

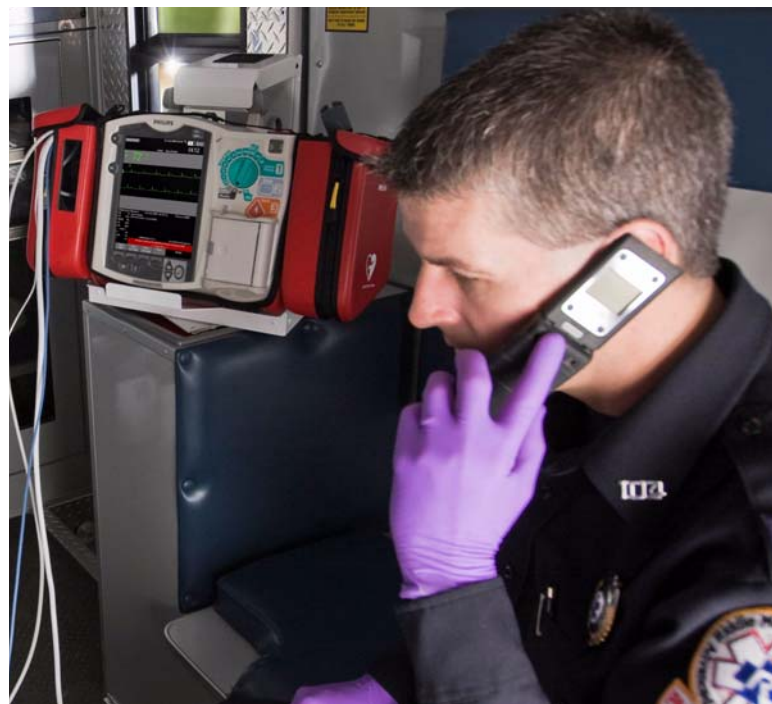
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Philips HeartStart MRx Owners Manual

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Instructions For Use

HeartStart MRx

M3535A/M3536A

PHILIPS

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About This Edition

Publication number: 989803160421

Edition 1 Printed in the USA

To determine the product level version to which these Instructions for Use are applicable, refer to the version level appearing on the back cover of this book or on the label of the User Documentation CD-ROM that accompanied this device. This information is subject to change without notice.

Edition	Print Date
1	April 2009

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Medical Device Directive

The HeartStart MRx complies with the requirements of the Medical Device Directive 93/42/EEC and carries the  0123 mark accordingly.

Manufacturer

Philips Medical Systems
3000 Minuteman Road
Andover, MA 01810 USA

Authorized EU-representative

Philips Medizin Systeme Böblingen GmbH
Hewlett Packard Str. 2
71034 Böblingen
Germany

Canada EMC:ICES-001

U.S. FCC and Industry Canada Radio Compliance:

Contains FCC ID: PQC-WMTS-MODULE

When using the IntelliVue networking option, operation of this equipment requires the prior coordination with a frequency coordinator designated by the FCC for the Wireless Medical Telemetry Service. This device complies with Part 15 of the FCC rules and RSS-210 of Industry Canada. Operation is subject to the following conditions:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation.

Notice

Any changes or modifications to this equipment not expressly approved by Philips Medical Systems may cause harmful radio frequency interference and void your authority to operate this equipment.

China:

After Sales Service: Beijing MEHECO-PHILIPS Medical Equipment Service Center.

After Sales Service Address: No. 208, 2nd District, Wang Jing Li Ze Zhong Yuan, Chao Yang District, Beijing.

Postal code: 100102.

Telephone: 8008100038.

Registration number: SFDA(I)20083211481.

Product Standard number: YZB/USA 1863-2008.

For the Declaration of Conformity Statement, please see the Philips Medical web site at <http://incenter.medical.philips.com/PMSPublic>. Scroll over the Quality and Regulatory Tab located in the upper left corner of the window. Click to select Regulatory by Modality. Then click to select Defibrillators and select the entry for Declaration of Conformity (DoC).

Warning

Radio frequency (RF) interference coming from devices other than the HeartStart MRx may degrade the performance of the MRx. Electromagnetic compatibility with surrounding devices should be assessed prior to using the monitor/defibrillator.

These Instructions for Use contain the following conventions:

WARNING Warning statements describe conditions or actions that can result in personal injury or loss of life.

CAUTION Caution statements describe conditions or actions that can result in damage to the equipment or loss of data.

NOTE Notes contain additional information on usage.

"Voice"	represents voice prompt messages
Text	represents messages that appear on the display
[Soft key]	represents soft key labels that appear on the display above the button to which they correspond.

Images of the HeartStart MRx display and menus appearing in this document are for illustration purposes only. Menu choices on your device are driven by the options you have purchased and selections you make in Configuration Mode.

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Introduction

Thank you for choosing the HeartStart MRx monitor/defibrillator. Philips Healthcare welcomes you to its family of resuscitation devices.

The HeartStart MRx is designed to meet your monitoring and resuscitation needs by providing advanced, multi-parameter monitoring functions, a full range of defibrillation therapies, industry-leading algorithms and a suite of data transmission options. This guide provides instructions for the safe and proper operation of the device, as well as set-up, configuration, and maintenance information.

Be sure to familiarize yourself with the features and operation of your HeartStart MRx prior to its use.

Overview

The HeartStart MRx is a lightweight, portable, monitor/defibrillator. It provides four modes of operation: Monitor, Manual Defib, AED, and Pacer (optional).

In Monitor Mode you can monitor up to four ECG waveforms, acquired through a 3-, 5-, or 10-lead ECG set. Optional monitoring of pulse oximetry (SpO₂), noninvasive blood pressure (NBP), carbon dioxide (EtCO₂), temperature, and invasive pressures are also available. Measurements from these parameters are presented on the display. Alarms are available to alert you to changes in the patient's condition. You can also display a Vital Signs Trending Report to view all key parameters and their measurements at a glance.

Monitor Mode also provides an optional 12-Lead ECG function, enabling you to preview, acquire, store, and print 12-lead ECG reports, with or without analysis/interpretation. In addition, there are several STEMI decision support tools, including STEMI Culprit Artery, Critical Values and the Acute Cardiac Ischemia Time-Insensitive Predictive Instrument (ACI-TIPI) and Thrombolytic Predictive Instrument (TPI) algorithms. You can also transmit 12-Lead reports and Event Summaries via the 12-Lead ECG Transmission and Event Summary Data Transfer options. Other transmission options are available. See "Data Transmission" on page 239.

Manual Defib Mode offers simple, 3-step defibrillation. You analyze the patient's ECG and, if appropriate: 1) select an energy setting, 2) charge, and 3) deliver the shock. Defibrillation may be performed using paddles or multifunction electrode pads. Manual Defib Mode also allows you to perform synchronized cardioversion and internal defibrillation. If desired, use of Manual Defib Mode may be password protected.

In AED Mode, the HeartStart MRx analyzes the patient's ECG and determines whether a shock is advised. Voice prompts guide you through the 3-step defibrillation process, providing easy-to-follow instructions and patient information. Voice prompts are reinforced by messages on the display.

The Manual Defib and AED modes incorporate Philips' low energy SMART Biphasic waveform for defibrillation. Both modes also offer the Q-CPR® option. Q-CPR offers real-time measurement and corrective feedback on the rate, depth/complete release of compressions (and lack of CPR activity) and ventilation rate. The HeartStart MRx displays a CPR Timer and compression counter to assist with protocol management.

The HeartStart MRx also has an optional Audio function which allows you to record audio during a patient event.

Optional Pacer Mode offers noninvasive transcutaneous pacing therapy. Pace pulses are delivered through multifunction electrode pads, using a monophasic waveform. If desired, use of Pacer Mode may be password protected.

The HeartStart MRx is powered by rechargeable lithium ion batteries. Available battery power is easily determined by viewing the convenient battery power indicators located on the device display or by checking the gauge on the battery itself. Additionally, an external AC or DC Power Module may be applied as a secondary power source and for continual battery charging.

The HeartStart MRx performs Automated Tests on a regular basis. The results of these tests are reported to the Ready For Use (RFU) indicator. The prominently displayed RFU indicator communicates the status of your device, letting you know it is operating correctly, needs attention, or is unable to deliver therapy. In addition, performing the specified Operational Check ensures that the HeartStart MRx is functioning properly.

The HeartStart MRx automatically stores critical event data, such as Event Summaries, 12-Lead Reports and Vital Signs Trending, in its internal memory. The HeartStart MRx also enables you to store data and event information on an optional data card for downloading to Philips' data management solution, HeartStart Event Review Pro, or you can send the data electronically via several methods to your destination point.

The HeartStart MRx is highly configurable to better meet the needs of diverse users. Be sure to familiarize yourself with your device's configuration before using the HeartStart MRx. See Chapter 17 "Configuration" for more details.

Intended Use

The HeartStart MRx is intended for use in hospital and pre-hospital settings by qualified medical personnel trained in the operation of the device and qualified by training in basic life support, advanced cardiac life support or defibrillation.

When operating as a semi-automatic external defibrillator in AED Mode, the HeartStart MRx is suitable for use by medical personnel trained in basic life support that includes the use of an AED.

When operating in Monitor, Manual Defib or Pacer Mode, the HeartStart MRx is suitable for use by healthcare professionals trained in advanced cardiac life support.

The SMART Biphasic waveform utilized in the HeartStart MRx has previously undergone clinical testing in adults. These trials support the waveform's effectiveness for defibrillation of ventricular tachyarrhythmias at 150J.

Indications for Use

The HeartStart MRx is for use for the termination of ventricular tachycardia and ventricular fibrillation.

The device is for use by qualified medical personnel trained in the operation of the device and qualified by training in basic life support, advanced cardiac support, or defibrillation. It must be used by or on the order of a physician.

AED Therapy

To be used in the presence of a suspected cardiac arrest on patients of at least 8 years of age that are unresponsive, not breathing and pulseless.

Manual Defibrillation

Asynchronous defibrillation is the initial treatment for ventricular fibrillation and ventricular tachycardia in patients that are pulseless and unresponsive. Synchronous defibrillation is indicated for termination of atrial fibrillation.

Noninvasive External Pacing Therapy

The pacing option is intended for treating patients with symptomatic bradycardia. It can also be helpful in patients with asystole, if performed early.

Pulse Oximetry

The SpO₂ option is intended for use when it is beneficial to assess a patient's oxygen saturation level.

Noninvasive Blood Pressure Monitoring

The NBP option is intended for noninvasive measurement of a patient's arterial blood pressure.

End-tidal CO₂

The EtCO₂ option is intended for noninvasive monitoring of a patient's exhaled carbon dioxide and to provide a respiration rate.

12-Lead ECG

The 12-Lead ECG function is to provide a conventional diagnostic 12-Lead ECG report, which may include measurements and interpretative statements.

Q-CPR

The Q-CPR option provides feedback designed to encourage rescuers to perform resuscitation in accordance with AHA/ERC guidelines for chest compression rate, depth, and duty cycle and ventilation rate, volume and flow rate (inflation time).

The Q-CPR option is contraindicated as follows:

- The Q-CPR option is contraindicated for use on neonatal and pediatric patients (under 8 years of age or weighing less than 25 kg).
- The Q-CPR option is not for use when CPR is contraindicated.

Invasive Pressures

The Invasive Pressures option is indicated for measuring arterial, venous, intracranial and other physiological pressures on patients.

Temperature

The Temperature option is indicated for measuring temperature in patients.

ACI-TIPI

This device is intended to be an aid to clinicians by focusing their attention on indicators of Acute Cardiac Ischemia.

TPI

Indications for Use: Physiological purpose: To aid the clinician deciding whether to administer thrombolytic therapy or to provide another avenue of treatment; Condition: Patient is a potential candidate for thrombolytic therapy; Patient Population: adult (35 to 75 years) patients diagnosed as having symptoms of Acute Myocardial Infarction; Body or type of tissue interacted with: No body or tissue contact. Prescription versus over-the-counter: TPI is a prescription device.

Contraindications: NOTE: The Thrombolytic Predictive Instrument (TPI) is contraindicated for patients with conditions which mimic acute myocardial infarction. Some of these conditions are: Prinzmetal variant angina, acute pericarditis, acute myocarditis, cardiomyopathy, and primary and secondary cardiac neoplasms.

The Thrombolytic Predictive Instrument (TPI) is also contraindicated for patients with conditions whom the administration of thrombolytics is contraindicated. Some of these conditions are: aortic dissection, acute myocardial infarction due to bacterial endocarditis, vasculitis, intracardiac thrombi, and acute nonsuppurative and suppurative pericarditis mimicking acute myocardial infarction.

These situations, as well as Posterior Acute Myocardial Infarction, were not considered or covered in the development of the predictive instrument calculations.

NOTE See note on page 140 for additional details on contraindications for TPI therapy.

Safety Considerations

General warnings and cautions that apply to use of the HeartStart MRx are provided in “Specifications and Safety” on page 321. Additional warnings and cautions specific to a particular feature are provided in the appropriate section of this guide.

WARNING Electric shock hazards exist internally. Do not attempt to open the device. Refer servicing to qualified personnel.

WARNING Use only supplies and accessories approved for use with your HeartStart MRx. Use of non-approved supplies and accessories could affect performance and results.

WARNING Use single-use supplies and accessories only once.

Documentation and Training

Available documentation and training for the HeartStart MRx includes:

- HeartStart MRx Instructions for Use
- HeartStart MRx Quick Reference Cards
- HeartStart MRx Battery Application Note
- HeartStart MRx Improving ECG Quality Application Note
- HeartStart MRx Web-based User Training (Located at:
www.medical.philips.com/goto/mrxtraining. Enter training access password: meetMRx.)
- HeartStart MRx User Training Videotape and DVD
- To purchase additional copies of the Instructions for Use or Quick Cards, visit the Philips Healthcare eStore at: www.philips.com/healthcarestore.
- Other Application Notes can be found on the Philips website at: www.medical.philips.com/goto/productdocumentation.

Getting Acquainted

The HeartStart MRx is designed with your needs in mind. Controls, indicators, and menus are carefully organized to facilitate easy use. Display information is tailored to the current task.

This chapter acquaints you with the HeartStart MRx operational modes, display views, controls, and indicators. It also provides general information on device use.

NOTE If your HeartStart MRx does not have some of the optional functionality listed in this chapter, disregard these controls and the related information described throughout this manual.

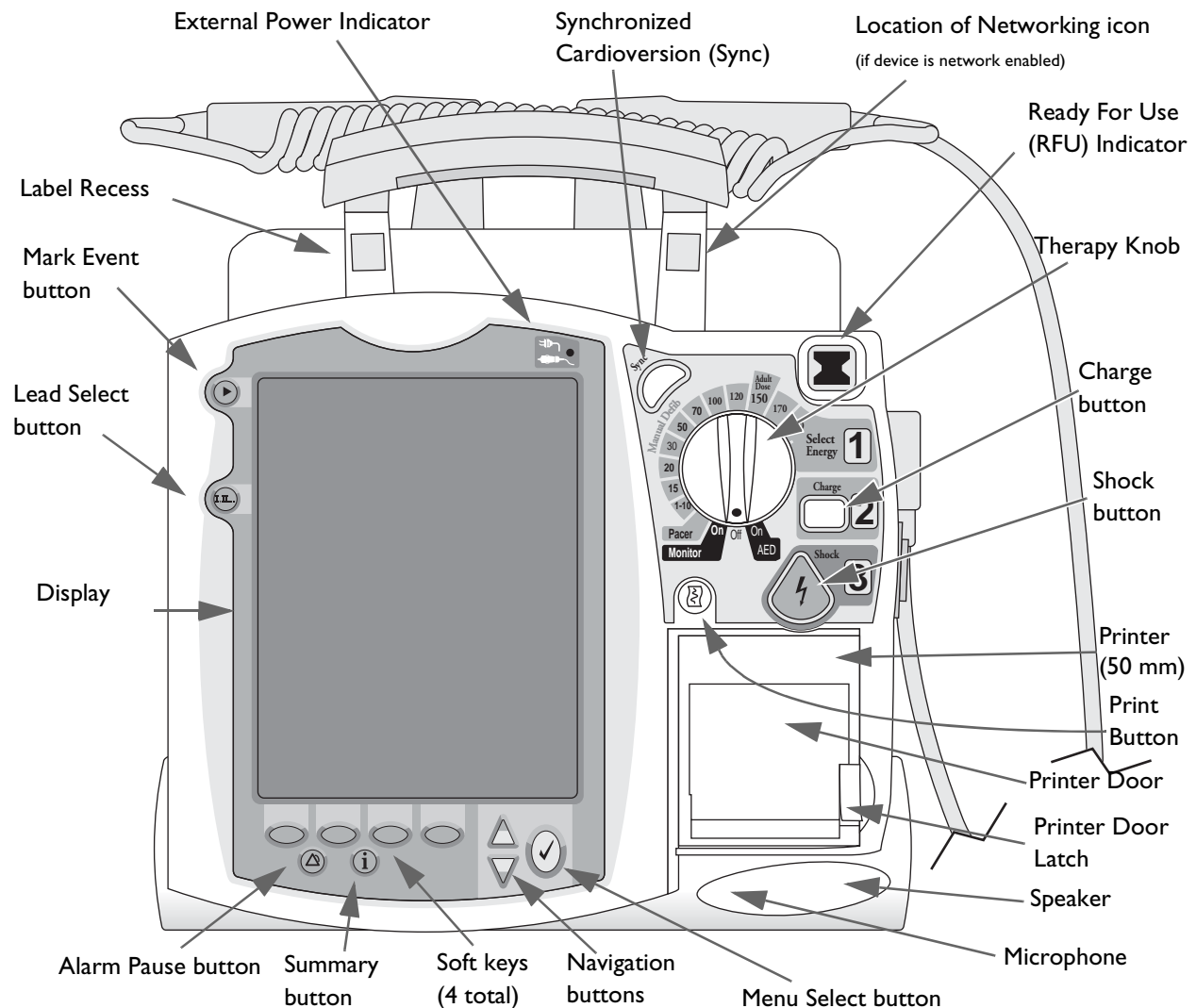
Basic Orientation

HeartStart MRx controls, indicators, and connections are carefully organized.

Front Panel

The front panel contains operational controls and indicators, as shown below.

Figure 1 Basic Orientation (Front)



Additional controls and indicators are on the paddles (if used) and batteries.

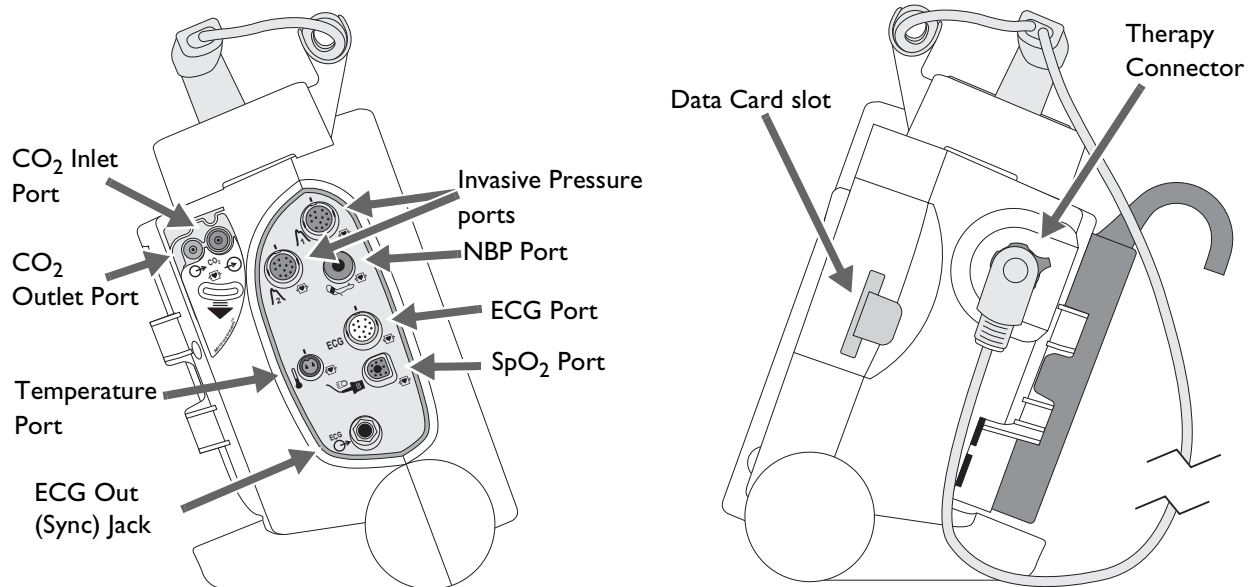
NOTE A palette of colored decals is included with your HeartStart MRx. These colored decals may be applied to the label recesses located on the device handle to aid in identification. Use an indelible marker to print identification information on the decal.

Side Panels

The left side of the HeartStart MRx has ports for monitoring cables, including ECG, pulse oximetry (SpO₂), noninvasive blood pressure (NBP), invasive pressure (2), temperature and carbon dioxide (CO₂). The ECG port may be used to connect a 3-, 5-, or 10-lead patient cable. The ECG Out jack may be used to connect to an external monitor.

The right side of the HeartStart MRx has a therapy port for paddles (external or internal), or therapy cable and multifunction electrode pads. It also has a slot for a data card to transfer patient information.

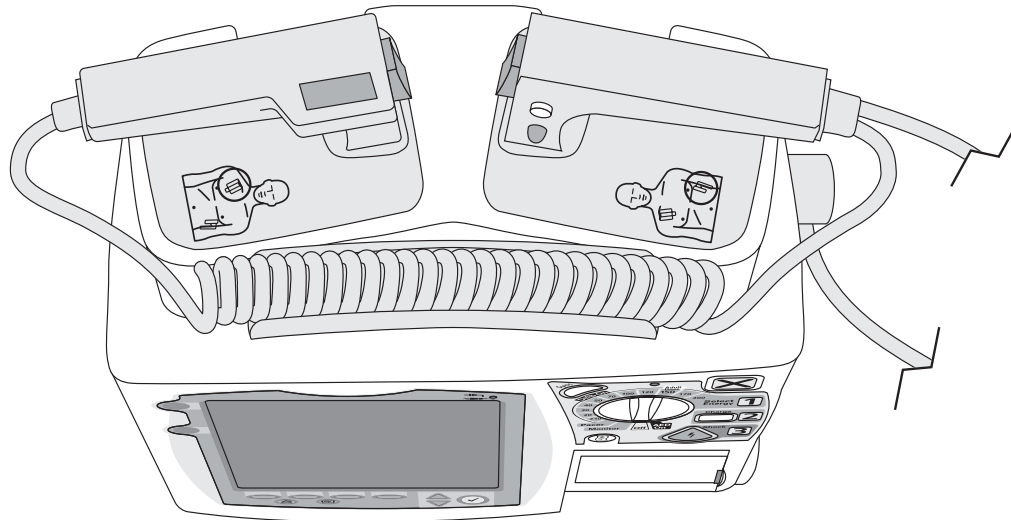
Figure 2 Basic Orientation (Right/Left Sides)



Top Panel

The top of the HeartStart MRx has a handle and basic operating instructions. If optional external paddles are present, they reside on the top panel as shown.

Figure 3 Basic Orientation (Top - with Optional Paddles)

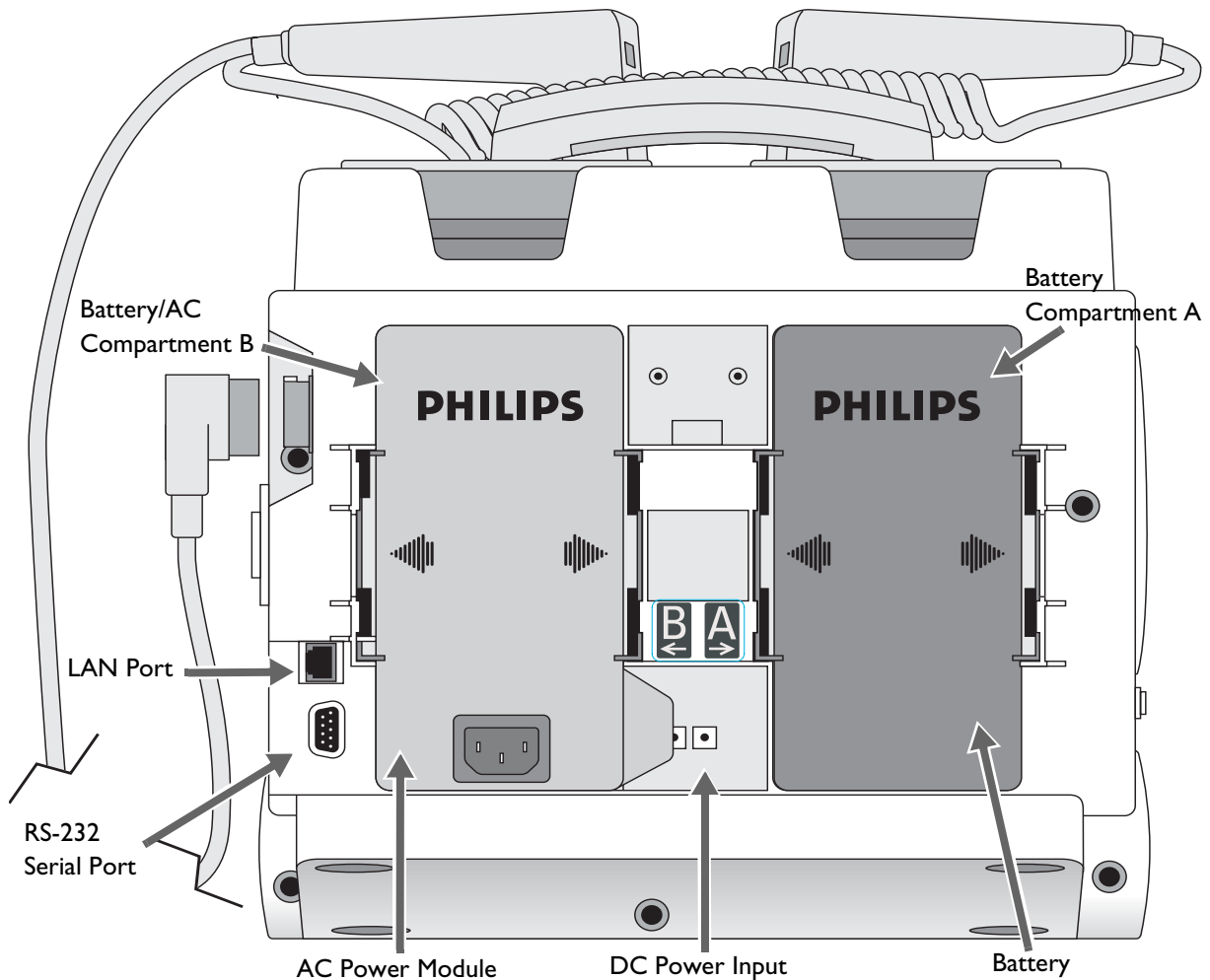


Back Panel

The back panel of the HeartStart MRx has two compartments for lithium ion batteries. Compartment B may also be used to connect an AC power module. Between the battery compartments is a DC Power Input port.

The back panel also has an RS-232 serial port for 12-lead ECG transmission or setting up a wireless connection to the IntelliVue Network. The LAN port is for a wired connection to the IntelliVue Network or for Batch LAN Data Transfer.

Figure 4 Basic Orientation (Back)



WARNING The HeartStart MRx LAN port is intended for connection to the IntelliVue Clinical Network or for Batch LAN Data Transfer. It should only be used for connection to devices that comply with IEC 60950-1 and IEC 60601-1. During real-time patient monitoring, the HeartStart MRx wired LAN connector should only be connected to the IntelliVue Network. For post-event Batch LAN Data Transfer, the HeartStart MRx should only be connected to the facility network.

The RS-232 Serial Port is intended for connection to the IntelliVue wireless backpack. It is also for connecting with the Rosetta-Lt and cellphones for data transmission. Improper system operation may result if any other device is connected to this port.

M3538A Lithium Ion Battery

The HeartStart MRx uses the M3538A Lithium Ion Battery. The battery has a fuel gauge with 5 LED indicators, each representing a charge of at least 20% of capacity. Press the fuel gauge button to illuminate the fuel gauge.

CAUTION A battery should be used as the primary power source. AC/DC should be used as a secondary source, if desired. If an AC/DC power module is used as the only power source, the HeartStart MRx takes longer to charge to the desired energy level and, in the event of power loss, all settings reset to the default settings and a new incident is created when power is returned. All stored data remains intact and can be found by retrieving the previous incident. Keep your unit charged.

Battery Capacity

A new, fully-charged M3538A battery, operating at room temperature 25°C (77°F), provides at least 5 hours of monitoring, with ECG, SpO₂, CO₂, temperature, two invasive pressures monitored continuously, NBP measured every 15 minutes, and 20 200J discharges. A fully charged new battery provides approximately 3.5 hours of monitoring, with ECG, SpO₂, CO₂, temperature, two invasive pressures monitored continuously, NBP measured every 15 minutes, and pacing at 180ppm at 160mA.

Battery Life

Battery life depends on the frequency and duration of use. When properly cared for, the M3538A Lithium Ion battery has a useful life of approximately 2 years. To optimize performance, a fully (or nearly fully) discharged battery should be charged as soon as possible.

Operating Modes


The HeartStart MRx has four clinical modes of operation, each with a customized display view. The modes are as follows:

Table 1 Operating Modes and Views

Mode of Operation	Display View	Description
Monitor Mode	Monitoring View, or 12-Lead View	Used to monitor ECG, take an optional 12-lead ECG, and monitor optional parameters such as SpO ₂ , EtCO ₂ , NBP, Invasive Pressures, Temperature and for viewing Vital Signs Trending data.
AED Mode	AED View	Used to analyze ECG and if necessary, perform semi-automatic external defibrillation. Q-CPR available.
Manual Defib Mode	Code View	Used to perform asynchronous and synchronous defibrillation (cardioversion). Q-CPR available.
Pacer Mode	Pacing View	Used to perform demand or fixed mode pacing.

NOTE Upon returning to a clinical mode from a non-clinical mode such as Configuration or Data Management, all settings reset to the default settings.

Password Security

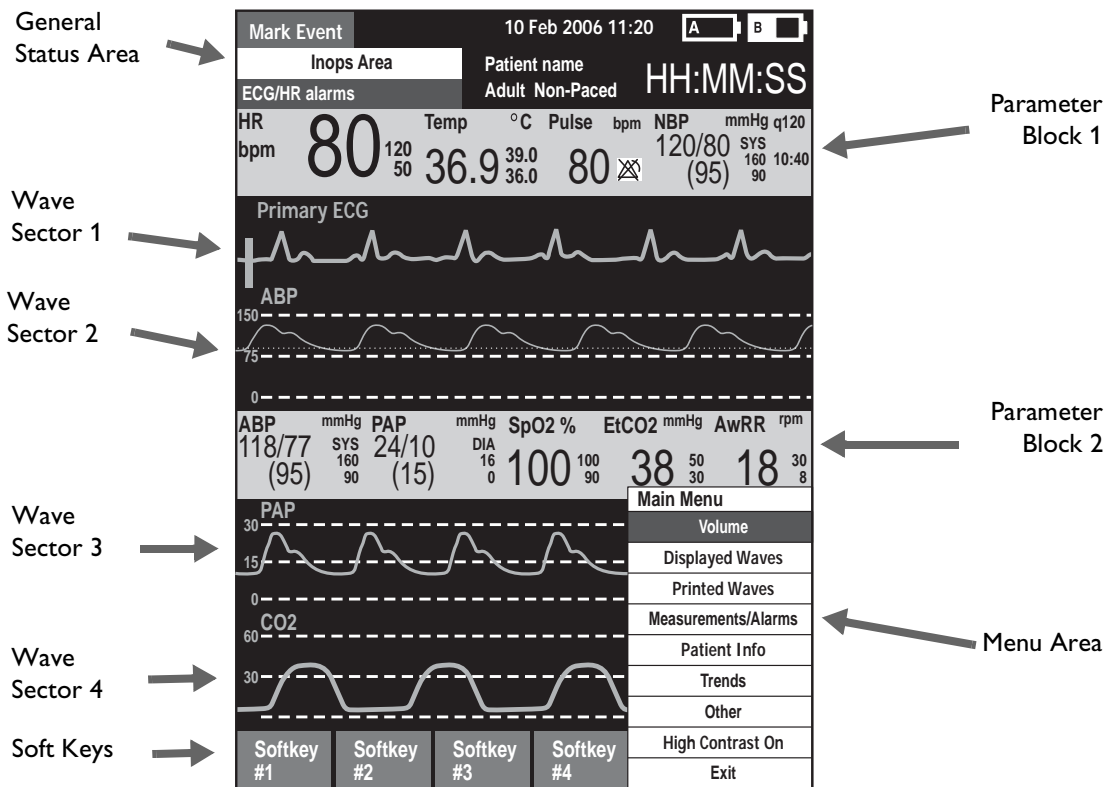
Access to Manual Defib Mode and Pacer Mode may be configured to be password protected. If the modes are password protected, you are prompted to enter the password upon moving the Therapy Knob to either the Pacer position or an energy selection. The password is entered by using the Navigation buttons to select the password numbers and then selecting **Done** to complete the entry. The Charge  button and the **[Start Pacing]** soft key remain inactive until the password is entered. AED mode is always available without a password.

WARNING Use of the Manual Therapy security password requires the clinician to know and remember the password, as defined in Configuration. Failure to enter the correct password will prevent the delivery of manual defibrillation or pacing therapy. Prior to selecting this Configuration option, review this potential risk with your Risk Manager.

Display Views

The HeartStart MRx display layout is segmented as shown in Figure 5.

Figure 5 Display Layout



NOTE Pictures of the HeartStart MRx display appearing in this manual are for illustration purposes only. The content of these areas varies with the display view, the options on your device and the function being performed.

General Status

The general status area of the display contains:

- Mark Event button label
- Date and time
- Audio recording icon. If the option is enabled, one of the audio recording icons is displayed to the left of the battery icons in all clinical modes to indicate the status of audio recording.
- Network Connectivity icon. If the option is enabled, a network connectivity icon will appear to the right of the Mark Event Statements. See “Networking” on page 177 for more information.
- Periodic Clinical Data Transmission (PCDT) icon. If the option is enabled, the PCDT icon will appear to the right of the Mark Event Statement. See “PCDT Icons” on page 250 for more information.
- Battery power indicators

Battery icons, labeled “A” and “B”, correspond with the battery compartments located at the back of the HeartStart MRx. Each battery icon displays the current available battery power, ranging from hollow (fully discharged) to full (fully charged), as shown in Figure 6. If the AC Power Module is inserted in Compartment B, the no battery icon is displayed.

Figure 6 Battery Charge Level Indicators



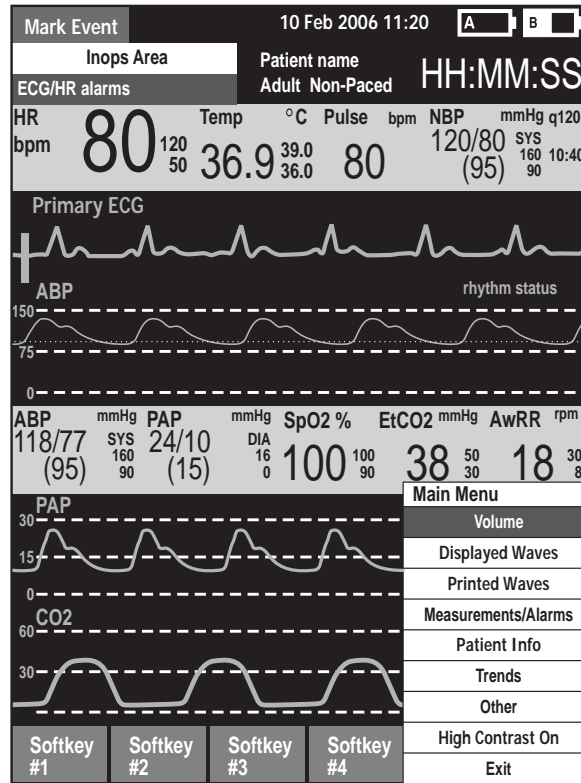
- INOP statements
INOP statements appear in the top left of the display if equipment problems are detected.
- ECG/HR alarm status
Alarm messages communicate arrhythmia alarms, as well as overall alarm status (alarms off, alarms paused).
- Patient Type
Some modes of operation allow for the entry of patient information via a menu choice. If no information is entered, the patient category is defaulted to **Adult**, unless configured otherwise, and the pacing status is set to **Non-Paced**, unless the Paced status has been previously set to paced for an internally paced patient. In Pacer Mode, Paced status is not displayed.
- Patient Name. If entered, the patient's name will appear above the patient type and paced status.
- Bed/Equipment Label. The HeartStart MRx equipment label is displayed when the device is not connected to the IntelliVue Network. The Equipment label is replaced by the bed label when connected to the IntelliVue Network.
- Event Timer
An Event Timer communicates the elapsed time for the current patient event.

Wave Sectors

The HeartStart MRx is configured to populate each wave sector with a predetermined waveform, when powered on in Monitor, Manual Defib, or Pacer Mode. Figure 7 shows the default Waves configuration choices for a device containing all monitor options. See “Configuration” on page 199 for more information.

A dashed line in a wave sector or an empty wave sector indicates that the waveform source is invalid. Wave sectors may contain a variety of information, as appropriate to the parameter, view, and task.

Figure 7 Default Waves Configuration



Wave Sector 1

Wave Sector 1 only contains an ECG waveform. This is the waveform used by the arrhythmia, heart rate derivation, and AED analysis algorithms.

If Pads are configured as the primary ECG source for Wave Sector 1, the ECG patient cable must be connected to the HeartStart MRx and to the monitoring electrodes on the patient in order to change the ECG source to a Leads selection.

NOTE When monitoring using a 3-lead ECG set, the HeartStart MRx displays 1 ECG lead at a time.


Wave Sectors 2-4

Wave Sectors 2 through 4 are automatically populated when parameter sources (cables/tubing) are connected to the HeartStart MRx. If the parameter source is the configured choice of a particular wave sector, it is displayed in that wave sector. If you connect a parameter source that is not configured to be displayed, it is displayed in the first empty wave sector. If you subsequently connect the configured parameter source, it replaces the current parameter. For invasive pressures, you should label your waveforms as they are connected to avoid possible confusion.

Changing Displayed Waveforms

Wave Sector 1 has a dedicated Lead Select button to change the displayed lead/source. Waveforms displayed in other wave sectors may be changed for the current patient through the menu. See “Menus” on page 17.

Parameter Blocks

Measurements for monitored parameters are provided in the parameter blocks. Parameter Block 1 always contains the heart rate and HR alarm settings. Other parameters are in fixed locations depending upon the options which were included in your HeartStart MRx. Each measurement is labeled and displays the current value and the high and low alarm limit settings or the  (alarms off) icon. A “-?-” is displayed until a valid measurement can be obtained.

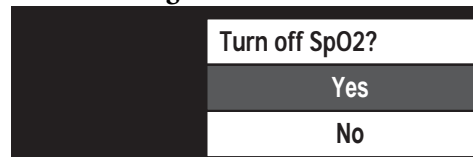
Your parameter text colors always match their corresponding wave.


Parameter Alarm Messages are displayed in the space above each numeric value, replacing the parameter label, except HR.

Turning Parameters On/Off

SpO₂, Invasive Pressures, EtCO₂ and Temperature parameters are activated when the associated parameter cable/tubing is connected. To turn the parameter off, disconnect the cable/tubing from the HeartStart MRx. A prompt message (see Figure 8) alerts you that the parameter has been disconnected and requests confirmation to turn the parameter off.

Figure 8 Parameter Message






Press the Menu Select  button to select **Yes**, confirm your action and turn off the parameter. If you do not wish to turn the parameter off, use the Navigation Buttons to highlight **No**. Press the Menu Select button to keep the parameter on and reconnect the cable/tubing. You can also ignore the message and reconnect the cable/tubing. The HeartStart MRx will detect the connection and remove the message.

Soft Key Labels

The four soft key labels correspond to the soft key buttons located immediately below. These labels change, as appropriate, according to the current display view and function. Soft key labels appearing as gray text indicate that the soft key is inactive.

Menus

Menus with controls and options specific to each function of the HeartStart MRx are easily accessible using the Menu Select and Navigation buttons located on the front panel. Menus are used to adjust volume, select waveforms for display, select waves for printed strips, set alarms, schedule measurements, enter patient information, perform the Operational Check, generate reports, and a variety of other tasks. Menus and submenus are organized to allow you to conveniently make selections and enter information.

To display a menu, press the Menu Select  button. Then use the up  or down  Navigation buttons to scroll through the available choices until the desired selection is highlighted. The menus have a wrap-around scrolling feature. Holding the Navigation button down accelerates scrolling through the menu choices. Once you hit the bottom of a menu, it automatically wraps around to the top of the menu and continues scrolling.

To activate a selection, press the Menu Select button. Select **Exit** to close the menu without activating a selection. Arrows at the bottom of the list indicate additional list options are available. An indication of which page you are on in the menu is located between the arrows. Scrolling down (or up) reveals the remaining options. Depending upon the situation, there are times when some options on various menus are unavailable for use. These options will appear in menus as “grayed out” and can’t be highlighted or selected. See Figure 9.

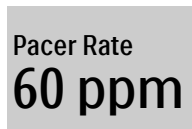
Figure 9 Sample Menus



Value Adjustment

By using the HeartStart MRx’s Navigation buttons you can set numeric values for several parameters by displaying a values box in the Menu area. See Figure 10. Some values are adjustable in increments other than 1. Hold the Navigation button down to accelerate scrolling through the numeric values. Release the Navigation button to stop the scrolling. The value initially displayed is the default value.

Figure 10 Setting Values

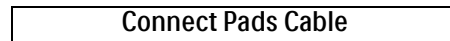


NOTE Accelerated scrolling is not available when setting Pacer Rate and Pacer Output.


Message Windows

Periodically, message windows appear on the display to provide additional status information, alert you to an error or a potential problem, or direct you to take action. Remain alert to these messages. If a response is required, use the Navigation buttons and Menu Select buttons to highlight and select the appropriate action.

Figure 11 Sample Message Window



High Contrast Display

To optimize visibility of the HeartStart MRx display when used in bright sunlight, the device provides a High Contrast feature which may be enabled. In this view, the MRx display appears using a yellow background with all other screen elements appearing in black or shades of gray. High Contrast is enabled in Manual Defib, Pacer and Monitor Modes by pressing the Menu Select  button and selecting **High Contrast On** from the Main Menu.

NOTE The High Contrast feature does not display colors configured as red or blue, therefore, be sure your device is configured correctly with the appropriate parameter color settings. Refer to “Configuration” on page 199 for more information.

Controls

The Therapy Knob is used to turn the HeartStart MRx on in the desired mode of operation. Operating controls are organized by function, with general function buttons located along the left and bottom sides of the display, defibrillation controls to the right of the display, and soft keys immediately below the display. (See Figure 1.)

Therapy Knob


The Therapy Knob serves as the power switch for the HeartStart MRx. It can be set to:


- **Off**
- **AED** - to enable AED Mode for semi-automated external defibrillation.
- **Monitor** - to enable Monitor Mode for 3- or 5-lead ECG monitoring, 12-lead ECG acquisition (optional), Vital Signs Trending, or monitoring of optional parameters.
- **Pacer** - to enable Pacer Mode (optional) for demand or fixed mode pacing.
- **Manual Defib** - to enable Manual Defib Mode for asynchronous or synchronous defibrillation (cardioversion) at the selected energy setting.


In Manual Defib Mode, without Pacing, the defibrillation energy settings are labeled as 1-9, 10, 15, 20, 30, 50, 70, 100, 120, 150, 170, and 200 Joules. If your unit is equipped with Pacing, the energy settings are labeled as 1-10, 15, 20, 30, 50, 70, 100, 120, 150, 170, and 200 Joules.


General Function Buttons

The general function buttons control monitoring or non-critical resuscitation activities. They include:


Mark Event button  - allows you to insert a time-stamped annotation in the Event Summary Report to note events as they occur, including the administration of certain drugs. A Mark Event button label appears at the top left corner of the display.


Lead Select button  - changes the ECG lead in Wave Sector 1. Pressing this button cycles through the available ECG waves, changing the displayed wave and label. The list of available ECG waves is based on the current lead set and device configuration, and includes pads or paddles, if the corresponding cable is connected to the device.

Alarm Pause button  - The Alarm Pause button pauses all visual and audible physiological alarms and audible inops for the configured time interval. At the end of the pause interval, each alarm returns to its previous setting (On or Off). Pressing the Alarm Pause button during the pause interval also returns alarms to their previous settings.

Print button  - The Print button initiates a continuous print-out of the primary ECG and other selected waveform(s) either real-time or with a 10-second delay, depending on your configuration. Pressing the Print button while printing is in progress stops the printing.

Summary button  - The Summary button displays a menu from which you can print the current or most recent Event Summary report or Vital Signs Trending Report.

Menu Select button  - Pressing the Menu Select button either brings up the current menu or confirms a menu selection.

Navigation buttons  - The Navigation buttons display the current menu just as the Menu Select button does. Additionally, within any menu or list, these buttons move to the next or previous item in the list. They also increase or decrease numbers or values in a sequence.

Defibrillation Controls

The defibrillation controls are shown in Figure 12. They include:

Therapy Knob - Enables AED or selects an energy for Manual Defib Mode defibrillation or cardioversion.

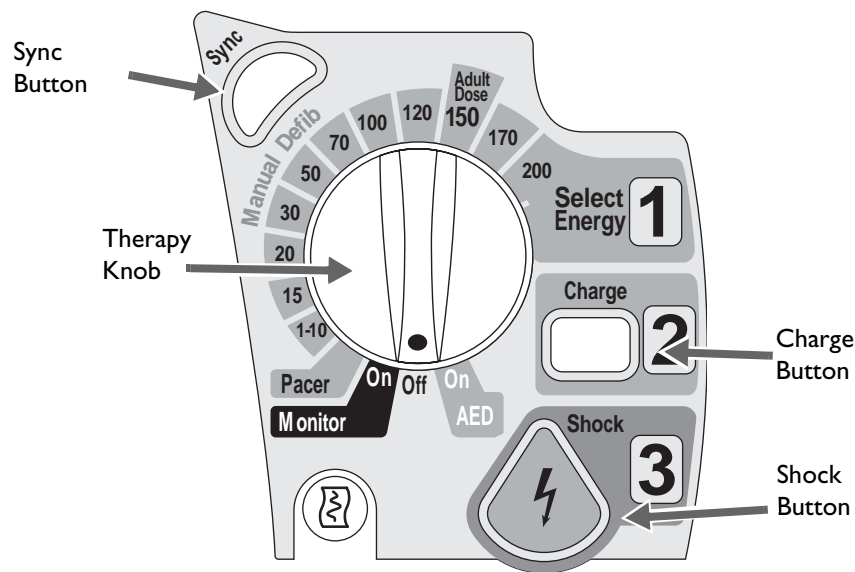
Charge Button - Charges the defibrillator to the selected Manual Defib energy setting. Used only in Manual Defib Mode. In AED Mode, the defibrillator charges automatically.

Shock Button - Delivers a shock through multifunction electrode pads or switchless internal paddles. In AED mode a 150J shock is delivered. In Manual Defib Mode, the shock is delivered at the selected Manual Defib energy setting.

NOTE When external paddles or switched internal paddles are used, once the HeartStart MRx is fully charged, the shock is delivered by pressing the Shock button(s) on the paddles.

Sync Button - Toggles between synchronized energy delivery used during cardioversion and asynchronous energy delivery used during defibrillation.

Figure 12 Defibrillation Controls







Soft Keys

The soft keys perform the function displayed as a label appearing immediately above on the display. The labels (and, therefore, the function) change appropriately for the various modes of operation and are described in the following chapters.

Indicators

The HeartStart MRx indicators provide a visual display of device status.

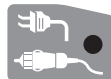
Ready For Use Indicator The Ready For Use (RFU) indicator is located on the upper, right corner of the device. It indicates the status of the therapy delivery functions of the monitor/defibrillator using the following definitions:

- A blinking black hourglass symbol  indicates the shock, pacing, and ECG functions of the device are ready for use. Sufficient battery power is available for device operation. Additionally, a blinking black hourglass, together with the presence of external power (AC or DC), indicates that installed battery(s) are being charged.
- A blinking red "X"  and a periodic audio chirp indicate no battery is present or a low battery condition. The device can be used, but its operation time is limited. If a battery is inserted and charging, the audio chirp is not present.
- A solid red "X"  and a periodic audio chirp indicate a failure has been detected that may prevent the delivery of defibrillation therapy, pacing, or ECG acquisition. When turned on, the device displays INOP messages for the failures detected.
- A solid red "X"  without periodic audio chirps indicates either there is no power available, or the device cannot power on. If, after power is supplied, the indicator reverts to the blinking black hourglass symbol, the device is once again ready for use.

NOTE The RFU indicator may briefly display a solid red "X" when initially turning the device on, when switching between clinical and non-clinical operating modes, and at the start of any automated test. This does not indicate a failure of the device.

External Power Indicator The external power indicator is located above the display. It is green if power is being provided by an external AC or DC power source. See Figure 13.

Figure 13 External Power Indicator



NOTE The external power indicator will momentarily go out when charging for defibrillation with a charged battery installed. This is normal operation, as the device is switching its power source to the battery for a faster charge time.



NOTE The AC Line Filter default setting of all HeartStart MRx devices is 60 Hz. You should adjust the AC Line Filter default to the electric power frequency of your country. See "Configurable Parameters" on page 202.

Audio Recording

If your device has the Audio Recording option, it is configured to “On” by default and cannot be turned off during use, but can be turned off in Configuration Mode. If configured, audio will be recorded in Manual, Pacing, 12-Lead, Monitor and AED modes, independent of whether Sync is on or off. You can record up to 90 minutes of audio during an event. The audio is synchronized with clinical event data.

One of the following icons is displayed to the left of the battery icon in all clinical modes:

Table 2 Audio Recording Icon

Symbol	Definition
	Audio recording on.
	Audio recording off.

Audio is not recorded if the Audio Recording configuration setting is set to Off or 90 minutes of audio has been recorded for the current event.

NOTE You need to be within five feet of the HeartStart MRx (three feet if the printer and CO₂ are running) for a quality voice recording.

Reviewing Recorded Audio

To review recorded audio, transmit your Event Summary from the HeartStart MRx to a receiving personal computer running Event Review Pro software. For more information about Event Review Pro, go to www.medical.philips.com and search for data management. For more information on HeartStart MRx transmission options see “Data Transmission” on page 239.

Alarms

The HeartStart MRx provides various alarm types indicating changes in patient condition or device/cable conditions which may require attention. Table 3 details different alarm types.

Table 3 HeartStart MRx Alarm Types

Type of Alarm	Condition
Red	High priority. Life-threatening alarm condition is present. Immediate operator response is required. Red alarm message; alarm tone.
Yellow	Medium priority. Non life-threatening alarm condition is present. Prompt operator response is required. Yellow alarm message; alarm tone.
INOP	Low priority. Most technical alarms are grouped together as INOPs and are handled as low priority alarms indicating a problematic condition exists related to the ability of part or all of the device to perform its intended monitoring function. Operator awareness is required. Exception: conditions which stop or may stop the delivery of pacing therapy and invasive pressure disconnect. These are classified as high priority technical alerts. They are potentially life-threatening conditions.
Latching	Alarm is announced and remains present regardless of whether the alarm condition continues to exist. A latching alarm is not removed until it is either acknowledged or a higher priority alarm condition occurs.
Non-latching	Alarm is automatically removed when the alarm condition no longer exists.

NOTE The presence of multiple alarm conditions is quite possible. Announcing all of the detected alarms would cause confusion and a less serious condition might hide a more serious condition. For this reason, alarms are prioritized and categorized so that the most serious or highest priority alarm condition is the one announced. If multiple same-parameter, same-priority alarms occur, all alarms will be displayed.

NOTE Audio is suppressed for INOP alarms for the first 60 seconds after the HeartStart MRx is turned on. INOP messages do appear on the display.

Responding to Alarms

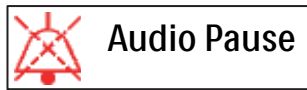
Alarm limits are displayed with each parameter if alarms for the parameter are on. When an alarm condition occurs and an alarm is indicated, visually and audibly, there are several ways to respond. Initially:

- 1 Attend to the patient.
- 2 Identify the alarm(s) indicated.
- 3 Silence the alarm(s). When a physiological alarm is announced, the audio pause label (see Figure 14) is displayed above the Navigation and Menu Select buttons. Pressing any of these buttons will silence the audio for all active alarms while you are attending to the patient. If the alarming condition continues to exist, it will re-alarm in two minutes. Silencing a specific alarm does not prevent another alarm condition from sounding. If you also silence the second alarm, it resets the two-minute audio pause for all active alarms.

When an INOP is announced without a concurrent physiological alarm, the audio off label is displayed above the Navigation and Menu Select buttons. Pressing any of these buttons will silence

the audio for all active alarms while you are attending to the patient. INOPs do not reannunciate after pressing audio off.

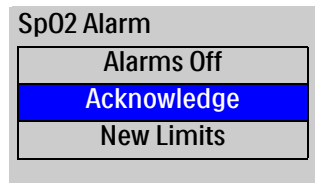
Figure 14 Audio Pause Label




Then:

- 4 Address the alarm condition on the HeartStart MRx. The menu shown in Figure 15 appears.

Figure 15 Sample Alarm Response Menu



Alarms Off Turns the monitoring parameter's alarms off and prevents future parameter alarms from alarming. The alarm message is no longer displayed, and the  icon appears next to the parameter value.

Acknowledge For latching alarms, acknowledge clears the alarm condition when the condition no longer exists.

New Limits Adjust the parameter alarm limits accordingly.

NOTE Alarm history can be accessed in the patient's Event Summary. This information is maintained after powering the device down and in the unlikely event of power loss.

WARNING Although the Alarm Pause button can be used when responding to alarms, the response procedures described above are recommended. Alarm Pause removes audio and visual indications of active alarm conditions as well as inhibiting indications of new alarm conditions.

A potential hazard exists if different alarm limits are used for the same or similar equipment in any single area.

Confirm the alarm limits are appropriate for the patient each time there is a new patient incident.

Do not set alarm limits to such extreme values that render the alarm system useless.

NOTE Heart Rate and Arrhythmia Alarms function a bit differently than other alarms. For information about responding to these alarms, see "Responding to HR and Arrhythmia Alarms" on page 59.

Printing on Alarms

You can configure your HeartStart MRx to automatically print on certain alarms and not on others. See “Printing Settings” on page 220 for more information.

Identifying Your Device

There are multiple ways to identify your HeartStart MRx and the data transmitted from it.

In Configuration Mode you can set up an Institution Name and/or Device ID. These two names are not configurable during a patient event. You can also set up multiple Reference IDs which are selectable during a patient event.

For example a HeartStart MRx could have the Institution Name "City Hospital" and a Reference ID of "Emergency Department 1" or "City Fire & EMS" and "Truck 32". The Institution Name and Reference ID are part of the data transmitted to a receiving device/institution.

For devices with the IntelliVue Network installed, Reference IDs are replaced with an Equipment Label if the device is not on an active network and a Bed Label if it is on an active network.

Reference ID information is entered using the Reference ID menu. You can pre-configure up to 20 Reference IDs and can also manually enter one new Reference ID during a clinical event. Each Reference ID can be up to 16 characters long and can include uppercase letters, numbers, spaces and hyphens. See “Configuration” on page 199 and “Periodic Clinical Data Transmission” on page 250.

The HeartStart MRx maintains Reference IDs until:

- changed by the user
- changed in Configuration Mode
- a new HeartStart MRx configuration is imported

Institution ID, Device ID and Equipment/Bed Label identifications are entered in Configuration Mode. See “Configuration” on page 199.

NOTE Institutions should develop clear naming conventions for users to follow in order to assure accurate post-event data review.

Entering Patient Information

Patient information may be entered for the following:

- Name
- ID
- Patient Category
- Age (Date of Birth if the IntelliVue Networking option is installed)
- Sex
- Chest Pain (if the ACI-TIPI and TPI option is installed)
- Paced (internal paced status)

Information is entered using the **Patient Info** menu. Patient Name is entered using 2 alphabetical lists, one to enter the last name, followed by another to enter the first name. When each name is complete, select **Done**. Select **Cancel** to close the patient name menu without saving.

NOTE Pediatric patients are defined on the HeartStart MRx as children under 8 years old or less than 25kg. Adult patients are defined as 8 years old and over or 25 kg (55 lbs.) and heavier.

Continued Use

Once a patient event begins, the Continued Use feature is activated. This feature facilitates continued treatment of the same patient by retaining the current settings and the patient record when the HeartStart MRx is turned off for less than 10 seconds, for instance when switching between AED and Manual Defib Modes or when the Therapy Knob is inadvertently moved to **Off**. When turned on within the 10-second time period, the HeartStart MRx retains the most recent settings, including:

- Alarm settings
- Wave Sector settings
- Event Timer
- QRS, alarm tone, and voice prompt volumes
- ECG gain
- Vital Signs Trending data
- Pacing settings (The device DOES NOT automatically resume pacing.)
- Patient record in the Event Summary Report; new data is appended to the record.


The Sync feature remains active if the HeartStart MRx is turned off for less than 10 seconds. However, Sync is disabled when AED Mode is activated, and must be turned on upon returning to Manual Defib Mode.

NOTE The Continued Use feature will not function if all sources of power (battery and external AC/DC power modules) are removed from the device, even briefly.


Printing Waveforms

By using the Print Button on the front of the HeartStart MRx, you can obtain a continuous printout of the primary ECG and one additional waveform if you have the 50mm printer installed; two additional waveforms if you have the 75mm printer installed. Certain waveforms (including invasive pressures and CO₂) will include scale indications on the printout. The printouts are generated either real-time or with a 10-second delay, depending on your configuration.

For devices with a 50mm printer, to change wave forms for the second wave printed, perform the steps below:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select the **Printed Waves** option and press the Menu Select button.
- 3 Using the Navigation buttons, select the wave form you want to print in Wave 2 and press the Menu Select button.

For devices with a 75mm printer, to change wave forms for the second or third waves printed, perform the steps below:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select the **Printed Waves** option and press the Menu Select button.
- 3 Using the Navigation buttons, select **Wave 2** or **Wave 3** and press the Menu Select button.
- 4 Using the Navigation buttons, select the wave form you want printed and press the Menu Select button.
- 5 Repeat Steps 2 through 4 for the other printed wave.


Return to Owner

The Return to Owner feature allows the owner of the HeartStart MRx to enable a specified loan period. When the time period is up, the borrower of the HeartStart MRx will be reminded to return the device to its owner as identified on the display. The feature is password protected in Configuration and enabled through the **Other** Menu, where the owner can activate, deactivate, and specify the length of the loan period.


NOTE Monitoring and defibrillation functions are suspended while the Return to Owner set-up screen is displayed. Alarms Off is indicated on the display. Monitoring and defibrillation functions will return when exiting the Return to Owner screen.

NOTE The appearance of the loan expiration message does not disable monitoring and defibrillation functionality.

To enable the Return to Owner feature:

- 1 Press the Menu Select  button.
- 2 Select **Other** from the menu and press the Menu Select button.
- 3 Select **Return To Owner** and press the Menu Select button.
- 4 Press the **[Activate]** soft key.
- 5 Enter the number of days in the loan period and press the Menu Select button.
- 6 Press the **[Exit Return-To]** soft key.

To disable the Return to Owner feature:

- 1 Press the Menu Select  button.
- 2 Select **Other** from the menu and press the Menu Select button.
- 3 Select **Return To Owner** and press the Menu Select button.
- 4 Press the **[Deactivate]** soft key.
- 5 Enter the password and press the Menu Select button.
- 6 Press the **[Exit Return-To]** soft key.

Setting Up

This chapter provides the basic set-up information you need to prepare your HeartStart MRx for operation and to connect the optional monitoring accessories.

NOTE If your HeartStart MRx does not have some of the optional functionality or accessory pouches listed in this chapter, disregard these features and related information.

Before using the HeartStart MRx, review the configuration settings of your device. Confirm and update the settings as appropriate.

Attaching the Carrying Case and Accessory Pouches

The HeartStart MRx accessory pouches are designed to hold your essential monitoring and defibrillation accessories. Follow the procedures below for assembly and recommended accessory placement.

- 1 Disconnect all external power and remove all batteries.
- 2 Lower the device into the sleeve of the carry case. The rear base of the device fits in the sleeve socket.

Paddle Tray

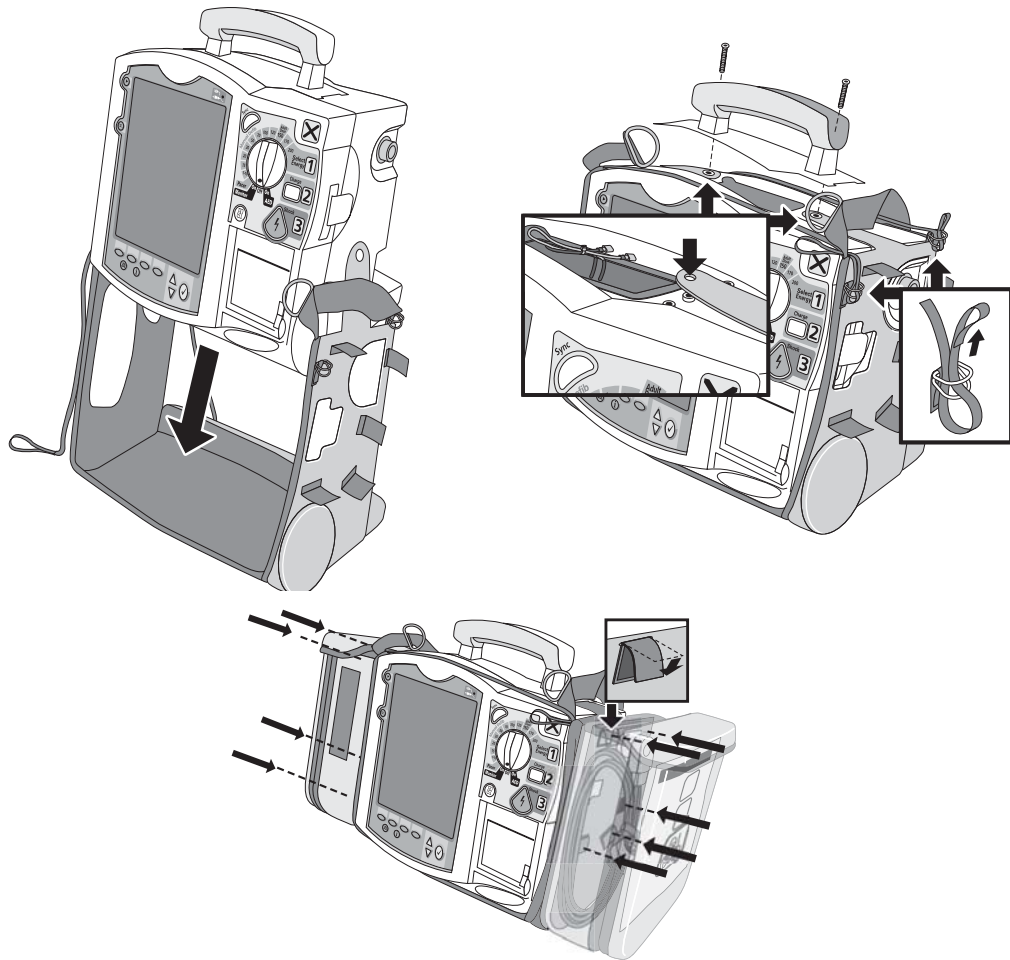
- a. If paddles are connected, disconnect them from the Therapy port and remove them from the paddle tray.
- b. Remove the 4 T-15 screws from the tray plates.
- c. Gently lift the paddle tray up, leaving all wires connected.

Handle Only

- a. Remove the handle cover by pushing in on either side of the handle cover and lifting up or by lifting the corners of the label to expose the two T-15 screws.
- b. Remove the 2 T-15 screws.
- c. Remove the handle.
- d. Gently lift the cap plate up.

- 3 Fold the two sleeve flaps over the top of the device, positioning them so that the screw holes are exposed.
- 4 Replace the paddle tray (and 4 T-15 screws) or cap plate, as appropriate, so that the molded openings fit over the sleeve flaps.
- 5 Replace the handle.
- 6 If your handle cover does not have screw holes, insert the 2 T-15 screws and tighten. Then snap the handle cover in place by pushing down on either side of the handle cover.
- 7 If your handle cover has screw holes, replace the handle cover and then insert the 2 T-15 screws and tighten. Smooth down the label corners to cover the screw holes.
- 8 Secure the front and rear cinch straps using the metal rings provided.
- 9 Perform an Operational Check as described in, “Operational Check” on page 270.
- 10 Attach the side pouches using the hook and loop fastener with the flaps and slots.

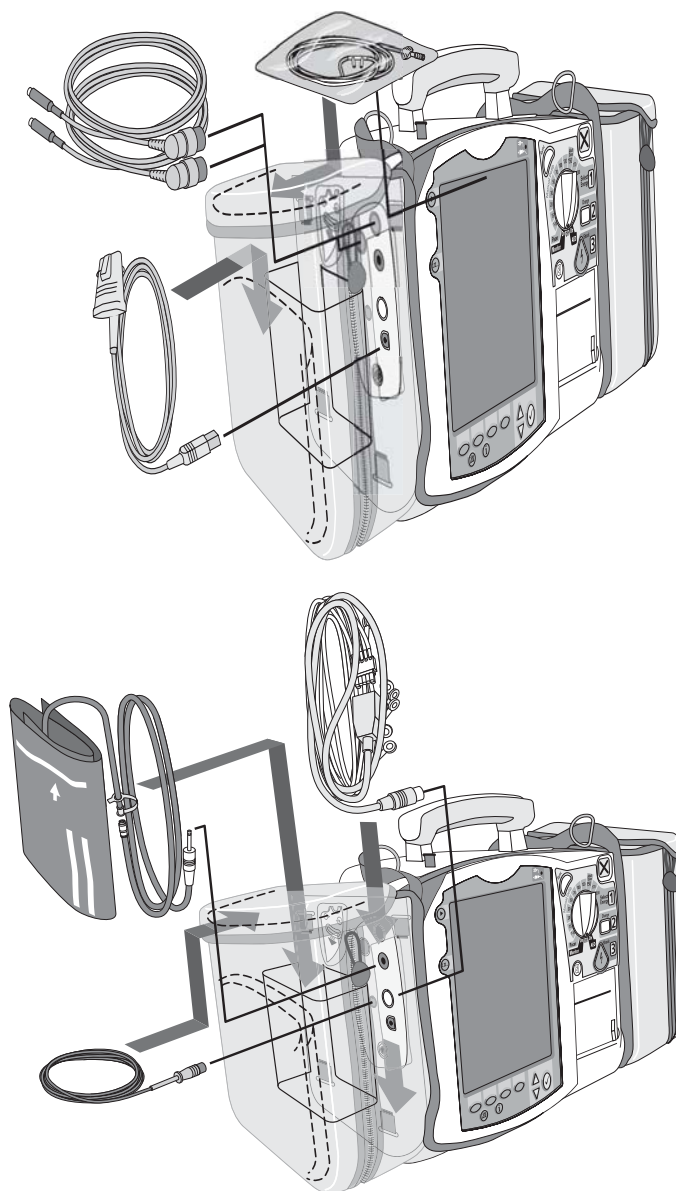
Figure 16 Accessory Pouch Assembly



Storing Accessories

Suggested parameter cabling and accessories storage is shown below.

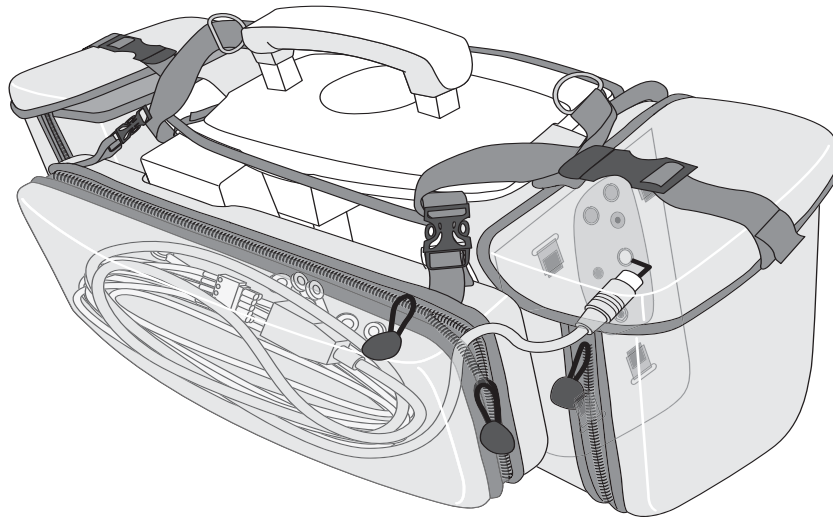
Figure 17 Storing Accessories



- 1 Attach the Therapy cable and route it through cable fastener loop, securing the cable just below the strain relief.
- 2 Attach the rear pouch using the buckles provided.

NOTE Depressions are provided on the inside of the rear pouch should you wish to make a cut-out to accommodate external power. Some devices may come with the cut-outs already made.

Figure 18 Connecting Cables



WARNING When using the carry bag to transport the HeartStart MRx, it is important to position it with the display facing away from the body. If not, the Therapy Knob may be bumped and inadvertently moved from its current position.

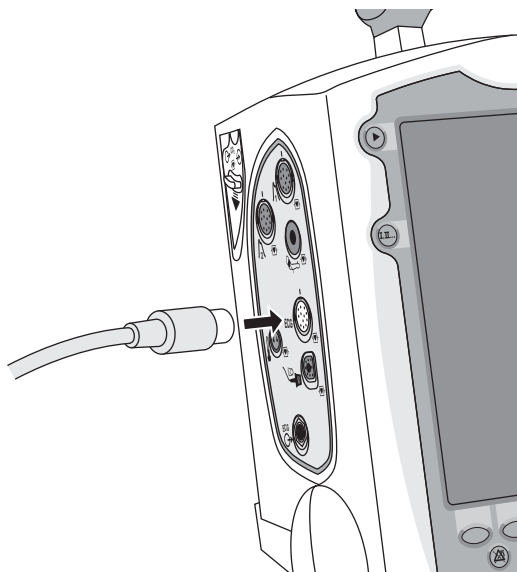
NOTE When packing cables into the carry bag, keep them untangled to ensure quick and easy deployment when needed.

Connecting the ECG Cable

To connect a 3-, 5- or 10-lead cable:

- 1 Align the ECG cable with the white ECG port, as shown in Figure 19. The white key marker on the ECG cable faces the top of the device.
- 2 Push the ECG cable firmly into the ECG port, until the white portion of the cable connector is no longer visible.

Figure 19 Connecting the ECG Patient Cable

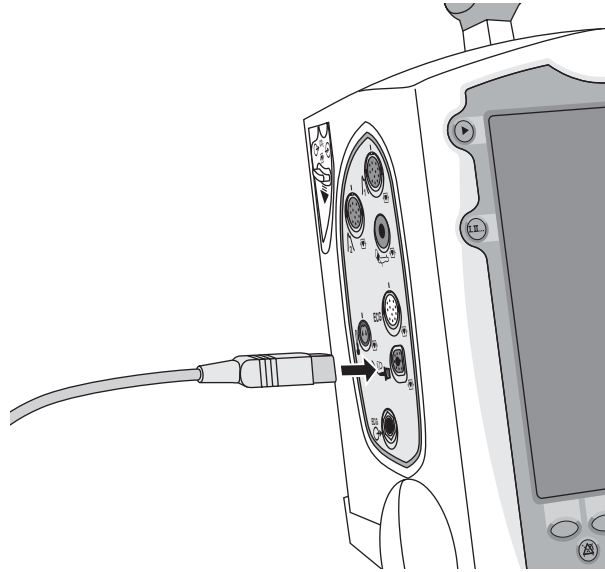


Connecting the SpO₂ Cable

To connect the SpO₂ cable:

- 1 Hold the cable connector with the flat side facing front, as shown in Figure 20.
- 2 Insert the cable into the blue SpO₂ port on the HeartStart MRx and push until the blue portion of the cable connector is no longer visible.

Figure 20 Connecting the SpO₂ Cable

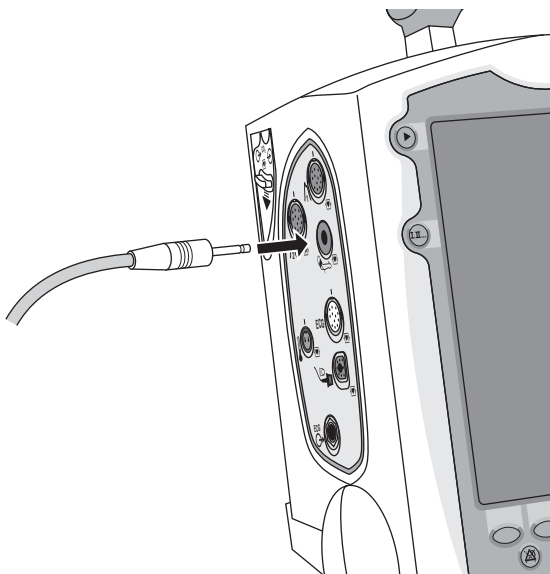


Connecting the NBP Interconnect Tubing

To connect the NBP Interconnect Tubing:

- 1 Insert the NBP Interconnect Tubing into the red NBP port as shown in Figure 21.
- 2 Attach the NBP Interconnect Tubing fitting to the NBP cuff.

Figure 21 Connecting NBP Interconnect Tubing / NBP Cuff

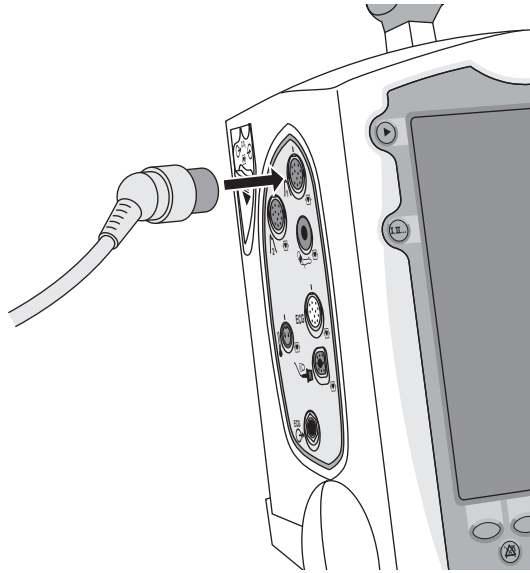


Connecting the Invasive Pressures Cable

To connect the invasive pressure cable:

- 1 Insert the invasive pressure cable into either of the invasive pressure ports as shown in Figure 22.
- 2 Attach the invasive pressure cable to your transducer/tubing.
- 3 Assign a label to the connection on the HeartStart MRx. See “Selecting a Pressure to Monitor” on page 117.

Figure 22 Connecting Invasive Pressure Cable

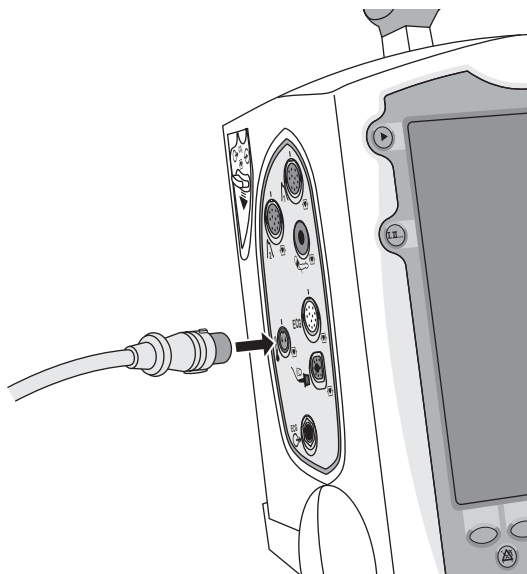


Connecting the Temperature Cable

To connect the temperature cable:

- 1 Insert the temperature cable into the temperature port as shown in Figure 23.
- 2 If needed, attach the cable to your probe.

Figure 23 Connecting the Temperature Cable

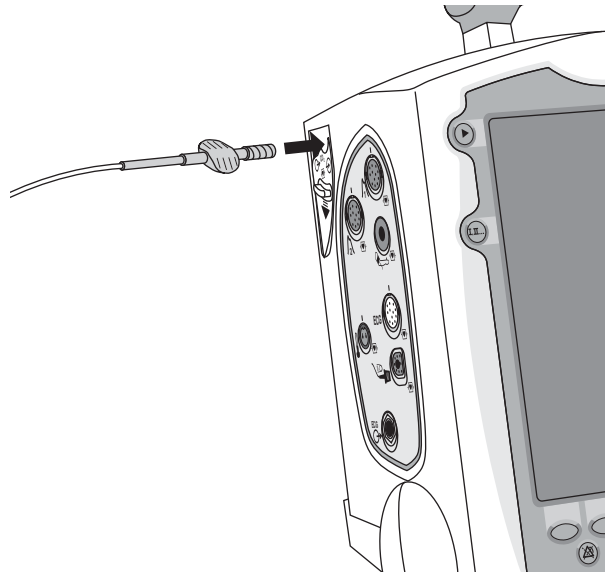


Connecting the CO₂ FilterLine

To connect the CO₂ FilterLine®:

- 1 Using the end of the FilterLine fitting, slide the CO₂ compartment door down.
- 2 Insert the fitting into the CO₂ Inlet port as shown in Figure 24.
- 3 Turn the fitting clockwise into place.

Figure 24 Connecting the CO₂ FilterLine

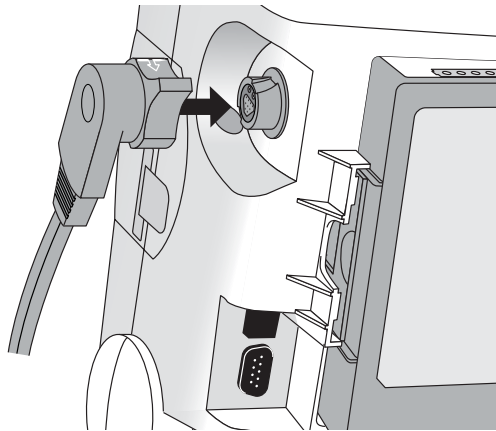


Connecting the Therapy or Pads/CPR cables

To connect the Therapy or Pads/CPR cable:

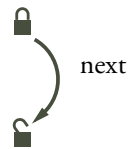
- 1 Align the white pointer on the cable with the white arrow on the green Therapy port as shown in Figure 25.
- 2 Insert the cable into the green Therapy port. Push until you hear it click into place.
- 3 If you are using the carry case, thread the cable through the fabric fastener at the bottom of the side pouch to secure the cable into position.

Figure 25 Connecting the Therapy or Pads/CPR Cable



To detach the Therapy or Pads/CPR cable:

- 1 Rotate the green knob in a clock-wise direction as indicated by the lock/unlock symbol to the Therapy door.
- 2 Pull the cable away from the device.



Installing Paper

50 mm paper

To install printer paper:


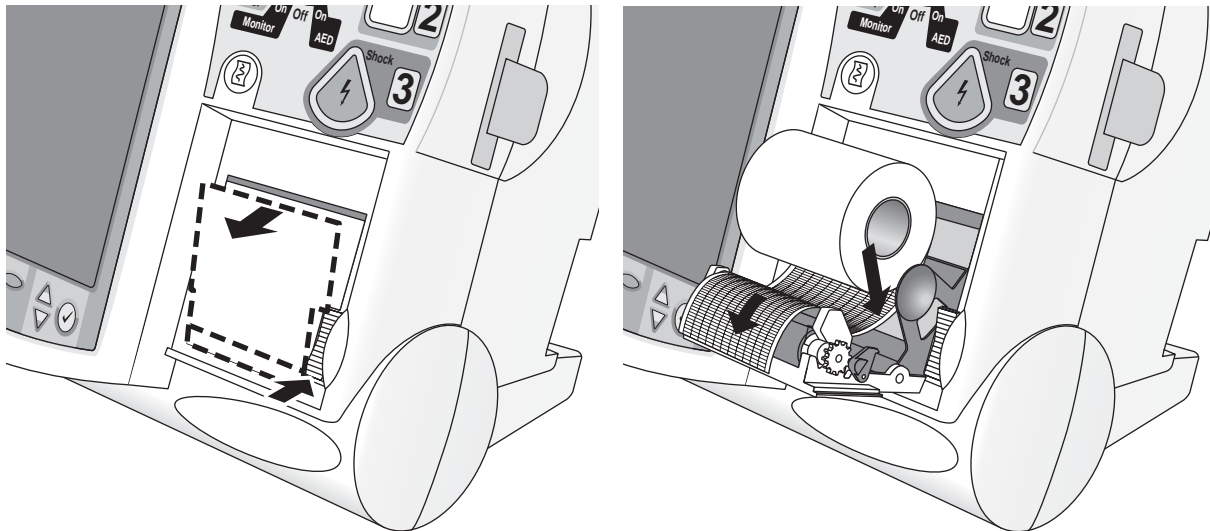
- 1 Open the printer door by pushing on the latch as shown in Figure 26.
- 2 If there is an empty or low paper roll in the printer, pull up on the roll to remove it.
- 3 Examine a new roll of printer paper and remove any remaining adhesive residue from the outer layer of paper.
- 4 Place the new roll of printer paper into the paper well, positioning the roll so that the end of the roll is on the bottom and the grid faces up as indicated by the symbol  inside the printer door.
- 5 Pull the end of the paper out past the paper roller.
- 6 Close the printer door.

Figure 26 Installing Paper (50mm)



75mm Printer (optional)

To install printer paper:


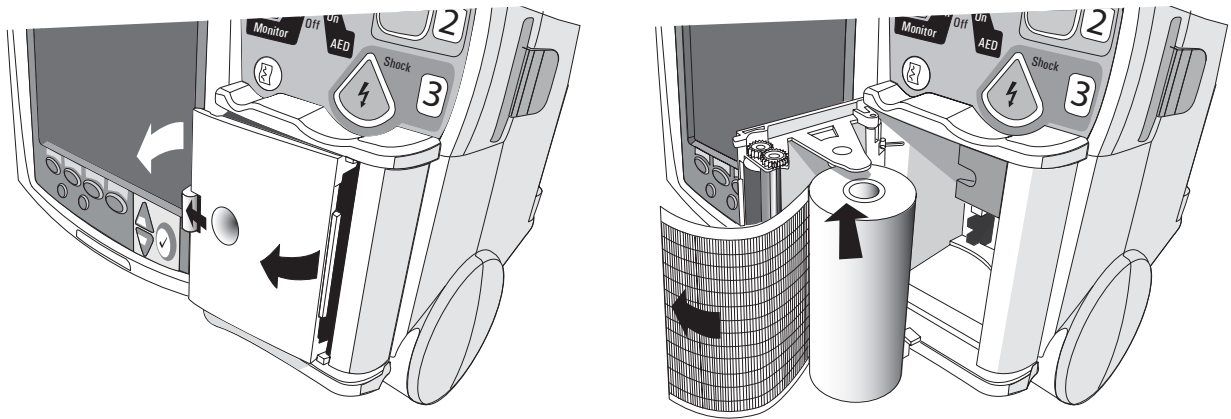
- 1 Open the printer door by pushing on the latch as shown in Figure 27.
- 2 If there is an empty or low paper roll in the printer, pull up on the tab holding the paper roll to remove it.
- 3 Examine a new roll of printer paper and remove any remaining adhesive residue from the outer layer of paper.
- 4 Place a new roll of printer paper into the paper well, positioning the roll so that the end of the roll is on the bottom and the grid faces up as indicated by the symbol  inside the printer door.
- 5 Pull the end of the paper out past the paper roller.
- 6 Close the printer door.

Figure 27 Installing Paper (75mm)

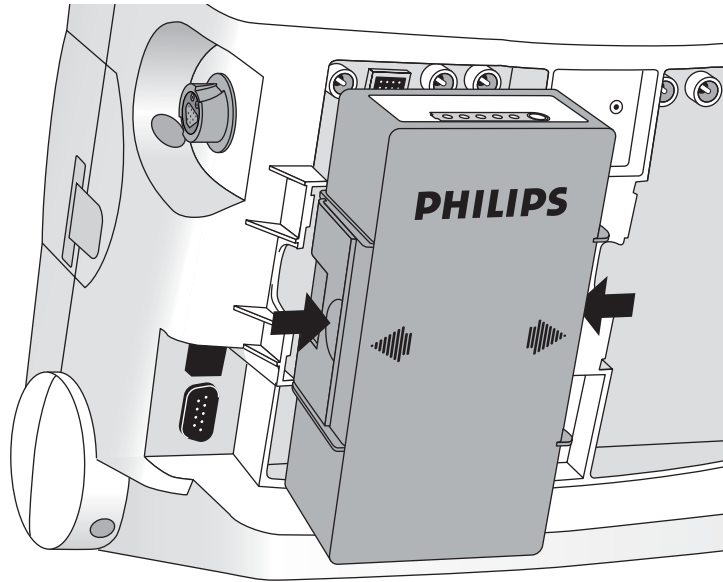


Installing Batteries

To install the batteries:

- 1 Align the M3538A Lithium Ion battery in a battery compartment.
- 2 Insert the battery, and press until you hear it click into place. Ensure that the latches located on both sides of the battery are engaged fully.

Figure 28 Installing Batteries



Charging Batteries

Charge batteries fully upon receipt and prior to use. Be sure to familiarize yourself with the battery maintenance procedures discussed in “Battery Maintenance” on page 283.

Battery Safety

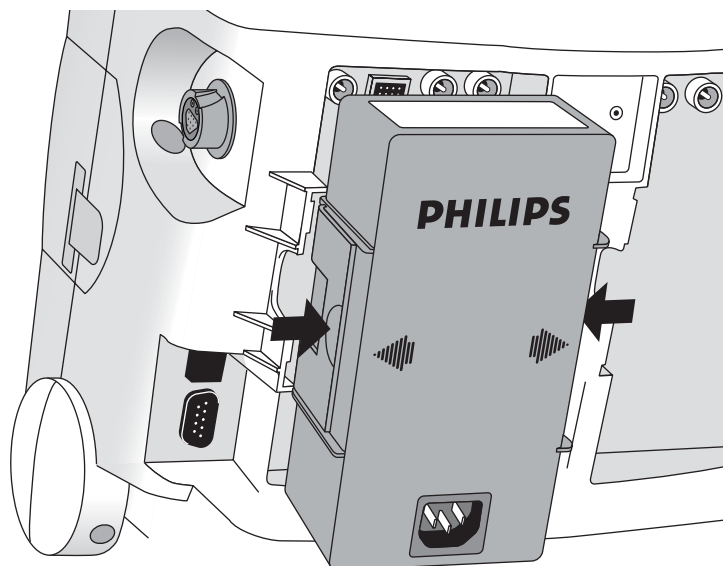
Review the Application Note, *M3538A Lithium Ion Battery - Characteristics and Care*, provided with your HeartStart MRx. Additionally, read the battery related warnings in “Specifications and Safety” on page 321, prior to using the M3538A Lithium Ion Battery.

Installing the AC Power Module

If not presently installed in your device, insert the M3539A AC power module as follows:

- 1 Align the M3539A AC power module in Compartment B.
- 2 Insert the AC power module, and press until you hear it click into place. Ensure that the latched located on both sides of the AC power module are engaged fully.
- 3 Insert the power cord into the AC power receptacle.
- 4 Plug into an AC power outlet.
- 5 Check that the External Power indicator on the front panel is illuminated.

Figure 29 Installing the AC Power Module



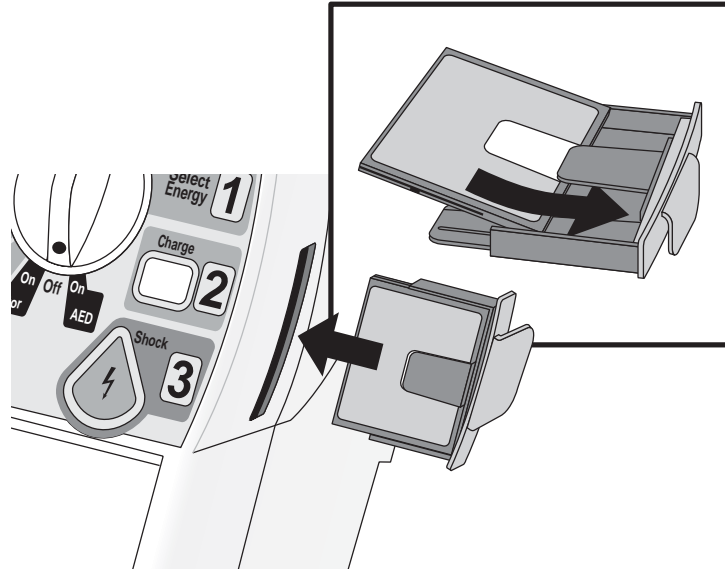
Installing the Data Card

If not presently installed in your device, install the data card as follows:

- 1 Insert the data card in the data card tray, sliding it under the tray clip. Confirm that the connector is facing away from the pull tab.
- 2 With the front of the tray facing forward, press the data card and tray firmly into the data card slot located on the right side of the HeartStart MRx and marked by the data card symbol.



Figure 30 Installing the Data Card/Tray



CAUTION Even if a data card is not used, the data card tray should always be installed to protect the device from the ingress of liquids or solids.

ECG and Arrhythmia Monitoring

This chapter describes the basic ECG and arrhythmia monitoring functions of the HeartStart MRx monitor/defibrillator. For specific information related to taking a 12-Lead ECG, refer to Chapter 13 “12-Lead ECG” on page 135.

Overview

The HeartStart MRx can be used for ECG and arrhythmia monitoring, allowing you to monitor through:

- multifunction electrode pads, or
- 3-, 5-, or 10-lead monitoring electrode ECG sets.

If both pads and monitoring electrodes are connected, monitoring allows you to select a lead from the 3-, 5- or 10-lead monitoring electrode ECG source, or to monitor through pads.

Configurable heart rate and arrhythmia alarms clearly communicate patient status, both audibly and visually.

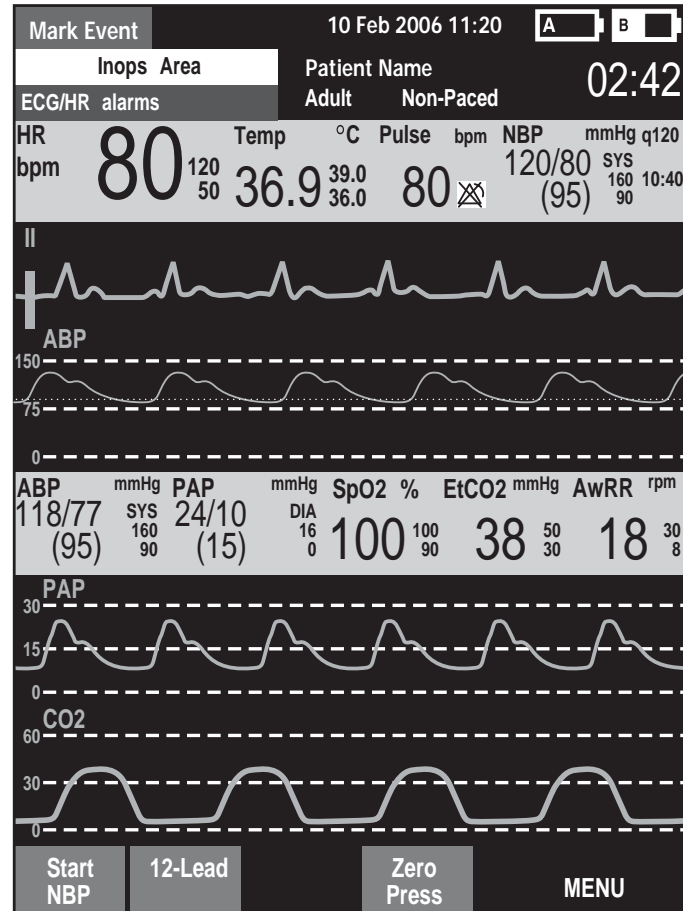
Waveforms may be acquired through the therapy port for pads/paddles or the monitoring port for 3-, 5-, or 10-lead monitoring electrodes. If the configured source is not connected to the HeartStart MRx when turned on, the first valid ECG source is displayed in Wave Sector 1. Once the configured source is available, it automatically populates Wave Sector 1. Should the configured source then become invalid, a Leads Off condition is displayed. The HeartStart MRx *does not* revert to the initial source of ECG but you can select a lead by pressing the Lead Select button.

WARNING Do not use the HeartStart MRx to monitor neonatal ECGs. Doing so could result in inaccurate measurements and alarms.

Monitoring View

Monitoring View appears on the display when the Therapy Knob is in the **Monitor** position. Figure 31 shows the information displayed in Monitoring View.

Figure 31 Monitoring View



Monitoring View can display up to four ECG waves. Numeric values for heart rate and all other available parameters are displayed, as well as any active alarm settings.

There are two separate sources of ECG: the ECG leads connection and the Pads/Paddles connection. Leads/pads are displayed according to your device's configuration. Lead II is configured as the primary ECG lead source and is displayed in Wave Sector 1. You may change this during use with the Lead Select button. You can also configure the HeartStart MRx to display up to 3 additional leads (or pads/paddles) when turned on (see "Configuration" on page 199). The leads displayed may be changed during use through the **Displayed Waves** menu item.

Monitoring View displays the first valid source of ECG acquired in Wave Sector 1. For example, if your HeartStart MRx has Lead II configured to display in Wave Sector 1, but pads are attached to the patient and connected to the defibrillator before a valid ECG can be obtained from the monitoring electrodes, then Pads will be displayed in Wave Sector 1. However, Lead II will take its place as soon as it is acquired.

NOTE The ECG lead source appearing in Wave Sector 1 is used to determine heart rate and monitor arrhythmia.

Preparing to Monitor ECG

To prepare for monitoring ECG, perform the following steps.

If monitoring via electrodes:

- 1 Prepare the patient's skin prior to applying monitoring electrodes. Skin is a poor conductor of electricity, so skin preparation is important in achieving good electrode-to-skin contact.
 - Identify the appropriate electrode sites (See Figures 33 and 34.)
 - If necessary, clip hair at the electrode sites (or shave sites if needed).
 - Clean and abrade the skin at the electrode site.
 - Dry the electrode sites briskly to increase capillary blood flow in the tissues and to remove oil and skin cells.
- 2 Attach the snaps to the electrodes before placing them on the patient.
- 3 Apply the electrodes by peeling them, one at a time, from the protective backing and sticking them firmly to the patient's skin. Refer to Figures 33 and 34 for proper electrode placement. Press around the entire edge of each electrode to ensure they are secure. Make sure the lead wires do not pull on the electrodes.

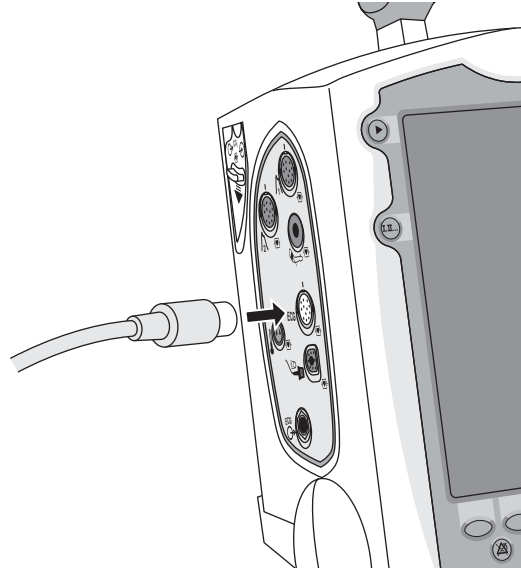
WARNING Be sure that the electrodes do not come in contact with other conductive materials, especially when connecting or disconnecting the electrodes to/from the patient.

NOTES Use only approved lead-sets with the HeartStart MRx. Failure to do so may introduce noise and result in intermittent leads off messages.

A signal from a TENS unit can cause ECG artifact.

- 4 If not preconnected, connect the ECG patient cable.
 - Align the keyed patient cable connector with the ECG port on the Measurement module, as shown in Figure 32.
 - Push the patient cable firmly into the ECG port until the white portion is no longer visible.

Figure 32 ECG Cable Connection



If monitoring via multifunction electrode pads:

- 1 If not preconnected, connect the pads cable to the HeartStart MRx. See Figure 41 on page 65.
- 2 Connect the pads to the pads cable. See Figure 42 on page 65.
- 3 Apply the pads as directed on the package.

NOTE If monitoring for extended periods of time, monitoring electrodes and multifunction electrode pads may need to be changed periodically. Refer to the manufacturer's documentation for how often to replace the monitoring electrodes or pads.

Electrode Placement

Figure 33 shows the typical electrode placement for a 3-lead ECG set.

Figure 33 3-lead Placement

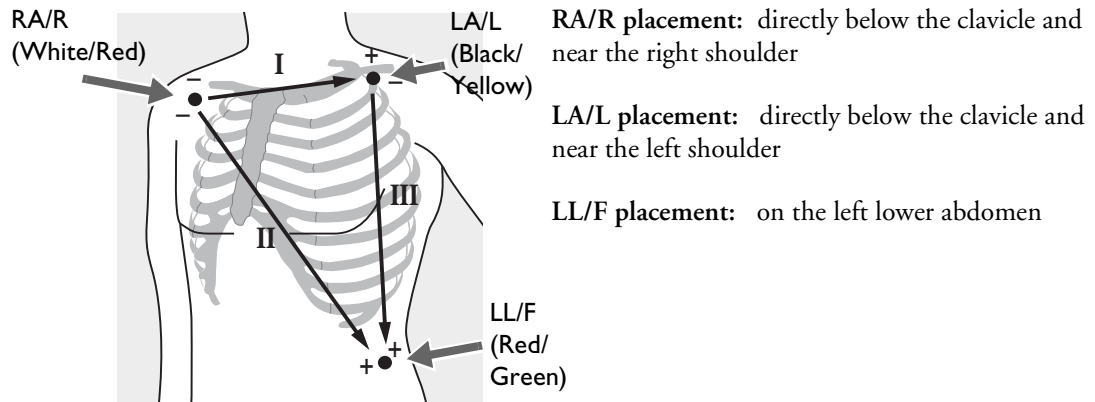
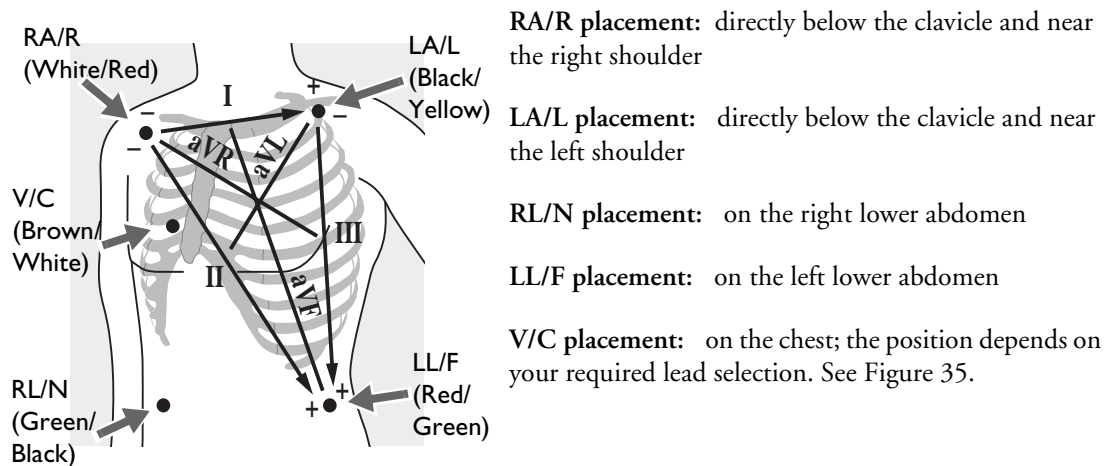


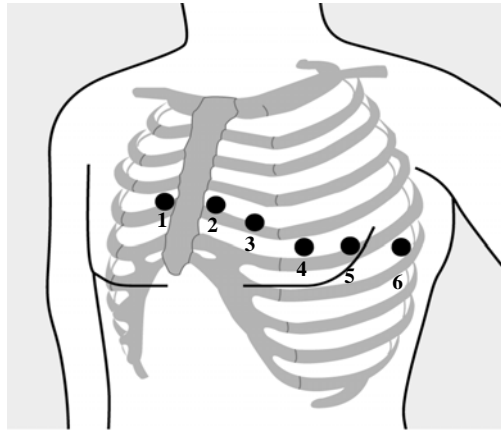
Figure 34 shows the typical electrode placement for a 5-lead ECG set.

Figure 34 5-lead Placement



The V/C lead may be placed in any of the precordial electrode positions as shown in Figure 35 (V1/C1 through V6/C6).

Figure 35 V/C Electrode Placement



V1/C1 placement: fourth intercostal space at right sternal margin.

V2/C2 placement: fourth intercostal space at left sternal margin.

V3/C3 placement: midway between V2 and V4.

V4/C4 placement: fifth intercostal space at left midclavicular line.

V5/C5 placement: same level as V4 on anterior axillary line.

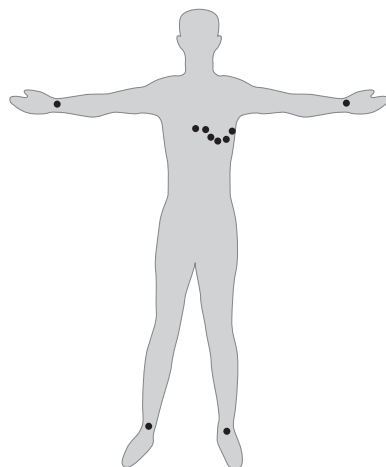
V6/C6 placement: same level as V4 at left mid axillary line.

For accurate V/C lead placement and measurement, it is important to locate the fourth intercostal space, as follows:

- 1 Locate the second intercostal space by first palpating the Angle of Lewis (the small bony protuberance where the body of the sternum joins the manubrium). This rise in the sternum is where the second rib is attached, and the space just below this is the second intercostal space.
- 2 Palpate and count down the chest until you locate the fourth intercostal space.

Figure 36 shows electrode placement for a 12-lead ECG set.

Figure 36 12-Lead Placement



12-Lead ECG In a 12-Lead ECG using 10 electrodes, an electrode is placed on the right arm, left arm, right leg, and left leg. Six V/C electrodes are placed on the chest as shown in Figure 36. The right leg electrode is the reference electrode.

NOTE When you do a 12-lead ECG, you should attach the limb leads to the patient's extremities.

Lead Selection

It is important to select a suitable lead for monitoring so that a QRS complex can be accurately detected. The guidelines for lead selection are as follows:

For non-paced patients:

- QRS complex should be tall and narrow (recommended amplitude > 0.5mV).
- R-wave should be above or below the baseline (but not biphasic).
- P-wave should be smaller than 1/5 R-wave height.
- T-wave should be smaller than 1/3 R-wave height.

NOTE To prevent detection of P-wave or baseline noises as QRS complexes, the minimum detection level for QRS complexes is set at 0.15 mV, according to AAMI-EC 13 specifications. If the ECG signal is too weak, you may get false alarms for asystole.

For paced patients with internal/transvenous pacemakers, in addition to the above, the pace pulse should be:

- not wider than the normal QRS complex.
- large enough to be detected (half the height of the QRS complex), with no re-polarization artifact.

NOTE Adjusting the ECG wave size on the display does not affect the ECG signal which is used for arrhythmia analysis.


Lead Choices

Available monitoring leads vary depending upon what type of ECG cable is connected to your HeartStart MRx and its configuration. Table 4 shows the choice of leads available for 3-, 5-, and 10-lead ECG sets.

Table 4 Lead Choices

If you are using:	These leads are available:
a 3-electrode ECG set	I, II, III
a 5-electrode ECG set	I, II, III, aVR, aVL, aVF, V
a 10-electrode ECG set	I, II, III, aVR, aVL, aVF, V1-V6

Selecting the Lead

The ECG lead for Wave Sector 1 is selected through the Lead Select  button or through the **Displayed Waves** menu. The ECG lead for Wave Sectors 2-4 is selected through the **Displayed Waves** menu, as follows:


- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select the **Displayed Waves** menu and press the Menu Select button.
- 3 Select the Wave Sector and press the Menu Select button.
- 4 Select the desired lead and press the Menu Select button.
- 5 If needed, use the Navigation buttons to adjust the ECG wave size (gain) and press the Menu Select button.

Figure 37 Displayed Waves Menu

Main Menu	Displayed Waves	Wave 1	II Size
Start Data Transmit	Wave 1	Pads	x4
Volume	Wave 2	I	x2
Displayed Waves	Wave 3	II	x1
Printed Waves	Wave 4	III	x1/2
Measurements/Alarms	Exit	aVR	x1/4
Patient Info		aVL	Auto
Trends		aVF	
Other		V1	
High Contrast On		V2	
Exit		1 of 2	

Arrhythmia Monitoring

The HeartStart MRx uses the ST/AR Basic Arrhythmia Algorithm. Arrhythmia analysis provides information on your patient's condition, including heart rate and arrhythmia alarms. The HeartStart MRx uses the ECG lead appearing in Wave Sector 1 for single-lead arrhythmia analysis.

NOTE Because the ST/AR Basic Arrhythmia Algorithm is the HeartStart MRx's cardiach source and is needed to generate heart rate and heart rate alarms, the algorithm can never be disabled. However, if desired, arrhythmia and heart rate alarms can be turned off.

During arrhythmia analysis, the monitoring function continuously:

- optimizes ECG signal quality to facilitate arrhythmia analysis. The ECG signal is continuously filtered to remove baseline wander, muscle artifact, and signal irregularities. Also, if the Patient Paced status is set to Yes, pace pulses are filtered out to avoid processing them as QRS beats.
- measures signal features such as R-wave height, width and timing.
- creates beat templates and classifies beats to aid in rhythm analysis and alarm detection.
- examines the ECG signal for ventricular arrhythmias, asystole.

Aberrantly-Conducted Beats

As P-waves are not analyzed, it is difficult and sometimes impossible for the algorithm to distinguish between an aberrantly-conducted supraventricular beat and a ventricular beat. If the aberrant beat resembles a ventricular beat, it is classified as a ventricular beat. You should always select a lead where the aberrantly-conducted beats have an R-wave that is as narrow as possible to minimize incorrect classifications.

Intermittent Bundle Branch Block

Bundle branch and other fascicular blocks create a challenge for the arrhythmia algorithm. If the QRS complex changes considerably from the learned normal due to a bundle branch block, the blocked beat may be incorrectly identified as ventricular, and may cause false PVC alarms. You should always select a lead where the bundle branch block beats have an R-wave that is as narrow as possible to minimize incorrect classifications.

NOTE For more information on arrhythmia analysis, refer to the Application Note, “Arrhythmia Monitoring Algorithm” available on the web at www.medical.philips.com/goto/productdocumentation.

Heart Rate and Arrhythmia Alarms

The HeartStart MRx detects arrhythmia alarm conditions by comparing ECG data to a set of pre-defined criteria. An alarm can be triggered by a rate exceeding a threshold (for example HR > XX), an abnormal rhythm (for example, Ventricular Tachycardia), or an ectopic event (for example, PVC > limit).

HR/Arrhythmia Alarms can be generated for the conditions shown in Tables 5 and 6. Once generated, they appear as alarm messages in the alarm status area of the display located just above the HR numeric. The notification of an alarm is indicated by both an audible and visual alert signal.

Arrhythmia Alarm Latching

Arrhythmia alarms are categorized as “latching” or “non-latching” alarms. Latching alarms are announced and remain present, regardless of whether the alarm condition still exists, until they are either acknowledged or a higher priority alarm condition occurs. Indications for non-latching alarms are automatically removed when their alarm condition no longer exists.

Latching and non-latching alarms are categorized in Tables 5 and 6.

Table 5 HR/Arrhythmia Red Alarms

Alarm Message	Condition	Indicator	Latching/ Non-Latching
Asystole	No detectable beats for four seconds in the absence of Vfib	Red alarm message, alarm tone	Latching
VFIB/VTACH	A fibrillatory wave detected for four seconds	Red alarm message, alarm tone	Latching
VTACH	Consecutive PVCs and HR exceed configured limits	Red alarm message, alarm tone	Latching
Extreme Brady	10 bpm below HR Low limit, capped at 30 bpm	Red alarm message, alarm tone	Latching
Extreme Tachy	20 bpm above HR High limit capped at 200 bpm (adult) or 240 bpm (pedi)	Red alarm message, alarm tone	Latching

Figure 38 Alarm Chain for Basic Arrhythmia Monitoring

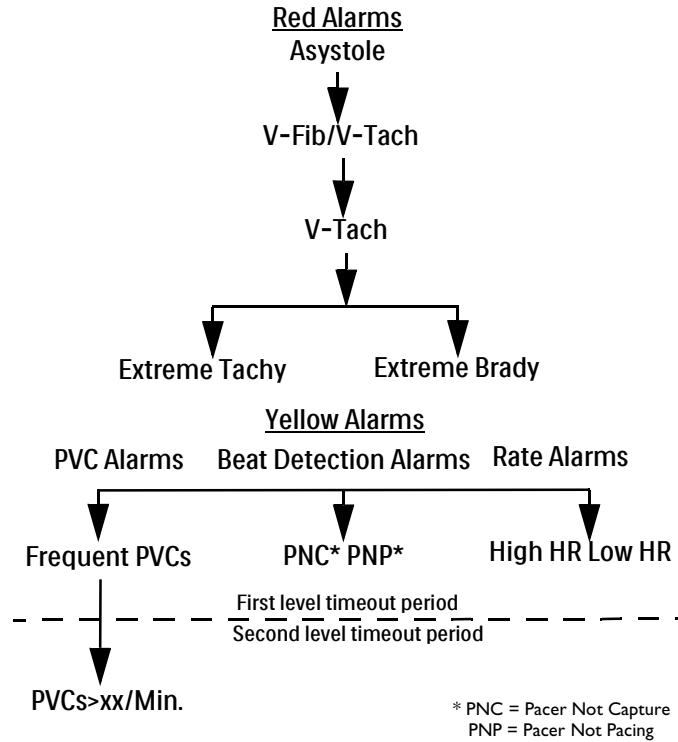


Table 6 HR/Arrhythmia Yellow Alarms

Alarm Message	Condition	Indication	Latching/ Non-Latching
HR High	The HR exceeds the configured HR high limit	Yellow alarm message, alarm tone	Non-Latching
HR Low	The HR is below the configured HR low limit	Yellow alarm message, alarm tone	Non-Latching
PVC/min High (value > limit)	The number of detected PVCs in a minute exceeds the limit of 15(adult/pedi.)	Yellow alarm message, alarm tone	Non-Latching
Pacer Not Capture	No QRS following a pacer pulse	Yellow alarm message, alarm tone	Latching
Pacer Not Pacing	No QRS or pacer pulse detected	Yellow alarm message, alarm tone	Latching

NOTE Pacer Alarm Messages are associated with internal/transvenous pacemakers only.

INOP Messages

INOP messages communicate conditions that prevent the device from monitoring or analyzing the ECG. INOP messages are displayed just above the HR/Arrhythmia alarm status area. If multiple INOP conditions exist, the associated INOP messages will cycle through, alternating every 2 seconds.

Table 7 ECG INOPs


Alarm Message	Condition	Indication
Cannot Analyze ECG	Cannot reliably monitor the ECG in Wave Sector 1.	INOP message, INOP tone
ECG Cable Failure	During the Operational Check, a short has been detected between a lead wire and ground	INOP message, INOP tone
Leads Off	An electrode used for Wave Sector 1 may be off or not attached securely.	INOP message, INOP tone
Pads /Paddles Off	The multifunction electrode pads or paddles used as the source for the Wave Sector 1 may be off or not attached securely.	INOP message, INOP tone
ECG Unplugged	The primary ECG is derived from leads and the ECG cable is not connected.	INOP message, INOP tone
ECG Equip Malfunction	A malfunction has occurred in the ECG hardware.	INOP message, INOP tone
Pads/Paddles Cable Failure	During the Operational Check, a failure was detected in the pads or paddles cable during the pads/paddles ECG test.	INOP message, INOP tone
Pads ECG Equip Malfunction	A device hardware failure was detected.	INOP message, INOP tone

Setting Alarms

Alarms are automatically enabled in Monitor and Pacer modes. In Manual Defib Mode alarms are automatically enabled if the Sync function is enabled. If the Sync function is not enabled, alarms are enabled in Manual Defib mode using the Alarm Pause button. Alarm settings for Heart Rate (HR) and VTACH are as configured but may be changed via the Menu Select button during operation for the current patient incident. The setting for PVC Rate Limit may only be changed in response to a PVC Rate alarm condition. Settings for other HR and arrhythmia alarms may not be changed.


Changing Heart Rate or VTACH Alarm Limits

To change the HR or VTACH limits:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select **Measurements/Alarms** from the menu and press the Menu Select button.
- 3 Select **HR/Arrhythmia** and press the Menu Select button.
- 4 Select **HR or VTACH Limits** and press the Menu Select button.
- 5 Using the Navigation buttons, select the new values and press the Menu Select button.

Enabling/Disabling Heart Rate and Arrhythmia Alarms

To enable/disable the HR and Arrhythmia alarms:

- 1 Press the Menu Select  button.
- 2 Select **Measurements/Alarms** from the menu and press the Menu Select button.
- 3 Select **HR/Arrhythmia** and press the Menu Select button.
- 4 Select **Alarms On/Off** and press the Menu Select button.

Responding to HR and Arrhythmia Alarms

When an alarm is announced, the audio pause label is presented above the Navigation and Menu Select buttons. Pressing any of these buttons temporarily silences the alarm audio while you are attending to the patient. See Figure 39. Alarms will reannunciate if conditions exist for two minutes or another alarm condition is generated.

Figure 39 Audio Pause Label



Then respond to the alarm condition on the HeartStart MRx. There are two ways to respond to an HR or Arrhythmia alarm:

- 1 **Acknowledge** the alarm condition.
- 2 Adjust the limits using the **New Limits** menu.


Displaying an Annotated ECG

You may choose to display an annotated ECG with arrhythmia beat labels in Wave Sector 2. The same ECG source appearing in the Wave Sector 1 is displayed with a six second delay along with white arrhythmia beat labels. See Table 8 below for additional information on beat classification.

Table 8 Arrhythmia Beat Labels

Label	Description	Displayed Location
N	Normal	Above QRS
V	Ventricular Ectopic	Above QRS
P	Paced	Above QRS
'	Pacer spike	Above the waveform where the pacer spike is detected. (If the patient is both atrially and ventricularly paced, the display will show two ' marks above the waveform aligned with the atrial and ventricular pacing.)
L	Learning Patient's ECG	Above QRS
A	Artifact (noisy episode)	Above the waveform where the noise is detected.
?	Insufficient information to classify beats	Above QRS
I	Inoperative condition (e.g. LEAD OFF)	Above the waveform at start of INOP, every second of INOP, and at end of INOP.
M	Pause, Missed Beat, No QRS	Above the waveform where the condition is detected.

To display an annotated ECG:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select **Displayed Waves** and press the Menu Select button.
- 3 Select **Wave 2** and press the Menu Select button.
- 4 Select **Annotated ECG** and press the Menu Select button.

Arrhythmia Learning/Relearning


When arrhythmia monitoring starts, a “learning” process is initiated. The goal is to learn the patient’s normal complexes and/or paced complexes (if the patient with an internal/transvenous pacemaker is in paced rhythm). The learning process involves the first 15 valid (non-noisy) beats encountered during the learning phase.

The family selected to represent the “normal” complex includes the beat that is the most frequently seen, narrowest, on-time beat. For this reason, learning should not be initiated when the patient’s rhythm is primarily ventricular.

Arrhythmia learning/relearning automatically occurs when the Therapy Knob is turned on to **Monitor**, **Pacer** or **Manual Defib**, any time there is a change in the lead selection for Wave Sector 1, and after the correction of a “**Leads or Pads Off**” INOP condition that has been active longer than 60 seconds.

Manual relearning should be initiated if the beat detection is not occurring or if beat classification is incorrect and results in a false alarm. Remember, however, that if the same signal condition which caused the algorithm to perform poorly still persists, relearning will not be able to correct the problem. The problem can only be corrected by improving the quality of the signal (e.g., by selecting a different lead.)

To initiate relearning manually,

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select **Measurements/Alarms** from the menu and press the Menu Select button.
- 3 Select **HR/Arrhythmia** and press the Menu Select button.
- 4 Select **Relearn Rhythm** and press the Menu Select button.

The messages “**Learning ECG**” and “**Learning Rhythm**” appear in the rhythm status area of the display.

WARNING If arrhythmia relearning takes place during a ventricular rhythm or during a period of poor ECG signal quality, ectopic beats may be incorrectly learned as the normal QRS complex. This may result in missed detection of subsequent events of V-tach and high PVC rates.

For this reason, you should:

- take care to initiate arrhythmia relearning only when the ECG signal is noise-free.
 - be aware that arrhythmia relearning can happen automatically.
 - respond to any INOP messages (for example, if you are prompted to reconnect electrodes).
 - display an annotated wave to ensure beat labels are correct.
-

Troubleshooting

If your HeartStart MRx does not operate as expected during ECG and Arrhythmia monitoring, see “Troubleshooting” on page 297.

AED Mode

Defibrillation therapy is the definitive method for termination of a variety of potentially fatal arrhythmias. The HeartStart MRx's Semi-Automated External Defibrillation (AED) Mode is designed to guide you through standard treatment algorithms for cardiac arrest. The HeartStart MRx provides therapy through the application of a brief biphasic pulse of electricity to the cardiac muscle. This electrical energy is transferred through disposable multifunction electrode pads applied to the patient's bare chest.

Configuration choices allow you to customize AED Mode to better meet the unique needs of your organization or resuscitation team. This chapter describes how to use AED Mode. It explains the prompts that guide you through the defibrillation process and describes how prompts vary depending upon the condition of the patient and the configuration of your device.

For information on annotating, storing, and printing event information acquired in AED Mode, see "Working with Data" on page 225.

For information on setting configuration choices, see "Configuration" on page 199.

Precautions for AED Therapy

WARNING The AED algorithm is not designed to handle erratic spiking problems caused by a properly or improperly functioning pacemaker. In patients with cardiac pacemakers, the HeartStart MRx may have reduced sensitivity and not detect all shockable rhythms.

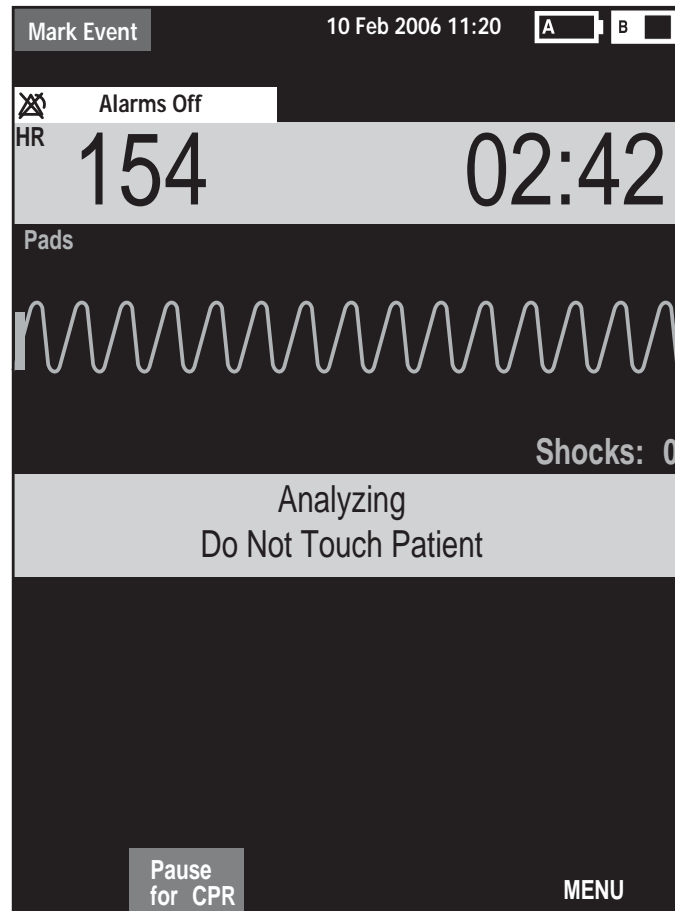
NOTES The Philips HeartStart MRx AED mode is not intended for children under 8 years of age. For children 8 years of age and older, the American Heart Association recommends that standard operating procedures for AEDs be followed. See the American Heart Association *Guidelines 2005 for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care*. Dallas, Texas; AHA; 2005.

Successful resuscitation is dependent on many variables specific to the patient's physiological state and the circumstances surrounding the patient incident. Failure to have a successful patient outcome is not a reliable indicator of monitor/defibrillator performance. The presence or absence of a muscular response to the transfer of energy during electrical therapy is not a reliable indicator of energy delivery or device performance.

AED View

Once the Therapy Knob is moved to AED, AED View is displayed.

Figure 40 AED View Display



Wave Sectors 1 and 2 are combined so that a large ECG may be shown. The Event Timer is also large for easier viewing. A Shock Counter is displayed just below the ECG and shows the total number of shocks delivered to the patient in AED and Manual Defib Mode. Also below the ECG is a prominent text message window which accompanies the voice prompts annunciated in AED Mode.

NOTE Only the ECG acquired through multifunction electrode pads is displayed in AED Mode.

Preparation

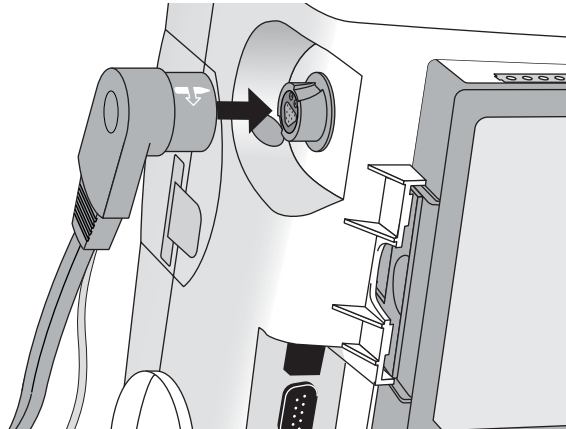
Confirm that the patient is:

- unresponsive
- not breathing
- pulseless

Then:

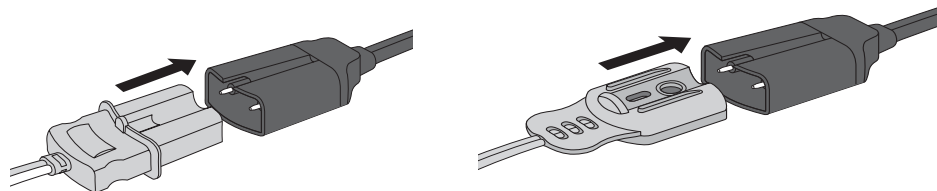
- 1 Remove clothing from the patient's chest. Wipe moisture from the patient's chest and, if necessary, clip or shave excessive chest hair.
- 2 Make sure the multifunction electrode pads packaging is intact and within the expiration date shown.
- 3 Apply multifunction electrode pads to the patient as directed on the pads package. Use the anterior-anterior electrode placement.
- 4 If not pre-connected, insert the pads cable into the green Therapy port located on the right side of the device. Push until you hear it click into place. See Figure 41.

Figure 41 Pads Cable Connection



- 5 Connect the pads to the pads cable as shown in Figure 42.

Figure 42 Pads Connections



WARNING Do not use anterior-posterior pads placement (multifunction electrode pads placed on the patient's chest and back). The AED algorithm used by the HeartStart MRx has not been validated using this placement.

WARNING Do not let the multifunction electrode pads touch each other or other monitoring electrodes, lead wires, dressings, transdermal patches, etc. Such contact can cause electrical arcing and patient skin burns during defibrillation and may divert defibrillation current away from the heart.

WARNING During defibrillation, air pockets between the skin and multifunction electrode pads can cause patient skin burns. To help prevent air pockets, make sure defibrillation pads completely adhere to the skin. Do not use dried-out multifunction electrode pads.

CAUTION Aggressive handling of multifunction electrode pads in storage or prior to use can damage the pads. Discard the pads if they become damaged.

NOTE Impedance is the resistance between the defibrillator's pads or paddles that the defibrillator must overcome to deliver an effective discharge of energy. The degree of impedance differs from patient to patient and is affected by several factors including the presence of chest hair, moisture, and lotions or powders on the skin.

The low-energy SMART Biphasic waveform is an impedance-compensating waveform that is designed to be effective across a wide range of patients. However, if you receive a "No Shock Delivered" message, check that the patient's skin has been washed and dried and that any chest hair has been clipped. If the message persists, change the pads and/or the pads cable.

Using AED Mode

To operate the HeartStart MRx in AED Mode, follow these three basic steps:

- 1 Turn the Therapy Knob to AED.
- 2 Follow the voice and screen prompts.
- 3 Press the orange Shock button, if prompted.

These steps are described more fully in the sections that follow.

While operating in AED Mode, the capabilities of the device are limited to those essential to the performance of semi-automated external defibrillation. Only the ECG acquired through pads is displayed. Previously set alarms and scheduled measurements are indefinitely paused and entry of patient information is disabled. Additionally, the Sync, Lead Select, and Alarm Pause buttons are inactive.

Step 1 - Turn the Therapy Knob to AED

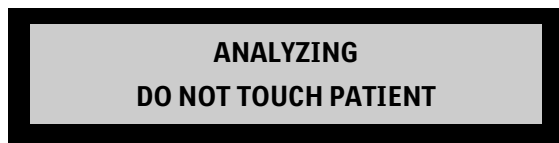
When the HeartStart MRx is turned on in AED Mode, it checks to see if the pads cable and multifunction electrode pads are properly connected. If the:

- pads cable is not properly attached, you are prompted to **"Connect Pads Cable"**.
- multifunction electrode pads are not connected to the pads cable, pads are not applied to the patient, or pads are not making proper contact with the patient's skin, you are prompted to **"Apply Pads"** and **"Plug in Connector"**.

Step 2 - Follow Screen and Voice Prompts

Once an ECG is detected through the multifunction electrode pads, the HeartStart MRx automatically analyzes the patient's heart rhythm and warns you not to touch the patient (Figure 43).

Figure 43 ECG Analysis Message in AED Mode



WARNING Handling or transporting the patient during ECG rhythm analysis can cause an incorrect or delayed diagnosis. Under these circumstances, if the HeartStart MRx issues a **"Shock Advised"** prompt, keep the patient as still as possible for at least 10 seconds so the HeartStart MRx can reconfirm the rhythm analysis before you deliver a shock.

If artifact interferes with analysis, the message **"Analyzing Interrupted, Do Not Touch the Patient"** is annunciated while the HeartStart MRx attempts to continue analyzing. If the artifact persists, the message **"Cannot Analyze"** is annunciated and the message **Paused. Attend To Patient** is displayed. While paused, analysis is suspended. Check that the pads are making proper contact with the patient's skin and minimize movement. Analysis resumes automatically after 30 seconds or when you press **[Resume Analyzing]**.

Always use the analyze function to determine if a rhythm is shockable.

Adjusting Voice Prompt Volume

You may adjust the volume of the voice prompts at any time by accessing the Voice Volume menu.

Press the Menu Select  button.

Select the desired volume level and press the Menu Select button.

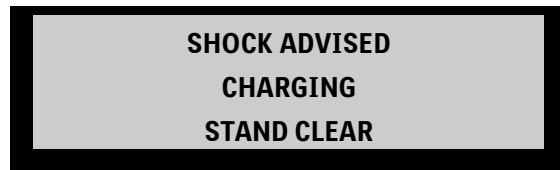
NOTE In loud environments, you can use the display prompts in lieu of voice prompts.

Shock Advised

If a shockable rhythm is detected, the HeartStart MRx automatically charges to 150J. Charging is accompanied by voice and screen prompts as shown in Figure 44. A steady high-pitched tone is sounded, and the orange Shock button flashes when the device is fully charged.

Heart rhythm analysis continues while the HeartStart MRx charges. If a rhythm change is detected before the shock is delivered and a shock is no longer appropriate, the defibrillator disarms.

Figure 44 Shock Advised, Charging Display



NOTE When the HeartStart MRx is fully charged, you can disarm it any time by turning the Therapy Knob to the "Off" position or by pressing the **[Pause for CPR]** soft key. Resume monitoring the patient by turning the Therapy Knob back to AED.

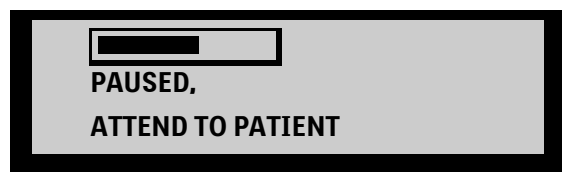
No Shock Advised (NSA)

If a shockable rhythm is not detected, the HeartStart MRx tells you, "**No shock advised**". If the NSA Action Configuration Choice is set to:

Monitor - The HeartStart MRx monitors the ECG and automatically resumes analysis if a potentially shockable rhythm is detected. You are periodically prompted to "**If needed, press Pause and begin CPR.**" The frequency of these prompts is defined in the Monitor Prompt Interval Configuration Choice. You may press **[Pause for CPR]** to suspend monitoring and administer CPR. The pause period is defined by the CPR Timer Configuration Choice.

Pause Time - Analysis is suspended for the specified period and you may administer CPR and attend to the patient. A Pause status bar is displayed as shown in Figure 45. The pause period is defined by the NSA Action Configuration Choice. At the completion of the pause period, the HeartStart MRx resumes analyzing.

Figure 45 Paused Display



Step 3 - Press Shock Button, if Prompted

Once charging is complete, the HeartStart MRx prompts you to **"Deliver Shock Now; Press the Orange Button Now"**. Make sure no one is touching the patient or anything connected to the patient. Call out clearly and loudly, "Stay Clear." Then press the orange Shock button to deliver a shock to the patient.

WARNING Defibrillation can cause operator or bystander injury. Do not touch the patient or equipment connected to the patient during defibrillation.

WARNING The Shock button must be pressed to deliver a shock. The HeartStart MRx will not automatically deliver a shock.

Delivery of the shock is confirmed by the message **"Shock Delivered"** and the shock counter on the display is updated to reflect the number of shocks given. The defibrillator will announce **"Paused. If needed, begin CPR."** The HeartStart MRx pauses for the configured CPR Timer period. Prompts may be brief or detailed, as defined by the CPR Prompt Configuration Choice. Analysis begins again at the completion of the pause period or when you press **[Resume Analyzing]**.

If you press **[Pause for CPR]** after a shock is delivered in the current Shock Series, the length of the CPR Pause is defined by the CPR Timer Configuration Choice.

NOTE You may return to analyzing the patient's heart rhythm at any time by pressing the **[Resume Analyzing]** soft key.

NOTE Once prompted to **"Deliver Shock Now; Press the Orange Button Now"**, if you do not do so within the configured Auto Disarm time interval, the HeartStart MRx disarms itself and provides a pause for CPR. The device resumes analyzing at the end of the configurable pause period or when the **[Resume Analyzing]** soft key is pressed.

NOTE Rhythm Monitoring is intended to provide a backup or secondary measure of potentially shockable rhythms in various environments but is not a substitute for being attentive to the state of the patient.

Using Q-CPR in AED Mode

If your HeartStart MRx is equipped with the Q-CPR option, your default view is Basic View. For more information, see "Basic View" on page 170. You can configure the device for Advanced View. See "AED Settings" on page 218 for more information.

Troubleshooting

If your HeartStart MRx does not operate as expected during defibrillation, see "Troubleshooting" on page 297.

Manual Defibrillation and Cardioversion

This chapter explains how to prepare for and perform asynchronous and synchronous (cardioversion) defibrillation using multifunction electrode pads, external paddles, and internal paddles.

NOTE Defibrillation is always performed through paddles or pads. However, during defibrillation you may choose to monitor the ECG using an alternate ECG source (3-, 5-, or 10-lead monitoring electrodes). If an alternate ECG source is connected, any available lead may be displayed.


For information on monitoring optional measurements while in Manual Defib Mode, see the corresponding chapters in these *Instructions for Use*.

Overview

Defibrillation therapy is the definitive method for termination of a variety of potentially fatal arrhythmias. The HeartStart MRx provides this therapy through the application of a brief biphasic pulse of electricity to the cardiac muscle. This electrical energy is transferred through attached paddles or disposable multifunction electrode pads applied to the patient's bare chest. Internal paddles for open-chest intrathoracic defibrillation can also be used.

In Manual Defib Mode, you must assess the ECG, decide if defibrillation or cardioversion is indicated, select the appropriate energy setting, charge the monitor/defibrillator, and deliver the shock. The entire defibrillation process is under your control. Voice prompts are not present. However, text messages on the display provide relevant information throughout the process. It is important to be attentive to these messages when displayed.

The ECG strip and Event Summary are easily annotated with event information using the Mark Event function button. See "Marking Events" on page 237 for more information.

Monitoring alarms are available in Manual Defib Mode, however, they are turned off once an energy is selected for defibrillation unless Sync is active. Alarms may be turned on in Manual Defib Mode by pressing the Alarm Pause  button. Alarms are also reactivated once the Therapy Knob is moved to **Monitor** or **Pacer** or Sync is selected.

When an energy is selected, automatic NBP measurements are discontinued. If a manual NBP measurement is requested by pressing the **[Start NBP]** soft key, the NBP information, including the current schedule, is displayed in its normal position, and scheduled NBP measurements resume.

NOTE The use of Manual Defib Mode may be password protected, as defined in Configuration. See "Password Security" on page 13.

Precautions for Manual Defibrillation Therapy

Defibrillating asystole can inhibit the recovery of natural pacemakers in the heart and completely eliminate any chance of recovery. Asystole should not be routinely shocked.

Synchronized Cardioversion Therapy

The HeartStart MRx provides synchronized cardioversion therapy by delivering a brief biphasic pulse of electricity to the cardiac muscle immediately following an R-wave detected in the ECG measurement. The SMART Biphasic waveform utilized in the HeartStart MRx has undergone clinical testing demonstrating its effectiveness for cardioversion of atrial fibrillation.

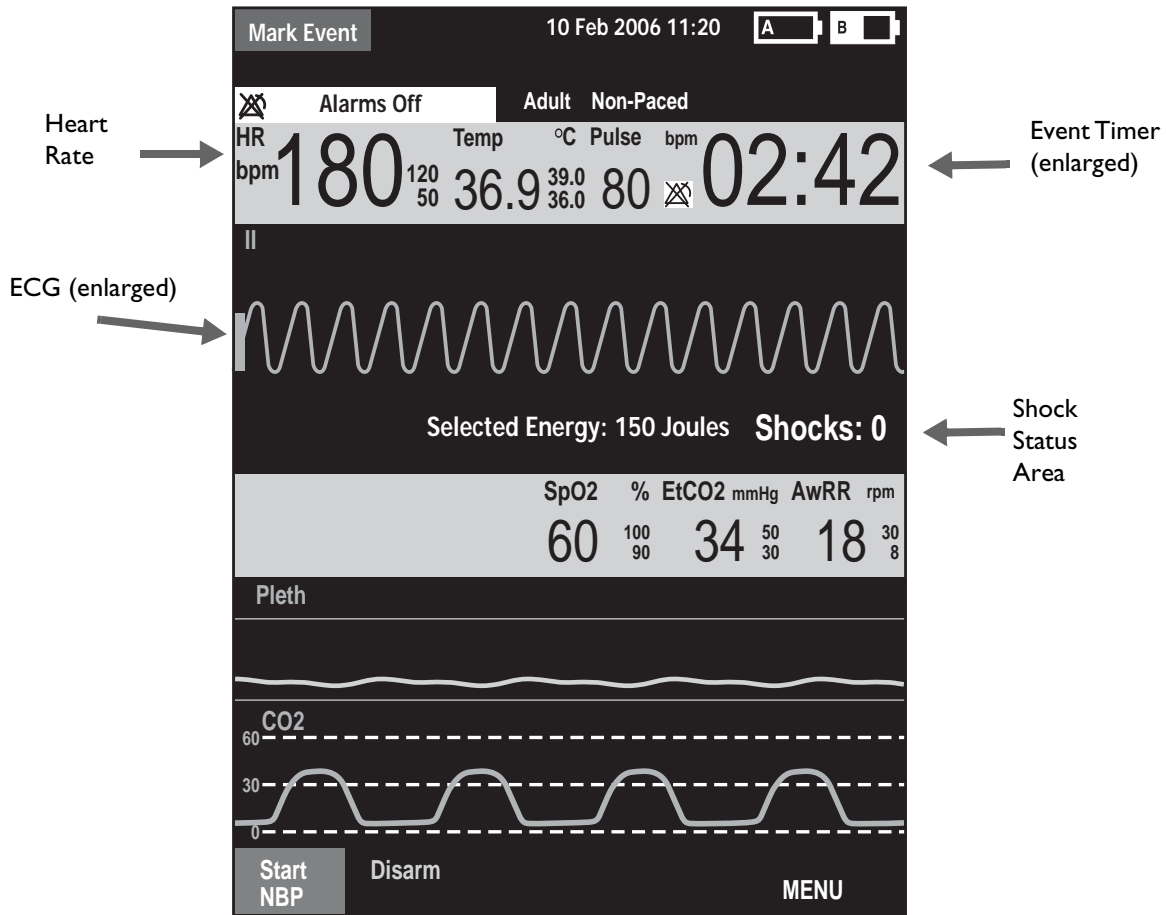
NOTES Successful resuscitation is dependent on many variables specific to the patient's physiological state and the circumstances surrounding the patient event. Failure to have a successful patient outcome is not a reliable indicator of monitor/defibrillator performance. The presence or absence of a muscular response to the transfer of energy during electrical therapy is not a reliable indicator of energy delivery or device performance.

Use only approved lead sets with the HeartStart MRx. Failure to do so may introduce noise and result in intermittent leads off messages.

Code View

In Manual Defib Mode, an energy is selected and the Code View is displayed. Code View is optimized to clearly communicate data associated with a resuscitation event. Notice the increased prominence of the Event Timer, as well as the enlarged ECG in Wave Sectors 1 and 2 as shown in Figure 46.

Figure 46 Code View Display



For details related to using Q-CPR in Manual Mode, see "Preparing to Use Q-CPR" on page 159.

NOTE The Shock Counter displays the number of shocks delivered while in AED and Manual Defib modes.

Preparing for Defibrillation

In preparation for defibrillation:

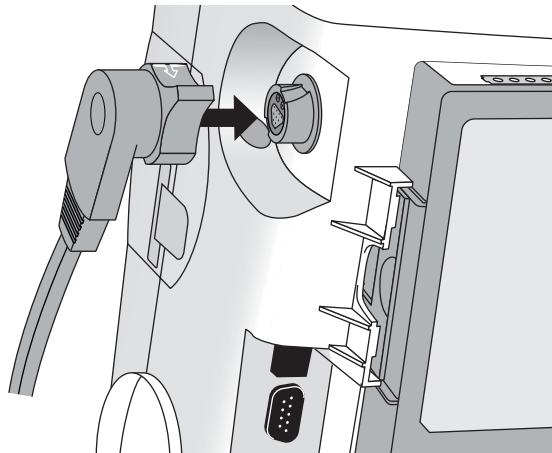
- 1 Connect the appropriate Therapy cable.
- 2 Apply the paddles or pads as described below.

Using Multifunction Electrode Pads

To prepare for defibrillation using multifunction electrode pads:

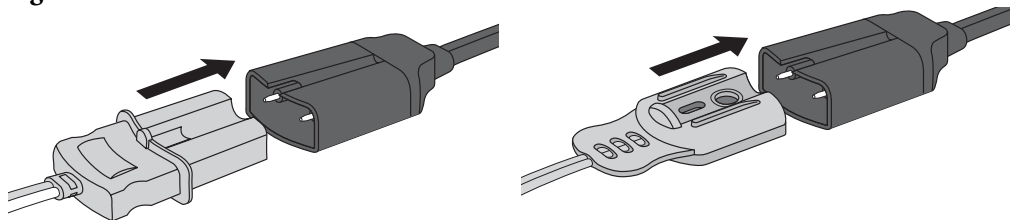
- 1 If not pre-connected, connect the pads cable to the HeartStart MRx by aligning the white pointer on the pads cable connector with the white arrow on the green Therapy port. Then push until you hear it click into place. See Figure 47.

Figure 47 Pads/Internal Paddles Cable Connection



- 2 Check the expiration date that appears on the pads package.
- 3 Inspect the packaging for any damage.
- 4 Connect the pads connector to the pads cable. See Figure 48.

Figure 48 Pads Connectors



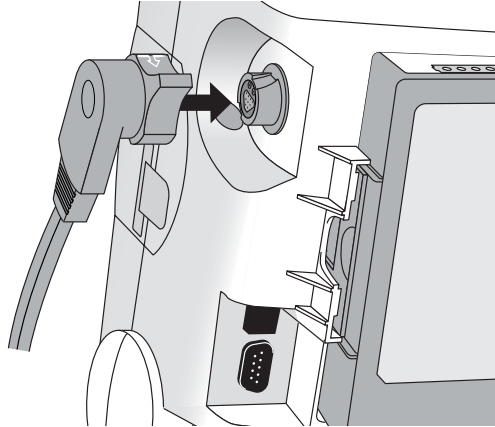
- 5 Apply the pads to the patient as directed on the pads packaging or according to your organization's protocol.

Using External Paddles

To defibrillate using external paddles:

- 1 If not pre-connected, connect the paddles cable to the HeartStart MRx by aligning the white pointer on the paddles cable connector with the white arrow on the green Therapy port. Then push until you hear it click into place. See Figure 49.

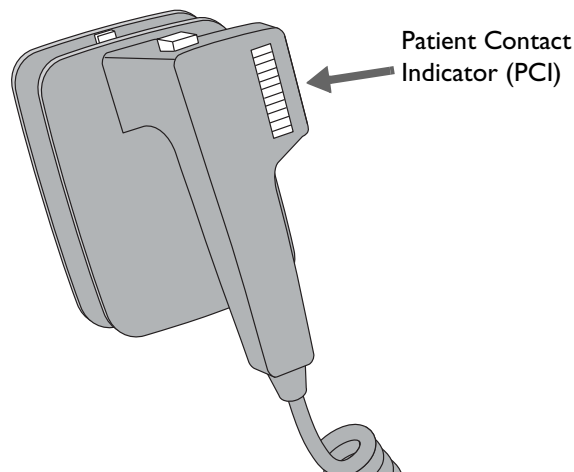
Figure 49 Paddles Cable Connection



- 2 Remove the Paddle Set from the Paddle Tray by pulling the paddles straight up and out of the paddle tray. Verify there is no debris or residue (including dried electrode gel) on the surfaces of the paddles. Clean if necessary.
- 3 Apply conductive matter to the paddle electrodes.
Do not distribute conductive matter by rubbing the paddle electrodes together.
- 4 Apply paddles to the patient's bare chest, using the anterior-anterior placement (or in accordance with your organization's protocol).

The sternum paddle contains a patient contact indicator (PCI). See Figure 50. If necessary, as indicated by the appearance of either a red or orange LED on the PCI, adjust paddle pressure and placement to optimize patient contact. Once proper contact is made, the PCI shows a green LED.

Figure 50 Patient Contact Indicator



NOTE Reasonable effort should be made to obtain a reading of at least one green LED. Due to impedance, this may not be possible for some patients, and orange LEDs may be the best that can be achieved.

Using Pediatric Paddles

The HeartStart MRx's external paddle set comes with pediatric paddles included. The American Heart Association recommends using pediatric paddles on children weighing < 10 Kg (larger paddles may be used as long as contact between the paddles is avoided).

To use the pediatric paddles set:

- 1 Depress the latch at the front of the external paddle set while pulling forward on the adult paddle electrode.
- 2 Store the adult paddle electrodes in the paddle tray pockets.
- 3 To defibrillate, see "Using External Paddles" on page 75.

NOTE Impedance is the resistance between the defibrillator's pads or paddles that the defibrillator must overcome to deliver an effective discharge of energy. The degree of impedance differs from patient to patient and is affected by several factors including the presence of chest hair, moisture, and lotions or powders on the skin.

The low-energy SMART Biphasic waveform is an impedance-compensating waveform that is designed to be effective across a wide range of patients. However, if you receive a "No Shock Delivered" message, check that the patient's skin has been washed and dried and that any chest hair has been clipped. If the message persists, change the pads and/or the pads cable.

Using Internal Paddles

To defibrillate using internal paddles:

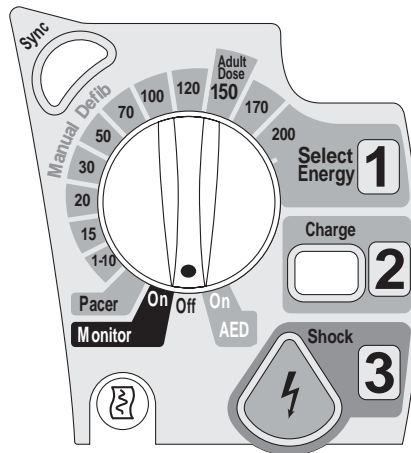
- 1 Select the appropriate paddle electrode size.
- 2 If using switchless internal paddles, connect the paddles to the M4740A Paddle Adapter Cable.
- 3 Connect the paddles cable (or the paddle adapter cable) to the HeartStart MRx by aligning the pointer on the paddles cable (or paddle adapter cable) with the white arrow on the green Therapy port. Then push until you hear it click into place. See Figure 47.

Defibrillating (asynchronously)

Once you have performed the necessary preparation for defibrillation, perform the following steps:

- 1 **Select Energy** - To select the energy setting, rotate the Therapy Knob to the desired energy level as shown in Figure 51. Energy choices range from 1 to 200, with 150J the recommended level for adult patients.

Figure 51 Energy Selection




Selecting the 1-10 (1-9) energy setting displays the Select Energy menu, with a default setting of 6J. The low energy setting can be changed using the Navigation buttons to increase or decrease the desired setting. Complete your selection by pressing the Menu Select (✓) button. Your current energy selection is shown in the Shock Status area of the display as shown in Figure 46.

WARNING Clinicians must select an appropriate energy level for defibrillation of pediatric patients.

WARNING The HeartStart MRx has a built-in limitation of 50 Joules when using internal paddles.

WARNING Do not leave patients unattended when the HeartStart MRx is in manual defibrillation mode with pads applied to the patient.


- 2 **Charge** - Press the Charge  button on the front panel. If using external paddles, the charge button on the paddles may be used instead. As the defibrillator charges, the energy selection shown in the Shock Status area changes to show the current charge energy. A continuous, low-pitch charging tone sounds until the desired energy level is reached, at which point you will hear a continuous, high-pitch charge done tone.

You may increase or decrease the selected energy at any time during charging or after charging is complete. Simply move the Therapy Knob to the desired energy level as explained above. The defibrillator charges to the selected energy level automatically.

To disarm the defibrillator, press **[Disarm]**. If the Shock button has not been pressed within the time period specified in the Time to Auto Disarm Configuration setting, the defibrillator disarms automatically.

- 3 **Shock** - Confirm that a shock is still indicated and that the defibrillator has charged to the selected energy level. Make sure no one is touching the patient or anything connected to the patient. Call out loudly and clearly, “Stay Clear!”

If using:

- pads or switchless internal paddles, press the flashing Shock  button to deliver a shock to the patient.
- external paddles, simultaneously press the shock buttons located on the paddles to deliver a shock to the patient.
- switched internal paddles, press the Shock button located on the paddles to deliver a shock to the patient.

The number of shocks delivered is displayed in the Shock Status area of the display. This number includes any shocks administered while in AED Mode.

WARNING Defibrillation current can cause operator or bystander injury. Do not touch the patient, or equipment connected to the patient, during defibrillation.

CAUTION Alarms are turned off when an energy is selected for asynchronous defibrillation, and the “Alarms Off” message is displayed. Alarms remain paused until toggled on using the Alarm Pause button, the Sync function is enabled, or the Therapy Knob is moved to **Monitor** or **Pacer**.

Performing Synchronized Cardioversion

Synchronized Cardioversion allows you to synchronize delivery of the shock with the R-wave of the ECG being monitored in Wave Sector 1. You may choose to perform synchronized cardioversion through either:

- multifunction electrode pads, or
- external paddles

When using paddles, you should monitor the ECG through monitoring electrodes connected to a 3-, 5- or 10-lead ECG cable or a Philips bedside monitor. You may choose to monitor through an alternate source when using pads, as well. Cardioversion is still delivered through either pads or paddles.

Preparing for Synchronized Cardioversion

In preparation for synchronized cardioversion:

- 1 Perform the tasks as described in “Preparing for Defibrillation” on page 74
- 2 If monitoring through a 3-, 5-, or 10-lead ECG cable, plug the ECG cable into the ECG port on the HeartStart MRx and apply monitoring electrodes to the patient. (See “ECG and Arrhythmia Monitoring” on page 47.)
- 3 Use the Lead Select button to select pads, paddles or a lead from attached monitoring electrodes. The selected ECG source should have a clear signal and a large QRS complex. (See “Lead Selection” on page 53.)

NOTE When the patient is already connected to Philips bedside monitoring equipment, an external ‘Sync’ cable plugs into the ECG Output jack of the bedside monitor and connects to the ECG port of the HeartStart MRx. This connects the ECG signal from the monitor into the HeartStart MRx, where it is displayed and synchronization occurs.

If you are using a SureSigns monitor and connect it to the HeartStart MRx, you will see a square waveform in place of the QRS.




The signal from the bedside monitor is displayed as Lead II on the HeartStart MRx, even though it is not necessarily Lead II coming from the bedside monitor.

WARNING If you use an external monitor as the ECG source, a biomedical technician **MUST** verify that the external monitor and the HeartStart MRx combination will deliver a synchronized shock within 60 ms of the peak of the R-wave. Use a 1 mV QRS complex with a QRS width of 40 ms. This performance cannot be guaranteed with all commercially available monitors.

WARNING When monitoring through paddles only, artifact introduced by paddle movement may resemble an R-wave and trigger a defibrillation shock.


Delivering a Synchronized Shock


To perform synchronized cardioversion:

- 1 With the Therapy Knob in the **Monitor** position, press the Sync  button located beside the Therapy Knob (see Figure 51) to activate the Sync function. A Sync message appears in the upper right corner of Wave Sector 1.
- 2 Confirm that the Sync marker appears with each R-wave.
- 3 Turn the Therapy Knob to the desired energy level setting.
- 4 Press the Charge  button on the HeartStart MRx or, if using paddles, the yellow charge button located on the handle of the paddle with the  symbol. Wait until the charge has reached the energy level selected, and you hear a continuous charge done tone.

To disarm the defibrillator, press **[Disarm]**. If Shock has not been pressed within the time period specified in the Time to Auto Disarm Configuration Choice, the defibrillator disarms automatically.

If desired, you may increase or decrease the selected energy level after pressing the Charge button by moving the Therapy Knob to the desired setting. The defibrillator charges to the modified energy level automatically. Wait until the current charge reaches the selected energy level before proceeding.

- 5 Make sure no one is touching the patient or anything connected to the patient. Call out clearly and loudly, “Stay Clear!”.
- 6 Press **and hold** the Shock  button on the HeartStart MRx or, if you are using external paddles, press **and hold** the orange buttons on both paddles. The shock will be delivered when the next R-wave is detected.

NOTE It is important to continue to hold the Shock  button (or the paddle shock buttons) until the shock is delivered. The defibrillator shocks with the next detected R-wave.

NOTE Should an ECG or pads INOP (such as Leads Off) occur while performing synchronized cardioversion, the HeartStart MRx will not charge, or if charged, will disarm automatically.

WARNING Defibrillation current can cause operator or bystander injury. Do not touch the patient or equipment connected to the patient during defibrillation.


Delivering Additional Synchronized Shocks

If additional synchronized shocks are indicated, perform the following steps:

- 1 Make sure the Sync function is still enabled, as indicated by the presence of the Sync message in the upper right corner of the Wave Sector 1.
- 2 Repeat Steps 4-6 under “Delivering a Synchronized Shock”.

The Sync function of the HeartStart MRx can be configured to either be enabled or disabled after each shock is delivered. If configured to remain enabled and the Therapy Knob is moved to either **Monitor** or **Pacer**, the Sync function is still enabled. However, should the Therapy Knob be moved to either the **Off** or **AED** positions, the Sync function is disabled.

Disabling the Sync Function

To turn off the Sync function of the HeartStart MRx, press the Sync  button.

Using Q-CPR in Manual Mode

If your HeartStart MRx has the Q-CPR option, refer to “Q-CPR Feedback on the HeartStart MRx” on page 167.

Troubleshooting

If your HeartStart MRx monitor/defibrillator does not operate as expected during defibrillation, see “Troubleshooting” on page 297.

Noninvasive Pacing

This chapter explains the noninvasive transcutaneous pacing option available with the HeartStart MRx and describes how to perform pacing.

Overview

Noninvasive transcutaneous pacing therapy is used to deliver pace pulses to the heart. Pace pulses are delivered through multifunction electrode pads that are applied to the patient's bare chest.

While in Pacer Mode, the ECG strip and Event Summary are easily annotated with event information using the Mark Event function button. See "Marking Events" on page 237 for more information.

NOTES Use only approved lead sets when pacing with the HeartStart MRx. Failure to do so may introduce noise and result in intermittent leads off messages.

For treatment of patients with implantable devices such as permanent pacemakers or cardioverter-defibrillators, consult a physician and the instructions for use provided by the device's manufacturer.

Waveforms, ECG monitoring, measurements, and most alarms remain active and retain their settings when you transition from Monitor or Manual Defib Mode to Pacer Mode. However, the waveform displayed in Wave Sector 4 is replaced by the pacing status bar.

The use of Pacer Mode may be password protected as defined in Configuration. See "Password Security" on page 13.

Alarms

Arrhythmia alarms for Pacer Not Pacing and Pacer Not Capture are associated with non-transcutaneous pacing (such as internal, transvenous or epicardial pacing), therefore, these alarms are off when the HeartStart MRx is in Pacer Mode. All other red and yellow alarms are active if enabled, and their limits may be changed while in Pacer Mode. Refer to the specific chapter for each measurement for information on red and yellow alarms and changing alarm limits.

While pacing, should a Pads Off condition occur or the pads cable get disconnected, a latching, red alarm is generated and pacing is stopped. The message, **Pacing Stopped. [Pads Off] [Pads Cable Off]** is displayed in the top line of the pacing status bar. Once the condition is corrected, resume pacing by pressing the **[Resume Pacing]** soft key.

While pacing, if the pacer output drops below the selected setting (sometimes caused by poor pads contact as a result of gas bubbles underneath the pads) by 20 percent or 10 mA (whichever is greater), a **Pacer Output Low** yellow alarm is displayed on the top line of the Pacer Status block. The alarm remains on the display until pacing is stopped, the condition clears or the therapy knob is moved off the Pacer position. A **Pacer Output Low** entry is logged in the Event Summary.

While pacing in demand mode, should the ECG source for Wave Sector 1 become invalid, e.g. a Leads Off condition or the ECG cable is disconnected, a latching, red alarm is generated and pacing is stopped. The message, **Pacing Stopped. Leads Off.** is displayed in the top line of the pacing status bar. Once the condition is corrected, resume pacing by pressing the **[Resume Pacing]** soft key.

When pacing in demand mode using a 3-lead ECG set, if the lead in Wave Sector 1 is changed, a latching, red alarm is generated. The message, **Pacing Stopped. Leads Off.** is displayed in the top line of the pacing status bar. Resume pacing by pressing the **[Resume Pacing]** soft key.

NOTE The Pacing Stopped red alarm cannot be disabled.

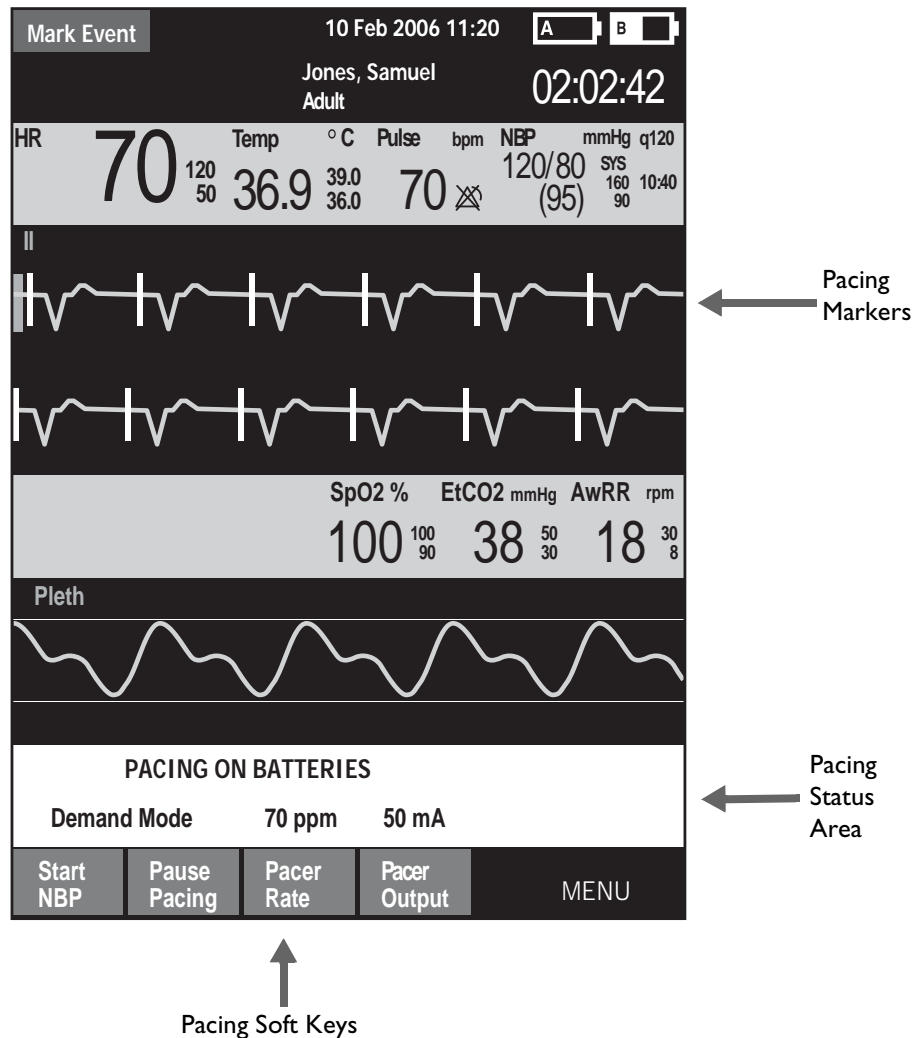
WARNING Heart rate displays and alarms function during pacing, but they can be unreliable. Observe the patient closely while pacing. Do not rely on the indicated heart rate or heart rate alarms as a measure of the patient's perfusion status.

NOTE When pacing is stopped due to a power interruption, a red **Pacing Stopped. Power Interrupted** alert will appear on the HeartStart MRx display when power is eventually restored.

Pacing View

Pacing View appears when the Therapy Knob is set to the **Pacer** position. Figure 52 shows information displayed in Pacing View.

Figure 52 Pacing View



Pacing View includes a status block which appears in Wave Sector 4 of the display. The first line of the status block communicates whether pacing is active or paused. If pacing is powered by batteries, this is indicated here as well, if configured. The second line of the status block identifies the Pacer Mode (demand or fixed), pacing rate (ppm), and pacing output (mA).

Soft keys are available for setting pacing status ([**Start Pacing**], [**Pause Pacing**], [**Resume Pacing**]) and adjusting [**Pacer Rate**], [**Pacer Output**].

NOTE If pacing is interrupted for any reason, the [**Resume Pacing**] soft key must be pressed to continue pacing.

A white pacing marker appears on the ECG waveform in Wave Sector 1 each time a pacer pulse is delivered to the patient. If pacing in demand mode, white R-wave markers also appear on the ECG until capture occurs.

NOTE R-wave markers do not appear on paced beats.

Demand Mode Versus Fixed Mode

The HeartStart MRx can deliver paced pulses in either demand or fixed mode.

- In **demand mode**, the pacer only delivers paced pulses when the patient's heart rate is lower than the selected pacing rate.
- In **fixed mode**, the pacer delivers paced pulses at the selected rate.

WARNING Use demand mode pacing whenever possible. Use fixed mode pacing when motion artifact or other ECG noise makes R-wave detection unreliable or when monitoring electrodes are not available.

The HeartStart MRx requires a 3-, 5-, or 10-lead ECG cable and monitoring electrodes as the source of the ECG during demand pacing. Pace pulses are delivered through the multifunction electrode pads. However, the pads cannot be used to monitor the ECG and deliver pace pulses simultaneously.

NOTE The ECG derived from pads does not need to be displayed in a wave sector in order to deliver pacing therapy.

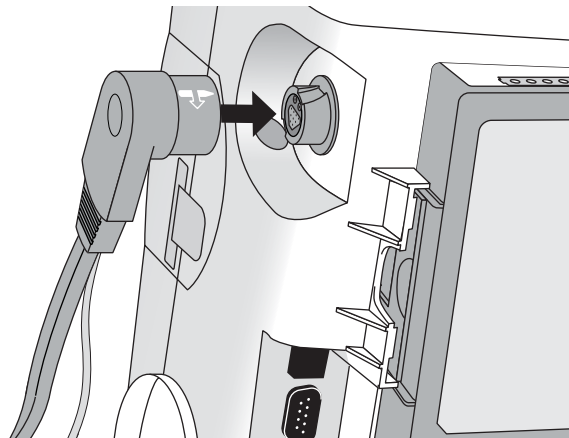
NOTE When using demand mode, pads are not an available choice for display in Wave Sector 1, through either the Lead Select button or the **Displayed Waves** menu.

Preparing for Pacing

To prepare for pacing:

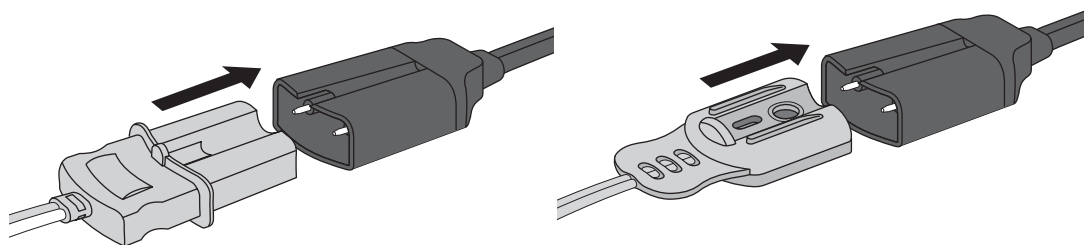
- 1 If not pre-connected, connect the pads cable to the HeartStart MRx by aligning the white pointer on the pads cable with the white arrow on the green Therapy port. Then push until you hear it click into place. See Figure 53.

Figure 53 Pads Cable Connection



- 2 Make sure the multifunction electrode pads packaging is intact and within the expiration date shown.
- 3 Connect the pads connector to the pads cable. See Figure 54.

Figure 54 Pads Connectors



- 4 Apply the pads to the patient as directed on the pads packaging or according to your organization's protocol. Prepare the patient's skin prior to applying the pads. Skin is a poor conductor of electricity, so skin preparation is important in achieving good contact.
 - If necessary, clip hair at the electrode sites (or shave sites if needed).
 - Clean and abrade the skin at the electrode site.
 - Dry the electrode sites briskly to increase capillary blood flow in the tissues and to remove oil and skin cells.

- 5 If pacing in demand mode, apply monitoring electrodes (see “Electrode Placement” on page 51), and connect the ECG cable to the HeartStart MRx (see “Connecting the ECG Cable” on page 35).

NOTE If pacing for long periods of time, new monitoring electrodes and multifunction electrode pads should be applied periodically. Refer to the manufacturer’s documentation for replacement recommendations.


NOTE The signal from a TENS unit can cause ECG artifact which may impact pacing.

Demand Mode Pacing

To pace in demand mode:

- 1 Turn the Therapy Knob to the **Pacer** position.

The message, **Pacing Paused**, appears in the status block and indicates that the pacing function is enabled, however, pace pulses are not being delivered. Pacing is enabled in demand mode, with the configured lead displayed in Wave Sector 1. If the configured lead is set to Pads, Lead II or the first available monitoring lead, that lead is displayed.

- 2 Press the Lead Select  button to select the best lead with an easily detectable R-wave. (See “Lead Selection” on page 53).

NOTE If you are using anterior-anterior pads placement while pacing and are experiencing difficulty with Lead II, select another lead.

- 3 Verify that white R-wave markers appear above or on the ECG waveform. A single marker should be associated with each R-wave. If the R-wave markers do not appear or do not coincide with the R-wave, select another lead.
- 4 Press [**Pacer Rate**] and use the Navigation and Menu Select buttons to select the desired number of pace pulses per minute. The initial rate is configurable.
- 5 If needed, adjust the initial pacer output. To do this, press [**Pacer Output**] and use the Navigation and Menu Select buttons to select the desired output. The initial output is configurable.
- 6 Press [**Start Pacing**]. The message, **Pacing**, appears.

WARNING Use care when handling the multifunction electrode pads on the patient to avoid shock hazard during pacing.

- 7 Verify that white pacing markers appear on the ECG waveform.
- 8 Press [**Pacer Output**]. Then use the Navigation and Menu Select buttons to:
 - a. increase the output until cardiac capture occurs. Capture is indicated by the appearance of a QRS complex after each pacing marker.
 - b. decrease the output to the lowest level that still maintains capture.
- 9 Verify the presence of a peripheral pulse.

NOTE Spontaneous beats may be present which are not associated with the delivery of pace pulses. Additionally, if the patient's heart rate is above the pacer rate, pace pulses are not delivered and, therefore, pacing markers do not appear.

To stop delivery of pace pulses, press **[Pause Pacing]**. Once paused, press **[Resume Pacing]** to resume delivery of pace pulses.

You may also stop delivery of pace pulses by moving the Therapy Knob off the **Pacer** position.

WARNING When Pacing in demand mode, the ECG cable must be directly connected from the patient to the HeartStart MRx.

WARNING If you are using the pacing function with battery power and the Low Battery Alarm is annunciated, connect the device to external power or insert a fully charged battery.

NOTE Routinely assess the patient's cardiac output by assessing peripheral pulses.

NOTE Pacing will not start if there is a problem with the multifunction electrode pads connection or patient contact. Pace pulses will not be delivered if there is a problem with the ECG monitoring electrodes connections. If either situation occurs, a system message is displayed to alert you that a lead is disconnected or that the pads have a poor connection.

Fixed Mode Pacing

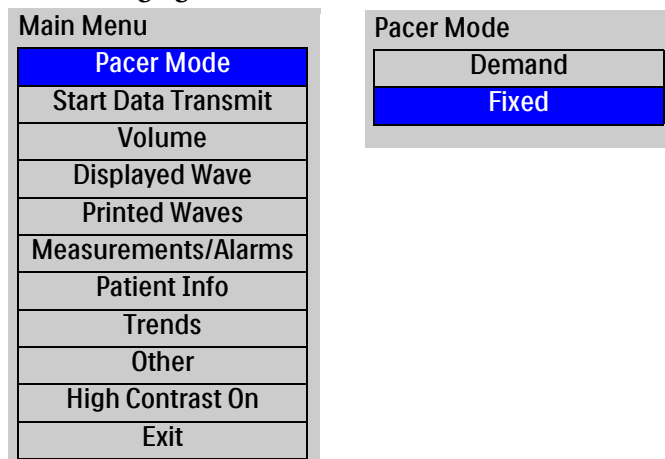
To pace in fixed mode:


- 1 Turn the Therapy Knob to the **Pacer** position.

The message, **Pacing Paused**, appears and indicates that the pacing function is enabled, however, pace pulses are not being delivered. Pacing is enabled in demand mode, with the configured lead displayed in Wave Sector 1. If the configured lead is set to Pads, Lead II or the first available monitoring lead is displayed.

- 2 Change the pacer mode to fixed mode, using the menu selections shown below in Figure 55

Figure 55 Changing Pacer Modes



- 3 Use the Lead Select  button to select the desired lead for viewing.

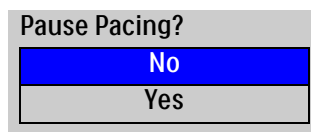
NOTE If you want to see the ECG waveform and related parameters while pacing, you must have electrodes on the patient with pads. Using pads only will give you an incorrect heart rate and inappropriate alarms.

- 4 Press **[Pacer Rate]** and use the Navigation and Menu Select buttons to select the desired number of paced pulses per minute. The initial rate is configurable.
- 5 If needed, adjust the initial pacer output. To do this, press **[Pacer Output]** and use the Navigation and Menu Select buttons to select the desired output. The initial output is configurable.
- 6 Press **[Start Pacing]**. The message, **Pacing**, appears.

WARNING Use care when handling the multifunction electrode pads on the patient to avoid shock hazard during pacing.

- 7 Verify that white pacing markers appear on the ECG waveform (if ECG electrodes are in place).
- 8 Press **[Pacer Output]**. Then use the Navigation and Menu Select buttons to:
 - a. increase the output until cardiac capture occurs. Capture is indicated by the appearance of a QRS complex after each pace pulse marker.
 - b. decrease the output to the lowest level that still maintains capture.
- 9 Verify the presence of a peripheral pulse.
- 10 To pause or stop pacing:
 - Press **[Pause Pacing]**.
 - A prompt message will ask you to confirm your action.

Figure 56 Pause Pacing Message



- Confirm your action. Use the Navigation buttons to highlight **Yes** and press the Menu Select button.
- OR
- Move the Therapy Knob off the **Pacer** position.

Defibrillating During Pacing

Should it be necessary to defibrillate the patient during pacing, refer to the procedure for defibrillating in Manual Defib Mode in Chapter 6, or AED Mode in Chapter 5. Once the Therapy Knob is moved from the **Pacer** position to a Manual Defib Mode energy setting or **AED**, pacing is stopped.

To resume pacing after defibrillation, repeat the pacing procedure, as described in “Demand Mode Pacing” on page 88 or “Fixed Mode Pacing” on page 89. When pacing is resumed, pacing settings selected prior to defibrillation (mode, rate, and output) are retained. Be sure to confirm that cardiac capture has been maintained.

CAUTION Pacing must be turned off before defibrillating with a second defibrillator. Failure to do so could damage the HeartStart MRx.

Troubleshooting

If your HeartStart MRx does not operate as expected during pacing, see Chapter 22, “Troubleshooting” on page 297.

Pulse Oximetry

Pulse Oximetry (SpO₂) monitoring is one of the tools available to assist in assessing a patient's cardiac and respiratory systems. This chapter explains how pulse oximetry works and describes how to use the HeartStart MRx to monitor SpO₂.

Overview

Pulse oximetry is a noninvasive method of continuously measuring functional oxygen saturation (SpO₂) in arterial blood. The resultant SpO₂ reading indicates the percentage of hemoglobin molecules in the arterial blood which are saturated with oxygen.

WARNING Do not rely solely on SpO₂ readings; assess the patient at all times. Inaccurate measurements can be caused by:

- Incorrect sensor application or use.
 - Significant levels of dysfunctional hemoglobins (such as carboxyhemoglobin or methemoglobin).
 - Injected dyes such as methylene blue, or intravascular dyshemoglobins such as methemoglobin or carboxyhemoglobin.
 - Exposure to excessive illumination such as surgical lamps (especially those with a xenon light source), bilirubin lamps, fluorescent lights, infrared heating lamps, or direct sunlight.
-

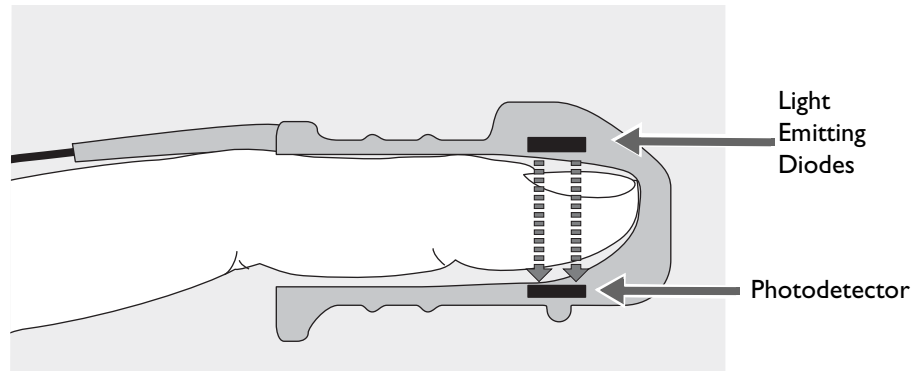
The HeartStart MRx allows you to monitor SpO₂ while in Monitor, Manual Defib, and Pacer modes. When using the Q-CPR option, SpO₂ monitoring functionality is not available.

NOTE For more information on SpO₂, refer to the Application Note, *Philips Pulse Oximetry*.

Understanding Pulse Oximetry

A pulse oximetry sensor sends light through patient tissue to a receiver on the other side of the sensor. As Figure 57 shows, light emitting diodes transmit red and infrared light through peripheral areas of the body, such as a finger.

Figure 57 Pulse Oximetry Sensor



A photodetector positioned opposite the light emitting diodes compares light absorption before and after pulsation. The amount of light getting through reflects the blood flow in the arterioles. This measurement of light absorption during pulsation is translated into an oxygen saturation percentage and an SpO₂ value is displayed.

For accurate SpO₂ measurements, the following conditions must apply:

- The patient must have perfusion in that extremity.
- The light emitter and the photodetector must be directly opposite each other.
- All of the light from the emitter must pass through the patient's tissue.
- The sensor site should be free of vibration and excessive motion.
- Power cables should be kept away from the sensor cable and connector.

Selecting a Sensor

See “SpO₂ Sensors and Cables” on page 293 for a list of the SpO₂ sensors that may be used with the HeartStart MRx.

-
- CAUTION**
- Do not use disposable sensors in high humidity environments or in the presence of fluids which may contaminate sensor and electrical connections, causing unreliable or intermittent measurements.
 - Do not use disposable sensors on patients who have allergic reactions to the adhesive.
 - Do not use the ear transducer on patients with small ear lobes, as incorrect measurements may result.
-

The most important factor when selecting a sensor is the position of the light emitting diodes in relation to the photodetector. When a sensor is applied, the diodes and the photodetector must be opposite each other. Sensors are designed for patients with a specific weight range and for specific sites. Be sure to:

- Select a sensor appropriate for the patient's weight.
- Select a sensor site with adequate perfusion. Improve perfusion at the site by rubbing or warming the site.
- Avoid application to sites with edematous tissue.

Reusable Sensors may be reused on different patients after they have been cleaned and disinfected (see the manufacturer's instructions supplied with the sensor).

Disposable Sensors should be used only once and then discarded. They may be relocated to another sensor site on the patient if the first location does not give the desired results. Disposable sensors must not be reused on different patients.

NOTE A 2-meter SpO₂ extension cable (M1941A) is available for use with the HeartStart MRx.

Applying the Sensor

Follow the manufacturer's directions for applying and using the sensor, making sure to observe any warnings or cautions. For the best results:

- Make sure the sensor is dry.
- If the patient is moving, secure the sensor cable loosely to the patient.
- Make sure the transducer is not too tight. Too much pressure can cause venous pulsation or can impede the blood flow, resulting in low readings.
- Keep power cables away from the sensor cable and connection.
- Avoid placing the sensor in an environment with bright lights. If necessary, cover the sensor with opaque material.
- Avoid placing the sensor on an extremity with an arterial catheter, blood pressure cuff, or intravenous infusion line.

-
- WARNING**
- Failure to apply the sensor properly may reduce the accuracy of the SpO₂ measurement.
 - Inspect the sensor application site at least every two hours for changes in skin quality, correct optical alignment, and proper sensor application. If skin quality is compromised, change the sensor site. Change the application site at least every four hours. More frequent checking may be required due to an individual patient's condition.
 - Using an SpO₂ sensor during MR imaging can cause severe burns. Minimize this risk by positioning the cable so that no inductive loops are formed. If the sensor does not appear to be operating properly, remove it immediately from the patient.
-

-
- CAUTION** Do not use more than one extension cable (M1941A).
Position the sensor cable and connector away from power cables to avoid electrical interference.
-

Monitoring SpO₂

To monitor SpO₂:

- 1 Connect the appropriate sensor cable to the to the HeartStart MRx as described in “Connecting the SpO₂ Cable” on page 36.
- 2 Apply the sensor to the patient.
- 3 If the HeartStart MRx is not turned on, turn the Therapy Knob to **Monitor**.
- 4 Check that the patient category is appropriate for the patient. If necessary, use the **Patient Info** menu to access **Patient Category** and select the correct patient category setting (adult/pediatric). This is used to optimize the calculation of the SpO₂ and pulse values.

A **·?·** is displayed in Parameter Block 2 while the oxygen saturation is initially measured and a value is calculated. In a few seconds a value appears, replacing the **·?·**. As the patient’s oxygen saturation changes, the SpO₂ value is updated continuously. See Figure 58.

If SpO₂ alarms are turned on, alarm limits are displayed to the right of the SpO₂ value. If alarms are turned off, the **XX** symbol is displayed instead of the alarm limits. SpO₂ alarms are on by default. See “SpO₂ Alarms” on page 99.

The patient’s pulse rate as derived from pulse oximetry, is displayed in Parameter Block 1 (see Figure 60). If pulse rate alarms are turned on, alarm limits are displayed to the right of the pulse rate value. If alarms are turned off, the **XX** symbol is displayed instead of the alarm limits. Pulse alarms are off by default. See “Pulse Rate Alarms” on page 100.

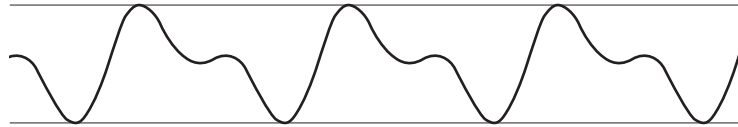
Figure 58 SpO₂ Parameter Block 2

ABP	mmHg	PAP	mmHg	SpO ₂	%	EtCO ₂	mmHg	AwRR	rpm
118/77 (95)	SYS 160 90	24/10 (15)	DIA 16 0	100	100 90	38	50 30	18	30 8

Pleth Wave

When the sensor is connected to the HeartStart MRx, the pleth wave is displayed in the configured Wave Sector or the first available empty Wave Sector. It is drawn at an approximate speed of 25 mm/second. Grid lines are displayed to indicate signal quality. When signal quality is good, the pleth wave is auto scaled to the grid lines. When signal quality is poor, the size of the pleth wave is proportionately decreased.

Figure 59 Pleth Wave Size



When the Therapy Knob is moved to an energy setting, the SpO₂ values and pleth wave continue to be displayed as long as they are not located in Wave Sector 2 or you're in Q-CPR View. When the Therapy Knob is moved to **Pacer**, the pacing status bar appears in Wave Sector 4, replacing the waveform in that sector. If the pleth wave was removed, the SpO₂ and Pulse values and alarm settings are retained. If the Therapy Knob is moved to **AED**, SpO₂ and pulse related information is no longer monitored.

SpO₂ Alarms

Alarms are annunciated if measurements fall outside the configured limits for high or low SpO₂, or if the measurement falls below the configured SpO₂ Desat Limit. SpO₂ alarms, except Desat, are all categorized as “non-latching” alarms, meaning they are automatically removed when their alarm condition no longer exists. Desat alarms are latching, meaning they remain present even if the alarm condition no longer exists. Table 9 lists SpO₂ alarms.

Table 9 SpO₂ Red/Yellow Physiological Alarms


Alarm Message	Type of Alarm	Indicator	Condition
Desat	Red	Red alarm message; alarm tone	The SpO ₂ value has fallen below the desat low limit.
SpO ₂ High	Yellow	Yellow alarm message; alarm tone	The SpO ₂ value exceeds the high alarm limit.
SpO ₂ Low	Yellow	Yellow alarm message; alarm tone	The SpO ₂ has dropped below the low alarm limit.

SpO₂ alarms are on unless you turn SpO₂ alarms off or alarms for the entire device are off. Once disabled, alarms remain off until they are turned on.

WARNING Turning off alarms prevents all alarms associated with the SpO₂ measurement from being annunciated. If an alarm condition occurs, NO alarm indication will be given.

Changing the SpO₂ Alarm Limits

To change the SpO₂ high and low alarm limits, perform the following steps:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select the **Measurements/Alarms** menu and press the Menu Select button.
- 3 Select SpO₂ and press the Menu Select button.
- 4 Select SpO₂ **Limits** and press the Menu Select button.
- 5 Using the Navigation buttons, select the new high limit value and press the Menu Select button.
- 6 Select the new low limit value and press the Menu Select button.


SpO₂ Desat Alarm

The HeartStart MRx also provides an alarm for SpO₂ Desat Limit. The SpO₂ Desat alarm provides an additional limit setting below the low limit setting to notify you of potentially life threatening decreases in oxygen saturation. This additional limit setting is preset through the **Configuration** menu.

NOTE If the SpO₂ Low Limit alarm value is set below the configured SpO₂ Desat Limit, the SpO₂ Desat Limit value is automatically adjusted to the SpO₂ Low Limit alarm value. Should the SpO₂ reading fall below this limit, the SpO₂ Desat Limit alarm is announced.

Enabling/Disabling the SpO₂ Alarms

To enable the SpO₂ Alarms, perform the following steps:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select the **Measurements/Alarms** menu and press the Menu Select button.
- 3 Select SpO₂ and press the Menu Select button.
- 4 Select **Alarms On/Off** and press the Menu Select button.

NOTE While an NBP measurement is in progress, SpO₂ INOP messages are suppressed for up to 60 seconds.

Pulse Rate Alarms


Pulse Rate alarms are off unless you enable them during use. The configured alarm limits may be changed during use. Alarms are annunciated if measurements fall outside the configured limits for high and low pulse rate. Pulse Rate alarms are all categorized as “non-latching” alarms, meaning they are automatically removed when their alarm condition no longer exists. Table 10 details Pulse Rate alarms.

Table 10 Pulse Rate Physiological Alarms

Alarm Message	Type of Alarm	Indicator	Condition
Pulse High	Yellow	Yellow alarm message; alarm tone	Pulse value exceeds the high alarm limit.
Pulse Low	Yellow	Yellow alarm message; alarm tone	Pulse value has fallen below the low alarm limit.


Enabling/Disabling the Pulse Rate Alarms

To enable/disable the Pulse Rate Alarms, perform the following steps:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select the **Measurements/Alarms** menu and press the Menu Select button.
- 3 Select **Pulse** and press the Menu Select button.
- 4 Select **Alarms On/Off** and press the Menu Select button.

Changing the Pulse Rate Alarm Limits

To change the Pulse Rate Alarm Limits, perform the following steps:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select the **Measurements/Alarms** menu and press the Menu Select button.
- 3 Select **Pulse** and press the Menu Select button.
- 4 Select **Pulse Limits** and press the Menu Select button.
- 5 Using the Navigation buttons, select the new high limit value and press the Menu Select button.
- 6 Select the new low limit value and press the Menu Select button.

Disabling the SpO₂ Monitoring Function

To disable the SpO₂ monitoring function, disconnect the sensor cable from the SpO₂ port. The message SpO₂ **Unplugged. Turn off SpO₂?** appears. Select **Yes** and press the Menu Select button.

Should the sensor cable be disconnected accidentally, the message SpO₂ **Unplugged. Turn off SpO₂?** appears to notify you of the disconnection. Select **No** and press the Menu Select button. Secure the connection. The SpO₂ monitoring function is once again enabled.

Caring for Sensors

Refer to the manufacturer's instructions for care and cleaning of sensors. To get the best results from your reusable SpO₂ sensors, always handle the sensor and cable with care and protect them from sharp objects. The sensor sleeve houses a sensitive electronic device that can be damaged. Harsh treatment of sensors will drastically reduce their lifetime.

WARNING Do not use a damaged sensor or one with exposed electrical circuits.

Troubleshooting

If your HeartStart MRx does not operate as expected during SpO₂ Monitoring, see Chapter 22, "Troubleshooting" on page 297.

Noninvasive Blood Pressure

This chapter describes how to monitor noninvasive blood pressure (NBP) with the HeartStart MRx.

Overview

Your HeartStart MRx measures blood pressure for both adult and pediatric patients using the oscillometric method. Systolic, diastolic, and mean measurements are provided, and alarms are available to alert you to changes in the patient's condition. NBP measurements may be taken while in Monitor, Pacer, or Manual Defib modes. NBP measurements can be taken automatically on a schedule or manually on demand.


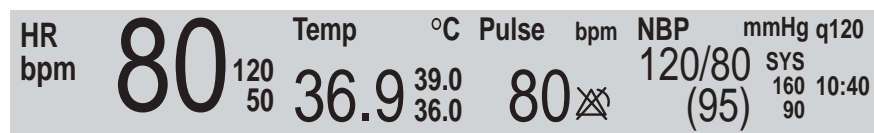
While an NBP measurement is in progress, the current cuff pressure is displayed in Parameter Block 1. Once the measurement is complete, the values for systolic, diastolic, and mean pressure are displayed, along with the measurement schedule (manual or automatic intervals) and a time stamp (see Figure 60). If NBP alarms are enabled, alarm limits appear next to the NBP value and the alarm source (systolic, diastolic, or mean) is displayed above the NBP alarm limits. If alarms are off, the alarms off symbol  replaces the limits.

Figure 60 NBP / Parameter Block 1



For more information on monitoring NBP, refer to the Application Note, *About Noninvasive Blood Pressure*.

WARNING Do not perform NBP monitoring on patients whose upper arm circumference is less than 13 cm. Doing so may result in inaccurate measurements.

The first time an NBP measurement is taken, the cuff's initial inflation pressure is 160 mmHg (adult) or 120 mmHg (pediatric). If the measurement is successful, the next inflation pressure is 35-40 mmHg above the systolic measurement, with a minimum inflation pressure of 120 mmHg. If the patient's systolic pressure measurement is higher than the inflation pressure, the cuff inflation pressure is automatically increased by 35-40 mmHg and another measurement is attempted. The maximum cuff inflation pressure is 280 mmHg, while the maximum systolic value is 260 mmHg.

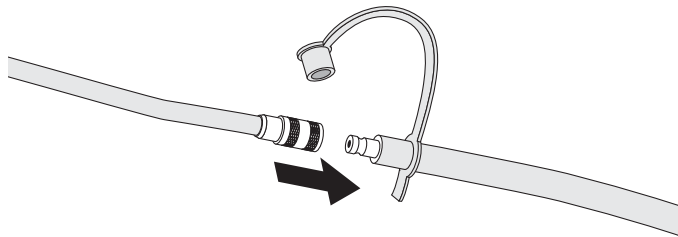
WARNING Initial cuff inflation pressure is based on the configured patient type, adult or pediatric. If necessary, select the correct patient type during use by changing the Patient Category selection through the Patient Info menu.

Preparing to Measure NBP

To prepare for NBP measurement:

- 1 Select the appropriately sized cuff for the patient. The cuff width should be either 40% of the limb circumference or 2/3 of the upper arm length. The inflatable part of the cuff should be long enough to encircle 50%-80% of the limb. The wrong cuff size may give false and misleading results. If you do not have the correct cuff size, use a larger one to minimize error.
- 2 Attach the cuff to the NBP tubing, making sure that air can pass through the tubing and that the tubing is not squeezed or kinked (see Figure 61).

Figure 61 Connecting the NBP Cuff/Tubing



- 3 Insert the NBP tubing into the NBP port as described in "Connecting the NBP Interconnect Tubing" on page 37.

- 4 Apply the blood pressure cuff to the patient's arm or leg as follows:
 - a. Ensure that the cuff is completely deflated.
 - b. The cuff should not be placed on the same extremity as an SpO₂ sensor. Wrap the cuff around the arm, making sure that the artery marker is aligned over the brachial artery. Ensure that the cuff is not wrapped too tightly around the limb. Excessive tightness may cause discoloration and eventual ischemia of the extremities. Also ensure that the NBP tubing from the defibrillator to the cuff is not compressed, crimped, or damaged.
 - c. Check that the edge of the cuff falls within the range identified by the <---> markings. If it does not, use a larger or smaller cuff that fits better.
- 5 Place the limb used for taking the measurement at the same level as the patient's heart.

WARNING

- Do not perform noninvasive blood pressure measurements on patients with sickle-cell disease or any condition where skin damage has occurred or is expected.
- Do not use in a hyperbaric chamber.
- Use clinical judgement to decide whether or not to perform automatic blood pressure measurements on patients with severe blood clotting disorders, because of the risk of hematoma in the limb wearing the cuff.
- Do not apply the cuff to a limb that has an intravenous infusion or arterial catheter in place. This could cause tissue damage around the catheter when the infusion is slowed or blocked during cuff inflation.
- Use only approved cuffs and tubing in order to prevent inaccurate data, injury, or damage. All specified cuffs are protected against the effects of the discharge of a defibrillator.
- Prolonged series of noninvasive blood pressure measurements in automatic mode may be associated with purpura, ischemia, and neuropathy in the limb wearing the cuff. When monitoring a patient, examine the extremities of the limb frequently for normal color, warmth, and sensitivity. If any abnormality is observed, stop the blood pressure measurements immediately.
- Blood pressure readings may be affected by the position of the subject, his/her physiologic condition, the presence of arrhythmia, and other factors.
- To obtain accurate blood pressure readings, the cuff must be the correct size and also be correctly fitted to the patient. Incorrect size or incorrect fitting may result in incorrect readings.

CAUTION

- Do not compress or restrict pressure tubes during an NBP measurement.
 - If a spill occurs and liquid appears to be inside the tubing, contact your service personnel.
-

NOTE

When using the HeartStart MRx aboard aircraft, NBP measurements should only be taken while on the ground or once cruising altitude is reached. Measurements taken during ascent or descent may not be accurate.

Measuring NBP

To measure NBP, press the **[Start NBP]** soft key. The cuff pressure is displayed as the cuff inflates and deflates. When the measurement is complete, the NBP values are displayed. Additional measurements are taken according to the configured NBP schedule. If the schedule is configured to:

Manual - There is no schedule for additional measurements. One measurement is taken each time you press **[Start NBP]**. Take additional measurements by pressing **[Start NBP]**.


Automatic - The measurement is repeated at the configured interval of 1, 2.5, 5, 10, 15, 30, 60, or 120 minutes from the time you press the **[Start NBP]** soft key. Additional manual measurements may be taken without affecting the automatic measurement schedule, by pressing **[Start NBP]**.

The configured NBP schedule may be changed during use through the **Measurements/Alarms** menu. If the automatic measurement schedule is changed, the new time interval is applied to the start time of the last measurement. If the new time interval is less than or the same as the time since the last measurement, a measurement begins immediately.

NOTE You may perform a manual NBP measurement at any time, even when an automatic schedule is set. Simply press the **[Start NBP]** soft key. To stop an NBP reading in progress, press the **[Stop NBP]** soft key.

Changing the NBP Schedule

To change the NBP schedule and/or the interval of automatic measurements for the current patient:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select the **Measurements/Alarms** menu and press the Menu Select button.
- 3 Select **NBP** and press the Menu Select button.
- 4 Select **NBP Schedule** and press the Menu Select button.
- 5 Using the Navigation buttons, select the desired interval and press the Menu Select button.

NOTE Interval choices are presented in the format “qx”, indicating measurements will be taken every “x” minutes from the time you first press **[Start NBP]**.

NOTE If no subsequent measurements are taken, NBP values will be removed from the display after 60 minutes but can still be obtained through Vital Signs Trending.

Alarms

An NBP alarm is annunciated when a measurement for the configured source (systolic, diastolic, or mean) falls outside the configured high or low limits. NBP alarms are all categorized as “non-latching” alarms, meaning they are automatically removed when their alarm condition no longer exists. Both the source of the alarm and the limits may be changed during use, for the current patient incident. NBP alarms are on unless you disable them. Once disabled, alarms remain off until enabled. Table 11 lists NBP alarms.


Table 11 NBP Red/Yellow Physiological Alarms

Alarm Message	Type of Alarm	Indicator	Condition
NBPs High	Yellow	Yellow alarm message; alarm tone	The NBP systolic value exceeds the high alarm limit.
NBPd High	Yellow	Yellow alarm message; alarm tone	The NBP diastolic value exceeds the high alarm limit.
NBPm High	Yellow	Yellow alarm message; alarm tone	The NBP mean value exceeds the high alarm limit.
NBPs Low	Yellow	Yellow alarm message; alarm tone	The NBP systolic value has fallen below the low alarm limit.
NBPd Low	Yellow	Yellow alarm message; alarm tone	The NBP diastolic value has fallen below the low alarm limit.
NBPm Low	Yellow	Yellow alarm message; alarm tone	The NBP mean value has fallen below the low alarm limit.

WARNING Turning off alarms prevents all alarms associated with the NBP measurement from being annunciated. If an alarm condition occurs, NO alarm indication will be given.


Changing NBP Alarms

To change the NBP alarm source and/or limits for the current patient incident:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select the **Measurements/Alarms** menu and press the Menu Select button.
- 3 Select **NBP** and press the Menu Select button.
- 4 Select **NBP Limits** and press the Menu Select button.
- 5 Select the desired source for the alarm, **Systolic**, **Diastolic**, or **Mean**, and press the Menu Select button.
- 6 Using the Navigation buttons, increase or decrease the high limit value and press the Menu Select button.
- 7 Set the new low limit value and press the Menu Select button.

Enabling/Disabling NBP Alarms

To enable/disable NBP Alarms:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select the **Measurements/Alarms** menu and press the Menu Select button.
- 3 Select **NBP** and press the Menu Select button.
- 4 Select **Alarms On/Off** and press the Menu Select button.

Troubleshooting

If your HeartStart MRx does not operate as expected during NBP Monitoring, see Chapter 22, “Troubleshooting” on page 297.

Monitoring Carbon Dioxide

This chapter describes how to monitor carbon dioxide (CO₂) and measure end-tidal carbon dioxide (EtCO₂) and Airway Respiration Rate (AwRR) with the HeartStart MRx using the Microstream[®] (sidestream) method. CO₂ Monitoring is available in Monitor, Pacer, and Manual Defib modes.

Overview

The carbon dioxide monitoring function of the HeartStart MRx, together with the appropriate FilterLine[®] and, if necessary, airway adapter, measures the partial pressure of carbon dioxide in a sample of the patient's exhaled breath aspirated from the breathing circuit. The HeartStart MRx may be used to monitor carbon dioxide in both intubated and non-intubated patients.

The partial pressure of carbon dioxide is derived by multiplying the measured carbon dioxide concentration with the ambient pressure. From the partial pressure measurement, the end-tidal carbon dioxide (EtCO₂) is derived. EtCO₂ is the peak CO₂ value measured during expiration. It is used to monitor the patient's respiratory status. The EtCO₂ measurement uses a technique based on the absorption of infrared radiation by some gases. It indicates the change in:

- The elimination of CO₂.
- The delivery of O₂ to the lungs.

The CO₂ monitoring function of the HeartStart MRx provides an EtCO₂ value, a CO₂ waveform, and an airway respiration rate (AwRR).

WARNING The EtCO₂ readings do not always correlate closely with blood gas values, especially in patients with pulmonary disease, pulmonary embolism or inappropriate ventilation.

Do not measure CO₂ in the presence of pharmaceuticals in aerosols.

NOTE For more information on capnography and EtCO₂, refer to the Application Note, *Uses of Capnography and Benefits of the Microstream Method*.

Preparing to Measure EtCO₂

Selecting the Accessories

There are some factors to consider when selecting accessories:

- the type of patient, adult, pediatric, or neonate.
- airway status of the patient, ventilated or not ventilated.
- if a ventilated patient, whether humidified or non-humidified ventilation is used.

WARNING Do not re-use, clean, or sterilize Microstream CO₂ accessories as they are intended for single-patient, one-time use.

Table 12 shows CO₂ accessories with their corresponding application areas.

Table 12 Microstream CO₂ Accessories

Part Number	Circuit	Description
M1920A	Intubated	FilterLine Set - Adult/Pediatric 25 sets/case
M1921A	Intubated	FilterLine H Set - Adult/Pediatric 25 sets/case
M1923A	Intubated	FilterLine H Set - Infant/Neonatal yellow, 25 sets/case
M2520A	Non-Intubated Dual Purpose	Smart CapnoLine™- Pediatric
M2522A	Non-Intubated Dual Purpose	Smart CapnoLine - Adult
M2524A	Non-Intubated Single Purpose	Smart CapnoLine - Pediatric
M2526A	Non-Intubated Single Purpose	Smart CapnoLine - Adult

WARNING Use only Microstream accessories (as listed above) to ensure correct functioning of the CO₂ sidestream measurement.

WARNING Due to a measurement delay, do not use Microstream (sidestream) CO₂ as a direct reference for determining the end expiratory point in the pressure curve.

NOTE The HeartStart MRx is equipped with automatic barometric pressure compensation.

Setting Up Microstream EtCO₂ Measurements

-
- WARNING**
- Danger - explosion hazard - sidestream measurement should not be used in the presence of flammable anesthetics such as:
 - flammable anesthetic mixture with air
 - flammable anesthetic mixture with oxygen or nitrous oxide
 - CO₂ should not be measured in the presence of aerosolized pharmaceuticals.
 - When using the nasal FilterLine, if one or both nostrils are partially or completely blocked, or the patient is breathing through the mouth, the displayed EtCO₂ values may be significantly low.
 - Reflux of gastric contents, mucus, pulmonary edema fluid or endotracheal epinephrine introduced into the detector can increase airway resistance and affect ventilation. Discard accessory if this occurs.
 - The presence of carbonated beverage or antacids in the stomach may cause incorrect readings and unreliable capnography in identifying esophageal intubation.
-

Using the Nasal FilterLine

To set up EtCO₂ measurements using the nasal FilterLine, perform the following steps:

- 1 Attach the FilterLine tubing to the CO₂ Inlet port as described in “Connecting the CO₂ FilterLine” on page 40.
- 2 Check that both nostrils are clear and position the nasal FilterLine on the face by inserting the FilterLine tips into the nostrils.
- 3 Pass the FilterLine tubing over the ears, then slide the sleeve up the tubing towards the neck to a comfortable fit under the chin. If using dual purpose FilterLine tubing, connect the green tubing to the oxygen source. Check the positioning of the FilterLine regularly to ensure proper monitoring function.
- 4 Change the nasal FilterLine every 24 hours, if the CO₂ **Occlusion** INOP message appears, or if measurement readings become erratic.

Using the FilterLine and Airway Adapter

To set up EtCO₂ measurements using the FilterLine and airway adapter:

- 1 Attach the FilterLine tubing to the CO₂ Inlet port as described in “Connecting the CO₂ FilterLine” on page 40.
- 2 Connect the wide end of the airway adapter to the endotracheal tube and connect the narrow end of the airway adapter to the ventilator tubing or manual resuscitator.

Disconnect the FilterLine during suctioning and nebulizing therapies. For best results for non-humidified use, change the FilterLine after 24 hours of continuous use. For humidified use, change the FilterLine H after 72 hours of continuous use.

WARNING When using the Microstream EtCO₂ measurement on patients who are receiving or have recently received anesthetics, connect exhaust tubing from the CO₂ Outlet port to a scavenging system or to the anesthesia machine/ventilator to prevent exposing medical staff to anesthetics. Use an exhaust tube to remove the sample gas to a scavenging system. Attach scavenging tube to the CO₂ outlet port.

NOTE Should the FilterLine or exhaust tubing be blocked when the HeartStart MRx is turned on, the CO₂ **Check Exhaust** INOP message is displayed. Should the blockage occur during CO₂ monitoring, the CO₂ waveform appears as a flat line, and if alarms are on, an apnea alarm is annunciated.

Measuring EtCO₂

The EtCO₂ measurement is automatically turned on when you connect a FilterLine to the CO₂ Inlet port. The CO₂ waveform is displayed in the configured Wave Sector if available. The measurement values for EtCO₂ and AwRR are displayed in Parameter Block 2 (see Figure 62).

Figure 62 EtCO₂ and AwRR / Parameter Block 2

ABP	mmHg	PAP	mmHg	SpO2	%	EtCO2	mmHg	AwRR	rpm
118/77	SYS	24/10	DIA	100	100	38	50	18	30
(95)	160	(15)	16	90	90	30	30	8	

EtCO₂ and AwRR Alarms

Alarms are annunciated if measurements fall outside the configured limits for high or low EtCO₂, high or low Airway Respiration Rate (AwRR) and Apnea time. EtCO₂ alarms, except Apnea, are all categorized as “non-latching” alarms, meaning they are automatically removed when their alarm condition no longer exists. Apnea alarms are latching, meaning they remain present even if the alarm condition no longer exists.

Table 13 EtCO₂ Red/Yellow Physiological Alarms


Alarm Message	Alarm Type	Indicator	Condition
Apnea	Red	Red alarm message; alarm tone	No detectable breaths for the configured number of seconds.
EtCO ₂ High	Yellow	Yellow alarm message; alarm tone	The EtCO ₂ value exceeds the high alarm limit.
EtCO ₂ Low	Yellow	Yellow alarm message; alarm tone	The EtCO ₂ value has fallen below the low alarm limit
AwRR High	Yellow	Yellow alarm message; alarm tone	The AwRR value exceeds the high alarm limit.
AwRR Low	Yellow	Yellow alarm message; alarm tone	The AwRR value has fallen below the low alarm limit.

EtCO₂ and AwRR alarms are on unless you turn them off or alarms for the entire device are off. Once disabled, alarms remain off until they are turned back on.

WARNING Turning off alarms prevents all alarms associated with EtCO₂ or AwRR measurements from annunciating. If an alarm condition occurs, NO alarm indication will be given.


Changing the EtCO₂ Alarm Limits

To change the EtCO₂ alarm limits:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select the **Measurements/Alarms** menu and press the Menu Select button.
- 3 Select EtCO₂ and press the Menu Select button.
- 4 Select EtCO₂ **Limits** and press the Menu Select button.
- 5 Using the Navigation buttons, increase or decrease the high limit value and press the Menu Select button.
- 6 Set the new low limit value and press the Menu Select button.


Enabling/Disabling the EtCO₂ Alarms

To enable or disable the EtCO₂ alarms:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select the **Measurements/Alarms** menu and press the Menu Select button.
- 3 Select EtCO₂ and press the Menu Select button.
- 4 Select **Alarms On/Off** and press the Menu Select button.


Changing the AwRR Alarm Limits

To change the AwRR alarm limits:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select the **Measurements/Alarms** menu and press the Menu Select button.
- 3 Select **AwRR** and press the Menu Select button.
- 4 Select **AwRR Limits** and press the Menu Select button.
- 5 Using the Navigation Buttons, increase or decrease the high limit value and press the Menu Select button.
- 6 Set the new low limit value and press the Menu Select button.


Changing the Apnea Time Alarm Limit

To change the apnea time alarm limit:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select the **Measurements/Alarms** menu and press the Menu Select button.
- 3 Select **AwRR** and press the Menu Select button.
- 4 Select **Apnea Time** and press the Menu Select button.
- 5 Using the Navigation buttons, increase or decrease the limit and press the Menu Select button.

Enabling/Disabling AwRR Alarms

To enable the AwRR alarms:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select the **Measurements/Alarms** menu and press the Menu Select button.
- 3 Select **AwRR** and press the Menu Select button.
- 4 Select **Alarms On/Off** and press the Menu Select button.

-
- WARNING**
- The safety and effectiveness of the respiration measurement method in the detection of apnea, particularly the apnea of infancy, has not been established.
 - The selected apnea alarm may be delayed by up to 17 seconds, if apnea occurs during the automatic zero process.
-

Disabling the EtCO₂ Monitoring Function

To disable the EtCO₂ monitoring function, disconnect the FilterLine from the CO₂ inlet port. The message CO₂ **Unplugged. Turn off EtCO₂?** appears. Select **Yes** and press the Menu Select button.

Should the FilterLine be disconnected accidentally, the message CO₂ **Unplugged. Turn off EtCO₂?** appears to notify you of the disconnection. Select **No** and press the Menu Select button. Secure the connection. The CO₂ monitoring function is once again enabled.

Troubleshooting

If your HeartStart MRx does not operate as expected during CO₂ Monitoring, see Chapter 22, “Troubleshooting” on page 297.

Invasive Pressures

This chapter describes how to monitor invasive pressures using the HeartStart MRx.

Overview

The Invasive Pressures option on your HeartStart MRx offers two channels of real-time continuous invasive pressure measurements and waveforms in Monitor, Manual Defib and Pacer modes. If the pressure signal is pulsatile, numeric values are displayed for systolic, diastolic and mean pressure. If the pressure signal is non-pulsatile, then only the mean is displayed. Alarms are provided to alert you to a change in the patient's condition. If alarms are enabled, alarm limits appear next to the pressure value and the alarm source is displayed above the alarm limits. If alarms are off, the Alarms Off symbol replaces the limits.

Setting up for a Pressure Measurement

- 1 Turn the HeartStart MRx on.
- 2 Connect the pressure cable to the HeartStart MRx.

NOTE The HeartStart MRx will perform a check of invasive pressure functionality when the option is turned on.

- 3 Connect the cable to the transducer.
- 4 Prepare the flush solution.
- 5 Flush the system to expel air from the tubing. Make sure the stopcocks and transducer are also free of air bubbles.

WARNING If air bubbles appear in the tubing system, flush the system with infusion solution again. Air bubbles may lead to an incorrect reading.

- 6 Connect the pressure line to the patient catheter.


- 7 If you are using an infusion pressure cuff with the pressure line, attach the pressure cuff to the fluid to be infused. Inflate it according to your hospital's standard procedure then begin the infusion. Position the transducer so that it is level with the heart, approximately at the level of the midaxillary line.

WARNING If measuring intracranial pressure (ICP) with a sitting patient, level the transducer with the top of the patient's ear. Incorrect leveling may lead to an incorrect reading.

Selecting a Pressure to Monitor

You need to assign a label to each pressure channel as it is connected. Channels are identified as Press 1 and Press 2. You can apply labels to each pressure channel by selecting the appropriate pressure label using the Menu Select button. Once you select a label, the HeartStart MRx will use that label's stored information (color, alarm source and limits, scale) as the default. You should check each pressure channel label as the cable is connected and make changes as appropriate.

To select a pressure label, perform the following steps:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select **Measurements/Alarms** and press the Menu Select button.
- 3 Select **Press 1** (or **Press 2**) and press the Menu Select button.
- 4 Select **Label** and press the Menu Select button.
- 5 Select the appropriate label from the list provided (see Table 14 for list) and press the Menu Select button.
- 6 Select the size of your scale (See "Pressure Waves" on page 118).
- 7 Select Alarm Source type (See "Alarms" on page 125).
- 8 Set the high and low alarm limits.

Repeat the steps to label the other pressure channel.

NOTE Changing the pressure site label activates scales and alarm settings associated with the new label. You will be presented with the controls for scale and alarm settings after selecting a label from the menu to either confirm or adjust the value. Table 14 lists pressure labels.

Table 14 Pressure Labels

Label	Description	Label	Description
ABP	Arterial Blood Pressure	LAP	Left Atrial Pressure
ART	Arterial Blood Pressure	PAP	Pulmonary Artery Pressure
Ao	Aortic Pressure	RAP	Right Atrial Pressure
CVP	Central Venous Pressure	P1	Non-specific pressure label (Channel 1)
ICP	Intracranial Pressure*	P2	Non-specific pressure label (Channel 2)

* - Cerebral Perfusion Pressure (CPP) is automatically displayed with ICP when one pressure is already set to ABP, ART or Ao and the other pressure is set to ICP. CPP will be displayed in the same color as ICP. Only one of the ICP or CPP alarms can be enabled at the same time. See Alarms page 125.


NOTE When selecting a pressure label for a pressure channel, the label assigned to the other pressure channel appears in your options list only if the other channel is not connected to a transducer. If you select the same label as the other channel, the label for the other channel changes to a non-specific label (P1 or P2). If you decide to re-label the first channel, the other channel's label remains non-specific (P1 or P2).

NOTE To monitor a pressure from an arterial waveform when using an intra-aortic balloon pump, connect your invasive pressure device directly to the balloon pump.

Pressure Waves

Each pressure label has a set of scales for the pressure wave. You can adapt the displayed wave to the offset and amplitude of the signal. The scale can be modified through the **Displayed Waves** menu.

To select a pressure wave and the associated scale for the display or printed strip, perform the following steps:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, highlight **Displayed Waves** and press the Menu Select button.
- 3 Select Wave Position (**Wave 1**, **Wave 2**, **Wave 3** or **Wave 4**) and press the Menu Select button.
- 4 Select the appropriate label and press the Menu Select button.
- 5 Select the appropriate scale and press the Menu Select button.

Available scales in mmHg:

300, 240, 180, 150, 120, 110, 100, 90, 80, 70, 60, 50, 40, 30, 20, 10, -5, -10, -15, and -20.

Available scales in kPa:

38.0, 32.0, 26.0, 24.0, 22.0, 20.0, 18.0, 16.0, 14.0, 13.0, 12.0, 11.0, 10.0, 9.0, 8.0, 7.0, 6.0, 5.0, 4.0, 3.0, 2.0, -1.0, -1.5, -2.0, -2.5.

NOTE A positive scale sets the top gridline to your selected scale and the bottom to zero. A negative scale will set the bottom gridline to the selected negative unit and the middle gridline to zero.

Zeroing the Pressure Transducer

To avoid inaccurate pressure readings, the HeartStart MRx requires a valid zero be performed on the pressure channel. It should be zeroed according to your hospital policy - at least once per day. Also, you should rezero in the following circumstances:

- Every time you reconnect the transducer cable to the HeartStart MRx.
- After a patient is moved.
- During changes in altitude when using the HeartStart MRx aboard an aircraft. Re-zero when reaching a cruising altitude.
- When you use a new transducer or tubing.
- When you think the pressure readings are not correct.


NOTE The numeric value will be invalid (displayed as ·?·) when the transducer is plugged in until zeroed successfully.

For each assigned label, the pressure channel can be zeroed through the Menu Select button menu or, when in Monitor Mode, through the use of a soft key. You can zero the pressure channels separately or together.

WARNING Before zeroing a pressure, make sure related pressure transducers are vented to atmospheric pressure and the stopcock to the patient is closed.

Zeroing Using the Menu Select Button

To Zero using the Menu Select button, perform the following:

- 1 Place the transducer at the appropriate level for the measurement site.
- 2 Close the transducer stopcock to the patient and vent the transducer to atmospheric pressure.
- 3 On the HeartStart MRx, press the Menu Select  button.
- 4 Using the Navigation buttons, select **Measurements/Alarms** and press the Menu Select button.
- 5 Select the pressure label you wish to perform the zero procedure on.
- 6 Press **Zero** and press the Menu Select button. Zeroing begins.

Zeroing Using a Soft Key in Monitor Mode

To Zero using the soft key in Monitor Mode, perform the following:

- 1 Place the transducer at the appropriate level for the measurement site.
- 2 Close the transducer stopcock to the patient and vent the transducer to atmospheric pressure.
- 3 Press the button under **[Zero Pressure]** on the display.
- 4 Using the Navigation buttons, select the pressure(s) you wish to zero from the **Zero** menu and press the Menu Select button. Zeroing begins.

WARNING Invasive pressure alarms and pulse alarms (if they are derived from invasive pressure readings) are temporarily turned off while the transducer is zeroing. The alarms will turn back on 30 seconds after zeroing is complete.

During the zeroing process, a message will appear on the HeartStart MRx display. If the process was successful, the message on the screen changes to **Pressure label zero done at date/time** (for example: ABP zero done at 25Jan2006, 9:26). If the process is unsuccessful, you get an **Unable to zero** message with a probable cause message displayed. Table 15 lists probable cause messages.

Table 15 Unable toZero Probable Causes:

Probable Cause Message	Corrective Action
Equipment Malfunction	Hardware is faulty. Contact your service personnel.
Excessive Offset	Make sure the transducer is vented to the air and try again. If this doesn't work, replace the transducer cable and try again. If it still doesn't zero, replace the transducer and try again. If it still will not zero, contact your service personnel.
Unstable Signal	
No Transducer	Reconfirm that the transducer is connected and try again. If this doesn't work, replace the transducer.
Pulsatile Pressure	Make sure that the transducer is vented to air and not the patient. Try again.


NOTE Upon successful completion of the process, close the stopcock to atmospheric pressure, which opens the stopcock to the patient.

Calibration

The HeartStart MRx allows you to input the calibration factor (see documentation supplied by the transducer's manufacturer) of a new transducer plugged into the pressure line.

Known Calibration Factor

To set a known calibration factor, perform the following:

- 1 Zero the transducer (see previous section)
- 2 Press the Menu Select  button.
- 3 Using the Navigation buttons, select **Measurements/Alarms** and press the Menu Select button.
- 4 Select the correct pressure (**channel: label**) and press the Menu Select button.
- 5 Select **Calibration Factor** and press the Menu Select button.
- 6 Set the calibration factor using the Navigation buttons. Values range from 180.0 to 220.0 in 0.2 increments. Press the Menu Select button.

NOTE Calibration only needs to be done on reusable transducers.

Calibrating Reusable Transducer CPJ840J6

Perform a mercury calibration when you use a new reusable transducer and at regular intervals according to your hospital policy. You will need:

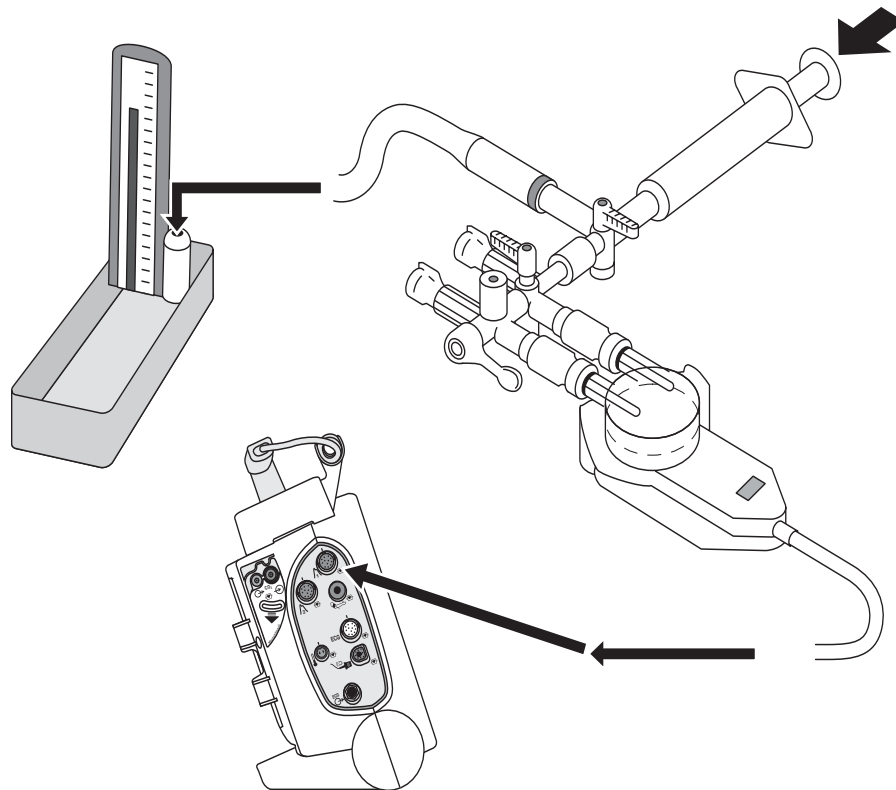
- standard sphygmomanometer
- sterile 10cc syringe with heparinized solution
- 3-way stopcock
- approximately 25cm of tubing.


WARNING Never perform invasive pressure mercury calibration while the patient is being monitored.

To perform a mercury calibration on the CPJ840J6, perform the following:

- 1 Zero the transducer (see previous section).
- 2 Connect the syringe and manometer. (See Figure 63.)
 - a. Attach the tubing to the manometer
 - b. Connect the 3-way stopcock to the stopcock that is not connected to the patient catheter.
 - c. Attach the syringe to one port and the manometer to the other port.
 - d. Open the port to the manometer

Figure 63 Connecting the Syringe and Manometer



- 3 Raise the manometer pressure to approximately 200 mmHg or 27.0 kPa.
- 4 Press the Menu Select  button.
- 5 Using the Navigation buttons, select **Measurements/Alarms** and press the Menu Select button.
- 6 Select the pressure (**channel: label**) you wish to calibrate and press the Menu Select button.
- 7 Select **Calibration Pressure** and press the Menu Select button.
- 8 Using the Navigation Buttons, select the **Calibration Pressure** you set for the manometer in Step 3 above. The default is 200 mmHg (27.0 kPa). Values range from 90 to 220 mmHg in increments of 1 (12.0 to 30.0 kPa in increments of 0.2).
- 9 Press the Menu Select button. The HeartStart MRx will automatically set and display the calibration factor.

NOTE Upon successful calibration, write the calibration factor on the transducer for future reference.

Calibration Confirmation

If the calibration process is successful, a brief message appears on the HeartStart MRx display with the date and time the calibration was completed and the new calibration factor. If calibration is not successful, an **Unable to Calibrate** message appears with a probable cause. See Table 16 for probable cause messages.

Table 16 Unable to Calibrate Probable Causes


Message	Corrective Action
Equipment Malfunction	Hardware is faulty. Contact your service personnel.
Out of range	Make sure you have selected a value for the calibration pressure that you are applying to the transducer. Repeat calibration.
Unstable Signal	Make sure there are no disturbances to the transducer. Repeat calibration.
No Transducer	Reconfirm that the transducer is connected and try again.
Perform Zero first	A valid zero does not exist. Zero the transducer.

WARNING Each time you use a reusable transducer, you should confirm the calibration factor written on the transducer is the same as the calibration factor displayed on your HeartStart MRx. Different calibration factors may lead to an inaccurate measurement.

Last Zero/Calibration

You can view dates and times for a channel's last zero or mercury calibration through the HeartStart MRx menu.

To view a channel's last zero and mercury calibration dates, perform the following steps:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select **Measurements/Alarms** and press the Menu Select button.
- 3 Select the pressure label (**channel: label**) you want and press the Menu Select button.
- 4 The last zero and Mercury calibration dates and times are displayed.

NOTE The information listed for the last mercury calibration is the date and time of either calibrating at a known pressure or entering the calibration factor manually.

Figure 64 Last Zero and Mercury Calibration Dates

Press 1: ABP	
Last Zero 28Nov 2005 09:05	
Last Mercury Cal 28 Nov 2005 9:06	
Label	
Zero ABP	
Calibration Pressure	
Calibration Factor	
Measurements/Alarms	
Alarms Off	
ABP Limits	
Exit	

Non-Physiological Artifact Suppression


Various clinical procedures (i.e. taking a blood sample) may affect invasive pressure readings. Your HeartStart MRx can be configured to suppress alarms when artifact is detected for a specific length of time. You can configure suppression lengths in Configuration Mode. Options are 30, 60 and 90 seconds or off. The default is 60 seconds. During suppression, the HeartStart MRx shows an INOP message and ? next to the pressure label. Pressure alarms and **Pressure Label Non-Pulsatile** INOPs are inactive during the suppressed period. The CPP high alarm is not suppressed.

Alarms

Alarms are provided to alert you to a change in the patient's condition. If alarms are enabled, alarm limits appear next to the pressure value. Invasive pressure alarms (except ABP, ART, Ao, PAP, P1 or P2 disconnect alarms) are all categorized as “non-latching” alarms, meaning they are automatically removed when their alarm condition no longer exists. The above listed disconnect alarms are latching, meaning they remain present even if the alarm condition no longer exists. Table 17 details invasive pressure alarms.

Table 17 Invasive Pressure Red/Yellow Physiological Alarms

Alarm Message	Type of Alarm	Indicator	Condition
[ABP, ART, Ao, PAP, P1, P2] Disconnect	Red	Red alarm message; alarm tone	The mean pressure has fallen below 10 mmHg (1.3 kPa) and the pressure is non-pulsatile.
[Pressure label]s High	Yellow	Yellow alarm message; alarm tone	The systolic pressure value exceeds the high alarm limit.
[Pressure label]d High	Yellow	Yellow alarm message; alarm tone	The diastolic pressure value exceeds the high alarm limit.
[Pressure label]m High	Yellow	Yellow alarm message; alarm tone	The mean pressure value exceeds the high alarm limit.
[Pressure label]s Low	Yellow	Yellow alarm message; alarm tone	The systolic pressure value has fallen below the low alarm limit.
[Pressure label]d Low	Yellow	Yellow alarm message; alarm tone	The diastolic pressure value has fallen below the low alarm limit.
[Pressure label]m Low	Yellow	Yellow alarm message; alarm tone	The mean pressure value has fallen below the low alarm limit.


Each pressure label has its own unique set of default alarm limits which are set in Configuration mode. See “Configuration” on page 199 for details. If the alarm is from a pulsatile source, the source is displayed above the alarm limits. If alarms are off, the Alarms Off  symbol replaces the limits.

If a wave becomes non-pulsatile, the measurement will become mean only and be compared to the current source (which may be systolic or diastolic) and alarm limits.

WARNING Make sure you enable/disable and set alarm limits for the correct label. These settings apply to that particular label only. Changing the label might change the alarm limits.

Enabling/Disabling alarms


To enable/disable alarms, perform the following steps:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select **Measurements/Alarms** and press the Menu Select button.
- 3 Select the pressure label (**channel: label**) you wish to modify alarm status on and press the Menu Select button.
- 4 Select **Alarms On** (or **Alarms Off**) and press the Menu Select button.


Viewing/Changing/Setting Source for Alarms

Alarm sources and limits can be viewed or modified for a given pressure label.

To view or modify alarm settings, perform the following steps:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select **Measurements/Alarms** and press the Menu Select button.
- 3 Select the pressure label (**channel: label**) you wish to view/modify alarms on and press the Menu Select button.
- 4 Select pressure label **Limits** and press the Menu Select button.
- 5 If the pressure label is pulsatile, select the desired source of the alarm (Systolic, Diastolic or Mean) and press the Menu Select button.
- 6 Using the Navigation buttons, increase or decrease the high limit and press the Menu Select button.
- 7 Set the new low limit and press the Menu Select button.

CPP Alarms

With CPP and ICP, only one of the two parameters can have alarms enabled at one time. If CPP alarms are turned on then ICP alarms are turned off. Both alarms can be turned off at the same time. The parameter with alarms off will be displayed at the bottom of the ICP/CPP parameter area with the Alarms Off  symbol. ICP alarms default to on; CPP to off.

Wedge

Perform a pulmonary artery wedge procedure according to your hospital protocol. The wedge numeric will not be stored in the Vital Signs Trending.

WARNING For Pulmonary Artery Wedge Pressure (PAWP) readings, due to a measurement delay, do not use Microstream (sidestream) CO₂ as a direct reference for determining the end expiratory point in the pressure curve.

If the pulmonary artery flotation catheter drifts into the wedge position without inflation of the balloon, the pulmonary artery pressure waveform will assume a wedged appearance. To correct the situation take appropriate action in accordance with standard procedures.

Pulse

The HeartStart MRx can provide pulse readings from either the SpO₂ or Invasive Pressures options. To understand how pulse works with SpO₂ only, read Chapter 8, Pulse Oximetry. If your device has both options, read the following section.

Pulse Sources

When both SpO₂ and Invasive Pressures options are present on the HeartStart MRx, pulse can be derived from an SpO₂ pleth wave or one of the two invasive pressure waves in Monitor, Pacing and Manual Defib modes. The pulse reading will be displayed in the color of its source (e.g. if your pleth wave is cyan and pulse is being derived from the pleth wave, then the pulse reading will appear in cyan.)

Pulse is on (and displayed) if one of the possible sources is activated. SpO₂ is the factory default but can be modified in Configuration Mode. If the default pulse source is not active during an event but a secondary source is, the pulse value will appear on screen but it will be invalid and display a **·?·** where the value should be. A **Pulse Check Source** INOP will also appear on the screen. To obtain a pulse rate, you must modify the pulse source to an active source for this incident.

If the pulse source you are using to obtain a pulse rate is disconnected during active measuring and a secondary pulse source is available, the pulse rate does not automatically switch to the secondary source. The pulse value (and the value of your source measurement) remains on screen but becomes invalid and displays a **·?·** where the value should be. An INOP message also appears on screen. To reactivate a pulse reading, reconnect the original pulse source or change the pulse source to the secondary option.

Changing Pulse Source

To change pulse source for the current incident, perform the following steps:



- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select **Measurements/Alarms** and press the Menu Select button.
- 3 Select **Pulse** and press the Menu Select button.
- 4 Select **Pulse Source** and press the Menu Select button. Pick a source with an arterial or pulmonary waveform.
- 5 Using the Navigation buttons, highlight the pulse source desired and press the Menu Select button.

Figure 65 Pulse Source

Main Menu	Measurements/Alarms	Pulse	Pulse Source
Start Data Transmit	HR/Arrhythmia	Pulse Source	SpO2
Volume	Press1:ABP	Alarms On	Press 1: ABP
Displayed Waves	Press2:PAP	Pulse Limits	Press 2: PAP
Printed Waves	CPP	Exit	
Measurements/Alarms	NBP		
Patient Info	EtCO2		
Trends	AwRR		
Other	SpO2		
High Contrast On	Pulse		
Exit	1 of 2		


Setting Pulse Alarms

When on, pulse alarms annunciate if measurements fall outside of the limits for high or low pulse. Alarms are turned off unless you turn them on during use. Once turned on, alarms remain on until they are turned back off.

NOTE If pulse alarms are enabled, alarm limits appear next to the pulse value. If alarms are off the Alarms Off  symbol replaces the limits.

Enabling/Disabling Pulse Alarms


Pulse alarms are turned off by default. To turn the pulse alarms on for the current incident perform the following steps:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select **Measurements/Alarms** and press the Menu Select button.
- 3 Select **Pulse** and press the Menu Select button.
- 4 Select **Alarms On** and press the Menu Select button.

The alarms will now be on. To turn alarms off, repeat the steps above except select **Alarms Off** in Step 4.

Pulse Alarm Limits

Pulse alarm limits can be changed for the current incident. To change alarm limits, perform the following steps:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select **Measurements/Alarms** and press the Menu Select button.
- 3 Select **Pulse** and press the Menu Select button.
- 4 Select **Pulse Limits** and press the Menu Select button.
- 5 Using the Navigation buttons, select the new high limit value and press the Menu Select button.
- 6 Select the new low limit and press the Menu Select button.

Changing Default Pulse Source and Alarm Limits

You can change the default pulse source in the pulse section of Configuration Mode. See “Pulse Settings” on page 210. Because pulse and heart rate share the same default alarm limits, default pulse alarm limits can be changed in the ECG section of Configuration Mode.

Caring For Your Transducers and Probes

Refer to the manufacturer’s instructions for care and cleaning of your invasive pressure transducers and cables. Inappropriate treatment of the cables will reduce their lifetime.

Troubleshooting

If your HeartStart MRx does not operate as expected during invasive pressure monitoring, see “Troubleshooting” on page 297.

Temperature

This chapter describes how to monitor temperature using the HeartStart MRx.

Overview

The HeartStart MRx offers one channel of real-time continuous temperature monitoring. The device can monitor nasopharyngeal, esophageal, rectal, skin, arterial, venous, core and urinary bladder temperatures. Measurements, which can be displayed in either Fahrenheit or Celsius, may be taken while in Monitor, Pacer or Manual Defib modes.


Selecting a Temperature Label

The HeartStart MRx monitors the temperature of the area where the sensor is located. To assure specific temperature settings are matched with the temperature reading, assign the proper temperature label to the measurement. When modifying a temperature label, all settings (including alarm limits) associated with that label become active. The default label is Temp.

Table 18 Temperature Labels

Label	Type	Label	Type
Tesoph	esophageal temperature	Tnaso	nasopharyngeal temperature
Trect	rectal temperature	Tvesic	urinary bladder
Tskin	skin temperature	Tart	arterial temperature
Temp	non-specific temp label	Tven	venous temperature
Tcore	core temperature		

To select a temperature label, perform the following:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select **Measurements/Alarms** and press the Menu Select button.
- 3 Select the temperature label option currently assigned to your measurement (default is **Temp**) and press the Menu Select button.
- 4 Select **Label** and press the Menu Select button.
- 5 Select the appropriate label from the list provided and press the Menu Select button.

Monitoring Temperature

To monitor temperature, perform the following:

- 1 Connect the temperature cable to the HeartStart MRx.
- 2 Select the correct temperature label for your measurement.
- 3 Check that the current device settings (including alarm settings) are appropriate for the patient.
- 4 Apply the temperature probe to the patient.

NOTE The temperature function performs a self-test when initially turned on and also performs hourly system tests when active.

Alarms

Setting Temperature Alarms


Temperature alarms are annunciated if measurements fall outside the configured limits for high and low temperatures. Temperature alarms are all categorized as “non-latching” alarms, meaning they are automatically removed when their alarm condition no longer exists. Table 19 details Temperature alarms.

Table 19 Temperature Physiological Alarms

Alarm Message	Type of Alarm	Indicator	Condition
[Temperature label] High	Yellow	Yellow alarm message; alarm tone	The temperature value exceeds the high alarm limit.
[Temperature label] Low	Yellow	Yellow alarm message; alarm tone	The temperature value has fallen below the low alarm limit.


Alarms are on unless you turn them off during use. Once turned off, alarms remain off until they are turned back on.

WARNING Make sure you enable/disable and set alarm limits for the correct label. These settings are stored for that particular label only. Changing the label may change the alarm limits.

NOTE If temperature alarms are enabled, alarm limits appear next to the temperature value. If alarms are off the Alarms Off  symbol replaces the limits.


Changing Temperature Alarm Limits

To change the temperature alarm limits for the current incident, perform the following:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select **Measurements/Alarms** and press the Menu Select button.
- 3 Select the temperature label option currently assigned to your measurement and press the Menu Select button.
- 4 Select **Temperature Limits** and press the Menu Select button.
- 5 Using the Navigation buttons, change the high limit and press the Menu Select button.
- 6 Using the Navigation buttons, change the low limit and press the Menu Select button.

Enabling/Disabling Temperature Alarms

Temperature alarms default to on. To disable temperature alarms, perform the following:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select the **Measurements/Alarms** menu and press the Menu Select button.
- 3 Select the temperature label option currently assigned to your measurement and press the Menu Select button.
- 4 Select **Alarms Off** and press the Menu Select button.

To turn alarms back on, repeat the steps above except select **Alarms On** in Step 4.

Changing Degree Units

The HeartStart MRx can display temperature in either Fahrenheit or Celsius. The default is Celsius and can only be changed through Configuration Mode. See “Configuration” on page 199 for more information.

Disabling the Temperature Function

To turn off the Temperature function, disconnect the temperature cable from the HeartStart MRx port. The message **Temp** (or the label currently activated) **unplugged. Turn off Temp?** appears. Select **Yes** and press the Menu Select button.

Should the temperature cable get disconnected accidentally or if the probe and cable separate, the message **Temp unplugged. Turn off Temp?** appears to notify you of the disconnection. To continue monitoring temperature, select **No** and press the Menu Select button. Reconnect the temperature cable to restart the temperature monitoring function. See “Turning Parameters On/Off” on page 16.

Caring For Your Temperature Cables and Probes

Refer to the manufacturer’s instructions for care and cleaning of your cables. Inappropriate treatment of the cables will reduce their lifetime.

Troubleshooting

If your HeartStart MRx does not operate as expected during temperature monitoring, see Chapter 22, “Troubleshooting”.

12-Lead ECG

This chapter describes how to use the diagnostic 12-lead ECG function of the HeartStart MRx.

Overview

The optional 12-lead ECG function, using Philips' DXL Algorithm, is available in Monitor Mode and allows you to preview, acquire, print, copy, and store a 12-lead ECG. In addition, the 12-lead function provides computerized ECG analysis using the DXL Algorithm. A report with measurements and interpretive statements from the analysis is displayed, stored and printed, as configured. Certain interpretive results generate Critical Value statements which alert you to an interpretation which may mean your patient needs immediate attention.

The Philips DXL Algorithm provides an analysis of the amplitudes, durations, and morphologies of the ECG waveforms and the associated rhythm. Patient age and gender are used to define normal limits for heart rate, axis deviation, time intervals, and voltage values, for interpretation accuracy in tachycardia, bradycardia, prolongation or shortening of PR and QT intervals, hypertrophy, early repolarization, myocardial infarction and culprit artery detection. DXL Algorithm adult criteria apply if the patient age is 16 years old or older. Pediatric criteria apply if the patient age is less than 16. The DXL Algorithm also identifies paced patients automatically.

The DXL Algorithm also includes the optional Acute Cardiac Ischemia Time-Insensitive Predictive Instrument (ACI-TIPI) and Thrombolytic Predictive Instrument (TPI) algorithms. ACI-TIPI generates a 0-100% predicted probability score of Acute Cardiac Ischemia (ACI). TPI predicts patient outcomes with and without thrombolytic therapy for an acute myocardial infarction.

WARNING Computerized ECG interpretation is not intended to be a substitute for interpretation by a qualified physician.

NOTE Refer to the *DXL Physician's Guide* for more information on the algorithm's functionality.

NOTES The Philips DXL Algorithm is capable of interpreting up to 16 leads, however the HeartStart MRx uses the 12-lead functionality only.

ACI-TIPI and TPI are to be used as part of a suite of diagnostic tools and used in an advisory basis. Clinical symptoms, 12-Lead ECG information and/or patient history may contradict the results of the predictive algorithms. Institutions should establish protocols before instituting the use of the predictive instrument algorithms.

You can configure the ACI-TIPI algorithm on your 12-lead without running the TPI algorithm. However to use the TPI algorithm, you must first run the data through ACI-TIPI algorithm.

Preparation

Proper skin preparation and electrode placement are the most important elements in producing a high quality 12-lead ECG. The patient should be supine and relaxed when an ECG is acquired. In preparation for acquiring the ECG:

- 1 Connect the 10-lead cable to the HeartStart MRx, as described in “Connecting the ECG Cable” on page 35.
- 2 Prepare the skin and apply electrodes, as described in “Electrode Placement” on page 51.
- 3 Turn the Therapy Knob to **Monitor**.
- 4 Enter patient information as described in “Entering Patient Information” on page 27.
- 5 Confirm the patient’s pacing status is correct.

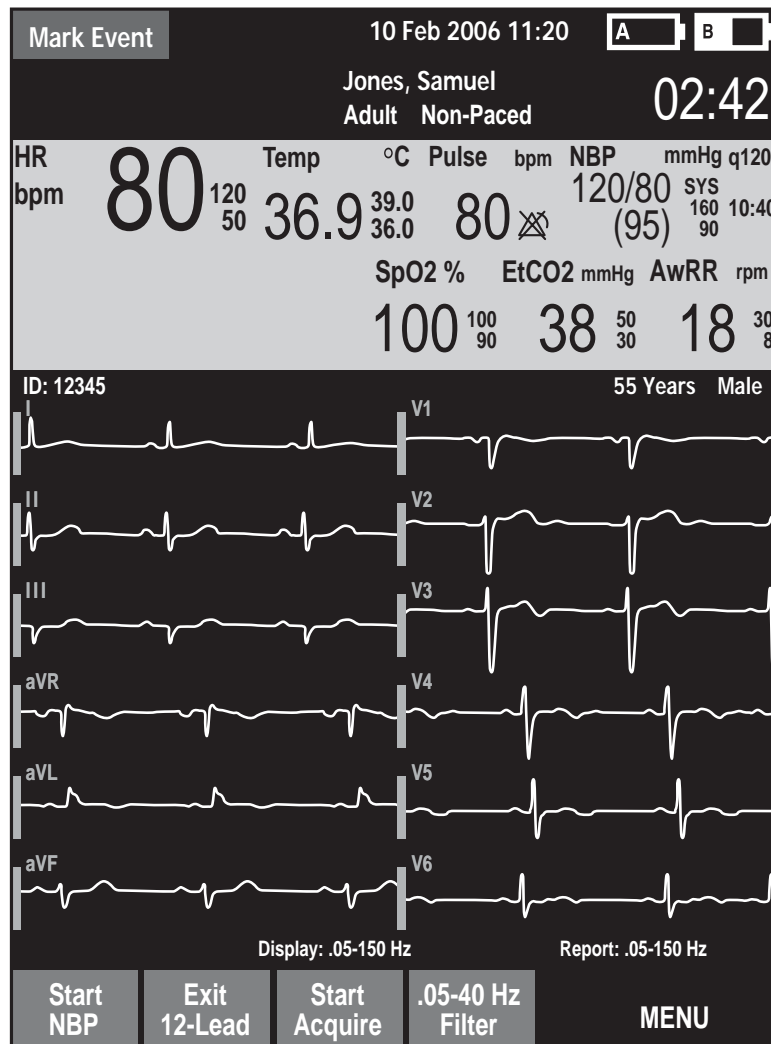
Preview Screen

The 12-lead function's Preview Screen allows you to see real-time 12-lead ECG data and verify signal quality before acquiring the ECG. As shown in Figure 66, it displays patient information and approximately 2.5 seconds of each of the 12 leads acquired. Waveforms are presented at a rate of 25mm/sec and the configured wave size. A dashed line is displayed if a lead cannot be derived. The message **(Lead-Wire) Lead Off** is displayed if an electrode is not making adequate contact with the patient.

The Preview Screen's patient information includes ID, age, and sex. The Event ID is displayed until you enter the patient's ID. Age and sex are displayed once entered (see "Entering Patient Information" on page 27).


Although waveforms for monitored parameters such as ECG, SpO₂, Invasive Pressures and CO₂ are not visible on the Preview Screen, related alarms, measurements and INOP messages remain active and are reported in Parameter Blocks 1 and 2 and the general status area.

Figure 66 12-Lead ECG Preview Screen



Acquiring a 12-Lead ECG

Once preparation is complete, to acquire a 12-lead ECG in Monitor Mode:

- 1 Press the **[12-Lead]** soft key.
The Preview Screen is displayed, as shown in Figure 66.
- 2 Check the signal quality on each lead and, if necessary, make adjustments as described in “Improving Signal Quality” on page 149.
- 3 Check filter settings.
- 4 Press the **[Start Acquire]** soft key. The message **Acquiring 12-Lead** is then displayed while the HeartStart MRx acquires ten seconds of ECG data.
- 5 If patient age and sex were not previously entered, you are prompted to enter the information.
 - a. For **age**, use the Navigation buttons to increase or decrease the displayed value of the patient’s age. Then press the Menu Select button . If connected to the IntelliVue Network, you enter the patient’s date of birth.
 - b. For **sex**, use the Navigation buttons to select the patient’s sex and press the Menu Select button.
 - c. If your device is configured to run the ACI-TIPI and TPI algorithms, you’re asked to enter the patient’s chest pain symptoms in the menu.
- 6 Keep the patient still while the message **Acquiring 12-Lead** is displayed.


Once ECG acquisition is complete, ECG analysis begins automatically and is accompanied by the message **Analyzing 12-Lead**. The patient does not need to be still during this time.

Following analysis, the 12-Lead Report is displayed, printed, and stored internally.

To acquire another 12-Lead ECG, press **[New 12-Lead]**. To exit the 12-lead function, press **[Exit 12-Lead]**.

WARNING Failure to enter correct patient age and sex can result in erroneous diagnosis.

NOTES A minimum of one chest lead and all limb leads are required to get a partial interpretation from the 12-Lead algorithm. You must have all six chest leads to get a full interpretation. Also, wet gel electrodes take less time to settle than hydrogel electrodes, thereby varying the amount of time you might have to wait before acquiring a 12-Lead ECG. Pressing the **[Acquire]** softkey a little too soon may result in a dashed line.

The Lead Select  button is disabled when the 12-lead function is active.

Acquiring a 12-lead ECG with ACI-TIPI and/or TPI Analysis

If configured to do so, the HeartStart MRx runs the ACI-TIPI and TPI predictive instrument algorithms after a 12-lead ECG has been acquired.

You can configure your device to:

- Auto ACI-TIPI — Auto ACI-TIPI runs the ACI-TIPI analysis if there isn't an Acute MI Critical Value statement and the ECG severity is not Normal.
- ACI-TIPI — ACI-TIPI prints the standard report followed by computer generated diagnostic statements using ACT-TIPI criteria.
- ACI-TIPI and TPI — ACI-TIPI & TPI uses the ACI-TIPI report followed by TPI inputs, computer generated diagnostic statements using TPI criteria and the user-selected Thrombolytic Therapy Contraindications.

To configure analysis, see Table 53 in the Configuration chapter.

CAUTION Proper lead placement must be used in order to receive proper predictive instrument algorithm calculations. See “V/C Electrode Placement” on page 52.

To acquire a 12-lead ECG in Monitor Mode with additional ACI-TIPI and/or TPI analysis:

- 1 Perform steps 1-5 from “Acquiring a 12-Lead ECG” on page 138.
- 2 If you had not previously entered information on Chest Pain symptoms, you are prompted to do so. Use the Menu Select button and Navigation buttons to select the proper value. See Table “Required ACI-TIPI & TPI data” on page 142.
- 3 Keep the patient still while the message **Acquiring 12-Lead** is displayed.
- 4 Once ECG acquisition is complete, ECG analysis begins automatically and is accompanied by the message **Analyzing 12-Lead**. The patient does not need to be still during this time.
- 5 If you are not configured for TPI analysis, the 12-Lead Report, including the ACI-TIPI predicted probability of Acute Ischemia percentage is displayed, printed and stored internally. If you are configured for TPI analysis, the HeartStart MRx next performs a TPI screening test to see if the ECG is a candidate for TPI analysis.
 - If the ECG is not a candidate for TPI analysis, the 12-Lead Report is displayed, printed and stored internally.
 - If the ECG is a candidate for TPI analysis, the HeartStart MRx asks you to input more patient information. Continue with Step 6.
- 6 When required, the HeartStart MRx displays a list of TPI inputs which require data entry (See Figure 67). Press the Menu Select button to view possible values for the first highlighted topic. (You can press the **[Skip TPI]** softkey to bypass TPI analysis.)
- 7 Use the Navigation buttons to highlight your answer and press the Menu Select button to select.
- 8 Use the Navigation buttons to select the next item and repeat steps 6 and 7 to complete all TPI inputs.
- 9 Once you've completed all inputs, press the **[Run TPI]** softkey.
- 10 You are now prompted to consider contraindications for thrombolytics. See “Contraindications for Thrombolytic Therapy” on page 140.

Figure 67 TPI Inputs

Candidate for Thrombolysis	
Time Since Onset of Ischemic Symptoms	Unknown
Blood Pressure	Unknown
History of Hypertension unknown	Unknown
History of Diabetes	Unknown
Patient Weight	Unknown

Contraindications for Thrombolytic Therapy

After entering TPI inputs, the HeartStart MRx prompts you to indicate the presence of thrombolytic therapy contraindications from a pre-configured list. Speak with and observe the patient to answer the contraindications.

The HeartStart MRx allows you to pre-configure up to 20 thrombolytic therapy contraindications. If you have configured 9 or less contraindications, they appear on the HeartStart MRx on a single screen. If you have more than 9 configured contraindications, they appear on multiple screens. Press the **[Next Page]** softkey to advance to the next page of contraindications.

If you do not enter any thrombolytic indications, the resulting printed 12-Lead Report prompts you to consider other Thrombolytic contraindications.

There are 10 default contraindications:

- Right vs. left arm systolic blood pressure difference > 15 mmHg
- History of structural central nervous system disease
- Significant closed head/facial trauma within previous 3 months
- Major trauma, surgery, GI/GU bleed within 6 weeks
- Bleeding or clotting problem or on blood thinners
- CPR for longer than 10 minutes
- Pregnant female
- Serious systemic disease
- Pulmonary edema
- Signs of shock

The default value for each contraindication is **Unknown**. You have the ability to change each contraindication to **Yes** or **No** or leave it as **Unknown**. Once entered, the contraindications are retained for the current patient.

Pressing the **[No Other Contra.]** softkey sets all contraindications on that page to **No** unless they were previously set to **Yes**.

NOTE The Intended Use statement for the Thrombolytic Predictive Instrument provides a list of some contraindications that were associated with thrombolytic therapy when the U.S. Food and Drug Administration (FDA) reviewed the software in 1997. It is important to understand that the second set of contraindications are associated with the therapy and not the TPI software. Each institution can configure the TPI software to reflect the processes it uses to determine if thrombolytic therapy should be administered.

To change a contraindication:

- 1 When the list of contraindications appears on the HeartStart MRx display (see Figure 68), use the Navigation buttons to highlight one of the contraindications and press the Menu Select button.
- 2 Use the Navigation buttons to select a new value for the contraindication and press the Menu Select button.
- 3 Use the Navigation buttons to select the next contraindication.
- 4 Complete steps 2-3 for the remaining contraindications in your list.
- 5 Press the **[Done]** softkey to exit contraindications to thrombolytic therapy. After analysis is complete, all settings are logged in the Event Summary and the 12-Lead analysis is complete.
- 6 To acquire another 12-Lead ECG, press **[New 12-Lead]**. To exit the 12-lead function, press **[Exit 12-Lead]**.

Figure 68 TPI Contraindications

25 Jan 2009 12:03:37		50 years Male	
Consider contraindications to thrombolysis		Page 1 of 2	
Right vs. left arm sys. BP difference > 15 mmHg		Unknown	
History of structural central nervous system disease		Unknown	
Significant closed head/facial trauma within prev. 3 mos.		Unknown	
Major trauma, surgery, GI/GU bleed within six wks.		Unknown	
Bleeding or clotting problem or on blood thinners		Unknown	
CPR for longer than 10 min.		Unknown	
Pregnant female		Unknown	
Serious systemic disease		Unknown	
Pulmonary edema		Unknown	
Start NBP	No Other Contra.	Next Page	Done
			MENU

Table 20 Required ACI-TIPI & TPI data

Patient Data	Required for ACI-TIPI	Required for TPI	Possible values	Default value
Chest pain symptoms - Is chest pain/pressure or left arm pain the patient's most important presenting symptom?	YES	NO	<ul style="list-style-type: none"> Primary complaint Secondary complaint None 	Primary Complaint
Time since ischemic symptoms onset	NO	YES	<ul style="list-style-type: none"> Hour settings ranging from 0 to 7 hours* 8+ hours Unknown 	unknown
Blood Pressure	NO	YES	The HeartStart MRx auto-populates the NBP value if there is a valid one. If not, the initial value is unknown and the starting values for entering an NBP are 120/80.	
Patient history of diabetes	NO	YES	<ul style="list-style-type: none"> Yes No Unknown 	unknown
Patient history of hypertension	NO	YES	<ul style="list-style-type: none"> Yes No Unknown 	unknown
Patient weight	NO	YES	50-450 Lbs (25-225 kg)	Initial value is unknown. Starting menu value is 160 Lbs
* - If 0-7 hours is selected, a second menu appears, asking you to select the number of minutes in 15-minute increments.				

ST and T Changes

The ACI-TIPI's probability value substantially depends on the primary values for ST and T changes. However, ventricular conduction abnormalities and ventricular hypertrophy cause secondary ST and T wave changes that, if misinterpreted as primary could cause erroneously high ACI-TIPI scores. Philips' algorithm attempts to sort out the primary from the secondary ST and T changes when conduction abnormalities are present. The algorithm issues a warning message if the distinction can't be made. The algorithm excludes the ST and/or T factors (as appropriate) from its calculations when it detects:

- Left ventricular hypertrophy (can alter T waves and the ST segment)
- Right bundle branch block (produces conduction delay)
- Left bundle branch block (produces conduction delay)
- Secondary repolarization (ST and T) abnormalities
- The presence of an artificial pacemaker

When such data is excluded from calculations, the HeartStart MRx prints a message indicating the reason for a lower ACI-TIPI score.

Critical Values

Certain interpretive results generate Critical Value statements which alert you to a condition which may need immediate attention. The Critical Value statements appear on the bottom of the HeartStart MRx 12-Lead display in white text on a red background with directional arrows (>>> <<<) on each side of the statement text.

Acute Myocardial Infarct

If the interpretive statement listed in Table 21 result from measurements generated by an ECG, the Critical Value statement **Acute MI** appears on the 12-Lead Report.

Table 21 Acute MI Statements

Interpretive Statement	Criteria
Probable anterolateral infarct, acute	ST >0.15 mV, V2-V6, aVL
Anterolateral infarct, possibly acute	Q >35 mS, ST >0.15 mV, V2-V6, I, aVL
Anterolateral infarct, acute	ST >0.20 mV, V2-V6, I, aVL
Anterolateral infarct, acute (LAD)	ST >0.20 mV, V2-V6, I, aVL
Probable anteroseptal infarct, acute	ST >0.15 mV, T UPRIGHT, V1-V2
Anteroseptal infarct, possibly acute	Q >35 mS, ST >0.15 mV, V1-V2
Anteroseptal infarct, acute	ST >0.20 mV, V1-V2
Anteroseptal infarct, acute (LAD)	ST >0.25 mV, V1-V2
Probable anterior infarct, acute	ST >0.15 mV, UPRIGHT T, V2-V5
Anterior infarct, acute	ST >0.25 mV, V2-V5
Anterior infarct, acute (LAD)	ST >0.25 mV, V2-V5
Anterior infarct, possibly acute	ST >0.15 mV, UPRIGHT T, V2-V5
Extensive anterior infarct, acute	ST >0.20 mV, V1-V6
Extensive anterior infarct, acute (LAD)	ST >0.20 mV, V1-V6
Extensive anterior infarct, possibly acute	Q >35 mS, ST >0.15 mV, V1-V6
Probable inferior infarct, acute	ST >0.10 mV, II III aVF
Inferior infarct, possibly acute	Q >30 mS, ST >0.10 mV, II III aVF
Inferior infarct, acute	ST >0.10 mV T UPRIGHT, II III aVF
Inferior infarct, acute (RCA)	ST >0.10 mV IN III > II
Inferior infarct, acute (LCX)	ST >0.10 mV II III aVF, STD V1-V3
Inferoposterior infarct, acute	ST >.1 INF, <-.1 V1-3 OR >.05 V7-9
Inferoposterior infarct, acute (RCA)	ST >.1 INF, <-.1 ANT
Inferoposterior infarct, acute (LCX)	ST >.1 INF, <-.1 V1-3 OR >.05 V7-9
Inferolateral infarct, acute	ST >.10 mV, INF-LAT LEADS
Inferolateral infarct, acute (LCX)	ST >.10 mV, INF-LAT LEADS
Inferolateral infarct, acute (RCA)	ST >.10 mV, INF-LAT LEADS
Probable lateral infarct, acute	Q >28 mS, ST >0.10 mV, V5 V6 I aVL
Lateral infarct, possibly acute	Q >28 mS, ST > 0.10 mV, V5 V6 I aVL
Lateral infarct, acute	ST >.10 mV, V5 V6 I aVL

Table 21 Acute MI Statements (Continued)

Interpretive Statement	Criteria
Lateral infarct, acute (LAD)	ST >.10 mV, V5 V6 I aVL
Posterior infarct, acute	ST<-.01 V1-V3 or ST>.05 V7-V9
Probable posterior infarct, acute	ST<-.05 V1-V3 or >.05 V7-V9
Posterior infarct, acute (LCX)	ST<-.01 V1-V3 or ST>.05 V7-V9

Acute Ischemia

If the interpretive statement listed in Table 22 result from measurements generated by an ECG, the Critical Value statement **Acute Ischemia** appears on the 12-Lead Report.

Table 22 Acute Ischemia Statements

Interpretive Statement	Criteria
Repol abnrm, severe global ischemia (LM/MVD)	STe aVR, STd & Tneg, ant/lat/inf

Extreme Tachycardia

If the interpretive statements listed in Table 23 result from measurements generated by an ECG, the Critical Value statement **Very High Heart Rate** appears on the 12-Lead Report.

Table 23 Extreme Tachycardia Statements

Interpretive Statements
Extreme tachycardia v-rate > (220-age)
Wide-QRS tachycardia vs-rate > ***, QRSD > ***
Extreme tachycardia with wide complex, no further rhythm analysis attempted

Complete Heart Block

If the interpretive statements listed in Table 24 result from measurements generated by an ECG, the Critical Value statement **Complete Heart Block** appears on the 12-Lead Report.

Table 24 Complete Heart Block Statements

Interpretive Statements
AV block, complete (third degree) v-rate < ***, AV dissociation
Complete AV block with wide QRS complex v-rate < ***, QRSD > ***, AV dissoc
Atrial flutter/fibrillation with complete AV block

Culprit Artery

If your 12-Lead interpretive statement contains an acronym in parenthesis (see Table 25), it is an indication the analysis is identifying the probable anatomical site of a coronary artery occlusion responsible for ischemia.

Table 25 Culprit Arteries

Acronym	Probable Anatomical Site
(RCA)	Right Coronary Artery
(LAD)	Left Anterior Descending
(LCx)	Left Circumflex
(LMMVD)	Left Main/Multi Vessel Disease

NOTE More information on the specificity and sensitivity of these statements can be found in the Physician's Reference Guide for the DXL algorithm.

12-Lead Report

The 12-Lead Report View is in a format similar to Monitor View, so that you may monitor the patient while viewing the report. In this view, the 12-Lead Report replaces Monitoring View's Wave Sectors 3 and 4, as shown in Figure 69, and includes the following information, if configured:

Measurements - The measurements component of the algorithm generates standard interval and duration measurements, in milliseconds, limb lead axis measurements, in degrees, and heart rate, in beats per minute.

Interpretive statements - Measurements and patient information are used by the Philips 12-Lead DXL Algorithm to generate statements describing the patient's cardiac rhythm and waveform morphology. There is also culprit artery detection which locates the probable anatomical site of a coronary artery occlusion responsible for ischemia. Statements regarding signal quality problems encountered during ECG acquisition are also included in this section.

Critical Values Statements - The HeartStart MRx displays Critical Value statements to aid in quickly identifying an interpretation that may mean your patient needs immediate attention. Statements identify any of four life-threatening conditions: acute myocardial infarction, acute ischemia, complete heart block and extreme tachycardia. The values appear as white text on a red background. For more information on Critical Values Statements see "Critical Values" on page 143.

ECG severity - Each interpretive statement on the report has an associated severity. The severities of all selected interpretive statements are assessed to determine an overall severity for the ECG. The categories of severity are "**Normal ECG**," "**Otherwise Normal ECG**," "**Borderline ECG**," "**Abnormal ECG**," and "**Defective ECG**."

Probability of Acute Ischemia - If your HeartStart MRx has the ACI-TIPI and TPI option configured for use, your 12-Lead Report contains a predicted probability score of Acute Cardiac Ischemia. The ACI-TIPI score does not appear if you are configured for Auto ACI-TIPI and you get an Acute MI statement or an ECG severity of normal. If the predicted probability is greater than or equal to the pre-configured ACI Threshold then results are displayed in white text on a red background.

Stored and printed 12-Lead Reports can be configured to include all 12 leads, measurements, interpretive analysis statements, ACI-TIPI analysis results, TPI analysis results and TPI contraindications.

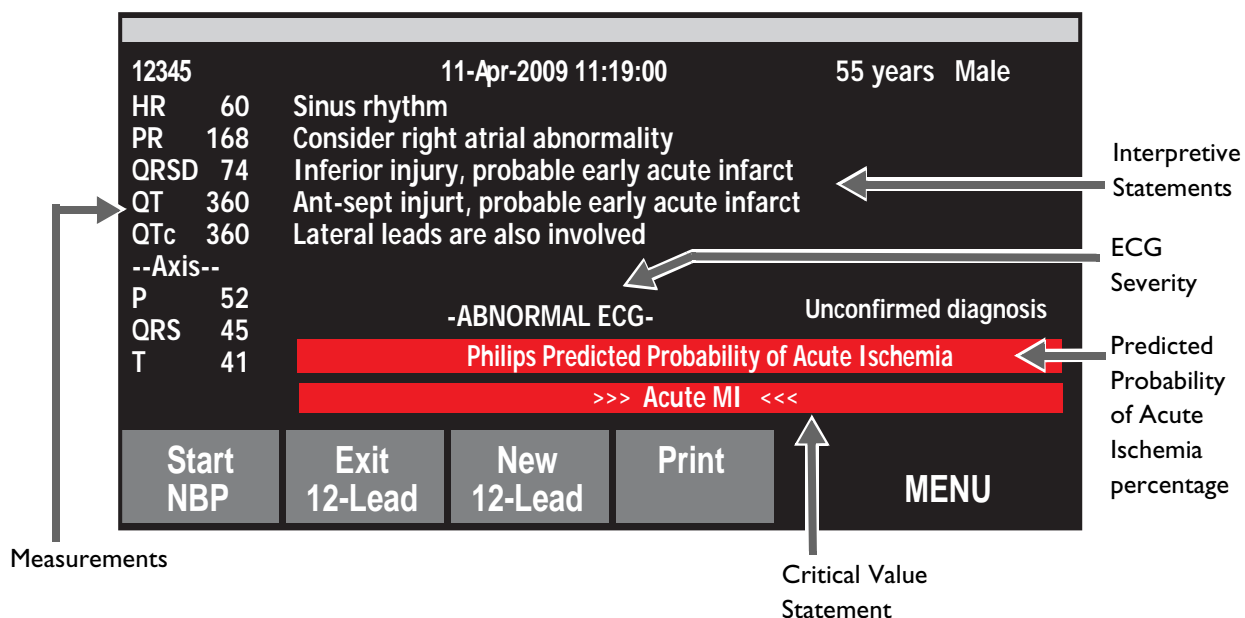
One or two copies of the 12-Lead Report are printed at the completion of acquisition and/or analysis, as configured. Press the **[Print]** soft key to print another copy. In addition to the information on the displayed 12-Lead Report, the printed report includes a rhythm strip with up to three ECG leads.

WARNING • Do not pull on the paper while a report is being printed. This can cause distortion of the waveform and lead to potential misdiagnosis.

NOTES Should an alarm condition occur while a 12-Lead Report is printing, an alarm strip is not printed, however, the corresponding ECG waveform is stored and available in the Event Summary.

A 12-Lead report must finish printing before you can acquire a new 12-lead. If you can't wait, cancel the printing and acquire the new 12-lead.

Figure 69 Displayed 12-Lead Report




NOTES TPI results and contraindications appear on the HeartStart MRx 12-Lead Report's printed results and in transmitted 12-Leads and Event Summaries. They do not appear on the 12-Lead Report displayed on the HeartStart MRx.

Full interpretive statements appear on the printed strip but may be shortened on the HeartStart MRx display.

Accessing Stored Reports

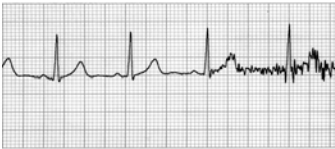
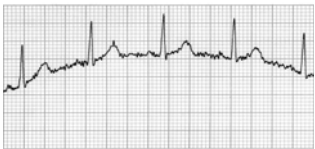
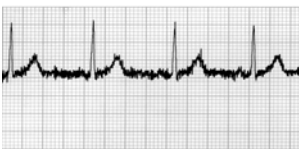
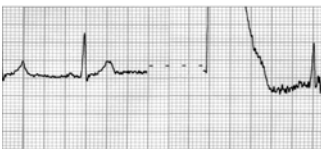
You may access stored reports to print additional copies or delete the report from internal storage. You may also copy the report to a data card. The list of stored reports for the current patient event may be accessed while a report is displayed or from either the 12-Lead Acquire Screen or the 12-Lead Preview Screen. To do this:

- 1 While in 12-Lead, press the Menu Select  button.
- 2 Using the Navigation buttons, select **Reports**.
Reports for the current patient event are listed by date, time and sequence number.
- 3 Use the Navigation buttons to select a report and press the Menu Select button.
- 4 Select **Print**, **Copy**, or **Delete** and press the Menu Select button.
- 5 To select another report repeat steps 1 through 3, or press **Exit** to close the menu.

Improving Signal Quality


Signal quality can impact ECG analysis. Refer to Table 26 for possible solutions to common ECG quality problems.

Table 26 ECG Signal Problems

Problem	Possible Causes	Possible Solutions
Tremor or muscle artifact 	<ul style="list-style-type: none"> Poor electrode placement. A cold patient. Tense, uncomfortable patient. Patient tremors. 	<ul style="list-style-type: none"> Clean the site and reapply electrodes. Be sure the electrodes are placed on flat, non-muscular areas of the body. Warm the patient. Reassure and relax the patient. Attach electrodes high on the extremities, near the trunk.
Baseline wander 	<ul style="list-style-type: none"> Patient movement Electrode movement. Poor electrode contact and skin preparation. Respiratory interference. 	<ul style="list-style-type: none"> Reassure and relax the patient. Be sure lead wires are not pulling on the electrodes. Move electrodes away from areas with the greatest respiratory motion, if possible.
Power line AC Interference 	<ul style="list-style-type: none"> Poor electrode contact. Dry or dirty electrodes. Interference from poorly grounded instrument near patient. 	<ul style="list-style-type: none"> Reapply electrodes. Route electrode wires along the limbs and away from other electrical equipment.
Intermittent or jittery waveform 	<ul style="list-style-type: none"> Poor electrode contact. Dry electrodes. Faulty lead wires 	<ul style="list-style-type: none"> Clean the site and reapply electrodes. Apply new electrodes. Repair or replace faulty leads.

Adjusting Wave Size

Adjusting ECG wave size may improve signal viewability. To do this:

- 1 While in 12-Lead, press the Menu Select  button.
- 2 Using the Navigation buttons, select **ECG Size** and press the Menu Select button.
- 3 Using the Navigation buttons, select the desired size value and press the Menu Select button.

The lead size is retained when you exit and then return to 12-lead functionality, without turning off power for more than 10 seconds.

NOTE Selecting ECG wave size of either **10mm/mV ½ V** or **20 mm/mV ½ V** displays V leads at half of the selection, 5 mm/mV and 10 mm/mV, respectively.

12-Lead Filters

ECG bandwidth filters of 0.15 - 40 Hz, 0.05 - 40 Hz, or 0.05 - 150 Hz may be selected in Configuration to apply to 12-lead ECG waveforms shown on the display. Additionally, the 12-Lead Report may be configured to apply either the same filter choice used for the display, or a 0.05 - 150 Hz filter. The filter setting for the 12-Lead Report is applied to both printed and stored 12-Lead Reports.

Regardless of filter settings for display or printing, the DXL Algorithm uses the full 0.05 - 150 Hz bandwidth for its analysis. The full bandwidth is also transmitted.

NOTE Although, the 0.05 - 150 Hz, or "Diagnostic" bandwidth filter may be selected for the display filter, LCD display limitations prevent the ECG from appearing in true diagnostic quality.

A filter soft key is available to switch between filter settings during use. When changing the filter during use, the filter setting is applied to both the display and the 12-Lead Report. The display and 12-Lead Report filter settings are returned to their configured settings whenever the [**New 12-Lead**] soft key is pressed or when the Therapy Knob is moved from the **Monitor** position.

Troubleshooting

If your HeartStart MRx does not operate as expected during 12-Lead ECG operation, see Chapter 22, "Troubleshooting" on page 297.

Vital Signs Trending

This chapter describes how to review patient data using HeartStart MRx Vital Signs Trending.


Overview

In Monitor Mode, your HeartStart MRx provides the ability to view and print numeric vital sign trending for the current incident. Trending data are automatically acquired if parameters are on.

When viewing trending, the Vital Sign Trending Report is displayed in the HeartStart MRx's lower two wave sectors and takes over the soft key functions. Trending data are presented at the selected interval for up to the most recent 12 hours of monitoring. The newest data appear when trending is initially displayed. The oldest measurements are deleted as needed to store the newest measurements.

Reviewing Trending Data

To review trending data:

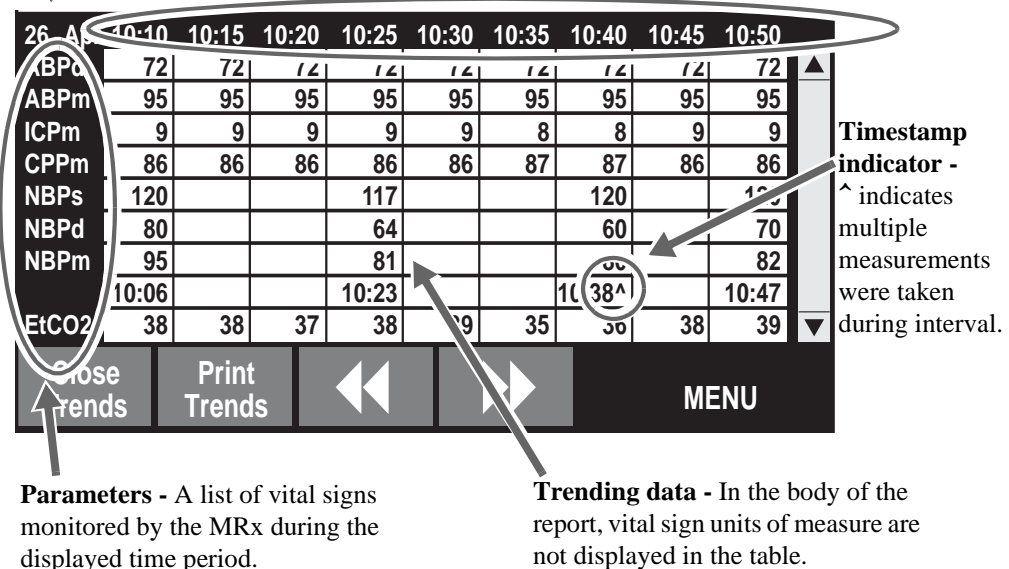
- 1 Place the HeartStart MRx into Monitor Mode.
- 2 Press the Menu Select  button.
- 3 Using the Navigation buttons, select **Trends** and press the Menu Select button.

The Vital Signs Trending Report takes over the bottom two wave sectors. See Figure 70.

Figure 70 Vital Signs Trending Report

Date of report - The earliest time displayed in the table determines the date of the report.

Time intervals - Vital Sign trends are displayed at the selected time interval. See "Vital Signs Trending Report Intervals" on page 153.



About The Data Displayed

- When trending is initially displayed, the latest (most recent) trending data will appear in the far right column.
- The display will auto-update as new vital sign data become available as long as the latest data are displayed on screen. If you have scrolled left to view older data, the screen will not update to new data when available. The latest data will be displayed when scrolling back to the most recent data.
- If a parameter has not been measured during the display period, it is not listed in the display.
- If a parameter in the display has invalid information, it is indicated by **?.** Questionable data are indicated by a question mark just before the numeric value and unavailable data are indicated by an empty space.
- Aperiodic measurements (e.g. NBP) are displayed with a measurement timestamp below the readings. A ^ after the timestamp indicates multiple measurements were taken during the interval. The most recent measurement within the interval is displayed.
- If an inactive parameter becomes active when viewing a Vital Signs Trending Report, the added parameter will automatically appear in the report when the interval is updated and the latest data is available.

NOTE When the time interval in the Vital Signs Trending Report is one minute, data from continuous measurements represents the average reading for that one-minute period. For all other time intervals, the measurement shown is the one-minute average from the most recent minute in the time interval.

Vital Signs Trending Report Parameter List Order

Vital Signs Trending Reports list parameters in the following order, beginning at the top of the table: HR, P1, P2, ABP, Ao, ART, PAP, RAP, CVP, LAP, ICP, CPP, NBP, EtCO₂, AwRR, SpO₂, Pulse, Temp.

If a parameter has not been measured during the display period, it is not listed in the display.

Scrolling in the Vital Signs Trending Report

Use the [<<] or [>>] softkeys to scroll left and right (backward and forward) in the Vital Signs Trending Report. The softkey will be displayed as inactive if there is no more data to be viewed in a particular direction.


If there are more vital signs than can be shown on the screen, use the Navigation buttons next to the Menu Select button to scroll up and down with the vertical scroll bar on the display. Make sure there is not a menu active at the same time.

Vital Signs Trending Report Intervals

Vital Signs Trending data can be shown at selected intervals for up to 12 hours of monitoring. You can adjust the display's time interval for the current incident to 1, 5, 10, 15, 30 or 60 minutes. The default is 5 minutes.

Adjusting Vital Signs Trending Report Interval

To adjust the intervals in the Vital Signs Trending report, perform the following steps:

- 1 With Vital Signs Trending active on your display, press the Menu Select  button.
- 2 Using the Navigation buttons, select **Trend Interval** and press the Menu Select button.
- 3 Using the Navigation buttons, select the trend interval you want and press the Menu Select button.

Printing the Vital Signs Trending Report

You can print the Vital Signs Trending Report two ways:


- 1 Press the soft key under the **Print Trends** label. A report for the displayed period and interval is printed.
- 2 Press the Summary  button and select **Trends** and then **Trends Interval**. A report for the entire incident period is printed.

Figure 71 Sample Vital Signs Trending Report Printout

Trend Report		26 Apr	10:55	10:50	10:45	10:40	10:35	10:30	10:25
DD Mon YYYY HH:MM	HR	bpm	100	100	100	100	100	100	100
	P2s	mmHg	25	25	25	25	25	25	25
Event ID: 0302	P2s	mmHg	10	10	10	10	10	10	10
LastName,First Name	P2s	mmHg	16	16	16	16	16	16	16
Patient ID:12345	ABPs	mmHg	118	118	118	118	118	118	118
	ABPd	mmHg	72	72	72	72	72	72	72
	ABPm	mmHg	95	95	95	95	95	95	95
M3535A S/N:US00112345									
SW Rev: 7.00.00 American English									

1st "page"

26 Apr	10:55	10:50	10:45	10:40	10:35	10:30	10:25
NBPs	mmHg	120		120			117
NBPD	mmHg	70		60			64
NBPM	mmHg	82		80			81
		10:47		10:30			10:23
EtCO2	mmHg	39	39	38	36	35	39
AwRR	rpm	12	12	12	12	12	12
SpO2	%	100	100	100	100	100	100
Pulse	bpm	95	95	95	95	95	95
Temp	F	99.0	99.0	99.0	99.0	99.0	99.0

2nd "page"

See "Vital Signs Trending Reports" on page 229 for more information.

NOTE If your device has a 50mm printer its report will have 11 lines of text. If the device has a 75mm printer, the report contains 16 lines.

Exiting Vital Signs Trending Report

To exit the Vital Signs Trending Report and return to a waveform display, press the soft key under the **[Close Trends]** label in the Vital Signs Trending Report display. You will be returned to Monitor Mode.

Troubleshooting

If your HeartStart MRx does not operate as expected during Vital Signs Trending, see Chapter 22, “Troubleshooting.”

Q-CPR and Data Capture

Overview

The Q-CPR option offers real-time measurement and corrective feedback on the rate, depth, and complete release of compressions, ventilation rate, and lack of CPR activity in accordance with current CPR guidelines. The feedback can appear on the HeartStart MRx display and on the CPR meter display (compression feedback only).

Compressions are measured by the CPR meter connected to the HeartStart MRx using a Pads/CPR meter cable. Ventilation data is acquired through Philips multifunction defib electrode pads applied to the patient and connected to the HeartStart MRx using the same Pads/CPR cable.

Q-CPR is available in both Manual Defib Mode and AED Mode. In both modes, easy-to-follow visual indicators and audio prompts provide feedback to the rescuer when CPR performance deviates outside of target ranges. Feedback from the HeartStart MRx is configurable. Manual Defib Mode provides advanced feedback while AED Mode can be configured to provide either advanced or basic feedback. (See the *Q-CPR Application Note* for more information on Q-CPR.)

The Q-CPR Data Capture option enables you to capture data on CPR quality from the HeartStart MRx using the Q-CPR option. The option enables the storage of CPR-related data for retrospective review and analysis in Event Review Pro.

NOTE Q-CPR is not available in 12-Lead Mode and is deactivated when entering Sync Mode.

WARNING The Q-CPR option is not intended for use in a moving environment, such as an ambulance. Additional movement introduced during patient transport may reduce the accuracy of the compression and ventilation measurements. If Q-CPR must be used in a moving environment, do not rely on the Q-CPR feedback during such conditions. It is not necessary to remove the CPR meter from the patient.

Q-CPR is not to be used on patients under 8 years of age or less than 25 kg (55 lbs.).

The Q-CPR option should not be used to verify placement of airway adjuncts, such as endotracheal tubes and laryngeal masks.

Ventilation feedback accuracy may be decreased when the patient is handled or moved, or when the Q-CPR option is used on patients with certain conditions such as trauma, seizures, reduced lung volume, or high cardiac ejections.

CPR is best performed when the patient is lying on a firm surface. If the patient is on a surface that yields, such as a mattress, compression depth feedback from the CPR meter is inaccurate. Either move the patient to a rigid surface or slide a backboard under the patient and compensate for mattress compliance by ensuring that each compression exceeds the minimum depth target shown on the CPR meter or exceeds the lower line of the depth target zone on the MRx display.

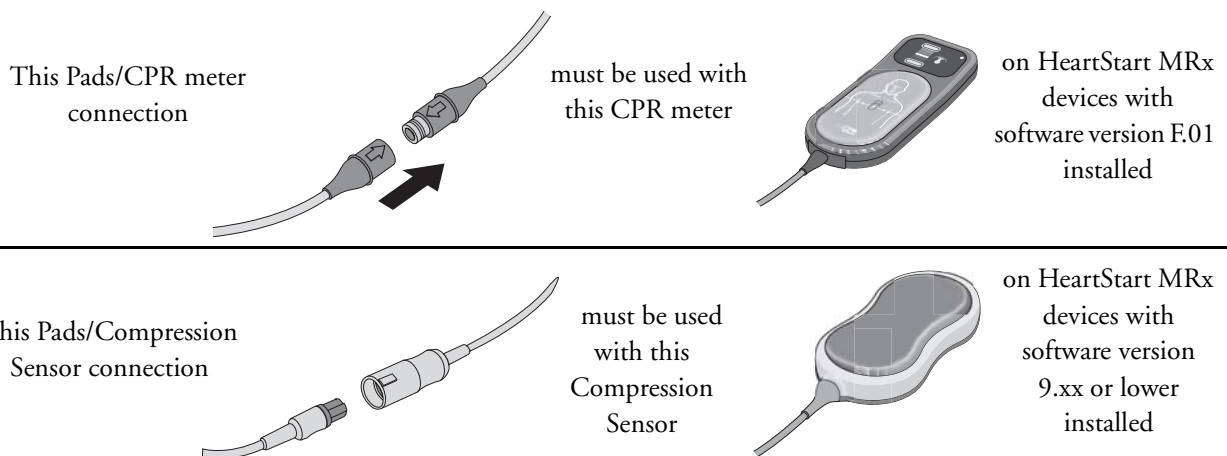
Do not rely on CPR meter feedback during aircraft ascent and descent as its accuracy is reduced in such conditions.

Do not practice with the CPR meter on a person. The CPR meter can be used with a training manikin or on a compliant surface for practice.

CAUTION The CPR meter and its Pads/CPR cable can only be used on HeartStart MRx devices with Software Version F.01 installed. Earlier versions of the Compression Sensor and Pads/CPR cable can't be used on a HeartStart MRx with Version F.01 installed. See Figure 72. Institutions with mixed fleets should develop a way for end users to identify which CPR devices go with which HeartStart MRx units.

The Q-CPR option is not intended for use with any other CPR compression devices.

Figure 72 CPR meter and Sensor Differences



Preparing to Use Q-CPR

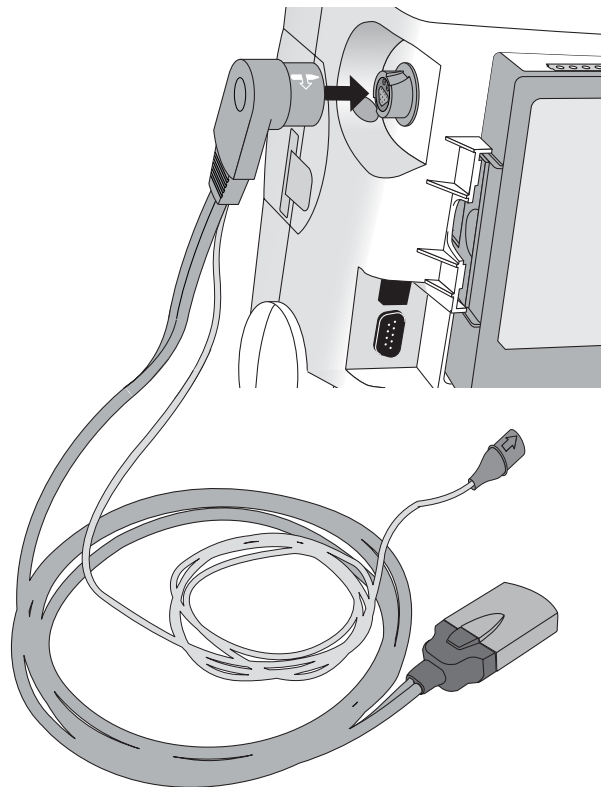
A Pads/CPR cable connects the CPR meter to the HeartStart MRx. To set up the Q-CPR option on the HeartStart MRx and prepare the patient for use, follow the steps described on the following pages.

Connecting the Pads/CPR Cable

To connect the Pads/CPR cable:

- 1 Align the white pointer on the cable with the white arrow on the green Therapy port as shown in Figure 73.
- 2 Insert the cable into the green Therapy port. Push until you hear it click into place. As a time saving measure, you may choose to always keep your Pads/CPR cable pre-connected to the MRx.

Figure 73 Connecting the Pads/CPR Cable



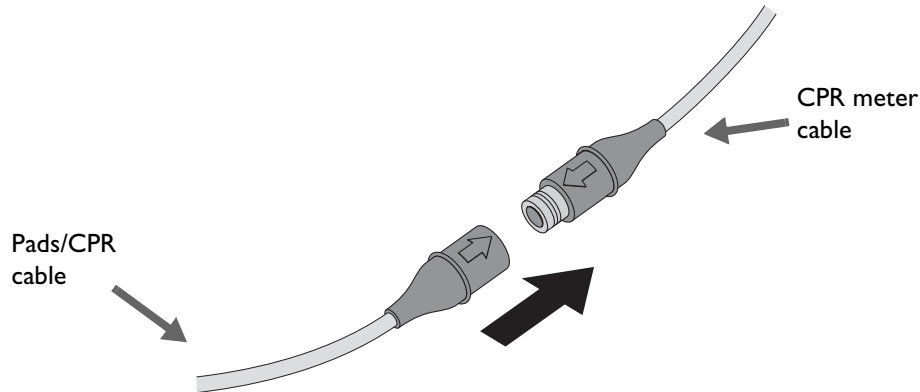
NOTE The Q-CPR option is operational only when the Pads/CPR cable is connected to the HeartStart MRx. CPR feedback is not available if the standard pads or paddles cable is connected.

Connecting the CPR Meter to the Pads/CPR Cable

To connect the CPR meter to the Pads/CPR cable:

- 1 Align the arrow on the CPR meter cable with the arrow on the receptacle end of the Pads/CPR cable as shown in Figure 74. As a time saving measure, you may choose to always keep your CPR meter cable pre-connected to the Pads/CPR cable.
- 2 Push until you feel it snap into place. There should be no gap between the two connectors.

Figure 74 Attaching the CPR meter to the Pads/CPR Cable



Applying Multifunction Electrode Pads

To apply pads to the patient:

- 1 Check the expiration date that appears on the pads package.
- 2 Inspect the packaging for any damage, then open.
- 3 Connect the pads connector to the Pads/CPR cable. See Figure 75.

Figure 75 Pads Connections



- 4 Apply the pads to the patient in the anterior/anterior position as shown on the pads package.

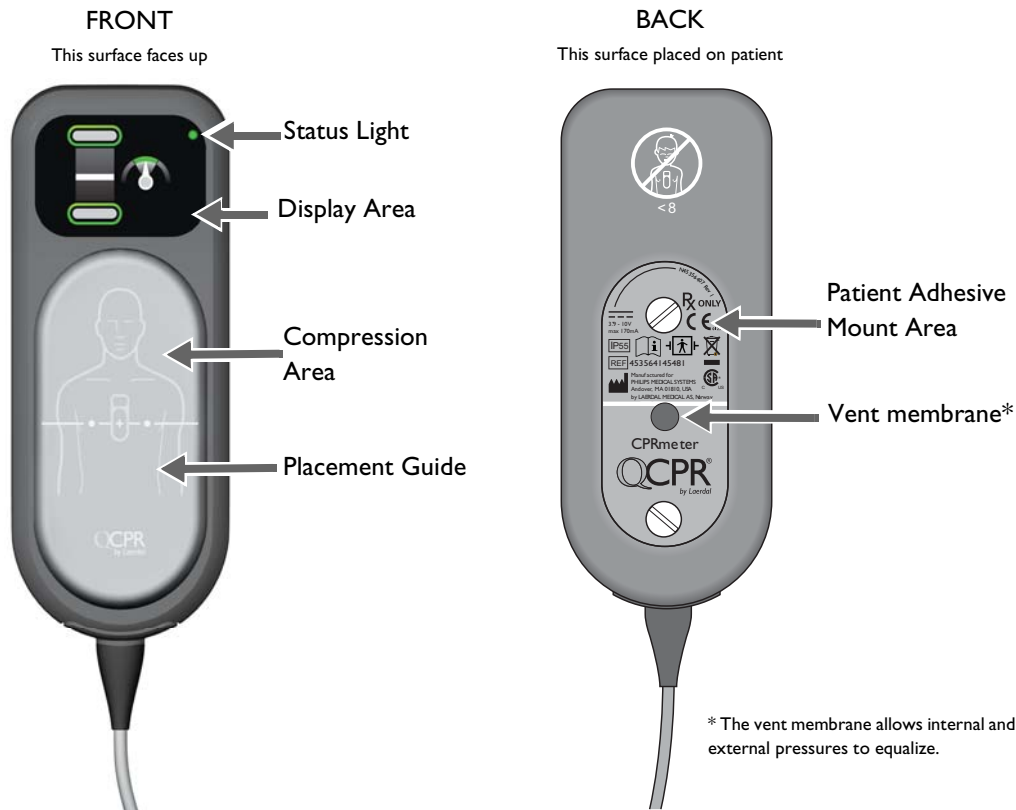
WARNING Anterior-posterior pad placement should not be used with the Q-CPR option.

CAUTION Philips multifunction defib electrode pads are required to measure ventilation activity, as well as acquire an ECG signal and deliver a shock, as appropriate.

CPR Meter

The CPR meter is a small, lightweight device that provides CPR feedback in a display area in the line of sight of the caregiver performing compressions. See Figure 76.

Figure 76 CPR Meter



* The vent membrane allows internal and external pressures to equalize.

NOTES Remove the protective film from the CPR meter's display screen before first use.

To prolong the life of the display, avoid storing the CPR meter where it is exposed to direct sunlight when not in use.

Status Light

The CPR meter's status light will be off when the meter is attached to a HeartStart MRx that is turned off. When the HeartStart MRx is turned on, the CPR meter's status light turns green to indicate that it has passed its self test. If the status light is orange or does not light during start-up, see Table 97 to troubleshoot. The status light turns off once the CPR meter display turns on. The status light turns on and remains on for 10 seconds after the HeartStart MRx is turned off.

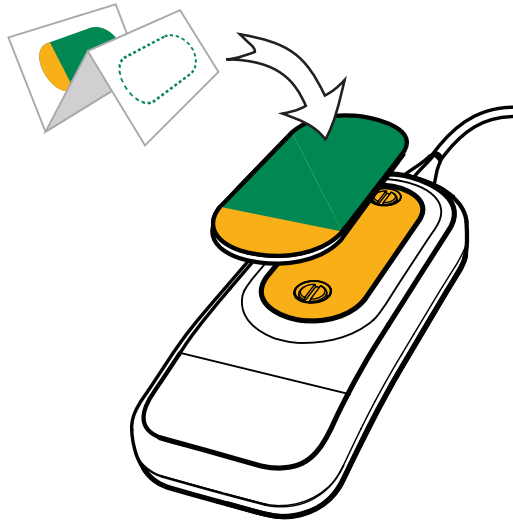
Attaching the CPR Meter Adhesive Pad

You need to attach an adhesive pad to the back of the CPR meter before using. To attach the CPR meter Adhesive Pad to the CPR meter:

- 1 Open the package of CPR meter Adhesive Pads and peel one from the liner strip to expose the adhesive surface on the underside.
- 2 Align the bottom of the patient adhesive with the yellow patient adhesive mount area on the back of the CPR meter. Make sure the channel on the adhesive (indicated by a dotted line on the front of the pad) is directly over the visible groove in the plastic. Press into place. See Figure 77. Do not peel off the green liner from the front of the pad until you are ready to apply the CPR meter to a patient.

WARNING Check the label on the outside packing to confirm the adhesive pads are within their expiration date. Do not use pads beyond their expiration date.

Figure 77 CPR Meter Adhesive Pad



WARNING The CPR meter Adhesive Pad is intended for single-patient use only. It should be replaced after each use.

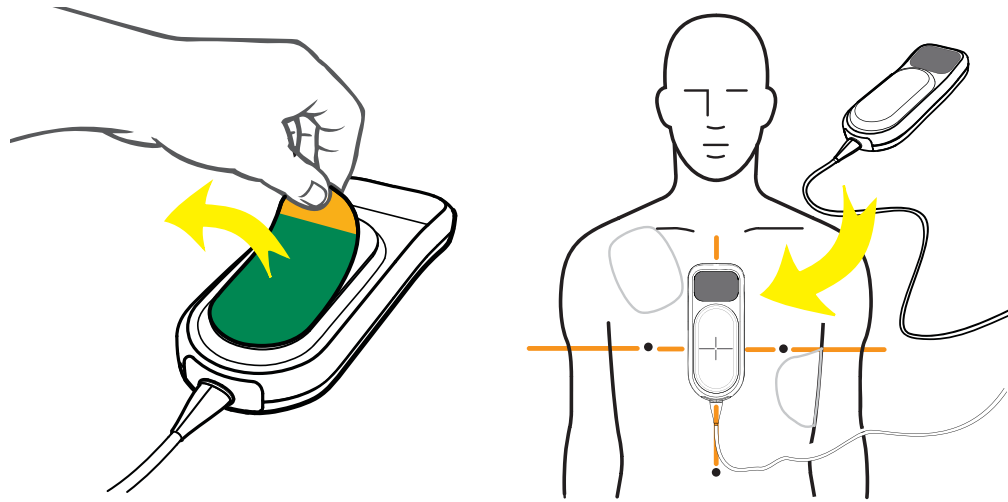
CAUTION The CPR meter should always be stored with the CPR meter Adhesive Pad in place as described above. Use of the adhesive pad assists in protecting the vent membrane from getting dirty or damaged.

Placing the CPR Meter on the Patient

To place the CPR meter on the patient:

- 1 Ensure the patient's skin is clean and dry. If necessary, clip or shave the hair from the sternum area.
- 2 Peel off the green liner from the CPR meter Adhesive Pad to expose the adhesive surface.
- 3 Position the CPR meter so the compression area is centered between the nipples and on the centerline of the bare chest as illustrated on the front of the CPR meter and in Figure 78. It is acceptable if the CPR meter overlaps the defibrillator pad.

Figure 78 CPR Meter Placement



If difficulty is encountered in applying the CPR meter, do not delay CPR. Remove the CPR meter and begin compressions. If the CPR meter moves during use, reposition it correctly in the center of the chest.

WARNING Do not apply the CPR meter to an open wound or recent incision site.

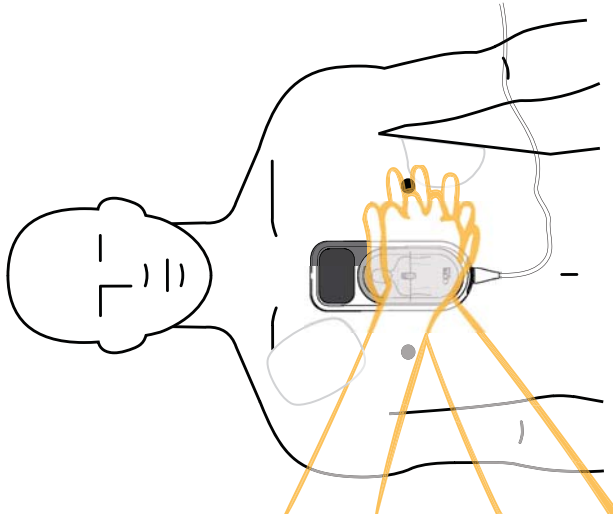
Do not use the CPR meter in conjunction with any mechanical or automated compression device.

If the CPR meter stops working, isn't working as expected or you are uncertain about the patient's age or the device fitting properly on the patient, remove the CPR meter from the patient and continue CPR according to your organization's protocol.

Starting CPR with the CPR Meter

Using standard CPR technique, place the heel of one hand directly over the compression area of the attached CPR meter. Place your other hand on top of the first, interlocking your fingers. You should be able to see the display area of the CPR meter to look for feedback (see Figure 79). Provide chest compressions according to your organization's CPR protocol.

Figure 79 CPR and Positioning



When the CPR meter first detects compressions, the display changes to enlarged compression indicators. See Figure 80. For a list of all feedback displays, see “Feedback Prompts” on page 172.

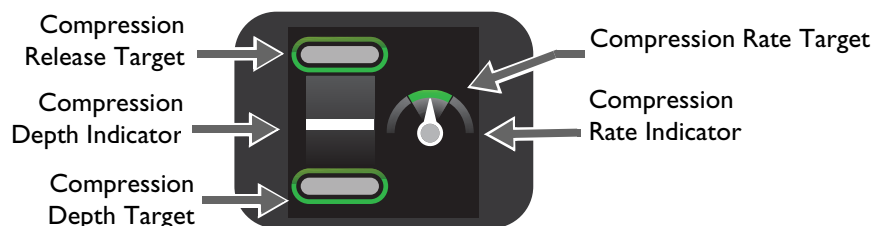
Figure 80 Beginning Compressions on CPR Meter



CPR Meter Display

The CPR meter provides real-time graphical feedback as a coaching tool once CPR compressions begin. See Figure 81.

Figure 81 CPR Meter Indicators



Compression Depth

As you perform CPR on the patient, the CPR meter display tells you what your compression depth is and if you are not completely releasing pressure after a compression. See Figure 82.

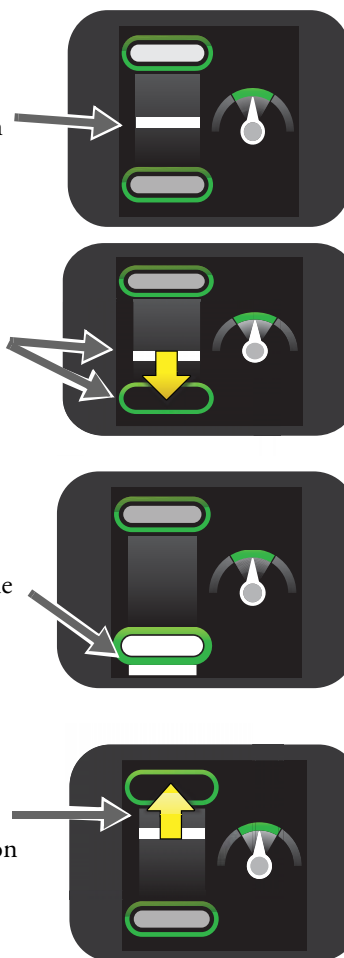
Figure 82 Compression Depth Indicator

Each compression performed is represented on the CPR meter display by a moving white compression depth indicator bar. When the correct compression depth is achieved, the bottom target lights up. When the pressure is completely released, the top target lights up.

If your compression fails to meet the target depth (40mm/1.5 inches), the compression depth target zone does not light up. If four consecutive compressions fail to meet the depth target, a yellow arrow appears on the display, pointing to the depth target zone. If the compression depth is not corrected the HeartStart MRx provides corrective voice prompts (if configured).

If your compression exceeds the compression depth target (50mm/2 inches), the CPR meter will show the depth indicator bar below the target area.

If you do not fully release pressure between four consecutive compressions, the CPR meter display shows a yellow arrow pointing up to the compression release target zone. You should allow the chest to completely recoil between compressions.



Compression Rate

The CPR meter also provides feedback on your rate of compressions and uses a speedometer to tell you to speed up or slow down your compression rate. See Figure 83.

Figure 83 Compression Rate Indicator

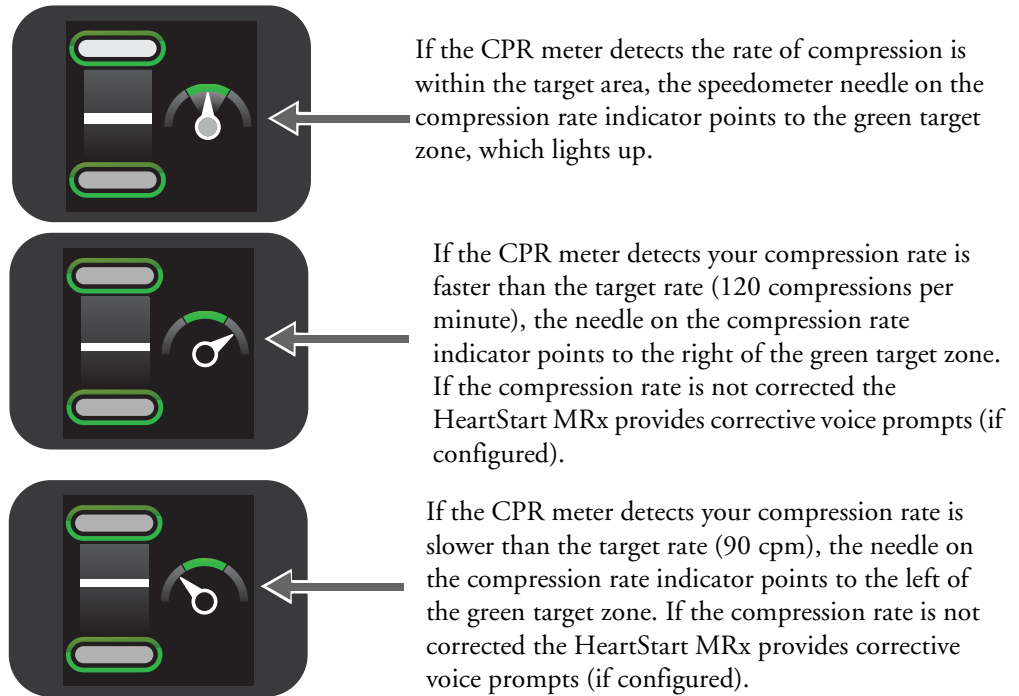





Table 27 Other Icons Appearing on the CPR Meter Display

Icon on Display	Definition
	The CPR meter displays the Do Not Touch The Patient Icon when the HeartStart MRx provides prompts to stop CPR for analyze of the patient's heart rhythm, the HeartStart MRx is charging or advises a shock is required. Stay clear of the patient when the icon is displayed. NOTE: Do not remove the CPR meter during rhythm analysis or shock delivery. Leave the CPR meter on the patient's chest.
	If compressions are stopped for 10 seconds the CPR meter display changes to a flashing white image to indicate that CPR should be resumed. If compressions are not resumed, the HeartStart MRx provides voice prompts (if configured) that no compressions are detected.
	The customer service indicator appears only at shutdown when the number of compressions performed on the CPR meter reaches the device's service limit. Take the CPR meter out of service and contact your local response center for more information.

Q-CPR Feedback on the HeartStart MRx

Depending upon how you configure your HeartStart MRx, you can receive a variety of information on the HeartStart MRx display. Feedback is also displayed on the CPR meter.

On the HeartStart MRx display, Advanced View can be displayed in both Manual Defibrillation Mode and in AED Mode while Basic View is available in AED Mode only. You can only configure which view is displayed in Configuration Mode, not during a patient event. See “Configuration” on page 199 for more information.

Advanced View

When configured for Advanced View, the HeartStart MRx can display the following parameters, depending upon your configuration (See Figure 84 “Advanced Q-CPR View” on page 168):

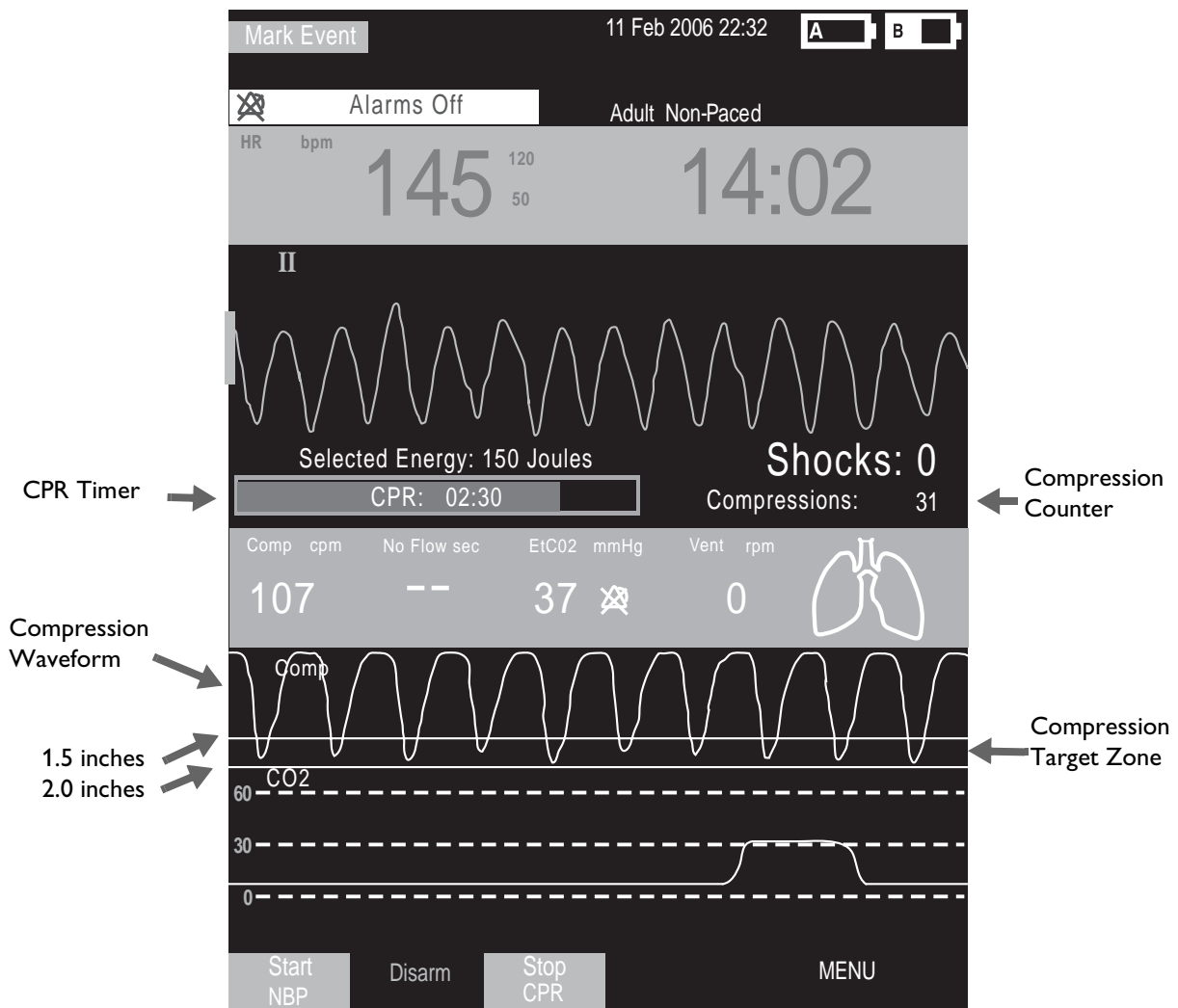
- Compression rate
- No flow time
- EtCO₂ numeric (if available)
- Ventilation Rate.
- Ventilation detected icon
- CPR Timer
- Compression Counter
- Compression Wave (if an IBP arterial or pulmonary arterial pressure wave is available it replaces the Compression Wave)
- CO₂ wave (if available)

Compression Waveform

If you do not have an invasive pressure waveform (ABP, ART, Ao or PAP) displayed, the compression waveform appears in Wave Sector 3 and is labeled **Comp**. The waveform is drawn at a speed of 12.5 mm/second. As the chest is compressed, the compression is shown as a downward stroke of the wave, rebounding up to a baseline as compression pressure is released. The wave sector contains lines drawn at minus 38 mm and minus 51 mm (minus 1.5 inches and minus 2 inches) that define a target zone to help you achieve good compression depth. Good compression depth is achieved when the peak, or minimum value, of the waveform appears between the lines. When pressure is not released between compressions, an asterisk (*) will annotate the baseline segment between compressions. This is also referred to as “leaning”. If the signal from the CPR meter becomes invalid (e.g., the meter is disconnected), the waveform appears as a dashed line.

In Manual Defib Mode, if you do have an arterial or pulmonary arterial invasive pressure waveform displayed, it displays in Wave Sector 3. The compression waveform remains in AED Mode.

Figure 84 Advanced Q-CPR View



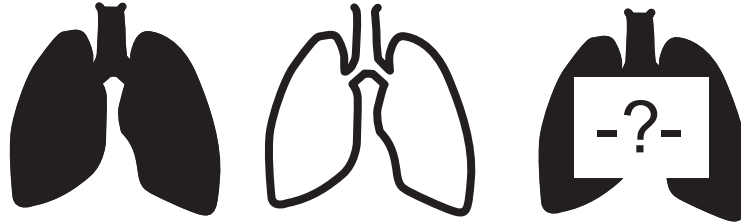
Parameter Block 2

In Advanced View, Parameter Block 2 contains the numeric values for compression rate, as well as ventilation rate. Both rates are a moving average rate, measured per minute. Based on the Q-CPR algorithm, the target compression rate is 100 compressions per minute within an acceptable range of 90-120 compressions per minute. The acceptable range for ventilation rate while CPR is being administered is 4-16 ventilations per minute (to reflect 2005 AHA/ERC resuscitation guidelines).

The acceptable range for ventilation rate following 60 seconds without compressions (such as while rescue breathing is being administered) is 9-16 ventilations per minute.

If your device does not have invasive pressure active, the ventilation detection icon is displayed in Parameter Block 2 and depicts the level of ventilation volume. A set of lungs graphically shows the three states of volume: full, empty and questionable (if ventilation cannot be measured, lungs marked with a “- ? -” appear). A filled ventilation icon indicates a ventilation was detected.

Figure 85 Ventilation Detection Icons



WARNING The graphical display of a set of lungs does not signify the actual filling (ventilation) or presence of both lungs in the patient. The actual ventilation volume associated with filling of the lung icon will vary from patient to patient. Actual tidal volumes should be determined based on chest rise.

The HeartStart MRx does not provide feedback on hyperventilation if the transthoracic impedance signal is too noisy. Proceed doing ventilations according to your organization's protocol.

Parameter Block 2 also contains a numeric value for No Flow Time. If no compressions are detected, the No Flow Timer starts. The No Flow Time value is displayed, beginning at 3 seconds and incremented with each additional second. A voice prompt is given every 15 seconds that compression activity is not detected. The No Flow Time value is reset when a compression occurs or when the Shock ⚡ button on the HeartStart MRx is pressed. If the No Flow Time value exceeds 1 minute, it is assumed that CPR compression activity has stopped intentionally and the value is reset to two dashes (- -).

If monitoring CO₂, the EtCO₂ numeric value is displayed in Parameter Block 2, along with its alarm limits. Annunciation of alarms is suspended in AED Mode.

Soft Keys

In Advanced View, to stop CPR, press the soft key labeled **[Stop CPR]**. If you want to return to the Advanced View, press the **[Start CPR]** soft key.

NOTE Pressing the **[Start CPR]** soft key turns off the Sync function. Conversely, pressing the Sync button turns off Q-CPR.

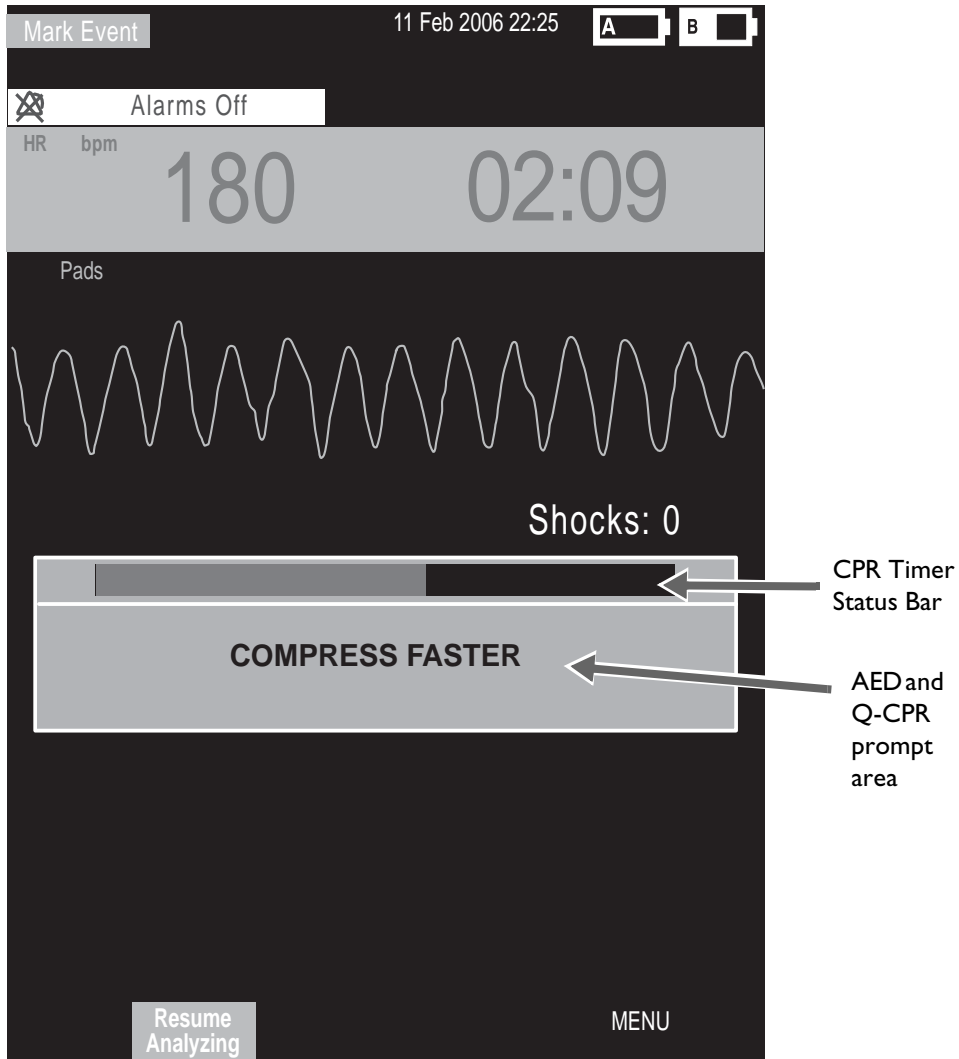
NOTE The **[Start CPR]** soft key is disabled if patient category is Pedi or patient age is less than 8 years old.

Basic View

When selecting Basic View, the HeartStart MRx displays the following parameters, depending upon your configuration (See Figure 86):

- CPR Timer
- AED and Q-CPR prompt commands. See “Feedback Prompts” on page 172.

Figure 86 Basic Q-CPR View



Using Q-CPR in Manual Defib Mode

When the Therapy Knob is moved to the 150J Manual Defib setting, the Advanced CPR View is automatically displayed only if the Sync function is disabled, patient category is Adult, and patient age is equal to or greater than 8 years old. Advanced View is automatically displayed after the Manual Therapy Security password is entered, only if Manual Defib Mode is password protected.

When the Therapy Knob is located on any other Manual Defib setting, a compression on the CPR meter turns on Advanced CPR View. Advanced View may also be manually displayed by pressing the **[Start CPR]** soft key. Also, the patient category must be Adult and the patient age must be equal to or greater than 8 years old to display the view for either action.

Wave forms for ECG, invasive pressure (ABP, ART Ao or PAP) and CO₂ parameters can be viewed during the use of Q-CPR. If an ABP, ART Ao or PAP pressure measurement is active, the waveform always appears in Wave Sector 3 and the pressure value displays in Parameter Block 2. If two pressures labeled ABP, ART, Ao or PAP are available, the label assigned to Pressure 1 is displayed. If no pressure is active, then the compression waveform appears in Wave Sector 3. Parameter Block 2 displays compression and ventilation measurement information. The EtCO₂ waveform will appear in Wave Sector 4 if present. AwRR numeric values are not displayed.

NOTES If the Pads/CPR cable is not connected when you turn the Therapy Knob to Manual Defib Mode, the message **Connect Pads/CPR Cable** displays.

When using Q-CPR, SpO₂ monitoring functionality is not available.

Compression and ventilation measurement values are printed in the annotation area of the ECG printed strip.

Using Q-CPR in AED Mode

In AED Mode, CPR feedback is provided automatically during the CPR Pause period of the AED protocol or manually when the **[Pause for CPR]** soft key is pressed. If your No Shock Advised (NSA) Action configuration item is set to provide a CPR Pause interval, Q-CPR can be activated by delivering a compression with the CPR meter.

As in Manual Defib Mode, voice prompts are issued to guide you if necessary, however, in AED Mode they are accompanied by a momentary text message appearing on the HeartStart MRx display. A configurable CPR Timer status bar is also displayed. The time period of the CPR Timer is determined by the Configuration setting for CPR Pause Time. See Figure 86.

NOTES Basic CPR View in AED Mode displays the ECG waveform only, Q-CPR prompts appear as text on the display and the compression waveform is not displayed while performing CPR in AED Mode.

If the Pads/CPR cable is not connected when you turn the Therapy Knob to AED Mode, the message **Connect Pads Cable** is displayed.

Compression and ventilation measurement values are printed in the annotation area of the ECG printed strip.

Feedback Prompts


Table 28 lists the feedback prompts that may be issued during the use of Q-CPR.

Table 28 CPR Feedback Prompts

CPR Component	Problem	HeartStart MRx Voice Prompt	Accompanying HeartStart MRx Text Prompt (Basic View only)
Compression Depth	Too shallow	Compress deeper	Compress deeper
Compression Rate	Too slow	Compress faster	Compress faster
	Too fast	Compress slower	Compress slower
Residual Pressure on the Patient's Chest	Incomplete release of compression (Leaning)	Release pressure between compressions	Release pressure between compressions
Ventilation Rate	Too high	Ventilate less often	Ventilate less often
No Compression Activity	15 seconds without sign of compressions	Fifteen seconds without sign of compressions	15 seconds without sign of compressions
	30 seconds without sign of compressions	Thirty seconds without sign of compressions	30 seconds without sign of compressions
	45 seconds without sign of compressions	Forty-five seconds without sign of compressions	45 seconds without sign of compressions
	60 seconds without sign of compressions	Sixty seconds without sign of compressions	60 seconds without sign of compressions
Poor pad/patient contact	Pads are on the patient but impedance is greater than 200 ohms or less than 25 ohms.	Press pads firmly to patient's bare chest	Press pads firmly to patient's bare chest

Adjusting CPR Feedback Volume

To adjust the volume of CPR feedback voice prompts:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select **Volume** from the menu and press the Menu Select button.
- 3 Select **Voice** and press the Menu Select button.
- 4 Select the desired volume level and press the Menu Select button.

A sample voice prompt is annunciated to confirm your selection.

NOTE In AED Mode, steps 2 and 3 are not applicable unless Q-CPR is active.

If desired, CPR feedback voice prompts may also be muted. When muted, a **CPR Voice Muted** text message displays in the middle of the wave sector containing the compression waveform during Manual Defib Mode or below the text prompt in AED Mode. CPR inactivity time is indicated by an audible tone.

To mute the CPR feedback voice prompts:

- 1 Press the Menu Select  button.
- 2 Press the Menu Select button again to select **Mute CPR Voice**.

To resume voice prompts set at the previously selected volume:

- 1 Press the Menu Select  button.
- 2 Press the Menu Select button again to select **Resume CPR Voice**.

NOTE Mute is only available when Q-CPR is active.

After Each Use

The CPR meter, vent membrane and horizontal groove on the rear of the meter should be inspected after each use and cleaned if necessary. Remove the CPR meter Adhesive Pad from the CPR meter and follow the cleaning directions listed in the Maintenance chapter section entitled “CPR meter” on page 289.

Q-CPR Data Capture

This section describes how to configure Q-CPR Data Capture settings, lists the data and events recorded, and provides information on reviewing Q-CPR data.

Q-CPR Feedback Setting

You can enable or suppress Q-CPR feedback, while still capturing CPR data. When Q-CPR feedback is enabled, the MRx displays the CPR view, with accompanying voice and/or text prompts.

When Q-CPR feedback is suppressed, the HeartStart MRx behaves in the following way:

Manual Defib Mode

- The CPR sub view (chest compression waves, compression rate and ventilation rate numerics, and no-flow time) is *not* displayed.
- There is *no* Q-CPR voice or text prompt feedback or storage.
- INOPs regarding ventilation are *not* displayed.

AED Mode

- For Advanced View, chest compression waves, compression rate and ventilation rate numerics, and no-flow time are *not* displayed. (They are never shown in Basic View.)
- There is *no* Q-CPR voice or text prompt feedback or storage.
- INOPs regarding ventilation are *not* displayed.

Data and Events Recorded

With the Data Capture option, the HeartStart MRx records CPR data in all clinical modes when data recording is active. It will start recording when a CPR meter is detected and stop when the CPR meter is removed from the HeartStart MRx or the HeartStart MRx leaves a clinical mode. In addition to the standard HeartStart MRx defibrillation and monitoring events and ECG waveform, the following data and events related to Q-CPR are captured. Q-CPR feedback prompts are captured if the Q-CPR Feedback configuration option is set to On. However, these Q-CPR related events are not included in the Event Summary report printed by the HeartStart MRx.

Table 29 Q-CPR Captured Data

Captured Data	Description
Compression Waveform	Waveform showing compression depth versus time.
Ventilation Waveform	Waveform showing change in chest impedance versus time.
Compression event	Compression occurs
Ventilation event	Ventilation occurs
Compression rate	Rate of compressions
Ventilation rate	Rate of ventilation
Level 2 feedback	Visual feedback on the CPR meter is displayed if some aspect of the CPR performed does not conform to CPR guidelines.
Level 3 feedback	Verbal feedback announced if some aspect of the CPR performed continues to fall outside CPR guidelines after Level 2 feedback is given.

Research Storage Setting

When you enable Research Storage, in addition to the data and events listed in Table 29 the following data is captured:

- CPR meter acceleration data
- CPR meter force data
- Patient Contact Impedance (PCI) from multifunction electrode pads

Reviewing Q-CPR Data

To review Q-CPR data:

- Copy the event data from the HeartStart MRx internal memory to an external data card. See the “Data Management” chapter for information.
- Import the data into the Event Review Pro application.

Troubleshooting

If your HeartStart MRx does not operate as expected during Q-CPR, see Chapter 22, “Troubleshooting.”

Networking

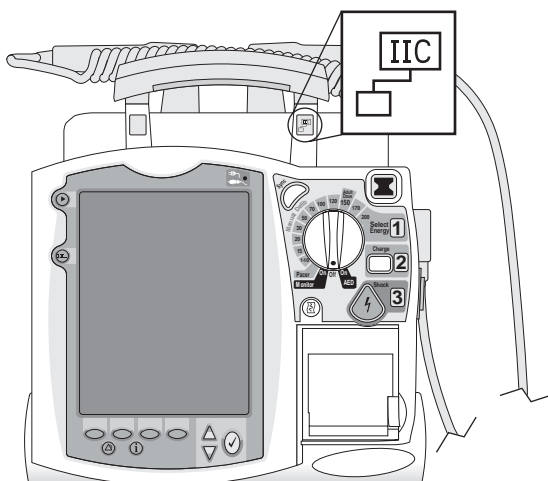
The IntelliVue Networking Option allows the HeartStart MRx monitor/defibrillator to connect and communicate with the Philips IntelliVue M3185 Clinical Network (System J or later) via a wired network connection or wirelessly. When on the network, the HeartStart MRx performs in a fashion similar to a bedside monitor - sending waveforms (ECG, Pleth, invasive pressure and CO₂) and patient parameters along with alarm and INOP messages to the Philips IntelliVue Information Center for monitoring.

Connection to the Information Center allows you to silence certain alarms and send patient demographic data to the HeartStart MRx from a remote location. Monitoring data can also be sent from the HeartStart MRx to the patient's electronic medical record through the IntelliVue HL 7 connection. Defibrillation and pacing capabilities can only be initiated at the HeartStart MRx.

The IntelliVue Networking Option is available in most countries; wireless functionality is available in the U.S. only.

HeartStart MRx devices that have the IntelliVue Networking Option have an identifying icon placed on the device's handle. See Figure 87.

Figure 87 HeartStart MRx with IntelliVue Networking Option





WARNING Before using the HeartStart MRx with IntelliVue Networking Option, you should familiarize yourself with the operation of the IntelliVue Information Center. Refer to the IntelliVue M3150 Information Center *Instructions for Use*.

IntelliVue Networking Display

When in a clinical mode, the status area of the HeartStart MRx with IntelliVue Networking Option provides network-related data (see Figure 88) including:

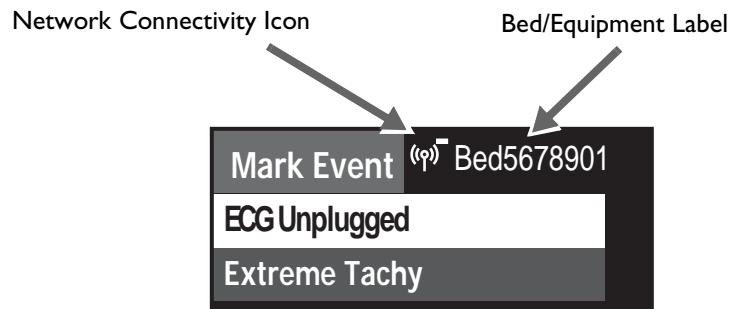
Network Connectivity Icon An icon indicating a wired or wireless Local Area Network (LAN) connection is displayed. It is located on the display's top line, to the left of the bed/equipment label. See Table 30.

Table 30 Icon Definitions

Symbol	Definition
No symbol	No connection/association with the Information Center is established.
	Connected. A wired connection is established. The HeartStart MRx is assigned to a sector and is being monitored by the Information Center.
	Connected. A wireless connection is established. The HeartStart MRx is assigned to a sector and is being monitored by the Information Center.

Bed/Equipment Label The HeartStart MRx equipment label is displayed when the device is not connected to the network. The equipment label will be replaced by a bed label when connected to the network.

Figure 88 HeartStart MRx With IntelliVue Networking Option Status Area



NOTE For a description of other information in the status area, refer to “Getting Acquainted” on page 7.

Connecting to the Network

There are two aspects to getting your HeartStart MRx up and active on the IntelliVue Network. Both need to be in working order before your HeartStart MRx can be used on the IntelliVue Network.

- 1 Configure the device and the IntelliVue Network to “talk” with each other. See "Configuring to Work on the Network" on page 181.
- 2 Physically connect your device to the IntelliVue network. See "Physical Connections" below.

Physical Connections

You can physically connect your HeartStart MRx to the network in three different configurations:

- 1 “Wired.” An IntelliVue Network LAN cable is plugged into the RJ 45 connector (labeled “LAN”) on the back of the HeartStart MRx. See "Wired Connection" on page 180.
- 2 “Wireless.” Philips’ Instrument Telemetry 1.4 GHz radio and A/C module (radio/AC power module backpack) is mounted on the HeartStart MRx and plugged into the RS-232 connector. See "Wireless Connection" on page 180.
- 3 A combination of wired and wireless. The wired LAN and wireless radio/AC power module are physically connected to the device at the same time. See "Combined Connection" on page 181.

CAUTION The radio module operating in the Wireless Medical Telemetry Service 1.4 GHz frequency is limited by US FCC 47 CFR Part 95 to operation and use in healthcare facilities only. Use in ambulances or other vehicles is prohibited.

If a HeartStart MRx M3535A leaves the healthcare facility, disconnect the radio module from the device.

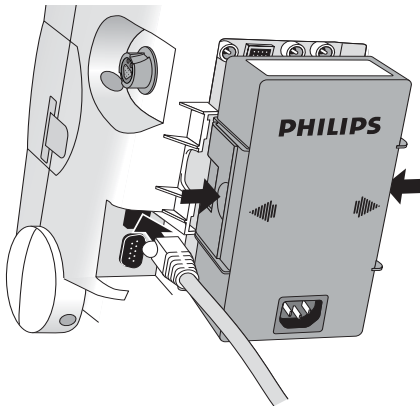
Do not place the radio module on the HeartStart MRx M3536A.

NOTE The IntelliVue Networking option is not available with the Batch LAN Data Transfer option.


Wired Connection

To connect your HeartStart MRx to the network using a wired connection, plug an active IntelliVue Network cable into the LAN port on the back of the device. See Figure 89.

Figure 89 Wired Connection Physical Setup



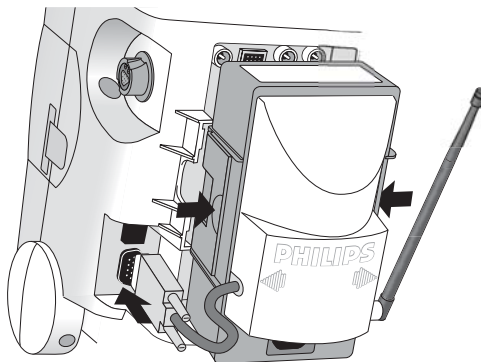
On the display:

The wired icon  appears on your display in all clinical views indicating a wired connection to the network. Data can be exchanged with and viewed at the Information Center.


Wireless Connection

The radio/AC power module snaps into the back of the HeartStart MRx and connects to the device using an RS-232/DB 9 connection. See Figure 90. Your institution must have a 1.4 GHz frequency wireless network to use this function. To connect your HeartStart MRx to the network using a wireless connection, make sure the device is off then insert the radio/AC power module into Compartment B and press in until you hear it click. Then plug the RS-232 connector into the RS-232 port on the HeartStart MRx and tighten the screwlocks. Do not wiggle the connections. Turn the device on.

Figure 90 Wireless Connection Physical Setup



On the display:

The wireless icon  appears on your display in all clinical views indicating a wireless connection to the network. Data can be exchanged with and viewed at the Information Center.

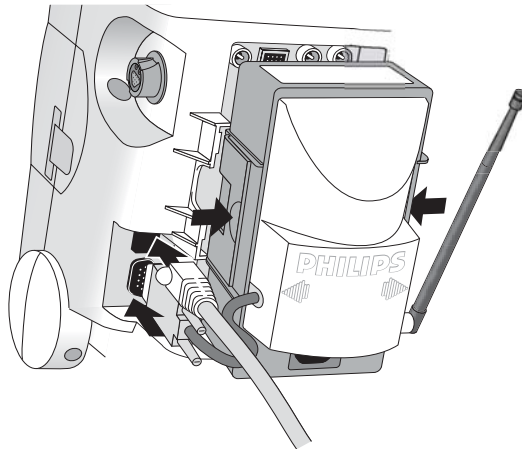
NOTE Be sure to fully connect the wireless radio/AC module to the HeartStart MRx before turning the device on. Failure to do so will prevent the HeartStart MRx from detecting the module. If you connect the wireless radio/AC module to the device after it has been turned on, turn the power off for 10 seconds. When you restart the HeartStart MRx, it finds the wireless module and starts a new patient incident.

Combined Connection

In instances when you have both wired and wireless connections available (See Figure 91), the wired connection takes priority.

NOTE If you lose the wired connection, the device automatically attempts to connect to the network via the wireless radio/AC module. If the radio/AC module is not connected to the device when you lose your wired connection, you will not automatically switch over to wireless operation. You must plug the module in and restart the device (turn it off for 10 seconds) before obtaining a wireless connection.

Figure 91 Simultaneous Wired and Wireless Physical Network Connections



On the display:

When both wired and wireless connections are available, the wired connection takes priority. Only the wired icon appears on your display (in all clinical views). The icon indicates data can be exchanged with and viewed at the Information Center.

WARNING The HeartStart MRx LAN port is intended for connection to the IntelliVue Clinical Network or for Batch LAN Data Transfer. It should only be used for connection to devices that comply with IEC 60950-1 and IEC 60601-1. During real-time patient monitoring, the HeartStart MRx wired LAN connector should only be connected to the IntelliVue Network. For post-event Batch LAN Data Transfer, the HeartStart MRx should only be connected to the facility network.

The RS-232 Serial Port is intended for connection to the IntelliVue wireless backpack. It is also for connecting with the Rosetta-Lt and cellphones for data transmission. Improper system operation may result if any other device is connected to this port.

NOTE Regardless of a wired or wireless connection, the HeartStart MRx provides the same level of network functionality. The device sends up to four waveforms (except Q-CPR) and a maximum of seven alarms to the Information Center. All arrhythmia processing and controls reside with the HeartStart MRx.

Configuring to Work on the Network

Before you can use the HeartStart MRx on the IntelliVue Network, it needs to be correctly configured AND the IntelliVue Information Center needs to be properly set up to accept the HeartStart MRx. For HeartStart MRx configuration instructions, see the HeartStart MRx *Service Manual*. To access configuration options on the HeartStart MRx, see “Troubleshooting” on page 197. For instructions on how to set up the IntelliVue Information Center, see the *IntelliVue Information Center System Installation and Service Manual*.

Using the Device Location Option

A HeartStart MRx that is powered on and has an active wireless connection to the IntelliVue Clinical Network can be located by using the Information Center's Device Location option. The Device Location option allows you to identify the general location of your HeartStart MRx by associating the device with network access points installed in the healthcare facility. These access points provide communication pathways between the HeartStart MRx and the Information Center.

WARNING Because the coverage range of access points can sometimes overlap, including floor levels, the Device Location feature is not intended for use when attempting to locate a patient.

There are device prerequisites for the Device Location function to work. See Table 31. For further Device Location information, see the IntelliVue M3150 Information Center *Instructions for Use*.

Table 31 Device Location prerequisites

At the ...	Prerequisite
HeartStart MRx	The device must have software Version 9.xx or Version F.xx installed
	The device's radio module must have Instrument Telemetry Subsystem firmware revision A.00.17 or greater.
	The device's radio module must have Instrument Telemetry Subsystem radio firmware revision A.00.52 or greater.
IntelliVue Network	The Information Center needs to be configured for the Device Locator functionality.
	Access Point firmware must be A.00.54 or greater.

NOTE The HeartStart MRx does not verify the above mentioned firmwares are at the correct levels. To confirm firmware versions on the HeartStart MRx, enter Service Mode and highlight **Instrument Telemetry**. Press the Menu Select button and wait for the version numbers to appear.

Network Settings

You can view your current network settings in Monitor, Pacer and Manual Defib modes. To view current network settings, perform the following:




- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons ( and ), select **Other** and press the Menu Select button.
- 3 Select **Network Settings** and press the Menu Select button. See Figure 92 and Table 32.

Figure 92 Network Settings Display

Network Settings	
Connection:	Wireless
MAC Address :	0009 F B03 A015
MAC Instr. Tele. :	0009 FB16 0035
RF Access Code :	45
IP Address :	172.31.6.40
Server IP :	172.31.3.0
Subnet Mask :	255.255.240.0
RSSI :	-50

Table 32 Network Settings Parameters

Field	Description
Connection	Displays current connection status: Wired, Wireless, or Inactive
MAC Address	HeartStart MRx MAC address (wired)
MAC Instr. Tele.	Instrument Telemetry Radio Module MAC address
RF Access Code	Used to identify which RF (radio frequency) channel the HeartStart MRx-Information Center wireless communications use (Set in Configuration Mode.)
IP Address	Current IP address - HeartStart MRx (wired) or Radio Module (wireless)
Server IP	Information Center IP address
Subnet Mask	Subnet mask of wired or wireless network
RSSI	Instrument Telemetry Radio's Received Signal Strength Indicator (Value updates while window is open)

Admit, Discharge, Transfer of Patients

A HeartStart MRx with the IntelliVue Networking Option synchronizes and maintains common patient demographic data with the Information Center. The HeartStart MRx can admit, discharge and transfer (ADT) patients to or from the Information Center and update or modify patient information. The HeartStart MRx will also accept certain patient admission data entered at the Information Center including name, medical record number (patient ID), patient type (category), date of birth, gender (sex) and paced status. It does not display height or weight from the Information Center.

Admit

The HeartStart MRx displays physiological data and stores it as soon as a patient is connected. This allows you to monitor a patient who is not yet admitted. You need to admit patients properly so you can correctly identify your patient on recordings, reports and network devices.

The HeartStart MRx admits patients by entering one or more of the following: patient name, patient ID, date of birth or sex. You can't admit a patient by changing patient type (category) or paced status.

To admit a patient from the HeartStart MRx, perform the following steps:


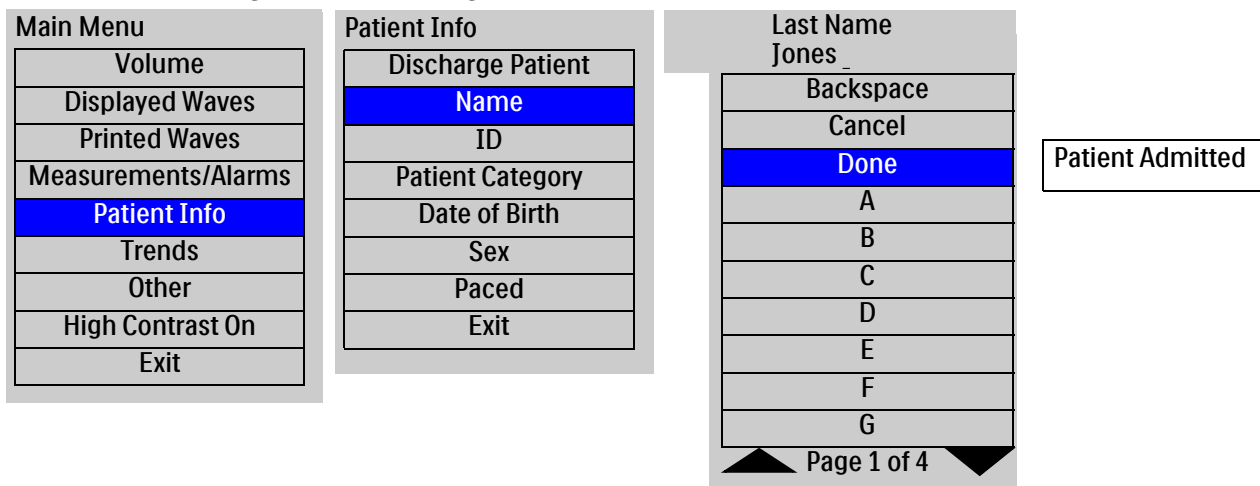
- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select **Patient Info** and press the Menu Select button (See Figure 93).
- 3 Select **Name, ID, Date Of Birth** or **Sex** and press the Menu Select button.
- 4 Enter the appropriate information and press the Menu Select button.
- 5 A **Patient Admitted** momentary message displays on the device when a patient is admitted.

Figure 93 Admitting a Patient



Main Menu	Patient Info	Last Name
Volume	Discharge Patient	Jones
Displayed Waves	Name	Backspace
Printed Waves	ID	Cancel
Measurements/Alarms	Patient Category	Done
Patient Info	Date of Birth	A
Trends	Sex	B
Other	Paced	C
High Contrast On	Exit	D
Exit		E
		F
		G
		Page 1 of 4

Patient Admitted

NOTE When admitting a patient from the HeartStart MRx, if you enter a Patient ID but do not enter a last name, the last name is set to "...". If you enter a first name, date of birth or sex and not a last name or ID, the last name is set to "...", the Patient ID is set to the HeartStart MRx Event ID and the Patient ID is sent to the Information Center. If you enter only a last name, no other patient information fields are affected. Patient ID is left blank. Once admitted, the last name field can not be cleared. If the field is cleared, ("..." in the field is acceptable and not considered cleared), the device will retain the previous last name and display a momentary message **"Last name must not be blank."**

WARNING **Patient Type** and **Paced** status will always have a value, regardless if the patient is admitted or not. If you do not specify settings for these two fields, the HeartStart MRx uses the default settings, which may not be correct for your patient. Changing a patient's type may change algorithms and alarm limits. For internally paced patients, you must set **Paced** to **Yes**. If incorrectly set to **No**, the device may identify a pace pulse as a QRS and not alarm during asystole.

Discharge

Discharge Patient is used to:

- Clear patient information
- Close a patient data record
- Reset patient type, paced status, alarm settings and all other MRx settings to default values
- Discharge a patient from the Information Center, if connected

CAUTION Discharging from the HeartStart MRx clears all data from the Information Center. To save event data at the Information Center, use the Information Center to discharge the patient.

Discharge Patient is an option whether a patient is admitted or not, whether the device is connected to the Information Center or not, or if in Transfer Mode. Discharge Patient is not available in Pacer, Manual Defib, 12-Lead or AED modes. At the Information Center, Discharge Patient - except for the Discharge for Transport function - is not available when the HeartStart MRx is in Pacer, Manual Defib or AED modes.

NOTE You should always perform a discharge, even if your previous patient was not admitted, to clear out patient data and reset all settings at the HeartStart MRx and Information Center.

To access Discharge Patient, perform the following steps:


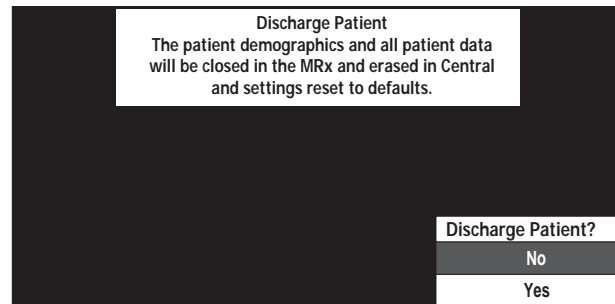
- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select **Patient Info** and press the Menu Select button.
- 3 Select **Discharge Patient** and press the Menu Select button.
- 4 Your screen will display one of two Discharge Patient messages (see Table 33) and prompt you with a **Discharge Patient?** question.

Table 33 Discharge Patient Messages

Network Status	Discharge Patient Message
Connected to network	The patient demographics and all patient data will be closed in the MRx and erased in Central and settings reset to defaults.
Not connected to network	All trends, events and patient identification of the current patient will be closed and settings reset to defaults.

- 5 Select **Yes** to discharge the patient, **No** to cancel discharge. See Figure 94.

Figure 94 Discharge Patient Confirmation



If a patient discharge is confirmed:

- 1 The current patient incident is closed.
- 2 The HeartStart MRx sends the discharge command to the Information Center (if connected) then automatically shuts down and restarts. While shutting down, the display will go black. You can turn the device off at this point. If you do not turn the device off, a Patient Discharged message will appear on the screen until the HeartStart MRx restarts. Upon restart, the patient name is displayed as **“Not Admitted”**. Patient type, paced status, and alarm limits are all reset to default values. Other patient information is cleared.

NOTE Data related to previous patient incidents must be accessed through Data Management. Refer to the HeartStart MRx *Instructions for Use*.

Transfer

The Transfer option is used to transfer the current patient’s data to another location on the IntelliVue Network by moving the patient to the transfer list at the Information Center.

To access Transfer, perform the following steps:


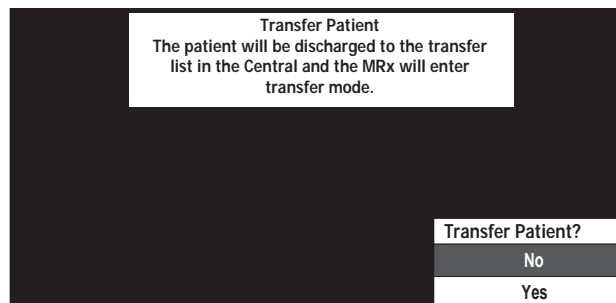
- 1 Confirm that the HeartStart MRx is on the network, not already in Transfer Mode and the patient has been admitted. (The patient’s name or “...” is displayed.)
- 2 Press the Menu Select  button.
- 3 Using the Navigation buttons, select **Patient Info** and press the Menu Select button.
- 4 Select **Transfer** and press the Menu Select button.
- 5 The Transfer Patient message (see Figure 95) prompts you with a **Transfer Patient?** question.

Figure 95 Transfer Patient Confirmation



- 6 Select **Yes** to transfer the patient, **No** to cancel transfer.

When a patient transfer is confirmed, the patient is discharged to the transfer list at the Information Center and the HeartStart MRx enters Transfer Mode. **“Prepared for transfer”** is displayed above the patient name. The HeartStart MRx continues to store data that can be accessed through the Data Management feature.


Transfer Mode

Transfer Mode is used to hand off patient data from one monitoring location to another. While in Transfer Mode patient information can't be modified. The HeartStart MRx continues to send data to the Information Center without an associated patient name. The data is not associated with the patient now on the transfer list. Patient data can be identified by a unique bed label common to both the HeartStart MRx and the specific data sector being monitored at the Information Center.

Re-admit Patient

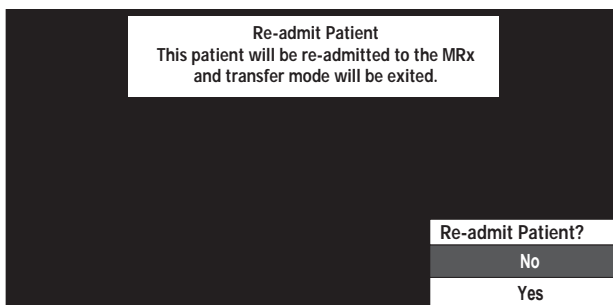
If you need to re-admit a patient, the Re-admit function restores patient data. It moves the patient off the Information Center's transfer list back into the corresponding Information Center sector, when connected to the network.

To select Re-admit perform the following steps:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select **Patient Info** and press the Menu Select button.
- 3 Select **Re-admit** and press the Menu Select button.

When Re-admit is selected, your screen displays the Re-admit Patient message (see Figure 96) and prompts you with a **Re-admit Patient?** question. Select **Yes** to re-admit the patient, **No** to cancel re-admission.


Figure 96 Re-admit Patient Confirmation



Clear Transfer

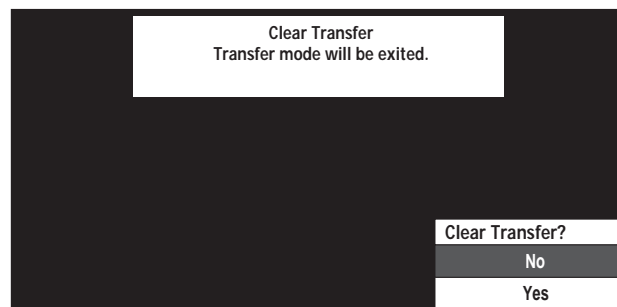
Clear Transfer exits the HeartStart MRx's Transfer Mode after losing connection to the network. Demographic or patient data remain in the Information Center's transfer list and are maintained at the HeartStart MRx.

To select Clear Transfer perform the following steps:

- 1 While in Transfer Mode, press the Menu Select  button.
- 2 Using the Navigation buttons, select **Patient Info** and press the Menu Select button.
- 3 Select **Clear Transfer** and press the Menu Select button.

When Clear Transfer is selected, the message “**Transfer mode will be exited.**” is displayed (see Figure 97). The display prompts you with a **Clear Transfer?** question. Select **Yes** to clear transfer, **No** to remain in transfer mode.

Figure 97 Clear Transfer Confirmation



Automatic Re-Admit

If a lost network connection between the HeartStart MRx and Information Center is restored while in Transfer Mode, the patient is automatically re-admitted from the transfer list. The HeartStart MRx exits Transfer Mode.

Turning the HeartStart MRx Off

When the HeartStart MRx is turned off or enters a non-clinical mode (i.e. Data Management, Operational Check, Battery Calibration, Configuration or Service modes) while in Transfer Mode the current patient incident is closed and the HeartStart MRx exits Transfer Mode. The patient remains on the Information Center's transfer list. When the HeartStart MRx is turned back on or you re-enter a clinical mode, patient information is reset to device defaults and the patient state is **Not Admitted**.

Sharing Information on the Network

Once connected to the IntelliVue Network, the HeartStart MRx shares information and data with the Information Center. You can also silence and reset most alarms remotely from the Information Center.

Patient Information


Updates

After the HeartStart MRx makes a network connection with the Information Center, all patient information (except height, weight, screen notes and care group which are not available on the HeartStart MRx) entered at one location is automatically reflected at the other.

Date Of Birth

The HeartStart MRx with IntelliVue Networking Option allows you to enter a patient's date of birth. Without the IntelliVue Option, you enter the patient's age. The valid range for date of birth is the current date to 150 years ago.

The patient's date of birth is unpopulated until entered. To enter the date of birth for a patient, perform the following:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select **Patient Info** and press the Menu Select button.
- 3 Select **Date Of Birth** and press the Menu Select button.
 - If the patient type is adult, the default menu option will be the current month and day, 50 years ago.
 - If the patient type is pediatric, the default menu option will be the current month and day, 7 years ago.
- 4 Using the Navigation buttons enter the date of birth and press the Menu Select button.

The date of birth will automatically be converted to an age for 12-Lead reports. Only the age will be displayed in the 12-Lead screen, printed on and stored with 12-Lead reports.

NOTE The HeartStart MRx supports adult and pediatric patient categories only. If the Information Center sends a neonatal patient type to the HeartStart MRx (this possibility exists only if a neonatal patient is admitted by a networked patient monitor which allows a neonatal status and then the monitor is replaced on the network by the HeartStart MRx), the HeartStart MRx modifies the setting to pediatric and sends it back to the Information Center.

Date and Time

In instances where the HeartStart MRx's date and time are not in agreement with the Information Center, the HeartStart MRx automatically synchronizes its date and time to match the Information Center's. The date and time displayed in the HeartStart MRx's status area reflect the new time.

When a time change occurs:

- Event Summary Report start times are adjusted and a “?” is placed in front to indicate the time change.
- The date and time printed in the waveform header prior to the time change are updated based on the new time and a “?” placed in front.
- Timestamps related to events prior to the time change are updated based on the new time and a “?” placed in front.
- When a time change occurs while you are printing a Trends Report, the printing stops because the printed time frame no longer matches the displayed timeframe.
- In the Trends Display and printed Trends reports, the interval times prior to and including a time change event and NBP timestamps will be updated based on the new time and a “?” placed in front.
- While a strip is printing, the change is reflected in the next header.
- For 12-Lead reports:
 - If you do not have any 12-Lead reports saved for the current incident, the next 12-Lead report is updated with the new date and time.
 - If you have one or more 12-Lead reports saved for the current incident, the date and time for new 12-Lead reports during the same incident are not updated to reflect the time change. The new reports retains the same time sequence as the saved 12-Lead reports to preserve the report order.
- Timestamps for the last invasive pressure zero and calibration along with a displayed NBP measurement occurring prior to a date/time change are not updated on your display. However, both are updated in the Event Summary. All timestamps of non-clinical events (events that occur outside of a patient incident such as NBP and CO₂ calibration, Operational Check, and Automated Tests) indicate the HeartStart MRx's time when the event occurred.

Apnea time is based on elapsed time and is not affected by a time change.

Conflict Handling

Conflicting patient information between the Information Center and the HeartStart MRx is automatically resolved (using the Information Center's "Same Patient" Conflict Resolution) when the HeartStart MRx associates with the Information Center.

If patient information on the HeartStart MRx has changed as a result of the resolution, the message **"Patient information from the MRx and Central has been merged"** and a menu to confirm or edit patient info appear in all modes, except AED (see Figure 98). When in AED Mode, only the **"Patient information from the MRx and Central has been merged."** message appears on the display for 10 seconds.

Figure 98 Patient Information

Patient information from the MRx and the Central has been merged	
Last Name:	Jones
First Name:	Samuel
ID:	1234567890123456
Patient Category:	Adult
DOB:	25 Jan 1977
Sex:	Male
Paced:	No
<div>Confirm</div> <div>Edit Patient Info</div>	

Press the Menu Select  button to confirm the information.

If you wish to edit the information, use the Navigation buttons to highlight **Edit Patient Info** and press the Menu Select button. The **Edit Patient Info** menu is displayed. See Figure 99.

Figure 99 Edit Patient Info

Edit Patient Info	
Name	
ID	
Patient Category	
Date of Birth	
Sex	
Paced	

Any selection from the **Edit Patient Info** menu brings up a screen for modifying the selection. After modifying the information and closing the screen, the Patient Information merged menu will reappear with the new patient information included. The Information Center is also updated with the modified information.

NOTE The **Patient Merged** and **Edit Patient Info** menus are removed from the screen when you change displayed views.

Viewing Patient Incident Data

While at the Information Center, you can view patient incident data sent from the HeartStart MRx. Refer to the IntelliVue Clinical Information Center *Instructions for Use* for details. Up to 30 single-valued and/or triple-valued parameters, up to four waveforms (except for Q-CPR) and seven alarms are viewable at the Information Center. The waveforms that appear at the Information Center are determined by the Information Center's wave wishlist.

Alarms

If configured, you can silence/reset HeartStart MRx alarms and INOPs from the Information Center. Refer to the IntelliVue Information Center *Instructions for Use* for details. As they do on the HeartStart MRx, alarms will re-sound after two minutes if the condition is not cleared.

NOTE **Pacing Stopped, Batteries Low** and **Defib Shutdown** alarms result in Red INOPs that can't be silenced at the Information Center. **Pacer Output Low** alarm results in a Yellow INOP that can't be silenced at the Information Center. All four alarms must be silenced at the HeartStart MRx.

Printing

When the HeartStart MRx prints data and information, it prints to the 50 mm or 75 mm printer installed in the device, not a printer located on the institution's network. Alarm recordings are configured at the HeartStart MRx and sent to the Information Center central recorder (if present). Once alarm recordings are configured at the HeartStart MRx they can be controlled at the Information Center from the Record/Store tab under All Controls. Vital Signs Trending Reports generated by the HeartStart MRx can only be printed at the device.

Turning a Networked Device Off

If a networked HeartStart MRx is turned off, wave and alarm data may be displayed at the Information Center for 10 more seconds. After 10 seconds, a **No data from bed** INOP statement appears on the Information Center display. The current patient incident is closed at the HeartStart MRx. The patient is not discharged from the Information Center.

If the HeartStart MRx is turned back on, the ADT state is initially set to **Not Admitted**. Patient type, paced status and alarm limits are reset to their default settings. If the patient is still admitted at the Information Center, the HeartStart MRx is updated with patient information from the Information Center. The ADT state is reset to "admitted."

In the event the HeartStart MRx loses its network connection with the Information Center, and both devices are still powered on, the devices retain the patient's status and other settings when a network connection is restored.

NOTE Prior to monitoring a new patient with the HeartStart MRx, you should discharge the old patient to ensure that all old data at the Information Center are removed.

Leaving a Clinical Mode

If a networked HeartStart MRx is changed to a non-clinical mode (i.e. Data Management, Operational Check, Battery Calibration, Configuration or Service modes) a “**No data from bed**” INOP statement appears on the Information Center display. The current patient incident is closed at the HeartStart MRx. The patient will not be discharged from the Information Center. If you re-enter a clinical mode, the ADT state is initially set to **Not Admitted** and patient type (category), paced status and alarm limits are reset to their default settings. If the patient is still admitted at the Information Center, the HeartStart MRx is updated with patient information from the Information Center. The ADT state is reset to “admitted.”

Events Logged

The HeartStart MRx automatically creates an Event Summary for each patient incident. Each Event Summary is assigned a unique event identification number and is date/time stamped.

Table 34 lists IntelliVue Networking-related events and information stored in the Event Summary. Refer to the "Working with Data" chapter of the HeartStart MRx *Instructions for Use* for a complete listing of all events stored.

Table 34 IntelliVue Networking Events Logged

Logged Event	Frequency
Audio Paused by Central	Logged when alerts are silenced/reset from the Information Center.
Time changed from (with original device time)	Logged when the HeartStart MRx time and date are synchronized to the Information Center time.
Date of Birth (day, month, year)	Logged when the Date of Birth is set or changed.
Central Monitoring Active	Logged when the HeartStart MRx associates with the Information Center.
Patient Discharged	Logged when the patient is discharged.
No Central Monitoring*	Logged when event occurs depending upon configuration - "Central Monitoring Mandatory"
Radio Malfunction*	Logged when event occurs. (INOP detected)
Radio Unplugged*	Logged when event occurs. (INOP detected)
Radio Weak Signal*	Logged when event occurs. (INOP detected)
All ECG Alarms Off*	Logged when event occurs. (INOP detected)

* See Table 99 for causes and possible solutions to these logged events.

INOPs, Alarms and Messages at the Information Center

Most HeartStart MRx alarms, INOPs and messages display at the Information Center in their entirety or in an abbreviated form. Table 35 lists alarms, INOPs and messages that appear differently at the Information Center. Refer to "Troubleshooting" on page 297 for a full list of alarms, INOPs and messages.

Table 35 HeartStart MRx Messages at the Information Center

HeartStart MRx		Information Center	
Defibrillation/Pacing			
	Alarm/INOP Type		Alarm/INOP Type
Charge Button Failure	Hard INOP	Defib Malf	Hard INOP
Shock Button Failure	Hard INOP	Defib Malf	Hard INOP
Shock Equip Malfunction	Hard INOP	Defib Malf	Hard INOP
Pacer Equip Malfunction	Hard INOP	Defib Malf	Hard INOP
Therapy Knob Failure	Hard INOP	Defib Malf	Hard INOP
Therapy Cable Failure	Hard INOP	Defib Malf	Hard INOP
Pacing Stopped. Pads Off.	Red Alarm	!!! Pacing Stopped	Red INOP
Pacing Stopped. Device Error.	Red Alarm	!!! Pacing Stopped	Red INOP
Pacing Stopped. Pads Cable Off.	Red Alarm	!!! Pacing Stopped	Red INOP
Pacing Stopped. Leads Off.	Red Alarm	!!! Pacing Stopped	Red INOP
Pacing Stopped. Power Interrupted.	Red Alarm	!!! Pacing Stopped	Red INOP
Other INOPs			
Batteries Low	Hard INOP	Batteries Low	Hard INOP
Batteries Low (while Pacing on batteries)	Red Alarm	!!! Batteries Low	Red INOP
Bluetooth Malfunction	Hard INOP	Check Device	Hard INOP
Event Storage Full	Soft INOP	Check Device	Soft INOP
Fan Failure	Hard INOP	Check Device	Hard INOP
Internal Memory Failure	Hard INOP	Check Device	Hard INOP
Radio Malfunction	Hard INOP	Check Device	Hard INOP
Radio Unplugged	Hard INOP	Check Device	Hard INOP
Power Supply Failure	Hard INOP	Defib Malf	Hard INOP
Replace Clock Battery	Hard INOP	Check Device	Hard INOP
Printer INOPs			
Incompatible Printer	Hard INOP	Check Device	Hard INOP
Check Printer	Hard INOP	Check Device	Hard INOP
Printer Temperature High	Hard INOP	Check Device	Hard INOP
Printer Malfunction	Hard INOP	Check Device	Hard INOP
Printer Not Ready	Soft INOP	None	NA
Other HeartStart MRx Messages			
Pacing on Batteries	Message only	Pace on Batteries	Soft INOP
Shutting Down 1 Min	Message only	!!! Defib Shutdown	Red INOP
Shutting Down Now	Message only	!!! Defib Shutdown	Red INOP
Power Interrupted. All settings have been reset to default values.	Message only	Check Settings	Hard INOP
Device Restarted. All settings have been reset to default values.	Message only	Check Settings	Hard INOP

Troubleshooting

If your HeartStart MRx does not operate as expected while trying to communicate with the IntelliVue Network, see “” on page 314 and “Network Connection Rejection Messages” on page 317.

Configuration


This chapter describes the configurable parameters of the HeartStart MRx and the procedures for modifying configuration.

Overview

Configuration settings allow you to customize the HeartStart MRx to best meet your needs. Configuration is performed through the Configuration menu of the device and may be saved to a data card for replication on multiple devices. At any time, configuration settings may be viewed and exported to a data card, and the date and time may be changed. However, a password is required to change the configuration of the device.

Accessing the Configuration Menu

To access the Configuration Main menu:

- 1 Turn the Therapy Knob to **Monitor**.
- 2 Press the Menu Select  button.
- 3 Using the Navigation buttons, select **Other** and press the Menu Select button.
- 4 Using the Navigation buttons, select **Configuration** and press the Menu Select button.


To return to normal operating mode, press the **[Exit Config]** soft key.

The Configuration Main menu is displayed, listing sub-menus for each category of configurable parameters. You may use this menu to view or print your device's configuration, as well as to modify the date and time settings. To modify any other settings, you must enter the configuration password printed on the front of the *HeartStart MRx User Documentation* CD-ROM.

WARNING The HeartStart MRx should never be connected to a patient while performing configuration activities.

Setting the Date and Time


To modify the date and time setting from the Configuration menu:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select **Date and Time**. Then press the Menu Select button.
- 3 Using the Navigation buttons, adjust the value for the year. Then press the Menu Select button.
- 4 Select the appropriate month. Then press the Menu Select button.
- 5 Adjust the value for the day. Then press the Menu Select button.
- 6 Adjust the value for the hour. Then press the Menu Select button.
If the device is configured to use a 12-hour clock format, **am** or **pm** is displayed next to the hour.
For a 24-hour format only the hour is shown, with choices from 0 to 23.
- 7 Press the **[Exit Config]** soft key if finished with configuration.

Date and time should be changed to correspond with local clock changes for Daylight Savings Time and Summer Time.

Modifying Settings

When modifying configuration settings, the device should be connected to external power and have a battery with at least 20% capacity installed. To modify configuration settings, from the Configuration Main menu:

- 1 Press the **[Change Config]** soft key.
- 2 When prompted, enter the configuration password.
- 3 Press the Menu Select  button. Use the Navigation buttons to select the sub-menu for the category of parameters to be changed. Then press the Menu Select button.
- 4 Use the **[Prev Item]** and **[Next Item]** soft keys to select a parameter.
- 5 Use the Navigation buttons to highlight the desired choices. Press the Menu Select button to select the highlighted choice.
- 6 Repeat steps 3, 4 and 5 to select another sub-menu and modify additional settings.
- 7 Once the desired setting changes have been made, from the Configuration Main screen, press the **[Save Changes]** soft key.
You may press the **[Cancel Changes]** soft key to return to the previous settings.
- 8 Press the **[Exit Config]** soft key to return to normal operating mode.
If you press **[Exit Config]** before saving the changes, you are prompted with the message **Configuration Not Saved - Exit Anyway?** Select **No** and press the Menu Select button. Then press the **[Save Changes]** soft key.

NOTE This chapter lists configuration parameters for all HeartStart MRx options. Your specific device may not have all options installed or data specific to an option programed in, therefore all related configuration parameters are not available for modification.

Saving Configuration Settings to a Data Card

To save configuration settings to a data card:

- 1 Make sure a data card is in the HeartStart MRx.
- 2 Press the **[Export]** soft key.

The HeartStart MRx copies the configuration settings to the data card.

Loading Configuration Settings from a Data Card

To load configuration settings from a data card:

- 1 Insert the data card with the saved configuration in the HeartStart MRx.
- 2 Press the Change Config soft key and enter the configuration password.
- 3 Press the Import soft key.
- 4 Make any device specific configuration changes, such as 12-Lead location code.
- 5 Press the **[Save Changes]** soft key.

Restoring the Default Settings

To return to using the configuration settings initially entered during manufacture:

- 1 Press the **[Change Config]** soft key.
- 2 Enter the Configuration password.
- 3 Press the **[Factory Defaults]** soft key.
- 4 Press the **[Save Changes]** soft key.

Printing Configuration Settings

To print the configuration settings, select **Print Configuration** from the Configuration Main menu and press the Menu Select button. The configuration report is printed on the printer.

NOTE Upon exiting Configuration and returning to a clinical mode (Monitor, Pacer, Manual Defib or AED), all settings will be reset to the device's configured values.

Configurable Parameters

The following tables list configurable parameters for each of the sub-menus on the Configuration Main menu. A description of each parameter is provided, along with the possible choices for settings. Default settings are in **bold** type.

Table 36 General Settings

Parameter	Description	Setting Choices
Institution Name	Enters your organization's name in the 12-Lead ECG Report. (If you are sending data to the TraceMasterVue database then this field must match a valid entry in the TraceMasterVue database.)	32 characters, blank
Voice Volume	Voice prompt volume level.	Very Soft, Soft, Medium , Loud, Very Loud
Alarm Volume	Audible alarm volume level.	Very Soft, Soft, Medium , Loud, Very Loud
Minimum Alarm Volume	Minimum audible alarm level available during use.	Very Soft, Soft , Medium, Loud, Very Loud
QRS Volume	Volume of audible beep with each QRS complex detected.	Off, Very Soft, Soft, Medium , Loud, Very Loud
Time Format	Selects time format to display.	12-hour, 24-hour
Pacing on Batteries Warning	Displays the warning message Pacing on Batteries if pacing using only battery power.	Yes, No
Unit Display	Defines if parameter values are displayed with or without corresponding measurement units.	On , Off
Patient Category	Selects the default patient category.	Adult , Pedi
Device Owner	Identification for Return to Owner feature.	20 characters
Return to Owner Password	Password required in order to deactivate the loan period setting.	4 characters
Audio Recording	Turns audio recording on or off.	On , Off

NOTE The Return to Owner Password should be documented in a secure manner. Should it need to be reset, all configuration settings must be reset to factory default values, and the device must then be re-configured.

NOTE Do not set alarm volumes so low that you can't hear them in loud environments.

Table 37 Heart Rate and ECG Settings

Parameter	Description	Setting Choices
Auto Gain	Determines whether ECG size is automatically adjusted to the standard maximum wave size without clipping the wave sector. If auto-gain is off, the gain is set to 1 (10mm/mV).	On, Off
AC Line Filter	Selects the setting used to filter out AC line noise. Adjust this setting to the power frequency of your country.	60 Hz, 50 Hz
ECG Bandwidth for Display	Selects the display filter frequency for the attached therapy cable or 3-/5-lead ECG cable. (This setting does not affect 12-Lead View.)	.15-40 Hz Monitor, 1-30 Hz EMS
ECG Bandwidth for Printer	Selects the printer filter frequency for the attached therapy cable or 3-/5-lead ECG cable. (This setting does not affect 12-Lead Reports.) If Diagnostic is selected, pads ECG is set to Monitor.	0.05-150 Hz Diagnostic, .15-40 Hz Monitor, 1-30 Hz EMS
ECG Electrode Labels	Selects electrode label format. AAMI: RA, LA, LL, RL, V. IEC: R, L, F, N, C.	AAMI, IEC
HR/Pulse High Limit	Selects the default High Alarm Limit for the HR derived from the ECG and the pulse derived from SpO ₂ or Invasive Pressures.	Adult: 35-200, 120 , (bpm) Pediatric: 35-240, 160 adjusted in increments of 5
HR/Pulse Low Limit	Selects default Low Alarm Limit for the HR derived from the ECG and the pulse derived from SpO ₂ or Invasive Pressures.	Adult: 30-195, 50 (bpm) Pediatric: 30- 235, 80 adjusted in increments of 5
VTACH	Detection of ventricular tachycardia based on heart rate limit and PVC run limit.	Heart Rate Limit: Adult: 95-150, 100 (bpm) Pediatric: 95-150, 120 adjusted in increments of 5 PVC run limit: Adult: 3-20, 5 Pediatric: 3-20, 5 adjusted in increments of 1
Color	Selects the HR/ECG color.	Red, Yellow, Blue, Green , Cyan, Magenta, White (Note: Red and blue text and numerics are not visible in high contrast mode.)

Table 38 Invasive Pressure Settings - Default Labels

Parameter	Description	Values / Default
Unit and Default Labels	Selects measurement units for all invasive pressures	mmHg, kPa
Press 1 Label	Selects default label for pressure channel 1	P1, ABP, ART, Ao, CVP, ICP, LAP, PAP, RAP
Press 2 Label	Selects default label for pressure channel 2	P2, ABP, ART, Ao, CVP, ICP, LAP, PAP, RAP,

Table 39 Invasive Pressure Settings - P1

Parameter	Description	Value/Defaults
Alarm Source	Selects the type of alarm source.	Systolic, Diastolic, Mean
Systolic High Limit	Selects the systolic high limit value.	Adult: -35 - 360, 160 (mmHg) Ped: -35 - 360, 120 Adjusted in increments of 5 mmHg or 1 kPa
Systolic Low Limit	Selects the systolic low limit value.	Adult: -40 - 355, 90 (mmHg) Ped: -40 - 355, 70 Adjusted in increments of 5 mmHg or 1 kPa
Diastolic High Limit	Selects the diastolic high limit value.	Adult: -35 - 360, 90 (mmHg) Ped: -35 - 360, 70 Adjusted in increments of 5 mmHg or 1 kPa
Diastolic Low Limit	Selects the diastolic low limit value.	Adult: -40 - 355, 50 (mmHg) Ped: -40 - 355, 40 Adjusted in increments of 5 mmHg or 1 kPa
Mean High Limit	Selects the mean high limit value.	Adult: -35 - 360, 110 (mmHg) Ped: -35 - 360, 90 Adjusted in increments of 5 mmHg or 1 kPa
Mean Low Limit	Selects the mean low limit value.	Adult: -40 - 355, 70 (mmHg) Ped: -40 - 355, 50 Adjusted in increments of 5 mmHg or 1 kPa
Scale	Selects the default wave form scale.	Adult: 300, 240, 180, 150 , 120, 110, 100, 90, 80, 70, 60, 50, 40, 30, 20, 10, -5, -10, -15, -20 Pedi: 300, 240, 180, 150, 120, 110, 100 , 90, 80, 70, 60, 50, 40, 30, 20, 10, -5, -10, -15, -20
Artifact Suppression	Specifies the duration for suppressing pressure alarms due to non-physiological artifacts. An INOP is displayed.	30 sec., 60 sec. , 90 sec., Off
Filter	Selects the filter setting.	12 Hz , 40 Hz
Color	Selects the P1 color.	Red, Yellow, Blue, Green, Cyan, Magenta, White. (Note: The High Contrast feature does not display the colors red or blue, therefore, be sure your device is configured correctly with appropriate parameter color settings.)

Table 40 Invasive Pressure Settings - P2

All setting options are exactly the same as P1 in Table 39 except for:

Parameter	Description	Value/Defaults
Color	Selects the P2 color.	Red, Yellow , Blue, Green, Cyan, Magenta, White

Table 41 Invasive Pressure Settings - ABP, ART, Ao

All setting options are exactly the same as P1 in Table 39

Table 42 Invasive Pressure Settings - CVP, RAP, LAP

Parameter	Description	Values / Default
Alarm Source		Source is always Mean and not configurable.
High Limit	Selects the high limit value.	Adult: -39 - 360, 10 (mmHg) Ped: -39 - 360, 4 Adjusted in increments of 1 mmHg or 0.1 kPa
Low Limit	Selects the low limit value.	Adult: -40 - 359, 0 (mmHg) Ped: -40 - 359, 0 Adjusted in increments of 1 mmHg or 0.1 kPa
Scale	Selects the default waveform scale	Adult: 300, 240, 180, 150, 120, 110, 100, 90, 80, 70, 60, 50, 40, 30, 20 , 10, -5, -10, -15, -20 Ped: 300, 240, 180, 150, 120, 110, 100, 90, 80, 70, 60, 50, 40, 30, 20 , 10, -5, -10, -15, -20
Artifact Suppression	Selects the default artifact suppression timeframe.	30 sec., 60 sec. , 90 sec., Off
Filter	Selects the filter setting.	12 Hz , 40 Hz
Color	Selects the parameter color.	Red, Yellow, Blue, Green, Cyan , Magenta, White

Table 43 Invasive Pressure Settings - PAP

Parameter	Description	Values / Default
Alarm Source	Selects the type of alarm source.	Systolic, Diastolic, Mean
Systolic High Limit	Selects the systolic high limit value.	Adult: -39 - 360, 35 (mmHg) Ped: -39 - 360, 60 Adjusted in increments of 1 mmHg or 0.1 kPa
Systolic Low Limit	Selects the systolic low limit value.	Adult: -40 - 359, 10 (mmHg) Ped: -40 - 359, 24 Adjusted in increments of 1 mmHg or 0.1 kPa
Diastolic High Limit	Selects the diastolic high limit value.	Adult: -39 - 360, 16 (mmHg) Ped: -39 - 360, 4 Adjusted in increments of 1 mmHg or 0.1 kPa
Diastolic Low Limit	Selects the diastolic low limit value.	Adult: -40 - 359, 0 (mmHg) Ped: -40 - 359, -4 Adjusted in increments of 1 mmHg or 0.1 kPa
Mean High Limit	Selects the mean high limit value.	Adult: -39 - 360, 20 (mmHg) Ped: -39 - 360, 26 Adjusted in increments of 1 mmHg or 0.1 kPa
Mean Low Limit	Selects the mean low limit value.	Adult: -40 - 359, 0 (mmHg) Ped: -40 - 359, 12 Adjusted in increments of 1 mmHg or 0.1 kPa
Scale	Default waveform scale	Adult: 300, 240, 180, 150, 120, 110, 100, 90, 80, 70, 60, 50, 40, 30, 20 , 10, -5, -10, -15, -20 Ped: 300, 240, 180, 150, 120, 110, 100, 90, 80, 70, 60, 50, 40, 30, 20 , 10, -5, -10, -15, -20
Artifact Suppression	Selects the default artifact suppression timeframe.	30 sec., 60 sec. , 90 sec., Off
Filter	Selects the filter setting.	12 Hz , 40 Hz
Color	Selects the parameter color.	Red, Yellow , Blue, Green, Cyan, Magenta, White

Table 44 Invasive Pressure Settings - ICP

Parameter	Description	Values / Default
Alarm Source		Source is always Mean and not configurable.
High Limit	Selects the high limit value.	Adult: -39 - 360, 10 (mmHg) Ped: -39 - 360, 4 Adjusted in increments of 1 mmHg or 0.1 kPa
Low Limit	Selects the low limit value.	Adult: -40 - 359, 0 (mmHg) Ped: -40 - 359, 0 Adjusted in increments of 1 mmHg or 0.1 kPa
Scale	Selects the default waveform scale	Adult: 300, 240, 180, 150, 120, 110, 100, 90, 80, 70, 60, 50, 40, 30, 20 , 10, -5, -10, -15, -20 Ped: 300, 240, 180, 150, 120, 110, 100, 90, 80, 70, 60, 50, 40, 30, 20 , 10, -5, -10, -15, -20
Artifact Suppression	Selects the default artifact suppression timeframe.	30 sec., 60 sec. , 90 sec., Off
Filter	Selects the filter setting.	12 Hz , 40 Hz
Color	Selects the parameter color. (Also applies to CPP)	Red, Yellow, Blue, Green, Cyan, Magenta , White

Table 45 Invasive Pressure Settings - CPP

Parameter	Description	Values / Default
Alarm Source		Source is always Mean and not configurable.
High Limit	Selects the high limit value.	Adult: -35 - 360, 130 (mmHg) Ped: -35 - 360, 100 Adjusted in increments of 5 mmHg or 1 kPa
Low Limit	Selects the low limit value.	Adult: -40 - 355, 50 (mmHg) Ped: -40 - 355, 40 Adjusted in increments of 5 mmHg or 1 kPa

Table 46 Noninvasive Blood Pressure Settings

Parameter	Description	Setting Choices
NBP Schedule	Selects the schedule for NBP measurements, manual, or automatic at the selected frequency.	Manual , q1, q2.5, q5, q10, q15, q30, q60, q120
NBP Alarm Source	Selects the alarm source.	Systolic , Diastolic, Mean
Unit	Selects the measurement units.	mmHg , kPa
Systolic High Limit	Selects the high limit alarm value used when systolic is the selected alarm source.	Adult: 35-270, 160 (mmHg) Pediatric: 35-180, 120 adjusted in increments of 5 mmHg or 1 kPa
Systolic Low Limit	Selects the low limit alarm value when systolic is the selected alarm source.	Adult: 30-265, 90 (mmHg) Pediatric: 30-175, 70 adjusted in increments of 5 mmHg or 1 kPa
Diastolic High Limit	Selects the high limit alarm value when diastolic is the selected alarm source.	Adult: 15-245, 90 (mmHg) Pediatric: 15-150, 70 adjusted in increments of 5 mmHg or 1 kPa
Diastolic Low Limit	Selects the low limit alarm value when diastolic is the selected alarm source.	Adult: 10-240, 50 (mmHg) Pediatric: 10-145, 40 adjusted in increments of 5 mmHg or 1 kPa
Mean High Limit	Selects the high limit alarm value when mean is the selected alarm source.	Adult: 25-255, 110 (mmHg) Pediatric: 25-160, 90 adjusted in increments of 5 mmHg or 1 kPa
Mean Low Limit	Selects the low limit alarm value when mean is the selected alarm source.	Adult: 20-250, 60 (mmHg) Pediatric: 20-155, 50 adjusted in increments of 5 mmHg or 1 kPa
Color	Selects the NBP color.	Red, Yellow, Blue, Green, Cyan, Magenta, White

Table 47 End-Tidal Carbon Dioxide Settings

Parameter	Description	Setting Choices
Unit	Selects the unit of measure	mmHg, kPa
EtCO ₂ High Limit	Selects the high limit alarm value.	Adult: 20-95, 50 (mmHg) Pediatric: 20-95, 50 adjusted in increments of 1mmHg or 0.1 kPa
EtCO ₂ Low Limit	Selects the low limit alarm value.	Adult: 10-94, 30 (mmHg) Pediatric: 10-94, 30 adjusted in increments of 1mmHg or 0.1 kPa
AwRR High Limit	Selects the high limit alarm value.	Adult: 10-100, 30 (rpm) Pediatric: 10-100, 60 adjusted in increments of 1
AwRR Low Limit	Selects the low limit alarm value.	Adult: 0-99, 8 (rpm) Pediatric: 0-99, 12 adjusted in increments of 1
Apnea Time	Length of time without respiration required to trigger an apnea alarm.	Adult: 10-40, 20 (seconds) Pediatric: 10-40, 20 adjusted in increments of 5
Color	Selects the EtCO ₂ and AwRR color.	Red, Yellow , Blue, Green, Cyan, Magenta, White

Table 48 SpO₂ Settings

Parameter	Description	Setting Choices
SpO ₂ High Limit	Selects high limit alarm value.	Adult: 51-100, 100 (%) Pediatric: 51-100, 100 adjusted in increments of 1
SpO ₂ Low Limit	Selects low limit alarm value.	Adult: 50-99, 90 (%) Pediatric: 50-99, 90 adjusted in increments of 1
SpO ₂ Desat Limit	Selects extreme low limit alarm value.	Adult: 50-low limit, 80 (%) Pediatric: 30-low limit, 80 adjusted in increments of 1
Color	Selects the SpO ₂ color.	Red, Yellow, Blue, Green, Cyan , Magenta, White

Table 49 Pulse Settings

Parameter	Description	Values / Default
Pulse Source	Sets default pulse source	SpO ₂ , Press 1: label, Press 2: label Default: SpO ₂ if device has SpO ₂ option, otherwise Press 1

NOTE Pulse is only included in the Configuration menu if your device has the Invasive Pressures option.

Table 50 Temperature Settings

Parameter	Description	Values / Default
Unit	Selects measurement units	°C, °F
Label	Selects the default temperature label	Temp, Tskin, Trect, Tnaso, Tesoph, Tart, Tven, Tvesic, Tcore
High Limit	Selects the high limit value.	Adult: 0.1 to 45.0, 39.0 °C (32.2 to 113 °F) Ped: 0.1 to 45.0, 39.0 °C Adjusted in increments of 0.1 °C or 0.2 °F
Low Limit	Selects the low limit value.	Adult: 0.0 to 44.9, 36.0 °C (32.0 to 112.8 °F) Ped: 0.0 to 44.9, 36.0 °C Adjusted in increments of 0.1 °C or 0.2 °F
Color	Selects the temperature color.	Red, Yellow, Blue, Green , Cyan, Magenta, White

Table 51 Wave Sector Settings

Parameter	Description	Setting Choices
Wave 1	Selects the waveform displayed in Wave Sector 1.	Pads, I, II, III, aVR, aVL, aVF, V
Wave 2	Selects the waveform displayed in Wave Sector 2.	Pads, I, II, III, aVR, aVL, aVF, V, CO ₂ , Pleth, Press 1, Press 2, Cascade, Annotated ECG, None Default: Press 1 if you have the Invasive Pressures option, Cascade otherwise.
Wave 3	Selects the waveform displayed in Wave Sector 3.	Pads, I, II, III, aVR, aVL, aVF, V, CO ₂ , Pleth, Press 1, Press 2, None Default: Press 2 if you have the Invasive Pressures option, Pleth if you have SpO ₂ , none otherwise.
Wave 4	Selects the waveform displayed in Wave Sector 4.	Pads, I, II, III, aVR, aVL, aVF, V, CO ₂ , Pleth, Press 1, Press 2, Cascade, None Default: CO ₂ if you have the CO ₂ option, none otherwise.

Table 52 Alarm Settings

Parameter	Description	Setting Choices
Alarm Tone	Selects either traditional Philips or IEC Standard alarm tones.	Philips, IEC
Alarm Pause Time	Selects the interval of time during which alarms are paused, after the Alarm Pause button is pressed.	1, 2, 3, 5, 10, indefinite (minutes)

Table 53 12-Lead Settings

Parameter	Description	Setting Choices
Institution Name	Enters your organization's name in the 12-Lead ECG Report. (If you are sending data to the TraceMasterVue database then this field must match a valid entry in the TraceMasterVue database.)	32 characters, blank
Facility ID	Enters the Facility ID in the 12-Lead ECG Report.	5 alpha-numeric characters, blank
Department ID	Enters the Department ID in the 12-Lead ECG Report.	10 alpha-numeric characters, blank
Device ID	Enters a device identification number.	4 digits
Analysis	<p>Defines the analysis information included on the 12-Lead Report.</p> <ul style="list-style-type: none"> • None prints waveforms, Event/patient ID, date and time. • Measurements Only adds HR, interval and axis measurements Standard adds severity, interpretive statements and reasons. • Standard prints waveform, ID, basic measurements and standard diagnostic statements. • Auto ACI-TIPI runs the ACI-TIPI analysis if there is no Acute MI Critical Value statement and the ECG severity is not Normal. • ACI-TIPI prints the standard report followed by computer generated diagnostic statements using ACT-TIPI criteria. • ACI-TIPI & TPI uses the ACI-TIPI report followed by TPI inputs, computer generated diagnostic statements using TPI criteria and the user-selected Thrombolytic Therapy Contraindications. 	None, Measurements Only, Standard , Auto ACI-TIPI, ACI-TIPI, ACI-TIPI and TPI
Critical Values Statements	Enables or disables the printing and exporting of Critical Value Statements.	Yes , No
ACI Threshold	Set the threshold above which the predicted probability of Acute Cardiac Ischemia is highlighted on the 12-Lead Report screen.	0-100 percent, 75%
Patient Weight Units	To set the units of weight measurement for TPI analysis. Weight is only used for TPI analysis	lbs. , kg.
ECG Bandwidth for 12-Lead Display	Defines the default ECG bandwidth for the 12-Lead preview display.	.15-40 Hz, .05-40 Hz , .05-150 Hz
ECG Bandwidth for 12-Lead Report	Defines the default ECG bandwidth for printed and stored 12-Lead Reports.	Same as Display , .05-150 Hz

Parameter	Description	Setting Choices
ECG Report	<p>Specifies how the 12-lead ECG segments are displayed for the 12-Lead Report. The segments are displayed in three rows, four columns for each row.</p> <ul style="list-style-type: none"> Sequential reports: Each column represents a sequential 2.5-second period of time for a total of 10 seconds. Simultaneous reports: Each column represents the same 2.5 seconds of time. 	Sequential, Simultaneous
Number of Automatic Printouts	Selects the number of 12-Lead ECG Reports printed at the completion of analysis.	0, 1, 2
Printer Format	Selects the number of rhythm strips to be printed with the 12-Lead Report, 0, 1, or 3.	3x4, 3x4 1R, 3x4 3R
Rhythm Strip #1	Selects the first rhythm strip printed in the 3x4 1R or 3x4 3R format.	I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6
Rhythm Strip #2	Selects the second rhythm strip printed for reports in the 3x4 3R format.	I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6
Rhythm Strip #3	Selects the third rhythm strip printed for reports in the 3x4 3R format.	I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6
12-Lead Export Format	Indicates which version of the 12-Lead XML schema the 12-Lead Reports are to conform to.	1.03, 1.04

NOTE If the same configuration file is used to configure multiple devices, be sure to assign a unique device ID number to each device.

NOTE The 3x4 3R Printer Format Setting is not for use with the 12-Lead Transmission option.

Table 54 Data Transmission - Serial Phone Profile Settings

Parameter	Description	Setting Choices
Profile Name	Name of the profile. (This field is fixed)	Serial Phone Profile
Configuration String	Available from your cell phone service provider.	45 characters, blank
Dial String	Available from your cell phone service provider.	40 characters, blank
Wait for Dial Tone	Available from your cell phone service provider.	Yes, No
PPP User Name	Typically not needed but may be required by some cell phone service providers.	30 characters, blank
PPP Password	Typically not needed but may be required by some cell phone service providers.	40 characters, blank
Static IP Address	Typically not needed but may be required by some cell phone service providers.	15 characters (nnn.nnn.nnn.nnn), blank
Primary DNS	Typically not needed but may be required by some cell phone service providers.	nnn.nnn.nnn.nnn, blank
Secondary DNS	Typically not needed but may be required by some cell phone service providers.	nnn.nnn.nnn.nnn, blank
http Proxy Address	Typically not needed but may be required by some cell phone service providers.	15 characters, blank
http Proxy Port	Typically not needed but may be required by some cell phone service providers.	15 characters, blank
Baud Rate	Available from your cell phone documentation. If your phone transmits “high speed” data, set to 115200.	9600, 19200 , 38400, 57600, 115200
Flow Control	Available from your cell phone documentation.	None, Hardware

Table 55 Data Transmission - Phone/Modem Settings

Parameter	Description	Setting Choices
Profile Name	Name of the profile.	Serial Phone Profile
Configuration String	Available from your cell phone service provider.	45 characters, blank
Landline	Set to Yes if you are using a modem.	Yes, No
Dial Prefix	Only configurable if Landline is set to Yes. The dial prefix is the number or numbers you dial before the phone number. For example, you may need to dial 9 for an outside line or an area code in addition to a number.	10 charaters, blank
Dial String	Available from your cell phone service provider.	40 characters, blank
User Name/Password	Sets how the user name/password pairs are configured. Per profile means a single user name/password is configurable for this profile; per device means a different user name/password is configurable for each device which uses this profile.	Per Profile , Per Device
PPP User Name	Typically not needed but may be required by some cell phone service providers.	30 characters, blank
PPP Password	Typically not needed but may be required by some cell phone service providers.	40 characters, blank
Static IP Address	Typically not needed but may be required by some cell phone service providers.	15 characters (nnn.nnn.nnn.nnn), blank
Primary DNS	Typically not needed but may be required by some cell phone service providers.	nnn.nnn.nnn.nnn, blank
Secondary DNS	Typically not needed but may be required by some cell phone service providers.	nnn.nnn.nnn.nnn, blank
http Proxy Address	Typically not needed but may be required by some cell phone service providers.	15 characters, blank
http Proxy Port	Typically not needed but may be required by some cell phone service providers.	15 characters, blank

Table 56 Data Transmission - 12-Lead Settings (Hub)

Parameter	Description	Setting Choices
Server URL	Hub server address. Available from your ISP.	40 characters, blank
User Name	http user name. Use your web server documentation to create user accounts on the hub.	30 characters, blank
Password	http password. Use your web server documentation to create user accounts on the hub.	40 characters, blank

Table 57 Data Transmission - 12-Lead Settings (Sites)

Parameter	Description	Setting Choices
Site Name	This label appears in the Send To menu when initiating a transmission. The label should be an easy to recognize name.	12-20 characters, blank
Site Type	Indicates the type of device receiving the transmission.	Fax, Printer, TraceMaster, 12LTS, Hub, Telemedicine
Phone Number	Phone number for fax site type, otherwise N/A. Note: It is important that the you know the dialing rules from the 12-Lead Transfer Station. For example, does the 12-Lead Transfer Station need to dial a 1 or an area code in addition to the number? If it does, the number sent by the MRx must include these digits.	20 characters, blank
URL	URL for PC site type (i.e., TraceMaster or another 12-Lead Transfer Station), otherwise N/A	40 characters, blank
Use Hub's Routing	Indicates whether or not to use hub routing. (Note: This field is not used by the 12-Lead Transfer Station 2.0.).	Yes, No
Default Site	If yes, this will be the highlighted site when the Send to menu is displayed. When set to yes, this field will automatically be set to no for all other sites.	Yes, No
User Name	Sets the http user name for the data viewing software server.	30 characters, blank
Password	Sets the http password for the data viewing software server.	40 characters, blank

Table 58 Data Transmission

Parameter	Description	Setting Choices
Transmit Interval	Sets the interval between Periodic Clinical Data Transmissions when connected to the data viewing software server.	1, 2, 3, 4, 5 minutes

Table 59 Reference ID

Parameter	Description	Setting Choices
Reference ID	Defines a maximum of 20 preconfigured Reference IDs. Each Reference ID has a maximum of 16 characters limited to uppercase letters, numbers, spaces and hyphens.	Up to 20 user-defined settings

Table 60 Manual Therapy Settings

Parameter	Description	Setting Choices
Remain In Sync Mode After Shock	Defines whether the device remains in Sync Mode after a synchronized shock is delivered.	Yes, No
Time To Auto Disarm	Determines the amount of time the device will remain charged if a shock has not been delivered. Applies to both Manual Defib and AED Modes.	30, 60, 90 (seconds)
Pacing Rate	Upon entering the selected Pacer Mode (Demand or Fixed), defines the default rate of delivery of paced pulses.	30-180, 70 (ppm) adjusted in increments of 10
Pacing Output	Upon entering the selected Pacer Mode (Demand or Fixed), defines the default current setting at which paced pulses are delivered.	10-160, 30 (mA) adjusted in increments of 5
Manual Therapy Security	Defines whether Manual Defib and Pacer Modes are password protected. A password entry screen is displayed when the setting is changed to On . Using the Menu, enter a 4-character password. Selecting Cancel during password entry resets the setting to Off . Once the password is set, changing the setting to Off clears the password from the device memory.	Off , On (See Warning below.)
CPR Timer	Defines whether the CPR Timer is displayed in Manual Defib mode (This does not affect the display of the timer in AED Mode.)	Off , On

WARNING Use of the Manual Therapy Security password requires the clinician to know and remember the password, as defined in Configuration. Failure to enter the correct password will prevent the delivery of manual defibrillation or pacing therapy. Prior to selecting this Configuration option, review this potential risk with your Risk Manager.

Table 61 AED Settings

Parameter	Description	Setting Choices
Shock Series	<p>Sets the number of shocks that must be delivered to activate an automatic CPR Pause. The length of the CPR pause is determined by the CPR Timer Setting. A new Shock Series begins when a shock is delivered:</p> <ul style="list-style-type: none"> • after the device is turned on, • after the automatic CPR pause, • after the [Pause for CPR] soft key has been pressed, or • if the time since the previous shock exceeds the Protocol Timeout setting. 	1, 2, 3, 4
Protocol Timeout	Sets the time interval used to determine if a delivered shock should be counted as part of the shock series (see Shock Series above.)	30, 60 , 90, 120, 150, 180, 210, Off (seconds)
No Shock Advised (NSA) Action	<p>Defines how the device behaves following a No Shock Advised (NSA) decision:</p> <ul style="list-style-type: none"> • Monitor - directs the device to monitor the patient's ECG following an NSA decision and prompts the user to periodically perform CPR. The CPR prompt interval is defined by the Monitor Prompt interval. • Time Setting - directs the device to provide a CPR Pause interval following a NSA decision. If a shock has been delivered in the current Shock Series, the length of the CPR Pause interval is defined by the CPR Timer setting. Otherwise, the length of the CPR Pause interval is defined by the NSA Action time setting. 	Monitor, 30, 60, 90, 120 , 150, 180 (seconds)
CPR Prompt	<p>Defines the level of detail provided in the CPR reminder voice prompts provided at the completion of a Shock Series.</p> <ul style="list-style-type: none"> • Long - provides detailed instruction to check airway, breathing and pulse/circulation before beginning CPR. • Short - provides instruction to begin CPR, if needed, only. 	Long, Short
Monitor Prompt Interval	Sets the interval for patient care prompts provided during AED monitoring of the patient's ECG following an NSA decision. Off means there are no prompts during AED monitoring.	30, 60 , 90, 120, 150, 180, Off (seconds)
CPR Display	If Q-CPR is installed and configured on, sets the look of Q-CPR data in the AED display. Basic display shows the CPR Progress Indicator and any prompt text. The Advanced view shows Compression Rate, No Flow Time, EtCO ₂ numeric (if available), Ventilation Rate (if configured), ventilation detected icon (if configured), CPR Timer, Compression Counter, Compression Wave, CO ₂ wave (if available).	Basic , Advanced

Table 62 Network Settings

Parameter	Description	Setting Choices
Equipment Label	A user-entered name that uniquely identifies the device; used to associate the HeartStart MRx with an Information Center monitoring sector.	up to 16 Unicode characters, blank
Central Monitoring	Controls whether the No Central Monitoring INOP appears at startup. “Mandatory” means when the HeartStart MRx is not connected to the Information Center and is turned on, or a connection is lost during monitoring, the No Central Monitoring INOP message appears. “Optional” means the INOP message only appears when a connection is lost during monitoring, not at startup.	Mandatory, Optional
Remote Controls	Sets or defines the ability of the Information Center to remotely control the HeartStart MRx. Silence/reset alarms can be controlled from the Information Center. Set controls to “Disabled” if you do not want operators to control this function from the Information Center.	Enabled, Disabled
RF Access Code*	Identifies which RF channel the HeartStart MRx-Information Center wireless communications are on.	0-255, 0

* - Change the default RF Access Code. The default 0 is not valid for clinical use

NOTE Network settings are not copied to a data card when exporting configurations and must be set individually on each device.

Table 63 Printing Settings

Parameter	Description	Setting Choices
Print on Alarm	Prints a 15 second strip (10 seconds of pre-alarm data and 5 seconds of post alarm data) when selected alarm type occurs. Red Arrhythmia: An alarm recording strip is printed for Asystole, VFIB/VTACH, VTACH, Extreme Tachy, Extreme Brady. Red: An alarm recording strip is printed for the Red Arrhythmia alarms plus IBP Disconnect, Apnea, SpO ₂ Desat. Red/Yellow: An alarm recording strip is printed for the Red alarms plus High and Low alarms for HR, NBP, SpO ₂ , Pulse Rate, EtCO ₂ , AwRR, IBP, CPP, and Temp; Also, Pacer Not Captured, Pacer Not Pacing, PVC, Pacer Output Low.	Red/Yellow, Red , Red Arrhythmia
Print on Charge	Prints a continuous strip during charging. Printing continues until a shock is delivered, the device is disarmed, or the Print button is pressed.	Yes , No
Print on Shock	Prints a 12 second strip when a shock is delivered or when a shock is attempted but unable to be delivered.	Yes , No
Print on Mark	Prints a strip when the Mark Event button is pressed. The strip includes the printer delay (if configured) and extends 6 seconds from the start of the annotation text or from the time the Events menu is removed from the display.	Yes , No
Printer Delay	Defines whether printed strips, including those requested manually and those generated by an event (mark, charge, or shock), include an additional 10 seconds of information - the 10 seconds occurring just prior to printing being initiated.	No Delay, 10 sec.
Event Summary Report	Selects the Event Summary Report format. Short includes a log of events and vitals. Medium adds waveforms. Long adds 12-Lead Reports.	Short, Medium , Long
Strip Print Speed	Selects the ECG strip print speed.	25, 50 (mm/sec)
12-Lead Print Speed	Selects the 12-Lead ECG Report print speed.	25, 50 (mm/sec)

NOTE Red arrhythmia alarms can't be turned off.

Table 64 Mark Event Settings

Parameter	Description	Setting Choices
Mark Event 1	Defines menu choice #1 on the Mark Events menu.	20 characters, ET Access
Mark Event 2	Defines menu choice #2 on the Mark Events menu.	20 characters, IV Access
Mark Event 3	Defines menu choice #3 on the Mark Events menu.	20 characters, Adrenaline (for Europe), Epinephrine (for the rest of the world)
Mark Event 4	Defines menu choice #4 on the Mark Events menu.	20 characters, Lidocaine
Mark Event 5	Defines menu choice #5 on the Mark Events menu.	20 characters, Atropine
Mark Event 6	Defines menu choice #6 on the Mark Events menu.	20 characters, Morphine
Mark Event 7	Defines menu choice #7 on the Mark Events menu.	20 characters, Nitroglycerin
Mark Event 8	Defines menu choice #8 on the Mark Events menu.	20 characters, Aspirin

Table 65 CPR Settings

Parameter	Description	Setting Choices
Q-CPR	In devices with the Q-CPR option, this setting defines whether Q-CPR is configured off or on.	On, Off
CPR Timer	<p>Sets the length of the pause interval that automatically starts when:</p> <ul style="list-style-type: none"> a Shock series is completed The [Pause for CPR Timer] softkey is pressed. A No Shock Advised (NSA) decision is made, the NSA CPR pause is enabled, and the conditions for using the CPR Timer setting for NSA CPR pause period are met (see NSA entry in Table 61.) The Shock Button is not pressed for the configured “Time to Auto Disarm” setting after the device is armed in AED Mode Continuous artifact is detected during rhythm analysis. 	30, 60, 90, 120, 150, 180, 240, 300
Q-CPR Voice	Sets default setting for Q-CPR voice prompts.	Audible, Muted
Compression only CPR	Enables/disables ventilation feedback and measurements.	On, Off
Comp Color	Selects the color of the compression waveform and values for compression rate and no flow time.	Red, Yellow, Blue, Green, Cyan, Magenta White
Q-CPR Feedback	Enables or suppresses Q-CPR feedback. Suppressing Q-CPR feedback will prevent Q-CPR View in Manual Mode, voice prompt feedback and storage of prompts in Manual and AED modes and Q-CPR text prompt feedback in AED Mode. (This configuration item is only displayed and printed if the Q-CPR Data Storage option is enabled.)	On, Off
Research Storage	If on, enables the storage of specific research data, including: acceleration and force data from the CPR Meter and PCI data from pads.	On, Off

Table 66 Thrombolytic Therapy Contraindications Settings

Parameter	Description	Setting Choices
Prompt for Contraindications	Enables/disables the prompt for Thrombolytic Therapy Contraindications.	Yes, No
Contraindication 1	Listing of contraindications to Thrombolytic Therapy for you to consider before treatment.	Right vs. left arm sys. BP difference > 15 mmHg
Contraindication 2		History of structural central nervous system disease
Contraindication 3		Significant closed head/facial trauma within prev. 3 mos.
Contraindication 4		Major trauma, surgery, GI/GU bleed within 6 wks
Contraindication 5		Bleeding or clotting problem or on blood thinners
Contraindication 6		CPR for longer than 10 min.
Contraindication 7		Pregnant female
Contraindication 8		Serious systemic disease
Contraindication 9		Pulmonary edema
Contraindication 10		Signs of shock
Contraindications 11-20		Blank (editable for you to list more contraindications)


Working with Data

This chapter describes the data management features of the HeartStart MRx. See “Data Transmission” on page 239 for instructions on how to send data from the HeartStart MRx.

Overview

The two most common uses of data coming from the HeartStart MRx are:

- Transmission of vital signs and related data.
- Post event data management.



The HeartStart MRx automatically creates a complete Event Summary for each patient event. Each Event Summary is assigned a unique event identification number and is date/time stamped. Measurements are stored for viewing, reporting and printing in the Vital Signs Trending Report. Event Summaries, including any trending and associated 12-Lead reports, are automatically stored in internal memory. When internal memory reaches capacity, each addition of an Event Summary to internal memory causes one or more of the oldest Event Summaries to be overwritten. The current or most recent Event Summary or Vital Signs Trending report may be printed by pressing the  button.

Event Summaries stored in internal memory may be individually selected and:

- Printed.
- Copied to a data card using the **Data Management** menu.
- Transmitted to a remote computer via Bluetooth or LAN for viewing in a data management application like Event Review Pro.

Initiating an Event Summary

New Event Summaries are initiated each time one of the following activities occurs:


- The arrival of a valid ECG signal.
- The arrival of valid SpO₂ data.
- The arrival of valid CO₂ data.
- The arrival of valid invasive pressure data.
- The arrival of valid temperature data.
- The arrival of a valid CPR meter compression.
- An NBP measurement is requested.
- The Charge  button is pressed.
- The Mark Event  button is pressed.

Patient data collected includes two ECG waveforms, two invasive pressure waveforms and one CO₂ waveform, and other clinical events. The number of incidents stored in memory at any given time is determined by the length of each incident and the amount of data collected. There is 12-hour data limit per incident with a maximum capacity of 55 patient incidents, regardless of card capacity or size of incidents. When deleting, records are erased oldest first.

NOTE Monitoring and defibrillation functions are disabled while using the data management features of the HeartStart MRx. An active patient event is closed upon entering Data Management.

Entering Data Management Mode

To enter Data Management Mode:

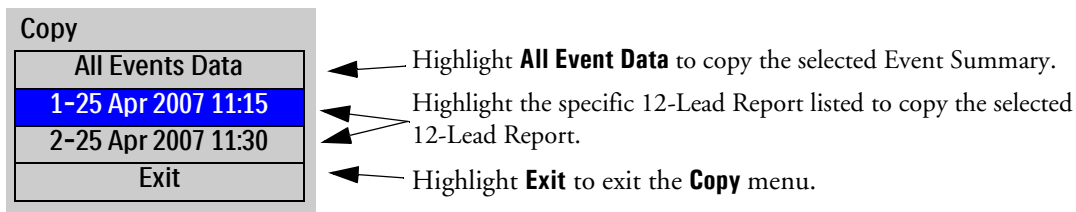
- 1 Turn the Therapy Knob to either **Monitor**, **Pacer** or **Manual Defib**.
- 2 Press the Menu Select  button.
- 3 Using the Navigation buttons, select the **Other** menu and press the Menu Select button.
- 4 Select **Data Management** and press the Menu Select button.
- 5 Press the Menu Select button to acknowledge the message, **Leaving Normal Operational Mode**.
- 6 Press the Menu Select button to display the Data Management menu.

Copying from Internal Memory

You can copy Event Summaries and 12-Lead ECG Reports stored in internal memory to a data card from Data Management Mode:

- 1 Insert a data card, see “Installing the Data Card” on page 46.
- 2 Enter Data Management Mode. See “Entering Data Management Mode” on page 226.
- 3 Use the **[Prev Item]** and **[Next Item]** soft keys to select an Event Summary.
- 4 Press the Menu Select button to display the Data Management menu.
- 5 Highlight **Copy** and press the Menu Select button.
- 6 Select the data option listed that you want to copy (see Figure 100) and press the Menu Select button to copy to the external data card.

Figure 100 Copying in Data Management Mode



NOTES If you print an event in Clinical Mode and switch to Data Management Mode, the printing must be complete before the event can be copied or sent. Failure to do so results in either a **Cannot copy this event while printing** or a **Cannot send this event while printing** message. If you get either message, wait for the printing to finish or cancel the printing before proceeding.

Do not remove the external data card from the HeartStart MRx while the device is copying data.

Viewing and Erasing the External Data Card

The contents and status of your data card are conveniently available for viewing. To display data card information:

- 1 Enter Data Management Mode. See “Entering Data Management Mode” on page 226.
- 2 Press the Menu Select button to display the Data Management menu.
- 3 Select **View Data Card** and press the Menu Select button.

[**Prev Page**] and [**Next Page**] soft keys appear to navigate to additional display pages.

Use the **Erase Card** menu entry to delete the contents of the data card.


CAUTION If you format a Philips data card in a PC card reader, you must use a FAT16 file system to format the data card. Using a FAT32 format makes the card incompatible with the HeartStart MRx.

Do not use the data card as a long term storage device. Follow your organization’s protocol for backing up electronic data.

Printing During a Patient Event

The HeartStart MRx allows you to print data reports during a patient event. The device also allows you to go back and print data reports after the fact from Data Management Mode, see “Printing from Data Management Mode” on page 231.

Event Summaries

You can print the current Event Summary at any time during a patient event by pressing the Summary  button and selecting **Event Summary** from the menu. If an event is not in progress, pressing the Summary button and selecting **Event Summary** prints the most recent Event Summary. The printed format of the Event Summary is defined in Configuration.

WARNING Should an alarm condition occur while an Event Summary is printing, an alarm strip is not printed. However, the corresponding ECG waveform is stored and available in the Event Summary.

Vital Signs Trending Reports

You can print the current Vital Signs Trending Report at any time during a patient event by pressing the Summary button and selecting **Trends** and then a **Trends Interval** from the menu or by hitting the soft key under the **[Print Trends]** label.

If an event is not in progress, pressing the Summary button and selecting **Trends** and then a **Trends Interval** prints the most recent Vital Signs Trending Report.

12-Lead ECG Reports

You can print individual 12-Lead ECG Reports for the current or most recent patient event through the 12-Lead Report View menu. You can print the current 12-Lead ECG report by hitting the **[Print]** softkey in 12-Lead View. To print a recent 12-Lead ECG Report:

- 1 Press the Menu Select button and highlight **Reports**
- 2 Use the Navigation buttons to highlight the report you want to print.
- 3 Press the Menu Select button and highlight **Print**
- 4 Press the Menu Select button to print the report.

Printing Individual Events

The HeartStart MRx can be configured to print automatically when certain events occur. Table 67 lists these events and the length of the strip printed, depending on whether the printer is configured to print real-time or with a 10-second delay.

Table 67 Printed Strip Lengths

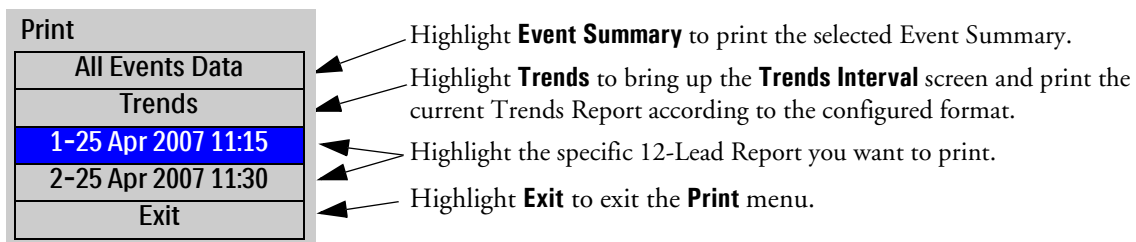
Event	Real-Time Strip Length	Delayed Strip Length
HeartStart MRx charges to deliver a shock.	Continuous	10 seconds just prior to charging, plus continuous printing through the charge duration.
Shock delivered	12 seconds	10 seconds just prior to shock, plus 12 seconds after shock.
Shock failed	12 seconds	10 seconds just prior to the message No Shock Delivered , plus 12 seconds after the message.
Alarm condition	15 seconds (10 seconds of pre-alarm data and 5 seconds of post alarm data when specified alarm type occurs.	Same as real-time strip.
Mark Event ► button pressed (For more information on this feature see “Marking Events” on page 237.)	6 seconds from the start of the annotation text or from the time the Events menu is removed from the display.	10 seconds prior to the Mark Event plus 6 seconds from the start of the annotation text or from the time the Events menu is removed from the display.

Printing from Data Management Mode

To print a historical Event Summary, Vital Sign Trends Report or 12-Lead Report:

- 1 Enter Data Management Mode. See “Entering Data Management Mode” on page 226.
- 2 Use the soft keys labeled **[Prev Item]** and **[Next Item]** to select the Event Summary you want to print.
- 3 Press the Menu Select button to display the Data Management menu.
- 4 Highlight **Print** and press the Menu Select button.
- 5 Select the data option listed that you want to print (see Figure 101) and press the Menu Select button to print.

Figure 101 Printing in Data Management Mode



NOTE To print an Event Summary stored on the removable data card, the information must first be downloaded to the HeartStart Event Review Pro data management system. Refer to the *HeartStart Event Review Pro Instructions for Use* for download instructions.

Events Stored in Event Summary

Table 68 lists events and related information stored in an Event Summary, if they occur. Not all are possible based on your device options. *Italicized* text is replaced by an appropriate value.

Table 68 Event Information

Logged Event	Frequency
Power On/Off	
Device On	Logged when device first turns on.
Device Off	Logged when Therapy Knob is turned to Off position.
Continued Use	Logged when device is turned on after being turned off for less than 10 seconds.
Mode	
AED Mode	Logged at start of incident and when mode or selected energy changes.
Monitor Mode	
Pacer Mode	
Selected Energy <i>xx J</i>	
Return To Owner Display	Logged when Return To Owner screen is displayed.
Patient Info	
Adult Patient/ Pediatric Patient	Logged at start of incident and when changed.
Paced Patient/ Non-Paced Patient	Logged at start of incident and when changed.
Age <i>xx unit</i>	Logged when set.
Male/Female	Logged when set.
Patient ID	Logged when set.
Battery Status	
Battery Low	Logged when batteries are low and external power is not available.
***Batteries Low	Logged when batteries are low and device is pacing.
Shutting Down in 1 Minute	Logged when warning issued.
Shutting Down Now	
Pads/Paddles/Leads	
Pads On	Logged when pads are applied to patient.
Pads Off	Logged after a Pads On event if adult/pediatric multifunction electrode pads are removed from the patient or the pads cable is disconnected.
External Paddles On	Logged when external paddles make contact with the patient.
External Paddles Off	Logged after an External Paddles On event if paddles lose contact with patient.
Internal Paddles On	Logged when internal paddles make contact with the patient.
Internal Paddles Off	Logged after an Internal Paddles On event if paddles lose contact with patient.
Leads On	Logged when monitoring electrodes for primary ECG are attached to the patient.
Leads Off	Logged after a Leads On event if a monitoring electrode for the primary wave loses contact with the patient.

Table 68 Event Information (Continued)

Logged Event	Frequency
Measurements	
PVC/min Limit	Logged when device is turned on if ECG alarms are on, when settings are changed, or when ECG alarms are turned on.
VTACH Limits HR <i>value Run value</i>	
ECG Alarms Off	Logged when ECG alarms are turned off.
Primary ECG <i>label</i>	Logged for initial or change in primary ECG source.
Gain $\times Y$	Logged for initial or change in ECG gain.
Learning Rhythm	Logged when ST/AR algorithm learns ECG rhythm.
SpO ₂ On/Off EtCO ₂ On/Off <i>Pressure Label</i> On/Off <i>Temperature Label</i> On/Off	Logged when device is turned on if measurement is connected and subsequently when measurement is disconnected/connected.
HR Limits <i>low high</i> SpO ₂ Limits <i>low high</i> EtCO ₂ Limits <i>low high</i> <i>Pressure Label</i> Limits <i>source low high</i> <i>Temperature Label</i> Limits <i>low high</i> AwRR Limits <i>low high</i> Pulse Limits <i>low high</i>	Logged with measurement on event if measurement alarms are on, when settings are changed, or when measurement alarms are turned on.
SpO ₂ Alarms Off EtCO ₂ Alarms Off <i>Pressure Label</i> Alarms Off <i>Temperature Label</i> Alarms Off AwRR Alarms Off	Logged when measurement alarms are turned off.
Apnea Time <i>limit</i> sec.	Logged when AwRR alarms are turned on and EtCO ₂ when settings are changed.
Pulse Alarms Off	Logged when Pulse alarms are turned off.
[Press 1 - Press 2] Label: <i>Pressure Label</i>	Logged when a pressure label is set or changed.
<i>Pressure Label</i> zeroed	Logged when <i>pressure label</i> is zeroed.
<i>Pressure Label</i> cal factor <i>value</i>	Logged when cal factor for <i>pressure label</i> is entered or a mercury calibration is completed.
Pulse Source <i>source</i>	Logged when the pulse source is initially determined and when changed.
NBP Schedule [<i>Manual, q1, ...</i>]	Logged when schedule is changed.
NBP On	Logged when Start NBP is initially pressed manually, or configured schedule.
NBP Limits <i>source low high</i>	Logged when Start NBP soft key pressed and when settings are changed.
NBP Alarms Off	Logged when NBP alarms are turned off.

Table 68 Event Information (Continued)

Logged Event	Frequency
[Temperature] Label: <i>Temperature Label</i>	Logged when a temperature label is set or changed.
Alarms	
<i>**yellow or ***red alarm</i>	Logged when alarm condition occurs.
Alarms Paused	Logged when action occurs.
Alarms Resumed	Logged when action occurs.
Alarms Off	Logged when action occurs.
Audio Paused	Logged when action occurs.
Audio Resumed	Logged when action occurs.
Audio	
Audio Recording Started	Logged when audio recording starts or resumes after being stopped.
Audio Recording Stopped	Logged when audio recording stops because of MRx mode change.
Audio Recording Full	Logged when audio recording stops because 90 minutes of audio has been recorded for the current event.
Q-CPR NOTE: Q-CPR events are logged to the patient incident record but are not included in the Event Summary report printed by the HeartStart MRx. Events and waveforms related to Q-CPR can be viewed through Event Review Pro. For more Q-CPR feedback messages see Table 28 in the Q-CPR and Data Capture chapter.	
Q-CPR feedback On	Logged at the beginning of an event if the Q-CPR Feedback configuration setting is On.
Q-CPR feedback Off	Logged at the beginning of an event if the Q-CPR Feedback configuration setting is Off.
Cannot Analyze Vent	Caused by ventilation events (either spontaneous respiration or noise) with an impedance change > 3 ohms.
Pads Off	Pads are off the patient while Q-CPR is active (ventilation invalid).
Poor Pads Contact	Pads are on the patient but the impedance is >140 ohms while Q-CPR is active.
CPR meter Malfunction	CPR meter responds with an error.
CPR meter Unplugged	Device cannot communicate with the CPR meter.
Compression Event	A CPR chest compression was detected.
Ventilation Event	A ventilation event was detected.

Table 68 Event Information (Continued)


Logged Event	Frequency
INOPs	See "Troubleshooting" chapter for information regarding INOP statements.
Defibrillation	
Charging to <i>xx</i> J	Logged when device starts charging to selected energy setting.
Disarm [<i>Manual, Auto</i>]	Logged when device disarmed by user or automatically after time-out period.
Shock # <i>x</i>	Logged when discharge to patient (energy delivered, impedance and peak current are stored with the waveform).
No Shock Delivered	Logged when discharge to patient fails.
Sync On	Logged when Sync function turned on by user.
Sync Off	Logged when Sync function turned off by user.
AED Mode	
Pause/Resume	Logged when the [Pause for CPR] or [Resume Analyzing] soft keys are pressed.
Analyzing	Logged when advisory algorithm begins analysis.
Artifact Detected	Logged when advisory algorithm detects noise or motion artifact.
Cannot Analyze ECG	Logged when advisory algorithm cannot complete analysis sequence.
No Shock Advised	Logged when a non-shockable rhythm is detected.
Shock Advised	Logged when a shockable rhythm is detected.
Pacer	
Pacer Mode [<i>Demand, Fixed</i>]	Logged when pacing is started and when mode is changed.
Pacer [<i>Start or Resume</i>] <i>xx</i> ppm <i>xx</i> mA	Logged when pacing is started and when pacing is resumed.
Pacer Rate ppm	Logged when rate or output is changed and maintained for 2 seconds while pacing. The logged time will be the time the setting took effect. If this event is logged out of order, a * will be appended to the time stamp.
Pacer Output <i>xx</i> mA	
Pacer Pause/Stop	Logged when the Therapy Knob is moved off the Pacer position while pacing.
Pacer Output Low <i>xx</i> in mA	Logged when the pacer output is less than the selected setting by 20 percent or 10 mA (whichever is greater)
12-Lead	
12-Lead Acquired	Logged when action occurs.
12-Lead Printed <i>date/time</i>	Logged when action occurs.
12-Lead Deleted <i>date/time</i>	Logged when action occurs.
12-Lead Transmitted <i>date/time</i>	Logged when 12-Lead Report is successfully transmitted from the MRx.
Mark Event	
Mark Event	Logged when Mark Event button is pressed.
Mark <i>event/drug</i>	Logged when user selects an entry from the Mark Event menu.

Table 68 Event Information (Continued)

Logged Event	Frequency
Print	
Print Strip	Logged when Print button is pressed
Periodic Clinical Data Transfer	
Start Data Transmit to (site)	Logged when the HeartStart MRx begins a periodic clinical data transfer session
End Data Transmit	Logged when the HeartStart MRx ends a periodic clinical data transfer session
Network	
Audio Paused by Central	Logged when alerts are silenced/reset from the Information Center.
Time changed from (with original device time)	Logged when the HeartStart MRx time and date are synchronized to the Information Center time.
Date of Birth (day, month, year)	Logged when the Date of Birth is set or changed.
Central Monitoring Active	Logged when the HeartStart MRx associates with the Information Center.
Patient Discharged	Logged when the patient is discharged.
No Central Monitoring*	Logged when event occurs depending upon configuration - "Central Monitoring Mandatory"
Radio Malfunction*	Logged when event occurs. (INOP detected)
Radio Unplugged*	Logged when event occurs. (INOP detected)
Radio Weak Signal*	Logged when event occurs. (INOP detected)
All ECG Alarms Off*	Logged when event occurs. (INOP detected)

* See Table 99 for causes and possible solutions to these logged events.


Marking Events



The Mark Event  button allows you to annotate the Event Summary and the ECG strip at the point in time the button is pressed. If configured, pressing the Mark Event button prints a 6-second ECG strip. Depending on configuration, the ECG strip is either printed real time, or prepended with the previous 10 seconds of data leading up to the marked event.

Once pressed, the Mark Event label in the upper left corner of the display changes to Select Event and the Mark Events menu is displayed (see Figure 102).

Figure 102 Mark Events Menu

Mark Events	
ET Access	
IV Access	
Epinephrine	
Lidocaine	
Atropine	
Morphine	
Nitroglycerin	
Aspirin	
Other	

Use the Navigation buttons to select the desired event and press the Menu Select  button.

The ECG strip is annotated with the mark event  symbol and the selected annotation. If an annotation item is not selected within five seconds after the Mark Event button is pressed, only the generic mark event  symbol will appear on the ECG strip.

The marked event is stored in the Event Summary.

NOTE Entries on the Mark Events menu are as configured. Changes are made using the Configuration menu.

Data Transmission

This chapter provides instructions on how to transmit data from the HeartStart MRx to various external devices using the suite of data transmission options available in the monitor/defibrillator.

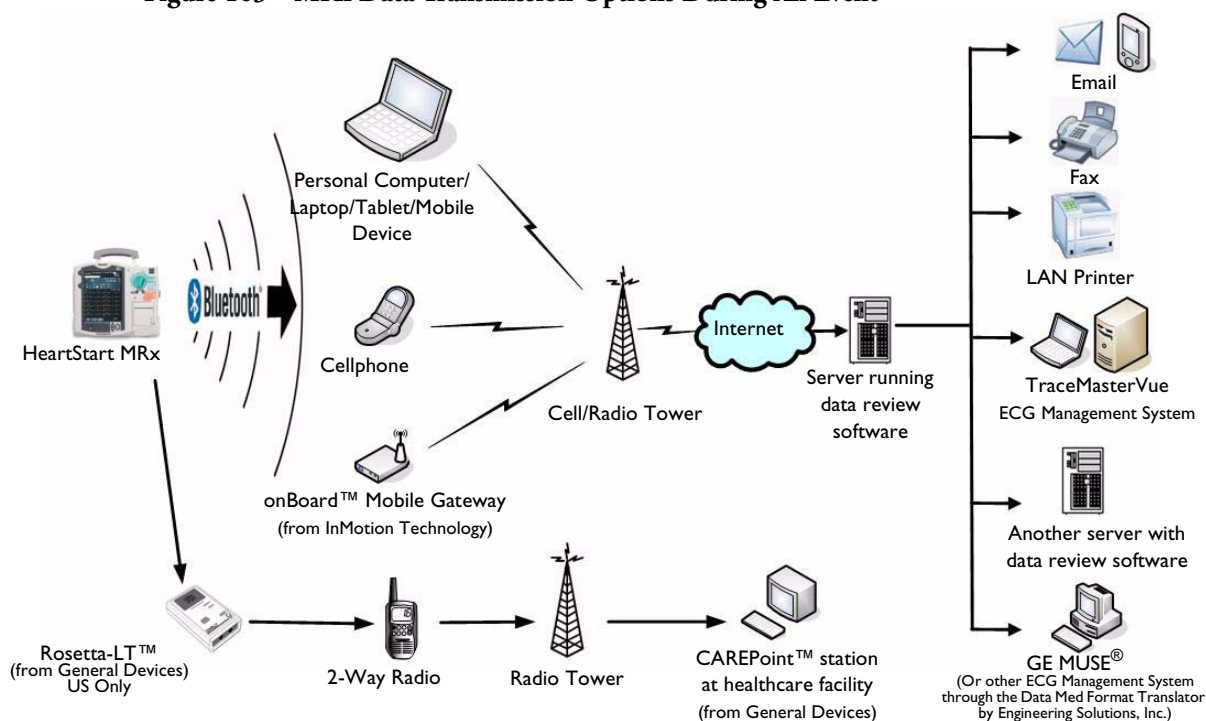
Overview

There are two applicable scenarios for transmitting HeartStart MRx data:

- During a critical care event: Transmission of vital signs and related data (12-lead waveforms and vital signs) ahead of a critical care patient (cardiac, stroke, trauma, respiratory, pediatric, etc.) to alert a healthcare facility of an incoming critical care patient so the facility can prepare for the next level of care before the patient arrives. See “Transmitting During a Critical Care Event” on page 240.
- Post event: Transmission of complete event data after an event has occurred for quality review, billing and eventual archiving. “Transmitting Event Summaries Post Event” on page 254.

Depending upon what you are trying to do, the HeartStart MRx can send 12-Lead Reports, Event Summaries and/or Periodic Clinical Data to a remote location. See Figure 103.

Figure 103 MRx Data Transmission Options During An Event



Transmitting During a Critical Care Event

The HeartStart MRx provides multiple options to transmit data during a critical care event. See Table 69.

Table 69 Critical Care Transmission Use Cases

I want to transmit:	The HeartStart MRx uses:	What transmission options does my HeartStart MRx need to make it work?	Where do I find instructions?
Clinical data to a destination point periodically during transport using Bluetooth wireless.	Dial Up Networking (DUN) and a Bluetooth wireless card to transmit a	The Periodic Clinical Data Transfer options (B18) and 989803153411 (Internal Bluetooth Card).	See “Periodic Clinical Data Transmission” on page 250 and “Transmitting Clinical Values” on page 250.
A 12-Lead ECG using Bluetooth wireless technology via a cell phone, land line modem or other cellular broadband gateway to the Internet.	12-Lead ECG through a cell phone, land line modem or other gateway to a destination point.	The 12-Lead Transmission - Bluetooth wireless technology option (B06) OR product upgrades M3801 (12-Lead BT Transmit) and 989803153411 (Internal Bluetooth Card).	See “Transmitting During a Critical Care Event” on page 240.
A 12-Lead ECG using my portable computer to forward to the Internet.	Bluetooth File Transfer and a Bluetooth wireless card to transmit the 12-Lead ECG to the PC. Data Messenger software will forward to the 12-Lead Transfer Station.	The 12-Lead Transmission - Bluetooth wireless technology option (B06) and either Event Summary Bluetooth option (B10) or Periodic Clinical Data Transmission options (B18). HeartStart Data Messenger software (861453).	See “Transmitting to a Personal Computer” on page 249.
A 12-Lead ECG using electronic PCR software in my portable computer ¹ .	Bluetooth File Transfer and a Bluetooth wireless card to transmit the 12-Lead ECG to the PC.	The Event Summary Bluetooth option (B10) AND one of the 12-Lead Transmission options (Serial, Bluetooth or Rosetta-Lt) installed.	See “Transmitting to a Personal Computer” on page 249.
A 12-Lead ECG using a 2-way radio and the Rosetta-Lt ² to a CAREpoint TM or Rosetta-Rx TM device at a healthcare facility.	An RS-232 cable ³ to connect the HeartStart MRx to the Rosetta-Lt, which then transmits to a destination point.	The 12-Lead Transmission, Rosetta-Lt interface option (B11) OR product upgrade 861326 (12-Lead transmission, Rosetta-Lt Interface).	See “Setting up Rosetta Transmissions” on page 245.
A 12-Lead ECG using the RS-232 port, a cell phone and the Internet to a destination point. ⁴	The RS-232 port to transmit data through a cell phone to a selected destination.	The 12-Lead Transmission - RS-232 and Bluetooth option (B07) OR product upgrades M3802 (12-Lead BT/RS-232 Transmit) and 989803153411 (Internal Bluetooth Card).	See “Setting Up for RS-232 Transmissions” on page 247.

1 – Patient Care Report (PCR) software must be able to deliver the file to the healthcare facility. The destination site set at the HeartStart MRx is contained in the file information transmitted. If you use a Philips product to deliver the file to the healthcare facility, it reads the destination site from the file sent. For more information on the set-up of your ePCR software, see the software’s Instructions for Use.

2 – Available in the U.S. only

3 – Cable provided by General Devices.

4 – There are a limited number of carriers and cellphones which support this feature. Consult your cellular handset sales representative for more information.

Preparing for Transmission

Before transmitting data, the HeartStart MRx needs to be set up properly based on the type of transmission option selected. If you are using Bluetooth wireless technology, your wireless devices need to be set up as well. If you are using Batch LAN Data transfer, set up your HeartStart Data Messenger Server ahead of time and configure both devices. See the instructions which came with the Data Messenger Server for more information. Regardless of the solution selected, test the transmission before using in a clinical situation.

If you are using a cell phone, data transmission can sometimes be unreliable. A strong signal and stationary transmission will improve the transmittal success rate. Follow instructions provided with your cell phone.


CAUTION Many institutions prohibit the use of cell phones on their premises. Please abide by local rules and regulations.

NOTES If transmitting in a clinical mode, waveforms for all monitored parameters can be viewed during the transmission process. However, the waveform appearing in Wave Sector 4 is partially obscured when the transmission status bar is displayed. Related alarms, measurements and INOP messages remain active and are reported in Parameter Blocks 1 and 2 and the general status area.

The HeartStart MRx transmits data from internal memory only. Data contained on the external data card only is not transmittable.

Modifying Reference IDs

You can change the Reference ID of your HeartStart MRx during an event by performing the following (for more information on Reference IDs, see “Identifying Your Device” on page 26).

- 1 Press the Menu Select  button.
- 2 Use the Navigation buttons to highlight **Other** and press the Menu Select button to select.
- 3 Highlight **Reference IDs** and press the Menu Select button to select.
- 4 Select the Reference ID you want to use or **Other** to add an additional Reference ID.

If you selected a reference ID from the list in Step 4, it becomes the Reference ID for the current event and subsequent events. If you selected **Other**, the HeartStart MRx prompts you to create a new Reference ID. Use the Menu Select button and the Navigation buttons to create the new entry. Selecting **Done** saves your edits as the current Reference ID. Selecting **Cancel** closes the menu and does not change the Reference ID.

Setting up Bluetooth Transmissions


To use Bluetooth technology to wirelessly transfer data from the HeartStart MRx, including Clinical Values Data Transmission, you must configure both the monitor/defibrillator and the receiving Bluetooth device.

Adding a Bluetooth Device

The HeartStart MRx can have up to 20 Bluetooth devices configured at one time. Adding a 21st device replaces the device used least recently.

NOTE Bluetooth devices may not be added or modified during transmission and transmission is not allowed during Bluetooth device configuration.

To add a Bluetooth device to the list of Transmission Devices:

- 1 Once in 12-Lead mode, press the Menu Select  button.
- 2 Using the Navigation buttons, select **Bluetooth Devices** and press the Menu Select button. A list of previously discovered Bluetooth devices is displayed.
- 3 Select **Add Device** and press the Menu Select button. The message **Searching for Bluetooth Devices** is displayed. The search lasts for 30 seconds.
- 4 From the Add Device menu, select the desired device and press the Menu Select button.

The selected device must now go through the “Pairing” process described below.

NOTE All Bluetooth devices within the specified range are discovered by the HeartStart MRx and are displayed on the Add Device menu, even if you have already paired with the device.

You can also add a Bluetooth device in Data Management Mode, during Periodic Clinical Data Transmission and from the **Other** option from the Main menu. The process is the same beginning with Step 2 above.

Pairing a Bluetooth Device with the HeartStart MRx

Once a Bluetooth device is selected from the Add Devices menu, a passkey sequence must be performed in order to communicate or “pair” the wireless device with the HeartStart MRx. The passkey is a user-defined character sequence, such as 000 or 1234, etc.

Some Bluetooth devices only allow pairing for 30 seconds, so be ready to enter the passkey.

- 1 Use the Navigation buttons to enter the passkey on the MRx and select **Done**.
The Bluetooth device prompts you for a passkey.
- 2 Enter the same passkey on your Bluetooth device. See the documentation that came with your Bluetooth device for instructions.
- 3 You are prompted to select a **Bluetooth Service**. Highlight **File Transfer** or **Dial-Up Networking** and press the Menu Select button. Generally, phones and gateways are Dial-Up Networking and personal computers are File Transfer. If you are unsure of which service to select, contact your Philips installation manager for more information.
- 4 If you selected dial-up networking, select the designated profile from the Phone/Modem Profiles menu. If you selected file transfer, proceed to the next step. (You will not be prompted to select a profile when adding a Bluetooth device as part of the Event Summary, Bluetooth option.)

- 5 Once the Bluetooth device is paired with the HeartStart MRx and the profile selected, the HeartStart MRx performs a transmission test. After successfully connecting, the message **Transmission Test Passed** is displayed. Press the Menu Select button to acknowledge the message. Should the transmission test fail, the message **Transmission Test Failed** is displayed, along with additional information about where the failure occurred. See “Transmission Problems (Bluetooth)” on page 304 for troubleshooting information.

NOTES The profile contains specific information about the Bluetooth device that enables it to communicate with the 12-Lead Transfer Station, personal computers and devices running data viewing software. Your administrator sets up the profiles and can tell you which one to choose.


There may be exceptions to the pairing process, particularly for devices that do not have a user interface. Please refer to the documentation for your Bluetooth device. Additionally, pairing may sometimes be referred to by other names, such as “bonding”.

Pairing information is not retained when importing a configuration file from the data card. The devices must be paired again using the process above.

CAUTION The HeartStart MRx is capable of communicating via Bluetooth with nearby devices such as computers, laptops, tablets and mobile devices. Each of these devices has a unique set of features and configuration options. In order to ensure reliable transmissions, familiarize yourself with the Bluetooth configuration choices of each. Some choices (either default or chosen by the user) could prevent receipt of data from the HeartStart MRx. For example, it is recommended that you disable features such as “Start discovery every 10 minutes”. Enabling this option could interfere with transmissions from the HeartStart MRx.

Changing Bluetooth Profiles

Once you have added and paired a Bluetooth device, you can change its profile using the following steps:

- 1 In 12-Lead Mode, press the Menu Select  button.
- 2 From the 12-Lead Main Menu, select **Bluetooth Devices** and press the Menu Select button. A list of paired Bluetooth devices is displayed.
- 3 Using the Navigation buttons, select a device and press the Menu Select button.
- 4 To change a profile, select Change Profile and press the Menu Select button. A menu of configured profiles for that device is displayed, with the currently associated profile highlighted.
- 5 Select the profile you want to associate with the device.

The MRx tests the profile to determine if the Bluetooth device can communicate with the 12-Lead Transfer Station. Progress messages are displayed during the test. If the test is successful, the message **Transmission Test Passed** is displayed. Press the Menu Select button to acknowledge the message. Should the transmission test fail, the message **Transmission Test Failed** is displayed, along with additional information about where the failure occurred. See “Transmission Problems (Bluetooth)” on page 304.

Additional Bluetooth Device Information

Keep the following points in mind when working with Bluetooth devices:

- Many Bluetooth devices are not discoverable by default. Check your device’s documentation to see if you need to enable discovery.
- As a general security practice, you should not leave your Bluetooth device in discoverable mode.
- Some devices require that you turn on the Bluetooth functionality.
- Some devices may prompt you to authenticate each time. Check your device’s documentation to see if you can configure it to always communicate with the HeartStart MRx.
- Give your Bluetooth device an easily recognizable name as this is the name that appears on the MRx menus. The name should be no more than 15 characters in order for it to display properly on the HeartStart MRx.
- Bluetooth modems and fax machines use analog lines to transmit data. If you are transmitting using a Bluetooth modem, plug it into the analog line used by the fax machine.

Transmitting Using Bluetooth

For instructions on transmitting with Bluetooth from 12-Lead Mode, see “Post Event Transmission Use Cases” on page 254.

Setting up Rosetta Transmissions

Using an easy cable connection, the HeartStart MRx enables you to transmit a 12-Lead Report to a Rosetta-Lt for two-way radio transmission to a healthcare facility running CAREpoint or Rosetta-Rx. See Figure 104. (Available in the United States only.)

Figure 104 Rosetta-Lt Transmissions



WARNING Do not connect the HeartStart MRx to the Rosetta-Lt when the Rosetta-Lt is connected to a telephone line. This combination is prohibited. Before connecting the Rosetta-Lt to a telephone line, disconnect it from the HeartStart MRx.

The 12-Lead Report sent to the Rosetta-Lt includes:

- Patient identification information
- Device identification information
- Event ID number
- Waveform data

Optional information in the 12-Lead Report includes:

- Measurements. The 12-Lead Report can also contain numerics for vital signs (SpO₂, EtCO₂, AwRR, Pulse, Temp, Invasive Pressure, NBP) if available. The vitals sent with the report are the values recorded at the beginning of the 12-Lead acquisition. If a vital numeric is unavailable or its source is off, then the vital numeric is not included in the report. NBP numerics are valid for 60 minutes. If no measurement has been taken in the last 60 minutes, NBP numerics are considered unavailable. NBP numerics include the measurement time.
- Interpretive Statements
- Acute MI Critical Values Statements
- Rhythm strips

NOTE The HeartStart MRx sends the above data to the Rosetta-Lt. Information displayed on the 12-Lead Report produced by the Rosetta-Lt is determined by Rosetta-Lt software.

CAUTION A 12-Lead Report sent to the Rosetta-Lt will overwrite any 12-Lead Report which currently exists on the Rosetta-Lt. It is your responsibility to forward the 12-Lead Report from the Rosetta-Lt to its destination. See the Rosetta-Lt *User's Guide* for more information.

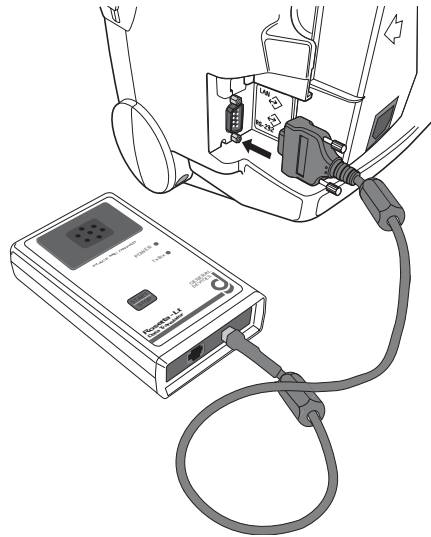
NOTES If your HeartStart MRx is transmitting a 12-Lead Report via means other than the Rosetta-Lt, the Rosetta-Lt option is disabled in the **Send to** menu until the transmission is complete.

Rosetta-LT is available in the United States only.

Connecting Rosetta-Lt

To connect the Rosetta-Lt to the HeartStart MRx, insert the Rosetta-Lt cable into the HeartStart MRx's RS-232 Serial port and tighten the screws. See Figure 105.

Figure 105 Attaching the Rosetta-Lt to the HeartStart MRx



NOTE For questions about the Rosetta-Lt and connector cable or to purchase a connector cable/additional items, contact General Devices. See the Rosetta-Lt Data Translator *User's Manual* for more information.

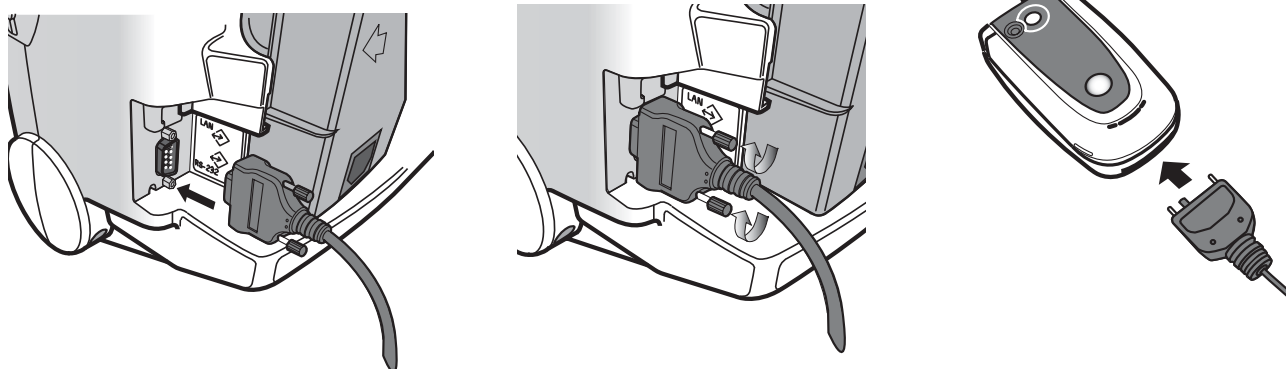
Transmitting Using Rosetta-Lt

For instructions on transmitting with Rosetta-Lt from 12-Lead Mode, see "Post Event Transmission Use Cases" on page 254. To transmit from Data Management Mode, see "" on page 254.

Setting Up for RS-232 Transmissions

12-Lead ECG Transmission using RS-232 requires a 9-pin serial cable connected to the RS-232 Serial Port located on the back panel of the HeartStart MRx. Attach the cable to the device and secure the screws into place. Then connect the cell phone to the other end of the cable. See Figure 106.

Figure 106 RS-232 Cable Connections



NOTE For further information concerning the setup and configuration of transmission devices and the HeartStart MRx, refer to the *Transmission Implementation Guide*. For further information concerning the 12-Lead Transfer Station, refer to the *12-Lead Transfer Station Instructions for Use*.

Transmitting using RS-232

For instructions on transmitting with RS-232 in 12-Lead Mode, see “Post Event Transmission Use Cases” on page 254.

Transmitting in 12-Lead Mode

You can transmit a 12-Lead Report while monitoring a patient in 12-Lead Mode. Reports can be transmitted to printers, fax machines, PDAs, Philips TraceMaster ECG Management System or other servers running Philips data viewing server software.

Reports are sent from the HeartStart MRx to the hub (a web server running Philips 12-Lead Transfer Station software).

Using Bluetooth transmission, they are transmitted to the hub using configured wireless devices such as cell phones, handheld devices and other external devices like computers, laptops and other mobile devices.

Using the Rosetta-Lt (available in the U.S. only), 12-Lead Reports are transmitted via two-way radio transmission to a healthcare facility running CAREpoint or Rosetta-Rx.

Using RS-232 Transmission, the reports are transmitted via a cell phone with internet capability connected to the MRx's RS-232 Serial Port. The 12-Lead Transfer Station then forwards the report to the selected destination site. Additionally, reports can be sent to a wireless modem connected to an analog line for areas where cell transmission is unavailable.

To send the current 12-Lead Report:


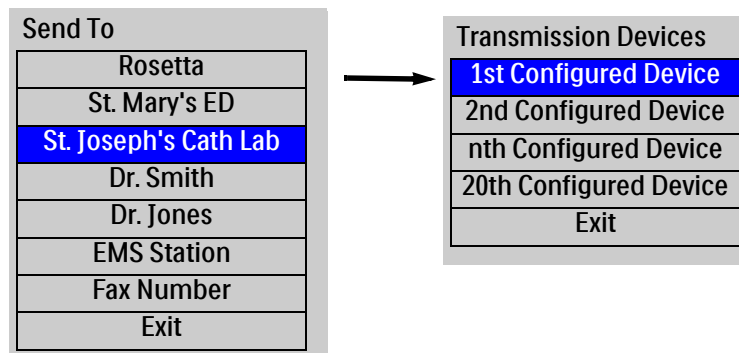
- 1 From the 12-Lead Report screen, press the Menu Select  button.
- 2 Select **Send** and press the Menu Select button.
- 3 Select the destination of the 12-Lead from the **Send To** menu and press the Menu Select button.
- 4 If your device is configured with just one option to transmit the 12-Lead Report or you selected the Rosetta-Lt, transmission begins when you press the Menu Select button. If your device has more than one configured transmission device, highlight the device you want to use and press the Menu Select button. Transmission begins. See Figure 107.

Figure 107 Steps to Sending 12-Leads



NOTES Patient Name and ID must be entered prior to 12-Lead acquisition in order for it to appear on the 12-Lead Report.

The HeartStart MRx transmits data from internal memory only. Data contained on the external data card only is not transmittable.

The .05 - 40 Hz 12-Lead filter setting is supported by TraceMasterVue version A.02.01 or higher.


NOTES For further information concerning the setup and configuration of transmission devices and the HeartStart MRx, refer to the *Transmission Implementation Guide*. For further information concerning the data viewing server, refer to the software's instructions for use.

Subsequent 12-Lead Reports can be placed in queue for transmittal while transmission is in progress, or the originally selected 12-Lead Report can be chosen for transmission to multiple sites.

Transmitting to a Manually Entered Fax Number

Upon acquisition of the 12-Lead ECG, the 12-Lead Report is displayed.

To manually enter a fax number destination:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select **Send** from the 12-Lead Main Menu and press the Menu Select button.
- 3 Using the Navigation buttons, select **Fax Number** from the Send To Menu.
- 4 Enter the fax number from the numeric list using the Navigation buttons. Include any extra digits necessary, such as 9 for an outside line or 1 plus the area code for long distance.
- 5 Select **Done** and press the Menu Select button.

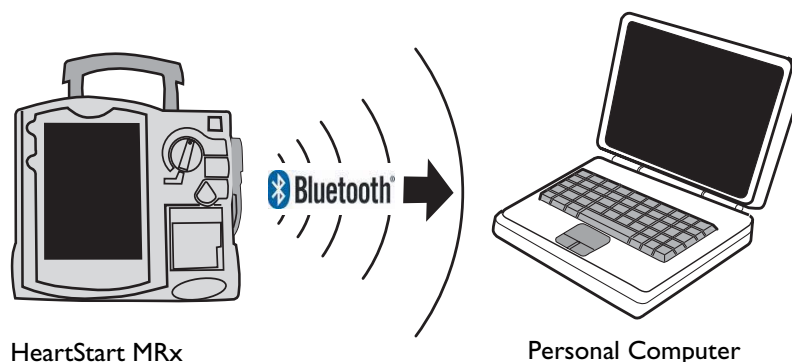
NOTE If you are transmitting to a manually entered fax number using a Bluetooth device, the device and landline prefix, if applicable, must be entered.

Transmitting to a Personal Computer

By using Bluetooth FTP either during an event/transport or post event, the HeartStart MRx can send its data to your personal computer. See Figure 108. You can:

- Transfer 12-Lead, Periodic Clinical Data or Event Summary data to a personal computer.
- Transfer data to be used by an ePCR, or Event Review Pro on the receiving personal computer or forwarded on to a remote destination using Data Messenger software.

Figure 108 Transmitting to a PC



Periodic Clinical Data Transmission

Periodic Clinical Data Transmission (PCDT) provides the ability to transmit clinical data from the point of care for a critical care patient to the receiving hospital to facilitate the next level of care. The PCDT option uses Bluetooth technology to automatically transmit periodic vitals and transmit 12-lead and waveform data upon a set of trigger events from a clinical mode to remote data viewing software. See Table 71 for details on the type of data sent.

Transmitting Clinical Values

With the Periodic Clinical Data Transmission (PCDT) option, the HeartStart MRx uses Bluetooth technology to transmit “live” clinical patient information from a HeartStart MRx in a clinical mode to a remote data viewing server for consultation and decision making assistance. When the option is turned on, the HeartStart MRx displays an icon indicating connectivity status. See Figure 109 and Table 70.

Figure 109 PCDT icon location

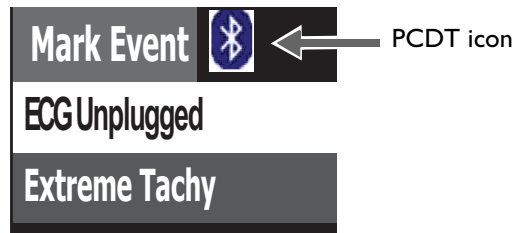





Table 70 PCDT Icons

Symbol	Definition
No symbol	No connection/association with the data viewing server is established. PCDT is not activated.
	A PCDT session has been established and is working properly. (Blue icon with white Bluetooth symbol)
	A PCDT session is currently transmitting data. (Blue icon with green Bluetooth symbol)
	A PCDT session has been started but the connection to the data viewing server has failed. (Blue icon with white Bluetooth symbol crossed out)

PCDT Contents

When a PCDT is initiated, the HeartStart MRx transmits patient vital signs trending data automatically at pre-configured intervals. You can configure your HeartStart MRx to automatically transmit clinical values every 1, 2, 3, 4 or 5 minutes. See “Configuration” on page 199 for details on how to configure this setting. The type of information sent in a PCDT depends on the event which triggers the transmission. See Table 71.

Table 71 Data Transmitted During PCDT

Event	When	What data is sent
Vital signs updated	every 1 to 5 minutes (based on configuration)	<ul style="list-style-type: none"> • Patient vital data for pulse, heart and AwRR rates, NBP, EtCO₂, SpO₂, Invasive Pressures and temperature for the parameters that are turned on; timestamp of vitals • HeartStart MRx device ID • HeartStart MRx incident ID
12-lead acquired	When obtained	<ul style="list-style-type: none"> • 12-lead ECG (may include ACI-TIPI and TPI information)
Marking an event	When Mark Event button is pressed	<ul style="list-style-type: none"> • All data with Vital signs update • Event label and time • Mark event description (NOTE: If a label is not selected within five seconds of pressing the Mark Event button, the event is labeled as generic and sent.) • A segment consisting of the 10 seconds prior to and the five seconds following the Mark Event, inclusive, for each of the waveforms configured to be printed
Delivering a shock	After shock is delivered or aborted due to impedance or other issues	<ul style="list-style-type: none"> • All data with Vital signs update • Event label and time • Shock number* • Number of Joules* • Data on impedance and peak current* • A segment consisting of the 10 seconds prior to and the five seconds following the shock, inclusive, for each of the waveforms configured to be printed <p>* - not sent with an aborted shock PCDT</p>
Physiological alarm including: Asystol, VFIB/VTACH, VTACH, Extreme Tachy, Extreme Brady, Apnea, Extreme Desat, Invasive Pressure Disconnect, PVC/min high, Pacer Not Captured, Pacer Not Pacing, Pacer Output Low and alarm limits for HR, NBP, EtCO ₂ , SpO ₂ , Pulse rate, AwRR, Invasive Pressure, CPP, and Temperature	When trigger event occurs	<ul style="list-style-type: none"> • All data with Vital signs update • Event label and time • A segment consisting of the 10 seconds prior to and the five seconds following the event trigger, inclusive, for each of the waveforms configured to be printed <p>* End PCDT does not send vitals or waveform data</p>
Print button is pressed		
Start/End PCDT*		

NOTE All transmitted personal patient-identifiable data is encrypted to insure patient confidentiality. Please handle in accordance with HIPAA or your local patient privacy requirements. To de-identify patient data, you must delete the event summary.


Configuring a receiving site

Before sending a Periodic Clinical Data Transmission, you need to have a receiving site destination configured, unless you are sending to an electronic Patient Care Record (ePCR) application. See “Modifying Settings” on page 200 in the Configuration chapter to modify the **Site** options in the **Data Transmission** configuration section.

Starting a Periodic Clinical Data Transmission

You can configure your HeartStart MRx to automatically transmit clinical values every, 1, 2, 3, 4 or 5 minutes. See “Configuration” on page 199 for details on how to configure this setting.

To begin PCD Transmission:

- 1 Confirm the HeartStart MRx is in a clinical mode and that your device has a properly configured data viewing software destination and Bluetooth FTP or DUN device. If it is not properly configured, see “Adding a Bluetooth Device” on page 242.
- 2 Press the Menu Select  button.
- 3 Using the Navigation buttons, select **Start Data Transmit** and press the Menu Select button.
- 4 From the **Send To** menu, use the Navigation buttons to select a pre-configured data viewing server location to send the data to and press the Menu Select button to select.
- 5 From the **Transmission Devices** menu, use the Navigation buttons to select the transmission device option you want to use and press the Menu Select button to select. The PCDT icon appears on the display and transmission begins. If your device does not have a transmission device, the HeartStart MRx prompts you to add a device. See “Adding a Bluetooth Device” on page 242.

NOTES If the connection between the HeartStart MRx and the destination server fails, the HeartStart MRx automatically tries to reconnect and sends the transmission when a connection is established.

If you start a PCDT within 10 seconds of turning the HeartStart MRx on, the first transmission contains no wave data.

Periodic Clinical Data Transmission is not available when the HeartStart MRx is connected to the IntelliVue network.

Priorities For Sending Data


In low bandwidth or poor signal quality areas, the HeartStart MRx has the ability to queue periodic data transmissions. See “Periodic Clinical Data Transmission” on page 250 for details on data transmitted. When you have more than one transmission in queue, the HeartStart MRx sends data according to a preset priority:

- If there are multiple transmissions, all patient vital signs transmissions are sent first, event transmissions second and 12-Lead Report transmissions third.
- If there are multiple transmissions of the same type, they will be sent in chronological order.
- If a pending vital signs transmission is greater than 15 minutes old, the message is not sent.
- If there is a pending 12-Lead report transmission and a new 12-Lead report is acquired, only the newest 12-Lead Report is sent.
- If there is a pending event message that's greater than a minute old, it is not sent.

NOTE The most recent 500 transmission events are logged in the Periodic Clinical Data Transmission log, available in Service Mode. See the *HeartStart MRx Service Manual* for more information.

Ending a Periodic Clinical Values Transmission

To end an on-going periodic clinical data transmission:

- 1 Press the Menu Select  button.
- 2 Using the Navigation buttons, select **End Data Transmit** and press the Menu Select button.
- 3 Confirm you want to end the transmission by highlighting **Yes** and press the Menu Select button. (Selecting **No** continues the transmission.)
- 4 The transmission stops and all pending transmissions are deleted.

NOTE Exiting a clinical mode cancels a data transmission session and all transmissions in queue.

Transmitting Event Summaries Post Event

The HeartStart MRx provides options (see Figure 110 and Table 72) to transmit data after an event for quality review, billing and archiving. You can:

- Save data to the data card for personal transport to another device. See “Copying from Internal Memory” on page 227.
- Send data via Bluetooth to a receiving device. See “Setting up Bluetooth Transmissions” on page 242.
- Send data via Batch LAN Data Transfer. See “Batch LAN Data Transfer” on page 259.

Figure 110 Post Event Transmission

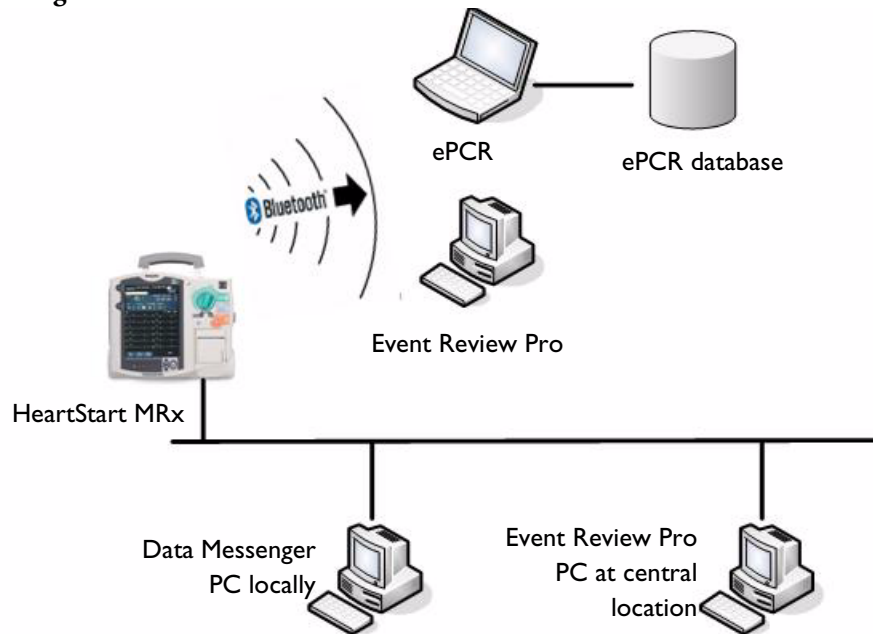


Table 72 Post Event Transmission Use Cases

I want to transmit:	The HeartStart MRx uses:	What transmission options does my HeartStart MRx need to make it work?	Where do I find instructions?
An Event Summary to an external computer wirelessly ¹ .	Bluetooth wireless technology to transmit data to a Bluetooth-enabled computer.	The Event Summary Bluetooth option (B10) OR product upgrades 861325 (Event Summary, Bluetooth) and 989803153411 (Internal Bluetooth Card).	See “Transmitting Event Summaries Post Event” on page 254.
A single Event Summary or group of Event Summaries to a local computer after an event or shift is finished.	A LAN cable connecting the device to your computer.	The Batch LAN Data Transfer (BLDT) option (B12) or product upgrades 861447 (Batch LAN Data transfer), 989803153411 (Internal Bluetooth Card). HeartStart Data Messenger software (861453).	See “Transmitting Event Summaries Post Event” on page 254.

¹ – Windows-based personal computer/laptop/tablet/mobile device with a Bluetooth stack installed that supports File Transfer Profile Server. See “Specifications” on page 321 for more information.

Transmitting in Data Management Mode

The HeartStart MRx Event Summary, Bluetooth option uses Bluetooth wireless technology to send an Event Summary (complete or partial) or a 12-Lead Report to a receiving Bluetooth device from Data Management Mode. The Rosetta-Lt transmission device uses two-way radio to transmit 12-Lead Reports from Data Management Mode. The Batch Data Transfer option uses a LAN cable to download a single Event Summary or all Event Summaries on your internal data card.

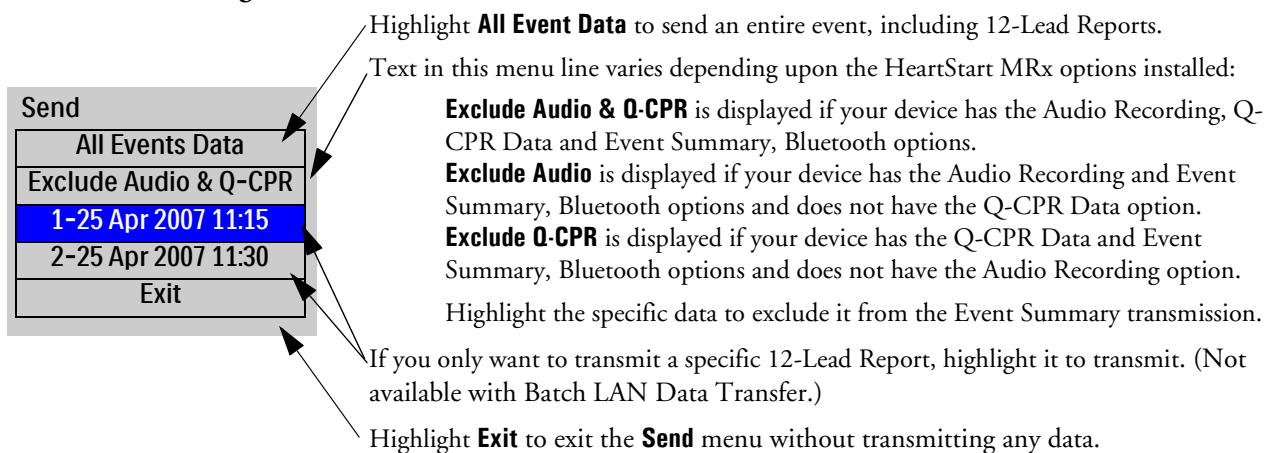
Transmitted Event Summaries include all stored waves, trending data, 12-Lead Reports and event files, including vital signs such as heart rate, pulse, SpO₂, EtCO₂, AwRR, NBP, invasive pressure and temperature numerics. If your HeartStart MRx has the Audio and/or Q-CPR Data options, you can include these parts of the Event Summary.

NOTE Event Summaries can only be transferred via Bluetooth to devices that support the Bluetooth File Transfer Profile Server.

To transmit an Event Summary or 12-Lead Report from the HeartStart MRx's internal memory to a receiving device, perform the following:

- 1 After you have finished monitoring the patient and removed them from the HeartStart MRx, place the device into Data Management Mode. The display reads **Data Management - Internal Memory** across the top.
- 2 Using the [**Prev Item**] and [**Next Item**] softkeys, highlight the Event Summary you want to transmit (or the Event Summary which contains the 12-Lead Report you want to transmit) and press the Menu Select button.
- 3 Highlight **Send** and press the Menu Select button.
- 4 Highlight the type of data you want to transmit (see Figure 111) and press the Menu Select button.

Figure 111 Send Functions

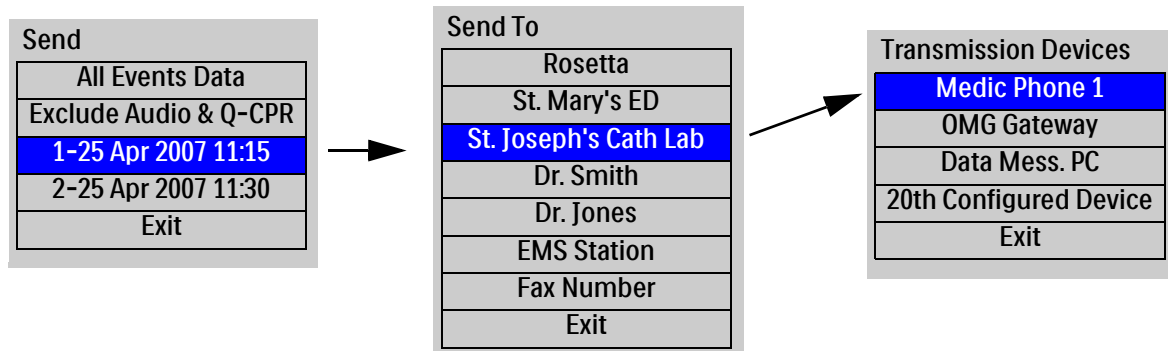


- 5 Depending upon which option you selected in Step 4, you are presented with different menus.

If you selected a 12-Lead Report:

- 1 Select a destination for the 12-Lead Report from the **Send To** menu. Highlight the destination and press the Menu Select button. If your device is configured with just one transmission device or you selected the Rosetta-Lt, transmission begins.
- 2 If your device has more than one configured transmission device, highlight the transmission device you want to use and press the Menu Select button. Transmission begins. See Figure 112.

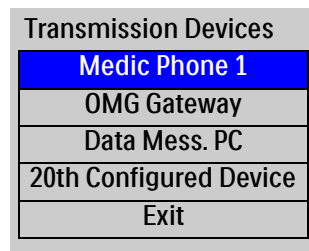
Figure 112 Sending 12-Leads from Data Management



If you selected an Event Summary:

If your device is configured with just one transmission device, transmission begins. If your device has more than one configured transmission device, highlight the option you want to use and press the Menu Select button. Transmission begins. See Figure 113.

Figure 113 Event Summary Transmission




NOTES If you press the **Exit Data Management** softkey while a transmission is ongoing, you need to confirm your selection. Selecting **Yes** exits Data Management, cancels your current transmission and any queued transmissions. Selecting **No** continues the current transmission.

If you print an event in Clinical Mode and switch to Data Management Mode, the printing must be complete before the event can be copied or sent. Failure to do so results in either a **Cannot copy this event while printing** or a **Cannot send this event while printing** message. If you get either message, wait for the printing to finish or cancel the printing before proceeding.

Tracking Data Transmission

After initiating a data transmission from the HeartStart MRx, you can track transmission progress on the device display. For events, the Event ID along with the date and time of the event data being sent are displayed while for 12-Lead reports, the date and time of the report are displayed. The phase (**Connecting to Device** and **Sending**) are also shown. If the HeartStart MRx is in the process of sending data, a percentage complete is also displayed. See Figure 114.

Figure 114 Transmission Status Bar



11 Aug 2004 10:52
Sending, 40% complete

Once transmission is complete, a brief **Confirming. Stand by ...** message appears on the display followed by a **Disconnecting** message. Then the transmission progress message is removed.

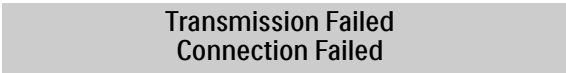
NOTE If a 12-Lead transmission occurs during a patient event, an event indicating the time of transmission is logged into the current Event Summary using the format, "12-Lead (hh:mm:ss) Transmitted to *site name*".

If you exit the Data Management screen or leave a clinical mode causing a reboot of the device during transmission, the transmission is aborted. Changing between clinical views (AED, Monitoring, Pacing, Manual Defibrillation) does not terminate a transmission. The status bar is displayed in all clinical modes.

Transmission Errors

If there is an error in transmission, a message is displayed on the HeartStart MRx screen, accompanied by an audio beep. Press the Menu Select button to acknowledge the error. See Figure 115. The error is logged into the Device Status Log.

Figure 115 Transmission Failure



Transmission Failed
Connection Failed

Cancelling a Transmission

To cancel a transmission in progress, perform the following:

- 1 From either 12-Lead Mode or Data Management Mode, press the Menu Select button.
- 2 Highlight **Cancel Transmission** and press the Menu Select button.
- 3 Confirm the **Cancel Transmission** action. Highlight **Yes** and press the Menu Select button to cancel; highlight **No** and press the Menu Select button to continue the transmission.

After confirming a transmission cancellation, the HeartStart MRx displays a **Disconnecting** message until the cancel process is completed. Some disconnections may occur so quickly that the **Disconnecting** message may not be visible.

Queuing Transmissions

You can queue more than one HeartStart MRx 12-Lead Report or Event Summary for a non-BLDT transmission using the same transmission device (except the Rosetta-Lt). 12-Lead Reports can be queued to the same or different locations. If you are using the Rosetta-Lt, you must complete the transmission from the HeartStart MRx to the Rosetta-Lt AND from the Rosetta-Lt to its communication device before beginning another transmission. Failure to do so results in overwriting the first transmission to the Rosetta-Lt with the second transmission.

To queue another transmission while a transmission is in progress, follow the same steps you used to send the first transmission except you are not asked to select a transmission device. Your data is sent following completion of the transmission in progress.

When you attempt to queue a transmission, items listed in the Send Menu which are incompatible with the current connection are unavailable and grayed out.

To transmit using different transmission devices, you must complete the first transmission before initiating the next one.

NOTE When a transmission fails or you cancel a transmission, any queued transmissions are cancelled and no events are logged.

Finding Transmission Results

When data is transmitted from the HeartStart MRx via Bluetooth File Transfer to a receiving device, it is placed in the default folder (typically located at: My Documents/Bluetooth Exchange Folder) set-up during Bluetooth configuration of the receiving device. The HeartStart MRx creates a “philipsMRx” folder and, depending on the data sent, a sub-folder: “12-Leads” or “events”. The “events” folder contains all event data sent, including any 12-Leads sent as part of the event. Independently sent 12-Leads are contained in the “12-Leads” folder.

NOTES If you press the **[Exit Data Mgt]** softkey to exit Data Management Mode while a batch download is processing, the HeartStart MRx displays an “**Exiting Data Management will cancel the current transfer.**” message and asks you to confirm the exit.

After all cases are successfully transferred and the internal data card is erased, the HeartStart MRx adjusts its system time based on the time provided by the Data Messenger computer’s response.

Batch Data Transfer is not available on devices with the IntelliVue Networking Option.

Event Summaries and 12-Lead Reports could contain information which could be considered Patient Healthcare Information (PHI) or patient identifiable data. This information can be printed or transferred from the HeartStart MRx. Please handle in accordance with HIPAA or your local patient privacy requirements.

Batch LAN Data Transfer

By using Batch LAN Data Transfer (BLDT) you can download either a single Event Summary or all Event Summaries on the Internal Data Card to an external personal computer running Data Messenger software for further review and archiving.

Data Messenger software 4.0, formerly Review Express Connect, is software that communicates with the HeartStart MRx to download Event Summaries. It monitors an inbox and forwards files as Event Review Pro files to a remote Event Review Pro computer. The Event Review Pro software 4.1 can then automatically import the cases into the Event Review Pro database.

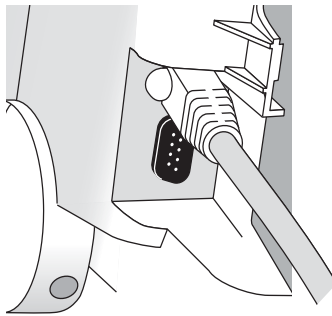
Data Management Part Numbers:

- Data Messenger: 861453
- Event Review Pro (single license): 861431 Option A01
- Event Review Pro (sitewide license): 861431 Option A03

Setting Up for Batch LAN Data Transfer

Batch LAN Data Transfer requires the LAN cable to be plugged into the LAN port on the back of the HeartStart MRx. See Figure 116. The LAN cable connects to either a router or Network Interface Card (NIC) on a local personal computer.

Figure 116 Batch LAN Data Transfer Connections



CAUTION After successfully sending all Event Summaries at once via Batch LAN Data Transfer, the HeartStart MRx adjusts its system time based on the time provided by the Data Messenger personal computer and the internal memory card is erased. If you want to keep other copies of the data, copy the files to an external data card (see “Entering Data Management Mode” on page 226) before doing a BLDT or transfer each of the Event Summaries independently.

Transferring Files with BLDT

To transfer data using the BLDT option:

- 1 Confirm the HeartStart MRx is in Data Management Mode, Data Messenger is running on the receiving personal computer and the LAN cable is securely connected. See “Setting Up for Batch LAN Data Transfer” on page 259.
- 2 Once the LAN cable is connected, the HeartStart MRx automatically communicates with the Data Messenger personal computer and prompts you to send data. See Figure 117. If you are not prompted to send data within a short period of time, see “Transmission Problems (Batch LAN Data Transfer)” on page 308.

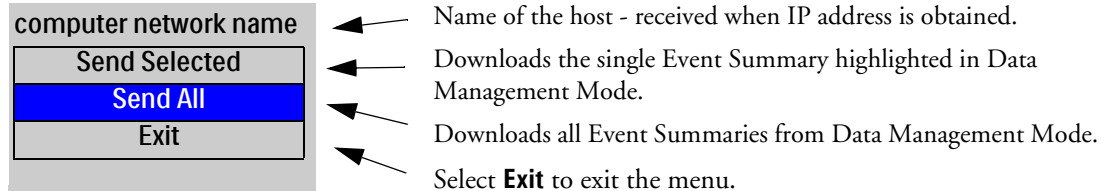
If you want to transfer a single event:

- 3 Use the **[Prev Item]** and **[Next item]** softkeys to highlight the correct Event Summary to download.
- 4 Use the Navigation buttons to highlight **Send Selected** and press the Menu Select button.
- 5 Use the Navigation buttons to highlight the type of data you wish to download. See Figure 111. Press the Menu Select button to select and send your data.

If you want to transfer all events:

- 3 Use the Navigation buttons to highlight **Send All** and press the Menu Select button to select and send your data.

Figure 117 Transferring files with BLDT



Tracking Transfer

Once the transfer begins, the HeartStart MRx tracks transmission progress indicating the number of files sent and the percent complete. See Figure 118.

Figure 118 BLDT Transmission Message

Processing 1 of 1, Sending 32% Complete

When the transmission is complete the HeartStart MRx displays a **Transmission Complete** message. Press the Menu Select button to acknowledge the message. The transmitted file appears in the destination folder which was set up on the Data Messenger Server.

NOTES You must wait for a BLDT to complete before starting to send the next set of information.

Cancelling BLDT

To cancel a BLDT currently being sent, press the Menu Select button, use the Navigation buttons to highlight **Cancel Transmission** and press the Menu Select button. The transfer stops and the HeartStart MRx is placed back in the Data Management screen.

Troubleshooting

If your HeartStart MRx does not operate as expected during transmission, see “Troubleshooting” on page 297.

Maintenance

This chapter describes how to care for your HeartStart MRx and its accessories.

Overview

Proper maintenance of the HeartStart MRx is a very simple, yet important factor in dependability. It involves:

- Providing power so automated tests can be run
- Observing the Ready For Use (RFU) indicator
- Performing the Operational Check
- Caring for batteries
- Cleaning the device and accessories
- Ordering replacement supplies and accessories

WARNING Electric shock hazards exist internally. Do not remove assembly screws. HeartStart MRx service should only be performed by qualified service personnel, in accordance with the *HeartStart MRx Service Manual*.

NOTE Calibration of the optional end-tidal CO₂ and noninvasive blood pressure modules of the HeartStart MRx needs to be performed yearly by a qualified service provider, as described in the *HeartStart MRx Service Manual*.

Automated Tests

The HeartStart MRx independently performs many maintenance activities, including three tests that run automatically at regularly scheduled intervals while the device is off to assess operational performance and alert you if a problem exists. Results of tests associated with critical functionality of the device are reported through the Ready For Use indicator and the Automated Test Summary report. Results are also reported through INOP statements on the display when the HeartStart MRx is turned on. Table 73 provides a brief explanation of the tests and lists the frequency with which each is performed.


Table 73 Automated Tests

Test Name	Description	Frequency
Hourly	Tests batteries, internal power supplies and internal memory.	Hourly
Daily	Tests batteries, internal power supplies, internal memory, internal clock battery, defibrillation, pacing, ECG, SpO ₂ , EtCO ₂ , NBP, Invasive Pressure, Temperature, Bluetooth and printer. The defibrillation test includes low energy internal discharges. If a 3-, 5-, or 10-lead ECG cable is attached, the cable is tested as well.	Daily, between 11 pm and 1 am
Weekly	Performs the Daily Test described above, plus delivers a high energy internal discharge to further exercise the defibrillation circuitry.	Weekly, between 11PM Sunday and 1 AM Monday

NOTE Automated tests do not test therapy cables, paddles, buttons, audio, or the display. An ECG cable is tested, if connected at the time of the test.

Automated Test Summary

An Automated Test Summary (ATS), showing the results of recent tests, may be printed as evidence that the HeartStart MRx is tested regularly. To display the ATS and print its results:

- 1 Turn the Therapy knob to **Monitor**.
- 2 Press the Menu Select  button.
- 3 Using the Navigation buttons, select **Other** and press the Menu Select button.
- 4 Select **Operational Check** and press the Menu Select button.
- 5 Using the Navigation buttons, select **Automated Test Summary** and press the Menu Select button. The Automated Test Summary is displayed.

The message, **Leaving Normal Operating Mode**, appears to let you know that you are exiting from clinical functionality of the monitor/defibrillator.

- 6 Press the **[Print]** soft key to print the report.

The report shows the results of the most recent Hourly Test, the Daily Tests that have run since the last Weekly Test, and the last 53 Weekly Tests. Test results are reported, as described in Table 74.

Table 74 Automated Test Summary Results

Result	RFU Indicator	Definition	Required Action
Pass	Hourglass	All tests passed	None
Fail/DX	Solid red X, chirp	A problem has been detected that may prevent the delivery of a shock, pacing, or ECG acquisition.	Turn the Therapy Knob to Monitor. An inop indicating a problem has occurred is displayed. Refer to Chapter 22, Troubleshooting, for the action to take.
Fail/BF	Blinking X	The total battery capacity (combination of both batteries) is less than 20%.	Charge the battery as soon as possible and/or replace the battery with a charged battery. Charging may be done in the HeartStart MRx or by connecting to AC/DC power, or in a Philips-approved battery support system.
Fail/D	Hourglass	A problem has been detected with a component that does not affect therapy delivery.	Turn the Therapy Knob to Monitor. An inop indicating the failed component is displayed. Refer to Chapter 22, Troubleshooting, for the action to take.

Ready For Use Indicator

The results from Automated Tests are reported through the Ready For Use (RFU) indicator. Be sure to observe the RFU indicator periodically and take the appropriate action, as described in Table 75.

Table 75 RFU Indicator Status

RFU Status	Meaning	Required Action
Blinking black hourglass	Shock, pacing, and ECG functions are ready for use and sufficient battery power is available.	None
Blinking red “X” with or without a periodic chirp	Low battery. The device can be used but run time is limited. Chirping indicates the battery is not being charged. No chirping indicates the battery is being charged.	Charge the battery as soon as possible and/or replace the battery with a charged battery. Charging may be done in the HeartStart MRx by connecting to AC/DC power, or in a Philips-approved battery support system
Solid red “X” and a periodic chirp	A failure has been detected that may prevent the delivery of a shock, pacing, or ECG acquisition.	Turn the Therapy Knob to Monitor . An inop message describing the failure is displayed. See Chapter 22, Troubleshooting, for the corrective action. If needed, run an Operational Check for further information. If the condition persists, take the device out of use and call for service.
Solid red “X” without a periodic chirp	No power, or device failure (cannot turn on).	Insert a charged battery or connect to AC/DC power. If the condition persists, take the device out of use and call for service.

NOTE The RFU indicator may briefly display a solid red “X” when initially turning on the device, switching between clinical and non-clinical operating modes, and at the start of any Automated test. This does not indicate a failure of the device.

Shift Checklist

In order to ensure defibrillators are ready when needed, the American Heart Association (AHA) recommends that users complete a checklist, often referred to as a shift check, at the beginning of each change in personnel. The activities on this check list include verifying that the appropriate supplies and accessories are present, the device is plugged in and has sufficient battery power, and the device is ready for use. Philips Healthcare supports the AHA checklist recommendations and has provided a Shift Checklist document with the device and published a copy in this book. See the “HeartStart MRx Shift Checklist” on page 268.

Weekly Shock Test

In addition to the shift check, you must verify the ability to deliver defibrillation therapy once a week by performing one of the following:

- Operational Check
- Weekly Shock Test (See following instructions.)

NOTE Test reusable sterilizable paddles (internal or external) prior to each use. See the *Sterilizable Defibrillator Paddles Instructions for Use* for more information.

To perform the Weekly Shock test:

- 1 If you are using paddles, make sure the paddles and the paddle tray are thoroughly clean and there is no debris or residue (including all conductive material) on the electrode surfaces of the paddles and tray. Secure the paddles in the paddle tray and confirm the Patient Contact Indicator (PCI) LEDs located on the sternum paddle are not lit. If the LEDs light, adjust the paddles in their pockets. If the LEDs continue to light, clean both the adult and pediatric paddle electrode surfaces.
or
If you are using multifunction electrode pads, attach a test load to the end of the patient Therapy cable.
- 2 Turn the Therapy knob to 150J.
- 3 Press the Charge button.

NOTE If it becomes necessary to disarm the defibrillator, press **[Disarm]**.

- 4 The strip prints if configured to do so. If the strip does not print immediately, press the Print button.
- 5 If using:
 - Pads, press the Shock button on the MRx to deliver a shock into the test load.
 - External paddles, simultaneously press the shock buttons located on the paddles to deliver a shock into the pockets.
- 6 Confirm on the printed strip that the energy delivered to the test load is $150\text{J} \pm 23\text{J}$ (127J to 173J). If not, take the device out of use and begin troubleshooting.

NOTE Detach the test load from the patient Therapy cable after performing the Shift Check. So your device is ready for use when needed, do not leave the test load attached after performing an Operational Check.



HeartStart MRx Shift Checklist

Inspect the MRx, accessories, and supplies at the change of every shift, per AHA guidelines. Place a check mark in the box as you check each item in the list below or place a dash (-) or N/A if not applicable. Then, initial the list to indicate the check was performed for that shift.

Device Name or Serial Number: _____ Unit or Department: _____

Date:															
Shift:	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
RFU Indicator - Hourglass If blinking red X - Plug into AC/DC power or insert charged battery If solid red X - Insert charged battery or AC/DC power. If condition persists, call for service															
Cables/connectors - present and inspected															
Paddles/Therapy cable - present and inspected															
Pads Present, sufficient supply _____															
CPR meter and Adhesive Pads _____															
Monitoring Electrodes - present, sufficient supply _____															
Charged Batteries - one in device, spares _____															
AC/DC Power Cord - plugged in, green light on															
Printer Paper - present, sufficient supply _____															
Data Card present, sufficient supply _____															
SpO ₂ Sensors - present, sufficient supply _____															
NBP cuffs/tubing - present, sufficient supply _____															
CO ₂ FilterLine - present, sufficient supply _____															
Invasive Pressure Transducers - present and inspected															
Temperature Sensors - present and inspected															
Initials															

Shift Checklist (page 2)**HeartStart MRx Weekly Shock Test**

Do one of the following at least once a week to verify the ability to deliver defibrillation therapy:

Operational check (See *Instructions for Use* for details)

Signature: _____ Date: _____

Deliver a 150J shock into a test load (See instructions below)

Signature: _____ Date: _____

Note: If the HeartStart MRx has Software Release B.05 or greater with the Pacing option, you cannot test external paddles through Operational Check. Perform the Weekly Shock Test to test the external paddles. Additionally, test reusable sterilizable paddles (internal or external) prior to each use. See the *Sterilizable Defibrillator Paddles Instructions for Use*.

How to Perform the Weekly Shock Test:

Test each type of patient therapy cable used (pads cable or paddles).

- 1 If you are using paddles, make sure the paddles and the paddle tray are thoroughly clean and there is no debris or residue (including all conductive material) on the electrode surfaces of the paddles and tray. Secure the paddles in the paddle tray and confirm the Patient Contact Indicator (PCI) LEDs located on the sternum paddle are not lit. If the LEDs are lit, adjust the paddles in the tray. If the LEDs continue to light, clean both the adult and pediatric paddle electrode surfaces.
- 2 If you are using multifunction electrode pads, attach a test load to the end of the patient Therapy cable. If your pads are preconnected, you need to detach them first before attaching the test load.
- 3 Turn the Therapy Knob to 150J.
- 4 Press the Charge button. NOTE: If it becomes necessary to disarm the defibrillator, press **[Disarm]**.
- 5 The strip prints if configured to do so. If the strip does not print immediately, press the Print button.
- 6 If using:
 - Pads/Cable, press the Shock button on the HeartStart MRx to deliver a shock into the test load.
 - External paddles, simultaneously press the shock buttons located on the paddles to deliver a shock into the test load.
- 7 Confirm on the printed strip that the energy delivered to the test load is 150J + 23J (127J to 173J). If not, take the device out of use and call for service.
- 8 **Detach the test load from the Therapy cable after performing the Shift Check and reattach your preconnected pads if you use them.**

What Gets Tested in an Operational Check

Operational Checks supplement the Automated Tests by verifying therapy cables, the ECG cable, paddles, audio, charge and shock buttons and the ability to deliver defibrillation and pacing therapy. Operational Checks also notify you if the battery, NBP module, or CO₂ module needs calibration and checks the SpO₂ module, printer, and CPR meter. If you choose to perform the weekly shock test in lieu of the Operational Check, you need to ensure the ECG cable, pacing functions, audio, battery calibration, NBP and CO₂ calibration, CO₂ and SpO₂ modules, temperature, Bluetooth, invasive pressures, printer, and CPR meter are checked periodically. The best way to do this is through an Operational Check. It is recommended that you establish a schedule for conducting periodic Operational Checks.

Operational Check

Operational Checks should be performed at regular intervals to supplement the hourly, daily, and weekly Automated Tests executed by the HeartStart MRx. Automated Tests provide adequate assurance that the device is in a functional state of readiness. Operational Checks supplement the Automated Tests by verifying therapy cables, the ECG cable, paddles, audio, the Charge and Shock buttons, Therapy Knob, and CPR meter, along with replicating the Weekly test. Operational Checks also notify you if the battery, NBP module, or CO₂ module need calibration.

WARNING Be sure the HeartStart MRx is not connected to the patient when performing an Operational Check.

NOTE It is important to establish a schedule for conducting Operational Checks, as well as for checking supplies and accessories associated with the HeartStart MRx. This will ensure that the device is ready to monitor and deliver therapy. The Operational Check is run with a battery installed to reflect optimal operating conditions for defibrillation. The device automatically disconnects AC/DC power.

NOTE If you have the Pacing option, test external paddles using the Weekly Shock test. You must run Operational Check with a pads cable in order to pass the Pacer test.

Prior to performing the Operational Check, ensure that the paddles (if tested) and the paddle tray are thoroughly clean and there is no debris or residue (including all conductive material) on the electrode surfaces of the paddles and tray. Make sure the paddles are secure in their pockets and that the PCI LEDs are not lit. Should the LEDs light, adjust the paddles in their pockets. If the LEDs continue to light, clean both the adult and pediatric paddle electrode surfaces.

At completion of the Operational Check, the message **Operational Check Passed** is displayed if all of the tests pass.

If any test fails the message **Operational Check failed** is displayed along with one (or more) of the following messages, depending upon the severity of the failed functionality:


- Service device.
- Replace battery.
- Replace CPR meter.
- Replace Pads cable.
- Replace Paddles cable.
- Replace Therapy cable.
- Replace ECG cable

You must fix the problem and successfully run the Operational Check to clear the failure.

NOTE If the HeartStart MRx is equipped with multifunction defib pads only and does not have a paddle tray, you cannot test paddles during an Operational Check. To test paddles, you **must** have a test load. Run the Weekly Shock Test, delivering the shock into the test load. See “Weekly Shock Test” on page 267.

Performing the Operational Check

To perform the Operational Check:

- 1 Insert a charged battery (capacity of 20% or greater).
- 2 Turn the Therapy Knob to **Monitor**.
- 3 Press the Menu Select  button
- 4 Using the Navigation buttons, select **Other** and press the Menu Select button.
- 5 Select **Operational Check** and press the Menu Select button.
- 6 Select **Run Operational Check** and press the Menu Select button.

The message window, **Leaving Normal Operating Mode**, appears to let you know that you are exiting from clinical functionality and entering a test mode of the monitor/defibrillator.
- 7 Press the Menu Select button to acknowledge the message.

Operational Check Setup

Carefully read the setup instructions on the screen. Once the HeartStart MRx is set up properly, you can proceed with the Operational Check. If the device has the Q-CPR option, you should run the Operational Check with the Pads/CPR cable and the CPR meter, keeping the CPR meter still during the test. If the HeartStart MRx has the Pacing option, you must run the Operational Check with a Pads cable.

WARNING Be sure to safely discharge internal and external paddles tested during the Operational Check.

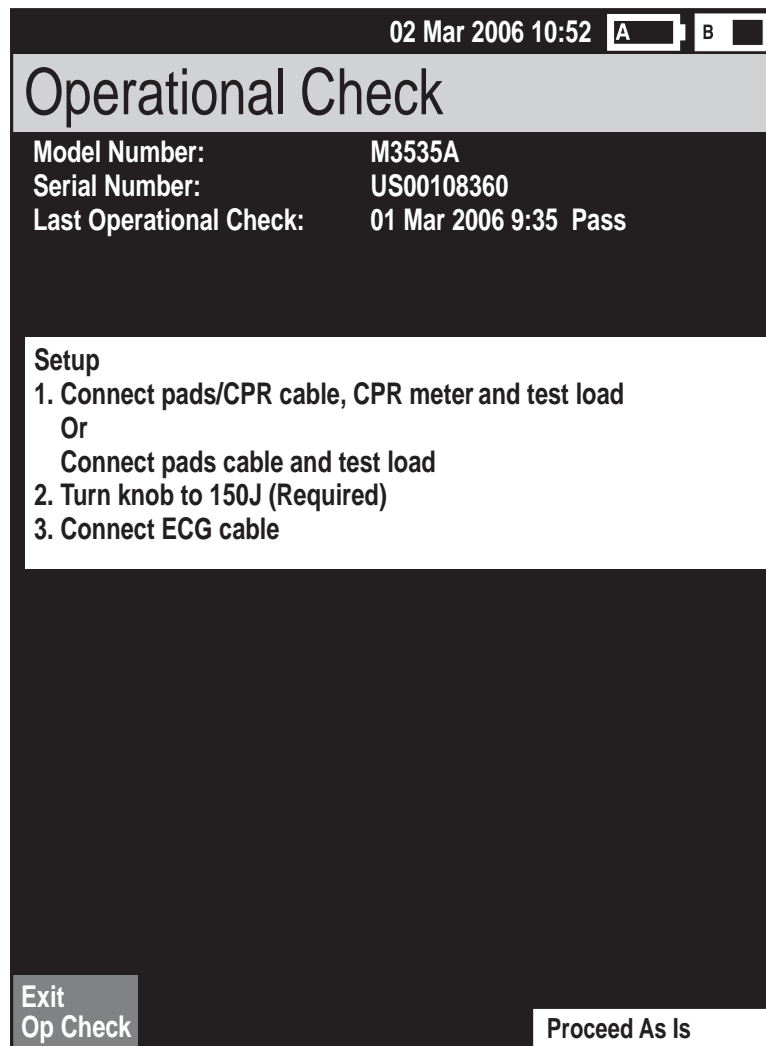
NOTE If you choose to proceed without setting up properly, the Operational Check may fail.

When a response is required, use the Navigation buttons to select your answer and the Menu Select button to confirm your choice. Table 76 shows the tests, in the order in which they are performed, explains the prompts that may appear, and describes the actions you should take (if any).

As each test is run, the name of the test appears on the display with the message **In Progress**, as shown in Figure 120.

Once you have answered the last prompt (Audio test), you can leave the HeartStart MRx unattended and the Operational Check will complete. If you cancel the Operational Check before it completes, there is no record of it in the Operational Check Summary.

Figure 119 Operational Check Setup Screen



The image shows a screen titled "Operational Check" with a dark background. At the top, it displays the date and time "02 Mar 2006 10:52" and two battery status icons labeled "A" and "B". Below the title, it lists device information: "Model Number: M3535A", "Serial Number: US00108360", and "Last Operational Check: 01 Mar 2006 9:35 Pass". A white box contains the "Setup" instructions: "1. Connect pads/CPR cable, CPR meter and test load", "Or", "Connect pads cable and test load", "2. Turn knob to 150J (Required)", and "3. Connect ECG cable". At the bottom, there are two buttons: "Exit Op Check" on the left and "Proceed As Is" on the right.

02 Mar 2006 10:52 A B

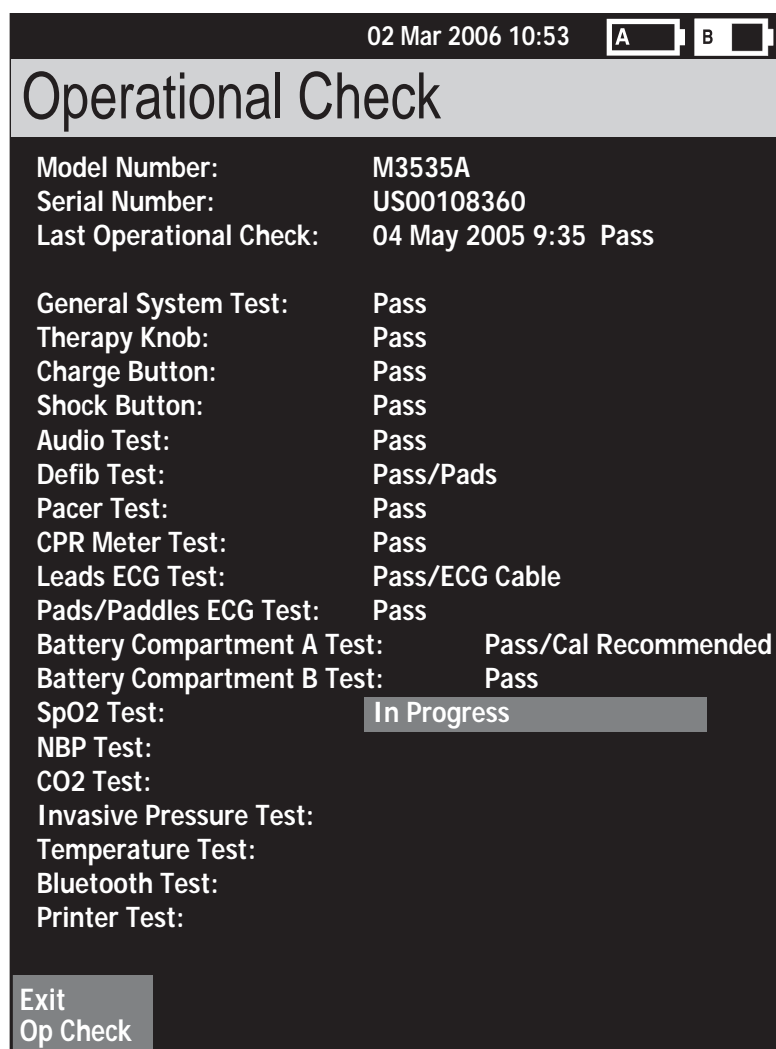
Operational Check

Model Number: M3535A
Serial Number: US00108360
Last Operational Check: 01 Mar 2006 9:35 Pass

Setup
1. Connect pads/CPR cable, CPR meter and test load
Or
Connect pads cable and test load
2. Turn knob to 150J (Required)
3. Connect ECG cable

Exit Op Check Proceed As Is

Figure 120 Operational Check Screen



The image shows a handheld device screen with a black background and white text. At the top, the date and time '02 Mar 2006 10:53' are displayed next to two battery status icons labeled 'A' and 'B'. Below this is a grey header bar with the title 'Operational Check'. The main screen area lists various system tests and their results. At the bottom left, there is a grey button labeled 'Exit Op Check'.

Model Number:	M3535A
Serial Number:	US00108360
Last Operational Check:	04 May 2005 9:35 Pass
General System Test:	Pass
Therapy Knob:	Pass
Charge Button:	Pass
Shock Button:	Pass
Audio Test:	Pass
Defib Test:	Pass/Pads
Pacer Test:	Pass
CPR Meter Test:	Pass
Leads ECG Test:	Pass/ECG Cable
Pads/Paddles ECG Test:	Pass
Battery Compartment A Test:	Pass/Cal Recommended
Battery Compartment B Test:	Pass
SpO2 Test:	In Progress
NBP Test:	
CO2 Test:	
Invasive Pressure Test:	
Temperature Test:	
Bluetooth Test:	
Printer Test:	

Exit
Op Check

Table 76 Operational Checks Test

Test	Description	Prompts	Action
General System	Tests internal clock battery, power supply, and internal memory card.	None.	None.
Therapy Knob	Tests if the Therapy Knob is set to 150J.	None.	None.
Charge Button	Tests the Charge button.	<p>Depending on the cable connected, as follows:</p> <ul style="list-style-type: none"> If the Pads cable is attached, you are prompted to, Verify Test Load is Attached and Press the Charge Button. If external paddles are attached, you are prompted to, Verify Paddles are in Holders and Press the Charge Button. If no cable is attached, the test is marked Not Tested. <p>If the MRx does not detect a press of the Charge button within 10 seconds the message If the Charge button does not work, select Charge from the menu below is displayed.</p>	<p>Respond to the prompt, as follows:</p> <ul style="list-style-type: none"> Check the test load is attached and press the Charge button. Make sure the paddles are seated in their pockets and press the Charge button. <p>If the Charge button is not working, press Charge from the No Button Response menu. The Charge button test is marked Fail and the Operational Check fails.</p>
Shock Button	Tests the Shock button.	<ul style="list-style-type: none"> Once charged the Shock button lights and you are prompted to, Press Shock or Press Shock buttons on paddles. If the MRx does not detect a press of the Shock button within 10 seconds the message If the Shock button does not work, select Shock from the menu below is displayed. <p>Note: The device automatically disarms after the time specified in the configuration is reached.</p> <ul style="list-style-type: none"> The message Defib Disarmed is displayed. 	<ul style="list-style-type: none"> Press the Shock button. If the Shock button is not working, press Shock from the No Button Response menu. The Shock button test is marked Fail. Select Shock from the menu to continue the Operational Check or press Exit Op Check. The Shock button test is marked Fail.

Table 76 Operational Checks Test (Continued)

Test	Description	Prompts	Action
Audio	<p>If a shock was delivered during the Shock test, the voice prompt, Shock Delivered is annunciated.</p> <p>If no shock was delivered during the Shock test, the voice prompt No Shock Delivered is annunciated.</p>	Did you hear Shock/No Shock Delivered?	Use the navigation buttons to respond Yes or No . Then press the Menu Select button.
Defib	<p>Tests defibrillation circuitry and delivers a shock through:</p> <ul style="list-style-type: none"> pads, into a test load, and/or external paddles, into the MRx <p>Note: The Defib test has two components: a high energy internal discharge and a low energy (5J) external discharge. The results of the device's ability to charge and shock are reported in the Defib test.</p>	None.	None.
Pacer	Tests pacing functionality and delivers a paced pulse into a 50 ohm test load.	None.	None.
CPR meter	Checks the basic communication circuitry of the meter.	None.	None.
Leads ECG	Tests leads ECG acquisition and the ECG cable.	None, if test passes. If test fails the following prompt is displayed at the end of all remaining tests: Leads ECG Test failed with cable. Disconnect ECG cable to rerun test without cable.	<p>If the ECG test fails with the cable and passes without the cable, the ECG cable is bad. Replace the ECG cable and rerun Operational Check.</p> <p>If the ECG test fails with and without the cable, see "Troubleshooting" on page 297.</p>

Table 76 Operational Checks Test (Continued)

Test	Description	Prompts	Action
Pads/Paddles ECG	Checks ECG acquisition through pad/paddles.	None, if test passes. If test fails the following prompt is displayed at the end of all remaining tests: Pads/Paddles ECG Test failed with cable. Disconnect therapy cable to rerun test without cable.	If the Pads/Paddles test fails with the cable and passes without the cable, the cable is bad. Replace the Therapy cable and rerun Operational Check. If the Pads/Paddles test fails with and without the cable, see “Troubleshooting” on page 297.
Battery A Battery B	Checks the total battery capacity (combination of both batteries) and calibration status of the batteries in Compartments A and B.	None.	None.
SpO ₂	Checks the internal SpO ₂ PCA. The SpO ₂ cable is not tested.	None.	None.
NBP	Checks to see if the NBP module is functioning; determines if it is due for calibration.	None.	None.
CO ₂	Checks to see if the CO ₂ module is functioning; determines if it is due for calibration.	None.	None.
Invasive Pressures	Checks to see if the invasive pressure hardware is working properly.	None.	None.
Temperature	Checks to see if the temperature hardware is working properly.	None.	None.
Bluetooth	Checks for the presence of the Bluetooth card and database integrity.	None.	None.
Printer	Runs a printer self test.	None.	None.

Operational Check Report

The Operational Check takes only a short time to complete. When it is done, a report is printed, as shown in Figure 121. The first part of the report lists test results. The second part lists checks to be performed by the user.

Figure 121 Operational Check Report

Operational Check Report Model Number: M3535A Serial Number: USD0123456 Ver.: F.00.00	Current Test Results:	
	General System Test: Pass	Battery Compartment A Test: Pass
	Therapy Knob: Pass	Battery Compartment B Test: Pass
	Charge Button: Pass	SpO2 Test: Pass
	Shock Button: Pass	NBP Test: Pass
Current Operational Check: DD Mon YYYY HH:MM:SS Pass	Audio Test: Pass	CO2 Test: Pass
	Defib Test: Pass/Pads	Invasive Pressure Test: Pass
	Pacer Test: Pass	Temperature Test: Pass
Last Operational Check: DD Mon YYYY HH:MM:SS Pass	CPR Meter Test: Pass	Bluetooth Test: Pass
	Leads ECG Test: Pass/ECG Cable	Printer Test: Pass
	Pads/Paddles ECG Test: Pass/Pads	

Qty/Check List:		Comments:
<input type="checkbox"/> Defibrillator Inspection	<input type="checkbox"/> SpO2 Sensor	<div style="border: 1px solid black; height: 100px; width: 100%;"></div>
<input type="checkbox"/> Cables/Connectors	<input type="checkbox"/> NBP Cuffs & Tubing	
<input type="checkbox"/> Paddles/Pads	<input type="checkbox"/> CO2 FilterLine	
<input type="checkbox"/> CPR meter Inspection	<input type="checkbox"/> Invasive Pressure Cables	
<input type="checkbox"/> CPR meter Pads	<input type="checkbox"/> Temperature Probes	
<input type="checkbox"/> Monitoring Electrodes		
<input type="checkbox"/> Charged Batteries		
<input type="checkbox"/> AC/DC Power & Cord		
<input type="checkbox"/> Printer Paper		
<input type="checkbox"/> Data Card		
		Inspected by: _____

Press the **[Print]** soft key when the Operational Check is complete to print an additional copy of the report.

User Checks

The guidelines for completing user checks are as follows:

Defibrillator Inspection Make sure the HeartStart MRx is clean (including the surfaces of the paddles and paddle tray), clear of objects, and has no visible signs of damage.

Cables/Connectors/Paddles/Pads/Monitoring Electrodes Make sure there are no cracks, broken wires, or other visible signs of damage. Make sure the connections are secure. Check expiration date and quantity of pads and monitoring electrodes

CPR meter Inspect the CPR meter and cable for visible signs of damage. If damaged, remove from use. Check the meter's status light to confirm it is green.

CPR meter Adhesive Pads Make sure there is a CPR meter Adhesive Pad applied to the CPR meter and there is an adequate supply available. Replace the pads at least every 2 years if it has not been used.

Batteries Make sure a charged battery is in the HeartStart MRx. Another charged battery should be available or should be charging. Ensure the batteries have no visible signs of damage.

AC/DC Power Check the AC/DC power source (and power cord available):

- 1 Connect the AC/DC power module to the HeartStart MRx and plug it into a power outlet.
- 2 Verify that the external power indicator on the front panel is lit.

Printer Paper Make sure the printer has sufficient paper and is printing properly.

Data Card If applicable, make sure a data card is inserted and has sufficient space available.

SpO₂ Sensor Inspect the sensor and cable for visible signs of damage.

NBP Cuffs and Tubing Inspect the pressure cuffs and tubing for visible signs of damage.

CO₂ FilterLine Confirm that at least one un-opened, sterile package is available.

Invasive Pressure Cables Inspect the cable for visible signs of damage.

Temperature Probes Inspect the probe and cable for visible signs of damage.

NOTES Upon completing the Operational Check and returning to a clinical mode (Monitor, Pacer, Manual Defib or AED), all settings will be reset to the device's configured values.

If your institution's protocol requires periodic alarm verification, and you wish to perform an alarm verification test (in a non-clinical environment) outside of the Operational Check testing, you can connect the HeartStart MRx up to a simulator, manually change the alarm limits to a setting which should cause an alarm to annunciate. Look at the display and listen for the alarm. Be sure to reset the alarm limits to the appropriate settings before returning the device to a clinical environment.

Table 77 Operational Check Test Results

Test	Results	Action if Test Does Not Pass
General System	<ul style="list-style-type: none"> Pass - The clock battery, power supplies, and internal memory are functioning. Fail - The clock battery, power supplies, and/or internal memory are not functioning. A failure may abort the remaining tests. 	If the test fails with the AC/DC power module present, remove the module and repeat the test. If the test continues to fail, call for service. If the test passes, replace the power module.
Therapy Knob	<ul style="list-style-type: none"> Pass - The Therapy Knob is set to 150J. Fail - The Therapy Knob is not set to 150J. Fail - The Therapy Knob is not functioning. 	If the test fails, confirm that the Therapy Knob is set to 150J and repeat the test. If the test continues to fail, call for service.
Charge Button	<ul style="list-style-type: none"> Pass - The Charge Button passed its self-test. Fail - Proceed was selected from the No Button Response Menu. Fail - The Charge Button is not functioning. 	Repeat the test. If the test continues to fail because there is no response from the Charge Button, call for service.
Shock Button	<ul style="list-style-type: none"> Pass - The Shock Button passed its self-test. Fail - Proceed was selected from the No Button Response Menu. Fail - The Shock Button was not pressed before the configured Auto Disarm time period ended. 	Repeat the test being sure to press the Shock Button before reaching the Auto Disarm time. If the test continues to fail, call for service.
Audio	<ul style="list-style-type: none"> Pass - You responded Yes, that you were able to hear the test voice prompt. Fail - You responded No, to hearing the voice prompt. 	Take the device out of use and call for service.
Defib	<ul style="list-style-type: none"> Pass/cable type - The defib test passed with the specified cable type (pads, external paddles) attached. Fail/cable type - The test failed with the specified cable type connected. 	If the test fails, repeat it using a different therapy cable. A passing result with a different cable indicates the previous cable is defective and should be replaced. If the test continues to fail, take the device out of use and call for service.
Pacer	<ul style="list-style-type: none"> Pass - Pacing is functioning. Fail - Pacing is not functioning. 	<p>If the pacer fails, attach a different pads cable and test load and repeat the test.</p> <p>If the pacer fails again, take the device out of use and call for service.</p>
CPR meter	<ul style="list-style-type: none"> Pass - The CPR meter passed its self test. Fail - The CPR meter failed its self test. 	If the test fails, call for service. If Q-CPR is essential to patient care, take the device out of use.
Leads ECG	<ul style="list-style-type: none"> Pass/ECG Cable - leads ECG acquisition and the ECG cable connected are both functioning. Pass/No Cable - leads ECG acquisition is functioning. Fail/ECG Cable- leads ECG acquisition and/or the ECG cable connected are not functioning. Fail/No Cable - leads ECG acquisition is not functioning. 	If the test fails without an ECG cable connected, take the device out of use and call for service. If the test fails with a cable, repeat the test without an ECG cable attached. A passing result without a cable attached indicates the cable is defective and should be replaced. If the test continues to fail, take the device out of use and call for service.

Table 77 Operational Check Test Results (Continued)

Test	Results	Action if Test Does Not Pass
Pads/Paddles ECG	<p>Pass/cable type - ECG acquisition and the cable are both functioning.</p> <p>Pass/No cable - ECG acquisition is functioning; a cable was not tested.</p> <p>Fail/cable type- ECG acquisition and/or the cable specified are not functioning.</p>	If the test fails with a cable connected, remove the cable and repeat the test. If the test passes without the cable, replace the cable. If the test continues to fail, take the device out of use and call for service.
Battery A Battery B	<ul style="list-style-type: none"> • None - There is no battery in the slot. • Pass - The battery has 20% or greater capacity. • Fail - The battery has 20% or less capacity. • Cal Recommended - The battery requires calibration. 	<p>Charge the battery.</p> <p>Calibrate the battery.</p>
SpO ₂	<ul style="list-style-type: none"> • Pass - SpO₂ passed its self-test. • Fail - SpO₂ is not functioning. 	If the test fails, call for service to repair the SpO ₂ module. If SpO ₂ monitoring is essential to patient care, take the device out of use.
NBP	<ul style="list-style-type: none"> • Pass - NBP passed its self-test. • Fail - NBP is not functioning. • Pass (Cal Due) - NBP passed its self-test and is due to be calibrated. • Fail (Cal Overdue) - NBP passed its self-test but is overdue for calibration. Measurements may be inaccurate. • Fail (Replacement Recommended) - NBP passed its self-test but has exceeded 50,000 cycles. 	<p>If the test fails, call for service to repair the NBP module. If NBP monitoring is essential to patient care, take the device out of use.</p> <p>If calibration is due or overdue, arrange for a qualified service provider to perform the calibration.</p> <p>If replacement is recommended, call for service.</p>
CO ₂	<ul style="list-style-type: none"> • Pass - CO₂ passed its self-test. • Fail - CO₂ is not functioning. • Pass (Cal Due) - CO₂ is passed its self-test and is due for calibration. • Fail (Cal Overdue) - CO₂ passed its self-test and is overdue for calibration. Measurements may be inaccurate. • Fail (Replacement Recommended) - CO₂ passed its self-test but has exceeded 15,000 operating hours. 	<p>If the test fails, call for service to repair the CO₂ module. If CO₂ monitoring is essential to patient care, take the device out of use.</p> <p>If calibration is due or overdue, arrange for a qualified service provider to perform the calibration.</p> <p>If replacement is recommended, call for service.</p>

Table 77 Operational Check Test Results (Continued)

Test	Results	Action if Test Does Not Pass
Invasive Pressures	<ul style="list-style-type: none"> • Pass - Invasive Pressures passed its self-test. • Fail - Invasive Pressures is not functioning. 	If the test fails, call for service (to replace the Invasive Pressures/Temperature board.) If invasive pressure monitoring is essential to patient care, take the device out of use.
Temperature	<ul style="list-style-type: none"> • Pass - Temperature passed its self-test. • Fail - Temperature failed its self-test. 	If the test fails, call for service (to replace the Invasive Pressure/Temperature board.) If temperature monitoring is essential to patient care, take the device out of use.
Bluetooth	<ul style="list-style-type: none"> • Pass - A Bluetooth card is detected and communicating. • Fail - A Bluetooth card is not installed or is not functioning. 	If the test fails, call for service.
Printer	<ul style="list-style-type: none"> • Pass - The printer passed its self-test. • Fail - The printer needs repair. 	If the test fails, call for service.

Operational Check Summary

The Operational Check Summary lists the results from the last 60 Operational Checks. Test results are reported as described in Table 77.

To view the Operational Check Summary:


- 1 Turn the Therapy Knob to **Monitor**.
- 2 Press the Menu Select  button.
- 3 Using the Navigation buttons, select **Other** and press the Menu Select button.
- 4 Select **Operational Check** and press the Menu Select button.
- 5 Using the Navigation buttons, select **Op Check Summary** and press the Menu Select button.
- 6 Press the Menu Select button to acknowledge the message, **Leaving Normal Operational Mode**.
The Operational Check Summary screen is displayed.
- 7 Press the **[Print]** soft key to print the report.

Table 78 Operational Check Summary Results

Result	RFU Indicator	Definition	Required Action
Pass	Hourglass	All tests passed	None
Fail/DX	Solid red X, chirp	A problem has been detected that may prevent the delivery of a shock, pacing, or ECG acquisition.	Turn the Therapy Knob to Monitor. An inop indicating the problem is displayed. See Chapter 22, Troubleshooting, for the corrective action.
Fail/CX	Solid red X, chirp.	A problem has been detected with a cable.	Turn the Therapy Knob to Monitor. An inop indicating the failed cable is displayed. Replace the failed cable.
Fail/BF	N/A ¹	A battery failure was detected.	Replace the battery.
Fail/D	Hourglass	A problem has been detected with a component that does not affect therapy delivery.	Turn the Therapy Knob to Monitor. An inop indicating the failed component is displayed. See Chapter 22, Troubleshooting, for the corrective action.
Fail/S	Hourglass	CPR meter failure.	Check the CPR meter and cable connections. If necessary, replace the CPR meter.

1.. The Automated Tests continually check for a low battery condition and set the RFU Indicator appropriately.

Battery Maintenance

Battery maintenance is essential to ensure that the battery's state of charge is accurately reported, there is sufficient charge and capacity to operate your HeartStart MRx, and battery life is optimized. Remove faulty batteries from service immediately.

Battery maintenance begins upon receipt of a new battery, and continues throughout the life of the battery. Detailed information on battery care is available in the Application Note, "*M3538A Lithium Ion Battery Characteristics and Care*", which was provided with your HeartStart MRx.

Table 79 lists battery maintenance activities and when they should be performed.

Table 79 Battery Maintenance Procedures

Activity	When to Perform
Perform a visual inspection.	As part of the Operational Check.
Charge the battery.	Upon receipt, after use, or if the message Batteries Low is displayed.
Perform a calibration.	When the Operational Check test results state Calibration Recommended , or every 6 months, whichever comes first.
Store batteries in a state of charge in the range of 20% - 40%	When not in use for an extended period of time.
Discard the battery.	When there are visual signs of damage or calibration reports less than 80% capacity.

Battery Life

Battery life depends on the frequency and duration of use. When properly cared for, the M3538A Lithium Ion battery has a useful life of approximately 2 years. To optimize performance, a fully (or nearly fully) discharged battery should be charged as soon as possible.

Charging Batteries

The M3538A Lithium Ion Battery should be charged in either the HeartStart MRx or in a Philips-approved battery support system. The two methods of charging in the HeartStart MRx are as follows:

Using AC power - Insert the battery to be charged into Battery Compartment A. Insert the AC Power Module into Battery Compartment B and connect to an AC power source.

Using DC power - Insert a battery to be charged into Battery Compartment A. If a second battery is in need of charging, insert it in Battery Compartment B. Connect the DC Power Module to the HeartStart MRx and the DC power source.

Once AC or DC power is applied, the External Power Indicator turns green and batteries in the HeartStart MRx charge. Batteries are charged one at a time. With the HeartStart MRx turned off and at a temperature of 25°C (77°F), a fully discharged battery typically charges to 80% of its capacity in 2 hours, and to 100% of its capacity in 3 hours. Batteries charge at a slower rate with the device turned on.

Batteries should be charged at temperatures between 0°C (32°F) and 45°C (113°F).

Charge Status


You can check the battery's state of charge by:

- periodically pushing the fuel gauge button on the battery to illuminate the fuel gauge. Each LED represents a charge of approximately 20% of capacity.
- turning the Therapy Knob to any mode of operation and observing the battery power indicators displayed in the General Status area (see "General Status" on page 14).

Battery Calibration

Battery capacity diminishes with use and age. Battery calibration checks to see if the battery is nearing the end of its useful life and should be discarded. Battery calibration also ensures that the fuel gauge provides accurate estimates of the battery's state of charge, based on the total available capacity.

Calibrate a battery when the **Cal Recommended** message appears during an Operational Check, or every 6 months, whichever comes first. Battery calibration may be performed in the HeartStart MRx or in a Philips-approved battery support system. To calibrate a battery in the HeartStart MRx:

- 1 Connect the HeartStart MRx to AC or DC power.
- 2 Insert the battery to be calibrated into Battery Compartment A or B.
- 3 Turn the Therapy Knob to **Monitor**.
- 4 Press the Menu Select  button.
- 5 Using the Navigation buttons, select **Other** and press the Menu Select button.
- 6 Select **Battery Calibration** and press the Menu Select button.
- 7 Press the Menu Select button to acknowledge the message, **Leaving Normal Operational Mode**. The Calibration view is displayed. If external power is not detected, you are prompted to **Apply External Power**. If there is no battery in either battery compartment, you are prompted to **Insert Battery**. If there are batteries in both battery compartments, you must select which battery to calibrate.

- 8 Press the **[Start]** soft key to begin calibrating.

The calibration procedure charges the battery to full capacity, drains the battery in preparation for calibration, calibrates the battery, and then charges it again following calibration. Once you see the message, **Calibration Complete. The battery charges faster when the device is turned off**, you may turn the Therapy Knob to **Off** to allow the battery to charge more quickly.

Calibration takes approximately 11 hours to complete in the HeartStart MRx. Progress is shown on the display. It takes significantly less time to calibrate in a Philips-approved battery support system. Monitoring/therapy functions are not available during battery calibration in the MRx. If it is necessary to terminate calibration to resume clinical use, press the **[Cancel]** soft key.

WARNING Battery calibration is terminated if external power or the battery being calibrated is removed before the calibration process is completed. If calibration is terminated, the battery will not be calibrated and its capacity may be very low.

Calibration Results

When a battery is calibrated in the HeartStart MRx, a **Pass** or **Fail** is reported to indicate whether calibration completed successfully. In addition, an estimate of battery capacity is provided so you can determine if the battery is fit for use.

When a battery is calibrated in a Philips-approved battery support system the estimated battery capacity is not displayed. To view the capacity:

- 1 Insert the calibrated battery into a HeartStart MRx that is not connected to a patient
- 2 Turn the Therapy Knob to Monitor
- 3 Press the Menu Select button, highlight **Other** and press the Menu Select button again
- 4 Highlight **Battery Calibration** and press the Menu Select button
- 5 Press the Menu Select button to acknowledge leaving normal operating mode
- 6 Press the **[Start]** softkey and wait until any information appears in the first **Charging:** line
- 7 Press the **[Cancel]** softkey
- 8 The battery capacity is displayed at the top of the screen

In either instance, if the capacity is:

- $\geq 80\%$ continue to use the battery
- $< 80\%$ discard the battery

NOTE After successfully calibrating your batteries, perform an Operational Check. You may be prompted to recalibrate depending upon the condition of your battery.

Storing Batteries

Batteries should be rotated regularly to ensure even usage. When storing batteries, make sure that the battery terminals do not come in contact with metallic objects.

If batteries are stored for an extended period of time, they should be stored in a cool place, with a partial charge of 20% (1 LED illuminated) to 40% (2 LED's illuminated) capacity. Storing batteries in a cool place slows the aging process. The ideal storage temperature is 15°C (60°F). Batteries should not be stored at temperatures outside the range of -20°C (-4°F) to 60°C (140°F).

-
- CAUTION**
- Do not store batteries in the HeartStart MRx if it is out of service for an extended period of time.
 - Storing batteries at temperatures above 38°C (100°F) for extended periods of time significantly reduces a battery's life expectancy.
-

Stored batteries should be charged every 2 months to 20% - 40% of their full capacity. They should be charged to full capacity prior to use.

Discarding Batteries

Batteries should be discarded if there are visual signs of damage or if they fail calibration. Batteries should be discarded in an environmentally safe manner. Properly dispose of batteries according to local regulations.

-
- WARNING** Do not disassemble, puncture, or incinerate batteries. Be careful not to short the battery terminals because this could result in a fire hazard.
-

-
- CAUTION** Use caution when handling, using, and testing the batteries. Do not short circuit, crush, drop, mutilate, puncture, apply reverse polarity, expose to high temperatures, or disassemble. Misuse or abuse could cause physical injury.
-

- NOTE** Wash skin with large amounts of water in the event of electrolyte leakage to prevent skin irritation and inflammation.

Cleaning Instructions

Listed below are recommendations for cleaning the HeartStart MRx and its associated accessories.

-
- CAUTION**
- The HeartStart MRx, along with its accessories and supplies, may not be autoclaved, steam sterilized, ultrasonically cleaned, or immersed unless otherwise indicated in the Instructions for Use that accompany the accessories and supplies.
 - Do not use abrasive cleaners or strong solvents such as acetone or acetone-based cleaners.
 - Do not mix disinfecting solutions (such as bleach and ammonia) as hazardous gases may result.
 - Do not clean electrical contacts or connectors with bleach.
 - Disinfect the device as determined by your institution's policy to avoid long-term damage to the device.
-

Monitor/Defibrillator

The following cleaning products may be used to clean the exterior surfaces of the monitor/defibrillator, as well as the batteries and data card:

- Isopropyl alcohol (70% solution in water).
- Mild soap and water.
- Sodium hypochlorite (chlorine bleach) (3% solution in water).
- Quaternary ammonium compounds (21% quaternary ammonium content) (such as Steris Coverage Plus NPD®) (.5 oz. per gallon water - one part Coverage Plus NPD® to 255 parts water).

Before cleaning, remove all adherent soil (tissue, fluids, etc.) and wipe thoroughly with a cloth dampened with water before applying the cleaning solution.

When cleaning, do not immerse. Wring any excess moisture from the cloth before cleaning. Be sure to avoid pouring fluids on the device, and do not allow fluids to penetrate the exterior surfaces of the device. To prevent scratching the display, the use of a soft cloth is recommended.

-
- CAUTION** Do not use quaternary ammonium compounds like Steris Coverage Plus NPD to clean the CPR meter.
-

Printer Printhead

If the printout has light or varying print density, clean the printhead to remove any buildup of paper residue.

To clean the printhead:

- 1 Push the printer door latch to open the door.
- 2 Remove the roll of paper.
- 3 Clean the printhead surface (above the brush) with a cotton swab dipped in isopropyl alcohol.
- 4 Replace the roll of paper.

Paddles, Therapy Cable

If external non-sterilizable paddles were used during defibrillation, make sure you thoroughly clean the paddles and paddle tray after each patient event and before performing an Operational Check or Weekly Shock Test. Verify that there is no debris or residue (including all conductive material) on the electrode surfaces of the paddles and paddle tray. External non-sterilizable paddles and the Therapy cables may be cleaned with a soft cloth moistened with:

- Mild soap and water.
- 3.4% glutaraldehyde content such as CidexPlus®
- Sodium hypochlorite (chlorine bleach) (3% solution in water).
- Quaternary ammonium compounds (21% quaternary ammonium content, such as Steris Coverage Plus NPD), (.5 oz. per gallon water - one part Coverage Plus NPD to 255 parts water).
- Isopropyl alcohol (70% solution in water).

CAUTION The paddles and Therapy cables may not be ultrasonically cleaned or immersed. Nor may they be autoclaved or ETO sterilized.

NOTE For information about cleaning and sterilizing internal and external sterilizable paddles, see the *Sterilizable Defibrillator Paddles Instructions for Use*.

Philips' disposable sterile internal defibrillation paddles, multifunction electrode pads and monitoring electrodes are single use items and do not require cleaning.

ECG Cable

For M3525A, M3526A, M3527A, M3528A, M3529A and 989803147691 ECG cables:

- Wipe clean with any of the following:
 - Isopropyl alcohol (70% solution in water).
 - Mild soap and water.
 - Glutaraldehyde solution (3.4% glutaraldehyde content such as CidexPlus).
 - Quaternary ammonium compounds (21% quaternary ammonium content such as Steris Coverage Plus NPD). Dilution: .5 oz. per gallon water - one part Coverage Plus NPD to 255 parts water.
 - Chlorine bleach (6% sodium hypochlorite), 3% solution in water. This solution may discolor the cable.

For any other approved ECG cable:

- Clean according to the manufacturer's instructions.

CAUTION Do not ultrasonically clean, immerse, autoclave, or steam sterilize the ECG cable. Do not clean electrical contacts or connectors with chlorine bleach.

Carrying Case

The carrying case may be cleaned by hand with mild soap and water. Fabric stain removers may be used to remove stubborn stains. Air dry the carrying case. Do not wash or dry by machine.

NBP Cuff

The cuff can be disinfected by immersion in a decontamination solution of 70-85% isopropyl alcohol, but remember to remove the rubber bag if you use this method. The cuff should not be dry cleaned.

The cuff can also be machine-washed or hand-washed as recommended by the manufacturer; the latter method will prolong the service life of the cuff. Before washing, remove the latex rubber bag and, for machine-washing, close the hook and loop fastening. Allow the cuff to dry thoroughly after washing, then reinsert the rubber bag.

SpO₂ Sensor and Cable

To clean the SpO₂ sensor and cable, follow the instructions provided with the accessory.

Invasive Pressures Transducer and Cable

To clean the invasive pressure cable, follow the instructions provided with the accessory.

Temperature Probe and Cable

To clean the temperature probe and cable, follow the instructions provided with the accessory.

CPR meter

You should examine the CPR meter vent membrane in the center of the rear cover after each use. If needed, use a soft cloth or toothbrush to gently clean the vent membrane. If damaged or still soiled after cleaning, replace the rear cover. Keep sharp objects away from the vent membrane. See the HeartStart MRx *Service Manual Addendum* for instructions.

If the CPR meter has been used in a training situation it can be cleaned using an alcohol wipe (70% ethanol solution).

If the CPR meter has been used in a clinical situation, clean it as follows:

- 1 Clean and scrub the exterior using a mild detergent and either a soft cloth or toothbrush until the surfaces are visually clean. Wipe the exterior with a soft cloth dampened with lukewarm tap water.
- 2 Clean the exterior using a 3% solution of RelyOn™ or Virkon®. Spray the solution on all exterior surfaces and wait at least five minutes. Alternative cleaning agents include isopropyl alcohol (70% solution in water).
- 3 Wipe the exterior with a clean soft cloth dipped in distilled water. Allow to dry completely.

CAUTION Do not immerse the CPR meter in water, hold it under running water or allow moisture to penetrate in. Do not sterilize.

Do not use quaternary ammonium compounds like Steris Coverage Plus NPD to clean the CPR meter.

HeartStart MRx Disposal

Prior to disposal, remove the batteries. Then dispose of the device and accessories in accordance with your country's regulations for equipment containing electronic parts.

WARNING Disposal of the device with the battery inserted presents a potential shock hazard.

To avoid contaminating or infecting personnel, the environment, or other equipment, make sure you disinfect and decontaminate the monitor/defibrillator and any appropriate device accessories appropriately prior to disposal.

NOTE This product consists of devices that may contain mercury, which must be recycled or disposed of in accordance with local, state or federal laws. Within this system, the backlight lamps in the monitor display contain mercury.

Empty Calibration Gas Cylinders Disposal

To dispose of empty calibration gas cylinders:

- 1 Empty the cylinder completely by pushing the pin of the regulator valve or by pulling out the pin of the fill valve using a tire valve stem wrench or a pair of needle nose pliers.
- 2 Write "Empty" on the cylinder and dispose of it appropriately for scrap metal.

CPR Meter and Adhesive Pads Disposal

The CPR meter contains electronic components. Dispose of it at an appropriate recycling facility in accordance with local regulations. A used patient adhesive pad may be contaminated with body tissue, fluid or blood. Dispose of it as infectious waste.

Supplies & Accessories

This chapter lists the various supplies and accessories for the HeartStart MRx.

Overview

Approved supplies and accessories for your HeartStart MRx are listed in the following tables. To order: In the USA, call 1-800-225-0230 (pads, electrodes, cables, paper, etc.).

Outside the USA, contact your local Philips Healthcare Sales Office, your authorized Philips Healthcare Dealer or Distributor, or visit our website at: <http://philips.com/healthcarestore> and follow the Medical Supplies link.

WARNING Use only supplies and accessories approved for use with your HeartStart MRx. Use of non-approved supplies and accessories could affect performance and results.

WARNING Use single-use supplies and accessories only once.

Table 80 Supplies and Accessories

External Paddles	
M3542A	Standard External Paddles
M3543A	Water Resistant External Paddles
M4745A	Sterilizable External Paddles
Internal Paddles	
M1741A	7.5 cm Switchless
M1742A	6.0 cm Switchless
M1743A	4.5 cm Switchless
M1744A	2.8 cm Switchless
M4741A	7.5 cm Switched
M4742A	6.0 cm Switched

Table 80 Supplies and Accessories (Continued)

M4743A	4.5 cm Switched
M4744A	2.8 cm Switched
M4740A	Internal Paddles Adapter Cable
Multifunction Electrode Pads	
M3713A	Adult Plus
M3716A	Adult Radiolucent
M3717A	Pediatric Plus
M3718A	Adult Radiotransparent/Reduced Skin
M3719A	Pediatric Radiotransparent/Reduced Skin
M3501A	Defib Adult, AAMI
M3502A	Defib Adult, IEC
M3503A	Defib Pediatric, IEC
M3504A	Defib Pediatric, AAMI
Pads Cables	
M3507A	Defib Hands-free Pads Cable, barrel style - 2.2m (7 ft.)
M3508A	Hands-free Pads Cable, plug style - 2.2m (7 ft.)
05-10200	Pads Adapter (use with M3507A)
989803158661	Defibrillator Pads Hands Free Cable; CPR meter cable and connector
ECG Monitoring Electrodes	
M2202A	High-Tack Foam ECG Electrodes, 5 electrodes/pack (60 packs/case)
M4612A	Solid Gel ECG Electrodes, 5 electrodes/pack (60 packs/case)
M4613A	Solid Gel ECG Electrodes, 30 electrodes/pack (10 packs/case)
12-Lead ECG Cable Set	
M3525A	2.7 meter 10-lead ECG Trunk Cable, 12-pin Connector (for 3-Lead, 5-Lead and 12-Lead use)
989803147691	1.3 meter 10-lead ECG Trunk Cable, 12-pin Connector (for 3-Lead, 5-Lead and 12-Lead use)
M3526A	3-wire Lead Set with Snap (AAMI)
M3527A	Add 7-wire Lead Set for 12-Lead use (AAMI)
M3528A	3-wire Lead Set with Snap (IEC)
M3529A	Add 7-wire Lead Set for 12-Lead use (IEC)
M5530A	Combiner Plug for 3-wire Lead Set for use with M3526A/M3528A
M1663A	10-lead ECG Patient Trunk Cable, 12-pin ECG Input Connector (for 5-Lead and 12-Lead use) (AAMI)
M1949A	10-lead ECG Patient Trunk Cable, 12-pin ECG Input Connector (for 5-Lead and 12-Lead use) (IEC)
M1968A	10-electrode Cable Set, Extremities, Grabber (use with M1976A) (AAMI)
M1976A	10-electrode Cable Set, Chest, Grabber (use with M1968A) (AAMI)
M1971A	10-electrode Cable Set, Extremities, Grabber (use with M1978A) (IEC)
M1978A	10-electrode Cable Set, Chest, Grabber (use with M1971A) (IEC)
3-Lead ECG Cable Set	
M1500A	3-lead ECG Trunk Cable (AAMI)

Table 80 Supplies and Accessories (Continued)

M1510A	3-lead ECG Trunk Cable (IEC)
M1605A	3-lead ECG Lead Set with Snaps (AAMI)
M1615A	3-lead ECG Lead Set with Snaps (IEC)
M1669A	3-Lead Trunk Cable
M1671A	3-Lead ICU Grabber (AAMI)
M1672A	3-Lead ICU Grabber (IEC)
M1673A	3-Lead ICU Snaps (AAMI)
M1674A	3-Lead ICU Snaps (IEC)
M1675A	3-Lead OR Grabber (AAMI)
M1678A	3-Lead OR Grabber (IEC)
5-Lead ECG Cable Set	
M1520A	5-lead ECG Trunk Cable (AAMI)
M1530A	5-lead ECG Trunk Cable (IEC)
M1602A	5-Lead Chest ICU Snaps (AAMI)
M1604A	5-Lead Chest ICU Snaps (IEC)
M1625A	5-lead ECG Lead Set with Snaps (AAMI)
M1635A	5-lead ECG Lead Set with Snaps (IEC)
M1644A	5-Lead ICU Snaps (AAMI)
M1645A	5-Lead ICU Snaps (IEC)
M1668A	5-Lead Trunk Cable
M1968A	5-Lead ICU Grabber (AAMI)
M1971A	5-Lead ICU Grabber (IEC)
M1973A	5-Lead OR Grabber (AAMI)
M1974A	5-Lead OR Grabber (IEC)
M1976A	5-Lead Chest ICU Grabber (AAMI)
M1978A	5-Lead Chest ICU Grabber (IEC)
M1979A	5-Lead Chest OR Grabber (AAMI)
M1984A	5-Lead Chest OR Grabber (IEC)
989803158061	5-Lead ECG Lead Set; Limb Leads; Snaps; Shielded Electrode (AAMI)
989803158071	5-Lead ECG Lead Set; Chest Leads; Snaps; Shielded Electrode (AAMI)
989803158081	5-Lead ECG Lead Set; Limb Leads; Snaps; Shielded Electrode (IEC)
989803158091	5-Lead ECG Lead Set; Chest Leads; Snaps; Shielded Electrode (IEC)
Sync Cables	
M1783A	Sync Cable (8 ft.)
M5526A	Sync Cable (25 ft.)
SpO₂ Sensors and Cables	
M1191A	Reusable SpO ₂ Sensor - Adult Finger (2 meters)
M1191AL	Reusable SpO ₂ Sensor - Adult Finger (3 meters)
M1191B	Reusable SpO ₂ Sensor - Adult Finger (2 meters)
M1191BL	Reusable SpO ₂ Sensor - Adult Finger (3 meters)
M1191T	Reusable Adult Finger Sensor (Nellcor® 9-pin D-sub connector)

Table 80 Supplies and Accessories (Continued)

M1192A	Reusable SpO ₂ Sensor - Pediatric/Small Adult Finger
M1192T	Reusable Pediatric Sensor (Nellcor 9-pin D-sub connector)
M1194A	Reusable SpO ₂ Sensor - Adult/Pediatric Ear Clip
M1195A	Reusable SpO ₂ Sensor - Infant
M1196A	Reusable Clip Adult Sensor
M1196T	Reusable Clip Adult Sensor (Nellcor 9-pin D-sub connector)
M1941A	SpO ₂ Extension Cable, 2 m
M1943A	1m Nellcor adapter
M1131A	Disposable SpO ₂ Sensor - Pediatric/Adult Finger
NBP	
	Interconnect Tubing
M1598B	Adult Pressure Interconnect Cable (1.5 m)
M1599B	Adult Pressure Interconnect Cable (3 m)
	Reusable Blood Pressure Cuffs
40400A	Reusable NBP Cuff Kit, 3 sizes (pediatric, adult, large adult)
40400B	Reusable NBP Cuff Kit, 5 sizes (infant, pediatric, adult, large adult, thigh)
40401A	Traditional Reusable NBP Cuff - Infant
40401B	Traditional Reusable NBP Cuff - Pediatric
40401C	Traditional Reusable NBP Cuff - Adult
40401D	Traditional Reusable NBP Cuff - Large Adult
40401E	Traditional Reusable NBP Cuff - Thigh
M4552B	Easy Care NBP Cuff - Infant
M4553B	Easy Care Reusable NBP Cuff - Pediatric
M4554B	Easy Care Reusable NBP Cuff - Small Adult
M4555B	Easy Care Reusable NBP Cuff - Adult
M4557B	Easy Care Reusable NBP Cuff - Large Adult
M4559B	Easy Care Reusable NBP Cuff - Thigh
M1572A	Multi-Patient Comfort Cuffs - Pediatric
M1573A	Multi-Patient Comfort Cuffs - Small Adult
M1574A	Multi-Patient Comfort Cuffs - Adult
M1575A	Multi-Patient Comfort Cuffs - Large Adult
	Disposable Blood Pressure Cuffs
M4572B	Soft Single-Patient Disposable Cuff - Infant
M4573B	Soft Single-Patient Disposable Cuff - Pediatric
M4574B	Soft Single-Patient Disposable Cuff - Small Adult
M4575B	Soft Single-Patient Disposable Cuff - Adult
M4576B	Soft Single-Patient Disposable Cuff - Adult X-Long
M4577B	Soft Single-Patient Disposable Cuff - Large Adult
M4578B	Soft Single-Patient Disposable Cuff - Large Adult X-Long
M4579B	Soft Single-Patient Disposable Cuff - Thigh

Table 80 Supplies and Accessories (Continued)

EtCO ₂	
	Intubated Circuits
M1920A	FilterLine Set - Adult/Pediatric (25 sets/case)
M1921A	Filter H Set - Adult/Pediatric (25 sets/case)
M1923A	Filter H Set - Infant/Neonatal (yellow, 25 sets/case)
	Non-Intubated Dual Purpose Circuits (CO₂ + O₂)
M2520A	Smart CapnoLine - Pediatric
M2522A	Smart CapnoLine - Adult
	Non-Intubated Single Purpose Circuits (CO₂)
M2524A	Smart CapnoLine - Pediatric
M2526A	Smart CapnoLine - Adult
Invasive Pressures	
CPJ840J6	Reusable pressure transducer
CPJ84022	Sterile disposable pressure dome for use with CPJ840J6
CPJ84046	Transducer holder for CPJ840J6
M1567A	Single channel disposable blood pressure kit (available in Europe and Asia only)
M1568A	Dual Line blood pressure kit for measuring CVP, ABP and other pressure measurements. (available in Europe and Asia only)
M1634A	Reusable adapter cable (available in Europe and Asia only)
TransPac® IV	Disposable transducer*
TruWave® PX212	Disposable transducer*
DTX Plus™ DT-4812	Disposable transducer*
* - Contact the individual manufacturers for purchasing and service information.	
Temperature	
	Disposable Temperature Probes
21090A	Esophageal/rectal
21091A	Skin surface
21093A	Esophageal stethoscope
21094A	Esophageal stethoscope
21095A	Esophageal stethoscope
21096A	Foley catheter
21097A	Foley catheter
M1837A	Esophageal/rectal
M2255A	Foley catheter
	Reusable Temperature Probes
21075A	Esophageal/rectal - adult
21076A	Esophageal/rectal - pediatric
21078A	Skin surface
	Reusable Temperature Probe Extension Cables
21082A	3.0m 2-pin plug extension cable for mini phone plug
21082B	1.5m 2-pin plug extension cable for mini phone plug

Table 80 Supplies and Accessories (Continued)

Power	
M3538A	Lithium Ion Battery
M3539A	AC Power Module
M5529A	DC Power Module
M5528A	DC Power Module Mounting Bracket
989803135301	2-Bay Battery Support System for Lithium Ion Batteries
989803135331	4-Bay Battery Support System for Lithium Ion Batteries
989803135341	4-Bay Battery Support System for Sealed Lead Acid and Lithium Ion Batteries
Q-CPR	
M4761A	Compression Sensor
M4762A	Compression Sensor Adhesive Pads (Package of 10)
M4763A	Pads/CPR Cable for use with Compression Sensor
989803158661	Pads/CPR Cable for use with CPR meter
989803162401	CPR meter (for Q-CPR option with HeartStart MRx software Rev. F or higher)
989803163291	CPR meter Adhesive Pads (10)
Networking	
989803148551	Instrument Telemetry 1.4 GHz radio and A/C module
M4842-61300	1.4 GHz replacement antenna
Paper	
40457C	50 mm Chemical Thermal Paper, Gray Grid (10 rolls)
40457D	50 mm Chemical Thermal Paper, Gray Grid (80 rolls)
989803138171	75 mm Chemical Thermal Paper, Red Grid (10 rolls)
989803138181	75 mm Chemical Thermal Paper, Red Grid (80 rolls)
Color Handle	
M5521A	Green
M5522A	Blue
M5523A	Yellow
M5524A	Rose
M5525A	Gray
Miscellaneous	
M1781A	Test Load for use with M3507A Pad Cable
M3725A	Test Load for use with M3508A Pad Cable
M3541A	Carrying Case
989803146981	Data Card and Tray
M3544A	Data Card Tray
M3853A	Data Card Tray (also used with HeartStart FR2)
M3854A	Data Card and Tray (also used with HeartStart FR2)
M4737A	Display Cover
M3549A	Wide bedrail hook
989803153411	Internal Bluetooth Card

Troubleshooting

If the HeartStart MRx detects an error or potential problem during use, it displays an INOP statement or a message window with text to guide you. INOP statements and messages are often accompanied by a voice prompt or an audible beeping tone. This chapter describes the INOP statements and messages that you may see, along with other symptoms, and provides suggestions for what to do. In addition, this chapter provides an explanation of audible tones and information on contacting your service representative.

If you are unable to resolve a problem using the suggestions in this chapter:

- Run an Operational Check to determine if there is a malfunction requiring service.
- If a malfunction is identified, call for service.
- Take the HeartStart MRx out of use if there is a malfunction affecting ECG monitoring, defibrillation, or pacing. For malfunctions related to SpO₂, NBP, Invasive Pressures, Temperature, CO₂ monitoring, or 12-Lead functionality, take the device out of service if the function is essential to patient care in your organization.

Results of Automated Tests associated with critical functionality of the device are reported through the Ready For Use indicator and the Automated Test Summary report. For information on responding to these results, see “Ready For Use Indicator” on page 266. To respond to errors reported through Operational Check see “Operational Check Test Results” on page 279.

For further technical and repair information, refer to the HeartStart MRx *Service Manual*.

WARNING Product servicing and repair should only be performed by qualified service personnel.

Symptoms

The following tables list symptoms, INOP statements, and messages that you may encounter, along with possible causes of the problem, and potential solutions. Symptoms are characterized by functionality.

Table 81 General Problems

Symptom	Possible Cause	Possible Solution
The HeartStart MRx does not turn on.	There is no power.	Insert a fully charged battery. Connect to AC/DC power.
Audio is too low or absent.	The QRS , Voice , or Alarm volume is configured to a Very Soft or Off setting.	Use the Volume menu to adjust the volume of the QRS beeper, voice prompts, and/or alarms.
Low battery life (appears to deplete quickly).	The battery may be nearing its end of life.	Replace the battery.
Battery charge indicators inaccurate.	The battery may need calibration.	Calibrate the battery.
All Settings Have Been Reset To Default Values message.	A power failure or critical software error has occurred.	Reset alarms, waveforms, volumes, and other settings previously defined for the current patient.
All Settings Have Been Set To Factory Default Values message, accompanied by a Power Interrupted or Device Restarted message.	Corrupt or incomplete configuration file.	Reload device configuration file.
Batteries Low message.	The batteries may not have enough remaining charge to provide 10 minutes of monitoring time or six 200J shocks.	Insert a fully charged battery. Connect to AC/DC power.
Battery A Low - Switching to Battery B (or vice-versa) message.	The specified battery needs charging.	Charge the low battery.
Device Error. Service Required. message	Failure detected during start-up.	Take the device out of use and call for service.
External Power Interrupted message.	AC/DC power was removed; now operating from battery power.	Connect to AC/DC power, if appropriate.
Fan Failure message.	The internal fan should be running but it is not.	Call for service.
Internal Memory Failure message. INOP message appears every time the device is turned on.	The internal memory card has been reformatted after failing an automated test.	Although all previous data stored on the card has been erased, it is now ready once again to record data.
	Patient data cannot be stored in internal memory because the internal memory card is not recognized.	Call for service.
	An attempt to print an Event Summary or trending report was requested during power up.	Data Card was not available. Cycle the power. Wait at least 16 seconds after power up before attempting to print an Event Summary or trending report.

Table 81 General Problems (Continued)

Symptom	Possible Cause	Possible Solution
Event Storage Full message.	Event Summary data for the current patient case exceeds the storage capacity of internal memory or you've reached the 12-hour limit.	Copy or print Event Summary to retain data and then begin a new patient case. Print the Event Summary Report. Begin a new patient case.
Power Supply Failure INOP.	There is a problem with the internal power supply.	Remove the device from use and call for service.
Replace Clock Battery message.	The battery on the internal clock needs to be replaced.	Call for service.
Shock Equip Malfunction INOP.	A shock can not be delivered due to a hardware failure.	Remove the device from use and call for service.
Shutting Down in 1 Minute message.	Very low battery and the device is not connected to AC/DC power.	Insert a charged battery and/or connect to AC/DC power.
Shutting Down Now message.	Battery charge is depleted and the device is not connected to AC/DC power.	Insert a charged battery and/or connect to AC/DC power. Settings for the current patient may need to be reset.
Arching or sparking during paddles-in-pocket test therapy discharge (Weekly Shock Test).	Debris or residue, such as electrolytic gel, on the surfaces of the paddles and/or paddles tray.	Clean paddles and paddles tray.

Table 82 ECG Monitoring Problems

Symptom	Possible Cause	Possible Solution
QRS beeper inaudible or beeps do not occur with each QRS complex.	The QRS volume is configured to Off or the setting is too low.	Configure the QRS beeper volume.
	The QRS volume was turned Off or set too low through the Volume menu.	Adjust the volume through the Volume menu.
	The amplitude of the QRS complex is too small to detect.	Select a different lead.
Poor ECG signal quality (noisy trace, wandering baseline, etc.) from signal acquired through monitoring electrodes.	The monitoring electrodes are not making proper contact with the patient.	Check that the monitoring electrodes are properly applied. If necessary, prepare the patient's skin and apply new electrodes. Check the date code on the electrodes. Do not open the electrode package until immediately prior to use.
	The monitoring electrodes are outdated or dried-out.	Check the date code on the electrodes. Do not open the electrode package until immediately prior to use
	Radio frequency interference (RFI) is causing artifact.	Relocate or turn off equipment that may be causing RFI. Try repositioning cables/leads.
	The ECG cable may be faulty.	Run the Operational Check with the ECG cable. If the test fails, run it without the ECG cable. If the test passes, replace the cable. If not, remove the device from use and call for service.

Table 82 ECG Monitoring Problems (Continued)

Symptom	Possible Cause	Possible Solution
Poor ECG signal quality (noisy trace, wandering baseline, etc.) from signal acquired through paddles/pads.	The paddles/pads are not making proper contact with the patient.	Ensure proper skin preparation and correction application. If necessary, apply new pads.
	The pads are outdated or dried-out.	Check the date code on the pads. Do not open the pads package until immediately prior to use.
	Radio frequency interference (RFI) is causing artifact.	Relocate or turn off equipment that may be causing RFI. Try repositioning the pads cable.
	The paddles/pads cable may be faulty.	Run the Operational Check with the pads cable. If the test fails, run it without the pads cable. If the test passes, replace the cable. If not, remove the device from use and call for service.
ECG Unplugged INOP.	No ECG cable is connected and the configured/selected ECG in Wave Sector 1 is from leads	Check that the ECG cable is firmly connected. Connect an ECG cable or a pads therapy cable.
Leads Off INOP.	Electrode(s) for the configured/selected ECG in Wave Sector 1 may be off or insecurely attached.	Apply electrodes/pads to the patient.
	Electrode(s) are not making proper contact with the patient.	Check that monitoring electrodes are properly applied. If necessary, prepare the patient's skin and apply new electrodes.
Solid flat line - no waveform, no Leads Off INOP.	Short in patient cable or leads.	Run the Operational Check with the ECG cable. If the test fails, run it without the ECG cable. If the test passes, replace the cable. If not, remove the device from use and call for service.
Pads/Paddles Off INOP	Pads/Paddles for Wave Sector 1 are off or insecurely attached.	Check that pads/paddles are properly applied. If necessary, replace the pads. Change the ECG in Wave Sector 1 to a lead derived from monitoring electrodes.
There is a dashed line (----) on the display instead of an ECG.	ECG data is not being acquired.	Check the pads, paddles or ECG cable is connected. Check the pads, paddles, or monitoring electrodes are properly applied. Check that the desired lead is selected.
"Lead-wire" Off message displayed in wave sector.	The specified monitoring electrode is off or not making proper contact with the patient.	Check that monitoring electrodes are properly applied. If necessary, prepare the patient's skin and apply new electrodes.
Check Limb Leads message displayed in wave sector.	2 or more limb lead electrodes are off or not making proper contact with the patient.	Check that the limb lead electrodes are properly applied.
Pads Off message displayed in a wave sector.	Pads are not making proper contact with the patient.	Make sure the pads therapy cable is connected and pads are properly applied. If necessary, prepare the patient's skin and apply new pads.
Cannot Analyze ECG INOP.	The arrhythmia or 12-Lead algorithm cannot reliably analyze the ECG data.	Check ECG signal quality. If necessary, improve lead position or reduce patient motion.

Table 82 ECG Monitoring Problems (Continued)

Symptom	Possible Cause	Possible Solution
Pads ECG Cable Failure INOP.	A short was detected between a lead wire and ground.	Replace the pads cable and perform an Operational Check.
ECG Cable Failure INOP.	A short has been detected between a lead wire and ground.	Replace the ECG cable.
Pads ECG Equip Malfunction INOP.	A device hardware failure was detected.	Perform an Operational Check. If the Pads/Paddles ECG Test fails with Therapy cable, disconnect the Therapy cable from the device when prompted in order for the Pads/Paddles ECG Test to run without the cable connected. If the Pads/Paddles ECG test passes without the cable connected, replace the Therapy cable.
ECG Equip Malfunction INOP.	A device hardware failure was detected.	Disconnect the ECG cable and perform an Operational Check. If the Leads ECG Test fails, remove the device from use and call for service. If the Leads ECG Test passes, replace the ECG cable and perform an Operational Check.
Lead Select button does not respond.	The 12-lead function is active.	Exit the 12-lead function.
	Device is in AED Mode.	None.
Lead Select button does not display a pads choice.	The pads therapy cable is not connected.	Connect the pads therapy cable.
	Demand mode pacing is active.	Exit pacing or choose fixed mode pacing.
One or more controls do not respond (e.g., select lead or soft keys).	Faulty control or connection.	Remove the device from use and call for service.
Therapy Cable Failure INOP	Performing an Operational Check without a therapy cable attached.	Connect a therapy cable and rerun Operational Check.

Table 83 NBP Monitoring Problems

Symptom	Possible Cause	Possible Solution
NBP Cuff Not Deflated INOP. The NBP numeric value is replaced with a -?-.	The NBP cuff pressure has been greater than 5mmHg (0.67kPa) for more than 3 minutes.	Remove cuff from patient. Release pressure in the cuff (disconnect cuff from tubing). Replace the cuff. If the problem persists, call for service.
NBP Cuff Overpressure INOP. The NBP numeric value is replaced with a -?-.	The NBP cuff pressure has exceeded the overpressure safety limit of 300 mmHg.	No action is required, the cuff should deflate automatically. If not, remove cuff from patient and deflate.
NBP Interrupted INOP. The NBP numeric value is replaced with a -?/-?-(?-).	The measurement needed longer than the maximum time provided for inflation, deflation, or the total measurement.	Check that the cuff size is appropriate. Check cuff placement.
NBP Measurement Failed INOP. The NBP numeric value is replaced with a -?/-?-(?-).	A measurement value could not be obtained.	Check cuff size and placement.
NBP Calibration Overdue INOP.	NBP module needs calibration. Calibration should be performed once a year or every 10,000 cycles, whichever comes first.	Call for service of the NBP module. Do not use the NBP monitoring capabilities until the calibration has been performed. If NBP monitoring is essential to patient care, take the device out of use.
NBP Equip Malfunction INOP.	NBP hardware failure.	Call for service of the NBP module. Do not use the NBP monitoring capabilities. If NBP monitoring is essential to patient care, take the device out of use.
NBP Service Required INOP.	The NBP module has reached its end of life, defined as 50,000 cycles.	Call for service of the NBP module. Do not use the NBP monitoring capabilities. If NBP monitoring is essential to patient care, take the device out of use.
Measurement cycle doesn't automatically start.	NBP is not configured for automatic measurements.	Check/modify the configuration as needed.
	Automatic measurements are not scheduled for the current patient.	Use the Measurements/Alarms menu to define an automatic schedule of measurements for the current patient.
	The [Start NBP] soft key has not been pressed.	Press the [Start NBP] soft key.
The pump operates, but the cuff does not inflate or fails to inflate fully.	Defective cuff.	Replace the cuff.
	Poor connection between the cuff and the HeartStart MRx.	Check connections and replace tubing, if needed.
NBP measurements appear high/low.	The cuff size is too small/large for the patient.	Use the correct cuff size.

Table 84 SpO₂ Monitoring Problems

Symptom	Possible Cause	Possible Solution
The SpO ₂ waveform is not displayed.	The sensor is not properly connected or the sensor cable is damaged.	Check the sensor connection and cable. Try another sensor.
	The SpO ₂ waveform is not configured to be displayed and there is not an unused wave sector.	Use the Displayed Waves menu to select a wave sector for display of the SpO ₂ waveform.
SpO ₂ Non Pulsatile INOP.	The patient's pulse is absent or too weak to be detected. The sensor has come off.	Check perfusion at the measurement site. Check that the sensor is applied properly. Make sure the sensor site has a pulse. Relocate the sensor to another site with improved circulation. If the message occurs due to NBP measurement on the same limb, wait until the NBP measurement is finished. Try another sensor.
SpO ₂ Erratic INOP. The SpO ₂ numeric value is replaced with a -?-.	SpO ₂ measurement readings are erratic.	Check that the sensor is applied properly. Make sure the sensor site has a pulse. Relocate the sensor to another site with improved circulation. Try another sensor.
SpO ₂ Noisy Signal INOP.	Excessive patient movement or electrical interference.	Minimize patient movement. Make sure the sensor cable is not positioned too close to power cables.
SpO ₂ Interference INOP. The SpO ₂ numeric value is replaced with a -?-.	Ambient light is too high.	Cover the sensor with an opaque material to minimize ambient light. Make sure the sensor cable is not positioned too close to power cables. Make sure that the sensor cable is not damaged.
SpO ₂ Unplugged INOP.	The SpO ₂ sensor is not connected.	Check the SpO ₂ connection.
	There is too much interference.	
	The sensor is damaged.	
SpO ₂ Unplugged. Turn off SpO ₂ ? message appears when the device is turned on and the SpO ₂ sensor is not connected.	The SpO ₂ sensor is not connected.	Check that the sensor connection is secure. Try another sensor.
	The software was not upgraded after an SpO ₂ repair or upgrade was performed.	Call for service.

Table 85 Transmission Problems (Bluetooth) (Continued)

Symptom	Possible Cause	Possible Solution
Bluetooth Connection Lost message.	The Bluetooth device is not within range.	Move the Bluetooth device closer to the MRx, within the transmitting range. (See the <i>Transmission Implementation Guide</i> for information on transmission ranges.)
Bluetooth device pairing failed message.	The wrong pass code was entered on the Bluetooth device	Check the pass code. Select the device from the MRx Add Devices list and pair again.
	The pairing process timed out.	Try pairing again.
	The Bluetooth card is corrupt.	Call for service.
No Bluetooth Devices Configured message.	The Bluetooth device has not been paired with the MRx.	Pair the Bluetooth device with the MRx.
No transmission devices detected message.	The Bluetooth device is not turned on.	Make sure the Bluetooth device is turned on.
	The Bluetooth device is not within range.	Move the Bluetooth device closer to the MRx, within the transmitting range. See the <i>Transmission Implementation Guide</i> for more information.
	The Bluetooth pairing information has been lost.	Pair the Bluetooth device with the MRx.
	The Bluetooth card is corrupt.	Replace the Bluetooth card.
Transmission Failed. No Dial Tone. message.	Cell phone service is unavailable.	Check that the cellular signal strength is sufficient.
	The Bluetooth modem connection is not secure.	Check that the connection between the Bluetooth modem and the analog line is secure.
	The connection you are using does not provide dial tones.	Set the “Wait for Dial Tone” configuration parameter to No . See the <i>Transmission Implementation Guide</i> for more information.
Transmission Failed. Error configuring transmission device. message.	The wrong Bluetooth Profile was selected.	Check the profile to ensure it is the correct one for that Bluetooth device.
	The Configuration String under the Bluetooth Profile settings is not correct.	Work with your cell phone provider to ensure that the Configuration String is correct.
Transmission Failed. Cannot reach server. message.	No server or the connection has been lost.	Resend the 12-Lead Report.

Table 85 Transmission Problems (Bluetooth) (Continued)

Symptom	Possible Cause	Possible Solution
Transmission Failed. Connection Interrupted.	An error occurred during transmission of one of the files.	Check that the cellular signal strength is sufficient. Move the Bluetooth device closer to the MRx, within the transmitting range. See the <i>Transmission Implementation Guide</i> for more information. Check permissions on FTP device configurations. permissions must allow for reading and writing. Reset receiving device and re-transmit.
	Receiving device is full.	Check available space on receiving device.
	User settings in the Bluetooth device do not allow transmission	Set Bluetooth device to allow all operations for the HeartStart MRx and re-transmit.
Transmission Failed. Server Unknown. message.	The DNS has timed out or there has been a failure in the DNS.	Work with your ISP to ensure the Bluetooth Profile and Hub settings are correct.
Transmission Failed. Settings Configured Incorrectly. message.	There is a problem with the Server URL, Proxy user name, Proxy password	Work with your ISP to ensure the Bluetooth Profile and Hub settings are correct.
Transmission Failed. Connection Failed. message.	A Bluetooth Card malfunction occurred.	Retry Transmission
	The wrong Bluetooth Profile was selected.	Check the profile to ensure it is the correct one for that Bluetooth device.
	The Dial String under the Phone Profile settings is incorrect.	Work with your cell phone provider to ensure that the Dial string is correct.
	Data transfer service is unavailable on the phone.	Work with your cell phone provider to ensure that your cell phone plan has data transfer capability.
	Wrong number.	Check the number and re-send.
Invalid Password message.	The wrong Bluetooth Profile was selected.	Check the profile to ensure it is the correct one for that Bluetooth device.
	The PPP User Name or PPP Password under the Profile Phone settings is incorrect.	Modify the Bluetooth Profile setting as needed.
	The server User Name or Password is incorrect.	Modify the Hub settings as needed.
Transmission Failed message.	The network is down.	Check with your ISP to see if your service is down.
	The server connection has timed out.	Re-send the 12-lead report.
	TCP/IP Failure	Re-send the 12-lead report. If still unsuccessful, check the MRx configuration settings.
	The web server has rejected the data.	Check the MRx and the 12-Lead Transfer Station to ensure that the correct product versions are installed.

Table 86 12-Lead Transmission Problems (RS-232)

First, attempt to solve the problem by disconnecting the serial cable from the cell phone, reconnecting it, and resending the 12-Lead Report.

Symptom	Possible Cause	Possible Solution
Transmission Settings Have Not Been Configured message.	Hub information has not been entered or is entered incorrectly in Configuration.	Modify the Hub configuration settings as needed.
No Transmission Devices Detected message.	The cell phone is not an approved model for 12-Lead Transmission.	Use an approved cell phone model. See the requirements listed in the <i>Transmission Implementation Guide</i> .
	The cell phone's RS-232 port has not been configured.	Check the cell phone configuration settings.
	The cell phone is not connected properly.	Check that the cell phone is turned on and the connection is secure. Disconnect and reconnect the serial cable.
	The serial cable is defective or incompatible.	Work with your cell phone provider to obtain a serial cable that connects to your phone with a 9-pin D serial cable connection.
No Dial Tone message.	There is no dial tone. Cell phone service is unavailable.	Check that the connections are secure. Check that the cellular signal strength is sufficient.
Transmission Failed message, accompanied by an Error Configuring Transmission Device message	The phone configuration settings are invalid/incorrect.	Modify the Serial Phone Profile configuration settings as needed. For more information refer to the <i>Transmission Implementation Guide</i> .
	Wrong number.	Check the number and re-send.
Invalid Password message.	The Internet Service Provider (ISP) or Hub user name or password is incorrect.	Modify the Serial Phone Profile or Hub configuration settings as needed. For more information refer to the <i>Transmission Implementation Guide</i> .
Transmission Failed message, accompanied by a Connection Failed message.	The connection with the ISP cannot be made.	Modify the Serial Phone Profile configuration settings as needed. For more information refer to the <i>Transmission Implementation Guide</i> .
Transmission Failed message, accompanied by a Cannot Reach Server message.	The network server is unavailable.	Contact the network administrator.
Transmission Failed message, accompanied by a Server Unknown message	Server Name or address is not recognized.	Modify the Server configuration settings as needed. For more information refer to the <i>Transmission Implementation Guide</i> .

Table 86 12-Lead Transmission Problems (RS-232) (Continued)

First, attempt to solve the problem by disconnecting the serial cable from the cell phone, reconnecting it, and resending the 12-Lead Report.

Symptom	Possible Cause	Possible Solution
Transmission Failed message, accompanied by a Connection Interrupted message.	The connection with the network server has terminated.	Choose the destination site again and re-connect.
Transmission Failed message, accompanied by a Settings Configured Incorrectly message	The URL or Proxy configuration settings are incorrect.	Modify the Serial Phone Profile, Hub or Site configuration settings as needed. For more information refer to the <i>Transmission Implementation Guide</i> .
Transmission Failed message.	The 12-Lead Report did not transmit correctly.	Choose the destination site again and re-connect. Check the cell phone connection to the HeartStart MRx.
	The network is down.	Check with your internet provider to see if your service is unavailable.

Table 87 Transmission Problems (Rosetta)

Symptom	Possible Cause	Possible Solution
No transmission device detected	The HeartStart MRx failed to connect to the selected transmission device.	Check cables and connections. Replace Rosetta-Lt battery.
Transmission Failed	The 12-Lead Report was not transmitted to the Rosetta-Lt.	
Transmission Failed Timeout	The transfer did not complete within the 1-minute timeout period.	

Table 88 Transmission Problems (Periodic Clinical Data Transmission)

Symptom	Possible Cause	Possible Solution
My vitals aren't being transferred as often as I want	The device is configured to a longer transmission interval.	In Configuration Mode, change the Transmit Interval to a shorter period of time.
Connection lost icon	The connection has timed out.	Connection will automatically be re-established with next PCDT
	Connection lost	see "Transmission Problems (Bluetooth)" on page 304

Table 89 Transmission Problems (Batch LAN Data Transfer)

Symptom	Possible Cause	Possible Solution
Device does not automatically display BLDT menu.	LAN cable is not properly connected to HeartStart MRx and external server	Unplug and re-plug in the LAN cable from both devices, assuring a solid connection.
Connection lost message	Successful connection to the Data Messenger server was lost	Confirm that HeartStart MRx is in Data Management Mode and Data Messenger is active on the receiving server. Contact your IT professional for assistance.

Table 90 CO₂ Monitoring Problems

Symptom	Possible Cause	Possible Solution
The CO ₂ waveform does not appear on the display.	The FilterLine is not properly connected.	Check the FilterLine connection. Check tubing for knots, kinks or pinches.
	The CO ₂ waveform is not configured to be displayed and there is not an unused wave sector.	Use the Displayed Waves menu to select a wave sector for display of the CO ₂ waveform.
CO ₂ Unplugged INOP.	The FilterLine is disconnected.	Check the FilterLine connection and tubing. Check the tubing for knots, kinks, or pinches.
CO ₂ Purging INOP.	A blockage in the FilterLine or airway adapter has been detected. If it is not successful, a CO ₂ Occlusion condition will occur.	The HeartStart MRx automatically attempts to purge the blockage.
CO ₂ Occlusion INOP.	Attempts to purge the FilterLine and exhaust tube were unsuccessful. A sample cannot be taken because of the blockage.	Make sure the FilterLine and exhaust tubing (if connected) are not kinked and are free of blockages. Then disconnect and reconnect the FilterLine to retry. If necessary, replace the FilterLine and/or exhaust tubing.
CO ₂ Overrange INOP.	The CO ₂ value is higher than the measurement range.	If you suspect a false high value, do not use the CO ₂ monitoring capabilities and call for service of the CO ₂ module. If CO ₂ monitoring is essential to patient care, take the device out of use.
CO ₂ Auto Zero INOP.	The automatic zero process is running. It takes from 10 to 30 seconds and CO ₂ values are invalid at this time.	No action required. The module automatically resets itself.
CO ₂ Calibration Overdue INOP.	The CO ₂ module should be calibrated once a year or after 4,000 operating hours.	Do not use the CO ₂ monitoring capabilities and call for service to calibrate the CO ₂ module. If CO ₂ monitoring is essential to patient care, take the device out of use.
CO ₂ Check Exhaust INOP.	When CO ₂ is turned on, the exhaust tube is blocked to the extent that a measurement sample cannot be taken.	Make sure the exhaust tubing is not kinked and is free of blockages. If necessary, replace the tubing.
CO ₂ Equip Malfunction INOP.	CO ₂ hardware failure.	Do not use the CO ₂ monitoring capabilities and call for service of the CO ₂ module. If CO ₂ monitoring is essential to patient care, take the device out of use.
CO ₂ Service Required INOP.	The CO ₂ module has reached its end of life, defined as 15,000 operating hours.	Do not use the CO ₂ monitoring capabilities and call for service of the CO ₂ module. If CO ₂ monitoring is essential to patient care, take the device out of use.

Table 91 Defibrillation and Pacing Problems

Symptom	Possible Cause	Possible Solution
Analyzing Stopped , or Cannot Analyze ECG message in AED Mode.	Excessive patient movement.	Minimize patient movement. If the patient is being transported, stop if necessary.
	Radio or electrical sources are interfering with ECG analysis.	Remove possible sources of interference from the area.
Charge Button Failure INOP	During an Operational Check, when the Charge button was pressed, there was no response.	Remove the device from use and call for service.
Defib Disarmed message.	The Shock button was not pressed within the time period specified in the Time to Auto Disarm Configuration setting.	No action required. If desired, charge the device and press the Shock button.
	Therapy cable not attached. Pads/paddles connection compromised.	Make sure the therapy cable is connected and the pads/paddles are making proper contact with the patient.
Maximum Energy 50J message.	Attempted delivery of greater than 50J using internal paddles.	Only energies up to 50J are available for internal defibrillation. Select a lower energy.
No Shock Delivered, Replace Pads Now message.	Faulty pads or poor pads application to patient. (Low impedance.)	Make sure pads are applied properly. If the problem persists, replace the pads.
No Shock Delivered, Press Pads Firmly message.	Poor pads contact with the patient. (High impedance.)	Make sure pads are applied properly. Firmly press pads on the patient's chest.
No Shock Delivered, Low/High Impedance message.	Poor paddles contact with patient skin.	Make sure paddles are making adequate contact with the patient's skin. If the problem persists, replace the paddles.
	Paddles failure.	
Pacer Equip Malfunction INOP	Pacing hardware failure.	Call for service. If pacing functionality is essential to patient care, take the device out of use.
Press Charge Before Shock message.	The device is not charged to the selected energy.	Make sure the desired energy is selected. Then press the Charge button.
Press Shock Buttons on Paddles message.	The Shock button on the device is disabled because external paddles or switched internal paddles are connected.	Press the Shock button(s) on the paddles to deliver a shock.
R-Wave Not Detected message.	During synchronized cardioversion, the r-wave was not detectable.	Choose a lead with a clearly define QRS complex.
Pacing Stopped. [Leads Off] message.	Pacing has stopped because the ECG source for Wave Sector 1 has become invalid because of a Leads Off condition or an ECG cable disconnection.	Check that the monitoring electrodes are applied properly to the patient. Check cable connections. Press the [Resume Pacing] soft key to continue pacing.
Pacing Stopped. [Pads Off] [Pads Cable Off] message.	Pacing has stopped because of poor pads/patient contact or a pads cable disconnection.	Check that the pads are applied correctly to the patient. Check cable connections. Press the [Resume Pacing] soft key to continue pacing.

Table 91 Defibrillation and Pacing Problems (Continued)

Symptom	Possible Cause	Possible Solution
Shock Button Failure INOP	During an Operational Check, when the Shock button was pressed, there was no response.	Remove the device from use and call for service.
Therapy Knob Failure INOP	During an Operational Check, the Therapy Knob test failed.	Remove the device from use and call for service.
Time to charge to selected energy is slow.	The device is being operated with only AC/DC power (no battery) or the battery power is low.	Install a fully charged battery.
Device displays a No Shock Delivered message but you see a physiological response from the patient	Poor skin contact; pads are not properly connected to the patient. Minimal patient movement is possible in this situation as the defibrillator may deliver a small amount of energy. The shock counter will remain at zero.	Make sure the pads are applied properly. Replace pads in necessary

Table 92 Printer Problems

Symptom	Possible Cause	Possible Solution
Paper won't move.	Paper improperly loaded or jammed, or paper is wet.	Reload paper or clear jam. If paper is wet, replace with fresh, dry roll.
Paper moves then stops.	Door improperly latched.	Check door latch.
	Paper improperly loaded or jammed.	Reload paper or clear jam.
Paper moves but printing is faint or absent.	Paper roll improperly installed. Incorrect paper type. Printhead temperature approaching maximum recommended operating temperature.	Check that the paper is installed correctly.
	Incorrect paper type.	Use only recommended paper type.
	Printhead temperature approaching maximum recommended operating temperature.	Wait until the printer cools down and restart printing.
Paper moves but print quality poor or some dots missing.	Dirty printhead.	Clean the printhead.
Loud buzzing or grinding noise.	Door improperly latched.	Check door latch.
White line running along paper.	Dirt on printhead.	Clean the printhead.

Table 92 Printer Problems (Continued)

Symptom	Possible Cause	Possible Solution
Incompatible Printer message.	The installed printer does not support the fonts required. Asian fonts require the 75 mm printer.	Install the 75 mm printer.
Check Printer message.	The printer is out of paper or the door is open.	Load/reload the printer paper. Make sure the printer door is closed.
Printer Malfunction message.	The printer is faulty or there is a problem communicating with the printer.	Turn the HeartStart MRx off for 15 seconds and then turn it on again. If the problem persists, call for service. If printing is essential to patient care, take the device out of use.
Printer Temperature High message.	The temperature of the print head exceeds the recommended operating temperature.	Wait until the printer cools down and restart printing.

Table 93 Data Card Problems

Symptom	Possible Cause	Possible Solution
Incompatible Data Card message.	Data card is not compatible with the HeartStart MRx.	Use only compatible Data Cards. For a listing of compatible Data Cards see Maintenance chapter.
Data Card Full message.	The data card has reached capacity.	Insert new data card or erase data from card.
No Data Card Present message.	A data card is not inserted in the device.	Insert data card. Once inserted, wait 5 seconds before trying to access the data card.
	Sufficient time not allowed for data card recognition.	Re-insert data card and wait 5 seconds before trying to access the data card.

Table 94 Invasive Pressure Monitoring Problems

Symptom	Possible Cause	Possible Solution
Invasive Pressure wave not displayed	The sensor is not properly connected or the sensor cable is damaged.	Check the sensor connection and cable. Try another sensor.
	The pressure waveform is not configured to be displayed and there is not an unused wave sector.	Use the Displayed Waves menu to select a wave sector for display of the pressure waveform.
CPP Check Sources INOP	The ICP and/or arterial pressure used to derive CPP is invalid.	Make sure ICP and arterial pressure cables are connected to the device and zeroed.
Invasive Pressure Label Artifact INOP	The device has detected a pressure change. A resulting alarm, most likely a high limit alarm, will be suppressed.	In the event you do not think you created a non-physiological event, check cable and tubing. Rezero and try again.
Invasive Pressure Label Equip Malfunction INOP	There has been a malfunction in the Invasive Pressure hardware.	Contact Service.

Table 94 Invasive Pressure Monitoring Problems (Continued)

Symptom	Possible Cause	Possible Solution
Invasive Pressure Label Noisy Signal INOP	This can only occur when pulse is determined from a pressure wave. The pulse rate is higher than 350 bpm. May be caused by movement artifact or electrical interference.	Stop movement. Minimize possible electrical interference.
Invasive Pressure Label Non-pulsatile INOP	This can only occur when pulse is determined from a pressure wave. The pulse rate is less than 25 bpm or the amplitude of the pressure wave is less than 3 mmHg.	Check the catheter and connections to the patient.
Invasive Pressure Label Overage INOP	The pressure wave is outside the measurement range.	Make sure the measurement has been properly prepared and zeroed and that the transducer is level with the heart. If the INOP message persists, try another transducer. Make sure the transducer is on the supported accessories list.
Invasive Pressure Label Unplugged INOP	The pressure transducer has been disconnected from the device or is faulty.	Try unplugging and then replugging the transducer. If the symptom does not go away, use a different transducer.
Invasive Pressure Label Zero + Check Cal INOP	Occurs when a new transducer is attached to the monitor.	Zero the transducer. Check the calibration factor, if applicable.
Check Scale displayed with pressure waveform	The wave is clipped in the displayed wave area.	Change the scale.
Unable to Zero message	The cause is displayed with the message.	Depends on the cause.
Unable to Calibrate message	The cause is displayed with the message.	Depends on the cause.

Invasive Pressure Label = one of the labels which can be applied to an Invasive Pressure pressure channel.

Table 95 Temperature Monitoring Problems

Symptom	Possible Cause	Possible Solution
Temperature Label Equip Malfunction INOP	There has been a malfunction in the temperature hardware.	Contact Service.
Temperature Label Overage INOP	The temperature value is outside the measurement range of the device ($<0^{\circ}\text{C}$ or $>45^{\circ}\text{C}$).	Check that the temperature probe is on the list of supported accessories. Try changing the application site.
Temperature Label Unplugged INOP	The temperature transducer is faulty or has been disconnected from the device.	Try unplugging and then replugging the temperature transducer. If the symptom does not go away, use a different transducer.

Temperature Label = one of the labels which can be applied to a temperature measurement.

Table 96 Pulse Problems

Symptom	Possible Cause	Possible Solution
Pulse Check Source INOP	The currently selected pulse source is not available but another possible pulse source is on.	Switch to the secondary pulse source.
See “SpO2 Monitoring Problems” on page 303 and “Invasive Pressure Monitoring Problems” on page 312 for further troubleshooting information.		

Table 97 Q-CPR Problems

Symptom	Possible Cause	Possible Solution
The CPR meter display is dark and the status light is not on.	The CPR meter is not connected to the HeartStart MRx	Confirm all CPR meter and cable connections are in place and the HeartStart MRx is turned on.
CPR meter status light is orange and the display is dark.	Malfunction in the meter.	Remove the CPR meter from service and contact Philips for technical support.
CPR meter does not adhere to the patient's chest.	Adhesive pad not sticking to the chest.	If there is no other responder present to help, provide CPR using the meter even though it does not adhere to the patient. Be sure to keep the meter properly positioned.
		If there is another responder present to perform CPR, remove the CPR meter and replace the patient adhesive pad and restart CPR with the CPR meter in place.
	Patient has a wet chest	If there is another responder present to perform CPR, remove the CPR meter, dry the patient's chest off (with minimal interruption to CPR), reapply a new patient adhesive pad and restart CPR with the CPR meter in place.
CPR meter Malfunction INOP.	The CPR meter power-on self-test has failed.	Check the CPR meter and cable connections. If necessary, replace the CPR meter.

Table 97 Q-CPR Problems (Continued)

Symptom	Possible Cause	Possible Solution
CPR meter Unplugged INOP.	The CPR meter is unplugged.	Check the CPR meter and cable connections.
	The device cannot communicate with the CPR meter.	Confirm your HeartStart MRx is running Version F.01 software and you are using the CPR meter not the CPR sensor. See "CPR meter and Sensor Differences" on page 158. Replace the CPR meter.
Poor Pads Contact INOP.	Thoracic impedance measured at 25-200 Ohms, therefore, the signal is not valid for ventilation detection.	Make sure the Pads/CPR cable is connected and pads are properly applied in an anterior/anterior position. If necessary, prepare the patient's skin and apply new pads.
Pads Off INOP.	Pads are not making proper contact with the patient.	Make sure the Pads/CPR cable is connected and pads are properly applied in an anterior/anterior position. If necessary, prepare the patient's skin and apply new pads.
Cannot Analyze Vent INOP.	Excessive noise on the impedance signal.	Make sure the Pads/CPR cable is connected and pads are properly applied. If necessary, prepare the patient's skin and apply new pads.

Table 98 IntelliVue Networking Problems

Symptom	Possible Cause	Possible Solution
Data from the HeartStart MRx are not on the Information Center display and you have no INOPs on your HeartStart MRx display.	The HeartStart MRx may not have the IntelliVue option installed.	Print Device Info to see if the IntelliVue Networking option is installed on the device. If not, the device can not be used on the network.
	The HeartStart MRx may have the No Central Monitoring INOP configured to optional.	If your institution's policy allows, configure the INOP to mandatory and troubleshoot No Central Monitoring INOP.
	The Information Center may have a different monitor assigned to the sector you are reviewing.	Confirm that the equipment label assigned to the sector you are reviewing matches the device.

Table 98 IntelliVue Networking Problems (Continued)

Symptom	Possible Cause	Possible Solution
No Central Monitoring INOP on HeartStart MRx (appears within 30 seconds of the interruption)	The device may not have a compatible therapy board.	Print Device Info report and verify therapy hardware revision is at least 14. If not, call for service to upgrade therapy board.
	No network connection.	At the HeartStart MRx, verify the equipment label is correct. At the Information Center, verify that the equipment label is assigned to the correct sector. Attend to any momentary connection rejection message (See Table 99). Verify that the IntelliVue Network is correctly configured to “see” the HeartStart MRx. Verify wired connection. Verify wireless radio module is connected prior to turning device on and within range of an access point. Check signal strength by reviewing the RSSI number. If the RSSI number: - is any value other than -128. The radio is communicating with the device and the device is communicating with the network. Check to see if the Information Center is configured correctly; check to see if the equipment label and RF Code are correct. - remains steady at -128. The radio is talking to the device but not to the network. Move the device closer to an access point and confirm the proper RF code is entered. - is blank. Call for service.
	(See “Network Connection Rejection Messages” on page 317 for other possible causes.)	
Radio Unplugged INOP on HeartStart MRx	The wireless radio module is unplugged from the device.	Confirm wireless radio module is solidly plugged into the device then turn the device on.
	Wireless radio module malfunction.	Replace wireless radio module.
Radio Malfunction INOP on HeartStart MRx	Wireless radio module malfunction.	Replace wireless radio module.
Radio Weak Signal INOP on HeartStart MRx	Radio signal strength is below an acceptable level.	Attempt to improve signal strength by moving device closer to access point.
All ECG Alarms Off	HR and arrhythmia alarms are turned off.	Turn HR and arrhythmia alarms on.
If you have the wireless radio module connected only, power is on, no connection to the Information Center and no INOP messages.	No Central Monitoring INOP is configured to optional.	If your institution’s policy allows, configure INOP to mandatory and troubleshoot No Central Monitoring INOP.

Table 99 Network Connection Rejection Messages

When the Information Center rejects a connection attempt from the HeartStart MRx, a momentary message accompanied by an audio beep is displayed in the middle of the HeartStart MRx display. Messages, possible causes and possible solutions:

Message	Possible Cause	Possible Solution
No Central assigned to this bed	No Information Center is configured to monitor the HeartStart MRx with the assigned equipment/monitor label.	Confirm the HeartStart MRx equipment label is correct. Assign the HeartStart MRx equipment label to the appropriate sector in the Information Center.
No Central - duplicate monitor label	Another bedside with the same equipment/monitor label as the HeartStart MRx has already been connected to the Information Center.	Change the HeartStart MRx equipment label to be unique and assign it to the Information Center or turn the other device off.
Assigned Central is not available	The Information Center assigned to monitor the HeartStart MRx is not functional.	Start the Information Center by powering on the PC.
No Central - check software revision	Software revisions on the HeartStart MRx and the Information Center are not compatible.	Verify that the Information Center revision is at Release J or beyond.
Central cannot identify this bed	The Information Center can not identify this bed because of unexpected errors.	Verify the Information Center is configured to monitor the HeartStart MRx.

Audio Tones and Alarm Indications

The following table describes the audio tones and alarm indications, when they occur, and their meaning.

NOTE Alarm tone volume levels exceed 60 dB. See the HeartStart MRx *Service Manual* for alarm signal pressure ranges.

Table 100 Audio Tones

Tone/Indication	Definition
Single beep.	Message tone. Accompanies a new message on the display. Informational such as switching to the other battery.
Continuous tone, lower pitch than charged tone.	Charging tone. Generated when the Charge button is pressed and continues until the device is fully charged.
Continuous tone.	Charged tone. Generated when the selected defibrillation energy is reached and continues until the Shock button is pressed, the [Disarm] soft key is pressed, or the device disarmed automatically after the configured time had elapsed since pressing the Charge button.
Periodic chirp.	Low battery or RFU failure. Repeated periodically while the condition exists.
Continuous tone, alternating pitch.	Device will shut down in one minute.
Tone repeated once a second. Red alarm indicator message for applicable HR/arrhythmia, apnea, extreme desat and pressure disconnect alarms.	Philips' Red Alarm Tone: Generated while at least one red alarm is occurring.
High pitched tone repeated five times followed by a pause. Red alarm indicator message for applicable HR/arrhythmia, apnea, extreme desat and pressure disconnect alarms.	IEC Red Alarm Tone: Generated while at least one red alarm is occurring.
Tone repeated every two seconds, lower pitch than red alarm tone. Yellow alarm indicator message for applicable HR/arrhythmia, SpO ₂ , NBP, Invasive Pressures, Temperature, Pulse and EtCO ₂ alarms.	Philips' Yellow Alarm Tone: Generated while at least one yellow alarm is occurring.
Lower pitched tone is repeated three times, followed by a pause. Yellow alarm indicator message for applicable HR/arrhythmia, SpO ₂ , NBP, Invasive Pressures, Temp, Pulse and EtCO ₂ alarms.	IEC Yellow Alarm Tone: Generated while at least one yellow alarm is occurring
Tone repeated every two seconds, lower pitch than yellow alarm tone. Cyan indicator message.	Philips' INOP Tone: Generated while at least one INOP condition is occurring.
Lower pitched tone is repeated twice, followed by a pause. Cyan indicator message.	IEC INOP Tone: Generated while at least one INOP condition is occurring.
Tone occurring synchronously with each heart beat.	QRS tone.

Calling for Service

For telephone assistance, call the Response Center nearest to you, or visit our website at: www.medical.philips.com/cms and click on “Support”.

Table 101 Response Center Phone Numbers

North America	
Canada	800-323-2280
United States of America	800-722-9377
Europe	
European International Sales	41 22 354 6464
Austria	01 25125 333
Belgium	02 778 3531
Finland	010 855 2455
France	0803 35 34 33
Germany	0180 5 47 50 00
Italy	800 825087
Netherlands	040 278 7630
Sweden	08 5064 8830
Switzerland	0800 80 10 23
United Kingdom	0870 532 9741
Asia/Asia Pacific	
Australia	1800 251 400
China (Beijing)	800 810 0038
Hong Kong Macau	852 2876 7578 0800 923
India New Delhi Mumbai Calcutta Chennai Bangalore Hyderabad	011 6295 9734 022 5691 2463/2431 033 485 3718 044 823 2461 080 5091 911 040 5578 7974
Indonesia	021 794 7542
Japan	0120 381 557
Korea	080 372 7777 02 3445 9010
Malaysia	1800 886 188
New Zealand	0800 251 400
Philippines	02 845 7875
Singapore	1800 PHILIPS
Thailand	02 614 3569
Taiwan	0800 005 616

Specifications and Safety

This chapter describes the specifications and safety features of the HeartStart MRx monitor/defibrillator.

Specifications

General

Dimensions with pads: 31.5 cm (W) x 21.0 cm (D) x 29.5 cm (H); (12.4 in. x 8.3 in. x 11.7 in.)

Dimensions with paddles: 34.0 cm (W) x 21.0 cm (D) x 34.5 cm (H); (13.4 in. x 8.3 in. x 13.6 in.)

Weight: Less than 13.2 lbs. including pads, pads cable, battery, and full roll of paper. Incremental weight of external standard paddles and paddle tray is less than 2.5 lbs. Additional battery weighs less than 1.8 lbs.

Standard Operator Position: Within one meter of device.

Defibrillator

Waveform: Biphasic Truncated Exponential. Waveform parameters adjusted as a function of patient impedance.

Shock Delivery: Via multifunction electrode pads or paddles.

Delivered Energy Accuracy

Selected Energy	Nominal Delivered Energy vs. Patient Impedance							Accuracy
	Load Impedance (ohms)							
	25	50	75	100	125	150	175	
1J	1.2	1.3	1.2	1.1	1.0	0.9	0.8	±2J
2J	1.8	2.0	2.0	1.9	1.7	1.6	1.5	±2J
3J	2.8	3.0	3.0	3.1	3.0	2.9	2.7	±2J
4J	3.7	4.0	4.0	4.1	4.2	4.2	4.0	±2J
5J	4.6	5.0	5.1	5.1	5.2	5.2	5.0	±2J
6J	5.5	6.0	6.1	6.2	6.3	6.3	6.1	±2J
7J	6.4	7.0	7.1	7.2	7.3	7.3	7.1	±2J
8J	7.4	8.0	8.1	8.2	8.4	8.3	8.1	±2J
9J	8.3	9.0	9.1	9.3	9.4	9.4	9.1	±2J
10J	9.2	10	10	10	10	10	10	±2J
15J	14	15	15	15	16	16	15	±15%
20J	18	20	20	21	21	21	20	±15%
30J	28	30	30	31	31	31	30	±15%
50J	46	50	51	51	52	52	50	±15%
70J	64	70	71	72	73	73	71	±15%
100J	92	100	101	103	104	104	101	±15%
120J	110	120	121	123	125	125	121	±15%
150J	138	150	152	154	157	156	151	±15%
170J	156	170	172	175	177	177	172	±15%
200J	184	200	202	206	209	209	202	±15%

Charge Time:

- Less than 5 seconds to 200 Joules with a new, fully charged Lithium Ion battery pack at 25°C.
- Less than 15 seconds when operating without a battery, using the M3539A AC power module alone at 90-100% rated mains voltage.
- Less than 15 seconds with a new, fully charged Lithium Ion battery pack at 25°C, depleted by up to 15 200 Joule discharges.
- Less than 25 seconds from initial power on, with a new, fully charged Lithium Ion battery pack at 25°C, depleted by up to 15 200 Joule discharges.
- Less than 25 seconds from initial power on when operating without a battery, using the M3539A AC power module alone at 90-100% rated mains voltage.
- Less than 30 seconds from initiation of rhythm analysis (AED Mode) with a new, fully charged Lithium Ion battery pack at 25°C, depleted by up to 15 200 Joule discharges.
- Less than 30 seconds from initiation of rhythm analysis (AED Mode) when operating without a battery, using the M3539A AC power module alone at 90-100% rated mains voltage.

- Less than 40 seconds from initial power on (AED Mode) with a new, fully charged Lithium Ion battery pack at 25°C, depleted by up to 15 200 Joule discharges.
- Less than 40 seconds from initial power on (AED Mode) when operating without a battery, using the 3539A AC power module alone at 90-100% rated mains voltage.

Patient Impedance Range: Minimum: 25 Ohm (external defibrillation); 15 Ohm (internal defibrillation); Maximum: 180 Ohm

Note: Actual functional range may exceed the above values.

Manual Defib Mode

Manual Output Energy (Selected): 1-10, 15, 20, 30, 50, 70, 100, 120, 150, 170, 200 Joules; maximum energy limited to 50J with internal paddles

Controls: On/Off Therapy Knob, Charge, Shock, Sync, ECG Lead Select, Disarm, Print, Mark Event, Alarm Pause, Event Review

Energy Selection: Front panel Therapy Knob

Charge Control: Front panel button, button on external paddles

Shock Control: Front panel button, buttons on external or switched internal paddles

Synchronized Control: Front panel SYNC button

Indicators: Text Prompts, Audio Alerts, QRS Beeper, Battery Status, Ready For Use, External Power, Sync Mode

Armed Indicators: Charging/charged tones, flashing shock button, energy level indicated on display

AED Mode

AED Energy Profile: 150 Joules nominal into a 50 ohm test load

AED Controls: On/Off, shock

Text and Voice Prompts: Extensive text/audible messages guide user through configured protocol.

Indicators: Monitor display messages and prompts, voice prompts, battery status, Ready For Use, external power

Armed Indicators: Charging/charged tones, flashing shock button, energy level indicated on display

ECG Analysis: Evaluates patient ECG and signal quality to determine if a shock is appropriate and evaluates connection impedance for proper defibrillation pad contact

Shockable Rhythms: Ventricular Fibrillation with amplitude >100 μ V and shockable wide-complex tachycardias. Shockable tachycardias include wide-complex rhythms of ventricular or unknown origin with heart rate greater than 150 bpm and polymorphic ventricular tachycardia at any heart rate.

Shock Advisory Algorithm Sensitivity and Specificity: Meets AAMI DF-39

Table 102 AED ECG Analysis Performance

Rhythm Class	ECG Test Sample Size ^a	Nominal Specifications
Shockable Rhythm Ventricular Fibrillation	600	Meets AAMI DF39 requirement and AHA recommendation ^b (sensitivity > 90%) for adult defibrillation
Shockable Rhythm Ventricular Tachycardia	300	Meets AAMI DF39 requirement and AHA recommendation ^b (sensitivity > 75%) for adult defibrillation
Non-shockable Rhythm Normal Sinus Rhythm	250	Meets AAMI DF39 requirement (specificity > 95%) and AHA recommendation ^b (specificity > 99%) for adult defibrillation
Non-shockable Rhythm Asystole	500	Meets AAMI DF39 requirements and AHA recommendation ^b (specificity > 95%) for adult defibrillation
Non-shockable Rhythm All other non-shockable rhythms	600	Meets AAMI DF39 requirements and AHA recommendation ^b (specificity > 95%) for adult defibrillation

a. From Philips Medical Systems ECG rhythm databases.

b. American Heart Association (AHA) AED Task Force, Subcommittee on AED Safety & Efficacy. Automatic External Defibrillators for Public Access Use: Recommendations for Specifying and Reporting Arrhythmia Analysis Algorithm Performance, Incorporation of New Waveforms, and Enhancing Safety. American Heart Association (AHA) AED Task Force, Subcommittee on AED Safety & Efficacy. *Circulation* 1997;95:1677-1682.

ECG and Arrhythmia Monitoring

Inputs: Up to four (4) ECG waves may be viewed on display and up to two (2) waves printed simultaneously. Lead I, II, or III is obtained through the 3-wire ECG cable and separate monitoring electrodes. With a 5-lead ECG cable, leads aVR, aVL, aVF, and V can also be obtained. Pads ECG is obtained through 2 multifunction electrode pads.

Lead Fault: LEAD OFF message and dashed line appear on the display if an electrode or lead becomes disconnected.

Pad Fault: Dashed line appears on the display if a pad becomes disconnected.

Heart Rate Display: Digital readout on display from 15 to 300 bpm, with an accuracy of $\pm 10\%$

Heart Rate/Arrhythmia Alarms: HR, Asystole, VFIB/VTACH, VTACH, Extreme Tachy, Extreme Brady, PVC rate, Pacer Not Capture, Pacer Not Pacing

Common Mode Rejection: Greater than 90 dB measured per AAMI standard for cardiac monitors (EC 13)

ECG Size: 2.5, 5, 10, 20, 40 mm/mV, autogain

Maximum T wave amplitude: Meets recommended minimum 1.2mV T-wave amplitude rejection.

Frequency Response:

- AC Line Filter - 60 Hz or 50 Hz
- Pads ECG for Display: Monitor - (.15-40 Hz) or EMS (1-30 Hz)
- Pads ECG for Printer - Monitor (.15-40 Hz) or EMS (1-30 Hz)
- Leads ECG for Display - Monitor (.15-40 Hz) or EMS (1-30 Hz)
- Leads ECG for Printer - Diagnostic (.05-150 Hz) or Monitor (.15-40 Hz) or EMS (1-30 Hz)

Heart rate accuracy and response to irregular rhythm: Meets AAMI standard for ventricular bigeminy (HR=80 bpm); slow alternating ventricular bigeminy (HR=60 bpm); rapid alternating ventricular bigeminy (HR=120 bpm); bidirectional systoles (HR=90 bpm)

Heart rate averaging: For heart rates ≥ 50 bpm, heart rate is determined by averaging the 12 most recent R-R intervals. Beats N, P and V are included. When heart rate drops below 50 bpm, the 4 most recent R-R intervals are used in the average. Note: For ventricular tachycardia alarms, which have a user-definable PVC run length limit, the heart rate is based on the user selected PVC length up to 9 PVCs maximum.

Heart Rate Response Time:

- 80 to 120 bpm: 7 seconds
- 80 to 40 bpm: 6 seconds

Time to Alarm for Tachycardia:

- 206 bpm (1 mV): 3 seconds
- 206 bpm (halved amplitude): 3 seconds
- 206 bpm (doubled amplitude): 3 seconds
- 195 bpm (2 mV): 3 seconds
- 195 bpm (halved amplitude): 3 seconds
- 195 bpm (doubled amplitude): 3 seconds

Patient Isolation (defibrillation proof):

- ECG: Type CF
- SpO₂: Type CF
- EtCO₂: Type CF
- NBP: Type CF
- Invasive Pressures: Type CF
- Temperature: Type CF
- External Defib: Type BF
- Internal Defib: Type CF
- CPR meter: Type BF

Other Considerations: The HeartStart MRx is suitable for use in the presence of electrosurgery. Burn hazard protection is provided via a 1K current limiting resistor contained in each ECG lead wire.

Display

Size: 128 mm x 171 mm

Type: TFT Color LCD

Resolution: 640 x 480 pixels (VGA)

Sweep Speed: 25mm/s nominal (stationary trace; sweeping erase bar) for ECG, Invasive Pressure and SpO₂; 6.25 mm/sec for CO₂

Wave Viewing Time: 5 seconds (ECG)

Battery

Type: Rechargeable, Lithium Ion; See battery label for capacity information.

Dimensions: 165 mm (H) x 95 mm (W) x 42 mm (D); (6.5 in. x 3.8 in. x 1.6 in)

Weight: Less than 1.8 lb. (0.82 kg)

Charge Time with instrument off: Approximately 3 hours to 100%. Approximately 2 hours to 80%, indicated by indicator. Charging the battery at temperatures above 45°C may degrade battery life.

Capacity: At least 5 hours of monitoring with ECG, SpO₂, CO₂, temperature and two invasive pressures monitored continuously, NBP measured every 15 minutes, and 20 200J discharges (with a new, fully charged battery, operating at room temperature, 25°C).

At least 3.5 hours of monitoring with ECG, SpO₂, CO₂, temperature and two invasive pressures monitored continuously, NBP measured every 15 minutes, and pacing at 180ppm at 160mA.

Battery Indicators: Battery gauge on battery, capacity indicator on display; flashing RFU indicator, chirp, and LOW BATTERY message appears on display for low battery condition*

*When LOW BATTERY message first appears, there is still enough energy remaining for at least 10 minutes of monitoring time and six maximum energy discharges (with a new battery at room temperature, 25°C).

Battery Storage: Storing the battery for extended periods at temperatures above 40°C will reduce battery capacity and degrade battery life.

Thermal Array Printer

Continuous ECG Strip: The Print key starts and stops the strip. The printer can be configured to run real time or with a 10-second delay. The strip prints the primary ECG lead and a second or third wave (75mm printer only) with event annotations and measurements.

Auto Printing: The printer can be configured to automatically print on Mark Events, Charge, Shock, and Alarm. When an alarm condition occurs, the unit prints the Primary ECG wave, the alarming wave, if configured, and a third wave (75mm printer only).

Reports: The following can be printed:

- Event Summary (short, medium, and long)
- Vital Sign Trends
- 12-Lead
- Operational Check
- Configuration
- Status Log
- Device Information

Speed: 25 or 50 mm/s with an accuracy of $\pm 5\%$

Amplitude Accuracy: $\pm 5\%$ or ± 40 uV, whichever is greater

Paper Size:

- 50 mm (W) x 30 m (100 ft.) (L)
- 75 mm (W) x 30 m (100 ft.) (L)

Noninvasive Pacing

Waveform: Monophasic Truncated Exponential

Current Pulse Amplitude: 10 mA to 175 mA (5 mA resolution); accuracy 10% or 5 mA, whichever is greater

Pulse Width: 40 ms with $\pm 10\%$ accuracy

Rate: 30 ppm to 180 ppm (10 ppm increments); accuracy $\pm 1.5\%$

Modes: Demand or Fixed Rate

Refractory Period: 340 msec (30 to 80 ppm); 240 msec (90 to 180 ppm)

SpO₂ Pulse Oximetry

SpO₂ Measurement Range 0-100%

SpO₂ Resolution: 1%

SpO₂ Update Period: 1-2 sec typical; maximum: ≤60 sec

SpO₂ Accuracy with:

- M1191A sensor - 1 standard deviation 70% to 100%, ± 2.0%
- M1191AL sensor - 1 standard deviation 70% to 100%, ± 2.0%
- M1191B sensor - 1 standard deviation 70% to 100%, ± 2.0%
- M1191BL sensor - 1 standard deviation 70% to 100%, ± 2.0%
- M1191T sensor - 1 standard deviation 70% to 100%, ± 3.0%
- M1192A sensor - 1 standard deviation 70% to 100%, ± 2.0%
- M1192T sensor - 1 standard deviation 70% to 100%, ± 3.0%
- M1194A sensor - 1 standard deviation 70% to 100%, ± 3.0%
- M1196A sensor - 1 standard deviation 70% to 100%, ± 3.0%
- M1196T sensor - 1 standard deviation 70% to 100%, ± 3.0%
- M1195A sensor - 1 standard deviation 70% to 100%, ± 3.0%
- M1131A sensor - 1 standard deviation 70% to 100%, ± 3.0%

NOTE Accuracy outside the range indicated for each sensor is not specified. The above referenced sensors were validated for use with the HeartStart MRx using the Philips picoSAT II SpO₂ module with Fourier Artifact Suppression Technology (FAST). This module is not available as a stand-alone device.

NOTE Pulse oximeter equipment measurements are statistically distributed, therefore only two-thirds of pulse oximeter equipment measurements can be expected to fall within ±Arms of the value measured by a CO-oximeter. The HeartStart MRx is calibrated to display functional oxygen saturation.

Ambient Light Sensitivity Interference from fluorescent light is <2% SpO₂ perfusion between 0.3% and 1% typical transmission (50nA/mA), 10 to 1000 1x light intensity, 50Hz +/- 0.5Hz as well as 60Hz +/-0.5Hz line frequency.

SpO₂ Alarm Range:

Low Limit: 50 to 99% (Adult/Pediatric)

High Limit: 51 to 100% (Adult/Pediatric)

SpO₂ and Pulse High/Low Alarm Signal Generation Delay: 10 seconds

SpO₂ Response Time (90 to 80%): average 18.9 seconds, standard deviation 0.88 seconds

SpO₂ Averaging Time: 20 seconds

Maximum Power Output: ≤15mW

Wavelength Range: 500-1000nm (Information about wavelength range can be useful to clinicians, especially those performing photodynamic therapy.)

average 18.9 seconds; standard deviation 0.88 seconds

Desat Alarm Signal Generation Delay: 20 seconds

Pulse Rate Measurement Range 30-300 bpm

Pulse Rate Resolution 1bpm

Pulse Rate Accuracy: 2% or 1 bpm (whichever is greater) over the measurement range

Pulse Alarm Range:

Low Limit: 30 to 195 (Adult); 30 to 235 (Pediatric)

High Limit: 35 to 200 (Adult); 35-240 (Pediatric)

Pulse Response Time (90 to 120 bpm): average 18.0 seconds; standard deviation 0.86 seconds

NBP

Pressure Range:

- Systolic: 40-260 mmHg
- Diastolic: 20-200 mmHg

Pulse Rate Range: 30 to 220 bpm

Initial Pressure: 160 mmHg Adult; 120 mmHg Pediatric

Maximum Pressure: 280 mmHg

Overpressure Safety Limits: Maximum of 300 mmHg

Cuff Inflation Time: 75 second maximum (pediatric or adult)

Pressure Transducer Accuracy: ± 3 mmHg

Alarm Range:

- Systolic high limit: 35-270 (Adult), 35-180 (Pediatric)
- Systolic low limit: 30-265 (Adult), 30-175 (Pediatric)
- Diastolic high limit: 15-245 (Adult), 15-150 (Pediatric)
- Diastolic low limit: 10-240 (Adult), 10-145 (Pediatric)
- Mean high limit: 25-255 (Adult), 25-160 (Pediatric)
- Mean low limit: 20-250 (Adult), 20-155 (Pediatric)

Rated Life: 50,000 measurement cycles (36/day for 2.3 years)

Auto Mode Repetition Time: 1, 2.5, 5, 10, 15, 30, 60, or 120 minutes

Maximum Measurement Time: 120 sec.

Interconnect Tube Length:

- M1598B Connect tubing 1.5 m
- M1599B Connect tubing 3.0 m

Recommended frequency of pressure transducer calibration: yearly

Invasive Pressures

Transducer Sensitivity: 5uV/V mmHg (37.5uV/V/kPa)

Sensitivity Adjustment Range: $\pm 10\%$

Transducer Load Resistance: 195 to 2200 Ohms

Transducer Output Resistance: 0 to 3000 Ohms

Frequency Response: 0-12Hz or 0-40Hz

Zero Adjustment Range: ± 200 mmHg (± 26.7 kPa)

Zero Adjustment Accuracy: ± 1.0 mmHg (± 0.1 kPa)

Zero Setting Drift: < 0.1 mmHg/ $^{\circ}$ C (0.013kPa/ $^{\circ}$ C)

Gain accuracy (excluding transducers): $\pm 1\%$ of reading or 1mmHg (0.1kPa) whichever is greater

Gain Drift: less than 0.05%/ $^{\circ}$ C

Overall Accuracy (included listed transducers): $\pm 4\%$ of reading or 4mmHg (0.5kPa) whichever is greater

Measurement Range: -40 to 361mmHg (-5.3 to 48.1kPa)

Measurement Resolution: 1mmHg (0.1kPa)

Noise: < 1 mmHg (0.1kPa)

Alarm Response Time (60 bpm - transition from 120/0 to 25/0): 11.1 seconds; standard deviation 0.001 seconds

Alarm Signal Generation Delay: ≤ 14 seconds after an INOP condition for that pressure channel clears or 8 seconds in the absence of an INOP for that pressure channel.

Transducer/Dome Volume Displacement: Refer to the specific device's specifications.

Additional Noise from EMI if operating under conditions according to EMC standard EN60601-1-2 (Radiated Immunity 3 V/m or Conducted Immunity 3 VRMS): ≤ 3 mmHg

Pulse Rate Range: 25-350 bpm

Pulse Rate Accuracy: 1% of full range

Pulse Rate Resolution: 1 bpm

Temperature

Measurement Range: 0° - 45°C (32 - 113°F)

Measurement Resolution: 0.1°C (0.2°F)

Measurement Accuracy (excluding any adapter cable): $\pm 0.1^{\circ}\text{C}$ from 25°C to 45°C; $\pm 0.3^{\circ}\text{C}$ from 0°C to 24.9°C (temperature probe adds an additional $\pm 0.1^{\circ}\text{C}$)

Settling Time Constant: <10 seconds

Alarm Signal Generation Delay: 5 seconds

Averaging Time: 1 second

Minimum measurement time: See the probe's *Instructions for Use* to obtain minimum measurement times for accurate readings. The HeartStart MRx does not add any clinically significant time to obtain accurate readings.

EtCO₂

Range: 0 to 99 mmHg at sea level

Resolution: 1 mmHg (0.1kPa)

Accuracy: For values between 0 and 38 mmHg: ± 2 mmHg. For values between 39 and 99 mmHg: $\pm 5\%$ of reading + 0.08% for every 1 mmHg above 38 mmHg. Values read at sea level. For breath rates above 80 and EtCO₂ values > 18 mmHg, accuracy is 4mmHg or $\pm 12\%$ of reading, whichever is greater.

Drift of Measurement Accuracy: Over any 24-hour period, the accuracy claims listed above are maintained.

The accuracy specification is maintained to within 4% for the following gas mixtures (all values are in Vol. %).

CO ₂	N ₂	O ₂	N ₂ O	H ₂ O	Anesthetic Agents
0 to 13	0 to 97.5	0 to 100	0 to 80	dry to saturated	According to EN21647

Rise Time: 190 ms maximum @ 10ml/min

System Response Time (with a standard length FilterLine): 2.9 seconds typical - includes the delay time and rise time (10% to 90%) in response to a step change in the CO₂ concentration

Alarm Delay Time: 5.2 seconds, standard deviation 0.08 seconds (includes the 2.9 second FilterLine delay).

Sample Flow Rate: Nominally 50 ml/min; - 7.5 to + 15 ml/min

Microstream CO₂ Humidity Correction Factor:

BTPS (Body Temperature and Pressure, Saturated - 37°C, 750mmHg, 100% humidity or 47mmHg) is the humidity correction factor for the Microstream CO₂ readings. Correction calculation formula:

$$P_{BTPS} = FCO_2 \times (P_b - 47) \\ - FCO_2 \times 0.94$$

Where FCO₂ = fractional concentration of CO₂ in dry gas.

F_{CO₂} = %CO₂/100; P_b = ambient pressure

Alarm Range:

- Low Limit: 10 to 94 mmHg (Adult/Pediatric)
- High Limit: 20 to 95 mmHg (Adult/Pediatric)

AwRR

Range: 0 to 150 rpm

Resolution: 1 rpm

Accuracy:

- 0 to 40 rpm ±1 rpm
- 41 to 70 rpm ±2 rpm
- 71 to 100 rpm ±3 rpm
- 101 to 150 rpm ± 5 rpm

Alarm Range:

- Low Limit: 0 to 95 rpm (Adult/Pediatric)
- High Limit: 10 to 100 rpm (Adult/Pediatric)

Apnea Alarm Delay: 10-40 seconds, in increments of 5

Calibration Gas for CO₂ Measurement System

Ingredients: 5% Carbon Dioxide, 21% Oxygen, 74% Nitrogen

Cylinder Size: BD

Method of Preparation: Gravimetric

Blend Tolerance: 0.03%

Accuracy: 0.03% absolute

Moisture: 10 PPM Maximum

Expiration Period: 2 years

Pressure: 144 PSIG, Volume: 10L

CPR Meter

Dimensions: 154mm x 64mm x 28mm with a .91m integrated cable.

Weight: 6 oz. (170 g)

Input voltage: 4.0-6.0V at 170mA. The CPR meter is electrically and galvanically isolated from the defibrillator power and communication sources.

Temperature: Storage: -20°C to 60°C (-4°F to 140°F); Operating: 0°C to 50°C (32°F to 122°F)

Relative Humidity: Storage: 0% to 75%; Operating: 0% to 95%

Solids/Water Resistance: IP55. Meets ISO/IEC 60529

EMC: Meets IEC 60601-1-2 and RTCA/DO-160E

Patient Adhesive Pads

Dimensions: 39mm x 90 mm

Temperature: Storage: -20°C to 60°C (-4°F to 140°F); Operating: 0°C to 50°C (32°F to 122°F)

Relative Humidity: Storage: 0% to 75%; Operating: 0% to 95%

Material: Foam pad with biocompatible adhesive on both sides

Shelf life: 2 years when applied to the CPR meter or 4 years in an unopened package.

12-Lead ECG

Inputs: With a 10-lead cable, leads I, II, III, aVR, aVL, aVF, V/C1-V/C6 can be obtained. All 12-Lead ECG waves can be viewed on the display simultaneously. All 12 leads can be printed on the strip chart printer in 3x4 format.

Networking

Delay time from alarm signal generation at the HeartStart MRx to presence of alarm representation at the device's network output port: ≤ 4 seconds

Time of alarm representation at HeartStart MRx network output port to appearance at Information Center: Dependent on inherent network delay. Check with your network administrator for further details.

Telemetry channels: The maximum number of telemetry channels may be limited in some geographies. The spacing between channel 4a and channels 5 and 6 is less than 1.6 MHz; therefore transmission on channel 4a may not be used simultaneously with transmissions on channels 5 or 6.

The device meets the U.S. FCC 47 CFR Part 15 and Part 95 for WMTS transmission.

Patient Data Storage

Internal Event Summary: The internal Event Summary stores up to 12 hours of 2 continuous ECG waves, 1 CO₂ and 2 invasive pressure waves, events and trending per Event Summary. There is a maximum capacity of 55 Event Summaries or 240 megabytes (62 megabytes for those devices with a 64 megabyte card) of patient data, whichever comes first.

Data Card Event Summary: The Data Card has a maximum capacity of 60 Event Summaries or 240 megabytes (62 megabytes for those devices with a 64 megabyte card) of patient data, whichever comes first.

Environmental (M3535A)

Temperature: 0°C to 45°C operating; -20° to 70°C storage

- Charging the battery at temperatures above 45°C may degrade battery life
- Storing the battery for extended periods at temperatures above 40°C will reduce battery capacity and degrade battery life

Humidity: Up to 95% Relative Humidity

- Printer paper may jam if paper is wet
- Thermal Printer may be damaged if wet paper is allowed to dry while in contact with printer elements

Atmospheric Pressure Range:

- Operating: 1014 hPa to 572 hPa (0 to 15,000 ft; 0 to 4,500 m)
- Storage: 1014 hPa to 572 hPa (0 to 15,000 ft; 0 to 4,500 m)

Shock:

- Operating: Half-sine waveform, duration < 3 ms, acceleration > 145 g, 1 time on all six faces
- Non-operating: Trapezoidal waveform, acceleration ≥ 30 g, velocity change=742 cm/s $\pm 10\%$ on all six faces

Vibration:

- Operating: Random vibration, 0.30 Grms, 5-500 Hz for ≥ 10 minutes/axis PSD=0.0002 g²/Hz from 5 to 350 Hz, -6 dB/octave slope from 350 to 500 Hz
- Non-operating: Random vibration, 2.41 Grms, 5-500 Hz for ≥ 10 minutes/axis PSD=0.02 g²/Hz from 5 to 100 Hz, -6 dB/octave slope from 100 to 137 Hz, 0 dB/octave slope from 137 to 350 Hz, -6 dB/octave slope from 350 to 500 Hz.
Swept sine vibration, (0.75 g [0 to peak] 5 to 500 Hz) resonant search, 1 octave/minute sweep rate, 5 minute resonant dwell at 4 resonances per axis.

Water/Solids Resistance: IP24 if used with water-resistant paddles (M3543A) or pads only. IP20 if used with other paddles.

EMC: Complies with the requirements of standard EN 60601-1-2:2001.

Safety: Meets UL 2601-1, CSA C22.2 No. 601-1, EN 60601-1 and 60601-2-4 standards.

Other Considerations:

- The HeartStart MRx is not suitable for use in the presence of concentrated oxygen or a flammable anesthetic mixture with air, oxygen, or nitrous oxide.
- Hazards arising from software errors were minimized by the product's compliance with the software requirements contained in EN 60601-1-4:1996.

Mode of Operation: Continuous

AC Line Powered: 100 - 240 VAC, 50 - 60 Hz, 1 - 0.46 A (Class 1)

Battery Powered: Minimum 14.4 V Rechargeable, Lithium Ion

DC Powered:

- Input: 11-32 VDC, 11 A
- Output: 18 V, 5 A, 90 W

Environmental (M3536A)

Temperature: 0°C to 45°C operating; -20° to 70°C storage

- Charging the battery at temperatures above 45°C may degrade battery life
- Storing the battery for extended periods at temperatures above 40°C will reduce battery capacity and degrade battery life

Humidity: Up to 95% Relative Humidity

- Printer paper may jam if paper is wet
- Thermal Printer may be damaged if wet paper is allowed to dry while in contact with printer elements

Atmospheric Pressure Range:

- Operating: 1014 hPa to 572 hPa (0 to 15,000 ft; 0 to 4,500 m)
- Storage: 1014 hPa to 572 hPa (0 to 15,000 ft; 0 to 4,500 m)

Shock:

- Operating: Half-sine waveform, duration < 3 ms, acceleration > 145 g, 1 time on all six faces
- Non-operating: Trapezoidal waveform, acceleration ≥ 30 g, velocity change=742 cm/s $\pm 10\%$ on all six faces
- Bump: EN60068-2-29 Bump (Half-sine, 40 g peak, 6 msec duration, 1,000 bumps x 3 axes)
- Free Fall: IEC 68-2-32 Free Fall. Drops on all faces onto a steel surface (excluding bed rail hook)
 - 30 in. (76.2 cm) with carrying case
 - 16 in. (40.6 cm) without carrying case

Vibration:

- Operating: MIL STD 810E 514.4 Category 6 Helicopter, General Storage, UH60

- Non-Operating:
 - IEC 68-2-6 Vibration (sinusoidal) (10-57 Hz \pm 0.15mm; 58-150 Hz, 2g; 20 sweeps x 3 axes)
 - IEC 68-2-64 Vibration, broad-band random (10-20 Hz, 0.05 g²/Hz; 20-150 Hz, -3 dB/octave; 150 Hz, 0.0065 g²/Hz; 1.5 hours x 3 axes)

Solids/Water Resistance: IP24. Water testing performed with cables connected to the device.

EMC: Complies with the requirements of standard EN 60601-1-2:2001.

Safety: Meets UL 2601-1, CSA C22.2 No. 601-1, EN 60601-1 and 60601-2-4 standards.

Other Considerations:

- The HeartStart MRx is not suitable for use in the presence of concentrated oxygen or a flammable anesthetic mixture with air, oxygen, or nitrous oxide.
- Hazards arising from software errors were minimized by the product's compliance with the software requirements contained in EN 60601-1-4:1996.

Mode of Operation: Continuous

AC Line Powered: 100 - 240 VAC, 50 - 60 Hz, 1 - 0.46 A (Class 1)

Battery Powered: Minimum 14.4 V Rechargeable, Lithium Ion

DC Powered:

- Input: 11-32 VDC, 11 A
- Output: 18 V, 5 A, 90 W

Bluetooth

The HeartStart MRx supports File Transfer Profile Server 1.1 and was tested with the following Bluetooth stacks: Toshiba™ 4.20.01, IVT™ 2.1.2.0(Product)/05.04.11.20060301 (stack) and Widcomm™ 4.0.1.2400. For other Bluetooth stacks, review your user documentation to see if File Transfer Profile Server 1.1 is supported. If not, it is recommended that you install drivers that support File Transfer Profile Server 1.1.

Symbol Definitions

Table 103 lists the meaning of each symbol shown on the HeartStart MRx and the M3538A battery.

Table 103 Monitor/Defibrillator, Battery and CPR Meter Symbols

















Symbol	Definition		
	Dangerous voltage		Dispose of in accordance to your country's requirements.
	Attention - See operating instructions in Instructions for Use.	IP24	Protected against ingress of solid foreign objects >12.5mm in diameter. Protected against access to hazardous parts with a finger. Protected against splashing water.
	Input.	IP2X	Protected against ingress of solid foreign objects >12.5mm in diameter. Protected against access to hazardous parts with a finger.
	Output.		Data In/Out
	Gas Sample Input.		Electrostatic sensitive device
	Gas Exhaust Output.		Invasive Pressure Port (Number indicates Port 1 or Port 2)
	Meets IEC type BF leakage current requirements and is defibrillator protected. (Patient Applied Part is isolated and defib-proof suitable for direct patient contact except the heart or major arteries.)		NBP port
	Meets IEC type CF leakage current requirements and is defibrillator protected. (Patient Applied Part is isolated and defib-proof suitable for direct patient contact including the heart or major arteries.)		SpO ₂ port
	Alarm Pause button		Temperature port

Table 103 Monitor/Defibrillator, Battery and CPR Meter Symbols (Continued)

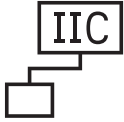








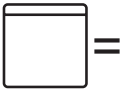
















Symbol	Definition		
	Device is Network-enabled.		Reference order number
	Non-Ionizing Radiation. Device contains a radio frequency transmitter.		The CPR meter meets IEC 60529 class IP55
	Device complies with the requirements of Medical Device Directive 93/42/EEC		Expiration date
	This product has passed relevant safety tests by the CSA, a nationally recognized test lab.		Does not contain natural rubber latex
	Single patient use only		Contains number of CPR meter patient adhesive pads shown after equals sign
	Manufacturer		Not for use on children under 8 years old
	RoHS exempt. Environmentally friendly for a use period of 50 years.		Device meets Directive 95/54/EC
	This device can be run off a battery.		This device can be run off AC power
	DC current		AC current

Table 104 lists the meaning of the symbols that may appear on the shipping carton.

Table 104 HeartStart MRx Shipping Carton Symbols

Symbol	Definition	Symbol	Definition
	Atmospheric pressure range.		Recyclable paper product.
	Temperature range		Fragile.
	Relative humidity range.		Do not get wet.
	Right side up.		Refer to operating instructions

Units and Abbreviations

Table 105 lists units and abbreviations used with the HeartStart MRx.

Table 105 Abbreviations

Unit	Definition	Unit	Definition
bpm	beats per minute	cpm	compressions per minute
°C	degrees Celsius	sec	seconds
°F	degrees Fahrenheit	min	minutes
mmHg	millimeters of mercury	mm/mV	millimeter per millivolt
kPa	kilo Pascal	Hz	Hertz
%	percent	ppm	pulses per minute
rpm	respirations per minute	mA	milliAmpere
mm	millimeter	J	Joule

Clinical Performance Summary - Defibrillation

An international, multicenter, prospective, randomized, clinical study was conducted to assess the effectiveness of the SMART Biphasic waveform in out-of-hospital sudden cardiac arrests (SCAs), as compared to monophasic waveforms. The primary objective of the study was to compare the percent of patients with ventricular fibrillation (VF) as the initial monitored rhythm that were defibrillated in the first series of three shocks or less.

This section summarizes the methods and results of this study.

Methods

Victims of out-of-hospital SCA were prospectively enrolled in four emergency medical service (EMS) systems. Responders used either 150J SMART Biphasic AEDs or 200-360J monophasic waveform AEDs. A sequence of up to three defibrillation shocks were delivered. For the biphasic AEDs, there was a single energy output of 150J for all shocks. For monophasic AEDs, the shock sequence was 200, 200, 360J. Defibrillation was defined as termination of VF for at least five seconds, without regard to hemodynamic factors.

Results

Randomization to the use of monophasic or SMART Biphasic automatic external defibrillators (AEDs) was done in 338 SCAs from four emergency medical service systems. VF was observed as the first monitored rhythm in 115 patients. The biphasic and monophasic groups for these 115 patients were similar in terms of age, sex, weight, primary structural heart disease, cause or location of arrest, and bystanders witnessing the arrest or performing CPR.

The 150J SMART Biphasic waveform defibrillated 98% of VF patients in the first series of three shocks or less, compared with 69% of patients treated with monophasic waveform shocks. Outcomes are summarized in Table 106.

Table 106 Clinical Summary - Defibrillation

	Biphasic Patients Number (%)	Monophasic Patients Number (%)	P Value (chi-square)
Defibrillation Efficacy			
- Single shock only	52/54 (96%)	36/61 (59%)	<0.0001
- ≤2 shocks	52/54 (96%)	39/61 (64%)	<0.0001
- ≤3 shocks	53/54 (98%)	42/61 (69%)	<0.0001
Patients Defibrillated	54/54 (100%)	49/58 (84%)	0.003
Return of Spontaneous Circulation	41/54 (76%)	33/61 (54%)	0.01
Survival to Hospital Admission	33/54 (61%)	31/61 (51%)	0.27
Survival to Hospital Discharge	15/54 (28%)	19/61 (31%)	0.69
CPC = 1 (Good)	13/15 (87%)	10/19 (53%)	0.04

Conclusion

The 150J SMART Biphasic waveform defibrillated at higher rates than 200-360J monophasic waveforms, resulting in more patients achieving return of spontaneous circulation (ROSC) ($p=0.01$). EMS system outcomes of survival discharge were not significantly different statistically. However, patients resuscitated with the lower energy SMART Biphasic waveform were more likely to have good cerebral performance (CPC, cerebral performance category) ($p=0.04$).

Clinical Performance Summary - Cardioversion

An international, multicenter, prospective, double-blinded, randomized, clinical trial was conducted to assess the effectiveness of the SMART Biphasic waveform in treatment of atrial fibrillation (AF), as compared to monophasic waveforms. The primary objective of the study was to determine the required energy for cardioversion of AF using the SMART Biphasic waveform, as compared with a monophasic damped sine waveform.

This section summarizes the methods and results of this study.

Methods

Patients enrolled for this study were adults scheduled for elective cardioversion of AF at one of 11 clinical sites. Clinicians used both a defibrillator delivering the SMART Biphasic waveform, and one delivering a monophasic waveform. A sequence of up to five shocks was administered: four with the initial defibrillator, and a fifth cross-over shock was delivered with the other defibrillator if necessary. The sequence of energy settings was 100J, 150J, 200J through the first three shocks on either type of defibrillator. A fourth shock, if necessary, was delivered at 200J if the initial defibrillator was biphasic, and at 360J if the initial defibrillator was monophasic. The cross-over shock was 360J monophasic if the initial defibrillator was biphasic, and 200J biphasic if the initial defibrillator was monophasic. Successful cardioversion was defined as the occurrence of two P waves uninterrupted by atrial fibrillation within 30 seconds of the shock.

Results

Randomization to the use of monophasic or SMART Biphasic defibrillators was done in 212 elective cardioversions involving 210 patients at eleven clinical sites in the United States and Europe. Of these, 203 results met the protocol criteria for inclusion in this analysis. The biphasic and monophasic groups were similar in terms of age, sex, weight, current medical history, cause of heart disease, and estimated ejection fraction.

The 150J SMART Biphasic waveform successfully converted far more patients with an initial 100J shock (60% compared with 22% for the monophasic waveform), and successfully converted patients at least as well with a maximum energy of 200J as the monophasic did with its maximum energy of 360J (91% compared to 85% for the monophasic waveform). Overall, the biphasic waveform required fewer shocks (1.7, compared to 2.8 for the monophasic waveform) and lower delivered energy (217J, compared to 548J for the monophasic waveform). Outcomes are summarized in Table 107.

Table 107 Clinical Summary - Cardioversion

	Biphasic Patients Number (%)	Monophasic Patients Number (%)	P Value
Cumulative Cardioversion Efficacy			
- Single shock only	58/96 (60%)	24/107 (22%)	<0.0001
- ≤2 shocks	74/96 (77%)	47/107 (44%)	<0.0001
- ≤3 shocks	86/96 (90%)	56/107 (53%)	<0.0001
- ≤4 shocks	87/96 (91%)	91/107 (85%)	0.29
Skin “burn”			
None	25/90 (28%)	15/105 (14%)	0.0001
Mild	50/90 (56%)	47/105 (45%)	
Moderate	15/90 (17%)	41/105 (39%)	
Severe	0/90 (0%)	2/105 (2%)	
Number of shocks	1.7 ± 1.0	2.8 ± 1.2	<0.0001
Cumulative delivered energy	217 ± 176J	548 ± 331J	<0.0001
Skin reaction definitions: (evaluated 24 - 48 hours after procedure)			
Mild - erythema, no tenderness			
Moderate - erythema, tenderness			
Severe - blistering or necrosis, tenderness			

Conclusion

The SMART Biphasic waveform cardioverted at higher rates than the monophasic damped sine waveform at each step of the protocol, although the cumulative biphasic rate after 4 shocks was not significantly different from the monophasic rate. Tissue damage was more pronounced in the monophasic population.

Clinical Performance Summary - Internal Defibrillation

Overview

A study was conducted during the first half of 2002 to assess the effectiveness of the HeartStart MRx (biphasic) for use in intra-thoracic application, as compared to a control biphasic waveform. This appendix summarizes the methods and results of the study.

Methods

Twelve swine, each weighing approximately 30 kg, were anesthetized and intubated. A sternotomy was performed to expose the heart. VF was induced electrically by 60 Hz current via a pacemaker catheter in the right ventricle. After 15 seconds of VF, a defibrillating shock was applied, using hand-held (2-inch diameter) "surgical" electrode paddles applied directly to the epicardium. Shock energies of 2, 5, 10, 20, and 30 J were used in random order. At least 4 shocks at each energy level were administered for 4 separate VF episodes to derive a "% success" data point at that energy. Success was defined as conversion of fibrillating rhythm to non-fibrillating rhythm five seconds after the shock.

Results

The results showed that the average impedance was about 40 ohms in this study, which is similar to the human impedance data encountered in direct heart defibrillation. The efficacy results of the HeartStart MRx are shown in Table 108, along with historical efficacy results of a standard monophasic damped sine (MDS) waveform.¹

Table 108 Clinical Performance Summary - Internal Defibrillation

	Energy				
	2J	5J	10J	20J	30J
HeartStart MRx (biphasic) Mean Success	4%	47%	77%	86%	88%
Sample Size	48	53	53	51	41
Control Biphasic Mean Success	10%	60%	93%	92%	92%
Sample Size	49	48	54	49	40
p-value Fisher's Exact (p<0.050)	0.436	0.232	0.032	0.526	0.712
Historical MDS Mean Success	3%	25%	34%	57%	76%

Conclusion

Overall, the intra-thoracic defibrillation success rate for the HeartStart MRx (Biphasic) versus a control biphasic waveform had no significant difference (p<0.05) except at 10J.

1. Zhang, Y., Davies R., Coddington W., Jones J., Kerber RE., Open Chest Defibrillation: Biphasic versus Monophasic Waveform Shocks, JACC 2001;37;320A.

Safety Considerations

The following general warnings and cautions apply to use of the HeartStart MRx. Additional warning and cautions specific to a particular feature are provided in the appropriate section.

General

WARNING The HeartStart MRx is not intended to be deployed in settings or situations that promote use by untrained personnel. Operation by untrained personnel can result in injury or death.

WARNING HeartStart MRx service should only be performed by qualified service personnel, in accordance with the *HeartStart MRx Service Manual*.

WARNING Use of the HeartStart MRx is restricted to a single patient at a time.

WARNING When transporting the HeartStart MRx, it is important to position it with the display facing away from the body. If not, the Therapy Knob may be bumped and inadvertently moved from its current position.

WARNING Remain attentive to the patient during the delivery of therapy. Delay in delivering a shock may result in a rhythm that was analyzed as shockable converting spontaneously to non-shockable and could result in inappropriate delivery of a shock.

WARNING Use only 3-wire AC power cords with 3-pronged grounded plugs.

WARNING Never operate the HeartStart MRx in standing water. Do not immerse, or pour fluids on, any portion of the HeartStart MRx. If the device does get wet, dry the device with a towel.

WARNING Do not use the HeartStart MRx in the presence of a flammable anesthetic mixture or oxygen concentrations greater than 25% (or partial pressures greater than 27.5 kPa/206.27 mmHg). This can cause an explosion hazard.

WARNING Avoid connecting the patient to several devices at once. Leakage current limits may be exceeded. Do not use a second defibrillator on the patient while pacing with the HeartStart MRx.

WARNING Electric shock hazards exist internally. Do not remove assembly screws except as described in the carry bag assembly procedure. Refer servicing to qualified personnel.

WARNING Operating the HeartStart MRx or its accessories in conditions outside the environmental specifications can result in device or accessory malfunction. The HeartStart MRx should be allowed to stabilize within the operating temperature range for 30 minutes prior to operation.

WARNING The HeartStart MRx should not be used adjacent to or stacked with other equipment. If adjacent or stacked use is necessary, the HeartStart MRx should be observed to verify normal operation in the configuration used.

WARNING Avoid touching monitoring electrodes and other measuring devices when they are applied to the patient. Doing so can degrade safety and may affect results.

WARNING Do not touch communication ports and a patient simultaneously.

CAUTION Do not discharge the defibrillator with the paddles shorted together.

CAUTION Conductive parts of electrodes and associated connectors for applied parts, including the neutral electrode, should not contact other conductive parts including earth.

CAUTION This device is suitable for use in the presence of high-frequency surgical equipment. Following electrosurgery interference, the equipment returns to the previous operating mode within 10 seconds without loss of stored data. Measurement accuracy may be temporarily decreased while performing electrosurgery or defibrillation. This does not affect patient or equipment safety. See the electrosurgery device's *Instructions for Use* for information on reducing hazards of burns in the event of a defect in its equipment. Do not expose the equipment to x-ray or strong magnetic fields (MRI).

CAUTION Be aware of patient cables, including ECG monitoring equipment when used with high frequency surgical equipment.

NOTE This device and its accessories are not intended for home use.

NOTE The HeartStart MRx can be operated with only AC/DC power, only 14V M3538A Lithium Ion Battery, or AC/DC power and M3538A battery simultaneously.

NOTE For operation in the U.S., the AC power cord must have the proper NEMA type plug.

NOTE The HeartStart MRx does not require the practice of any special ElectroStatic Discharge (ESD) precautionary procedures.

Defibrillation

WARNING Keep hands and feet clear of paddle electrode edges. Use your thumbs to depress the shock buttons on the paddle handle.

WARNING Do not allow multifunction electrode pads to touch each other or to touch other ECG monitoring electrodes, lead wires, dressings, etc. Contact with metal objects may cause electrical arcing and patient skin burns during defibrillation and may divert current away from the heart.

WARNING During defibrillation, air pockets between the skin and multifunction electrode pads may cause patient skin burns. To help prevent air pockets, make sure the pads completely adhere to the skin. Do not use dried out pads; do not open pads package until just prior to use.

WARNING Never touch the patient or any equipment connected to the patient (including the bed or gurney) during defibrillation.

WARNING Avoid contact between the patient and conductive fluids and/or metal objects, such as the gurney. Contact with metal objects could cause unintentional current pathways.

WARNING Medical electrical equipment which does not incorporate defibrillator protection should be disconnected during defibrillation.

WARNING In AED Mode, the multifunction electrode pads must be in the anterior-anterior position as shown on the packaging. The HeartStart MRx was not designed to assess data acquired from pads in an anterior-posterior position.

Battery

WARNING Properly dispose of or recycle depleted batteries according to local regulations. Do not puncture, disassemble, or incinerate batteries.

WARNING Built in safety circuits can not protect against handling abuse. Adhere to all warnings and cautions in handling and using lithium ion batteries.

WARNING Do not expose batteries to temperatures greater than 60°C (140°F). Excess temperatures may result in battery damage.

WARNING Keep batteries away from flame and other heat sources.

WARNING Do not short circuit the battery. Avoid placing batteries around metal objects that may short circuit the battery.

WARNING Avoid getting batteries wet or using batteries in high humidity environments.

WARNING Do not crush, dent or allow any deformation of the batteries.

WARNING Do not disassemble or open batteries. Do no attempt to alter or bypass the safety circuit.

WARNING Avoid extreme shock and vibration to the battery.

WARNING Do not use or connect the battery to batteries of other chemistries.

Supplies and Accessories

WARNING Use only the multifunction electrode pads, battery, and accessories as listed in this guide. Substitutions may cause the HeartStart MRx to function improperly.

WARNING Use multifunction electrode pads prior to their expiration date. Discard pads after use. Do not reuse pads. Do not use for more than 8 hours of continuous pacing.

Electromagnetic Compatibility

When using the HeartStart MRx, electromagnetic compatibility with surrounding devices should be assessed.

A medical device can either generate or receive electromagnetic interference. Testing for electromagnetic compatibility EMC with and without the appropriate accessories has been performed according to the international standard for EMC for medical devices (IEC 60601-1-2). This IEC standard has been adopted in Europe as the European Norm (EN 60601-1-2).

The EMC standards describe tests for both emitted and received interference. Emission tests deal with interference generated by the device being tested.

WARNING Radio frequency (RF) interference from devices other than the HeartStart MRx may degrade performance of the HeartStart MRx. Electromagnetic compatibility with surrounding devices should be assessed prior to using the defibrillator.

Fixed, portable, and mobile radio frequency communications equipment can affect the performance of medical equipment. See Table 113 for the minimum recommended separation distance between RF communications equipment and the HeartStart MRx.

Reducing Electromagnetic Interference

The HeartStart MRx and associated accessories may be susceptible to interference from other RF energy sources and continuous, repetitive, power line bursts. Examples of other sources of RF interference are medical devices, cellular products, information technology equipment and radio/television transmission. Should interference be encountered, as demonstrated by artifact on the ECG or dramatic variations in parameter measurement values, attempt to locate the source. Assess:

- Is the interference intermittent or constant?
- Does the interference occur only in certain locations?
- Does the interference occur only when in close proximity to certain medical devices?
- Do parameter measurement values change dramatically when the AC line cord is unplugged?

Once the source is located, attempt to attenuate the EMC coupling path by distancing the monitor/defibrillator from the source as much as possible. If assistance is needed, call your local service representative.

Restrictions for Use


Artifact on the ECG and parameter waveforms caused by electromagnetic interference should be evaluated by a physician or physician authorized personnel to determine if it will negatively impact patient diagnosis or treatment.

Emissions and Immunity

The HeartStart MRx is designed and tested to comply with the radiated and conducted emissions requirement of international and national standards IEC 60601-1-2:2001 and EN 60601-1-2:2002. See Tables 109 through 113 for detailed information regarding declaration and guidance.

WARNING The use of accessories, transducers and cables other than those specified may result in increased emissions or decreased immunity of the HeartStart MRx.

The list of cables, transducers, and other accessories with which Philips claims compliance with the emissions and immunity requirements of IEC standard 60601-1-2 are listed in “Supplies & Accessories” on page 291.

The local area network (LAN) connector of the HeartStart MRx is marked with the  label. The pins of connectors marked with this warning symbol should not be touched or connections made to until the following precaution is taken:

Discharge yourself to a conductive metal surface which is connected to earth ground before making connections or touching the marked connector.

All staff using the HeartStart MRx should be instructed on these precautionary measures in order to avoid damage to this sensitive medical equipment.

The EMC standards state that manufacturers of patient-coupled equipment must specify immunity levels for their systems. See Tables 109 through 112 for this detailed immunity information. See Table 113 for recommended minimum separation distances between portable and mobile communications equipment and the HeartStart MRx.

Immunity is defined in the standard as the ability of a system to perform without degradation in the presence of an electromagnetic disturbance. Degradation in ECG quality is a qualitative assessment which can be subjective.

Caution should, therefore, be taken in comparing immunity levels of different devices. The criteria used for degradation is not specified by the standard and may vary with the manufacturer.

Guidance and Manufacturer's Declaration

The HeartStart MRx is intended for use in the electromagnetic environment specified in the tables below. The customer or the user of the HeartStart MRx should assure that it is used in such an environment.

Table 109 Electromagnetic Emissions

Emissions Test	Compliance	Electromagnetic Environment - Guidance
RF emissions CISPR 11	Group 1	The HeartStart MRx uses RF energy only for its internal function. Therefore, its RF emissions are very low and not likely to cause interference in nearby electronic equipment.
RF emissions CISPR 11	Class B	The HeartStart MRx is suitable for use in all establishments, including domestic establishments or those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions IEC 61000-3-2	Class A	
Voltage fluctuations/flicker emissions IEC 61000-3-3	Complies	

Table 110 Electromagnetic Immunity - General

Immunity Test	IEC 60601 Test Level	Compliance Level	Electromagnetic Environment - Guidance
Electrostatic discharge (ESD) IEC 61000-4-2	± 6 kV contact ± 8 kV air	± 6 kV contact ± 8 kV air	Floors should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC 61000-4-4	± 2 kV for power supply lines ± 1 kV for input/output lines	± 2 kV for power supply lines ± 1 kV for input/output lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	± 1 kV differential mode ± 2 kV common mode	± 1 kV differential mode ± 2 kV common mode	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions, and voltage variations on power supply input lines IEC 61000-4-11	$< 5\% U_T$ ($> 95\%$ dip in U_T) for 0,5 cycle $40\% U_T$ (60% dip in U_T) for 5 cycles $70\% U_T$ (30% dip in U_T) for 25 cycles $< 5\% U_T$ ($> 95\%$ dip in U_T) for 5 sec	$< 5\% U_T$ ($> 95\%$ dip in U_T) for 0,5 cycle $40\% U_T$ (60% dip in U_T) for 5 cycles $70\% U_T$ (30% dip in U_T) for 25 cycles $< 5\% U_T$ ($> 95\%$ dip in U_T) for 5 sec	Mains power quality should be that of a typical commercial or hospital environment.
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
U_T is the AC mains voltage prior to application of the test level.			

Table 111 Electromagnetic Immunity - Life Supporting Functions

Immunity Test	IEC 60601 Test Level	Compliance Level	Electromagnetic Environment - Guidance
			Portable and mobile RF communications equipment should be used no closer to any part of the HeartStart MRx, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.
Conducted RF IEC 61000-4-6	3 Vrms 150 kHz to 80 MHz outside ISM bands ^a	3 Vrms	Recommended Separation Distance $d = 1.2\sqrt{P}$
	10 Vrms 150 kHz to 80 MHz in ISM bands ^a	10 Vrms	Recommended Separation Distance $d = 1.2\sqrt{P}$

Table 111 Electromagnetic Immunity - Life Supporting Functions (Continued)



Immunity Test	IEC 60601 Test Level	Compliance Level	Electromagnetic Environment - Guidance
Radiated RF IEC 61000-4-3	10 V/m 80 MHz to 2.5 GHz	10 V/m	$d = 1.2\sqrt{P}$ 80 MHz to 800 MHz $d = 2.3\sqrt{P}$ 800 MHz to 2.5 GHz where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter's specified output power and d is the recommended separation distance in meters (m). ^b Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey, ^c should be less than the compliance level in each frequency range. ^d Interference may occur in the vicinity of equipment marked with the following symbol: 
At 80 MHz and 800 MHz, the higher frequency range applies. These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.			
^a The ISM (industrial, scientific, and medical) bands between 150 kHz and 80 MHz are 6.765 MHz to 6.795 MHz; 13.553 MHz to 13.567 MHz and 26.957 MHz to 27.283 MHz; and 40.66 MHz to 40.70 MHz. ^b The compliance levels in the ISM frequency bands between 150 kHz and 80 MHz and in the frequency range 80 MHz to 2.5 GHz are intended to decrease the likelihood that mobile/portable communications equipment could cause interference if it is inadvertently brought into patient areas. For this reason, an additional factor of 10/3 is used in calculating the recommended separation distance for transmitters in these frequency ranges. ^c Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the HeartStart MRx is used exceeds the applicable RF compliance level above, the HeartStart MRx should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the HeartStart MRx. ^d Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.			

Table 112 Electromagnetic Immunity - Nonlife Supporting Functions

Immunity Test	IEC 60601 Test Level	Compliance Level	Electromagnetic Environment - Guidance
			Portable and mobile RF communications equipment should be used no closer to any part of the HeartStart MRx, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.
Conducted RF IEC 61000-4-6	3 Vrms 150 kHz to 80 MHz	3 Vrms	<p>Recommended Separation Distance</p> $d = 1.2\sqrt{P}$
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2.5 GHz	3 V/m	$d = 1.2\sqrt{P} \quad 80 \text{ MHz to } 800 \text{ MHz}$ $d = 2.3\sqrt{P} \quad 800 \text{ MHz to } 2.5 \text{ GHz}$ <p>where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter's specified output power and d is the recommended separation distance in meters (m).</p> <p>Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey,^a should be less than the compliance level in each frequency range.^b</p> <p>Interference may occur in the vicinity of equipment marked with the following symbol:</p> 
<p>At 80 MHz and 800 MHz, the higher frequency range applies.</p> <p>These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.</p> <p>^a Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the HeartStart MRx is used exceeds the applicable RF compliance level above, the HeartStart MRx should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the HeartStart MRx.</p> <p>^b Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.</p>			

Recommended Separation Distances

The HeartStart MRx is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the HeartStart MRx can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the HeartStart MRx as recommended below, according to the maximum output power of the communications equipment.

Table 113 Recommended Separation Distances

Rated Maximum Output Power of Transmitter (W)	Separation Distance According to Frequency of Transmitter (m)	
	150 kHz to 800 MHz $d = 1.2\sqrt{P}$	800 MHz to 2.5 GHz $d = 2.3\sqrt{P}$
0.01	0.1 m	0.2 m
0.1	0.4 m	0.7 m
1	1.2 m	2.3 m
10	4 m	7 m
100	12 m	23 m
<p>For transmitters rated at a maximum output power not listed above, the recommended separation distance d in meters (m) can be determined using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter's manufacturer.</p> <p>At 80 MHz and 800 MHz, the higher frequency range applies.</p> <p>These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.</p>		

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989803160421
Edition 1
Philips Medical Systems
Printed in the U.S.A. April 2009



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