

GE Healthcare

MAC™ 2000 ECG Analysis System Operator's Manual

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English
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Publication Information

The information in this manual applies only to MAC™ 2000 Version 1.1. It does not apply to earlier product versions. Due to continuing product innovation, specifications in this manual are subject to change without notice.

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This product includes software developed by the OpenSSL Project for use in the OpenSSL Toolkit (<http://www.openssl.org/>). This product includes cryptographic software written by Eric Young (ey@cryptsoft.com). This product includes software written by Tim Hudson (tjh@cryptsoft.com).

This product complies with the requirements concerning medical devices from the following regulatory bodies:



The document part number and revision are on each page of the document. The revision identifies the document's update level. The revision history of this document is summarized in the following table.

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To access other GE Healthcare Diagnostic Cardiology manuals, go to the Common Documentation Library (CDL), located at www.gehealthcare.com/documents, and click **Cardiology**.

To access Original Equipment Manufacturer (OEM) manuals, go to the device manufacturer's Web site.

Contents

1 Introduction

Intended User of this Product	9
Indications for Use	9
Contraindications	10
Prescription Device Statement	10
Regulatory and Safety Information.....	10
Safety Conventions	10
Safety Hazards.....	11
Classification of Medical Device	13
Certification Information.....	13
Recording ECGs During Defibrillation	14
Accuracy of Input Signal Reproduction.....	14
Modulating Effects in Digital Systems	14
EMI/EMC/RF Safety Information	14
Biocompatibility.....	15
Legal Notice	15
Supplies and Accessories	16
Responsibility of the Manufacturer.....	16
Responsibility of the Purchaser/Customer.....	16
Product and Packaging Information.....	16
Equipment Identification.....	25
Product Label	25
Serial Number Format.....	25
Device Address Label and Rating Plate.....	26
Product Codes	26
Service Information.....	27
Service Requirements	27
Warranty Information	27
Additional Assistance.....	27
Manual Information	27
Manual Purpose	27
Document Conventions	27
Related Documents.....	28

2 Product Overview

Product Description	29
Product Specifications	29
Hardware Descriptions.....	29
Optional Software Features	35

	Using the System	35
	Navigating the User Interface.....	38
	Resting ECG Power Up Mode	39
	Arrhythmia Power Up Mode	39
	Main Screen Power Up Mode.....	40
	Stress ECG Power Up Mode.....	40
	Order Manager Power Up Mode.....	41
3	Setting Up the Equipment	
	Inserting the Battery.....	43
	Connecting the AC Power.....	43
	Connecting the Patient Cable	44
	Connecting the Barcode Reader	46
	Connecting the LAN Option.....	46
	Connecting the WiFi Option	46
	Connecting External Devices (Stress Option)	47
	Connecting an Internal Modem	47
	Inserting the Paper	47
	Turning on the System	47
	Configuring the Device.....	47
	Testing the Device.....	48
4	Preparing the Patient	
	Preparing the Patient's Skin.....	49
	Electrode Placement	50
	Resting ECG Placement	50
	Stress 12-Lead Placement.....	53
5	Entering Patient Information	
	Entering Patient Information With an Internal Keypad or External Keyboard.....	55
	Entering Patient Information with a Barcode Reader	56
	Scanning the Barcode	56
	Downloading Patient Demographics	57
6	Order Manager	

	Communication Media	59
	Simple Orders.....	59
	Advanced Order Manager	60
	Downloading Orders.....	60
	Selecting and Completing Orders	61
	Using the Order Manager Interface	62
	Deleting Orders	62
7	Recording a Resting ECG	
	Hookup Advisor	66
	Resting ECGs	68
	Recording a Resting ECG.....	68
	ECG Options	69
	Post-Acquisition Options.....	71
	Special Considerations.....	73
	Recording ECGs of Pacemaker Patients.....	73
	Recording ECGs During Defibrillation	74
	Generating a Rhythm Report (Manual Recording)	74
8	Arrhythmia Mode Recording	
	Recording in Arrhythmia Mode	77
	Recording Arrhythmia ECGs.....	77
	Arrhythmia Recording Options.....	78
	Printing	79
	Printing an Arrhythmia Report	79
	Arrhythmia Printing Options.....	80
	Arrhythmia Codes	80
9	RR Analysis	
	RR Analysis Mode	83
	RR Analysis Setup.....	83
	Acquiring a Recording for an RR Analysis Report.....	87
	Output Options.....	87
10	Stress Testing	
	Stress Mode Interface	90
	Stress Test Information Bar.....	90
	Stress Test Keys.....	92
	Stress Options.....	92
	Conducting Stress Tests.....	94
	Conducting a Stress Test with a Treadmill or Ergometer.....	94
	Conducting a Stress Test with a Master's Step Device	96

11	Managing Internal Storage	
	Importing Records	99
	Printing the File Manager Directory.....	100
	Finding Records.....	101
	Editing Patient Data.....	101
	Previewing Records.....	102
	Deleting Records.....	103
	Printing Records.....	103
	Transmitting Records.....	103
	Exporting Records.....	104
	Setting Up Export Options	105
	Exporting Records.....	105
12	System Configuration	
	Basic Setup.....	107
	Resting ECG Setup.....	112
	Arrhythmia Setup	121
	Stress ECG Setup	124
	Stress ECG Settings.....	124
	Editing Stress Protocols	128
	Communication Setup.....	131
	Country Setup	141
	Print Setup Report.....	143
	Patient Setup.....	144
	User Setup.....	149
	Select Setup.....	151
	Import Setup	152
	Export Setup.....	153
	Options Setup.....	153
	Service Setup.....	155

Date/Time Setup	155
Order Manager Setup.....	156
RR Analysis Setup.....	157
PDF File Naming Convention.....	157
Default Naming Convention.....	157
Customizing the Naming Convention.....	158
Retrieving Your Password	159
Exporting the Audit Trail	159

13 Maintenance

Equipment Cleaning and Storage	161
Inspecting the Equipment.....	161
Cleaning the Device.....	162
Cleaning, Disinfecting, and Storing ECG Cables and Leadwires.....	162
Cleaning Guidelines	163
Cleaning and Disinfecting Cables and Leadwires	163
Storing Cables and Leadwires	165
Cleaning, Disinfecting, and Sterilizing Reusable Electrodes	165
Replacing Leadwire Adapters	166
Paper Maintenance	166
Replacing Paper	167
Adjusting the Tray for Paper Size	168
Removing the Paper Pack.....	169
Storing Thermal Paper.....	170
Battery Maintenance	170
Replacing the Battery.....	171
Conditioning the Battery Pack	172
Battery Status Indicator.....	172
Supplies and Accessories	173

14 Troubleshooting

General Troubleshooting Tips	175
Frequently Asked Questions (FAQ)	176
Equipment Problems	176
System Does Not Power Up	176
ECG Data Contains Noise	177
External Stress Equipment does not Move.....	177
Paper Jams.....	178
Import/Export/Save Errors.....	178
SD Card Not Present	178
Cannot Import or Transmit Records via Modem.....	178

	Cannot Transmit Records via LAN.....	179
	Cannot Transmit Records via WiFi.....	179
	Cannot Export to Shared Directories.....	180
	Acquisition/Printer Error Messages	180
	Report Errors.....	180
	ACI-TIPI Statement is not Included on Report	181
	System Errors.....	181
A	Creating Barcodes	
	Setting Up the Patient Data Scheme.....	185
	Configuring the Barcode Reader.....	186
	Configuring the Barcode Reader Manually	186
	Configuring the Barcode Reader Automatically	187
B	Master's Step Data	
	Master's Step Table.....	189
	ST-T Changes	192
C	Technical Specifications	
	System Specifications	193
	Acquisition, Processing, and Performance.....	195
	Operating Modes, Features, and Options	197

1

Introduction

This document describes the **MAC™ 2000 ECG Analysis System**, also referred to as the “product”, “system”, or “device”. The document is intended to be used by clinical professionals who use, maintain, and/or troubleshoot the system. Clinical professionals are expected to have a working knowledge of appropriate medical procedures, practices, and terminology used in the treatment of patients.

This chapter provides general information required for the proper use of the system and this manual. Familiarize yourself with this information before using the system.

Intended User of this Product

The *MAC™ 2000 ECG Analysis System* is a portable ECG acquisition, analysis, and recording system that is intended for use by trained operators in a hospital or medical professional’s facility environment, as well as used in clinics, physician offices, outreach centers, or wherever ECG testing is performed.

Indications for Use

The *MAC™2000 ECG Analysis System* is a portable device intended to be used by or under the direct supervision of a licensed healthcare practitioner using surface electrodes to acquire, analyze, display, and record information for adult and pediatric populations in a hospital, medical professional’s facility, clinics, physician’s office or outreach centers.

NOTE:

Pediatric populations are defined as patients between the ages of 0 and 15 years.

The *MAC™2000 ECG Analysis System* provides the following modes of operation:

- Resting ECG mode
- Arrhythmia mode
- Exercise mode for exercise stress testing (optional)
- RR analysis mode for RR interval analysis (optional)

The basic system prints 6 or 12 leads of ECG and is upgradeable to provide software options such as 12-lead ECG measurement and interpretive analysis.

Arrhythmia detection is provided for the convenience of automatic documentation. Transmission and reception of ECG data to and from a central ECG cardiovascular information system is optional.

Contraindications

This system is not intended for use in the following manner:

- During patient transport
- With high-frequency surgical units
- As an intra-cardiac application
- As a vital signs physiological monitor

Prescription Device Statement

CAUTION:

United States federal law restricts this device to sale by or on the order of a physician.

Regulatory and Safety Information

This section provides information about the safe use and regulatory compliance of this system. Familiarize yourself with this information, and read and understand all instructions before attempting to use this system. The system software is considered medical software. As such, it was designed and manufactured to the appropriate medical regulations and controls.

NOTE:

Disregarding the safety information provided in this manual is considered abnormal use of this system and could result in injury, data loss, or a voided warranty.

Safety Conventions

A **Hazard** is a source of potential injury to a person, property, or the system.

This manual uses the terms DANGER, WARNING, CAUTION, and NOTICE to point out hazards and to designate a degree or level of seriousness. Familiarize yourself with the following definitions and their significance.

Definitions of Safety Conventions

Safety Convention	Definition
DANGER	Indicates an imminent hazard, which, if not avoided, will result in death or serious injury.
WARNING	Indicates a potential hazard or unsafe practice, which, if not avoided, could result in death or serious injury.

Definitions of Safety Conventions (cont'd.)

Safety Convention	Definition
CAUTION	Indicates a potential hazard or unsafe practice, which, if not avoided, could result in moderate or minor injury.
NOTICE	Indicates a potential hazard or unsafe practice, which, if not avoided, could result in the loss or destruction of property or data.

Safety Hazards

The following messages apply to the system as a whole. Specific messages may also be provided elsewhere in the manual.

WARNING:

EQUIPMENT MALFUNCTION — Any attempt by unauthorized personnel to service the device could result in equipment malfunction and void the warranty.

This equipment contains no user-serviceable parts. Refer servicing to authorized service personnel.

WARNING:

PATIENT INJURY–STRANGULATION — Cables present a possible strangulation hazard.

To avoid possible strangulation, route all cables away from the patient's throat. Use a short version of cable for pediatric patients.

WARNING:

PERSONAL INJURY–STUMBLING HAZARD— Patients can become entangled in the cables and leadwires connected to the device, which could cause the patient to stumble or trip.

Route cables and leadwires in a way to avoid creating a stumbling hazard: keep them off the floor, and route leadwires away from the patient's legs and the healthcare provider's work area.

WARNING:

MAGNETIC AND ELECTRICAL INTERFERENCE — Magnetic and electric fields can interfere with the acquisition of ECG readings.

Make sure that all peripheral components operated in the vicinity of the device comply with the relevant EMC requirements. X-ray equipment, MRI devices, radio systems (cellular phones) and so forth, are possible sources of interference because they may emit higher levels of electromagnetic radiation. Verify the performance of the system before use.

WARNING:

EXPLOSION HAZARD — Using this device in the presence of anesthetic vapors or liquids can cause explosions.

Do not use this device in the presence of anesthetic vapors or liquids. Only persons with adequate training in the correct use of this device may use this device.

WARNING:

EQUIPMENT FAILURE — Polarizing electrodes (stainless steel or silver constructed) may cause the electrodes to retain a residual charge after defibrillation. A residual charge blocks acquisition of the ECG signal.

Whenever patient defibrillation is a possibility, use non-polarizing electrodes (silver-silver chloride construction) for ECG monitoring.

WARNING:

PERSONAL INJURY — Contact with patients during defibrillation can cause serious injury or death.

Do not contact patients during defibrillation. Patient signal inputs labeled with the CF and BF symbols with paddles are protected against damage resulting from defibrillation voltages.

To ensure proper defibrillator protection, use only GE Healthcare recommended cables and leadwires. Proper placement of defibrillator paddles in relation to the electrodes is required to ensure successful defibrillation.

WARNING:

INTERPRETATION HAZARD — Results of the automated QT analysis are not considered a diagnosis.

A qualified physician or cardiologist must review and confirm the measurements and waveforms recorded by the system. It should be used only as an adjunct to the clinical history, symptoms, and results of other tests.

WARNING:

INTERPRETATION HAZARD — Computerized interpretation is only significant when used in conjunction with clinical findings.

A qualified physician must overread all computer-generated tracings.

WARNING:

POOR SIGNAL QUALITY — Improper skin preparation can cause poor signal quality during the ECG recording.

Careful skin preparation is the key to an interference-free ECG.

WARNING:

IMPROPER USE — This is a prescriptive device.

This equipment is intended for use by or under the direct supervision of a licensed healthcare practitioner.

WARNING:

EXPLOSION HAZARD — Batteries may explode in fires

Do not dispose of the battery by fire. Follow local environmental guidelines concerning disposal and recycling.

WARNING:

ELECTRIC SHOCK HAZARD/SYSTEM MALFUNCTION Liquids inside a device can cause electric shock or system malfunction.

Do not allow liquids to enter the device. If liquids enter the device, turn it off and inform your service technician. Do not use the device until it is checked by a service technician.

WARNING:

ELECTRIC SHOCK — Improper connection of this equipment may cause electric shock.

To avoid risk of electric shock, this equipment must only be connected to a supply mains with protective earth.

NOTE:

Follow the instructions provided. Do not position equipment in a way that makes it difficult to disconnect the device when using an appliance coupler, mains plug, or other separable plug as a means of isolation.

Classification of Medical Device

The device is classified as follows, according to IEC 60601-1:

Medical Device Classifications

Category	Classification
Type of protection against electrical shock	Class I internally powered equipment
Degree of protection against electrical shock	Type CF defibrillation-proof applied part
Degree of protection against solids	The IP code for this device is IP20. Protected against solid foreign objects with a diameter of 12.5 mm and greater The object probe, a sphere 12.5 mm diameter, shall not fully penetrate. The jointed test finger 12 mm diameter, 80 mm length, shall have adequate clearance from hazardous parts.
Degree of protection against harmful ingress of liquids (IP20)	The IP code for this device is IP20. Non-protected This device is ordinary equipment (enclosed equipment without protection against ingress of liquids)
Degree of safety of application in the presence of flammable anesthetic mixture with air or with oxygen or with nitrous oxide	Equipment is not suitable for use in the presence of a flammable anesthetic mixture with air or with oxygen or with nitrous oxide
Method(s) of sterilization or disinfection recommended by the manufacturer	Not applicable
Mode of operation	Continuous operation

Certification Information



Medical Equipment

With respect to electric shock, fire, and mechanical hazards only in accordance with UL 60601-1, and CAN/CSA C22.2 NO. 601.1.

Recording ECGs During Defibrillation

This equipment is protected against the effects of cardiac defibrillator discharge to ensure recovery, as required by test standards. The patient signal input of the acquisition module is defibrillation-proof. Therefore, it is not necessary to remove the ECG electrodes prior to defibrillation.

When using stainless steel or silver electrodes, a defibrillator discharge current may cause the electrodes to retain a residual charge causing a polarization or DC offset voltage. This electrode polarization blocks acquisition of the ECG signal. To avoid this condition, if there is a situation where a defibrillation procedure might be necessary, use non-polarizing electrodes (which do not form a DC offset voltage when subjected to a DC current) such as silver/silver-chloride types.

If you use polarizing electrodes, GE Healthcare recommends disconnecting the leadwires from the patient before delivering the shock.

Electrode defibrillation recovery is the ability of the electrode to allow the ECG trace to return after defibrillation. GE Healthcare recommends using non-polarizing disposable electrodes with defibrillation recovery ratings as specified in AAMI EC12 5.2.2.4. AAMI EC12 requires that the polarization potential of an electrode pair does not exceed 100 mV 5 seconds after a defibrillation discharge.

Refer to the supplies and accessories reference guide for this system for a list of approved electrodes.

Accuracy of Input Signal Reproduction

- Overall System Error meets AAMI EC11 3.2.7.1 requirements. Overall System Error is between or within $\pm 5\%$ or $\pm 40 \mu\text{V}$, whichever is greater.
- Frequency Response meets AAMI EC11 3.2.7.2 requirements, using testing methods A and D. Frequency response is between or within $\pm 10\%$ between 0.67 and 40 Hz and between +0 and -10% for 20 ms, 1.5 mV triangular input.

Modulating Effects in Digital Systems

This device uses digital sampling techniques that may produce some variation in amplitudes of Q, R, and/or S waves from one heart beat to the next, which may be particularly noticeable in pediatric recordings. If you observe this phenomenon, be aware that the origin of amplitude variations is not entirely physiological. For measuring voltages of Q, R, and S waves, GE Healthcare advises using the QRS complexes with the largest deflection of the particular waves.

EMI/EMC/RF Safety Information

This system is designed and tested to comply with applicable regulations regarding EMC and must be installed and put into service according to the EMC information stated in the Electromagnetic Compatibility appendix of the Service and/or Operator's manual. Changes or modifications to this system not expressly approved by GE Healthcare could cause EMC issues with this or other equipment.

Before installing or using the device or system, be aware of the proximity of known RF sources, such as the following:

- Radio and TV stations
- Portable and mobile RF communication devices (cell phones, two-way radios)
- X-ray, CT, or MRI devices
These devices are also possible sources of interference as they may emit higher levels of electromagnetic radiation.

WARNING:

EQUIPMENT MALFUNCTION/INTERFERENCE — Use of portable phones or other radio frequency (RF) emitting equipment near the system may cause unexpected or adverse operation.

Do not use portable phones or other electronic equipment that may emit radio frequency (RF) near this system.

WARNING:

EQUIPMENT MALFUNCTION/INTERFERENCE — Do not use the equipment or system adjacent to, or stacked with, other equipment.

If adjacent or stacked use is necessary, test the equipment or system to verify normal operation in the configuration in which you are using it.

WARNING:

ACCESSORIES/COMPONENTS — Adding accessories or components, or modifying the medical device or system, may result in increased EMISSIONS or decreased IMMUNITY of the device or system.

Use the following resources for more information on EMI/EMC and RF concerns:

- The Supplies and Accessories Reference Guide for your system
- Qualified GE Healthcare or approved third-party personnel
- The Electromagnetic Compatibility appendix in your system service or operator's manual

Biocompatibility

The parts of the system described in this manual that come into contact with the patient during the intended use, including all accessories, fulfill the biocompatibility requirements of the applicable standards. If you have questions in this matter, contact your GE Healthcare representative.

Legal Notice

GE Healthcare software contains several fields that can be filled in before performing an ECG. Some of these fields are required, while others are optional and left to the user to assess whether they are needed to perform the exam. The field **Race** is one of these optional fields. **Race** has been acknowledged by the medical profession as useful to analyze some pathologies. You should be aware that, in some jurisdictions, the processing of data revealing an individual's racial origin is subject to legal requirements, such as obtaining the patient's prior consent. If you elect to collect this type of data, it is your responsibility to ensure that you comply with all applicable legal requirements.

Supplies and Accessories

You should use only supplies and accessories that GE Healthcare recommends. For a list of recommendations, refer to the supplies and accessories reference guide for this system

Contact GE Healthcare before using anything that is not recommended for this system.

Responsibility of the Manufacturer

GE Healthcare is responsible for the safety, reliability, and performance of hardware supplied by GE Healthcare only if the following conditions are met:

- Assembly operations, extensions, readjustments, modifications, or repairs are performed by persons authorized by GE Healthcare.
- The electrical installation of the room where the device is used complies with the requirements of the appropriate local, state, and other government regulations.
- The equipment is used in accordance with the instructions for use.

Responsibility of the Purchaser/Customer

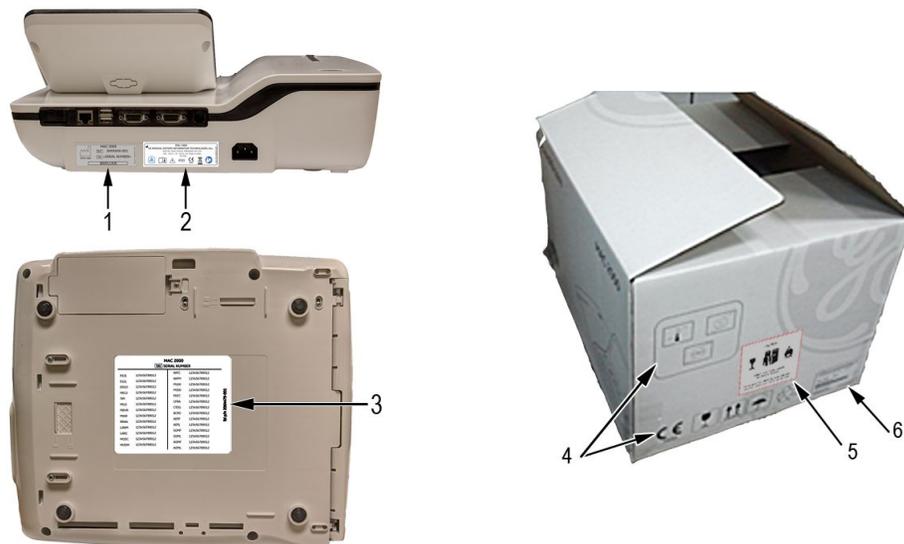
The customer is responsible for providing appropriate desks, chairs, electrical wall outlets, network connections, and analog phone lines, and for locating any of the system components described in this manual in compliance with all local, state, and national codes.

Product and Packaging Information

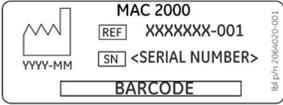
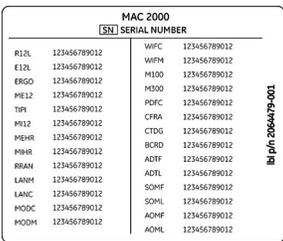
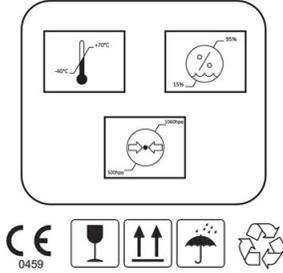
This section identifies the following:

- Hardware labels and their locations on [page 16](#)
- Symbol Descriptions on [page 17](#)

Hardware Label Locations



Label Descriptions on Hardware and Packaging

Item	Label	Location	Description
1		Back of the device	Product Label Identifies this device. See “Product Label” on page 25 for a description of the label contents.
2		Back of the device	Device Address Label and Rating Plate It provides regulatory and cautionary information. See “Device Address Label and Rating Plate” on page 26 for an explanation of the label.
3		Bottom cover of the device	The Option Code label. Use the option codes to setup the purchased options in your system. See “Options Setup” on page 153 for an explanation of the Option Codes.
4		On the shipping package	Environmental symbols required for shipping.
5		On the shipping package	Battery Shipping Label. FRAGILE—Lithium Ion batteries can cause fire if damaged.
6		On the shipping package	The shipping label.

Symbol Descriptions

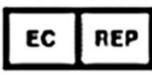
The following table describes symbols or icons that may be on the device or its packaging. Not all of the symbols defined in the table apply to your device or its packaging.

Symbols are used to convey warnings, cautions, prohibitions, mandatory actions, or information. Any symbol on your device or packaging with markings in color indicates there may be a danger, warning, or mandatory action. Any symbol on your device or packaging that is in black and white provides additional information or may

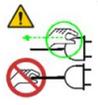
indicate a caution. Familiarity with these symbols assists in the use and disposal of the equipment.

For equipment symbols not shown, refer to the original equipment manufacturer (OEM) manuals.

Symbol Descriptions

Symbol	Description
	Catalog or Orderable Part Number Indicates the manufacturer's catalog or part number.
	Serial Number Indicates the manufacturer's serial number.
	Batch Code or Lot Number Indicates the manufacturer's batch code or lot number.
	Date of Manufacture (Year-Month) Indicates the original manufacture date for this device.
	Manufacturer Indicates the name and address for the manufacturer of this device. It may also include the date it was manufactured.
	Authorized Representative in the European Community Indicates the name and address of the authorized representative in the European Community for this device.
Rx Only	Rx Only US Federal law restricts this device to sale by or on the order of a physician.
	12SL Indicates the device uses the Marquette™ 12SL ECG Analysis Program to analyze and interpret ECG readings.
IPxy	IP Code (Ingress Protection Rating) Classifies and rates the degree of protection provided against the intrusion of solid objects (such as body parts like hands and fingers, dust, accidental contact), and liquids. The first numeral (x) represents the degree of protection against the ingress of solid objects. The second numeral (y) represents the degree of protection against the ingress of liquids. For products with an IPxy rating, see the <i>Classification of Medical Device</i> in this chapter for a description of that rating. Not all products have an IPxy rating.
	Class II Equipment Identifies equipment that meets the safety requirements specified for class II equipment by IEC 60601-1. This device was designed so that it does not require a safety connection to electrical earth (US ground). No single failure results in dangerous voltage becoming exposed and causing an electric shock. This is achieved without relying on an earthed metal casing.

Symbol Descriptions (cont'd.)

Symbol	Description
	Consult Instructions for Use Consult the operating instructions.
	Defibrillation-proof Type BF Applied Part Identifies a defibrillation-proof type BF applied part on medical equipment that complies with IEC 60601-1. This device meets the requirements for protection against electric shock for an earth-free (floating) applied part (one intended for contact with patients).
	Defibrillation-proof Type CF Applied Part Identifies a defibrillation-proof type CF applied part on medical equipment that complies with IEC 60601-1. This device meets the requirements for protection against electric shock for an earth-free (floating) applied part (one intended for contact with patients) for cardiac application.
	No User- or Field-serviceable Parts Do not open or disassemble the device for any reason.
	Protective Earth (ground) Identifies the terminal of a protective earth (ground) electrode or any terminal that is intended for connection to an external conductor for protection against electric shock in case of a fault.
	Non-ionizing Electromagnetic Radiation Indicates that the equipment emits elevated, potentially hazardous, levels of non-ionizing radiation (electromagnetic energy) for diagnosis or treatment.
	Follow Instructions For Use Read and understand the operator's manual before using the device or product. <i>As a mandatory action sign, this symbol is identified by a blue background and white symbol.</i>
	CAUTION: SAFETY GROUND PRECAUTION Pulling on the cable can cause the cord to deteriorate resulting in electrical problems. Remove the power cord from the mains source by grasping the plug. DO NOT pull on the cable.
	CAUTION: CONSULT ACCOMPANYING DOCUMENTS There may be specific warnings or precautions associated with the device that are not otherwise found on the label. Consult the accompanying documentation for more information about safely using this device.

Symbol Descriptions (cont'd.)

Symbol	Description
	<p>CAUTION: ELECTRIC SHOCK Indicates the presence of hazardous energy circuits or electric shock hazards.</p> <p>To reduce the risk of electric shock hazards, do not open this enclosure. Refer servicing to qualified personnel.</p>
	<p>CAUTION: HOT SURFACE Indicates that the marked item may be hot.</p> <p>Take appropriate precautions before touching the item.</p>
	<p>WARNING: BODILY INJURY Indicates the presence of mechanical parts that can result in pinching, crushing, or other bodily injury.</p> <p>To avoid risk of bodily injury, keep away from moving parts. Disconnect power before reaching into area or servicing.</p> <p><i>As a warning sign, this symbol is identified by a yellow background, black triangular band, and a black symbol.</i></p>
	<p>WARNING: HAND CRUSHING HAZARD This device contains moving parts that could crush the user's hand.</p> <p>Keep hands clear of the device while it is in operation. Disconnect power before reaching into or servicing the device.</p> <p><i>As a warning sign, this symbol is identified by a yellow background, black triangular band, and a black symbol.</i></p>
	<p>WARNING: BODILY INJURY Indicates the presence of a sharp edge or object that can cause cuts or other bodily injury.</p> <p>To prevent cuts or other bodily injury, do not contact sharp edge of object.</p> <p><i>As a warning sign, this symbol is identified by a yellow background, black triangular band, and a black symbol.</i></p>

Symbol Descriptions (cont'd.)

Symbol	Description
	<p>WARNING: BODILY INJURY Indicates the presence of a potential tip-over hazard that can result in bodily injury.</p> <p>To avoid risk of bodily injury, follow all instructions for maintaining the stability of the equipment during transport, installation, and maintenance.</p> <p><i>As a warning sign, this symbol is identified by a yellow background, black triangular band, and a black symbol.</i></p>
	<p>WARNING: PINCH POINT This device contains moving parts that could pinch body parts.</p> <p>Keep hands clear of the device while it is in operation. Disconnect the power before reaching into or servicing the device.</p> <p><i>As a general prohibition sign, this symbol is identified by a white background, red circular band and slash, and a black symbol.</i></p>
	<p>WARNING: PERSONAL INJURY DO NOT REACH IN Reaching into the equipment can cause personal injury.</p> <p>Do not place hands into any openings.</p> <p><i>As a general prohibition sign, this symbol is identified by a white background, red circular band and slash, and a black symbol.</i></p>
	<p>WARNING: ENVIRONMENTAL OR HEALTH HAZARD Incinerating the device or product could present a risk to the environment or human health.</p> <p>Do not incinerate this device or product.</p> <p><i>As a general prohibition sign, this symbol is identified by a white background, red circular band and slash, and a black symbol.</i></p>
	<p>WARNING: BREAKAGE DUE TO HEAVY LOAD Heavy objects on the surface may cause it to break.</p> <p>Do not load objects heavier than the maximum permissible load indicated for a safe working load.</p> <p><i>As a general prohibition sign, this symbol is identified by a white background, red circular band and slash, and a black symbol.</i></p>
	<p>Can Be Recycled Indicates you may recycle this material or device. Recycle or dispose of in accordance with local, state, or country laws.</p>

Symbol Descriptions (cont'd.)

Symbol	Description
	Waste Electrical and Electronic Equipment (WEEE) Indicates this equipment contains electrical or electronic components that must not be disposed of as unsorted municipal waste but collected separately. Contact an authorized representative of the manufacturer for information concerning the decommissioning of your equipment.
	Contains <heavy metal chemical symbol> Indicates this equipment contains heavy metal and must not be disposed of as unsorted municipal waste but collected separately. The example shows Lithium Ion.
	Environmental Friendly Use Period (EFUP) Per Chinese standard SJ/T11363-2006, indicates the number of years from the date of manufacture during which you can use the product before any restricted substances are likely to leak, causing a possible environmental or health hazard. NOTE: <ul style="list-style-type: none"> • If the device contains less than the maximum concentration of restricted substances, the symbol contains a lowercase e • This is also referred to as China RoHS.
	Japan RoHS Indicates the device or product meets the regulations limit or ban for specific substances in new electronic and electric equipment in Japan. The Green Mark (with the G) indicates the product is within the tolerances of hazardous chemicals. The Content Mark (with the R and letters below) indicates which hazardous substance(s) was used during the manufacturing of the electrical or electronic equipment that exceeds maximum tolerances.
	Fragile Indicates the contents are fragile. Handle with care.
	This Way Up Indicates the correct upright position of the package.
	Do Not Stack Indicates that you should not stack the container or place a load on the container.
	Keep Dry Indicates that you need to keep the container away from rain and other sources of moisture.

Symbol Descriptions (cont'd.)

Symbol	Description
	Humidity Limits Indicates upper and lower humidity limits for the transportation and handling of this package. They are indicated next to the upper and lower horizontal lines.
	Atmospheric Limits Indicates the upper and lower barometric pressure limitations for the transportation and handling of this package. They are indicated next to the upper and lower horizontal lines.
	Upper Temperature Limit Indicates the maximum temperature for transportation and handling of this package. The limit is indicated next to the upper horizontal line.
	Temperature Limits Indicates the upper and lower temperature limits for the transportation and handling of this package. They are indicated next to the upper and lower horizontal lines.

The following table describes certification symbols that may be used on your device or its packaging. The inclusion of a symbol in this table **does not** indicate that your product was certified by that symbol's governing body and is listed for reference only. To identify which organizations have certified your device, refer to the labeling on your device or its packaging.

Certification Symbol	Description
	UL Mark Indicates compliance with applicable Underwriters Laboratories requirements.
	UL Listed Mark Indicates compliance with international or regional standards for Underwriters Laboratories safety requirements.
	UL Listed, Canada/US Indicates compliance with international or regional standards for Underwriters Laboratories safety requirements in Canada and the United States.
	UL Classification Mark Indicates this medical equipment is UL Classified with respect to electric shock, fire, and mechanical hazards only in accordance with UL 60601-1, CAN/CSA C22.2 NO. 601.1, and IEC 60601-2-25.
	UL Classification Mark, Canada/US Indicates this medical equipment is UL Classified with respect to electric shock, fire, and mechanical hazards only in accordance with UL 60601-1, CAN/CSA C22.2 NO. 601.1, and IEC 60601-2-25 for the US and Canada.

Certification Symbol	Description
	CE Mark Indicates the device or product conforms with applicable EU (European Union) directives.
	PCT (GOST-R) Mark Indicates the device or product conforms with applicable Russian Gosstandart technical and safety standards.
	NRTL Certification Indicates the device or product has met the National Recognized Testing Laboratories certification. The NRTL certification attained is added to the mark of the applicable testing laboratory. The example displays the NRTL certification with the MET Laboratories mark.
	China Metrology Certification Indicates the device or product complies with applicable China Metrology Certification requirements.
	TÜV Rheinland Indicates the device or product complies with applicable technical and safety requirements following testing by Technischer Überwachungs-Verein, (Technical Inspections Organization).

Installation and Connection

If the installation of this equipment in the USA will use 240V rather than 120V, the source must be a center-tapped, 240V, single-phase circuit.

Contact GE Healthcare for information before connecting any devices to this equipment that are not recommended in this manual or the supplies and accessories reference guide for this system.

Training

This manual is intended as a supplement to, not a substitute for, thorough product training. If you have not received training on the use of the system, you should request training assistance from GE Healthcare.

To see available training, go to the GE Healthcare training Web site (www.gehealthcare.com/training). Select *Education>Product Education-Technical>Diagnostic Cardiology*.

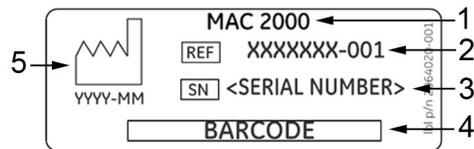
For more self-paced course offerings, tools, and reference guides you may find useful, please visit the GE Healthcare Education Store at www.gehealthcare.com/educationstore.

Equipment Identification

Every GE Healthcare product has a product label that identifies the product name, part number, manufacturing information, and unique serial number. This information is required when contacting GE Healthcare for support.

Product Label

The product label is laid out in the following format. Depending on the product, the label may vary slightly in format, but it contains the same information.

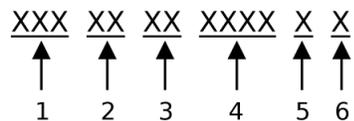


Product Label Format

Item	Description
1	Product description
2	Product part number
3	Device serial number (See "Serial Number Format" on page 25 for more information.)
4	Product bar code
5	Date of manufacture in YYYY-MM format

Serial Number Format

Each device has a serial number that uniquely identifies it and provides important information. You need the product code and the entire serial number before servicing or requesting support for your product. The serial number format is shown in the following illustration:



Serial Number Format

Item	Name	Description
1	Product Code	Three-letter code that uniquely identifies the product line. See "Product Codes" on page 26 for more information.
2	Year Manufactured	Two-digit code identifying the year the device was manufactured. Values range from 00 to 99 For example: 00 = 2000, 04 = 2004, 05 = 2005 (and so on).

Serial Number Format (cont'd.)

Item	Name	Description
3	Fiscal Week Manufactured	Two-digit code identifying the week the device was manufactured. Values range from 01 to 52. GE Healthcare's fiscal weeks correspond to the calendar week. For example, 01 = first week in January.
4	Product Sequence	Four-digit number identifying the order in which this device was manufactured. Values range from 0001 to 9999.
5	Manufacturing Site	One-letter code identifying the site where the device was manufactured. For example, F = Milwaukee, N = Freiburg, P = Bangalore
6	Miscellaneous Characteristic	For example, P = device is a prototype, R = device was refurbished, U = device was upgraded to meet the specifications of another product code, A= device is in production.

Device Address Label and Rating Plate

The Device Address label and Rating Plate is laid out in the following format. Depending on the product, the label may vary slightly in format.



Item	Description
1	Product description
2	Country of origin
3	Symbols See "Symbol Descriptions" on page 17 for a description of the symbols used on this label.
4	Electrical rating of the device
5	Manufacturer name and address

Product Codes

The product code identifies specific system platforms.

You can identify the product code using the serial number listed on the product label located in one of the following places:

- On the product label attached to the device.
- On the product label provided with the application CD.

For software application systems, you can view the serial number by launching the system application and clicking **Help > About**.

For information on launching the application, refer to the service or operator's manual for this system.

Service Information

This section provides information pertaining to the maintenance and servicing of the system. Familiarize yourself with this information before requesting service from GE Healthcare or its authorized representatives.

Service Requirements

For systems with hardware provided by GE Healthcare, failure on the part of the responsible individual, hospital, or institution using this equipment to implement a satisfactory maintenance schedule may result in equipment failure and possible safety hazards.

For software only products, maintenance of the hardware and operating system on which the software resides is the responsibility of the customer.

Regular maintenance, irrespective of usage, is essential to ensure that the components of this system are always functional when required.

Warranty Information

This device is considered GE Healthcare-supplied hardware. Only authorized GE Healthcare service personnel should service the device. Any unauthorized attempt to repair equipment under warranty voids that warranty. It is the user's responsibility to report the need for service to GE Healthcare or to one of their authorized agents.

Additional Assistance

GE Healthcare maintains a trained staff of application and technical experts to answer questions and respond to issues and problems that may arise during the installation, maintenance, and use of this system.

Contact your local GE Healthcare representative to request additional assistance.

Manual Information

This section provides information for the correct use of this manual.

Keep this manual with the equipment at all times and periodically review it. You should request training assistance from GE Healthcare, if needed.

Manual Purpose

The purpose of this manual is to provide the operator with information concerning the safety and use of their ECG system.

Document Conventions

This manual uses the following conventions.

Typographical Conventions

Convention	Description
Bold Text	Indicates keys on the keyboard, text to enter, or hardware items such as buttons or switches on the equipment.
<i>Italicized-Bold Text</i>	Indicates software terms that identify menu items, buttons or options in various windows.
CTRL+ESC	Indicates a keyboard operation. A plus (+) sign between the names of two keys indicates that while holding the first key, you should press and release the second key. For example, Press CTRL+ESC means to press and hold the CTRL key and then press and release the ESC key.
<space>	Indicates that you must press the spacebar. When instructions are given for typing a precise text string with one or more spaces, the point where you must press the spacebar is indicated as <space> . This ensures that the correct number of spaces is inserted in the correct positions within the literal text string. The purpose of the < > brackets is to distinguish the command from the literal text within the string.
Enter	Indicates that you must press the Enter or Return key on the keyboard. Do not type <i>Enter</i> .
>	The greater than symbol, or right angle bracket, is a concise method to indicate a sequence of menu selections. For example, the statement "From the main menu, select System > Setup > Options to open the Option Activation window" replaces the following: <ol style="list-style-type: none"> 1. From the main menu, select System to open the System menu. 2. From the System menu, select Setup to open the Setup menu. 3. From the Setup menu, select Options to open the Option Activation window.

Illustrations

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

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

Notes

Notes provide application tips or additional information that, while useful, are not essential to the correct operation of the system. They are called out from the body text through a flag word and indentation, as follows:

NOTE:

The tip or additional information is indented below the **NOTE** flag word.

Related Documents

For a complete list of related manuals, refer to the "Related Manuals" appendix in the service manual.

2

Product Overview

This chapter provides a description of the product, its features, and the requirements necessary to operate this system.

Product Description

This system provides two basic modes of operation:

- Resting ECG
This mode is the standard mode for your system.
- Arrhythmia
This mode is provided for the convenience of automatically generating documentation.

You can upgrade the basic system with two other modes of operation:

- Exercise
This mode is for exercise stress testing.
- RR Analysis
This mode is for RR intervals analysis.

The basic system prints 6 or 12 leads of ECG and provides optional transmission and reception of ECG data to and from a central ECG cardiovascular information system. You can also upgrade it with software options such as 12-lead ECG measurement and interpretive analysis.

Product Specifications

This section describes the device's hardware components and system specifications. Familiarize yourself with this information before using the device.

Hardware Descriptions

This section identifies the key components of the system hardware. Familiarize yourself with these components, their location, and their use before attempting to use the equipment.

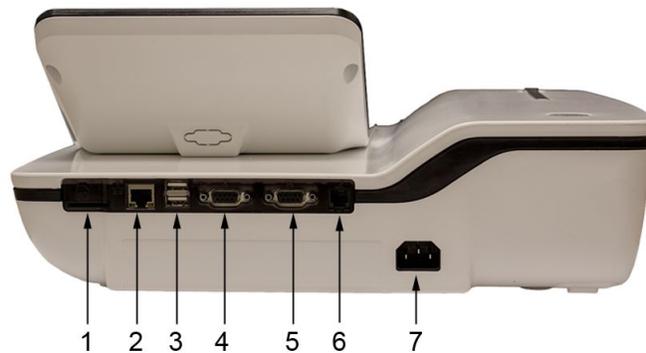
Front View



Front View of Device

Item	Name	Description
1	Display	Presents waveform and text data.
2	Function Keys	Selects menu options on the screen.
3	Keypad	Use to select menu options on the screen.
4	Printer door push button	Opens the printer door.
5	Printer/Printer door	Prints reports.

Rear View



Rear View of Device

Item	Name	Description
1	SD card slot	Connection for Secure Digital (SD) card. This system supports SD cards formatted for the FAT or FAT16 file systems.
2	LAN connection	RJ45 network connector.

Rear View of Device (cont'd.)

Item	Name	Description
3	USB ports (2)	Standard Universal Serial Bus (USB) connector for USB devices, such as the optional barcode reader, optional USB WiFi Dongle, or an external non-multimedia USB keyboard.
4	COMM A port	Serial connector for data communication with CASE/CardioSoft or MUSE systems.
5	COMM B port	Serial connector for stress devices (bicycle, ergometer, or treadmill).
6	Phone jack	RJ11 connector from the internal modem to an analog phone line.
7	AC Power Cord connection	Standard connector for the AC power cable.

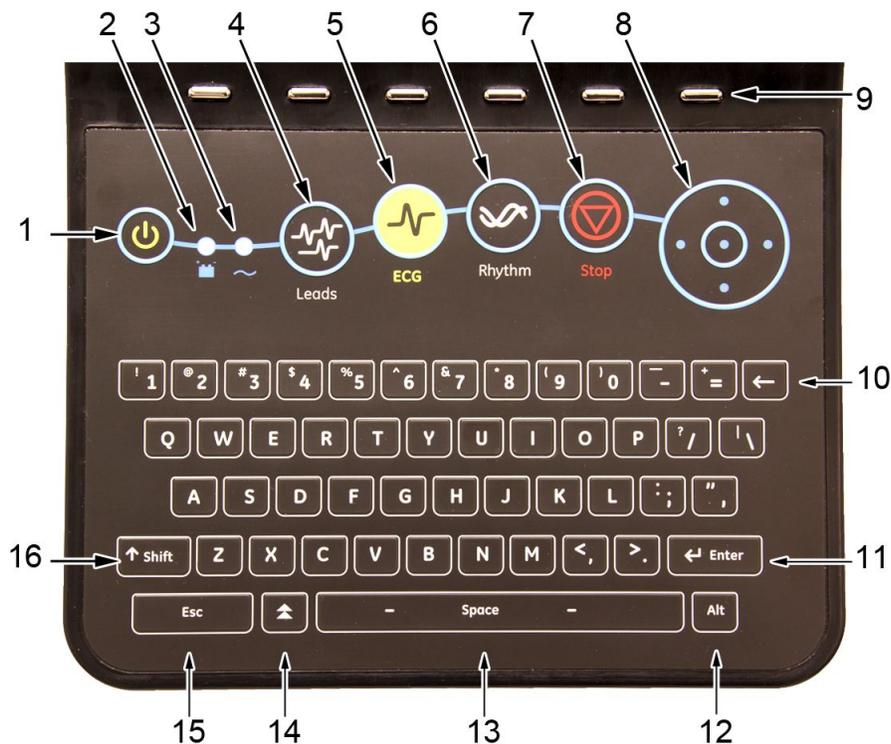
Side View



Side View of Device

Item	Name	Description
1	KISS connection	Connection port for the optional KISS Pump system.
2	ECG Patient Cable connection	D-sub 15-pin female connector for the acquisition cable.

Standard Keypad



Standard Keypad

Item	Name	Description
1	Power on/off	Turns the system on or off.
2	Battery LED	Indicates various battery states: <ul style="list-style-type: none"> • Steady amber indicates the battery is charging • Flashing amber indicates the battery is low • No light indicates the battery is neither charging nor low
3	Power LED	Indicates the unit is plugged in and receiving power.
4	Leads key	Scrolls through the leads and allows you to select the display formats for the lead sequence.
5	ECG key	Acquires and prints a 12-lead ECG.
6	Rhythm key	Prints real-time continuous rhythm.
7	Writer Stop	Stops the printing function.
8	Trimpad/Cursor Control keys	Provides movement through menus and windows. For descriptions on using the trimpad and cursor control keys, see “Using the Trimpad” on page 36.

Standard Keypad (cont'd.)

Item	Name	Description
9	Function keys	Use to select menu options on the screen. NOTE: There is no marking on the keypad for the function keys. Up to six menu options may be available at any given time, and each option corresponds to a function key directly below the display.
10	Backspace key	Deletes characters.
11	Enter key	Use to advance the focus in a window or to select items from the screen.
12	Alt key	Switches between different input methods for Japanese and Korean keyboard languages.
13	Space bar	Enters a space in the text. As a secondary function, it moves through the menu lists.
14	Option key	Use to enter special characters on non-English keyboards.
15	ESC (escape)	Closes a window on a screen.
16	Shift key	Use to enter a capital letter. For example, press Shift + p to type a capital P .

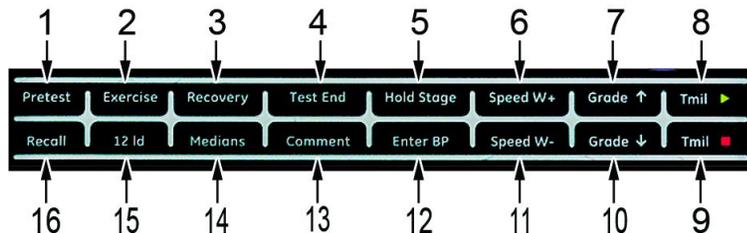
Stress Keypad

The stress keypad has the same keys as a standard keypad with the addition of specific stress keys. If you do not have the stress option, you do not have a stress keypad.



Item	Name	Description
1	Stress keys	Controls stress equipment connected to the system.

Stress Keys



Stress Keys

Item	Name	Description
1	Pretest stress key	Selects the pretest phase or advances to the next stage within the phase.
2	Exercise stress key	Selects the exercise phase or advances to the next stage within the phase
3	Recovery stress key	Selects the recovery phase or advances to the next stage within the phase
4	Test End stress key	Selects the test end phase.
5	Hold Stage stress key	Remains at the current stage.
6	Speed W+ stress key (Speed/Load up)	Manually increases the treadmill speed or ergometer load.
7	Grade ↑ stress key (Grade up)	Increases the elevation of the treadmill.
8	Tmil stress key	Starts the treadmill during the test
9	Tmil stress key	Stops the treadmill during the test.
10	Grade ↓ stress key (Grade down)	Decreases the elevation of the treadmill.
11	Speed W- stress key (Speed/Load down)	Manually decreases the treadmill speed or ergometer load.
12	Enter BP stress key	Allows you to enter blood pressure values or start a blood pressure measurement.
13	Comment stress key	Allows you to enter a comment during the stress test.
14	Medians stress key	Prints a median report during the test.
15	12ld stress key	Prints a 12-lead report
16	Recall stress key	Prints the previous 10 seconds of ECG

Hardware Specifications

See “Technical Specifications” on page 193 for a complete description of all hardware and system specifications for this device.

Optional Software Features

Optional Software Features

Item	Description
QT Correction Formula	The system provides the following QT correction formulas: Bazett (default) Framingham Fridericia
Hookup Advisor	Hookup Advisor alerts users of poor lead quality based on noise measurement and lead-off detection results.
ACI-TIPI	Acute Cardiac Ischemia Time-Insensitive Predictive Instrument (ACI-TIPI) Option (K974199).
Clinical Trials (CT) Data Guard and Audit Trail	CT Data Guard and Audit Trail supports 21 CFR part 11 compliance for the data generated using the device. Option includes password protection and time stamped audit trails.
ECG Analysis/Interpretation	12SL ECG Analysis Program (V22) K042177.
HEART exercise	HEART exercise v5.2.2.1.

Using the System

This section describes the startup screen, keypad use, and ECG data acquisition.

Startup Screen

Depending on the options you selected for **Power up** mode in **Basic Setup**, one of the following screens is your startup screen:

- Resting ECG
- Stress ECG
- Arrhythmia
- Main Screen
- Order Manager
- A window prompting you to enter your User ID and Password.

NOTE:

The password window is displayed only if you selected the **High Security Mode** option in **Basic Setup**. You can use the system to take a **STAT ECG** without logging into the system. Press the function key directly below the **STAT ECG** tab to select it.

Using the Keypad

You interact with the system by using the keypad. In addition to entering data as you would on any keypad, you can also use it to do the following tasks:

- Select menu options
- Navigate through data entry fields
- Control optional stress equipment

Using the Function Keys

You can configure the device and initiate an ECG reading by selecting menu options that are across the bottom of the display. Up to six menu options are available at any given time, and each option corresponds to a function key directly below the display.

Press the function key below the corresponding menu option to select it. The following table describes some of the possible options.

Using the Function Keys

Desired Action	Example Results
Take an ECG	Selecting the Resting ECG menu option opens the Resting ECG function and displays additional menu items related to taking a resting ECG.
Change a setting during an ECG recording	During a resting ECG, selecting the 25 mm/s option changes the speed of the waveform. Other options are available to change different settings.
Open a window	Selecting the Patient Data option opens the Enter Patient Data window.
Change menu options	Selecting the More option displays additional menu options.
Save your selections	Selecting the Save option allows you to save changes after entering data or changing a configuration.

Using the Trimpad

Use the trimpad to navigate through data entry windows.



Press the arrows to move the cursor left, right, up and down through the data fields.

Press the center button to select the field in which the cursor is currently resting. If the field is associated with a list of valid value, that list is displayed.

Using the Stress Keys

If you purchased the optional stress module, use the stress keys on the keypad to control stress equipment connected to the system. For a description of the stress keys and their function, see [“Stress Keys” on page 34](#).

ECG Data Acquisition

ECG Data Acquisition provides the following:

- Samples with a minimum 500 Hz or 1000 Hz to the ECG processing algorithms and the application software
- Pace enhancement enable/disable through the user interface
- QRS detection and heart rate calculation
- Lead sequences with 6 or 12 leads, where each lead is an element of the set (I, II, III, aVR, aVL, aVF, D, A, J, V1...V6) with an optional -aVR

ECG Data Acquisition supports the following:

- Default high pass filter (0.04 Hz), if ADS is on high pass filter (0.56 Hz)
- Selectable low pass filter (20, 40, 100, 150 Hz)
- Selectable mains filter (50 Hz, 60 Hz)
- Anti Drift System (ADS): Baseline shift correction with finite impulse response high pass filter enable/disable through the user interface in Resting ECG, Stress, and RR analysis modes

The following are selectable data formats for external ECG storage:

- DCAR XML, 500 Hz uncompressed
- DCAR XML, 1000 Hz uncompressed
- Hilltop, 500 Hz DVS
- PDF

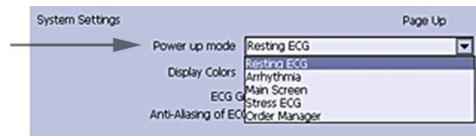
External Storage

This system supports a Secure Digital High Capacity (SDHC) card with 4 GB capacity as external storage.

Navigating the User Interface

You can configure the system in a number of ways. The configuration choices you make determine the actions you need to perform in order to proceed from the **Power up** display to the **Main Menu**.

- The **Power up mode** selected in **Basic Setup** determines which window opens on startup.



- If **High Security Mode** is enabled in **Basic Setup**, you are required to enter a user ID and password.



- The **BCRD** option in the **Option Code** window indicates that the **USB Barcode Reader support** is activated.

Option	Description
CTDG	CT Data Guard
R12L	12 lead resting waveform display
MI12	Measurement and 12SL Interpretation
M300	Internal storage 300 Resting ECGs
LANC	LAN to CardioSoft
LANM	LAN to MUSE
MODC	Modem or Serial to CardioSoft
MODM	Modem or Serial to MUSE
ERGO	Stress test with treadmill, bicycle or Master
E12L	12 lead Stress test waveform display
CFRA	21 CFR Part 11 audit trail
BCRD	USB Barcode Reader support
TIP1	ACI-TIPI

The following sections describe how to navigate from the **Power up** screen to the **Main Menu** for the each possible logon configuration. Use the procedure that applies to your logon configuration settings.

- If your system is configured to power up in the **Resting ECG** mode, go to [“Resting ECG Power Up Mode” on page 39](#).
- If your system is configured to power up in the **Arrhythmia** mode, go to [“Arrhythmia Power Up Mode” on page 39](#).
- If your system is configured to power up in the **Main Screen** mode, go to [“Main Screen Power Up Mode” on page 40](#).
- If your system is configured to power up in the **Stress ECG** mode, go to [“Stress ECG Power Up Mode” on page 40](#).
- If your system is configured to power up in the **Order Manager** mode, go to [“Order Manager Power Up Mode” on page 41](#).

Resting ECG Power Up Mode

This procedure describes how to navigate to the **Main Menu** after powering on the system when **Resting ECG** is selected for **Power up mode** in **Basic Setup**.

NOTE:

If you need to perform system setup functions, be sure you log in as a user who is assigned setup editing privileges.

If the system is configured for **Resting ECG Power Up Mode** and **High Security Mode** is not enabled, the **Resting ECG** screen opens on power up. To go to the **Main Menu**, press **More > Main Menu**.

If **High Security Mode** is enabled, when the window opens prompting for a user ID and password, use the following procedure:

1. In the **User ID** field, enter your user ID.
2. To move the cursor to the **Password** field, press **Enter** or the **down arrow** on the **Trimpad**.
3. In the **Password** field, enter your password.
4. Press **Login**.

The **Resting ECG** screen is displayed.

If the **Barcode Reader** option is enabled, a window opens prompting you to **Scan the Patient barcode**.

5. If the barcode reader prompt is not displayed, press **Cancel > More > Main Menu**.

Arrhythmia Power Up Mode

This procedure describes how to navigate to the **Main Menu** after powering on the system when **Arrhythmia** is selected for **Power up mode** in **Basic Setup**.

NOTE:

If you need to perform system setup functions, be sure you log in as a user who is assigned setup editing privileges.

If the system is configured for **Arrhythmia Power Up Mode**, and **High Security Mode** is not enabled, the **Arrhythmia** screen opens on **Power up**. To go to the **Main Menu**, press **Cancel > More > Main Menu**.

If **High Security Mode** is enabled, when the window opens prompting for a user ID and password, use the following procedure:

1. In the **User ID** field, enter your user ID.
2. To move the cursor to the **Password** field, press **Enter** or the **down arrow** on the **Trimpad**.
3. In the **Password** field, enter your password.
4. Press **Login**.

The **Arrhythmia** screen is displayed.

If the **Barcode Reader** option is enabled, a window opens prompting you to **Scan the Patient barcode**.

5. If the barcode reader prompt is not displayed, press **Cancel > More > Main Menu**.

Main Screen Power Up Mode

This procedure describes how to navigate to the **Main Menu** after powering on the system when **Main Screen** is selected for **Power up mode** in **Basic Setup**.

NOTE:

If you need to perform system setup functions, be sure you log in as a user who is assigned setup editing privileges.

If the system is configured for **Main Screen Power up mode** and does not have **High Security Mode** enabled, the **Main Menu** is displayed after powering up the system. You do not need to press any other keys in order to display the **Main Menu**.

If **High Security Mode** is enabled, when the window opens prompting for a user ID and password, use the following procedure:

1. In the **User ID** field, enter your user ID.
2. To move the cursor to the **Password** field, press **Enter** or the **down arrow** on the **Trimpad**.
3. In the **Password** field, enter your password.
4. Press **Login**.

The **Main Menu** is displayed.

Stress ECG Power Up Mode

This procedure describes how to navigate to the **Main Menu** after powering on the system when **Stress ECG** is selected for **Power up mode** in **Basic Setup**.

NOTE:

If you need to perform system setup functions, be sure you log in as a user who is assigned setup editing privileges.

If the system is configured for **Stress ECG Power up mode** and **High Security Mode** is not enabled, the **Stress ECG** screen opens on power up. To go to the **Main Menu**, press **Cancel** > **More** > **Main Menu**.

If **High Security Mode** is enabled, when the window opens prompting for a user ID and password, use the following procedure:

1. In the **User ID** field, enter your user ID.
2. To move the cursor to the **Password** field, press **Enter** or the **down arrow** on the **Trimpad**.
3. In the **Password** field, enter your password.
4. Press **Login**.

The **Stress ECG** screen is displayed.

If the **Barcode Reader** option is enabled, a window opens prompting you to **Scan the Patient barcode**.

5. If the barcode reader prompt is not displayed, press **Cancel** > **More** > **Main Menu**.

Order Manager Power Up Mode

This procedure describes how to navigate to **Main Menu** after powering on the system when **Order Manager** is selected for **Power up mode** in **Basic Setup**.

NOTE:

If you need to perform system setup functions, be sure you log in as a user who is assigned setup editing privileges.

If the system is configured for **Order Manager Power Up Mode** and it does not have **High Security Mode** enabled, press **Main Menu**. The **Order Manager** screen is displayed after turning on the system.

If **High Security Mode** is enabled, when the window opens prompting for a user ID and password, use the following procedure:

1. In the **User ID** field, enter your user ID.
2. To move the cursor to the **Password** field, press **Enter** or the **down arrow** on the **Trimpad**.
3. In the **Password** field, enter your password.
4. Press **Login**.
The **Order Manager** screen is displayed.
5. Press **Main Menu**.

3

Setting Up the Equipment

Setting up this system consists of the following steps:

1. "Inserting the Battery"
2. "Connecting the AC Power"
3. "Connecting the Patient Cable"
4. "Connecting the Barcode Reader"
5. "Connecting the LAN Option"
6. "Connecting the WiFi Option"
7. "Connecting External Devices (Stress Option)"
8. "Connecting an Internal Modem"
9. "Inserting the Paper"
10. "Turning on the System"
11. "Configuring the Device"
12. "Testing the Device"

Each step is described in more detail in the following sections.

Inserting the Battery

The system is shipped with a lithium ion battery that is charged when inserted into the system connected to AC power.

NOTE:

Do not use the system on battery power until the battery is fully charged, as indicated by the battery charging LED on the keysheet. You may use the system on AC power while the battery is charging.

Connecting the AC Power

This system can run using AC or battery power. When the device is plugged into an AC outlet, it uses AC power and charges the installed battery.

Use the following instructions to connect the system to an AC power outlet.



Item	Description
1	Female end of the device's power cord connected to the back of the device.
2	Male end of the device's power cord connected to an AC outlet.

1. Connect the female end of the device's power cord (1) to the AC power connector on the back of the device.
2. Plug the male end of the device's power cord (2) into an AC outlet.

NOTE:

It is recommended that you plug the device into an uninterruptible power supply (UPS) or a surge suppressor.

3. Check the Power LED to make sure the device is receiving power from the AC outlet.

Connecting the Patient Cable

This system supports a variety of patient cables.

WARNING:

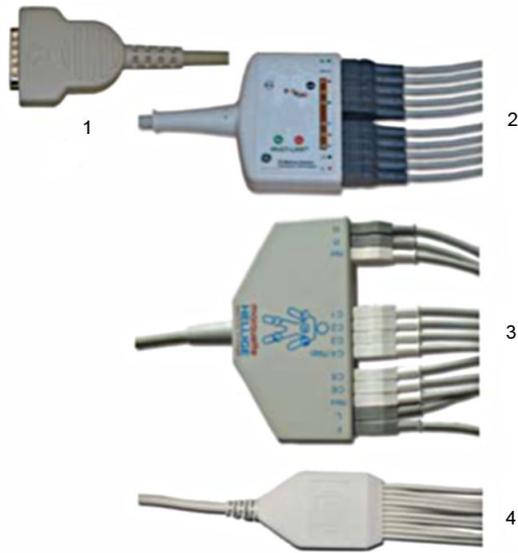
HIGH-FREQUENCY BURNS — Use of cables not supplied with this equipment can lead to serious injury.

Use only the acquisition cable that ships with this equipment.

CAUTION:

INACCURACIES IN ECG Improper connection can cause inaccuracies in the ECG.

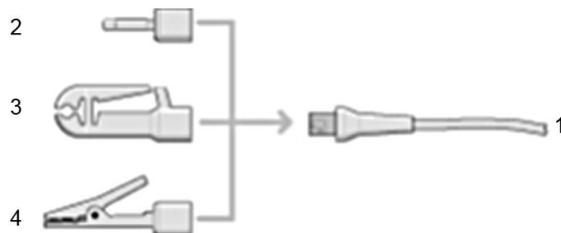
Trace each individual leadwire from its acquisition cable label to the colored connector and then to the proper electrode to ensure that it is matched to the correct label location.



Patient Cables

Item	Name	Description
1	D-Sub 15-pin male connector	Connects to the system's ECG signal input connector. One end of each acquisition cable consists of a D-sub 15-pin male connector.
2	Multi-link Acquisition Cable Leads	The lead end of the multi-link acquisition cable attaches to the leadwire adapters and uses 10 or 12 leadwires.
3	NEHB Acquisition Cable Leads	The lead end of the NEHB acquisition cable attaches to the leadwire adapters and uses 12 leadwires.
4	Value Acquisition Cable leads	The lead end of the value acquisition cable consists of 10 leadwires.

The leadwires require an adapter to connect to an electrode, as shown in the following diagram.



Leadwire Adapters

Item	Description
1	Leadwire end
2	4 mm pin
3	Grabber
4	Mactrode clip

Use the following procedure to connect the patient cable:

1. Assemble the leadwires and adapters.
See [“Replacing Leadwire Adapters” on page 166.](#)
2. Connect the leadwires to the front of the patient cable.
3. Connect the patient cable to the system.
Ensure the cable is seated securely.

Connecting the Barcode Reader

If the optional barcode reader was purchased with the device, connect it to the USB port on the device.

NOTE:

The BCRD option to use the reader is activated at the factory when the barcode reader is purchased with the device. However, you need to configure the barcode settings for your site before you can use the reader, [See Appendix A.](#)

Connecting the LAN Option

If you purchased the LANC (LAN Communication to CardioSoft) or LANM (LAN Communication to MUSE) options, connect an Ethernet cable to the RJ45 network connector on the back of the device.

NOTE:

This applies only if you are using the device as a stationary device. If you are using it as a mobile unit, do not connect the device to a LAN until you are ready to import, transmit, or export records.

This system is compatible with MUSE v7.1.1 and v8.0.1, and with CardioSoft v6.51, v6.61, and v6.71.

Connecting the WiFi Option

If you purchased a WiFi option, connect the WiFi dongle to the USB port available on the back of the device.

WIFC is WiFi Communication to the CardioSoft system.

WIFM is WiFi Communication to the MUSE system.

This system is compatible with MUSE v7.1.1 and v8.0.1, and with CardioSoft v6.51, v6.61, and v6.71.

Connecting External Devices (Stress Option)

If you purchased the stress option **ERGO**, connect the external stress device to the system using a serial cable to the COMM B port on the back panel of the device.

This system works with any of the following devices:

- GE model T2100 treadmill
- GE model T2000 treadmill
- eBike ergometer
- Master's Step (acoustic signal only)

Connecting an Internal Modem

If you purchased this system with the internal modem option, connect the modem to an analog phone line using the RJ11 connector on the back of the device.

MODC is Modem Communication to the CardioSoft system.

MODM is Modem Communication to the MUSE system.

This system is compatible with MUSE v7.1.1 and v8.0.1 and with CardioSoft v6.51, v6.61, and v6.71.

Inserting the Paper

Before you can print ECG reports, complete the following steps:

1. Make sure the system is set up for the correct paper size.

This device can print on the following papers: A4, standard letter (8.5 x 11 inches), or modified letter (8.433 x 11 inches).

For information on adjusting the printer for the paper size, see [“Adjusting the Tray for Paper Size” on page 168](#).

2. Insert the appropriately sized paper.

Turning on the System

1. Press the power button to turn on the system.
2. Verify the system welcome screen is displayed with no errors.

NOTE:

If you encounter any problems powering on the system, see [“System Does Not Power Up” on page 176](#) for further troubleshooting instructions.

Configuring the Device

When the device is ready for operation, configure the system settings using the information in [“System Configuration” on page 107](#).

If you are applying the same settings to multiple devices at the site, export the settings to an SD card and use that card to import the settings to other systems.

Testing the Device

After you have set up and configured the device, test the device completely before using it with patients. Use the following test scenarios:

- Conducting and printing a resting ECG
See ["Recording a Resting ECG" on page 65](#) for instructions.
- Conducting and printing an arrhythmia ECG
See ["Arrhythmia Mode Recording" on page 77](#) for instructions.
- Conducting and printing a stress ECG.
See ["Stress Testing" on page 89](#) for instructions.
- Saving, importing, printing, deleting, transmitting, and exporting records.
See ["Managing Internal Storage" on page 99](#) for instructions.

4

Preparing the Patient

This chapter provides the procedures for preparing the patient's skin and properly placing electrodes.

NOTE:

These instructions do not cover the application of electrodes for the KISS Electrode Application System (not available in the United States). To use the KISS system, see the KISS operator's manual for instructions.

Preparing the Patient's Skin

Careful skin preparation is the key to an interference-free ECG. Signal quality is indicated on the device via the Hookup Advisor indicator.

1. Select the electrode placement sites for ECG monitoring or diagnosis per the protocol specified by the hospital or physician.

Refer to ["Electrode Placement" on page 50](#) for diagrams and descriptions of electrode placement for various protocols.

2. Ensure that each site is dry, clean, and free of excessive hair.

NOTE:

Do not use solvents to clean the skin; solvents trapped under electrodes may lead to abnormal skin reactions.

3. To prepare for a stress test, do the following:
 - a. Mark each electrode site with a felt tip pen.
 - b. Degrease each site with a skin preparation cream.
 - c. Use a mild abrasion to remove the mark left by the felt tip pen.

4. Apply electrodes to the prepared sites.
Electrodes should be placed only by a physician or ECG technician.

WARNING:

SHOCK HAZARD — Touching the conductive elements cancels the protection provided by the isolated signal input.

Ensure that conductive parts of the electrodes or lead wires do not come in contact with other conductive parts.

5. Look at the lead-check screen for indication of lead problems.

NOTE:

Use only electrodes and contact agents recommended by GE Healthcare. The signal quality on the lead-check screen is not indicated until the RA/R and RL/N electrodes are applied. If RA/R becomes disconnected, the system reports that all electrodes are off the patient.

Electrode Placement

This section describes various methods for placing electrodes for both resting and exercise ECGs.

CAUTION:

DELAYED DIAGNOSIS — Improper connection of the leadwires will cause inaccuracies in the ECG.

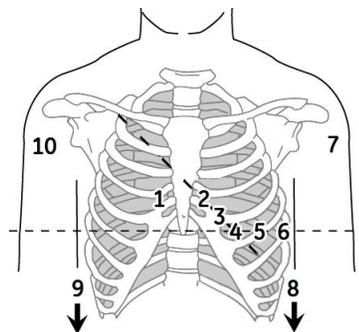
Ensure the leadwires are connected properly. Trace each leadwire from its acquisition module label to its colored connector and then to its electrode to ensure that it is matched to the correct label leadwire connection location.

Resting ECG Placement

The following methods are applicable for resting ECGs.

Standard 12-Lead Placement

To acquire a standard 12-lead ECG, use the placement shown in the following diagram.



12-Lead Electrode Placement

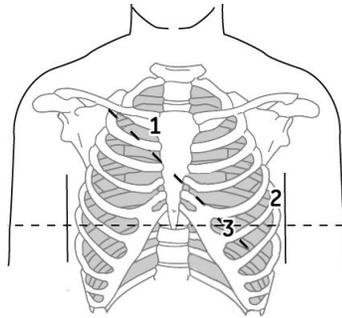
	AHA Label	IEC Label	Description
1	V1 red	C1 red	Fourth intercostal space at the right sternal border
2	V2 yellow	C2 yellow	Fourth intercostal space at the left sternal border

12-Lead Electrode Placement (cont'd.)

	AHA Label	IEC Label	Description
3	V3 green	C3 green	Midway between location 2 and 4
4	V4 blue	C4 brown	Mid-clavicular line in the fifth intercostal space
5	V5 orange	C5 black	Anterior axillary line on the same horizontal level as 4
6	V6 purple	C6 purple	Mid-axillary line on the same horizontal level as 4 and 5
7	LA black	L yellow	Left deltoid
8	LL	F green	Above left ankle (Alternate placement, upper leg as close to torso as possible)
9	RL green	N black	Above right ankle (Alternate placement, upper leg as close to torso as possible)
10	RA white	R red	Right deltoid

NEHB Placement

To acquire a NEHB ECG, use the standard 12-lead electrode placement and items 1 and 2 as shown in the following diagram.

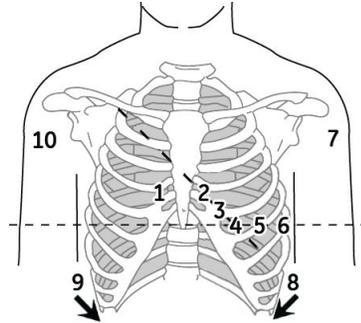


NEHB Electrode Placement

	AHA Label	IEC Label	Description
1	A1 orange	Nst white	Attachment point of the second rib to the right sternal edge
2	A2 orange	Nax white	Fifth intercostal space on the left posterior axillary line (Same position as V7 or C7)
3	V4 blue	Nap white	Mid-clavicular line in the fifth intercostal space (Same position as C4)

Stress 12-Lead Placement

To acquire a stress 12-lead ECG use the placement shown in the following diagram.



12-Lead Stress Electrode Placement

	AHA Label	IEC Label	Description
1	V1 red	C1 red	Fourth intercostal space at the right sternal border
2	V2 yellow	C2 yellow	Fourth intercostal space at the left sternal border
3	V3 green	C3 green	Midway between location 2 and 4
4	V4 blue	C4 brown	Mid-clavicular line in the fifth intercostal space
5	V5 orange	C5 black	Anterior axillary line on the same horizontal level as 4
6	V6 purple	C6 purple	Mid-axillary line on the same horizontal level as 4 and 5
7	LA black	L yellow	Left deltoid
8	LL red	F green	Above left ankle (Alternate placement, upper leg as close to torso as possible)
9	RL green	N black	Above right ankle (Alternate placement, upper leg as close to torso as possible)
10	RA white	R red	Right deltoid

5

Entering Patient Information

The following sections describe how to enter patient information using the following methods:

- With an internal keypad or external keyboard
- With a barcode reader

Entering Patient Information With an Internal Keypad or External Keyboard

Patient information should be entered for each new patient from whom readings are taken. Use the following procedure to enter the information if you do not use a barcode reader or if you want to modify or add to the patient data entered with a barcode reader.

NOTE:

Patient information may be retained from a previous patient. Be sure to check the patient information screen for each new patient. Data assigned to the wrong patient causes erroneous patient information that can affect diagnosis and treatment of the patient(s).

1. Open the **Enter Patient Data** window.
For Resting ECG, press **Main Menu > Resting ECG > Patient Data** to open the window.
For Arrhythmia or Stress, the window opens automatically when you initially select the application.
For subsequent patients, you need to do one of the following to reopen the **Enter Patient Data** window.
 - In Arrhythmia mode, press **Start Recording > New Patient**.
 - In Stress mode, press **Patient Data**.
2. Enter the patient information, or press **Patient List** to select a patient from the established list.

NOTE:

If you select a patient from the **Patient List**, only the first page of patient information is reused; you need to manually enter all subsequent pages.

3. Use the **Page up** and **Page down** keys to move through the patient data windows.

NOTE:

If the **CTDG (Clinical Trial Data Guard)** option is activated, you enter clinical trial data on the last window.

4. When all the patient data has been entered, press **Save** to save the data.

Entering Patient Information with a Barcode Reader

Using a barcode reader can simplify the entry of patient information and reduce the chance of introducing errors. When you scan a patient's barcode, it retrieves the patient information encoded in the barcode. You can then verify or modify the information as appropriate.

Before you can use the barcode scanner, you need to verify that it is connected to the system and that the system is correctly configured to use the peripheral.

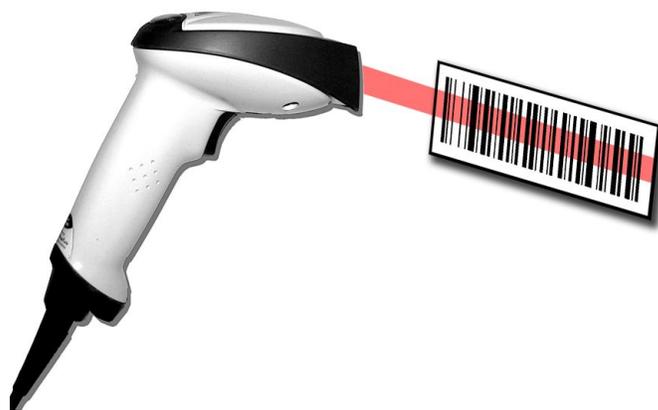
If it is not connected, follow the instructions for connecting and configuring the barcode reader in the section ["Connecting the Barcode Reader" on page 46](#) and [Appendix A "Creating Barcodes" on page 185](#).

Scanning the Barcode

Use the following procedure to scan the patient's barcode:

1. When the following prompt is displayed on the screen, scan the patient's barcode:

Scan the Patient Barcode



The following message is displayed on the screen: **Please wait.**

The barcode reader beeps. The first **Patient Data** window opens with the data from the patient's barcode entered in the appropriate fields.

2. Confirm that the data entered from the patient's barcode is accurate.

3. Enter or modify patient information as necessary.
Refer to “[Entering Patient Information With an Internal Keypad or External Keyboard](#)” on page 55 for details.
4. After verifying that the patient information is correct, press **Save** to save the patient data.

Downloading Patient Demographics

The method for downloading patient demographics depends on the option you purchased and the input method you selected.

You will use one of the following option codes:

- ADTF-ADT — Patient demographics download using the MUSE system or a non-MUSE system
- ADTL-ADT — Patient demographics download using a non-MUSE system

You can download patient demographics using the following input methods. The one you use depends on your system settings.

For information on setting this option, see “[Basic Setup](#)” on page 107.

- Internal keypad
- External keyboard
- Barcode Reader

Using the Barcode Reader

Use the following procedure to query the database and select the patient demographics using a barcode reader.

1. Navigate to **Resting ECG**.
2. Select the **Patient Data** menu.
A dialog box opens instructing you to scan the patient barcode.
3. Scan the patient barcode using the barcode reader.
A dialog box opens with the scanned **Patient ID**.
4. Click **OK** to accept the selection.
The patient demographic data is downloaded and displayed.

Using the Internal Keypad or External Keyboard

Use the following procedure to query the database and select the patient demographics using the internal keypad or external keyboard.

1. Navigate to **Resting ECG**.
2. Select the **Patient Data** menu.
A dialog box opens instructing you to enter the **Patient ID**.

Entering Patient Information

3. Enter the **Patient ID** using the internal keypad or external keyboard.
A dialog box opens with the **Patient ID** you entered.
4. Click **OK** to accept the selection.
The patient demographic data is downloaded and displayed.

6

Order Manager

The MAC 2000 system may retrieve orders from a Hospital Information System (HIS) through MUSE or non-MUSE systems. There are two types of order managers: Simple Orders and Advanced Order Manager.

You can complete orders using any of the communication media outlined in the following section.

Communication Media

MUSE or non-MUSE systems can communicate with the MAC 2000 system in the following ways:

- **SD Card**
If you are communicating to MUSE systems, this is only available with MUSE v7.1.1 or later.
- **Modem**
You can only connect to an internal modem.
- **Local Area Network (LAN)**
Connect the MAC system to the LAN through the communications port of the MAC system.
- **Direct Serial Connection**
Connect the MAC system to the remote system using a standard serial cable.
- **Wireless**
Connect the MAC system to the remote system using a USB wireless module connected to the MAC system.

This system is compatible with MUSE v7.1.1 and v8.0.1, and CardioSoft v6.51, v6.61, and v6.71.

Simple Orders

Simple Orders provides an interface to quickly download and execute one order at a time. To use Simple Orders, you need to enable either the **SOML** or **SOMF** option. When the options are enabled, the **Orders** function key is available on the **Resting ECG** screen.

When you select the **Orders** function key, this system queries for orders in the default location you set in **Communication Setup**. As a response to this query, the system

displays a list of available orders at the location specified. You can select a single order from the list. The **Patient Information** screen of the Resting ECG application opens with the information populated from the order.

Use the following procedure to execute orders in Simple Orders.

1. Navigate to **Resting ECG** in the application.
2. Select **More > Orders**.
The system displays a list of orders available at the default location.
3. Select an order and press **Load**.
The selected single order is automatically downloaded from the remote system and populated in the **Patient Information** screen.

You can also automatically execute a single order if the **Auto Execute Single Order** setting is enabled in **Resting ECG Setup** and only one open order for the given location is present in the remote system.

Use the following procedure to automatically execute a single order:

1. Navigate to **Resting ECG** in the application.
2. Select **More > Orders**.
The single order available at the default location is automatically downloaded from the remote system and populated in the **Patient Information** screen.

Advanced Order Manager

Advanced Order Manager provides an interface to download and store multiple orders on the system and execute them later. To use Advanced Order Manager, you need to enable either the **AOML** or **AOMF** option.

Advanced Order Manager is available as a separate application named **Order Manager** on the main menu of the system.

The Advanced Order Manager application has an interface that displays a list of orders that are already downloaded to the system. The application allows you to query for orders from the remote systems based on multiple locations. All matching orders are displayed as the response to this query and you can download a single order or multiple orders to the system. The downloaded orders are displayed as open resting ECG orders in the application main screen.

Downloading Orders

Regardless of the method you use to communicate with the remote system, use the following procedure to receive orders:

1. From the **Main Menu**, select **Order Manager**.
The **Order Manager** window opens.
2. Select **Load Orders**.
A pop-up window opens.
3. Enter the location(s) from which you want to retrieve orders.
Locations must match the locations used on the remote system. Separate multiple locations with commas (for example 1, 13, 55).

4. Press **Enter**.
The system connects to the remote system and retrieves a list of matching orders.
5. To select one order from the list, use the **Select** function key to select the order you want and press **Enter**.
If you need to select multiple orders, use the **trimpad** and the **Enter** key to highlight multiple orders.
6. After you have selected all the orders you want to download, press the **Load Orders** function key.
The system loads and stores the selected orders.
7. Proceed to [“Selecting and Completing Orders” on page 61](#).

The downloaded order list displays the **Patient Name**, **Patient ID**, **Room**, **Time**, **Type**, **Location**, and **Order Number**. The list changes as you navigate the list. You can select and execute only one order at a time from the list. When you select an order, the resting ECG application opens and the **Patient Information** window is populated with the patient demographics from the selected order.

An order is completed when the ECG record is saved or transmitted to the MUSE or non-MUSE system. Completed orders are marked as completed.

Selecting and Completing Orders

After you have orders on the system, use the following procedure to select and complete them.

1. On the **Order Manager** window, choose **Select**.
The cursor moves to the list of available orders.
2. Select the order you want to use and press **Enter**.
A window opens with the order details.
3. Do one of the following:
 - To select a different order, select **Cancel**.
The detail window closes and you return to the **Order Manager** window.
 - To use the selected order, select **Okay**.
 - If the **TIPI** option is activated, the **Patient Information** window opens with the information from the order.
 - If the **TIPI** option is not activated, select **Patient Data** to open the **Patient Information** window.
4. Enter or correct the patient data.
5. Acquire an ECG for the order and save or transmit the acquired ECG.
6. Select **Main Menu** to return to the **Main Menu** window.
7. Select **More > Order Manager** to return to the **Order Manager** application.
An asterisk (*) on the left side of the **Patient Name** indicates that the order is completed.

Using the Order Manager Interface

You can do the following things with orders:

- Sort the list.
- Print the list.
- Delete single, multiple, completed, or all stored orders.

Patient Name	Patient ID	Location	Room	Time	Type	Order Number
Carrey, Mark	00491	1	12	16:20 Dec-13	ECG	3006785
Grey, Sarah	00493	14	12	16:20 Dec-13	ECG	3006788
Kumar, Varun	00494	7	12	16:20 Dec-13	ECG	3006789
Timothy, Mary	00490	12	12	16:20 Dec-13	ECG	3006785
Varma, Tarun	00495	7	12	16:20 Dec-13	ECG	3006790
William, Jerry	00492	0	12	16:20 Dec-13	ECG	3006785

Order Manager Interface Options

Option	Description
Select	Selects the patient from the List of orders and displays the patient information in an editable format.
Load Orders	Obtains the orders from the MUSE system and displays them on the Order List Display screen.
Delete Orders	Provides the user a set of options to delete orders stored locally on the device. See "Deleting Orders" on page 62 .
Sort Orders	Allows the user to sort the orders based on a user-selected field.
Print	Prints the selected order.
Main Menu	Returns the user to the Main Menu .

Deleting Orders

You can automatically delete a stored order when the associated ECG record is automatically deleted, by enabling **Auto Order Deletion** in the **Order Manager Setup** screen. See ["Order Manager Setup" on page 156](#).

You can also configure automatic order deletion separately from automatic record deletion. In this case, the system does not automatically delete a stored order when the associated ECG record is manually deleted.

Use the following procedures to access the **Delete Orders** menu and delete orders stored locally on the device.

Accessing the Delete Orders Menu

Use the following procedure to access the **Delete Orders** menu.

1. On the **Main Menu**, select **Order Manager**.
The **Order Manager Interface** window opens with a list of local orders displayed.
2. Select **Delete Orders**.
The available options on the menu change.
3. Do one of the following:
 - To select orders to delete, proceed to [“Deleting Specific Orders” on page 63](#).
 - To delete all of the orders on the device, proceed to [“Deleting All Orders” on page 64](#).
 - To delete all completed orders on the device, proceed to [“Deleting Completed Orders” on page 64](#).
4. To cancel without deleting any order, select **Cancel**.
You return to the **Delete Orders** menu options.

Deleting Specific Orders

On the **Delete Orders** menu, use the following procedure to delete one or more specific orders.

The cursor is placed at the first order in the list of orders.

1. Select the order(s) you want to delete.
 - Use **Page Up**, **Page Down**, and the **trimpad** to navigate through the list of orders.
 - To select an order, highlight it and press **Enter**.

2. Select as many orders as necessary.

NOTE:

If you select an order that has not been processed, a window opens to ask whether you want to delete the unprocessed order.

- Select **Yes** to continue deleting the unprocessed order.
 - Select **No** to cancel the selection.
3. After you have selected all of the orders to delete, select **Delete Selected**.
The following message is displayed: **Are you sure you want to delete the orders?**
 4. Do one of the following:
 - To delete the selected orders, select **Yes**.
The orders are deleted and you return to the **Delete Orders** menu options.
 - To cancel the deletion, select **No**.
The orders are not deleted and you return to the **Delete Orders** menu options.

Deleting All Orders

On the **Delete Orders** menu, use the following procedure to delete all of the orders.

1. Select **Delete All**.

The following message is displayed: **Are you sure you want to delete the orders?**

2. Do one of the following:

- To delete all of the orders, select **Yes**.
The orders are deleted and you return to the **Delete Orders** menu options.
- To cancel the deletion, select **No**.
The orders are not deleted and you return to the **Delete Orders** menu options.

Deleting Completed Orders

On the **Delete Orders** menu, use the following procedure to delete all completed orders:

1. Select **Del Completed**.

The following message is displayed: **Are you sure you want to delete all completed orders?**

2. Do one of the following:

- To delete all of the completed orders, select **Yes**.
The orders are deleted and you return to the **Delete Orders** menu options.
- To cancel the deletion, select **No**.
The orders are not deleted and you return to the **Delete Orders** menu options.

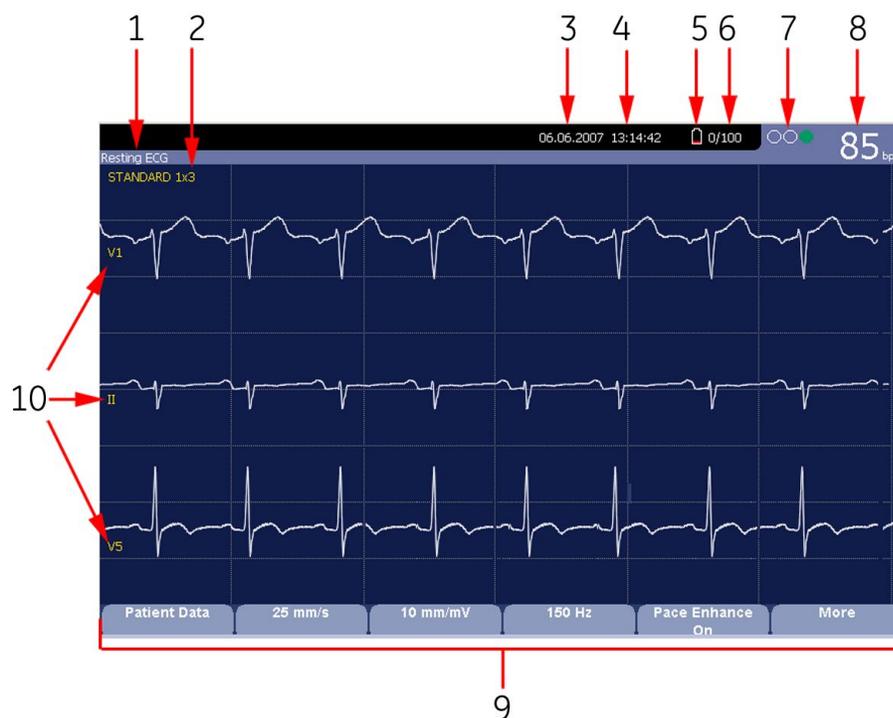
NOTE:

Non-MUSE systems, such as EMR Gateway and Optima EMS, are GE Healthcare proprietary systems.

7

Recording a Resting ECG

The Resting ECG function is part of the basic ECG cart system. **Resting ECG** mode is the default **Power up** mode. When the system is turned on, the Resting ECG display is similar to the following screen. You can modify the default in the **Basic Setup**.



Resting ECG Display

Item	Name	Description
1	ECG Type	The following are valid types of ECGs: <ul style="list-style-type: none"> Resting ECG Arrhythmia Stress Test
2	Display Format	Format of current waveforms. Press Leads to cycle through all 12 leads.

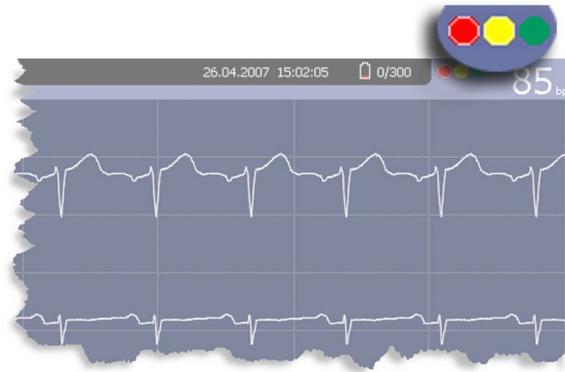
Resting ECG Display (cont'd.)

Item	Name	Description
3	Date	Current system date.
4	Time	Current system time.
5	Battery status indicator	Displays the current battery level. For a description of the battery status indicator see "Battery Status Indicator" on page 172.
6	Internal storage indicator	This indicator is displayed only if the internal storage option is enabled. It displays the approximate number of ECG records that you can store in the remaining memory. X represents the number of ECGs that you can store in the remaining memory. YY represents the total number of ECGs that the system can store. YY can be either 100 (if the M100 option is activated) or 200 (if the M200 option is activated). The difference equals the number of ECGs currently stored in the system.
7	Hookup Advisor Indicator	A tool for monitoring the quality of ECG signals. For more information, see "Hookup Advisor" on page 66.
8	Patient's Heart Rate	Current patient heart rate measured in beats per minute.
9	Menu Options	The list of available menu options changes depending on the function and the current location within that function. For more information, see "Using the Function Keys" on page 36.
10	Lead Labels	Identifies each waveform and indicates the waveform quality. Yellow = a noisy lead Red = disconnected lead

Hookup Advisor

This system offers the Hookup Advisor feature, which is a tool for monitoring the quality of ECG signals, and is available in the Resting, Arrhythmia, and RR Analysis applications. It can reduce or eliminate the occurrence of poor technical quality ECGs, save time, and prevent the need for retakes.

The Hookup Advisor is displayed as a three-circle indicator in the upper right corner of the screen.



The following table describes each of the indicator's conditions.

Hookup Advisor Indicators

Indicator	Description
Red	Indicates a leadfail condition or extreme baseline shifts. The red indicator is always the left-most circle of the of the indicator and flashes when lit.
Yellow	Indicates muscle artifact, power line interference, baseline wander, or electrode noise. The yellow indicator is always the middle circle of the of the indicator. NOTE: In RR Analysis mode, the yellow indicator is not active. RR Analysis supports only the red and green indicators of Hookup Advisor.
Green	Indicates acceptable signal quality. The green indicator is always the right-most circle of the of the indicator.

When the lead quality is red or yellow, a message describing the lead problem or status is displayed on the screen.

Hookup Advisor continuously reviews the ECG data for acceptable lead quality.

When an ECG is acquired, Hookup Advisor runs a complete and more comprehensive assessment of the full 10 seconds of ECG data and possibly prompts the user regarding any poor lead quality conditions.

- If **Preview before analysis** is turned off in the system setup, a lead quality message and prompt may be displayed, depending on the current lead quality level and the Prompt level in the system setup. If a message and prompt is displayed, the lead quality indicator will reflect the overall 10-second lead quality.
- If **Preview before analysis** is enabled, the system setup Prompt level is disregarded and the system immediately displays the Preview screen. Any lead quality messages will be displayed in this screen along with the overall 10-second lead quality indicator.

In either case, users may then do either of the following:

- Select **Continue** to continue (print the ECG).
- Select **Cancel** to cancel.

Resting ECGs

A resting ECG is the default mode of the ECG cart system, although you may change this in the system configuration. This section describes how to record a resting ECG and the available options.

Recording a Resting ECG

The following steps describe how to conduct a resting ECG.

NOTE:

To take a stat ECG, go directly to step 6.

1. Prepare the patient as described in [“Preparing the Patient” on page 49](#).
2. Select **Patient Data** and enter the patient data as described in [“Entering Patient Information” on page 55](#).
3. Adjust the **Speed**, **Gain** and **Low pass filter** until the waveforms are configured as desired.
4. If the patient has a pacemaker, turn on **Pace Enhance**.
For more information, see [“ECG Options” on page 69](#).
5. Select **More > Printer Leads** to scroll through the leads or change the lead format.
6. When the waveforms are configured, press **ECG** to begin the acquisition.
A progress bar indicates the percentage of the data acquired. When the acquisition is complete, one of the following occurs, depending on the setting of the **Preview Before Analysis** option on the **Resting ECG Setup** window.
 - If the **Preview Before Analysis** option is enabled, a preview of the 10-second ECG is displayed. Continue with step 7.
 - If the **Preview Before Analysis** option is not enabled, the ECG data is analyzed and printed after it is acquired. Proceed to step 8.
7. While reviewing the preview, do one of the following:
 - Discard the reading and press **Cancel**. Begin again from step 3.
 - Wait for the menu options to change and then continue with step 8.
8. Use the options to change patients, to print a copy of the ECG, or to save, transmit, or reanalyze the data.

For more information on each option, see [“Post-Acquisition Options” on page 71](#).

ECG Options

This system provides several options for configuring an ECG. The options, presented as option keys across the bottom of the display, are listed in the following tables.

ECG Options–First Row

Option	Description
Patient Data	Opens the patient data entry window.
25 mm/s NOTE: The initial measurement displayed is set in System Configuration > Resting ECG Setup .	Changes the speed of the waveform on the display and printout. Changing the speed also changes the speed at which the wiper bar moves across the display. Measurement is in millimeters per second (mm/s) and includes the following options: <ul style="list-style-type: none"> • 25 mm/s • 50 mm/s • 12.5 mm/s - 5 mm/s • 12.5 mm/s When the option includes two speeds (12.5 mm/s - 5 mm/s), the first speed is for the display and the second speed is for the printout. Changing the measurement here does not change the measurement set in System Configuration .
10 mm/mV. NOTE: The initial measurement displayed is set in System Configuration > Resting ECG Setup .	Changes the magnitude of the ECG signal on the display or in the report. Measurement is in millimeters per millivolt (mm/mV) and includes the following options: <ul style="list-style-type: none"> • 5 mm/mV • 10 mm/mV • 20 mm/mV • 40 mm/mV • 2.5 mm/mV • Automatic The larger the selected measurement, the larger the waveform. Only the representation of the waveform changes; signal strength is not affected. NOTE: If Automatic is selected, the system calculates the best gain based on the peak-to-peak amplitudes of all displayed leads and the selected display format. Changing the measurement here does not change the measurement set in System Configuration .

ECG Options–First Row (cont'd.)

Option	Description
150 Hz. NOTE: The initial measurement displayed is set in System Configuration > Resting ECG Setup .	Eliminates noise in the waveform by restricting which frequencies are included. Frequencies are measured in Hertz (Hz) and include the following options: <ul style="list-style-type: none"> • 20 Hz • 40 Hz • 100 Hz • 150 Hz Selecting a frequency eliminates signals that exceed that frequency. The smaller the frequency selected, the more signal is filtered out. For example, a filter of 40 Hz displays only signals at 40 Hz or less; signals greater than 40 Hz are ignored. Changing the measurement here does not change the measurement set in System Configuration .
Pace Enhance	Improves the readability of pacemaker ECGs. Options are On and Off .
More	Toggles between the first row of options (previous) and the second row of options (following).

ECG Options–Second Row

Option	Description
Printer Leads NOTE: The initial measurement displayed is set in System Configuration > Resting ECG Setup .	Selects which leads to include in the printout. Options are: <ul style="list-style-type: none"> • First 6 • Second 6 • Rhythm 6 • 12 Use this option only when conducting rhythm ECGs. For more information, see “Generating a Rhythm Report (Manual Recording)” on page 74. Changing the measurement here does not change the measurement set in System Configuration .
ADS	Toggles the anti-drift system (ADS) on and off . ADS helps reduce baseline drift.
Main Menu	Exits Resting ECG and returns you to the Main Menu .
More	Toggles between the first row of options (previous) and the second row of options (following).

Post-Acquisition Options

In addition to setup options, the Resting ECG functionality offers additional options after an ECG is acquired. The following screens and tables describe the option keys across the bottom of the display.



Post-Acquisition Options—Screen One

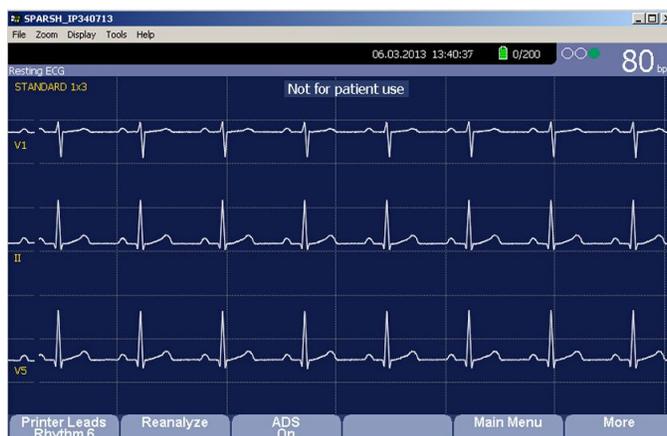
Option	Description
Next Patient	Displays two new options: <ul style="list-style-type: none"> • New Patient opens a blank Patient Information window. • Same Patient opens the Patient Information window populated with data from the previous patient.
Print	Prints the ECG report.
Save	Stores the current ECG report. This option is available only if the internal storage option is enabled.
Transmit	Sends the current ECG report to the location defined on the Communication Setup window. This option applies only if a valid LAN or Modem communication option is enabled. Refer to “ System Configuration ” on page 107 for more information.
RR Analysis	Allows you to enter into RR Analysis mode.
More	Returns to the setup options. For more details, refer to “ ECG Options ” on page 69.

Recording a Resting ECG



Post Acquisition Options—Screen Two

Option	Description
Next Patient	Opens the patient entry window allowing you to enter or select a new patient.
Speed	Changes the speed of the waveform on the display and printout. Changing the speed also changes the speed the wiper bar moves across the display.
Gain	Changes the magnitude of the ECG signal on the display or in the report. Measurement is in millimeter per millivolt (mm/mV).
Filter	Eliminates noise in the waveform by restricting which frequencies are included. Frequencies are measured in Hertz (Hz).
Pace Enhance	Standardizes the pace spike. Options are On and Off.
More	Toggles between the second and third row of acquisition options.



Post Acquisition Options—Screen Three

Options	Description
Printer Leads Rhythm	Selects which leads to include in the printout.
Reanalyze	Allows you to edit the global measurements and T-wave dispersion. This option is available only if the Measurement option is enabled and the Reanalysis option is selected in the Resting ECG Setup window. For more information, refer to “ Resting ECG Setup ” on page 112.
ADS	Toggles the anti-drift system (ADS) on and off. ADS helps reduce baseline drift.
Main Menu	Exits the Resting ECG function and returns to the Main Menu.
More	Toggles between the second and third row of acquisition options.

Special Considerations

When recording ECGs, you need to make special considerations for the following situations:

- Recording ECGs of pacemaker patients
- Recording ECGs during defibrillation

Recording ECGs of Pacemaker Patients

Because of slow paper speed, pacer pulses cannot be displayed directly on the ECG recording. For example, with a paper speed of 50 mm/s and a pulse duration of only 0.5 ms, the width of the recorded pacer pulse would be only 0.025 mm.

If **Pace Enhance** is enabled, the recorder reduces the pulse amplitude and expands its width to make pacer pulses easier to identify. The system records the pulse with the correct polarity, a width of 5 ms, and equal amplitude in all leads. Depending on the polarity of the pacer pulse in leads I and II, the pacer pulse in lead III may be suppressed. The following figure of an ECG recording with pacer pulses shows the amplitude of the reverse current.



Recording ECGs During Defibrillation

NOTICE:

EQUIPMENT DAMAGE — Damaged cables can cause mechanical problems.

Before connecting the cable to the device, check it for signs of physical damage. Do not use a damaged cable.

For patient safety, use only the original GE Healthcare patient cable.

WARNING:

SHOCK HAZARD — Touching the patient, electrodes, or leadwires during defibrillation can cause a shock.

During defibrillation, do not touch the patient, the electrodes, or the leadwires.

Observe all defibrillator safety information.

This equipment is protected against the effects of cardiac defibrillator discharge to allow the ECG trace to return after defibrillation, as required by test standards.

The patient signal input is defibrillation-proof; it is not necessary to remove the ECG electrodes before defibrillating the patient if non-polarizing electrodes are being used.

When using stainless steel or silver electrodes, the defibrillator discharge current may cause the electrodes to retain a residual charge, causing an electrode polarization or DC offset voltage. This blocks ECG signal acquisition for several minutes. If polarizing electrodes are used, GE Healthcare recommends that you disconnect the leadwires from the patient before delivering the shock.

To prevent polarization, GE Healthcare recommends the use of non-polarizing disposable electrodes with defibrillation recover ratings as specified in AAMI EC12 3.2.2.4 (MMS PN 9623-105 Silver MacTrodes, MMS spec TP9623-003), which requires the polarization potential of an electrode pair not exceed 100 mV five seconds after a defibrillation discharge.

Generating a Rhythm Report (Manual Recording)

The **Resting ECG** mode allows you to generate Rhythm Reports, which are printed reports only. They do not have computer-generated interpretation or measurements, and you cannot store them to internal memory or transmit them. Use the following steps to generate a Rhythm Report.

1. Prepare the patient as described in [“Preparing the Patient” on page 49](#).
2. Verify that the system is in **Resting ECG** mode.
If the system is not in **Resting ECG** mode, on the **Main Menu** press **Resting ECG**.
3. Enter the patient data as described in [“Entering Patient Information” on page 55](#).
4. Adjust the **Speed**, **Gain**, and **Low Pass Filter** until the waveforms are configured as desired.
For more information, see [“ECG Options” on page 69](#).
5. If the patient has a pacemaker, press **Pace Enhance**.
For more information, see [“ECG Options” on page 69](#).

6. Press **Leads** to scroll through all 12 leads.
For more information on display formats, see [“Resting ECG Setup” on page 112](#).
7. Press **More > Printer Leads** to select the appropriate option.
For more information on the **Printer Leads** option, see [“ECG Options” on page 69](#).
8. Press **Rhythm** to begin recording the ECG.
9. Press **Stop** to stop the ECG recording.

If you press **Rhythm** after pressing **Stop**, the new report either begins printing immediately on the current sheet of paper or advances to a new page, depending on the setting of the field: **Start rhythm report on a new page**. This field is located on the **Resting ECG Setup** window. See [“Resting ECG Setup” on page 112](#) for details.

8

Arrhythmia Mode Recording

The Arrhythmia mode is part of the basic ECG cart system. The interface of the Arrhythmia mode is similar to the interface for the Resting ECG mode. For more information on the Resting ECG interface, see [“Recording a Resting ECG” on page 65](#).

Recording in Arrhythmia Mode

This section describes the process for recording an arrhythmia report, the waveform options, and the printing options.

Recording Arrhythmia ECGs

1. Prepare the patient as described in [“Preparing the Patient” on page 49](#).
2. Select **Main Menu > Arrhythmia**.
The **Enter Patient Data** window opens.
3. Enter the patient data as described in [“Entering Patient Information” on page 55](#).
4. Adjust the gain, speed, filter, and pacemaker enhancement as necessary.
Refer to [“Arrhythmia Recording Options” on page 78](#).
5. After the settings are adjusted as required, select **Start Recording** to begin the arrhythmia ECG.
6. After you have recorded an adequate amount of information, press **Stop Recording**.
Two new options become available: **Confirm Stop** and **Continue Recording**.
7. Do one of the following:
 - If you need to record additional information, press **Continue Recording**. This returns to the recording mode. Repeat from step 6.
 - If you have determined enough information was recorded, press **Confirm Stop**. Report options become available.

If you want to print the Arrhythmia recording, continue with [“Printing an Arrhythmia Report” on page 79](#).

Arrhythmia Recording Options

Arrhythmia Options- first row

Option	Description
Start Recording	<p>Starts the arrhythmia reading.</p> <p>If you did not fill out the Patient Data to select a patient, you receive the following message: No Patient Selected. Do you want to continue without patient data?</p> <ol style="list-style-type: none"> 1. Select the No tab to continue. The Enter Patient Data window opens. 2. Enter the information on each page and select Save. 3. Select Start Recording.
25 mm/s NOTE: The initial measurement displayed is set in System Configuration > Arrhythmia Setup .	<p>Changes the speed of the waveform on the display and printout. Changing the speed also changes the speed at which the wiper bar moves across the display.</p> <p>Measurement is in millimeters per second (mm/s) and includes the following options:</p> <ul style="list-style-type: none"> • 25 mm/s • 50 mm/s • 12.5 mm/s - 5 mm/s • 12.5 mm/s <p>When the option includes two speeds (12.5 mm/s - 5 mm/s), the first speed is for the display and the second speed is for the printout.</p> <p>Changing the measurement here does not change the measurement set in System Configuration.</p>
5 mm/mV NOTE: The initial measurement displayed is set in System Configuration > Arrhythmia Setup .	<p>Changes the magnitude of the ECG signal on the display or in the report. Measurement is in millimeters per millivolt (mm/mV) and includes the following options:</p> <ul style="list-style-type: none"> • 5 mm/mV • 10 mm/mV • 20 mm/mV • 40 mm/mV • 2.5 mm/mV • Automatic <p>The larger the selected measurement, the larger the waveform. Only the representation of the waveform changes; signal strength is not affected.</p> <p>NOTE: If Automatic is selected, the system calculates the best gain based on the peak-to-peak amplitudes of all displayed leads and the selected display format.</p> <p>Changing the measurement here does not change the measurement set in System Configuration.</p>

Arrhythmia Options- first row (cont'd.)

Option	Description
20 Hz NOTE: The initial measurement displayed is set in System Configuration > Arrhythmia Setup .	Eliminates noise in the waveform by restricting which frequencies are included. Frequencies are measured in Hertz (Hz) and include the following options: <ul style="list-style-type: none"> • 20 Hz • 40 Hz • 100 Hz • 150 Hz Selecting a frequency eliminates signals that exceed that frequency. The smaller the frequency selected, the more signal is filtered out. For example, a filter of 40 Hz displays only signals at 40 Hz or less; signals greater than 40 Hz are ignored. Changing the measurement here does not change the measurement set in System Configuration .
More	Toggles between the first row of options (previous) and the second row of options (following).

Arrhythmia Options second row

Option	Description
Pace Enhance	Improves the readability of pacemaker ECGs. Options are On and Off .
Patient Data	Opens the Patient Data Entry window. This tab is available only if you did not complete the Portent Data Entry window earlier.
Main Menu	Exits the Arrhythmia function and returns to the Main Menu .
More	Toggles between the first row of options and the second row of options

Printing

You can manually generate an arrhythmia printout in a table format, an episode format, or a summary format.

Printing an Arrhythmia Report

Use the following procedure to print an Arrhythmia report.

1. Select the type of Arrhythmia report you want to print and press the appropriate function key.
 - To print the summary report, press **Print Summary**.
 - To print the table report, press **Print Table**.
 - To print the arrhythmia episodes, press **Print Episodes**.

Refer to “Arrhythmia Printing Options” on page 80 for details.

- Review the report as necessary.

For more information, refer to “Arrhythmia Codes” on page 80.

Arrhythmia Printing Options

When printing an arrhythmia report, you have the following options:

Arrhythmia Printing Options

Option	Description
Print Summary	Prints a combined report that includes both the Table and Episode formats.
Print Table	Prints a breakdown of the recording in tabular format. The report includes: <ul style="list-style-type: none"> the analysis duration in minutes and seconds the artifact duration in minutes and seconds a code for each event type recorded the number of each event type recorded For a description of the possible event codes, refer to “Arrhythmia Codes” on page 80.
Print Episodes	Prints a standard waveform report of the recorded events. The signal from all recorded leads is printed and each event is marked with the corresponding arrhythmia code. For a description of the possible event codes, see “Arrhythmia Codes” on page 80 .
Main Menu	Exits the Arrhythmia function and returns to the Main Menu .
More	Toggles between the arrhythmia recording options and the arrhythmia printing options.

Arrhythmia Codes

The following table identifies the codes used on the Arrhythmia reports and the events they represent.

Code	Arrhythmia Event
A	Artifact
ASYSTO	Asystole, limit value 3s
CPLT	Ventricular couplet (2 PVCs)
ESC	Ventricular escape beat
L	Learn phase
PAU1	Pause of 1 missed beat
PAU2	Pause of 2 missed beats
PCAP	Pacemaker capture

Code	Arrhythmia Event
<i>PERR</i>	Pacemaker error
<i>PSVC</i>	Premature supraventricular contraction
<i>PVC</i>	Premature ventricular contraction
<i>QRSL</i>	Learned QRS complex
<i>RUN</i>	Ventricular run (3 PVCs)
<i>VBIG</i>	Ventricular bigeminy
<i>VFIB</i>	Ventricular fibrillation/flutter
<i>VTACH</i>	Ventricular tachycardia (>3 PVCs)

RR Analysis

RR Analysis is an optional mode of the system. It detects hidden patterns underlying the complex dynamic phenomena of heart rate variability (HRV) and measures the cardiac RR intervals. This option is not available in the U.S.

RR Analysis Mode

This section outlines the procedure for generating an RR Analysis report and describes the available setup, waveform, and output options.

RR Analysis Settings Window

Option	Description
Start Test	Starts the RR Analysis test.
Patient Data	Opens the Patient Data Entry window.
RR Analysis Setup	Configures the RR Analysis test. See “RR Analysis Setup” on page 83 for details.
Main Menu	Exits the RR Analysis mode and returns to the Main Menu .

RR Analysis Setup

The **RR Analysis Setup** function allows you to configure the RR Analysis report, including:

- Target
 - Record lead
 - Waveform parameters
 - Report options
1. Prepare the patient as described in [“Preparing the Patient” on page 49](#).
 2. From the device **Main Menu**, press **RR Analysis**.
 3. Press **Patient Data** and enter the patient data as described in [“Entering Patient Information” on page 55](#).
 4. Press **RR Analysis Setup** and adjust the setup options as necessary.

RR Analysis

RR Analysis Settings

Target

Record Lead

Line Filter

Pace Enhancement

Gain [mm/mV]

Speed [mm/s]

Low Pass Filter [Hz]

ADS

Rhythm Record

RR Table

RR Analysis Settings Window

Field	Description
Target	Selects the target of the test. Available options are: <ul style="list-style-type: none"> • 100 Beats • 200 Beats • 300 Beats • 400 Beats • 500 Beats • 1 min • 2 min • 3 min • 4 min • 5 min
Record Lead	Selects which rhythm lead is displayed and stored. Available options are: <ul style="list-style-type: none"> • I • II • III • aVR • aVL • aVF • V1 • V2 • V3 • V4 • V5 • V6
Line Filter	Enables/disables the line filter defined in Country Setup . See “Country Setup” on page 141 for more information.
Pace Enhancement	Improves the readability of pacemaker ECGs. Options are On and Off .

RR Analysis Settings Window (cont'd.)

Field	Description
Gain [mm/mV]	<p>Sets the magnitude of the ECG signal. Measurement is in millimeters per millivolt (mm/mV) and includes the following options:</p> <ul style="list-style-type: none"> • 2.5 mm/mV • 5 mm/mV • 10 mm/mV • 20 mm/mV • 40 mm/mV • Automatic <p>The larger the selected measurement, the larger the waveform. Only the representation of the waveform changes; signal strength is not affected.</p> <p>NOTE: If Automatic is selected, the system calculates the best gain based on the peak-to-peak amplitudes of all displayed leads and the selected display format.</p>
Speed [mm/s]	<p>Changes the speed of the waveform on the display and printout. Changing the speed also changes the speed at which the wiper bar moves across the display.</p> <p>Measurement is in millimeters per second (mm/s) and includes the following options:</p> <ul style="list-style-type: none"> • 12.5 mm/s • 25 mm/s • 50 mm/s
Low Pass Filter [Hz]	<p>Eliminates noise in the waveform by restricting which frequencies are included. Frequencies are measured in Hertz (Hz) and include the following options:</p> <ul style="list-style-type: none"> • 20 Hz • 40 Hz • 100 Hz • 150 Hz <p>Selecting a frequency eliminates signals that exceed that frequency. The smaller the frequency selected, the more signal is filtered out. For example, a filter of 40 Hz displays only signals at 40 Hz or less; signals greater than 40 Hz will be ignored.</p>
ADS	Enables or disables ADS (Anti Drift System).
Rhythm Record	Enables/disables the printing of the rhythm lead waveform on the report.
RR Table	Enables/disables the printing of the RR table on the report.

5. Press **Save** to record your settings.
6. Continue with “Acquiring a Recording for an RR Analysis Report” on page 87.

Acquiring a Recording for an RR Analysis Report

1. Press **Start Test**.
The device begins to acquire the ECG. The target beats, acquired beats, and acquired time are updated in real time on the screen.
2. While the ECG is being acquired, you can do any of the following:
 - Change the **Speed**.
 - Change the **Gain**.
 - Change **Low Pass Filter**.
 - Toggle **Pace Enhancement**.

For more information on any of these options, see “RR Analysis Setup” on page 83.

When the target is achieved, the system automatically stops, and displays a preview of the summary results, histogram, trendgram, and output options.

3. While reviewing the preview, execute one of the output options described in “Output Options” on page 87.

Output Options

The following options are available after the RR Analysis test completes:

Output Options

Option	Description
Press Return .	Discards the reading and returns to pre-test status. Repeat the steps in “Acquiring a Recording for an RR Analysis Report” on page 87.
Press Main Menu .	Discards the reading, exits the RR Analysis mode, and returns to the Main Menu .
Press Print .	Accepts the reading and prints the RR Analysis Report on the thermal printer.
PDF Export	Accepts the reading and exports the RR Analysis Report to a PDF file.

10

Stress Testing

The Stress mode is an optional feature that allows you to conduct stress tests with any of the following devices.

Stress Equipment	Description
Supported treadmills and ergometers	Supported equipment connects to the ECG cart system through the serial port labelled COMM A on the back of the device. You can control the equipment through this connection. When a test phase changes, a signal is sent from the system to the equipment to change the speed, grade, or load, as appropriate. You can also manually override the equipment from the ECG cart keyboard. See “Stress Test Keys” on page 92 , for more information. Supported equipment includes the following: <ul style="list-style-type: none">• T2000 and T2100• eBike
Ergometers with remote start	This equipment also connects to the ECG cart system through the serial port labelled COMM A on the back of the device. However, the system does not control the equipment. Instead, when the equipment changes load, it signals the system, which changes test stages accordingly.
Unsupported treadmills and ergometers	Unsupported equipment does not connect to the ECG cart system. Instead of signaling the equipment when a test phase changes, the system notifies the operator, who manually adjusts the equipment’s parameters.
Master Step	This equipment does not connect to the system. The system emits a tone to instruct the patient when to take a step.

Stress tests include the following parameters:

- Patient data
- Waveform speed and gain
- Pacemaker enhancement
- Finite residual filter
- Printer leads
- Report format

- Target heart rate
- Test protocol

You cannot store the results of the test to internal storage or the external SD card. Instead, you must print the results. You can select any of the following report formats:

- **Summary Report**
- **Tabular Summary**
- **Trend Report**
- **ST Trend Report**
- **ST Summary Report**
- **Episode Report**

To use the Stress ECG mode, you must meet the following conditions:

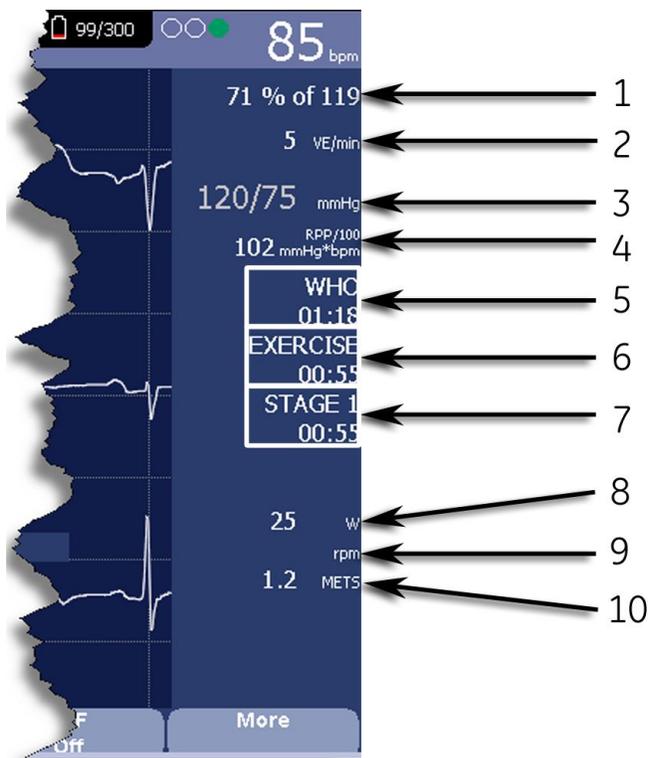
- You must purchase the **ERGO** option and add it to the system.
For more information, see [“Options Setup” on page 153](#).
- You must select the correct equipment on the **Basic System Setup**.
For more information, see [“Basic Setup” on page 107](#).
- You must configure the **Stress ECG Setup** correctly.
For more information, see [“Stress ECG Settings” on page 124](#).

Stress Mode Interface

The Stress ECG mode uses two special features: a *Stress Test Information Bar* and *Stress Test Keys*. It also offers several configuration options.

Stress Test Information Bar

The **Stress ECG** mode adds an information bar on the right side of the ECG cart system display, as seen in the following illustration. Descriptions of the bar's key elements follow the illustration.



Stress Test Information Bar

Item Number	Feature	Description
1	Target Rate	The target heart rate and the current heart rate's percentage of that target.
2	VE/min	Ventricular ectopics per minute (also known as premature ventricular contraction). This is calculated as the sum of all Premature Ventricular Contractions (PVCs) and Ventricular Escape beats (ESCs) detected in the past 60-second interval.
3	Blood Pressure	Blood pressure in mmHg (millimeters of mercury) or kPa (kilopascals), depending on the <i>Blood Pressure Unit</i> setting on the <i>Country Settings</i> window. For more information, see "Country Setup" on page 141.
4	RPP/100	The Rate-Pressure Product divided by 100. The rate-pressure product is calculated by multiplying the systolic blood pressure with the current heart rate. The product is then divided by one hundred. For example, an RPP of 10200 displays as 102.
5	Protocol	Name of the current test protocol and its total duration in minutes and seconds.

Stress Test Information Bar (cont'd.)

Item Number	Feature	Description
6	Phase	Name of the current test phase and its total duration in minutes and seconds.
7	Stage	Name of the current test stage and its total duration in minutes and seconds. Displays in red when the system is in manual mode.
8	Speed/Load	Speed of the treadmill or load of the ergometer. Speed may be displayed as km/h (kilometers per hour) or mph (miles per hour) depending on the <i>Speed Unit</i> selected on the <i>Country Settings</i> window. Load is displayed in watts. For more information, see “Country Setup” on page 141.
9	Grade/RPM	The grade for a treadmill, in percent, or the revolutions per minute for an ergometer.
10	METS	Metabolic equivalent of the current exercise level.

Stress Test Keys

The Stress keys are described in “Stress Keys” on page 34.

Stress Options

This ECG cart system provides several options for configuring a Stress ECG. The options, presented as option keys across the bottom of the display, are listed in the following tables.

Stress Option Keys—First Row

Option	Description
Patient Data	Opens the patient data entry window.
Sweep Speed	Changes the speed of the waveform on the display and printout. Changing the measurement also changes the speed of the wiper bar on the display. The measurement is in millimeters per second (mm/s) and includes the following options: <ul style="list-style-type: none"> • 25 mm/s • 50 mm/s • 12.5 mm/s - 5 mm/s • 12.5 mm/s When the option includes two measurements (12.5 mm/s - 5 mm/s), the first speed is for the display and the second speed is for the printout.

Stress Option Keys—First Row (cont'd.)

Option	Description
Gain	<p>Changes the magnitude of the ECG signal on the display or in the report. The measurement is in millimeters per millivolt (mm/mV) and includes the following options:</p> <ul style="list-style-type: none"> • 5 mm/mV • 10 mm/mV • 20 mm/mV • 40 mm/mV • 2.5 mm/mV • Automatic <p>The larger the selected measurement, the larger the waveform. Only the representation of the waveform changes; signal strength is not affected.</p> <p>NOTE: If Automatic is selected, the system calculates the best gain based on the peak-to-peak amplitudes of all the displayed leads and the selected display format.</p>
Low Pass Filter	<p>Toggles through the Low Pass Filter options: 20 Hz, 40 Hz, 100 Hz, and 150 Hz. It defaults to the setting selected on the Stress Setup window. (See “Stress ECG Settings” on page 124 for more information.)</p> <p>If the ADS filter type was selected in Stress Setup, this softkey is displayed regardless of whether the filter is on or off. If the FRF filter type was selected in Stress Setup, this softkey is displayed only if the filter is off.</p>
ECG Filter Type	<p>Toggles on and off the ECG filter type (ADS or FRF) selected on the Stress Setup window. In addition, if the FRF filter type was selected, toggling the filter off also displays the Low Pass Filter softkey.</p>
More	<p>Toggles between the first and second row of options.</p>

Stress Text Option Keys—Second Row

Option	Description
Pace Enhance	<p>Increases the readability of pacemaker ECGs. Options are On and Off.</p>
Printer Leads	<p>Selects which leads to include in the printout. Options are:</p> <ul style="list-style-type: none"> • First Six • Second Six • Rhythm Six • 12 <p>Use this setting only when conducting rhythm ECGs. For more information, see “Generating a Rhythm Report (Manual Recording)” on page 74.</p>

Stress Text Option Keys—Second Row (cont'd.)

Option	Description
Select Protocol	Selects a predefined set of test criteria. For more information, see “Editing Stress Protocols” on page 128.
Report Format	Selects the components and episodes to include in the report. Allows you to override the defaults set on the Stress ECG Setup window. For more information, see “Stress ECG Settings” on page 124.
Target HR	Enter the maximum heart rate calculated for the patient based on weight, gender, age, and condition. The ECG cart system monitors the heart rate against this target.
More	Toggles between the first, second, and third row of options.

Stress Text Option Keys—Third Row

Option	Description
Main Menu	Exits the Stress ECG function and returns to the Main Menu .
More	Toggles between the first, second, and third row of options.

Conducting Stress Tests

There are two basic processes for conducting a stress test:

- Conducting a stress test with a treadmill or ergometer
- Conducting a stress test with a Master’s Step device

Each process is described in this section. For information on the **Stress Mode** interface, see [“Stress Mode Interface” on page 90.](#)

Conducting a Stress Test with a Treadmill or Ergometer

Use the following instructions to conduct a stress test with a treadmill or ergometer. The process is essentially identical for all devices with only minor differences between supported equipment, unsupported equipment, and ergometers with remote start. Deviations for specific accessories are noted where appropriate.

WARNING:

PATIENT INJURY — When on a moving treadmill, a patient could fall and sustain an injury.

To minimize the possibility of a falling caused by the belt’s sudden movement, have the patient step onto the belt only after it begins moving.

When conducting stress tests on a supported treadmill, press the **Stop TM** button twice to immediately stop the belt in the case of an emergency (for example, if the patient stumbles or falls while the belt is moving).

1. Prepare the patient as described in [“Preparing the Patient” on page 49.](#)
2. On the **Main Menu** press the **Stress ECG** option.
The **Enter Patient Data** window opens.

3. Enter patient data as described in [“Entering Patient Information” on page 55](#).
4. Adjust the stress options as necessary:
This includes the speed and gain, finite residual filter, pacemaker enhancement, printer leads, test protocol, report format, and target heart rate. For more information on setting these options, see [“Stress Options” on page 92](#).
5. Record a preliminary ECG.
This may be a seated, standing, supine, or hyperventilating ECG, depending on the requirements of the selected protocol.
6. Begin the pretest phase.
 - a. Have the patient get on the device.
 - b. Press the **Pretest** key.
 - c. Allow the patient to warm up before beginning the exercise phase of the test.

NOTE:

On supported treadmills, press **Start TM** to start the belt.

7. When the patient is ready to begin the stress test, press the **Exercise** key.
During the test, you can use the stress keys to hold the current stage, enter blood pressure, add a comment, change the displayed leads, and toggle the finite residual filter. With supported equipment, you can also use the stress keys to adjust the equipment’s speed, grade, or load. With unsupported equipment, the equipment must be adjusted manually at the equipment itself.
For more information on making these adjustments, see [“Stress Test Keys” on page 92](#).
8. When the exercise phase is complete, press the **Recovery** key to begin the recovery phase of the test.

NOTE:

When using an ergometer with remote start, you do not need to press the **Recovery** key because the recovery phase begins automatically at the end of the last stage. However, you can press the **Recovery** key to begin the recovery phase before the last stage ends.

On supported treadmills, the belt begins to slow and the grade drops to 0%. On supported ergometers, the load begins to lighten. On unsupported treadmills and ergometers, these adjustments must be made manually.

Continue to monitor the patient and record the ECG until the device stops.

9. When the recovery phase is over, press the **Test End** key.
The menu options at the bottom of the screen change to **Confirm Test End** and **Continue Test**. Do one of the following:
 - To return to the test, press **Continue Test**.
The previous menu options return. Continue to record the ECG as needed. When you are done, repeat this step.
 - To stop the test, press **Confirm Test End**.

The menu options change. Continue to step [10](#).

10. Do any of the following, as necessary.
 - Press **Next Patient** to test another patient.
You are warned that testing another patient discards the results of the current test. Do one of the following:
 - Press **No** to cancel the change in patients and return to the current test.
You can either print the current test report or change the report formats.
 - Press **Yes** to erase the current test results and test a new patient.
Repeat from step [3](#) for the next patient.
 - Press **Print** to print the test's report.
The report prints with the selected format options.
 - Press **Report Format** to modify the report format.
The **Report Format** window opens. Select the options you want to include in the report and press **Save**. You can now print the test's report.

Conducting a Stress Test with a Master's Step Device

Use the following instructions to conduct a stress test with a Master's Step device, if it is selected in **Basic Setup**.

1. Prepare the patient as described in ["Preparing the Patient" on page 49](#).
2. On the **Main Menu** press **Stress ECG**.
The **Enter Patient Data** window opens.
3. Enter patient data as described in ["Entering Patient Information" on page 55](#).
Be sure you enter accurate information for **Date of Birth**, **Gender**, and **Weight**. The number of steps is determined by these three parameters.
For more information on using Master's Step, see ["Master's Step Data" on page 189](#).
4. Adjust the stress options as necessary:
This includes the speed and gain, finite residual filter, pacemaker enhancement, printer leads, test protocol, report format, and target heart rate. For more information on setting these options, see ["Stress Options" on page 92](#).
5. Record a preliminary ECG.
This may be seated, standing, supine, or hyperventilating, depending on the requirements of the selected protocol.
6. Begin the pretest phase to allow the patient to warm up.
 - a. Remove the leadwires from the patient, but leave on the electrodes.
This prevents the patient from tripping on the leadwires during the test.
 - b. Instruct the patient to take a step whenever the system beeps.
 - c. Press the **Pretest** key.

7. Press the **Exercise** key to begin the test.

The duration of the exercise phase is dependent on the selected protocol:

- **SINGLE** is 90 seconds
- **DOUBLE** is 180 seconds
- **TRIPLE** is 270 seconds

When the test is complete, the first **POST EXER.** stage begins and the **ELECTR.ON** message is displayed.

8. Reattach the leadwires to the electrodes.

The median report prints at pre-configured intervals during the post exercise stages. When the last post exercise stage is complete, a summary report with trends and tables prints.

11

Managing Internal Storage

The **File Manager** provides an interface to the system's optional internal storage. It provides the tools to:

- Import records from an external source
- Print the internal storage directory
- Search stored records
- Edit a record's patient data
- Delete records
- Print records
- Transmit records to an external device
- Export records to a secure digital card or shared directory

You can print resting ECGs or save them to internal storage. You can only print arrhythmia and stress ECGs.

You can store resting ECGs automatically or manually:

- To save resting ECG records automatically, on the **Resting ECG Settings** window, select the **Auto Store ECG** check box. For more information, see ["Resting ECG Setup" on page 112](#).
- To save resting ECG records manually, after the resting ECG is acquired, press **Save**. For more information, see ["Post-Acquisition Options" on page 71](#).

To enable internal storage, you must enable the M100 option, **Internal Storage for 100 ECGs**, or the M200 option, **Internal Storage for 200 ECGs** (at a 500 Hz sampling rate).

Importing Records

In addition to saving ECGs recorded with the system, you can also import ECG records to internal storage from the following sources:

- Secure Digital (SD) cards
- CardioSoft systems connected via serial port or modem
- MUSE systems connected via modem

No additional set up is required to import from an SD card.

To import data via serial port or modem you need to do the following:

- Purchase and activate the appropriate communications option.
For more information see “[Options Setup](#)” on page 153.
- Configure the system’s data communication settings.
For more information, see “[Communication Setup](#)” on page 131.

NOTE:

Imported records have a **Sent** status of **Recv** and you cannot edit, transmit or export them.

Use the following instructions to import a record into internal storage:

1. On the **Main Menu** press **File Manager**.
The **File Manager** window opens.
2. Press **Import**.
The function keys change.



3. Select the appropriate import source from the following options:
 - To import ECGs via serial port, press **Serial**
The serial port opens. The system waits while the external device transmits the records.
 - To import ECGs via modem, press **Modem**.
The modem initializes. The system waits while the external device transmits records.
 - To import ECGs from an SD card, insert the SD card and press **SD Card**.
A list of the available ECGs on the card opens. Continue with step 4.
4. Select the records you want to import from the SD card.
5. When the correct records are selected, press **Import**.

Printing the File Manager Directory

Use the following instructions to print the directory of ECGs stored in internal memory:

1. On the **Main Menu** press **File Manager**.
The **File Manager** window opens.
2. Press **Print Directory**.
The directory prints on the writer.

Finding Records

The **File Manager** may have up to 200 records to manage (if the M200 option is enabled), making it difficult to find a specific record. To help you locate a record or a group of records, use the following instructions.

1. On the **Main Menu**, press **File Manager**.
The **File Manager** window opens.
2. Press **Search**.
The **Enter Search Criteria** window opens.

The screenshot displays the 'File Manager' window with an 'Internal Directory Listing' table. The table has columns for Patient Name, Patient ID, Date, Time, Sent, Y/C, and Order Number. The first row shows 'Soloman, Pietro'. Overlaid on this is the 'Enter search criteria' dialog box, which contains the following fields:

- Last Name:
- First Name:
- Patient ID:
- Date: . .
- Time: :
- Sent:
- Confirmed:
- Order Number:

At the bottom of the dialog box are three buttons: Search, Clear All, and Return.

3. Enter your search criteria.
4. Press **Search**.
The **File Manager** retrieves all the records that match your search criteria.
5. To clear the search results, do one of the following:
 - Press **Main Menu** > **File Manager**.
 - Press **Search** > **Return**.
 - Press **Search** > **Clear All** > **Search**.

Editing Patient Data

Use the following instructions to edit a record's patient data:

1. On the **Main Menu** press **File Manager**.
The **File Manager** window opens.
2. Press **Select**.
This enters the **File Manager** into **Select** mode.

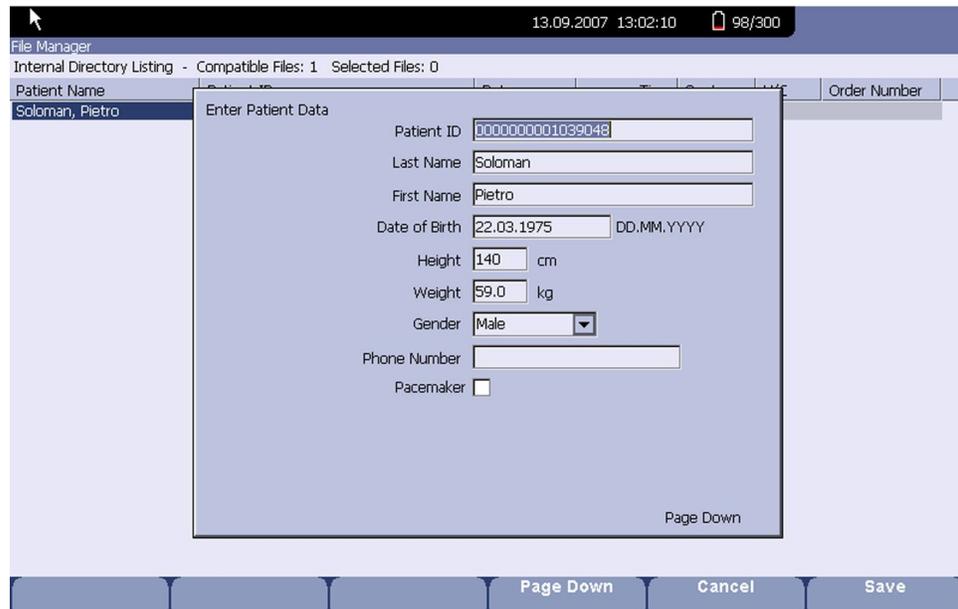
- Use the **trimpad** to select the record you want to edit.

NOTE:

You cannot edit the patient data for records that were imported to internal storage. Imported records have a **Sent** status of **Recv**.

- Press **Edit**.

The **Enter Patient Data** window opens.



- Edit the information as appropriate.

For instructions on editing patient information, see [“Entering Patient Information” on page 55](#).

- After the information is updated, press **Save**.

The updated information is saved, and you return to the **File Manager** window.

NOTE:

If you only edit demographic information, the record is still transmitted to the MUSE system as an unconfirmed record.

Previewing Records

Use the following instructions to preview recorded patient data:

- From the **Main Menu**, press **File Manager**.
The **File Manager** window opens.
- Press **Select** and use the **trimpad** to select the record you want to preview.
- Press **Preview**.
A window opens with the record for you to review.
- After reviewing the record, press **Return** and return to the **File Manager**.

Deleting Records

Use the following instructions to delete all records from internal storage:

1. On the **Main Menu**, press **File Manager**.
The **File Manager** window opens.
2. Do one of the following.
 - To delete select records, press **Select** and use the **trimpad** to select the record(s) you want to delete.
 - To delete all the records in storage, press **Select All**.
3. Press **Delete**.
A window opens and prompts you confirm that you want to delete the selected record(s).
4. Do one of the following:
 - To cancel the deletion, press **No**.
 - To delete the record(s), press **Yes**.

Printing Records

Use the following instructions to print records:

1. On the **Main Menu**, press **File Manager**.
The **File Manager** window opens.
2. Do one of the following:
 - To print select records, press **Select** and use the **trimpad** to select the record(s) you want to print.
 - To print all the records in storage, press **Select All**.
3. Press **Print**.
The selected records are printed on the writer.

Transmitting Records

Use the following instructions to transmit records from internal storage to an external device.

Before transmitting a record, you must do the following:

- Purchase and activate a communication option.
See [“Options Setup” on page 153](#) for more information.
- Configure data communications.

See “[Communication Setup](#)” on page 131 for more information.

- Connect the device to the communication option.
 - To set up a LAN connection to a CardioSoft system, see “[Connecting the LAN Option](#)” on page 46.
 - To set up a WiFi connection to a CardioSoft system, refer to “[Connecting the WiFi Option](#)” on page 46.
 - To set up a WiFi connection to a MUSE system, refer to “[Connecting the WiFi Option](#)” on page 46 .

NOTE:

For more information on setting up a LAN or WiFi connection to a MUSE system, refer to the *LAN Option Installation and Troubleshooting Guide*. To locate the part number for this manual, refer to “Related Documents” in the service manual.

Use the following procedure to transmit records

1. On the **Main Menu**, press **File Manager**.
The **File Manager** window opens.
2. Do one of the following:
 - To transmit select records, press **Select** and select the record(s) you want to transmit.

NOTE:

You cannot transmit records that were imported to internal storage. Imported records have a **Sent** status of **Recv**.

- To transmit all the records in storage, press **Select All**.
3. Press **Transmit**.
One of two things happens, depending on the number of locations defined in **Communications Setup**:
 - If only one location is defined, the files are transmitted to the default location.
 - If multiple locations are defined, a window listing the locations opens. Select the correct location and press **OK**.

Exporting Records

You can export records from internal storage to a Secure Digital card or a shared directory, in either a Hilltop/XML or PDF format. The maximum number of records you can export in XML format is determined by which storage option is enabled:

- If **M100** is enabled, the maximum is 100.
- If **M200** is enabled, the maximum is 200 (with a sampling rate of 500 Hz).
- Records exported in PDF format have no maximum limit.

NOTE:

The SD card capacity and manufacturer determine data transfer rates and storage space. This may affect the time required to read or write to the SD card. It may also limit the number of records that you can store on the card. GE Healthcare recommends you use Secure Digital High Capacity (SDHC) cards with a capacity of 4 GB, either supplied by GE Healthcare or manufactured by SanDisk.

Setting Up Export Options

The requirements for setting up export differ depending on the export method:

- To export XML data to an SD card, you must first enable Export XML in **Communication Setup**.
- To export PDF files to an SD card, you must first enable the **PDFC** (PDF Export) system option. Refer to “[Options Setup](#)” on page 153 for details.
- To export either Hilltop/XML or PDF to a shared directory, you must do the following:
 - Purchase and activate the **LAN Communications to CardioSoft (LANC)** option or **WiFi Communications to CardioSoft (WIFC)** option. Refer to “[Options Setup](#)” on page 153 for details.
 - Define the shared directory setting on **Communications Setup**. Refer to “[Options Setup](#)” on page 153 for details

Exporting Records

Once the necessary configurations are complete, use the following instructions to export records from internal storage:

1. On the **Main Menu**, press **File Manager**.
The **File Manager** window opens.
 2. Select the record(s) you want to export.
 - To export select records, press **Select** and use the **trimpad** to select the records you want to export.

NOTE:
Records that are imported to internal storage cannot be exported from internal storage in Hilltop or XML formats; those records can be exported in PDF format. Imported records have a **Sent** status of **Recv**.

 - To export all records in storage, press **Select All**.
 3. Press **More > Export**.
The function keys change. Depending on which options were activated, the function keys may include **Hilltop XML**, **PDF**, and **Return**.
 4. If you are exporting to an SD card, insert the card into the SD card slot.
Make sure the card has sufficient free space for the selected records and that it is not write-protected.
- NOTE:**
If you do not enter the SD card into the SD card slot, you receive the following warning when attempting to export data to the card:
- SD Card is not present.**
- Refer to “[SD Card Not Present](#)” on page 178 for further instructions.

5. Press the appropriate function key:
 - To export in both XML and Hilltop formats, press **Hilltop XML**.
 - To export in PDF format, press **PDF**.
 - To return to the previous set of function keys, press **Return**.

If you press **Hilltop XML** or **PDF**, one of two things happens, depending on your system configuration:

- If a shared directory was configured, the **Select Export Destination** window opens.
Go to step 6
- If a shared directory was not configured, the records are automatically exported in the selected format to the SD card.
When the export is complete, one of two things happens, depending on the selected format:
 - For the **Hilltop XML** format, the screen clears and the function keys change.
 - For the **PDF** format, a summary window opens with the number of records that exported successfully and the number that failed to export. Press **OK** to close the summary window.
If you want to select additional records to export, return to step 2 or continue to step 6.

6. In the **Select Export Destination** window, select the appropriate export destination:
 - To export to an SD card, select **SD Card**.
 - To export to the shared directory, select **Shared Directory**.

NOTE:

When exporting to a shared directory, the device logs on to the directory with the user name and password defined on the **Communications Setup** window. If either of those values are incorrect, you receive an error message. Correct the user name and password on the **Communications Setup** window and repeat the export process.

7. Press **OK**.

System Configuration

System Configuration provides access to functions that allow you to customize the system settings and to utilities to help manage those settings. This chapter describes the settings managed by each function and the process followed by each utility.

NOTE:

Configuration changes can cause data loss. After making configuration changes, you **MUST** return to the **Main Menu** to ensure the changes are saved.

Depending on which options were activated, some of these functions may not be available on your system.

Basic Setup

The **Basic Setup** function allows you to define the following information:

- Institutional identification
- Default physicians
- System settings
- Stress test accessory (if the **ERGO** stress test option is activated)
- System security
- Time servers

NOTE:

You must add physicians in **User Setup** before they can be picked as default physicians. For more information, see [“User Setup” on page 149](#).

For more information on the **ERGO** and **CFRA** options, see [“Options Setup” on page 153](#).

To access **Basic Setup**, on the **Main Menu**, press **System Configuration > Basic Setup**.

The following tables describe each setting available on **Basic Setup**.

Basic Setup Fields—Page 1

Field	Description
Name	The name of the institution.
Street	The street address of the institution.
City	The city where the institution is located.
Ordering Physician	The physician who ordered the ECG. Defaults on any patient records created on the system.
Referring Physician	The physician who referred the patient. Defaults on any patient records created on the system.
Attending Physician	The physician who supervised the ECG. Defaults on any patient records created on the system.
Technician	The technician who conducted the ECG. Defaults on any patient records created on the system.
Location	Location ID where the device is located. Defaults on any patient records created on the system.
Site #	This field is required to store ECG reports on a cardiology information system such as the MUSE system.
Cart #	Unique cart number of the device. Defaults on any patient records created on the system.
Test Patient (temporary)	Enables/disables simulated ECGs. When enabled, simulated waveforms are generated in the resting, arrhythmia, RR analysis, or stress ECG functions. This is useful for demonstration, training, or testing purposes. NOTE: This setting clears when the system is reset.

System Settings Page Up

Power up mode: Resting ECG

Display Colors: dark blue

ECG Grid on Display

Anti-Aliasing of ECG Waveforms

Devices

Stress Test: Internal Ergometer

Blood Pressure: 110

Page Down

Basic Setup Fields–System Settings

Field	Comment
<i>Power up mode</i>	Determines which screen is displayed when the system is powered on. Available options are: <ul style="list-style-type: none"> • <i>Resting ECG</i> (default) • <i>Arrhythmia</i> • <i>Main Screen</i> • <i>Stress ECG</i> • <i>Order Manager</i>
<i>Display Colors</i>	Determines the appearance of the ECG display. Select a color combination that is legible for you.
<i>ECG Grid on Display</i>	Determines whether a grid is displayed behind the waveforms. A grid may make reading the ECG easier. The default is <i>on</i> .
<i>Anti-Aliasing of ECG Waveforms</i>	Determines whether anti-aliasing is applied to waveforms to reduce distortion caused by the video display. The default is <i>on</i> .

Basic Setup Fields–System Settings (cont'd.)

Field	Comment
Stress Test	<p>Identifies the device used to perform the stress test. Available options are:</p> <ul style="list-style-type: none"> • Internal Ergometer • Ergometer eBike • Internal Treadmill • Treadmill T2000 • Treadmill T2100 • Master’s Step device <p>This field is only available if the Stress option is enabled.</p> <p>For information on enabling stress tests, see “Stress ECG Setup” on page 124.</p> <p>For information on conducting stress tests, see “Stress Testing” on page 89.</p>
Blood Pressure	<p>Indicates whether the patient’s blood pressure should be taken by the stress device. Available options are:</p> <ul style="list-style-type: none"> • No • In ergometer <p>This field is only available if the Stress option is enabled.</p>

System Security Setup Page Up

High Security Mode

Audit Trail

Auto Logoff

Auto Logoff Time (1-255 min)

Time Server Settings

Automatically synchronize with Time Server

Time Server Name

Last synchronization at

Last synchronized from Time Server

Input Method Select

Patient Data Input Device

Enable Data Retrieval

Page Down

Basic Setup Fields–System Security Setup

Field	Comment
High Security Mode	When High Security Mode is enabled, users are prompted to enter an ID and password when logging on to the system. You must add each user in User Setup .
Audit Trail	Copies the system audit trail in XML format to an SD card and then clears the audit trail on the system. For more information see “Exporting the Audit Trail” on page 159 .
Auto Logoff	Determines whether the system automatically logs the user off after a predefined period of inactivity. See also Auto Logoff Time . This is available only if High Security Mode is enabled.
Auto Logoff Time (1–255 min)	Determines the length of inactivity, in minutes, before the system logs off the user. This is available only if High Security Mode is enabled.
Automatically synchronize with Time Server	Enables/disables automatic synchronization with an external time server either on the institution’s network or the Internet. You must activate a LAN option to set this option.
Time Server Name	Identifies the server with which the device synchronizes its time. This can be a server on the institution’s network or on the Internet. Contact your server administrator for this information.
Last synchronization at	Display-only field that identifies when the last synchronization occurred.
Last synchronized from Time Server	Display-only field that identifies where the last synchronization occurred.
Patient Data Input Device	Allows the user to select the input methods to download patient demographics. The available options are: <ul style="list-style-type: none"> • Internal Keypad • External keyboard • Barcode Reader
Enable Data Retrieval	If this option is enabled, the user can download patient demographics.

If the **PDFC** option is enabled, you receive the **System Settings–PDF Naming Settings** window.

Basic Setup Fields–System Settings (PDF Naming Settings)

Field	Description
<i>Generate automatic file name</i>	Select the checkbox; the numbered fields are enabled. Use the drop-down arrow to select each setting.

For more information, see “Customizing the Naming Convention” on page 158.

Resting ECG Setup

The **Resting ECG Setup** window allows you to define:

- Waveform parameters
- Lead usage
- Analysis options
- Lead sequence
- Report options
- Storage options (if the internal storage option is activated)
- Transmission options (if a communications option is activated)

To access the **Resting ECG Setup** window, on the **Main Menu** press **System Configuration**> **Resting ECG Setup**.

The following tables describe each setting available on **Resting ECG Setup**.

Resting ECG Settings

Gain [mm/mV] 10

Speed [mm/s] 25

Low Pass Filter [Hz] 150

ADS

Line Filter

Enabled

6 leads : 1x6

6 leads : 2x3

12 leads : 2x6

12 leads : 4x3

Display Format 3 leads : 1x3

Display Lead Group 3 Rhythm leads

Page Down

Resting ECG Setup Fields–Page 1

Field	Comment
Gain	<p>Sets the amplitude of the ECG signal. Measurement is in millimeters per millivolt and includes the following options:</p> <ul style="list-style-type: none"> • 2.5 mm/mV • 5 mm/mV • 10 mm/mV • 20 mm/mV • 40 mm/mV • Automatic <p>The larger the selected measurement, the larger the waveform. Only the representation of the waveform changes; signal strength is not affected.</p> <p>NOTE: If Automatic is selected, the system calculates the best gain based on the peak-to-peak amplitudes of all displayed leads and the selected display format.</p>
Speed	<p>Changes the speed of rhythm printing and the wiper bar movement across the display.</p> <p>Measurement is in millimeters per second (mm/s) and includes the following options:</p> <ul style="list-style-type: none"> • 5 mm/s (rhythm) / 12.5 mm/s (display) • 12.5 mm/s • 25 mm/s • 50 mm/s

Resting ECG Setup Fields–Page 1 (cont'd.)

Field	Comment
Low Pass Filter	<p>Sets the maximum frequency to include in the waveform. Restricting frequencies can help eliminate noise in the waveform. Frequencies are measured in Hertz (Hz) and include the following options:</p> <ul style="list-style-type: none"> • 20 Hz • 40 Hz • 100 Hz • 150 Hz <p>Selecting a frequency eliminates signals above that frequency. For example, if you select 40, only signals that have a frequency of 40 Hz or lower are included in the waveform.</p>
ADS	Toggles the anti-drift system (ADS) on and off. ADS helps reduce baseline drift.
Line Filter	Enables/disables the line filter defined in Country Setup .
6 leads: 1x6	Enables/disables a display option that shows one six-waveform column.
6 leads: 2x3	Enables/disables a display option that shows two three-waveform columns.
12 leads: 2x6	Enables/disables a display option that shows two six-waveform columns.
12 leads: 4x3	Enables/disables a display option that shows four three-waveform columns.
Display Format	Selects the display format of the resting ECG. The default value is 3 leads: 1x3 . Other values depend on which of the previous two fields are set.
Display Lead Group	<p>Determines which group of leads is displayed. The available values depends on which Display Format is selected. For example, if 3 Leads: 1x3 is selected, the available values are:</p> <ul style="list-style-type: none"> • 3 rhythm leads • 1st group • 2nd group • 3rd group • 4th group

Resting ECG Settings Page Up

Printer Leads Rhythm 6 ▼

Start rhythm report on new page

Pace Enhancement

Preview before Analysis Always ▼

Reanalysis

QTC Calculation Bazett ▼

Screening Criteria

Suppress normal statement

Suppress abnormal/borderline

Suppress all statements

ACI-TIPI

Sample Rate 500 Hz ▼

Page Down

Resting ECG Setup Fields–Page 2

Field	Comment
Printer Leads	Identifies the default set of leads to use for printing. The values are: <ul style="list-style-type: none"> • First 6 • Second 6 • Rhythm 6 • 12
Start rhythm report on new page	Determines whether the rhythm report prints on a separate page.
Pace Enhancement	Increases the readability of pacemaker ECG either by augmenting small pace pulses or by truncating large pace pulses. If enabled, pace enhancement is done in two steps: <ol style="list-style-type: none"> 1. Add a marker (1.5 mV amplitude, 6 ms duration) to the electrode signal. 2. Limit the sum to 0.5 mV in the lead signal.
Preview before Analysis	Determines waveform preview options. Values include: <ul style="list-style-type: none"> • No Waveforms are never previewed. • Always Waveforms are always previewed. • Yellow electrodes Waveforms are previewed when the Hookup Advisor indicator shows a yellow or red electrode. • Red electrodes Waveforms are previewed when the Hookup Advisor indicator shows a red electrode. <p>For additional information, see “Hookup Advisor” on page 66.</p>

Resting ECG Setup Fields–Page 2 (cont'd.)

Field	Comment
Reanalysis	<p>Enables/disables the reanalysis feature, which allows you to adjust the following ECG measurements:</p> <ul style="list-style-type: none"> • P Duration • PR Interval • QRS Duration • QT Interval <p>This is available only if Audit Trail is disabled and one of the following options is activated: ME12, MEHR, MI12, or MIHR.</p> <p>For more information on activating options, see “Options Setup” on page 153.</p>
QTC Calculation	<p>Determines which formula is used to correct QT calculations. Available options are:</p> <ul style="list-style-type: none"> • Bazett $QTc = QT \sqrt{HR/60}$ Bazett is available only if the MEHR or MIHR option is activated. • Framingham $QTc = QT + 154 (1 - 60/HR)$ Framingham is available only if the ME12 or MI12 option is activated. • Fridericia $QTc = QT^3 \sqrt{HR/60}$ Fridericia is available only if the ME12 or MI12 option is activated. <p>NOTE: In all formulas, HR = Heart Rate.</p>
Screening Criteria	<p>Enables/disables the inclusion of the screen criteria. This setting is available only if the MI12 option is activated.</p>
Suppress normal statement	<p>Enable/disables the inclusion of the normal statement. This setting is available only if the MI12 option is activated.</p>
Suppress abnormal/borderline	<p>Enable/disables the inclusion of the abnormal/borderline statements. This setting is available only if the MI12 option is activated.</p>
Suppress all statements	<p>Enable/disables the inclusion of all statements. This setting is available only if the MI12 or MIHR option is activated.</p>

Resting ECG Setup Fields–Page 2 (cont'd.)

Field	Comment
ACI-TIPI	<p>Enables/disables the inclusion of the ACI-TIPI (Acute Cardiac Ischemia Time Insensitive Predictive Instrument) statement and enables the Chest Pain field on the Patient Information window.</p> <p>To include ACI-TIPI statements, the following conditions must be met:</p> <ul style="list-style-type: none"> • MI12 or ME12 system option is activated • TIPI system option is activated • ACI-TIPI is enabled • 10s ECG Report Format is enabled • Print Interpretation is enabled • Patient data includes: gender, date of birth, and chest pain indication • Patient cannot be a pediatric patient (15 years or younger) as calculated from the date of birth
Sample Rate	Determines the report frequency. Options are 500 Hz or 1000 Hz . 1000 HZ is supported only for XML output.

Resting ECG Settings Page Up

Lead Sequence

Sequence Name

Lead	Label
1	I
2	II
3	III

Lead	Label
4	aVR
5	aVL
6	aVF
7	V1
8	V2
9	V3
10	V4
11	V5
12	V6

Rhythm Leads

1	V1
2	II
3	V5
4	V2
5	V3
6	V4

Page Down

Resting ECG Setup Fields–Page 3

Field	Description
Lead Sequence	Determines the lead sequence to use. Values are: <ul style="list-style-type: none"> • Standard • Cabrera • NEHB • SEQ4 SEQ4 allows you to configure a custom 12-lead sequence using the following fields. If either 12SL option (ME12 or MI12) is activated, you must select leads I (-I), II (-II), V1, V2, V3, V4, V5, and V6 for a correct 12SL analysis.
Sequence Name	Set the display name for a custom lead sequence. Available only if SEQ4 is selected for the Lead Sequence .
1–12 Lead	Twelve fields that allow you to define the sequence in which the leads are displayed. Available only if SEQ4 is selected for the Lead Sequence .
1–12 Label	Twelve fields that allow you to define the labels that are displayed/printed for the corresponding leads. Available only if SEQ4 is selected for the Lead Sequence .
1–6 Rhythm Leads	Six fields that allow you to define the rhythm leads and their sequence. You can select the rhythm leads for all four lead sequences.

Resting ECG Settings Page Up

10s ECG Report Format:

Detailed Results Report Format:

Report Copies:

Print Interpretation:

Auto Store ECG:

File Manager Sort by:

Auto Transmit ECG:

Delete after Transmission:

Print Transmission Log:

Auto Export ECG:

Auto Execute Single Order:

Page Down

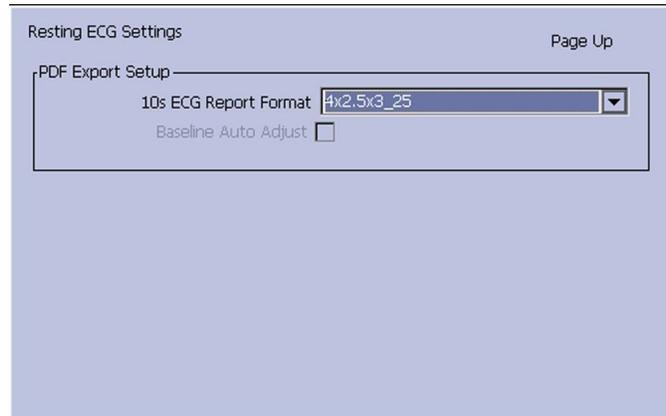
Resting ECG Setup Fields–Page 4

Field	Description
10s ECG Report Format	<p>Determines how the 10s ECG report prints. If no format is selected, the report does not print.</p> <p>The values are:</p> <ul style="list-style-type: none"> • 1x10x12_25 • 1x10x12_50 • 2x10x6_25 • 1x10x3_25 • 2x5x6_25 • 2x5x6_50 • 2x5x6_25_R1 • 4x2.5x3_25 • 4x2.5x3_25_R1 • 4x2.5x3_25_R3 • 4x2.5x3_25_R2_P • H1 • H2 <p>If the CTDG option is enabled, the report format is 4x2.5x3_25_R2_P.</p>
Detailed Results Report Format	<p>Determines how the Detailed Results report prints. If no format is selected, the report does not print.</p> <p>The values are:</p> <ul style="list-style-type: none"> • Median_25 • Median_50
Report Copies	<p>Determines how many copies of the selected report print.</p> <p>The values are:</p> <ul style="list-style-type: none"> • 0 • 1 • 2 • 3 • 4 • 5
Print Interpretation	<p>Determines whether ECG interpretation prints on the report. Available only if either the MI12 or MIHR option is activated.</p>

Resting ECG Setup Fields–Page 4 (cont'd.)

Field	Description
Auto Store ECG	<p>Determines whether the ECG is automatically stored on the internal storage.</p> <p>This is available only if the M100 or M200 internal storage option is activated.</p> <p>For more information, see “Options Setup” on page 153.</p>
File Manager Sort by	<p>Determines the field by which the File Manager sorts records in internal storage.</p> <p>This is available only if the M100 or M200 internal storage option is activated. Available options are:</p> <ul style="list-style-type: none"> • Patient Name • Date • Patient ID • Order Number
Auto Transmit ECG	<p>Determines whether the ECG is transmitted automatically to an external device. Available only if one of the communications options is activated.</p> <p>For more information, see “Options Setup” on page 153.</p>
Delete After Transmission	<p>Determines whether the ECG is deleted from internal storage after it is transmitted to an external device. Available only if one of the communications options is activated.</p> <p>For more information, see “Options Setup” on page 153.</p>
Print Transmission Log	<p>Determines whether the transmission log prints after an ECG is transmitted from File Manager to an external device. Available only if one of the communications options is activated.</p> <p>For more information, see “Options Setup” on page 153.</p>
Auto Export ECG	<p>Determines whether the ECG is automatically exported in Hilltop, Hilltop/XML, or PDF format to the shared directory location. This is available only if the user has configured and enabled shared directory settings in the Communication Setup. Availability of Hilltop/XML format depends on whether Export XML option was enabled in Communication Setup. Availability of PDF format depends on PDFC option activation in Options Setup.</p> <p>For more information, see “Communication Setup” on page 131.</p>
Auto Execute Single Order	<p>Determines whether the single order requested by the user is automatically downloaded and executed. This is available only if the SOML/SOMF simple order manager options are activated in Options Setup.</p>

If the **PDFC** option is enabled, you receive the **Resting ECG Settings–PDF Export Setup** window.



Resting ECG Setup Fields–Page 4 (PDF Export Setup)

Field	Description
10s ECG Report Format	<p>Determines how the 10s ECG report prints to a PDF file.</p> <p>The options are:</p> <ul style="list-style-type: none"> • 4x2.5x3_25 • 4x2.5x3_25_R1 • 4x2.5x3_25_R3 • MUSE1 • MUSE2 • 1x10x12_25 <p>NOTE: Options MUSE1 and MUSE2 are not available in the Chinese version.</p>
Baseline Auto Adjust	<p>Enables/disables the PDF export.</p> <p>Available only when the 1x10x12_25 of 10s ECG Report Format option is selected.</p>

Arrhythmia Setup

The **Arrhythmia Setup** function allows you to define:

- Waveform parameters
- Lead usage
- Analysis options
- Lead sequence
- Report options

To access **Arrhythmia Setup**, on the **Main Menu** press **System Configuration> Arrhythmia Setup**.

Most of the fields on the **Arrhythmia Setup** windows are the same as those on **Resting ECG Setup**. The following tables list the arrhythmia settings that are unique or differ from resting ECG. For all other fields, see “Resting ECG Setup” on page 112.

The screenshot shows the 'Arrhythmia Setup' window with the following settings:

- Gain [mm/mV]: 10
- Speed [mm/s]: 5 (Rhythm) / 12.5 (Display)
- Low Pass Filter [Hz]: 150
- ADS:
- Line Filter:
- Enabled section:
 - 6 leads : 1x6:
 - 6 leads : 2x3:
 - 12 leads : 2x6:
 - 12 leads : 4x3:
- Display Format: 3 leads : 1x3
- Display Lead Group: 3 Rhythm leads

Page Down

Arrhythmia Setup Fields–Page 1

Field	Description
ADS	Enables/disables the Anti-Drift System , which helps reduce baseline shift. In Arrhythmia mode, this setting is always available.

The screenshot shows the 'Arrhythmia Setup' window with the following settings:

- Pace Enhancement:
- Rhythm Printing:
- Printer Leads: 12
- Arrhythmia Event Printing: Unequal Events
- Episodes Printout in Summary Report: Chronological Order

Page Up

Page Down

Arrhythmia Setup Fields–Page 2

Field	Description
Rhythm Printing	Determines whether the rhythm report starts automatically when recording starts.
Arrhythmia Event Printing	Determines which events print on the Arrhythmia Report: <ul style="list-style-type: none"> • All events • Unequal events • No event printing
Episodes Printout in Summary Report	Determines how arrhythmia events print. Options are: <ul style="list-style-type: none"> • Chronological order • Priority order • Only episodes with ventricular events • No episodes

Arrhythmia Setup Page Up

Lead Sequence

Sequence Name

	Lead	Label
1	<input type="text" value="I"/>	<input type="text" value="I"/>
2	<input type="text" value="II"/>	<input type="text" value="II"/>
3	<input type="text" value="III"/>	<input type="text" value="III"/>
4	<input type="text" value="V2"/>	<input type="text" value="V2"/>
5	<input type="text" value="V4"/>	<input type="text" value="V4"/>
6	<input type="text" value="V6"/>	<input type="text" value="V6"/>

Arrhythmia Setup Fields–Page 3

Field	Description
Lead Sequence	<p>Determines the lead sequence to use. Arrhythmia Setup includes the following options in addition to the four options available in the Resting ECG Setup:</p> <ul style="list-style-type: none"> • STD_C • STD_RED • STD_LI • CABR_LI • NEHB_6 • HIGH_C
1–6 Rhythm Leads	<p>Six fields that allow you to define the rhythm leads and their sequence. You can select the rhythm leads for all four lead sequences.</p> <p>If you chose any of the following in Lead Sequence, the rhythm leads are not displayed:</p> <ul style="list-style-type: none"> • STD_C • STD_RED • STD_LI • CABR_LI • NEHB_6 • HIGH_C

Stress ECG Setup

Stress ECG Setup is available only if the **ERGO Stress Test** option was activated. For more information, see “[Options Setup](#)” on page 153.

The **Stress ECG Setup** differs from the resting or arrhythmia ECGs. In addition to defining the stress ECG settings, you can create, edit, or delete test protocols.

Stress ECG Settings

The **Stress ECG Setup** function allows you to define:

- Waveform parameters
- Lead usage
- Analysis options
- Report options
- Lead sequence

To access the Stress ECG Setup, on the **Main Menu** press **System Configuration** > **Stress ECG Setup**.

Many of the fields on the **Stress ECG Setup** windows are the same as those on the **Resting ECG Setup** or the **Arrhythmia Setup**. The following tables list the settings that

are unique or differ from the resting or arrhythmia setups. For all other fields, see “Resting ECG Setup” on page 112 or “Arrhythmia Setup” on page 121.

Stress Setup

Gain [mm/mV] 10

Speed [mm/s] 25

Low Pass Filter [Hz] 40

ECG Filter Type FRF

FRF

Line Filter

Enabled

6 leads : 1x6

6 leads : 2x3

12 leads : 2x6

12 leads : 4x3

Display Format 3 leads : 1x3

Display Lead Group 3 Rhythm leads

Page Down

Stress ECG Setup Fields–Page 1

Field	Comment
ECG Filter Type	Determines which method to use to filter the ECG signal. Options are: <ul style="list-style-type: none"> • ADS Anti-Drift System – reduces baseline shift • FRF Finite Residual Filter – reduces noise and artifacts The selection also determines the behavior of the Lower Pass Filter [Hz] and ADS/FRF fields.
ADS/FRF	Enables/disables the selected ECG Filter Type . The label for this field changes depending on the filter type selected.

Stress Setup

Page Up

Pace Enhancement

Max Predicted HR Formula WHO

Target HR [%] 100

Protocol WHO

Edit Protocols

J+x Point Formula Rautaharju

Calculation (E, J point) Continuous

Page Down

Stress ECG Setup Fields–Page 2

Field	Comments
Max Predicted HR Formula	<p>Determines the formula that predicts the patient’s maximum heart rate. Options are:</p> <ul style="list-style-type: none"> • WHO This formula, recommended by the World Health Organization, subtracts the patient’s age from 220. For example, a patient who is 50 years old has a maximum predicted heart rate of $220 - 50 = 170$. • AHA This formula, recommended by the American Heart Association, varies depending on the age of the patient. <ul style="list-style-type: none"> • < 25 years old = 160 bpm • > 75 years old = 115 bpm • 25–75 years old = $160 - (\text{age} - 25) * 0.9$ For example, a patient who is 50 years old has a maximum predicted heart rate of $160 - (50-25) * 0.9 = 138$.
Target HR [%]	Determines the percentage of the maximum predicted heart rate the stress test is targeting.
Protocol/Master’s Step Mode	<p>Determines which protocol conducts the stress test. The protocol determines the test phases, stages, stage durations, stage loads, and the times at which auto reports are printed and blood pressure is recorded.</p> <p>You can create custom protocols by selecting the Edit Protocols button.</p> <p>For more information, see “Editing Stress Protocols” on page 128.</p> <p>NOTE: If Master’s Step device is selected as the Stress Test Device in Basic Setup (see “Basic Setup” on page 107), this field is labeled Master’s Step Mode instead of Protocol.</p>

Stress ECG Setup Fields–Page 2 (cont'd.)

Field	Comments
J+x Point Formula	<p>Determines the method that calculates the post J-Point. Options are:</p> <ul style="list-style-type: none"> • 0 ms • 10 ms • 20 ms • 40 ms • 80 ms • Rautaharju (default value) • RR/16 <p>The numeric values (0 ms–80 ms) add the selected number of milliseconds to the J-point</p>
Calculation (E, J point)	<p>Determines when the select J+x point formula is used. Valid options are:</p> <ul style="list-style-type: none"> • Single The E and J points are calculated once in the beginning and remain unchanged during the stress test. • Continuous The E and J points are continuously updated during the PRETEST, EXERCISE, and RECOVERY phases of the stress test.

Stress Setup Page Up

Arrhythmia Event Printing No Event Printing ▼

Printer Leads 12 ▼

In-Test Reports Comparative Medians Report ▼

Median Report Speed [mm/s] 25 ▼

12-Lead Report 2x6 ▼

Summary Report Format

Summary Report
 Tabular Summary
 Trend Report
 ST Trend Report
 ST Summary Report

Episodes Printout in Summary Report
Chronological Order ▼

Page Down

Stress ECG Setup Fields–Page 3

Field	Comments
<i>In-Test Reports</i>	Determines the format of the report. Options are: <ul style="list-style-type: none"> • Median Report • Comparative Medians Report
<i>Median Report Speed [mm/s]</i>	Determines the speed in millimeters per second at which the waveforms are represented on the report. Options are: <ul style="list-style-type: none"> • 25 • 50
<i>12-lead Report</i>	Determines the layout of a 12-lead report. Options are: <ul style="list-style-type: none"> • 1x12 One column showing 10 seconds from all 12 leads. • 2x6 Two columns each showing 5 seconds from 6 leads.
<i>Summary Report</i>	Determines whether the summary report format is included in the stress report.
<i>Tabular Summary</i>	Determines whether the tabular report format is included in the stress report.
<i>Trend Report</i>	Determines whether the trend report format is included in the stress report.
<i>ST Trend Report</i>	Determines whether the ST trend report format is included in the stress report.
<i>ST Summary Report</i>	Determines whether the ST summary report format is included in the stress report.
<i>Episodes Printout in Summary Report</i>	Determines how episodes are presented in the stress report. Options are: <ul style="list-style-type: none"> • Chronological Order • Priority Order • Only Episodes with Ventricular Events • No Episodes

Editing Stress Protocols

The following pre-defined stress test protocols are available.

Pre-defined Stress Test Protocols

Device	Protocols		
Treadmills	BRUCE	MODBRUCE	NAUGHTON
	ELLESTAD	MODBALKE	USAFSAM
	SLOWUSAFSAM	CORNELL	BALKEWARE
	MODBALKEWARE	ADENOSINE	DOBUTAMINE
	PERSANTINE		

Pre-defined Stress Test Protocols (cont'd.)

Device	Protocols		
Ergometers	WHO	WHO50	WHO75
	HOLLMANN	BAL	STD.FRANCE
	MODWHO	CONCONI	
Master's Step	SINGLE	DOUBLE	TRIPLE

Most treadmill and ergometer protocols consist of three pre-defined *phases*: **Pretest**, **Exercise**, and **Recovery**. Each phase can include multiple stages that define the parameters of the test. The parameters differ slightly depending on the device, as seen in the following table.

Stress Test Parameters

Parameter	Treadmill	Ergometer	Master's Step	Comment
Stage	✓	✓	The stage name.	The stage name.
Stage Time	✓	✓	✓	The stage duration, in minutes.
Speed	✓		The treadmill speed in kilometers or miles per hour, depending on the Country Setup .	The treadmill speed in kilometers or miles per hour, depending on the Country Setup .
Grade [%]	✓			The percentage of increase in the treadmill's elevation.
Basic Load (W)		✓	The load at which the ergometer operates, in watts.	The load at which the ergometer operates, in watts.
Store Median First	✓	✓		The interval at which the first median reading is stored.
Store Median Repeat	✓	✓	The interval at which a subsequent median reading is stored.	The interval at which a subsequent median reading is stored.

Stress Test Parameters (cont'd.)

Parameter	Treadmill	Ergometer	Master's Step	Comment
BP First	✓	✓		The interval at which the first blood pressure reading is stored.
BP Repeat	✓	✓	The interval at which subsequent blood pressure readings are stored.	The interval at which subsequent blood pressure readings are stored.

You can modify the pre-defined protocols to create custom protocols. Use the following instructions to create a custom protocol:

1. On the **Main Menu** press **System Configuration > Stress ECG Setup**.
The **Stress ECG Setup** window opens.
2. Press **Page Down**.
The second page opens.
3. Select **Edit Protocols** and press either **Enter** or the **trimpad**.
For treadmills and ergometers, the **Select Protocol** window opens to display applicable protocols. Perform step 4 through step 16.
For **Master's Step** devices, the **Edit Master Step Post-Exercise** window opens to display the display the post-exercise stages. Perform step 8 through step 12.
4. Press **Add**.
A list of templates opens.
5. Select the template on which you want to base the new protocol.
The templates are based on the existing protocols. An **Empty Protocol** is also available.
6. Press **OK**.
The **Add Protocol** window opens.
7. Type a name for the new protocol and press **OK**.
The **Protocol** window opens with all the stages from the template. You can now add, edit, or delete stages.
8. To add a stage, do the following:
 - a. Select the stage that precedes the new stage.
 - b. Press **Add Stage**.
The selected stage is duplicated.
 - c. Edit the duplicate stage as appropriate.
See step 9.

9. To edit a stage, do the following:
 - a. Select the stage to edit.
 - b. Press **Edit**.
The **Edit Stage** window opens.
 - c. Modify the stage parameters as appropriate.
Refer to the table preceding these instructions for a description of each parameter.
 - d. When you are done, press **OK**.
The **Edit Stage** window closes.
10. To delete a stage, do the following:
 - a. Select the stage you want to delete.
 - b. Press **Delete Stage**.
The selected stage is deleted.
11. To remove custom **Master's Step** stages, press **Factory Defaults**.
NOTE:
Reset treadmills and ergometers to factory defaults at the protocol level.
See step 15.
12. Repeat steps 8 through 10 as necessary.
13. To rename the protocol, do the following:
 - a. Press **Edit Name**.
The **Edit Name** window opens.
NOTE:
This option is not available when editing a **Master Step** protocol.
 - b. Change the name as appropriate.
 - c. Press **OK**.
The protocol's name is changed.
14. When you are done with the stages, press **Save**.
This saves your changes and returns you to the previous window.
15. To remove custom protocols, press **Factory Defaults**.
16. When the protocol is done, press **Return**.
The protocol is saved and you return to the **Select Protocol** window.

Communication Setup

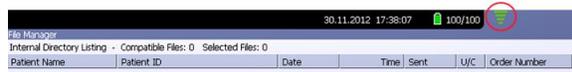
The **Communication Setup** function allows you to define the following settings:

- Basic communication settings
- Shared directory settings
- Destination location settings
- Modem settings (if a modem option is activated)

- LAN settings (if a LAN option is activated)
- Wireless settings (if a WiFi option is activated)

NOTE:

This MAC device displays a signal strength indicator for WiFi.



- DCP settings

NOTE:

This system is compatible with MUSE v7.1.1 and v8.0.1, and CardioSoft V6.51, V6.61, and V6.71.

To access the **Communication Setup**, on the **Main Menu** press **System Configuration > More > Communication Setup**.

The following tables describe the settings on **Communication Setup**.

The screenshot shows the 'Data Communication Settings' screen. It includes a 'Default Location' dropdown menu set to 'Location 1', an 'Export XML' checkbox which is unchecked, and a 'Serial Baud Rate' dropdown menu set to '115200'. Below these is a 'Shared Directory Settings' section with an unchecked checkbox for 'Allow Export using Shared Directory' and input fields for 'Share Name', 'Username', 'Password', 'Confirm', and 'Domain'. A note next to the 'Share Name' field states 'Above field converts / to #'. At the bottom right of the screen is a 'Page Down' button.

Communication Setup–Data Communication Settings Fields

Fields	Description
Default Location	Determines which of the four available communication locations is the default. The locations are defined on Page 2 of this <i>Communication Setup Fields</i> table.
Export XML	Determines whether ECG records are transmitted as XML. If this field is set, ECG records exported to an SD card are stored in both XML and Hilltop formats. If this field is not set, ECG records exported to an SD card are stored only in Hilltop format. NOTE: This field is displayed only if the M100 or M200 (Internal storage) option is activated.

Communication Setup–Data Communication Settings Fields (cont'd.)

Fields	Description
Serial Baud Rate	<p>Determines the speed at which data is transmitted across the serial communications port when using a modem.</p> <p>NOTE: This field is displayed only if the Modem Communications to CardioSoft (MODC) or Modem Communications to MUSE (MODM) option is activated.</p>
Allow Export Using Shared Directory	<p>Determines whether ECG records can be exported to a shared network drive.</p> <p>NOTE: This field is displayed only if the LAN Communications to CardioSoft (LANC) or WiFi Communications to CardioSoft (WIFC) option is activated.</p> <p>If this field is checked, the following five fields become available (Share Name, Username, Password, Confirm, and Domain).</p>
Share Name	<p>Identifies the name of the shared network drive. It must be the share drive's name; IP addresses are not supported. This field allows a maximum of 256 characters.</p> <p>This field is available only if the Allow Export Using Shared Directory field is checked.</p>
Username	<p>Identifies the user name that the system uses to log on to the shared directory. The user must be set up on the domain with the appropriate permissions to access the shared directory. This field allows a maximum of 30 characters.</p> <p>This field is available only if the Allow Export Using Shared Directory field is checked.</p>
Password	<p>Identifies the password that the system uses to log on to the shared directory. This field allows a maximum of 30 characters.</p> <p>This field is available only if the Allow Export Using Shared Directory field is checked.</p>

Communication Setup–Data Communication Settings Fields (cont'd.)

Fields	Description
Confirm	Re-enter the password in this field to confirm that the password was entered correctly. This field is available only if the Allow Export Using Shared Directory field is checked.
Domain	Identifies the user's domain. This field allows a maximum of 30 characters. This field is available only if the Allow Export Using Shared Directory field is checked.

Communication Setup–Data Communication Locations

Field	Description
Location	Identifies the name of a communication location that receives the transmission from the system. You can define up to four locations.
Device	Identifies the type of device to use to transmit data to the location. Options are: <ul style="list-style-type: none"> • Serial • Modem • LAN Modem and LAN are available only if the corresponding option was activated. This field becomes active only after a corresponding location is entered.

Communication Setup–Data Communication Locations (cont'd.)

Field	Description
<i>Phone Number</i>	Identifies the location's phone number. This field is available only if the selected device is Modem .
<i>Protocol</i>	<p>Determines the protocol to use to communicate with the device. Options are:</p> <ul style="list-style-type: none"> • A5 • CSI • DCP <p>Select CSI for MUSE connections and A5 for CardioSoft connections.</p> <p>DCP is available only if the selected device is LAN.</p> <p>NOTE:</p> <ul style="list-style-type: none"> • When using DCP to connect to the MUSE 8.0.1 system and get orders, the MUSE system only returns orders that have a location value. • When using DCP to connect to the MUSE 8.0.1 system to get orders, the MUSE system does not return the order priority (Normal, Preop, Stat).

This system can use several protocols to communicate test data and retrieve patients or orders. You should choose the protocol based on systems with which you want to connect, the data you want to send and receive, and the connection type (LAN, WiFi, modem, or serial).

- **DCP**
This is a newer protocol that is faster than CSI and A5. DCP does not require this system to use a fixed IP address. It is currently compatible with the MUSE 8.0 system or later, and other GE Healthcare systems that support DCP. It supports retrieving patient demographics and orders and sending patient tests. You can use it with LAN or WiFi connections.
- **CSI**
This is a protocol that receives a connection from a server and requires a fixed IP address. It is currently compatible with all versions of the MUSE system and CardioSoft system v6.6 and later. It supports retrieving patient demographics and orders and sending patient tests. You can use it with LAN, WiFi, modem, and serial connections.
- **A5**

This is a serial protocol that you can use for backward compatibility. It is compatible with all versions of the CardioSoft system. It supports sending patient tests. You can use it with modem or serial connections.

Communication Setup–Modem Settings Fields

Field	Description
Modem	Informs the user that the device is using the internal modem.
Dialing Method	Determines whether the system uses a tone or pulse to dial.
Dialtone Required	Determines whether the system must receive a dial tone before dialing.
PIN Dialing	Identifies whether a personal identification number (PIN) is required to dial out. If this field is checked, you must complete the following three fields (Delay , Service Provider Number , and PIN Number).
Delay	Determines how long, in seconds, the system should pause between dialing the Service Provider Number and the PIN Number and between dialing the PIN Number and the Outside Line .
Service Provider Number	Identifies the service provider's access telephone number.
PIN Number	Identifies the personal identification number to enter.

Communication Setup–Modem Settings Fields (cont'd.)

Field	Description
Outside Line	Identifies any access numbers that must be dialed to reach an outside line.
Manual Dialing	Determines whether the system automatically dials. If this field is checked, the connection must be made manually. If this field is cleared, the system automatically dials and you must complete the following fields: <ul style="list-style-type: none"> • Dialing Method • Dialtone Required • PIN Dialing

Wired LAN Settings Page Up

Cardiograph Device Name

Serial/IP Redirector Listen Port

Obtain an IP address automatically (DHCP)

IP Address 0.0.0.0

Netmask 0.0.0.0

Gateway 0.0.0.0

Obtain DNS server address automatically (DHCP)

Preferred DNS Server 0.0.0.0

Alternate DNS Server 0.0.0.0

Preferred WINS Server 0.0.0.0

Alternate WINS Server 0.0.0.0

The following fields are only displayed if one or both of the following options is activated:

- LAN communications to a CardioSoft system (**LANC**)
- LAN communications to a MUSE system (**LANM**)

Communication Setup–Wired/Wireless LAN Settings Fields

Field	Description
Cardiograph Device Name	Identifies the name of the device on the network. By default, the value is set to GE_<serial number> . A valid network device name contains between 1 and 20 alphanumeric and underscore characters. The first character must be a letter. This field is available only if a LAN or WIF option was activated.
Serial/IP Redirector Listen Port	Identifies the port where the device should listen for incoming serial/IP connections. These communications must match the values defined on the transmitting MUSE system. This setting only applies to the CSI protocol.
Obtain an IP address automatically (DHCP)	Determines whether the device automatically receives an IP address from the network. If this box is checked and LAN communication to a MUSE system is enabled, you must configure the DHCP server to reserve a static IP address for the device. Contact your network administrator for assistance. If this field is checked, the IP Address , Netmask , and Gateway fields are display only. If this field is cleared, you must complete those fields.
IP Address	Identifies the IP address of the device. If the Obtain an IP address automatically (DHCP) field is cleared, you must define a unique IP address.
Netmask	Identifies the netmask of the device. If the Obtain an IP address automatically (DHCP) field is cleared, you must define a netmask.
Gateway	Identifies the IP address of the gateway for the device to use. If the Obtain an IP address automatically (DHCP) field is cleared, you must enter the gateway's IP address.
Obtain DNS service address automatically (DHCP)	Determines whether the device automatically obtains a DNS (Domain Name Server) IP address. If this field is checked, the following two fields are display-only. If this field is cleared, you must define the IP address of the DNS servers to use.
Preferred DNS Server	Identifies the IP address of the primary DNS server used to resolve Internet domain names.
Alternate DNS Server	Identifies the IP address of the secondary DNS server used to resolve Internet domain names.

Communication Setup–Wired/Wireless LAN Settings Fields (cont'd.)

Field	Description
<i>Preferred WINS Server</i>	Identifies the IP address of the primary WINS server used to resolve Windows host names. You must have the correct WINS address configured if you are using a shared folder for communication.
<i>Alternate WINS Server</i>	Identifies the IP address of the secondary WINS server used to resolve Windows host names. You must have the correct WINS address configured if you are using a shared folder for communication.

The following fields are only displayed if one or both of the following options is activated:

- WiFi communications to a CardioSoft system (**WIFC**)
- WiFi communications to a MUSE system (**WIFM**)

Wireless Networking Settings Page Up

Enable Wireless LAN

Network Name (SSID)

Authentication

Encryption

Key Index

Key

Communication Setup—Wireless Networking Settings

Field	Description
Enable Wireless LAN	Enables/disables wireless LAN connectivity (WiFi). Check the field to enable WiFi. Clear the field to disable WiFi. The field is cleared by default. NOTE: In order to connect to WiFi, please insert the USB WiFi device after the device status indicates it is working. Otherwise, WiFi is not connected correctly.
Network Name (SSID)	Specifies the name of the wireless local area network (WLAN). This field allows a maximum of 32 characters. NOTE: When the Network name is empty, the system connects to any available network. The system uses Infrastructure Mode (Wireless access point) to provide the connection with Enterprise network or internet.
Authentication	Specifies the authentication protocol. Values are: <ul style="list-style-type: none"> • Open • Shared • WPA-PSK • WPA2-PSK
Encryption	The user net configuration determines the encryption. Values are: <ul style="list-style-type: none"> • Disabled • WEP
Key Index	This field depends on the user's network configuration. This field is only available when the encryption is WEP. Values are: <ul style="list-style-type: none"> • 1 • 2 • 3 • 4
Key	ASCII or Hexadecimal characters (0-9, A-F) for encryption. This field depends on the user's network configuration.

Communication Setup–DCP Settings Fields

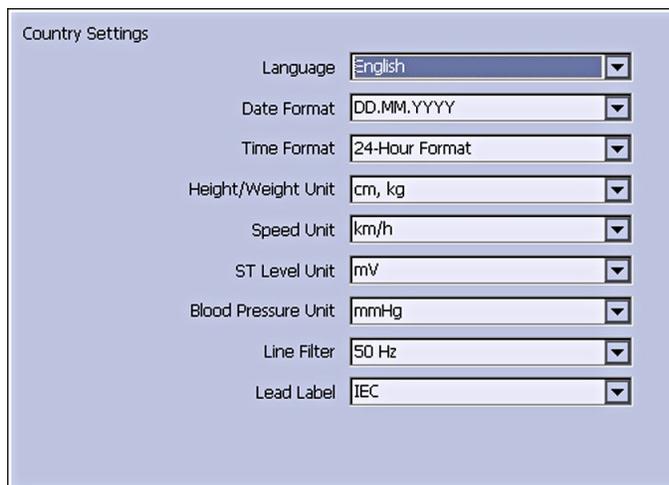
Field	Description
Discover DCP Device	Allows you to discover GE Healthcare systems that support DCP servers on the same network subnet as this system. This command returns a list of DCP servers and you can select one of them for communication. Usually there is only one server from which to choose. If no servers are displayed, you can enter one manually.
DCP WS Address	Displays the address of the DCP server to use for communication. You can locate this address using Discover DCP Device or enter it manually. A server address has the form http://<server-name>:<port>/SendTest , where <server-name> is the server name or IP address and <port> is the server port number, usually 9240.
Test Device Connection	Allows you to test the connection to the selected DCP server. The status of the connection is displayed in the text box.

Country Setup

The **Country Setup** function allows you to define the following:

- System language
- Date and time formats
- Measurement units
- Line filter
- Lead label

To access the **Country Setup**, on the **Main Menu** press **System Configuration > More > Country Setup**.



Country Settings

Language: English

Date Format: DD.MM.YYYY

Time Format: 24-Hour Format

Height/Weight Unit: cm, kg

Speed Unit: km/h

ST Level Unit: mV

Blood Pressure Unit: mmHg

Line Filter: 50 Hz

Lead Label: IEC

The following table identifies the settings on **Country Setup**.

Country Setup Fields

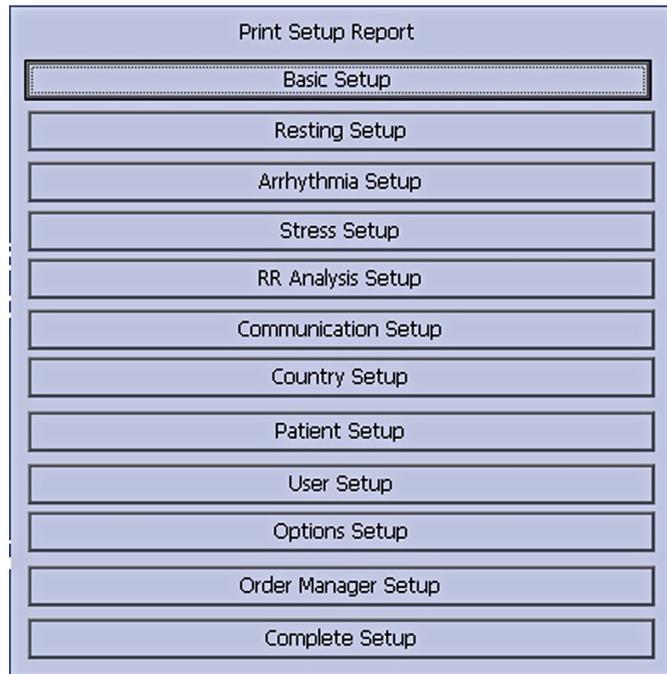
Field	Comments
Language	Determines the language the interface and reports use.
Date Format	Determines the format in which dates are displayed. Options are: <ul style="list-style-type: none"> • DD.MM.YYYY • MM/DD/YYYY • YYYY-MM-DD
Time Format	Determines whether the system uses a 12-hour or a 24-hour format.
Height/Weight Unit	Determines whether the system uses metric measurements (cm, kg) or American measurements (in, lb) for patient weight and height.
Speed Unit	Determines whether the speed of stress devices is measured in kilometers per hour (km/h) or miles per hour (mph).
ST Level Unit	Determines whether the ST segment is measured in millivolts (mV) or millimeters (mm).
Blood Pressure Unit	Determines whether blood pressure is measured in millimeters of mercury (mmHg) or kilopascals (kPa).

Country Setup Fields (cont'd.)

Field	Comments
<i>Line Filter</i>	Determines the frequency of the line filter. Options are 50 Hz and 60 Hz.
<i>Lead Label</i>	Determines whether the system labels leads using the standards of the International Electrotechnical Commission (IEC) or the American Heart Association (AHA).

Print Setup Report

The **Print Setup Report** utility prints a report of individual settings or the complete system settings. You may use the report to verify that all of your devices are configured identically or as a reference if you need to re-configure a device.



Use the following instructions to print a setup report:

1. On the **Main Menu** press **System Configuration > More > Print Setup Report**.
2. On the **Print Setup Report** window, select the report you want to print.
 - **Basic Setup**
 - **Resting Setup**
 - **Arrhythmia Setup**
 - **Stress Setup**
 - **RR Analysis Setup**
 - **Communication Setup**
 - **Country Setup**

- **Patient Setup**
- **User Setup**
- **Options Setup**
- **Order Manager Setup**
- **Complete Setup**

3. When you are done, press **Return** to return to the **Main Menu**.

Patient Setup

The **Patient Setup** function allows you to define the following information:

- Available and required patient information
- Available test information
- Available clinical trial information
This is available only if the **CTDG CT Data Guard** option is activated.
- Barcode reader settings
This is available only if the **BCRD USB Barcode Reader** option is activated

To access **Patient Setup**, on the **Main Menu** press **System Configuration > More > Patient Setup**.

The following tables identify the settings on **Patient Setup**.

Patient Information Setup Fields

Field	Description
Patient ID	Determines whether the patient ID is required. On reports, it is labelled ID .
Secondary ID	Determines whether a secondary patient ID is available when entering patient data and whether it is required. It can only be required if it is first enabled. On reports, it is labelled ID 2 .

Patient Information Setup Fields (cont'd.)

Field	Description
Last Name	Determines whether the patient's last name field is available when entering patient data and whether it is required. It can only be required if it is first enabled.
First Name	Determines whether the patient's first name field is available when entering patient data and whether it is required. It can only be required if it is first enabled.
Kanji Name	Determines whether the Kanji name field is available when entering patient data.
Date of Birth	Determines whether the date of birth field is available when entering patient data.
Age	Determines whether the age field is available when entering patient data.
Height	Determines whether the height field is available when entering patient data.
Weight	Determines whether the weight field is available when entering patient data.
Gender	Determines whether the gender field is available when entering patient data.
Race	Determines whether the race field is available when entering patient data.
Phone Number	Determines whether the phone number field is available when entering patient data.
Pacemaker	Determines whether the pacemaker field is available when entering patient data.
Enable Patient ID Check	Determines whether additional checks are performed to ensure that the patient ID meets the requirements of the national patient ID used in Scandinavian countries. If this field is set, you must select the appropriate Patient ID Type .
Patient ID Type	This field is available only if the Enable Patient ID Check field is set. This field determines which type of ID is used and, therefore, which checks to perform. Options are: <ul style="list-style-type: none"> Swedish Patient ID Danish Patient ID Norwegian Patient ID When a patient ID is entered, the system verifies its format, extracts the patient's gender and date of birth, and populates those fields if they are enabled.
Patient ID Length (3-30)	Defines the maximum length of the patient ID within the range of 3 to 30 characters. This field is available only if the Enable Patient ID Check field is cleared.

Patient Information Setup Fields (cont'd.)

Field	Description
Patient ID with leading zeros	Determines whether the system should prefix the Patient ID with zeroes to fill in the length of the Patient ID specified in the field Patient ID Length . For example, If the user selected the length of the Patient ID field as 10 and entered the PID PID098 , it is displayed by the system as 0000PID098 .
Sort Patient List by	Determines the field by which the patient list is sorted. Options are: <ul style="list-style-type: none"> • Patient ID • Secondary ID • Patient Name

Test Information Window

Fields	Comments
Systolic BP	Determines whether the systolic blood pressure field is available when entering test information.
Diastolic BP	Determines whether the diastolic blood pressure field is available when entering test information.
Location	Determines whether the location field is available when entering test information.
Room	Determines whether the room field is available when entering test information.
Order Number	Determines whether the order number field is available when entering test information.
Indication	Determines whether the indication field is available when entering test information.
Ordering Physician	Determines whether the ordering physician field is available when entering test information.

Test Information Window (cont'd.)

Fields	Comments
<i>Referring Physician</i>	Determines whether the referring physician field is available when entering test information.
<i>Attending Physician</i>	Determines whether the attending physician field is available when entering test information.
<i>Technician</i>	Determines whether the technician field is available when entering test information and whether it is required. It is required only if it is enabled.
<i>Medications (0-3)</i>	Determines the number of medications that you can enter into the test information window.
<i>Extra Questions...</i>	Opens the Extra Questions window, which allows you to define up to four custom fields. Each field consists of a Prompt and a Type . The Prompt can be up to 10 characters. The Type can be any of the following: <ul style="list-style-type: none"> • Alphanumeric • Numeric • Yes/No/Unknown

Patient Setup—Clinical Trial Setup Window

Field	Comments
<i>Visit Number</i>	Determines whether the visit number field is available when entering clinical trial information.
<i>Visit Type</i>	Determines whether the visit type field is available when entering clinical trial information.
<i>Dose Type</i>	Determines whether the Dose Type field is available when entering clinical trial information. If this field is set, use Dose List... to define the types of doses that are available when entering clinical trial information.
<i>Investigator ID</i>	Determines whether the investigator ID field is available when entering clinical trial information.

Patient Setup—Clinical Trial Setup Window (cont'd.)

Field	Comments
Extra Questions	<p>Opens the Extra Questions window, which allows you to define up to five custom clinical test fields.</p> <p>Each field consists of a Prompt and a Type. The Prompt can be up to 10 character. The Type can be any of the following:</p> <ul style="list-style-type: none"> • Alphanumeric • Numeric • Yes/No/Unknown
Dose List	<p>Opens the Dose List window, which allows you to define the dose types that will be available when entering clinical trial information.</p> <p>Doses are plain text up to 32 alphanumeric characters.</p> <p>The user can add up to 20 doses.</p>
Project Code and Trial ID	<p>Identifies the Project Code and Trial ID that are displayed when entering clinical trial information.</p> <p>Allows the user to define up to five sets of Project Code and Trial ID.</p>

Barcode Scanner Setup Page Up

Auto Configure

Total number of bytes

	Offset	Length
Patient ID	<input type="text" value="0"/>	<input type="text" value="0"/>
First Name	<input type="text" value="0"/>	<input type="text" value="0"/>
Last Name	<input type="text" value="0"/>	<input type="text" value="0"/>
Year of Birth	<input type="text" value="0"/>	<input type="text" value="0"/>
Month of Birth	<input type="text" value="0"/>	<input type="text" value="0"/>
Day of Birth	<input type="text" value="0"/>	<input type="text" value="0"/>
Gender	<input type="text" value="0"/>	<input type="text" value="0"/>

Barcode Scanner Setup

Field	Comments
Auto Configure	<p>Automatically configures the barcode reader. When you click this link, you are prompted to scan a configuration barcode created by the site's IT department.</p> <p>For more information on creating the barcodes, see "Creating Barcodes" on page 185.</p>
Total number of bytes	Identifies the total number of bytes on the barcode.

Barcode Scanner Setup (cont'd.)

Field	Comments
<i>Offset</i>	Identifies the position of the initial character of the corresponding field.
<i>Length</i>	Identifies the number of characters for the corresponding field.

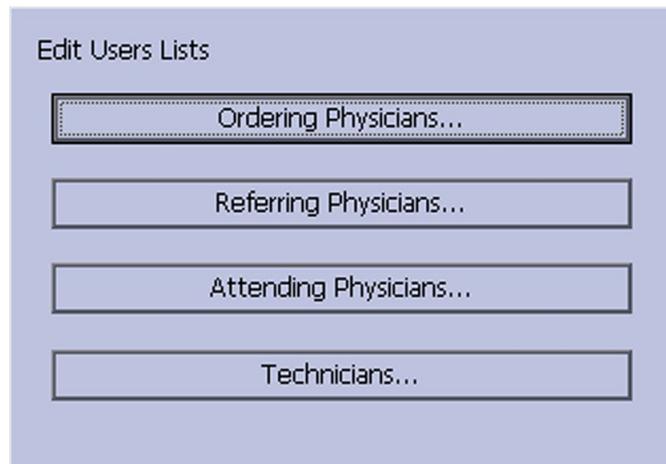
User Setup

The **User Setup** function allows you to define the following:

- User names
- User identification
- User roles
- User privileges

Users entered in setup can be selected for system defaults and patient information. If **High Security Mode** is enabled, anyone who uses the system must be set up as a user with a user ID, a password, and privileges to log on to the system. For more information on setting system defaults and enabling **High Security Mode**, see [“Basic Setup” on page 107](#).

To access **User Setup**, on the **Main Menu** press **System Configuration > More > User Setup**.



When you run **User Setup**, the **Edit User Lists** window opens to offer four choices:

- Ordering Physicians
- Referring Physicians
- Attending Physicians
- Technicians

When you select one of these roles, a list of existing users with that role opens. You can now add, edit, and delete users.

The following table identifies the settings on **User Setup**.

Field	Comment
Last Name	Identifies the user's surname. This field is required and allows a maximum of 40 alphanumeric characters.
First Name	Identifies the user's given name. This field is optional, but if used, allows a maximum of 20 alphanumeric characters.
User ID	Defines a unique ID for the user. If High Security Mode is enabled, the user needs to enter this ID to log on to the system. This field is required and allows a maximum of 30 alphanumeric characters. NOTE: The system does not prevent duplicate IDs. If the same ID is used more than once, only the first user created with the ID is able to log on to the system.
MUSE ID	Defines the ID with which the user logs on to the MUSE system. This field is used if reports from this system are transmitted to a MUSE system.
Ordering	Determines whether the user fills the role of ordering physician. If this is the role that was selected on the Edit User List window, this field is checked by default. You may select multiple roles, but you must select at least one role.
Referring	Determines whether the user fills the role of referring physician. If this is the role that was selected on the Edit User List window, this field is checked by default. You may select multiple roles, but you must select at least one role.
Attending	Determines whether the user fills the role of attending physician. If this is the role that was selected on the Edit User List window, this field is checked by default. You may select multiple roles, but you must select at least one role.
Technician	Determines whether the user fills the role of technician. If this is the role that was selected on the Edit User List window, this field is checked by default. You may select multiple roles, but you must select at least one role.
Password	Defines the password the user must enter along with the User ID to log on to the system if High Security Mode is enabled. This field must be between 6 and 30 alphanumeric characters.
Retype Password	Confirms the password was entered correctly.
Edit Setup	Enables/disables the user's ability to edit system setup information.
Edit Date and Time	Enables/disables the user's ability to edit system date and time.
Edit Users	Enables/disables the user's ability to edit user information.
Edit Record	Enables/disables the user's ability to edit ECG records.

Field	Comment
Delete Record	Enables/disables the user's ability to delete ECG records.
Transmit Records	Enables/disables the user's ability to transmit ECG records.

NOTE:

In the fields **Edit Users** and **Edit Setup**, privileges are required by the activated user to activate **High Security** mode.

In the fields **Edit Setup** and **Delete Record**, privileges are required by the activated user to export the system audit trail log.

Select Setup

The **Select Setup** utility allows you to save up to five system configurations and switch between them. This is useful if the system is shared by departments or used in multiple clinical trials.

Use the following instructions to save and load configuration files:

1. On the **Main Menu** press **System Configuration > More > More > Select Setup**.
The **Select Setup** window opens. The name of the setup the system is using currently is displayed in the **Loaded Setup** field.
2. To save a copy of the current setup, do the following:
 - a. Press **Save As**.
The **Setup Name** window opens.
 - b. Type a name for the configuration and press **Save**.
The configuration is saved, and the **Setup Name** window closes.
3. To load a different setup, do the following:
 - a. Select the setup you want to load.
 - b. Press **Load Setup**.
 - c. Restart the system.
You must power the device off and then on for all setup changes to take effect, especially if the new setup includes a change to the language setting; the language does not change until the system restarts.
4. To delete a setup file, do the following:
 - a. Select the file you want to delete.
 - b. Press **Delete**.
You are prompted to confirm the deletion.
 - c. Press **OK**.

NOTE:

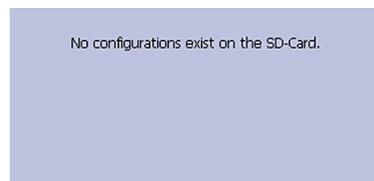
You cannot delete a configuration that is currently loaded.

5. To change the name of a system setup file, do the following:
 - a. Select the setup file you want to change.
 - b. Press **Edit Name**.
The **Setup Name** window opens.
 - c. Type the new name and press **Save**.
6. To remove all custom settings, do the following:
 - a. Select the setup file you want to reset.
 - b. Press **Factory Defaults**.
 - c. When prompted to confirm, press **Save**.
7. When you are done, press **Return** to exit.

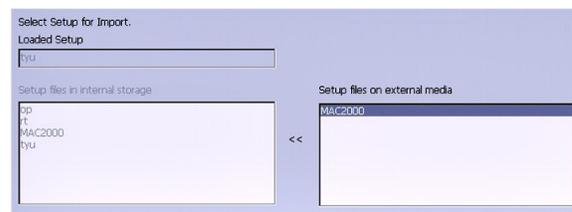
Import Setup

The **Import Setup** utility allows you to import up to five system setup files from another device that were exported to an SD card. This feature is useful to sites with multiple systems that need to have the same or similar setups.

1. Insert the SD card with the saved setup file.
If you do not have a valid SD card, you receive the following message:



2. On the **Main Menu** press **System Configuration > More > More > Import Setup**.
The **Select Setup for Import** window opens.

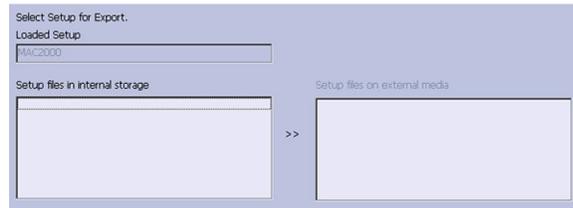


All saved settings on the device are listed in the left column. All saved settings on the SD card are listed in the right column.

3. In the right pane, select the setup file you want to import.
4. Press **Import**.
The selected file is copied to the device and is displayed in the left column.
5. Repeat step 3 through step 4 for each saved configuration file you want to import.
6. When you are done, press **Return**.

Export Setup

The **Export Setup** utility allows you to export saved settings from the device to an SD card. You can then use the SD card to import the settings to another device, greatly simplifying the installation and configuration of multiple devices.



1. Insert an SD card into the SD card slot in the back panel, as shown in the following illustration:

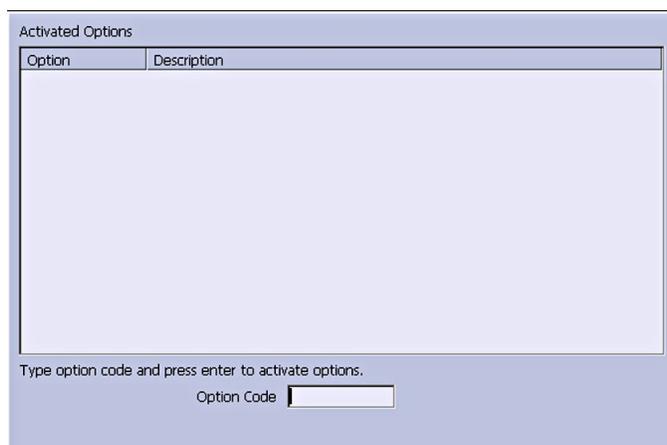


2. Push the SD card into the slot to seat it in place.
3. On the **Main Menu** press **System Configuration > More > More > Export Setup**.
The **Select Setup for Export** window opens. All saved settings on the device are listed in the left column. All saved settings on the SD card are listed in the right column.
4. In the left pane, select the setup file you want to export.
5. Press **Export**.
The selected file is copied to the SD card and is displayed in the right column.
6. Repeat step 4 through step 5 for each saved configuration file you want to export.
7. When you are done, press **Return**.

Options Setup

The **Options Setup** function allows you to activate options by entering **Option Codes**, which are generated for a specific serial number and can only activate options on the device with that serial number.

All purchased options are activated when the system ships. If you purchase a new option or re-activate an option, use the following instructions:



1. On the **Main Menu** press **System Configuration > More > More > Options Setup**.
2. In the **Option Code** field, type the 12-digit activation code.
You can find activation codes for purchased options on the **Active Code Summary Sheet** provided with the system or with additional purchased options.
3. Press **Enter**.
The **Option Activated** message is displayed at the bottom of the window.
4. Repeat step 2 through step 3 for any additional options you want to activate.
5. Press **Save** to save the configuration options.

Option Codes

Option Code	Name
CTDG	CT Data Guard
R12L	12-Lead display for Resting ECG. This is always active.
ME12	12SL Measurement
MEHR	HEART Resting Measurement
MI12	12SL Measurement and Interpretation
MIHR	HEART Resting Measurement and Interpretation
M100	Storage for 100 ECGs
M200	Storage for 200 ECGs.
LANC	LAN Communication to the CardioSoft system
LANM	LAN Communication to the MUSE system
MODC	Modem or serial communication to the CardioSoft system
MODM	Modem or serial communication to the MUSE system
ERGO	Stress test with treadmill, bicycle, or Master's Step test. This is a 6-lead waveform display.
E12L	12-Lead display for Stress Test

Option Codes (cont'd.)

Option Code	Name
CFRA	21 CFR Part 11 Audit Trail
BCRD	USB Barcode Reader
TIPI	ACI-TIPI (Acute Cardiac Ischemia – Time Insensitive Predictive Instrument) This option is disabled if MEHR or MIHR is enabled.
RRAN	RR analysis
PDFC	PDF file copy
WIFC	WiFi to the CardioSoft system
WIFM	WiFi to the MUSE system
SOML	Simple Orders from non-MUSE systems
SOMF	Simple Orders from MUSE and non-MUSE systems
AOMF	Order Manager for MUSE and non-MUSE systems
AOML	Order Manager for non-MUSE systems
ADTF	ADT (Patient Demographics) downloaded from MUSE and non-MUSE systems
ADTL	ADT (Patient Demographics) downloaded from non-MUSE systems

Service Setup

The **Service Setup** option allows service personnel to configure the following:

- **Device Settings**
- **Event Log**
- **System Diagnostics**
- **Software Update**
- **Format Flash**
- **Open Command Prompt**

Service personnel need to enter the service password to gain access to the system.

Refer to the service manual for your system for more details.

Date/Time Setup

The **Date/Time Setup** function allows you to configure the system's date and time settings.

To access **Date/Time Setup**, on the **Main Menu** press **System Configuration > More > More > More > Date/Time Setup**.

The following table identifies the settings on **Date/Time Setup**.

Date and Time Setup Fields

Field	Description
Date	Sets the current system date. The format of the fields depends on the date format selected on Country Setup . For more information, see “Country Setup” on page 141 .
Time	Sets the current system time. If the Automatically Synchronize with Time Server field is set on Basic Setup , any changes made to the time are overwritten during the next synchronization. For more information, see “Basic Setup” on page 107 . NOTE: Daylight Saving Time changes take effect only after a restart.

Order Manager Setup

Order Manager Setup Fields

Field	Comment
Initial sort value	Determines how the Order Manager initially sorts the ECGs. Select one of the following values: <ul style="list-style-type: none"> • Patient Name • Patient ID • Location
Auto Order Deletion	If enabled, the system deletes orders associated with ECG files that were deleted automatically. Automatic deletion of ECG files can happen in the following conditions: <ul style="list-style-type: none"> • Delete after Transmission field on the Resting ECG Setup window is enabled and the associated ECG file was successfully transmitted to a receiving system. • After the successful transmission of an ECG file associated with an order, provided the ECG was never saved on the system.
Default Order Location(s), for example 1,13,65:	Identifies the locations displayed on the prompt when downloading orders. This will typically be the device's location (see "Basic Setup" on page 107). If the device is used in multiple locations, enter multiple locations and separate them with commas: 1,3,10, and so on.

RR Analysis Setup

The RR Analysis Setup function allows you to configure the RR Analysis report. For details, see ["RR Analysis Setup" on page 83](#).

PDF File Naming Convention

The device provides two types of naming conventions:

- Default Naming
- Customize Naming

Default Naming Convention

To help identify the exported PDF files, they are automatically named with the following descriptive components:

`product_version_serial_ECGmode_cartID_creationdata.pdf`

For example:

`GEMAC2000_1.0_SDS07410016WP_resting_1_2007-11-22T17-56-32.pdf`

The following table identifies each component in the example:

Components of the File Naming Convention

Value	Component Description
GEMAC2000	Product name: this is always GEMAC2000.
1.0	Software version: this varies based on the software version installed.
SDS07410016WP	The device serial number: this varies from device to device.
resting	ECG mode: this is either resting (Resting ECG mode) or rrana (RR Analysis mode).
1	Cart ID: this varies from device to device. The Cart ID is the same as the Cart # field in Basic Setup . For more information see "Basic Setup" on page 107 .
2007-11-22T17-56-32	Creation data: this consists of the following subcomponents: <ul style="list-style-type: none"> • 2007 - Year the PDF was written. • 11 - Month the PDF was written. • 22 - Date the PDF was written. • T - Indicates the following numbers are time. • 17 - Hour, in 24 hour format, the PDF was written. • 56 - Minute the PDF was written. • 32 - Second the PDF was written.

Customizing the Naming Convention

Users can name the PDF files according to their own requirements by using given elements:

1. On the **Main Menu**, press **System Configuration**.
The **System Configuration** window opens.
2. Press **Basic Setup**.
The **Basic Setup** window opens.
3. Press **Page Down** to the **PDF Naming Settings** option.
4. Select the **Generate Automatic File Name** check box.
The following elements are available:
 - **Patient ID**
 - **Last Name**
 - **First Name**
 - **Date of Birth**

- **Procedure**
Procedure means **ECG Mode**. This is either **resting** (Resting ECG mode) or **rrana** (RR Analysis mode).
- **Date of Test**
- **Export Date**
- **Secondary ID**

5. Press **Save** and return to the **System Configuration** window.

Retrieving Your Password

If the system is set up for **High Security Mode** and you forget your password, use the following procedure to access the system:

1. Contact GE Healthcare Technical Support and provide the serial number of the device you want to access.

GE Healthcare Technical Support generates a temporary, device-specific name and password that you can use for 24 hours.
2. Log in to the system with the user ID **MACService** and the password provided by GE Healthcare Technical Support.

NOTE:

If the keypad on the device does not include the letters for the **MACService** user ID, type **6227378423** for the user ID.

3. Immediately after logging into the system, verify the name and password for your device.
4. Record this information and store it in a secure location for future reference.

Exporting the Audit Trail

The **Audit Trail Export** function copies the system audit trail in XML format to an SD card and then clears the audit trail on the system. If a previous audit trail exists on the SD card, it is overwritten automatically by the new audit trail.

GE Healthcare recommends exporting the audit trail weekly to long term storage to meet archive requirements. If the audit trail is not exported regularly, it consumes storage space and reduces the number of ECGs that you can store on the device.

To export an audit trail, the following conditions must be met:

- **High Security Mode** must be enabled.
To enable **High Security Mode**, see [“Basic Setup” on page 107](#).
- **Audit Trail** must be enabled.
To enable **Audit Trail**, see [“Basic Setup” on page 107](#).
- You must have **Edit Setup** and **Delete Records** permissions set.
To set permissions for Edit Setup and Delete Records, see [“User Setup” on page 149](#).

Use the following procedure to export the audit trail to an SD card:

1. Insert an SD card into the device.
2. On the **Main Menu**, press **System Configuration > More > More > More > Export Audit**.

After the audit trail is copied to the SD card and cleared from the system a message notifies you that the export was successful.

After the XML file is exported, you can review or print the audit trail as needed. For more information on how to parse the XML file for viewing or printing, refer to the *GE Cardiology Open XML Reference Manual*. To locate the part number for this manual, refer to "Related Documents" in the service manual.

13

Maintenance

Regular maintenance, irrespective of usage, is essential to ensure that the equipment functions when required. This chapter provides basic maintenance information for the following components:

- Device
- Cables and leadwires
- Paper
- Battery

See the documentation provided with your peripherals for additional maintenance procedures.

This device does not require any calibration.

Equipment Cleaning and Storage

The device is designed to require little more than regular inspection and cleaning to function properly. Qualified GE Healthcare service personnel should perform any additional maintenance.

CAUTION:

ELECTRICAL HAZARD — Improper handling during inspection or cleaning could result in electrical shock.

To avoid potential shock, observe the following guidelines at all times:

- Before inspecting or cleaning the device, turn it off, unplug it from AC power, and remove the battery.
- Do NOT immerse any part of the equipment in water.

Inspecting the Equipment

Perform a visual inspection daily, preferably before the equipment's first use each day. During the inspection, verify that the device meets the following minimum conditions:

- The case and display screen are free of cracks and other damage.
- All plugs, cords, cables, and connectors are free of kinks, frays, and other damage.
- All cords and connectors are securely seated.
- All keys and controls operate properly.

If you notice any items that need repair, contact an authorized service representative to make the repairs. Discontinue using the device until the appropriate repairs can be made.

Cleaning the Device

Clean the exterior surface of the device monthly, or more frequently if needed.

Cleaning Materials to Use

Use the following materials to clean the device:

- Mild dishwashing detergent
- Clean, soft cloth
- Water

Cleaning Materials to Avoid

DO NOT use any of the following materials to clean the device, because their use may damage equipment surfaces.

- Organic solvents
- Ammonia-based solvents
- Abrasive cleaning agents
- Alcohol
- Virex
- Sani-Master

Cleaning the Device Surfaces

Use the following procedure to clean the surfaces of the device.

1. Dilute mild dishwashing detergent in water to create a cleaning solution.
2. Soak a clean cloth in the solution and wring out any excess.
3. Thoroughly wipe the surface of the device with the damp cloth.
Do NOT drip the solution or any liquid on the writer assembly.
Avoid contact with open vents, plugs, or connectors.
4. Repeat step 2 and step 3 as necessary until the surface is adequately cleaned.
5. Wipe the surfaces with a dry, clean cloth or paper towel.

Cleaning, Disinfecting, and Storing ECG Cables and Leadwires

In addition to keeping the system clean and in good repair, it is important to keep the cables and leadwires clean and disinfected. This section provides instructions for cleaning, disinfecting, and storing ECG cables and leadwires to extend their life and

protect patients. Cables and leadwires come into contact with patients and should be cleaned and disinfected after every use.

NOTE:

For devices with the KISS system, refer to the KISS operator's manual for cleaning and disinfecting information.

Cleaning Guidelines

Observe the following guidelines when cleaning and disinfecting the cables, leadwires, and electrodes for your system.

- Follow the cleaning instructions exactly.
- Wring excess disinfectant from the wipe before using it.
- Never immerse the device, cables, or leadwires in any liquid, as this may corrode metal contacts and affect signal quality.
- Do not allow liquids to collect around the connection pins. If this happens, blot them dry with a soft, lint-free cloth.
- Never use conductive solutions or solutions that contain chlorides, wax, or wax compounds to clean the device, cables, or leadwires.
- Never use solutions or products that contain any type of Ammonium Chloride such as, but not limited to:
 - Dimethyl Benzyl Ammonium Chloride
 - Quaternary Ammonium Chloride solutions
 - Abrasive cleaners or solvents of any kind
 - Acetone
 - Ketone
 - Betadine
 - Alcohol-based cleaning agents
 - Sodium salts
- Never autoclave or steam clean the device, cables, or leadwires.
- Do not use any of the accessories until thoroughly dry.
- Do NOT immerse either end of a cable or leadwire connector in any solution. Immersing or soaking the connector ends may corrode metal contact ends and affect signal quality.
- Do NOT let liquids collect around the connection pins. If this happens, blot them dry with a soft, lint-free cloth.

Cleaning and Disinfecting Cables and Leadwires

Proper cleaning and disinfecting prolongs the life of the cables and leadwires. Failure to use the proper cleaning solutions or to follow the proper procedures can result in the following:

- Damage or corrosion
- Diminished signal quality
- Product discoloration
- Metal part corrosion

- Brittle wires and connectors
- Reduced cables and leadwires life
- Device malfunction
- Voided warranty

Cleaning the Cables and Leadwires

Use the following procedure to clean the cables and leadwires:

NOTE:

- While performing the following procedure, use care in cleaning the leadwires to prevent pulling the wires from the connector ends, because the metal connections can be pulled away from the connectors.
 - Cleaning removes dirt and marks but does not disinfect the cables and leadwires.
1. Remove the cables and leadwires from the device before cleaning.
 2. Wipe them with a cloth lightly moistened with a mild solution of soap and water.
Do not use any of the following cleaning products, or products that contain the same active ingredients and solutions, which are known to cause the problems previously listed:
 - Sani-Cloth® Wipes
 - Ascepti® Wipes
 - HB Quat®
 - Clorox® Wipes (they do not contain bleach)
 - Over-the-counter detergents (such as Fantastic®, Tilex®, and so on)
 3. Wipe the cables and leadwires with a dry, clean cloth or paper towel and let them air dry.

Disinfecting the Cables and Leadwires

Use the following procedure to disinfect the cables and leadwires:

1. Clean and dry the cables and leadwires before disinfecting them.
See “Cleaning the Cables and Leadwires” on page 164 for instructions.
2. Wipe the cables and leadwires with a soft, lint-free cloth that is moistened with an appropriate disinfectant.

Use the following solutions, as recommended in *APIC Guidelines for Selection and Use of Disinfectants (1996)*:

- Sodium hypochlorite (5.2% household bleach) minimum 1:500 dilution (minimum 100 ppm free chlorine) and maximum 1:10 dilution.
 - Any sodium hypochlorite wipe product that meets the previous guidelines.
3. Dry the cables and leadwires with a clean cloth or paper towel and let them air dry for at least 30 minutes.

NOTE:

- Drying times vary based on the environmental conditions.
- DO NOT use excessive drying techniques, such as ovens, forced heat, or sun drying.

Storing Cables and Leadwires

To ensure that the cables and leadwires are in proper working order, use the following guidelines to store them when not in use:

- Store cables and leadwires in a dry, well-ventilated area.
- Hang cables and leadwires vertically
- Do NOT coil cables or leadwires around the device.

Cleaning, Disinfecting, and Sterilizing Reusable Electrodes

Clean reusable electrodes immediately after using them on a patient.

Cleaning and Disinfecting Reusable Electrodes

Use the following procedure to clean and disinfect the reusable electrodes:

1. Use warm water and a small brush to remove any cream or gel from the electrode.
Do not use pointed or sharp objects for cleaning.
2. Disinfect the electrodes with alcohol-free disinfectant.
Ensure that the connectors and sockets do not get wet.

Sterilizing Reusable Electrodes

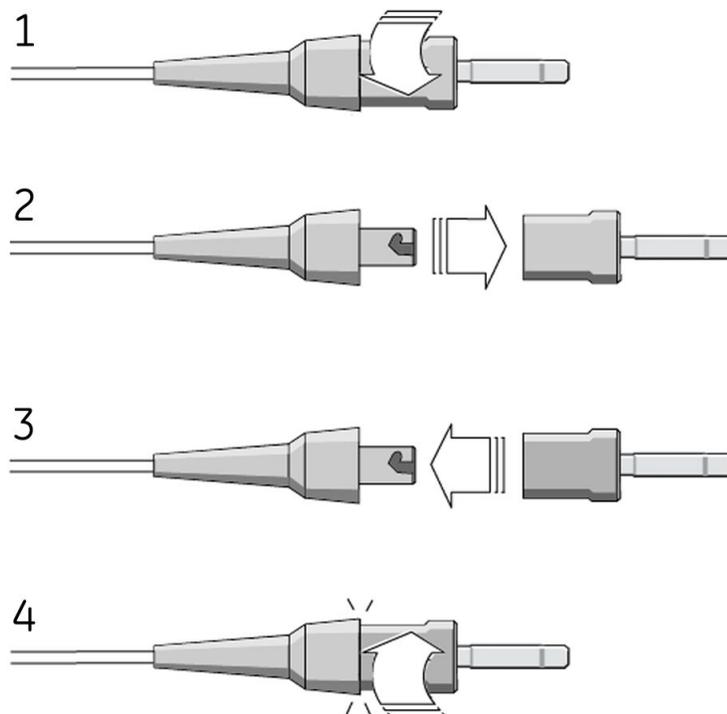
Use the following procedure to sterilize reusable electrodes:

The only approved sterilization method is gas sterilization.

1. Sterilize reusable electrodes with ethylene oxide gas (EtO) at a maximum temperature of 50°C (122°F).
2. After sterilization is complete, follow the manufacturer's recommendations for required aeration.

Replacing Leadwire Adapters

Although proper cleaning and storage prolong the life of leadwires, you eventually need to replace the leadwire adapters. The following illustration shows the proper method for replacing adapters.



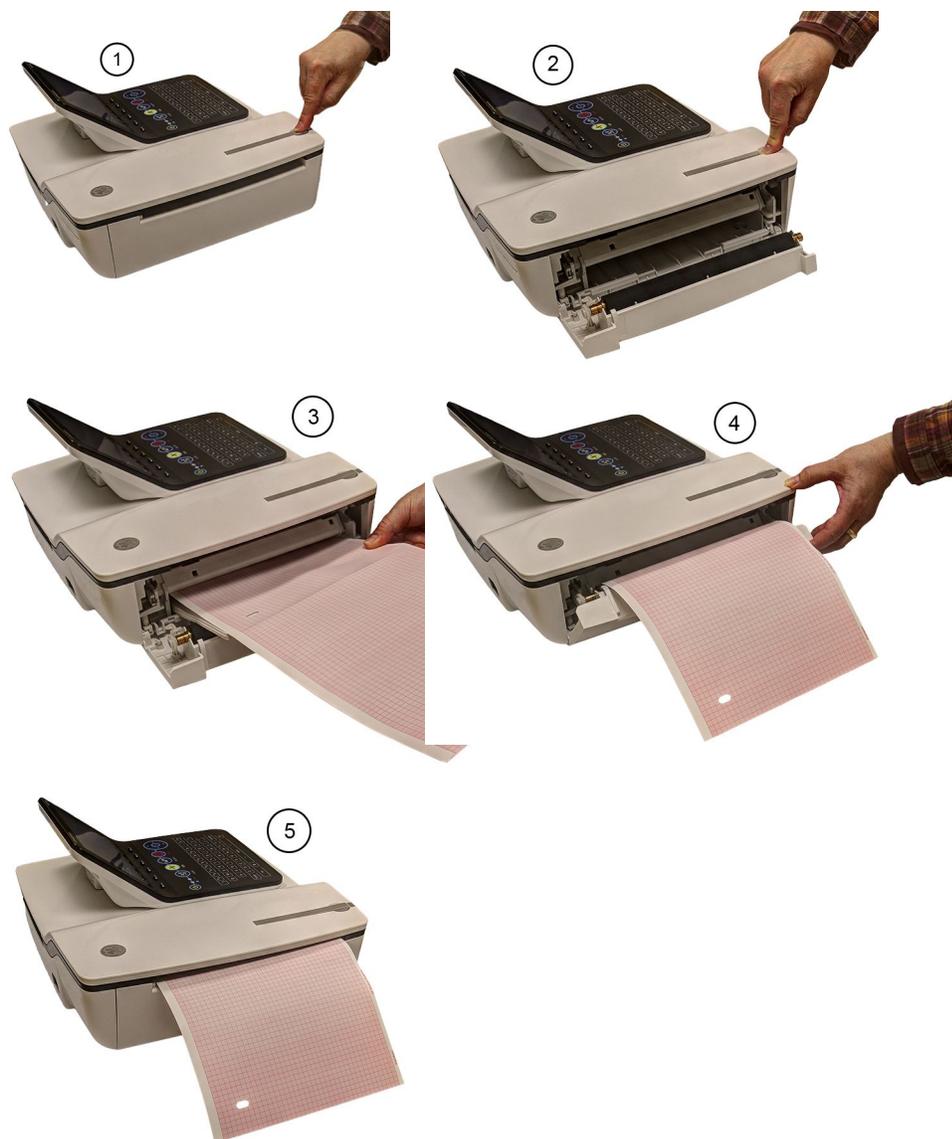
Paper Maintenance

For the proper handling of the device's thermal writer, you need to know how to do the following:

- Replace the paper
- Adjusting the tray for paper size
- Remove the paper pack
- Store the thermal paper

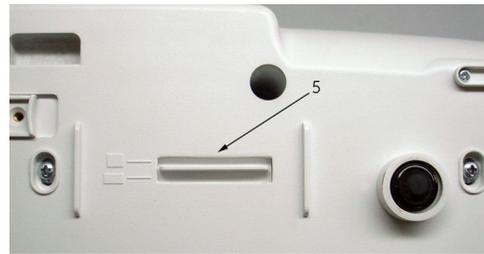
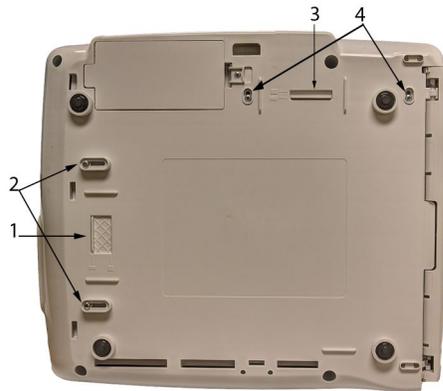
Replacing Paper

Use the following procedure to add or replace paper:



1. Press the push button on the top of the device (1) to open the printer door (2).
2. Extend the top sheet of the pack of paper and insert the pack into the paper compartment (3).
Align the top sheet of the paper to the line located on the near side of the printer door.
3. Close the printer door (4) until it clicks into place (5).

Adjusting the Tray for Paper Size



Adjusting the Tray for 8.5 x 11 inches or A4

Use the following procedure to adjust the tray for the correct paper size if you are using letter (8.5 x 11 inches) or A4 paper.

1. Turn the device over so the bottom of the device is facing you.
2. Loosen the length and width fasteners (2 and 4) situated close to the paper spacers.
3. Slide the spacers (1 and 3) to the appropriate position for the paper size that you are using.
4. Tighten the screws (2 and 4) in the selected position.
5. Turn the device to the upright position and press the push button to open the printer door (6).
6. If you are using letter size (8.5 x 11 inches), remove the paper spacer post print (7).

NOTE:

If you are using A4 paper, the paper spacer post print should be snapped on. By default, the tray is set to A4 paper and therefore the paper spacer post print is in place.

Adjusting the Tray for Modified Letter Paper (8.433 x 11 inches)

Use the following procedure to adjust the tray for modified letter paper (8.433 x 11 inches).

1. Press the push button to open the printer door (6) and insert the modified letter paper.
2. Turn the device over so the bottom of the device is facing you.
3. Loosen the screws for the paper tray spacer (4).
4. Slide the spacer (3) until it presses the paper that is already loaded.
Ensure that the paper spacer (5) is positioned in between the letter and A4 symbol.
5. Tighten the screws (4) with the spacer (5) at this position.
6. Loosen the other set of screws for the paper spacer (2).
7. Move the spacer (1) to the letter symbol.
8. Tighten the screws (2) with the spacer (1) at this position.

Removing the Paper Pack

Use the following procedure and pictures to remove the pack of paper from the device.



Use the following procedure to remove the paper pack from the printer:

1. Press the push button on the top of the device to open the printer door (1).
2. Lift up the pack of paper (2).
3. Press the pack of paper against the top plate of the paper compartment (3).
4. Pull the pack of paper out of the device (4).

Storing Thermal Paper

When imaged and stored properly, ECG tracings resist fading for several years. If your retention requirements exceed five years, consider using GE Healthcare Archivist paper.

To ensure the tracing is imaged properly, the device must be maintained in accordance with its service manuals and technical memoranda.

To ensure the tracing lasts for the paper's expected lifespan, observe the following guidelines when storing your printouts:

- Store in a cool, dark, and dry location.
 - Standard paper
Temperature must be less than 27°C (80°F).
Relative humidity must be less than 65%.
 - Archivist paper
Temperature must be less than 40°C (104°F).
Relative humidity must be between 40% and 60%.
- Avoid exposure to bright light or UV sources.
Sources of ultraviolet light include sunlight, fluorescent lights, halogen lights, mercury vapor lamps, and germicidal lamps.
- Avoid contact with cleaning liquids and solvents.
Solvents to avoid include alcohols, ketones, esters, ether, and so forth.
- Store thermal paper separately in manila folders or polyester or polyimide protectors.
Plastic document protectors, envelopes, or sheet separators made of polystyrene, polypropylene, or polyethylene do not degrade thermal traces. However, these materials afford no protection against fading from external causes.
- Do NOT store thermal papers with any of the following:
 - carbon or carbonless forms
 - document protectors, envelopes, and sheet separators containing polyvinyl chloride or other vinyl chlorides.
 - non-thermal chart papers or any other products containing tributyl phosphate, dibutyl phthalate, or any other organic solvents

NOTE:

Many medical and industrial charts contain these chemicals.

- Do NOT use mounting forms, pressure-sensitive tapes, and labels that use solvent-based adhesives.
Use only mounting forms and pressure-sensitive tapes made with starch or water-based adhesives.

Battery Maintenance

The device uses a rechargeable battery containing lithium-ion cells. The battery contains an integrated electronic fuel gauge and a safety protection circuit.

Because of the bias current needed to operate the integrated electronics, the battery discharges even when it is not installed in the device. The rate at which it discharges is dependent on the ambient temperature at which it is stored. The higher the

temperature, the more quickly it discharges. To prolong the battery's charge when not in use, store the battery in a cool, dry location.

A new, fully-charged battery should last for approximately 3 hours of normal operation. An on-screen LED indicates the condition and capacity of the battery's charge. (For more information on the battery gauge, refer to ["Front View" on page 30](#) and ["System Errors" on page 181](#)). When the LED flashes amber, connect the device to AC power to charge the battery to full capacity.

As the battery ages, the full charge capacity of the battery degrades and is permanently lost. As a result, the amount of charge that is stored and available for use is reduced. When the capacity is no longer sufficient for your daily operation, you need to replace the battery.

Replacing the Battery

WARNING:

ENVIRONMENTAL HAZARD — Do NOT dispose of the battery by fire or burning.

Follow local environmental guidelines concerning disposal and recycling.

Use the following procedure to replace the battery:

1. Unplug the device from the AC adapter.
2. Gently turn the device over and remove the screw holding the battery cover.



3. Push the tab to remove the cover of the battery compartment.



4. Gently lift the cover of the battery compartment.



5. Remove the battery from the compartment.



6. Place the new battery in the compartment and push until it clicks into place.



7. Replace the cover on the battery compartment.
It should click into place.
8. Tighten the screw to hold the cover in place.

Conditioning the Battery Pack

To maintain the storage capacity of the battery installed in the device, GE Healthcare recommends that you condition the battery once every 6 months to recalibrate its electronic fuel gauge. A condition cycle consists of an uninterrupted “charge-discharge-charge” cycle.

Use the following instructions to condition the battery:

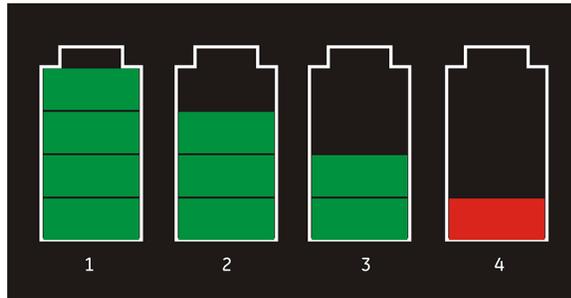
1. Insert the battery into a device that is not recording patient tests.
For details, refer to [“Replacing the Battery” on page 171](#).
2. Disconnect the AC mains power from the device.
3. Enter the **Battery Status Service Diagnostic** window.
For details on accessing the **Battery Status Service Diagnostic** window, refer to this device’s service manual.
4. Allow the battery to discharge until its **Charge Level** is less than 90%.
5. Turn off the device and reconnect the AC mains power.
6. Allow the battery to fully charge.
The **Battery LED** is steady amber while it is charging and turns off when charging is complete.
7. Remove the AC mains power and turn on the device.
8. Allow the battery to discharge until the device shuts down.
9. Reconnect the AC mains power to the device and leave the device turned off.
10. Allow the battery to fully charge.

When the **Battery LED** indicator stops flashing and shines steadily, the battery is fully charged and the conditioning cycle is complete.

Battery Status Indicator

The battery status indicator is located on the top of the screen. For the exact location, see the screen in [“Recording a Resting ECG” on page 65](#).

The following diagram and table describe the battery status.



Battery Status

Item	Description
1	The battery is fully charged and above 75%.
2	The battery charge is above 50%.
3	The battery charge is above 25%.
4	The battery charge is below 25%. This status is also used when the battery charge is unknown.

Supplies and Accessories

For a list of available supplies and accessories, refer to the supplies and accessories reference guide for this device.

Troubleshooting

This section identifies some of the more common problems with the system and lists their potential causes and solutions. If the information in this section cannot resolve your issue, contact GE Healthcare Technical Support.

General Troubleshooting Tips

Use the following general troubleshooting tips to help diagnose problems not specifically discussed elsewhere in this chapter.

- Thoroughly inspect the equipment.
Disconnected or loose cables, missing hardware, and damaged equipment can cause what may seem to be unrelated symptoms or equipment failure.
For additional information, refer to [“Inspecting the Equipment” on page 161](#).
- Verify the equipment was not modified.
Unauthorized modifications to the equipment may cause unexpected results, poor performance, or system failure.
If the equipment has unauthorized modifications, contact GE Healthcare Technical Support.
- Verify the software was not updated.
Updated software may change system functionality. If the user is unaware of the changes, they may seem to be unexpected results.
If the software has been updated, refer to the revised Operator’s Manual to determine whether the update changed features.
- Verify whether there were changes in the equipment’s location or environment that could cause the failure.
For example, equipment that emits radio waves could cause interference during acquisition.
If the environment or location has changed, try using the equipment in the original location to determine whether the problem persists.
- Verify the problem was not caused by operator error.
Repeat the scenario and compare that to the operation as described in the manual.
If the operator deviated from the manual, repeat the task using the instructions as written.

If these steps do not resolve the problem, refer to the following sections for specific problems and solutions. If the problem still cannot be resolved, contact GE Healthcare Technical Support.

Frequently Asked Questions (FAQ)

This section addresses frequently asked questions concerning maintenance, system setup, and clinical topics.

Question	Procedure
How do I save changes I have made to the System Configuration?	Refer to “Export Setup” on page 153.
How do I restore system setups from the SD card?	Refer to “Import Setup” on page 152
How do I obtain a printed record of the System configuration file?	Refer to “Print Setup Report” on page 143.
I need to reactivate the options on my system. Where can I find the Option Codes?	The codes are listed on the last page of your printed setup report. Refer to “Print Setup Report” on page 143. They are also found on a label next to the battery compartment.
Why won't any of the ECGs I perform save to the SD card?	Refer to “Exporting Records” on page 104.
Should I clean the device?	Refer to “Maintenance” . “Equipment Cleaning and Storage” on page 161.
What is the capacity of the battery?	Refer to the Battery information in “Product Overview” . “Hardware Specifications” on page 35.
I need to provide the address of the device to the network administrator to enable the LAN communication option. How do I obtain the address?	After the LANM/LANC option is enabled and the network cable connected, you can obtain the IP address from “Communication Setup” on page 131 .

Equipment Problems

The following issues are discussed in this section:

- [“System Does Not Power Up”](#) on page 176
- [“ECG Data Contains Noise”](#) on page 177
- [“External Stress Equipment does not Move”](#) on page 177
- [“Paper Jams”](#) on page 178

System Does Not Power Up

If the system does not power up, do the following:

- Verify the device is turned on.
If it is not, turn the device on. Refer to [“Turning on the System”](#) on page 47 for instructions.
- Verify the battery is installed and charged.
Refer to [“System Errors”](#) on page 181 for instructions on verifying whether the battery is installed and charged.

Refer to [“Replacing the Battery” on page 171](#) for instructions on installing the battery.

- Verify the device is connected to an AC power outlet.
Refer to [“Connecting the AC Power” on page 43](#) for instructions.
- Verify the equipment is receiving power from the outlet.
If the device is receiving power, the **Power LED** is lit.

ECG Data Contains Noise

If the acquired ECG data displays unacceptable noise levels, do the following:

- Check the patient’s position.
The patient should remain motionless during the acquisition of a resting ECG.
- Use the **Hookup Advisor** indicator to help determine the cause of the noise.
For more information, refer to [“Hookup Advisor” on page 66](#).
- Verify the electrodes are placed properly.
Refer to [“Electrode Placement” on page 50](#) for information on proper electrode placement.
- Verify the electrodes are applied correctly.
You must remove perspiration, excessive hair, lotions, and dead skin cells from the electrode site.
Refer to [“Preparing the Patient’s Skin” on page 49](#) for more information.
- Check for defective or expired electrodes.
Replace the electrodes if there are any questions about their effectiveness.
- Check for defective, broken, or disconnected leadwires.
Replace the leadwires if there are any questions about their effectiveness. Refer to [“Connecting the Patient Cable” on page 44](#).
- Consider using filters, **ADS**, and **FRF** to help eliminate or reduce ECG noise.
For more information, refer to [“ECG Options” on page 69](#), [“Arrhythmia Printing Options” on page 80](#), or [“Stress Options” on page 92](#).

External Stress Equipment does not Move

If the external stress equipment does not move automatically when expected, do the following:

- Verify the correct stress equipment is selected in **Basic Setup**.
For more information, refer to [“Basic Setup” on page 107](#).
- Verify the selected stress equipment is supported.
For a list of supported stress equipment, refer to [“Connecting External Devices \(Stress Option\)” on page 47](#).
- Verify the stress equipment is connected to the cart.
External stress equipment is connected to the cart through a serial cable. For more information, refer to [“Rear View” on page 30](#).
- Verify the protocol is set up to activate the stress equipment.
The protocol can set the stress equipment’s speed and grade or load. For more information, refer to [“Editing Stress Protocols” on page 128](#).
- Verify the **Stop TM** button is not depressed.
For more information, refer to [“Stress Test Keys” on page 92](#).

Paper Jams

If the paper jams while printing, do the following:

- Verify the paper was inserted correctly.
For details, refer to [“Replacing Paper” on page 167](#).
- Verify the paper tray spacers are set appropriately for the paper size.
For details, refer to [“Adjusting the Tray for Paper Size” on page 168](#).

Import/Export/Save Errors

The following issues are discussed in this section:

- [“SD Card Not Present” on page 178](#)
- [“Cannot Import or Transmit Records via Modem” on page 178](#)
- [“Cannot Export to Shared Directories” on page 180](#)

SD Card Not Present

If you receive an error message stating that the SD card is not present or cannot be found, do the following:

- Verify an SD card is inserted into the card slot on the device.
For details, refer to [“Rear View” on page 30](#).
- Verify the SD card is seated firmly.
The SD card clicks into place when seated firmly.
- Verify the SD card is formatted for a **FAT** or **FAT16** file system.

To verify an SD card is formatted for the correct file system, do the following:

1. Insert the card into an SD card reader attached to a PC.
2. Copy any files you want to save from the SD card to a folder on the PC.
3. Using the Windows **Format** command, specify either **FAT** or **FAT16** for the file system and format the card.

NOTE:

Formatting the SD card erases any existing files on the card.

4. Copy the files from the folder on the PC to the newly formatted SD card.

Cannot Import or Transmit Records via Modem

If you receive an error while attempting to import or transmit ECG records via modem, do the following:

- Verify the correct communication option was activated.
The system supports two options for communicating via modem: **MODC** (for communicating with a CardioSoft system) and **MODM** (for communicating with a MUSE system). For more information, refer to [“Options Setup” on page 153](#).
- Verify the modem is connected to an analog telephone line using a standard RJ11 phone jack.
For more information, refer to [“Rear View” on page 30](#).

- Check **Communications Setup** to verify the correct dialing method is selected and configured accurately.
For details, refer to [“Communication Setup” on page 131](#).
- If transmitting records, check the selected location to verify the following:
 - **Modem** is the selected device.
 - The **Phone Number** is correct.
 - The correct **Protocol** is selected.
For details, refer to [“Communication Setup” on page 131](#).

Cannot Transmit Records via LAN

If you receive an error while attempting to transport records via LAN, use the following procedure:

1. Verify the correct communication option was activated.
The system supports two options for communicating via LAN:
 - LANC (for communicating with a CardioSoft system)
 - LANM (for communicating with a MUSE system)
 For more information on setting up LAN communication, see [“Options Setup” on page 153](#).
2. Verify the LAN cable is connected properly to the LAN connection slot.
For information on where the LAN cable connects to the device, see [“Rear View” on page 30](#).
3. Check communication setup to verify whether the IP, Netmask, Gateway, and DNS addresses are all correct.
For details on checking addresses, see [“Communication Setup” on page 131](#).

Cannot Transmit Records via WiFi

If you receive an error while attempting to transmit records via WiFi, use the following procedure:

1. Verify the correct communication option was activated.
The system supports two options for communicating via WiFi:
 - WIFC (for communicating with a CardioSoft system)
 - WIFM (for communicating with a MUSE system.)
 For more information on setting up LAN communication, see [“Options Setup” on page 153](#).
2. Verify the WiFi dongle is connected properly to the USB port on the rear of the device.
If the WiFi dongle is not working, try changing the port.
For information on where the WiFi dongle connects to the device, see [“Rear View” on page 30](#).

3. Check communication setup to verify whether the IP, Netmask, Gateway, and DNS addresses are all correct.
For details on checking addresses, see [“Communication Setup” on page 131](#).
4. Check whether the wireless LAN is enabled and the authentication details are correct.
For information on the wireless LAN setup, see [“Wireless Networking Settings” in “Communication Setup” on page 131](#).

Cannot Export to Shared Directories

To resolve errors received while attempting to export ECG records to a shared directory, do the following:

- Verify the **LANC** communication option was activated.
Refer to [“Options Setup” on page 153](#) for information on activating options.
- Verify connectivity by checking the following:
 - The network cables are connected.
 - The **IP, netmask, gateway, and DNS** server addresses are all correct.
Refer to [“Communication Setup” on page 131](#) for instructions on setting these values.
 - The two systems can communicate.
To verify this, ping the device from the file server.
- Verify the logon information is correct.
Check the user name, password, and domain information. Refer to [“Communication Setup” on page 131](#) for information on the log on information.
- Verify share and directory permissions.
Ensure that the account used to log on to the shared directory has read/write/create permissions to both the share and the directory.
Refer to Microsoft Windows online help for instructions on how to set user permissions.

Acquisition/Printer Error Messages

If you receive an acquisition/printer error message, along with an error code, use the following table to determine what you need to do.

Message	Action
Message displays for a short duration and then stops.	No action to take.
Message displays persistently.	Try rebooting the system.
Message displays persistently, even after rebooting the system.	Contact GE Healthcare Service.

Report Errors

This section addresses the following report error: [“ACI-TIPI Statement is not Included on Report” on page 181](#).

ACI-TIPI Statement is not Included on Report

If the ACI-TIPI statement is not displayed when expected, do the following:

- Verify the **ACI-TIPI** option is activated.
For information on activating the **ACI-TIPI** option, refer to “Options Setup” on page 153.
- Verify **ACI-TIPI** is enabled on the ECG.
For information, refer to “Resting ECG Setup” on page 112.
- Verify the information **ACI-TIPI** requires was entered.
The ACI-TIPI statement prints only if the patient’s gender, date of birth, and chest pain indication are included in the patient information.
- Verify the patient is 16 years old or older.
The ACI-TIPI statement does not print for pediatric patients.
- Verify the original ECG was acquired in an electrocardiograph with the **ACI-TIPI** option.
If you attempt to print an ECG that was imported from an external device, the cart does not generate an ACI-TIPI statement; it prints only if the statement was saved as part of the ECG.

System Errors

The following table identifies some potential errors that may occur while you are operating the system, the possible causes, and a recommended course of action to resolve the error.

If performing the recommended actions does not resolve the problem, contact authorized GE Healthcare service personnel.

Problem	Cause	Solution
 This icon is displayed and the battery LED is flashing.	System is operating from the battery and the battery charge is low.	Connect the system to an AC outlet to charge the battery.
 This icon is displayed and the battery LED is not lit.	System is operating from AC power and battery is not installed.	Install a battery.
The system does not power up while operating from battery power.	Battery is fully discharged.	Connect the system to an AC outlet to charge the battery

Problem	Cause	Solution
The system powers down while operating from battery power.	Battery is fully discharged	Connect the system to an AC outlet to charge the battery
You are prompted to enter User ID and/or Password while attempting to export records to a shared network directory.	The User ID and/or Password defined on the Communication Setup window (" Communication Setup " on page 131) are incorrect.	<ol style="list-style-type: none"> 1. Press Esc to close the prompt. 2. Exit the export program. 3. Run Communication Setup. 4. Enter the correct User ID and Password for the shared directory and save the new values. 5. Export the records.
User cannot log on to the system.	High Security Mode is enabled and the user's User ID or Password were entered incorrectly.	<p>Try the following:</p> <ul style="list-style-type: none"> • Verify the user is setup in the system. Refer to "User Setup" on page 149. • Verify the user typed the User ID and Password correctly. • Contact the administrator to reset the user's User ID or Password. • Contact GE Healthcare technical support to obtain a temporary supervisor password.

Problem	Cause	Solution
<p>The following error message is displayed while printing: Printer internal error – Printing not possible</p>	<p>The printer encountered a temporary condition that caused it to stop printing the current report.</p>	<p>To restart any of the following reports, push the appropriate button:</p> <ul style="list-style-type: none"> • Rhythm Report in Resting ECG Mode • Arrhythmia recording in Arrhythmia Mode • In-test Reports in Stress Test Mode <p>All other reports restart automatically.</p>
<p>The following error message is displayed while printing: Battery low – Printing not possible</p>	<p>The battery is low and does not have enough charge to power the printer.</p>	<p>Try the following:</p> <ul style="list-style-type: none"> • Allow the battery to charge to 50% before printing again. • Connect the device to an AC outlet. • Power down the device then power it back on.



Creating Barcodes

The following sections provide the information you need to configure bar codes.

The barcode reader can read any of the following codes:

- 39
- 39EX
- 128
- PDF-417
- Interleaved Code 2 of 5
- Data Matrix

Regardless of which code is used, the site's IT department must do the following:

- Set up the patient data scheme.
- Configure the barcode reader.

NOTE:

All data resides in fixed-width fields. The bar code must be programmed to add "trailing spaces" after fields shorter than the fixed length of the fields your system is using.

Setting Up the Patient Data Scheme

Use the following rules to set up a data scheme, including patient demographic data, for your barcodes.

Patient Data Scheme

Item	Byte Length
<i>Patient ID</i>	The <i>Patient ID</i> length should not exceed the 30-character maximum and should be equal to the ID length set up on the system in the <i>Patient Setup</i> window. If the system is communicating with a MUSE system, the length of the <i>Patient ID</i> should be the same as the Patient ID that the MUSE system uses.
<i>Last Name</i>	40 (maximum)
<i>First Name</i>	20 (maximum)

Patient Data Scheme (cont'd.)

Item	Byte Length
<i>Year of birth</i>	4
<i>Month of birth</i>	2
<i>Day of birth</i>	2
<i>Gender</i>	1

Configuring the Barcode Reader

Configure the barcode reader on the **Patient Setup** window. You can choose to configure it manually or automatically. The requirements for each method are described in the following sections.

Configuring the Barcode Reader Manually

The following table identifies the available fields for configuring your bar code reader.

Manual Bar Code Reader Configuration Fields

Field	Description and Byte Length
<i>Total number of bytes</i>	Enter the total number of bytes contained in the patient bar code. This is usually the sum of the bytes listed in the following fields.
<i>Patient ID offset</i>	Enter the Patient ID's Offset .
<i>Patient ID length</i>	Enter the Patient ID's Length . Be aware of the following criteria when setting the length: <ul style="list-style-type: none"> • Can be from 3 to 30 • Should equal the ID length set up on the Patient Question window • Should equal the patient ID length for the MUSE CV system with which the MAC system communicates.
<i>First name offset</i>	The patient's first name Offset .
<i>First name length</i>	The patient's first name Length . Be aware of the following criteria when setting the length: <ul style="list-style-type: none"> • value can be from 0 to 20 • should equal the length from the MUSE CV system with which the MAC system communicates. <p>NOTE: The MAC system does not support "long" names; if the MUSE system uses long names, this field should be set to its maximum value.</p>
<i>Last name offset</i>	The patient's last name Offset .

Manual Bar Code Reader Configuration Fields (cont'd.)

Field	Description and Byte Length
<i>Last name length</i>	The patient's last name Length . Be aware of the following criteria when setting the length: <ul style="list-style-type: none"> • value can be from 0 to 40 • should equal the length from the MUSE CV system with which the MAC system communicates NOTE: The MAC system does not support "long" names; if the MUSE system uses long names, this field should be set to its maximum value.
<i>Year of birth offset</i>	The year the patient was born. Enter the field's Offset
<i>Year of birth length</i>	The year the patient was born. Enter the field's Length The length must be set to 4.
<i>Month of birth offset</i>	The month the patient was born. Enter the field's Offset .
<i>Month of birth length</i>	The month the patient was born. Enter the field's Length . The length must be set to 2.
<i>Day of birth offset</i>	The day the patient was born. Enter the field's Offset .
<i>Gender offset</i>	The patient's gender. Enter the field's Offset .
<i>Gender length</i>	The patient's gender. Enter the field's Length . The length must be set to 1.

Configuring the Barcode Reader Automatically

You can configure the barcode reader automatically by scanning a barcode that has been set up using the following information:

Automatic Bar Code Reader Configuration Fields

Item	Character Used to Reserve Byte Space
<i>Patient ID</i>	9
<i>First name</i>	5
<i>Last name</i>	6
<i>Year of birth</i>	3
<i>Month of birth</i>	1
<i>Day of birth</i>	2
<i>Gender</i>	M or m for male F or f or female

B

Master's Step Data

The following sections provide the information you need to run a **Master's Step** stress test.

Master's Step Table

The following table identifies the number of steps to set according to the patient's age, gender, and weight.

Weight (kg)	Gender	Age (Years)														
		5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79
18-22	Male	35	36													
	Female	35	35	33												
22-26	Male	33	35	32												
	Female	33	33	32												
27-31	Male	31	33	31												
	Female	31	32	30												
32-35	Male	28	32	30												
	Female	28	30	29												
36-40	Male	26	30	29	29	29	28	27	27	26	25	25	24	23	23	22
	Female	26	28	28	28	28	27	26	24	23	22	21	21	20	19	18
41-44	Male	24	29	28	28	28	27	27	26	25	24	23	22	22	21	22
	Female	24	27	26	27	26	25	24	23	22	21	20	19	18	18	17
45-49	Male	22	27	27	28	28	27	26	25	25	24	23	22	22	21	20
	Female	22	25	25	26	26	25	24	23	22	21	20	19	18	18	17
50-53	Male	20	26	26	27	27	26	25	25	24	23	22	22	22	21	20
	Female	20	23	23	25	25	24	23	22	21	20	19	18	18	17	16
54-58	Male	18	24	25	26	27	26	25	24	23	22	22	21	21	20	19
	Female	18	22	22	24	24	23	22	21	30	19	18	18	17	16	15
59-63	Male	16	23	24	25	26	25	24	23	23	22	21	20	20	19	18
	Female	16	20	20	23	23	22	21	20	19	19	18	17	16	15	15
64-67	Male		21	23	24	25	24	24	23	22	21	20	20	19	18	18
	Female		18	19	22	22	21	20	19	19	18	17	16	15	15	14
68-72	Male		20	22	24	25	24	23	22	21	20	20	19	18	18	17
	Female		17	17	21	20	20	19	19	18	17	16	16	15	14	13

Weight (kg)	Gender	Age (Years)														
		5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79
73-76	Male		18	21	23	24	23	22	22	21	20	19	18	18	17	17
	Female		15	16	20	19	19	18	18	17	16	16	15	14	13	12
77-81	Male			20	22	23	23	22	21	20	19	18	18	17	17	16
	Female		13	14	19	18	18	17	17	16	16	15	14	13	13	12
82-85	Male			19	21	23	22	21	20	19	19	18	17	16	16	15
	Female			13	18	17	17	17	16	16	15	14	14	13	12	11
86-90	Male			18	29	22	21	21	29	18	17	17	16	15	15	14
	Female			12	17	16	16	16	15	15	14	13	13	12	12	11
91-93	Male				19	21	21	20	19	18	17	16	16	15	14	14
	Female				16	15	15	15	14	14	13	13	12	11	11	10
94-99	Male				18	21	20	19	18	17	17	16	15	14	14	13
	Female				15	14	14	14	13	13	13	12	11	11	11	10
100-104	Male				17	20	20	19	18	17	16	15	14	13	13	12
	Female				14	13	13	13	13	12	12	11	11	10	10	09

ST-T Changes

The existence of any ST-T change is assessed by classifying ST-T into three assessment levels:

- **Positive**

One of the following criteria must be met on 2 or more leads:

- ST Depression ≥ 0.1 mV
- ST Elevation ≥ 0.2 mV
- T wave change ≥ 1.0 mV

- **Borderline**

One of the following criteria must be met on any lead:

- ST Depression ≥ 0.05 mV
- ST Elevation ≥ 0.1 mV
- T wave change ≥ 0.5 mV

- **Negative**

This is assessed if neither the Positive nor Borderline criteria are met.

The following formulas are used to calculate the values in the previous criteria:

- ST depression = (rest ST - post J) - (post exercise ST - post J)
- ST depression = (rest ST - post J) - (post exercise ST - post J)
- T wave change = absolute value of (rest T wave amplitude - post-exercise T wave amplitude)
- (ST - post J: amplitude at the post J point)

When the assessment is positive or borderline, the lead with the largest change prints.



Technical Specifications

System Specifications

Hardware Device

Item	Specifications
Device type	Portable, integrated unit
Width	390 mm (15.4 in)
Depth	330 mm 13.0 in)
Height	200 mm (7.9 in)
Weight	approx. 5 kg (11.0 lb) (including battery, without paper)
CRT Interface	No CRT interface connector
USB Port	Two USB 2.0 ports available
Mechanical design	Housing with built-in graphics display SW on mainboard

Environmental Conditions

Item	Operating Specifications	Transport/Storage Specifications
Temperature	+10°C to +40°C (50°F to 104°F)	-40°C to +70°C (-40°F to 158°F)
Relative humidity	20% to 95% (RH non-condensing)	15% to 95% (RH non-condensing)
Pressure	700 hPa to 1060 hPa (Altitude range: 3010.9m to -381.9m [9878.28 ft. to -1252.95 ft.]	500 hPa to 1060 hPa (Altitude range 5570m to -380m [18274.28 ft. to -1246.72 ft].)

Display

Item	Specifications
Type	7-inch (177.8 mm) color TFT graphics display with support of minimum 32K colors
Resolution	WVGA – 800 x 480 pixels

Display (cont'd.)

Item	Specifications
Data	Heart rate, patient ID, clock, battery power indicator, waveforms, lead labels, speed, gain and filter settings, warning messages, prompts, and help messages. Standard display: 6 leads Optional display: 12 leads
Traces	3, 6, 12
Sweep Speed	12.5, 25, and 50 mm/s
Filtered ECG	The raw or filtered ECG curves are displayed on the screen as selected by the user.

Keypad

Item	Specifications
Pad	Membrane board with tactile feedback
Keys	Soft function keys Full alphanumeric keyboard (Qwerty key set) Writer controls Triypad cursor controls
Keypad	Standard keypad with additional function keys. Keypad and lettering are water resistant and meet MDM4021 Cleaning and Chemical Resistance Performance Guidelines
Functions	Standard Stress

Printer

Item	Specifications
Technology	Integrated thermal dot array
Paper Speed	5, 12.5 mm/s at $\pm 10\%$ accuracy 25, 50 mm/s at $\pm 2\%$ accuracy
Printer motor speed	Report printing within 25 seconds
Number of traces	Up to 12 ECG traces sampled at 500 or 1000 Hz
Sensitivity/gain	2.5, 5, 10, 20, 40 mm/mV with $\pm 5\%$ accuracy
Speed accuracy	5, 12.5 mm/s at $\pm 5\%$ 25, 50 mm/s at $\pm 2\%$
Amplitude accuracy	$\pm 5\%$
Horizontal resolution	40 dots/mm at 25 mm/s in rhythm mode
Vertical resolution	8 dots/mm
Paper type	Z-fold thermal with pre-printed grid and perforation
Paper size	215 mm x 280 mm (8.5 in x 11 in) (letter) 210 mm x 295 mm (8.25 in x 11.6 in) (A4) 214.2 mm x 279.4 mm (8.43 in x 11 in) (modified letter)
Paper tray capacity	Holds up to 150 sheets

Electrical

Item	Specifications
Power supply	Internal AC/DC or battery operation
Input voltage	100–240 VAC ±10%
Input current (Maximum power consumption)	1.5A at 115V to 230V AC
Input frequency	47–63 Hz
Safety requirement	IEC60601–1 protection class I
Fuse requirement	Phase and neutral meet UL/IEC requirements
Power inlet socket	IEC C14 type

Battery

Item	Specifications
Type	Replaceable and rechargeable, Lithium Ion
Capacity	14.4V, 2.2 AH ±10% 100 single page resting ECG recording or 3 hours (typical) of continuous monitoring without printing (minimum)
Charge time	Approximately 3.5 hours from total discharge (with device off)

Acquisition, Processing, and Performance

LEDs

Item	Specifications
Battery charging	Steady amber: Battery charging Flashing amber: battery low Off: battery fully charged (when connected to AC Mains); neither charging nor low (when running on battery)
External power	Steady green: external power connected Off: no external power

ECG Data Acquisition

Item	Specification
ECG front end	Internal ECG front end with DSP provides 10 simultaneously sampled electrode channels
Signal input	Type CF
Amplitude resolution	4.88 μ V ±1% per LSB @ 500 SPS
Dynamic range	AC differential: ±5 mV DC offset: ±300 mV
Frequency range	0.04 to 150 Hz
Common mode rejection	>135 dB with 50/60 Hz filter on

ECG Data Acquisition (cont'd.)

Item	Specification
Input impedance	>10 MΩ @ 10 Hz
Patient leakage current	<10 μA normal condition (NC) <50 μA single fault condition (SFC)
Remote control	Advancing to the next stage can be initiated from the bicycle ergometer.

Processing

Item	Specifications
Processor	Application: 32 bit ARM9 processor Peripheral Management: 32 bit ARM Cortex-M3 processor Signal Chain Processing: 400 MHz DSP
ECG Interpretation	Marquette 12SL™ ECG Analysis Program for adults and pediatrics Heart Algorithm (Stress)
Computerized measurements	12-lead analysis
ECG analysis frequency	500 or 1000 samples/second/channel
Digital sampling rate	16000 samples/second/channel for normal data acquisition
Pace sample rate	75K samples/second/channel
ECG on-screen preview	On-screen preview of acquired 10-second ECG waveform
Acquisition mode	Pre-acquisition or post acquisition, provides 10 seconds of instantaneous ECG acquisition
Resolution	4.88 μV/LSB
Frequency range	0.04 to 150 Hz
Low cutoff frequency	0.04 Hz (-3 dB limits)
High cutoff frequency	Configurable at 20 Hz, 40 Hz, 100 Hz, 150 Hz
Common mode rejection	>135 dB (with 50/60 Hz filter on)
Input impedance	>10 MΩ @ 10 Hz (defibrillator protected)
Patient leakage	<10 μA NC <50 μA SFC
Electrodes monitored for disconnection	Every electrode except RL and RA
Heart rate meter	30 to 300 BPM
Operating system	Microsoft Windows CE 6.0
Startup time	Less than 30 seconds.
ECG transmission	Resting ECGs can be transferred via the serial interface, modem, LAN, as well as SD-card from the MAC2000 system to other ECG systems (CardioSoft/CardioSys, MUSE) for further processing and archiving. In addition, Resting ECG can be received via serial line, modem, and SD Card.

Processing (cont'd.)

Item	Specifications
Patient Data	Patient information entry: Patient ID, Secondary Patient ID, Height, Weight, Gender, Race, Pacemaker Patient, Systolic BP, Diastolic BP, Location#, Room, Order Number, Phone Number, Medication, Ordering Physician, Referring Physician, Attending Physician, Technician, Test indication, four user-definable fields.
Electrode connections	RA, RL, LA, LL, V1–V6, Nax, Nst
Detection of pacemaker pulse	Lower scale: 0.2 ms duration, 0.5 mV amplitude Higher scale: 2.0 ms duration, 250 mV amplitude
Archiving	ECG data is printed out Internal memory is present on this system.
External Storage	SD Card available for storage
Input/Output Interface	RS232 port for connectivity to MUSE systems v7.1.1 and v8.0.1 and CASE/CardioSoft systems V6.51, V6.61, and CardioSoft V6.71, and remote control signal from ergometers
Ethernet interface	RJ45 connector
Channels	6, 12
QRS detection	Available
Muscle filter	20 Hz, 40 Hz, 100 Hz, 150 Hz
Automatic baseline correction	User-selectable

Operating Modes, Features, and Options

Operating Modes and Features

Item	Specifications
Resting ECG Mode	Records and prints 12-lead resting ECGs with 10 seconds duration as a standard feature.
Arrhythmia Mode	Continuously monitors ECG and prints report when arrhythmia events of the user-selected class occur
Exercise/Stress Test Mode	Exercise mode for exercise stress testing
RR Analysis Mode	RR Analysis for RR interval analysis
Hookup Advisor	Provides visual indication of signal quality
Multi-language support	User Interface supports 19 languages User Manual supports 31 languages
Order Manager	Provides an interface for managing orders

Accessories

Item	Specification
Consumables	Electrodes, leadwires, cables, and so forth For a complete list of all available supplies and accessories for this system, refer to the <i>MAC™ 2000 Supplies and Accessories Reference Guide</i> .
Barcode Scanner	Use to enter patient information from a patient barcode
Secure Digital High Capacity (SDHC) Card	4 GB

Product Options

For a complete list of product options and codes, refer to “Options Setup” in the operator’s manual.

Index

- 12 Lead Display for Resting ECG 154
- 12 Lead Display for Stress Test 154
- 12ld stress key 34
- 12SL Measurement 154
- 12SL Measurement and Interpretation 154
- 21 CFR Part 11 Audit Trail 155

A

- A (artifact) 80
- ACI-TIPI
 - option 155
 - optional software feature 35
- Adenosine (protocol) 128
- ADS
 - definition 125
 - on arrhythmia setup 114, 122
 - on stress ECG setup 125
- ADTF option 155
- ADTL option 155
- Allow Export Using Shared Directory 133
- alt key 33
- AOMF option 155
- AOML option 155
- arrhythmia codes 80
- Arrhythmia ECG
 - printing options 80
- Arrhythmia Event
 - Printing 80, 123
- Arrhythmia Setup
 - ADS 114, 122
 - episode printout 123
 - event printing 123
 - lead sequence 124
 - overview 121
- arrow pad
 - using to navigate 36
- artifact 80
- Assistance 27
- ASYSTO (asystole) 80
- asystole 80

- Audit Trail 111
- auto configuring a reader 148
- Auto Logoff 111

B

- backspace key 33
- Bal (protocol) 129
- Balkeware (protocol) 128
- barcode
 - scanning 56
- barcode reader
 - automatic configuration 187
 - configuring 148
 - entering patient information 56
 - option 155
- baseline shift, reducing 70
- Basic Setup
 - audit trail 111
 - auto logoff 111
 - high security mode 111
 - overview 107
 - power up mode 109
 - time synchronization 111
- battery
 - conditioning 172
 - maintenance 170
- battery status indicator
 - resting ECG display 66
- BCRD option 155
- biocompatibility statement 15
- Bruce (protocol) 128

C

- cables
 - cleaning and disinfecting 163
 - storing 165
- CardioSoft system
 - communication option 154
 - importing from 99
- CFRA option 155
- changing a setting
 - function key menu option 36
- changing menu options

- function key menu option 36
- classification
 - medical device 13
- cleaning
 - device exterior 162
 - guidelines 163
 - materials to avoid
 - device 162
 - materials to use
 - device 162
 - solutions not to use 163
- cleaning and disinfecting
 - cables 163
 - electrodes 165
 - leadwires 163
- cleaning, disinfecting, and sterilizing
 - electrodes 165
- clinical trials data guard and audit trail
 - optional software feature 35
- comment key 34
- Common Documentation Library (CDL) 2
- communication protocol 135
- Communication Setup
 - cardiograph device name 138
 - default location 132
 - device 134
 - DHCP settings 138
 - DNS settings 138
 - location 134
 - modem settings 136
 - overview 131
 - protocol 135
 - serial baud rate 133
 - shared directory settings 133
- compliance 2, 10
- CONCONI (protocol) 129
- configurations, switching between 151
- configuring
 - barcode reader
 - automatically 187
- contraindications 10
- conventions
 - document 27
 - illustrations 28
 - Notes 28
 - safety 10
 - typographical 28
- Cornell (protocol) 128
- Country Setup
 - Blood Pressure Unit 142
 - date format 142
 - height/weight unit 142
 - language 142
 - overview 141
 - speed unit 142
 - ST Level Unit 142
 - time format 142
- CPLT (ventricular couplet) 80
- CT Data Guard 154
- CTDG option 56, 154
- cursor control keys 32

D

- data acquisition
 - ECG 37
- data formats
 - selectable 37
- date
 - resting ECG display 66
- date format 142
- Date Setup 155
- daylight savings time 155
- Default Location 132
- default naming conventions
 - PDF files 157
- defibrillation
 - recording an ECG during 74
- deleting records 103
- device
 - front view 30
 - maintenance 161
 - rear view 30
 - side view 31
 - symbols 17
- device exterior
 - cleaning 162
- DHCP settings 138
- disinfecting
 - guidelines 163
 - solutions not to use 163
- display format
 - resting ECG display 65
- Display Format 114
- Display Lead Group 114
- DNS settings 138
- Dobutamine (protocol) 128
- document
 - part number 2
 - revision 2
- document conventions 27
- Dose Type 147

E

- E12L option 154
- ECG 65, 83, 89
 - See also Resting ECG
 - , RR Analysis mode, Stress
- ECG
 - deleting record 103
 - editing patient information 101
 - exporting records 104, 105
 - finding records 101
 - importing records 99
 - previewing records 102
 - printing records 103
 - transmitting records 103
- ECG analysis/interpretation
 - optional software feature 35
- ECG Filter Type 125
- ECG key 32
- ECG records
 - previewing 102
- ECG type
 - resting ECG display 65
- editing patient information 101
- electrodes
 - cleaning and disinfecting 165
 - cleaning, disinfecting, and sterilizing 165
 - NEHB placement 52
 - placement 50
 - sterilizing 165
- Ellestad (protocol) 128
- EMC 14
- EMI 14
- Enable Patient ID Check 145
- enter BP key 34
- enter key 33
- Episode Printout 123
- equipment
 - identification 25
- ERGO option 90, 107, 154
- ergometer
 - conducting a stress test with 94
 - supported models 89
 - unsupported models 89
 - with remote start 89
- ESC (ventricular escape beat) 80
- escape key 33
- exercise stress key 34
- Export Setup 153
- export XML 132
- exporting

- ECG records 104
- exporting ECG records 105
- exporting records
 - setting options 105
- external devices
 - supported models 89
 - unsupported models 89

F

- File Manager
 - deleting records 103
 - editing patient information 101
 - exporting records 105
 - finding records 101
 - importing records 99
 - overview 99
 - printing directory 100
 - printing records 103
 - transmitting records 103
- finding ECG records 101
- Finite Residual Filter, See FRF
- FRF
 - definition 125
 - on stress ECG setup 125
- front view 30
- function keys 33
 - menu options 36
 - changing a setting 36
 - changing menu options 36
 - opening a window 36
 - saving your selections 36
 - taking an ECG 36
 - using for menu options 36

G

- gain 86, 93, 113
- GE Healthcare
 - Common Documentation Library (CDL) 2
 - manuals 2
- grade down key 34
- grade up key 34
- guidelines
 - when cleaning and disinfecting 163

H

- HEART exercise
 - optional software feature 35

- HEART Resting Measurement 154
- HEART Resting Measurement and Interpretation 154
- Height/Weight Unit 142
- High Security Mode 111
- hold stage key 34
- Hollmann (protocol) 129
- hookup advisor
 - indicators 67
 - optional software feature 35
- Hookup Advisor
 - affected by skin preparation 49
- hookup advisor indicator
 - resting ECG display 66

I

- identification
 - equipment 25
- illustration conventions 28
- Import Setup 152
- Importing ECG records 99
- indications for use 9
- inspecting a device 161
- intended user 9
- internal storage, *See* File Manager
- internal storage indicator
 - resting ECG display 66

J

- J+x Point Formula 127

K

- Kanji Name 145
- keypad
 - standard 32
 - stress 34
- keys
 - alt 33
 - backspace 33
 - cursor control 32
 - ECG 32
 - enter 33
 - escape 33
 - function 33
 - lead 32
 - on/off 32
 - option 33

- power on 32
- rhythm 32
- shift 33
- space bar 33
- writer stop 32

L

- L (learn phase) 80
- LAN Communication to CardioSoft 154
- LAN Communication to MUSE 154
- LANC option 154
- LANM option 154
- lead key 32
- lead labels
 - resting ECG display 66
- Lead Sequence 118, 124
- leadwires
 - cleaning and disinfecting 163
 - replacing adapters 166
 - storing 165
- learn phase 80
- LED description
 - external power 195
- LED descriptions
 - battery charging 195
- Line Filter 85
- Location 134
- Low Pass Filter 114

M

- M100 option 154
- M200 option 154
- maintenance
 - battery 170
 - cleaning device surfaces 162
 - cleaning materials to avoid
 - device 162
 - cleaning materials to use
 - device 162
 - device 161
 - inspecting a device 161
 - overview 161
 - replacing leadwire adapters 166
- manufacturer responsibilities 16
- Master's Step
 - mode 126
 - overview 89

- selecting 126
- Maximum Predicted HR
 - Formula 126
- ME12 option 154
- medians stress key 34
- medical device
 - classification 13
- MEHR option 154
- menu options
 - resting ECG display 66
- MI12 option 154
- MIHR option 154
- ModBalke (protocol) 128
- ModBalkeware (protocol) 128
- ModBruce (protocol) 128
- MODC 178
- MODC option 154, 178
- modem
 - settings 136
 - troubleshooting 178
- Modem or serial
 - communication to
 - CardioSoft 154
- Modem or serial
 - communication to MUSE 154
- MODM 178
- MODM option 154, 178
- ModWHO (protocol) 129
- MUSE system
 - communication setup 154
 - importing from 99
 - User ID 150

N

- naming conventions
 - customizing 158
- Naughton (protocol) 128
- Notes conventions 28

O

- OEM 2
- on/off key 32
- opening a window
 - function key menu option 36
- option
 - ADTF 155
 - ADTL 155
 - AOMF 155
 - AOML 155
 - BCRD 155
 - CFRA 155
 - CTDG 56, 154

- E12L 154
- ERGO 90, 154
- LANC 154
- LANM 154
- M100 154
- M200 154
- ME12 154
- MEHR 154
- MI12 154
- MIHR 154
- MODC 154
- MODM 154
- PDFC 155
- R12L 154
- RRAN 155
- setup 153
- SOMF 155
- SOML 155
- TIPI 155
- WIFC 155
- WIFM 155
- option key 33
- optional features
 - software 35
- optional software features
 - ACI-TIPI 35
 - clinical trials data guard
 - and audit trail 35
 - HEART exercise 35
 - hookup advisor 35
 - QT correction formula 35
- options
 - setting for exporting
 - records 105
- order manager 59
- Original Equipment
 - Manufacturer (OEM) 2

P

- Pace Enhancement 85
- pacemaker
 - capture code 80
 - error 81
 - improving ECG
 - readability 70, 85, 115
 - recording ECGs of patient
 - with 73
- packaging
 - symbols 17
- paper
 - problems with 178
 - storing 170

- troubleshooting problems
 - with 178
- part number
 - document 2
- patient
 - setup
 - auto configure 148
 - dose type 147
 - enabling ID check 145
 - extra questions 147
 - ID type 145
 - Kanji name 145
 - overview 144, 147
 - skin preparation 49
 - patient heart rate
 - resting ECG display 66
 - Patient ID Type 145
 - patient information
 - editing with File Manager 101
 - entering manually 55
 - entering with a barcode reader 56
 - PAU1 (pause of 1 missed beat) 80
 - PAU2 (pause of 2 missed beats) 80
 - pause
 - 1 missed beat 80
 - 2 missed beats 80
 - PCAP (pacemaker capture) 80
 - PDF Export 87
 - PDF file copy 155
 - PDF file naming conventions
 - default 157
 - PDFC option 155
 - PERR (pacemaker malfunction) 81
 - Persantine (protocol) 128
 - PIN Dialing 136
 - post-J point 127
 - power on key 32
 - Power Up Mode 109
 - prescription device
 - statement 10
 - pretest stress key 34
 - previewing records 102
 - printer leads 70
 - Printer Leads 115
 - printing
 - File Manager directory 100
 - printing ECG records 103
 - product
 - codes 26

- description 29
- features 29
- protocol
 - communication 135
 - description 129
 - editing 128
 - list 128
 - selecting 126
- PSVC (premature supraventricular contraction) 81
- purchaser/customer
 - responsibilities 16
- PVC (premature ventricular contraction) 81

Q

- QRSL (learned QRS complex) 81
- QT correction formula
 - optional software feature 35

R

- R12L option 154
- Radio Frequency (RF)
 - cautions 15
 - devices 15
- rear view 30
- recall stress key 34
- Record Lead 85
- recording a resting ECG 68
- recording during
 - defibrillation 74
- recovery stress key 34
- replacing
 - leadwire adapters 166
- requirements
 - service 27
 - system 29
- responsibilities
 - manufacturer 16
 - purchaser/customer 16
- Resting ECG
 - deleting records 103
 - editing patient information 101
 - exporting records 105
 - finding records 101
 - importing records 99
 - mode 65
 - options 69
 - post-acquisition options 71
 - printing records 103

- recording 68
- rhythm report 74
- saving automatically 99
- saving manually 99
- setup
 - display format 114
 - display lead group 114
 - gain 113
 - Lead Sequence 118
 - low pass filter 114
 - overview 112
 - pace enhancement 115
 - printer leads 115
 - speed 113
 - transmitting records 103
- resting ECG display
 - battery status indicator 66
 - date 66
 - display format 65
 - ECG type 65
 - hookup advisor indicator 66
 - internal storage indicator 66
 - lead labels 66
 - menu options 66
 - patient heart rate 66
 - time 66
- revision history 2
- rhythm key 32
- Rhythm Record 86
- Rhythm Report 74
- RR analysis
 - option 155
- RR Analysis
 - post-test options 87
 - setup
 - anti drift system 86
 - gain 86
 - line filter 85
 - low pass filter 86
 - pace enhancement 85
 - record lead 85
 - rhythm record 86
 - RR table 86
 - sweep speed 86
 - target 85
- RR Analysis mode 83
- RR Table 86
- RRAN option 155
- RUN (ventricular run) 81
- definitions 10
 - hazards 11
 - saving your selections
 - function key menu option 36
 - screens
 - startup 35
 - SD card 105, 152, 153, 178
 - selectable data formats 37
 - Serial Baud Rate 133
 - service
 - information 27
 - requirements 27
 - Service Setup, See the Service Manual
 - Setup Report 143
 - shared directory 104, 133
 - shift key 33
 - side view 31
 - SlowUSAFSAM (protocol) 128
 - software
 - optional features 35
 - solutions
 - not to use when cleaning or disinfecting 163
 - SOMF option 155
 - SOML option 155
 - space bar 33
 - speed 113
 - Speed Unit 142
 - speed/load down key 34
 - speed/load up key 34
 - standard keypad 32
 - start treadmill key 34
 - Std.France (protocol) 129
 - sterilizing
 - electrodes 165
 - stop treadmill key 34
 - storage
 - cables and leadwires 165
 - paper 170
 - Storage for 100 ECGs 154
 - Stress ECG
 - blood pressure 91
 - conducting with ergometer 94
 - conducting with treadmill 94
 - mode 89
 - options 92
 - prerequisites 90
 - rate-pressure product 91
 - report formats 90
 - setup
 - ADS 125

S

- safety
 - conventions

- ECG filter type 125
- FRF 125
- J+x Point Formula 127
- Master's Step Mode 126
- maximum predicted
 - heart rate 126
- overview 124
- protocol 126
- target heart rate 126
- target heart rate 91
- test information bar 90
- VE/min 91
- stress keypad 34
- stress keys
 - 12ld 34
 - comment 34
 - enter BP 34
 - exercise 34
 - grade down 34
 - grade up 34
 - hold stage 34
 - median 34
 - pretest 34
 - recall 34
 - recovery 34
 - speed/load down 34
 - speed/load up 34
 - start treadmill 34
 - stop treadmill 34
 - test end 34
 - using to control stress
 - equipment 36
- stress test information bar 90
- Stress Test option 154
- supraventricular
 - premature contraction 81
- sweep speed 86, 92
- symbols
 - device 17
 - packaging 17
- system
 - requirements 29
- System Setup 83, 107, 112, 121, 124, 131, 141, 144, 149, 153, 157
 - See also Arrhythmia ECG
 - , Basic Setup,
 - Communication Setup,
 - Country Setup, Options Setup, Patient Setup,
 - Resting ECG, RR Analysis

- Setup, Stress ECG, User Setup
 - Date/Time 155
 - exporting 153
 - importing 152
 - switching configurations 151

T

- taking an ECG
 - function key menu option 36
- Target 85
- target heart rate 91, 126
- test end key 34
- time
 - resting ECG display 66
- Time Format 142
- Time Setup 155
- time synchronization 111
- TIPI option 155
- training 24
- transmitting ECG records 103
- treadmill
 - conducting a stress test
 - with 94
 - supported models 89
 - unsupported models 89
- troubleshooting
 - operator error 175
 - visual inspection 175
- typographical conventions 28

U

- USAFSAM (protocol) 128
- User Setup
 - MUSE ID 150
 - overview 149

V

- VBIG (ventricular bigeminy) 81
- ventricular
 - bigeminy 81
 - couplet 80
 - ectopics per minute 91
 - escape beat 80
 - fibrillation/flutter 81
 - premature contraction 81
 - run 81
 - tachycardia 81
- VFIB (ventricular fibrillation/flutter) 81
- visual inspection 175

VTACH (ventricular
tachycardia) 81

W

warranty information 27
WHO (protocol) 129
WHO50 (protocol) 129
WHO75 (protocol) 129
WIFC option 155
WiFi to CardioSoft option 155
WiFi to MUSE option 155
WIFM option 155
writer stop key 32

X

XML export 132



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