ApexPro™ Telemetry System

Operator's Manual

Software Version 1

2001989-002 Revision A

marquette

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For your notes

About This Manual

Manual Purpose

This manual contains the instructions necessary to operate the ApexPro telemetry system safely and in accordance with its function and intended use.

This manual addresses the operation of the ApexPro telemetry system at the Clinical Information Center. Be sure to read the entire manual before using the equipment.

Intended Audience

This manual is geared for clinical professionals. Clinical professionals are expected to have a working knowledge of medical procedures, practices, and terminology, as required for monitoring of critically ill patients.

This manual assumes that you are familiar with the operating procedures of the Clinical Information Center. If you would like more information about using the Clinical Information Center, refer to the Clinical Information Center Operator's Manual.

This manual also assumes that you are familiar with the operation of a two-button computer mouse. If you would like more information about operating the mouse, refer to the Clinical Information Center Operator's Manual, or to the documentation supplied with the mouse.

Revision History

Each page of the document has the document part number and revision letter at the bottom of the page. The revision letter changes whenever the document is updated.

Revision	Date	Comments
A	5 June 2000	Initial release of this document, corresponding to ApexPro telemetry system software version 1.

Manual Conventions

This section describes terminology, standards, and other conventions that are used throughout this manual.

Product References

In this manual:

- The ApexPro telemetry system is referred to as the ApexPro system, or simply the system.
- The Clinical Information Center is referred to as the clinical information center, the CIC, or the central station.
- The SunTech Medical Systems Accutracker DX noninvasive blood pressure monitor is referred to as the blood pressure monitor or the Accutracker.
- The PRN 50 Digital Writer is referred to as the digital writer or the writer.
- The Direct Digital Writers are referred to as DDWs or writers.
- The laser printer is referred to as the printer.

Definitions

The following terms are used in this manual:

Buttons — The word “button” is defined in two ways:

1. A button is a labeled gray or red rectangle on the clinical information center. Clicking on a button with the mouse pointer opens a tab sheet or performs the specified action (such as *Print*). Red buttons are used to view beds in alarm.
2. A button is a labeled circle, square, or rectangle located on the ApexPro transmitter, the Apex Oximeter, or the Accutracker blood pressure monitor. Pressing the button with your finger activates it.

NOTE: The computer mouse used with the clinical information center also has two buttons. Refer to the Clinical Information Center Operator’s Manual for information about using those buttons.

Messages/Prompts — A message is text that appears on the clinical information center. It informs you of conditions occurring that are not necessarily part of normal operating conditions. Prompts are text messages that appear, instructing you to perform a specific action.

Multiple patient viewer — The multiple patient viewer is the clinical information center display in its normal state. Bed windows for admitted patients are shown, as well as a menu bar at the bottom of the display.

Screen text — Any text that appears on the clinical information center display. In this manual, screen text is shown in italics (for example, *ECG*, *SAVING*, etc.).

Single patient viewer — When you click on a patient's bed window at the clinical information center, the display rearranges to accommodate a set of tab sheets (see definition below) in the bottom portion of the display. This set of tab sheets is referred to as the single patient viewer because it contains information specific to one patient.

Tab options — Tab options are the choices and text entry fields available on a tab sheet. The information presented as tab options may pertain to a patient's data, or may be control information (such as alarm settings) that can be modified to meet the user's specific needs.

Tab sheets — Tab sheets look like labeled index cards. The menu tab labels indicate the type of information to be viewed and/or changed on its tab sheet. Clicking on a tab brings its tab sheet to the front of the "index card" stack, or to the front of the currently viewed window.

Tabs — Tabs are the labeled section of the tab sheets. Clicking on a tab brings its tab sheet to the front. Tab and tab sheet are sometimes used interchangeably.

Illustrations

All illustrations in this manual are provided as examples only. They may not necessarily reflect your telemetry monitoring setup or data displayed on your equipment.

Common Operations

Some operations are used repetitively at the clinical information center or the ApexPro telemetry system. Rather than explaining how to perform each operation every time it appears in this manual, these operations are presented below. Please familiarize yourself with the proper procedure for each.

“Clicking” the Mouse

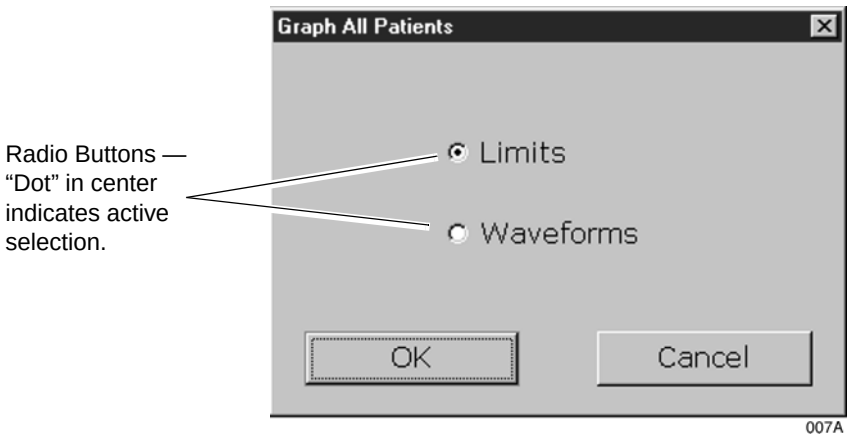
The term “click” refers to positioning the mouse pointer on a selection and pressing the left mouse button one time.

In situations where the right mouse button should be pressed, this is specifically called out. In all other cases, assume that you should press the **left** mouse button.

Pressing the mouse button two times in a row is called double clicking. In situations where the mouse needs to be double clicked to perform a function, this is specifically called out. In all other cases, assume that you only need to click the mouse button **one** time.

Radio Buttons

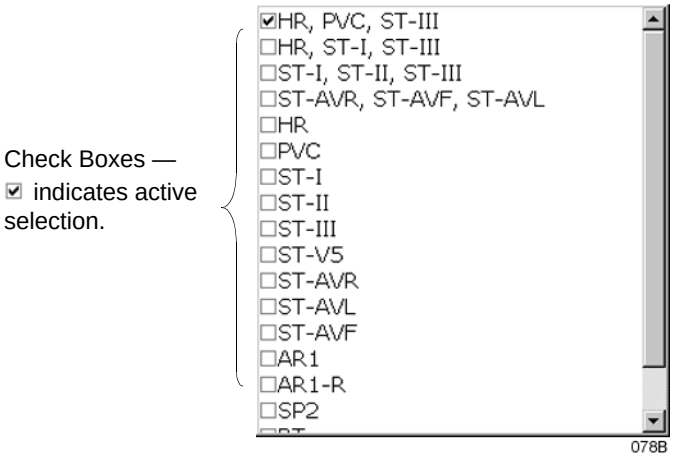
To use a radio button control, click on the white circle (radio button) or the text next to it. When selected, a black dot is shown in the white circle. To deselect a radio button control, click again on the label text or in the white circle. When it is not selected, no black dot is shown.



Radio Buttons — “Dot” in center indicates active selection.

Check Boxes

To use check box controls, click on the square or the text next to it. When selected, a check mark is shown in this square. To deselect a check box control, click again on the text or in the square. When deselected, no check mark is shown.



Scroll Bars

Use horizontal and vertical scroll bars to move a window's contents left/right and up/down. Place the mouse pointer on the appropriate arrow to move the scroll bar, or click and hold the mouse button down while dragging the scroll bar until the desired information is displayed.

Popup Lists

Clicking in a text field may produce a down arrow button on the right side of the field. This arrow button is used to open a popup list. A popup list is a list of options available for that particular field. Use the mouse to click on the arrow button, which opens the popup list.

Once the popup list is open, use the mouse to click on an option. This selects the option and closes the popup list.

NOTE: If you click on the right side of a field, the down arrow button and the popup list of selections may appear simultaneously.

Unit Defaults Worksheet

This worksheet has been provided as an optional reference tool to record your care unit's default settings. Fill out the information and keep it in a prominent place to refer to your setup. Before you fill it out, you may want to make additional copies of the worksheet for future use.

Date: _____ Unit: _____

Unit Defaults — Arrhythmia Alarm Levels

	Crisis	Warning	Advisory	Message
Asystole				
VFIB/VTAC				
V Tach				
VT > 2				
V Brady				
Couplet				
Bigeminy				
Acc Vent				
Pause				
Trigeminy				
R on T				
PVC				
Tachy				
Brady				
Irregular				

Unit Defaults — Parameter Alarm Levels

	Crisis	Warning	Advisory	Message
HR				
NBP-S				
NBP-D				
NBP-M				
SPO2				
SPO2-R				
PVC				
ST-I				
ST-II				
ST-III				
ST-V				
ST-V2				
ST-V3				
ST-V4				
ST-V5				
ST-V6				
ST-AVR				
ST-AVL				
ST-AVF				

Unit Defaults — Limits

	Low	High
HR		
PVC (number per minute limit)		
NBP-S		
NBP-D		
NBP-M		
SPO2		
SPO2-R		

Unit Defaults — Telemetry

Manual Graph Location	
Alarm Graph Location	
Print Window Graph Location	
ECG 1 Waveform Display	
Waveform 2 Display	
Waveform 3 Display	
Waveform 4 Display	
Transmitter Graph	
Alarm Graph On/Off	
Display Lead	
Arrhythmia	
Lead Analysis	
ST Analysis	
Va Lead	
Vb Lead	
Detect Pace	
Patient Data Transfer PIRP Server	
Patient Data Transfer PDT Server	
Patient Age	
Transmitter Alarm Pause	
Alarm Pause Breakthrough	

For your notes

2 Safety

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For your notes

For Your Safety

Intended Use

The ApexPro telemetry system is intended to acquire and monitor physiological data for ambulating patients within a defined coverage area. It is intended for installation in the hospital or clinical environment to provide clinicians with patient physiological data while allowing for patient mobility. The physiological parameters monitored include ECG, noninvasive blood pressure, and SpO2.

Definitions

The terms danger, warning, and caution are used throughout this manual to point out hazards and to designate a degree or level or seriousness. Familiarize yourself with their definitions and significance.

Hazard is defined as a source of potential injury to a person.

DANGER indicates an imminent hazard which, if not avoided, will result in death or serious injury.

WARNING indicates a potential hazard or unsafe practice which, if not avoided, could result in death or serious injury.

CAUTION indicates a potential hazard or unsafe practice which, if not avoided, could result in minor personal injury or product/property damage.

NOTE provides application tips or other useful information to assure that you get the most from your equipment.

System Safety

The safety statements presented in this chapter refer to the equipment in general and, in most cases, apply to all aspects of the telemetry system. There are additional safety statements in other chapters that are specific to the information presented in that chapter.

The order in which safety statements are presented in no way implies order of importance.

Dangers

There are no dangers that refer to the equipment in general. Specific “Danger” statements may be given in the respective sections of this manual.

Warnings

WARNINGS

ACCIDENTAL SPILLS — To avoid electric shock or device malfunction liquids must not be allowed to enter the device. If liquids have entered a device, take it out of service and have it checked by a service technician before it is used again.

ACCURACY — If the accuracy of any value displayed on the monitor, central station, or printed on a graph strip is questionable, determine the patient's vital signs by alternative means. Verify that all equipment is working correctly.

ALARMS — Do not rely exclusively on the audible alarm system for patient monitoring. Adjustment of alarm volume to a low level or off during patient monitoring may result in a hazard to the patient.

Do not rely exclusively on the alarm pause breakthrough feature for alarm notification during an alarm pause. This may result in a hazard to the patient. Only crisis alarms break through an alarm pause.

Remember that the most reliable method of patient monitoring combines close personal surveillance with correct operation of monitoring equipment.

After connecting the monitor to the central station, nurse-call system, and/or network, verify the function of the alarm system.

The functions of the alarm system for monitoring of the patient must be verified at regular intervals.

BEFORE USE — Before putting the system into operation visually inspect all connecting cables for signs of damage. Damaged cables and connectors must be replaced immediately.

Before using the system, the operator must verify that it is in correct working order and operating condition.

Periodically, and whenever the integrity of the product is in doubt, test all functions.

CABLES — Route all cables away from patient's throat to avoid possible strangulation.

WARNINGS

CONDUCTIVE CONNECTIONS — Extreme care must be exercised when applying medical electrical equipment. Many parts of the human/machine circuit are conductive, such as the patient, connectors, electrodes, transducers. It is very important that these conductive parts do not come into contact with other grounded, conductive parts when connected to the isolated patient input of the device. Such contact would bridge the patient's isolation and cancel the protection provided by the isolated input. In particular, there must be no contact of the neutral electrode and ground.

DEFIBRILLATION — Do not come into contact with patients during defibrillation. Otherwise serious injury or death could result.

DISCONNECTION FROM MAINS — When disconnecting the system from the power line, remove the plug from the wall outlet first. Then you may disconnect the power cord from the device. If you do not observe this sequence, there is a risk of coming into contact with line voltage by inserting metal objects, such as the pins of leadwires, into the sockets of the power cord by mistake.

DISPOSAL — Dispose of the packaging material, observing the applicable waste control regulations and keeping it out of children's reach.

EXPLOSION HAZARD — Do not use this equipment in the presence of flammable anesthetics, vapors or liquids.

INTERFACING OTHER EQUIPMENT — Devices may only be interconnected with each other or to parts of the system when it has been determined by qualified biomedical engineering personnel that there is no danger to the patient, the operator, or the environment as a result. In those instances where there is any element of doubt concerning the safety of connected devices, the user must contact the manufacturers concerned (or other informed experts) for proper use. In all cases, safe and proper operation should be verified with the applicable manufacturer's instructions for use, and system standards IEC 60601-1-1/EN 60601-1-1 must be complied with.

LEAKAGE CURRENT TEST — When interfacing with other equipment, a test for leakage current must be performed by qualified biomedical engineering personnel before using with patients.

WARNINGS

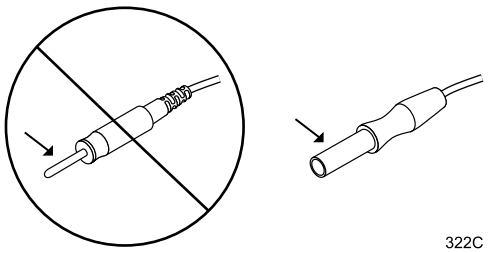
NETWORK INTEGRITY — The clinical information center resides on the hospital's computer network, and it is possible that inadvertent or malicious network activity could adversely affect patient monitoring. The integrity of the computer network is the responsibility of the hospital.

POWER SUPPLY — The device must be connected to a properly installed power outlet with protective earth contacts only.

All devices of a system must be connected to the same power supply circuit. Devices which are not connected to the same circuit must be electrically isolated when operated (electrically isolated RS232 interface).

Do not use this power unit in the presence of flammable anesthetics.

PROTECTED LEADWIRES — Only use protected leadwires and patient cables with this device. The use of unprotected leadwires and patient cables creates the potential for making an electrical connection to ground or to a high voltage power source which can cause serious injury or death to the patient.



Unprotected Leadwire **Protected Leadwire**

RATE METERS — Keep pacemaker patients under close observation. Rate meters may continue to count the pacemaker rate during cardiac arrest and some arrhythmias. Therefore, do not rely entirely on rate meter alarms.

SITE REQUIREMENTS — For safety reasons, all connectors for patient cables and sensor leads are designed to prevent inadvertent disconnection, should someone pull on them. Do not route cables in a way that they may present a stumbling hazard. For devices installed above the patient, adequate precautions must be taken to prevent them from dropping on the patient.

Cautions

CAUTIONS

ACCESSORIES (SUPPLIES) — To ensure patient safety, use only parts and accessories manufactured or recommended by GE Marquette Medical Systems.

Parts and accessories used must meet the requirements of the applicable IEC 60601 series safety standards and essential performance standards, and/or the system configuration must meet the requirements of the IEC 60601-1-1 medical electrical systems standard.

ACCESSORIES (EQUIPMENT) — The use of ACCESSORY equipment not complying with the equivalent safety requirements of this equipment may lead to a reduced level of safety of the resulting system. Consideration relating to the choice shall include:

- use of the accessory in the PATIENT VICINITY; and
- evidence that the safety certification of the ACCESSORY has been performed in accordance to the appropriate IEC 60601-1 and/or IEC 60601-1-1 harmonized national standard.

BEFORE INSTALLATION — Compatibility is critical to safe and effective use of this device. Please contact your local sales or service representative prior to installation to verify equipment compatibility.

DEFIBRILLATOR PRECAUTIONS — Patient signal inputs labeled with the CF and BF symbols with paddles are protected against damage resulting from defibrillation voltages. To ensure proper defibrillator protection, use only the recommended cables and leadwires.

Proper placement of defibrillator paddles in relation to the electrodes is required to ensure successful defibrillation.

DISPOSABLES — Disposable devices are intended for single use only. They should not be reused as performance could degrade or contamination could occur.

DISPOSAL — At the end of its service life, the product described in this manual, as well as its accessories, must be disposed of in compliance with the guidelines regulating the disposal of such products. If you have questions concerning disposal of the product, please contact GE Marquette Medical Systems or its representatives.

CAUTIONS

ELECTROCAUTERY PRECAUTIONS — To prevent unwanted skin burns, apply electrocautery electrodes as far as possible from all other electrodes, a distance of at least 15 cm/6 in. is recommended.

EMC — Magnetic and electrical fields are capable of interfering with the proper performance of the device. For this reason make sure that all external devices operated in the vicinity of the monitoring system comply with the relevant EMC requirements. X-ray equipment or MRI devices are a possible source of interference as they may emit higher levels of electromagnetic radiation.

INSTRUCTIONS FOR USE — For continued safe use of this equipment, it is necessary that the listed instructions are followed. However, instructions listed in this manual in no way supersede established medical practices concerning patient care.

LOSS OF DATA — Should the monitor at any time temporarily lose patient data, the potential exists that active monitoring is not being done. Close patient observation or alternate monitoring devices should be used until monitor function is restored.

Once monitoring is restored, you should verify correct monitoring state and alarm function.

MAINTENANCE — Regular preventive maintenance should be carried out annually. You are responsible for any requirements specific to your country.

MPSO — The use of a multiple portable socket outlet (MPSO) for a system will result in an enclosure leakage current equal to the sum of all individual earth leakage currents of the system if there is an interruption of the MPSO protective earth conductor. Do not use an additional extension cable with the MPSO as it will increase the chance of the single protective earth conductor interruption.

NEGLIGENCE — GE Marquette Medical Systems does not assume responsibility for damage to the equipment caused by improperly vented cabinets, improper or faulty power, or insufficient wall strength to support equipment mounted on such walls.

OPERATOR — Medical technical equipment such as this monitor/monitoring system must only be used by persons who have received adequate training in the use of such equipment and who are capable of applying it properly.

CAUTIONS

POWER REQUIREMENTS — Before connecting the device to the power line, check that the voltage and frequency ratings of the power line are the same as those indicated on the unit's label. If this is not the case, do not connect the system to the power line until you adjust the unit to match the power source.

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

SECURITY — The web browser which runs in conjunction with the clinical information center is intended for hospital INTRANET use only. If confidential patient information is made available from the hospital intranet, the security of the data is the responsibility of the hospital.

SUPERVISED USE — This equipment is intended for use under the direct supervision of a licensed health care practitioner.

UNINTENTIONAL RADIO FREQUENCY (RF) INTERFERENCE — Unintentional RF interference could degrade the reliability and performance of the wireless data link. The facility must maintain an RF environment free from unintentional interference. Refer to the service manuals for more information.

VENTILATION REQUIREMENTS — Set up the device in a location which affords sufficient ventilation. The ventilation openings of the device must not be obstructed. The ambient conditions specified in the technical specifications must be ensured at all times.

Notes

- Put the system in a location where you can easily see the screen and access the operating controls.
- This product is not likely to cause abnormal operation of other patient-connected equipment such as cardiac pacemakers or other electrical stimulators. Exceptions are noted in the pacemaker monitoring section, if applicable.
- This product is protected against the effects of cardiac defibrillator discharges to ensure proper recovery, as required by test standards.

Reference Literature

Medical Device Directive 93/42/EEC.

EN 60601-1/1990 + A1: 1993 + A2: 1995: Medical electrical equipment. General requirements for safety.

EN 60601-1-1/9.1994 + A1 12.95: General requirements for safety. Requirements for the safety of medical electrical systems.

IEC Publication 513/1994: Fundamental aspects of safety standards for medical equipment.

ROY, O.Z.: Summary of cardiac fibrillation thresholds for 60-Hz currents and voltages applied directly to the heart. Med. & Biol. Engn. & Computing 18: 657...659 (1980).

Classification

The telemetry system is classified, according to IEC 60601-1, as:

Type of protection against electrical shock	Transmitter — Internally powered Receiver system — Class I
Degree of protection against electrical shock	Transmitter — Type B Equipment
Degree of protection against harmful ingress of water	Transmitter — IPX3 (IEC 529) Receiver system — **Ordinary Equipment** (enclosed equipment without protection against ingress of water)
Degree of safety of application in the presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide	**Equipment not suitable** for use in the presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide
Method(s) of sterilization or disinfection recommended by the manufacturer	Not applicable
Mode of operation	Continuous operation

Underwriters Laboratories, Inc.

Classified by Underwriters Laboratories Inc. with respect to electric shock, fire, mechanical and other specified hazards, only in accordance with UL 2601-1, CAN/CSA C22.2 No. 601.1, IEC 60601-1, and, if required, IEC 60601-2-27, IEC 60601-2-30, IEC 60601-2-34, IEC 60601-1-1.

Equipment Symbols

NOTE: Some symbols may not appear on all equipment.

ATTENTION: Consult accompanying documents.

CAUTION: To reduce the risk of electric shock, do NOT remove cover. Refer servicing to qualified service personnel.

NOTE: The rating of protection against electric shock (indicated by symbol for CF or BF) is achieved only when used with patient applied parts recommended by GE Marquette.

TYPE CF APPLIED PART: Isolated (floating) applied part suitable for intentional external and internal application to the patient including direct cardiac application. “Paddles” outside the box indicate the applied part is defibrillator proof.

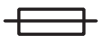
[Medical Standard Definition:] F-type applied part (floating/isolated) complying with the specified requirements of IEC 60601-1/UL 2601-1/CSA 601.1 Medical Standards to provide a higher degree of protection against electric shock than that provided by type BF applied parts.

TYPE BF APPLIED PART: Isolated (floating) applied part suitable for intentional external and internal application to the patient excluding direct cardiac application. “Paddles” outside the box indicate the applied part is defibrillator proof.

[Medical Standard Definition:] F-type applied part (floating/isolated) complying with the specified requirements of IEC 60601-1/UL 2601-1/CSA 601.1 Medical Standards to provide a higher degree of protection against electric shock than that provided by type B applied parts.

TYPE B APPLIED PART: Non-isolated applied part suitable for intentional external and internal application to the patient excluding direct cardiac application.

[Medical Standard Definition:] Applied part complying with the specified requirements of IEC 60601-1/UL 2601-1/CSA 601.1 Medical Standards to provide protection against electric shock, particularly regarding allowable leakage current.



Fuse

Equipotentiality

Alternating current (AC)

Power; I = ON; O = OFF

Indicates where to press to open the door on the 7160 DDW.

For your notes

3 Equipment Overview

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For your notes

Introduction

This chapter provides an overview of the equipment used in the ApexPro telemetry system. For battery installation and equipment interconnection instructions, refer to Chapter 4, Connection, in this manual. For detailed installation instructions, refer to the appropriate service manual.

ApexPro Telemetry System

The ApexPro telemetry system consists of the following components:

- ApexPro transmitter (one for each monitored patient)
- Apex Oximeter (optional)
- Accutracker DX noninvasive blood pressure monitor (optional)
- ApexPro antenna system
- ApexPro quad receiver module (4 receivers)
- ApexPro receiver system (holds up to 4 ApexPro quad receivers)
- Unity network
- Clinical Information Center (software version 2 or later)

Compatibility with Bedside Monitors

ApexPro telemetry system patient data can be viewed on most GE Marquette patient monitors. The monitor must be connected to the Unity network and in the same care unit as the ApexPro telemetry system.

The telemetry patient can be viewed on the bedside monitor using the monitor's split screen view, or when the monitor is set for either Combo or Rover Combo monitoring mode. Refer to the appropriate monitor's operator's manual for more information.

CAUTION

Only ECG monitoring is compatible when viewing an ApexPro telemetry system patient in the Combo and Rover Combo modes on:

- Eagle 4000 patient monitor running software version 6F or earlier.
- Solar 7000/8000 patient monitor running software version 5E or earlier.
- Tram critical care monitor (Tramscope) running software version 7D or earlier.

Monitoring other parameters is not compatible. Erroneous patient data may result.

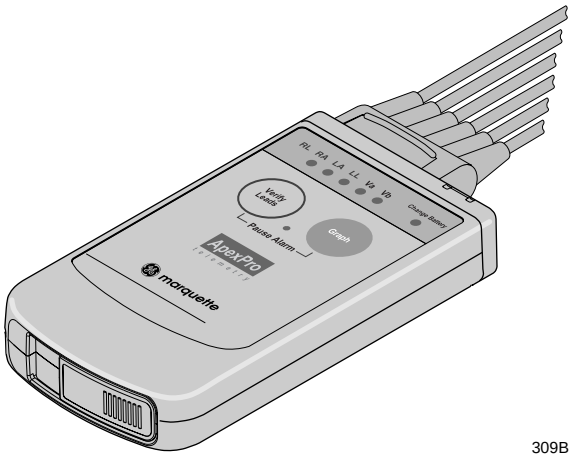
The Dash 2000 patient monitor must be running software version 2A or later to work with the ApexPro telemetry system.

Contact your GE Marquette representative if you have questions regarding compatibility.

ApexPro Transmitter

The ApexPro transmitter sends the patient's ECG data to the ApexPro receiver subsystem for processing. Data is then transmitted via a dedicated Ethernet interface to the clinical information center for further processing and viewing.

Additionally, the ApexPro transmitter can send the patient's SpO2 and noninvasive blood pressure data when the optional Apex Oximeter and/or Accutracker DX noninvasive blood pressure monitor are connected to it.



ApexPro Transmitter

ApexPro Transmitter Buttons and LEDs

Verify Leads

Pressing the **Verify Leads** button enables the good lead LEDs. After this button is pressed, the LEDs for good leads are illuminated for one minute.

Graph

Pressing the **Graph** button initiates a 20-second graph strip to be printed on the writer or printer.

When an IMPACT.*wf* paging system (version II or later) is also available in the same care unit, pressing the **Graph** button enables the View on Demand feature (also called the Apex Graph Button Push feature). The IMPACT.*wf* server generates a manually initiated sample page or snapshot of the patient's ECG waveform and any other enabled/monitored non-arrhythmia parameters.

When you press the **Graph** button on the ApexPro transmitter, it generates both an IMPACT.*wf* update as well as a standard ECG waveform graph at the clinical information center. The IMPACT.*wf* update is labeled "Sample" when this data is displayed on the IMPACT.*wf* receiver and stored in history. Additionally, all receivers assigned to the patient receive an update/sample.

Dust Covers

The ApexPro transmitter has two dust covers, used when the **INTFC** (interface) connectors are not being utilized.

WARNING

DUST COVERS — If the dust covers for the **INTFC** (interface) connectors become detached from the ApexPro transmitter, they may pose a choking hazard for pediatric patients. Inspect the dust covers before each use to verify that they are securely attached. If the dust covers become detached and cannot be reinserted into their retaining slot, do not use them on the ApexPro transmitter, and keep them out of pediatric patients' reach.

Pausing Alarms

Refer to Chapter 8, Alarm Control, for important information regarding transmitter alarm pause, alarm pause breakthrough, and the *Enable Transmitter Pause* option.

The *Enable Transmitter Pause* option for a telemetry patient admitted to the clinical information center must be activated before the patient can initiate an alarm pause from the transmitter.

To pause the alarms for five minutes, press both transmitter buttons simultaneously. The **Pause Alarm** LED flashes. "*ALARM PAUSE*" is also displayed in the patient's waveform window on the clinical information center screen. After five minutes, the LED on the transmitter will no longer flash and alarms will be reactivated.

WARNING

Alarms do not sound and alarm graphs do not print during an "*ALARM PAUSE*" condition.

Reactivating Alarms

To reactivate the alarms before the five minute time period has elapsed, press both transmitter buttons simultaneously again.

Low Batteries

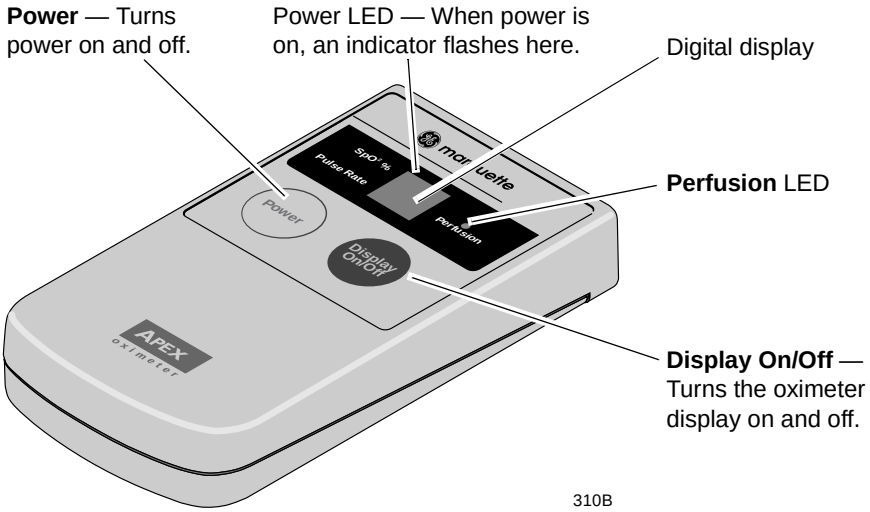
The **Change Battery** LED flashes when battery power is running low. Change the batteries in the ApexPro transmitter when this LED flashes. Refer to the ApexPro Transmitter Battery Installation section in Chapter 4, Connection, for more information about changing the batteries.

Apex Oximeter SpO2 Module

The Apex Oximeter is an optional module that can be connected to the ApexPro transmitter, allowing telemetry monitoring of a patient's pulse oximetry data. The Apex Oximeter must be connected to an ApexPro transmitter in order to convey SpO2 data to the clinical information center. Only digital data is available; no waveforms are generated or transmitted. Digital data is stored in Graphic Trends and Vital Signs on the CIC, and it is also displayed on the Apex Oximeter.

NOTE: SpO2 and SPO2 are used interchangeably throughout this manual.

Apex Oximeter Buttons and LEDs



Pressing the **Power** button turns on the battery power to the Apex Oximeter. The digital display also turns on for one minute. After one minute, the display will turn off, but power to the Apex Oximeter remains on. This is indicated by the flashing Power LED (horizontal bar).

When display power is off (flashing Power LED), pressing the **Display On/Off** button turns the display on for one minute. After one minute the display turns off, but power to the Apex Oximeter remains on, indicated by the flashing Power LED.

To turn the display on continuously, press and hold the **Display On/Off** button for 2 seconds. The flashing Power LED turns off to verify that the display has been turned on in continuous mode. To turn the display off at any time, press the **Display On/Off** button again.

NOTE: Using the Apex Oximeter with the display on continuously will result in reduced battery life.

To turn all power to the Apex Oximeter off, press and hold the **Power** button for 2 seconds.

The **Perfusion** LED indicates the strength of the patient's SPO2 signal. For more information, refer to Chapter 12, SpO2 Monitoring.

Accutracker DX Noninvasive Blood Pressure (NBP) Monitor

NOTE: The Accutracker DX noninvasive blood pressure monitor is available in the United States only. This model, available from GE Marquette, has been modified by SunTech Medical Instruments to operate with the ApexPro telemetry system.

The Accutracker DX noninvasive blood pressure monitor is an optional module that can be connected to the ApexPro transmitter, allowing telemetry monitoring of a patient's NBP data. The blood pressure cuff is connected to the blood pressure monitor, which measures and displays systolic and diastolic blood pressures using the auscultatory method. When the blood pressure monitor is connected to an ApexPro transmitter, digital values are also displayed at the clinical information center, and stored in Graphic Trends and Vital Signs on the CIC.

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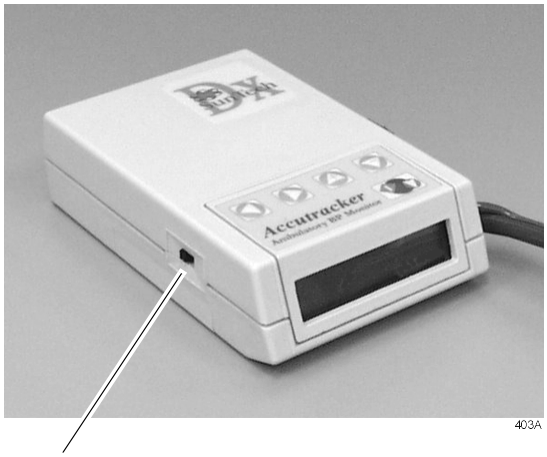
Accutracker DX Buttons and Switches

An on/off switch and five buttons control the functions of the blood pressure monitor. Their functions are described below.



On/Off switch

LAST button

NO – button

NEXT button

YES + button

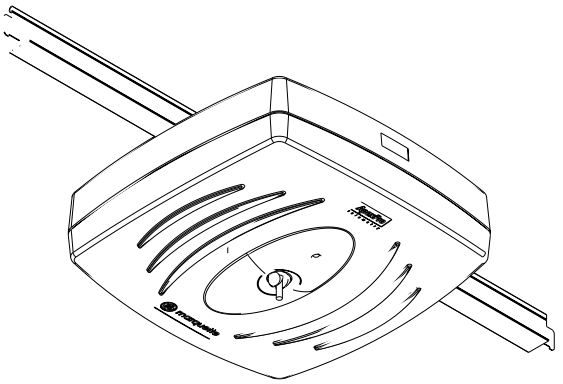
START/STOP button

- The on/off switch, labeled **1/0**, is located on the side of the blood pressure monitor. The on position is **1**; the off position is **0**. It is used to turn the main power on and off.
- The **START/STOP** button starts and stops blood pressure readings. During the monitoring period, it can be used by the patient at the clinician's discretion. Pressing the **START/STOP** button once while a patient is being monitored "wakes up" the blood pressure monitor from sleep mode and offers the options to change the measurement interval, view the time left until the next measurement, or perform a manual reading by pressing the **START/STOP** button a second time.
- The **NEXT** button moves forward to the next menu item on the blood pressure monitor display.
- The **LAST** button moves back to the previous menu item on the blood pressure monitor display.
- The **YES +** button allows a yes response to a question or an increase in the value shown on the blood pressure monitor display.
- The **NO –** button allows a no response to a question or a decrease in the value shown on the blood pressure monitor display.

Refer to Chapter 13, NBP Monitoring, for more information about Accutracker DX operation.

Antenna System

The antenna system is used for transmission of data from the transmitter to the receiver system. An ApexPro receiver antenna is illustrated below.



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Receiver System

Each receiver in the quad receiver module, located in the receiver subsystem, receives data from the transmitters. This data is processed by the receiver system and then transmitted via the dedicated Ethernet interface to a clinical information center for further processing and display. The quad receivers and the receiver subsystem together are known as the receiver system.

Unity Network

The Unity network is GE Marquette's information network system, used to transmit information from one GE Marquette product to others connected to the same Unity network.

Clinical Information Center

The Clinical Information Center is the central station that displays ApexPro telemetry system data sent to it via the dedicated Ethernet interface. The clinical information center also allows modification of telemetry defaults and setup information, among other telemetry functions.

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4 Connection

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For your notes

ApexPro Transmitter Setup

ApexPro Transmitter Battery Installation

Install two new AA alkaline batteries in the transmitter.

1. Locate the battery cover at the bottom of the transmitter.
2. Slide the cover over to open the battery compartment.
3. Insert the batteries, being careful to follow the polarity signs embossed on the lower back side of the transmitter.
4. Close the battery cover.

NOTE: When the **Change Battery** LED starts flashing, the ApexPro transmitter has approximately one hour of reserve power before the unit shuts down.

Battery Functional Life

The ApexPro transmitter runs on two AA batteries. Battery life is approximately 40 hours.

For optimum performance, follow these guidelines:

- Install two new alkaline batteries each time you begin monitoring a new patient.
- Install two new alkaline batteries whenever the **Change Battery** LED on the ApexPro transmitter is flashing.
- Do not use rechargeable batteries.
- Always change both batteries at the same time.
- Always use new batteries.

CAUTION
GE Marquette Medical Systems recommends that you always replace both batteries at the same time. Re-using old batteries or using a combination of old and new batteries in the ApexPro transmitter will compromise functionality of the transmitter and increase the risk of fire hazard.

ApexPro Transmitter Leadwires

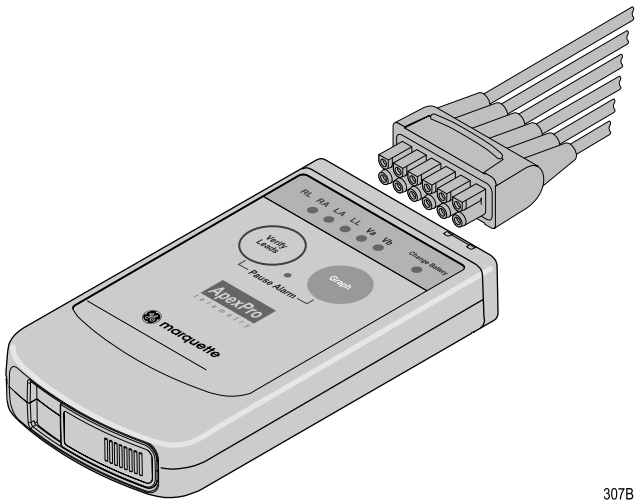
Installation

The ApexPro transmitter can be used with the following Multi-Link leadwire sets:

- Multi-Link six-leadwire set
- Multi-Link five-leadwire set
- Multi-Link three-leadwire set

NOTE: Although the Multi-Link three-leadwire set is no longer manufactured, existing sets will function with the ApexPro transmitter.

To install a leadwire set into the ApexPro transmitter, align the leadwire pins with the connector on the top of the transmitter, then push the leadwire set firmly into the transmitter.



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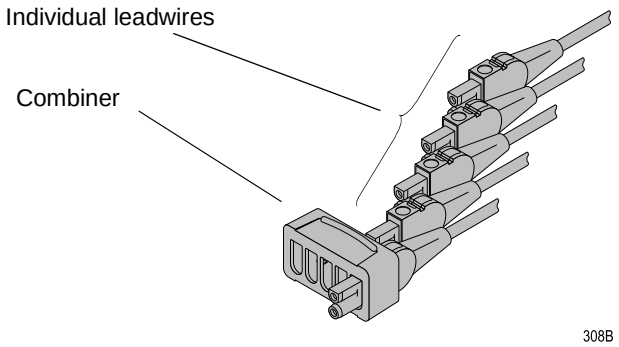
Disconnection from the Transmitter

To disconnect the leadwires from the ApexPro transmitter, grasp the molded end or the combiner firmly and pull away from the transmitter.

Multi-Link Leadwire Sets

To use sets of Multi-Link individual leadwires, firmly press the individual leadwires into their appropriate locations on the combiner. Use the colors on the leadwires to place them in corresponding order with the colors that appear on the back of the ApexPro transmitter.



Attachment to the Electrodes

1. Attach leadwires to the transmitter by plugging the Multi-Link leadwire set into the transmitter.
2. Attach leadwire clip to the terminal on the electrodes. Take care to attach the color-coded clips to the corresponding electrode locations.
3. Loop the leadwires and secure them to the patient with tape. Stress loops prevent the connection to the electrode from being loosened or pulled apart as the patient moves.

   NOTE: Do not tape across the electrode.

Apex Oximeter Setup

Apex Oximeter Battery Installation

Install two new AA alkaline batteries in the Apex Oximeter:

1. Locate the battery cover at the bottom of the back of the Apex Oximeter.
2. Press the latch tab and lift up to open the battery compartment.
3. Insert the batteries, being careful to follow the polarity signs located within the battery compartment.
4. Close the battery cover.

NOTE: When the digital displays on the Apex Oximeter start flashing, the Apex Oximeter has approximately one hour of reserve power left before the unit shuts down.

Battery Functional Life

The Apex Oximeter runs on two AA batteries. Battery life is approximately 60 hours.

For optimum performance, follow these guidelines:

- Install two new alkaline batteries each time you begin monitoring a new patient.
- Install two new alkaline batteries whenever the digital displays on the Apex Oximeter start flashing.
- Always change both batteries at the same time.
- Always use new batteries.

CAUTION
GE Marquette Medical Systems recommends that you always replace both batteries at the same time. Re-using old batteries or using a combination of old and new batteries in the Apex Oximeter will compromise functionality of the transmitter and increase the risk of fire hazard.

Apex Oximeter Connections

To function correctly, the Apex Oximeter must be connected to a pulse oximetry (SpO2) probe. To transmit data to the clinical information center, the Apex Oximeter must also be connected to the ApexPro transmitter.

SpO2 Probe Connection

Connect the SpO2 probe to the Apex Oximeter by plugging the non-sensor end of the probe into the 9-pin connector on the top of the Apex Oximeter.

CAUTION
Use only Nonin SpO2 probes with the Apex Oximeter. The reliability of SpO2 data obtained with any other probe has not been verified.

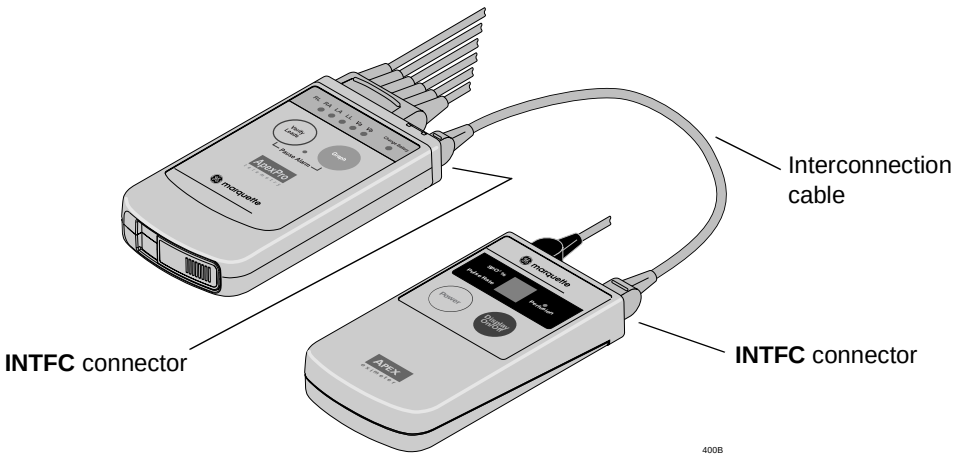
Connection to the ApexPro Transmitter

Connect the Apex Oximeter to the ApexPro transmitter by using the interconnection cable supplied with the Apex Oximeter.

NOTE: Refer to the Interconnection Cables section in this chapter for information about cable compatibility.

Plug one end of the interconnection cable into the 5-pin connector labeled **INTFC** (interface) on the Apex Oximeter. Plug the other end into one of the 5-pin connectors labeled **INTFC** on the ApexPro telemetry transmitter.

When properly interconnected, the Apex Oximeter and the ApexPro transmitter should appear similar to the illustration below.



The Apex Oximeter and the ApexPro transmitter can now be attached to the patient. Follow your unit's protocol for attaching them to the patient. A common method is to place them back-to-back in the same pouch and belt them on the patient.

Accutracker DX Setup

NOTE: The Accutracker DX noninvasive blood pressure monitor is available in the United States only.

Tips for Monitoring

- Use a microphone pad to maintain the best microphone position.
- Use a cuff anchor to maintain the blood pressure cuff's position.
- Advise the patient not to shower or bathe while being monitored.

Battery Installation

Install four new AA alkaline batteries in the Accutracker DX blood pressure monitor. Follow these steps:

1. Locate the battery cover on the back of the blood pressure monitor.
2. Press down and gently slide off the cover.
3. Remove the old batteries by lifting up on the ribbon in the battery case. Dispose of the old batteries properly, following your local ordinances.
4. Insert the new batteries, being careful to follow the polarity signs. Be sure to place the batteries on top of the ribbon.
5. Slide the battery cover back on securely.

NOTE: Change the batteries in the blood pressure monitor when the message "*Low Batt*" appears on the Accutracker display.

Accutracker DX Functional Life

IMPORTANT — Store and use the Accutracker DX blood pressure monitor with four good AA batteries installed.

The four AA batteries will last for approximately 250 blood pressure readings, taken at an average interval of 15 minutes.

Install four new alkaline batteries each time you begin monitoring a patient.

The Accutracker DX blood pressure monitor contains an internal lithium battery capable of sustaining the Accutracker for a **maximum** of 9 months (6400 hours) **without** AA batteries installed. If the lithium battery becomes fully discharged, the Accutracker must be returned to the factory for service. To extend the life of the lithium battery, always store the Accutracker DX with four good AA batteries installed.

NOTE: This is a **cumulative** 9-month period, spanning the entire life of the blood pressure monitor.

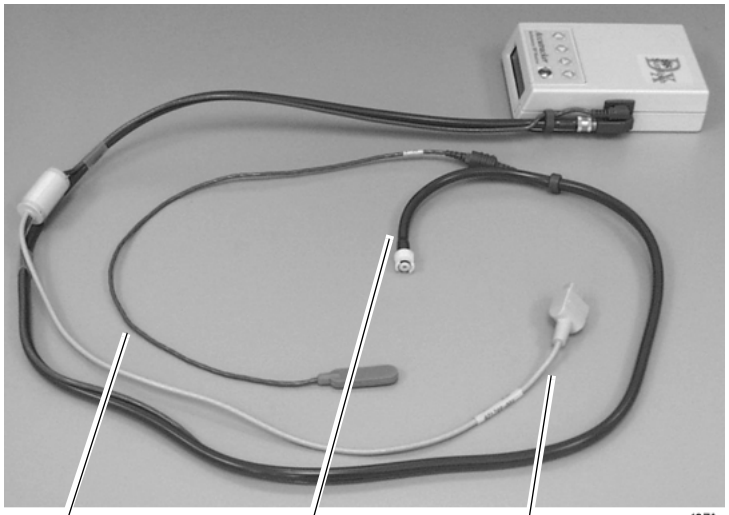
If the lithium battery is completely drained, the unit will not function. The internal lithium battery is **not** user replaceable. The unit must be returned for service if the lithium battery needs to be replaced.

It is recommended that the lithium battery be serviced every three to five years.

Store and use the Accutracker DX blood pressure monitor with four good AA batteries installed. For long-term storage, install new batteries and replace them every four months.

Accutracker DX Connections

The patient cable, microphone cable, and interconnection cable are attached to one another in one assembly. Refer to the illustration below.

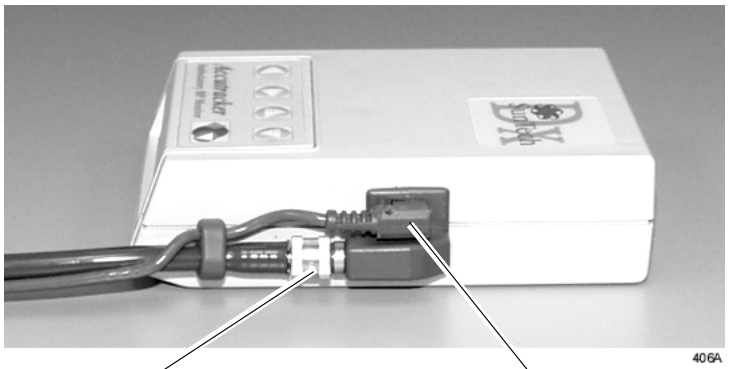


Microphone Cable Patient Cable Interconnection Cable

NOTE: Refer to the Interconnection Cables section in this chapter for information about cable compatibility.

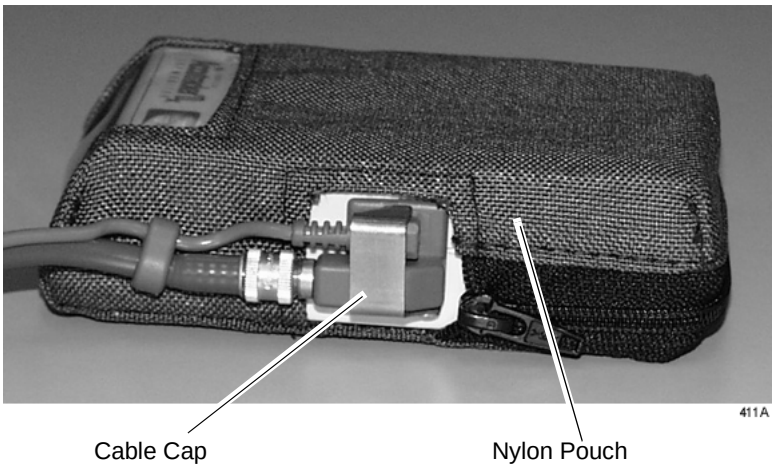
If the patient cable/microphone cable/interconnection cable assembly is not already connected to the Accutracker DX noninvasive blood pressure monitor, follow this procedure to connect it:

1. Attach the brass end of the patient cable to the blood pressure monitor by screwing it onto the brass air hose connector on the side of the blood pressure monitor.
2. Connect the microphone cable to the blood pressure monitor by plugging it into the 6-pin connector on the side of the blood pressure monitor, near the air hose connector.



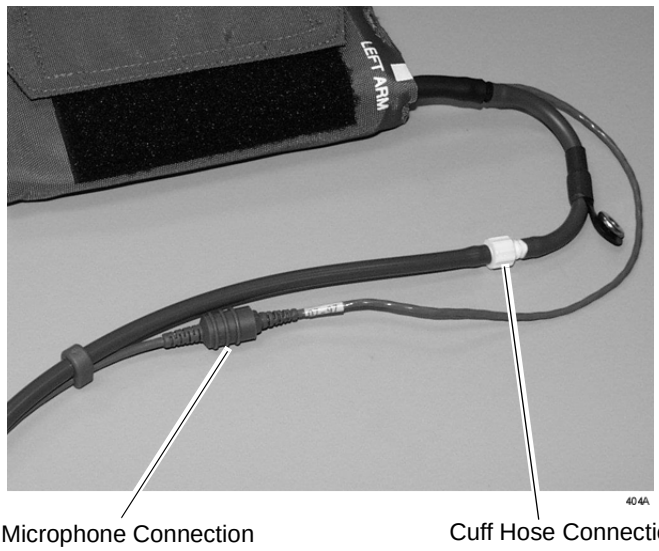
Patient Cable Connection Microphone Cable Connection

3. Secure the cable by screwing on the metal cable cap, then insert the blood pressure monitor into the nylon pouch. When the patient cable assembly is connected, the blood pressure monitor will look similar to the following photograph.



Completed Patient Cable Assembly Connection

4. Attach the blood pressure cuff hose to the patient cable already attached to the blood pressure monitor. Insert the cuff hose into the white plastic fitting on the patient cable. Turn the fitting to the right approximately one quarter turn. Some connector models will click when they are connected, otherwise, be sure that it is securely tightened. Then plug the 3-pin microphone connector into 3-pin connector on the microphone cable.



Blood Pressure Cuff Connections

5. Connect the 5-pin end of the interface cable to one of the 5-pin port labeled **INTFC** (interface) on the top of the ApexPro transmitter. The interface cable is already connected to the blood pressure monitor because it is a branch of the patient cable. Ensure that the ApexPro transmitter's patient leadwires are properly connected. The leadwires must be connected for telemetry transmission of NBP data.

Interconnection Cables

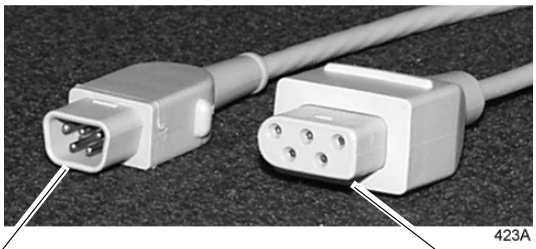
The interconnection cables used to connect the ApexPro transmitter with the Apex Oximeter and/or the Accutracker DX blood pressure monitor are not the same as those used with the Apex S transmitter (CD Telemetry-LAN monitoring system).

NOTE: The Accutracker DX noninvasive blood pressure monitor is available in the United States only.

The connector ends that are plugged into the telemetry transmitters are different and are not interchangeable.

Be sure to use the correct interconnection cable when you connect the Apex Oximeter or Accutracker DX blood pressure monitor to the ApexPro transmitter.

The figure below illustrates the difference in connector ends for each system.



ApexPro telemetry system interconnection cable connector — plugs into the ApexPro transmitter.

CD Telemetry-LAN monitoring system interconnection cable connector — plugs into the Apex S transmitter.

For your notes

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For your notes

Biocompatibility

When used as intended, the parts of the product described in this operator manual, including accessories that come in contact with the patient during the intended use, fulfill the biocompatibility requirements of the applicable standards. If you have questions about this matter, please contact GE Marquette Medical Systems or its representatives.

Inspection

An effective maintenance schedule should be established for your monitoring equipment and reusable supplies. This should include inspection as well as general cleaning on a regular basis. The maintenance schedule must comply with the policies of your institution's infection control unit and/or biomedical department.

CAUTION
Failure on the part of the responsible hospital or institution employing the use of this monitoring equipment to implement a satisfactory maintenance schedule may cause undue equipment failure and possible health hazards.

Check with your biomedical department to be sure preventive maintenance and calibration have been done. The service manuals contain detailed information.

Follow these guidelines when inspecting the equipment:

- Inspect the equipment for obvious physical damage and replace damaged items.
- Inspect all cords for fraying or other damage. Inspect all plugs and connectors for bent prongs or pins. Repair or replacement must be performed by qualified service personnel.
- Inspect all cable insulation. Qualified service personnel should repair or replace damaged or deteriorated cables.

In the United States, GE Marquette Service is available 24-hours a day by calling 800-558-7044.

Outside the United States, please contact your sales/service office.

NOTE: Refer to the service manuals for more comprehensive checkout procedures.

General Cleaning

WARNING
Disconnect AC-powered equipment from the power line before cleaning or disinfecting its surface. Turn off the power to battery-powered equipment before cleaning or disinfecting its surface.

The equipment should be cleaned on a regular basis. (Comply with the policies of your institution's infection control unit and/or biomed department.) The exterior surfaces of the equipment may be cleaned with a dampened, lint-free cloth. Use one of the following approved solutions:

- ammonia (diluted)
- Cidex
- sodium hypochlorite bleach (diluted)

  NOTE: Severe corrosion may occur to any metal parts that come in contact with bleach. Do not submerge patient cable ends or leadwire ends.

- mild soap (diluted)

To avoid damage to the equipment, follow these rules:

CAUTION
Failure to follow these rules may melt, distort, or dull the finish of the case, blur lettering on the labels, or cause equipment failures.

- Always dilute the solutions according to the manufacturer's suggestions.
- Always wipe off all the cleaning solution with a dry cloth after cleaning.
- Never use a cleaning substance containing wax.
- Never pour or spray water or any cleaning solution on the equipment.
- Never permit fluids to run behind switches, into the connectors, or into any ventilation openings in the equipment.
- Never use these cleaning agents:
  - abrasive cleaners or solvents of any kind,
  - acetone,
  - ketone,
  - alcohol-based cleaning agents, or
  - Betadine

Cleaning the Transmitters

These cleaning instructions apply to the ApexPro transmitter, the Apex Oximeter, and the Accutracker DX blood pressure monitor.

CAUTION
Do not autoclave the transmitters.

For general cleaning, wiping with mild soap and water and wiping dry is recommended.

For more intensive disinfecting or sterilization:

- Aqueous disinfectants such as glutaraldehydes (Sporicidin, etc.), 2-part sodium chloride/lactic acid mixture (i.e., Exspor and other chlorine dioxide action types), and other cold cleaning agents are acceptable. These solutions may shorten the transmitter's useful lifetime after repeated applications.
- Ethylene Oxide (ETO) is acceptable but may discolor and/or reduce the useful lifetime of the transmitter.

CAUTION
The decision to sterilize must be made per your institution's requirements with an awareness of the effect on the integrity of the transmitter.

Do not submerse the transmitters.

Cleaning the Leadwires

CAUTION
Do not use acetone or ketone solvents for cleaning; do not use an autoclave or steam cleaner.

For general cleaning, wipe with a lint-free cloth dampened with mild soap and water. Drying off excess cleaning solution is recommended. Leadwires should hang freely when wiping. Leadwires can be cleaned with isopropyl alcohol wipes. For more intensive disinfecting or sterilization:

- Aqueous disinfectants such as glutaraldehydes (Sporicidin, etc.), 2-part sodium chloride/lactic acid mixture (i.e., Exspor and other chlorine dioxide action types), and other cold cleaning agents are acceptable. These solutions may shorten the leadwire's useful lifetime after repeated applications.
- Ethylene Oxide (ETO) is acceptable but may discolor and/or reduce the useful lifetime of the leadwire.

CAUTION
The decision to sterilize must be made per your institution's requirements with an awareness of the effect on the integrity of the leadwire.

Do not submerse telemetry leadwires.

Cleaning the Power Unit

Follow these precautions when cleaning the power unit connected to the antenna system.

WARNING
When cleaning the power unit, use a cloth dampened with cleaning alcohol on the outside of the enclosure only. Do not immerse the product in water or a safety hazard could arise during use.

Periodic leakage current testing should be done on the combined power supply and end-use system on a yearly basis when used in a hospital environment where such test equipment is commonly available.

Transmitter and Leadwire Storage

Transmitter Holder

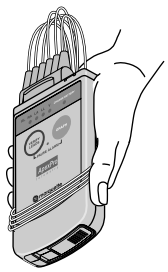
It is recommended that you store the transmitter and leadwires in the optional transmitter holder (not pictured). This wall-mounted holder can store up to six ApexPro transmitters. The leadwires hang freely below the holder, minimizing the possibility of damage.

Storage Guidelines

If a transmitter holder is not available, follow these guidelines for storage.

Correct Storage

Wrap the leadwires around the transmitter, allowing the top of the leadwires to remain loose. Leadwires should **not** be stretched tightly during storage.



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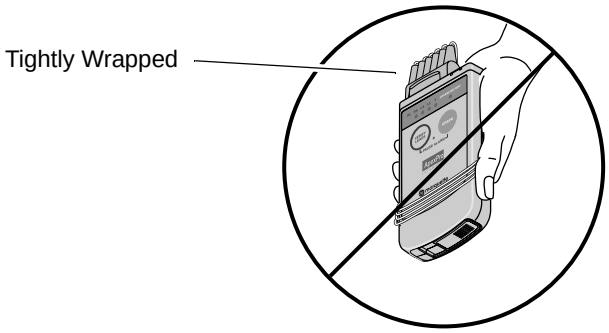
Incorrect Storage

Do **not** bend or stretch leadwires tightly before wrapping around the transmitter. Improper storage will cause damage and shorten the leadwires' useful lifetime.



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Technical Maintenance

Schematic diagrams and other relevant technical information can be found in the service manuals supplied with this equipment. Comply with the policies of your institution's biomedical department, or the recommendations made within the Preventive Maintenance section of the product's service manual.

6 Telemetry Setup

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For your notes

Introduction

The *Setup CIC* button, located in the clinical information center's main menu at the bottom of the display, opens the CIC Setup window. The CIC Setup window contains the tab sheets used for customizing the clinical information center.

The Telemetry Unit Defaults, CIC Defaults, Current Telemetry Listings, Full Disclosure Defaults, and Service Password tab sheets are discussed in this chapter. The Telemetry Alarm Control Defaults tab sheet is discussed in Chapter 8, Alarm Control.

For information about the Display Format and Screen Calibration tab sheets, refer to the Clinical Information Center Operator's Manual.

While all of the tab sheets within the CIC Setup window can be viewed from user mode, most of the functions on these tab sheets can only be configured from within the service mode.

The functions available on these tab sheets are discussed in detail in the service manual for the clinical information center.

Telemetry Factory Default Settings

These factory defaults are in effect, depending upon the patient's age, unless they have been modified through Telemetry Unit Defaults.

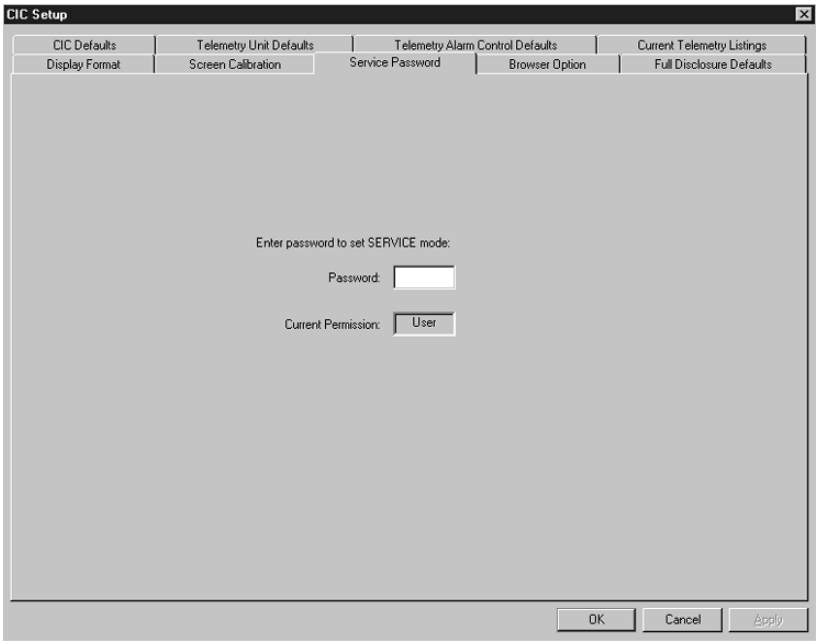
- ECG displayed lead is II
- Multi-lead analysis
- Heart rate alarm limits (high/low):
  - Adult—150/50
  - 0–2 years—200/90
  - 3–10 years—180/60
  - 11–13 years—150/50
- ST measurement:
  - Adult— J+ 60ms
  - 0–2 years— J+ 30ms
  - 3–10 years— J+ 40ms
  - 11–13 years— J+ 50ms
- PVC limit is 6
- 1X size
- Pace off
- Arrhythmia on (arrhythmia changes with age)
- ST off
- Graph leads II and V
- 25 millimeters per second speed
- Alarm graph location at the clinical information center where patient was admitted
- TTX (manual) graph location at the clinical information center where patient was admitted
- Print window location at the clinical information center where patient was admitted

Service Password

The Service Password tab sheet contains a field for entering the password to access the clinical information center's service mode.

To open the Service Password tab sheet, follow these steps.

1. Use the mouse to click on *Setup CIC* in the main menu.
2. Click on the *Service Password* tab to bring it to the front.



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CAUTION
The service mode is intended for use only by qualified personnel with training and experience in its use. The consequences of misuse include loss of alarm configuration, loss of patient data, corruption of the clinical information center operating system software, or disruption of the entire Unity network.

3. To change from the user mode to the service mode, use the keyboard to enter the service password, then click *Apply*. The *Current Permission* entry changes from *User* to *Service*.

NOTE: Contact your biomedical engineering department or your GE Marquette representative to access the service mode.

Telemetry Unit Defaults

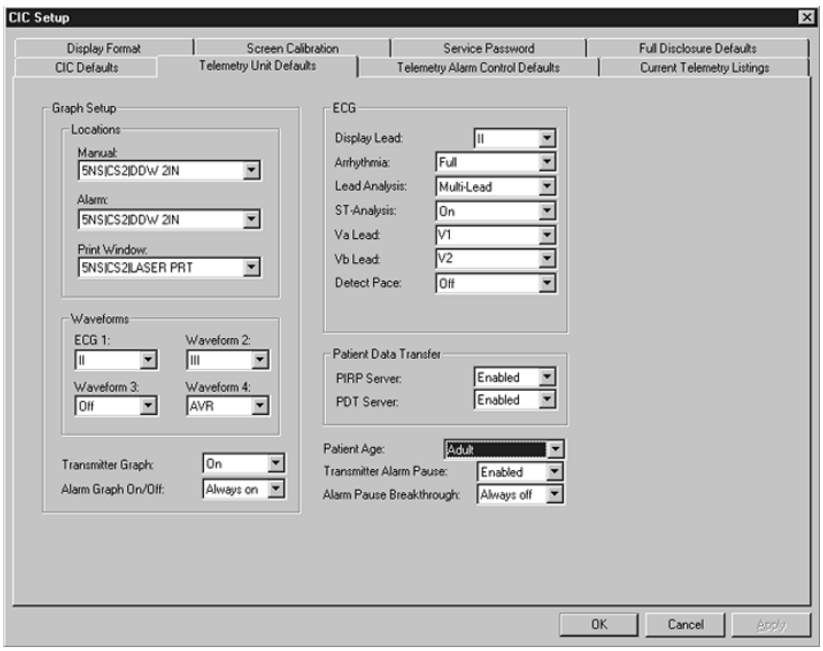
Unit defaults are saved settings for various features and alarm levels that apply to telemetry monitoring at the clinical information center. Unit defaults can be set only in service mode, and once they are set, they remain in effect and are automatically applied each time a new telemetry patient is admitted to the clinical information center.

Viewing Telemetry Unit Defaults

You can view the current telemetry unit defaults settings by clicking on the *Setup CIC* button, but defaults can only be modified when in the service mode. Unless you are in the service mode, you will not be able to see all available options, you will not be able to highlight the options, and the current settings will appear dimmed.

To view Telemetry Unit Defaults, follow this procedure.

1. Click on the *Setup CIC* button at the bottom of the clinical information center display. A set of tabs appears.
2. Click on the *Telemetry Unit Defaults* tab. The current settings for the unit appear.



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Telemetry unit defaults can be set for the following features:

- Manual, alarm, and print window graph locations
- ECG 1, and Waveforms 2, 3, and 4
- Transmitter graph
- Alarm graph on/off
- Display lead
- Arrhythmia
- Lead analysis
- ST analysis
- Va and Vb leads
- Detect pace
- Patient data transfer PIRP server and PDT server
- Patient age
- Transmitter alarm pause
- Alarm pause breakthrough

Once you have entered the service mode, you may modify the telemetry unit defaults, as described below. Refer to the Service Password section in this chapter for information about entering the service mode.

Graph Setup

Graph location defaults can be set for a Manual graph location, an Alarm graph location, and a Print Window graph location. Refer to Chapter 9, Printing, for more information about graphing.

Waveforms

The *ECG 1* popup list is used to set the unit default for the waveform that will print in the first position on a graph. Lead II is the default.

The *Waveform 2, 3,* and *4* options are used to set the unit defaults for the waveforms that will be printed in the second, third, and fourth positions on the graph.

The options found in these popup lists are:

- *I*
- *II*
- *III*
- *V* (This option will indicate the V lead being monitored, e.g., V2.)
- *AVR*
- *AVL*
- *AVF*
- *Off* (available for Waveform 2, 3, and 4 only)

Transmitter Graph

The *Transmitter Graph* option can be set to *On* or *Off*. When this option is set to *On*, a telemetry patient can initiate a graph by pressing the **Graph** button on the telemetry transmitter. When this option is set to *Off*, graphs cannot be initiated at the transmitter.

This option sets the unit default for all telemetry patients admitted to the CIC. When the *Transmitter Graph* option is set to *On*, transmitter graph privileges can also be set on an individual patient basis using the *Enable Transmitter Graph* check box in the patient's Graph Setup tab sheet.

Alarm Graph

The *Alarm Graph On/Off* option allows you to select whether a graph will be printed when an alarm occurs. The choices are:

- *Always off*
- *Always on* (factory default selection)

This option sets the unit default for all patients admitted to the CIC. It cannot be changed on an individual patient basis.

Display Lead

The options found in the popup list for the *Display Lead* field are:

- *I*
- *II* (factory default selection)
- *III*
- *V* (This option will indicate the V lead being monitored, e.g., V2.)
- *AVR*
- *AVL*
- *AVF*

Arrhythmia

The options found in the popup list for the *Arrhythmia* field are:

- *Off*
- *Lethal*
- *Full* (factory default selection)

Lead Analysis

The options found in the popup list for the *Lead Analysis* field are:

- *Multi-Lead* (factory default selection)
- *Single Lead*

ST Analysis

The options found in the popup list for the *ST Analysis* field are:

- *Off* (factory default selection)
- *On*

Va and Vb Lead

Use the *Va Lead* and *Vb Lead* options to set the defaults for the V leads that will be monitored in these positions. A 6-lead cable is required for dual V-lead monitoring. The options are:

- *V1*
- *V2*
- *V3*
- *V4*
- *V5*
- *V6*

Detect Pace

NOTE: Refer to Chapter 11, ECG Monitoring, for important information regarding *Detect Pace* and the pacemaker detection programs.

The options found in the popup list for the *Detect Pace* field are:

- *Off* (factory default selection)
- *Pace 2*
- *Pace 1*

Patient Data Transfer

The *PIRP Server* (patient identification registration protocol server) and *PDT Server* (patient data transfer server) options allow you to set the default for patient data transfer information. Choices are:

- *Enabled*
- *Disabled* (factory default selection for both)

NOTE: Changing these settings from *Disabled* to *Enabled* while patients are admitted and full disclosure is enabled causes a loss of full disclosure data. Full disclosure data collection stops, then starts again immediately. However, previously stored full disclosure data is not available.

This loss of data can be avoided by enabling the patient data transfer options and the full disclosure option before patients are admitted.

Patient Age

The options found in the pull-down list for the *Patient Age* field are:

- *0-2 years*
- *3-10 years*
- *11-13 years*
- *Adult* (factory default selection)

The patient age setting chosen in the Telemetry Unit Defaults tab sheet affects the alarm settings. Refer to the example below.

Example 1. Patient Age

Telemetry Unit Defaults Tab Sheet Setting	Age Chosen In The Admit Tab Sheet When Patient Admitted	Resulting Limits	Unit Default Alarm Level (Brady)	Resulting Alarm Level
Adult	Adult 0-2 years 3-10 years 11-13 years	10, 155* 90, 200 60, 180 50, 150	Message Message Message Message	Message Crisis Crisis Advisory
0-2 years	Adult 0-2 years 3-10 years 11-13 years	50, 150 10, 155* 60, 180 50, 150	Message Message Message Message	Advisory Message Crisis Advisory
3-10 years	Adult 0-2 years 3-10 years 11-13 years	50, 150 90, 200 10, 155* 50, 150	Message Message Message Message	Advisory Crisis Message Advisory
11-13 years	Adult 0-2 years 3-10 years 11-13 years	50, 150 90, 200 60, 180 10, 155*	Message Message Message Message	Advisory Crisis Crisis Message

*These reflect the unit default values set for this example. These values will reflect whatever your unit default is set to.

NOTE: This is an example of *Brady* changes associated with age changes.

The Telemetry Unit Defaults tab sheet settings take precedence when the patient age chosen in the Admit tab sheet and the age default setting from the Telemetry Unit Defaults tab sheet match.

When the ages do not match, the Admit tab sheet age setting takes precedence.

Transmitter Alarm Pause

NOTE: Refer to Chapter 8, Alarm Control, for important information about Transmitter Alarm Pause.

The options found in the popup list for the *Transmitter Alarm Pause* field are:

- *Disabled* (factory default selection)
- *Enabled*
- *Always Off*

This option sets the unit default for all telemetry patients admitted to the CIC. When the *Transmitter Alarm Pause* option is set to *Disabled* or *Enabled*, transmitter alarm pause privileges can also be set on an individual patient basis using the *Enable Transmitter Pause* check box in the patient's Alarm Control tab sheet.

Alarm Pause Breakthrough

NOTE: Refer to Chapter 8, Alarm Control, for important information about Alarm Pause Breakthrough.

The *Alarm Pause Breakthrough* option allows you to set the default for when a crisis alarm will sound, even if an alarm pause has been set. The choices are:

- *Always On*
- *Always Off* (factory default selection)

This option sets the unit default for all telemetry patients admitted to the CIC. It cannot be changed on an individual patient basis.

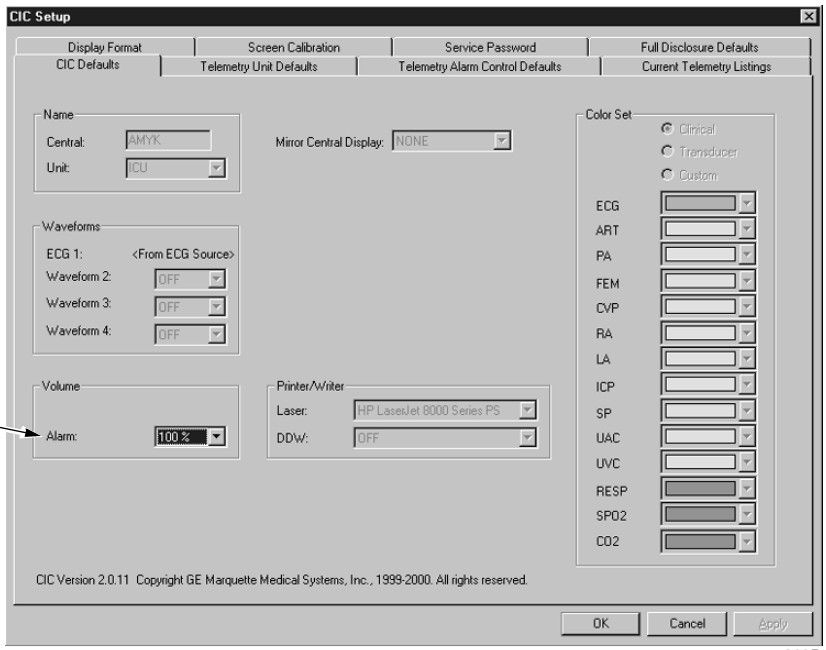
CIC Defaults

You can view the current CIC default settings by clicking on the *CIC Setup* button, but defaults can only be modified when in the service mode. Unless you are in the service mode, you will not be able to see all available options, you will not be able to highlight the options, and the current settings will appear dimmed. Refer to the Service Password section in this chapter.

To open the CIC Defaults tab sheet, follow these steps.

1. Click on the *Setup CIC* button at the bottom of the CIC display. A set of tabs appears.
2. Click on the *CIC Defaults* tab to bring it to the front.

In user mode, this is the only active control.



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The following features of the CIC Defaults tab sheet can be modified in the service mode.

- *Name:*
  - *Central*—allows you to enter the name for this clinical information center.
  - *Unit*—allows you to enter the care unit name for use on the Unity network.

- *Waveforms:*
  - *ECG 1*—this is defined by the ECG source.
  - *Waveform 2 – 4*—allows you to define multiple patient viewer waveforms.

- *Volume:*
  - *Alarm*—allows you to set a default alarm volume.

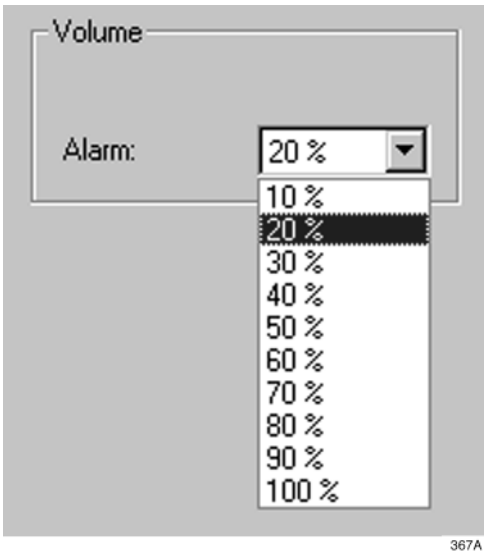
- *Printer/Writer:*
  - *Laser*—allows you to designate the default laser printer for this clinical information center.
  - *DDW*—allows you to designate the default writer for this clinical information center.

- *Color Set*:
  - *Clinical*—selects a preset clinical color scheme for waveforms.
  - *Transducer*—selects a preset transducer color scheme for waveforms.
  - *Custom*—allows you to set each waveform color individually.

Adjusting Alarm Volume

The default alarm volume can be adjusted without entering the service mode. Follow these steps.

1. Click on the *Alarm* field in the *Volume* control area. The Alarm Volume popup menu opens.



2. Click on the desired volume level. The volume can be set between 10% and 100%.

   NOTE: Alarm volume settings below 40% are password protected. You must enter the service password to set the volume below 40%.

3. When you are satisfied with the new volume level, use the mouse to click *Apply* to activate your change.

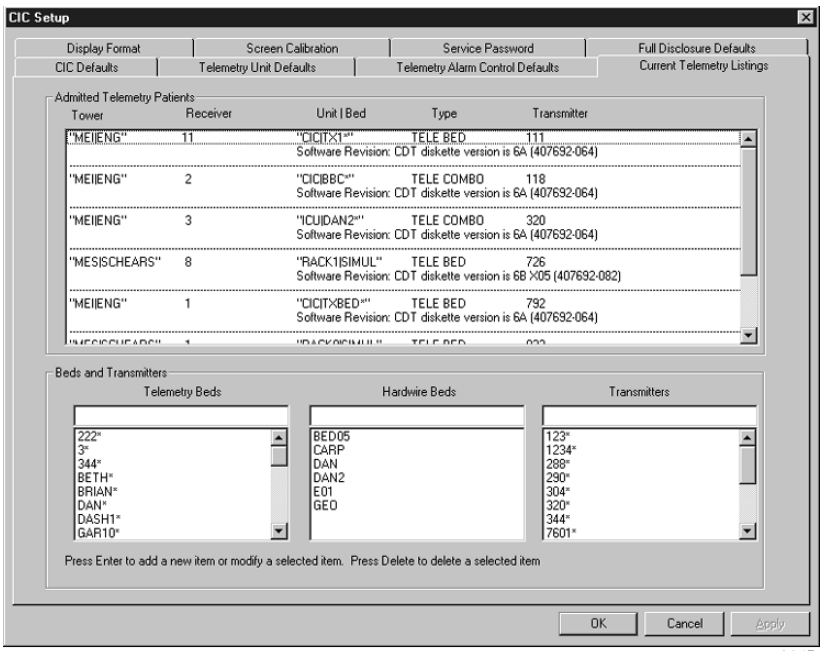
4. Click on another tab to bring the corresponding tab sheet to the front, or click on the *OK* button in the bottom right corner of the tab sheet to close the close the CIC Setup window and return to the multiple patient viewer.

Current Telemetry Listings

You can view the Current Telemetry Listings by clicking on the *Setup CIC* button, but defaults can only be modified when in the service mode. Refer to the Service Password section in this chapter.

The Current Telemetry Listings tab sheet allows you to view characteristics of telemetry settings. To open the Current Telemetry Listings tab sheet, follow these steps.

1. Click on the *Setup CIC* button at the bottom of the display. A set of tabs appears.
2. Click on the *Current Telemetry Listings* tab to bring it to the front.



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The *Admitted Telemetry Patients* control is for information only. The *Beds and Transmitters* controls can only be modified from within the service mode.

Admitted Telemetry Patients

NOTE: This overview covers the controls in a row. Each row contains information for one telemetry patient.

The second line of an entry shows the current software level for the patient bed in question.

- *Tower*—indicates which telemetry receiver system this telemetry patient is communicating with.
- *Receiver*—indicates the receiver inside the telemetry receiver system with which this telemetry transmitter is communicating.
- *Unit | Bed*—indicates the unit and bed to which this patient has been assigned.
- *Type*—indicates the type of patient this is: *Tele Bed* or *Tele Combo*.
- *Transmitter*—indicates the identification number assigned to this patient's transmitter.

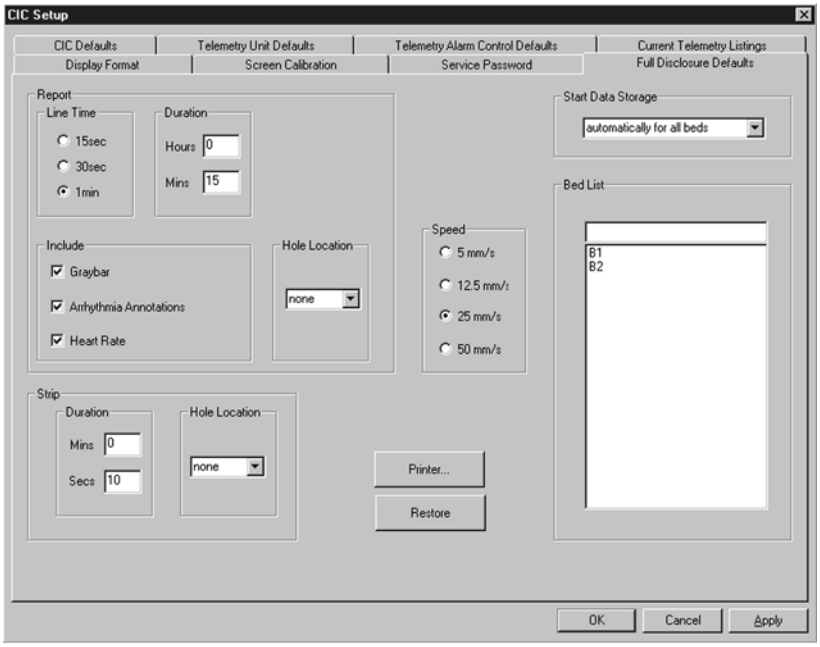
Bed and Transmitters

- *Telemetry Beds*—allows you to add, modify, or delete a telemetry bed name.
- *Hardwire Beds*—allows you to add, modify, or delete a hardwire bed name.
- *Transmitters*—allows you to add, modify, or delete a telemetry transmitter.

Full Disclosure Defaults

The Full Disclosure Defaults tab sheet is used to set up the defaults for full disclosure monitoring. You must enter the service mode to make any modifications to this tab sheet. Refer to the Service Password section in this chapter for more information about entering the service mode.

Below is an illustration of the Full Disclosure Defaults tab sheet. For complete details about the full disclosure function, please refer to the Clinical Information Center Operator's Manual.



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For your notes

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About Admitting

Switching Transmitters

If you wish to switch to an ApexPro transmitter from a CD Telemetry-LAN transmitter (Apex S, Apex 5, Apex 3, or CD Telemetry transmitter) or vice versa while a patient is admitted, you must follow this procedure:

- Discharge the patient (losing stored data).
- Switch transmitters.
- Re-admit the patient.

Monitoring will stop if you switch transmitters while a patient is admitted. Attempting to change the TTX number for an admitted telemetry patient at the CIC will generate the message "*INVALID TTX*."

Terminology

For the purposes of this document, the following terms apply:

Telemetry Monitoring

Telemetry monitoring occurs when patient vital signs data is transmitted by a telemetry transmitter to a telemetry receiver system over an established antenna system and viewed at a clinical information center. The clinical information center identifies a telemetry bed by placing an asterisk next to the bed name (e.g., IMC|BED4*). ECG data is processed by the telemetry receiver system.

Bedside Monitoring

A bedside monitor is a stationary monitor (user-configured or factory-configured). These monitors are connected directly to the patient via an ECG cable. They are set up with a unit name as well as a bed name (e.g., IMC|BED4). For a user-configured monitor, ECG data is processed by an acquisition module. For a factory-configured monitor, ECG data is processed within the monitor itself.

For information about bedside monitoring at the clinical information center, refer to the Clinical Information Center Operator's Manual.

Locked and Unlocked Beds

The clinical information center can be configured with the bed names in either locked or unlocked mode. When locked, the bed names are permanently assigned to specific windows.

For information about locked and unlocked beds, refer to the service manual for the clinical information center.

NOTE: It is possible to admit a patient to a window with a bed name that is locked to *NONE*. To avoid duplication of patient waveforms, a window locked to *NONE* should not be used to admit a patient.

Admit Instructions

Admitting a telemetry patient is a simple, yet important procedure. After you have prepared the patient's skin, properly placed the electrodes, and set up the transmitter(s), the patient can be admitted.

Admit Procedure

1. At the clinical information center, choose a bed window that is blank except for an *Admit* button.

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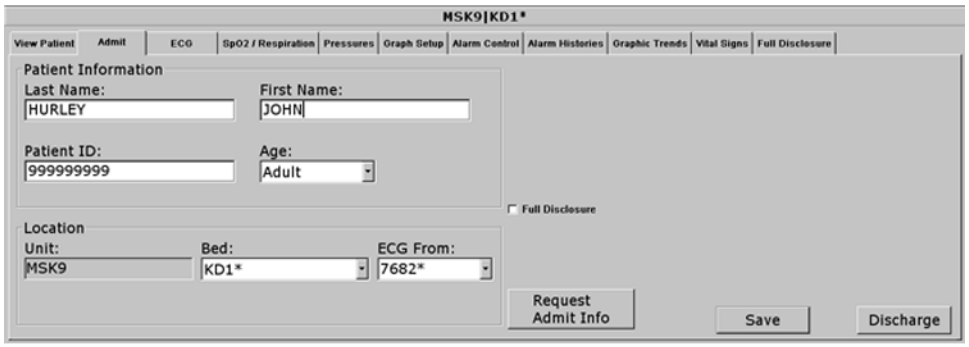
If a bed window similar to the one illustrated above does not appear on your clinical information center, click on the *Auto Display* button in the main menu at the bottom of the display. The display will rearrange to add at least one empty bed window with an *Admit* button.

NOTE: If there are no additional bed windows available, the message "*Reconfiguration failed!*" will appear. Do a discharge to make a bed window available for admit. For more information on discharging, refer to the Discharging a Patient section in this chapter.

NOTE: A bed window that still contains some patient information and the message "*DISCHARGED*" is available for admit. For information on clearing the data and making this type of window available for admit, refer to the Clearing a Patient Window section in this chapter.

2. Use the mouse to click on the *Admit* button. The single patient viewer appears at the bottom of the display, with the Admit tab in front.



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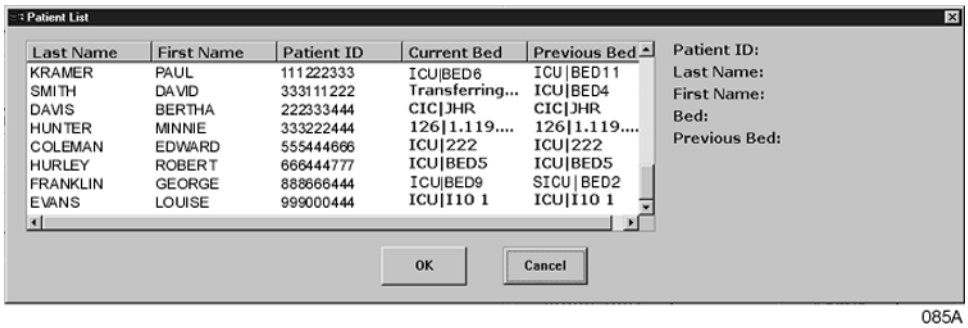
3. Click on the *Request Admit Info* button. If any patient information is available from the PDT server, the *Patient List* window opens.



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   a. If the patient information you want is listed in the Patient List window, click on it.

   b. Click *OK* to select your choice, or click *Cancel* to close the window without making a selection.

   If no information is available from the PDT server, or if the PDT server itself is not available, the clinical information center will query the hospital information system. If HL7 admit data is available on a MUSE system or a QS system, the appropriate fields on the Admit tab sheet are populated with data from those devices.

   If patient information is not available from either the PDT server or the hospital information system, an error message appears. Information for the fields on the Admit tab sheet must be entered manually. Proceed to step 4 to do this.

   Proceed to step 7 if you do not need to enter or change any of the patient information.

4. Select the desired bed number by using the mouse to click on the down arrow that appears to the right of the *Bed* field. A popup list of beds in the unit appears. Click on your choice to select it.

   The bed number selection will not change if the bed number is locked. (Refer to the service manual for the clinical information center for more information about locked beds.)

5. Select the source of the ECG in the *ECG From* field. Click on the down arrow at the right of the field, and a popup list of choices will appear. Click on your choice to select it.

   Be sure that the TTX number you select from this list matches the TTX number on the back of the ApexPro transmitter connected to the patient.

6. You can enter patient information by clicking in the various patient information fields, typing in the information, and then tabbing into or clicking in the next field. The patient information that should be entered is: *Last Name, First Name, Patient ID*, and *Age*. You do not have to enter this information in order to admit a patient. However, it is recommended that you enter it.

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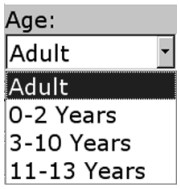
Backspace Key

   - *Last Name, First Name,* and *Patient ID* are entered using the keyboard. Click or tab into the field before typing the information. Press the backspace key (shown at left) to delete characters when changing or correcting the patient's name or ID number.
   - *Age* appears as a popup list of selections. Click on the down arrow to the right of the field to open the list. Click on your choice to select it.



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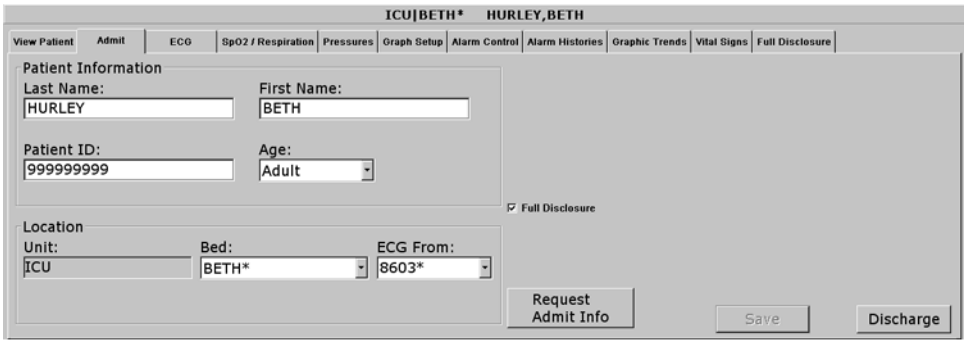
7. Once you have entered all the patient information desired, click on the *Admit* button in the lower right corner of the tab sheet to admit the patient.

Discharge Instructions

To discharge a patient, follow this procedure:

1. At the clinical information center, click on the bed window of the patient you wish to discharge. The display rearranges to accommodate the single patient viewer at the bottom of the display.
2. Click on the *Admit* tab to bring the tab sheet to the front.



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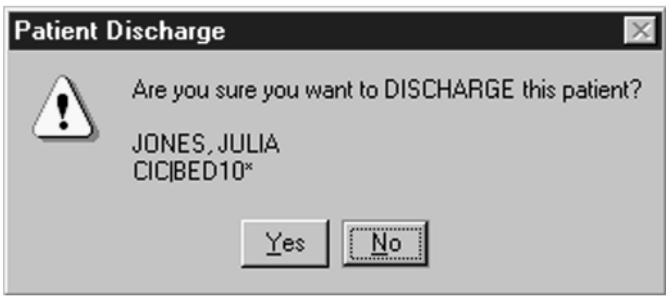
3. Click on the *Discharge* button in the lower right corner of the tab sheet. A dialog box similar to the one below appears on the display.



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4. Click on the *Yes* button or type the letter **Y** on the keyboard if this is the patient you wish to discharge. All patient information will clear.

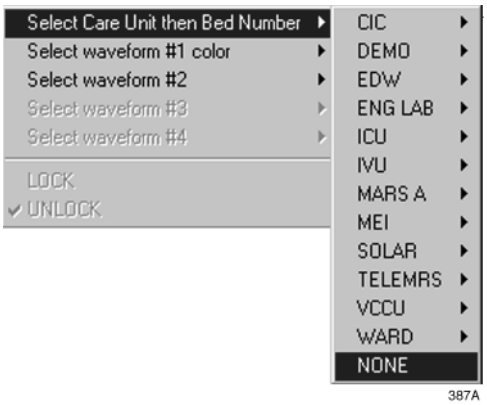
   While the information is being cleared, the message *"Discharging patient…"* appears briefly on the Admit tab sheet.

The single patient viewer closes, and the display returns to the multiple patient viewer. The bed window of the patient you just discharged will show the message *"DISCHARGED"* at the bottom of the window. If the bed is not locked, the *"DISCHARGED"* message disappears and an *Admit* button appears in the window as soon as the display is rearranged or refreshed. If the bed is locked, the *"DISCHARGED"* message remains on the bed window.

Clearing a Patient Window

To clear discharged patient information from the window and bring up the *Admit* button, use the right-click menu.

1. Use the **right** mouse button to click anywhere inside a discharged bed window. The right-click menu appears.

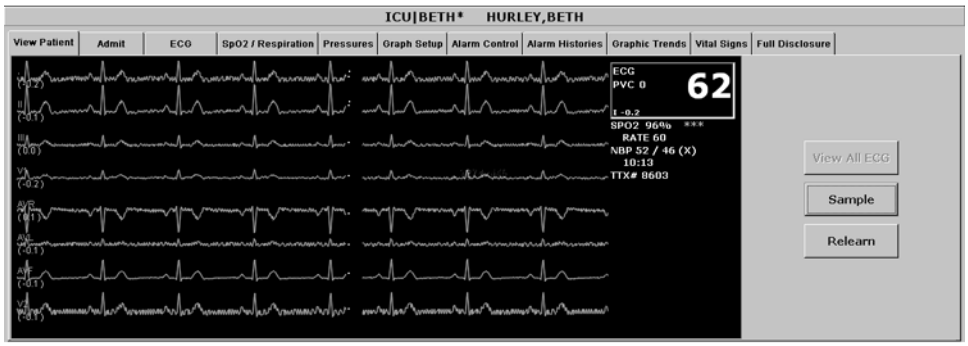


2. Slide the mouse over the *Select Care Unit, then Bed Number* text, without pressing either mouse button. The text highlights, and a list of units on the network pops up.
3. Without pressing either mouse button, slide the mouse pointer to *None* at the bottom of the list. Click the left mouse button on *None*.
4. The popup list closes, and the patient window will now be empty, except for an *Admit* button.

Viewing a Patient

When you wish to see detailed information about a patient's status, you can use the *View Patient* tab in the single patient viewer.

1. Click in the bed window of the patient you wish to view. The display rearranges to accommodate the single patient viewer at the bottom.
2. Click on the *View Patient* tab to bring it to the front.



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The View Patient tab sheet shows all the information that normally appears in patient's bed window in the multiple patient viewer, and also displays up to eight leads of ECG waveforms.

There are two buttons in the View Patient tab sheet that can be used for telemetry patients. Their functions are described below.

NOTE: The third button, *View All ECG*, is dimmed when viewing telemetry patients because all the ECG waveforms available for telemetry patients are normally displayed.

Sample

Clicking on the *Sample* button records a sample of the patient's real-time ECG data. This sample is then stored in alarm histories, and can be viewed in the *Alarm Histories* tab sheet under the title of *Sample*. For more information about viewing alarm histories, refer to Chapter 10, Patient Data, in this manual.

Relearn

Clicking on the *Relearn* button initiates a relearn of the patient's ECG rhythm. The relearn takes only a few seconds. The patient's heart rate reading will appear as Xs momentarily, and then be replaced by numerics once the relearn is complete.

Use the relearn function whenever there has been a significant change in the patient's rhythm.

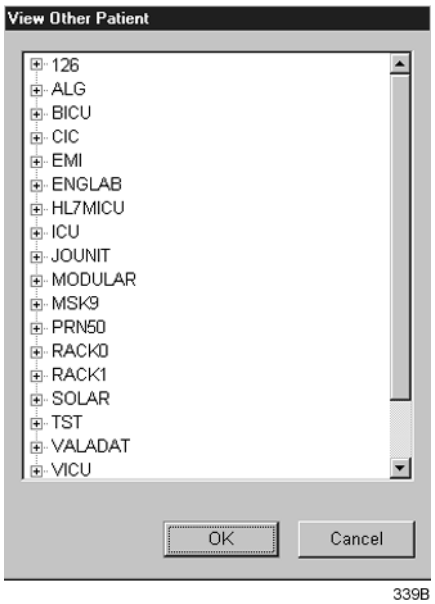
Viewing Another Patient

NOTE: When viewing a patient from another unit, you cannot make any changes to the patient's information or settings.

Viewing in the Single Patient Viewer

To display the single patient viewer of a patient on the network who is not currently displayed on your clinical information center, follow the steps below.

1. Click on the *View Other* button in the Main Menu at the bottom of the clinical information center display.
2. The *View Other Patient* window appears. This window displays all the units currently available on your network.



3. Click on the ⊞ next to the unit from which you wish to view a bed. A list of beds admitted to that unit appears below the unit name.

   NOTE: If a unit name has a ⊟ next to it but no bed list below it, there are no beds admitted into that unit.

4. Click on the bed name you wish to view. The name is highlighted.
5. Click on the *OK* button. The single patient viewer opens at the bottom of the display, showing the viewed patient's data.

Viewing in the Multiple Patient Viewer

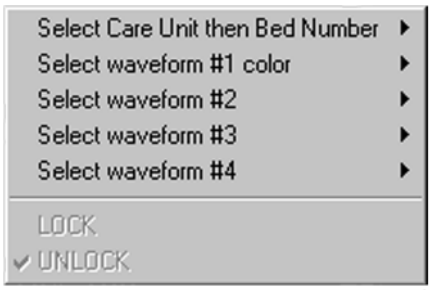
When in the multiple patient viewer, you can replace the data in any bed window with the data from another patient on the network who is not currently displayed on your clinical information center.

NOTE: The data for the patient who was originally displayed in the bed window you select will not be visible on your clinical information center once you use that patient's bed window to view another patient.

To view another patient in the multiple patient viewer, follow the steps below.

1. Use the right mouse button to click anywhere inside a bed window. The right-click menu appears.

   NOTE: You must use the right mouse button to access the right-click menu.



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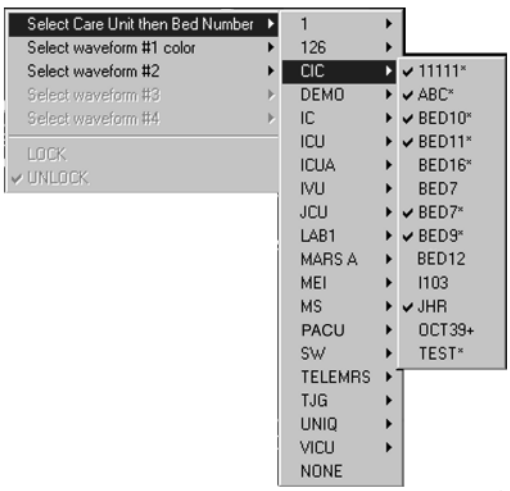
2. Slide the mouse over the *Select Care Unit then Bed Number* text, without pressing either mouse button. The text highlights, and a list of units on the network pops up.
3. Without pressing either mouse button, slide the mouse pointer to the unit name you wish to select a bed from. The unit name highlights, and a list of beds on that unit pops up.



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4. Without pressing either mouse button, slide the mouse pointer to the bed you wish to view. The bed name becomes highlighted.

   NOTE: A check mark next to a bed name means that the bed is already being viewed at this clinical information center.

5. Once you have chosen the bed you wish to view, and its bed name is highlighted on this list, use the **left** mouse button to click on the bed name.

6. The popup lists close, and the viewed patient's data appears in the bed window.

   For more detailed patient information, use the left mouse button to click in the bed window. The single patient viewer will open at the bottom of the display, allowing you to view all the patient's data.

Alarm Condition Indicators

You can open the single patient viewer for any patient in your care unit who is experiencing an alarm condition.

When a patient experiences an alarm condition, a red button appears at the bottom of the clinical information center display. The button contains the unit name and bed number, as well as the cause of alarm.

To access the single patient viewer for the alarming patient, simply click on the red button at the bottom of the display. The display rearranges to accommodate the single patient viewer at the bottom of the display, and all the patient's information will be available to you.

For your notes

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For your notes

Alarm Structure

The alarm structure of the clinical information center is divided into two classifications:

- Patient status alarms
- System status alarms

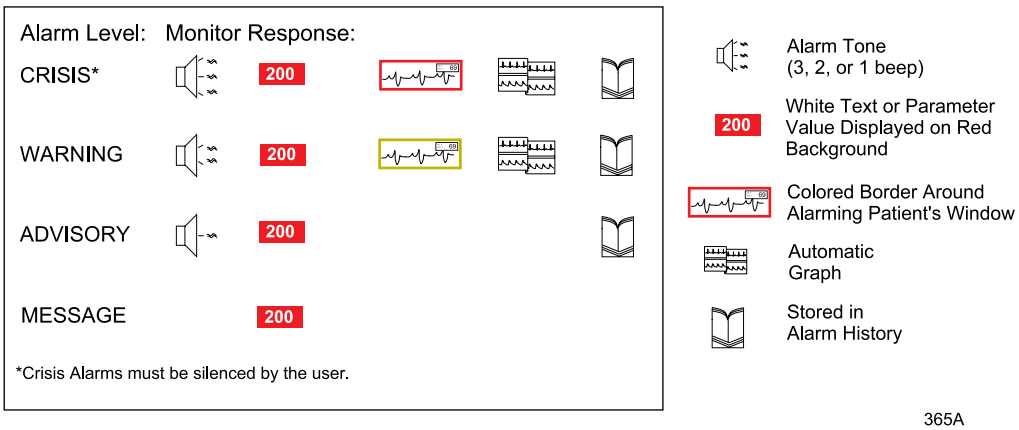
Within each classification there are levels that correlate to the severity of the condition that is causing the alarm. The levels and how the clinical information center responds to each are described below.

Patient Status Alarms

Patient status alarms are triggered by a patient condition that exceeds parameter limits, or by an arrhythmia condition. Patient status alarms provide the highest priority information.

The levels within the patient status alarm category and how the clinical information center responds to each are shown in the following chart. The chart begins with the most critical type of alarm (Crisis) and ends with the least critical type of alarm (Message).

NOTE: Only arrhythmia alarm conditions are stored in alarm histories.



Patient Status Alarms Chart

Colored Window Borders

Crisis and Warning alarms are indicated with a large border around the individual patient's bed window in the multiple patient viewer. This border flashes on and off several times when the alarm occurs before staying on. The color of the border indicates the severity of the alarm — red for a Crisis alarm and yellow for a Warning alarm. When the alarm is silenced, the colored border reverts to the black background.

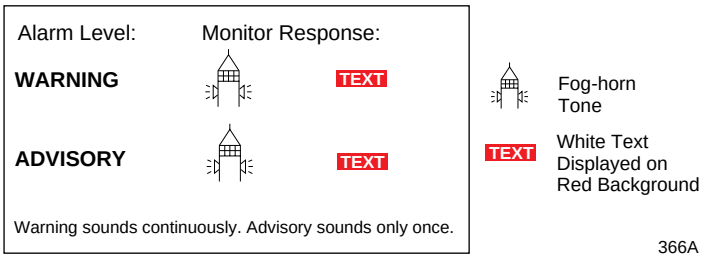
NOTE: Only Crisis and Warning alarms activate the colored border. Patients selected for single patient view have a white border in the multiple patient viewer.

Automatic Alarm Graphs

A graph prints automatically when a patient experiences a Crisis or Warning alarm. Arrhythmia alarm graphs run until the end of the alarm event. The printer prints the 10 seconds of data that occurred immediately before the event, and prints for the duration of the event. The printer stops printing when the patient returns to a normal rhythm. If a printer is not available at the time of the alarm event, a 20-second graph is saved. This saved graph will print when a printer becomes available.

System Status Alarms

System status alarms are triggered by mechanical or electrical problems and are of lesser priority than patient status alarms. The levels within the system status alarm category and how the clinical information center responds to each are shown in the following chart.



System Status Alarms Chart

Unlike patient status alarms, system status alarms cannot be moved from one level to another.

Alarm Control Tab

Parameter and arrhythmia alarm levels are, from most critical to least critical, Crisis, Warning, Advisory, and Message.

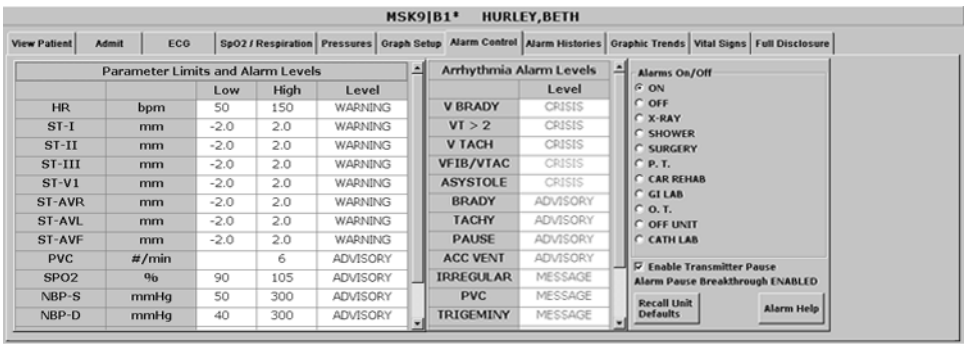
Each alarm level elicits a specific response from the clinical information center. The four alarm levels are configurable. This means that an alarm can be moved from one category to another if the default is not satisfactory to your situation. This is done in the Alarm Control tab sheet for the patient whose alarm settings you wish to adjust.

NOTE: *ASYSTOLE* and *VFIB/VTAC* alarms cannot be moved from the Crisis level.

For neonatal patients, *BRADY*, *ASYSTOLE*, and *VFIB/VTAC* alarms cannot be moved from the Crisis level.

Accessing the Alarm Control Tab

1. Use the mouse to click in the window of the telemetry patient whose alarm settings you wish to view or change.
2. The clinical information center display rearranges as the single patient viewer opens at the bottom of the display. Click on the patient's *Alarm Control* tab to bring the tab sheet to the front.



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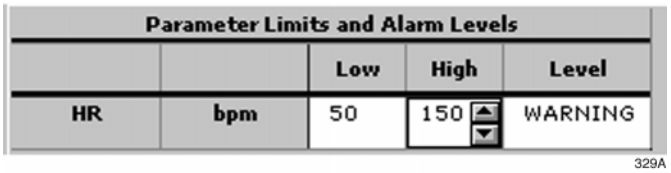
The telemetry patient *Alarm Control* tab sheet is divided into three sections: *Parameter Limits and Alarm Levels*, *Arrhythmia Alarm Levels*, and *Alarms On/Off*. The options on this tab sheet are detailed on the following pages.

Parameter Limits

1. To change the individual patient's settings for *Parameter Limits and Alarm Levels*, click in the *Low* or *High* field for the parameter you wish to change.

   NOTE: The alarm limits for some parameters cannot be changed. To indicate that they cannot be changed, the text in the *Low* and *High* fields for these parameters always appears dimmed.

   Once you click in the field, it is framed by a rectangle, and up and down arrow buttons appear in the field.



NOTE: Alarms generated by parameter limit violations are not stored in Alarm Histories.

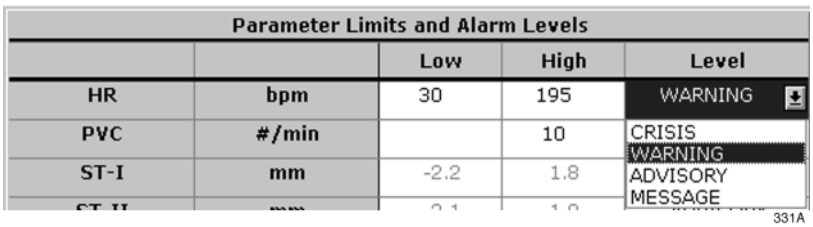
2. To increase or decrease the limit by 5, click on the up or down arrow button.

   To increase or decrease the limit in increments other than 5, use the keyboard to enter a new limit value.

3. If you are finished making changes in the *Alarm Control* tab sheet, click on the *Close* button in the bottom right corner of the display to close the single patient viewer.

Parameter Alarm Levels

1. Click in the *Level* field for the parameter whose alarm level is to be changed. A down arrow button appears in the field.
2. Click on the down arrow button. A popup list of alarm level selections appears.



NOTE: Alarms are always sorted from top to bottom in highest to lowest priority. When you change a level, the list is re-sorted to reflect the change in alarm priority.

3. Click on the desired alarm level to select it.
4. If you are finished making changes in the *Alarm Control* tab sheet, click on the *Close* button in the bottom right corner of the display to close the single patient viewer.

Arrhythmia Alarm Levels

1. To change the *Arrhythmia Alarm Levels*, click in the *Level* field of the arrhythmia alarm you wish to change. A down arrow button appears in the field.

   NOTE: The Arrhythmia Alarm Levels for *ASYSTOLE* and *VFIB/VTAC* cannot be changed. Therefore, the text in the *Level* field for these alarms always appears dimmed.

   For neonatal patients, the Arrhythmia Alarm Levels for *BRADY*, *ASYSTOLE* and *VFIB/VTAC* cannot be changed. Therefore, the text in the *Level* field for these alarms always appears dimmed.

   NOTE: You may need to use the scroll bar on the right side of the Arrhythmia Alarm Levels section in order to view the arrhythmia alarm that you wish to modify.

   NOTE: Alarm levels are usually shown in black type. An alarm level shown in blue indicates that it is **not** the default level.

2. Click on the down arrow button. A popup list of alarm level selections appears.

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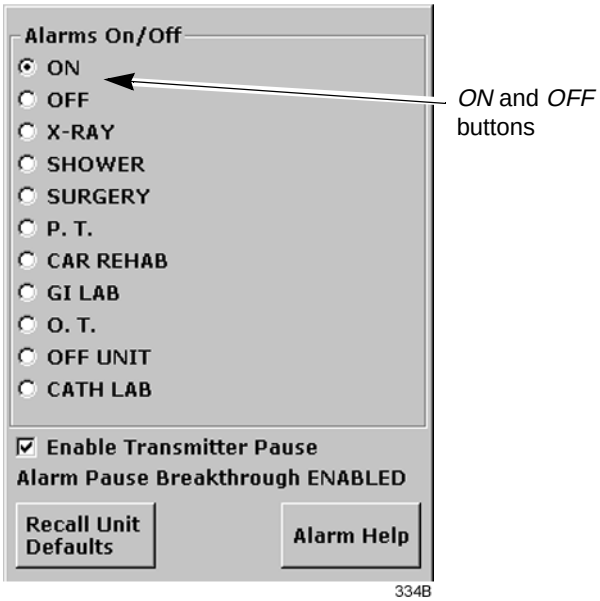
3. Click on your choice to select it.

4. If you are finished making changes in the *Alarm Control* tab sheet, click on the *Close* button in the bottom right corner of the display to close the single patient viewer.

Alarms On/Off

To turn a telemetry patient's alarms on or off, click on the appropriate radio button or on the text itself in the *Alarms On/Off* section of the Alarm Control tab.



Selecting *Off* turns all alarms off until you turn them back on by selecting *On*.

NOTE: Refer to the Alarm Pause Breakthrough section in this chapter for important information about turning alarms off.

Alarm Off Reason

Selecting from a list of reasons, you can define why alarms have been turned off. This text is displayed in addition to the *ALARMS OFF* message in the patient's window at the clinical information center.

The following are the options for alarms off reasons.

Alarms Off Reason	Text Displayed At Clinical Information Center	Text Printed On Graph
On	(no text)	(no text)
Off	*ALARMS OFF*	*OFF*
X-ray	*XRAY*	*XRA*
Shower	*SHOWER*	*SHW*
Surgery	*SURGERY*	*OR*
Physical therapy	*P.T.*	*PT*
Cardiac rehab	*CAR REHAB*	*CR*
GI Lab	*GI LAB*	*GI*
Occupational therapy	*O.T.*	*OT*
Off unit	*OFF UNIT*	*UNT*
Cath Lab	*CATH LAB*	*CL*

- Selecting *OFF* turns all alarms off until you turn them back on.
- Selecting any reason establishes an alarm pause state for 5 minutes in the presence of a valid waveform. After 5 minutes, alarms will reactivate if the patient is within range of the antenna system for 15 seconds or longer. If the patient remains out of antenna range, the alarm pause state will continue until the patient re-enters antenna range for 15 seconds or longer.

  NOTE: The patient must be in antenna range for the alarm pause state to cease.

WARNING
Alarms do not sound, alarm histories are not stored, and alarm graphs do not print during an alarms off with reason condition.

- The alarms off reason appears in the event trend for graphic trends.
- If the patient is in *LEADS FAIL* or *NO TELEM* and an alarms off reason is selected, the reason is displayed in the waveform window.

NOTE: Refer to the Alarm Pause Breakthrough section in this chapter for important alarm pause information.

Enable Transmitter Pause

The *Enable Transmitter Pause* check box, when checked, allows the telemetry patient to pause alarms by pressing both ApexPro transmitter buttons simultaneously.

To enable the transmitter pause option for a telemetry patient admitted to the clinical information center, click in the *Enable Transmitter Pause* check box. A check mark appears in the check box.

To disable the transmitter pause option, click in the *Enable Transmitter Pause* checkbox. The check mark is removed from the check box and the option is disabled.

NOTE: This option is shown as "*Transmitter Pause DISABLED*" and no check box is available if *Always Off* is selected for the *Transmitter Alarm Pause* option in the Telemetry Unit Defaults tab sheet.

To make the *Enable Transmitter Pause* option active (check box available), either *Enabled* or *Disabled* must be selected for the *Transmitter Alarm Pause* option in the Telemetry Unit Defaults tab sheet. Refer to Chapter 6, Telemetry Setup, for information about setting the Transmitter Alarm Pause option.

Alarm Pause Breakthrough Enabled/Disabled

Refer to the Alarm Pause Breakthrough section in this chapter for information about this alarm pause breakthrough status message.

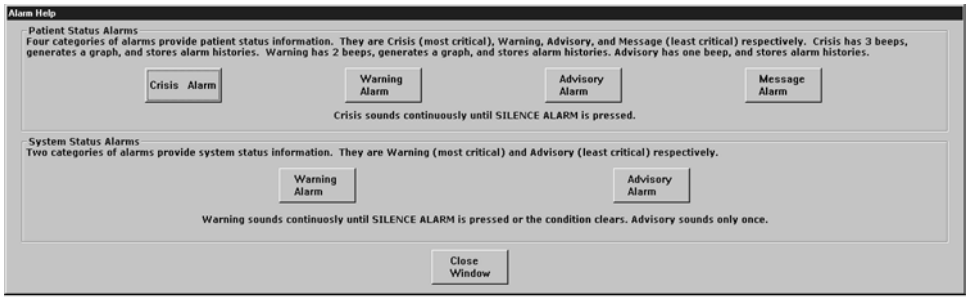
Recalling Unit Defaults

To recall the preset telemetry patient unit defaults for all options in the Alarm Control tab, simply click on the *Recall Unit Defaults* button on the bottom right side of the Alarm Control tab sheet. All data on the tab sheet will clear, and after a moment the preset unit defaults will appear.

In addition, clicking on the *Recall Unit Defaults* button also restores the default graph locations and settings on the patient's ECG tab sheet.

Alarm Help

For additional information about alarms, click on the *Alarm Help* button at the bottom right side of the *Alarm Control* tab sheet. An *Alarm Help* window appears.



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You can click on the buttons in this window to hear how each type of alarm sounds. When you are finished browsing the window, click on the *Close Window* button to close the window and return to the single patient viewer.

Printing Alarm Settings

A telemetry patient's Alarm Control tab sheet can be printed, showing all current alarm settings and limits. Click on the *Print* button in the main menu to start a printout of the Alarm Control tab sheet.

The Alarm Control tab sheet prints at the Print Window location. For more information about setting the Print Window location, refer to Chapter 9, Printing, in this manual.

NOTE: The Alarm Control tab sheet must be the front tab of the single patient viewer in order to print it. Click on the *Alarm Control* tab to bring it to the front if necessary.

Alarm Pause Breakthrough

The alarm pause breakthrough feature allows any crisis level alarm to "break through" (interrupt) an alarm pause and sound at the clinical information center.

In other words, when this feature is turned on in the Telemetry Unit Defaults tab sheet, Crisis level alarms will sound at the clinical information center, even if an alarm pause is in effect.

NOTE: The Alarm Pause Breakthrough feature defaults to *Always Off*. It must be set to *Always On* in the Telemetry Unit Defaults tab sheet **before** admitting a telemetry patient if you wish to have Crisis level alarms break through alarm pauses.

This feature cannot be set on an individual patient basis. It is either on or off for all telemetry patients admitted to the CIC. A status message on each patient's Alarm Control tab sheet indicates whether it is enabled (on) or disabled (off).

The chart below illustrates the function of the alarm pause breakthrough feature during the various alarm states.

Alarm State	Alarm Pause Breakthrough Function
Alarms on	No alarm pause breakthrough; all alarms are on.
Alarms off	No alarm pause breakthrough; all alarms are off.
Alarm off reason (X-ray, shower, etc.)	Alarms are paused; Crisis level alarms will break through the alarm off reason if the patient is in antenna range.
Alarms paused from the ApexPro transmitter	Alarms are paused; Crisis level alarms will break through the alarm pause.

After a Crisis level alarm has broken through an alarm pause, the telemetry system does **not** return to an alarm pause state. All alarms at any alarm level will sound at the clinical information center.

If you wish to continue pausing alarms after an alarm pause breakthrough occurs, you must re-initiate the alarm pause:

1. To re-initiate an alarms off with reason condition, select the alarms off reason in the telemetry patient's *Alarm Control* tab sheet.
2. To re-initiate an alarm pause from the ApexPro transmitter, press both transmitter buttons simultaneously twice.

   NOTE: The transmitter buttons must be pressed once to "end" the alarm pause at the transmitter, then a second time to start a new alarm pause at the transmitter (see below).

The **Pause Alarm** LED on the ApexPro transmitter continues to flash after an alarm pause breakthrough occurs. This is because there is no communication from the clinical information center back to the ApexPro transmitter to indicate that the alarm pause has ended. After an alarm pause breakthrough occurs, you can turn off the flashing **Pause Alarm** LED by pressing both transmitter buttons simultaneously.

Factory Alarm Default Settings

Patient Status Alarms

The factory default conditions for each category of alarms are listed below.

Crisis Alarms

- Asystole
- VFIB/VTAC
- Ventricular Tachycardia (V-Tach)
- VT > 2
- V Brady
- Bradycardia (applies only to 0-2 year and 3-10 year age selections)

Warning Alarms

- Heart rate limits
- ST deviation limits

Advisory Alarms

- Pause
- PVC
- ACC Vent (accelerated ventricular rhythm)
- Tachycardia
- Bradycardia (applies only to Adult and 11-13 year age selections)
- SPO2
- NBP

Message Alarms

- R-on-T phenomenon
- Couplet
- Bigeminy
- Trigeminy
- PVC
- Irregular
- SPO2 rate

System Status Alarms

System Warning Alarms

System warning alarms examples:

- *ARR SUSPEND/ARTIFACT* (refer to the appendices)
- *LEADS FAIL* (refer to the appendices)
- *NO TELEM* (refer to the appendices)

System Advisory Alarms

System advisory alarms example:

- *CHANGE BATTERY* (refer to the appendices)

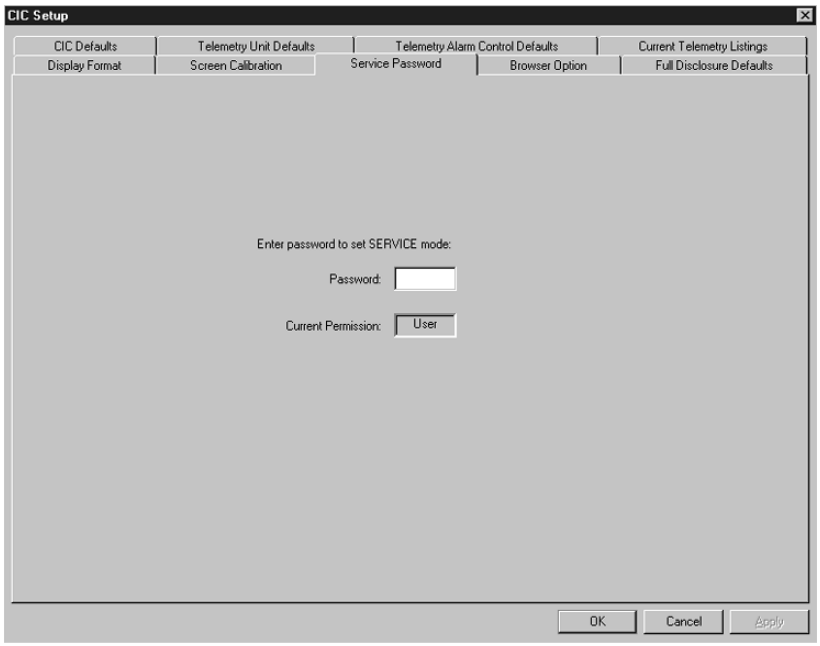
Unit Default Settings for Alarms

Telemetry Alarm Control Defaults

You can set Telemetry Unit Defaults for parameter limits and alarm levels, as well as for arrhythmia alarm levels. These defaults are in effect for all telemetry patients admitted to your unit, unless they are modified in an individual patient's Alarm Control tab sheet (for more information, see the Alarm Control Tab section in this chapter).

To set telemetry alarm control defaults, follow the steps below:

1. Click on the *Setup CIC* button at the bottom of the clinical information center display. A set of tabs appears.
2. Click on the *Service Password* tab to bring it to the front.



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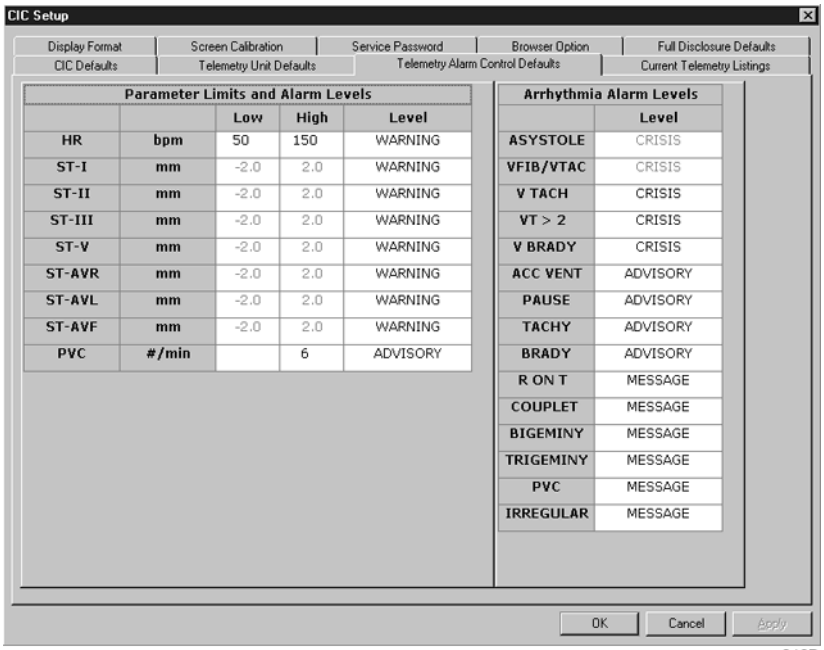
3. Use the keyboard to enter the service password, then click the *Apply* button. The *Current Permission* entry changes from *User* to *Service.*

CAUTION
The service mode is intended for use only by qualified personnel with training and experience in its use. The consequences of misuse include loss of patient data, corruption of the clinical information center operating system software, or disruption of the entire Unity network.

4. Click on the *Telemetry Alarm Control Defaults* tab to bring it to the front.



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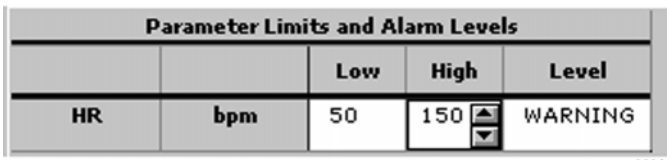
Parameter Limits

5. To change the unit defaults for *Parameter Limits and Alarm Levels*, use the mouse to click in the *Low* or *High* field for the parameter you wish to edit. The field is framed by a rectangle, and up and down arrow buttons appear in the field.



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6. To increase or decrease the limit by 5, click on the up or down arrow button.

   To increase or decrease the limit in increments other than 5, use the keyboard to enter a new limit value.

7. Once you have set the desired limit, click on the *Apply* button for the changes to take effect.

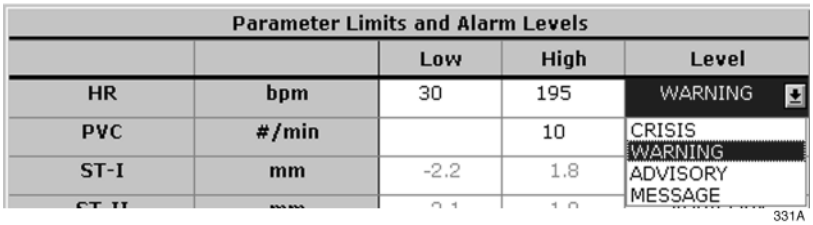
   NOTE: If you make only one change, you do not need to click on the *Apply* button. The change will take effect automatically, and the *Apply* button will appear dimmed.

8. If you are finished making changes to the Telemetry Alarm Control Defaults tab sheet, click the *OK* button.

Parameter Alarm Levels

To make a change in the telemetry unit default alarm level for a parameter, first access the *Telemetry Alarm Control Defaults* tab as described in the Telemetry Alarm Control Defaults section in this chapter. Then follow the procedure below.

1. In *Telemetry Alarm Control Defaults* tab, use the mouse to click in the *Level* field of the parameter for which the alarm level is to be changed. A down arrow button appears in the field.
2. Click on the down arrow button. A popup list of alarm level selections appears.



3. Click on the desired alarm level to select it.
4. Once you have set the desired level, click the *Apply* button for the changes to take effect.
5. If you are finished making changes to the Telemetry Alarm Control Defaults tab sheet, click the *OK* button.

Arrhythmia Alarm Levels

To make a change in the telemetry unit default alarm level for arrhythmia alarms, first access the *Telemetry Alarm Control Defaults* tab as described in the Telemetry Alarm Control Defaults section in this chapter. Then follow the procedure below.

1. In the *Telemetry Alarm Control Defaults* tab, the arrhythmia alarm levels for which unit defaults can be set appear on the right side of the window:

Arrhythmia Alarm Levels	
	Level
ASYSTOLE	CRISIS
VFIB/VTAC	CRISIS
V TACH	CRISIS
VT > 2	CRISIS
V BRADY	CRISIS
ACC VENT	ADVISORY
PAUSE	ADVISORY
TACHY	ADVISORY
BRADY	ADVISORY
R ON T	MESSAGE
COUPLET	MESSAGE
BIGEMINY	MESSAGE
TRIGEMINY	MESSAGE
PVC	MESSAGE
IRREGULAR	MESSAGE

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2. Click in the *Level* field of the arrhythmia alarm you wish to modify. A down arrow button appears in the field.

   NOTE: The arrhythmia alarm levels for *ASYSTOLE* and *VFIB/VTAC* cannot be changed. Therefore, the text in the *Level* field for these alarms always appears dimmed.

3. Click on the down arrow button. A popup list of alarm level selections appears.
4. Click on your choice to select it.
5. Once you have set the desired level, click the *Apply* button for the changes to take effect.

If you are finished making changes to the Telemetry Alarm Control Defaults tab sheet, click the *OK* button.

For your notes

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For your notes

Initiating a Graph

If you click on a patient's ECG parameter window, a continuous graph is initiated for the patient. Clicking on the ECG parameter window again will stop the graph.

The PRN 50 digital writer and the Direct Digital Writers (DDW) print patient data (generally referred to as a graph or graph strip). Data can also be printed on a laser printer.

The waveforms graphed and graph speed are controlled in the individual patient's Graph Setup tab sheet. Unit defaults for telemetry patients can be set in the CIC Defaults tab sheet and the Telemetry Unit Defaults tab sheet. Refer to Chapter 6, Telemetry Setup, for more information on setting telemetry unit defaults.

Automatic Alarm Graphs

A graph prints automatically when a patient experiences a Crisis or Warning alarm condition. Arrhythmia alarm graphs run until the end of the alarm event. The printer prints up to 10 seconds of data that occurred immediately before the event, and prints for the duration of the event. The printer stops printing when the patient returns to a normal rhythm.

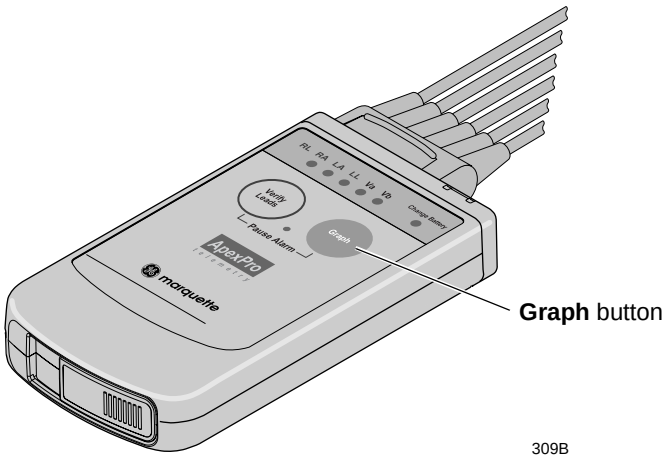
If a printer is not available at the time of the alarm event, a 20-second graph is saved. This saved graph will print when a printer becomes available.

Transmitter Initiated Graphs (Manual Graphs)

When the **Graph** button on the ApexPro transmitter is pressed, a 20-second graph strip is printed at a speed of 25 millimeters per second.

When an IMPACT.*wf* paging system (version II or later) is also available in the same care unit, pressing the **Graph** button enables the View on Demand feature (also called the Apex Graph Button Push feature). The IMPACT.*wf* server generates a manually initiated sample page or snapshot of the patient's ECG waveform and any other enabled/monitored non-arrhythmia parameters.

When you press the **Graph** button on the ApexPro transmitter, it generates both an IMPACT.*wf* update page as well as a standard ECG waveform graph at the clinical information center. The IMPACT.*wf* page is labeled "Sample" when this data is displayed on the IMPACT.*wf* receiver and stored in history. Additionally, all pagers assigned to the patient receive a page.



Graph Messages

One of the following messages is displayed on the clinical information center screen during graphing:

GRAPH ALARM—An alarm graph was initiated and is running.

GRAPH MANUAL—A manual graph was requested and is running.

GRAPH TTX—The **Graph** button on the transmitter was pressed and a 20-second graph strip is running.

PRINTING—A non-real time graph is currently being printed.

SAVING—An alarm or a manual graph has been requested but the writer is in use; the writer door is open; or the writer is out of paper. The graph is being saved until the writer is available. (The most recent 20-second alarm or manual graph will be saved.)

Graph All Patients

Clicking on the *Print* button at the bottom of the clinical information center display sends a Graph All Patients request to all beds displayed on the clinical information center, initiating a 10-second graph for each admitted telemetry patient. When this option is selected for telemetry patients, graph requests always print at a speed of 25 millimeters per second.

NOTE: This Graph All Patients function is only available when the single patient viewer is closed. If a single patient viewer is open, selecting *Print* from the main menu initiates a printout of whichever tab sheet is in front.

The print process stops automatically. If the **Graph Stop** control key is pressed on the external DDW, the current patient's graph stops and the writer begins to print a 10-second graph for the next patient.

If a patient's data is currently printing or is being saved to print when a Graph All Patients request is initiated, this patient's data will not be included in the Graph All Patients graph. This patient's data will print independently of the Graph All Patients graph.

Clicking on the ECG parameter window for a patient whose data is saving will cancel the Graph All Patients request for that patient.

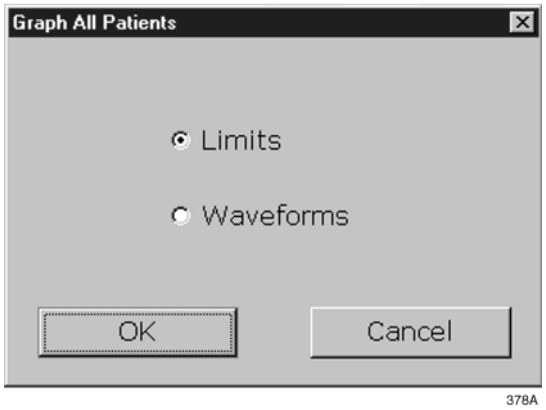
If, while a Graph All Patients request is in progress, an arrhythmia alarm occurs for a patient, the alarm data will replace the data that was saved for the Graph All Patients request. The alarm data will then appear on the graph printout.

If, while a Graph All Patients request is running, a telemetry patient initiates a graph from his or her telemetry transmitter, the saved data for the Graph All Patients graph will be replaced by data from the patient's telemetry transmitter. The data from the telemetry transmitter will then appear on the graph printout.

Initiating a Graph All Patients Request

To initiate a Graph All Patients request, follow these steps.

1. Click on the *Print* button at the bottom of the CIC display. The Graph All Patients window opens.



2. Click on *Limits* or *Waveforms*.
   - Selecting *Limits* graphs all patient limits.
   - Selecting *Waveforms* graphs all patient waveforms.

3. Click on the *OK* button to complete the Graph All Patients request.

Graph Location Defaults

Graphs print at the graph locations specified in the patient's Graph Setup tab sheet. Upon admission of a patient, these locations are set from the unit defaults, but they can be modified if desired.

- When the patient is no longer displayed at the original clinical information center (the *Admit* button is displayed in the waveform window), the graph default changes to where the patient is displayed, provided the patient has been moved to another clinical information center.
- If a printer cannot be found at the time of admission for a telemetry patient, the message *Saving No Writer* is displayed when a graph is requested because graphs are not sent to printers outside the unit.
- Alarm graphs always print at the patient's designated alarm graph location.
- Manual graphs and print window requests print at the clinical information center where the graph was requested, provided that clinical information center has the same type of writer or printer as the patient's set location for that type of graph. If the clinical information center where the graph was requested does not have the same type of writer or printer, the graph then prints to the patient's specified graph location.

For more information on designating graph locations, refer to the Graph Location Controls section in this chapter.

Stopping a Graph

To stop a graph request that has been sent to an external writer, press its **Graph Stop** control key. This stops any graph already in process. If this key is pressed when no graph is in process, it advances the paper in the writer.

NOTE: Because the clinical information center can communicate with many laser printers, the specific procedure for stopping a graph sent to a laser printer is not documented in this manual. Refer to the laser printer manufacturer's instructions.

Graph Paper Out Indicator

When there is no graph paper in the writer (or the door is open), the message *Graph Paper Out/Door Open* is displayed at the top of the screen.

When printing to a laser printer, a similar status message is displayed if the printer is unable to print.

NOTE: Because the clinical information center can communicate with many laser printers, specific status messages are not documented in this manual.

Graph Setup Tab Sheet

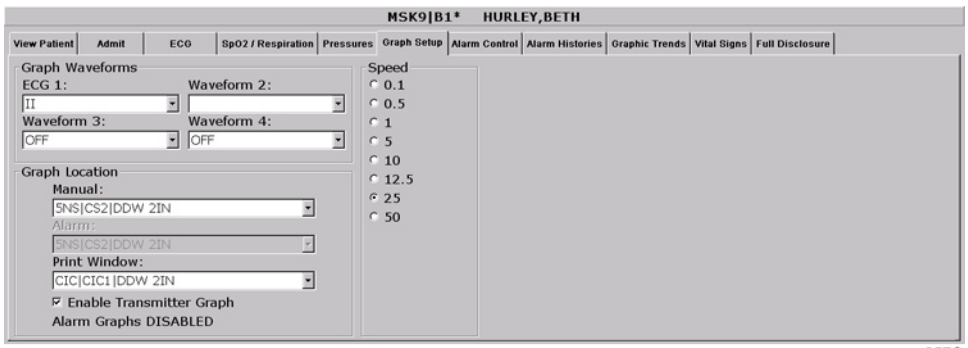
The Graph Setup tab sheet allows you to define the waveforms to be graphed, change the graph location and speed, and turn the telemetry transmitter graph on and off.

NOTE: Changes made in the Graph Setup tab sheet affect only the patient currently being viewed.

To make changes to graph information for all telemetry patients in the unit, you must use the CIC Setup and the Telemetry Unit Defaults tab sheets (refer to Chapter 6, Telemetry Setup, in this manual).

To view a patient's Graph Setup tab sheet, follow these steps.

1. Click on the desired patient's information in the multiple patient viewer. The single patient viewer for that patient opens.
2. Click on the *Graph Setup* tab. The Graph Setup tab sheet moves to the front.



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Graph Waveforms Controls

The *Graph Waveforms* controls allow you designate which waveforms should print in which positions on a patient's graph printout.

ECG 1 Control

1. Click in the *ECG 1* field. A down arrow button is displayed next to the waveform currently in the ECG 1 position.
2. Click on the down arrow to display a list of available ECG waveforms.
3. Click on the desired ECG waveform. The ECG 1 menu closes, with the selected ECG waveform name remaining visible.

Waveform 2, Waveform 3, and Waveform 4

1. Click in the field for the waveform you wish to designate. A down arrow icon is displayed next to the waveform currently in the Waveform X position.
2. Click on the down arrow to display a list of available waveforms.
3. Click on the desired waveform. The waveforms menu closes, with the selected waveform name remaining visible.

NOTE: Waveform X refers to Waveform 2, Waveform 3, or Waveform 4, depending on which field you are in.

Graph Location Controls

The *Graph Location* controls allow you to set the print destinations for manual, alarm, and print window graphs.

Manual Graph Location

To designate where manual graph requests will print, follow these steps.

1. Click in the *Manual* field. A down arrow icon is displayed next to the printer currently designated for printing manual graphs.
2. Click on the down arrow to display a list of available printers.
3. Click on the desired printer. The printers menu closes, with the selected printer name remaining visible.

Alarm Graph Location

To designate where alarm graphs will print, follow these steps.

1. Click in the *Alarm* field. A down arrow icon is displayed next to the printer currently designated for printing alarm graphs.
2. Click on the down arrow to display a list of available printers.
3. Click on the desired printer. The printers menu closes, with the selected printer name remaining visible.

Print Window Location

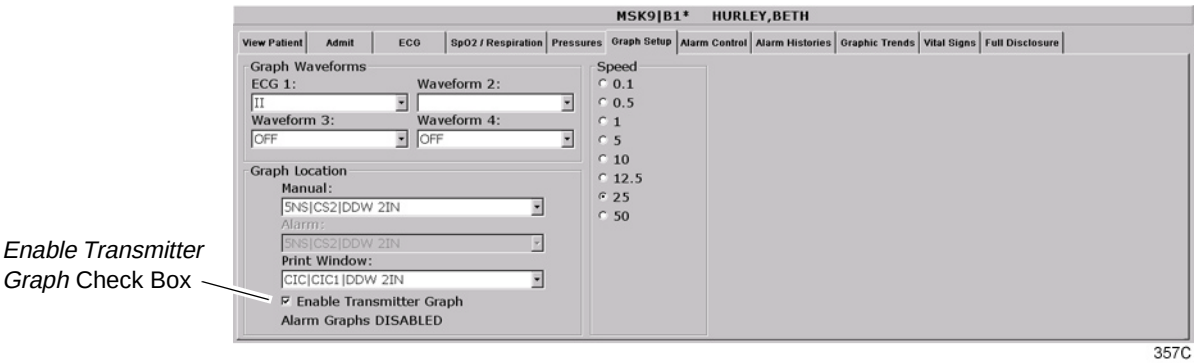
To designate where print window requests will print, follow these steps.

1. Click in the *Print Window* field. A down arrow icon is displayed next to the printer currently designated for printing alarm graphs.
2. Click on the down arrow to display a list of available printers.
3. Click on the desired printer. The printers menu closes, with the selected printer name remaining visible.

Enable Transmitter Graph

The *Enable Transmitter Graph* option allows you to turn off/on the transmitter graph function for telemetry patients. When this option is enabled, a telemetry patient can initiate a graph by pressing the **Graph** button on the ApexPro transmitter. When this option is disabled, no graph can be initiated. To enable or disable this option, follow this procedure:

1. To enable the transmitter graph option, point and click with the mouse to place a check mark in the *Enable Transmitter Graph* check box.



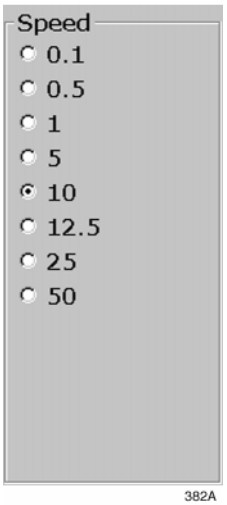
2. To disable the transmitter graph option, point and click with the mouse to remove the check mark in the *Enable Transmitter Graph* check box.

Alarm Graphs Enabled/Disabled

This message line indicates whether the graph on alarm feature is on (*Alarm Graph ENABLED*) or off (*Alarm Graph DISABLED*). This feature cannot be set on an individual patient basis. Use the *Alarm Graph* option in the Telemetry Unit Defaults tab sheet to set it for all patients admitted to the CIC.

Graph Speed Controls

The graph *Speed* controls allow you to adjust the speed at which a graph prints (mm/s). Simply click on the desired speed.



Laser Printer

A laser printer can be connected to the back of the clinical information center. (Refer to the service manual for more information on printer connections.) The clinical information center must be formatted for a laser printer upon installation in order for a laser printer to function with it. Refer to the service manual for the clinical information center for more information.

Printing to a laser printer for a telemetry patient may be configured on an individual basis or set up as a unit default. For more information, refer to the Graph Setup Tab Sheet section in this chapter, and to Chapter 6, Telemetry Setup, in this manual.

You can send all information that can currently be formatted for a writer to a laser printer at the clinical information center.

To graph information to a laser printer at the clinical information center, select the laser printer under the Graph Location controls in the Graph Setup tab sheet.

For your notes

10 Patient Data

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For your notes

Introduction

For the purposes of this manual, patient data consists of the information presented within these tab sheets:

- Alarm Histories
- Graphic Trends
- Vital Signs
- Full Disclosure

Once a patient is admitted to the clinical information center, a history of the patient's vital signs is continually collected. The most recent 24 hours of data can be viewed in a tabular format (vital signs) or in a graphic format (graphic trends).

Every non-episodic parameter is sampled every two seconds. A median value is determined, and that value is stored for display at one-minute resolution. Episodic parameters (NBP, etc.) are stored every time one occurs. If more than one episodic event occurred during the same minute, the more recent event will overwrite the earlier one.

Alarm histories for arrhythmia events are recorded and stored, up to a maximum of 100 events (36 events in Combo mode) per patient.

When full disclosure is turned on, complete ECG data for each patient is recorded and stored for viewing.

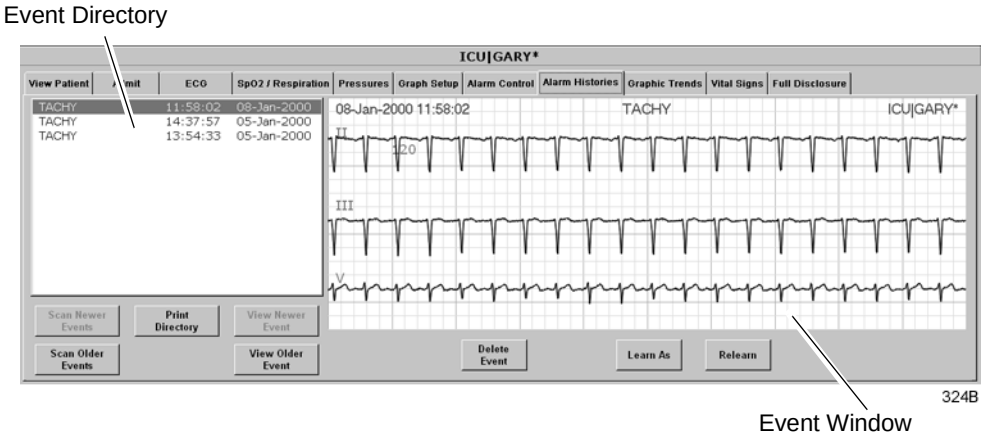
You cannot change any patient data values, but you can use the controls to view all the data collected.

Patient data can be viewed in varying time scales and can be printed to a connected laser printer or a writer.

Alarm Histories

A patient's arrhythmia events are stored in Alarm Histories, and can be reviewed, printed, and deleted at the clinical information center. To access a patient's Alarm Histories tab sheet, follow the instructions below.

1. Click in the bed window of the patient whose Alarm Histories you wish to view. The clinical information center display rearranges to accommodate the single patient viewer at the bottom of the display.
2. In the single patient viewer, click on the *Alarm Histories* tab, bringing it to the front.



The Alarm Histories tab sheet contains an event directory (a list of arrhythmia events recorded) for the patient, and an event window for viewing individual events. It also contains several buttons, which control the functions available in Alarm Histories. These functions are described in this chapter.

Event Directory

An event directory appears on the left side of the Alarm Histories tab. This directory is a list of all arrhythmia events that have occurred for this particular patient.

A maximum of 100 events is stored for each patient (36 events in the Combo monitoring mode). After 100 events have been stored, the oldest event is deleted to make room for any new event that occurs.

Approximately 10 events can be seen in the event directory at one time. There are two ways to access events that are not currently visible in the event directory. You can use the mouse and the scroll bar on the right side of the event directory to scroll up and down through all the events, or you can use the *Scan Newer Events* and/or *Scan Older Events* buttons. How to use these two buttons is discussed later in this chapter.

Event Window

The event window appears on the right side of the Alarm Histories tab sheet. The event shown in the event window corresponds to the event that is highlighted in the event directory. The date, time, and name of the event are shown in the event window header.

The event window displays 10 seconds of the patient's ECG waveform that was recorded when the event occurred. It displays up to three leads that were being monitored at the time the event occurred. For an ST event, the alarm ST event is displayed, along with a superimposed ST template for reference purposes.

To print an event shown in the event window, use the mouse to click on the *Print* button in the Main Menu at the bottom of the clinical information center. One event is printed per page.

Alarm Histories Buttons

There are eight buttons that perform various functions in the Alarm Histories tab. They are described below.

Scan Newer Events

Click on the *Scan Newer Events* button to move through all events in the event directory that are newer than the event that is currently highlighted. If there are no events newer than the highlighted event, this button is dimmed and does not function. This button changes to *STOP* when a scan is in process. To stop a scan, click on the button again. While the scan is in progress, you can also select *Scan Older Events* to reverse the scanning direction.

Scan Older Events

Click on the *Scan Older Events* button to move through all events in the event directory that are older than the event that is currently highlighted. If there are no events older than the highlighted event, this button is dimmed and does not function. This button changes to *STOP* when a scan is in process. To stop a scan, click on the button again. While the scan is in progress, you can also select *Scan Newer Events* to reverse the scanning direction.

Print Directory

Click on the *Print Directory* button to print a list of all events currently stored in the event directory. The list prints at the Print Window graph default location.

View Newer Event

Click on the *View Newer Event* button to view the next newer event waveforms, if any. If there are no events newer than the highlighted event, this button is dimmed and does not function.

View Older Event

Click on the *View Older Event* button to view the next older event waveforms, if any. If there are no events older than the highlighted event, this button is dimmed and does not function.

Delete Event

Click on the *Delete Event* button to delete the event that is currently highlighted in the event directory. This cannot be undone.

If more than one event is highlighted (using **Shift** or **Ctrl** and the mouse), a message appears when you press the *Delete Event* button, asking if you are sure you wish to delete the events. Click on *Ok* to continue the delete.

Learn As

The *Learn As* button is used to indicate to the clinical information center that the arrhythmia algorithm the telemetry patient is in is a "normal" rhythm for this patient.

This changes the name of the arrhythmia call on the template in the alarm history. The new name is displayed with an "*---*" to indicate it has been renamed.

NOTE: If a call name is changed via this option, it only applies to subsequent occurrences of this call. It will not change the names of calls stored in history before the change was made.

Once *Learn As* is used for an active template, the arrhythmia algorithm will adhere to that change.

WARNING
Do not use the *Learn As* feature for rhythms that include true ventricular beats in the 10 second history. This could affect the ventricular template, depending on its relation to the beats involved in the arrhythmia call.

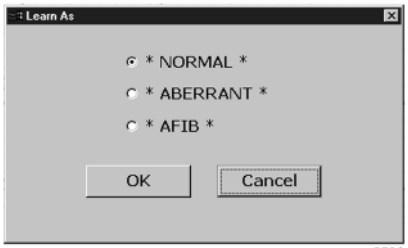
The following rhythm categories allow user feedback to reclassify arrhythmia calls:

Category	Description	Limitations
NORMAL	Used when the patient is normally in a paced rhythm and then has an early and wide beat or rhythm that is the patient's normal rhythm.	Disallowed when the heart rate of the ventricular beats exceeds the high heart rate limit.
ABERRANT	Used when the system is alarming as a VTach or Accelerated Ventricular arrhythmia. The rhythm is most likely a bundle branch block.	Disallowed when the heart rate of the ventricular beats exceeds the high heart rate limit.
AFIB (Atrial Fibrillation)	Used when the system is alarming for an irregular rhythm, for example.	

NOTE: This feature does not correct noise-related arrhythmia calls. Address noise-related arrhythmia calls with proper skin preparation and electrode placement.

Changing the Name of an Arrhythmia Call

1. To change the name of an arrhythmia call, display the alarm history for the event that is in question by clicking on that event in the event directory.
2. Click on the *Learn As* button in the Alarm Histories tab.
3. The *Learn As* dialog box opens, providing the list of new names to apply to the rhythm.



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4. Click on the radio button to select the new name choice for the call.

The alarm history will be updated, and the new name for the call is marked with "*---*" to indicate that it has been renamed.

NOTE: The *Relearn* option is available in the Alarm Histories tab, the ECG tab, and the View Patient tab. If selected, it will clear the patient's waveforms and all templates. When all of the templates are cleared, all renamed calls will revert to their original names, and the Learn As intervention is nullified.

If you try to apply a template that is no longer active, a "*Template Inactive*" message will be displayed, and the arrhythmia call in question will not be renamed.

Relearn

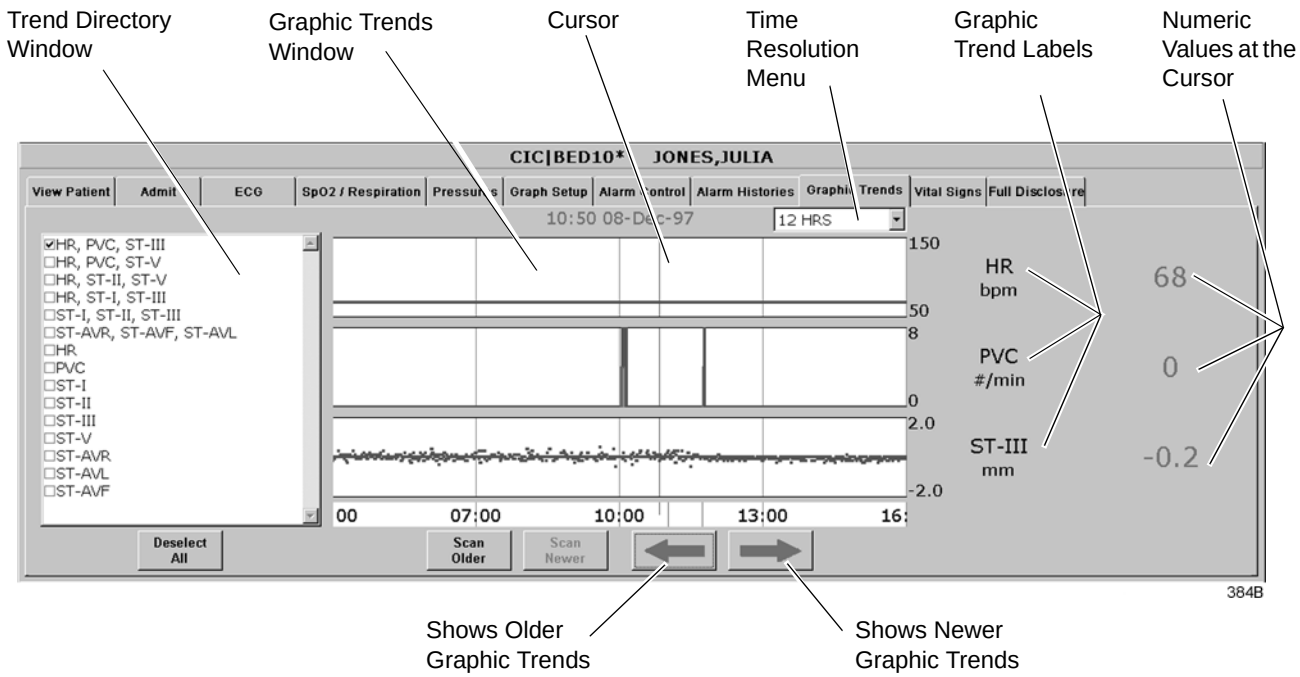
Select the *Relearn* button to initiate a relearn procedure. A relearn will clear the patient's waveforms and templates, and learn the patient's current rhythm as the dominant, "normal" rhythm.

Relearn is useful when you have changed a patient's electrodes or leadwires, or when it appears that false alarm calls are being made by the arrhythmia program. The relearn takes only a few seconds.

Graphic Trends

To view a patient's graphic trends, follow these steps.

1. Click on the desired patient's bed window in the multiple patient viewer. The single patient viewer for that patient opens.
2. Click on the *Graphic Trends* tab in the single patient viewer. The Graphic Trends tab sheet moves to the front.



- The *Trend Directory* window lists trends and preset trend combinations for display.
- The *Graphic Trends* window displays the selected graphic trends in blue.

  NOTE: Data points that go off the scale are shown at the graticule limit in red, not in the usual blue.

- *Deselect All* "turns off" all currently selected graphic trends.
- The cursor shows the locations on the graphic trend corresponding with numeric values.
- Arrow keys move the cursor right or left, showing older or newer trend values.
- The *Time Resolution* menu is a popup menu to adjust the time resolution for displayed trend data.

NOTE: After either *Scan Older* or *Scan Newer* is selected, the button label changes to *STOP*.

- *Scan Older* scans older data.
- *Scan Newer* scans newer data.

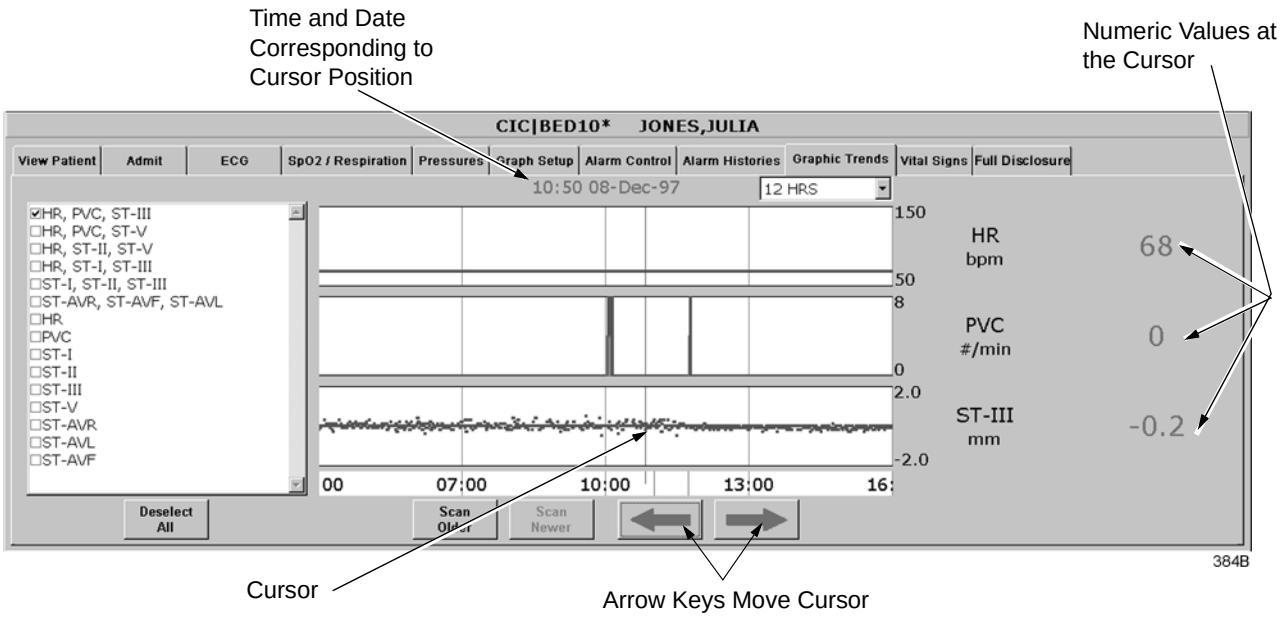
Trend Directory Window

Up to three graphic trend plots can be displayed in the Graphic Trends window at one time. You can select from preset groupings of trends or individual trends.

To select the trends for display in the Graphic Trends window, click on a preset trend grouping or individual trends (up to three). When selected, a check appears in the box to the left of the label.

Cursor

One-minute median values can be accessed through the use of a cursor at the clinical information center.

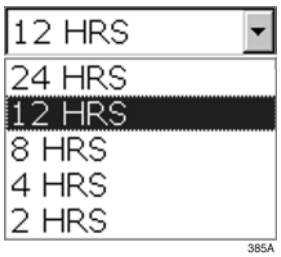


- The default cursor location is at the current time when entering the Graphic Trends tab sheet.
- You can move the cursor to any median value and review the actual numeric data.
- The cursor is not printed with the graphic trend data.

Time Resolution Menu

In the Graphic Trends tab sheet, you can define the amount of trend data (resolution) to display in the trend window. This is done with the popup menu located to the right of the time and date.

1. Click on the down arrow to display the time options.



2. Click on the desired time resolution. The time resolution menu closes, with the selected resolution remaining visible. The selected time resolution is also reflected immediately in the Graphic Trends window.

Graphic Trends Buttons

There are five buttons that perform various functions in the Graphic Trends tab. The function of each button is described below.

Deselect All

Click on the *Deselect All* button to clear all trends from the Graphic Trends window. Selecting this option also removes any checks from the Trend Directory window.

Scan Older

Click on the *Scan Older* button to initiate a scan of older trend data. When clicked, the scan begins and older trend data scrolls across the display. While the scan is in progress, you can select *Scan Newer* to reverse the scanning direction.

This button changes to *STOP* when a scan is in process. Click on the *STOP* button to stop a scan in process. When the oldest event is displayed, the scan automatically stops, and the label on this button will be dimmed.

Scan Newer

Click on the *Scan Newer* button to initiate a scan of newer trend data. When clicked, the scan begins and newer trend data scrolls across the display. While the scan is in progress, you can select *Scan Older* to reverse the scanning direction.

This button changes to *STOP* when a scan is in process. Click on the *STOP* button to stop a scan in process. When the most recent event is displayed, the scan automatically stops, and the label on this button will be dimmed.

Arrow Keys

Clicking the left arrow moves the cursor one minute in the “older” direction. When the oldest (least recent) event is displayed, the left arrow is dimmed.

Clicking the right arrow moves the cursor one minute in the “newer” direction. When the newest (most recent) event is displayed, the right arrow is dimmed.

Printing Graphic Trends

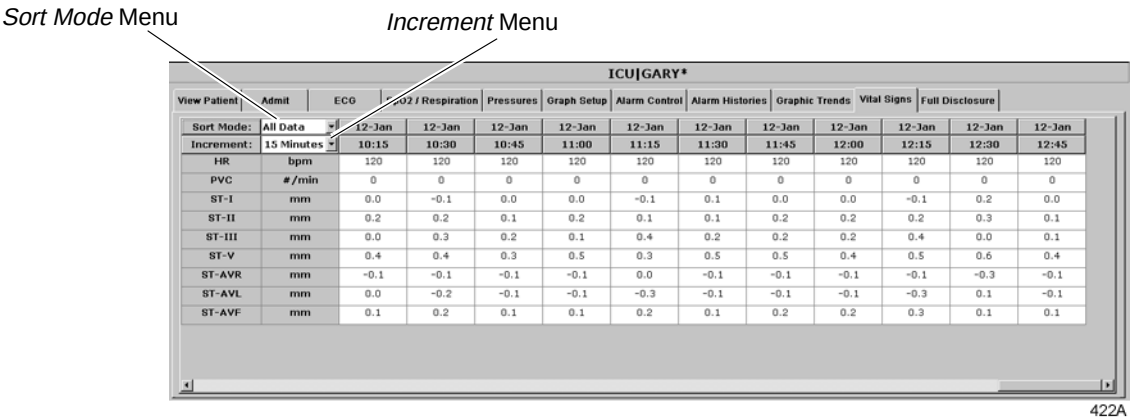
Trends can be printed using the same time scale as the display. To print a graphic trend, click on the *Print* button at the bottom of the CIC display.

Graphic trend printouts for telemetry patients can be printed to a laser printer or to a writer. Graphic trends print to the Print Window default printer location.

Vital Signs

To view a patient's vital signs, follow these steps.

1. Click in the desired patient's bed window in the multiple patient viewer. The single patient viewer for that patient opens.
2. Click on the *Vital Signs* tab in the single patient viewer. The Vital Signs tab sheet moves to the front. The Vital Signs tab sheet displays periodic and episodic trend data in tabular, or spreadsheet, form.



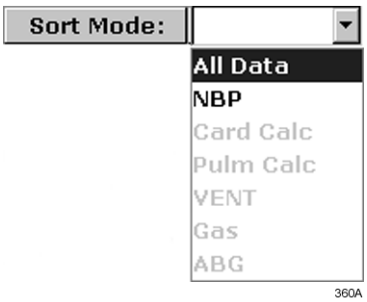
		12-Jan	12-Jan	12-Jan	12-Jan	12-Jan	12-Jan	12-Jan	12-Jan	12-Jan	12-Jan	12-Jan
		10:15	10:30	10:45	11:00	11:15	11:30	11:45	12:00	12:15	12:30	12:45
HR	bpm	120	120	120	120	120	120	120	120	120	120	120
PVC	#/min	0	0	0	0	0	0	0	0	0	0	0
ST-I	mm	0.0	-0.1	0.0	0.0	-0.1	0.1	0.0	0.0	-0.1	0.2	0.0
ST-II	mm	0.2	0.2	0.1	0.2	0.1	0.1	0.2	0.2	0.2	0.3	0.1
ST-III	mm	0.0	0.3	0.2	0.1	0.4	0.2	0.2	0.2	0.4	0.0	0.1
ST-V	mm	0.4	0.4	0.3	0.5	0.3	0.5	0.5	0.4	0.5	0.6	0.4
ST-AVR	mm	-0.1	-0.1	-0.1	-0.1	0.0	-0.1	-0.1	-0.1	-0.1	-0.3	-0.1
ST-AVL	mm	0.0	-0.2	-0.1	-0.1	-0.3	-0.1	-0.1	-0.1	-0.3	0.1	-0.1
ST-AVF	mm	0.1	0.2	0.1	0.1	0.2	0.1	0.2	0.2	0.3	0.1	0.1

NOTE: When a telemetry patient's vital signs are printed to a Direct Digital Writer, the anchor column (the column closest to the time interval selected) and four additional columns print, based on the time interval selected.

Printed data may be delayed by one minute from the displayed data due to time of request and update of trend files.

Sort Mode

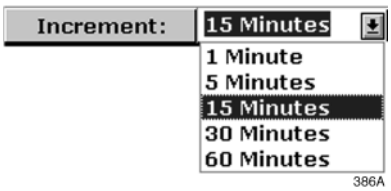
The *Sort Mode* popup menu provides options for sorting the way vital signs data is viewed. If the telemetry patient is being monitored for NBP, the sort options are *All Data* and *NBP*. If the patient is not being monitored for NBP, the only option available is *All Data*. All other sort options appear dimmed.



Increment

In the Vital Signs tab sheet, you can define the amount of data (resolution) to display in the Vital Signs window. This is done with the *Increment* popup menu.

1. Click on the down arrow to display all of the Increment options.



2. Click on the desired increment. The Increment menu closes, with the selected increment remaining visible. The selected increment is also reflected immediately in the Vital Signs window.

Scroll Bars

If all of the Vital Signs data does not fit into the available display space, use the scroll bars to navigate among columns and rows of data. For more information on using scroll bars, refer to the Clinical Information Center Operator's Manual.

Printing Vital Signs

Displayed trends can be printed using the same time scale as the display. To print a graphic trend, click on the *Print* button at the bottom of the CIC display.

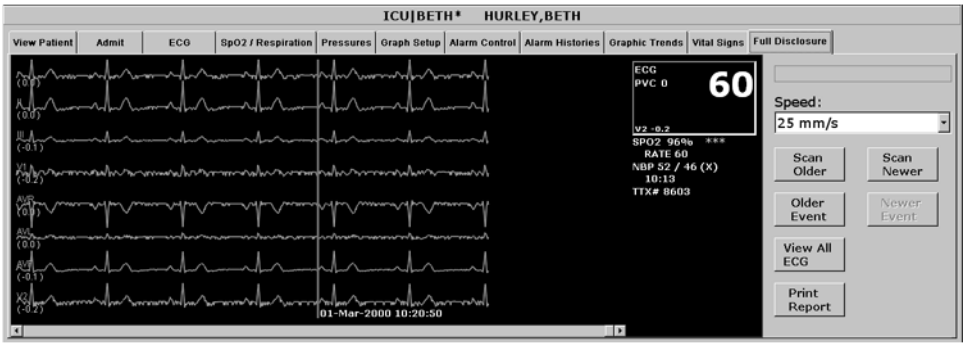
Full Disclosure

NOTE: This section provides a brief overview of the Full Disclosure function. Refer to the Clinical Information Center Operator's Manual for detailed information.

The full disclosure feature must be enabled in the Full Disclosure Defaults tab sheet. Refer to the Clinical Information Center operator's manual for details on enabling this feature.

When full disclosure is enabled, follow these steps to view a patient's Full Disclosure window.

1. Click in the desired patient's bed window in the multiple patient viewer. The single patient viewer for that patient opens.
2. Click on the *Full Disclosure* tab in the single patient viewer. The Full Disclosure tab sheet moves to the front.



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Full Disclosure Options

Speed

The *Speed* popup list allows you to set the waveform compression for the full disclosure waveform display.

Scan Older

Clicking on the *Scan Older* button initiates a scan of older full disclosure data. When the button is clicked, the scan begins and older trend data scrolls across the display. While the scan is in progress, you can select *Scan Newer* to reverse the scanning direction.

This button changes to *STOP* when a scan is in process. Click on the *STOP* button to stop a scan in process. When the oldest data is displayed, the scan automatically stops and the label on this button will be dimmed.

Scan Newer

Clicking on the *Scan Newer* button initiates a scan of newer full disclosure data. When the button is clicked, the scan begins and newer data scrolls across the display. While the scan is in progress, you can select *Scan Older* to reverse the scanning direction.

This button changes to *STOP* when a scan is in process. Click on the *STOP* button to stop a scan in process. When the newest data is displayed, the scan automatically stops and the label on this button will be dimmed.

Older Event

Clicking on the *Older Event* button moves the cursor to the next older alarm history event.

Newer Event

Clicking on the *Newer Event* button moves the cursor to the next most recent alarm history event.

View All ECG/Monitor

This option switches between *View All ECG* and *Monitor*. The *View All ECG* option displays all ECG waveforms. The *Monitor* option displays all waveforms that are displayed at the bedside at the time of full disclosure. In the case of telemetry patients, these are the same, since only ECG waveforms are displayed for telemetry patients.

Print Report

Clicking on the *Print Report* button initiates a full disclosure report printout. This report prints at the printer designated in the Full Disclosure Defaults tab sheet.

Time Focus

The clinical information center has a feature called time focus. When you are viewing one of the four types of patient data (alarm histories, vital signs, graphic trends, or full disclosure), time focus allows you to view the other three types of patient data that were recorded at that same time.

For example, if you are viewing an arrhythmia event in the Alarm Histories tab that occurred at 1:00 pm, clicking on the Vital Signs tab would move that tab sheet to the front, with data corresponding to the time focus (1:00 pm) highlighted. Likewise, if you click on any of the other patient data tabs, that tab sheet will move to the front, with data corresponding to the time focus (1:00 pm) at the cursor location.

Since graphic trends are only visible for the period of time specified in the Graphic Trends tab (refer to the Graphic Trends section in this chapter for more details), it is possible to view vital signs data, full disclosure data, or an alarm history event for which the corresponding graphic trend is no longer stored in the clinical information center. In this case, clicking on the Graphic Trends tab takes you to the most recent graphic trend, not the trend that corresponds to the alarm history, vital signs, or full disclosure you were viewing.

Alarm histories are episodic events. Therefore, clicking on the Alarm Histories tab in a time focus situation displays the alarm history event that occurred closest to the time focus.

11 ECG Monitoring

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Introduction

This chapter describes how a telemetry patient's ECG monitoring information is displayed at the clinical information center.

Data Synchronization

Information displayed on the ECG tab sheet is synchronized with the source (ApexPro transmitter) every two seconds. If differences are detected, the display is refreshed with new information.

Patient Preparation

The quality of ECG information received and displayed is a direct result of the quality of the electrical signal at the electrode.

Skin Preparation

Proper skin preparation is necessary for good signal quality at the electrode.

Choose flat, non-muscular areas to place electrodes, then follow the established prep protocol for your unit. Following is a suggested guideline for skin preparation:

1. Shave hair from skin at chosen sites.
2. Gently rub skin surface at sites to remove dead skin cells.
3. Thoroughly cleanse site with a mild soap and water solution. Be sure to remove all oily residue, dead skin cells, and abrasives. Leftover abrasion particles can be a source of noise.
4. Allow the skin to dry completely before applying the electrodes.

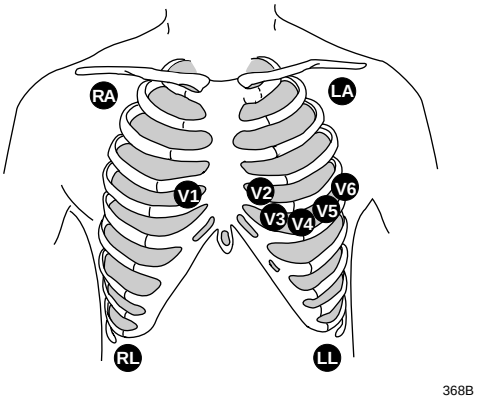
Electrode Placement

Following is a chart identifying each lead and its associated color code—AHA and IEC.

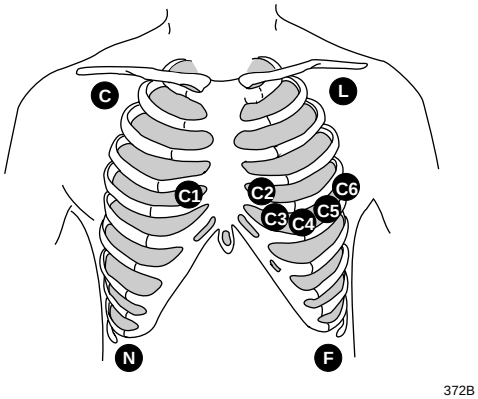
Leadwire (Software Label)	AHA Color	AHA Label	IEC Color	IEC Label
V (precordial)	brown	V	white	C
LL (left leg)	red	LL	green	F
RL (right leg)	green	RL	black	N
LA (left arm)	black	LA	yellow	L
RA (right arm)	white	RA	red	R

5-Leadwire (Einthoven + V Lead) and 6-Leadwire Electrode Placement

Following are the standard 5- and 6-leadwire electrode configurations for AHA and IEC:



AHA Configuration



IEC Configuration

Right arm and left arm electrodes should be placed just below the right and left clavicle.

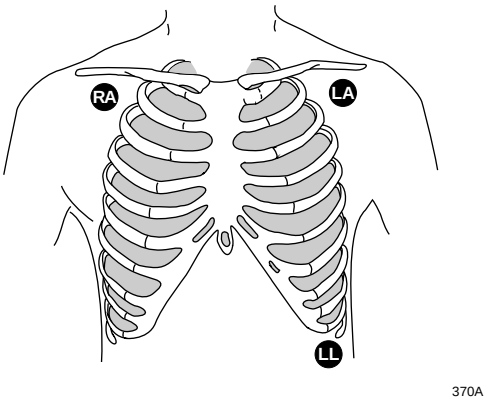
Right leg and left leg electrodes should be placed on a flat non-muscular surface on the lower edge of the rib cage.

For standard 5-leadwire electrode placement, the chest electrode should be placed according to the physician's preference.

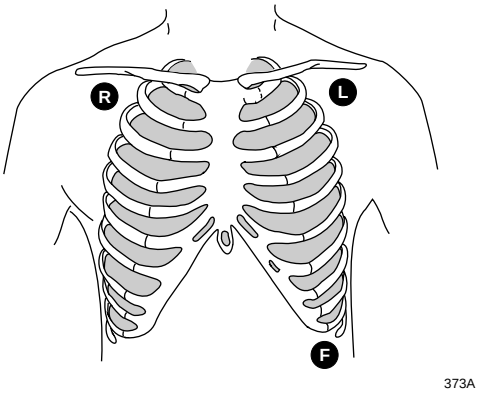
For standard 6-leadwire electrode placement, any **two** V leads (chest electrodes) may be placed according to the physician's preference.

3-Leadwire Electrode Placement

When a 5-leadwire electrode configuration is not desirable, a 3-leadwire cable can be used.



3-Leadwire AHA Configuration



3-Leadwire IEC Configuration

NOTE: Electrode configuration will vary depending on the type of leadwire set you are using.

Right arm and left arm electrodes should be placed just below the right and left clavicle.

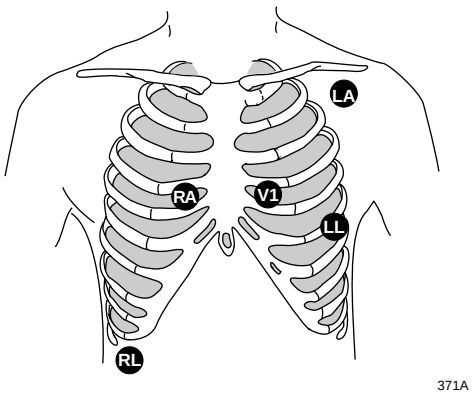
Left leg electrode should be placed on a non-muscular surface on the lower edge of the rib cage.

Electrode Placement for Pediatric Patients

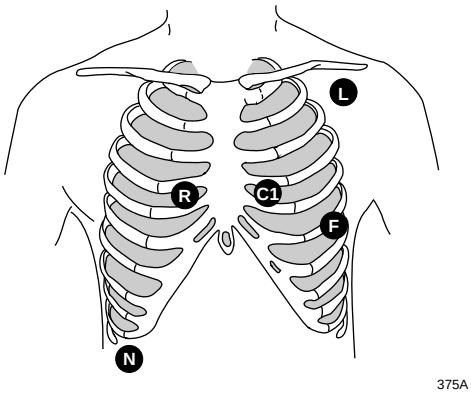
Typically, pediatric patients are large enough for a 5- or 6-leadwire electrode configuration. This is the preferred monitoring setup for receiving the benefits of multi-lead analysis. However, if the patient is too small for five or six electrodes, the 3-leadwire electrode configuration can be used. The right arm and left arm electrodes are positioned on the right and left sides of the chest. The right leg electrode can be placed on either the right or left side of the abdomen. Refer to the illustrations in the 3-Leadwire Electrode Placement section above.

Modified Chest Lead (MCL) Electrode Placement

Following is the modified chest lead (MCL) electrode configuration with the associated location:



AHA Configuration
MCL Electrode Placement



IEC Configuration
MCL Electrode Placement

Right arm electrode should be placed in the fourth intercostal space to the right of the sternum.

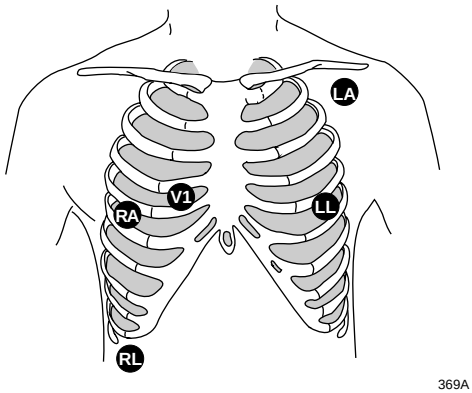
Left arm electrode should be placed just below the left clavicle.

Left leg electrode should be placed in the sixth intercostal space along the mid-axillary line.

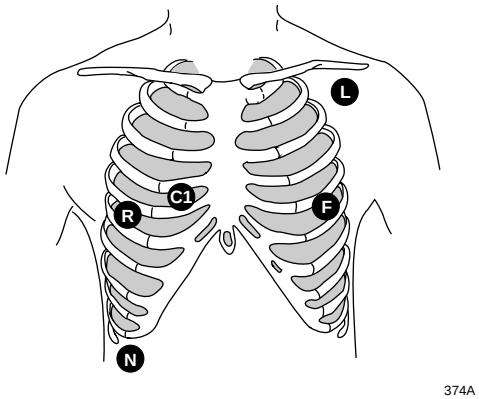
Right leg electrode should be placed on a flat non-muscular surface on the lower edge of the rib cage.

Electrode Placement for Pacemaker Patients

Electrodes need to be repositioned to modify detection of the electrical signals generated by the pacemaker. Following is a suggested configuration:



AHA Configuration
Pacemaker Electrode Configuration



IEC Configuration
Pacemaker Electrode Configuration

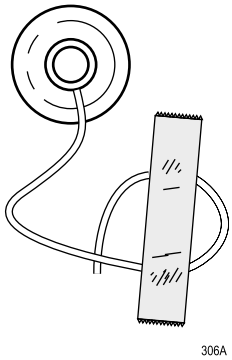
The right arm electrode is moved down to the fifth intercostal space, and the left leg electrode is moved up to the fifth intercostal space.

NOTE: After all electrodes are in place, ensure that a minimum of 1/2 mV of signal is present on each lead (I, II, III, V).

Maintaining Quality ECG Signal

Regardless of patient type, electrodes should be replaced at least every 48 hours to maintain quality signals during long-term monitoring. Over the course of 48 hours, the electrode gel will start to dry out and the adhesive will age. This may irritate the patient's skin.

Stabilize the electrode and leadwire with a leadwire stress loop near the electrode. Tape the stress loop to the patient. A secured stress loop prevents leadwire rotation about the electrode snap, leadwire tugging at the electrode, and ECG artifact.



Stress Loop

Special Considerations for 6-Lead Monitoring

V FAIL Message

CAUTION
The clinical information center does not detect 6-lead monitoring until a signal from the sixth lead is received at the clinical information center. Therefore, if the sixth lead on the ApexPro transmitter has failed before the telemetry patient is admitted to the clinical information center, the clinical information center will **not** generate a *V FAIL* message for the sixth lead.

At the patient's ApexPro transmitter, verify that the sixth lead on the ApexPro transmitter is good. Press the **Verify Leads** button on the ApexPro transmitter and ensure that all the good lead LEDs illuminate. (Refer to Chapter 3, Equipment Overview, for button and LED locations.)

Relearn

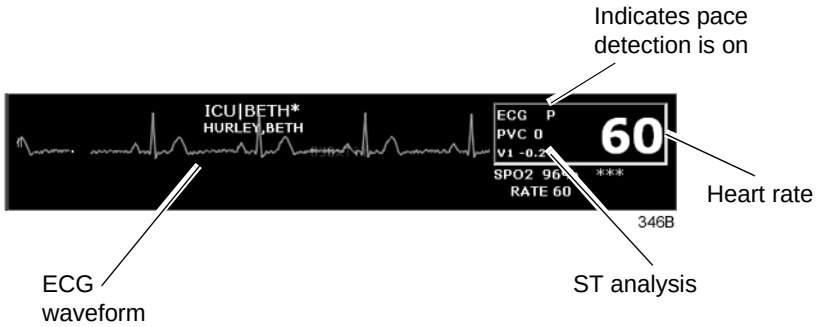
If a telemetry patient is switched from 6-lead monitoring to 5-lead monitoring while **admitted** to the clinical information center, a *V FAIL* message will appear. The clinical information center "assumes" that the telemetry patient is being monitored for six leads and that the sixth lead has failed.

In situations where the admitted telemetry patient has been switched from 6- to 5-lead monitoring, the associated *V FAIL* message can be cleared by clicking on the *Relearn* button in the telemetry patient's ECG tab sheet. (Refer to the ECG Tab Sheet section in this chapter for information about the *Relearn* button.)

ECG Monitoring

ECG in the Multiple Patient Viewer

For telemetry patients, up to four leads of ECG can be displayed in the bed window of the multiple patient viewer. Also displayed are the patient's heart rate, current PVC per minute value, ST analysis, and a "*P*" if pace detection is turned on. Below is an example of a telemetry patient's bed window in the multiple patient viewer.



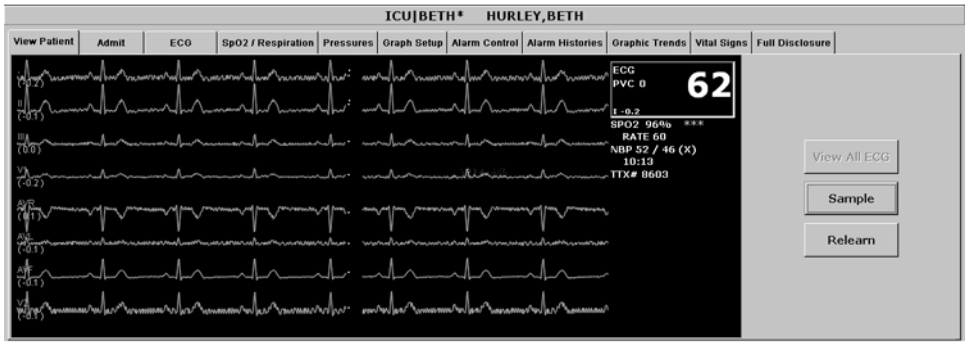
ECG in the Single Patient Viewer

View Patient Tab Sheet

For telemetry patients, up to eight leads of ECG can be seen in the View Patient tab sheet. It is also possible to sample ten seconds of ECG data for storage in Alarm Histories, and to initiate a relearn of the patient's rhythm. The patient's heart rate, current PVC per minute value, ST information, and "*P*" for pace detection (if turned on) are also displayed.

To access the View Patient tab sheet, follow the steps below.

1. Click in the desired patient's bed window in the multiple patient viewer. The display rearranges to accommodate the single patient viewer for that patient.
2. If it is not already visible at the front of the tabs, click on the *View Patient* tab to bring the tab sheet to the front.



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For more details about the features and functions of the View Patient tab sheet, refer to Chapter 7, Admit/View a Patient, in this manual.

Full Disclosure Tab Sheet

If full disclosure is turned on, 72 hours of ECG data can be viewed in the Full Disclosure tab sheet.

To access the Full Disclosure tab sheet, follow the steps below.

1. Click in the desired patient's bed window in the multiple patient viewer. The display rearranges to accommodate the single patient viewer for that patient.
2. Click on the *Full Disclosure* tab to bring the tab sheet to the front.

For more details about the features and functions of the Full Disclosure tab sheet, refer to the Clinical Information Center Operator's Manual.

ECG Limits

You can adjust the alarm limits for ECG (such as HR, ST, etc.) in the Telemetry Alarm Control Defaults tab and in the patient's Alarm Control tab. For more information on how to set the alarm limits, refer to Chapter 8, Alarm Control, in this manual.

ECG Artifact

The clinical information center has two levels for artifact alarms.

- Level 1 artifact displays the *ARTIFACT* message, but continues to display a heart rate.
  - The *ARTIFACT* message does not flash or generate an audible alarm.
  - The *ARTIFACT* message will be relocated to the lead fail area of the display.
  - If the patient is in a lead fail, the lead fail message has priority over the *ARTIFACT* message on the display.
- Level 2 artifact displays the *ARTIFACT* message, but the heart rate values are removed from the display.
  - The *ARR SUSPEND* message is a system warning alarm.
  - The clinical information center supports the *ARR SUSPEND* message when it is determined that the arrhythmia is in the level 2 *ARTIFACT* state.
  - The *ARR SUSPEND* message is displayed in the Arrhythmia event line and is sent to the ADU line for alarm notification at the level 2 state.

For more information about alarms, refer to Chapter 8, Alarm Control, in this manual.

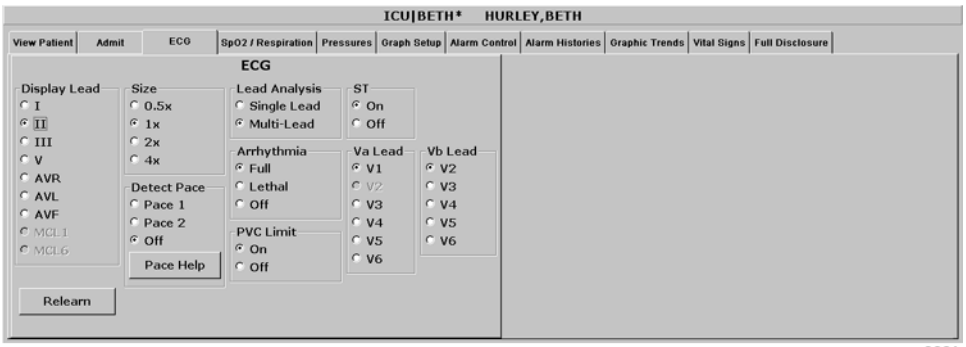
ECG Tab Sheet

The ECG tab sheet allows you to view and modify settings specific to the viewed patient's ECG display. Settings may be viewed for any patient. However, you can only modify settings for patients who are admitted to a bed in your care unit.

Accessing the ECG Tab Sheet

To access a patient's ECG tab sheet in the single patient viewer, follow this procedure:

1. Click in the desired patient's bed window in the multiple patient viewer. The display rearranges to accommodate the single patient viewer for that patient.
2. Click on the *ECG* tab in the single patient viewer. The ECG tab sheet moves to the front.



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Display Lead

This option allows you to change the lead currently displayed as the primary lead. Use the mouse to click on your *Display Lead* selection.

Relearn

Clicking on the *Relearn* button initiates a relearn of the patient's ECG rhythm. The relearn takes only a few seconds. The patient's heart rate reading is momentarily replaced by Xs. Numerics return once the relearn is complete.

You should use the relearn function whenever there has been a significant change in the patient's rhythm.

Size

This option allows you to change the size of the ECG waveforms displayed at the clinical information center. This may be necessary when diagnosing or problem solving. Normal size (*1x*) is recommended unless circumstances require otherwise.

To change the waveform display size, use the mouse to click on an option.

NOTE: If a size other than 1x is used, the size is displayed on the left side of the screen next to the ECG waveform.

Detect Pace

Safety Considerations

Be aware of the following when monitoring a patient with a pacemaker.

WARNINGS

FALSE CALLS—False low heart rate indicators or false asystole calls may result with certain pacemakers because of electrical overshoot.

MONITORING PACEMAKER PATIENTS—Monitoring of pacemaker patients can only occur with the pace program activated.

PACEMAKER SPIKE—An artificial pacemaker spike is displayed in place of the actual pacemaker spike. All pacemaker spikes appear uniform. Do not diagnostically interpret pacemaker spike size and shape.

PATIENT HAZARD—A pacemaker pulse can be counted as a QRS during asystole in either pace mode. Keep pacemaker patients under close observation.

RATE METERS—Keep pacemaker patients under close observation. Rate meters may continue to count the pacemaker rate during cardiac arrest and some arrhythmias. Therefore, do not rely entirely on rate meter alarms.

CAUTION

FDA POSTMARKET SAFETY ALERT—The United States FDA Center for Devices and Radiological Health issued a safety bulletin October 14, 1998. This bulletin states “that minute ventilation rate-adaptive implantable pacemakers can occasionally interact with certain cardiac monitoring and diagnostic equipment, causing the pacemakers to pace at their maximum programmed rate.”

The FDA further recommends precautions to take into consideration for patients with these types of pacemakers. These precautions include disabling the rate responsive mode and enabling an alternate pace mode. For more information contact:

Office of Surveillance and Biometrics, CDRH, FDA
1350 Piccard Drive, Mail Stop HFZ-510
Rockville, MD 20850
U.S.A.

NOTE: ECG monitoring with patients on non-invasive transcutaneous pacemakers may not be possible due to large amounts of energy produced by these devices. Monitoring ECG with an external device may be needed.

Monitoring Pacemaker Patients

The *Detect Pace* option enables/disables the pacemaker detection program. It must be used whenever the monitored patient has a pacemaker. Pace detection choices are *Pace 1, Pace 2,* and *Off*. Use the mouse to click on a Detect Pace selection.

There are two pacemaker processing modes, Pace 1 and Pace 2. The Pace 1 and Pace 2 modes use different algorithms for pacemaker artifact rejection. The clinician must be the judge as to which mode is better for each patient. The pacemaker detection program defaults off so if you have a patient with a pacemaker, you will have to turn the program on.

The *Pace 2* mode is much more conservative in recognizing paced QRS morphologies and is recommended for use whenever possible. It is designed to minimize the possibility of counting pacemaker artifact as QRS complexes during *ASYSTOLE*. If the monitor does not adequately detect paced beats in the *Pace 2* mode, then the user may wish to try the *Pace 1* mode. ***Please observe all cautions as described when choosing the Pace 1 mode of operation.***

The *Pace 1* mode allows successful detection of the largest variety of paced QRS morphologies. As a direct consequence, this mode does have a higher risk of counting pacemaker artifact as QRS complexes during *ASYSTOLE*. For this reason, it is imperative that the user keep patients with pacemakers under close observation. It is also recommended that the user set the low heart rate limit on the monitor close to the minimum pacing rate, and that the *BRADY* arrhythmia alarm level be elevated to a WARNING or CRISIS level.

When either pace mode is enabled, the software places an artificial spike on the waveform whenever the pacemaker triggers. When pacemaker detection is on, it is indicated by a "*P*" in the patient's ECG parameter window.

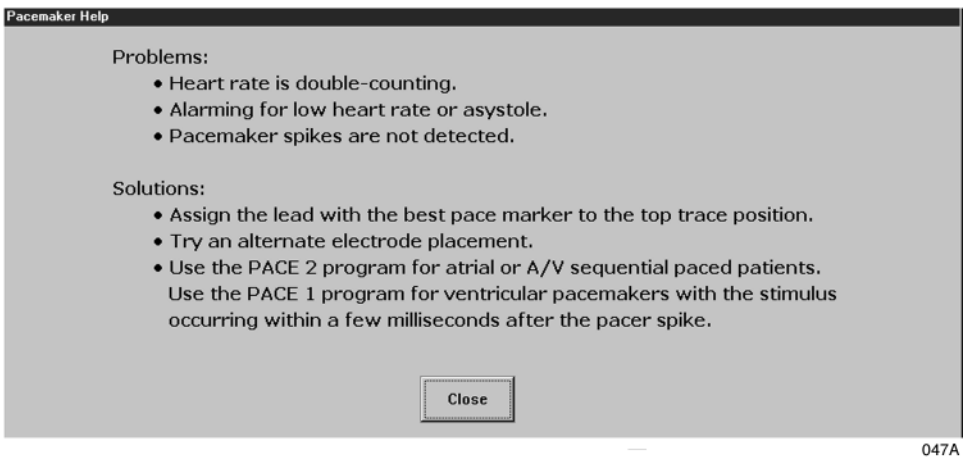
For successful monitoring of pacemaker patients follow these suggestions:

- Use recommended electrode placement.
- Brady, Pause, and Low Heart Rate are additional alarms available for use when monitoring pacemaker patients.
- Problems you may experience are:
  - heart rate double counting;
  - inaccurate alarms for low heart rate or asystole;
  - pacemaker spikes not recognized by the software.
- Possible solutions to above problems are:
  - relearn arrhythmia;
  - try an alternate electrode placement;
  - try single-lead analysis;
  - try switching to the other pace detection mode.
- Pacemaker mode:
  In most cases, *Pace 2* mode will effectively monitor a pacemaker patient. However, if you are experiencing problems, select the *Pace 1* mode as an option, and observe all cautions as described for the *Pace 1* mode of operation.

For more information, refer to the Pacemaker Troubleshooting section in this chapter.

Pace Help

Clicking on the *Pace Help* button opens a window that shows common problems and solutions in regard to pacemaker detection. This window is shown below.



Lead Analysis

The Lead Analysis control signals the ApexPro transmitter to process the ECG in *Single Lead* or *Multi-Lead* mode. Use the mouse to click on your selection. Multi-lead analysis is the default setting for adults.

Multi-Lead Analysis

Multi-lead analysis simultaneously examines ECG leads I, II, III, and V (whether they are displayed or not) to help eliminate false alarms and improve the ability of the system to:

- Detect beats which occur isoelectric to a single chest lead.
- Discriminate artifact that appears in one lead compared to the other lead vectors.
- Provide a “smart-lead fail” feature, where the failed lead is identified, and if available, another lead is provided for display.
- Continue arrhythmia processing even after a lead change.

Single Lead Analysis

Single lead analysis uses only the lead displayed on the clinical information center screen to process ECG and arrhythmia information. To change the lead used for single lead analysis, you must change the displayed lead.

Single lead analysis is beneficial when troubleshooting pacemaker detection and/or arrhythmia detection. Single lead analysis must always be used when monitoring with a 3-lead cable. Single lead analysis can be set up as a unit default. Refer to Chapter 6, Telemetry Setup, for more information.

Arrhythmia

NOTE: Full arrhythmia processing is suspended when the level 1 "*ARTIFACT*" message is displayed. Lethal arrhythmia is still active but its accuracy may be hindered by the artifact.

WARNINGS

SUSPENDED ANALYSIS—Certain conditions suspend arrhythmia analysis. When suspended, arrhythmia conditions are not detected and alarms associated with arrhythmias do not occur. The messages which alert you to the conditions causing suspended arrhythmia analysis are: *ALL ALARMS OFF*, *ALARM PAUSE*, *ARR OFF*, *ARR SUSPEND*, *DISCHARGED*, *LEADS FAIL*, and *NO TELEM*. Additionally, the alarms off with reason options and disabling the alarm pause breakthrough feature also suspend arrhythmia analysis.

VENTRICULAR ARRHYTHMIAS—The arrhythmia analysis program is intended to detect ventricular arrhythmias. It is not designed to detect atrial or supraventricular arrhythmias. Occasionally it may incorrectly identify the presence or absence of an arrhythmia. Therefore, a physician must analyze the arrhythmia information in conjunction with other clinical findings.

The arrhythmia control signals the clinical information center to ignore or accept arrhythmia calls. To modify arrhythmia settings, use the mouse to click on *Full*, *Lethal*, or *Off*.

NOTE: When arrhythmia program is in Full mode, the program counts the number of PVCs that occur within a minute.

Turning arrhythmia on automatically starts a relearn procedure.

When arrhythmia is turned off, *ARR OFF* appears in the ECG parameter window.

Full Arrhythmia Conditions

Below is an alphabetical list of the arrhythmia messages that are displayed when full arrhythmia is selected and the condition occurs. Definitions of each condition are included. The CIC's response to each condition is determined by the alarm level to which the arrhythmia has been assigned.

ACC VENT	**Adult**—Accelerated ventricular occurs when six or more ventricular beats are detected with an average heart rate for the ventricular beat between 50 and 100 beats per minute. **0-2 years**—Occurs when six or more ventricular beats are detected with an average heart rate for the ventricular beat between 60 and 160 beats per minute. **3-10 years**—Occurs when six or more ventricular beats are detected with an average heart rate for the ventricular beat between 60 and 140 beats per minute. **11-13 years**—Occurs when six or more ventricular beats are detected with an average heart rate for the ventricular beat between 60 and 130 beats per minute.
ASYSTOLE	Ventricular asystole occurs whenever the displayed heart rate drops to zero.
BIGEMINY	Occurs when three or more bigeminal cycles (a ventricular beat followed by a non-ventricular beat) are detected.
BRADY	Bradycardia is the average of the most recent eight R-to-R intervals at a heart rate less than the set **low** heart rate limit. **NOTE:** The Brady limit matches the low heart rate limit. If the low heart rate limit is changed, the Brady limit changes.
COUPLET	Occurs when two ventricular beats are detected and have non-ventricular beats before and after the couplet. The coupling interval must be less than 600 milliseconds.
IRREGULAR	Occurs when six consecutive normal R-to-R intervals vary by 100 milliseconds or more.
PAUSE	Occurs when a 3-second interval without a QRS complex is detected.
PVC	Isolated premature ventricular complexes occur when a premature ventricular beat is detected and has non-ventricular beats before and after.
R ON T	Occurs when a ventricular complex is detected within the repolarization period of a non-ventricular beat.

TACHY

Tachycardia is four R-to-R intervals at a heart rate greater than the set **high** heart rate limit.

NOTE: The Tachy limit matches the high heart rate limit. If the high heart rate limit is changed, the Tachy limit changes.

TRIGEMINY

Occurs when three or more trigeminal cycles (a ventricular beat followed by two non-ventricular beats) are detected.

V BRADY

Adult—Ventricular bradycardia occurs when a run of three or more ventricular beats is detected with an average heart rate that is less than or equal to 50 beats per minute.

0-2, 3-10, and 11-13 years—Occurs when a run of three or more ventricular beats is detected with an average heart rate that is less than or equal to 60 beats per minute.

VFIB/ VTAC

Ventricular fibrillation occurs when the ECG waveform indicates a chaotic ventricular rhythm.

WARNING

VFIB/VTAC should not be considered a substitute for the *V TACH* arrhythmia call. Efforts to lower the *V TACH* alarm level can result in missed ventricular tachycardia alarms.

V TACH

Adult—Ventricular tachycardia occurs when a run of six or more ventricular beats is detected with an average heart rate greater than or equal to 100 beats per minute.

0-2 years—Occurs when a run of six or more ventricular beats is detected with an average heart rate greater than or equal to 160 beats per minute.

3-10 years—Occurs when a run of six or more ventricular beats is detected with an average heart rate greater than or equal to 140 beats per minute.

11-13 years—Occurs when a run of six or more ventricular beats is detected with an average heart rate greater than or equal to 130 beats per minute.

VT > 2

Adult—Ventricular tachycardia >2 occurs when a run of ventricular beats is detected with a duration of less than six beats but longer than two beats and with an average heart rate that is greater than or equal to 100 beats per minute.

0-2 years—Occurs when a run of ventricular beats is detected with a duration of less than six beats but longer than two beats and with an average heart rate that is greater than or equal to 160 beats per minute.

3-10 years—Occurs when a run of ventricular beats is detected with a duration of less than six beats but longer than two beats and with an average heart rate that is greater than or equal to 140 beats per minute.

11-13 years—Occurs when a run of ventricular beats is detected with a duration of less than six beats but longer than two beats and with an average heart rate that is greater than or equal to 130 beats per minute.

Lethal Arrhythmia Conditions

When Lethal arrhythmia is selected, the following conditions (as defined for Full arrhythmia) are detected:

- *ASYSTOLE*
- *VFIB/VTAC*
- *V TACH* (defaults to the Crisis level, but can be moved to a different level)
- *BRADY* (if the patient age range selected is 0-2 years or 3-10 years)

PVC Limit

When on, the PVC Limit control displays a PVC counter in the ECG parameter window. When off, the PVC counter is not displayed. Use the mouse to turn the PVC Limit control *On* or *Off*.

The PVC limits are preset in Alarm Control defaults. For more information on setting the limits, refer to Chapter 8, Alarm Control, in this manual.

ST

The ST control turns the display of ST segment analysis data on and off. Use the mouse to turn ST segment analysis *On* or *Off*. For more information about ST analysis, refer to the ST Analysis section in this chapter.

Va Lead and Vb Lead

These two option lists allows you to label the V leads. Use the mouse to click on your *Va Lead* and *Vb Lead* selections.

NOTE: Vb Lead selections are only available with 6-lead monitoring.

ST Analysis

The patient's most dominant, normal beat is used for ST measurement. This beat is identified by the arrhythmia analysis program. Turn ST on to display the numerics calculated for ST at the clinical information center.

GE Marquette identifies the ST segment of the QRS complex as beginning at the J point and ending 60 milliseconds following the J point. The ST numeric displayed (millimeters) indicates either a positive or negative elevation in relation to the isoelectric reference point (which is also determined by the arrhythmia program and the patient's age).

When ST is on, numerics are displayed under each ECG lead label on the screen. (A negative deflection is preceded by a minus sign.) These numerics are updated about every 15 seconds.

The ST value shown in the ECG parameter window is the lead with the greatest ST deviation. This may or may not be the lead that is in alarm, since a lead with a lesser deviation from the isoelectric line may have changed more than the lead with the greatest deviation.

NOTE: ST numerics are always calculated with reference to 1X size. Displaying the ECG waveform at a different size does **not** affect the ST values.

NOTE: When a new dominant beat is detected or a relearn occurs, the arrhythmia program calculates ST based on the new beat. This could affect the ST values displayed. This may not necessarily represent a change in the patient's condition. The clinician needs to assess the patient any time there is an ST change.

ST Deviation Alarm

When any individual ST value is beyond the limit, an ST deviation alarm occurs. It is considered a parameter alarm, and the default alarm level is warning. This can be modified in the parameter alarm level setup.

NOTE: ST is not stored in alarm history since it is treated as a parameter alarm.

- When the ST program is turned on, or a relearn is done with ST on, the ST deviation values are set for all leads of ST.
- +/- 2 mm absolute limits are automatically set around the ST value during a Relearn.
- The current ST value is determined in all eight leads.
- The ST value in the ECG parameter window flashes to indicate an alarm.
- To reset the limits for ST after an alarm violation, select *Relearn*.
- ST limits can also be adjusted individually in the patient's Alarm Control tab.

Arrhythmia Troubleshooting

Problem: Inaccurate heart rate and/or false asystole

Solution: Check ECG signal from patient:

1. Check/adjust lead placement.
2. Check/perform skin preparation.
3. Check/replace electrodes.

Check amplitude of ECG waveform:

1. Click on the patient's *ECG* tab.
2. Click on all ECG leads in the Display section and check for 0.5 mV amplitude at normal (1X) size. (At least 0.5 mV amplitude is required for QRS detection.) For borderline signals, validate on a graph.
3. If amplitudes are low, electrodes may need to be repositioned or replaced.

Relearn arrhythmia:

1. Click on the patient's *ECG* tab.
2. Click on the *Relearn* button.

IF PROBLEM CONTINUES: Change to single lead ECG detection and processing:

1. Click on the patient's *ECG* tab.
2. Click on *Single Lead* in the Lead Analysis section.
3. Click on the ECG leads in the Display section and change top ECG waveform to display the lead with the greatest amplitude. (At least 0.5 mV amplitude is required for QRS detection.)

Problem: False ventricular calls

Solution: Check ECG signal from patient: (V leads may exhibit polarity changes which may occasionally cause an inaccurate call.)

1. Check/adjust lead placement.
2. Check/perform skin preparation.
3. Check/replace electrodes. (If V lead is a problem, move the V lead to another V position.)
4. Relearn ECG:
   a. Click on the patient's *ECG* tab.
   b. Click on the *Relearn* button.

IF PROBLEM CONTINUES:

1. Remove the V lead(s).
2. Click on the patient's *ECG* tab.
3. Click on the *Relearn* button.

Pacemaker Troubleshooting

There are two general things that occur when the pace mode is activated for pacemaker patients:

1. Beats that would otherwise be classified as ventricular are instead classified as V-paced if a ventricular pacemaker event is detected.
2. Residual pacemaker energy that might otherwise appear in the ECG is removed, and a “pacemaker enhancement spike” (shown in an offset color from the ECG waveform) is artificially placed in the ECG.

Pace detection is indicated visually in the ECG parameter box. When watching the ECG waveform, pace detection is indicated by uniform, upright pacemaker enhancement spikes in the ECG data (both displayed and graphed).

During telemetry monitoring, the pacemaker signal is acquired from lead II. Changing the displayed lead has no effect on pacemaker detection.

NOTE: With all leads connected, pacemaker signal acquisition occurs on lead II. In a lead fail condition, signal acquisition occurs on any available lead. Single channel acquisition occurs on the programmed lead.

To improve pacemaker detection, reposition the electrodes and assure a good skin preparation to maximize R-wave detection.

Problem: Inaccurate pacemaker detection

Solution: Use pacemaker processing:

1. Click on the patient's *ECG* tab.
2. In the Detect Pace section, select either *Pace 1* or *Pace 2*.

Notes:

- ***In general, be aware that a pacemaker pulse could be falsely counted as a QRS during asystole.***
- *Pace 1* mode analyzes the presence of a pacer spike, assesses the waveform for residual pacemaker energy, and determines the presence of an R wave following the pacer spike. If an event occurs during the first few milliseconds following the pacer spike, it will be counted.
- *Pace 2* mode analyzes waveforms with the added capability of minimizing the chance of counting severe residual pacemaker energy as QRS complexes. In relation to the event rejection capability of Pace 2 pace mode, certain morphologies may not be detected. Arrhythmia calls like asystole or pause may be made with heart rate identified as less than actual.

Again, ***pacemaker patients should be kept under close observation***. The appropriate pace mode may be determined at the time the pacemaker patient is admitted to the monitoring system. The *Pace 2* mode is recommended for use whenever possible.

Check ECG signal from patient:

1. Check/adjust lead placement.
2. Check/perform skin preparation.
3. Check/replace electrodes.

ST Troubleshooting

Problem: ST numerics changed to Xs

Solution: An ST value changes to Xs when the patient's dominant morphology has not been detected 16 times in the last 30 seconds. The program waits one minute and then automatically relearns. ST numerics will be displayed after the relearn.

IF PROBLEM CONTINUES:

1. Check for morphology change.
2. Check for noise on ECG.
3. Relearn:
   a. Click on the patient's *ECG* tab.
   b. Click on the *Relearn* button.

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For your notes

Introduction

NOTE: SpO2 and SPO2 are used interchangeably throughout this manual to refer to pulse oximetry.

The Apex Oximeter functions as a stand-alone device, and displays digital values for SpO2 and pulse rate. When the Apex Oximeter is connected to the ApexPro transmitter, digital values for SpO2 and pulse rate are also displayed at the clinical information center.

NOTE: When monitoring SpO2 via telemetry, an SpO2 waveform is neither generated nor displayed on the Apex Oximeter or clinical information center. Additionally, no alarm histories are generated or stored.

SpO2 Probe Safety

Be sure to read all literature accompanying probes for specific safety information. Be aware of the following safety precautions when using SpO2 probes.

WARNINGS

DATA VALIDITY—Do not expose probe detector to strong ambient light while monitoring a patient. A poor signal may result.

DATA VALIDITY—Do not allow tape to block the probe light detector.

PATIENT SAFETY—Prolonged monitoring may require changing the probe site periodically. Move the probe if there is any sign of skin irritation or impaired circulation. *Change the probe site at least every four hours to prevent ischemic skin necrosis. If required, reduce the application periods to half the times recommended above.*

PATIENT SAFETY—If a probe is damaged in any way, discontinue use immediately.

CAUTION

Use only Nonin SpO2 probes with the Apex Oximeter. The reliability of SpO2 data obtained with any other probe has not been verified.

Infants and Pulse Oximetry

WARNING
The display of inaccurate pulse oximetry (SPO2) values has been linked to the presence of poor signal strength or artifact due to patient motion during signal analysis. This condition is most likely to be encountered when the equipment is used on infants. These same conditions in adults do not impact the SPO2 values to the same extent.

When using pulse oximetry on infants, always observe the following precautions.

Precautions

We recommend the application of the following criteria when using the pulse oximetry function on infants:

1. The peripheral pulse rate (PPR) as determined by the SPO2 function must be within 10% of the heart rate, and
2. the SPO2 signal strength indicator must have 2 or 3 asterisks displayed, and
3. stable SPO2 values are displayed for six seconds.

Procedures or devices previously applied in your facility for SPO2 monitoring should be used in the event that the SPO2 value from the equipment cannot be validated by the above criteria.

CAUTION
Do not use the Apex Oximeter on neonatal patients. It is not designed for use on neonates.

Signal and Data Validity

It is extremely important to determine that the probe is attached to the patient correctly and the data is verifiable. To make this determination, the signal strength indicators on the Apex Oximeter and the clinical information center are of assistance.

Signal Strength Indicator

A signal strength (perfusion) indicator is displayed on the Apex Oximeter display and at the clinical information center in the appropriate patient window.

On the Apex Oximeter, this indicator is a perfusion LED that blinks with each SpO2 pulse detected. The LED blinks green for each acceptable strength pulse. It blinks yellow for SpO2 signals of marginal quality, and blinks red when the SpO2 signal is too weak or the quality is very poor. When the perfusion LED blinks red, the numeric data displayed on the Apex Oximeter will be replaced by dashes within 10 seconds.

At the clinical information center, the signal strength indicator consists of 0, 1, 2, or 3 (strongest) asterisks, depending on the strength of the signal.

Proper environmental conditions and probe attachment help ensure a strong signal.

WARNING
In the monitoring of patients the coincidence of adverse conditions may lead to a disturbed signal going unnoticed. In this situation artifacts are capable of simulating a plausible parameter reading, so that the monitor fails to sound an alarm. In order to ensure reliable patient monitoring, the proper application of the probe and the signal quality must be checked at regular intervals.

Error Messages

If the probe is not correctly attached to the patient and data is not verifiable, one of the following error messages may appear in the patient's bed window at the clinical information center:

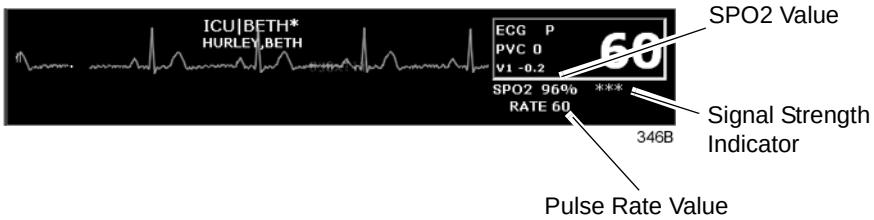
- *SPO2 PROBE OFF*
- *SPO2 PROBE*

If either of the above messages appears, check the position of the probe or replace the probe. If the problem persists, call GE Marquette Service or contact your sales/service representative.

SPO2 Monitoring

SPO2 in the Multiple Patient Viewer

In the multiple patient viewer, the bed window for a telemetry patient being monitored for SpO2 displays the current SPO2 value; one, two, or three asterisks indicating signal strength; and, if turned on, the derived pulse rate for the patient. Below is an example of a telemetry patient's bed window in the multiple patient viewer.

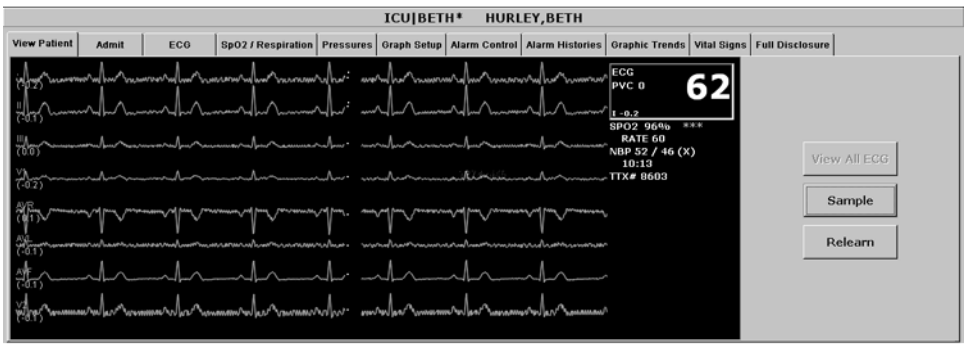


SPO2 in the Single Patient Viewer

In the single patient viewer, SpO2 data appears in the View Patient tab sheet in the same format and location as it does in the multiple patient viewer.

To access the View Patient tab sheet, follow the steps below.

1. Click in the desired patient's bed window in the multiple patient viewer. The display rearranges to accommodate the single patient viewer for that patient.
2. If it is not already visible at the front of the tabs, click on the *View Patient* tab to bring the tab sheet to the front.



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For more information about the View Patient tab sheet, refer to Chapter 7, Admit/View a Patient, in this manual.

SPO2 Limits

You can adjust alarm limits for SPO2 and rate in the Alarm Control tab sheet for each patient. SPO2 alarm limits cannot be set as unit defaults. For more information on how to set the alarm limits, refer to Chapter 8, Alarm Control, in this manual.

SPO2 Tab Sheet

The SpO2/Respiration tab sheet allows you to view and modify settings specific to the viewed patient's SpO2 display. Settings may be viewed for any patient. However, you can only modify settings for patients who are admitted to a bed in your unit.

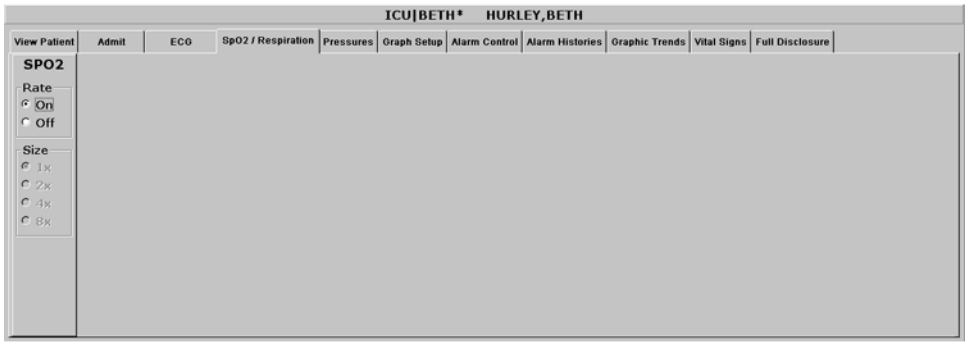
NOTE: The SPO2 tab is labeled *SpO2/Respiration* because respiration monitoring settings are available on this tab sheet for bedside monitored patients only.

Respiration monitoring is not an option for telemetry patients. Therefore only SpO2 information appears on this tab sheet when monitoring a telemetry patient.

Accessing the SPO2 Tab Sheet

To access a patient's SpO2 tab sheet in the single patient viewer, follow this procedure.

1. Click in the desired patient's bed window in the multiple patient viewer. The display rearranges to accommodate the single patient viewer for that patient.
2. Click on the *SpO2/Respiration* tab in the single patient viewer. The SpO2 tab sheet moves to the front.



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Rate

A pulse rate is derived from the SPO2 signal and is displayed in the parameter window. You can turn this displayed rate off and on. Simply click *On* to turn rate on, or *Off* to turn rate off.

Size

Because no waveform is displayed when SpO2 is monitored via telemetry, the *Size* option does not function for telemetry patients. *Size* and its selections appear dimmed when monitoring telemetry patients.

Troubleshooting

SpO2 Messages

Below is a list of system status alarm messages that may be displayed in the patient's bed window during monitoring. SpO2 messages appear in abbreviated form in graph headers. If you are unable to resume SpO2 monitoring, contact your sales/service representative.

CHANGE BATTERY

Message displayed with SPO2 data displayed—The batteries in the Apex Oximeter are low. There is approximately 1 hour of reserve power left in the batteries. Change the batteries. Refer to Chapter 4, Connection, for information about changing batteries.

Message displayed, no SPO2 data displayed—The batteries in the Apex Oximeter are depleted. Replace the batteries. Refer to Chapter 4, Connection, for information about changing batteries. This is a system advisory alarm. The alarm will sound, and a red alarm button will appear on the clinical information center display. If the batteries are not replaced within 20 minutes, all SPO2 parameter information will be removed from the display. If the batteries are replaced within 20 minutes, SpO2 monitoring will resume.

SPO2 PROBE

The probe has been disconnected from the Apex Oximeter (no data is displayed).

SIGNAL

SpO2 data continues to be displayed, but the quality of the signal is questionable. Check the patient and the probe.

NO DATA

The Apex Oximeter is still connected, but no valid data is being transmitted to the receiver. Check that the patient is within antenna range. If the problem persists, contact GE Marquette Service.

SPO2 PROBE OFF

The probe is off the patient. Check the probe.

The saturation value is X

The Apex Oximeter is still connected, but no valid data is being received at the receiver. The patient may be in an area of poor antenna reception, where some, but not all data is being transmitted.

This message remains on the clinical information center for three minutes. If no data is detected after three minutes, the message changes to *NO DATA*.

For your notes

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For your notes

Introduction

NOTE: The Accutracker DX noninvasive blood pressure monitor is available in the United States only. This model, available from GE Marquette, has been modified by SunTech Medical Instruments to operate with the ApexPro telemetry system.

NBP monitoring via telemetry is done with an Accutracker DX noninvasive blood pressure monitor connected to the ApexPro transmitter. The blood pressure cuff is connected to the Accutracker DX blood pressure monitor, which measures and displays systolic and diastolic blood pressures using the auscultatory method. When the blood pressure monitor is connected to an ApexPro transmitter, digital values are also displayed at the clinical information center.

WARNING
The following conditions may affect the accuracy of noninvasive blood pressure readings: seizures, tremors, extreme hypotension or hypertension, arrhythmias, or extremely high or low heart rate.

Safety Considerations

Keep the following warnings and cautions in mind when using the Accutracker DX noninvasive blood pressure monitor.

WARNINGS

The Accutracker DX noninvasive blood pressure monitor is designed for use with adult patients only. Do not use on neonates or on patients known to be susceptible to bruising.

Do **not** attach the blood pressure cuff to a limb being used for IV infusions as the cuff inflation can block the infusion, causing harm to the patient.

CAUTIONS

The blood pressure monitor's safety and effectiveness in neonates has not been established.

Blood pressure measurements may be affected by the patient's position, physical condition, and other factors.

Do not use the blood pressure monitor if it has failed its diagnostic self test or if it displays a pressure greater than zero with no cuff attached. The values displayed by such a unit may be inaccurate.

If you must ship the Accutracker DX noninvasive blood pressure monitor for service or other reasons, place it in a sealable plastic bag, seal it tightly, then package it in a cardboard box. Label the shipping container "–20 to +50 Deg. C" and ship appropriately. Failure to follow these instructions can result in device failure due to improper shipping/storage conditions.

Programming the Blood Pressure Monitor

The blood pressure measurement interval, the maximum and minimum inflation pressures, dynamic or fixed inflate, and the deflate rate can all be adjusted on the Accutracker DX blood pressure monitor. Follow the instructions below to set these options.

Setting the Measurement Interval

When the blood pressure monitor is turned on, it performs a battery voltage check, then the display shows the following:

INT= 5 (***)

INCR DECR START?

NOTE: The number *5* above represents any measurement interval, including *MAN* (manual). When the blood pressure monitor is turned on, the number displayed is the last measurement interval set as the default.

Use the **YES +** button or the **NO –** button on the blood pressure monitor to increase or decrease the interval (*INT*) at which the blood pressure readings are taken.

The available measurement intervals are: *MAN* (manual), or 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 90, 120, or 240 minute intervals.

When the desired measurement interval is reached, press the **START/STOP** button. The blood pressure monitor immediately begins a measurement cycle. It will attempt one retry if the first measurement cycle fails.

Measurements are taken at the selected interval. A measurement may be initiated in between intervals by pressing the **START/STOP** button. This “wakes up” the blood pressure monitor from sleep mode, and offers the option to change the measurement interval as described above, as well as the option to view the time left until the next measurement. A manual measurement is initiated by pressing the **START/STOP** button a second time. The next measurement will then be taken at the scheduled interval (X number of minutes) after the manual measurement is complete.

The patient’s blood pressure is displayed for one minute on the blood pressure monitor and for two hours on the clinical information center. The blood pressure reading is updated each time a measurement is successfully completed.

Measurements are taken at the selected interval until the blood pressure monitor is turned off, or until the monitor determines that the batteries are too weak for additional measurements.

A measurement may be stopped by pressing the **START/STOP** button while the measurement is in progress.

Setting Test Parameters

The maximum and minimum inflation pressures, dynamic or fixed inflate, and deflate rate can be adjusted. Follow these steps:

1. Turn the blood pressure monitor on while holding down the **NO –** button. The display shows:
   CHANGE TEST
   PARAMETERS?
2. Press the **YES +** button to change the parameters.
3. The *MAXIMUM PRESSURE* can be set to: 250, 240, 230, 220, 210, 200, 190, 180, 170, 160, 150, 140, 130, 120, 110, or 100 mmHg using the **YES +** and **NO –** buttons. A setting of 200 to 250 mmHg is recommended for the maximum cuff inflation pressure.
4. When the maximum pressure has been set, press the **NEXT** button to set the *MINIMUM PRESSURE*. It can be set to: 100, 90, 80, 70, 60, 50, 40, 30, 20, or 10 mmHg using the **YES +** and **NO –** buttons. A setting of 40 mmHg is recommended for the minimum cuff deflate pressure.
5. When the minimum pressure has been set, press the **NEXT** button to select *DYNAMIC INFLATE* or *FIXED INFLATE*. Press the **YES +** button to turn dynamic inflate on, or press the **NO –** button for fixed inflate.

   When dynamic inflate is turned on, the blood pressure cuff inflation pressure automatically ranges 30 mmHg above the most recent systolic reading.

   Fixed inflate always inflates the blood pressure cuff to the set maximum inflation pressure.

   Dynamic inflate is recommended for most patients. However, if a patient's systolic pressure readings vary by 25 mmHg or more, fixed inflate may be more comfortable for the patient. In all likelihood, dynamic inflate would not inflate the cuff high enough for such a patient, prompting the blood pressure monitor to retry, and causing the patient to endure two inflations for each reading. A fixed inflation to the set maximum pressure eliminates the double inflation and increases the patient's comfort. Reducing the maximum cuff inflation pressure setting for a patient being monitored with fixed inflate will also increase the patient's comfort.

6. After selecting dynamic or fixed inflate, the *DEFLATE RATE* can be set. It can be set to: 6, 5, 4, 3, or 2 mmHg, using the **YES +** and **NO –** buttons. A deflate rate of 3 mmHg per second is recommended.

   NOTE: A patient with a slow heart rate requires a slower deflation rate than a patient with a faster heart rate. If the cuff deflates too quickly, it may not be possible to determine a blood pressure. If the cuff deflates too slowly, it may be uncomfortable for the patient. The recommended deflate rate of 3 mmHg per second meets most patients' requirements, but it can be adjusted when needed.

7. Press the **NEXT** button to return to the *CHANGE TEST PARAMETERS?* prompt, then press the **NO –** button to return to:
   INT= 5 (***)
   INCR DECR START?

Setting Limits

It is possible to set the maximum and minimum values, as well as the change (delta) limit, at which the blood pressure monitor will reject a systolic, diastolic, or pulse pressure reading and attempt a new measurement. Contact technical support (refer to "How to Reach Us" at the beginning of this manual) for more information about setting these limits.

Software and Hardware Versions

To verify what software and hardware versions your Accutracker DX blood pressure monitor has, turn on the blood pressure monitor while holding down the **LAST** button. A display similar to the following appears:

Vsn: XX/ZZ
K3: 0 PR: 0

Your hardware version appears in place of the *XX* in the above example; your software version appears in place of the *ZZ* in the above example.

NOTE: Although it is not shown on the Accutracker DX display, both the software and hardware version have a period in them. For example, if the hardware version reads 11 on the display, this actually indicates that it is hardware version 1.1.

Patient Preparation

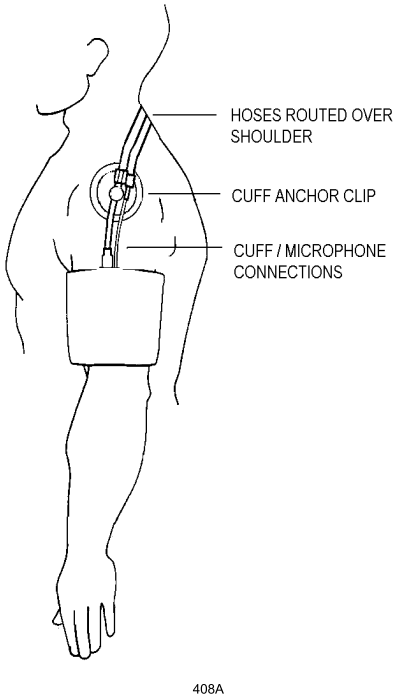
Blood pressure cuff selection and application are important. Inappropriate selection or improper application of the cuff will result in erroneous measurements.

Most people use their non-dominant arm for acquiring ambulatory noninvasive blood pressure readings.

Follow these steps to prepare the patient for NBP monitoring:

1. Place the K-sound microphone in the microphone pad (or blood pressure cuff). For more information on microphone placement, refer to the Microphone Placement section in this chapter.
2. Locate the patient's brachial artery on the inside of the arm, just above the elbow. Mark the location with a pen for easy microphone placement.
3. Remove the backing from the microphone pad and adhere it in the location marked on the patient's arm. Do not bend or squeeze the microphone. Route the microphone cable up, toward the patient's shoulder.
4. Wrap the blood pressure cuff around the arm. Be sure that the artery marker is aligned over the brachial artery.
5. Drape the cuff hose over the patient's shoulder and attach an adhesive cuff anchor to the snap on the cuff hose. Do not adhere the cuff anchor to the patient at this time.
6. Place the blood pressure monitor in its pouch and attach it to the patient using the belt or shoulder strap provided.
7. Adhere the cuff anchor to the patient's upper arm by removing the adhesive backing and pressing firmly.

When attached, the blood pressure cuff and hoses should be positioned like those in the following illustration.



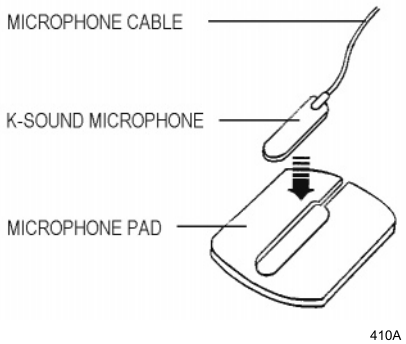
Patient with Cuff and Hoses Attached

Microphone Placement

A microphone is used to “hear” the Korotkoff sounds (K-sounds) that the blood pressure monitor uses to determine the systolic and diastolic pressure readings. The microphone can be placed in a microphone pad and adhered to the patient’s arm under the blood pressure cuff, or alternatively, it can be placed directly into the microphone pocket inside the blood pressure cuff.

Placement in the Microphone Pad

Using a microphone pad is recommended. Place the microphone in the pad as illustrated below. Do not bend or squeeze the microphone when placing it in the pad, or when adhering the pad to the patient’s arm.



Placing the Microphone in the Microphone Pad

Placement in the Blood Pressure Cuff

As already stated, using the microphone pad is recommended, especially in the case of ambulatory patients or patients with weak K-sounds. However, as an alternative, the microphone can also be placed directly in the blood pressure cuff. Follow the directions below.

NOTE: Blood pressure readings taken with the microphone in the blood pressure cuff may not be as accurate as readings obtained when using the microphone pad.

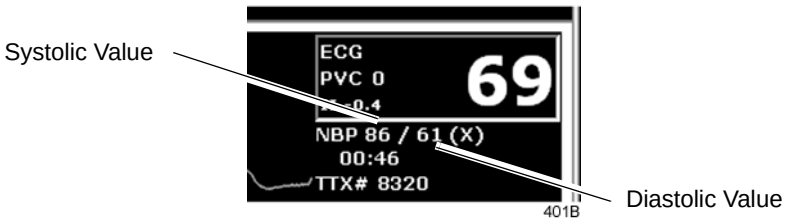
1. Remove the bladder from the cuff.
2. Turn the cuff bladder pouch inside out to expose the microphone pocket.
3. Open the Velcro pocket flap and gently insert the microphone into the pocket.
4. When the microphone is completely inserted, close the Velcro flap over the microphone cable and turn the cuff right side out.
5. Replace the bladder and exit the bladder hose and microphone cable out of the same exit site, either right arm or left arm, as marked on the cuff.

NBP Monitoring

NBP in the Multiple Patient Viewer

In the multiple patient viewer, the bed window for a telemetry patient being monitored for NBP displays an NBP label, along with the systolic and diastolic values from the most recent measurement.

NOTE: The mean blood pressure value is not measured or calculated when monitoring blood pressure via telemetry. Therefore, an X always remains on the display in place of a mean value when a telemetry patient's blood pressure is being monitored.



NBP in the Single Patient Viewer

In the single patient viewer, NBP data appears in the View Patient tab sheet in the same format and location as it does in multiple patient viewer.

To access the View Patient tab sheet, follow the steps below.

1. Click in the desired patient's bed window in the multiple patient viewer. The display rearranges to accommodate the single patient viewer for that patient.
2. If it is not already visible at the front of the tabs, click on the *View Patient* tab to bring the tab sheet to the front.

For more information about the View Patient tab sheet, refer to Chapter 7, Admit/View a Patient, in this manual.

NBP Limits

You can adjust alarm limits for NBP in the Alarm Control tab sheet for each patient. For more information on how to set the alarm limits, refer to Chapter 8, Alarm Control, in this manual.

NOTE: The mean pressure limits can be changed, but there will be no effect on alarms for telemetry patients because the mean pressure is not measured or calculated for telemetry patients.

Pressures Tab Sheet

The Pressures tab sheet allows you to view and modify settings specific to the viewed telemetry patient's NBP display. Settings may be viewed for any patient. However, you can only modify settings for patients who are admitted to a bed in your unit.

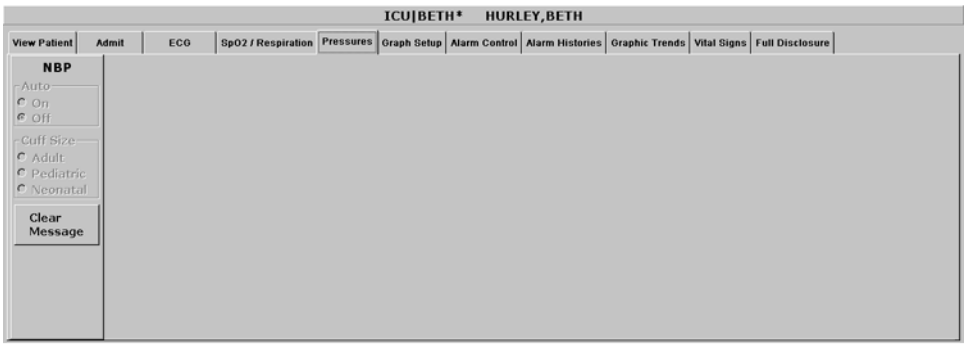
NOTE: The NBP tab is labeled *Pressures* because other invasive pressures settings are available on this tab sheet for bedside monitored patients only.

Invasive pressure monitoring is not an option for telemetry patients. Therefore, only NBP information appears on this tab sheet when monitoring a telemetry patient.

Accessing the Pressures Tab Sheet

To access a patient's Pressures tab sheet in the single patient viewer, follow this procedure.

1. Click in the desired patient's bed window in the multiple patient viewer. The display rearranges to accommodate the single patient viewer for that patient.
2. Click on the *Pressures* tab in the single patient viewer. The Pressures tab sheet moves to the front.



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Auto

The interval for automatic NBP measurements is controlled at the blood pressure monitor, not at the clinical information center. Because the control is in the blood pressure monitor, the *Auto* option is inactive for telemetry patients and appears dimmed.

Cuff Size

The *Cuff Size* option is inactive for telemetry patients and appears dimmed.

Clear Message

If you want to remove the displayed NBP values, use the mouse to click on the *Clear Message* button. The values are replaced with Xs. Any Message, Advisory, and Warning level NBP alarms are also cleared.

Troubleshooting

Problem: Erroneous NBP measurement

Solution:

1. Check for proper cuff size:
   - Too small a cuff can give an erroneously high value.
   - Too large a cuff can give an erroneously low value.
2. Check for residual air left in the cuff from a previous measurement. This could indicate a hardware problem that may require service.
3. Make sure the cuff is not too tight or too loose.
4. Make sure the cuff and the heart are at the same level; otherwise hydrostatic pressure will offset the NBP value.
5. Watch for pulsus paradoxis.
6. Check for leak in cuff or tubing.
7. Patient may have a weak pulse.
8. Calibration may be necessary.

NBP Status Messages

Below is a list of system status alarm messages that may be displayed in the patient's bed window during monitoring.

NBP status messages appear in abbreviated form in graph headers, when applicable.

A message will clear when the next measurement is initiated, or a message can be cleared manually with the *Clear Message* option on the NBP tab sheet.

CHANGE BATTERY

An NBP measurement was attempted with low batteries. Change the batteries in the blood pressure monitor and try another measurement.

FAIL

A hardware failure has been detected in the blood pressure monitor. In the United States, contact GE Marquette Service. Outside the United States, contact your local sales/service representative.

LEAK

The NBP cuff is loose or there is an air leak in the cuff or tubing. Check that the cuff is on snugly. Check the connection between the cuff and the tubing. Check the connection between the tubing and the blood pressure monitor. Try another measurement. If the problem persists, contact your local sales/service representative.

LOW INFLATION PRESS

This message appears when K-sounds are detected immediately upon inflation. The inflation pressure is too low for proper NBP measurement. Try another measurement or adjust dynamic/fixed inflate. Refer to the Setting Test Parameters section in this chapter for more information. If the problem persists, contact your local sales/service representative.

MOVEMENT

This message appears when there is excessive patient arm movement, or if the patient's arm was bent during the measurement. Check the patient and try another measurement.

SENSOR?

This message appears when the K-sounds on the measurement were too weak, or not enough sounds were detected. Reposition the microphone and try another measurement. This message can also appear if the deflate rate is not properly adjusted. Refer to Setting Test Parameters in this chapter for more information. If the problem persists, contact your local sales/service representative.

WEAK PULSE

The patient's heart rate is erratic. Check that the microphone cable is plugged firmly into the patient cable, and check that the microphone is positioned correctly on the patient. Try another measurement. If the problem persists, it could indicate a defective microphone, microphone cable, or patient cable. Contact your local sales/service representative.

For your notes

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For your notes

Appendix A — Message Glossary

Alarm Messages

The following messages appear in the patient's bed window at the clinical information center.

NOTE: Refer to the Arrhythmia section in Chapter 11, ECG Monitoring.

ALARM PAUSE	All alarms for this patient have been turned off for five minutes. This is initiated from the transmitter. Refer to *ALL ALARMS OFF*.
ALL ALARMS OFF	All alarms for this patient have been turned off. No graph strips run, arrhythmia events are not stored, and no audible tones sound if an alarm condition should occur.
ARR OFF	The arrhythmia program for a selected patient has been turned off. No arrhythmia messages are displayed, no graph strips run, and no audible tones sound if an arrhythmia alarm condition occurs.
ARTIFACT *ARR SUSPEND*	All artifact begins at level 1. Sustained artifact progresses to level 2 when noise on ECG lasts for 20 of the last 30 seconds. ■ Level 1—Upon immediate detection of artifact, the message *ARTIFACT* is displayed. There is no alarm tone. ■ Level 2—Arrhythmia monitoring is suspended in this condition. Heart rate and PVC values change to X, an additional message, *ARR SUSPEND*, is displayed, and a system warning alarm (repeating foghorn tone) is heard.
LEADS FAIL	All leads have failed. A repeating, low-pitched foghorn tone will sound. This will self-silence if condition is corrected, or the user can silence for one minute with the *Silence Alarms* button at the bottom of the CIC display.

NO TELEM

The *NO TELEM* alarm occurs in two situations:

NOTE: Refer to the Suspended Analysis warning in the Arrhythmia section of Chapter 11, ECG Monitoring.

1. The patient moves out of range.

   Transmitter is out of range. A repeating, low-pitched foghorn tone sounds after sensing *NO TELEM* for 30 seconds. The *Silence Alarms* button silences this alarm for 60 seconds. If, after one minute, the *NO TELEM* alarm condition is still present, the alarm sounds again. Use the *Alarm Off Reason* option when extended alarm silencing is desired. Refer to Chapter 8, Alarm Control, for more information about this feature. Should a *LEADS FAIL* condition occur prior to a *NO TELEM* condition, the *LEADS FAIL* condition takes priority. The *LEADS FAIL* message is displayed along with the *NO TELEM* message.

NOTE: Patient must be within antenna range to receive a *CHANGE BATTERY* message.

2. Transmitter batteries are extremely low or dead.

   If batteries are extremely low or completely dead, the *NO TELEM* message appears, a *CHANGE BATTERY* message appears in the patient's bed window, and the audible alarm sounds. Activating the *ALL ALARMS OFF* feature prevents the audible alarm from sounding.

OFF NETWORK

In the Combo mode, telemetry patient data is provided from the bedside monitor to the clinical information center. If the bedside monitor is removed from the network or becomes otherwise unavailable, the *OFF NETWORK* alarm is generated. The clinical information center will then display patient data directly from the telemetry bed along with this message in that clinical information center bed window. This alarm sounds a one-beep Advisory alarm tone. Should the bedside monitor reappear on the network, the Combo monitoring application will automatically resume and the alarm will be cleared.

This alarm is also generated if the receiver system is removed from the network or becomes otherwise unavailable. The bedside monitor does not sound alarms, but the alarms must be turned back on at the bedside monitor if they were previously paused or off.

Graph Messages

The following messages appear in the patient's bed window on the clinical information center display. These relate to running graphs at the printer.

GRAPH ALARM	An alarm graph was initiated and is running.
GRAPH MANUAL	A manual graph was requested and is running.
GRAPH TTX	The **Graph** button on the transmitter was pressed and a 20-second graph strip is running.
PRINTING	A non-real time graph is currently being printed.
SAVING	An alarm or a manual graph has been requested but the writer is in use, the writer door is open, or the writer is out of paper. The request is saved and will run as soon as the writer is available.

Transmitter-Related Messages

The following messages appear in the patient's bed window on the clinical information center display.

CHANGE BATTERY	This message flashes when the batteries are low. There is approximately 1 hour of use left after this message appears. If the batteries are extremely low or completely dead, a *NO TELEM* message flashes, and an audible alarm sounds.
LEADS FAIL	All leads have failed. A repeating, low-pitched foghorn tone sounds. This will self-silence if condition is corrected, or user can silence for one minute with *Silence Alarms* button.
RA (LA, LL, V) FAIL	One of these may appear, indicating failure of a lead.
NO TELEM	When the receiver can no longer reliably receive patient signals from the programmed transmitter, patient waveforms and heart rate are removed from the display. If this condition persists, call service.

System Status Messages

System status alarms (generated by mechanical conditions) are displayed in the lower left corner of the clinical information center screen. Each message is preceded by the receiver system's name, if it has been entered, or a name created by using the last six numbers of the receiver system Ethernet address. If necessary, call service (refer to "How to Reach Us" at the front of the manual).

DUPLICATE TOWER NAME	A network problem exists. Restart the system. Call service to correct this problem.
DUPLICATE NAME	A network problem exists. Restart the system. Call service to correct this problem.

Patient Status Messages

Patient status messages are also displayed in the lower left corner of the clinical information center screen. They are not, however, preceded by the receiver system name or Ethernet address.

"Unit/Bed" IS UNMONITORED	A telemetry patient is admitted but is not displayed (and therefore is unmonitored) on any clinical information center. If an alarm occurs on an unmonitored bed, the information will appear in the alarm text line and an audible tone will sound. You must view the patient first if you would like to silence the alarm. To view an unmonitored bed, click on the *View Other* button. (Refer to Chapter 7, Admit/View a Patient for more information on viewing a patient.)
"Unit/Bed": DUPLICATE NAME	There is another device on the network with the same bed name. The duplicate device must be renamed.

Appendix B — Supplies

To ensure patient safety, use only supplies manufactured or recommended by GE Marquette Medical Systems, Inc. Your local sales representative can provide current supplies lists, or you can contact GE Marquette Supplies. (Refer to “How to Reach Us” at the front of this manual.)

Appendix C — Technical Specifications

Below are the technical specifications for the ApexPro telemetry system. Due to continual product innovation, GE Marquette designs and specifications are subject to change without notice. Contact your sales/ service office for the most current information.

ApexPro Transmitter

Performance Specifications

Battery type: ANSI/NEDA 15A, 1.5 V AA alkaline (2 req.)
Battery life: 40 hours typical
Polarity: Electronic reverse polarity protection
Static withstand: Meets and exceeds IEC 801-2 second edition
Shock withstand: 5 random drops from 4 ft onto tiled concrete floor
Water resistance: IEC 529 IPX3 rating
Cleaning/Sterilization: Isopropyl alcohol, ammonia (diluted), Cidex, sodium hypochlorite bleach (diluted) or mild soap (diluted).

Alarms and Controls

Battery integrity: Transmitted and indicated via LED
Lead fail indication: Transmitted and indicated via LED
Alarm Pause: Transmitted and indicated via LED
Graph request: Transmitted
Power on/off: Battery insertion/removal

Transmission

Channel spacing: 25 kHz
Frequency stability: ± 0.0001% of assigned channel frequency
Modulation: GMSK
Bit rate: 10 kb/sec
Antenna: Formed by leadwire shield

Frequency range: (programmable synthesizer)	Power output: Meets FCC requirements Part 15.242
560.025 – 613.975 MHz	Meets FCC requirements Part 15.242
420 – 460 MHz	As per country specifications

ECG

Multi-channel (5- or 6-leadwire) configuration: I, II, III, Va, Vb, aVR, aVL, aVF
Leads analyzed simultaneously: Four (I, II, III and V)
Single-channel (3-leadwire) configuration: I, II or III, programmable
Heart rate detection range: 3 to 300 beats/minute
QRS detection range: 0.5 to 5 mV
Frequency response: 0.05 Hz to 40 Hz (–3dB)
Dynamic range: ± 5 mV (RTI)
Input offset: ± 400 mV (RTI)
Input impedance: 15 Megohm min differential at 10 Hz
ECG gain selection: 5, 10, 20, 40 mm/mV (RTI)
Gain accuracy: ± 5% at 15 Hz
Common mode rejection: 100 dB min at 60 Hz
Lead fail detection: DC type; indicates leadwire failed (i.e., RA, LA, LL, Va, or Vb)
Pacemaker detection: ± 2 mV to ± 700 mV (RTI); 100 µsec to 2 msec; either polarity
Defibrillator protection: ± 5000 VDC, 360 joules into 50 ohm load
Defibrillation recovery time: Limited only by electrode recovery time. Transmitter recovers within 2 sec.

Analog/Digital

A/D converter resolution: 10 bits, 9.76 µV (RTI)
Sample rate: 240 samples/sec
Serial communications: 2 – 9600 baud asynchronous

Environmental Specifications

Operating conditions

Ambient temperature: 0°C to 50°C (32°F to 122°F)
Relative humidity: 5% to 95% (noncondensing)

Storage conditions

Temperature: –40°C to 70°C (–40°F to 158°F)
Relative humidity: 30% to 95% (noncondensing)
Pressure: 700 hPa to 1060 hPa

Physical Specifications

Height: 13.7 cm (5.4 in)
Width: 7.4 cm (2.9 in)
Depth: 2.3 cm (0.9 in)
Weight: 141.8 g (5 oz) Weight excludes batteries and leadwire assembly.

Certification

560.025 – 613.975 MHz – FCC Part 15.
UL 2601-1.

Warranty

Standard warranty is one year.* Other options are available.

* Unit must be returned to the factory with freight prepaid.

Electromagnetic Compatibility Compliance

Radiated RF Immunity Verification Results

The ApexPro telemetry system meets the requirements of EN60601-1-2 (1993-04) Medical Electrical Equipment, Part 1: General Requirements for Safety, 2. Collateral Standard: Electromagnetic compatibility – Requirements and tests, with the following exceptions.

NOTE: This data was collected December 6 - 8, 1999.

Exceptions:

EN60601-1-2 Second Edition Draft 200X-YY clause 2.210 Exclusion bands for intentional radiating/receiving devices = +/- 5% of frequency or frequency band.

EN60601-1-2 Second Edition Draft 200X-YY clause 36.202.3 - a - 4 – Radiated RF Electromagnetic fields Immunity - Exclusion Band

EN60601-1-2 Second Edition Draft 200X-YY clause 36.202.6 - a - 4 – Conducted RF Electromagnetic fields Immunity - Exclusion Band

- The antenna system tested operates in a frequency band of 560 - 614 MHz. The allowable exclusion band would then be 532 - 645 MHz. The level of compliance is not 1 V/m in the ranges of 520 - 534 MHz and 645 - 660 MHz.
- The transmitter tested operates at a frequency of 614 MHz. The allowable exclusion band would then be 583 - 645 MHz. The level of compliance is 1 V/m.

If operating under the conditions defined in EMC Standard EN60601-1-2 (Radiated Immunity 3 V/m), field strengths above 1 V/m may cause waveform distortions and erroneous numeric data at various electromagnetic interference (EMI) frequencies.

Recommendations:

- Review the AAMI EMC Committee technical information report (TIR-18) titled Guidance on electromagnetic compatibility of medical devices for clinical/biomedical engineers - Part 1: Radiated radio-frequency electromagnetic energy. This TIR provides a means to evaluate and manage the EMI environment in the hospital.
- The following actions can be taken:
  - Manage (increase) distance between sources of EMI and susceptible devices.
  - Manage (remove) devices that are highly susceptible to EMI.
  - Reduce power from internal EMI sources under hospital control (i.e., paging systems).
  - Label devices susceptible to EMI.
  - Educate staff (nurses and doctors) to be aware of and to recognize potential EMI-related problems.

FCC Compliance Information Statement

This device complies with Part 15 of the FCC Rules and with RSS-210 of Industry Canada.

Operation is subject to the following two conditions:

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

WARNING

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Apex Oximeter

Performance Specifications

Battery Type: ANSI/NEDA 15A, 1.5V AA alkaline (2 required)
Battery Life: 30 hrs. typical with display on continuously; 60 hrs. typical with display off
Polarity: Electronic reverse polarity protection
Static withstand: Meets and exceeds IEC 802.2 second edition
Shock withstand: 5 random drops from 4 ft onto tiled concrete floor
Water resistant with sensor in place
Cleaning/Sterilization: Isopropyl alcohol, ammonia (diluted), Cidex, sodium hypochlorite bleach (diluted) or mild soap (diluted).

Controls and Indicators

Power on/off: Button switch
Display on/off: Button switch
LED indicator: Numerical SPO2 value; numerical HR value; signal quality indicator
SPO2 sensors: Full line of Nonin qualified reusable and disposable sensors

Processing

Saturation range: 0 to 100%
Saturation accuracy: 70 to 100% ± 3 digits (± 1 S.D.)
Pulse rate range: 18 to 300 BPM
Pulse rate accuracy: ± 3 % or 1 BPM, whichever is greater

Central Display

Messages: Check probe, Low signal quality, Probe off patient
Numerical display: SPO2 (% value), HR (bpm)
Alarms: SPO2 high/low, HR high/low

Physical Specifications

Height: 12.7 cm (5.0 in)
Depth: 2.0 cm (0.8 in)
Width: 6.9 cm (2.7 in)
Weight: 113.4 g (4.0 oz)
Weight excludes batteries and SPO2 probe

Certification

UL 2601-1
CE marking for the 93/42/EEC Medical Device Directive.

Warranty

Standard warranty is one year.* Other options are available.

* Unit must be returned to the factory with freight prepaid.

The Apex Oximeter is manufactured for GE Marquette Medical Systems by Nonin Medical, Inc. It is recommended for use with Nonin sensors only.

Accutracker DX Noninvasive Blood Pressure Monitor

Performance Specifications

Technique: Ausculatory. Diastolic pressure is determined from Phase 5 Korotkoff sounds.

Accuracy: Blood pressure measurements determined with this device are equivalent to those obtained by a trained observer using the cuff/ stethoscope auscultation method, within the limits prescribed by the American National Standard, Electronic or automated sphygmomanometers.

Pressure: Dynamic or fixed programmable. Dynamic pressure configuration maximizes patient comfort by limiting cuff inflation to 30 mmHg greater than the previous systolic pressure, without exceeding configurable limits.

Pressure Range: 0 to 250 mmHg

- Maximum pressure programmable limits: 100 to 250 mmHg, increments of 10 mmHg
- Minimum pressure programmable limits: 10 to 100 mmHg, increments of 10 mmHg

Auto retry: Automatically initiates an additional reading in the event a reading fails to satisfy any of the programmable criteria.

***NOTE:** Contact technical support for information on setting these limits.

Blood Pressure Range:

- Systolic: 10 to 250 mmHg
  - Upper auto-retry programmable limits: 50 to 240 mmHg, increments of 10 mmHg*
  - Lower auto-retry programmable limits: 50 to 150 mmHg, increments of 10 mmHg*
  - Systolic change (delta) limits: 30 to 100 mmHg, increments of 10 mmHg*
- Diastolic: 10 to 250 mmHg
  - Upper auto-retry programmable limits: 50 to 150 mmHg, increments of 10 mmHg*
  - Lower auto-retry programmable limits: 30 to 100 mmHg, increments of 10 mmHg*
  - Diastolic change (delta) limits: 20 to 100 mmHg, increments of 10 mmHg*
- Pulse Pressure
  - Upper auto-retry programmable limits: 40 to 150 mmHg, increments of 10 mmHg*
  - Lower auto-retry programmable limits: 10 to 100 mmHg, increments of 10 mmHg*
  - Pulse pressure change (delta) limits: 30 to 100 mmHg, increments of 10 mmHg*

Deflation rate: True linear deflation according to AHA guidelines. Programmable for 2, 3, 4, 5, or 6 mmHg per second.

Display: 32 character LCD (16 characters per row) provides a clear view of data and message prompts.

Sample quantity: Over 250 samples per set of 4 new batteries.

Sample periods: Manual and interval programmable. Intervals of 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 90, 120 or 240 minutes can be selected/programmed.

Start key: Allows the patient or caregiver to initiate readings on demand.

Power source: Four 1.5 (AA) alkaline batteries. Rechargeable batteries are not recommended (sample quantity with rechargeable batteries typically limited to 25 samples/measurements vs. 250 samples/ measurements with new alkaline batteries).

Environmental Specifications

Operating temperature: +10ºC to 40ºC (50ºF to 104ºF)
Relative Humidity: <95%
Storage temperature: -20ºC to +50ºC (-4ºF to +122ºF)
Relative Humidity: <95%
Power: 6 Vdc, four 1.5V “AA” Alkaline batteries.

Electromagnetic Compatibility Compliance

The Accutracker DX noninvasive blood pressure monitor complies with EN60601-1-2 (1993-04) Medical Electrical Equipment, Part 1: General Requirements for Safety, 2. Collateral Standard: Electromagnetic compatibility - Requirements and tests.

Exception: IEC 60601-1-2 clause 36.202.1 - Immunity: ESD

- The level of compliance is ± 2, 4, 6 kV Contact discharge and ± 2, 4, 6 kV Air discharge.

Air discharges of ± 8 kV or greater may cause the cuff to deflate and the unit to lock up. By turning the power switch off, then back on (manual reset), the unit will be restored to the user-defined settings and normal operation.

Recommendations:

- The Accutracker DX blood pressure monitor should be kept in the carrying pouch supplied with each unit.
- Care should be taken to minimize the ESD potential when the Accutracker DX blood pressure monitor is removed from the pouch. This includes:
  - Handling the unit in an ESD-protected area.
  - Maintaining humidity levels of 50% relative humidity or greater.
  - Discharging ESD potential on human hands prior to handling the unit out of the pouch.

Physical Specifications

Length: 12.7 cm (5.0 in)
Width: 8.25 cm (3.25 in)
Thickness: 3.3 cm (1.30 in)
Weight: 357.2 g (12.6 oz)

Accutracker Dx Certification

UL2601

Warranty

1 year

ApexPro Receiver System

Performance Specifications

Quad Receiver Module

Type: GMSK digitally demodulated
Frequency range: 560.025 MHz to 613.975 MHz (U.S.)
420 MHz to 460 MHz (international)
Frequency step resolution: Frequency synthesized tuning to any transmitter. 25 KHz spacing.
Frequency stability: ±0.00015% of assigned channel frequency
Demodulation: GMSK
Bit rate: 10 kb/sec
Sensitivity: 0.8 µV (–95 dBm) minimum for 1 bit error/1 million bits received

Receiver Subsystem

Capacity: 1 to 4 quad receiver modules (4 to 16 receivers)
System status indicators: 7 bicolor LEDs

Network

IEEE 802.3 compatible, physical connector via 10 Base T
Serial diagnostics: 19200 baud, 1 stop bit, 8 data bits, no parity, XON/XOFF flow control

Environmental Specifications

Power requirements: 85 to 264 VAC, 47 to 63 Hz
Power consumption: 25 watts max with 4 quad receiver units
Cooling: Free convection

Operating conditions

Ambient temperature: 0°C to 40° C (32°F to 104°F)
Relative humidity: 10% to 90% (noncondensing)

Storage conditions

Temperature: –40°C to 70°C (–40°F to 158°F)
Relative humidity: 15% to 95% (noncondensing)

Physical Specifications

Subsystem

Height: 170 mm (6.7 in)
Width: 325 mm (12.8 in)
Depth: 250 mm (9.8 in)
Weight: 6.4 kg (14 lb)

Certification

Receiver Unit: FCC Part 15, Subpart B Class B (U.S. only)
Subsystem: UL 2601-1 Listed. IEC 60601-1 Certified.

Warranty

Standard warranty is one year. Other options are available.

ApexPro Antenna System

Performance Specifications

Antenna

Style: Omni-directional
Fields: Four (A, B, C, D)
Diversity: Based on received signal level

Environmental Specifications

Power requirements: 85 to 264 VAC, 47 to 63 Hz
Power consumption: 25 watts max with 4 quad receiver units
Cooling: Free convection

Operating Conditions

Ambient temperature: 10°C to 35°C (50°F to 95°F)
Relative humidity: 25% to 85% (noncondensing)

Storage Conditions

Temperature: –40°C to 70°C (–40°F to 158°F)
Relative humidity: 15% to 95% (noncondensing)
Pressure: 500 hPa to 1060 hPa

Electromagnetic Compatibility Compliance

For important compliance information, refer to the Electromagnetic Compatibility Compliance information in the ApexPro Transmitter section of these technical specifications.

Warranty

Standard warranty is one year. Other options are available.

Appendix D — Abbreviations and Symbols

Abbreviations and symbols you may encounter while reading this manual or using the ApexPro telemetry system or the clinical information center are listed below, along with their meanings.

Abbreviations

	A
AO2	arterial oxygen saturation
ARRY	arrhythmia
ART	arterial
Auto, AUTO	automatic
AVF	left foot augmented lead
AVL	left arm augmented lead
AVR	right arm augmented lead
	B
BP	blood pressure
BT	blood temperature
	C
C	Celsius, centigrade
CALCS	calculations
cc, CC	cubic centimeter
CCU	critical care unit
COMM	communication
CPP	cerebral perfusion pressure
CVP	central venous pressure
	D
D	diastolic
DDW	Direct Digital Writer
DIA	diastolic
	E
ECG	electrocardiograph
	F
F	Fahrenheit

	H
HR	heart rate
	I
ICP	intracranial pressure
ICU	intensive care unit
IEEE	Institute of Electrical and Electronics Engineers
Inc.	incorporated
INT	interface
	L
LA	left arm
LAN	Local Area Network
LL	left leg
	M
M	mean
mm/S	millimeters per second
mmHg	millimeters of mercury
	N
NBP	noninvasive blood pressure
No.	number
NRT	non-real time
	O
OR	operating room
	P
PA	pulmonary artery
PPR	peripheral pulse rate
	Q
QRS	interval of ventricular depolarization
	R
RA	right arm
RESP	respiration
RL	right leg
RR	respiration rate

	S
S	systolic
SpO2, SPO2	arterial oxygen saturation
SP	special
SYS	systolic
	T
T1	temperature site 1
T2	temperature site 2
Temp, TMP	temperature
TTX #	identification number on back of transmitter
	V
V	precordial lead
V-Fib, V-FIB	ventricular fibrillation
V-Tach, V-TACH	ventricular tachycardia

Symbols

°	degrees
%	percent
#	number

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For your notes

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