Norav Users Guide

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For Models: S, M, HR, W and Blue-ECG software versions: 5.34

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Standards Compliance

The interference generated by the device was tested according to the EMC 89/336/EEC and found compliant with the standard.

The software complies with *Standards for Analysis of Ventricular Late Potentials Using High Resolution or Signal Averaged Electrocardiography*, published in 1991 by the *Task Force Committee of the European Society of Cardiology*, the *American Heart Association,* and the *American College of Cardiology.*

The PC-ECG conforms to MDD 93/42 EEC Annex V, EC11 and EN 60601-2.

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> **!**   US Federal Law restricts this device to sale by, or on the order of, a physician
>
> **Caution**

The PC-ECG 1200 is tested and certified for the following standards:

EN60601/1:	International
EN60601/2/25:	International
EN60601/2/27:	International
Protection type and class:	Model M – II BF, Model S – II CF
Defibrillation protection:	Built in for Models 1200M, 1200HR, 1200W, Blue-ECG and 1200S.

Disclaimer

This system is intended as a decision support system for persons who have received appropriate medical training, and should not be used as a sole basis for making clinical decisions pertaining to patient diagnosis, care, or management. Any application of medical information from the program, other than the original design or intended use thereof, is not advised and considered a misuse of the software product.

Norav Limited Warranty

Norav products are warranted to be free from manufacturing and material defects for a period of one (1) year from the date of shipment from Norav or the dealer to the original purchaser.

Excluded from this warranty are expendable supply items including, but not limited to, electrodes, lead wires, patient cables, and batteries. This warranty does not apply to any product that Norav determines that it has been modified or damaged by the customer.

Except for the express warranties stated above, Norav disclaims all warranties including implied warranties of merchantability and fitness. The stated express warranties are in lieu of all obligations or liabilities on the part of Norav for damages, including but not limited to, special, indirect, or consequential, arising out of or in connection with the use or performance of Norav products.

Any action for breach of warranty shall be commenced within one (1) year of said breach or be forever barred. Any repairs made to the product that are not covered by the warranty shall be billed to the customer.

For service or technical support contact your local supplier or Norav Medical.

Document History

Version	Date	Updates	Changed by
060408	06/04/2008		David
060708	06/07/08	Norav Logo; Document history; RS232 controlled treadmill types;	David
100708	10/07/2008	Stress – Add Dynamic ST function	David
181110	18/11/2010	Updates	David
241110	24/11/2010	Updates	David

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CHAPTER 1:   INTRODUCTION

Manual Organization

This manual explains in detail how to install and use the PC-ECG 1200.

At the beginning of each application chapter, there is a **Quick Start** section, which is a brief explanation of how to carry out a study, including the keyboard short-cuts for the main functions. If you are familiar with ECG procedures, you can use this Quick Start section to get up and running quickly.

The software must be installed before the hardware. See Software Installation, page *9* and Hardware Installation*, page *17*.

Document Conventions

Notes and Cautions

Pay particular attention at specific points in a procedure when one of the following messages appears:

⚠️ **WARNING**	Warnings call attention to possible hazards involving potential damage or injury to persons.

! **Caution**	Cautions refer to practices necessary to protect against potential damage or loss to equipment. Pay careful attention to instructions.

📝 **Note**	Notes provide pertinent information to help obtain optimum performance from the software or signify an important step or procedure that requires special attention.

Abbreviations and Acronyms

Abbreviation	Meaning
BP	Blood pressure
ECG	Electrocardiogram
Database	Database application
HRV	Heart Rate Variability
ID	Identification
LP	Late Potential
LQTS	Long QT Syndrome
METS	Metabolic Stress Estimation
SN	Serial Number
USB	Universal Serial Bus

Equipment Symbols

Symbol	Description
	Type BF equipment
	Type CF equipment
	Class II equipment
	Complies with the Medical Device Directive of the European Union
	Non-ionizing radiation.

CHAPTER 2:   OVERVIEW

Package Contents

The PC-ECG 1200 package contains the following elements:

- Acquisition box

- Patient cable

- Data cable combined with power supply or USB cable

- Software CD with the PC-ECG 1200 installation package, including:

  ◊ Rest

  ◊ Measurements and Interpretation (MEANS)

  ◊ Stress

  ◊ Monitor

  ◊ HRV

  ◊ LP

  ◊ Database

- Software key (if optional software is included)

- One of the following devices:

  ◊ PC-ECG 1200S (page 20)

  ◊ PC-ECG 1200M (page **Error! Bookmark not defined.**)

  ◊ PC-ECG 1200HR (page 25)

  ◊ PC-ECG 1200W (page 27)

  ◊ Blue-ECG (page 31)

Programs

Each program has a specific purpose. The following is a brief description of when to use each one:

Rest	Records and measures short ECG tests on patients in resting position (up to 10 seconds)
Stress	Records and measures ECG tests on patients under stress conditions using a pre-defined test protocol. The stress test includes 3 basic stages: • Rest • Stress • Recovery Each stage may be divided into more than one phase according to the testing protocol used.
Monitor	Works with an ECG device to record, monitor and save a prolonged ECG test in rest condition
HRV	Tests according to time how patient pulse and heart rate varies with load, medication, etc.
LP	Predicts tendency to ventricular tachycardia
Database	ECG Database Management System. Manages patients and ECG tests details.

PC-ECG Models

1200 S	Record ECG test during stress condition (stationed on table)
1200 M	Record ECG test at rest condition
1200 HR	Portable device to record ECG during stress condition (attached to patient's body)
1200 W	Wireless RF ECG Recording test during stress and rest condition (attached to patient's body)
Blue-ECG	Wireless Bluetooth ECG Recording test during rest condition (attached to patient's body)

Indications for Use of the PC-ECG 1200

ECG Intended Use

ECG is intended to disclose either normal condition or patterns of arrhythmia, myocardial ischemia, rate abnormalities, or features of prognostic value in the following cases:

◊ Patients with suspected cardiac abnormalities

◊ Populations of patients at an age or period in which a routine baseline evaluation of ECG characteristics is desired.

QT Analysis is useful in the assessment of long QT syndrome (LQTS). In some instances, LQTS can be corrected by pharmacological therapy. QT analysis is also used to measure QT dispersion, the difference between maximal and minimal QT values. QT dispersion is a measure of the in homogeneity of ventricular repolarization.

The PC ECG 1200 has been tested to measure Heart Rate Variability to within 1 millisecond tolerance. The clinical significance of Heart Rate Variability measures should be determined by a physician.

The PC ECG 1200 has been tested to measure Late Potential to a tolerance of within 1 millisecond, and 1 microvolt. The clinical significance of Late Potential measures should be determined by a physician.

Stress Testing Intended Use

Angina pectoris (chest pain) is a clinical syndrome resulting from myocardial ischemia, indicative of reduced blood supply to the cardiac muscle. The electrocardiogram may establish the diagnosis of ischemic heart disease if characteristic changes are present. Stress testing is the most widely used method to decide whether this chest pain is related to myocardial ischemia, and thus to coronary artery disease. In stress testing, the contractile capability of the heart muscle is monitored via ECG during patient exercise. Patients exercise by bicycle, treadmill, or other means, while the ECG is monitored continuously. Exercise loads are determined by predefined protocols. The ECG signals are recorded for the resting, exercise, and recovery phase portions of the exercise protocol. The changes in ECG waveforms are compared to the resting ECG records. Most of the commercial stress test systems control the bicycle or treadmill automatically according to the requirements of the chosen protocol, although this is not essential.

ST segment monitoring is intended as an aid in the evaluation of myocardial ischemia in patients with known or suspected coronary artery disease. The ST segment algorithm has been tested for accuracy of the ST segment data, and a database is used as a tool for performance testing.

The significance of the ST segment changes **must** be determined by a physician.

Contraindications for Use and Adverse Effects

The device has no contraindications or adverse events.

CHAPTER 3: SOFTWARE INSTALLATION

System Requirements and Prerequisites

Hardware

> **Note**
>
> Stress application with real-time printout is resource intensive.
>
> To optimize performance, we recommend that you disable "Start Up" programs to free system resources. For instructions, see Windows help.

> **Note**
>
> The PC should not be set up to work under saving power conditions. Do not enable PC sleep mode (standby), hibernate, or turning off the hard disk while running an ECG test.

PC Minimum Configuration

Application	CPU Speed (MHz)	RAM Memory (MB)	Disk Space (GB)	Number of Free RS232 or USB Ports
Rest	100	32	2	1
Monitoring Application	200	32	4	1
LP	450	128	2	1
HRV	450	128	2	1
Database	200	64	8	1
Stress	1000	128	20	2
Stress + R trigger	1300	128	20	2
Stress + Blood pressure monitor	1500	128	20	3

Table 1: Minimum Computer Configuration

Installing Printers

Application	Technology	RAM Memory (MB)	Driver
Rest	LASER/INK	2	Vendor / MS
Monitoring Application	LASER/INK	2	Vendor / MS
LP	LASER/INK	2	Vendor / MS
HRV	LASER/INK	2	Vendor / MS
Database	LASER/INK	2	Vendor / MS
Stress	Fast LASER	8	MS

Table 2: Printers Installation Requirements

Installing the Thermal Printer

Use a 4 inch or 8 inch thermal printer. The thermal printer driver is installed separately from the PC-ECG 1200 program.

A thermal printer can be supplied by Norav (MP200, 8 inch). This printer requires the purchase of a dongle with P1 license permission. The MP200 driver is available on the PC-ECG 1200 CD at the following path: "<CD>:\MP200\OEMPRINT.inf".

Installing or Updating The PC Software

Note: Install the software before installing the hardware. If the device is connected to the PC, disconnect the device before installing the software.

The software package works under Windows XP, VISTA, Windows 7 OS.

To Install PC-ECG 1200

1.   Insert the CD in the drive.
      The installation program starts automatically.

Follow the instructions on-screen.0 .

After you have completed installation, a group icon called PC-ECG 1200 is added to the desktop. Double-click the group icon to display the following program icons:

Note:	Icons are displayed only for those programs for which you have purchased the license

Icon	Explanation
	Heart Rate Variability
	Late Potential Signal Averaging
	Monitoring
	Resting ECG
	Stress Test
	Database application

Table 3: Program Icons

Resting ECG is the basic software package. It does not require a software key.

The following are optional and require software keys:

◊   Measurement and interpretation functions for Resting ECG

◊   ECG Database

◊   Heart Rate Variability

◊   Late Potential

◊   Monitoring

◊   Stress Test

You can activate optional packages that have no key by selecting **Simulator** in Setup (see Simulator ECG, Page 44).

If you have purchased the **S2** remote viewing, install the **Remote View** program from the **Remote View** directory on the CD. This program enables a remote viewer for an ECG study. The image is displayed in JPEG format.

Note	Only one HASP key/dongle per computer is possible. If you already have a HASP key/dongle with a Norav option and would like to add an additional option/s it will need to be added to your present key. When requesting an additional software option, kindly inform your local supplier that you already have a HASP key/dongle, its serial number and the option codes. To find this information go to Help-About and copy HASP ID Number and Permissions.

To Uninstall PC-ECG 1200

New Version Replacing Old Version

There is no need to remove the previous installation. The existing setup will remain for the new version.

If the new software version does not operate properly, remove the old installation (see *Old Version Replacing New Version*, below) and then remove the old existing setup as follows:

Start → Run→ Type regedit→ OK→ Choose HKEY_CURRENT_USER → Software→ NORAV MEDICAL→ Edit→ Delete

Old Version Replacing New Version

Uninstall the existing version as follows:

My Computer → Control Panel → Add/Remove Programs → PC-ECG 1200 → Add/Remove → OK

To Free Disk Space and Ensure Smooth Operation

Windows provides utilities to delete superfluous files, and to defragment the disk. Refer to Windows help for instructions on using Disk Cleanup and Defragment.

Backing up and Restoring Setups and Protocols

When you reinstall or upgrade PC-ECG 1200, the program overwrites your existing configurations and protocols.

To save the configuration data for stress application, follow these procedures:

To Save Stress Test Setup

Start Stress ECG.

Click View**Save Setup (see** Figure 1**).**
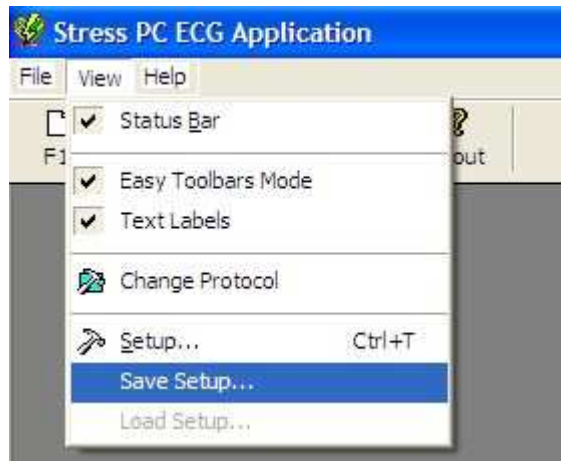
Figure 1: Saving Stress Setup

Name the file.

Provide a location in which to save the file and Click **OK.**

To Load Stress Test Setup

1. Start **Stress ECG.**

Click View**Load Setup.**

Click **Browse** and find the location in which the file is saved.

Select the file (with the name you gave it and the suffix 'STF') and click **OK.**

To Save Stress Protocols

1. Create a new directory in C:\My Documents, with a name like **PcBackup.**

Copy file **StWorked.mdb** from the directory where PC-ECG is installed (normally C:\Program Files\PC-ECG).

Paste it into a backup directory (e.g., C:\My Documents\PcBackup).

To Load Stress Protocols

1.   Copy the file **StWorked.mdb** from the directory where you saved it (e.g., C:\My Documents\PcBackup).

Paste it into the directory where PC-ECG is installed (normally C:\Program Files\PC-ECG).
A window is displayed, asking you if you would like to replace the existing file.

Click **Yes**.

To Set Preferences

1.   After installing the PC-ECG 1200 package, and prior to operation, click **Setup** to tailor your preferences.

Begin with **Environment**, which configures the hardware.

Continue with the other tabs in any order.

CHAPTER 4: HARDWARE INSTALLATION

Safety

![WARNING triangle] **WARNING**	The PC-ECG 1200 uses mains power supply (unless connected via the USB port). It is also sensitive to electrical interference.
	The wireless PC-ECG 1200W transmitter uses battery power supply. PCECG1200WR receiver uses Power supply via USB port. It is also sensitive to electrical interference. The wireless Blue-ECG uses battery power supply. It is also sensitive to electrical interference.
	The PC-ECG 1200 controls exercise machines.
	To prevent possible injury, read this page carefully prior to installing the device.

- A patient undergoing a test must be at a distance of at least:

  - ❑ 1.5 meters from the computer, printer and other peripherals, and

  - ❑ 2.5 meters from the ceiling.

- If such conditions cannot be fulfilled, the entire system needs to be connected to the A/C power supply through an Isolation transformer meeting the EN60601/1 standard.

- Use only the original data cable/power adaptor assembly.

- Use only the recommended battery type as instructed in the technical specifications to operate the PCECG1200W (4 - AA alkaline or NIMH rechargeable) or for Blue-ECG (2 batteries).

- Do not use batteries with expired dates.

- Remove batteries form the unit (PCECG1200W/Blue-ECG) when it is not in use.

- Any treadmill used with the PC-ECG 1200 must contain a manual control in order to allow the user to stop the operation of the treadmill in case of emergency.

- In the event of apparent changes in the performance of the device, discontinue use immediately. Do not resume use until the device is approved by the manufacturer or by a representative of the manufacturer.

- If audio is playing on the PC, the ECG shows interference. Do not run an audio CD on the PC while running an ECG test via the USB connection.

- Defibrillation protection is built in for Models W, M, HR, S and Blue-ECG.

- Operate the unit only at clinics and hospitals. Do not use at home.

- Operation only by trained medical staff.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference and
(2) This device must accept any interference received, including interference that may cause undesired operation.

Note   The manufacturer is not responsible for any Radio or TV interference caused by unauthorized modifications to this equipment. Such modifications could void the user's authority to operate the equipment.

Note   Install hardware only after software installation.

CLASSIFICATION OF THE EQUIPMENT

o According to the type of protection against electric shock:
   INTERNALLY POWERED EQUIPMENT

o According to the degree of protection against electric shock:
   TYPE CF APPLIED PART

o According to the degree of protection against ingress of water:
   ORDINARY EQUIPMENT

o According to the degree of safety of application in the presence of a flammable anaesthetic mixture with air or with oxygen or nitrous oxide: EQUIPMENT NOT SUITABLE FOR USE IN THE PRESENCE OF A FLAMMABLE ANAESTHETIC MIXTURE WITH AIR OR WITH OXYGEN OR NITROUS OXIDE.

o According to the mode of operation: CONTINUOUS OPERATION

Installing Model 1200S and Model 1200M

The PC-ECG 1200S or PCECG 1200M kit contains the following items:

◊ Acquisition box (see Figure 2, below)

◊ Patient cable (see Figure 3, page 21)

◊ USB cable (see Figure 4, Page 22)

◊ Software CD of PC-ECG 1200 installation package.

◊ Software key (if optional software is included)
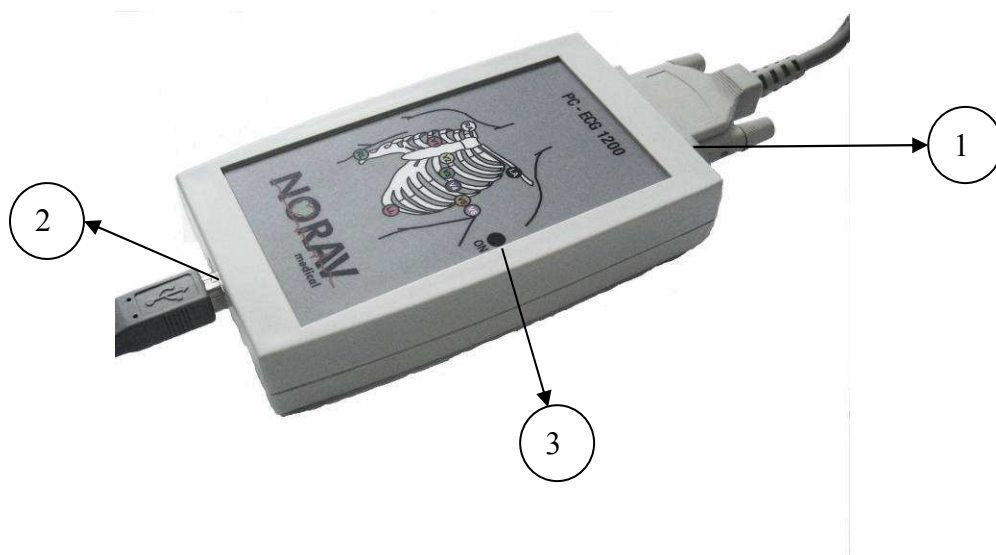
Figure 2: PC-ECG 1200S / PCECG 1200M

Clip connections

8

Banana type connections

Press-stud type connections
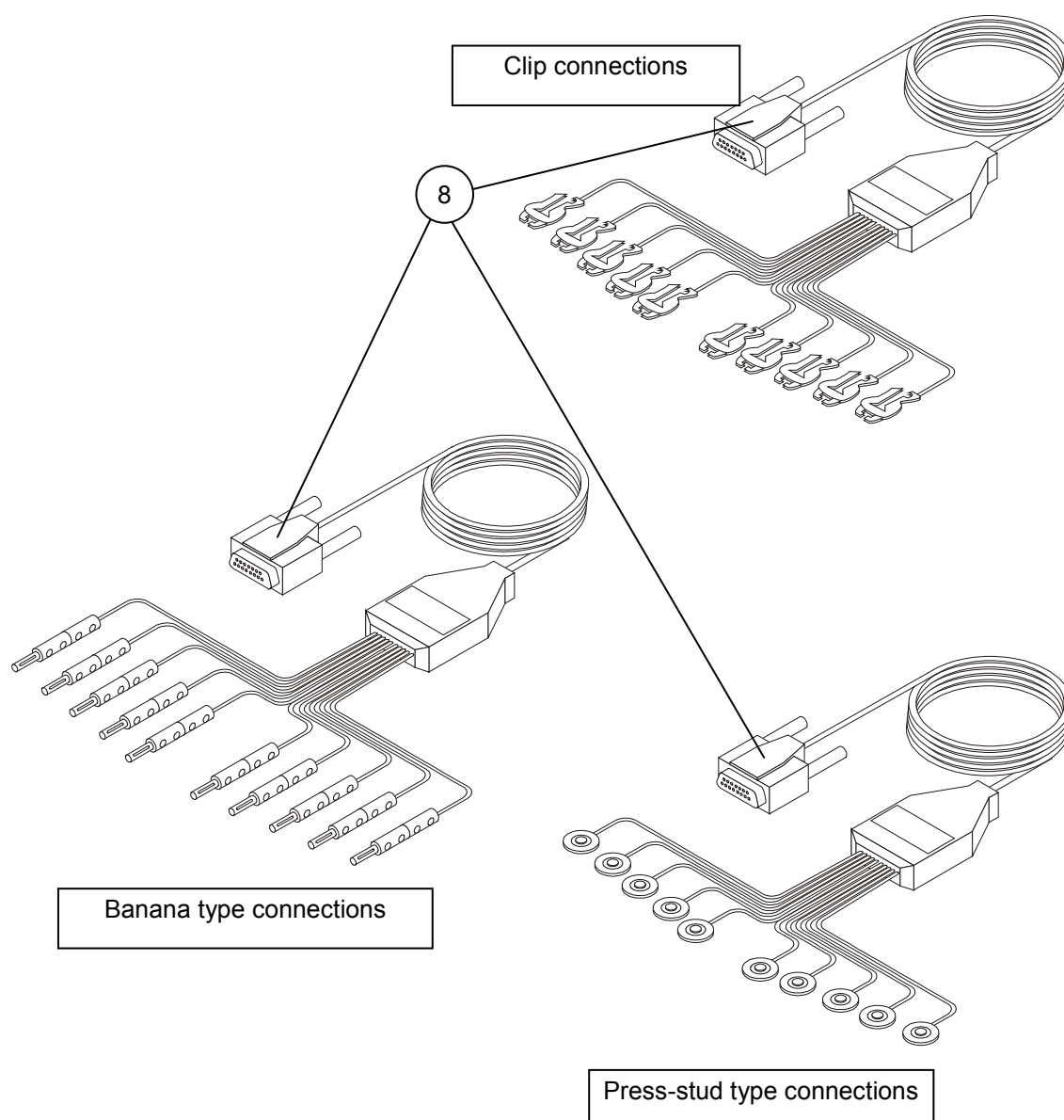
Figure 3: Patient Cable
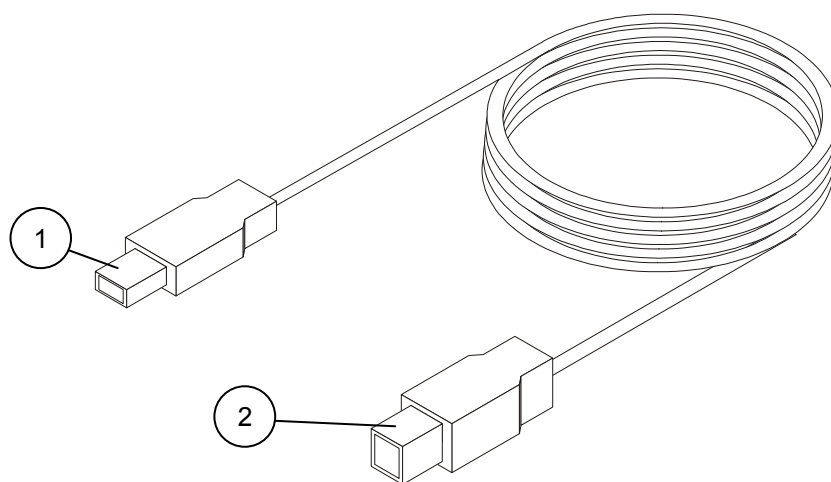
Figure 4: USB Cable

To Connect Via USB

> **!**
>
> Make sure the device is switched off Cautions refer to practices necessary to protect against potential damage or loss to equipment.
>
> **Caution**

1. Connect the A-type connector of the USB cable (Figure 4, Page 22, detail 1) to the PC.

2. Connect the B-type connector of the USB cable (Figure 4, Page 22, detail 2) to the input of the 1200 S unit (Figure 2, Page 20. detail 1).

A wizard for installing new hardware driver appears. Follow the instructions. If working under Windows XP press "Continue anyway" on message regarding the digital signature. After the driver is installed make sure the green light is illuminated on the 1200 S unit (Figure 2, detail 3).

Verify that the ON light is illuminated (Figure 2, detail 3).

Connect the patient cable (Figure 3, Page 21, detail 8) to the 15-pin plug of the PC-ECG 1200S (Figure 2, page 20, detail 1).

If the optional software key is included, connect it to the parallel port of the computer or USB (if of such type).

If a printer is connected, plug the printer cable into the key.

To Verify the Connections

1. Run REST application.

2. Press F1 for a new test.

3. Insert patient details in the dialog and then press OK.

4. Verify that traces are acquired and displayed on the screen.

To Perform Maintenance

!	The device is not waterproof. Do not expose the device to water or any kind of liquid. Maintain in a dry place.
Caution	

Use alcohol pads to clean the device of moisture and hairs.

Calibration

The device does not need any calibration.

Installing Model 1200HR

The PC-ECG 1200HR kit contains the following items:

◊   Acquisition box (see Figure 5, below)

◊   Patient leads

◊   Built-in USB cable (see Figure 5, below)

◊   Software CD of PC-ECG 1200 installation package.

◊   Software key (if optional software is included)
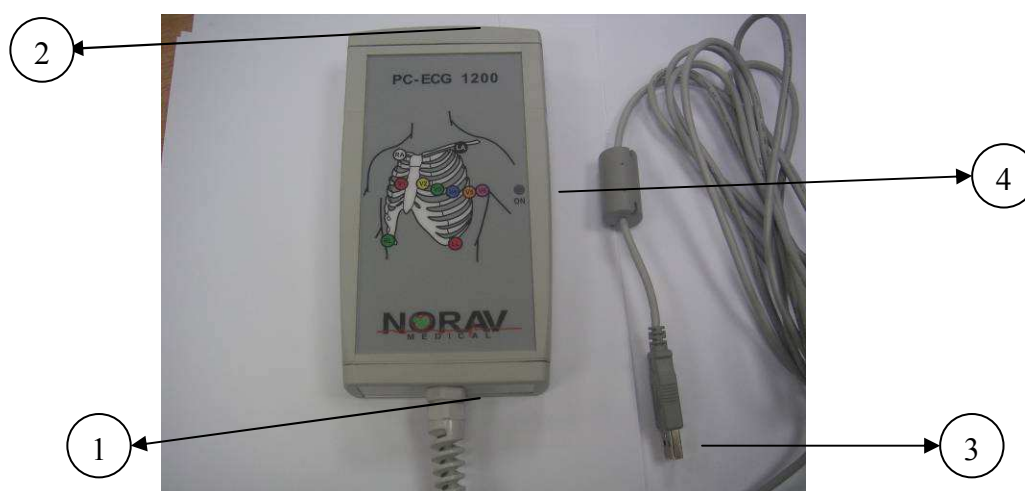
Figure 5: PC-ECG 1200HR (with built-in USB cable)

To Connect Via USB

> **!**   Make sure the device is switched off Cautions refer to practices necessary to protect against potential damage or loss to equipment.
>
> **Caution**

1. Connect the USB A-type connector of the USB cable (Figure 5, Page 25, detail 3) to the PC.

2. A wizard for installing new hardware driver appears. Follow the instructions. If working under Windows XP press "Continue anyway" on message regarding the digital signature (each time it appears). After the driver is installed make sure the green light is illuminated on the 1200 HR (Figure 5, Page 25, detail 4)

3. Connect the patient cable (Figure 3, page 21, detail 8) to the 15-pin plug of the PC-ECG 1200HR (Figure 5, Page 25, detail 2).

To Verify the Connections

1. Run REST application.

2. Press F1 for a new test.

3. Insert patient details in the dialog and then press OK.

4. Verify that traces are acquired and displayed on the screen.

To Connect to the Patient and the Computer

1. Verify that the indication LED is on.

2. Connect the electrode leads to the electrodes, starting with RL.

3. If the optional software key is included, connect it to the parallel port of the computer.

4. If a printer is connected, plug the printer cable into the key.

To Verify the Connections

1. Connect the PC-ECG 1200 to the patient.

2. Connect the electrode leads to the electrodes, starting with RL.

3. Verify that an ECG is acquired and displayed on the screen.

To Perform Maintenance

> **!** The device is not waterproof. Do not expose the device to water or any kind of liquid. Maintain in a dry place.
>
> **Caution**

Use alcohol pads to clean the device of moisture and hairs.

Calibration

No calibration is required.

Installing Model 1200W

The PC-ECG 1200W kit contains the following items:

◊   Acquisition box (see Figure 6, below)

◊   Patient leads

◊   USB cable (see Figure 7, page 28)

◊   Antenna

◊   1200 WR receiver (see Figure 8, page 30)

◊   Software CD of PC-ECG 1200 installation package.

◊   Software key (if optional software is included)

Figure 1 **C-ECG 1200W**
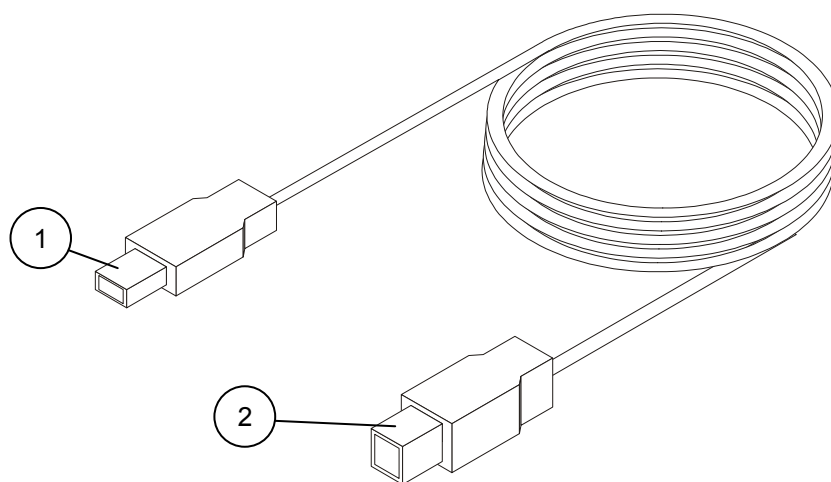
Figure 7: USB Cable

To Connect Via USB

> ! **Caution**   Make sure the device is switched off Cautions refer to practices necessary to protect against potential damage or loss to equipment.

1. Connect Antenna (Figure 8, Page 30, detail 4) to the connector on 1200WR Receiver (Figure 8, Page 30, detail 2).

2. Connect the A-type connector of the USB cable (Figure 7, Page 28, detail 1) to the PC.

3. Connect the B-type connector of the USB cable (Figure 7, Page 28, detail 2) to the input of the 1200WR Receiver (Figure 8, Page 30, detail 1).

4. A wizard for installing new hardware driver appears. Follow the instructions. If working under Windows XP press "Continue anyway" on message regarding the digital signature (each time it appears). After the driver is installed make sure the green light is illuminated on the 1200 WR Receiver (Figure 8, Page 30, detail 3)

5. Insert 4 - AA alkaline or NIMH rechargeable batteries into the battery compartment of the PCECG1200W unit.

6. Switch on the PC-ECG 1200W (Figure 6, Page 27, detail 2) and verify that the ON light is illuminated Figure 6, Page 27, detail 3).

7. Connect the 10 patient leads according to the lables to the 10 connectors of the PC-ECG 1200W (Figure 6, Page 27, detail 1).

8. If the optional software key is included, connect it to the parallel port of the computer.

9. If a printer is connected via the parallel port, plug the printer cable into the key.

The optional BNC output (Figure 8, Page 30, detail 5) is a trigger control for connecting to an external device, such as an ergometer or the Tango unit.
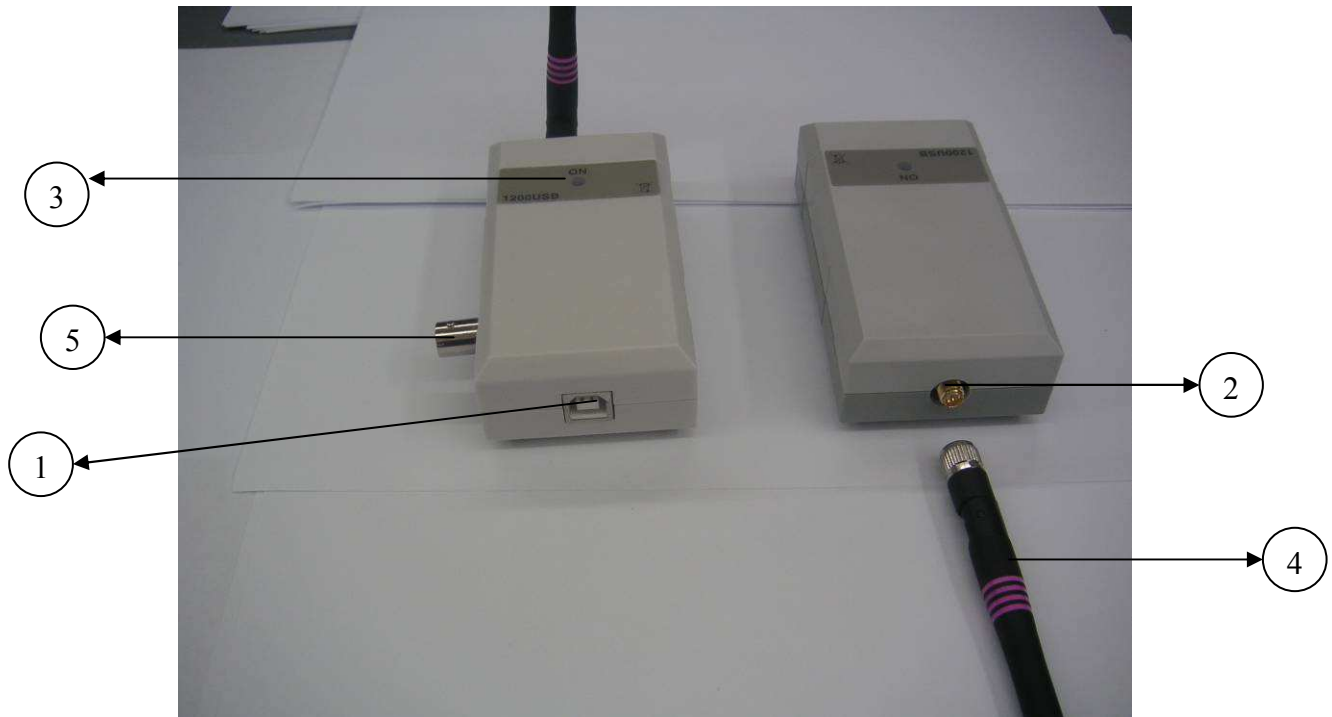
Figure 8: 1200 WR Receiver

To Verify the Connections

10. Connect the PC-ECG 1200W to the patient.

11. Connect the electrode leads to the electrodes, starting with RL.

12. Verify that an ECG is acquired and displayed on the screen.

To Perform Maintenance

> **!**
>
> The device is not waterproof. Do not expose the device to water or any kind of liquid. Maintain in a dry place.
>
> **Caution**

1. Use alcohol pads to clean the device of moisture and hairs.

Calibration

The device does not need any calibration.

Installing Model Blue ECG

The PC-ECG 1200 Blue ECG kit contains the following items:

◊　Acquisition box

◊　Patient cable

◊　Two AA size alkaline batteries (optional)

◊　Bluetooth USB adaptor

◊　USB extension cable

◊　Software CD of PC-ECG 1200 installation package

◊　Software key (if optional software is included)

Figure 9: PC-ECG 1200 Blue ECG

To install the Blue ECG device

1. If PC doesn't have built-in Bluetooth device connect the Bluetooth adapter to computer's USB port and check that it installed correctly.

 Note	The Blue ECG is only compatible with **Microsoft Bluetooth Stack** communication software. Toshiba laptops and other computers having **Toshiba Bluetooth Stack** software are **not compatible**.

Check that Bluetooth icon appears in system tray:

Figure 10: Bluetooth Icon on system tray

2. Add the Blue ECG to Bluetooth devices list:
   a. Switch ON the Blue ECG device
   b. Double click on the Bluetooth icon in the system tray.
   c. On the Bluetooth Devices tab, click on the Add button.
   d. Check the "My device is setup and ready to be found" option and click on the Next button.
   e. When Windows will detect the Blue ECG device select it in a list then click on the Next button.
   f. On next panel select "Use the passkey found in the documentation". Enter **12345** as the passkey and click on the Next button.
   g. Click Finish button to finalize registration.

3. Run the Resting ECG program, select **Bluetooth** option in setup ENVIRONMENT panel.
4. Close the Resting ECG program.
5. Connect the patient cable.
6. If the optional software key is included, connect it to USB port of the computer.

Connecting an Exercise Device

You can connect a treadmill or ergometer to the computer independently of the PC-ECG 1200S/M/HR/W/Blue-ECG. You can also operate the exercise device without using an ECG recorder by using the software with Simulator option selected.

To Connect an RS232 Controlled Treadmill/Ergometer

Connect the RS232 cable (as specified by the vendor) to COM 2 (if COM 2 is in use, then wait until the software has been installed and use the assigned COM port).

To Connect an Analog Controlled Treadmill/Ergometer

A digital/analog converter (D/A) board converts the digital signal from the computer into an analog signal that the treadmill or ergometer can read.

1. Insert the D/A board into the PC.

Connect the cable from the D/A board as specified in the D/A board table.

Cabling

The connection cables may be purchased from Norav Medical distributors.

The RS232 cable should contain at least 3 wires: TD, RD using pin 2 and 3 and GROUND using pin 5.

Straight type means that pin 2 on the PC side connects to pin 2 on the exercise device side, pin 3 on the PC side connects to pin 3 on the exercise device side, and pin 5 on the PC side connects to pin 5 on the exercise device side.

Crossed type means that pin 2 on the PC side connects to pin 3 on the exercise device side, pin 3 on the PC side connects to pin 2 on the exercise device side and pin 5 on the PC side connects to pin 5 on the exercise device side.

To Determine Treadmill Cabling

Check which pins are assigned for TD and RD on the exercise device connector.

*   If pin 2 is RD and pin 3 is TD, then the exercise device requires a crossed cable

*   If pin 2 is TD and pin 3 is RD, then the exercise device requires a straight cable.

CHAPTER 5:   ACCESSORIES INSTALLATION

Installation of the TANGO Automatic BP Unit

Norav Stress ECG Tango+ Interface Notes

To setup Tango+ with the Norav Stress ECG system, simply follow the directions below.

1. Verify Correct RS-232 and ECG Trigger Cables

- **RS-232 Cable** – used to communicate with the stress system. This cable enables the stress system to prompt Tango+ when it needs a BP measurement, and allows the Tango+ BP reading to be transferred to the stress system's display and reports.
    - o SunTech Part Number = 91-0013-00
    - o Connection Ends:

Norav Stress ECG Connection 9 pin female

Figure 11: Stress ECG Connection

Tango+ Connection 9 pin female

Figure 12: Tango+ connection

- **ECG Trigger Cable** – provides the ECG signal from the stress system to the Tango+.
    - o SunTech Part Number = 91-0011-00
    - o Connection Ends:

Norav Stress ECG Connection BNC male

Figure 13: BNC Connection to Stress

Tango+ Connection BNC male

Figure 14: BNC Connection to Tango+
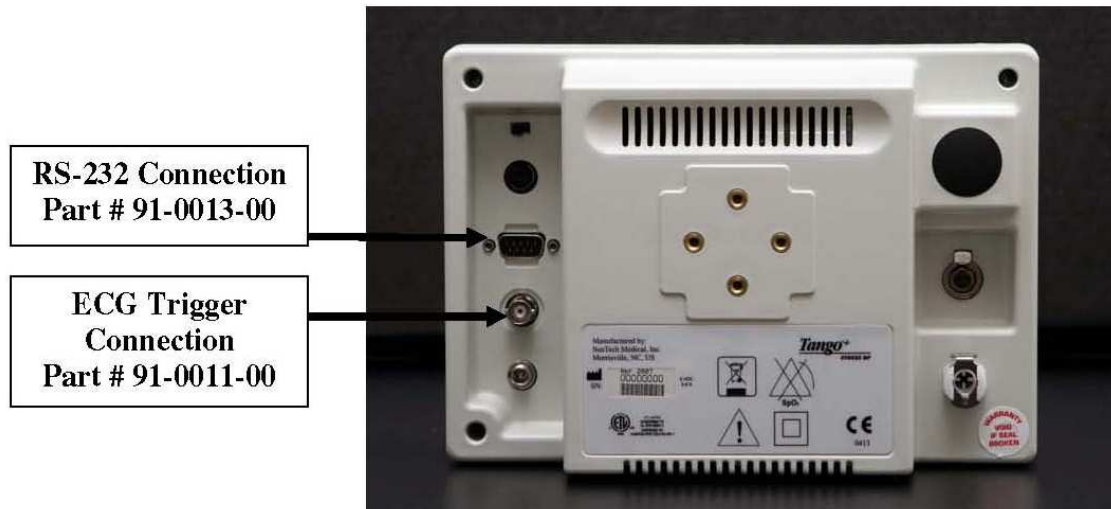
Figure 15: Tango+ monitor back side

2. Connect the RS-232 Cable

From: the RS-232 connection on the rear panel of the Tango+.
To: a COM port on the back of the stress system PC.

3. Connect the ECG Trigger Cable

From: the BNC External ECG connection on the rear panel of the Tango+.
To: the BNC connection on the 1200 USB-A adapter part of the Norav Stress ECG.

4. Tango+ Monitor Setup

a. When the operating screen is displayed, press the **SELECT** button 2 times. This will bring up the **MAIN MENU** screen.

b. Using the UP or DOWN arrows, highlight **MONITOR SET UP** and press the **SELECT** button.

c. Using the UP or DOWN arrows, highlight **STRESS SYSTEM** and press the **SELECT** button.

d. Using the UP or DOWN arrows, scroll through the list until **CUSTOM** is highlighted and press the **SELECT** button to confirm the choice.

e. With **PROTOCOL** highlighted, press the **SELECT** button.

f. Using the UP or DOWN arrows, scroll through the list until **SUNTECH** is highlighted and press the **SELECT** button to confirm the choice.

g. Press the DOWN arrow to highlight **ECG Trigger**, and press the **SELECT** button.

h. Using the UP or DOWN arrows, scroll through the list until **DIGITAL** ⬆ is highlighted and press the **SELECT** button to confirm the choice.

    i.   Using the UP or DOWN arrows, select **EXIT** twice to return to the operating screen.

5. Norav Stress ECG System Setup

    a.   In the Stress ECG software, go to **Setup -> Environment**

    b.   Open the **Automatic BP COM Port** scroll box and choose the communications port to which you connected the RS-232 cable in Step 2.

    c.   Check **Measure BP by automatic device** option.

    d.   Click **Advance** header, select **R-wave Trigger/Rising** option on **USB** frame.

    e.   Click **OK** to close the Setup dialog.

    f.   To check functionality, start a new stress test and when you click the **Measure BP** option under the **Test** main menu, the Tango+ will take a measurement.

FAQs for Tango+

Q. The Tango+ displays a status message. What does it mean and what do I do?
A. See the Quick Set-Up guide (that is attached to your Tango+) or the Troubleshooting section in your User's Guide for details on the Status Message and solution.

Q. The Tango+ monitor returns results of 0/0 after blood pressure measurements. What do I need to do to get a BP reading?
A. There are certain noisy conditions where the Tango+ cannot accurately measure BP. When the Tango+ encounters these situations, it returns a reading of 0/0. Placement of the microphone attached to the cuff is critical for reliable operation of the Tango+. Follow the instructions in the **Cuff Tutorial** (located on the SunTech Medical website under Products**->** Tango+) for correct microphone placement. Follow steps 1 and 2 in Conducting the Stress Test in the User's Guide to provide the best conditions to obtain a measurement.

Q. Can I use a heart rate or blood pressure simulator to test whether the Tango+ is working correctly with my stress system?
A. You cannot use a heart rate or blood pressure simulator to test whether the Tango+ is working with your stress system. The Tango+ monitor requires that the ECG signal and the Korotkoff sounds, collected by the microphone in the cuff, originate from the same source, meaning the patient.

Q. I cannot clearly see the Tango+ display. How do I fix this?
A. If you cannot clearly read Tango+, you can adjust the contrast of the display by following these steps:

    1.   When the operating screen is displayed, press the **SELECT** button 2 times. This will bring up the **MAIN MENU** screen.

    2.   Using the UP or DOWN arrows, highlight **MONITOR SET UP** and press the **SELECT** button.

    3.   Using the UP or DOWN arrows, highlight **CONTRAST** and press the **SELECT** button.

    4.   Using the UP or DOWN arrows, modify the contrast of the screen. When you are finished, and press the **SELECT** button to confirm the choice.

    5.   Using the UP or DOWN arrows, select **EXIT** twice to return to the operating screen.

Q. My Tango+ displays a message, "Please VERIFY CALIBRATION" or "Equipment
Maintenance and Calibration Required." What do I do?

A. Verification of Pressure Calibration
Equipment Required:
1. Calibrated electronic manometer or equivalent.
2. 500mL volume or the Orbit-K Adult Plus cuff wrapped around something that will not break or crush (no glass).
3. Hand Inflation Bulb with bleed valve.
4. Tubing, Tee pieces, and miscellaneous connectors or you can order the T-Tube Kit (SunTech Part # 98-0030-00).

Procedure:
1. When the operating screen is displayed, press the **SELECT** button 2 times. This will bring up the **MAIN MENU** screen.
2. Using the UP or DOWN arrows, highlight **MONITOR SET UP** and press the **SELECT** button.
3. Using the UP or DOWN arrows, highlight **VERIFY CALIBRATION** and press the **SELECT** button. The monitor will close its bleed valves and will display on its screen the pressure applied to the patient hose connector.
4. Verify the Tango+ calibration by manually inflating and checking the manometer against the pressure reading on the Tango+ display.
5. Once the calibration has been completed, use the UP or DOWN arrows to select **EXIT** twice and return to the operating screen.

CHAPTER 6:   PATIENT PREPARATION

The ECG traces quality depends very much on the stability and conductivity of the electrodes during the test, especially during high stages when the patient movements can cause artifacts. Here are some basic rules to ensure good electrical contact:

◊   Shave hair at the electrode contact points

◊   Use a special shirt that attaches the electrodes and lead wires to the body

◊   Use high quality liquid gel electrodes

◊   Make sure that the lead wires do not swing

Attach the leads as shown in Figure 16, below (RA=right arm, LA=left arm, RL=right leg, LL=left leg).
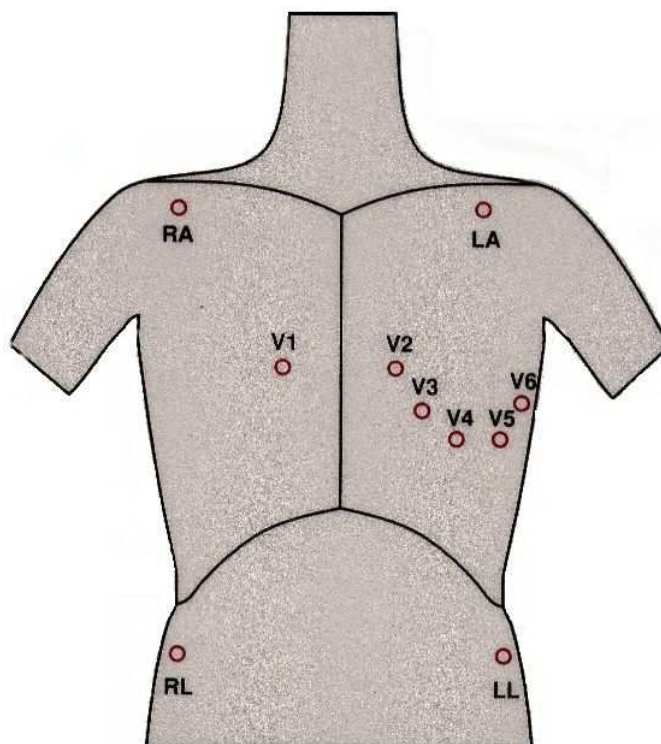
Figure 16: Electrode Placement

CHAPTER 7:   RESTING ECG

Program | Menu bar | Toolbar | Blood pressure systole/diastole (user input) | Heart rate (beats/min)

Timed recording | Selected strip display (strip lead) | Multiple lead display | Horizontal (mm/sec) and vertical (mm/mV) scale
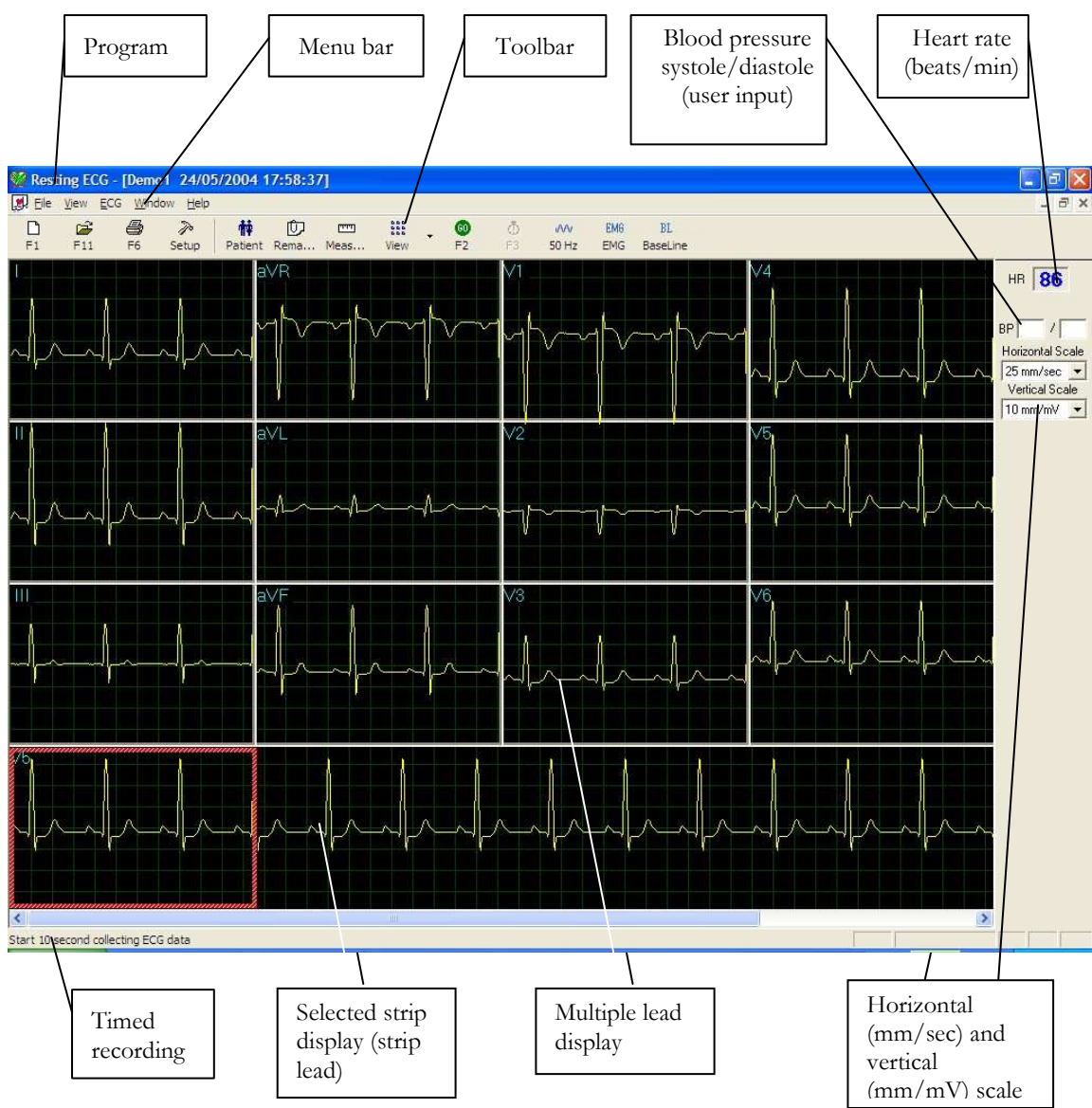
Figure 17: Resting ECG Main Screen

Quick Start

To Perform a New Test

Click **F1** (or the **New** button on the tool bar).

Insert patient details in the dialog box.

Click **OK.**

Enter blood pressure.

Click **F2** to stop data collection or **F3** to start data collection (10 seconds).

Operation with Function Keys

F1	New Recording
F2	Start/Stop
F3	10 sec. recording
F6	Print
F11	Open Saved Study

Table 4: Operation with Function Keys

For an example of a printed report, see Appendix C:, page 132.

Resting 12 Lead ECG

This application uses the standard 10 contact cables. It contains four limbs (RA, LA, LL, and RL) and six chest (V1-V6) contacts. 12 derivations are recorded and displayed:

- 3 Bipolar derivations: I, II, III

- 3 Augmented derivations: aVR, aVL, aVF

- 6 Unipolar derivations: V1-V6

- You can use a simpler cable with four contacts (only limbs). It produces six derivations only: three Bipolar and three Augmented

Leads Placement

You can place the leads on the patient in various ways. The usual method is to place the leads in the standard positions on the chest (V1-V6). To identify the placement of the leads, the channels are renamed. Additional options for lead placement are Posterior (V7-V9), Right side chest Lead system (V3R-V6R) and Pediatric Lead system (V7, V3R, V4R).

To Define the Lead System

Click Setup > **Lead**.

Select the lead system to use (Default: Standard).

Toolbar Overview

The Toolbar (Easy Toolbars Mode)
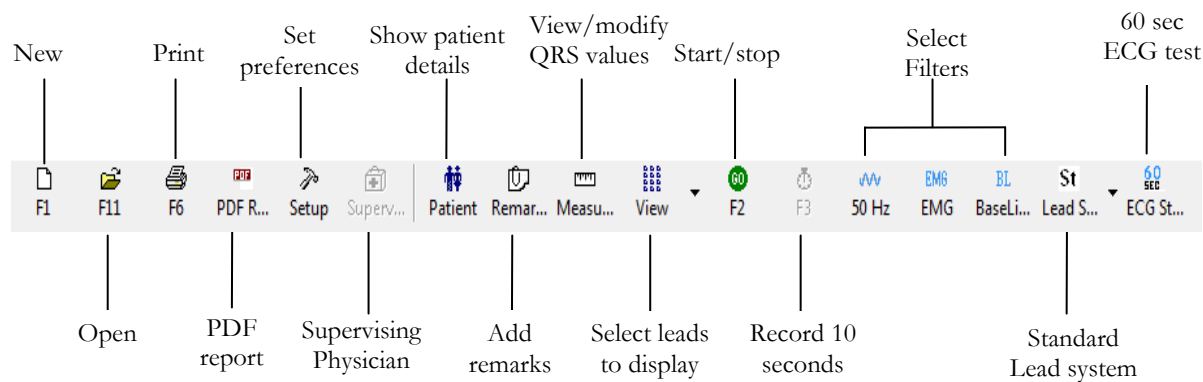
Figure 18: Resting ECG Toolbar

Resting ECG Setup

Click **Setup** on the Toolbar to access the following parameters:

Tab	Option	Description
Leads	Lead Systems	Define the lead system to be used and displayed according to the electrode placement on the patient. Choose between Standard, Cabrera, Posterior (V7-V9), Right side (V3R-V5R) and Pediatric (V7, V3R, V4R) lead systems (default: standard system).
	Default 3 leads	Define the 3 leads that will be displayed as default when using 3x1-view format.
	Default 6 leads	Define the 6 leads that will be displayed as default when using 6x1 or 3x2-view format.
	Strip Lead	10 sec lead to appear in 4x3 and 6x2 formats.
ECG Recording	Filter 50/60Hz	Default is cleared. When checked, the default status of 50/60Hz filter is ON (according to the checked frequency 50 or 60).
	EMG Filter	Default is cleared. When checked, the default status of the EMG filter is ON.
	Baseline Filter	Default is cleared. When checked, the default status of the Baseline filter is ON.
	Save options	If **Auto Save** is ON, the file is stored by last name or by ID. If **Auto Save** is OFF, a dialog box is displayed asking the user to enter a file name.
	Auto stop after 10 sec	If cleared (default), recording runs till stopped by the user. If checked, stops recording automatically after 10 sec.
	Auto Print	Use this option for automatic printing of the test at the end of the Rest test. If more than one printer is defined in the network, select the appropriate one from the list.
	Simulator ECG	If cleared (default), ECG recording is done from the PC-ECG unit. If checked, the ECG recording is done from the demo file included in the software package. In this case, the recording unit is not needed.
	ECG Status	Enables to set a long rest test (up to 60 seconds). User can select to view and report 30 sec back and 30 sec ahead or 60 sec ahead.
	Minimum Test Time	Set minimum test time for any test (in seconds).
	Data Directory	Allows the user to define a directory for saved ECG recordings (if ECG database is not used). Use a secondary hard disk, if one is available.

Tab	Option	Description
	Use ECG Database	Select this option to connect to the default ECG database. When this option is selected (checked) the ECG tests are saved in the database.
	BACKUP Data directory for AutoSave mode	When Auto Save option is selected, this allows the user to define a local path for a backup directory. The backup directory is useful when the data directory or database is not on the same computer. In such a case, ECG file save can fail due to failure in connection.
Diagnosis		Optional. Active only if the measurement option (I1/I3) is installed.
	ST after J	Defines the ST spot relative to the J point.
	Default "Confirm Diagnosis" status	Relates to the checkbox status of the "Confirm Diagnosis" on the Remarks dialog of the Interpretations. If checked, the default value of the checkbox on the Remarks dialog will be checked. If not checked, the checkbox on the dialog will be unchecked.
	Print Options	Allows the user to determine if and when to have automatic results printed. Define if measurements and/or interpretations should be added to printouts. Options are Never, After Confirmation, or Always.
View	Draw over lead borders	If checked (default), does not limit the extreme high amplitude ECG pulses from exceeding the borders. If cleared, chops the pulses at the borders.
	View calibration pulse 1 mV	If cleared (default), the 1-mV pulse will appear only in printing. If checked, the 1-mV pulse will also appear on the screen.
	Leads Base line shift	If cleared (default), the base line of each lead is exactly in the middle of the lead's area. If checked, a special shift is added to each lead to view its maximum. For example: lead V6, being positive pulsed, gets negative shift.
	Separate Leads	If checked, leads are displayed framed and separated from each other. If cleared, leads are not separated. Default is checked.
	Draw Grid	If checked, displays grid lines when the application is opened. If cleared, the application is opened with no grid lines Default is checked.
	Open in Tile mode	Select Tile mode to set the mode (horizontal or vertical) which 2 or more opened tests will be viewed.
	Horizontal Scale	Sets the default value for the horizontal scale window on the screen (mm/sec).
	Vertical Scale	Sets the default value for the vertical scale window on the screen (mm/mV).
	Rest ECG color selection	Allows the user to choose colors for the Rest ECG application for background, traces, grid, and text.
	Restore Defaults	When activated, restores the factory default colors: black for background, yellow for traces, green for grid, turquoise for text.

Tab	Option	Description
	Easy Toolbar Mode	If checked, allows the user to use the regular Icons. If cleared, allows the user to use the optional Icons
	Text Label	Adds text to the Icons. Enables use by keyboard.
Installation		Saves users' data (hospital, physician and modality name). This data is printed on any print out and sent as email.
	Supervising Physician	Add/Remove Physician name to list (Add/Remove button). Select from list and set as default Supervising Physician.
	Measurement Standard	Define whether measurements will be calculated according to the metric or the USA standard. Default is metric.
	Magnetic Card Reader	Select this option to use a magnetic card with bar-code to insert patient details. (Select the magnetic card type.)
Environment	Connection	Select the option button (COM port/USB/Bluetooth), to choose the port the device should be connected through. If the COM port option is selected, select the serial input for the PC-ECG unit from the COM port selection list. If the USB/Bluetooth connection is selected, the COM PC-ECG selection list is disabled. (Default at installation is USB).
	Display Size	Choose between 14/15-inch, 17-inch (default), 19 inch, W22 inch screen or custom screen (X, Y settings). This setting is required in order to display the ECG and grid in the correct scale.
	Graph paper	If set to **On**, prints 1mm and 5 mm squares on printouts. **Regular Grid** is guaranteed to fit any printer. **Improved Grid** shows a fine grid but may not work on some printers.
	Paper Size	Sets paper size. either conventional printer or 4-inch thermal printer.
	Large Remarks Font	Enables large font for user entered free text.
	Color Printout	Select this option for colored printouts.
	Shadow/Frame For Area of Interest	Allows the user to choose between shadow and frame to highlight the interest area.
Picture Format	AutoSave ECG in Picture Format	Select this option to save the test automatically as a JPG image.
	Set File Name By	Set the file names to include Patient Last Name or Patient ID. Check date and/or hour to include them in the file name.
	Picture Format	Select the resolution of the picture (normal or high resolution).
	Picture File Type	Select picture JPG/TIF/Both as file type for picture

Tab	Option	Description
	Picture Directory	Set the directory for saved pictures. The default is C:\Program Files\PCECG\Data.
GDT/BDT Format	Automatic	Setup automatic GDT/BDT format.
	Save test in GDT/BDT	If checked, save test automatically to GDT/BDT format.
	Import from GDT/BDT	If checked, imports tests automatically as GDT/BDT format.
	File Format	Select the file format: GDT or BDT.
	Import Codepage 437	Check this option to import Code page 437.
	Export Codepage 437	Check this option to export Code page 437.
	Edit Labels	Click this button to open a dialog box with an editable list of the field labels used in the GDT and BDT files.
	GDT/BDT Data Directory	Define the directory path where the GDT/BDT files should be maintained.
	Token for PCECG	Default is PEKG.
	Token for Practice EDP	Default is EDV1.
Text File	Auto Save Test Data in Text file	Select this option to save the test data in a text file automatically at the end of the rest test.
	Set Text file Name by	Set the text file name according to Test File Name or according to the fields Patient ID and/or Patient Last Name.
	Text File Data Directory	Set the directory path to maintain the text files with the ECG data. Default is C:\Program Files\PCECG\Data.
FDA XML\SCP\Mckesson \DICOM	FDA XML format	Set FDA XML saving options, ID Root and directory
	Auto Save in FDA XML format	Select this option to save the test data in a FDA XML file automatically at the end of the rest test.
	Annotations for leads	Check this option to set annotations for leads. Select the leads that should be annotated. If not checked, the leads are disabled and no annotations will be saved in the FDA XML file.
	File Data directory	Set the directory path to maintain the FDA XML files with the ECG data. Default is C:\Program Files\PCECG\Data.
	Parameters	Insert ID Root for the FDA XML file
	SCP format	Set Autosave option for SCP format and the SCP files directory. Default is C:\Program Files\PCECG\Data.

Tab	Option	Description
	Mckesson format	Set Autosave option for Mckesson format and the Mckesson files directory. Default is C:\Program Files\PCECG\Data.
	DICOM format	Set Autosave option for DICOM ECG format and the DICOM ECG files directory. Default is C:\Program Files\PCECG\Data.
PDF File	Autosave in PDF format	Select this option to save the test data as a PDF file automatically at the end of the rest test.
	Set PDF file name	Set the PDF file name according to Test File Name or according to the selected field.
	PDF file data directory	Set the directory path to maintain the PDF files with the ECG data. Default is C:\Program Files\PCECG\PDF.

Table 5: Resting ECG Setup Options

Toolbar and Menus

To do this	Click this icon	Or use this short-cut key	Or select this menu	Description
Start a new study		F1	File > New Rest Test	Starts a new 12 lead recording. The patient data can be entered prior to ECG recording, but this is not mandatory. The recording time is according to the setup for ECG Recording: either continuous or limited to 10 sec. To stop recording, click **GO/STOP**.
Open an existing study		F11	File > Open	Shows recordings that are saved on disk.
Import Data from SCP Format			File > Import from SCP Format (Select the required file(s) and path from the dialog box and click **OK**)	SCP format is a European format for ECG files. The Rest application can identify these files, import them, and save them as Rest files, either to the database or to the defined folder for the Rest files.
Import demographic data from HIS to PC-ECG			File > GDT/BDT Format For details see **Import from GDT/BDT**, page 125	This file always contains the last patient data.

To do this	Click this icon	Or use this short-cut key	Or select this menu	Description
Export the GDT/BDT file from PC-ECG to HIS			File > GDT/BDT Format For details see **Save Test in GDT/BDT** page 125	This file always contains the last patient data.
Save a recording	💾	Ctrl+S	File > Save	Saves recording on disk (default file name: REST).
Send results via email	✉		File > Send	Sends recording data via email. If the large icons are used the operation must be performed through the FILE menu Prerequisites: e-mail software package, modem, and internet provider (not included in the PC-ECG 1200 package). Once an ECG study is displayed on the screen of the transmitting side, click this icon to attach the ECG file and send an e-mail to a specified address. The receiver must have the PC-ECG 1200 software installed. A regular email is sent with the ECG as an attached file. The receiver can either double click the file to display the ECG on the screen, or save it in the PC-ECG 1200 studies default directory.
Export to MATLAB format		Ctrl+E	File > Export to Matlab Format	Saves ECG results in MATLAB format. (For details see **Using the Matlab Feature within PC-ECG 1200**, page 53).
Export to FDA XML format			File > Export to FDA Format	Saves ECG results in FDA XML format.
Export to SCP format			File > Export to SCP Format	Saves ECG results in SCP format.
Export to Mckessen format			File > Export to Mckessen Format	Saves ECG results in Mckessen format.
Export to DICOM format			File > Export to DICOM Format	Saves ECG results in DICOM format. (For details see DICOM Communication, page 126).
Create a text file			File > Create Text File	Saves ECG data in text format.

To do this	Click this icon	Or use this short-cut key	Or select this menu	Description
Save the test as an image			File > Save ECG to Picture Format	Saves ECG test as a JPG image.
Print a miniature printout of results			File > Print Average Mini Card	Prints results as a mini-card that can be carried in the pocket or wallet.
Print results	🖨	F6	File > Print	Prints the recordings currently shown on the screen. Note that the 1-mV signal is always printed.
PDF Report of 10 sec ECG	PDF		File-> PDF Report for 10 sec. ECG	Create PDF file of 10 sec ECG.
PDF Report of Entire ECG			File -> PDF Report of entire ECG	Create PDF file of the entire ECG (up to 60 sec. If the ECG is longer than 10 sec.)
Set preferences			View > Setup	Allows the user to set preferences for Leads, ECG Recording, Diagnosis, View, Installation, Environment, Picture Format, GDT/BDT Format, and Text File. For details see Table 5, page 48.
Change Supervising Physician			View -> Change Supervising Physician	Opens a dialog with list of supervising physicians which enables to select a different supervising Physician from the list.
Display program, hardware, and contact information			Help > About	Displays software version number (which should be quoted on any software inquiry) software key, and permissions; Norav contact information; memory size and free disk space; HASP ID number (ID of existing software keys). This ID number is used for adding software options.
Print patient data		—	View > Patient Data	Can be added to the recording. It will be printed together with ECG traces. If the recording is saved, then the PATIENT DATA will be saved together with the ECG traces. Use the Previous option if the same patient undergoes a second study.
Add remarks		—	View > Remarks\ Interpretation	Allows the user to enter free text during or after the ECG recording. This is printed and saved together with ECG traces. If the Interpretation option is installed, then Interpretation Statements is also displayed.

To do this	Click this icon	Or use this short-cut key	Or select this menu	Description
View and modify QRS values		—	View > Measurements	An optional feature that requires a software key (I1 or I2 license). Displays a comprehensive table of measured values. You can alter the values either by editing them in the table or by using Caliper to change the horizontal and vertical markers. When Caliper is activated, a large QRS is shown with the standard markers. Open the Standard Markers window (upper right side) and select the QRS interval of interest for modification. The area changes to blue. Use the mouse to move the markers. (For details see **Measurements/ Interpretation**, page 105).
Display/hide the grid		—	View > Grid	Displays or hides the 5mm raster grid. Print outs are always with 1mm raster.
Display information from different leads (5 options)				
Display 3x4		—	View > Leads Format > 3x4 Windows	Classical format. 12 lead ECG of 2.5sec ECG + 10sec trace.*
Display 6x2		—	View > Leads Format > 6x2 Windows	12 lead ECG of 5sec ECG + 10sec trace.*
Display 12x1		—	View > Leads Format > 12 Leads	12 lead ECG of 10sec ECG.*
Display 6x1		—	View > Leads Format > 6 Leads	6 lead ECG of 10sec ECG.*
Display 3x1		—	View > Leads Format > 3 Leads	3 lead ECG of 10sec ECG.*
View/print averages		—		Produces a typical QRS for every lead from the raw ECG data. The averages can be printed either full size or minimized in a credit card size. To perform a miniature print, enter FILE and then PRINT MINIATURE.
Scroll between displays from different leads		—	View > Leads Format > Next leads	Double function: Scrolls for all leads in the 3X1 display Points to the requested lead

To do this	Click this icon	Or use this short-cut key	Or select this menu	Description
Start/stop ECG		F2	ECG > Start/Stop	Controls start and stop of ECG recording.
Record a 10 second segment		F3	ECG > 10 Sec	Start 10-sec timer for recording ECG data.
Start/stop 50/60 Hz filter		—	ECG > Filters > 50/60 Hz	ON/OFF for line interference filter. Set Options for 50 or 60 Hz prior to operation.
Start/stop EMG filter		—	ECG > Filters > EMG	ON/OFF for muscle noise filter.
Start/stop Baseline filter		—	ECG-> Filters -> Baseline	ON/OFF for baseline filter.
Select Lead System	St ▾	—		Select the Lead system to display and report, according to the lead placement on the patient.
ECG Status			ECG->ECG Status	ON/OFF long ECG test (60 sec or 30/30 sec) according to the set-up status.
Compare			View > Compare Tests	Select two or more Rest tests from the Database interface and click **Compare.** This option is only available when you check **Setup > ECG Recording > Use ECG Database.** Click **Compare** again to end Compare mode and display the Rest test.

*   ECG data can be set up as limited amplitude or unlimited amplitude, which can cause one lead data to overlap a neighboring lead.

Table 6: Recording Resting ECG

Using the Matlab Feature within PC-ECG 1200

Record a rest study and apply the MATLAB function under the File menu.
A file with extension LIB is created in the default data folder.
The file has the following structure:
10,000 bytes X 12 Leads (I, II, III, AVR, AVL, AVF, V1, V2, V3, V4, V5, V6);
1sec = 1000 bytes = 500 samples.

Start Matlab (not included in PC-ECG software) and perform the required
operation.

Example of ECG Display with MATLAB

1. Open a file: handle = fopen('c:\default_\ patient_name.lib,'r')

Choose from which lead and which second to display the ECG:
fseek(handle, (Lead-1) * 10000 + (Sec-1) * 500,-1)
where Lead (1,2,3,...,12) and Sec (1,2,3,...10)

> For example, if lead AVR (number 4) from the second 3 is requested:
> fseek(handle,3*10000+2*500,-1)
> t = fread(handle, [sec * 500 ,1], 'int16')
> where sec(1,2,3,4,...,10)

Type: `plot(t)`
The graph is displayed.

CHAPTER 1:   STRESS ECG

(This option is available with S1 and S2 licenses)
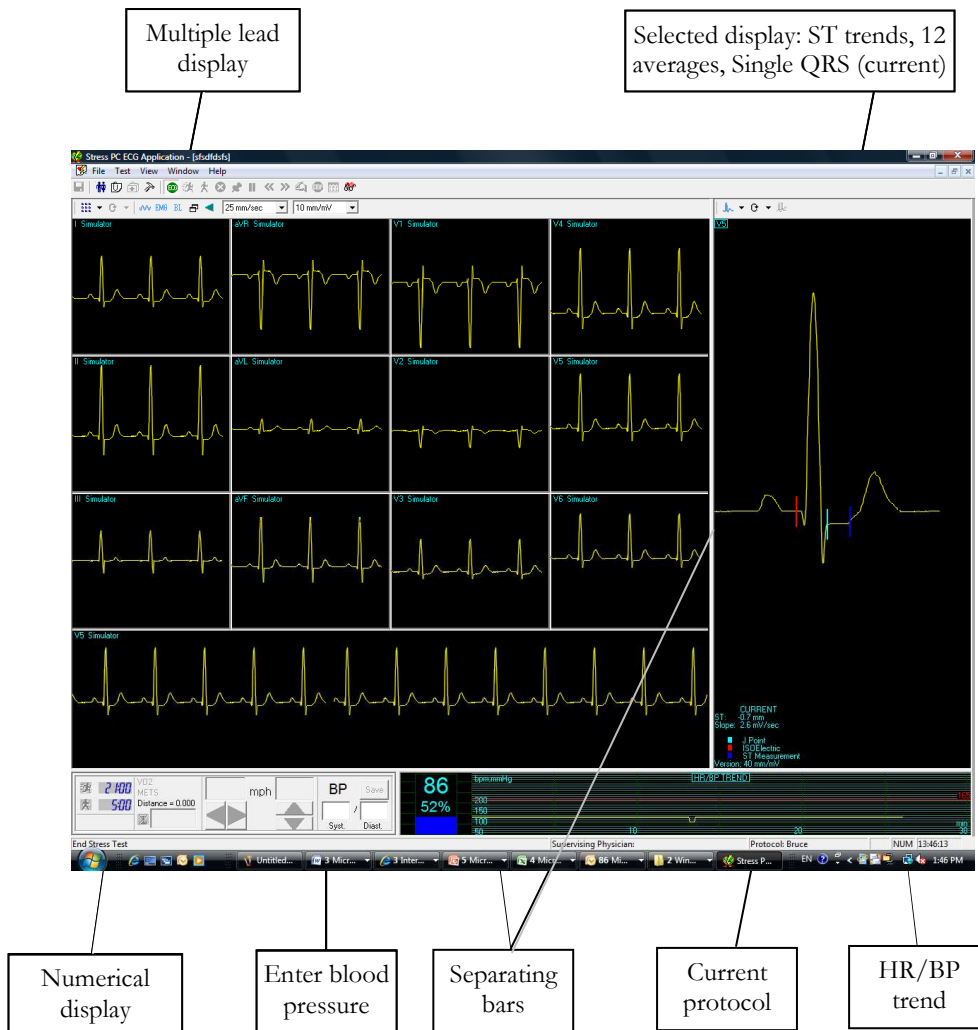
Figure 19: Stress ECG Results Screen

To Customize the Display

Click and drag the separating bar between two sections with the mouse cursor.

To Lock Screen Window Borders

If you want to keep the display in its present format:

Click Setup > **View** tab.

Check **Lock Splitter**.

Quick Start

To Perform a New Test

1. Click **F1** (or the **New** button on the toolbar).

Insert patient details in the dialog box.

Click **OK**.
The preliminary Rest phase begins.

Click **F3** (or **Stress** button) to start the Stress phase.

Insert blood pressure and/or remarks (if relevant) in the dialog box and click **OK**.

Click **F5** (or **Recovery** button) to begin the Recovery phase.

Enter blood pressure and/or remarks (if relevant) in the dialog box and click **OK**.

Click **F4** (or **Stop** button) to stop the test.

To Print an ECG

1. Select **Print ECG** from File menu.

Select **Current Stage\Entire Study** from the **Print ECG** submenu.

Select the printer from the print dialog box.

Click **OK** to close the dialog box and start printing.

To Print a Report

1. Click **Print** on the toolbar.

Select the report/s to print.

Click **OK** to start printing to the default printer.

> Or

1. Select **Print Reports** item from the File menu.

Select the report.

Define the printer in the Print dialog box.

Click **OK** to start printing the report.

For an example of a printed report, see Appendix C: page 132.

Leads Placement

You can place the leads on the patient in various ways. The usual method is to place the leads in the standard positions on the chest (V1-V6). To identify the placement of the leads, the channels are renamed. One option for standard lead placement is V7-V9. Another is the Right chest Lead system.

To Define the Lead System

Click Setup > **Lead**.

Select the lead system to use (the default is Standard).

Operation with Function Keys

F1	New recording
F2	Run/stop pre-test monitoring
F3	Begin stress test
F4	Stop test
F5	Begin Recovery phase
F6	Set Event
F7	Freeze stage
F8	Next stage
F9	Manual control
F10	Previous stage
F11	Open saved study
F12	Stop treadmill or ergometer in emergency

Table 7: Stress Function Keys

Note	Before using the stress test package define preferred parameters in Setup. Otherwise the program will operate according to the factory setup.

Toolbar Overview

Main Toolbar (Easy Toolbars Mode)

This toolbar is displayed at startup. Use it to open an existing test or to begin a new one.
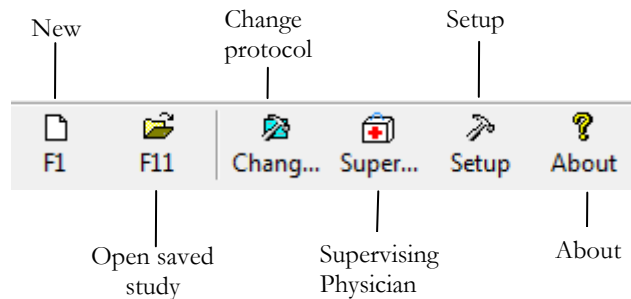
Figure 20: Main Stress Toolbar

Stress Test Commands

This toolbar is displayed at the start of a new test.
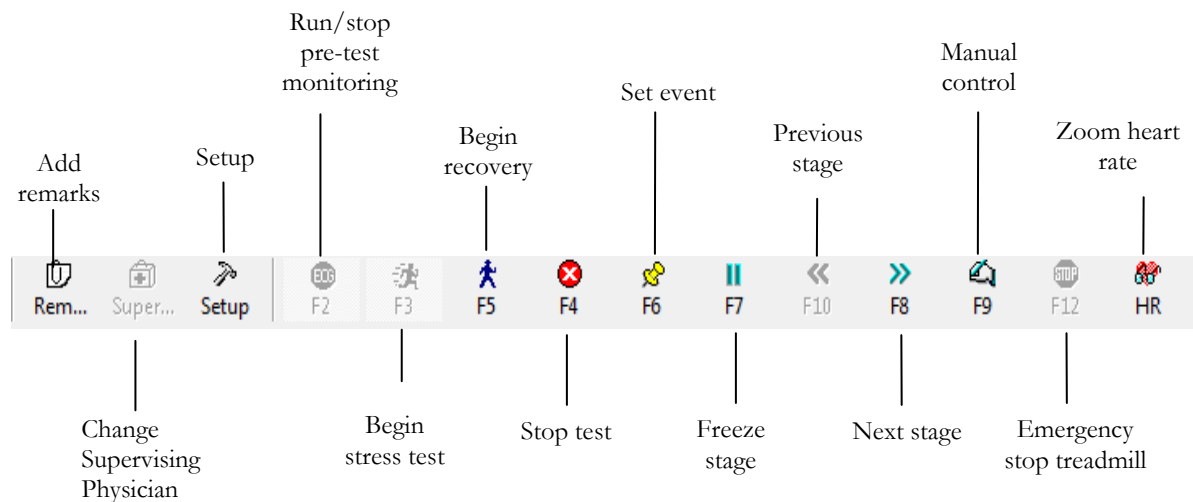
Figure 21: Stress Test Commands Toolbar

Views and Filters Toolbar

The toolbar controlling views filters appears beneath the main toolbar.
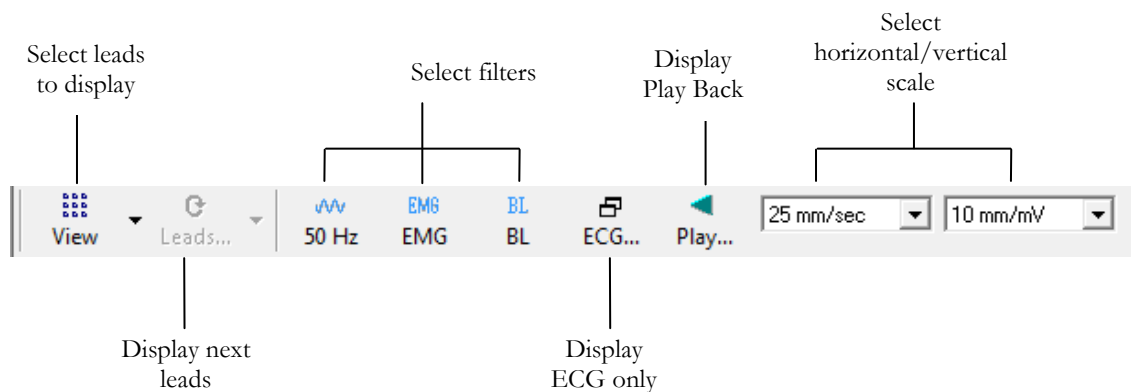
Figure 22: Stress ECG Views and Filters Toolbar

Average Viewer Toolbar

The toolbar displaying various post processing views appears to the right of the Views and Filters toolbar.
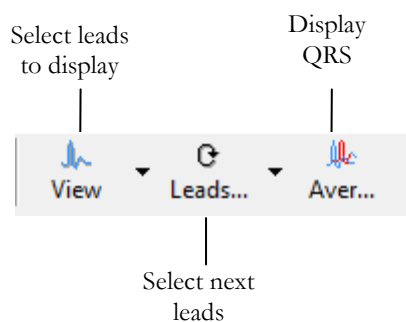
Figure 23: Stress ECG Post Processing Display Toolbar

Post Processing Options Toolbar

When the test is complete you can review it using the Post Processing Options Toolbar.
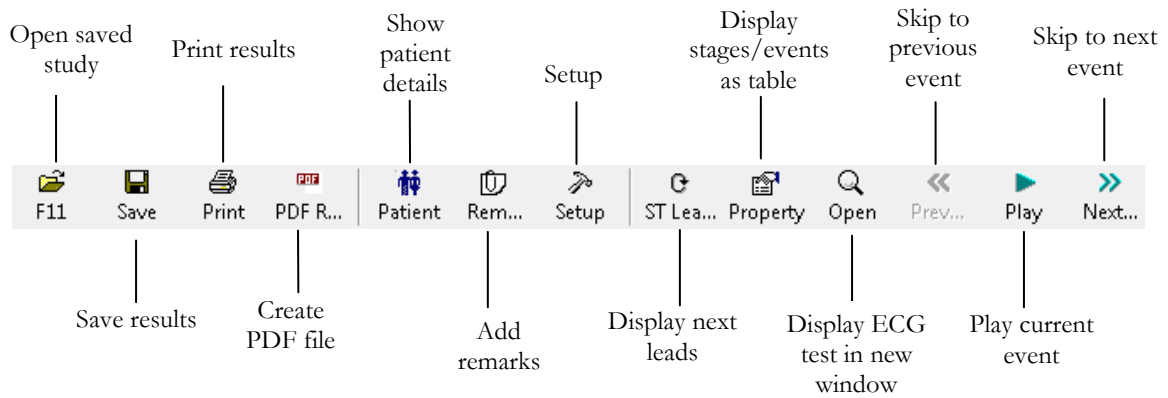
Figure 24: Stress ECG Playback Toolbar

Stress ECG Setup

Printer Definition:

Printer definition is very important because of the high data rate during real time printing. If the printer has about 8–10 MB RAM, set the graphic resolution at 600 dpi. If the printer has about 2 MB RAM, reduce the resolution to 300 dpi.

Click **Setup** on the Toolbar to access the following parameters:

Tab & Secondary Tab	Option		Description
ECG Recording	Default filters		Defines the filter's initial status in ECG recording.
	Save Options	Save format	Defines the amount of data to be saved on the disk.
		Auto Save	Select this option to save the ECG test automatically at the end of the test. The test will be saved into the defined directory or to the database (if used).
		Set File Name by	To add the Patient ID or Patient Last Name to the file name, select the required option.
	Simulator ECG		When cleared (default), ECG recording is performed from the PC-ECG unit. When checked, the ECG recording is performed from the demo file included in the software package. In this case, the recording unit is not needed. On leads display (and on reports). the word "Simulator" will appear
	Alert Signal OFF		There is an alert (beep) when reach the target\warning zone of HR. If this option is marked, there is no alert.
	Beep on QRS		When marked, beep is heard every time QRS is detected.
	ECG Leads		When using the standard 12 lead patient cable, select the "12 Leads" option to read and display up to 12 leads (default). When using a 6 lead cable, select the "6 Leads" option to read and view up to 6 leads.
	Use ECG Database		Select this option to connect to the default ECG database. If this option is selected (checked) the ECG tests are saved in the database.
	Data Directory		Allows the user to define a directory for saved ECG recordings (if ECG database is not used). Use a secondary hard disk, if one is available.
Lead Systems	Default 3 leads		Define the 3 leads that are displayed as default when using 3x1 view format.
	Default 6 leads		Define the 6 leads that are displayed as default when using 6x1 or 3x2 view format.
	Strip Lead		10 sec lead to appear in 4x3 and 6x2 formats.
View	Count Recovery Time Separately from Stress		Check this option to have separate times for the Stress phases and the Recovery phases. Clear this option to have the time displayed on screen (in Real time and in Review Screen) as the overall test time including the Stress and the Recovery phases.

Tab & Secondary Tab	Option	Description
	Default Colors	To define the default colors for background, traces, grid, light grid, text, and base average, click the appropriate button and select the color from the color palette. To restore the default colors click **Restore Default** in the frame.
	Default ECG View	Select the default on screen lead display from the list in the combo box. When "6 Leads" is defined in the ECG Recording tab, the maximum view is 6 leads.
	Easy Toolbar mode	Check this option to display fewer icons.
	Text Labels	Check this option to add text labels to the toolbar buttons.
	Separate Leads	Check this option to have the leads separated by borders. Clear this option to have the leads not separated by borders.
	Draw over Leads Border	Check this option to have high signals (exceeding the channel display) drawn beyond the lead border. Clear this option to have high signals cut off.
	Draw Grid	Check to display grid lines. Uncheck to hide gridlines.
	Cabrera Display	Check this option when using a Cabrera lead system. When using the standard LEDs system, clear this option.
	Lock Splitter	When this option is checked, the window splitters cannot be moved and the sections in the viewer cannot be resized. To resize the different sections in the viewer, clear this option.
	Clock count up	Check this option to set the time from beginning of the current stage (count up). If not checked, the time displayed is the time left until the end of the current stage (count down). The default: not checked.
	Horizontal scale	Sets the default value for the horizontal scale window on screen (mm/sec).
	Vertical scale	Sets the default value for the vertical scale window on screen (mm/mV).
	Ergometer METS/Watt	Applies to an Ergometer test. The selected units (METS or WATT) are displayed for the Workload on the Review Screen (post-processing).
	Real Time Average QRS	Select Static or Dynamic (worst case ST) to display Average QRS. If Static option is selected, the Average QRS displayed is of the default strip channel selected in the setup. If Dynamic option is selected, the channel of the displayed Average QRS dynamically changed according to the channel with the worst case ST.
	Smooth ECG Trace	Check this option to display a smooth ECG trace on the screen. Default: Not checked.
Installation		Saves user data (hospitaldetails, Modality name and supervising physician). This data is recorded on any print out and sent as email.
	Measurement Standard	Define whether measurements are calculated according to the metric or the USA standard. The default is metric.
	Magnetic Card Reader	Select this option to use a magnetic card with bar-code to insert patient details. Select the magnetic card type.
Environment	Connection	If an automatic blood pressure monitor (Tango) is to be connected to the system, checks for the appropriate COM port.

Tab & Secondary Tab	Option	Description
	Display Size	Choose between 14/15-inch, 17-inch (default), 19 inch, W22 inch screen or custom screen (X, Y settings). This setting is required in order to display the ECG and grid in the correct scale.
	Measure BP by Automatic Device	If a blood pressure monitor is used, define whether automatic measurements should be performed in addition to manual measurements.
	Automatic BP COM Port	Set the COM Port that the BP device (optional) is connected to.
	Exercise Device COM Port	Select the COM port that the exercise device is connected to from the list.
Advance	Cards	R wave trigger (requires D1-t board) should be ticked if a blood pressure monitor is used or if external synchronization is needed. If analog out (requires D/A board) for metabolic or exercise device control is needed, select the appropriate options. The software is compatible with a metabolic chart manufactured by Ganshorn, Germany.
	USB	Check R wave trigger option (when using USB connection with BNC output) if a blood pressure monitor is used or if external synchronization is needed. Select the required R-wave trigger width from the option list. Check ECG option for analog ECG signal.
	Use Transfer file "Trnsf.txt"	Check this option to use Trnsf.txt file (see page 74).
	Use real time protocol export file	Check this option to use external CareFusion LAB 5 CPET system to export ECG exercise real time data. When checked, the path and file name can be defined. (Default: C:\LAB5\DB\ERGOSPIR.DAT)
Exercise device	Type	Set up for PC-ECG connection, the external device (treadmill or ergometer) connection, and type. The factory default setup for the external device type is "None". In this mode, the software does not control an external device. Define the type of ergometer or treadmill that is being used.
Exercise Device	Default protocol	Valid for S1, S2 options. Choose one of the available protocols or define your own protocol.
Exercise Device	Speed unit	Set up for MPH or KPH. This option refers to treadmills only.
Exercise Device	Emergency STOP	Select the procedure for Emergency STOP. Select "Immediately" for abrupt stop of the treadmill or "Slow Down" for gradually slowing down the treadmill until final stop.
Metabolic Card Control	Metabolic Card Control	Check this option to control an external metabolic testing device for blood gas content. If this option is cleared (default) no communication is made with the metabolic testing device.
	Metabolic Card Manufacturer	Select the metabolic card manufacturer from the list.
	Auto Print (Print Report)	Check this option to print the metabolic test report automatically at the end of the test.
Printouts	Auto Print Default Reports on End Test	Check this option to automatically print the default reports at the end of each test.
	Default Reports	Define the default reports.

Tab & Secondary Tab	Option	Description
	Paper Size for ECG Printing	Set paper size, either conventional printer or 4-inch thermal printer.
	Use Large fonts for Remarks	Enables large font for user entered free text.
	Shadow/Frame for Area of Interest	Allows the user to choose between shadow and frame to highlight the area of interest .
	Load Printer Drivers Ahead	Check this option to save time by reading the driver before sending the print action.
	ECG Line	Define the line width in the printouts, either Normal or Bold.
	Event Format	Set Event format for printout to either 3 lead or 12 leads format.
	Tabular Results Format	Check this option to print out results in a tabular format.
	Graph Paper	When set to **On**, prints 1mm and 5 mm squares on printouts. **Regular Grid** works with any printer. **Improved Grid** shows a fine grid but may not work on some printers.
	Color printout	Select this option for colored printouts.
	Blending out ST values	Select this option to print results without ST values.
	Rest Event	Select Interpretation and/or Measurements to display Interpretation and/or Measurements on Rest stage printout.
GDT/BDT Format	Automatic Options	Setup automatic options for saving and/or importing files in GDT/BDT format.
	File Format	Select the file format: GDT or BDT.
	Import Codepage 437	Check this option to import Code page 437.
	Export Codepage 437	Check this option to export Code page 437.
	Edit Labels	Click this button to open a dialog box with an editable list of the field labels used in the GDT and BDT files.
	GDT/BDT Data Directory	Define the directory path where the GDT/BDT files should be maintained.
	Token for PCECG	The default is PEKG.
	Token for Practice EDP	The default is EDV1.
Text File	Auto Save Test Data in Text File	Check this option to save the test data automatically to a text file at the end of the test (according to the naming and directory defined in this tab).
	Set Text File Name by	Define the naming convention of the text file, created automatically or on demand.
	Text File Data Directory	Define the directory where the text files will be maintained.
PDF File	Auto Save Test Data in PDF File format	Check this option to save the test data automatically to a PDF file at the end of the test (according to the naming and directory defined in this tab).
	Set PDF File Name by	Define the naming convention of the PDF file, created automatically or on demand.
	PDF File Data Directory	Define the directory where the PDF files will be maintained.
Target HR/METS	Target HR	Set the maximum male and female HR for to be allowed for use in the Target HR equation . The target HR is affected by the age of the patient.

Tab & Secondary Tab	Option	Description
	Target HR warning zone %	Set the percentage of target HR for warning. Above this level, the HR trend is displayed in a different color. If the percentage value is reached during the test and "Switch to Recovery when reaches HR Warning zone" option is checked, the stress test stops automatically and recovery phase begins.
	Stop Stress and start Recovery	Check this option to stop stress test when HR reaches the target HR or warning zone and start the recovery phase. When "Switch to Recovery when reaches HR Warning Zone" is cleared, the Stress test continues according to the test protocol.
	METS/VO2 Formula selection	Set the formula to calculate the METS/VO2 values: • To use a single formula check "single formula for any speed". • To use one formula for speed up to 3.7 m/h and a second formula above that speed, set the option "Two formulas (Up to and from 3.7 m/h)".
	METS/VO2 Updating Method	Select the method for updating the METS/VO2 values. The values can: • remain constant through the entire stage • switch to the current METS value 1 or 2 minutes after the stage begun • have values vary during the stage (at every quarter of the stage time).
ST.VPB Options	ST Measurements After J	Choose the number of milliseconds after the J point at which the ST is measured. The factory set up is 60 Ms.
	Detect ST Event	Define the mm level for elevation and depression. This option also allows the user to save only deteriorated ST episodes.
	Worst case ST Report	Select ST Elevation, ST Depression or both to be reported as Worst case ST.
	Arrhythmia Detection	Select VPB or SVPB event to be detected and stored. Check "Store one event per stage only" option or clear this option if you wish all selected event type to be stored.
Real Time	Printing	Set the events to print (including ST/VPB/SVPB). Any checked event will be printed. Cleared events will not be printed (9 events).
	Show Dialog	Check events to display a dialog box at the beginning. Clear events to prevent display of dialog box.
	Print Page Format	Check the required option for printout format.
	Print Scale Format	Select the scale for printout format.
	ST, Slope Printing	Select this option to print the ST and ST slope values. Clear to prevent printing.
	Use last saved BP value during the stage	Select this option to continue to use the same BP value that was last saved. When not selected, the last BP value will not be used.
	Switch to Review Automatically	Check this option to switch automatically to the Review screen at the end of the test. When cleared, the real-time screen remains
	Print User Event	Select "5 sec Prior and 5 sec Post Request" or "10 sec Prior" to set the time of ECG printed in reference to the time the Print button is pressed.

Tab & Secondary Tab	Option	Description
Remarks		Defines statements that can be entered during the test. It is divided into five sets of statements used during real time and post processing.
Remote View		Valid for option S2. Enables viewing a study that takes place in any of the network stations, across the whole network. Enables a physician to view a study remotely.

Table 8: Stress ECG Setup Options

Toolbar and Menus: Main

To do this	Click this icon	Or use this short-cut key	Or select this menu	Description
Start a new study	🗋	F1	File > New	Creates a new study
Open an existing study	📂	F11	File > Open	Opens an existing study
Save a recording	💾	Ctrl+S	File > Save	Saves the active study
Print results	🖨	Ctrl+P	File > Print Report or Print ECG	Prints the active study
Recover file to Monitoring format			File > Recovery File to Monitoring Format	Enables saving and viewing data if the Stress application crashes. Select this option in the main frame. In the dialog box, provide a name and path for the file (*.TMP). To view the ECG open this file with the Monitoring application (main frame menu).
Import demographic data from HIS to PC-ECG			File > GDT/BDT Format For details see **Import from GDT/BDT**, page 125	This file always contains the last patient data.
Export the GDT/BDT file from PC-ECG to HIS			File > GDT/BDT Format For details see **Save Test in GDT/BDT** page 125	This file always contains the last patient data.
Create a text file			File > Create Text File	Saves ECG data in text format.
Restore default window size			View > Set Default Window Size	Restores the default window size of the sections in the window. (Available in realtime)
Set/change patient data	👥		View > Patient	Sets or changes patient data
Add/view remarks	🛡	Ctrl+R	View > Remarks	Allows you type free text during or after the ECG recording. It is printed and saved together with the ECG traces.
Change Supervising Physician	📋		View->Change Suprvising Physician	Opens a dialog with a list of defined physicians to enable to change the supervising physician.

Select a different protocol			View > Change current protocol	Changes the protocol
Set preferences		Ctrl+T	View > Setup	Displays the setup dialog box
To display information			Help > About Stress…	Displays program information, version number, and copyright

Table 9: Main Stress Toolbar and Menus

Toolbar and Menus: Stress Test Commands

To do this	Click this icon	Or use this short-cut key	Or select this menu	Description
Start/stop monitoring		F2	Test > Run/stop monitoring	Runs/stops monitoring
Start stress test		F3	Test > Stress test begin	Starts stress test
Start recovery phase		F5	Test > Recovery begin	Starts recovery phase
Stop test/recovery phase		F4	Test > Stop test	Stops stress test or recovery phase
Set an event		F6	Test > Set event	Sets events and prints according to options
Measure blood pressure			Test > Measure BP	Activates the blood pressure monitor
Freeze the current stage		F7	Test > Freeze stage	Freezes the current protocol stage
Return to the previous protocol stage		F10	Test > Previous stage	Returns to the next protocol stage
Advance to the next protocol stage		F8	Test > Next stage	Advances to the next protocol stage
Control the exercise device manually		F9	Test > Manual management	Manually controls the exercise device
Stop the treadmill or ergometer in an emergency		F12	Test > Stop exercise device	Emergency stop for treadmill or ergometer
Display enlarged heart rate		Ctrl+H	View > Zoom up heart rate	Enlarges display of heart rate window
Display Play Back during Real-Time		Space bar key	Test->Play back	Opens window to Play-Back any previous 10 second selected section during real time.
Display study results			Test > Review	Displays study results

Table 10: Stress Test Commands

Toolbar and Menus: Average Viewer

To do this	Click this icon	Description
Display 3 lead average		Averages of 3 leads and ST trends
Display 12 lead average		12 leads averages
Display single QRS		Single QRS
Scroll between lead displays		Double function: a) scroll for all leads in the 3X1 display b) point to the requested lead
Display QRS		Base line QRS in white and current QRS in yellow

Table 11: Average Viewer Toolbar

Toolbar and Menus: Post Processing

(Right hand side of tool bar)

To do this	Click this icon	Or use this short-cut key	Or select this menu
View 12 leads ST trends results			View > 12 Leads ST
View 3 leads ST trends results			View > 3 Leads ST
View next ST trends Triplet			View > Next ST Leads
View numerical results		Ctrl+V	View > Properties
Undo the last action		Ctrl+Z	
View ECG 10 sec data		Enter	View > Open ECG Data (requires I1 or I2 license).
Move marker to previous event		Ctrl+←	View > Event > Previous Event
Move marker left 10 sec		←	View > Event > Left
Play back results			View > Play ECG Data
Move marker right 10 sec		→	View > Event > Right
Move marker to next event		Ctrl+→	View > Event > Next Event
Add (create) a new event			View > Add New Event
Delete the current event			View > Delete Current Event
Set preferences		Ctrl+T	View > Setup

To do this	Click this icon	Or use this short-cut key	Or select this menu
Print the study		File/Print ECG	This enables you to print the entire study or a single stage
Position the ST marker		View/Rec alculate ST	This enables you to position the ST marker for the entire study

Table 12: Post Processing Toolbar and Menus

To Start the Stress Recording Program

Double click the stress icon.
The initial screen is displayed.

To Start a New Test

1. Define the exercise machine (Treadmill/Ergometer). (See page 63.)

2. If necessary, click the **Change Protocol** icon ![Chan...] to select a test protocol.
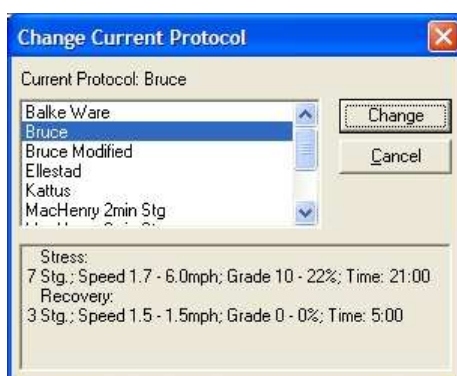
Figure 25: Change Test Protocol

3. Click the white page icon.
    The Stress working screen and patient data entry screen are displayed.

Figure 26: Patient Data Entry

Enter patient data and click **OK**.
Monitoring of 12 leads begins. After about 15 sec the average QRS is displayed.

Inspect the protocol label in the lower right hand corner. To choose another protocol, click the **Change Protocol** icon (or select View > **Change Protocol**), select the requested protocol, and click **Change.**

Enter blood pressure for rest. You can print a **Rest** printout using the EVENT icon without starting the **Stress** program. This enables multiple **Rest** printouts.

To start the stress session, click the **Stress** icon (running man). The stress time is displayed in the lower left-hand corner.

The following options are available:

◊   Define events

◊   Go to Manual

◊   Freeze Stage

◊   Advance Stage

◊   Go to Recovery phase.

Play Back display

During a Stress test at real time a period of any 10 second period of the recorded ECG can be viewed in a separate window. This option is enabled 10 seconds after beginning of the stress test (available only for S2 software key option).

To start play back:

1. Press on ▶ or on space-bar key or select Test->Play Back menu to open the Play Back window (See Figure 27, 71)

ECG Period
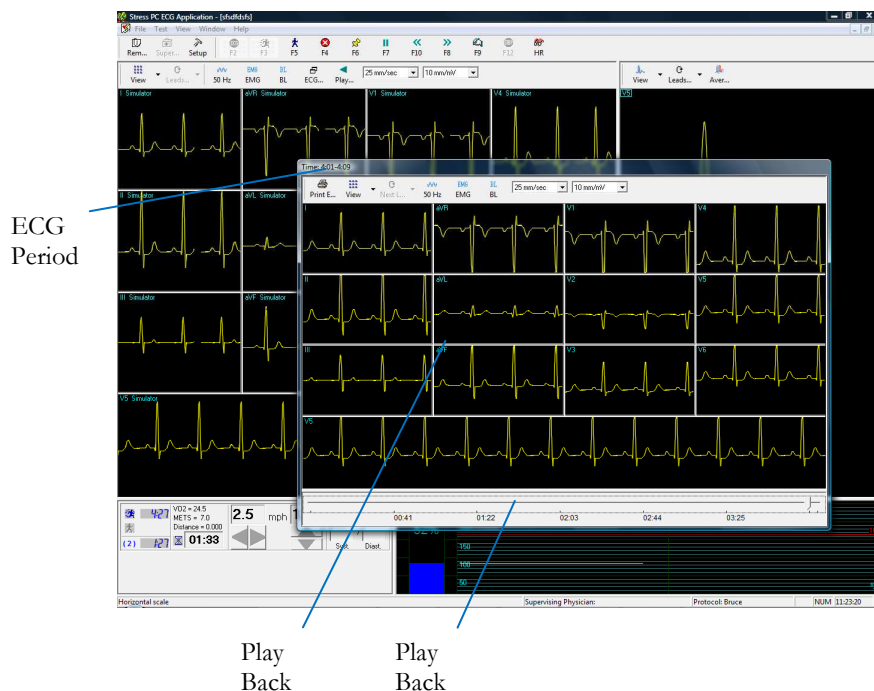
Play Back   Play Back

Figure 27: Play Back Window

2. Navigate with the scroll bar to the requested time.

3. Press on or on space-bar key or select Test->Play Back menu to close the Play Back window.

Recovery Phase

When you switch to recovery phase, the recovery phase elapsed time is counted as well as the total elapsed time. Wait for recovery phase to finish according to protocol or stop it using the stop icon. Both TEST time and RECOVERY time are fixed. Patient monitoring continues. Click and disable **Go** to stop it.

Viewing Results

There are two options for completing a stress test.

- Display the post-processing data screen (Review Screen) automatically

- Remain in ECG display.

To View Study Results

Click the **Post Processing** icon.
This enables display and printout of the entire study. Note that before saving the study to disk, the entire ECG is kept for review.

To Display the Review Screen Automatically

In Setup, click the **Real-Time** tab and check **Switch to Review Automatically**.
At the end of the test protocol, or after clicking **F4**, the display switches automatically to the Review Screen, and the post-processing information is displayed.

To Display the Review Screen Manually

If **Switch to Review Automatically** is not enabled:

1. Click **F4**
   The test (exercise device) stops but the ECG signal continues to run.

2. Click **F2**
   The ECG signal stops and a Review button is displayed on the tool bar.
   (The Review button is not displayed if **Switch to Review Automatically** is enabled).

3. To review the post-processing information, click **Review**.
   The Review Screen is displayed with the post processing data. It provides the following options:

   ◊ Print reports automatically.

   ◊ Save and display ORIGINAL Data with real time filters (with removal option).

   ◊ Print All Events in REVIEW.

   ◊ Print on an additional page if necessary.

   ◊ Print ST Measurements optionally.

To Save Study Results

1.   Click Setup > **ECG Recording**.

2.   Select options for saving the study and click **OK**.

3.   Click File > **Save**, define the file name and path, and click **OK**.

Metabolic Stress Estimation (METS)

A very important feature of the software is the estimation of Metabolic Equivalency (METS). This estimates how many ml of oxygen the body produces for every kg of weight per minute. The results are shown in units of METS or VO2 Max. (One unit of VO2 is 3.5 units of METS.)

1 METS corresponds to a person at rest.

A higher METS indicates a higher fitness level.

Transfer File "Trnsf.txt"

Use this option when the PC-ECG 1200 shares the same PC with another application in real time.

To Transfer a File

4. Click Setup > **Environment**.

5. Click the **Advance** tab.

6. Check **Use transfer file "TRNST.TXT"**

A transfer file is created in the directory containing the Stress application file. The default is C:\Program Files\Pc-ecg. The transfer file receives real time data from the Stress application, such as: current Heart Rate, Workload, Speed, and Grade of external device. It is a text file, updated every 5 seconds.

The format is as follows: Each text line starts with a descriptive header and a parameter that always starts at character number 13. The value of each parameter may change during the study.

Parameter		Current Value	Range (not included in text file)
HR	**:**	**86**	(0-200)
Speed(mph)	**:**	**3.3**	(0- 25)
Grade(%)	**:**	**1.0**	(0 – 30)
Workload	**:**	**10.1**	(0 – 1000)

Table 13: Transfer File Format

> **Note**
> A Sharing Violation error may occur if the file is read while the Stress Application is updating it. Wait until updating is completed (a second or two).

Export the exercise protocol real time values.

Use this option when the PC-ECG 1200 shares the exercise protocol measurements with another application in real time. The protocol data stored to single line text file.

To enable the exercise protocol export file feature

1. Click Setup > **Environment**.

2. Click the **Advance** tab.

3. Check **Use real time protocol export file**

4. Insert the export file full file name including directory path.

An export file is created in the specified directory. The export file receives real time data from the Stress application, such as: stage Name, exercise device type (Treadmill or Ergometer), Speed or Workload, Grade or RPM, Heart Rate, Blood Pressure, ST value and slope. It is a text file, updated every 1 second.

Export file format

[AAAA~BBBB~C
DDDD~E~FFFF~GGGG~HHHH~IIII~JJJJ~KKKK~LLLL~MMMM~]NNPP
    (where a space is shown as "~")

   AAAA *– combined Phase and Stage name*
       *"**Chck**" – initialization*
       *"**Base**" - base phase (Resting stage)*
       *"**Warm**" – warming phase (pre-test manual warming stage)*
       *"**Exer**" – exercise phase (stress stages)*
       *"**Reco**" – recovery phase (all recovery stages)*
       *"**Stop**" – finish of test (post processing, no ECG running)*
   BBBB *– value for **Load Parameter 1***
   C *– designator for Load Parameter 1*
       M *– treadmill Speed in [0.1 mph]*
       K *– treadmill Speed in [km/h]*
       W *– ergometer Load [Watt]*
   DDDD *– value for **Load Parameter 2***
   E *– designator for Load Parameter 2*
       % *- treadmill Grade in [0.1 percent]*
       U *– ergometer revolutions in [/min] = [RPM]*
   FFFF *– Heart Rate in [bpm]*
   GGGG *– Ventricular Ectopic beats per minute (not used, always **~~~0**)*
   HHHH *– BP measurement NBR (not used, always **-999**)*
   IIII *– Systolic BP in [mmHg] (**-999** if unavailable)*
   JJJJ *– Diastolic BP in [mmHg] (**-999** if unavailable)*
   KKKK *– ST Level for most significant ECG lead in [0.01 mV] (**-999** if unavailable)*
   LLLL *– ST Slope for most significant ECG lead in [0.01 mV/s] (**-999** if unavailable)*
   MMMM *– ST Integral for most significant ECG lead (not used, always **-999**)*
   NN *– rightmost 2 ASCII characters of checksum expressed hexadecimal in UPPER CASE*
   PP *– fixed string "CR" for Carriage return*

Example: connect the Norav Stress ECG to <u>CareFusion LAB 5</u> CPET system

1. In *Norav Stress ECG* setup:

    a. **Advanced** panel of Environment tab

        -   Insert "**C:\LAB5\DB\ERGOSPIR.DAT**" for export file name

    b. **GDT\BDT** tab

        -   enable the **Import from GDT\BDT** check box

        -   insert the "**C:\LAB5\DB**" path for GDT\BDT Data Directory

        -   insert "**Hell**" text to **Token for PC-ECG** field

2. In *CareFusion LAB5 CPET* system setup:

    a. select **Extern ECG** for Oxycon Configuration Tool.

    b. perform "**Service-Login**".

    c. open Settings and select **Norav** from the **<u>ECG-Type</u>** list.

    d. in **<u>Path and program name</u>** field select the **Stress.EXE** application executable name with full path.

    e. insert "**Stress**" in **<u>Title: Use the text in ECG application</u>** field

    f. insert "**C:\LAB5\DB**" in **<u>Path: When ECG is not located …</u>** field.
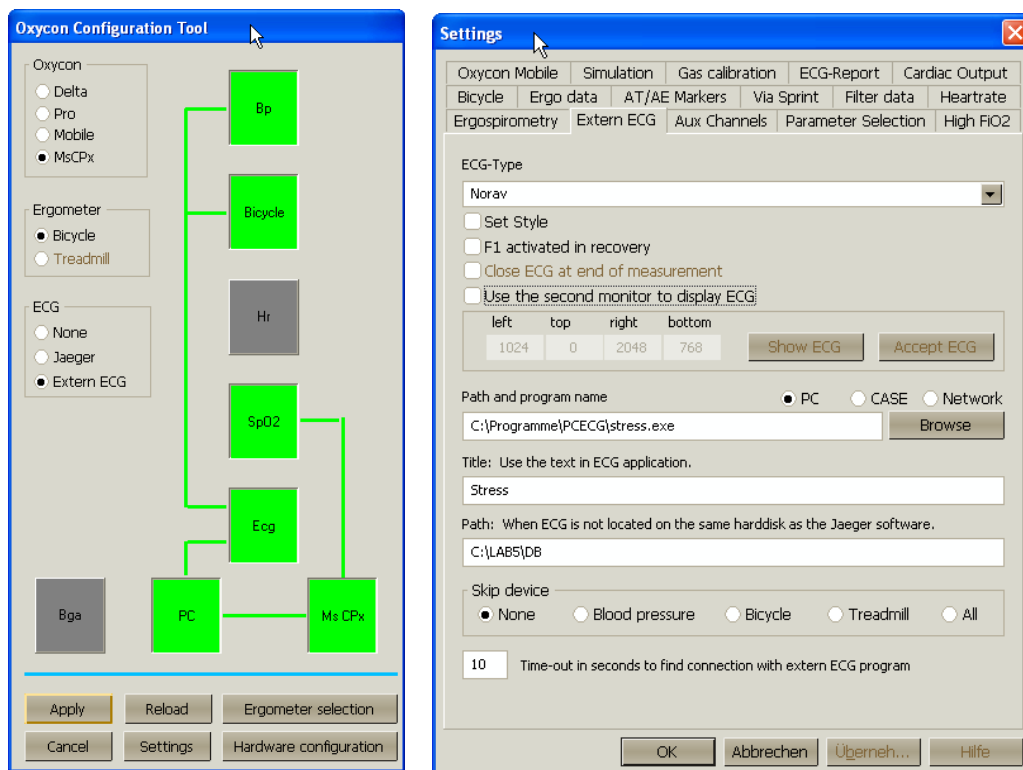
Figure 28: CareFusion LAB5 CPET Settings

Additional Features

To Define Max. HR

1. Open a test in a Review Screen (post processing).

2. Click **Properties** on the toolbar
    The Properties dialog box is displayed.

3. Select the cell with the highest HR value.

4. Click **Define Max HR**.
    The cell is highlighted and the background color of the cell is changed.

To Define Worst ST

1. Open a test in a Review Screen (post processing).

2. Click **Properties** on the toolbar
    The Properties dialog box is displayed.

3. Select a cell in one of the channels with the worst ST.

4. Click **Define Worst ST**.
    The cells in the 12 channels of the same event are highlighted and the background color is changed.

A Dynamic ST function

This feature automatically displays the lead with the current worst ST in the Average QRS display on the upper right hand side of the screen.

To enable this function:

1. In Setup choose View and at the bottom in Real time Average QRS select the Dynamic (Worst Case ST).

2. Go to *ST, VPB Options* and select from amongst the 3 options in the *Worst Case ST Report*.

3. Press Apply and OK and you are ready to enjoy this great new tool.

	The Dynamic ST function is available exclusively with the S2 Advanced Stress software.
Note	

RS232 Controlled Treadmill Types

Vendor	Model	Vendor's Fax	Email	RS232 Connector on the TM	RS232 Wiring Type
Norav/ Trackmaster	TM425	+1-316-283-3350		D-9 female	Straight
Norav/ Trackmaster	TMX425	+1-316-283-3350		D-9 female	Straight
GE /Marquette	2000 series			D-9 female (RS422)	M422*
				DIN 5 pin female	Tx –5 Rx – 4 GND - 2
Cardiac Science /QUINTON	TM-55		internationalservice@cardiacscience.com	D-9 female	Straight
Cardiac Science /QUINTON	ST-55		internationalservice@cardiacscience.com	D-9 female (RS422)	Q422*
HP COSMOS / Schiller	All models	+49-8669-864249		D-9 female	Crossed
Lode	Lode Valiant 110082			DB9, female	Crossed
Woodway	PPS55-MED			D-9 male	Crossed
Technogym (Treadmill)	C-Safe protocol				
RAM	770	+39-049-8703388		D-9 female	Straight
SBI					
Powerjog	GM, J	+44-121-4333035			
System Biomedical		+91-22-4963147			
KIP Machines	KIP Series	+5411-4327-2963 +54341-464-7302 +54341-463-7919		DB9 Male	Lines: RX, TX, GND standard place in DB9 Male connector
BONTE MACHINEFABRIEK B.V.	Bonte	+ 31 038-4554030		DB9, crossed	Treadmill (SUB-D 25) <----> PC (SUB-D 25) 2 ---------- 3 3 ---------- 2 7 ---------- 7
BONTE MACHINEFABRIEK B.V.	Bonte2				
Parker	PM	+1-334-8213221		D-9 female	Straight
Parker	Parker 1200				
Micromed	Micromed				

* Requires a special adaptor, supplied by Norav Medical

Table 14: Controlled Treadmills

RS232 Controlled Bicycle Ergometers

Vendor	Model	Vendor's Fax	RS232 Connector on the Ergometer	RS232 Wiring Type
LODE BV	Corival			
LODE	EXCALIBUR			
Ergoline	ER900	+49-7431-989427	DIN 5 pin	
SECA	CT100	+49-40-20000050	D-9 male	Crossed
ERGOSANA		+41-41-7618022	D-9 female	Straight
Daum	ERGOFIT			
Tunturi	T-PROTOCOL			
Monark	Monark, Monark 839E			
Technogym (Bike)	C-Safe protocol			
Dimeq	770	+49-30-72376240		
ELMED				

Table 15: Controlled Ergometers

CHAPTER 2:   LATE POTENTIAL SIGNAL AVERAGING

(This option is available with the L1 license)
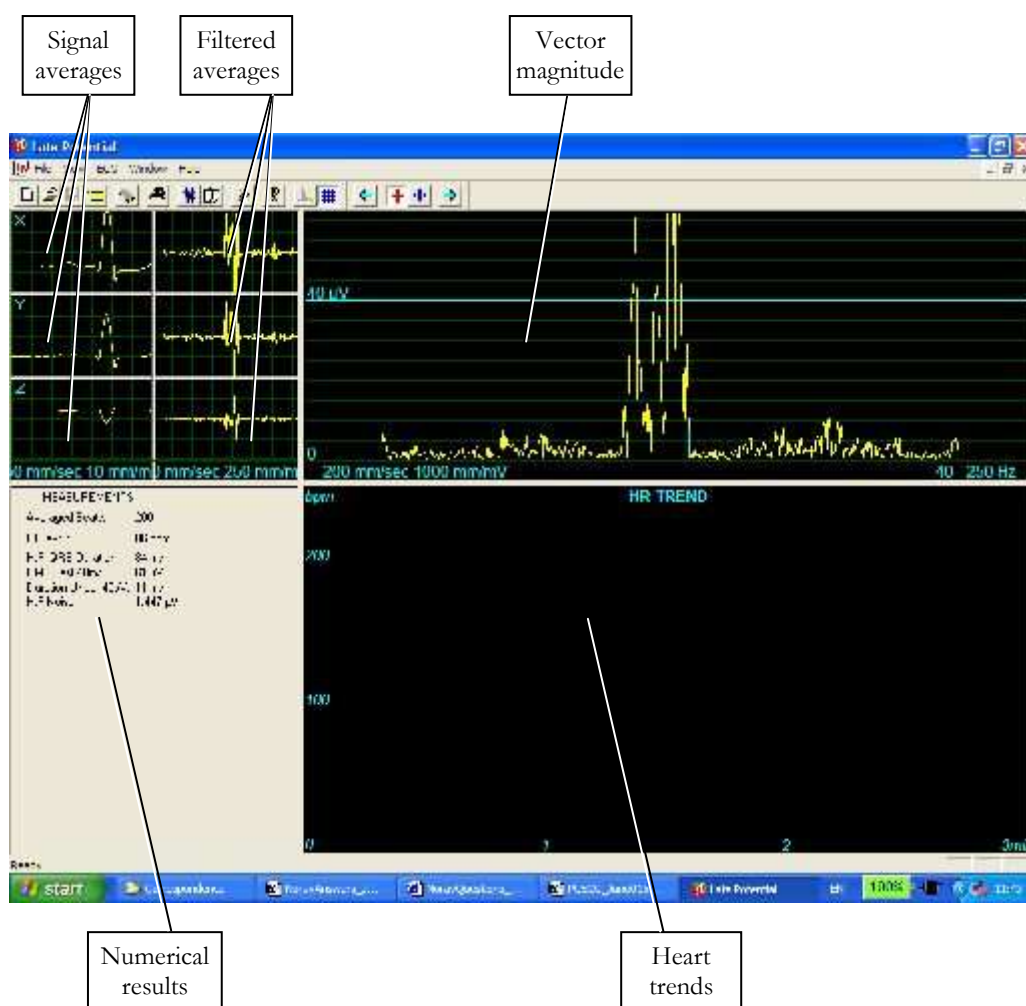
Figure 29: Late Potential Signal Averaging Screen

Quick Start

To Start a New Test

1. Click **F1** (or the **New** button on the tool bar).

1. Insert patient details in the dialog box.

2. Click **OK**.

3. Click **F3** or **F4** to start the LP averaging test.

4. Enter the interval name and/or remarks as appropriate in the dialog box and click **OK**.

5. Click **F3** or **F4** (or **Start**/**Stop Averaging** button) to stop the LP averaging test (or wait until it terminates).

To Print

1. Click **F6**, or select **Print item** from the File menu.

1. Select the printer from the Print dialog box.

2. Click **OK** to close the dialog box and print the display (the LP averaging report or the ECG test).

Operation with Function Keys

F1	New recording
F3/F4	Start/stop
F6	Print
F11	Open saved study

Table 16: LP Signal Averaging Function Keys

For an example of a printed report, see Appendix C:, page 132.

Leads

Recording is performed for leads X, Y, and Z (orthogonal) using the regular 12 lead cable. Arrange the leads as follows:

12 Lead	**Orthogonal Lead (position)**
V2	X+ left side of the chest
V1	X- right side of the chest
V4	Y+ lower side of the chest
V3	Y- upper side of the chest
V6	Z+ middle of the chest
V5	Z- middle of the back
RA,LA,LL,RL	Same position as in 12 leads

Table 17: LP Signal Averaging Leads Placement

LP Signal Averaging Setup

Click **Setup** on the Toolbar to access the following parameters:

Tab	Option	Description
ECG Recording	Auto Save(Save Options)	When Auto Save is ON, the file is stored by Last name or by ID. When Auto Save is OFF, the program requests a filename.
	Set File Name by (Save Options)	Set the naming convention for saving files (by Patient Last Name or ID)
	Simulator ECG	When cleared (default), ECG recording is performed from the PC-ECG unit. If checked, the ECG recording is performed from the demo file included in the software package. The recording unit is not required.
	Stop to confirm QRS	When ON, the user can choose the Normal QRS. When OFF, the program chooses the Normal QRS automatically.
	Template Correlation	Defines the QRS percentage match during signal averaging. A higher number corresponds to a better match.
	Target Number of Beats	Number of typical heartbeats that will be counted during the averaging stage.
	Use ECG Database	Check this option to connect to the default ECG database. ECG tests are saved in the database.
	Data Directory	Defines the directory for saved ECG recordings.
View	ECG's Colors	To modify the ECG colors, click the appropriate button and select the color from the color palette.
	Averages Color	To modify the colors in the Averages window, click the appropriate button and select the color from the color palette.
	HR Trend's Color	To modify the colors in the HR Trend's window, click the appropriate button and select the color from the color palette.
	Restore Defaults	Click to restore the default factory colors
Installation		Saves hospital and physician data. This data is included in print out and email.
	Measurement Standard	Define whether measurements will be calculated according to the metric or the USA standard. The default is metric.

Tab	Option	Description
	Magnetic Card Reader	Select this option to use a magnetic card with bar-code to insert patient details. Select the magnetic card type.
Environment	Connection	Use the option button (COM port/USB) to select the port for device connection.
		If COM port is selected, select the serial input for the PC-ECG unit from the COM port list.
		If the USB connection is selected, the COM PC-ECG selection list is disabled. (Default at installation is USB).
	Graph paper	If ON, prints 1mm and 5 mm squares on printouts.
		Regular grid prints from all printers.
		Improved grid shows a fine grid but may not work on some printers.
	Use Large Fonts for Remarks	Enlarges font for free typed text.
	Color printouts	Clear this option to force B/W printing on color printer.
	Display Size	Choose between 14/15-inch screen (default) and 17-inch screen. This setting is required in order to display the ECG and grid in correct scale.
GDT/BDT Format	Automatic Options	Define automatic options for saving and/or importing files in GDT/BDT format.
	File Format	Select the file format: GDT or BDT
	Import Codepage 437	Check this option to import Code page 437.
	Export Codepage 437	Check this option to export Code page 437.
	Edit Labels	Click this button to open a dialog box with an editable list of the field labels used in the GDT and BDT files.
	GDT/BDT Data directory	Define the directory path where the GDT/BDT files will be maintained.
	Token for PCECG	Default is PEKG.
	Token for Practice EDP	Default is EDV1.
Holter File Path	Download Flash Card Program	Define the path for the flash card program directory.
	Download Directory	Define the directory to maintain the downloaded Holter files.

Table 18: LP Signal Averaging Setup

Toolbar and Menus

To do this	Click this icon	Or use this short-cut key	Or select this menu	Description
Start a new study		F1	File > New	Starts a new XYZ recording. The patient's demographic data can be entered prior to ECG recording (optional). The three channels are displayed on the screen for quality assurance. If the results are unsatisfactory, check skin preparation and disposable electrode contacts. Then click **Start/Stop Averaging**.
Open an existing study		F11	File > Open	Opens an existing study
Save a recording		Ctrl+S	File > Save	Saves recording to disk (default file name: REST).
Send data via email			File >Send...	Sends recording data via email, if present on the computer.
Print results		F6	File > Print	Prints the active study
Import demographic data from HIS to PC-ECG			File > GDT/BDT Format For details see **Import from GDT/BDT**, page 125	This file always contains the last patient data.
Export the GDT/BDT file from PC-ECG to HIS			File > GDT/BDT Format For details see **Save Test in GDT/BDT** page 125	This file always contains the last patient data.
Set/change patient data			View > Patient Data	Adds this data to the recording. It is printed together with the ECG traces. If the recording is saved, then the PATIENT DATA is saved together with the ECG traces. Use the **Previous** option if the same patient undergoes a second study.

To do this	Click this icon	Or use this short-cut key	Or select this menu	Description
Add/view remarks			View > Remarks	Allows you type free text during or after the ECG recording. It is printed and saved together with the ECG traces.
Set preferences		Ctrl+T	View > Setup	Displays the setup dialog box and allows the user to tailor operation preferences.
To display information			Help > About…	Displays software version number (which should be quoted on any inquiry regarding the software). Also displays memory size and disk free space.
Start/Stop Averaging		F3/F4	ECG > Start/Stop Averaging	Allows the user to start the averaging period. The averaging period default is 200 beats. It can be changed in OPTIONS, ECG RECORDING, and TARGET NUMBER
Display/Hide the grid			View > Grid	Optional display of 5mm raster. Print outs are always with 1mm raster.
Start monitoring.		F2	ECG > Start/Stop Monitoring	Starts monitoring.
Stop monitoring		F2	ECG > Start/Stop Monitoring	Stops monitoring.
Activate Onset Marker		Ctrl+←	ECG Onset marker	Allows the user to move the Onset Marker using the direction arrow icons.
Activate Offset Marker		Ctrl+→	ECG Offset marker	Allows the user to move the Offset Marker using the direction arrow icons.
Move the On and Off markers				Allows the user to move the ON/OFF markers.

Table 19: LP Signal Averaging Toolbar and Menus

Interpreting Results

When the signal-averaging phase is complete, the result screen is displayed:
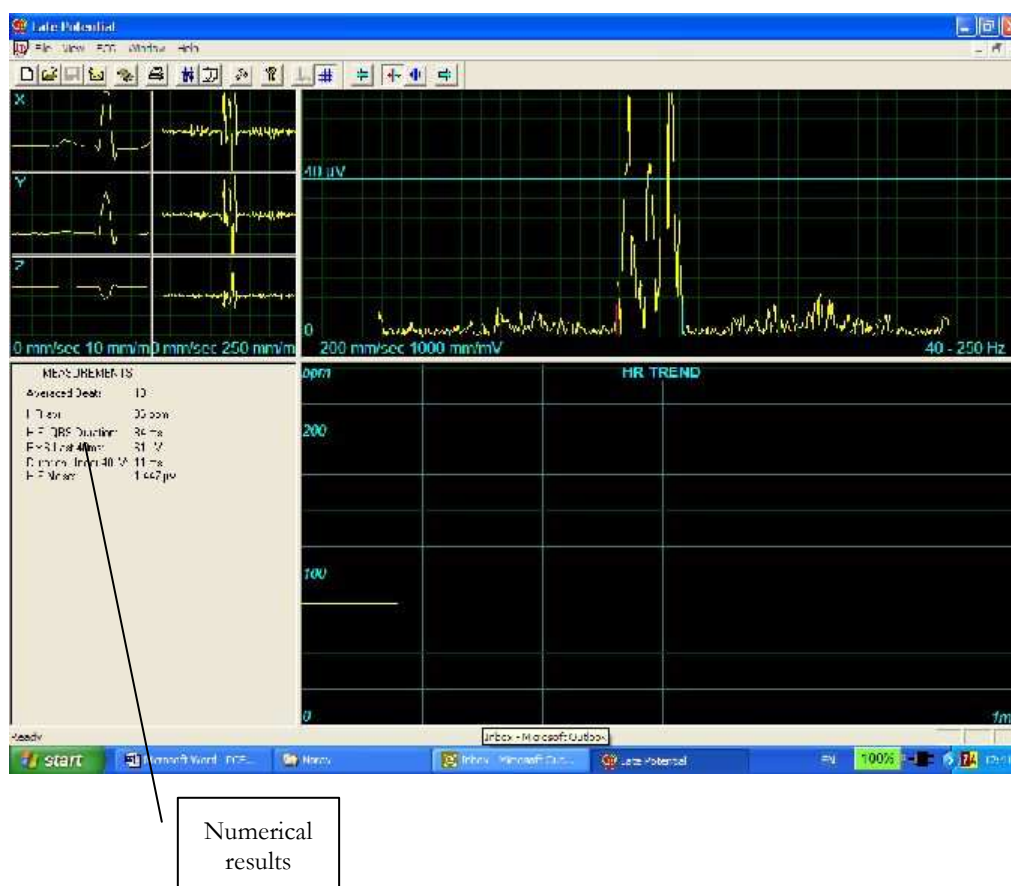
Numerical
results

Figure 30: LP Signal Averaging Review Screen

Numerical Results

Averaged Beats	Displays the number of averaged normal beats captured during the study.
HR Average in beat/min	
High Frequency QRS Duration in Milliseconds from ONSET to OFFSET	Displays the width of the filtered QRS containing only high frequencies. A higher number indicates higher patient risk.
RMS LASTS 40 milli-seconds in Microvolts	Displays the total activity for the last (40ms) portion of the QRS. A lower number indicates higher patient risk.
DURATION UNDER 40 Microvolts in Milliseconds	Shows the period in ms from offset of the QRS till the first point of 40uV activity. A higher number indicates higher patient risk.
H.F. Noise: in Microvolts	Quality assurance. A lower number corresponds to higher result accuracy. The maximum number should not exceed 1 µV.

Table 20: LP Signal Averaging Numerical Results

The results are calculated automatically. You can overrule the automatic positioning of the ONSET/OFFSET markers with the direction keys.

CHAPTER 3: MONITORING

(This option is available with the M1 license)

This option enables long-term recording and storage to disk. The user decides which leads and at which sample rate to monitor on screen and save to disk. During the study, you can print in real time on a thermal printer.
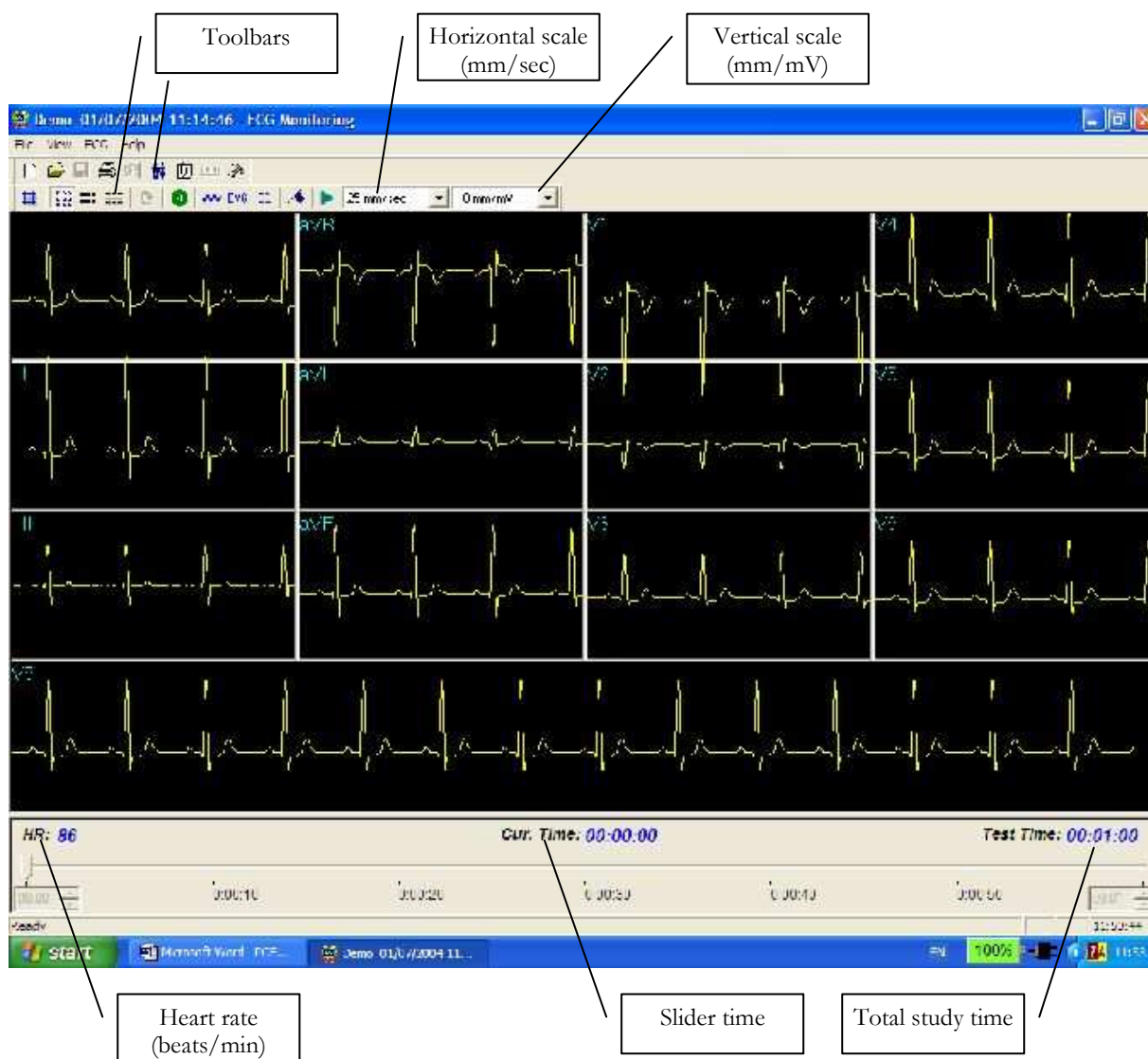
Figure 31: Monitoring Screen

Quick Start

To Start a New Test

1.   Click **F1** (or the **New** button on the tool bar).

1.   Insert patient details in the dialog box.

2.   Click **OK.**

3.   Click **F2** (or **Start/Stop** button) to stop data collection or wait until end time.

To Print

1.   Click **F6**, or select **Print item** from the File menu.

1.   Select the printer from the Print dialog box.

2.   Click **OK** to close the dialog box and print the display.

Print Study (print a selected time range and leads)

1.   Click **Print Study** on the toolbar or select **Print Study Item** from the File menu.

1.   Define the time range and select the leads to print from the dialog box.

2.   Click **OK** to acknowledge selection and close the dialog box.

3.   Select the printer in the Print dialog box.

4.   Click **OK** to start printing.

Monitoring ECG Setup

Click **Setup** on the Toolbar to access the following parameters:

Tab	Option	Description
Sample Rate\Leads Selection	Leads	Allows the user to select leads. To select all leads, click **Select All**. To deselect all leads click **Unselect**.
	Sample rate	Allows the user to choose requested samples per second per channel.

Tab	Option	Description
	X,Y,Z	Check this option to monitor X, Y, and Z axis. Clear the option to select the other leads to be displayed and monitored on screen. With this option, monitoring other leads is not possible (default is cleared).
12 Leads View	Default 3 leads	This function is available only if 12 lead monitoring is selected. 3 leads appear if 3X1 format is used.
	Strip Lead	10 sec. lead appears in 4X3 and 6X2 formats.
ECG recording	Filter 50/60Hz	When checked, the default status of 50/60Hz filter is ON (according to the checked frequency 50 or 60). Default is cleared.
	EMG Filter	When checked, the default status of the EMG filter is ON. Default is cleared.
	Baseline filter	When checked, the default status of the Baseline filter is ON. Default is cleared.
	Save options	If **Auto Save** is ON the file is stored by last name or by ID. If **Auto Save** is OFF the program requests a filename.
	Simulator ECG	If cleared (default), ECG recording is performed from PC-ECG unit. If checked, ECG recording is performed from the demo file included in the software package. The recording unit is not needed.
	ECG Recording time (h:m)	Determines study duration in minutes.
	Data Directory	Defines the directory for saved ECG recordings. Use secondary hard disk if available.
View	Draw Over Lead Borders	If checked (default), does not limit the extreme high amplitude ECG pulses from exceeding the borders. If cleared, chops the pulses at the borders.
	Horizontal Scale	Sets the default value for the Horizontal scale window on the screen.
	Vertical Scale	Sets the default value for the Vertical scale window on the screen.
	Slider step size	Off line function. Sets the default value for slider steps when moved by mouse or arrow keys.
	Colors	Allows the user to choose colors.
	Restore Defaults	Restores factory defaults.

Tab	Option	Description
Installation		Saves hospital and physician data. This data is included in print out mail.
	Measurement Standard	Define whether measurements will be calculated according to the metric or the USA standard. The default is metric.
	Magnetic Card Reader	Select this option to use a magnetic card with bar-code to insert patient details. Select the magnetic card type.
Environment	Connection	Select the option button (COM port/USB) to choose the port for device connection.
		If the COM port option is selected, select the serial input for the PC-ECG unit from the COM port list.
		Disabled if the USB connection is selected. (Default at installation – USB)
	Display Size	Choose between 14/15-inch screen (default) and 17-inch screen. This setting is required to display the ECG and grid in correct scale.
	Graph paper	If set to On, it prints 1mm and 5 mm squares on printouts.
		Regular Grid is guaranteed to fit any printer.
		Improved Grid shows a fine grid but may not work on some printers.
	Large Remarks font	Enlarges printed text.
	Color Printout	Forces B/W printing on color printer.
	Thermal Plotter	Sets LPT port for optional thermal paper.
GDT/BDT Format	Automatic options	Setup automatic options for saving and/or importing files in GDT/BDT format.
	File Format	Select the file format: GDT or BDT
	Import Codepage 437	Check this option to import Code page 437.
	Export Codepage 437	Check this option to export Code page 437.
	Edit Labels	Click this button to open a dialog box with an editable list of the field labels used in the GDT and BDT files.
	GDT/BDT Data directory	Define the directory path where the GDT/BDT files will be maintained.
	Token for PCECG	Default is PEKG.
	Token for Practice EDP	Default is EDV1.

Table 21: Monitoring Setup Options

Toolbar and Menus

To do this	Click this icon	Or use this short-cut key	Or select this menu	Description
Start a new study		F1	File > New Test	Starts a new monitoring session. Patient data can be entered prior to ECG recording (optional). The recording time is set in SETUP for ECG RECORDING. The user can stop recording by clicking the GO/STOP icon.
Open an existing study		F11	File > Open	Shows recordings saved on disk.
Save a recording		Ctrl+S	File > Save	Saves recording to disk.
Print results		F6	File > Print	Off line printing. Determine the time range to be printed. The acquired ECG is printed in miniature format horizontal: 6.25mm/sec and vertical: 2.5 mm/mV.
Export to Rest			File > Export to Rest	A 10 sec segment containing original leads I,II,V1-V6 and calculated leads III, aVR, aVL, aVF is transferred into Rest format (up to 12 leads 10 sec). Calculated leads are performed only if I and II are acquired.
Export to MATLAB			File > Export to MATLAB	A 10 sec segment containing acquired leads is transferred into MATLAB format.
Import from ISHNE			File > Import from ISHNE	Long-term high resolution ECG recorded on Holter can be transferred into a monitoring study
Plot in real time				Real time printing on a thermal printer. Can print continuously while monitoring up to 8 leads.
Set/change patient data			View > Patient data	Displays patient demographic information.
Add/view remarks			View > Remarks	Allows the user to enter free text during or after the ECG recording. This is printed and saved together with ECG traces.
Set preferences				Allows the user to tailor operation preferences.
To display information			Help > About…	Software version number. Quote this for any software inquiry. Also shows memory size and free disk space. The HASP ID number is the ID of existing software keys. This ID number is used for adding software options.

To do this	Click this icon	Or use this short-cut key	Or select this menu	Description
Display/Hide the grid			View > Grid	Optional display of 5mm raster.
Start ECG Recording.		F2	ECG > Start/Stop	Starts ECG recording.
Stop ECG Recording		F2	ECG > Start/Stop	Stops ECG recording.
Display 3X4 Leads		Ctrl+1	View > Leads format > Windows	Classical format. Displays 12 lead ECG of 2.5sec ECG + 10sec trace.*
Display 12X1 Leads		Ctrl+2	View > Leads format > All leads	Displays 12 lead ECG of 10sec ECG.*
Display 3X1 Leads		Ctrl+3	View > Leads format > Lead group	Displays 3 lead ECG of 10sec ECG.*
Display the next leads		Ctrl+0	View > Leads format > Next leads	Allows the user to scroll through all leads in the 3X1 display
Set 50/60 Hz filter			ECG > Filters > 50/60 Hz	ON/OFF for line interference filter. Set OPTIONS for 50 or 60 Hz prior to operation
Set EMG filter			ECG > Filters > EMG	ON/OFF for muscle noise filter
Set base line filter			ECG > Filters > BaseLine	ON/OFF for baseline filter on ECG data

Table 22: Monitoring Toolbar and Menus

* ECG data can be set up as limited amplitude or unlimited amplitude, which can cause one lead data to overlap a neighboring lead.

CHAPTER 4:   HEART RATE VARIABILITY (HRV)

(This option is available with the H1 license)

Time and frequency domain analysis is designed for short studies in which one or more time segments are measured, as in a Tilt study.

Measured/reported parameters are according to NASPE/ESC Guidelines.

Histogram

P.S.D.

Tachogram

Slider

HRV results

Key:	
Histogram	The histogram relates to the active part (yellow) of the tachogram
P.S.D.	The power spectrum distribution
Tachogram	The tachogram trend shows all intervals. Each beginning of an interval is checked with a red line followed by the interval's name. To activate an interval, click it. To activate several neighboring segments, press SHIFT and move the slider.
Slider	Use the slider at the bottom to: • Define new intervals • Change interval duration, and • Activate several intervals
HRV results	The HRV results pane displays the results in numerical format.

Table 23: HRV Screen

Quick Start

To Start a New Test

1. Click **F1** (or the **New** button on the tool bar).

1. Insert patient details in the dialog box.

2. Click **OK.**

3. Click **F3** or **F4** to start the HRV test.

4. Enter the interval name and/or remarks as appropriate in the dialog box
    and click **OK.**

5. Click **F3** or **F4** (or the **Start/Stop HRV** button) to stop the HRV test
    (or wait until it ends).

To Print an HRV Report

1. Click **Print** on the toolbar or select **Print** from the file menu.

1. Select the printer from the print dialog box.

2. Click **OK** and the report is printed.

For an example of a printed report, see Appendix C:, page 132.

To Print an ECG

1. Click the **Print ECG** button on the toolbar or select **Print ECG** from the file menu.

3. Select the beats and leads to print from the dialog box and click **OK**.

4. Select the printer from the print dialog box.

5. Click **OK** to close the dialog and print the ECG.

HRV Setup

1. Click the **HRV** icon.
    The HRV window is displayed.

1. Click the **Setup** icon (hammer).
    The following folders are displayed:

Tab	Option	Description
Sample Rate\Leads Selection	Leads	Choose leads and sampling rate. Select up to four neighboring leads for calculations.
ECG Recording	Filters	Set filters as active.
	Test Duration	Define the test duration either by target number of beats or by the ECG recording time. Select the preferred parameter and define the value for the test duration.
	Save Options	Set the Preferred saving options: To save test automatically at the end of the test, check the **Auto Save** option. When this option is cleared, the test is saved only on demand. Define the saving format either as **No ECG Data** or **Full Disclosure**. Define the file naming convention of the saved files, either by Patient Last Name or ID.
	Use ECG Database	Select this option to connect to the default ECG database. When this option is checked, the ECG tests are saved in the database.
	Data Directory	Define a directory for saved ECG recordings (if ECG database is not used). Use a secondary hard disk, if one is available.
	Simulator ECG	When cleared (default), ECG recording is performed from the PC-ECG unit. When checked, the ECG recording is performed from the demo file included in the software package. In this case, the recording unit is not needed.
View		Change default colors for ECG and for graphs.

Tab	Option	Description
	Restore Defaults	Restores factory default color definitions for ECG display and graphs.
Installation		Saves hospital and physician data. This data is included in print out and mail.
	Measurement Standard	Define whether measurements will be calculated according to the metric or USA standard. The default is metric.
	Magnetic Card Reader	Select this option to use a magnetic card with bar-code to insert patient details. Select the magnetic card type.
Environment	Connection	Select the option button (COM port/USB) to choose the port for device connection. If the COM port option is selected, select the serial input for the PC-ECG unit from the COM port list. The option is disabled if the USB connection is selected. Default at installation is **USB**.
	Display Size	Choose between 14/15-inch screen (default) and 17-inch screen. This setting is required to display the ECG and grid in correct scale.
	Graph Paper (Print options)	When set to On, prints 1mm and 5 mm squares on printouts. **Regular Grid** works with any printer. **Improved Grid** shows a fine grid but may not work on some printers.
	Large Remarks Font	Enlarges font for free typed text.
	Color Printout	Clear the check-box to force B/W printing on color printer.
GDT/BDT Format	Automatic Options	Define automatic options for saving and/or importing files in GDT/BDT format.
	File Format	Select the file format: GDT or BDT
	Import Codepage 437	Check this option to import Code page 437.
	Export Codepage 437	Check this option to export Code page 437.
	Edit Labels	Click to open a dialog box with an editable list of the field labels used in the GDT and BDT files.
	GDT/BDT Data directory	Define the directory path where the GDT/BDT files will be maintained.
	Token for PCECG	Default is PEKG.
	Token for Practice EDP	Default is EDV1.

Starting a Study

1.   Click **New.**

1.   Enter patient data in the Patient Data field.
     The ECG leads are monitored on the screen for quality check.
     If you are satisfied with the quality check, click the **R-R** icon. The display comprises three sections:

     ◊   The ECG leads are displayed on the upper part of the screen

     ◊   The tachogram trend display is built up in the middle strip.

     ◊   A slider shows the study status and time at the bottom

     During the study, define a new time segment (interval) by clicking the flag icon (interval). Name each interval during the study to retain it as a valid interval. When all predefined beats are completed, or if terminated by clicking the R-R icon, the HRV screen is displayed:

To Add or Subtract an Interval

1.   Select the interval with the slider.

1.   Click **+** or **−** at the top of the HRV results pane.

To Edit Interval Names

Use the pencil icon.

To Import or Save GDT/BDT Format

 See **Import from GDT/BDT** and **Save Test in GDT/BDT**, page 125.

Results Display

The AVERAGE HEART RATE is displayed in the lower left side.

All results are for the chosen segment (check the yellow selection or the From-To bits number).

Other results are shown in the right hand side as follows:

	RR no.	Number of beats in the active interval
	max RR	Longest R-R period
	min RR	Shorter R-R period
	Average RR	Average of interval in active interval
Time Domain	SDNN	Standard deviation of all R-R periods in interval
	SDANN	Standard deviation of the averages of R-R periods in all 5 min segments of the active interval
	RMSSD	The square root of the mean of the sum of the squares of differences between adjacent NN intervals
	HRV triangular Index	Total number of all R-R intervals divided by the height of the histogram of all R-R intervals measured on a discrete scale
	ULF	Power of the ultra low frequency range
Frequency Domain	VLF	Power of the very low frequency range
	LF	Power of the low frequency range
	HF	Power of the high frequency range

Figure 32: HRV Results

HRV Interval Measurement

A QRS detector measures the interval between any two valid beats. It calculates a sliding N-N average and compares each interval to it. When a significant change occurs, the current beat is either a premature beat (as in PVC) or a prolonged one, which may indicate either a compensatory pause following a PVC or a missing beat. A premature interval and a following prolonged interval (compensatory pause) timed in the range of twice the current N-N interval are averaged. This methodology maintains a consistent time axis in the presence of PVCs. If a prolonged interval follows a normal interval, but at twice the current N-N interval, it indicates the presence of a missing beat. Accordingly, the missing beat is computed as present. This last event is very rare, because the recording is made in rest condition and the software detects the QRS efficiently under such conditions.

CHAPTER 5:   MEASUREMENTS/ INTERPRETATION (MEANS)

(This option is available with the I1, I2 or I3 license)

Measurements is not an autonomous application. The **Measurements** application is used for calculations of QRSs and interpretation of the ECG signal. The user can manually change the QRS identification parameters. 10 seconds of data are calculated.
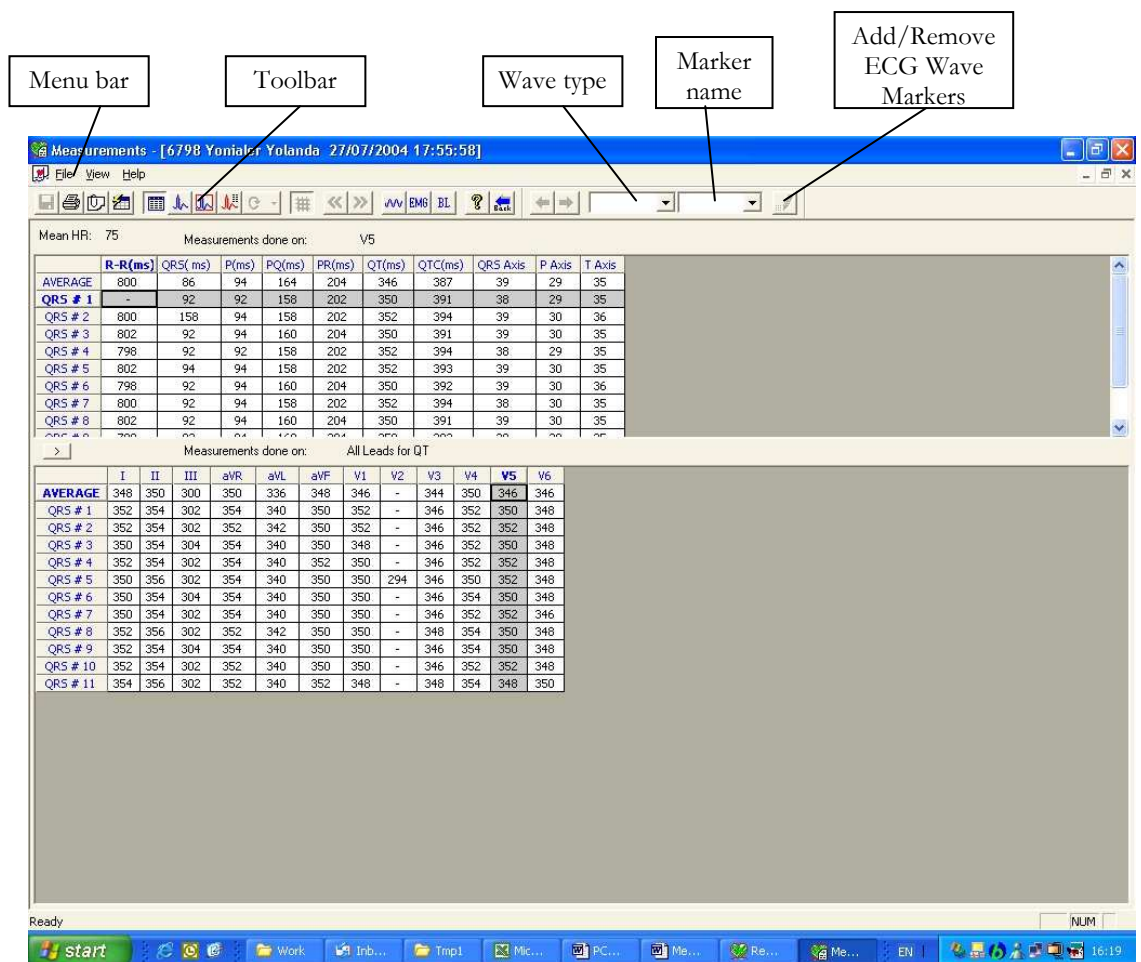
Figure 33: Measurements—Tabular Screen

Quick Start

To Start Measurements

Click the ruler icon in the **Rest**, **Stress**, and **Monitoring** applications,

or click View > **Measurements**

The application has four view formats:

- Measurements Table (default display)

- ECG Averages

- QRS Signal

- Caliper

To Print Reports

1. Click the printer icon or select File > Print Reports.

2. Select the reports to print and click OK.

Performing Changes in Calculations

To Move the QRS Marker

(Averages and QRS views only)

1. Click and drag the marker to the required position (between the previous and next markers).

2. The calculations are modified accordingly.

To Add or Remove a Wave Marker

1. Click the **Add/Remove ECG Wave Markers** icon on the toolbar (or select File > **Add/Remove ECG Wave Markers**).

2. Check or clear wave markers in the dialog box displayed.

3. Click **OK** to save the selection, close the dialog box, and display the change.

To Move the Wave Marker

(Caliper view only)

1. Select a wave from the wave list on the left hand side of the viewer (or from the **Wave Type** combo box).

2. Select the marker from the **Marker Name** combo box in the toolbar or by clicking the marker.

3. Use the Left/Top/Right/Bottom arrows on the toolbar or drag & drop the marker to the required position.
   The calculations are modified accordingly.

Features

View all calculated parameters on every QRS, on every channel and average calculations in tabular format.

The upper table displays measurements for a channel.

The lower table displays measurements values for a QRS.

To View the Measurements on a QRS

Select a QRS from the upper table and view the results on the lower table.

To View the Measurements on a Channel

Select a channel from the lower table and view the values on the upper table.

To View the Measurements on All Channels for QT

Click **">"** (between the two tables) to view measurements for **All Leads for QT** on the lower table.

Tabular Screen

The Tabular screen (see page 105) displays calculations of the QRS parameters in all the leads in a tabular format. Original calculations or changes performed in the other screens (Averages, QRS, or Caliper) are displayed in a tabular format and can be printed out.

Averages Display

Figure 34: Measurements—Averages Display

The Averages screen displays the average QRS in each of the leads and the average ECG of the Strip lead. Each QRS identified is marked with a red marker in the strip lead (The marker actually marks the R wave of every QRS). The QRS markers can be moved to the left and right (between the previous and the next marker). Changes in marker positions are recalculated and displayed in the tabular screen and the QRS screen.

QRS Display
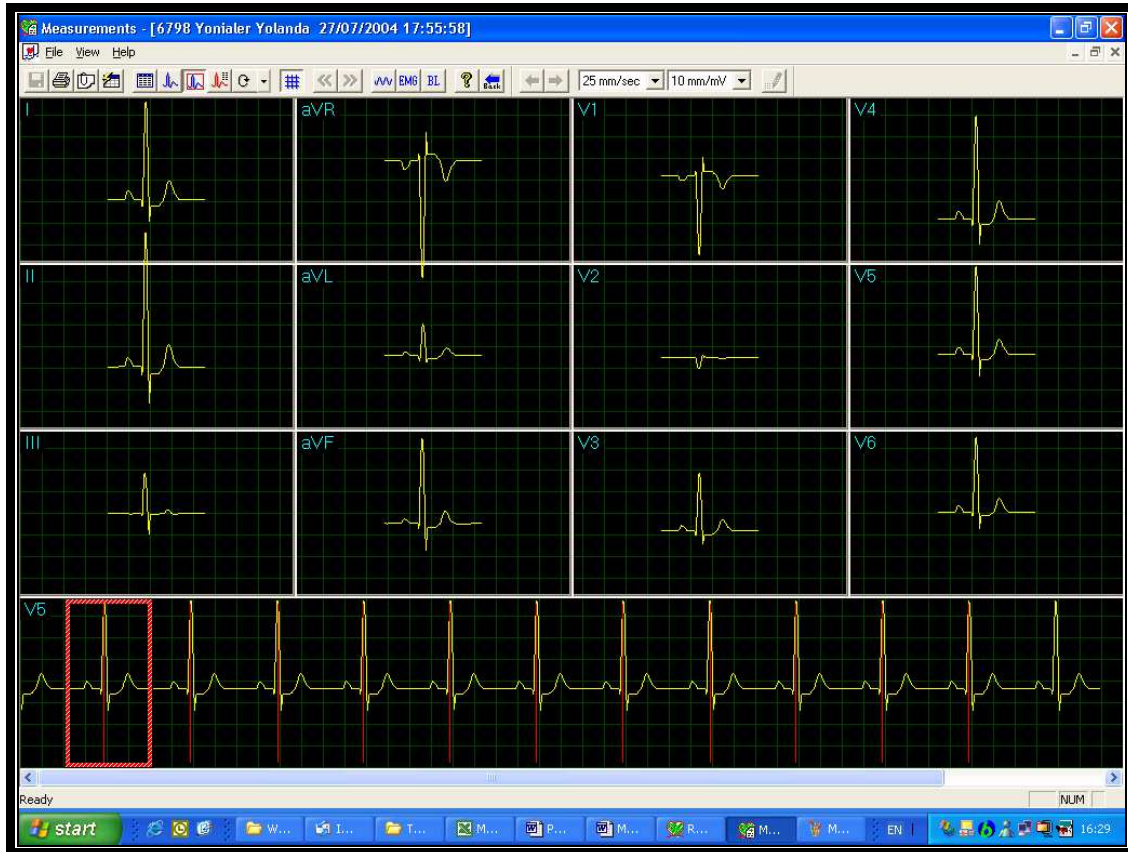
Figure 35: Measurements—QRS display

The QRS screen displays the QRS in each of the leads and a strip lead of a default lead (defined in the setup of the application from which Measurements was accessed). The QRS displayed in each of the leads is marked by a red rectangle in the strip lead. To view a different QRS in all the leads, drag and drop the square by to a different QRS. The QRS markers can be moved to the left and right (between the previous and the next marker). Changes in marker positions are recalculated and displayed in the tabular screen and the Averages screen.
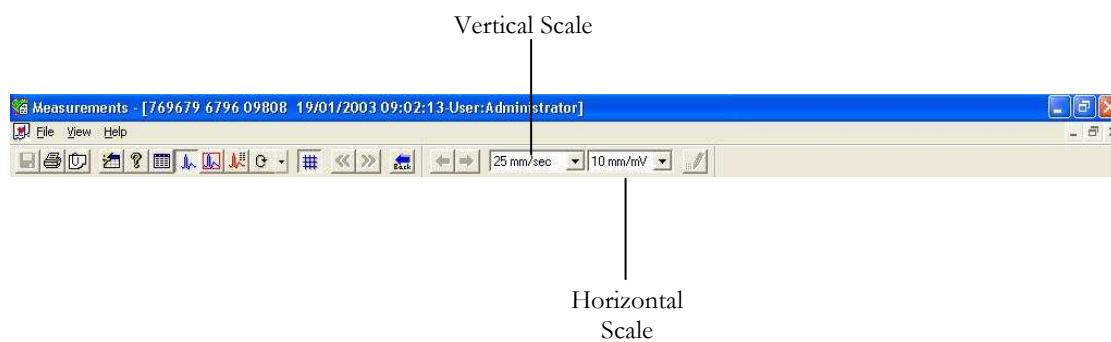
Toolbar of Averages/QRS Displays

Vertical Scale

Horizontal
Scale

Figure 36: Toolbar of Averages/QRS

Caliper Display

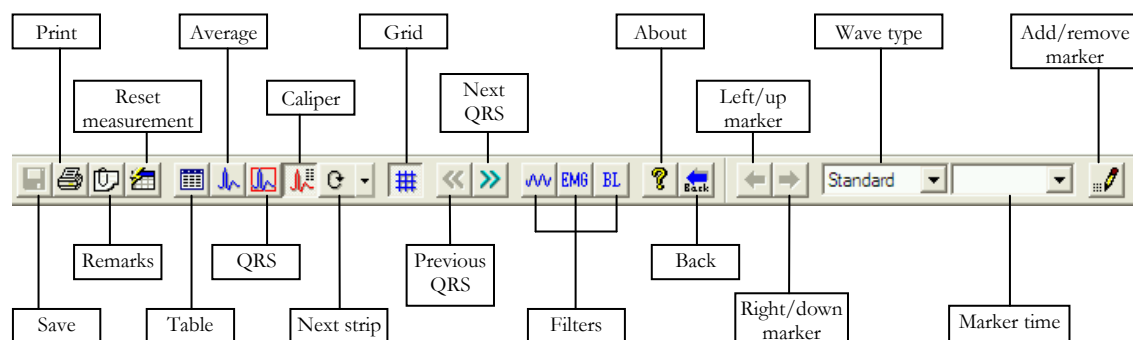**Figure 37: Measurements—Caliper**

Toolbar of Caliper Display

Figure 38: Toolbar of Caliper

The Caliper screen (above) is opened via the menu, the toolbar, or by double clicking a lead in the QRS or Averages screens. It displays one QRS with its values. The user can edit locations of wave markers, display different QRS in the same lead, or navigate through leads and display QRS in different leads. Changes in wave marker positions are recalculated and displayed in the tabular screen.

Toolbar and Menus

To do this	Click this icon	Or use this short-cut key	Or select this menu	Description
Save Measurements		Ctrl+S	File > Save	Saves measurements to test file on disk.
Print ECG		F6	File > Print ECG	Off line printing. The ECG is printed in miniature format. Horizontal: 6.25 mm/sec, vertical: 2.5 mm/mV.
Add/View Remarks		Alt+V+R	View > Remarks	Lets you enter free text during or after the ECG recording. This is printed and saved together with ECG traces.
Reset Measurements		Alt+F+M	File > Reset Measurements	Reset measurements to those calculated by the application. This option will eliminate all the modification performed manually in the measurements.
To Open Measurements in Table Format			View > View Format > Measurements table	Displays the measurements in a table format.
To Display QRS Averages			View > View Format > Averages	Displays the QRS averages on screen.
To Display QRSs in All the Channels			View > View Format > QRS	Displays the QRSs in all the channels on screen .
Display Caliper			View > View Format > Caliper	Displays the Caliper.
Display the Next Leads		Ctrl+0	View > View Format > Next strip	Lets you scroll through all leads in the 3X1 display.
Display/Hide the Grid			View > Grid	Optional display of 5mm raster.

To do this	Click this icon	Or use this short-cut key	Or select this menu	Description
To Display Information			Help > About…	Displays software version number. Quote this for any software inquiry. Also shows memory size and free disk space. The HASP ID number is the ID of existing software keys. This ID number is used for adding software options.
Previous QRS			View > View Format > Previous QRS	Moves to previous QRS on the same channel.
Next QRS			View > View Format > Next QRS	Moves to next QRS on the same channel.
Set 50/60 Hz Filter			ECG > Filters > 50/60 Hz	ON/OFF for line interference filter. Set OPTIONS for 50 or 60 Hz prior to operation.
Set EMG Filter			ECG > Filters > EMG	ON/OFF for muscle noise filter.
Set Base Line Filter			ECG > Filters > BaseLine	ON/OFF for baseline filter on ECG data.
Move Marker to Right/Bottom			------------	Enabled in Caliper screen when a wave type and marker name are selected. Click to move the marker right or down (according to the marker selected). Disabled when no wave marker is selected or the Caliper screen is not displayed.
Horizontal Resolution	25 mm/sec		--------------	(Averages and QRS screens) Lets you choose between horizontal displays of 12.5, 25, 50, and 100 mm/sec. (Default: 25 mm/sec)
Select QRS Wave Type	P Wave		-------------	In Caliper, lets you select the QRS wave type from the list to view its markers. After selecting the wave type, select a marker name to move it.
Vertical Resolution	10 mm/mV		-------------	(Averages and QRS screens) Lets you choose between vertical displays of 5, 10, 20, and 40 mm/mV. (Default: 10 mm/mV)

To do this	Click this icon	Or use this short-cut key	Or select this menu	Description
Select Name of QRS Marker	Poff ▾		-------------	In Caliper, lets you select the name of a marker to edit it (move it up/down/left/right).
Add/Remove ECG Wave Marker	✎		File > Add/Remove ECG Wave Marker	(Caliper screen only) Opens a dialog box and lets you check/clear the wave markers to be displayed and calculated.
Print Reports	------		File > Print Reports	Lets you choose the report to be printed from the sub-menu: Single QRS/QT Report, Multiple QRS Report, or All Reports.

Table 24: Measurements Toolbar and Menus

CHAPTER 6:   NEMS APPLICATION

(This option is available with the D1\D3 license)

Norav ECG Management System (NEMS) application is an optional package requiring a D1 (NEMS-A) or D3 (NEMS-Q) permission license. Install NEMS (Database) from the PC-ECG1200 package.

Keep and manage ECG studies in a catalog organized according to patient name or ID. In a network, users can share the database (save it in the server). Data acquisition for all applications can be initiated either in the application itself or from the NEMS main screen.

Select group field values for query of displayed list of patients

List of tests referring to selected patient (selected test highlighted)
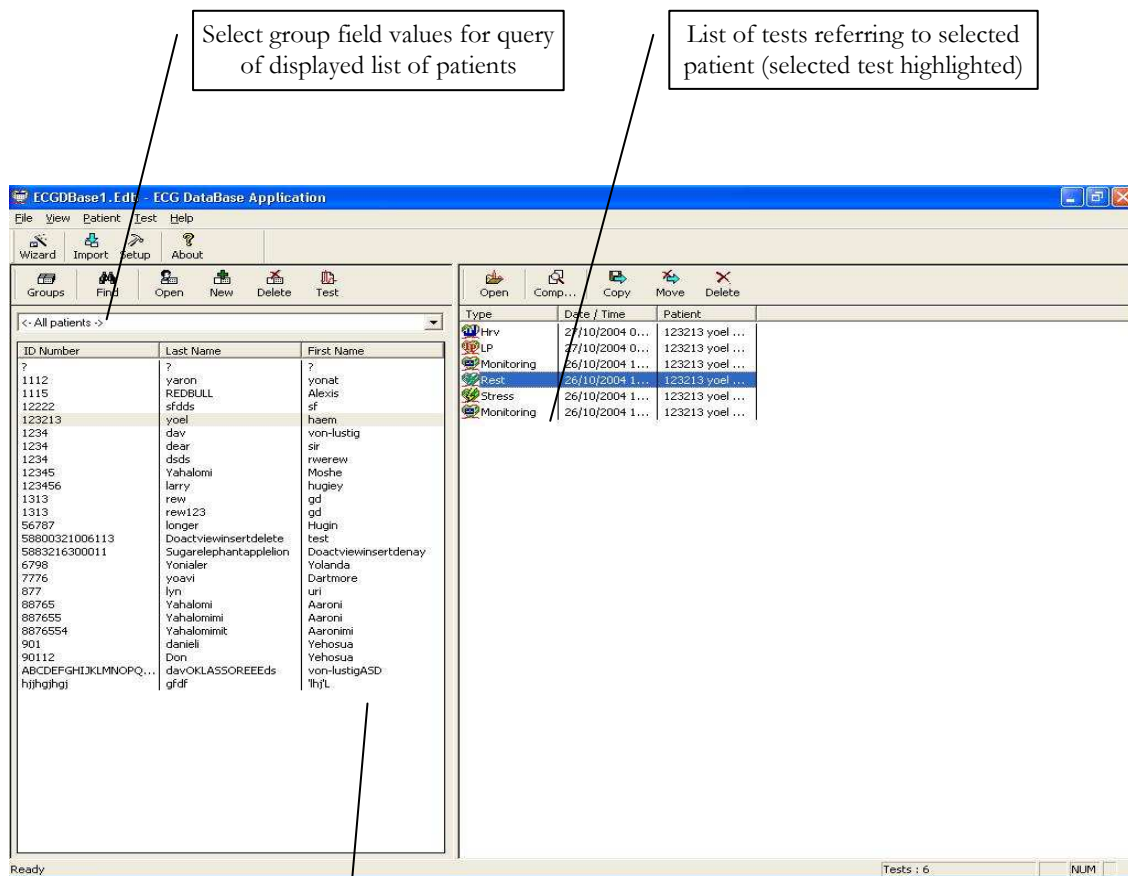
Figure 39: NEMS Main Screen

List of patients in database (or in selected group)

First Time Use

When you first start NEMS application, you are prompted to confirm the location of the database.

- Choose **New** if no database exists

- Choose **Open** to work with an existing database
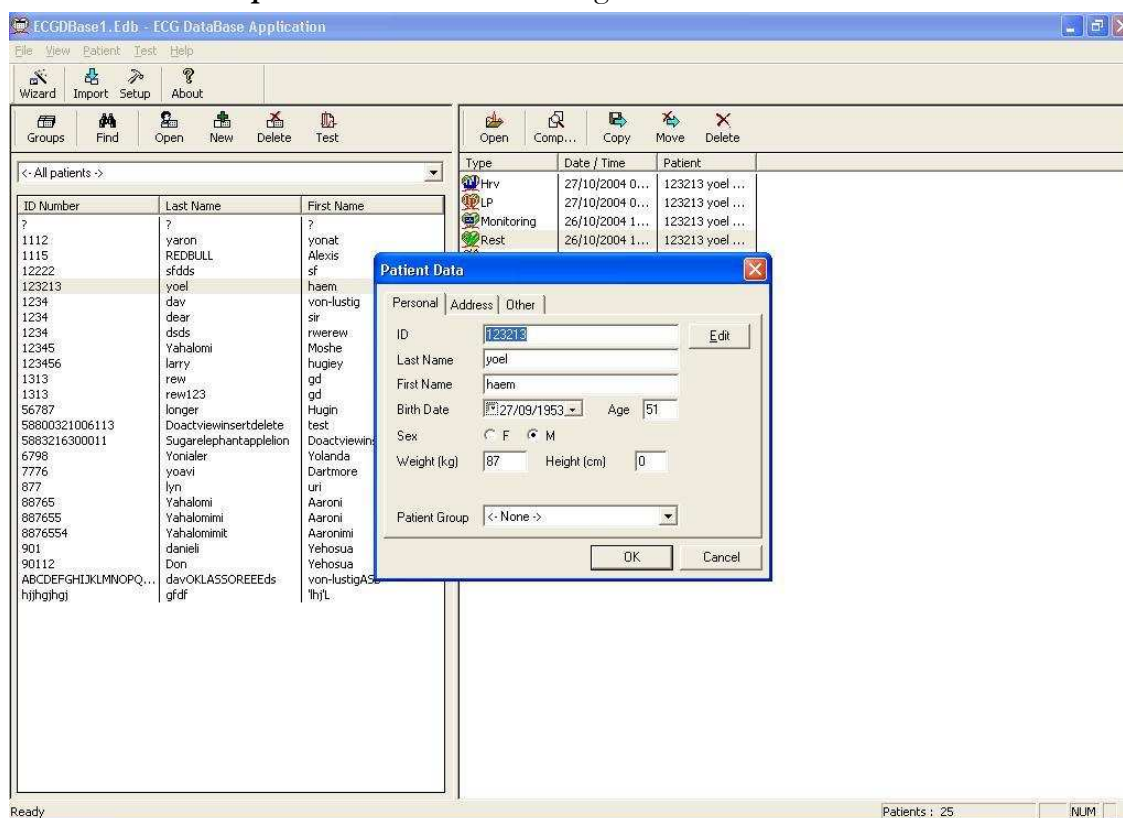
Figure 40: Database Patient Query
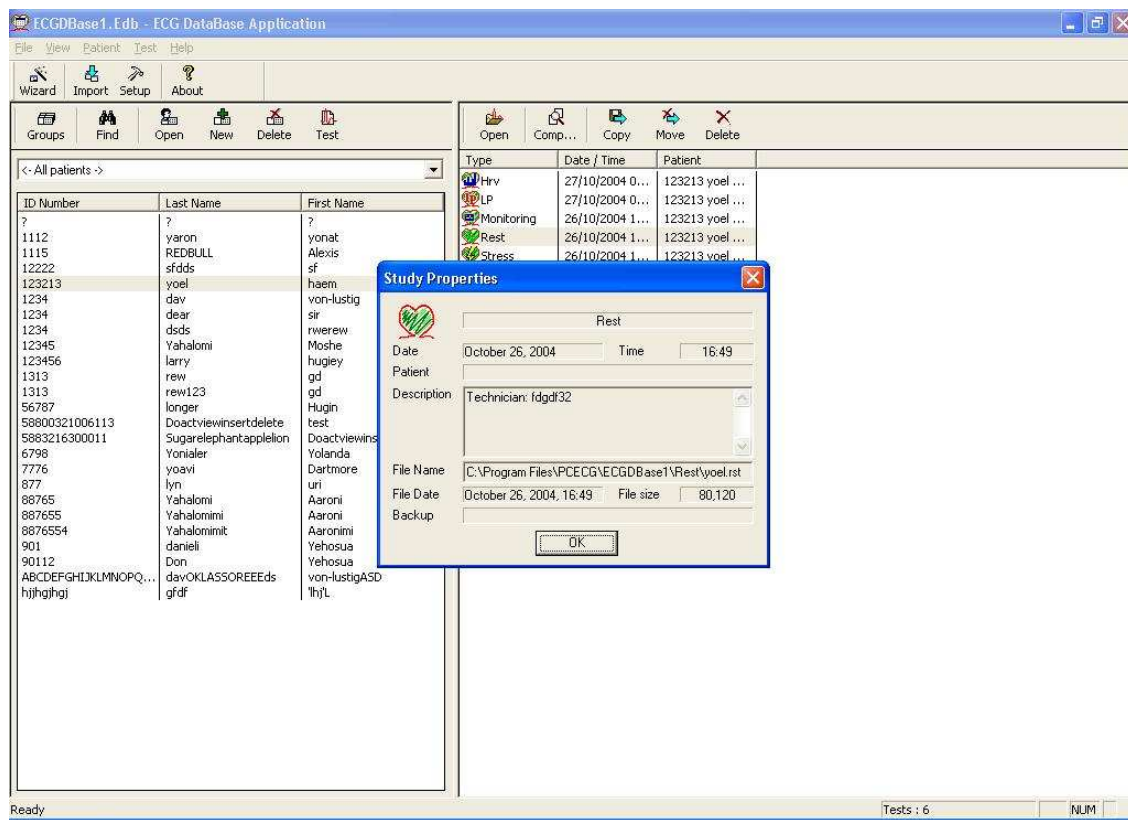
Figure 41: Database Properties of Selected test

Comparing Rest Tests

NEMS application allows the user to compare rest tests on 1 or 12 channels.

To Compare Rest Tests

1.   Select two or more Rest tests from the NEMS interface
1.   Click **Compare**

NEMS Setup
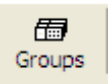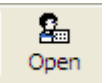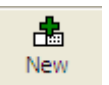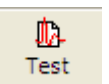
Click Setup on the Toolbar to access the following parameters:

Tab	Description
Default Workspace	Select the default workspace.
Choose Data Directory	Input data directory (with browsing option).
External Patient Data file	Input the location of the external patient data file (with browsing option for PatientFile.INI file).
Delete with Password	Check this option to require a password for DELETE (default: unchecked).
Check NET key	Check this option if NET key is installed on another computer/server on the network. Uncheck this option if the dongle is installed on the local working PC (if NET key is not installed elsewhere, it is recommended to clear this option to save the software searching time).
External Blood Pressure Application	Browse to select the path and file name of the ABPM application. This field can be filled in only through browsing (It is not possible to insert directly in the text box).

Table 25: NEMS Setup Options

Toolbar and Menus

To do this	Click this icon	Or use this short-cut key	Or select this menu	Description
Main Toolbar				
Connect to Database	Wizard	Ctrl+W	File > Database Connection Wizard	Creates a new database or retrieve path for an existing one.
Import tests to database	Import	Ctrl+I	File > Import ECG Data File	Adds studies recorded and saved outside the database. To select all patient data files within a directory, press CTRL + A and verify that all files are checked.

To do this	Click this icon	Or use this short-cut key	Or select this menu	Description
Define Workspace Preferences	Setup	Ctrl+T	View > Setup	Defines the location of default workspace, patient identification, and a special file called External File. This file (Windows.INI format) allows the user to prepare a list of patients that can be read by PC-ECG 1200 applications. Note: This feature does not require the D3 software key.
Edit Groups	Groups		File > Groups	Defines different patient groups, such as Private, HMO, Military, etc.
View Application Information	About		Help > About	Displays version number, communication and web information, and disk and RAM memory size. The HASP ID number is used for identification of the software key for adding software options.
Patient Toolbar				
Find a Patient	Find		Patient > Find	Allows the user to find a patient by entering a string in any or all of ID, Last Name, and First Name fields.
Open Patient Detail	Open		Patient > Open Patient	Allows the user to check for patient information before performing a study on a patient.
Add New Patient to Database	New		Patient > New Patient	Inserts a new patient. You are prompted to enter partial or complete patient details. Enter ID, Last, and First Name at least. If patient details match an existing one you cannot add this patient to the list. The existing patient matching the details will be checked to allow the user to add a study.
Delete a Patient	Delete		Patient > Delete Patient	Deletes an entry. If the entry is not empty of studies, you will be asked to confirm deletion.
Perform a New Test	Test		Patient > New Test	Starts the application and starts recording.
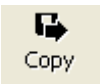
To do this	Click this icon	Or use this short-cut key	Or select this menu	Description
Test Toolbar				
Open a Test	Open		Test > Open Test	Allows the user to view a study. You must first select a study to activate OPEN.
Compare Rest tests	Comp…		Test > Compare	Select two or more Rest tests from the Database interface and click **Compare.** This option is only available when you check **Setup > ECG Recording > Use ECG Database.** Click **Compare** again to end Compare mode and display the Rest test.
Copy a Test	Copy		Test > Copy Test	Copies a study.
Move a Test	Move		Test > Move Test	Moves a study and deletes it from the database. The default option is to leave the study's properties in the database: upon completion of the operation. The study remains in the list with an X sign. You can choose to remove the entire study instead.
Delete a Test	Delete		Test > Delete Test	Deletes a study from the database. The default option is to leave the study's property in the database: upon completion of the operation, the study remains in the list with an X sign. You can choose to delete the entire study instead.
Update Database			File > Update Database	Updates the database.
Print Setup			File > Print Setup	Opens the **Print Setup** dialog box to set printing preferences.
View Test Properties			Test > Test Properties	Displays study properties.

Table 26: NEMS Toolbar and Menus

APPENDIX A: INTERFACING WITH INFORMATION SYSTEMS

There are several ways to exchange information between PC-ECG 1200 and Hospital Information System (HIS). These are described below:

Demographic Data

Information System Prepares Patient Demographic Data for PC-ECG 1200:

This uses a text file called PatientFile.ini. The location is defined in Database setup.

File Name: PatientFile.ini

File Format:

[PATIENTDATAXXX]

ID=

LastName=

FirstName=

BirthDay=

BirthMonth=

BirthYear=

Sex=

Weight=

Height=

Address=

Phone1=

Phone2=

Fax=

E-Mail=

Medications=

Other=

[PatientDataXXX]—Section name. XXX—number from 000 to 200.

At least one of the keys **ID**, **LastName,** or **FirstName** must be completed. If all these keys are empty, section of this patient will be ignored.

The keys **Height**, **Address**, **Phone1**, **Phone2**, **Fax**, **Email**, **Medications** and **Other** appear only with Database.

Example:

[PatientData001]

ID=1234567890

LastName=Smith

FirstName=Worker

BirthDay=11

BirthMonth=6

BirthYear=1959

Sex=1

Weight=59

Height=170

Address=523 Main st. Tacoma Mexico

Phone1=702-8765643

Phone2=702-8743031

Fax=702-8743032

E-Mail=nkir@sympo.ca

Medications=none

Other=none

[PatientData003]

ID=123456789

LastName=Smith

FirstName=Worker3

HL7 Format File

PC-ECG Prepares HL7 Format File with Stress Test Results

This file is created upon demand in the study review screen.

The file of Stress test in Format HL7 includes:

1. **Patient Information:**

Name:	John
Last Name:	Smith
Id Number:	12345678
Birth Date:	24/1/1955
Sex:	M
Weight:	80 kg

2. **Hospital and Physician Information:**

Hospital Name:	General Hospital
Hospital Address:	Megapolis
Physician Name:	Dr. Stern

3. **Test Date and Time:**

Test Date:	18/09/1999
Test Time:	12:41:51

4. **Test Results:**

Protocol:	Bruce
Target HR:	183
Max HR:	175 (95%)
Max. SBP:	200
Max. DBP:	100
Max. METS:	8.8
Max. VO2:	30.9
ST =	J+60

5. **Results of Blood Pressure, HR, Double Product (HRXBP sys.), ST level (mm) and ST Slope (mV/sec) for the Most Important Stages of Stress Test:**

Rest: BP: 150/100, HR: 79, Product: 11850, ST Level (mm), Slope (mV/sec) (-1.2/0.7, 0.2/1.8, 1.9/-0.5, -2.0/0.4, -2.9/3.3, -1.1/2.6, -1.4/2.2, -1.6/1.8, -1.3/6.1, -1.8/2.5, -1.7/1.5)

Max HR: Time: 7:05, BP: 200/100, HR: 175, Product: 35000, ST Level (mm), Slope (mV/sec) (-1.2/0.7, 0.2/1.5, 1.9/-0.5, -2.0/01, -2.9/3.3, -2.1/2.6, -1.4/2.2, -1.4/1.8, -1.7/6.1, -1.2/2.4, -1.7/1.5)

Worst ST: Lead aVF:-1.2 mm, Time:4:15, BP:200/100, HR:137, Product: 27400, ST Level (mm),   Slope (mV/sec) (-1.3/0.4, 0.2/1.5, 1.2/-0.5, -2.0/01, -2.5/3.3, -2.1/2.6, -1.7/2.2, -1.4/1.8, -1.3/2.1,   -1.2/2.4, -1.7/1.5)

Recovery: Time: 10:59, BP: 170/80, HR: 127, Product: 21590, ST Level (mm), Slope (mV/sec) (-1.3/0.4, 0.6/1.5, 1.3/-0.5, -2.0/01, -1.5/3.3, -2.1/2.6, -1.5/2.2, -1.4/1.9, -1.3/2.1,   -1.2/2.3, -1.7/1.5)

6. **Physician Remarks and Conclusions:**

Reason for Test:	Chest pressure
Reason for Ending Test:	Fatigue
Conclusions:	Normal blood pressure

GDT/BDT Type Communication

PC-ECG and HIS (Hospital Information System) Maintain Bi-Directional GDT/BDT Type Communication

1. Import demographic data from HIS to PC-ECG
   a. In setup, select **GDT/BDT**.
   b. Check **Import from GDT/BDT**.
   c. Define the GDT/BDT directory (in which the HIS file will be ready).
   d. Define the first four characters of the "Token for PC-ECG" file.
      This file always contains the last patient data.

7. Export the GDT/BDT file from PC-ECG to HIS.
   a. In setup, select **GDT/BDT**.
   b. Check **Save Test in GDT/BDT**.
   c. Define the GDT/BDT directory (in which PC-ECG file will be ready). It can be the same as in 1.
   d. Define the first four characters of the "Token for Practice EDP" file.
      This file always contains the last patient data.

DICOM Communication

The Norav PC-ECG 1200 is enabled for following DICOM operations:
    a. Receive ECG orders using DICOM Modality Work list (MWL).
    b. Store study reports as Encapsulated PDF files.
    c. Store Resting ECG study as 12-Lead ECG Waveform.

Interaction with DICOM occurs through mediation of **NoravScheduler** executable that exists in main PCECG folder.

Receive ECG orders from DICOM MWL

To enable the MWL functionality:

    a.   Start **NoravScheduler** application, open **OPTIONS** panel.

    b.   On *Patient List* section:

        -   Mark **Update Worklist** checkbox

        -   Insert correct **File name** for Patient List file

        -   Insert correct path for store the Patient List file.

> The **Patient List** settings must be same as selected in Database application setup (see **External Patient Data file** under **Database Setup** chapter)
>
> **Note**

        -   Select **import from DICOM MWL** option

    c.   On *DICOM* section fill the DICOM **MWL** Server connection parameters

Workflow:

    a.   **NoravScheduler** utility fills the **PatientFile.ini** with list of *orders for current date* that is taken from MWL.

    b.   On begin of a new test select the patient name from list using the EXTERNAL button on a patient dialog box
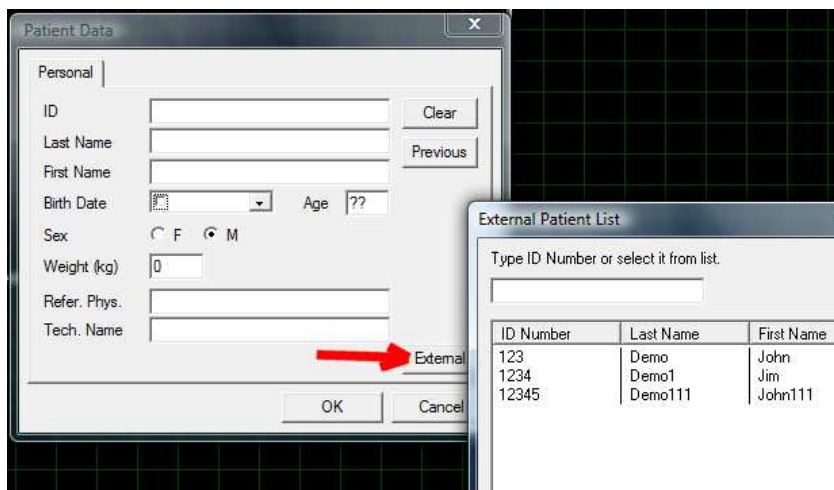
Figure 42: External Patient List

Store Encapsulated PDF reports to DICOM SCP

Supported in Resting ECG and Stress ECG applications.

To enable the Encapsulated PDF report functionality:

a. In **Resting ECG/Stress ECG** software setup:

- Enable **Auto Save** parameter for PDF files

- Select all checkboxes under the **Checked Fields** option for PDF file name.

b. In **NoravScheduler** tool OPTIONS

- On *Reports* panel: mark **Store PDF reports** and **send to DICOM SCP**

> **Note**
>
> The **FROM** directory path for PDF files must be same as **PDF File Data Directory** parameter in Resting ECG/Stress ECG application setup

- On *DICOM* panel fill the DICOM **SCP** Server connection parameters.

Store 12-lead ECG Waveforms to DICOM SCP

Supported in Resting ECG application.

To enable the 12-lead ECG Waveform functionality:

a. In **Resting ECG** software setup:

- Enable **Auto Save** parameter for **DICOM ECG** format files

b. In **NoravScheduler** tool OPTIONS

- On *Reports* panel: mark **Send DICOM ECG** and **send to DICOM SCP**

> **Note**
>
> The **FROM** directory path for DICOM ECG files must be same as **DICOM ECG File Data Directory** parameter in Resting ECG application setup

- On *DICOM* panel fill the DICOM **SCP** Server connection parameters.

Saving the Stress Test as a RAW Data ("native binary") Format File

1. Record a stress study

2. Under File menu, create a RAW Data File.
   A file with extension RDT is created, with the following structure:
   (low byte, high byte) x **12 Leads** x **n samples** (1sec = 500 samples).
   Leads sentence - *I, II, III, AVR, AVL, AVF, V1, V2, V3, V4, V5, V6.*

Byte Number	Byte Type	Lead Number	Sample Number	Second Number
1	Lb	I		
2	Hb			
3	Lb	II		
4	Hb			
…	…	…	1	
21	Lb	V5		
22	Hb			
23	Lb	V6		
24	Hb			**1**
25	Lb	I		
26	Hb			
27	Lb	II		
28	Hb			
…	…	…	2	
45	Lb	V5		
46	Hb			
47	Lb	V6		
48	Hb			
…	**…**	**…**	**…**	**…**
1+(n-1)*24	Lb	I		
2+(n-1)*24	Hb			
3+(n-1)*24	Lb	II		
4+(n-1)*24	Hb			
…	…	…	n	n/500
21+(n-1)*24	Lb	V5		
22+(n-1)*24	Hb			
23+(n-1)*24	Lb	V6		
n * 24	Hb			

Table 27: Stress Raw Data File Format

Saving the Monitor Test as a Raw Data ("Native Binary") Format File

1. Record a Monitor study.

2. Under File menu, create a RAW Data File.
    A file with extension RDT is created, with the following structure:
    Number Leads (low byte, high byte) **+ Sample Rate** (low byte, high byte) **+ (low byte, high byte)** x **Number Leads** x **n samples** (1sec = (sample rate)).

Byte Number	Byte Type	Lead Number	Sample Number	Second Number
1	Lb	1	1	1
2	Hb			
3	Lb	2		
4	Hb			
…	…	…		
2N -1	Lb	N		
2N	Hb			
2N +1	Lb	1	2	
2N +2	Hb			
2N +3	Lb	2		
2N +4	Hb			
…	…	…		
2N*2-1	Lb	N		
2N*2	Hb			
…	…	…	…	…
1+(n-1)*2N	Lb	1	n	n/ (sample rate)
2+(n-1)*2N	Hb			
3+(n-1)*2N	Lb	2		
4+(n-1)*2N	Hb			
…	…	…		
2N*n-1	Lb	N		
2N*n	Hb			

Table 28: Monitor Raw Data file format

APPENDIX B: TECHNICAL SPECIFICATIONS

	Model			
Feature	**1200S / 1200M**	**1200HR**	**1200W**	**Blue-ECG**
Size [mm]	128 x 75 x 27	170 x 90 x 30	160 x 100 x 45	125 x 65 x 22
Weight [gram]	200	300	350	100
Power	5V$^{\pm\,5\%}$	5V$^{\pm\,5\%}$		
Current	100mA$^{\pm\,10\%}$	<200mA$^{\pm\,10\%}$		
Lead cable	Standard 12 leads	Standard 12 leads	Standard 12 leads	Standard 10 leads AHA/IEC
Patient leads			Detachable 10 wires conform to AAMI	
Lead OFF detection		Detached Lead or Offset >0.5 V		Detached Lead or Offset >0.5 V
Pacemaker Pulse detection		From 0.1 to 2 ms at 2 to 700 mV		From 0.1 to 2 ms at 2 to 700 mV
Sensitivity (mm/mV)	5, 10, 20, 40	5, 10, 20, 40	5, 10, 20, 40	5 , 10 , 20 , 40
Horizontal scale (mm/sec)	5, 12.5, 25, 50, 100 (Stress- 1200S)) 12.5, 25, 50, 100 (Rest-1200M)	12.5, 25, 50, 100	12.5, 25, 50, 100	12.5 , 25 , 50 , 100
ECG Max. sample rate (samples/sec)	4000	16,000	4000	8 channels 250 ,500 XYZ channels 250 ,500 ,1000 4 , 2 channels 250 ,500 ,1000
Resolution A/D bits	12 (2.44 μV/LSB)	16 bits (0.3 (V/LSB)	16 bits (0.3 V/LSB)	12 bits (2.44 μV/LSB)
Defibrillation protection	Yes	Protected against 360 J discharge	Protected against 360 J discharge	Yes
Patient leakage current			<10 A	
Simultaneously 12L	Yes	Yes, with sample/hold circuitry to assure zero delay between leads	Yes	Yes
CMMR	> 100 dB	> 100 dB	> 100 dB	> 100 dB
Input impedance	> 100Mohm	> 100Mohm	> 100Mohm	> 100Mohm
Signal dynamic range	10mV	20mV	20mV	10mV
DC max. input	± 300mV	± 300mV	± 300mV	± 300mV
Frequency range (-3db)	0.05 – 150 Hz	0.05 - 300 Hz	0.05 – 150 Hz	0.05 – 150 Hz
Low pass filter (software)	20, 35, 40 Hz	20, 35, 40 Hz	20, 35, 40 Hz	20 , 35, 40 Hz
Base line (software)	Yes	Yes	Yes	Yes
Line noise filter (software)	50/60Hz	50/60Hz	50/60Hz	50/60Hz

Communication interface	USB	Digital RF	Bluetooth 2.0+EDR, Class1 up to 100m open space
Radio frequency range	---	2400 – 2483.5 MHz	
RF output power	---	0.4mW, conform to FCC	
Battery	---	4 AA alkaline or NiMH rechargeable	2 - AA Alkaline or NIMH
Operation Time	---	Up to 40 hours with alkaline batteries	Up to 12 hours
Storing temperature	-20^0C–60^0C	-40^0C–70^0C	-20^0C–60^0C
Operating temperature	0^0C–50^0C		
Humidity	0–85%		
Safety standard	IEC 60601-1, EN 60601-2, IEC 60601-2-25, IEC 60601-2-27, and EC11		
Certification	CE , FDA		

APPENDIX C: REPORT SAMPLES

Figure 43: Rest Report

Figure 44: Stress Applications - Comprehensive Report
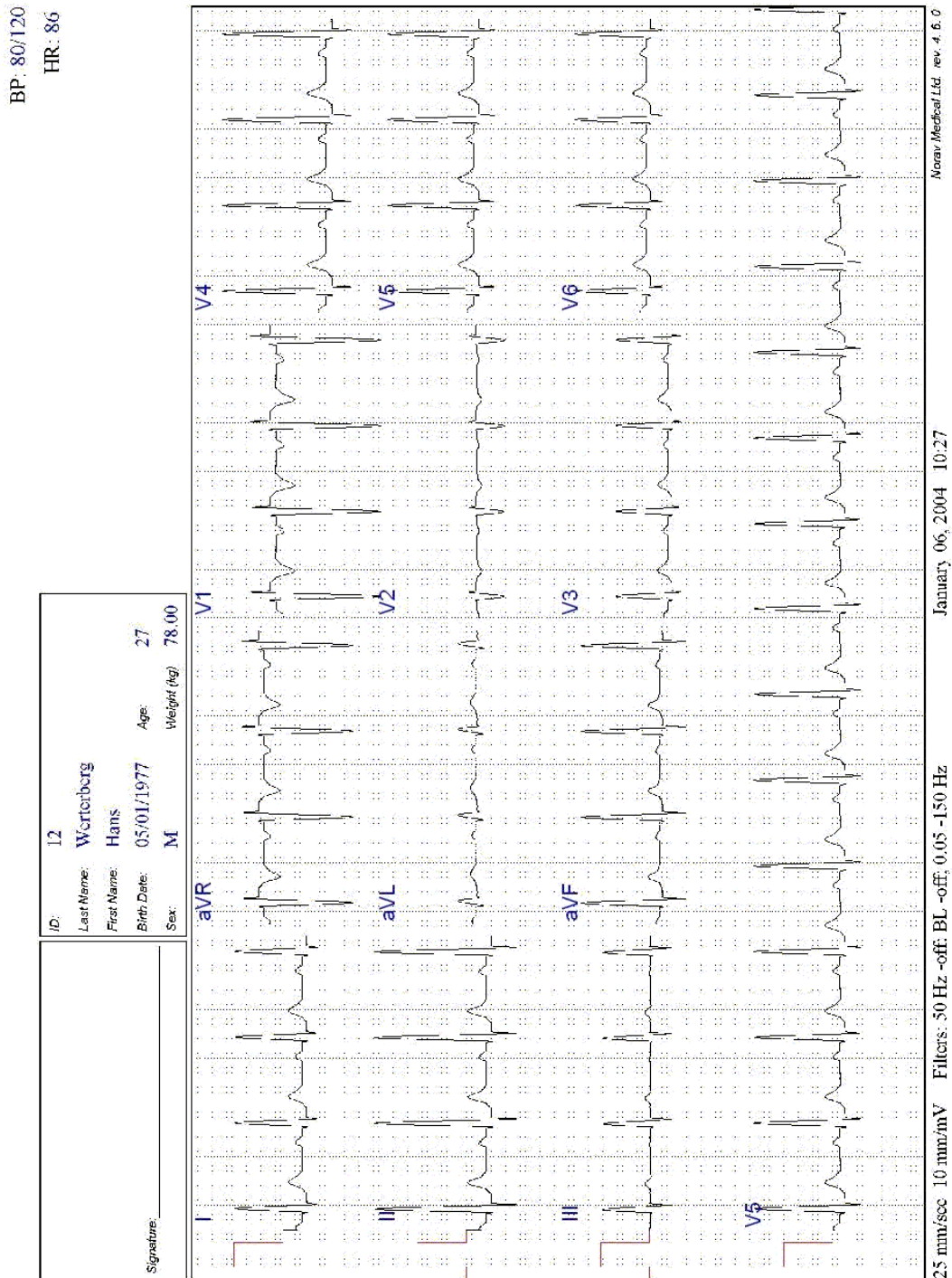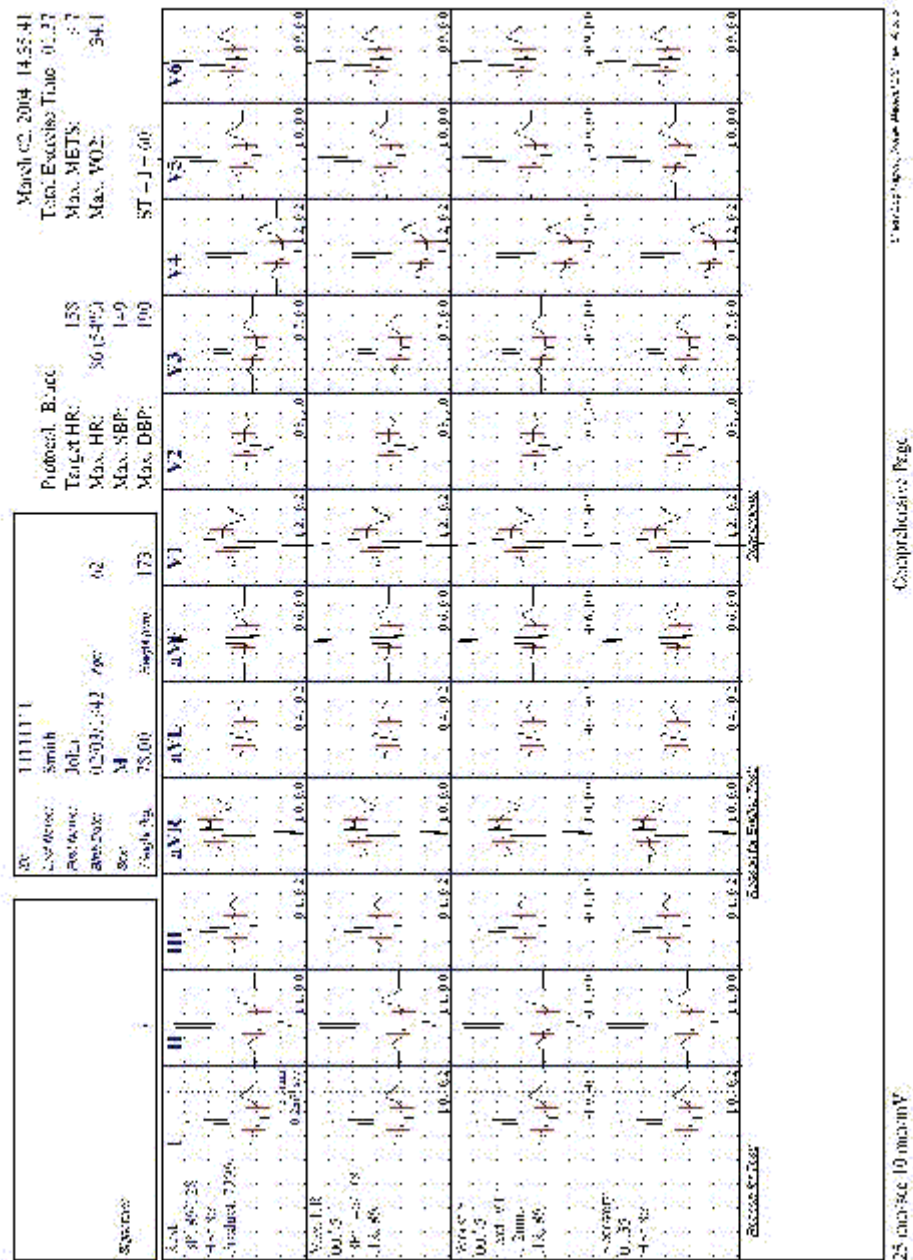
Figure 45: ECG Monitoring Report
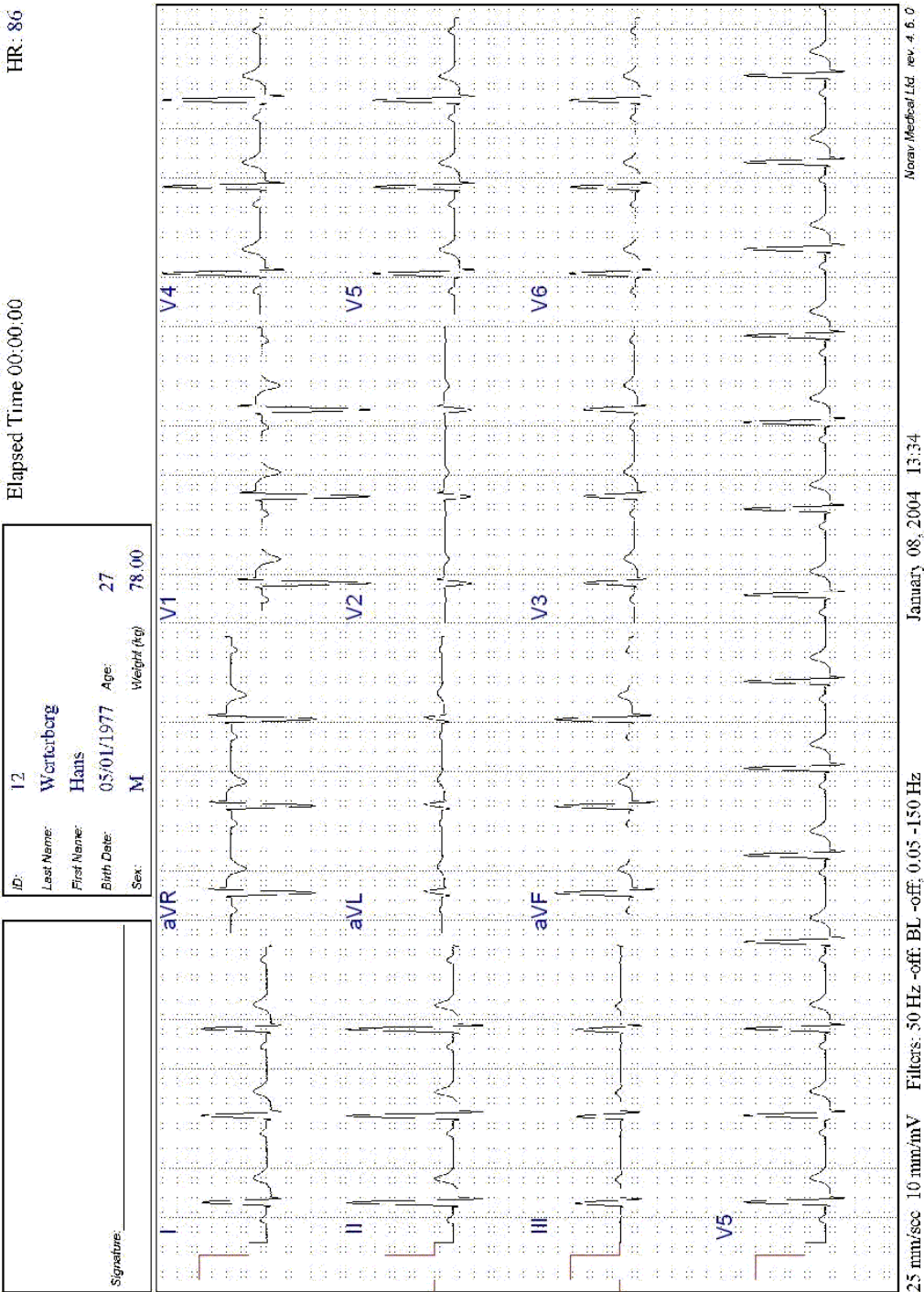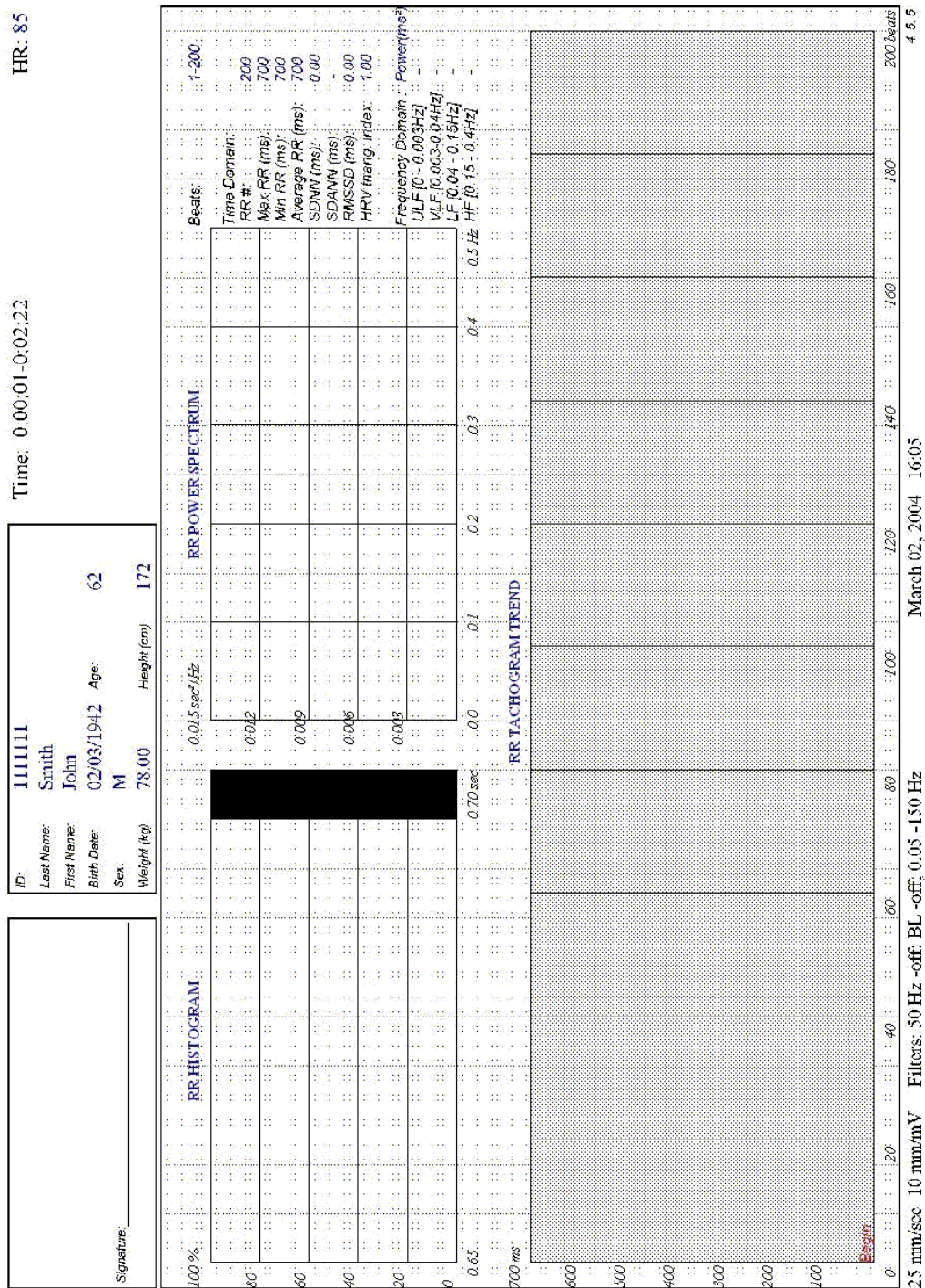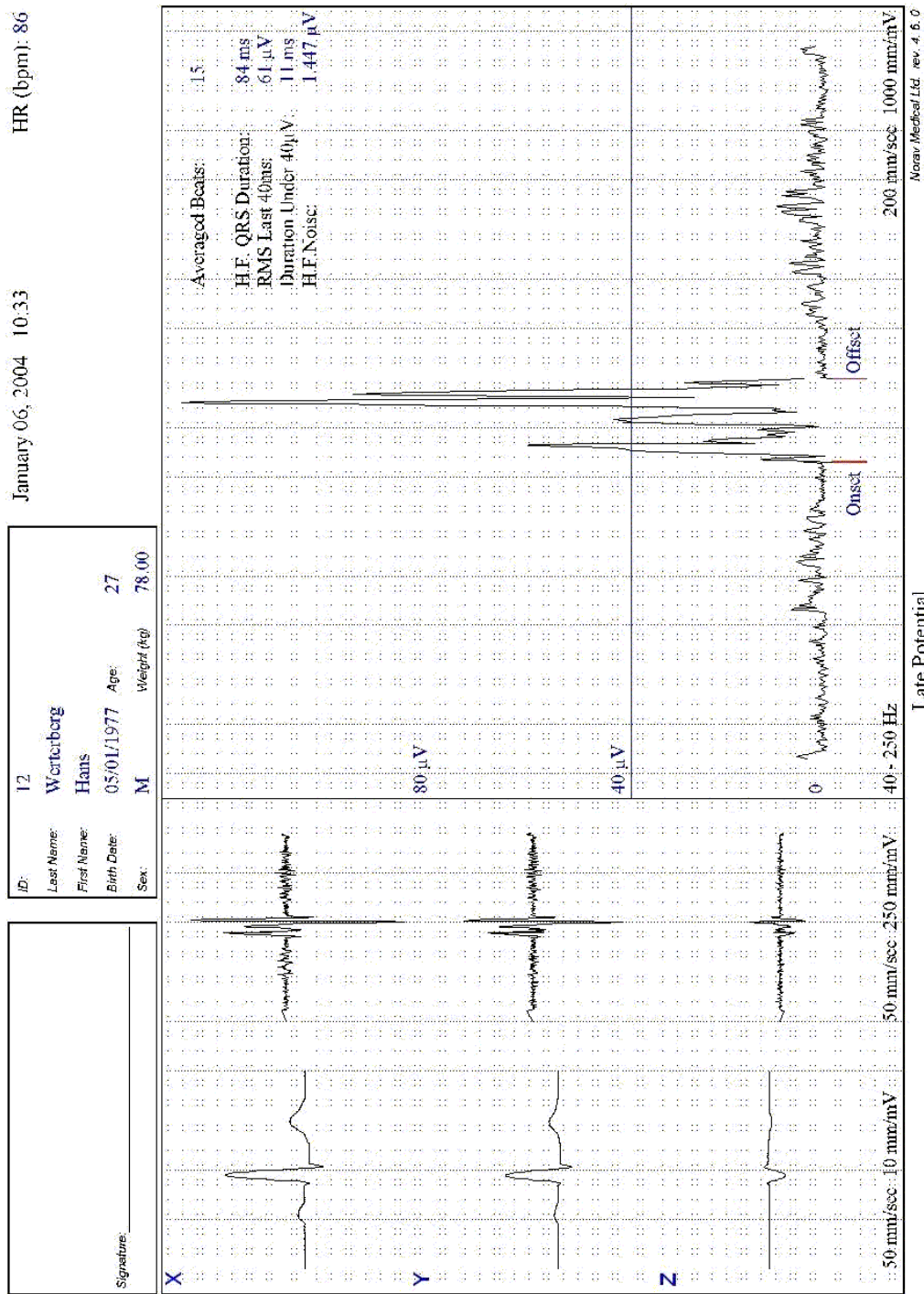
Figure 46: Heart Rate Variability Report

Figure 47: Late Potential Report

APPENDIX D: TROUBLESHOOTING

USB Driver is not Installed Properly on Windows XP During PC-ECG Installation

Problem

If you connect the device to the PC via the USB before installing PC-ECG 1200 (including the USB driver), the USB driver is not installed. The Windows operating system identifies new hardware and starts the hardware installation wizard. If you complete the wizard, the driver is not found and the hardware is defined in the Device Manager as "USB device" with an icon '?' indicating that the driver is not correctly installed.

If the USB cable is left connected while trying to install the driver from the PC-ECG1200 installation CD—a message regarding Win XP signature does not appear and the driver is not installed.

Solution

1. Disconnect the USB cable.

3. Install the PCECG software from the CD-ROM.
    During installation a message should appear about the Windows XP signature. If the message does not appear during the installation of PC-ECG, then the driver is not installed. If working under Windows XP press "Continue anyway" on message regarding the digital signature.

4. Check if the driver is now installed correctly (there is no question mark icon next to the USB driver in the device manager and the LED on the USB adaptor is on).

    If the device is still not correctly installed, then complete the following steps:

5. uninstall the unidentified USB driver as follows:
    a.   While still connected to the USB, right click **My Computer**.
    b.   Select **Properties** from the pop-up menu.
    c.   Click **Device Manager** on the Hardware tab.
    d.   Double click the USB Device with the **?** icon in the list of devices.
    e.   Select **Driver** tab.
    f.   Click **Uninstall** and then **OK**.

6. After the driver is deleted, disconnect the USB cable from the PC.

7. Install the PC-ECG software and continue to the next step.

8. Reconnect the USB cable to the computer connector.
    Windows XP identifies the new hardware automatically and the new hardware wizard opens.

9. Follow the instructions on screen. If working under Windows XP press "Continue anyway" on message regarding the digital signature. After the driver is installed make sure the green light is illuminated on the 1200 USB adaptor

Recovering ECG Data after Unexpected Shutdown of the Stress Application

Problem

If the application terminates unexpectedly before the ECG test is completed and saved, it may be possible to recover the ECG data of the (exhausted [??]) patient.

Solution

Stress ECG application stores native ECG data in the temporary file. You can convert this data into Monitoring ECG application file format as follows:

1.   Start the Stress ECG application.

10. Click **Recovery File to Monitoring Format…** in the **File** main menu.
     The **Choose files for conversion…** dialog box is displayed.

11. Select the Windows\Temp folder.

12. Select **strXX.tmp** last created temporary file and click **Open**.

13. Select the Monitoring ECG files folder.

14. Insert monitoring ECG file name according to patient ID or last name and click **Save**.

15. Close the Stress ECG application.

16. Open the Monitoring ECG files folder and double click on the last stored file.
     The monitoring ECG application opens.

17. Click the **Patient** main menu button and insert patient data.

18. Save the updated Monitoring ECG file.
      You can now inspect and print ECG strip from the Monitoring ECG application.

Working in AutoSave Mode Without Saving Modifications

If you perform modifications (adds/edit remarks, measurements, recalculations, etc…) while in AutoSave mode, but do not wish to save the modifications, do the following:

1.   Click **Setup**.

19. Uncheck the **Auto Save** option and click **OK**.

20. Close the application (or the file) with the X button.
     A dialog box is displayed requesting acknowledgement for the save.

21. Click **No**.

22. Reopen the application and the file.

23. Check that the modifications were not saved.

24. It is now safe to re-enable the Auto Save mode (if required).

A Thick Straight Line is Displayed For All Leads

Problem

A thick straight line appears on screen for all leads when the connection to the acquisition box fails.

Solution

When using USB connection, check that the led on the 1200USB adapter is illuminated.

If the led on USB adapter is not illuminated, check connections to the USB port and to the adapter.

If the led on the USB adapter is illuminated or if connected through RS232, check the connection to the acquisition box and make sure the box is switched on.

Noisy ECG Signal on Leads

Problem

A noisy ECG signal on one or more of the leads may be caused due to poor connection of the appropriate electrodes or leads on the patient.

Solution

Check the connection of the appropriate leads on the patient Make sure the electrodes are applied OK on the patient.

Missing data after a thick line

Problem

On the screen and in printouts of the ECG, appears for a few seconds a thick strait line and after that there is missing data for a period of time. The ECG traces resume after this random period of time. This problem may be caused due sleep mode or hibernation mode the PC entered while the ECG test was running.

Solution

Any settings related to the power management should be disabled: no standby, no stop HD, no hibernation, etc... on the laptop during the Stress test.

To set the power management do the following:

1. right click on the desktop.
2. select PROPERTIES form the pop-up menu.
3. Select SCREENSAVER tab.
4. Press on POWER button in the Monitor Power frame.
5. Select Power Schemes as either PRESENTATION or HOME\OFFICE DESK.
6. Set NEVER to "Turn off Hard Disk", "System Standby" and "System Hibernates".
7. Press OK to apply this configuration.