Philips Zymed Holter

2010 Plus / 1810 Series
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- Electrical installation in the relevant room complies with applicable requirements.
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- Buyer-supplied software or interfacing.
- Unauthorized modification or misuse.
- Operation outside of the environmental specifications for the product.
- Improper site preparation.
- Improper maintenance.

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Periodic inspections and maintenance service are recommended to ensure effective operation. Call your Philips Sales and Service Office for details regarding a Customer Support Services Agreement for your specific requirements.

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The equipment is packed in its own reusable shipping container. When unpacking the equipment, inspect the carton for physical damage. Any damage should be reported immediately to the shipping company. Open the shipping container and compare the contents to the packing list. There is only one packing list per shipment. If there are several parcels, the shipping list is normally attached to the largest container. If the packing list does not agree with the items received, contact a Philips Response Center (see Chapter 7 for telephone numbers). The shipping container should be saved to permit reshipment.

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Philips Zymed Holter 2010 Plus / 1810 Series complies with the requirements of the Medical Device Directive 93/42/EEC and carries the CE 0123 mark accordingly.

Authorized EU-representative:
Philips Medizinsysteme Böblingen GmbH
Hewlett Packard Str. 2
71034 Böblingen
Germany
# Conventions

This book uses the following text conventions:

<table>
<thead>
<tr>
<th>WARNING</th>
<th>Warning statements describe conditions or actions that can result in personal injury or loss of life.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAUTION</td>
<td>Caution statements describe conditions or actions that can result in damage to the equipment or loss of data. Caution statements alert the user that the clinician has the responsibility of determining significance of results due to actions and varying factors present with each case.</td>
</tr>
<tr>
<td>NOTE</td>
<td>Notes contain additional information on using this product.</td>
</tr>
</tbody>
</table>
About this Book

This book describes the functions and operations of the the Philips Zymed Holter 2010 Plus / 1810 series scanner, called the "Philips Zymed Holter" scanner in this document. The goal of this book is to provide an understanding of the features of this system to enable the user to attain the most accurate Holter analysis possible.

It is assumed that the reader is familiar both with Windows functionality and ECG morphology and arrhythmias.

NOTE
The term "ECG" is used to mean both ECG and EKG.

Please note that the screens on your system may be slightly different from the screens shown in this book, which present the "leather jacket" configuration. See Chapter 10, "Configuring the Scanner", for examples of additional screen configurations. Also the screen illustrations are not to scale, and some of the screen may be cut off.

NOTE
An 1810 system may not have all the functionality described in the book. Chapter 1, "Models and Options" contains a list of features in each model.
Explanation of Symbols

The system hardware can display one or more of the following symbols:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>⚠️</td>
<td>Attention: Consult accompanying documents</td>
</tr>
<tr>
<td>🔄</td>
<td>Off (power disconnected from mains)</td>
</tr>
<tr>
<td>🔄</td>
<td>On (power connected to mains)</td>
</tr>
<tr>
<td>🎀 0123</td>
<td>Symbol on label indicates Philips meets the applicable requirements of the European directive 93/42/EEC</td>
</tr>
<tr>
<td>🦹</td>
<td>Type B equipment contains adequate protection against electrical shock, particularly regarding the allowable leakage current and the reliability of protective earth connection (when present)</td>
</tr>
<tr>
<td>⚪️</td>
<td>Fuse</td>
</tr>
<tr>
<td>✅️</td>
<td>Use correct voltage. See manual</td>
</tr>
<tr>
<td>📅</td>
<td>Date of manufacture</td>
</tr>
<tr>
<td>V</td>
<td>Volts</td>
</tr>
<tr>
<td>A</td>
<td>Amperes</td>
</tr>
</tbody>
</table>

Electrical Safety

The electrical safety of this product has been considered in its design and production. Philips medical products are designed to comply with applicable national and international electrical codes.
### Notices to Review before Operation

Do not operate the Holter scanner without first reviewing the following notices.

<table>
<thead>
<tr>
<th>CAUTION</th>
<th>Nurses, clinicians, or technicians should be familiar with clinical procedures surrounding ECGs before using the equipment.</th>
</tr>
</thead>
</table>

### Influences that Affect Heart Rate Variability (HRV)

Heart Rate Variability (HRV) beat-to-beat measurements are not valid in patients with sinus node dysfunction, second or third degree Atrioventricular block, or temporary or permanent pacemakers. Atrial or Ventricular prematurity is excluded.

<table>
<thead>
<tr>
<th>CAUTION</th>
<th>Since various neural, respiratory, and humoral influences are generally known to affect heart rate, the significance of the data must be determined by the clinician.</th>
</tr>
</thead>
</table>

Some HRV parameters are highly dependent on mean heart rate. Careful consideration should be given to the interpretation of results between and within specific patient populations.

HRV analysis results may differ among devices from different manufacturers since the methods, such as inclusion/exclusion of ectopy or pauses, are not standardized. Therefore, caution should be used in applying conclusions drawn from studies with other devices.

### Improper Use of Software

Philips Zymed Holter assumes that the scanner is dedicated to the task of analyzing ECG scanned from tape (cassette, DigiTrak-Plus, DigiTrak) or disk. Operators can compromise the ability of the machine to perform its job by running unapproved software (for example, games, Internet applications, etc.) that is not qualified and tested to run with scanner software and that uses resources needed for the scanning process.
While performing Holter scanning analysis, do not run unqualified software on the machine. Unqualified software can compromise the accuracy of the analysis.

**Inadequate Hardware**

When Philips Zymed Holter software is installed, the system is checked to see that it meets minimum requirements for processing Holter data accurately. If the system does not meet requirements, the following message is displayed each time Holter is run:

*This computer does not meet the requirements to run Zymed Holter. Analyzed data may not be accurate*

**Check Equipment Before Operating**

Before each use of the equipment, check all connector cables and the power receptacle for signs of damage.

**WARNING**

Do not operate the equipment if the integrity of the connector cables or the power receptacle is in question. When connecting Philips approved auxiliary equipment, be sure the summation leakage current does not exceed local or provincial standards. An isolation transformer or other protective device might be required. Use only Philips approved parts and accessories. Do not operate the equipment in the presence of flammable anesthetics.

**Additional Warnings and Cautions**

The following warnings and cautions are also located in relevant sections of this manual.

*In Chapter 1*

**CAUTION**

Philips Zymed Holter has been tested to reliably detect the following dysrhythmias:

- Atrial ectopy (PAC, bigeminy/trigeminy)
- Atrial fibrillation
- Atrial tachycardia/bradycardia
- Minimum/maximum heart rates
- Pauses (for example, asystole, long/short pauses)
- Ventricular ectopy (unifocal or multifocal), such as, PVCs, couplets, triplets, bigeminy/trigeminy, R-on-T
- Ventricular dysrhythmia
<table>
<thead>
<tr>
<th><strong>In Chapter 3</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CAUTION</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>In Chapter 6</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CAUTION</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>In Chapter 7</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CAUTION</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>In Chapter 9</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CAUTION</strong></td>
</tr>
</tbody>
</table>

The following Caution refers to using the flashcard utility.

| **CAUTION** | Use the flashcard utility procedure to label (or erase) DigiTrak-Plus and DigiTrak recorders only. This utility erases all ECG on the media when you click Write to. |
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1 Introduction

Overview

The Philips Zymed Holter system scans a patient’s recorded heart beats, analyzes them, and provides a report that a cardiologist can use to make diagnostic determinations.

The scanner uses a variety of media and formats to analyze from 24 to 48 hours of the patient’s heart activities. Once a recording is completed, you scan the data, and the system provides a preliminary analysis.

You are a partner with the internal analysis algorithm. At each point in the scan, you have control over the analysis to reject artifact and reclassify beats. You play an important part in using the Holter system to provide the cardiologist with an accurate Report.

Philips Zymed Holter analysis provides:

- A view of the data and a summary of the heart events that have taken place.
- Detection of anomalies such as Ventricular Ectopy and Supraventricular Ectopy.
- Patency of the pacemaker and pacemaker anomalies.
- Advanced scanning techniques, such as determining ST and QT anomalies.
- Heart rate data and heart rate variability.
- Full Disclosure reports.

NOTE

An 1810 system, including its associated suites, may not have all the functionality described in the book. "Models and Options" on page 1-15 contains a list of features in each model.
See the following sections in this chapter for more information:

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>EASI Hookup and Options</td>
<td>1-3</td>
</tr>
<tr>
<td>Types of Scanning</td>
<td>1-5</td>
</tr>
<tr>
<td>Intended Use</td>
<td>1-5</td>
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<td>Startup</td>
<td>1-7</td>
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<tr>
<td>Major Holter Screens</td>
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<tr>
<td>Using the On-Line Help</td>
<td>1-9</td>
</tr>
<tr>
<td>Keyboard Functions and Shortcuts</td>
<td>1-11</td>
</tr>
<tr>
<td>Holter Toolbars</td>
<td>1-13</td>
</tr>
<tr>
<td>Models and Options</td>
<td>1-15</td>
</tr>
</tbody>
</table>
EASI Hookup and Options

Philips Zymed Holter can analyze data from 2- or 3-channel recorders or from the Agilent/Philips Information Center. An EASI hookup provides 12-Lead data from 5 electrodes. EASI has two main uses: arrhythmia analysis and ischemic detection. The EASI lead placement is required to obtain a 12-Lead ECG. EASI hookup must be selected at the beginning of the scan. (See “Step 2. Set Up for a New Scan” on page 1-3.)

EASI Lead Configuration and 12-lead ECG

The EASI lead configuration generates three monitoring channels, which are orthogonal. With the EASI configuration, we use calculus to generate the 12-Lead ECG.

The science behind EASI comes from Dr. Frank's work in vectorcardiography and Dr. Dower's work in extending Dr. Frank's principles to the more practical EASI lead placement. Indeed, the E, A, and I electrode placements are modified Frank leads. For Holter, EASI electrodes are placed as shown in the following diagram. Raw ECG represents the areas between two EASI leads (electrodes), and translate into three raw channels (Ch1, Ch2, and Ch3).

Placement of Electrodes for EASI Hookup

<table>
<thead>
<tr>
<th>Electrode</th>
<th>Placement</th>
</tr>
</thead>
<tbody>
<tr>
<td>E (Brown)</td>
<td>Level of 5th intercostal space, midsternum</td>
</tr>
<tr>
<td>A (Black)</td>
<td>Same level as E and I, left mid-axillary line</td>
</tr>
</tbody>
</table>

NOTE

Accurate placement and care in proper hookup technique are absolutely critical for Holter leads.
Introduction

NOTE
If one of the raw channels has artifact or a poor hookup, the 12-lead display will be affected. Consider turning off the bad lead from analysis through the Morphology Rules dialog box. Excessive artifact and/or loss of ECG signal in one or more of the three raw monitoring channels will adversely affect the generated 12-lead ECG.

Raw EASI Channels

<table>
<thead>
<tr>
<th>Electrode</th>
<th>Placement</th>
</tr>
</thead>
<tbody>
<tr>
<td>S (Red)</td>
<td>Centered over the manubrium of the sternum</td>
</tr>
<tr>
<td>I (White)</td>
<td>Same level as E and A, right mid-axillary line</td>
</tr>
<tr>
<td>Ground (Green)</td>
<td>Any convenient location</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Raw Channel</th>
<th>Description</th>
</tr>
</thead>
</table>
| Channel 1   | E (+) to S (-)  
Similar to MC V1, anterior view of the heart |
| Channel 2   | A (+) to S (-)  
Similar to MC V6, a lateral view of the heart -- useful  
for ST measurements |
| Channel 3   | A(+) to I (-)  
CC6, similar to the inferior lead aVF -- approximation suitable for ST measurements |

NOTE
Raw monitoring channels 1, 2, and 3 are not the same as Leads I, II, and III. Leads I, II, and III are generated from raw channels (Ch 1, Ch 2, and Ch 3).

Scanning Options with EASI Configuration

View any three channels while analyzing the ECG file using Philips Zymed Holter. Choose from the following options:

- Raw monitoring channels -- Ch1, Ch 2, Ch3 (system default).
- Generated 12-lead ECG -- Lead I - V6.
- Combinations of raw and generated ECG.

The above user options apply to both the Diagnostic window and the Page window.
Types of Scanning

There are two types of scanning available in Holter: prospective and retrospective. Each type has editing options that allow you to change the class label of the beat that you see on the screen. Prospective editing is available while you are in the process of scanning an ECG; retrospective editing options are available after the file has been scanned. The system also allows these modes to be used alternately in a combined fashion for optimal accuracy.

<table>
<thead>
<tr>
<th>Type</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prospective</td>
<td>Lets you supervise the analysis by viewing the ECG chronologically and fine-tuning the arrhythmia processor on-line for error-free results. You can classify unknown beats as specific types of beats through the Learn process.</td>
</tr>
<tr>
<td>Retrospective</td>
<td>Analyzes the ECG automatically without user intervention and lets you verify and edit.</td>
</tr>
</tbody>
</table>

Intended Use

Holter 2010/1810 Plus for Windows is intended for use in a hospital or clinical setting, by trained personnel who are acting on the orders of a physician. The scanner evaluates the heartbeats of ambulatory patients recorded over an extended period. The final decision regarding the treatment of patients is the responsibility of the physician.

CAUTION

Nurses, clinicians, or technicians should be familiar with clinical procedures surrounding ECGs before using the equipment.

Indications for Use

- Assessment of symptoms that may be related to rhythm disturbances of the heart in patients from pediatric to adult age: Patients with palpitations.

- Assessment of risk in Patients With or Without Symptoms of Arrhythmia: Patients with symptomatic or asymptomatic idiopathic hypertrophic cardiomyopathy and postmyocardial infarction patient with left Ventricular dysfunction using arrhythmia e.g.: Ventricular ectopy, as method of risk assessment.

- Assessment of efficacy of Antiarrhythmia Therapy: Patients with baseline high frequency, reproducible, sustained, symptomatic premature Ventricular complexes, Supraventricular arrhythmia or Ventricular tachycardia.
• Assessment of Pacemaker Function: Evaluation of patients with paroxysmal symptoms, detection of myopotential inhibition, detection of pacemaker mediated tachycardia, evaluation of antitachycardia pacing device function, evaluation of rate-responsive physiological pacing function.

• Detection of Myocardial Ischemia, including patients with chest pain suggestive of Prinzmetal’s angina.

• Assessment of EASI generated 12-Lead ST measurements has been tested in patients that meet the following parameters:
  - Ages: 33 to 82 years
  - Heights: 147 to 185 cm (58 to 73 in)
  - Weights: 53 to 118 kg (117 to 261 lb)
  - Height to Weight ratios: 1.41 to 2.99 cm/kg (0.25 to 0.54 in/lb.)

• QT measurements can be used by the physician in the risk assessment process indicated for patients with and without symptoms of arrhythmia. QT measurement is intended to be used by competent health professionals in hospital or clinic environment. QT measures the interval only and is not intended to produce any interpretation or diagnosis of those measurements.

---

**CAUTION**

Philips Zymed Holter has been tested to reliably detect the following dysrhythmias:

• Atrial ectopy (PAC, bigeminy/trigeminy)
• Atrial fibrillation
• Atrial tachycardia/bradycardia
• Minimum/maximum heart rates
• Pauses (for example, asystole, long/short pauses)
• Ventricular ectopy (unifocal or multifocal), such as, PVCs, couplets, triplets, bigeminy/trigeminy, R-on-T
• Ventricular dysrhythmia
Startup

Important: Before you Start
Before you can use the system, you must install a Philips Zymed hardlock on the USB or parallel port.

- If the hardlock is a USB type, insert it in the USB port on the back of the machine.

- If the system is attached to a parallel-type printer:
  1. Unplug the printer cable.
  2. Plug the hardlock (male connector) into the parallel port.
  3. Plug the printer cable into the back (female connector) of the hardlock.

Defaults and Remembered Settings
The Holter system remembers many optional settings which eliminates the need for re-typing default settings. However, be sure to check all settings during the startup sequence.
## Major Holter Screens

There are four major screens that you use to complete a scan and Report.

<table>
<thead>
<tr>
<th>Screen</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Startup screen</td>
<td>Appears when you run the software. The screen contains Philips and Zymed logos and the scanning menu bar. From the Startup screen you can start a scan, open an existing scan or Report, enter patient demographics for DigiTrak, DigiTrak-plus, or cassette recorders, and view on-line Help. The menu bar allows the user to customize limited settings in the Holter program. (i.e., menu color, arrhythmia highlighting color, report colors, etc.).</td>
</tr>
<tr>
<td>Scanning screen</td>
<td>Appears when you begin to read a file. You can use one of four modes (Page, QuickScan, Retro, or SI) to display pages. If you save and exit an active file before the scan is completed, the system remembers what portion has been analyzed and begins with unanalyzed data if you re-load the file.</td>
</tr>
<tr>
<td>Diagnostic (Diag) window</td>
<td>Appears in the top-half of the Scanning screen when you click the Diag icon. The diagnostic view of the ECG allows the user to look at specific beats in a diagnostic mode.</td>
</tr>
<tr>
<td>Report Summary</td>
<td>Displays a multi-section (as configured) Summary of the current scan. The Summary includes information such as the patient's demographic data, heart rate, totals for all ectopic beats, and a Narrative Summary of the scan.</td>
</tr>
</tbody>
</table>

Each of these screens has icons and menu selections which, when chosen, present dialog boxes for specific functions.
Using the On-Line Help

This section describes the on-line Help that is available for Holter.

Help Menu

The Help menu contains three items: Tip of the Day, Help Topics, and About Holter.

Tip of the Day

You can view a tip of the day (for example, a keyboard shortcut) to improve your efficiency in using Holter. Turn this option off by de-selecting the Show Tips on StartUp check box.

NOTE

On-line Help and Tip of the Day are available in English only.

Help Topics

You can select Help Topics from the Welcome page of the Holter scanner on-line Help. Press F1 to display Help; or highlight a menu item, then press F1 to display Help for that particular topic. To get help on any icon on the screen, press Shift + F1, then click the icon.

Printing a Topic from On-Line Help

Use the following procedure to print a topic in on-line Help (for example, in a Troubleshooting table):

1. Click the Contents tab, if necessary, and double-click the Contents book (for example, Troubleshooting Tips or Terms and Concepts) that contains the topic to be printed.

2. Double-click the current book (for example, the Beat/Arrhythmia Identification book).
Items in this book appear in the same order as those listed in the table (for example, What If ...Condition table). If you know which topic you want to print, skip to step 5.

3. Click the item for which you need a printed page.

4. Match the suggested correction/definition to the topic in the Contents book.

5. Click the desired topic in the Contents window to display it as the current Help topic.

6. Use the Print button at the top of the page to print the topic.

**About Holter...**

The About Holter item displays the release level of the Holter software currently installed on your system.

---

**NOTE**

It is important to know the release version and build date of your software when troubleshooting any difficulties you are having with the system. To find the release version and build date, click on the Help icon, and then click on About Holter. The version and build date can be found under Information.
Keyboard Functions and Shortcuts

Keyboard Functions (Hot Keys)

You can use a combinations of keys on the keyboard instead of the mouse for a variety of actions. When a letter is underscored on a menu or screen, that letter plus the Ctrl key performs the function. Keyboard accelerators for icons are the underscored letter plus the Alt key.

NOTE

To access menu functions, press F10 plus the letter(s) that is/are underlined on the menu.

Other keyboard functions are listed in the following table:

<table>
<thead>
<tr>
<th>Function Key</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arrows</td>
<td>Moves cursor to the left, right, up, or down</td>
</tr>
<tr>
<td>Backspace</td>
<td>Jumps back (return) to the screen just displayed</td>
</tr>
<tr>
<td>Ctrl+N</td>
<td>New scan (File New is a Windows standard)</td>
</tr>
<tr>
<td>Ctrl+O</td>
<td>Opens file (File Open is a Windows standard)</td>
</tr>
<tr>
<td>Ctrl+P</td>
<td>Prints file (File Print is a Windows standard)</td>
</tr>
<tr>
<td>Ctrl+S</td>
<td>Saves scan (File Save is a Windows standard)</td>
</tr>
<tr>
<td>Esc</td>
<td>Cancels an action</td>
</tr>
<tr>
<td>Enter</td>
<td>Continues the analysis</td>
</tr>
<tr>
<td>F1</td>
<td>Displays context-sensitive Help for a highlighted menu item or a highlighted Holter icon</td>
</tr>
<tr>
<td>Home</td>
<td>Goes to the beginning of the scan</td>
</tr>
<tr>
<td>Page Down</td>
<td>Advances to next page of ECG</td>
</tr>
<tr>
<td>Page Up</td>
<td>Returns to prior page of ECG</td>
</tr>
<tr>
<td>Print Screen</td>
<td>Prints a copy (screen capture) of the current screen on the system printer</td>
</tr>
<tr>
<td>Shift + F1</td>
<td>Changes the cursor to a question mark that allows you to get context-sensitive help, when available, for any item on which you click</td>
</tr>
<tr>
<td>Alt Key Combinations</td>
<td>Function</td>
</tr>
<tr>
<td>----------------------</td>
<td>----------</td>
</tr>
<tr>
<td>Alt+ A</td>
<td>Displays the Auto Stop dialog box to set/clear Auto Stops - available only when scanning</td>
</tr>
<tr>
<td>Alt+ C</td>
<td>Inserts a new caliper into the Diagnostic window – available only when the Diagnostic window is visible</td>
</tr>
<tr>
<td>Alt+ D</td>
<td>Hides or shows the Diagnostic window – available only in views that have Diagnostic windows (Scan View, Event Review, Important Events, Strips, and Graph)</td>
</tr>
<tr>
<td>Alt+ E</td>
<td>Displays the Event Review dialog box to select events to review – available when scanning through the Event Review icon</td>
</tr>
<tr>
<td>Alt+ G</td>
<td>Allows you to jump to a selected time (Go to Time) – available only when scanning</td>
</tr>
<tr>
<td>Alt + R</td>
<td>Displays the Rules dialog box</td>
</tr>
<tr>
<td>Alt + S</td>
<td>Displays the Scan Speed dialog box – available only when scanning</td>
</tr>
<tr>
<td>Alt + Space</td>
<td>Centers the focus (Doc) rectangle and ECG within the Page window</td>
</tr>
<tr>
<td>Alt + T</td>
<td>Toggles the Diagnostic window between 3 and 12 leads – available only when the Diagnostic window is visible and the hookup is EASI</td>
</tr>
<tr>
<td>Alt + X</td>
<td>Toggles the Diagnostic window between 3 raw and generated 12 leads – available only when the Diagnostic window is visible and the hookup is EASI</td>
</tr>
<tr>
<td>Alt + Z</td>
<td>Goes to the end of the analysis region and moves the selection region when scanning to the last analyzed location – only available when scanning</td>
</tr>
</tbody>
</table>
Holter Toolbars

Use the icons in the Holter toolbars to perform the indicated operation with a single click. For a description of an icon, move the cursor over the icon, click the icon, and press F1.

Main Toolbar

<table>
<thead>
<tr>
<th>New</th>
<th>Open</th>
<th>Save</th>
<th>Print</th>
<th>Scan</th>
<th>Class</th>
<th>Detail</th>
<th>Review</th>
<th>Events</th>
<th>Graph</th>
<th>ST</th>
<th>Strips</th>
</tr>
</thead>
</table>

Main Toolbar (continued)

<table>
<thead>
<tr>
<th>Report</th>
<th>Rules</th>
<th>Display</th>
<th>Dieg</th>
</tr>
</thead>
</table>

Scanning Toolbar

<table>
<thead>
<tr>
<th>Go</th>
<th>View</th>
<th>Doc</th>
<th>Erase</th>
<th>UnErase</th>
<th>Redo A</th>
<th>Redo L</th>
<th>Alt.View</th>
<th>Speed</th>
<th>Stops</th>
<th>Time</th>
<th>Select</th>
</tr>
</thead>
</table>

Diagnostic Pick-A-Beat Toolbar

<table>
<thead>
<tr>
<th>Caliper</th>
<th>R-R</th>
<th>Change</th>
<th>Count</th>
<th>Count</th>
<th>Count</th>
<th>Learn</th>
<th>Learn</th>
<th>Learn</th>
<th>Relearn</th>
<th>Detail</th>
<th>12 Lead</th>
</tr>
</thead>
</table>

Auto Stop Toolbar

Note: The options on this toolbar alternate according to the analysis made by Holter. Some options may not appear with every Auto Stop.

Report Toolbar

<table>
<thead>
<tr>
<th>Page</th>
<th>Page</th>
<th>Section</th>
<th>Section</th>
<th>Zoom</th>
</tr>
</thead>
</table>

ST Episode Toolbar

<table>
<thead>
<tr>
<th>View</th>
<th>Doc</th>
<th>Zoom</th>
<th>Zoom</th>
<th>Left</th>
<th>Right</th>
<th>B.L.</th>
<th>Revert</th>
<th>H.R.</th>
<th>Chan.1</th>
<th>Chan.2</th>
<th>Chan.3</th>
<th>Create</th>
</tr>
</thead>
</table>
Holter Toolbars

Class Edit Toolbar

Class Edit Toolbar (continued)

Beat Detail Toolbar

Advanced Pick-A-Beat Toolbar

Advanced Pick-A-Beat Toolbar (continued)
# Models and Options

There are two basic Philips Zymed Holter models: the 1810 and the 2010. The following table lists the basic functionality of Model 1810, the upgrades that can be added to expand the 1810 system’s capabilities, and Model 2010. The font used for an item represents the additional features that are included.

<table>
<thead>
<tr>
<th></th>
<th>1810</th>
<th>1810 w/Technical Suite</th>
<th>1810 w/Tech. &amp; Cardiology Suites</th>
<th>1810 w/Tech. &amp; Admin. Suites</th>
<th>2010 (Includes all Suites)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EASI</td>
<td>EASI</td>
<td>EASI</td>
<td>EASI</td>
<td>EASI</td>
<td>EASI</td>
</tr>
<tr>
<td>3-Channel ST</td>
<td>3-Channel ST, QT</td>
<td>3-Channel ST, QT</td>
<td>3-Channel ST, QT</td>
<td>3-Channel ST, QT</td>
<td>3-Channel ST, QT</td>
</tr>
<tr>
<td>Automatic Strip</td>
<td>Automatic Strip</td>
<td>Automatic Strip</td>
<td>Automatic Strip</td>
<td>Automatic Strip</td>
<td>Automatic Strip</td>
</tr>
<tr>
<td>Documentation</td>
<td>Documentation</td>
<td>Documentation</td>
<td>Documentation</td>
<td>Documentation</td>
<td>Documentation</td>
</tr>
<tr>
<td>Pacer Display</td>
<td>Pacer Display</td>
<td>Pacer Display</td>
<td>Pacer Display</td>
<td>Pacer Display</td>
<td>Pacer Display</td>
</tr>
<tr>
<td>HRV Time</td>
<td>HRV Time Domain</td>
<td>HRV Time Domain</td>
<td>HRV Time Domain</td>
<td>HRV Time Domain</td>
<td>HRV Time Domain</td>
</tr>
<tr>
<td>Full Disclosure</td>
<td>Full Disclosure</td>
<td>Full Disclosure</td>
<td>Full Disclosure</td>
<td>Full Disclosure</td>
<td>Full Disclosure</td>
</tr>
<tr>
<td>Superimposition</td>
<td>Superimposition of</td>
<td>Superimposition of</td>
<td>Superimposition of</td>
<td>Superimposition of</td>
<td>Superimposition of</td>
</tr>
<tr>
<td>Templates</td>
<td>Templates</td>
<td>Templates</td>
<td>Templates</td>
<td>Templates</td>
<td>Templates</td>
</tr>
<tr>
<td>Retrospective</td>
<td>Retrospective</td>
<td>Retrospective</td>
<td>Retrospective</td>
<td>Retrospective</td>
<td>Retrospective</td>
</tr>
<tr>
<td>Scanning</td>
<td>Scanning</td>
<td>Scanning</td>
<td>Scanning</td>
<td>Scanning</td>
<td>Scanning</td>
</tr>
<tr>
<td>30-min. ECG</td>
<td>Scanning</td>
<td>Scanning</td>
<td>Scanning</td>
<td>Scanning</td>
<td>Scanning</td>
</tr>
<tr>
<td>Preview</td>
<td>Scanning</td>
<td>Scanning</td>
<td>Scanning</td>
<td>Scanning</td>
<td>Scanning</td>
</tr>
<tr>
<td>Paging Scanning</td>
<td>Paging Scanning</td>
<td>Paging Scanning</td>
<td>Paging Scanning</td>
<td>Paging Scanning</td>
<td>Paging Scanning</td>
</tr>
<tr>
<td>Superimposition</td>
<td>Superimposition Scanning</td>
<td>Superimposition</td>
<td>Superimposition Scanning</td>
<td>Superimposition Scanning</td>
<td>Superimposition Scanning</td>
</tr>
<tr>
<td>QuickScan</td>
<td>QuickScan</td>
<td>QuickScan</td>
<td>QuickScan</td>
<td>QuickScan</td>
<td>QuickScan</td>
</tr>
<tr>
<td>Zybit Central</td>
<td>Zybit Central S/W</td>
<td>Zybit Central S/W</td>
<td>Zybit Central S/W (Unlimited</td>
<td>Zybit Central S/W</td>
<td>Zybit Central S/W</td>
</tr>
<tr>
<td>S/W (2 remote</td>
<td>S/W (2 remote max)</td>
<td>S/W (2 remote max)</td>
<td>(Unlimited remotes)</td>
<td>S/W (Unlimited remotes)</td>
<td>(Unlimited remotes)</td>
</tr>
<tr>
<td>max)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12-Lead ST,</td>
<td>12-Lead ST, 3D reporting</td>
<td>12-Lead ST, 3D</td>
<td>12-Lead ST, 3D reporting</td>
<td>12-Lead ST, 3D reporting</td>
<td>12-Lead ST, 3D reporting</td>
</tr>
<tr>
<td>3D reporting</td>
<td>Operator Created</td>
<td>Operator Created</td>
<td>Operator Created</td>
<td>Operator Created</td>
<td>Operator Created</td>
</tr>
<tr>
<td>Pacer Analysis</td>
<td>Rule Sets</td>
<td>Rule Sets</td>
<td>Rule Sets</td>
<td>Rule Sets</td>
<td>Rule Sets</td>
</tr>
<tr>
<td>Comprehensive</td>
<td>Comprehensive Alg Rules</td>
<td>Comprehensive Alg Rules</td>
<td>Comprehensive Alg Rules</td>
<td>Comprehensive Alg Rules</td>
<td>Comprehensive Alg Rules</td>
</tr>
<tr>
<td>Alg Rules</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Printer Support</td>
<td>Support</td>
<td>Support</td>
<td>Support</td>
<td>Support</td>
<td>Support</td>
</tr>
</tbody>
</table>

Philips Zymed Holter
With each model:

- **1810** = Plain text
- **Technical Suite** = *Italics*
- **Cardiology Suite** = Underlined text
- **Administrative Suite** = **Bold text**
- **2010** = includes all suites

Holter software for Windows offers optional upgrade paths. Your Philips representative can provide information about the specifics of each feature to help determine which application will best meet your needs.
2  Getting Started

Overview

This chapter lists the basic step-by-step procedures for completing a Philips Zymed Holter scan. Its three sections provide:

- Directions for scanning a new patient’s ECG in the first part of the chapter.

- Directions for opening an existing Holter file or Report in the second part of the chapter.

- A quick start scanning tutorial (summary of scanning modes) in the third part of the chapter.

See the following sections in this chapter for more information:

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1: Access the Program</td>
<td>2-2</td>
</tr>
<tr>
<td>Step 2: Set Up for a New Scan</td>
<td>2-3</td>
</tr>
<tr>
<td>Step 3: Do the Scan</td>
<td>2-7</td>
</tr>
<tr>
<td>Step 4: Edit the Scan</td>
<td>2-25</td>
</tr>
<tr>
<td>Step 5: Set Up the Report, Save, and Print</td>
<td>2-26</td>
</tr>
<tr>
<td>Accessing an Archived/Saved Holter File</td>
<td>2-26</td>
</tr>
<tr>
<td>Summary of How to Use Scanning Modes</td>
<td>2-29</td>
</tr>
</tbody>
</table>
Step 1. Access the Program

Double-click the Holter scanner icon on the desktop or use the Start menu. The Holter scanner Startup screen is displayed after the program loads an input file.

NOTE

A source of ECG (for example, a DigiTrak-Plus recorder) is automatically detected. If it is not present, the program requires that you identify the source of input (DigiTrak, DigiTrak Plus, and cassette recorders). You only have to do this once: after you have identified a source of ECG, the system remembers that source when you start the program again.

Holter Startup Screen

- Click the New icon for a new patient recording analysis.
- Click the Open icon for an existing archived patient recording (e.g., one that comes from Zybit or a partial scan).
Step 2. Set Up for a New Scan

Perform the following steps to set up the scan for a new patient:

1. Insert the Cassette tape or DigiTrak flashcard, or attach the DigiTrak-Plus.

2. Click the New icon at the top of the Holter Startup screen.

The following dialog box is displayed:

![New Patient - Recorder Format dialog box]

3. Complete the New Patient - Recorder Format dialog box.
   a. If using a DigiTrak, DigiTrak Plus, or cassette, confirm that the correct icon under ECG Source is highlighted.
      If using a Philips Zymed ECG File, click that icon, and select the file through the scroll list box that will appear on the bottom right.

   **NOTE**
   Remember that the Holter system retains many optional settings to eliminate the need for changing default settings. Therefore, be sure to check all settings during the startup sequence.

   b. Select:
      - Hookup type: EASI or Other (default is EASI).
      - Pacer: Not Paced or Paced (default is Not Paced).
      - Number of Channels you want to scan: 1, 2, or 3 -- used for non-EASI hookups (default is 3).

   **NOTE**
   Calibrating a cassette tape correctly is crucial for ST analysis. (See "Calibrating from the Cassette Control Dialog Box" on page 9-6.)

   b. Select:
      - Hookup type: EASI or Other (default is EASI).
      - Pacer: Not Paced or Paced (default is Not Paced).
      - Number of Channels you want to scan: 1, 2, or 3 -- used for non-EASI hookups (default is 3).

   **NOTE**
   12-lead analysis is only for EASI hookups.
e. Click Next, to go to the next dialog box.

The following dialog box is displayed:

4. Enter information in the New Patient - Demographics dialog box. When you are finished, confirm that the patient’s data is accurate, then click Next.

The required fields are:

- Sex (default is M)
- Test Date (default is current date)
- Analysis Date (default is current date)
- Hookup Time (default is 12:00 PM). If using the DigiTrak Plus recorder, the time is generated from the recorder.

The remaining fields are optional.

NOTE

You can enter up to 24 characters (letters, punctuation, special characters) in text fields that allow a description (for example, Last Name). Numeric fields can contain up to 20 numbers (that is, ID Number can be a mixture of letters and punctuation, for example, 1245-609-20). You can enter up to 64 characters in the Medications field.

Date formats vary by language -- use the appropriate format. Enter times as HH (hours) and MM (minutes). Leading zeros are required for times, and military time (for example, 16:30) is optionally allowed. Use AM or PM (no periods) if military format is not used. Time and Date formats can be only be selected in the Windows operating system. The format is selected when the computer is installed. The Windows time and date format is reflected in Holter. See your Windows users guide to set up the time and date format.
5. (Optional) Enter extended demographic information on the patient in optional user fields if that function is set for the current scan, then press Next->. For information and a procedure for configuring this Report function, see "B. Select Report formats" on page 6-14.

If extended demographic user fields are not enabled, the following dialog box is displayed:

6. Complete the New Patient - Diary dialog box, using the patient’s paper diary.

   a. For each Diary entry, specify the time and either select an item from the Diary Entry list at the right or type it in, then click Add (center of screen).

   NOTE

   If you want to add the entry text as a permanent Diary entry, click Add at the bottom of the Diary Entry list. Conversely, click Delete to remove Patient Event or Diary entry.
Step 2. Set Up for a New Scan

b. Click Next.

The following dialog box is displayed:

![New Patient - Scan Setup dialog box]

7. Complete the New Patient - Scan Setup dialog box,

   a. Select a Rule set (most patients use the Standard setting).
   
   b. Turn ST analysis on or off.
   
   c. Turn QT analysis on or off.
   
   d. Click Finish.

You are now ready to start the scan.
Step 3. Do the Scan

When you click Finish from the New Patient - Scan Set Up dialog box, the Scanning screen with a Diagnostic window is displayed.

**NOTE**

The right-most icons are not shown in the toolbars in the illustration above. You can find illustrations of the complete toolbars under "Holter Toolbars" on page 1-13.

**Diag (Diagnostic) Window**

You can open/close the Diagnostic window by clicking the Diag icon. The Diagnostic window, which appears in the top-half of the Scanning screen, allows you to take a closer look at beats from the area of the Page Focus box. You can independently set which channels are analyzed and viewed via the Rules icon, using the Morphology tab.
NOTE

The tick marks at the center of the focus box can be used to position beats in the center of the Diagnostic window.

To change the view, double-click in the Page area. This action toggles the view from a Scan/Diagnostic view to a Scan/Page view (one window of ECG).

**Status Bar**

Click Status Bar from the View menu to show or hide the status bar at the bottom of the Scanning screen. The Status Bar shows:

- Tooltip text, on the left, displays the description of the Auto Stop.
- Status messages (progress information, such as when files are opened, saved, and scanned), or error messages on the right.

**Browse Object Buttons**

Use the Browse Object buttons at the bottom right of the screen (see page 2-7) to scroll to the next or previous object you selected.

NOTE

Browse buttons are used to search analyzed data only and not data that has not been analyzed by the system.

Browse functions available are:

- Top button -- find next instance/object above the current cursor position.
- Middle button -- select type of object (click on this button first) from Objects Available (see the following illustration).
- Bottom button -- find next instance/object below the current cursor position.
### Step 3. Do the Scan

#### Objects Available

<table>
<thead>
<tr>
<th>Object Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Go-to-Time:</td>
<td>Use the slider to display the ECG at a particular time.</td>
</tr>
<tr>
<td>Browse Diary:</td>
<td>Display the next or previous diary event.</td>
</tr>
<tr>
<td>Browse PVC:</td>
<td>After selecting this option, click the down arrow to jump to the next PVC (Couplet, Late, or VRun) or the up arrow to go to the previous one.</td>
</tr>
<tr>
<td>Browse PAC:</td>
<td>After selecting this option, click the down arrow to jump to the next PAC (Couplet, Atrial late, or Atrial dropped) or the up arrow to go to the previous one.</td>
</tr>
</tbody>
</table>
Step 3. Do the Scan

A. Determine the Scan Mode

Click the Mode box on the upper left of the screen (below the toolbar) to select the Scan mode.

The modes are:

- Page -- you view the ECG one page at a time. The system stops at pre-set Auto Stops.
- QuickScan -- the system analyzes in combination, using Prospective and Retrospective scanning modes.
- Retro -- analyses the ECG automatically, with no operator intervention (does not stop at Auto Stops). Depending on the model of the scanner (see the Note), you can stop the scanning process by clicking the mouse or pressing any key on the keyboard.
- SI -- superimposes (overlays) individual beats with additional beats to form an image, and stops at each pre-set Auto Stop.

NOTE

Page, QuickScan, and SI are prospective modes, and allow intervention. Retro mode does not allow intervention, unless you manually stop the scanning process and return to a Scanning screen or Diagnostic window. Optimally, you can use Page for the first hour of patient data, then switch to QuickScan or Retro. This approach reduces the amount of time you have to spend editing. Model 1810, Retro only, scans in Page mode for the first 30 minutes (during which the scan stops at Auto Stops), then automatically goes into Retro mode to the end of the scan, allowing no further editing during the analysis. Auto Stops can be turned off for Page, QuickScan, and Superimposition modes.

For a summary of the procedure for each scanning mode, see "Summary of How to Use Scanning Modes" on page 2-29.
B. Start the Scan

Click the Time box at the center top of the ECG, the Go icon, or press the space bar to start the scan. The ECG scans until the first pre-set Auto Stop (see the explanation below) unless you are in Retro mode.

Auto Stops

The Auto Stops dialog box lists all arrhythmia categories identified by Holter. Other categories include: unqualified beats, Artifact beats, ST Episodes, Min/Max Heart Rates, and Pacemaker failures.

Setting up the scan to automatically stop on any or all of these categories allows the user to verify, correct, or document the arrhythmias as they are seen by Holter. All pre-set Auto Stops can be removed at any time throughout the scan.

The Auto Stops dialog box can be accessed by clicking the Stops icon. Click to add a check mark in any box corresponding to the arrhythmia on which you want to stop. Once you are confident that the arrhythmia call is correct and you have documented the appropriate number of strips, you can click on the Stops icon and remove the check mark for that arrhythmia.

Holter Auto Stops defaults:

Atrial: Drop

Ventricular: Couple, Triplet, VRun-All

Other: New Class, ‘n’ & ‘v’ beats-Pre
Auto Stop Toolbar
The Auto Stop toolbar provides the user with the capability to: verify, correct, or document an event and then automatically continues to scan.

NOTE
Auto Stop icons vary by type and position, either depending on beat classification or relative to the beat or event in question.

When the first Auto Stop is reached, the Auto Stop toolbar appears.

- The Go icon allows you to continue scanning.
- The Doc icon allows you to document a strip.
- The Count and Learn icons allow you to reclassify beats.
- The Prev icon allows you to go back to the previous Auto Stop to view, change, or document that strip.

To progress to the next Auto Stop, click one of the icons in the Auto Stop toolbar. Holter will perform the designated action and continue scanning.

Pick-A-Beat Icons
During the analysis, each beat or complex is assigned a class label. You can change the class label of either an individual beat or the entire group of beats within a class template.

There are three groups of Pick-A-Beat edit icons you can use to change beat or class labels:

- Diagnostic Pick-A-Beat toolbar -- see the following paragraph.
- Class Edit Pick-A-Beat toolbar -- see page 2-21.
- Advanced Pick-A-Beat toolbar -- see page 5-11.
**Diagnostic Pick-A-Beat Toolbar**

These icons are found in the toolbar of the Diagnostic screen. To change the label for an individual beat, use the following steps:

1. In the Diagnostic screen, click a Pick-A-Beat icon.
2. Click on the beat you want to change.

The color of the beat and the beat annotation will change appropriately. If there are any multiple beats that are mislabeled, editing the class may be appropriate (see 2-18).

The Diagnostic Pick-A-Beat toolbar and Scanning toolbar are shown and described in the following illustrations and tables. You should become familiar with them so that you can easily use them while scanning and editing.

<table>
<thead>
<tr>
<th>Icon Label</th>
<th>Tooltip</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caliper</td>
<td>DescCreation</td>
<td>Insert a new caliper into the Diagnostic window – available only when the Diagnostic window is visible. See &quot;Adding Calipers to Strips&quot; on page 5-39 and &quot;Creating and Configuring Calipers&quot; on page 10-11.</td>
</tr>
<tr>
<td>R-R Change</td>
<td>DescIgnore</td>
<td>Toggles between making the R-to-R interval (the space between beats) valid or invalid. When an interval is invalid, it is not counted in summaries and measurements. When an interval is valid, its length is counted in various measurements such as longest R-R intervals. When scanning, an invalid interval can be recognized by a dash (&quot;-&quot;) between beats.</td>
</tr>
<tr>
<td>Change *</td>
<td>DescNoise</td>
<td>Relabels a beat as noise. As noise, the beat and the interval created by the noised beat are not counted in HRV summaries. Thus a long R-R interval cannot be created by noising a beat. Since the noise beat is a toggle, you can reverse noise (beat label = &quot;*&quot;) back to beat, by just picking it again.</td>
</tr>
<tr>
<td>Count Normal</td>
<td>DescNormal</td>
<td>Operates on a single beat. The beat that is selected is counted as Normal. This type of Pick-A-Beat is typically used to correct a one-time mistake. Use for Normals with artifact. Use for Ventriculars with artifact.</td>
</tr>
<tr>
<td>Count Ventricular</td>
<td>DescVentricular</td>
<td>Operates on a single beat. The beat that is selected is counted as Ventricular. This type of Pick-A-Beat is typically used to correct a one-time mistake.</td>
</tr>
</tbody>
</table>
### Step 3. Do the Scan

<table>
<thead>
<tr>
<th>Icon Label</th>
<th>Tooltip</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Count</td>
<td>Count Beat Artifact</td>
<td>Operates on a single beat. The beat that is selected is counted as Artifact. This type of Pick-A-Beat is typically used to correct a one-time mistake.</td>
</tr>
<tr>
<td>Learn</td>
<td>Learn Normal</td>
<td>Creates a new Class Edit template for a new Normal class. In the future, as other beats are encountered with the same shape, they are grouped into this new Learned Class Edit template. <strong>Note:</strong> Until three instances of this beat are encountered, it is called &quot;unqualified&quot; and annotated in the Diagnostic window with a lower-case letter. Lowercase &quot;n&quot; appears above prospective Normal beats. When the third instance of the beat is found, it becomes a new class. Use for Normals with artifact. Use for Ventriculars with artifact.</td>
</tr>
<tr>
<td>Learn</td>
<td>Learn Ventricular</td>
<td>Creates a new class edit template for a new Ventricular class. In the future, as other beats are encountered with the same shape, they are grouped into the new template. <strong>Note:</strong> Until three instances of this beat are encountered, it is called &quot;unqualified&quot; and annotated in the Diagnostic window with a lower-case letter. Lowercase &quot;v&quot; appears above prospective Ventricular beats.</td>
</tr>
<tr>
<td>Learn</td>
<td>Learn Artifact</td>
<td>Creates a new class edit template for an Artifact class. In the future, as other beats are encountered with the same shape, they are grouped into this new Learned class edit template. <strong>Note:</strong> This is helpful to pull out artifact labeled as beats (such as a T wave labeled as Normal).</td>
</tr>
<tr>
<td>Relearn</td>
<td>Relearn Normal</td>
<td>Discards all analysis and sets a new Primary Normal class to the selected beat. All analysis then begins with the selected beat. Use this feature when the scanner has picked an inappropriate beat for its Primary Normal. The condition can occur when the beginning of the scan contains calibration pulses or when the beginning of the record contains noisy ECG that later improves. When you choose Relearn Normal, be aware that all analysis to the current point is discarded (nothing is reanalyzed).</td>
</tr>
<tr>
<td>Detail</td>
<td>Beat detail</td>
<td>See &quot;Beat Detail Editing&quot; on page 5-5.</td>
</tr>
<tr>
<td>12 Lead</td>
<td>Twelve Lead</td>
<td>Toggle switch to view the ECG in 12-lead mode in the Diagnostic window.</td>
</tr>
</tbody>
</table>
Step 3. Do the Scan

Scanning Toolbar

<table>
<thead>
<tr>
<th>Icon Label</th>
<th>Tooltip</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Go</td>
<td>Go</td>
<td>Starts the scanning process.</td>
</tr>
<tr>
<td>View</td>
<td>View</td>
<td>Allows viewing of selected ECG in Diagnostic window.</td>
</tr>
<tr>
<td>Doc</td>
<td>Document Strip</td>
<td>Toggles between documenting and deleting a strip. Strips can be viewed via</td>
</tr>
<tr>
<td></td>
<td></td>
<td>the Strips icon and included in the Report.</td>
</tr>
<tr>
<td>Erase</td>
<td>Erase Area</td>
<td>Used in Page mode to &quot;noise out&quot; (substitute &quot;***&quot; for beat labels) in the</td>
</tr>
<tr>
<td></td>
<td></td>
<td>selected area. Excludes a selected area from being reported.</td>
</tr>
<tr>
<td>UnErase</td>
<td>Unerase Area</td>
<td>Allows you to quickly recover an area of ECG that you have mistakenly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>erased.</td>
</tr>
<tr>
<td>Redo A.</td>
<td>Redo Analysis</td>
<td>Reanalyzes the selected area of the scanned ECG based on a new Rule setting.</td>
</tr>
<tr>
<td></td>
<td>Area</td>
<td>See &quot;Using the Redo Analysis Area Icon&quot; on page 2-15 for detailed instructions on using this icon.</td>
</tr>
<tr>
<td>Redo L.</td>
<td>Redo Last</td>
<td>Reanalyzes the ECG from the end of the scan back a selected number of</td>
</tr>
<tr>
<td></td>
<td>Analysis</td>
<td>minutes. See &quot;Using the Redo Last Icon&quot; on page 2-16 for detailed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>instructions on using this icon.</td>
</tr>
<tr>
<td>Alt View</td>
<td>Alternative View</td>
<td>Toggles between Page size (larger or smaller) than the current Page size in</td>
</tr>
<tr>
<td></td>
<td></td>
<td>the Scan window.</td>
</tr>
<tr>
<td>Speed</td>
<td>Scanning Speed</td>
<td>Controls the length of time the user can view the ECG in the Page mode or</td>
</tr>
<tr>
<td></td>
<td></td>
<td>in Superimposition. The higher the setting, the shorter amount of time the</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ECG is viewed.</td>
</tr>
<tr>
<td>Stops</td>
<td>Set Auto Stops</td>
<td>Sets the scanner to automatically stop on each instance of a chosen event</td>
</tr>
<tr>
<td></td>
<td></td>
<td>that you set in the Auto Stops dialog box.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tip: You can quickly clear all Auto Stops by clicking Select All twice.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The first click selects all items; the second de-selects (clears) all of</td>
</tr>
<tr>
<td></td>
<td></td>
<td>them.</td>
</tr>
<tr>
<td>Time</td>
<td>Go to Time</td>
<td>Allows you to display scanned data from a specific time on a selected day</td>
</tr>
<tr>
<td></td>
<td></td>
<td>of the Report (default is one day). In the Go to Time dialog box, you</td>
</tr>
<tr>
<td></td>
<td></td>
<td>select the starting time or day using the arrows in the list box or by</td>
</tr>
<tr>
<td></td>
<td></td>
<td>moving the slider. The dialog box is useful for moving around in the</td>
</tr>
<tr>
<td></td>
<td></td>
<td>scanned file.</td>
</tr>
<tr>
<td>Select</td>
<td>Event Review</td>
<td>Toggles to the Event Review dialog box.</td>
</tr>
</tbody>
</table>

Using the Redo Analysis Area Icon

1. From the Scan screen, click the Redo Analysis Area icon.
2. In the Page window, click and drag the mouse highlighting area of the ECG to be effected by the new Rules change.
Step 3. Do the Scan

3. The Rules dialog box will appear in the middle of the screen.

4. Make the desired Rules changes and Apply Setting to the Selected Area. (See "Applying Rules Settings" on page 3-4.)

Using the Redo Last Icon

1. Make the desired Rules changes and Apply Setting to the Selected Area.

2. Click OK to close the dialog box.

3. From the Scan screen, click the Redo Last icon.

4. The Redo Last dialog box appears.

5. Select the number of previous minutes for rescanning. You can use Redo Last, for example, if 16 minutes into the file, you discover a noisy channel you want to exclude and are not sure how much previous analysis is affected. Redo Last allows you to rescan the 16 minutes up to the current point, after excluding the noisy channel.

| NOTE | The most recent Rules setting used supersedes previous Rules settings in a given area. |
Editing Beats through Class Edit

Each class template is a group of like-shaped and labeled morphologies called beats. These beats have been grouped by the algorithm or labeled by the operator as a class (for example, Normal or Ventricular). The purpose of editing beats is to correct or change class labels and to combine classes with like morphologies.

Class Edit Screen

The Class Edit screen (shown on page 2-18) has two windows. The upper window is the Work area, and the lower window is the Class Template window, which contains pictures of class template(s). A class template is a representative picture of what the algorithm automatically or what the operator has determined to be like-shaped beats and then grouped together.

Each template, viewed in the bottom window, has a name that identifies the beat label -- for example, Normal (“N”) or Ventricular (“V”). The label is found over each beat throughout the scan, based on the Display Annotation setup. See "Class Templates Available in Class Edit Screen" on page 2-19.

Each template is represented in the Morphology Section of the Report. Therefore, it is important to edit beats and class templates not only so that they are accurately labeled, but also so that the groups are uncontaminated and free from questionable beats or artifact. Combine templates so that there are as few templates left in the window as possible prior to saving the Report.

To help the scanner reduce the number of false-positive beat labels or class templates, there are a number of techniques:

- Verify Class Edit for incorrectly labeled beats.
- Verify class templates through the Beat Detail icon for questionable classes that could have cross contaminated the class template. See "Beat Detail Editing" on page 5-5.

Use the icons on the Class Edit screen to:

- Correct (Reclassify) a beat, which changes the name of a class template and label.
- Combine class templates, which reduces the number of Report Morphology templates.
- Split templates- reverse the action of combining class templates.

(See "Pick-A-Beat Icons" on page 2-12 for more details.)
Step 3. Do the Scan

**Class Edit Screen, with Class Type and Beat Count Box.**

From this window, you can:

1. Use Class Edit Pick-A-Beat icons to:
   - Reclassify, correct, or customize beat labels.
   - View in detail all beats grouped into a given class template.
   - Erase artifact from morphology.
   - Combine like beats, to reduce morphology templates, and Split (Reverse) any previous combining of templates.

2. Determine the number of beats in a given class by:
   - Hovering the mouse over the beat to display the Class Type and Beat Count box.
   - or
Step 3. Do the Scan

- Clicking on the beat to display the template with its label and count in the Work area.

3. Click the Detail icon to view all beats within a given template.

4. Edit multiple beats at one time using Advanced options (see "Advanced Pick-A-Beat Editing Icons" on page 5-11).

Class Templates Available in Class Edit Screen

All class templates, including their label and count, are transferred to the Morphology section of report. The classes available in Class Edit are described in this section.

NOTE

All beat morphologies displayed inside the Class Edit screen, bottom window, are representative of like beats grouped together.

Primary Normal

The algorithm identifies the Primary Normal class by its shape and determines it to be the most common Normal complex with the highest count.

There is restrictive editing with this class of beats: the Reclassify editing buttons are grayed out. The only action you can take is to Exchange the Primary Normal class template with another giving you a cleaner Normal representative for the final report.

To do this:

1. Click the Normal class template that you want to use as your Primary Normal.

2. Click the Exchange Normal icon. This action converts the two templates: the template that had been Primary Normal becomes Normal, and the template that had been Normal is exchanged and becomes the Primary Normal.

NOTE

The following class templates are less restrictive than Primary Normal, and you can perform all the Edit functions on them.

Normal

The Normal class of beats is identified by its shape. Click the image to display the total count of this type of beat. You can use the Exchange Normal function to select a new Primary Normal class.
Alternate Normal

Alternate Normal beats are Atrial beats from a different focus than the Normal class. For example, the beat could be Bundle Branch Block with a different conduction, or it could be paced.

Use the Label Alternate Normal dialog box (only available to Reclassify as Alternate Normal icon) to create a special class label.

1. Click a complex in the Class Template (bottom) window -- it will jump to the Work area.

2. Click the Reclassify as Alternate Normal icon.

3. In the Label Alternate Normal dialog box, either:
   - Type a custom label, and click OK.
   - Highlight the label you want from the default labels, and click OK.

Result: The class template has a custom label with the count, appears in an alternate color in Scan, and transfers data to Report, Morphology Section.

Examples of Alternate Normals are:

- Aberrant
- Alternate Normal
- BBB: Bundle Branch Block
- FLB: Funny Looking Beat
- Fusion
- Junctional
- LBBB: Left Bundle Branch Block
- Nodal
- RBBB: Right Bundle Branch Block
- Atrial Fibrillation
- Ischemic
**Ventricular**

Ventricular ectopic beats include all Ventricular foci. The total counts for all Ventricular classes are transferred to the Report. Use the Ventricular options on the Correct to Ventricular icon to reclassify classes to fusion or Ventricular.

**Artifact**

The algorithm identifies an unrecognizable area/beat (of unknown morphology) as “Artifact.”

You can edit this class by choosing one of the following:

- Reclassify to a beat label.
- Combine it with another class.
- Combine Artifact and Correct to Not a Beat.
- Delete it by using Correct to Not a Beat.

**NOTE**

You are not limited to editing classes retrospectively from the Class Edit screen. During a prospective scan, you can edit multiple beats at one time. This can be done in Class Edit or with Advanced options (see "Advanced Pick-A-Beat Editing Icons" on page 5-11).

**NOTE**

From the Class Edit screen, click Detail, then Diag; click on any beat and use any available Pick-A-Beat icon listed in the next section to change a class.

**Class Edit Pick-A-Beat Toolbar**

Class Edit icons are found at the bottom of the Class Edit screen. They are listed in the following table:

<table>
<thead>
<tr>
<th>Icon</th>
<th>Tool Tip for Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Reclassify to Normal" /></td>
<td>Reclassify to Normal</td>
<td>Reclassify as Normal beat, unpaced normal, single paced normal, dual paced normal, single paced normal with fusion, or dual paced normal with fusion.</td>
</tr>
<tr>
<td><img src="image" alt="Reclassify to Alternate Normal" /></td>
<td>Reclassify to Alternate Normal</td>
<td>Reclassify as Alternate Normal, with option to add new types and comments.</td>
</tr>
<tr>
<td><img src="image" alt="Reclassify to Ventricular" /></td>
<td>Reclassify to Ventricular</td>
<td>Reclassify as Ventricular or fusion.</td>
</tr>
<tr>
<td><img src="image" alt="Reclassify to Artifact" /></td>
<td>Reclassify to Artifact</td>
<td>Changes to Artifact beats.</td>
</tr>
</tbody>
</table>
### Step 3. Do the Scan

#### NOTE

The Show and Hide classes feature provides a simple way for the user to see all classes that have the same shape. After all the classes of that shape have been viewed, the user may decide to combine all the classes into one class.

<table>
<thead>
<tr>
<th>Icon</th>
<th>Tool Tip for Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Correct" /></td>
<td>Not a Beat</td>
<td>Deletes the area from Total Count. <strong>Note:</strong> A Warning Dialog box is displayed to inform you that your operation cannot be reversed. You can disable the Warning.</td>
</tr>
<tr>
<td><img src="image" alt="Correct" /></td>
<td>Erase to Normal</td>
<td>Deletes the count from the source and adds to the Total (Normal beat) Count. <strong>Note:</strong> A Warning Dialog box is displayed to inform you that your operation cannot be reversed. You can disable the Warning.</td>
</tr>
<tr>
<td><img src="image" alt="Combine" /></td>
<td>Combine</td>
<td>Groups together like complexes. See &quot;Class Edit: Combine Classes&quot; on page 2-23.</td>
</tr>
<tr>
<td><img src="image" alt="Split" /></td>
<td>Split</td>
<td>Reverses action of a Combine class, separates merges.</td>
</tr>
<tr>
<td><img src="image" alt="Exch. N." /></td>
<td>Exchange Normal</td>
<td>Exchanges a selected Normal class with the Primary Normal class.</td>
</tr>
<tr>
<td><img src="image" alt="Detail" /></td>
<td>Detail</td>
<td>Verifies individual beats within a class.</td>
</tr>
<tr>
<td><img src="image" alt="Show" /></td>
<td>Show or Hide Normal Classes</td>
<td>Show or hide all Normal classes.</td>
</tr>
<tr>
<td><img src="image" alt="Show" /></td>
<td>Show or Hide Alt. Normal Classes</td>
<td>Show or hide all Alternate Normal classes.</td>
</tr>
<tr>
<td><img src="image" alt="Show" /></td>
<td>Show or Hide Ventricular Classes</td>
<td>Show or hide all Ventricular classes.</td>
</tr>
<tr>
<td><img src="image" alt="Show" /></td>
<td>Show or Hide Artifact Classes</td>
<td>Show or hide all Artifact classes.</td>
</tr>
</tbody>
</table>

### Using the Class Edit Pick-A-Beat Toolbar

This section describes how to use the Class Edit icons described in the preceding table.

To begin, click the Class icon on the Main toolbar to jump to the Class Edit screen, then click a class of beats (template) in the Class Template (lower) window of the Class Edit screen to change an entire class template.
**Irreversible Class Edit Options**
Select whether or not you want to be warned, while editing, about an edit that cannot be undone. If the option is set, what you are about to perform is irreversible. (Irreversible, in this context, means that you would have to run the scan again in order to undo the editing operation that you are about to perform.)

**Class Edit: Correct**
There are six types of Correct icons: Normal, Alternate Normal, Ventricular, Artifact, Not a Beat, and Erase to Normal. Use the Correct (Reclassify) icons on the Class Edit screen to Reclassify a type of heartbeat as one of the options available in the editing menu.

For example, with Class Edit, you can change a class from Normal to Aberrant (selected from the Alternate Normal dialog box). To do this:

- Click a Normal beat, then select the Correct operation (in this case, Reclassify to Alternate Normal).
- Then, in the Alternate Normal dialog box, select Aberrant.

**Class Edit: Combine Classes**
Use the Combine icon to combine similar types of complexes, after two or more classes are selected (this is illustrated in the Class Edit screen on page 2-18). If you have selected only one class to edit, this option is grayed out (not available).

**Class Edit: Split a Class**
Use the Split icon to reverse the action that has combined two or more classes, separating beats that have been merged into one class.

**NOTE**
If you combine two different classes and then reverse, or split, the action the Holter scanner does not attempt to change the labels back. For example, if you combine Artifact and Normal classes, after the split, Artifact is still labeled Normal until you change it. You can change the class type by choosing the appropriate Class Edit: Correct option.
**Class Edit: Exchange Normal**

Use this icon to define the currently selected Normal class as the Primary Normal class. This allows the user to select a template that is free of artifact to represent the Normal shape. To use Exchange Normal, choose a Normal class, then click the Exch. N icon.

**NOTE**

If you have combined another class into Primary Normal (see "Primary Normal" on page 2-19), you may want to separate out, or split, the combined classes by using the Split icon function prior to Exchanging a Primary Normal for another class.

**Class Edit: Detail**

This icon allows the user to view all the beats in any class. When viewing all the shapes in a class, the user can reclassify a beat.

To use this feature, click on a class, then click the Detail icon. The upper half of the screen shows the beat in context with the surrounding beats; the lower half shows each beat one at a time. To reclassify a beat, select the appropriate icon in the Pick-A-Beat toolbar, then click on the beat in the Diag. window.

**Class Edit: Show (Show or Hide) Classes**

Use the four Show icons at the bottom of the Class Edit screen to display specific classes. To display or hide a class, click the appropriate icon.

**NOTE**

You can use this icon to reduce the number of templates viewed while combining morphologies. For example, you can hide all but Ventricular classes, then hide all but Normal, and so on.
C. Make Adjustments

Holter allows the user to make adjustments to the analysis and scan style as the scan progresses. The items you can adjust are:

- Rules -- the Rules dialog box allows the user to select any rule that affects arrhythmia analysis, ST analysis and Morphology analysis. See Chapter 3, "Using the Rules Feature" for details.

- ECG Display -- the ECG Display Options dialog box allows for different views of the ECG, choices in beat annotation function, and size of the scan page. See Chapter 10, "Configuring the Scanner" for details.

- Auto Stops (except Retro mode) -- all selected stops can be turned off/on at any time throughout the scan by clicking on the Auto Stop icon to access the Auto Stop dialog box and removing/adding checks in the appropriate boxes.

Step 4. Edit the Scan

You can utilize the editing functions at any time during or after the scan. Editing that you do during the scan usually reduces the amount of total editing time.

See Chapter 5, "Editing the Scan" for instructions.
Step 5. Set up the Report, Save, and Print

To complete the scanning process, set up the Report, save it, and then print it.

1. You can customize the Report. For example, you can choose different formats and include specific sections. See Chapter 5, "Editing the Scan" for information.

2. Use the File menu to save the Holter Report in one of two formats:
   - .zhr Format -- Report data from raw ECG or fully analyzed ECG are saved. Click the Save icon in the Main toolbar.
   - .zpt Format -- Report data and Strips are saved. Click the File menu and click Save Report.

3. Print the Report.
   - Click the Print icon in the Main toolbar.

NOTE
See Chapter 6, "Setting Up and Printing Reports" for printing instructions. See Appendix A, "Exporting the Scan", for instructions to transfer the Report.

Accessing an Archived/Saved Holter Report

There are two ways to access Reports.

- Click the Open icon in the Main toolbar. Click the name of the Report. Click Open in the dialog box.
  or
- Click the File menu, then click Open Report. Click the name of the Report. Click Open in the dialog box

After the Report has been opened, you can review the data and/or print any section of the Report.
NOTE

All Philips Information Center (PIC) files are stored in the subdirectory named “C:\PIC\”. PIC files have one of the following file extensions: .rfe (EASI format) or .rfv (conventional PIC format). You must use the New icon (or function) to process a PIC file.

If this is a file that you have partially scanned, the system remembers where you stopped, and continues from where you left off. If the scan was completed and saved, the system goes to the end of the file.
Quick Tips

The following table describes functions you can change within Holter. Follow the How To Do It procedure on the page referenced in the table below for help with the feature.

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<th>How To Do It</th>
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</tr>
</tbody>
</table>
Summary of How to Use Scanning Modes

Philips Zymed Holter gives you four methods to scan Holter records:

- Paging (interactive)
- QuickScan (a combination of interactive and automatic)
- Retro (automatic)
- Superimposition (interactive)

This section summarizes the procedural steps for each method.

NOTE

You can begin the scan in one mode (e.g., Paging or QuickScan) for the first 1 hour of patient data, and then switch to another mode as appropriate (e.g., QuickScan or Retro). This approach reduces the amount of time required in editing.

Paging (Page Mode)

Page mode gives constant feedback on the performance of the arrhythmia algorithm, with complexes identified by labels and color highlighting.

Paging: Starting the Analysis

1. Select New.

2. In the New Patient - Recorder Format dialog box, select a recorder format for the ECG data you want to analyze, 2- or 3-channel, EASI hookup, and pacemaker and click Next. (The recorder format will determine if Cassette Control dialog box is next. For cassette tape, refer to page 9-6 for Calibration prior to doing step #3.)

3. In the New Patient - Demographics dialog box, enter patient demographics and click Next.

4. In the New Patient - Diary dialog box, enter any patient diary entries and click Next.

5. In the Scan Setup dialog box select the scanning format (most recordings can be analyzed using the Standard setting.). (Optional) activate ST and QT analysis if appropriate.

6. Click Finish to go to the patient’s ECG.

Paging: Performing the Analysis

1. Select the Page mode in the upper left corner of the screen.

2. Check the processing speed (icon/menu item) and adjust, as appropriate to the user’s difficulty of viewing the recording.
**NOTE**

The speed adjustment is for viewing speed, not the algorithm’s speed of analysis or processing.

3. Choose appropriate Auto Stops (Stops icon/menu item), with the following suggested default values:
   - In the Atrial column, choose Drop.
   - In the Ventricular column, choose Couple, Triplet, and V-Run-All.
   - In the Other column, choose New Class, ‘n’ & ‘v’ beats-Pre.

4. Select OK to close the Auto Stops dialog box and start the analysis process.

**NOTE**

Options to Restart or Stop scanning:
- to Restart analysis, click the Go icon, or press the Enter key or space bar on the keyboard.
- to Stop the scanner, press the spacebar or click anywhere on the ECG.

5. Take diagnostic strips for the final Report by clicking the Doc (document) icon and then clicking on the area of ECG to save.

6. View selected or stored strips by clicking the Strips icon.

7. Convert any EASI ECG strip to 12-lead format, as appropriate, while under the Strips icon (to Save for Report) or in the Diagnostic window (to view only).

8. Relabel shapes, as appropriate.

9. Turn off Auto Stops, as appropriate.

**Paging: Editing Your Analysis**

When you have completed an analysis, you can edit the data and the Report. See Chapter 5, "Editing the Scan".

**QuickScan Mode**

QuickScan allows the user to rapidly analyze ECG data, in a retrospective mode while stopping on pre-set Auto Stops. Holter will stop on all Auto Stop settings in the default or any settings made at the beginning of the scan. Using Auto Stops in a retrospective mode, allows the user to validate, correct, and document important events, allowing the algorithm to quickly scan through the normal ECG in between.

In this method, you should begin the analysis in the either Page or QuickScan mode to get a sense of the patient’s rhythm and arrhythmias. Then, after approximately one hour of viewing the patient data, switch to Retro mode for the remaining ECG analysis.
QuickScan: Starting the Analysis
1. Select New on the File menu and perform the normal start-up sequence (see "Paging: Starting the Analysis" on page 2-29).
2. Click Finish to go to the patient’s ECG.

QuickScan: Performing the Analysis
1. Select the QuickScan mode in the upper left corner of the screen to start the analysis.
2. Choose appropriate Auto Stops (Stops icon/menu item), with the following suggested default values:
   - In the Atrial column, choose Drop.
   - In the Ventricular column, choose Couplet, Triplet, and V-Run-All.
   - In the Other column, choose New Class, ’n’ & ’v’ beats-Pre.
3. Select OK to close the Auto Stops dialog box and start the analysis process.
4. Take diagnostic strips by selecting Doc (document) and clicking the area of ECG to save.
5. (Optional) View strips in real time by clicking the Strips icon.
6. Convert any EASI ECG strip to 12-lead format, as appropriate.
7. Relabel shapes, as appropriate.
8. Turn off Auto Stops, as appropriate or switch to Retro mode.
**Retro Mode**

This scanning method is completely automatic. It is appropriate for patients who have relatively normal ECGs and artifact-free recordings.

**Retro: Starting the Analysis**

1. Select New on the File menu and perform the normal start-up sequence. (see "Paging: Starting the Analysis" on page 2-29.)

2. Click Finish to go to the patient’s ECG.

**Retro: Performing the Analysis**

1. Select the Retro mode in the upper left corner of the screen.

2. Select Go to start the analysis process.

**Retro: Editing the Analysis**

When you have completed an analysis, you can edit the data and the Report. See Chapter 5, "Editing the Scan".

**Superimposition (SI Mode)**

Superimposition stacks both normal and abnormal QRSs on top of one another, for visual comparisons of the patterns. Superimposition also includes a page display for you to validate arrhythmias easily.

**SI: Starting the Analysis**

1. Select New on the File menu and perform the normal start-up sequence. (see "Paging: Starting the Analysis" on page 2-29.)

2. Click Finish to go to the patient’s ECG.

**SI: Performing the Analysis**

1. Select the SI (Superimposition) mode in the upper left corner of the screen.

2. Check the processing speed (icon/menu item) and adjust, as appropriate to the user’s difficulty of viewing the recording.

   3. Choose appropriate Auto Stops (Stops icon/menu item), with the following suggested default values:

   - In the Atrial column, choose Drop.
   - In the Ventricular column, choose Couplet, Triplet, and V-Run-All.
   - In the Other column, choose New Class, ‘n’ & ‘v’ beats-Pre.

   **NOTE**

   The speed adjustment is for viewing speed, not the algorithm’s speed of analysis or processing.
4. Select OK to close the Auto Stops dialog box and start the analysis process. To restart analysis, click the Go icon, or press the Enter key or the space bar on the keyboard.

5. Relabel shapes and turn off Auto Stops as appropriate.

6. Take diagnostic strips by selecting the Doc (Document) icon and then clicking on ECG in the Page window to save.

7. (Optional) View strips saved for the final Report by clicking on the Strips icon.

8. Convert any EASI ECG strip to 12-lead format, as appropriate, while under the Strips icon (to Save for Report) or in the Diagnostic window (to view only).

**SI: Editing the Analysis**

When you have completed an analysis, you can edit the data and the Report. See Chapter 5, "Editing the Scan".
3 Using the Rules Feature

Overview

Rules are used to change the scanning environment and the effect of how the algorithm labels the beats and events. Under the Rules icon you can change Rules to effect a selected area or the entire scanned area. You can customize a set of rules used to scan data by using a different Named Set of rules (rules and morphology options). You can then add that set to the list of Rule Sets on your system.

This chapter describes how to use the Rules dialog box to perform these actions. See the following sections in this chapter for more information:

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<th>Section</th>
<th>Page</th>
</tr>
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<tbody>
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<td>3-10</td>
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<td>3-13</td>
</tr>
</tbody>
</table>

NOTE

Customized rule sets are features in the Cardiology Suite and the 2010 Holter only.
The Rules Dialog Box

Activate the Rules dialog box (See figure on page 3-5) by clicking the Rules icon.

The Rules dialog box is used for editing the scan globally or in specified areas. Use the Rules dialog box to change the criteria for Atrial, Ventricular, ST Analysis, and Morphology for enhanced arrhythmia detection. You can also adjust the level of noise sensitivity for ECG through the Morphology tab.

WARNING

When you change settings in the Rules dialog box, the outcome of the Report is affected. Changes in noise levels can increase or erase beat counts.

Changing or Setting Up Rules

1. From the Rules dialog box, choose a tab.

2. Adjust the Rules as desired, using the menus or typing in new values.

3. After adjustments have been made:
   a. Determine if you want to Save these changes as a New Rules Set.
   b. Select the area(s) to which the new Rules are to apply from the Apply Setting to: pull-down menu.
   c. Click OK.

Directions for performing these tasks are provided on the following pages.
The Rules Dialog Box

Selecting the Named Rules Set
It is helpful to have a separate Rules Set for individual physician's preferences. After adjusting or setting up the Rules as desired on the appropriate Rules dialog box, click Select Rules Set to access the Rule Sets dialog box.

From the Rule Sets dialog box you can:

- Change to a different existing Rules Set.
- Modify and create a new Rules Set under a new name.
- Delete a Rules Set.

To Change to a Different Rules Set:
1. Highlight the Named Set in the list.
2. Click the Use button to access the Rules dialog box (shown on page 3-5).

To Modify and/or Create a New Rules Set:
1. Set up the rules according to the physician’s preference, using the Atrial, Ventricular, ST, and/or Morphology tabs on the Rules dialog box.
2. On the Rules dialog box, click Select Rules Set.
3. Click Add.
   a. Type in the name of the set.
   b. Click OK.
4. Click the name just entered in the list of Named Sets.
5. Click Use.

To Delete a Rules Set:
1. Highlight a Named Set.
2. Click Delete.
Applying Rules Settings
Rules changes apply only to conditions or areas that you specify.

1. Click the Rules icon. An area in the Page window highlights.
2. Change any setting that you want applied to the scan.
3. Choose from one of five conditions (see the table below) by selecting from the Apply setting to: pull-down menu.
4. Click OK

NOTE
The most recent Rules setting used supersedes previous Rules settings in a given area.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Change</td>
<td>Describes the state of the current rules (for example, Morphology rules) within the rule set. No Change is the default setting.</td>
</tr>
<tr>
<td>Forward</td>
<td>Applies the current (if modified) Atrial, Ventricular, ST, and/or Morphology Rules from the point at which you stopped the scan and to future analysis.</td>
</tr>
<tr>
<td>Selected Area</td>
<td>Applies the current (if modified) Atrial, Ventricular, ST, and/or Morphology Rules to the selected area only; then reverts to previously set rules for the balance of the scan.</td>
</tr>
<tr>
<td>Selected Area &amp; Forward</td>
<td>Applies the current (if modified) Atrial, Ventricular, ST, and/or Morphology Rules to the selected area and to future analysis.</td>
</tr>
<tr>
<td>Everywhere</td>
<td>Applies the current (if modified) Atrial, Ventricular, ST, and/or Morphology Rules to all analyzed ECG.</td>
</tr>
</tbody>
</table>

Applying Rules Changes to Selected Area
Use this option to reanalyze an area you have selected, usually with new Rules settings. You must change rule settings after clicking the Redo icon.

1. Click the Redo Area icon.
2. In the Page window, highlight the area to which you want to apply the Rules.
3. When the Rules dialog box appears, make the Rules adjustments.
4. Choose Selected Area in the Apply Setting to: pull-down menu.
5. Click OK.
Atrial Rules

You can change the Holter scanner’s sensitivity to Atrial events any time during the analysis for proper detection. Use the Atrial Rules dialog box to customize the sensitivity of the scanner, within the ranges allowed on the dialog box.

NOTE

The default values shown in the dialog box have been pre-set at the factory.

Premature

The Atrial prematurity rule defines the degree of prematurity required for a supraventricular beat to qualify as a PAC. Percentage values are measured relative to preceding normal rhythm. If 25% (system default) is the selected criteria, a beat must occur 25% earlier than the preceding, regular R-R intervals to qualify as a PAC. A beat is premature only if it is early in relation to the preceding beats/rhythm. If the system overcalls PACs, slightly increase the percentage. If PACs are not detected, slightly decrease the percentage. Marked sinus arrhythmia may cause the detection of false PACs (overcalling). If this occurs, you have the option of increasing the percentage in small increments to achieve the desired results.

Late

The Late beat rule sets the threshold for how late a beat must be to qualify as late. If 50% is selected, all beats that occur 50% later than the previous R-R intervals are detected as Late beats. Decreasing this percentage value increases the number of detected late beats, and selecting Off will disable late beat detection.

To detect more late beats, decrease the percentage. With marked sinus arrhythmia you might want to turn off late beat detection.
**Drop**
The Drop beat rule determines the threshold of how late a beat is before it is classified as a Drop (pause). The criteria is determined in seconds or as a percentage and is measured relative to the preceding, normal rhythm. If the R-R intervals of a sustained, regular rhythm are equal to or greater than the selected Drop criteria, a drop beat will be detected. If drop beat detection is desired for very slow, regular rhythms, 100% should be selected from the Rules icon, Atrial tab, pull-down menu.

**Min. Atrial Run Rate**
Min. Atrial Run Rate helps qualify all Atrial runs.
In order to qualify as an Atrial Run, the run must meet three (3) criteria. The criteria for an Atrial Run are as follows:

- Three (3) beats or more that are premature.
- The first three (3) beats must meet the criteria for prematurity in Atrial rules.
- Three (3) beats or more must meet the criteria for min Atrial Run Rate.

Adjusting the Min. Atrial Run Rate criteria helps eliminate false Atrial runs due to Sinus Arrhythmia.
To increase or decrease the minimum Atrial Run Rate, click the Rules icon and select a heart rate (range 60-160 BPM) or enter a heart rate.

**Max. Bradycardia Rate**
Max. Bradycardia rate sets the heart rate that is considered to be Bradycardia.
To increase or decrease the criteria for Max. Bradycardia, click the Rules icon and select a heart rate (range from 30 BPM-99 BPM, OFF) or enter a heart rate.

**Min. Tachycardia Rate**
Min. Tachycardia rate sets the heart rate that is considered to be Tachycardia.
To increase or decrease the criteria for Min. Tachycardia, click the Rules icon and select a heart rate (range from 100 BPM-240 BPM, OFF) or type in a heart rate.

**AFib Variability/AFib Duration/Recovery**
Holter detects AFib as a variation from R-R interval and the number of beats it lasts. The Holter algorithm requires that two (2) criteria be met in order to call AFib. The criteria for AFib are as follows:

**AFib Variability**: The percent of variation from R-R.
**AFib Duration and Recovery**: The number of beats that the variation must last before AFib is called. Also, the number of beats at the end of an episode where the beats do not vary.
R-R intervals must vary according to the criteria for AFib variability. To increase or decrease the variability criteria, click on the Rules icon and select a percent of variation.

**NOTE**
Holter is looking at R-R intervals, to see if they vary in length from beat to beat.

The lower the percentage, the more sensitive Holter is to AFib. The higher the percentage, the less sensitive Holter is to AFib. To change the amount of variation, click on the Rules icon and select a percent (range from 5%-65%, ALL, OFF) or type in a number for percent.

Once the percent of variation is met, it must be sustained for a certain number of beats. To change the number of beats that the variation has to be sustained, click on the Rules icon and select a setting (range from 5-30 beats) or type in a number for beats.

**NOTE**
When the system detects Atrial fibrillation, Normal beats in the Scanning/Diagnostic screen are labeled “F” for Atrial fibrillation.

**Atrial Bi/Tri Cycles**
The system default is 2 consecutive cycles. To detect Atrial bigeminal or trigeminal episodes, select the number of cycles to define an episode. A cycle of bigeminy is a PAC-normal-PAC-normal; trigeminy is a PAC-Normal-normal-PAC.

To change the Atrial bigeminy or trigeminy criteria, click on the Rules icon and select a setting for Atrial Bi/Tri Cycles (range from 1-9, OFF) or type in a number.
Ventricular Rules

Ventricular Premature
The default is 15%. The system counts an abnormal beat as a PVC if the beat is 10 to 40% early in relation to the preceding beats, depending upon the threshold setting. If the abnormal does not meet this prematurity value, it is counted as a VE (Ventricular ectopic).

To select another prematurity value, click the box and choose a default percent or enter a value. When you select a lower percent, more PVCs are counted; the higher the percent, the more abnormals are counted as VEs.

Ventricular Late
A Ventricular late beat is an abnormal beat that occurs later than the preceding R-to-R interval. To change the percent, click on the Rules icon and select a number of percent (range from 1-67%, OFF) or type in a number.

R on T
R on T is a very early PVC that occurs around the apex of the preceding T wave. If the PVC meets the predetermined rate, it is counted as an R on T. The default is Rate.

The range of values is:
- Off
- Rate - considers a beat to be R on T if the interval of the beat is less than 0.4 times the square root of the expected interval
- 40 to 50% - the percentages are measured relative to the preceding normal rhythm
- 200 to 400 ms early

To change the value, click on the Rules icon and select a different setting or type in a value. The Rate formula cannot be changed.

**Couplets**

The Ventricular Couplet rule specifies the number of abnormal shapes within the couplet that must be premature in order for the couplet to be counted. The default is ALL.

- **ALL** indicates that any two consecutive VE shapes are counted as couplets regardless of coupling interval.
- **EITHER** indicates that one beat in the abnormal pair (either the first or second shape) must be premature for a couplet to be counted.
- **BOTH** indicates that two beats (both shapes) must be premature for a couplet to be counted.

**Enable Triplets**

Ventricular triplets are called when the rule is enabled. When the rule is disabled, all 3-beat runs or greater will be called Vruns.

**Ventric. Bi/Tri Cycles**

Ventricular bigeminy and trigeminy are repetitious patterns of normal and abnormal beats. For the system to detect these patterns, you need to determine the number of cycles defining an episode. One bigeminal cycle consists of a PVC-normal-PVC; trigeminy is PVC-normal-normal-PVC. For physicians who do not want interpolated PVCs counted in episodes of bigeminy or trigeminy, select “No I”.

The default is 2. The range of acceptable values is:

- **Off**: Bi/Tri episodes not counted
- **1-9**: cycles any PVC in the cycle
- **1 no I - 9 no I**: cycles without interpolated PVCs

| NOTE | Triplets and VRuns start by being couplets, and are converted to a run when the Rules thresholds are met. |
ST Analysis Rules

Depending upon clinical needs, you can set and store ST Analysis Rules data permanently as default settings or in a separate file (for example, for a drug study).

How ST is Determined

ST measurements in the Holter system are based on “relative” measurements specified in the ST Rules dialog box and “absolute measurements” taken by the scanner. The following table defines each of the major elements in the calculations:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
<th>When Active/When Derived</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute ST</td>
<td>Vertical distance in voltage between the isoelectric and the ST measurement points. This value is based on the patient's actual reference points (not the relative reference points).</td>
<td>Calculated at the beginning of the analysis.</td>
</tr>
<tr>
<td>Isoelectric</td>
<td>Derived on a per beat, per channel basis.</td>
<td>Computed by averaging all candidate normal beats in a 30-second window.</td>
</tr>
<tr>
<td>Relative ST</td>
<td>Vertical distance in voltage between the absolute isoelectric baseline reference of 0.</td>
<td>Relative offsets are specified in the ST Rules dialog box in order to compensate for chronic ST levels that are not necessarily 0 mm absolute.</td>
</tr>
<tr>
<td>Baseline Reference Value</td>
<td>An absolute ST measurement of the patient's non-ischemic, chronic ST level.</td>
<td>Calculated at the beginning of the analysis period.</td>
</tr>
<tr>
<td>ST Episode</td>
<td>Consecutive 30-second windows each of whose average value exceeds the episode threshold.</td>
<td>The entire ECG record is divided into 30-second windows. ST values measured on all beats within a window are averaged together to be the ST value for a 30-second window.</td>
</tr>
<tr>
<td>ST Level</td>
<td>Vertical distance in voltage (elevation or depression) between the isoelectric and the ST measurement point.</td>
<td>An ST baseline reference is determined from Normal shaped beats. Subsequent ST levels are determined from this baseline.</td>
</tr>
</tbody>
</table>

How ST Numbers are Generated

This section describes how ST measurements are generated when they are requested.

1. On a per-beat, per-channel basis, the scanner determines the R wave, isoelectric, and J-point locations.

2. On a per-beat, per-channel basis, the scanner determines whether to include the beat in ST measurements (exclusion comes from noise, Ventricular ectopy, and Alternate Normals).
3. For each channel of each candidate beat, the scanner computes the ST values by averaging all candidate beats in a six-second window centered on each beat.

4. Beat values (average, minimum, maximum) are stored by the scanner software.

5. Using normals at the beginning of the analysis period and relative ST values (if necessary to offset a chronic condition), the scanner derives absolute values which are then reported to you.

**NOTE**

All reported ST level measurements are absolute. A measurement of -1 mm *always* means that the ST-level value is 1 mm below the isoelectric value.

**ST Analysis Rules Dialog Box**

You can set elevation, depression, and slope for each individual channel, using the ST Analysis Rules dialog box.

To change ST episode thresholds for a particular patient, click the arrow boxes for elevation and depression in each channel.

**Minimum Duration**

The Minimum Duration for an ST episode declaration is the least amount of time a specific ST episode lasts to qualify. (The Minimum duration for an event is set by the episode criteria.) The default is 60 seconds.
**Minimum Separation**

The Minimum Separation is the minimum distance in time between episodes in seconds. The default is 60 sec. If episodes are closer than this value, they are bridged to form one episode.

**Hysteresis**

The threshold for an ST episode, once detected, is lessened by this amount (in mm) to determine the actual start and termination of the episode. This allows inclusion of a pre-event period (when ST segments begin to deviate from baseline but have not reached set criteria) and a post-event period (before ST segments return to baseline). This pre/post time will increase the total ischemia burden.

**Channel Control**

The section for Channel Control allows the user to remove analysis or change a setting for each individual channel. To remove ST analysis after the scan has started, remove the check mark in any of the three channels. Turning off ST analysis is extremely useful in areas of high artifact or if the patient loses an electrode.

**Elevation (mm)**

An ST elevation that is found to be greater than this threshold signifies an ST event. The default is +2.0 mm.

**Depression (mm)**

An ST depression that is found to be lower than this threshold MAY signify an ST event, depending on the corresponding Slope Qualifier. If the Slope Qualifier AND the ST Depression indicate an ST event, then the episode is called an event. The default is -1.0 mm.

**Slope Qualifier**

The slope of the ST segment is used, along with ST Depression, to detect ST events. An ST slope equal to or less than the slope qualifier value is considered episodic from an ST slope perspective. This is combined with the ST Depression level to determine if an actual ST episode exists.

**Notes on ST Settings**

When analyzing and editing ST recordings, use the suggestions in the following table:

<table>
<thead>
<tr>
<th>Item</th>
<th>Suggestion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cassettes</td>
<td>ST analysis should be performed on calibrated tapes only. ST analysis should not be done on an ECG with bundle branch block conduction problems, paced rhythm, Atrial fibrillation/flutter, or very low voltage.</td>
</tr>
<tr>
<td>Validation</td>
<td>To validate and document ST episodes, use the ST Review, and Events screens when you complete the analysis, and document the ST trend.</td>
</tr>
</tbody>
</table>
Morphology Rules

Use the Morphology Rules dialog box to select the channels analyzed, noise sensitivity, and class creation. You can use the dialog box to easily adjust the settings for ECG in recordings with extreme artifact or baseline wander, intrinsic beats with a high degree of QRS variability.

<table>
<thead>
<tr>
<th>Item</th>
<th>Suggestion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Review</td>
<td>Philips Zymed recommends review of the trend and actual ECG for level, slope, and duration verification.</td>
</tr>
<tr>
<td>Inversion on ECG Display Option</td>
<td>Do not invert the ECG if doing an ST analysis. Note: This setting is accessed from the ECG Display Options dialog box (see Chapter 10), and is available for non-EASI recordings only.</td>
</tr>
<tr>
<td>Slope Errors</td>
<td>Philips Zymed has determined that the slope measurements have an estimated tolerance of less than 12°, and the level measurements have an estimated potential error of less than 15 microvolts.</td>
</tr>
</tbody>
</table>

**NOTE**

If a channel is distorted by baseline wander or noise, you might want to deselect the channel and perform the analysis on the better channel(s).

Sometimes recordings with a high degree of QRS variability, such as bundle branch block patterns or paced beats, are easier to analyze when Automatic Class Creation is turned off.
Morphology Rules Options

The adjustments described in the following table help you determine the best strategy for scanning recordings with extreme artifact, intermittent loss of channel(s), or very complex arrhythmias.

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
</table>
| Channels Analyze/Gain         | Analyze: Removing a check mark from Analyze excludes that channel(s) from analysis. This is helpful for high-artifact channels and channels distorted by consistent baseline wander or consistent noise.  
Gain: The checked channels are analyzed at the gain set (x0.25 to x4). Adjust gain per channel. In areas with high artifact, sizing down the gain of the ECG also sizes down the size of the artifact. |
| Sensitivity/Noise             | Four options: from lowest sensitivity and least noise to highest sensitivity and most noise. For more information, see "Sensitivity/Noise Options" on page 3-15.                                               |
| Automatic Class Creation      | A check mark in this box allows the scanner to open new classes automatically. The scanner forms a new class when the scanner detects three unknown beats that have a similar shape (morphology).  
Removing the check mark from the box will prevent the automatic creation of new classes, allowing the user to Learn new beats manually. This option is available for management of recordings with frequent QRS variability, such as bundle branch block or paced beats, or excessive classes. |
| Set J-Point Measurement       | Measures ST level (relative to J-point out toward the T wave in milliseconds). You have four choices:  
• J+80 ms on every beat (default setting)  
• J+60 ms on every beat  
• EST: Uses J+80 when HR<120 BPM and J+60 when HR >= 120 BPM  
• Variable: Uses J+80 for HR<80 BPM, J+60 for HR=120 BPM, and linearly varies the measurement point between J+80 and J+60 based on the HR variable |
| Select Rules Set              | Changes the current Rules Set, either by adding a new set or selecting another set of rules through the Use option.                                                                                           |
**Sensitivity/Noise Options**

The Noise Algorithm settings determine the system’s sensitivity to artifact. The default setting is “medium” which is appropriate for the most recordings. To change the noise sensitivity, click the “Sensitivity/Noise” box and make your selection.

<table>
<thead>
<tr>
<th>Sensitivity Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowest</td>
<td>Rejects beats and counts the most noise. Use for recordings with large amounts of artifact.</td>
</tr>
<tr>
<td>Medium</td>
<td>Rejects beats and counts more noise. Use this setting for recordings with moderate artifact.</td>
</tr>
<tr>
<td>High</td>
<td>Counts more beats and rejects less noise.</td>
</tr>
<tr>
<td>Highest</td>
<td>Counts more beats and rejects least noise. Use this setting for recordings that are high in ectopy and moderate in noise. The setting will search through the artifact to find the ectopy.</td>
</tr>
</tbody>
</table>

**CAUTION**

To help the scanner reduce the number of false-positive calls or beat labels, as a rule-of-thumb, **before changing Sensitivity/Noise rules**, the majority of recordings should be treated with the following options first:

1. Verify in Class Edit for incorrectly labeled beats.
2. Verify class templates through the Detail icon for questionable classes that could have cross-contaminated the class template
3. Adjust Rules settings, Gain, and raw monitoring channels.
Overview

Philips Zymed Holter performs pacemaker analysis by recognizing the relationship between beats and pacemaker output signals (spikes). High quality spike detection is critical for proper analysis. Actual spike detection is performed by the Holter recorders: for quality analysis, proper patient preparation and recorder pacemaker configuration are required. Refer to Zymed DigiTrak-Plus Recorder manual (P/N 172069-035) for instructions on configuring the recorder.

Select the Pacemaker option in the New Patient - Recorder format dialog box to enable the following features within Holter:

- Display of pacemaker spikes. By default pacemaker spikes appear as small vertical positive deflection green bars in the ECG.
- Pacemaker-related histograms. (These are described in detail later in this chapter).
- Pacemaker-related Report sections.
- Pacemaker analysis on the Report Summary page.

This chapter describes the system’s pacemaker analysis and how you can edit the pacemaker events. See the following sections in this chapter for more information:

<table>
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<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enhanced Pacemaker Analysis</td>
<td>4-2</td>
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<td>Pacemaker Failures</td>
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<td>Pacemaker Histograms</td>
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<tr>
<td>Editing FTC Events</td>
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<td>Pacemaker Event Review</td>
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<tr>
<td>Pacemaker and Enhanced Report Format</td>
<td>4-23</td>
</tr>
</tbody>
</table>
Enhanced Pacemaker Analysis

Activate pacemaker analysis during patient setup at the start of a scan (see Chapter 2, "Getting Started").

If you activate Pacemaker analysis during patient setup, Holter analyzes the pacemaker during the scan. Class Edit reports pacemaker beats in four categories which can be accessed in groups with surrounding ECGs via the Detail icon.

- Singly paced
- Dual paced (two pacemaker spikes)
- Single paced with fusion
- Dual paced with fusion

Fusion occurs when the patient’s intrinsic heartbeat and the pacemaker fire at approximately the same time. This fusion creates a beat that has a pacemaker spike and a slightly different shape from an intrinsic beat.

Paced beats are excluded from ST analysis.

These four categories of paced beats are further disseminated into nine categories for Report, which is referred to as an enhanced pacemaker analysis. Use the Report Summary tab and the Pacer tab (available through the Report icon) to review reported paced beats through the Review icon. You can display pacemaker failures through the Review or through the Graph icon Pacemaker histograms.

Pacemaker Codes

Pacemaker codes, shown in the following table, define the modes of operation for single and dual pacemakers:

<table>
<thead>
<tr>
<th>Type</th>
<th>Chamber(s) Paced</th>
<th>Chamber(s) Sensed</th>
<th>Response</th>
<th>Programmable</th>
<th>Antitachycardia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>V</td>
<td>V</td>
<td>I</td>
<td>R</td>
<td>*</td>
</tr>
<tr>
<td>Dual</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>R</td>
<td>*</td>
</tr>
</tbody>
</table>

* Antitachycardia functions: P=Pacing, S=Shock, D=Dual (P+S)
Extra pacemaker spikes can occur on DigiTrak-Plus Holter recordings for either of the following two reasons:

- The pacemaker is rate-responsive.
  A rate-responsive pacemaker sends out signals to detect how fast the pacemaker should fire, before it actually fires. Sometimes, the lower voltage detection signal is picked up as though the pacemaker actually fired. The perceived voltage varies due to positional changes, which is why the detection signal is not always recorded.

- Extra pacemaker spikes are occasionally detected (false positive) due to artifact.
  Artifact is any stray voltage that is caused by static electricity, positional changes, lead hookup issues, etc. Although these artifacts are usually filtered out, they sometimes appear similar to a pacemaker spike and are recorded as such.

### Determining the Number of Pacemaker Chambers

Because of the many programmable features, such as body motion, temperature, minute volume, etc., it is sometimes difficult to determine pacemaker functions from viewing the surface ECG alone. The tips that follow can help you determine whether the pacemaker is single or dual chamber.
Pacemaker Failures

- If you observe a consistent P wave prior to each paced QRS, the pacemaker is a dual chamber pacemaker programmed typically to a DDD mode.

- If the patient has a normal sinus P wave, you will not see a pacing spike since the Atrial lead wire senses the natural P wave and synchronizes the response of the Ventricular wire.

- Dual chamber pacemakers generally have rate parameters of 50-150 BPM. If the sinus P wave rhythm slows to 50 BPM, you expect to see the Atrial lead fire, causing a paced P wave.

- Because of its sensing ability, an Atrial lead wire can even sense ectopic P waves and initiate a mechanical AV interval to produce paced PACs.

**Tips for Better Scanning of Paced Beats**

When scanning a file that contains paced beats, check the following settings:

1. Atrial Drop beat settings: set Drop to 100%.
2. Late beat settings: set Late to 20%.
3. Atrial prematurity settings: set Prematurity to 15-20%.
4. Set Auto Stops for relevant beats: Drop, Late, and premature beats.

---

**NOTE**

To maximize accuracy in evaluation of pacemaker functions, the person analyzing the ECG must know the programmed mode, lower and upper rate limits, and critical features, such as hysteresis and mode switching. Additionally, include these parameters and adjust them accordingly under Rules.

**Pacemaker Failures**

Philips Zymed Holter detects the following pacemaker failures:

- Failure to Output (FTO)
- Failure to Sense (FTS)
- Failure to Capture (FTC)
Failure to Output (FTO)

FTO occurs when the pacemaker fails to output a spike and is further recognized by a long R-to-R interval. The following ECG is an example of FTO:

Notice that a pacemaker paced the first 3 beats, but the last beat is missing a spike. The missing spike coinciding with an extended R-R interval is an example of pacemaker FTO.

FTO is generally caused by the pacemaker failing to deliver an output spike that results in stimulation. This can be caused by pacemaker malfunction, poor pacemaker electrode position or connection, or diseased heart tissue in the area of the electrode.

An oversensitive pacemaker can mistake noise as an R wave and fail to output.

---

Failure to Sense (FTS)

FTS occurs during ectopic activity (both Atrial and Ventricular) and rapid tachycardia when the pacemaker fails to detect an R wave and fires a short time after the R wave. The following ECG is an example of FTS:

Notice that the pacemaker failed to detect the second beat and fired after the R wave. FTS is generally caused when the pacemaker fails to sense ECG properly. This can be caused by a malfunction in the pacemaker itself, by fractured lead wires or a poor electrode connection, or by diseased heart tissue in the area of the electrode.
Failure to Capture (FTC)

FTC occurs when the pacemaker fires but fails to stimulate a beat. The following is an example of FTC:

As shown in the figure, the third spike failed to stimulate a beat, resulting in an extended R-R interval, longer than the programmed pacing interval.

FTC is generally caused when the pacemaker output cannot stimulate a beat either because the output is below the necessary threshold to stimulate a beat, the electrode is loose, fractured lead wires, the electrode is in a poor location, or low battery power.

Pacemaker Histograms

To obtain a report of pacemaker failures:
1. Click the Graph icon.
2. Click the desired Graph icon Pacer tab at the bottom of the screen.

Histograms provide a graphical representation of the regularity of intervals. Holter displays two types of intervals:

- the time interval between two consecutive beats (such as R-R interval)
- the time interval between spikes and beats (such as Spike-R, R-Spike, or Spike-Spike).

**NOTE**

If you determine that the R-R interval is invalid, eliminate it. Use the R-R Change icon to eliminate the interval and the invalid Pacemaker Failure from Report. An invalid R-R interval is indicated by a dash ("-" ) between the beats and is not counted as a Failure.
Holter has four types of histograms relating to pacemaker analysis, as follows:

1. R wave to R wave interval with no spike in between (R-R no Spike). This histogram is useful for showing the patient’s intrinsic rhythm and unusually long R-R intervals that can indicate FTO.

2. R wave to Spike intervals (R-Spike). This histogram is useful for showing spikes in close proximity to the R wave, indicating possible failure to sense (FTS).

3. Spike to R wave intervals (Spike-R). This histogram shows beats that occurred a large distance away from spikes and indicates possible failure to capture (FTC). For dual chamber pacemakers, this histogram is also instrumental in showing both the frequency and location of Atrial and Ventricular spikes.

4. Spike to spike intervals (Spike-Spike). This histogram is useful for indicating a pacemaker’s programmed rate. For dual chamber pacemakers this histogram also provides information on the interval between the Atrial and Ventricular spikes and the interval between a Ventricular spike and the following Atrial spike.

**Pacemaker Threshold Markers**

Pacemaker-related histograms contain markers that indicate threshold settings for various failures. There are five markers within the various histograms, as follows:

- FTO
- FTS1
- FTS2
- FTC
- Atrial Spike

Markers appear as a vertical line with a flag at the top as shown in the following figure:

The direction of the flag indicates the direction where failures or events can occur. For example, the flag for the FTC marker in the figure points to the right, indicating that FTC events can be found to the right of the marker line. The current value for the marker is indicated to the right of the marker’s title - in this FTC example it is currently 500 ms.
To adjust the marker lines:

1. Place the mouse pointer over a marker line until the mouse pointer changes to a †.

2. Press and hold the left mouse button while moving the mouse pointer to the left or right to adjust the marker line.

**R-R no Spike Histogram**

The R-R no Spike histogram is useful for showing the patient’s intrinsic rhythm and unusually long R-R intervals that can indicate FTO.
Example 1

The following figure is Example 1 of an R-R no Spike histogram:

This histogram was generated from a fully paced patient over a 12 hour period. By inspecting this histogram, you can draw the following conclusions:

- The patient was predominately paced. The absence of a large number of intervals in the R-R no Spike histogram indicates that nearly all beats were paced.
- There are no intervals to the right of the FTO marker, indicating that no FTO events were detected.
**Example 2**

The following figure is Example 2 of an R-R no Spike histogram for another paced patient over a 24 hour period:

On this histogram you can see:

- The patient has a large number of unpaced beats evident by the large number of R-R intervals containing no spike.

- The peak visible near 820 ms indicates the patient’s overall intrinsic rhythm was around 73 BPM.

- There are no intervals to the right of the FTO marker indicating that no FTO events were detected.
Example 3

The following figure is Example 3 of an R-R no Spike histogram for a paced patient over a 24 hour period:

On this histogram you can see:

- The patient has a large number of unpaced beats evident by the large number of R-R intervals containing no spike.
- The peak visible near 875 ms indicates the patient’s overall intrinsic rhythm was around 68 BPM.
- There are some intervals to the right of the FTO marker, indicating that possible FTO events were detected.
- All intervals on and to the right of the FTO marker are possible FTO events. Initially Holter assumes all of these events are FTO and they are shown on the Report. You should review and edit these intervals to determine if they are in fact FTO.
- The selected R-R interval in the figure for Example 3 displays some of the characteristics of a pacemaker FTO event.
- The interval length (1125 ms) is greater than the current threshold setting of 1050 ms.
- No spike exists between the consecutive R waves.
Closer inspection reveals the beat preceding the extended R-R wave was slightly premature. It is likely that the pacemaker was designed to inhibit for a longer interval after a premature beat. An intimate knowledge of the pacemaker is required to determine whether this is the programmed behavior of the pacemaker or if this is an example of FTO. If you determine that this is not an FTO event, see the following section on how to edit this interval so it won’t be included on the Report as a failure.

**Editing FTO Events**

To identify FTO events, review the R-to-R no Spike Graph for long R-R intervals. You also have the option to use the Caliper function to measure the R-R interval in the Diagnostic window.

The R-R no Spike graph allows you to define the interval for Failure to Output (FTO) in milliseconds. Drag the FTO cursor within the graph to the right or left to change the length of the interval for measurement, as follows:

1. To lengthen the interval for FTO, move the FTO cursor to the right.
2. To shorten the interval for FTO, move the FTO cursor to the left.

Example 3 contains an example of a possible FTO event. If you determine that the interval in question does not represent a pacemaker failure to output, indicate that the R-R interval should be ignored and not counted as FTO using the following procedure:

1. Click the R-R Change icon to select the Ignore R-R Interval tool.
2. In the Diagnostic window, move the mouse to the extended R-R interval and click.
The preceding figure shows the screen after the R-R interval is ignored. A dash "-" appears in the interval on the Diagnostic window between the P and the N to indicate the R-R interval is ignored. Holter does not count this R-R interval, and thus it is not counted as FTO.

Note that the histogram is unaffected. The histogram plots all intervals regardless of whether they are ignored or not. Therefore, do not assume that all intervals to the right of the FTO marker are reported as FTO events.
The R-Spike histogram is useful for showing spikes in close proximity to the R wave, indicating possible failure to sense. The following figure is an example of an R-Spike histogram:

Notice that this histogram contains two marker lines, labeled FTS1 and FTS2. These lines bound a region where failure to sense can be counted.

- The first marker, FTS1, sets the distance after the R wave where the FTS region begins.
- The second marker, FTS2, sets the distance after the R wave where the FTS region ends. The following figure illustrates where the FTS region lies with respect to the R wave:
The FTS1 marker allows the FTS region to start either directly on the R wave or a short time afterwards. Typically, the FTS1 marker is set a short distance after the R wave to allow the pacemaker an opportunity to detect the R wave and to inhibit. If the FTS1 marker were set directly on the R wave (by setting it to zero ms. after the R wave), any instance of pacemaker fusion would be counted as FTS. The FTS2 marker specifies the end of the FTS region.

The FTS region should be configured to be wide enough to capture all FTS events, but not so wide that it impinges on the following beat. Thus FTS2 values greater than 200-300 ms are not recommended.

The Diagnostic window in the previous figure shows an interval that appears to be failure to sense (FTS). Notice that the spike occurs a short distance after the R wave and within the region defined by FTS1 and FTS2.
Editing FTS Events

You can usually recognize this type of failure by locating R-to-R-intervals that are terminated by paced beats. In pacemakers with fractured lead wires, FTS can be accompanied by episodes of Failure to Capture (FTC). (You can identify both forms of failure by reviewing the R-to-R-interval graph of a completed scan.) The R-Spike graph allows you to define the interval for FTS in measurement of milliseconds, from the R wave to the next spike of the pacemaker. To do this, drag the FTS marker to the desired measurement.

- The FTS1 is the interval from the R wave to the next spike. If a spike is detected within the interval, it is called FTS.
- The FTS2 is a longer interval. If a spike falls within the longer interval, it is considered to be a normal distance from the R wave. This would normally be the spike for the next QRS complex.

The preceding figure contains an example of a possible FTS event. If you determine that the interval in question does not represent a pacemaker failure to sense, indicate that the interval should be ignored and not counted as FTS using the following procedure:

1. Click the R-R Change icon on the Scanning toolbar to select the Ignore Interval tool.
2. In the Diagnostic window, move the mouse to the interval containing the FTS spike and click the dash between the two N’s.
The preceding figure shows the screen after the R-R interval is ignored. A dash "-" appears in the interval on the Diagnostic window between two N’s to indicate that the R-R interval is ignored. Holter does not count this interval as FTS.

Note that the histogram is unaffected. The histogram plots all intervals regardless of whether they are ignored or not. Therefore do not assume that all intervals between the FTS1 and FTS2 markers are reported as FTS events.

**Spike-R Histogram**

The Spike-R histogram is useful for showing beats occurring a large distance away from spikes, indicating possible failure to capture (FTC). For dual chamber pacemakers this histogram is also instrumental in showing both the frequency and location of Atrial and Ventricular spikes. The following figure is an example of a Spike-R histogram:
This histogram contains both Atrial Spike and FTC markers. The Atrial Spike marker is used to classify pacemaker spikes as being either Atrial or Ventricular. This marker indicates a dividing line between Atrial and Ventricular spike locations relative to the R wave. Since the horizontal axis of the histogram is the interval from the spike to the R wave, moving right on the histogram indicates a movement left of the R wave. This movement can be counterintuitive and, possibly, result in confusion. However, the Atrial Spike marker points right, since values to the right of the marker represent increasing distances between spikes and R waves. Atrial spikes occur farther before the R wave than Ventricular spikes. Ventricular spikes occur to the left of the Atrial Spike marker, representing a closer proximity to the R wave, where Ventricular spikes are expected.
The example of the Spike-R histogram shows two distinct peaks just before and after the Atrial Spike marker. These dual peaks are expected when analysis is performed on dual chamber pacemakers. Optimal positioning of the Atrial Spike marker when analyzing dual chamber pacemakers is often the valley between the two peaks representing Atrial and Ventricular spikes.

The FTC marker is used to indicate where failure to capture events can occur. FTC occurs to the right of the FTC marker line as indicated by the FTC marker flag direction. The region to the right of the FTC marker represents large intervals between spikes and the following R waves.

The Spike-R histogram has two subtleties that are important to keep in mind:

1. Since multiple spikes can occur within an R-R interval, all Spike-R intervals are plotted within the histogram. Thus, an R wave can be used for more than one Spike-R interval. This allows for proper A/V peak display for dual chamber pacemakers. The R-Spike histogram does not behave this way. Each R wave can be used only once and thus only the spike nearest the R wave is used. The following figure attempts to show this:

2. FTS events often show up in the FTC region of the Spike-R histogram, as shown in the following figure. Notice that both Spike-R intervals are long. Although FTS events can be plotted in the FTC region of the Spike-R histogram, Holter does not count them as FTC events.
Editing FTC Events

The Diagnostic window in the figure on page 4-18 contains an example of a possible FTC event. The pacemaker spikes failed to stimulate the heart, resulting in a late beat. To prove FTC, the pause is noted longer than the programmed pacing interval and can be shown in the R-to-R graph or Spike-R graph.

The Spike-R graph allows you to define the spike to R interval for FTS, as follows:

1. Make the measurement from the pacemaker Atrial spike to the next R wave.
2. Drag the measurement cursors to set the time in milliseconds from Spike (Atrial Spike cursor) to R wave (FTC cursor). When the pacemaker spike is identified and is not followed by an R-wave, within the set interval, the system calls FTC and graphs to the right of the FTC cursor.
3. Edit these areas to the right for invalid R-R intervals.

NOTE
Artifact can trigger a pacemaker spike or a beat label. It is important that you edit paced ECGs for invalid R-R intervals.

In the event that it is determined the interval in question does not represent a pacemaker FTC, indicate that the R-R interval should be ignored and not counted as FTC using the following procedure:

1. Click the R-R Change icon on the Scanning toolbar to select the Ignore Interval tool.
2. In the Diagnostic window move the mouse to the beat to beat (R-R) interval containing the FTC spike and click. An ignore dash ("." ) appears between beats.

Spike-Spike Histogram

The Spike-Spike histogram is useful for indicating a pacemaker’s programmed rate. For dual chamber pacemakers this histogram also provides information on the interval between the Atrial and Ventricular spike and the interval between a Ventricular spike and the following Atrial spike.
The preceding figure is an example of a Spike-Spike histogram from a patient with a dual chamber pacemaker. Inspection of the histogram reveals three peaks.

- The first peak, at around 250 ms, corresponds to the interval between Atrial and Ventricular spikes. It is clear from the Diagnostic window that this patient is not dependent on the pacemaker (i.e. the pacemaker fires only as required). Since the first spike is relatively tall it is apparent that a large number of beats are dual paced.

- The second peak at around 750 ms represents the interval between a Ventricular spike and the following Atrial spike.

- The third peak at around 1000 ms roughly represents the R-R intervals where the patient is in single chamber pacing. The Diagnostic window shows an interval from the third peak. It appears that this patient’s pacemaker is capable of operating both in single and dual chamber modes.
Pacemaker Event Review

In addition to the Graph icon histograms described in earlier sections, you can use the Review icon (Event Review) to find and correct pacemaker failure. Both have the ability to find invalid R-R pacemaker failures, FTO, FTS, and FTC events.

NOTE

Once a beat to beat (R-R) interval is assumed invalid, it is not counted as a failure in Report. An invalid R-R interval is indicated by a dash ("-"), a dash ("-"), between beats.

To find pacemaker events:

1. Click the Review icon.
2. Select pacemaker options (FTO, FTS, FTC) from the Event Review dialog box.
3. Click OK to view events.
4. Click the Diagnostic icon, then click the event for a close-up view.
5. Use the keyboard arrow keys to move around and view specific events in the Diagnostic window.
6. Click the Doc icon, then click an event to document a strip for the Report.
7. Edit pacemaker failures from the Diagnostic window.

Edit and correct invalid R-R interval pacemaker events via the Diagnostic window using the following procedure:

1. Click the R-R Change icon on the Scanning toolbar to select the Ignore Interval tool. This icon toggles to make an R-R interval valid or invalid ("- ").
2. In the Diagnostic window click on the R-R interval to be changed.

NOTE

Keep in mind that Event Review is limited to reviewing failures and cannot be used to adjust pacemaker threshold markers. Use the Graph icon and histogram for threshold markers.
Pacemaker and Report Enhanced Format

Pacemaker analysis is reported in the Report (use the Report icon). Pacemaker totals, in enhanced formats, are reported in nine categories, defined in the table that follows.

To view reported paced beats:
1. Right-click on the cell containing the number (total) of paced beats from either the Report Summary tab or Pacer tab.
2. Select Review from the menu to jump to the Review screen for selected reported Paced events.

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sinus Beats</td>
<td>Calculated by taking the total beat count and then subtracting all paced beat counts (including single paced or Atrial + Ventricular paced, dual paced, fusion) and also subtracting Ventricular beat counts.</td>
</tr>
<tr>
<td>Paced Beats</td>
<td>The total of all paced beats and includes single paced beats (Atrial + Ventricular), dual paced beats, and fusion beats. Unqualified beats are not counted.</td>
</tr>
<tr>
<td>Atrial Paced</td>
<td>Identifies this class of beats and reports the total beat count. To view beats in this class, right-click on the total on the Report screen.</td>
</tr>
<tr>
<td>Ventricular Paced</td>
<td>Identifies this class of beats and reports the total beat count. To view beats in this class, right-click on the total on the Report screen.</td>
</tr>
<tr>
<td>Dual Paced</td>
<td>Identifies this class of beats and reports the total beat count.</td>
</tr>
<tr>
<td>Fusion Beats</td>
<td>Identifies this class of beats and reports the total beat count.</td>
</tr>
<tr>
<td>FTO</td>
<td>Failure to Output. With FTO, there is no representative pacemaker output on the marker channel. To identify this phenomena, review the R-to-R No Spike graph.</td>
</tr>
<tr>
<td>FTS</td>
<td>Failure to Sense. Failures can be identified by reviewing the R-to-R interval graph of a completed scan.</td>
</tr>
<tr>
<td>FTC</td>
<td>Failure to Capture. Failures are represented, potentially, by R-to-R intervals that are longer than the pacing interval.</td>
</tr>
</tbody>
</table>
5 Editing the Scan

Overview

When an analysis is complete, you can use any of the icons, or methods, listed in the table below to edit the scan.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Icon</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Class Edit</td>
<td><img src="image" alt="Class" /></td>
<td>Review, edit, and combine class template morphologies.</td>
<td>5-3</td>
</tr>
<tr>
<td>2. Detail</td>
<td><img src="image" alt="Detail" /></td>
<td>Presents a screen that enlarges one beat close up, individually, and in progression with all other beats within the class template, for special editing on a beat-by-beat basis.</td>
<td>5-5</td>
</tr>
<tr>
<td>3. Review</td>
<td><img src="image" alt="Review" /></td>
<td>View and edit class templates, and document arrhythmias. <strong>Note:</strong> Always review “n”, “v”, “max”, “?”, and “.”. This is where you will find any false negative events buried in artifact.</td>
<td>5-12</td>
</tr>
<tr>
<td>4. Events</td>
<td><img src="image" alt="Events" /></td>
<td>View, edit, and document significant extremes of heart rates, runs, ST episodes, and normal N-N complexes.</td>
<td>5-15</td>
</tr>
<tr>
<td>5. Graph</td>
<td><img src="image" alt="Graph" /></td>
<td>Review and edit beat labels, beat-to-beat (for example, R-R) intervals, enhanced Pacer spikes (for example, R-Spike), view 3D 12-lead, Spectral Power, and QT.</td>
<td>5-18</td>
</tr>
<tr>
<td>6. ST</td>
<td><img src="image" alt="ST" /></td>
<td>Review ST data. Delete/create ST episodes, adjust Baseline. Review and edit beat labels from the ST Diagnostic window.</td>
<td>5-28</td>
</tr>
<tr>
<td>7. Strips</td>
<td><img src="image" alt="Strips" /></td>
<td>Review diagnostic strips selected for the final Report. <strong>Note:</strong> You may choose to create EASI 12-lead ECG strips for printing, enter custom interpretations, or delete redundant strips as necessary.</td>
<td>5-14</td>
</tr>
</tbody>
</table>
The remainder of this chapter discusses modes of editing in the order listed in the preceding chart, beginning with the Class Edit screen and the icons associated with class editing.

Additional information on editing can be found in Chapter 2, under "Editing Beats through Class Edit" on page 2-17.

NOTE

Please note that the figures of the screens in this book show the "leather jacket" configuration. The screen appearance of colors, lines, fonts, and icon configurations can be changed to accommodate your preferences. See "Customizing the Holter Screen" on page 10-2 and "The Customize Dialog Box" on page 10-7 for information.
Class Edit

Editing Through the Class Edit Screen

Each class template is a group of like-shaped and labeled morphologies called beats that are labeled into a class (for example, Normal or Ventricular). The purpose of editing beats is to tighten, correct, or change class labels, as well as combine class template morphologies so that there are as few templates as possible.

You can edit or change the label of an entire group of beats, or class template, at any time. To do this, click on the Class icon to view the Class Edit screen. In the following example, the Class Edit screen has three Ventricular (Vfib or Artifact) classes chosen for editing.

Class Edit Screen with Ventricular/Fusion Popup Menu
To change a class label from the Class Edit screen:

1. Select a class by clicking it in the Class Editing (lower) window.

2. Select an editing option from Class Edit Pick-A-Beat icons at the bottom of the Class Edit screen. The option chosen changes the individual class label and ripples into the Morphology section of the Report.

---

**NOTE**

After you choose a class for editing, it is grayed out in the bottom window and appears for editing in the upper window Work area, as shown in the illustration.

---

### Additional Ways to Change Class Labels

To change any class beat label, you must choose a Pick-A-Beat icon, discussed in "Pick-A-Beat Icons" on page 2-12. In addition to the Class Edit icon, individual beats and/or class templates can be re-labeled from the following areas:

- From the Diag icon, at anytime -- use the Pick-A-Beat toolbar or right-click on a beat and choose the Pick-A-Beat option to relabel a beat.

- From the Beat Detail screen (see page 5-6) -- change the label on a beat in the Diagnostic window.


- From the Review icon -- choose events from the dialog box that appears (Event Review dialog box), click on the Diag icon and proceed, using the Pick-A-Beat icons in view. Additionally, use the Multi-Pick-A-Beat option (see page 5-14).

- From the Events icon/screen (see page 5-15) -- edit, or change, class beat labels and R-R intervals. Editing from the Events screen may impact the hierarchy of the top 10 events.

- From the Graph icon/screen (see page 5-18) -- edit, or change, class beat labels and R-R intervals.

- From the ST icon/screen (see page 5-29) -- edit, or change, class beat labels and R-R intervals.

- From the Report icon, Morphology tab -- double-click on the Morphology complex or right-click on the Morphology complex and choose “Review.” Each method jumps to the Class Edit screen. Proceed as described in Class Edit using the available Pick-A-Beat icons.
Beat Detail Editing

The Beat Detail screen allows you to see each beat individually, magnified, and all other complexes grouped within the same Class Edit template. The Detailed form of editing allows you to pull out mixed classes (such as T waves labeled Normal beats).

There are two types of Detail icons: one with a magnifying glass, and one with a graph. Each enables you to view individual beats or all beats within a Class Edit template from the Beat Detail screen close up, one-by-one, by overlay or by superimposition.

*Detail Icon with magnifying glass (Diagnostic Toolbar)*

- Clicking this icon, then double-clicking the desired beat jumps right to the Beat Detail screen.

**NOTE**
The Detail icon with magnifying glass is not available in all languages.

*Detail Icon with graph (Main Toolbar)*

- Clicking this icon *once* takes the centered beat seen in the Diagnostic window and jumps to the Beat Detail screen.
- Clicking this icon *twice* (or *once* on the Select icon) jumps to a Beat Selection dialog box (shown in the figure that follows). You now have two choices:
  - Click on a class template -- it moves to the Selected field. Click OK to jump to the Beat Detail screen and edit.
  - Choose from the options given (for example, All beats) and click OK to jump to the Beat Detail screen and edit.
Through the Beat Selection dialog box shown above, you can display beats from the following groups:

- **Type**: a listed class of beats (for example, All Ventricular beats).
- **Classes** (the default): all scanned classes (either unedited or edited by the operator).
- **Templates**: basic shapes (classes) determined by the Holter algorithm.

Once in the Beat Detail screen, select the class template for viewing and editing.
Use the icons at the bottom of the screen to:

- **Select** the beats for viewing. You then jump to the Beat Selection dialog box.

- **Overlay** groups of beats, using the pop-up Overlay Options dialog box (details follow).

- **Chan. 1, Chan. 2, Chan. 3**: View in any combination of raw channels. Toggle the icon on or off.

- **Zoom** in or out. Each click of the Zoom icon increases or decreases the size of the complex in view by increments.

- **Gain**: to increase or decrease the gain (size). Each click of the Gain icon increases or decreases the size of the complex in view by increments.

- **Superimpose (SI)** all beats within the class template. Each click of the SI icon increases or decreases the speed at which all determined beats superimpose.

- **MEAS**: Display and set special fiduciary calipers for adjusting points (for example, Iso and J point measurement range setting).

- **Diag**: Click the Diag icon to set up the Diagnostic window to perform class edits using Pick-A-Beat options.

**TIP:**

Use the slider (at the bottom of the Diagnostic window, above the toolbar) and/or arrows (on the keyboard) to scroll through groups and individual beats.

**Detail Overlay Icon**

Clicking the Overlay icon brings you to the following dialog box:
**Beat Detail Overlay Dialog Box - Looking at Individual Beats**

The Overlay icon lets you look at all beats within a class, either individually or by superimposing them upon each other. When you choose to overlay beats, you can limit the number of beats that are displayed through the Overlay Options dialog box by typing a number in the field Beats to show or Show all (up to 5,000). Average is another option that can be chosen.

**Beat Spanning -- An Advanced Overlay Option**

If Enable advanced Shape Detail view is set on the Advanced tab of the Customize dialog box, the Beat Spanning options are displayed, as shown in the preceding figure. See Chapter 8, "Using Advanced Scanning".

**Measure and Fiducial Default Points Overview**

The isoelectric point is related to the J point for ST episode determination. The advanced user may wish to display or change the measurement of the fiducial points that are automatically calculated and placed by the Holter algorithm. (See "Measure (Meas) Icon and Changing Fiducial Points" on page 5-10).

You can display and edit the fiducial points for clarity and logic in the Diagnostic window (as seen in the top window of the following figure). Click on the Display icon to display the ECG Display Options dialog box. In the Diagnostic Area for Annotations, check Show fiducial points.

---

**NOTE**

Manipulate the isoelectric and J-Point settings as little as possible due to changes in the heart rate. Use the right or left arrow keys to view multiple complexes. Depending upon the heart rate, the QT interval shortens or lengthens, thereby forcing you to keep loose fiduciary calipers for the best results.
Click the Detail icon to display the fiducial points on individual beats from the Beat Detail screen. The points are coded as shown in the following table:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>Isoelectric point</td>
</tr>
<tr>
<td>I</td>
<td>Q measurement point</td>
</tr>
<tr>
<td>□</td>
<td>R measurement point</td>
</tr>
<tr>
<td>O</td>
<td>J measurement point</td>
</tr>
<tr>
<td>I</td>
<td>T measurement point</td>
</tr>
</tbody>
</table>
**Measure (Meas) Icon and Changing Fiducial Points**

You can adjust fiducial point calipers for ST and QT when in the Beat Detail screen by clicking the Meas icon at the bottom of the screen. Drag the vertical adjustment lines that correspond to ST settings (for example, the J point), as shown in the following figure:

**Beat Detail Screen with Fiduciary Calipers**

You can change isoelectric and J point variabilities by dragging the P-Q and J-point adjustment calipers to new widths. It is recommended that you let Holter determine these points from the widest P-Q and J-point settings that are reasonable, due to heart rate variability.
Advanced Pick-A-Beat Editing Icons

The purpose of the Advanced Pick-A-Beat Editing icons is to tighten class templates, or groups of beats at the same time. These icons are only usable from the Scan Diagnostic window or from the Beat Detail screen. Advanced methods are specific to upgraded models of Holter and are turned on under the Tools\Customize\Advanced tab. For details, refer to page 8-1.

**NOTE**

When using the Advanced function, you need to either have a large screen or make the screen resolution higher in order to display all of the icons.

For additional information on Advanced Pick-A-Beat icons, see "Advanced Pick-A-Beat Toolbar" on page 8-3.

**Extract A Class (Advanced)**

Use this Pick-A-Beat icon to extract a beat that has a slightly different morphology from its existing class. The extracted beat will represent a new class/template; then, the scanner automatically reanalyzes the previously scanned data to extract all previously matching beats and transfer them to the new, specified class.

**Erase A Class to: Normal, Ventricular, or Artifact (Advanced)**

Use this Pick-A-Beat icon to erase a class and place all the counts for that class either into the Normal, Ventricular, or Artifact category.

**Correct A Class to: Normal, Ventricular, or Artifact (Advanced)**

This Pick-A-Beat category is equivalent to performing a Class Edit Correct operation. As an example, a class can be changed (corrected) from Normal to Ventricular. By selecting the center Pick-A-Beat operation (Correct to Ventricular) and clicking on a normal beat, the same operation can be performed using Pick-A-Beat rather than going to Class Edit and using Extract A Class.
Editing Through Review

Overview

Use the Review icon to display the Event Review dialog box. By making selections in Event Review, you can quickly find, edit, and document all events (Atrial, Ventricular, and Other) that occurred from a scanned ECG by groups (ST, Heart Rates, R on T, PACs, etc.).

To view and select events:

1. Click the Review icon to display the Event Review dialog box (figure above), or double-click the Review icon if you are re-entering and have Events in view. (See the example on the following page.)

2. Click in the appropriate check box to select the beats and/or events.

3. Click OK. The scanner displays the selected events on the Review Editing screen.

4. Always review "n", "v", "*", "?", and "-". This is where you will find any false negative events buried in artifact.
From the Review Editing screen you can:

- View the events.
- Document events and create strips for the Report.

To edit events or beats, you must click the Diag icon to access the Diagnostic window. You can edit beats one-by-one or by Multi Pick-A-Beat (see page 5-14).

To use the Review Editing screen:

1. Click an event.
2. Using the Pick-A-Beat toolbar, correct the beat.
3. Click the View icon to see the event in context with the surrounding ECG.
4. Click the Doc icon at the bottom of the screen and click an event. (Alternatively, you can right-click the event and choose Document Event.)
5. To review all events, use the arrow keys or the page up and down keys to scroll through all selected events.
Using Multi Pick-A-Beat

While in Review mode, every Pick-A-Beat operation is automatically memo-
rized, for example, Count Normal, Learn Ventricular.

Once you select an event and choose a Pick-A-Beat function to rename it, hold down the Control (Ctrl) key and click on the next event (or several simi-
lar events). With each click, the Pick-A-Beat function is applied.

Reviewing the Hour with the Most Episodes

To review the hour of the scan with the most PVCs, SVEs, or ST episodes:

1. Click the Report icon.
   A page summarizing all beats is displayed.

2. Click the Ventricular, Supraventricular, or the ST Summary tab to view hourly totals.

3. Right-click the mouse over the cell with the highest value indicated in a red font.


Documenting Strips from Review

1. After an input file has been scanned, click the Review icon.

2. Select one or more items to review (for example, Couplets, Late Beats, etc.).

3. Click OK to have the scanner assemble the Review screen.

4. Click in the header of a selection to make it the focus.

5. Click the Doc icon at the bottom of the screen and click an event. (Alter-
nately, you can right-click the event and choose Document Event.)

6. You can review the items in the Strips section of the Report.

For more information, see "Editing and Documenting Strips" on page 5-34.
Editing from Events

Overview

In scanned areas, you can use the Events icon to review the top ten events (the events that have the most extreme values, in hierarchical order) by categories. From the upper window, review for proper R-R intervals and correct beat labeling.

Events Screen

NOTE

Editing from the Event screen may eliminate the chosen event and/or change the hierarchy of events.
To view the 10 most important events:

1. Click the Events icon.

2. Scroll up to ten events (one event for Maximum HR and Minimum HR) of each category by clicking the Prev/Next icons in the top right corner of the Events list.

3. Edit (clear out all artifact and ensure correct beat labels and that R-R intervals are valid, using the Pick-A-Beat icons).


**Fields in Important Events**

*Heart Rate, Runs, and Interval Values*

The values in the left-hand column are determined in Holter scans as described in the following table. Use the Doc icon at the bottom of the screen to document any or all of the important events.

<table>
<thead>
<tr>
<th>Field</th>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Heart Rate</td>
<td>Min HR</td>
<td>Slowest heart rate in beats per minute (BPM) during the recording (one event)</td>
</tr>
<tr>
<td>Maximum Heart Rate</td>
<td>Max HR</td>
<td>Fastest heart rate in beats per minute (BPM) during the recording (one event)</td>
</tr>
<tr>
<td>Max Ventricular Run</td>
<td>Max VRun</td>
<td>Fastest Vrun, in beats per minute (BPM)</td>
</tr>
<tr>
<td>Min Ventricular Run</td>
<td>Min Vrun</td>
<td>Slowest Vrun, in beats per minute (BPM)</td>
</tr>
<tr>
<td>Max Atrial Run</td>
<td>Max Arun</td>
<td>Fastest Arun, in beats per minute (BPM)</td>
</tr>
<tr>
<td>Maximum Atrial Fibrillation</td>
<td>Max AFib</td>
<td>Fastest AFib, in beats per minute (BPM)</td>
</tr>
<tr>
<td>Maximum Tachycardia</td>
<td>Max Tachy</td>
<td>Fastest Tachycardia, in beats per minute (BPM)</td>
</tr>
<tr>
<td>Minimum Bradycardia</td>
<td>Min Brady</td>
<td>Slowest Bradycardia, in beats per minute (BPM)</td>
</tr>
<tr>
<td>Longest Normal-to-Normal</td>
<td>Longest N-N</td>
<td>Time and length of longest N-N interval</td>
</tr>
<tr>
<td>Dropped or Late Beats</td>
<td>Drop/Late</td>
<td>Time and length of longest dropped/late beat</td>
</tr>
</tbody>
</table>
**ST Episodes and Longest Run Fields**
The values in the right-hand column of the Important Events display are described in the following table:

<table>
<thead>
<tr>
<th>Field</th>
<th>Abbr</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST Depression 1</td>
<td>Depr 1</td>
<td>Greatest depressions in Channel 1, in mm</td>
</tr>
<tr>
<td>ST Depression 2</td>
<td>Depr 2</td>
<td>Greatest depressions in Channel 2, in mm</td>
</tr>
<tr>
<td>ST Depression 3</td>
<td>Depr 3</td>
<td>Greatest depressions in Channel 3, in mm</td>
</tr>
<tr>
<td>ST Elevation 1</td>
<td>Elev 1</td>
<td>Greatest elevation in Channel 1, in mm</td>
</tr>
<tr>
<td>ST Elevation 2</td>
<td>Elev 2</td>
<td>Greatest elevation in Channel 2, in mm</td>
</tr>
<tr>
<td>ST Elevation 3</td>
<td>Elev 3</td>
<td>Greatest elevation in Channel 3, in mm</td>
</tr>
<tr>
<td>Longest Run: Ventricular</td>
<td>Ventricular</td>
<td>Length and time of longest Vrun</td>
</tr>
<tr>
<td>Longest Run: Atrial</td>
<td>Atrial</td>
<td>Length and time of longest Arun</td>
</tr>
<tr>
<td>Longest Run: Tachycardia</td>
<td>Tachy</td>
<td>Length and time of longest tachycardia episode</td>
</tr>
<tr>
<td>Longest Run: Bradycardia</td>
<td>Brady</td>
<td>Length and time of longest bradycardia episode</td>
</tr>
</tbody>
</table>

**Viewing ECGs at Min/Max Heart Rate**
To view the ECG at the time of the most extreme minimum or maximum heart rate:

1. After scanning the file, click the Events icon.
2. Select a minimum (or maximum) heart rate and then click the View button.
3. Each instance of ECG is displayed. To document the event, click the Doc icon at the bottom of the screen.

**Viewing ECGs at Longest/Fastest VRun**
To view the longest/fastest VRun, scan a portion or all of the file:

1. Click the Events icon.
2. Click the time when the longest/fastest VRun occurred. The ECG will be displayed with the VRun highlighted.
Editing Through the Graph Icon

Overview

Use Graph histograms to ensure correct class beat labels, to locate mislabeled beats, artifact, and R-R intervals. Also, use the histograms to edit the shortest, longest, and most common intervals in analyzed Holter data. (See "Graph Options" on page 5-19 to review the available formats.) From the Diagnostic window, you can review each Graph using the left and right arrows. You can view the ECG and perform edits using the Scanning icons.

NOTE

Heart Rate Variability (HRV) calculations are affected by R-R values (bad gaps). The Graph gives you the opportunity to clean out bad gaps and mislabeled areas.

Editing from Graphs

Find the type of Event you would like to Edit using the tabs from the bottom of the Graph screen.

Graph Screen with R-R Histograms
**Graph Options**

The Graph (histograms) icon allows you to display intervals in various graphic formats, described in the following table. Through color and two- or three-dimensional graphs, Holter displays complex calculations in simple visual formats.

<table>
<thead>
<tr>
<th>Graphic Format</th>
<th>Interval</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>#Intervals/Sec</td>
<td>R-R</td>
<td>Distribution of intervals between all beats</td>
</tr>
<tr>
<td>#Intervals/Sec</td>
<td>N-N</td>
<td>Distribution of intervals between Normal beats</td>
</tr>
<tr>
<td>#Intervals/Sec</td>
<td>N-V</td>
<td>Distribution of intervals between Normal-to-Ventricular beats</td>
</tr>
<tr>
<td>#Intervals/Sec</td>
<td>V-N</td>
<td>Distribution of intervals between Ventricular-to-Normal beats</td>
</tr>
<tr>
<td>#Intervals/Sec</td>
<td>V-V</td>
<td>Distribution of intervals between Ventricular beats</td>
</tr>
<tr>
<td>#Intervals/Sec</td>
<td>N-N-N</td>
<td>Expresses each N-N interval as a percentage of the preceding N-N</td>
</tr>
<tr>
<td>Time/Leads</td>
<td>12-lead</td>
<td>Three-dimensional (color coded for scale) view of ST episodes, with time values marked in one margin and leads (I through V6) labeled in the other</td>
</tr>
<tr>
<td>Power/Hz</td>
<td>Spectral Power</td>
<td>Three dimensional view of heart rate variability power distribution that expresses heart rate variability by frequency and time.</td>
</tr>
<tr>
<td>Rate/Time</td>
<td>QT</td>
<td>Heart rates (or R-R intervals) are plotted in the top graph and correlated by time in the QT graphs.</td>
</tr>
</tbody>
</table>

To find the event with the shortest, or longest, interval:

1. Click the Graph icon.
2. Click a graph type tab at the bottom of the screen.
3. Click Zoom to enlarge the graph, and adjust using the Left and Right arrow keys on the bottom of the screen to display the shortest coupling interval to longest in the Diagnostic window. Also, click and drag the cursor to view intervals. If there is more than one interval at that measurement, use the up and down arrow keys to view all of them.
4. Click View to see the ECG in the context of the Scan mode.
6. Document the desired area or beat through the Doc icon at the bottom of the screen.

**NOTE**

The shortest coupling interval is found at the extreme left of the graph.

You cannot use these options to manipulate an ST edit.
Editing Graph Spectral Power

Spectral Power mathematically represents physiological mechanisms that generate R-R interval variation. Spectral Power is a representation of the frequency content of successive normal R-R intervals.

The figure that follows shows a sample spectral power. The 3D spectral power plot is composed of a series of 5-minute (configurable) spectral power graphs that are stacked, showing how they vary over time. Each 5-minute spectral power graph is a plot of a spectral power density (ms²/Hz) for a given frequency (Hz).

To display the Spectral Power graph:

1. Click the Graph icon.

2. Click the Spectral Power tab at the bottom of the screen.

Spectral Power Graph
**Advanced Configuration for Spectral Power**

You can configure the most effective segment for your data through the Frequency Domain Heart Rate Variability Configuration dialog box. The options and horizontal and vertical sliders let you set up a default plotting display for your site or change the default configuration by resetting its options.

**NOTE**

Click the Defaults button to reset options to factory defaults.

To display the Frequency Domain Heart Rate Variability Configuration dialog box:

1. Right-click in the graph.

2. Select the Spectrum Smoothing Window and Interpolation Limit.

   - **Spectrum Smoothing Window (hz):** This value determines how much smoothing (averaging) to use for plotting the graph. Larger values will result in smoother graphs but may eliminate pertinent peaks. Smaller values will result in a larger number of peaks and valleys that may make determining overall trends more difficult.

   - **Interpolation Limit (%):** This value specifies the amount of interpolation that will be allowed. Since Spectral Power calculations rely only on normal beats, any noise or ectopic beats must be eliminated by a mathematical process called “interpolation”. Interpolation literally replaces these undesirable areas with expected rhythm. Excessive interpolation is undesirable and thus this parame-
ter is used to place a limit on the amount that is acceptable. Any segment that exceeds this amount is discarded.

For example, if your segment size is set at 5 minutes and the Interpolation Limit is at 2%, the formula looks like this:

\[
5 \text{ minutes (segment size) } \times 60 \text{ minutes } = 300 \text{ seconds} \\
2\% \text{ (or } 2/100) \times 300 \text{ seconds } = 6 \text{ seconds}
\]

In this example, if there is more than 6 seconds of noise or ectopic beats within this segment it will be discarded.

3. Click OK.
12-Lead ST

You can obtain a view of a three-dimensional (3D) display of ST values through the Graph icon or the 12-lead ST tab on the Report display. Levels of elevation or depression are color coded as presented in the scale on the right-hand side of the graph. Time values are marked in one margin and leads (I through V6) are labeled in the other. Use the horizontal and vertical sliders to adjust the orientation of the display.
Editing QT Episodes

Overview

QT and QTc Interval measurements are calculated automatically by the Holter system when the measurement is turned on in the patient setup sequence (see "Step 2. Set Up for a New Scan" on page 2-3).

Why is QT important?

Long QT intervals suggest abnormal function of the myocardium. Extremely prolonged QT/QTcs increase the patient’s chances of sudden cardiac death. When a patient has QT prolongation and episodes of syncope, he or she is suspected of having “Long QT Syndrome.” This phenomenon can lead to arrhythmias, such as R on T. R on T can lead to Torsade de Pointes, which, if uncontrolled, can lead to Ventricular fibrillation and sudden cardiac death. QT measurements can help you recognize life-threatening problems before they happen.

What is QT and QTc?

The QT interval is a measurement that starts at the Q wave and extends through the end of the T wave. (If there is no Q wave, then the starting point would be the very beginning of the R wave.)

The “c” in QTc stands for a heart rate correction formula. QTc is a mathematical formula that independently removes (corrects) the influence of the heart rate from QT measurements.

Why use QTc?

QT interval measurements are heart-rate sensitive. As heart rates increase, QT intervals decrease.

Physicians use QTc measurements because they want to know what the QT normal values are, independent of heart rate influence. Preset mathematical formulas were devised to correct heart rate fluctuations from their affect on QT equation, thus a QTc formula.

Understanding the QT measurement

A useful rule for evaluating QT intervals is that when the heart rate is between 65-90 BPM, the QT interval should be less than half the preceding R-R interval. See the following example formulas:

A formula for Normal QT =

Square Root of R-R (in seconds) divided by 0.39 +/- 10%

Bazett’s formula for QTc =

Square Root of R-R (in seconds) divided by measured QT

Reference Normal QTc= in Males: 0.390 and in Females 0.410
**QTc Correction Options**

There are five (5) QTc correction options: No correction, Bazett, Fridericia, Linear, and Exponential. You can toggle Low Heart Rate on or off for all of the correction formulas.

To view or change the correction formulas:
1. Click the Graph icon and click the QT tab.
2. Right-click in the QT graph area to view the formulas.
3. To select a different formula, click the appropriate button.
4. You also have the choice of plotting heart rate or R-R intervals.

You can also make the following adjustments in the QT Properties dialog box:

- You can choose between plotting heart rate or R-R intervals.
- You can select the QTc percent reporting criteria. QTc Percent Reporting Criteria (ms) tells you the percentage of QTc beats over the duration of scanned areas that are greater than the ms value that was set. This percentage is transferred to the QT Analysis section of the Report.
Editing QT Episodes

QT Properties are defined as follows:

<table>
<thead>
<tr>
<th>Formula</th>
<th>Histogram Code</th>
<th>Description of Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Correction</td>
<td></td>
<td>No formula correction applied</td>
</tr>
<tr>
<td>Bazett</td>
<td>QTb</td>
<td>QT divided by square root (RR); shown in ms, with low heart rate correction</td>
</tr>
<tr>
<td>Bazett</td>
<td>QTbn</td>
<td>QT divided by square root (RR); shown in ms, without low heart rate correction</td>
</tr>
<tr>
<td>Fridericia</td>
<td>QTf</td>
<td>QT divided by cube root (RR); shown in ms, with low heart rate correction</td>
</tr>
<tr>
<td>Fridericia</td>
<td>QTfn</td>
<td>QT divided by cube root (RR); shown in ms, without low heart rate correction</td>
</tr>
<tr>
<td>Linear</td>
<td>QTl</td>
<td>QT plus a(1-RR), shown in ms, where a = 0.154, with low heart rate correction</td>
</tr>
<tr>
<td>Linear</td>
<td>QTln</td>
<td>QT plus a(1-RR), shown in ms, where a = 0.154, without low heart rate correction</td>
</tr>
<tr>
<td>Exponential</td>
<td>Qte</td>
<td>QT – b[exp (-k) – exo (-kRR)], shown in ms, where b = 0.431 and k = 2.3, with low heart rate correction</td>
</tr>
<tr>
<td>Exponential</td>
<td>Qten</td>
<td>QT – b[exp (-k) – exo (-kRR)], shown in ms, where b = 0.431 and k = 2.3, without low heart rate correction</td>
</tr>
<tr>
<td>Low heart rate correction</td>
<td></td>
<td>When set: If heart rate &lt;60 BPM, use correction formula; if not set, do not use low heart rate correction</td>
</tr>
</tbody>
</table>
The following figure shows a sample QT Histogram:

**Graph Screen with QT Measurements**

QT measurements are reported during the scan, on the QT Summary Analysis page of the Report (at the bottom of the page) and the QT page of the Report. The formula you select for the scan is designated at the bottom of the Report page for QT Analysis Summary (see "QT Summary" on page 6-10).
Editing ST Episodes

Overview

ST segments (start of the J point just after the QRS complex to the beginning of the T wave) are used to evaluate when the ST segment shifts into an ST episode. A qualified ST episode is based on a qualified ST segment shift, or deviation, of 1mm or greater (depending on protocol) from its normal isoelectric baseline and its angle (either elevated or depressed with a horizontal or down-slope). The ST Rules threshold must be met before the algorithm creates an ST episode. (See "ST Analysis Rules" on page 3-10 for more information.) ST episode is said to be indicative of injury, myocardial infarction and/or ischemia.

ST editing is used to:

- Verify the ST episodes created by the algorithm.
- Eliminate or delete false episodes. (Repositioning and or artifact may cause a false ST episode.)
- Create or define new ST episodes that you think the scanner has missed.
- Redefine the isoelectric baseline and/or ST rules.

To View and document Strips of ST episodes, use one of the following screens:

1. **Review**: Choose ST Episodes -- shows all ST elevation and depression areas for documentation -- helpful to rule out false episodes due to artifact.

2. **Events**: Scroll through the top 10 most extreme ST episode events per raw channel.

3. **ST Graph**: This is the ST Editing screen -- it displays, in a solid, highlighted bar graph form, qualified elevation and depressions. You must become familiar with ST Rules (see "ST Analysis Rules" on page 3-10) to understand the ST Graph.
The preceding illustration of an ST Graph indicates that:

- The ST Graph screen is in Diagnostic mode. The heart rate and all three raw channels of ST are present.

- The Baseline (B.L.) is set at Abs (Absolute ST values). Note Abs at left of screen. The isoelectric baseline is indicated by a horizontal "dot/dash" line. Channel 3 has a baseline of +0.2mm Absolute. ST deviations will be based on this starting value.

- Channel 3 ST rules are set at 2mm elevation and 1mm depression, indicated by the dotted horizontal lines and deviation values (+2.2mm and -0.8mm) noted on the left.

- The ECG in the top window relates to where the cursor is placed in the bottom Graph window. The cursor is at 1:00 pm, indicated by the Time box, bottom half, and the corresponding ECG time in the Diagnostic window. (The Diagnostic window is 5 seconds later because the window of ECG starts five seconds to the left of the time.)

- The average HR at 1:00 pm is 84. Channel 3’s 30-second averaged ST area is 1.8 mm elevation.
Editing ST Episodes

- Channel 1 has six ST episodes: three are elevated, one is a modified/edited episode, (indicated by a solid bar graph), and two are algorithm-created (indicated by a slit bar graph).

- The Revert/Mark selection dialog box is displayed with a right-click.

Using the ST Graph Window

- Slide Bars are for scanning an ECG ST averaged area from left (front) to right (end). There are two slider bars:

  1. Slide bar in the middle of the screen: covers different lengths of ECG in the Diagnostic window, based upon whether you are using the cursor or a mouse click. Using the cursor, the slide bar shows an ST averaged area of 30 seconds. Using the mouse, when you highlight an ST episode by a click, the slide bar rolls across the entire length of a qualified ST episode and shows 30-second rolling ST averages.

  2. Slide Bar, at the bottom of the screen: moves left to right across the entire scanned ECG

- ST episodes are indicated by a thick solid or slit bar graph in the ST Graph window. A slit bar indicates an algorithm-created ST episode. A solid bar indicates an edited ST episode.

- Clicking in an episode displays the time and the minimum depression or maximum elevation that occurred during that particular episode in a box in the top left corner of the ST Graph window.

- The “ST Baseline” is represented by a thin solid horizontal line in either “Absolute” or “Relative” value, dependent on the B.L. (Baseline) icon setting. (See "ST Analysis Rules" on page 3-10). You can edit or change the ST baseline by dragging the line, which ripples into the ST Rules settings and changes all analysis.

  Rule of thumb: It is usually best to leave the baseline as the algorithm created it. However, if the baseline started in an episode and the intrinsic baseline is in another place, you need to edit the baseline. Drag the baseline marker to the appropriate place.

- The dotted lines indicate the ST episode Rules threshold setting. (See "ST Analysis Rules" on page 3-10). You can change the ST thresholds by dragging the lines, which ripples into the ST Rules Settings and changes all analysis.

- Any ECG graphic outside the threshold, dotted lines, creates an ST episode.

- Clicking the Doc (Document) icon places a strip of the event from wherever the cursor is positioned. To center an ST episode on its minimum depression or maximum elevation, for the Strip and the Report, click the episode bar prior to clicking the Doc icon.
The time line located at the bottom of the graph depicts the entire length of areas scanned. You can use the Zoom icon to view the entire scanned area or portions.

Use the ST toolbar icons at the bottom of the ST screen to hide/show elements of the display, to edit, and to move around the screen.

### ST Toolbar Options

<table>
<thead>
<tr>
<th>Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>View</td>
<td>Jumps to the ECG in the Scanning screen, based on placement of cursor</td>
</tr>
<tr>
<td>Doc</td>
<td>Prints a strip from where the cursor is or from a highlighted ST episode</td>
</tr>
<tr>
<td>Zoom +/-</td>
<td>Decreases the size of the ST graph to include all scanned areas (up to 24 hours) or enlarges the graph to zoom in on specific areas</td>
</tr>
<tr>
<td>Left/Right</td>
<td>Moves the ST graph from left to right</td>
</tr>
<tr>
<td>B.L.</td>
<td>Baseline: toggles between Absolute and Relative isoelectric baseline</td>
</tr>
<tr>
<td>Revert</td>
<td>Undoes all edits of ST episodes and returns to the algorithm-created ones</td>
</tr>
<tr>
<td>H.R.</td>
<td>Show or hide the HR graph</td>
</tr>
<tr>
<td>Chan 1</td>
<td>Show or hide the Channel 1 graph</td>
</tr>
<tr>
<td>Chan 2</td>
<td>Show or hide the Channel 2 graph</td>
</tr>
<tr>
<td>Chan 3</td>
<td>Show or hide the Channel 3 graph</td>
</tr>
<tr>
<td>Create</td>
<td>Create an ST episode -- see the directions following this table</td>
</tr>
</tbody>
</table>

### How to Edit ST Episodes

You can edit an ST episode through:

- ST Graph icon.
- Rules icon (See "ST Analysis Rules" on page 3-10).

The pages that follow provide six methods and instructions for making the following edits to ST episodes through the ST Graph icon:

- Create an episode you think the scanner has missed.
- Delete an undesired existing episode.
- Undo ST edits.
- Adjust ST episode criteria.
- Change elevation/depression limits as desired.
- Document a Strip for Report.
**Creating/ (Adding) an ST Episode**

1. Click the Create icon in the ST toolbar at the bottom of the screen.

![Create Icon]

2. Click in the display window at the point where you want to add the episode, *at the outside boundary line*. A cross-hair cursor appears.

3. Click in the display and drag a corner of the line to the length you want. (A boxed highlight surrounds the active part of the line.)

4. Click in the margin to end your editing session.

5. To revert your edits or mark selection as modified, right-click to display the dialog box (see "ST Graph Screen" on page 5-29). Select the option you want.

**Deleting an ST Episode**

1. Click the yellow ST episode to activate the line. (A thick highlight box surrounds the active part of the line.)

2. Drag a corner inward or to the opposite corner until the message “Will delete episode” appears at the top of the display or use the Delete key on the keyboard.

**Undoing or Reverting ST Edits**

To understand the editing of ST episodes, you need to know the action of:

- **Revert icon**: is a form of deleting/resetting ST episodes. This selection deletes an episode(s) that you have created using the Create icon. If you select this option, ALL EPISODE EDITS ARE DELETED.

- **B.L. icon**: toggles the ST Baseline between Absolute and Relative. In both Absolute and Relative, an isoelectric baseline is set: the difference is that the Absolute ST value is a patient-specific baseline value, while the Relative ST uses a baseline of zero. All ST episodes are then determined once the deviation threshold is met.

---

**NOTE**  
For more information on how ST is measured, see "How ST Numbers are Generated" on page 3-10.

---

**Adjusting ST Episode Criteria**

1. Select the Rules icon.

2. Select the ST Analysis tab -- increase/decrease values by clicking the up/down arrow boxes beside each selection.

3. Minimum Duration/Minimum Separation -- adjust in 30-second increments; the single value effects all channels.
4. Hysteresis -- adjust in millimeters (mm); the single value effects all channels.

5. Elevation and Depression -- adjust in millimeters (mm) for each individual channel.

6. Slope -- adjust in degrees for each individual channel.

7. Stop ST analysis in any channel by removing the check mark from the box beside the appropriate channel.

---

**NOTE**

ST adjustments will be applied throughout entire recording (Apply Setting to: Everywhere)

---

**Changing Elevation/Depression Limits**

You can change elevation/depression thresholds (and episodes) by:

- Using Rules/ST Rules dialog box -- see "ST Analysis Rules Dialog Box" on page 3-11.

  or

- Dragging the limit rules in the left-hand margin (dotted ST value line). These values are automatically reflected in the ST Rules dialog box. These settings can be made permanent by adding them as a new set of rules through the Rule Sets procedure.

---

Changing ST Rules redefines the ST settings and performs a Ripple effect into:

- ST episodes (it may delete or create ST episodes automatically).
- ST values in Report.

---

**Documenting an ST Strip for the Report:**

Use the Doc icon from any of the ST View areas (Review, Events, or ST Graph) to create strips for the Report. The strip is transferred to Report/Strips. Strips containing ST episodes automatically are labeled with the ST episode highest or lowest value and the time and duration.

---

**NOTE**

You must complete ST editing prior to using the Document Strip function because the “Ripple Effect” of edit changes does not transfer to Strips already documented.
Editing and Documenting Strips

Overview

Strips are an important part of the Report as they offer the clinician an opportunity to review an event and its surrounding complexes. You are expected to document, label, and edit strips for the Report.

You can automatically document strips, or you can manually document them. Any strips maintained in the Strips screen are transferred to the Report.

See Chapter 10, "Configuring the Scanner" to change the strip length.

Manually Documenting Strips from any Screen

When the Review, Event, Graph, or ST icons are active:

1. Highlight the desired event or item.

2. Click the Doc icon.

When the Scan icon is active:

1. Click the Doc icon.

2. Click over the desired area in the Page window (The center mark on the Focus Box will be the center of the strip).

Using Auto Document

You can automatically document events after a complete or partial scan.

Setting up Auto Document Strips

Auto Document allows the user to create multiple strips of pre-chosen events for the Report with one click of the Auto Document (Auto Doc) icon. First, the type and frequency of events, or style of Auto Documentation, must be set up.
Use the following steps to set up an Auto Document Style:

1. On the Tools menu, select Auto Document to access the Auto Document dialog box.

2. Select the Events for which strips will be taken.

3. Configure the frequency of the strips. Choose from All, None, or Limit (the maximum number of strips to create during the period of time you specify).

4. Click Save As...

   - If you change a setting on an event, the Save As button becomes active, and you can save the style with the same name or type in a different name.

**NOTE**

Delete is active only when an existing style is selected. To modify an existing style, make the changes to the events, then choose an existing name in the drop-down (combo) list box. Save As... will overwrite the new event choices to the chosen style.

5. Enter a name for the collection of events configured in the field Save this Style as. You can enter a name (alphanumeric characters) that describes the activity you want to document or the types of events that your site usually documents in a Holter Report.

6. Click OK to save the new named style.
7. Click either:
   Close, for later use.
   or
   Document Now to create the strips at this time. Then, click the Strips icon
   and/or Strips tab in the Holter Report to verify that these strips have been
   created.

To modify an existing style, after accessing the Auto Document dialog box,
1. Select a default style via the pull-down menu.
2. Follow Steps 2-7.

**Saving Strips via Auto Document**
Once the Auto Document style is set up, there are two ways to create strips
automatically. Use the following steps after a complete or partial scan:
   a. In the Auto Document dialog box, select a default Styles settings for
      your site.
   b. Click Document Now.
2. From the Strips screen, click the Auto Doc icon.
3. Verify that these strips have been stored for the Report file.
   If you have documented too many strips for the Report, de-select the strips by
   right-clicking on a strip and choosing Delete.

**Strips Filter Options**
All types of strips are visible from the Strips screen. Click a Show icon at
the bottom of the screen to show or hide types of strips (for example,
Show Ventricular) to view only the type of strip selected.
**Strips Screen**

![Strips Screen Image]

**Strips Options**

Click the Edit Icon, or right-click a strip in the display. The following menu appears:

- **Twelve Lead** -- to change the view of the strip to 12-lead for the Report.
- **View at ECG** - takes you to the event in the scan that caused the strip to be taken.
- **Edit** - allows you to add comments through the Strip Information dialog box. (See "Changing a Label on a Strip" on page 5-38.)
- **Delete** - deletes the current strip.
**Changing a Label on a Strip**

The Strip Information dialog box allows you to add comments to or change information in the strip header. You can use pre-identified labels for quick editing or type in customized labels into the Comments field. You can add or delete default strip labels.

Make changes, then click OK.

To access the Strip Information dialog box, use one of the Editing Strip options from the Strips icon screen:

- Double-click the header of a strip.
- Click a strip, then click the Edit icon at the bottom of the screen.
- Right-click a strip, then select Edit from the dialog box.

**Calipers**

The Holter scanner allows you to measure typical distances (P-R, QRS, R-R, etc.) of individual beats by using the temporary caliper option in the Diagnostic window. As you drag caliper lines, the measurement displays below the lines to reflect distances between the configured lines.
**Adding Calipers to Strips**

You can add calipers to strips that will be displayed and printed in Reports though the following procedure:

1. In Scan mode, take a strip (or strips) of the beat(s) that you want to document by clicking the Doc icon.

2. Display the Strips window by clicking the Strips icon (or menu item).

3. Click the Diagnostic icon to display a Diagnostic window in the upper half of the screen.

4. Add a caliper through the Caliper icon (menu item or Alt + C).

**NOTE**

For details on creating and configuring calipers, see "Creating and Configuring Calipers" on page 10-11.

**Reporting Strips**

When you view strips in the Report section, right-click the strip to display the following options:

- Viewing the ECG where the strip was taken.
- Reviewing the strip in the context of other strips.

**NOTE**

To return immediately from an ECG, Review, or Strips page to a Report page, press the Backspace key.
Editing Reports

In addition to the Report icon that produces a Holter Report, you can use tabs on the Report toolbar to display graphical summaries of data. If you are viewing a Report, use the tabs at the bottom of the display. In addition to tabs, you can locate the same data by pulling down menu pages at the top of the screen. Chapter 6, "Setting Up and Printing Reports" contains instructions for setting up the Report.

There are three ways you can edit the Report:

- From Strips, Morphology, and Full Disclosure tabs, jump to the desired editing screen, using the following steps:
  1. Move the mouse over the desired area and right-click.
  2. Choose View at ECG or Review.
  3. Use the Tools and Scanning icons.

- From the other Report tabs, go to each of the specific areas to review and edit the data. Edit the Report data fields, using the following procedure:
  1. Click in an area of the Report that you want to change.
  2. Observe that the field is highlighted in another color.
  3. Enter the new data.

NOTE
Observe that the changed Report data appears in italics (but does not print in italics).

- Edit the Narrative Summary on a Report. The entire area acts like a big cell.
  For information on configuring how fields are displayed in the Narrative on a Report, see "Narrative Summary Template" on page 10-13.

NOTE
If you do not see Report sections that you know should be there, go to the Tools menu, and select Configure Reports to add missing tabs. Make sure to save your Report before or after printing.

To Change the Counts on a Report Page

Changes to fields on the Summary pages are reflected in the totals of the appropriate Report pages, and vice versa. Similar to a spreadsheet, the detail fields are in table format. You can manually change a value and the changes are reflected in the column total and Summary totals. When totals are changed, however, detail fields are not changed. Zero affects all fields (detail and total) in that section.
From the other Report tabs, go to each of the specific areas to review and edit the data. Edit the Report data fields, using the following procedure:

1. Open a Report file (.zpt or .zhr file) or click the Report icon for the current file.

2. Select the Summary page (or a page in a section of the Report).

3. Click in the field that you want to edit (it turns a different color).

4. Enter the new data for that field. (The new value appears in italics on the screen but is printed in normal font.)

5. Observe that the totals for the item in both the Summary page and the table cell of the related section of the Report now agree with the new numbers.

6. (Optional) To restore the totals originally reported by the Holter scanner, right-click and choose Reset.

**Ripple Edit**

Ripple edit allows changes in table cells on Event pages of the Report to ripple down to the totals. Ripple edit can be helpful if during the scan there is excessive artifact. Correcting beats one by one becomes time consuming. Click on the Report Event page and edit the totals.

Observe that the changed data appears in italics (but does not print in italics).
Editing Reports
Overview

When you click the Report icon or menu option, Holter displays a 14-section Summary of the current Holter scan. You can customize each Report to include (or exclude) individual sections. Also, you can select the format or configure each section.

Sample Holter Report
See the following sections in this chapter for more information:

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working with and Moving Around Reports</td>
<td>6-2</td>
</tr>
<tr>
<td>Select the Report Sections</td>
<td>6-4</td>
</tr>
<tr>
<td>Description of Report Sections</td>
<td>6-5</td>
</tr>
<tr>
<td>Select Report Formats</td>
<td>6-14</td>
</tr>
<tr>
<td>Edit the Report Data</td>
<td>6-15</td>
</tr>
<tr>
<td>Print the Report</td>
<td>6-17</td>
</tr>
</tbody>
</table>

### Working with and Moving Around Reports

When the Holter Report is generated, you can:

- Print full or partial Reports (See Print Reports on page 6-17).
- Edit/change data (by clicking and typing new information in a field).
- Select sections of the Report to include or exclude.
- Perform the functions listed in the following table:

<table>
<thead>
<tr>
<th>Function</th>
<th>To Select</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Properties</td>
<td>Right-click</td>
<td>Displays the section's/page's Properties dialog box for configuring page style (unique to each section).</td>
</tr>
<tr>
<td>Reset item or page</td>
<td>Right-click</td>
<td>Displays original data after editing (resetting the Report to the data originally displayed).</td>
</tr>
<tr>
<td>Review</td>
<td>Right-click</td>
<td>Jumps you to the beats (strips) or episode from which the data is derived. To move to the next beat, press the plus (+) key; to move to the previous beat, press the minus (-) key.</td>
</tr>
<tr>
<td>Rules</td>
<td>Left-click</td>
<td>From any Events page, left-click on the rule setting in the second line of the profile (the mouse will change). The hyperlink will take you to the Rules dialog box. This allows the user to adjust the rule setting.</td>
</tr>
<tr>
<td>View at ECG</td>
<td>Right-click</td>
<td>Jumps to the ECG at the time the beat or event occurred.</td>
</tr>
<tr>
<td>Zoom</td>
<td>Right-click</td>
<td>Changes the size of the page of the Report on the screen.</td>
</tr>
</tbody>
</table>
Moving Around the Report

Use the following icons located at the bottom of the Report window to move around the Report.

**NOTE**

To jump back immediately from an ECG, Review, or Strips page to a Report page, press the Backspace key.

<table>
<thead>
<tr>
<th>Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>🔄 Page</td>
<td>Moves to the previous page.</td>
</tr>
<tr>
<td>🔄 Page</td>
<td>Moves to the next page.</td>
</tr>
<tr>
<td>🔄 Section</td>
<td>Moves to the previous section.</td>
</tr>
<tr>
<td>🔄 Section</td>
<td>Moves to the next section.</td>
</tr>
</tbody>
</table>

Philips Zymed Holter
Setting up the Report

A. Select the Report Sections

You select the areas of the Report that you want to include using the Report Section Options dialog box.

To configure Report Section Options:

1. Scan a portion or all of the file.
2. Click the Report icon.
3. Click Tools/Configure Reports.
   The Report Section Options dialog box is displayed.

4. Set up sections of the Report to be viewed by clicking the check box associated with the section.
5. Click OK. (Observe that the Report sections match what you have set up in Step 4.)
6. Click the associated Report tabs to display individual sections of the Report. Your selections become the default values for the next scan.

**NOTE**

The Report Section Options menu item is grayed out until you have scanned (part or all) a file and have generated Report data.

The Analysis Summary on the Report Sections Options dialog box is always greyed out because it is mandatory for every Report.
Selecting Data for Summaries

Some Report sections are in tabular page format, which consists of cells. Tabular summary pages refer to the following Report areas that provide optional one-minute to sixty-minutes of statistical information per row:

- Supraventricular beats/events
- Ventricular beats/events
- ST analysis
- QT analysis
- Pacemaker analysis

<table>
<thead>
<tr>
<th>If you want to...</th>
<th>Do this</th>
</tr>
</thead>
<tbody>
<tr>
<td>See the rules that generated these statistics</td>
<td>Click in a column header on a Supraventricular, Ventricular, or ST Summary page.</td>
</tr>
<tr>
<td>Change a field in a Report</td>
<td>Left-click in the field.</td>
</tr>
<tr>
<td>Display strips that you have documented</td>
<td>Click the Strips tab.</td>
</tr>
<tr>
<td>See a full disclosure of the beats in the Report</td>
<td>Click the Full Disclosure tab.</td>
</tr>
</tbody>
</table>

Description of Report Sections

Use the Report tabs, shown in the following graphic, to display a specific section of the Report. The tabs that appear are dependent on the sections you set up in the Report Sections Options dialog box.

Summary

This is the cover page or Summary page of the Report and uniquely identifies the Report. It is always the first page of the Report. This area of the Report contains the patient information you entered through the New Patient - Demographics screen or that was read from a data source.

Heart Rate Data

This area of the printout reports on heart rates (minimum, maximum, and average) and the variability of those rates during a specified period.
Heart Rate Variability Averages

Heart Rate Variability (HRV) is the study of the degree of R-R regularity of normal sinus rhythms for specific time intervals. HRV is reported in two formats: time domain and frequency domain.

Time Domain Format

The time domain format represents the amount of variability of the R-R intervals, as expressed in a standard deviation average, and appears in the totals on the Summary page of the Report. Standard deviation is a measure of the degree of regularity of the R-R intervals for each 5-minute interval that is averaged and calculated in milliseconds. Abnormal beats are excluded when calculating standard deviation.

Standard Deviation Reporting

<table>
<thead>
<tr>
<th>ASDNN 5:+</th>
<th>Average of all five minute standard deviations</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDANN 5:+</td>
<td>Standard deviation of all five minute averages</td>
</tr>
<tr>
<td>SDNN +</td>
<td>Standard deviation for all analyzed N-N intervals</td>
</tr>
</tbody>
</table>

Interpretation

You can enter up to 2,048 letters (approximately one screen) to recap the analysis. If the text continues over onto the next page, scroll bars appear in the right-hand margin that allow you to scroll through the description.

NOTE

The Transcription Assistant can speed up the time spent typing interpretation statements by allowing you to add often-used phrases and sentences to the Interpretation section.

Narrative Summary


CAUTION

Changes to the Narrative Summary do not ripple through the Report. Therefore, you must complete all edits to the Report before using the Narrative Summary.

See Chapter 10, "Configuring the Scanner" for information on using the Narrative Summary template.
**Supraventricular**

The Supraventricular Profile/Events pages of the Report describe Supraventricular ectopy within a specified time period. This time period is configurable (see "Properties" on page 6-2). To review the definition for each category, see "The Rules Dialog Box" on page 3-2.

Supraventricular Special Event graphics follow the Profile/Event pages.

<table>
<thead>
<tr>
<th>Beat</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total SVE beats</td>
<td>Total number of Supraventricular beats.</td>
</tr>
<tr>
<td>N-N Max</td>
<td>Longest Normal-to-Normal interval in msec.</td>
</tr>
<tr>
<td>R-R Max</td>
<td>Longest R-R interval. This interval may include Ventricular beats (i.e., PVC-Normal, Normal-PVC, Ventricular-Ventricular). This interval is measured in msec.</td>
</tr>
<tr>
<td>Atrial Pairs</td>
<td>The number of Atrial pairs. Reported in events.</td>
</tr>
<tr>
<td>Bi/Trigeminy beats</td>
<td>Total number of beats in Bi- and Tri-geminy episodes.</td>
</tr>
<tr>
<td>AFib Beats</td>
<td>Total number of Atrial Fibrillation beats.</td>
</tr>
<tr>
<td>AFib Duration</td>
<td>The length of time in Atrial Fibrillation.</td>
</tr>
<tr>
<td>Single PAC’s</td>
<td>Total number of single Premature Atrial Contractions.</td>
</tr>
<tr>
<td>Drop beats</td>
<td>Total number of long pauses.</td>
</tr>
<tr>
<td>Late beats</td>
<td>Total number of shorter pauses.</td>
</tr>
<tr>
<td>Arun Events</td>
<td>Total number of Atrial runs.</td>
</tr>
<tr>
<td>Arun beats</td>
<td>Total number of beats in all Atrial runs.</td>
</tr>
<tr>
<td>Max BPM</td>
<td>Fastest heart rate reported in Atrial runs. Measured in beats per minute.</td>
</tr>
<tr>
<td>Max Length</td>
<td>Longest Atrial run. Measured in number of beats.</td>
</tr>
<tr>
<td>Brady Events</td>
<td>Number of events that meet the criteria for Bradycardia.</td>
</tr>
<tr>
<td>Brady duration</td>
<td>The total duration in time of Bradycardia episodes.</td>
</tr>
<tr>
<td>Tachy Events</td>
<td>Number of events that meet the criteria for Tachycardia.</td>
</tr>
<tr>
<td>Tachy duration</td>
<td>The total duration in time of Tachycardia episodes.</td>
</tr>
</tbody>
</table>
**Ventricular**

The Ventricular Profile/Events pages of the Report describe Ventricular ectopy within a specified time period. This time period is configurable (see "Properties" on page 6-2). To review the definition for each category, see "The Rules Dialog Box" on page 3-2.

Ventricular Special Event graphics follow the Profile/Events pages.

<table>
<thead>
<tr>
<th>Beat</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VE Total</td>
<td>The total number of Ventricular beats.</td>
</tr>
<tr>
<td>VE Single</td>
<td>Total number of single Ventricular ectopic beats that are not premature.</td>
</tr>
<tr>
<td>VE Late</td>
<td>Total number of late Ventricular ectopic beats.</td>
</tr>
<tr>
<td>Vrun Events</td>
<td>Total number of Ventricular runs.</td>
</tr>
<tr>
<td>Vrun beats</td>
<td>Total number of beats in Ventricular runs.</td>
</tr>
<tr>
<td>Max BPM</td>
<td>Fastest Ventricular run, measured in beats per minute.</td>
</tr>
<tr>
<td>Max Length</td>
<td>Longest Ventricular run, measured in total beats.</td>
</tr>
<tr>
<td>Couplet (Cplt)</td>
<td>Number of Couplet episodes.</td>
</tr>
<tr>
<td>Triplet (Tplt)</td>
<td>Number of Triplet episodes.</td>
</tr>
<tr>
<td>R on T</td>
<td>Number of R on T beats.</td>
</tr>
<tr>
<td>Bigeminy beats</td>
<td>Number of beats in an episode of Bigeminy.</td>
</tr>
<tr>
<td>Trigeminy beats</td>
<td>Number of beats in an episode of Trigeminy.</td>
</tr>
<tr>
<td>PVC Single</td>
<td>Total number of single Ventricular beats that meet the criteria for prematurity.</td>
</tr>
<tr>
<td>PVC Interp</td>
<td>Total number of single Ventricular beats that meet the criteria for Interpolated PVCs.</td>
</tr>
</tbody>
</table>

**Spectral Power**

Spectral analysis evaluates and quantifies periodicites in the R-R intervals of Normal beats. For more information about spectral power and analysis, see "Advanced Configuration for Spectral Power" on page 5-21.

**12-Lead ST**

You can obtain a three-dimensional (3D) display of ST values through the 12-lead ST tab on the Report display. Levels of elevation or depression are color coded as presented in the scale on the right-hand side of the graph. Time values are marked in one margin and leads (I through V6) are labeled in the other.
Customizing 12-Lead ST

The 12-Lead ST tab displays a 3-dimensional graphic of the 24-hour ST measurement. No editing of ST can be done from this report view. To customize the view of the 12-Lead ST graph, right click the mouse and choose Properties. The following options are available:

- Plotting Method: a view of the surface by either Surface or Pixel.
  - Surface: Report shows pixels, plus the lines that connect them (as seen in the following illustration).
  - Pixel: values are represented by dots.
- Contours: a view from Bottom, Top, or Off.

ST Episodes

The ST Episodes tab of the Report gives totals for the number of ST episodes, with minimum, average, and maximum levels, within a specific time period. This time period is configurable (see "Properties" on page 6-2). To review the definition for each category, see "The Rules Dialog Box" on page 3-2.

ST measurement is reported as follows:

- ST Episodes
  
  Only the ST measurement that meets the criteria for an episode will be reported on the first page. This includes ST episodes for all three channels. If there are no qualified ST episodes, this page will be blank.
• **ST Summary**

  The summary pages reflect ST measurement in each individual channel. The summary pages include qualified ST episodes and global measurement.

• **ST Special event graphics**

  The Special Event graphic pages reflect the global ST measurement. The graphic includes Heart Rate, ST Level, and ST Slope for all three channels.

The following table lists the categories in which ST is reported. This table is the same for ST Episodes and ST Summary:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel</td>
<td>The channel of the recording with an ST episode.</td>
</tr>
<tr>
<td>Starting Time</td>
<td>The time the ST episode started.</td>
</tr>
<tr>
<td>Ending Time</td>
<td>The time the ST episode ended.</td>
</tr>
<tr>
<td>Total duration</td>
<td>The length of the episode, measured in time.</td>
</tr>
<tr>
<td>Elev/Depr</td>
<td>Indicates if the episode was in elevation or depression.</td>
</tr>
<tr>
<td>Area (mm*min)</td>
<td>Reports the area (millimeters x minutes) of elevation or depression within an episode.</td>
</tr>
<tr>
<td>Level Min</td>
<td>Reports the minimum depression level of the ST episode.</td>
</tr>
<tr>
<td>Level Avg</td>
<td>Reports the average level of the ST episode.</td>
</tr>
<tr>
<td>Level Max</td>
<td>Reports the maximum elevation level of the ST episode.</td>
</tr>
<tr>
<td>SlopeMin/Avg/Max</td>
<td>Reports the minimum, average, and maximum slope measurement, in degrees.</td>
</tr>
</tbody>
</table>

**QT Summary**

Access this section of the Report by clicking the QT Summary tab.

QT measurement is a method of risk assessment indicated for patients with and without symptoms of arrhythmia. QT measurements are based upon available channels (up to three) that are averaged, then combined, using EASI coefficients (assuming an EASI hookup). QT measurements are based on Normal beats only and not intended to produce an interpretation or diagnosis of those measurements.

For more information on QT, see "Editing QT Episodes" on page 5-24. The QT analysis summary reports the min/max/avg measurement for QT and QTc, in a specific time period. See "Properties" on page 6-2 to learn more about setting up specific time periods.

QT Special Events graphics follow the QT Analysis Summary.
**Pacer**

The Pacer tab reports the Pacemaker Analysis in a specific time period. This time period is configurable (see "Properties" on page 6-2). Pacemaker special event graphics follow the analysis report. See chapter 4 for detailed information on pacemaker analysis.

Holter reports pacemaker activity in eight categories.

- % of paced beats
- Atrial paced
- Ventricular paced
- Dual paced beats
- Fusion beats (a paced beat plus a normal sinus beat)
- Failure to output (FTO)
- Failure to sense (FTS)
- Failure to capture (FTC)

**Index, Strips, and Morphology**

Holter provides an inventory of all diary entries, morphology types, and strips saved in the Report. Access this information by clicking the Index tab in the Holter Report.

**Index Page**

The Index page includes a list of all diary entries, morphology entries, and selected strips. You can add the Index page to the Report by accessing the Tools menu.

1. Click Tools\Configure Report.
2. Click the Diary, Strip & Morphology Index button, then click OK. (See the figure that follows.)

**NOTE**

The beat annotations that appear on the Index page of the Report (listed in Appendix B) are localized for each language."
### Setting up the Report

**6-12**

#### Setting Up and Printing Reports

**Selected strips are a part of the Report that show the ECG strips that are automatically transferred from the Strips icon area. Hover over a strip, right-click, and choose one of the following options:**

- **View at ECG**: hover over the desired area and right-click.
- **Previous/Next Page**: jumps from the current Report page forward or backward.
- **Zoom**: choose from the various page size options to enlarge or reduce the view of the page. Click OK to apply the new setting.

### Diary, Strip & Morphology Index

#### Diary Entry Index

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>HR</th>
<th>ECG Type</th>
<th>Strip</th>
</tr>
</thead>
<tbody>
<tr>
<td>12:10 PM</td>
<td>Chest Pain</td>
<td>80 BPM</td>
<td>Normal</td>
<td>Strip 1 of 20</td>
</tr>
<tr>
<td>12:30 PM</td>
<td>Dizzy</td>
<td>80 BPM</td>
<td>Normal</td>
<td>Strip 2 of 20</td>
</tr>
<tr>
<td>12:50 PM</td>
<td>Faint</td>
<td>80 BPM</td>
<td>Normal</td>
<td>Strip 3 of 20</td>
</tr>
</tbody>
</table>

#### Morphology Index

<table>
<thead>
<tr>
<th>Time</th>
<th>ECG Type</th>
<th>HR</th>
<th>Strip</th>
</tr>
</thead>
<tbody>
<tr>
<td>12:00:07 PM</td>
<td>Normal</td>
<td>80 BPM</td>
<td>Strip 1 of 20</td>
</tr>
<tr>
<td>12:05:00 PM</td>
<td>Normal</td>
<td>80 BPM</td>
<td>Strip 2 of 20</td>
</tr>
<tr>
<td>12:06:10 PM</td>
<td>Ventricular</td>
<td>80 BPM</td>
<td>Strip 3 of 20</td>
</tr>
<tr>
<td>12:10:20 PM</td>
<td>Normal</td>
<td>77 BPM</td>
<td>Strip 4 of 20</td>
</tr>
<tr>
<td>12:10:40 PM</td>
<td>Normal</td>
<td>84 BPM</td>
<td>Strip 5 of 20</td>
</tr>
<tr>
<td>12:11:17 PM</td>
<td>Normal</td>
<td>71 BPM</td>
<td>Strip 6 of 20</td>
</tr>
<tr>
<td>12:20:03 PM</td>
<td>Normal</td>
<td>95 BPM</td>
<td>Strip 7 of 20</td>
</tr>
<tr>
<td>12:40:30 PM</td>
<td>Normal</td>
<td>60 BPM</td>
<td>Strip 8 of 20</td>
</tr>
<tr>
<td>12:46:30 PM</td>
<td>Normal</td>
<td>60 BPM</td>
<td>Strip 9 of 20</td>
</tr>
<tr>
<td>12:50:01 PM</td>
<td>Ventricular</td>
<td>171 BPM</td>
<td>Strip 10 of 20</td>
</tr>
<tr>
<td>12:50:30 PM</td>
<td>Ventricular</td>
<td>171 BPM</td>
<td>Strip 11 of 20</td>
</tr>
<tr>
<td>12:52:00 PM</td>
<td>Ventricular</td>
<td>171 BPM</td>
<td>Strip 12 of 20</td>
</tr>
<tr>
<td>12:54:22 PM</td>
<td>Normal</td>
<td>116 BPM</td>
<td>Strip 13 of 20</td>
</tr>
<tr>
<td>12:54:04 PM</td>
<td>Ventricular</td>
<td>174 BPM</td>
<td>Strip 14 of 20</td>
</tr>
<tr>
<td>12:52:03 PM</td>
<td>Ventricular</td>
<td>171 BPM</td>
<td>Strip 15 of 20</td>
</tr>
<tr>
<td>12:54:33 PM</td>
<td>Normal</td>
<td>60 BPM</td>
<td>Strip 16 of 20</td>
</tr>
<tr>
<td>1:00:11 PM</td>
<td>Normal</td>
<td>70 BPM</td>
<td>Strip 17 of 20</td>
</tr>
<tr>
<td>1:00:52 PM</td>
<td>Ventricular</td>
<td>80 BPM</td>
<td>Strip 18 of 20</td>
</tr>
<tr>
<td>1:02:00 PM</td>
<td>Ventricular</td>
<td>171 BPM</td>
<td>Strip 19 of 20</td>
</tr>
<tr>
<td>1:02:38 PM</td>
<td>Ventricular</td>
<td>162 BPM</td>
<td>Strip 20 of 20</td>
</tr>
</tbody>
</table>

#### Strip Index

<table>
<thead>
<tr>
<th>Time</th>
<th>HR</th>
<th>ECG Type</th>
<th>Strip</th>
</tr>
</thead>
<tbody>
<tr>
<td>12:02:14 PM</td>
<td>80 BPM</td>
<td>Sx x1,x1,x1</td>
<td>Strip 1 of 17</td>
</tr>
<tr>
<td>12:10:00 PM</td>
<td>80 BPM</td>
<td>Sx x1,x1,x1</td>
<td>Strip 2 of 17</td>
</tr>
<tr>
<td>12:16:23 PM</td>
<td>60 BPM</td>
<td>Sx x1,x1,x1</td>
<td>Strip 3 of 17</td>
</tr>
<tr>
<td>12:28:17 PM</td>
<td>64 BPM</td>
<td>Sx x1,x1,x1</td>
<td>Strip 4 of 17</td>
</tr>
<tr>
<td>12:39:57 PM</td>
<td>75 BPM</td>
<td>Sx x1,x1,x1</td>
<td>Strip 5 of 17</td>
</tr>
<tr>
<td>12:30:18 PM</td>
<td>75 BPM</td>
<td>Ventricular Run</td>
<td>Strip 6 of 17</td>
</tr>
<tr>
<td>12:30:57 PM</td>
<td>75 BPM</td>
<td>Ventricular Run</td>
<td>Strip 7 of 17</td>
</tr>
<tr>
<td>13:01:24 PM</td>
<td>64 BPM</td>
<td>Sx x1,x1,x1</td>
<td>Strip 8 of 17</td>
</tr>
</tbody>
</table>

**Strips Pages**

Selected strips are a part of the Report that show the ECG strips that are automatically transferred from the Strips icon area. Hover over a strip, right-click, and choose one of the following options:
• **Properties** for Strip Information dialog box. Configure a Report strip by choosing one of the following:
  
  a. Display Options: to invert a lead or to choose which lead or channel to be displayed, and the gain.
  b. Heart Rate: change the heart rate of a strip (type in the value).
  c. Comments: type a comment to be added to the strip label.
  d. Strip label: change the strip label from the options given or create a new label.

**Morphology Pages**

When you view classes of beats in the Morphology Review section, you can right-click on the ECG display (left-hand side) to display the following options:

• **Review**: jumps to Class Edit to change the class of a beat.
• **Previous/Next Page**: jumps from the current Report page forward or backward.
• **Zoom**: choose from the various page size options to enlarge or reduce the view of the page. Click OK to apply the new setting.

**Full Disclosure**

Full Disclosure (FD) in the Report is a view, page-by-page, of all ECG beats that have been scanned. The default view size is 100% in Channel One, a 60-minute page, without beat annotations. In FD, right-click and choose one of the following options:

• **View at ECG**: hover over the desired area and right-click.
• **Document a Strip**: hover over the desired area and right-click.
• **Previous/Next Page**: jumps from the current Report page forward or backward.
• **Zoom**: choose from the various page size options to enlarge or reduce the view of the page. Click OK to apply the new setting.
• **Properties**: to change Page configurations. Access the Full Disclosure dialog box by single-clicking from the FD page or right-click for the following fields:
  
  a. Display Lines: to invert a lead or to choose which lead or channel to be displayed, and the gain.
  b. Annotations: add/delete annotation (labels) of beats on the FD page. Choices are: (1) Off, (2) Arrhythmia, (3) Normal + Arrhythmia.
  c. Size: adjust the size of the page, in minutes. Choose 15-60 minutes per page.

| NOTE | Viewing and printing full disclosure can add several pages to the Report. |
B. Select Report formats

The Summary Properties dialog box allows you to:

- Select Report styles (display more, or fewer, sections of beat and episode summaries). Five styles of formatting are used to report Summary data from scanning.
- Select the Logo for the Report.
- Select a customizable report format for extended demographic fields.

**To select Report styles:**

1. Click the Report icon.  
The Report Summary page is displayed.

2. Right-click the Summary Page 1 of the Report.

3. Click Properties to display the Summary Properties dialog box.

![Summary Properties dialog box]

4. Select one of the five Summary Page styles.  
   For your default setting, select the format that applies to the predominant type of scans you perform, and then choose either Detailed or Summary for those scans that display that data.

**NOTE**  
You must select Pacer and ST on the Recorder Format and Scan Setup dialog boxes before the scan is performed, in order to have the data appear in the Report.

5. Click OK.  
   Report Page 1 changes to reflect the summary page style you selected.
## Setting up the Report

### To add a Logo to the Report Summary page:

**NOTE**

Logo files are not supplied with the Holter software.

1. Copy your logo file (.emf) to the Holter directory (usually C:\Program Files\Holter).

2. Click the Report icon.
   The Report Summary page is displayed.

3. Right-click the Summary Page 1 of the Report.

4. Click Properties to display the Summary Properties dialog box

5. Click in either the Left Logo File or Right Logo File list box and browse to the directory where the logo is located.

6. Click the logo you want to use.

7. Click OK
   The selected logo displays on the Report Summary page.

### To Customize Patient Demographic Data

**NOTE**

Make sure that the Enable extended demographics user fields on the Tools - >Customize ->Misc dialog box is set (see "The Customize Dialog Box" on page 10-7) before performing the steps in this procedure.

You can customize the Patient Demographics section of a Report Summary through the following procedure:

1. On the Tools-> Customize-> Misc dialog box, confirm that the Enable extended demographics user fields checkbox is set.

2. On the Tools-> Customize ->User Field Labels dialog box, add customized names (see page 6-16 for a sample of user fields) for up to 20 of the optional fields.

3. Click OK to exit from the Customize ->User Field Labels dialog box.

4. Start a New scan, opening a new ECG file to be scanned.

5. Follow the normal sequence of steps for a new scan (for example, completing Recorder Format, Demographics, etc).

6. After you press Next on the Demographics dialog box, enter data (up to 20 characters) for the user fields you labeled in step 2 above.

7. Complete the remaining dialog boxes to start a scan; then run the Holter scan.

8. Click the Reports icon (or View ->Reports) to display the analyzed ECG and customized fields in the Patient Demographics section.
C. Edit the Report data

Changes to fields on Summary pages are reflected in the totals of the appropriate Report pages, and vice versa. Like a spreadsheet, the detail fields are in table format. You can manually change a value, and the changes are reflected in the column totals and summary totals. When totals are changed, however, detail fields are not changed. Zero affects all fields (detail and total) in that section.

To edit data fields on the Report:

1. Right-click in an area of the Report that you want to change.
2. Observe that the field is highlighted in another color.
3. Enter the new data.

NOTE

After you make a manual change to the data, the changes in table cells on Event pages of the Report ripple down to the totals.

4. Observe that the changed data appears in italics (but does not print in italics).
D. Print the Report

You can configure what parts of the Holter Report you want included or excluded from the printed Report by clicking the Holter Report icon. See "Setting up the Report" on page 6-4.

There are three ways to print the Report:

- Print a full/partial Report.
- Print selected pages.
- Print by shortcut

To Print a Full Report or Partial Report:

1. Determine which Report sections are to be included or excluded. (See "Setting up the Report" on page 6-4.)

2. Click File\Print. The Print dialog box is displayed.

3. From the Print dialog box, select the following items:
   - Name of a printer (or use the default)
   - Range of pages to be printed (the default is “ALL”)
   - Number of copies (the default is “1”)

4. Click OK. The Report is printed.

To Print Selected Pages:

1. When in Report mode, click the Pages menu.

2. Determine which pages you want to print.
3. Click File\Print.
   The Print dialog box is displayed.

4. Enter the name of the printer, number of copies, and the range of pages
   that you want to print.

5. Click OK
   The selected pages of the Report are printed.

To Print by Shortcut

From Report mode, click the Print icon on the top toolbar.

The Report prints, using the default sections or custom setup.
Overview

This chapter contains system messages and tips that will help you troubleshoot the Philips Zymed Holter Scanner. Choose one of the following topics for more information:

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Messages</td>
<td>7-2</td>
</tr>
<tr>
<td>Ventricular</td>
<td>7-4</td>
</tr>
<tr>
<td>Atrial</td>
<td>7-7</td>
</tr>
<tr>
<td>Beat/Arrhythmia Identification</td>
<td>7-9</td>
</tr>
<tr>
<td>Noise</td>
<td>7-12</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>7-13</td>
</tr>
<tr>
<td>Calling for Service</td>
<td>7-14</td>
</tr>
</tbody>
</table>
# System Messages

If an error occurs in the scanning or processing of ECG data, one of the following messages is displayed on the screen:

<table>
<thead>
<tr>
<th>Message</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;At 0&quot; uses an ST level of 0 as the reference for episode thresholds. &quot;Calculated&quot; uses the baseline reference calculated by the ST algorithm as the reference.</td>
<td>Information only.</td>
</tr>
<tr>
<td>&lt;name&gt; successfully uploaded</td>
<td>Your file has been successfully loaded into the scanner from a DigiTrak recorder, tape, or flashcard.</td>
</tr>
<tr>
<td>Can't access &lt;device name&gt;.</td>
<td>Cannot access recorder or tape reader.</td>
</tr>
<tr>
<td>Connecting &lt;device name&gt;.</td>
<td>Advisory message: connecting to recorder or tape reader.</td>
</tr>
<tr>
<td>Could not move %s. The file may be in use or read-only.</td>
<td>Indicates that the files are in use. If a crash occurred, you will have to log off your system and restart it to free up the files.</td>
</tr>
<tr>
<td>Could not move &lt;name&gt;.</td>
<td>The file may be in use or read-only.</td>
</tr>
<tr>
<td>Disk free space: &lt;message&gt;</td>
<td>Status of disk: free space.</td>
</tr>
<tr>
<td>DISK SPACE CRITICAL</td>
<td>Warning about lack of disk space.</td>
</tr>
<tr>
<td>DISK SPACE LOW</td>
<td>Warning about lack of disk space.</td>
</tr>
<tr>
<td>Downloading</td>
<td>Advisory message. Displays when you call up a patient to perform analysis.</td>
</tr>
<tr>
<td>ECG earlier than patient info.</td>
<td>Potential mismatch of patient information and ECG. This can be caused by the recorder clock and the PC clock being out of synchronization. Confirm match before proceeding.</td>
</tr>
<tr>
<td>ECG re-recorded.</td>
<td>Option.</td>
</tr>
<tr>
<td>Error renaming &lt;name&gt; to &lt;name&gt;. Err=&lt;number&gt;</td>
<td>The file may be in use or read-only.</td>
</tr>
<tr>
<td>Error uploading file &lt;name&gt;. Err=&lt;number&gt;</td>
<td>The recorder is either blank or the file must be reloaded.</td>
</tr>
<tr>
<td>Export to …</td>
<td>Selected file(s) have been exported to &lt;location&gt;.</td>
</tr>
<tr>
<td>Fast - Fast file save, smaller files</td>
<td>Information only.</td>
</tr>
<tr>
<td>Fixing ECG recording, please wait. Repair may take up to 10 minutes.</td>
<td>Advisory message. Occurs when the early out procedure on the Digi-Trak Plus recorder is not performed.</td>
</tr>
<tr>
<td>No ECG recorded. Click Cancel.</td>
<td>Advisory message: to terminate the scan since the tape is blank.</td>
</tr>
<tr>
<td>No files to download.</td>
<td>Check the cable connection to the machine.</td>
</tr>
<tr>
<td>Off - Fastest file save, largest files</td>
<td>Information only.</td>
</tr>
<tr>
<td>OUT OF DISK SPACE</td>
<td>Warning about lack of disk space.</td>
</tr>
<tr>
<td>Message</td>
<td>Interpretation</td>
</tr>
<tr>
<td>---------</td>
<td>----------------</td>
</tr>
<tr>
<td>Patient info more than 1 day older than ECG.</td>
<td>Possible mismatch of patient information and ECG. Confirm match before proceeding.</td>
</tr>
<tr>
<td>Preloading Complete</td>
<td>Advisory message.</td>
</tr>
<tr>
<td>Preloading...</td>
<td>Advisory message. Displays when the data goes from the recorder to the PC.</td>
</tr>
<tr>
<td>Preparing to read ECG recording.</td>
<td>Advisory message.</td>
</tr>
<tr>
<td>Reconnect recorder.</td>
<td>Disconnect and reconnect the recorder.</td>
</tr>
<tr>
<td>Recording already scanned.</td>
<td>Advisory message.</td>
</tr>
<tr>
<td>Resuming download of <code>&lt;name&gt;</code></td>
<td>Status of download.</td>
</tr>
<tr>
<td>Resuming upload of <code>&lt;name&gt;</code></td>
<td>Status of download.</td>
</tr>
<tr>
<td>Small - Slow file save, smallest files</td>
<td>Information only.</td>
</tr>
<tr>
<td>Starting to download <code>&lt;name&gt;</code></td>
<td>Status of download.</td>
</tr>
<tr>
<td>The directory is invalid and must be corrected before continuing. Insure that the directory name is correct and that it exists.</td>
<td>Enter a valid name.</td>
</tr>
<tr>
<td>The file%s could not be deleted. The file is probably in use or is read only.</td>
<td>Indicates that the files are in use. If a crash occurred, log off your system and restart it to free up the files.</td>
</tr>
<tr>
<td>The file <code>&lt;name&gt;</code> could not be deleted.</td>
<td>The file is probably in use or is read only.</td>
</tr>
<tr>
<td>The selected files will be deleted. Continue?</td>
<td>Requires operator action (Y or N) before Holter proceeds.</td>
</tr>
<tr>
<td>This directory is used to store information about errors in the software program.</td>
<td>Information only.</td>
</tr>
<tr>
<td>This directory is used to store temporary data files needed by the scanner. Please be sure to have at least 250 MB of unused space in this directory.</td>
<td>Advisory message about disk space requirements.</td>
</tr>
<tr>
<td>Waiting for recorder connection.</td>
<td>Advisory message about a recorder connected to Holter.</td>
</tr>
<tr>
<td>WARNING: The Report currently includes the Full Disclosure section. This section will drastically increase your Report file size. Remove Full Disclosure from the saved Report?</td>
<td>Advisory message.</td>
</tr>
</tbody>
</table>
Ventricular

This section presents troubleshooting procedures to help fix Ventricular problems.

For background information on the arrhythmias described in this section, refer to Appendix B, "Terms and Concepts".

Ventricular Ectopy Not Being Counted

If some of the PVCs are being counted as VEs (not premature):

1. Click the Rules icon.
2. Click the pull-down menu for Premature.
3. Decrease the prematurity to a lower percent.

If Ventricular ectopy is not being counted:

First, check the overall look of the beat in all three channels.

If the PVC is very small in voltage:

1. Click the Rules/Morphology icons.
2. Increase the gain in the appropriate channel(s).

If the PVC looks similar to the Normal in any of the three channels:

1. Click the Rules/Morphology icons.
2. Take the check mark out of the analysis box for the channel that looks like the Normal.

If the PVC is very large in voltage:

1. Click the Rules/Morphology icons.
2. Decrease the gain in the appropriate channel(s).

If the PVC continues to not be counted:

1. Click the Rules/Morphology icons.
2. Change the Sensitivity/Noise setting to a higher sensitivity setting.

If the ECG baseline is high in artifact:

1. View all three channels of ECG.
2. Click the Rules/Morphology icons.
3. Take the check mark out of the channel (s) with the most baseline artifact.
Ventricular Shapes being Called Normal

*If Ventricular ectopy is being called Normal:*
1. Click the Class icon.
2. View all Normal classes. Check to make sure all the shapes in the Normal classes are Normal shapes. Any Normal class that has a Ventricular shape as the representative shape should be reclassified as Ventricular.

*If the scanner continues to call Ventricular shapes Normal:*
1. View all three channels of ECG.
2. If one or more of the channels look similar to the Normal, take the check mark out of the box for that channel(s).

Ventricular Fusion Beats are Counted as Normal

Most fusion beats do not meet the criteria for prematurity. If the patient's learned Normal is similar in shape to the fusion beat it will be called Normal.

To eliminate the false Normal call:
1. Click the Class icon.
2. Click the class(es) with the shape of the fusion beat.
3. Reclassify as Ventricular.

If the beat continues to be called Normal:
1. Click the Rules/Morphology icons.
2. Remove the analysis on the channel(s) where the fusion beats looks the most like Normal.

Adjust the gain of the channel(s) that look most like the Normal:
1. Click the Rules/Morphology icons.
2. Click the Gain pull-down menu for the channel(s) you want to change.

Isolating Ventricular Ectopy in Artifact

In most situations any combination of the following steps solves counting errors, using Pick-A-Beat icons:

*To correct artifact that is highlighted as Ventricular:*

From the Class Edit screen:
1. Click the Class icon.
2. View the Ventricular class(es) that is artifact.
3. Reclassify as Artifact.
In the Diagnostic Screen:
1. Click the Diag icon.
2. Click the Count as Artifact icon in the Diagnostic toolbar.
3. Click the artifact that is being called Ventricular.

From the Advanced icon:
1. Click the Diag icon.
2. Click the Extract to Artifact icon in the Diagnostic toolbar.

**Normal Shapes are Identified as Ventricular**

*If Normal shapes are being called Ventricular:*
1. Click the Class icon.
2. Verify that all Ventricular classes are correct.
3. If there is a Normal shape that is being called Ventricular, reclassify as Normal.

*If Normal beats are still being called Ventricular:*
1. Click the Class icon.
2. Select a Ventricular class.
3. Click the Detail icon at the bottom of the screen.
4. Use Pick-A-Beat icons to correct each incorrect shape to Normal.

*If Normal shapes continue to be called Ventricular:*
1. Check the overall look of the ECG in all three channels. If the ECG looks like a Ventricular class in any of the three channels:
2. Click the Rules/ Morphology icons.
3. Remove the check mark in the analyze box for the channel(s) that looks like the Ventricular class. Leave the check mark in the box for the channel(s) that looks the most different from the Ventricular class. The scanner will then analyze the channels that look the most different in shape.
Atrial

This section presents troubleshooting procedures to help fix Atrial problems.

For background information on the arrhythmias described in this section, refer to Appendix B, "Terms and Concepts".

Marked Sinus Arrhythmia is Present and False PACs are Counted

Marked sinus arrhythmia can create longer and shorter intervals between beats. The algorithm identifies the longer interval as pauses, calling them Late and Drop beats. The algorithm identifies the shorter intervals as Premature Atrial Contractions (PACs).

To eliminate Late/Drop calls:
1. Click the Rules icon.
2. Click the Late pull-down menu. Increase the limit of the setting.
3. Click the Drop pull-down menu. Increase the limit of the setting.
4. Click the Apply Setting To pull-down menu and select Everywhere.

To eliminate false PACs:
1. Click the Rules icon.
2. Click the Premature pull-down menu.
3. Increase the limit of the setting.

Normal QRS is Wide, with Much Variability

Use the following procedure if the patient does not appear to have frequent Ventricular ectopics near the beginning of the exam:
1. Click the Rules icon.
2. Click the Morphology tab.
3. Click the check mark in the Automatic Class Creation dialog box.

Dropped or Late Beats are not Counted or Highlighted

To make the scanner more sensitive to Dropped or Late beats:
1. Click the Rules.
2. Click the Late or Drop pull-down menus.
3. Decrease the setting.
If Dropped or Late beats are in areas of high baseline artifact:
1. Click the Rules/Morphology icons.
2. Click the Sensitivity/Noise pull-down menu.
3. Select a higher Sensitivity/Noise setting.

(This last step means the scanner will now try to analyze more of the artifact in the baseline. This could create extra false positives.)

**NOTE**
When the scan is resumed, the scanner searches the artifact for abnormal events. If beats in artifact are rare, wait until the end of the scan and correct the interval with the Ignore/Restore Pick-A-Beat icon.

---

**P or T Waves are Highlighted or Counted as Beats**
Tall T waves and tall P waves can become classified as beats.

**To eliminate these false calls:**
1. Click the Class icon.
2. Click the class that has the T wave or the P wave highlighted.
3. Reclassify as Artifact.

**If the T wave or the P wave continues to create new classes:**
1. Click the Rules/Morphology icons.
2. Size down any or all of the channels of ECG.

**While scanning, if T waves and P waves continue to open new classes:**
At the Auto Stop for New Classes, click the Pick-A-Beat icon in the Diagnostic toolbar to Learn as Artifact. (This might take more than one Learn process to correct.)

---

**Adjusting ST Episode Criteria**

**To adjust the Criteria for ST Episodes:**
1. Click the Rules/ST Analysis icons.
2. Select the channel(s) to adjust.
3. Click the arrow keys at the right of the setting to increase or decrease the setting.

**NOTE**
Adjusting the Minimum Duration and Minimum Separation affects all three channels.
Adjusting Hysteresis affects all three channels.
Elevation, Depression, and Slope should be adjusted per channel.
Beat/Arrhythmia Identification

This section presents troubleshooting procedures to help fix Noise/Match problems.

For background information on the arrhythmias described in this section, refer to Appendix B, "Terms and Concepts".

Basic Rhythm is Atrial Fibrillation

NOTE

Remember the algorithm is only looking at R-R intervals. It does not see the Fib/Flutter waves in the baseline. All Atrial Fibrillation calls are based on regular versus irregular R-R intervals.

Atrial Fibrillation

If there is Atrial Fibrillation in the scan that is NOT being counted as Atrial Fibrillation:

To adjust the Atrial Fibrillation rule settings:

1. Click the Rules/Atrial icons.
2. Click Select Rules Set.
3. Click Atrial Fibrillation.
4. Click Use.

In the ALL setting, everything will be called Atrial Fibrillation.

Intermittent Atrial Fibrillation

1. Click the Rules/Atrial icons.
2. Click Afib Variability.
3. Adjust the setting to a lower/higher setting.

Click the pull-down menu for Duration/Recovery.

This setting determines how many beats have to meet the Afib percent setting before it calls Atrial Fibrillation. For example, if the settings are: Variability 10% and Duration/Recovery 25 beats:

The R-R intervals have to vary 10% for 25 beats (Duration) for the algorithm to call Atrial Fibrillation. Then at the end of the Atrial Fibrillation, the R-R intervals have to stay regular for 25 beats (Recovery) so the algorithm will start calling Normal Sinus Rhythm again.

Since Atrial Fibrillation varies so much in rate and number of beats in the episode, it will take more that one adjustment to get the algorithm to call the intermittent Atrial Fibrillation correctly.
NO Atrial Fibrillation

When the R-R intervals are irregular because of multiple PACs, PJC, Paced rhythm with rate changes, Paced rhythm with intermittent intrinsic rhythm or any Atrial arrhythmia that causes irregular R-R intervals, the algorithm will call Atrial Fibrillation.

To eliminate the Atrial Fibrillation call:
1. Click Rules/Atrial icons.
2. Click on Afib variability.
3. Adjust the percent setting to a higher/OFF setting.

If Non-conducted P Waves are Present During R to R intervals

Non-conducted P waves often create pauses in the R-R interval. These pauses can be identified and quantified by adjusting the rules criteria for Late or Dropped beats.

To make the algorithm more sensitive:
1. Click the Rules/Atrial icons.
2. Click the Late or Dropped pull-down menu.
3. Decrease the setting.

After the scan is finished. The non-conducted P waves should be within the count for Late or Dropped beats.

Search for other significant areas of block by clicking on the Graph icon and reviewing R-R or N-N intervals.

If there is Artifact in the Minimum and Maximum Heart Rate

If the Maximum heart rate has artifact in the baseline that is being called a beat, creating an incorrect heart rate:
1. Click the Events icon.
2. In the Diagnostic Pick-A-Beat toolbar, click the Count beat Artifact icon.
3. Click the artifact in the baseline that is incorrect.

Continue these steps until the heart rate is correct.

If the Minimum heart rate is incorrect because of baseline wander or low QRS voltage:
1. Click the Events icon.
2. In the Diagnostic Pick-A-Beat toolbar, click the Ignore R-R icon.
3. Click on the interval that is incorrect.
Continue these steps until the heart rate is correct.

**If the Normal QRS Widens**

If the P wave, PR interval, QRS complex, and the QT interval all widen and the rate slows, at the same time, this is probably a cassette recorder malfunction.

*If the Normal QRS widens and you are not certain if the rhythm is still sinus:*

1. Look for the presence of P waves before the wide QRSs.
2. If P waves precede each wide QRS, the rhythm may still be sinus, with intermittent bundle branch block.
3. If the PR interval shortens and the initial QRS vector is slurred, the rhythm is sinus with intermittent WPW.
4. If P waves are absent or dissociated from the wide QRSs, the rhythm may be idioventricular or junctional with aberrancy.

**NOTE**

In very rare cases Atrial fibrillation with aberration may be present if the R-R intervals are grossly irregular.

**Run Is Incorrectly Highlighted as a VRun**

*To correct a VRun that is not valid:*

1. Using the Diagnostic window, locate the VRun.
2. Click the Class Edit icon and select the incorrectly labeled beats.
3. Click Correct to Normal.
4. Click Learn Normal on the Pick-A-Beat toolbar to count the run as Atrial beats.

**Alternate Normal Classes do not Appear in the Beat Classes**

You can reclassify Normal classes to Alternate Normal classes using the Class Edit toolbar:

1. Click the Class icon.
2. Click the class shape you want to reclassify as an Alternate Normal.
3. Click the icon to Reclassify as Alt. Normal.
4. Label the Alternate Normal as appropriate.
5. The class shape will now be highlighted in yellow.

*To combine all Alternate Normal classes that have the same shape:*
1. Click the Class icon.
2. Click all the Alternate Normal shapes that look alike.
3. Click the Combine icon.

---

**Noise**

**Tape is Very Noisy**

The scanner can be too sensitive in recordings with high amounts of artifact.

*If artifact is a problem:*

1. Click the Rules/Morphology icons.
2. Size down the channel(s) with the most artifact in the ECG.

Always remember: If you size down ECG, you size down artifact. This step will help you almost every time you encounter artifact on an exam.

*To eliminate false calls caused by artifact:*

1. Click the Rules/Morphology icons.
2. Remove the check mark in the box of the channel(s) with the most noise.

*If artifact is still a problem:*

1. Click the Rules/Morphology icons.
2. Click the Sensitivity/Noise pull-down menu.
3. Change the setting to a lower sensitivity setting.

**Elimination of Events Created by Artifact.**

There are five ways to eliminate events created by artifact:

- **Ripple edit** - You may have a scenario where the patient moves around a lot during a one hour period and creates artifact that is read as Ventricular Ectopy. Once you verify that the ectopy for that hour is false, go to the Ventricular table in the final Report and delete the total in that hour. This change ripples through all of the pages in the final Report.

- **Multi Pick-a-Beat** - Use this method to address random errors throughout the exam. If you have true ectopics and false ectopics scattered throughout the exam, display the first false one in the Diagnostic window and choose the appropriate editing command. Press and hold the Ctrl key and click on the other small boxes to correct the false positives without having to see them in the Diagnostic window.

- **Turn off the channel** - If you see that one channel is consistently full of noise, click the Rules\Morphology icons and turn off that channel.
• Change the gain setting - If the size of the ECG is so big in one channel that the T waves look like R waves, click the Rules/Morphology icons and lower the gain. If the size of the ECG is too small and you get false pauses, click Rules/Morphology and increase the gain.

• Erase - If you see a period of time that is full of artifact while paging through the exam, select Erase and click and drag it through the area of artifact.

## Miscellaneous

### You Can No Longer Learn a New Class

When the bin that holds all the class templates is full, a warning will be displayed "Out of shapes needed for Learn/Extract". Follow the instructions suggested in the Warning box.

![Warning message](image)

### Too Many Classes are Being Opened

The Class Edit bottom window will have many complexes that are quite similar because the algorithm is scrutinizing closely. You need to combine and reduce the number of templates. In doing this, you have determined that you prefer to allow the algorithm to differentiate between complexes less and match more complexes into existing templates, as opposed to making new templates for slight irregularities.

After combining complexes, follow these suggested steps:

1. Click the Rules/Morphology icons.
2. Click the check mark in the Automatic Class Creation dialog box.

The scanner will not open new classes from this point on. The operator can stop at any time or can open new classes with the auto stop functions.
Calling for Service

For telephone assistance, call the Response Center nearest to you, or visit our website at:
www.medical.philips.com/cms and follow the link for services.

The telephone and fax numbers are listed on the next page.
### United States of America

| Medical Response Center | Tel: 800-548-8833 |

### Latin America

| Medical Response Center | Tel: 954-835-2600 |

### Canada

| Medical Response Center | Tel: 800-323-2280 |

### Other International Areas

#### Australia and France

<table>
<thead>
<tr>
<th>Australia</th>
<th>France</th>
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<tbody>
<tr>
<td>Tel: 131147</td>
<td>Tel: 0803 35 34 33</td>
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#### Germany and Italy

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<th>Italy</th>
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<td>Tel: 800-825087</td>
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#### Netherlands and United Kingdom

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<th>United Kingdom</th>
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<tr>
<td>Tel: 31 20 547 2555</td>
<td>Tel: 00 44 7002 432584</td>
</tr>
<tr>
<td>Fax: 31 29 547 2949</td>
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#### Belgium (for Dutch) and Belgium (for French)

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<tr>
<td>Fax: 32 2 525 71 91</td>
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#### Spain and Poland

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<th>Spain</th>
<th>Poland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tel: 34 902 30 40 50</td>
<td>Tel: 48 22 5710499</td>
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<tr>
<td>Fax: 34 91 326 39 66</td>
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#### Austria and Finland

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<td>Tel: 43 1 60101 820</td>
<td>Tel: 09 6158 0400</td>
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</table>

#### Switzerland and Russia

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<th>Russia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tel: 0800 80 10 23</td>
<td>Tel: 7 095 933 0339</td>
</tr>
<tr>
<td></td>
<td>Fax: 7 095 933 0338</td>
</tr>
</tbody>
</table>
8 Using Advanced Scanning

Overview
This chapter discusses how to set up and use the Advanced options for scanning. See the following sections in this chapter for more information:

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<td>Pick-A-Beat Toolbar</td>
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</tbody>
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Advanced Options Setup
The Advanced tab on the Customize dialog box allows the user to turn ON/OFF advanced scanning features. To access the dialog box, click on the Tools menu and click on Customize.

There are two features:
- Enable Retrospective Pick-A Beats - *Requires restart
- Enable advanced Shape Detail view
Enable Retrospective Pick-A-Beats

When Retrospective Pick-A-Beat is enabled, the Advanced Pick-A-Beat icons are displayed in the Diagnostic toolbar. Use these icons to analyze beats in the Diagnostic window.

To enable Retrospective/Advanced Pick-A-Beat:

1. Set the computer screen resolution to 1152x870, using Windows/Control Panel/Display. (See your Windows documentation for more information.)
2. From Holter, click the Tools menu and click Customize.
3. Click the Advanced tab.
5. Shut down and restart your computer. Launch the Holter program.

The Advanced Pick-A-Beat icons will be in the Diagnostic toolbar.

Advanced Shape Detail

When enabled, the advanced Shape Detail allows for Beat Spanning in the Beat Detail editing/Overlay screens. To review Detail editing, see Chapter 5, "Editing the Scan".

Beat Spanning is an advanced Overlay option. The option controls how the beats will be displayed.

- Consecutive from the starting point (for example, beats 1-100, then 201-300, etc.) in the chosen class.
- Interleaved from a mathematical sampling in the class (for example, 100 beats from a class of 2014).
- Signal-averaged composite (averaged) beats for that group.

To enable advanced Shape Detail:

1. Click the Tools menu and click Customize.
2. Click the Advanced tab.
3. Click to add/delete a checkmark next to Enable advanced Shape Detail view. The Advanced Overlay options are in the Detail/Overlay/Beat Spanning screen.
**Advanced Pick-A-Beat Toolbar**

When Advanced Retrospective Pick-A-Beat is enabled, the Diagnostic toolbar displays the following icons for editing scanned beats in the Diagnostic window:

<table>
<thead>
<tr>
<th>Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Correct" /></td>
<td>Performs a Class Edit Correct operation. It is the same operation, within Class Edit, as changing all beats with the same shape to Normal.</td>
</tr>
<tr>
<td><img src="image" alt="Correct" /></td>
<td>Performs a Class Edit Correct operation. It is the same operation, within Class Edit, as changing all beats with the same shape to Ventricular.</td>
</tr>
<tr>
<td><img src="image" alt="Correct" /></td>
<td>Performs a Class Edit Correct operation. It is the same operation, within Class Edit, as changing all beats with the same shape to Artifact.</td>
</tr>
<tr>
<td><img src="image" alt="Erase" /></td>
<td>Erases a class and places all the counts for that class into the Normal category.</td>
</tr>
<tr>
<td><img src="image" alt="Erase" /></td>
<td>Erases a class and places all the counts for that class into the Ventricular category.</td>
</tr>
<tr>
<td><img src="image" alt="Erase" /></td>
<td>Erases a class and places all the counts for that class into the Artifact category.</td>
</tr>
<tr>
<td><img src="image" alt="Extract" /></td>
<td>Creates a new class (similar to Learn) of the Normal type. However, after the class is created the entire file is reanalyzed for any beats that match the newly created shape.</td>
</tr>
<tr>
<td><img src="image" alt="Extract" /></td>
<td>Creates a new class (similar to Learn) of the Ventricular type. However, after the class is created the entire file is reanalyzed for any beats that match the newly created shape.</td>
</tr>
<tr>
<td><img src="image" alt="Extract" /></td>
<td>Creates a new class (similar to Learn) of the Artifact type. However, after the class is created the entire file is reanalyzed for any beats that match the newly created shape.</td>
</tr>
</tbody>
</table>
Advanced Pick-A-Beat Toolbar

Using Advanced Scanning
Overview

Holter scans cassette tapes, DigiTrak-Plus recorders, and DigiTrak flashcards, in multiple channel and pacemaker formats. Use the procedures provided in this chapter to set up the media and input data properly from these external devices.

See the following sections in this chapter for more information:

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Working with DigiTrak-Plus Recorders

Data collected in the DigiTrak-Plus recorder is transferred to the Holter system either via a direct cable connection or a USB docking station. The docking station is connected to the PC through a USB port; you place the recorder in the docking station to transfer the data.

After the docking station is connected to the PC and you place the recorder into the docking station, the operating system detects that new hardware is in place and configures the appropriate device driver.

In rare cases, the system may display an error message stating that it cannot find the driver for the device. If this occurs, when prompted, specify the location of the driver: C:\Windows\System32\Drivers.

NOTE

Connect the docking station after you have installed the Holter for Windows software as described in the appropriate installation guide. Never plug in a recorder while software installation is in progress.

To download ECGs recorded on a DigiTrak-Plus Recorder:
1. Connect the docking station cable to an available USB port on the PC.
2. Gently slide the recorder straight into the docking station (at the angle shown) with the pins facing the front (under flap).

**CAUTION**

Do not insert the recorder at a high angle or with the pins facing out. Inserting the recorder from a high angle will result in bent pins.

3. Gently push down on the product label (as shown). The recorder snaps into place.

4. The PC operating system detects that new hardware is connected. The operating system automatically configures the appropriate device driver.

**NOTE**

The Windows 98 Operating System does not display any messages while the device driver is being configured.
If an error message appears stating that the device driver cannot be found, enter the file location of the driver (when prompted). The file location is: C:\Windows\System32\Drivers.

For set up information on the recorder, see the Philips DigiTrak-Plus Operator/Service manual.

5. When the DigiTrak-Plus label appears on the recorder screen, the docking station is operational and you are ready to download data.

6. To cancel a preload sequence in progress, double-click on the “Preloading” message.

7. Select DigiTrak-Plus in the Format list box.

8. Click Next to proceed with the download and scan.

**CAUTION**

With DigiTrak-Plus recordings, make sure that you do **not** unplug the recorder while the “Preloading” message flashes in the Holter status bar. If you accidentally unplug the recorder during a preload sequence, restart the system to clear the DigiTrak-Plus device. **If the recorder is unplugged prematurely, the ECG is corrupted.**
DigiTrak-Plus Recorder

When loading data from a DigiTrak-Plus Recorder, go to "Step Four--Downloading Data from the Recorder to the PC" on page 9-5.

Before You Start

- Insert a fresh AA battery with each patient.
- Instruct the patient not to: tamper with the recorder, remove the battery, or disconnect the patient cable.

Recorder Date/Time Settings (First Time Use only)

1. Make sure the docking station cable is connected to the USB port of the PC.
2. Press the Enter button to turn the recorder on and display “DigiTrak-Plus, Zymed”.
3. Proceed to “Date and Time” by pressing the right arrow key four times.
4. Correct the display to your local Date and Time. Use the up and down arrows to select the parameter you want to change (hour, minute, date, etc.), and use the left and right arrows to change the setting of the parameter. Press Enter when you are done.
5. Press the right arrow twice to proceed to Start and press the Enter button to begin recording.
6. Simultaneously press the right arrow and the Enter button to shut the recorder down after setting up the recorder’s date and time.

Step One---Entering the Patient’s Name

1. For a new patient, insert a fresh battery in the recorder.
2. With the docking station connected to the PC, insert the recorder in the docking station.
3. Launch the Holter program (if necessary).
4. Click Tools\Flashcard Utility\DigiTrak Plus.
5. Enter the patient name, identification number, and the physician’s name.
6. Click Write to DigiTrak-Plus.
7. After two or three seconds, remove the recorder from the docking station.

Step Two---Preparing the Patient

1. Apply the electrodes to the patient in the EASI configuration
2. Connect the patient cable (lead wires) to the recorder.
3. Press the Enter button to turn the recorder on and display “DigiTrak-Plus, Zymed”.
   Channel 1 ECG tracing appears in the window.

4. Press the right arrow to Channel 2, and press it again to Channel 3.

5. Press the up and down arrows for larger or smaller visualization of the ECG on the screen.

6. Proceed to “Settings” and select Pacer mode, if applicable.

**NOTE**
For instructions on recorders, see the DigiTrak-Plus Operator/Service Manual (P/N 172069-035), Rev. 2 or higher.

7. Press the right arrow three more times and then press the Enter button to start recording.

**NOTE**
Remind the patient not to tamper with the recorder.

### Step Three--Removing and Shutting Down the Recorder
When the patient returns the next day, remove the recorder from the patient. Perform the shut down procedure, then remove the battery and the patient cable.

To shut down the recorder before 24 hours expire, press the up arrow and the Enter button at the same time.

**NOTE**
The recorder automatically shuts down after 24 hours of continuous recording.

### Step Four--Downloading Data from the Recorder to the PC
Load ECG data recorded on a DigiTrak-Plus to the Holter system using the following procedure:

1. Connect the recorder to the USB cable.
   “Preloading” appears in the lower right-hand corner of the PC screen.

**CAUTION**
Do not disconnect the recorder whenever the “Preloading” message is flashing.

2. Leave the recorder connected until downloading of the data is complete. You can perform an analysis while downloading data.

**NOTE**
If you need to stop downloading for any reason, click the “Preloading” icon and select Abort. Do not disconnect the recorder from the USB without stopping the downloading process.
3. When downloading of the data is complete, detach the recorder from the USB cable, then scan and save the ECG.

4. Repeat steps 1-3 for subsequent new patients.

---

**Cassette Format**

When you choose Cassette as the input source from the New Patient -- Recorder Format dialog box and a cassette is inserted, automatically:

- a Cassette Control dialog box appears.
- the scanner rewinds the tape.
- the scanner calibrates the calibration pulses.

**Cassette Control Dialog Box**

You use the Cassette Control dialog box to select specific formats and verify calibration of the tape. The user is responsible for verifying and adjusting the calibration of the caliper pulse for each raw monitoring channel.

**Calibrating from the Cassette Control Dialog Box**

1. **Verify the Tape Status:**

   As the cassette software prepares the cassette for scanning, wait for the mode Rewinding and Verifying Calibration to take place until the Action "Done" appears in the list box. Proceed to calibrate.

2. **Verify the Tape Format:**

   Select from two sets of options: EASI/Pacer and 3-channel/2-channel.

3. **Verify Speed Control:**
You can scan with or without a timing track. If you select 2-channel Tape Format, you can choose a Tape Speed other than 1.00 mm/sec from the pull-down menu.

4. Adjust **Offset into Tape**:

   Using the up and down arrows will offset in minutes and seconds into the recording from the beginning point. Choose a clean caliper pulse picture that best aligns with the horizontal dotted lines.

5. Adjust the **Amplitude**:

   For each raw monitoring channel, the calibration status is displayed. You can increase or decrease amplitude by scrolling the amplitude (by centimeters (cm), up or down.

   The calibration pulse has a low level and high level -- the difference between them is the amplitude.

   The illustration on page 9-6 shows the amplitude for channels 1, 2, and 3.

   - The ideal calibration pulse is seen in Channel 3. The upper and lower levels align with the horizontal dotted line.
   - If the calibration pulse is shorter than the horizontal line, as seen in Channel 2, increase the amplitude by using the up arrow.
   - If the calibration pulse is taller than the horizontal line, as seen in Channel 1, decrease the amplitude by using the down arrow.

   If a channel cannot be calibrated, its status reads: Unable to Calibrate.

---

**NOTE**

Calibration of the amplitude is imperative for ST scanning. In this scanner, aligning the picture of the caliper pulse is a priority over a desired amplitude of 1.00 cm.

6. **Verify Calibration**:

   Click the Verify Calibration box. The scanner will reassess the calibrated cal pulses. Then, the Action box will say "Done". If caliper pulse alignment is not acceptable, repeat Steps 5 and 6. If the caliper pulse alignment is acceptable, proceed to Step 7.

7. **At the completion of calibration adjustment, verify that the Action is "Done" and click OK.**
Flashcard Utility

Use the Flashcard Utility to prepare flashcards for DigiTrak and DigiTrak-Plus recorders. With the utility, you can label flashcards and recorders with new patient information.

Flashcard Utility Dialog Box

Use the Flashcard Utility dialog box to label a flashcard (for example, DigiTrak) recording or a DigiTrak-Plus recorder with patient information.

CAUTION

Use the flashcard utility procedure to label (or erase) flashcards/digital recorders only. This utility erases all ECG on the media when you click Write to.

Procedure to Label a DigiTrak-Plus or a DigiTrak Recorder

To label or relabel the patient demographics on the DigiTrak-Plus or DigiTrak recorder when the Holter Scanner is running:

1. Insert the flashcard in the drive on the Holter system.
2. Click Tools/Flashcard Utility.
3. Select the correct type for the flashcard inserted (for example, DigiTrak).
4. Enter the patient information (Last name, first name, ID, etc.).
5. Click Write to Flashcard.
6. (Optional) Insert a new flashcard and repeat steps 3 through 5.
10 Configuring the Scanner

Overview

You can customize the operation of the Holter scanner through the dialog boxes discussed in this section. Each dialog box presents options associated with features you use on a regular basis. See the following sections in this chapter for more information:

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Languages Menu</td>
<td>10-1</td>
</tr>
<tr>
<td>Customizing the Holter Screen</td>
<td>10-2</td>
</tr>
<tr>
<td>Customize Dialog Box</td>
<td>10-7</td>
</tr>
<tr>
<td>Edit Configurations</td>
<td>10-9</td>
</tr>
<tr>
<td>Creating and Configuring Calipers</td>
<td>10-11</td>
</tr>
<tr>
<td>Report Configurations</td>
<td>10-13</td>
</tr>
<tr>
<td>Help Options</td>
<td>10-17</td>
</tr>
</tbody>
</table>

Languages Menu

Holter ships with English as the default language. You can change the language of the Holter menus, analysis, Reports, and toolbars to one of the following languages:

- English
- Spanish (European)
- French (European)
- German
- Italian
- Portuguese (Brazilian)
- Chinese (Simplified)
- Japanese
- Dutch
- Russian
Customizing the Holter Screen

Holter scanner allows you to customize its basic screen and appearance easily by:

- Dragging and dropping toolbars
- Selecting overall appearance (schemes)
- Customizing individual appearance items

Moving Toolbars

You can move the large toolbars on the Holter screen by clicking on the edge of a toolbar and moving it (docking it), as shown in the scheme below called "Zymed 2010 for DOS" format (default). The Scanning toolbar and the Diagnostic Pick-A-Beat toolbars, for example, have been relocated on the sides of the screen.

The Auto Stops toolbar (shown above) can be moved around on the screen dragging it to a new location. Its shape can be adjusted by moving an edge.
Selecting An Overall Appearance

Through the Customize item on the Tools menu, you can change the appearance of the screen by selecting another scheme name. The screen below shows the scheme name "The Blues".
The scheme recommended for previewing how a screen capture will print on a black-and-white printer is called "Newspaper", as shown below.

**Customizing Individual Items**

For information on changing individual items, see "The Customize Dialog Box" (page 10-5).

**ECG Display Options**

**Diagnostic Window Options**

Click the Display icon to access the ECG Display Options dialog box.
Use this dialog box to configure the channels/leads, gain, annotations, and the size of the display for both raw and generated (derived) leads in the Scanning/Diagnostic windows.

**Raw Leads**
For each channel you can:

- Show the lead in the Page display and/or the Diagnostic window
- Invert the signal (non-EASI connection only)
- Choose a gain (0.5 to x4.0), with the default being 1

**Derived Leads**
For each lead:

- Select one to three leads (default is leads VI, V6, and II)
- Show the lead in the Page display and/or the Diagnostic window
- Choose a gain (0.5 to x4.0), with the default being 1

**Raw/Derived**
Select whether to show raw or generated (derived) leads.

**Diagnostic Area/Page Area Annotation**
Select the items from the list to display in the Scanning/Diagnostic windows:

- Off: No annotation of beats
- Arrhythmias labeled
- Heart rate (Diagnostic window only)
- Normal beats, plus Arrhythmias, labeled in the Diagnostic window.
- Labeling of ST episodes (Requires ST to be set in Scan mode before scanning ECG file)
- Fiducial points

**Page Size**
You can choose the amount of data/size of the individual beats displayed on a single page of the scanned ECG. Size is measured in minutes of continuous ECG from the upper left-hand corner to the lower right-hand corner. To increase the size of the ECG, choose a smaller number of minutes. ECG sizes range from small (when 20 minutes is displayed) to extra large (1 minute). The default is Large (2 minutes).

**NOTE**
If you open the Diagnostic window, it covers the top half of the current window, and the data display is moved down. You can configure the relative size of the Diagnostic display through Configuring Class Edits on the Tools menu.

**Alternate Page Size**
You can set up an alternate page size display through the Alt. View icon on the Scanning toolbar. An alternate view is set up the same way as you set up the Diagnostic window (see "Diagnostic Window Options" on page 10-4). Follow these four steps:

1. Click on the Alt. View icon on the Scanning toolbar.
2. Right-click in the Diagnostic window.
3. Select Display Options.
4. When the ECG Display Options - Alternate dialog box appears, select another Page Size (see the lower right-hand corner for the Page Size list box).

**NOTE**
This procedure establishes an alternate view for page size, but you can also set up an alternate view of leads, channels, etc.
The Customize Dialog Box

You can customize the appearance and operation of Holter through the Customize dialog box available from the Tools menu.

The following table lists the functions available in the Customize dialog box:

<table>
<thead>
<tr>
<th>Tab Label</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Customizes line, font (where applicable), color, and display appearance options. See &quot;Customizing the Holter Screen&quot; on page 10-2 and &quot;Appearance Options&quot; on page 10-8.</td>
</tr>
<tr>
<td>Strips</td>
<td>Vary the length of strips from 6-to-7 seconds (6000-7000 milliseconds). If you document a strip that is longer than the set length, the Holter Scanner creates a second strip from the &quot;extra&quot; length. As noted on the dialog box, the length set affects only subsequent strips (does not change the length of those already taken).</td>
</tr>
<tr>
<td>Site Information</td>
<td>Specify the text you want displayed at the top of the Report Summary page. You can include name, address, phone number, and two user fields for additional information. Add your logo to the Report by placing the logo (must be a *.emf file) in the Holter directory, normally, “C:\Program Files\Holter\”.</td>
</tr>
<tr>
<td>Directories</td>
<td>Specify the directories you want to use for temporary storage of .rf input files and for debug information.</td>
</tr>
</tbody>
</table>

This is the color used for caliper labels. Caliper labels are letters and numbers that describe a caliper line.
Customizing the Holter Screen

Appearance Options
You can customize the colors Holter uses for lines, background, and beat identification, for example, an ECG gridline, and other items. You can modify an existing color scheme, or you can create a new one.

1. Select a name from the Scheme Name drop-down list box.
2. Select an item from the Item drop-down list box.
3. Choose the characteristics (for example a different font or color) from the options shown on the screen.
4. Repeat steps 2 and 3, as needed.

If you are just modifying an existing scheme, click OK. If this is a new scheme, click Save As, and enter the name when the Save Scheme dialog box appears.
Edit Configurations

Configuring Class Edit

The Class Edit dialog box allows you to reconfigure the work areas for best editing by changing the appearance of the Work Area and Class Bin size. The Work Area refers to the top window and the Class Bin size refers to the bottom window of Class Edit. A large scan may display more than 50 classes of beats that you want to see all at one time.

NOTE

You must be in prospective Scan mode to access the Class Edit dialog box.

To access the Class Edit dialog box you must start from the Class Edit window:

1. Click the Class icon.

2. From the Tools menu, click Configure Class Edit.

![Class Edit dialog box](image)
### Explanation of Options

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work Area: Scale Width (sec)</td>
<td>Sets the scale of the grid (and graphic display): larger is wider.</td>
</tr>
<tr>
<td>Work Area: Classes Per Line</td>
<td>Determines how many class icons are displayed on one line.</td>
</tr>
<tr>
<td>Work Area: Font Height</td>
<td>Changes the point size of the label above the icon being displayed.</td>
</tr>
<tr>
<td>Work Area: Work Area Height %</td>
<td>Percentage taken by upper portion of the screen.</td>
</tr>
<tr>
<td>Class Bin Area: Lines Per Page</td>
<td>Determines how many lines of classes are displayed.</td>
</tr>
<tr>
<td>Class Bin Area: Scale Width (sec)</td>
<td>Allows you to increase or diminish the scale of the class work area.</td>
</tr>
<tr>
<td>Class Bin Area: Classes Per Line</td>
<td>Increases or decreases the number of class icons per line.</td>
</tr>
</tbody>
</table>
Creating and Configuring Calipers

The Holter scanner allows you to measure typical distances (P-R, QRS, R-R’, etc.) of individual beats through the temporary caliper option in the Diagnostic window. As you drag caliper lines, the measurement displays below the lines reflect distances between configured lines.

Creating a New Set of Calipers

1. You must have the Diagnostic window open to create a caliper.

2. Click the Caliper icon in the Diagnostic toolbar or right-click in the Diagnostic window and select New Caliper (or use Alt + C).

3. Set the starting point, usually the line for the R wave.

4. If necessary, use the Configuring Calipers procedure on the following page.

5. Drag the measurement lines to the appropriate point for measurement.
Configuring Calipers

1. Position the mouse arrow over the caliper line until the mouse arrow changes. The mouse arrow changes to three different shapes:
   - R caliper line: changes to a hand.
   - R’ caliper line: changes to parallel lines.
   - Horizontal caliper line: changes to horizontal lines.

2. Select the channels to measure.

3. Select the items to measure.


**NOTE**

Once you create a caliper it remains in effect for the current session. If you want to use another set of calipers, you should delete and reconfigure it.
Report Configurations

Narrative Summary Template

The Narrative Summary template controls how fields are reported in the Narrative Summary. Use this dialog box to change the way data is reported by modifying fields of the template, as described in “Editing the Narrative Summary Template” on page 10-14. Changes you make to the template appear in subsequent reports that are generated.

To access the Narrative Summary template:

1. Click the Report icon.
2. Click the Narrative tab at the bottom of the screen. Right-click Narrative Summary.
3. From the list, select Properties. The Narrative Summary template is displayed.

For information about fields and keywords in the template, see the table that follows.

<table>
<thead>
<tr>
<th>Parola chiave</th>
<th>frase</th>
<th>Data frase</th>
<th>Frazione frasi</th>
<th>Data frazione frasi</th>
<th>Data frasi</th>
<th>Formato</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Senza parola chiave</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Nuovo p.</td>
<td></td>
</tr>
<tr>
<td>Ora di connessione</td>
<td>Monitor:</td>
<td>Monitori:</td>
<td></td>
<td></td>
<td></td>
<td>Nuova s 2:00 PM</td>
<td></td>
</tr>
<tr>
<td>Durata della registrazione</td>
<td>prosegui:</td>
<td>prosegui:</td>
<td></td>
<td></td>
<td></td>
<td>Senza fc h 10 min</td>
<td></td>
</tr>
<tr>
<td>Frequenza cardiaca media</td>
<td>La frequenza:</td>
<td>BPM:</td>
<td>La frequenza:</td>
<td>BPM:</td>
<td>Frequen:</td>
<td>Senza fc 65</td>
<td></td>
</tr>
<tr>
<td>Frequenza cardiaca minima</td>
<td>con una frequenza:</td>
<td>BPM:</td>
<td>con una frequenza:</td>
<td>BPM:</td>
<td>Senza fc 36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ora frequenza cardiaca minima</td>
<td>verificata:</td>
<td>verificata:</td>
<td></td>
<td></td>
<td>Senza fc 1:17 AM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequenza cardiaca massima</td>
<td>e una frequenza:</td>
<td>BPM:</td>
<td>e una frequenza:</td>
<td>BPM:</td>
<td>Senza fc 90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ora frequenza cardiaca massima</td>
<td>verificata:</td>
<td>verificata:</td>
<td></td>
<td></td>
<td>Senza fc 8:14 PM</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Monitoraggio iniziato alle 12:00 PM proseguito per 21 h 10 min. La frequenza cardiaca media è stata di 65 BPM, con una frequenza minima di 36 BPM, verificatisi alle 3:11:17 AM, e una frequenza cardiaca massima di 90 BPM, verificatisi alle 2:18:14 PM.

Si è rilevata un'attività ektopica ventricolare che era di 2021 battiti, dei quali, 1246 erano in 150 run, 150 erano in triplett, 204 erano in coppia patologiche, 421 erano PVC singoli, 421 erano PVC interpolati, 3 erano R su T, 3 erano VE singoli, 3 erano tadi, 60 erano in trigeminismo, 40 erano in trigeminismo. I battiti ventricolari sono stati caratterizzati da una frequenza di 92.9 VE/ora. Il run ventricolare più lungo si è verificato alle 10:11:21 PM, caratterizzato da 41 battiti con una frequenza cardiaca massima di 102 BPM. Il run ventricolare più veloce si è verificato alle 6:07:14 PM, caratterizzato da 100 battiti, con una frequenza cardiaca massima di 102 BPM.

NOTE
For every change you make to a cell, that changed format remains in effect for all future scans. The changes become your new Report Narrative default set-up. You can revert back to the Philips Zymed default setting from the Narra-
Configuring the Scanner

Click the Defaults button to open the Defaults dialog box. From the Defaults dialog box, click OK.

**Editing the Narrative Summary Template**

<table>
<thead>
<tr>
<th>Field</th>
<th>Definition/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keyword</td>
<td>Corresponds to field totals reported on page 1 of the Summary Report.</td>
</tr>
<tr>
<td>PrePhrase Plural</td>
<td>Words that precede a field total when the value is plural.</td>
</tr>
<tr>
<td>PostPhrase Plural</td>
<td>Uses the displayed text when a field value is plural.</td>
</tr>
<tr>
<td>PrePhrase Singular</td>
<td>Words that precede a field total when the value is singular.</td>
</tr>
<tr>
<td>PostPhrase Singular</td>
<td>Uses the displayed text when a field value is singular.</td>
</tr>
<tr>
<td>Null Phrase</td>
<td>Text to display when the count for this item is zero. Note: If a New Section field is zero (for example, Pacer Total Paced Beats), the totals associated with those keywords do not appear in the Narrative Summary.</td>
</tr>
<tr>
<td>Flag</td>
<td>Text processing options for flags, sections, paragraphs, etc.</td>
</tr>
<tr>
<td>Test</td>
<td>Numeric value you supply to test the display.</td>
</tr>
<tr>
<td>Defaults</td>
<td>Resets all changes to the default Narrative template.</td>
</tr>
</tbody>
</table>

Use the following procedure to edit the Narrative Summary template. Use caution when making changes to the Narrative Summary template.

1. Right click a keyword to change a cell or row.
2. Select an editing option: edit, insert, or delete.
3. If you select Edit, the following dialog box appears:

4. Modify a field (Plural, Singular, or Null Phrase) by typing new text in the field.

5. (Optional) Select a new keyword or flag from the options displayed.

6. (Optional) Enter a test value to be displayed in the template sample.

7. Click OK to exit from the dialog box and save your edits.

---

**CAUTION**

Changes to the Narrative Summary do not ripple through the Report. Therefore, you must complete all edits to the Report *before* using the Narrative Summary.
Transcription Assistant

The Transcription Assistant has a number of standard phrases, organized in categories. The Transcription Assistant can speed up the time spent typing interpretation statements by allowing you to insert statements that are repeated in multiple reports with a single click.

To access the Transcription Assistant:

1. With the Summary page of the Report displayed, scroll to the Interpretation section.

2. Click in that section. The Transcription Assistant appears.

3. Double-click a category to open it.

4. Click the phrase, then click the Insert icon to add it to the interpretation field.
   - The phrase may require a statement to complete the sentence. Click the Categories icon, scroll down to Rhythm Episodes, and double-click. Scroll down to the appropriate rhythm category to complete the phrase and double-click. Select the phrase or phrases that complete the statement and click Insert. Multiple selections can be made. Click the Done icon when the phrase is complete.
   - You can add multiple statements to the sentence by continuing to click Insert.

5. Once the sentence is complete, click the Done icon.

6. To exit the Transcription assistant program, click any part of the Summary page.

NOTE

You can type in the interpretation without the help of the Transcription Assistant. Click in the Interpretation field. When the pop up box appears, click the X in the upper right hand corner and close it. You have the option to always hide the assistant.
**Help Options**

Use the menus in the menu bar at the top of the Help screen to control how the Help pages appear and how the Help behaves.

The table below describes the menu functions.

<table>
<thead>
<tr>
<th>Menus</th>
<th>Menu Items and Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>File</td>
<td><strong>Open</strong> another Help file</td>
</tr>
<tr>
<td></td>
<td><strong>Print</strong> the current topic</td>
</tr>
<tr>
<td></td>
<td><strong>Close</strong> the current Help file</td>
</tr>
<tr>
<td>Edit</td>
<td><strong>Copy</strong> text from the current page to another file</td>
</tr>
<tr>
<td></td>
<td><strong>Annotate</strong> the current page with a personal comment</td>
</tr>
<tr>
<td>Bookmark</td>
<td><strong>Define</strong> a bookmark for this page</td>
</tr>
<tr>
<td>Options</td>
<td><strong>Keep Help</strong> as the top window or allow it to be hidden</td>
</tr>
<tr>
<td></td>
<td><strong>Display History window</strong>: keep track of the pages you have accessed</td>
</tr>
<tr>
<td></td>
<td><strong>Font</strong>: display all text in a smaller or larger font</td>
</tr>
<tr>
<td></td>
<td><strong>Use System Colors</strong>: changes colors to match your system</td>
</tr>
</tbody>
</table>

**Maintenance Options**

You can edit, delete, or add a Category or Statement by clicking Maintenance on the Transcription Assistant.

Use the buttons on the right side of the dialog box to delete, edit, or add statements.

**NOTE**

All changes are permanent in the Transaction Assistant. If you have a need for a change that affects only one report, edit the "global" statement in the Interpretation section of the report.
Help Options
Appendix A Exporting the Scan

Overview

Export on the File menu allows you to save the current file to an external device for export or comparison.

You can choose to export the files in the following formats:

- MIT
- Zymed ECG
- AT1
- Zymed ASCII

Export to MIT

This option saves a copy of the current scanned file (name and directory of your choice) as an .mit file (a format used to evaluate the performance of arrhythmia detection). The beat-by-beat evaluations in the file can then be compared to the annotated databases from Massachusetts Institute of Technology (MIT) and Beth Israel Hospital (BIH).

Export to Zymed ECG Format

This option saves a copy of the current input file (name and directory of your choice) as an .rf file (a format used for input to Holter). This option can be used to export cassette tapes and flashcard files to your hard disk in scanner format (200 samples per second, 10-bit data).

Export to AT1 Format

This option saves a copy of the current input file (name and directory of your choice) as an .AT1 file (a format used in Hewlett Packard scanners). This option can be used to export cassette tapes and flashcard files to your hard disk in HP scanner format.
Export to Zymed ASCII

This option saves a copy of the currently scanned file (name and directory of your choice) in .dat format. The option creates a Unicode ASCII file containing various Holter Report results. These results include patient demographics and detailed Holter summaries. Since this output is an ASCII text file, however, no graphics (strips or histograms) are included. Zymed ASCII format is intended for researchers and for integration of data into custom Hospital Information Systems.

NOTE

You must complete the scan and display at least one section (tab) of the Holter Report before exporting data in ASCII format. Failure to display at least one section of the report before exporting (or after editing Report data) may cause loss of ASCII data.
Appendix  B Terms and Concepts

Overview

This appendix provides background for Holter functions, concepts, and terms. In addition, it lists abbreviations and terms used in this book, under "Additional Terms".

The major sections of this chapter are as follows:

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</tbody>
</table>
Beat Annotation

The Holter scanner annotates beats/events with the codes and colors listed in the tables below. Codes appear above beats in the Diagnostic/Page windows and the default color schemes assume either a black, white, or gray background.

Annotation of Ventricular Beats

<table>
<thead>
<tr>
<th>Code</th>
<th>Sample Color</th>
<th>Ventricular Beats</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Red</td>
<td>Bigeminy</td>
</tr>
<tr>
<td>C</td>
<td>Red</td>
<td>Couplet</td>
</tr>
<tr>
<td>I</td>
<td>Red</td>
<td>Interpolated PVC</td>
</tr>
<tr>
<td>P</td>
<td>Red</td>
<td>Isolated PVC</td>
</tr>
<tr>
<td>L</td>
<td>Red</td>
<td>Late Ventricular Ectopies</td>
</tr>
<tr>
<td>E</td>
<td>Red</td>
<td>Non-premature Ventricular Ectopies</td>
</tr>
<tr>
<td>R</td>
<td>Red</td>
<td>R on T</td>
</tr>
<tr>
<td>3</td>
<td>Red</td>
<td>Trigeminy</td>
</tr>
<tr>
<td>T</td>
<td>Red</td>
<td>Triplet</td>
</tr>
<tr>
<td>V</td>
<td>Red</td>
<td>Ventricular Run</td>
</tr>
</tbody>
</table>

Annotation of Atrial Beats

<table>
<thead>
<tr>
<th>Code</th>
<th>Sample Color</th>
<th>Atrial Beats</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Yellow</td>
<td>Atrial Bigeminy</td>
</tr>
<tr>
<td>C</td>
<td>Yellow</td>
<td>Atrial Couplet</td>
</tr>
<tr>
<td>F</td>
<td>Yellow</td>
<td>Atrial Fibrillation</td>
</tr>
<tr>
<td>A</td>
<td>Yellow</td>
<td>Atrial Run</td>
</tr>
<tr>
<td>3</td>
<td>Yellow</td>
<td>Atrial Trigeminy</td>
</tr>
<tr>
<td>B</td>
<td>White</td>
<td>Bradycardia</td>
</tr>
<tr>
<td>D</td>
<td>Yellow</td>
<td>Dropped Beats</td>
</tr>
<tr>
<td>L</td>
<td>Yellow</td>
<td>Late Beat, long, but not yet significant intervals</td>
</tr>
<tr>
<td>P</td>
<td>Yellow</td>
<td>Premature Atrial Contraction (PAC)</td>
</tr>
<tr>
<td>T</td>
<td>White</td>
<td>Tachycardia</td>
</tr>
</tbody>
</table>
Annotation for Other Beats

<table>
<thead>
<tr>
<th>Code</th>
<th>Sample Color</th>
<th>Unknown Morphology</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>White</td>
<td>Normal</td>
</tr>
<tr>
<td>n</td>
<td>Gray</td>
<td>Unqualified Normal</td>
</tr>
<tr>
<td>v</td>
<td>Gray</td>
<td>Unqualified beat in a Ventricular shape</td>
</tr>
<tr>
<td>*</td>
<td>White</td>
<td>Noisy area: no beat, no R-R calculation of preceding/following beats</td>
</tr>
<tr>
<td>?</td>
<td>White</td>
<td>Artifact: Does not recognize/count the beat, but R-R values of preceding/following beats are counted</td>
</tr>
<tr>
<td>-</td>
<td>White</td>
<td>Bad gap: no beat, no R-R calculation of preceding/following beats</td>
</tr>
</tbody>
</table>

Atrial Terms

Term | Definition and Predominant Characteristics
---|-------------------------------------------------|
Atrial Bigeminy | Atrial bigeminy is a pattern of alternating sinus and ectopic beats that can occur randomly or in patterns (for example, PAC/N/PAC/N).

Atrial Fibrillation | Atrial fibrillation is present when multiple areas within the atria depolarize at different times. P waves are rapid and chaotic and replaced by fibrillatory (f) waves, producing random oscillation in the baseline. Since conduction through the AV node is random, R-to-R intervals are grossly irregular and unpredictable. Second degree AV block and complete heart block may occur on rare occasions. Sudden regularity of the R-to-R intervals with a slow rate or groups of beats that form patterns may signal the onset of AV block. The baseline still retains waves in the presence of AV block.

Atrial Flutter | Atrial flutter is a tachyarrhythmia originating in the atria. The isoelectric line presents a characteristic sawtooth pattern and conduction to the ventricles can be regular or irregular. Because of the rapid Atrial rate (250 BPM or greater) not all flutter waves conduct to the ventricles. AV block is present as a physiological response. The Ventricular response to Atrial flutter may be rapid, variable, or slow, depending on the degree of AV block. If conduction is regular, the number of flutter waves to one QRS is expressed as a ratio: 2:1, 4:1, 8:1, for example.

Atrial Prematurity | Beats that originate from single or multiple foci above the ventricles (excluding the sinus node) are Supraventricular ectopics. If these beats occur earlier than expected in relation to the preceding beats, they are premature Atrial contractions (PACs) or premature junctional contractions (PJC).
**Block Terms**

The characteristics of AV blockages are summarized in "Characteristics of AV Blocks" on page B-9.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition and Predominant Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paroxysmal Atrial Tachycardia</td>
<td>Paroxysmal Atrial tachycardia is an abnormal rapid arrhythmia originating from a focus in the atrium. This foci may fire rapidly or the impulse may reenter and activate the atria in a circular fashion. The onset and offset of PAT is sudden. If P waves were not discernible, a more appropriate term for this tachyarrhythmia would be Supraventricular tachycardia. PAT with block is a term used to describe nonconducted ectopic P waves during the episode of PAT. These nonconducted ectopic P waves may be a physiological response or a response to medication.</td>
</tr>
<tr>
<td>Bundle Branch Block</td>
<td>Bundle branch block and intraventricular conduction delay are terms to describe abnormally wide, notched QRSs with duration greater than 0.12 seconds.</td>
</tr>
<tr>
<td>Complete Heart Block</td>
<td>When the AV node does not conduct any impulses from the atria, complete heart block occurs. Cells below the blocked area may produce impulses which activate the ventricles and, depending on the location of these cells, junctional escape rhythm or Ventricular escape rhythm will result. Two independent rhythms characterize complete heart block: sinus rhythm and either junctional or escape. The sinus node Ventricular rhythm produces nonconducted P waves at a set rate unrelated to any QRS. The escape rhythm produces QRS complexes at a much slower rate than the sinus node. Complete heart block can also occur in the presence of Atrial fibrillation. Sudden and slow regularity of the R-to-R intervals could indicate periods of Atrial fibrillation.</td>
</tr>
<tr>
<td>First Degree AV Block</td>
<td>The amount of time for a sinus impulse to travel through the AV node and activate the ventricles varies from 0.12 second to 0.20 second for adults. This time delay is called the PR interval and is measured from the onset of the P wave to the onset of the QRS. First degree AV block is an abnormal prolongation of the PR interval. For first degree AV block to be present, the PR interval must measure 0.21 or greater.</td>
</tr>
<tr>
<td>SA Block</td>
<td>The failure of the sinus node to generate an impulse or the inability of an impulse to escape from the surrounding tissue may produce a sinus pause/arrest. To distinguish a sinus pause from a blocked PAC or second degree AV block, note that P waves are absent during the long R-to-R interval. In addition, as a rule, the long R-to-R interval is twice the length of the preceding R-to-R interval. The frequency of sinus pauses during a time interval may suggest the presence of SA block. Rhythmic patterns, or group beats separated by long R-to-R intervals, indicate SA block.</td>
</tr>
</tbody>
</table>
**Block Terms**

| Second Degree AV Block, Type I | When the AV node fails to conduct a sinus impulse to the ventricles, second degree AV block is present. Type I, or Wenckebach, second degree AV block is characterized by a progressive lengthening of the PR interval resulting in a nonconducted sinus P wave. During this long delay, the AV node recovers, and the next PR interval may be conducted within normal limits. The P-to-P interval is regular. The R-to-R interval may be regular or irregular and may resemble Type I, second degree AV sinus pause or a blocked PAC. A sinus pause lacks a nonconducted P wave and a blocked PAC occurs prematurely from a different focus. |

| Second Degree AV Block, Type II | When the AV node fails to conduct an impulse to the ventricles, second degree AV block is present. Type II, or high grade, second degree AV block indicates a serious diagnosis and may require a pacemaker to guard the patient from the results of complete heart block. Type II second degree AV block is characterized by a consistent PR interval. One or several nonconducted sinus P waves may occur within a single long R-to-R interval. Often, Type II second degree AV block is associated with intraventricular conduction delay or bundle branch block QRS configurations. |
## General Terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition and Predominant Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abnormal Q Wave</td>
<td>An abnormal Q wave has a duration of greater than 0.04 seconds or an amplitude greater than 25% of the following R wave. These guidelines do not apply to leads III, aVL, aVR, and V1 where wide and deep Q waves are found in normal patients.</td>
</tr>
<tr>
<td>Blocked PACs</td>
<td>If an ectopic P wave occurs too early for conduction through the AV node, the impulse is blocked, or not conducted to the ventricles. This results in a relatively long R-to-R interval with the nonconducted ectopic P wave distorting the T wave or the ST segment.</td>
</tr>
<tr>
<td>Dropped beat</td>
<td>R-to-R interval that exceeds the threshold for normal sinus rhythm, either as a percentage or by a fixed interval (in ms.)</td>
</tr>
<tr>
<td>Heart Rate</td>
<td>Calculated by the Holter algorithm for a region of interest (a strip, for example). Heart rate is determined by dividing the total number of valid R-to-R intervals by the sum of the lengths of valid R-to-R intervals in ms, then multiplying by 60000. The results are expressed in beats per minute (BPM) Unvalidated R-to-R intervals (for noise, for example) are excluded.</td>
</tr>
<tr>
<td>Junctional Rhythm</td>
<td>Three or more consecutive impulses originating from the AV nodal area (rate 40-60 BPM, PRI &lt;.12, if present) represent junctional rhythm. The QRS for junctional rhythm closely resembles the QRS for the patient’s intrinsic rhythm. Junctional rhythm can be recognized by (a) a change in configuration of the P wave with short PR interval (b) sudden absence of P waves or (c) if seen, P waves will be retrograde. Since P waves and PR interval help determine the origin of impulses, any change in the shape of the P wave or the shortening of the PR interval indicates a change in origin of the impulse.</td>
</tr>
<tr>
<td>Junctional Accelerated Rhythm</td>
<td>Three or more consecutive impulses originating from the AV nodal area (rate 60-100 BPM, PRI &lt;.12, if present) represent junctional accelerated rhythm. With junctional tachycardia, the heart rate is 100-180 BPM.</td>
</tr>
<tr>
<td>Junctional Rhythm with AV Dissociation</td>
<td>When junctional and sinus rhythm are present as two independent rhythms, the sinus P waves are not associated with the junctional QRS complexes. The P waves appear to walk through the QRS. When sinus rhythm resumes, a consistent PR interval is present.</td>
</tr>
<tr>
<td>Late Beat</td>
<td>R-to-R interval exceeds the threshold for normal sinus rhythm by a specified percentage (for example, 25 percent).</td>
</tr>
</tbody>
</table>
### General Terms

**Normal Sinus Rhythm**

In a normal sinus rhythm, a P wave precedes each QRS complex and the rate is between 60 and 100 BPM. The axis of the P wave varies from 15 to 75 degrees and is upright in leads I, II, V3-V6, and aVF (inverted in aVR). The P-P variation is normally less than .16 second; otherwise, it is sinus arrhythmia.

**Pause**

A dropped beat (see above) with a second threshold for late beats (see above). A pause is an R-to-R interval that exceeds normal length criteria by a fixed length (for example, two seconds) and a user-selectable percentage.

**Sinus Arrhythmia**

Irregular impulses from the sinus node produce sinus arrhythmia. This irregularity is considered normal for most children and adults. However, marked or pronounced sinus arrhythmia may be the result of a disease process or medication.

**Sinus Bradycardia**

A sinus rate of less than 60 BPM in an adult. The P wave has a normal axis and the PR interval is usually greater than 0.12 seconds.

**Sinus Tachycardia**

A sinus rate of greater than 100 BPM in an adult, frequently occurring because of a stimulus (for example, caffeine) or disease (fever, hypoxia, myocarditis, for example). Tachycardia occurs in approximately one third of MI patients.

**Sinus Pause and Sinus Arrest**

The failure of the sinus node to produce an impulse or the impulse's inability to escape from the surrounding tissue is a sinus pause/arrest. If a junctional or Ventricular escape rhythm is not present, a long R-to-R interval will result. Frequent sinus pauses may suggest the presence of SA block. Marked sinus arrhythmia may mimic sinus pauses. However, as a general rule, the R-to-R interval preceding the sinus pause should be equal to the R-to-R interval after the pause.

**WPW and LGL**

WPW is an impulse conduction abnormality. Although the impulse originates from the sinus node, the impulse bypasses the AV node and travels a different pathway to activate parts of the ventricles earlier than expected. This pre-excitation of the ventricles results in a characteristic slurring at the onset of the QRS. The QRS resembles a delta wave and is prolonged. The PR interval is very short. Patients with WPW may be prone to tachyarrhythmias. LGL is also an impulse conduction abnormality. The impulse may bypass the AV node or conduction through the AV node may be accelerated. Conduction through the ventricles than proceeds normally.
## Ventricular Terms

The characteristics of Ventricular terms are summarized in "Characteristics of Ventricular Rhythms" on page B-10.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition and Predominant Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventricular Bigeminy</td>
<td>Bigeminy can occur randomly or in patterns (one normal sinus rhythm followed by a PVC). When each sinus or intrinsic beat is followed by a Ventricular ectopic, an alternating pattern is present.</td>
</tr>
<tr>
<td>Ventricular Escape Beats</td>
<td>A Ventricular escape beat is an abnormal beat originating from a focus in the ventricles. If a sinus or other Supraventricular impulse does not activate the ventricles in timely manner, a Ventricular focus will produce an impulse. This property of foci to generate a beat after a certain delay is called automaticity.</td>
</tr>
<tr>
<td>Ventricular Fibrillation</td>
<td>Ventricular fibrillation represents total disorganization within the ventricles. No structured QRS exists. The wavy baseline is caused by small areas in the ventricles depolarizing but no Ventricular deflections are present.</td>
</tr>
<tr>
<td>Flutter-Torsade de Pointes</td>
<td>Ventricular flutter/torsade de pointes is an extremely rapid episode of Ventricular tachycardia. Torsade de pointes means twisting of the points, which refers to rhythmic changes in the QRS vectors during the episode.</td>
</tr>
<tr>
<td>Fusion Beats</td>
<td>A fusion beat is an abnormal Ventricular beat occurring at the same time that a sinus beat activates the ventricles. The blending of these two impulses produces a QRS that resembles a sinus beat and a PVC.</td>
</tr>
<tr>
<td>Interpolated PVCs</td>
<td>PVCs are abnormal premature beats originating from foci in the ventricles. Most PVCs are followed by compensatory pauses. PVCs sandwiched between normal beats are called interpolated PVCs.</td>
</tr>
<tr>
<td>Prematurity</td>
<td>Ventricular ectopics originate from single focus or multiple foci within the ventricles. When these abnormal beats occur earlier than expected in relation to the preceding normal beats, PVCs (premature Ventricular contractions) are present. Ventricular prematurity defines the degree of prematurity required for Ventricular beats to be PVC’s. Ventricular beats which exceed this prematurity parameter are called Ventricular ectopics and include fusion and Ventricular escape beats.</td>
</tr>
<tr>
<td>Quadrigeminy</td>
<td>A Ventricular quadrigeminy can occur randomly or in patterns. Groups of Ventricular beats consisting of three sinus (or intrinsic) beats and one Ventricular ectopic are patterns of quadrigeminy.</td>
</tr>
</tbody>
</table>
### Ventricular Terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trigeminy</td>
<td>A Ventricular trigeminy can occur randomly or in patterns. Groups of Ventricular ectopic beats consisting of two sinus (or intrinsic) beats and one Ventricular ectopic are patterns of trigeminy.</td>
</tr>
<tr>
<td>Ventricular Ectopic (VE)</td>
<td>A Ventricular ectopic is an abnormal beat which originates in the ventricles. Since the Ventricular ectopic does not exceed the parameter for prematurity, the abnormal beat may be either a Ventricular fusion or a Ventricular escape beat. A series of three or more consecutive Ventricular ectopics at a rate of less than 100 BPM is Ventricular escape, or idioventricular, rhythm. A high number of Ventricular ectopics may indicate the presence of Ventricular parasystole. See also Characteristics of Ventricular Rhythms</td>
</tr>
<tr>
<td>Ventricular Standstill</td>
<td>Ventricular standstill describes an excessively long R-to-R interval in presence of Atrial fibrillation or high grade complete heart block. Although the sinus node may be functioning appropriately, or in the case of Atrial Fibrillation, p-waves may be present, the ventricles fail to be activated.</td>
</tr>
</tbody>
</table>
### Characteristics of AV Blocks

<table>
<thead>
<tr>
<th>Term</th>
<th>Rhythm</th>
<th>Rate</th>
<th>P Wave</th>
<th>QRS</th>
<th>PRI</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Degree AV Block</td>
<td>Regular</td>
<td>Usually 60-100</td>
<td>Upright</td>
<td>&lt;10</td>
<td>&gt;20 Constant</td>
</tr>
<tr>
<td>Second Degree, Type II (Wenckebach, Mobitz I)</td>
<td>Irregular</td>
<td>Atrial &gt; Ventricular, usually 60-100</td>
<td>Normal, but some P waves are not followed by a QRS</td>
<td>&lt;10</td>
<td>Lengthens until a P wave appears without a QRS</td>
</tr>
<tr>
<td>Second Degree, Type II (Mobitz II)</td>
<td>Irregular</td>
<td>Atrial &gt; Ventricular</td>
<td>Normal but some P waves are not followed by a QRS</td>
<td>Usually &gt; 10</td>
<td>May be normal or prolonged but is constant for each conducted QRS</td>
</tr>
<tr>
<td>Second Degree, 2:1 Conduction</td>
<td>Regular</td>
<td>Atrial &gt; Ventricular</td>
<td>Two P waves for each QRS</td>
<td>May be &gt; or &lt; .10</td>
<td>Constant</td>
</tr>
<tr>
<td>Complete (Third Degree) AV Block</td>
<td>Regular</td>
<td>Atrial &gt; Ventricular</td>
<td>More P than QRSs</td>
<td>&lt; .10 junction &gt; .10 Ventricular</td>
<td>None (no real PRI)</td>
</tr>
</tbody>
</table>

### Characteristics of Ventricular Rhythms

<table>
<thead>
<tr>
<th>Term</th>
<th>Rhythm</th>
<th>BPM</th>
<th>P Wave</th>
<th>QRS</th>
<th>PRI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agonal Rhythm</td>
<td>Irregular</td>
<td>&lt;20</td>
<td>Absent</td>
<td>&gt;.12</td>
<td>Not measurable</td>
</tr>
<tr>
<td>Idioventricular Rhythm</td>
<td>Essentially regular</td>
<td>20-40</td>
<td>May be absent or may appear after QRS</td>
<td>&gt;.12</td>
<td>Not measurable</td>
</tr>
<tr>
<td>Accelerated Idioventricular Rhythm (AIVR)</td>
<td>Essentially regular</td>
<td>40-100</td>
<td>May be absent or may appear after QRS</td>
<td>&gt;.12</td>
<td>Not measurable</td>
</tr>
<tr>
<td>Monomorphic Ventricular Tachycardia</td>
<td>Usually regular</td>
<td>&gt;100</td>
<td>May be absent or may appear after QRS</td>
<td>&gt;.12</td>
<td>Not measurable</td>
</tr>
<tr>
<td>Polymorphic Ventricular Tachycardia (Torsades de Pointes)</td>
<td>Irregular</td>
<td>&gt;150</td>
<td>Independent or none</td>
<td>&gt;.12</td>
<td>Not measurable</td>
</tr>
</tbody>
</table>
Additional Terms

The following abbreviations and their definitions apply to the instructions in this manual:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AF or AFib</td>
<td>Atrial flutter or Atrial fibrillation</td>
</tr>
<tr>
<td>AHA</td>
<td>Reference to database of two-channel Holter-type recordings annotated by the American Heart Association (80 records of 35 minutes each)</td>
</tr>
<tr>
<td>Algorithm</td>
<td>Set of rules the program uses to analyze the scan</td>
</tr>
<tr>
<td>ASDNN</td>
<td>Average of all standard deviations</td>
</tr>
<tr>
<td>BBB</td>
<td>Bundle branch block</td>
</tr>
<tr>
<td>BIH</td>
<td>Beth Israel Hospital</td>
</tr>
<tr>
<td>BPM</td>
<td>Beats per minute (b/min)</td>
</tr>
<tr>
<td>EASI</td>
<td>Using five electrodes (A, E, and I positions of the Frank system and S position over the upper end of the sternum) to record ECG data</td>
</tr>
<tr>
<td>ECG or EKG</td>
<td>Electrocardiogram</td>
</tr>
<tr>
<td>HRV</td>
<td>Heart rate variability</td>
</tr>
<tr>
<td>KB/MB</td>
<td>Kilobyte/Megabyte: units of measurement for storage space in a computer</td>
</tr>
<tr>
<td>MIT</td>
<td>Reference to arrhythmia database of ECG records maintained at Massachusetts Institute of Technology</td>
</tr>
<tr>
<td>NSR</td>
<td>Normal sinus rhythm where a P wave precedes each QRS complex (of normal width) with a rate is between 60-100 BPM</td>
</tr>
<tr>
<td>PAC</td>
<td>Premature Atrial Contraction</td>
</tr>
<tr>
<td>PVC</td>
<td>Premature Ventricular Contraction</td>
</tr>
<tr>
<td>QRS</td>
<td>The waveform presented in an ECG during Ventricular depolarization</td>
</tr>
<tr>
<td>SDANN</td>
<td>Standard deviation of all averages</td>
</tr>
<tr>
<td>SDNN</td>
<td>Standard deviation for all analyzed N-N intervals</td>
</tr>
<tr>
<td>SI</td>
<td>Superimposition mode</td>
</tr>
<tr>
<td>ST</td>
<td>Distance between J point at end of QRS wave and start of T wave</td>
</tr>
<tr>
<td>VE</td>
<td>Ventricular Ectopic</td>
</tr>
</tbody>
</table>
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