **Cardiospy Installation and Update Guide**.

- Date format: You can set the short and long form of system date here.

- Select systems:

Here, you can enable / disable systems that you want / do not want to use.

You can activate or deactivate a system by ticking or unticking the checkbox next to the name of it.



3.4.2 Help

- **Installation and update guide:** The guide on software installation and system configuration also contains a description of the software update process.

- **User manual:** First of all, choose the system in the Select systems panel. Once you click on User manual button, the user manual of the currently selected system will appear.

- **What's new:** The novelties of the current software version can be found in this file.

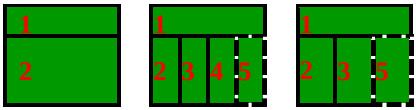
- **Languages:** The software offers a choice of several languages, from which you can select the one you wish to work in.

- **Multilanguage translator:** With this function, the user is able to translate each term is appearing in the software into the desired language. A password is necessary to enter this menu point. In case you would like to use this function, ask your distributor for the password.

- **About:** Information about the software version, the operating system and the copyrights can be found here.

- **Device Connection Status Indicator:** This indicator shows the current connection status of the devices (the USB-02 interface, the ECG recorder, the blood pressure monitor and the stress device).

The Device Connection Status Indicator has three types: the first one is used with the Holter, ABP and Resting Test systems. The second type is used with the Stress Test systems, and the third type with the Continuous ECG systems.



1. Status of Bluetooth or direct connection

2. Status of connection with Holter ECG recorder /ABP recorder / Resting ECG recorder / Test ECG recorder

3. Status of connection with blood pressure monitor

4. Status of connection with loading machine

5. Status of connection with Pulse Oximeter (this section is only available when Pulse Oximeter is activated under System Configuration menu).

Colour codes for the ECG Devices Connection Status Window:

Green - The device is properly connected

Yellow - Manual operation, the device is not connected to the computer

Red – No connection with the device

Grey – No connection is needed for recording

3.4.3 Records toolbar

This is a toolbar for managing existing records.

Load record: Opens the selected record from the list. Once the record is open we can edit, analyze or print it.

- Import: There are three methods to import records:

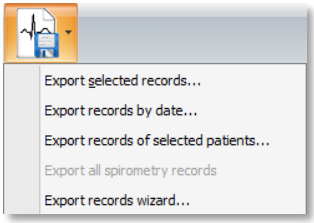
Import records: With this function we can import records from a directory of our choice.

Import records by date: You can import records from an existing folder within a date interval.

Import sample data: It is only working if you have the installation DVD inserted into the PC. This function will import demo records from it into your database.

The imported records are automatically saved into the current database.

- Export: In this menu point we can save the current record to an existing folder of our choice. This directory can also be on a network drive or on a portable drive (e.g., USB stick).



There are five methods to export records:

Export selected records: If you have single or multiple records selected, then you can export them with this function.

Export records by date: You can export records to an existing folder within a date interval.

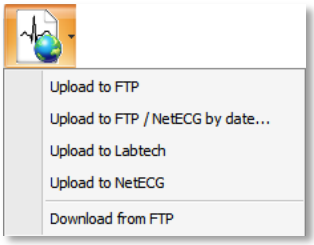
Export records of selected patients: If you have a single or multiple patients selected, then you can export all of their records at once.

Export all spirometry records: With this function, you are able to export spirometry records.

Export record wizard: You can export records without the personal data of the patient.

- FTP - upload and download:

To set an FTP server, please check **Cardiospy Installation and Update Guide**.



Upload to FTP: We can select multiple records from a single patient and upload them to the currently connected FTP server.

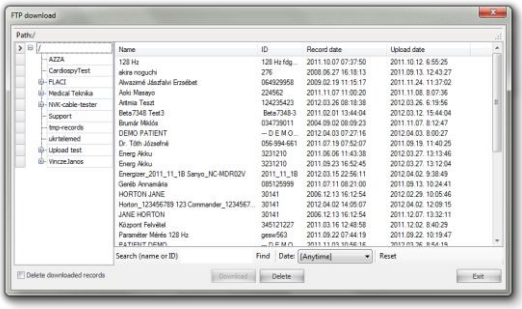
Upload to FTP by date: You can upload records within a date interval.

Upload to Labtech: In case you have any problem with the records, then you can upload them to the Labtech server.

Furthermore, you have the possibility to automatically upload records to FTP. You can enable it in the “System configuration” / “Settings” menu.

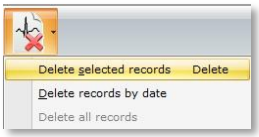
Upload to NetECG: Here you can upload records to NetECG.

Download from FTP: We can download records from the currently connected FTP server. You can select multiple records to download at the same time.



- Print rest records by date: You are able to print every Rest record of the selected physician within a date interval.

- Delete records:

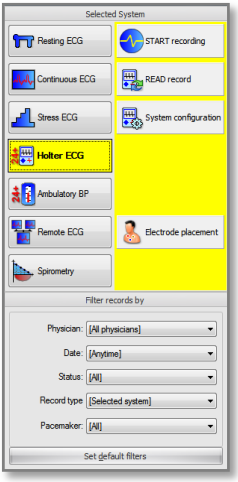


Delete selected record: This buttons deletes every selected record from the database. You can only restore them from the record recycle bin (if it is enabled in the settings). You can enable it in the Administration / Settings by set “Move deleted records to recycle bin” to “Yes”.

Delete records by date: It deletes every record within a date interval.

Delete all records: It deletes every record.

3.4.4 Selected System



Here you can select the ECG systems you wish to use, configure systems, add new recorders before you start recording. You can also start Demo recording in this field. Please keep in mind that a demo recording can only be started if the USB-02 device is not connected to the PC.

3.4.5 Filters

This field provides a few filters which enable the filtering of records by different criteria.

You can filter records by:

- **Physician:** You can filter the database to show records made by the selected physician only.

- **Date:** When this filter is used, you can only see the records that were made today / in the last 2 days / in the last 7 days / this month / this year.

- **Status:** You can filter records by their current status (Temporary, Pre-evaluated, Evaluated, Approved).

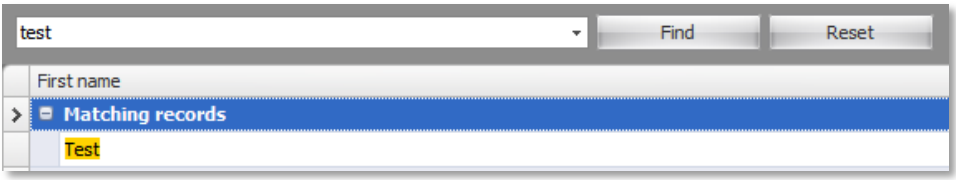
- **Record type**: You can filter records by device types.

- **Pacemaker:** You are able to filter records with or without pacemaker.

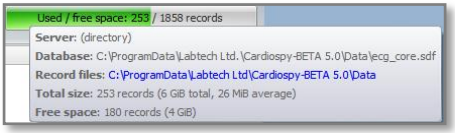
By default, no filter is enabled, the database shows every records.

3.4.6 Search

In this search-bar you can filter patients by typing characters that matches any of the patient's personal data.



3.4.7 Database information



Hover the mouse over the disk space info bar between the patient and record list and a small field appears which contains general information about the database, such as access path, number and size of records contained, etc.

3.5 How to start a new recording?

3.5.1 Patient preparation

3.5.1.1 *Preparation for ECG measurement*

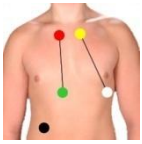
Step 1: Place the case of the recorder unit on the right side of the patient and fix it on the belt on his/her waist. Although the case is washable, it is recommended to avoid skin-contact.

2. Shave excess body hair with razor on the electrode placement points.

3. Rub skin with abrasive prep pads for better contact.

4. Wipe surface of skin with alcohol pads and allow skin to dry.

5. Connect electrodes to the lead of the patient cable.



6. Attach electrodes to patient's body.

3.5.1.2 *Preparation for BP measurement (EC-3H/ABP)*

Attach the cuff to the patient's arm

It is important to select the cuff size that is appropriate for the diameter of the patient's upper arm.

The cuff may be worn over a thin shirt, without compromising accuracy or performance. However, it is recommended that the cuff be secured using the cuff anchor.

Ensure the air hose from the monitor to the cuff is not compressed, crimped or damaged.

⚠ Please remember that using the wrong cuff size may result in inaccurate readings.

Attach the adhesive cuff anchor

With the patient cable draped over the patient's shoulder, attach an adhesive cuff anchor to the snap on the hose of the cuff bladder.

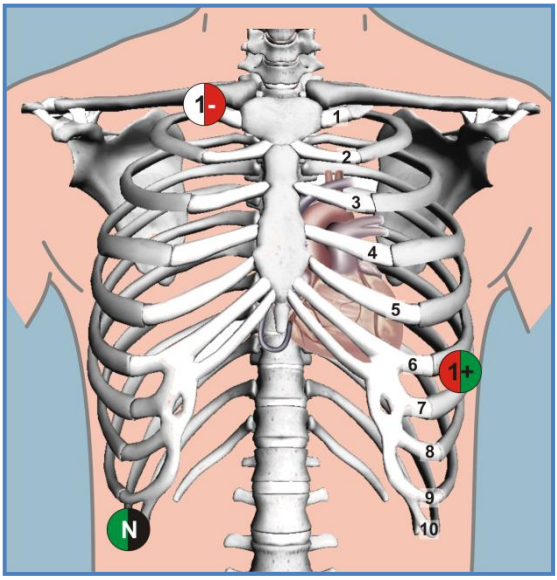
Do not remove the adhesive backing of the cuff anchor at this time.

NOTE: A NOISE-FREE RECORD CAN BE OBTAINED ONLY IF ALL THE STEPS OF PATIENT PREPARATION HAVE BEEN FOLLOWED ACCORDING TO THE INSTRUCTIONS. DO NOT START THE RECORDING IF ECG SIGN IS NOISY.

3.5.1.3 *Electrode placement methods*

3 lead placement (1 CH)

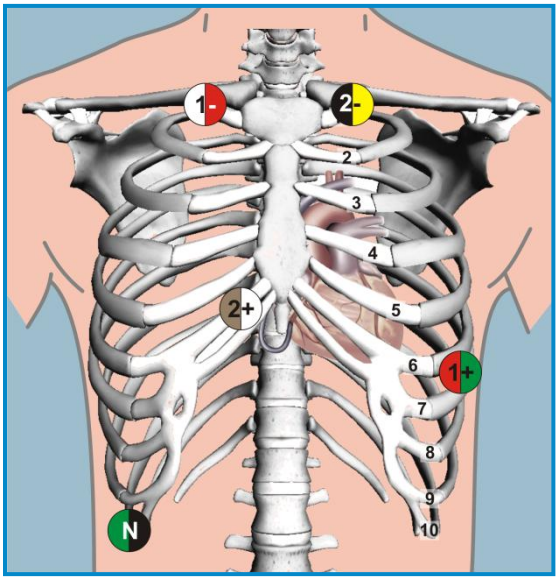
Standard 1



AHA Label	IEC Label	Electrode Placement
CH1+	CH1+	6th intercostal space at the anterior axillary's line
CH1-	CH1-	Right clavicle, lateral to the mid-clavicle line
RL	N	Lowest rib on right side of chest

5 lead placement (2 CH)

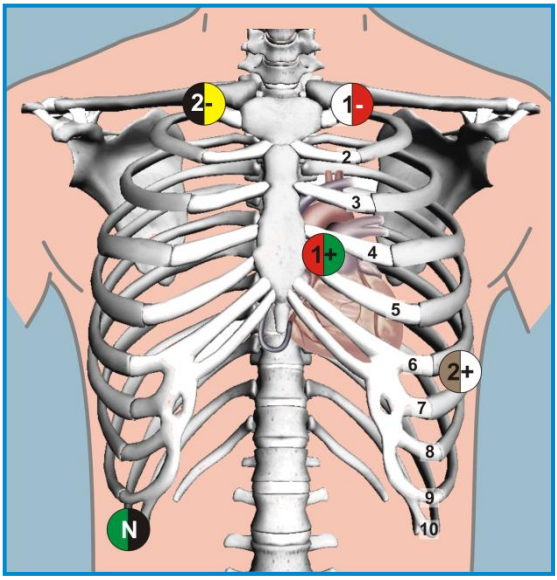
Standard 1



AHA Label	IEC Label	Electrode Placement
CH1+	CH1+	6th intercostal space at the anterior axillary's line
CH1-	CH1-	Right clavicle, lateral to the mid-clavicle line
CH2+	CH2+	Approximately 1 inch right of Xiphoid Process on the rib.
CH2-	CH2-	Left clavicle, lateral of sternum border
RL	N	Lowest rib on right side of chest

5 lead placement (2 CH)

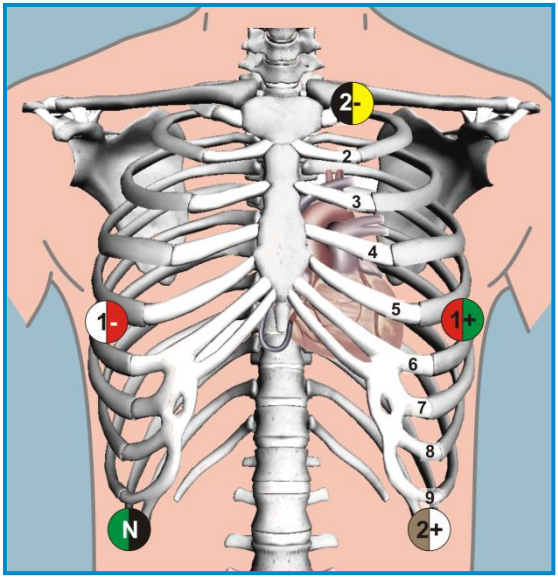
Standard 2



AHA Label	IEC Label	Electrode Placement
CH1+	CH1+	4th intercostal space at left border of sternum
CH1-	CH1-	Left clavicle, lateral of sternum border
CH2+	CH2+	6th intercostal space at the anterior axillary's line
CH2-	CH2-	Right clavicle, lateral to the mid-clavicle line
RL	N	Lowest rib on right side of chest

5 lead placement (2 CH)

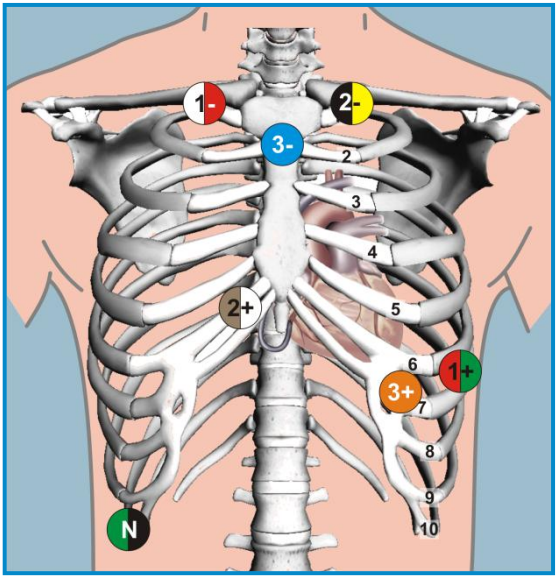
Orthogonal



AHA Label	IEC Label	Electrode placement
CH1+	CH1+	5th intercostal space at the mid line of left axillary
CH1-	CH1-	5th intercostal space at the mid line of right axillary
CH2+	CH2+	Lowest rib on left side of chest
CH2-	CH2-	Left clavicle, lateral of sternum border
RL	N	Lowest rib on right side of chest

7 lead placement (3 CH)

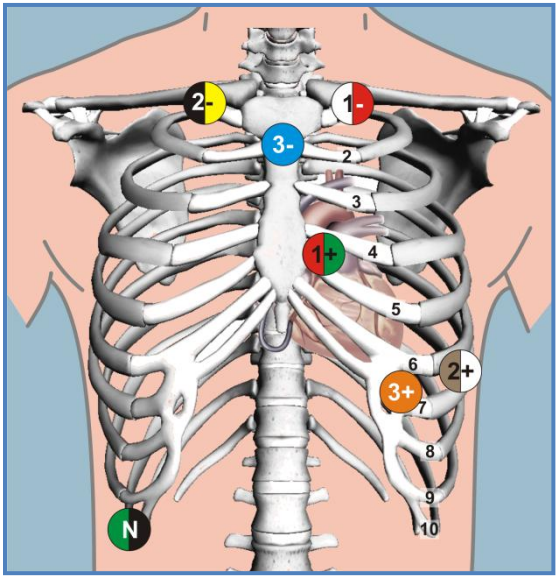
Standard 1



AHA Label	IEC Label	Electrode Placement
CH1+	CH1+	6th intercostal space at the anterior axillary's line
CH1-	CH1-	Right clavicle, lateral to the mid-clavicle line
CH2+	CH2+	Approximately 1 inch right of Xiphoid Process on the rib.
CH2-	CH2-	Left clavicle, lateral of sternum border
CH3+	CH3+	6th intercostal space on left midclavicular line
CH3-	CH3-	Manubrium sternum
RL	N	Lowest rib on right side of chest

7 lead placement (3 CH)

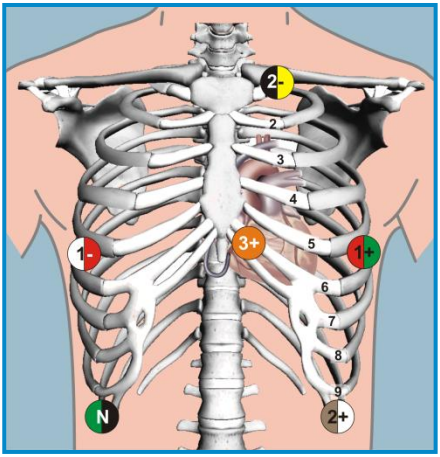
Standard 2

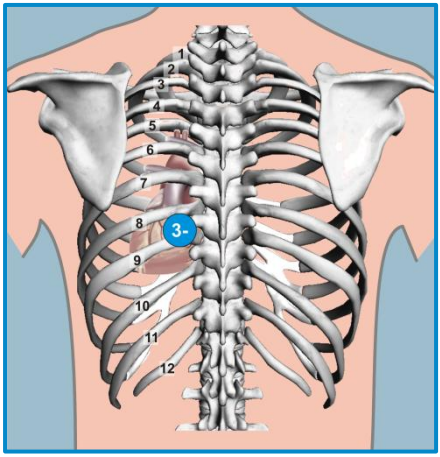


AHA Label	IEC Label	Electrode Placement
CH1+	CH1+	4th intercostal space at left border of sternum
CH1-	CH1-	Left clavicle, lateral of sternum border
CH2+	CH2+	6th intercostal space at the anterior axillary's line
CH2-	CH2-	Right clavicle, lateral to the mid-clavicle line
CH3+	CH3+	6th intercostal space on left midclavicular line
CH3-	CH3-	Manubrium sternum
RL	N	Lowest rib on right side of chest

7 lead placement (3 CH)

Orthogonal

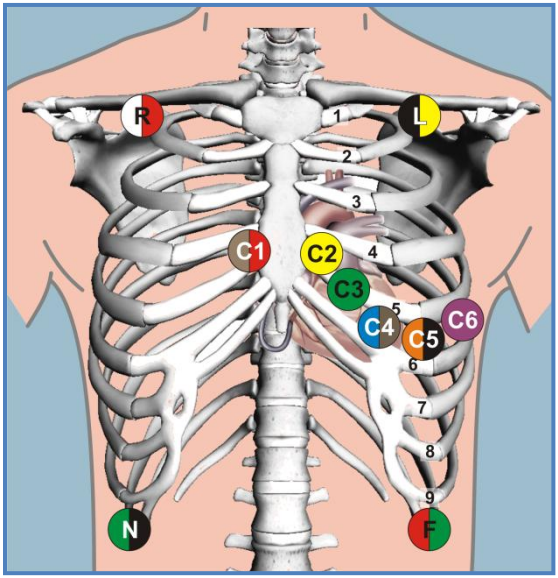




AHA Label	IEC Label	Electrode Placement
CH1+	CH1+	5th intercostal space at the mid line of left axillary
CH1-	CH1-	5th intercostal space at the mid line of right axillary
CH2+	CH2+	Lowest rib on the left side of chest
CH2-	CH2-	Left clavicle, lateral lateral of sternum border
CH3+	CH3+	Approximately 1 inch left of Xiphoid Process on the rib.
CH3-	CH3-	8th intercostal space at the center of the back, opposite the CH3+ electrode
RL	N	Lowest rib on right side of chest

10 lead placement (12 CH)

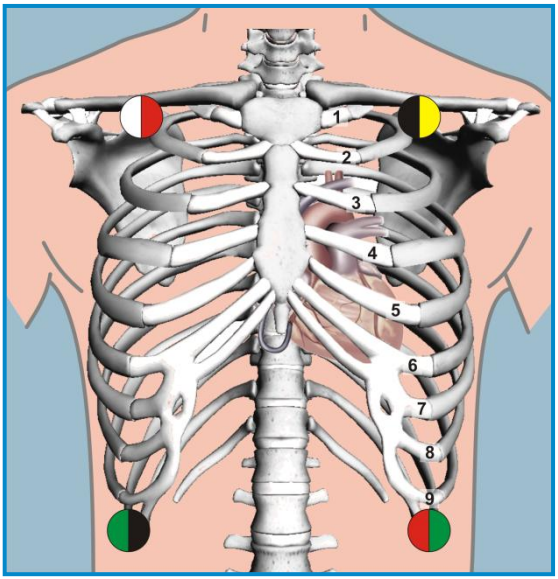
Standard 1



AHA Label	IEC Label	Electrode Placement
V1	C1	Fourth intercostal space at the right sternal border.
V2	C2	Fourth intercostal space at the left sternal border.
V3	C3	Midway between C4 and C2.
V4	C4	Mid-clavicular line in the fifth intercostal space.
V5	C5	Anterior axillary line on the same horizontal level as C4.
V6	C6	Mid-axillary line on the same horizontal level as C4 and
LA	L	Slightly below left clavicle.
RA	R	Slightly below the right clavicle
LL	F	Lower edge of the rib cage, or at the level of the umbilicus at the left and right mid-clavicular lines.
RL	N	

NEHB placement

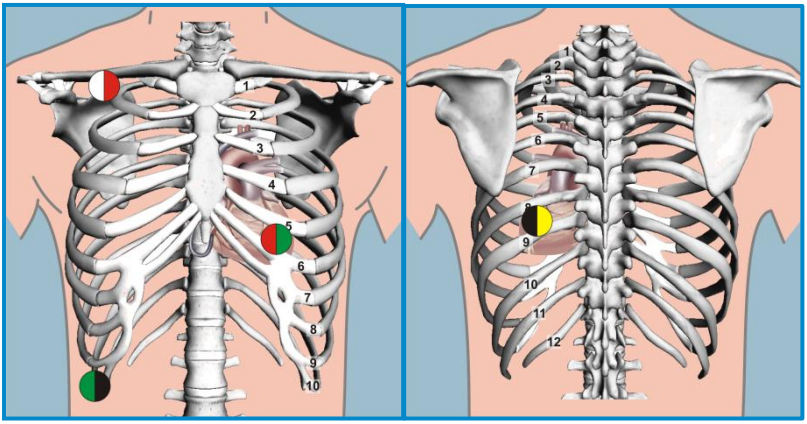
Standard 1



AHA Label	IEC Label	Electrode Placement
		Slightly below left clavicle.
		Slightly below the right clavicle
		Lower edge of the rib cage, or at the level of the umbilicus at the left and right mid-clavicular lines.

NEHB placement

Standard 2



AHA Label	IEC Label	Electrode Placement
V1	C1	Nst – 2nd rib at the right sternal border
V2	C2	Nax - 5th intercostal space on the left posterior axillary line directly opposite (on the back,) from 3 (Nap)
V3	C3	Nap- 5th intercostal space mid-clavicular line (cardiac apex) equates to (V4 / C4)
RL	N	On the middle line of midaxillary, on the position of ribcage

3.5.2 New Recording

First of all, you have to connect the device to the PC, the software will read the record (that was made at the final measurement) in from the device automatically and open the record viewer.

You can read about how to read a record in the CHAPTER 3.6. You can start recording only from the database screen.

If you already have your device(s) registered in the list of the recorders, then you can start to work with it/them.

BEFORE STARTING A NEW RECORDING, YOU HAVE TO READ THE PREVIOUS RECORD FROM THE DEVICE

You can start a new recording in three possible ways:

- Via Bluetooth: By this way, you can monitor the quality of the ECG signal and start a test BP measurement if you have a combined (EC-3H/ABP) device, then start the recording from the PC, while the recorder is already attached to the patient. The patient data is automatically programmed to the device.

- Via USB cable: This way you do not have the ability to monitor the quality of the ECG signal or start a test BP measurement, but it makes the process quicker. You have to start the recording by pushing the “Event button” on the device for 3 seconds after programming the patient data to it.

- Without prespecified patient data: This method is used in big hospitals where you have to start recording as quickly as possible. This way you do not have to go through the patient data programming process at the start. You can start recording by pushing the “Event button” on the device for 3 seconds. You have to register the patient while reading the record from the device.

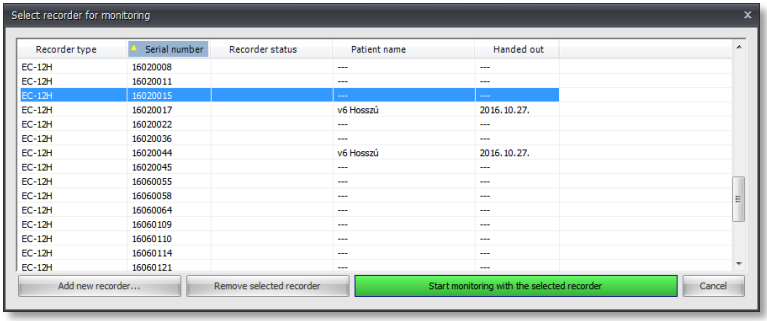
3.5.2.1 *Start recording via Bluetooth – start from the PC*

To start a new recording via Bluetooth connection, please follow these steps:

1. Make sure the USB-02 dongle is connected to the PC and working properly.

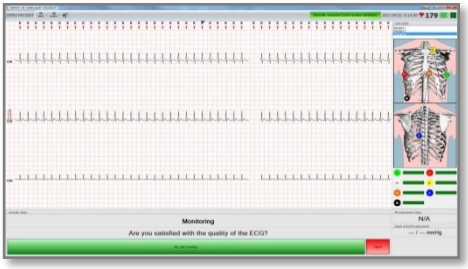
2. Make sure the Holter ECG system is selected at the Selected System menu.
3. The device **must not be connected** to the PC.
4. Add or Select a patient who you want to examine.
5. At the Selected System / Holter ECG menu, click on "START recording".

6. Select the device from the list with the proper serial number and then click on the "Start monitoring with the selected recorder" button.

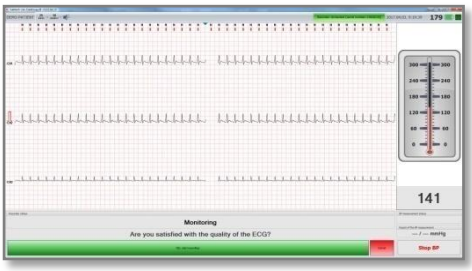


7. In the next window, you can set the measuring parameters for the recording. For further information about the "Holter Monitoring Settings" window, please check CHAPTER 3.5.3. After you are done with the settings, click on the "Start monitoring" button.

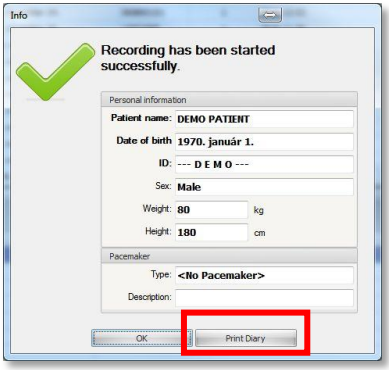
8. Check the quality of the ECG signals and make sure that the electrodes are properly attached to the patient and there is no lead-off on the illustration.



9. If you have a combined device, then you can start a test BP measurement by clicking on the “Start BP” button.



10. From this point, you can continue the process two ways:
11. Start the recording from the software:
12. If you are satisfied with the quality, you can start the recording by clicking on the “YES, START recording” button.
13. After you have started the recording successfully, a new window will pop up in which you can print the patient diary.



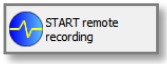
14. Check the display of the device. The following message should appear:

15. Start recording remotly from the device:
16. If you want to continue this way, then click on the „Cancel” button.
17. Hold the “Event button” on the recorder for 3 seconds to start recording.
18. Check the display of the device. The following message should appear:

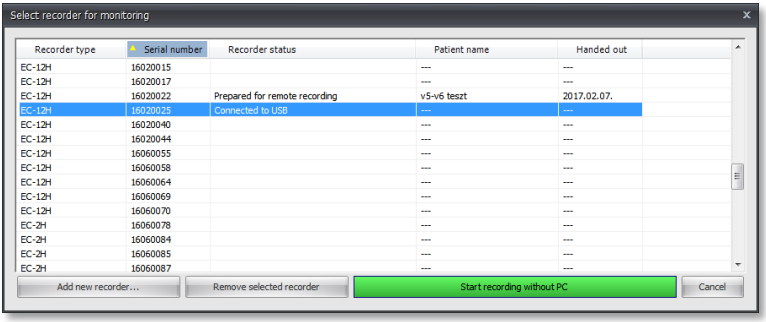
19. Please check CHAPTER 3.6 about how to read a record.

3.5.2.2 *Start recording via USB cable*

1. Make sure the Holter ECG system is selected at the Selected System menu.
2. The device **must be connected** to the PC.
3. Add or Select a patient who you want to examine.
4. At the Selected System / Holter ECG menu, click on "START remote recording".

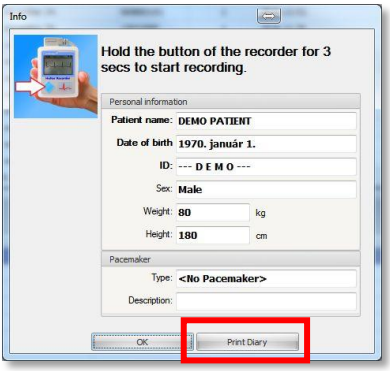


5. Select the device from the list with the proper serial number and then click on the "Start recording without PC" button.



6. In the next window, you can set the measuring parameters for the recording. For further information about the "Holter Monitoring Settings" window, please check CHAPTER 3.5.3. After you are done with the settings, click on the "Start recording" button.

7. After the successful programming, a new window will pop up in which you can print the patient diary.
8. Disconnect the device from the PC, connect the patient cable to it and then hold the "Event button" on the recorder for 3 seconds to start recording.
9. Check the display of the device. The following message should appear:



10. Please check CHAPTER 3.6 about how to read a record.

3.5.2.3 *Start recording without prespecified patient data*

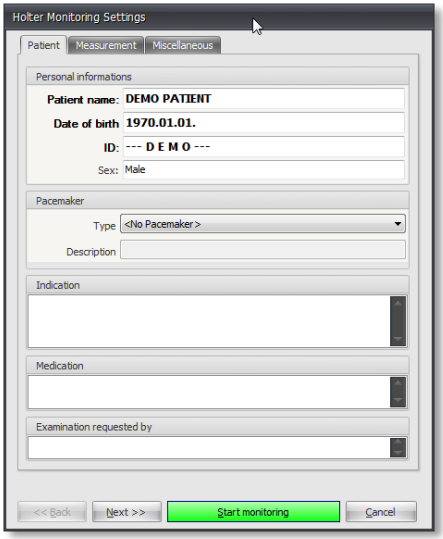
1. To make this work, you have to enable an option in the Settings / Control Panel / Reading and recording settings. Tick the checkbox next to the "Enable Holter recording without prespecified patient data" text and then click "OK".
2. Connect the device you wish to use to the PC.
   a. If you have not worked with this device before, please follow the instructions in CHAPTER 3.5.2.1 or CHAPTER 3.5.2.2 and then start this process over from point 2/b.
   b. If it has a record in it, the Cardiospy will read it first. This way the software will automatically be programmed as a "dummy patient" with the last measuring settings. For further information about the "Holter Monitoring Settings" window, please check CHAPTER 3.5.3.
3. Disconnect the device from the PC.
4. Connect the patient cable to the device and then hold the "Event button" on the recorder for 3 seconds to start recording.

5. Check the display of the device. The following message should appear:
6. Please check CHAPTER 3.6 about how to read a record.

3.5.3 Measurement settings

Patient tab: When starting a new recording, there is an opportunity in the software to enter the name of the doctor who requested the examination, the medication and the symptoms of the patient. The information will be stored if you read it on a PC.

At the **Measurement tab** you can find the settings of the awake period that you can also modify after the record was read. You can also set the frequency of the BP measurement the maximum pressure of the cuff and right after the output of the recorder it is able to measure.



Miscellaneous tab: Here you can disable to load the record after reading (enabled by default). You can manage the sound settings like Heart Rate beep and Lead-off signal. It is possible to set the length and frequency of the recording. For further information about the ECG filters, please check CHAPTER 5.5.1.

3.5.4 Informing patient about batteries and further instructions

Note that the patient can safely change the batteries at any time. The recording will continue until the device runs out of memory or connected to the PC for reading.

Please also provide the following instructions to your patient:

The patient can mark events (e.g. exercising, feeling pain or nausea, etc.) by the “Event button”, so the doctor can measure the ECG and BP values at these times.

The patient can stop a BP measurement in progress by pressing the Event button. Starting a BP measurement is also possible at any time with this button.

When the pressure in the cuff increases, the patient should avoid excess movement. Let the instrumented arm hang loosely, slightly away from the body. Avoid flexing the muscles or moving the hand and fingers of the instrumented arm.

While sleeping, the patient should make sure that the hose is not crimped.

Inform the patient on how and when to fill out the patient diary.

If the device or cuff causes extreme pain or pain not normally associated with blood pressure measurement, the patient should remove the cuff and stop the measuring.

3.6 How to read a record

The recording stops automatically if the device runs out of memory or connected to the PC for reading.

During recording it is possible to replace flat batteries. The recording will continue.

It is advisable to remove the batteries first and then the cables from the electrodes.

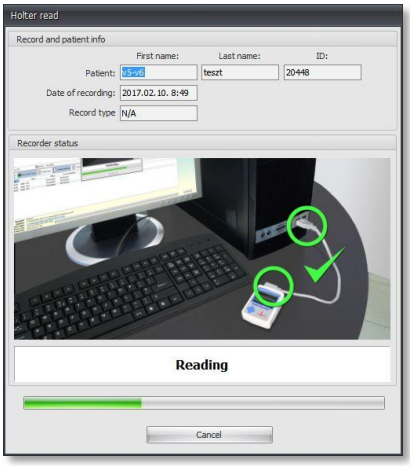
For reading a record, please follow the steps below:

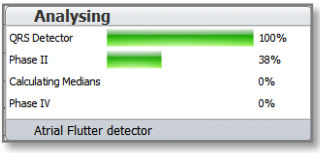
3.6.1 In case of normal records (via USB cable or Bluetooth)

1. Take off the recorder-case from the patient, remove the batteries and then remove the electrodes (and cuff) from him/her.

For faster reading process, please place fully charged batteries into the device before you connect it to the PC.

2. Start the Cardiospy program on the computer. Then select the Holter system
3. Connect the recorder to the USB reader cable. The reading will start automatically (by default).
4. After the software finished with the reading, the "Record viewer" window will appear where you can analyze and evaluate the record.
5. If the automatic analyzing is enabled (see CHAPTER 4.2.9.6), an analyzing process will be performed.

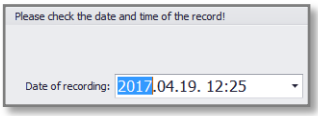




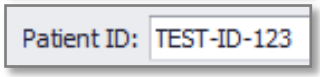
6. Now you can start to examine and edit the record. See CHAPTER 4.

3.6.2 In case you have started the recording without prespecified patient data

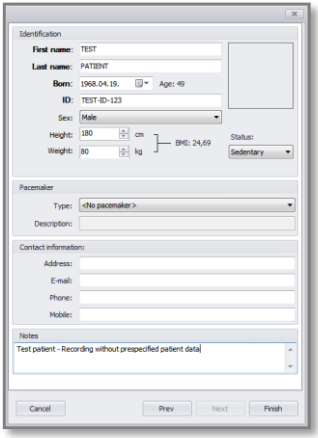
1. Take off the recorder-case from the patient, remove the batteries and then remove the electrodes (and cuff) from him/her.
2. For faster reading process, please place fully charged batteries into the device before you connect it to the PC.
3. Start the Cardiospy program on the computer. Then select the Holter system.
4. Connect the recorder to the USB reader cable. The reading will start automatically (by default).
5. Since the recorder was started without prespecified patient data, thus you have to fill the personal data at the beginning of the reading process in a pop-up window.



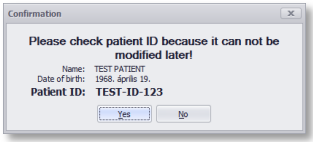
6. Since the recording was started without any PC connection, you have to verify the date and time when the recording was started.



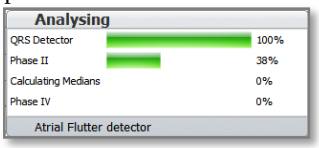
7. Click “Next” and then type the ID of the patient.
8. Click “Next” again and then fill the personal data of the patient.



9. Click “Finish”. A confirmation window will pop up.



10. After the software finished with the reading, the “Record viewer” window will appear where you can analyze and evaluate the record.
11. If the automatic analyzing is enabled (see CHAPTER 4.2.9.6), an analyzing process will be performed.

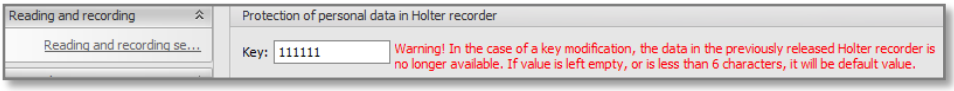


12. Now you can start to examine and edit the record. See CHAPTER 4.

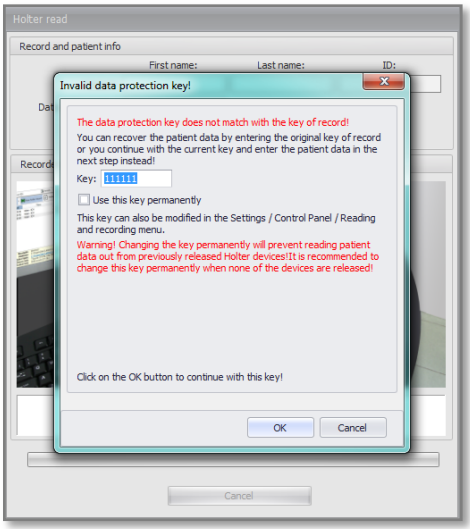
3.6.3 Patient data protection

From 25 May of 2018, a new General Data Protection Regulation (GDPR) was enforced. For this reason, our analysing software (Cardiospy) was improved to meet the necessary expectations. Since every Holter record contains patient data in order to be able to recover it at the reading phase, the data must be encoded to prevent it to be used by unauthorized persons.

The encoding works based on an encoding key, which is automatically created at the first usage of Cardiospy (6 digits random number), but it can be modified in the Settings / Control panel / Reading and recording menu.



To sum the above, you can only recover the original patient data from a record, if you are using the same encoding key in your software (that same key which was used for starting the recording), otherwise, you will get a pop-up window, that your key is invalid and you will be prompted to enter the patient data manually.



As you can see, the current key - "111111" - is invalid, because the record was started on another computer, where the code was different from "111111".

You can continue to read the record by clicking on the OK button, but as it was mentioned above, you will be prompted to enter the patient data manually. Works the same way as the method used in CHAPTER 3.6.2.

You can only recover the original patient data, if you enter the original key into the "Key" field. If you modify its value, you have the opportunity to decide if you want to use the new key permanently or to just use it once and leave the current key in your settings. To save the new key permanently, tick the "Use this key permanently" checkbox!

If you have successfully entered the original data and you click on the OK button, then the record will be read with the original patient data automatically - without re-entering it. Cancelling this window will stop the reading process.

It is **always recommended to save your key**, so in that case you have to move your Cardiospy to another PC, you will still be able to read your pending records without any inconvenience.

However, it is especially necessary to know the function of this key when you are using the recorders on multiple computers:

- Start recording on a PC, then read the record on another PC.
- Star recording on multiple PCs, then read them on a single or on multiple computers.

In that case where you are using multiple computers in a system, you will have to set the same protection key for every computer (in Cardiospy) to be able to read the records with the original patient data.

The data protection key itself only affect recorders where the patient data is actually stored on the device: **EC-ABP, EC-2-3-12H, EC-3H/ABP**.

4 Analyzing with the Cardiospy Software

4.1 Views

We can view the recorded ECG curve and its calculated parameters in many forms. The following chapter is dedicated to list these views in the order they appear in the software interface.

4.1.1 Main window

The “Main window” has three fields. “HR graph” (with BP and accelerometer values), “Trends” and the “ECG viewer”. The graphs are colour-coded, which means that areas suspected to be pathological are highlighted in different colours.

4.1.1.1 *HR, BP, ACL graph*

The “HR graph” displays heart rate calculated from the ECG signal (for the definition of Avg. Hr see CHAPTER 8.1.1), motion intensity and in case the recorder comes with an integrated ABPM component, this graph shows blood pressure values as well.

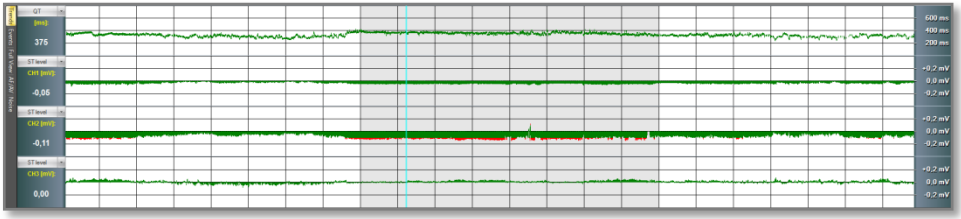
You can hide the values from the graph by clicking on the tabs at the left side. With the arrow below the tabs, you can hide the whole graph, giving more space to “Trends window” and the “ECG viewer”. The heart rate graph is able to display the time distribution of events selected in **Events** menu. The temporal occurrence of individual events is indicated by small vertical lines.

Customization of the „HR graph” ranges is also available by clicking on the arrow below the tabs at the left side of the graph:

1. Off (hides the whole graph)
2. Default (0-250) ordinary enlargement
3. Optimized: enlarging the range between the minimum and maximum value
4. 50-150 range display
5. 50-200 range display

4.1.1.2 *Trends*

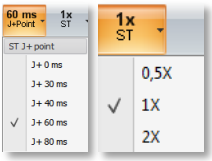
QT/ST



The algorithm can calculate ST and QT values from normal beats, bundle branch blocks (LBB, RBB, IVB) and pacemaker beats (aPMI, vPMI, dPMI, fPMI). You can set which type of beats should be included in the calculation in the **Settings/Parameters/ECG-ST/QT** menu.

The displayed value is calculated from the averages of beats within a ten-second range of the given ruler position. In case a section of ECG does not contain any of the selected beats from the settings, then ST is not calculated or displayed. The ST level is calculated from the J+ point (see **Settings / Parameters / ECG-ST/QT**). We can also edit QT, QTc and ST values in the software.

For further information about the Parameters menu, please check CHAPTER 5.



The scaling of the ST chart (the ST levels) can be changed with the zoom button found on the toolbar. If the ST level does not fit into the 1X range then you can set it to 0,5X range, and if the ST levels are too small you can set it to 2X range to zoom in.

You can also change the J+ point parameter on the toolbar.

For information about the editing possibilities, please check CHAPTER 6.4.

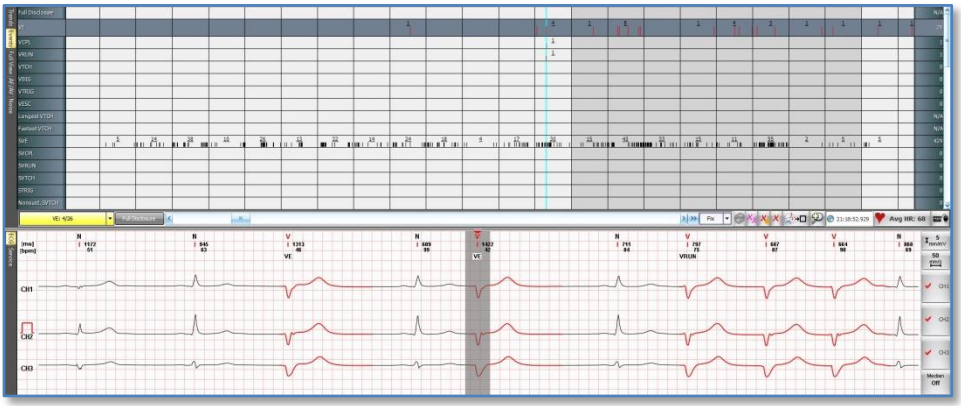
4.1.1.3 *Events*

By selecting **Events** from the tabs on the left side, we can see a summary containing events of the entire record.

The graph has three columns:

1. the left column contains Event types,
2. the middle column displays their time distribution
3. the column on the right side shows the aggregate number of each event.

“Single” or “group” type of events can be selected by clicking on them.



You can edit the list of events. Under the menu of “Settings” / “Events”, see more in CHAPTER 4.2.9.3.

If you select an event type by clicking on its row in the table, then you can move between its elements with the slidebar or with the arrow (←→) buttons on the keyboard. Editing – CHAPTER 6.2.

You can only do this if the event that you have selected is not an “interval type” event. The “interval type” events are showed in % value (e.g. Atrial fibrillation, Atrial flutter, AV I, AV II, etc.). To edit these event types, please check CHAPTER 6.2.10.

Atrial flutter and fibrillation events are not available for EC-2H devices!

There is another function that you can select from this list, the “Event summary”.

TIME [hh:mm-hh:mm]	Max RR	HEART RATE MIN	AVG	MAX	VENTRICULAR BEATS	SINGLE	CPL	RUN	FASTCH	BIG	TRIG	SUPRAVENTRICULAR BEATS	SINGLE	CPL	RUN	FASTCH	BIG	TRIG	PAUSE	MARKED
08:03-09:00	5597	61	103	153	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09:00-10:00	4682	57	81	117	0	0	0	0	0	0	0	5	5	0	0	0	0	0	0	0
10:00-11:00	4616	57	80	119	0	0	0	0	0	0	0	14	14	0	0	0	0	0	0	0
11:00-12:00	4395	56	77	143	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:00-13:00	4620	58	79	120	0	0	0	0	0	0	0	7	7	0	0	0	0	0	0	0
13:00-14:00	4970	58	87	138	0	0	0	0	0	0	0	25	25	0	0	0	0	0	0	0
14:00-15:00	4836	56	84	119	8	0	0	0	2	0	0	13	13	0	0	0	0	0	0	0
15:00-16:00	4908	55	86	142	0	0	0	0	0	0	0	32	32	0	0	0	0	0	0	0
16:00-17:00	4194	56	73	122	1	1	0	0	0	0	0	14	14	0	0	0	0	0	0	0
17:00-18:00	4299	55	75	118	6	1	0	0	0	0	0	24	[illegible]	0	0	0	0	0	0	0
18:00-19:00	3973	55	68	124	0	0	0	0	0	0	0	18	18	0	0	0	0	0	0	0
19:00-20:00	3816	53	64	90	0	0	0	0	0	0	0	4	4	0	0	0	0	0	0	0
20:00-21:00	3642	51	62	110	0	0	0	0	0	0	0	4	4	0	0	0	0	0	0	0
21:00-22:00	3408	47	58	115	15	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0
22:00-23:00	3272	45	56	108	1	1	0	0	0	0	0	15	15	0	0	0	0	0	0	0
23:00-00:00	3118	42	53	98	8	8	0	0	0	0	0	50	50	0	0	0	0	0	0	0
00:00-01:00	3023	41	51	103	0	0	0	0	0	0	0	33	33	0	0	0	0	0	0	0
01:00-02:00	3268	44	56	101	1	1	0	0	0	0	0	16	16	0	0	0	0	0	0	0

This function is completely like a summary table, but here you can jump to the highlighted events.

The “event cells” that are highlighted with grey background include all the events within the time interval that you can see in the first column.

The “event cells” that are highlighted with yellow background show the Min and Max HR in the Heart Rate column. In the Ventricular and Supraventricular columns, the event cells are also highlighted with yellow background where the most events happened in the whole record (time interval) from the same type of event.

The selected / used “event cells” are highlighted with red background.

In the main row, as you can see, the cell of the Tachycardia is also highlighted with grey background. That is because you can switch between the Longest and Fastest Tachycardia.

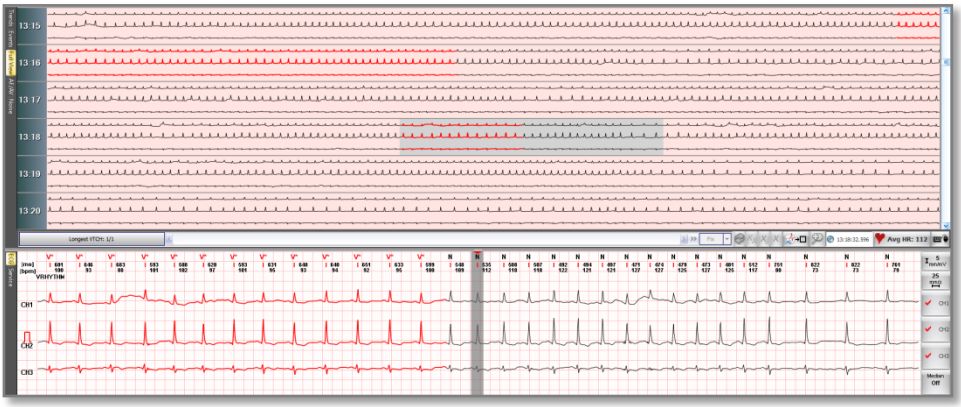
If you select an event type by clicking on a highlighted cell, then you can move between its elements with the slidebar or with the arrow (←→) buttons on the keyboard.

4.1.1.4 *Full View*

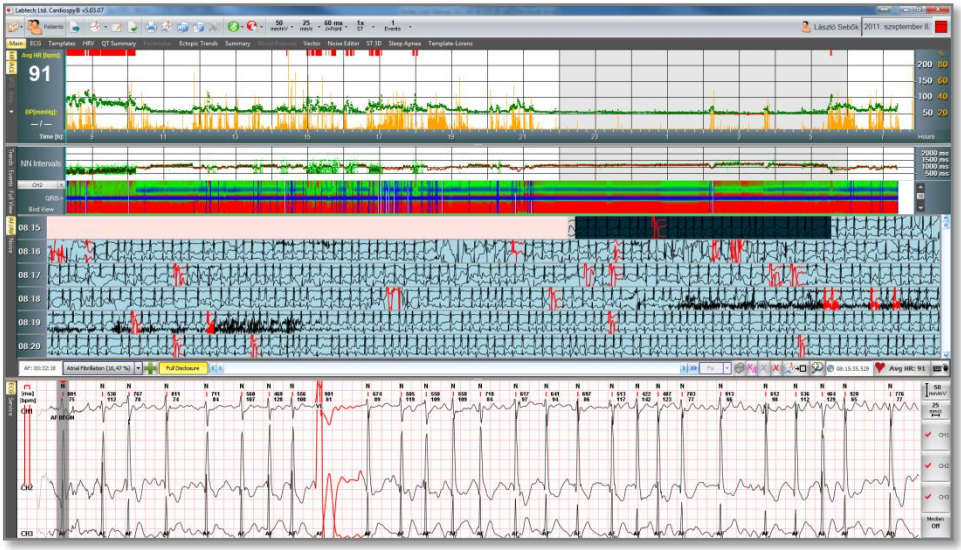
In this menu we can overview a longer section of the ECG curve. The window displays the number of ECG channels selected in the “ECG viewer”. The selected ECG interval changes with the settings of the ECG paper speed.

The “ECG viewer” in the lower section displays the sub-section which we select in the “Full View” by left-clicking with the mouse.

You can see a longer section of the ECG on your screen with turning off from the channels (1 must be enabled) or if you disable the “HR graph” at the top of the screen.

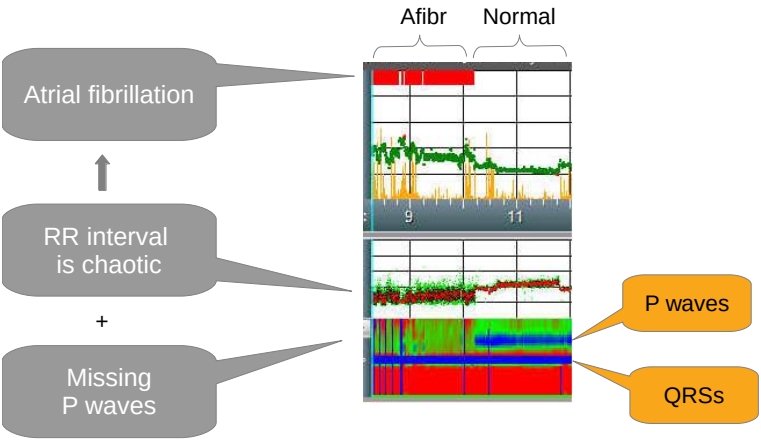


4.1.1.5 *AF/AV + Bird View*

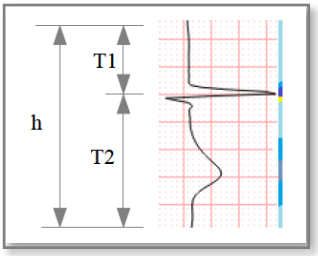


This tab displays the graph of NN Intervals, which helps us checking the correct detection of Atrial Fibrillation, Atrial Flutter, AV I, AV II M1, AV II M2 and AV III events. There is also another graph called **Bird View**.

This function makes detecting Atrial Fibrillation very easy and very quick.



This Bird View graph is formed based on the amplitude of the periods before (T1) and after (T2) the QRS with colors.



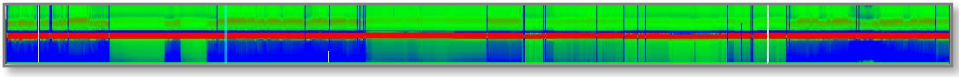
Meaning of colors:

Blue: positive amplitude

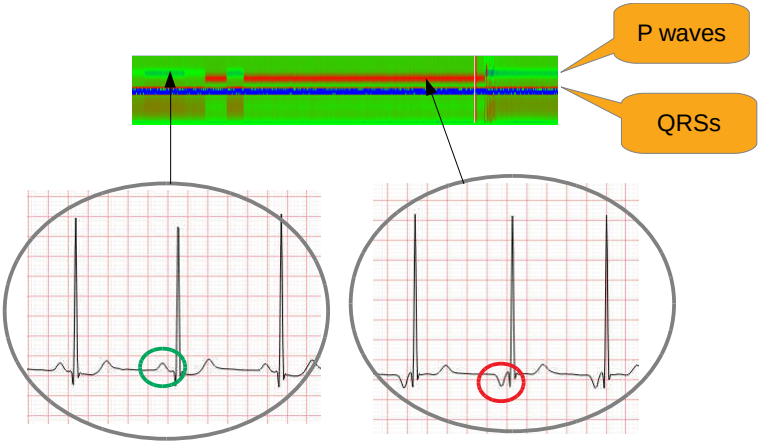
Green: amplitude is around zero

Red: negative amplitude

On the below picture, you can see ST elevation. Where the Bird View is bluer after the QRS, it means ST elevation. Where it is greener, it means the ST is normal.



P wave morphology change:



For further information about editing these events, please check CHAPTER 6.2.10.

4.1.1.6 *Noise*

The significance of this function is that it enables us to mark any section as noise, either from the “HR graph” or the “ECG viewer”. However, sections of noise can also be marked as normal in this function. Apart from this, the intervals marked as noise by the software’s automatic noise detector are indicated by a different background colour.

For further information about the editing possibilities, go to CHAPTER 6.6.

4.1.1.7 *ECG viewer*

The „ECG viewer” displays the selected channels in the desired size. Clicking on the “Median” button in the lower left corner displays the median that belongs to the selected ECG section. Both the median and the ECG curve can be measured in terms of time and amplitude. Editing is enabled in the „ECG viewer” (e.g., insert, delete or classify QRS).

For further information about the editing possibilities, go to CHAPTER 6.2.

4.1.1.8 *Service*

The Service field illustrates the technical details of the device. It displays the lead-off events of each electrode, and the state of battery. Here, you can see the firmware version of the recorder, the quality of the record, and the end point criteria.

4.1.2 ECG viewer – large window

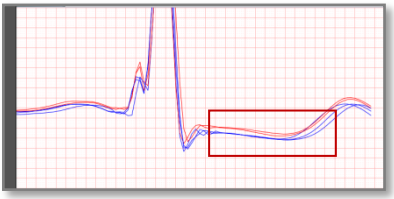
The ECG tab displays the ECG curve in a larger size. You can also view the ECG channels in two columns and you can edit beats in the „ECG viewer” (e.g., insert, delete or classify QRS.).

For further information about the editing possibilities, go to CHAPTER 6.2.

4.1.2.1 *T-alternans*

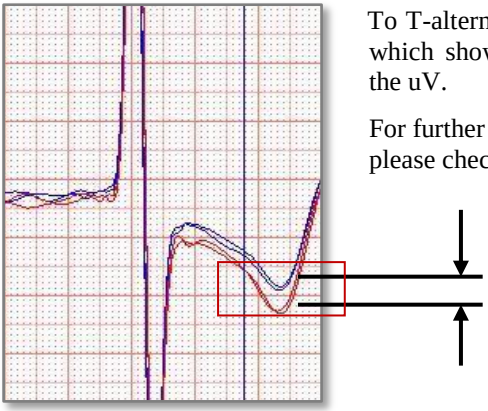
This feature is not available for EC-2H and EC-3H devices!

The term alternans applies to conditions characterized by the sudden appearance of a periodic beat-to-beat change in some aspect of cardiac electrical or mechanical behavior. You can clearly see it on the below two photos.



In the HR field the time interval is marked with red line, where the SW detected T-alternans. The detection is completed for each Holter channel, so that is why the event line belongs to that channel, which was chosen in the „ECG viewer”.

The meaning of the amplitude of alternans:



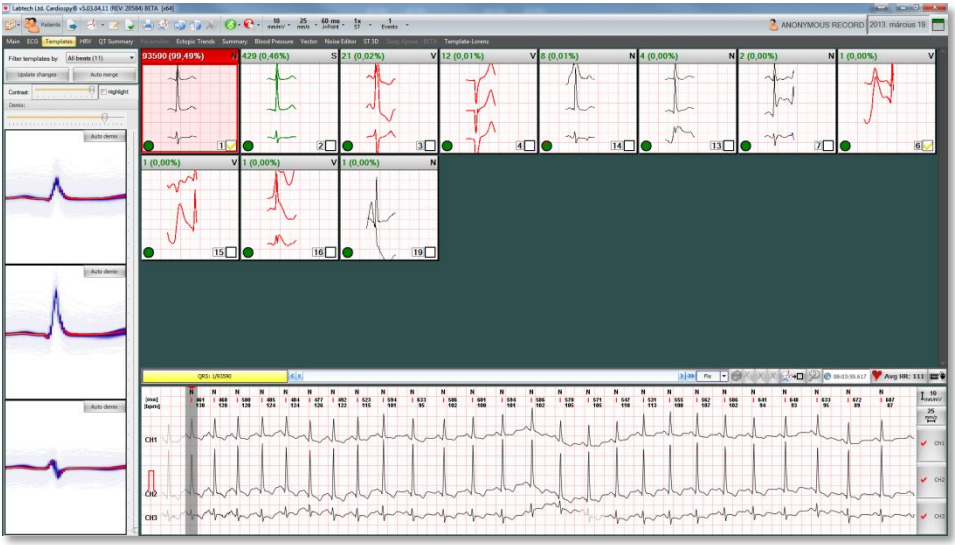
To T-alternans events the amplitude belongs as well, which shows the amplitude size of the alternans in the uV.

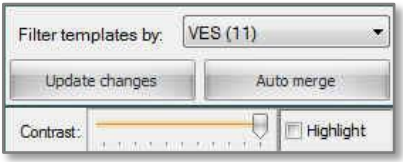
For further information about the editing possibilities, please check CHAPTER 6.5.

X [uV] $A = \frac{X}{2}$.

On the picture the QRS with even indexes are marked with blue, the odd ones are marked with red.

4.1.3 Templates

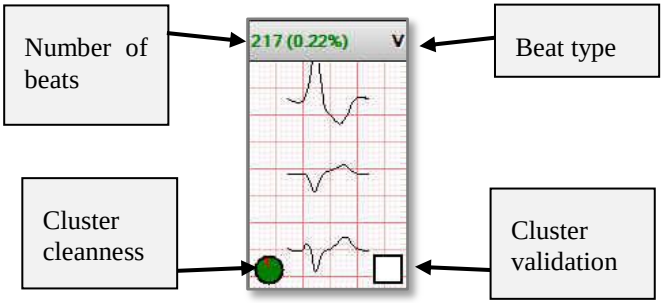




The analysis software classifies each heartbeat (N, S, V) and clusters similar formations.

Filter templates by function in the upper left corner serves to display QRS complexes of different types altogether or individually.

Meaning of the information on cluster pictures:



Cluster cleanness measuring circle (homogeneity)

Clean cluster

Extremely mixed cluster

Somewhat mixed cluster

If a cluster is marked with green circle, it means that the QRS complexes belong to the cluster show very similar forms to the cluster QRS shape. The red area in a circle signifies the percentage of non-similar QRS shapes.

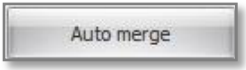
The validation of a type of cluster means the affirmation of the type. If you click on a template the program automatically puts a yellow check mark as a default setting. This is good to see in which template you have already been. You can switch off the automatic check mark under the menu of Settings (Automatic check mark, choosing form). If you want to confirm the automatic checking you can click on the yellow check mark which will turn green as proof of that the template has been searched thoroughly.

Not validated type.

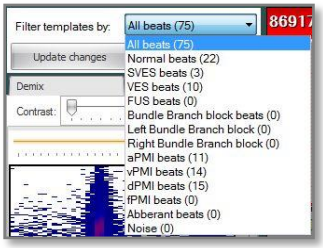
Automatic marking

Validated type by user

With the “Update changes” function, the software will reorder the clusters by the size of them (number of elements).



With the “Automerge” function, the software will automatically recognize the same beat types with similar forms and then it is merging them into the right clusters (it even create new ones if it is necessary).



You can filter the templates by beat types.

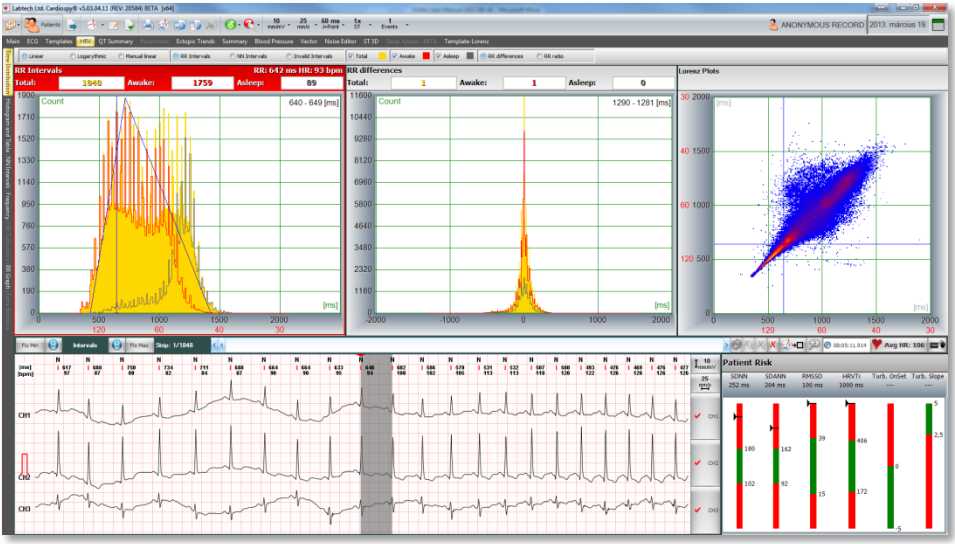
Please check CHAPTER 6.1 for more detailed information about the functions.

4.1.4 HRV window

The HRV window provides detailed information on time and frequency parameters of RR variability.

4.1.4.1 *Time Distribution*

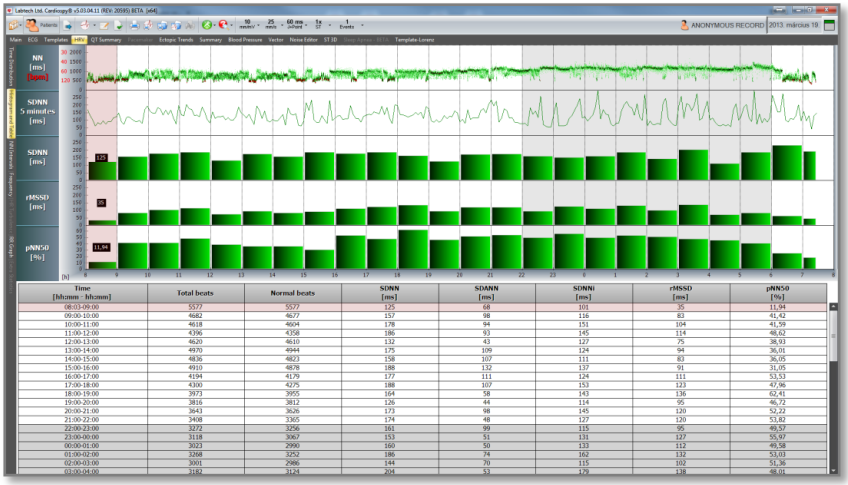
Three graphs are displayed in this section: RR Intervals, RR Differences and Lorenz plots. We can also edit data in the RR Intervals graph, for example we can validate or revalidate the intervals (see CHAPTER 6.3). Data edition is convenient, because the ECG pertaining to each selected interval is displayed immediately in a lower section. Next to the ECG-display we can see the Patient Risk graph, which is calculated from the HRV parameters. To check the exact meaning of each parameter, go to CHAPTER 8.



To check data edition possibilities, go to CHAPTER 6.3.

4.1.4.2 *Histogram and Table*

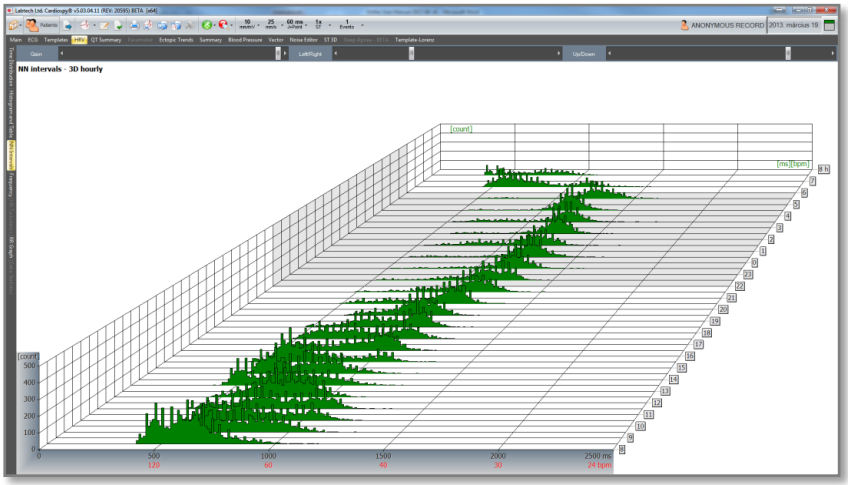
The first row of this graph displays SDNN values by a 5-minute division, the second one contains SDNN calculated for 1 hour, the last two rows contain rMSSD and PNN50% values. In the lower part of the screen we can see these values in table format.



Time [hh:mm - hh:mm]	Total beats	Normal beats	SDNN [ms]	SDANN [ms]	SDNNi [ms]	rMSSD [ms]	pNN50 [%]
08:03-09:00	5577	5577	125	68	101	35	11,94
09:00-10:00	4682	4677	157	98	116	83	41,42
10:00-11:00	4618	4604	178	94	151	104	41,59
11:00-12:00	4396	4358	186	93	145	114	48,62
12:00-13:00	4620	4610	132	43	127	75	38,93
13:00-14:00	4970	4944	175	109	124	94	36,01
14:00-15:00	4836	4823	158	107	111	83	36,05
15:00-16:00	4910	4878	188	132	137	91	31,05
16:00-17:00	4194	4179	177	111	124	111	53,53
17:00-18:00	4300	4275	188	107	153	123	47,96
18:00-19:00	3973	3955	164	58	143	136	62,41
19:00-20:00	3816	3812	126	44	114	95	46,72
20:00-21:00	3643	3626	173	98	145	120	52,22
21:00-22:00	3408	3365	174	48	127	120	53,82
22:00-23:00	3272	3256	161	99	115	95	49,57
23:00-00:00	3118	3067	153	51	131	127	55,97
00:00-01:00	3023	2990	160	50	133	112	49,58
01:00-02:00	3268	3252	186	74	162	132	53,03
02:00-03:00	3001	2986	144	70	115	102	51,36
03:00-04:00	3182	3124	204	53	179	138	48,01

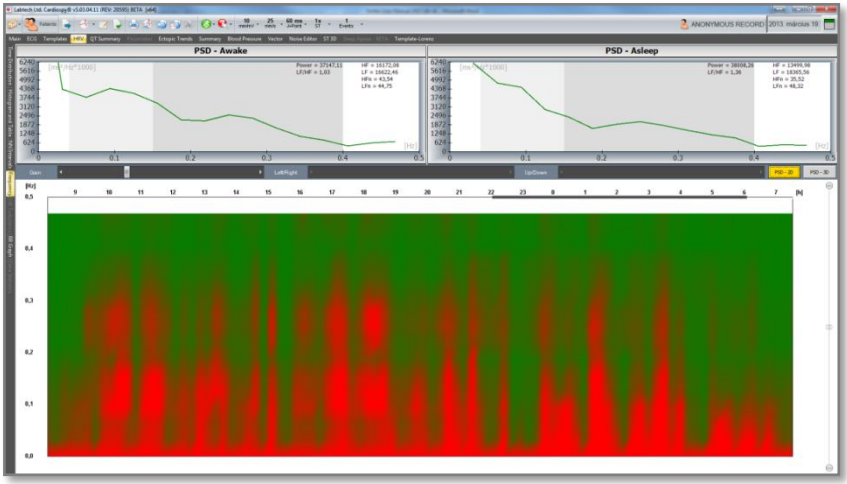
4.1.4.3 *NN Intervals*

This graph displays NN intervals in an hourly division in 3D.



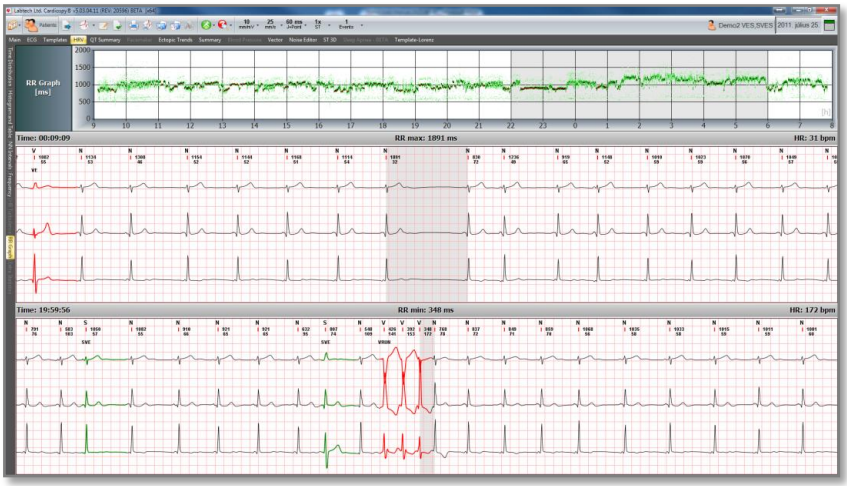
4.1.4.4 *Frequency*

In the representation of frequency range, three graphs are displayed: one showing the period when the patient is awake, one when he/she is asleep and one for the total period of the measurement time, represented in a 3D HRV frequency graph. The latter can be represented in a 2D format as well. Parameters: CHAPTER 8.



4.1.4.5 *RR Graphs*

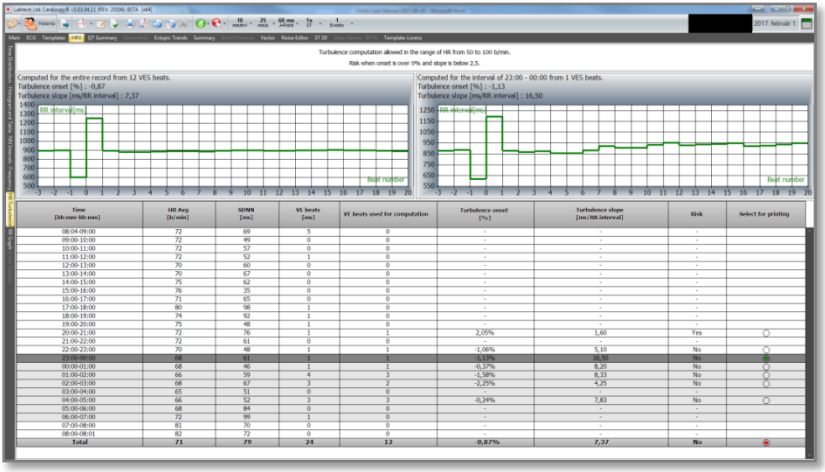
Here you can see the RR Max and Min ECG views and the diagram shows the distribution of the RR intervals.



4.1.4.6 *HR Turbulence*

This feature is not available for EC-2H and EC-3H devices!

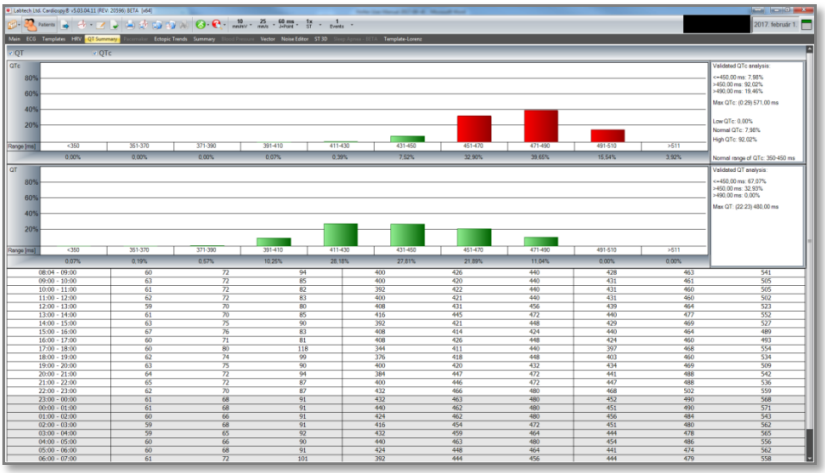
This menu point displays the HR turbulence both in graph and table formats.



For more info about its calculation, see CHAPTER 8.

4.1.5 QT Summary window

The values of the QT analysis are shown in the form of a distribution graph and a table. We can choose to display QT or QTc values by selecting one of them at the left side of the distribution graph, while the table displays both values.

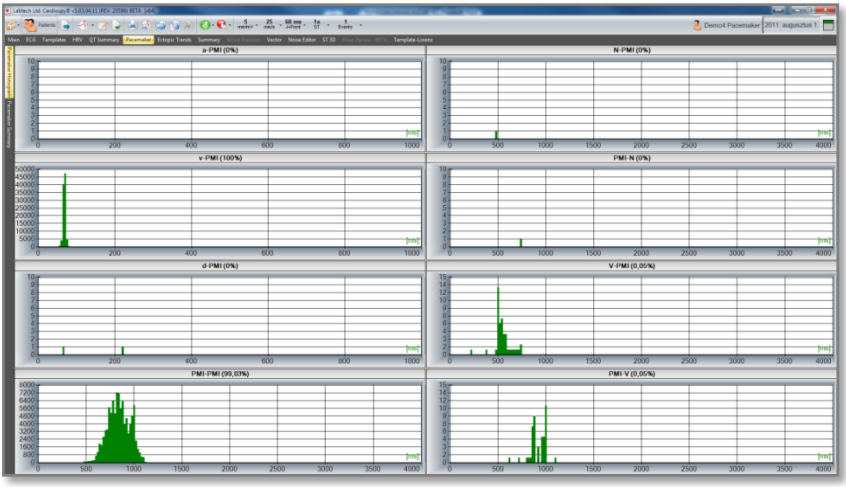


4.1.6 Pacemaker

This feature is not available for EC-2H devices!

4.1.6.1 *Pacemaker Histograms*

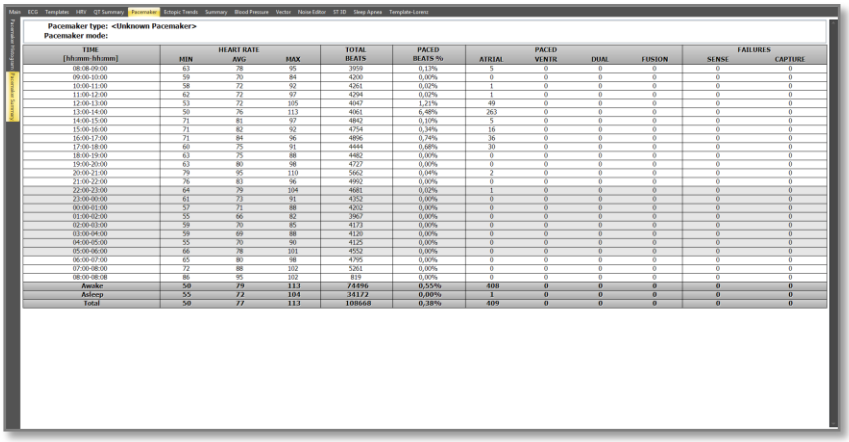
This menu displays 8 graphs according to what follows below:



a-PMI	The time distribution between the stimulation of the atrium and the heart beat (induced by the heart on this stimulation).
v-PMI	The time distribution between the stimulation of the ventricle and the heart beat (induced by the heart on this stimulation).
d-PMI	The time distribution between the stimulation of the atrium and the ventricle and the heart beat (induced by the heart on this stimulation).
N-PMI	The distribution graph of the normal and PM induced beats.
V-PMI	The distribution graph of the ventricular and PM induced beats.
PMI-N	The distribution graph of the PM induced and normal beats.
PMI-V	The distribution graph of the PM induced and ventricular beats.
PMI-PMI	The distribution graph of consecutive PM induced beats.

4.1.6.2 *Pacemaker Summary*

Here you can view a table summary of the pacemaker analysis. The number of beats induced by the PM is presented in the table in groups based on the type of the induction in an hourly division. The table shows the failure of electric capture and failure to sense events detected by the program as well.



Pacemaker type: <Unknown Pacemaker>
Pacemaker mode:

TIME [hh:mm-hh:mm]	HEART RATE MIN	HEART RATE AVG	HEART RATE MAX	TOTAL BEATS	PACED BEATS %	PACED ATRIAL	PACED VENTR	PACED DUAL	PACED FUSION	FAILURES SENSE	FAILURES CAPTURE
08:08-09:00	63	78	95	3959	0,13%	5	0	0	0	0	0
09:00-10:00	59	70	84	4200	0,00%	0	0	0	0	0	0
10:00-11:00	58	72	92	4261	0,02%	1	0	0	0	0	0
11:00-12:00	62	72	97	4294	0,02%	1	0	0	0	0	0
12:00-13:00	53	72	105	4047	1,21%	49	0	0	0	0	0
13:00-14:00	50	76	113	4061	6,48%	263	0	0	0	0	0
14:00-15:00	71	81	97	4842	0,10%	5	0	0	0	0	0
15:00-16:00	71	82	92	4754	0,34%	16	0	0	0	0	0
16:00-17:00	71	84	96	4896	0,74%	36	0	0	0	0	0
17:00-18:00	60	75	91	4444	0,68%	30	0	0	0	0	0
18:00-19:00	63	75	88	4482	0,00%	0	0	0	0	0	0
19:00-20:00	63	80	98	4727	0,00%	0	0	0	0	0	0
20:00-21:00	79	95	110	5662	0,04%	2	0	0	0	0	0
21:00-22:00	76	83	96	4992	0,00%	0	0	0	0	0	0
22:00-23:00	64	79	104	4681	0,02%	1	0	0	0	0	0
23:00-00:00	61	73	91	4352	0,00%	0	0	0	0	0	0
00:00-01:00	57	71	88	4202	0,00%	0	0	0	0	0	0
01:00-02:00	55	66	82	3967	0,00%	0	0	0	0	0	0
02:00-03:00	59	70	85	4173	0,00%	0	0	0	0	0	0
03:00-04:00	59	69	88	4120	0,00%	0	0	0	0	0	0
04:00-05:00	55	70	90	4125	0,00%	0	0	0	0	0	0
05:00-06:00	66	78	101	4552	0,00%	0	0	0	0	0	0
06:00-07:00	65	80	98	4795	0,00%	0	0	0	0	0	0
07:00-08:00	72	88	102	5261	0,00%	0	0	0	0	0	0
08:00-08:08	86	95	102	819	0,00%	0	0	0	0	0	0
Awake	**50**	**79**	**113**	**74896**	**0,55%**	**408**	**0**	**0**	**0**	**0**	**0**
Asleep	**55**	**72**	**104**	**34172**	**0,00%**	**1**	**0**	**0**	**0**	**0**	**0**
Total	**50**	**77**	**113**	**108668**	**0,38%**	**409**	**0**	**0**	**0**	**0**	**0**

The failure to capture (FTC) means that the pacemaker spike appears at the right time, but it is not followed by QRS. The failure to sense (FTS) refers to premature pacemaker stimulation, in which case the pacemaker produces a stimulus, without being stimulated by the patient's heart.

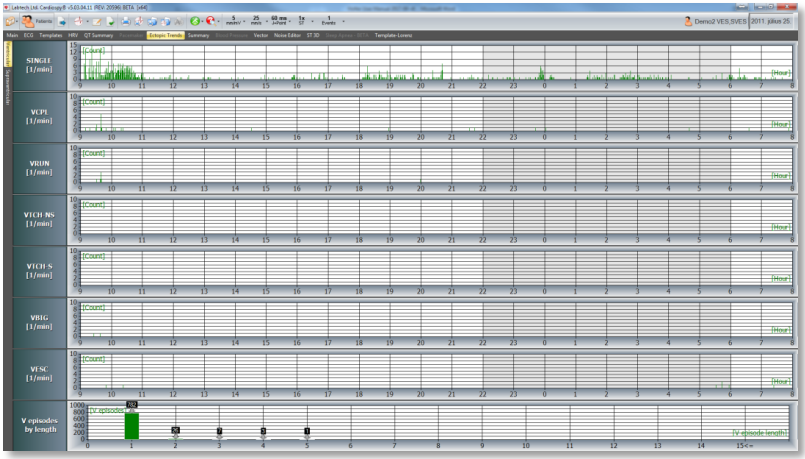
The possible pacemaker beat types are the following:

- **aPMI:** The atrium is paced, there is one pacemaker spike found before the P wave.
- **vPMI:** The ventricum is paced, there is one pacemaker spike found before the QRS.
- **dPMI**: Dual paced QRS, both the atrium and ventricum are paced. There are two pacemaker spikes found before the QRS.
- **fPMI:** Fusion beat. Spike is found on the QRS.

4.1.7 Ectopic Trends

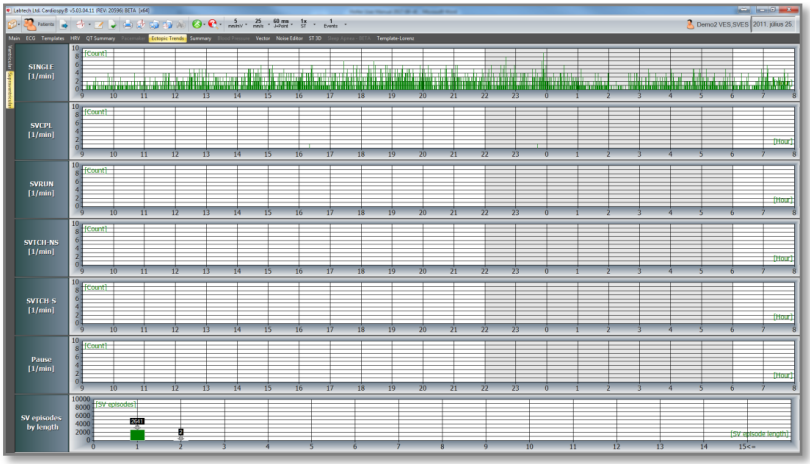
4.1.7.1 *Ventricular*

Represents the frequency of events related to V beats on the time axis. The last graph shows the frequency of V episodes (consecutive V beats by length).



4.1.7.2 *SupraVentricular*

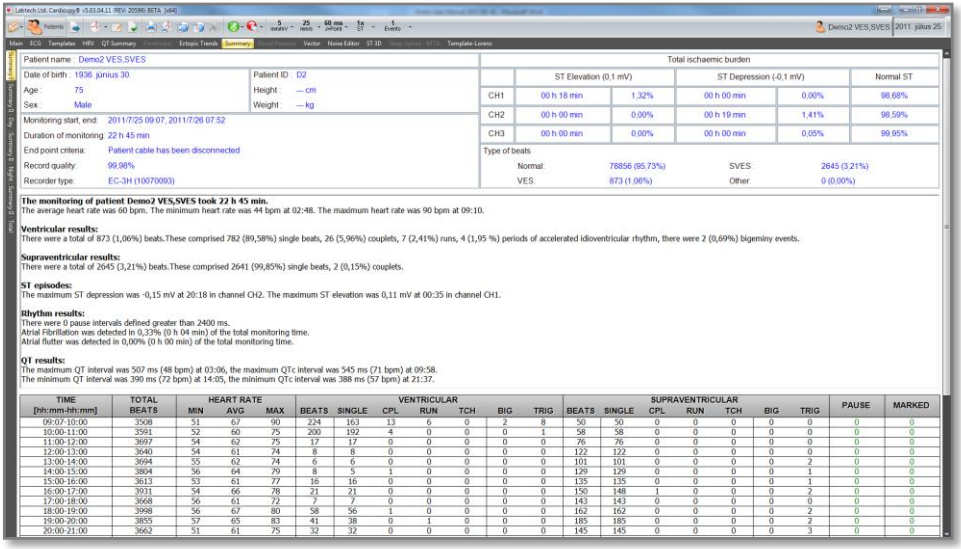
Represents the frequency of events related to S beats on the time axis. The last graph shows the frequency of S episodes (consecutive S beats by length).



For more information, please check CHAPTER 5.2.2 and CHAPTER 8.

4.1.8 Summary window

This menu displays the most important findings in the automatic summary of the monitoring in 4 formats (Summary I, Summary II Day, - Night, - Total).



Patient name : Demo2 VES,SVES
Date of birth : 1936. június 30.
Patient ID : D2
Age : 75
Height : --- cm
Sex : Male
Weight : --- kg
Monitoring start, end : 2011/7/25 09:07, 2011/7/26 07:52
Duration of monitoring : 22 h 45 min
End point criteria : Patient cable has been disconnected
Record quality : 99,98%
Recorder type : EC-3H (10070093)

Total ischaemic burden

	ST Elevation (0,1 mV)		ST Depression (-0,1 mV)		Normal ST
CH1	00 h 18 min	1,32%	00 h 00 min	0,00%	98,68%
CH2	00 h 00 min	0,00%	00 h 19 min	1,41%	98,59%
CH3	00 h 00 min	0,00%	00 h 00 min	0,05%	99,95%

Type of beats

Normal:	78856 (95,73%)	SVES:	2645 (3,21%)
VES:	873 (1,06%)	Other:	0 (0,00%)

The monitoring of patient Demo2 VES,SVES took 22 h 45 min.
The average heart rate was 60 bpm. The minimum heart rate was 44 bpm at 02:48. The maximum heart rate was 90 bpm at 09:10.

Ventricular results:
There were a total of 873 (1,06%) beats.These comprised 782 (89,58%) single beats, 26 (5,96%) couplets, 7 (2,41%) runs, 4 (1,95 %) periods of accelerated idioventricular rhythm, there were 2 (0,69%) bigeminy events.

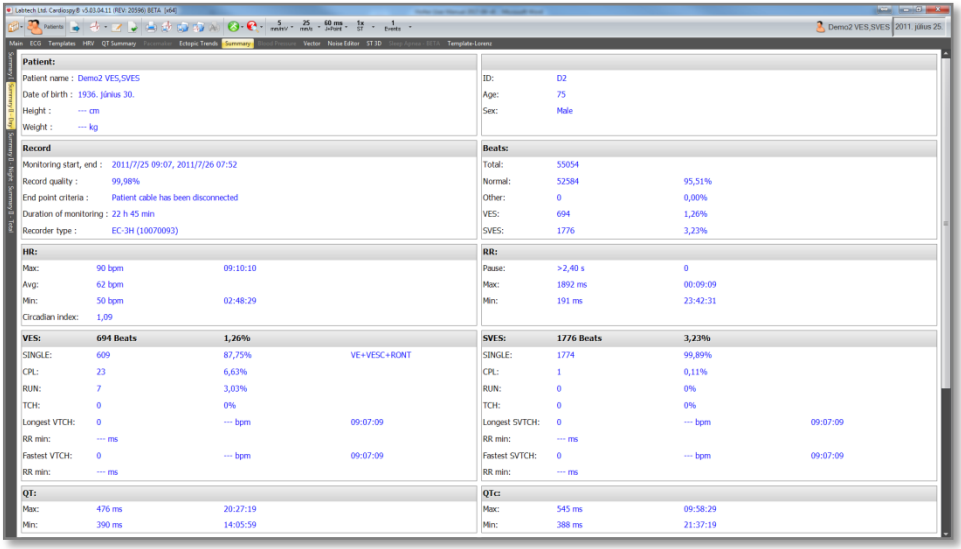
Supraventricular results:
There were a total of 2645 (3,21%) beats.These comprised 2641 (99,85%) single beats, 2 (0,15%) couplets.

ST episodes:
The maximum ST depression was -0,15 mV at 20:18 in channel CH2. The maximum ST elevation was 0,11 mV at 00:35 in channel CH1.

Rhythm results:
There were 0 pause intervals defined greater than 2400 ms.
Atrial Fibrillation was detected in 0,33% (0 h 04 min) of the total monitoring time.
Atrial flutter was detected in 0,00% (0 h 00 min) of the total monitoring time.

QT results:
The maximum QT interval was 507 ms (48 bpm) at 03:06, the maximum QTc interval was 545 ms (71 bpm) at 09:58.
The minimum QT interval was 390 ms (72 bpm) at 14:05, the minimum QTc interval was 388 ms (57 bpm) at 21:37.

TIME	TOTAL	HEART RATE			VENTRICULAR							SUPRAVENTRICULAR							PAUSE	MARKED
[hh:mm-hh:mm]	BEATS	MIN	AVG	MAX	BEATS	SINGLE	CPL	RUN	TCH	BIG	TRIG	BEATS	SINGLE	CPL	RUN	TCH	BIG	TRIG		
09:07-10:00	3508	51	67	90	224	163	13	6	0	2	8	50	50	0	0	0	0	0	0	0
10:00-11:00	3591	52	60	75	200	192	4	0	0	0	1	58	58	0	0	0	0	0	0	0
11:00-12:00	3697	54	62	75	17	17	0	0	0	0	0	76	76	0	0	0	0	0	0	0
12:00-13:00	3640	54	61	74	8	8	0	0	0	0	0	122	122	0	0	0	0	0	0	0
13:00-14:00	3694	55	62	74	6	6	0	0	0	0	0	101	101	0	0	0	0	2	0	0
14:00-15:00	3804	56	64	79	8	5	1	0	0	0	0	129	129	0	0	0	0	1	0	0
15:00-16:00	3613	53	61	77	16	16	0	0	0	0	0	135	135	0	0	0	0	1	0	0
16:00-17:00	3931	54	66	78	21	21	0	0	0	0	0	150	148	1	0	0	0	2	0	0
17:00-18:00	3668	56	61	72	7	7	0	0	0	0	0	143	143	0	0	0	0	0	0	0
18:00-19:00	3998	56	67	80	58	56	1	0	0	0	0	162	162	0	0	0	0	2	0	0
19:00-20:00	3855	57	65	83	41	38	0	1	0	0	0	185	185	0	0	0	0	2	0	0
20:00-21:00	3662	51	61	75	32	32	0	0	0	0	0	145	145	0	0	0	0	3	0	0



Patient:
Patient name : Demo2 VES,SVES
Date of birth : 1936. június 30.
Height : --- cm
Weight : --- kg

ID: D2
Age: 75
Sex: Male

Record
Monitoring start, end : 2011/7/25 09:07, 2011/7/26 07:52
Record quality : 99,98%
End point criteria : Patient cable has been disconnected
Duration of monitoring : 22 h 45 min
Recorder type : EC-3H (10070093)

Beats:

Total:	55054	
Normal:	52584	95,51%
Other:	0	0,00%
VES:	694	1,26%
SVES:	1776	3,23%

HR:

Max:	90 bpm	09:10:10
Avg:	62 bpm	
Min:	50 bpm	02:48:29
Circadian index:	1,09	

RR:

Pause:	>2,40 s	0
Max:	1892 ms	00:09:09
Min:	191 ms	23:42:31

VES: 694 Beats 1,26%

SINGLE:	609	87,75%	VE+VESC+RONT
CPL:	23	6,63%	
RUN:	7	3,03%	
TCH:	0	0%	
Longest VTCH:	0	--- bpm	09:07:09
RR min:	--- ms		
Fastest VTCH:	0	--- bpm	09:07:09
RR min:	--- ms		

SVES: 1776 Beats 3,23%

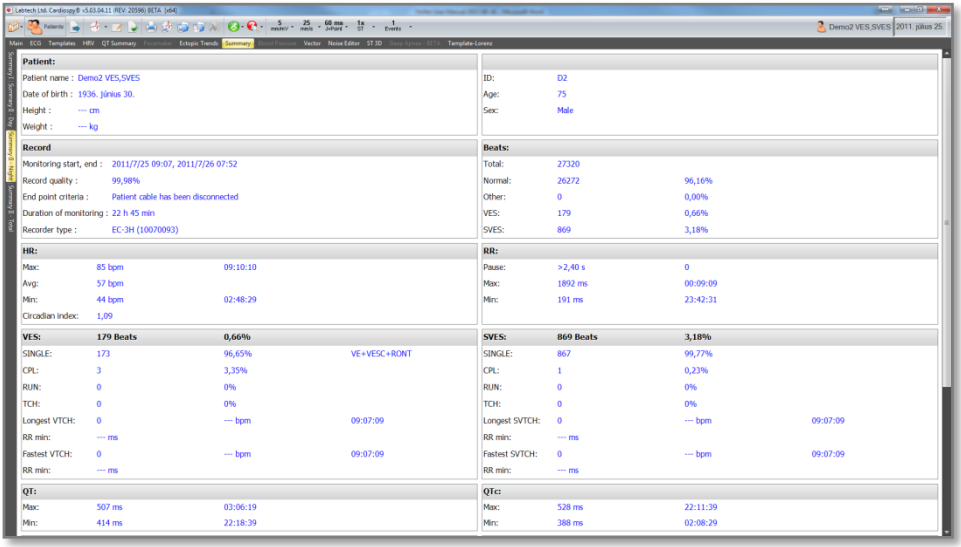
SINGLE:	1774	99,89%	
CPL:	1	0,11%	
RUN:	0	0%	
TCH:	0	0%	
Longest SVTCH:	0	--- bpm	09:07:09
RR min:	--- ms		
Fastest SVTCH:	0	--- bpm	09:07:09
RR min:	--- ms		

QT:

Max:	476 ms	20:27:19
Min:	390 ms	14:05:59

QTc:

Max:	545 ms	09:58:29
Min:	388 ms	21:37:19



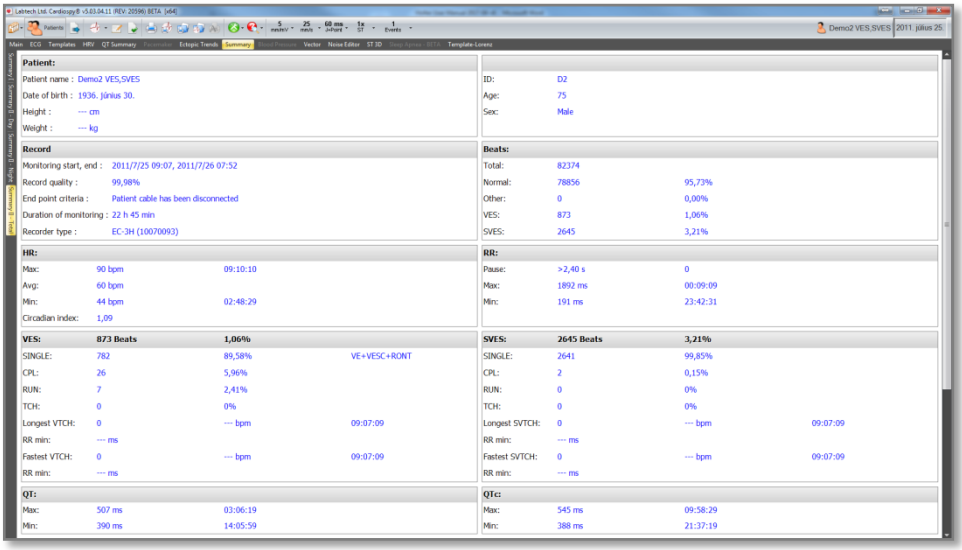
Patient:			
Patient name :	Demo2 VES,SVES		
Date of birth :	1936. Június 30.		
Height :	--- cm		
Weight :	--- kg		
ID:	D2		
Age:	75		
Sex:	Male		

Record			
Monitoring start, end :	2011/7/25 09:07, 2011/7/26 07:52		
Record quality :	99,98%		
End point criteria :	Patient cable has been disconnected		
Duration of monitoring :	22 h 45 min		
Recorder type :	EC-3H (10070093)		
Beats:			
Total:	27320		
Normal:	26272	96,16%	
Other:	0	0,00%	
VES:	179	0,66%	
SVES:	869	3,18%	

HR:			
Max:	85 bpm	09:10:10	
Avg:	57 bpm		
Min:	44 bpm	02:48:29	
Circadian index:	1,09		
RR:			
Pause:	>2,40 s	0	
Max:	1892 ms	00:09:09	
Min:	191 ms	23:42:31	

VES:	179 Beats	0,66%	
SINGLE:	173	96,65%	VE+VESC+RONT
CPL:	3	3,35%	
RUN:	0	0%	
TCH:	0	0%	
Longest VTCH:	0	--- bpm	09:07:09
RR min:	--- ms		
Fastest VTCH:	0	--- bpm	09:07:09
RR min:	--- ms		
SVES:	**869 Beats**	**3,18%**	
SINGLE:	867	99,77%	
CPL:	1	0,23%	
RUN:	0	0%	
TCH:	0	0%	
Longest SVTCH:	0	--- bpm	09:07:09
RR min:	--- ms		
Fastest SVTCH:	0	--- bpm	09:07:09
RR min:	--- ms		

QT:			
Max:	507 ms	03:06:19	
Min:	414 ms	22:18:39	
QTc:			
Max:	528 ms	22:11:39	
Min:	388 ms	02:08:29	



Patient:			
Patient name :	Demo2 VES,SVES		
Date of birth :	1936. Június 30.		
Height :	--- cm		
Weight :	--- kg		
ID:	D2		
Age:	75		
Sex:	Male		

Record			
Monitoring start, end :	2011/7/25 09:07, 2011/7/26 07:52		
Record quality :	99,98%		
End point criteria :	Patient cable has been disconnected		
Duration of monitoring :	22 h 45 min		
Recorder type :	EC-3H (10070093)		
Beats:			
Total:	82374		
Normal:	78856	95,73%	
Other:	0	0,00%	
VES:	873	1,06%	
SVES:	2645	3,21%	

HR:			
Max:	90 bpm	09:10:10	
Avg:	60 bpm		
Min:	44 bpm	02:48:29	
Circadian index:	1,09		
RR:			
Pause:	>2,40 s	0	
Max:	1892 ms	00:09:09	
Min:	191 ms	23:42:31	

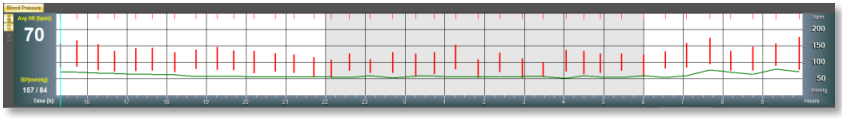
VES:	873 Beats	1,06%	
SINGLE:	782	89,58%	VE+VESC+RONT
CPL:	26	5,96%	
RUN:	7	2,41%	
TCH:	0	0%	
Longest VTCH:	0	--- bpm	09:07:09
RR min:	--- ms		
Fastest VTCH:	0	--- bpm	09:07:09
RR min:	--- ms		
SVES:	**2645 Beats**	**3,21%**	
SINGLE:	2641	99,85%	
CPL:	2	0,15%	
RUN:	0	0%	
TCH:	0	0%	
Longest SVTCH:	0	--- bpm	09:07:09
RR min:	--- ms		
Fastest SVTCH:	0	--- bpm	09:07:09
RR min:	--- ms		

QT:			
Max:	507 ms	03:06:19	
Min:	390 ms	14:05:59	
QTc:			
Max:	545 ms	09:58:29	
Min:	388 ms	21:37:19	

4.1.9 Blood Pressure (EC-3H/ABP)

4.1.9.1 *HR, BP graph*

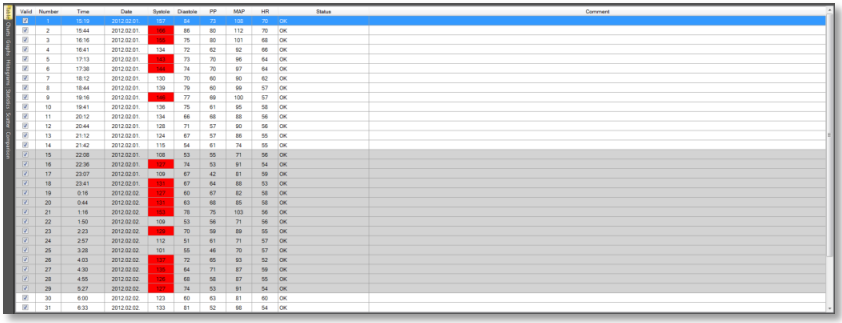
The graph presents Heart Rate and Blood Pressure measured by the ABPM device.



4.1.9.2 *Table*

The table displays all the BP results in a chronological order. We can validate / invalidate each result by ticking / un-ticking the relevant checkbox in the column marked “Valid”.

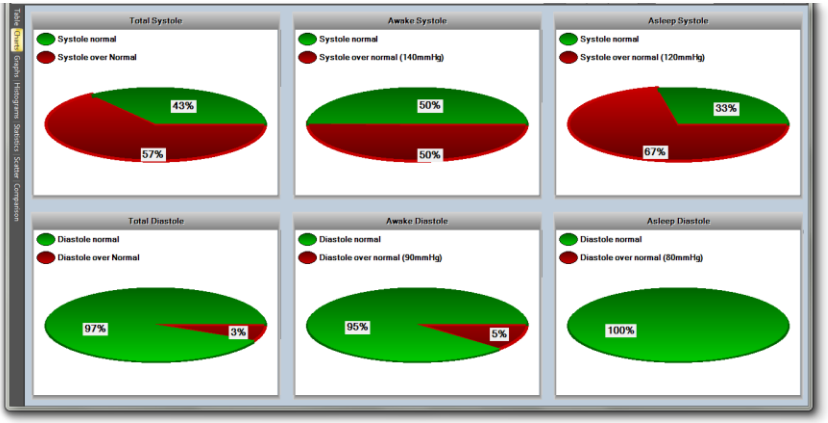
We can add short remarks to each measurement in the Comment column (double click).



Valid	Number	Time	Date	Systole	Diastole	PP	MAP	HR	Status	Comment
✓	1	15:16	2012.02.01.	157	84	73	108	70	OK	
✓	2	15:44	2012.02.01.	166	86	80	112	70	OK	
✓	3	16:16	2012.02.01.	154	75	80	101	68	OK	
✓	4	16:41	2012.02.01.	134	72	62	92	66	OK	
✓	5	17:13	2012.02.01.	143	73	70	96	64	OK	
✓	6	17:38	2012.02.01.	144	74	70	97	64	OK	
✓	7	18:12	2012.02.01.	130	70	60	90	62	OK	
✓	8	18:44	2012.02.01.	139	79	60	99	57	OK	
✓	9	19:16	2012.02.01.	146	77	69	100	57	OK	
✓	10	19:41	2012.02.01.	136	75	61	95	58	OK	
✓	11	20:12	2012.02.01.	134	66	68	88	56	OK	
✓	12	20:44	2012.02.01.	128	71	57	90	56	OK	
✓	13	21:12	2012.02.01.	124	67	57	86	55	OK	
✓	14	21:42	2012.02.01.	115	54	61	74	55	OK	
✓	15	22:08	2012.02.01.	108	53	55	71	56	OK	
✓	16	22:36	2012.02.01.	127	74	53	91	54	OK	
✓	17	23:07	2012.02.01.	109	67	42	81	59	OK	
✓	18	23:41	2012.02.01.	131	67	64	88	53	OK	
✓	19	0:15	2012.02.02.	127	60	67	82	58	OK	
✓	20	0:44	2012.02.02.	121	63	58	85	58	OK	
✓	21	1:16	2012.02.02.	143	78	75	103	56	OK	
✓	22	1:50	2012.02.02.	109	53	56	71	56	OK	
✓	23	2:23	2012.02.02.	126	70	59	89	55	OK	
✓	24	2:57	2012.02.02.	112	51	61	71	57	OK	
✓	25	3:28	2012.02.02.	101	55	46	70	57	OK	
✓	26	4:03	2012.02.02.	127	72	55	93	52	OK	
✓	27	4:30	2012.02.02.	135	64	71	87	59	OK	
✓	28	4:55	2012.02.02.	135	68	58	87	55	OK	
✓	29	5:27	2012.02.02.	127	74	53	91	54	OK	
✓	30	6:00	2012.02.02.	123	60	63	81	60	OK	
✓	31	6:33	2012.02.02.	133	81	52	98	54	OK	

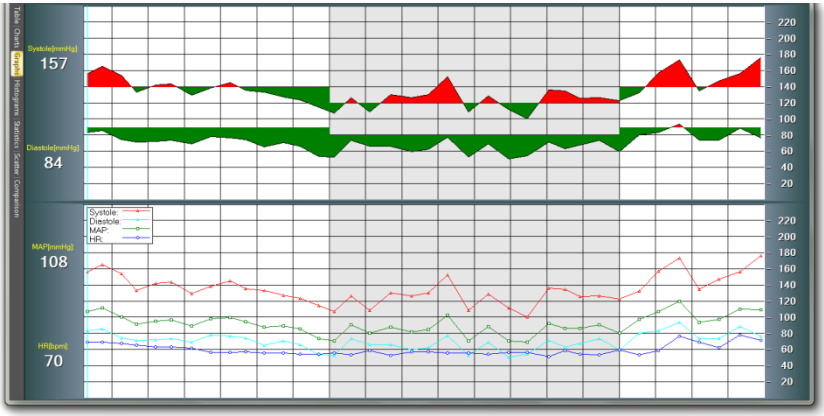
4.1.9.3 *Charts*

The software represents systole and diastole values in the form of pie-charts.



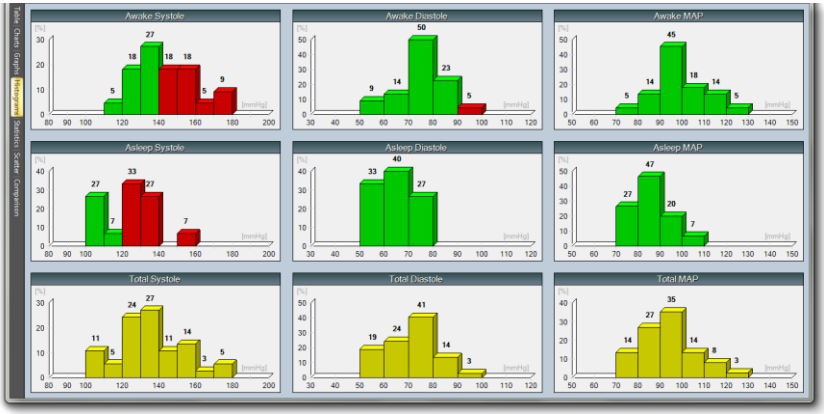
4.1.9.4 *Graphs*

The software shows BP burdens in the upper graph, while in the second graph Systole, Diastole, MAP and HR values are displayed.



4.1.9.5 *Histograms*

In this part Systole, Diastole and Map values are represented in the form of histograms.



4.1.9.6 *Statistics*

Statistical parameters calculated from the validated Blood Pressure and Heart Rate values are shown in a table format.

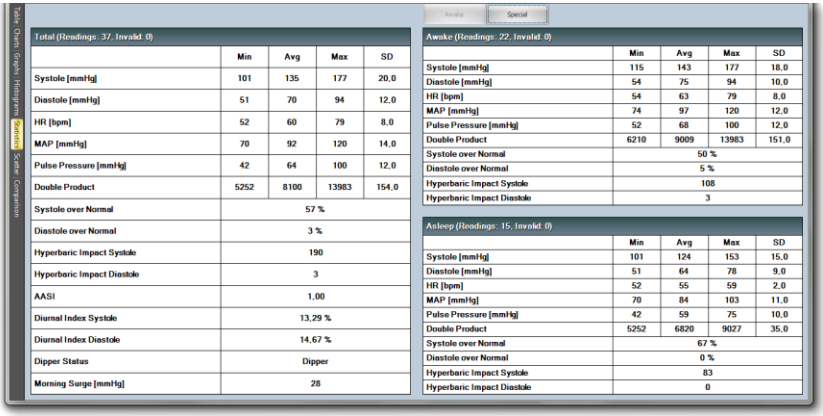


Table Chart Graph Histogram Statistics Scatter Comparison

Awake Special

Total (Readings: 37, Invalid: 0)

	Min	Avg	Max	SD
Systole [mmHg]	101	135	177	20,0
Diastole [mmHg]	51	70	94	12,0
HR [bpm]	52	60	79	8,0
MAP [mmHg]	70	92	120	14,0
Pulse Pressure [mmHg]	42	64	100	12,0
Double Product	5252	8100	13983	154,0
Systole over Normal	57 %			
Diastole over Normal	3 %			
Hyperbaric Impact Systole	190			
Hyperbaric Impact Diastole	3			
AASI	1,00			
Diurnal Index Systole	13,29 %			
Diurnal Index Diastole	14,67 %			
Dipper Status	Dipper			
Morning Surge [mmHg]	28			

Awake (Readings: 22, Invalid: 0)

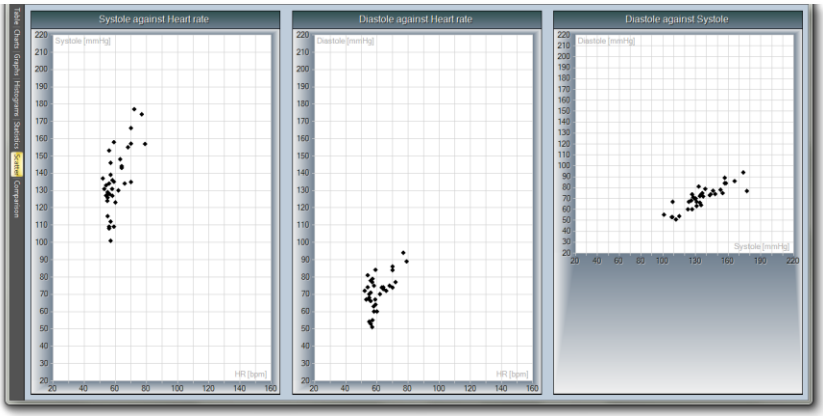
	Min	Avg	Max	SD
Systole [mmHg]	115	143	177	18,0
Diastole [mmHg]	54	75	94	10,0
HR [bpm]	54	63	79	8,0
MAP [mmHg]	74	97	120	12,0
Pulse Pressure [mmHg]	52	68	100	12,0
Double Product	6210	9009	13983	151,0
Systole over Normal	50 %			
Diastole over Normal	5 %			
Hyperbaric Impact Systole	108			
Hyperbaric Impact Diastole	3			

Asleep (Readings: 15, Invalid: 0)

	Min	Avg	Max	SD
Systole [mmHg]	101	124	153	15,0
Diastole [mmHg]	51	64	78	9,0
HR [bpm]	52	55	59	2,0
MAP [mmHg]	70	84	103	11,0
Pulse Pressure [mmHg]	42	59	75	10,0
Double Product	5252	6820	9027	35,0
Systole over Normal	67 %			
Diastole over Normal	0 %			
Hyperbaric Impact Systole	83			
Hyperbaric Impact Diastole	0			

4.1.9.7 *Scatter*

In this function, the cohesive systole-HR, diastole-HR and Systole-Diastole points are displayed.



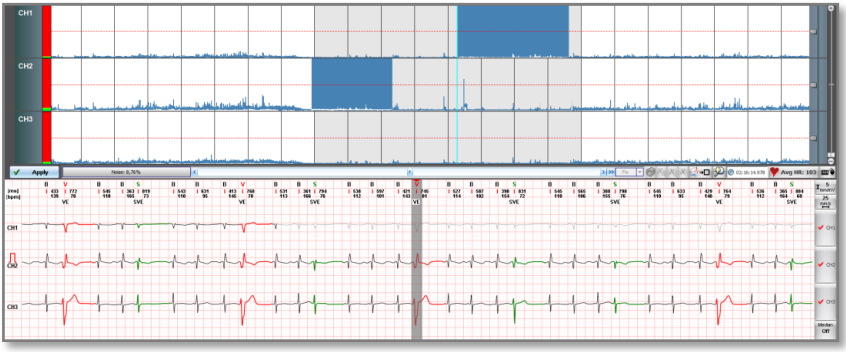
4.1.10 Vectorcardiography

This feature is not available for EC-2H devices!

The Vectorcardiographic display mode is available with records made with EC-3H or EC12H recorders using 3-channel patient cables in orthogonal electrode placement. The medians of the ECGs are displayed in 2D and 3D coordinate systems. Their display is colour-coded which makes it easy to keep track of the QRS in the vectorcardiogram. The assigning of ECG channels to axes is displayed by the software.

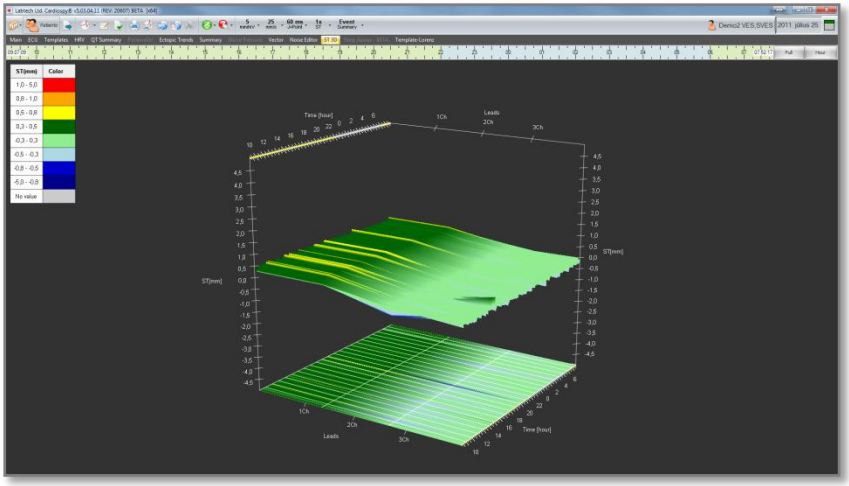
4.1.11 Noise Editor

This function gives you the opportunity to mark a selected interval as noise per channels separately! For further information about the editing, check CHAPTER 6.6.2.



4.1.12 ST 3D

In this menu, you can see the ST level values in a 3D graph. The three parameters of the chart are: Time (h), Leads (separately), ST level (mm). You can set the graph to view the ST level for the full time or divided into hours. On the time scale, you can go to any time to view the ST level in a 1 hour interval by dragging the left mouse button on it. You can also rotate the graph by dragging the left mouse button on it to any direction.

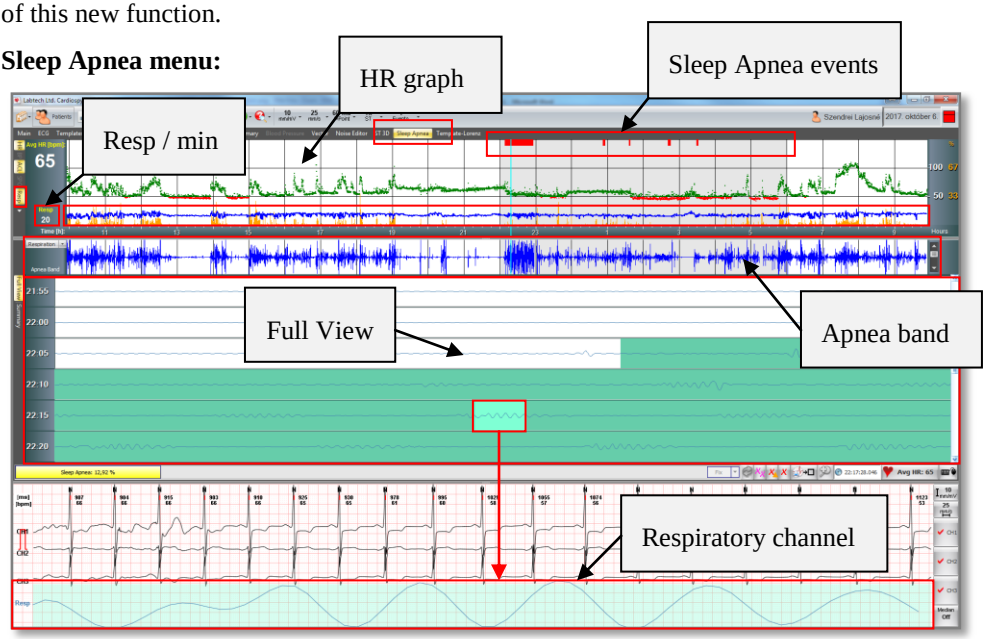


4.1.13 Sleep Apnea

We have implemented a new function - Sleep Apnea - into Cardiospy, which allows the user to examine respiratory signals.

This function is only available for EC-3H, EC-12H and EC-3H/ABP devices. These devices can be used with any supported patient cable to be able to take the advantages of this new function.

Sleep Apnea menu:



This respiration channel shows the selected section of respiration in the Full view menu in a zoomed version.

4.1.13.1 *Sleep Apnea components*

1. “Resp.” tab at HR graph: You can turn on / off respiration on the HR graph.
2. Full respiration on HR graph:

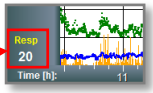
The blue element of the HR graph shows the full respiration signal hourly for the whole record.

3. Sleep Apnea events:

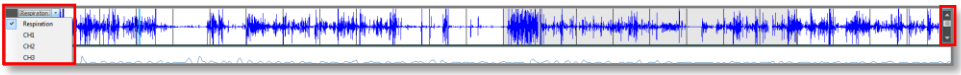
You can see the Sleep Apnea events marked with red on the HR graph.

4. Resp / min:

It displays the number of breaths per minute (20/min).



5. Sleep Apnea band:



Here you can see the Apnea frequency band, where you can also measure the time period of Apnea. With the combo box at the left side, you can select which method you would like to use to analyze the respiratory signal. You can adjust the amplitude of Apnea band with the scrollbar at the right side.

In V6 recorders, there is a separate channel that is used for recording respiratory signals, which can be selected in this menu ("Respiration").

However, **Cardiospy is also able to generate respiratory signals from chest impedance or from QRS amplitudes.** You can select this method by selecting the other channels.

This method makes the previous type of recorders (V5 Holter, and EC-3H/ABP) able to calculate respiratory signals from ECG.

6. Sleep Apnea – Full view

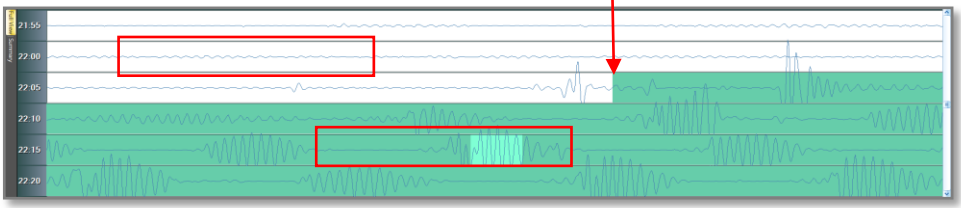
Here, you can see the full view of respiration per 5 minutes of data in each row.

In daytime, the patient moves a lot. Therefore, the respiration is not consistent. Since it is impossible to measure and detect respiratory malfunctions in this time period, Sleep Apnea is only detected in the night time of the days, when the patient rests (sleeping).

How respiration looks like in night time when Sleep Apnea is detected:

Respiratory signals are highlighted with blue background where Apnea events are detected by Cardiospy algorithm.

Beginning of Sleep Apnea event



The difference is clearly visible. The patient has started to breath less and less, then he /she started “gasping for breath” (took big breath).

7. Respiratory channel (under ECG channels)

4.1.13.2 *Sleep Apnea - Summary table*

Time [hh:mm-hh:mm]	Total beats	Normal beats	V beats	S beats	Apnea episodes in minutes	Risk
21:00-22:00	3828	3822	0	6		
22:00-23:00	3401	3386	3	12	48	Apnea
23:00-00:00	3154	3147	6	1	0	Normal
00:00-01:00	3521	3519	0	2	4	Normal
01:00-02:00	3288	3283	0	5	2	Normal
02:00-03:00	2862	2859	0	3	5	Possible Apnea
03:00-04:00	3027	3023	2	2	3	Normal
04:00-05:00	3175	3152	5	18	0	Normal
05:00-06:00	3064	3034	8	22	0	Normal
06:00-07:00	3572	3563	1	8		
07:00-08:00	4970	4933	0	37		
08:00-09:00	4291	4253	0	38		
09:00-09:55	3089	3051	0	38		
Awake	**59445**	**58899**	**48**	**498**		
Asleep	**25492**	**25403**	**24**	**65**	**62**	**Apnea**
Total	**84937**	**84302**	**72**	**563**		

This menu shows a summary about the result of the Sleep Apnea algorithm.

Hourly Risk ratings of the Sleep Apnea algorithm:

- Apnea, if - in that given hour -, the number of minutes where Apnea is detected is more than or equal with 15.
- Possible Apnea - if in that given hour -, the number of minutes where Apnea is detected is more than or equal with 5, but less than 15.
- Normal, in every other cases.

Ratings of the Asleep summary in the table:

In the night period, if the number of minutes where Apnea is detected - calculated in percent - is more than 5% and

- at least 1 hour is rated as Apnea
- if not rated as Apnea, but at least 1 hour is rated as Possible Apnea

Normal, in every other cases.

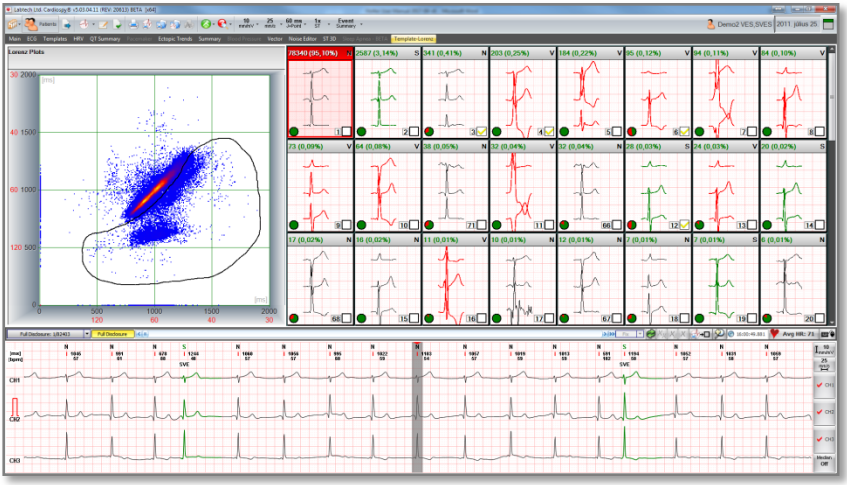
4.1.13.3 *Modifying Sleep Apnea events*

Since Sleep Apnea is only detected in night time of the days, it is recommended to adjust this period correctly. Please, read CHAPTER 5.1 for more information about how to set time periods.

You can read about the editing possibilities of Sleep Apnea events at CHAPTER 6.7.

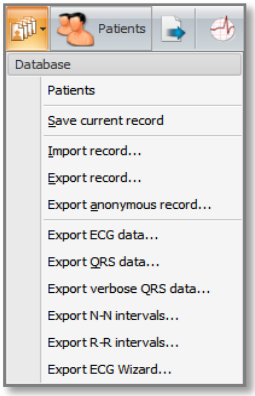
4.1.14 Template-Lorenz

Here, you can demix the templates manually on a graphic interface. To see how, please check CHAPTER 6.8.



4.2 Toolbar

4.2.1 Database



From this menu, you can go back to the patient database, save the current record (it is recommended if you have made changes in it), import and export record (even anonymously).

You are able to export data into ".txt" file like QRS data, N-N intervals and R-R intervals.

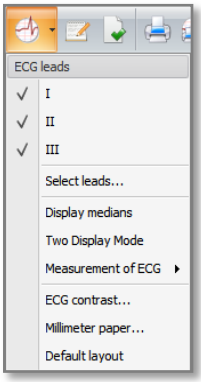
4.2.1.1 *Export wizard:*

This function guides you through the exporting process, where you can also select all of the above options.

The mostly used exportable data is the "ECG data". You can export it in 3 possible extensions: CSV, SCP and DAT. You can export both RAW and Filtered ECG as well. At the end of the export wizard, you can edit the name of the file and the path where you wish to export it.

You can go back to the patient database more quickly with this button.

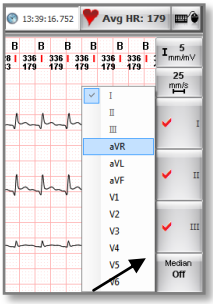
4.2.2 ECG leads



In this menu, you can set which channels you want to see. This menu controls the visibility of the channels in menus where only 3 channels are visible. It does not control the “ECG” menu.

4.2.2.1 *Select leads...*

You can enable (only) 3 channels in a new window. This menu is recommended to use if you are using 12 channel.



There is another option in the ECG view (at the right-bottom part of the screen), where you are able to manage the visibility of the channels (even more quickly).

If you move the cursor above the button, then a new list will appear, where you can choose which channel you want to see. You can do it with the other two channels as well.

4.2.2.2 *Display medians*

You can enable / disable the medians in the ECG view with this menu point. You can also do it by clicking on the “Median” button.

4.2.2.3 *Two display mode*

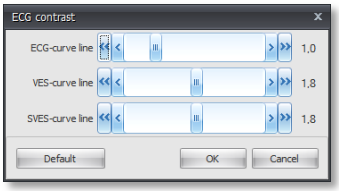
Since it is recommended to use two displays (monitors) with the PC, you are able to use the software in “two display mode”, when you analyze a record.

In the secondary window, the ECG (large window) menu will be showed.

4.2.2.4 *Measurement of ECG*

Here you can choose what kind of unit you want to use for the ST level values. (mm, mV or µV).

4.2.2.5 *ECG contrast...*

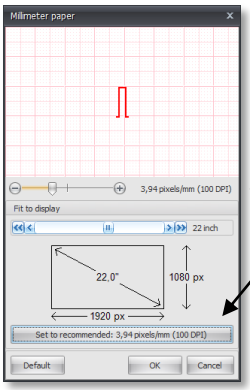


In this menu, you can change the contrast of the ECG-curve lines.

As you can see on the picture, you can even set it by events separately.

By default, the VES and SVES events are thickened to make them more visible.

4.2.2.6 *Millimeter paper...*



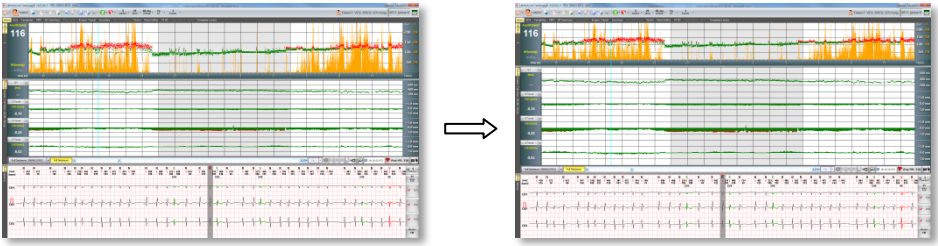
This window is active in stress and Holter system, by clicking view menu, Millimetre paper menu. Adjustment of millimetre paper size correlating to the monitor is possible. It is possible to setup real, 1:1 scale appearance of the millimetre paper on screen.

You can manually set how many pixels match for 1 mm.

You can also use the “Set to recommended” button, so the software will automatically set the scale to 1:1.

4.2.2.7 *Default layout*

If you change the size of the windows inside the software, you can reset them back to the default sizes by this menu point.



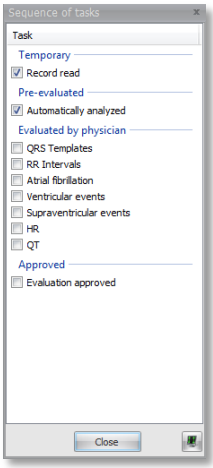
4.2.3 Report

By selecting the Report menu, a text editor appears in which you can write remarks. By selecting the “Import report” / “Automatic report” menu, both patient’s data and the automatic report of the program will be copied to this page. If you have filled the Indication and the Medication box when you set up the measurement settings then the content of the symptoms and medication fields will be imported to the report, as well. The doctor’s name will be imported to every report’s letterhead.

You can create your own templates by selecting the “Import report” / “Create a new template” menu. These templates can be imported later. Here you can insert many variables.

In the Print View, you will see the content of the Report as a new sheet “Report”.

4.2.4 Sequence of tasks



In this menu, you can follow through the whole operation from reading in to the approving of the evaluated record.

When you finished evaluating a section (like QRS templates, RR intervals, HR, QT, etc.), then you can tick the checkboxes next to the name of the sections separately.

It is suggested to check the longer (> 1000 ms) invalid RR intervals as well. In case of a noisy record it can happen that a real Pause gets among the invalid intervals. (An invalid RR interval can be made valid as it is written in CHAPTER 4.1.4.1)

After you finished with the evaluating, you can mark the record as “approved”, so it cannot be edited from then, until you untick the

checkbox next to it. The status of the record will turn into “Approved” at the database screen.

4.2.5 Print

In this menu we can go through all the reports prepared by the software and print them separately.

4.2.6 Printing of screen section

This function gives you the possibility to print the ECG section, which can be seen on the screen.

4.2.7 Export

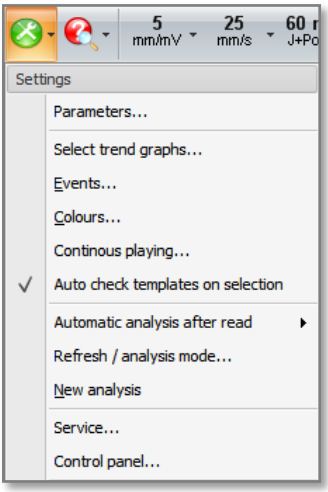
In this menu we can go through all the reports prepared by the software and export them separately (JPG, BMP, PDF, etc).

4.2.8 Export Current Samples

There is an opportunity to directly export the selected ECG section on the screen.

You can learn more about printing / exporting and its settings in CHAPTER 7.

4.2.9 Settings



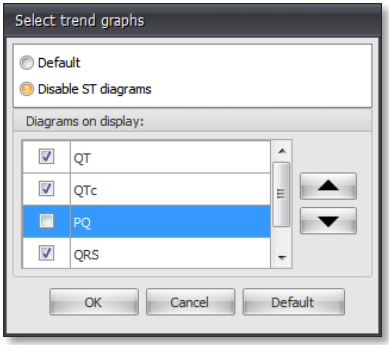
In this menu it is possible to set the various parameters of the program, such as parameters relevant to the analysis, colours of the screen, graphs to be displayed in the Main/Events menu, etc.

4.2.9.1 *Parameters...*

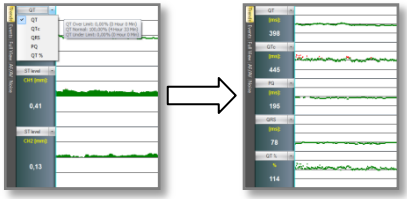
You can set parameters here like “Awake” and the “Special time”, Rhythm analysis limits, options for V and SV events, ST, QT, SAECG and ECG-HR turbulence calculation options, filters for the ECG, paediatric options for easier QRS detection and filters for noise detection.

Since these parameters are very important and they need a detailed description, we will explain their uses and meanings in CHAPTER 5.

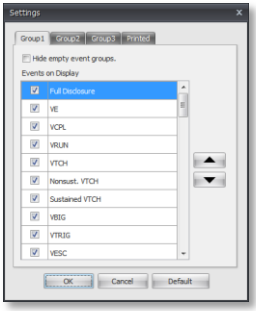
4.2.9.2 *Select trend graphs...*



By default, in the “Trends” window, you can see all these option at the first row in a list. In this menu, you can disable the ST diagrams, and enable these options instead.



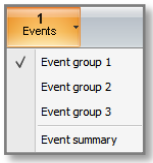
4.2.9.3 *Events...*



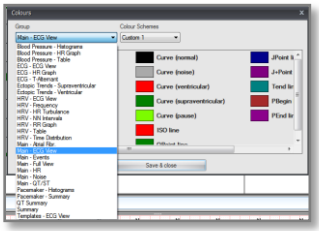
You can set the order of the events or you can even enable or disable them from the list.

You can configure 3 different presets for the displaying and 1 for the printout.

After you configurated the presets, you can select from them on the toolbar.



4.2.9.4 *Colours...*

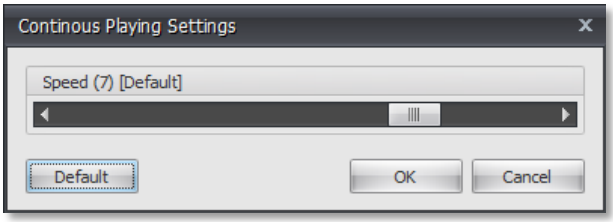


In this window, you can create your own custom colour schemes for the Cardiospy's looking or you can use the default ones. The default schemes cannot be modified.

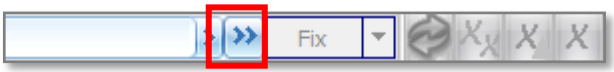
You can set the colour of the windows and menus separately by any way you want, since you can change almost every element of the software (like curves, background, ruler, QRS mark, etc.)

4.2.9.5 *Continuous playing...*

It is possible to modify the speed of continuous playing of the Holter ECG records. Setting>continuous playing menu>select the proper speed from 1 to 9.



You can play the record with this button next to the scrollbar at the middle of the screen.



4.2.9.6 *Automatic analyzing after read*

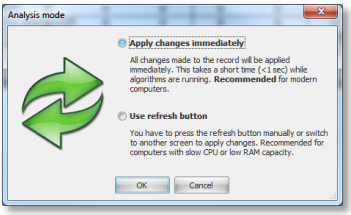
There are 3 options that you can set here: “Never”, “Ask every time” and “Always”.

Never: If you read in a record from the device, then it will be stored in the database, but the software is leaving it unfiltered and the analyzing process will not be performed.

Ask every time: If you read in a record from the device, then a prompt window will pop up every time about if you want to perform the analyzing process or not.

Always: This is the default option. The software will always perform the analyzing process.

4.2.9.7 *Refresh / Analysis mode...*



Apply changes immediately: The software runs the automatic analysis every time we edit the record, this way we’ll see the results on the screen immediately. This function is only recommended for modern and fast computers.

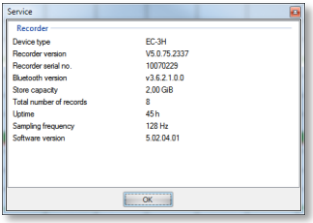
Use refresh button: The software does not run the automatic analysis each time the record is edited, the analysis only runs when the user presses the refresh button or change the screen. It is recommended for computers with slow CPU or insufficient RAM. Refresh button can be found in the middle of the screen, next to the horizontal slide.

4.2.9.8 *New analysis*

With this menu point, you can run a new analyzing process. It is useful when you have a record that was not analyzed before, you have updated the Cardiospy from an old version recently or you want to start the measuring from the start.

BE CAREFUL, THE NEW ANALYZIS WILL DELETE ALL OF YOUR PREVIOUS CHANGES THAT YOU HAVE MADE MANUALLY!

4.2.9.9 *Service*



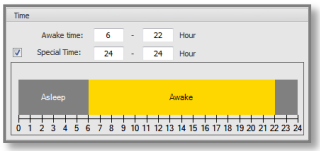
In this window, you can see information about the device that was used for the current record. You can see the device type, recorder version, recorder serial number, Bluetooth module version, story capacity, total number of records that was made with the device, uptime (total time of usage), previously defined sampling frequency and the current software version (if you have made the current record in an older version of Cardiospy, you will see its version number as well).

4.2.9.10 *Control panel...*

You can also open the Control panel, just like at the main screen (patient database). You can read more about the control panel in the **Cardiospy Installation and Update Guide**.

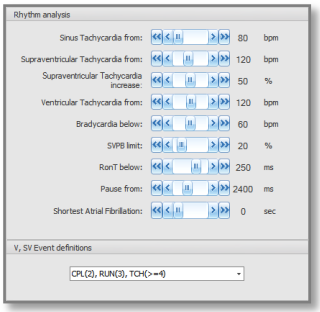
5 Parameters

5.1 Time:



Here, you can change the “Awake” and the “Special time”. E.g. you can set when the patient was asleep if you set the parameters of the “Awake time to the beginning and the end of the sleeping period.

5.2 ECG-Rhythm:



On this tab, you can change the parameters of the rhythm analysis, the V, SV event definitions and there is an option to set the algorithm to only include N-N intervals in the maximum and minimum heart rate calculations.

5.2.1 Rhythm Analysis

5.2.1.1 *Sinus Tachycardia from:*

If the HR of an ECG section (on the AVG HR graph) is above this parameter and the QRS types in it are dominant (N, R, L or B), the SW will mark it as Sinus Tachycardia.

5.2.1.2 *Supraventricular Tachycardia from and -increase*

These parameters are used for detecting Paroxysmal Supraventricular Tachycardia. The Paroxysmal Supraventricular Tachycardia is an ECG section, where the HR suddenly increases and then it returns back to normal after a short or a longer time (sustained or non-sustained). Depending on the settings (V, SV Event definitions), the algorithm will detect Supraventricular Tachycardia, if the HR of an ECG section (on the AVG HR graph) is above the "from" parameter and if the HR has increased compared to the previous section of the ECG more or equal to the "increase" parameter. The QRSs are not ventricular type. The "Supraventricular Tachycardia from" parameter is for setting the HR limit and the "Supraventricular Tachycardia increase" is for setting the rate of the increase. The last one is important to avoid detecting Paroxysmal Supraventricular Tachycardia instead of Sinus Tachycardia.

5.2.1.3 *Ventricular Tachycardia from*

Depending on the settings (V, SV Event definitions), the algorithm will detect Ventricular Tachycardia if the HR of an ECG section (on the AVG HR graph) with V type beats is above the "from" parameter.

5.2.1.4 *Bradycardia below*

The algorithm will detect Bradycardia where the HR of an ECG section (on the AVG HR graph) is below this parameter. This parameter affects Sinus-, Supraventricular- and Ventricular Bradycardia as well.

5.2.1.5 *SVPB limit*

This parameter is used for detecting single Supraventricular (SupraVentricular Premature Beat) type of QRSs. The single S type QRS is an early QRS which occurs earlier compared to the previous average RR intervals, calculated from dominant beats.

The value of the SVPB limit means the deviation from the regular RR intervals. The higher this value, the less single S QRS will occur.

5.2.1.6 *RonT below*

If a ventricular (V) QRS is closer to a previous dominant (N, R, L, B) QRS than this parameter (ms), it will be marked as an RonT event.

5.2.1.7 *Pause from*

If the RR interval between 2 QRS is higher than this parameter, it will be marked as Pause.

5.2.1.8 *Shortest Atrial Fibrillation*

This parameter is used for detecting Atrial Fibrillation. It forces the algorithm to delete AF events where its length is shorter than this parameter.

5.2.2 V, SV Event definitions

There are 4 possible options to show V and SV events:

1. CPL(2), RUN(3), TCH(>=4)
2. CPL(2), RUN(3), TCH_S(>=4), TCH_S(>=4)
3. CPL(2), TCH(>=3)
4. CPL(2), TCH_S(>=3), TCH_NS(>=3)

TCH_S = Sustained Tachycardia (>=30s)

TCH_NS = Non-sustained Tachycardia (<30s)

These options affect some summary table, so they will be showed according to this option. The “Ectopic Trends” menu is also affected.

It is important to know that the algorithm marks the ECG section as RHYTHM instead of TCH, if the HR of the ECG section (on the AVG HR graph) is below the “... Tachycardia from” parameter and it is more or equal to the “Bradycardia below” parameter. It will be marked as BRAD if the HR of the ECG section (on the AVG HR graph) is lower than the “Bradycardia below” parameter.

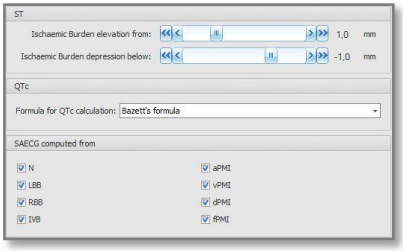
5.2.3 Only include N-N intervals in minimum and maximum heart rate calculation

The algorithm will calculate the minimum and maximum heart rate only from the dominant type of QRS (N, R, L or B), if this option is enabled.

In case we run a new analysis of the record, default settings will be restored, so all previous editing will be lost.

5.3 ST/QT

5.3.1 ST



5.3.1.1 *Ischaemic Burden elevation from*

ST elevation, if the ST level on the ST graph is higher than this parameter. It is calculated per channels separately.

5.3.1.2 *Ischaemic Burden depression below*

ST depression, if the ST level on the ST graph is lower than this parameter. It is calculated per channels separately.

5.3.2 QTC

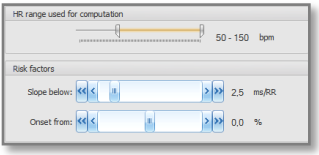
5.3.2.1 *Formula for QTc calculation*

These options are corrected QT calculation methods. The correction is based on the data of the QT curve (calculated from the SAECG) and the AVG HR graph.

5.3.3 SAECG computed from

The SAECG (Signal Averaged ECG) is calculated from intervals of QRSs per 10 seconds. You are able to choose which QRS types you want to use for the calculation of the SAECG.

5.4 ECG-HR Turbulence



5.4.1 HR range used for computation

The HRT calculation is only happens in case of a V beat, where the HR is within the range of the "HR range used for computation" parameter.

5.4.2 Risk factor

5.4.2.1 *Slope below*

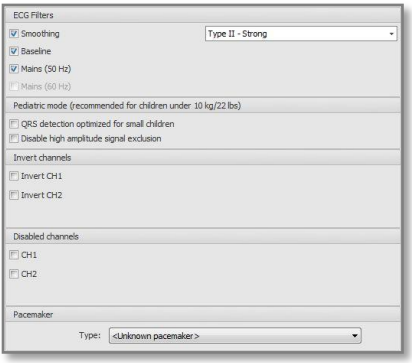
The SW shows a risk factor, if the HRT Slope is lower than this parameter.

5.4.2.2 *Onset from*

The SW shows a risk factor, if the HRT Onset is lower than this parameter.

You can see these risk factors under the HRV / HR Turbulence menu.

5.5 ECG – Misc

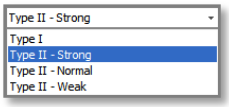


5.5.1 ECG Filters

You can turn off and on the filters for the ECG.

IT IS HIGHLY RECOMMENDED TO LEAVE THEM TURNED ON (by default), because it may (quite likely) lower the quality of the ECG and the rhythm analysis will not be completely precise.

5.5.1.1 *Smoothing*



There are two types of smoothing. The first one is the Type I, which is a Slew Rate type filter. It allows the filtering on ECG sections, where the slew rate is low (no QRS). It might happen that in case of certain QRS shapes, the filter affects those as well.

The second one is filtering the baseline between the QRSs, which can be set in three options by intensity (Strong, Normal, Weak). This type of filter does not affect the QRSs, thus leaving them in their original shape. **Type II – Strong is the default.**

5.5.1.2 *Baseline*

It is a baseline-fluctuating filter.

5.5.1.3 *Mains (50, 60Hz)*

It is a circuit-interference filter.

5.5.2 Pediatric mode

5.5.2.1 *QRS detection optimized for small children*

In case of babies and small children it is common that the QRSs are very narrow. If this option is enabled, it allows the algorithm to detect very narrow QRSs as well.

5.5.2.2 *Disable high amplitude signal exclusion*

It is turning off modules in the noise-filtering system, which is used for detecting and marking narrow, high-amplitude and pulse-like QRSs as noise. In case of babies, the amplitude of the QRS can be up to 10-12mV high.

5.5.3 Invert channels

You can choose channels to show inverted (1-2-3CH). It is not allowed in case of records that was made by an EC-12H device. After modifying, a new analysis will be performed.

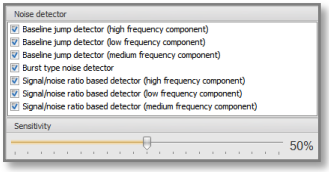
5.5.4 Disable channels

You can exclude channels from all of the analysis. After modifying, a new analysis will be performed. In case of the EC-12H devices, you are not able to disable the “I”, “aVR”, “aVL” and the “aVF” channels.

5.5.5 Pacemaker

Regardless of the set pacemaker type at the patient data, you can independently set it for the records here as well. It is useful when there are previous records in the database for the patient where he/she did not have pacemaker yet.

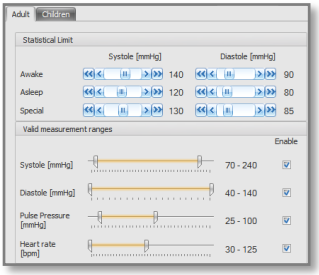
5.6 Noise detection



The Cardiospy software has fairly complex noise-filtering modules. These modules can be turned on and off. Besides, you can set the sensitivity of the noise-filtering if necessary.

5.7 Blood Pressure

Here we can set parameters used for statistical calculations and measurement ranges used for automatic pre-filtering. Limits for children and adults can be adjusted separately.



5.7.1 Statistical Limit

You can set the normal systole and diastole limits in every interval separately (awake, asleep and special). If the patient's result exceeds this limit the software indicates that it is in a high range (with red colour).

5.7.2 Valid measurement ranges

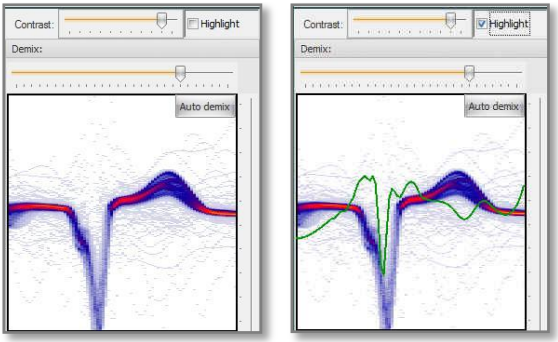
The program's analysis accepts BP values within these ranges. If the results of certain measurements are outside of this range the software takes the measurements out of the evaluation and marks them as invalid.

6 Editing and measuring options

6.1 Templates – functions

6.1.1 Using the Highlight function

If this function is on, QRS complex displayed in the ECG window will be marked by a continuous line in the Demix window.



The function is off The function is on

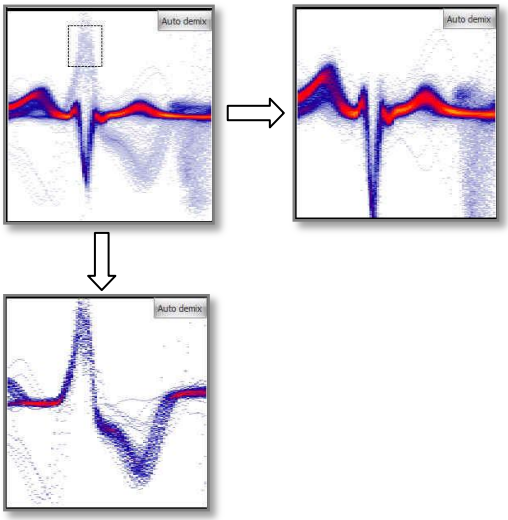
6.1.2 Manual demix

The purpose of this function is to clear the cluster of the inappropriate QRS complexes and artefacts. This function enables us to select one or more QRS complexes in order for them to be moved to a new cluster.

Select cluster (it is going to be a parent cluster)

Mark a rectangle in Demix window in any channel by pressing left mouse button.

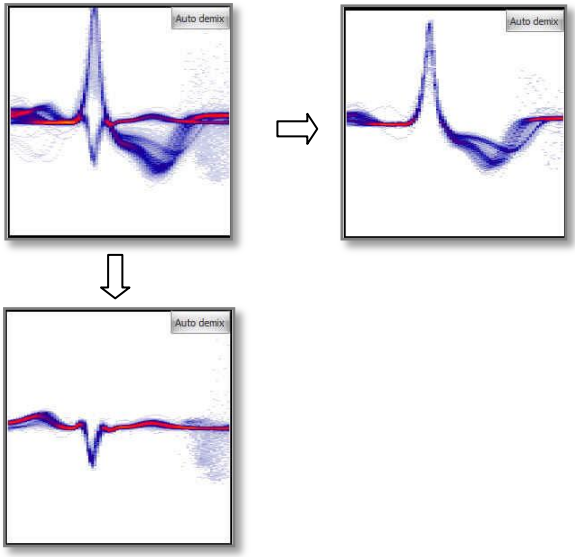
All QRS complexes can be moved to a new cluster (it is going to be a child cluster), which has at least one point within the rectangle.



The program automatically modifies and creates the QRS image characteristic of the given cluster. The created child cluster is marked in red. The marking remains on the parent cluster until a new cluster is marked.

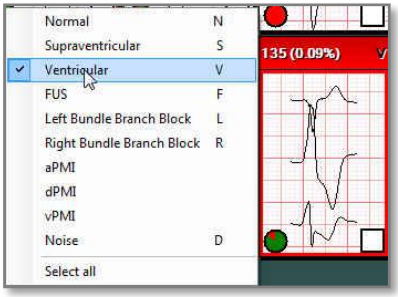
6.1.3 Auto demix

In the Auto Demix function we can “clean” the marked clusters of each channel. If a new cluster is created, the focus moves to the new cluster. The original cluster is marked with a red frame.



6.1.4 Editing the clusters

The type of a cluster can be changed by right-clicking the template. The chosen type will automatically appear next to each heartbeat of a cluster.



6.1.5 Merging of clusters

All the similar cluster types can be merged manually or by the drag-and-drop method familiar from Windows. This means that with the left mouse button we mark the cluster and while holding this button just move the marked cluster to the one with which we wish to merge, then release the button. The program allows merging only similar type of clusters, e.g. N can be merged with N, V with V etc.

Before completing the contraction, it is advisable to display only one particular type of group in the “Filter templates by” drop-down menu.

6.1.6 Cluster group operations

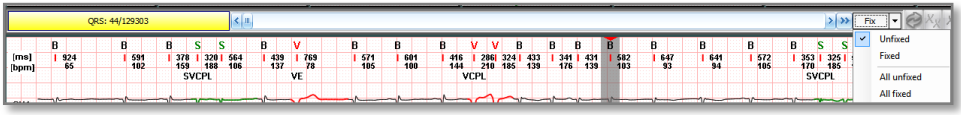
We can select all the clusters for group operations by holding the right mouse button, then choosing Select all.

We can select the specified multiple clusters for group operations by pressing and holding the Shift button while clicking the left mouse button at one point and pulling the cursor the desired clusters.

The selected clusters can be merged or their types can be modified together.

6.1.7 The function of the “Fix” button

By clicking on the “Fix” button, a certain type of QRS can be fixed in the marked cluster. Marking a new cluster invalidates all the previously set cluster types.



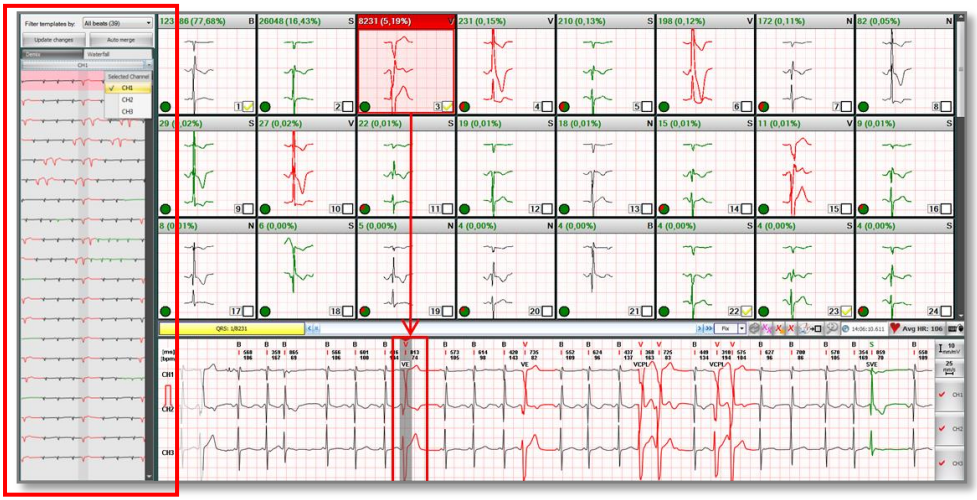
It is advisable to use this button, if we would like to modify the type of a complex cluster, with the exception of some QRS complexes.

If you click on the arrow next to the “Fix” button, then you can make all the elements of the selected template to fixed or unfixed.

6.1.8 Determination of QRS clusters

If you select a beat in the “Main” or “ECG” window and then go into the “Templates”, then the focus will go to the cluster in which there is the appropriate QRS.

6.1.9 Waterfall view

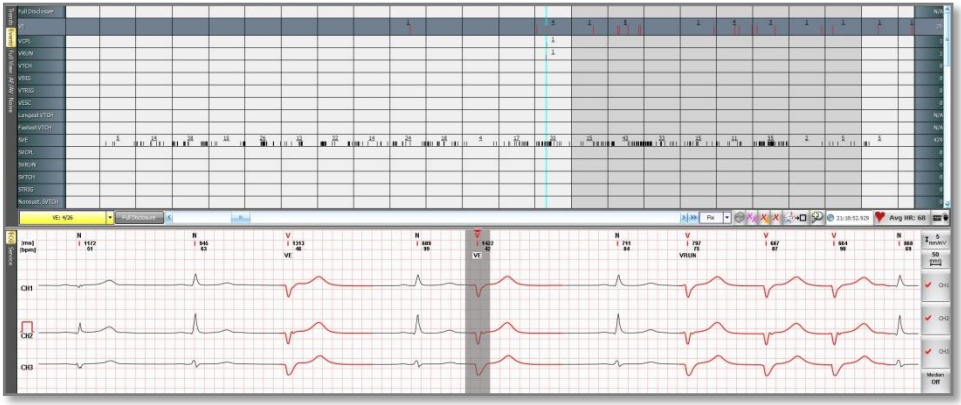


Next to the Demix option you can choose also the Waterfall method to expand a template. All the actions (renaming, deleting, QRS etc.) can be performed using this design. This way, you can quickly overview a lot of beats under each other from the same template at once, together with the surrounding beats.

6.2 Handling events

6.2.1 Sections where you can track and edit events

1. The easiest way to edit events is to go into the **"Main / Events"** menu.

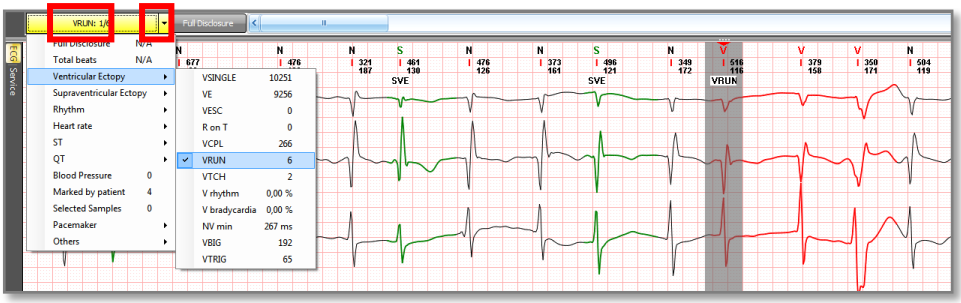


If you want to edit the elements of the list, please go back to CHAPTER 4.2.9.3.

In this list, you can find all the type of events separately. If you select a "single" (e.g. VE, SVE, RonT, etc) or a "group" (e.g. CPL, RUN, TCH, etc.) type of event, then you can run through all of its elements and change them as you wish.

If you click on an event, then the "filter menu" will also change.

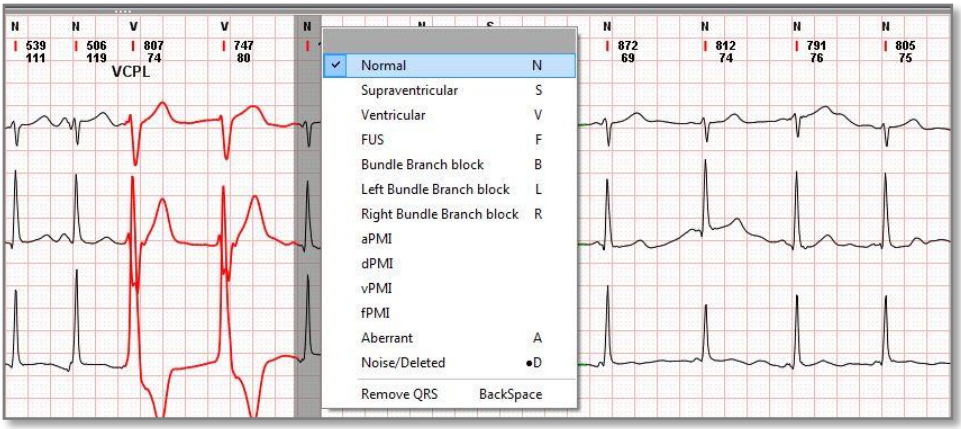
2. Using the **"filter menu"**. You can find this menu on these tabs: Main, ECG (large window), Templates, Event summary.



In this menu, all type of events are listed. If you select an event, then in the ECG viewer (at the bottom of the screen), you can move through only between the fitting beats or beat groups, but you can edit every other beats as well.

6.2.2 Modification of unique QRS types

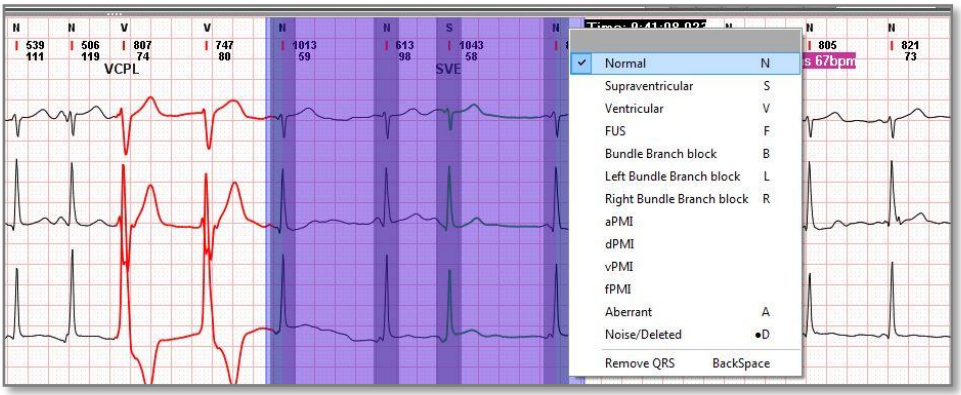
Right-click the relevant QRS and choose the appropriate QRS type from the list offered by the program.



6.2.3 Modification of group QRS types

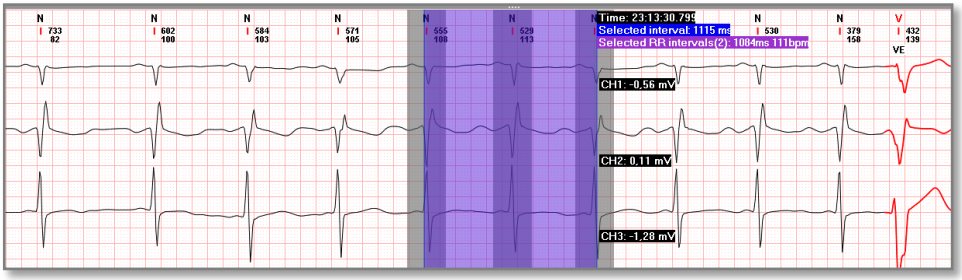
Moving the mouse by holding the left mouse button mark all those QRS, which are found next to each other and the type of which you would like to modify.

If you have selected a group of beats, you can change their type by right click on one of its elements and select a type from the list.



You can also change the type of the beats using the proper keys of the keyboard. You can see the letters in the dropdown list.

6.2.4 Using the ECG ruler - measurement



We can measure time and amplitude by holding the left mouse button while moving the cursor, this way you select a certain section of the ECG curve.

Time: Represents the “current” time at the selection.

Selected interval: Represents the time interval of the selection.

Selected RR interval: Here we can see the number of the selected beats, the time interval between the first and last QRS and the average HR measured from the selection. Amplitude is measured by calculating the difference of the two points where the first and second ruler intersects the ECG curve.

6.2.5 Insert a QRS

Move the cursor to the point at which you intend to insert the selected QRS. While holding the left mouse button, click with the right mouse button. Choose the appropriate QRS type from the list offered by the program.

6.2.6 Remove a QRS

Choose the relevant QRS by the right mouse button and then choose “Remove QRS” from the list offered by the program.

As a result of QRS removal, the relevant QRS disappears from the QRS list, while it remains when marked as noise. We should remove QRS, if there is an artefact between the two QRS complexes of a real pause, which hinders pause detection. When the artefact has been removed, the pause becomes detectable. If several artefacts follow each other, it is advisable to rename them as noise, because their removal can create a pause.

6.2.7 Delete a single event

In the selected event type, we can delete the currently displayed event by pressing the button. When the event has been deleted, all the QRS complexes belonging to this event type will automatically be renamed as noise.

6.2.8 Delete a group of events

In the selected event type, we can delete all events by pressing the button. When the event has been deleted, all the QRS complexes belonging to the pertinent event will automatically be renamed as noise.

6.2.9 Using the Fix button

The “Fix” button is a great help when you want to delete a group of events, but you want to exclude some from the deleting or when you want to delete only the “fixed” beats from this type of event.

With this button, you can delete all the “unfixed” events from the selected type of event, while the “fixed” events will remain.

With this button, you can delete all the “fixed” events from the selected type of even, while the “unfixed” events will remain.

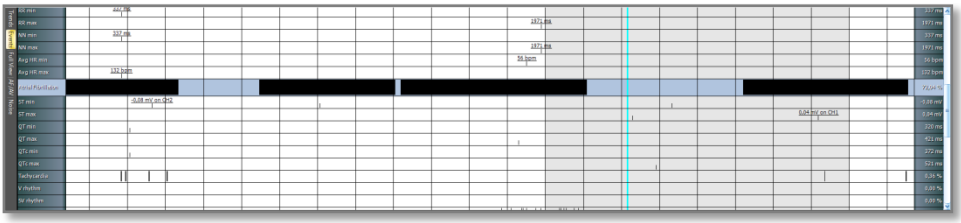
With this button, you can delete a single beat or you can delete all beats within a selection from the same type of event.

These delete functions are not allowed in case of interval type events (e.g. Atrial fibrillation, Atrial flutter, AV I, AV II, etc.).

6.2.10 Interval type events

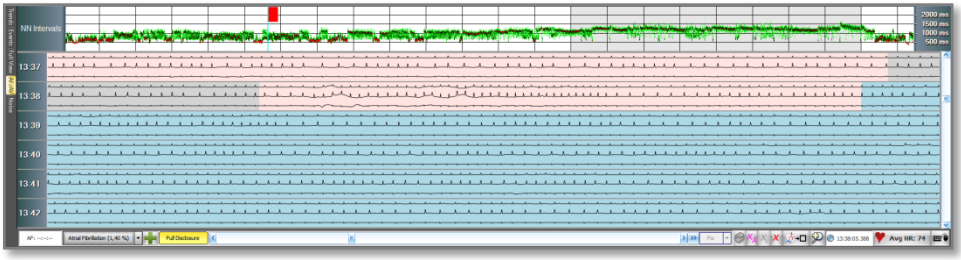
You can edit these interval type events by three possible ways:

6.2.10.1 *Main / Events*



If you hold the “Shift” button on your keyboard and the left mouse button on the mouse while dragging it on the screen, then (for example) the software will ask you if the selected range is an Atrial Fibrillation or not. You can also delete falsely detected intervals this way by clicking on the “No” button.

6.2.10.2 *Main / AF/AV*

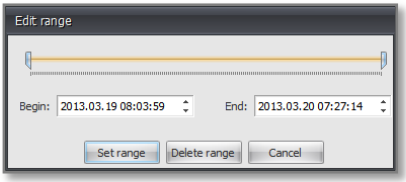


Here, it is enough to hold the left mouse button and drag the mouse on the full view.

6.2.10.3 *In the "ECG viewer"*

The other way here is to click on the "+" button next to the name of the selected event type.

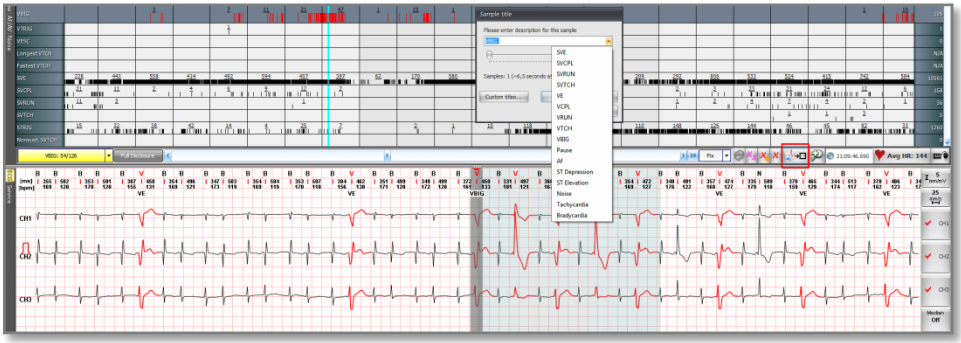
A new window will pop up, where you can select an interval and tell it to set this interval to this type of event or delete from it.



You can type the start and the end of the interval manually or you can choose the slide to select the range of the interval.

6.2.11 Selecting actual samples for printing

You can select intervals in the program with the help of this button and these samples will appear on the printed report as well. The samples can be named and own default titles can be prepared which can be set easily. The length of the sample selected for printing can also be modified with the help of the slider.



6.2.12 Erasing the end of the record

If the end of the record is lead-off and does not contain any ECG signals it is possible to erase the unnecessary part from the end of the record.

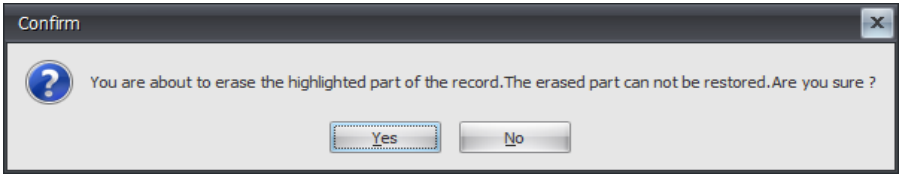
> **NOTE**: Once you have erased the end of the record it can not be recovered anymore.

The process of the erasing:

1. Setting the ruler: mark the starting time of the section you want to delete.

2. Click on the scissor icon.

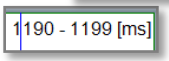
3. A warning window will pop up. If you click on No button, nothing happens. After clicking the Yes button the section after the selected point (marked with grey bar) will be erased definitively.



6.3 HRV – Editing and validation

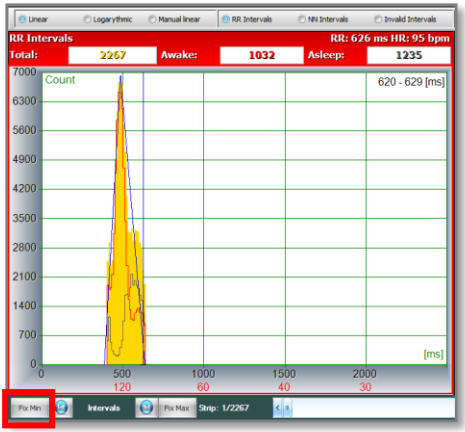
In the HRV window we can validate or invalidate RR or NN intervals individually or as a group.

Choose the Intervals graph to edit intervals. The displayed intervals can be RR, NN, or invalid intervals.



The intervals are represented in a 10 ms histogram.

6.3.1 Fixation of RRmin, RRmax, NNmin, NNmax



These parameters will appear in the reports and in other calculations as well, so it is important to have their precise values.

The HRV window enables a fast editing of these values.

To edit the RRmin, choose “RR intervals”. With the left mouse button move the cursor above the ruler in the graph of HRV intervals and then move it horizontally to the point where you want to set the RRmin. On that point, you can see how many intervals are in the selected range. From now, you can move between the RR intervals more precisely in a 0-10 ms interval. You can do it with the slidebar at the middle, with the arrow (←→) buttons on the keyboard or with these buttons:

If you have selected the RR interval that you wish to set as RRmin, click on the “Fix Min” button.

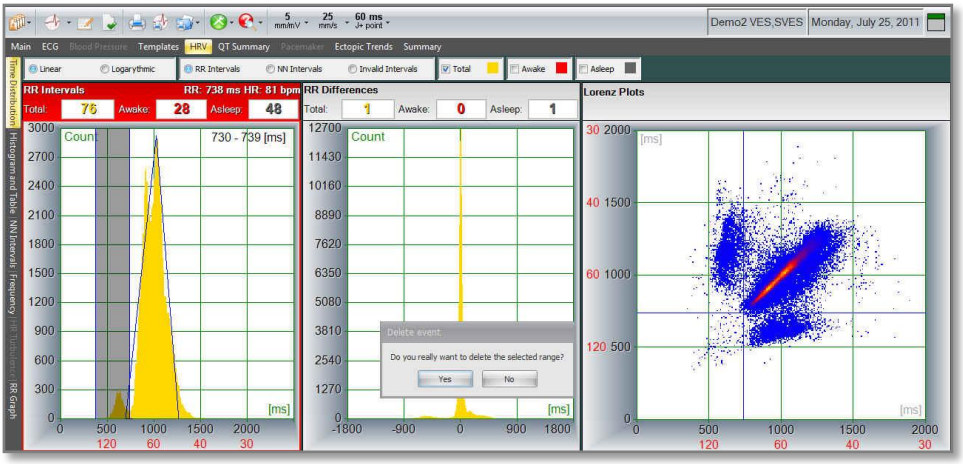
The same procedure must be followed for editing the RRmax, NNmin, and NNmax.

6.3.2 Invalidation of single intervals

The currently displayed interval can be invalidated by clicking on the button next to the slidebar at the middle. Invalidation means that intervals of the given types are ignored by all algorithms during the evaluation. The QRS complexes belonging to the given interval retain their original type.

6.3.3 Invalidation of groups of intervals

By holding the 'Shift' button you can select a wider interval if you drag the mouse through a section while holding the left mouse button as well.



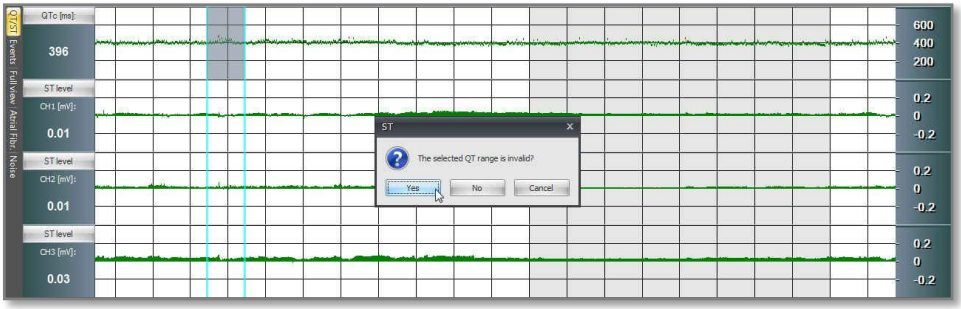
6.3.4 Recovery of invalid intervals

The invalid intervals can be displayed by selecting 'Invalid intervals'. There are opportunities to validate individually by pressing the button or collectively by holding Shift + left mouse. This way we can restore more units at the same time.

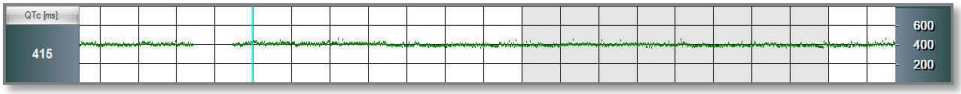
6.4 ST, QT, QTc graph

6.4.1 Invalidate selected interval

We can select an interval in the QT, QTc and AT graphs by pressing and holding the Shift button while clicking the left mouse button at one point of the ECG curve and dragging the cursor to the desired point. When the selection has been made, these intervals can be invalidated. This action has no effect on intervals which have already been invalidated.



Result of the invalidation:



6.4.2 Restoring invalidated intervals

We can select an interval in the QT, QTc and AT graphs by pressing and holding the Shift button while clicking the left mouse button at one point of the ECG curve and dragging the cursor to the desired point. When the selection has been made, these invalidated intervals can be restored. This action has no effect on valid intervals.

6.4.3 Deleting Min, Max values

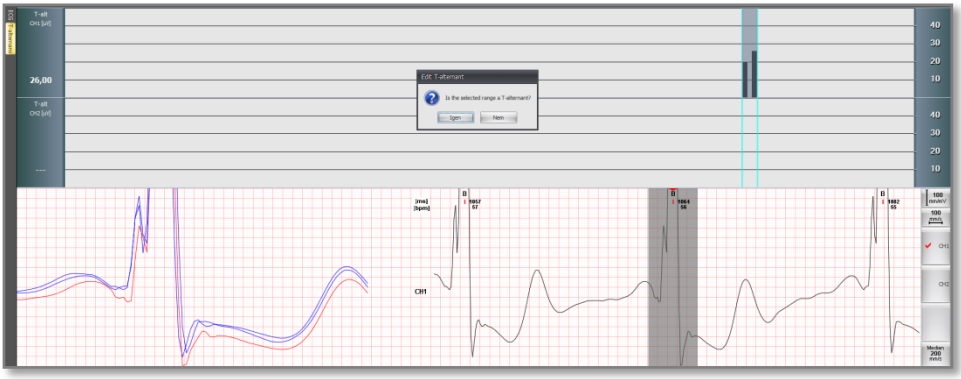
We can select the desired parameter in the Event menu point and then click on the button in case the selected value is not acceptable. Deleting can be repeated until the result is acceptable.

6.5 T-alternant

6.5.1 Delete the T-alternant sections

There are multiple options to delete T-alternant sections.

One option is to delete by using the and the buttons. Clicking on the button deletes the T-alternant section on which the ruler is placed at the moment, while clicking on the button deletes all T-alternant sections.



Another option is to select a desired interval by pressing and holding the Shift button while clicking the left mouse button at one point of the ECG curve and dragging the cursor to the desired point. When the selection has been made, the software prompts us to answer a question concerning what to do with the selected section next. In case we decide to mark the selected section not as T-alternant section, all the corresponding T-alternant sections will be deleted. On the manually deleted T-alternant sections the automata analyses does not show more T-alternant, but manually the T-alternant may be marked to any place.

6.5.2 Insert the T-alternant sections

Select a desired interval by pressing and holding the Shift button while clicking the left mouse button at one point of the ECG curve and dragging the cursor to the desired point. When the selection has been made, the software prompts us to answer a question concerning what to do with the selected section next. If we choose this section, as T-alternant section, the T-alternant mark will appear on it. Manually marked T-alternant section may be deleted according to ones demand.

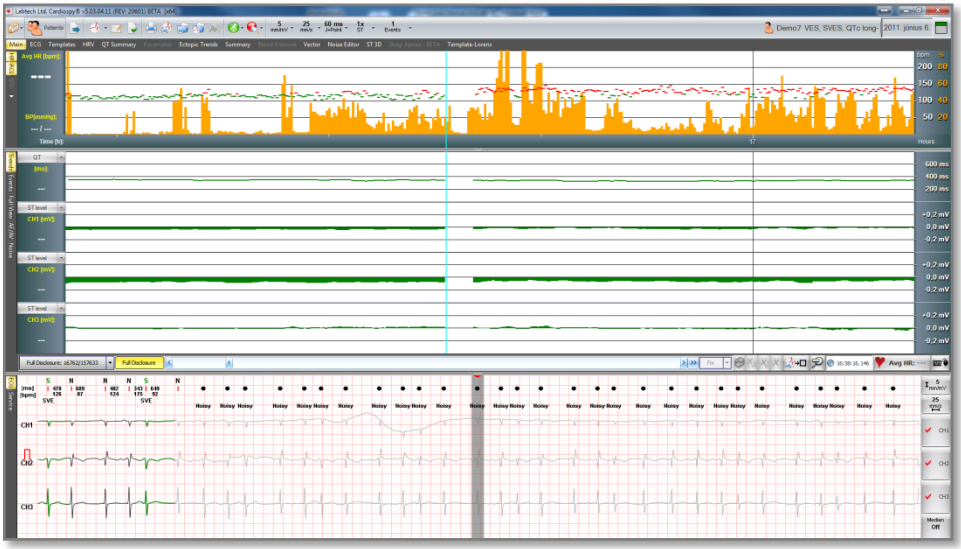
6.6 Noise editing

6.6.1 Editing in the Main / Noise window

6.6.1.1 *Invalidate selected interval*

We can select an interval by pressing and holding the Shift button while clicking the left mouse button at one point of the ECG curve and dragging the cursor to the desired point. When the selection has been made, the software prompts us to answer a question concerning what to do with the selected section next. In case we decide to mark the selected section as noise the software marks all pertaining QRS complexes as noise, which means they will be excluded from further analysis.

Result:

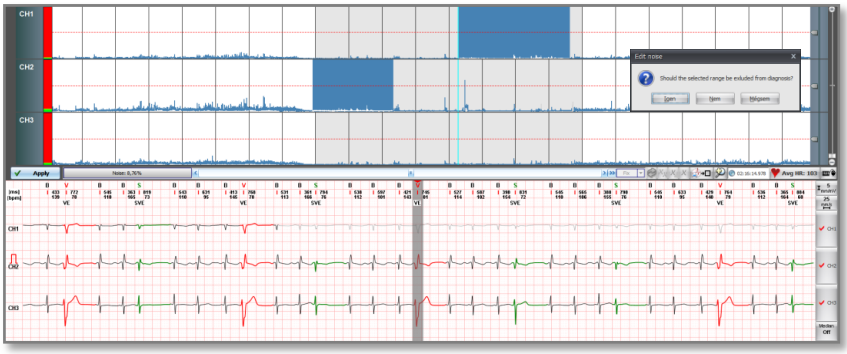


6.6.1.2 *Restoring invalidated intervals*

We can select an interval by pressing and holding the Shift button while clicking the left mouse button at one point of the ECG curve and dragging the cursor to the desired point. When the selection has been made, the software prompts us to answer a question concerning what to do with the selected section next. In case we decide to mark the selected section as not noise the software restores all pertaining QRS complexes, which means that they will be included in further analysis.

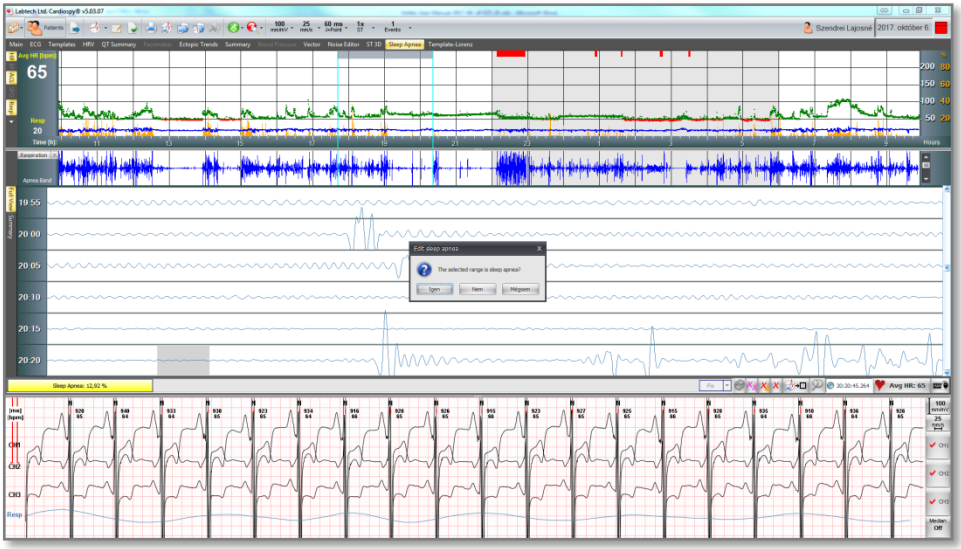
6.6.2 Editing in the Noise Editor

You can select intervals as noise **per channels separately**. If you hold the "Shift" button on your keyboard and the left mouse button on the mouse while dragging it on the screen, then the selected range can be excluded from the diagnosis.



6.7 Editing in Sleep Apnea

You can edit Sleep Apnea the same way as e.g. Atrial Fibrillation. You can delete events one by one, by selecting a period (by holding "Shift" button and dragging the cursor on the HR graph while holding the "left click" of the mouse or in the Full view of Sleep Apnea by dragging the cursor on the Full view while holding the "left click" of the mouse) or by deleting all of them.



Events will be deleted if you click on the „No” button, but you can also insert Sleep Apnea event by clicking on the „Yes” button.

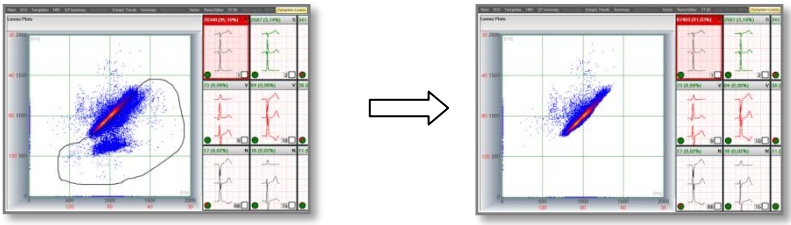
You can read more about how to edit events in CHAPTER 6.2.

6.8 Editing in Template-Lorenz

In this menu, you can designate any area on the graphic interface to demix the selected template manually. You can do it by moving the cursor on the graph from where you want to start to draw, then hold the left mouse button and drag it in any shape until you get back to the starting point.

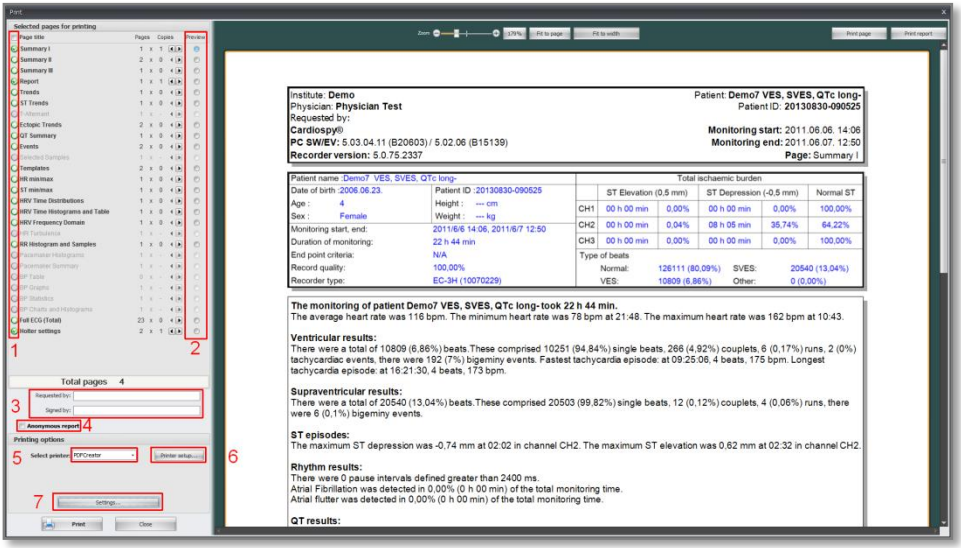
If you want to verify your selection and delete it from the selected template, then double-click on the point where you have started / ended the drawing.

If you want to cancel the drawing, just move the cursor out of the graph.



7 Print and Export

7.1 Parts of the Print view



You can select the pages for printing by tick or untick the checkboxes next to the name of the pages.

You are able switch between the pages that you want to see with the radio buttons next to the name of the pages.

It is possible to type in the name of the doctor who is requested the examination and who signed the report.

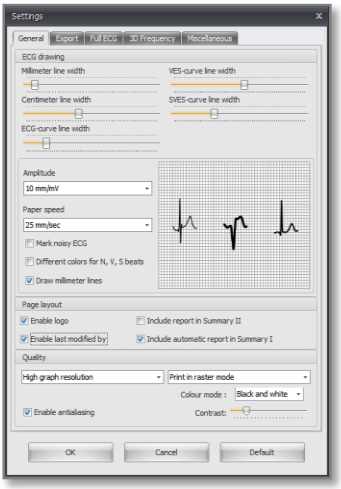
With this checkbox you can hide the personal data of the examined patient, making the report anonymous.

Here you can select the printer (or file format in case of exporting) you want to use from the list. First you have to set the printer in Windows to be able to choose it from here.

General printer settings. Number of copies, orientation, etc.

Print view settings. More in the next sub-chapter.

7.2 Printing settings



7.2.1 General:

ECG drawing:

1. Here we can set the thickness of the graph paper, the ECG curve, the VES and the SVES curve on the pages.

2. In the whole ECG view the program completely cuts the noisy sections, so they will not appear on the reports.

3. You can print beats with different colours.

4. You can set the visibility of the millimetre lines on the reports.

Page layout:

1. You can show/hide the logo at the header of the report.
2. It is possible to make the name of the expert and the date of the last modification visible on the “Report” page (if you have).
3. You are able to show/hide the automatic report on the Summary I page.
4. You can enable to show the interpretation (“Report”) on the Summary II page.
5. Quality:
6. You can set the quality of the printing to low or high graph resolution.

7. You are able to set to print in raster or vectorgraphics mode.

"The major difference is that raster image pixels do not retain their appearance as size increases - when you blow a photograph up, it becomes blurry for this reason. Vector images do retain appearance regardless of size, since the mathematical formulas dictate how the image is rendered."

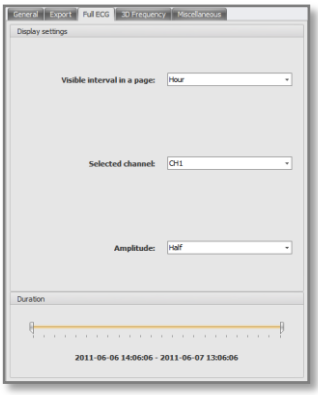
8. In "Black and white" colour mode, it is possible to set the contrast of the millimetre paper lines.

7.2.2 Export

On this page, you can set the file names of the exported reports and the resolution of the exported images.

7.2.3 Full ECG

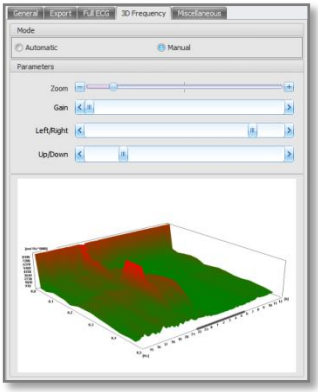
Display settings:



1. You can set the visible interval of ECG on the Full ECG (Total) page to “Hour” and “Half hour”.
2. You are able to select the channel that you want to see on the Full ECG (Total) page.
3. It is possible to change the amplitude of the ECG on the Full ECG (Total) page.
4. Duration:

You can select the interval of the ECG that you want to print on the on the Full ECG (Total) page.

7.2.4 3D Frequency



Mode: You can set it to automatic or manual.

If you select manual:

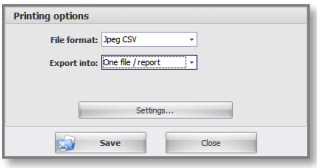
Parameters:

1. You can zoom-in and out for better view.
2. You can increase the gain to set the range of the [ms^2/Hz*1000] parameter.
3. You can rotate the diagram to left and right.
4. You can rotate the diagram to up and down.

7.2.5 Miscellaneous

You can show / hide a table with the marked samples at the bottom of the “Selected samples” page.

7.3 Exporting



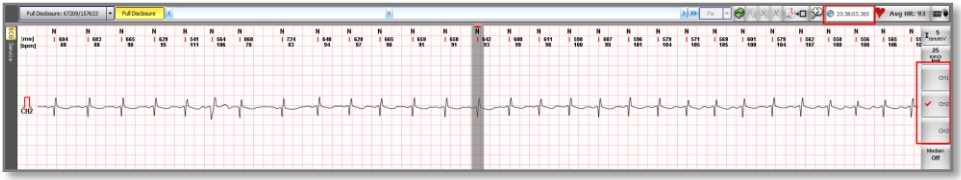
The only thing that is different in this view is the “Printing options” section.

Instead of a printer, you can choose from different file formats (PDF, Jpeg, BMP, Png, Dicom, Jpeg CSV and DCM/PDF file).

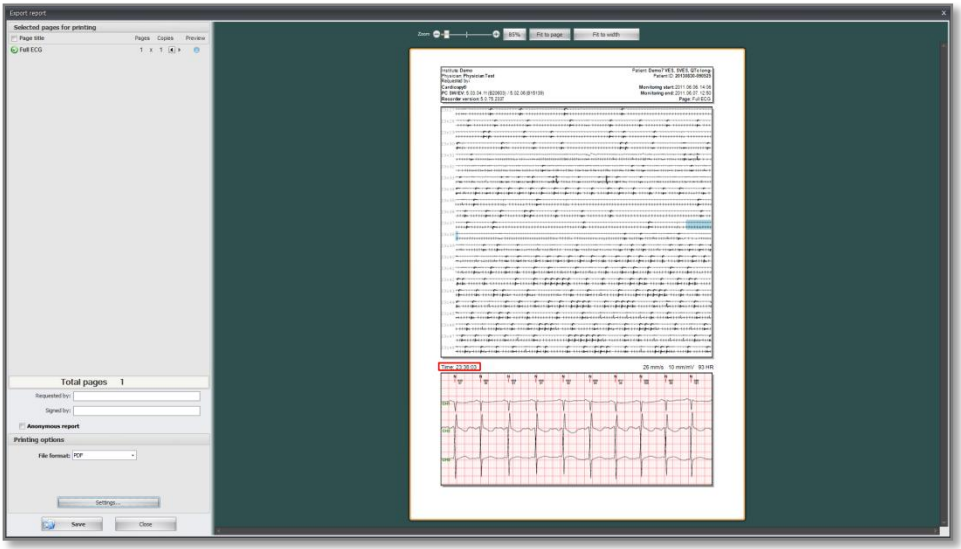
You are able to export the reports by “One file / page” and “One file / page”.

7.4 Print / Export current samples

It is possible to print / export the currently selected ECG section (in the main window).



If you select only 1 or 2 channels, a bigger interval of ECG will be seen.



8 Calculation and Evaluation methods

8.1 ECG

8.1.1 HR calculations

Heart rate (HR graph, Avg HR min, Avg HR max, ECG widow)

$$Avg\ HR = \frac{1000 * 60}{\sum_{10s} RRi}$$

AvgHR is computed from RR intervals in every 10s interval.

$$Act\ HR = \frac{1000 * 60}{\sum_{window}\ RRi}$$

ActHR is computed from the ECG stream on display.

8.1.2 QT, QTc and ST calculations

Corrected QT (Bazett's formula)**:** $QT_c = \frac{QT}{\sqrt{RR}}$

ST level:

ST = ECG[J+] - ECG[Izo]

8.1.3 Turbulence and RR interval calculation:

Determining valid VES beats:

There are at least 3 sinus beats before the VES

There are at least 20 sinus beats after the VES

RR_0 <= 0.8 * RR_{-1},

RR_1 >= 1.2 * RR_{-1},

The heart rate in the pertinent section falls into the HR range which can be set in the Settings menu

Calculation of Reference RR: $RR_{ref} = \frac{\sum_{i=15}^{20} RR_i}{5}$

VES is omitted when any RR interval (except RR_0 and RR_1) is

< 300ms,

2000ms,

RR_i-RR_{i-1} > 300ms,

RR_i / RR_{ref} > 1.2 or RR_i / RR_{ref} < 0.8

Averaging RR intervals: Average RR intervals are computed from RR intervals before and after the valid VES beats in every hour.

Turbulence onset $= \frac{(RR_1+RR_2)-(RR_{-2}+RR_{-1})}{(RR_{-2}+RR_{-1})}$

Calculating Turbulence slope: The maximal positive slope of an average of 5 sinus beats occurring after RR1 (compensatory pause) applied to one beat.

8.1.4 Calculation criteria for VES and SVES events:

VSINGLE – Ventricular single beat:

It contains three types of events in Cardiospy:

1. VE – Ventricular Beat (V): Ventricular extrasystole
2. **VESC:** Escape type ventricular beat
3. **RonT:** If a ventricular (V) QRS is closer to a previous dominant (N, R, L, B) QRS than the "RonT below" parameter (ms) in the Settings / Parameters / ECG-Rhythm menu, it will be marked as an RonT event.

VCPL – Ventricular Couplet:

Two successive ventricular beats.

VRUN – Ventricular Run:

Three successive ventricular beats.

VTCH – Ventricular Tachycardia:

Depending on the settings (V, SV Event definitions), the algorithm will detect Ventricular Tachycardia if the HR of an ECG section (on the AVG HR graph) with V type beats is above the "Ventricular Tachycardia from" parameter.

VTCH_S – Ventricular Sustained Tachycardia:

Sustained Ventricular Tachycardia (>=30s)

VTCH_NS – Ventricular Non-sustained Tachycardia:

Non-sustained Ventricular Tachycardia (<30s)

VRHYTHM – Ventricular Rhythm:

Depending on the settings (V, SV Event definitions), the algorithm will detect Ventricular Rhythm, if the HR of the ECG section (on the AVG HR graph) is below the "Ventricular Tachycardia from" parameter and it is more or equal to the "Bradycardia below" parameter in the Settings / Parameters / ECG-Rhythm menu.

VBRAD – Ventricular Bradycardia:

Depending on the settings (V, SV Event definitions), the algorithm will detect Ventricular Bradycardia, if the HR of the ECG section (on the AVG HR graph) is lower than the “Bradycardia below” parameter in the Settings / Parameters / ECG-Rhythm menu.

VBIG – Ventricular Bigeminy:

A series of subsequently alternating Ventricular and dominant beats.

(Ventricular-dominant-Ventricular-dominant)

VTRIG – Ventricular Trigeminy:

A series of subsequently alternating Ventricular and dominant beats.

(Ventricular-dominant-dominant-Ventricular-dominant-dominant)

SSINGLE – Supraventricular single beat:

It contains one type of event in Cardiospy:

1. SVE – Supraventricular beat (S): Supraventricular extrasystole

SVCPL – Supraventricular Couplet:

Two successive Supraventricular beats.

SVRUN – Supraventricular Run:

Three successive Supraventricular beats.

SVTCH - Supraventricular Tachycardia:

Depending on the settings (V, SV Event definitions), the algorithm will detect Supraventricular Tachycardia, if the HR of an ECG section (on the AVG HR graph) is above the “Supraventricular Tachycardia from” parameter and if the HR has increased compared to the previous section of the ECG more or equal to the “Supraventricular Tachycardia increase” parameter.

SVTCH_S – Ventricular Sustained Tachycardia:

Sustained Supraventricular Tachycardia (>=30s)

SVTCH_NS – Ventricular Non-sustained Tachycardia:

Non-sustained Supraventricular Tachycardia (<30s)

SVRHYTHM – Ventricular Rhythm:

Depending on the settings (V, SV Event definitions), the algorithm will detect Supraventricular Rhythm, if the HR of the ECG section (on the AVG HR graph) is

below the “Supraventricular Tachycardia from” parameter and it is more or equal to the “Bradycardia below” parameter in the Settings / Parameters / ECG-Rhythm menu.

SVBRAD – Supraventricular Bradycardia:

Depending on the settings (V, SV Event definitions), the algorithm will detect Supraventricular Bradycardia, if the HR of the ECG section (on the AVG HR graph) is lower than the “Bradycardia below” parameter in the Settings / Parameters / ECG-Rhythm menu.

SVBIG – Supraventricular Bigeminy:

A series of subsequently alternating Supraventricular and dominant beats.

(Supraventricular-dominant-Supraventricular-dominant)

SVTRIG – Supraventricular Trigeminy:

A series of subsequently alternating Supraventricular and dominant beats.

(Supraventricular-dominant-dominant- Supraventricular -dominant-dominant)

PAUSE:

The time between two heartbeats reaches or exceeds the “Pause from” parameter in the Settings / Parameters / ECG-Rhythm menu.

8.1.5 Interpretation of HRV time domain parameters

(Reference: Circulation 1996, 93:1043-1065, 1996 American Heart Association Inc.)

NN interval:

The interval between two consecutive normal beats. The dominant QRS complexes are interpreted as Normal-N beats.

NN min:

The shortest NN interval measured in the record.

NN max:

The longest NN interval measured in the record.

NN avg:

The sum of NN intervals divided by the number of normal beats.

N-Normal beats:

The number of normal beats during in the record.

SDNN:

The standard deviation of NN intervals in relation to the total recording time. The individual NN intervals must be counted during measurement time. The NN distribution function is obtained by representing these values, by calculating the standard deviation of which the SDNN values measured in ms are obtained. As the SDNN value greatly depends on measurement time, it is recommended to calculate it for 24 hours every time. In addition, it is the only way to interpret properly the comparison of the data with normal values represented in the reference, because these values refer to 24-hour recordings. (Normal range for 24 hours is: 102 – 180 ms)

SDANN:

Standard deviation of the averages of NN intervals in every 5-minute segment of the entire recording. The NN intervals are averaged for every five minutes, and the distribution function is obtained by representing the frequency of the averages. The SDANN parameter is obtained by calculating the standard deviation. (Normal range for 24 hours: 92 - 162 msec)

RMSSD:

The squares of the differences between consecutive NN intervals are added up, divided by the number of the intervals, and taken the square root of.

This value is the RMSSD calculated for the total measurement time. (Normal range for 24 hours: 15 - 39 msec)

SDNNi:

The standard distribution of NN represented is calculated for every five minutes; the values are added up and averaged for the total measurement time.

SDSD:

Standard distribution of differences between consecutive NN intervals.

The distribution of the difference between consecutive NN intervals is represented, the SDSD parameter is obtained by calculating the standard deviation, which is interpreted for the total measurement time.

pNN50:

The value of pNN50 parameter in percentage is obtained by counting the consecutive NN interval couplets having a difference greater than 50 msec, dividing it with the total count of NN intervals, and multiplying by 100.

HRVTi:

Approaching the RR distribution linearly represented with a triangle that covers the given distribution as fully as possible. The HRVTi parameter is obtained by calculating the differences between the intersections of the given triangle and the time axis.

8.1.6 Interpretation of HRV frequency range parameters

(Reference: Circulation 1996, 93:1043-1065, 1996 American Heart Association Inc.)

Total power [ms^2]:

Efficiency spectrum 0.03125 – 0.40625 Hz

LF [ms^2]:

Efficiency spectrum in the low frequency range 0.03125 – 0.15625 Hz

HF [ms^2]:

Efficiency spectrum in the high frequency range 0.15625 – 0.40625 Hz

Normalized values:

$$LFn[\%] = \frac{100 * LF}{LF + HF}$$

$$HFn[\%] = \frac{100 * HF}{LF + HF}$$

The parameters are calculated according to the Wavelet Packets method.

8.1.7 Mathematical methods applied for calculating parameters

Standard deviation:

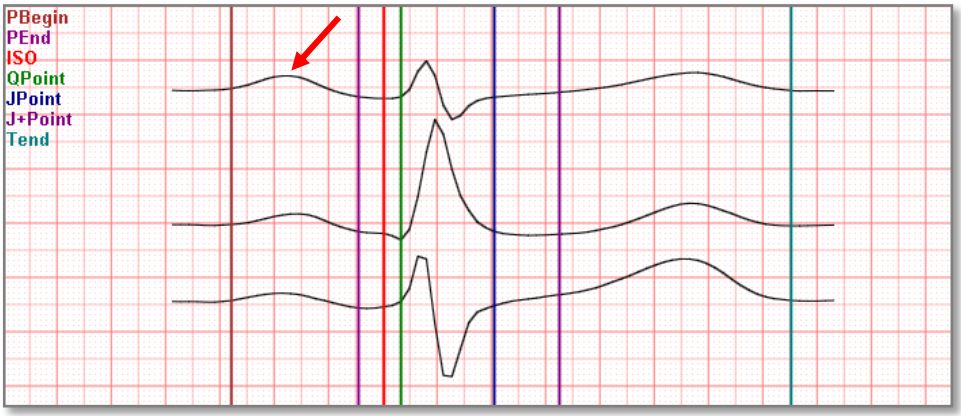
$$SD = \sqrt{\frac{\sum_{i=1}^{N}(Xi - M)^2}{N}}$$

Root Mean Square:

$$RMS = \sqrt{\frac{\sum_{i=1}^{N}(Xi)^2}{N}}$$

8.1.8 P-curve analysis

The Cardiospy is able to detect the P-curve:



8.2 BP

8.2.1 General calculation methods

Pulse Pressure: $PPi = Sys_i - Dia_i$

Medium Arterial Pressure:

$$MAP_i = Dia_i + \frac{(Sys_i - Dia_i)}{3}$$

Diurnal Index:

$$\frac{Data_{(Awake,\,mean)} - Data_{(Asleep,\,mean)}}{Data_{(Awake,\,mean)}}$$

Where Data: Sys, Dia.

Hyperbaric Impact:

$$24 * \frac{\Sigma_{(i=1)}^{N}(Data_i - Norm_i) * Time_i}{\Sigma_{(i=1)}^{N} Time_i}$$

where $Data_i$: Sys_i, Dia_i

$Norm_i$ = the normal value related to the measurement (in Settings)

$Time_i$ = the represented time of the measurement

$$Time_i = \frac{(T_i - T_{i-1}) + (T_{i+1} - T_i)}{2}$$

where T_i = the time of the measurement

Double Product:

Double Product = Sys*HR

Dipper Status:

$$Dipper[\%] = 100 * \left(1 - \frac{Sys_{Asleep,mean}}{Sys_{Awake,mean}}\right)$$

Meaning:

Dipper	Dipper Status
< 0	Reverse Dipper
0-10%	Non-Dipper
10-20%	Dipper
>20%	Extreme Dipper

8.2.2 Morning Surge

Morning Surge is medically defined as the difference in systolic blood pressure during the first two hours after awakening and the lowest level recorded during the day. The greater the difference the more likely is the risk of stroke.

(Article Source: http://EzineArticles.com/3086388)

AASI (Ambulatory Arterial Stiffness Index)

AASI=1-Slope

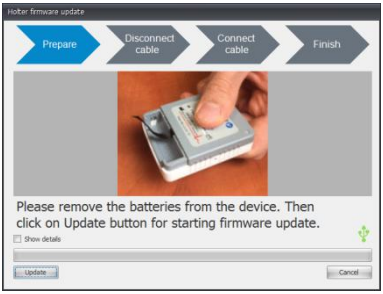
where Slope = Diastole – Systole graph (Scatter) steepness of the regressive line.

9 Troubleshooting and Maintenance

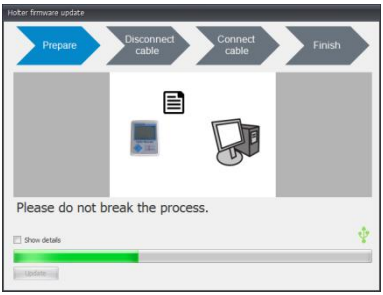
9.1 Firmware update

With every new Cardiospy version, we also **update the Firmware** (internal software of the device) **of V6 Holters** (serial number starts with 1602xxxx or higher). To be able to enjoy the advantages of it, an updating process is required. To update the Firmware of your device(s), please follow the following steps (takes approx. 0,5-1 min):

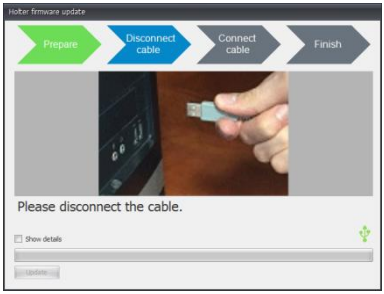
1. Connect the Holter device to the PC with the data transfer cable! **Make sure that you do not have battery in the device!**
2. Wait for the pop-up window of the automatic record reading! After the reading has been finished (close this window if the record has been read already), then a new firmware update window should appear.
3. Click on the Update button!



4. Wait for the process to finish! **If you break this process, you will have to start the update from the beginning!**



5. Now disconnect the cable from the device! **If you do not continue the process from this point, THE DEVICE WILL NOT TURN ON!!!**



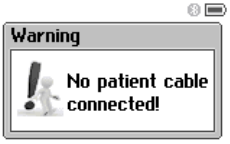
6. Now connect the cable back to the PC! **If you left the battery in the device during the firmware deleting process, now please remove it before you connect the cable back. LEAVING THE BATTERY IN THE DEVICE WILL PREVENT THE PROCESS TO BE CONTINUED!**

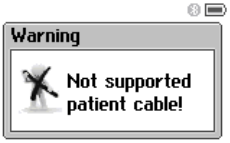
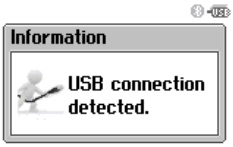
7. Click on the Update button once again! At this point the software will copy the new firmware to the device. **DO NOT BREAK THIS PROCESS OR THE DEVICE WILL NOT TURN ON and the process must be repeated!!!**

8. After the updating has been finished, you should be confirmed by this window:

9. The update was successful. Now click on the Close button. After this point, you can continue to work with your device and enjoy the improvements and new functions!

9.2 Troubleshooting

Error / Event	What to do?
BATTERY ERROR	Batteries are not properly charged in the recording unit. Please use well-charged batteries.
LEAD OFF ERROR	Please place the lead back properly.
COMMUNICATION ERROR	Please check if the connection between the recorder unit and computer is working properly.
NOISE ARTIFACTS ON ECG SIGNAL	Please check if all the electrodes are securely attached to the patient. The electrodes must be applied with sufficient care and expertise in order to make good quality recording.
SELECTED PAGE CAN NOT BE PRINTED	Check if the printer selected is turned on. If you have selected a local printer, check if it is connected to the computer.
RECORDER DOES NOT RECORD FOR 24 HOURS	Please make sure that you use well-charged batteries. Recharge the batteries only with the supplied battery charger according to the enclosed instructions. Please use batteries only of the same type and capacity.
	Please connect the patient cable to the Recorder.
	Please Read the latest record. Please connect the appropriate patient cable to the recorder unit. Please check if the batteries are charged properly.

Error / Event	What to do?
	Please connect the appropriate patient cable to the recorder unit. The compatibility of cables depends on the type of recorder being used.
	The recorder is connected to the USB port.
	Recording has started successfully.
	Recording has stopped.
	It is the start-up screen of the recorder, indicating the recorder configuration type.
	ECG sign, which appears on the recorder's display during the monitoring process.
	The recorder starts.

Error / Event	What to do?
	A message which appears in the upper part of LCD in case of informing.
	A message which appears in the upper part of LCD in case of warning.

9.3 Sending a bug report

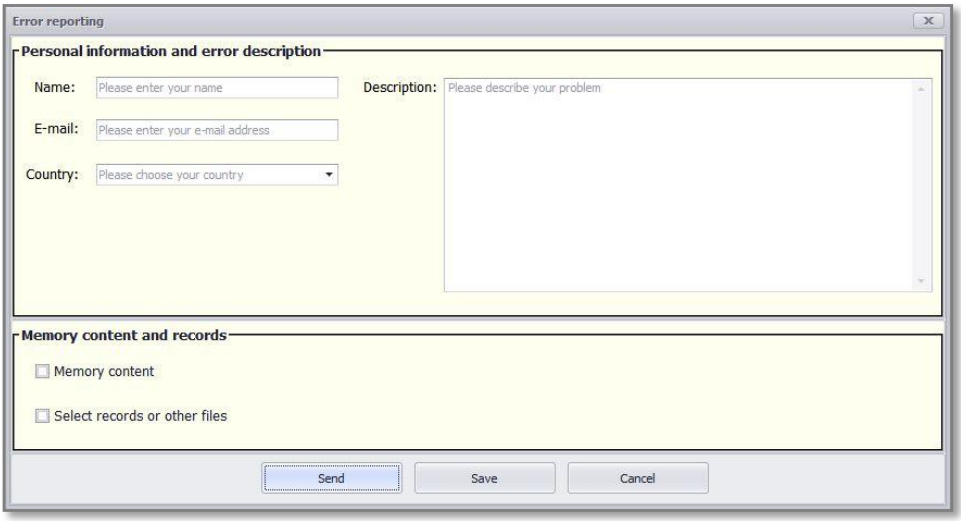
Creating Blackbox:

After the installation you can find a Generate black box shortcut under the Start Menu / Labtech / Cardiospy/. You can also reach this window from the Cardiospy, if you go into the Help / Bug report... menu.

Please fill the description based on your experiences with as much info as possible.

If you are ready to send us the bug report, then you can do it two ways.

1. If you click on the "Send" button, then the bug report will be automatically registered in our Issue Tracking System (Jira).
2. If you chose to save the blackbox file, please send it to our e-mail address. (develop@labtech.hu)



If you have problem with the recorder (you cannot read in for example), then connect the device to the PC and tick the "Memory content" checkbox.

If you exported the record files that you have problem with, you can attach them to the bug report by ticking the "Select records or other files" (like screenshots).

You can make screenshot with the Print Screen button, then import it to Paint with CTRL+V and save the file. The screenshots are important in that case you got an error message or to show in the record where you have problem with it.

9.4 Maintenance and Calibration

9.4.1 Calibration

Calibration of the devices has to be carried out from time to time as prescribed by the relevant standards. To ensure calibration is performed according to the relevant standards, please return the device to Labtech Ltd. where we will perform calibration free of charge.

The accuracy of controls is assured by using long lasting parts and techniques that are able to preserve their accuracy during the life cycle of the product.

9.4.2 Maintenance

Inspect every cable, pneumatic hose and the monitor case for cracks or fraying before each measurement. Do not use the monitor in case it shows any sign of damage.

The case of the recorder unit may be cleaned or washed if necessary. Do not immerse the monitor in any fluid, or attempt to clean with liquid detergents, cleaning agents, or solvents.

The quality of the batteries declines with time: it is recommended to switch to new ones after 6 months of usage.

Cleaning of the device

Do not dip the device in liquid, for cleaning the device use moistened wipes with a moderate acting (not aggressive) disinfectant or cleaning agent. Liquid getting inside of the device can cause electric failures!

Cleaning of the Blood Pressure cuff

First, remove the rubber tube and to clean the textile cuff.

Wipe or wash the cuff with moistened wipes with a moderate acting (not aggressive) and temperature (max. 30 °C) disinfectant or cleaning agent. Dry on room temperature.

10 Technical Specifications

10.1 Specification table of Holter recorders (EC-2H; EC-3H; EC-12H)

TECHNICAL SPECIFICATIONS OF DIFFERENT HOLTER SYSTEMS			
Type of Holter Recorders	**EC-2H**	**EC-3H**	**EC-12H**
Bipolar ECG Channels	1, 2	1, 2, 3	1, 2, 3
Other ECG Channels	-	+PM, Nehb	+PM Standard 12 CH, Nehb
Respiration	-	Yes	Yes
Number of snap type Leads	3, 5	3, 4, 5, 7	3, 4, 5, 7, 10
The battery can be changed during recording	Yes		
Recording duration maximum (with battery changing)	336h		
Dynamic Bandwidth	±20 mV		
DC Offset Range	±600 mV		
Frequency Response maximum	0.05 Hz … 150Hz		
Sampling Rate	125 Hz, 250 Hz, 500 Hz, 1000 Hz		
Recording Rate	125 Hz, 250 Hz, 500 Hz, 1000 Hz		
Common Mode Rejection Ratio	120dB		
A/D Resolution	16 bit		
Input impedance	>100 MΩ		
Power Source	1x1.2 V AAA NiMH (or 1x1.5 V AAA alkaline)		
Battery Life	min. 24 h, up to 48 h using a high-capacity battery		

TECHNICAL SPECIFICATIONS OF DIFFERENT HOLTER SYSTEMS	
Storage Card Capacity	built-in 2GB (microSD)
Internal Voltage (max)	3.3 V
Display	LCD (Grey Scale 160x100 pixels)
Movement detection-3D	Yes
Patient Event button	Yes
Monitoring ECG	On PC via Bluetooth and on LCD as well
Reading Record	via USB cable
International Protection Rating Against Water: IPX0	Yes
Size	53 x 67.5 x 18.5 mm
Weight	~ 50 g

10.2 Specification table of Holter recorders (EC-3H/ABP)

TECHNICAL SPECIFICATION I.	
Bipolar ECG Channels	1, 2, 3
Other ECG Channels	NEHB +PM
Number of snap type Leads	3, 4, 5, 7
Recording Period (hours)	24, 48, 72 h
The battery can be changed during recording	Yes
Dynamic Bandwidth (min)	±20 mV
DC Offset Range (min)	±800 mV
Frequency Response (max)	0.05 Hz … 150Hz
Sampling Rate	256 Hz … 2048 Hz
Recording Rate	128 Hz … 1024 Hz

Common Mode Rejection Ratio (min)	120dB
A/D Resolution	16 bit
Input impedance (min)	100 MΩ
Power Source	2 x 1.2 V AA rechargeable batteries of minimum 2500 mAh capacity or 2 x 1.5V AA high quality alkaline batteries
Battery Life (min)	24 hours
Storage Card Capacity	2GB (µSD)
Internal Voltage (max)	3.3 V
Movement detection-3D	Yes
Monitoring ECG	On PC via Bluetooth
Reading Record	via USB 2.0 (USB A – HDMI)
International Protection Rating Against Water: IPX0	Yes
Size	Approx. 125 x 70 x 33 mm
Weight	Approx. 250 g (incl. Batteries)

TECHNICAL SPECIFICATION II.	
BP measurement method:	Oscillometric with step deflation, Diastolic values correspond to Phase 5 Korotkoff Sounds
BP measurement range:	25 – 260 mmHg (max inflate 300 mmHg)
Pressure Transducer Accuracy:	± 3 mmHg
Pulse Rate Range:	30 – 220 BPM (Beats Per Minute)
Pulse Rate Accuracy:	± 2% or ±3 BPM, whichever is greater
Calibration:	The device should be verified on a yearly interval.
Safety Systems:	Max. inflation pressure is limited to 300 mmHg; Auto safety release valve for power failure. Maximum cuff inflation time is limited to 75 seconds. Duration of blood pressure reading is limited to 130 seconds.
Clinical Accuracy:	Meets accuracy requirements of ANSI/AAMI SP10:2002(R)2008, EN1060-4:2004 and ISO 81060-2:2009.