



Service Guide

SureSigns VS2 Vital Signs Monitor

Release A.00

English

PHILIPS

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SureSigns VS2 **Vital Signs Monitor**

SERVICE GUIDE

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English

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Printing History

New editions of this document incorporate all material updated since the previous edition. Update packages may be issued between editions and contain replacement and additional pages to be merged by a revision date at the bottom of the page. Pages that are rearranged due to changes on a previous page are not considered revised.

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First Edition December 2008

Conventions

The manual uses the following conventions for Notes, Cautions, and Warnings.




























Note — A **Note** calls attention to an important point in the text.

















Caution	A Caution calls attention to a condition or possible situation that could damage or destroy the product or the user's work.
----------------	--

Warning	A Warning calls attention to a condition or possible situation that could cause injury to the user and/or patient.
----------------	---

Explanation of Symbols

The following symbols appear on the monitor and its packaging.

Symbol	Description	Symbol	Description
	New Patient key		Alarm Silence key
	Print key		NBP key
	System Menu key		Main Screen key
	Display Mode key		On/Standby key
	CE marking		Serial number
Rx Only	Prescription Use Only (US Federal Law)		Batch code
	Humidity		Date of manufacture
	Fragile, handle with care		Keep out of sun
	Keep dry		Keep Upright
	Catalog number		RF Interference
	Electrostatic sensitive device handling		Sterile
SpO₂	SpO ₂ connector		USB port
	Temperature connector		Charging LED
	NBP connector		AC power LED
ICES-001	Canadian ISM requirement		Option number

Symbol	Description	Symbol	Description
	Compliance with WEEE standard		Ethernet port
15V \equiv 4A 60W	Power label		CSA mark
	Caution, consult accompanying documents		Nurse call connector
	Polarity of DC power connector (appears on VS2 monitor)		Polarity of DC power connector (appears on External Power Supply)
	UL Recognized Component		VDE Verification
	PSE marking		FCC mark - USA
	Defibrillator Proof		Indoor use only
	Class II Equipment		Earth, ground
	EUFP (Environmentally-friendly use period — China)		

Regulatory and Safety Specifications

Declaration



The SureSigns VS2 vital signs monitor is a Class IIb device and complies with the requirements of the Council Directive 93/42/EEC of 14 June 1993 concerning medical devices and carry CE-marking accordingly.

Authorized EU Representative

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

Rx Only

Caution

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

Safety Standards

Parameter	Specification
UL 60601-1, CAN/CSA C22.2 No. 601.1-M90, EN/IEC 60601-1, EN/IEC 60601-1-1 (as applicable), EN/IEC60601-1-2, ISO 9919	
Protection Class	Class II, internally powered equipment, per IEC 60601-1
Degree of Protection	Type CF defibrillator-proof: per IEC 60601-1
Mode of Operation	Continuous

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1

Introduction

Monitor Overview

The SureSigns™ VS2 vital signs monitor is easy to use and versatile. The monitor is available in several configurations and with optional features to best suit your needs.



The SureSigns VS2 is a vital signs monitor that measures blood pressure, pulse rate, oxygen saturation (SpO₂), and temperature. Features include:

- Adult, pediatric, and neonatal capability
- Lithium ion battery
- Stores up to 100 patient records
- Optional recorder
- Optional roll stand or wall mount
- Optional barcode scanner for Patient ID entry
- LAN and serial data export
- Optional wireless network connection to EMR

SureSigns VS2 Monitor Configurations

The SureSigns VS2 vital signs monitor is available in the configurations shown in the following table.

Model	Measurement Parameters and Features			
	NBP	SpO ₂	Temperature	Recorder
863079	Yes	No	No	No
863080	Yes	Yes	No	No
863081	Yes	Yes	Yes	No
863082	Yes	Yes	Yes	Yes

Indications for Use

The SureSigns VS2 vital signs monitor is for use by health care professionals whenever there is a need for monitoring the physiological parameters of patients.

Intended Use

The SureSigns VS2 vital signs monitor is for monitoring, recording and alarming of multiple physiological parameters of adults, pediatrics, and neonates in healthcare environments. Additionally, the monitor is intended for use in transport situations within a healthcare facility.

Intended Audience

This guide is for biomedical engineers or technicians responsible for troubleshooting, repairing, and maintaining Philips patient monitoring systems.

Unpacking and Shipping

Overview

This chapter describes how to:

- Unpack the monitor
- Return the monitor
- Dispose of the monitor

Unpacking the Monitor

To unpack the monitor:

Step	
1	Open the shipping container and remove the monitor from the container.
2	Examine the monitor for visible damage, like broken components, cables, dents, or scratches on the surface of the equipment.
3	Store all documentation in an appropriate location
4	Save the packaging material for possible reuse.

Submitting a Damage Claim

If there is physical damage, or if an item does not meet specified operational requirements, notify the carrier and the nearest Philips Medical Systems sales/service office. Philips will arrange for immediate repair or replacement of the damaged/inoperative part.

Returning the Monitor For Service

To return the monitor for service, call the Philips Customer Care Center or your local Philips representative for a Returned Materials Authorization (RMA) number. Have all equipment serial numbers available when calling. Mark the shipping carton and any shipping documents with the RMA number.

Warning Before returning any equipment to Philips:

- **Back up the configuration** (see “Exporting Configuration Settings” on page 4-14).
 - **Clean and disinfect it** (see “Cleaning and Disinfecting” on page 3-2).
 - **Delete all patient data** (see “Clearing Patient Data” on page 4-20).
 - **Remove the battery** (see “Replacing the Battery” on page 7-2).
 - **If your monitor is equipped with a wireless assembly, remove all of the wireless components** (see the *SureSigns VS2 Wireless Installation and Setup Guide*).
-

To pack the monitor for return, disconnect all cables. It is not necessary to return accessories or the external power supply. If available, use the original carton and packing materials.

Ensure that the monitor is transported within the following specifications:

- Temperature: -20°C to +40°C (-4°F to 104°F)
- Humidity: 15% to 90%
- Atmospheric Pressure: 708 hPa to 1014 hPa

To return the monitor in the original packaging:

Step	
1	Place the monitor in the original packaging.
2	Seal the carton with packaging tape.
3	Label the carton with the shipping address, return address, and RMA number.

If the original carton is not available, use the following procedure to pack the monitor:

Step	
1	Place the monitor in a plastic bag.
2	Locate a corrugated cardboard shipping carton with at least 200 psi (pounds per square inch) bursting strength.
3	Fill the bottom of the carton with at least 2 inches of packing material.
4	Place the bagged unit on the layer of packing material and fill the box completely with packing material.
5	Seal the carton with packaging tape.
6	Label the carton with the shipping address, return address, and RMA number.

Disposing of the Monitor

To avoid contaminating or infecting personnel, the environment, or other equipment, make sure that you disinfect and decontaminate the monitor appropriately before disposing of it in accordance with your country's law for equipment containing electrical and electronic parts.

For disposal of parts and accessories, where not otherwise specified, follow local regulations regarding disposal of hospital waste.

Note — Before disposing of a SureSigns VS2 monitor, delete all patient information. To delete patient data from the monitor, see “Clearing Patient Data” on page 4-20.

Performing Routine Maintenance

Recommended Frequency

Perform the maintenance procedures at the recommended frequency shown in the following table.

Caution The frequency recommendations in the following table do not supersede local requirements. Always perform locally required testing in addition to the testing outlined here.

Maintenance Procedure	Frequency
Routine Safety and Operational Checks	
• Visual Inspection of exterior for damage	Before use
• Inspection of labels for legibility	Before use
Cleaning and Disinfecting	According to your institution's policy or between each patient
Battery	
• Charging	As needed
• Reconditioning	Every six months

Routine Safety and Operational Checks

Philips recommends that you regularly:

- Visually inspect the monitor exterior for damage.
- Inspect the monitor labels for legibility.

If the labels are not legible, contact the Philips Customer Care Center or your local Philips representative.

Philips recommends that you perform certain test and verification checks at least once a year and after each repair. For complete information on performing verification testing and checks, see Chapter 5, "Performance Verification Testing."

Cleaning and Disinfecting

To clean or disinfect your SureSigns VS2 vital signs monitor, use only the approved cleaning agents listed in this chapter.

Warning Do not use unapproved cleaning or disinfecting agents. Even small quantities of some cleaning agents will damage the monitor or external power supply.

Do not use abrasive cleaners or strong solvents such as acetone or acetone-based compounds. The warranty does not cover damage caused by using unapproved substances.

General Guidelines

Keep the monitor, cables, external power supply, and accessories free of dust and dirt. After cleaning and disinfecting, check the equipment carefully. Do not use the monitor if you see signs of deterioration or damage.

If you need to return any equipment to Philips, clean and disinfect it first.

Follow these general precautions:

- Always dilute cleaning agents according to the manufacturer's instructions or use the lowest possible concentration.
- Do not allow liquid to enter the case.
- Do not immerse any part of the equipment in liquid.
- Do not pour liquid onto the system.
- Never use abrasive material (such as steel wool or silver polish).
- Do not autoclave, steam sterilize, or ultrasonically clean the monitor or cables.
- Do not use bleach on electrical contacts or connectors.
- Do not use alcohol on the patient cables. Alcohol can cause the plastic to become brittle and fail prematurely.

Caution If you spill liquid on the exterior of the monitor or external power supply, use a clean cloth to dry them. If you believe the liquid may have gotten inside the monitor or external power supply, contact your biomedical engineer, who can verify the performance and safety of the equipment.

Cleaning and Disinfecting the Monitor

To clean the monitor:

Step	
1	Dampen a soft cloth with mild soap and water.
2	Wring any excess moisture from the cloth and gently clean the monitor.

To disinfect the monitor:

Step	
1	Dampen a soft cloth with any of the following: <ul style="list-style-type: none"> • Isopropyl alcohol (70% solution in water) • Sodium hypochlorite (chlorine bleach), 3% solution in water • Ammonium chloride solution, <0.2% solution
2	Wring any excess moisture from the cloth and wipe the monitor to disinfect it.

Cleaning and Disinfecting the Cables and External Power Supply

Caution Do not use alcohol to clean the cables. Alcohol can cause the cables to become brittle.

To clean the cables and external power supply:

Step	
1	Dampen a soft cloth with alcohol-free hand soap.
2	Wring any excess moisture from the cloth and gently clean the cables and external power supply.
3	Clean the areas again with damp cloth moistened with water only.

To disinfect the cables and external power supply:

Step	
1	Dampen a soft cloth with sodium hypochlorite (chlorine bleach), 3% solution in water. Caution: Sodium hypochlorite may discolor the cable.
2	Wring any excess moisture from the cloth and gently clean the cables.
3	Clean the areas again with damp cloth moistened with water only.

Cleaning the Barcode Scanner

To clean the scanner:

Step	
1	Disconnect the scanner from the monitor.
2	Dampen a soft cloth with water (or a mild detergent-water solution). Wring any excess moisture from the cloth.
3	Wipe the surfaces of the scanner. If a detergent solution is used, rinse the scanner with a soft cloth dampened with water only.

Reading performance may degrade if the barcode scanner's window is not clean. If the window is visibly dirty, or if the scanner isn't operating well:

Step	
1	Dampen a soft cloth or lens tissue with water (or a mild detergent-water solution). Wring any excess moisture from the cloth.
2	Clean the window. If a detergent solution is used, rinse the window with a soft cloth dampened with water only.

Caution Do not submerge the barcode scanner in water. Do not use abrasive wipes or tissues on the scanner's window — abrasive wipes may scratch the window. Never use solvents (for example, acetone, benzene, ether, or phenol-based agents) on the housing or window. Solvents may damage the finish or the window.

Maintaining the Battery

About the Battery

The rechargeable lithium ion battery used in the monitor is a *smart battery* with built-in circuitry that communicates battery status information to the monitor. Battery power lasts a minimum of four hours of continuous monitoring with no printing and one NBP measurement every 15 minutes.

Observe these guidelines:

- If a battery shows damage or signs of leakage, replace it immediately.
- **Never** use a faulty battery in the monitor.
- **Never** dispose of the battery in a normal waste container.
- **Never** leave a battery inside the monitor if it is not used for a long period of time.
- **Never** store a battery that is more than 50% charged.

Battery Status Indicators

You can check the status of the battery (level of charge) by using:

- The **Battery Status** pane
- The **Charging LED**
- Battery messages and alarms (see “Battery Messages and Alarms” on page 3-6).



Battery Status



Charging LED

The **Battery Status** pane at the bottom of the main screen indicates the remaining charge in the battery.

The color of the **Charging LED** on the front panel indicates how much charge remains on the battery:

- **Green:** The battery is at least 90% charged.
- **Flashing Green:** More than 30% charge, but less than 90%.
- **Yellow:** More than 21% charge, but less than 30%.
- **Flashing Yellow:** More than 12% charge, but less than 21% charge.
- **Off:** The monitor is in Deep Sleep, the battery has less than 12% charge, or the battery is removed.

Charging the Battery

When the monitor is connected to AC power, the battery begins charging.

When you first receive the monitor, the battery charge may be low. Connect the monitor to an AC power source before using it on battery power alone.

You can recharge the battery while the monitor is in use. If the monitor is not in use, a complete battery recharge requires less than four hours.

Reconditioning the Battery

Each time the battery is charged, its capacity decreases slightly. Therefore, the operating time the monitor can run on battery power decreases slightly with each charge cycle. Battery reconditioning recalibrates the battery to ensure that the value stored in the battery for its full capacity takes this decrease in capacity into account and allows the remaining battery charge to be calculated accurately.

Philips recommends that you condition the battery by fully discharging and recharging it every six months.

Step	
1	Press the System Menu key.
2	In the System Menu , rotate the wheel to System Admin , and then press the wheel.
3	In the window that appears, enter the Administrator password, 2-1-5 , as shown: <div> </div>
4	In the System Admin Menu , rotate the wheel to Service , and then press the wheel.

5	In the Service Menu , rotate the wheel to Diagnostics , and then press the wheel.
6	Rotate the wheel to Battery Info , and then press the wheel.
7	Unplug the monitor.
8	Rotate the wheel to Recondition , and then press the wheel. The charge percentage will decrease to 0%.
9	When the monitor shuts down, plug in the monitor and repeat Step 1 through Step 6.
10	Allow the battery to charge to 100%.
11	Repeat Step 7 and Step 8.
12	When the monitor shuts down, plug in the monitor and allow the battery to charge to 100%.

Replacing the Battery

If the monitor operates for less than one hour on a fully charged battery before the low battery alarm occurs, replace the battery. For information on replacing the battery, see Chapter 7, “Repairing the Monitor.”

Warning Dispose of used batteries in an environmentally responsible manner. Do not dispose of the battery in normal waste containers. Consult your hospital administrator to find out about local arrangements.

Battery Messages and Alarms

The condition of the battery is reported by technical alarms and error codes:

Technical Alarms

The following battery technical alarms appear in the monitor’s message area:

- Low Batt — Remaining battery power is less than 30%.
- Extreme Low Batt — Remaining battery power is less than 21%.

Error Codes

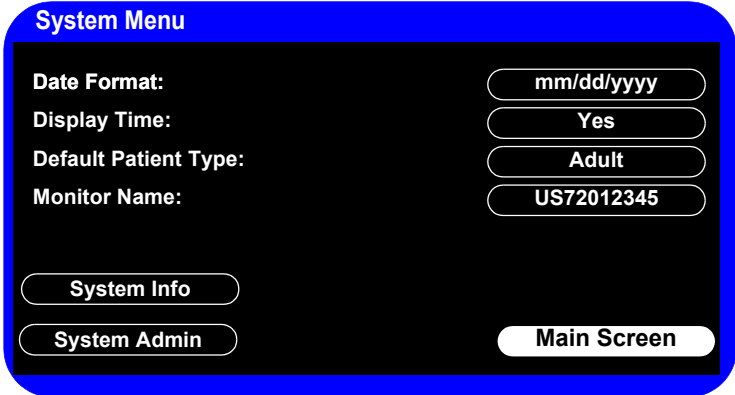
An error code (for example, “257 System Error”, indicating Battery charger power failure) appears in the monitor’s Error Log. To view the Error Log, see “Viewing and Printing the Error Log” on page 6-33. For a complete list of error codes and actions to take, see Chapter 6, “Troubleshooting.”

Configuring the Monitor

Accessing the System Menu

Use the **System Menu** to configure monitor-wide default settings and parameters.

To access the **System Admin Menu**:

Step	
1	<p>Press the System Menu key. The System Menu appears with the current settings displayed.</p> 
2	<p>To change the Date Format, Display Time, or Default Patient Type, rotate the wheel to the appropriate button, press the wheel, and then select the appropriate option.</p>
3	<p>To change the Monitor Name, rotate the wheel to the appropriate button, press the wheel, and use the keyboard that appears to enter the name. The default name is the serial number.</p>

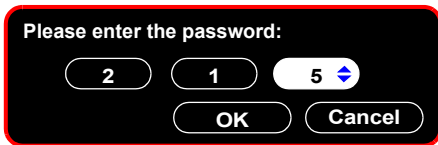
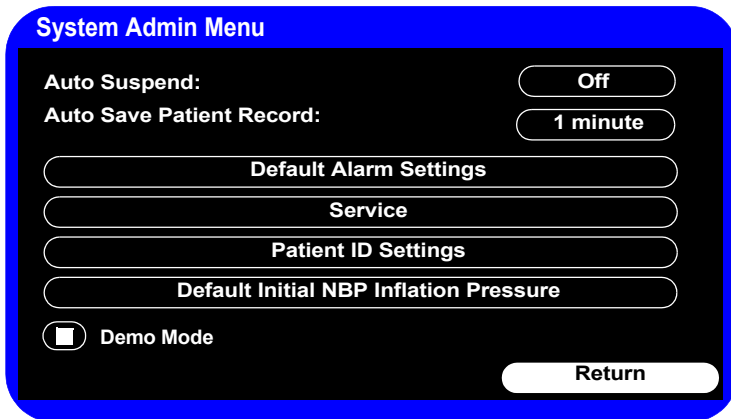
Note — For information about the **System Info** button, see “Viewing System Information” on page 6-2.

Accessing the System Admin Menu

Use the **System Admin Menu** to access the following menus and settings:

- Default Alarm Settings menu
- Service menu
- Patient ID Settings menu
- Default Initial NBP Inflation Pressure
- Auto Suspend
- Auto Save Patient Record
- Demo Mode

To access the **System Admin Menu**:

Step	
1	In the System Menu , rotate the wheel until the System Admin button is highlighted, and then press the wheel.
2	<p>In the window that appears, enter the Administrator password, 2-1-5, as shown:</p>  <p>The image shows a black rectangular box with a red border. Inside, the text 'Please enter the password:' is at the top. Below it are three buttons: '2', '1', and '5' with a small blue arrow pointing right. At the bottom are two buttons: 'OK' and 'Cancel'.</p>
3	<p>Rotate the wheel until OK is highlighted, and then press the wheel.</p> <p>The System Admin Menu appears.</p>  <p>The image shows a blue rectangular box with rounded corners. At the top, it says 'System Admin Menu'. Below are several settings: 'Auto Suspend:' with a button 'Off'; 'Auto Save Patient Record:' with a button '1 minute'; 'Default Alarm Settings' with a button; 'Service' with a button; 'Patient ID Settings' with a button; 'Default Initial NBP Inflation Pressure' with a button; and 'Demo Mode' with a checkbox. At the bottom right is a 'Return' button.</p> <hr/> <p>Caution</p> <p>During system configuration, the System Admin Menu remains unlocked for 1 minute after you close it. This allows you to open the menu again without having to re-enter the password. Do not leave the monitor unattended during this time.</p> <hr/>
4	Use the System Admin Menu to set system parameters. See the following section for available options.

System Admin Menu Options

The following table describes the buttons in the **System Admin Menu** and the default settings.

Button	Description	Default
Auto Suspend:	Specifies the time interval for the monitor to automatically enter suspend mode when the monitor is running on battery power, no measurements are ongoing, and the user does not touch the monitor. Pressing the Power key turns the monitor back on. For more detailed information, see “Setting Auto Suspend” on page 4-5.	Off
Auto Save Patient Record:	Specifies the time an open record is automatically saved and closed after it is opened, or after an NBP or Temperature measurement is completed, or after SpO ₂ reading appears in the SpO ₂ pane, whichever happens last. For SpO ₂ , when there is no open record, the auto save period starts when the record is opened. For more detailed information, see “Setting Auto Save Patient Record” on page 4-5.	1 minute
Default Alarm Settings	Allows you to configure the alarm settings to be used as defaults. For more detailed information, see “Configuring the Default Alarm Settings” on page 4-6.	Philips
Service	Allows access to the following settings: <ul style="list-style-type: none"> • Language • Diagnostics • Networking • Export Settings • Upgrade Software • Shutdown • Data Export • Import Settings For more detailed information, see “Configuring the Service Settings” on page 4-12.	Depends on country

Button	Description	Default
Patient ID Settings	<p>Specifies which type of information used to identify patients, including:</p> <ul style="list-style-type: none"> • Primary Identification • Default Location • MRN • Transaction ID • First Name • Middle Name • Last Name • Location ID • Operator ID <p>For more detailed information, see “Configuring the Patient Identification Settings” on page 4-17</p>	<p>MRN</p> <p>Blank</p> <p>Checked</p> <p>Checked</p> <p>Checked</p> <p>Checked</p> <p>Checked</p> <p>Checked</p> <p>Checked</p>
Default Initial NBP Inflation Pressure	<p>Specifies the default cuff inflation pressure for NBP.</p> <p>For more detailed information, see “Configuring the Default Initial NBP Inflation Pressure” on page 4-19.</p>	<p>Adult: 160 mmHg (21.3 kPa)</p> <p>Pediatric: 140 mmHg (18.7 kPa)</p> <p>Neonate: 100 mmHg (13.3 kPa)</p>
Demo Mode	<p>Sets the monitor in Demo Mode. Demo Mode allows the monitor to be demonstrated without actually monitoring parameters.</p> <p>For more detailed information, see “Setting Demo Mode” on page 4-20.</p>	Unchecked
Return	Returns the monitor to the System menu or previous menu.	—

Setting Auto Suspend

Use the **Auto Suspend** setting to configure the period of time after which the monitor will automatically enter suspend mode when the monitor is not in use.

To set Auto Suspend:

Step	
1	In the System Admin Menu , rotate the wheel until the Auto Suspend menu is highlighted.
2	Press the wheel and rotate it to select the from the following options: <ul style="list-style-type: none"> • Off • 5 minutes • 10 minutes • 15 minutes • 30 minutes
3	Press the wheel to save the setting.
4	Rotate the wheel until Return is highlighted, and then press the wheel.
5	Press the Main Screen key on the front panel to close the menu.

Setting Auto Save Patient Record

Use the **Auto Save Patient Record** setting to configure the period of time after which the monitor will automatically close and save the current open record.

Step	
1	In the System Admin Menu , rotate the wheel until the Auto Save Patient Record menu is highlighted.
2	Press the wheel and rotate it to select the from the following options: <ul style="list-style-type: none"> • 1 minute • 2 minutes • 3 minutes
3	Press the wheel to save the setting.
4	Rotate the wheel until Return is highlighted, and then press the wheel.
5	Press the Main Screen key on the front panel to close the menu.

Configuring the Default Alarm Settings

You can set the default alarm settings that the monitor uses rather than the factory defaults. The factory default settings are listed in “Factory Default Alarm Limits” on page 4-10.

Accessing the Default Alarm Settings Menu

To open the **Default Alarm Settings Menu**:

Step	
1	Press the System Menu key. The System Menu appears.
2	In the System Menu , rotate the wheel until the System Admin button is highlighted, and then press the wheel.
3	In the window that appears, enter the Administrator password, 2-1-5 , as shown: <div> </div>
4	Rotate the wheel until Default Alarm Settings is highlighted, and then press the wheel. The Default Alarm Settings appear: <div> </div>

The following table describes the buttons in the **Default Alarm Settings** menu and the default settings

Button	Description	Default
Alarm Tone:	Specifies the type of alarm tones that the monitor uses. See “Setting the Alarm Tone Pattern” on page 4-8.	Philips
Alarm Pause Duration:	Specifies the amount of time for which alarms do not sound when alarms are paused by the user. See “Setting the Alarm Pause Duration” on page 4-8.	120 seconds
Minimum Nurse Call Alarm Priority:	Specifies the minimum alarm level that triggers the nurse call signal. For example, if the value is set to Medium, Medium and High priority alarms will trigger the nurse call signal, but Low will not. See “Setting the Minimum Nurse Call Alarm Priority” on page 4-9.	Low
Minimum Alarm Tone Volume:	Specifies the minimum volume of the alarm tone that the monitor sounds. See “Setting the Minimum Alarm Tone Volume” on page 4-9.	3
Save Current Alarm Settings as Default	Specifies that the monitor use the current alarm settings as the default settings. See “Changing the Default Alarm Settings” on page 4-10.	—
Restore Factory Default Alarm Settings	Specifies that the monitor use the factory alarm settings as the default settings. See “Changing the Default Alarm Settings” on page 4-10.	—
Latch Physiological Alarms	Specifies that the monitor latches <i>all</i> physiological alarms. This means that they will continue to sound until you acknowledge the alarm by pressing the monitor’s Alarm Silence key. See “Latching Physiological Alarms” on page 4-11.	Unchecked
Allow Alarm Disable	Specifies whether a user is allowed to disable monitor alarms. Checking the box allows a user to disable alarms. See “Restricting Alarm and Audio Settings” on page 4-11.	Checked
Allow Audio Off	Specifies whether a user is allowed to turn off the alarm audio on the monitor. Checking the box allows a user to turn off the audio. See “Changing the Default Alarm Settings” on page 4-10.	Checked

Setting the Alarm Tone Pattern

The Alarm Tone setting controls the pattern of audible sounds during alarms.

The default setting is Philips.

To set the alarm tone:

Step	
1	In the System Admin Menu , rotate the wheel until the Default Alarm Settings button is highlighted and press the wheel.
2	Rotate the wheel until the Alarm Tone menu is highlighted.
3	Press the wheel, and then rotate it to select the default setting for alarm tone. The options are: <ul style="list-style-type: none"> • Philips • IEC
4	Press the wheel again to save the setting.
5	To return to the System Admin Menu , rotate the wheel until Return is highlighted, and then press the wheel or press the Main Screen key on the front panel to close the menu.

Setting the Alarm Pause Duration

Alarm Pause mode disables audible alarm notification for all current and future alarms for a configured time. If the user presses the **Alarm Silence** key twice in two seconds, Alarm Pause mode activates, and a banner appears displaying the message, **Audio Paused**, and counts down the remaining seconds until Alarm Pause mode ends.

When Alarm Pause mode ends, all current alarms become audible (except technical alarms), even if they were silenced before entering Alarm Pause mode. When alarms are paused, the nurse call signal does not alarm. This does not affect other alarm indication methods.

The default setting is 120 seconds.

To configure the duration for which alarms are paused during alarm pause mode:

Step	
1	In the System Admin Menu , rotate the wheel until the Default Alarm Settings button is highlighted and press the wheel.
2	Rotate the wheel until the Alarm Pause Duration menu is highlighted.
3	Press the wheel, and then rotate it to select the default setting for alarm pause duration. The options are (in seconds): 30, 60, 90, 120, 180 .
4	Press the wheel again to save the setting.
5	To return to the System Admin Menu , rotate the wheel until Return is highlighted, and then press the wheel or press the Main Screen key on the front panel to close the menu.

Setting the Minimum Nurse Call Alarm Priority

The nurse call signal is a physical connection on the monitor that can connect to a variety of external signals. For example, lights, alarm buzzers, or paging systems. When any alarm condition exists, the nurse call signal activates.

You can configure the alarm priority that triggers the nurse call signal. Pausing (or turning off) alarms, turns off the nurse call signal. The nurse call alarm priority is the minimum alarm priority level that triggers the nurse call signal. The value is *inclusive*. For example, if the value is set to medium, and then anything other than a low priority alarm triggers the nurse call signal.

The default is **Low**.

To configure the nurse call alarm priority:

Step	
1	In the System Admin Menu , rotate the wheel until the Default Alarm Settings button is highlighted.
2	Rotate the wheel until the Minimum Nurse Call Alarm Priority menu is highlighted.
3	Press the wheel, and then rotate it to select Low , Medium , or High priority.
4	Press the wheel to save the selected priority.
5	To return to the System Admin Menu , rotate the wheel until Return is highlighted, and then press the wheel or press the Main Screen key on the front panel to close the menu.

Setting the Minimum Alarm Tone Volume

You can configure the minimum volume to which the user can set the monitor.

The default setting is 3.

To set the minimum alarm tone volume:

Step	
1	In the System Admin Menu , rotate the wheel until the Default Alarm Settings button is highlighted and press the wheel.
2	Rotate the wheel until the Minimum Alarm Tone Volume menu is highlighted.
3	Press the wheel and rotate it to select the default setting for the minimum alarm tone volume that a user can set. The volume options are: 1–10 .
4	Press the wheel again to save the setting.
5	To return to the System Admin Menu , rotate the wheel until Return is highlighted, and then press the wheel or press the Main Screen key on the front panel to close the menu.

Changing the Default Alarm Settings

You can set the default alarm settings by either configuring the current monitor settings as the default or by restoring the original factory settings. “Factory Default Alarm Limits” below lists the factory alarm settings.

To change the default alarm setting:

Step	
1	In the System Admin Menu , rotate the wheel until the Default Alarm Settings button is highlighted and press the wheel.
2	Rotate the wheel until either the Save Current Alarm Settings as Default or Restore Factory Default Alarm Settings button is highlighted, and then press the wheel to save the setting.
3	In the window that appears, rotate the wheel to select Yes , and then press the wheel. The monitor uses this setting (current or factory settings) as the default alarm setting value.
4	To return to the System Admin Menu , rotate the wheel until Return is highlighted, and then press the wheel or press the Main Screen key on the front panel to close the menu.

Factory Default Alarm Limits

The following table lists the factory default alarm limits.

	Adult		Pediatric		Neonatal	
	High	Low	High	Low	High	Low
Heart Rate	120 bpm	50 bpm	160 bpm	75 bpm	200 bpm	100 bpm
NBP Diastolic	90 mmHg (12.0 kPa)	50 mmHg (6.6 kPa)	70 mmHg (9.3 kPa)	40 mmHg (5.3 kPa)	60 mmHg (8.0 kPa)	20 mmHg (2.6 kPa)
NBP MAP (Mean)	110 mmHg (14.6 kPa)	70 mmHg (8.0 kPa)	90 mmHg (12.0 kPa)	50 mmHg (6.6 kPa)	70 mmHg (9.3 kPa)	24 mmHg (3.2 kPa)
NBP Systolic	160 mmHg (21.3 kPa)	90 mmHg (12.0 kPa)	120 mmHg (16.0 kPa)	70 mmHg (9.3 kPa)	90 mmHg (12.0 kPa)	40mmHg (5.3 kPa)
SpO₂	100%	90%	100%	90%	95%	85%
Temperature	102.2°F 39°C	96.8°F 36°C	102.2°F 39°C	96.8°F 36°C	102.2°F 39°C	96.8°F 36°C

Restricting Alarm and Audio Settings

You can control whether a user can disable alarms and/or turn off the audio.

To set whether or not a user can disable alarms and audio:

Step	
1	In the System Admin Menu , rotate the wheel until the Default Alarm Settings button is highlighted and press the wheel.
2	Rotate the wheel until the Allow Alarm Disable or Allow Audio Off check box is highlighted.
3	Press the wheel to insert a check in the box to allow a user to disable alarms or turn off the audio.
4	To return to the System Admin Menu , rotate the wheel until Return is highlighted, and then press the wheel or press the Main Screen key on the front panel to close the menu.

Latching Physiological Alarms

You can set all physiological alarms to be latched alarms. Latched alarms continue to sound until they are acknowledged at the monitor by pressing the **Alarm Silence** key.

To latch all physiological alarms:

Step	
1	Open the System Admin Menu . See “Accessing the System Admin Menu” on page 4-1.
2	Rotate the wheel until the Latch Physiological Alarms check box is highlighted.
3	Press the wheel to insert a check in the box.
4	To return to the System Admin Menu , rotate the wheel until Return is highlighted, and then press the wheel or press the Main Screen key on the front panel to close the menu.

Configuring the Service Settings

Accessing the Service Menu

To open the Service Menu:

Step	
1	Press the System Menu key. The System Menu appears.
2	In the System Menu , rotate the wheel until the System Admin button is highlighted, and then press the wheel.
3	In the window that appears, enter the Administrator password, 2-1-5 , as shown: <div><div>Please enter the password:</div><div><div>2</div><div>1</div><div>5</div></div><div><div>OK</div><div>Cancel</div></div></div>
4	Rotate the wheel until Service is highlighted, and then press the wheel. The Service Menu appears: <div><div>Service Menu</div><div><div>Language:English</div><div><div>Diagnostics</div><div>Shutdown</div><div>Networking</div><div>Data Export</div><div>Export Settings</div><div>Import Settings</div><div>Upgrade Software</div><div>Return</div></div></div></div>

The following table describes the options in the **Service Menu** and the default settings.

Button	Description	Default
Language:	Specifies which language the monitor displays. Changing the language setting opens a confirmation window; pressing OK reboots the monitor. For instructions for setting the language, see “Selecting a Language” on page 4-14.	Depends on country
Diagnostics	Displays the System Diagnostics menu. Monitoring is suspended while this menu is open. The Diagnostics button is unavailable when the monitor is running in Demo mode. For more information about using the System Diagnostics menu, see Chapter 5, “Performance Verification Testing” and “System Admin Menu Options” on page 4-3.	—
Networking	Displays the Network Configuration menu. Use this menu to set up how the monitor connects to a network. For more information about using the monitor on a network or exporting data, see the <i>SureSigns VS2 Data Export Guide</i> .	—
Export Settings	Exports monitor configuration settings to a USB flash drive. See “Exporting Configuration Settings” on page 4-14.	—
Upgrade Software	Displays the confirmation window for upgrading the monitor software. See “Upgrading the Software” on page 4-15.	—
Shutdown	Shuts down the monitor (for battery change) after you press OK in the confirmation window. For more information, see “Performing a Hard Shutdown” on page 7-2.	—
Data Export	Displays the Data Export window. Use this menu to set up where the monitor exports data. For more information about using the monitor on a network or exporting data, see the <i>SureSigns VS2 Data Export Guide</i> .	—
Import Settings	Imports monitor configuration settings from a USB flash drive. See “Importing Configuration Settings” on page 4-17.	—

Selecting a Language

You can configure a variety of languages on the monitor. The default language is English.

To change the language:

Step	
1	In the Service Menu , rotate the wheel until the Language menu is highlighted, and then press the wheel. (To access the Service Menu, see “Accessing the Service Menu” on page 4-12.)
2	Rotate the wheel to select the language in which you want to use the monitor from the following options: <ul style="list-style-type: none"> • English • Spanish • German • French • Italian • Dutch • Portuguese • Russian
3	Press the wheel again to save the setting. A window appears warning that to change the language, the system must restart.
4	In the window, rotate the wheel to Yes , and then press the wheel to change the language and restart the system.

Exporting Configuration Settings

Use **Export Settings** to transfer the user settings, using a USB flash drive, from one monitor to other monitors with the same hardware configuration and same software version.

The following data are exported:

- All system settings, except: Maintenance settings in the **Diagnostics** section, **Monitor Name**, **Static IP address**, **Static Subnet address**, and **Static Gateway address**
- All settings in the menus
- All settings (except alarm limits, alarm enables and Initial NBP Inflation Pressure for the current patient) in all number pane menus
- User default settings of the alarm limits and alarm enables
- Error log database
- Patient record database
- Patient list database

For information about importing the exported settings into another monitor, see “Importing Configuration Settings” on page 4-17.

To export settings to a USB flash drive:

Step	
1	Insert a USB flash drive into the USB port.
2	<p>In the Service Menu, rotate the wheel until the Export Settings is highlighted, and then press the wheel. (To access the Service Menu, see “Accessing the Service Menu” on page 4-12.)</p> <p>A message appears displaying the name of the exported file in the format:</p> <p><product name>_<hardware configuration>_<software version>.cfg</p>
3	Press the wheel to select OK and return to the Service Menu .

Upgrading the Software

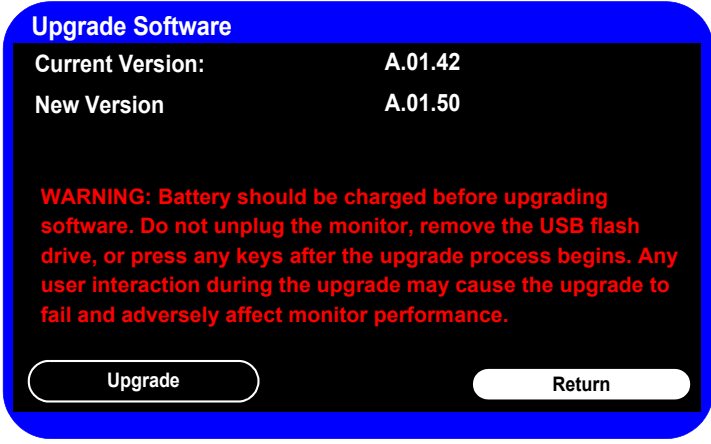
Caution Charge the battery before upgrading the software. The monitor should not be connected to a patient when the upgrade is performed. Disconnect any USB peripherals. If the USB port has a clamp in place, you may need to remove the clamp to ensure that the flash drive fits properly. Once the upgrade starts:

- Do not unplug the monitor.
- Do not remove the USB flash drive.
- Do not press any keys.

User interaction during the upgrade can cause the upgrade to fail.

To upgrade the software:

Step	
1	Connect the monitor to AC power and turn on the monitor.
2	<p>Insert the USB flash drive with the software upgrade into the USB port on the back of the monitor.</p> <p>Note — Philips recommends using a SanDisk® or Kingston® USB flash drive for software upgrades.</p>

3	<p>In the System Admin Menu, rotate the wheel to highlight the Upgrade Software button, and then press the wheel.</p> <p>The monitor looks for a valid software image on the USB flash drive and displays the updated image information in the Upgrade Software window.</p> 
4	<p>Rotate the wheel to highlight the Upgrade button and press the wheel to start the upgrade.</p> <hr/> <p>Caution If a loss of power interrupts the upgrade progress, the monitor cannot boot. If this happens, contact the Customer Care Center or a Philips representative.</p> <hr/> <p>The system saves the data and the upgrade process begins. Progress information indicates the current status of the upgrade.</p> <p>After the software upgrade, the monitor restarts.</p>
5	<p>Remove the USB flash drive.</p>

Importing Configuration Settings

Use Import Settings to import user settings from a USB flash drive containing settings from a monitor with the same hardware configuration and same software version.

The monitor restarts after importing.

To import settings:

Step	
1	Insert a USB flash drive containing exported settings into the USB port. For more information about exporting settings, see “Exporting Configuration Settings” on page 4-14.
2	In the Service Menu , rotate the wheel until the Import Settings is highlighted, and then press the wheel. A message appears asking you to confirm the file to import.
3	Rotate the wheel to highlight Yes and then press the wheel. When the import is complete, the message, The system will restart now. , appears.
4	Press the wheel to select OK and restart the monitor.

Configuring the Patient Identification Settings

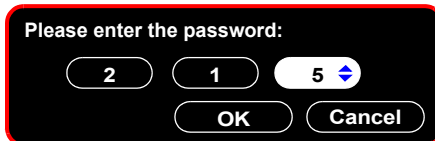
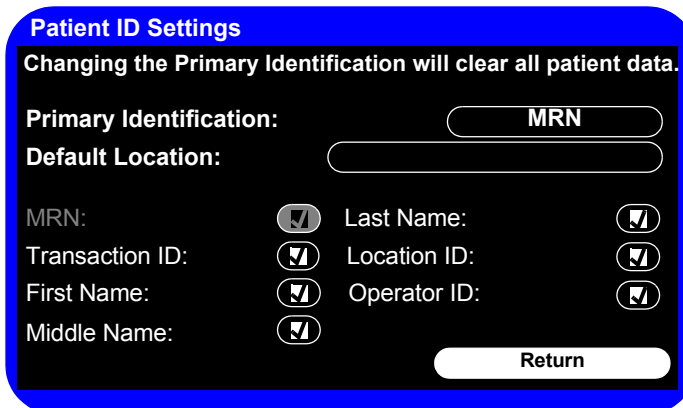
Changing the Patient ID Settings

Use **Patient ID Settings** to select the identification fields to be used in the **New Patient Menu** and assign one field as the patient primary identification. After the primary identification is selected, the corresponding checkbox cannot be selected.

Caution When you change the patient primary identification, the patient record database is cleared.

To access the **Patient ID Settings**:

Step	
1	Press the System Menu key. The System Menu appears.
2	In the System Menu , rotate the wheel until the System Admin button is highlighted, and then press the wheel.

3	<p>In the window that appears, enter the Administrator password, 2-1-5, as shown:</p> 
4	<p>Rotate the wheel until Patient ID Settings is highlighted, and then press the wheel. The Patient ID Settings appear:</p> 
5	Configure the settings as needed for your institution.

The following table describes the **Patient ID Settings**.

Button	Description
Primary Identification:	Specifies which type of identifying information, MRN , Transaction ID , or Location ID , is the default primary patient identification used in the New Patient Menu .
Default Location:	The physical location of the monitor that will be automatically entered with each new patient in the New Patient Menu .
MRN:	Medical Record Number. A unique number used to track and identify a patient. The maximum length is 20 characters.
Transaction ID:	Also known as the visit ID, the transaction ID is a unique number used to track a single patient visit. The maximum length is 20 characters.
First Name:	Patient's first name. The maximum length is 15 characters.
Middle Name:	Patient's middle name. The maximum length is 15 characters.
Last Name:	Patient's last name. The maximum length is 15 characters.
Location ID:	Typically, a description of the physical location of the VS2 monitor, for example, a room number. The maximum length is 15 characters.
Operator ID:	The identification of the person using the VS2 to measure a patient's vital signs. The maximum length is 15 characters.

Configuring the Default Initial NBP Inflation Pressure

You can specify the initial NBP inflation pressure value for Adult, Pediatric, and Neonatal patients. The monitor uses this default value for new patient starts.

The default is:

- Adult: 160 mmHg (21.3 kPa)
- Pediatric: 140 mmHg (18.7 kPa)
- Neonatal: 100 mmHg (13.3 kPa)

To change the NBP and alarm setting values:

Step	
1	In the System Admin Menu , rotate the wheel until the Default Initial NBP Inflation Pressure menu is highlighted.
2	For each patient type, press the wheel and rotate it to select the initial NBP cuff inflation pressure. The options are: <ul style="list-style-type: none"> • Adult: 80–240 mmHg in 20 mmHg steps (10.7–31.9 kPa in 2.7 kPa steps) • Pediatric: 80–240 mmHg in 20 mmHg steps (10.7–31.9 kPa in 2.7 kPa steps) • Neonate: 60–120 mmHg in 20 mmHg steps (8.0–16.0 kPa in 2.7 kPa steps)
3	Press the wheel to save the settings.
4	Rotate the wheel until Return is highlighted, and then press the wheel.
5	Press the Main Screen key on the front panel to close the menu.

Setting Demo Mode


Warning Do not connect a patient to the monitor running in Demo mode. Values represented in Demo mode do not represent measurements from a patient connected to the monitor, and may lead to incorrect diagnoses.

Demo mode lets you demonstrate the monitor without monitoring parameters. Demo mode simulates all the low-level data source components, including NBP. Demo mode generates alarms when alarm settings are exceeded.

The default is regular user mode.

Entering or exiting demo mode clears the patient data.

To set the monitor to Demo mode:

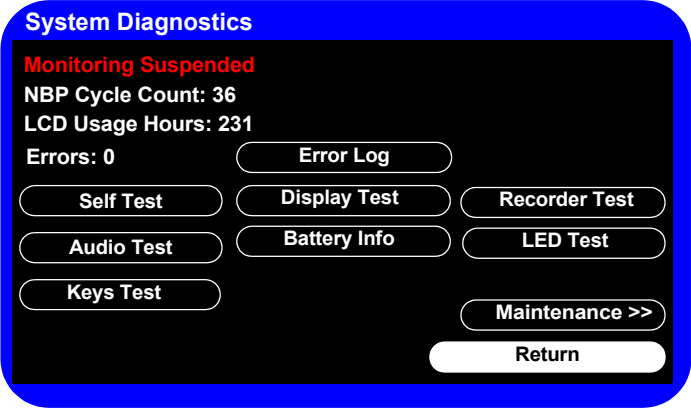
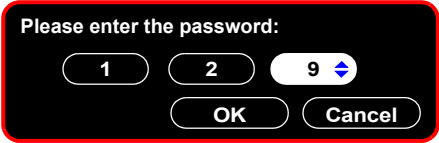
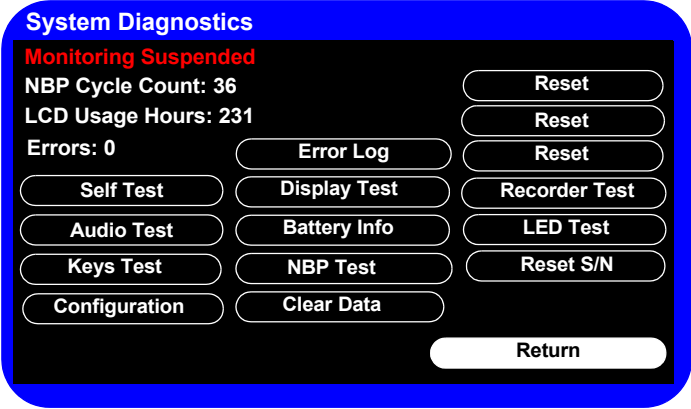
Step	
1	In the System Admin Menu , rotate the wheel until the Demo Mode check box is highlighted and press the wheel to insert a check in the Demo Mode box.
2	Rotate the wheel to highlight Return and press the wheel to select it. A window appears asking if you want to enter demo mode and clear all patient data.
3	In the window, rotate the wheel to Yes , and press the wheel again to select it.
4	Rotate the wheel to highlight Main Screen and press the wheel to select it. Demo mode activates, and a DEMO banner appears in the message area. 
5	To exit Demo Mode , press the Power key to turn the monitor off. The monitor clears all patient data.

Clearing Patient Data

Resetting the system clears all of memory and patient data, except for calibration and hardware configuration data. When you reconfigure a system, you should reset the system first.

To reset the system data:

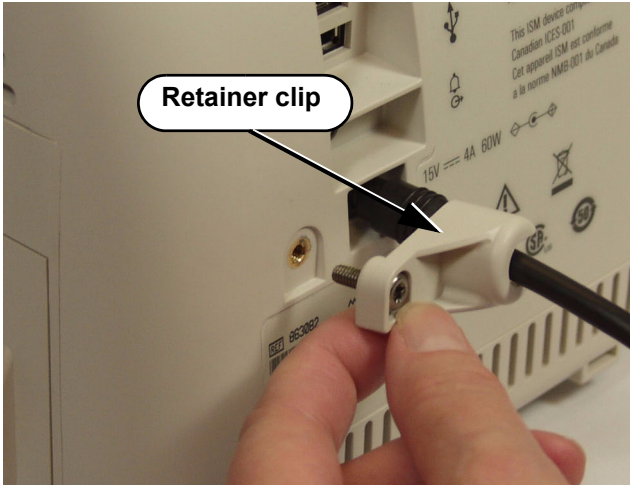

Step	
1	In the System Admin Menu , rotate the wheel until the Service button is highlighted and then press the wheel. The Service Menu appears.

2	<p>Rotate the wheel until the Diagnostics button is highlighted and then press the wheel. The System Diagnostics menu appears.</p>  <p>The System Diagnostics menu is displayed with a blue border. It shows 'Monitoring Suspended' in red, followed by 'NBP Cycle Count: 36' and 'LCD Usage Hours: 231'. Below this, 'Errors: 0' is shown. A grid of buttons includes 'Error Log', 'Self Test', 'Display Test', 'Recorder Test', 'Audio Test', 'Battery Info', 'LED Test', 'Keys Test', and 'Maintenance >>'. A 'Return' button is at the bottom right.</p>
3	<p>Select the Maintenance >> button and press the wheel.</p>
4	<p>In the window that appears, enter the password, 1-2-9, as shown:</p>  <p>The password entry screen has a red border. It says 'Please enter the password:' and shows three input fields with the numbers 1, 2, and 9. Below the fields are 'OK' and 'Cancel' buttons.</p> <p>The Maintenance options appear.</p>  <p>The System Diagnostics menu is shown again, but with additional buttons: 'Reset' (three times), 'Recorder Test', 'LED Test', 'Reset S/N', 'NBP Test', 'Clear Data', and 'Configuration'. The 'Return' button remains at the bottom right.</p>
5	<p>Rotate the wheel to highlight the Clear Data button, and then press the wheel.</p>
6	<p>In the window that appears, rotate the wheel to select Yes, and press the wheel. The monitor restarts, clears all data, and resets the system.</p>

Installing the Power Cord Retainer Clip

Warning Secure the external power supply cable to the roll stand or wall mount to prevent patient entanglement or strangulation.

To install the power cord retainer clip:

Step	
1	Insert the power cable into the monitor.
2	Slide the retainer clip over the power cord. <div></div>
3	Secure the retainer clip to the monitor with the T20 Torx screw. <div></div>

Installing the USB Hub

Warning To ensure patient electrical isolation, connect only to other equipment that provides patient electrical isolation. Use only unshielded network cables.

A USB hub enables you to use the RS-232 serial interface adapter (see “Installing the RS-232 Serial Interface Adapter” on page 4-24) and a barcode scanner on the monitor at the same time.

Step	
1	Shut down the monitor as described in “Performing a Hard Shutdown” on page 7-2.
2	Remove the backing from the mounting stickers on the hub.
3	Place the hub on the back of the monitor and connect the hub USB cable to the monitor USB port. <div> </div>
4	Connect the RS-232 serial interface adapter cable to one of the hub USB ports and the barcode scanner cable to another of the hub USB ports. <div> <p>Caution Do not allow liquid to penetrate connectors or openings on the hub. Wet connectors could prevent connected devices from operating. If liquid spills on the hub, clean and dry it thoroughly before reuse. If you believe the liquid may have gotten inside the hub, contact your biomedical engineer, who can verify the performance and safety of the equipment.</p> </div>

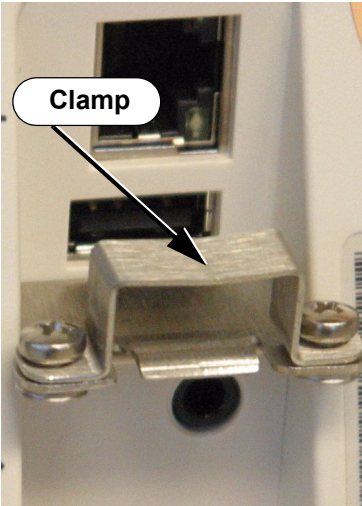
Installing the RS-232 Serial Interface Adapter

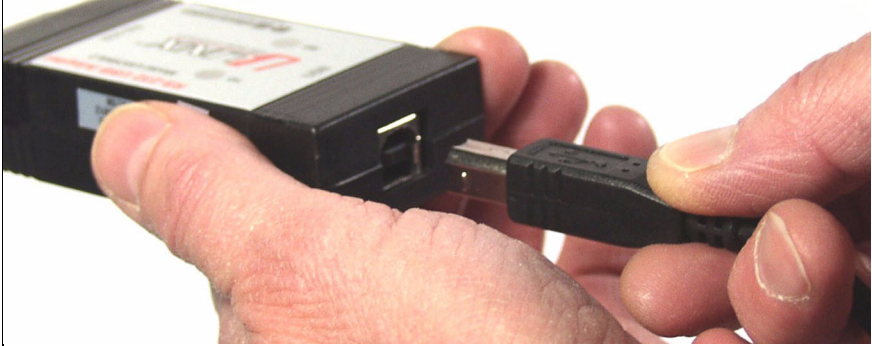

You can use an optional USB/RS-232 serial interface adapter to export patient data. For more information, see the *SureSigns VS2 Data Export Guide*.

Warning To ensure patient electrical isolation, connect only to other equipment that provides patient electrical isolation. Use only unshielded network cables.

Note — If you are also using a barcode scanner on the monitor, install the USB hub first. See “Installing the USB Hub” on page 4-23.

To install the RS-232 serial adapter:

Step	
1	Shut down the monitor as described in “Performing a Hard Shutdown” on page 7-2.
2	Clean the site where the USB clamp attaches to the monitor. This ensures that the clamp attaches securely. For cleaning instructions, see the instructions on “Cleaning and Disinfecting the Monitor” on page 3-2.
3	Peel the paper from the foam pad on the USB clamp and attach the clamp to the rear of the monitor. <div></div>
4	Slide the adapter’s USB plug through the clamp and into the port.
5	Tighten the screws on the USB clamp with a #1 Phillips-head screwdriver.

Step	
6	<p>Insert the other end of the USB cord into the adapter.</p> 
7	<p>Slide the insulator sheath over the adapter, wide end first, and push it down to completely cover the adapter.</p> 
8	<p>Attach the adapter to the RS-232 serial port of the export device.</p> <hr/> <p>Caution Do not allow liquid to penetrate connectors or openings on the adapter. Wet connectors could prevent connected devices from operating. If liquid spills on the adapter, clean and dry it thoroughly before reuse. If you believe the liquid may have gotten inside the adapter, contact your biomedical engineer, who can verify the performance and safety of the equipment.</p> <hr/>

Removing the Insulator Sheath

To remove the adapter insulator sheath:

- Pull apart the wide side of the sheath with your fingers and push on the adapter metal connector with your thumbs to slide the adapter out of the sheath.



Performance Verification Testing

Overview

This chapter includes the following information:

- Testing and inspection guidelines
- Recommended frequency of performance test
- Test procedures following monitor repair or during routine maintenance

If the monitor fails any test, it must be repaired before it is returned to use.

Note — The procedures in this chapter assume knowledge of basic monitor operation. For details on using the monitor, see the *SureSigns VS2 Vital Signs Monitor Instructions for Use*.

Testing and Inspection Guidelines

The following table lists the tests that Philips requires that you complete after performing monitor installations, repairs, or software upgrades.

See Chapter 3, “Performing Routine Maintenance,” for information on routine maintenance.

See Chapter 7, “Repairing the Monitor,” for information on repair procedures.

After ...	Complete These Tests ...
Installing or exchanging a monitor	<ul style="list-style-type: none"> • Visual inspection • Power-on
Upgrading the software	<ul style="list-style-type: none"> • Visual inspection • Power-on
Opening the monitor for any reason	<ul style="list-style-type: none"> • Power-on • Pneumatic leakage • All safety tests
Replacing any internal parts (except NBP parts, SpO ₂ board)	<ul style="list-style-type: none"> • Power-on • Pneumatic leakage • All safety tests
Replacing the NBP module or parts	<ul style="list-style-type: none"> • Power-on • NBP test • Pneumatic leakage • All safety tests
Replacing the SpO ₂ board	<ul style="list-style-type: none"> • Power-on • SpO₂ Test • Pneumatic leakage • All safety tests

Recommended Frequency

Perform the test procedures at the recommended frequency outlined in the following table.

Caution The frequency recommendations in the following table do not supersede local requirements. Always perform locally required testing in addition to the testing outlined in the table.

Suggested Testing	Frequency
Preventive Maintenance	
NBP calibration	Once every two years, or more often if specified by local laws.
Performance	
<ul style="list-style-type: none"> • Temperature accuracy • NBP accuracy test • SpO₂ • Nurse call relay¹ 	Once every two years, or if you suspect the measurement is incorrect.
Safety —Patient leakage current In accordance with IEC 60601-1	Once a year and after repairs where the unit has been opened (front and back separated) or the monitor has been damaged by impact.

1. When used as part of facility protocols

Required Test Equipment

The following table lists the additional test equipment that you need to perform each of the tests in this chapter. Many of these tests also use the standard accessories that are shipped with the monitor.

To Perform This Test ...	You Need This Test Equipment ...
“Visual Test” on page 5-6	None
“Power-On Self Test” on page 5-7	None
“Alarms Test” on page 5-7	NBP cuff
“SpO ₂ Test” on page 5-8	Adult SpO ₂ sensor
“NBP Test” on page 5-9	<ul style="list-style-type: none"> • Reference manometer (includes hand pump and valve), accuracy 0.2% of reading • Expansion chamber (volume 500 ml ± 10%) • Appropriate tubing
“Temperature Test” on page 5-13	SureSigns temperature calibration key (part number 4535 640 33691)
“Safety Test” on page 5-14	Multimeter

To Perform This Test ...	You Need This Test Equipment ...
“Nurse Call Relay Test” on page 5-15	<ul style="list-style-type: none"> • Patient simulator • Ohmmeter • Phono connector
“Barcode Scanner Test” on page 5-19	Barcode scanner

Test Recording

Authorized Philips personnel report test results back to Philips to add to the product development database. Hospital personnel, however, do not need to report results.

The following table describes what to record on the service record after you complete the tests in this chapter.

Note: P = pass, F = fail, X = measured value as defined in tests in this chapter

Test	What to record
Visual	V:P or V:F
Power-On	PO:P or PO:F
NBP	NBP:P/X1/X2/X3 or NBP:F/X1/X2/X3
Safety	S(3): P/X1 or S(3): F/X1

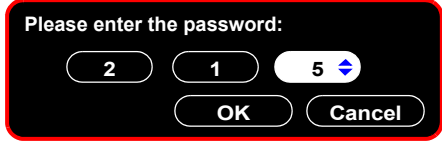
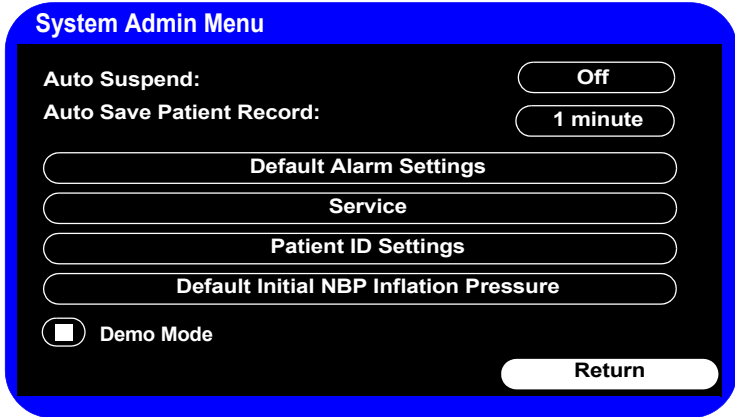
Performing Verification Tests

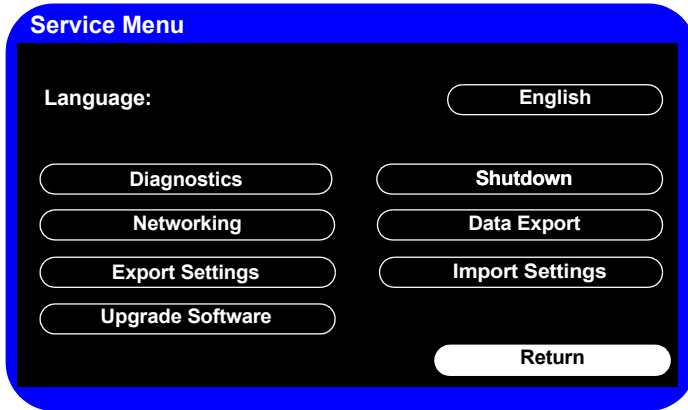
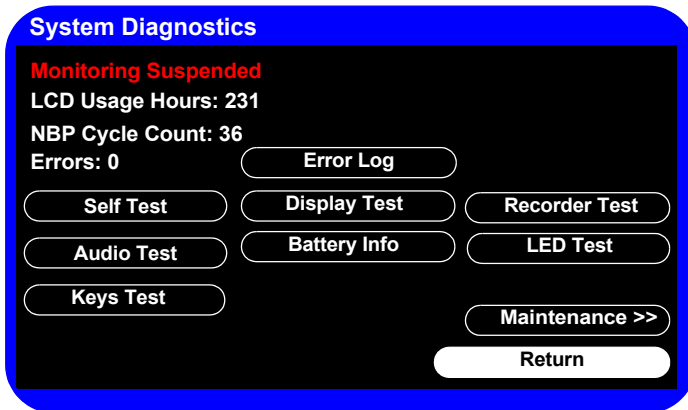
Some of the verification tests require using the **Diagnostics** menu or the **Maintenance** options. When you enter the Diagnostics menu, monitoring is suspended.

Note — The **System Diagnostics** menu is not available in Demo mode.


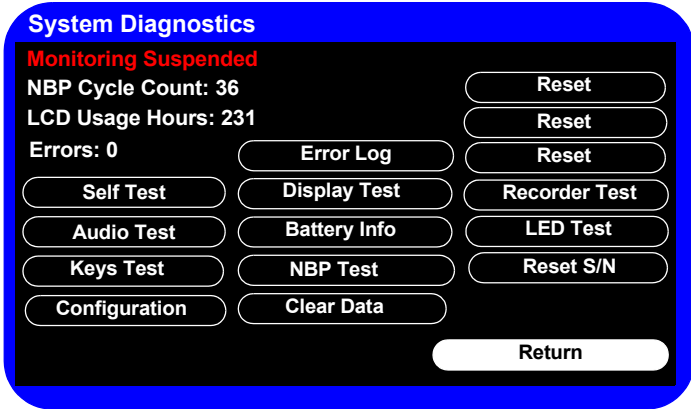
To access the **System Diagnostics** menu:

Step	
1	Press the System Menu key. The System Menu appears.
2	Rotate the wheel until the System Admin button is highlighted, and then press the wheel.

3	<p>In the window that appears, enter the Administrator password, 2-1-5, as shown:</p> 
4	<p>Rotate the wheel until OK is highlighted, and then press the wheel.</p> <p>The System Admin Menu appears.</p> 

5	<p>Rotate the wheel until Service is highlighted, and then press the wheel.</p> <p>The Service Menu appears.</p> 
6	<p>Rotate the wheel until Diagnostics is highlighted, and then press the wheel.</p> <p>The System Diagnostics window appears.</p> 

To access the **Maintenance** options:

Step	
1	In the System Diagnostics window, rotate the wheel to highlight the Maintenance >> button and press the wheel.
2	<p>In the window that appears, enter the password, 1-2-9, as shown:</p> 
3	<p>The Maintenance options appear.</p> 

Visual Test

To perform the visual test:

Step	
1	Inspect the system for obvious signs of damage. For example: cracks, cuts, or breakage.
2	Check all external cables and accessories for damage. For example: cuts, kinks, or wrong connections.
3	Ensure that all markings and labeling are legible.
4	<p>Check for any obstructions to mechanical parts.</p> <p>The expected test result is that the system has no obvious signs of damage or obstruction.</p>

Power-On Self Test

To perform the power-on self test:

Step	
1	Connect the monitor to the external power supply and plug the power supply cord into an AC power source.
2	Press the Power key to turn on the monitor.
3	<p>Make sure that the monitor boots up successfully as described in the following sequence:</p> <ul style="list-style-type: none"> • The screen displays color bars for about five seconds. • The LCD turns off for three seconds, and the battery LED lights. • The Philips screen appears for one second, and a startup tone sounds. • The main screen appears. <p>The expected result is that the monitor boots up and displays the main (or appropriate) screen. For detailed information on the boot and power sequences, see “Boot and Power Sequences” on page 6-4.</p> <p>If the LEDs do not function as expected, see “Power Problems” on page 6-6.</p>

Alarms Test

To perform this test, you need an NBP cuff and hose.

To verify that the general monitor alarms are working, test them while using the NBP monitoring function.

To test the monitor alarm:

Step	
1	With the monitor turned on, make sure that all alarms are enabled (the monitor is not in Audio Pause or Audio Off mode).
2	Make sure the NBP alarm is enabled (the crossed bell icon does not appear in the NBP numeric pane).
3	Connect the NBP hose to the NBP input connector, but do not place the cuff on your arm.
4	Press the NBP button on the front panel.
5	Check that the NBP Timeout or NBP Loose Cuff message appears and an alarm tone sounds.
6	If you do not get the results in Step 5, see Chapter 6, “Troubleshooting”.

SpO₂ Test

This test checks the performance of the SpO₂ measurement.

To perform this test, you need:

- Adult SpO₂ transducer: M1191A, M1191AL, M1191B, M1191BL, or M1196A

To perform the SpO₂ Test:

Step	
1	Connect an adult SpO ₂ transducer that you know to be working correctly to the SpO ₂ connector on the monitor. Ensure that the red LED in the transducer is lit.
2	Connect the other end of the transducer to your finger (this assumes that you are healthy).
3	Verify that the SpO ₂ value displayed on the monitor is between 95% and 100%. If it is not, try the test again with a patient simulator.
4	If you still do not get the expected results, see “SpO ₂ Measurement Problems” on page 6-11

SpO₂ sensor accuracy was obtained by performing controlled hypoxie studies on healthy, non-smoking adult volunteers (according to EN ISO 9919). The SpO₂ readings have been compared to CO-oximeter measurements on arterial blood samples. To represent the general population, data from at least 10 subjects (male and female) with a wide range of skin color was taken to validate SpO₂ accuracy. Because pulse oximeter equipment measurements are statistically distributed, only approximately two-thirds of pulse oximeter equipment measurements can be expected to fall within the \pm Arms value measured by a CO-oximeter.

The update rate for the SpO₂ value and pulse rate is typically 1 second. Data averaging and other signal processing on the displayed and transmitted data values of SpO₂ and pulse rate is controllable by the user-selectable SpO₂ Response Mode: Slow (20 seconds), Normal (10 seconds), and Fast (5 seconds). Depending on the magnitude of difference between the alarm limit and the displayed value, the alarm signal generation delay may be from 1 second to the value of the response time (5, 10, or 20 seconds).

Caution

A functional tester cannot be used to assess the accuracy of a pulse oximeter monitor. However, if there is independent demonstration that a particular calibration curve is accurate for the combination of a pulse oximeter monitor and a pulse oximeter sensor, then a functional tester can measure the contribution of a monitor to the total error of a monitor/sensor system. The functional tester can then measure how accurately a particular pulse oximeter monitor is reproducing that calibration curve.

NBP Test

These tests check the performance of the non-invasive blood pressure measurement. Perform each of these NBP checks and procedures when checking the NBP unit:

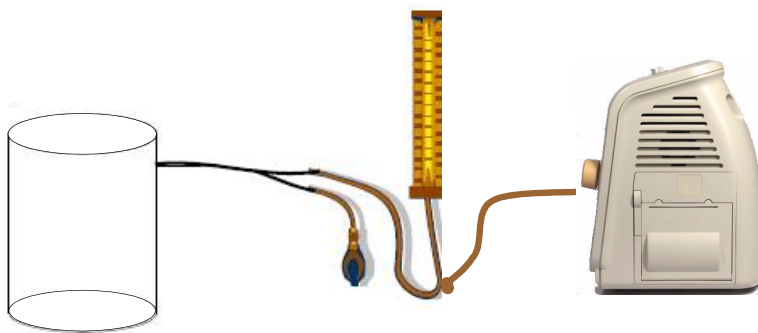
- NBP accuracy
- NBP calibration procedure (if required)
- NBP pneumatic leakage
- NBP overpressure valve

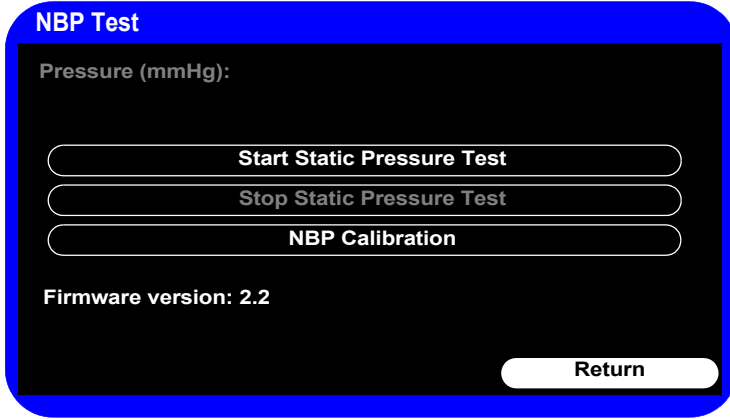
To perform this test, you need:

- Reference manometer (includes hand pump and valve), accuracy 0.2% of reading
- Expansion chamber (volume 500 ml \pm 10%)
- Appropriate tubing

NBP Accuracy

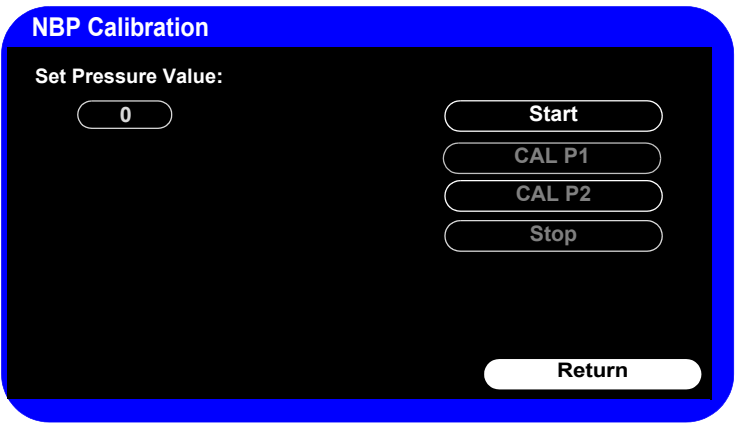
To test the NBP accuracy:

Step	
1	Connect the manometer and the pump with tubing to the NBP connector on the SureSigns VS2 monitor.
2	<p>Connect the tubing to the expansion chamber (500 ml cylinder).</p>  <p style="text-align: center;"> Expansion chamber Manometer SureSigns VS2 monitor </p>
3	Connect the manometer and the pump with tubing to the NBP connector on the SureSigns VS2 monitor.
4	Open the Maintenance options (see “Performing Verification Tests” on page 5-3 for information on accessing the Maintenance options).

5	<p>Turn the wheel to highlight NBP Test, and then press the wheel.</p> <p>The NBP Test window appears.</p> 
6	<p>Rotate the wheel to highlight the Start Static Pressure Test button and press the wheel to start the test.</p>
7	<p>Squeeze the manometer pump and apply a pressure of 50 mmHg.</p>
8	<p>Note the pressure displayed in the NBP Test window and record this result as X1 (see “Test Recording” on page 5-3). It should be 50 mmHg \pm 3 mmHg.</p>
9	<p>Squeeze the manometer pump to apply a pressure of 250 mmHg to the monitor.</p>
10	<p>Note the pressure displayed in the NBP Test window and record this result as X2. The pressure in the NBP Test window should be 250 mmHg \pm 3 mmHg.</p>
11	<p>Press the Stop Static Pressure Test button to stop the test.</p>
12	<p>If you do not get the expected results, calibrate the monitor (see “NBP Calibration Procedure” on page 5-11).</p> <p>If the results are as expected, continue with the “Pneumatic Leakage Test” on page 5-12.</p>

NBP Calibration Procedure

To calibrate the NBP module:

Step	
1	<p>In the NBP Test window, rotate the wheel to select NBP Calibration, and then press the wheel.</p> <p>The NBP Calibration window appears.</p> 
2	<p>Rotate the wheel to highlight the Start button, and then press the wheel to begin calibration.</p> <p>Note — <i>To stop the calibration process at any time, rotate the wheel to select Stop, and then press the wheel to stop calibration.</i></p>
3	Squeeze the manometer pump to apply a pressure of 250 mmHg to the monitor.
4	In the NBP Calibration window, rotate the wheel to the Set Pressure Value: menu and press the wheel. Rotate it to 250, and then press the wheel to save the value.
5	Rotate the wheel to CAL P1 , and then press the wheel to save this as the first calibration point.
6	Release the pressure in the manometer to 50 mmHg.
7	In the NBP Pressure window, rotate the wheel to the Set Pressure Value menu, and then press the wheel and rotate it to 50, and press the wheel to save the setting.
8	Rotate the wheel to select CAL P2 , and press the wheel to save this as the second calibration point.
9	<p>Rotate the wheel to highlight the Stop button and press the wheel to stop the test.</p> <p>The message, NBP calibration successful, appears.</p>
10	Rotate the wheel to the Return button and press the wheel to exit the test.
11	To verify calibration, repeat the NBP Accuracy Test in “NBP Accuracy” on page 5-9.
12	If you do not get the expected results after several attempts, see “NBP Problems” on page 6-9.

Pneumatic Leakage Test

To check the pneumatic system and valve:

Step	
1	In the System Diagnostics menu, select NBP Test .
2	Rotate the wheel to highlight the Start Static Pressure Test button and press the wheel to start the test.
3	Squeeze the manometer pump to apply a pressure of 250 mmHg to the monitor and record the value displayed as P1 .
4	Let the manometer pressure stabilize for 15 seconds.
5	Watch the pressure value in the NBP Test window for 60 seconds, and record this value as P2 .
6	Calculate and document the leakage test value X3 (where X3 = P1 - P2). The leakage test value should be less than or equal to 6 mmHg.
7	If the leakage test value exceeds 6 mmHg, check the test setup cuff and tubing, and then test again. If the test still fails, check the pneumatic tubing inside the monitor.
8	If you cannot eliminate the leak, see “NBP Problems” on page 6-9.

NBP Overpressure Valve Test

To check the overpressure operation of the NBP valves:

Step	
1	When performing the static pressure test (see “NBP Accuracy” on page 5-9), squeeze the manometer pump to apply a pressure of 290 mmHg to the monitor.
2	Verify that the valves open, releasing pressure on the manometer. The monitor displays an NBP Overpressure message.
3	If you do not get the expected results, see “NBP Problems” on page 6-9.

Temperature Test

This test uses a fixed temperature value to check the performance of the temperature measurement on the SureSigns VS2 monitor.

To perform this test, you need:

- SureSigns temperature probe
- SureSigns temperature calibration key (part # 4535 640 33691)

To test the performance of the predictive temperature measurement:

Step	
1	Connect the temperature probe to the monitor.
2	Place the monitor in Monitored mode using the Temperature menu.
3	Remove the temperature probe and the probe well and disconnect the temperature probe connector from the monitor. Note — <i>A temperature probe error may be generated and an alarm may sound.</i>
4	Connect the SureSigns temperature calibration key to the temperature module.
5	Replace the temperature probe and the probe well. Note — <i>If temperature probe error was generated, the alarm stops.</i>
6	Remove the temperature probe from the probe well.
7	Wait for the monitor to display the static temperature value.
8	Check that the displayed temperature reads $36.3 \pm 0.1^{\circ}\text{C}$ ($97.3 \pm 0.2^{\circ}\text{F}$).
9	If the value is not within tolerance, see “Temperature Measurement Problems” on page 6-10.

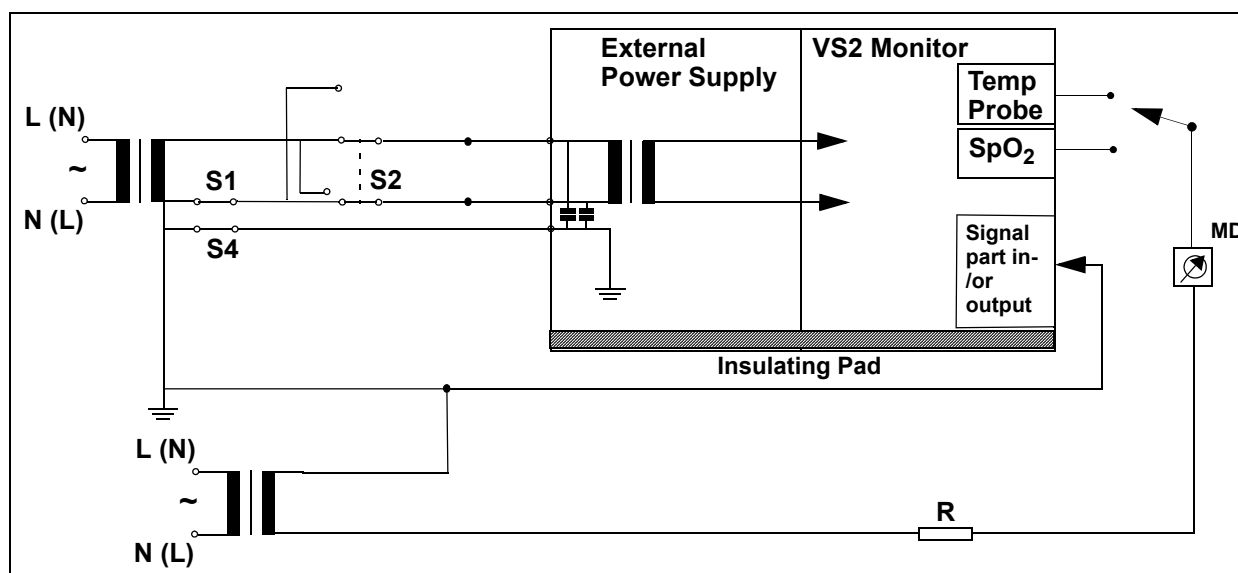
Safety Test

Use the following safety test to verify safe installation or service of the monitor. The setup and acceptable ranges of values are derived from local and international standards, but may not be equivalent. The test is not a substitute for local safety testing where it is required for an installation or a service event. If you use the Metron Safety tester, perform the test in accordance with your local regulations. For example, in Europe, use IEC 60601-1 and in the US, use UL 60601-1. The Metron Report should print results with the names listed below, together with other data. To perform this test, you need a multimeter.

Note — Safety tests meet the standards of, and are performed in accordance with IEC 60601-1. The SureSigns VS2 monitor is classified as Class II equipment.

Patient Leakage Current with Mains Voltage

Patient Leakage current — Single Fault Condition (S.F.C.) mains on applied part



Expected Test Results

Maximum leakage current, $x = 50 \mu\text{A}$ @ 250V (IEC 60601-1 and UL 60601-1).

Measures patient leakage current from applied part to earth. Each polarity combination possible is tested using S2.

Nurse Call Relay Test

The nurse call relay test checks the nurse call alarm output relay. The nurse call alarm output in the SureSigns VS2 monitor uses a phone jack connector tip or ring and is capable of both normally closed *and* normally open relay operation. Only perform this test if your site uses the nurse call.

To perform this test, you need:

- Patient simulator
- Ohmmeter
- 3.5 mm Phono connector




To perform the nurse call relay test:

Step			
1	Plug the phono connector into the Nurse Call connector on the back of the monitor.		
2	Use the ohmmeter and simulator to verify relay operation as follows:		
	Condition	Phone Jack Connector Tip (Relay Normally Open)	Phone Jack Connector Ring (Relay Normally Closed)
	Alarm	Closed	Open
	No alarm	Open	Closed

Barcode Scanner Test

The barcode scanner test checks the scanner's ability to accurately read data and input that information into the monitor.

To perform the barcode scanner test:

Step	
1	<p>Print the following sample barcodes.</p> <div style="text-align: center;"> <p>Code 39</p>  <p>B C 3 2 1</p> </div> <div style="text-align: center;"> <p>Code 128</p>  <p>C o d e 1 2 8</p> </div> <div style="text-align: center;"> <p>PDF417</p>  <p>Advanced D</p> </div>
2	Scan the first barcode.
3	<p>The New Patient Menu opens.</p> <p>The information written below the sample barcode should appear in the Patient ID fields.</p> <p>If the barcode information does not appear, see Chapter 6, "Troubleshooting."</p>
4	Press the Main Screen key on the front panel to close the menu.
5	Repeat Step 2 through Step 4 for the remaining barcodes.

6

Troubleshooting

Overview

Use this information in this section to diagnose and resolve problems with the monitor.

There are two methods of repairing the monitor:

- Bench repair
- Spare parts

Before performing a repair, consider whether a replacement would be more suitable.

Special tools are required to repair the monitor. The section, “Tools Required for Service” on page 7-1 lists these. If you open the case for a repair, you then must perform specific tests after reassembly. Chapter 5, “Performance Verification Testing,” lists these tests in detail and also includes recommended frequency.

The troubleshooting techniques in this chapter show how to troubleshoot a monitor that is not operating correctly. Chapter 7, “Repairing the Monitor,” describes how to perform the recommended repairs.

The Philips Parts Center stocks board level assemblies and mechanical parts.

Chapter 8, “Replacement Parts and Assembly Drawings,” lists these parts and assemblies.

Service notes announce the availability of additional spare parts.

When You Cannot Correct a Problem

Use the troubleshooting tables, run the diagnostics, refer to the error codes in this chapter, and then take the recommended actions to correct the majority of problems. If you still cannot isolate a problem after using the tables and diagnostics in this chapter, call the Philips Customer Care Center or your local representative.

Viewing System Information

Before you troubleshoot the monitor, identify important information about the monitor, such as the hardware and software version, which is displayed in **System Information** window.

To view the **System Information**:

Step															
1	<p>Press the System Menu key. The System Menu appears with the current settings displayed.</p> <div><p>System Menu</p><table><tr><td>Date Format:</td><td>mm/dd/yyyy</td></tr><tr><td>Display Time:</td><td>Yes</td></tr><tr><td>Default Patient Type:</td><td>Adult</td></tr><tr><td>Monitor Name:</td><td>CN00001</td></tr></table><div><div>System Info</div><div>System Admin</div><div>Main Screen</div></div></div>	Date Format:	mm/dd/yyyy	Display Time:	Yes	Default Patient Type:	Adult	Monitor Name:	CN00001						
Date Format:	mm/dd/yyyy														
Display Time:	Yes														
Default Patient Type:	Adult														
Monitor Name:	CN00001														
2	<p>Rotate the wheel to the System Info button and press the wheel. The System Information window appears.</p> <div><p>System Information</p><table><tr><td>Serial Number:</td><td>CN00000001</td></tr><tr><td>Hardware Version:</td><td>9.0 - 0</td></tr><tr><td>Software Version:</td><td>A.00.13</td></tr><tr><td>LAN MAC Address:</td><td>00-20-CB-FF-13-E1</td></tr><tr><td>LAN IP Address:</td><td>0.0.0.0</td></tr><tr><td>Language:</td><td>English</td></tr><tr><td>Configuration:</td><td>VS2 SpO2 Temp Recorder</td></tr></table><div>Return</div></div> <p>Note — You can also find the serial number on the back of the monitor.</p>	Serial Number:	CN00000001	Hardware Version:	9.0 - 0	Software Version:	A.00.13	LAN MAC Address:	00-20-CB-FF-13-E1	LAN IP Address:	0.0.0.0	Language:	English	Configuration:	VS2 SpO2 Temp Recorder
Serial Number:	CN00000001														
Hardware Version:	9.0 - 0														
Software Version:	A.00.13														
LAN MAC Address:	00-20-CB-FF-13-E1														
LAN IP Address:	0.0.0.0														
Language:	English														
Configuration:	VS2 SpO2 Temp Recorder														

Diagnosing a Problem

Note — Before you begin to troubleshoot a problem or open the monitor ensure that the monitor has power and a functioning display.

Check the following basics first:

1. Is the power switch turned on?
2. Is the battery adequately charged?
3. Is the power cord connected to the monitor and plugged into an AC outlet?

You can isolate many problems by observing the indicators on the monitor before you open it for repair.

Note — It may take several seconds for the AC Power LED to light/turn off after the power cord has been connected/disconnected.

If the monitor is not receiving power:

1. Check “Boot and Power Sequences” on page 6-4, and then follow the troubleshooting steps in “Power Problems” on page 6-6.
2. If the monitor has no display or an incorrect display, follow the troubleshooting steps in “Display Problems” on page 6-8.

Having power and an active, functioning display is critical to understanding the status of the monitor. After the monitor has power and a functioning display, you can use the information in this chapter to diagnose other monitor problems.

Boot and Power Sequences

The following describes the regular boot and power on phases of the monitor and its components. If the monitor does not behave as described in the following table, see “Power Problems” on page 6-6.

For the monitor to start correctly, it must be powered correctly. This is indicated by the green LED over the battery icon.

The following table shows the boot and power on sequences.

User Action	Expected Result
Plug the power cord or battery (or both) into an unpowered monitor. Press the Power key.	The screen displays color bars for about five seconds. The LCD turns off for three seconds and the battery LED lights (when a battery is available). The Philips screen appears and a tone sounds. The Date/Time Menu opens. After you acknowledges the Date/Time Menu , the main screen appears.
Press the Power key of a monitor (with AC and/or battery) that is off.	The screen displays color bars for about five seconds. The LCD turns off for three seconds and the battery LED lights (when battery available). The Philips screen appears and a tone sounds. The main screen appears.
Software reset (system or user).	The screen displays color bars for about five seconds. The LCD turns off for three seconds and the battery LED lights (when battery available). The Philips screen appears and a tone sounds. The main screen appears.
Plug AC into a monitor that is off (battery only). Press the Power key.	The screen displays color bars for about five seconds. The LCD turns off for three seconds and the battery LED lights (when battery available). The Philips screen appears and a tone sounds. The main screen appears.
Press the Power key when monitor is in Standby mode (AC and/or battery).	A tone sounds. The main screen appears.
Press the Power key when monitor is on (AC and/or battery).	The Philips screen appears and the LCD turns off.
Press the Shutdown button in the System Admin menu.	The Philips screen appears and the LCD turns off.

Troubleshooting Tables

Use the following tables to diagnose and fix monitor problems. The tables describe a monitor problem by symptom, list a possible cause, and suggested actions. Check the first possible cause listed, and then perform the associated action to repair the problem. Perform all actions in the order that they appear in a table.

Monitor problems can be related to:

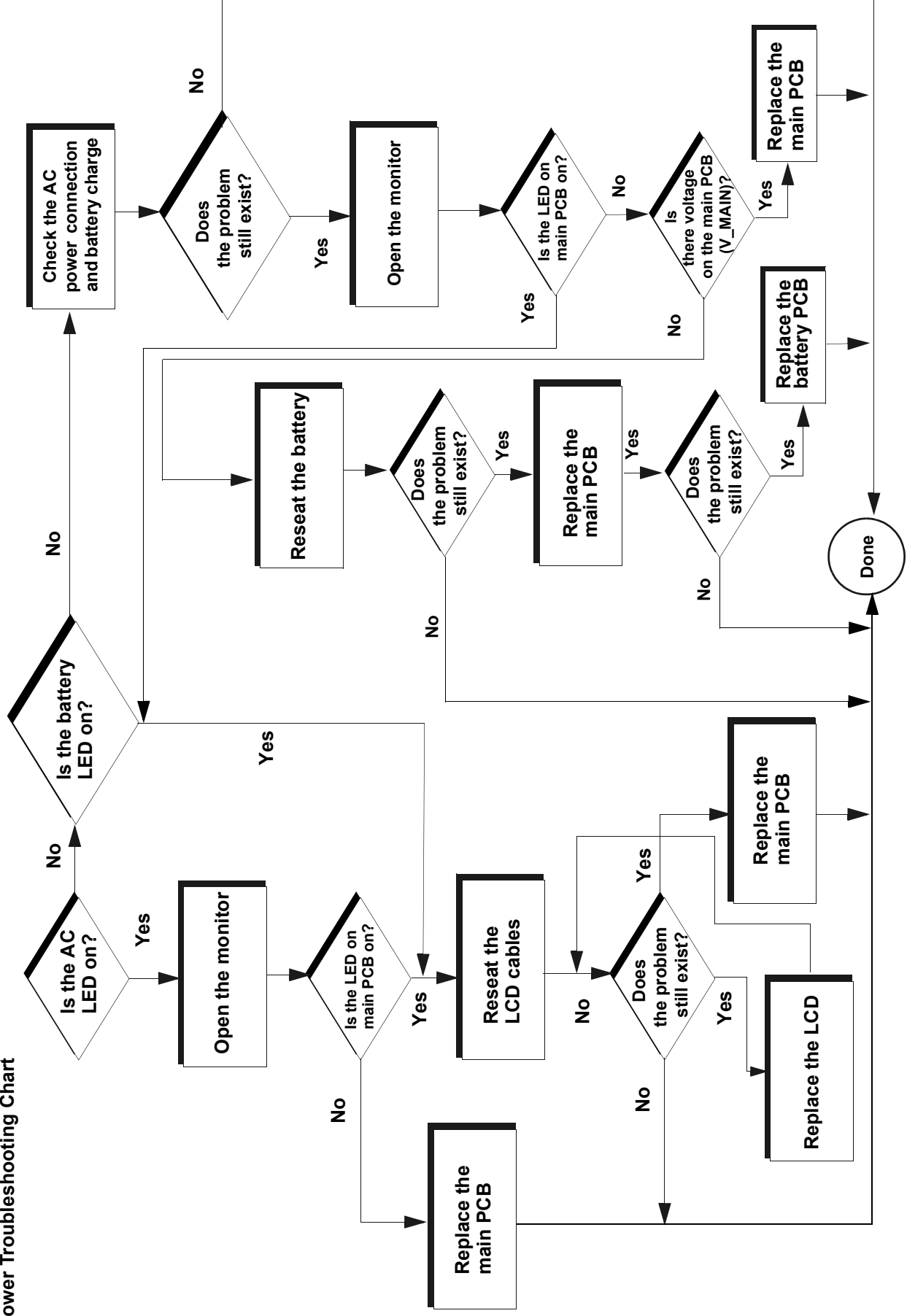
- Power
- Display
- Alarms
- Measurements, including:
 - NBP
 - Temperature
 - SpO₂
- Recorder
- Barcode Scanner

If you cannot resolve a problem by using the following troubleshooting tables, see “Running System Diagnostics” on page 6-25.

Power Problems

Symptom	Possible Cause	Action
I can't turn on the monitor with AC power, but can with battery power.	The cord is unplugged or broken.	Ensure that the power cord is plugged into an outlet.
	The monitor keypad is worn.	Replace the front panel. See "Removing the LCD" on page 7-36.
	The main board has malfunctioned.	Replace the main board. See "Removing the Main Board" on page 7-30.
I can turn on the monitor with AC power, but not battery power.	The battery has lost its charge.	Charge the battery. For more information, see "Maintaining the Battery" on page 3-4.
	The battery or connector is loose.	Reseat both the battery and battery cable.
	The battery does not have a connection to the main board.	Replace the battery board. See "Removing the Battery Connector Board" on page 7-26.
	The main board has malfunctioned.	Replace the main board. See "Removing the Main Board" on page 7-30.
I can't get the monitor to turn on with either AC or battery power.	The LCD, cables, battery, power supply, or main PCB has malfunctioned.	Follow the steps shown in the "Power Troubleshooting Chart" on page 6-7.
Only one of the Battery Charging LED colors is displayed.	The membrane switch assembly malfunctioned.	Replace the Front Panel assembly. See "Removing the LCD" on page 7-36.

Power Troubleshooting Chart



Display Problems

Symptom	Possible Cause	Action
The power is on, but the monitor screen is blank.	The monitor is in power save mode.	Push the Power key to end power save mode.
	The main board has malfunctioned.	Replace the main board. See “Removing the Main Board” on page 7-30.
	The LCD is bad.	Replace the LCD. See “Removing the LCD” on page 7-36.
The monitor displays random/distorted graphics with a white background.	The LCD cable is not attached correctly.	Open the monitor and reseal the LCD signal cable. See “Removing the LCD” on page 7-36.
	The LCD is bad.	Replace the LCD. See “Removing the LCD” on page 7-36.
	The main board malfunctioned.	Replace the main board See “Removing the Main Board” on page 7-30.
I turn on the monitor and the opening screen and/or color bar starts, but then just hangs.	The main board is defective.	Replace the main PCB. See “Removing the Main Board” on page 7-30.

Alarm Problems

Symptom	Possible Cause	Action
Audible alarms do not sound.	There is a bad connection to the speaker.	Ensure that the connection to speaker is correct.
	The speaker is bad.	Replace the speaker. See “Removing the Speaker” on page 7-15.
	The main board has malfunctioned.	Replace the main board. See “Removing the Main Board” on page 7-30.

NBP Problems

Symptom	Possible Cause	Action
The NBP cuff does not inflate.	The tube or cuff is kinked.	Straighten the tube or cuff.
	There is an air leak in the air tube or cuff.	Replace the cuff and ensure that there is no air leakage in the tube.
	The NBP module has malfunctioned.	Replace the NBP pump module. See “Removing the NBP Module” on page 7-24.
	The NBP pump filter is blocked.	Replace the NBP pump filter. See “Removing the NBP Filter” on page 7-26.
	The Daughter board has malfunctioned.	Replace the Daughter board. See “Removing the Daughter Board” on page 7-21.
There are no NBP readings.	Wrong cuff size, or incorrect cuff placement.	Use proper cuff size, ensure proper cuff placement.
	There is an incorrect initial pressure setting.	Set a proper initial pressure. See “Configuring the Default Initial NBP Inflation Pressure” on page 4-19.
	The tube is kinked or there is air leakage in the air tube or cuff.	Ensure that the tube is straight and not kinked. Replace the cuff and ensure that there is no air leakage in tube.
	There has been some external problem.	Ensure that all external blood pressure reading requirements are met and that the patient is not moving excessively.
	The NBP pump filter is blocked.	Replace the NBP pump filter. See “Removing the NBP Filter” on page 7-26.
	There is an NBP module error.	Replace the NBP module or Daughter board. See “Removing the NBP Module” on page 7-24 or “Removing the Daughter Board” on page 7-21.
I’m getting unreliable NBP readings.	Wrong cuff size, or incorrect cuff placement.	Use proper cuff size, ensure proper cuff placement.
	There is an incorrect initial pressure setting.	Set the initial pressure properly. See “Configuring the Default Initial NBP Inflation Pressure” on page 4-19.
	There has been some external problem.	Ensure that all external blood pressure reading requirements are met and that the patient is not moving excessively.
	The calibration is unreliable.	Recalibrate the NBP module see “NBP Calibration Procedure” on page 5-11.

Temperature Measurement Problems

Symptom	Possible Cause	Action
There are no temperature readings.	The probe is misplaced.	Ensure that the probe is properly placed in the measurement site.
	The temperature is over range.	Ensure that temperature readings are in the range of 15°-45°C. See “Temperature Test” on page 5-13.
	The probe has malfunctioned.	Replace the temperature probe.
	The main board has malfunctioned.	Replace the main board. See “Removing the Main Board” on page 7-30.
I’m getting unreliable temperature readings.	The probe has malfunctioned.	Replace the temperature probe.
	The module is not calibrated.	Calibrate the temperature module. See “Temperature Test” on page 5-13.
	The temperature adapter board has malfunctioned.	Replace the temperature adapter board. See “Replacing the Temperature Adapter Board” on page 7-7.
There are no temperature readings.	The probe lead is off.	Ensure that the temperature probe is connected.
	The temperature is over range.	Ensure that temperature reading are in the range of 15°-45°C). See “Temperature Test” on page 5-13.
	The probe has malfunctioned.	Replace the probe.
	The temperature adapter board has malfunctioned.	Replace the temperature adapter board. See “Replacing the Temperature Adapter Board” on page 7-7.
	The temperature module has malfunctioned.	Replace the temperature module. See “Removing the Temperature Module” on page 7-5.
	The main board has malfunctioned.	Replace the main board. See “Removing the Main Board” on page 7-30.

SpO₂ Measurement Problems

Symptom	Possible Cause	Action
There are no SpO ₂ readings.	The SpO ₂ module is in the learning phase.	Wait until the module finishes the learning phase.
	The SpO ₂ sensor has malfunctioned.	Replace the SpO ₂ sensor. See “Removing the SpO ₂ Board” on page 7-19.
	The SpO ₂ board has malfunctioned.	Replace the SpO ₂ board. See “Removing the SpO ₂ Board” on page 7-19.
	The main board has malfunctioned.	Replace the Daughter board. See “Removing the Daughter Board” on page 7-21.
The SpO ₂ readings are unreliable.	There has been some external problem.	Ensure that all external SpO ₂ reading requirements are met and that the patient is not moving excessively.
	Perfusion is low.	Reset the SpO ₂ function. See “SpO ₂ Test” on page 5-8.

Navigation Wheel and Key Problems

The monitor does not respond to the navigation wheel or front panel keys.	There is a bad connection to the main board.	Ensure that all connectors to the main board are seated correctly.
	The monitor keypad or navigation wheel is broken.	Replace the front panel or navigation wheel. See “Removing the Rear Case” on page 7-10 and “Removing the Navigation Wheel Assembly” on page 7-28.
	The main board has malfunctioned.	Replace the main board. See “Removing the Main Board” on page 7-30.
	The membrane switch assembly malfunctioned.	Replace the front panel assembly. See “Removing the Rear Case” on page 7-10.
Pushing a key does not access the expected function. For example, I press the Print key, but NBP is initiated.	The membrane switch assembly malfunctioned.	Replace the front panel assembly. See “Removing the Rear Case” on page 7-10.
I feel a key is collapsed, or when I push a key it doesn’t click.	The membrane switch assembly malfunctioned.	Replace the front panel assembly. See “Removing the Rear Case” on page 7-10.

Recorder Problems

Symptom	Possible Cause	Action
The recorder paper is jamming.	The paper is not installed correctly.	Remove paper and reinstall correctly.
	The recorder is using improper paper.	Use only the recommend recorder paper.
	The recorder has a mechanical problem.	Replace the recorder module. See “Removing the Recorder Faceplate” on page 7-8.
The recorder does not print.	An optional recorder is not installed.	Verify recorder is installed.
	The recorder is out of paper.	Install a new paper supply.
	The recorder door is open.	Open the recorder door, and then close it again.
	The system does not recognize the recorder.	Check the recorder’s physical connections. See “Removing the Recorder Faceplate” on page 7-8.
	The recorder module has malfunctioned.	Replace the recorder module. See “Removing the Recorder Faceplate” on page 7-8.
	The main board has malfunctioned.	Replace the main board. See “Removing the Main Board” on page 7-30

Barcode Scanner Problems

Symptom	Possible Cause	Action
The barcode scanner doesn’t function. (No laser, no sound; scanner cannot read barcodes.)	The scanner is not plugged into the USB port of the monitor.	Check the scanner’s physical connection to the monitor’s USB port. See <i>Installing the Barcode Scanner</i> for more information.
	The scanner window is not clean or is blocked.	Clean the barcode scanner. See “Cleaning the Barcode Scanner” on page 3-4.
	The system does not recognize the scanner.	Use only the scanner approved by Philips. See “Replacement Parts and Assembly Drawings” on page 8-1.
	The scanner has a mechanical problem.	Replace the scanner. See “Spare Parts” on page 8-1.

Symptom	Possible Cause	Action
The barcode scanner cannot read barcodes. (Laser and sounds function, but scanner cannot read barcodes.)	The scanner is held too close or too far from the barcode.	The scanner must be held between 6 and 12 inches from the barcode.
	The system does not recognize the barcode format.	Patient ID/Bed ID barcodes must be written in a recognizable format. See for a list of recognized symbologies. If the barcode is written in a recognizable format, and the scanner cannot read the barcode, reset the scanner. See “Resetting the Barcode Scanner” on page 6-13.
	The system does not recognize the scanner.	Use only the scanner approved by Philips. See the instructions, <i>Installing the Barcode Scanner</i> , for a list of recognized symbologies.
	The scanner has a mechanical problem.	Replace the scanner. See “Spare Parts” on page 8-1.

Resetting the Barcode Scanner

You can reset the barcode scanner to Philips’ default settings.

To reset the scanner:

Step	
1.	Print this page.
2.	Scan the following barcode: <div> </div>
3.	When the barcode is processed, the scanner beeps to indicate that the scanner has been reset to Philips’ default settings.
4.	Shut down the monitor as described in “Performing a Hard Shutdown” on page 7-2.

Error Codes

When the monitor detects an error condition (depending on the type of error) an error message appears on the screen or an error code is written to the Error Log. An error code is an indication that the monitor has detected an error in operation and service might be required. An error code is a hexadecimal number that indicates the nature of the error.



If an error occurs during monitoring, an audible alarm also sounds. Press the **Alarm Silence** key to end the audible alarm.

Alarm Silence
key

The following table lists the error codes that correspond to monitor malfunctions and actions to take when the error occurs. These errors are written to the Error Log. To print an error code log, see “Viewing and Printing Error Logs” on page 6-35.

Code	Error Message	Possible Cause	Action
257	System Error	Battery charger power failure	Check the external power supply. Replace the battery. See “Removing the Battery” on page 7-3. If the problem persists, replace the Daughter PCB. See “Removing the Daughter Board” on page 7-21.
261	System Error	Battery is overcharged	Run the monitor without AC power. If the problem persists, replace the battery. See “Removing the Battery” on page 7-3. If the problem persists, replace the Daughter PCB. See “Removing the Daughter Board” on page 7-21.
264 <i>temp value</i>	System Error	Battery over temperature	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the battery. See “Removing the Battery” on page 7-3. If the problem persists, replace the Daughter PCB. See “Removing the Daughter Board” on page 7-21.
817	FPGA FIFO Overrun	NBP software error	Informational message. No action required.
818 (2)	NBP Equip Malfunc (2)	NBP power-on self test failed because the A/D converter is inoperative, or the pressure transducer offset is too large.	Replace the NBP module. See “Removing the NBP Module” on page 7-24. If the problem persists, replace the Daughter PCB. See “Removing the Daughter Board” on page 7-21. If the problem persists, replace the main PCB. See “Removing the Main Board” on page 7-30.

Code	Error Message	Possible Cause	Action
818 (15)	NBP Equip Malfunc (15)	NBP abnormal, unrecoverable system errors with internal firmware.	Replace the Daughter PCB. See “Removing the Daughter Board” on page 7-21.
818 (25)	NBP Equip Malfunc (25)	NBP hardware has malfunctioned because of no data	<p>If the problem persists, replace the Daughter PCB. See “Removing the Daughter Board” on page 7-21.</p> <p>Replace the NBP module. See “Removing the NBP Module” on page 7-24.</p> <p>If the problem persists, replace the main PCB. See “Removing the Main Board” on page 7-30.</p>
819	NBP Equip Malfunc - Not Calibrated	NBP not calibrated	<p>Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor.</p> <p>If the problem persists, recalibrate the NBP unit. See “NBP Calibration Procedure” on page 5-11.</p>
833 (1)	SpO ₂ Equip Malfunc (1)	SpO ₂ ROM checksum error	Replace the SpO ₂ board. See “Removing the SpO ₂ Board” on page 7-19.
833 (2)	SpO ₂ Equip Malfunc (2)	SpO ₂ RAM test error	Replace the SpO ₂ board. See “Removing the SpO ₂ Board” on page 7-19.
833 (4)	SpO ₂ Equip Malfunc (4)	SpO ₂ analog signal path self-test failed	Replace the SpO ₂ board. See “Removing the SpO ₂ Board” on page 7-19.
833 (6)	SpO ₂ Equip Malfunc (6)	SpO ₂ self-test timeout	<p>Reseat the SpO₂ board.</p> <p>If the problem persists, replace the SpO₂ board. See “Removing the SpO₂ Board” on page 7-19.</p>
833 (8)	SpO ₂ Equip Malfunc (8)	SpO ₂ internal DSP communication error	Replace the SpO ₂ board. See “Removing the SpO ₂ Board” on page 7-19.
833 (10)	SpO ₂ Equip Malfunc (10)	SpO ₂ host communication error	<p>Replace the SpO₂ board. See “Removing the SpO₂ Board” on page 7-19.</p> <p>If the problem persists, replace the SpO₂ Adapter PCB. See “Removing the SpO₂ Adapter Board” on page 7-20.</p> <p>If the problem persists, replace the Daughter PCB. See “Removing the Daughter Board” on page 7-21.</p> <p>If the problem persists, replace the main PCB. See “Removing the Main Board” on page 7-30.</p>
833 (20)	SpO ₂ Equip Malfunc (20)	SpO ₂ hardware defect	Replace the SpO ₂ board. See “Removing the SpO ₂ Board” on page 7-19.

Code	Error Message	Possible Cause	Action
833 (40)	SpO ₂ Equip Malfunc (40)	SpO ₂ non-volatile memory corrupted	Replace the SpO ₂ board. See “Removing the SpO2 Board” on page 7-19.
834	SpO ₂ Sensor Malfunc	Malfunction of the SpO ₂ sensor or sensor cable	<p>Check the SpO₂ sensor and extension cable.</p> <p>If the problem persists, check the connector block cable connection on the SpO₂ board.</p> <p>If the problem persists, replace the SpO₂ board. See “Removing the SpO2 Board” on page 7-19.</p> <p>If the problem persists, replace the connector block. See “Removing the Connector Panel Assembly” on page 7-16.</p>
835	FPGA FIFO Overrun	SpO ₂ software error	Informational message. No action required.
836	SpO ₂ Communication Error	SpO ₂ communication error	<p>Informational message. No action required.</p> <p>If the message continues, replace the SpO₂ board.</p>
837	SpO ₂ Error. The front end will now reset itself.	No data from SpO ₂	<p>Allow the monitor to reset.</p> <p>Replace the SpO₂ board. See “Removing the SpO2 Board” on page 7-19.</p> <p>If the problem persists, replace the SpO₂ Adapter board. See “Removing the SpO2 Adapter Board” on page 7-20.</p> <p>If the problem persists, replace the Daughter PCB. See “Removing the Daughter Board” on page 7-21.</p> <p>If the problem persists, replace the main PCB. See “Removing the Main Board” on page 7-30.</p>
865	FPGA FIFO Overrun	Temperature software error	Informational message. No action required.
866 (21)	Temp Probe Error (21)	The probe is operating in temperature conditions above 112°F/43.3°C. Probe tip is defective: heater too close to thermistor.	<p>Replace the probe.</p> <p>If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.</p>
866 (22)	Temp Probe Error (22)	Excessive heater energy. Heater not working or it could have taken too long to predict.	<p>Repeat the measurement.</p> <p>If the problem persists, replace the probe.</p>

Code	Error Message	Possible Cause	Action
866 (32)	Temp Probe Error (32)	Thermistor pulled away from the tip or heater broken.	Repeat the measurement. If the problem persists, replace the probe.
866 (33)	Temp Probe Error (33)	Probe not responsive. Probe not characterized/calibrated.	Repeat the measurement. If the problem persists, replace the probe.
866 (34)	Temp Probe Error (34)	Probe not characterized/calibrated.	Repeat the measurement. If the problem persists, replace the probe.
866 (45)	Temp Probe Error (45)	Measurement below allowable temperature values and far below the low ambient limits.	Verify ambient temperature of 50°F. If conditions are valid and problem persists, replace the temperature probe. If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.
866 (46)	Temp Probe Error (46)	Measurement above allowable temperature values and far above the high ambient limits.	Verify ambient temperature of 50°F. If conditions are valid and problem persists, replace the temperature probe. If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.
866 (52)	Temp Probe Error (52)	Probe not characterized/calibrated.	Replace the probe. If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.
866 (63)	Temp Probe Error (63)	Probe well missing or not installed properly	Reseat or replace the well. If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.
866 (70)	Temp Probe Error (70)	Problem reading the probe's EEPROM.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the temperature probe.
866 (75)	Temp Probe Error (75)	Problem reading the probe's EEPROM correctly or the probe was not factory tested.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the temperature probe.
866 (78)	Temp Probe Error (78)	Probe error.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.

Code	Error Message	Possible Cause	Action
866 (79)	Temp Probe Error (79)	Module memory error	<p>Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor.</p> <p>If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.</p>
866 (80)	Temp Probe Error (80)	Software is trying to turn off the probe heater, but the heater feedback signal says it is still on.	<p>Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor.</p> <p>If the problem persists, replace the temperature probe. If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.</p>
866 (81)	Temp Probe Error (81)	Software is trying to turn on the probe heater, but the heater feedback signal says it is still off.	<p>Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor.</p> <p>If the problem persists, replace the temperature probe.</p> <p>If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.</p>
867 (24)	Temp Module Malfunc (24)	Ambient temperature too high.	<p>Verify that the venting slots of the temperature module are not blocked and are free of dust.</p> <p>Verify that the ambient temperature does not exceed operating specifications.</p> <p>If the problem persists, replace the temperature probe.</p> <p>If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.</p>
867 (25)	Temp Module Malfunc (25)	Ambient temperature too low.	<p>Verify that the ambient temperature does not exceed operating specifications.</p> <p>If the problem persists, replace the temperature probe.</p> <p>If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.</p>
867 (27)	Temp Module Malfunc (27)	Battery or power supply voltage exceeds maximum value.	<p>Replace the Temperature Module board. See “Replacing the Temperature Adapter Board” on page 7-7.</p> <p>If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.</p>

Code	Error Message	Possible Cause	Action
867 (28)	Temp Module Malfunc (28)	Battery or power supply voltage below minimum value	Replace the Temperature Module board. See “Replacing the Temperature Adapter Board” on page 7-7. If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.
867 (47)	Temp Module Malfunc (47)	Internal calibration resistor (RCAL) on the board is damaged.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.
867 (48)	Temp Module Malfunc (48)	Internal calibration resistor (RCAL) is damaged.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.
867 (49)	Temp Module Malfunc (49)	Internal circuit validation resistor (PTB) is damaged.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.
867 (50)	Temp Module Malfunc (50)	Internal circuit validation resistor (PTB) is damaged.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.
867 (51)	Temp Module Malfunc (51)	A/D measurement timed out and did not finish in the allowed time slot.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.
867 (59)	Temp Module Malfunc (59)	Battery or power supply voltage below maximum value.	Replace the Temperature Module board. See “Replacing the Temperature Adapter Board” on page 7-7. If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.

Code	Error Message	Possible Cause	Action
867 (60)	Temp Module Malfunc (60)	Battery or power supply voltage exceeds minimum value	Replace the Temperature Module board. See “Replacing the Temperature Adapter Board” on page 7-7. If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.
867 (61)	Temp Module Malfunc (61)	Reference voltage circuit under voltage or unstable.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.
867 (62)	Temp Module Malfunc (62)	The module is not calibrated.	Replace the temperature module. See “Removing the Temperature Module” on page 7-5.
867 (65)	Temp Module Malfunc (65)	Problem saving to the module’s EEPROM.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.
867 (66)	Temp Module Malfunc (66)	The module’s non-volatile calibration memory error detection mechanism detected an error.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.
867 (67)	Temp Module Malfunc (67)	Problem reading/writing to the module’s EEPROM.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.
867 (68)	Temp Module Malfunc (68)	Problem reading/writing to the module’s EEPROM.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.
867 (69)	Temp Module Malfunc (69)	Problem reading/writing to the module’s EEPROM.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.

Code	Error Message	Possible Cause	Action
867 (74)	Temp Module Malfunc (74)	Internal error. Module is trying to initialize the EEPROM if it detects that it has not been initialized before.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.
867 (82)	Temp Module Malfunc (82)	Signal HTR_Q is on and signal HTRC is off, but still have voltage.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.
867 (83)	Temp Module Malfunc (83)	Signal HTR_Q is tri-stated with signal HTRC enabled, and has heater power.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.
867 (84)	Temp Module Malfunc (84)	Signal Q&C is turned on and the heater voltage is not high enough.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.
867 (85)	Temp Module Malfunc (85)	Heater hardware fail-safe should have turned off, but did not.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.
868	Temp Error. The front end will now reset itself.	No data from temperature.	Allow the monitor to reset. Verify that the Temperature module is seated correctly and secured to the side of the monitor. Check the Temperature Adapter PCB connection cable. If the problem persists, replace the temperature module. See “Removing the Temperature Module” on page 7-5.
1025	System Error	Could not load ResourceDLL.dll.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main Board” on page 7-30.

Code	Error Message	Possible Cause	Action
1026	System Error	Could not load data from flash.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main Board” on page 7-30.
1027	System Error	Could not start front end.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main Board” on page 7-30.
1028	System Error	Could not stop front end.	Shut down and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main Board” on page 7-30.
1029	System Error	Could not allocate enough memory.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main Board” on page 7-30.
1030	System Error	An error occurred when system shut down front end devices.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main Board” on page 7-30.
1031	System Error	The monitoring and watchdog thread could not initialize.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main Board” on page 7-30.
1032	System Error	Could not open audio files.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main Board” on page 7-30.

Code	Error Message	Possible Cause	Action
1033	System Error	Unspecified error.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main Board” on page 7-30.
1034	System Error	Failed to load product info.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main Board” on page 7-30.
1035	System Error	Cannot initialize front end manager.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main Board” on page 7-30.
1036	System Error	Failed to start work thread.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main Board” on page 7-30.
1037	System Error	Cannot start polling thread.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main Board” on page 7-30.
1042	System Error	Failed to start up network driver.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main Board” on page 7-30.
1043	System Error	Front end software error.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main Board” on page 7-30.

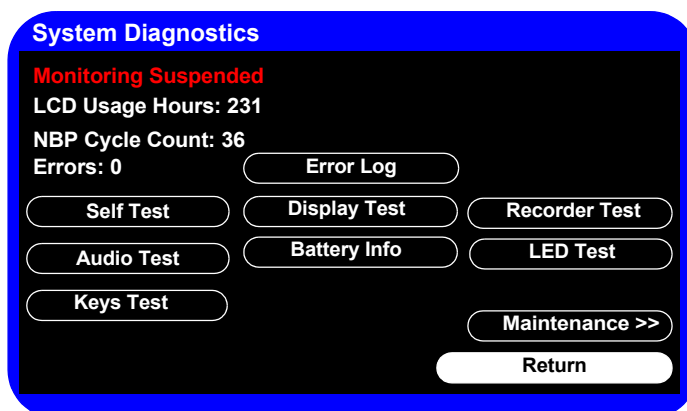
Code	Error Message	Possible Cause	Action
1044	System Error	Front end software error.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main Board” on page 7-30
1045	System Error	Printing software error.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main Board” on page 7-30.
1047	System Error	Monitoring software error.	Shut down and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main Board” on page 7-30.
1048	System Error	An exception was detected in the alarming software.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main Board” on page 7-30.
1050	System Error	Failed to stop work thread.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main Board” on page 7-30.
1051	System Error	Cannot initialize NBP.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the Daughter PCB. See “Removing the Daughter Board” on page 7-21. If the problem persists, replace the main PCB. See “Removing the Main Board” on page 7-30.
1052	System Error	Memory error.	Shut down (see “Performing a Hard Shutdown” on page 7-2) and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main Board” on page 7-30.
1053	System Error	Loss of monitoring.	Informational message. No action required.

Running System Diagnostics

If you cannot identify a problem by using the troubleshooting tables on page 6-5 or the Error Code table on page 6-14, run the system diagnostics software.

To access the system diagnostics software, use the **Diagnostics** button on the **Service Menu** in the **System Admin Menu**. For detailed information, see “Accessing the Service Menu” on page 4-12.

The following figure shows the **System Diagnostics** window.



Note — You must enter another password to access the **Maintenance** options. Only trained biomedical engineers or support persons should access the **Maintenance** options.

Maintenance Options

When the **System Diagnostics** menu is open, patient monitoring stops. When you exit the **System Diagnostics** menu, measurements restart.

To access the **Maintenance** options:

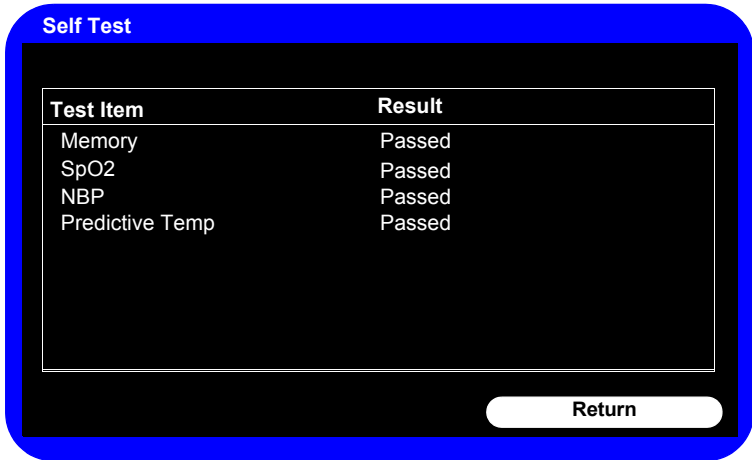
Step	
1	Rotate the wheel to highlight the Maintenance >> button in the System Diagnostics window and press the wheel.
2	<div>In the window that appears, enter the password, 1-2-9, as shown:<div><div>Please enter the password:<div><div>1</div><div>2</div><div>9 ▾</div><div>OK</div><div>Cancel</div></div></div></div><div>The complete System Diagnostics menu appears.<div><div><div><div>System Diagnostics</div><div>Monitoring Suspended</div><div>LCD Usage Hours: 231</div><div>NBP Cycle Count: 36</div><div>Errors: 0</div><div>Self Test</div><div>Audio Test</div><div>Keys Test</div><div>Configuration</div><div>Error Log</div><div>Display Test</div><div>Battery Info</div><div>NBP Test</div><div>Clear Data</div><div>Reset</div><div>Reset</div><div>Reset</div><div>Recorder Test</div><div>LED Test</div><div>Reset S/N</div><div>Return</div></div></div></div></div></div>

The following sections describe the diagnostic tests that you can run on the monitor. You can also run several verification tests from this menu. For more information on using the **Maintenance >>** menu to run verification tests, see Chapter 5, “Performance Verification Testing.”

Running the Self Test

The resident self test performs a complete memory and front end test. The monitor could have any of these modules: SpO₂, NBP, Predictive Temperature. If the test cannot sense a certain module or an error occurs, and then the front end test fails.

To run the monitor resident self test:

Step											
1	<p>In the System Diagnostics window, rotate the wheel until the Self Test button is highlighted and press the wheel.</p> <p>A window appears displaying the status of the self test. If a test fails, the window displays FAILED in red text beside the test.</p> <p>If a test has not completed, the window displays In Progress.</p>  <p>The screenshot shows a window titled "Self Test" with a blue border. Inside, there is a table with two columns: "Test Item" and "Result". The table lists four items: Memory, SpO2, NBP, and Predictive Temp, all with a "Passed" result. At the bottom right of the window is a "Return" button.</p> <table border="1"> <thead> <tr> <th>Test Item</th><th>Result</th></tr> </thead> <tbody> <tr> <td>Memory</td><td>Passed</td></tr> <tr> <td>SpO2</td><td>Passed</td></tr> <tr> <td>NBP</td><td>Passed</td></tr> <tr> <td>Predictive Temp</td><td>Passed</td></tr> </tbody> </table>	Test Item	Result	Memory	Passed	SpO2	Passed	NBP	Passed	Predictive Temp	Passed
Test Item	Result										
Memory	Passed										
SpO2	Passed										
NBP	Passed										
Predictive Temp	Passed										
2	<p>Rotate the wheel to highlight the Return button, and then press the wheel to return to the main screen when all tests complete.</p> <p>The Self Test window closes. Detected errors are written to the error log with detailed error information and error codes.</p> <p>Note — <i>The self test automatically runs each time that the monitor is powered on (cold or warm start), unless it has already run that day.</i></p>										

Testing the Speaker

The audio test plays a sample sound on each of the different Db levels.

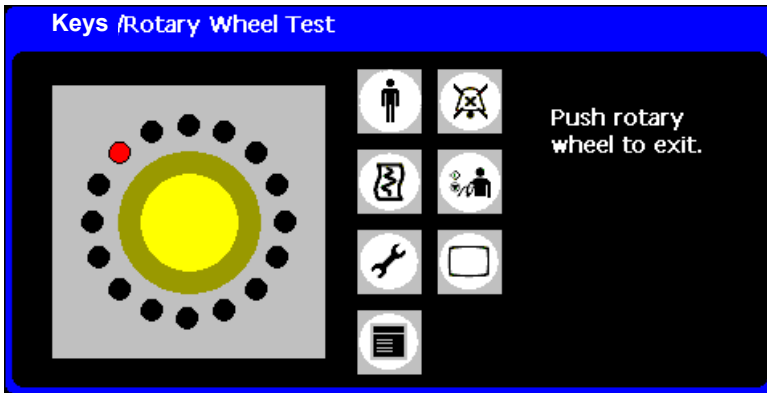
To perform the audio test:

Step	
1	In the System Diagnostics menu, rotate the wheel to highlight the Audio Test button, and then press the wheel to start the test. The Audio Test window appears and displays the text: Listen for three short tones .
2	Verify that the monitor sounds three short tones at different Db levels. When the test completes, the Audio Test window closes.

Testing the Navigation Wheel and Keys

The **Keys Test** tests the functions of the navigation (rotary) wheel and system keys. If you do not get the expected results, see “Navigation Wheel and Key Problems” on page 6-11.

To run the Keys test:

Step	
1	In the System Diagnostics menu, rotate the wheel to highlight Keys Test , and then press the wheel. The Keys/Rotary Wheel Test window appears with the system key icons in the right side of the window. 
2	To test a system icon button, press a button on the monitor. If the button you press on the monitor is working properly, the corresponding icon in the test window lights with a border for five seconds.

3	To test the rotary wheel, turn the wheel clockwise or counterclockwise. If the rotary wheel on the monitor is working properly, the a black dots sequentially change to red in the direction that you turn the wheel.
4	To test each small movement of the monitor's rotary wheel, move the wheel by small increments. If the rotary wheel on the monitor is working properly, the black dots change to red for each small movement of the monitor wheel.
5	To end the test, press the monitor rotary wheel.

Testing the Display

To test the display:

Step															
1	<p>In the System Diagnostics window, rotate the wheel to highlight the Display Test button, and then press the wheel to start the test.</p> <p>The display test draws a sequence of patterns on the monitor screen. Each pattern is displayed for five seconds. When the last pattern is drawn, the sequence starts again from the first pattern. The following table describes the test patterns that are displayed.</p> <table> <tr> <th>Pattern</th><th>Description of Screen</th></tr> <tr> <td>Vertical Bars</td><td>Alternating black and white vertical bars, starting with white. This description is displayed in red text across the top of the screen.</td></tr> <tr> <td>Vertical Bars (inverse)</td><td>Alternating black and white vertical bars, starting with black. This description is displayed in red text across the top of the screen.</td></tr> <tr> <td>Solid White</td><td>The screen background is white. White is displayed in black text that moves across the screen.</td></tr> <tr> <td>Solid Red</td><td>The screen background is red. Red is displayed in black text that moves across the screen.</td></tr> <tr> <td>Solid Green</td><td>The screen background is green. Green is displayed in black text that moves across the screen.</td></tr> <tr> <td>Solid Blue</td><td>The screen background is blue. Blue is displayed in black text that moves across the screen.</td></tr> </table>	Pattern	Description of Screen	Vertical Bars	Alternating black and white vertical bars, starting with white. This description is displayed in red text across the top of the screen.	Vertical Bars (inverse)	Alternating black and white vertical bars, starting with black. This description is displayed in red text across the top of the screen.	Solid White	The screen background is white. White is displayed in black text that moves across the screen.	Solid Red	The screen background is red. Red is displayed in black text that moves across the screen.	Solid Green	The screen background is green. Green is displayed in black text that moves across the screen.	Solid Blue	The screen background is blue. Blue is displayed in black text that moves across the screen.
Pattern	Description of Screen														
Vertical Bars	Alternating black and white vertical bars, starting with white. This description is displayed in red text across the top of the screen.														
Vertical Bars (inverse)	Alternating black and white vertical bars, starting with black. This description is displayed in red text across the top of the screen.														
Solid White	The screen background is white. White is displayed in black text that moves across the screen.														
Solid Red	The screen background is red. Red is displayed in black text that moves across the screen.														
Solid Green	The screen background is green. Green is displayed in black text that moves across the screen.														
Solid Blue	The screen background is blue. Blue is displayed in black text that moves across the screen.														
2	To exit the test, press or turn the wheel.														

Viewing the Battery Information

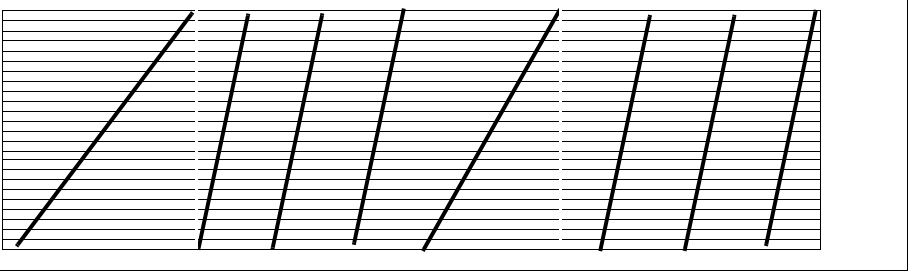
The **Battery Info** button allows communication with the battery to determine and display information battery parameters.

To view the battery information:

Step																	
1	<p>In the System Diagnostics window, rotate the wheel to the Battery Info button and then press the wheel.</p> <p>The Battery Info window appears, showing battery parameters. For example:</p> <div><div>Battery Info</div><table><thead><tr><th>Parameter</th><th>Value</th></tr></thead><tbody><tr><td>Manufacturer</td><td>EONEMOLI</td></tr><tr><td>Chemistry</td><td>LION</td></tr><tr><td>Serial Number</td><td>#48</td></tr><tr><td>Manufact. Date</td><td>07/24/2008 (mm.dd.yyyy)</td></tr><tr><td>Cycle Count</td><td>1</td></tr><tr><td>Max Error</td><td>2%</td></tr><tr><td>Relative Charge</td><td>80%</td></tr></tbody></table><div>ReconditionReturn</div></div> <p>Note — <i>If the message, No data from battery. Please see your Service Guide. appears, you must reseal the battery. For detailed information, see “Replacing the Battery” on page 7-2.</i></p>	Parameter	Value	Manufacturer	EONEMOLI	Chemistry	LION	Serial Number	#48	Manufact. Date	07/24/2008 (mm.dd.yyyy)	Cycle Count	1	Max Error	2%	Relative Charge	80%
Parameter	Value																
Manufacturer	EONEMOLI																
Chemistry	LION																
Serial Number	#48																
Manufact. Date	07/24/2008 (mm.dd.yyyy)																
Cycle Count	1																
Max Error	2%																
Relative Charge	80%																
2	<p>To view the entire list of results, rotate the wheel to highlight the list, press the wheel, and then rotate the wheel.</p>																

Testing the Optional Recorder

To test the optional recorder:

Step	
1	<p>In the System Diagnostics window, rotate the wheel to highlight the Recorder Test button, and then press the button to start the test.</p> <p>The recorder prints a test pattern similar to the following:</p> 
2	<p>Use the pattern to identify the recorder problem. For example, a faulty print head or motor.</p>

Testing the LED

To test the monitor LED:

- In the **System Diagnostics** menu, turn the wheel to highlight the **LED Test** button, and then press the wheel to select the test.

A window appears describing the expected LED behavior during the test. If the battery LED is working properly, it does the following:

- Lights in yellow for five seconds
- Lights in green for five seconds
- Flashes in yellow for five seconds
- Flashes in green for five seconds

The power LED remains green during the test.

If the LEDs do not function as expected, see “Power Problems” on page 6-6.

Viewing and Resetting Tracked Parameters

The monitor tracks the usage of some of its parameters and displays them on the **System Diagnostics** window. This can be helpful in diagnosing problems with the monitor.

The monitor tracks the following parameters:

Parameter	Description
LCD Usage Hours	The number of hours that something has been displayed on the monitor screen.
NBP Cycle Count	Number of times an NBP measurement has been taken.
Errors	The number of errors that the system has recorded in the error log. For more information about tracked errors, see “Viewing and Printing the Error Log” on page 6-33.

Resetting Parameters

Caution You must always reset a tracked parameter after replacing the associated part.

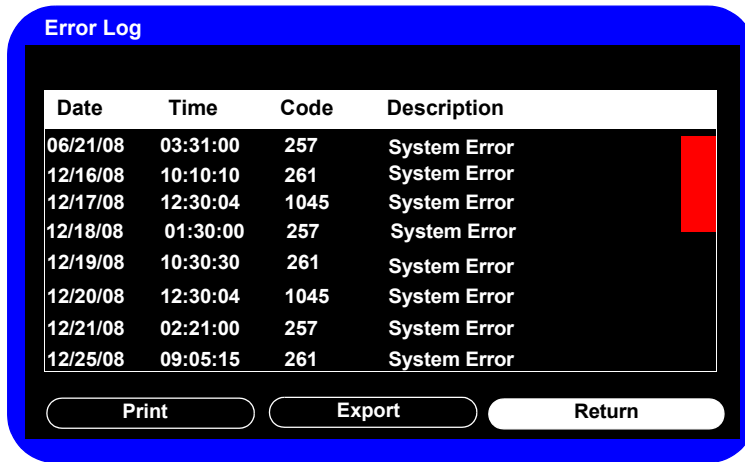
To reset a tracked parameter:

Step	
1	In the System Diagnostics window, in the Maintenance options, rotate the wheel to highlight the Reset button to the right of the parameter you want to reset, and then press the wheel. A message appears before the parameter is cleared asking for confirmation.
2	Turn the wheel to highlight Yes , and then press the wheel to reset the parameter to 0.

Viewing and Printing the Error Log

The monitor flashes when it has detected an error code, including errors that occur during the self test. In addition, when the monitor detects a system error, it writes that error to a log. The log includes a timestamp for when the error occurred. For detailed information on errors and error codes, see “Error Codes” on page 6-14.

To view the error log:

Step	
1	<p>In the System Diagnostics menu, rotate the wheel to highlight the Error Log button, and then press the wheel to view the error log.</p> <p>The Error Log window appears, showing the error log entry, timestamp, unique error code, description of the error, and an optional block of error information.</p> 
2	If needed to view the entire list of errors, rotate the wheel to highlight the list, press the wheel, and then rotate the wheel.
3	To clear the error count and log, see the section, “Resetting Parameters” on page 6-32.
4	<p>To print the error log to the recorder (optional):</p> <p>In the Error Log window, rotate the wheel to the Print button, and then press the wheel.</p>
5	<p>To export the error log to a USB flash drive:</p> <p>Connect a compatible USB flash drive to the USB port on the rear of the monitor.</p> <p>In the Error Log window, rotate the wheel to the Export button, and then press the wheel.</p> <p>The error log is saved to the USB flash drive as an .xls file.</p>

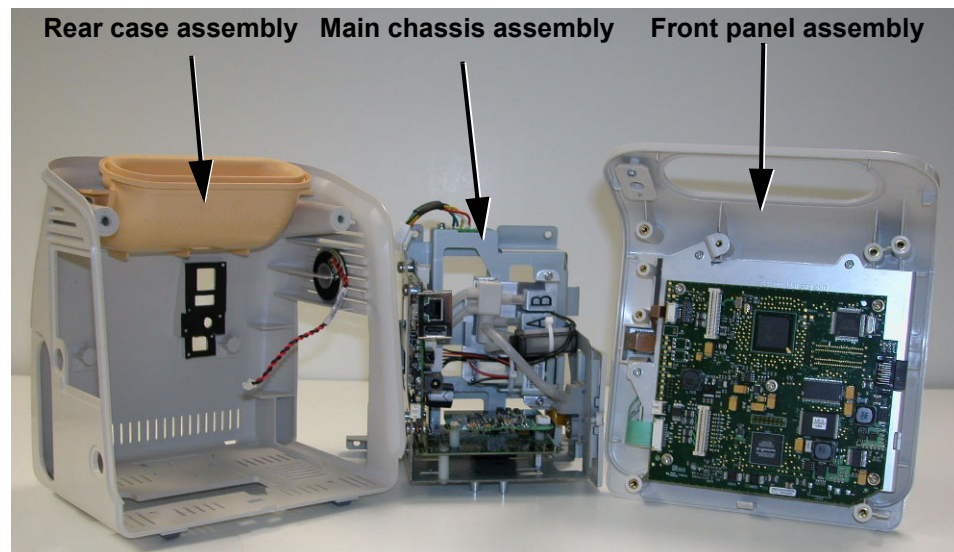
Repairing the Monitor

Disassembling the Monitor

This chapter contains the procedures for disassembling and assembling the monitor to replace or repair defective assemblies or components.

The monitor has three main assemblies:

- Rear case assembly
- Main chassis assembly
- Front panel assembly



For more information on replaceable parts, see Chapter 8, “Replacement Parts and Assembly Drawings.”

Warning	Before attempting to open or disassemble the monitor, disconnect the AC power from the monitor and remove the battery. High voltage is generated by the LCD backlight driver.
----------------	--

Caution	Observe ESD (electrostatic discharge) precautions when working inside the unit.
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Warning	After any monitor repair, you must perform the recommended Performance and Safety tests before putting the monitor into operation. Failure to perform these tests might result in erroneous monitor readings. For more information on performing safety and performance tests, see Chapter 5, “Performance Verification Testing.”
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Note — If your monitor is equipped with a wireless assembly, remove all of the wireless components before performing any of the following procedures. For more information, see the *SureSigns VS2 Wireless Installation and Setup Guide*.

Tools Required for Service

The tools and equipment required to disassemble, repair, and re-assemble the monitor follow:

- #1, #2 Phillips head screwdrivers
- Torx T10, T20 screwdrivers
- Medium slotted screwdriver
- Needle-nose pliers
- Plastic cable zip ties
- Wire cutters
- ESD mat and wrist strap

Replacing the Battery

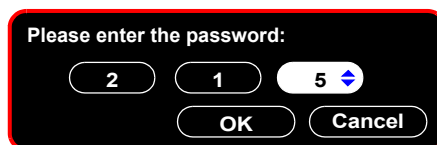
Caution Before removing the battery, perform a monitor hard shutdown.

Performing a Hard Shutdown

Perform a hard shutdown whenever you need to power down for a battery change or reset the barcode scanner. This ensures that all patient and system data is saved in memory.

To perform a hard shutdown:

1. Press the **System Admin** key.
2. In the **System Menu**, rotate the wheel until the **System Admin** button is highlighted, and then press the wheel.
3. In the window that appears, enter the Administrator password, **2-1-5**, as shown:

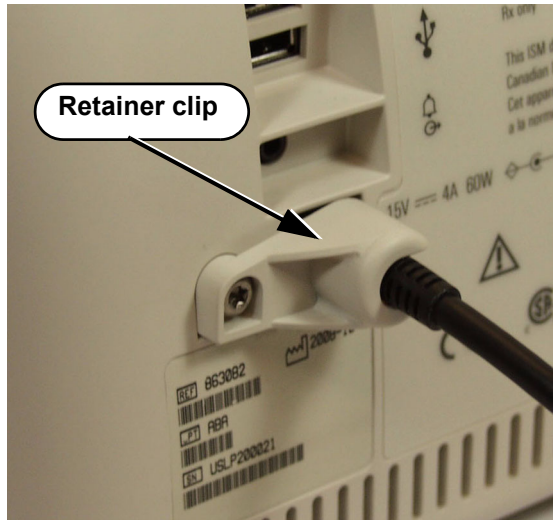


4. In the **System Admin Menu**, rotate the wheel until the **Service** button is highlighted, and then press the wheel.
5. In the **Service Menu**, rotate the wheel until the **Shutdown** button is highlighted and then press the wheel.
6. In the window that appears, rotate the wheel until **Yes** is highlighted and then press the wheel.
The system shuts down.

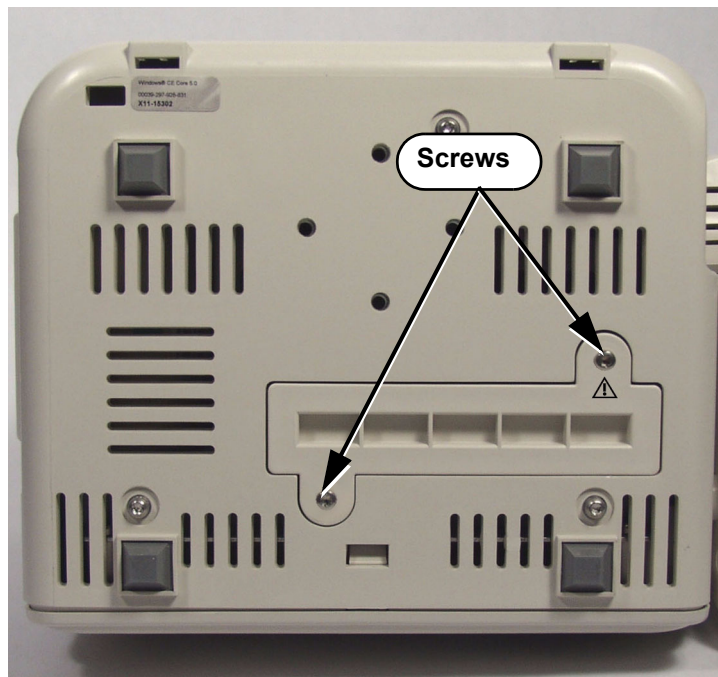
Removing the Battery

To remove the battery:

1. Remove the power cord retainer clip and then remove the power cord from the rear of the monitor.



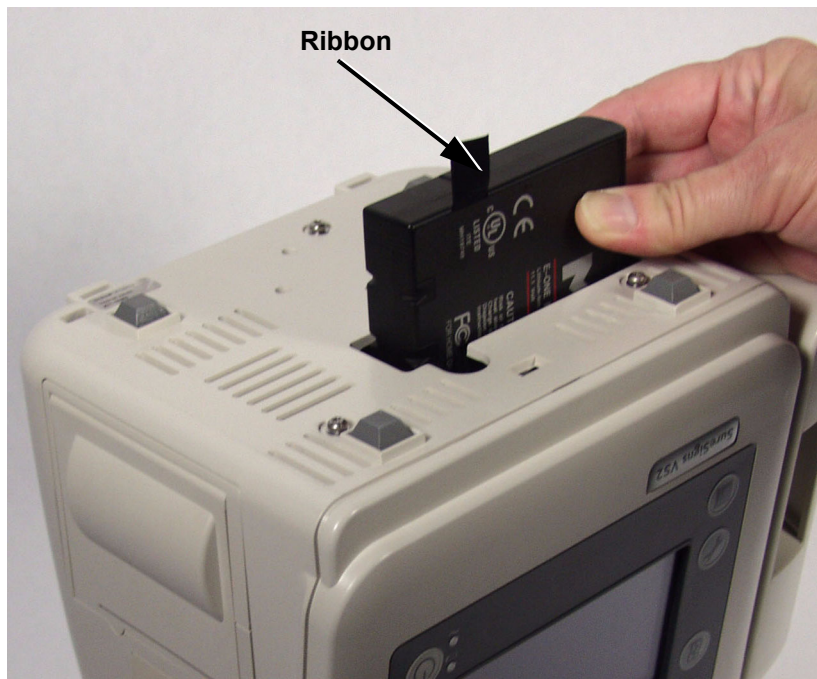
2. Remove the 2 screws from the battery cover on the bottom of the monitor.



Caution Place the monitor upside down when you remove the battery. The battery is not secured inside the monitor and may fall out when the cover is removed.

Replacing the Battery

3. Grasp the ribbon on the battery and pull the battery out of the monitor.



Installing the Battery

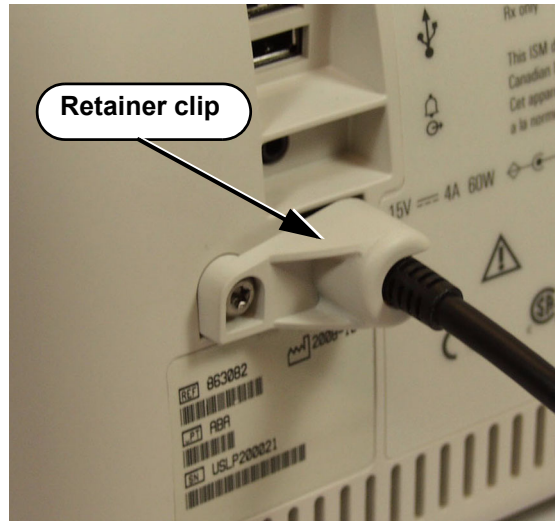
To install the battery:

1. Orient the battery so that the contacts are toward the rear case and the ribbon is towards the front panel.
2. Insert the battery into the empty battery compartment.
3. Replace the battery cover and the two screws.
4. Confirm that the battery is seated by observing that the battery LED is lit.

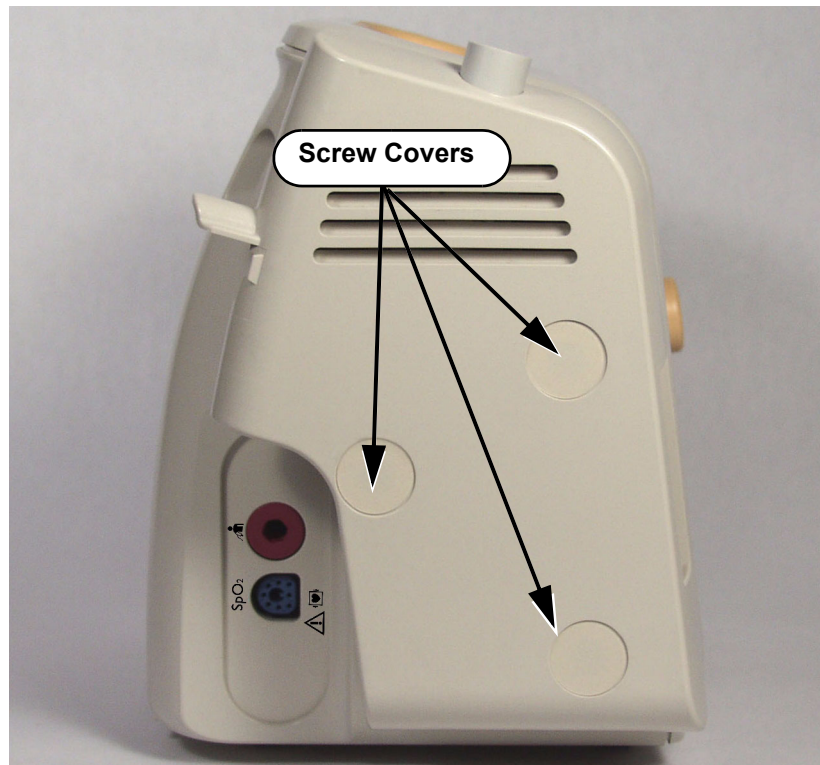
Removing the Temperature Module

To remove the temperature module:

1. If necessary, remove the power cord retainer clip and then remove the power cord from the rear of the monitor.

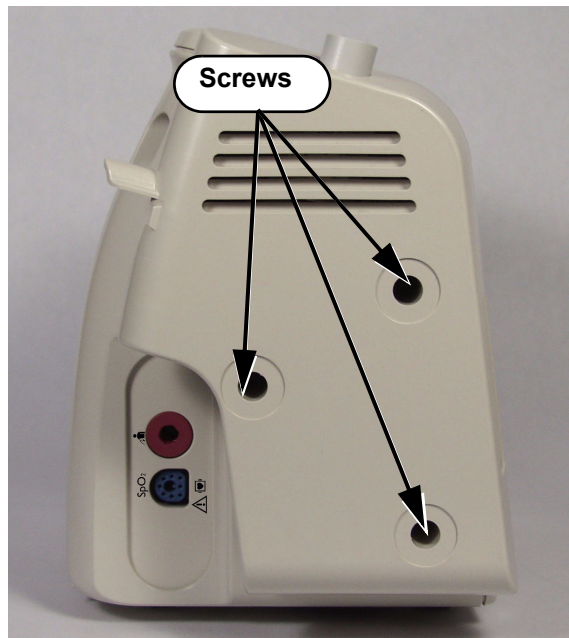


2. Remove the temperature probe and well.
3. Remove the battery from the monitor. See “Removing the Battery” on page 7-3.
4. Remove the adhesive covers from the screw holes by inserting a sharp, pointed tool under the edge of the covers.



Removing the Temperature Module

5. Remove the three Torx T20 screws from the temperature module.



6. Pull the module straight away from the monitor.

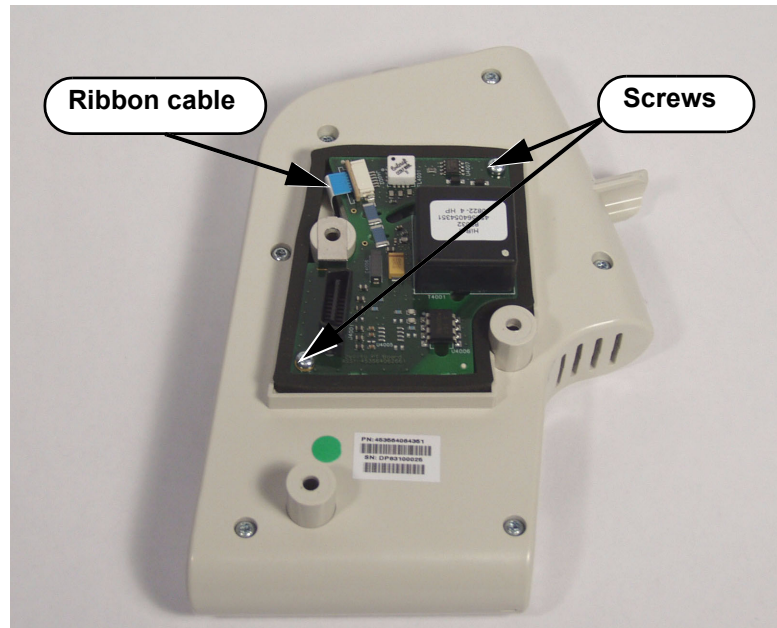


Caution After you replace the temperature module, perform the temperature accuracy test. For more information, see the “Temperature Test” on page 5-13.

Replacing the Temperature Adapter Board

To replace the Temperature Adapter board:

1. Remove the temperature module. See “Removing the Temperature Module” on page 7-5.
2. Remove the ribbon cable.



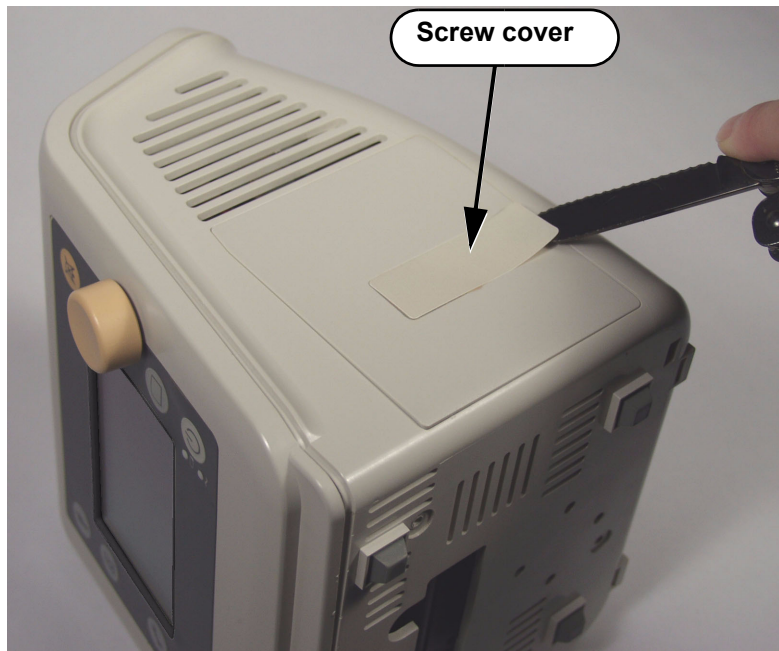
3. Remove the two Torx T10 screws from the board and remove the board from the module.



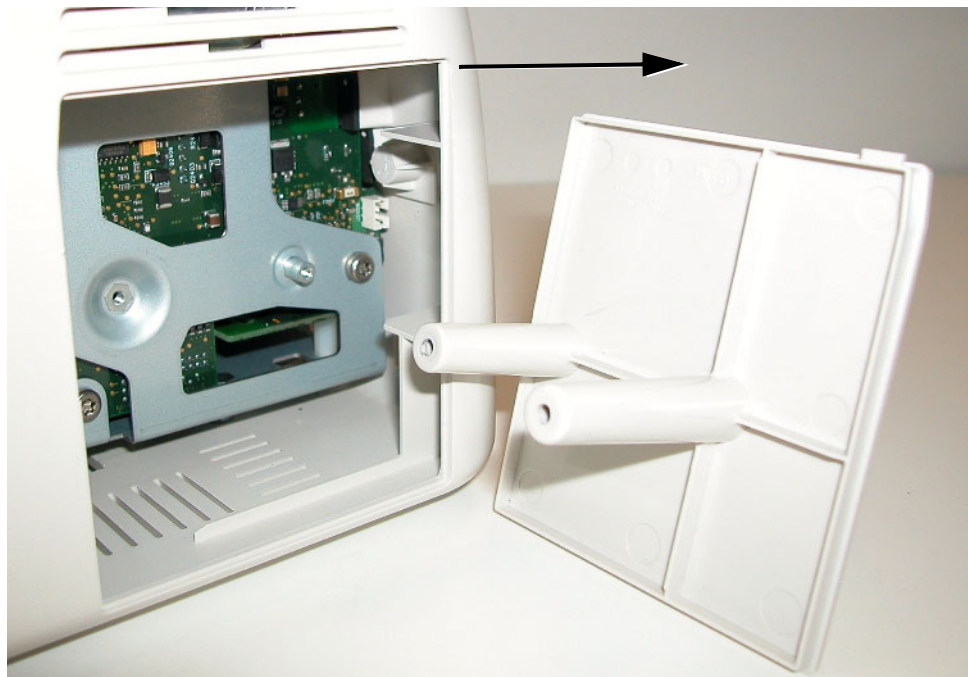
Removing the Recorder Faceplate

For monitors without an optional recorder, remove the faceplate as follows:

1. Remove the plastic strip covering the two Torx T10 screws holding the faceplate to the monitor case.



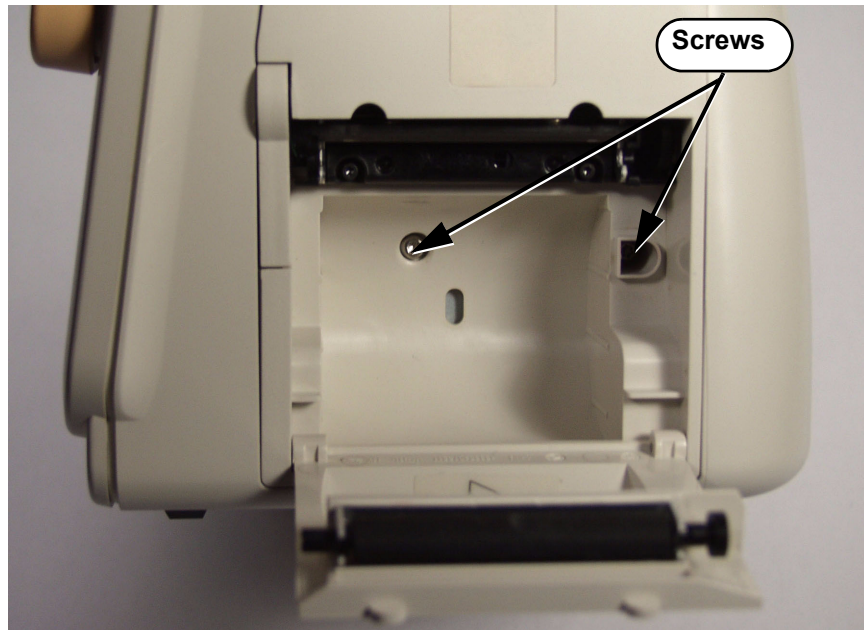
2. Remove the two screws and pull the faceplate straight away from the monitor.



Removing the Optional Recorder

To remove the optional recorder:

1. Open the recorder door on the rear case assembly and remove the paper roll.
2. Loosen (do not try to remove) the two Torx T10 screws holding the recorder to the monitor case.



3. Place your two thumbs on either side of the recorder case and pull it straight out of the assembly and away from the recorder connector on the main board.



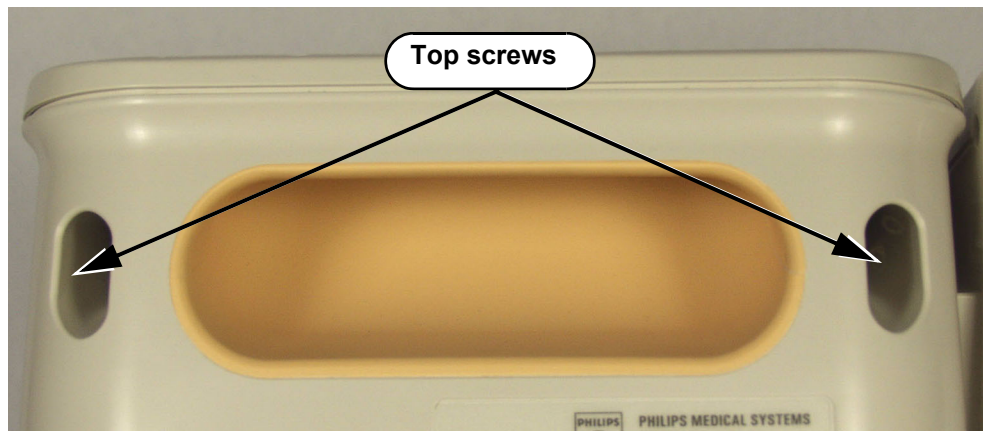
Caution When you reassemble the recorder or faceplate, do not overtighten the screws.

Removing the Rear Case

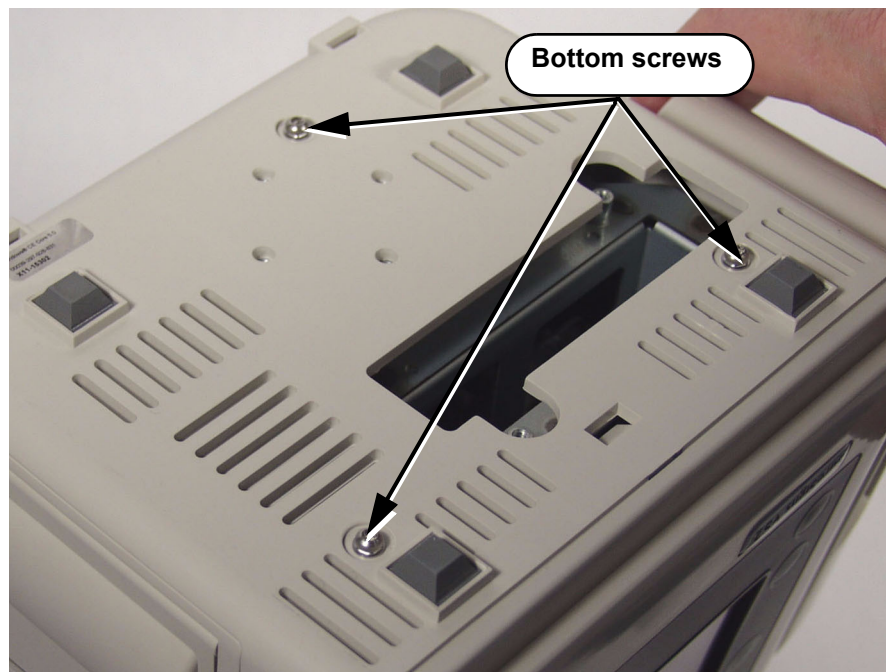
To open the monitor to install internal replacement parts, you must first separate the rear case from the front panel and main chassis assemblies.

To remove the rear case:

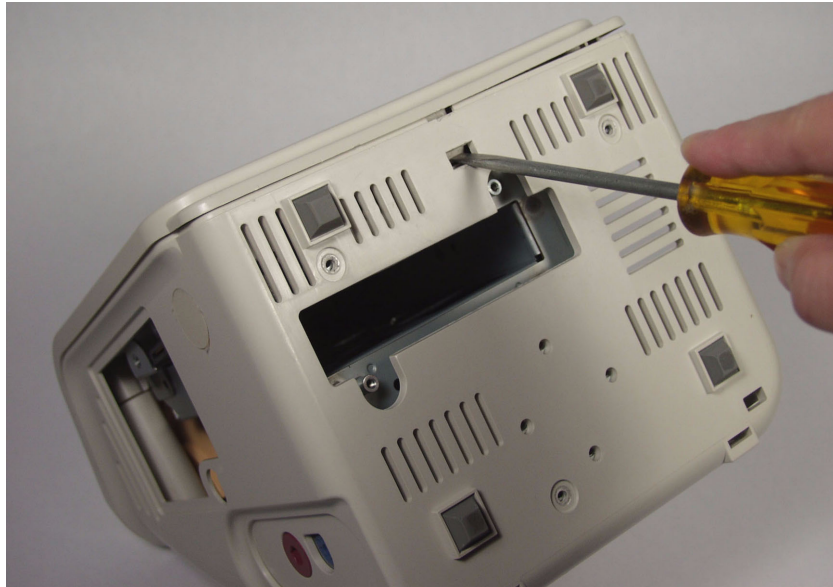
1. Remove any lines from the patient monitoring and communication connectors.
2. If the monitor has a power cord retainer clip, remove it, and then remove the power cord from the back of the monitor. See “Installing the Power Cord Retainer Clip” on page 4-22.
3. Remove the battery from the monitor. See “Removing the Battery” on page 7-3.
4. If the monitor has a recorder, remove it. See “Removing the Recorder Faceplate” on page 7-8.
5. If the monitor has a temperature module, remove it. See “Removing the Temperature Module” on page 7-5.
6. Remove the two Torx T20 screws from the top of the monitor.



7. Remove the three bottom screws.

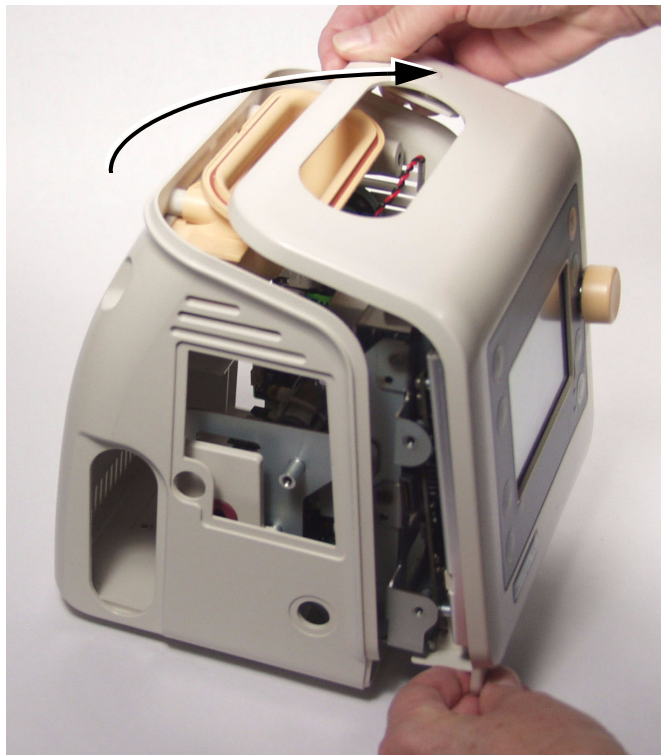


8. Insert a small slotted screwdriver into the slot on the bottom of the monitor and press the tab to release the front panel from the monitor.



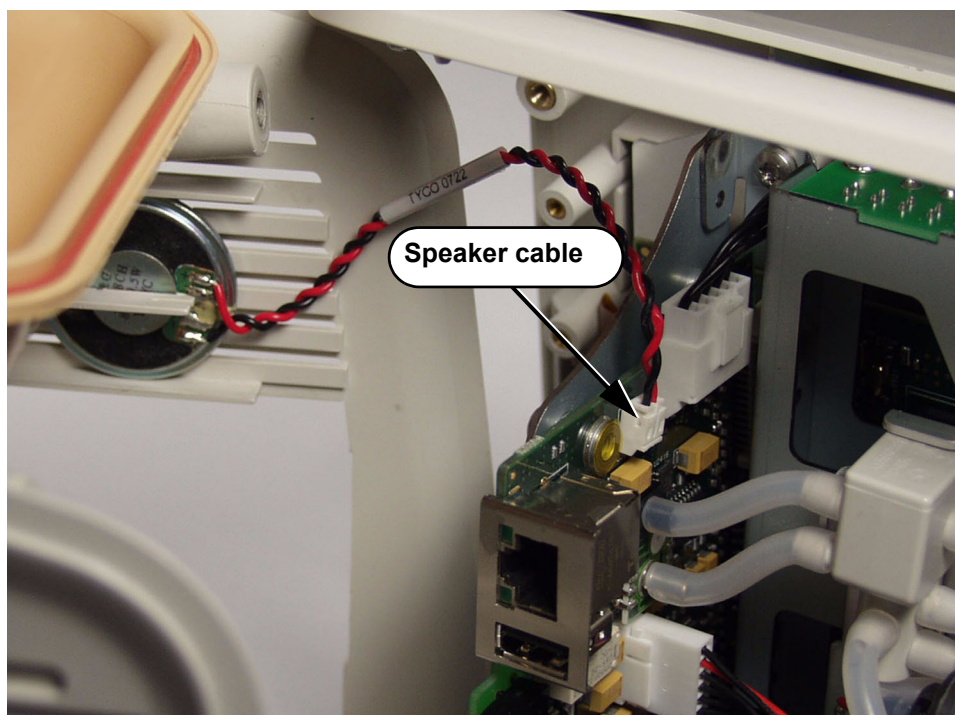
9. Lift the front panel assembly carefully and slowly over the handle and pull it away.

Caution Connectors run between the front and rear case assemblies.

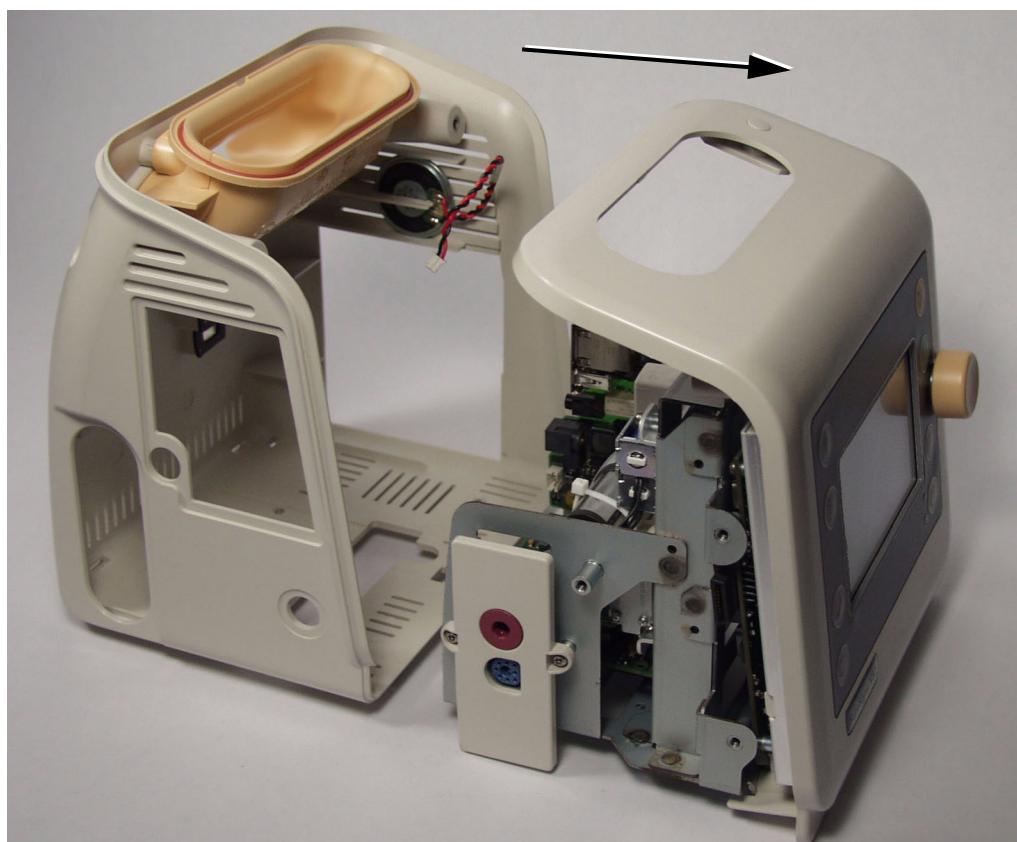


Removing the Rear Case

10. Disconnect the speaker cable from the assembly.



11. Separate the front and rear cases.



Reassembling the Monitor

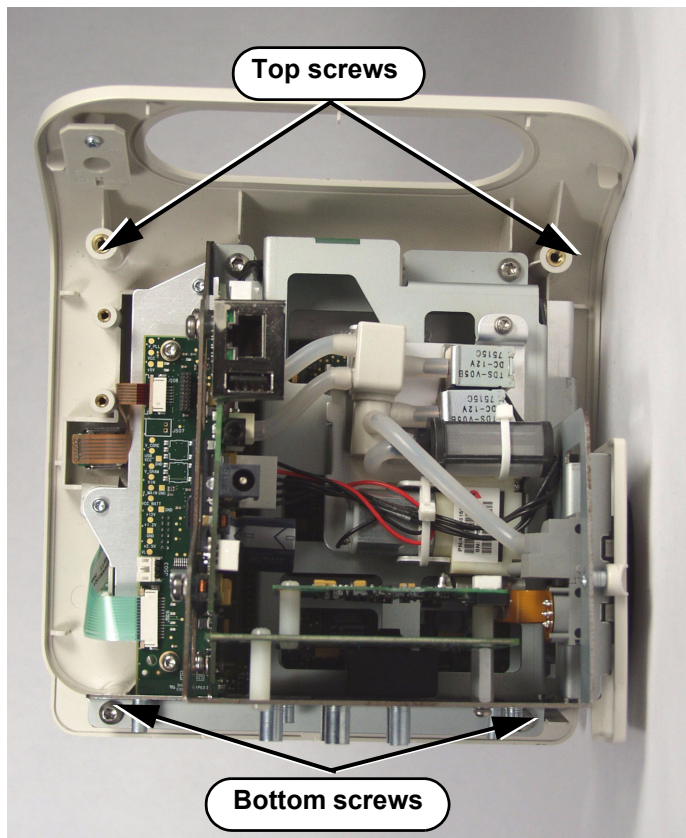
To reassemble the monitor:

1. Reconnect the cables.
2. Line up the tab on the front case with the slot on the bottom of the rear case and slip the front assembly case over the handle.
3. Snap the two assembly cases together and install the three screws.
4. Replace the power cord and the power cord retainer. See “Installing the Power Cord Retainer Clip” on page 4-22, and then power up the monitor.
5. If the monitor starts up properly, perform the required performance tests. See “Testing and Inspection Guidelines” on page 5-1.

Removing the Main Chassis Assembly

To remove the main chassis assembly from the front case:

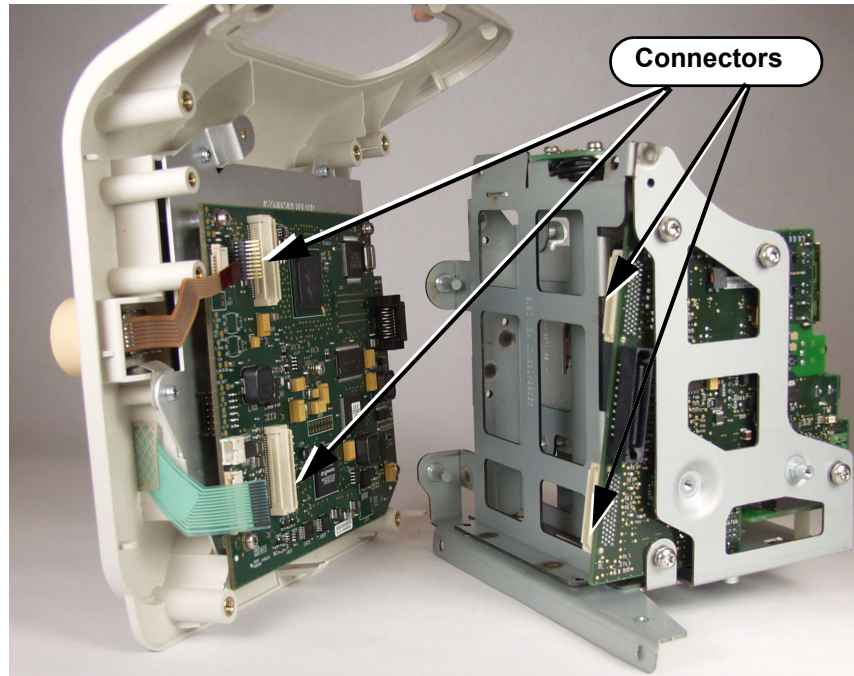
1. Separate the front and rear case assemblies. See “Removing the Rear Case” on page 7-10.
2. On the front case, remove the four Torx T20 screws from the main chassis assembly and pull it away from the front panel assembly.



Reassembling the Main Chassis Assembly

To reassemble the main chassis assembly:

1. Line up the connectors on the daughter board with those on the main board.

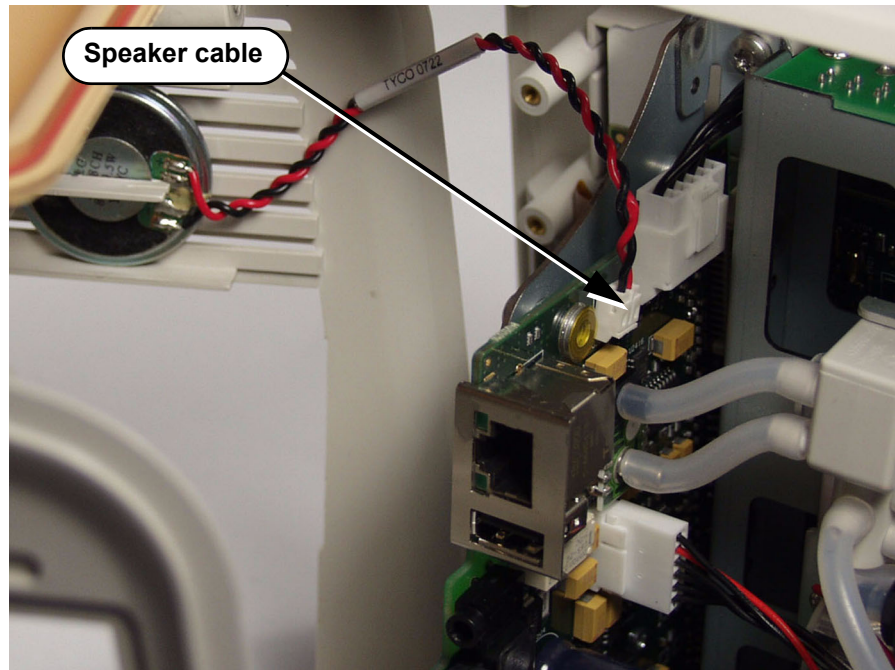


2. Push the parts together until they snap in place.
3. Replace the four Torx T20 screws.

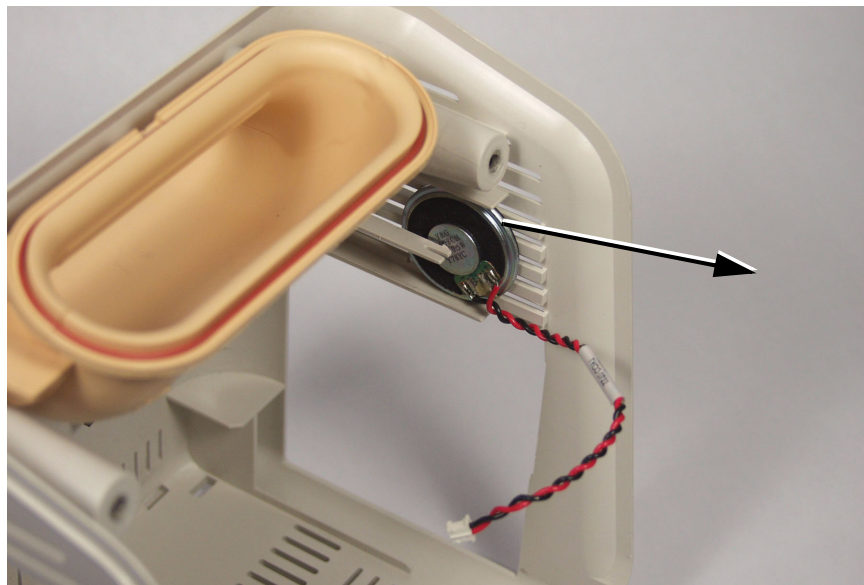
Removing the Speaker

To remove the speaker:

1. Separate the front and rear case assemblies. See “Removing the Rear Case” on page 7-10.
2. Disconnect the speaker cable from the daughter board.



3. Remove the speaker by sliding it out of the rear case.

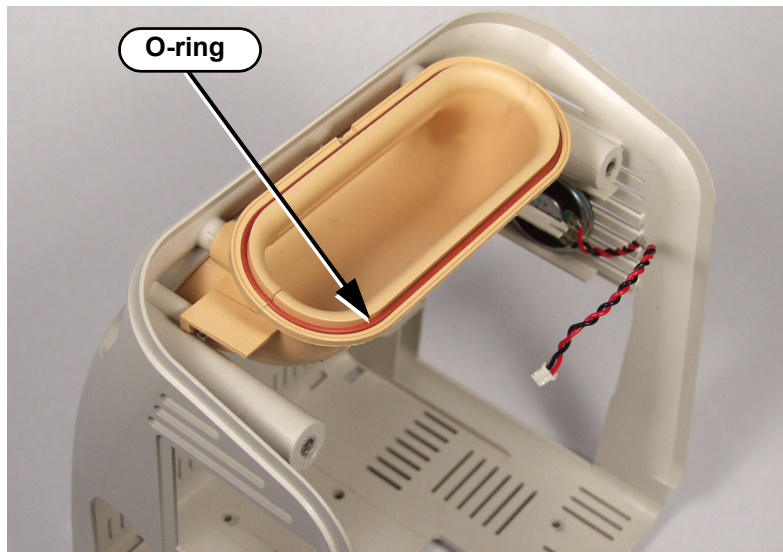


4. After reassembling the monitor, ensure the speaker works. Verify that a chime sounds when you power on the monitor and test the alarms. See “Alarms Test” on page 5-7.

Replacing the Handle O-Ring

To replace the handle O-ring:

1. Separate the front and rear case. See “Removing the Rear Case” on page 7-10.
2. Gently pull the O-ring from its position in the handle. If the O-ring has been damaged or torn, be sure to remove all of the pieces from the channel in the handle.



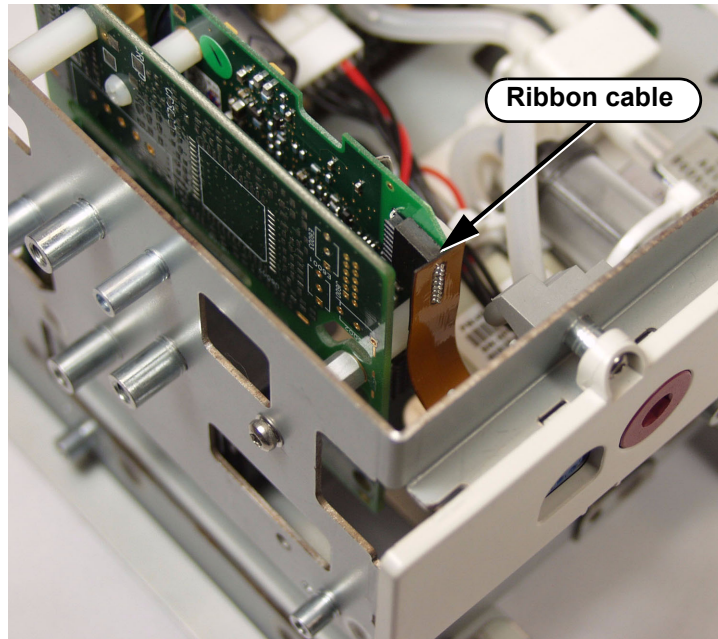
3. Place a new O-ring in the handle and tap it into place all along the channel.

Removing the Connector Panel Assembly

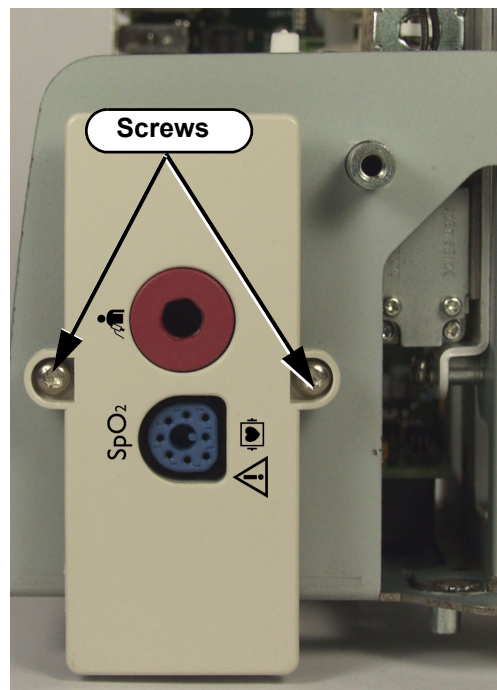
To remove the connector panel from the monitor:

1. Separate the front and rear monitor cases. See “Removing the Rear Case” on page 7-10.

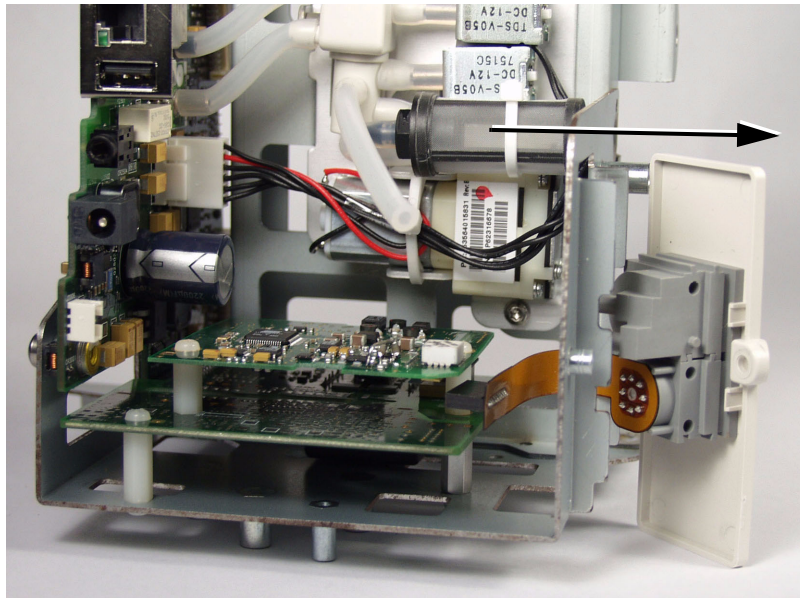
2. Use a knife to remove the glue between the connector and the board, and then disconnect the ribbon cable from the SpO₂ board.



3. On the main chassis, remove the two screws from the connector panel assembly.



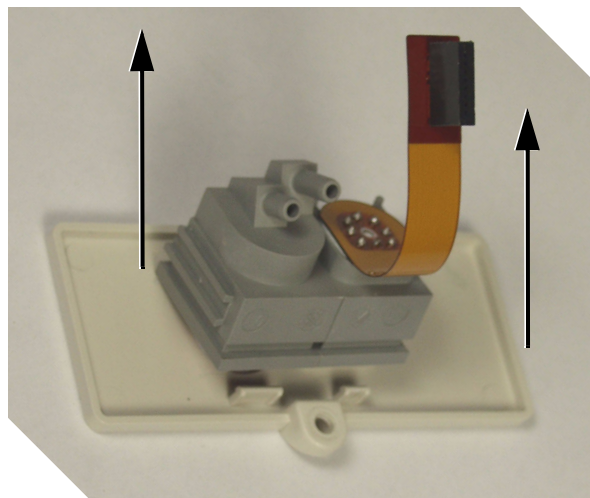
4. Remove the connector panel assembly from the chassis.



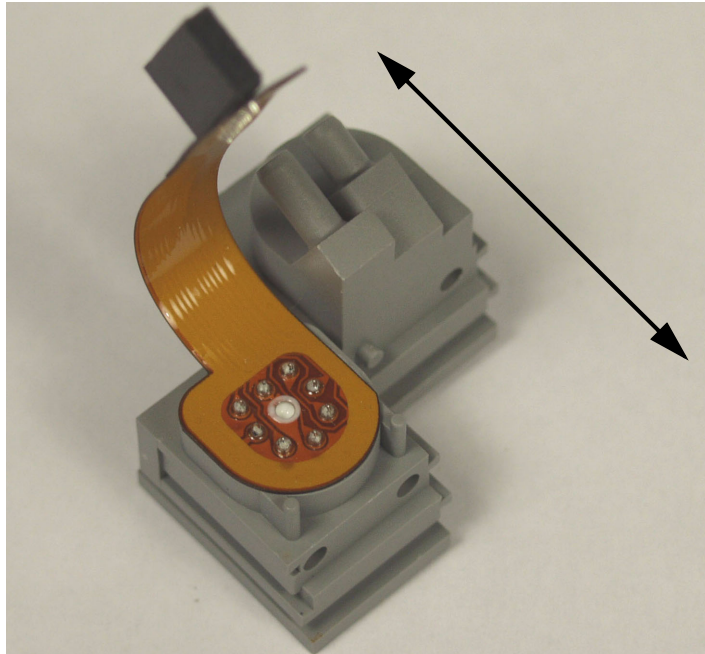
Removing the Connector Blocks

To remove the connector blocks from the connector panel assembly:

1. Separate the front and rear monitor case assemblies. See “Removing the Rear Case” on page 7-10.
2. Remove the connector panel assembly. See “Removing the Connector Panel Assembly” on page 7-16.
3. Press the connector blocks in the direction shown until they are released and lift them out of the connector panel assembly.



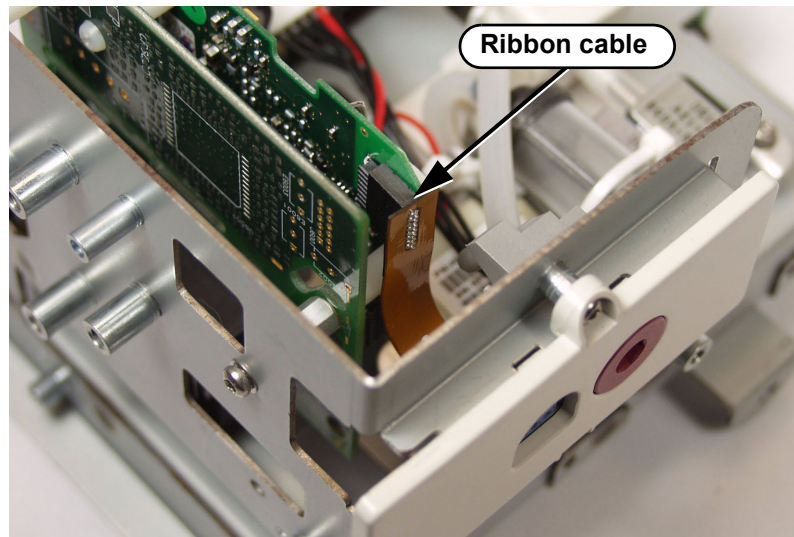
4. Slide the blocks in opposite directions to separate the NBP and SpO₂ connectors.



Removing the SpO₂ Board

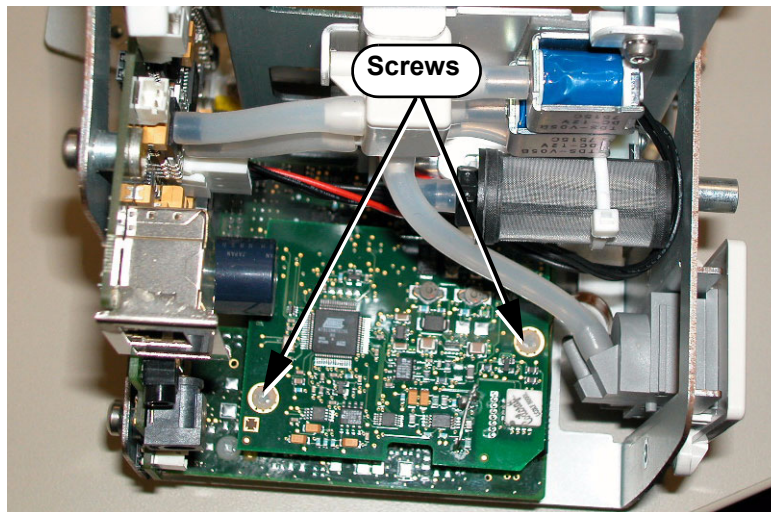
To remove the SpO₂ board:

1. Remove the rear case. See “Removing the Rear Case” on page 7-10.
2. Disconnect the SpO₂ ribbon cable.



Removing the SpO₂ Adapter Board

3. Remove the two white plastic #1 Phillips-head screws on the SpO₂ board.



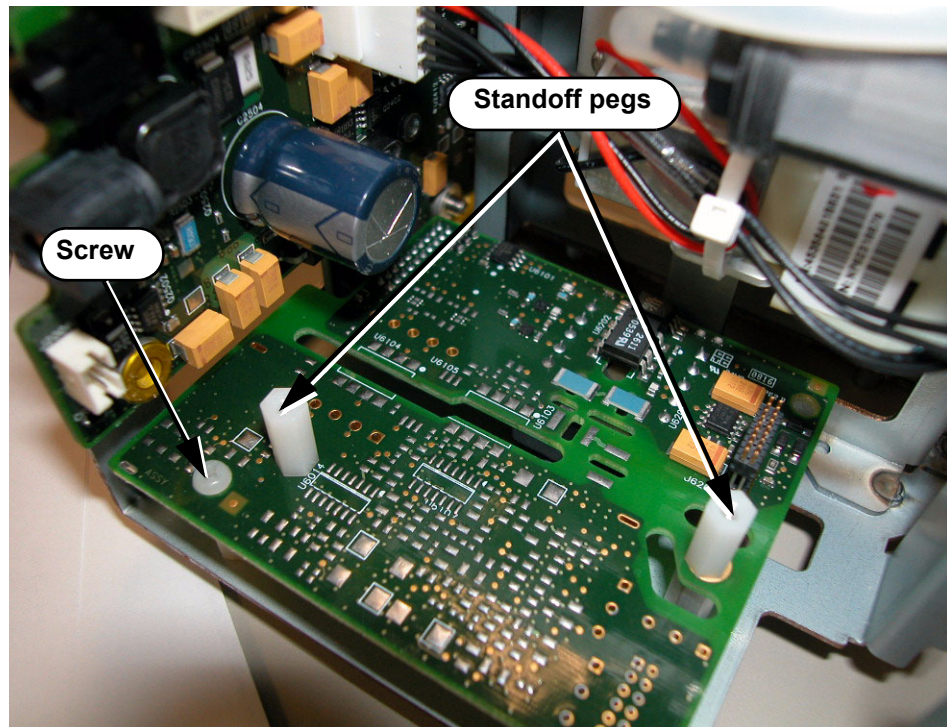
4. Remove the SpO₂ board from the standoff pegs on the SpO₂ adapter board.

Removing the SpO₂ Adapter Board

To remove the SpO₂ adapter board:

1. Remove the rear case. See “Removing the Rear Case” on page 7-10.
2. Remove the front panel from the chassis. See Chapter 7, “Repairing the Monitor.”
3. Remove the SpO₂ board. See “Removing the SpO₂ Board” on page 7-19.
4. Remove the standoff pegs.

5. Remove the white plastic #1 Phillips-head screw on the SpO₂ Adapter board.



6. Gently pull the board away to disconnect it from the daughter board.

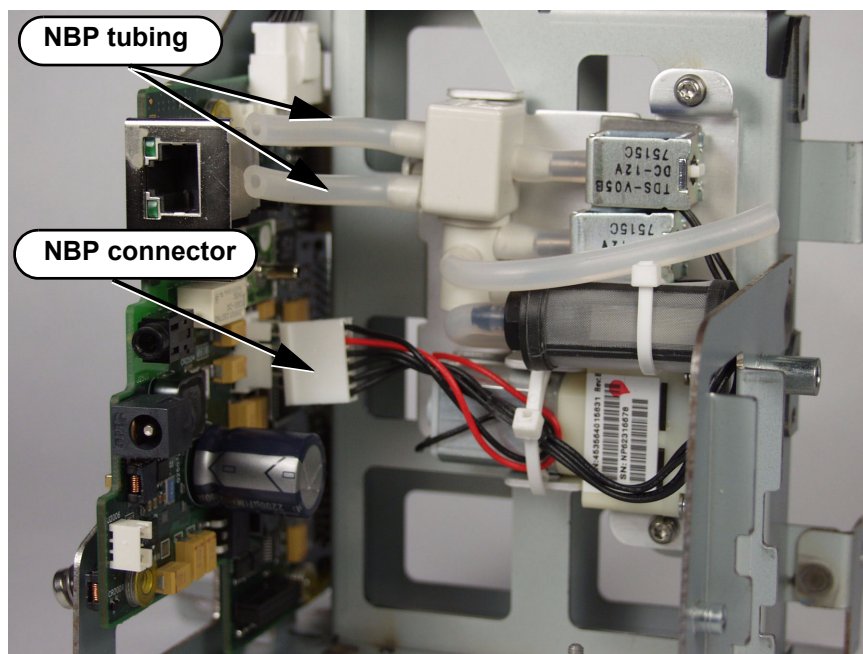
Removing the Daughter Board

To remove the Daughter board:

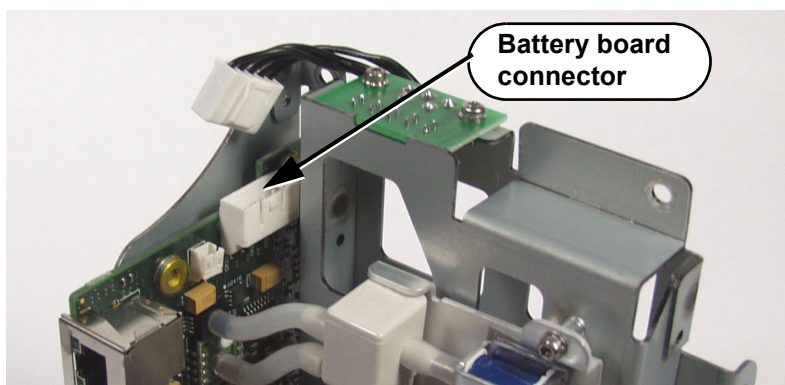
1. Separate the front and rear monitor case assemblies. See “Removing the Rear Case” on page 7-10.
2. Remove the main chassis assembly. See “Removing the Main Chassis Assembly” on page 7-13.
3. Remove the SpO₂ board. See “Removing the SpO₂ Board” on page 7-19.
4. Remove the SpO₂ Adapter board. See “Removing the SpO₂ Adapter Board” on page 7-20.

Removing the Daughter Board

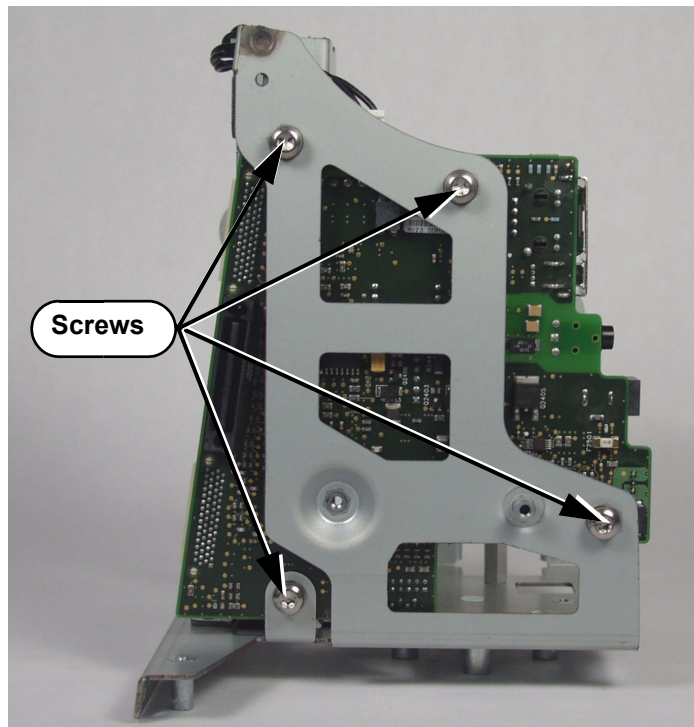
5. Remove the NBP tubing and connector.



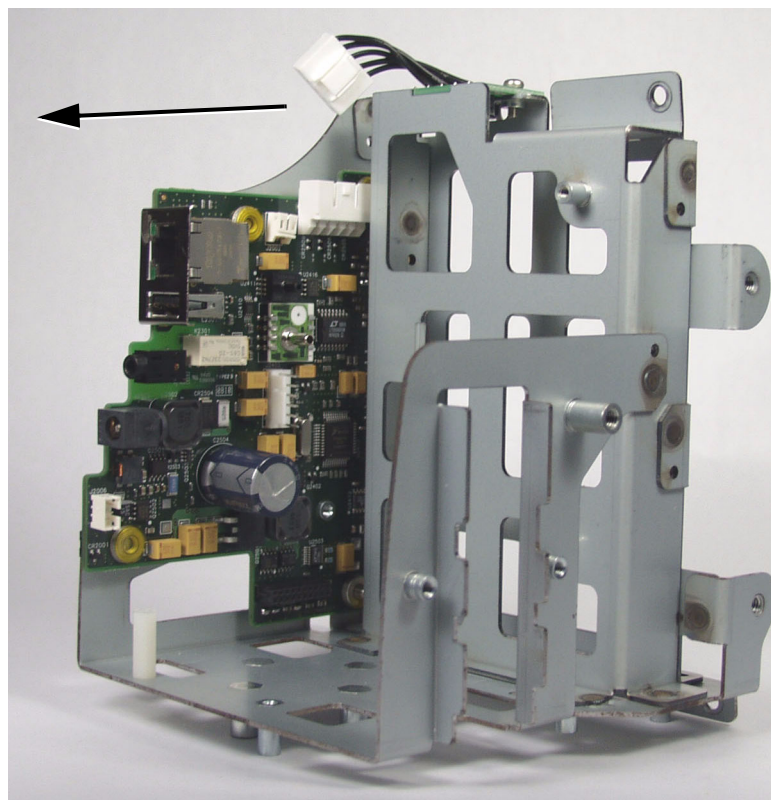
6. Disconnect the Battery board cable from the connector.



7. Remove the four Torx T20 screws on the Main Chassis.



8. Gently pull the board away from the chassis.

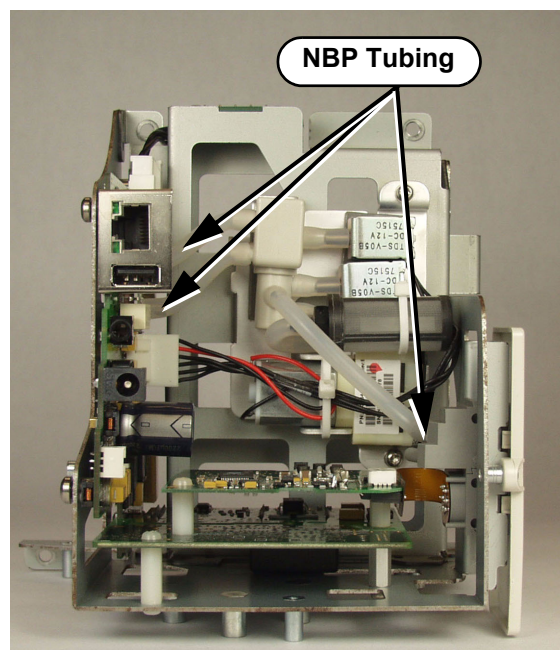


Removing the NBP Module

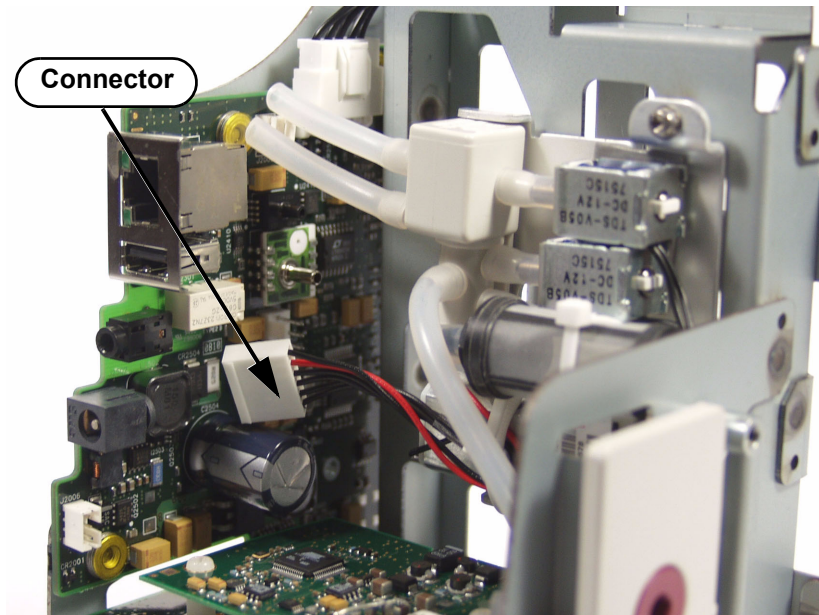
Caution After you replace the NBP module, you must reset the NBP cycle count and run the NBP test. For information on resetting the NBP cycle count, see “Viewing and Resetting Tracked Parameters” on page 6-32. For information on running the NBP test, see “NBP Test” on page 5-9.

To remove the NBP module:

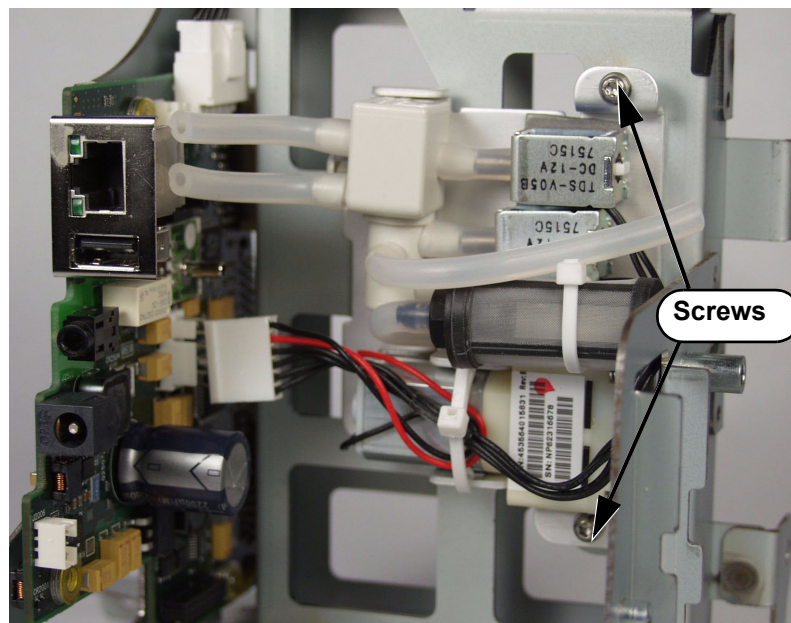
1. Separate the front panel assembly from the rear case. See “Removing the Rear Case” on page 7-10.
2. “Removing the Main Chassis Assembly” on page 7-13.
3. Disconnect the NBP tubing.



4. Disconnect the NBP connector from the Daughter board.



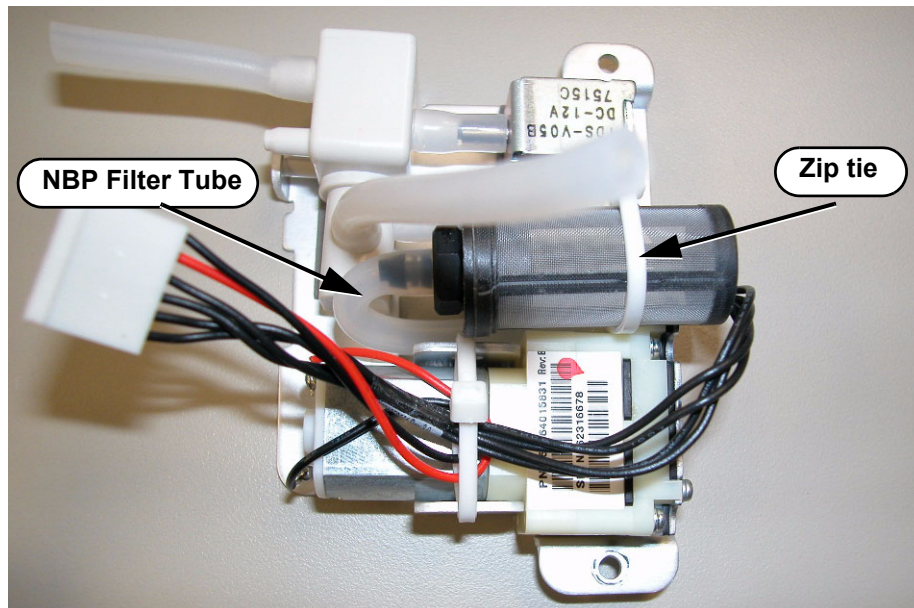
5. Remove two Torx T10 screws and washers from the metal bracket holding the NBP module assembly to the bottom of the main board.



Removing the NBP Filter

To remove the NBP filter:

1. Remove the NBP module. See “Removing the NBP Module” on page 7-24.
2. Use wire cutters to cut the plastic zip tie securing the filter to the module, and disconnect the filter from the NBP filter tube.



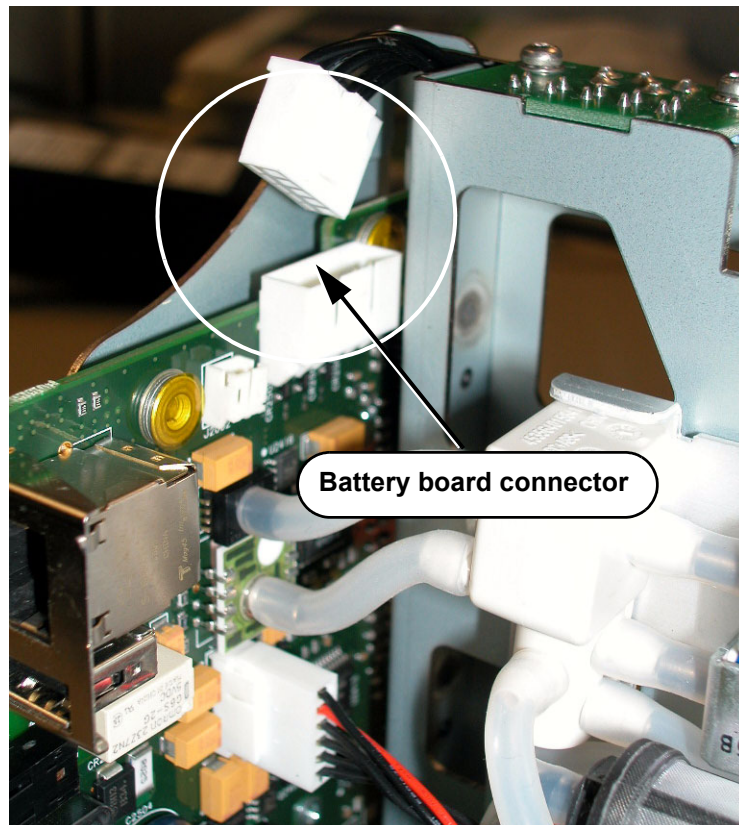
Caution When you replace the NBP filter, secure it to the NBP module with a new plastic zip tie.

Removing the Battery Connector Board

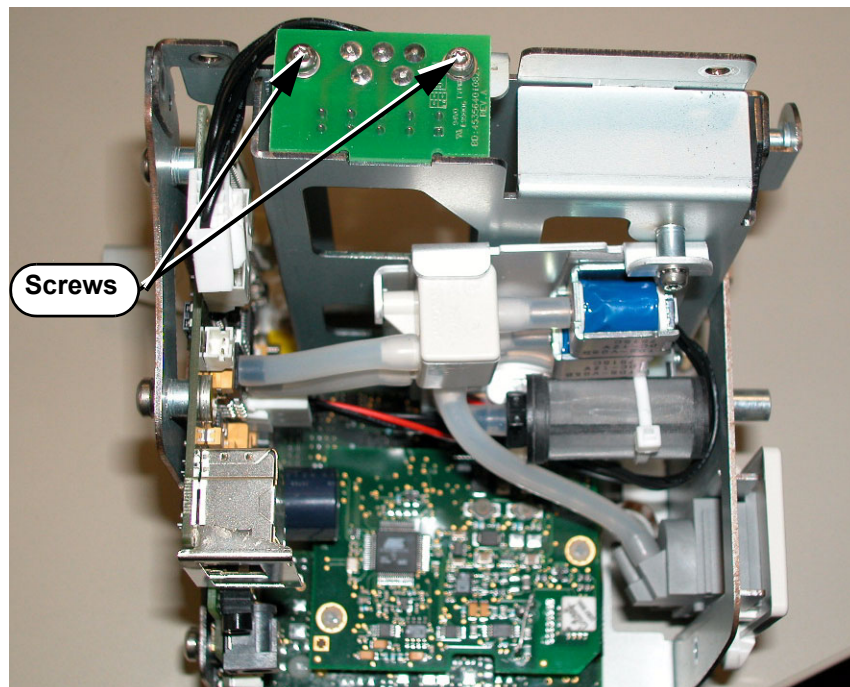
To remove the battery connector board:

1. Separate the front and rear monitor case assemblies. See “Removing the Rear Case” on page 7-10.
2. Remove the main chassis assembly. See “Removing the Main Chassis Assembly” on page 7-13.

3. Disconnect the battery board connector from the Daughter board.



4. Remove the two Torx T10 screws and washers holding the battery connector board.



5. Lift the board away from the chassis and remove it.

Removing the Navigation Wheel Assembly

To remove the navigation wheel assembly board:

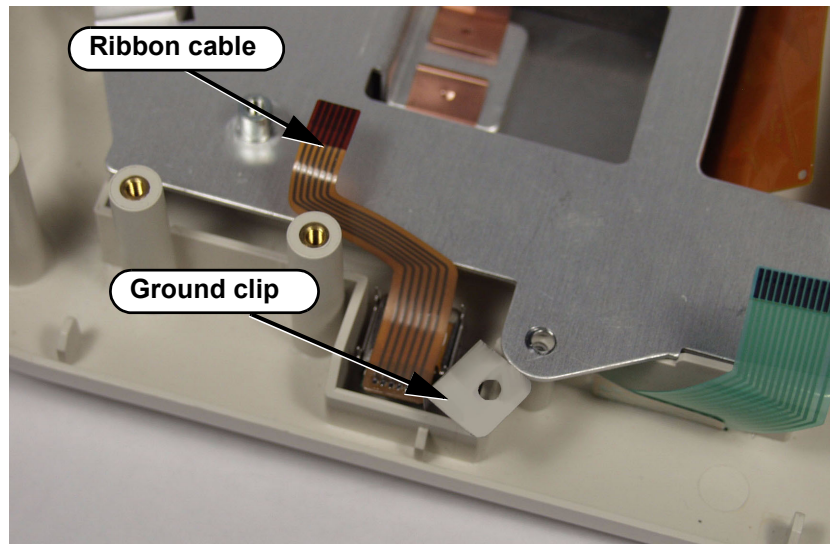
1. Separate the front and rear monitor case assemblies. See “Removing the Rear Case” on page 7-10.
2. Pull the wheel off of the stem.



3. Remove the locking nut and washer.



4. Disconnect the ribbon cable and remove the screw from the ground clip.



5. Remove the Navigation wheel assembly from the front panel.

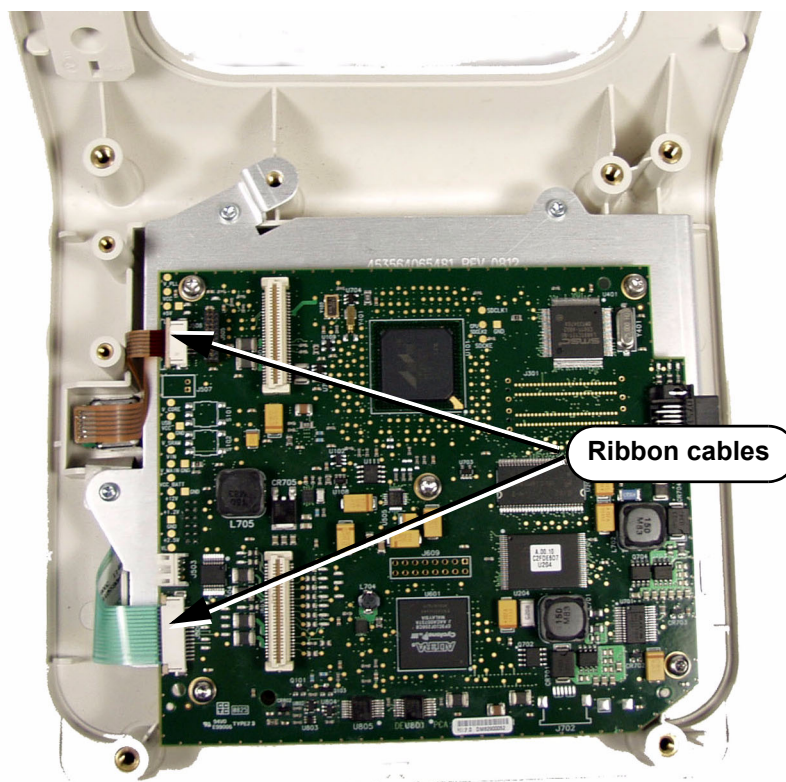


Removing the Main Board

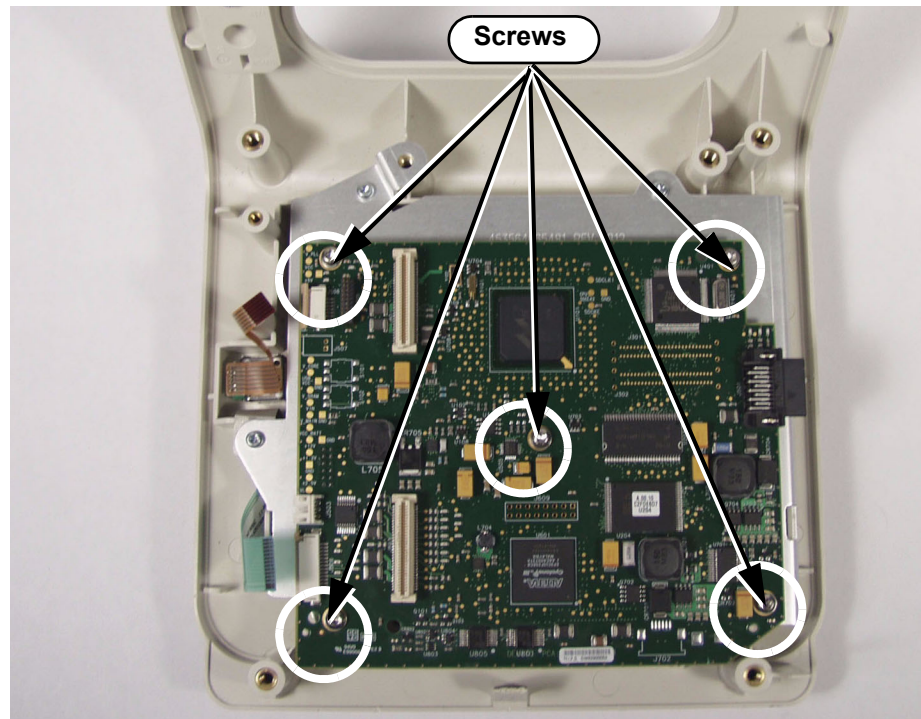
Caution To save your current configuration settings, export them before you replace the main board. For more information, see “Exporting Configuration Settings” on page 4-14. After you replace the main board, you must reset the monitor serial number and reconfigure the system. For information on resetting the serial number, see “Resetting the Serial Number” on page 7-32. For information about importing previous configuration settings, see “Importing Configuration Settings” on page 4-17.

To remove the main board:

1. Separate the front and rear monitor case assemblies. See “Removing the Rear Case” on page 7-10.
2. Remove the main Chassis assembly. See “Removing the Main Chassis Assembly” on page 7-13.
3. Disconnect the ribbon cables from the Main board.

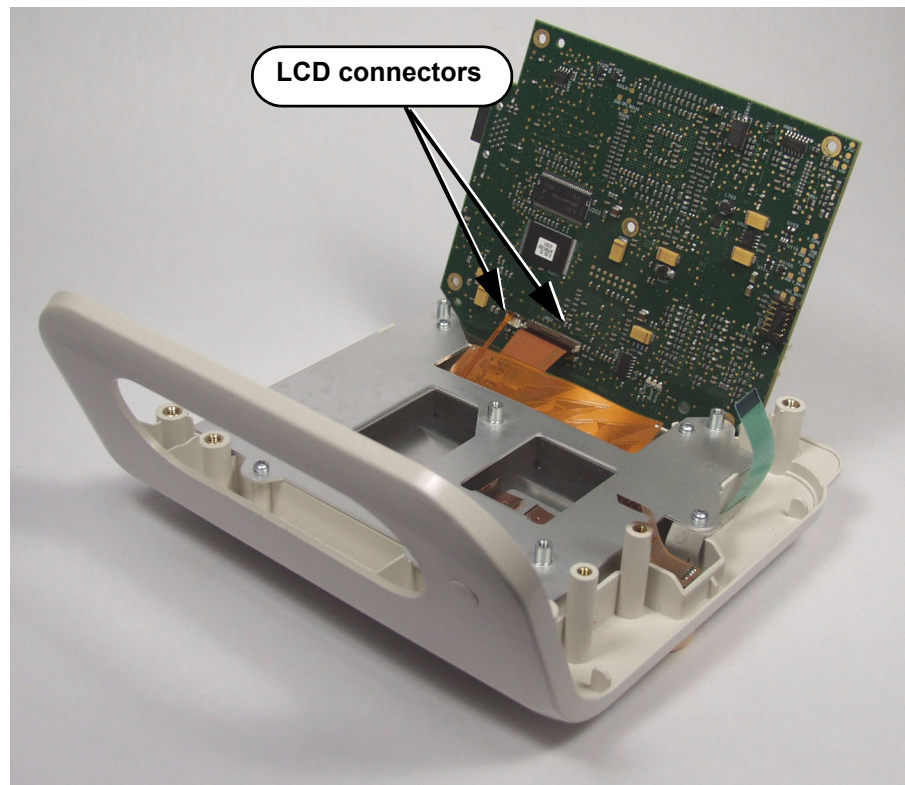


4. Remove the five Torx T10 screws from the main board.



5. Disconnect the LCD ribbon cables from the main board.

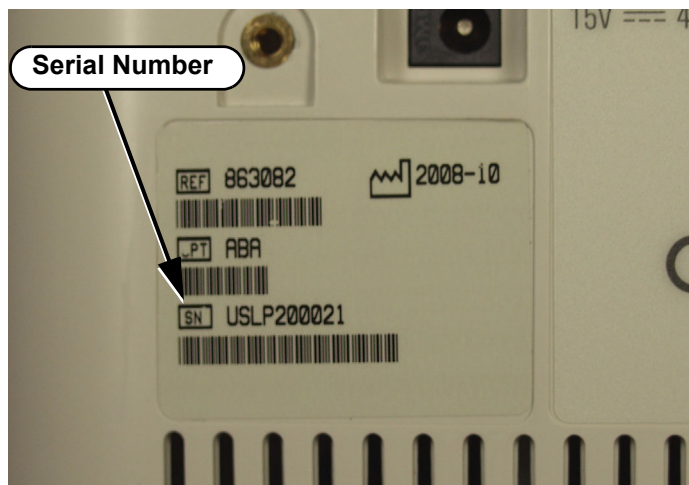
Caution The small ribbon cable is fragile. Use caution and remove it gently.



6. Remove the main board from the assembly.
7. After you replace the main board and reassemble the monitor, you must perform the following procedures before use:
 - “Resetting the Serial Number” on page 7-32.
 - “Setting the System Configuration” on page 7-34 or “Importing Configuration Settings” on page 4-17.

Resetting the Serial Number

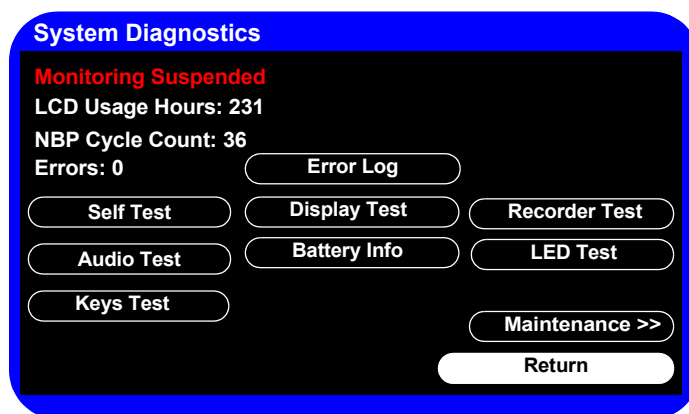
When you replace the main board, you must reset the unit’s serial number. The serial number appears in a label (marked **SN**) on the back of the monitor.



To reset a serial number:

1. Access the **System Diagnostics** menu using the **Diagnostics** button on the **Service Menu** in the **System Admin Menu**. For detailed information, see “Accessing the Service Menu” on page 4-12.
2. In the **Service Menu**, rotate the wheel until the **Diagnostics** button is highlighted and then press the wheel.

The **System Diagnostics** menu appears.

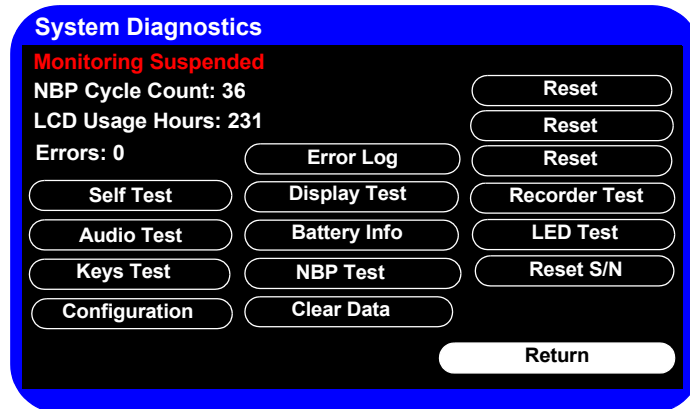


3. Rotate the wheel until the **Maintenance >>** button is highlighted and press the wheel.

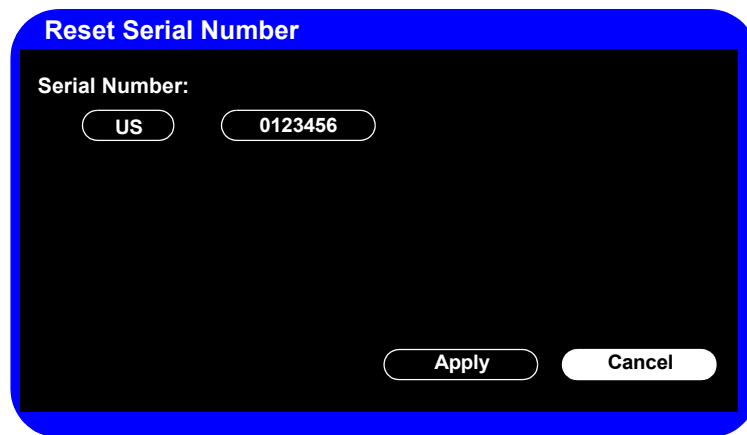
4. In the window that appears, enter the password, **1-2-9**, as shown:



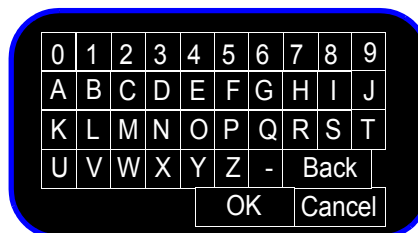
The complete **System Diagnostics** menu, including the **Maintenance** options, appears.



5. Turn the wheel to highlight the **Reset S/N** button and press the wheel.
The **Reset Serial Number** window appears.



6. Rotate the wheel to the country button, push the wheel and select the letters that correspond to those shown on your monitor.
7. Rotate the wheel to the serial number button, and then push the wheel.
A keyboard appears.



8. Use the wheel to enter the serial number.
9. Press **Back** to backspace, **Cancel** to close the keyboard without saving, or **OK** to save the changes.

10. Rotate the wheel to select the **Apply** button, and then push the wheel to save the change.
 11. In the window that appears, rotate the wheel to select **OK**.
- The monitor restarts.

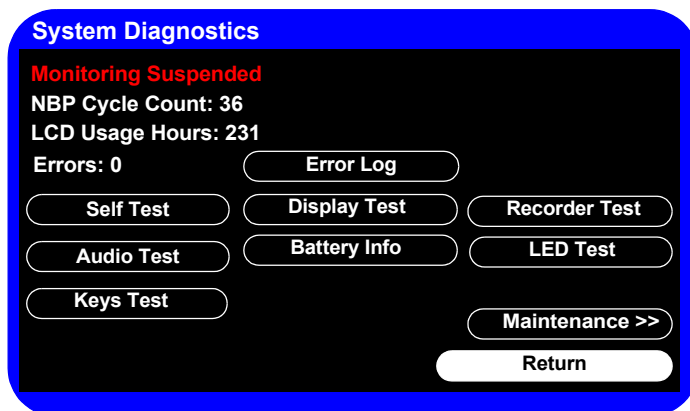
Setting the System Configuration

When the monitor performs a self test, it first checks its system configuration. If you replace the main board in the unit, you must reprogram the system configuration.

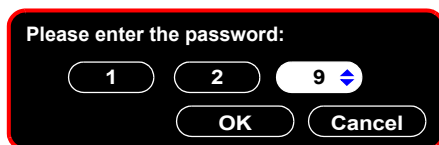
Caution The system configuration settings must match the hardware installed on the monitor. Incorrect settings can damage the monitor.

To reset the system configuration:

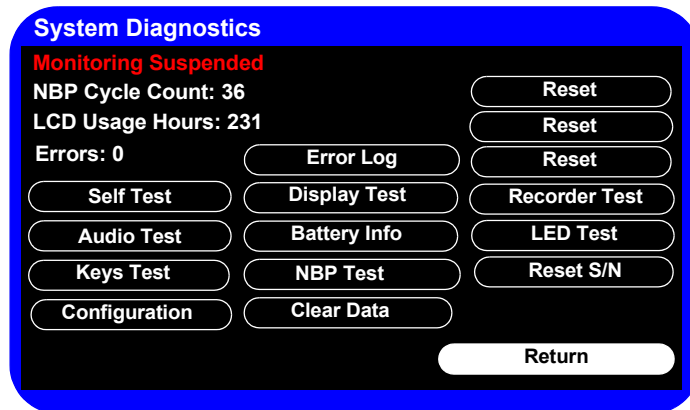
1. In the **Service Menu**, rotate the wheel until the **Diagnostics** button is highlighted and then press the wheel.
- The **System Diagnostics** window appears.



2. Select the **Maintenance >>** button and press the wheel.
3. In the window that appears, enter the password, **1-2-9**, as shown:

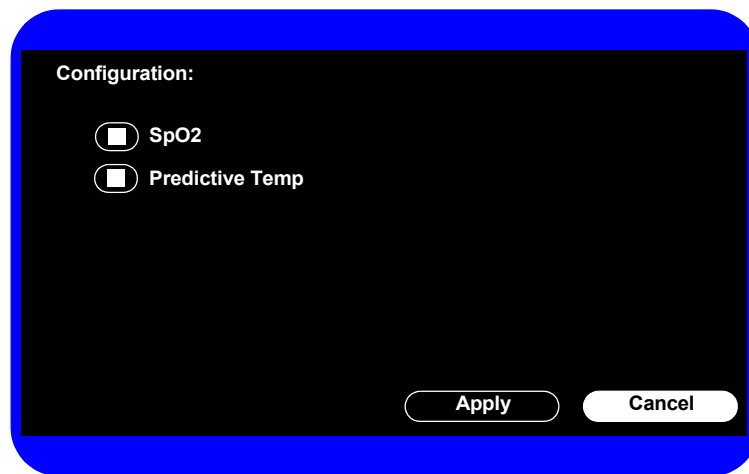


The complete **System Diagnostics** menu, including the **Maintenance** options, appears.



4. In the **System Diagnostics** window, rotate the wheel to highlight the **Configuration** button, and then press the wheel.

The **Configuration** menu appears:



5. Rotate the wheel and press it to place a check mark by each option to be used.
6. Rotate the wheel to highlight the **Apply** button, and then press the wheel.
7. In the window that appears, rotate the wheel to select **OK** and then press the wheel.

The monitor restarts.

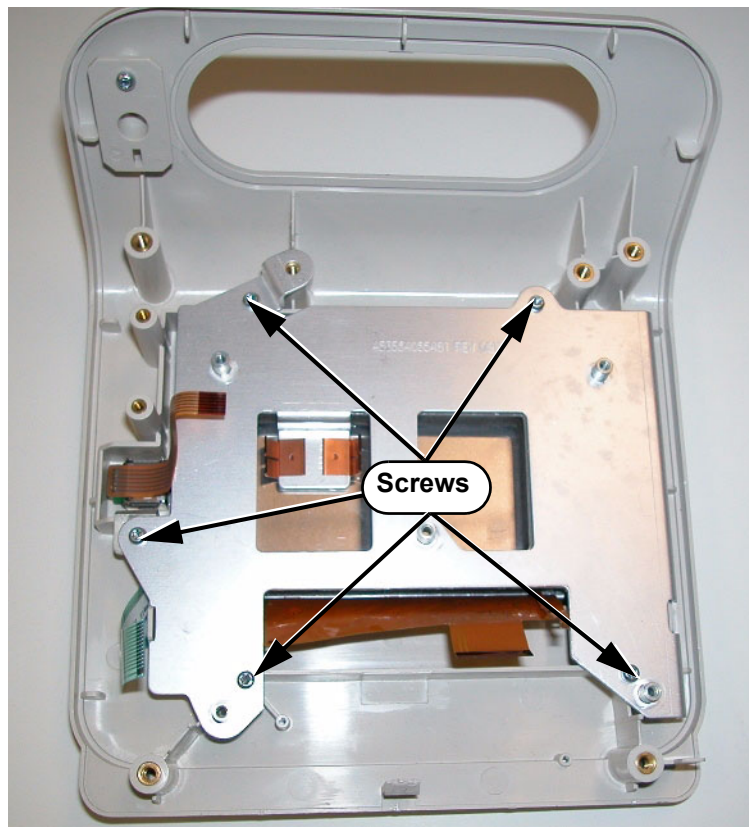
Removing the LCD

Caution After you replace the LCD, you must reset the LCD Usage Hours. For more information on resetting the LCD Usage Hours, see “Viewing and Resetting Tracked Parameters” on page 6-32.

Caution Perform this procedure in a dust-free environment to avoid damage to the LCD display.

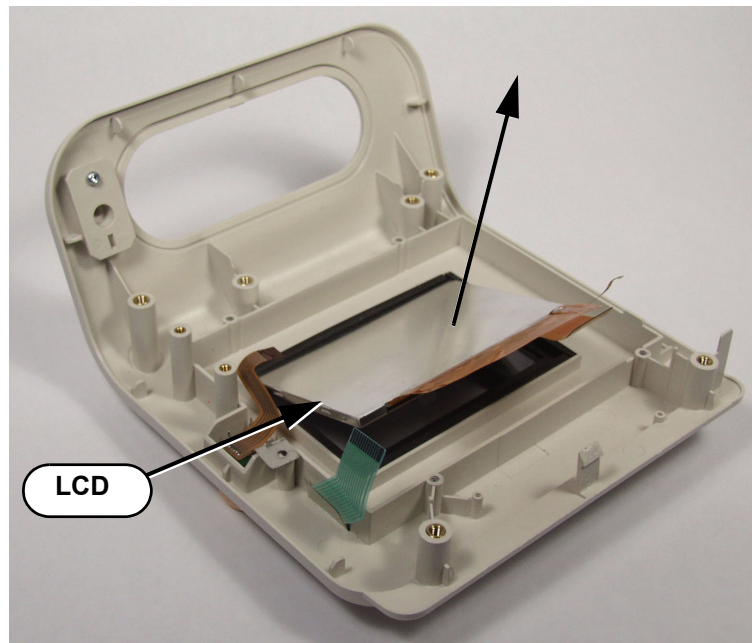
To remove the LCD:

1. Separate the front and rear monitor case assemblies. See “Removing the Rear Case” on page 7-10.
2. Remove the Main Chassis. See “Removing the Main Chassis Assembly” on page 7-13.
3. Remove the Main board. See “Removing the Main Board” on page 7-30.
4. Remove the five Torx T10 screws that hold the LCD frame in place.



5. Lift off the LCD frame.

6. Remove the LCD from the front panel.



Replacement Parts and Assembly Drawings

Spare Parts

The following table lists the SureSigns VS2 spare parts, their Philips part numbers, and in which of the following figures they appear. See “Assembly Drawings” on page 8-3 for the referenced figures.

Note — For clarity, some screws and connector lines do not appear in the drawings.

Description	Part Number	Figure	Item
Barcode Scanner	4535 640 51331	8-2	22
Battery (lithium ion)	989 803 144631	Not Shown	
Battery connector PCB	4535 640 95491	8-2	12
Bracket, power supply, for roll stand	989 803 160321	Not Shown	
Bracket, power supply, for wall mount	989 803 161091	Not Shown	
Cable – Temperature	4535 640 95481	Not Shown	
Connector panel assembly	4535 640 95681	8-2	14
Connector block, NBP	4535 640 95641	8-2	14
Connector block, SpO ₂	4535 640 95631	8-2	14
Cover (faceplate, without recorder)	4535 641 31711	8-2	21
Daughter PCB	4535 640 95611	8-2	10
SpO ₂ Adapter PCB	4535 640 95621	8-2	16
Front panel without LCD	4535 640 95571	8-1	5
LCD assembly	4535 640 95501	8-1	4
LCD frame	4535 640 95531	8-1	3
Main PCB	4535 640 95601	8-1	1
Navigation wheel assembly	4535 640 95551	8-1	2
NBP filter, replacement	4535 640 41171	8-2	11A
NBP pump/valve assembly with filter	4535 640 20461	8-2	11
Power supply (external)	4535 641 21021	Not shown	
Rear case	4535 640 95521	8-2	7
Recorder assembly	4535 640 95691	8-2	20
Roll stand with power supply bracket	989 803 161281	Not shown	

Description	Part Number	Figure	Item
RS-232 serial adapter (includes USB hub, insulator sheath, and USB clamp)	9898 031 59601	Not shown	
Small parts kit:	4535 640 95561	Not shown	
– Rubber feet (4)		Not shown	
– Battery case cover (1)		8-2	19
– Navigation wheel (1)		8-1	6
– M3 x 0.5 10 mm screws (5)		Not shown	
– M3 x 0.5 12 mm screws (2)		Not shown	
– M4 x 0.7 12 mm screws (6)		Not shown	
– Ground strip (1)		8-1	2
– O-ring		8-2	8
– Power cord retainer clip		Not shown	
Speaker	4535 640 24681	8-2	9
SpO ₂ PCB	4535 641 31451	8-2	15
Temperature calibration key	4535 640 33691	Not shown	
Temperature module	4535 641 21011	8-2	17
Temperature adapter PCB	4535 640 95591	8-2	18
USB Hub	4535 640 39661	Not shown	
Wall mount with power supply bracket	989 803 161291	Not shown	
Wireless assembly replacement kit	4535 641 04781	Not shown	

Assembly Drawings

See “Spare Parts” on page 8-1 for the part numbers referenced in the following figures.

Figure 8-1 Front Panel Assembly

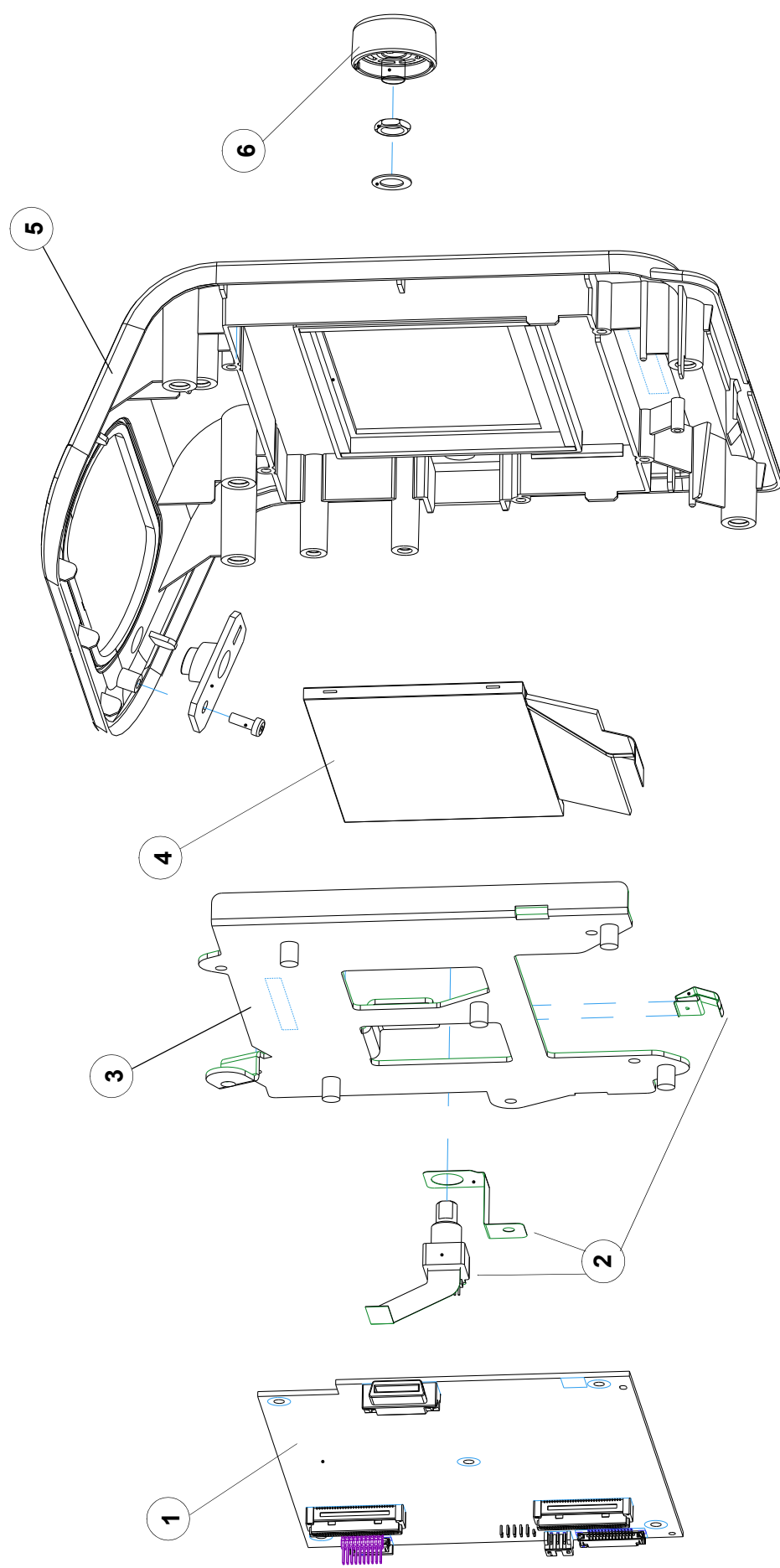
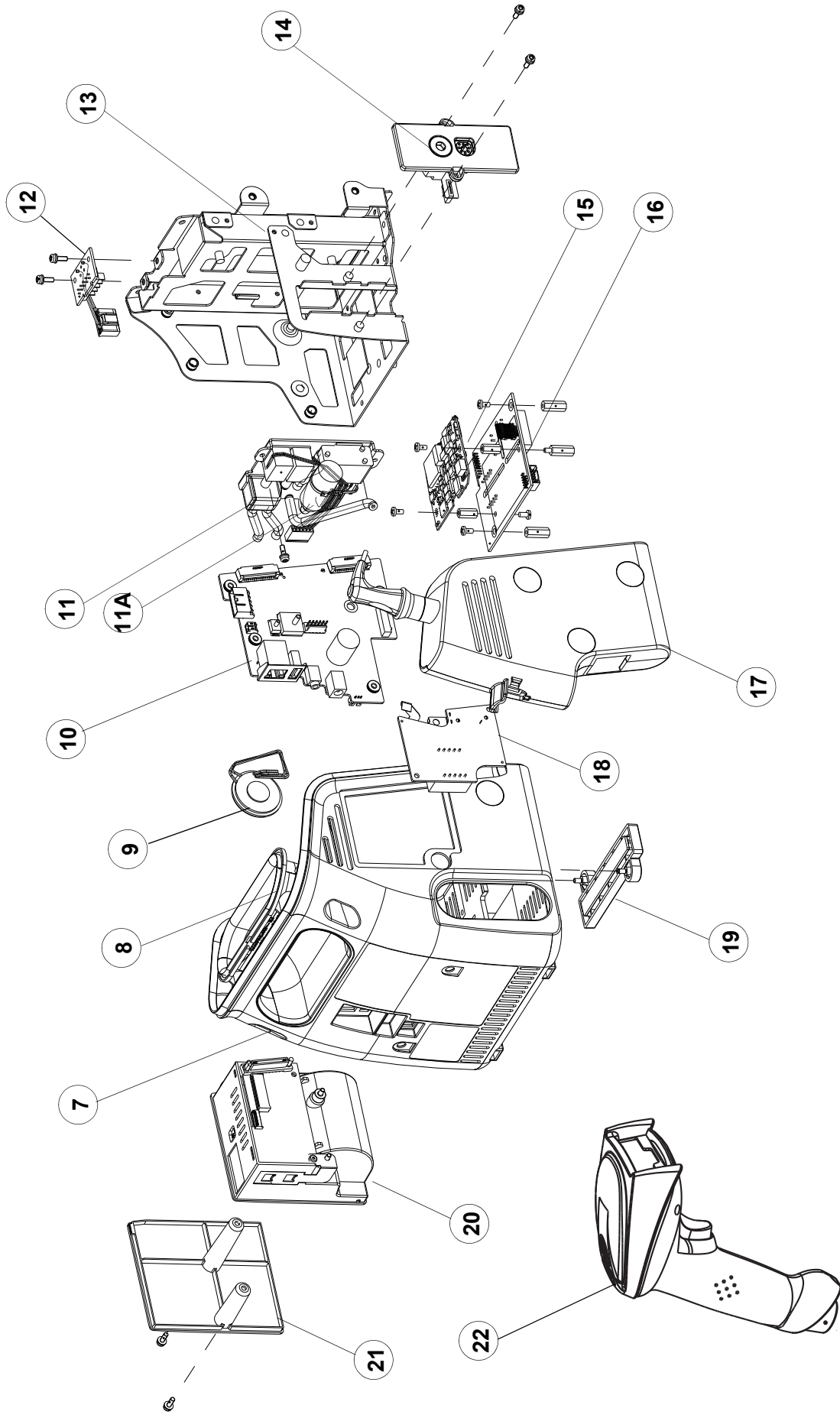


Figure 8-2 Rear Case and Main Chassis Assembly



Power Supply Cords

The following table lists the power supply cord part number and description.

Description	Part Number
Power cord (903), 2.4 m Taiwan, US, Canada, Latin America, Singapore, Caribbean, Laos	8120-5429
Power cord (902), 2 m Portugal, Korea, Russia, South America, Indonesia, West Indies, Libya	8120-1689
Power cord (906), 2 m Switzerland	8120-2104
Power cord (917), 2 m India, South Africa	8120-4211
Power cord (901), 2 m Australia, New Zealand	8120-4475
Power cord (902), 2 m France, Germany, Luxemburg	8120-6869
Power cord (919), 2 m Israel	8120-5182
Power cord (900), 2 m United Kingdom, Singapore, Hong Kong	8120-1351

A

Theory of Operation

Overview

This section contains a system overview of the SureSigns VS2 vital signs monitor, including a high-level block diagram. This block diagram shows major components of the monitor, including the power supply, an isolated front end, the NBP control, SpO₂ processing, and a microcontroller.

The monitor is a full function monitor for use on adult, pediatric, and neonatal patients. The measurements performed by the system include:

- Blood pressure
- Blood oxygen saturation
- Temperature

In addition to monitoring and displaying the status of physiological parameters, the monitor performs various microprocessor-programmed analytical functions, including:

- Creating both visual and audible alarm signals when settings are violated
- Creating and displaying warning messages when conditions are detected that would degrade or prevent valid measurements
- Providing input to an optional recorder for printout of current or trend waveforms or tabular data

The SureSigns VS2 monitor operates from either an AC power source or battery power. The monitor charges the battery when powered by an AC line.

Block Diagram Components

The SureSigns VS2 monitor contains several major blocks, including:

- Main PCB
- Daughter PCB
- SpO₂ Adapter PCB
- Temperature Adapter PCB

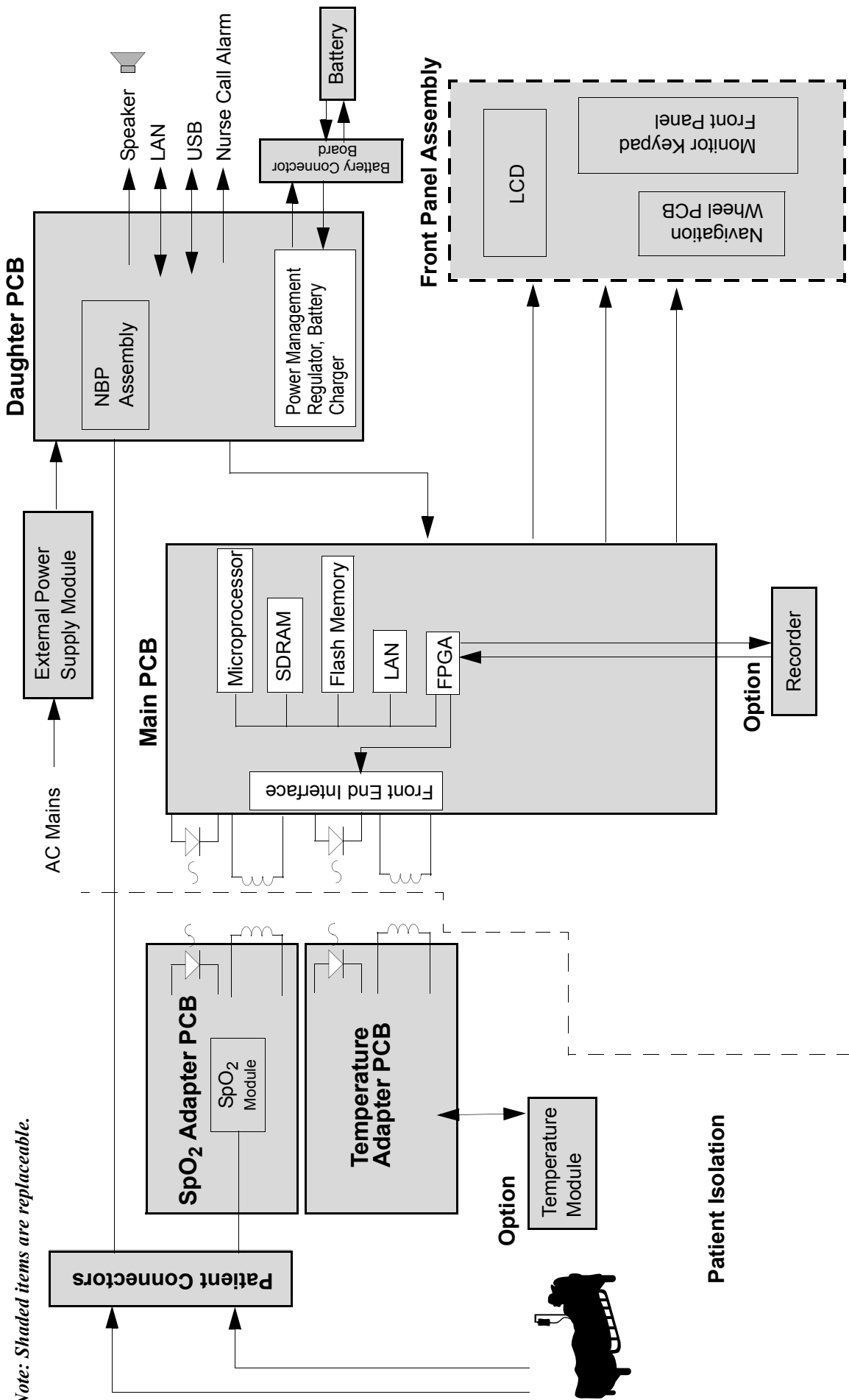
In addition, the SureSigns VS2 monitor may contain optional modules.

Note — Shaded blocks (and items) in the diagram indicate parts that are field replaceable. For more information, see Chapter 8, “Replacement Parts and Assembly Drawings.”

The following sections briefly describe many of the functional units in the block diagram.

Block Diagram

Note: Shaded items are replaceable.



Main PCB

The main PCB contains the following components:

- PXA270 microprocessor
 - 32 MB flash memory
 - 64 MB SDRAM
- LAN controller—10/100T
- FPGA

Daughter PCB

The Daughter PCB contains the following components:

- NBP circuit
- Power management and regulation circuit
- Smart battery interface and charge
- Connectors
 - DC power input
 - Nurse call alarm
 - Speaker
 - USB
 - LAN
 - B2B: SpO2 Interface PCB
 - B2B: Main PCB
 - B2B: Recorder

NBP Assembly and Circuitry

The NBP assembly and circuitry contain these elements:

- Pump
- Valves (2-valve system of dump and safety valve)
- Manifold
- Filter
- Pressure measurement and control circuitry

Pressure data is converted to digital format and conveyed to the processor. The NBP pump uses an oscillometric method that employs stepwise pressure deflation. Pump software eliminates most ambient noise and motion interference. Applications are neonatal, pediatric and adult patients. The blood pressure range is: Systolic, 30-255 mmHg and Diastolic, 15-220 mmHg. Accuracy is ± 5 mmHg, with standard deviation no greater than 8 mmHg.

NBP processing uses an oscillometric technique to provide needed measurements at selected intervals. This technique uses an inflatable sphygmomanometer cuff similar to those used by clinicians in routine measurements. At the default initial inflation pressure, a motorized pump inflates the cuff to approximately 160 mmHg (adult mode) initially, at which point the pressure effectively stops the flow of blood. Then, under monitor control, the pressure in the cuff is gradually reduced, while a pressure transducer detects the pressure and transmits the parameter signal to the NBP input circuitry. As the pressure is reduced, blood flows in the previously occluded artery, and changes the measurements made by the transducer. The point at which oscillation increases sharply is defined as systolic pressure. As the

cuff continues to deflate, the oscillation amplitude increases to a maximum, and then decreases. The peak oscillation amplitude is defined as the mean arterial pressure. The point at which the system detects a rapid decrease in oscillation is defined as the diastolic pressure.

Power Management

The power management module contains:

- Li + battery
 - 11.1 V
 - 7200 mAH
- Smart battery charger
- DC/DC converter

The power management circuitry charges a Li-Ion battery through a *smart* battery charger. Both the battery and the AC/DC power module can power the system through several DC/DC converters that provide various voltage outputs required by various chips. Isolated transformers provide the power to the front ends floating area.

Speaker

The speaker is driven by an amplifier and Audio CODEC that interfaces to the microprocessor. The speaker provides the monitor's audio during alarm conditions. The microprocessor outputs different audio tones specified by different alarm priorities and conditions.

Nurse Call Contacts

The nurse call alarm contacts are available through a 3.5mm, miniature insulated phone jack on the back of the unit. The alarm contacts close (open) for any alarm condition detected by the monitor.

The alarm contacts are the three switching signals associated with a single pole, double throw relay. These are the:

- Normally open contact (NO)
- Common contact
- Normally closed contact (NC)

Contact Rating of:

NO = 1A @ < 25Vac

Common contact = 1A @ < 60Vdc

Isolation of 1.5Kv

SpO₂ Adapter PCB

Contains isolation circuitry:

- Opto-isolators to provide isolated communication to and from the SpO₂ module.
- Power transformer and power supply circuit to provide isolated power for the SpO₂ module.

Temperature Adapter PCB

Contains isolation circuitry:

- Opto-isolators to provide isolated communication to and from the Temperature module.
- Power transformer and power supply circuit to provide isolated power for the Temperature module.

Front Panel Assembly

The front panel assembly contains these elements:

- LCD
 - 4.3" WVGA display
 - 480 pixels x 272 lines
- Monitor keypad
- Navigation wheel

Navigation Wheel

The navigation wheel is a rotating, push-switch wheel. The associated wheel circuitry generates a pulse when pressed and generates a digitally encoded pair of quadrature signals whose relative magnitudes and polarities represent the angular position of the wheel. These outputs are connected to the microprocessor where they are interpreted as required for the functions involved. Successive angular positions determine the direction of wheel rotation. In addition to the functions performed in conjunction with the keypad, the wheel operates in conjunction with the display to select menus and lists of parameter variables.

Power Supply Module

The external power supply module is a medical grade power supply module and contains circuitry that converts AC lines (100–240V) to DC (15V). The maximum power consumption is 75 VA.

Recorder

The recorder contains these components:

- Digital thermal head array assembly
- Printing width
 - 48mm on 58mm paper
 - Resolution:
 - Time axis = 16 dots/mm at the speed of ≤ 25 mm/sec, 8 dots/mm at 50 mm/sec
 - Voltage axis = 8 dots/mm
- Motor (paper drive) and driver circuitry
- Paper out/door open detector

Print head control logic is implemented in the FPGA, which is located on the main PCB.

SpO₂ Module

The SpO₂ module is a measure oxygen saturation in the blood that using an optical spectrophotometry technique. The technique is based on the differences in the absorption of red and infrared light by oxygenated and de-oxygenated Hemoglobin.

A pulse oximeter passes red and infrared light into an arteriolar bed and measures changes in light absorption during the pulsatile cycle. The light sources are red and infrared light emitting diodes (LEDs). A photo diode provides detection.

To identify the oxygen saturation of arterial hemoglobin, the SureSigns VS2 monitor uses the pulsatile nature of arterial flow. During systole, a new pulse of arterial blood enters the vacuolar bed, and both blood volume and light absorption increase. During diastole, blood volume and light absorption reach their lowest point. The measurement is based on the difference between maximum and minimum absorption, focusing on the pulsatile arterial blood. In addition to the oximetry function, the measurement can also provide the heart rate.

Temperature

The temperature module is a fully integrated microprocessor-based thermistor thermometer that takes oral, axillary, and rectal temperatures for all patient populations. The module provides two types of temperature measurement:

- Predictive
- Monitored

Predictive Measurements

In Predictive mode, the monitor measures the patient's temperature for approximately 4 seconds for oral measurements and approximately 16 seconds for axillary and rectal measurements. The monitor then displays the final measurement.

If the monitor cannot get a reading after 1 minute, it automatically switches to Monitored mode.

Monitored Measurements

In Monitored mode, the monitor measures the patient's temperature continuously and displays the temperature in the numeric pane as long as the probe is in contact with the patient. You use Monitored mode when a situation prevents accurate predictive measurement.

Note — Temperature measurements taken in Monitored mode are not saved to a patient record.

Electromagnetic Compatibility

This appendix lists the tests and compliance levels that make the SureSigns VS2 vital signs monitor suitable for use in the specified electromagnetic environment according to IEC 60601-1-2:2001.

Instructions for Use

Medical electrical equipment can either generate or receive electromagnetic interference. This product has been evaluated for electromagnetic compatibility (EMC) with the appropriate accessories according to IEC 60601-1-2:2001, the international standard for EMC for medical electrical equipment. This IEC standard has been adopted in the European Union as the European Norm, EN 60601-1-2:2001.

Radio frequency (RF) interference from nearby transmitting devices can degrade performance of the product. Electromagnetic compatibility with surrounding devices should be assessed prior to using the product.

Fixed, portable, and mobile radio frequency communications equipment can also affect the performance of medical equipment. See your service provider for assistance with the minimum recommended separation distance between RF communications equipment and the product.

The cables, sensors/transducers, and other accessories for which compliance is claimed are listed earlier in this manual.

Warning

- **Use of accessories, transducers, and cables other than those specified may result in increased emissions and/or decreased immunity of the SureSigns VS2 vital signs monitor.**
 - **The SureSigns VS2 vital signs monitor should not be used adjacent to or stacked with other equipment. If adjacent or stacked use is necessary, the monitor should be observed to verify normal operation in the configuration in which it is used.**
-
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Reducing Electromagnetic Interference

The SureSigns VS2 vital signs monitor and associated accessories can be susceptible to interference from other RF energy sources and continuous, repetitive, power line bursts. Examples of other sources of RF interference are other medical electrical devices, cellular products, information technology equipment, and radio/television transmission. If interference is encountered, as demonstrated dramatic variations in physiological parameter measurement values, attempt to locate the source. Assess the following:

- Is the interference due to misplaced or poorly applied sensors? If so, re-apply sensors correctly according to directions in the product's *Instructions for Use*.
- Is the interference intermittent or constant?
- Does the interference occur only in certain locations?
- Does the interference occur only when in close proximity to certain medical electrical equipment?
- Do parameter measurement values change dramatically when the AC line cord is unplugged?

Once the source is located, attempt to attenuate the interference by distancing the product from the source as much as possible. If assistance is needed, contact your local service representative.

Emissions and Immunity

The SureSigns VS2 vital signs monitor is designed and evaluated to comply with the emissions and immunity requirements of international and national EMC standards. See Tables 1 through 4 for detailed information regarding declaration and guidance.

The EMC standards state that manufacturers of patient-coupled equipment must specify immunity levels for their systems. See Tables 2 and 3 for this detailed immunity information. See Table 4 for recommended minimum separation distances between portable and mobile communications equipment and the product.

Immunity is defined in the standard as the ability of a system to perform without degradation in the presence of an electromagnetic disturbance. Degradation in system performance is a qualitative assessment which can be subjective.

Caution should, therefore, be taken in comparing immunity levels of different devices. The criteria used for degradation is not specified by the standard and can vary with the manufacturer.

Guidance and Manufacturer's Declaration

The SureSigns VS2 vital signs monitor is intended for use in the electromagnetic environment specified in the following tables. The customer or the user of the product should assure that it is used in such an environment.


Table 1. Electromagnetic Emissions

Emissions Test	Compliance	Electromagnetic Environment Guidance
RF emissions CISPR 11	Group 1	The SureSigns VS2 vital signs monitor uses RF energy only for its internal function. Therefore, RF emissions are very low and not likely to cause any interference in nearby electronic equipment. The SureSigns VS2 vital signs monitor is suitable for use in all establishments other than domestic establishments and those directly connected to a low voltage power supply network which supplies building used for domestic purposes.
RF emissions CISPR 11	Class A	
Harmonic emissions IEC 61000-3-2	Class A	
Voltage fluctuations/flicker emissions IEC 61000-3-3	Complies	

Table 2. Electromagnetic Immunity (ESD, EFT, Surge, Dips and Magnetic Field)

Immunity Test	IEC 60601 Test Level	Compliance Level	Electromagnetic Environment - Guidance
Electrostatic discharge (ESD) IEC 61000-4-2	± 6 kV contact ± 8 kV air	± 6 kV contact ± 8 kV air	Floors should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC 61000-4-4	± 1 kV differential mode ± 2 kV common mode	± 1 kV ± 2 kV	In the event of reduced performance, it may be necessary to operate the patient monitor from a filtered power connection or battery power (no electrical connection to the AC mains while monitoring).
Surge IEC 61000-4-5	± 1 kV differential mode ± 2 kV common mode	± 1 kV ± 2 kV	Mains power quality should be that of a typical commercial and/or hospital environment.
Voltage dips, short interruptions, and voltage variations on power supply input lines IEC 61000-4-11	$< 5\% U_T$ $(> 95\% \text{ dip in } U_T)$ for 0,5 cycle $40\% U_T$ $(60\% \text{ dip in } U_T)$ for 5 cycles $70\% U_T$ $(30\% \text{ dip in } U_T)$ for 25 cycles $< 5\% U_T$ $(> 95\% \text{ dip in } U_T)$ for 5 sec	$< 5\% U_T$ $40\% U_T$ $70\% U_T$ $< 5\% U_T$	
Power frequency (50/60 Hz) Magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
Note: U_T is the AC mains voltage prior to application of the test level.			

Table 3. Electromagnetic Immunity (RF Radiated and Conducted)

Immunity Test	IEC 60601 Test Level	Compliance Level	Electromagnetic Environment - Guidance
			Portable and mobile RF communications equipment should be used no closer to any part of the SureSigns VS2 vital signs monitor, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.
Conducted RF IEC 61000-4-6	3 Vrms 0.15 to 80 MHz Outside ISM bands	3 V rms	Recommended Separation Distance $d = \left[\frac{3.5}{3} \right] \sqrt{P} \text{ ; 0.150 to 80 MHz}$
Radiated RF IEC 61000-4-3	3 V/m 80 to 2500 MHz	3 V/m	$d = \left[\frac{3.5}{3} \right] \sqrt{P} \text{ ; 80 to 800 MHz}$ $d = \left[\frac{7}{3} \right] \sqrt{P} \text{ ; 800 to 2500 MHz}$ <p>where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m).</p> <p>Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey,^a should be less than the compliance level in each frequency range.^b</p> <p>Interference may occur in the vicinity of equipment marked with the following symbol:</p> 
<p>^a Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the SureSigns VS2 vital signs monitor is used exceeds the applicable RF compliance level above, the SureSigns VS2 vital signs monitor should be observed to verify normal operation. If abnormal performance is observed, additional measures are necessary, such as re-orienting or relocating the SureSigns VS2 vital signs monitor.</p> <p>^b Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m. Respiration measurement may be subject to interference at 900 - 1100 kHz and 70 - 80 MHz at less than 3 V/M field strength.</p>			

Recommended Separation Distances

The SureSigns VS2 vital signs monitor is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the product can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the product as recommended below, according to the maximum output power of the communications equipment.

Table 4. Recommended Separation Distances Between Portable and Mobile RF Communication Equipment and the SureSigns VS2 Vital Signs Monitor

Frequency of Transmitter	150 kHz to 80 MHz	80 to 800 MHz	800 MHz to 2.5 GHz
Equation	$d = \left[\frac{3.5}{3} \right] \sqrt{P}$	$d = \left[\frac{3.5}{3} \right] \sqrt{P}$	$d = \left[\frac{7}{3} \right] \sqrt{P}$
Rated Maximum Output Power of Transmitter (Watts)	Separation Distance (d) (meters)	Separation Distance (d) (meters)	Separation Distance (d) (meters)
0.01	0.12	0.12	0.23
0.1	0.37	0.37	0.74
1	1.17	1.17	2.33
10	3.69	3.69	7.38
100	11.67	11.67	23.33
<p>For transmitters rated at a maximum output power not listed above, the separation distance d can be estimated, in meters, using the equation in the corresponding column, where P is the maximum output power rating of the transmitter in watts according to the transmitter's manufacturer.</p> <p>These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.</p>			

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