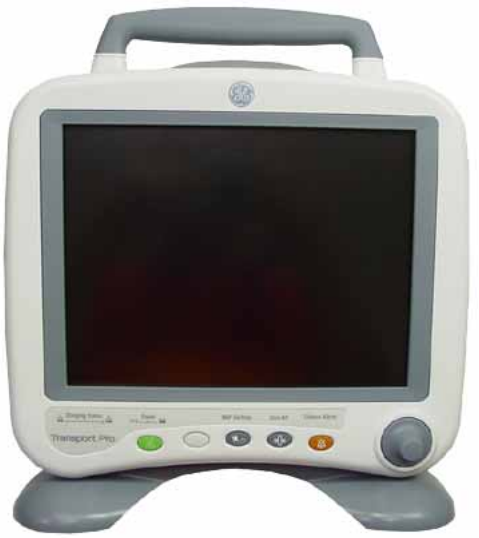
GE Healthcare

Transport Pro™ Patient Monitor

Operator's Manual

Software Version 2.1



Transport Pro™
English
2024598-003 (CD)
2024579-020A (paper)

NOTE

The information in this manual applies to Transport Pro Patient Monitor software version 2.1. Due to continuing product innovation, specifications in this manual are subject to change without notice.

NOTE

For technical documentation purposes, the abbreviation GE is used for the legal entity name GE Medical Systems *Information Technologies.*

NOTE

The Patient Data Module is described in promotional materials as CARESCAPE Patient Data Module.

Compliance

The Transport Pro™ Patient Monitor bears CE mark CE-0459 indicating its conformity with the provisions of the Council Directive 93/42/EEC concerning medical devices and fulfills the essential requirements of Annex I of this directive. The product is in radio-interference protection class A in accordance with EN 55011.

The country of manufacture can be found on the equipment labeling.

The product complies with the requirements of standard EN 60601-1-2 “Electromagnetic Compatibility - Medical Electrical Equipment”.

The safety and effectiveness of this device has been verified against previously distributed devices. Although all standards applicable to presently marketed devices may not be appropriate for prior devices (i.e. electromagnetic compatibility standards), this device will not impair the safe and effective use of those previously distributed devices. See user’s information.

Exceptions

The Transport Pro™ Patient Monitor EMC: Immunity Performance.

There are no safety and/or EMC compliance exceptions with this product.

Users should be aware of known RF sources, such as radio or TV stations and hand-held or mobile two-way radios, and consider them when installing a medical device or system.

Be aware that adding accessories or components, or modifying the medical device or system may degrade the EMI performance. Consult with qualified personnel regarding changes to the system configuration.

General Information

- This manual is an integral part of the product and describes its intended use. It should always be kept close to the equipment. Observance of the manual is a prerequisite for proper product performance and correct operation and ensures patient and operator safety.
- The symbol ⚠ means ATTENTION: Consult accompanying documents.
- Information which refers only to certain versions of the product is accompanied by the model number(s) of the product(s) concerned. The model number is given on the nameplate of the product.
- The warranty does not cover damages resulting from the use of accessories and consumables from other manufacturers.
- GE is responsible for the effects on safety, reliability, and performance of the product, only if
  - assembly operations, extensions, readjustments, modifications, or repairs are carried out by persons authorized by GE;
  - the electrical installation of the relevant room complies with the requirements of the appropriate regulations; and,

- the device is used in accordance with the instructions for use.

- All publications are in conformity with the product specifications and applicable IEC publications on safety and essential performance of electromedical equipment as well as with UL and CSA requirements and AHA recommendations valid at the time of printing.
- The quality management system complies with the international standards ISO 9001 and ISO 13485, and the Council Directive on Medical Devices 93/42/EEC.

Contents

1 The Basics

About This Manual

Manual Purpose

This manual contains the instructions necessary to operate the Transport Pro Patient Monitor safely and in accordance with its function and intended use.

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.

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	Comments
A	Initial release of this document.

Ordering Manuals

A paper copy of this manual will be provided upon request. Contact your local GE representative and request the part number on the first page of the manual.

Manual Conventions

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

Definitions

The following terms are used in this manual to describe various Transport Pro Patient Monitor features and functions.

Term	Definition
transport monitor	Transport Pro Patient Monitor
acquisition devices	Patient Data Module (also referred to as PDM) and TRAM module
docking stations	PDM dock and TRAM chute
key	A labeled button found on the front of the transport monitor.

Term	Definition
menu	Text which appears at the bottom of the display screen. A menu is composed of a set of menu options.
menu option	A choice found in a menu. A menu option is enclosed by a rectangle.
screen text	Any text that appears on the transport monitor display screen. In this manual, screen text is shown in bold italics (for example, ***ECG***, ***MAIN MENU***, etc.).

Text styles

This manual uses the following text styles to identify hardware terms, software terms and the correct way to enter data.

Style	Definition
Bold	Indicates hardware items, such as keys, labels or connectors.
Bold and italicized	Indicates software items, such as menus, menu options or screen text.
Italics	Emphasizes a word.
>	Indicates menu options or control settings to select consecutively.

Illustrations and Names

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

In this manual, all names appearing in examples and illustrations are fictitious. The use of any real person's name is purely coincidental.

Equipment Overview

Transport Pro Patient Monitoring System

The transport monitoring system consists of the following components:

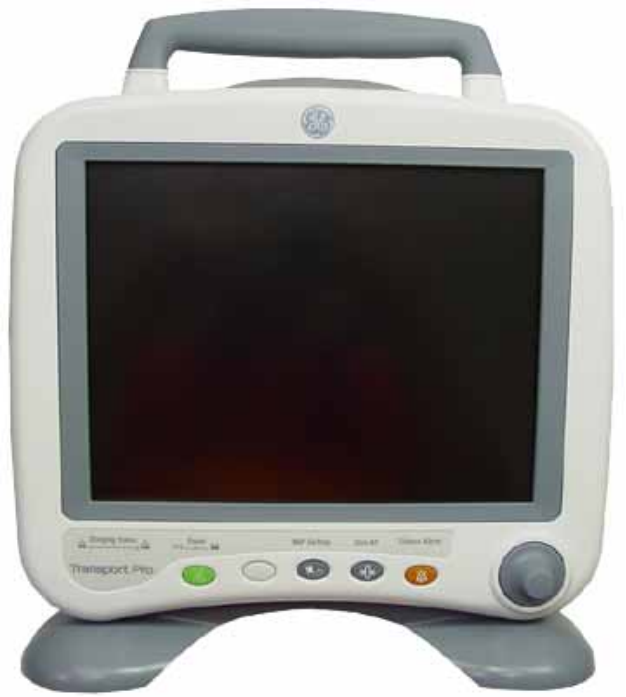
Transport Monitor with Patient Data Module	Transport Monitor with TRAM module
Transport Pro Patient Monitor	Transport Pro Patient Monitor
Patient Data Module (PDM)	TRAM module
PDM dock	TRAM chute
PDM battery	Interconnection cable

Transport Monitor with Patient Data Module	Transport Monitor with TRAM module
Transport monitor batteries	Transport monitor batteries
External power supply (AC adapter)	External power supply (AC adapter)

The components of the system are discussed on the following pages. For complete setup information, refer to the service manual.

Front View

Keys are located on the front of the transport monitor. See Controls and Indicators on page 1-9.



853D

Alarm Light Indicator

An alarm light indicator is built into the top of the transport monitor. When activated, the alarm light indicator flashes red for ***CRISIS*** patient status alarms, flashes yellow for ***WARNING*** patient status and system status alarms, and illuminates yellow (no flashing) for ***ADVISORY*** patient status and system status alarms. See Alarm Structure on page 7-2.

859B

Alarm Light Indicator

Left Side View

Acquisition modules attach to the back of the transport monitor via the PDM dock or the TRAM chute. The battery compartments are located on the left side of the transport monitor.

857C

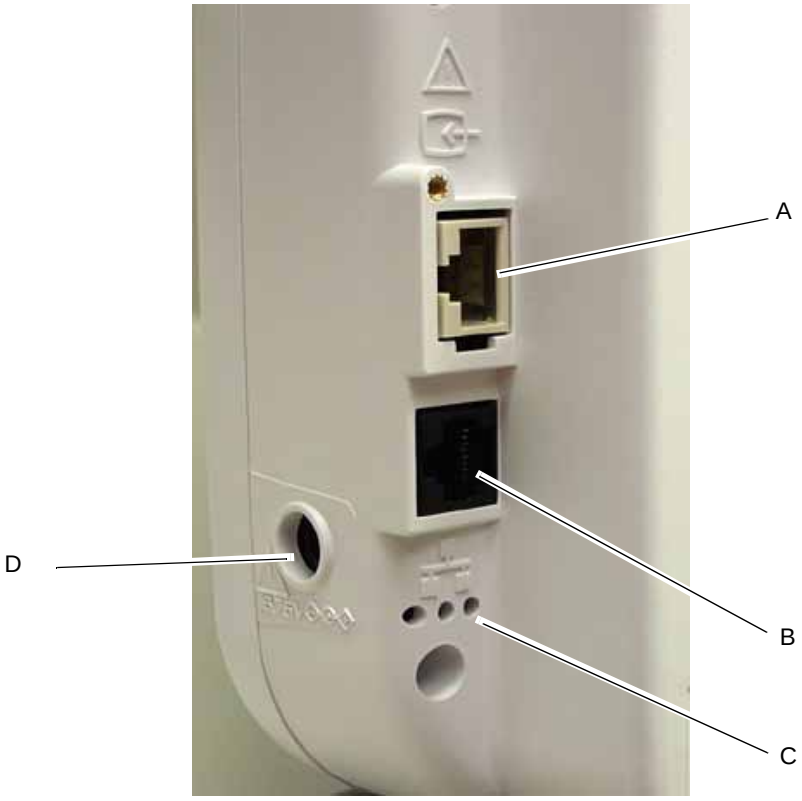
Side View of Monitor with TRAM Module Connected

856A

Side View of Monitor with Patient Data Module Connected

Right Side View

The connectors are located on the right side of the transport monitor. Refer to the service manual for system safety requirements when connecting the transport monitor to accessory equipment.



858B

Right Side View of Transport Monitor

A	 834A	Video In connector. The TRAM interconnection cable plugs in here.
B	 593A	Ethernet connector. This connector is used for software updates. Refer to the service manual for more information. **NOTE** Networking via the Ethernet connector is not available.
C	 868A	Main processor diagnostic LEDs. The main processor PCB provides three LEDs to help troubleshoot the transport monitor. Refer to the service manual for more information.
D	 836A	Power connector. The external power supply connects here.

Acquisition Devices and Docking Stations

The transport monitor can use either the Patient Data Module and PDM dock, or TRAM module and TRAM chute.

Patient Data Module and PDM Dock

Patient Data Module

Patient Data Modules are self-contained, portable acquisition devices that acquire patient data and sends the data to the transport monitor for processing and display.

PDM Dock

The PDM dock is fastened by 4 screws to the back of the transport monitor and holds one Patient Data Module. Refer to the Patient Data Module service manual for PDM dock installation information.

How to Install and Remove a Patient Data Module

Install a Patient Data Module

1. Guide the mounting rails of the Patient Data Module onto the PDM dock mounting rails.
2. Gently slide the Patient Data Module onto the PDM dock until the locking key secures it to the PDM dock.

Release a Patient Data Module

1. Pull the release tab in front of the Patient Data Module to retract the locking key and release the Patient Data Module from the PDM dock.
2. Grasp the Patient Data Module firmly and slide it off the PDM dock mounting rails.

TRAM Module and TRAM Chute

TRAM Modules

The transport monitor displays data acquired from a TRAM module.

TRAM Chute

The TRAM chute attaches to the back of the transport monitor and holds one TRAM module. Refer to the service manual for TRAM chute installation information.

How to Install and Remove a TRAM Module

Install TRAM Module

1. Facing the TRAM chute, guide the back end of the TRAM module into the slot.
2. Gently push the module into the chute. You will hear a click when the module is fully inserted.

Remove TRAM Module

1. Release levers are found on each side on the front of the TRAM module.

2. Press and hold the release levers simultaneously and pull the TRAM module out about 15 cm (6 inches).
3. Once released, grasp the TRAM module firmly with both hands and remove the rest of the way. Do not try to hold the module by the release levers.

How to Connect the Transport Monitor to the TRAM Module

To connect the transport monitor to the TRAM module, plug the transport monitor's interconnection cable into the connector labeled **DISPLAY** on the front of the TRAM module. Plug the other end of the cable into the **VIDEO IN** connector on the monitor.

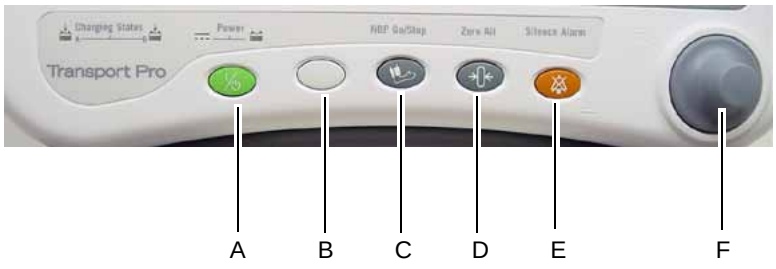
NOTE

On some TRAM modules, this connector is labeled **DISPL**.

Controls and Indicators

Control Panel

On the front control panel there are five control keys. Their functions are described below. Press the control key to activate the function. The **Trim Knob** control is also found on the control panel.



839C

Front Control Panel

	Key	Icon	Description
A	**Power**	 814A	When the transport monitor is battery powered or powered by the Patient Data Module, this key turns the power on and off. When the transport monitor is powered using the external power supply, or when it is powered by a TRAM module plugged into a powered Tram-rac housing, this key turns the monitoring standby mode on and off. When the standby mode is turned on, patient monitoring is discontinued while patient data already accumulated is retained. When the transport monitor is in standby mode and is powered using the external power supply, the battery charging function continues. When the transport monitor is in standby mode and is powered from a TRAM module plugged into a powered Tram-rac housing, the battery charging function does not continue. **NOTE** This key must be depressed for 0.25 seconds before the function is activated. This helps prevent inadvertently turning the transport monitor off. **NOTE** When connecting a Patient Data Module, or powering on the transport monitor with a Patient Data Module, the transport monitor can not be turned off until the Patient Data Module boots up. If the Power key is pressed during this boot time a message is displayed on the transport monitor: ***PDM booting—Power button disabled***.
B	(blank key)		This key is reserved for future use. The message ***NOT ACTIVE*** appears on the transport monitor display when this key is pressed.
C	**NBP Go/Stop**	 816A	This key starts one noninvasive blood pressure measurement. It can also be used at any time to stop a measurement in process.
D	**Zero All**	 822A	This key zeros all invasive pressure lines which are open to atmosphere. Each pressure can also be zeroed, if desired, with a menu option in the pressure menu.

	Key	Icon	Description
E	**Silence Alarm**	 818A	**NOTE** This manual contains more information on alarms. See Chapter 7. The function of this key can be set to ***NORMAL***, ***SILENCE ONLY***, or ***FLASH PAUSE*** (See Setup Default Display on page 5-11.) When set to ***NORMAL*** or ***FLASH PAUSE***, this key silences a current, audible alarm for 60 seconds. Only new alarms of equal or higher level interrupt the silence command. **WARNING** Alarms do not sound during an “Alarm Pause” condition. Press the key twice during an alarm to start an alarm pause (5 minutes for Adult-ICU, 3 minutes for Neonatal-ICU). Press the key again during the alarm pause to reactivate alarms. If no alarm is sounding, press this key to start an alarm pause. If your transport monitor is set up for Operating Room mode, you have three levels of alarm pause: ■ Press once (if an alarm is sounding you must press twice) to start a 5-minute alarm pause; ■ Press again to start a 15-minute alarm pause; ■ Press again to start a permanent alarm pause; ■ Press again to reactivate alarms. When set to ***SILENCE ONLY***, this key works as a silence key. Press once to silence alarms; press again to reactivate alarms. Pressing this key when no alarms are occurring does not affect the transport monitor.
F	**Trim Knob** control		The main operator control is the **Trim Knob** control. The **Trim Knob** control rotates in either direction to highlight parameter labels and menu options. After highlighting the desired selection, press the **Trim Knob** control to view a new menu or a small popup menu. This procedure is referred to as “select” throughout the manual. Remember, when using the **Trim Knob** control, rotate to highlight, then press to select.

Transport Monitor Indicators

Power and battery indicators are located on the front panel of the transport monitor.

Indicator	Monitor Label
DC power	
Battery power	
Battery charge	 821A

DC Power Indicator

The indicator illuminates green when power is applied to the transport monitor using the external power supply. The indicator is not illuminated when the transport monitor is not plugged into an electrical outlet.

Battery Power Indicator

The indicator illuminates yellow when the transport monitor is battery powered, when the transport monitor is powered by a TRAM module plugged into a powered Tram-rac housing, or when the transport monitor is powered by the PDM battery. The indicator is not illuminated when the transport monitor is not powered or when using the external power supply.

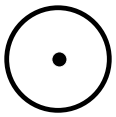
Battery Charging/Ready Indicator

An icon for each transport monitor battery indicates its charging status. The battery charge icon illuminates yellow when the respective battery is being charged. If both batteries are present and require charging, then both icons will illuminate even though they will be charged sequentially. The battery charge icon illuminates green when the respective battery is fully charged.

When the transport monitor is powered by the Patient Data Module or operating under battery power, the battery charge icons are not illuminated. The icons are also not illuminated when the respective battery is either not installed or has failed.

Patient Data Module Indicators

Power and communication indicators are located on the front panel of the Patient Data Module.

Indicator	Patient Data Module Label
Power Indicator	
Communication Indicator	

Power Indicator

- The power indicator illuminates yellow during boot-up and turns green after boot-up.
- The indicator illuminates green when the Patient Data Module is powered by the transport monitor (AC power or transport monitor battery power) and when the Patient Data Module is powered by its own battery.
- The indicator flashes yellow when the battery is almost out of power (5 minutes of battery run-time remaining). See Battery Alarms on page 4-17.
- The indicator is not illuminated when no power is applied to the Patient Data Module.

Communication Indicator

- The communication indicator illuminates yellow during boot-up and turns green after boot-up.
- The indicator flashes yellow if communication fails.
- The indicator is not illuminated when no power is applied to the Patient Data Module.

Turning on the Power

External Power Supply

The transport monitor is powered at all times when using the external power supply (there is no power switch). Refer to the label on the power supply for the voltage and current requirements. This manual contains other important power information. See Chapter 2.

All of the front panel indicators will illuminate until the power-up sequence is complete. After approximately 10 seconds you should see a display on the screen.

Normal Mode

Two modes of operation are available when using the external power supply. The transport monitor will enter ***NORMAL*** mode when plugged into an electrical outlet and the monitoring function is turned **ON**. Normal mode operation provides all functional capabilities of the transport monitor including vital signs monitoring, communications, and battery charging.

Standby Mode

The transport monitor will enter ***STANDBY*** mode when plugged into an electrical outlet and the monitoring function is turned **OFF**. When the transport monitor is in standby mode, the battery charging function is still provided, the acquisition device is still powered, and the DC power indicators remain illuminated.

Off

To turn the transport monitor completely off, you must turn the monitoring function off by pressing the **Power** key on the front of the transport monitor, and then disconnect the external power supply from the electrical outlet.

Additionally, to turn the transport monitor off when the TRAM module is in a Tram-rac housing, it must be removed from the housing or the interconnection cable must be disconnected from the TRAM module.

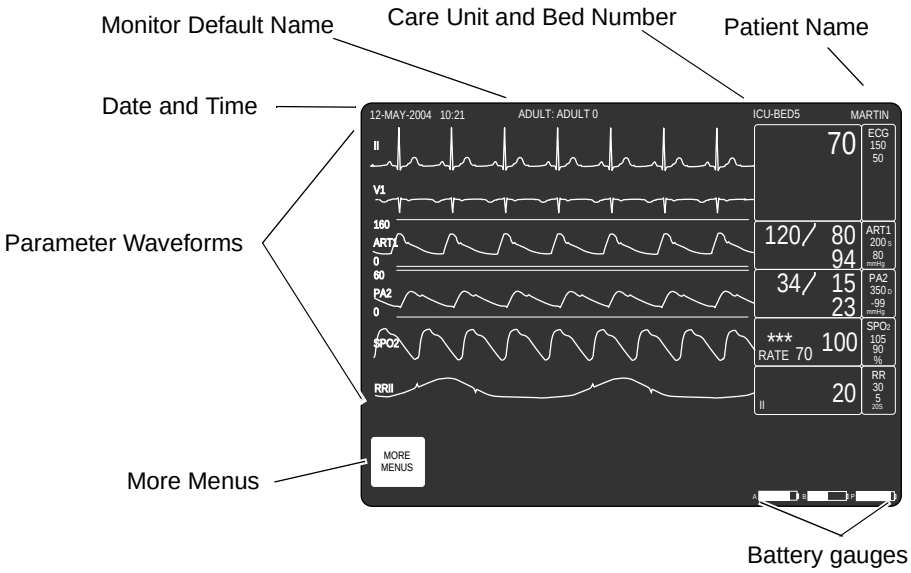
Indicators are not illuminated when the transport monitor is not powered.

Battery Power

The transport monitor is designed to operate on battery power during transport or whenever AC power is interrupted. The transport monitor can be powered by either transport battery, the PDM battery, or any combination thereof via the integrated battery power system. The battery capacity gauges are labeled ***A*** and ***B*** for the respective transport monitor batteries, and ***P*** for the PDM battery. See Chapter 4.

Software Overview

Transport Monitor Display



509D

Menus

A menu is a selection of available options. These options are displayed at the bottom of the screen and are accessed with the **Trim Knob** control. Some menus have some empty spaces. These spaces are available for future software enhancements.

There are two important menu options to note. One or both of these options is found in every menu with the exception of the Main Menu.

- The ***MAIN MENU*** option takes you back to the ***MORE MENUS*** option. Use it when you are finished making adjustments or accessing stored information.
- The ***PREVIOUS MENU*** option allows you to back up to the previous menu when a subordinate menu is displayed.

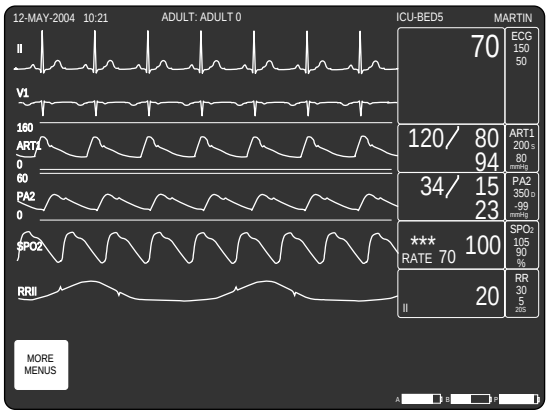
Think of these as escape or exit options.

Menu Timeout

The transport monitor automatically returns to the Main Menu when you have displayed another menu and have not used the **Trim Knob** control for 5 minutes (default time). This is a ***MONITOR DEFAULTS*** display setting which can be set for a longer period of time or no timeout at all. Some menus are not affected by the timeout setting. You must exit them using one of the exit options described above.

Main Menu

The Main Menu has one menu option, ***MORE MENUS***, in the lower left corner of the screen. With the Main Menu displayed, the screen shows all monitored parameters and waveforms



509D

Main Menu

From the Main Menu, you can access a parameter menu by selecting the appropriate parameter label, or you can access other menus (not related to a specific parameter) by selecting the ***MORE MENUS*** option.

Parameter Menus

Each parameter has its own menu from which to access features. Below is an example of the ECG parameter menu when using a Patient Data Module.

MAIN MENU	DISPLAY: LEAD II	ECG SIZE: 1X	DETECT PACE: OFF	ECG LIMITS	VIEW ALL ECG	UPDATE LEAD SET
ARRHYTHMIA: ON	RELEARN			IDENTIFY V LEAD: V1	IDENTIFY VB LEAD: V5	MORE ECG

851B

ECG Parameter Menu

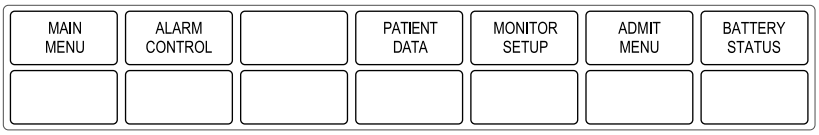
The Main Menu must be displayed to access a parameter menu.

To access a parameter menu (e.g., ECG), highlight a parameter label and then press the **Trim Knob** control.

Each parameter menu is discussed in detail in the specific parameter chapter.

More Menus

In the lower left corner of the Main Menu is the ***MORE MENUS*** option. Select this option to display the following menu.



511B

More Menus Menu

- ***ALARM CONTROL*** — This option displays a menu which allows you to view and modify all alarm limits, change alarm levels, and adjust alarm volume.
- ***PATIENT DATA*** — This option displays a menu which allows you to view patient data graphic trends. (This option only appears when an acquisition device is connected.)
- ***MONITOR SETUP*** — This option displays a menu which allows you to set up the transport monitor to suit your needs—waveforms displayed, color scheme, parameters on/off, monitor defaults, etc. The service menu is accessed here also.
- ***ADMIT MENU*** — This option displays a menu to enter patient information. (In Operating Room mode, this option reads ***NEW CASE SETUP***. This option only appears when an acquisition device is connected.)
- ***BATTERY STATUS*** — This menu option opens a menu and information window that provides current battery status information.

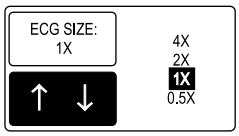
Each of these options is covered in more detail in following chapters.

Popup Menus

When some menu options are selected, a small menu “pops up” around the selected menu option. These are called popup menus. There are different types of popup menus. Those most commonly used are described below.

Note that with all popup menus, the original menu remains on the screen but the options are dimmed. The popup menu must be closed before you can select other options from the original menu.

Scrolling Popup



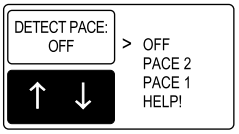
512C

Scrolling Popup Menu

All available selections appear, with the current selection highlighted. The arrows are also highlighted, indicating that the **Trim Knob** control can be rotated (scrolled) to change the selection. When the **Trim Knob** control is rotated, the new selection is highlighted and the change occurs immediately on the screen so that the user can see

if the selection is appropriate before exiting the popup. Press the **Trim Knob** control to close the popup menu.

Pointer Popup

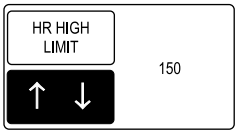


513C

Pointer Popup Menu

All available selections appear and a pointer (>) is displayed. The arrows are highlighted, indicating that the **Trim Knob** control can be rotated to move the pointer to another selection. However, before the change is actually implemented, the **Trim Knob** control must be pressed. The popup menu closes and the change is in effect.

Numeric Popup



514C

Numeric Popup Menu

The available selections are many; therefore, only the current selection is displayed. The arrows are highlighted indicating the **Trim Knob** control can be rotated. Rotate the **Trim Knob** control to enter a new value. Like the pointer popup, the change will not be in effect until the **Trim Knob** control is pressed.

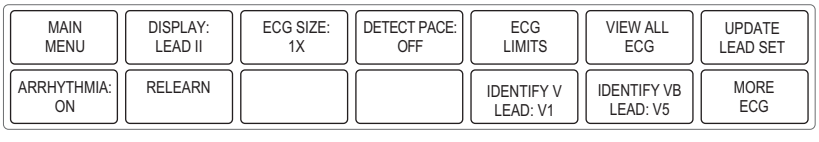
Subordinate Menus

Whenever possible, short popup menus are displayed when selecting menu options. In some cases, however, a whole new menu is displayed. This is a menu within a menu, or a subordinate menu.

Many, but not all, subordinate menus have the ***PREVIOUS MENU*** option to allow you to return to the previously displayed menu.

Following is an example of a subordinate ***ECG*** menu when using a Patient Data Module:

Display the ***ECG*** menu.



851B

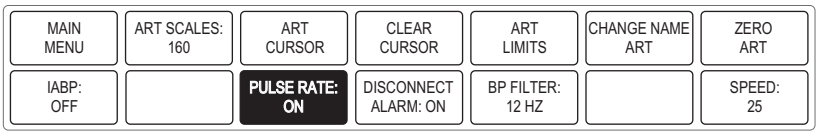
From the ***ECG*** menu select ***ECG LIMITS***. The entire ***ECG*** menu is replaced with the subordinate ***ECG LIMITS*** menu.

515B

Select ***PREVIOUS MENU*** to redisplay the ECG menu.

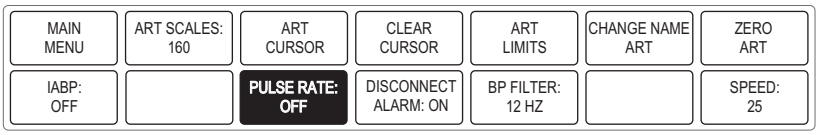
Direct Action Menu Options

A direct action menu option, when selected, displays neither a popup menu nor a subordinate menu. The option either turns a feature on or off, or starts a processing function. For example, selecting the ***PULSE RATE: ON*** option from the ***ART*** parameter menu turns the arterial pulse rate feature off. In ON/OFF cases, the menu option reflects the current state; selecting it switches to the other state.



516C

PULSE RATE: ON



517C

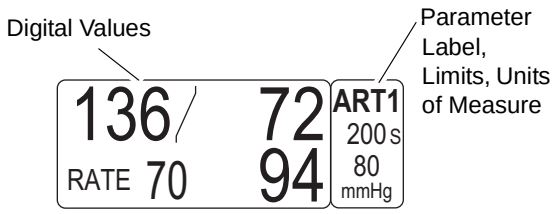
PULSE RATE: OFF

Other direct action options start a process. For example, selecting the ***RELEARN*** option from the ECG parameter menu tells the transport monitor to immediately start to relearn the patient's ECG rhythm. You cannot stop these processes as they are short term and stop automatically; therefore, the words identifying the menu option do not change as in on/off actions.

Parameter Windows

Parameter windows are displayed on the far right side of the screen, and, when necessary, across the bottom. Every monitored parameter has a parameter window.

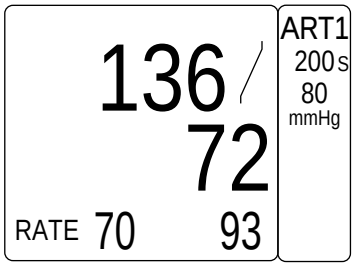
Each parameter window has two parts — a parameter label and digital values. Depending on how you have set your defaults, limits and units of measure may be displayed under the parameter label.



518A

ART Parameter Window

Parameter windows are displayed in different sizes depending on the display layout and the number of parameters you are monitoring. Following are examples of parameter windows at double high size (twice the height of a normal parameter block), normal size, and reduced size.

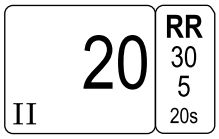


519A

ART Parameter Window, Double High Size

The double high parameter window is displayed when monitoring in the ***INDV 3 WFS*** (individual 3 waveforms) display mode.

CVP Parameter Window, Normal Size



Respiration Parameter Window, Reduced Size

684A & 521A

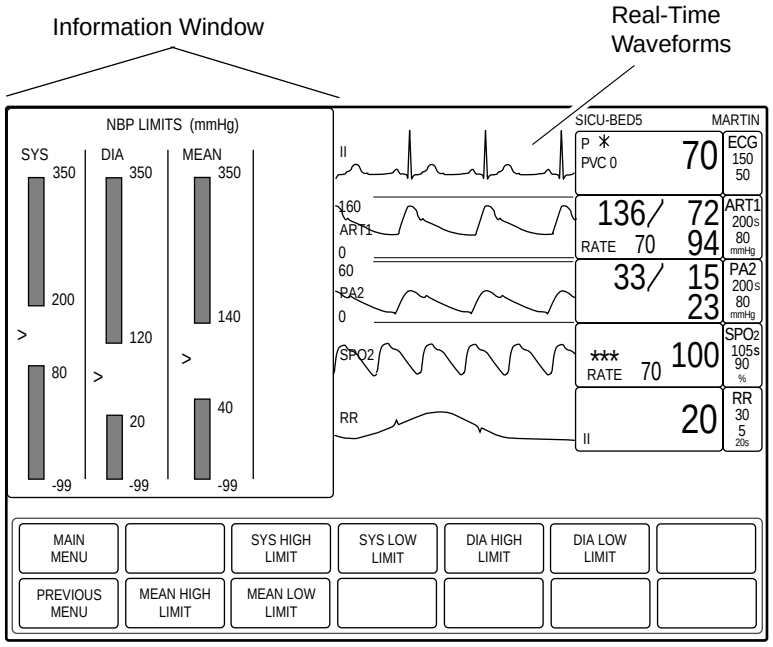
Parameters windows which may be displayed in reduced size when positioned at the bottom of the screen are: CVP, RA, UVC, LA, ICP, SP, SPO2, RESP, and TEMP.

Information Windows

Another window that is sometimes displayed on the screen is called an information window. This large window is superimposed over the upper left portion of the screen. Up to six parameter windows and 2 seconds of all the real-time waveforms continue to be displayed.

Information windows are displayed when a Help option is selected and with certain menu options, such as Limits. The information window contains instructions or other non-realtime information.

Following is an example of an information window:



503A

NBP Limits Information Window

Sometimes an information window will contain a list. The window is limited to the amount of information that can be displayed at one time. There may be more information to view, but not enough room to display it at one time. If this is the case, an arrow is displayed at the bottom of the information window.

If a popup menu is displayed with the window, you must turn the **Trim Knob** control to scroll to more information. If a menu is displayed you must select the ***PAGE UP*** or ***PAGE DOWN*** option to display more information.

↓	There is more information. Scroll down or use ***PAGE DOWN*** to display more information.
↑↓	You are in the middle of the list. Scroll up or down, or use ***PAGE UP*** or ***PAGE DOWN*** to display additional information.
↑	You are at the end of the list. Scroll up or use ***PAGE UP*** to display additional information.

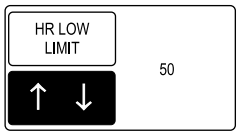
Trim Knob Control Operation When Setting Alarm Limits

Limits which trigger alarms for monitored parameters can be modified. You should refer to the specific parameter chapter for details. When setting alarm limits, the following information is helpful and applies to most parameters.

The **Trim Knob** control will always increase (or decrease) the displayed number in increments of one for the first five numbers. Thereafter, it increases (or decreases) in increments of five. There may be situations where the limit you wish to modify does not fall into this incremental sequence. For example, the low heart rate limit default is 50. For your patient, a limit of 44 is desired.

The fastest way to achieve this using the **Trim Knob** control is to use the following procedure:

1. Open the ***HR LOW LIMIT*** popup menu. The number 50 is displayed.



783C

HR Low Limit Popup Menu

2. Rotate the **Trim Knob** control until the number reads 45. It will follow this sequence: 49, 48, 47, 46, 45.

   NOTE

   The next rotation will take the number to 40 which, in this instance, is too low.

3. Close the popup menu when the number is 45 and immediately open it again.

4. Rotate the **Trim Knob** control to 44.

   NOTE

   Closing the popup menu and then reopening it allows you to reset again in increments of one.

The same principle applies when setting limits for other parameters.

Putting the Transport Monitor Into Operation

Transport Monitor Installation and Connection

WARNING

Before using the transport monitor for the first time, read the safety information. See Chapter 2.

The operating position does not influence the performance of the transport monitor in any way.

- Choose a location which affords an unobstructed view of the transport monitor screen and easy access to the operating controls.

WARNING

Do *not* install the monitor above a patient.

The potential exists for a battery to leak a chemical on the patient if the monitor is mounted above the patient.

- Set up the device in a location which affords sufficient ventilation. The ventilation openings of the device must not be obstructed (by external equipment, walls or blankets, for instance). The ambient conditions specified in the Technical Specifications section of the service manual must be ensured at all times.
- The transport monitor is designed to comply with the requirements of IEC 60601/EN 60601.
- If monitoring with the external power supply, connect the power cord to the power line. Use only the original cord or an equivalent one.

WARNING

When the external power supply is the power source, the monitor must be connected to a properly installed power outlet with protective earth contacts only. If the installation does not provide for a protective earth conductor, disconnect the monitor from the power line and operate it on battery power.

WARNING

For safety reasons, all connectors for patient cables and sensor leads are designed to prevent inadvertent disconnection, should someone pull on the leads.

Do not route cables in a way that they may present a stumbling hazard. Do not install the monitor in a location where it may drop on the patient. All consoles and brackets used must have a raised edge at the front.

Performance Check

Turn on the device with the power switch on the front of the transport monitor.

- All of the front panel indicators will illuminate until the power-up sequence is complete.
- An information window appears on the transport monitor after approximately 10 seconds.
- Patient monitoring begins once communication with the acquisition device has been established.

After power-up and during operation the transport monitor runs automatic self-tests. When a malfunction is detected, the transport monitor displays a message and a prompt, asking whether the user wishes to continue operation.

WARNING

If this message appears *during* operation, it is the physician's responsibility to decide whether the unit is still suitable for patient monitoring. As a general rule, monitoring with this unit should continue only in extremely urgent cases and under the supervision of a physician. The unit must be repaired before being used again on a patient. If this message appears *after* power-up, the unit must be repaired before being used on a patient.

Language-Specific Information

The following information describes differences in the transport monitor functionality when the transport monitor is set to certain languages.

Chinese and Japanese Language Information

When the transport monitor language is set to Chinese or Japanese, all text input is in English only (i.e., text for unit name, bed name, patient information, and custom default name).

French Language Information

When the transport monitor ***LOCALE*** (language) is set to French_France, alarm pause duration is three minutes. See Pausing Alarms on page 7-5.

2 Safety

For Your Safety

Intended Use

The transport monitoring system (includes the Patient Data Module (PDM) and Transport Monitor) is intended for use under the direct supervision of a licensed healthcare practitioner, or by personnel trained in proper use of the equipment in a professional medical facility, such as a hospital, clinic, surgical center or doctor's office. It can be used in multiple areas such as operating room (OR), post anesthesia care unit (PACU), emergency department (ED), chest pain clinic, general intensive care unit (ICU), critical care unit, surgical intensive care unit (SICU), respiratory intensive care unit, coronary care unit (CCU), medical intensive care unit (MICU), pediatric intensive care unit (PICU), or neonatal intensive care unit (NICU).

The Patient Data Module (PDM) is intended to provide uninterrupted acquisition of physiologic parameter data on adult, pediatric and neonatal patients during non-transport/bedside and transport patient care episodes. Physiological parameter data acquired by the PDM includes ECG, invasive pressure, non-invasive blood pressure, pulse oximetry, temperature, cardiac output and respiration. This device acquires, processes and stores information for all aforementioned parameters and transmits this information to a transport or bedside central processing unit for viewing and alarm surveillance purposes.

The Transport Monitor is intended for use as part of a transport monitoring system for intra-healthcare facility transport. When used with the Patient Data Module (PDM) or the TRAM acquisition module, this device is intended to provide uninterrupted monitoring of physiologic parameter data for adult, pediatric, and neonatal patients during transport from one area of the healthcare facility to another. Physiological parameter data includes ECG, invasive pressure, non-invasive blood pressure, pulse oximetry, temperature and respiration. Both the PDM and TRAM acquisition module acquire, process and store information for all aforementioned parameters.

Terminology

The terms danger, warning, and caution are used throughout this manual to point out hazards and to designate a degree or level of 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.

Transport Monitor Safety

The safety statements presented in this chapter refer to the equipment in general and, in most cases, apply to all aspects of the transport monitor. There are additional safety statements in the parameter chapters which are specific to that monitored parameter.

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

WARNING

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.

WARNING

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

WARNING

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

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

WARNING

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.

WARNING

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

WARNING

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.

WARNING

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

WARNING

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.

WARNING

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

WARNING

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

WARNING

EXPLOSION OR FIRE—Using non-recommended batteries could result in injury/burns to the patients or users.

Only use batteries recommended or manufactured by GE. The warranty can be voided if non-recommended batteries are used.

WARNING

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 EN 60601-1-1 must be complied with.

WARNING

INTRACARDIAC APPLICATION— When applying devices intracardially, electrically conductive contact with parts connected to the heart (pressure transducers, metal tube connections and stopcocks, guide wires, etc.) must be avoided in all cases.

To prevent electrical contact, we recommend the following:

- always wear isolating rubber gloves
- keep parts that are conductively connected to the heart isolated from ground
- if possible, do not use tube fittings or stopcocks made of metal

During intracardiac application of a device, a defibrillator and pacemaker whose proper functioning has been verified must be kept at hand.

WARNING

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.

WARNING

PATIENT AMBULATION— A patient must be assisted if ambulating with a roll-stand mounted monitor.

WARNING

PHYSICAL INJURY—Do *not* install the monitor above a patient. Make sure the batteries are completely inserted and battery doors are completely closed.

Falling batteries could seriously or fatally injure neonatal or other vulnerable patients.

WARNING

PHYSICAL INJURY—Do *not* install the monitor above a patient. The potential exists for a battery to leak a chemical on the patient if the monitor is mounted above the patient.

Leaks from battery cells can occur under extreme conditions. The liquid is caustic to the eyes and skin. If the liquid comes in contact with eyes or skin, flush with clean water and seek medical attention.

WARNING

PHYSICAL INJURY—Do *not* install monitoring devices or accessories above the patient's head.

Falling equipment could seriously hurt or fatally injure neonatal or other vulnerable patients.

WARNING

PHYSICAL INJURY—Do *not* hang equipment or accessories on the IV pole that are not related to the Patient Data Module’s use.

Excessive equipment or accessories may cause the IV pole to become unbalanced and tip over. A falling IV pole could seriously hurt or fatally injure neonatal or other vulnerable patients.

WARNING

PHYSICAL INJURY—Do *not* mount the Patient Data Module more than 147 cm (58 in) from the floor when mounting on an IV pole with a base not less than 58 cm (23 in) in diameter.

Doing so may cause the IV pole to become unbalanced and tip over. A falling IV pole could seriously hurt or fatally injure neonatal or other vulnerable patients.

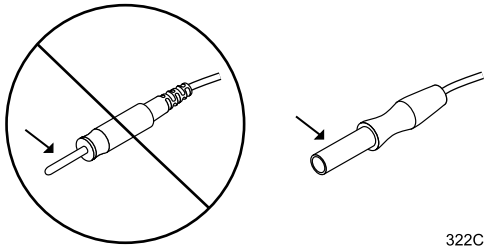
WARNING

POWER SUPPLY—The device must be connected to a properly installed power outlet with protective earth contacts only. If the installation does not provide for a protective earth conductor, disconnect the monitor from the power line and operate it on battery power, if possible.

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).

WARNING

PROTECTED LEADWIRES—



Only use protected leadwires and patient cables with this monitor.

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.

WARNING

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.

WARNING

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.

Cautions

CAUTION

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

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

CAUTION

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 EN 60601-1 and/or EN 60601-1-1 harmonized national standard.

CAUTION

BATTERY POWER —If a device equipped with an optional battery pack will not be used or not be connected to the power line for a period of over six months, remove the battery.

CAUTION

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.

CAUTION

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.

CAUTION

DISPOSABLES— Disposable devices are intended for single use only.

They should not be reused as performance could degrade or contamination could occur.

CAUTION

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 or its representatives.

CAUTION

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.

CAUTION

ELECTRODES— Whenever patient defibrillation is a possibility, use non-polarizing (silver/silver chloride construction) electrodes for ECG monitoring. Polarizing electrodes (stainless steel or silver constructed) may cause the electrodes to retain a residual charge after defibrillation.

A residual charge will block acquisition of the ECG signal.

CAUTION

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 monitor 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.

CAUTION

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.

CAUTION

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.

If the monitor does not automatically resume operation within 60 seconds, power cycle the monitor using the power on/off switch. Once monitoring is restored, you should verify correct monitoring state and alarm function.

CAUTION

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

CAUTION

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.

CAUTION

NEGLIGENCE —GE 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.

CAUTION

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.

CAUTION

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.

In U.S.A., if the installation of this equipment will use 240V rather than 120V, the source must be a center-tapped, 240V, single-phase circuit.

This equipment is suitable for connection to public mains as defined in CISPR 11.

CAUTION

PREVENTIVE MAINTENANCE— If the monitor displays the message “EC1,” contact your biomedical department immediately to perform the yearly preventive maintenance as described in the service manual.

CAUTION

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

CAUTION

SINGLE PATIENT USE— This equipment is designed for use on one patient at a time.

Using this equipment to monitor different parameters on different patients at the same time compromises the accuracy of data acquired.

CAUTION

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

CAUTION

TRANSPORT USE —The transport monitor is approved by the U.S. Food and Drug Administration for use as a transport monitor. It is not intended or approved for use as a stand-alone bedside monitor.

CAUTION

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 monitor 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 pacemaker 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. (The screen may blank during a defibrillator discharge but recovers within seconds as required by test standards.)
- This equipment is suitable for use in the presence of electrosurgery.

Classifications

The device is classified, according to IEC/UL/EN 60601-1, as:

Type of protection against electrical shock	Class II (internally powered equipment)
Degree of protection against electrical shock	Not classified - no applied parts
Degree of protection against harmful ingress of water	IPX0 (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, oxygen or nitrous oxide
Method(s) of sterilization or disinfection recommended by the manufacturer	Not applicable
Mode of operation	Continuous operation

Underwriters Laboratories, Inc.

4P41

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

Equipment Symbols

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.

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.

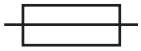
[Medical Standard Definition:] F-type applied part (floating/isolated) complying with the specified requirements of EN 60601-1/UL 60601-1/CAN/CSA C22.2 No. 601.1 Medical Standards to provide a higher degree of protection against electric shock than that provided by type BF applied parts.

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 EN 60601-1/UL 60601-1/CAN/CSA C22.2 No. 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 EN 60601-1/UL 60601-1/CAN/CSA C22.2 No. 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

Direct current (DC)

Battery

Battery charging

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

2006-08

This symbol indicates the date of manufacture of this device. The first four digits identify the year and the last two digits identify the month.

Non-ionizing electromagnetic radiation: To indicate elevated, potentially dangerous, levels of non-ionizing radiation. Note - In case of application in a warning sign the rules according to ISO 3864-1 shall be adhered to.

IEC 60878 note: See safety sign ISO 7010 - W005 “Warning, non-ionizing radiation”.

NOTE

The following symbols (required by China law *only*) are representative of what you may see on your equipment.

The number in the symbol indicates the EFUP period in years, as explained below. Check the symbol on your equipment for its EFUP period.

This symbol indicates the product contains hazardous materials in excess of the limits established by the Chinese standard SJ/T11363-2006 *Requirements for Concentration Limits for Certain Hazardous Substances in Electronic Information Products*. The number in the symbol is the Environment-friendly User Period (EFUP), which indicates the period during which the toxic or hazardous substances or elements contained in electronic information products will not leak or mutate under normal operating conditions so that the use of such electronic information products will not result in any severe environmental pollution, any bodily injury or damage to any assets. The unit of the period is “Year”.

In order to maintain the declared EFUP, the product shall be operated normally according to the instructions and environmental conditions as defined in the product manual, and periodic maintenance schedules specified in Product Maintenance Procedures shall be followed strictly.

Consumables or certain parts may have their own label with an EFUP value less than the product. Periodic replacement of those consumables or parts to maintain the declared EFUP shall be done in accordance with the Product Maintenance Procedures. This product must not be disposed of as unsorted municipal waste, and must be collected separately and handled properly after decommissioning.

This symbol indicates that this electronic information product does not contain any toxic or hazardous substance or elements above the maximum concentration value established by the Chinese standard SJ/T11363-2006, and can be recycled after being discarded, and should not be casually discarded.

3 Maintenance

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 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 biomed department.

WARNING

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 has 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 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 manual for more comprehensive checkout procedures.

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.

General Cleaning/Disinfecting

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 soft, lint-free cloth, using the following solution, as recommended in the APIC Guideline for Selection and Use of Disinfectants (1996):

- Sodium hypochlorite (5.2% household bleach) 1:500 dilution (100 ppm free chlorine)

CAUTION

Severe corrosion may occur to any metal parts that come in contact with non-diluted bleach.

To avoid damage to the equipment, follow these rules:

- Always dilute the solutions according to the manufacturer's suggestions.
- Always wipe off all the cleaning solution with a dry, lint free cloth after cleaning or let air dry for at least 15 minutes.
- Never use conductive solutions, solutions that contain chlorides, wax, or wax compounds.
- 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,
  - quaternary ammonium solutions
  - alcohol-based cleaning agents, or
  - Betadine

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.

Cleaning, Disinfecting and Storing GE ECG Cables and Leadwires

Cleaning and Disinfecting

1. Remove cables and leadwires from the handheld device or system before cleaning.
2. Use care in cleaning leadwires to prevent pulling the long wires from the connector ends. Metal connections can be pulled away from the connectors.

3. For general cleaning of cables and leadwires, wipe using a lightly moistened cloth with a mild soap and water solution. Then wipe and air dry.
4. For disinfecting the cables and leadwires, wipe exterior with a soft lint-free cloth, using the following solution as recommended in the APIC Guidelines for Selection and Use of Disinfectants (1996):
   - Sodium hypochlorite (5.2% household bleach) minimum 1:500 dilution (minimum 100 ppm free chlorine) and maximum 1:10 dilution.
   - Any sodium hypochlorite wipe product that meets the above guidelines can be used.

     NOTE

     Wring excess disinfectant from wipe before using.

   NOTE

   Any contact of disinfectant solutions with metal parts may cause corrosion.
5. Do *not* immerse either end of a cable or leadwire connector. Immersing or "soaking" the connector ends may corrode metal contact ends and affect signal quality.
6. Wipe off cleaning solutions with a clean, lightly moistened cloth.
7. Dry thoroughly with a dry, lint-free cloth and let air dry for at least 30 minutes.

   NOTE

   Drying times may vary based on the environmental conditions.
8. Take care not to let fluid "pool" around connection pins. If this should happen, blot dry with a soft, lint-free cloth.
9. *Do not* use excessive drying techniques, such as oven, forced heat or sun drying.

Sterilization

NOTE

EtO sterilization is *not recommended*, but may be required for cables and leadwires. Frequent sterilization will reduce the useful life of cables and leadwires.

Sterilize with ethylene oxide gas (EtO) at a maximum temperature of 50° C (122° F). After EtO sterilization, follow the recommendations from the sterilizer manufacturer for required aeration.

Cautions

- Never immerse the handheld device, cables, or leadwires in any liquid.
- Do not pour or spray any liquid directly on cables or leadwires or permit fluid to seep into connections or openings.
- Never use conductive solutions, solutions that contain chlorides, wax, or wax compounds to clean handheld devices, cables or leadwires.
- Never use solutions or products that contain the following:

  - Any type of Ammonium Chloride such as, but not limited to: Dimethyl Benzyl Ammonium Chloride or Quaternary Ammonium Chloride solutions
  - Abrasive cleaners or solvents of any kind
  - Acetone
  - Ketone
  - Betadine
  - Alcohol-based cleaning agents
  - Sodium salts
- Never autoclave or steam clean cables or leadwires.

Storage

- Store in a dry well-ventilated area.
- Vertically hang cables and leadwires.
- Do not coil leadwires or cables tightly around any medical device.

Improper Cleaning Products and Processes Impact/Results

- Product discoloration.
- Metal part corrosion.
- Brittle wires.
- Brittle and breaking connectors.
- Reduced cables and leadwires life.
- Unit malfunction.
- Void warranty.

Cleaning Products to Avoid

Cleaning products known to cause the types of problems listed above include, but are not limited to:

- Sani-Cloth® Wipes
- Ascepti® Wipes
- HB Quat
- Clorox® Wipes (they do not contain bleach).
- Over-the-counter detergents (e.g. Fantastic®, Tilex®, etc.).

Products that contain active ingredients and solutions similar to these products should also be avoided.

Cleaning the Display

To clean the display screen, use a soft, clean cloth dampened with a glass cleaner. Never spray the glass cleaner directly onto the display, and never use alcohol or hospital disinfectants like Cidex or Betadine.

Cleaning Other Applied Parts

For other applied parts such as temperature sensors, catheters, pulse oximetry probes, and NBP cuffs, you must consult the manufacturer for cleaning, sterilization, or disinfecting methods.

More Intensive Disinfecting or Sterilization

CAUTION

The decision to sterilize must be made per your institution's requirements with an awareness of the effect on the integrity of the equipment and applied parts.

Technical Maintenance

Technical specifications 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.

Safety Tests

- Safety tests should be performed every 12 months.
- Safety tests may only be performed by qualified personnel not subject to directives with respect to these tests.
- If a service contract exists, safety tests may be performed by GE service personnel.
- Detailed information about safety tests can be found in the service manual.
- No additional regular maintenance is required.

Temperature Testing

Check both temperature channels during normal operation.

Use temperature simulator 22010401.

Requirements: Only use standards that guarantee sufficient accuracy. All such standards must be based on national or European standards.

Connect the temperature simulator to the monitor with connector 402015-004. Verify that the switch on the connector is set to 400.

Check the temperature values at the following simulator settings:

Simulator Setting	Displayed Values
43.8° C	43.6° C - 44.0° C
38.8° C	38.6° C - 39.0° C
30.0° C	29.8° C - 30.2° C
4.0° C	3.8° C - 4.2° C
open	Sensor
short	Sensor

4 Batteries

Battery Power

The transport monitor is designed to operate on battery power during transport or whenever AC power is interrupted. The transport monitor can be powered by either transport battery, the PDM battery, or any combination thereof.

A complete battery management system consisting of two transport monitor batteries and one PDM battery provides maximum battery performance. The transport monitor uses two rechargeable lithium-ion battery packs. One battery pack can easily be exchanged while the monitor operates from the other. The battery compartments for the battery packs are located on the left side of the transport monitor.

The Patient Data Module uses one rechargeable lithium-ion battery. The PDM battery and the transport monitor batteries contain an integrated electronic fuel gauge and a safety protection circuit.

NOTE

This section includes instructions for the safe use and handling of the batteries. See Safety on page 4-11.

Battery System Run Time

The transport monitor can get up to five hours of battery run time with combined use of the PDM battery and both transport monitor batteries. The table below represents run times for new batteries that have 100% capacity and are charged to 100% of this capacity (fully-charged). As the charge capacity declines, due to aging, the approximate run time of a fully charged battery will decrease. See Battery Capacity Gauges on page 4-4.

NOTE

Monitoring NBP and SpO_2 will drain battery power faster than other parameters. The display brightness can also alter battery run times.

PDM battery	Transport Batteries	Approximate Run Time
1	0	1 Hour
0	1	2 Hours
1	1	3 Hours
0	2	4 Hours
1	2	5 Hours

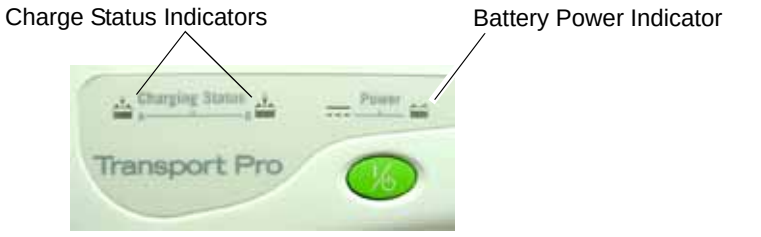
NOTE

A ***"BATTERY LOW"*** message at the top of the screen warns you prior to complete loss of battery power. You should replace the battery or use the external power supply when the message is displayed.

Battery Indicators

Transport Monitor Indicators

Battery indicators are located on the front panel of the transport monitor. They alert you to when battery power is being used or provide the battery charging status.



Transport Monitor Battery Indicators

Battery Power Indicator

The indicator illuminates yellow when the transport monitor is battery powered, when the transport monitor is powered by a TRAM module plugged into a powered Tram-rac housing, or when the transport monitor is powered by the PDM battery.

The indicator is not illuminated when using the optional external power supply, or when no power is applied.

Charge Status Indicators

An icon for each transport monitor battery indicates its charging status. The battery charging icon illuminates yellow when the respective battery is being charged. If both batteries are present and require charging, then both icons will illuminate even though they will be charged sequentially. The battery charging icon illuminates green when the respective battery is fully charged.

When the transport monitor is operating under battery power the battery charging icons will not be illuminated. The icons are also not illuminated when the respective battery is either not being charged, not installed, or has failed.

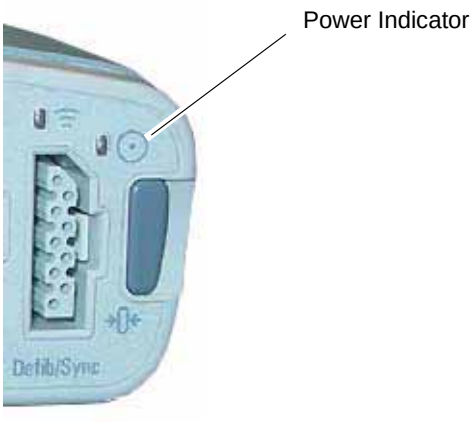
Battery Status Indicators

The battery status indicators (not shown) are located within the battery compartment and can be viewed through the battery door. One green LED indicator is located below battery slot A and one is located above battery slot B. When the transport monitor is operating on battery power, one of the LEDs will illuminate to indicate which battery is powering the unit.

Patient Data Module Indicators

A power indicator is located on the front panel of the Patient Data Module.

- The power indicator illuminates yellow during boot-up and turns green after boot-up.
- The indicator illuminates green when the Patient Data Module is powered by the transport monitor (AC power or transport battery power) and when the Patient Data Module is powered by its own battery.
- The indicator flashes yellow when the battery is almost out of power (5 minutes of battery run-time remaining). See Battery Alarms on page 4-17.
- The indicator is not illuminated when no power is applied to the Patient Data Module.



849A

Patient Data Module Power Indicator

Charge Status Indicator

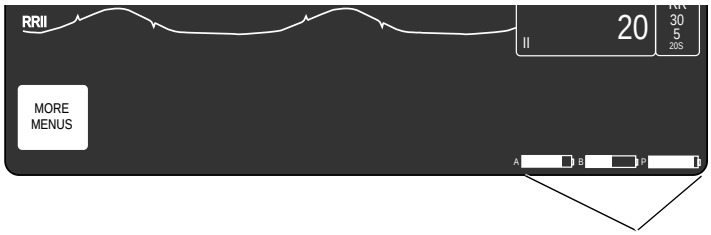
The PDM battery is charged when the battery is installed in a Patient Data Module that is connected to a transport monitor powered by AC power. The PDM battery capacity gauge appears in the lower right corner of the transport monitor display, indicating the charge status of the battery.

Battery Capacity Gauges

On-screen Capacity Gauges

On-screen capacity gauges indicate battery charge condition and capacity of the total battery system. The total battery system refers to the combination of batteries within the transport monitor and the Patient Data Module.

A battery capacity gauge for each battery present in the transport monitor system is displayed below the parameter blocks in the lower right corner of the display. The capacity gauge indicates the charge capacity (usable energy remaining) for each battery.



509D

Location of Battery Capacity Gauges on the Display

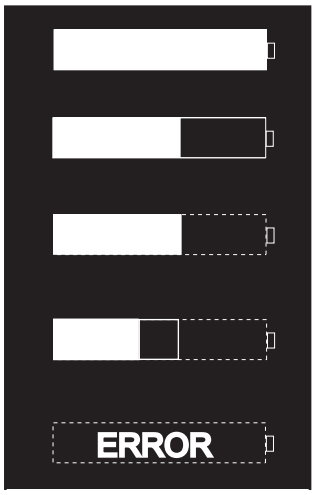
NOTE

The illustration above represents the battery capacity gauges when using the transport monitor with a Patient Data Module. The battery capacity gauges are labeled ***A*** and ***B*** for the transport monitor batteries, and ***P*** for the PDM battery.

On-screen Capacity Gauges Description

The on-screen capacity gauges are filled in from left to right proportional with the battery charge level.

- The solid portion represents the current charge level of the battery as a percentage of its maximum charge level.
- The solid outlined portion represents the maximum charge level for the battery. As the battery wears, this level becomes a smaller percentage of the full rated capacity shown by the dashed line.
- The dashed outlined portion represents the full rated capacity of an older battery that has lost some of its capacity due to aging.



New battery, fully charged.

New battery, approximately 60% charged.

Old battery, fully charged with approximately 40% of its capacity lost due to age.

Old battery, charged to approximately 75% of its current capacity (less than half of its new capacity).

Battery status in question. Refer to the BATTERY STATUS information window for specifics.

635B

Capacity Gauges on the Batteries

Press the **TEST** button on the Patient Data Module and transport monitor batteries to check the percentage of charge capacity remaining before they are inserted into the Patient Data Module or transport monitor (see table below).

860A

Transport Pro Battery

848A

PDM Battery

	Name	Description
A	Battery Charge Test Button	Press this button to illuminate the charge LEDs and check the approximate percentage of remaining charge.
B	Remaining Charge LEDs	Measures the approximate percentage of remaining charge in 25% increments. The number of LEDs that illuminate designates the remaining percentage of charge. ■ 4 LEDs illuminated = 75% to 100% of full charge capacity remaining ■ 3 LEDs illuminated = 50% to 74.9% of full charge capacity remaining ■ 2 LEDs illuminated = 25% to 49.9% of full charge capacity remaining ■ 1 LED illuminated = 10% to 24.9% of full charge capacity remaining ■ 1 LED flashing = < 10% of full charge capacity remaining

Battery Maintenance

How to Charge the Battery

Overview

A battery experiences a short cycle when it is charged before it is completely discharged. Short cycles result in a battery's full charge capacity becoming a smaller percentage of its original capacity and predicted run times becoming increasingly inaccurate. After too many short cycles, the battery will request a ***CONDITIONING*** cycle. (See Battery Status Menu on page 4-14.) The length of time between requests for conditioning cycles can be lengthened by using one battery until it is empty before allowing it to be charged.

A battery can be charged by one of two methods:

- With the batteries installed in a transport monitor or Patient Data Module that is connected to an AC power source.
- With the batteries removed from a transport monitor or Patient Data Module and charged using the Cadex SMart Two+ charger.

NOTE

To extend the life of the battery, GE recommends that you charge the battery using the Cadex SMart Two+ charger.

Charging the Battery With a Cadex SMart Two+ Charger

1. Insert the battery into the battery charger. The **RUN** LED illuminates.
2. Leave the battery in the battery charger until the **READY** LED illuminates.

NOTE

If the **FAIL** LED illuminates, remove the battery from the battery charger and reinsert it. This will correct any battery charger time-out errors.

Charging the Battery Inside the Transport Monitor or Patient Data Module

When you store the battery inside a transport monitor or Patient Data Module that is connected to an AC power source (a state known as "floating"), the battery will self-discharge to less than 90% of its Full Charge Capacity after approximately two weeks (depending upon the temperature of the battery). At this time, the monitor will automatically recharge the battery to 100% of its Full Charge Capacity.

- The transport battery is charged whenever the transport monitor is connected to AC power regardless of whether or not the transport monitor is currently on. A fully depleted battery will take approximately two hours to fully charge.
- The PDM battery is charged whenever the Patient Data Module is connected to the transport monitor and the monitor is using AC power.

How to Condition the Battery

The battery can be conditioned by one of two methods:

- With the batteries installed in a transport monitor or Patient Data Module that is connected to an AC power source.
- With the batteries removed from a transport monitor or Patient Data Module and conditioned using the Cadex SMart Two+ charger.

NOTE

To extend the life of the battery, GE recommends that you condition the battery using the Cadex SMart Two+ charger.

Conditioning the Battery With a Cadex SMart Two+ Charger

A conditioning cycle using the battery charger requires approximately nine hours to complete. Complete the following steps to automatically condition the battery.

1. Insert the battery into the battery charger.
2. Press the **CONDITION** button when one of the following conditions occur:
   - While the **RUN** LED light is still flashing.
   - While the **CONDITION** LED is flashing.
3. Remove the battery from the battery charger when the **RUN** LED illuminates. This completes the conditioning cycle.

Conditioning the Battery Inside a Transport Monitor

A battery conditioning cycle is one complete, uninterrupted charge of the battery then a complete, uninterrupted discharge of the battery followed by a complete, uninterrupted recharge of the battery. Batteries should be conditioned regularly to maintain their useful life. Condition a battery once every six months, when the run time of the battery becomes noticeably shorter, when the predicted run times become noticeably inaccurate, or when the associated battery is requesting a conditioning cycle (i.e., ***CONDITION*** is displayed for ***BATTERY QUALITY*** in the Battery Status information window).

To condition a battery on the transport monitor, follow this procedure:

WARNING

PATIENT RISK HAZARD—Never condition a battery while the bedside monitor or transport monitor is connected to a patient. Serious injury or death could result.

1. Disconnect the transport monitor from the patient and remove it from service.
2. Remove one of the batteries from the transport monitor.
3. Access the transport monitor's ***Battery Status*** window to monitor the battery's Charge Level.

4. Allow the battery to discharge to less than a 90% Charge Level.
5. Using the external power supply, apply AC power to the transport monitor and allow the battery to charge uninterrupted until the **Charging Status** indicator on the front panel turns green.
6. Remove AC power and allow the transport monitor to run from the battery until it shuts off.
7. Apply AC power again to the transport monitor and allow the battery to charge uninterrupted until the **Charging Status** indicator on the front panel turns green.

This battery is now conditioned and the transport monitor can be returned to service or the process can be repeated on the second transport battery.

Conditioning the Battery Inside a Patient Data Module

The battery can be conditioned inside the Patient Data Module when connected to a transport monitor powered by AC mains power.

WARNING

PATIENT RISK HAZARD—Never condition a battery while the bedside monitor or transport monitor is connected to a patient. Serious injury or death could result.

Complete the following steps to manually condition the battery using the Patient Data Module connected to the transport monitor.

1. Remove all batteries from the transport monitor.
2. Insert a battery into the Patient Data Module.
3. Disconnect the transport monitor from the AC-derived power source.
4. Access the transport monitor's ***Battery Status*** window to monitor the battery's Charge Level.
5. Allow the battery to discharge to less than a 90% Charge Level.
6. Reconnect the AC-derived power source and fully charge the battery.
7. Disconnect the transport monitor from the AC-derived power source and allow it to run until it displays the ***BATTERY LOW*** message, or until the transport monitor shuts down.
8. Reconnect the transport monitor to the AC-derived power source. Allow the battery to fully charge to complete the conditioning cycle.

How to Wake Up the Battery

Overview

When the battery is stored for a long period of time without being charged, it will eventually lose all of its charge and *fall asleep*. When the battery is *asleep* none of the

LEDs on the battery will illuminate when the battery's test button is pressed. You must *wake up* the battery before you can use it again.

There are two methods to wake up the battery:

- With the batteries installed in a transport monitor or Patient Data Module that is connected to an AC power source.
- With the batteries removed from a transport monitor or Patient Data Module and *awakened* using the Cadex SMart Two+ charger.

Waking Up the Battery With a Cadex SMart Two+ Charger

NOTE

A deep discharged battery will require you to repeat the following steps more than once before the battery will *wake up*.

1. Insert the battery into the battery charger and wait for the **RUN** LED light to illuminate (approximately three minutes).
2. If the **RUN** LED light does *not* illuminate, complete the following steps:
   a. Remove the battery from the battery charger.
   b. Reinsert the battery into the battery charger and let the battery trickle charge for two to three minutes while the **FAIL** LED flashes. (If the **RUN** LED light illuminates, ignore it.)
   c. Watch the battery charger LEDs and immediately remove the battery from the battery charger when the **FAIL** LED stops flashing *and* remains illuminated, *or* when both the **RUN** and **CONDITION** LEDs flash.
   d. Wait for one to two seconds, then reinsert the battery into the battery charger. The **RUN** and **CONDITION** LEDs will flash for five to ten seconds while the charger initializes the battery. If the **FAIL** LED illuminates, remove the battery and reinsert it into the battery charger.
   e. Watch the battery charger LEDs. The **RUN** LED should stop flashing and remain illuminated for approximately one minute. Later the **CONDITION** LED should stop flashing. At this time, the battery is awake and being charged.

Waking Up the Battery With a Transport Monitor

The procedure for "waking up" the battery using the transport monitor should be performed by a qualified service person. Ask your biomed or service department to wake up the battery using the transport monitor. Instructions are in the Transport Pro Patient Monitor Service Manual.

Waking Up the Battery With a Patient Data Module

1. Connect the Patient Data Module with its battery installed to a transport monitor connected to an AC-derived power source. The transport monitor sends a trickle charge to the PDM battery until the battery has enough of a charge to "wake up."

2. Wait for Patient Data Module to boot-up.

During the “wake-up” process the ***PDM BATTERY STATUS*** window displays ***CHARGING*** in the ***SLOT STATUS*** field. See PDM Battery Status Window on page 4-15.

How to Store the Battery

Store the Patient Data Module and the transport monitor batteries outside of the unit at room temperature. When the battery is stored inside the unit that is powered by an AC power source, the battery cell temperature increases by approximately 10°C (18°F) above the room’s ambient temperature. This reduces the life of the battery.

The Cadex SMart Two+ Charger

Battery Charger LED Indicators

The following is a quick guide which identifies the meaning of the charger LEDs.

LED Indicators	Illuminated	Flashing
RUN	Charging in progress.	Initializing the battery.
RUN and CONDITION	Conditioning in progress.	
READY	Charging is complete.	
READY and CONDITION	Conditioning is complete — pass target.	Conditioning is required.
FAIL	Battery fault.	Charger fault.
FAIL and CONDITION	Conditioning is complete — fail target.	

Replacing the Battery

Safety

WARNING
PHYSICAL INJURY—Do *not* install the monitor above a patient. Make sure the batteries are completely inserted and battery doors are completely closed.

Falling batteries could seriously or fatally injure neonatal or other vulnerable patients.

WARNING
EXPLOSION OR FIRE—Using non-recommended batteries could result in injury/burns to the patients or users.

Only use batteries recommended or manufactured by GE. The warranty can be voided if non-recommended batteries are used.

WARNING
PHYSICAL INJURY—Do *not* install the monitor above a patient. The potential exists for a battery to leak a chemical on the patient if the monitor is mounted above the patient.

Leaks from battery cells can occur under extreme conditions. The liquid is caustic to the eyes and skin. If the liquid comes in contact with eyes or skin, flush with clean water and seek medical attention.

How to Replace the Transport Monitor Battery

1. Open the battery door by gently pulling on the battery door pull tab.
2. Pull on the battery pull strap to remove the original battery from the transport monitor.
3. Insert the new battery.
   a. Insert the connector end of the battery into the battery slot. The arrow on the battery should be pointing into the battery slot. Verify the connector ends are facing the back of the transport monitor. The battery label should face towards the front of the transport monitor.
   b. Push the battery firmly into the slot.

861A

4. Gently push the battery door closed until it *snaps* into position. The battery door will not close if the battery is not fully inserted into the battery slot.

WARNING

PHYSICAL INJURY—Make sure the batteries are completely inserted and that the battery doors are securely shut.

Falling batteries could seriously or fatally injure neonatal or other vulnerable patients.

5. Confirm that the ***A*** and/or ***B*** battery capacity gauges are displayed in the lower right corner of the transport monitor.

How to Replace the PDM Battery

1. Open the battery door by gently pulling on the battery door pull tab.

862A

2. Pull the battery tray out of the Patient Data Module using the battery tray strap and remove the battery.
3. Insert the new battery with the test button facing up and the arrow pointing into the Patient Data Module.

855A

4. Press the battery door closed until it seals the battery compartment.

WARNING

PHYSICAL INJURY—Make sure the battery is completely inserted and that the battery door is securely sealed.

Falling batteries could seriously or fatally injure neonatal or other vulnerable patients.

5. Connect the Patient Data Module to the transport monitor.
6. Confirm the ***P*** battery capacity gauge is displayed in the lower right corner of the transport monitor.

Recycle the Battery

When the battery no longer holds a charge, it should be replaced. Remove the old battery and follow your local recycling guidelines.

WARNING

EXPLOSION HAZARD—Do *not* incinerate the battery or store at high temperatures. Serious injury or death could result.

Rechargeable Battery Collection Sites

In the United States and Canada, the Rechargeable Battery Recycling Corporation (RBRC) can help you locate your nearest rechargeable battery collection site. You can contact RBRC by telephone or by accessing their internet web site.

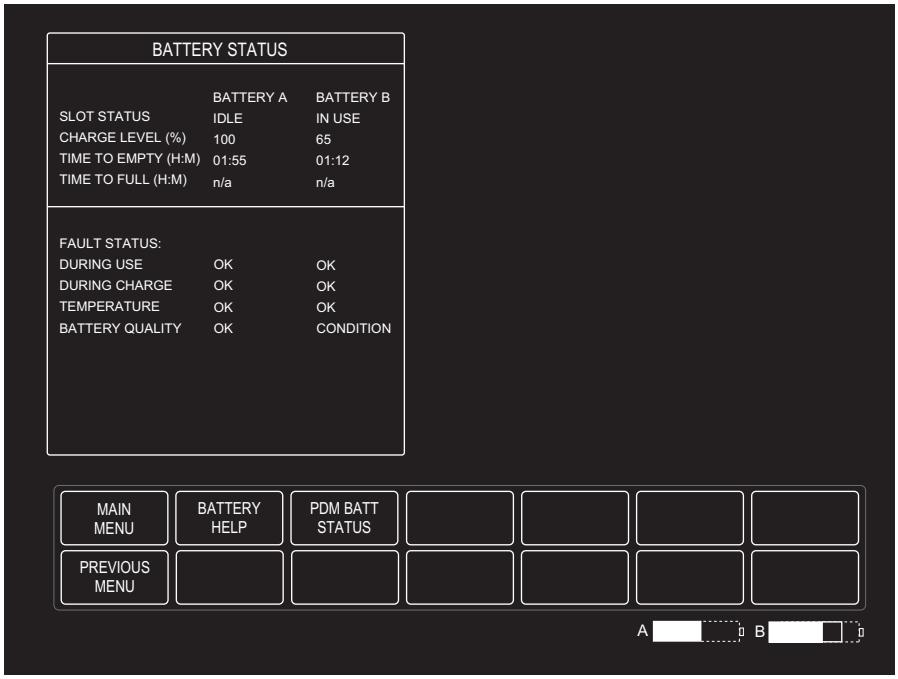
- telephone: 1-800-8-BATTERY (800-822-88379)
- internet address: www.rbrc.org

Battery Status Menu

TRAM Module Battery Status Window

This menu option opens a menu and information window that provides current battery status information for the transport monitor when using a TRAM module with both batteries installed.

1. Select ***MORE MENUS*** from the Main Menu.
2. Select ***BATTERY STATUS*** to display the ***BATTERY STATUS*** menu and information window.



637C

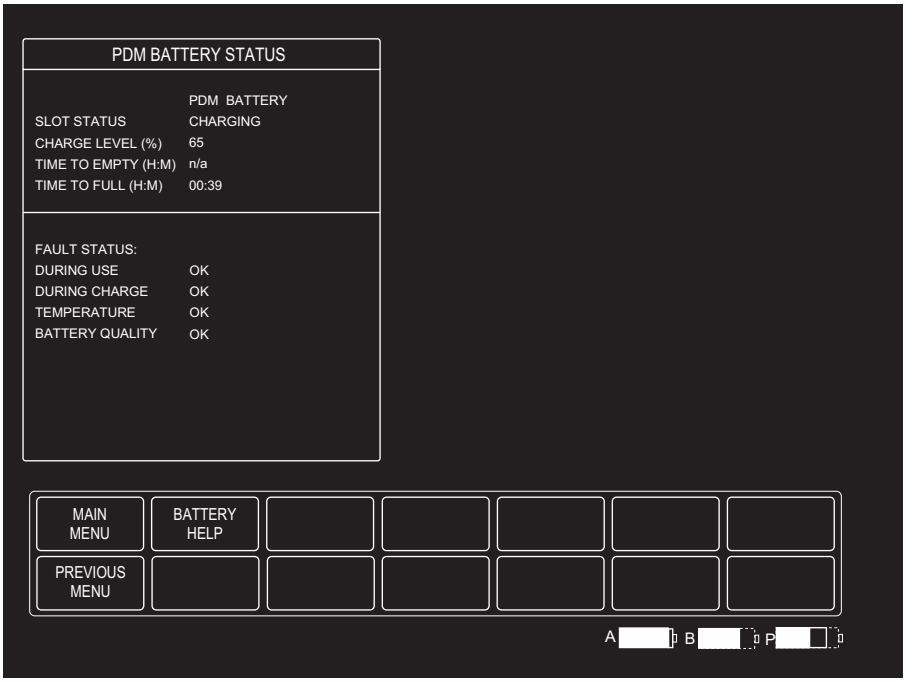
Battery Status Menu and Information Window

If a battery is not present, nothing is displayed in its column. If the battery is ***NO COMM*** (communication with this battery has failed), *unknown* is displayed for all rows except the ***SLOT STATUS*** row.

PDM Battery Status Window

This menu option opens a menu and information window that provides current battery status information for the PDM battery. The battery capacity gauges indicate that the PDM battery is present as well as both transport monitor batteries.

1. Select ***MORE MENUS*** from the Main Menu.
2. Select ***BATTERY STATUS*** > ***PDM BATT STATUS*** to display the ***PDM BATTERY STATUS*** menu and information window.



PDM Battery Status Menu and Information Window

If a battery is not present, a ***NO BATT*** message is displayed in this column. If the battery is ***NO COMM*** (communication with this battery has failed), “unknown” is displayed for all rows except the ***SLOT STATUS*** row.

Battery Help

This menu option opens a popup menu. Selecting one of the options in the popup menu opens an information window that provides help material for that option. The options are:

- ***RETURN*** — Returns to the Battery Status menu.
- ***SLOT STATUS*** — Provides definitions of the battery conditions.
  - No Battery
  - Initializing
  - No comm
  - Incompatible
  - Fail
  - In use
  - Full
  - Charging
  - Idle
- ***TIMES*** — Defines “time to empty” and “time to full.”
- ***FUEL GAUGES*** — Explains the battery capacity gauges.
- ***ALARMS*** — Explains low battery and battery fault alarms and messages.

Battery Alarms

Overview

There are three alarm conditions that activate battery-associated alarms:

- Low battery,
- Battery failures, and
- Charger failures.

The chart below describes the alarm condition and the type of alarm the condition triggers.

Alarm Condition	Alarm Response
Critical Low Battery — At least 5 minutes of battery run-time remaining. This alarm prompts you to replace the battery with a charged battery, or power the transport monitor with the AC power supply.	Triggers a system warning alarm. The message ***BATTERY LOW*** is displayed in the ECG waveform area.
Empty Battery — There is no battery run time remaining.	Triggers a system warning alarm. The message ***POWERING DOWN!*** is displayed in the ECG waveform area.
Battery Failure — A minor failure has occurred while using or charging the battery.	Triggers a system message alarm. The message ***CHECK BATT STATUS*** is displayed in the ECG waveform area.
Battery Failure — A serious failure has occurred while using or charging the battery.	Triggers a system warning alarm. The message ***BATTERY ERROR*** is displayed in the ECG waveform area.
Charger Failure — Charger communications have failed.	Triggers a system message alarm. The message ***CHECK BATT STATUS*** is displayed in the ECG waveform area and the message ***INTERNAL CHARGER FAILED, CALL SERVICE*** is displayed in the Battery Status information window.
Condition — The battery is requesting a conditioning cycle.	***CONDITION*** is displayed in the Battery Status information window.

ERROR is Displayed in the Battery Capacity Gauge Icon

When the current state of the battery's health is in question, the word ***ERROR*** will display inside of the battery capacity gauge icon. The Battery Status information window will provide more specific information about the health of the battery. See Battery Status Menu on page 4-14.

864B

Battery Capacity Gauge Identifying a Battery ERROR

Battery LEDs will not Illuminate

The battery is “asleep.” See How to Wake Up the Battery on page 4-9.

5 Monitor Setup

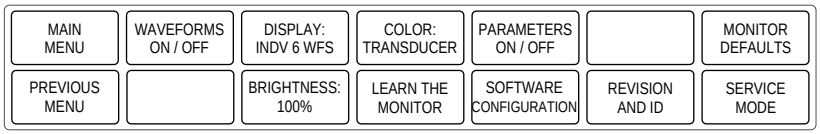
Monitor Setup Menu

Overview

The Monitor Setup menu lets you customize the transport monitor to best suit your unit's and patients' needs. In some cases these changes can be saved as monitor defaults, which may be recalled each time the acquisition device is connected to the transport monitor.

Follow this procedure to access the Monitor Setup menu:

1. Select ***MORE MENUS*** from the Main Menu.
2. Select ***MONITOR SETUP*** to display the Monitor Setup menu.



557B

Monitor Setup Menu

- ***WAVEFORMS ON/OFF*** — Reassign waveform positions on the screen or turn some waveforms off.
- ***DISPLAY*** — Choose a display mode which puts pressure waveforms on an individual or full (common) scale.
- ***COLOR*** — Choose a color configuration.
- ***PARAMETERS ON/OFF*** — Clear unneeded parameter windows from the display and turn them back on again when needed.
- ***MONITOR DEFAULTS*** — Configure alarms, set alarm limits, and establish display defaults to be recalled whenever a discharge is performed.
- ***BRIGHTNESS*** — Control how bright the display is.
- ***LEARN THE MONITOR*** — Display information windows containing basic instructions on operating the transport monitor.
- ***SOFTWARE CONFIGURATION*** — Display the transport monitor's software configuration.
- ***REVISION AND ID*** — Display software revisions and hardware IDs.
- ***SERVICE MODE*** — Access the service mode (for qualified service personnel).

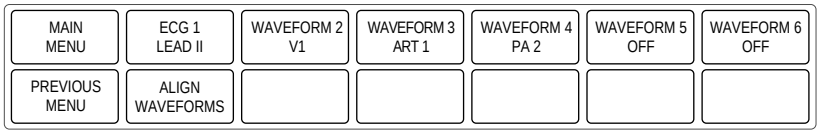
Detailed information on each option is found in this chapter.

Waveforms On/Off

The ***WAVEFORMS ON/OFF*** menu option allows you to reassign waveforms on the display or turn an individual waveform off.

Individual Display Mode

1. Select ***WAVEFORMS ON/OFF*** from the Monitor Setup menu. A new set of menu options is displayed. Your display mode determines the menu options available. (See Display on page 5-4.) If you are using the ***INDV 6 WFS*** display mode, the menu will look like this:



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Waveforms On/Off Menu — Individual Mode

2. Select the ***WAVEFORM 2*** menu option to display a popup menu. The choices in the popup menu indicate which waveforms can be displayed in the second waveform position.
3. Rotate the **Trim Knob** control to move the pointer in front of the waveform you would like to display in that position. Choose ***OFF*** if you want no waveform displayed in that position.
4. Press the **Trim Knob** control to complete the change and close the popup menu.

Use this same procedure for the other waveform positions.

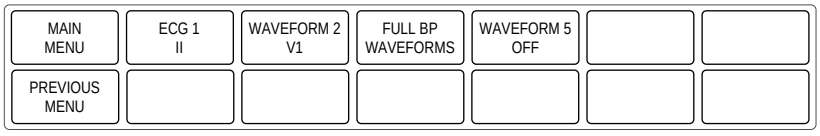
Align Waveforms

When monitoring in the individual display mode, the waveforms will automatically align with their respective parameter windows. You can override alignment with the ***WAVEFORMS ON/OFF*** menu.

Use the ***ALIGN WAVEFORMS*** option in this menu to automatically realign waveforms with their parameter windows.

Full Display Mode

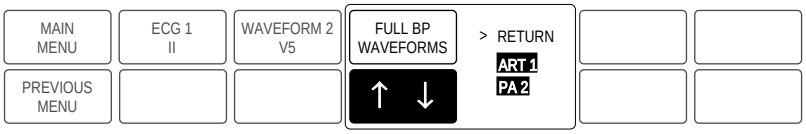
If you are using a full display mode (refer to the next page), the menu will look like this:



560A

Waveforms On/Off Menu—Full Mode

The menu option ***FULL BP WAVEFORMS*** allows you to select the pressure waveforms you want to display on the full scale. See the popup menu below.



561A

Full BP Waveforms Popup Menu

The selections displayed are determined by how many pressures are being monitored. The pressure waveforms currently on the full scale are highlighted. Up to four pressures can be displayed at one time on the full scale.

Rotate and press the **Trim Knob** control to select or deselect pressure waveforms.

NOTE

There are left and right scales. To position a waveform on a right or left scale, use the Scales option in the individual pressure menus.

Display

The ***DISPLAY*** menu option controls the display mode for monitored pressure parameters. The Display popup menu offers the choices described below. Use the **Trim Knob** control to make your selection.

NOTE

Display mode can be set as a monitor default. See Monitor Defaults on page 5-7.

Individual 6 Waveform Display

With the ***INDV 6 WFS*** option, you can display a maximum of six waveforms, each with an independent scale. When monitoring in this display mode, the waveforms automatically align with their respective parameter windows.

Individual 3 Waveform Display

With the ***INDV 3 WFS*** option, you can display a maximum of three waveforms, each with an independent scale. When monitoring in this display mode, each parameter window is displayed at double-high size. Waveforms automatically align with their respective parameter windows.

Full Display

With the ***FULL*** option, a maximum of seven waveforms can be displayed. The first two waveform positions are on individual scales. The next four pressure waveforms are displayed on the full (common) scale, and the last waveform, if any, is on an individual scale.

Full Grid Display

The ***FULL GRID*** display mode is the same as the full display mode, with additional graticules displayed on the screen.

NOTE

The ***FULL*** and ***FULL GRID*** modes have left and right scales. Read ART, FEM, UAC, and SP pressures using the left scale markers. Read PA, CVP, RA, UVC, LA, and ICP pressures using the right scale markers. Use the Scales menu option in the individual parameter menu to change pressures from one side to the other.

Color

Selecting the ***COLOR*** menu option opens a popup menu to select a color format. The tables below indicate the parameter colors used in each color format.

TRANSDUCER Color Format	
Parameter(s)	**Color**
ECG	Green
Priority ART1/FEM1/UAC1	Red
Additional ART/FEM/UAC	White
PA	Yellow
CVP/RA/UVC	Blue
LA/ICP	White
SP	Green
Alarms	Red
All other parameters	Green

CLINICAL Color Format	
Parameter(s)	**Color**
ECG	Amber
Hemodynamics	Green
Cardiopulmonary	Blue
Temperature	Blue
Alarms	Red
All other parameters	Blue

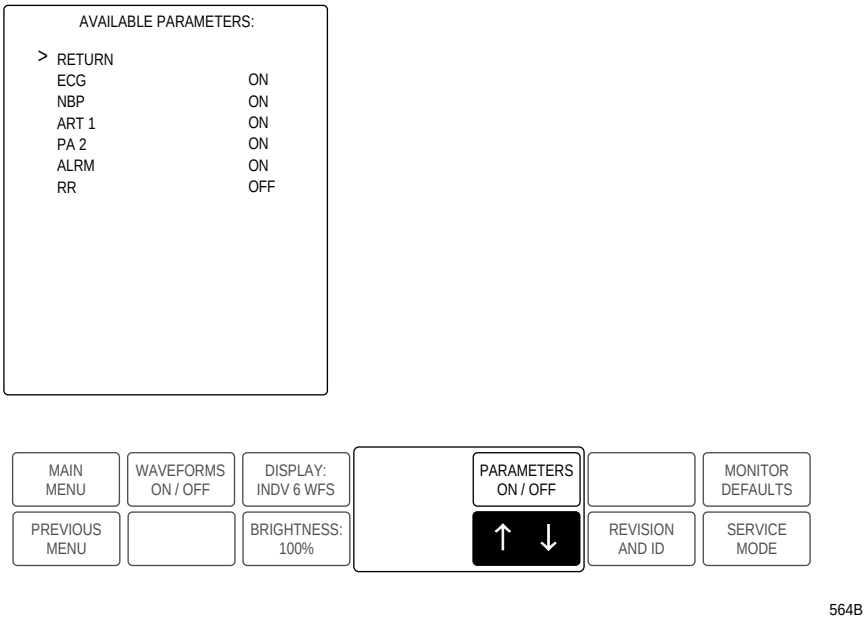
NOTE

The pressure colors are based on the priority set up in Monitor Defaults. The arterial line (ART, FEM, or UAC) set at the highest priority is red and all others are white.

Parameters On/Off

This menu option allows you to turn off and on specific parameters. Turning a parameter off removes the waveform as well as the parameter windows. Alarms for that parameter are off and data is not collected in vital signs.

1. Select the ***PARAMETERS ON/OFF*** option from the Monitor Setup menu. A popup menu opens and an information window is displayed listing all parameters that have cables connected.



Parameters On/Off Popup Menu And Information Window

The first column in the information window shows the parameter name, the second column shows whether this parameter is on or off.

2. Rotate the **Trim Knob** control to move the pointer to the desired parameter.
3. Press the **Trim Knob** control. If the parameter reads ***ON***, pressing the **Trim Knob** control turns it off and vice versa. The change is in effect immediately. The information window remains open so you can select another parameter if desired.

NOTE

ECG cannot be turned off.

4. When finished, select ***RETURN*** to close the information window and popup menu.

Monitor Defaults

Overview

NOTE

This option may be password protected. See Monitor Defaults Password on page 5-14.

Alarm levels and many of your transport monitor settings can be set up as monitor defaults. Monitor defaults can only be set when the transport monitor is disconnected from the acquisition device. They may, however be changed when connected to an acquisition device when the transport monitor is in Operating Room mode. Monitor defaults can be recalled while monitoring an admitted patient. There is a monitor defaults worksheet in the Appendices of this manual. You can use this worksheet to record your default settings.

NOTE

- When using a TRAM module, Parameter Alarm Level default settings are taken from the TRAM module. They cannot be set on the transport monitor.
- When using a Patient Data Module, you can choose which Parameter Alarm Level default settings to use:
  - Select ***CONTINUE MONITORING*** to accept the Parameter Alarm Level settings of the bedside monitor. Existing parameter alarm levels and patient data from the bedside monitor are retained.
  - Select ***ADMIT NEW PATIENT*** to accept the Parameter Alarm Level default settings from the transport monitor. Existing parameter alarm levels and patient data acquired from the bedside monitor are not retained.
- Arrhythmia alarm level settings are always taken from the transport monitor.

See Admitting a Patient on page 6-2.

Whenever the monitor mode is changed, (Adult-ICU, Neonatal-ICU, Operating Room) any Monitor Defaults you have set up will revert to factory default settings. The monitor mode (also called the patient-monitor type), however, is usually established at the time of installation and can only be changed in the Service menu. See Patient-Monitor Type on page 5-19.

CAUTION

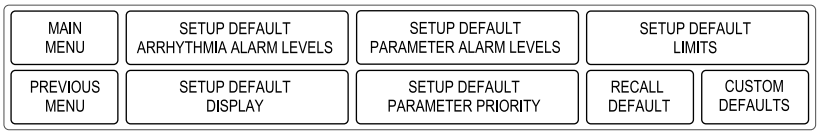
If you disconnect a parameter cable at any point along the cable or disconnect it from the module, and the parameter window is removed from the transport monitor display, all alarm limits may revert to the set monitor default alarm limits when the cable is reconnected.

If you disconnect the acquisition device from the transport monitor, the monitor defaults will remain active upon reconnection to the acquisition device.

NOTE

In Adult-ICU and Neonatal-ICU modes, monitor defaults can only be changed when the transport monitor is disconnected from the acquisition device. Changes made are in effect immediately, but an acquisition device must be connected to the transport monitor for fully functional alarms.

To display the menu to set up your Monitor Defaults, select ***MONITOR DEFAULTS*** from the Monitor Setup menu.



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Monitor Defaults Menu when using a Patient Data Module

- ***SETUP DEFAULT ARRHYTHMIA ALARM LEVELS*** — Adjust arrhythmia alarms to other alarm levels.
- ***SETUP DEFAULT PARAMETER ALARM LEVELS*** — Adjust parameter alarm levels to other alarm levels.
- ***SETUP DEFAULT LIMITS*** — Set alarm limits for all parameters (Patient Data Module only).
- ***SETUP DEFAULT DISPLAY*** — Determine display settings such as color format, etc.
- ***SETUP DEFAULT PARAMETER PRIORITY*** — Determine the priorities you want for display of parameters.
- ***RECALL DEFAULT*** — Recall monitor defaults without disconnecting and reconnecting the acquisition device.
- ***CUSTOM DEFAULTS*** — Modify multiple monitor defaults.

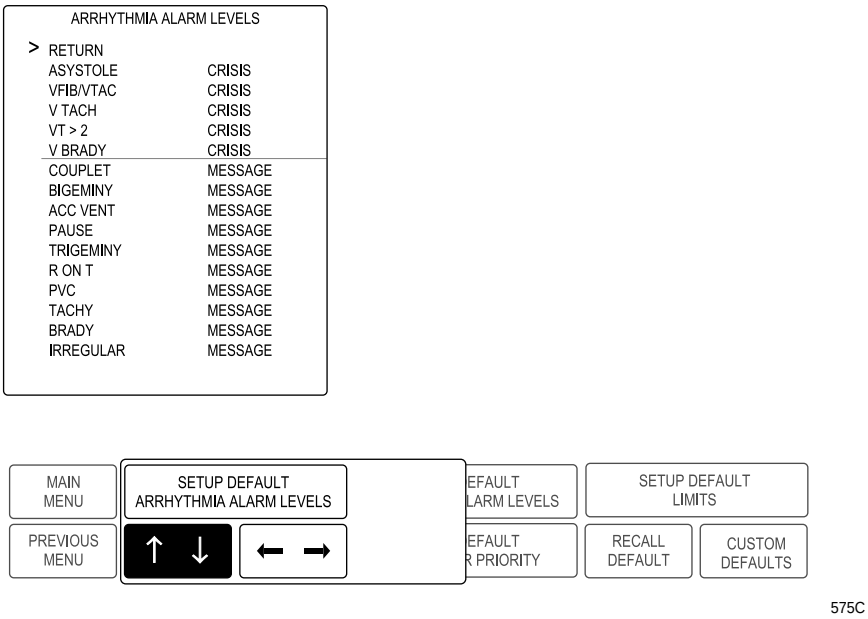
Setup Default Arrhythmia Alarm Levels

Arrhythmia calls are assigned to one of the four patient status alarm levels. The ***SETUP DEFAULT ARRHYTHMIA ALARM LEVELS*** option allows you to view the levels assigned, and change them if desired.

NOTE

Asystole and ventricular fibrillation (V FIB/V TAC) cannot be moved in the Adult-ICU or Neonatal-ICU mode.

Select the ***SETUP DEFAULT ARRHYTHMIA ALARM LEVELS*** option from the Monitor Defaults menu to open a popup menu and information window. The information window displays a list of the arrhythmia calls and their corresponding alarm levels.



575C

Setup Default Arrhythmia Alarm Levels Popup Menu and Information Window

If you want to move an arrhythmia call to another level for your Monitor Default, follow this procedure. (In this example we will change ***V TACH*** from a Crisis to a Warning level.)

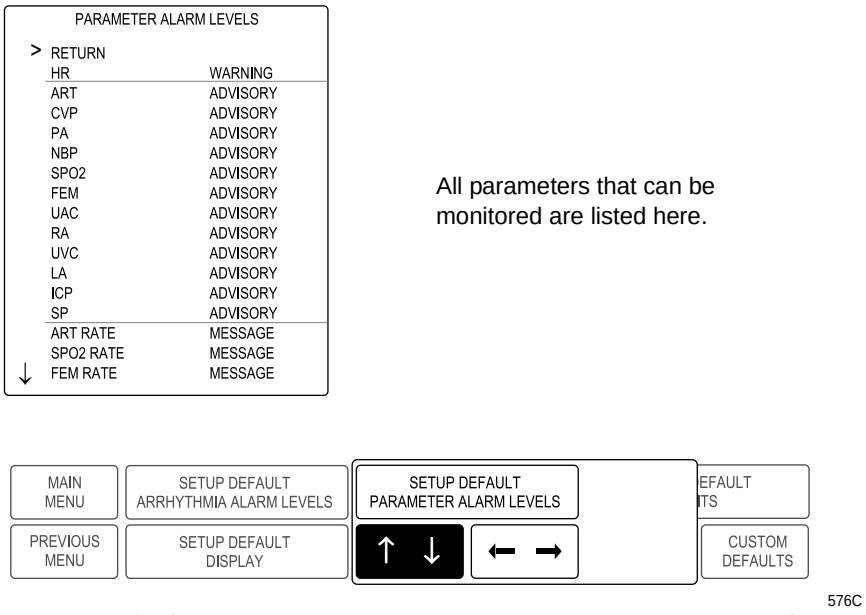
1. Rotate the **Trim Knob** control to move the pointer (>) up and down the list. Stop when the pointer is in front of ***V TACH***.
2. Press the **Trim Knob** control. Notice that the level for the ***V TACH*** call is highlighted.
3. Rotate the **Trim Knob** control until ***WARNING*** is displayed.
4. Press the **Trim Knob** control to complete the change. The information window is reorganized to include ***V TACH*** as a ***WARNING*** alarm.

   The information window remains open for you to make any other changes.
5. When you have completed all changes, move the pointer to ***RETURN*** and press the **Trim Knob** control to close the information window.

Setup Default Parameter Alarm Levels

You can set default alarm levels for all parameters.

Use the ***SETUP DEFAULT PARAMETER ALARM LEVELS*** option to view and adjust default alarm levels for parameters. Follow the same procedure as described for changing arrhythmia alarm level defaults.

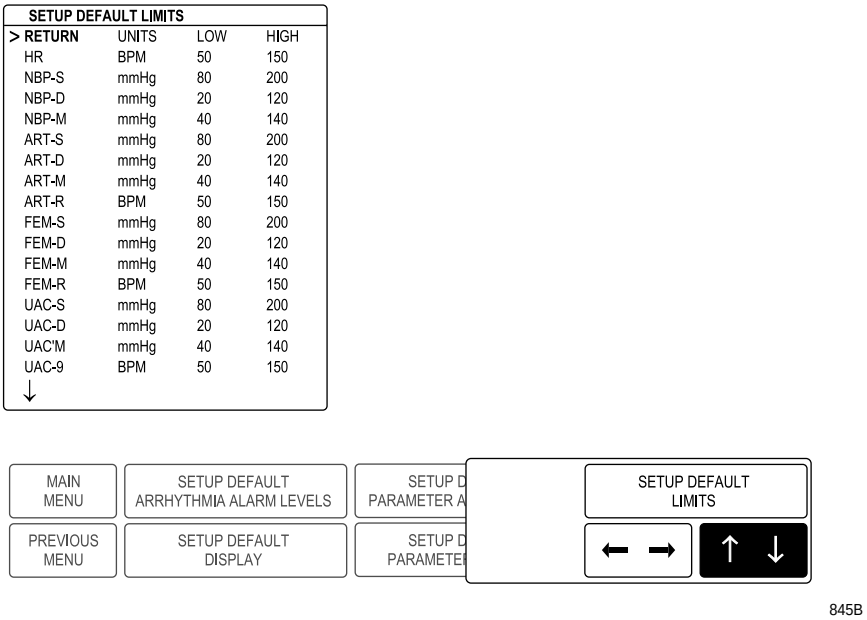


Setup Default *PARAMETER ALARM LEVELS* Popup Menu and Information Window

Setup Default Limits

You can set default limits for all parameters also. This option only appears when using the transport monitor with a Patient Data Module.

1. Select ***SETUP DEFAULT LIMITS*** from the Monitor Defaults Menu. A popup menu and information window are displayed.



***SETUP DEFAULT LIMITS* Popup Menu and Information Window**

2. Rotate the **Trim Knob** control to move the pointer (>) through the list.

3. Press the **Trim Knob** control when the pointer is in front of the parameter for which you want to change default limits.
4. Turn the **Trim Knob** control to highlight the low or high limit.
5. Press the **Trim Knob** control again and rotate to change the value. Press the **Trim Knob** control to complete the change.
6. Rotate the **Trim Knob** control to highlight the parameter label and press to unhighlight.
7. Select ***RETURN*** when all changes are completed. The popup menu and information window close.

Setup Default Display

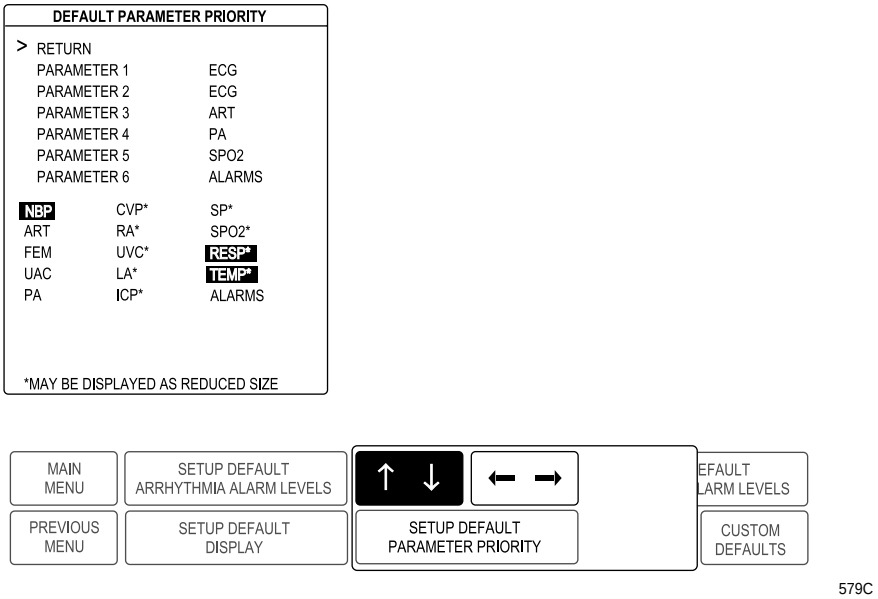
This menu option allows you to set up certain aspects of the display as defaults. When ***SETUP DEFAULT DISPLAY*** is selected, a popup menu and information window open. Use the **Trim Knob** control to select and change the desired item(s), then select ***RETURN*** to close the information window and popup menu.

The default display settings, along with a worksheet to record your default display settings, can be found in the Appendices of this manual.

Setup Default Parameter Priority

This menu option allows you to select how the parameter windows are prioritized on the display.

1. Select ***SETUP DEFAULT PARAMETER PRIORITY*** option from the Monitor Defaults menu. A popup menu and information window open.



Setup Default Parameter Priority Popup Menu and Information Window

2. Using the rotate and press technique with the **Trim Knob** control, select parameters for positions on the display.

3. Select ***RETURN*** when you have finished. The information window and popup menu close.

The ***PARAMETER*** selections in the top half of the window are the ones displayed as full-size windows on the right side of the screen. You control the order of these when you designate a parameter for each position.

The parameters in the lower half of the window are displayed at the bottom of the screen only when there is no room at the side. Parameters designated with an asterisk can be displayed in a reduced size to accommodate up to ten parameters. The software automatically resizes a window when necessary.

You can control the order in which parameters are displayed by first deselecting the highlighted parameters in the information window, then reselecting them in the order you want them displayed (first selected equals first displayed).

Here is some additional information regarding parameter priorities:

- The first parameter cannot be changed. It must always be ECG.
- If the second parameter is set for ECG, the ECG parameter window is always displayed as the larger size. This size window occupies the space of two parameter windows.
- If six or fewer parameters are being monitored, the parameter windows occupy the six positions on the right side of the display. These windows are always normal size windows. If more than six parameters are being monitored, some will occupy space at the bottom of the display.
- A maximum of 10 parameters can be displayed when some half-size parameters are chosen. The software will not allow you to pick more parameters than can be displayed.
- If you are not monitoring a designated parameter, the space is filled with the next prioritized parameter. Should you begin monitoring the designated parameter, the screen reconfigures so the parameter occupies its designated space.
- Whenever possible waveforms align with their parameter window. You can override waveform alignment with the ***WAVEFORMS ON/OFF*** option.
- You can realign waveforms to their parameter window with the ***ALIGN WAVEFORMS*** option in the Waveforms On/Off menu.

Recall Default

Two monitor defaults are a feature of the transport monitor. This menu option allows you to recall previously named monitor defaults while monitoring an admitted patient. You do not have to disconnect and reconnect the acquisition module when you use the ***RECALL DEFAULT*** option.

Selecting the ***RECALL DEFAULT*** option from the Monitor Defaults menu opens a popup menu and an information window, which lists two sets of monitor defaults. Only the defaults for the monitoring mode (e.g., Adult-ICU, Neonatal-ICU) that the transport monitor is in will appear. Using the **Trim Knob** control, select the desired default set. Select ***RETURN*** to close the popup menu and information window.

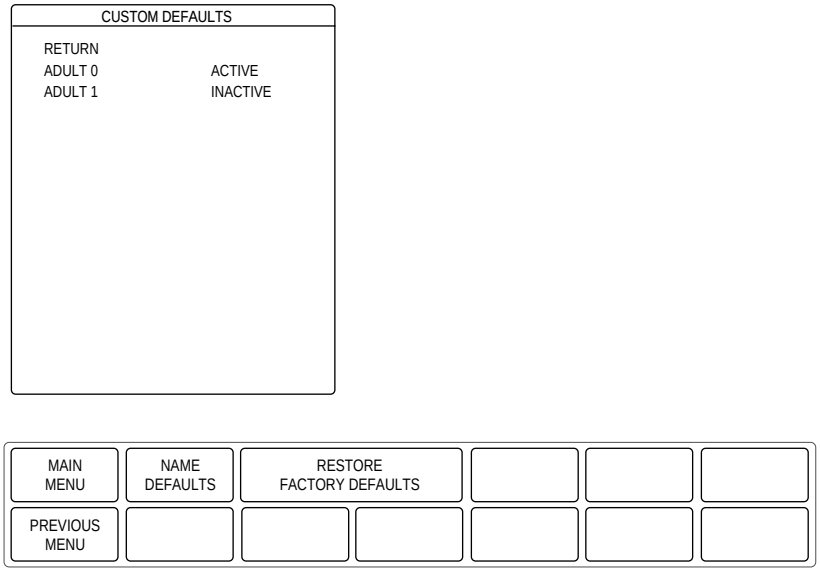
The name of the monitor default you selected appears at the top of the display.

Custom Defaults

Overview

Select ***CUSTOM DEFAULTS*** from the Monitor Defaults menu to open a menu and information window that allow you to change the name of the monitor default entry or restore factory defaults.

The acquisition module must be disconnected before this menu can be opened.

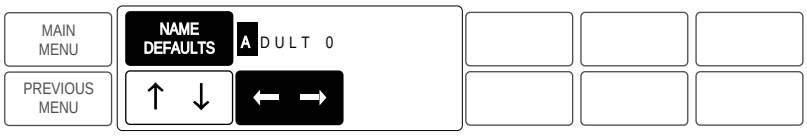


581B

Custom Defaults Menu and Information Window

Name Defaults

1. Select the ***NAME DEFAULTS*** option from the Custom Defaults menu. A new popup menu is displayed below the information window.
2. Rotate the **Trim Knob** control to move the pointer in the Custom Defaults information window to the default name you wish to change.
3. Press the **Trim Knob** control. The selected default name appears in the popup menu.



582A

Name Defaults Popup Menu

4. Rotate the **Trim Knob** control to highlight the first character block. Then press the **Trim Knob** control. The vertical arrows are now highlighted. Rotate the **Trim Knob** control to scroll through alphanumeric characters.

5. Press the **Trim Knob** control to set the desired character. The horizontal arrows are now highlighted again. Rotate the **Trim Knob** control to highlight another character block. Continue with the rotate, press, rotate procedure until all characters have been entered. You can enter up to 12 characters for each monitor default name.

6. When the change is complete, highlight ***NAME DEFAULTS*** and press the **Trim Knob** control to return to the Custom Defaults information window.

Restore Factory Defaults

This option allows you to restore the factory default settings.

Select the ***RESTORE FACTORY DEFAULTS*** option from the Custom Defaults Menu and position the arrow to the default you wish to have overwritten by the factory default.

Press the **Trim Knob** control. The transport monitor automatically erases the custom default and replaces it with the factory default.

Upon restoration, the custom default name will change to the factory default name. The predefined names for the multiple monitor defaults are determined by the patient-monitor mode:

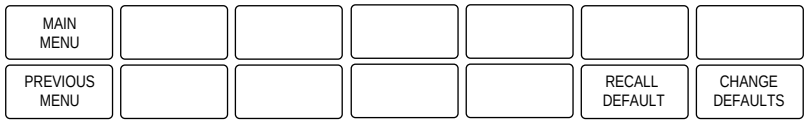
- ***NEO 0*** and ***NEO 1***
- ***ADULT 0*** and ***ADULT 1***
- ***OR 0*** and ***OR 1***

An asterisk (*) indicates that the user has modified the monitor default values from the factory default. The asterisk is only displayed when the predefined monitor default name is used (e.g., ***ADULT 1****).

When a patient is discharged, the monitor default recalled depends on the patient-monitor mode. If the patient-monitor mode is Adult-ICU or Neonatal-ICU, the monitor default recalled is the first entry in the Recall Default information window. If the monitor mode is Operating Room, the monitor default recalled is the currently active monitor default.

Monitor Defaults Password

Monitor Defaults password protection can be used to restrict access to the Monitor Default menu. When the password protection is enabled, selecting ***MONITOR DEFAULTS*** from the Monitor Setup menu will display a Monitor Defaults menu with limited options.



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Monitor Defaults Menu with Password Enabled

- ***RECALL DEFAULT*** — Recall monitor defaults without disconnecting and reconnecting the acquisition device.

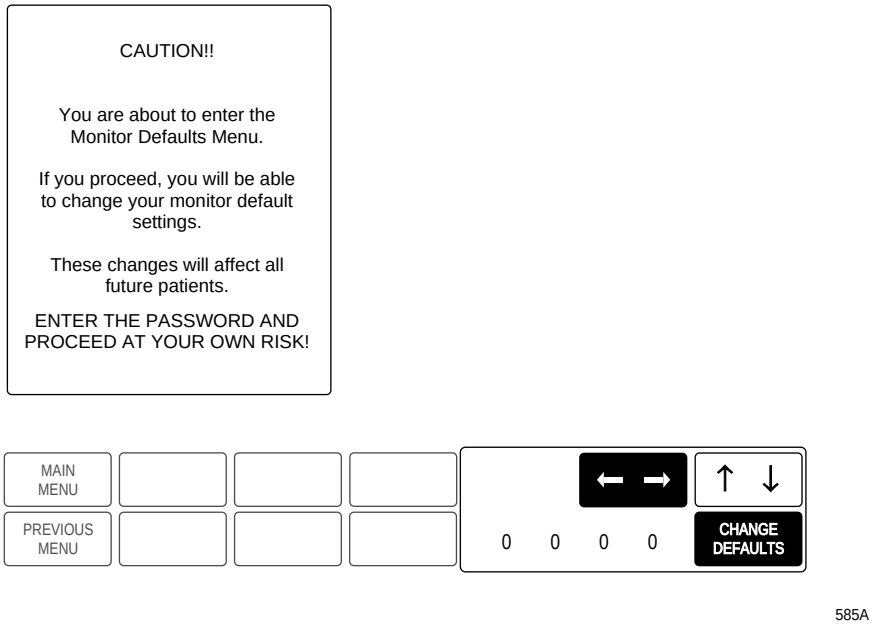
- ***CHANGE DEFAULTS*** — Open a popup menu to enter the password that allows access to the complete Monitor Defaults menu.

Recall Defaults

This menu option allows you to recall previously named monitor defaults while monitoring an admitted patient. See Recall Default on page 5-12.

Change Defaults

Select ***CHANGE DEFAULTS*** option from the Monitor Defaults menu to display the Change Defaults popup menu and information window.



Change Defaults Popup Menu and Information Window

When the password is entered and the popup menu closed, the Monitor Defaults menu will be displayed with all options available.

In some cases you may not want password protection for the Monitor Defaults menu. The password protection feature can be enabled or disabled from a menu option in the Service menu. See Service Mode on page 5-18.

Brightness

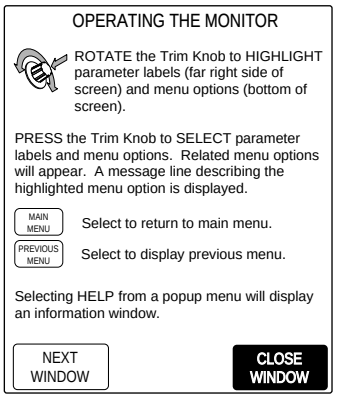
This option is used to control the brightness of the transport monitor's screen.

1. Select the ***BRIGHTNESS*** option from the Monitor Setup menu. A popup menu is displayed with all choices.
2. Rotate the **Trim Knob** control to change the brightness of the display. The change takes place immediately so you can judge the appropriate percentage.
3. Press the **Trim Knob** control to close the popup menu.

Learn the Monitor

With the Mentor educational program, basic instructions for the new user are presented right on the transport monitor.

1. Select ***LEARN THE MONITOR*** option from the Monitor Setup menu. The first of six information windows is displayed on the screen.



587B

Learn The Monitor Information Window

2. **Trim Knob** control operation is now in the information window. ***CLOSE WINDOW*** will close the Mentor information window and ***NEXT WINDOW*** and ***PREVIOUS WINDOW*** enable you to move forward and backward through the six windows.

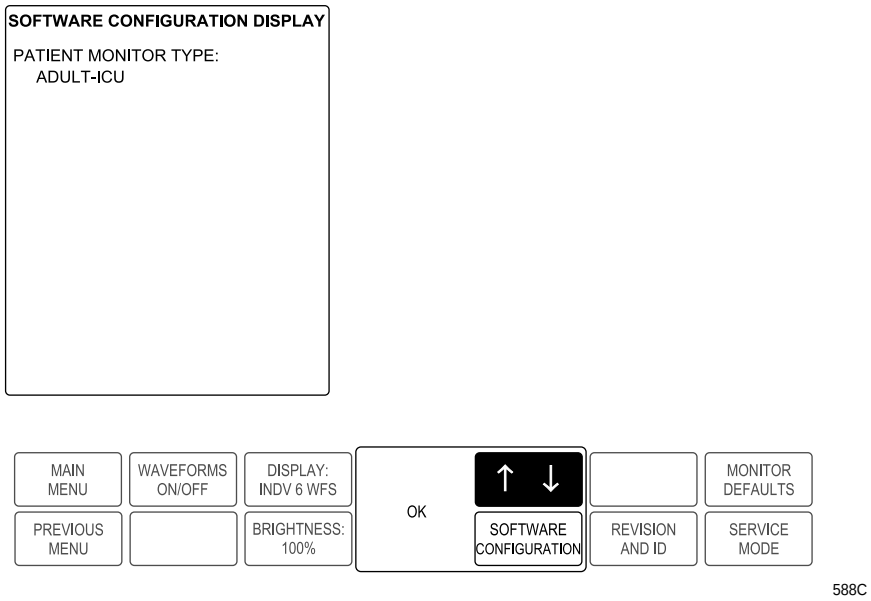
   The six Mentor information windows are:

   - Operating the Monitor
   - Skin Prep and Electrode Placement
   - Patient Status Alarms
   - System Status Alarms
   - Silencing Alarms
   - NBP Procedure and Zero Reference Procedure

Software Configuration

It is important to know how to find out your transport monitor's software configuration. Follow this procedure.

1. Select ***SOFTWARE CONFIGURATION*** option from the Monitor Setup menu. A popup menu and information window are displayed.



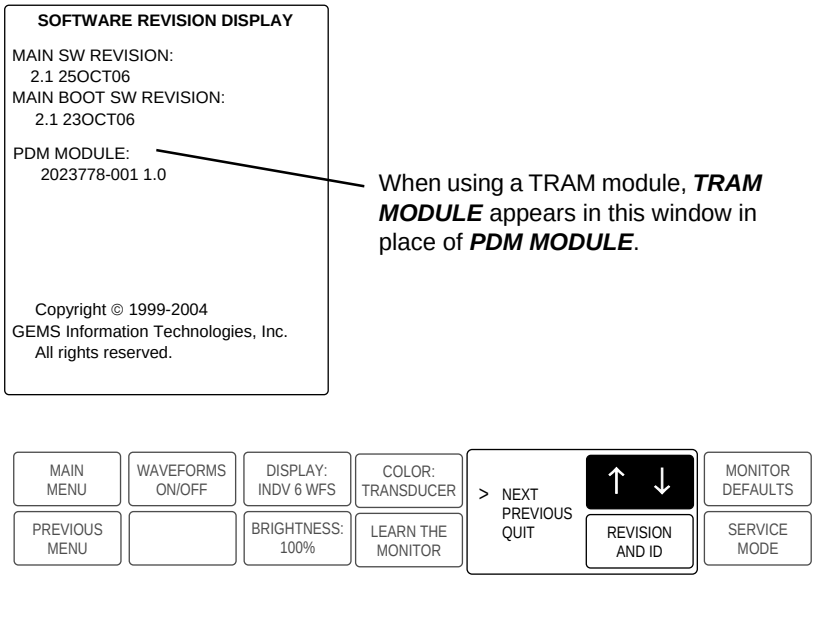
Software Configuration Popup Menu and Information Window

2. Select ***OK*** to close the popup menu and information window.

Revision and ID

This menu option opens the Software Revision Display and Hardware ID Display information windows. This information is most useful to service personnel.

1. Select ***REVISION AND ID*** option from the Monitor Setup menu. A popup menu and the Software Revision Display information window are displayed.



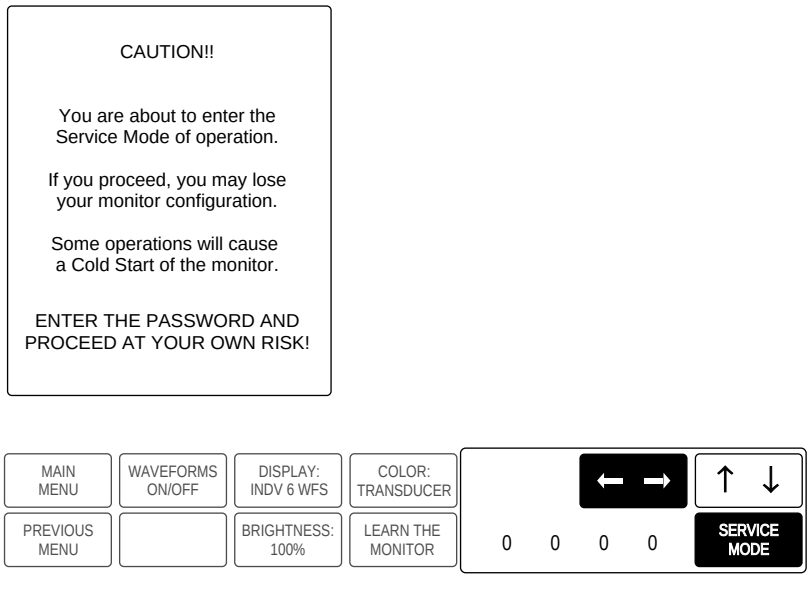
Revision And ID Popup Menu and Information Window

2. Select ***NEXT*** to display the Hardware ID Display information window.
3. Select ***QUIT*** to close the popup menu and information window.

Service Mode

Overview

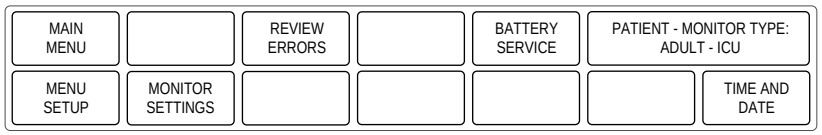
The service menu is meant for qualified service personnel and, therefore, is password protected. If you select the ***SERVICE MODE*** option from the Monitor Setup menu you will see a screen similar to the one shown below.



590A

SERVICE MODE Popup Menu and Information Window

When the password is entered and the popup menu closed, the Service menu will be displayed.



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Service Menu

The service mode is used by qualified field engineers, factory service personnel, and hospital biomedical engineers to set up, troubleshoot, and repair the transport monitor. If you want more details please refer to the appropriate product service manual.

The following Service menu items are mentioned in other places in this manual:

Patient-Monitor Type

Your transport monitor is set up for monitoring in one of three modes (patient-monitor types) with the ***PATIENT-MONITOR TYPE*** option:

- Adult-ICU (***ADULT***)
- Neonatal-ICU (***NEO***)
- Operating Room (***OR***)

The monitor mode (shown above in italics) appears next to the date and time at the top of the display.

When you change the patient-monitor type any monitor defaults you have set are lost and factory defaults are in effect again.

Menu Setup

The Menu Setup option opens a new menu where the Monitor Defaults Password can be turned on and off.

Monitor Defaults Password

Monitor Default password protection is used to restrict access to the Monitor Default menu. The monitor default password feature can be enabled or disabled using this option. The choices are ***REQUIRED*** and ***NOT REQUIRED***.

6 Admitting and Transporting a Patient

Admitting a Patient

CAUTION

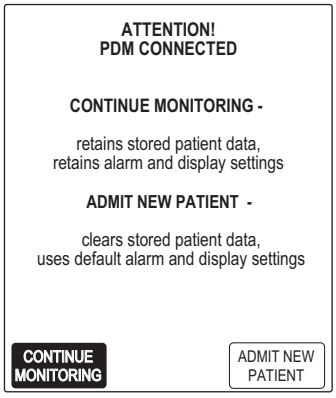
TRANSPORT USE —The transport monitor is approved by the U.S. Food and Drug Administration for use as a transport monitor. It is not intended or approved for use as a stand-alone bedside monitor.

Admitting a patient to the transport monitor is important. Audible alarms are OFF until the transport monitor is in the admit mode. When you power up the transport monitor, an information window containing one of three messages is displayed.

Acquisition Device Connected to the Transport Monitor

Patient Data Module Connected to the Transport Monitor

If a Patient Data Module is already connected to the transport monitor, this information window appears.



844A

If you wish to retain and use the stored patient data and alarm and display settings saved to the Patient Data Module from the bedside monitor, select ***CONTINUE MONITORING***.

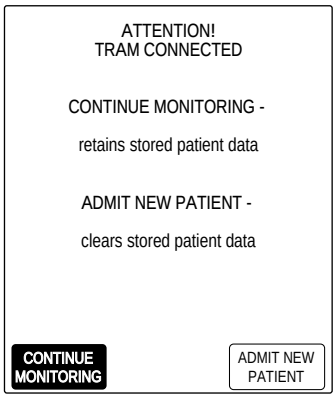
If you wish to clear the Patient Data Module of any stored patient data, select ***ADMIT NEW PATIENT***. All data will be cleared from the Patient Data Module and parameter limit and alarm limit settings will be returned to the transport monitor default settings. Monitoring will begin with no previous patient data.

NOTE

The transport monitor will default to ***CONTINUE MONITORING*** and the information window closes if no selection is made within 25 seconds.

TRAM Module Connected to the Transport Monitor

If a TRAM module is already connected to the transport monitor (i.e., the interconnection cable is plugged into the **DISPLAY** connector on the front of the TRAM module), this information window appears.



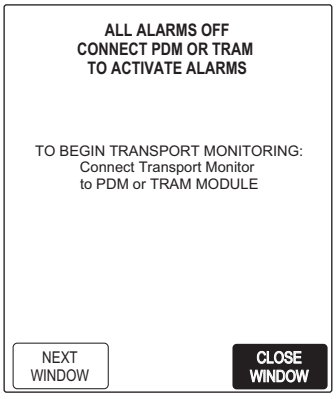
502B

If you wish to use the stored patient data that is already in the TRAM module, select ***CONTINUE MONITORING***. The transport monitor will begin monitoring using the patient data, parameter limit settings, and alarm limit settings in the TRAM module.

If you wish to clear the TRAM module of any stored patient data so you can acquire data for a new patient, select ***ADMIT NEW PATIENT***. All data will be cleared from the TRAM module, and parameter limit and alarm limit settings will be returned to the TRAM module default settings. The transport monitor will begin monitoring with no previous patient data.

Acquisition Device Not Connected to the Transport Monitor

If an acquisition device is *not* connected to the transport monitor, this information window appears.



501D

Select the ***CLOSE WINDOW*** option to close this information window.

Select the ***NEXT WINDOW*** option to open a Mentor Help information window. See Learn the Monitor on page 5-16.

You must connect an acquisition device before you can monitor a patient. Once an acquisition device is connected, the information window for the acquisition device will appear. See Patient Data Module Connected to the Transport Monitor on page 6-2. See TRAM Module Connected to the Transport Monitor on page 6-3.

TRAM Module Connected to Two Monitors

NOTE

This section only applies when the transport monitor and a bedside monitor are connected to a shared TRAM module and the bedside monitor is in a ***DISCHARGED*** state.

In general, simultaneous connection of two monitors to one TRAM module only occurs in two situations:

- When switching a patient between the bedside monitor (e.g., Solar® 8000M/i patient monitor) and the transport monitor in preparation for or return from transport monitor.
- In the operating room, when multiple monitors are connected to the same TRAM module to provide a second display (e.g., one for use by the surgeon and another for use by the anesthesiologist).

Admit the patient at the bedside monitor before removing the TRAM module from the Tram-rac housing. Once the TRAM module is removed from the Tram-rac housing, admit the patient. See Acquisition Device Connected to the Transport Monitor on page 6-2.

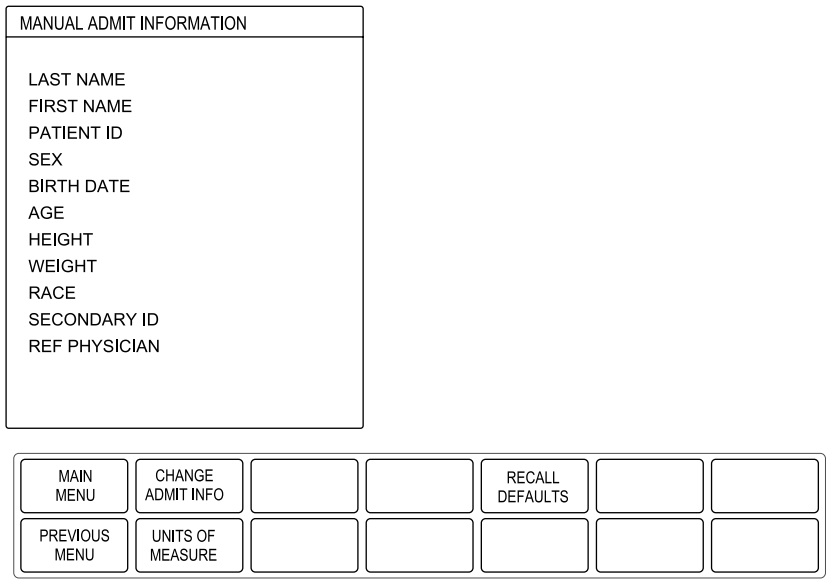
Admit Menu

Use the Admit menu to view, add, or change patient information, or to recall the admit defaults.

1. Select ***MORE MENUS*** from the Main Menu. A new menu opens.
2. Select the ***ADMIT MENU*** option. The Admit menu and information window are displayed.

   NOTE

   In Operating Room mode, this option is labeled ***NEW CASE SETUP***.



Admit Menu and Information Window

NOTE

If you selected the option to use patient data from the acquisition device, the information window will be populated with any patient information that was stored in the acquisition device.

- ***CHANGE ADMIT INFO*** — Allows you to enter or change patient information such as name, ID, etc., that appears in the information window.
- ***UNITS OF MEASURE*** — Opens a popup menu and information window that allows you to change the units of measure for height and weight.
- ***RECALL DEFAULTS*** — Allows you to recall previously named monitor defaults while monitoring an admitted patient (Patient Data Module only).

See Admit Menu Options on page 6-5.

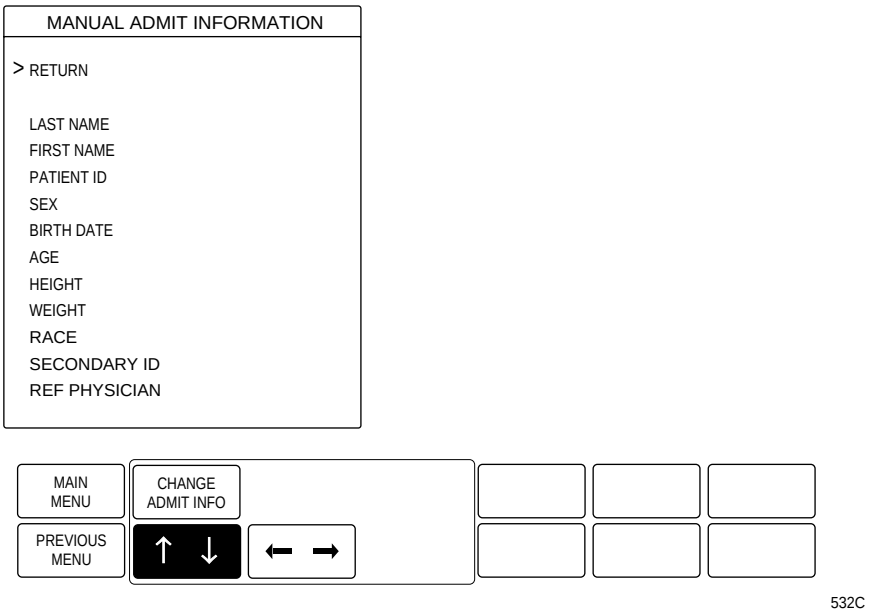
Admit Menu Options

Change Admit Info

Procedure

The ***CHANGE ADMIT INFO*** option allows you to change or enter information pertinent to the monitored patient.

1. Select ***CHANGE ADMIT INFO*** option from the Admit menu. A popup menu and information window are displayed.



Change Admit Info Popup Menu and Information Window

2. Rotate the **Trim Knob** control to move the pointer (>); press, turn, press to enter characters or make selections.

   - ***NAME***: enter up to 10 characters for the first name and 16 characters for the last name. At least part of the name is displayed in the upper right corner of the transport monitor display.
   - ***PATIENT ID***: enter up to 13 characters. A default patient ID number of ***999999999*** is used if no patient ID is entered.
   - ***SEX***: select male or female. Some algorithms use gender-specific analysis; therefore, it is important to enter the correct sex for the patient. A default sex of Male is used if no sex is selected.
   - ***BIRTH DATE***: enter the patient's birth date. ***AGE*** is automatically calculated.
   - ***AGE***: automatically calculated when the birth date is entered. Age is calculated in years for adults and weeks, days, or years for neonates (weeks if age is greater than 14 days but less than 2 years, days if age is less than 14 days, and years if age is greater than 2 years). If you enter an age, the birth date is calculated with current day and month and appropriate year.
   - ***HEIGHT/WEIGHT***: enter the patient's height and weight.
   - ***RACE***: scroll through the selections in the popup menu to select the patient's race.
   - ***SECONDARY ID***: if you need to enter a secondary ID, use this popup menu to enter up to 13 characters.
   - ***REF PHYSICIAN***: enter up to 16 characters for the referring physician's name and/or number.

3. When all information is entered, select ***RETURN***. A prompt appears in the popup menu, giving you the option to ***SAVE CHANGES*** or ***DO NOT SAVE CHANGES***. Selecting an option closes the popup menu and returns you to the Admit menu.

Changing Admit Information on Multiple Monitors

NOTE

For use with TRAM modules only.

When the transport monitor and another monitor, such as the bedside monitor, are simultaneously connected to the same TRAM module, special conditions apply to admit information.

In general, simultaneous connection of two monitors to one TRAM module only occurs in two situations:

- When switching a patient between the bedside monitor (e.g., Solar 8000M/i patient monitor) and the transport monitor in preparation for or return from transport.
- In the operating room, when multiple monitors are connected to the same TRAM module to provide a second display (e.g., one for use by the surgeon and another for use by the anesthesiologist).

Changing Admit Information on the Transport Monitor

If you change the admit information on the transport monitor while two monitors are connected to the same TRAM module, the change is made on the transport monitor and the TRAM module, but not the bedside monitor. For example, if you change the patient's first name from *John* to *Michael* on the transport monitor, the name *Michael* would appear on the transport monitor, but the name *John* would remain on the bedside monitor. Disconnecting the TRAM module from the bedside monitor (with or without the transport monitor) and connecting it to another monitor would cause the name to change to *Michael* on the new monitor because the patient name information is also stored in the TRAM module.

Transfer of Admit Information to the Transport Monitor

Any information entered in the fields ***RACE***, ***SECONDARY ID***, or ***REF PHYSICIAN*** is stored only in the bedside or transport monitor, not in the Patient Data Module or TRAM module. Therefore, the transport monitor does not pick up this admit information from the acquisition module.

NOTE

When the bedside monitor is set to neonatal mode and the acquisition device is removed and connected to a transport monitor set to operating room or adult ICU mode, the ***BIRTH DATE*** field transfers over, but the ***AGE*** field is converted to years. For example: if the neonatal age is less than a year (8 days), the ***AGE*** field displays as 1 year on the transport monitor admit information window.

Units of Measure

This menu option opens a popup menu and information window that allow you to change the units of measure for the weight displayed between ***KG*** and ***LBS*** and the units of measure for the height displayed between ***CM*** and ***INCHES***.

Recall Default

This menu option allows you to recall previously named monitor defaults while monitoring an admitted patient. The ***RECALL DEFAULT*** option is available as an ***ADMIT MENU*** option when using a Patient Data Module.

NOTE

The ***RECALL DEFAULT*** menu option is available for both Patient Data Module and TRAM modules from the ***MONITOR DEFAULTS*** menu. See Recall Default on page 5-12.

Discharging a Patient

When it is no longer necessary to monitor a patient, simply disconnect the acquisition device from the transport monitor to clear the transport monitor of all patient data.

NOTE

When using a TRAM module, you must disconnect the “curly” interconnection cable from the **DISPLAY** connector on the front of the TRAM module. Removing the TRAM module from the TRAM chute does not terminate the connection between the transport monitor and the TRAM module.

Transporting a Patient

This procedure describes how to transfer a patient from a compatible bedside monitor with an acquisition device (e.g., Solar 8000M/i patient monitor) to the transport monitor for transport.

WARNING
This manual contains other important safety information. See Chapter 2.

Transport Monitor with Patient Data Module

1. Make sure at least one fully charged battery is inserted in either the transport monitor or PDM battery compartment. For maximum transport time, use two fully charged transport monitor batteries and one fully charged PDM battery. See Chapter 4.
2. Move the transport monitor to the transport bed or install it into a holder on the bed. Refer to the transport monitor mounting instructions for more information.
3. Install the Patient Data Module currently being used to monitor the patient onto the PDM dock on the transport monitor.
4. After approximately 10 seconds, you should see a display on the transport monitor screen. See Turning on the Power on page 1-13.

5. Select ***CONTINUE MONITORING*** from the ***ATTENTION! PDM CONNECTED*** window to retain and use the stored patient data and alarm and display settings from the bedside monitor. See Patient Data Module Connected to the Transport Monitor on page 6-2.

6. Transport the patient.

WARNING

Make sure the cables do not drag on the floor or interfere with the movement or operation of the transport bed. The cables must be placed so they do not entangle infusion pump lines or become a hazard to the patient.

NOTE

You can connect the optional power supply to a protected wall outlet when you reach the final destination. The transport monitor will automatically switch to AC power and begin recharging the batteries.

7. Reverse the above procedure when the patient returns to their room.

Transport Monitor with TRAM Module

1. Be sure that at least one fully charged transport monitor battery is inserted in the transport monitor battery compartment. For maximum transport time, use two fully charged transport monitor batteries. See Chapter 4.

2. Move the transport monitor to the transport bed or install it into a holder on the bed. Refer to the transport monitor mounting instructions for more information.

3. Connect the transport monitor to the TRAM module currently being used to monitor the patient:

   a. If it is not already connected, plug one end of the interconnect cable into the connector on the right side of the transport monitor.

   b. Plug the other end of the interconnect cable into the **DISPLAY** connector on the TRAM module.

4. Turn on the transport monitor. After approximately 10 seconds, you should see a display on the transport monitor screen. See Turning on the Power on page 1-13.

5. Select ***CONTINUE MONITORING*** from the ***ATTENTION! TRAM CONNECTED*** window. See TRAM Module Connected to the Transport Monitor on page 6-3.

6. Once the patient is admitted on the transport monitor, you can remove the TRAM module from the Tram-rac housing (thereby discontinuing communication with the bedside monitor), and place it in the chute on the transport monitor.

7. Transport the patient.

WARNING

Make sure the cables do not drag on the floor or interfere with the movement or operation of the transport bed. The cables must be placed so they do not entangle infusion pump lines or become a hazard to the patient.

NOTE

You can connect the optional power supply to a protected wall outlet when you reach the final destination. The transport monitor will automatically switch to AC power and begin recharging the batteries.

8. Reverse the above procedure when the patient returns to his/her room.

Mounting Configurations

Several methods can be used to attach the transport monitor to the transport bed or IV pole. Refer to the transport monitor mounting instructions for more information.

7 Alarm Control

Smart Alarms

Alarm processing for each parameter is not activated until the transport monitor has detected valid physiologic data from the patient. This allows you to admit a patient and proceed with necessary patient connections without bothersome alarm tones. When a new parameter is added during monitoring, the alarm processing for that parameter is not activated until valid physiologic data has been detected.

NOTE

To properly use the smart alarm feature, remove all patient cables connected to the acquisition device and perform a patient discharge before admitting a new patient. This assures that no data remains on the transport monitor after the discharge.

WARNING

After an interruption of the electric power supply (e.g., for an emergency power test), you must check whether alarm processing is active again, and whether an arrhythmia has occurred while the power supply was interrupted.

Alarm Structure

The alarm structure of the transport monitor is divided into two classifications:

- Patient Status Alarms
- System Status Alarms

Within each classification there are levels which correlate to how severe the condition is that is causing the alarm. The levels and how the transport monitor responds to each are described below. Patient status alarms can, in most cases, be moved from one level to another. See Arrhythmia Alarm Level on page 7-9. See Parameter Alarm Level on page 7-9.

Patient Status Alarms

Patient status alarms are the highest priority alarms. They are triggered by a patient condition which exceeds a parameter's alarm limits or by an arrhythmia condition.

There are four levels of patient status alarms.

- ***CRISIS*** — Life-threatening events. ***CRISIS*** alarms sound until silenced by the user.
- ***WARNING*** — Serious but non-life-threatening events. ***WARNING*** alarms sound until the condition is resolved.
- ***ADVISORY*** — Events that require monitoring, but are not serious or life threatening. ***ADVISORY*** alarms sound until the condition is resolved.
- ***MESSAGE*** — Additional information.

The transport monitor's response to patient status alarms is as follows.

Indicator	*CRISIS*	*WARNING*	*ADVISORY*	*MESSAGE*
Alarm tone	Three beeps	Two beeps	One beep	No
Alarm light	Red	Yellow	Yellow	No
On-screen message	Yes	Yes	Yes	Yes
ALARM HISTORY	Yes[1]	Yes[1]	Yes[1]	No

[1]Arrhythmia events are stored in the alarm history.

NOTE

Alarm histories are stored during transport, and can be viewed when the acquisition device is reconnected to the bedside monitor. Alarm histories cannot be viewed from the transport monitor.

System Status Alarms

System status alarms are triggered by mechanical or electrical problems. They are of lesser priority than patient status alarms.

There are three levels of system status alarms:

- ***WARNING*** — Serious mechanical or electrical problems.
- ***ADVISORY*** — Mechanical or electrical problems.
- ***MESSAGE*** — Additional information.

The transport monitor's response to system status alarms is as follows.

Indicator	*WARNING*	*ADVISORY*	*MESSAGE*
Alarm tone	Repeating foghorn	Single foghorn	No
Alarm light	Yellow	Yellow	No
On-screen message	Yes	Yes	Yes

NOTE

System status alarms cannot, in most cases, be moved from one level to another. However, when using the transport monitor with a Patient Data Module, you can set default alarm levels for the following alarms: ***ECG LEADS FAIL***, ***SPO2 PROBE OFF***, ***CONNECT SPO2 PROBE***, and ***SPO2 PULSE SEARCH***.

The ***System Alarm Levels*** are configurable in Monitor Defaults. See Setup Default Display on page 5-11.

Service Patient Data Module Message

After connecting the Patient Data Module, and during operation, the Patient Data Module runs automatic self-tests. If a malfunction is detected, the monitor displays a ***SERVICE PDM*** message.

WARNING
SERVICE PDM MESSAGE

As a general rule, monitoring with the Patient Data Module should continue only in extremely urgent cases and under the supervision of a physician. The unit must be repaired before being used on a patient again. If this message appears after power-up, the Patient Data Module must be repaired before being used on a patient.

If the Patient Data Module displays a ***SERVICE PDM*** message, replace the Patient Data Module with another acquisition device. Choose the ***ADMIT NEW PATIENT*** option when replacing the Patient Data Module and continue monitoring the patient.

Alarm Light Functionality During Multiple Alarm Events

When a Patient ***ADVISORY*** alarm event and a System ***WARNING*** alarm event occur at the same time, the audible alarm tone will reflect the higher priority Patient ***ADVISORY*** alarm (one beep). However, the alarm light will flash yellow for the System ***WARNING*** alarm.

In all other cases of multiple alarm events, the audible alarm and the alarm light both alarm at the level of the higher priority alarm.

On-Screen Alarm Help

See Alarm Help on page 7-11.

Controlling Audio Alarms

Using the ***SETUP DEFAULT DISPLAY*** option in the monitor defaults menu, the function of the **Silence Alarm** key can be set to ***NORMAL***, ***SILENCE ONLY***, or ***FLASH PAUSE***.

Silencing Alarms

When set to ***SILENCE ONLY***, the **Silence Alarm** key works as a silence key.

- Press once to silence alarms.
- Press again to reactivate alarms.
- Pressing this button when no alarms are occurring has no effect.

The current alarm is silenced for 60 seconds, and the message ***"SILENCED"*** is displayed on the transport monitor.

The silence command is cancelled and the alarm tone will sound when any new ECG or arrhythmia alarm of an equal or higher level occurs.

An ***ALARM PAUSE*** menu option is available when ***SILENCE ONLY*** is selected. See Alarm Control Menu on page 7-7.

Pausing Alarms

When set to ***NORMAL*** or to ***FLASH PAUSE***, the **Silence Alarm** key works as an alarm pause key. The only difference between the ***NORMAL*** and the ***FLASH PAUSE*** settings is that the alarm pause message flashes on and off when ***FLASH PAUSE*** is selected, and displays steady when ***NORMAL*** is selected.

WARNING

Alarms do not sound and alarm histories are not stored during an alarm pause condition.

NOTE

When the crisis alarm pause breakthrough feature is turned on, crisis alarms do sound during an alarm pause condition. See Alarm Pause Breakthrough on page 7-6.

- When pressed once, it silences a current, audible alarm for 60 seconds.
- When pressed twice during an alarm, it starts a 5-minute alarm pause in the Adult-ICU mode (3 minutes in Neonatal-ICU mode and when the transport monitor's country selection is set to ***France***). A countdown timer is displayed on the screen. During the alarm pause, press the **Silence Alarm** key again to reactivate alarms.
- If no alarm is sounding, press it once to start an alarm pause as described above.
- If the transport monitor is set up for Operating Room mode, there are three levels of alarm pause:
  - Press the button once (twice if an alarm is sounding) to start a 5-minute alarm pause;
  - Press again to start a 15-minute alarm pause;
  - Press again to start a permanent alarm pause;
  - Press again to reactivate alarms.

Pausing and Silencing Alarms on Multiple Monitors

When the transport monitor and another monitor, such as the Solar 8000M/i patient monitor, are simultaneously connected to the same TRAM module, the **Silence Alarm** key must be pressed on *each* monitor to silence alarms on that monitor. That is, pressing the **Silence Alarm** key on the transport monitor will silence an alarm only on the transport monitor. The **Silence Alarm** key on the bedside monitor must also be pressed to silence the same alarm there.

The transport monitor and the bedside monitor respond to their respective alarm silence commands based on the individual monitor mode for which each one is set. See Silencing Alarms on page 7-4. See Pausing Alarms on page 7-5.

In general, simultaneous connection of two monitors to one TRAM module only occurs in two situations:

- When switching a patient between the bedside monitor (e.g., Solar 8000M/i patient monitor) and the transport monitor in preparation for or return from transport.
- In the operating room, when multiple monitors are connected to the same TRAM module to provide a second display (e.g., one for use by the surgeon and another for use by the anesthesiologist).

Alarm Pause Breakthrough

The alarm pause breakthrough feature allows any crisis level alarm to *break through* (interrupt) an alarm pause with an audible and visual alarm.

In other words, when this feature is turned on (set to ***CRISIS***) in the Setup Display Defaults window found in Monitor Defaults, crisis level alarms will sound, even if an alarm pause is in effect.

NOTE

Only alarms set to crisis level can break through an alarm pause. Alarms set to any other alarm level will not break through the alarm pause, even when the feature is turned on.

When a crisis alarm breaks through an alarm pause, arrhythmia histories are not stored.

This feature is labeled as ***PAUSE BREAKTHRU*** in the Setup Display Defaults window. It can be set to ***CRISIS***, which indicates that the alarm pause breakthrough feature is active, or ***OFF***, in which case no alarms will break through an alarm pause.

Alarm Window

Overview

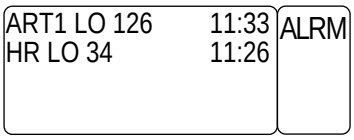
NOTE

This feature defaults off when the transport monitor is set up for Operating Room mode. It can be turned on with the ***PARAMETERS ON/OFF*** software option in the Monitor Setup Menu.

NOTE

Alarm histories are stored during transport, and are viewed from the 8000M/i patient monitor. Alarm histories can not be viewed from the transport monitor.

The Alarm window, which is displayed when you admit your patient to the transport monitor, is used to automatically record any patient status alarm set for ***Crisis***, ***Warning***, or ***Advisory*** level. The most recent four resolved alarms are displayed in chronological order along with the extreme parameter value and time stamp.



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Alarm Window

The extreme numerical value for all active, displayed alarms is continuously updated. Active alarms are displayed in red. Upon resolution of an active alarm, the alarm text is displayed in the color associated with the alarm parameter.

If you do not want to display this window, simply use the ***PARAMETERS ON/OFF*** menu option in the Monitor Setup menu to turn it off.

Clear Alarms

Information displayed in the window remains until you manually clear it or you discharge the patient from the transport monitor. To manually clear the information follow this procedure:

1. Select the ***ALRM*** label to display the ***ALARM CONTROL*** menu. Note that the ***CLEAR ALARMS*** option is already highlighted.
2. Press the **Trim Knob** control to clear the data and exit the menu.

NOTE

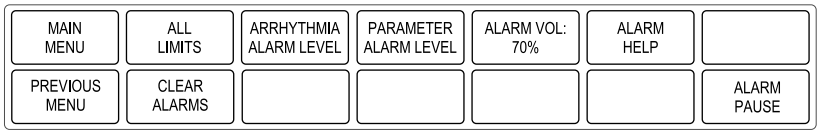
Clearing alarms on a transport monitor does *not* clear the alarms on a bedside monitor, or vice versa. This is true even when the bedside monitor and the transport monitor are simultaneously connected to the same TRAM module. The alarms must be cleared separately at each monitor.

Alarm Control Menu

Menu

There are two ways to access the ***ALARM CONTROL*** menu:

- Select ***MORE MENUS*** from the Main menu, then select ***ALARM CONTROL***, OR
- Select the ***ALRM*** label in the Alarm window to display the menu.



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Alarm Control Menu

- ***ALL LIMITS*** — Displays an information window of all currently monitored parameters and their alarm limits, as well as the unit of measure for each. Alarm limits can also be changed.
- ***ARRHYTHMIA ALARM LEVEL*** — Displays arrhythmia alarm levels. These can be adjusted to other levels.
- ***PARAMETER ALARM LEVEL*** — Displays parameter alarm levels. These can be adjusted to other levels.
- ***ALARM VOL*** — Adjusts the volume of the alarm tone.
- ***ALARM HELP*** — Displays on-screen help describing patient status alarms and system status alarms.
- ***CLEAR ALARMS*** — Clears the alarm information displayed in the alarm window.
- ***ALARM PAUSE*** — Starts and stops an alarm pause. This option is only available when the Silence Alarm default setting is set to ***SILENCE ONLY***. (See Setup Default Display on page 5-11.)

All Limits

The ***ALL LIMITS*** menu option allows you to view the high and low alarm limits and unit of measurement for each parameter currently monitored. You can change the limits for any monitored parameter without having to go into each individual parameter menu.

To view the ***ALL LIMITS*** information window, select the ***ALL LIMITS*** option from the ***ALARM CONTROL*** menu. An information window is displayed, showing a list of patient parameters currently being monitored, their units of measure, and their current high and low limits. Only parameters currently being monitored are listed.

Changing a Limit

To change one or more limits in the ***ALL LIMITS*** information window, follow the procedure below. Any changes made with this menu option are temporary and will revert to defaults upon discharge.

1. Rotate the **Trim Knob** control to move the pointer (>).
2. When the pointer is in front of the parameter you wish to change, press the **Trim Knob** control. The parameter label highlights.
3. Rotate the **Trim Knob** control to highlight the low or high limit.
4. Press, then rotate the **Trim Knob** control to change the limit value.
5. Press the **Trim Knob** control again to complete the change. The new limit is in effect immediately.
6. Rotate the **Trim Knob** control to highlight the parameter label, then press to unhighlight. You can now move to another parameter if you want.
7. When finished with all changes, move the pointer to ***RETURN***, and press the **Trim Knob** control to close the ***ALL LIMITS*** information window.

Arrhythmia Alarm Level

The arrhythmia calls recognized by the transport monitor are assigned to one of the four patient status alarm categories. The ***ARRHYTHMIA ALARM LEVEL*** option allows you to view the levels assigned to the arrhythmia calls.

To display a list of arrhythmia calls and their assigned alarm levels, select the ***ARRHYTHMIA ALARM LEVEL*** option from the ***ALARM CONTROL*** menu. An information window is displayed, showing a list of the arrhythmia calls on the left with their corresponding alarm levels on the right. A popup menu also opens.

The monitor default settings and the acquisition device used determine what arrhythmias are listed.

Adjusting Arrhythmia Alarm Levels

NOTE

Asystole and ventricular fibrillation (***V FIB/V TAC***) cannot be moved in the Adult-ICU or Neonatal-ICU mode.

If you want to move an arrhythmia call to another level, follow this procedure. (In this example, we will change ***V BRADY*** from a ***CRISIS*** level to a ***WARNING*** level.) Any changes made with this menu option are temporary and will revert to the default setting upon discharge.

1. Rotate the **Trim Knob** control to move the pointer in front of ***V BRADY***.
2. Press the **Trim Knob** control. The level for the ***V BRADY*** call highlights.
3. Rotate the **Trim Knob** control until ***WARNING*** is displayed.
4. Press the **Trim Knob** control to complete the change. The information window is reorganized to include ***V BRADY*** as a ***WARNING*** alarm and the change is in effect.

   The information window remains open for you to make any other changes.
5. When you have completed all changes, move the pointer to ***RETURN*** and press the **Trim Knob** control to close the information window.

Parameter Alarm Level

Parameter alarms are assigned to one of the four patient status alarm categories. The ***PARAMETER ALARM LEVEL*** option allows you to view and reassign parameter alarms to other levels.

NOTE

The heart rate limit alarm level cannot be set to the ***MESSAGE*** level in Neonatal-ICU mode.

If you want to move a parameter alarm to another level, use the ***PARAMETER ALARM LEVEL*** option, and follow the same procedure as described for arrhythmia alarm levels. Any changes made with this menu option are temporary and will revert to defaults upon discharge.

Alarm Volume

Adjust Volume

To adjust the volume of the alarm tones, follow this procedure:

1. Select the ***ALARM VOL*** option from the ***ALARM CONTROL*** menu.
2. A popup menu opens, displaying the alarm volume settings.
3. Rotate the **Trim Knob** control to change the selection. Each time the control is rotated, you hear a tone at that volume. The message "***ALARM VOL. OFF***" is displayed at the top of the screen if ***OFF*** is selected.

   NOTE

   When in Neonatal-ICU mode, alarm volume cannot be turned off. 10% is the lowest setting available.

4. When you are satisfied with the volume level, press the **Trim Knob** control to close the popup menu.

Any change made with this menu option is only temporary and will revert to default upon discharge.

NOTE

The ***ALARM VOLUME*** options shown are dependent on the ***MIN ALARM VOLUME*** and ***ALARM VOLUME OFF*** settings in the ***SETUP DISPLAY*** window found in Monitor Defaults.

Minimum Alarm Volume

The ***SETUP DISPLAY*** window in Monitor Defaults offers a ***MIN ALARM VOLUME*** setting. With this setting, you can control the minimum level to which alarm volume can be set.

For example, if you do not want alarm volume to be less than 40%, you would select 40% as the ***MIN ALARM VOLUME*** default. The ***ALARM VOLUME*** popup menu would not show any volume options lower than 40%.

If you set the ***ALARM VOLUME OFF*** option to ***DISABLE*** (see below) in Monitor Defaults, you *must* set a minimum alarm volume using this setting.

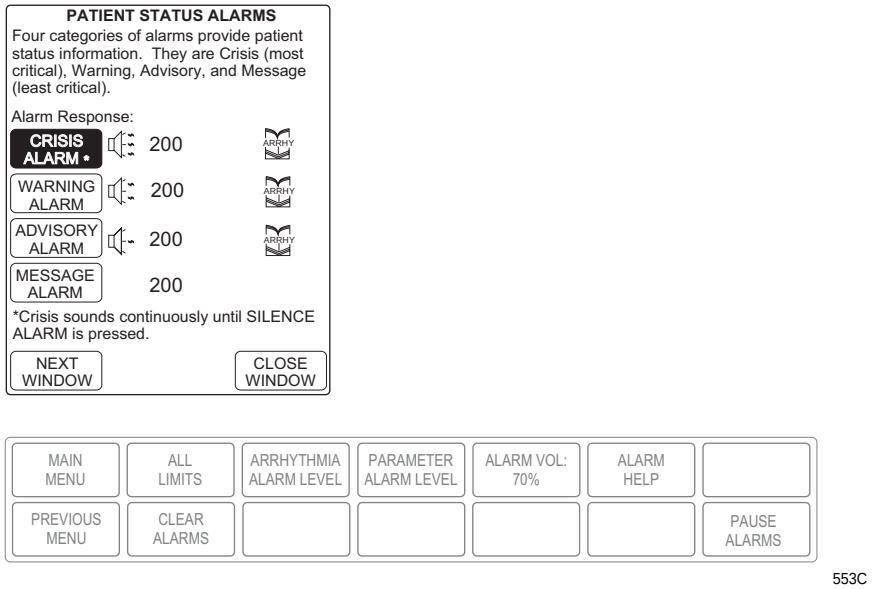
Alarm Volume Off

The Setup Display window in Monitor Defaults offers an ***ALARM VOLUME OFF*** setting. This default setting lets you determine whether monitor alarm volume can be turned off using the ***ALARM VOLUME*** popup menu. Choices are ***ENABLE*** and ***DISABLE***. If ***DISABLE*** is selected as the default setting, the option ***OFF*** will *not* appear in the ***ALARM VOLUME*** popup menu.

Alarm Help

This menu option displays an information window containing alarm information.

Select the ***ALARM HELP*** option from the ***ALARM CONTROL*** menu. An information window titled ***PATIENT STATUS ALARMS*** is displayed.



Alarm Help Information Window

In the ***PATIENT STATUS ALARMS*** information window you can highlight ***CRISIS ALARM***, ***WARNING ALARM***, or ***ADVISORY ALARM***, then press the **Trim Knob** control to hear the tone associated with that level alarm.

Select ***NEXT WINDOW*** to display the ***SYSTEM STATUS ALARMS*** window. Use the **Trim Knob** control to hear the tones. See System Status Alarms on page 7-3.

Select ***CLOSE WINDOW*** to close the alarm status information window and return to the ***ALARM CONTROL*** menu.

Clear Alarms

This is a direct action menu option which, when selected, clears any alarm information displayed in the Alarm window.

Alarm Pause

This option is only available when the **Silence Alarm** button default setting is set to ***SILENCE ONLY***. See Controlling Audio Alarms on page 7-4.

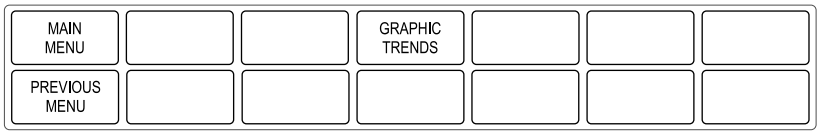
When available, selecting this direct action menu option starts or stops an alarm pause. See Pausing Alarms on page 7-5.

8 Patient Data

Patient Data Menu

Overview

Select ***MORE MENUS*** from the Main menu, then select the ***PATIENT DATA*** option to display the Patient Data menu.



603C

Patient Data Menu

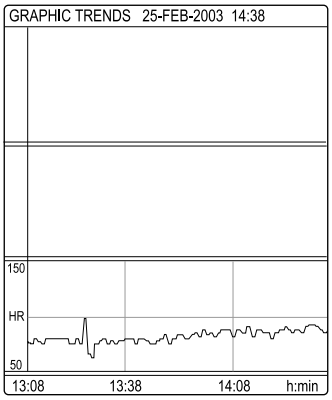
- ***GRAPHIC TRENDS*** — Plots trends for selected parameters.

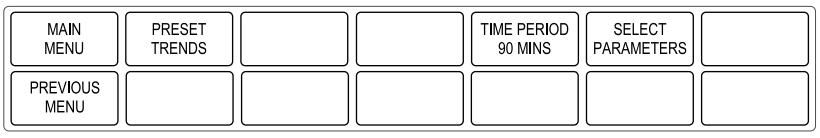
Graphic Trends

View Graphic Trends

A trend is a graphic representation of one parameter over a specified period of time. Every non-episodic parameter is sampled 30 times a minute. A median value is determined and that value is stored for trend display at one-minute resolution.

To view graphic trends, select the ***GRAPHIC TRENDS*** option from the Patient Data menu. A menu and information window are displayed.





611B

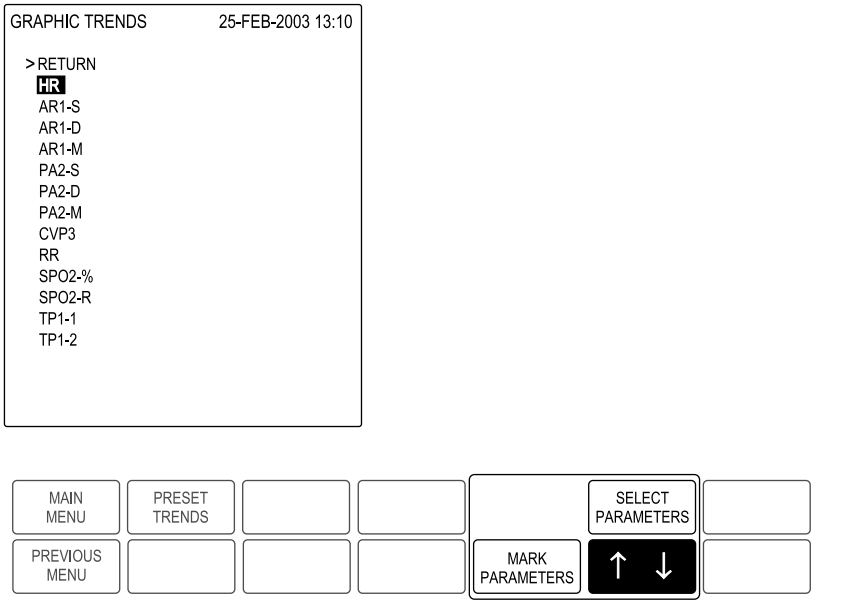
Graphic Trends Menu and Information Window

The graphic trends for the last selected parameters are displayed. Heart rate is the default if none were previously selected.

Select Parameters

Follow this procedure to select parameters for graphic trends.

1. Select the ***SELECT PARAMETERS*** option from the Graphic Trends menu. A popup menu and information window are displayed.



Select Parameters Popup Menu and Information Window

2. To mark (highlight) a parameter for trending, rotate the **Trim Knob** control to move the pointer and then press the **Trim Knob** control. In this example ***HR*** is highlighted because that is the default.

   Up to three parameters can be selected. Selecting a fourth will unmark the first selection chosen.

   NOTE

   An invasive pressure with a systolic, diastolic, and mean value is considered one selection. For example, if you select ***AR1-S***, the other two parameters (***AR1-D*** and ***AR1-M***) will also highlight. However, the trends for these parameters will appear in only one trend window. If you only want to plot one of the three pressure parameters, simply unmark those you don't want.

   If all three values of an invasive pressure are selected, you can only select one additional parameter for trending.

3. When the parameters you want to plot as trends are highlighted, move the pointer to ***RETURN*** and press the **Trim Knob** control. The popup menu closes and the information window reconfigures to display the trends.

Preset Trends

This menu option may be useful as a shortcut in plotting trends. Follow this procedure.

1. Select the ***PRESET TRENDS*** option from the Graphic Trends menu. A popup menu opens with preset combinations of parameters for trending.

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Preset Trends Popup Menu

2. If a parameter combination meets your needs, use the **Trim Knob** control to move the pointer in front of it.
3. Press the **Trim Knob** control. The information window immediately displays the parameters as graphic trends.
4. Select ***RETURN*** to close the popup menu.

Time Period

Use this option to open a popup menu to select a time period for viewing the displayed trends.

Displayed trends do not update automatically. They are updated every time you enter the Graphic Trends menu, exit the Select Parameters popup menu, or change the time period.

9 ECG

Introduction

This chapter gives guidelines for proper ECG monitoring, including skin preparation, electrode placement, adjusting ECG setup, and troubleshooting.

ECG can be monitored with any of the acquisition devices. The insulated input ensures patient safety and protects the device during defibrillation and electrosurgery. The signal input is a high-insulation port and it is defibrillator-proof. 

ECG Checklist

1. Electrodes have been placed on the patient following proper skin preparation.

   NOTE

   When using *snap* leadwires, attach leadwires to electrodes first then apply electrodes to the patient. This prevents the gel from spreading and becoming ineffective as you attach the snaps to the electrodes.

2. Leadwires are attached to electrodes on the patient.
3. Leadwires are connected to patient cable and patient cable is connected to the transport monitor.
4. Verify the V-lead label is correct if using a 5- or 6-leadwire patient cable. See Display Lead on page 9-9.
5. Adjust ECG setup if necessary. Follow detailed procedures within this chapter.

Skin Preparation

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

Proper skin preparation is necessary for good signal quality at the electrode. A good signal at the electrode provides the transport monitor with valid information for processing the ECG data.

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 or clip hair from skin at chosen sites.
2. Gently rub skin surface at sites to remove dead skin cells.
3. Thoroughly cleanse the site with alcohol or 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. Dry the skin completely before applying the electrodes.

Electrode Placement

Leadwires

NOTE

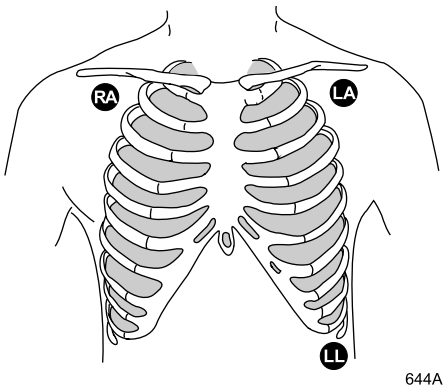
See Cleaning, Disinfecting and Storing GE ECG Cables and Leadwires on page 3-3.

The chart below shows the label and its associated color code used to identify each leadwire per AHA and IEC standards.

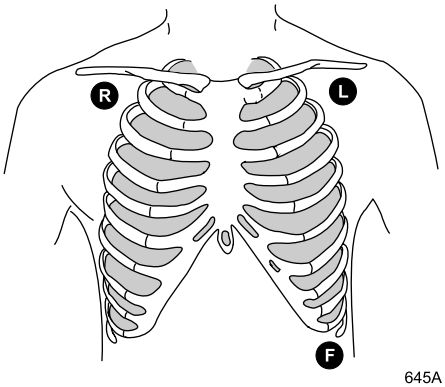
Leadwire (Software Label)	AHA Color	AHA Label	IEC Color	IEC Label
RA (right arm)	white	RA	red	R
LA (left arm)	black	LA	yellow	L
RL (right leg)	green	RL	black	N
LL (left leg)	red	LL	green	F
V1 (precordial)	brown	V1	white	C1
V2 (precordial)	yellow	V2	yellow	C2
V3 (precordial)	green	V3	green	C3
V4 (precordial)	blue	V4	brown	C4
V5 (precordial)	orange	V5	black	C5
V6 (precordial)	purple	V6	purple	C6

3-Leadwire Electrode Placement

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



Shown using AHA labels



Shown using IEC labels

644A & 645A

NOTE

Electrode configuration will vary depending on the type of leadwire set you are using. See Three-leadwire Configuration on page 9-4.

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.

Three-leadwire Configuration

The molded 3-leadwire sets can be placed in the 5-lead Multi-Link patient cable.

Standard Molded 3-Leadwire Set (Rotating Reference)

- Selectable lead I, II, or III cable with a rotating reference (right arm, left arm, left leg)

Operation of the transport monitor with this standard cable allows you to select one of three leads (I, II, or III) for monitoring.

When using the standard 3-leadwire configuration the following operating conditions occur:

- ***LD ANALYSIS*** automatically switches to single lead analysis.
- ***DISPLAY LEAD*** choices are limited to I, II, and III.
- Any options usually allowing more than one ECG lead selection are disallowed. A message line is displayed briefly, indicating such.
- Respiration can be monitored from either lead I, II, or RL-LL. It is not dependent on the displayed lead.

Fixed Right Leg Reference 3-Leadwire Patient Cables

NOTE

For use with the Tram module only.

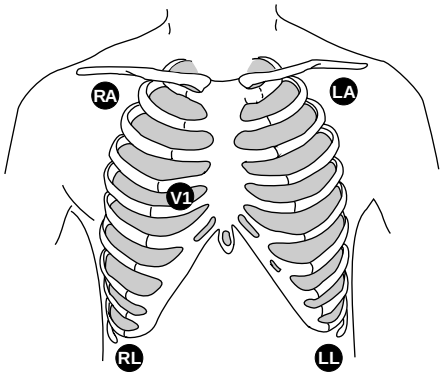
There is also an older style of 3-leadwire patient cables with a fixed right leg reference:

- Lead I cable with a fixed right leg reference (right arm, left arm, left leg). Respiration is monitored from lead I only.
- Lead II cable with a fixed left arm reference (right arm, left leg, left arm). Respiration is monitored from lead II only.

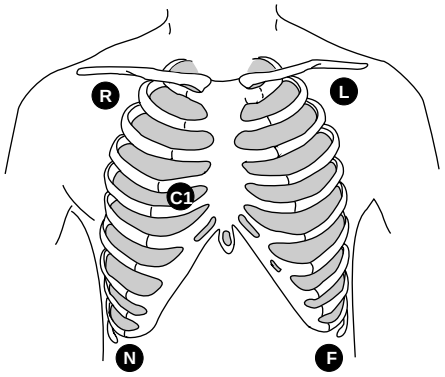
Operation of the transport monitor and Tram module with a fixed right leg reference is limited to the fixed lead designated. If using a lead I cable, respiration is monitored from lead I, etc. If in Adult-ICU or Operating Room mode, multi-lead analysis defaults on. With a 3-leadwire cable with a fixed reference, you should change lead analysis to single lead analysis on the transport monitor.

5-Leadwire Electrode Placement

Following is a suggested configuration when using five leadwires:



Shown using AHA labels



Shown using IEC labels

642A & 643A

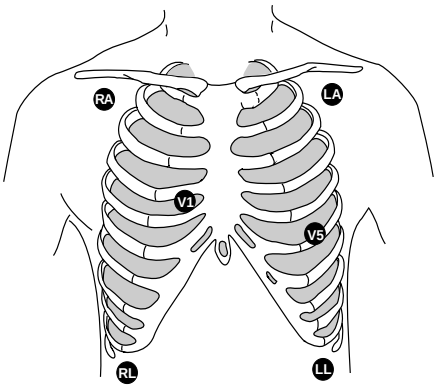
Right arm and left arm electrodes should be placed just below the right and left clavicle.

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

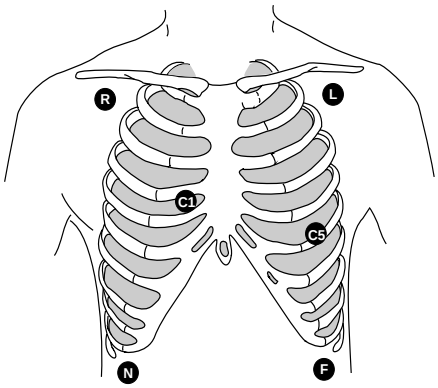
The chest electrode should be placed according to the physician's preference.

6-Leadwire Electrode Placement

Following is a suggested configuration when using 6 leadwires:



Shown using AHA labels



Shown using IEC labels

100A & 101A

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 non-muscular surface on the lower edge of the rib cage.

For telemetry monitoring, any two precordial electrodes may be placed according to the physician's preference.

NOTE

The V1 lead is recommended for arrhythmia detection, and the V5 lead is recommended for ST depression monitoring.*

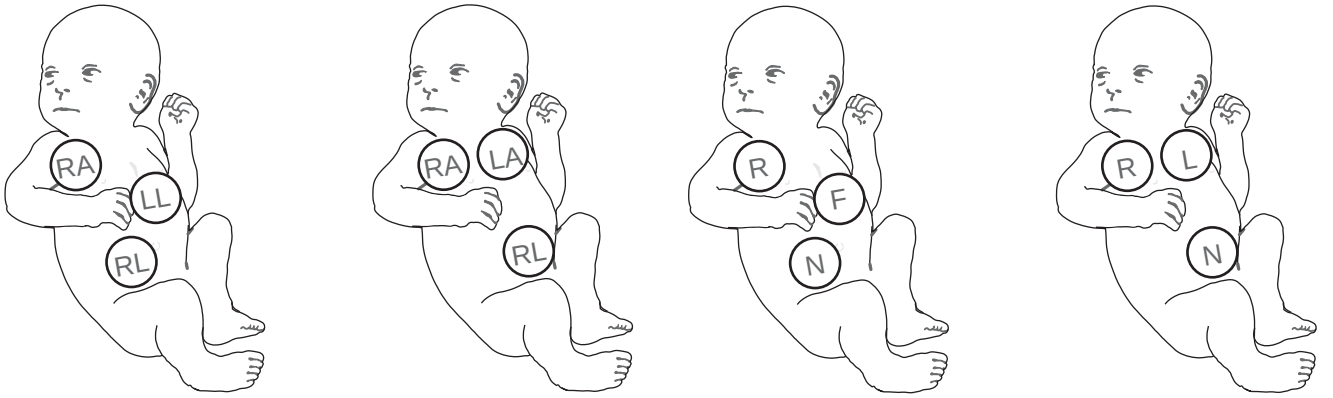
*Barbara J. Drew, RN, Ph.D., FAAN (2000). Value of Monitoring a Second Precordial Lead for Patients in a Telemetry Unit, GE Medical Systems (order document number M04243ME0).

Electrode Placement for Neonates

WARNING

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

Because of the size of neonatal patients, there is usually only enough room for a 3-leadwire electrode configuration. A 3-lead neonatal ECG cable is available, and a Multi-Link DIN adapter is available for the 5-lead Multi-Link cable. The right arm and left arm, or right arm and left leg electrodes are positioned on the right and left sides of the chest. The third electrode (right leg) can be placed on either the right or left side of the abdomen.



Lead II | Lead I | Lead II | Lead I

Shown using AHA labels | Shown using IEC labels

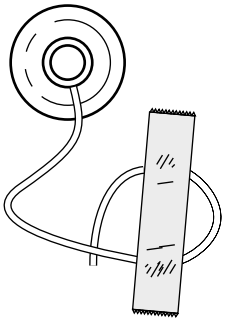
646A & 647A

Electrode Placement for Pacemaker Patients

Follow the standard electrode placement for the type of leadwire being used.

Maintaining Quality ECG Signal

654A



Regardless of patient age, 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. After a long period of time, the patient's sensitive skin also may be irritated by the gel or adhesive causing discomfort.

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.

Surgical Considerations for Electrode Placement (Adults)

Thorough skin preparation is very important to help keep electrosurgical unit (ESU) interference to a minimum. Do a thorough skin prep on the skin next to the grounding pad as well.

Place the right leg electrode close to the ESU grounding pad.

ESU ECG Filters

Electrosurgical Unit (ESU) Cable

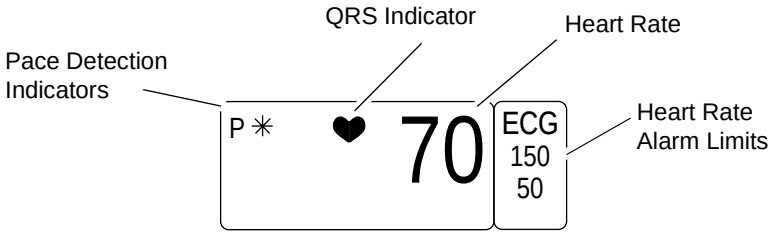
The Multi-Link ESU ECG patient cable is recommended when using the transport monitor in the presence of an electrosurgical unit. This cable, with a built-in ESU filter, helps reduce electrosurgical noise detected on the ECG signal.

ECG Display

Overview

An ECG waveform is always displayed at the top of the display. Depending on the transport monitor settings, more may be displayed.

An ECG parameter window is also displayed. Your software package and parameter settings determine the information displayed in the window.



656B

ECG Parameter Window

The parameter window displays the current heart rate and pacemaker indicators.

The transport monitor displays alarm limits, but you can choose to turn them off in Monitor Defaults.

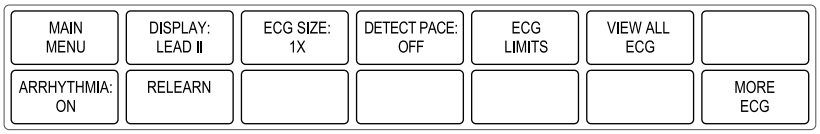
Also displayed are a QRS indicator (flashing heart) and a large, flashing asterisk for each detected pacemaker spike (when pacemaker detection is on).

Use the ECG parameter menu to make changes during monitoring.

Getting to the ECG Menu

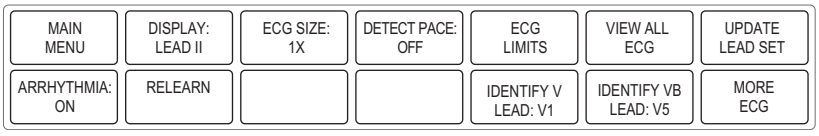
To display the ECG menu, use the **Trim Knob** control to select the ECG parameter label. Remember, selecting with the **Trim Knob** control is a two-step process—rotate to highlight, then press to select.

The ECG menu is displayed at the bottom of the screen. The menu options available depends on the acquisition device connected to the transport monitor.



510C

ECG Menu with a TRAM Module



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ECG Menu with a Patient Data Module

- ***DISPLAY LEAD*** — Changes the top displayed (primary) ECG lead.
- ***ECG SIZE*** — Changes the size of all ECG waveforms displayed and graphed.
- ***DETECT PACE*** — Turns pacemaker detection on/off or access help.
- ***ECG LIMITS*** — Displays a new menu and an information window to adjust heart rate alarm limits.

- ***VIEW ALL ECG*** — Displays six leads of ECG.
- ***UPDATE LEAD SET***— Clears the "***V2-V6 FAIL***" message displayed on the screen after removing the 5 V leads of a 10-leadwire cable (Patient Data Module only).
- ***ARRHYTHMIA*** — Turns arrhythmia processing off/on.
- ***RELEARN*** — Relearns the patient's QRS pattern to enable more accurate monitoring.
- ***IDENTIFY V LEAD*** — Identify or label the V lead being used for ECG (Patient Data Module only).
- ***IDENTIFY VB LEAD*** — Identify or label the VB lead being used for ECG (Patient Data Module only).
- ***MORE ECG*** — Displays a new menu with an option to adjust the QRS tone volume.

Detailed information on each option is found in this chapter.

ECG Menu Options

Display Lead

Overview

This option enables you to change the lead currently displayed as the primary lead — the one in the top trace position. This option is useful when you are selecting a lead for pacemaker detection or analog output.

NOTE

If your system uses multi-vector pacemaker detection, the above statement is not applicable since two leads are used to detect pace.

Follow this procedure:

1. Select the ***DISPLAY LEAD*** option from the ECG menu. A popup menu opens, showing all leads available. The lead currently displayed is highlighted in the list of options.

   NOTE

   There is only one V lead choice even if you are using a 10-leadwire cable.

   If you are using a standard (selectable lead), three-leadwire cable, the available choices in popup menu are leads I, II, and III.

2. Rotate the **Trim Knob** control to select the displayed lead. The change occurs immediately on the screen.
3. Press the **Trim Knob** control to close the popup menu.

Synchronized Cardioversion

The lead displayed in the top trace position is the signal output to the **DEFIB SYNC** connector on the acquisition module. The software provides a defib sync pulse for digital synchronization and places a return marker on the ECG waveform.

If the defibrillator is to be synchronized with the analog ECG signal, review the patient's ECG leads and place the one with the greatest amplitude in the top position on the transport monitor.

Smart-Lead Fail

NOTE

The smart-lead fail feature works only when using a 5-, 6-, or 10-leadwire electrode configuration.

The smart-lead fail feature is continually checking the integrity of the electrodes to allow uninterrupted monitoring. Should the quality of an electrode signal degrade to an inadequate level, a lead fail message will be displayed. If the lead fail affects the ECG waveform monitored in the top trace position on the screen, monitoring will automatically switch to another lead. Refer to the chart below.

Message	New lead monitored
RA FAIL	Lead III
RL FAIL (Patient Data Module only)	The lead selected to display in the top trace position. See Display Lead on page 9-9.
LL FAIL	Lead I
LA FAIL	Lead II
V FAIL	Lead II
LEADS FAILED	No waveforms displayed—multiple leads fail or RL fail when using a TRAM module.

If you are using a 10-leadwire electrode configuration you have the additional V2-V6 leads. If one of these V leads fails while it is displayed in the top trace position, monitoring will switch to lead II.

Individual lead fail messages will not be displayed when using single-lead analysis, but lead switching will occur.

Leads Fail Patient Condition

There is a system alarm to alert you when more than one lead fails. In Operating Room mode, this "leads fail patient" condition defaults as a system advisory alarm. You can, however, set it as a crisis alarm in Monitor Defaults.

In Adult-ICU and Neonatal-ICU modes this alarm defaults to a system warning alarm but can also be set to a crisis alarm. See Setup Default Display on page 5-11.

ECG Size

This option enables you to change the size of all the ECG waveforms displayed on the screen. This may be necessary when diagnosing or problem solving. Normal size (1X) is recommended unless circumstances require otherwise.

Size 2X and greater will lower the QRS detection threshold. This may be helpful for low amplitude QRS waveforms. Use with caution since the lower threshold may also result in false QRS detections if artifact is also present.

Selecting the ***ECG SIZE*** option from the ECG menu opens a popup menu. Size options are:

- ***4X*** = 0.25mV amplitude
- ***2X*** = 0.5mV amplitude
- ***1X*** = 1.0mV amplitude
- ***0.5X*** = 2.0mV amplitude

The current size for all displayed ECG waveforms is highlighted in the menu, and the corresponding mV is shown on the display next to the top waveform.

Follow this procedure to change the ECG size:

1. Select the ***ECG SIZE*** option from the ECG menu. A popup menu opens showing all sizes available. The current size of all displayed ECG waveforms is highlighted.
2. Rotate the **Trim Knob** control to change the size. The change occurs immediately on the screen and affects all displayed ECG waveforms.
3. Press the **Trim Knob** control to close the popup menu.

Detect Pace

Safety Considerations

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

WARNING

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

WARNING

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

WARNING

PACEMAKER SPIKE— A white colored artificial pacemaker spike is displayed in place of the actual pacemaker spike. All pacemaker spikes appear upright and uniform.

Do not diagnostically interpret pacemaker spike size and shape.

WARNING

PATIENT HAZARD— A pacemaker pulse can be counted as a QRS during asystole in pace mode.

Keep pacemaker patients under close observation.

WARNING

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

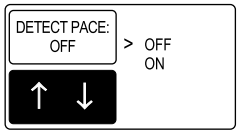
ECG monitoring with patients on non-invasive transcutaneous pacemakers may not be possible due to large amounts of energy produced by these devices. Monitoring ECG with an external device may be needed.

Monitoring Pacemaker Patients

The ***DETECT PACE*** menu option enables and disables the pacemaker detection program. It *must* be used whenever the monitored patient has a pacemaker.

NOTE

When using a Patient Data Module, or TRAM module with software version 12A or later, the menu options are ***OFF*** and ***ON***.



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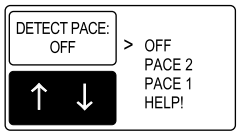
NOTE

When using TRAM modules earlier than version 12A, the menu options are ***OFF***, ***PACE 2***, ***PACE 1***, and ***HELP!***.



513C

NOTE

The ***OFF*** option turns pacemaker detection off. It does *not* perform pacemaker detection.

Pace 1 and Pace 2 for TRAM Modules earlier than Version 12A

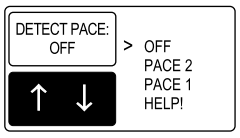
NOTE

Moderate and maximum ECG filtering is not recommended with pacemaker patients. See ESU ECG Filters on page 9-7.

The ***PACE 2*** and ***PACE 1*** 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.

Follow this procedure:

1. Select the ***DETECT PACE*** option from the ECG menu. A popup menu opens.



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TRAM Module *DETECT PACE* Popup Menu

2. Rotate the **Trim Knob** control so the pointer is in front of your choice.

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 transport monitor does not adequately detect paced beats in the ***PACE 2*** mode, then the user may wish to try the ***PACE 1*** mode.

NOTE

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 transport monitor close to the minimum pacing rate, and that the ***BRADY*** arrhythmia alarm level be elevated to a ***WARNING*** or ***CRISIS*** level.

3. Press the **Trim Knob** control to confirm the change and close the popup menu.

When either pace mode is enabled, the software places a white colored 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. See Electrode Placement on page 9-3.
- 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.

Here are some additional guidelines for successful monitoring pacemaker patients:

- When using the 10-leadwire patient cable with all electrodes attached, pace detection occurs on any V lead selected for the top trace position.
- See Pacemaker Troubleshooting on page 9-26.

Multi-Vector Pace Detection for Patient Data Module

The Patient Data Module uses multi-vector pace detection. Here are some additional guidelines for monitoring pacemaker patients when using the Patient Data Module.

- When using the 5- or 6-leadwire patient cables with all the electrodes attached, pace detection occurs on two ECG leads simultaneously.
- The default leads used for detection are II and V5. If these leads are not available, multi-vector pace detection switches to available leads.
- Pace detection switches to single-lead when using a 3-leadwire patient cable.

See Pacemaker Troubleshooting on page 9-26.

Pace Help

Selecting the ***HELP*** option from the Detect Pace popup menu opens an information window describing common problems and solutions in regard to pacemaker detection, and the PACE 1 and PACE 2 options. (TRAM modules earlier than version 12A only).

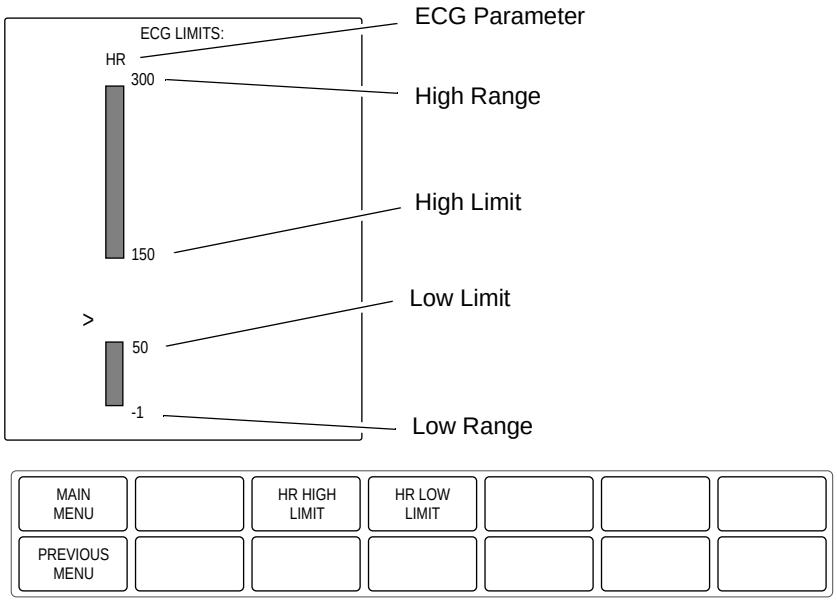
Select any other option in the Detect Pace popup menu to close the popup menu and information window.

ECG Limits

Overview

This option provides an information window with a bar graph that shows the alarm limits for heart rate. A limits menu is displayed to allow you to adjust these limits.

To view the limits, select ***ECG LIMITS*** from the ECG menu. An information window and a new menu are displayed.



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ECG Limits Menu and Information Window

The information window shows the range as well as the alarm limits. The pointer (>) indicates the current value of the patient's heart rate. As long as this indicator remains between the high and low limits, there will be no alarm. Should a limit be exceeded, an alarm will occur.

Heart Rate

If the patient's heart rate exceeds a limit, an alarm will occur. The transport monitor's response is dependent on the alarm category setting. If the limits need to be adjusted, follow this procedure:

1. Select the ***HR HIGH LIMIT*** option from the ***ECG LIMITS*** menu. (Follow this same procedure with the ***HR LOW LIMIT***.)
2. A popup menu opens with the current high heart rate alarm limit displayed.
3. Rotate the **Trim Knob** control and the value displayed will change. The bar graph is also adjusted. The limit will not be in effect until the **Trim Knob** control is pressed and the popup menu closed.
4. Press the **Trim Knob** control to confirm the change and close the popup menu.
5. Select ***PREVIOUS MENU*** to return to the ECG menu.

Artifact Alarm

ECG artifact will generate an alarm. All artifact begins at level 1 and 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 — Heart rate values change to X, an additional message, "***ARRHY SUSPEND***," is displayed, and a System Warning alarm (repeating foghorn tone) is heard.

View All ECG

To view six leads of ECG on the display, select ***VIEW ALL ECG*** option from the ECG menu. A popup menu opens and the display is reconfigured to show six ECG leads—I, II, III, V, AVL, and AVF (this is assuming you are using five electrodes on your patient).

NOTE

The Patient Data Module labels the V lead according to which V lead is being monitored; for example: V1, V2, V3, etc.

Press the **Trim Knob** control to close the popup menu and return to the normal display.

Update Lead Set

There may be instances when you use the 10-leadwire cable for routine monitoring. In these instances, you may only use the standard 5-leadwire portion of the cable. The monitor displays the message "***V2-V6 FAIL***" when it does not detected the extra V leads. Use the ***UPDATE LEAD SET*** menu option to clear this message from the screen (Patient Data Module only).

CAUTION
V2-V6 FAIL MESSAGE—If after selecting the Update Lead Set menu the ***V2-V6 FAIL*** message remains on the display, verify that the leads are correctly connected to the patient.

Arrhythmia

Safety Messages

WARNING

VENTRICULAR ARRHYTHMIAS—The arrhythmia analysis program is intended to detect ventricular arrhythmias. It is not designed to detect atrial or supra-ventricular 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.

NOTE

Some monitors offer atrial fibrillation detection. When the atrial fibrillation arrhythmia detection feature is selected, it replaces the irregular arrhythmia alarm text with the atrial fibrillation alarm text.

WARNING

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: ***ARR OFF***, ***ARRHY SUSPEND***, ***LEADS FAIL***, ***ALARM PAUSE*** and ***ALL ALARMS OFF***.

The EK-Pro algorithm simultaneously uses leads I, II, III, and the V lead for ECG and arrhythmia analysis.

NOTE

Arrhythmia messages are displayed when ***ALARM PAUSE*** or ***ALL ALARMS OFF*** is displayed, but there are no alarm tones.

Turning Arrhythmia On/Off

To manually turn arrhythmia analysis off and on, select the ***ARRHYTHMIA*** option from the ECG menu. A popup menu with the selections ***ON*** and ***OFF*** opens. Use the **Trim Knob** control to make your selection. The menu option changes to reflect it.

Arrhythmia analysis defaults on. The message ***"ARR OFF"*** appears in the ECG parameter window when it is turned off. Turning arrhythmia on automatically starts a relearn procedure.

Arrhythmia Alarms Off Message

The following message may appear in the waveform area of the transport monitor when the monitor is in the Adult-ICU or Neonatal-ICU monitoring mode:

ARRHYTHMIA ALARMS OFF

TURN ARRHYTHMIA ON TO ACTIVATE ALARMS

NOTE

Arrhythmia analysis is off when this message is displayed. No arrhythmia alarms will sound.

This message appears because the transport monitor is connected to an acquisition device with arrhythmia analysis turned off. The message is not displayed if the transport monitor is in the Operating Room mode because arrhythmia analysis is generally turned off in Operating Room mode.

To clear the message, select the ***ARRHYTHMIA*** option from the ECG menu. In the popup menu that opens, select ***CLEAR ARRHY MESSAGE***. The message will clear from the display.

NOTE

The ***CLEAR ARRHY MESSAGE*** option only appears in Arrhythmia popup menu when the message "***ARRHYTHMIA ALARMS OFF TURN ARRHYTHMIA ON TO ACTIVATE ALARMS***" is displayed.

To clear the message *and* enable arrhythmia analysis, select the ***ARRHYTHMIA*** option from the ECG menu. In the popup menu that opens, select ***ON***. The message will clear and arrhythmia analysis will begin.

Arrhythmia Conditions

Following is a list of the arrhythmia messages that are displayed when arrhythmia is on and the condition occurs. A definition of each arrhythmia condition is included. How the transport monitor responds to each condition is determined by the alarm level to which the arrhythmia has been assigned. See Arrhythmia Alarm Level on page 7-9.

- ***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.
- ***ATRIAL FIB***

  Characterized by random, chaotic, low-amplitude deflections of the supraventricular component of the ECG waveform, resulting in irregular timing of QRS complexes and an absence of uniform P waves preceding the QRS complex.

  NOTE

  Available when using the Patient Data Module, with the transport monitor in Adult or Operating Room mode only. See AFIB Identification on page 9-21.
- ***ASYSTOLE***

  Ventricular asystole occurs whenever the displayed heart rate drops to zero.
- ***BIGEMINY***

  Occurs when two 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.

  NOTE

  Not used if AFIB is enabled.

- ***PAUSE***

  Occurs when the interval between two consecutive beats exceeds three seconds.

- ***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 two 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

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

- ***V TAC***

  - 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.

AFIB Identification

AFIB Identification is available when using a Patient Data Module only. Atrial fibrillation (AFIB) is characterized by random, chaotic, low-amplitude deflections of the supraventricular component of the ECG waveform, resulting in irregular timing of QRS complexes and an absence of uniform P waves preceding the QRS complex.

The AFIB algorithm feature identifies atrial fibrillation arrhythmias when using the transport monitor with a Patient Data Module. When the AFIB arrhythmia detection feature is enabled, it replaces the ***IRREGULAR*** arrhythmia alarm text with the ***ATRIAL FIB*** alarm text. AFIB can be enabled or disabled in the Boot Code ***Service Menu*** > ***Set Configuration*** > ***AFIB Identification***. Ask your biomed or service personnel to change the setting in the boot code.

NOTE

AFIB identification is not available for Neonatal mode. If AFIB identification is enabled in the boot code and the transport monitor is set to Neonatal mode, the AFIB identification remains disabled and ***IRREGULAR*** will be used.

When transferring a patient from a Solar 8000M/i patient monitor to a transport monitor with AFIB enabled in boot code, the following conditions apply:

- If the transport monitor is set to Adult or Operating Room mode and you select ***ADMIT NEW PATIENT***, AFIB identification will be set to the transport monitor boot code setting (eg, if the boot code is set for AFIB identification, AFIB identification will be on).
- If the transport monitor is set to Adult or Operating Room mode and you select ***CONTINUE MONITORING***, AFIB identification will be set to the Solar 8000M/i monitor setting (eg, if the Solar 8000M/i patient monitor is set to use AFIB identification, AFIB identification will be on).

- AFIB identification is not available in Neonatal mode. When transferring a patient from the Solar 8000M/i patient monitor and the transport monitor is in Neonatal mode, AFIB identification will be off, regardless of any settings at either monitor.

See Admitting a Patient on page 6-2.

Alarms

A patient status alarm is triggered when an AFIB arrhythmia is detected. The message ***ATRIAL FIB*** is displayed in the message area of the display.

NOTE

There is approximately a 90-second delay while the AFIB algorithm verifies the AFIB arrhythmia condition.

The AFIB alarm defaults to a message alarm level but can be changed in Monitor Defaults.

Relearn

During monitoring of ECG, it may be necessary to use the ***RELEARN*** option when a dramatic change in the patient's ECG pattern has occurred. A change in the ECG pattern could result in:

- incorrect arrhythmia calls, and/or
- inaccurate heart rate.

The ***RELEARN*** option allows the transport monitor to learn the new ECG pattern to correct arrhythmia calls and heart rate value.

Select the ***RELEARN*** option from the ECG menu. This is a direct action menu option.

During the learning process, an X replaces the heart rate value in the ECG values window.

NOTE

Whenever arrhythmia is turned on, relearn automatically takes place.

Identify V Lead and VB Lead

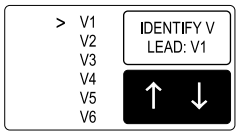
NOTE

These options are only available when using the transport monitor with a Patient Data Module.

Correctly labeling V leads is important to facilitate correct ECG analysis when viewing real-time waveforms, histories or printouts. These two options allow you to:

- Label the V Lead when using a 5- or 6-leadwire ECG cable.
- Label the VB Lead when using a 6-leadwire cable.

Select either the ***IDENTIFY V LEAD*** or the ***IDENTIFY VB LEAD*** option to open a popup menu.



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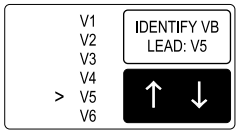
***IDENTIFY V LEAD* popup Menu**



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***IDENTIFY VB LEAD* Popup Menu**

Rotate the **Trim Knob** control to move the pointer to the V lead name of choice. Press the **Trim Knob** control to confirm the change and close the popup menu.

IDENTIFY V LEAD Option with a 5- or 6-Leadwire Cable

With a standard 5-leadwire or 6-leadwire patient cable, this menu option labels the V lead as placed in your electrode configuration. With a 5-leadwire cable you only connect one V lead, therefore, you must place the electrode in the V position you want and then be certain the label matches the position. With a standard 6-leadwire patient cable, use this option to label the first of the two V leads that are connected. The monitor defaults this label as V1, but you can change it here or in Monitor Defaults, Setup Default Display.

IDENTIFY V LEAD Option with a 10-Leadwire Cable

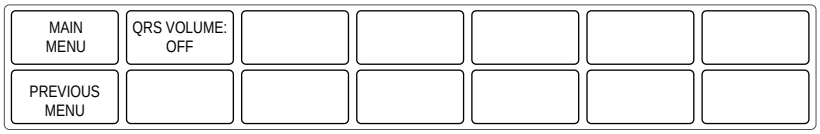
With a 10-leadwire patient cable (with all V leads attached to the patient), the arrhythmia analysis program only uses one V lead, and it is identified here. Changes made with the ***IDENTIFY V LEAD*** menu option only affect the V lead used for arrhythmia analysis. The monitor defaults this option to V1, but you can change it here or in Monitor Defaults, Setup Default Display.

IDENTIFY VB LEAD Option with a 6-Leadwire Cable

With a standard 6-leadwire patient cable, this menu option labels the VB lead as placed in your electrode configuration. With a 6-leadwire cable you must place the electrode in the V and the VB position you want and then be certain the label matches the position. The monitor defaults this label as V5. You can change it here or in Monitor Defaults, Setup Default Display.

More ECG

The ***MORE ECG*** option opens a menu with an additional ECG setting.



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More ECG Menu

QRS Volume

The ***QRS VOLUME*** option turns on a tone which sounds each time a QRS complex is detected. You can adjust the volume of this tone. Follow this procedure:

1. Select the ***QRS VOLUME*** option from the More ECG menu. A popup menu opens displaying all choices.
2. Rotate the **Trim Knob** control. Each time the **Trim Knob** control is rotated, you will hear a tone at that volume.
3. When you are satisfied with the volume level, press the **Trim Knob** control to close the popup menu.

NOTE

Turning QRS volume on will automatically turn off the SpO_2 rate volume, if on. See Chapter 12.

When in Operating Room mode, the 10% and 20% volume tone is slightly quieter than the 10% and 20% volume tone in Adult-ICU or Neonatal-ICU modes.

QRS Tone With Brady Alarm

This feature is only found in the Neonatal mode. With this feature, the QRS tone automatically starts when the transport monitor alarms for bradycardia. The QRS tones will stop when the bradycardia alarm stops.

NOTE

The QRS tone with this feature is 20% louder than the set alarm volume.

Be aware that during an alarm pause, the QRS tone will not sound, just like any other alarm tone. The QRS tone is silenced with the **Silence Alarm** key on the transport monitor.

To enable this feature (factory default is ***OFF***):

1. Select the ***QRS VOLUME*** option from the More ECG menu.
2. With the **Trim Knob** control, highlight ***BRADY ALARM***.
3. Press the **Trim Knob** control to set your selection and close the popup menu.

NOTE

Turning SPO2 rate volume on will turn this feature off. This feature can be set to default on. See Setup Default Display on page 5-11.

Troubleshooting

Inaccurate Heart Rate and/or False Asystole

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. Select ECG parameter label.
2. Select ***DISPLAY LEAD***.
3. Scroll through all ECG leads and check for 0.5 mV amplitude at normal (1X) size. (At least 0.5 mV amplitude is required for QRS detection.)
4. If amplitudes are low, electrodes may need to be repositioned or replaced.

Relearn Arrhythmia

1. Select ECG parameter label.
2. Select ***RELEARN***.

If Problem Continues and ECG Amplitude is Low

1. Select ECG parameter label.
2. Select ***ECG SIZE***.
3. Select 2X or higher.
4. Close the popup menu.
5. Select ***RELEARN***.

False Ventricular Calls

Check ECG signal from patient: (The chest lead may exhibit polarity changes which may occasionally cause an inaccurate call.)

1. Check/adjust electrode placement.
2. Check/perform skin preparation.
3. Check/replace electrodes. (If the chest lead is a problem, move the chest lead to another chest position or leg position.)
4. Relearn ECG:
    a. Select ECG parameter label.

b. Select ***RELEARN***.

5. IF PROBLEM CONTINUES:

   a. Select ECG parameter label.

   b. Select ***RELEARN***.

Pacemaker Troubleshooting

Overview

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 waveform is removed, and a “pacemaker enhancement spike” is artificially placed in the ECG waveform.

Pace detection is indicated visually in the ECG parameter box. By watching the ECG waveform, pace detection is indicated by uniform, upright pacemaker enhancement spikes in the ECG data.

Two effective approaches for improving pacemaker detection are:

- Change the primary displayed ECG trace to a different lead.

  NOTE

  If your system uses multi-vector pacemaker detection, the above statement is not effective since two leads are used to detect pace.

- Move the electrodes associated with the primary displayed trace.

Pacemaker patients should be kept under close observation.

Inaccurate Pacemaker Detection

Use Pacemaker Processing

1. Select ECG parameter label.
2. Display the lead of ECG with the greatest amplitude in the top waveform position.
3. Select ***DETECT PACE***.
4. Select ***PACE 2*** or ***PACE 1***.

NOTE

For TRAM modules earlier than version 12A only.

NOTE

In general, be aware that a pacemaker pulse could be falsely counted as a QRS during asystole.

NOTE

- Pace 1 pace 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 pace 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.

NOTE

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. See Electrode Placement for Pacemaker Patients on page 9-6.
2. Check/perform skin preparation.
3. Check/replace electrodes.

10 Pressures

Introduction

This chapter gives guidelines for preparation, adjusting setup, and specialized features for invasive pressure monitoring. Detailed operating procedures are given for the ART pressure site. Other pressure sites have menu items similar to those in the ART menu so you can apply the same principles when monitoring those sites.

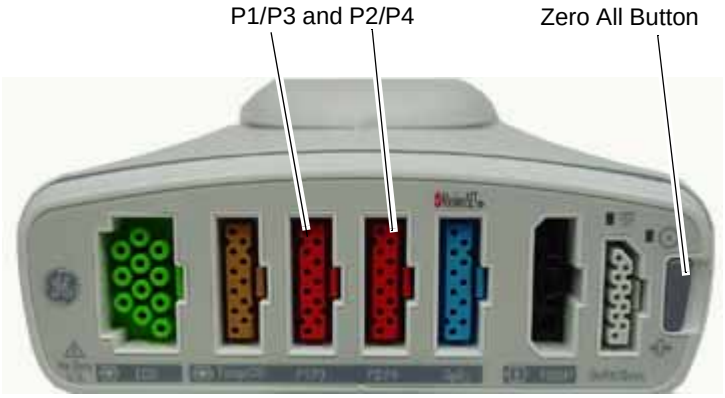
NOTE

The signal input is a high-insulation port and it is defibrillator-proof.

The insulated input ensures patient safety and protects the device during defibrillation and electrosurgery.

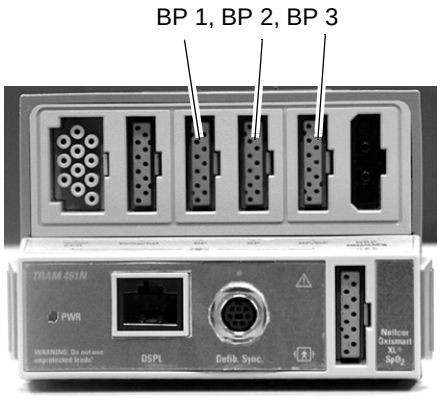
Invasive Pressure Connectors

The Patient Data Module's Power **ON** button functions as a Zero All button after power has been applied to the Patient Data Module.



404B

Patient Data Module



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TRAM 451M module

Assigned Pressure Names

The invasive pressure connectors are labeled differently on the Patient Data Module and TRAM module:

- **P1/P3, P2/P4** on the Patient Data Module
- **BP** on the TRAM module

For convenience, the transport monitor has a specific pressure name assigned for each invasive pressure connector. However, these names can be changed during the setup procedure, so you can plug any pressure line into any connector. Having names properly reflect the site is important for proper processing of the waveform since different algorithms are used for processing different pressure sites.

Site names supported and values displayed are:

- arterial (ART)—systolic, diastolic, mean, and rate
- femoral (FEM)—systolic, diastolic, mean, and rate
- pulmonary artery (PA)—systolic, diastolic, and mean
- central venous (CVP)—mean
- left atrial (LA)—mean
- right atrial (RA)—mean
- intracranial (ICP)—mean and CPP when combined with ART or FEM. See CPP Pressure on page 10-6.
- special (SP)—mean

Additional site names available in the Neonatal-ICU mode are:

- umbilical artery catheter (UAC)—systolic, diastolic, mean, and rate
- umbilical venous catheter (UVC)—mean

The chart below shows the pressures assigned to the invasive pressure connectors on the acquisition devices. For reference purposes, this manual refers to the TRAM module connectors as 1, 2, etc., beginning with the left-most connector.

	Assigned Pressure Names			
Acquisition Device	1	2	3	4
Patient Data Module with a single cable in each P1/P3 and P2/P4 connector	ART	PA	—	—
Patient Data Module with one single cable and one Y-adapter cable to monitor three pressure sites[1]	ART	PA	CVP	—
Patient Data Module with two Y-adapter cables to monitor four pressure sites[1]	ART	PA	CVP	LA
TRAM modules with two BP connectors	ART	PA	—	—
TRAM modules with three BP connectors	ART	PA	CVP	—
TRAM modules with four BP connectors[2]	ART	PA	CVP	LA

[1]The Y-adapter cable can be connected to either pressure connection when the pressure site is licensed and activated. P1/P3 connector monitors ART and CVP, P2/P4 connector monitors PA and LA.

[2]or, fourth BP when using a TRAM 451 series modules with the split BP3/BP4, Y-adapter cable plugged into the third BP connector.

NOTE

If an invasive blood pressure cable is connected to the fourth **BP** connector on the TRAM module, noninvasive blood pressure (NBP) cannot be activated.

Invasive Pressure Y-Adapter Cable

Up to four invasive pressures can be monitored with a Patient Data Module or TRAM 451 series module.

Patient Data Module

The Patient Data Module can monitor up to four invasive blood pressures when two Y-adapter cables are used. The Y-adapter cables plug into the **P1/P3** and **P2/P4** connectors on the Patient Data Module, and allows two separate invasive blood pressures to be monitored from each connector. Follow these cable configurations to monitor invasive pressures:

- To monitor a single invasive blood pressure, connect a standard cable to the **P1/P3** connector.
- To monitor two invasive blood pressures, connect a standard cable to the **P1/P3** and **P2/P4** connectors.
- To monitor three invasive blood pressures, connect a single cable and a Y-adapter cable to the **P1/P3** connector and the **P2/P4** connector. The 3rd (P3) or 4th (P4) pressure sites must be licensed and activated.
- To monitor four invasive blood pressures, connect a Y-adapter cable to the **P1/P3** connector and a Y-adapter cable to the **P2/P4** connector. The 3rd (P3) and 4th (P4) pressure sites must be licensed and activated.

TRAM 451 Series Modules

The TRAM 451 series modules can monitor four invasive blood pressures when a Y-adapter cable is used. This cable plugs into the **BP3** connector on the module, and allows two separate invasive blood pressures to be monitored from that connector.

This cable is designed to fit only in the **BP3** connector. Do not attempt to plug it into any other connector; it will not function.

The Y-adapter cable can *only* be used with TRAM 451 series modules. It cannot be used with any other TRAM module series.

Zero Reference

Zeroing the pressure transducers is important for accurate pressure measurements. Follow the manufacturer’s recommendations and refer to your hospital policy for zeroing guidelines. You can zero all transducers at one time or each one individually.

To zero all the pressure transducers at one time, follow this procedure:

1. Level the transducer according to your unit's policy. (The recommended standard is level of phlebostatic axis.)
2. Close the transducer stopcock(s) to the patient.
3. Open the venting stopcock(s) to air (atmosphere).
4. Press the **Zero All** key on the transport monitor.
5. Verify that zero reference has been established. (Watch the pressure parameter windows for messages.)
6. Close the venting stopcock(s) to air (atmosphere).
7. Open the transducer stopcock(s) to the patient. Within seconds pressure numerics should be displayed in the pressure parameter windows.

You can also zero a single pressure transducer. See Pressure Menu Options on page 10-7.

Pressures Checklist

1. Patient cable is attached to the invasive pressure connector on the module.
2. Transducers are level according to your unit's policy. (The recommended standard is level of phlebostatic axis.)
3. All transducers are zeroed.
4. Any entrapped air is removed from the system.

   NOTE

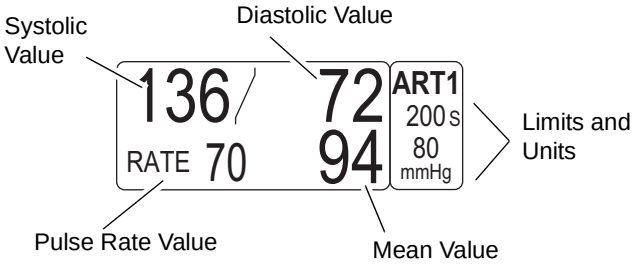
   Refer to the transducer manufacturer's instructions for suggested means of removing entrapped air from the hydraulic system.

5. Pressure setup is adjusted, if necessary. Details are provided in this chapter.

Pressure Monitoring Features

Pressure Information

A labeled, pressure waveform is displayed when the patient cable is connected. After a zero reference procedure is done, numerics are displayed in the pressure parameter windows on the right side of the screen.



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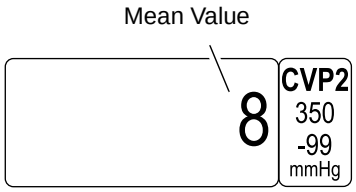
ART Pressure Parameter Window



684A

CVP Pressure Parameter Window

The current systolic, diastolic, and mean values are displayed. Some pressures only display a mean value. Limits and the units of measurement may also be displayed. For pressures with multiple values, the limits are labeled (S=systolic, D=diastolic, M=mean). For sites labeled ART, FEM, and UAC, a pulse rate value can be turned on.

The pressure monitoring features are found in the pressure menu. All pressure menus include scales, cursor, site name, limits, and zero. Some pressure menus have additional features, which are detailed in this chapter.

CPP Pressure

When both ART and ICP are monitored, or both FEM and ICP are monitored, a cerebral perfusion pressure (CPP) value is calculated and displayed in the ICP values window. The formula for this is the mean ART/FEM pressure value minus the ICP pressure value.

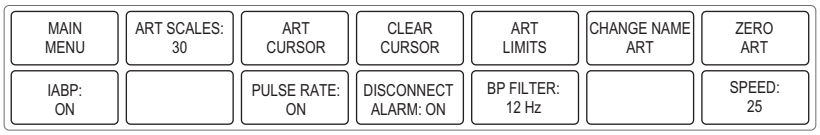
NOTE

When the transport monitor is connected to the Patient Data Module, CPP trends are not collected.

Getting to the Pressure Menu

To display a pressure menu, use the **Trim Knob** control to select the pressure parameter label. In this example, we will use the ART menu with a Patient Data Module. Remember, selecting with the **Trim Knob** control is a two-step process—rotate to highlight, then press to select.

The ART menu is displayed at the bottom of the screen.



686D

ART Menu with Patient Data Module

With the **Trim Knob** control, you now can select any of the displayed options:

- ***SCALES*** — Changes the displayed scale for this pressure.
- ***CURSOR*** — Displays a moveable cursor on the waveform.
- ***CLEAR CURSOR*** — Removes the cursor from the waveform.
- ***LIMITS*** — Displays a new menu and an information window to adjust alarm limits.
- ***CHANGE NAME*** — Changes to another name.
- ***ZERO*** — Zero reference this transducer only.
- ***IABP*** — Turns on/off a function that measures arterial (femoral) pressure and displays both the pressure waveform and numerical pressure values (For ART and FEM sites only).
- ***PULSE RATE*** — Turns on/off a pulse rate display in the pressure parameter window (For ART and FEM, and UAC in neonatal mode, sites only).
- ***DISCONNECT ALARM*** — Turns on/off potential catheter disconnection detection alarm (For ART and FEM sites with Patient Data Module only).
- ***BP FILTER*** — Selects a 12Hz or 40Hz filter.
- ***SPEED*** — Changes the sweep speed for the displayed pressure waveform.

These menu options are found in all pressure menus unless otherwise noted. The only difference is the site name, for example, ART Cursor, PA Cursor, etc. More details on each option are found in this chapter.

Pressure Menu Options

The ART menu is used in this section to demonstrate the pressure menu options. Follow the same procedure to use the same option in any other pressure menu.

Scales

Adjusting Scales

The ***SCALES*** option allows you to change the scale on which the pressure waveform is displayed on the screen. Changing the scale changes the size of the waveform. Scales can be set in Monitor Defaults.

Follow this procedure:

1. Select the ***ART SCALES*** option from the ART menu. A popup menu opens showing the scale sizes available. The scale currently used is designated with the pointer (>).

NOTE

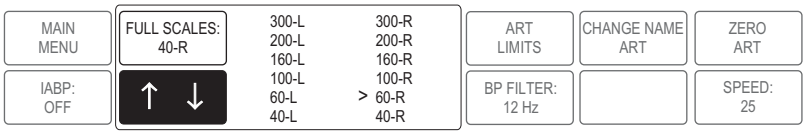
The ***AUTO*** option is only available once the pressure is zeroed.

2. With the **Trim Knob** control, move the pointer to the desired scale size. The scale on the display will not change until the **Trim Knob** control is pressed. Pressing the **Trim Knob** control also closes the popup menu.

   Selecting ***AUTO*** will calculate a scale based on the patient's current arterial blood pressure.

Full Scales

If the waveform is on a full scale, the menu option will read ***FULL SCALES***, and the popup menu will look like this:



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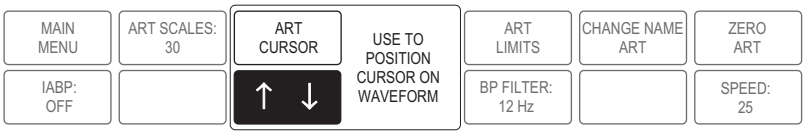
Full Scales Popup Menu

Use this popup menu to place the waveform on a right (R) or left (L) scale.

Cursor

This option places a cursor (dashed, horizontal line) across the pressure waveform. The cursor is moveable and is used to give accurate pressure values at selected points on the pressure waveform. A numeric value is displayed on the screen to the right of the cursor.

1. Select the ***ART CURSOR*** option from the ART menu. A popup menu opens.



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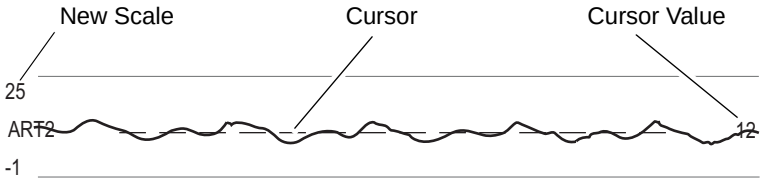
ART Cursor Popup Menu

When displaying the pressure waveforms on individual scales, the transport monitor automatically calculates a scale and the new scale and cursor are displayed with the waveform. A numeric cursor value is displayed to the right of the cursor.



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Cursor on ART Waveform

2. With the popup menu open, rotate the **Trim Knob** control to move the cursor. The cursor value changes as you move the cursor.

3. Press the **Trim Knob** control to close the popup menu. The cursor remains on the waveform.

NOTE

In the ***FULL*** and ***FULL GRID*** display modes, only one cursor can be displayed at a time, but it can be moved throughout the entire full scale range.

The cursor remains on the screen until you turn it off (***CLEAR CURSOR***), change the scale size, or change display mode.

When the cursor is removed, the pressure scale returns to the scale used before the cursor was turned on.

Clear Cursor

To remove the cursor from the waveform, select the ***CLEAR CURSOR*** option from the pressure menu. This is a direct action menu option.

NOTE

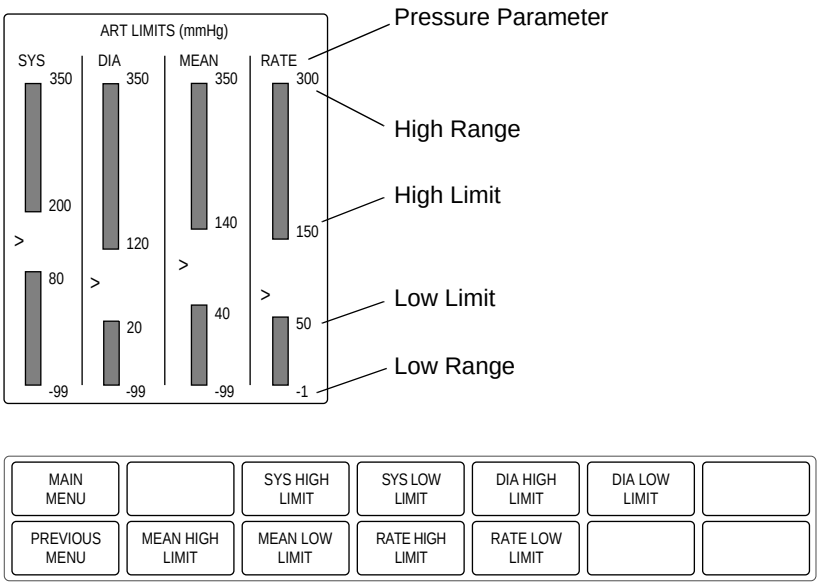
The cursor remains on the screen until you turn it off (Clear Cursor), change the scale size, or change display mode. When you have the cursor selected in 6 individual display and change to 3 individual display (or vise-versa) the cursor remains. When you have the cursor selected in individual displays and change to Full display (or vise-versa) the cursor is removed.

Limits

This option provides an information window with bar graphs that show the alarm limits for displayed pressures (systolic, diastolic, and/or mean). A new set of menu options is displayed to allow you to adjust these limits.

For this example, the ART information is used. Follow this procedure:

1. Select the ***ART LIMITS*** option from the ART menu. An information window is displayed on the screen and a new set of menu options is displayed in the menu area.



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ART Limits Menu and Information Window

The information window shows the range as well as the alarm limits. The pointer (>) indicates the current value of that parameter for the monitored patient. As long as that value remains between the high and low limits, there will be no alarm. Should the value exceed one of the limits, an alarm will occur.

2. To change a set limit, for example the high rate limit, select the ***RATE HIGH LIMIT*** option from the Limits menu. A popup menu opens.

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Rate High Limit Popup Menu

3. Rotate the **Trim Knob** control and the value displayed will change. The bar graph is also adjusted. The limit will not be in effect until the **Trim Knob** control is pressed and the popup menu closed.
4. Press the **Trim Knob** control to confirm the change and close the popup menu.
5. Select ***PREVIOUS MENU*** to exit the Limits menu and return to the pressure menu. Follow this procedure to set any other pressure parameter limits in this menu.

Change Name

This option allows you to change the designated name for this pressure connector.

Having the names properly reflect the site is important for proper processing of the waveform since different algorithms are used for different pressure sites.

Follow this procedure to change a name:

1. Select the ***CHANGE NAME*** option from the pressure menu. A popup menu opens showing all choices. The name presently assigned is designated with the pointer (>).
2. Rotate the **Trim Knob** control to place the pointer in front of the desired name. The change will not take effect until the popup menu is closed.
3. Press the **Trim Knob** control to confirm the change and close the popup menu. This causes a change in the parameter window and the main menu is displayed.

Zero

Use the ***ZERO*** option to zero this transducer only.

1. Level the transducer according to your unit's policy. (The recommended standard is level of phlebostatic axis.)
2. Close the transducer stopcock to the patient.
3. Open the venting stopcock to air (atmosphere).
4. Use the **Trim Knob** control to select (highlight and press) the ***ZERO*** option in the pressure menu.
5. Verify that zero reference has been established. (Watch the pressure parameter window messages.)
6. Close the venting stopcock to air (atmosphere).
7. Open the transducer stopcock to the patient. Within seconds pressure numerics should be displayed in the pressure parameter window.

IABP

NOTE

The IABP feature is not available when the transport monitor is set up for Neonatal-ICU mode.

Triggering

IMPORTANT — GE recommends that the signal source used to trigger an intra-aortic balloon pump (IABP) should be the balloon pump device itself. This insures that the trigger signal is compatible with all modes of the IABP. An extra set of ECG electrodes, or an additional connection from the arterial line can be connected to the transport monitor to produce waveforms on the transport monitor's display for consolidated waveform viewing.

WARNING

PATIENT HAZARD—If you choose to trigger the balloon pump from the transport monitor, contact the balloon pump manufacturer directly for interface requirements as they vary between manufacturers.

Some trigger modes on certain balloon pump devices may not be compatible with the GE analog output signal, and use may contribute to patient injury or sub-optimal pumping results.

If you choose to use the transport monitor for triggering, you must follow the instructions below. Failure to follow these instructions may result in an incompatible analog output signal which may contribute to patient injury.

1. Contact the balloon pump manufacturer for interface requirements. GE's ECG analog output delay specification is indicated below.

   NOTE

   The maximum ECG analog output delay specification with the diagnostic ECG filter applied is less than 35 milliseconds. Refer to step 2.

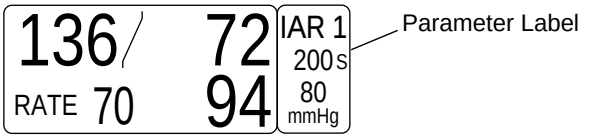
2. Cable connection and ECG filter.
   - Use the appropriate compatible analog output cable from GE.
   - Cable the balloon pump to the transport monitor through the **DEFIB SYNC** connector.
3. Primary displayed ECG lead. If the balloon pump triggers off the R wave of the QRS complex, review the patient's ECG leads and place the one with the greatest amplitude in the top (primary) position on the transport monitor's screen.
4. Pacemaker Detection. If the patient has a pacemaker, be sure pacemaker detection is on (selected from the ECG menu). Failure to turn pacemaker detection *on* may cause poor beat detection which may result in inadequate triggering of the balloon pump.
5. BP Filter. If the blood pressure is used to trigger the balloon pump, use the 40 Hz pressure filter (selected from the pressure menu).

Using the IABP Feature

The transport monitor measures arterial (femoral) pressure and displays both the pressure waveform and numerical pressure values. The IABP feature compensates for the irregularities in the pressure waveform caused by the use of an intra-aortic balloon pump.

Starting the IABP Program

To turn the IABP program on and off, select ***IABP*** option from the ART or FEM pressure menu. When on, the parameter label will begin with an "I" as shown in the figure below.



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ART Parameter Label with IABP On

Displayed Values

Displayed pressure values are affected by the intra-aortic balloon pump.

The IABP program displays three values, for example 150 / 45 (98). The first value, systolic, is the highest pressure in one cardiac cycle; the second, diastolic, is the lowest pressure in one cardiac cycle; and the third (mean) is the average pressure during one cardiac cycle.

The displayed numerical values are computing a rapidly varying waveform generated during IABP treatment and do not always reflect a true arterial pressure. For accuracy and reliability, always combine the recommended methods listed below for reading arterial and/or femoral blood pressure:

- the IABP waveform displayed on the screen (use scales for evaluation), and
- the balloon pump display if available.

Since there are a number of points along the IABP waveform that could be the displayed value, it is important for you to know which ones the program chooses. The values displayed will differ depending on the timing of the pump.

For 1:1 or 1:2 Timing:

Systolic Numerics

- When the augmented diastole is greater that the patient systole, the displayed systole will equal the augmented diastole. (See figure 1, Augmented Diastole > Patient Systole, below.)
- When the patient systole is greater than the augmented diastole, the displayed systole will equal the patient systole. (See figure 2, Patient Systole > Augmented Diastole, below.)

Diastolic Numerics

- The displayed diastole will always equal the balloon end diastole. (See the figures on the following page.)

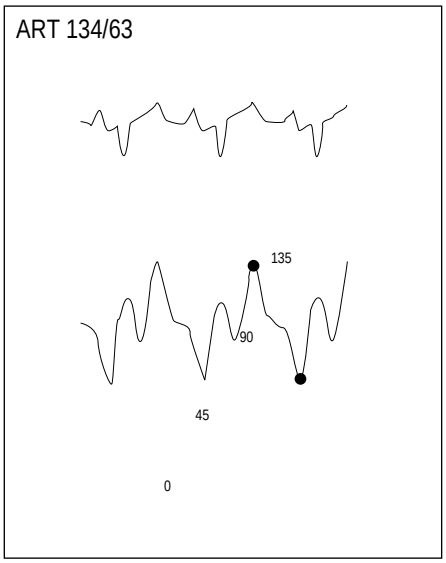

Figure 1

Augmented Diastole > Patient Systole

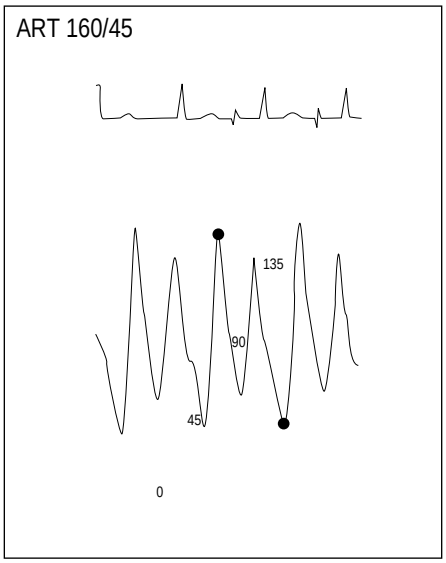

Figure 2

Patient Systole > Augmented Diastole

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For 1:3 or More Timing:

Systolic Numerics

- The displayed systolic numerics will switch between the augmented diastole and patient systole. (See figure 3 below.)

Diastolic Numerics

- The displayed diastolic numerics will switch between the balloon end diastole and the patient end diastole. (See figure 3 below.)

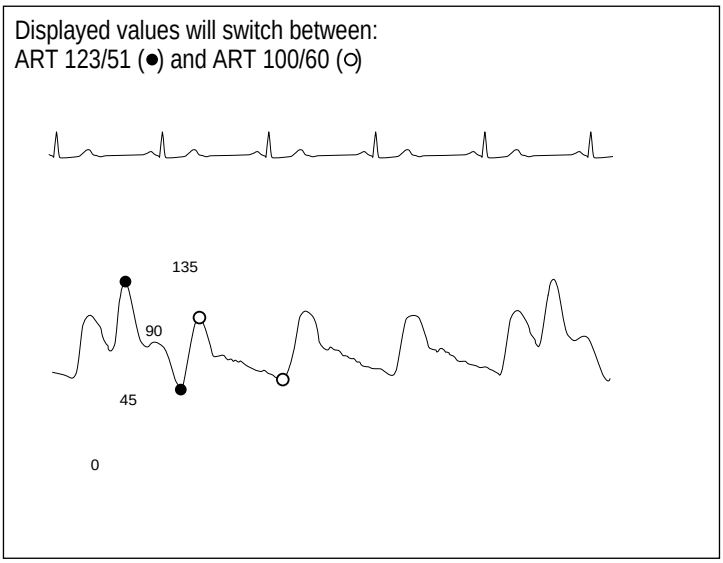

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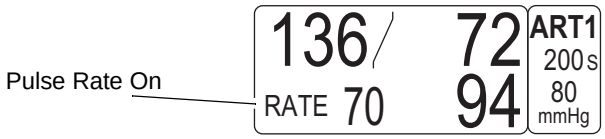
Figure 3

Pulse Rate

The ***PULSE RATE*** feature is found in the ART, FEM, and UAC (neonatal mode only) pressure sites only. When turned on, a Rate value is displayed in the appropriate parameter values window.



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Pulse Rate Displayed in ART Parameter Window

To turn the pulse rate value on and off, simply select the ***PULSE RATE*** option in the applicable pressure menu. This feature can be set in Monitor Defaults.

Disconnect Alarm

Turns the feature on or off. This detects potential catheter disconnections. When on, if the mean pressure falls below 25 mmHg, a Warning patient status alarm sounds and the message ***DISCONNECT*** displays in the parameter window. This alarm can be set as a default in the Setup Display Default window > ***ART DISCONNECT***. See Setup Default Display on page 5-11.

NOTE

The ***DISCONNECT ALARM*** menu is available when monitoring ART and FEM sites with a Patient Data Module only. This menu is not available when the transport monitor is set to neonatal mode.

NOTE

TRAM modules support the ART Disconnect alarm feature based on the settings received from the Solar patient monitor, but the setting *cannot* be changed when the TRAM module is connected to the transport monitor.

1. Locate the ***DISCONNECT ALARM*** option in the ART or FEM menu.
2. Select ***ON*** or ***OFF***.

BP Filter

Select the ***BP FILTER*** option to open a popup menu. Use the **Trim Knob** control to select a ***12Hz*** or ***40Hz*** filter.

The 12Hz filter is recommended for typical monitoring applications. The 40Hz filter allows higher frequency waveform components to be processed. This may result in elevated pressure values.

This menu also offers a ***Help*** option, which opens an information window that provides additional information about BP filters.

Speed

Use this menu option to open a popup menu to select a sweep speed for all displayed pressure waveforms. Choices are ***6.25***, ***12.5***, and ***25*** (factory default) millimeters per second.

Troubleshooting

Problem:

Displayed pressure values are different than expected.

Solution:

- Check the patient. Values could be valid, the patient could be lying on the tubing, or the tubing could be kinked.
- Check tubing for bubbles.
- Remove excess tubing.
- Check phlebostatic axis placement of transducer.
- Rezero pressure. (See Zero Reference on page 10-4.)
- Is patient on IABP? If so, verify that the transport monitor's IABP program is turned on. If necessary, turn it on. (Refer to your transport monitor operator's manual.)

1. Select the ART parameter label.
2. Select ***IABP: OFF***. The menu option toggles to ***IABP: ON***.

11 NBP

Introduction

A patient's vital signs may vary dramatically during the use of cardiovascular agents such as those that raise or lower blood pressure or those that increase or decrease heart rate.

Because treatment protocol based on the patient's blood pressure may rely on specific values and differing measurement methods, such as auscultatory, clinicians should note a possible variance from values obtained with this unit in planning patient care management. The transport monitor values are based on the oscillometric method of noninvasive blood pressure measurement and correspond to comparisons with intra-aortic values described within the ANSI/AAMI SP10 standard.

Automatic noninvasive blood pressure monitoring uses the oscillometric method of measurement. To understand how this method works, we'll compare it to the auscultative method. With auscultation, the clinician listens to the blood pressure and determines the systolic and diastolic pressures. The mean pressure can then be calculated with reference to these pressures as long as the arterial pressure curve is normal.

Since the transport monitor cannot hear the blood pressure, it measures cuff pressure oscillation amplitudes. Oscillations are caused by blood pressure pulses against the cuff. The oscillation with the greatest amplitude is the mean pressure. This is the most accurate parameter measured by the oscillometric method. Once the mean pressure is determined, the systolic and diastolic pressures are calculated with reference to the mean.

Simply stated, auscultation measures systolic and diastolic pressures and the mean pressure is calculated. The oscillometric method measures the mean pressure and determines the systolic and diastolic pressures. Due to the difference in these methods, one cannot be used to check the accuracy of the other.

NBP Connectors

- The Patient Data Module noninvasive blood pressure connector is labeled **NIBP**.
- The TRAM module noninvasive blood pressure connector is labeled **NBP**.
- In this manual, the term NBP is used in general reference of noninvasive blood pressure.

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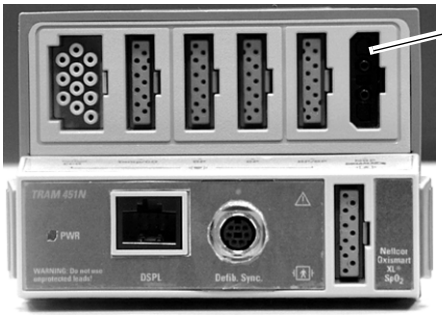
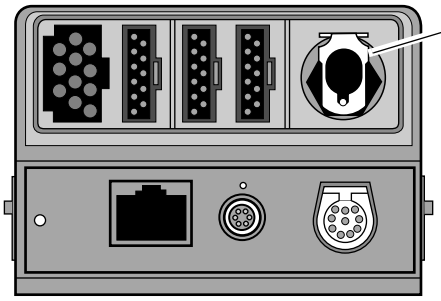
Patient Data Module

Most TRAM modules have a rectangular NBP connector. Some older models have a rounded connector. Examples of the two types of connectors are shown below.



TRAM 451N Module



TRAM 200SL Module

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NOTE

The signal connector is a high-insulation port and it is defibrillator-proof.

The insulated input ensures patient safety and protects the device during defibrillation and electrosurgery.

Safety

WARNING

The NBP parameter will not measure blood pressure effectively on patients who are experiencing seizures or tremors.

WARNING

Arrhythmias will increase the time required by the NBP parameter to determine a blood pressure and may extend the time beyond the capabilities of the parameter.

WARNING

Devices that exert pressure on tissue have been associated with purpura, skin avulsion, compartmental syndrome, ischemia and/or neuropathy.

To minimize these potential problems, especially when monitoring at frequent intervals or over extended periods of time, make sure the cuff is applied appropriately and examine the cuff site and the limb distal to the cuff regularly for signs of impeded blood flow.

WARNING

Do not apply external pressure against the cuff while monitoring.

Doing so may cause inaccurate blood pressure values.

WARNING

Use care when placing the cuff on an extremity used to monitor other patient parameters.

CAUTION

Accuracy of NBP measurement depends on using a cuff of the proper size.

It is essential to measure the circumference of the limb and choose the proper size cuff.

CAUTION

The pulse rate derived from an NBP determination (measurement) may differ from the heart rate derived from an ECG waveform because the NBP parameter measures actual peripheral pulses, not electrical signals or contraction from the heart. Differences may occur because electrical signals at the heart occasionally fail to produce a peripheral pulse or the patient may have poor peripheral perfusion. Also, if a patient's beat-to-beat pulse amplitude varies significantly (e.g., because of pulsus alternans, atrial fibrillation, or the use of a rapid-cycling artificial ventilator), blood pressure and pulse rate readings can be erratic, and an alternate measuring method should be used for confirmation.

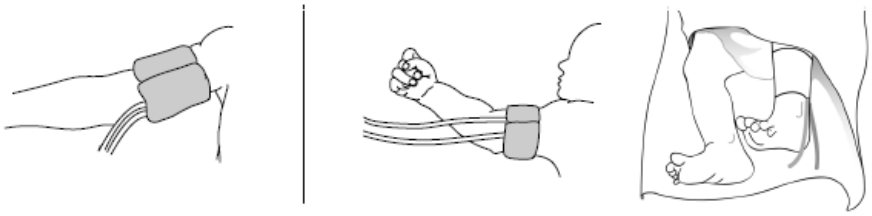
NOTE

A patient's vital signs may vary dramatically during the use of cardiovascular agents such as those that raise or lower blood pressure or those that increase or decrease heart rate.

Checklist

1. The acquisition module is properly connected to the monitor.
2. A cuff appropriate for the limb size has been selected.
3. Cuff is properly placed on patient.

   Choose the appropriate blood pressure measurement site. In Adult/Pediatric, because normative values are generally based on this site and as a matter of convenience, the upper arm is preferred. When upper arm size or shape or the patient's clinical condition or other factors prohibit use of the upper arm, the clinician must plan patient care accordingly, taking into account the patient's cardiovascular status and the effect of an alternative site on blood pressure values, proper cuff size and comfort. The figure shows the recommended sites for placing cuffs.



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4. Patient cable is connected to acquisition module.

   NOTE

   Do not connect more than one NBP patient cable.

5. Tubes between the cuff and the monitor are not kinked or blocked.
6. Correct cuff size has been selected from the NBP menu.

   WARNING

   The cuff size selected in the NBP menu and the cuff size used must be correct to obtain reliable NBP data and to prevent overpressure in neonatal or pediatric use.

7. Start an NBP reading following Auto or Stat mode procedures as detailed in this chapter, or use the **NBP Go/Stop** button on the keypad or remote control.

NOTE

If an invasive blood pressure cable is connected to the fourth **BP** connector on the TRAM module, NBP cannot be activated. The message "***FOURTH BP ACTIVE - NBP NOT AVAILABLE***" is displayed.

Patient Preparation

Cuff selection and application are important. Inappropriate selection or improper application of the cuff will result in erroneous measurements.

WARNING

The system is designed for use with dual-hose cuffs and tubing. The use of single-hose cuffs with dual hose tubing can result in unreliable and inaccurate NBP data.

Do not place the cuff on a limb being used for A-V fistulas, intravenous infusion, or any area where circulation is compromised or has the potential to be compromised.

Cuff Selection

1. Identify patient limb circumference.
2. Select appropriate cuff. Limb circumference is identified on each cuff.

Cuff Placement

1. Confirm that the cuff is fully deflated before positioning it on the patient.
2. Place cuff snugly around extremity being used.
3. Marking on cuff should match artery location.
4. Cuff should be 2.5–5 cm (1–2 in) above the elbow if using brachial artery.
5. The air pad should be exactly over the brachial artery. Tubing is immediately to the right or left of the brachial artery to prevent kinking when elbow is bent.
6. Position the patient so that no external pressure is applied against the cuff while monitoring. External pressure may cause inaccurate blood pressure values.

Other Considerations

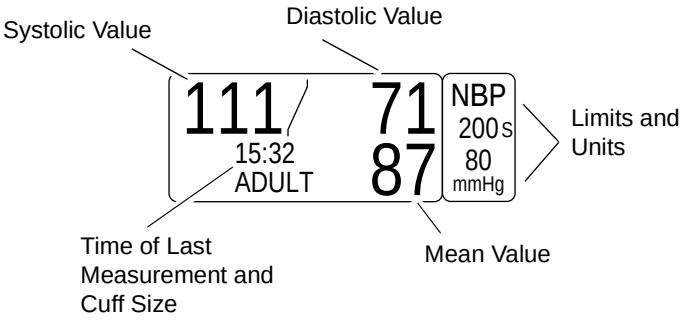
1. Perform NBP measurement on the patient’s non-dominant arm.
2. Roll up sleeve before measurement. Only very thin fabrics will not impair the measurements.
3. Place the arm on a surface level with the patient’s heart.
4. The palm of the hand should face up.

For further information on cuffs, please contact your sales/service representative.

NBP Monitoring Features

NBP Information

There is no waveform displayed when monitoring noninvasive blood pressure. However, numerics are displayed in the NBP parameter window.



NBP Parameter Label and Windows

The current systolic, diastolic, and mean values are displayed. Limits and the units of measurement may also be displayed. The limits displayed are labeled (S=systolic, D=diastolic, M=mean). The cuff size and time of last measurement are also displayed. The time is displayed with a 24-hour clock. During a measurement, the cuff inflation pressure (updated every second) is displayed in place of the mean value.

If Auto mode is on, a countdown timer is displayed in the lower left corner.

The NBP values change to Xs if no NBP monitoring has taken place for 2 hours in Adult-ICU mode, 15 minutes in Operating Room mode, and 12 hours in Neonatal-ICU mode.

Mean Arterial Pressure

The following conditions may cause the NBP parameter block to display the mean arterial pressure (MAP) value while the associated systolic and diastolic values appear as Xs.

- Very low systolic and diastolic amplitude fluctuations (e.g., patients in shock).
- Very small difference between the MAP and the systolic pressure or the MAP and the diastolic pressure.
- Loss of system integrity (e.g., loose connections or worn parts). Be sure to perform a visual inspection to ensure system integrity.

Systolic Search

NOTE

The cuff target pressure must be higher than the patient's systolic pressure to obtain an accurate systolic and diastolic reading.

If a systolic blood pressure cannot be found, the transport monitor will search for a systolic reading by re-inflating the cuff at a higher pressure. This systolic search may occur once per NBP determination. During a systolic search, the maximum cuff inflation pressure will not exceed the normal pressure range of the cuff.

NBP Go/Stop Key

The **NBP Go/Stop** key on the front of the transport monitor is a quick way to take one measurement without going into the NBP menu. It can also be used to stop a measurement already in progress, or initiate the Auto NBP program when in OR mode and using a Patient Data Module.

Display Off

If you turn the display off, NBP is also turned off. This applies to both auto NBP (if running) and manual NBP. Turning the display on again enables manual NBP. It does not automatically restart auto NBP.

Silence NBP Alarm Greater Than 1 Minute

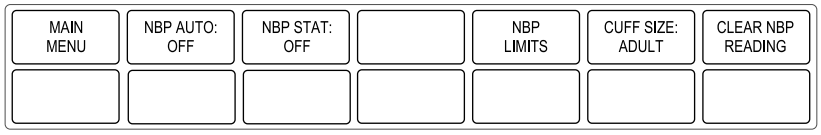
NBP alarms can be silenced for greater than one minute. This option is selected in the Monitor Defaults menu, Setup Default Display.

The NBP Silence Alarm setting defaults to ***NORMAL***. The Normal setting allows the silencing of the NBP limit alarm to function like the other parameter limit alarms. However, when set to ***> 1 MINUTE***, pressing the **Silence Alarm** key silences the NBP limit alarm indefinitely.

The alarm level for NBP must be set by the user to Advisory level or higher to activate an audible alarm. Once the alarm is silenced, the alarm converts to a Message alarm level and responds accordingly. Any new NBP alarms will respond to the alarm level set by the user.

Getting to the NBP Menu

To display the NBP menu, use the **Trim Knob** control to select the NBP parameter label. Remember, selecting with the **Trim Knob** control is a two-step process—rotate to highlight, then press to select. The NBP menu is displayed at the bottom of the screen.



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NBP Menu

With the **Trim Knob** control, you now can select any of the displayed options:

- ***NBP AUTO*** — Starts/stops the automatic mode; selects appropriate time interval.

- ***NBP STAT*** — Starts 5 minutes of continuous, sequential NBP measurements. (Not available in Neonatal-ICU mode.)
- ***NBP LIMITS*** — Displays an information window and a new menu to adjust systolic, diastolic, and mean limits.
- ***CUFF SIZE*** — Select the size of cuff being used (adult, pediatric, neonatal).
- ***CLEAR NBP READING*** — Removes the values from the NBP parameter window.

Detailed information on each option is found in this chapter.

NBP Menu Options

NBP Auto

WARNING
Periodically check patient limb circulation distal to the cuff. Check frequently when using auto NBP in 1- and 2-minute intervals. Intervals shorter than 10 minutes are not recommended for extended periods of time.

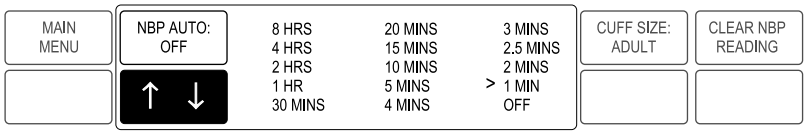
WARNING
NBP AUTO DISCONTINUED—The ***NBP AUTO*** setting reverts to ***OFF*** when the Patient Data Module is removed from the bedside monitor and is connected to a transport monitor *if* the PDM battery is not installed.

If the Patient Data Module is used for bedside and transport monitoring, its battery should be installed when in use. In the event that the PDM battery is not installed, the settings for ***NBP AUTO*** can be reset after connecting the Patient Data Module to the transport monitor.

This option allows you to program the transport monitor to automatically take NBP measurements at specific time intervals.

Follow this procedure:

1. Select the ***NBP AUTO*** option from the NBP menu. A popup menu opens, showing all time interval choices.



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NBP Auto Popup Menu

2. Rotate the **Trim Knob** control to move the pointer (>) to the desired time interval. The change will not be in effect until the **Trim Knob** control is pressed and the popup menu closed.

   NOTE

   The NBP Auto program is a timed cycle. If, when first turned on, it is set to run at 5-minute intervals, the cuff inflates immediately and then every 5 minutes thereafter. If you change the timing interval (e.g., 15 minutes) without turning Auto off, the timing cycle does not start over. The next cuff inflation will occur 15 minutes after the last inflation and every 15 minutes thereafter. Turning Auto off and then on again restarts the timing cycle with an immediate cuff inflation.

3. Press the **Trim Knob** control to confirm the change and close the popup menu. A count-down timer is displayed in the NBP parameter window when the time interval set (or remaining) is 60 minutes or less. The last minute will count down in seconds.

NBP Auto

The NBP Auto timer can also be set as a default in Monitor Defaults. See Setup Default Display on page 5-11. This default is for Operating Room mode when used with a Patient Data Module only.

Follow this procedure to set the NBP Auto timing default and initiate the program:

1. The monitor must be in Operating Room mode and using a Patient Data Module.
2. Select ***MORE MENUS*** from the Main Menu.
3. Select ***MONITOR SETUP*** > ***MONITOR DEFAULTS*** > ***SETUP DEFAULT DISPLAY***.
4. Find and select ***NBP AUTO*** in the ***SETUP DISPLAY*** window.
5. Select a time interval for the automatic NBP measurements.
6. Select ***RETURN*** to close the ***SETUP DISPLAY*** window and return to the Main Menu.
7. Press the **NBP Go/Stop** button to initiate the NBP Auto measurements.

   An NBP measurement begins. When the measurement completes a count-down timer displays in the NBP parameter window. The next NBP Auto measurement begins when the count-down timer reaches zero.

NOTE

The NBP Auto time interval selected as the default also displays in the ***NBP AUTO*** popup menu. A new time interval can be selected from the ***NBP AUTO*** popup menu at any time. See NBP Auto on page 11-9. Selecting a new time interval from the ***NBP AUTO*** popup menu will override the default setting.

NBP Stat

Turn NBP Stat On/Off

NOTE

The NBP Stat feature is not available when the transport monitor is set up for Neonatal-ICU mode.

The ***NBP STAT*** option enables 5 minutes of continuous, sequential, automatic NBP measurements. The default setting is off.

Follow this procedure to turn NBP Stat on:

1. Select the ***NBP STAT*** option from the NBP menu. A popup menu opens, displaying ***ON***, ***OFF***, and ***HELP!*** options.

   NOTE

   The ***HELP!*** option opens an information window with more details on this feature.

2. Rotate the **Trim Knob** control so the pointer (>) is in front of ***ON***. The change will not be in effect until the **Trim Knob** control is pressed and the popup menu closed.

3. Press the **Trim Knob** control to confirm the change and close the popup menu. The first inflation occurs within seconds.

Repeat the procedure and select ***OFF*** to discontinue the STAT process before the 5-minute period is up, or simply press the **NBP Go/Stop** key on the front of the transport monitor.

Early Systolic Measurement

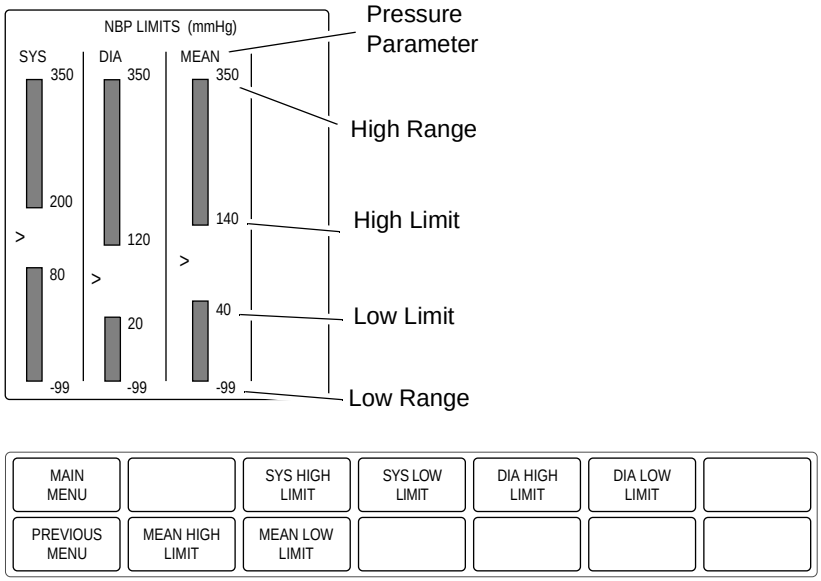
Early systolic measurement is a feature of the NBP Stat mode. As soon as you enter NBP Stat mode, cuff inflations begins, a measurement is taken, and the systolic, diastolic, and mean values are displayed. For each measurement thereafter, the systolic value is displayed shortly after the measurement starts. When the measurement is complete the transport monitor will beep and the diastolic and mean values will be displayed.

NBP Limits

This option provides an information window with bar graphs that show the alarm limits for systolic, diastolic, and mean pressures. A new set of menu options is displayed to allow you to adjust these limits.

Follow this procedure:

1. Select ***NBP LIMITS*** from the NBP menu. An information window is displayed on the screen and a new set of menu options is displayed in the menu area.



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NBP Limits Menu and Information Window

The information window shows the range as well as the alarm limits. The pointer (>) indicates the current value of that parameter for the monitored patient. As long as that value remains between the high and low limits, there will be no alarm. Should the value exceed one of the limits, an alarm will occur.

2. To change a set limit, for example the high systolic (SYS) limit, select the ***SYS HIGH LIMIT*** option from the limits menu. A popup menu opens.
3. Rotate the **Trim Knob** control and the value displayed will change. The bar graph is also adjusted. The limit will not be in effect until the **Trim Knob** control is pressed and the popup menu closed.
4. Press the **Trim Knob** control to confirm the change and close the popup menu.
5. Follow this procedure to set any other NBP limit. Select ***PREVIOUS MENU*** to exit the limits menu and return to the NBP menu.

Cuff Size

This option programs the transport monitor for the appropriate inflation pressure. The cuff size setting is based on the patient's age. There are three choices — Adult, Pediatric, and Neonatal.

A label showing your choice — ***ADULT***, ***PED***, ***NEO*** — is displayed at the bottom of the parameter window.

CAUTION
INCOMPATIBLE CUFF SIZE SETTINGS—TRAM module only. When a NBP cable is connected to a TRAM module, the cuff size defaults to the cuff size set on the TRAM module. Therefore, it is possible that the transport monitor is in one monitoring mode, but the cuff size is set to another. For example, the transport monitor is set for the Neonatal-ICU mode, and the TRAM module is in Adult-ICU mode. The cuff size will then be ***ADULT***, even though the transport monitor is in Neonatal-ICU mode.

If you need to select a different size, follow this procedure:

1. Select the ***CUFF SIZE*** option from the NBP menu. A popup menu opens displaying the three options.
2. Use the **Trim Knob** control to make your selection. The change will not be in effect until the **Trim Knob** control is pressed and the popup menu closed.
3. Press the **Trim Knob** control to close the popup menu.

Clear NBP Reading

If you want to remove the values displayed in the NBP parameter window, select this option. The values will be replaced with Xs. This also applies to error messages that appear in the parameter window.

Troubleshooting

NBP Status Messages

A status message is displayed in the NBP values window if a measurement is unable to be completed. Following is an alphabetical list of the status messages with the transport monitor's response and action to take.

Status Message	Monitor Response	Solution
CUFF INFLATION TIME EXCEEDED	System status alarm. Auto mode will shut off.	Check cuff, if no air is in cuff, try another measurement. If problem persists, contact service. If air is in cuff, remove cuff and contact service.
DEFLATION FAIL REMOVE CUFF	System status alarm. Auto mode will shut off.	Remove cuff and contact service.
NBP HARDWARE MALFUNCTION	System status alarm. Auto mode will shut off.	Contact service.
NO DETERMINATION	System status alarm. Auto mode will shut off.	Check patient and cuff placement; try another measurement. If problem persists, contact service.
OVER PRESSURE	System status alarm.	Remove cuff and contact service.

Status Message	Monitor Response	Solution
PUMP TIMEOUT (inflation failure/pressure leak)	System status alarm.	Check connections between cuff and module; try another measurement. If problem persists, contact service. Check for worn connector “O” rings. Contact service.
TOTAL TIMEOUT (measurement > 3 minutes)	System status alarm. Auto mode will shut off.	Possible excessive patient movement or arrhythmia condition. Check patient; try another measurement. For neonatal mode, the status message will appear after 90 seconds.

Some NBP status messages will shut Auto mode off if it is running.

A message will clear when the next measurement is initiated, or a message can be cleared manually with the ***CLEAR NBP READING*** option in the NBP menu.

An NBP status message will also be included in the graph header in an abbreviated form, when applicable.

Erroneous NBP Measurement

1. Check for proper cuff size:
   a. Too small a cuff can give an erroneously high value.
   b. Too large a cuff can give an erroneously low value.
2. Check for residual air left in the cuff from a previous measurement.
3. Make sure cuff is not too tight or too loose.
4. Make sure cuff and heart are at same level, otherwise hydrostatic pressure will offset the NBP value.
5. Minimize patient movement during measurement.
6. Watch for pulsus paradoxis.
7. Check for leak in cuff or tubing.
8. Patient may have a weak pulse.
9. Calibration may be necessary.

12 SpO_2

Introduction

SpO_2 (pulse oximetry) monitoring is a noninvasive technique used to measure the amount of oxygenated hemoglobin and pulse rate by measuring the absorption of selected wavelengths of light. The light generated in the probe passes through the tissue and is converted into an electrical signal by the photodetector in the probe. The monitor processes the electrical signal and displays on the screen a waveform and digital values for SpO_2 and pulse rate.

SpO_2 monitoring is done with an acquisition device that has the SpO_2 feature. SpO_2 monitoring can be done using acquisition devices with Masimo SET compatibility or Nellcor compatibility. This chapter provides guidelines for successful SpO_2 monitoring.

NOTE

The signal input is a high-insulation port and it is defibrillator-proof. 

The insulated input ensures patient safety and protects the device during defibrillation and electrosurgery.

Acquisition Devices and Probe Compatibility

NOTE

Nellcor, GE, and Masimo pulse oximetry is calibrated to display functional saturation. Ohmeda pulse oximetry is calibrated to display fractional saturation.

Patient Data Module Compatibility

- The Nellcor Patient Data Module is compatible with Nellcor OxiMax probes. It uses Nellcor OxiMax CaRe cables only. Other Nellcor cables are not compatible with the Patient Data Module.

  NOTE

  If a non-compatible cable is used, the message ***WRONG CABLE USE Nellcor OxiMax*** is displayed in the SpO_2 parameter window.

- The Masimo SET Patient Data Module is compatible with Masimo LNOPand LNCS probes. It uses Masimo CaRe cables and legacy series 7000 cables.

  NOTE

  If a non-compatible cable is used, the message ***WRONG CABLE USE Masimo SET*** is displayed in the SpO_2 parameter window.

  A Masimo SET label is displayed next to the patient cable connectors on the Patient Data Module if it is equipped with the Masimo SET option.

TRAM Module Compatibility

- TRAM x51 modules are compatible with GE probes.
- TRAM x51M modules are compatible with Masimo LNOP probes.

- TRAM x51N modules are compatible with Nellcor Oxismart XL probes. Other Nellcor cables cannot be plugged into this connector.

WARNING

TRAM 451N and TRAM 851N modules require Nellcor Oxismart XL cables and probes. Older (non-Oxismart XL) cables must not be plugged into the SpO_2 connector on these modules. Use of non-Oxismart XL cables may result in erroneous readings.

- TRAM x51N5 modules are compatible with Nellcor OxiMax cables and probes. Other Nellcor cables cannot be plugged into this connector.
- TRAM x00 modules with SpO_2 are compatible with Ohmeda probes.
- TRAM x50 modules are compatible with Nellcor and GE probes.

NOTE

The SpO_2 cable should plug into the SpO_2 connector easily and securely. Do not use excessive force to connect the cable. If the SpO_2 cable does not easily fit into the SpO_2 connector, it is likely that you do not have the appropriate cable for your SpO_2 configuration.

A Masimo SET label is displayed next to the patient cable connectors on the TRAM module if it is equipped with the Masimo SET option.

Safety

WARNING

NO-BREATH/APNEA— A pulse oximeter should *not* be used as a no-breath/apnea monitor.

WARNING

EARLY WARNING— A pulse oximeter should be considered an early warning device. As a trend toward patient deoxygenation is indicated, blood samples should be analyzed by a laboratory co-oximeter to completely understand the patient's condition.

WARNING

EXPLOSION HAZARD— Do not monitor SpO_2 in the presence of flammable anesthetics or other flammable substance in combination with air, oxygen-enriched environments, or nitrous oxide.

WARNING

INTERFERING SUBSTANCES— Carboxyhemoglobin may erroneously increase SpO_2 readings. The level of increase is approximately equal to the amount of carboxyhemoglobin present. Dyes, or any substance containing dyes, that change usual arterial pigmentation may cause erroneous readings.

WARNING

MRI INTERFERENCE— Do not monitor SpO_2 or use SpO_2 probes during magnetic resonance imaging (MRI) scanning. Induced current could potentially cause burns. SpO_2 monitoring may affect the MRI image, and the MRI unit may affect the accuracy of the oximetry measurements.

Measurements

If the accuracy of any measurement does not seem reasonable, first check the patient's vital signs by alternate means, then check the module for proper SpO_2 functioning.

Inaccurate measurements may be caused by:

- Incorrect probe application or use.
- Significant levels of dysfunctional hemoglobins (e.g., carboxyhemoglobin or methemoglobin).
- Intravascular dyes such as indocyanine green or methylene blue.
- Exposure to excessive illumination, such as surgical lamps, bilirubin lamps, fluorescent lights, infrared heating lamps, or direct sunlight.

  NOTE

  Exposure to excessive illumination can be corrected by covering the probe with a dark or opaque material.

- Excessive patient movement.
- Venous pulsations.
- Placement of a probe on an extremity with a blood pressure cuff, arterial catheter, or intravascular line.
- Excessive environmental motion or electromagnetic interference may prevent tracking of pulse. Measurements may seem inappropriate or the transport monitor may not seem to operate correctly.

SpO_2 monitoring can be done during defibrillation, but the readings may be inaccurate for a short time.

Neonates and Infants

The following precautions apply when monitoring neonate and infant patients.

WARNING

The display of inaccurate pulse oximetry (SpO_2) 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 monitor is used on neonates or infants. These same conditions in adults do not impact the pulse oximetry values to the same extent.

Use the following criteria when measuring SpO_2 on neonates and infants:

- The peripheral pulse rate (PPR) as determined by the pulse oximetry function must be within 10% of the heart rate.
- The SpO_2 signal strength indicator must have 2 or 3 asterisks displayed.

SpO_2 Checklist

1. SpO_2 probe is correctly positioned on the patient. (Follow instructions provided with the probe.)
2. Patient cable is connected to the transport monitor.
3. SpO_2 setup is adjusted, if necessary. Follow detailed procedures within this chapter.

Patient Preparation

Prepare the patient for SpO_2 monitoring using the following steps:

1. Choose the probe that is best suited to your patient—ear, finger, disposable, reusable, etc.

   NOTE

   If you are using a Nellcor compatible module, Nellcor's RS-10 reflective probe is not recommended for use. Contact Nellcor for other probe options.

2. Clean the surface of the probe before and after each patient use.
3. Following the instructions provided with the probe, correctly position and attach the probe to your patient.

Be aware of the following general safety precautions when using SpO_2 probes:

WARNING

DATA VALIDITY—

- Do not expose probe detector to strong ambient light while monitoring a patient. A poor signal may result.
- Do not allow tape to block the probe light detector.
- Check that the SpO_2 waveform is physiological in shape (not applicable when monitoring SpO_2 with the Masimo SET configuration).

WARNING

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. Be particularly careful when monitoring neonates. If required, reduce the application periods to half the times recommended above.
- If a probe is damaged in any way, discontinue use immediately.

Be sure to read all literature accompanying probes for specific safety information.

Signal and Data Validity

Overview

It is extremely important to determine that the probe is attached to the patient correctly and the data is verifiable. To make this determination, three indications from the transport monitor are of assistance — the signal strength indicator, the quality of the SpO_2 waveform, and the stability of the SpO_2 values. It is critical to observe all three indications simultaneously when ascertaining signal and data validity.

Signal Strength Indicator

The signal strength indicator is displayed in the SpO_2 values window. It consists of 0, 1, 2, or 3 (strongest) asterisks, depending on the strength of the signal. Proper environmental conditions and probe attachment will help ensure a strong signal.

Quality of SpO_2 Waveform

NOTE

This section is not applicable to monitoring SpO_2 with the Masimo SET configuration for Masimo Patient Data Module or TRAM x51M modules).

Under normal conditions, the SpO_2 waveform corresponds to (but is not proportional to) the arterial pressure waveform. The typical SpO_2 waveform indicates not only a good waveform, but helps the user find a probe placement with the fewest noise spikes present. The figure below represents an SpO_2 waveform of good quality.

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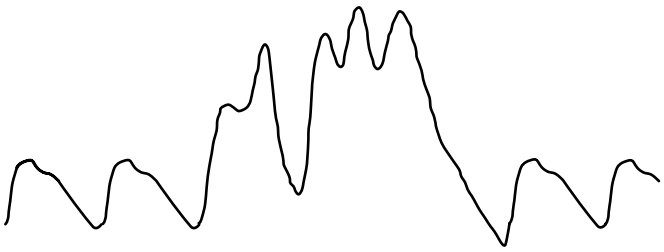
Good Quality SpO_2 Waveform

If noise (artifact) is seen on the waveform because of poor probe placement, the photodetector may not be flush with the tissue. Check that the probe is secured and the tissue sample is not too thick. Pulse rate is determined from the SpO_2 waveform which can be disrupted by a cough or other hemodynamic pressure disturbances. Motion at the probe site is indicated by noise spikes in the normal waveform. (See the figure below.) It has been noted that letting the patient view the SpO_2 waveform enables them to assist in reducing motion artifact.



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SpO_2 Waveform with Artifact

Stability of SpO_2 Values

The stability of the displayed SpO_2 values can also be used as an indication of signal validity. Although stability is a relative term, with a small amount of practice one can get a good feeling for changes that are artifactual or physiological and the speed of each.

Messages are provided in the SpO_2 values window to aid you in successful SpO_2 monitoring. See Troubleshooting on page 12-14.

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 transport 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.

Masimo SET Configuration and Probes

Overview

The Masimo SET configuration is used to non-invasively measure the amount of oxygenated hemoglobin and pulse rate. The absorption of selected wavelengths of light is measured with Masimo LNOP probes. Although this software processes the SpO_2 measurements differently, the function and appearance of SpO_2 on your transport monitor is essentially the same as SpO_2 monitoring with other SpO_2 software.

No Implied License

Possession or purchase of the Masimo SET configuration does not convey any express or implied license to use the device with unauthorized replacement parts which would, alone, or in combination with this device, fall within the scope of one or more of the patents relating to this device.

Probes

Before use, carefully read the Masimo LNOP or LNCS probe directions for use.

Use only Masimo oximetry probes when monitoring SpO_2 with the Masimo SET configuration.

CAUTION

Tissue damage can be caused by incorrect application or use of an LNOP or LNCS probe, for example by wrapping the probe too tightly.

Inspect the probe site as directed in the probe's directions for use to ensure skin integrity and correct positioning and adhesion of the probe.

Do not use damaged LNOP or LNCS probes. Do not use an LNOP or LNCS probe with exposed optical components. Do not immerse the probe in water, solvents, or cleaning solutions. The probes are not waterproof. Do not sterilize by irradiation, steam, or ethylene oxide. See the cleaning instructions in the directions for use for reusable Masimo LNOP and LNCS probes.

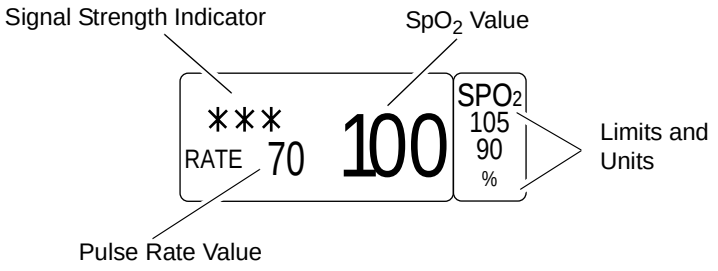
SpO_2 Monitoring Features

SpO_2 Information

A waveform labeled SpO_2 is displayed on the screen when the patient cable is connected to the module. Numerics are also displayed in the SpO_2 parameter windows on the right side of the screen.

NOTE

Visual indication of the patient's pulse is not proportional to the pulse amplitude.



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SpO_2 Parameter Window

The current SpO_2 value and the derived pulse rate (RATE) are displayed. The asterisks indicate the signal strength (three asterisks indicate the strongest signal).

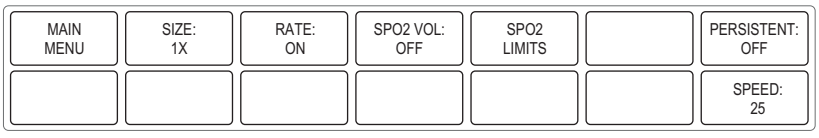
NOTE

The transport monitor display is updated every 2 seconds.

Getting to the SpO_2 Menu

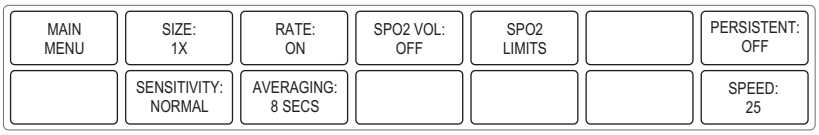
To display the SpO_2 menu, use the **Trim Knob** control to select the ***SPO2*** parameter label. Remember, selecting with the **Trim Knob** control is a two-step process—rotate to highlight, then press to select.

The SpO_2 menu is displayed at the bottom of the screen. The menu options that appear are dependent on the type of SpO_2 software and probe used.



721C

SpO_2 Menu—Nellcor Patient Data Module and all TRAM Modules



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SpO_2 Menu—Masimo Patient Data Module

With the **Trim Knob** control, you now can select any of the displayed options:

- ***SIZE*** — Adjusts the size of the displayed SpO_2 waveform.
- ***RATE*** — Turns the displayed rate value off and on.
- ***SPO2 VOL*** — Turns the rate volume on/off; adjusts the volume when on.
- ***SPO2 LIMITS*** — Displays a new menu and an information window to adjust SpO_2 percent and rate (beats per minute) alarm limits.
- ***PERSISTENT***— Displays "Probe Is Off The Patient" alarm in the SpO_2 parameter box when a sensor or cable is disconnected.
- ***SENSITIVITY*** — Adjusts the Masimo probe sensitivity when using Masimo Patient Data Module and probes.
- ***AVERAGING*** — Adjusts the SpO_2 averaging time when using Masimo Patient Data Module and probes.
- ***SPEED*** — Changes the sweep speed for the displayed SpO_2 waveform.

Detailed information on each option is found in this chapter.

SpO_2 Menu Options

Size

The Size option allows you to change the size of the displayed SpO_2 waveform. When you select the ***SIZE*** option from the SpO_2 menu, a popup menu opens, displaying the following choices: ***8X***, ***4X***, ***2X***, ***1X***.

Rotate the **Trim Knob** control to change the size. The change occurs immediately on the screen. When you are satisfied with your selection, press the **Trim Knob** control to close the popup menu.

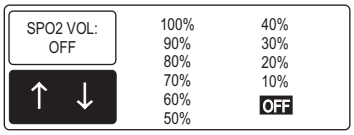
Rate

A pulse rate is derived from the SpO_2 signal and is displayed in the parameter window. You can turn this displayed rate off and on. Simply select the ***RATE*** option from the SpO_2 menu. This is a direct action menu option.

SPO2 Volume

The ***SPO2 VOL*** option turns on a tone which sounds each time an SpO_2 pulse is detected. This is a variable pitch tone which changes as the patient's saturation level changes; as the saturation level decreases, the pitch of the tone also decreases. The volume of this tone can be adjusted up or down.

1. Select the ***SPO2 VOL*** option from the SpO_2 menu. A popup menu opens.



723D

SpO_2 Volume Popup Menu

2. Rotate the **Trim Knob** control to select an option. You will hear the tone volume when an option is highlighted.
3. When you have selected the volume level, press the **Trim Knob** control to confirm the change and close the popup menu.

NOTE

Turning the rate volume on will automatically turn the QRS volume off.

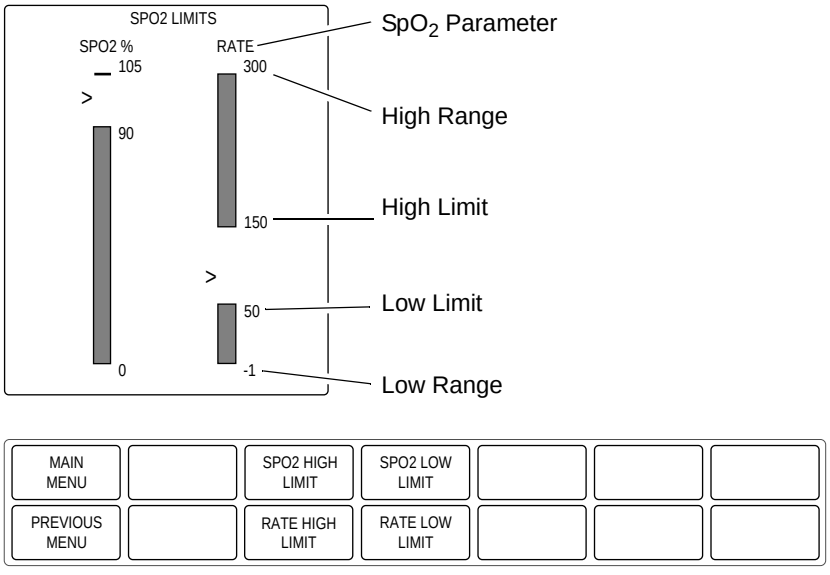
When in the Operating Room mode, the 10% and 20% volume tones are slightly quieter than the 10% and 20% volume tone in Adult-ICU and Neonatal-ICU modes.

SPO2 Limits

This option provides an information window with bar graphs that show the alarm limits for SpO_2 and pulse rate. A new set of menu options is displayed to allow you to adjust these limits.

Follow this procedure:

1. Select the ***SPO2 LIMITS*** option from the SpO_2 menu. An information window is displayed on the screen and a new set of menu options is displayed in the menu area.



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SpO_2 Limits Menu and Information Window

The information window shows the range as well as the alarm limits. The pointer (>) indicates the current value of that parameter for the monitored patient. As long as that value remains between the high and low limits, there will be no alarm. Should the value exceed one of the limits, an alarm will occur.

2. To change a set limit, for example the SpO_2 low limit, select the ***SPO2 LOW LIMIT*** option from the SpO_2 Limits menu. A popup menu opens.
3. Rotate the **Trim Knob** control and the value displayed will change. The bar graph is also adjusted. The limit will not be in effect until the **Trim Knob** control is pressed and the popup menu closed.
4. Press the **Trim Knob** control to confirm the change and close the popup menu.
5. Follow this procedure to set any other SpO_2 limit. Select ***PREVIOUS MENU*** to exit the SpO_2 Limits menu and return to the SpO_2 menu.

Persistent

NOTE

Persistent SpO_2 is a default setting in the ***SETUP DEFAULT DISPLAY*** menu. The default setting is ***OFF***.

You can override the Persistent SpO_2 default setting for the current patient in the SpO_2 parameter menu.

Use the **Trim Knob** control or touchscreen to select the desired option.

When this option is turned ***ON*** and the SpO_2 cable or sensor probe is disconnected, the SpO_2 parameter box will remain displayed on the monitor, an audible alarm will sound and the "***PROBE IS OFF THE PATIENT***" will alarm at both the monitor and the central station. When the SpO_2 cable or sensor probe is reconnected, the SpO_2 limits remain as they were before the disconnection.

When this option is turned ***OFF*** and the SpO_2 cable or sensor probe is disconnected, the parameter box does not display and there is no alarm. When the SpO_2 cable or sensor probe is reconnected, the SpO_2 limits return to the system default.

When the patient is discharged, the Persistent SpO_2 limits return to the system default.

Sensitivity

NOTE

Masimo Patient Data Module and probes only.

The Sensitivity menu option allows you to select ***NORMAL*** or ***MAXIMUM*** sensitivity. The default setting is ***NORMAL***.

- Use the ***NORMAL*** sensitivity setting for normal patient monitoring purposes.
- Use the ***MAXIMUM*** sensitivity setting for improved low perfusion performance and for faster tracking of rapid SpO_2 saturation changes.

CAUTION

Using the ***MAXIMUM*** sensitivity setting delays the Probe Off Patient detection alarm.

Averaging

Masimo Patient Data Module and probes only.

The Averaging menu option provides the following selections for SpO_2 averaging time: ***2***, ***4***, ***8***, ***10***, ***12***, ***14***, or ***16*** seconds. The default averaging time for all monitoring modes is ***8*** seconds. The selected averaging time is displayed on the Averaging menu option.

NOTE

For the 2- and 4-second averaging settings, the actual averaging times may range from 2 to 4 seconds and 4 to 6 seconds, respectively.

Speed

Use this menu option to open a popup menu to select a sweep speed for all displayed SpO_2 waveforms. Choices are ***6.25***, ***12.5***, and ***25*** (factory default) millimeters per second.

Probe Off Patient Condition

When using a reusable finger probe, there is a system alarm to alert you when the probe is off the patient. The transport monitor defaults this “probe off patient” condition as a System Warning alarm. You can, however, set it as a System Advisory alarm in Monitor Defaults. See Setup Default Display on page 5-11. It is identified as ***SPO2 PROBE OFF*** in the Setup Display information window.

Pulse Search Condition

When using a reusable finger probe or a Masimo adhesive probe, there is a system alarm to alert you when detection of a repeatable pulse has ceased. This “pulse search” condition defaults to a System Advisory alarm. You can change it to a System Warning alarm in Monitor Defaults. It is identified as ***SPO2 PULSE SEARCH*** in the Setup Display information window. See Setup Default Display on page 5-11.

Connect Probe Condition

When using a reusable finger probe, there is a system alarm to alert you when the probe is not connected to the cable. The transport monitor defaults this “connect probe” condition as a System Warning alarm. You can, however, set it as a System Advisory alarm in Monitor Defaults. See Setup Default Display on page 5-11. It is

identified as ***CONNECT SPO2 PROBE*** in the Setup Display information window (Patient Data Module only).

Troubleshooting

SpO_2 Messages

Below is a list of system status alarm messages which may be displayed in the SpO_2 parameter window during monitoring.

If you are unable to resume SpO_2 monitoring, call GE service at 1-800-558-7044 (US only). Outside the United States, please contact your sales/service office.

LOW QUALITY SIGNAL

SpO_2 data continues to be displayed, but the quality of the signal is questionable. Check the patient and the probe.

PROBE IS OFF THE PATIENT

The disposable or reusable probe is off the patient. No SpO_2 data is displayed. Check the probe.

NOTE

The factory default for this alarm is system warning. You can set it to be a system advisory alarm in your Monitor Defaults.

PROBE OR MODULE MALFUNCTION

No SpO_2 data is displayed due to a hardware failure or an unrecognized or defective probe. This message will only appear when monitoring SpO_2 with the Masimo SET configuration.

Try the following solutions in order:

1. Change the probe.
2. Change the cable.
3. If the message remains, the system may have detected hardware failures. These failures are recorded in the Input Error Log.
4. Call service.

The factory default for this alarm is system warning.

POOR SIGNAL QUALITY DETECTED

The SpO_2 signal is too low. No SpO_2 data is displayed. This can be due to a low patient pulse, patient motion, or some other interference. Check the patient and the probe.

PULSE SEARCH

One of the following conditions is indicated:

- Defective or damaged probe.

- Defective or damaged cable.
- Probe is off of the patient.
- Detection by the transport monitor of a repeatable pulse has ceased.

Check the patient. Then, check the probe and cable; reposition or replace as needed.

WRONG CABLE

The SpO_2 cable is not compatible with the Patient Data Module. Use the correct Nellcor or Masimo cable (Patient Data Module only). See Patient Data Module Compatibility on page 12-2.

CONNECT SPO2 PROBE

The SpO_2 probe is not connected to the SpO_2 cable. Connect the probe (Patient Data Module only).

ARTIFACT DETECTED

This condition is generated from ambient light or electrical interference. Reposition the probe on the patient (Patient Data Module only).

ARTIFACT

This condition is generated from motion. Reposition the probe on the patient (Patient Data Module only).

Clinical Questions

The following clinical questions are frequently asked about SpO_2 monitoring. These may help in troubleshooting when monitoring SpO_2.

Why does the monitor (pulse oximeter) sometimes read differently than an ABG?

Arterial blood gas analyzers calculate the O_2 saturation based on normal values for pH, $PaCO_2$, Hb, temperature, etc. (i.e., a normal oxyhemoglobin dissociation curve). Depending on the patient's physiologic and metabolic status, his curve and all his values may be shifted away from “normal.” Thus the oximeter, which measures O_2 saturation, may not agree with the ABG.

A CO-oximeter is an analyzer which also measures O_2 saturation. The saturation of hemoglobin may be much closer to a pulse oximeter in these cases.

How does a pulse oximeter “read” the various types of hemoglobins?

All pulse oximeters utilize two wavelength absorption. This is because reduced hemoglobin (RHb) and oxyhemoglobin (HbO_2) absorb these two wavelengths differently. The hemoglobin saturation is then figured from the measured amounts of the hemoglobins: (SpO_2–HbO_2)/(HbO_2 + RHb). Carboxyhemoglobin (COHb) absorbs similarly to HbO_2 and thus can raise the SpO_2. Normal levels of COHb are 1-2%. Methemoglobin (MetHb) usually represents less than 1% total Hgb, but in cases such as some IV dyes, antibiotics, etc. this level may go up sharply. MetHb absorbs similarly to RHb, and thus could lower the SpO_2 reading. Fetal Hb absorbs like adult Hb, thus the oximeter has the same accuracy with neonates and adults.

What effect can ambient light have on pulse oximetry monitoring?

Ambient light can have numerous effects. In the newborn, ICU bili lights can affect the readings of the oximeters. Outside light striking the probe detector can give poor waveform and inaccurate readings. Sunlight or bright indoor lights can have the same effect in other areas of the hospital using oximetry. Error message of ***PROBE IS OFF PATIENT*** is possible. Shielding the probe with opaque tape, the posey wrap or other material can thus increase oximetry accuracy—verified by good waveform and signal strength.

What things can create inaccurate pulse oximeter readings?

Certain IV dyes, such as methylene blue, can affect the readings. Methylene blue will give falsely low readings due to excess absorption of the Red wavelength.

Nail polish, especially violets and blues, can also reduce the reading due to the same absorption. Removal of the polish is always recommended.

Long nails, and artificial or acrylic nails can interfere with good LED/detector opposition through the tissue.

Patients with deeply pigmented skin may be tough to monitor, although finger pigmentation is usually less than the rest of the body.

Patients with sickle cell anemia undergoing a sickling crisis may have erroneous readings due to the absorption spectrum of HbS being different than for normal adult Hb.

Severely jaundiced patients have high levels of bilirubin in their blood. A product of bilirubin metabolism is CO and thus high levels of carboxyhemoglobin can be formed, causing the oximeter to read artificially high SpO_2.

Patients with severe anemia can have low SpO_2 readings.

Patients with heavy smoke inhalation can have transiently high CO levels and thus a high amount of carboxyhemoglobin.

Certain antibiotics, such as the sulfas, can create high levels of methemoglobin. Methemoglobin is unable to bind O_2 and will absorb light similarly to reduced hemoglobin, thus giving an artificially low SpO_2.

What does electrosurgical interference look like and how can it be minimized?

Electrosurgical interference will be most obvious on the displayed waveform. It is a very spiky, erratic looking waveform caused by the electrosurgical unit's overwhelming interference in the OR. It can result in grossly inaccurate pulse oximeter parameters.

Electrosurgical interference can be minimized by:

- Making sure the pulse oximeter probe is as far away from the return pad and operating site as possible.
- Making sure the probe is not between the return pad and operating site.
- Keeping the power cord and probe cable away from the power cord of the electrosurgical unit.
- Plugging the electrosurgery unit into a separate set of outlets from the transport monitor.

What does motion artifact look like, what problems can it cause, and how can it be corrected?

NOTE

This section is not applicable to monitoring SpO_2 with the Masimo SET configuration for Masimo Patient Data Module or TRAM x51M modules.

Motion artifact occurs with excessive motion of the probe, the cable leading to the probe or the cable/probe junction. In other words anything that causes any of these things to move, like the patient moving his hands, or the cable laying across the ventilator tubing and being moved with every cycle, can cause motion artifact. A non-arterial, often erratic looking waveform, and a pulse rate that does not coincide with the HR on the ECG will result.

The main problem motion artifact can cause is erroneous SpO_2 readings.

Motion artifact can be reduced, if not eliminated, by selecting a “quieter” site on the patient. An ear probe if he refuses to keep his hands still, or an adhesive probe on the toe, an adhesive probe on the little finger for an adult, or on the sole of the foot in a newborn, can help greatly.

Cable movement can be reduced by applying the probe with the cable leading toward the patient, then taping the cable to the side of the hand or foot. In the case of the butterfly probe, the tape was designed to secure the cable to the finger.

13 Respiration

Introduction

Impedance respiration monitoring can be done with any ECG cable. This manual includes information for patient preparation and electrode placement. See Chapter 9.

This chapter gives guidelines for adjusting respiration setup, and problem solving.

NOTE

The signal input is a high-insulation port and it is defibrillator-proof. 

The insulated input ensures patient safety and protects the device during defibrillation and electrosurgery.

NOTE

Respiration monitoring is not adversely affected by the use of an ESU ECG filter.

No Breath and Apnea Events

The Patient Data Module and TRAM modules use the same respiration detection algorithm, but they report different messages for cessation of inspiratory gas flow events. The Patient Data Module reports ***NO BREATH***; TRAM modules report ***APNEA***.

General Information

WARNING

NO-BREATH/APNEA EVENTS— The transport monitor may not detect all episodes of inadequate breathing, nor does it distinguish between central, obstructive and mixed no-breath /apnea events.

WARNING

ELECTRODE CONFIGURATION—Impedance respiration monitoring is not reliable when ECG electrodes are placed on the limbs.

NOTE

Respiration monitoring is not adversely affected by the use of an ESU ECG filter.

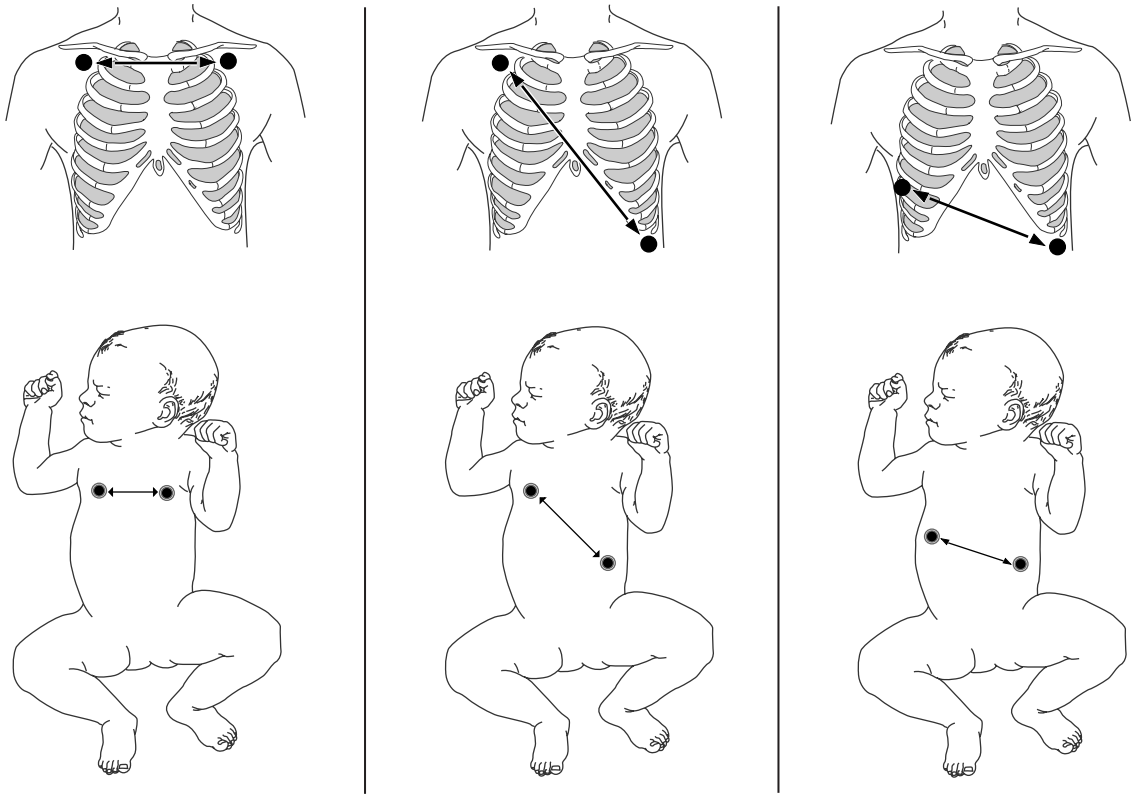
Respiration rate is detected by measuring thoracic impedance changes through ECG lead I, lead II or RL-LL vector.

- Lead I provides good thoracic (upper chest) breath detection. However, lead I is more susceptible to cardiogenic artifact than the RL-LL vector.
- Lead II provides good thoracic breath detection and upper abdominal (lower chest) breath detection. However, lead II is more susceptible to both cardiogenic and motion (head, neck, or arm) artifact than the RL-LL vector.

- The RL-LL vector provides good abdominal breath detection and is not as susceptible to cardiogenic artifact or motion artifact. (This respiration lead can only be monitored when using a Patient Data Module.)

NOTE

The figures below are used to show the relationship between breathing and ECG lead. They do not represent an electrode configuration. Lead placement information is provided in this manual. See Chapter 9.



ECG Lead I for Upper Chest Breather

ECG Lead II for Chest or Upper Abdominal Breather

RL-LL for Abdominal Breather (Patient Data Module only)

853A

When monitoring respiration through the RL-LL vector, use a standard 5-leadwire electrode placement, *except* place the RL electrode on the fifth intercostal space on the right side of the chest. See 5-Leadwire Electrode Placement on page 9-4.

NOTE

A 3-leadwire electrode placement cannot be used for the RL-LL vector. You must use a 5-leadwire electrode placement.

When starting respiration monitoring, the transport monitor “learns” the patient’s respiration pattern. Eight breaths are averaged and the average amplitude of the respiration waveform is found. Detection sensitivity is automatically set at 40% of the average amplitude.

NOTE

The message "***LEARNING***" is displayed in the RR values window during this process.

Markers displayed on the waveform show this 40% detection range. One marker is at inspiration, the other at expiration. The detection sensitivity can be manually adjusted by using the ***SENSITIVITY*** option from the respiration menu.

The waveform size is also set automatically during the learning process, but may be adjusted if necessary.

NOTE

Respiration detection is not dependent on the size of the waveform. Size is for visual purposes only.

Even though the same electrodes are used for ECG and respiration monitoring, it is possible to get a lead fail message for respiration without one for ECG. The impedance may be too high for respiration detection, but the electrode is still good for ECG. See Smart-Lead Fail on page 9-10.

Monitoring Respiration on Pacemaker Patients

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.

Respiration Checklist

Since respiration monitoring is so closely linked with ECG monitoring, patient preparation and electrode placement are important. See Chapter 9.

1. Electrodes have been placed on the patient following proper skin preparation.
2. Leadwires are attached to electrodes on the patient.

3. Leadwires are connected to patient cable and patient cable is connected to the transport monitor.
4. Respiration setup is adjusted, if necessary. Follow detailed procedures within this chapter.

How to Start Respiration Monitoring

Procedure

Respiration monitoring may not be turned on. If the RR parameter window does not appear on the display, follow these steps to turn it on:

1. Select the ***MORE MENUS*** option from the Main menu.
2. Select the ***MONITOR SETUP*** option.
3. Select the ***PARAMETERS ON/OFF*** option from the Monitor Setup menu. A popup menu and information window open.
4. Rotate the **Trim Knob** control to move the pointer to the ***RR*** parameter.
5. Press the **Trim Knob** control to turn the respiration parameter on.
6. Select ***RETURN*** to close the information window.

Special Conditions for Respiration Monitoring on Multiple Monitors

NOTE

These conditions do not exist when the transport monitor is used with a Patient Data Module.

When the transport monitor and another monitor, such as the Solar 8000M/i patient monitor, are simultaneously connected to the same TRAM module, special conditions apply to respiration monitoring.

In general, simultaneous connection of two monitors to one TRAM module only occurs in two situations:

- When switching a patient between the bedside monitor (e.g., Solar 8000M/i patient monitor) and the transport monitor in preparation for or return from transport.
- In the operating room, when multiple monitors are connected to the same TRAM module to provide a second display (e.g., one for use by the surgeon and another for use by the anesthesiologist).

Turning Respiration On with Multiple Monitors

When respiration monitoring is turned off at both monitors, it cannot be turned on from the transport monitor. You must first turn respiration on at the bedside monitor (e.g., Solar 8000M/i patient monitor); the respiration parameter will then be automatically turned on at the transport monitor.

Turning Respiration Off with Multiple Monitors

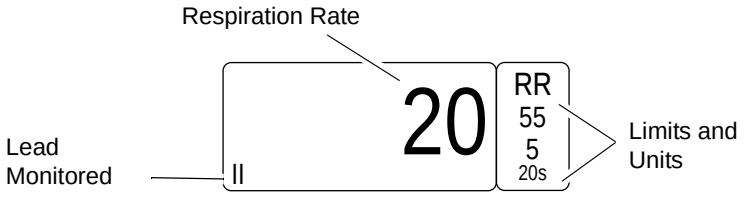
If you turn respiration off while the transport monitor and the bedside monitor are both connected to the same TRAM module, you must also turn respiration off at the bedside monitor.

Respiration Monitoring Features

Respiration Information

When respiration monitoring is on, a labeled respiration waveform is displayed when the learning process is complete. The label includes the ECG lead used to derive the respiration waveform, for example, RR II. See General Information on page 13-2.

Numerics are displayed in the RR parameter window on the right side of the screen.



RR Parameter Window

The parameter window displays the current respiration rate and the ECG lead used to monitor respiration. Alarm limits may be displayed for respiration rate and no-breath /apnea events.

The respiration monitoring features are found in the RR parameter menu.

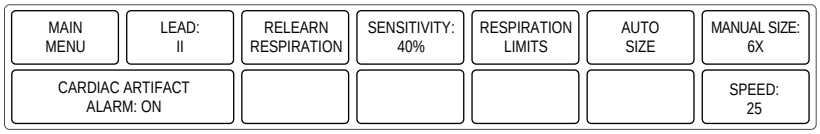
Getting to the Respiration Menu

To display the respiration menu, use the **Trim Knob** control to select the ***RR*** parameter label. Remember, selecting with the **Trim Knob** control is a two-step process—rotate to highlight, then press to select.

NOTE

If the parameter label is not displayed, select ***PARAMETERS ON/OFF*** option in the Monitor Setup menu to turn respiration on. Then select the ***RR*** parameter label.

The Respiration menu is displayed at the bottom of the display.



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Respiration Menu

With the **Trim Knob** control, you now can select any of the displayed options.

- ***LEAD*** — Changes the lead from which the respiration rate is derived.
- ***RELEARN RESPIRATION*** — Tells the transport monitor to examine and relearn the patient's respiration pattern.
- ***SENSITIVITY*** — Increases or decreases the sensitivity setting.
- ***RESPIRATION LIMITS*** — Displays a new menu and an information window to adjust respiration rate and no-breath/apnea alarm limits.
- ***AUTO SIZE*** — Automatically sizes the respiration waveform to fit in a predetermined area on the screen.
- ***MANUAL SIZE*** — Manually increases or decreases the size of the respiration waveform.
- ***CARDIAC ARTIFACT ALARM*** — Turns the artifact alarm on and off.
- ***SPEED*** — Changes the sweep speed for the displayed respiration waveform.

Detailed information on each option is found in this chapter.

Respiration Menu Options

Lead

The choice of respiration leads depend on the acquisition device used.

- When using the TRAM module there are two choices for the respiration lead: lead I, and lead II.
- When using the Patient Data Module there are three choices for the respiration lead: lead I, lead II, and RL-LL vector.

This menu option allows you to switch the monitored lead for respiration. The label of the lead currently being monitored (I, II or RL-LL) appears in the menu option, in the lower left corner of the RR parameter window, and with the waveform label. Respiration leads can also be changed in Monitor Defaults, Setup Default Display.

Changing leads automatically starts the relearn process.

NOTE

If you are monitoring with a fixed-lead 3-lead cable, respiration can only be obtained from the lead for which the cable is manufactured. For example, if your cable is a fixed lead II cable, you will see a "***LD I FAIL***" message in the RR parameter window should you try to change the respiration lead.

Relearn Respiration

A “learning” process always takes place for a few seconds whenever respiration monitoring is started. If your patient’s breathing pattern changes after the initial learning process has taken place, it may be necessary to relearn.

Select the ***RELEARN RESPIRATION*** option from the respiration menu. This is a direct action menu option.

The message “***LEARNING***” is displayed in the RR values window. There is no respiration rate displayed during the learning process. When learning is complete, the message will clear and the respiration rate will be displayed.

NOTE

Sensitivity is reset at 40% and the waveform is automatically sized.

Sensitivity

During the learning process, the transport monitor automatically sets the detection sensitivity at 40% of the average amplitude. Markers are displayed on the waveform, showing the detection points at inspiration and expiration.

To change the detection sensitivity because of varying amplitudes or artifact, select the ***SENSITIVITY*** option from the respiration menu. A popup menu opens showing the choices available.

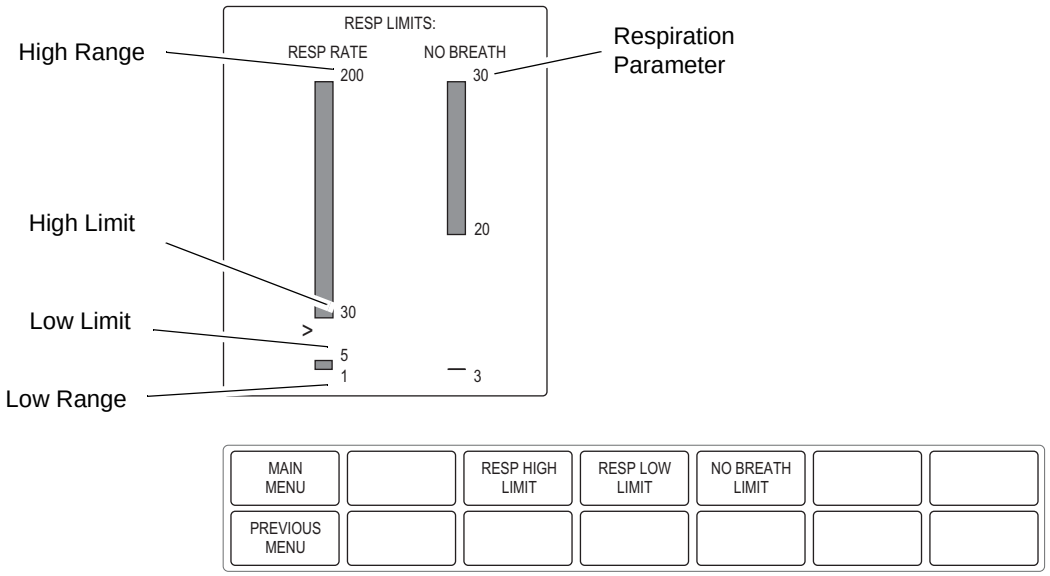
Select a sensitivity percentage. The markers on the waveform will move to reflect the new percentage. The lower the percentage, the greater the detection sensitivity.

Respiration Limits

This option provides an information window with bar graphs that show the alarm limits for respiration rate and no-breath/apnea. A new set of menu options is displayed to allow you to adjust these limits.

Follow this procedure:

1. Select the ***RESPIRATION LIMITS*** option from the respiration menu. A menu and information window open.



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Respiration Limits Menu and Information Window for Patient Data Module

NOTE

When a TRAM module is used, ***NO BREATH*** is labeled as ***APNEA***.

The information window shows the range as well as the alarm limits. Where applicable, a pointer (>) indicates the current value of that parameter for the monitored patient. As long as that value remains between the high and low limits, there will be no alarm. Should the value reach or exceed one of the limits, an alarm will occur.

2. To change a set limit, for example the resp high limit, select the ***RESP HIGH LIMIT*** option from the limits menu. A popup menu opens.
3. Rotate the **Trim Knob** control and the value displayed will change. The bar graph is also adjusted. The limit will not be in effect until the **Trim Knob** control is pressed and the popup menu closed.
4. Press the **Trim Knob** control to confirm the change and close the popup menu.
5. Follow this procedure to set the no-breath/apnea limit. Select ***PREVIOUS MENU*** to exit the limits menu and return to the respiration menu.

Auto Size

NOTE

The size of the waveform has no effect on the detection capability of the program.

During the learning process, the displayed waveform is automatically sized to fit a predetermined area of the screen. During monitoring, the size may have been changed manually (see below). Select the ***AUTO SIZE*** option to automatically resize the waveform to fit the predetermined area. This is a direct action menu option.

Manual Size

If desired, you can manually change the size of the respiration waveform.

1. Select the ***MANUAL SIZE*** option from the respiration menu. A popup menu opens displaying the choices available.
2. Rotate the **Trim Knob** control to highlight another size. The change will occur immediately.
3. When you are satisfied with the size, press the **Trim Knob** control to close the popup menu.

NOTE

The manual size you select will be cancelled if you change the lead from which respiration is derived. When you change leads, the learning process is started and the waveform is automatically sized.

Cardiac Artifact

The cardiac artifact alarm alerts you to the fact that the respiration rate is within 5% of the heart rate (over 30 consecutive breaths). If this happens, the respiration program may be counting heartbeat artifact as respiration. The cardiac artifact alarm is an Advisory alarm. The message "***ARTIFACT***" is displayed in the RR values window, and a one-beep tone sounds.

There is no adjustable limit for this alarm, but you can turn it off and on.

WARNING

If the cardiac artifact alarm is turned off, no-breath/apnea events may not be detected.

Select the ***CARDIAC ARTIFACT ALARM*** option from the Respiration menu to turn the alarm off and on. This is a direct action menu option.

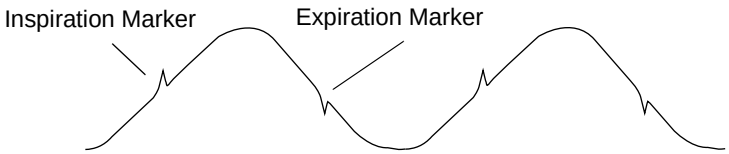
Speed

Use this menu option to open a popup menu to select a sweep speed for all displayed respiration waveforms. Choices are ***6.25***, ***12.5***, and ***25*** (factory default) millimeters per second.

Troubleshooting

Respiratory Waveform

Illustrated below is a respiratory waveform which is regular and even. The inspiration and expiration markers are identified.



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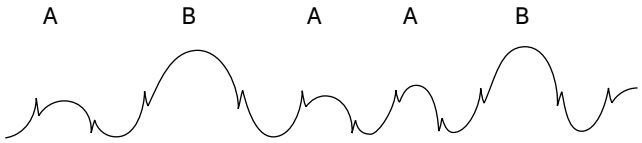
Regular and Even

Cardiac Artifact

Problem: The transport monitor is detecting cardiac artifact as breaths.

Solution: The breath detection threshold is too low. Increase the detection sensitivity percentage until the markers correctly identify each inspiration and expiration. See the markers in the following figures (A = artifact, B = breath).



760A

Incorrect Detection

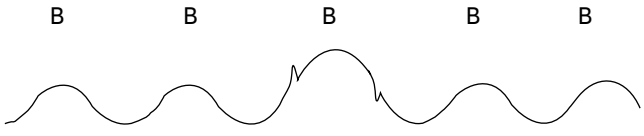
761A

Correct Detection

Varying Amplitudes

Problem: The waveform has a combination of shallow and deep breaths, and the transport monitor is not detecting the shallow breaths.

Solution: The detection sensitivity threshold is set too high and the shallow breaths are not being detected. Decrease the detection sensitivity percentage until the markers correctly identify each inspiration and expiration. See the markers in the following figures (B = breath).



762A

Incorrect Detection

763A

Correct Detection

Motion Artifact

Problem: The transport monitor is detecting patient movement as breaths.

Solution: Head, neck, and arm movement can cause large disruptions to the respiration waveform, which can be falsely detected as breaths. If available on your transport monitor, use the RL-LL vector and place the RL lead in the V5R position (right side mirror image of the standard V5 ECG position). The RL-LL vector will detect abdominal breathing and is less sensitive to patient head, neck, and arm movement.

Messages

Below is a list of all the messages that may be displayed in the RR parameter window during respiration monitoring. The message meanings, as well as actions to take, are included. These messages may appear in abbreviated form if the parameter window is sized smaller due to the number of parameters being monitored. The abbreviated form, if there is one, is shown in parentheses.

LEARNING

The transport monitor takes approximately 8 breaths to learn the patient's respiration pattern before displaying a respiration value. Learning automatically occurs whenever respiration is turned on and when the lead from which respiration is determined is switched.

NO BREATH/APNEA

CHECK THE PATIENT. This is an alarm condition that requires action. Breathing has not been detected for a predetermined number of seconds. If necessary, the no-breath (Patient Data Module) or apnea limit (TRAM module) can be changed. See Respiration Limits on page 13-8.

ARTIFACT

CHECK THE PATIENT. This is an alarm condition that requires action. The transport monitor is unable to successfully determine respiration. If it is determined that patient condition is not the cause, it may be necessary to re-prep the patient's skin and change the electrodes to resume monitoring of respiration.

LD I FAIL, LD II FAIL, or RL-LL FAIL

CHECK THE PATIENT. This is an alarm condition which requires action. The lead monitoring respiration has failed. You can manually switch respiration detection to the other lead, or it may be necessary to re-prep the patient's skin and change the electrodes.

LEADS FAIL (LDS FAIL)

CHECK THE PATIENT. This is an alarm condition which requires action. It may be necessary to re-prep the patient's skin and change the electrodes.

14 Temperature

Introduction

Two temperature sites can be monitored.

NOTE

The **TEMP/CO** cable connector is a high-insulation port and it is defibrillator-proof.

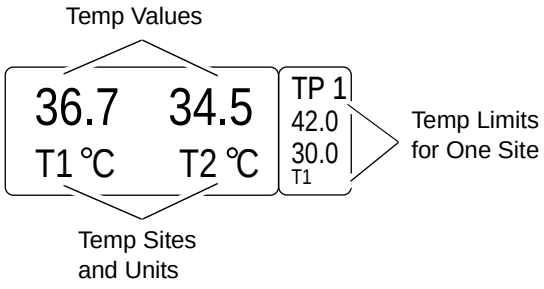
Temperature Checklist

1. The temperature probe(s) is correctly positioned on the patient. (Follow appropriate medical procedures.)
2. If using the dual temperature cable, the switch is turned to **400** or **700** depending on the type of probe used.
3. Temperature cable is attached to the module.
4. Temperature setup is adjusted, if necessary. Follow detailed procedures within this chapter.

Temperature Monitoring Features

Temperature Information

Temperature monitoring provides numerical information only. No waveform is generated or displayed. Numerics are displayed in the temperature (***TP***) parameter window on the right side of the screen.



764A

Temperature Parameter Window

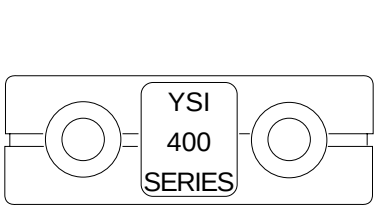
The parameter window displays the current temperature values, along with the unit of measurement. If the defaults are set up to display limits, the T1 limits are displayed.

NOTE

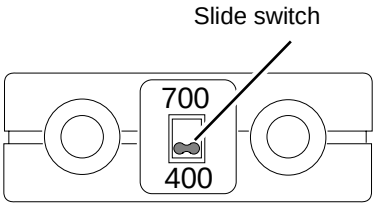
When both temperature sites are being monitored, the alarm limits for the T1 site only are displayed in the limits window. If the T1 site is turned off, the displayed alarm limits automatically switch to the T2 alarm limits.

You can monitor a patient's temperature at multiple sites. Both internal and external temperature sensors may be used. The monitor calculates the monitored temperatures and displays their values on the screen. The temperature sites are identified in the values window as ***T1*** and ***T2***.

The module is compatible with both YSI series 400 and 700 probes. If you are using the dual temperature cable, you must select **400** or **700** (depending on the type of probe) for correct operation. (See the figures below.) The switch is located on the cable.



YSI 400 Series Temperature Cable



Dual Temperature Cable Selection Switch

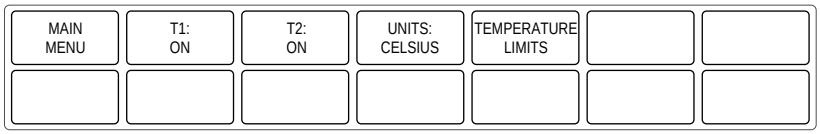
765A & 766A

The temperature cable is plugged into the **TEMP/CO** cable connector on the module. The temperature monitoring features are found in the temperature parameter menu.

Getting to the Temperature Menu

To display the temperature menu use the **Trim Knob** control to select the TP parameter label. Remember, selecting with the **Trim Knob** control is a two-step process—rotate to highlight, then press to select.

The temperature menu is displayed at the bottom of the screen.



768A

Temperature Menu

With the **Trim Knob** control, you now can select any of the displayed options:

- ***T1*** — Turns the T1 temperature site off and on.
- ***T2*** — Turns the T2 temperature site off and on.
- ***UNITS*** — Switches the units of measurement between Celsius and Fahrenheit.
- ***TEMPERATURE LIMITS*** — Displays a new menu and an information window to adjust alarm limits for both temperature sites.

Temperature Menu Options

T1

This direct action menu option turns monitoring off and on at temperature site 1. When off, no values are displayed in the temperature parameter windows.

T2

This direct action menu option turns monitoring off and on at temperature site 2. When off, no values are displayed in the temperature parameter windows.

Units

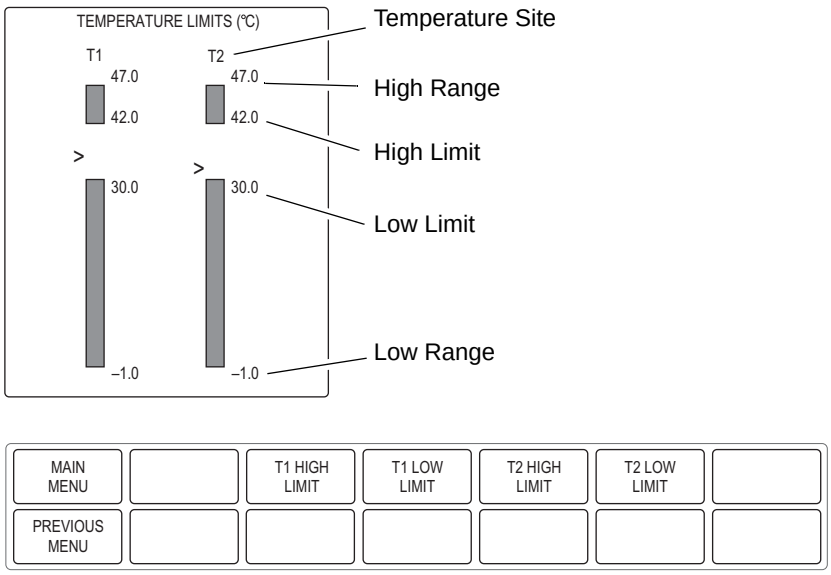
This direct action menu option switches the units of measure between Celsius (C) and Fahrenheit (F).

Temperature Limits

This option provides an information window with bar graphs that show the alarm limits for both temperature sites. A new set of menu options is displayed to allow you to adjust these limits.

Follow this procedure:

1. Select the ***TEMPERATURE LIMITS*** option from the temperature menu. An information window is displayed on the screen and a new set of menu options is displayed in the menu area.

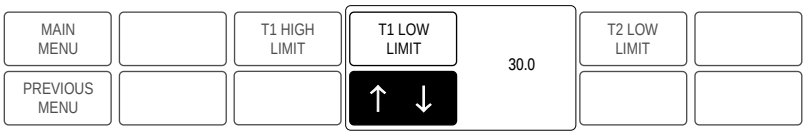


769A

Temperature Limits Menu and Information Window

The information window shows the range as well as the alarm limits. The pointer (>) indicates the current temperature value for the monitored patient. As long as that value remains between the high and low limits, there will be no alarm. Should the value exceed one of the limits, an alarm will occur.

2. To change a set limit, for example the low temperature limit for the T1 site, select the ***T1 LOW LIMIT*** option from the limits menu. A popup menu opens.



770A

T1 Low Limit Popup Menu

3. Rotate the **Trim Knob** control and the value displayed will change. The bar graph is also adjusted. The limit will not be in effect until the **Trim Knob** control is pressed and the popup menu closed.
4. Press the **Trim Knob** control to confirm the change and close the popup menu.
5. Follow this procedure to set other limits. Select ***PREVIOUS MENU*** to exit the limits menu and return to the temperature menu.

Troubleshooting

Messages

If you experience problems with temperature monitoring, one of the following messages may be displayed in the TP parameter window:

CAL CHECK

There is a 0.1°C (0.18 °F) deviation between the temperature value and the internal calibration. No temperature value will be displayed. Service on the monitor is required (TRAM modules only).

CAL FAIL

There is a 1°C (1.8 °F) deviation between the temperature value sensed and the internal calibration. No temperature value will be displayed. Service on the monitor is required.

SENSOR

No sensor is detected. Either no sensor is present or a sensor has failed. If no sensor is present, turn the temperature site off to clear the message.

A Appendix A – Supplies

Supplies

To ensure patient safety, use only supplies manufactured or recommended by GE. Your local sales representative can provide current supplies lists, or you can contact GE Supplies. (Refer to “How to Reach Us” page.)

B Appendix B — Adult-ICU Mode Defaults

Patient Data Module Adult-ICU Mode Defaults

Following are the monitor defaults for the Patient Data Module Adult-ICU mode. You can change these using the monitor defaults feature. Monitor defaults are recalled upon discharge. See Chapter 5.

NOTE

The defaults displayed depend on the acquisition device connected to the monitor. Below is a list of all Display Defaults supported by the transport monitor with a Patient Data Module.

Display Defaults	
Display Mode	***INDV 6 WFS***
Color Format	***TRANSDUCER***
Primary ECG	***II***
ECG Waveform 2	***V***
Arrhythmia	***ON***
Detect Pace	***OFF***
Arterial Rate	***ON***
ST V Lead	***V1***
ST VB Lead	***V5***
ART Disconnect	***ON***
Arterial Scale	***160***
PA Scale	***60***
CVP-RA-UVC Scale	***30***
LA Scale	***30***
ICP Scale	***30***
SP Scale	***160***
BP WF Speed	***25***
NBP Auto	***OFF***
NBP Cuff Size	***ADULT***
RR Lead	***II***
RR WF Speed	***25***
SPO2 WF Speed	***25***
Alarm Volume Off	***ENABLE***
Min Alarm Volume	***10%***
Alarm Volume	***70%***
Silence Alarm	***NORMAL***

Display Defaults	
QRS Volume	***OFF***
Rate Volume	***OFF***
ECG Leads Fail	***SYS WARNING***
SPO2 Probe Off	***SYS WARNING***
Connect SPO2 Probe	***SYS WARNING***
SPO2 Pulse Search	***SYS ADVISORY***
Display Limits	***ON***
Display Units	***OFF***
Units For Height	***CM***
Units For Weight	***KG***
Temperature Units	***C DEG***
NBP Limits Type	***SYSTOLIC***
Arterial Limits Type	***SYSTOLIC***
PA Limits Type	***DIASTOLIC***
Menu Timeout	***5 MINS***
BP Filter	***12 Hz***
NBP Silence Alarm	***NORMAL***
Pause Breakthru	***CRISIS***
Masimo Averaging	***8 SECS***

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				✓

Arrhythmia Alarm Levels				
	Crisis	**Warning**	**Advisory**	**Message**
PVC				✓
Tachy				✓
Brady				✓
Atrial Fib (Patient Data Module only - Irregular is used if AFIB is *disabled* in boot code)				✓
Irregular (Atrial Fib is used if AFIB is *enabled* in boot code)				✓

Parameter Alarm Levels				
	Crisis	**Warning**	**Advisory**	**Message**
HR		✓		
ART			✓	
PA			✓	
SPO2			✓	
NBP			✓	
FEM			✓	
UAC			✓	
CVP			✓	
RA			✓	
UVC			✓	
LA			✓	
ICP			✓	
SP			✓	
ART Rate				✓
SPO2 Rate				✓
TMP				✓
RR				✓
Resp No Breath				✓
FEM Rate				✓
UAC Rate				✓

Default Limits		
	Low	**High**
HR	***50***	***150***
NBP-S	***80***	***200***
NBP-D	***20***	***120***
NBP-M	***40***	***140***
ART-S	***80***	***200***
ART-D	***20***	***120***
ART-M	***40***	***140***
ART-R	***50***	***150***
FEM-S	***40***	***200***
FEM-D	***20***	***120***
FEM-M	***40***	***140***
FEM-R	***50***	***150***
UAC-S	***80***	***200***
UAC-D	***20***	***120***
UAC-M	***40***	***140***
UAC-R	***50***	***150***
PA-S	***-99***	***350***
PA-D	***-99***	***350***
PA-M	***-99***	***350***
CVP	***-99***	***350***
RA	***-99***	***350***
UVC	***-99***	***350***
LA	***-99***	***350***
ICP	***-99***	***350***
SP	***-99***	***350***
SPO2	***90***	***105***
SPO2-R	***50***	***150***
RR	***5***	***30***
RR-No Breath	***—***	***20***
TEMP 1	***30.0°C/86.0°F***	***42.0°C/107.6°F***
TEMP 2	***30.0°C/86.0°F***	***42.0°C/107.6°F***

Parameter Priority Defaults

The following parameters, when monitored, always appear in parameter windows at the right side of the display.

Parameter 1	***ECG***
Parameter 2	***ECG***
Parameter 3	***ART***
Parameter 4	***PA***
Parameter 5	***SPO2***
Parameter 6	***ALARMS***

The NBP, RESP, and TEMP parameters appear in parameter windows at the bottom of the display *only* when there is no room at the side.

NBP	CVP[1]	SP[1]
ART	RA[1]	SPO2[1]
FEM	UVC[1]	RESP[1]
UAC	LA[1]	TEMP[1]
PA	ICP[1]	ALARMS

[1] May be displayed as reduced size (determined by software).

TRAM Module Adult-ICU Mode Defaults

Following are the monitor defaults for the TRAM Module Adult-ICU mode. You can change these using the monitor defaults feature. Monitor defaults are recalled upon discharge. See Chapter 5.

NOTE

The defaults displayed depend on the acquisition device connected to the monitor. Below is a list of all Display Defaults supported by the transport monitor with a TRAM module.

Display Defaults	
Display Mode	***INDV 6 WFS***
Color Format	***TRANSDUCER***
ECG Waveform 2	***V***
BP WF Speed	***25***

Display Defaults	
RR WF Speed	***25***
SPO2 WF Speed	***25***
Alarm Volume Off	***ENABLE***
Min Alarm Volume	***10%***
Alarm Volume	***70%***
Silence Alarm	***NORMAL***
QRS Volume	***OFF***
Rate Volume	***OFF***
ECG Leads Fail	***SYS WARNING***
SPO2 Probe Off	***SYS WARNING***
SPO2 Pulse Search	***SYS ADVISORY***
Display Limits	***ON***
Display Units	***OFF***
Units For Height	***CM***
Units For Weight	***KG***
Temperature Units	***C DEG***
NBP Limits Type	***SYSTOLIC***
Arterial Limits Type	***SYSTOLIC***
PA Limits Type	***DIASTOLIC***
Menu Timeout	***5 MINS***
NBP Silence Alarm	***NORMAL***
Pause Breakthru	***CRISIS***

Arrhythmia Alarm Levels				
	Crisis	**Warning**	**Advisory**	**Message**
Asystole	✓			
VFib/VTac	✓			
V Tach	✓			
VT > 2	✓			
V Brady	✓			
Couplet				✓
Bigeminy				✓
Acc Vent				✓

Arrhythmia Alarm Levels				
	Crisis	**Warning**	**Advisory**	**Message**
Pause				✓
Trigeminy				✓
R on T				✓
PVC				✓
Tachy				✓
Brady				✓
Atrial Fib (Patient Data Module only - TRAM uses Irregular)				✓
Irregular				✓

Parameter Alarm Levels				
	Crisis	**Warning**	**Advisory**	**Message**
HR		✓		
ART			✓	
PA			✓	
SPO2			✓	
NBP			✓	
FEM			✓	
UAC			✓	
CVP			✓	
RA			✓	
UVC			✓	
LA			✓	
ICP			✓	
SP			✓	
ART Rate				✓
SPO2 Rate				✓
TMP				✓
RR				✓
Resp Apnea				✓

Parameter Alarm Levels				
	Crisis	**Warning**	**Advisory**	**Message**
FEM Rate				✓
UAC Rate				✓

Parameter Priority Defaults

The following parameters, when monitored, always appear in parameter windows at the right side of the display.

Parameter 1	***ECG***
Parameter 2	***ECG***
Parameter 3	***ART***
Parameter 4	***PA***
Parameter 5	***SPO2***
Parameter 6	***ALARMS***

The NBP, RESP, and TEMP parameters appear in parameter windows at the bottom of the display *only* when there is no room at the side.

NBP	CVP[1]	SP[1]
ART	RA[1]	SPO2[1]
FEM	UVC[1]	RESP[1]
UAC	LA[1]	TEMP[1]
PA	ICP[1]	ALARMS

[1] May be displayed as reduced size (determined by software).

C Appendix C — Neonatal-ICU Mode Defaults

Patient Data Module Neonatal-ICU Mode Defaults

Following are the monitor defaults for the Patient Data Module Neonatal-ICU mode. You can change these using the monitor defaults feature. Monitor defaults are recalled upon discharge. See Chapter 5.

NOTE

The defaults displayed depend on the acquisition device connected to the monitor. Below is a list of all Display Defaults supported by the transport monitor with a Patient Data Module.

Display Defaults	
Display Mode	***INDV 6 WFS***
Color Format	***TRANSDUCER***
Primary ECG	***II***
ECG Waveform 2	***OFF***
Arrhythmia	***ON***
Detect Pace	***OFF***
Arterial Rate	***ON***
ST V Lead	***V1***
ST VB Lead	***V5***
Arterial Scale	***100***
PA Scale	***60***
CVP-RA-UVC Scale	***30***
LA Scale	***30***
ICP Scale	***30***
SP Scale	***160***
BP WF Speed	***25***
NBP Auto	***OFF***
NBP Cuff Size	***NEONATAL***
RR Lead	***II***
RR WF Speed	***25***
SPO2 WF Speed	***25***
Alarm Volume Off	***DISABLE***
Min Alarm Volume	***10%***
Alarm Volume	***70%***
Silence Alarm	***NORMAL***
QRS Volume	***OFF***

Display Defaults	
Rate Volume	***OFF***
ECG Leads Fail	***SYS WARNING***
SPO2 Probe Off	***SYS WARNING***
Connect SPO2 Probe	***SYS WARNING***
SPO2 Pulse Search	***SYS ADVISORY***
Display Limits	***ON***
Display Units	***OFF***
Units For Height	***CM***
Units For Weight	***KG***
Temperature Units	***C DEG***
NBP Limits Type	***SYSTOLIC***
Arterial Limits Type	***SYSTOLIC***
PA Limits Type	***DIASTOLIC***
Menu Timeout	***5 MINS***
BP Filter	***12 Hz***
NBP Silence Alarm	***NORMAL***
Pause Breakthru	***CRISIS***
Masimo Averaging	***8 SECS***

Arrhythmia Alarm Levels				
	Crisis	**Warning**	**Advisory**	**Message**
Asystole	✓			
VFib/VTac	✓			
V Tach	✓			
VT > 2	✓			
V Brady	✓			
Brady	✓			
Couplet				✓
Bigeminy				✓
Acc Vent				✓
Pause				✓
Trigeminy				✓
R on T				✓

Arrhythmia Alarm Levels				
	Crisis	**Warning**	**Advisory**	**Message**
PVC				✓
Tachy				✓
Atrial Fib (not available for neonatal mode - neonatal uses Irregular)				✓
Irregular				✓

Parameter Alarm Levels				
	Crisis	**Warning**	**Advisory**	**Message**
Resp No Breath	✓			
HR		✓		
UAC			✓	
UVC			✓	
SPO2			✓	
NBP			✓	
ART			✓	
FEM			✓	
PA			✓	
CVP			✓	
RA			✓	
LA			✓	
ICP			✓	
SP			✓	
UAC RATE				✓
RR				✓
SPO2 RATE				✓
TMP				✓
ART Rate				✓
FEM Rate				✓

Default Limits		
	Low	**High**
HR	***90***	***200***
NBP-S	***40***	***100***
NBP-D	***20***	***60***
NBP-M	***30***	***70***
ART-S	***40***	***100***
ART-D	***20***	***60***
ART-M	***30***	***70***
ART-R	***90***	***200***
FEM-S	***40***	***100***
FEM-D	***20***	***60***
FEM-M	***30***	***70***
FEM-R	***90***	***200***
UAC-S	***40***	***100***
UAC-D	***20***	***60***
UAC-M	***30***	***70***
UAC-R	***90***	***200***
PA-S	***-99***	***350***
PA-D	***-99***	***350***
PA-M	***-99***	***350***
CVP	***-99***	***350***
RA	***-99***	***350***
UVC	***-99***	***350***
LA	***-99***	***350***
ICP	***-99***	***350***
SP	***-99***	***350***
SPO2	***88***	***100***
SPO2-R	***90***	***200***
RR	***15***	***100***
RR-No Breath	***—***	***15***
TEMP 1	***00.0°C/32.0°F***	***42.0°C/107.6°F***
TEMP 2	***00.0°C/32.0°F***	***42.0°C/107.6°F***

Parameter Priority Defaults

The following parameters, when monitored, always appear in parameter windows at the right side of the display.

Parameter 1	***ECG***
Parameter 2	***UAC***
Parameter 3	***UVC***
Parameter 4	***RR***
Parameter 5	***SPO2***
Parameter 6	***NBP***

The TEMP and ALARMS parameters appear in parameter windows at the bottom of the display *only* when there is no room at the side.

ART	NBP	ICP
FEM	CVP[1]	SP[1]
UAC	RA[1]	SPO2[1]
PA	UVC[1]	TEMP[1]
RESP[1]	LA[1]	ALARMS

[1] May be displayed as reduced size (determined by software).

TRAM Module Neonatal-ICU Mode Defaults

Following are the monitor defaults for the TRAM Module Neonatal-ICU mode. You can change these using the monitor defaults feature. Monitor defaults are recalled upon discharge. See Chapter 5.

The defaults displayed depend on the acquisition device connected to the monitor. Below is a list of all Display Defaults supported by the transport monitor with a TRAM module.

Display Defaults	
Display Mode	***INDV 6 WFS***
Color Format	***TRANSDUCER***
ECG Waveform 2	***OFF***
BP WF Speed	***25***
RR WF Speed	***25***

Display Defaults	
SPO2 WF Speed	***25***
Alarm Volume Off	***DISABLE***
Min Alarm Volume	***10%***
Alarm Volume	***70%***
Silence Alarm	***NORMAL***
QRS Volume	***OFF***
Rate Volume	***OFF***
ECG Leads Fail	***SYS WARNING***
SPO2 Probe Off	***SYS WARNING***
SPO2 Pulse Search	***SYS ADVISORY***
Display Limits	***ON***
Display Units	***OFF***
Units For Height	***CM***
Units For Weight	***KG***
Temperature Units	***C DEG***
NBP Limits Type	***SYSTOLIC***
Arterial Limits Type	***SYSTOLIC***
PA Limits Type	***DIASTOLIC***
Menu Timeout	***5 MINS***
NBP Silence Alarm	***NORMAL***
Pause Breakthru	***CRISIS***

Arrhythmia Alarm Levels				
	Crisis	**Warning**	**Advisory**	**Message**
Asystole	✓			
VFib/VTac	✓			
V Tach	✓			
VT > 2	✓			
V Brady	✓			
Brady	✓			
Couplet				✓
Bigeminy				✓
Acc Vent				✓

Arrhythmia Alarm Levels				
	Crisis	**Warning**	**Advisory**	**Message**
Pause				✓
Trigeminy				✓
R on T				✓
PVC				✓
Tachy				✓
Atrial Fib (not available for neonatal mode - neonatal uses Irregular)				✓
Irregular				✓

Parameter Alarm Levels				
	Crisis	**Warning**	**Advisory**	**Message**
Resp Apnea	✓			
HR		✓		
UAC			✓	
UVC			✓	
SPO2			✓	
NBP			✓	
ART			✓	
FEM			✓	
PA			✓	
CVP			✓	
RA			✓	
LA			✓	
ICP			✓	
SP			✓	
UAC Rate				✓
RR				✓
SPO2 Rate				✓
TMP				✓
ART Rate				✓
FEM Rate				✓

Parameter Priority Defaults

The following parameters, when monitored, always appear in parameter windows at the right side of the display.

Parameter 1	***ECG***
Parameter 2	***UAC***
Parameter 3	***UVC***
Parameter 4	***RR***
Parameter 5	***SPO2***
Parameter 6	***NBP***

The TEMP and ALARMS parameters appear in parameter windows at the bottom of the display *only* when there is no room at the side.

ART	NBP	ICP[1]
FEM	CVP[1]	SP[1]
UAC	RA[1]	SPO2[1]
PA	UVC[1]	TEMP[1]
RESP[1]	LA[1]	ALARMS

[1]May be displayed as reduced size (determined by software).

D Appendix D — Operating Room Mode Defaults

Patient Data Module Operating Room Mode Defaults

Following are the monitor defaults for the Patient Data Module Operating Room mode. You can change these using the monitor defaults feature. Monitor defaults are recalled upon discharge. See Chapter 5.

NOTE

The defaults displayed depend on the acquisition device connected to the monitor. Below is a list of all Display Defaults supported by the transport monitor with a Patient Data Module.

Display Defaults	
Display Mode	***INDV 6 WFS***
Color Format	***TRANSDUCER***
Primary ECG	***II***
ECG Waveform 2	***OFF***
Arrhythmia	***OFF***
Detect Pace	***OFF***
Arterial Rate	***ON***
ST V Lead	***V1***
ST VB Lead	***V5***
Art Disconnect	***OFF***
Arterial Scale	***160***
PA Scale	***60***
CVP-RA-UVC Scale	***30***
LA Scale	***30***
ICP Scale	***30***
SP Scale	***160***
BP WF Speed	***25***
NBP Auto	***OFF***
NBP Cuff Size	***ADULT***
RR Lead	***II***
RR WF Speed	***25***
SPO2 WF Speed	***25***
Alarm Volume Off	***ENABLE***
Min Alarm Volume	***10%***
Alarm Volume	***40%***
Silence Alarm	***NORMAL***

Display Defaults	
QRS Volume	***OFF***
Rate Volume	***40%***
ECG Leads Fail	***SYS ADVISORY***
SPO2 Probe Off	***SYS WARNING***
Connect SPO2 Probe	***SYS WARNING***
SPO2 Pulse Search	***SYS ADVISORY***
Display Limits	***OFF***
Display Units	***OFF***
Units For Height	***CM***
Units For Weight	***KG***
Temperature Units	***C DEG***
NBP Limits Type	***SYSTOLIC***
Arterial Limits Type	***SYSTOLIC***
PA Limits Type	***DIASTOLIC***
Menu Timeout	***5 MINS***
BP Filter	***12 Hz***
NBP Silence Alarm	***NORMAL***
Pause Breakthru	***CRISIS***
Masimo Averaging	***8 SECS***

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				✓

Arrhythmia Alarm Levels				
	Crisis	**Warning**	**Advisory**	**Message**
PVC				✓
Tachy				✓
Brady				✓
Atrial Fib (Patient Data Module only - Irregular is used if AFIB is *disabled* in boot code)				✓
Irregular (Atrial Fib is used if AFIB is *enabled* in boot code)				✓

Parameter Alarm Levels				
	Crisis	**Warning**	**Advisory**	**Message**
HR			✓	
NBP			✓	
ART			✓	
PA			✓	
SPO2			✓	
FEM			✓	
UAC			✓	
CVP			✓	
RA			✓	
UVC			✓	
LA			✓	
ICP			✓	
SP			✓	
ART Rate				✓
SPO2 Rate				✓
RR				✓
Resp No Breath				✓
TMP				✓
FEM Rate				✓
UAC Rate				✓

Default Limits		
	Low	**High**
HR	***-1***	***150***
NBP-S	***40***	***200***
NBP-D	***20***	***120***
NBP-M	***40***	***140***
ART-S	***40***	***200***
ART-D	***20***	***120***
ART-M	***40***	***140***
ART-R	***-1***	***150***
FEM-S	***40***	***200***
FEM-D	***20***	***120***
FEM-M	***40***	***140***
FEM-R	***-1***	***150***
UAC-S	***40***	***200***
UAC-D	***20***	***120***
UAC-M	***40***	***140***
UAC-R	***-1***	***150***
PA-S	***-99***	***350***
PA-D	***-99***	***350***
PA-M	***-99***	***350***
CVP	***-99***	***350***
RA	***-99***	***350***
UVC	***-99***	***350***
LA	***-99***	***350***
ICP	***-99***	***350***
SP	***-99***	***350***
SPO2	***90***	***105***
SPO2-R	***-1***	***150***
RR	***1***	***200***
RR-No Breath	***—***	***20***
TEMP 1	***00.0°C/32.0°F***	***42.0°C/107.6°F***
TEMP 2	***00.0°C/32.0°F***	***42.0°C/107.6°F***

Parameter Priority Defaults

The following parameters, when monitored, always appear in parameter windows at the right side of the display.

Parameter 1	***ECG***
Parameter 2	***NBP***
Parameter 3	***ART***
Parameter 4	***PA***
Parameter 5	***SPO2***
Parameter 6	***RR***

The TEMP and ALARMS parameters appear in parameter windows at the bottom of the display *only* when there is no room at the side.

SPO2[1]	UAC	LA[1]
TEMP[1]	PA	ICP[1]
NBP	CVP[1]	SP[1]
ART	RA[1]	RESP[1]
FEM[1]	UVC[1]	ALARMS

[1] May be displayed as reduced size (determined by software).

TRAM Module Operating Room Mode Defaults

Following are the monitor defaults for the TRAM Module Operating Room mode. You can change these using the monitor defaults feature. Monitor defaults are recalled upon discharge. See Chapter 5.

NOTE

The defaults displayed depend on the acquisition device connected to the monitor. Below is a list of all Display Defaults supported by the transport monitor with a TRAM module.

Display Defaults	
Display Mode	***INDV 6 WFS***
Color Format	***TRANSDUCER***
ECG Waveform 2	***OFF***
BP WF Speed	***25***

Display Defaults	
RR WF Speed	***25***
SPO2 WF Speed	***25***
Alarm Volume Off	***ENABLE***
Min Alarm Volume	***10%***
Alarm Volume	***40%***
Silence Alarm	***NORMAL***
QRS Volume	***OFF***
Rate Volume	***40%***
ECG Leads Fail	***SYS ADVISORY***
SPO2 Probe Off	***SYS WARNING***
SPO2 Pulse Search	***SYS ADVISORY***
Display Limits	***OFF***
Display Units	***OFF***
Units For Height	***CM***
Units For Weight	***KG***
Temperature Units	***C DEG***
NBP Limits Type	***SYSTOLIC***
Arterial Limits Type	***SYSTOLIC***
PA Limits Type	***DIASTOLIC***
Menu Timeout	***5 MINS***
NBP Silence Alarm	***NORMAL***
Pause Breakthru	***CRISIS***

Arrhythmia Alarm Levels				
	Crisis	**Warning**	**Advisory**	**Message**
Asystole			✓	
VFib/VTac			✓	
V Tach			✓	
VT > 2			✓	
V Brady			✓	
Couplet				✓
Bigeminy				✓
Acc Vent				✓

Arrhythmia Alarm Levels				
	Crisis	**Warning**	**Advisory**	**Message**
Pause				✓
Trigeminy				✓
R on T				✓
PVC				✓
Tachy				✓
Brady				✓
Atrial Fib (Patient Data Module only - TRAM uses Irregular)				✓
Irregular				✓

Parameter Alarm Levels				
	Crisis	**Warning**	**Advisory**	**Message**
HR			✓	
NBP			✓	
ART			✓	
PA			✓	
SPO2			✓	
FEM			✓	
UAC			✓	
CVP			✓	
RA			✓	
UVC			✓	
LA			✓	
ICP			✓	
SP			✓	
ART Rate				✓
SPO2 Rate				✓
RR				✓
Resp Apnea				✓
TMP				✓

Parameter Alarm Levels				
	Crisis	**Warning**	**Advisory**	**Message**
FEM Rate				✓
UAC Rate				✓

Parameter Priority Defaults

The following parameters, when monitored, always appear in parameter windows at the right side of the display.

Parameter 1	***ECG***
Parameter 2	***NBP***
Parameter 3	***ART***
Parameter 4	***PA***
Parameter 5	***SPO2***
Parameter 6	***RR***

The TEMP and ALARMS parameters appear in parameter windows at the bottom of the display *only* when there is no room at the side.

SPO2[1]	UAC	LA[1]
TEMP[1]	PA	ICP[1]
NBP	CVP[1]	SP[1]
ART	RA[1]	RESP[1]
FEM	UVC[1]	ALARMS

[1]May be displayed as reduced size (determined by software).

E Appendix E — Monitor Defaults Worksheet

Patient Data Module Monitor Defaults Worksheet

You can customize alarm levels, as well as numerous display options. Your settings can be set up as monitor defaults, to be recalled after disconnection from a Patient Data Module. See Chapter 5.

This worksheet is provided as an optional reference tool. Fill it out and keep it in a prominent place to refer to your setup. Before filling it out, you may want to make additional copies of the worksheet for future use.

_____

Customer Authorization Signature

Date: _____ Unit: _____

Monitor Type and Default Number (circle one):

Adult-ICU	0	1
Neonatal-ICU	0	1
Operating Room	0	1

NOTE

Changing the patient-monitor type after setup erases your monitor defaults and reinstates the factory defaults.

Display Defaults	
Display Mode	
Color Format	
Primary ECG	
ECG Waveform 2	
Arrhythmia	
Detect Pace	
Arterial Rate	
ST V Lead	
ST VB Lead	
Art Disconnect	
Arterial Scale	
PA Scale	
CVP-RA-UVC Scale	
LA Scale	
ICP Scale	

Display Defaults	
SP Scale	
BP WF Speed	
NBP Auto	
NBP Cuff Size	
RR Lead	
RR WF Speed	
SPO2 WF Speed	
Alarm Volume Off	
Min Alarm Volume	
Alarm Volume	
Silence Alarm	
QRS Volume	
Rate Volume	
ECG Leads Fail	
SPO2 Probe Off	
Connect SPO2 Probe	
SPO2 Pulse Search	
Display Limits	
Display Units	
Units For Height	
Units For Weight	
Temperature Units	
NBP Limits Type	
Arterial Limits Type	
PA Limits Type	
Menu Timeout	
BP Filter	
NBP Silence Alarm	
Pause Breakthru	
Masimo Averaging	

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				
Atrial Fib (Patient Data Module only - Irregular is used if Atrial Fib is disabled. Not available for neonatal mode.)				
Irregular (not used if Atrial Fib is enabled)				

Parameter Alarm Levels				
	Crisis	**Warning**	**Advisory**	**Message**
HR				
ART				
PA				
CVP				
NBP				
SPO2				
FEM				
UAC				
RA				
UVC				

Parameter Alarm Levels				
	Crisis	**Warning**	**Advisory**	**Message**
LA				
ICP				
SP				
ART Rate				
SPO2 Rate				
FEM Rate				
RR				
Resp No Breath				
TMP				
UAC Rate				

Parameter Limits		
	Low	**High**
HR		
NBP-S		
NBP-D		
NBP-M		
ART-S		
ART-D		
ART-M		
ART-R		
FEM-S		
FEM-D		
FEM-M		
FEM-R		
UAC-S		
UAC-D		
UAC-M		
UAC-R		
PA-S		
PA-D		
PA-M		

Parameter Limits		
	Low	**High**
CVP		
RA		
UVC		
LA		
ICP		
SP		
SPO2		
SPO2-R		
RR		
RR-No Breath		
TEMP 1		
TEMP 2		

Parameter Priority Defaults

The following parameters, when monitored, always appear in parameter windows at the right side of the display.

Parameter 1	***ECG***
Parameter 2	
Parameter 3	
Parameter 4	
Parameter 5	
Parameter 6	

Circle the other parameters you want to have priority after position 6. Size of the parameter window determines how many selections you can make (3 full size, 5 reduced size, or a combination thereof). The software prevents you from selecting more parameters than allowable.

NBP	CVP[1]	SP[1]
ART	RA[1]	SPO2[1]
FEM	UVC[1]	RESP[1]
UAC	LA[1]	TEMP[1]
PA	ICP[1]	ALARMS

[1] May be displayed as reduced size (determined by software).

TRAM Module Monitor Defaults Worksheet

You can customize alarm levels, as well as numerous display options. Your settings can be set up as monitor defaults, to be recalled after disconnection from a Tram module. See Chapter 5.

This worksheet is provided as an optional reference tool. Fill it out and keep it in a prominent place to refer to your setup. Before filling it out, you may want to make additional copies of the worksheet for future use.

_____

Customer Authorization Signature

Date: _____ Unit: _____

Monitor Type and Default Number (circle one):

Adult-ICU	0	1
Neonatal-ICU	0	1
Operating Room	0	1

NOTE

Changing the patient-monitor type after setup erases your monitor defaults and reinstates the factory defaults.

Display Defaults	
Display Mode	
Color Format	
ECG Waveform 2	
BP WF Speed	
RR WF Speed	
SPO2 WF Speed	
Alarm Volume Off	
Min Alarm Volume	
Alarm Volume	
Silence Alarm	
QRS Volume	
Rate Volume	

Display Defaults	
ECG Leads Fail	
SPO2 Probe Off	
SPO2 Pulse Search	
Display Limits	
Display Units	
Units For Height	
Units For Weight	
Temperature Units	
NBP Limits Type	
Arterial Limits Type	
PA Limits Type	
Menu Timeout	
NBP Silence Alarm	
Pause Breakthru	

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				

Arrhythmia Alarm Levels				
	Crisis	**Warning**	**Advisory**	**Message**
Atrial Fib (Patient Data Module only - TRAM uses Irregular. Not available for neonatal mode.)				
Irregular				

Parameter Alarm Levels				
	Crisis	**Warning**	**Advisory**	**Message**
HR				
ART				
PA				
SPO2				
NBP				
FEM				
UAC				
CVP				
RA				
UVC				
LA				
ICP				
SP				
ART Rate				
SPO2 Rate				
TMP				
RR				
Resp Apnea				
FEM Rate				
UAC Rate				

Parameter Priority Defaults

The following parameters, when monitored, always appear in parameter windows at the right side of the display.

Parameter 1	***ECG***
Parameter 2	
Parameter 3	
Parameter 4	
Parameter 5	
Parameter 6	

Circle the other parameters you want to have priority after position 6. Size of the parameter window determines how many selections you can make (3 full size, 5 reduced size, or a combination thereof). The software prevents you from selecting more parameters than allowable.

NBP	CVP[1]	SP[1]
ART	RA[1]	SPO2[1]
FEM	UVC[1]	RESP[1]
UAC	LA[1]	TEMP[1]
PA	ICP[1]	ALARMS

[1]May be displayed as reduced size (determined by software).

F Appendix F — Technical Specifications

Technical Specifications

Performance Specifications		
	Display Size	26.4 cm (10.4 in)
	Display Type	Active Matrix LCD
	Display Resolution	640 x 480
	Sweep Speed	6.25, 12.5, & 25 mm/sec. User has the ability to vary speeds of the individual traces
	Information Window	Displays non-real time information without obstructing life-critical patient information
	Display Organization	Prioritized by parameter
	Number of Traces	6
	Alarm Indication	Visual on display and integrated alarm light
		Audible with 3 different tones for 3 alarm severity levels
	Frequency Response	Limited by input response data from acquisition device
Power Specifications		
	Power Requirements	Batteries or external DC
	Power Consumption	60W with TRAM module
		19.5W with Patient Data Module
		Transport Display 15W
		Patient Data Module 4.5W
		TRAM module 45W
	DC Power Supply	AC/DC Converter
	Input	100-240 VAC, 50/60 Hz single phase
	Output	16.75 VDC, 4.0 Amps
	Batteries Quantity	2 Exchangeable Lithium Ion
	Run Time	Up to 4 hours with 2 fully charged monitor batteries
		Up to 5 hours with 2 fully charged monitor batteries and 1 fully charged PDM battery
	Charge Time	Less than 4 hours to charge both batteries
	Battery Life	500 cycles to 50% capacity
	Battery Status	Display Indicators
Operating Conditions		
	Temperature	10° to 40°C (50° to 104°F)

	Relative humidity	5% to 95% (non-condensing)
	Atmospheric pressure	425-817 mmHg (56-109 kPa)
	Power dissipation	120 Vtu/hour (maximum)
	Cooling	Passive
Storage Conditions		
	Maximum	-40° to 70°C (-40° to 158°F)
	Batteries	-20° to 60°C (-4° to 140°F)
	Relative humidity	5% to 95% (non-condensing)
Physical Specifications		
	Monitor	Height: 33.0 cm (13.0 in)
		Depth: 14.8 cm (5.8 in)
		Width: 29.3 cm (11.5 in)
		Weight: 3.8kg (8.4 lbs) with 2 batteries
	Monitor with TRAM	Height: 33.0 cm (13.0 in)
		Depth: 22.1 cm (8.7 in)
		Width: 29.3 cm (11.5 in)
		Weight: 7.2 kg (15.8 lbs) with 2 batteries
	Monitor with Patient Data Module	Height: 33.0 cm (13.0 in)
		Depth: 21.2 cm (8.3 in)
		Width: 29.3 cm (11.5 in)
		Weight: 5 kg (11 lbs) with 3 batteries
Masimo SpO2		
	Display Messages	***LOW QUALITY, PROBE IS OFF THE PATIENT, PROBE OR MODULE MALFUNCTION, PULSE SEARCH***
	Measurement Range	Saturation: 30 to 100% SpO2 Pulse Rate: 25 to 240 beats per minute Perfusion: 0.02 to 20%
	Accuracy	Displayed saturation data: Functional saturation Saturation, no motion: SpO2 over the range 70 to 100%, below 69% is unspecified +/- 2 digits for adults and pediatrics, +/- 3 digits for neonates Saturation, motion: SpO2 over the range 70 to 100%, below 69% is unspecified +/- 3 digits for adults, pediatrics, and neonates Pulse rate, no motion: 25 to 240 bpm, +/- 3 bpm Pulse rate, motion: 25 to 140 bpm, +/- 5 bpm

Alarms	User-selectable upper and lower limits for SpO2 and PPR.
Patents	This device is covered under one or more of the following U.S.A. patents: 5,758,644, 5,823,950, 6,011,986, 6,157,850, 6,263,222, 6,501,975 and other applicable patents listed at http://www.masimo.com/patents.htm.

G Appendix G – Abbreviations

Abbreviations

A

A	amps
AACN	American Association of Critical-Care Nurses
AaDO2	alveolar arterial oxygen gradient
ABG	arterial blood gas
AC	alternating current
ACCV	accelerated ventricular
ACC VENT	accelerated ventricular
ADT	adult
AFIB	Atrial Fibrillation
ANT	anterior
AO2 (aO2)	arterial oxygen saturation
AR	argon
ARR	arrhythmia
ART	arterial
ASYS	asystole
Auto, AUTO	automatic
AUX	auxiliary
a–vO2	arterial venous oxygen content difference
AVF	left foot augmented lead
AVG	average
AVL	left arm augmented lead
AVR	right arm augmented lead

B

BE	base excess
BGMY	bigeminy
BP	blood pressure
BP 1	blood pressure connector 1
BP 2	blood pressure connector 2
BP 3	blood pressure connector 3

BP 4	blood pressure connector 4
BPM	beats per minute
BRAD	bradycardia
BSA	body surface area
BT	blood temperature

C

C	Celsius
CAL	calibration
CALC	calculation
CALCS	calculations
CaO2	arterial oxygen content
CARD	cardiac
CC	computation constant
cc, CC	cubic centimeter
CCU	critical care unit
CEd	effective dynamic compliance
CH	channel
CI	cardiac index
cm, CM	centimeter
CO	carbon monoxide
CO	cardiac output
CO2	carbon dioxide
COHb	carboxyhemoglobin
COMM	communication
CP	cardiopulmonary
CPLT	couplet
CPP	cerebral perfusion pressure
CS	central station
CvO2	mixed venous oxygen content difference
CVP	central venous pressure

D

D	diastolic
DC	direct current
DDW	Direct Digital Writer
DEFIB, Defib	defibrillator
DES	desflurane
DIA	diastolic
DISCH	discharge
dyn	dyne

E

E	expired
ea–vO2	estimated arterial venous oxygen content difference
eCaO2	estimated arterial oxygen content
ECG	electrocardiograph
eCvO2	estimated mixed venous oxygen content
eg	for example
EMC	electromagnetic compatibility
EMI	electromagnetic interference
ENF	enflurane
eO2CI	estimated oxygen consumption
eO2DI	estimated oxygen delivery
eO2R	estimated oxygen extraction ratio
eQs/Qt	estimated shunt fraction
Esopho	esophageal
ESU	electrosurgical cautery unit
et al	and others
EtCO2, ETCO2	end-tidal carbon dioxide
ETO	Ethylene Oxide
EX, Exp	expired

F

F	Fahrenheit
FEM	femoral
FiO2	fraction of inspired oxygen
FR	French (catheter size)

G

g	gram
GTT/CC, gtt/cc	drops per cubic centimeter

H

HAL	halothane
Hb	hemoglobin
HbO2	oxyhemoglobin
HCO3	bicarbonate
HE	helium
Hgb	hemoglobin
HR	heart rate
HR	hour
HT	height
Hz	hertz

I

I	inspired
IABP	intra-aortic balloon pump
ICP	intracranial pressure
ICU	intensive care unit
ie	that is
IN	inspired
Inc	incorporated

INF	infusion, inferior
INIT	initialization
Inj, INJECT	injectate
Insp	inspired
IRRG	irregular
ISO	isoflurane
ISU	inlet select unit
IT	injectate temperature
IV	intravenous

K

kg, KG	kilogram
kPa	kilopascal

L

L	liter, left
LA	left arm, left atrial
LAT	lateral
LBS	pounds
LCD	liquid crystal display
LD	lead
LED	light emitting diode
LL	left leg
LVSWI	left ventricular stroke work index

M

M	mean, minute
m	meter
MAP	mean arterial pressure
MAWP	mean airway pressure
MCG	micrograms
MetHb	methemoglobin

MG	milligrams
MIN, min	minute
mL	milliliter
MM, mm	millimeters
MM/S	millimeters per second
MMHG,	
mmHg	millimeters of mercury
MRI	magnetic resonance image
MTR	motor
MUNITS	milliunits
mV	millivolt
MV	minute volume

N

N2	nitrogen
N2O	nitrous oxide
NBP	noninvasive blood pressure
NC	non-capture
NEO, Neo	neonatal
NET	network
NS	non-sense

O

O2	oxygen
O2CI	oxygen consumption index
O2DI	oxygen delivery index
O2R	oxygen extraction ratio
OR	operating room

P

PA	pulmonary artery
PaCO2	partial pressure of carbon dioxide in arterial

PAD	pulmonary artery diastolic
Pa/FiO2	oxygenation ratio
PAM	pulmonary artery mean pressure
PaO2	partial pressure of oxygen in arterial blood
PAO2	alveolar pressure
PAUS	pause
PAW	pulmonary artery wedge pressure
PBAR	barometric pressure
PCO2	partial pressure of arterial carbon dioxide
PEAKP	end inspiratory pressure
PED	pediatric
PEEP	positive end expiratory pressure
pH	hydrogen ion concentration
PIP	peak inspiratory pressure
PO2	partial pressure of arterial oxygen
PPLAT	plateau pressure
PT-RR	patient respiration rate
PULM	pulmonary
PVC	premature ventricular complex
PvO2	partial pressure of oxygen in mixed venous
PVR	pulmonary vascular resistance
PVRI	pulmonary vascular resistance index
PWR	power

Q

QA	quality assurance
QRS	interval of ventricular depolarization
Qs/Qt	shunt fraction
QTY	quantity

R

R	rate
R	right

RA	right arm
RA	right atrial
RESP	respiration
RHb	reduced hemoglobin
RHY	rhythm
RL	right leg
RM	respiratory mechanic
RMT ALM	remote alarm
RMT VID	remote video
RR	respiration rate
RTFC	artifact
RVSWI	right ventricular stroke work index

S

S	systolic
SaO2	arterial oxygen saturation
sec	second
SOL	solution
SP	special
SPEC	spectrometer
SpO2	arterial oxygen saturation from pulse oximetry
SUM	summation
SV	stroke volume
SvO2	mixed venous oxygen saturation
SVR	systemic vascular resistance
SVRI	systemic vascular resistance index
SYNC, Sync	synchronization
SYS	systolic

T

T1	temperature site 1
T2	temperature site 2
TACH	tachycardia

Temp, TEMP	temperature
TGMY	trigeminy
TIR	technical information report
TMP	temperature
TV	tidal volume

U

UAC	umbilical artery catheter
UVC	umbilical venous catheter

V

V	precordial lead
V	volt
VAC	volts AC (alternating current)
VBRADY	ventricular bradycardia
VBRD	ventricular bradycardia
VENT	ventilator
V-Fib, V-FIB	ventricular fibrillation
VID	video
VNT	ventilator
VT	ventricular tachycardia
VTAC	ventricular tachycardia
V-Tach, V-TACH	ventricular tachycardia
VOL	volume

W

WT	weight

X

X	multiplier when used with a number (2X), denotes invalid data when used in place of a value on the display

Symbols

12SL	12-lead ECG analysis
&	and
°	degree(s)
>	greater than
<	less than
–	minus
#	number
%	percent
±	plus or minus

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