







To do this	Click this icon	Or use this short-cut key	Or select this menu	Description
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
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.
Compare			View > Compare Tests	Select two or more Rest tests from the Database interface and click <b>Compare</b> . This option is only available when you check <b>Setup &gt; ECG Recording &gt; Use ECG Database</b> .  Click <b>Compare</b> 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 8: 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')`
2. 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)
```

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

## CHAPTER 8: STRESS ECG

(This option is available with S0, S1, and S2 licenses)

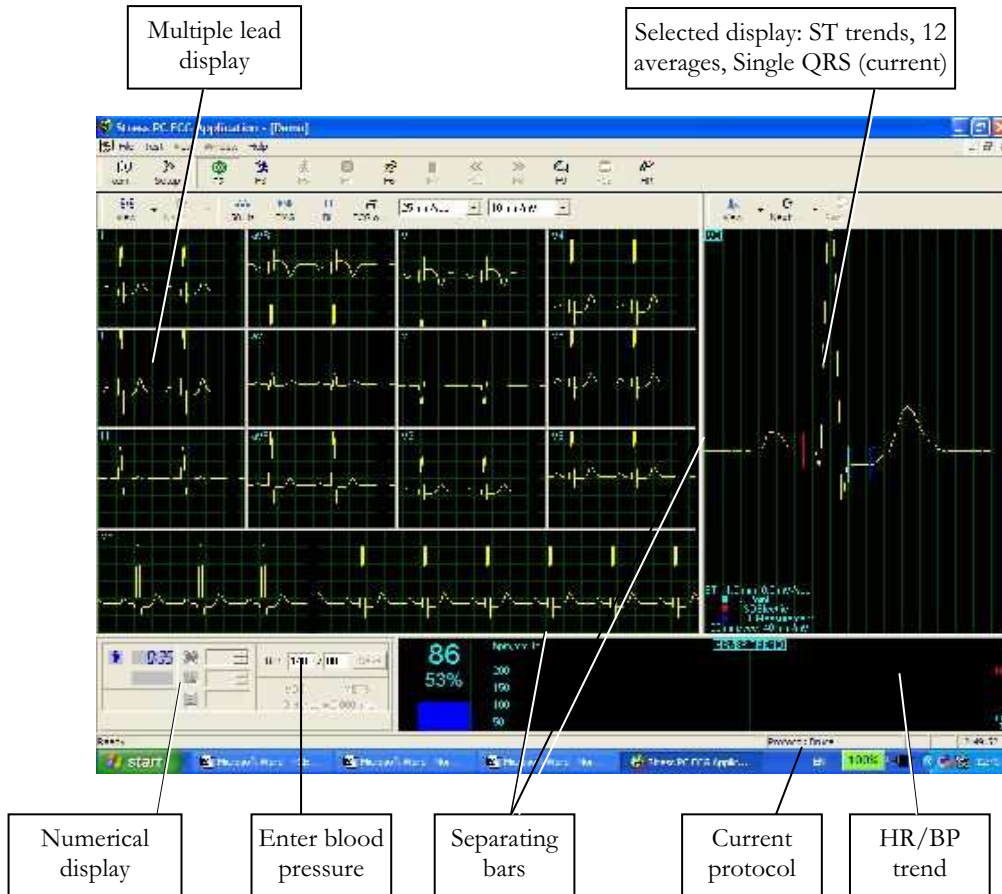


Figure 8: Stress ECG Results Screen

### 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:

1. Click Setup > **View** tab.
2. Check **Lock Splitter**.

## Quick Start

### To Perform a New Test

1. Click **F1** (or the **New** button on the toolbar).
2. Insert patient details in the dialog box.
3. Click **OK**.  
The preliminary Rest phase begins.
4. Click **F3** (or **Stress** button) to start the Stress phase.
5. Insert blood pressure and/or remarks (if relevant) in the dialog box and click **OK**.
6. Click **F5** (or **Recovery** button) to begin the Recovery phase.
7. Enter blood pressure and/or remarks (if relevant) in the dialog box and click **OK**.
8. Click **F4** (or **Stop** button) to stop the test.

### To Print an ECG

1. Select **Print ECG** from File menu.
2. Select **Current Stage\Entire Study** from the **Print ECG** submenu.
3. Select the printer from the print dialog box.
4. Click **OK** to close the dialog box and start printing.

### To Print a Report

1. Click **Print** on the toolbar.
2. Select the report/s to print.
3. Click **OK** to start printing to the default printer.  
Or
1. Select **Print Reports** item from the File menu.
2. Select the report.
3. Define the printer in the Print dialog box.
4. Click **OK** to start printing the report.

For an example of a printed report, see Appendix C: page 111.

## 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

1. Click Setup > **Lead**.
2. Select the lead system to use (the default is Standard).

## Operation with Function Keys

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

**Table 9: 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.

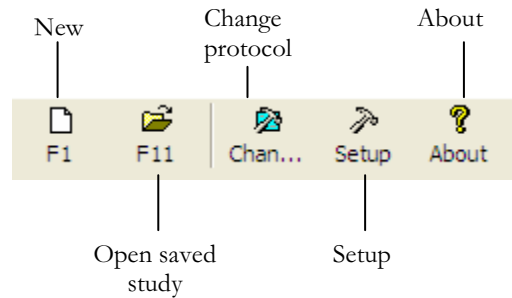


Figure 9: Main Stress Toolbar

### Stress Test Commands

This toolbar is displayed at the start of a new test.

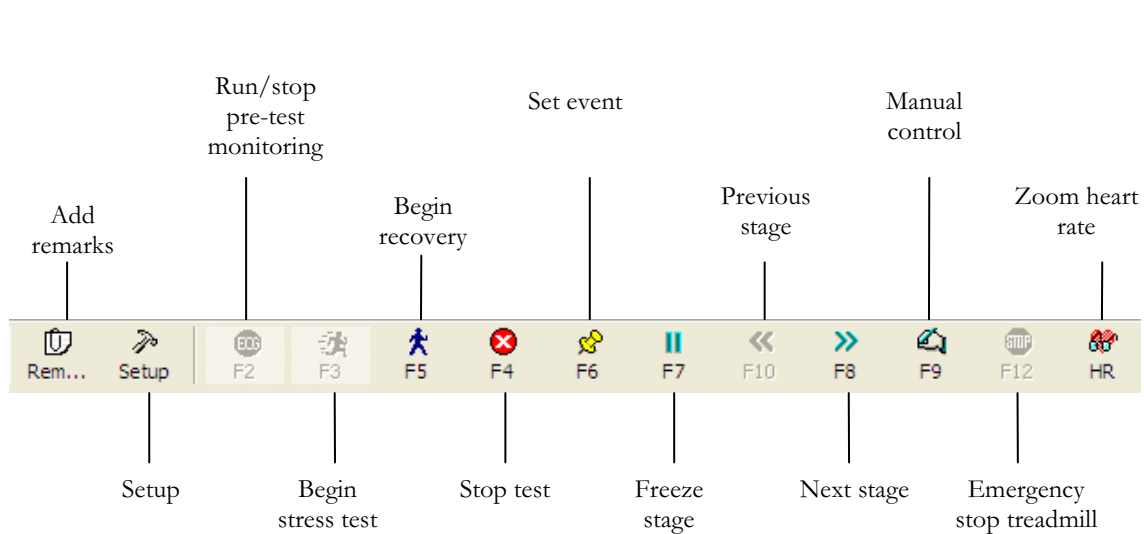


Figure 10: Stress Test Commands Toolbar

## Views and Filters Toolbar

The toolbar controlling views filters appears beneath the main toolbar.

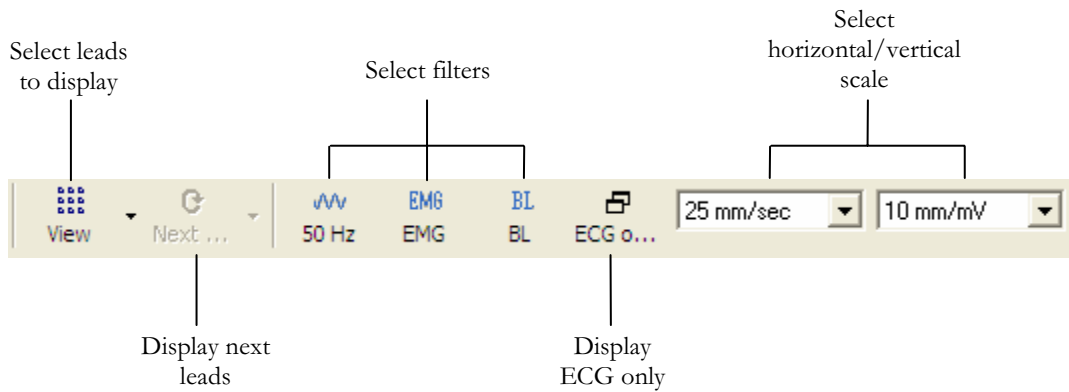


Figure 11: Stress ECG Views and Filters Toolbar

## Average Viewer Toolbar

The toolbar displaying various post processing views appears to the right of the Views and Filters toolbar.

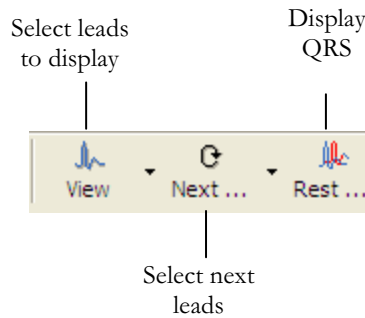
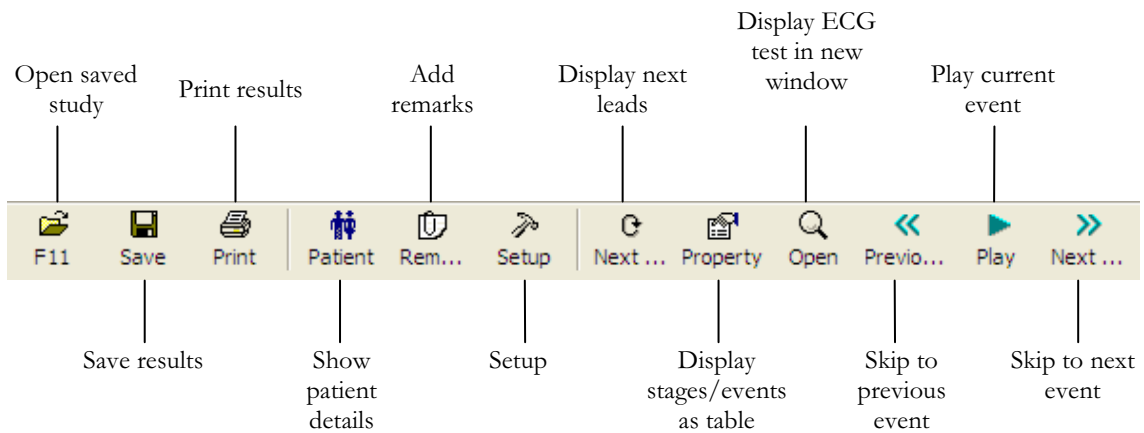


Figure 12: Stress ECG Post Processing Display Toolbar

## Post Processing Options Toolbar

When the test is complete you can review it using the Post Processing Options Toolbar.



**Figure 13: 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.	
	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 <b>Restore Default</b> 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 splitters cannot be moved and the sections in the viewer cannot be resized. To resize the different sections in the viewer, clear this option.
	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).
<b>Installation</b>		Saves user data (hospital and 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.
<b>Environment</b>	Connection	If an automatic blood pressure monitor (Tango) is to be connected to the system, checks for the appropriate COM port.
	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 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.










Tab & Secondary Tab	Option	Description
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 58).
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.
	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.

Tab & Secondary Tab	Option	Description
	Tabular Results Format	Check this option to print out results in a tabular format.
	Graph Paper	When set to <b>On</b> , prints 1mm and 5 mm squares on printouts. <b>Regular Grid</b> works with any printer. <b>Improved Grid</b> 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.
<b>GDT/BDT Format</b>	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.	
<b>Text File</b>	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.
<b>Target HR/METS</b>	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.
	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: <ul style="list-style-type: none"> <li>To use a single formula check “single formula for any speed”.</li> <li>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)”.</li> </ul>

Tab & Secondary Tab	Option	Description
	METS/VO2 Updating Method	Select the method for updating the METS/VO2 values. The values can: <ul style="list-style-type: none"> <li>• remain constant through the entire stage</li> <li>• switch to the current METS value 1 or 2 minutes after the stage begun</li> <li>• have values vary during the stage (at every quarter of the stage time).</li> </ul>
<b>ST.VPB Options</b>	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.
<b>Real Time</b>	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.
	Switch to Review Automatically	Check this option to switch automatically to the Review screen at the end of the test. When cleared, the realtime screen remains
<b>Remarks</b>		Defines statements that can be entered during the test. It is divided into five sets of statements used during real time and post processing.
<b>Remote View</b>		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 10: 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 <b>Import from GDT/BDT</b> , page 105	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 <b>Save Test in GDT/BDT</b> page 105	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.
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 11: 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 study results			Test > Review	Displays study results

**Table 12: 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 13: 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





To do this	Click this icon	Or use this short-cut key	Or select this menu
Set preferences		Ctrl+T	View > Setup
Print the study		File/Print ECG	This enables you to print the entire study or a single stage
Position the ST marker		View/Recalculate ST	This enables you to position the ST marker for the entire study

Table 14: 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 49.)
2. If necessary, click the **Change Protocol** icon  to select a test protocol.

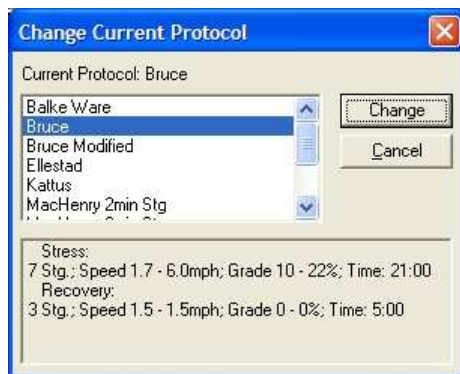



Figure 14: Change Test Protocol

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

**Figure 15: Patient Data Entry**

4. Enter patient data and click **OK**.  
Monitoring of 12 leads begins. After about 15 sec the average QRS is displayed.
5. 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**.
6. 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.
7. 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.

## 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 VO<sub>2</sub> Max. (One unit of VO<sub>2</sub> 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


1. Click Setup > **Environment**.
2. Click the **Advance** tab.
3. 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)
<b>HR</b>	<b>86</b>	(0-200)
<b>Speed (mph)</b>	<b>3.3</b>	(0- 25)
<b>Grade (%)</b>	<b>1.0</b>	(0 – 30)
<b>Workload</b>	<b>10.1</b>	(0 – 1000)

**Table 15: 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).

## 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.

## RS232 Controlled Treadmill Types

Vendor	Model	Vendor's Fax	RS232 Connector on the TM	RS232 Wiring Type
Trackmaster	TM425	+1-316-283-3350	D-9 female	Straight
Trackmaster	TMX425	+1-316-283-3350	D-9 female	Straight
Parker	PM	+1-334-8213221	D-9 female	Straight
RAM	770	+39-049-8703388	D-9 female	Straight
Woodway	PPS55-MED		D-9 male	Crossed
Powerjog	GM, J	+44-121-4333035		
System Biomedical		+91-22-4963147		
HP COSMOS	All models	+49-8669-864249		
QUINTON	TM-55		D-9 female	Straight
QUINTON	ST-55		D-9 female (RS422)	Q422*
Marquette	2000 series		D-9 female (RS422)	M422*
			DIN 5 pin female	Tx - 5 Rx - 4 GND - 2
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 MACHINEFABRI EK B.V.		+ 31 038-4554030	DB9, crossed	Treadmill (SUB-D 25) <----> PC (SUB-D 25) 2 ----- 3 3 ----- 2 7 ----- 7

\* Requires a special adaptor, supplied by Norav Medical

**Table 16: Controlled Treadmills**

## RS232 Controlled Bicycle Ergometers

Vendor	Model	Vendor's Fax	RS232 Connector on the Ergometer	RS232 Wiring Type
Ergoline	ER900	+49-7431-989427	DIN 5 pin	
SECA	CT100	+49-40-20000050	D-9 male	Crossed
Dimeq	770	+49-30-72376240		
LODE	EXCALIBER			
ELMED				

**Table 17: Controlled Ergometers**





# CHAPTER 9: LATE POTENTIAL SIGNAL AVERAGING

(This option is available with the L1 license)

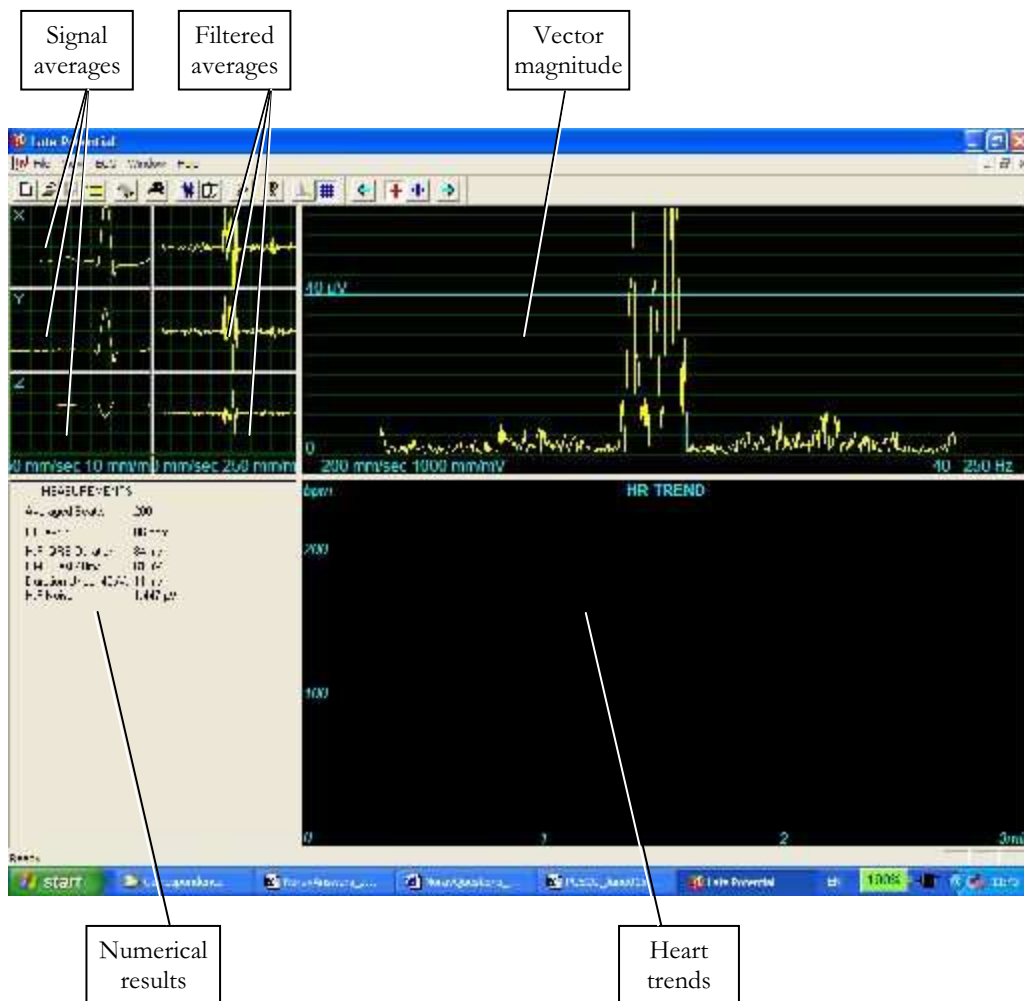


Figure 16: Late Potential Signal Averaging Screen

## Quick Start

### To Start a New Test

1. Click **F1** (or the **New** button on the tool bar).
2. Insert patient details in the dialog box.
3. Click **OK**.
4. Click **F3** or **F4** to start the LP averaging test.
5. Enter the interval name and/or remarks as appropriate in the dialog box and click **OK**.
6. 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.
2. Select the printer from the Print dialog box.
3. Click **OK** to close the dialog box and print the display (the LP averaging report or the ECG test).

## Operation with Function Keys

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

**Table 18: LP Signal Averaging Function Keys**

For an example of a printed report, see Appendix C., page 111.

## Leads

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

<b>12 Lead</b>	<b>Orthogonal Lead (position)</b>
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 19: LP Signal Averaging Leads Placement**

## LP Signal Averaging Setup








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










Tab	Option	Description	
<b>ECG Recording</b>	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.	
	<b>View</b>	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	
<b>Installation</b>		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.	
	Magnetic Card Reader	Select this option to use a magnetic card with bar-code to insert patient details. Select the magnetic card type.	

Tab	Option	Description
<b>Environment</b>	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.
<b>GDT/BDT Format</b>	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.
<b>Holter File Path</b>	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 20: LP Signal Averaging Setup**

## Toolbar and Menus

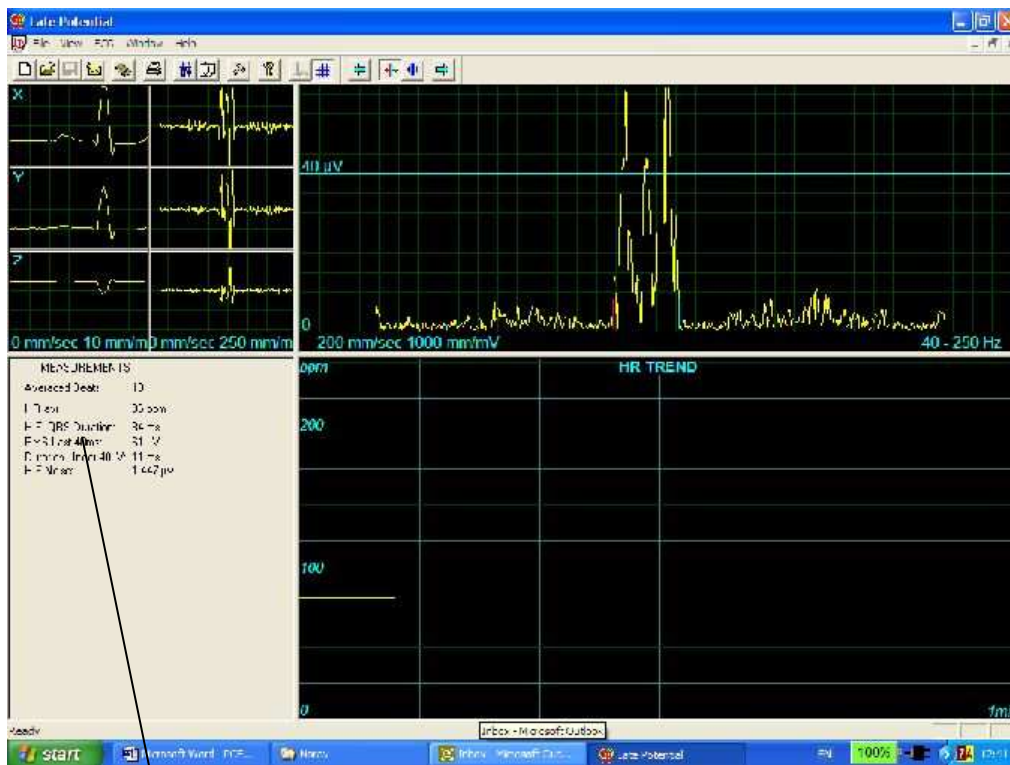
To do this	Click this icon	Or use this short-cut key	Or select this menu	Description
Start a new study		F1	File > New	Starts a new XYZ recording. The patient's demographic data can be entered prior to ECG recording (optional). The three channels are displayed on the screen for quality assurance. If the results are unsatisfactory, check skin preparation and disposable electrode contacts. Then click <b>Start/Stop Averaging</b> .
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 <b>Import from GDT/BDT</b> , page 105	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 <b>Save Test in GDT/BDT</b> page 105	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 <b>Previous</b> option if the same patient undergoes a second study.
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.

To do this	Click this icon	Or use this short-cut key	Or select this menu	Description
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 21: LP Signal Averaging Toolbar and Menus**

## Interpreting Results

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



Numerical  
results

**Figure 17: LP Signal Averaging Review Screen**



## Numerical Results

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

**Table 22: 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 10: 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.

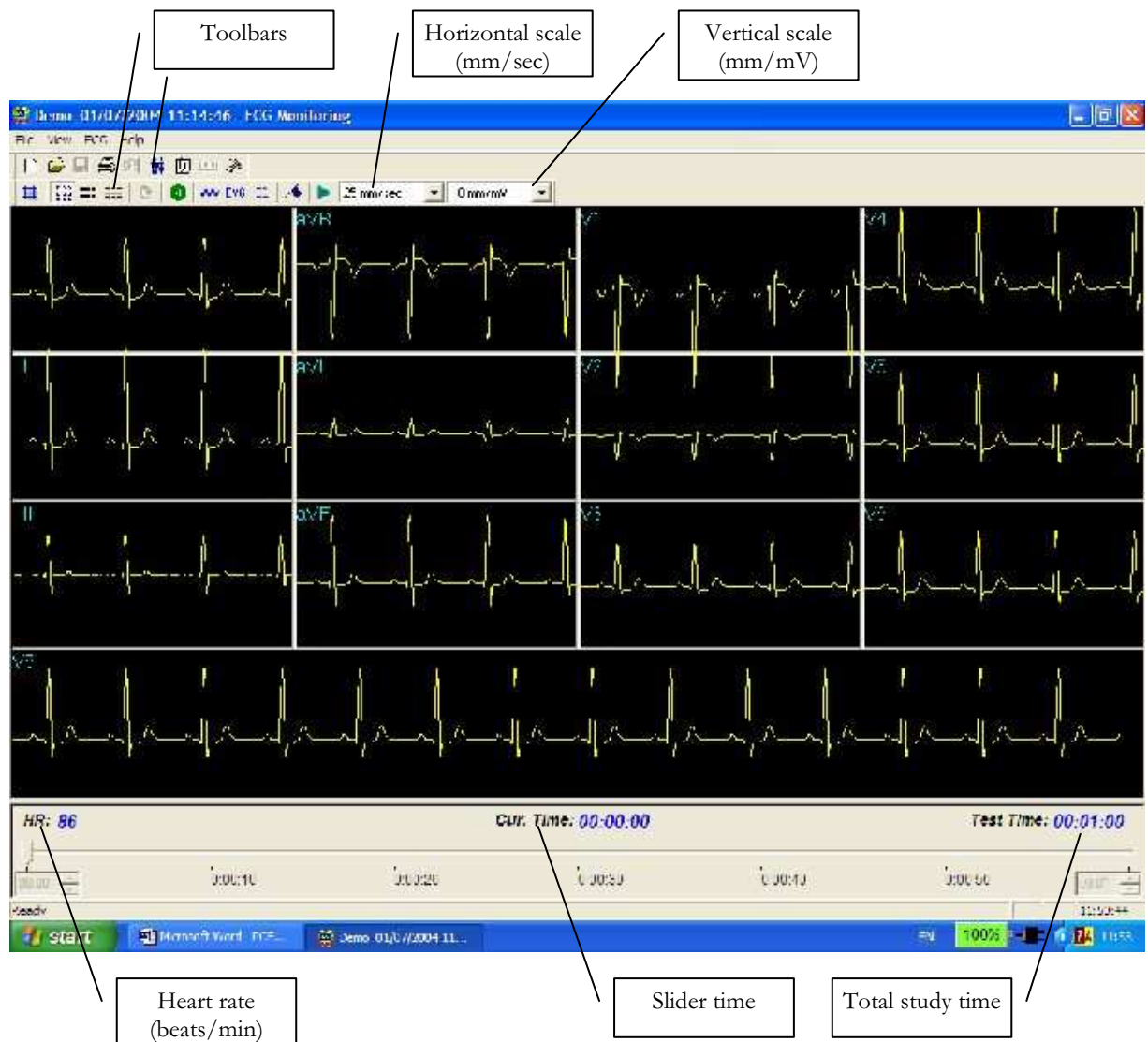


Figure 18: Monitoring Screen

## Quick Start

### To Start a New Test

1. Click **F1** (or the **New** button on the tool bar).
2. Insert patient details in the dialog box.
3. Click **OK**.
4. 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.
2. Select the printer from the Print dialog box.
3. 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.
2. Define the time range and select the leads to print from the dialog box.
3. Click **OK** to acknowledge selection and close the dialog box.
4. Select the printer in the Print dialog box.
5. 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 <b>Select All</b> . To deselect all leads click <b>Unselect</b> .
	Sample rate	Allows the user to choose requested samples per second per channel.
	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).











Tab	Option	Description
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 <b>Auto Save</b> is ON the file is stored by last name or by ID. If <b>Auto Save</b> 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.
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.

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.
<b>Environment</b>	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. <b>Regular Grid</b> is guaranteed to fit any printer. <b>Improved Grid</b> 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.
<b>GDT/BDT Format</b>	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 23: 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 24: 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.





<b>Key:</b>	
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: <ul style="list-style-type: none"> <li>• Define new intervals</li> <li>• Change interval duration, and</li> <li>• Activate several intervals</li> </ul>
HRV results	The HRV results pane displays the results in numerical format.

**Table 25: HRV Screen**

## Quick Start

### To Start a New Test

1. Click **F1** (or the **New** button on the tool bar).
2. Insert patient details in the dialog box.
3. Click **OK**.
4. Click **F3** or **F4** to start the HRV test.
5. Enter the interval name and/or remarks as appropriate in the dialog box and click **OK**.
6. 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.
2. Select the printer from the print dialog box.
3. Click **OK** and the report is printed.

For an example of a printed report, see Appendix C:, page 111.

## To Print an ECG

1. Click the **Print ECG** button on the toolbar or select **Print ECG** from the file menu.
2. Select the beats and leads to print from the dialog box and click **OK**.
3. Select the printer from the print dialog box.
4. Click **OK** to close the dialog and print the ECG.

## HRV Setup

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

Tab	Option	Description
<b>Sample Rate\Leads Selection</b>	Leads	Choose leads and sampling rate. Select up to four neighboring leads for calculations.
<b>ECG Recording</b>	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 <b>Auto Save</b> option. When this option is cleared, the test is saved only on demand.  Define the saving format either as <b>No ECG Data</b> or <b>Full Disclosure</b> .  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.
<b>View</b>		Change default colors for ECG and for graphs.

Tab	Option	Description
	Restore Defaults	Restores factory default color definitions for ECG display and graphs.
<b>Installation</b>		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.
<b>Environment</b>	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 <b>USB</b> .
	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. <b>Regular Grid</b> works with any printer. <b>Improved Grid</b> 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.
<b>GDT/BDT Format</b>	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**.
2. 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.
2. 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 105.

## 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:

<b>Time Domain</b>	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
	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
<b>Frequency Domain</b>	ULF	Power of the ultra low frequency range
	VLF	Power of the very low frequency range
	LF	Power of the low frequency range
	HF	Power of the high frequency range

**Figure 19: 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 12: MEASUREMENTS/ INTERPRETATION

(This option is available with the I1 or I2 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.

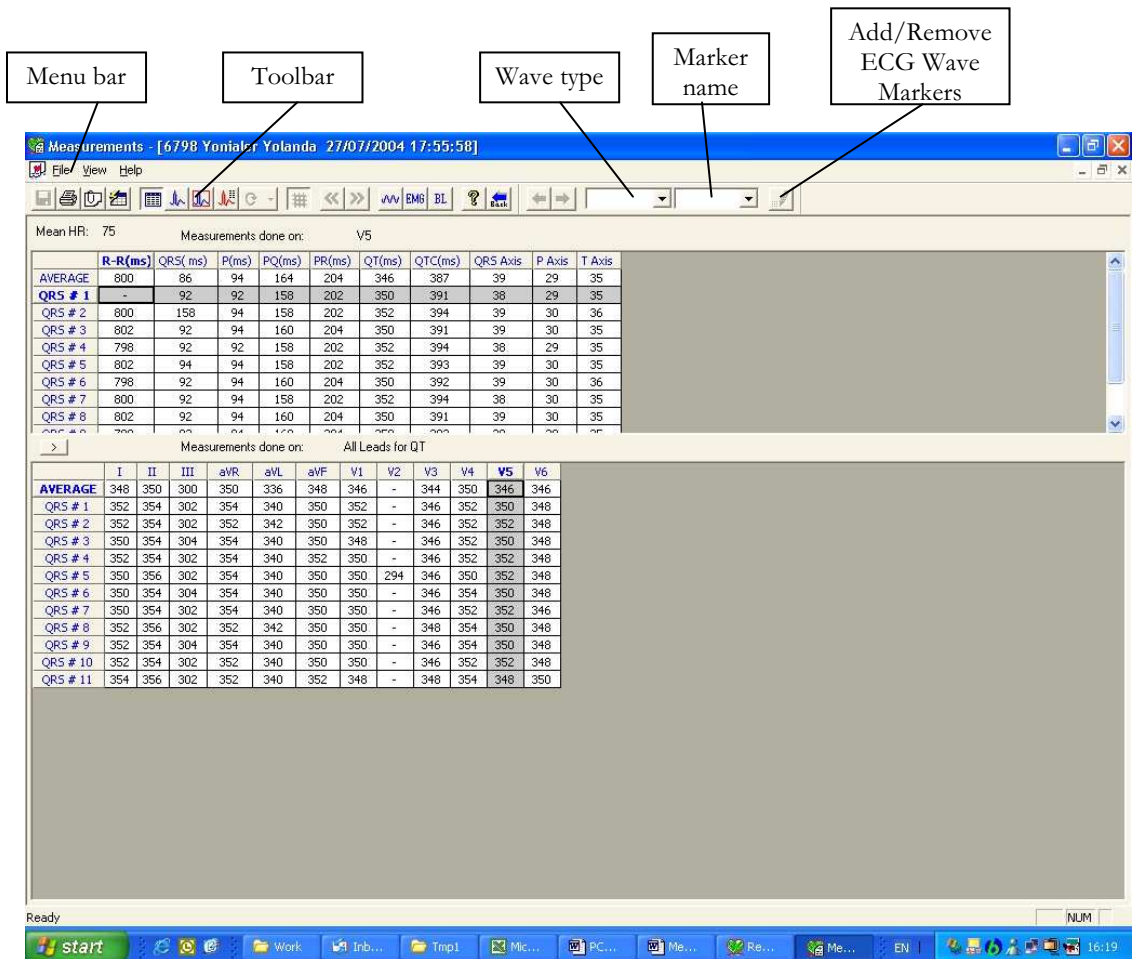


Figure 20: Measurements—Tabular Screen

## 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.

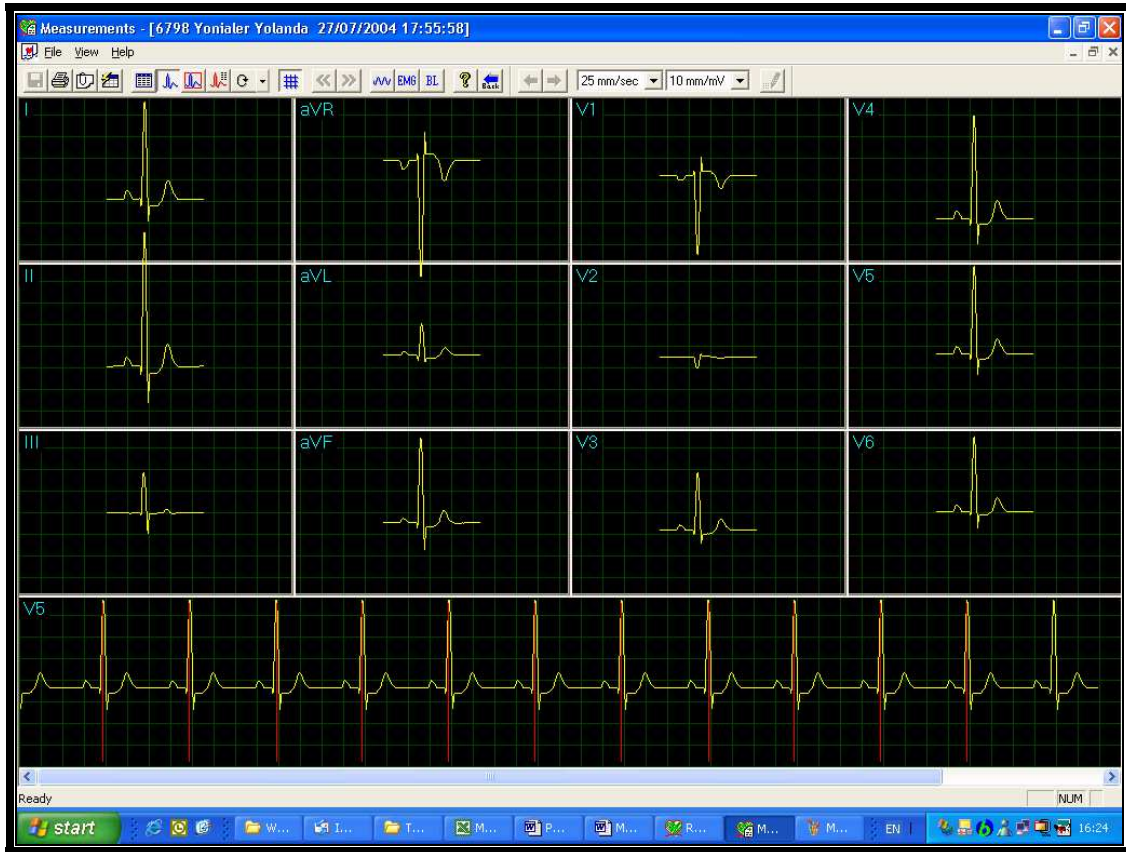
### To View the Measurements on All Channels for QT

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

## Tabular Screen

The Tabular screen (see page 85) 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 21: 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.