GE Healthcare

MARS™ Ambulatory ECG System
Operator's Manual

Software Version 8
2027879-034 Revision D

Publication Information

The information in this manual only applies to MARS™ Ambulatory ECG System software version 8. It does not apply to earlier software versions. Due to continuing product innovation, specifications in this manual are subject to change without notice.

This product complies with regulatory requirements of the following European Directive 93/42/EEC concerning medical devices.

The document number and revision appear on the bottom of each page. The following table outlines the changes applied with each revision.

Revision	Date	Comment
A	19 March 2010	Initial release.
B	28 May 2010	Miscellaneous typographic errors were corrected.
C	16 July 2010	Modified CIC Configuration to address primary and secondary servers.
D	29 October 2011	Updated Morpheus licensing information.

Contents

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Manual Overview

This manual provides the information necessary to operate the MARS™ Ambulatory ECG System safely in accordance with its function and intended use. It is organized into the following sections:

- Introduction
- System Overview
- System Setup
- Data Acquisition
- Patient Selection
- Data Review
- Printing
- Archiving
- Special Features

Intended Use

This manual is intended solely as a reference for the operation of the MARS Ambulatory ECG System. It is not intended as a replacement for thorough and complete training on the system capabilities and operation by a qualified instructor; it is intended as a supplement to such training. Nor is it intended as a reference for the clinical interpretation of ECG data.

Intended Audience

This manual is intended to be used by trained operators of the MARS Ambulatory ECG System under the direct supervision of a licensed health care practitioner in a hospital, clinic, or office environment.

Typographical Conventions

The following typographical conventions are used throughout this document.

Convention	Description
Bold	Indicates keys on the keyboard, text to be entered, or hardware items such as buttons or switches on the equipment.
Italics	Indicates software terms that identify menu items, buttons, or options in various windows.
Ctrl + Esc	Indicates a keyboard operation. A (+) sign between the key names indicates that you press the two keys simultaneously. For example, "Press **Ctrl + Esc**" means to press and hold the **Ctrl** key. While still holding the **Ctrl** key, press and release the **Esc** key.
<space>	Indicates that you must press the spacebar. When instructions are given for typing a precise text string with one or more spaces, the point where the spacebar must be pressed is indicated as: **<space>**. The purpose of the < > brackets is to ensure you press the spacebar when required.
Enter	Indicates that you must press the "**Enter**" or "**Return**" key on the keyboard. Do not type "enter."

Illustrations

All illustrations in the manual are provided as examples only. Depending on system configuration, screen shots that appear in the manual may differ from the screens as they appear on your system.

All patient names and data are fictitious. Any similarity to actual persons is coincidental.

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System Overview

This chapter is an overview of the MARS™ Ambulatory ECG System. It provides the following information:

- System Description
- Safety Information
- System Basics
- Process Overview

System Description

The MARS Ambulatory ECG System provides the tools to analyze, review, and generate reports for ECG data acquired from Holter recorders and bedside monitors. Its features include:

- multiple scanning techniques for complex editing
- algorithm enhancement for precise beat and noise detection
- up to 12 high-resolution trends simultaneously on one screen
- pre-configured final reports
- user-configured final reports
- three-channel superimposition displayed at up to 240 times real time
- programmable event definition for detailed analysis

The MARS Ambulatory ECG System is available in a turnkey package in which GE Healthcare provides the necessary hardware and software to operate. It is also available in a software-only package in which the customer must supply the minimum hardware and software requirements to operate. Both packages require a PC platform using one of the following operating systems (OS):

- Microsoft Windows Server 2003 (SP2)
- Microsoft Windows Server 2008
- Microsoft Windows XP (SP3)
- Microsoft Windows 7 (Home Premium, Professional, or Ultimate editions)

The OS is dependent on whether the system is a server, a client, or a standalone system.

System Features

The MARS Ambulatory ECG System is modular. You can purchase and activate only the features that you need. The following table identifies both core and optional features. Optional features may be purchased and activated separately.

Core Features	Optional Features
• Event Review • Client Server • Episode Review • Holter Analysis • Trend Review • Shape Review • WaterFall Display • Strip Review • Page Review	• Heart Rate Turbulence • Heart Rate Variability • ST Measurements • T Wave Analysis • MARS to MUSE • View 12SL • QT Analysis • CIC Interface • WebUpload • Sleep Export

For information on activating features, refer to "Software Activators" on page 79.

NOTE:

WebUpload and ***Client Server*** are available only in server configurations. ***Sleep Export*** is not available in all markets.

System Components

The following table lists the components of the MARS Ambulatory ECG System. This list may differ slightly from your system, depending on its configuration.

MARS Ambulatory ECG System Components	
Component	**Description**
PC	The base unit, which contains the power supply, hard disk drive(s), RAM, central processing unit (CPU), internal speaker, floppy disk drive, and network interface.
Optical Drive	CD-ROM or DVD-ROM drive. Used to perform system updates and archive patient information.
Monitor	Video display of system information and messages.
Keyboard	Data entry device.
Mouse	Navigational device for moving the cursor on the screen.
Mouse Pad	Provides an optimal surface for improved mouse movement. Also protects both the work surface and the mouse from damage.
Printer	Provides hard copy output of selected reports or records.
Acquisition Unit	Downloads ECG data from a digital recorder.

Intended Use

The MARS Holter Analysis Workstation is designed for the acquisition, analysis, edit, review, report, and storage of ambulatory and multi-parameter ECG data.

Results of the automated analysis are intended to assist the physician in the interpretation of the recorded data. This information is not intended to serve as a substitute for the physician overread of the recorded ECG data.

The MARS system is intended to be used by trained operators under the direct supervision of a licensed healthcare practitioner in a hospital or clinic environment.

Patient population includes both adult and pediatric (greater than 10Kg) human patient.

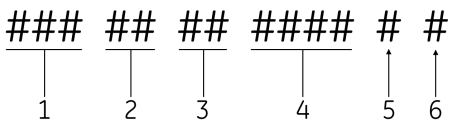
The MARS system provides the user arrhythmia studies and Holter analysis capabilities.

Data acquired may be used for the following indications:

- Evaluation of symptoms that may be caused by cardiac arrhythmia and/or conduction disturbances.
- Evaluation of symptoms that may be due to myocardial ischemia.
- Detection of ECG events that alter prognosis in certain forms of heart disease.
- Detection and analysis of pacemaker function and failure.
- Determination of cardiac response to lifestyle.
- Evaluation of therapeutic interventions
- Investigations in epidemiology and clinical trials.

Identification

Every GE Healthcare device has a unique serial number for identification. The serial number is located on the product label. Besides uniquely identifying the unit, the serial number provides additional information about the device, as explained in the following diagram:



1. **Product Code**
   Three-letter code that uniquely identifies the product line.
2. **Year of manufacture**
   Two-digit code identifying the year that the device was manufactured. Values range from 00 to 99. For example: **00** corresponds to 2000, **01** corresponds to 2001, **02** corresponds to 2002, and so on.
3. **Fiscal week of manufacture**
   Two-digit code identifying the week that the device was manufactured. Values range from 01 to 52. GE Healthcare's fiscal weeks correspond to the calendar week. For example, **01** corresponds to the first week in January.
4. **Product sequence number**
   Four-digit number identifying the order in which this device was manufactured. Values range from **0001** to **9999**.

5. **Site of manufacture**
   One-letter code identifying the site where the device was manufactured. For example, the code for Milwaukee is **F**; for Freiburg it is **N**; and for Bangalore it is **P**.
6. **Miscellaneous characteristic**
   For example, **P** indicates the unit is a prototype, **R** indicates the unit has been refurbished, and **U** indicates the unit has been upgraded to meet the specifications of another product code.

Safety Information

GE Healthcare asserts that the equipment covered by this manual is safe, reliable, and effective as long as the following conditions are met:

- The electrical installation in the areas of use complies with the requirements of the regulations governing the equipment.
- The equipment is assembled, adjusted, modified, or repaired only by service personnel authorized by GE Healthcare. The use of unauthorized personnel to service equipment voids any warranties covering the equipment.
- The equipment is used in accordance with the instructions for use, as provided in this manual.

Equipment Compliance

The MARS Ambulatory ECG System software is considered medical software. As such, it has been designed and manufactured to the appropriate medical regulations and controls.

The hardware components of the MARS system, however, are not considered medical equipment. They are considered Information Technology Equipment (ITE). The system's individual components comply with the standards for Safety of Information Technology Equipment, including Electrical Business Equipment (EN 60950, UL 60950).

Because the MARS system may be used in a patient's vicinity, it must comply with the standard requirements for current leakage in medical systems (EN/IEC 60601-1-1). To comply with this standard, the MARS components and all attached accessories must be connected to a medical grade (EN/IEC 60601-1) uninterruptible power supply (UPS).

In addition, any nonmedical electrical equipment used with the MARS system must comply with the IEC and ISO safety standards that are relevant for that equipment, such as IEC 60950, Safety of Information Technology Equipment.

NOTE:
If the equipment is installed in the USA using 240 V rather than 120 V, the source must be a center-tapped, 240 V, single-phase circuit.

Part and Accessory Safety

To ensure patient safety, use only parts and accessories manufactured or recommended by GE Healthcare. If you want to connect a device that is not recommended in this manual, contact GE Healthcare before connecting the device.

Any part or accessory used with the device must meet the requirements of the applicable EN/IEC 60601 series of safety standards, and/or the system configuration must meet the requirements of the EN/IEC 60601-1-1 medical electrical systems

standard. The use of accessory equipment not complying with the equivalent safety requirements may lead to a reduced level of safety of the resulting system. Consideration relating to the choice shall include:

- use of the accessory in the patient vicinity; and
- evidence that the safety certification of the accessory has been performed in accordance with the appropriate EN/IEC 60601-1 and/or EN/IEC 60601-1-1 harmonized national standard.

Equipment Symbols

The following symbols may appear on the device or its packaging. Familiarity with these symbols will assist in the safe use and disposal of the equipment.

General warning. Consult the documentation before use.

WARNING:
INJURY/DAMAGE — Component exceeds the recommended weight for one individual to handle safely.

To reduce the risk of personal injury or damage to the equipment, observe local occupational health and safety requirements and guidelines for manual material handling.

WARNING:
HOT SURFACE

Recyclable. Please recycle or dispose of in accordance with local, state, or country laws. (Taiwan)

Indicates that the waste of electrical and electronic equipment must not be disposed as unsorted municipal waste and must be collected separately. Please contact an authorized representative of the manufacturer for information concerning the decommissioning of your equipment.

SE SCSI device.

Mains power switch. **1** is on. **0** is off.

Power switch.

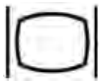
Ethernet

Indicates serial port connection.

Indicates USB port connection.

Indicates PS/2 keyboard connection.

Indicates PS/2 mouse connection.



Indicates VGA video connection.

Identifies the product's catalog, or orderable part, number.

Identifies the unit's serial number.

Identifies the unit's date of manufacture.

C-Tick Mark —Symbolizes compliance with applicable EMC requirements for Australia.

Environment-friendly Use Period per Chinese standard SJ/T11363-2006

cULusListed Mark — Symbolizes compliance with applicable requirements for Canada and USA. In accordance with; *

- UL 60601-1 *
- CAN/CSA C22.2 NO. 601.1

CE mark — Symbolizes conformity with applicable EU (European Union) directives.

PCT (GOST-R) Mark — Symbolizes compliance with applicable requirements for Russia.

CCC Mark — Symbolizes conformity with applicable China requirements.

BSMI Commodity Inspection Mark — Symbolizes compliance with applicable requirements for Taiwan.

TUV GS Mark — Symbolizes full compliance with the German Equipment Safety Law, showing the product meets electrical, chemical and ergonomic safety requirements.

VCCI Mark — Symbolizes the equipment meets Japan's EMI requirements as set down by the Voluntary Control Council for Interference for Information Technology Equipment.

Safety Messages

Safety messages alert you to possible hazards (sources of potential personal injury). Observance of all safety messages will help protect the user and the patient against those hazards.

Definitions

Safety messages are indicated with the terms CAUTION, WARNING, and DANGER. In addition, the term NOTE is used to indicate additional information which, while important, is not related to a hazard. Each term designates a different degree or level of seriousness. Familiarize yourself with each term's definition and significance:

DANGER	Indicates an imminent hazard which, if not avoided, will result in death or serious injury.
WARNING	Indicates a potential hazard or unsafe practice which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a potential hazard or unsafe practice which, if not avoided, could result in minor personal injury or damage to the product or property.
NOTE	Indicates additional information or tip to help you get the most out of your equipment.

Cautions and Warnings

The following safety messages apply to the general use of the MARS Ambulatory ECG System. Additional safety messages that apply in specific circumstances may be found where appropriate throughout the manual .

WARNING:

EXPLOSION HAZARD — Flammable anesthetic vapors or liquids can cause explosions.

Do NOT use the device in the presence of flammable anesthetic vapors or liquids.

WARNING:

CONNECTION TO MAINS — This is class I equipment.

The mains plug must be connected to an appropriate power supply/source.

WARNING:

LEAKAGE CURRENT — Electrical shock to patient could result from component failure and lack of power isolation.

In the event this system is used in the patient vicinity, it must be configured in such a way that it and all of its electrically-connected peripheral devices are isolated from mains power to prevent excessive leakage current to the patient. This can be accomplished through the use of isolated mains power or a medical grade isolation transformer or medical grade UPS (in compliance with UL 60601, CAN/CSA C22.2 No. 601.1, IEC 60601-1). All non-medical peripheral devices shall comply with IEC and ISO safety standards that are relevant to that equipment (i.e., IEC 60950, UL 60950).

Use of the SEER Light Connect device in the patient vicinity requires that these measures be observed.

WARNING:
ELECTRIC SHOCK — To reduce the risk of electric shock, do NOT remove cover or back.

Refer servicing to qualified personnel authorized by GE Healthcare.

WARNING:
RF INTERFERENCE — Known RF sources—such as cell phones, radio or TV stations, and two-way radios—may cause unexpected or adverse operation of this device.

Consult qualified personnel regarding system configuration.

CAUTION:
ACCESSORIES — The use of accessories, transducers, and cables other than those specified may result in increased emissions or decreased immunity performance of the device/system.

Use only the accessories, transducers, and cables that have been approved for use with this system.

CAUTION:
INTERPRETATION OF ECG DATA — Results of the automated analysis are intended to assist the physician in the interpretation of the recorded data. This information is not intended to serve as a substitute for the physician overread of the recorded ECG data.

A physician must overread the ECG data and use the information in conjunction with the patient's clinical history, symptoms, and other diagnostic tests for final clinical judgement.

CAUTION:
POWER SUPPLY — This device/system is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.

Mains power should be that of a typical commercial or hospital environment.

CAUTION:
RESTRICTED SALE — U.S. federal law restricts this device to sale by or on the order of a physician.

CAUTION:
EQUIPMENT CONFIGURATION — The equipment or system should not be used adjacent to, or stacked with, other equipment.

If adjacent or stacked use is necessary, test the equipment or system to verify normal operation.

System Basics

This section provides the following basic information needed to use the MARS Ambulatory ECG System:

- System Access
- Screen Layout
  - Menu Bar
  - Control Panel
  - Application Menus
- Date and Time Formats

An understanding of these topics is assumed throughout the rest of the manual.

System Access

The safe operation of the MARS Ambulatory ECG System requires that it be powered on and off properly, as described in the following sections.

CAUTION:

SOFTWARE COMPATIBILITY — Running the MARS Ambulatory ECG System while running incompatible software can result in instability or system failure.

The MARS application should be run only with software that has been validated to run with it.
The following applications have been validated to run simultaneously with the MARS application:

- Norton Antivirus
- McAfee Antivirus
- WinFAX
- Adobe Distiller

The following applications have been validated to run on the system when the MARS application is not running:

- Microsoft Outlook
- WinZIP

The MARS software should be run either alone or in conjunction with the applications that have been validated to run simultaneously with it. In the event of a conflict, the other application should be shut down and the MARS software run alone.

To Power On the MARS System

Use the following procedure to power on the MARS system. Do not attempt to power on the system until all cables have been properly connected and the MARS workstation has been connected to a power source that meets the minimum power

requirements, as described in the *MARS v8 Ambulatory ECG System Service Manual* (PN 2027879-035).

1. Turn on the workstation, monitor, and attached printers.

   Watch for error messages as the system boots up.

2. When the operating system's welcome screen appears, log on using your normal procedure.

   NOTE:
   The logon procedure depends on the operating system and configuration. Typically you enter a user name and password, but your system may be configured not to require this information. If you are not familiar with your system logon procedure, contact your system administrator.

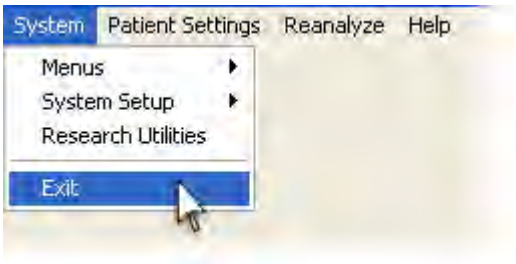
   One of two things happens when you log on to the workstation:

   - The MARS application runs automatically.
     If the MARS software was configured to run automatically on system start up, the application launches.
   - The Windows desktop opens.
     If the MARS software was configured with the default startup options, you must manually launch the application by double-clicking the MARS icon:

To Shut Down the MARS Application

Properly shutting down computers running the Windows operating system allows the operating system and applications to safely shut down open files, preventing potential errors that could corrupt data or damage hardware. Use the following procedure to safely shut down the MARS workstation.

1. From the MARS application, select ***System > Exit***.



   The MARS application shuts down and returns to the Windows desktop.

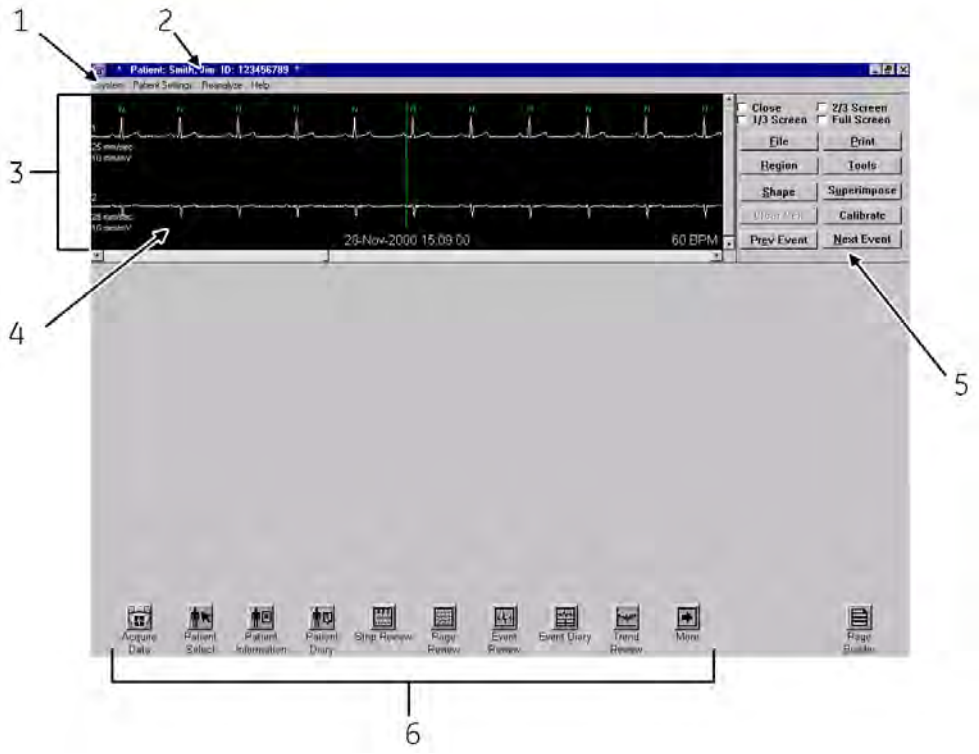
2. From the Windows desktop, select ***Start > Shut Down***.

   One of three things happens, depending on which version of Windows is on the system.

   - A menu may open. Select ***Shut Down the Computer?*** from the menu.
   - A ***Shut Down Windows*** dialog box may open. Select ***Shut down*** from the drop-down list and click ***OK***
   - The operating system may close and the workstation may shut off.

Screen Layout

The MARS Ambulatory ECG Analysis window is divided into 6 regions, as shown in the following illustration.



NOTE:
This is a typical screen as it appears after an application window has been opened. It is shown only to illustrate the key components of the MARS screen layout and is not intended to illustrate the initial screen on system boot up.

1. **Menu Bar**
   The menu bar contains the following menus: Setup, Reanalyze, Patient Settings, and Help. Use these menus to select the ***Application Menu***, to configure the MARS system, to manually reanalyze ECG data, to set patient overrides, and to get additional help. For more information on the system menus, refer to "Menu Bar" on page 22.

2. **Title Bar**
   The title bar displays the selected patient's name and ID.

3. **Application Window**
   The selected application displays in this area. Features include Data Acquisition, Patient Selection, Patient Information, Patient Diary, Strip Review, Event Review, and so on. In this illustration, the Strip Review application is displayed in the top third of the screen. A application may be configured to fill 1/3, 2/3, or the full screen. Up to three features may be displayed at one time.
   The application window is divided into the ***Display Panel*** and ***Control Panel***.

4. **Display Panel**
   The display panel displays a portion of the selected record. Depending on the application, this area may display text or graphics. The Strip Review application, shown in this example, displays the ECG waveforms of the selected record.

5. **Control Panel**
   The control panel provides access to settings and tools that allow you to manage the application window and edit the selected record. Some controls are common to all features. Some tools are specific to an application. For more information, refer to "Control Panel" on page 23.

6. **Application Menu**
   The application menu displays a group of icons used to run the associated applications. The list of available icons depends on which application menu is selected. For more information, refer to "Application Menus" on page 23.

Menu Bar

The Menu Bar provides access to the following menus and items:

System	
Menus	Selects which group of icons will appear in the icon strip at the bottom of the window. The MARS system ships with several predefined menus. In addition, custom menus can be created. For more information, refer to "Application Menus" on page 23.
System Setup	Sets up the MARS system's global features. For more information, refer to Chapter 3, "System Setup".
Research Utilities	Saves the selected patient file in a special output format for further analysis and interpretation outside of the MARS system. For information, refer to Appendix E, "Research Utilities".
Exit	Closes the MARS system and returns to the Windows desktop. For information on using ***Exit***, see "To Shut Down the MARS Application" on page 20.
Patient Settings	
Event Definitions	Defines the parameters that constitute an event for the current patient's ECG. Global events can be defined using the System Setup, but this allows you to override those global settings on a per patient basis. For more information, refer to "Overriding Event Definitions" on page 116.
Heart Rate	Defines the parameters that determine which types of beats are shown in the current patient's analysis. Global parameters can be defined using the System Setup, but this allows you to override those global settings on a per patient basis. For more information, refer to "Overriding Heart Rate Settings" on page 117.
Reanalyze	
Reanalyze	Initiates a reanalysis for the currently selected patient record. You can modify the analysis options prior to initiating the reanalysis.
Help	
About	Provides additional information about the system, including product version, copyright information, and product serial number.

Control Panel

Each application has a control panel that provides access to settings and tools that you can use to manage the application and to interact with the current record. Many features have settings and tools that are unique to that application, but the following controls are common to many, if not all, applications.

Control	Description
Close	Closes the application.
1/3 Screen	Resizes the application window to one-third the height of the MARS window.
2/3 Screen	Resizes the application window to two-thirds the height of the MARS window.
Full Screen	Resizes the application window to the full height of the MARS window.

For information on more common controls, refer to Appendix H "Using Common Controls".

Application Menus

The icon strip along the bottom of the window is referred to as the Application Menu. It displays the icons used to run the individual applications of the MARS system. The icons that appear in this area are determined by the application menu selected from the menu bar.

Menu Reference

The MARS Ambulatory ECG System is shipped with the following predefined menus providing access to 11 different icon groups, as shown in the following table.

Menu	Included Applications
Standard	Acquire Data, Patient Select, Patient Information, Patient Diary, Shape Review, Episode Review, SVE Editor, Trend Review, Super Page, Report Review
Monitoring	Patient Select, Waveform Review, Report Review
Rapid Review	Acquire Data, Patient Select, Patient Information, Patient Diary, Event Review, Shape Review Trend Review, Report Review
Rapid Review with 12 Lead	Acquire Data, Patient Select, Patient Information, Patient Diary, Event Review, Shape Review Trend Review, View 12SL, View 12SL Trends, Report Review
Rapid Review (All Apps)	Acquire Data, Patient Select, Patient Information, Patient Diary, Event Review, Shape Review Trend Review, Episode Review, Waveform Measurements, View 12SL, Heart Rate Variability, Heart Rate Turbulence, Waterfall Display
Rapid Review with HRV	Acquire Data, Patient Select, Patient Information, Patient Diary, Event Review, Shape Review Trend Review, Heart Rate Variability, Report Review

Menu	Included Applications
Rapid Review with Episode Review	Acquire Data, Patient Select, Patient Information, Patient Diary, Event Review, Shape Review Trend Review, Episode Review, Report Review
Rapid Review with Episode Review and HRV	Acquire Data, Patient Select, Patient Information, Patient Diary, Event Review, Shape Review Trend Review, Episode Review, Heart Rate Variability, Report Review
Rapid Review with Episode Review and Waveform Measurements	Acquire Data, Patient Select, Patient Information, Patient Diary, Event Review, Shape Review Trend Review, Episode Review, Waveform Measurements, Report Review
Rapid Review with Waveform Measurements	Acquire Data, Patient Select, Patient Information, Patient Diary, Event Review, Shape Review Trend Review, Waveform Measurements, Report Review
Rapid Review with Waveform Measurements and HRV	Acquire Data, Patient Select, Patient Information, Patient Diary, Event Review, Shape Review Trend Review, Waveform Measurements, Heart Rate Variability, Report Review
Tools	Acquire Data, Patient Select, Patient Information, Patient Diary, Strip Review, Page Review, Event Review, Event Diary, Trend Review, Episode Review, Shape Review, Waveform Measurements, Heart Rate Variability, Heart Rate Turbulence, Waterfall Display, View 12SL Directory, View 12SL, Report Review

In addition, you can create your own custom menus based on any of the predefined menus or built from scratch.

NOTE:

The ***Tools*** menu behaves differently from the other menus. First, each icon in the ***Tools*** menu opens a single application; all the other menus can open up to 3 applications. Second, the ***Tools*** menu does not close any open windows; all other menus close any open windows before opening the selected application. If you have six applications open, you will receive a warning message asking you to close some applications.

Icon Reference

The following table lists each application alphabetically, identifies the associated icon, and describes the application.

NOTE:

The following table lists the icons as they appear on the Tools menu. The icons may differ on other menus. This is especially true of custom menus created to group applications specific to the way in which your organization uses the software.

Application	Icon(s)	Description
Acquire Data		Initiates the acquisition of data from a connected Holter or data card.
Episode Review		Displays episodes as histograms based on the frequency of occurrence and measurement value. For example: an R-R interval of 1200 milliseconds versus an R-R interval of 750 milliseconds. Histograms can be filed for the final report. Use in conjunction with the Strip Review.
Event Diary		Displays user-defined clinical events and the date and time they occurred. Use in conjunction with the Strip Review.
Event Review		Displays user-defined clinical events in a miniaturized format. Events can be sorted by severity or chronology. Event examples: VE runs, SVT, multi-format PCCs,. Events can be filed for the final report.
Heart Rate Turbulence		Displays a tachogram with the computed output values of heart rate turbulence (HRT). The tachogram includes the average RR intervals surrounding the trigger events. The output values include the turbulence onset and slope. The HRT information can be filed for the final report.
Heart Rate Variability		Displays heart rate variability (HRV) information as histograms. Provides adjustable calipers for taking measurements. The HRV information can be filed for the final report.
More	 	Scrolls the icons left or right. Available only if there are more icons than can be displayed at one time.
Page Builder	 	Customizes pages for print without entering the Report Review application. An active window can be sent to the one-page print queue by selecting ***Print > Page Builder*** from the control panel.

Application	Icon(s)	Description
Page Review		Displays the entire ECG in a single page for review. Select beats and events are highlighted in user-defined colors for easy identification. Provides three methods to review the data: • You can scroll through the ECG manually. • You can use ***Auto Page*** to scroll through the ECG automatically one page at a time. • You can use ***Next Event*** and ***Previous Event*** buttons to jump to marked events and episodes. Select pages can be filed for the final report. Use in conjunction with Strip Review for final review before generating the final report.
Patient Diary		Records information regarding patient events, episodes, activities, and symptoms. Use in conjunction with Strip Review and Page Review for the final report.
Patient Information		Records patient and test demographic information.
Patient Select		Displays a list of patient slots and their statuses. Allows the selection of servers and data type (Holter, Monitoring, Select Beds, and Stored Reports).
Report Review		Displays the final report for review and editing. You can remove unwanted strips or information, add an interpretation, and rearrange the report sections.
Shape Review		Groups similar beats into templates for easy review. Each group identifies the beat type and number of beats included. You can review the beats in each group and reclassify individual beats to an existing template or a new template. Use in conjunction with Strip Review.
Strip Review		Displays waveforms in a measurable 10-second strip and includes date, time, and heart rate. Waveforms can be: • Calibrated using built-in calipers • Reviewed using superimposition • Scanned for events using the ***Next Event*** and ***Previous Event*** buttons • Relabeled, as appropriate
Super Page		Displays the Strip Review and Page Review applications simultaneously. Review those applications for a list of available features and functions.
SVE Editor		Displays the Strip Review, Event Review, and Page Review applications simultaneously. Review those applications for a list of available features and functions.

Application	Icon(s)	Description
Trend Review		Displays a variety of measurements—such as Heart Rate, ST Deviation, and so on—in a compressed format. This allows you to see how those measurements vary over the duration of the test. The selected trend group controls which measurements are displayed. Additional trends can be selected at any time. The X-axis of each trend represents the duration of the ECG. The Y-axis varies depending on the trend. For example, the Y-axis on the Heart Rate Trend represents beats per minute while on the R-R Interval trend it represents milliseconds.
View 12SL		Displays a 10-second strip of 12-lead data corresponding to the 12-lead measurement highlighted in the 12SL Directory.
View 12SL Directory		Displays a listing of every 12-lead measurement taken during the selected Holter study.
View 12SL Trend		Displays the entire ECG in a compressed strip format to make it easier to spot trends. By default, the 12-lead trend includes Heart Rate, but this can be modified to include other trends associated with the 12-lead data.
Waterfall Display		Displays a vertical map of cardiac cycles stacked and aligned in time sequence with the signal amplitude indicated by color.
Waveform Measurements		Displays a waveform and trend window that allows you to analyze ST deviations, QT interval, and T-Wave Alternans trends. The key fiducial points (isoelectric, J, and Post J) can be measured automatically or manually. Measurements can be filed for the final report.
Web Alert		Indicates that patient slots are full and new patients are ready to be uploaded via the Web Client. When it indicates patients are waiting to be uploaded, open Patient Select to archive and delete patients to make room to acquire new records. Available only on servers and connected clients, not on standalone systems.

Icon-Menu Reference

The following table identifies the menus each icon is available on. The columns identify the menus. The rows identify the icons. If an icon is available on a menu, an X is entered in the cell where the icon row and menu column intersect.

	Standard	Rapid Review	Rapid Review w/ 12SL	Rapid Review w/ HRV	Rapid Review w/ Episode Review	Rapid Review w/ HRV and Episode Review	Rapid Review (All Apps)	Rapid Review Episode and Waveform	Rapid Review w/ Waveform Measure-	Rapid Review w/ Waveform and HRV	Tools	Monitoring
Acquire Data	X	X	X	X	X	X	X	X	X	X	X	
Episode Review	X				X	X	X	X			X	
Event Diary											X	
Event Review		X	X	X	X	X	X	X	X	X	X	
Heart Rate Turbulence							X				X	
Heart Rate Variability				X		X	X			X	X	
Page Builder	X	X	X	X	X	X	X	X	X	X	X	
Page Review											X	
Patient Diary	X	X	X	X	X	X	X	X	X	X	X	
Patient Information	X	X	X	X	X	X	X	X	X	X	X	
Patient Select	X	X	X	X	X	X	X	X	X	X	X	X
Report Review	X	X	X	X	X	X	X	X	X	X	X	X
Shape Review	X	X	X	X	X	X	X	X	X	X	X	
Strip Review											X	
Super Page	X											
SVE Editor	X											
Trend Review	X	X	X	X	X	X	X	X	X	X	X	
View 12SL			X				X				X	
View 12SL Directories											X	
View 12SL Trends			X									
Waterfall Display							X				X	
Waveform Measurements							X	X	X	X	X	
Waveform Review												X
Web Alert	X	X	X	X	X	X	X	X	X	X	X	

Date and Time Formats

The MARS Ambulatory ECG System displays dates in the *dd-mmm-yyyy* format: **15–Jun-2010**.

It displays times in the *hh:mm:ss* format using a 24–hour clock: **18:39:55**.

Neither format is configurable.

Process Overview

This section provides a high-level overview of the process for using the MARS Ambulatory ECG System.

1. Record ECG data.

   ECG data can be recorded from two sources: an ambulatory digital analysis recording device (Holter) that acquires 24, 48, or 76 hours of 2, 3, or 12 channel ECG data, or a bedside monitor connected to a CIC Pro system. This step is performed on the instructions of a physician and occurs outside of the MARS Ambulatory ECG System.

   NOTE:
   Refer to the recording device's operators manual for information on recording ECG data.

   NOTE:
   A 12-lead ambulatory electrocardiographic device is not intended to be a substitute for a standard diagnostic electrocardiograph and is designed to meet the standards for ECG cardiographs as indicated for the respective recording device.

2. Download the ECG data to the MARS system.

   To download ECG data from a Holter recorder, refer to Chapter 4, "Holter Acquisition", for details.

   To download ECG data from a bedside monitor connected to a CIC Pro system, refer to Chapter 5, "CIC Acquisition", for details.

3. Select the patient .

   This identifies the patient whose ECG data you want to review, analyze, edit, and store. Refer to "Selecting the Patient" on page 107 for details.

4. Enter patient information.

   This includes demographic and clinical information. Refer to "Entering Patient Information" on page 112 for details.

5. Enter patient diary information.

   This information typically consists of patient symptoms and activities and corresponds to events noted in the ECG. Refer to "Entering Patient Diary Information" on page 114 for details.

6. Review the ECG data.

   This consists of reviewing the ECG shapes, reviewing episodes, adjusting SVEs, reviewing trends, reanalyzing waveforms, running the afib detector, and conducting a final review. The objectives of this process are four fold:

   - Verify that the MARS system marked waveforms and events correctly.
   - Make any necessary corrections.

- Interpret the data.
- File key data for inclusion on a patient's final report.

NOTE:
All data included in the report should tell a story of the entire recording period. If you are unsure of the importance of an event or reading, file it. The primary goal is to document any deviation from a normal beat.

Refer to Chapter 7, "ECG Review", for details.

NOTE:
In addition to the standard review processes, the MARS system provides several optional features to provide advanced review of the ECG. Refer to the appendices for details.

7. Print the final report.

   The final report consists of the key ECG data selected while reviewing the data along with the interpretation of that data. This information is a record of the ECG analysis. A copy of the report is provided to the physician for review. Refer to Chapter 8, "Printing the Final Report", for details.

8. Archiving the data.

   This stores the patient data and final report on a local hard drive, a network drive, a CD-ROM, or a DVD-ROM. It also clears a patient slot on the MARS Ambulatory ECG System. Refer to Chapter 9, "Storing Patient Data", for details.

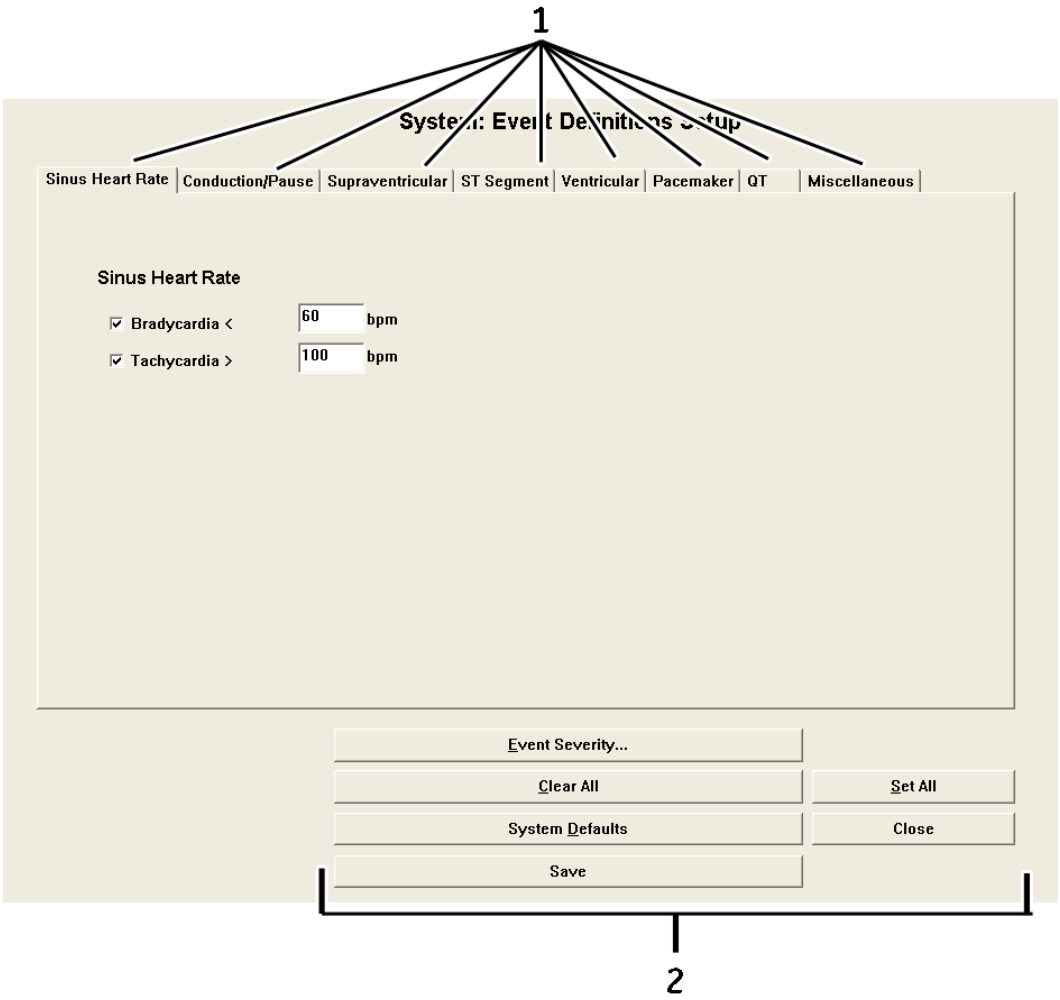
3

System Setup

Before you can use the MARS Ambulatory ECG System, you must configure the workstation's features. To reach the System Setup menu, select ***System > System Setup***. Then select any of the following options:

Event Definitions

The ***System: Event Definitions Setup*** window is used to define the parameters that the system will use to identify events in the ECG. It is also used to determine which events will receive an event label.



System: Event Definitions Setup window

The ***System: Event Definitions Setup*** window consists of two areas:

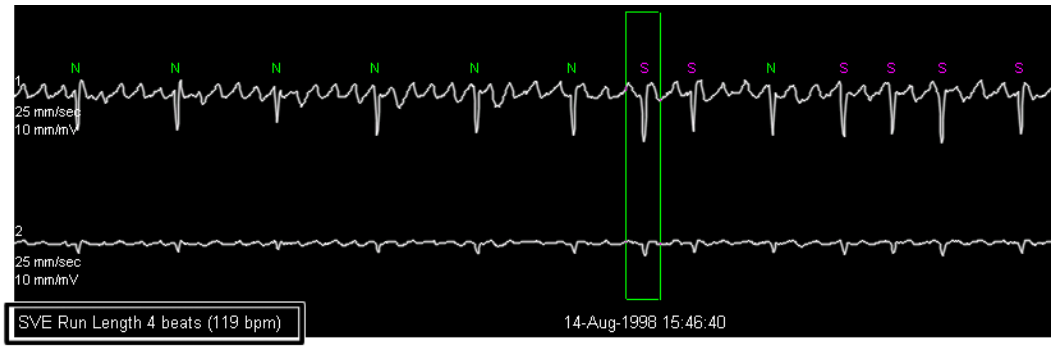
1. **Page tabs**
   The page tabs group related events. The available tabs are Sinus Heart Rate, Conduction/Pause, Supraventricular, ST Segment, Ventricular, Pacemaker, QT, and Miscellaneous. Refer to "Event Definition Field Descriptions" on page 33 for more information.

2. **Controls**
   The controls provide additional options for defining events. The controls are the same regardless of which tab is selected. Refer to "Event Definition Controls" on page 39 for more information.

Event Definition Field Descriptions

The ***System: Event Definitions Setup*** window consists of two field types:

- **Numeric fields**
  Use the numeric fields to set the parameters that the system will use to determine whether a beat qualifies as an event. Examples of a numeric field include beats per minute, milliseconds, percentage, and millimeters.
- **Check boxes**
  Use the check boxes to determine whether the system will display an event label in the lower left corner when the event is visible in the ECG strip, as seen in the following illustration.



NOTE:
If two or more events are visible in the strip, as seen in this example, the ***Event Severity...*** determines which label will be displayed. Refer to "Event Definition Controls" on page 39 for more information.

Sinus Heart Rate Tab

The following table describes the fields on the ***Sinus Heart Rate Tab*** of the ***System: Event Definitions Setup*** window.

Field	Description
Bradycardia <	Sets the lowest number of beats per minute (bpm) that will be considered normal. Beats below this number will be considered bradycardia. The default is 60 bpm. Example: If this field is set to 60 bpm, a rate of 59 bpm or less would be labeled Bradycardia.
Tachycardia >	Sets the highest number of beats per minute (bpm) that will be considered normal. Beats above this number will be considered tachycardia. The default is 100 bpm. Example: If this field is set to 100 bpm, a rate of 101 bpm or higher would be labeled Tachycardia.

Conduction/Pause Tab

The following table describes the fields on the ***Conduction/Pause Tab*** of the ***System: Event Definitions Setup*** window.

Field	Description
R-R Pause >	Sets the maximum duration, in milliseconds (ms), between two R waves that will be considered normal. Any duration above that limit will be labeled a significant R-R Pause. The default is 2000 ms. Example: If this field is set to 2000 ms, a duration of 2100 ms or higher between two R waves would be labeled an R-R Pause.
N-N Pause >	Sets the maximum duration, in milliseconds (ms), between two normal beats that will be considered normal. Any duration above that limit will be labeled a significant N-N Pause. The default is 2000 ms. Example: If this field is set to 2000 ms, a duration of 2100 ms between normal beats would be labeled an N-N Pause.
N-N Delay >	Sets the maximum percentage of the average duration between two normal beats. Any duration above that percentage will be labeled an N-N Delay. The default is 110%. Example: If this field is set to 110% and the average duration between normal beats on the ECG is 2000 ms, any duration of 2200 ms or longer would be labeled an N-N Delay.

Supraventricular Tab

The following table describes the fields on the ***Supraventricular Tab*** of the ***System: Event Definitions Setup*** window.

Field	Description
SVE Prem >	Sets the percentage of the typical R-R interval that is used to determine whether a beat should be labeled premature. R-R intervals that are shorter by this percentage will labeled SVE. The default is 20%. Example: If this field is set to 20% and if the typical R-R interval for the ECG is 2000 ms, an R-R interval of 1600 ms or shorter would be considered premature and labeled SVE. Used in conjunction with the ***SVE Intervals*** field on the Analysis Options. See ***SVE Intervals*** in the "Analysis Options Field Descriptions" on page 44 for more information.
Tachycardia >	Sets the number of beats per minute above which SVE runs would be labeled tachycardic. The default is 150 bpm. Example: If this field is set to 150 bpm, an SVE run of 151 bpm or higher would be labeled tachycardic.
Iso SVE	Determines whether an event label will be displayed for isolated SVE beats.
SVE Couplet	Determines whether an event label will be displayed for two consecutive SVE beats.
SVE Run Length	Determines whether an event label will be displayed for three or more consecutive SVE beats.

Field	Description
SVE Bigeminy	Determines whether an event label will be displayed when an SVE occurs every other beat.
SVE Trigeminy	Determines whether an event label will be displayed when an SVE occurs every third beat.
SVE Quadrigeminy	Determines whether an event label will be displayed when an SVE occurs every fourth beat.

ST Segment Tab

The following table describes the fields on the ***ST Segment Tab*** of the ***System: Event Definitions Setup*** window.

Field	Description
Elevation >=	Sets the length, in millimeters, above a measurement point for which an ST segment will be marked as an elevation by the Waveform Measurement application. The measurement point differs according to field. • ***Absolute*** Measures from an absolute isolectric point of zero. • ***Relative*** Measures by comparing to an average ST reference point calculated by averaging ST segments across a user-defined time period (see ***Basal Time Constant***). The default is 1.0 mm for both fields.
Depression >=	Sets the length, in millimeters, below a measurement point for which an ST segment will be marked as a depression by the Waveform Measurement application. The measurement point differs according to field. • ***Absolute*** Measures from an absolute isolectric point of zero. • ***Relative*** Measures by comparing to an average ST reference point calculated by averaging ST segments across a user-defined time period (see ***Basal Time Constant***). The default is 1.0 mm for both fields.
Apply Relative Criteria Only	Instructs the system to use only the Relative settings for Elevation and Depression measurements. You cannot set both this field and the ***Apply Relative and Absolute Criteria*** field, but at least one must be set.
Apply Relative and Absolute Criteria	Instructs the system to use both the Relative and Absolute settings when determining elevation and depression. You cannot set both this field and the ***Apply Relative Criteria Only*** field, but at least one must be set.
Duration >=	Sets the minimum duration between two ST episodes. The default is 1 minute.

Field	Description
Time Between >=	Sets the minimum time between two episodes for them to be considered separate events. Two adjacent episodes will be considered a single episode if the duration between them is shorter than this specified time. The default is 1 minute.
J+	Defines how much time beyond the J point to make the ST measurement. The default is 60 ms.
Basal Time Constant	Defines the amount of time before or after an event in which the ST segments are averaged to calculate the basal ST reference point used when calculating Relative Elevation and Relative Depression values. The shorter this value is, the more sensitive the system will be to detecting ST episodes. A typical basal time constant is eight times the longest ST episode. The default is 0 minutes.
Detect Horizontal or Downsloping Only	Instructs the system to use the ST segment criteria only when the system labels ST changes.

Ventricular Tab

The following table describes the fields on the ***Ventricular Tab*** of the ***System: Event Definitions Setup*** window.

Field	Description
Tachycardia >	Sets the maximum heart rate at which VE runs will be considered acceptable. Runs higher than this value will be labeled tachycardic. The default value is 150 bpm. Example: If this value is set to 150 bpm, SVE runs at 151 bpm and higher will labeled tachycardic.
Idioventricular<	Sets the minimum heart rate at which VE runs will be considered acceptable. Runs lower than this value will be labeled idioventricular. The default value is 40 bpm.
R on T<	Indicates the minimum amount of time, in milliseconds, between a T-wave and the following R-wave before the QRS complex will be considered premature. For example, if you enter 250 ms, an R-wave that occurs 249 ms after the previous T-wave will be considered premature
Iso VE	Determines whether an event label will be displayed for isolated VE beats.
VE Couplet	Determines whether an event label will be displayed for two consecutive VE beats.
VE Run Length	Determines whether an event label will be displayed for three or more consecutive VE beats.
VE Bigeminy	Determines whether an event label will be displayed when a VE occurs every other beat.
VE Trigeminy	Determines whether an event label will be displayed when a VE occurs every third beat.
VE Quadrigeminy	Determines whether an event label will be displayed when a VE occurs every fourth beat.

Pacemaker Tab

The following table describes the fields on the ***Pacemaker Tab*** of the ***System: Event Definitions Setup*** window.

Field	Description
Capture Fail >	Sets the maximum duration, in milliseconds, prior to a beat that a pacemaker spike would be considered successful. Any spike earlier than that would indicate a Capture Failure. The default is 1100 ms. Example: If this field is set to 1100 ms, a pacemaker spike that occurs 1200 ms prior to the following beat would be labeled *Capture Fail*.
Under Sense Between	Sets the range of time, in milliseconds, during which a pacemaker spike following a heart beat would indicate the pacemaker's failure to detect the spike. Default values are 0 ms and 500 ms. Example: If the range is set to 0 ms and 500 ms, a pacemaker spike that follows a beat by 400 ms would indicate that the pacemaker failed to detect the beat.
Output Fail >	Sets the maximum duration, in milliseconds, during which a pacemaker spike is expected. If a spike does not occur within that duration, it would indicate an Output Failure. The default is 1100 ms. Example, If this field is set to 1100 ms, the system would expect either a beat or a spike to occur at least every 1100 ms. If neither occurs within that time, it would indicate that the pacemaker failed to output a spike.

QT Tab

The following table describes the fields on the ***QT Tab*** of the ***System: Event Definitions Setup*** window.

Field	Description
QT [offset] >=	Sets the maximum acceptable duration, in milliseconds, between a Q wave and the offset of the following T wave. Any value that exceeds that value would be labeled a QT event. The default value is 500 ms. Example: If this field is set to 500 ms, a T wave offset that is 501 ms or longer after the Q wave would be labeled a QT event.
QT [peak] >=	Sets the maximum acceptable duration, in milliseconds, between a Q wave and the peak of the following T wave. Any value that exceeds that value would be labeled a QT event. The default value is 450 ms. Example: If this field is set to 450 ms, a T wave peak that is 451 ms or longer after the Q wave would be labeled a QT event.
QTc [offset] >=	Sets the maximum acceptable duration, in milliseconds, between a corrected Q wave and the offset of the following T wave. Any value that exceeds that value would be labeled a QTc event. The default value is 500 ms. Example: If this field is set to 500 ms, a T wave offset that is 501 ms or longer after the corrected Q wave would be labeled a QTc event.

Field	Description
QTc [peak] >=	Sets the maximum acceptable duration, in milliseconds, between a corrected Q wave and the peak of the following T wave. Any value that exceeds that value would be labeled a QTc event. The default value is 450 ms. Example: If this field is set to 450 ms, a T wave peak that is 451 ms or longer after the corrected Q wave would be labeled a QTc event.
Duration >=	Sets the duration, in minutes, at which a QT interval is considered an event. The default is 1 minute. Example: If this field is set to 1 minute, a QT interval that measures 1 minute or longer will be labeled as an event.
Time Between >=	Sets the duration, in minutes, at which two QT events are considered separate and distinct. Any pairing closer than this will be considered a single event. The default is 1 minute. Example: If this field is set to 1 minute, a QT interval that occurs 1 minute or longer after the previous QT interval is considered a separate event.
Correction Method	Selects which method will be used to adjust heart rate to calculate the corrected QT (QTc). You have two choices: • Bazett • Fridericia The default is Bazett.
Valid R-R Interval for QTc	Sets the range of acceptable R-R durations, in milliseconds, that will be considered valid for calculating the corrected QT (QTc). The default range is 800 ms to 1200 ms. ***Correction Method*** uses the R-R interval to calculate QTc.

Miscellaneous Tab

The following table describes the fields on the ***Miscellaneous Tab*** of the ***System: Event Definitions Setup*** window.

Field	Description
New Shape	Determines whether the MARS system will document all new shapes as they are defined in within Shape Review. Refer to "Reviewing Shapes" on page 120 for more information.
Noise	Determines whether the MARS system will document noise.
Atrial Fib	Determines whether the MARS system will document atrial fibrillation.
Atrial Flutter	Determines whether the MARS system will document atrial flutter.
Diary Notes	Determines whether the MARS system will document all diary events.
Sleep Start	Defines the sleep start time. Used by the ***QT Summary Table for Sleep and Wake Periods*** in the final report. Optional.
Sleep End	Defines the sleep end time. Used by the ***QT Summary Table for Sleep and Wake Periods*** in the final report. Optional.

Field	Description
Wake Start	Defines the wake start time. Used by the ***QT Summary Table for Sleep and Wake Periods*** in the final report. Optional.
Wake End	Defines the wake end time. Used by the ***QT Summary Table for Sleep and Wake Periods*** in the final report. Optional.

Event Definition Controls

The following table describes the controls available when defining events.

Control	Description
Event Severity...	Sets event severity, or priority. If two or more events are visible at once, their relative severity determines which event's label will be displayed. When you click the ***Event Severity...*** button, the ***System: Event Severity Setup*** window opens. Refer to "Configuring Event Definitions", following, for more information.
Clear All	Clears all the check boxes on the ***System: Event Definitions Setup*** window.
Set All	Sets all the check boxes on the ***System: Event Definitions Setup*** window.
System Defaults	Reverts all fields to their default settings.
Close	Closes the ***System: Event Definitions Setup*** window.
Save	Saves the current settings.

Configuring Event Definitions

Use the following procedure to define your system event parameters.

1. Select ***System > System Setup > Event Definitions*** from the menu bar.

   The ***System: Event Definitions Setup*** window opens.

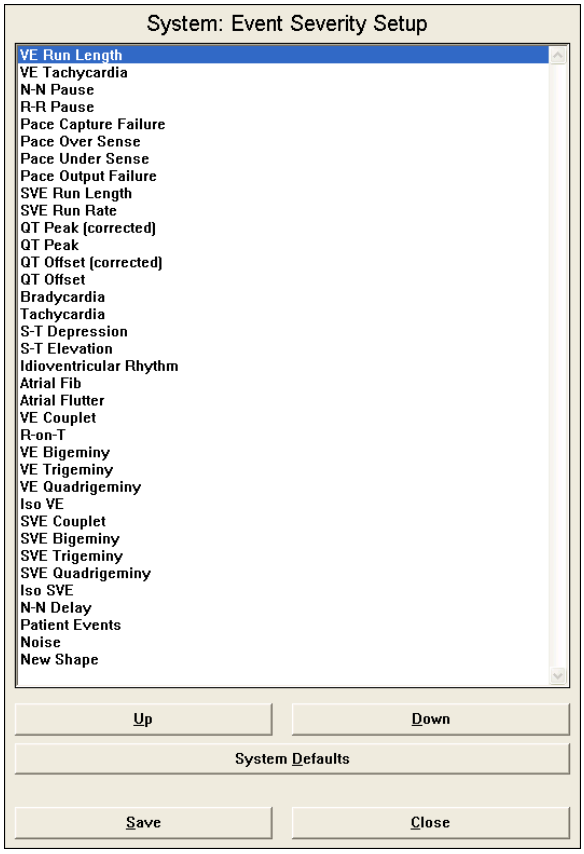
2. Review the current event settings and modify them as necessary.

   Refer to "Event Definition Field Descriptions" on page 33 for a description of the fields.

3. Set the event priorities as appropriate.

   a. Click the ***Event Severity...*** button.

      The ***System: Event Severity Setup*** window opens.



b. To increase an event's priority, select the event and click the ***Up*** button.

c. To decrease an event's priority, select the event and click the ***Down*** button.

d. To reset the priorities to their default order, click the ***System Defaults*** button.

e. To save the priorities, click the ***Save*** button.

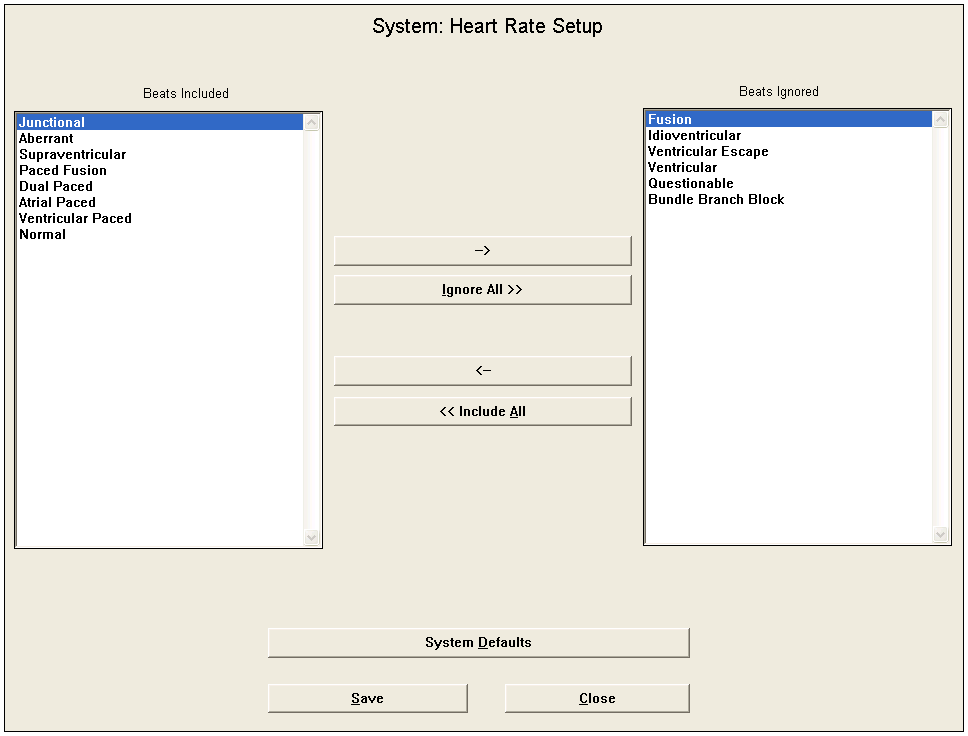
f. To close the window, click the ***Close*** button.

4. Click the ***Save*** button to save your settings.

5. Click the ***Close*** button to close the ***System: Event Definitions Setup*** window.

Heart Rate

The ***System: Heart Rate Setup*** window is used to select which beat types will be included in heart rate calculations and which beats will be ignored.



Heart Rate Field Descriptions

The following table describes the fields on the ***System: Heart Rate Setup*** window.

Field	Description
Beats Included	Identifies the beats that will be used in heart rate calculations and labeled on the ECG. The beat types included by default are: • Bundle Branch Block • Junctional • Aberrant • Supraventricular • Paced Fusion • Dual Paced • Atrial Paced • Ventricular Paced • Normal
Beats Ignored	Identifies the beats that will not be used in heart rate calculations and ignored on the ECG. The beat types ignored by default are: • Fusion • Idioventricular • Ventricular Escape • Ventricular • Questionable

Heart Rate Controls

The following table describes the available controls for setting up heart rate.

Control	Description
—>	Moves the selected beat type from the ***Beats Included*** field to the ***Beats Ignored*** field.
Ignore All >>	Moves all beat types from the ***Beats Included*** field to the ***Beats Ignored*** field.
<—	Moves the selected beat type from the ***Beats Ignored*** field to the ***Beats Included*** field.
<< Include All	Moves all beat types from the ***Beats Ignored*** field to the ***Beats Included*** field.
System Defaults	Restores both fields to their default values.
Save	Saves the current settings.
Close	Closes the ***System: Heart Rate Setup*** window.

Configuring Heart Rates

Use the following procedure to select which beat types to include in system heart rate calculations.

1. Select ***System > System Setup > Heart Rate*** from the menu bar.

   The ***System: Heart Rate Setup*** window opens.

2. To exclude a beat type, select the type in the ***Beats Included*** field and click the **—>** button.

   The selected beat is moved to the ***Beats Ignored*** field.

3. To exclude all beat types, click the ***Ignore All >>*** button.

   All the beats are moved to the ***Beats Ignored*** field.

4. To include a beat type, select the type in the ***Beats Ignored*** field and click the **<—** button.

   The selected beat is moved to the ***Beats Included*** field.

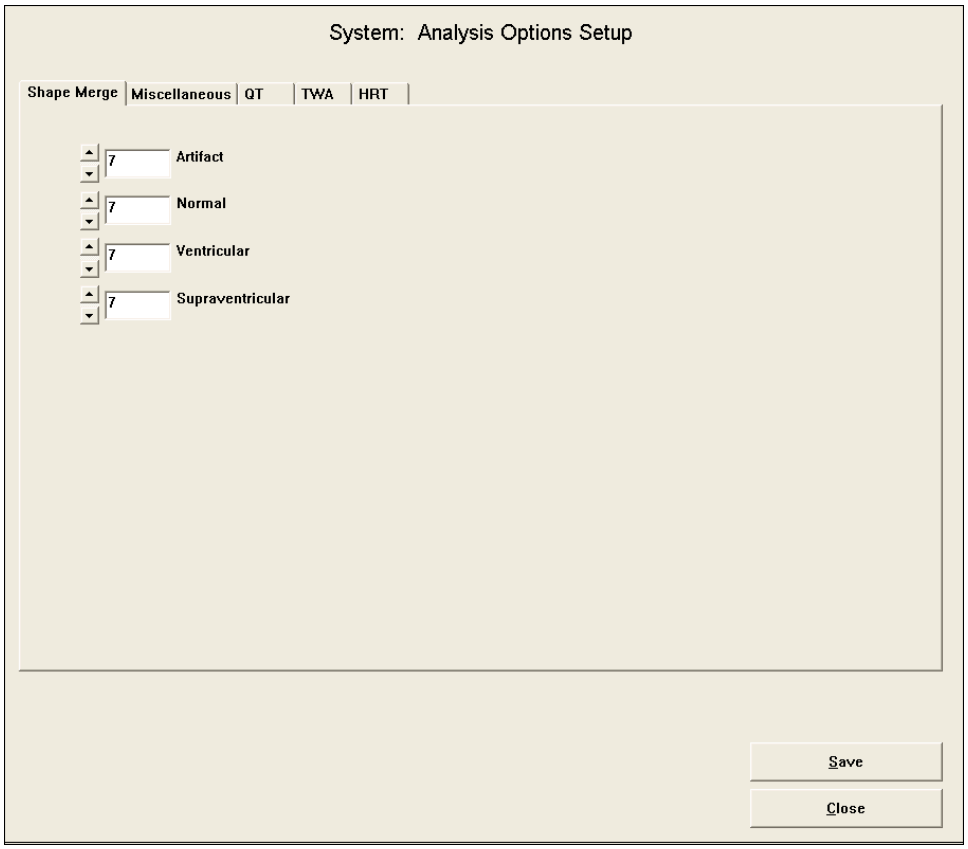
5. To include all beat types, click the ***<< Include All*** button.

   All the beats are moved to the ***Beats Included*** field.

6. To restore both fields to their factory settings, click the ***System Defaults*** button.
7. Click ***Save*** to save the settings.
8. Click ***Close*** to close the ***System: Heart Rate Setup*** window.

Analysis Options

The ***System: Analysis Options Setup*** window is used to define the parameters used by the system when it analyzes a patient's ECG. These parameters govern the way the system handles shape merge, QT trends, T Wave Alternans (TWA), Heart Rate Turbulence (HRT), and various intervals.



Analysis Options Field Descriptions

The following tables describe the fields available on each tab on the ***System: Analysis Options Setup*** window.

Shape Merge Tab

The following table describes the fields on the ***Shape Merge*** tab of the ***System: Analysis Options Setup*** window.

Field	Description
Artifact	Determines the maximum number of shape templates the system will generate for artifacts. Default is 7 but you can enter any number from 1 through 50. For information on how the system generates shapes, refer to "Reviewing Shapes" on page 120.
Normal	Determines the maximum number of shape templates the system will generate for normal beats. Default is 7 but you can enter any number from 1 through 50. For information on how the system generates shapes, refer to "Reviewing Shapes" on page 120.
Ventricular	Determines the maximum number of shape templates the system will generate for ventricular beats. Default is 7 but you can enter any number from 1 through 50. For information on how the system generates shapes, refer to "Reviewing Shapes" on page 120.
Supraventricular	Determines the maximum number of shape templates the system will generate for supraventricular beats. Default is 7 but you can enter any number from 1 through 50. For information on how the system generates shapes, refer to "Reviewing Shapes" on page 120.

Miscellaneous Tab

The following table describes the fields on the ***Miscellaneous*** tab of the ***System: Analysis Options Setup*** window.

Field	Description
SVE Intervals	Determines the number of intervals that will be used to calculate the average R to R interval to be used with the ***SVE Prem*** field to determine SVE prematurity. The default is 4, but you can enter any value from 1 through 16. For more information, refer to ***SVE Prem*** in "Event Definition Field Descriptions" on page 33).
Heart Rate Intervals	Determines the number of intervals that will be used to calculate heart rate in the Strip Review. The default is 6, but you can enter any value from 1 through 16.
R-R Intervals	Determines the number of intervals that will be used to calculate R to R interval. The default is 4, but you can enter any value from 1 through 16.
Allows SVE Relabel	Determines whether you will be allowed to change a Supraventricular template to a Normal template and vice versa. If this option is turned off, you will not be able to manually change the two template types. The only way to change SVEs would be to adjust the SVE prematurity percentage. Refer to ***SVE Prem*** in "Event Definition Field Descriptions" on page 33 for more information. This option is turned off by default.

NOTE:
In a client/server environment, these settings must be identical on the server and on all clients, otherwise discrepancies may arise. For example, if ***SVE Intervals*** are set differently on each client, the number of SVEs may be different on screen than they are in the final report.

QT Tab

The following table describes the fields on the QT Tab of the ***System: Analysis Options Setup*** window.

Field	Description
T Amplitude Threshold (uV)	Sets the minimum T wave amplitude in microvolts (µV). Used for QT measurements. Any value lower than this will be considered noise and not used for T-wave measurement. The default is 50, but you can enter any value from 5 to 500.
Trend to Display	Determines which QT trend will be displayed. You have three choices: ***QTp*** (QT Peak), ***QTo*** (QT Offset), and ***QTp + QTo***. The default is ***QTp***.

TWA Tab

The following table describes the fields on the TWA Tab of the ***System: Analysis Options Setup*** window.

Field	Description
Update Dividing Factor	Determines the divisor to be used when the system generates a median waveform. The default is 32, but you can select 4, 8, 16, 32, or 64. The larger the number, the smaller the increment used. For example, a selection of 32 means that the system uses an increment of 1/32 to generate the median, while a selection of 4 means that the system uses an increment of 1/4. Therefore, smaller numbers could result in a greater incremental change to the median for any given update.
Channel for Calibration	Selects the channel to be used for calibration. The default is channel 1, but you can select channels 1, 2, or 3.
Noise Level (uV)	Sets the maximum level, in microvolts (µV), at which noise is acceptable. Noise above this level will cause the system to reject TWA values. Higher noise levels result in TWA measurements that are more sensitive but less specific. The default is 20 µV, but you can set it to any value from 0 to 100.
Upper Heart Rate Limit (bpm)	Sets the maximum heart rate, in beats per minute (bpm), for which the system will calculate TWA. Any beats above this value will not be included in TWA calculations. The default is 120 bpm, but you can set it to any value from 80 to 250.
Amplitude Resolution (uV)	Sets the amplitude resolution, in microvolts (µV), to use when converting analog waveform signals to digital. This allows you to compensate for varying signal strengths. The default is 5 µV, but you can change it to any value from 1 to 100.
Impose Amplitude Resolution	Determines whether the ***Amplitude Resolution*** will be used to override the recorder's native resolution. This allows you to compensate for varying signal strengths.

HRT Tab

The following table describes the fields on the HRT Tab of the ***System: Analysis Options Setup*** window.

Field	Description
Number of reference RR intervals	Sets the number of adjacent normal-to-normal intervals that will serve as a measure of the actual heart rate. The default is 5, but you can enter any value from 5 to 20. The remaining fields on this tab determine whether a sequence should be excluded because of highly varying normal-to-normal intervals.
Percent RR to call a normal RR premature	Sets the percentage used to determine whether an RR interval is premature and, therefore, to be excluded from the HRT calculations. For example, if this field is set to 20%, an RR interval that is more than 20% shorter than the previous RR interval (RR2 < 0.8*RR1) will be excluded. The default is 20, but you can enter any value from 5 to 50.
Percent RR to call a normal RR late	Sets the percentage used to determine whether an RR interval is late and, therefore, to be excluded from the HRT calculations. For example, if this field is set to 20%, an RR interval that is more than 20% longer than the previous RR interval (RR2 > 1.2*RR1) will be excluded. The default is 20, but you can enter any value from 5 to 50.
Maximum difference to call a normal RR premature or late (ms)	Sets the maximum acceptable difference, in milliseconds (ms), between two consecutive RR intervals. Any interval that varies from the previous or following interval by more than this amount will be excluded from the HRT calculations. For example, if RR2 is more than 200 ms longer than the previous interval (RR2 > RR1+200) or less than 200 ms shorter than the previous interval (RR2 < RR1-200), it will be excluded from the HRT calculations. The default is 200, but you can enter any value from 50 to 500.
Percent value to call a PVC RR premature	Sets the percentage used to determine whether an RR interval next to a premature ventricular beat (PVC) is premature and, therefore, to be excluded from the HRT calculations. The default is 20%, but you can enter any value from 5 to 50.
Percent value to call a PVC RR late	Sets the percentage used to determine whether an RR interval next to a premature ventricular beat (PVC) is late and, therefore, to be excluded from the HRT calculations. The default is 20%, but you can enter any value from 5 to 50.
Minimum value for an RR to be included (ms)	Sets the minimum acceptable RR interval duration, in milliseconds (ms), to be included in the HRT calculations. Shorter intervals will be excluded. For example, if this value is set to 100 ms, a 99 ms interval will be excluded. The default value is 200. You can enter any value from 100 to 300.
Pause threshold (ms)	Sets the maximum acceptable pause duration, in milliseconds (ms), to be included in the HRT calculations. Intervals with longer pauses will be excluded. For example, if this value is 2500 ms, an interval with a 2600 ms pause would be excluded. The default value is 2500, but you can enter any value from 200 to 5000.

Field	Description
Number of RR intervals before target event	Sets the number of intervals prior to the target event to be included in the HRT calculations. The default is 2, but you can enter any value from 2 to 10.
Number of RR intervals after target event	Sets the number of intervals following the target event to be included in the HRT calculations. The default is 15, but you can enter any value from 5 to 30.

Analysis Options Controls

The following table describes the available controls for setting up the analysis options.

Control	Description
System Defaults	Returns the current tab to its factory settings. Available only on the HRT and TWA tabs.
Save	Saves the current settings.
Close	Closes the ***System: Analysis Options Setup*** window.

Configuring Analysis Options

Use the following procedure to configure the analysis options.

1. Select ***System > System Setup > Analysis Options*** from the menu bar.

   The ***System: Analysis Options Setup*** window opens.

2. Define the options as appropriate for your facility.

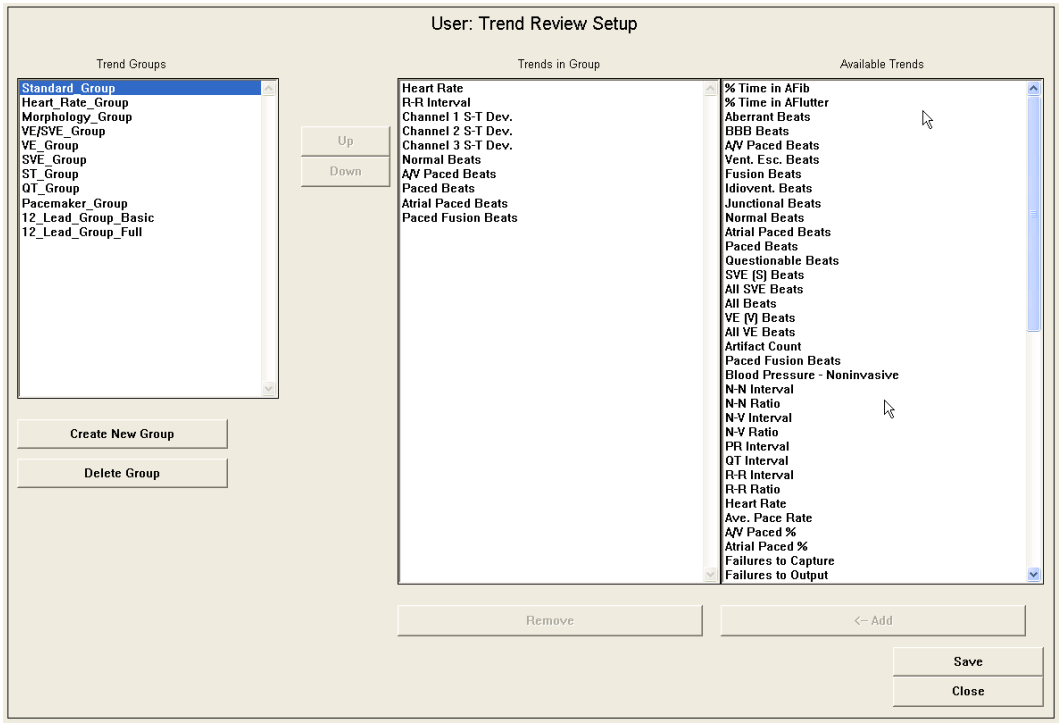
   Refer to "Analysis Options Field Descriptions" on page 44 for a detailed description of each field.

3. After you are done defining the analysis options, click the ***Save*** button to save your settings.

4. After you are done saving the analysis options, click the ***Close*** button to close the ***System: Analysis Options Setup*** window.

Trend Groups

The ***User: Trend Review Setup*** window is used to combine individual trends into groups. This allows you to quickly and easily select multiple trends by selecting a single trend group instead of the individual trends themselves. Trend groups are available when using the ***Trend Review*** application.



Trend Groups Field Descriptions

The following table describes the fields on the ***User: Trend Review Setup*** window.

Field	Description
Trend Groups	A list of the trend groups that have already been defined. You can modify the contents of these groups, delete these groups, or create new groups. You cannot modify the name of an existing group.
Trends in Group	A list of the system trends that have been added to the currently selected group. These trends can be removed from the group and others added.
Available Trends	A list of the system trends that can be added to the currently selected group.

Trend Groups Controls

The following table describes the available controls for defining trend groups.

Control	Description
Create New Group	Adds a group to the ***Trend Groups*** field and selects it.
Delete Group	Removes the selected group from the ***Trend Groups*** field.
Remove	Removes the selected trend from the ***Trends in Group*** field.
<— Add	Adds the trend selected in the ***Available Trends*** field to the selected group.
Save	Saves the changes made to the currently selected group.
Close	Closes the ***User: Trend Review Setup*** window.

Configuring Trend Groups

Use the following procedures to add, modify, and delete trend groups.

To Add a Trend Group

1. Select ***System > System Setup > Trend Groups*** from the menu bar.

   The ***User: Trend Review Setup*** window opens.

2. Click the ***Create New Group*** button.

   The following dialog box opens.

3. Enter a descriptive name for the group and click ***OK***.

   The dialog box closes. The new group is added to the ***Trend Groups*** field and selected.

4. To add a trend to the group, select a trend in the ***Available Trends*** field and click the ***<— Add*** button.

   The trend is added to the ***Trends in Group*** field.

5. To remove a trend from the group, select the trend in the ***Trends in Groups*** field and click the ***Remove*** button.

   The trend is removed from the group.

6. Repeat step 4 and step 5 until the group contains all the trends to be tracked with this group.

7. When you are done defining the group's trends, click the ***Save*** button to save the new group.

8. Continue to add, modify, and delete groups as necessary.
9. After all the groups have been configured as appropriate, click the ***Close*** button to close the ***User: Trend Review Setup*** window.

To Modify a Trend Group

1. Select ***System > System Setup > Trend Groups*** from the menu bar.

   The ***User: Trend Review Setup*** window opens.
2. Select the group to be modified in the ***Trend Groups*** field.

   The trends associated with that group are displayed in the ***Trends in Group*** field.
3. To add a trend to the group, select a trend in the ***Available Trends*** field and click the ***<— Add*** button.

   The trend is added to the ***Trends in Group*** field.
4. To remove a trend from the group, select the trend in the ***Trends in Groups*** field and click the ***Remove*** button.

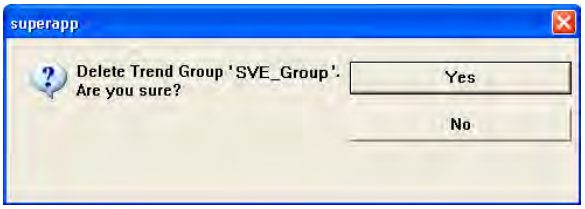
   The trend is removed from the group.
5. Repeat step 3 and step 4 until the group contains all the trends to be tracked with this group.
6. When you are done modifying the group's trends, click the ***Save*** button to save your changes.
7. Continue to add, modify, and delete groups as necessary.
8. After all the groups have been configured as appropriate, click the ***Close*** button to close the ***User: Trend Review Setup*** window.

To Delete a Trend Group

1. Select ***System > System Setup > Trend Groups*** from the menu bar.

   The ***User: Trend Review Setup*** window opens.
2. Select the group to be deleted in the ***Trend Groups*** field.
3. Click the ***Delete Group*** button.

   The following window opens.



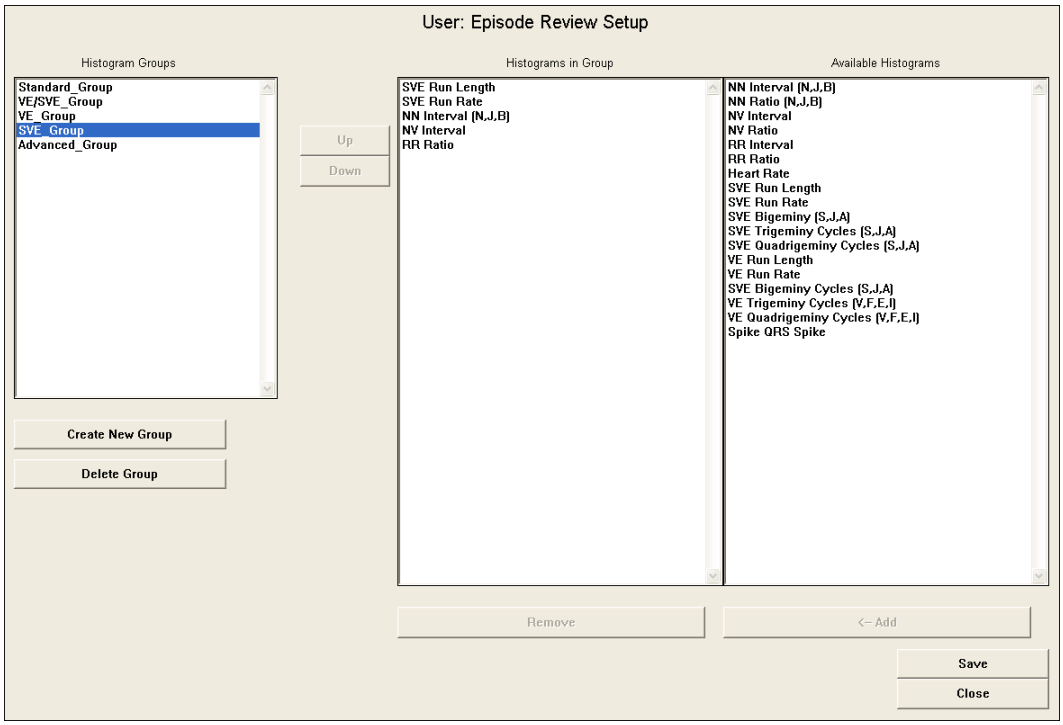
4. Click ***Yes***.

   The dialog box closes and the selected group is deleted from the ***Trends Group*** field.
5. Click the ***Save*** button to save your changes.

6. Continue to add, modify, and delete groups as necessary.
7. After all the groups have been configured as appropriate, click the ***Close*** button to close the ***User: Trend Review Setup*** window.

Histogram Groups

The ***User: Episode Review Setup*** window is used to combine individual histograms into groups. This allows you to quickly and easily select multiple histograms by selecting a single group instead of the individual histograms themselves. Histogram groups are available when using the ***Episode Review*** application.



Histogram Group Field Descriptions

The following table describes the fields on the ***User: Episode Review Setup*** window.

Field	Description
Histogram Groups	A list of the histogram groups that have already been defined. You can modify the contents of these groups, delete these groups, or create new groups. You cannot modify the name of an existing group.
Histograms in Group	A list of the system histograms that have been added to the currently selected group. These histograms can be removed from the group and others added.
Available Histograms	A list of the system histograms that can be added to the currently selected group.

Histogram Group Controls

The following table describes the available controls for defining histogram groups.

Control	Description
Create New Group	Adds a group to the ***Histogram Groups*** field and selects it.
Delete Group	Removes the selected group from the ***Histogram Groups*** field.
Remove	Removes the selected histogram from the ***Histograms in Group*** field.
<— Add	Adds the histogram selected in the ***Available Histograms*** field to the selected group.
Save	Saves the changes made to the currently selected group.
Close	Closes the ***User: Episode Review Setup*** window.

Configuring Histogram Groups

Use the following procedures to add, modify, and delete histogram groups.

To Add a Histogram Group

1. Select ***System > System Setup > Histogram Groups*** from the menu bar.

   The ***User: Episode Review Setup*** window opens.

2. Click the ***Create New Group*** button.

   The following dialog box opens.

3. Enter a descriptive name for the group and click ***OK***.

   The dialog box closes. The new group is added to the ***Histogram Groups*** field and selected.

4. To add a histogram to the group, select a histogram in the ***Available Histograms*** field and click the ***<— Add*** button.

   The histogram is added to the ***Histograms in Group*** field.

5. To remove a histogram from the group, select the histogram in the ***Histograms in Groups*** field and click the ***Remove*** button.

   The histogram is removed from the group.

6. Repeat step 4 and step 5 until the group contains all the histograms to be tracked with this group.

7. When you are done modifying the group's histograms, click the ***Save*** button to save the new group.

8. Continue to add, modify, and delete histogram groups as necessary.
9. After all the histogram groups have been configured as appropriate, click the ***Close*** button to close the ***User: Episode Review Setup*** window.

To Modify a Histogram Group

1. Select ***System > System Setup > Histogram Groups*** from the menu bar.

   The ***User: Episode Review Setup*** window opens.
2. Select the group to be modified in the ***Histogram Groups*** field.

   The histograms associated with that group are displayed in the ***Histograms in Group*** field.
3. To add a histogram to the group, select a histogram in the ***Available Histograms*** field and click the ***<— Add*** button.

   The histogram is added to the ***Histograms in Group*** field.
4. To remove a histogram from the group, select the histogram in the ***Histograms in Groups*** field and click the ***Remove*** button.

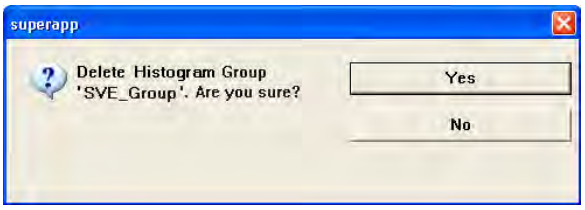
   The histogram is removed from the group.
5. Repeat step 3 and step 4 until the group contains all the histograms to be tracked with this group.
6. When you are done modifying the group's histograms, click the ***Save*** button to save your changes.
7. Continue to add, modify, and delete histogram groups as necessary.
8. After all the histogram groups have been configured as appropriate, click the ***Close*** button to close the ***User: Trend Review Setup*** window.

To Delete a Histogram Group

1. Select ***System > System Setup > Histogram Group***s from the menu bar.

   The ***User: Episode Review Setup*** window opens.
2. Select the group to be deleted in the ***Histogram Groups*** field.
3. Click the ***Delete Group*** button.

   The following window opens.



4. Click ***Yes***.

   The dialog box closes and the selected group is deleted from the ***Histogram Group*** field.
5. Click the ***Save*** button to save your changes.

6. Continue to add, modify, and delete groups as necessary.
7. After all the groups have been configured as appropriate, click the ***Close*** button to close the ***User: Episode Review Setup*** window.

Menus

The ***System: Menu Setup*** window is used to customize the MARS system's application menus. Using this window, you can do the following:

- Create custom page layouts
  You can combine up to three applications per page, allowing you to create pages with related applications in a layout that complements your workflow. For example, you could combine the ***Patient Select*** and ***Patient Information*** windows onto a single page to provide one-click access to all the patient activities.
- Assign an icon to the custom layouts
  You can select any of the existing icons and enter a descriptive name that reflects your institution's terminology.
- Create new menus
  You can create blank menus from scratch or copy existing menus as a starting point.
- Edit menus
  You can add icons to an existing menu, but you cannot delete or rearrange existing icons. Nor can you change a menu's name.
- Delete menus
  You can delete any of the standard or custom menus except for the Tools menu, which is used by the ***System: Menu Setup*** window.

Menus are built from left to right in the order in which the icons are added. Best practice is to build the menu so that the icons appear in the order in which they would be used in the workflow: the icon for the first task should be added first, followed by the icon for the second task, the third task, and so on. For example, the first task in a workflow would typically be to acquire data, followed by selecting a patient, then by editing patient information. These applications should be added to a menu in that order.

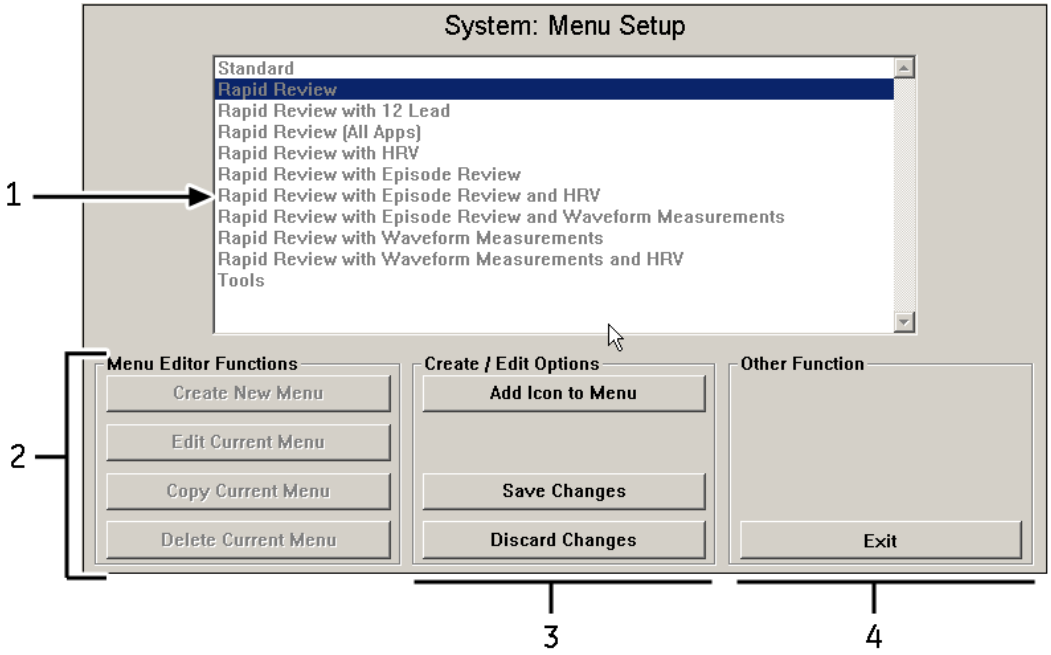
To ensure that your icons are added in the correct sequence, plan your menu before you begin. Consider the workflow for which the menu will be built. Identify the applications that will be needed and the order in which they will be used. Only after you have identified the workflow, the applications, and the correct sequence should you create your custom page layouts and menus.

NOTE:

Icons cannot be removed from a menu; if you need to remove an icon from a menu, you must delete the menu and rebuild it. Therefore, when adding icons to a menu, it is best practice to copy the menu and edit the copy instead of the original. In this way, if you make a mistake and need to delete the menu, you still have the original as a source.

Menu Setup Page Layout

The ***System: Menu Setup*** window is divided into four areas:



1. **Menu List**
   A list of the currently defined menus.
2. **Menu Editor Functions**
   Controls for creating, editing, and deleting menus. Refer to "Menus Controls" on page 56.
3. **Create/Edit Options**
   Controls for creating, saving, and discarding icons. Refer to "Menus Controls" on page 56.
4. **Other Function**
   Control for closing the ***System: Menu Setup*** window.

Menus Controls

The following table describes the controls available for customizing application menus.

Control	Description
Create New Menu	Creates a new blank menu. When you click this button, the ***System: Menu Setup*** window closes and all available icons are displayed in the icon strip along the bottom of the window. You can then build your custom menu from scratch.
Edit Current Menu	Displays the controls in the ***Create/Edit Options*** area. When you click this button, you can add icons to end of the selected menu.

Control	Description
Copy Current Menu	Duplicates the selected menu. When you click this button, you are prompted to enter a name for the new menu. By default, the system appends *[copy]* to end of the selected menu's name, but you can change the name as appropriate. Once a menu is copied, use ***Edit Current Menu*** to add icons to it.
Delete Current Menu	Removes the currently selected menu. When you click this button, you are prompted to confirm that you want to delete the selected menu. You have the option of canceling the deletion.
Add Icon to Menu	Adds icons to the selected menu. When you click this button, the ***System: Menu Setup*** window closes. You can then create new page layouts and icons to add to the menu.
Save Changes	Saves the changes made to the selected menu. When you click this button, you are prompted to enter a name for the edited menu. It defaults to the name of the selected menu, but you can change it. This gives you the choice to either modify the existing menu or create a copy.
Discard Changes	Discards unsaved changes made to the selected menu. When you click this button, you are prompted to confirm that you want to discard the changes.
Quit Menu Editor	Exits the ***System: Menu Setup*** window. When you click this button, you are warned if there are any unsaved changes and given the opportunity to save or discard them before exiting the application.

Configuring Menus

Use the following procedures to create, edit, copy, or delete menus.

To Create or Modify a Menu

The procedure for creating a new menu and modifying an existing menu are nearly identical. Differences between the two procedures are noted where appropriate.

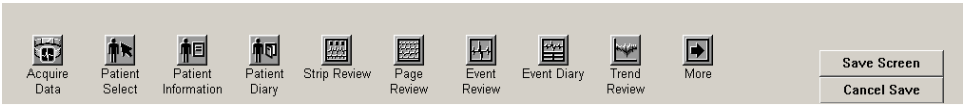
1. Select ***System > System Setup > Menus*** from the menu bar.

   The ***System: Menu Setup*** window opens.

2. Do one of the following:

   - To create a new menu, click the ***Create New Menu*** button.
   - To modify an existing menu, select the menu in the ***Menu List*** and then click the ***Edit Current Menu*** button.

   The ***System: Menu Setup*** window closes, the icon strip displays the available icons from which to choose, and two control buttons become available, as seen in the following illustration.



3. Click the icon of the application you want to add to the menu and drag it to the desired position on the page.

   In the following example, the ***Patient Select*** icon is being dragged to the top third of the page.

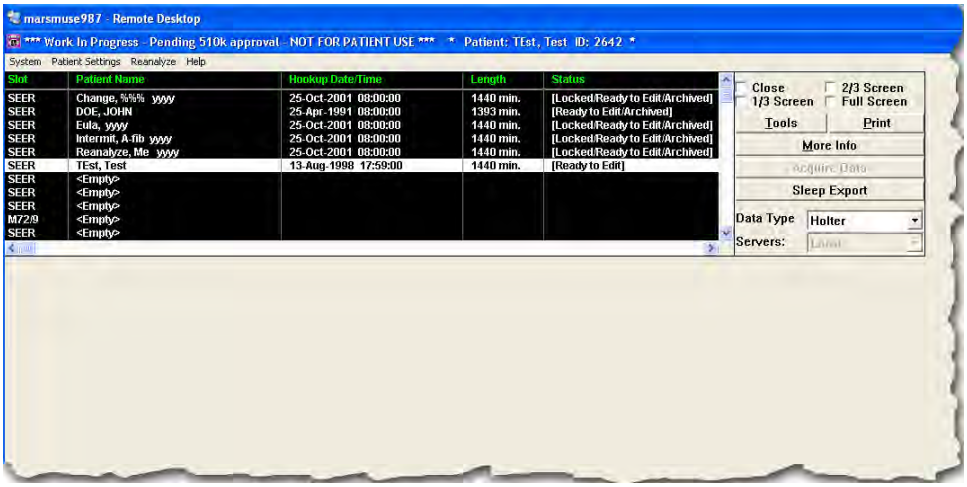
   If the application you want to add to the page is not visible in the icon strip, use the ***More*** icons to scroll through the icon strip until the desired application is visible.

   NOTE:

   Some applications require that a patient be selected. If you try to drag the icon for one of these applications onto the page when no patient is selected, you will receive a warning. If that happens, open the ***Patient Select*** application, select a patient, close the ***Patient Select*** application, and try again to drag the icon.

4. Once the icon is in the correct position, release it.

   The application opens in the selected position, as seen in the following illustration.

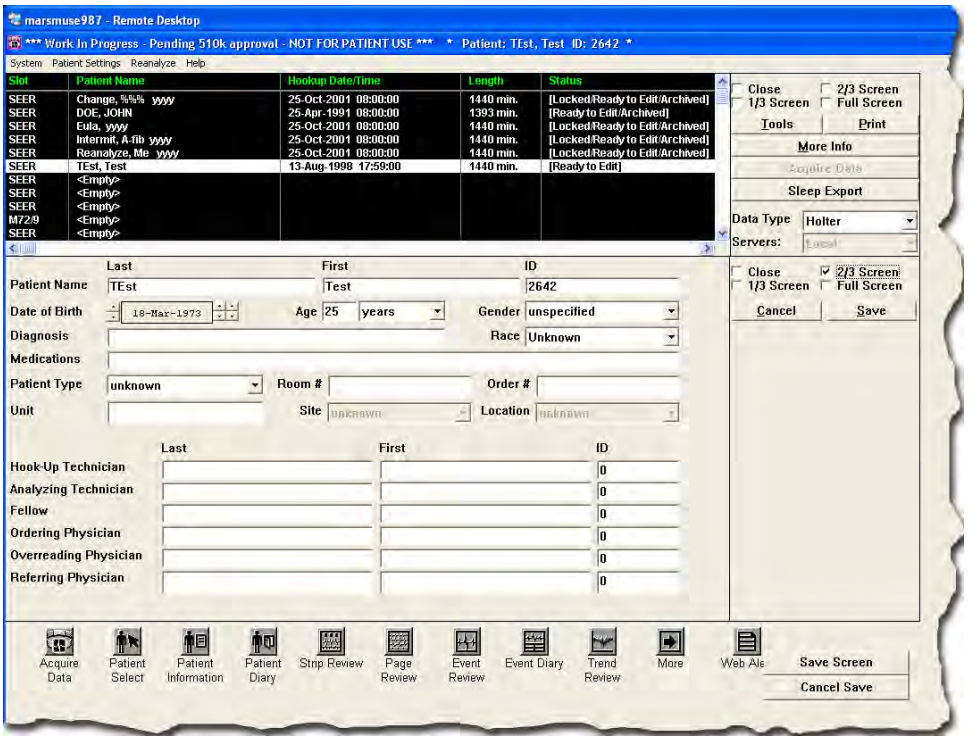


5. Use the page controls to size the application as desired.

   For details, refer to "Control Panel" on page 23.

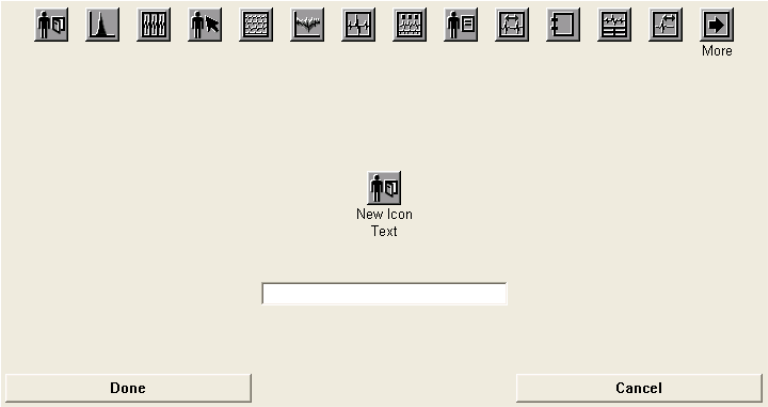
6. Repeat step 3 through step 5 for each application you want to combine.

   In the following illustration, the ***Patient Select*** and ***Patient Information*** applications were combined. The ***Patient Information*** application was resized to fill the bottom 2/3 of the page.



7. Once you have the page layout as you want it, click the ***Save Screen*** button.

   An icon selection window opens.

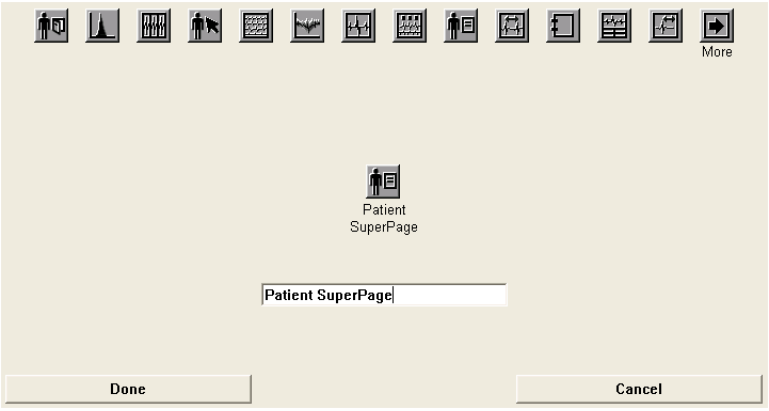


8. Click on the icon you want to use.

   The selected icon appears in the middle of the window. If the desired icon is not visible, use the ***More*** icons to scroll through the list of available icons.

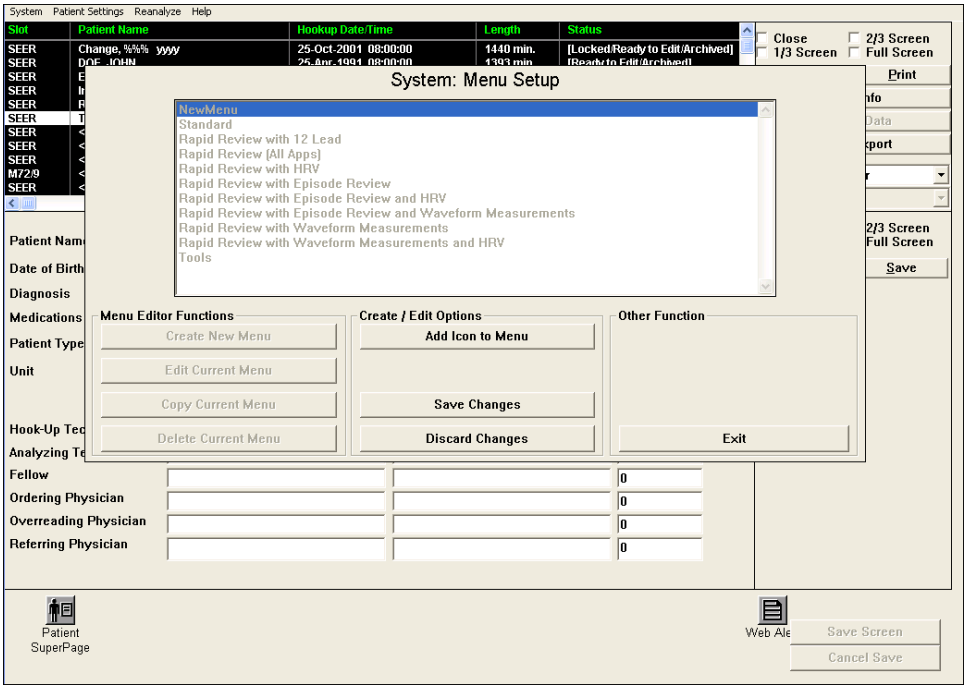
9. Type an appropriate name in the text field.

   Use a name that identifies the intent of the new page layout. In the following example, the selected name is Patient SuperPage, since the new layout can be used to select a patient and to enter patient information on the same page.



10. Once the icon has been selected and an appropriate name has been entered, click ***Done***.

    The icon selection window closes, the ***System: Menu Setup*** window opens, and the menu is selected.

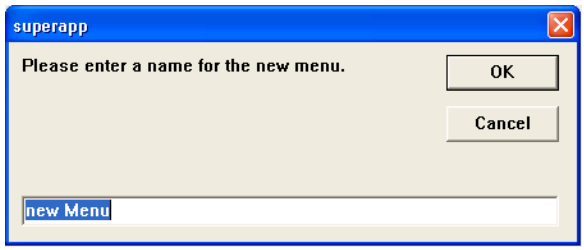


11. To add more icons to the menu, click the ***Add Icon to Menu*** button and repeat from step 3.

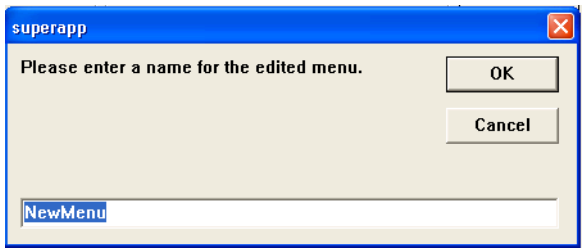
12. When you are done adding icons to the menu, click the ***Save Changes*** button.

    One of two things happens.

    - If you are creating a menu, the following dialog box opens.



    - If you are modifying a menu, the following dialog box opens.



13. Enter a descriptive name for the menu and click ***OK***.

    The dialog box closes.

14. Do one of the following:

    - To create or modify another menu, repeat from step 2.
    - To copy a menu, see "To Copy a Menu" on page 61.
    - To delete a menu, see "To Delete a Menu" on page 62.
    - To close the ***System: Menu Setup*** window, click ***Exit***.

To Copy a Menu

1. Select ***System > System Setup > Menus*** from the menu bar.

   The ***System: Menu Setup*** window opens.

2. In the ***Menu List***, select the menu to be copied and click the ***Copy Current Menu*** button.

   The following dialog box opens.

3. Enter a descriptive name for the menu and click ***OK***.

   The dialog box closes. The copied menu is selected in the ***Menu List***.

4. Do one of the following:
   - To copy another menu, repeat from step 2.
   - To add icons to the menu, see "To Create or Modify a Menu" on page 57.
   - To delete a menu, see "To Delete a Menu" on page 62.
   - To close the ***System: Menu Setup*** window, click ***Exit***.

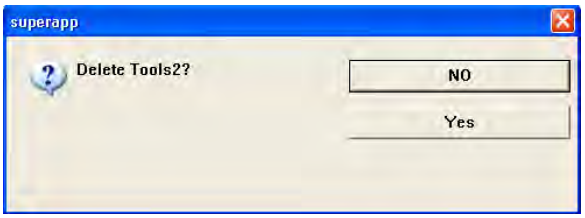
To Delete a Menu

1. Select ***System > System Setup > Menus*** from the menu bar.

   The ***System: Menu Setup*** window opens.

2. In the ***Menu List***, select the menu to be deleted.
3. Click the ***Delete Current Menu*** button.

   The following dialog box opens.



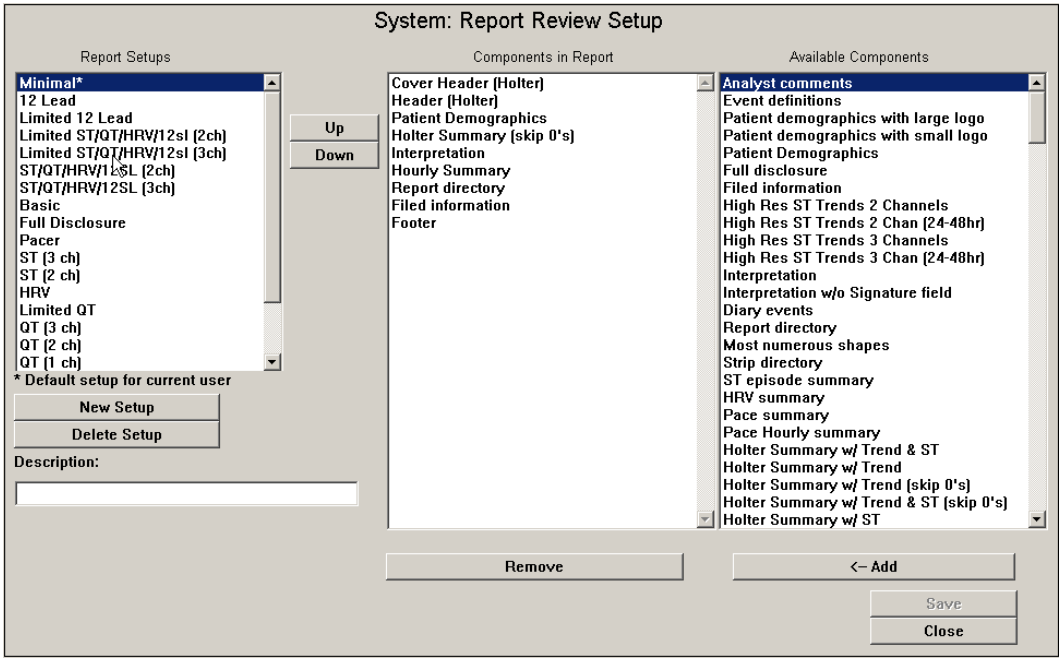
4. Click ***Yes***.

   The selected menu is removed from the ***Menu List***.

5. Do one of the following.
   - To delete another menu, repeat from step 2.
   - To create or modify a menu, see "To Create or Modify a Menu" on page 57.
   - To copy a menu, see "To Copy a Menu" on page 61.
   - To close the ***System: Menu Setup*** window, click ***Exit***.

Report Configuration

The ***System: Report Review Setup*** window is used to customize the standard Holter Report formats or create new formats. You select which report components will be printed in the report and the order in which they appear.



For information on using the reports after they have been configured, refer to Chapter 8, “Printing the Final Report”.

Report Configuration Field Descriptions

The following table identifies the fields available on the ***System: Report Review Setup*** window.

Field	Description
Report Setups	Lists the report formats that have already been defined. The default format is marked with an asterisk (*).
Description	Describes the selected report in more detail. Optional field to provide additional information about the report.
Components in Report	Lists the report components that have already been added to the selected report format. Components print in the order in which they appear in the list.
Available Components	Lists all the available report components.

Report Configuration Controls

The following table lists the controls available for configuring Holter report formats.

Control	Description
New Setup	Creates a new report format and sets it as the default.
Delete Setup	Deletes the selected report. **NOTE:** You cannot delete the default report format. If you want to delete the default format, you must first change the default to a different format.
Up	Moves the selected component up in the ***Components in Report*** field. Use in conjunction with the ***Down*** button to set the order in which a format's components print.
Down	Moves the select component down in the ***Components in Report*** field. Use in conjunction with the ***Up*** button to set the order in which a format's components print.
Remove	Deletes the selected component from the ***Components in Report*** field.
<— Add	Copies the selected component from the ***Available Components*** field to the ***Components in Report*** field.
Save	Saves your changes. Not available until changes have been made.
Close	Closes the ***System: Report Review Setup*** window. If you have not saved your changes, you will receive a warning and asked whether to discard your changes.

Configuring Reports

Use the following procedures to create, modify, and delete Holter report formats. In addition, you can add a customized logo that will be displayed on all Holter reports.

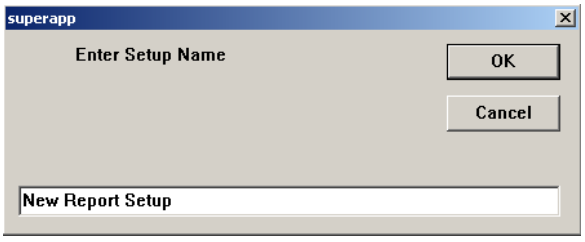
To Create a Report Format

1. Select ***System*** > ***System Setup*** > ***Report Configuration*** from the menu bar.

   The ***System: Report Review Setup*** window opens.

2. Click the ***New Setup*** button.

   The following dialog box opens.



3. Enter a name for the new format and click ***OK***.

The dialog box closes. The blank report is added to the Report Setups field and set as the default report. See "To Modify a Report Format", following, for instructions on adding components.

To Modify a Report Format

1. Select ***System > System Setup > Report Configuration*** from the menu bar.

   The ***System: Report Review Setup*** window opens.

   NOTE:
   If you are editing a report just created, this step is not necessary.

2. In the ***Report Setups*** field, select the report to modify.

   The format's components are displayed in the ***Components in Report*** field.

3. To add components to the report, select the component in the ***Available Components*** field and click the ***<— Add*** button.

   The component is added to the end of the ***Components in Report*** field.

4. To rearrange the order of a component on the report, select the component in the ***Components in Report*** field and do either of the following:

   - To move the component up in the report, click the ***Up*** button.
   - To move the component down in the report, click the ***Down*** button.

   Continue clicking the ***Up*** and ***Down*** buttons until the component is in the desired location.

5. To delete a component from the report, select the component in the ***Components in Report*** field and click the ***Remove*** button.

   The component is removed from the list.

6. Continue to add, rearrange, and delete components until the report contains all desired components in the correct sequence.

7. Once the format is as desired, click the ***Save*** button.

   The report format is saved and the ***Save*** button is greyed out.

8. Do one of the following:

   - To modify another report, repeat from step 2.
   - To add a new report, see "To Create a Report Format" on page 64.
   - To delete a report, see "To Delete a Report Format" on page 66.
   - To close the ***System: Report Review Setup*** window, click the ***Close*** button.

To Delete a Report Format

You cannot delete the default report format. If you want to delete the default format, you must first change the default to another format. For instructions on setting the default format, refer to Chapter 8, "Printing the Final Report".

1. Select ***System > System Setup > Report Configuration*** from the menu bar.

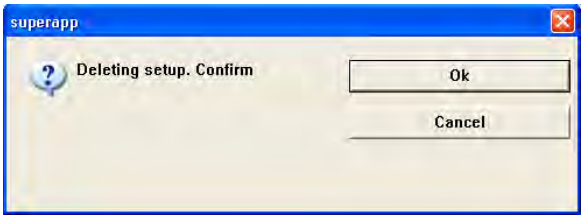
   The ***System: Report Review Setup*** window opens.

2. In the ***Report Setups*** field, select the report to delete.

   The format's components are displayed in the ***Components in Report*** field.

3. Click the ***Delete Setup*** button.

   The following dialog box opens.



4. Click ***OK***.

   The report is removed from the ***Report Setups*** field.

5. Do one of the following:

   - To delete another report, repeat from step 2.
   - To create a report, see "To Create a Report Format" on page 64.
   - To modify a report, see "To Modify a Report Format" on page 65.
   - To close the ***System: Report Review Setup*** window, click the ***Close*** button.

To Add a Custom Logo to Reports

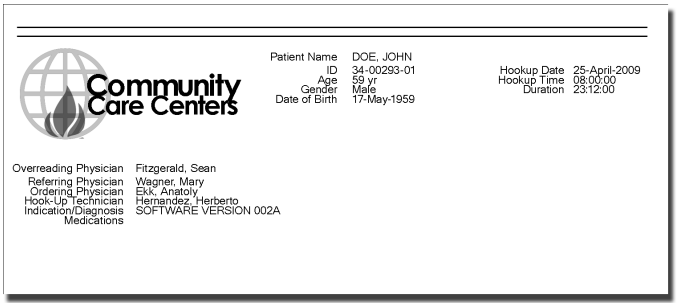
Two of the report components—***Patient Demographics with Large Logo*** and ***Patient Demographics with Small Logo***—allow you to add a custom logo to your reports. Use the following procedure to add the logos that will be used by these components.

1. Create a logo that meets the following requirements.

	Patient Demographics with Large Logo	***Patient Demographics with Small Logo***
File Type	Bitmap	Bitmap
Dimensions	2.125 inches x 1.5 inches 5.3975 cm x 3.81 cm	2.125 inches x 0.75 inches 5.3975 cm x 1.905 cm
Name	large_logo.bmp	small_logo.bmp

2. Save the file(s) to ***x\gemsit\var\MarsNT\system***, where ***x:*** is the drive where the MARS system is installed.

   When you add the ***Patient demographics with large logo*** and ***Patient demographics with small logo*** components, the logo will be displayed on the report, as seen in the following illustration.

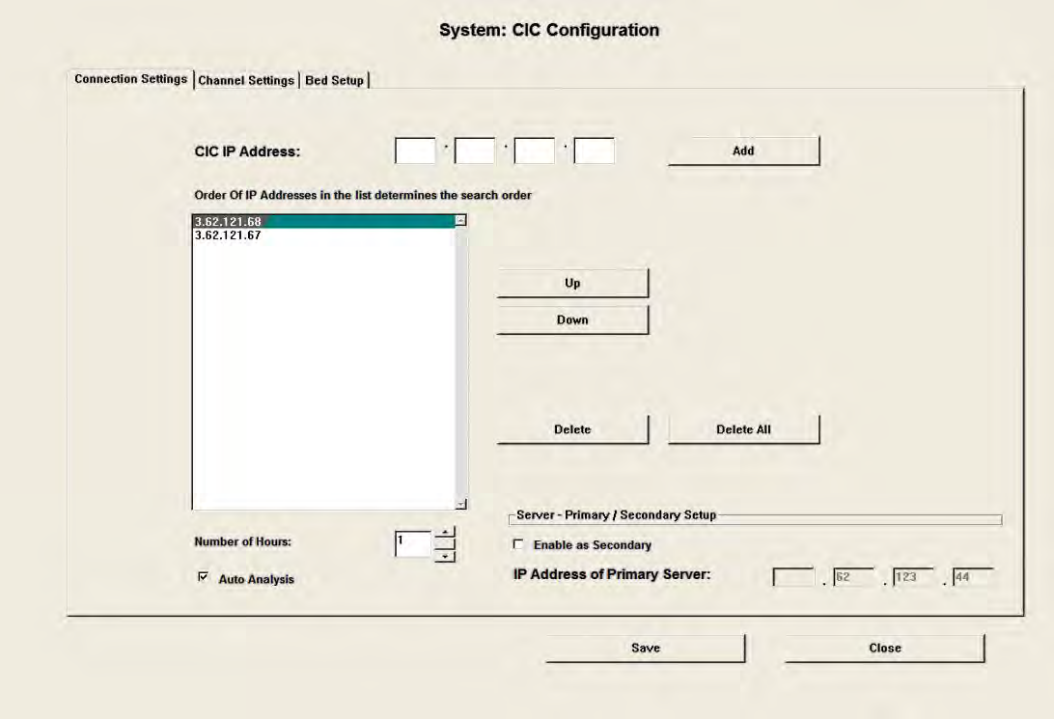


CIC Configuration

The ***System: CIC Configuration*** window is used to establish connections to Clinical Information Centers (CICs) that are on your system network.

In addition, if you will be setting up more than one MARS server, you must also identify which will be the primary server and which will be secondary servers. The primary MARS server contains the ***ciclimit.ini*** file. This file lists each CIC being accessed and the MARS clients accessing them. Each time a MARS client wants to connect to a CIC, it checks the ***ciclimit.ini*** file to determine whether the maximum number of connections has been reached. If the maximum number has not been reached, the MARS client is added to the ***ciclimit.ini*** and the connection to the CIC is established; when the connection is complete, the MARS client is removed from the ini file. If the maximum number of connections has been reached, the connection is disallowed and a message is displayed. The secondary MARS servers contain the ***cic.ini*** file, which redirects clients to the primary server and ciclimit.ini file.

Once the primary and secondary servers have been identified and the CIC connections established, you can acquire ECG data from the patient monitors connected to those CICs. Refer to Chapter 5, "CIC Acquisition", for more information.



The window is divided into three tabs:

- **Connection Settings**
  Identifies the IP information of the available CICs and sets their search order.
- **Channel Settings**
  Selects the ECG channels that will be acquired from the CICs.
- **Bed Setup**
  Selects the bedside monitors from which data will be acquired.

CIC Configuration Field Descriptions

The following tables describe the fields available on each tab of the ***System: CIC Configuration*** window.

Connection Settings Tab

The following table describes the fields on the ***Connection Settings Tab*** of the ***System: CIC Configuration*** window.

Fields	Description
CIC IP Address	The IP (Internet Protocol) address of the CIC.
Order of IP Addresses	List of CIC addresses that have been added to the MARS system. The first CIC in the list is the primary CIC the MARS system will use; any others are used only if the MARS system cannot connect to the first for whatever reason. Under those circumstances, the MARS system will use the next CIC in the list and so on down the list until it makes a connection.
Number of Hours	Defines the number of hours of ECG data to acquire. It defaults to 24 hours, but you can change it to any quantity from 1 to 76.
Auto Analysis	Determines whether the MARS system will automatically analyze the data as it is acquired. It is checked by default.
Enable as Secondary	Selects the current MARS server as a secondary server. Not available on MARS Clients or Standalone systems. When you select this check box, you must also enter a value in the ***IP Address of the Primary MARS Server***.
IP Address of Primary MARS Server	Identifies the IP address of the primary MARS server. The primary MARS server contains the ***ciclimit.ini*** file used to limit the number of simultaneous connections to a single CIC. This field is not available if the ***Enable as Secondary*** field is not checked.

Channel Settings Tab

The following table describes the fields on the ***Channel Settings Tab*** of the ***System: CIC Configuration*** window.

Fields	Description
Available Channels	List of ECG channels that are available for acquisition.
Selected Channels	List of ECG channels that have been selected for acquisition.

Bed Setup Tab

The following table describes the fields on the ***Bed Setup Tab*** of the ***System: CIC Configuration*** window.

Fields	Description
Available Beds	List of bedside monitors that are available for acquisition.
Selected Beds	List of bedside monitors that have been selected for acquisition.

CIC Configuration Controls

The following table describes the controls that are available for configuring your CIC connections.

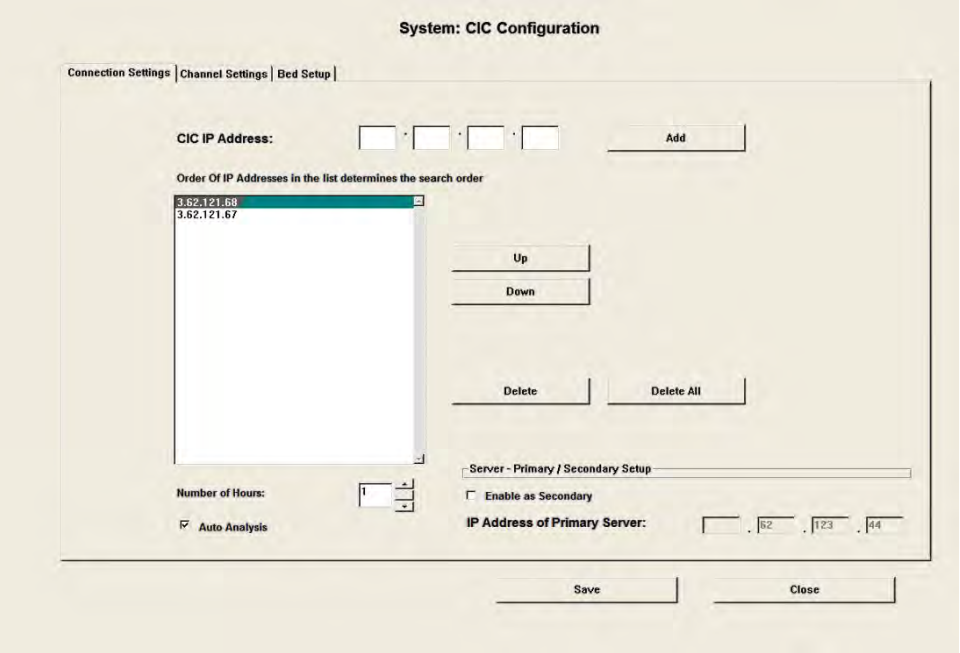
Controls	Description
Add	Moves the address entered in the ***CIC IP Address*** to the ***Order of IP Addresses***. Available on the ***Connection Settings*** tab.
Up	Moves the selected CIC IP address up in the ***Order of IP Addresses***. Used in conjunction with the ***Down*** button to rearrange the CIC search order. Available on the ***Connection Settings*** tab.
Down	Moves the selected CIC IP address down in the ***Order of IP Addresses***. Used in conjunction with the ***Up*** button to rearrange the CIC search order. Available on the ***Connection Settings*** tab.
Delete	Removes the selected CIC IP address from the ***Order of IP Addresses*** field. Available on the ***Connection Settings*** tab.
Delete All	Removes all CIC IP addresses from the ***Order of IP Addresses*** field. Available on the ***Connection Settings*** tab.
Select—>	Copies the selected item from the ***Available Channels*** or ***Available Beds*** field to the ***Selected Channels*** or ***Selected Beds*** field. Available on the ***Channel Settings*** and ***Bed Setup*** tabs.
Remove	Removes the selected item from the ***Selected Channels*** or ***Selected Beds*** field. Available on the ***Channel Settings*** and ***Bed Setup*** tabs.
Remove All	Removes all items from the ***Selected Channels*** or ***Selected Beds*** field. Available on the ***Channel Settings*** and ***Bed Setup*** tabs.

Controls	Description
Select Channels for Sleep Apnea—>	Adds the following channels used for sleep apnea studies to the ***Selected Channels*** field: • ECG_I • ECG_II • ECG_III • ECG_V1 • RR_P • RR_W • SP02_P • SP02_W • ETC02_W **NOTE:** Not all the fields are required. The sleep apnea study requires only one RR, one SPO2, and one ECG field. Available on the ***Channel Settings*** tab. Refer to Appendix G, "Sleep Export", for more information.
Save	Saves your changes to the CIC configuration. Available on all tabs.
Close	Closes the ***System: CIC Configuration*** window. Available on all tabs.

Configuring CIC Connections

Use the following procedures to configure your CIC address, acquisition channels, and bedside monitors.

To Add an IP Address



1. Select ***System > System Setup > CIC Configuration*** from the menu bar.

   The ***System: CIC Configuration*** window opens. The ***Connection Settings*** tab is selected by default.

2. Type the IP address of a CIC in the ***CIC IP Address*** field.

3. Click the ***Add*** button.

   The IP Address is appended to the end of the ***Order of IP Address*** field.

4. Repeat step 2 and step 3 until all the CIC address have been added to the list.

5. Set the ***Number of Hours*** field.

   Refer to "CIC Configuration Field Descriptions" on page 69 for a description of this field.

6. Set the ***Auto Analysis*** check box.

   Refer to "CIC Configuration Field Descriptions" on page 69 for a description of this field.

7. Click the ***Save*** button.

   A dialog box opens to ask whether you want to save your settings.

8. Click ***Yes***.

   A dialog box opens to notify you that your settings have been saved.

9. Click ***OK***.

   The dialog box closes. You can now modify the search order, select the ECG channels to acquire, or select the bedside monitors from which to acquire data.

To Modify the IP Address List

1. Select ***System > System Setup > CIC Configuration*** from the menu bar.

   The ***System: CIC Configuration*** window opens. The ***Connection Settings*** tab is selected by default.

2. To change the order in which the MARS system searches the CICs, do the following:

   a. Select the address in the ***Order of IP Addresses*** field.

   b. Click the ***Up*** button to move the address toward the top of the list.

   c. Click the ***Down*** button to move the address toward the bottom of the list.

   d. Continue to use the ***Up*** and ***Down*** buttons until the address is in the desired position.

   e. Repeat for each address until the CICs are in the desired search order.

3. To remove a single address from the ***Order of IP Addresses*** field, do the following:

   a. Select the address in the ***Order of IP Addresses*** field.

   b. Click the ***Delete*** button.

      A dialog box opens and asks if you are sure you want to delete the selected server.

   c. Click ***OK***.

      The selected address is removed from the field.

   d. Repeat for each address you want to remove.

4. To remove all addresses from the ***Order of IP Addresses*** field, do the following:

   a. Click the ***Remove All*** button.

      A dialog box opens and asks if you are sure you want to delete the selected server.

   b. Click ***OK***.

      All the addresses are removed from the field.

5. When you are done modifying the ***Order of IP Addresses*** field, click the ***Save*** button.

   A dialog box opens to ask whether you want to save your settings.

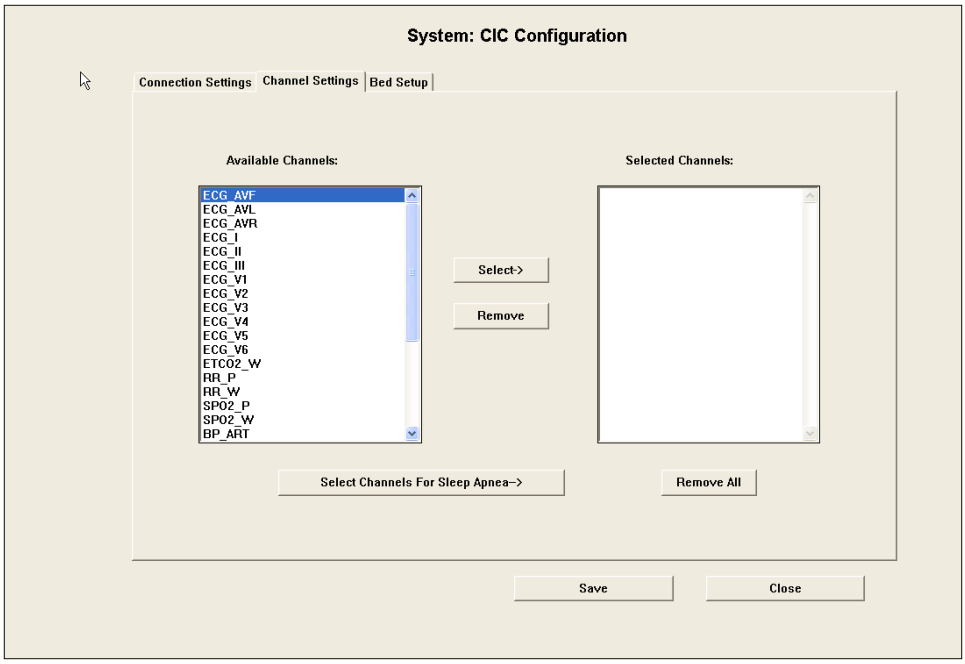
6. Click ***Yes***.

   A dialog box opens to notify you that your settings have been saved.

7. Click ***OK***.

   The dialog box closes. You can now modify or add a new IP address, select the ECG channels to acquire, or select the bedside monitors from which to acquire data.

To Select ECG Channels



1. Select ***System > System Setup > CIC Configuration*** from the menu bar.

   The ***System: CIC Configuration*** window opens. The ***Connection Settings*** tab is selected by default.

2. Select the ***Channel Settings*** tab.

3. To select the CIC channels to acquire, do the following:

   a. In the ***Available Channels*** field, select the channel to be acquired from the CIC.

   b. Click the ***Select—>*** button.

      The channel is moved to the ***Selected Channels*** field.

   c. Repeat for each channel you want to acquire.

4. To acquire only those channels required for a sleep apnea study, click the ***Select Channels for Sleep Apnea—>*** button.

   The ***Selected Channels*** field is cleared, then the required sleep apnea channels are moved to the field. For a list of these channels, refer to "CIC Configuration Field Descriptions" on page 69.

5. To remove a single channel from acquisition, do the following:

   a. Select the channel in the ***Selected Channels*** field.

   b. Click the ***Remove*** button.

      The channel is removed from the field.

   c. Repeat for each channel you want to remove.

6. To remove all channels from acquisition, do the following:
   a. Click the ***Remove All*** button.

      A dialog box opens to ask if you want to remove all channels.

   b. Click ***OK***.

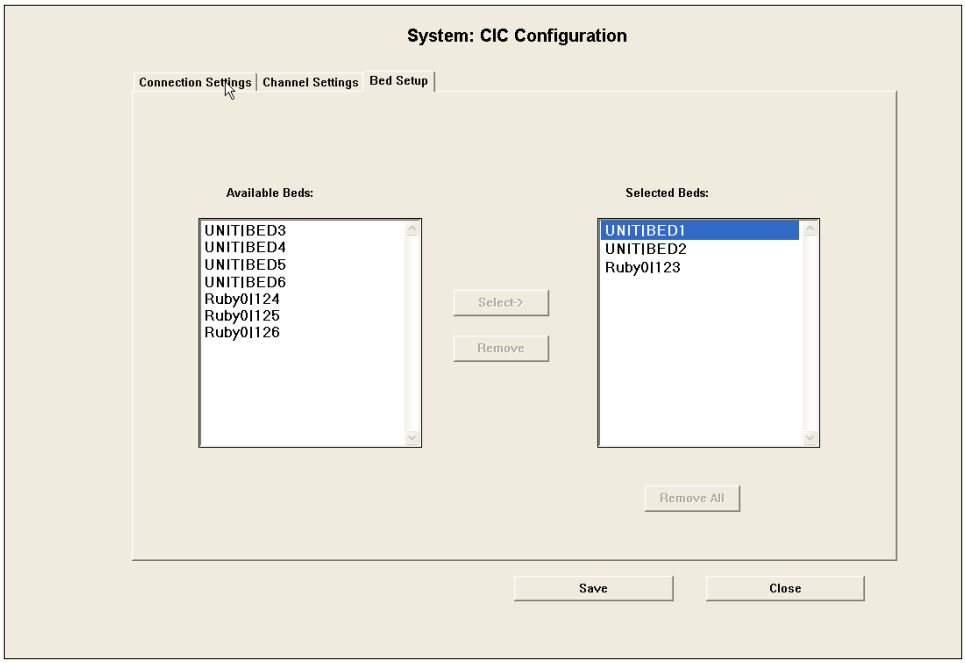
      The dialog box closes and all the channels are removed from the field.
7. After you have selected all the channels to acquire, click the ***Save*** button.

   A dialog box opens to ask whether you want to save your settings.
8. Click ***Yes***.

   A dialog box opens to notify you that your settings have been saved.
9. Click ***OK***.

   The dialog box closes. You can now modify or add a new IP address, select the ECG channels to acquire, or select the bedside monitors from which to acquire data.

To Select Bedside Monitors



1. Select ***System > System Setup > CIC Configuration*** from the menu bar.

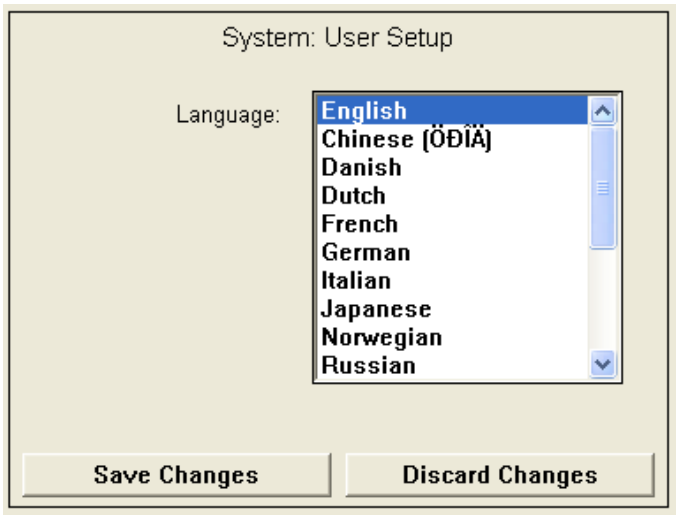
   The ***System: CIC Configuration*** window opens. The ***Connection Settings*** tab is selected by default.
2. Select the ***Beds Setup*** tab.
3. To select the beds from which to acquire data, do the following:
   a. In the ***Available Beds*** field, select the bed to acquire data from.
   b. Click the ***Select—>*** button.

      The bed is moved to the ***Selected Beds*** field.
   c. Repeat for each bed you want to acquire data from.

4. To remove a single bed from acquisition, do the following:
   a. Select the bed in the ***Selected Beds*** field.
   b. Click the ***Remove*** button.
      The bed is removed from the field.
   c. Repeat for each bed you want to remove.
5. To remove all beds from acquisition, do the following:
   a. Click the ***Remove All*** button.
      A dialog box opens to ask if you want to remove all beds.
   b. Click ***OK***.
      The dialog box closes and all the beds are removed from the field.
6. When you have selected all the beds to be acquired from, click the ***Save*** button.
   A dialog box opens to ask whether you want to save your settings.
7. Click ***Yes***.
   A dialog box opens to notify you that your settings have been saved.
8. Click ***OK***.
   The dialog box closes. You can now modify or add a new IP address, select the ECG channels to acquire, or select the bedside monitors from which to acquire data.

Language

The ***System: User Setup*** window is used to select the language used by the MARS Ambulatory ECG System. Once a language is selected, all screens and reports will use the selected language.



NOTE:

Changing the system language will shut down the MARS system. The selected language will be activated the next time the MARS system boots up.

Language Field Descriptions

The following table describes the fields available on the ***System: User Setup*** window.

Field	Description
Language	Lists the languages available for selection. Languages are: • Chinese ÖÐÌÄ • Czech • Danish • Dutch • English • Finnish • French • German • Hungarian • Italian • Japanese • Korean • Norwegian • Polish • Portuguese • Russian • Spanish • Swedish

Language Controls

The following table describes the controls available on the ***System: User Setup*** window.

Controls	Description
Save Changes	Changes the system language to the language selected in the ***Language*** field.
Discard Changes	Closes the ***System: User Setup*** window without changing the system language.

Changing the System Language

Use the following procedure to change the system language.

1. Select ***System > System Setup > Language*** from the menu bar.

   The ***System: User Setup*** window opens.

2. Select the desired language in the ***Language*** field.

3. Click the ***Save Changes*** button.

   A dialog box opens to notify you that the system language is being changed to the selected language.

4. Click ***OK***.

   The MARS system shuts down.

5. Restart the MARS system for the new language to go into effect.

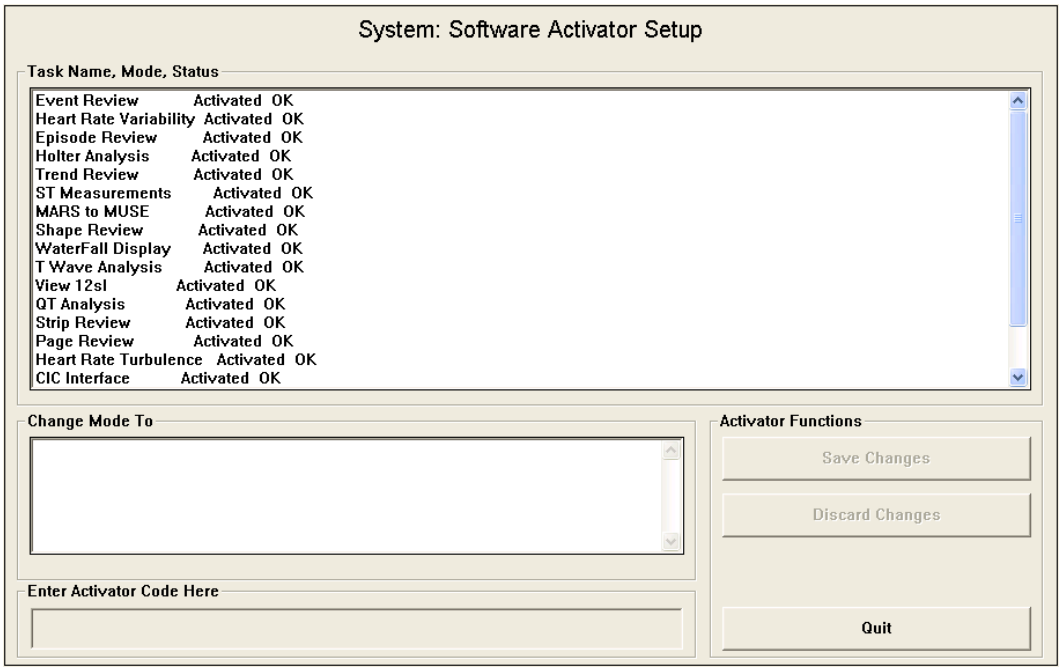
   For instructions on restarting the MARS system, see "To Power On the MARS System" on page 19.

Software Activators

The ***System: Software Activator Setup*** window is used to review, activate, and deactivate the MARS system software options. Some options are included with the core system and are activated by default. Others can be purchased and are activated by entering an activation code.

NOTE:

Be careful when using the ***System: Software Activator Setup*** window. Modifications to options and option codes may result in those features not functioning in the MARS system.



For a list of the available options, refer to "System Features" on page 12.

Software Activator Field Descriptions

The following table describes the fields available on the ***System: Software Activator Setup*** window.

Field	Description
Task Name, Mode, Status	Lists the tasks (software options) available on the system and indicates their current mode and status. Select a task in this field to change its mode.
Change Mode To	Toggles the selected task between ***Activated*** and ***Disabled***.
Enter Activator Code Here	Records the selected task's activation code.

Software Activator Controls

The following table describes the controls available on the ***System: Software Activator Setup*** window.

Control	Description
Save Changes	Saves the change made to the selected task.
Discard Changes	Discards the change made to the selected task.
Quit	Closes the ***System: Software Activator Setup*** window.

Maintaining Software Options

Use the following procedures to activate or disable software options.

To Activate a Software Option

1. Select ***System > System Setup > Software Activators*** on the menu bar.

   The ***System: Software Activator Setup*** window opens.
2. Select the option to be activated in the ***Task Name, Mode, Status*** field.
3. Select ***Activated*** in the ***Change Mode To*** field.
4. Enter the activation code in the ***Enter Activator Code Here*** field.

   You receive the activation code when you purchase the option. Keep this code safe in case you need to reactivate it at a later date.
5. Click the ***Save Changes*** button.
6. Repeat step 2 through step 5 for each option you purchased.
7. When you are done activating your options, click ***Quit*** to close the ***System: Software Activator Setup*** window.

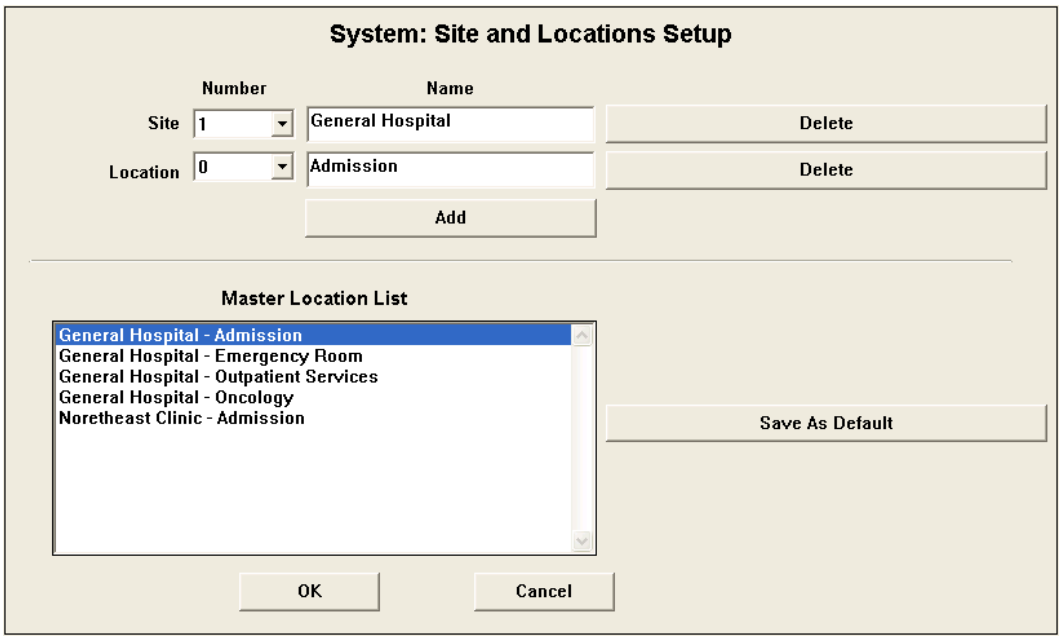
To Disable a Software Option

1. Select ***System > System Setup > Software Activators*** on the menu bar.

   The ***System: Software Activator Setup*** window opens.
2. Select the option to be disabled in the ***Task Name, Mode, Status*** field.
3. Select ***Disabled*** in the ***Change Mode To*** field.
4. Click the ***Save Changes*** button.
5. Repeat step 2 through step 4 for each option you want to disable.
6. When you are done disabling options, click ***Quit*** to close the ***System: Software Activator Setup*** window.

Site

The ***System: Site and Locations Setup*** window is used to maintain the sites and locations where Holters may be hooked up to patients.



Typically, sites represent different facilities, such as a hospital's main campus, individual clinics, and doctors' offices. Similarly, locations typically represent departments within those facilities, such as the Emergency Room, Outpatient Services, Heart Center, and so on. Sites and locations are recorded on the patient's information and can be displayed on the Holter reports.

If the MARS system is used independently of any other system, you can enter any site and location numbers. However, if the MARS system is to be used in conjunction with the GE Healthcare MUSE Cardiology Information System, the site and location numbers used by the MARS system should match those used by the MUSE system. If specific Holter locations are not defined in the MUSE system, it is recommended you add them to that system before you define them in the MARS System. Once the sites and locations are established in the MUSE system, print the site and location setups from the MUSE system and use the printout as a reference.

Site Field Descriptions

The following table describes the fields on the ***System: Site and Locations Setup*** window.

Field	Description
Site Number	Select an ID to associate with a site. Valid site numbers are 1 to 254.
Site Name	Enter a descriptive name for the site. You can enter up to 32 characters, including spaces.
Location Number	Select an ID to associate with a location. Valid location numbers are 0 to 65534.

Field	Description
Location Name	Enter a descriptive name for the location. You can enter up to 32 characters, including spaces.
Master Location List	Lists the locations that have already been added to the system. Locations are grouped by site and displayed in this format: Site Name - Location Name. Example: *Community Care Center - Emergency Room*.

Site Controls

The following table describes the controls available when setting up your sites and locations.

Control	Description
Delete	Deletes the selected site or location. If you delete a site, all locations associated with that site are also deleted.
Add	Adds the new Site/Location combination to the ***Master Location List***.
Save as Default	Saves the location selected in the ***Master Location List*** as the default location.
OK	Saves any changes made to the Master Location list.
Cancel	Closes the ***System: Site and Locations Setup*** window. Any unsaved changes will be lost.

Setting Up Sites and Locations

Use the following procedure to set up your sites and locations.

1. Select ***System > System Setup > Site*** from the menu bar.

   The ***System: Site and Locations Setup*** window opens.

2. To add a site and location, do the following:

   a. Select an available number from the ***Site Number*** field.

   b. Type a descriptive name in the ***Site Name*** field.

   c. Select an available number from the ***Location Number*** field.

   d. Type a descriptive name in the ***Location Name*** field.

   e. Click the ***Add*** button.

      The site and location are added to the ***Master Location List***.

   f. To add another location to the current site, repeat from step c.

   g. To add a location to a new site, repeat from step a

3. To set a location as the default, select the location in the ***Master Location List*** and click ***Save As Default***.

4. To remove a location, do the following:
   a. Select the location in the ***Master Location List***.

      The site and location are displayed in the site and location fields at the top of the window.

   b. Click the ***Delete*** button to the right of the location.

      A dialog box opens to ask if you want to delete the location.

   c. Click ***Yes***.

      The location is removed from the ***Master Location List***.

   d. Repeat from step a for each location you want to remove.
5. To delete a site, do the following:
   a. Select the location in the ***Master Location List***.

      The site and location are displayed in the fields at the top of the window.

   b. Click the ***Delete*** button to the right of the site.

      A dialog box opens to ask if you want to delete the site and all associated locations.

   c. Click ***Yes***.

      The site and all of its locations are removed from the ***Master Location List***.

   d. Repeat from step a for each site you want to remove.
6. To save your sites and locations, do the following:
   a. Click ***OK***.

      A dialog box opens to ask if you want to save your changes.

   b. Click ***Yes***.

      The dialog box closes and the changes are saved.
7. To close the ***System: Site and Locations Setup*** window, do the following:
   a. Click ***Cancel***.

      One of two things happens:

      - If no changes have been made since the last save, the ***System: Site and Locations Setup*** window closes.
      - If changes have been made but not saved, a dialog box opens to ask if you want to discard the unsaved changes.

   b. If the dialog box opens, do one of the following:

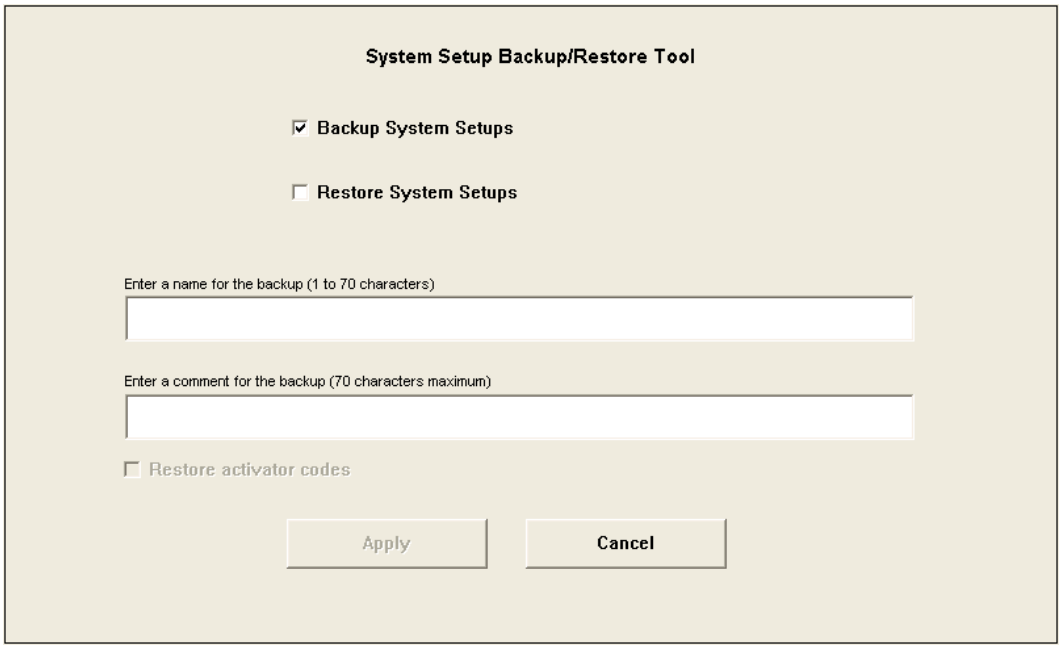
      - To continue without saving your data, click ***Yes***.
        The changes are discarded and the ***System: Site and Locations Setup*** window closes.
      - To save the data before closing the window, click ***No***.
        The dialog box closes and returns you to the ***System: Site and Locations Setup*** window so you can save your data. Refer to step 6 for instructions on how to save your data.

Backup and Restore

The ***System Setup Backup/Restore Tool*** is used to back up and restore the MARS system configuration. This ensures that you can quickly and easily get the MARS system up and running if you ever need to reinstall the MARS application. You can also use the tool to back up the configuration from one MARS system and restore it to other MARS systems; this provides a quick and easy way to configure multiple systems.

NOTE:

This only backs up system configuration files. It does not back up patient data. For information on backing up patient data, refer to Chapter 9, "Storing Patient Data".



Backup/Restore Field Descriptions

The following table describes the fields available on the ***System Setup Backup/Restore Tool*** window.

Field	Description
Backup System Setups	Sets the tool to backup mode. When this check box is selected, the tool will back up the MARS configuration. You cannot select both this field and the ***Restore System Setups*** field.
Restore System Setups	Sets the tool to restore mode. When this check box is selected, the tool will restore the MARS configuration. You cannot select both this field and the ***Backup System Setups*** field.
Enter a name for the backup	Sets the name of the backup file. You can enter up to 70 letters or numbers. Dashes, underscores, and spaces are not allowed. Available only if the ***Backup System Setups*** field is set.

Field	Description
Enter a comment for the backup	Provides additional information about the backup file. You can enter up to 70 characters. Dashes, underscores, and spaces are allowed. Available only if the ***Backup System Setups*** field is set.
Restore activator codes	Determines whether the software activation codes will be restored with the configuration. Available only if the ***Restore System Setups*** field is set.

Backup/Restore Controls

The following table describes the controls available on the ***System Setup Backup/Restore Tool***.

Control	Description
Apply	Initiates the backup or restore process.
Cancel	Closes the ***System Setup Backup/Restore Tool***.

Managing System Backups

Use the following procedures to back up and restore your MARS configuration.

To Back Up the MARS Configuration

1. Select ***System > System Setup > Backup and Restore*** from the menu bar.

   The ***System Setup Backup/Restore Tool*** opens.

2. Set the ***Backup System Setups*** check box.

   The ***Enter a name for the backup*** and ***Enter a comment for the backup*** fields open.

3. Enter a name and optional comment for the backup.

   The ***Apply*** button becomes available after you enter a name for the backup.

4. Click ***Apply***.

   The ***Browse for Folder*** dialog box opens.

5. Browse to the folder where you want to save the backup file and click ***OK***.

   A dialog box opens to confirm the location.

6. Click ***OK***.

   When the backup file is saved, a dialog box confirms the file was saved successfully.

7. Click ***OK***.

   The dialog box and ***System Setup Backup/Restore Tool*** close.

To Restore the MARS Configuration

1. Select ***System > System Setup > Backup and Restore*** from the menu bar.

   The ***System Setup Backup/Restore Tool*** opens.

2. Set the ***Restore System Setups*** check box.

   The ***Restore activator codes*** field becomes available.

3. Set the ***Restore activator codes*** check box.

   NOTE:
   Set the ***Restore activator codes*** field ONLY if you are restoring a backup file to the same system on which the backup was created. If you are restoring the backup to a different MARS system, the activator codes will not work.

4. Click ***Apply***.

   The ***Browse for Folder*** dialog box opens.

5. Locate and select the backup file.

6. Click ***Open***.

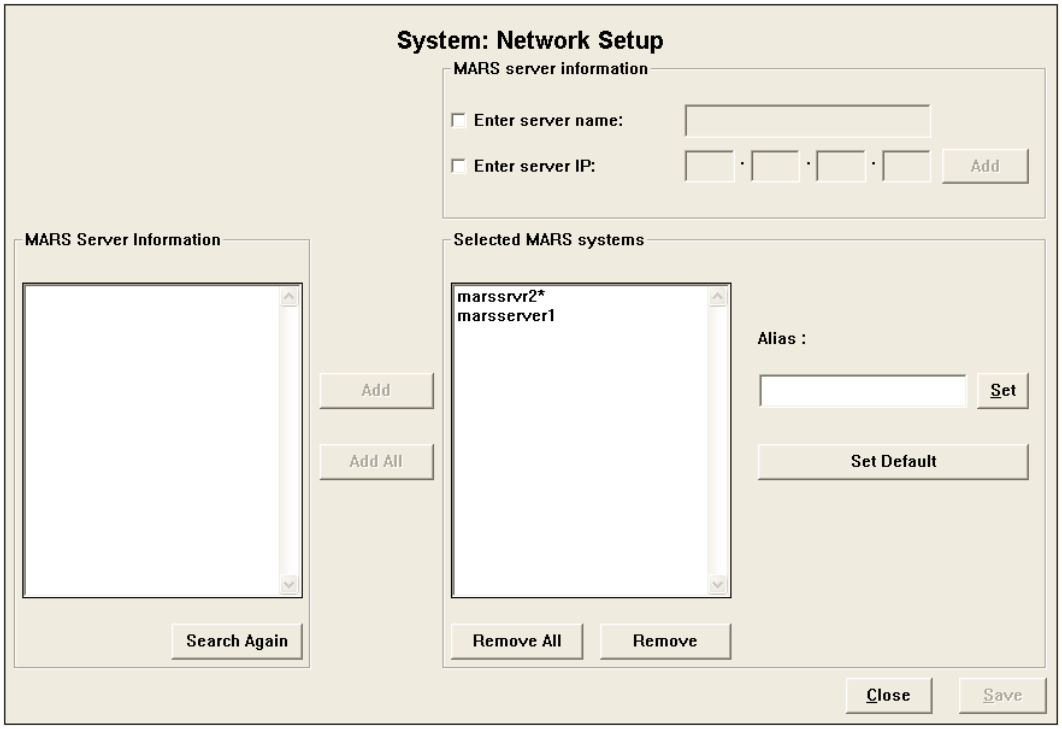
   A message lists the backup name and comment.

7. Do one of the following:

   - If it is not the correct backup, click ***No***.
     The message closes and you can browse for another file.
   - If it is the correct backup, click ***Yes***.
     The message closes and the backup is restored. When the restore is complete, the MARS system closes. Restart the system for the new configuration to go into effect. Refer to "To Power On the MARS System" on page 19 for instructions on starting the MARS system.

Network

The ***System: Network Setup*** window is used to select the MARS servers with which the workstation will connect. It is available only on systems that are configured as clients. On servers and standalone systems, the ***Network*** option is greyed out.



MARS servers can be selected using any of three methods:

- Select from a list of servers detected on the network
- Manually enter the server's name
- Manually enter the server's IP address

Network Field Descriptions

The following table describes the fields available on the ***System: Network Setup*** window.

Field	Description
Enter server name	Identifies the DNS name of the MARS server to which you want to establish a connection. To manually identify a MARS server by name, select the check box in front of this field and then enter the server's name.
Enter server IP	Identifies the IP (Internet Protocol) address of the MARS server to which you want to establish a connection. To manually identify a MARS server by IP, select the check box in front of the field and then enter the address.

Field	Description
MARS Server Information	Lists the MARS servers detected on the network.
Selected MARS Systems	Lists the MARS servers to which the client will connect. It can be populated by manually entering a server's name or IP address or by selecting a server detected on the network.
Alias	Assigns an alias to a server selected in the ***Selected MARS Systems*** field. Aliases make it easier to distinguish the selected servers.

Network Controls

The following table describes the controls that are available when configuring the MARS network settings.

Control	Description
Add	Adds the selected server to the ***Selected MARS Systems*** field.
Add All	Adds all the servers listed in the ***MARS Server Information*** field to the ***Selected MARS Systems*** field.
Search Again	Refreshes the list of MARS servers in the ***MARS Server Information*** field.
Remove	Removes a selected server from the ***Selected MARS Systems*** field.
Remove All	Removes all servers from the ***Selected MARS Systems*** field.
Set	Associates the name entered in the ***Alias*** field with the server selected in the ***Selected MARS Systems*** field.
Set Default	Sets the server selected in the ***Selected MARS Systems*** field as the default server for this client.
Close	Closes the ***System: Network Setup*** window.
Save	Saves the changes made on the ***System: Network Setup*** window.

Configuring Network Settings

Use the following procedures to add and remove MARS servers.

To Add a MARS Server

1. Select ***System > System Setup > Network*** from the menu bar.

   The ***System: Network Setup*** window opens.

2. To select a MARS server manually by name, do the following:

   a. Select the ***Enter server name*** check box.

   b. Enter the server's name in the field that opens.

   c. Click the ***Add*** button.

      The server is added to the ***Selected MARS Systems*** field.

3. To select a MARS server manually by IP address, do the following:
   a. Select the ***Enter server IP*** check box.
   b. Enter the server's IP address in the field that opens.
   c. Click the ***Add*** button.

      The server is added to the ***Selected MARS Systems*** field.
4. To select a MARS server from a list of servers detected on the network, do the following:
   a. Click the ***Search Again*** button.

      The client searches the network for existing MARS servers to which the client can connect. Depending on the number of available servers, this search may take several minutes. When the client is done searching, the ***Add*** and ***Add All*** buttons become available and the ***MARS Server Information*** field displays a list of all servers it located.

      NOTE:
      During the search, the ***Search Again*** button changes to ***Cancel***. Click it to abort the search if necessary.

   b. To add a single MARS server, select the server in the ***MARS Server Information*** field and click ***Add***.

      The server is moved to the ***Selected MARS Systems*** field.
   c. To add all the MARS servers, click ***Add All***.

      All the servers in the ***MARS Server Information*** field are moved to the ***Selected MARS Systems*** field.
5. Repeat step 2 through step 4 until all the desired servers are displayed in ***Selected MARS Systems*** field.
6. Once all the servers have been selected, set the default server for the client.
   a. Select the server in the ***Selected MARS Systems*** field.
   b. Click the ***Set Default*** button.

      An asterisk (*) appears at the end of the server name to indicate it has been selected as the default server.
7. Click ***Save***.

   The changes are saved.
8. Click ***Close***.

   The ***System: Network Setup*** window closes.

To Remove a MARS Server

1. Select ***System > System Setup > Network*** from the menu bar.

   The ***System: Network Setup*** window opens.
2. Do one of the following:
   - To remove a single server, select the server in the ***Selected MARS Systems*** field and click ***Remove***.

The selected server is removed from the list. Repeat for each server you want to remove.

- To remove all the servers, click ***Remove All***.
  All the servers are removed from the ***Selected MARS Systems*** field.

3. Once all the desired servers have been removed from the ***Selected MARS Systems*** field, click ***Save***.

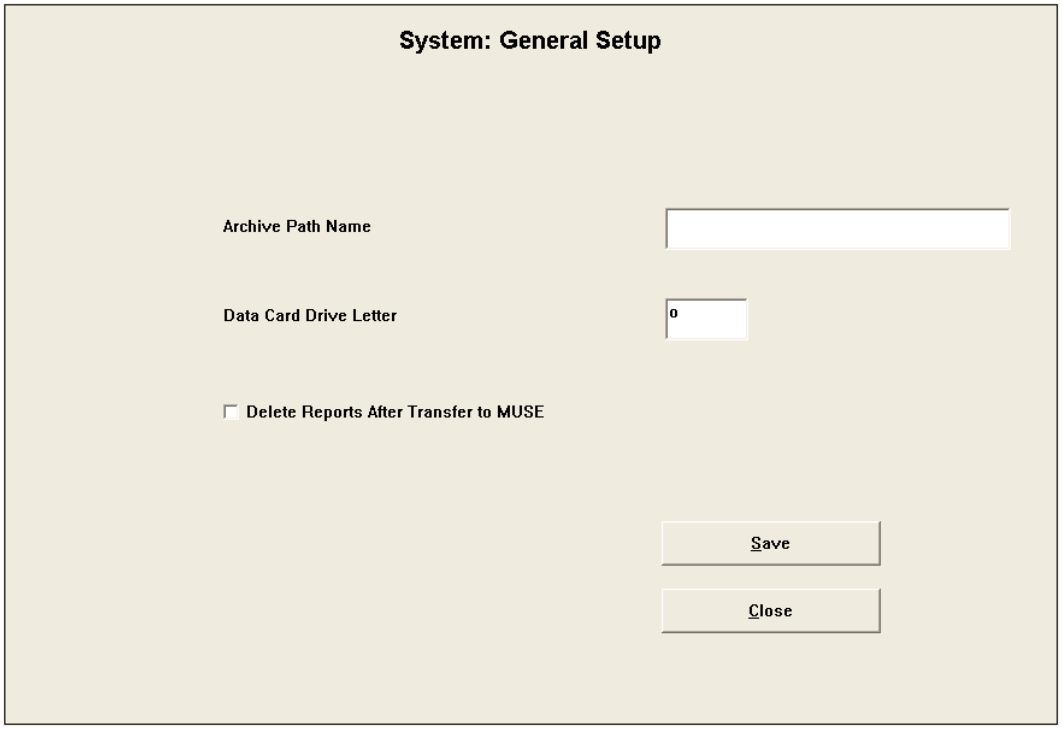
   The changes are saved.

4. After the changes have been saved, click ***Close***.

   The ***System: Network Setup*** window closes.

General

The ***System: General Setup*** window is used to define the path used to archive data, the letter of the drive where the data card will be located, and the disposition of reports that are successfully transferred to the MUSE system.



General Setup Field Descriptions

The following table describes the fields on the ***System: General Setup*** window.

Field	Description
Archive Path Name	Identifies the default path to use when archiving patient data. This can be a local or network drive, but it must include the full path. For example: ***D:\MARS\ARCHIVE***.
Data Card Drive Letter	Identifies the drive letter where the data card will be located. Default is ***O***. Available only on standalone and server configurations. If you are configuring a client, this option will not be available.
Delete Reports After Transfer to MUSE	Determines whether the MARS system will delete patient reports after they have been successfully transferred to the MUSE system. By default it is not set. If you do not set the field, the reports will be retained on the MARS system after they have been successfully transferred to the MUSE system.

General Setup Controls

The following table describes the controls available on the ***System: General Setup*** window.

Control	Description
Save	Saves your settings
Close	Closes the ***System: General Setup*** window.

Setting Up General System Settings

Use the following procedure to set up your general system settings.

1. Select ***System > System Setup > General*** from the menu bar.

   The ***System: General Setup*** window opens.

2. Define the settings as desired.

   Refer to "General Setup Field Descriptions" on page 91 for a description of each field.

3. When you are done, click ***Save***.

   A dialog box opens to inform you that the settings were saved successfully.

4. Click ***OK*** .

   The dialog box closes.

5. Click ***Close***.

   The ***System: General Setup*** window closes.

4

Holter Acquisition

The first step in analyzing a patient's ECG is to acquire, or download, data from the patient's Holter recorder to the MARS™ Ambulatory ECG System. This chapter identifies the supported Holter recorders and instructs you how to download data from them.

NOTE:

For information on acquiring data from a CIC, refer to Chapter 5, "CIC Acquisition".

Supported Holter Devices

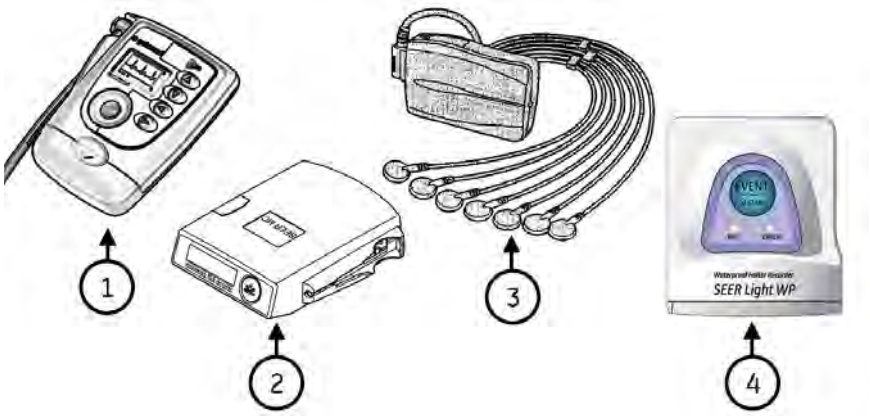
The MARS™ Ambulatory ECG System can download ECG data from the following Holter recorders.

1. SEER 12
2. SEER MC
3. SEER Light/SEER Light Extend
4. SEER Light WP

NOTE:

The SEER MC Holter Recorder (2) is no longer available from GE Healthcare. However, the MARS system still supports acquisition using legacy recorders.

The SEER Light WP Recorder (4) is not available in all markets. Contact your GE Healthcare Sales Representative for availability.



The following table summarizes the key features of each recorder.

Supported Features	SEER 12	SEER MC	SEER Light	SEER Light Extend	SEER Light WP
Data Type	Digital	Digital	Digital	Digital	Digital
CompactFlash (CF) Card	Yes[1]	Yes	Yes	Yes	No
PCMCIA (Linear Flash) Card	No	Yes	No	No	No
Secure Digital (SD) Card	No	No	No	No	Yes
2 channels	Yes	Yes	Yes	Yes	Yes
3 channels	Yes	Yes	Yes	Yes	Yes
8 channels	Yes[2]	Yes	No	No	No
In-Recorder Analysis	No	Yes	No	No	No
Acquire via Data Card	Yes	Yes	Yes	Yes	Yes
Acquire via Direct Connect	No	No	Yes	Yes	No
Maximum Acquisition Length	72 hours	48 hours	24 hours	48 hours	48 hours

1 Although the OmniDrive readers support the CF card used by the SEER 12 recorder, the SEER 12's large file size and the readers' slow transfer rates can cause problems. GE Healthcare recommends you use a standard multi-card reader to acquire data from the SEER 12 CF card.
2 Available only with optional 4–lead cable.

NOTE:

In-Recorder Analysis — Because the SEER MC conducts its own analysis, the MARS system downloads the recorder's analysis with the raw ECG data. For all other recorders, the MARS system conducts its own analysis as it downloads the ECG data.

Acquire via Data Card — This method of acquisition requires a card reader and a CompactFlash adapter. Both are available from GE Healthcare.

Acquire via Direct Connect — This method of acquisition requires that you connect the Holter recorder to the MARS workstation using the SEER Light Connect unit and a USB cable. Available only for the SEER Light and SEER Light Extend recorders.

CAUTION:

INVALID RESULTS — The use of unsupported recorders may result in invalid values (heart rate, ST values, and so on).

Use only the supported ECG recorders listed.

Downloading Data from a Holter Recorder

You can download data from all digital recorders by inserting the recorder's CompactFlash card into the card reader attached to the MARS system. For the SEER Light and SEER Light Extend recorders, you also have the option of connecting the recorder directly to the MARS system using the SEER Light Connect unit and a USB cable. Other than the method of connection, the procedures for downloading from a data card and from a recorder are identical.

NOTE:
If both a data card and recorder are connected simultaneously, you will receive an error message. If this happens, remove either the card or the recorder and try again.

1. Verify the system has an open patient slot.
   a. Click the ***Patient Select*** icon.

      The ***Patient Select*** window opens.

   b. Confirm that at least one appropriate patient slot reads ***<Empty>***.

      NOTE:
      Each slot is associated with a device type (Tape, SEER, and so on). If no SEER slot is ***<Empty>***, the slot with the oldest reviewed patient record will be overwritten with the new record. To prevent this, it is recommended that you archive the oldest record before continuing. Refer to Chapter 9, "Storing Patient Data", for details.

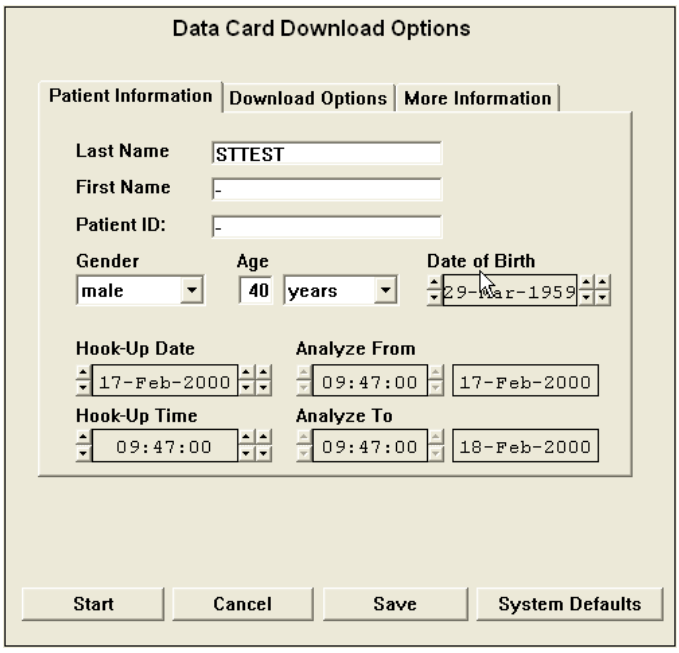
2. Connect a device to the MARS system.
   - To connect a data card to a SanDisk reader, insert the card into the card reader.
   - To connect a data card to an OmniDrive card reader, do the following:
     a. Insert the recorder's CompactFlash card into the CF adapter.
     b. Insert the adapter into the card reader.
   - To connect a SEER Light or SEER Light Extend, do the following:
     a. Plug the SEER Light Connect unit into an available USB port on the MARS workstation.

        NOTE:
        GE Healthcare recommends that the SEER Light Connect unit remain connected to the USB port at all times. If that is the case, this step may not be required.

     b. Plug the SEER Light recorder into the SEER Light Connect unit.
3. Click the ***Acquire Data*** icon.

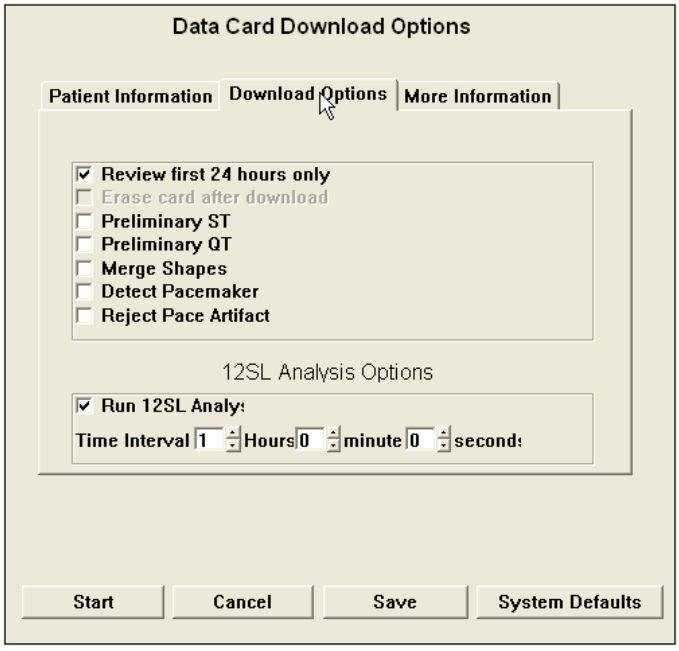
   The ***Data Card Download Options*** window opens.

4. Review and modify the data on the ***Patient Information*** tab as necessary.



The fields on this tab are read from the digital recorder. If the data was not loaded onto the recorder when the patient was hooked up, enter the information now. If the information is incorrect, make any necessary changes. The fields are self-explanatory.

5. On the ***Download Options*** tab, set the options as appropriate.



Refer to the following table for a description of each option.

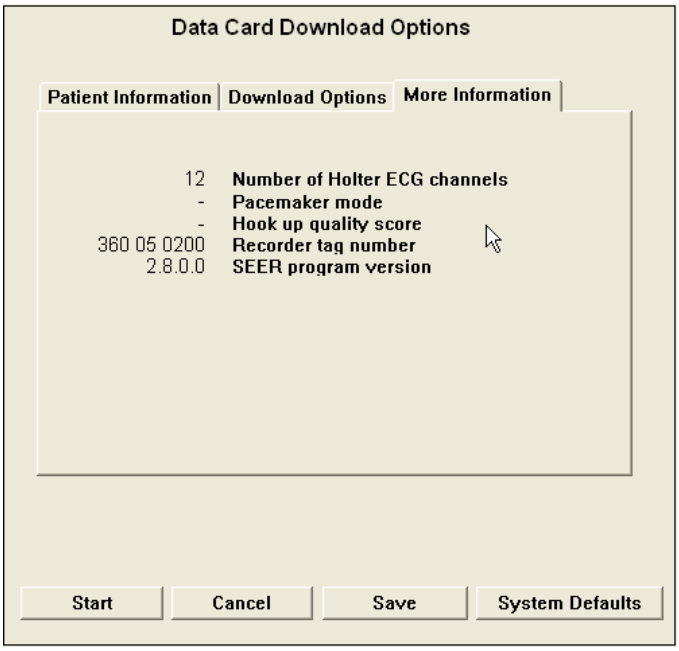
Field	Description
Review first 24 hours only	Restricts the MARS system's analysis to the first 24 hours of ECG data, regardless of how much data was downloaded. The field is selected by default. Clear the field to analyze all the acquired data.
Erase card after download	Clears the CompactFlash card after the data has been successfully downloaded to the MARS system. Applies only for the SEER MC recorder. The field is cleared by default. Select it to erase the card.
Preliminary ST	Conducts preliminary ST measurements on the ECG data during download. Available only if the ST Measurements option is activated (see "Software Activators" on page 79). The field is cleared by default. Select it to conduct the preliminary measurements.
Preliminary QT	Conducts preliminary QT analysis on the ECG data during download. Available only if the QT Analysis option is activated (see "Software Activators" on page 79). The field is cleared by default. Select it to conduct the preliminary analysis.
Merge Shapes	Merges the waveforms into the designated number of templates as defined in the Analysis Options (see "Analysis Options" on page 44). The field is cleared by default. Select it to merge the waveforms.
Detect Pacemaker	Identifies pace spikes in the ECG data as it is downloaded to the MARS system. This option is available only for data acquired by the following Holter recorders: • SEER 12 • SEER Light/SEER Light Extend The field is cleared by default. Select it to mark pace spikes on the ECG.
Reject Pace Artifact	Removes pace artifacts from the ECG data. Available only if the ***Detect Pacemaker*** option is selected. The field is cleared by default. Select it to remove pace artifacts from the ECG.
Run 12SL Analysis	Initiates the 12SL analysis of the ECG data upon download. Available only for data acquired with the SEER 12 recorder. This field is selected by default for SEER 12 ECGs with 12SL data. It is unavailable for all other ECGs.
Time Interval	Identifies the interval, in hours, minutes, and seconds, at which the MARS system will extract ECG data for 12SL analysis. For example, if you enter 1 hour, 30 minutes, and 0 seconds, the MARS system will extract a 10-second strip at every hour-and-a-half interval of ECG data. Accessible only if the ***Run 12SL Analysis*** option is set. The fields are blank by default.

NOTE:

To revert to the system defaults, click ***System Defaults***.

To overwrite the system defaults with your current settings, click ***Save***.

6. On the ***More Information*** tab, review the data as necessary.



The information includes the number of available channels, the status of the recorder's Pacemaker mode, the hookup quality score, the recorder tag, and the recorder's software version. None of it can be modified, but it can be used to help evaluate the ECG data.

For example, if the number of available channels is 2, you know that the 12SL analysis will not be available. Likewise, if the hookup quality score is 3, you know that the ECG will probably be noisy and poor quality.

NOTE:

The SEER MC rates the connection of each lead on a scale of 1 to 10, with 1 being the lowest quality connection and 10 being the highest. The hookup quality score lists the lowest rating. Hookup Quality is not available for other recorders.

7. After you have entered the patient information and set your download options, click ***Start*** to initiate the download.

A status bar opens. It indicates the current task and percentage towards completion.

When the download is complete, the ***Data Card Download Options*** window closes.

8. Verify the data was downloaded successfully.
   a. Click the ***Patient Select*** icon.
   b. In the patient selection window, verify the following:
      - The patient record exists.
      - Its ***Status*** is set to ***Ready to Edit***.
      - Its ***Length*** is correct for the duration of the study:
        - 24 hours = 1440 minutes.
        - 48 hours = 2880 minutes.
        - 76 hours = 4560 minutes.

      NOTE:
      If the trial period was for a shorter time period, or if it was stopped early, these times will be different.

9. Remove the card or recorder from the MARS system.

   NOTE:
   It is safe to remove the card or recorder once the download window closes.

5

CIC Acquisition

In addition to acquiring data from Holter recorders (see Chapter 4), the MARS Ambulatory ECG System can acquire data from bedside monitors connected to a Clinical Information Center (CIC).

Before You Begin

Before you begin to acquire data from a CIC, you need to do the following:

- **Connect the MARS system to the network**
  The MARS system must be connected to the network to be able to access CIC systems. For more information, refer to the *MARS Installation Guide* (2027879-036).
- **Activate the CIC Interface**
  The CIC Interface is a software option that must be purchased and activated before it is available for use. For information on activating software options, refer to "Software Activators" on page 79.
- **Set up the CIC Connections**
  To set up the CIC Connections, you select the CICs from which you will acquire data, the channels to be acquired, and the beds to monitor. The MARS system uses this information to locate and present the records available for acquisition. For information on setting up the CIC Configuration, refer to "CIC Configuration" on page 68.

Acquiring Data from a CIC

The procedure for acquiring data from a CIC differs from the procedure for acquiring data from Holter recorders in two ways:

- You use the ***Patient Select*** application.
  When you acquire data from a Holter, you use ***Acquire Data*** to initiate the acquisition.
- You select the amount of ECG data to acquire.

When you acquire data from a Holter, you automatically acquire the entire ECG (24 or 48 hours of data). With the CIC, you can select to acquire any amount of time from a single minute up to 76 hours.

NOTE:
Familiarity with the ***Patient Select*** application is assumed in the following instructions. If you are not familiar with the application, its fields, or its controls, refer to "Selecting the Patient" on page 107.

1. Click the ***Patient Select*** icon.

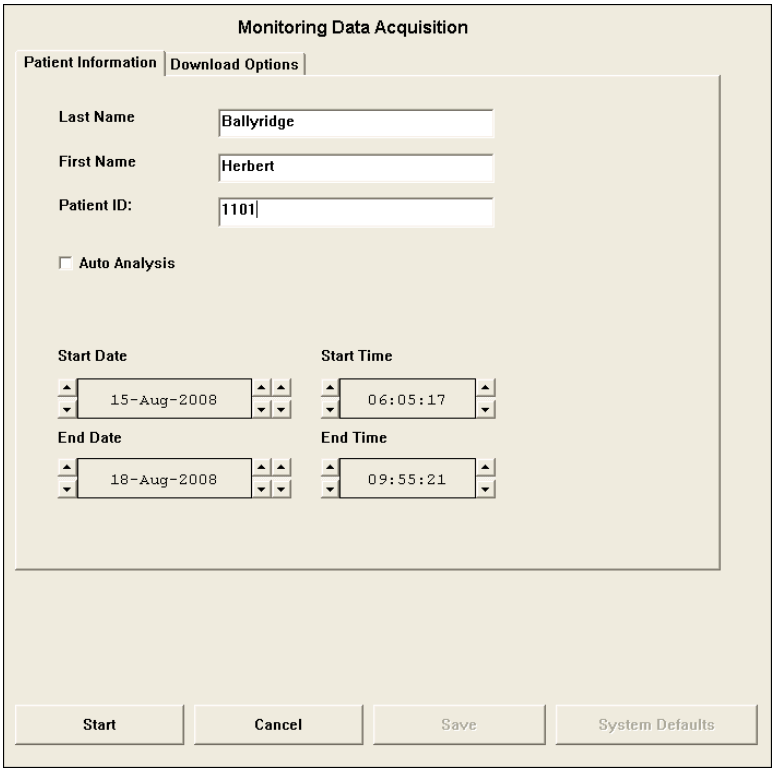
   The ***Patient Select*** application opens.

2. In the ***Data Type*** field, select ***Select Beds***.

   The list of available beds is displayed in the application window.

3. Select the patient and click the ***Acquire Data*** button.

   The ***Monitoring Data Acquisition*** window opens.



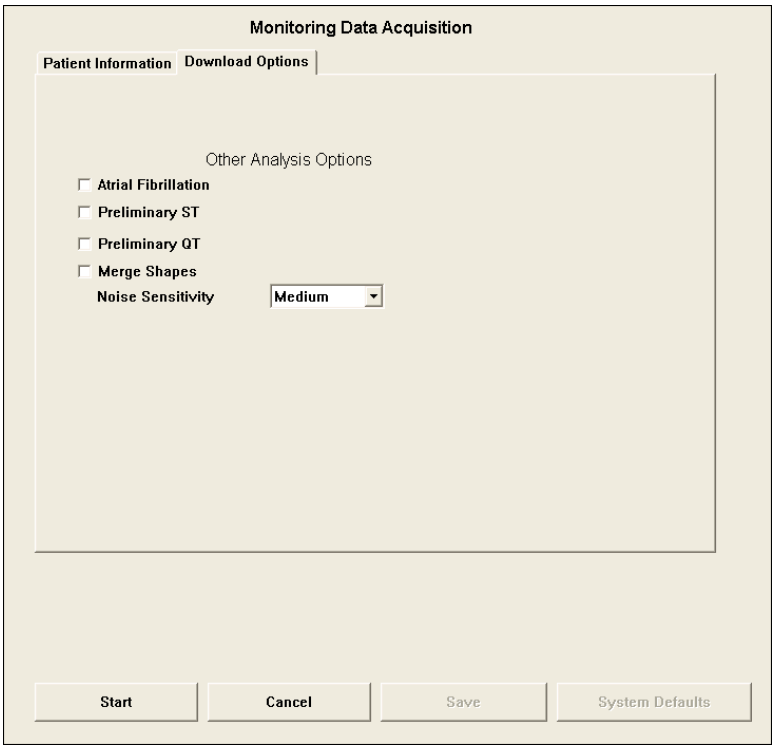
4. Complete the fields on the ***Patient Information*** tab.

   Refer to the following table for a description of the available fields.

Field	Description
Last Name	Identifies the surname of the patient. It defaults to the name from the CIC, but you can modify it; however, to retain the record's relation with the CIC record, GE Healthcare recommends that you do not modify it.
First Name	Identifies the given name of the patient. It defaults to the name from the CIC, but you can modify it; however, to retain the record's relation with the CIC record, GE Healthcare recommends that you do not modify it.
Patient ID	Identifies the ID of the patient. It defaults to the ID from the CIC, but you can modify it; however, to retain the record's relation with the CIC record, GE Healthcare recommends that you do not modify it.
Auto Analysis	Determines whether the MARS system will analyze the data as it downloads to the workstation. The settings on the ***System: CIC Configuration*** window determine whether the field is selected by default. See "CIC Configuration Field Descriptions" on page 69 for more information. This field also determines where the record can be found after it has been acquired: • If the data is analyzed, the record can be found by selecting the ***Holter*** data type. • If the data is not analyzed, the record can be found by selecting the ***Monitoring*** data type.
Start Date	Determines the date at which the acquisition begins. It defaults to the earliest CIC date, but it can be changed. You cannot change it to an earlier date or to a date later than the ***End Date***.
Start Time	Determines the time at which the acquisition begins. It defaults to the earliest time on the ***Start Date***, but it can be changed. It cannot be changed to an earlier time or to a time later than the ***End Time***. **NOTE:** If you scroll past midnight (00:00:00), the ***Start Date*** will change accordingly. For example, if the ***Start Date*** is 14-Apr-2009 and you scroll forward to 01:00:00, the ***Start Date*** will change to 15-Apr-2009. Likewise, if you scroll backward to 23:00, the ***Start Date*** will change to 13-Apr-2009.
End Date	Determines the date at which the acquisition ends. It defaults to the latest CIC date, but it can be changed. You cannot change it to a later date or to a date earlier than the ***Start Date***.
End Time	Determines the time at which the acquisition ends. It defaults to the latest time on the ***End Date***, but it can be changed. It cannot be changed to a later time or to a time earlier than the ***Start Time***. **NOTE:** If you scroll past midnight (00:00:00), the ***End Date*** will change accordingly. For example, if the ***End Date*** is 15-Apr-2009 and you scroll backward to 23:00:00, the ***End Date*** will change to 14-Apr-2009. Llikewise, if you scroll forward to 01:00:00, the ***End Date*** will change to 16-Apr-2009.

5. Select the ***Download Options*** tab and complete the fields.

   The Download Option fields become available.



Refer to the following table for a description of the available fields.

NOTE:

If the ***Auto Analysis*** check box is not set on the ***Patient Information*** tab, the MARS system will not analyze the data as it is downloaded; therefore, none of these settings will have any effect.

Fields	Description
Atrial Fibrillation	Determines whether the system will indicate atrial fibrillation during the analysis. For more information, refer to "Event Definitions" on page 32. The field is cleared by default. Select it to mark atrial fibrillation.
Preliminary ST	Performs preliminary ST measurements on the ECG data during download. Available only if the ST Measurements option is activated (see "Software Activators" on page 79). The field is cleared by default. Select it to conduct the preliminary measurements.
Preliminary QT	Performs preliminary QT measurements on the ECG data during download. Available only if the QT Measurements option is activated (see "Software Activators" on page 79). The field is cleared by default. Select it to conduct the preliminary measurements.

Fields	Description
Merge Shapes	Merges the waveforms into the designated number of templates as defined in the Analysis Options (see "Analysis Options" on page 44). The field is cleared by default. Select it to merge the waveforms.
Noise Sensitivity	Determines how sensitive the MARS system will be to noise levels in the ECG. Valid options are Low, Medium, and High. Medium is the default value.

6. After setting the ***Patient Information*** and ***Download Options***, click ***Start*** to initiate the download.

   A status bar opens. It indicates the current task and percentage towards completion.

   When the download is complete, the status bar and acquisition window close.

7. Verify the data downloaded successfully.

   a. In the Patient Select control panel, select the correct ***Data Type***.

      - If you selected the ***Auto Analysis*** field on the ***Download Options*** tab, select the ***Holter*** data type.
      - If you cleared the ***Auto Analysis*** field on the ***Download Options*** tab, select the ***Monitoring*** data type.

   b. In the application window, verify the patient record exists and contains the correct information.

6

Patient Data

There are four steps to setting up patient data in the MARS Ambulatory ECG System. Those steps are explained in the following topics.

NOTE:

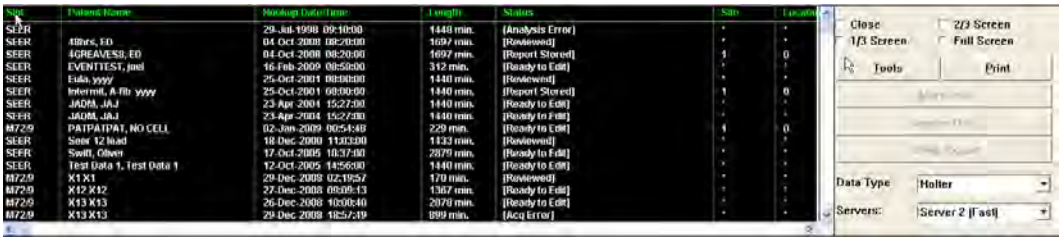
The procedures described in this chapter use the ***Standard*** application menu. If you use a different menu, your available icons and page layouts may differ.

Selecting the Patient

The ***Patient Select*** application is used to do the following:

- Select a patient record.
- Analyze the selected record.
- Delete the selected record.
- Archive the selected record.
- Restore an archived record.
- Store the selected record on the MUSE system.
- Acquire CIC data
- Export sleep study data

This section focuses on the process for selecting a patient record. The other processes are described elsewhere in the manual.



You can select patient records using the following data sources:

- Analyzed patient records from a Holter recorder or CIC
- Unanalyzed patient records from the CIC
- Monitored beds on the CIC
- Stored patient reports
- Archived patient records

Patient Select Field Descriptions

The fields on the ***Patient Select*** window change depending on which source, or data type, is selected. (See "Patient Select Controls" on page 110 for more information on data types.) The following table describes all the fields, in alphabetic order, and identifies the data types for which each is available. Use this information to help identify and select the correct record.

Field	Data Types	Description
Acquisition Time	Stored Reports	Identifies the time that the acquisition began.
Acquisition Start Time	Monitoring	Identifies the time that the acquisition began.
Bed Number	Monitoring Select Beds	Identifies the bedside monitor used to acquire the ECG. For more information on beds, refer to "CIC Configuration Field Descriptions" on page 69.
Care Unit	Monitoring Select Beds	Identifies the care unit associated with the bedside monitor used to acquire the ECG.
File	Archive	Identifies the report number.
End Time	Select Beds	Identifies the time at which the acquisition ended.
Hookup Date/Time	Holter	Identifies the date and time that the Holter recorder was hooked up to the patient.
Length	Holter	Identifies the duration of the recording. The following record lengths are typical for complete Holter studies: • 1440 minutes (*24 hours*) • 2880 minutes (*48 hours*) • 4560 minutes (*76 hours*) Other file lengths are possible if the Holter study was stopped prematurely or if the data was acquired from a CIC, since users can choose to acquire any duration of CIC data. A file length may be as short as 2 minutes.
Location	Holter Stored Reports	Identifies the location where the study originated. For more information, refer to "Site Field Descriptions" on page 81.
Owner	Holter Stored Reports	Identifies the workstation and Windows user name of the person who has the record currently selected. To prevent conflicts when a user is working on a file, a patient record is "checked out" when a user selects it; it cannot be selected by anyone else while it is checked out.

Field	Data Types	Description
Patient ID	Select Beds	Identifies the ID of the patient on this record.
Patient Name	Holter Monitoring Select Beds Stored Reports Archive	Identifies the patient's last and first names.
Report	Stored Reports	Sequential number used to count the number of reports on the system.
Site	Holter Stored Reports	Identifies the Site where the study originated. For more information, refer to "Site Field Descriptions" on page 81.
Slot	Holter	Identifies the slot type: SEER, Monitor, or Tape. The monitor and tape slots include information about the number of hours and maximum possible channels included. For example, a slot type of **M72/9** indicates the slot is reserved for Monitor studies with 76 hours and up to 9 channels of data, while a slot type of **T48/3** indicates the slot is reserved for Tape studies with 48 hours and up to 3 channels of data.
Slot File Name	Holter Monitoring Stored Reports	Identifies the path and file name of the record on the MARS system.
Start Time	Select Beds	Identifies the time at which the ECG study began.
Status	Holter Monitoring Select Beds Stored Reports Archive	Identifies the status of the record. Valid statuses vary depending on the record's data type. Following are the valid statuses when the record's data type is Holter, Stored Reports, or Archive: • **Ready to Edit —** Indicates the record has been imported by not yet edited. • **Reviewed —** Indicates the record's report has been reviewed using the ***Report Review*** application. • **Report Stored —** Indicates a Holter study report has been stored to the disk. • **Printed —** Indicates the report has been printed. • **Archived —** Indicates the report has been archived and can be safely deleted. • **Locked —** Indicates the report has been locked. Locked reports cannot be deleted. Holter, Stored Report, or Archive records may have multiple statuses. For example: Locked/Reviewed/Archived. Following are the valid statuses when the record's data type is Monitoring or Select Beds: • **Admitted —** The patient has been admitted and is still in the facility. • **Discharged —** The patient has been disconnected from the monitor. Monitoring and Select Bed records can have only one status.

Field	Data Types	Description
Store Date	Archive	Identifies the date on which the archive was stored.
Store Time	Archive	Identifies the time at which the archive was stored.
Type	Archive	Identifies the slot type: SEER, Monitor, or Tape. The monitor and tape slots include information about the number of hours and channels included. For example, a slot type of **M72/9** indicates the slot is reserved for Monitor studies with 76 hours and 9 channels of data, while a slot type of **T48/3** indicates the slot is reserved for Tape studies with 48 hours and 3 channels of data.

Patient Select Controls

The following table describes the controls available when selecting a patient.

Control	Description
Tools	Opens the Tools control panel. The following tools are available for Patient Select: • **Analyze —** Analyzes the selected patient record. If the record was analyzed during download, it is reanalyzed. • **Delete —** Deletes the selected record. This control is not available if the selected record is locked. • **Lock —** Changes the selected record's status to ***Locked***. When the record is locked, it cannot be deleted and the tool changes to **unLock**. • **Archive —** Copies the selected record to the location specified by the ***Archive Path Name*** on the ***System: General Setup*** window. For information on setting the archive path, refer to "General Setup Field Descriptions" on page 91. For information on using the Archive tool, refer to Chapter 9, "Storing Patient Data". • **Sort —** Rearranges the patient records according to the field you select. • **Restore from Archive —** Restores records from the archive to the MARS Ambulatory ECG System. You have the option of restoring the selected record or all the records in the archive. Available only if the selected ***Data Type*** is ***Archive***. • **Store to MUSE —** Copies the selected record to a shared directory on the MUSE system. Available only if the MARS to MUSE software option has been activated. Refer to "Software Activators" on page 79.
More Info	Displays the recorder used, the channels analyzed, and the pacemaker options.
Acquire Data	Acquires the ECG data from the selected record. Available only when the selected record's ***Data Type*** is Select Beds.
Sleep Export	Exports the channels required for a sleep apnea study from the selected record. Available only if the record's ***Data Type*** is Holter or Monitoring. For more information, refer to Appendix G, "Sleep Export".

Control	Description
Data Type	Selects the source of the patient records to be displayed. Following are the valid data types: • **Holter —** Displays the patient records that have been analyzed already. This includes Holter data and bedside monitors that were analyzed on acquisition. This is the default selection. • **Monitoring —** Displays CIC records that have not yet been analyzed. • **Select Beds —** Displays a list of beds on the CIC from which the MARS system can acquire data. • **Stored Reports —** Displays the stored patient reports. • **Archive —** Displays the archived records stored on a CD-ROM. **NOTE:** This data type appears only if the system detects archived records in the ***Archive Path Name*** defined on the ***System: General Setup*** window. For more information, refer to "General" on page 90.
Servers	Selects the server where the desired records are located. The drop-down list displays the servers that were defined on the ***System: Network Setup*** window. (See "Network" on page 87 for more information on servers.) Servers are listed using their Alias (if defined) or Network name. In addition to servers, you can select to display patient records stored locally. **NOTE:** This control changes the default server. As a result, the MARS system rechecks the new default server for empty slots.

Selecting a Patient Record

Use the following procedure to select a patient record.

1. Click the ***Patient Select*** icon.

   The ***Patient Select*** window opens and displays the Holter records stored on the default server.

2. If necessary, change the ***Data Type*** or ***Server*** to retrieve a different set of records.

   Refer to "Patient Select Controls" on page 110 for more information.

3. If necessary, sort the records to help you find the desired record.

   a. Select ***Tools > Sort***.

      The ***Select sort method*** panel opens.

   b. Select the field to sort by.

      The MARS system sorts the records by the selected field. The displayed records' ***Data Type*** determines which fields are available.

   c. Click ***Close > Close*** to return to the control panel.

4. Locate the correct record and click on it.

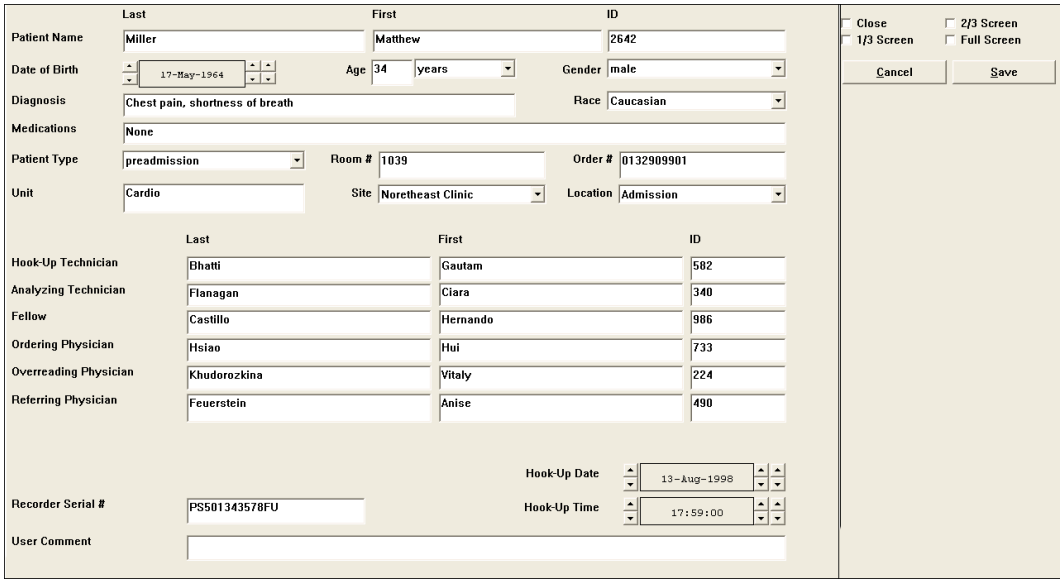
   The selected record is highlighted. You can now review and modify the patient information.

NOTE:
When running in a client-server environment, the ***Patient Select*** window does not automatically update when records are added on other clients. Do either of the following to refresh the screen:

- Restart the ***Patient Select*** application (step 1).
- Reselect the desired ***Data Type*** (step 2).

Entering Patient Information

The ***Patient Information*** window contains logistical information about the study. Information entered on this window appears on the final report.



Patient Information Field Descriptions

The following table describes the fields available on the ***Patient Information*** window.

Field	Description
Patient Name	Series of free text fields for recording the patient's last name, first name, and ID. If the MARS to MUSE option is activated, the ID should match the ID from the MUSE system. See "Software Activators" on page 79 for more information about the MARS to MUSE option.
Date of Birth	Date field for recording the patient's birth date.
Age	Series of fields that identify the patient's age at the time of the study. Calculated from the ***Date of Birth*** to the ***Hook-Up Date***. By default, the age is displayed in years, but you can change the unit of measure to Months, Weeks, Days, and Hours.
Gender	Drop-down list that identifies the patient's sex.
Diagnosis	Free text field for entering the diagnosis of the patient's condition.
Race	Drop-down list identifying the patient's race. If race is unimportant to the study, select ***Unknown***.

Field	Description
Medications	Free text field for entering the medications the patient is currently taking.
Patient Type	Drop-down list that identifies the kind of patient: preadmission, inpatient, outpatient, emergency, same day surgery, day surgery, unknown.
Room #	Free text field that identifies the patient's room.
Order #	Free text field that identifies the order authorizing the study.
Unit	Free text field that identifies the part of the hospital (ICU, CCU, and so on) where the patient is located.
Site	Drop-down list that identifies the site where the study was conducted. Lists only those sites that have been added to the MARS system. For more information on sites, refer to "Site" on page 81.
Location	Drop-down list that identifies the location where the study was conducted. Lists only those locations that have been added to the MARS system. For more information on locations, refer to "Site" on page 81.
Hook-Up Technician	Free text fields that identify the last name, first name, and ID of the technician who hooked up the recorder to the patient.
Analyzing Technician	Free text fields that identify the last name, first name, and ID of the technician who analyzed the study.
Fellow	Free text fields that identify the last name, first name, and ID of the fellow involved in reading the study.
Ordering Physician	Free text fields that identify the last name, first name, and ID of the physician who ordered the study.
Overreading Physician	Free text fields that identify the last name, first name, and ID of the physician who overread the study.
Referring Physician	Free text fields that identify the last name, first name, and ID of the physician who referred the patient for the study.
Recorder Serial #	Free text field that identifies the serial number of the recorder used in the study.
Hook-Up Date	Date field that identifies the date on which the recorder was hooked up to the patient.
Hook-Up Time	Time field that identifies the time at which the recorder was hooked up to the patient.
User Comment	Free text field for entering additional comments. User comments may be acquired via Web Download.

Patient Information Controls

The ***Patient Information*** window includes no controls specific to the application. For a description of the common controls, refer to "Control Panel" on page 23.

Editing Patient Information

Use the following procedure to edit patient information.

1. If necessary, select a patient to edit.

   Refer to "Selecting a Patient Record" on page 111 for details.

2. Click the ***Patient Information*** icon.

   The ***Patient Information*** window opens. Any patient information that had been imported with the ECG or added during download are displayed.

3. Modify the information as necessary.

   Refer to "Patient Information Field Descriptions" on page 112 for an explanation about any of the fields.

4. When you are done modifying the patient information, click ***Save***.

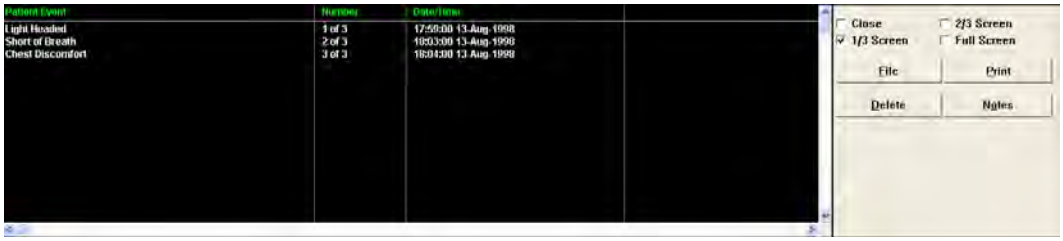
   A dialog box opens to notify you when the record is saved.

5. Click ***OK*** to close the dialog box.

6. Select the ***Close*** check box in the control panel to close the ***Patient Information*** window.

Entering Patient Diary Information

The ***Patient Diary*** window is used to record observations, symptoms, and events that occurred during the study. Typically, when the patient experiences an event while hooked up to the recorder, he or she will press an event button on the device, which marks the event on the ECG. The patient then records the symptoms on a paper diary that was provided during hookup. This application can be used to transfer those symptoms and observations to the electronic record and linked to specific times in the ECG.



NOTE:

The ***Patient Diary*** icon in the ***Standard*** application menu opens the ***Strip Review***, ***Page Review***, and ***Patient Diary*** windows. When you select a patient event in the ***Patient Diary*** window, the associated ECG segment is displayed in both the ***Strip Review*** and ***Page Review*** windows. You can then use the ***Strip Review*** and ***Page Review*** windows to file the ECG segment associated with a specific event for inclusion in the final report.

Patient Diary Field Descriptions

The following table describes the fields on the ***Patient Diary*** window.

Field	Description
Patient Event	Describes the patient event. Example: Light Headed.
Number	Identifies the total number of events and the current event's sequence. Example: 1 of 3.
Date/Time	Identifies the time and date at which the event occurred.

Patient Diary Controls

The following table describes the controls available when entering patient diary events.

Control	Description
Notes	Opens the Notes control panel. From this panel you select the event's date, time, and description. The panel provides a set of predefined event descriptions, but you can modify those predefined events and add your own. For more information, refer to "Notes" on page 252.

Entering Information in the Patient Diary

Use the following procedure to add entries to the patient diary and to file those entries for inclusion in the final report.

1. If necessary, select the patient whose diary you will be modifying.

   Refer to "Selecting a Patient Record" on page 111 for instructions.

2. Click the ***Patient Diary*** icon.

   The ***Patient Diary*** window opens. Any pre-existing events are displayed on the window.

3. Use the ***Notes*** control to enter the events reported by the patient.

   Refer to "Notes" on page 252 for details on adding events.

4. To file the ECG strip associated with an event, do the following:

   a. Select the event in the ***Patient Diary*** window.

      The associated waveform is displayed in the ***Strip Review*** window.

   b. Click ***File*** in the ***Strip Review*** control panel.

      The ***Enter Comment*** control panel opens. The description from the selected ***Patient Event*** appears in the window.

   c. Modify the comment as necessary.

   d. Click ***File***.

      The ***Enter Comment*** control panel closes and the strip and comment are filed in the final report.

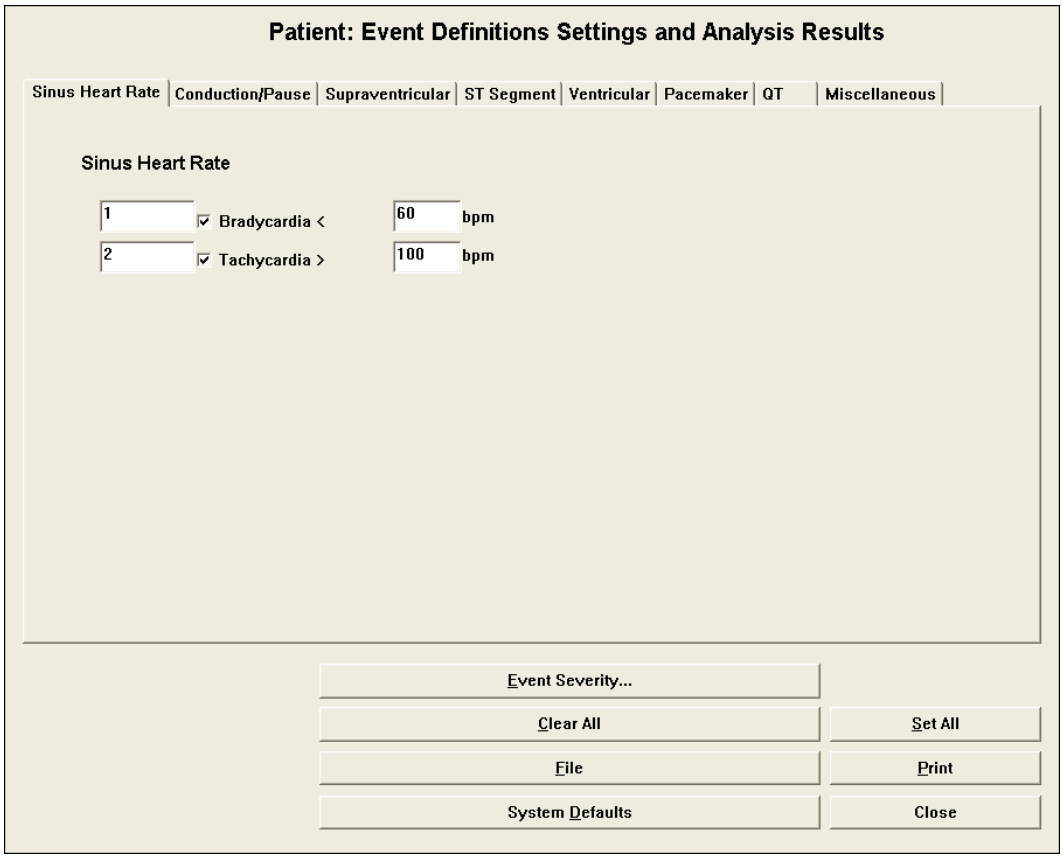
   e. Repeat for each patient event you want to include in the report.

Overriding Patient Settings

In addition to entering logistical information and diary entries on a patient-by-patient basis, you can also customize event definitions and heart rate settings for a patient. This allows you to override the global settings for a patient with special circumstances without changing the global settings.

Overriding Event Definitions

The ***Patient: Event Definitions Settings and Analysis Results*** window is used to override the global event definitions for a single patient.



This window is identical to the ***System: Event Definitions*** window with three exceptions:

- Each event includes the number of times that event occurred in the selected study. As seen in the previous screen shot, the patient study had 1 Bradycardia event and 2 Tachycardia events.
- A ***File*** button replaces the ***Save*** button.
  This button adds the current settings and number of occurrences to the final report.
- A ***Print*** button has been added.
  This button prints the current settings and number of each event.

Use the following procedure to override the event definitions for the currently selected patient.

1. If necessary, select a patient.

   Refer to "Selecting a Patient Record" on page 111 for instructions.

2. Select ***Patient Settings > Event Definitions*** from the menu bar.

   The ***Patient: Event Definitions Settings and Analysis Results*** window opens.

3. Modify the settings as appropriate for the patient.

   Refer to "Event Definitions" on page 32 for a description of each field and control.

4. When you are done modifying the settings, click ***Close***.

   This closes the ***Patient: Event Definitions Settings and Analysis Results*** window and applies the changes to the patient study.

Overriding Heart Rate Settings

The ***Patient: Heart Rate Settings*** window is used to override the global heart rate settings for a single patient. This window is identical to the ***System: Heart Rate Setup*** with one exception: it has no ***Save*** button.

Use the following procedure to override the heart rate settings for a specific patient.

1. If necessary, select a patient.

   Refer to "Selecting a Patient Record" on page 111 for instructions.

2. Select ***Patient Settings > Heart Rate*** from the menu bar.

   The ***Patient: Heart Rate Settings*** window opens.

3. Modify the settings as appropriate for the patient.

   Refer to "Heart Rate" on page 41 for a description of each field and control.

   NOTE:
   Heart rate calculations are based on the selected beat types. Excluded beat types that are not used in the calculation.

4. When you are done modifying the settings, click ***Close***.

   This closes the ***Patient: Heart Rate Settings*** window and applies the changes to the patient study.

7

ECG Review

The goal of the MARS Ambulatory ECG System is to generate a report that accurately summarizes raw ECG data, highlights key trends, identifies significant episodes, and interprets that data so an accurate diagnosis can be made about the patient's condition. The MARS system streamlines that process by automatically analyzing the raw ECG data based on the settings defined in system setup (see Chapter 3, "System Setup").

However, the automatic analysis does not eliminate the need for human intervention. The data still needs to be reviewed to verify that the system accurately analyzed the ECG, to select key and representative data for inclusion on the report, and to interpret the data. The MARS Ambulatory ECG System provides several applications and tools to simplify and streamline this review process.

A typical ECG review would follow this general process:

1. Review shapes.
2. Review episodes.
3. Adjust SVEs.
4. Review trends.
5. Conduct a final review.

The MARS Ambulatory ECG System also offers several additional applications and tools to augment this standard workflow. Refer to the following appendices for information on these additional applications and how they can be used to supplement the standard workflow:

- Appendix A, "HRV"
- Appendix B, "HRT"
- Appendix C, "12-Lead Analysis"
- Appendix D, "Waveform Analysis"
- Appendix E, "Research Utilities"
- Appendix F, "Waterfall Display"
- Appendix G, "Sleep Export"

Reviewing Shapes

The Shape Review application groups ECG complexes of similar shapes into templates. This simplifies the review process by reducing the number of waveforms to review; instead of reviewing thousands of individual beats, you review a handful of templates. If any of the templates contain a shape that bears further scrutiny, you can drill down to review the individual beats within that template.

You can simplify this review process further by limiting the number of templates generated for the four most common beat types (see "Shape Merge Tab" on page 44 for more information). When the MARS system initially generates templates, it creates as many templates as there are distinct shapes. It then merges the templates with the fewest beats until it reaches the number defined by the ***Shape Merge*** tab on the ***System: Analysis Options Setup*** window. Finally, it labels the merged template *(M)* to indicate that it is the result of a merge.

For example, suppose the MARS system generated 40 *Normal* templates for an ECG. If the limit for *Normal* templates was set to 7, the MARS system would identify the 6 dominant templates (templates with the largest number of beats) and merge the remaining 34 subordinate templates (templates with fewer number of beats) into a single 7th template. If the number of *Normal* templates was set to 10, the MARS system would identify the 9 dominant templates and merge the remaining 30 subordinate templates into a single 10th template.

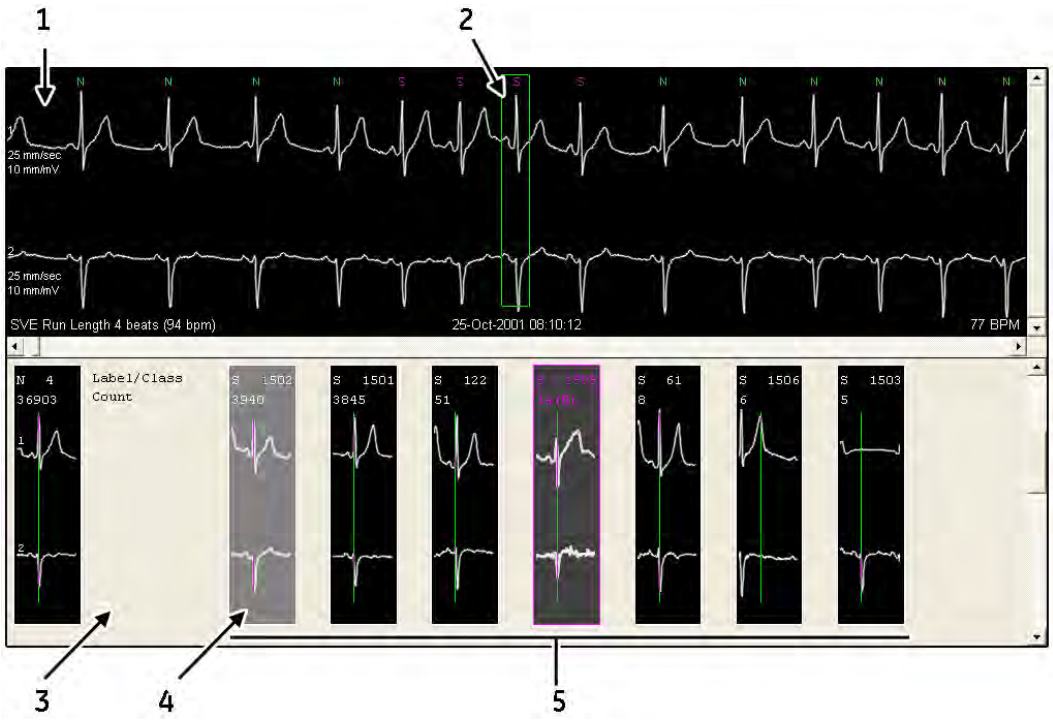
The remainder of this section describes the following:

- ***Shape Review*** layout
- ***Strip Review*** layout
- ***Shape Review*** controls
- ***Strip Review*** controls
- How to review shapes
- How to demix a template
- How to superimpose beats

Page Layout

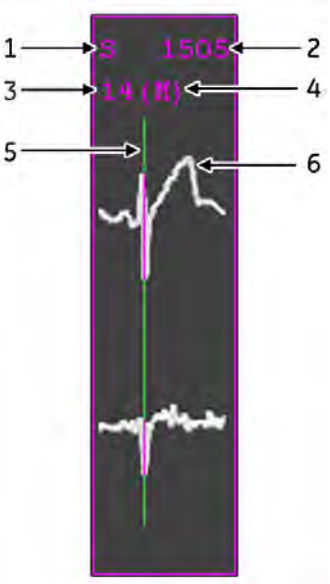
The Shape Review application consists of the following components.

NOTE:
The examples in this section use the ***Standard*** application menu. If you use a different menu, your page layout may differ.



1. **Strip Review Window**
   Used to review and relabel individual beats within the selected template.
2. **Selected beat**
   Identified by a green box.
3. **Shape Review Window**
   Used to review and relabel shape templates.
4. **Selected Template**
   Identified by grey shading.
5. **Shape Templates**
   Grouped by label and sorted in descending order based on the number of individual beats within the template.

Each template consists of the following components:



1. **Label**
   Identifies the label of the beats included in the template. In this example, the template is labeled Supraventricular (S).
2. **Class**
   Classifies the distinct shapes in an ECG. It essentially is a bin number used to group each shape in a template. As the MARS system analyzes a beat, it compares the beat to the shape of each previously defined class. If the beat matches any classified shape, the beat is assigned to that class. If the beat does not match any classified shape, the beat is assigned the next available class number and becomes a new template. The MARS system repeats this process for each beat in the ECG.
   For example: the MARS system assigns the first beat in an ECG to class 1. It then compares the second beat to the first beat. If they match, the second beat is also assigned to class 1. If they do not match, the second beat is assigned to class 2. It then compares the third beat to first and second beats to determine if the third beat belongs with either of those classes or if it belongs to a new class. This process continues until it reaches the end of the ECG.
   In this example, the template class is 1505.
3. **Beat Number**
   Indicates the total number of beats included in the template. In this example, the template has 14 beats.
4. **Merge Flag**
   Identifies templates that are the result of a merge. In addition to the flag, a merged template's border and text are magenta, while the border and text of a non-merged template are white.
5. **Cursor**
   Indicates the point used to determine the beat label.
6. **Representative Waveform**
   Indicates the shape of the beats within the template. For merged templates, the system uses the shape with the most beats.

Page Controls

Although they are used together to review shapes, the ***Shape Review*** and ***Strip Review*** windows serve different purposes and have separate controls. The ***Shape Review*** window and its controls are used to review and edit the shape templates. The ***Strip Review*** window and controls are used to review and edit the individual beats that make up the templates.

Strip Review Controls

Control	Description
File	Files the displayed section of the ECG strip on the final report. Refer to "File" on page 249 for more information.
Print	Prints the displayed section of the ECG strip. Refer to "Print" on page 250 for more information.
Region	Allows you to edit a contiguous range of beats simultaneously. For more information, refer to "Region" on page 253.
Tools	Controls the display options and enables a variety of instruments for use with the strip. For details, refer to "Tools" on page 258.
Shape	Changes the label of the selected beat. For details, refer to "Reviewing Templates" on page 124.
Superimpose	Displays beats in rapid succession so you can observe the progression of the ECG beat by beat. For details, refer to "Superimposing Beats" on page 131.
Clear Sel.	Deselects all selected beats. Available only if multiple beats are selected.
Calibrate	Adjusts the amplitude of a selected channel by using calipers to measure the ECG channel calibration pulses at the beginning of the ECG. Used only when reading an analog ECG (that is, an ECG acquired from tape). For details, refer to "Calibrating Analog ECGs" on page 269.
Prev. Event	Displays the previous event in the ECG.
Next Event	Displays the next event in the ECG.

Shape Review Controls

Control	Description
File	Files the displayed templates for the final report. When you click this button, you are prompted to enter a title.
Print	Prints the displayed templates. When you click this button, you are prompted to enter a title. You are then given the option of printing the templates immediately or adding them to the Page Builder, which allows you to combine several print jobs into a single print job.
Tools	Controls the shape display options. For details, refer to "Tools" on page 258.
Shape	Changes the label of the selected template(s) and associated beats. Refer to "Reviewing Templates" on page 124 for instructions on using this control.

Control	Description
Review	Scrolls through the beats that are contained within the selected template. When you click this button, you can scroll forward and backward through the ECG strip reviewing only those beats .
Demix	Places the beats one on top of another to help you split a template with mixed morphology into separate templates. You can manually separate the shapes, or you can let the system separate them. For details, refer to "Demixing a Template" on page 128.
Group	Navigates between the available template groups. Refer to "Reviewing Templates" on page 124 for details on using this control.
Unmerge	Splits a merged template into its original template groupings. This control is available only when a merged template is selected in the ***Shape Review*** window.

Reviewing Shapes

Use the following procedures to review and relabel templates and beats, to demix a template, and to superimpose beats. These procedures are written with the assumption that you have already selected a patient. Refer to "Selecting a Patient Record" on page 111 for instructions.

Reviewing Templates

Review the templates to determine whether any shapes were mislabeled and to identify any anomalies that require further scrutiny or inclusion in the final report. The following procedure describes how to review templates, review the beats within a template, relabel a template or a group of templates, and how to relabel the beats within a template.

1. After selecting a patient, click the ***Shape Review*** icon.

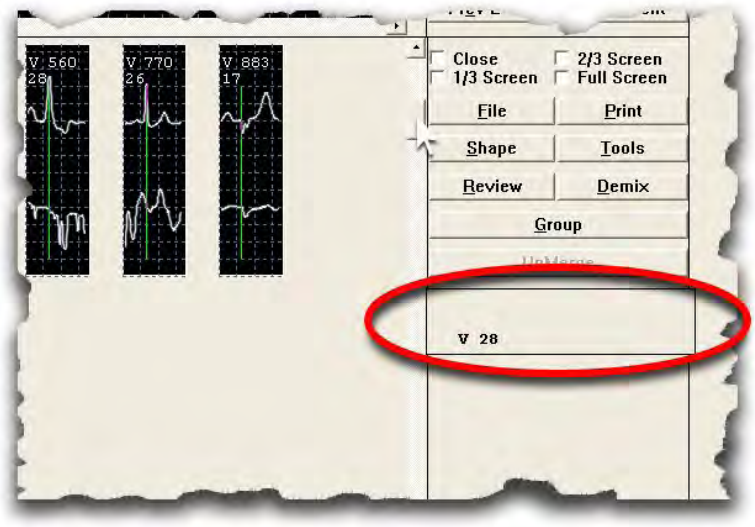
   The ***Shape Review*** and ***Strip Review*** windows open for the selected patient.

2. To adjust the display of the ***Shape Review*** window, use the ***Tools*** button in the ***Shape Review*** control panel.

   Refer to "Tools" on page 258 for details on using the Tools panel.

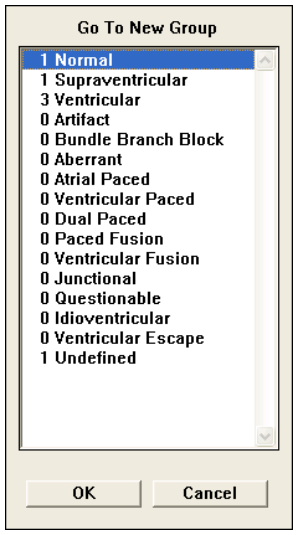
3. To navigate through the templates, do either of the following:

   - In the ***Shape Review*** window, use the vertical scroll bar.
     Click the scroll bar arrows to move through the templates one page at a time, or drag the scroll box to jump to a new group of templates.



If you drag the scroll box, the label and number of beats of the first template on the destination page are displayed in the control panel (see circle in the previous illustration). This helps identify the page to stop on.

- Click the ***Group*** button.
  The ***Go to New Group*** control panel opens.



The panel lists all the available beat types. The numeral to the left of each type identifies the number of templates for that type. To jump to a group, select the beat type and click ***OK***. The templates will be displayed in the ***Shape Review*** window.

4. To review the beats within a template, do the following:

   a. Click the template to be reviewed.

      The template changes color to indicate it has been selected. The cursor in the ***Strip Review*** window jumps to the first beat in the template.

   b. Click the ***Review*** button in the ***Shape Review*** control panel.

      The following control panel opens.

      The template class, current beat number, and total number of beats are displayed at the top of the panel.

   c. To jump to the next beat in the template, click ***Next Beat***.

      The next beat is selected in the ***Strip Review*** window and the current beat number changes.

      NOTE:
      The button is not available when the last beat in the template is selected.

   d. To jump to the previous beat in the template, click ***Previous Beat***.

      The previous beat is selected in the ***Strip Review*** window and the current beat number changes.

      NOTE:
      The button is not available when the first beat in the template is selected.

   e. Repeat step b and step c as necessary to review the beats.

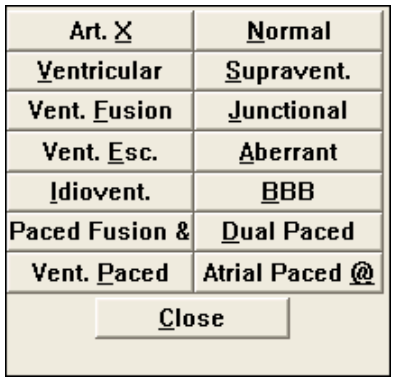
5. To adjust the display of the ECG strip or to use any of the available instruments to measure the beats, use the ***Tools*** button in the ***Strip Review*** control panel.

   Refer to "Tools" on page 258 for details on using the Tools panel.

6. To relabel the selected beat, do either of the following:

   - In the ***Strip Review*** control panel, click the ***Shape*** button.

The following buttons appear:



Click the button listing the label to which you want to change the beat. For example, to change a beat to Ventricular, click the ***Ventricular*** button.

- Press the key corresponding to the underlined letter of the new label. For example, to change a beat to Ventricular, press **V**.

  NOTE:
  You do not need to open the Shape panel in order to use the keyboard shortcut to relabel a beat.

Regardless of which method you use, the beat's label changes. Repeat for each beat you want to relabel.

7. To adjust multiple beats at once, click the ***Region*** button in the ***Strip Review*** control panel.

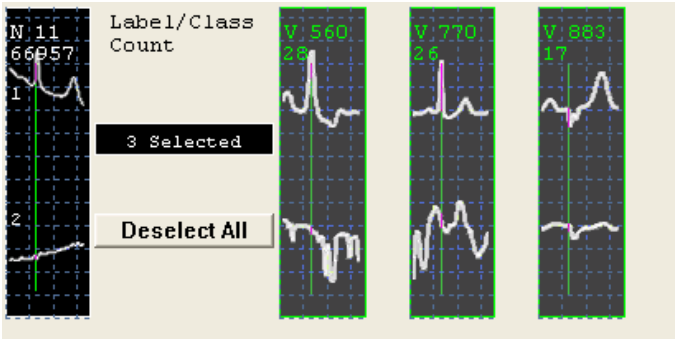
   Refer to "Region" on page 253 for instructions on using the Region control panel.

8. To relabel one or more templates, do the following:

   a. Select the template or templates to relabel.

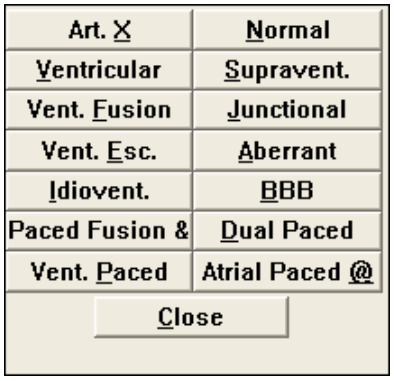
      - To select a single template, click on the template using the left mouse button.
        The selected template changes color to indicate is has been selected. The first beat in the template is selected in the ***Strip Review*** window.
      - To select multiple templates, click on each template using the middle mouse button.

The selected templates change color to indicate they have been selected. The number of selected templates is displayed to the left of the first beat, and a ***Deselect All*** button appears.



b. Do one of the following:

- In the ***Shape Review*** control panel, click the ***Shape*** button. The following buttons appear:



  Click the button listing the label to which you want to change the template(s). For example, to change a template to Ventricular, click the ***Ventricular*** button.

- Press the key corresponding to the underlined letter of the new label. For example, to change a template to Ventricular, press **V**.

  NOTE:
  You do not need to open the Shape panel in order to use the keyboard shortcut to relabel a template.

  Regardless of which method you use, the selected template(s) and all the beats within the template(s) are relabeled. Repeat for each template you want to relabel.

9. Repeat these steps until you have reviewed and relabeled all the templates and beats as necessary.

Demixing a Template

Occasionally, a template may contain mixed morphologies, that is, a template may contain shapes that do not match. In cases like this, you want to split that template into a separate template for each distinct shape. For example, suppose a template contains both normal and ventricular beats. You could correct this by reviewing the individual beats within the template and manually relabeling them one by one, but

that would be a long and tedious process. Instead, you can use the Demix control to let the system separate the distinct shapes into separate templates.

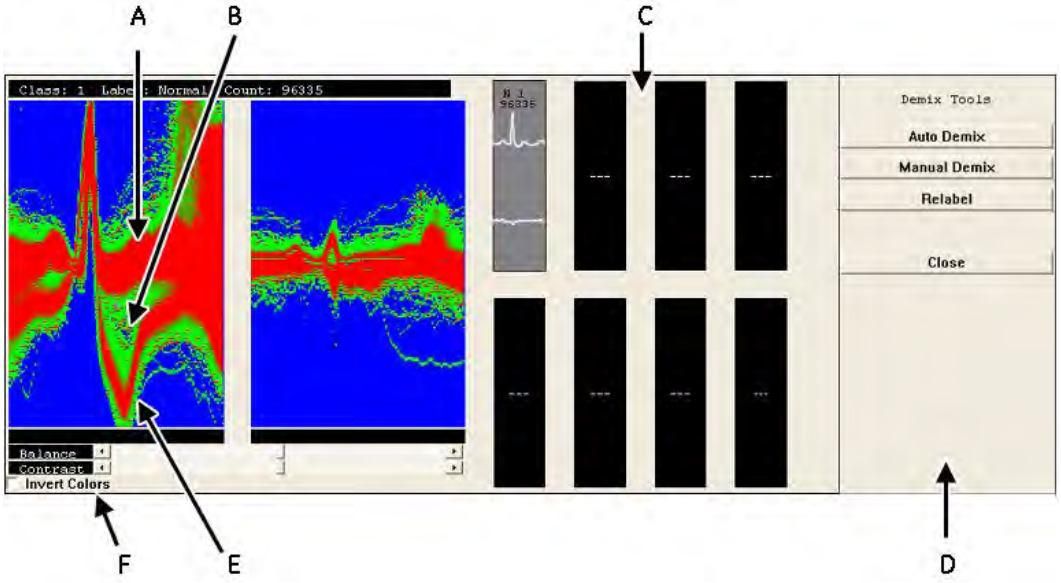
The Demix control lets you lets you manually separate shapes within a template, or you can let the system separate them.

1. Select a template with mixed morphology.

   The selected template changes color to indicate it has been selected.

2. Click the ***Demix*** button in the ***Shape Review*** control panel.

   The ***Shape Review*** window and control panel change as seen in the following illustration.



   In the panels on the left, the beats are laid one on top of another. As more beats are laid on top of each other, they are outlined in red (A). Beats that do not match the dominant beats, called outliers, are outlined in green (E). The gap between the dominant beats and outliers, called the doughnut hole (B), is the shape you would select to demix the template manually.

3. To adjust the display of the waveforms for better visibility, use the display controls (F) below the waveforms.

   With these controls you can adjust the balance and contrast. You can also invert the colors.

4. To automatically demix the template, click the ***Auto Demix*** button in the Demix panel (D).

   The system reviews the shapes and splits the second most dominant shape into another template, which is added to the template grouping to the right of the waveforms (C). The new template retains the same label as the original template.

   NOTE:

   For most cases, GE Healthcare recommends that you manually demix templates, as this gives you greater control over the process. Refer to step 5 for details.

5. To manually demix a shape, click in the doughnut hole (B) and click the ***Manual Demix*** button in the Demix panel (D).

   The system extracts the selected shape into another template, which is added to the template grouping to the right of the waveforms (C). The new template retains the same label as the original template.

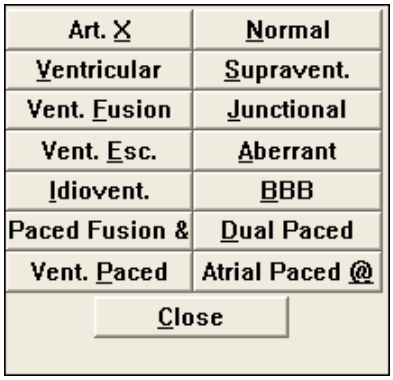
6. Repeat step 4 and step 5 until you have separated all the mismatched shapes.

   You can select any of the new templates (C) to demix them as well.

7. To relabel any of the templates, select the desired template and do the following:

   a. Click the ***Relabel*** button in the Demix panel (D).

      The following buttons appear:



   b. Click the button listing the label to which you want to change the template.

      For example, to change a template to Ventricular, click the ***Ventricular*** button.

8. When you are done demixing the templates, click ***Close*** in the Demix panel (D).

   The ***Demix*** window closes and you return to the ***Shape Review*** window.

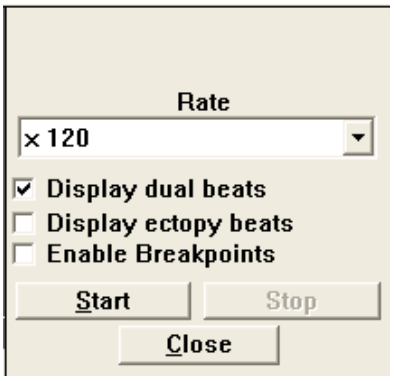
9. Repeat step 1 through 8 for each template you need to demix.

Superimposing Beats

Use Superimpose to review beats in rapid succession so you can observe the progression of the ECG. By superimposing the beats, it is easier to spot changes on a beat-by-beat basis.

1. In the ***Strip Review*** control panel, click ***Superimpose***.

   The following panel opens.



2. Set the options as appropriate.

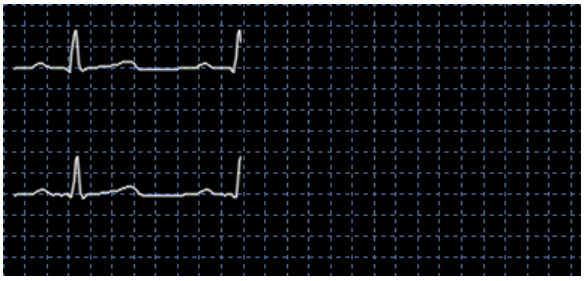
   Refer to the following table for details.

Field	Description
Rate	Sets the speed at which the beats are displayed. Options are ***x80***, ***x120***, ***x240***.
Display dual beats	Displays beats in pairs. This shows beats in context, allowing you to see how the RR interval changes beat to beat.
Display ectopy beats	Calls out ectopic beats by displaying them on the right side of the screen.
Enable breakpoints	Stops the superimposition when it reaches a marked event. This allows you to review the event in context. You can then resume the superimposition from the point at which it stopped.

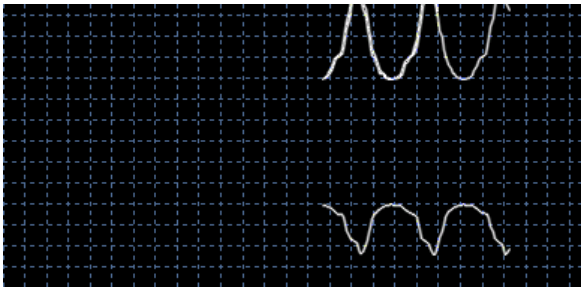
3. After the options are set, click ***Start***.

   The beats are displayed at the selected rate on the left side of the ***Strip Review*** window, as seen in the following illustration.

   NOTE:
   Depending on the ***Strip Review Tools*** settings, the grid seen in the following illustration may not appear on your system.



   If ***Display ectopy beats*** is selected, ectopic beats are displayed on the right of the strip, as seen in the following illustration.



   Once started, the superimposition will continue from the current location of the cursor to the end of the ECG, unless ***Enable Breakpoints*** is set and an event is encountered.

4. To manually stop the display, do either of the following:

   - Click the ***Stop*** button in the control panel. You can restart the superimposition by clicking the ***Start*** button.
   - Click in the ***Strip Review*** window then press **<Space>**. You can restart the superimposition by pressing **<Space>** again.

   When you stop the superimposition, the grid closes, if it were enabled in the ***Strip Review Tools***, and you return to the ECG strip. You can now review or modify the ECG from the current position.

5. Repeat step 3 through step 4 as necessary.

Reviewing Episodes

The ***Episode Review*** application lets you review histograms that plot the distribution of specific episodes throughout an ECG. Histograms are available for the following cardiac events:

- Heart Rate
- N-N Interval
- N-N Ratio
- N-V Interval
- N-V Ratio
- R-R Interval
- R-R Ratio
- Spike-QRS-Spike [1]
- SVE Bigeminy
- SVE Quadrigeminy
- SVE Run Length
- SVE Run Rate
- SVE Trigeminy
- VE Run Length
- VE Run Rate
- VE Bigeminy
- VE Quadrigeminy
- VE Trigeminy

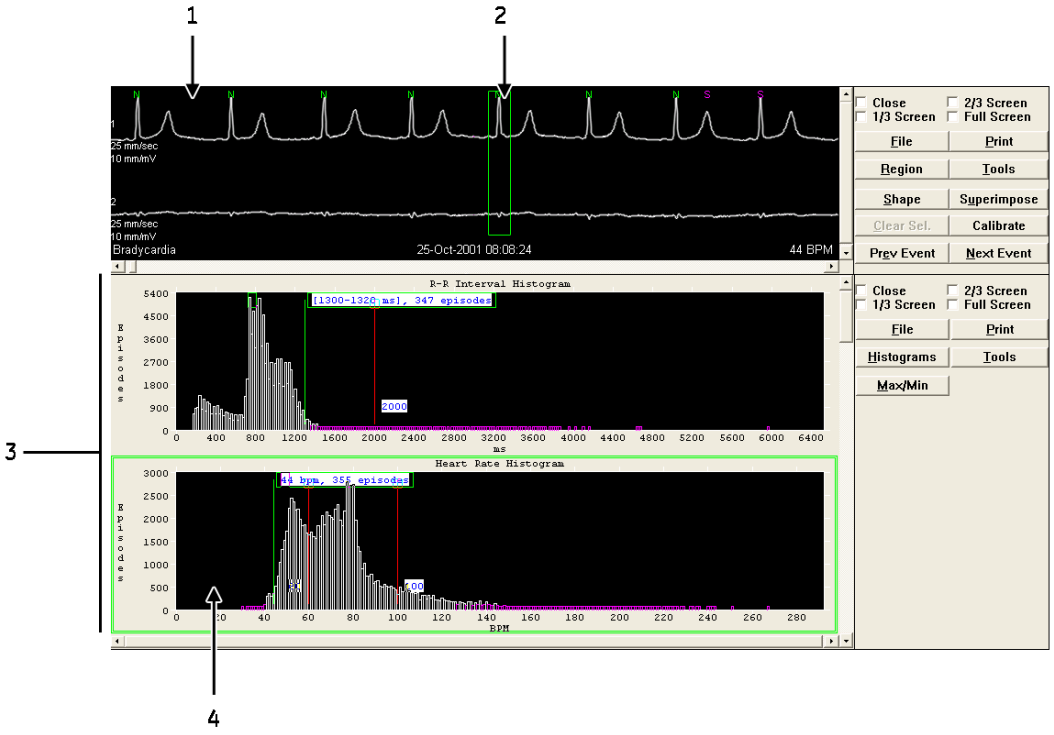
1 Available only for pacemaker patients.

This section describes the page layout of the ***Episode Review*** application, lists the available controls, and provides instructions for selecting histograms, setting the minimum and maximum values for a histogram, and filing the minimum and maximum episodes on the final report.

Episode Review Page Layout

The ***Episode Review*** application consists of the following components:

NOTE:
All examples in this section use the ***Standard*** application menu. If you use a different menu, your page layout may differ.

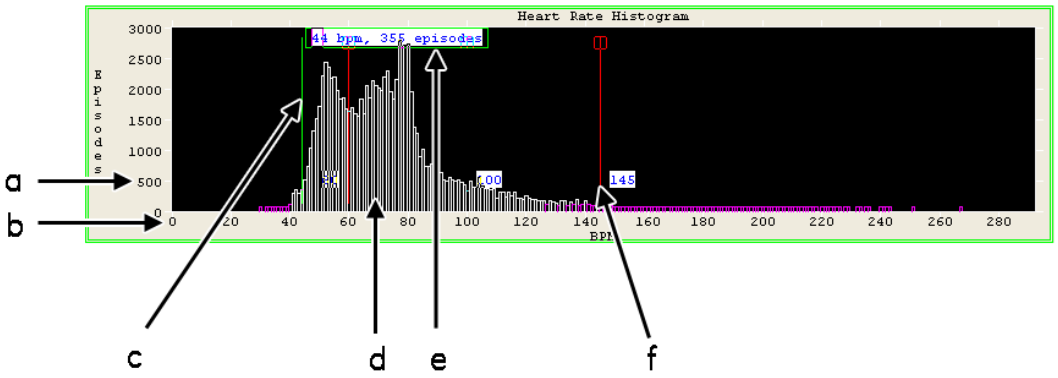


1. **Strip Review Window**
   Used to review and modify individual beats within the selected histogram.

2. **Selected Beat**
   Identified by a green box.

3. **Episode Review Window**
   Used to select and review individual episode histograms.

4. **Individual Histogram**
   Used to review the distribution of episodes for the selected event. The individual histograms consist of the following components.



   a. **Y-Axis**
      In all histograms, the y-axis indicates the number of episodes. The scale of the y-axis varies depending on the number of episodes for a specific event. For example, the R-R Interval Histogram may have a scale of 0 to 5400 episodes, while the N-V Interval Histogram may have a scale of 0 to 10 episodes.

   b. **X-Axis**

The x-axis indicates the unit for which the episodes are being measured. This varies from histogram to histogram. For example, the x-axis could be beats per minute (BPM), total beats, milliseconds (ms), or cycles.

c. **Cursor**
The cursor is a green line that indicates the position in the histogram represented by the beat selected in the strip. For example, the cursor in this example is at 44 BPM, indicating that the beat selected in the strip is one of the beats at the 44 BPM mark. As you move the cursor in the ***Strip Review***, this cursor moves accordingly, and vice versa.

d. **Histogram**
The histogram is a bar chart that shows the distribution of the individual episodes.

e. **Cursor label**
The cursor label is a text description of the values at the cursor's current location. In this example, we can see that there are 355 episodes at 44 BPM.

f. **Event Threshold**
The Event Threshold is a red marker used to identify the location of the event limits as defined on the ***Patient: Event Definitions Settings and Analysis Results*** or ***System: Event Definitions Setup*** windows. In this example, an event threshold marker in the Heart Rate Histogram is located at 145 BPM, which is the maximum limit defined on the ***Patient: Event Definitions Settings and Analysis Results*** window for a sinus heart rate; anything over 145 BPM is labeled tachycardia. Depending on the event, some histograms may have two or more such threshold markers. For more information on the event definitions, refer to "Event Definitions" on page 32 and "Overriding Patient Settings" on page 116.

Episode Review Controls

Although they are used together to review episodes, the ***Episode Review*** and ***Strip Review*** windows serve different purposes and have separate controls. The ***Episode Review*** window and controls are used to review and edit the episode histograms. The ***Strip Review*** window and controls are used to review and edit the individual beats that comprise the episodes.

The ***Episode Review*** controls are described in the following table. For a description of the ***Strip Review*** controls, refer to "Strip Review Controls" on page 123.

Control	Description
File	Files the selected histogram on the final report. Refer to "File" on page 249 for more information.
Print	Prints the displayed histograms. Refer to "Print" on page 250 for more information.
Histograms	Selects the histograms to display. For details on using this control, refer to "Selecting Histograms" on page 138.

Control	Description
Tools	Sets the histogram display options. For details on using this control, refer to "Setting the Episode Display Options" on page 136.
Max/Min	Selects the maximum and minimum episodes for the selected histogram. For details on using this control, refer to "Setting the Maximum and Minimum Episodes" on page 141.

Reviewing Episodes

Use the following procedures to set the episode display options, select which histograms to display, and set the maximum and minimum episodes for a histogram.

NOTE:
Each procedure is written with the assumption that you have already selected a patient. Refer to "Selecting the Patient" on page 107 for instructions.

Setting the Episode Display Options

The Tools control allows you to set the following display options:

- Scale
- Label display
- Zoom factor
- Plot size

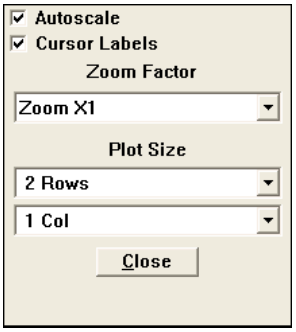
These settings affect all the histograms, not just the selected histogram. Use the following instructions to set each option to suit your needs.

1. Click the ***Episode Review*** icon.

   The ***Episode Review*** and ***Strip Review*** windows open with their default settings.

2. In the ***Episode Review*** control panel, click ***Tools***.

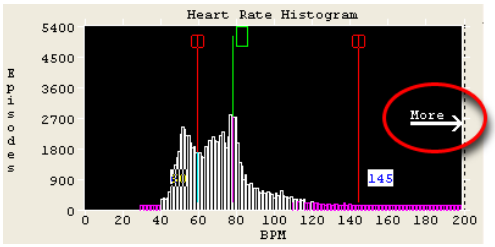
   The following panel opens.



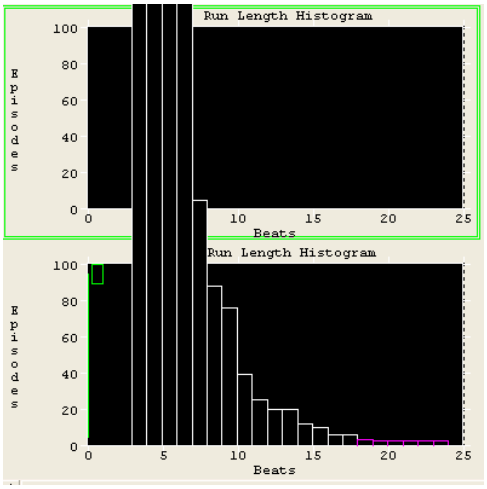
3. To turn off the automatic scaling of the x and y axes, clear the ***Autoscale*** field.

   Automatic scaling, which is enabled by default, ensures that the entire histogram is visible within the available space. If automatic scaling is disabled, portions of the histogram may not be visible. If portions of the x-axis cannot fit within the

available space, a warning appears on the histogram to indicate that there are more data than can be displayed, as seen circled in the following illustration.



If the number of episodes exceeds the scale of the y-axis, the bar chart will extend beyond the histogram's borders, as seen in the following illustration.



For these reasons, GE Healthcare recommends that you leave ***Autoscale*** selected.

4. To disable the cursor label, clear the ***Cursor Labels*** field.

   The cursor label provides valuable information about the cursor's current location. However, if the histogram becomes cluttered, or if the label interferes with the use of the **Event Threshold** marker, you can turn off the label.

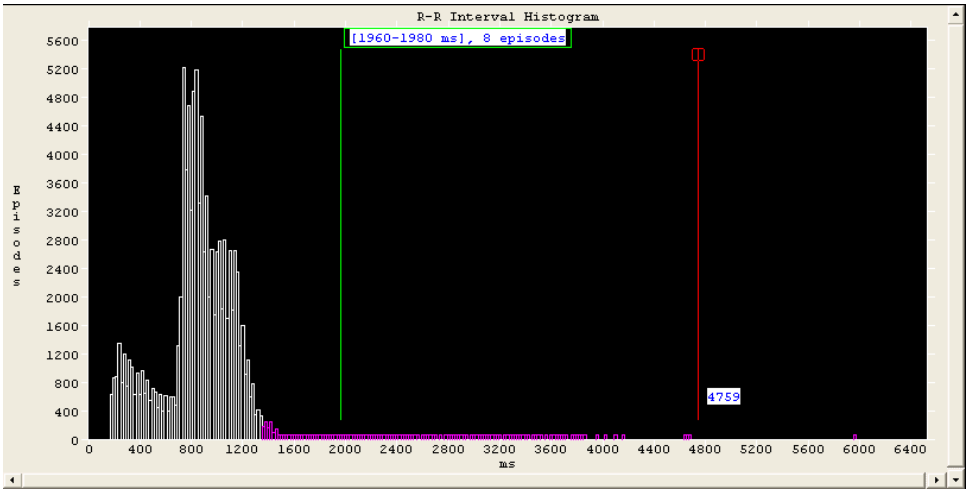
5. To change the size of the histogram without changing the scale, select the appropriate value from the ***Zoom Factor*** field.

   You have four zoom magnifications: ***X1*** (the default), ***X2***, ***X5***, and ***X10***. As with the automatic scaling feature (see step 3), changing the scale may cause portions of the histogram to be unviewable.

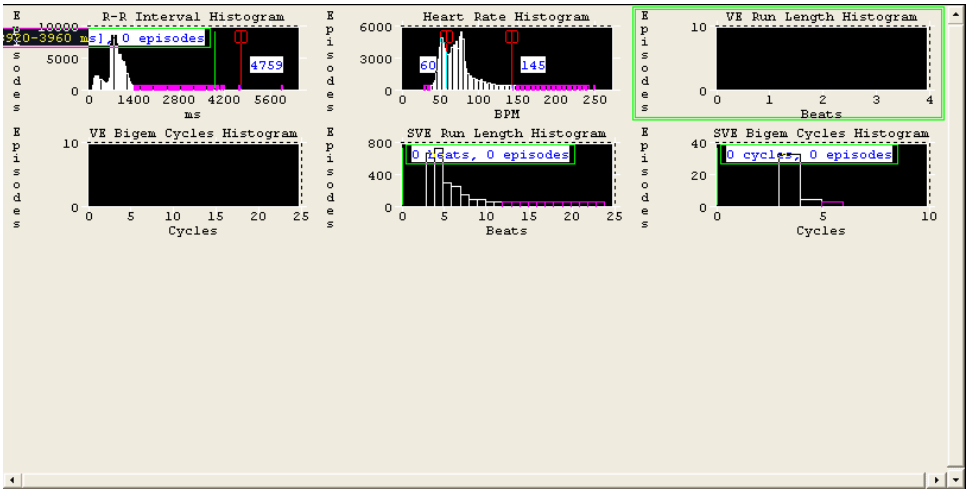
6. To change the number of histograms visible at once, change the ***Plot Size*** fields.

   Plot Size lets you select the number of rows and the number of columns to be displayed. The default is 2 rows and 1 column. You can, however, select from 1 to 4 rows and from 1 to 3 columns. Your selection has an impact on the legibility

of each histogram. For example, the following illustration, in which ***Plot Size*** is set to 1 row and 1 column, is clear and legible:



The following example, though, in which ***Plot Size*** is set to 4 rows and 3 columns, is less legible but provides a broader view of the patient's episodes:



7. After you set the display options, click ***Close*** to close the ***Tools*** panel and return to the ***Episode Review*** control panel.

Selecting Histograms

The ***Episode Review*** application provides several predefined histogram groups. In addition, it provides the option to switch one histogram for another. The following table lists the five histogram groups that provide access to the most commonly used histograms and the histograms available in each group. GE Healthcare recommends that you review all the available histogram groups to learn what histograms are available in each group.

	Standard	VE / SVE	VE	SVE	Advanced
Heart Rate	X	X			X
N-N Interval				X	X
N-N Ratio					X
N-V Interval			X	X	X
N-V Ratio			X		X
R-R Interval	X	X			X
R-R Ratio				X	X
Spike-QRS-Spike					
SVE Bigeminy Cycles	X	X			X
SVE Quadrigeminy Cycles					
SVE Trigeminy Cycles		X			
SVE Run Length	X	X		X	X
SVE Run Rate		X		X	X
VE Run Length	X	X	X		X
VE Run Rate		X	X		X
VE Bigeminy Cycles	X	X	X		X
VE Quadrigeminy Cycles			X		
VE Trigeminy Cycles		X	X		

Use the following procedures to change histogram groups and to switch histograms.

1. In the ***Episode Review*** control panel, click ***Histogram***.

   The following control panel opens.

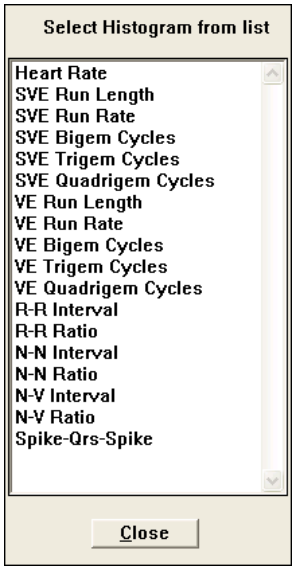
2. To change histogram groups, click on the group to use.

   The histograms in the ***Episode Review*** window change automatically. Depending on your display options and the group you selected, the change may not be noticeable immediately.

3. To switch individual histograms, do the following:

   a. Click ***Select Histogram***.

      The following control panel opens.



   b. In the ***Episode Review*** window, click on the target histogram (that is, the histogram you want to switch from).

      A green border surrounds the selected histogram.

   c. In the ***Select Histogram from List*** panel, click on the destination histogram (that is, the histogram you want to switch to).

      The destination histogram immediately replaces the target histogram in the ***Episode Review*** window.

   d. Repeat step a and step b for each histogram you want to switch.

   e. When done, click ***Close*** to return to the histogram group control panel.

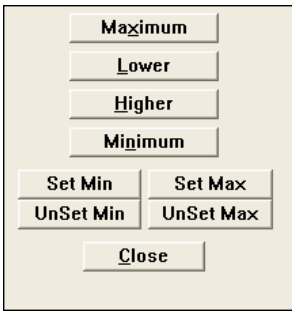
4. When you are done selecting histograms, click ***Close*** on the histogram group control panel to return to the Episode Review control panel.

Setting the Maximum and Minimum Episodes

Setting the maximum and minimum episodes for a histogram is the process of finding the true maximum and minimum point for each event and then filing that episode for the final report. While the criteria for what constitutes a true maximum or minimum will vary from histogram to histogram, the process is identical for all histograms.

1. Click the ***Max/Min*** button.

   The following control panel opens.



2. To set the maximum episode for a histogram, do the following:

   a. Click on the histogram you want to set the maximum for.

      A green border indicates that the histogram is selected.

   b. Click ***Maximum*** in the Episode Review control panel.

      The MARS system analyzes the episodes and moves the cursor to the most likely candidate for maximum in both the ***Episode Review*** window and the ***Strip Review*** window.

   c. Review the candidate in the ***Strip Review*** window to verify that it is a true maximum.

      The criteria for determining whether a candidate is a true maximum varies depending on a number of factors, including which histogram is being reviewed. For example, when reviewing the maximum for R-R Interval, you want to verify that the beat immediately preceding the candidate is properly labeled; if not, the candidate is not a true maximum and you need to look for the next likely candidate.

   d. If the candidate is not a true maximum, click ***Lower*** in the ***Episode Review*** window.

      The cursors in the ***Episode Review*** and ***Strip Review*** windows move to the next most likely candidate for maximum.

   e. Repeat step b and step c until you find the true maximum.

f. Once you identify the true maximum, click ***Set Max*** in the ***Episode Review*** control panel.

NOTE:
If you pick the wrong candidate for maximum, you can undo the selection by clicking ***UnSet Max*** in the ***Episode Review*** control panel.

g. Once you set the maximum episode, click ***File*** in the ***Strip Review*** control panel to file the strip for the final report.

For details on filing a strip for the final report, refer to "File" on page 249.

3. To set the minimum episode for a histogram, do the following:

a. Click on the histogram you want to set the minimum for.

A green border indicates that the histogram is selected.

b. Click ***Minimum*** in the ***Episode Review*** control panel.

The MARS system analyzes the episodes and moves the cursor to the most likely candidate for minimum in both the ***Episode Review*** window and the ***Strip Review*** window.

c. Review the candidate in the ***Strip Review*** window to verify that it is a true minimum.

The criteria for determining whether a candidate is a true minimum varies depending on a number of factors, including which histogram is being reviewed. For example, when reviewing the minimum for R-R Interval, you want to verify that the beat immediately preceding the candidate is properly labeled; if not, the candidate is not a true minimum and you need to look for the next likely candidate.

d. If the candidate is not a true minimum, click ***Higher*** in the ***Episode Review*** window.

The cursors in the ***Episode Review*** and ***Strip Review*** windows move to the next most likely candidate for minimum.

e. Repeat step b and step c until you find the true minimum.

f. Once you identify the true minimum, click ***Set Min*** in the ***Episode Review*** control panel.

NOTE:
If you pick the wrong candidate for minimum, you can undo the selection by clicking ***UnSet Min*** in the ***Episode Review*** control panel.

g. Once you set the minimum episode, click ***File*** in the ***Strip Review*** control panel to file the strip for the final report.

For details on filing a strip for the final report, refer to "File" on page 249.

4. Repeat step 2 and step 3 for each histogram for which you want to set the maximum and minimum episodes.

5. After you have filed all the maximum and minimum episodes you need, click ***Close*** in the ***Max/Min*** control panel to return to the ***Episode Review*** control panel.

Adjusting SVEs

The ***SVE Editor*** allows you to adjust event definitions for the current ECG and review the effects of those adjustments in real-time. Although this can be used to adjust all event definitions, it is used primarily to adjust the ***SVE Prematurity*** percentage. This section primarily focuses on that use, but the same principles can be applied to all event definitions.

NOTE:

You can also change event definitions by modifying the system-wide event definitions ("Event Definitions" on page 32) or the patient event definitions ("Overriding Patient Settings" on page 116), although neither method provides real-time review of the results.

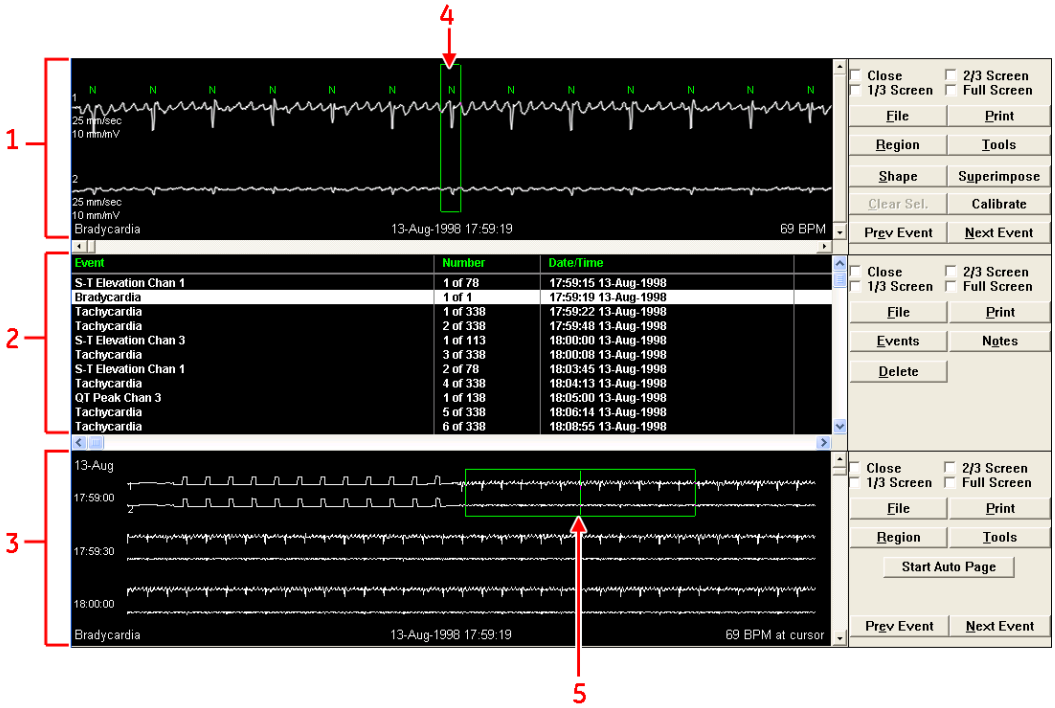
The following sections describe the ***SVE Editor*** page layout, list the available controls, and instruct you on how to adjust the SVE Prematurity.

SVE Editor Page Layout

The ***SVE Editor*** consists of the following components:

NOTE:

All examples in this section use the ***Standard*** application menu. If you use a different menu, your page layout may differ.



1. **Strip Review window**
   Used to review and modify the beat associated with the selected event.
2. **Event Diary window**
   Used to review and edit events recorded for the selected patient study.
3. **Page review window**

Used to review the selected beat in context within the ECG.

4. **Strip Review cursor**
   Identifies the current location within the strip. When a beat is selected, the cursor changes to a green box.

5. **Page Review cursor**
   Indicates the position of the strip within the context of the entire ECG. The green box indicates the area displayed in the ***Strip Review*** window.

SVE Editor Controls

Although used together to review and adjust events and their definitions, the ***Strip Review***, ***Event Diary***, and ***Page Review*** windows serve different purposes and have separate controls. The ***Strip Review*** window and controls are used to review and edit individual beats within the strip. The ***Event Diary*** window and controls are used to review the individual events and adjust their definitions. The ***Page Review*** window and controls are used to review and edit the selected event in context within the ECG.

The ***Event Diary*** and ***Page Review*** controls are described in the following tables. For information on the Strip Review controls, refer to "Strip Review Controls" on page 123.

Event Diary Controls

Control	Description
File	Files the currently displayed events on the final report. Refer to "File" on page 249 for more information.
Print	Prints the currently displayed events. Refer to "Print" on page 250 for more information.
Events	Edits the event display options and adjusts the event definitions. For more information, refer to "Adjusting the SVE Prematurity" on page 145.
Notes	Adds patient diary notes to the list. For details, refer to "Notes" on page 252.
Delete	Removes the selected event from the diary. How events are deleted varies depending on whether it is a system recorded event or a patient diary events. Patient diary events are simply removed from the list. System generated events, however, are replaced with 5 seconds of noise on either side of the event. Any event within that 10 second window of noise will be removed from the ECG.

Page Review Controls

Controls	Description
File	Files the currently displayed page of ECG on the final report. Refer to "File" on page 249 for more information.
Print	Prints the currently displayed page of ECG. Refer to "Print" on page 250 for more information.
Region	Allows you to edit a contiguous range of beats simultaneously. For more information, refer to "Region" on page 253.
Tools	Allows you to edit the display options. For more information, refer to "Tools" on page 258.

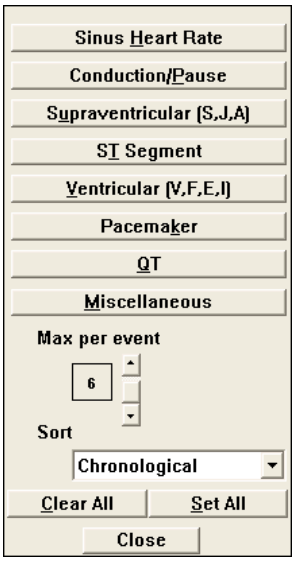
Controls	Description
Start Auto Page	Scrolls automatically through the ECG one page at a time. When you click the button, it changes to ***Stop Auto Page***. Click ***Stop Auto Page*** to stop automatic scrolling.
Prev Event	Moves the cursor to the nearest event preceding the cursor's current position. Use it in conjunction with ***Next Event*** to review suspect beats within the ECG.
Next Event	Moves the cursor to the nearest event following the cursor's current position. Use it in conjunction with ***Prev Event*** to review suspect beats within the ECG.

Adjusting the SVE Prematurity

Use the following procedure to adjust the ***SVE Prematurity*** settings. The same principles also can be used to adjust the definitions for other events. The procedure is written with the assumption that the patient has already been selected. For more information, refer to "Selecting the Patient" on page 107.

1. In the Event Diary control panel, click ***Events***.

   The following panel opens.



2. To adjust the number of episodes displayed per event, adjust the ***Max per event*** field.

   Use the arrow buttons to the right of the field to change the number. Click the top arrow to increase the number. Click the bottom arrow to decrease the number. By default, it is set to a maximum of 3 episodes per event, but can be changed to any value from 1 to 999.

   The change is reflected immediately in the ***Event Diary*** window.

3. To change the order in which episodes are displayed, select the desired sort order from the ***Sort*** field.

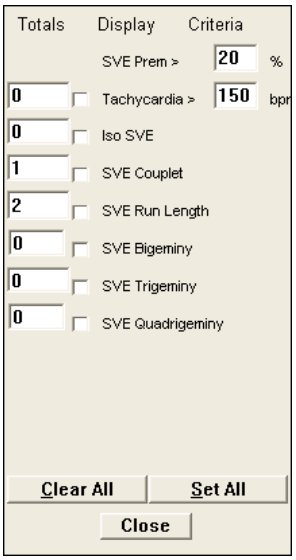
   By default, episodes are displayed in descending priority mode. You can also choose to sort them chronologically.

4. Click ***Clear All***.

   All events are cleared from the ***Event Diary*** window.

5. Click ***Supraventricular (S,J,A)***.

   The following control panel opens:



   The ***Totals*** column indicates the number of episodes identified for each SVE event type. As you change the event criteria, these fields update accordingly. In this example, The ECG contains a single SVE Couplet and two SVE Run Length episodes.

   The ***Display*** column identifies which SVE event types have been selected for display. A check mark next to an event type means that the event type will be displayed in the ***Event Diary***. In this example, no SVE Event Type has yet been selected for display.

   The ***Criteria*** column lets you modify the criterion for the event type. Not all event types have a criterion. These values default from the system or patient event definitions.

6. Select the SVE event types to display.

   - To display all SVE event types, click ***Set All***.
   - To display select SVE event types, select the corresponding check boxes in the ***Display*** column.

   The ***Event Diary*** window updates immediately with the selected events.

7. Review the episodes listed in the ***Event Diary*** window to determine whether each episode is a true episode or a misdiagnosed episode.

   When you click on an episode, the corresponding beat is selected in the ***Strip Review*** and ***Page Review*** windows. Review the beat in context to determine whether it is a true episode.

8. If a large number of episodes are mislabeled, use the following procedure to adjust the ***SVE Prematurity*** percentage.
   a. In the ***Supraventricular (S,J,A)***control panel, increase the ***SVE Prem*** percentage.

      Increasing the percentage decreases the number of qualifying SVEs. GE Healthcare recommends that you adjust the percentage in 5% increments.

   b. Click outside of the ***SVE Prem*** field.

      The ***Event Diary*** window updates with the new episode count. The numbers in the ***Totals*** column update accordingly.

   c. Review the remaining episodes.

   d. Repeat step f through step b until you are satisfied with the quality and quantity of the remaining episodes.
9. When you are done, click ***Close*** on the ***Supraventricular (S,J,A)*** control panel to return to the Events control panel.
10. Click ***Close*** on the ***Events*** control panel to return to the ***Event Diary*** control panel.

Reviewing Trends

The ***Trend Review*** application allows you to review and edit trends detected in the ECG. You have the following options while reviewing trends:

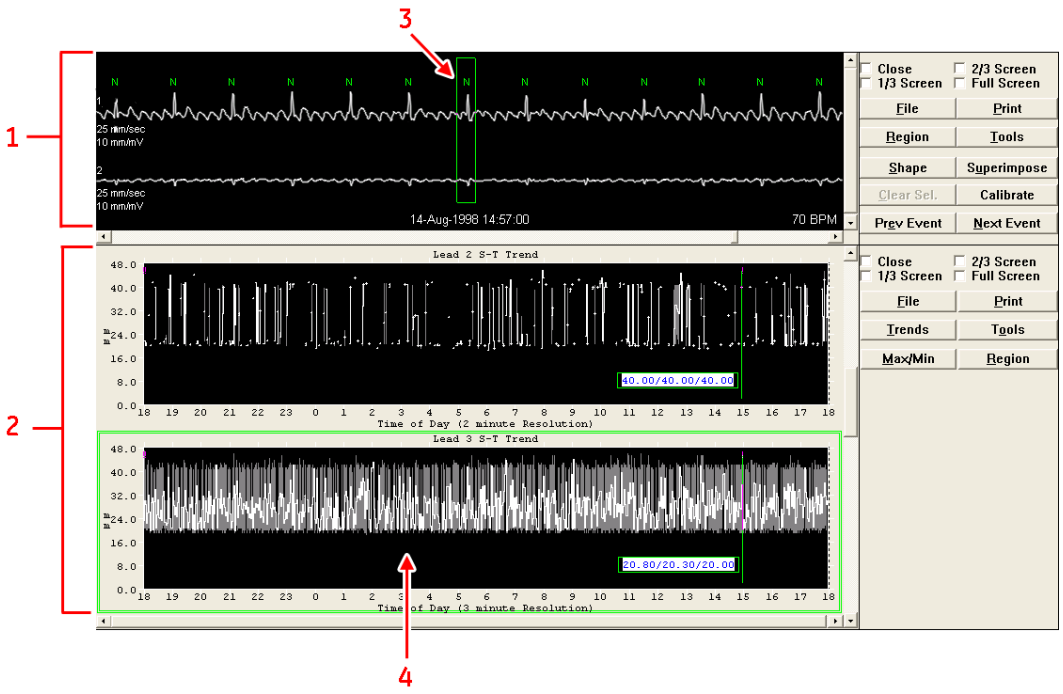
- Selecting trends to review
- Filing trends on the final report
- Setting a trend's minimum and maximum values
- Editing a region within a trend

The remainder of this section describes the ***Trend Review*** page layout, identifies its available controls, and instructs you on how to review and edit trends.

Trend Review Page Layout

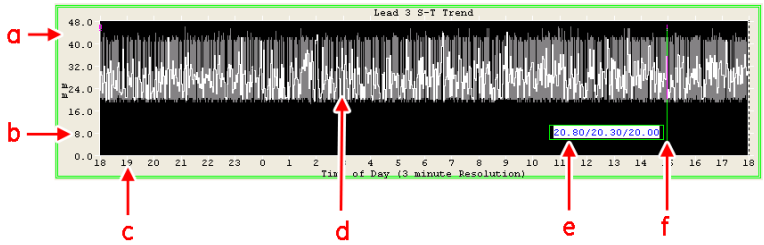
The ***Trend Review*** application consists of the following components.

NOTE:
The examples in this section use the ***Standard*** menu. If you use a different menu, your page layout may differ.



1. ***Strip Review*** window
   Used to review and edit individual beats within a trend.
2. ***Trend Review*** window
   Used to select and review individual trends in the ECG.
3. ***Strip Review*** cursor
   Identifies the current location within the ECG. When between beats, the cursor is a single green line. When a beat is selected, it is a green box. Synchronized with the cursors in the accompanying trends.
4. ***Trend Review*** diagram
   Used to review the individual trends. Depending on the trend group selected and the display options, not all trends may be visible at the same time. In this case, use the scroll bar along the right of the screen to scroll through the available trends.

The individual trends consist of the following components:



a. Green border
Indicates the selected trend.

b. Y-Axis
Indicates the unit by which the trend's episodes are measured. The unit varies depending on the trend. For example, the y-axis could be beats per minute (BPM), total beats, milliseconds (ms), or millimeters (mm).

c. X-Axis
Indicates the time of day that an episode occurred. The scale of the x-axis varies depending on (a) the selected trend and (b) the selected screen size (see "Trend Review Controls" on page 150).

d. Trend diagram
Represents graphically the distribution of events across the ECG.

e. Cursor label
Indicates the value at the cursor's current location. Represents the unit of measure from the y-axis. In some cases, the value will be beats per minute. In others, it may be total beats, milliseconds, or millimeters. Check the label on the y-axis to determine the unit of measure.
The format of the label varies depending on the trend, but they all generally follow one of these three formats:

- Maximum/Average/Minimum
  For example, the Heart Rate trend indicates the maximum bpm, average bpm, and minimum bpm (70/66/55).
- Maximum/Minimum
  For example, the R-R Interval trend indicates the maximum and minimum milliseconds between R-waves (204/200).
- Current
  For example, the Paced Beats trend indicates the current number of beats (35).

f. Cursor
Indicates the current position in the trend. Synchronized with the Strip Review cursor.

Trend Review Controls

Although used together to review and adjust trends, the ***Strip Review*** and ***Trend Review*** windows serve different purposes and have separate controls. The ***Strip Review*** window and controls are used to review and edit individual beats within the strip. The ***Trend Review*** window and controls are used to review and edit the trends themselves.

The following table describes the ***Trend Review*** controls. For information on the ***Strip Review*** controls, refer to "Strip Review Controls" on page 123.

Control	Description
File	Files the currently displayed trends on the final report. Refer to "File" on page 249 for more information.
Print	Prints the currently displayed trends. Refer to "Print" on page 250 for more information.
Trends	Selects the trend groups and/or individual trends to display.
Tools	Allows you to edit the trend display options.
Max/Min	Sets the maximum and minimum values of a selected trend.
Region	Allows you to edit a range of contiguous beats within a trend. For more information, refer to "Region" on page 253.

Reviewing Trends

Use the following procedures to set the display options, select the trends to review, and set the maximum and minimum incidents. For information on editing a region within a trend, refer to "Region" on page 253.

The procedures are written with the assumption that the patient has already been selected. For more information, refer to "Selecting the Patient" on page 107.

Setting the Trend Display Options

The ***Tools*** control allows you to set the following display options:

- Scale
- Label display
- ECG Date and Time
- Plot size

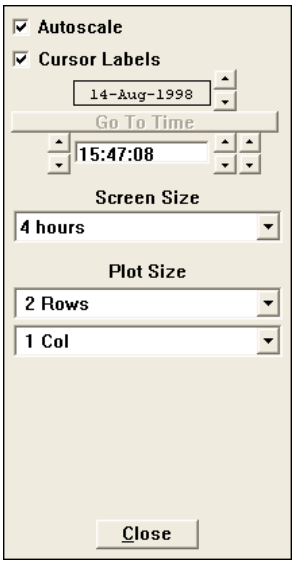
These settings affect all the trends, not just the selected trend. Use the following instructions to set each option to suit your needs.

1. Click the ***Trend Review*** icon.

   The ***Trend Review*** and ***Strip Review*** windows open with their default settings.

2. In the Trend Review control panel, click ***Tools***.

   The following panel opens.



3. To turn off the automatic scaling of the y-axis, clear the ***Autoscale*** field.

   Automatic scaling, which is enabled by default, ensures that the entire trend is visible within the available space. If automatic scaling is disabled, portions of the trend may not be visible.

   For this reason, GE Healthcare recommends that you leave ***Autoscale*** selected.

4. To set the scale of the x-axis, select the appropriate duration from the ***Screen Size*** field.

   This field determines how much of the ECG will be visible within the trend window. Options range from 5 minutes to 72 hours.

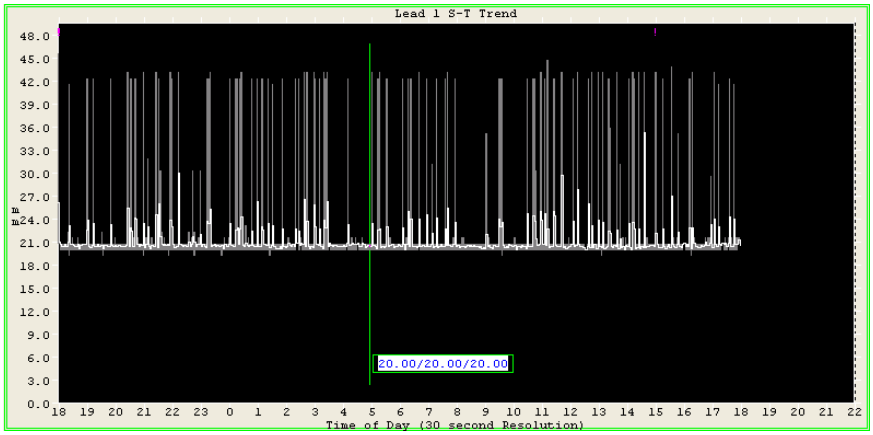
5. To disable the cursor label, clear the ***Cursor Labels*** check box.

   The cursor label provides valuable information about the cursor's current location. However, if the trend becomes cluttered, you can turn it off to improve legibility.

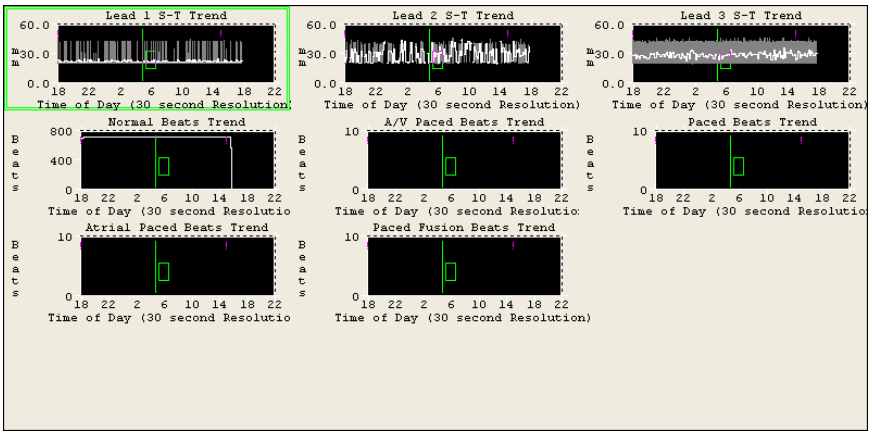
6. To change the number of trends visible at once, change the ***Plot Size*** fields.

   Plot Size lets you select the number of rows and columns to be displayed. The default is 2 rows and 1 column. You can, however, select from 1 to 4 rows and from 1 to 3 columns. Your selection has an impact on the legibility of each trend.

For example, the following illustration, in which ***Plot Size*** is set to 1 row and 1 column, is clear and legible.



The following example, though, in which ***Plot Size*** is set to 4 rows and 3 columns, is less legible but provides a broader view of the selected trends.



NOTE:

Cursor labels were turned off in the previous example for legibility.

7. To display a specific point in the ECG, do the following:

   a. Set the date using the field above the ***Go To Time*** button.

      Use the arrows to the right of the field to scroll through the available dates. The up arrow scrolls forward, and the down arrow scrolls backward.

   b. Set the time using the field below the ***Go To Time*** button.

      Use the arrows to the left of the field to change the hour. Use the arrows to the immediate right of the field to change the minutes. And use the

arrows to the far right of the field to change the seconds. In all cases, the up arrows scroll forward, and the down arrows scroll backward.

c. After the desired date and time are selected, click the ***Go To Time*** button.

The cursor jumps to the selected date and time in the ***Strip Review*** window.

8. After you set the display options, click ***Close*** to close the ***Tools*** panel and return to the ***Trend Review*** control panel.

Selecting Trends

The ***Trend Review*** application offers several predefined trend groups that provide access to the most commonly viewed trends. In addition, it offers the option to switch one trend for another.

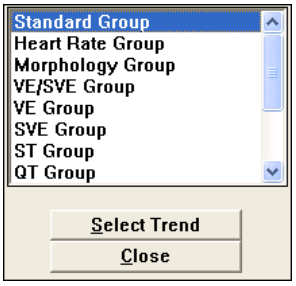
NOTE:

For information on defining your own trend groups, refer to "Trend Groups" on page 49.

Use the following procedures to change trend groups and to switch trends.

1. In the ***Trend Review*** control panel, click ***Trends***.

The following control panel opens.



2. To change trend groups, click on the group to use.

The trends in the ***Trend Review*** window change automatically. Depending on your display options and the group you selected, the change may not be noticeable immediately.

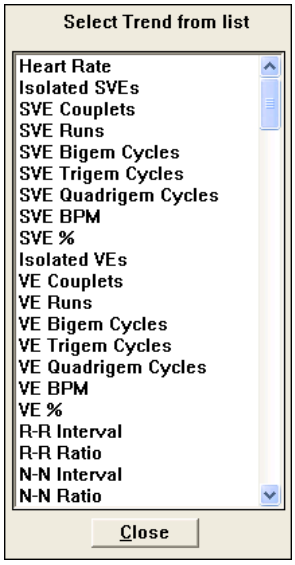
NOTE:

GE Healthcare recommends the use of the VE/SVE Group: it contains Heart Rate, VE Couplets, VE Isolated, SVE Couplets, and SVE Isolated. It is easiest to find and file isolated VEs and SVEs using this group.

3. To switch individual trends, do the following:

   a. Click ***Select Trend***.

      The following control panel opens.



   b. In the ***Trend Review*** window, click on the target trend (that is, the trend you want to switch from).

      A green border surrounds the selected trend.

   c. In the ***Select Trend from List*** panel, click on the destination trend (that is, the trend you want to switch to).

      The destination trend immediately replaces the target trend in the ***Trend Review*** window.

   d. Repeat step a and step b for each trend you want to switch.

   e. When you are done, click ***Close*** to return to the ***Trend Group*** control panel.

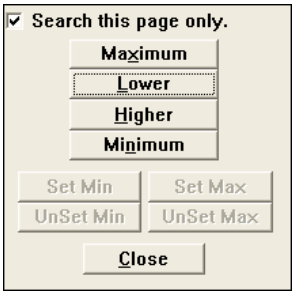
4. When you are done selecting trends, click ***Close*** on the ***Trends Group*** control panel to return to the ***Trend Review*** control panel.

Setting the Maximum and Minimum Values

Setting the maximum and minimum values for a trend is the process of finding the true maximum and minimum point for a selected trend. Maximum and minimum can be set only for the Heart Rate and R-R Interval trends.

1. Select the ***Heart Rate*** or ***R-R Interval*** trend.
2. Click the ***Max/Min*** button.

   The following control panel opens.



3. To restrict the search for maximum/minimum incident to the visible trend area, set the ***Search this page only*** field.

   By default, searches for a trend's maximum and minimum candidates are conducted across the entire ECG. By using this field in conjunction with the ***Screen Size*** control, you can restrict the search to a specific time range.

   Before setting this field, you can use the ***Screen Size*** control (see step 4 on page 151) to display the portion of ECG you want to search. For example, if you want to restrict the search to the time the patient was sleeping, set the ***Screen Size*** control to 8 hours and then scroll through the trend until only the 8 hours during which the patient slept are displayed. Once the correct portion of the ECG is displayed in the trend, set the ***Search this page only field***. When you search for maximum and minimum candidates, the MARS system will search only through the 8 hours displayed on the screen.

4. To set the maximum episode for a trend, do the following:

   a. Click on the trend you want to set the maximum for.

      A green border indicates that the trend is selected.

   b. Click ***Maximum*** in the ***Trend Review*** control panel.

      The MARS system analyzes the trends and moves the cursor to the most likely candidate for maximum in both the ***Trend Review*** window and the ***Strip Review*** window.

   c. Review the candidate in the ***Strip Review*** window to verify that it is a true maximum.

      The criteria for determining whether a candidate is a true maximum varies depending on a number of factors, including which trend is being reviewed.

d. If the candidate is not a true maximum, click ***Lower*** in the ***Trend Review*** control panel.

   The cursors in the ***Trend Review*** and ***Strip Review*** windows move to the next most likely candidate for maximum.

e. Repeat step b and step c until you find the true maximum.

f. Once you identify the true maximum, click ***Set Max*** in the ***Trend Review*** control panel.

   NOTE:
   If you pick the wrong candidate for maximum, you can undo the selection by clicking ***UnSet Max*** in the ***Trend Review*** control panel.

g. Once you set the maximum value, click ***File*** in the ***Strip Review*** control panel to file the strip for the final report.

   For details on filing a strip for the final report, refer to "File" on page 249.

5. To set the minimum episode for a trend, do the following:

   a. Click on the trend you want to set the minimum for.

      A green border indicates that the trend is selected.

   b. Click ***Minimum*** in the ***Trend Review*** control panel.

      The MARS system analyzes the trends and moves the cursor to the most likely candidate for minimum in both the ***Trend Review*** window and the ***Strip Review*** window.

   c. Review the candidate in the ***Strip Review*** window to verify that it is a true minimum.

      The criteria for determining whether a candidate is a true minimum varies depending on a number of factors, including which trend is being reviewed.

   d. If the candidate is not a true minimum, click ***Higher*** in the ***Trend Review*** window.

      The cursors in the ***Trend Review*** and ***Strip Review*** windows move to the next most likely candidate for minimum.

   e. Repeat step b and step c until you find the true minimum.

   f. Once you identify the true minimum, click ***Set Min*** in the ***Trend Review*** control panel.

      NOTE:
      If you pick the wrong candidate for minimum, you can undo the selection by clicking ***UnSet Min*** in the ***Trend Review*** control panel.

   g. Once you set the minimum value, click ***File*** in the ***Strip Review*** control panel to file the strip for the final report.

      For details on filing a strip for the final report, refer to "File" on page 249.

6. Repeat step 4 and step 5 for the other trend if desired.

   For example, if you set the maximum and minimum for the Heart Rate trend, repeat it for the R-R Interval trend.

7. After you have filed all the maximum and minimum episodes, click ***Close*** in the Max/Min control panel to return to the Trend Review control panel.

Conducting the Final Review

The ***Super Page*** application offers the opportunity to review the ECG prior to generating the final report. This allows you to double-check the work done while reviewing shapes (page 120), reviewing episodes (page 133), reviewing trends (page 147), and adjusting SVEs (page 143).

The ***Super Page*** application displays an entire ECG one page at a time. You have three methods for navigating through an ECG:

- **Manually**
  Using the **Home**, **End**, **Page Up**, and **Page Down** keys, you can navigate through the entire ECG page by page at your own pace.
- **Automatically**
  Using the ***Auto Page*** feature, you can navigate through the entire ECG page by page at a tempo set by the system. You have the option of pausing and resuming the ***Auto Page*** feature.
- **By event**
  Using ***Next Event*** and ***Previous Event***, you can navigate through the entire ECG event by event.

Beats within the ECG are color-coded to ensure that they stand out and are easily recognizable. This allows you to quickly scan the ECG for anomalies. You can use the default color codes, or you can modify them to better suit your needs.

If you discover errors or omissions while reviewing an ECG, you can do any of the following:

- File a page for inclusion on the final report
- Print a page
- Edit a range of beats within the page

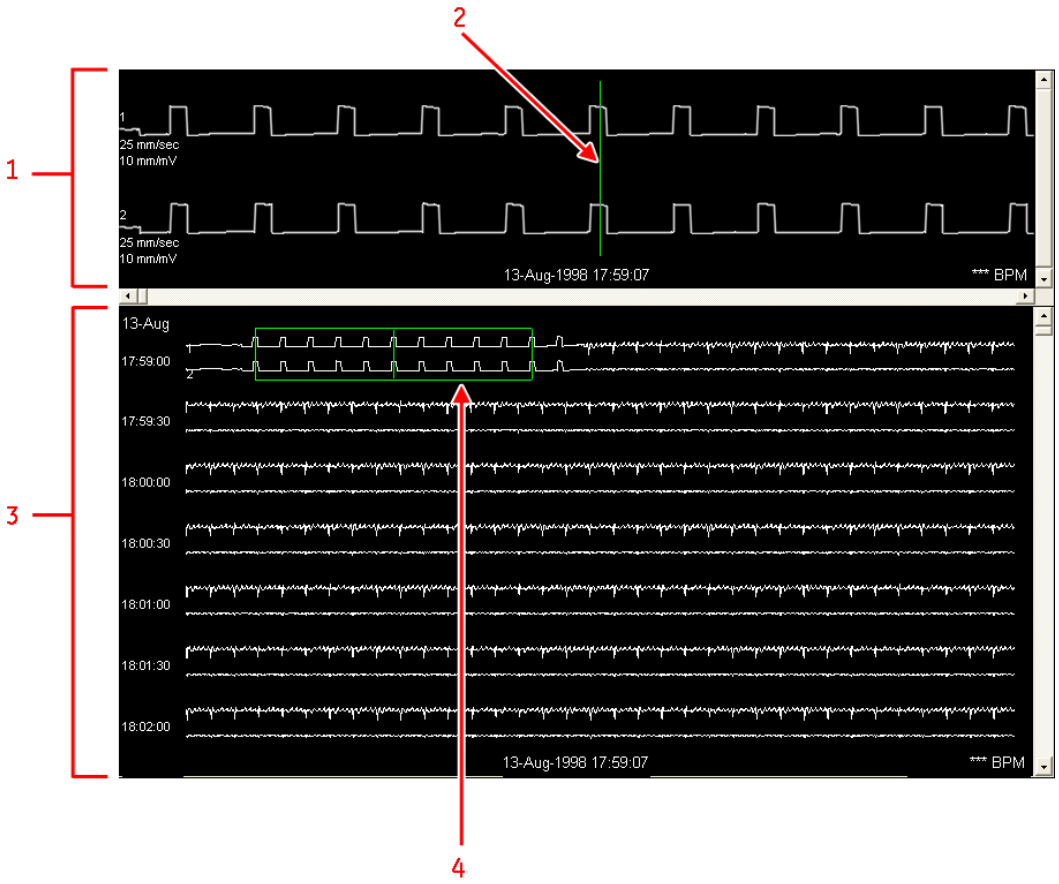
When you are done reviewing and making any necessary corrections, you will be ready to generate, edit, and print the final report.

The remainder of this section describes the Super Page layout, lists the available controls, and instructs you how to review the ECG.

Super Page Layout

The ***Super Page*** application consists of the following components:

NOTE:
The examples in this section use the ***Standard*** application menu. If you use a different menu, your page layout may differ.



1. ***Strip Review*** window
   Used to review and modify individual beats within the selected page.
2. ***Strip Review*** cursor
   Indicates the current position within the strip. When located between beats, the cursor is a vertical green line. When selecting a beat, it is a vertical green box.
3. ***Super Page***window
   Used to review and modify an ECG one page at a time.
4. ***Super Page*** cursor
   Indicates the position of the strip within the context of the entire ECG. The green box indicates the area displayed in the ***Strip Review*** window.

Super Page Controls

Although used together to review and adjust the ECG, the ***Strip Review*** window and ***Super Page*** window serve different purposes and have separate controls. The ***Strip Review*** window and controls are used to review and edit individual beats within the strip. The ***Super Page*** window and controls are used to review and edit the ECG in its entirety.

The ***Super Page*** controls are described in the following table. For information on the ***Strip Review*** controls, refer to "Strip Review Controls" on page 123.

Control	Description
File	Files the currently displayed ECG page on the final report. Refer to "File" on page 249 for more information.
Print	Prints the currently display ECG page. Refer to "Print" on page 250 for more information.
Region	Allows you to edit a contiguous range of beats simultaneously. Refer to "Region" on page 253 for more information.
Tools	Edits the page display options and beat color codes. Refer to "Tools" on page 258 for more information.
Start Auto Page	Initiates automatic scrolling through the ECG one page at a time starting at the cursor's current location. When selected, it changes to ***Stop Auto Page***.
Stop Auto Page	Pauses automatic scrolling through the ECG. When selected, it changes to ***Start Auto Page***.
Previous Event	Jumps to the first event to the left of the cursor's current position. If there are no events to the left of the cursor's current position (that is, if you are at the first event in the ECG), the control is unavailable.
Next Event	Jumps to the first event to the right of the cursor's current position. If there are no events to the right of the cursor's current position (that is, if you are at the last event in the ECG), the control is unavailable.

Reviewing the ECG

Use the following procedure to review the ECG. The procedure is written with the assumption that you have already selected a patient. For more information, refer to "Selecting the Patient" on page 107.

1. Click the ***Super Page*** icon.

   The ***Super Page*** application opens.

2. If necessary, adjust the display options or color codes to make the ECG easier to review.

   Refer to "Tools" on page 258 for instructions on setting the display options and color codes.

3. Review the ECG for omissions or errors.

   Use any combination of the following methods to move through the ECG.

   - To scroll through the ECG manually, use the following keys:
     - The ***Page Down*** key scrolls forward one page at a time.
     - The down arrow key scrolls forward one line at a time.
     - The ***End*** key jumps to the last page of the ECG.
     - The ***Page Up*** keys scrolls backward one page at a time.
     - The up arrow keys scrolls backward one line at a time.
     - The ***Home*** key jumps to the first page of the ECG.
   - To scroll through the ECG automatically, use the following buttons:
     - The ***Start Auto Page*** button scrolls forward through the ECG by page at a pre-defined pace.
     - The ***Stop Auto Page*** button stops the automatic scrolling so you can review the page in more detail.

     NOTE:
     After you press ***Start Auto Page***, you can use the spacebar to pause and resume automatic scrolling.
   - To jump through the ECG event by event, use the following buttons:
     - The ***Next Event*** button jumps to the next event to the right of the cursor.
     - The ***Prev Event*** button jumps to the next event to the left of the cursor.

4. To review a section of the ECG in more detail, click on the section in the ***Super Page*** window.

   The cursor jumps to that location in both the ***Super Page*** and ***Strip Review*** windows.

   NOTE:
   If you are using ***Auto Page***, pause the automatic scrolling before you click in the ***Super Page*** window.

5. To edit a section of the ECG, click the ***Region*** button in the ***Super Page*** control panel.

   For details on editing a section of the ECG, refer to "Region" on page 253.

6. To file a page of the ECG on the final report, click the ***File*** button.

   Refer to "File" on page 249 for details.

7. To print a page of the ECG, click the ***Print*** button.

   Refer to "Print" on page 250 for details.

8. Continue to review, edit, file, and print the ECG pages as necessary.

   When you are confident that you made all the necessary corrections and filed the necessary pages, you are ready to prepare the final report. Refer to Chapter 8, "Printing the Final Report", on page 161.

8

Printing the Final Report

The ***Report Review*** application allows you to review, edit, save, and print the final patient report.

The first step in the process is to select an appropriate report from several pre-loaded formats. (You can also define your own formats. See "Report Configuration" on page 63 for details.) Your selection is important because it determines what data will appear on the final report. Each format is designed for a specific goal and contains the data that support that goal. For example, the ***Full Disclosure*** format is intended to provide the physician with a complete picture of the study and includes every beat on the recorded ECG. By contrast, the ***Minimal*** format is intended to provide the physician with a high-level overview and includes merely an hourly summary. Other formats fall somewhere in between these extremes.

Some formats are provided in 1, 2, and 3 channel versions. These versions are noted by the addition of *[1ch]*, *[2ch]*, and *[3ch]* appended to the report name. For example: *QT [1ch]*, *QT [2ch]*, and *QT [3ch]* The data is identical in each version; only the number of channels provided differs.

NOTE:
Select 3 channel reports only if you used a 7–lead hookup on the patient.

In addition to any default data included in each format, all reports also include any data filed for inclusion on the report during the ECG review.

After you select the report format, you review the report. During the review, you can edit the report in the following ways:

- Deleting sections
- Moving sections
- Editing section comments
- Editing strip display
- Editing full disclosure display
- Adding interpretation and analysis

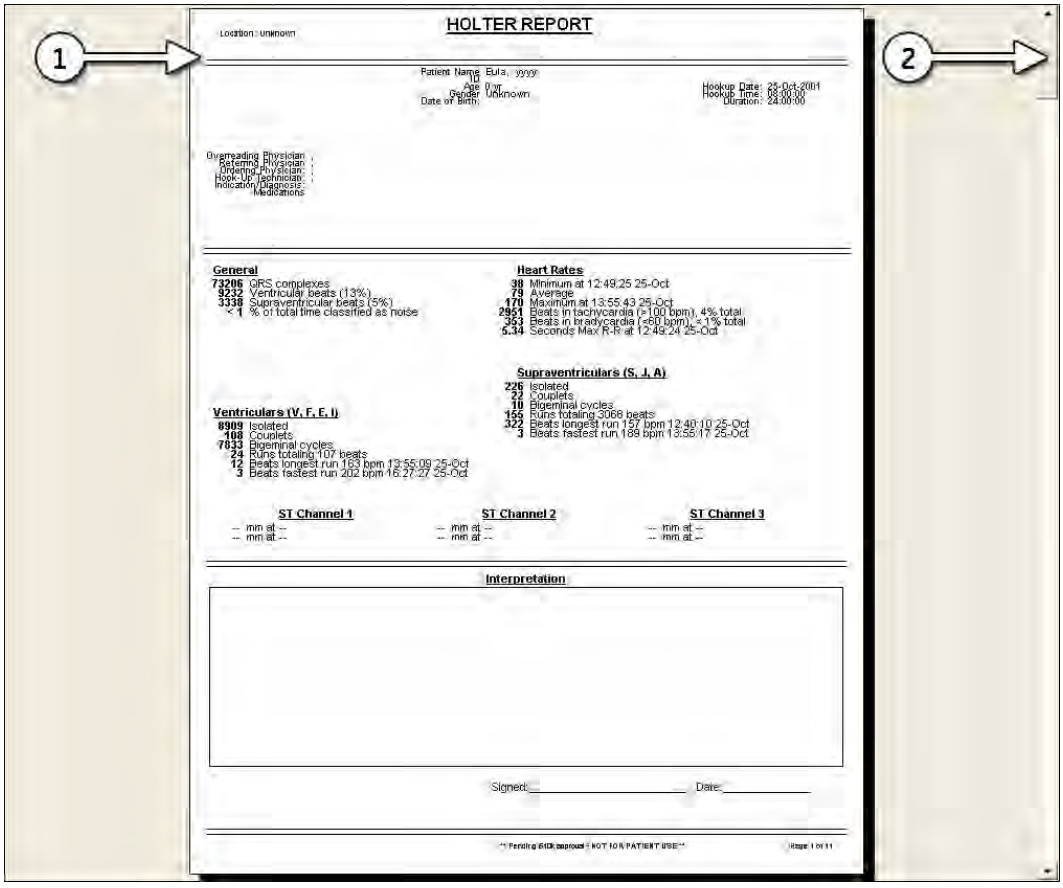
After you have reviewed and edited the report, you can print and store it.

Report Review Layout

The layout of the ***Report Review*** application consists of two components: the layout of the ***Report Review*** window and the layout of the report itself. Each is described in the following sections.

Report Review Window Layout

The ***Report Review*** window consists of the following components.



1. **Holter Report**
   Displays the selected report and data. For information on the layout of the report itself, refer to "Report Format Layout" on page 163.

2. **Scroll Bar**
   Used to scroll through the report one page at a time. You can also use the **Page Up**, **Page Down**, up arrow, and down arrow keys to scroll through the report.

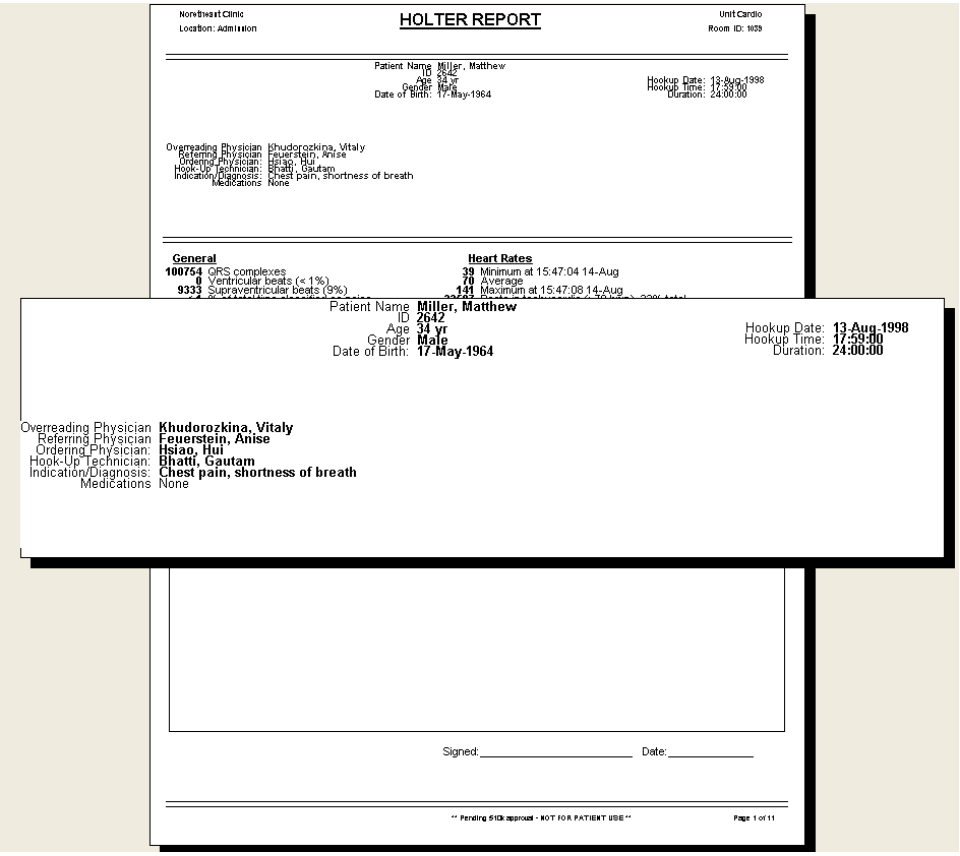
Report Format Layout

The specific data in the Holter Report vary depending on the selected format. However, each format includes the same overview sections and layout.

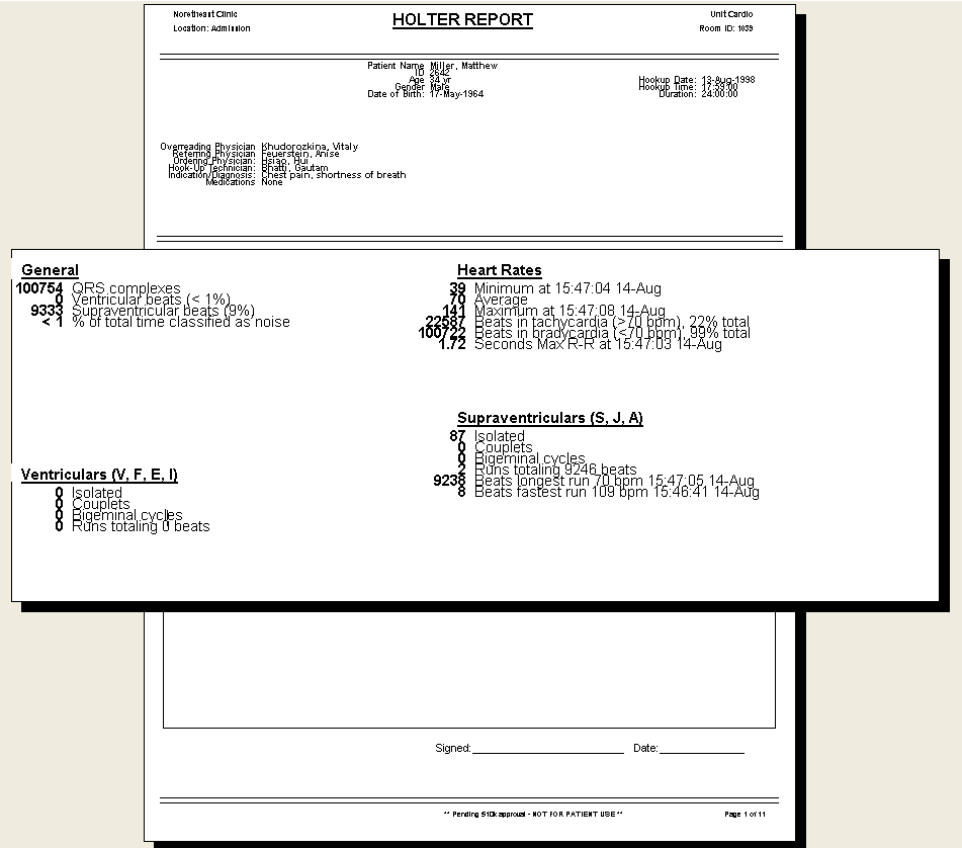
NOTE:

In the following descriptions, the sections were enlarged by right-clicking in them. Right-clicking in the expanded sections returned them to their normal magnification. Pressing the ***Delete*** key while a section is expanded will delete the section from the report.

- **Patient Information Summary**
  Contains patient demographic information. If this data needs to be changed, use the ***Patient Information*** application.



- **Beat Summary**
  Contains a statistical overview of the ECG. The categories vary depending on the selected report format.



Northheart Clinic
Location: Admission

HOLTER REPORT

Unit:Cardio
Room ID: 1039

Patient Name: Miller, Matthew
ID: 9048
Age: 33 yr
Gender: Male
Date of Birth: 17-May-1964

Hookup Date: 13-Aug-1998
Hookup Time: 17:29:50
Duration: 24:00:00

Overreading Physician: Khudorozkina, Vitaly
Referring Physician: Feuerstein, Anise
Ordering Physician: Feiao, Rui
Hook-Up Technician: Bhatti, Gautam
Indication/Diagnosis: Chest pain, shortness of breath
Medications: None

General

100754 QRS complexes
0 Ventricular beats (< 1%)
9333 Supraventricular beats (9%)
< 1 % of total time classified as noise

Heart Rates

39 Minimum at 15:47:04 14-Aug
70 Average
141 Maximum at 15:47:08 14-Aug
22587 Beats in tachycardia (>70 bpm), 22% total
100722 Beats in bradycardia (<70 bpm), 99% total
1.72 Seconds Max R-R at 15:47:03 14-Aug

Supraventriculars (S, J, A)

87 Isolated
0 Couplets
0 Bigeminal cycles
3 Runs totaling 9246 beats
9238 Beats longest run 70 bpm 15:47:05 14-Aug
8 Beats fastest run 109 bpm 15:46:41 14-Aug

Ventriculars (V, F, E, I)

0 Isolated
0 Couplets
0 Bigeminal cycles
0 Runs totaling 0 beats

Signed:_____ Date:_____

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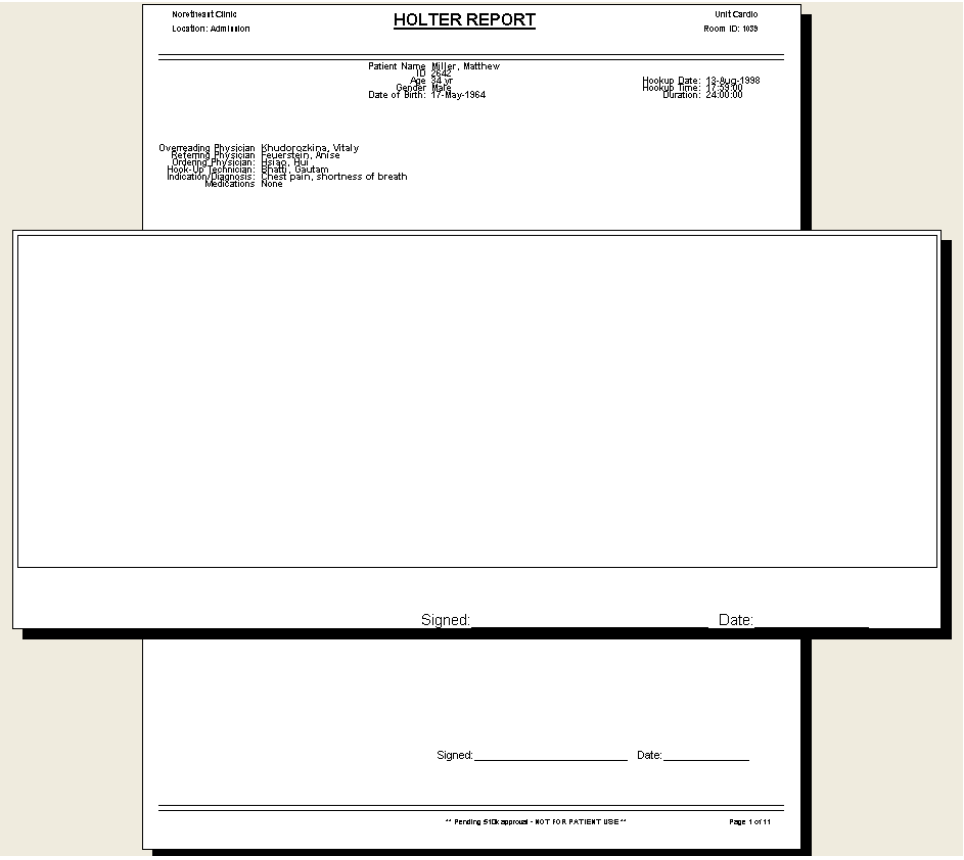
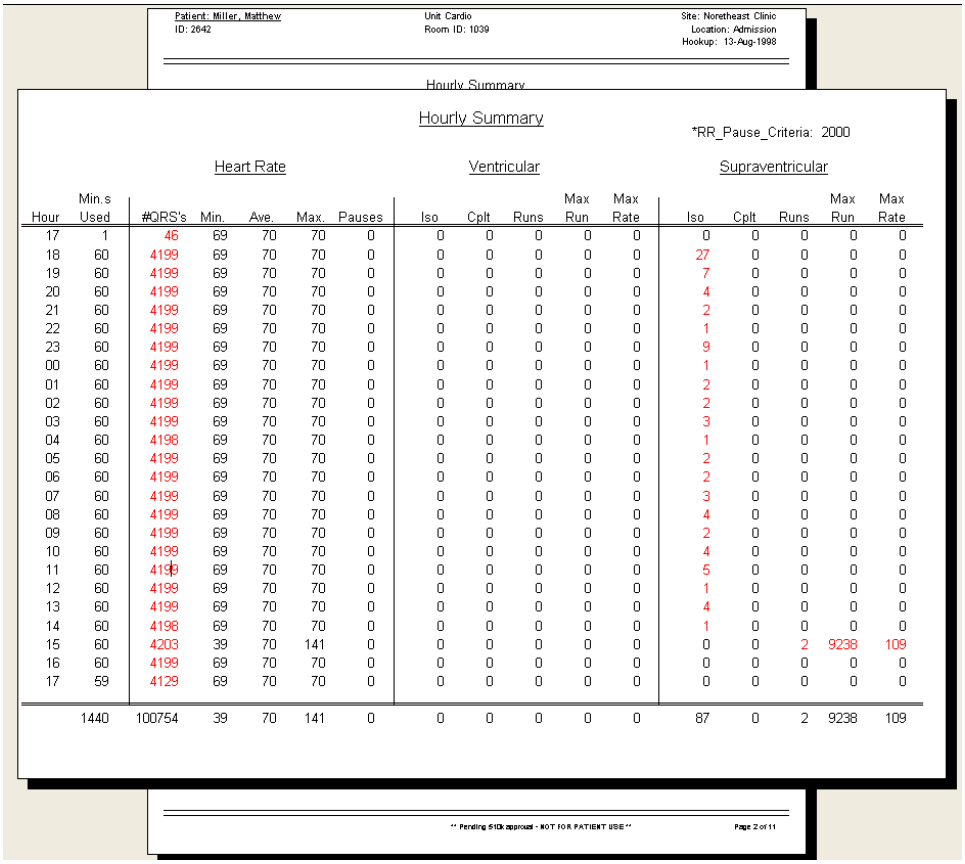
- **Interpretation**
  Allows the physician to record an interpretation of the study. After right-clicking in the Interpretation section, you can write or edit the information.



- **Hourly Summary**
  Contains an hour-by-hour overview of the heart rate, ventricular beats, and supraventricular beats.



Patient: Miller, Matthew
ID: 2642

Unit Cardio
Room ID: 1039

Site: Noretheast Clinic
Location: Admission
Hookup: 13-Aug-1998

Hourly Summary

Hourly Summary

*RR_Pause_Criteria: 2000

		Heart Rate					Ventricular					Supraventricular				
Hour	Min.s Used	#QRS's	Min.	Ave.	Max.	Pauses	Iso	Cplt	Runs	Max Run	Max Rate	Iso	Cplt	Runs	Max Run	Max Rate
17	1	46	69	70	70	0	0	0	0	0	0	0	0	0	0	0
18	60	4199	69	70	70	0	0	0	0	0	0	27	0	0	0	0
19	60	4199	69	70	70	0	0	0	0	0	0	7	0	0	0	0
20	60	4199	69	70	70	0	0	0	0	0	0	4	0	0	0	0
21	60	4199	69	70	70	0	0	0	0	0	0	2	0	0	0	0
22	60	4199	69	70	70	0	0	0	0	0	0	1	0	0	0	0
23	60	4199	69	70	70	0	0	0	0	0	0	9	0	0	0	0
00	60	4199	69	70	70	0	0	0	0	0	0	1	0	0	0	0
01	60	4199	69	70	70	0	0	0	0	0	0	2	0	0	0	0
02	60	4199	69	70	70	0	0	0	0	0	0	2	0	0	0	0
03	60	4199	69	70	70	0	0	0	0	0	0	3	0	0	0	0
04	60	4198	69	70	70	0	0	0	0	0	0	1	0	0	0	0
05	60	4199	69	70	70	0	0	0	0	0	0	2	0	0	0	0
06	60	4199	69	70	70	0	0	0	0	0	0	2	0	0	0	0
07	60	4199	69	70	70	0	0	0	0	0	0	3	0	0	0	0
08	60	4199	69	70	70	0	0	0	0	0	0	4	0	0	0	0
09	60	4199	69	70	70	0	0	0	0	0	0	2	0	0	0	0
10	60	4199	69	70	70	0	0	0	0	0	0	4	0	0	0	0
11	60	4199	69	70	70	0	0	0	0	0	0	5	0	0	0	0
12	60	4199	69	70	70	0	0	0	0	0	0	1	0	0	0	0
13	60	4199	69	70	70	0	0	0	0	0	0	4	0	0	0	0
14	60	4198	69	70	70	0	0	0	0	0	0	1	0	0	0	0
15	60	4203	39	70	141	0	0	0	0	0	0	0	0	2	9238	109
16	60	4199	69	70	70	0	0	0	0	0	0	0	0	0	0	0
17	59	4129	69	70	70	0	0	0	0	0	0	0	0	0	0	0
	1440	100754	39	70	141	0	0	0	0	0	0	87	0	2	9238	109

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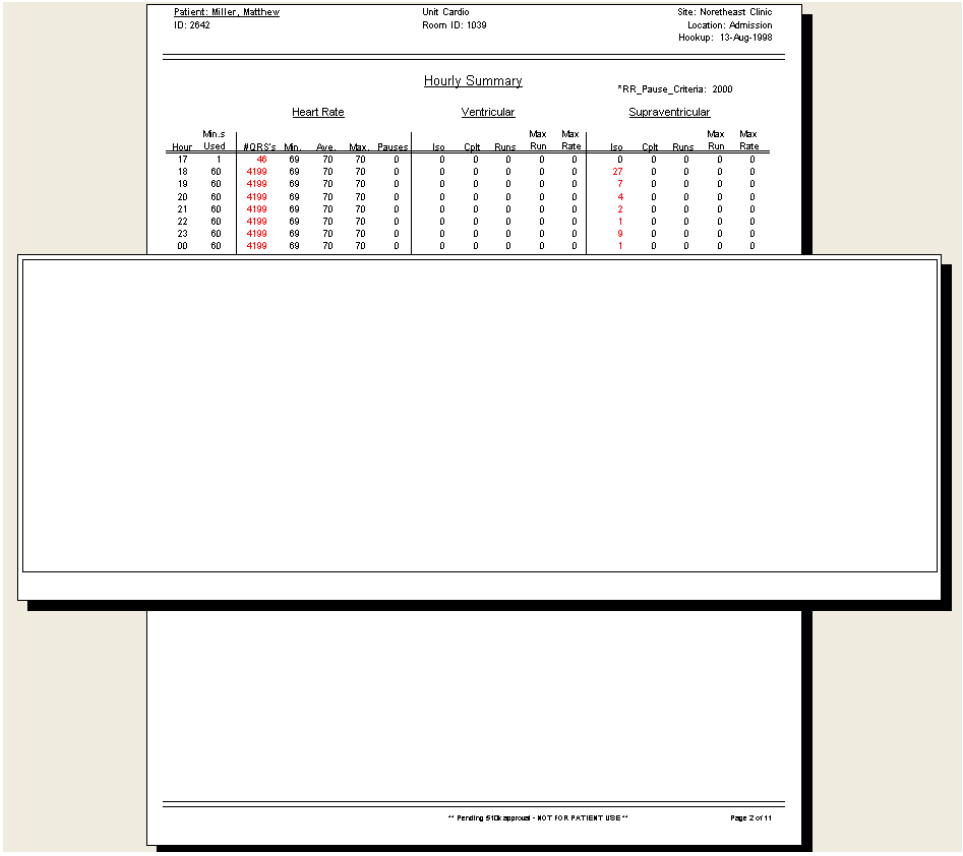
- **Analyst Comment**
  Allows the analyst to record comments about the study. After right-clicking in the Analyst Comment section, you can write or edit the information.



Patient: Miller, Matthew
ID: 2642

Unit Cardio
Room ID: 1039

Site: Noretheast Clinic
Location: Admission
Hookup: 13-Aug-1998

Hourly Summary

*RR_Pause_Criteria: 2000

		Heart Rate					Ventricular					Supraventricular				
Hour	Min.s Used	#QRS's	Min.	Ave.	Max.	Pauses	Iso	Cplt	Runs	Max Run	Max Rate	Iso	Cplt	Runs	Max Run	Max Rate
17	1	46	69	70	70	0	0	0	0	0	0	0	0	0	0	0
18	60	4199	69	70	70	0	0	0	0	0	0	27	0	0	0	0
19	60	4199	69	70	70	0	0	0	0	0	0	7	0	0	0	0
20	60	4199	69	70	70	0	0	0	0	0	0	4	0	0	0	0
21	60	4199	69	70	70	0	0	0	0	0	0	2	0	0	0	0
22	60	4199	69	70	70	0	0	0	0	0	0	1	0	0	0	0
23	60	4199	69	70	70	0	0	0	0	0	0	9	0	0	0	0
00	60	4199	69	70	70	0	0	0	0	0	0	1	0	0	0	0

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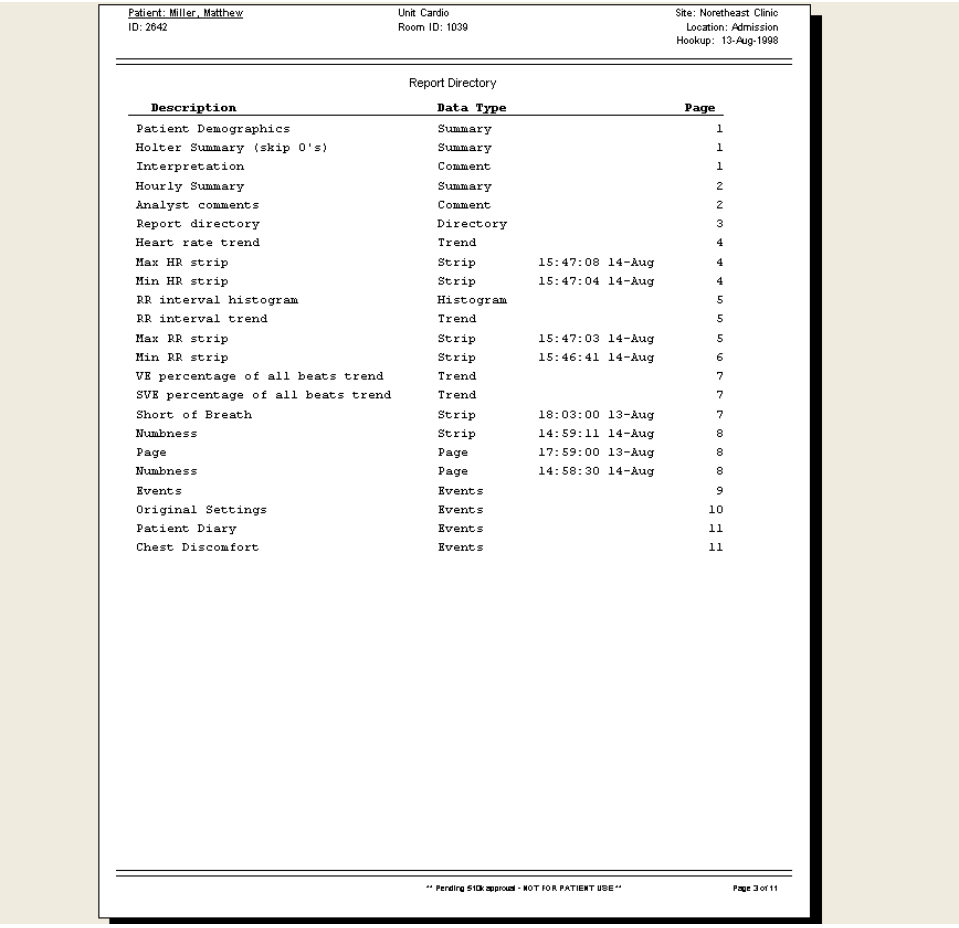
- **Report Directory**
  Identifies the sections contained within the report and the pages on which they appear. The directory can also be used to delete or rearrange the sections of a report.



Patient: Miller, Matthew
ID: 2642

Unit Cardio
Room ID: 1039

Site: Noretheast Clinic
Location: Admission
Hookup: 13-Aug-1998

Report Directory

Description	Data Type		Page
Patient Demographics	Summary		1
Holter Summary (skip 0's)	Summary		1
Interpretation	Comment		1
Hourly Summary	Summary		2
Analyst comments	Comment		2
Report directory	Directory		3
Heart rate trend	Trend		4
Max HR strip	Strip	15:47:08 14-Aug	4
Min HR strip	Strip	15:47:04 14-Aug	4
RR interval histogram	Histogram		5
RR interval trend	Trend		5
Max RR strip	Strip	15:47:03 14-Aug	5
Min RR strip	Strip	15:46:41 14-Aug	6
VE percentage of all beats trend	Trend		7
SVE percentage of all beats trend	Trend		7
Short of Breath	Strip	18:03:00 13-Aug	7
Numbness	Strip	14:59:11 14-Aug	8
Page	Page	17:59:00 13-Aug	8
Numbness	Page	14:58:30 14-Aug	8
Events	Events		9
Original Settings	Events		10
Patient Diary	Events		11
Chest Discomfort	Events		11

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- **Report Body**
  The remainder of the report is the report body. It consists of the specific sections that pertain to the selected format.

Report Review Controls

The ***Report Review*** controls are used to select the report format and edit, save, and print the report. The following table identifies all the controls and describes their use.

Control	Description
Print Page	Prints the current page of the report to the default Windows printer on the MARS system.
Print Report	Prints the entire report to the default Windows printer on the MARS system.
Sleep Report	Opens the default system browser and displays a report generated by an external third-party sleep study application. You can then either copy the interpretation from this report and paste it into the MARS report, or you could simply print both reports. This button is available only if the sleep study report exists in a watched system folder. For more information, refer to Appendix G, "Sleep Export".
Select Setup	Opens a list of available report formats from which to select.
Report Directory	Jumps to the Report Directory section of the report.
Up	Moves the section selected in the Report Directory forward in the report.
Down	Moves the section selected in the Report Directory backward in the report.
Delete Selection	Deletes the section selected in the Report Directory. Although the section is removed from the report, it is not removed from the Report Directory: it is retained and marked with an asterisk. This allows you to undelete it if necessary.
Un-Delete Selection	Restores the deleted section selected in the Report Directory.
Save Report	Stores the report for future reference. Stored reports can be retrieved using ***Patient Select***. Refer to "Selecting the Patient" on page 107 for more information.
Close	Closes the ***Report Review*** application.

Printing the Report

Use the following procedure to prepare and print the final patient report.

NOTE:
The following procedure is written under the assumption that a patient has already been selected (see "Selecting the Patient" on page 107) and that the ECG has already been reviewed (see "ECG Review" on page 119).

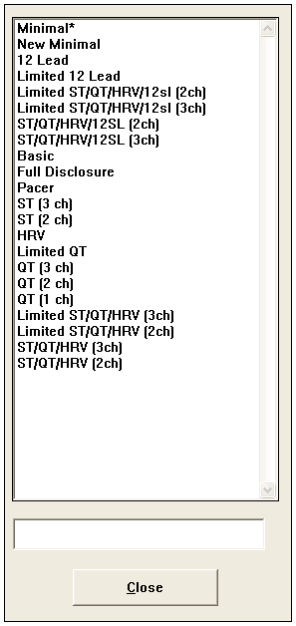
1. Click the ***Report Review*** icon.

   The ***Report Review*** application opens with the default report format.

2. If necessary, change the report format using the following steps.

   a. Click ***Select Setup*** in the control panel.

      The ***Select Setup*** control panel opens with a list of available report formats.



   b. Click on the format to use.

      The review window is updated to the new format. The selected format becomes the new default format and an asterisk appears at the end of the format name.

   c. Click ***Close*** to close the ***Select Setup*** control panel.

3. Review the report.

   The goals of this review are to verify that:

   - The report contains all the necessary information.

If the report is missing important information, select a different format. Return to step 2.

NOTE:
You could also re-review the ECG to file the necessary information. Refer to "ECG Review" on page 119 for more information.

- The sections support the analysis and interpretation.
  If any section in the report is not pertinent to the study, delete the section. Go to step 4.
- The sections are organized appropriately.
  If the sections of the report are not in the desired order, rearrange them to better suit your needs. Go to step 5.
- The ECG strips are formatted appropriately.
  If any strip is not formatted appropriately, modify the display options as necessary. Go to step 6.
- The Full Disclosure data is formatted appropriately.
  If the Full Disclosure is not formatted appropriately, modify the display as necessary. Go to step 7.

4. If any of the sections are not pertinent to the study or do not support the analysis or interpretation, use the following steps to delete those sections.

   a. In the ***Report Review*** control panel, click ***Report Directory***.

      The Report Directory is displayed in the Report Review window.

   b. In the Report Directory, click on the section to be deleted.

      A box surrounds the section to indicate it has been selected.

   c. Click ***Delete Selection***.

      The section is removed from the report and the description of the section in the Report Directory is marked with an asterisk to indicate that it has been removed.

      NOTE:
      You can restore the section to the report at any time by clicking the section in the Report Directory and clicking ***Un-Delete Selection***.

   d. Repeat step a and step b until all appropriate sections have been deleted.

5. If the report is not organized appropriately, use the following steps to rearrange the report sections.

   a. If necessary, click the ***Report Directory*** button to display the Report Directory section of the report.

   b. In the Report Directory, click on the section to moved.

      A box surrounds the section to indicate it has been selected.

   c. To move the section forward in the report, click the ***Up*** button repeatedly until the section is positioned appropriately.

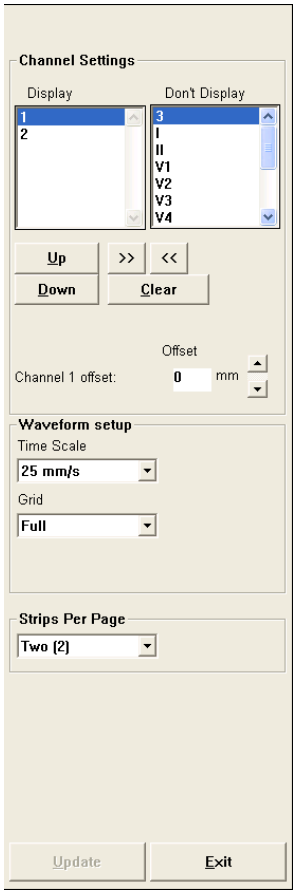
   d. To move the section backward in the report, click the ***Down*** button repeatedly until the section is positioned appropriately.

   e. Repeat step a through step c until all the sections are positioned appropriately.

6. To modify the format of all ECG strips in the report, use the following steps.

   a. Click in any strip.

      The following control panel opens.



      This panel is very similar to the ***Tools*** control panel used by the ***Strip Review*** window.

   b. Set the ***Channel Settings*** as appropriate.

      Refer to "Tools Page Layout" on page 258 for a detailed description of any of the available fields.

   c. Set the ***Waveform Setup*** as appropriate.

      Refer to "Tools Page Layout" on page 258 for a detailed description of any of the available fields.

   d. Select the number of strips to print per page.

      You can include two (2), three (3), or four (4) strips per page. The more strips per page, the smaller the strips will be.

   e. After you have set up the options, click ***Update***.

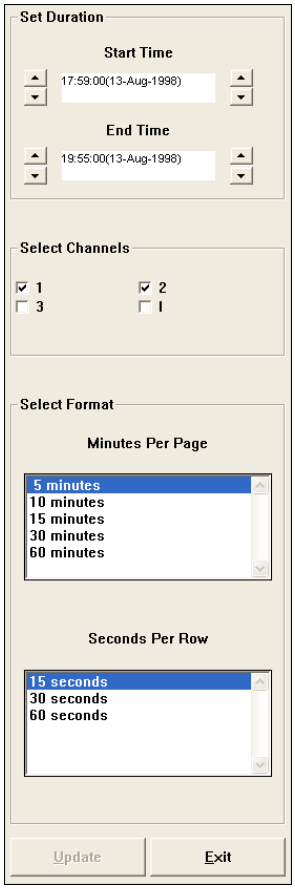
      All strips in the report update accordingly.

   f. Click ***Exit*** to close the control panel.

7. To modify the format of the full disclosure data in a report, perform the following steps.

   a. Click anywhere in the full disclosure data.

      The following control panel opens.



   b. In the ***Set Duration*** box, select the ***Start Time*** and ***End Time***.

      By default, the full disclosure includes the entire ECG, but you can use these fields to limit the ECG to a specific time range.

   c. In the ***Select Channels*** box, select the channels to include in the full disclosure.

      When a channel has a check mark in the field, it will be included on the report.

   d. In the ***Select Format*** box, select the ***Minutes Per Page*** and ***Seconds Per Row***.

      This affects the size of the waveforms and the number of pages required for the report.

   e. After you have set up the options, click ***Update***.

      The Full Disclosure information is updated accordingly.

   f. Click ***Exit*** to close the control panel.

8. To enter or edit the analyst comments, perform the following steps:
   a. Right-click in the ***Analyst Comment*** section.
      The section opens in the middle of the screen.
   b. Write or edit the comments as appropriate.
   c. When you are done, right-click in the ***Analyst Comment*** section again.
      The expanded section closes with the comments.
9. To enter or edit the interpretation, perform the following steps:
   a. Right-click in the ***Interpretation*** section.
      The section opens in the middle of the screen.
   b. Write or edit the interpretation as appropriate.
   c. When you are done, right-click in the ***Interpretation*** section again.
      The expanded section closes with the comments.
10. After you have reviewed and edited the report to your satisfaction, click ***Print Report***.
    The report prints to the default Windows printer.
11. After you have printed the report, click ***Save Report***.
    This saves the report for future reference. The saved report can be retrieved using the Patient Select application. For more information, refer to "Selecting the Patient" on page 107. The saved report can also be transferred to a MUSE system if the optional MARS to MUSE module was purchased. For more information, refer to "Transferring Stored Reports to a MUSE System" on page 179.

9

Storing Patient Data

The MARS Ambulatory ECG System offers the following storage options:

- Archiving Patient Data and Reports
  With the standard MARS system, patient data and reports can be archived to an optical drive (CD/DVD), shared network drive, or local drive.
- Transferring Patient Reports
  With the MARS to MUSE communication option, patient reports can also be transferred to a MUSE system.

Each storage option is described in detail in the following sections.

Archiving Patient Data and Stored Reports

The MARS Ambulatory ECG System has a limited number of patient slots. Once the slots are full, additional patient studies cannot be uploaded to the MARS system and additional reports cannot be stored. Therefore, after a study has been uploaded, reviewed, edited, printed, and stored, it can be archived for future review or restoration. Once the record has been successfully archived, it can be safely deleted to free a patient slot for additional studies.

Patient data and reports can be archived to any of the following locations:

- An optical drive
  The MARS system supports the use of CD-ROM and DVD-ROM disks. It does not support CD-RW or DVD-RW disks since rewritable (RW) disks can be accidentally overwritten or erased. Archiving to an optical drive offers three advantages. First, an optical disk is portable and can be transported to and loaded by another MARS system. Second, the optical disk can be stored off site, which provides protection against physical loss of the data due to natural disasters such as earthquakes and fires. Third, the disk can be duplicated, allowing storage in multiple locations, which provides an additional level of security.
- A shared network drive
  The MARS system supports any shared network drive. Archiving to a network drive offers two advantages. First, network drives are typically backed up on a regular basis, which provides an additional level of security for the data. Second, shared network drives can typically be accessed from anywhere on the network, which could allow the data to be accessed from any MARS system on the network. Before

archiving to a network drive, consult with your IT administrator to make sure only authorized personnel can access the drive.

- A local system drive
  While the MARS system can archive patient data to the local drive on the MARS system, GE Healthcare recommends against using this option. It does not protect the data against physical damage at the location, nor does it provide additional backup options. This method should be used only if the other options are unavailable.

Before archiving patient data and reports, you must define the archive location on the ***System: General Setup*** window. Refer to "General" on page 90 for details.

NOTE:
Archives on network and local drives are limited to a maximum of 5000 records, regardless of available space on the drives. Once this limit is reached, you will need to specify a new archive location before you can archive additional patient records.

To archive patient records and reports

Use the following procedure to archive patient data.

1. If you are archiving to an optical disk, insert a formatted CD-ROM or DVD-ROM disk into the MARS system's optical drive.

   If you purchase unformatted disks, use a third-party application or the operating system utilities to format the disk. Refer to the application's documentation for instructions on formatting the disk.

2. Click the ***Patient Select*** icon.

   The ***Patient Select*** application opens.

3. Select the type of record to be archived from the ***Data Type*** field.

   - To archive patient records, select ***Holter***.
   - To archive patient reports, select ***Stored Reports***.

4. Click ***Tools***.

   The ***Tools*** control panel opens.

5. In the ***Patient Select*** window, select the records to be archived.

   Use the appropriate method to select the record(s).

   - To select a single record, click on it.
     The selected record will be highlighted.
   - To select a range of consecutive records, click on the first record to be archived, press **Shift**, then click on the last record to be archived.
     The first record, the last record, and all the records in between will be highlighted.
   - To select a range of nonconsecutive records, click on the first record to be archived, press **CTRL**, then click on each record to be archived.
     All selected records will be highlighted.

6. Click ***Archive***.

   A dialog box opens to ask you to confirm that you want to archive the record(s). The dialog box and its options vary depending on the number of records selected.

   - If one record was selected, the dialog box identifies the record and offers two choices.
     Do one of the following:
     - To cancel the archive, click ***No***.
       The archive is canceled and the dialog box closes.
     - To archive the record, click ***Yes***.
       The archive begins, and a status bar opens to indicate progress. When it is done, a dialog box opens to tell you that the record was archived. Click ***OK*** to close the dialog box.
   - If more than one record was selected, the dialog box lists the number of selected records and offers three choices.
     Do one of the following:
     - To cancel the archive, click ***No***.
       The archive is canceled and the dialog box closes.
     - To archive all the records, click ***Yes to All***.
       The archive begins, and a status bar opens to indicate the progress. When it is done, the status bar closes and a dialog box opens to tell you that the records were archived. Click ***OK*** to close the dialog box.
     - To archive a portion of the selected records, click ***Yes***.
       A dialog box opens for the first selected record. To include the record in the archive, click ***Yes***. To exclude it, click ***No***. This process repeats for each selected record. After the last dialog box closes, the archive begins and a status bar opens to indicate progress. When it is done, the status bar closes and a dialog box opens to tell you that the records were archived. Click ***OK*** to close the dialog box.

7. After the selected records have been archived, use the following procedure to delete them from the MARS system.

   a. Select the record(s) to be deleted.

      Refer to step 5 for instructions.

   b. Click ***Delete***.

      A dialog box opens to ask if you want to delete the record(s). The dialog box and options vary depending on the number of records selected.

      - If one record was selected, the dialog box identifies the selected record and offers two choices.
        Do one of the following:
        - To cancel the deletion, click ***No***.
          The deletion is canceled and the dialog box closes.
        - To delete the record, click ***Yes***.

The deletion begins, and a status bar opens to indicate progress. When it is complete, the status bar closes and a dialog box opens to tell you that the record was deleted. Click ***OK*** to close the dialog box.

- If more than one record was selected, the dialog box lists the number of records and offers three choices.
  Do one of the following:
  - To cancel the deletion, click ***No***.
    The deletion is canceled and the dialog box closes.
  - To delete all the records, click ***Yes to All***.
    The deletion begins, and a status bar opens to indicate progress. When the deletion is complete, the status bar closes and a dialog box opens to tell you that the records were deleted. Click ***OK*** to close the dialog box.
  - To delete a portion of the selected records, click ***Yes***.
    A dialog box opens for the first selected record. To include the record in the deletion, click ***Yes***. To exclude it, click ***No***. This process repeats for each selected record. After the last dialog box closes, the deletion begins and a status bar opens to indicate progress. When it is done, the status bar closes and a dialog box opens to tell you that the records were deleted. Click ***OK*** to close the dialog box.

To restore an archive

Use the following procedure to restore an archived record.

1. If you are restoring from an optical disk, insert the CD-ROM or DVD-ROM with the archive into the MARS system's optical drive.
2. Click the ***Patient Select*** icon.

   The ***Patient Select*** application opens.
3. Select ***Archived Files*** from the ***Data Type*** field.

   The archived files available in the archive folder are displayed in the ***Patient Select*** window.
4. Click ***Tools***.

   The ***Tools*** control panel opens.
5. In the ***Patient Select*** window, select the records to be restored.

   Use the appropriate method to select the record(s).

   - To select a single record, click on it.
     The selected record will be highlighted.
   - To select a range of consecutive records, click on the first record to be restored, press **Shift**, then click on the last record to be restored.
     The first record, the last record, and all the records in between will be highlighted.
   - To select a range of nonconsecutive records, click on the first record to be restored, press **CTRL**, then click on each record to be restored.

All selected records will be highlighted.

6. After the records are selected, click ***Restore from Archive***.

   A dialog box opens. It lists the number of records that are selected and prompts you to confirm that you want to restore the records. You have three options. Do one of the following:

   - To cancel the restore, click ***No***.
     The restore is canceled and the dialog box closes.
   - To restore all the records, click either ***Yes*** or ***Yes to All***.
     The restoration begins, and a status bar opens to indicate progress. When the restoration is complete, the status bar closes and a dialog box opens to tell you that the records were restored. Click ***OK*** to close the dialog box.

Transferring Stored Reports to a MUSE System

With the purchase and activation of the MARS to MUSE communication option, you can transfer stored patient reports from the MARS workstation over a network connection to a MUSE system. After the transfer, the reports can be viewed and edited on the MUSE system.

In order to transfer stored reports to a MUSE system, the following requirements must be met:

- The MARS to MUSE communication option must be purchased and activated on the MARS system.
  Refer to "Software Activators" on page 79 for more information.
- The MARS system and the MUSE system must both be set up with the same Site information.
  Refer to "Site" on page 81 for more information.
- Communication between the MARS and MUSE systems must be set up.
  Refer to the *MARS to MUSE Communication Installation Instructions* (2027879-038) for details.

In addition, you can set up the MARS system to automatically delete stored reports after they have been successfully transferred to the MUSE system. Refer to "General" on page 90 for details. If you do not set up this option, you must manually delete the reports after the transfer.

1. Click the ***Patient Select*** icon.

   The ***Patient Select*** application opens.

2. Select ***Stored Reports*** from the ***Data Type*** control.

   All the patient reports stored on the MARS system appear in the ***Patient Select*** window.

3. Click ***Tools***.

   The ***Tools*** control panel opens.

4. In the ***Patient Select*** window, select the records to be transferred.

   Use the appropriate method to select the record(s).

   - To select a single record, click on it.

The selected record will be highlighted.

- To select a range of consecutive records, click on the first record to be transferred, press **Shift**, then click on the last record to be transferred. The first record, the last record, and all the records in between will be highlighted.
- To select a range of nonconsecutive records, click on the first record to be transferred, press **CTRL**, then click on each record to be transferred. All selected records will be highlighted.

5. After the records are selected, click ***Store to MUSE***.

   A dialog box opens. It lists the number of records that are selected and prompts you to confirm that you want to transfer the records. You have three options. Do one of the following:

   - To cancel the transfer, click ***No***.
     The transfer is canceled and the dialog box closes.
   - To transfer all the records, click ***Yes to All***.
     The transfer begins and a status bar opens to indicate progress. When it is complete, the status bar closes and a dialog box opens to notify you that the records were queued to be transferred to the MUSE system. Click ***OK*** to close the dialog box.
   - To transfer a portion of the selected records, click ***Yes***.
     A dialog box opens for the first selected record. To include the record in the transfer, click ***Yes***. To exclude it, click ***No***. This process repeats for each selected record. After the last dialog box closes, the records are marked for transfer and a status bar opens to indicate progress. When it is done, the status bar closes and a dialog box opens to tell you that the records were queued for transfer to the MUSE system. Click ***OK*** to close the dialog box.

A

HRV

Heart Rate Variability (HRV) is defined as the beat-to-beat alterations in heart rate. When a healthy patient is at rest, the HRV exhibits respiratory sinus arrhythmia (RSA), in which the patient's R-R intervals fluctuate with the phases of respiration. Studies have shown that the frequency of this fluctuation can be a predictor of certain disease states. For example, reduced HRV has been shown to predict sudden death in patients with myocardial infarction, even among patients with no coronary heart disease.

The MARS Ambulatory ECG System offers an optional HRV module that collects and reports HRV statistics. No analysis is performed on this information. You can use this module "as is" straight out of the box, or you can adjust a number of settings to control the collection, display, and measurement of HRV data.

You can define the following parameters for collecting the HRV data:

- Time range to review
  Select a time range by defining a start and end time or by using calipers.
- Beats to exclude
  Exclude beats by beat type and number, R-R ratio, and R-R interval.
- Frequency band definitions
  Define the ranges of the five frequencies for which HRV results are reported.
- Report units
  Choose amplitude (ms), power (ms^2). or the natural log of power (ln (ms^2)).
- Trend time control method
  Choose either of two methods: resolution (based on time) or calipers.
- X-axis frequency
  Select from three scales: 0.5 Hz, 1.0 Hz, and 2.0 Hz.

You can also define the manner in which interval data is displayed:

- Stacked Spectra
  Displays a series of frequency spectra taken at equal intervals and stacked on top of each other.
- Histograms
  Displays a grid of histograms that present the distribution of HRV frequencies at different times.

Finally, you can select the method used to measure HRV:

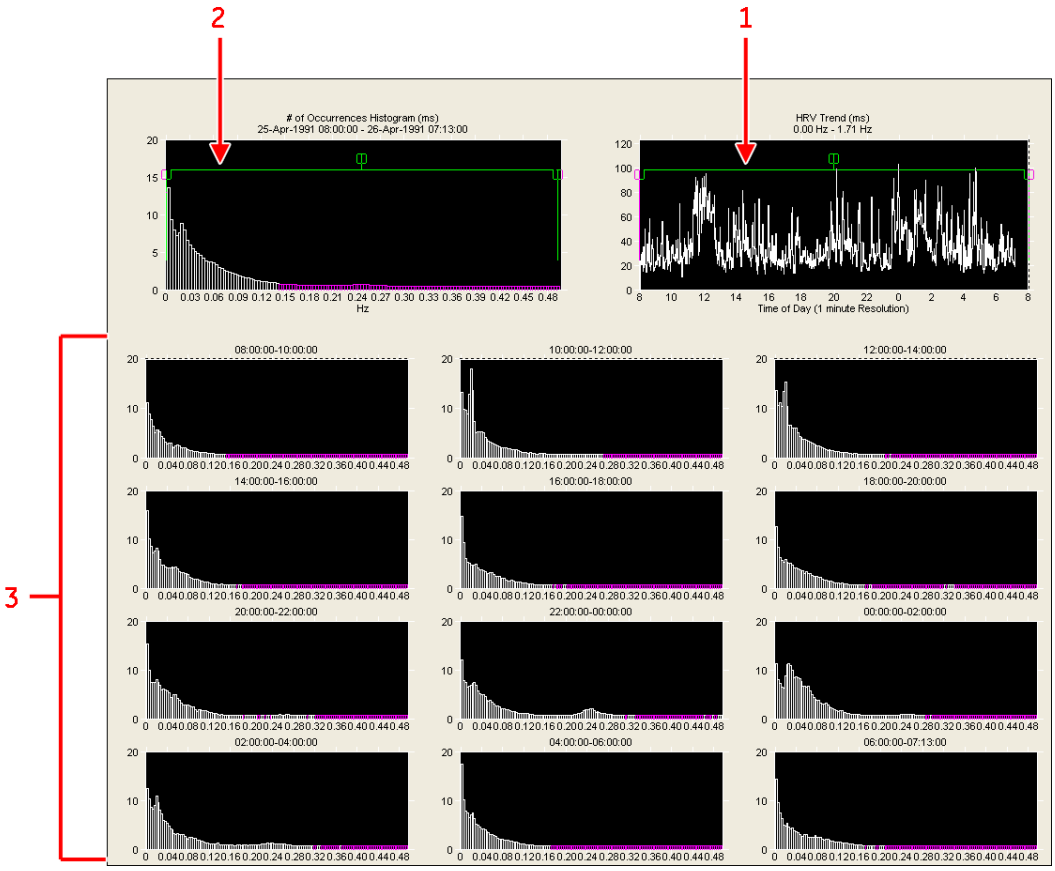
- Frequency Domain
  Reports the HRV power index for five preset frequencies.
- Time Domain
  Reports the mean R-R interval for 11 standard indices.

These concepts are discussed in detail in the following sections:

- "HRV Page Layout" on page 182
- "HRV Controls" on page 185
- "HRV Setup" on page 185
- "Calculating HRV" on page 190

HRV Page Layout

The HRV window layout consists of the following components:



1. **HRV Trend**
   Displays a tachogram of the HRV across the duration of the selected time range. The x-axis indicates the time of day and the y-axis indicates the unit of measure (amplitude, power, or the natural log of power) selected on the ***HRV Setup*** window. If ***Use calipers*** is selected on the ***HRV Setup*** window, you can use the calipers in the tachogram to narrow the study to a portion of the time range.

2. **# of Occurrences**
   Displays a histogram that shows the number of occurrences at each frequency. The x-axis indicates the frequency (in Hz) and the y-axis indicates the number of occurrences. Use the calipers in the histogram to restrict the study to a specific range of frequencies.

3. **Interval Data**
   Displays the HRV information for distinct intervals. The information can be displayed using either of two methods: Stacked Spectra or Individual Histograms. This example shows the stacked histograms, which is the default method. Both methods are described in more detail in the following sections.

Individual Histogram View

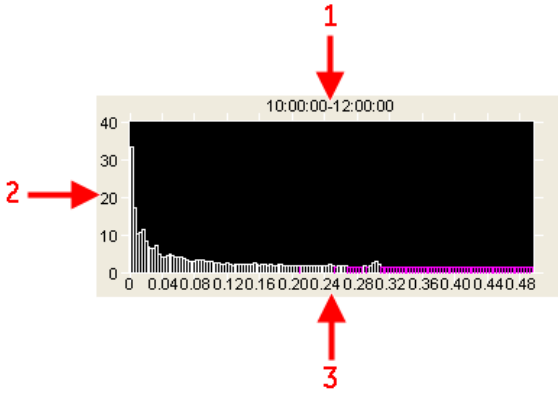
The default method for displaying interval data, individual histograms display the distribution of occurrences for a select period of time. Each individual histogram is a subset of the ***# of Occurrences*** histogram. Whereas the ***# of Occurrences*** histogram displays data for the entire selected time range, each individual histogram displays data for an equal percentage of that range. The duration of the period displayed by each histogram is determined by two factors: the amount of time selected for the HRV trending and the number of histograms displayed.

When the ***HRV*** window is opened full screen, 12 individual histograms appear in the Interval Data area. Therefore, each histogram displays 1/12 of the selected time range. For example, if the selected time range is 12 hours, each histogram displays one hour of data. Likewise, if the selected time range is 24 hours, each histogram displays two hours of data.

When the ***HRV*** window is opened on 2/3 of the screen, 6 individual histograms appear in the Interval Data area. Therefore, each histogram displays 1/6 of the selected time range. For example, if the selected time range is 12 hours, each histogram displays two hours of data. Likewise, if the selected time range is 24 hours, each histogram displays four hours of data.

When the ***HRV*** window is opened on only 1/3 of the screen, the individual histograms are not displayed.

Each histogram consists of the following components:



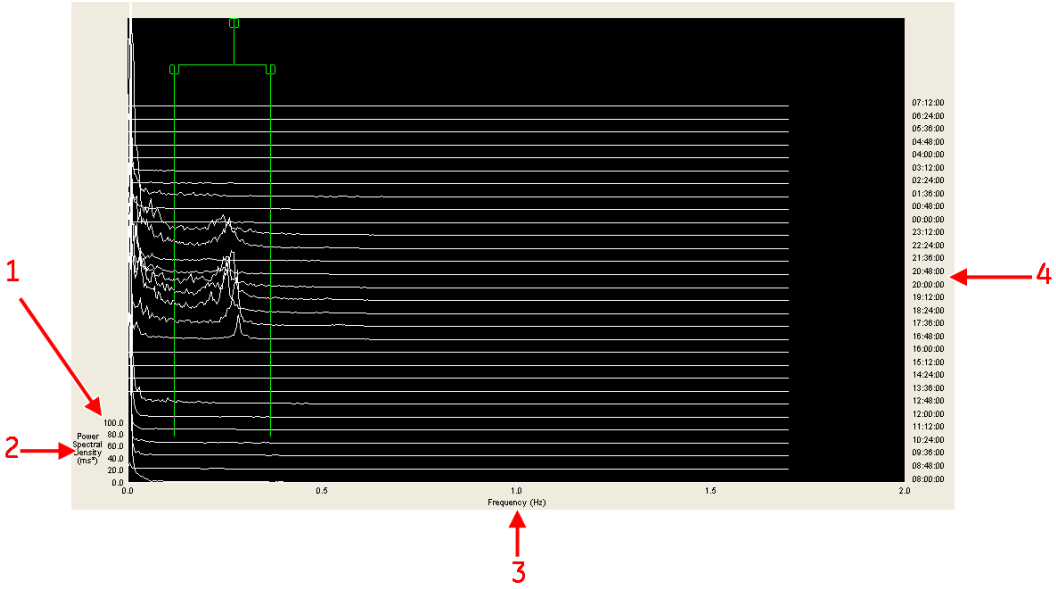
1. Time Range
   Indicates the time range represented by the histogram. This varies depending on the range selected for the HRV and the number of histograms displayed.

2. Y-Axis
   Indicates the number of occurrences. These values vary depending on the setting of the ***Report in unit of...*** field defined on the ***HRV Setup*** window.
3. X-Axis
   Indicates the frequency. These values vary depending on the setting of the ***X Axis Max Frequency*** field defined on the ***HRV Setup*** window.

Stacked Spectra View

An optional method for displaying interval data, stacked spectra divides the frequency spectrum of the selected time range into 30 equal time periods and stacks them one on top of the other. This method makes it easier to detect trends. The duration of the time periods depends on the duration of the selected time range. For example, if the selected time range were 30 hours, each spectrum would cover one hour. Likewise, if the selected time range were 24 hours, each spectrum would cover 48 minutes. The stacked spectra method works only when the HRV window is opened to full screen.

The stacked spectra consists of the following components:



1. Y-axis
   Indicates the number of occurrences. The values for the y-axis are determined by the ***Report in units of...*** field on the ***HRV Setup*** window.
2. Unit of Measure
   Identifies the unit of measure used for the y-axis.
3. X-axis
   Indicates the frequency (in Hz). The values for the x-axis are determined by the ***X Axis Max Frequency*** field on the ***HRV Setup*** window.
4. Z-axis
   Indicates the time represented by each spectrum. The earlier times are at the bottom of the stack.

HRV Controls

The following table identifies the controls available on the HRV control panel and describes their use.

Control	Description
File	Files the displayed HRV information on the patient report. For detailed information on how to use this control, refer to "File" on page 249. **NOTE:** Several of the preloaded report formats include complete HRV histograms and frequency domain readouts. If you plan to use one of those formats, you do not need to file the HRV information for the report.
Print	Prints the displayed HRV information on the Windows default printer. For detailed information on how to use this control, refer to "Print" on page 250.
Setup	Opens the ***HRV Setup*** window. Refer to "HRV Setup" on page 185 for more information.
Backup	Undoes the previous adjustment. For example, if you adjusted the calipers in the ***HRV Trend*** tachogram, clicking ***Backup*** returns the calipers to their position before the adjustment. You can repeatedly click this button to back up several adjustments.
Frequency Domain Readout	Calculates the HRV statistics for the preset frequencies. For more information on the preset frequencies, refer to "HRV Setup Page Layout" on page 186. For more information on using this control, refer to "Calculating HRV" on page 190.
Time Domain Readout	Calculates the HRV statistics for the standard HRV indices. For more information on using this control, refer to "Calculating HRV" on page 190.

HRV Setup

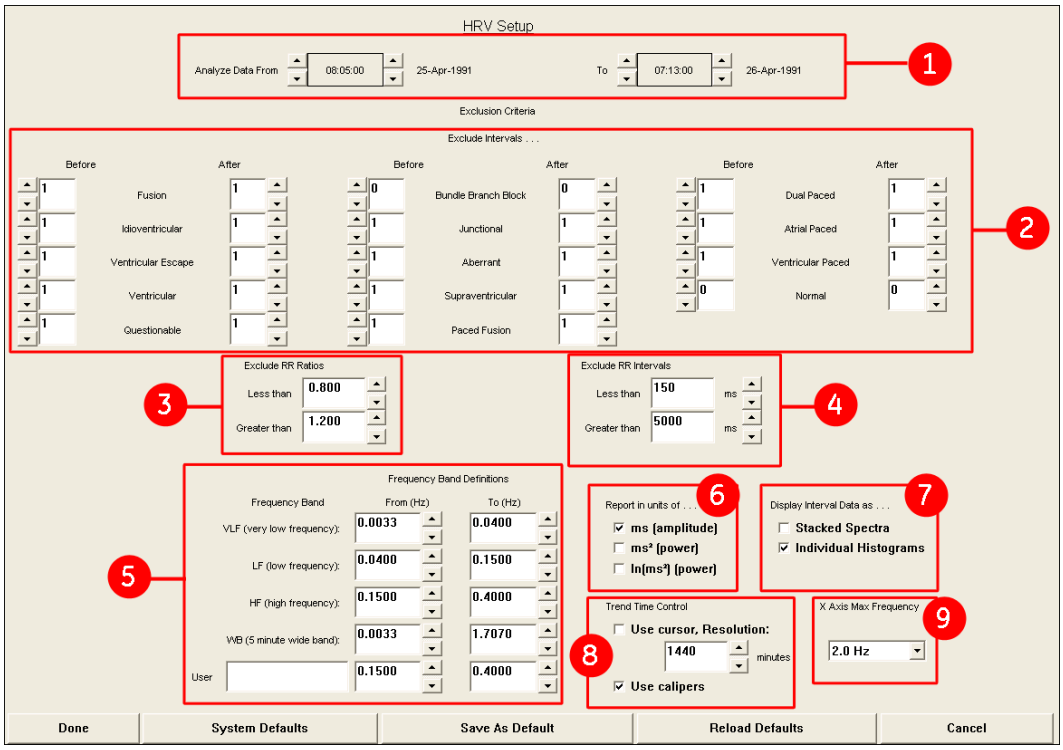
There are two steps to setting up the HRV application: activating it and configuring it. This section describes how to configure the ***HRV*** application and provides the following information:

- HRV Setup Page Layout
- HRV Setup Controls
- Configuring HRV

For information on activating the HRV application, refer to "Software Activators" on page 79.

HRV Setup Page Layout

The ***HRV Setup*** window consists of the follow components



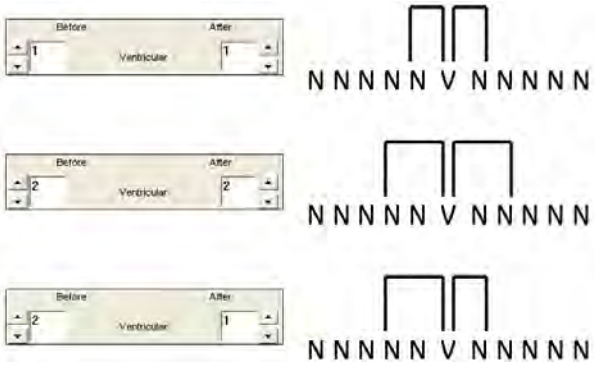
1. **Analyze Data**
   Allows you to set the time range for the HRV analysis. In the ***From*** field, select the starting time. In the ***To*** field, select the ending time. Use the arrow buttons to the left of each field to adjust the hours of the corresponding field. Use the arrow buttons to the right of each field to adjust the minutes of the corresponding field.

   NOTE:
   Because the HRV algorithm requires five minutes of data to calculate each minute of the spectra data, the start time must be at least 5 minutes after hookup and the end time must be at least 4 minutes before the end of the recording.

2. **Exclude Intervals**
   Allows you to set the number of beats to exclude from the HRV calculations for each of the listed beat types. You define the number of beats to exclude both before and after each type. When the HRV algorithm performs its calculations, it ignores the beats that fall within that range.
   For example, suppose you have the following pattern:

   N N N N N V N N N N N

The following illustration shows how various settings for Ventricular beats would affect the HRV calculations.



3. **Exclude R-R Ratios**
   Allows you to exclude beats based on their R to R ratio. You define the minimum and maximum acceptable values. If a beat exceeds either value, it is excluded from the HRV calculations.
   For example, suppose the ***Less than*** ratio was set to 0.800 (80%). If the average R-R interval was 160 ms, 80% would be 128 ms. Any beat that followed the previous beat by 127 ms or less would be excluded. Likewise, suppose the ***Greater than*** ratio was set to 1.200 (120%). If the average R-R interval was 160 ms, 120% would be 192 ms. Any beat that followed the previous beat by 193 ms or more would be excluded.

   NOTE:
   You can use the ***Episode Review*** application to determine the appropriate values for these fields. Set the ratios so sinus beats are included but premature ectopic and escape beats are excluded.

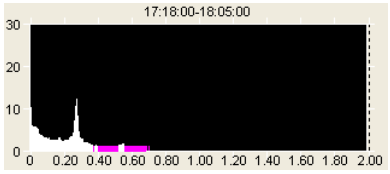
4. **Exclude R-R Intervals**
   Allows you to exclude beats based on their actual duration. You define the minimum and maximum acceptable values. If a beat exceeds either value, it is excluded from the HRV calculations.
   For example, suppose the ***Less than*** interval was set to 150 ms. Any beat that follows the previous beat by 149 ms or less would be excluded. Likewise, suppose the ***Greater than*** interval was set to 5000 ms. Any beat that follows the previous beat by 5001 ms or more would be excluded.

5. **Frequency Band Definitions**
   Defines the low and high frequencies, in Hz, for five presets: *VLF* (very low frequency), *LF* (low frequency), *HF* (high frequency), *WB* (wide band), and *User*. In addition, you can assign a custom name to the user band to describe its intent. These predefined bands are used by the ***Frequency Domain Readout*** to quickly move the calipers to the defined frequencies, allowing you to adjust the readout on the fly.

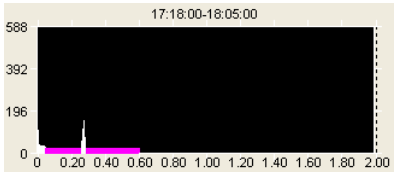
   NOTE:
   Do not set an ultra-low frequency range (that is, a range from 0.0001 Hz to 0.0033 Hz). The system is designed to analyze only very low frequencies (0.0033 Hz) and greater. Defining a lower range may cause unexpected results.

6. **Report Units**
   Allows you to set the magnitude of the y-axis in the histograms and stacked spectra. The following list shows the effect of each choice on the same histogram:

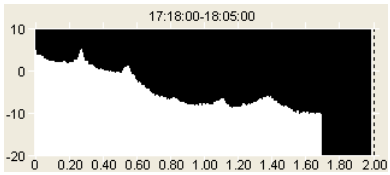
   - Amplitude (ms)



   - Power (ms^2)



   - Natural log of Power (ln ms^2)



7. **Display Interval Data**
   Allows you to select whether interval data will be displayed as individual histograms or stacked spectra. Refer to "HRV Page Layout" on page 182 for a description of each option.

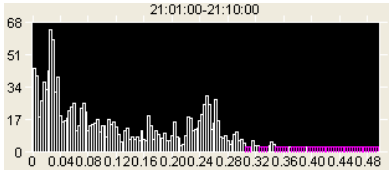
8. **Trend Time Control**
   Allows you to choose the mechanism for selecting values in the HRV Trend tachogram. You have two options:

   - Use cursor, Resolution
     Uses a cursor to select a single point in the tachogram. If you select this method, you need to define the resolution. The resolution determines the amount of time, in minutes, displayed in each mini histogram in the Interval Data section of the screen. When you move the cursor in the trend at the top of the screen, the first half of the mini histograms will show the HRV data before the cursor and the last half will show the HRV data after the cursor.
     For example, suppose you enter a resolution of 30 minutes and then place the cursor at 12:00 in the trend. If 12 mini histograms are displayed, the first six will show data from 9:00 — 12:00 in 30 minute increments and the last six will show data from 12:00 — 15:00 in 30 minute increments. If only eight mini histograms are displayed, the first four will show data from 10:00 — 12:00 in 30 minute increments and the last four will show data from 12:00 — 14:00 in 30 minute increments.

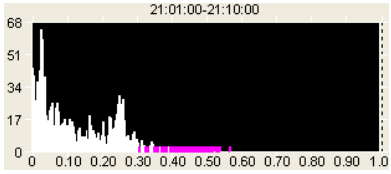
   - Use calipers
     Uses calipers to select a range in the tachogram. For information on using calipers, refer to "Setting the Caliper" on page 267; while those procedures were written for using the calipers in the ***Strip Review***, the same principles apply here.

9. **X Axis Max Frequency**
   Allows you to select the scale of the x-axis. The following list shows the effect of each choice on the same histogram:

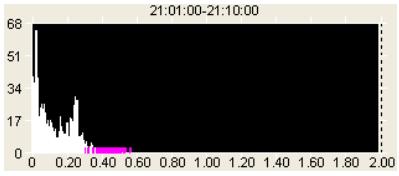
   - 0.5 Hz



   - 1.0 Hz



   - 2.0 Hz



HRV Setup Controls

The following table lists the controls available on the ***HRV Setup*** window and describes their use.

Control	Description
Done	Applies your configuration and returns to the HRV window.
System Defaults	Reapplies the factory default settings.
Save as Default	Saves the current configuration as your default. The next time you use the HRV module, it will use this configuration instead of the factory defaults. You can always return to the factory defaults by clicking ***System Defaults***.
Reload Defaults	Reapplies the defaults saved using ***Save as Default***. Use this to return to your working defaults after temporarily changing the configuration.
Cancel	Closes the ***HRV Setup*** window without applying any configuration changes.

Configuring HRV

Use the following procedure to configure the HRV module. Typically, the HRV module will be configured once and will rarely need to be reconfigured. The following procedure is written under the assumption that you have already selected a patient. For more information, refer to "Selecting the Patient" on page 107

1. Click the ***Heart Rate Variability*** icon.

   The ***HRV*** icon is available on the following preloaded menus:

   - Rapid Review with HRV
   - Rapid Review with Episode Review and HRV
   - Rapid Review with Waveform Measurements and HRV

   You may also have created your own custom menus with the HRV icon.

2. Click ***Setup***.

   The ***HRV Setup*** window opens.

3. Define your settings as appropriate.

   Refer to "HRV Setup Page Layout" on page 186 for details.

4. Do one of the following:

   - To discard your changes and return to the factory defaults, click ***System Defaults***.
   - To discard your changes and return to your working defaults, click ***Reload Defaults***.
   - To save your current changes as your new working defaults, click ***Save As Default***.

5. After you have configured the settings as appropriate, click ***Done***.

   The ***HRV Setup*** window closes and the settings are applied to the HRV window. You are now ready to calculate the HRV.

Calculating HRV

Use the following procedure to calculate the HRV. The procedure is written under the assumption that you have already selected a patient. Refer to "Selecting the Patient" on page 107 for details.

NOTE:

HRV should be calculated on a clean ECG. Therefore, you should review and edit the ECG prior to calculating HRV. Refer to Chapter 7, "ECG Review", for details.

1. Click the ***Heart Rate Variability*** icon.

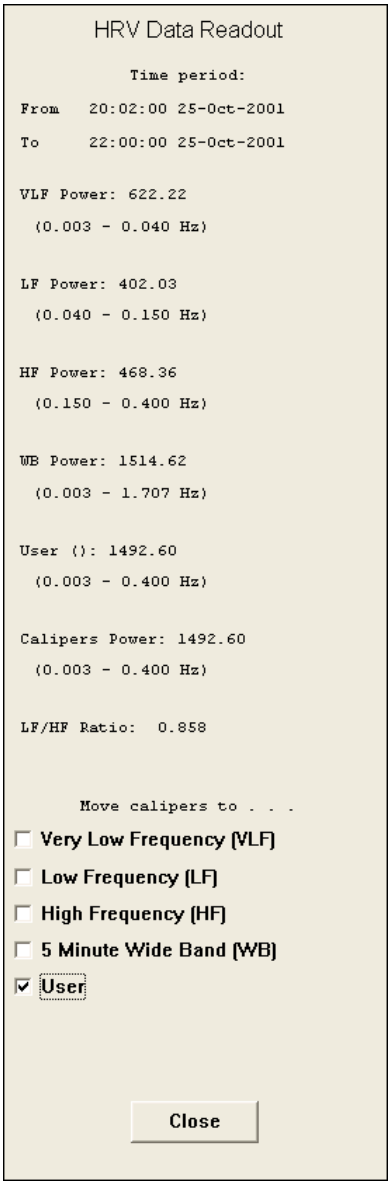
   The ***HRV*** icon is available on the following preloaded menus:

   - Rapid Review with HRV
   - Rapid Review with Episode Review and HRV
   - Rapid Review with Waveform Measurements and HRV

You may also have created your own custom menus with the HRV icon.

2. To calculate the frequency readout, click ***Frequency Domain Readout*** in the control panel.

   The HRV is calculated and the following information is displayed in the control panel:



3. If desired, you can adjust the readout in any of the following ways:

   - Adjust the calipers in the ***HRV Trend*** tachogram or the ***# of Occurrences Histogram***
   - Select one of the frequency check boxes at the bottom of the control panel to adjust the calipers based on the preset frequencies.
   - Click in any of the individual histograms or stacked spectra.

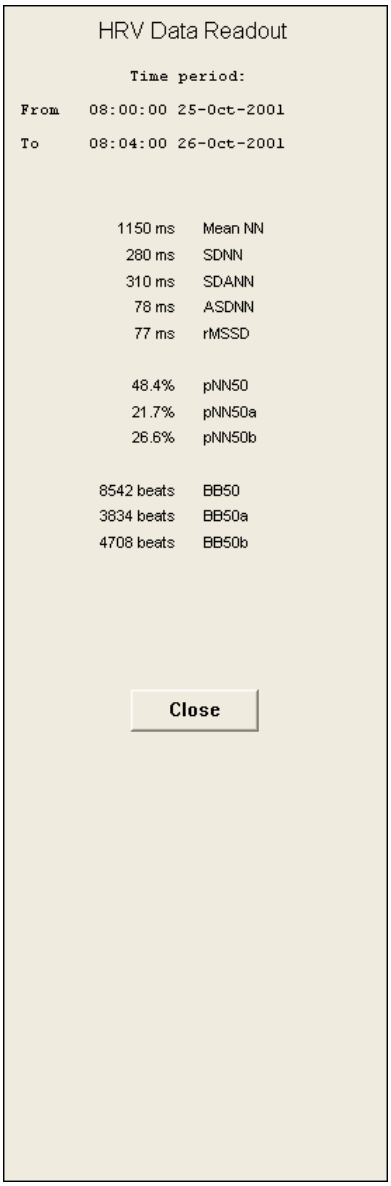
   Each method changes the criteria used to calculate the HRV readout and forces the readout to update with new data.

4. When you are done with the Frequency Domain Readout, click ***Close***.

   This closes the readout and returns you to the HRV control panel.

5. To calculate the time readout, click the ***Time Domain Readout*** button.

   The HRV is calculated and the following information is displayed in the control panel:



The following table describes each of the 11 indices.

Index	Description
Mean NN	Average of all intervals between normal beats excluding ectopy or noise intervals and intervals exceeding either the ***R-R Interval*** or ***R-R Ratio*** defined on ***HRV Setup***.
SDNN	Standard deviation of intervals of all normal beats. Reflects the variability within five–minute periods above 0.0033 Hz.

Index	Description
SDANN	Standard deviation of five–minute mean R-R intervals. Sensitive to the lowest frequencies of heart rate variability.
ASDNN	Mean of five–minute standard deviations of intervals.
rMSSD	Root mean square of the difference of successive R-R intervals. Sensitive to the highest frequency components of HRV.
pNN50	Percentage of intervals that are more than 50 ms different from the previous interval. Sensitive to the highest frequency components of HRV.
pNN50a	Percentage of intervals more than 50 ms longer than the previous interval.
pNN50b	Percentage of intervals that are less than 50 ms shorter than the previous interval.
BB50	Count of intervals that are more than 50 ms different from the previous interval.
BB50a	Count of intervals that are more than 50 ms longer than the previous interval.
BB50d	Count of intervals that are less than 50 ms shorter than the previous interval.

Because the Time Domain Readout is calculated using the five-minute 1024 point Fast Fourier Transform calculation across the selected time range, adjusting the position of the calipers or selecting a histogram or spectrum have no effect on the readout.

6. When you are done with the Time Domain Readout, click ***Close***.

   This closes the readout and returns you to the HRV control panel.

7. To include the HRV histograms or spectra on the patient report, click ***File***.

   Refer to "File" on page 249 for details.

8. To print the HRV histograms or spectra to the Windows default printer, click ***Print***.

   Refer to "Print" on page 250 for details.

Additional Resources

For additional information on reviewing or interpreting the HRV information, refer to the Heart Rate Variability Physician's Guide (2027879-039).

B

HRT

The ***Heart Rate Turbulence*** (HRT) application is an optional feature that analyzes ECG signals and measures heart rate turbulence in patients undergoing cardiovascular disease testing for the purpose of risk stratification and prediction of sudden cardiac death. The application provides measurements only; it provides no interpretation. The measurements must be reviewed and interpreted by a qualified health care practitioner in conjunction with the patient's clinical history, symptoms, and other diagnostic tests.

The algorithm used by the HRT application measures short-term fluctuations in the heart rate following a premature ventricular contraction (PVC). The measurements generated by the algorithm provide additional information to identify patients at high risk for fatal arrhythmias.

The HRT application provides two methods for viewing HRT information:

- Averaged Triggers
  The default method for viewing HRT, ***Averaged Triggers*** displays a single tachogram that plots the average RR interval surrounded by the trigger events. It includes additional information, such as turbulence onset, turbulence slope, and number of selected PVCs. For additional information, refer to "Averaged Trigger Layout" on page 197.
- Single Triggers
  An alternate method for viewing HRT, ***Single Triggers*** displays individual tachograms for each trigger event. For additional information, refer to "Single Trigger Layout" on page 198.

In addition to reviewing the HRT information on the screen, the MARS Ambulatory ECG Analysis system provides three HRT report components that can be added to a custom report:

- HRT — Averaged Tachogram
- HRT — Superimposed Tachogram
- HRT — Option Settings

For more information, refer to "HRT Report Components" on page 199.

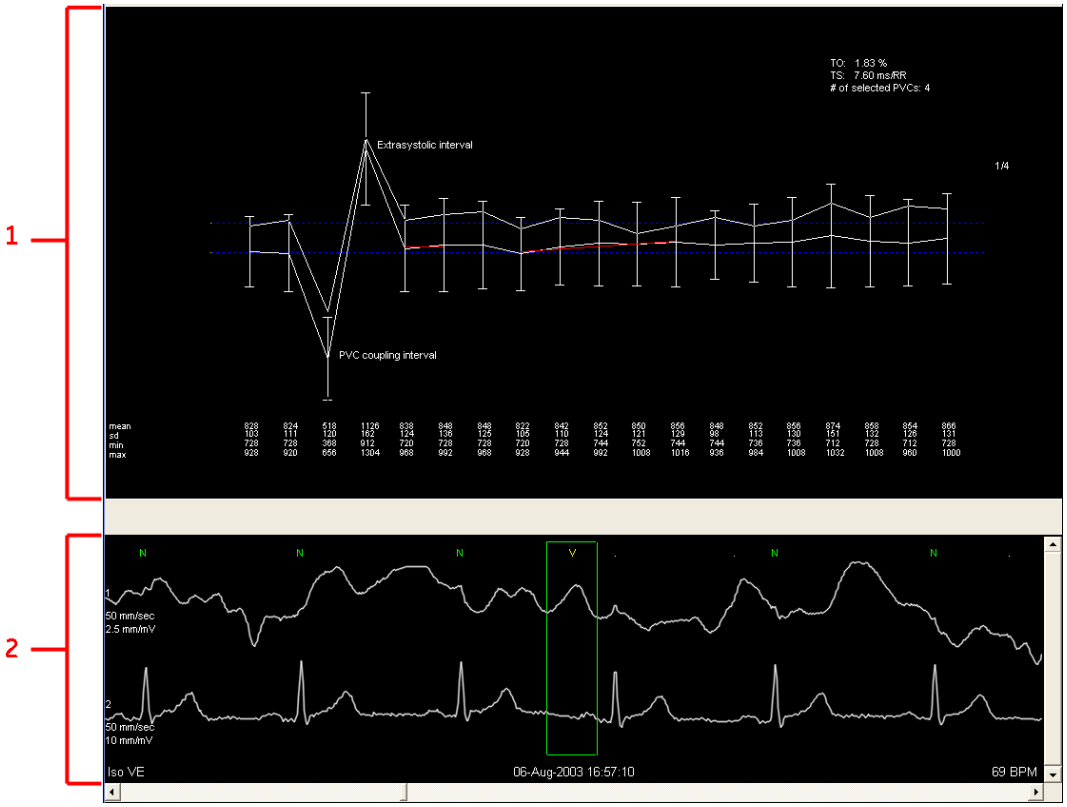
Before using the Heart Rate Turbulence application or report components, you must purchase and activate the optional HRT module. For more information, refer to "Software Activators" on page 79.

HRT Page Layout

The ***Heart Rate Turbulence*** application consists of the following components.

NOTE:

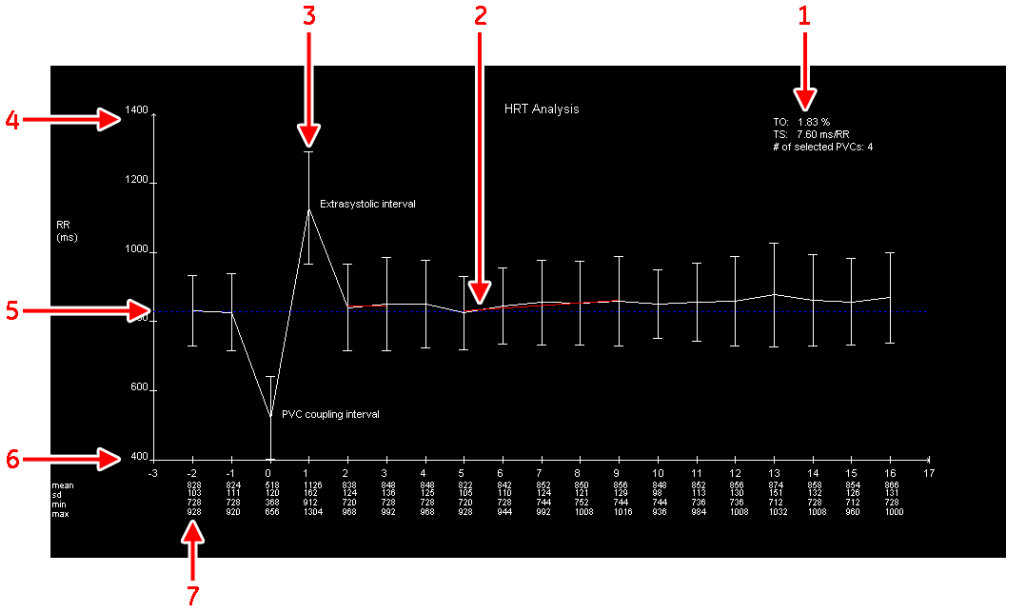
The examples in this section use the ***Rapid Review (All Apps)*** application menu. If you use a different menu, your page layout may differ.



1. **HRT** window
   Displays the tachogram and numerical data representing the heart rate turbulence calculations. The layout of the window differs slightly depending on the selected viewing method. For more information, refer to "Averaged Trigger Layout" on page 197 and "Single Trigger Layout" on page 198.
2. **Strip Review** window
   Displays the ECG strip. When using the ***Single Trigger*** display option, the ECG strip displays the segment corresponding to the tachogram displayed in the HRT window.

Averaged Trigger Layout

The layout for the ***Averaged Trigger*** display method consists of the following components:



1. **Turbulence Statistics**
   Provides the numerical results of the HRT calculations. Values are:

   - TO
     (Turbulence Onset) Indicates the percentage of difference between the heart rate immediately following the PVC and the heart rate immediately preceding the PVC. Positive values indicate deceleration of the sinus rhuthm, while negative values indicate acceleration.
   - TS
     (Turbulence Slope) Indicates the steepest slope of the linear regression line for each sequence of five consecutive normal intervals after the PVC. Expressed in milliseconds per RR Interval.
   - # of Selected PVCs
     Indicates the number of PVCs used in the calculations.

2. **Turbulence Slope**
   The red line running through the tachogram indicates the slope represented by TS in the Turbulence Statistics.

3. **Beat Range**
   The vertical I-beam running through each beat indicates the upper and lower limits of the beats used to create the average.

4. **Y-Axis**
   Indicates the rate of the R-R Interval, in milliseconds.

5. **Initial Frequency**
   The blue dotted line running through the tachogram indicates the initial R-R frequency prior to the PVC. It is used as a reference point for analyzing the adjustment of the beats following the PVC.

6. **X-Axis**

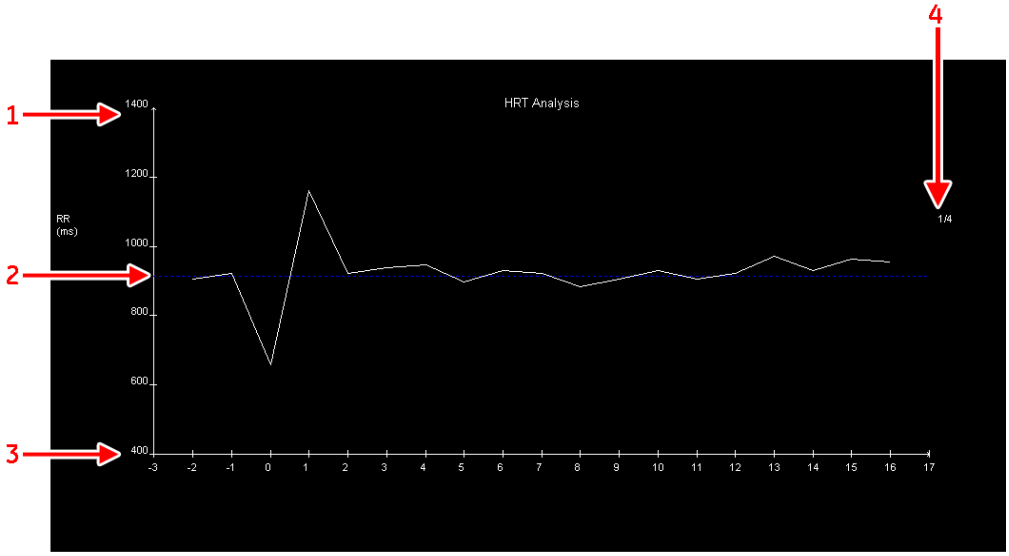
Identifies the beats that comprise the tachogram. The HRT application uses 20 beats to calculate turbulence: the PVC (represented by 0), the two beats preceding the PVC (represented by —1 and —2), and the 17 beats following the PVC (represented by 1 through 17).

7. **Beat Statistics**
   Provides the Mean, Standard Deviation, Minimum, and Maximum (in milliseconds) for each group of beats.

   NOTE:
   If the ***HRT*** window is displayed at 1/3 screen instead of 2/3 screen, only the Mean is displayed.

Single Trigger Layout

The layout of the Single Triggers display method consists of the following components:



1. **Y-Axis**
   Indicates the rate of the R-R Interval, in milliseconds.
2. **Initial Frequency**
   The blue dotted line running through the tachogram indicates the initial R-R frequency prior to the PVC. It is used as a reference point when analyzing the adjustment of the beats following the PCV.
3. **X-Axis**
   Identifies the locations of the beats that comprise the tachogram. The HRT application uses 20 beats to calculate turbulence: the PVC (represented by 0), the two beats preceding the PVC (represented by —1 and —2), and the 17 beats following the PVC (represented by 1 through 17).
4. **Counter**
   Identifies the total number of tachograms and the position of the current tachogram in a *[current record number] / [total record number]* format. Example: 1/4, 2/4, 3/4, and 4/4.

HRT Controls

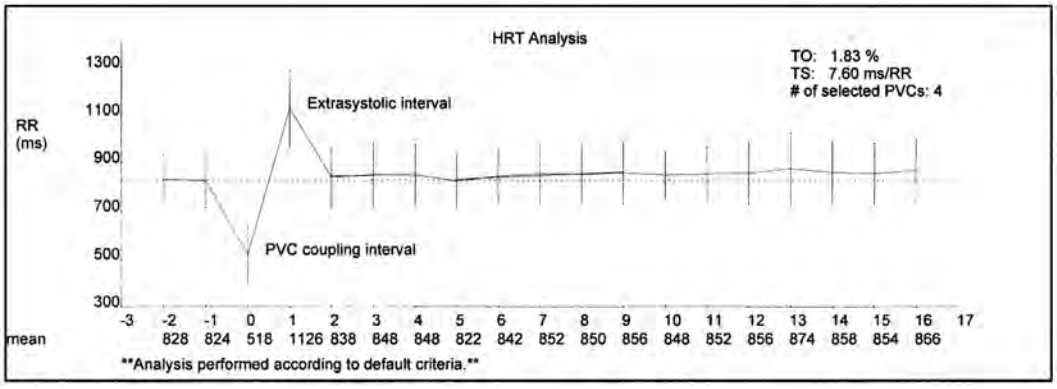
The following table identifies the HRT controls and describes their uses.

Control	Description
File	Files the displayed tachogram on the final report. Refer to "File" on page 249 for more information. If you plan to use a final report format that includes the HRT Report Components, you do not need to file the HRT to include the information on the report. Refer to "HRT Report Components" on page 199.
Print	Prints the displayed tachogram to the Windows default printer. Refer to "Print" on page 250 for more information.
Autoscale	Automatically scales the Y-axis so the entire tachogram fits within the graph. Disabled by default.
Options	Opens the ***HRT Display Options*** control panel. From this panel you can switch between ***Averaged Triggers*** and ***Single Triggers***. If you switch to ***Single Triggers***, you can also jump between the individual tachograms, superimpose all the tachograms on the graph, review unused triggers, delete triggers, and reset the HRT to its original form. For more information, refer to "Analyzing HRT" on page 201.

HRT Report Components

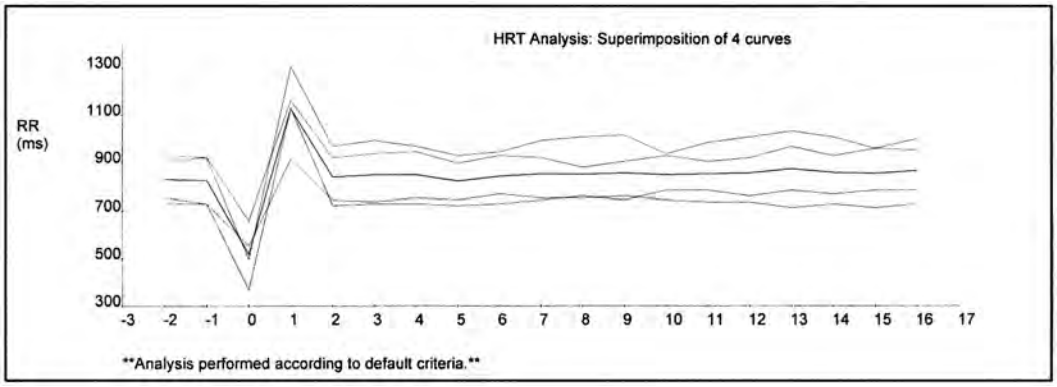
The MARS Ambulatory ECG Analysis system provides the following HRT-related components that can be added to an existing report format or to a new custom format. For information on adding any of these components to a report format, refer to "Report Configuration" on page 63.

- ***HRT — Averaged Tachogram***
  Includes the tachogram that appears when the Averaged Triggers display method is selected, as seen in the following illustration.



- ***HRT — Superimposed Tachogram***

Includes the tachogram that appears when the Single Triggers display method is selected with all the PVCs superimposed, as seen in the following illustration.



- ***HRT — Option Settings***
  Identifies the target event and lists the analysis options used to calculate the HRT, as seen in the following illustration.

Heart Rate Turbulence Analysis Options

Target event: Single premature PVC with compensatory pause
Number of reference RR intervals: 5
Percent RR to call a normal RR premature: 20%
Percent RR to call a normal RR late: 20%
Maximum difference to call a normal RR premature or late: 200 ms
Percent value to call a PVC RR premature: 20%
Percent value to call a PVC RR late: 20%
Minimum value for an RR to be included: 200 ms
Pause threshold: 2500 ms
Number of RR intervals before target event: 2
Number of RR intervals after target event: 15

Analysis performed according to default criteria.

The HRT analysis options are set on the ***System: Analysis Options Setup*** window. For a description of each field, refer to "HRT Tab" on page 47.

Analyzing HRT

Use the following procedure to analyze the heart rate turbulence. This procedure is written with the assumption that you have already selected a patient. Refer to "Selecting the Patient" on page 107 for more information.

1. Click the ***Heart Rate Turbulence*** icon.

   The HRT is calculated and the Averaged Trigger tachogram is displayed on the HRT window.

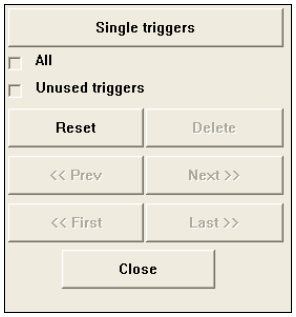
2. If the tachogram does not fit completely within the graph, select ***Autoscale*** in the control panel.

   The y-axis and tachogram automatically rescale to fit within the graph.

3. To view the individual tachograms used to generate the average, do the following:

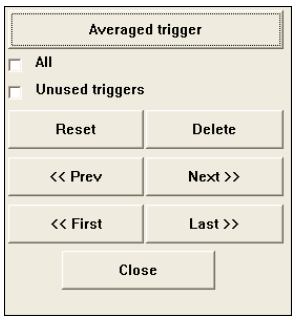
   a. Click ***Options***.

      The following control panel opens:

   b. Click ***Single Triggers***.

      The ***Single Triggers*** button changes to ***Averaged Triggers***, and all the fields and controls become accessible, as seen in the following illustration.

   c. Use the following buttons to scroll through the individual tachograms as necessary.

      - ***<< Prev*** scrolls to the preceding tachogram.
      - ***Next >>*** scrolls to the following tachogram.
      - ***<< First*** jumps to the first tachogram.
      - ***Last >>*** jumps to the last tachogram.

As you scroll through the tachograms, the counter on the right side of the screen changes (see "Single Trigger Layout" on page 198). In addition, the ***Strip Review*** window displays the PVC associated with the tachogram.

d. To remove an individual tachogram from the HRT calculations, scroll to the desired tachogram and click ***Delete***.

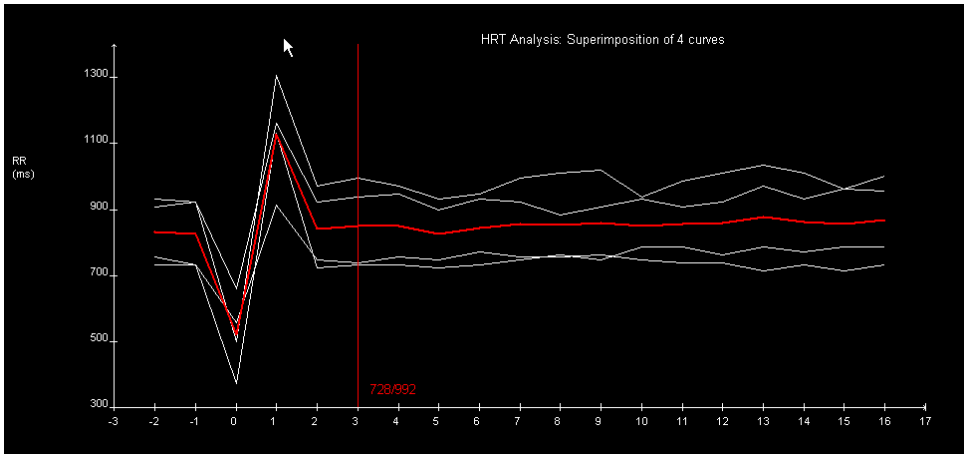
   The selected tachogram is removed from the group, the counter on the right side of the screen updates accordingly, and the HRT is recalculated using the updated set of PVCs.

e. To restore all deleted tachograms, click ***Reset***.

   All deleted tachograms are restored, the counter on the right side of the screen updates accordingly, and the HRT is recalculated using the original set of SPVCs.

f. To view all of the tachograms together, select ***All***.

   All the tachograms are superimposed in the window, as seen in the following illustration.

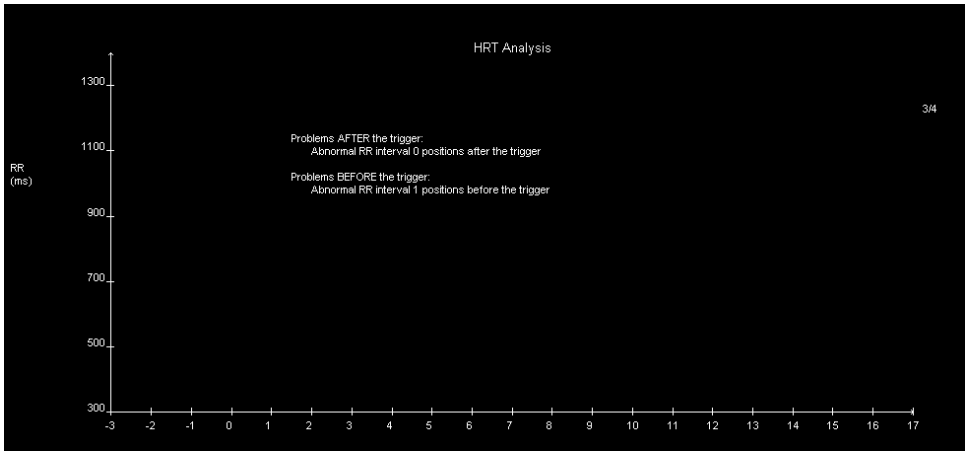


The vertical red line marks the set of beats. The numbers at the bottom of the line indicate the range of R-R Intervals, in milliseconds, for that set. The format is *[lowest interval]/[highest interval]*. For example: 720/928.

Use ***<< Prev*** and ***Next >>*** to move the red line accordingly.

g. To review PVCs that were not used in the HRT calculations, click ***Unused Triggers***.

The first unused trigger is displayed in the ***Strip Review*** window and an explanation of why the PC was not used is displayed in the ***HRT*** window, as seen in the following illustration.



Click ***<< Prev*** and ***Next >>*** to review the unused triggers as necessary.

h. To redisplay the averaged tachogram, click ***Averaged Triggers***.

The average tachogram is displayed in the HRT window.

i. Click ***Close*** to return to the HRT control panel.

Additional Resources

For additional information on interpreting HRT measurements, refer to the *Heart Rate Turbulence Physician's Guide* (2020044-105).

C

12-Lead Analysis

The MARS Ambulatory ECG Analysis system offers two optional applications for reviewing the 10–second, 12–lead ECG strips generated by the SEER MC and SEER 12 Holter recorders:

- View 12SL
- View 12SL Trends

The following sections describe how to use both applications.

NOTE:
Ambulatory ECG data from a Holter recorder is not intended to be used as a substitute for a standard, diagnostic-quality resting 12–lead ECG.

NOTE:
To acquire 12SL data from a SEER MC, you must use Combo cards that contain both Holter and 12SL data. The MARS system cannot acquire data from SEER MC cards that contain only 12SL data.

Activating 12SL

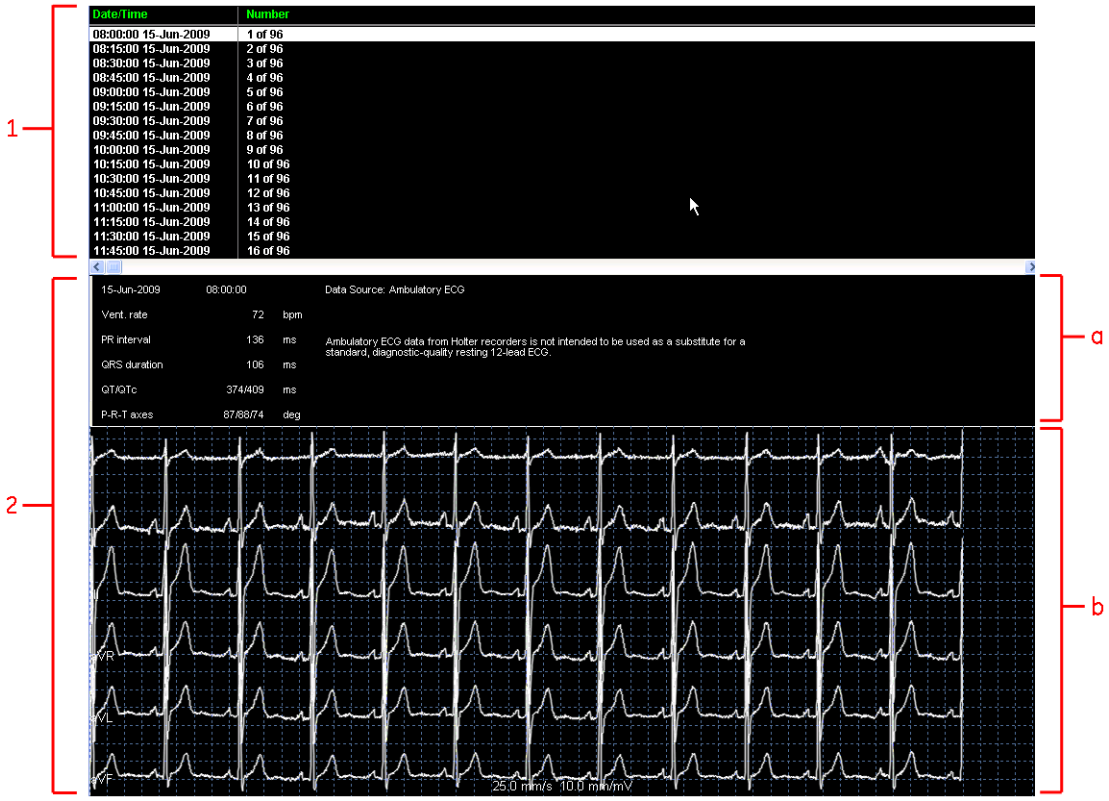
Before you can use the ***View 12SL*** or ***View 12SL Trends*** applications, you must purchase and activate the optional ***View 12SL*** feature. For information on activating optional features, refer to "Software Activators" on page 79.

View 12SL

The ***View 12SL*** application lets you review the individual 10–second, 12–lead strips uploaded from a SEER MC or SEER 12 Holter recorder to the MARS Ambulatory ECG System. From this application, you can file a strip for inclusion on the patient report or print a strip to the default MARS printer. In addition, you can adjust the way the strips are displayed.

View 12SL Page Layout

The ***View 12SL*** application consists of the following components:



1. ***12SL Directory*** window
   Lists each 10–second, 12–lead strip available for the selected study. Each strip is identified by the date and time the strip was recorded and a sequential number.

2. ***View 12SL*** window
   Provides detailed information about the strip selected in the ***12SL Directory***. The View 12SL window is divided into the following sections:

   a. ***ECG Measurements***
      Displays the following information for the selected strip:

      - Demographic information
        This includes date, time, and data source.
      - Ventricular rate
        This is measured in beats per minute.
      - PR interval
        This is the average interval measured in milliseconds.
      - QRS duration
        This is the average duration measured in milliseconds.
      - QT/QTc durations
        These are the average durations measured in milliseconds.
      - P-wave, R-wave, and T-wave axes
        These are the average axes measured in degrees.

- Noise Level
  This is an aggregate score of four possible noise sources: power line, muscle tremor, baseline sway, and saturation. Possible scores are 0, 8, 16, 24, or 32.

  NOTE:
  Noise level is available only for readings taken with a SEER MC Holter recorder.

b. ***12–Lead View***
Displays the waveforms for all 12 leads.

View 12SL Controls

The ***View 12SL*** controls are described in the following table.

Control	Description
File	Files the current 12–lead strip on the patient report. For more information on using the ***File*** control, refer to "File" on page 249.
Print	Prints the current 12–lead strip to the default Windows printer. For more information on using the ***Print*** control, refer to "Print" on page 250.
<<Previous	Displays the previous 12–lead strip. The active strip will be selected in the ***12SL Directory*** window.
Next >>	Displays the next 12–lead strip. The active strip will be selected in the ***12SL Directory*** window.
Tools	Opens the Tools control panel. From this control panel, you can modify the following display options: • Grid • Gain • Time Scale

Viewing 12SL Strips

Use the following procedure to review 12SL strips.

These procedures are written under the assumption that you have already selected a patient with 12–lead data. For more information, refer to "Selecting the Patient" on page 107.

1. Click the ***View 12SL*** icon.

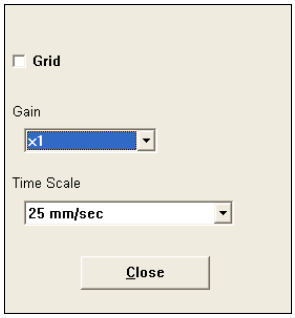
   The ***View 12SL*** application opens. The first strip is selected automatically.

   NOTE:
   Refer to "Icon-Menu Reference" on page 28 for a list of the menus on which the ***View 12SL*** icon is available.

2. To modify the display of the waveforms, do the following:

   a. Click ***Tools***.

   The following control panel opens.



b. Set the options as appropriate.

Refer to the following table for a description of each option.

Control	Description
Grid	Determines whether a grid will appear behind the waveforms. It is cleared by default. Set the field to enable the grid.
Gain	Determines the height at which the waveforms will be displayed. By default, the gain is set to x1, or actual size. Options include x.25, x.5, x1, x2, and x4. Changing the gain affects only the display of the waveforms. It does not affect their measurements.
Time Scale	Determines the length at which the waveforms will be displayed. By default, the time scale is set to 25 mm/sec. Options include 5 mm/sec, 10 mm/sec, 12.5 mm/sec, 25 mm/sec, and 50 mm/sec. Changing the time scale affects only the display of the waveforms. It does not affect their measurements.

c. After the options are set accordingly, click ***Close*** to close the Tools control panel.

3. To view the waveforms for all 12 leads, use the vertical scroll bar on the ***View 12SL*** window.

NOTE:
At its default height (2/3 screen), the ***View 12SL*** window can display only 6 leads at a time. As an alternative to using the scroll bar, you could change the application height to full screen to display all 12 leads at once.

4. To view a specific strip, click the strip in the ***12SL Directory*** window.

The strip's waveforms and measurements appear in the ***View 12SL*** window.

5. To scroll through the strips, use the ***<<Previous*** and ***Next>>*** buttons in the ***View 12SL*** control panel.

As you scroll through the available strips, the measurements and waveforms of the selected strip appear in the ***View 12SL*** window.

6. To file the visible 12–lead information on the patient report, click ***File***.

Refer to "File" on page 249 for details.

NOTE:
Only the visible information is filed on the report. To file all 12 waveforms on the report, change the screen height to full screen prior to filing.

7. To print the visible 12–lead information on the default Windows printer, click ***Print***.

   Refer to "Print" on page 250 for details.

   NOTE:
   When you click ***Print***, a vertical line appears on the waveforms to indicate the right margin of the printable page. If the entire waveform will not print, change the display's time scale to reduce the waveform's length. For more information, refer to step 2.

8. Continue to review, file, and print the 12–lead strips as necessary.

View 12SL Trends

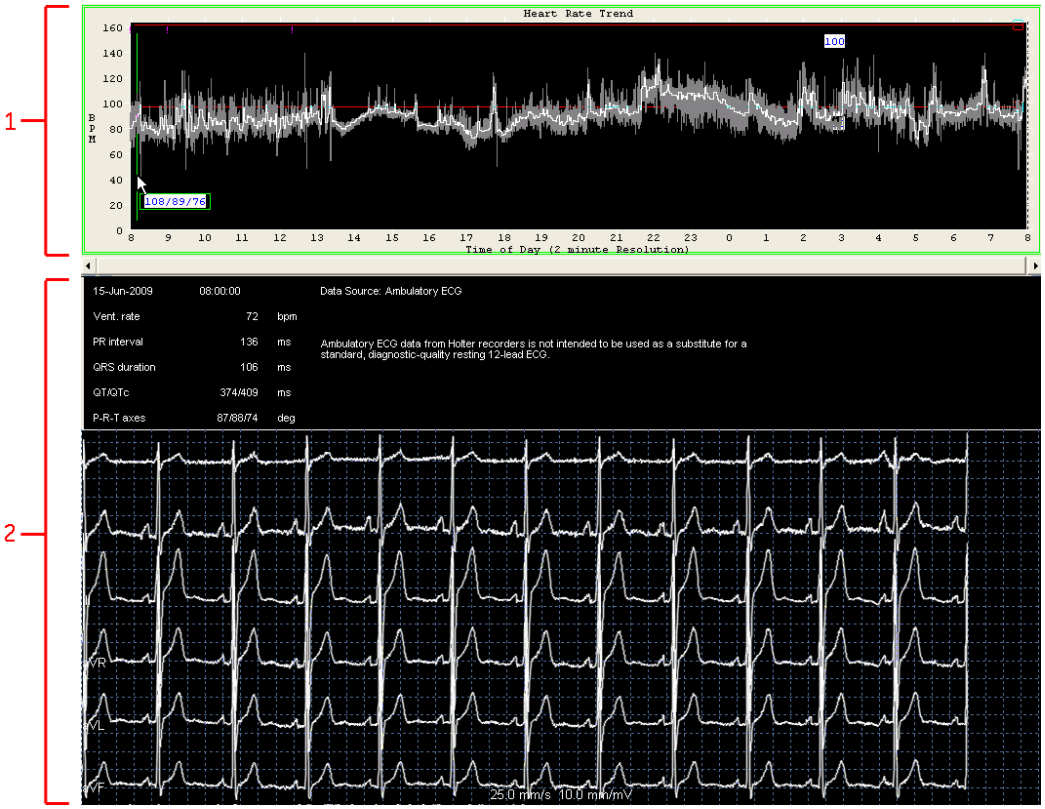
The ***View 12SL Trends*** application lets you review and edit trends detected in the ECG. You have the following options while reviewing trends:

- Selecting trends to review
- Filing trends on the final report
- Setting a trend's minimum and maximum values
- Editing a region within a trend

The ***View 12SL Trends*** application is nearly identical to the ***Review Trends*** application. The following sections will point out the similarities and differences.

View 12SL Trends Page Layout

The ***View 12SL Trends*** application consists of the following components:



1. ***Trend Review*** window
   Displays the selected trends. Identical to the standard Trend Review window. For a detailed description of this window, refer to "Trend Review Page Layout" on page 148.

2. ***View 12SL*** window
   Displays detailed information about the selected 12–lead strip. The window is divided into two sections: ECG Measurements and Waveforms. For a detailed description, refer to "View 12SL Page Layout" on page 206.

View 12SL Trend Controls

The ***View 12SL Trend*** Controls are identical to the standard ***Trend Review*** controls. Refer to "Trend Review Controls" on page 150 for details.

Viewing 12SL Trends

Use the following procedure to review 12SL trends.

These procedures are written under the assumption that you have already selected a patient with 12 lead data. For more information, refer to "Selecting the Patient" on page 107.

1. Click the ***View 12SL Trends*** icon.

   The ***View 12SL Trends*** application opens with the default trend selected.

   NOTE:
   Refer to "Icon-Menu Reference" on page 28 for a list of the menus on which the ***View 12SL Trend*** icon is available.

2. Change the display as necessary.

   You can enable automatic scaling, display cursor labels, set the screen size, set the plot size, and jump to a specific point in the trend. This procedure is identical to setting the display options for the standard Trend Review application. Refer to "Setting the Trend Display Options" on page 150 for details.

3. Select the trends to display.

   You can select from pre-defined trend groups or individual trends. When reviewing 12SL trends, you should select one of the two 12–lead trend groups: *12 Lead Group (Basic)* or *12 Lead Group (Full)*. Otherwise, the procedure is identical to selecting trends with the standard Trend Review application. Refer to "Selecting Trends" on page 153 for details.

4. Set the maximum and minimum values as necessary.

   You can set the maximum and minimum values for the Heart Rate trend or the R-R Interval trend. The procedure is identical to setting the maximum and minimum using the standard ***Trend Review*** application. Refer to "Setting the Maximum and Minimum Values " on page 155 for details.

5. Edit a region if necessary.

   You can select a contiguous range of beats and perform a number of actions upon on the beats within that range. For details, refer to "Region" on page 253.

6. File trends on the patient report as necessary.

   For details on how to file trends, refer to "File" on page 249.

7. Print trends to the default printer as necessary.

   For details on printing to the default printer, refer to "Print" on page 250.

Additional Resources

For additional information about 12SL analysis, refer to the *Marquette ™ 12SL ™ ECG Analysis Program Physician's Guide* (416791-004).

D

Waveform Analysis

The ***Waveform Measurements*** application allows you to conduct the following optional analyses:

- ST Analysis
  Measures the interval between the end of the QRS complex to the beginning of the T-Wave. You can choose to manually position the fiducial points used in the measurement, or you can let the MARS system position them automatically. The ST Analysis can be run separately or in tandem with the QT Analysis.
- QT Analysis
  Measures the interval from the beginning of the QRS complex to the end of the T-Wave. The MARS system automatically positions the fiducial points used in the measurement. The QT Analysis can be run separately or in tandem with the ST Analysis.
- T Wave Analysis
  Measures the T-Wave Alternans, an ECG pattern that exhibits different ST/T-Wave morphologies on alternating beats. The T-Wave Alternans measurements have been found to be predictive of arrthythmic death. When analyzed in conjunction with the patient's clinical history, symptoms, and other diagnostic tests, the T-Wave Alternans can be used for the purpose of risk stratification. The MARS system automatically positions the fiducial points used in the measurement. The T-Wave Analysis must be run independently of the ST and QT analyses.

You can pause an analysis to adjust the fiducial markers on a beat-by-beat basis. Waveform analysis creates trends that you can add to the final patient report.

Requirements

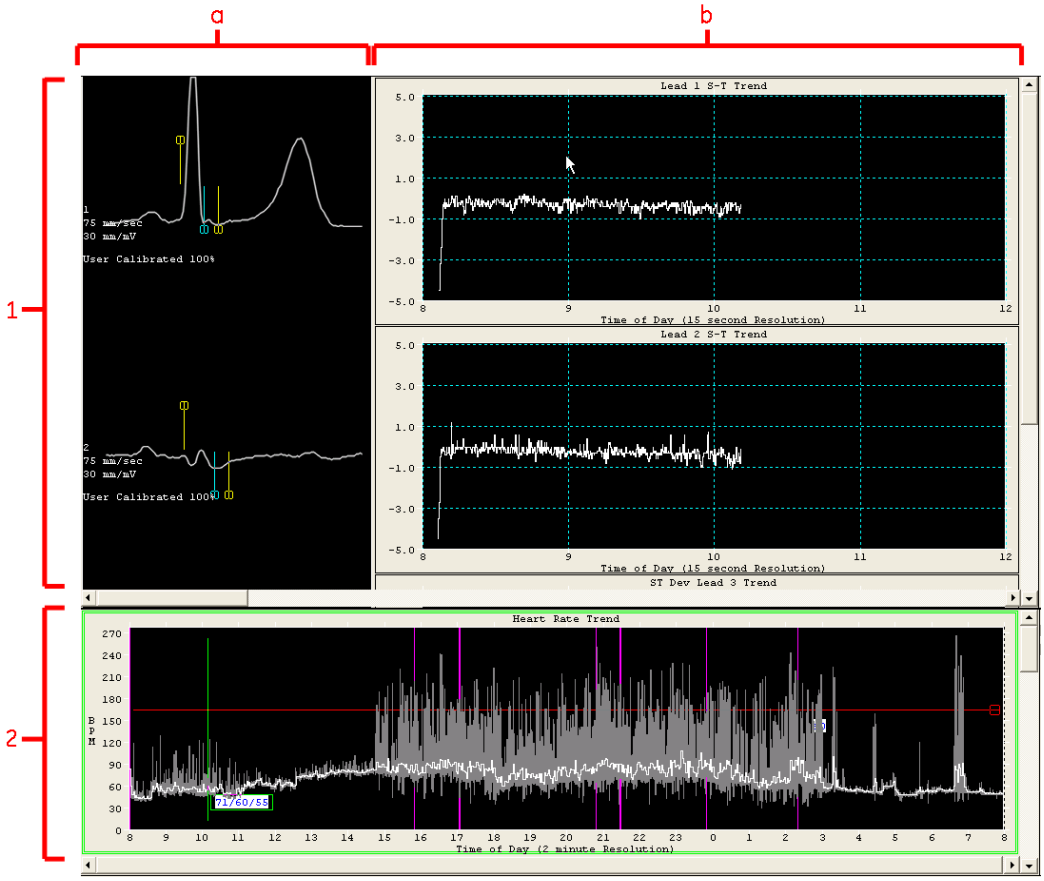
Which analyses you can conduct depends on which of the following requirements have been met:

- To conduct an ST Analysis, the following requirements must be met:
  - The ***ST Measurements*** option must be purchased and activated.
    Refer to "Software Activators" on page 79 for more information.
  - The ST event criteria must be defined.
    Refer to "Event Definition Field Descriptions" on page 33 for more information.

- To conduct a QT Analysis, the following requirements must be met:
  - The ***QT Analysis*** option must be purchased and activated.
    Refer to "Software Activators" on page 79 for more information.
  - The QT event criteria must be defined.
    Refer to "Event Definition Field Descriptions" on page 33 for more information.
  - The QT analysis options must be defined.
    Refer to "Analysis Options" on page 44 for more information.
- To conduct a T Wave Analysis, the following requirements must be met:
  - The ***T Wave Analysis*** option must be purchased and activated.
    Refer to "Software Activators" on page 79 for more information.
  - The T Wave Analysis options must be defined.
    Refer to "Analysis Options" on page 44 for more information.

Waveform Measurement Page Layout

The Waveform Measurements application consists of the following components:



1. ***Waveform Measurements*** window
   Conducts the selected analysis. It consists of the following components:

   a. ***Single Beat Panel***
      Displays up to three channels for a single beat. The display settings in the control panel determine how many channels you can see: ***1/3 Screen*** displays a single channel, ***2/3 Screen*** displays 2 channels, and ***Full Screen*** displays all three channels. Refer to "Control Panel" on page 23 for more information. Each beat includes color-coded markers used to indicate the fiducial points measured by the analysis. The fiducial points and their markers vary depending on the selected analysis.

      - ST Analysis uses the following fiducial points:
        - Isoelectric — Yellow
        - J-Point — Cyan
        - Post J-Point — Yellow
      - QT Analysis uses fiducial points:
        - Q-Wave Onset — Green
        - T-Wave Peak — Magenta
        - T-Wave Offset — Blue
      - TWA uses a single fiducial point: T-Wave Onset and Peak — Green

   b. ***Scrolling Trend Panel***
      Displays a scrolling trend in real-time as the analysis is conducted. Which trends are displayed depends on which analysis is being run and how many channels are being used.

      - ST Analysis trends
      - QT Analysis trends
      - TWA trends

      Typically the trends display leads 1, 2, and 3. If a 12–lead ECG is selected, the leads could also include I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, or V6.

2. ***Trend Review Window***
   Displays individual trends. For more information on the ***Trend Analysis*** window, refer to "Reviewing Trends" on page 147.

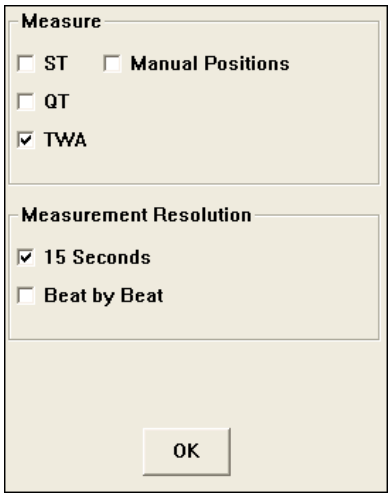
Waveform Measurement Controls

Although used together to set up and conduct waveform analyses, the ***Waveform Measurement*** and ***Trend Review*** windows serve different purposes and have separate controls. The ***Waveform Measurement*** window and controls are used to set up the analysis options and run the selected analysis. The ***Trend Review*** window is used to review the trends generated by the analysis. The ***Trend Review*** controls are used to edit the standard trends. The following table describes the ***Waveform Analysis*** controls. For information on the ***Trend Review*** controls, refer to "Trend Review Controls" on page 150.

Control	Description
Print	Prints the currently displayed beat and trends. Refer to "Print" on page 250 for more information.
Setup	Opens the ***Waveform Measurement Setup Control Panel***, which is used to select the analysis to conduct and the resolution in which the trends will be displayed. Refer to "Waveform Measurement Setup Controls", next, for details.
Tools	Opens the ***Waveform Measurement Tools Control Panel***, which is used to set the display options for the Single Beat Panel. Refer to "Tools" on page 258 for more information.
Run	Opens the ***Waveform Measurement Run Control Panel***, which is used to conduct the analysis. Use this control panel to initiate and pause the analysis, set the beat polarities, set the display rate, scroll through the analyzed beats, and delete key fiducial points on a beat-by-beat basis. Refer to "Waveform Measurement Run Controls" on page 217 for details.
Save	Opens the ***Waveform Measurement Save Trend Control Panel***, which is used to save the trends generated by the selected analysis. Offers the option to delete select trends. Refer to "Waveform Measurement Save Controls" on page 218 for details.

Waveform Measurement Setup Controls

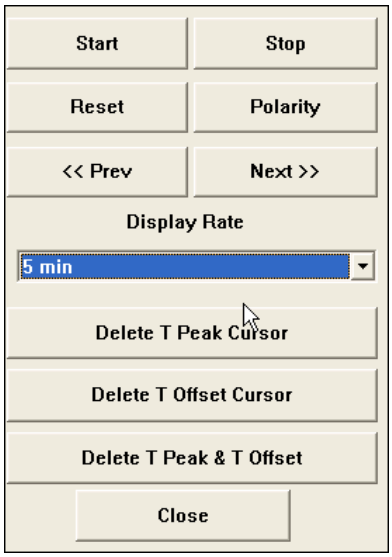
The ***Waveform Measurement Setup Control Panel*** is used to select the analysis to run and the resolution of the trend windows.



Control	Description
ST	Selects the ST Analysis. This is the default analysis. It can be selected alone or in conjunction with ***QT***.
Manual Positions	Enables fiducial markers in the Single Beat Panel that can be used to manually set the position of the isoelectric point, the J point, and Post J point. If this field is not set, the MARS system automatically determines the best position of the fiducial markers. You can manually position the fiducial markers only for ***ST*** analysis. The QT, combined ST/QT, and T-Wave analyses are always positioned automatically. Markers that are positioned automatically can be adjusted after the analysis. Changes to the fiducial markers apply only to subsequent beats; data analyzed prior to the change are not affected.
QT	Selects the QT Analysis. It can be selected alone or in conjunction with ***ST***.
TWA	Selects the T-Wave Analysis. It must be selected alone; it cannot be selected in conjunction with ***ST*** or ***QT***.
15 Seconds	Sets the trends to display at a 15 second resolution. This option is available for all three analyses.
Beat by Beat	Sets the trends to display beat by beat. This option is available only for QT analysis.

Waveform Measurement Run Controls

The ***Waveform Measurement Run Control Panel*** is used to conduct the selected analysis.

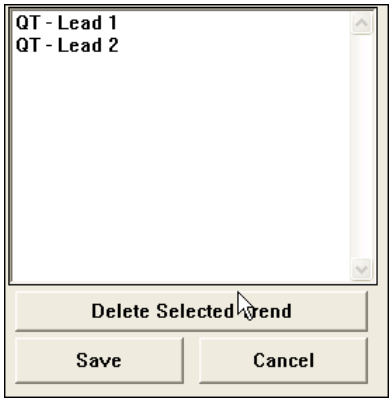


Control	Description
Start	Initiates the analysis selected in the ***Waveform Measurement Setup*** Control Panel.
Stop	Stops the current analysis. Use this control to pause the analysis so you can review and modify the current results.
Reset	Clears the analysis results.

Control	Description
Polarity	Opens the ***Waveform Measurement Polarity Control Panel***. Use to adjust the polarity of T Waves for the best viewing. Choices are: • **+** (positive) for upright T Waves • **-** (negative) for inverted T Waves • **+/-** (biphasic) for automatic adjustment
<< Prev	Scrolls backward one beat at a time. Use in conjunction with ***Next >>*** to review the analysis results.
Next >>	Scrolls forward one beat at a time. Use in conjunction with ***<< Prev*** to review the analysis results.
Display Rate	Sets the frequency at which the screen is refreshed. Lower display rates will result in longer analysis times. The field is set to 5 minutes by default.
Delete T Peak Cursor	Removes the T Peak fiducial point marker from the currently displayed beat. This control is available only for QT Analysis. **NOTE:** After removing the T Peak fiducial point marker, you can re-add it by holding the **Shift** key and double right-clicking on the beat in the Single Beat Panel.
Delete T Offset Cursor	Removes the T Offset fiducial point marker from the currently displayed beat. This control is available only for QT Analysis. **NOTE:** After removing the T Offset fiducial point marker, you can re-add it by double right-clicking on the beat in the Single Beat Panel.
Delete T Peak & Offset	Removes both the T Peak and T Offset fiducial point markers from the currently displayed beat. This control is available only for QT Analysis.
Close	Closes the ***Waveform Measurement Run Control Panel*** and returns to the ***Waveform Measurement Control Panel***.

Waveform Measurement Save Controls

The ***Waveform Measurement Save Control Panel*** is used to save the trends generated by the selected analysis.



Control	Description
Trend List	Lists the trends generated by the analysis.
Delete Selected Trend	Removes the trend selected in the ***Trend List***.
Save	Saves the trends listed in the ***Trend List***.
Cancel	Cancels the save and closes the ***Waveform Measurement Save Control Panel***, returning to the ***Waveform Measurement Control Panel***.

Analyzing Waveforms

Use the following procedure to conduct a waveform analysis. These procedures were written with the assumption that you have already selected a patient. Refer to "Selecting a Patient Record" on page 111 for instructions.

1. After selecting a patient, click the ***Waveform Measurements*** icon.

   The ***Waveform Measurements*** application opens.

   NOTE:
   The ***Waveform Measurements*** icon is not available on the ***Standard*** application menu. If the icon is not present, switch to an application menu that does include it. Refer to "Application Menus" on page 23.

2. Set the analysis options.

   a. In the ***Waveform Measurement Control Panel***, click ***Setup***.

      The ***Waveform Measurement Setup Control Panel*** opens. Refer to "Waveform Measurement Setup Controls" on page 216 for details on any of the controls.

   b. Select which analysis to run.

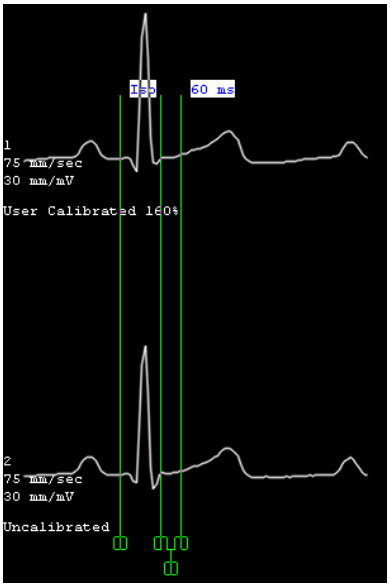
   c. If you selected ***ST***, set or clear the ***Manual Positions*** check box as appropriate.

   d. Select the desired ***Measurement Resolution***.

   e. Click ***OK*** to return to the ***Waveform Measurement Control Panel***.

3. If you selected to run the ***ST*** analysis with ***Manual Positions***, adjust the fiducial marker positions as appropriate.

   When you choose to manually position the fiducial markers, the markers change to green calipers, as seen in the following illustration.



   Use the calipers to position the isoelectric point, J-point, and post J-point markers. Refer to "Setting the Caliper" on page 267 for instructions.

4. If necessary, click ***Tools*** to set the Single Beat Panel display options.

   Refer to "Tools" on page 258 for details on using the Tools control panel.

5. Click ***Run*** in the ***Waveform Measurement Control Panel***.

   The ***Waveform Measurement Run Control Panel*** opens. Refer to "Waveform Measurement Run Controls" on page 217 for details on any of the controls.

6. If appropriate, change the ***Display Rate***.

   NOTE:
   You can change the ***Display Rate*** at any time during the analysis, even while the analysis is running.

7. If necessary, click ***Polarity*** to adjust the waveforms for optimal viewing.

8. Click ***Start***.

   The analysis begins. As the analysis progresses, each beat is displayed in sequence in the Single Beat Panel and the associated trends are built in real-time in the Scrolling Trend Panel. Depending on the ***Display Rate*** you selected and the length of the ECG being analyzed, this may take several minutes.

9. To pause the analysis, click ***Stop***.

   Pause the analysis if you want to review and adjust the results. For example, if you selected a slow Display Rate, you may notice that the fiducial point markers were positioned incorrectly on a beat. You would pause the analysis so you could adjust the markers before continuing the analysis.

   You can also adjust the results after the analysis is complete.

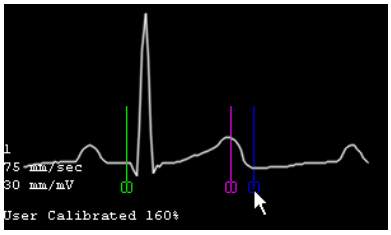
10. To adjust the analysis, do the following:

    a. Click in the Scrolling Trend Panel to select the beat to adjust.

    NOTE:
    With a measurement resolution of 15 seconds, you may not be able to select the exact beat you want to adjust.

    b. If necessary, use the ***<<Prev*** and ***Next>>*** controls to fine tune your selection.

    c. In the ***Single Beat*** Window, click the handle of the marker to be repositioned, drag it to the new position, and release.



    d. To delete a marker, do one of the following:

    - To delete the T Peak marker, either double-click on the marker or click the ***Delete T Peak Cursor*** control. You can later re-add the marker by holding the **Shift** key and double right-clicking on the beat in the Single Beat Panel.
    - To delete the T Offset marker, either double-click on the marker or click the ***Delete T Offset Cursor*** control. You can later re-add the marker by double right-clicking on the beat in the Single Beat Panel.
    - To delete both the T Peak and T Offset markers, click the ***Delete T Peak & T Offset*** control.

    NOTE:
    You can only delete the T Peak and T Offset markers when conducting a QT analysis.

    e. Repeat step d through step c for all the beats you want to adjust.

11. When you are done adjusting the results, click ***Start*** to resume the analysis.

12. Repeat step 9 through step 10 as necessary until the analysis completes.

13. When the analysis is complete and the results adjusted as appropriate, click ***Close***.

    The ***Waveform Measurement Run Control Panel*** closes and you return to the ***Waveform Measurement Control Panel***.

14. To save the analysis results, do the following:

    a. Click ***Save*** in the ***Waveform Measurement Control Panel***.

       The ***Waveform Measurement Save Control Panel*** opens.

    b. To remove any of the generated trends, select the trend in the Trend List and click the ***Delete Selected Trend*** control.

       The selected trend is removed from the list. Repeat for each trend you want to remove.

    c. When the list contains only the trends you want to keep, click ***Save***.

       The trends are saved and the ***Waveform Measurement Save Control Panel*** closes. They are now ready for inclusion on the patient report. Refer to "Including Analysis Trends on Patient Reports", next, for additional information.

Including Analysis Trends on Patient Reports

To include the trends generated by the analysis on a patient report, select a report format that includes the appropriate components. You have two options:

- Select one of the following pre-defined formats in the ***Report Review*** application:
  - Limited ST/QT/HRV/12SL (2ch)
  - Limited ST/QT/HRV/12SL (3ch)
  - ST/QT/HRV/12SL (2ch)
  - ST/QT/HRV/12SL (3ch)
  - HRV
  - ST (3ch)
  - ST (2ch)
  - Limited QT
  - QT (2ch)
  - QT (3ch)
  - Limited ST/QT/HRV (2ch)
  - Limited ST/QT/HRV (3ch)
  - ST/QT/HRV (2ch)
  - ST/QT/HRV (3ch)

Refer to Chapter 8, "Printing the Final Report", for details on selecting a report format.

NOTE:
These pre-defined formats include ST and/or QT components. The MARS system does not currently provide pre-defined formats that include T Wave Alternans components. To include T Wave information on the patient report, you must use the following option.

- Create a report format that contains the appropriate components in the ***Report Configuration*** application.
  Refer to "Report Configuration" on page 63 for details on configuring custom report formats.

E

Research Utilities

The MARS ***Research Utilities*** application extracts signals or annotations from patient ECGs and writes them to external files. Using a third party tool, you can import the data from those files into a database for processing, study, or analysis outside of the MARS Ambulatory ECG Analysis system.

The following table provides an overview of the available utilities:

Utility Name	Data Extracted	Format Type	File Extensions
Raw Data	ECG signal	Binary	*.raw
QRSDK	ECG annotations	Binary	*.qrs
MIT Signal Format	ECG signal	MIT-BIH	*.hdr *.sig
MIT Annotation Format	ECG annotations	MIT-BIH	*.hdr *.ann

This following sections provide detailed information about the available utilities:

- "Extracting Data Using Research Utilities" on page 226
- "File Layouts" on page 228

Extracting Data Using Research Utilities

Research Utilities can extract data to any standard supported media, including floppy disk, local drive, or shared network drive.

NOTE:

To extract data to a shared network drive, you must log on to the MARS system using a Windows user account with sufficient read/write permissions to the destination drive.

Use the following procedure to extract a patient study.

1. Log on to the MARS workstation using a Windows account with read/write permissions to the destination drive.

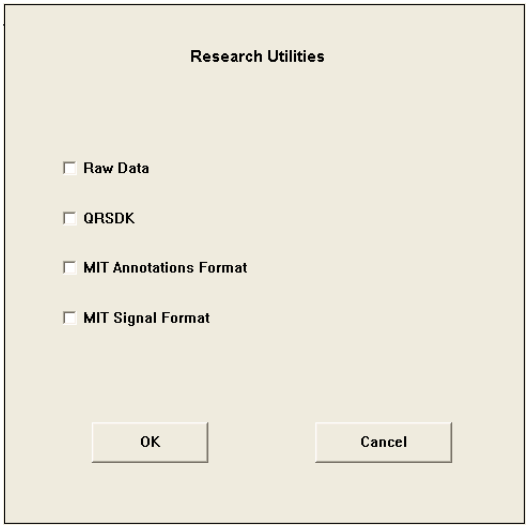
   Refer to "To Power On the MARS System" on page 19 for details.

2. Select the patient study to be extracted.

   Refer to "Selecting the Patient" on page 107 for details.

3. Select ***System*** > ***Research Utilities*** from the MARS menu.

   The following window opens.

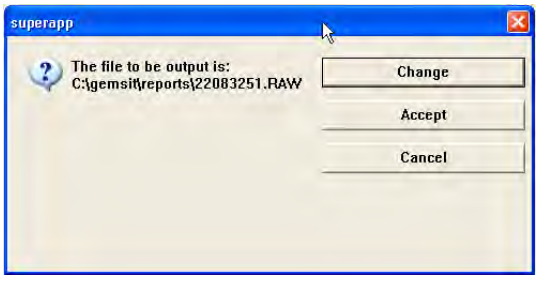


4. Select the utility to use.

   Refer to the table on page 225 for a description of each utility.

5. Click ***OK***.

   A dialog box opens to identify the location and name of the file to be saved.



6. Do one of the following:

   - To cancel the extraction, click ***Cancel***.
     A dialog box opens to notify you that the extraction was cancelled successfully. Click ***OK*** to close the dialog box and return to the ***Research Utilities*** window.
   - To accept the default file name and location, click ***Accept***.
     The record is extracted to the default location and file name. A status bar opens to display the progress. When the extraction is complete, the status bar closes and a dialog box opens to inform you that the data was extracted successfully. Click ***OK***.
     One of two things happens:
     - If you selected the ***Raw Data*** or ***QRSDK*** utility, you return to the ***Research Utilities*** window.
     - If you selected the ***MIT Signal Format*** or ***MIT Annotation Format*** utility, a dialog box opens to identify the location and name of the second file to be saved. Repeat step 6 for the second file.
   - To change the file name or location, do the following:
     a. Click ***Change***.
        The Windows ***Save As...*** dialog box opens.
     b. Browse to a new location if necessary.
     c. Enter a new file name if necessary.
        The file name defaults to the last 8 digits of the selected record's patient ID. If the selected record does not have a patient ID, the file name defaults to the current day of the month, hour, minute, and second. For example, if the record is being exported at 15:35:26 on 22 June, the file name would be 22153526.
     d. Click ***Save***.
        If you changed the file location, a dialog box opens to ask whether you want to use the new location as your default. Do one of the following:
        - To save the location as your new default, click ***Yes***.
        - To retain your current default location, click ***No***.

        The data record is extracted with the new file name to the new location. A status bar opens to display the progress. When the extraction is complete, the status bar closes and a dialog box opens to inform you that the data was extracted successfully.
     e. Click ***OK***.
        One of two things happens:
        - If you selected the ***Raw Data*** or ***QRSDK*** utility, you return to the ***Research Utilities*** window.
        - If you selected the ***MIT Signal Format*** or ***MIT Annotation Format*** utility, a dialog box opens to identify the location and name of the second file to be saved. Repeat step 6 for the second file.

File Layouts

The files generated by the ***MIT Signal Format*** and ***MIT Annotation Format*** utilities follow the MIT-BIH model. This model, developed and standardized by the Massachusetts Institute of Technology and Beth Israel Hospital, is well documented. Refer to http://www.physionet.org for detailed information and for open source applications for reading and analyzing the files.

The files generated by the ***Raw Data*** and ***QRSDK*** utilities, however, follow a proprietary model developed for the MARS Ambulatory ECG Analysis System. To read and analyze these files, you will need to develop your own applications. Refer to the following sections for the detailed information you need to develop those applications.

RAW Data

The ***Raw Data*** utility extracts ECG signals into a single binary file with the *.raw file extension. The file consists of the following components:

- a 1024–byte ASCII header that contains the record's demographic information
- a 10–byte binary header that describes the structure of the raw data
- a variable-length binary body that contains the raw data

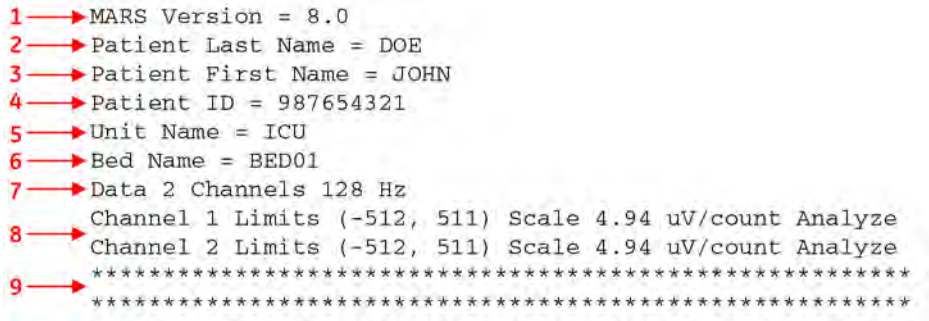
Each component is described in detail in the following sections.

ASCII Header

Bytes 0 —1023 of the Raw Data file contain demographic data—such as software version, patient information, and channel information—in a human-readable ASCII format.

Header Layout

The following illustration is an example of the layout and contents of the ASCII header.



The following table describes each item in the ASCII header. Each item in the header is variable length, but the accumulated length of all items will not exceed 1024 bytes.

Item	Description
1	Identifies the software version.
2	Lists the patient's last name.
3	Lists the patient's first name.
4	Lists the patient ID.
5	Identifies the name of the unit that recorded the ECG.
6	Identifies the patient's bed.

Item	Description
7	Identifies the number of channels recorded on the ECG and their sample rate. The format is as follows: Data *x* Channels *y* Hz In this example, the ECG contains 2 channels at 128 Hz. Sample rate indicates the number of samples per second. In this example, the ECG includes two channels at 128 samples per second. That equates to 7680 samples per minute per channel. At this rate, a 24 hour ECG would contain 11,059,200 samples per channel. A file generated for an ECG with two channels would contain 22,118,400 total samples. Each device records samples at a different rate: • CIC = 120 Hz • SEER = 120 Hz • SEER MC = 125 Hz • SEER 12 = 128 Hz • Tape = 128 Hz
8	Identifies the channels, their data limits, and their scale factors. Each channel in the ECG will have a line using the following format: Channel *channelname* Limits (*lowlimit*, *highlimit*) Scale *scalefactor* Analyze The variables are defined as follows: • *channelname* identifies the channel's lead. Refer to "Channel Names", next, for a list of channel names. • *lowlimit*, *highlimit* identifies the lower and upper physical limits of the acquisition device. • *scalefactor* identifies the number and units per count. Analyze is reserved for future use. In this example, there are two channel lines. The first line is for Channel 1, which has a lower limit of —512, an upper limit of 511, and a scale of 4.94 microvolts per count.
9	The unused bytes at the end of the ASCII header are filled with asterisks.

Channel Names

The following table lists the channel names used in the ASCII Header and identifies the leads associated with each name.

Channel Name	Description
1	Holter Channel 1
2	Holter Channel 2
3	Holter Channel 3
A	Holter Channel A
B	Holter Channel B
C	Holter Channel C
I	Lead I
II	Lead II

Channel Name	Description
III	Lead III
aVL	Lead aVL
aVF	Lead aVF
aVR	Lead aVR
V1	Lead V_1
V2	Lead V_2
V3	Lead V_3
V4	Lead V_4
V5	Lead V_5
V6	Lead V_6
X	Frank X
Y	Frank Y
Z	Frank Z

Binary Header

Bytes 1024–1033 of the Raw Data file describe the structure of the raw data in the remainder of the file. You use this information to parse the raw data. The following table describes the components of the binary header.

Starting Byte	Length in Bytes	Description
1024	4	Identifies the total number of samples in the record. For example, a 24–hour ECG with two channels at a sample rate of 128 Hz each would have a total of 22,118,400 samples: 128 (samples/second) * 60 (seconds/minute) * 60 (minutes/hour) * 24 (hours) * 2 (channels) Format: Unsigned long word.
1028	4	The number of samples per minute. At 128 Hz, a minute of data would contain 7,680 samples per channel. An ECG with 2 channels of data would contain 15,360 samples per minute. Format: Unsigned long word.
1032	1	The method used to encode the raw data. This value is always 0 (non-multiplexed, uncompressed words).
1033	1	Reserved. Format: 0

Raw Data

The remainder of the Raw Data file (beginning with byte 1034) presents the ECG signals in minute-long segments alternating by channel. The following table provides an example of the structure for the first four minutes of an ECG with two channels at 128 Hz each.

Minute	Channel	Offset	Description
1	Channel 1	1034	7680 samples of signed 16–bit words
	Channel 2	16394	7680 samples of signed 16–bit words
2	Channel 1	31754	7680 samples of signed 16–bit words
	Channel 2	47114	7680 samples of signed 16–bit words
3	Channel 1	62474	7680 samples of signed 16–bit words
	Channel 2	77834	7680 samples of signed 16–bit words
4	Channel 1	93194	7680 samples of signed 16–bit words
	Channel 2	108554	7680 samples of signed 16–bit words

The raw signal data starts at byte 1034, but the offset of the remaining channels will vary depending on the sample rate. For example, in the previous example, the sample rate of each channel was 128 Hz. This results in 7680 samples per minute. At 2 bytes per sample, each channel is 15,360 bytes long. However, if the sample rate were 120 Hz, each channel contains 7200 samples per minute and is 14,400 bytes long.

QRSDK

The ***QRSDK*** utility, which stands for QRS to DisK, extracts ECG annotations into a single binary file with the *.qrs extension. The file consists of the following components:

- a 512–byte header block
- a series of 2–byte annotation blocks

Each component is described in more detail in the following sections.

QRSDK Header Block

Bytes 0–511 of the QRSDK file contain demographic data—such as software, version, patient information, sample rate, and starting date and time. The following table describes each item in the header block.

Item	Data Type	Offset	Description
Patient Name	char	0	The patient's full name. *Length*: 39 characters + NULL terminator
Patient ID	char	40	The patient's identification number. *Length*: 15 characters + NULL terminator
File Type	char	56	The file type. The QRSDK file is hardcoded as DAT. *Length*: ASCII encoded + NULL terminator
ECG Start Time	char	60	The time that the ECG began. Displayed as HH:MM:SS. *Length*: 8 characters + 2 NULL terminators
ECG Start Date	char	70	The date on which the ECG began. Displayed as DD-MMM-YY. *Length*: 9 characters + NULL terminator
File Date	char	80	The date on which the QRSDK file was saved. Displayed as DD-MMM-YY. *Length*: 9 characters + NULL terminator
Sample Rate	short	90	The number of samples per second.
Maximum RR	short	92	The number of samples for the maximum R-R interval.
Free	short	94	Unused.
System Type	short	96	The system that generated the QRSDK file. Two possible values: • 1 = SXP (Marquette Laser SXP) • 2 = MARS
Version	short	98	The software version of the system that generated the QRSDK file. Example: 8.0.
Checksum	short	100	The checksum for the QRSDK file. It is the sum of the header block's signed words by byte order. It is added to the file after it is put in the PC DOS format.

QRSDK Annotation Blocks

The remainder of the file, from byte 512 on, consists of a series of two-byte blocks. The following table describes the content and structure of the blocks.

Byte	Description
0	The number of samples from the previous annotation. Maximum value: FF (255 in decimal). For example, with a sample rate of 128 Hz, the ECG contains 128 samples per second. At 60 BPM, there will be 128 samples between beats. At 90 BPM, there will be roughly 85 samples between beats (60 seconds / 90 beats * 128 Hz = 85.33).
1	The annotation label. The QRSDK file uses the following labels: • N = Normal • B = Bundle Branch Block • A = Aberrant • V = Ventricular • F = Ventricular Fusion • S = Supraventricular • E = Ventricular Esc. • J = Junctional • P = Ventricular Paced • I = Idioventricular • 00 = no signal • 01 = noise on channel 1 • 02 = noise on channel 2 • 03 = noise on both channels (unreadable)

Typically, there is a one-to-one relationship between QRS complexes and blocks. In other words, each complex typically requires a single block. However, if there are more than 255 samples between beats, additional blocks are needed.

For example, suppose you have a ventricular beat that occurs 3 seconds after the previous beat. At a sample rate of 128 Hz, that would equate to 384 samples between the beats. Since each block can handle a maximum of 255 samples between beats, you will need two blocks to adequately describe the ventricular beat, as seen in the following table:

Block	Byte	Value	Comment
1	0	FF	Maximum number of samples (255), in hexadecimal notation.
	1	00	Indicates no signal.
2	0	81	Total samples between beats minus the value from the previous block, in hexadecimal notation. In this example, that would be 129 in decimal notation (384 — 255) or 81 in hexadecimal notation (160 — FF).
	1	V	Indicates a Ventricular beat.

F

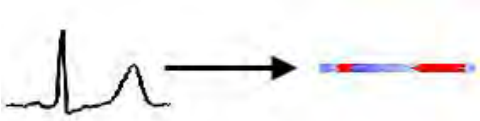
Waterfall Display

Waterfall Display provides an alternate view of the ECG by color coding the cardiac cycles and lining them up in a vertical cascade, similar to a waterfall.

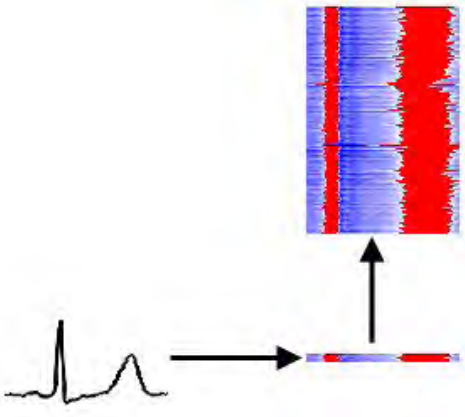
Each point on a complex is color coded according to its amplitude:

Amplitude	Color
Positive	Red
Baseline (0 mV)	White
Negative	Blue

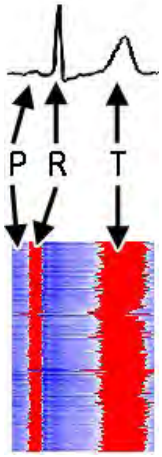
The following example shows a complex represented as a typical waveform (left) and as a color-coded line segment (right).



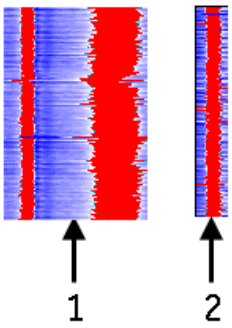
As each subsequent complex is color coded into a line segment, it is aligned with the R-Wave of the previous complex and cascaded in a vertical column, as shown in the following example:



The following illustration identifies the various points in a complex and equates them with their corresponding points on the waterfall:



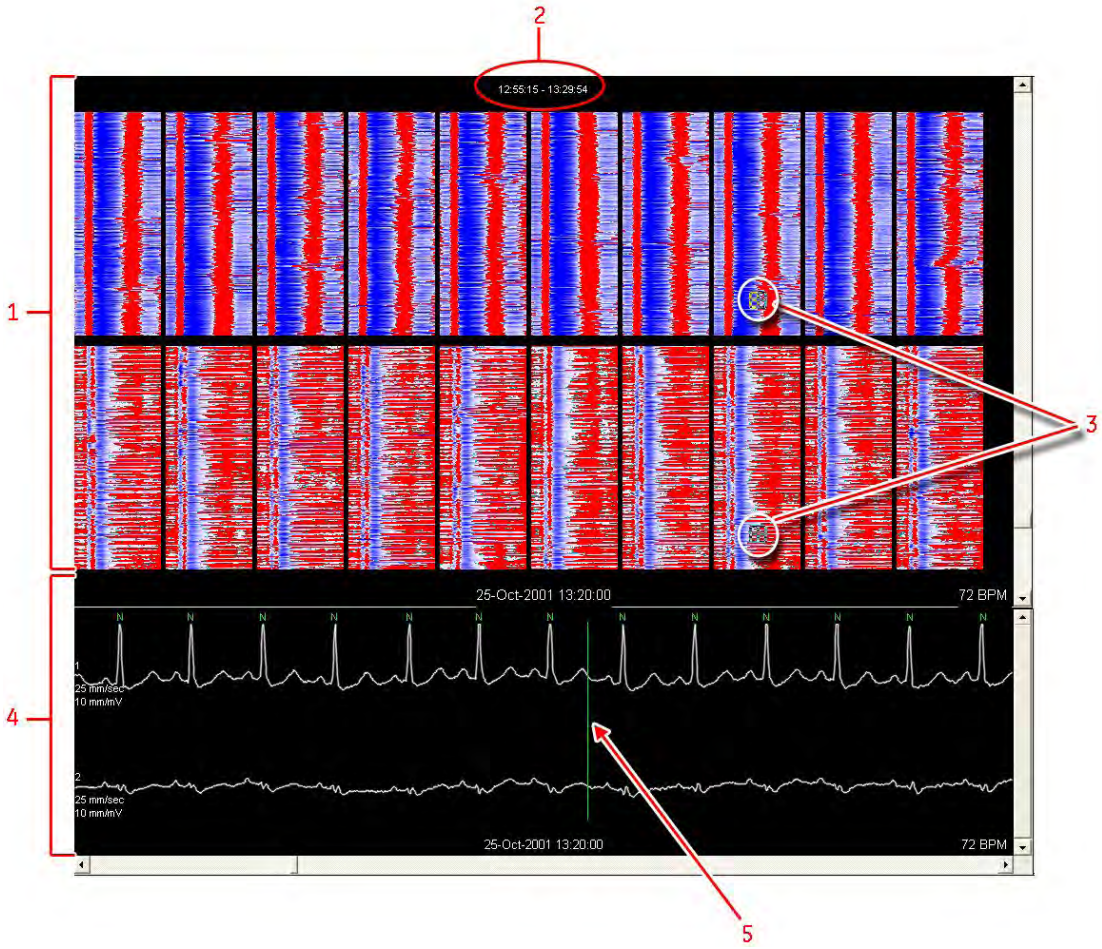
You can set the start and end points for each complex, which affects the width of the columns. In the following example, the column on the left (1) includes signals from 120 ms prior to the R-Wave to 400 ms after the R-Wave. This 520 ms span typically includes the P-Wave, QRS, and T-Wave of each complex. By contrast, the column on the right (2) includes signals from 80 ms prior to the R-Wave to 80 ms after the R-Wave. This 160 ms span contains the QRS and is much narrower.



The ***Waterfall Display*** method shows more data in a smaller space than is possible with a conventional ECG. It is useful for reviewing long term recordings and for identifying short and long term ischemic and arrhythmic events, such as P-Wave changes including prolonged first degree AV block.

Waterfall Display Page Layout

The ***Waterfall Display*** application consists of the following components:



1. ***Waterfall Display window***
   Displays the color-coded cardiac cycles. You can specify the start and end points to be included for each complex, enable baseline correction, and select how the channels will be displayed.

2. ***Waterfall Time Range***
   Identifies the start and end times of the displayed ECG segments using a 24–hour clock. In the example, the time range is 12:55:15 to 13:29:54 (12:55 PM to 1:29 PM).

3. ***Waterfall Cursors***
   Each channel has a crosshair cursor that identifies the selected complex in the waterfall display. The two cursors are synchronized: when you move one, the other moves accordingly. In addition, when you select a point in the ***Waterfall Display*** window, the corresponding complex is selected in the ***Strip Review*** window.

4. ***Strip Review window***
   Displays the ECG in a standard waveform format. For more information on using the Strip Review, refer to "Reviewing Shapes" on page 120.

5. ***Strip Review Cursor***

When you select an area in the ***Strip Review*** window, the corresponding color-coded line segment is selected in the ***Waterfall Display*** window.

Waterfall Display Controls

The following table identifies the controls available for the ***Waterfall Display*** application and describes their use.

Control	Description
Setup	Configures the display options for the ***Waterfall Display*** window. Refer to "Configuring the Waterfall Display Settings" for more information.
Tools	Configures the ECG options for the ***Waterfall Display*** window. Refer to "Tools" on page 258 for details.

Configuring the Waterfall Display Settings

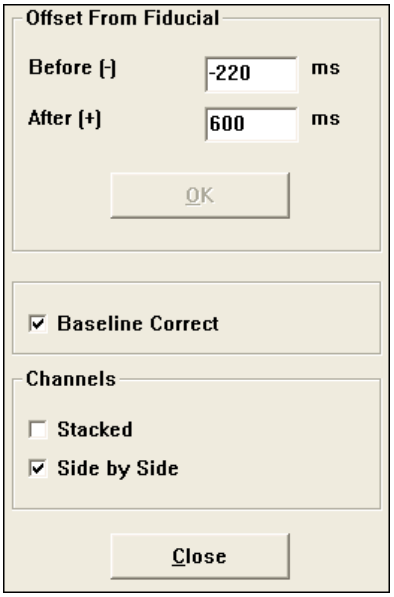
Use the following procedure to configure the ***Waterfall Display*** settings. The procedure is written under the assumption that a patient has already been selected. For more information, refer to "Selecting the Patient" on page 107.

1. Click the ***Waterfall Display*** icon.

   The ***Waterfall Display*** application opens and displays the ECG for the selected patient.

2. In the ***Waterfall Display*** control panel, click ***Setup***.

   The following control panel opens:



3. To adjust the ***Offset from Fiducial***, do the following:

   a. Enter the starting point of the complex in the ***Before [-]*** field.

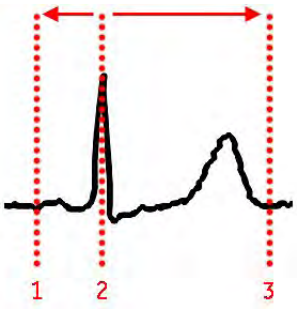
      This is the earliest duration, in milliseconds, prior to the R-Wave to include in the waterfall display. Because this is prior to the R-Wave, it is a negative number and must begin with a minus sign (-).

   b. Enter the end point of the complex in the ***After [+]*** field.

      This is the latest duration, in milliseconds, after the R-Wave to include in the waterfall display. Because this is after the R-Wave, it is a positive number.

   c. Click ***OK***.

      Using the measurements you entered, the system calculates the area of the complex to include in the waterfall, as shown in the following illustration:



      1. Start point listed in the ***Before [-]*** field.
      2. Reference point (fiducial) is the R-Wave (0 ms).
      3. End point listed in the ***After [+]*** field.

      The line segment 1–3 is the area that will be included in the ***Waterfall Display***.

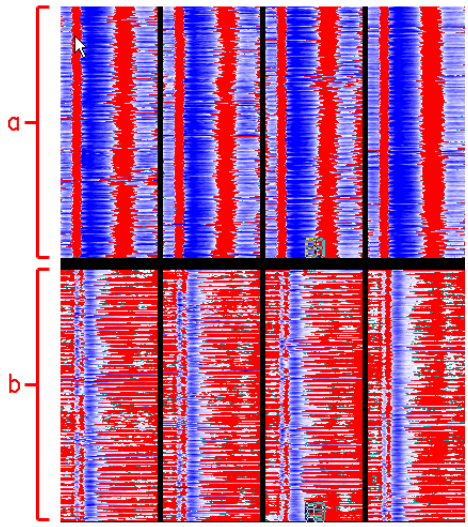
4. Set the ***Baseline Correct*** as necessary.

   Baseline Correct adjusts the amplitude ranges for the colors so that larger differences in amplitude are visible. This is especially important if you have a large R-Wave. Without ***Baseline Correct***, the R-Wave would be red and the P and T waves would be white or blue. Setting ***Baseline Correct*** would result in the P and T waves displaying as red, making it easier to identify those components.

5. Select the appropriate ***Channels*** display method.

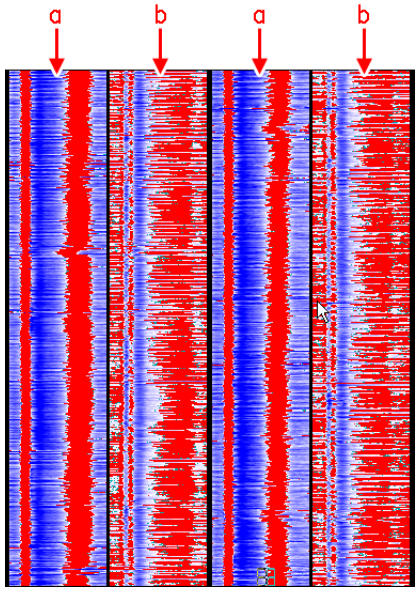
   Channels can be displayed in either of two ways:

   - ***Stacked***
     When stacked, the channels are displayed in two rows:



     a. Channel 1
     b. Channel 2

   - ***Side by Side***
     When placed side by side, channel 1 and channel 2 alternate in a single row:



     a. Channel 1
     b. Channel 2

6. When you are done, click ***Close***.

   The Setup control panel closes and returns to the Waterfall Display control panel. You are now ready to review the ECG.

G

Sleep Export

The ***Sleep Export*** option exchanges data between the MARS Ambulatory ECG Analysis System and ***Morpheus Hx®***, an automatic sleep study scoring and data management system developed by Widemed Ltd and purchased separately. When this option is activated, the MARS system can collect the data required for a sleep study from a CIC and export it to a shared network directory. When the ***Morpheus Hx*** system detects a new study in the shared directory, it analyzes the data, generates a report, and exports that report back into the shared directory. The sleep study report will then be available when you generate the final patient report in the MARS system's ***Report Review*** application.

NOTE:
The ***Sleep Export*** option is not available in all markets.

Licensing

The ***Morpheus Hx*** license limits the number of sleep studies that can be performed per day. Additional licenses can be purchased , as needed. Contact your sales representative for licensing options.

Requirements

Before you can use ***Sleep Export*** , the following requirements must be met:

- The ***Sleep Export*** option must be activated.
  For information on activating options, refer to "Software Activators" on page 79.
- The ***CIC Interface*** option must be activated.
  Currently, only the CIC collects the data required for the sleep study. For information on activating options, refer to "Software Activators" on page 79.
- The ***CIC Interface*** must be configured to acquire the required channels.
  For a list of the channels required for the sleep study and instructions on configuring the CIC interface to acquire them, refer to "CIC Configuration" on page 68.
- The ***Morpheus Hx*** server must be installed and configured.
  Morpheus Hx is a third-party application that must be purchased separately. Typically, the ***Morpheus Hx*** server will be installed and configured by GE Healthcare service personnel. For more information, refer to the *Morpheus Hx Automatic Sleep Study Scoring and Data Management System Service Manual*.
- A shared network directory must be set up.

The MARS and ***Morpheus Hx*** systems exchange data via a shared directory. This directory must be set up with the correct permissions for both systems, and both systems must be configured to monitor that directory. For more information, refer to the *MARS Ambulatory ECG Analysis System Installation Guide* (2027879-036).

Using Sleep Export

The ***Sleep Export*** process consists of two steps, which are integrated in the standard MARS workflow:

- Exporting Sleep Data
  Data for a sleep study is acquired from a CIC and exported to the ***Morpheus Hx*** system by using the ***Patient Select*** application. Refer to "Selecting the Patient" on page 107 for details on the standard workflow.
- Importing a Sleep Analysis Report
  Data from the sleep analysis report generated by the ***Morpheus Hx*** system can be reviewed and incorporated in the final patient report by using the ***Report Review*** application. Refer to Chapter 8, "Printing the Final Report", for details on the standard workflow.

Each step is described in detail in the following two sections.

Exporting Sleep Data

Use the following procedure to export a sleep study:

1. Click the ***Patient Select*** icon.

   The ***Patient Select*** application opens.

2. If necessary, acquire the desired CIC study.

   Refer to Chapter 5, "CIC Acquisition", for details on acquiring a CIC study.

3. In the ***Patient Select*** control panel, select ***Monitoring*** or ***Holter*** from the ***Data Type*** field.

   The ***Patient Select*** window updates with the list of available studies for the selected data type. If ***Monitoring*** is selected, the list includes all CIC studies that have been acquired but not yet analyzed. If ***Holter*** is selected, the list includes all Holter studies as well as all CIC studies that have been acquired and analyzed.

   NOTE:
   The ***Sleep Export*** button is available for both data types; however, that does not mean that all displayed records will qualify for export.

4. In the ***Patient Select*** window, select the patient study to be exported.

   To qualify for export, a patient study must meet the following requirements:

   - It must contain the required channels.

Currently, only the CIC collects all the channels required for a sleep study. Refer to "CIC Configuration" on page 68 for a list of the required channels and instructions on how to configure the CIC interface to acquire them.

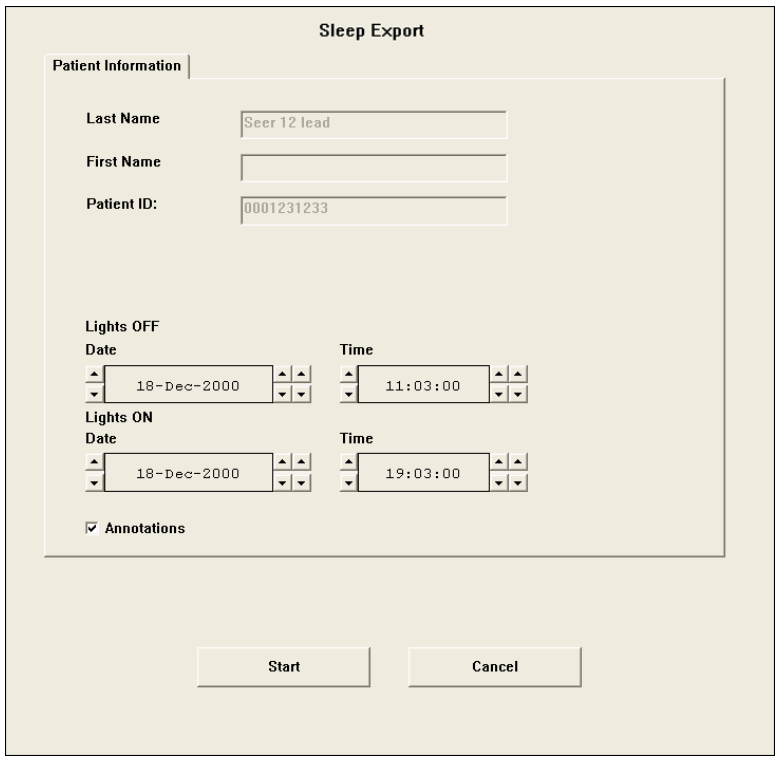
- It must contain the following demographic information:
  - ***Patient ID***
  - ***Date of Birth***
  - ***Age***

  If the study does not contain this information, you will receive an error message when you attempt to export it.

5. Click the ***Sleep Export*** button in the control panel.

   One of the following will occur:

   - If the study does not contain the necessary patient demographics, you will receive an error message indicating the data must be added to the record. Do the following:
     a. Click ***OK*** to close the message.
     b. Add the necessary information to the study using ***Patient Information***.
     c. Repeat from step 1.
     Refer to "Entering Patient Information" on page 112 for instructions on entering patient data.
   - When the study contains the necessary patient demographics, the following dialog box opens.



6. Enter the ***Lights OFF*** date and time.

   Lights OFF indicates the date and time that the patient went to bed (that is, the time that the sleep study began). These fields default as follows:

   - If the ECG is longer than 8 hours, starts before 22:00, and extends 8 or more hours after 22:00, the fields default to 22:00 on the first date of the ECG.
   - If the ECG is longer than 8 hours and starts after 22:00, the fields default to the earliest available time on the first date of the ECG.
   - If the ECG is shorter than 8 hours, the fields default to the beginning of the ECG.

   The following restrictions apply:

   - They cannot be earlier than the beginning date and time of the ECG.
   - They cannot be later than the ***Lights ON*** fields.

7. Enter the ***Lights ON*** date and time.

   Lights ON indicates the date and time that the patient woke up (that is, the time that the sleep study ended). These fields default as follows:

   - If the ECG is longer than 8 hours, the fields default to 8 hours after the ***Lights OFF*** fields.
   - If the ECG is shorter than 8 hours, the fields default to the end of the ECG.

   The following restrictions apply:

   - They cannot be earlier than the ***Lights OFF*** fields.
   - They cannot be later than 16 hours after the ***Lights OFF*** fields.
   - They cannot be later than the end of the ECG.

8. If desired, clear the ***Annotations*** field.

   If the selected study has been analyzed, checking this field will extract that analysis, along with the raw ECG data, in the standard MIT format. If you are extracting an unanalyzed CIC study, this field is unavailable.

   It is checked by default.

9. Click ***Start***.

   One of two things happens.

   - If the selected study does not include the necessary ECG data, an error message opens to indicate the export failed. Click ***OK*** to close the error message and repeat from step 4 with a valid sleep study.
   - If the selected study includes the necessary ECG data, a progress bar opens to indicate the progress of the extraction. When the extraction is complete, the ***Sleep Export*** window closes.

10. Do one of the following:

    - To export additional sleep study information from the currently selected patient study, repeat from step 5 using different values for ***Lights OFF*** and ***Lights ON***.

ECGs with 48 and 72 hours of data will have multiple sleep periods. Repeat this process for each sleep period to be exported. Each period gathered will result in a separate report.

- To export sleep study information for a different patient, repeat from step 4 with a different patient study.

Importing a Sleep Analysis Report

Use the following procedure to review sleep reports generated by the ***Morpheus Hx*** system and to include data from those reports in the MARS system patient report.

NOTE:

The Sleep Analysis Report may not be available immediately after exporting the sleep data to the Morpheus Hx server. The time it takes for the Morpheus Hx system to analyze and return the report is dependent on a number of factors, including the size of the study, the number of studies in the queue, the frequency with which the Morpheus Hx server scans the shared network directory for new studies, and network speed and traffic.

1. Click the ***Patient Select*** icon.

   The ***Patient Select*** application opens.

2. In the ***Patient Select*** control panel, select the ***Data Type*** that was originally used when the sleep study was exported .

   This ensures that the patient study from which you extracted the sleep study will be displayed.

3. Select the patient who's sleep study is to be reviewed.

   Refer to "Selecting a Patient Record" on page 111 for details if necessary.

4. Select the ***Report Review*** icon.

   The ***Report Review*** application opens with the patient report for the selected patient.

5. Click the ***Sleep Report*** button in the control panel.

   One of two things happens.

   - If only one report exists for the selected patient, the report automatically opens in your default browser. Skip to step 6.
   - If multiple sleep reports exist for the selected patient, a list of the reports opens. Do the following:

     a. Select the report to review.

     b. Click ***OK***.
     The report opens in your default browser. Proceed to step 6.

6. Review the report in your browser.

7. To include data from the sleep report in the MARS patient report, do the following:

   a. In the browser, select the text to be copied.

   b. Press **CTRL + C** to copy the selected text.

   c. In the MARS system, right-click in the Interpretation section of the Holter Report to open it for editing.

d. Press **CTRL + V** to paste the copied text into the Interpretation section.

e. Repeat step b through c for each section of text to be copied from the sleep study to the Holter report.

f. When you are done copying text, right-click in the Interpretation section again to close it.

g. Complete the remainder of the Holter Report.

Refer to Chapter 8, "Printing the Final Report", for information on completing the report.

File Reference

The following sections describe the files and directory structure used by the ***Sleep Export*** option.

On Export

When the MARS system exports a sleep study, it creates an export directory with this naming convention: *<patientID>_<date_stamp>_<time_stamp>_NEW*. The *date_stamp* is the date on which the study was exported, and the *time_stamp* is the time at which the study was exported. The appendix *_NEW* indicates the study has been exported but not yet analyzed by Morpheus Hx. For example, if you were to export a sleep study for patient 105433 at 10:31:15 on 29 July 2009, the MARS system would create an export directory with the name *105433_20090729_103115_NEW*.

Within the export directory, the MARS system creates a *data* subdirectory, which will contain the following files:

- *<patientID>_<date_stamp>_<time_stamp>.xml*
  Contains the patient demographic data in an XML format. The file name follows the same conventions as the export directory. Continuing the previous example, this file would be named *105433_20090729_103115.xml*.
- *<patientID>_<date_stamp>_<time_stamp>_MIT.hea*
  Contains the header for the MIT version of the extracted data. The file name follows the same conventions as the export directory. Continuing the previous example, this file would be named *105433_20090729_103115_MIT.hea*.
- *<patientID>_<date_stamp>_<time_stamp>_MIT.sig*
  Contains the signal data in the standard MIT format. The file name follows the same conventions as the export directory. Continuing the previous example, this file would be named *105433_20090729_103115_MIT.sig*.
- *<patientID>_<date_stamp>_<time_stamp>_MIT.ann*
  Contains the analysis data in the standard MIT format. The file name follows the same conventions as the export directory. Continuing the previous example, this file would be named *105433_20090729_103115_MIT.ann*. This file is extracted only if the ***Annotations*** option is selected during export.

On Analysis

When the Morpheus Hx system analyzes the exported sleep study, it updates the export directory in one of two ways:

- If the analysis fails, the Morpheus Hx system does the following:
  - Changes the name of the export directory to *<patientID>_<date_stamp>_<time_stamp>_ERR*.
    Following the examples in "On Export" on page 246, an analysis failure would result in the export directory name being changed to *105433_20090729_103115_ERR*. If an expected sleep study is not available in the ***Report Review*** application, locate the export directory on the shared network drive to see whether there was an error during the analysis.
  - Adds an ***error.xml*** file to the export directory.
    This file contains information describing the cause of the error. You will need this information when troubleshooting the failure.
  - Adds an ***error.txt*** file to the export directory.
    This file is a plain text (ASCII) version of ***error.xml***.
- If the analysis is successful, the Morpheus Hx system does the following:
  - Changes the export directory name to *<patientID>_<date_stamp>_<time_stamp>_PROCESSED*.
    Following the examples in "On Export" on page 246, a successful analysis would result in the export directory name being changed to *105433_20090729_103115_PROCESSED*.
  - Adds a *Results* subdirectory.
    This subdirectory will contain the following reports generated by the Morpheus Hx system.
    - *ClinicalReport.html*
      HTML file containing the data upon which the sleep study interpretation was based.
    - *InterpretationLetter.html*
      HTML file containing both an interpretation letter and a clinical report of the sleep study data.

      NOTE:
      The filename of the interpretation letter is configurable, so the name on your system may differ.

      To change the filename, open ***system.ini***, locate the ***[Sleep Export]*** section, and change ***ReportFileName=InterpretationLetter.html*** to the desired name.

H

Using Common Controls

The following common controls are used by several applications throughout the MARS Ambulatory ECG System. Rather than repeat instructions for their use for each application, they are provided here.

File

The ***File*** control adds the displayed data to the patient report. You have the option of adding a title.

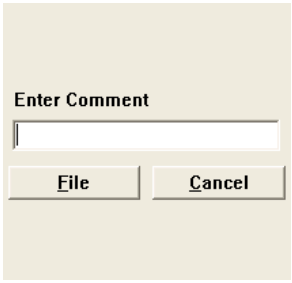
The data included on the report depends from which application the control is used. The control is available on the following applications:

- Patient Diary
- Strip Review
- Page Review
- Event Review
- Event Diary
- Trend Review
- Episode Review
- Shape Review
- Heart Rate Variability
- Heart Rate Turbulence
- View 12SL

To file data on the patient report

1. Click the ***File*** button.

   The following panel opens.



2. Type a descriptive comment in the ***Enter Comment*** field.

   This comment will be used as the title for the data in the patient report.

3. Click the ***File*** button.

   The panel closes and the selected data, along with the comment, are added to the patient report.

4. Continue to review and edit the data as appropriate.

Print

The ***Print*** control prints the displayed data. You have the option of adding a title to the data. You also have the option of printing the data immediately or adding it to the Page Builder, which lets you group several print jobs together before printing.

The data printed depends from which application the control is used. The control is available on the following applications:

- Patient Select
- Patient Diary
- Strip Review
- Page Review
- Event Review
- Event Diary
- Trend Review
- Episode Review
- Shape Review
- Waveform Measurements
- View 12SL

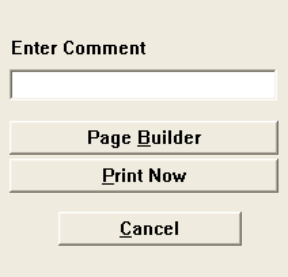
- Heart Rate Variability
- Heart Rate Turbulence

NOTE:
The MARS system prints to the Windows default printer. You will not be able to print from the MARS system if a default printer has not been established. Before using the ***Print*** control, verify that a default printer has been set up. Refer to the Microsoft Windows documentation or help system for information on setting up a default printer.

To print data

1. Click the ***Print*** button.

   The following panel opens.



2. Type a descriptive comment in the ***Enter Comment*** field.

   The comment will used as a title for the data in the printout.

3. Do one of the following:

   - To print the data immediately, click the ***Print Now*** button.
     The data prints to the Windows default printer and the print panel closes. Continue to review and edit data as necessary.
   - To add the data to the Page Builder, click the ***Page Builder*** button.
     The data is added to the page builder and the print panel closes. Continue to add data to the Page Builder as necessary. When the page builder is full, as indicated by the white area, it will begin to print automatically. Additional material is then placed on a subsequent page. If you are ready to print before the page fills, click the ***Page Builder*** icon.

     The page with all the selected data is then printed on the Windows default printer.

Notes

The ***Notes*** control allows you to add events to the ECG. You select the date and time the event occurred and enter a description of the event. You can use the predefined events or enter your own.

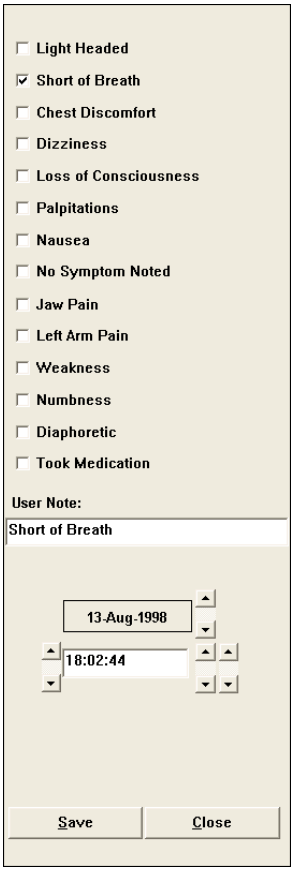
The ***Notes*** control is used by the following applications:

- Patient Diary
- Event Review
- Event Diary

To add notes to an event

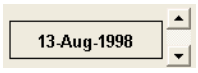
1. Click the ***Notes*** button in the control panel.

   The ***Notes*** panel opens.



2. Select the date on which the event occurred.

   Use the arrows to the right of the field to set the date.



3. Select the time at which the event occurred.

   Use the arrows on either side of the time to set the time. The left set of arrows changes the hours. The middle set of arrows changes the minutes. The right set of arrows changes the seconds.

4. After setting the date and time of the event, enter the event symptoms.

   - To select a predefined description, select the description's check box. The description appears in the ***User Note*** field. You can modify the description or select another description.
   - To enter a custom description, click in the ***User Note*** field and type your description.

   The ***User Note*** cannot exceed 33 characters.

5. Click ***Save***.

   The entry is added to the list of events and the ***Notes*** panel clears.

6. Repeat step 2 through step 5 for each event to be added.

7. When you are done adding entries, click ***Close***.

   The ***Notes*** panel closes and you return to the application control panel. Continue to review and edit the record as necessary.

Region

The ***Region*** control allows you to select a contiguous range of beats and perform any of the following actions upon all the beats within that range:

- Mark as atrial flutter
- Mark as noise
- Relabel
- Invalidate ST
- Invalidate QT
- Run the Afib Detector

NOTE:
Relabelling works only on beats that have already been labeled. It will not work with unlabeled beats.

In addition, it allows you to review the entire ECG for atrial fibrillation. You do not need to select a region to run the afib detector.

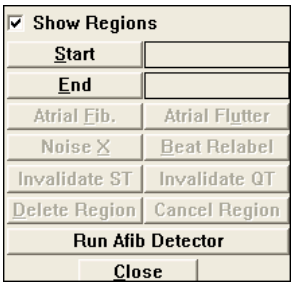
The ***Region*** control is available from the following applications:

- Strip Review
- Page Review
- Trend Review

To edit a region

1. Click the ***Region*** button.

   The following panel opens.

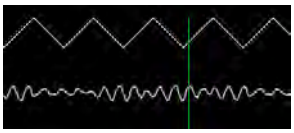


2. Verify the ***Show Regions*** check box is selected.

   If selected, a marker appears above each defined region. You can use the marker to reselect the region. For a description of the markers, refer to step 5.

3. To check the ECG for atrial fibrillation, click the ***Run Afib Detector*** button.

   The system checks the entire ECG for atrial fibrillation. If the Show Regions check box was selected, a sawtooth marker appears of the regions marked as atrial fibrillation, as seen in the following illustrations.



   You can select these regions by clicking on the marker. When selected, the marker will turn magenta.

4. To select a region, do the following:

   a. In the waveform, right-click to the left of the first beat to be included in the range.

      A blue marker appears at that location.

   b. Click the ***Start*** button

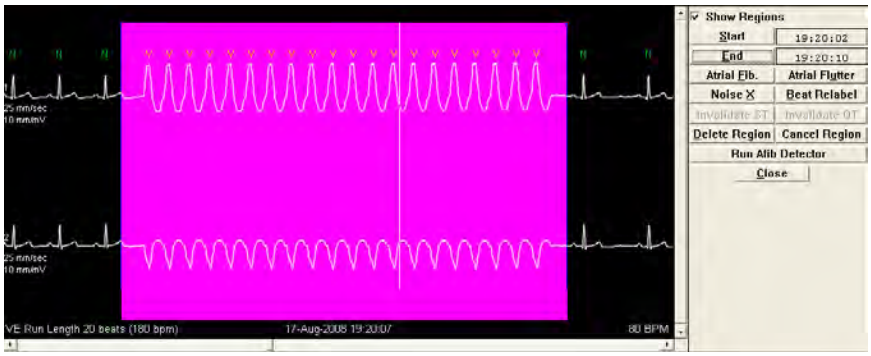
      The time of the marker's position appears in the field to the right of the ***Start*** button, as seen in the following illustration.

c. In the waveform, right-click to the right of the last beat to be included in the range.

A white marker appears at that location.

d. Click the ***End*** button

The time of the marker's position appears in the field to the right of the ***End*** button and the selected range is highlighted in magenta, as seen in the following illustration.



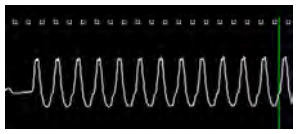
5. After the region has been selected, do any of the following:

- To mark the region as atrial flutter, click the ***Atrial Flutter*** button.
  The magenta highlighting disappears. If the ***Show Regions*** check box was selected, a series of X's appears above the region, as seen in the following illustration.

  You can reselect the region by clicking on the marker. When selected, the marker will turn magenta.

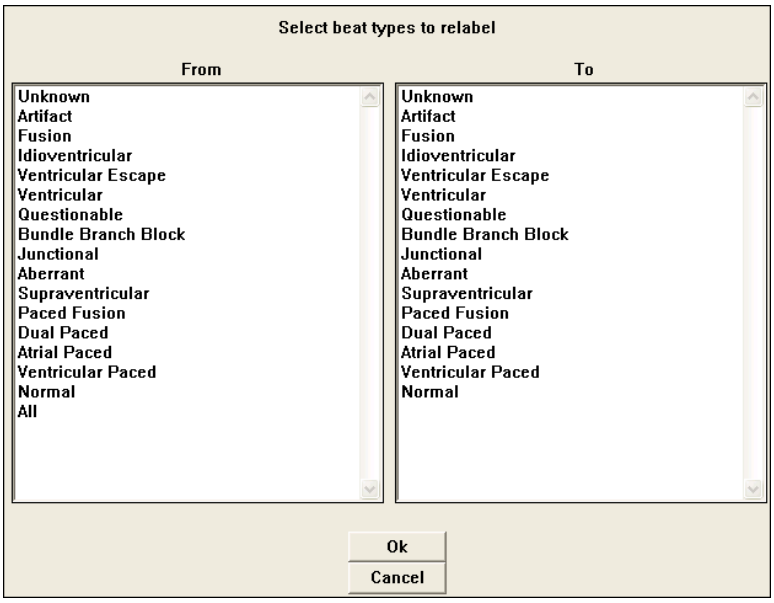
- To mark the region as noise, click the ***Noise X*** button.
  The magenta highlighting disappears. If the ***Show Regions*** check box was selected, a series of empty boxes appears above the region, as seen in the following illustration.

  You can reselect the region by clicking on the marker. When selected, the marker will turn magenta.

- To relabel beats in the region, click the ***Beat Relabel*** button.

The following window opens.



a. In the ***From*** box, select the type of beat you want to change. Relabelling works only on beats that have already been labeled. It will not work with unlabeled beats.

b. In the ***To*** box, select the new type of beat.

c. Click ***OK***.
The window closes and all the beats that match the ***From*** beat in the range are changed to the new beat type.

- To invalidate the ST measurements in the region, click the ***Invalidate ST*** button.
This removes the selected region from the ST measurements. The ***Invalidate ST*** button is available only if the ST Trend is selected.
- To invalidate the QT measurements in the region, click the ***Invalidate QT*** button.
This removes the selected region from the QT measurements. The ***Invalidate QT*** button is available only if the QT Trend is selected.

6. To cancel the region without applying any changes, click the ***Cancel Region*** button.

The highlighting, blue region marker, and white region marker disappear. You can now select a new region. Repeat from step 4.

7. To remove a region that has already been defined, do the following:

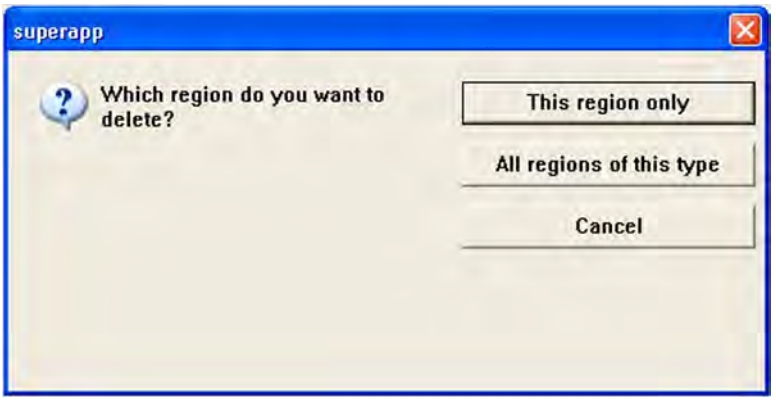
   a. Click the marker above the region.

      The marker changes to magenta to indicate it has been selected. Refer to step 5 for a description of the various markers.

      NOTE:
      If the markers are not visible, select the ***Show Regions*** check box to display them.

   b. Click the ***Delete Region*** button.

      The following dialog box opens.



   c. Do one of the following:

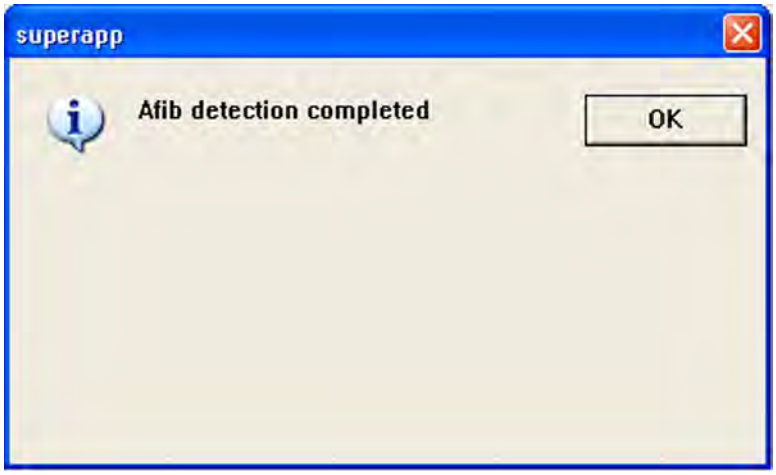
      - To delete only the selected region, click ***This region only***.
      - To delete all regions of the same type, click ***All regions of this type***. For example, if the selected region is Atrial Flutter, all regions marked Atrial Flutter will be cleared.

      The dialog box closes and removes the region marker. It does not delete the content from the regions.

8. Repeat step f through step 7 for each region you want to define and edit.

9. To run the atrial fibrillation detector on the ECG, do the following:
   a. Click the ***Run Afib Detector*** button.

      The atrial fibrillation detector runs. When it is done, the following window opens.



   b. Click ***OK*** to close the window.
10. When you are done editing regions, click ***Close*** to close the Region control panel.

Tools

The ***Tools*** control sets the ECG display options and enables various instruments for use with ECGs and waveforms. It is available from the following applications:

- Strip Review
- Page Review
- Event Review
- Shape Review
- Waveform Measurements
- Waterfall Display

Settings apply only to the application from which they were made.

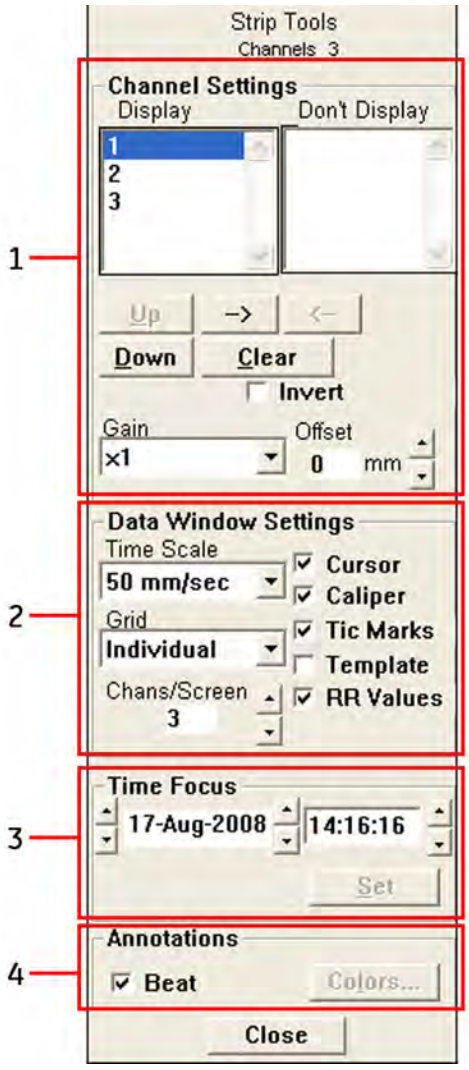
Tools Page Layout

Each application has its own version of the ***Tools*** control panel, but all are divided into the same general sections.

1. ***Channel Settings***
   Determines which channels are displayed, the order they are displayed, the gain of the waveforms, and their offset from the baseline.
2. ***Data Window Settings***
   Determines the time scale of the display, the grid settings, the number of channels displayed, and the informational tools available.
3. ***Time Focus***
   Precisely sets the cursor's position in the ECG.
4. ***Annotations***

Determines whether beat annotations are displayed. Annotation type depends on the application.

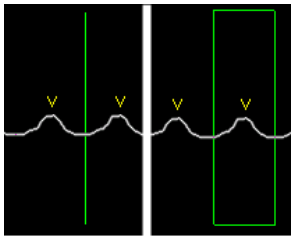
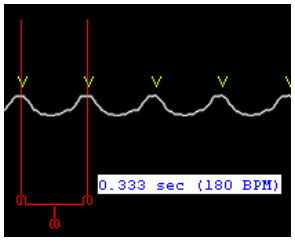
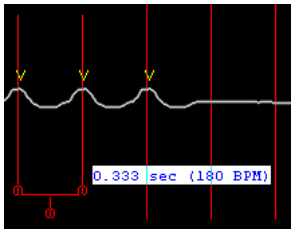
The following illustration shows the position and content of each section.

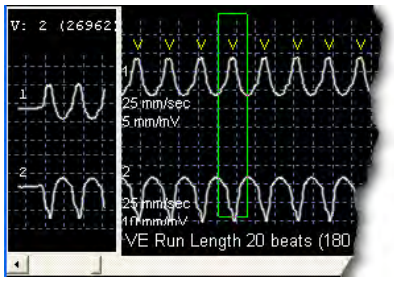
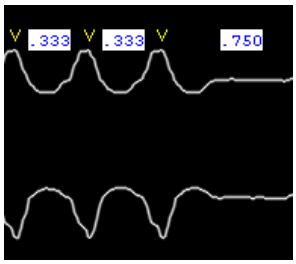


The following table describes each field available on the Tools control panels.

Field	Description
Display	Lists the channels to be displayed by the application. The channels are displayed in the order they appear in this field.
Don't Display	Lists the channels that will not be displayed by the application.
Up	Moves the selected channel upward in the ***Display*** field. Use this button, in conjunction with the ***Down*** button, to rearrange the channels
Down	Moves the selected channel downward in the ***Display*** field. Use this button, in conjunction with the ***Up*** button, to rearrange the channels.
—>	Moves the selected channel from the ***Display*** field to the ***Don't Display*** field.
<—	Moves the selected channel from the ***Don't Display*** field to the ***Display*** field.

Field	Description
Clear	Moves all channels from the ***Display*** field to the ***Don't Display*** field.
Invert	Flips the waveform of the channel selected in the ***Display*** field. Inverting a channel can be useful for correcting the presentation of improperly applied leads.
Gain	Sets the vertical scale of the channel selected in the ***Display*** field. Changing the gain affects only the display of the waveform. It does not affect how the system analyzes the data. Available options are x.25, x.5, x1, x2, and x4. The larger the number, the larger the waveform.
Offset	Sets the distance of the channel selected in the ***Display*** field from its baseline. Positive numbers move the channel upward from its baseline. Negative numbers move the channel downward from its baseline. Use this control to move the displayed channels closer to or further away from each other.
Time Scale	Sets the scale of the ECG's X-axis. Changing the scale changes the number of waveforms visible at one time. The available scale depends on the application. For ***Strip Review***, the smaller the scale, the more condensed the ECG will be, allowing more waveforms to be displayed per screen. Available scales are: • 5 mm/sec • 10 mm/sec • 12.5 mm/sec • 25 mm/sec • 50 mm/sec For ***Page Review***, the larger the scale, the more condensed the ECG will be, allowing more waveforms to be displayed per screen. Available scales are: • 15 sec/line • 30 sec/line • 60 sec/line • 90 sec/line
Grid	Determines whether a grid will be displayed behind the waveforms. There are three valid options: • None No grid is displayed. • Full A single grid is displayed behind all the channels. • Individual A separate grid is displayed behind each channel.
Chans/Screen	Determines the number of channels to be displayed per page. For 5–lead hookups, select 2 channels. For 7–lead hookups, select 3 channels.

Field	Description
Cursor	Determines whether the cursor will be displayed in the ECG. It is selected by default. GE Healthcare recommends that you leave the cursor displayed, since it plays a crucial role in relabeling beats. The cursor changes shape when you select an ECG complex.  1. A single green line indicates the cursor is between beats. 2. A green box indicates that the enclosed beat is selected.
Caliper	Places a caliper on the ECG. Use the caliper to accurately measure the distance between any two points. When you set the caliper, the duration between the selected points (in seconds) and the average BPM represented by the selected distance are displayed.  For information on how to use the caliper, refer to "Setting the Caliper" on page 267.
Tic Marks	Places vertical lines on the ECG at regular intervals based upon the current caliper measurement. When you change the caliper measurement, the tic marks change accordingly. Tic marks make it easier to see changes in the heart rate.  This option is available only if ***Caliper*** is selected.

Field	Description
Template	Displays a shape review window to the left of the ECG.  When a beat is selected in the ECG, the template to which the beat belongs is displayed in the shape review window. You can change the label of the template, which changes the label of all the beats in the template, or you can change the label of the selected beat, which adds the beat to a more appropriate template.
RR Values	Displays the R to R measurements between each beat.  If you file a strip with the RR values displayed, the RR values will be included in the final report.
Date	Selects the ECG date to display. Use the arrows to the left of the field to select the date. The up arrow scrolls backward through the dates and the down arrow scrolls forward through the dates.
Time	Selects the ECG time to display. Use the arrows to the left of the field to select the hour and the arrows to the right of the field to select the minute. The up arrows scroll backward and the down arrows scroll forward.
Set	Displays the ECG at the selected date and time.
Beat	Toggles the display of beat labels. GE Healthcare recommends that you leave this option selected to facilitate the review and editing of the ECG.
Beat Coloring	Toggles the display of beat colors. GE Healthcare recommends that you leave this option selected to facilitate the review and editing of the ECG.
Colors	Opens a window to allow you to customize the colors for the various beat groups. For information on using this window, refer to "Customizing Beat Colors" on page 266.

While all the ***Tools*** control panels share many of the same fields and controls, they don't share all of them. The following table identifies which fields and controls are available for each application.

		Strip Review	Page Review	Event Review	Shape Review	Waveform Measurements	Waterfall Display
Channel Settings	Display	Y	Y	Y	Y	Y	Y
	Don't Display	Y	Y	Y	Y	Y	Y
	Up	Y	Y	Y	Y	Y	Y
	Down	Y	Y	Y	Y	Y	Y
	->	Y	Y	Y	Y	Y	Y
	<-	Y	Y	Y	Y	Y	Y
	Clear	Y	Y	Y	Y	Y	Y
	Invert	Y	Y	Y	Y	X	Y
	Gain	Y	Y	Y	Y	X	NA
	Offset	Y	Y	Y	Y	Y	NA
Data Control Settings	Time Scale	Y	Y	X	X	X	NA
	Grid	Y	NA	NA	Y	NA	NA
	Chans/Screen	Y	NA	NA	NA	NA	NA
	Cursor	Y	NA	NA	Y	NA	NA
	Caliper	Y	NA	NA	NA	NA	NA
	Tic Marks	Y	NA	NA	NA	NA	NA
	Template	Y	NA	NA	NA	NA	NA
	RR Values	Y	NA	NA	NA	NA	NA
Time Focus	Date	Y	Y	Y	Y	Y	Y
	Time	Y	Y	Y	Y	Y	Y
	Set	Y	Y	Y	Y	Y	Y
Anno-tations	Beat	Y	NA	NA	X	X	NA
	Beat Coloring	NA	Y	Y	NA	NA	NA
	Colors	X	Y	Y	X	X	NA

Legend:
Y = Available and editable,
X = Available but not editable,
NA = Not available

Using the Tools Control Panel

Use the following procedures to set the display options, customize beat colors, and use the caliper.

Setting the Display Options

Use the following general procedure to set the display options from any of the listed applications. The procedures assume that you have already selected a patient and opened one of the applications listed on page 258. If necessary, refer to "Tools Page Layout" on page 258 for detailed description of any of the fields or their use.

NOTE:
A step may not apply in all cases. Refer to the table on page 263 for a list of which controls are available for which applications.

1. Select the ***Tools*** button.

   The ***Tools*** control panel opens.

2. In the ***Channel Settings*** section, do the following:

   a. Move the desired channels to the ***Display*** field.

      The selected channels appear in the ECG.

   b. Use the ***Up*** and ***Down*** buttons to change the order in which the channels are displayed.

      The channels switch position in the ECG accordingly.

   c. To invert the display of a channel, click the channel in the ***Display*** field and select the ***Invert*** check box.

      The selected channel is inverted, or flipped upside down.

   d. To adjust the displayed amplitude of a channel, click the channel in the ***Display*** field and select the appropriate value from the ***Gain*** field.

      The size of the selected channel changes accordingly.

   e. To adjust the distance between two channels, click one of the channels in the ***Display*** field and then use the ***Offset*** field to move that channel up or down from its baseline.

      The distance between the channels changes accordingly.

3. In the ***Data Window Settings*** section, do the following:

   a. In the ***Time Scale*** field, select an appropriate scale for the ECG.

      The ECG expands or contracts accordingly. When the ECG is contracted, more waveforms are visible but the complexes will be smaller and harder to read. When the ECG is expanded, the waveforms will be larger and easier to read, but fewer waveforms will be visible. GE Healthcare recommends a medium setting to strike a balance between quantity and legibility.

   b. In the ***Grid*** field, select the type of grid to display behind the ECG.

      The selected grid appears in the display.

c. In the ***Chans/Screen*** field, select the number of channels to display.

The selected number of channels is displayed in the ECG.

d. Select the tools to be used in the ECG.

The selected tools appear in the ECG. For a description of the available tools, refer to "Tools Page Layout" on page 258.

4. In the ***Time Focus*** section, do the following:

a. Select the date of the ECG to be displayed.

b. Select the time of the ECG to be displayed.

c. Click ***Set***.

The ECG moves to the selected date and time. If the cursor is enabled, it will be set to the specified date and time.

5. In the ***Annotations*** section, do the following:

a. To turn off beat labels, clear the ***Beat*** field.

Labels are enabled by default. GE Healthcare recommends that you not disable them.

b. To turn off beat coloring, clear the ***Beat Coloring*** field.

Coloring is enabled by default. GE Healthcare recommends that you not disable them.

c. To customize the beat colors, refer to "Customizing Beat Colors" on page 266.

6. On the ***Tools*** control panel, click ***Close***.

The ***Tools*** control panel closes and you return to the current application's control panel.

Customizing Beat Colors

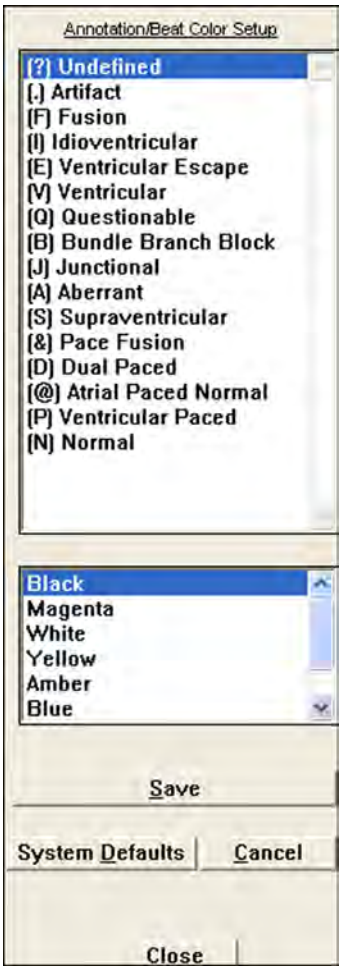
Page Review and Event Review use colors instead of labels to identify beat types. Use the following procedure to customize those colors to better suit your needs.

1. On Page Review or Event Review, click ***Tools***.

   The ***Tools*** control panel opens.

2. Click the ***Colors...*** button.

   The ***Annotation/Beat Color Setup*** control panel opens.



3. In the top field, select a type of beat whose color you want to change.
4. In the lower field, select the color to associate with the beat.
5. Click ***Save***.

   The display updates with the new colors.

6. Repeat step 3 through step 5 for each beat whose color you want to change.
7. To reset the colors to their defaults, click ***System Defaults***.

   The display updates with the default system colors.

8. When you are done, click ***Close***.

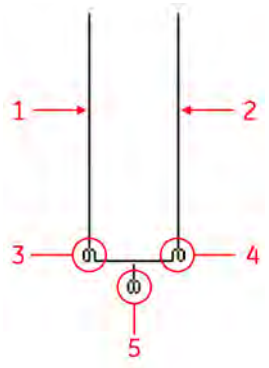
   The ***Annotations/Beat Color Setup*** control panel closes and you return to the ***Tools*** control panel.

Setting the Caliper

The Caliper allow you to precisely measure the distance between any two points on the ECG. It can be used in conjunction with Tic Marks to set up guides at established distances, making it easy to detect changes in heart rate.

The caliper consists of the following components:

1. Left leg
2. Right leg
3. Left leg control handle
4. Right leg control handle
5. Caliper control handle

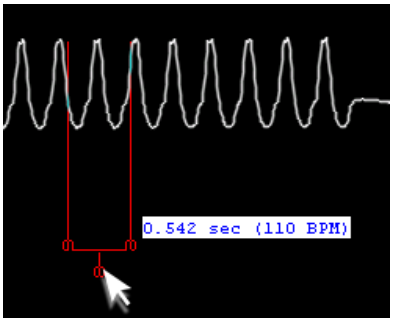


1. On the Strip Review, enable the caliper and, if desired, tic marks.

   Refer to "Setting the Display Options" on page 264 for instructions.

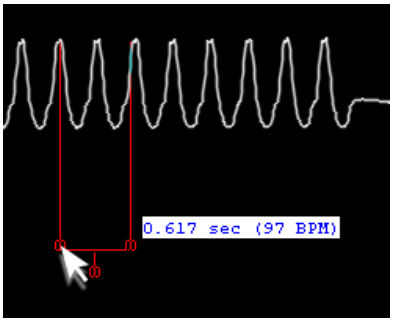
2. To position the caliper, click on the caliper control handle, drag it to the correct position, and release.

   This places the caliper in the general location.



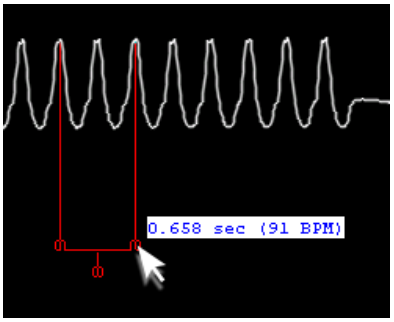
3. To position the left leg, click on the left leg control handle, drag it to the correct position, and release.

   The caliper measurements update accordingly.

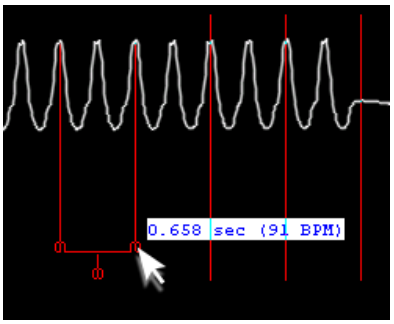


4. To position the right leg, click on the right leg control handle, drag it to the correct position, and release.

   The caliper measurements update accordingly.



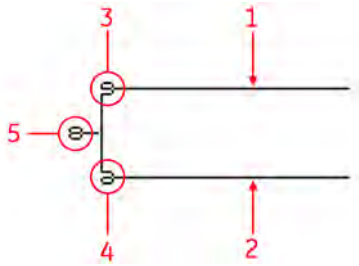
   If Tic Marks are enabled, they adjust accordingly.



Calibrating Analog ECGs

ECGs acquired through digital Holter recorders are automatically calibrated for use with the MARS Ambulatory ECG Analysis system. However, ECGs acquired through analog Holter recorders may need to be calibrated to ensure that they are displayed and measured correctly by the system.

You calibrate an analog ECG on the ***Strip Review*** window by using a horizontal caliper to measure the 1 millivolt calibration pulses that appear at the beginning of the ECG. The caliper precisely measures the top of the pulses to the baseline and consists of the following components:



1. Top leg
2. Bottom leg
3. Top leg control handle
4. Bottom leg control handle
5. Caliper control handle

Calibrating an ECG

Use the following procedure to calibrate analog ECGs. Repeat the procedure for each recorded channel.

1. Select a patient with an analog ECG.

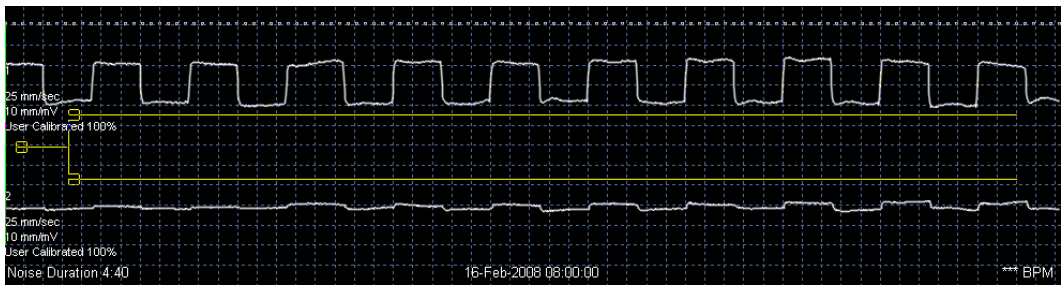
   Refer to "Selecting the Patient" on page 107 for instructions.

2. Click the ***Strip Review*** icon.

   The patient's ECG is opened in the ***Strip Review*** window.

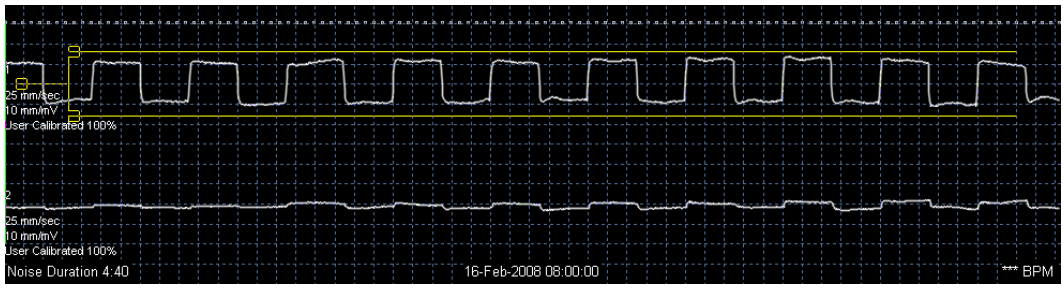
3. In the control panel, click ***Calibrate***.

   The caliper appears in the ECG strip.



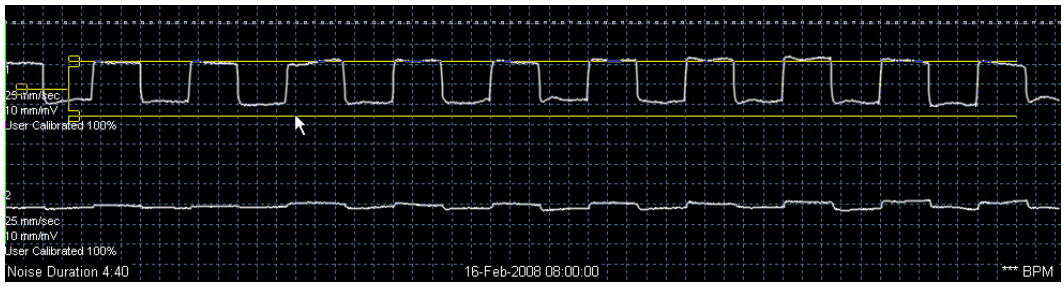
4. To position the caliper, click on the caliper control handle, drag it to the correct position, and release.

   This places the caliper in the general position.



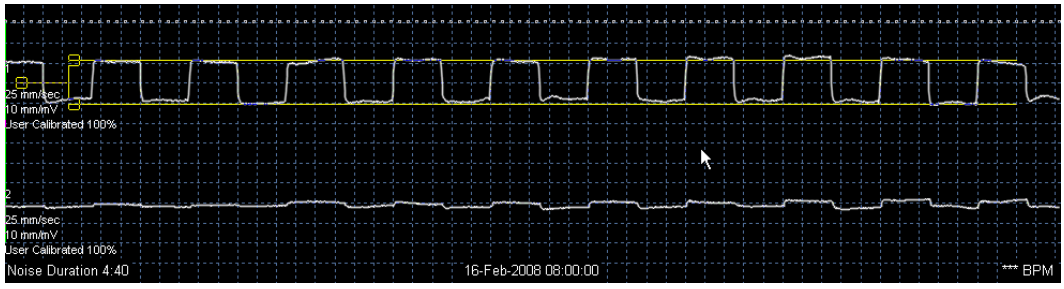
5. To position the top leg, click on the top leg control handle, drag it into the top of the waveform, and release.

   This marks the top position of the waveform.

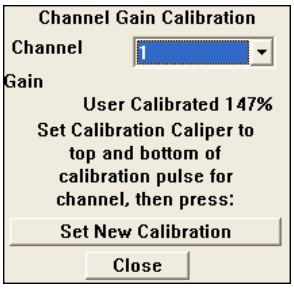


6. To position the bottom leg, click on the bottom leg control handle, drag it into the baseline, and release.

   This marks the baseline of the waveform.



7. In the control panel, select the channel that you are calibrating and click the ***Set New Calibration*** button.



The waveform adjusts accordingly.

8. Repeat step 3 through step 7 for each channel.

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