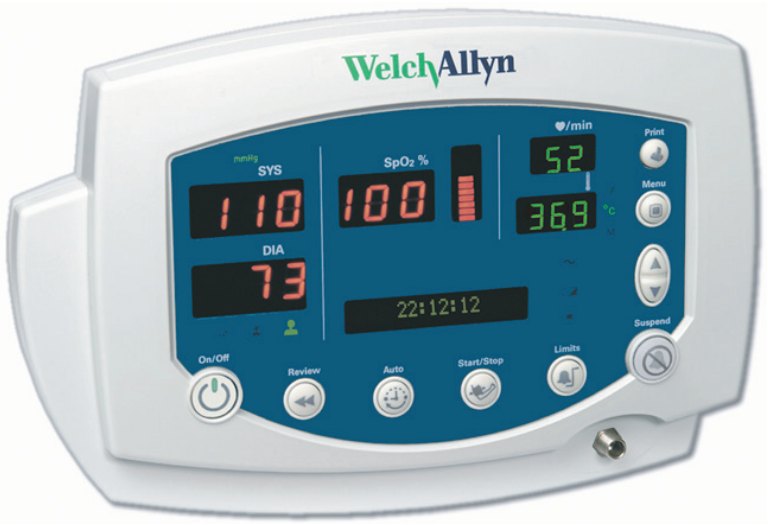
Vital Signs Monitor
300 Series



Service Manual

WelchAllyn®

Advancing Frontline Care™

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USA	+ 1 315 685 4560 800 535 6663	Australia	+ 61 2 9638 3000
Canada	800 561 8797	China	+ 86 216 327 9631
European Call Center	+ 35 3 46 906 7790	France	+ 33 1 55 69 58 49
Germany	+ 49 7477 92 71 86	Japan	+81 42 703 6084
Latin America	+ 1 305 669 9003	Netherlands	+ 31 202 061 360
Singapore	+ 65 6419 8100	South Africa	+ 27 11 777 7555
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This device complies with Part 15 of the FCC rules and with the rules of the Canadian ICES-003. Operation is subject to the following two conditions: (1) This device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.

Caution! Changes or modifications not expressly approved by Welch Allyn could void the purchaser's authority to operate the equipment.

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Manual Part Number 810-1651-04 Rev A, 09/2011

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WORKS

MASIMO SET

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1 Safety

All personnel must read and understand all safety information presented in this manual before using or repairing the monitor.

Caution Use only the Welch Allyn Monitor Service Utility (810-1784-XX) with this monitor.

Software service tools, such as the "Custom Repair Software" (part number 130S29E), distributed for use with previous models of the Vital Signs Monitor, **must not be used** with the Model 300 Series. Use of any tool other than the Welch Allyn Monitor Service Utility (810-1784-XX) may set the monitor in an undefined and unrecoverable state.

United States federal law restricts this device to sale, distribution, or use by or on the order of a licensed medical practitioner.

General safety considerations

Always consider the following safety points when using the monitor:

- Place the monitor and accessories in locations where they cannot harm the patient should they fall from a shelf or mount.
- Do not connect more than one patient to a monitor.
- Do not connect more than one monitor to a patient.
- Do not use the monitor in an MRI suite or hyperbaric chamber.
- Do not autoclave the monitor.
- Accessories can be autoclaved only if the manufacturer's instructions clearly approve it. Many accessories can be severely damaged by autoclaving.
- Inspect the power adapter cord periodically for fraying or other damage. Replace the adapter as needed. Do not operate the monitor from mains power if the adapter, the adapter cord, or the cord plug is damaged.
- Frequently check all cables, both electrically and visually.
- To avoid explosion, do not operate the monitor in the presence of flammable anesthetics.

WARNING Use only accessories approved by Welch Allyn. Visit www.welchallyn.com. The use of any other accessories can result in inaccurate patient data, can damage the equipment, and can void your product warranty.

WARNING Always use accessories according to the standards of your facility and according to the manufacturer's directions for use.

- A monitor that has been dropped or otherwise damaged or abused must not be used until it has been tested and verified by qualified service personnel for proper operation.
- If the monitor detects an unrecoverable problem, an error code and a brief message appear in the message display. Report all such errors to Welch Allyn.
- While under warranty, the monitor must be serviced only by a Welch Allyn service technician.

Electrostatic discharge (ESD)

WARNING Electrostatic discharge (ESD) can damage or destroy electronic components. Handle static-sensitive components only at static-safe workstation.

WARNING Consider all electrical and electronic components of the monitor as static-sensitive.

Electrostatic discharge is a sudden current flowing from a charged object to another object or to ground. Electrostatic charges can accumulate on common items such as foam drinking cups, cellophane tape, synthetic clothing, untreated foam packaging material, untreated plastic bags, and work folders, to name only a few.

Electronic components and assemblies, if not properly protected against ESD, can be permanently damaged or destroyed when near or in contact with electrostatically charged objects. When you handle components or assemblies that are not in protective bags and you are not sure whether they are static-sensitive, assume that they are static-sensitive and handle them accordingly.

- Perform all service procedures in a static-protected environment. Always use techniques and equipment designed to protect personnel and equipment from electrostatic discharge.
- Remove static-sensitive components and assemblies from their static-shielding bags only at static-safe workstations—a properly grounded table and grounded floor mat—and only when you are wearing a grounded wrist strap (with a resistor of at least 1 megohm in series) or other grounding device.
- Use only grounded tools when inserting, adjusting, or removing static-sensitive components and assemblies.
- Remove or insert static-sensitive components and assemblies only with monitor power turned off.
- Insert and seal static-sensitive components and assemblies into their original static-shielding bags before removing them from static-protected areas.
- Always test your ground strap, bench mat, conductive work surface, and ground cord before removing components and assemblies from their protective bags and before beginning any disassembly or assembly procedures.

Symbols

The symbols illustrated on the following pages appear on the monitor or in this document.

Documentation symbols	
	WARNING Indicates conditions that could lead to illness, injury, or death.
	Caution In this manual, indicates conditions that could damage equipment or other property.
	Caution On the product, means "Consult accompanying documentation."

Certification and operation labels			
	This device has been tested and certified by the Canadian Standards Association International to comply with applicable U.S. and Canadian medical safety standards.		Urgent alarm notification (output to Nurse Call system)
	Patient connections are Type BF, and protected against defibrillation.		Recycle used batteries properly and in accordance with local regulations. Do not dispose of batteries in refuse containers.
	Australian Registered Importer		Sealed lead-acid battery, 6V 4 Ah

Shipping, storing, and environment labels			
	Keep this end of the package or shipping crate up.		Protect the monitor from exposure to rain.
	Do not expose the monitor to relative humidity above this limit.		Do not subject the monitor to altitudes outside these limits.
	Fragile contents—handle with care.		Limit stacking to this number of units.
	Do not expose the monitor to temperatures outside these limits.		

Monitor connector labels			
	Temperature Probe Cable Connector	**SpO_2**	SpO_2 Sensor Cable Connector
	RS232 Cable Connector		AC Power Adapter Cable Connector
	Nurse Call Cable Connector		NIBP Hose Connector

Printer door label			
	Press to open the printer door		Load paper this direction

The monitor front panel controls are described in more detail throughout this document.

Front panel controls			
	Set alarm limits		Power on/off
	Silence alarms		Print patient data
	Scroll up/down, Scroll forward/back, Increase/decrease value		Review patient data
	(The scroll icon appears as these two arrows in the documentation.)		
	Set an NIBP automatic measurement interval		Start/stop an NIBP cycle (AUTO button)
	Cycle to the next menu selections		

Front panel displays and indicators			
SYS **DIA** **SpO_2**	Systolic pressure Diastolic pressure Arterial hemoglobin oxygen saturation		Temperature
♥/min	Pulse rate	pulse amplitude indicator	Pulse strength
message window	MAP (mean arterial pressure)		Neonatal
°C	Degrees Celsius		Pediatric
°F	Degrees Fahrenheit		Adult
M	Monitored temperature		AC power Battery charging (flashing) Battery charged (steady)
	Battery low Battery fully discharged		

2 Service overview

Purpose and scope

This service manual is a reference for periodic preventive maintenance and corrective service procedures for the Vital Signs Monitor 300 Series.

Corrective service is supported to the level of field-replaceable units. These include some circuit-board assemblies and some subassemblies, case parts, and other parts. (See "Replacement parts" on page 87 for a complete list of user-replaceable service parts.)

Note Repair and replacement of the main board is not supported. All service work on the main board must be performed by certified and qualified service personnel at an authorized Welch Allyn service center.

Caution No component-level repair of circuit boards and subassemblies is supported. Use only the repair procedures described in this manual.

WARNING When performing a service procedure, follow the instructions exactly as presented in this manual. Failure to do so could damage the monitor, invalidate the product warranty, and lead to serious personal injury.

This guide provides troubleshooting information, assembly procedures, and instructions for functional testing and performance verification. It is intended for use only by technically qualified service personnel.

This guide applies only to the Vital Signs Model 300 Series. For servicing the previous (52000-series) version of the Vital Signs Monitor, refer to Welch Allyn service manual 95P445E, which is available on the TechView CD (900298-1).

Technical support services

Welch Allyn offers the following technical support services:

Telephone support
Loaner equipment
Service agreements
Service training
Replacement service parts
Factory Service

For information on any of these services, contact Welch Allyn at the Technical Support: numbers listed on page ii.

Returning products

To return a product for service, contact Welch Allyn Technical Support and request a Return Material Authorization (RMA) number.

Note Welch Allyn does not accept returned products without an RMA.

When requesting an RMA, please have the following information available:

- Product name, model number, and serial number
- A complete return shipping address, including a contact name and phone number; include any special shipping instructions
- A purchase-order number or credit-card number if the product is not covered by warranty or service agreement
- A full description of the problem or service request

To ship the monitor, please observe these packing guidelines:

- Remove from the package all hoses, connectors, cables, sensors, power cords, and other ancillary products and equipment, except those items that might be associated with the problem.
- Use the original shipping carton and packing materials, or as close an approximation as possible.
- Include a packing list.
- Write the Welch Allyn RMA number with the Welch Allyn address on the outside of the shipping carton.

United States federal regulations require that any unit received by Factory Service must be free from blood-borne pathogens before processing. All incoming products are cleaned as well as possible, but products that cannot be effectively cleaned cannot be accepted for repair. Please thoroughly clean all organic residues from the product before shipment. This will ensure safe receipt, processing and repair, and will help expedite the return of your monitor.

Product configurations

Model numbers for the configurations are as follows:

Model	Features	Model	Features
53000	Standard (NIBP, Pulse Rate, and MAP)	**530T0**	Standard + Temperature
5300P	Standard + Printer	**530TP**	Standard + Temperature + Printer
53N00	Standard + Nellcor® SpO_2	**53S00**	Standard + Masimo® SpO_2
53NT0	Standard + Nellcor SpO_2 + Temperature	**53ST0**	Standard + Masimo SpO_2 + Temperature
53N0P	Standard + Nellcor SpO_2 + Printer	**53S0P**	Standard + Masimo SpO_2 + Printer
53NTP	Standard + Nellcor SpO_2 + Temperature + Printer	**53STP**	Standard + Masimo SpO_2 + Temperature + Printer

Recommended service intervals

Interval or Condition	Action Recommended	Procedure	Page
Every 6 - 24 months (per hospital protocols)	Complete functional test	Functional verification	9
Battery does not hold a charge	Check battery capacity Replace battery	Functional verification Disassembly procedure	9 55
Monitor has been dropped or otherwise damaged	Complete functional test	Functional verification	9
Monitor malfunctioning	Complete functional test	Functional verification	9
Monitor does not pass Functional Verification	Troubleshooting and repair followed by functional test; if necessary, return to authorized service center	Troubleshooting and repair Disassembly procedure Functional verification	33 55 9

Service options

Warranty service

All repairs on products under warranty must be performed or approved by Welch Allyn. Refer all warranty service to Welch Allyn Factory Service or another authorized Welch Allyn Service Center. Obtain an RMA number for all returns to Welch Allyn Factory Service – see "Returning products" on page 6.

Caution Unauthorized repairs will void the product warranty.

Non-warranty service

Welch Allyn Factory Service and authorized Service Centers support non-warranty repairs. Contact any Welch Allyn regional service center for pricing and service options.

Welch Allyn offers modular repair parts for sale to support non-warranty service. This service must be performed only by qualified end-user biomedical/clinical engineers using this service manual.

The Welch Allyn Monitor Service Utility supports certain service functions. For information, see "Welch Allyn monitor service utility" on page 37.

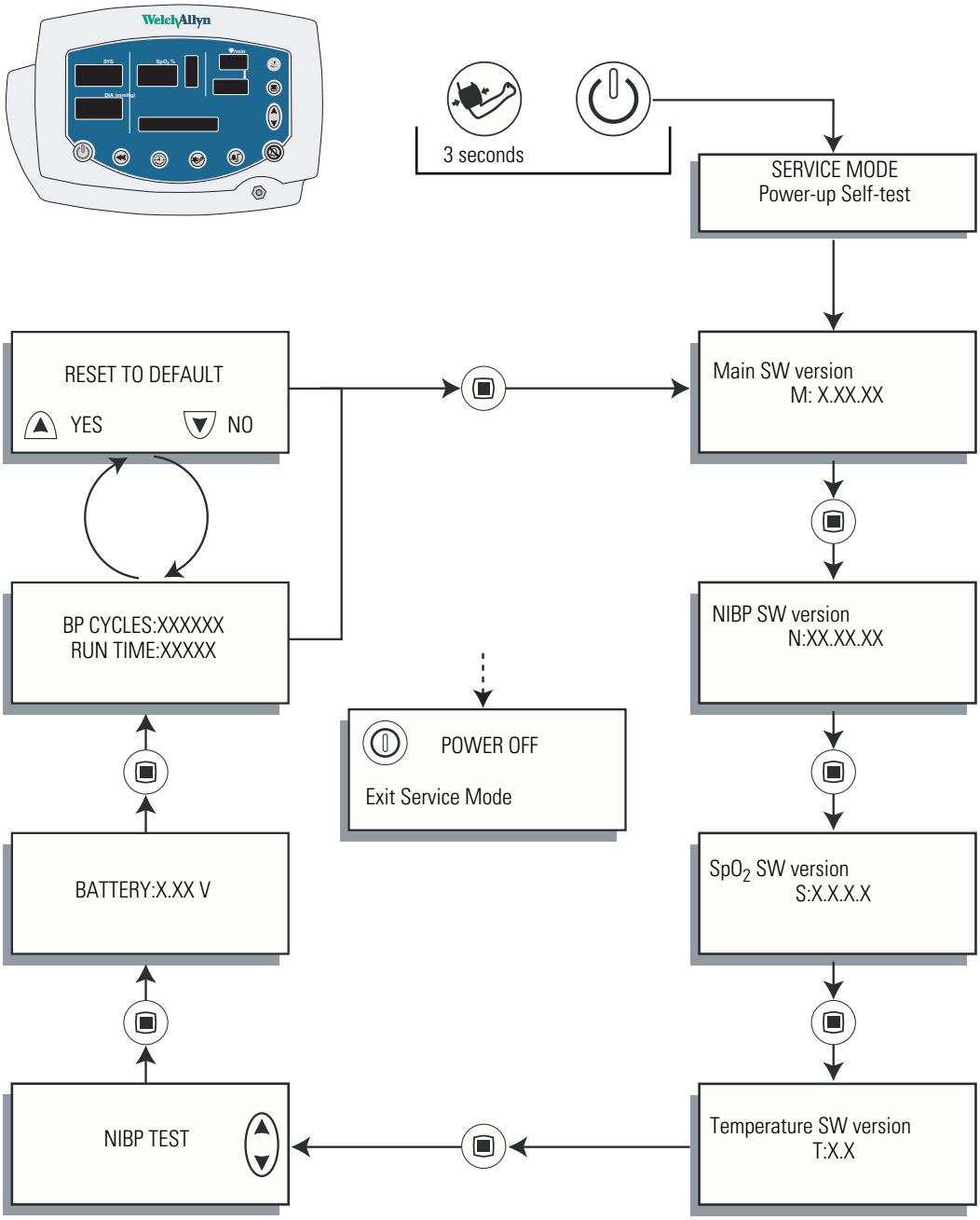
Related documents

Title	Reorder number
Vital Signs Monitor 300 Series Directions for Use (Masimo, multilanguage)	810-2250-XX
Vital Signs Monitor 300 Series Directions for Use (Nellcor, multilanguage)	810-2252-XX

Service menu

To see the service menu, first power the monitor off. Press and hold ✓ for 3 seconds. While ✓ is depressed, press ⏻ until the monitor displays the message **Service Mode**.

The monitor runs a self-test and then displays the main software version number (**M: X.XX.XX**). Press ▣ repeatedly to cycle to the menu selection of interest.



3 Functional verification

Functional verification overview

This section describes the procedure for a complete functional test to support recommended preventive-maintenance schedules.

The verification includes tests for a monitor configured with the printer, temperature, and SpO_2 options. Perform only the tests applicable to the actual configuration.

A checklist of the functional tests is provided on "Checklist and test results report form" on page 31. It is recommended that you print a copy of the checklist each time you perform the functional verification procedure, so that you can record and save the test results. If the monitor ever requires service, the records of test results can often facilitate troubleshooting.

Functional verification does not require opening the monitor case.

Equipment required

This equipment is required for functional verification of a fully configured monitor.

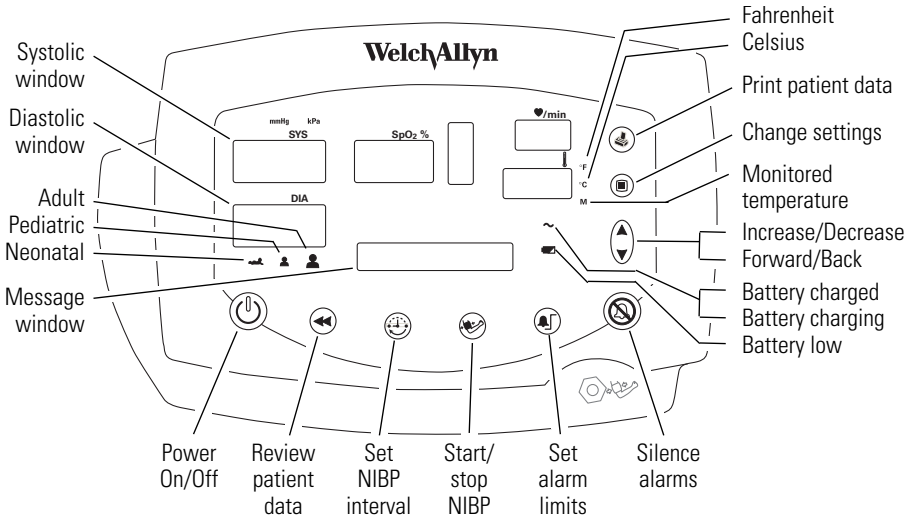
Commercially available general-purpose/medical test equipment	
Item	**Manufacturer part number/specification**
Power supply	Variable, 0-8 VDC, 0.75 amperes (minimum), with voltage and current indicators (for 1mA current measurement)
Digital pressure meter	Netech Digimano 1000 or equivalent
AC withstand voltage (hi-pot) tester	Associated Research 3605 or equivalent
SpO_2 functional tester (Nellcor, for testing the monitor only)	Nellcor SRC-MAX
SpO_2 functional tester (Masimo, for testing the monitor only)	Masimo Tester REF 1593
SpO_2 extension cable (required for SRC-MAX)	Nellcor DEC-8
SpO_2 simulator (for testing the monitor and the SpO_2 sensor)	Fluke (Biotek) Index2 XL/XLFE or equivalent
Syringe, 60 mL, Slip tip, Luer	BD (Becton, Dickinson) 309654 or equivalent
Hi-pot cable connectors	See "Test connections" on page 29.
Timer (to display elapsed time, in seconds)	

Welch Allyn accessories and test equipment

Order number	Description
06138-000	Temperature test key (for testing the monitor only)
01802-110, 110 V 01802-220, 220 V	9600 Plus Calibration Tester (for testing the monitor and the temperature probe)
008-0265-XX	Neonatal cuff hose, 96-inch
008-0620-XX	Neonatal #1 cuff, disposable, box of 10
020-0702-XX	Cuff simulator (or equivalent 500 cc test volume)
5200-101A	DC power adapter
407590	Battery substitution connector
810-1784-XX	Welch Allyn Monitor Service Utility (required for NIBP repair or replacement; not required for functional testing)
008-0842-XX	Service Serial Cable (for use with the Welch Allyn Monitor Service Utility 810-1784-XX)
WA 5088-01	Tycos air release valve and small bulb
600-0021-XX	NIBP tubing connector, threaded
600-0179-XX	Tubing, 1′
600-0043-XX	Tee, plastic

Functional verification procedure

Reference illustration



System/power

Note Other than the optional NIBP overpressure test (page 18), the tests described here must be performed as part of a complete functional verification procedure.

Setup

- If the monitor is configured with the temperature option, connect the temperature probe and insert it into the probe well.
- If you are using an optional Welch Allyn Model Calibration Tester, plug it in and set it to the values that match your tester model:

Model	Temperature	
9600	96.4 °F	(35.8 °C)
9600 Plus	96.8 °F	(36.0 °C)

- If the monitor is configured with the SpO_2 option, connect the SpO_2 sensor.

Battery charge and beeper

1. With the monitor turned off, disconnect the power adapter from the monitor.
2. Verify that the charge LED ~ is off.
3. Connect the power adapter. The monitor emits a single beep tone.
4. Verify that the charge LED ~ is on.

Note Depending on the charge level of the battery, the charge LED may be either flashing or steady.

~ flashing indicates that the monitor is running on AC, the battery is charging, and the battery is charged to less than 90% capacity.

~ steady indicates that the monitor is running on AC, the battery may or may not be charging, and the battery is charged to at least 90% capacity.

Battery substitution cable setup

1. Disconnect the power adapter.
2. Remove the battery cover and remove and disconnect the battery.
3. Connect the open-ended red (+) and black (–) wires of the battery substitution cable (407590) to the variable DC power supply.
4. Set the power supply to 6.0 V ± 0.25 V.

   WARNING Do not exceed 8.0 V.

5. Connect the test power cable to the battery connector on the monitor.

Monitor-off current

With the monitor powered down, verify that the current draw from the power supply is less than 1 mA.

Power-on self-test

1. Power the monitor on.

   Note If the monitor displays error E38, power the monitor off and then power it on again.

2. Verify that the start-up tone (double beep) is audible.
3. Verify that all front-panel lights (background indicators, LCD pixels, and LED segments and periods) come on in the proper order: left, center, and right.

Initialization/idle mode current

Note If your monitor is configured without the temperature option and without the SpO_2 option, skip these steps and proceed to "Baseline current draw" on page 13.

1. If the temperature option is present:
   a. Verify that the temperature probe is in the probe well.
   b. Set the temperature mode to MONITOR.
   c. Remove the temperature probe from the probe well.
   d. Verify that the temperature reading appears within 4 seconds.

e. Do not return the probe to the probe well.

2. If the SpO_2 option is present:

   a. Verify that the SpO_2 sensor cable is connected to the monitor.

   b. Verify that the current draw from the bench power supply is less than 800 mA.

3. Disconnect the SpO_2 sensor (if equipped).

4. Insert the temperature probe (if the monitor is so equipped) into the probe well.

Baseline current draw

1. With the monitor powered on, wait for the monitor LEDs to blank. In this state, the SpO2 % reads - -, the time of day is displayed in the message window, and the rest of the displays are blank.

2. Note and record the exact current from the power supply. (This value will be used in the NIBP and printer tests.)

Battery voltage

1. Power the monitor off.

2. Simultaneously press and hold and to bring up the monitor in SERVICE MODE. (When the monitor completes the power-on self-test in service mode, the main software version number appears in the message display.)

3. Press repeatedly until BATTERY VOLTAGE appears in the message display.

4. Verify that the displayed battery voltage is within 0.1 volt of the DC power supply input.

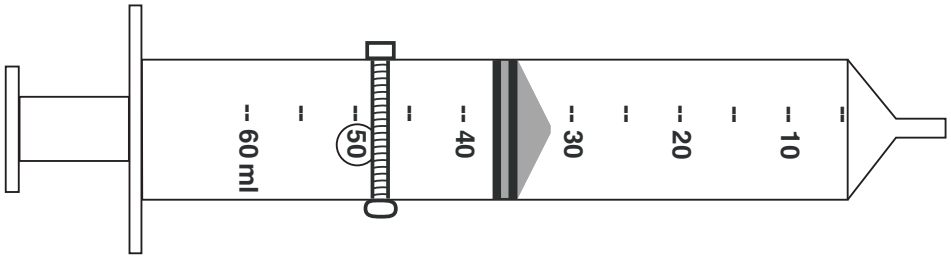
5. Exit Service Mode by turning off the monitor and then turning it on again.

NIBP

Note The tests described in this section are to be performed only as part of a complete functional verification procedure.

Characterization test

1. Attach a neonate hose (part 008-0265-01) to the NIBP fitting on the monitor.
2. Prepare the 60-mL syringe as follows, with reference to the illustration below:
   a. Move the syringe plunger to the 35 mL line.
   b. Drill a small hole (for example, 9/64 inch) through the syringe and the plunger shaft, at a location between the plunger and the top of the syringe.
   c. Insert a rod or bolt (for example, a 6-32 screw) through the hole so that the plunger cannot move, creating a constant volume in the syringe of 35 mL ± 2 mL. Secure the rod or bolt so that it cannot fall out of the hole.



3. Insert the tip of the syringe into the open end of the neonate hose. Verify that the fit is tight and secure.
4. Set the monitor patient type to **Adult**, as follows:
   a. Press ◉ once.
   b. If the monitor is not already in **Adult** mode, press ▲ once or twice until **Adult** appears in the message display.
   c. Press ⊘.
5. Press ✓.
6. Verify that the error code **C03** appears in the message display within a few seconds.

WARNING If the error code C03 does not appear, characterize NIBP according to the instructions presented on page 36, and then repeat the NIBP characterization test.

WARNING Do not use the monitor if it does not pass the NIBP characterization test. If the NIBP module is not properly characterized, the monitor could overinflate a neonatal cuff, which could create a hazard for neonatal patients.

WARNING If you cannot characterize the NIBP module, remove the monitor from service immediately and return it to Welch Allyn for service. (See "Returning products" on page 6.)

Leak test

This tests the NIBP system for abnormal leakage.

If the NIBP system is leaking, check for leaks in the external plumbing before opening the case to look for internal leaks.

If you determine that any NIBP module component is causing abnormal leakage, you must replace the NIBP module before returning the monitor to clinical use.

Caution Do not attempt component-level repair of the NIBP module. Any change to the NIBP module requires that the monitor be returned to the factory for NIBP module calibration.

1. Put the monitor in Service mode:
   a. Power the monitor **off**.
   b. Power the monitor **on** while pressing .

WARNING Do not connect the monitor to a patient while the monitor is in Service mode. Overpressure detection is disabled while the monitor is in NIBP test mode.

2. Attach a #1 neonatal cuff and hose to the monitor

   Wrap the cuff securely around a solid cylindrical object of circumference between 1.6 and 1.9 inches (4.1 and 4.8 cm).

3. Press repeatedly until **NIBP TEST** appears in the message window and **0** is displayed in the SYS and DIA windows.

Note When you first enter the NIBP test mode, give the monitor about a minute to initialize NIBP before you change the target test pressure.

When switching from one target pressure to the next, give the monitor time to fully inflate and stop before you select the next target pressure.

In the NIBP test mode, press repeatedly to select the target NIBP test pressure. The target pressure is displayed on the DIA LEDs. The measured instantaneous pressure determined by the monitor is displayed on the SYS LEDs.

4. Press once to select 80 mmHg (10.7 kPa). The cuff inflates to approximately 115 mmHg (15.3 kPa).

Note In the NIBP test mode, and especially at small test volumes, the pressure achieved can vary significantly (30-40 mmHg or 4-5.3 kPa) from the target pressure.

5. Wait 15 seconds, and note the current pressure.
6. Wait another 10 seconds and verify that the pressure has not dropped more than 8 mmHg (1.1 kPa) below the pressure noted in step 5.

   If the pressure drop is greater than 8 mmHg (1.1 kPa), check the cuff, the hose, and all external connections for leaks, and then repeat from step 3.

7. Press ▲ several times to select 0 mmHg (0 kPa). The valve opens to release pressure.
8. Disconnect the neonate cuff.

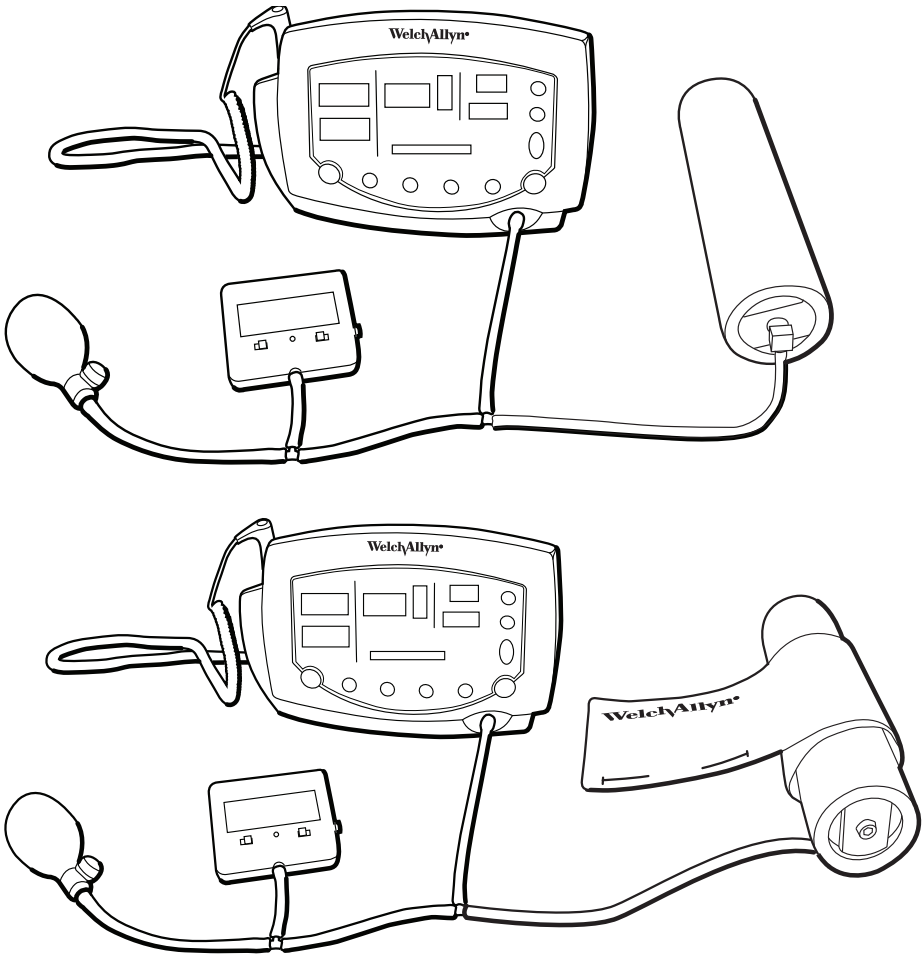
Pressure calibration verification

This tests pressure readings on the monitor against a calibrated external pressure meter.

1. Put the monitor in Service mode:
   a. Power the monitor **off**.
   b. Power the monitor **on** while pressing ⏻.

   WARNING Do not connect the monitor to a patient while the monitor is in Service mode. Overpressure detection is disabled while the monitor is in NIBP test mode.

2. Connect the monitor to an adult cuff or a 500 cc test volume, a pressure meter or a manometer, and a pump bulb, as shown.



3. Press ⏹ repeatedly until **NIBP TEST** appears in the message window and **0** is displayed in the SYS and DIA windows.

4. Press ▲ once to select 80 mmHg (10.7 kPa). The cuff quickly inflates to approximately 80 mmHg (10.7 kPa), and then settles at a slightly lower pressure level. Wait a few seconds for the pressure to stabilize.
5. Verify that the value displayed in SYS is within 3 mmHg (0.4 kPa) of the value displayed on the digital pressure meter.
6. Press ▲ to select 150 mmHg (20 kPa) target pressure. The cuff quickly inflates to approximately 150 mmHg (20 kPa), and then settles at a slightly lower pressure level. Wait a few seconds for the pressure to stabilize.
7. Verify that the value displayed in SYS is within 3 mmHg (0.4 kPa) of the value on the digital pressure meter.
8. Press ▲ to select 300 mmHg (40 kPa). The cuff quickly inflates to approximately 300 mmHg (40 kPa), and then settles at a slightly lower pressure level. Wait a few seconds for the pressure to stabilize.
9. Verify that the value displayed in SYS is within 6 mmHg (0.8 kPa) of the value on the digital pressure meter.

Valve and pump current, inflation, and deflation tests

Note Replace the internal battery with an external power supply. (See "Battery substitution cable setup" on page 12.)

To test pump current

1. Put the monitor in Service mode:
   a. Power the monitor **off**.
   b. Power the monitor **on** while pressing ⏻.

WARNING Do not connect the monitor to a patient while the monitor is in Service mode. Overpressure detection is disabled while the monitor is in NIBP test mode.

2. Press ▣ repeatedly until **NIBP TEST** appears in the message window and **0** is displayed in the SYS and DIA windows.
3. Press ▲ to select 0 mmHg (0 kPa) target pressure.
4. While watching the current meter, press ▲ to select 80 mmHg (10.7 kPa) target pressure.
5. Note the highest current reading during inflation.
6. While the pump is running, verify that the reading on the current meter is not more than 750 mA above the current level noted in step 2 of the verification test ("Baseline current draw" on page 13).
7. Press ▲ three times to select 0 mmHg (0 kPa) target pressure.

To test inflation

1. Press ▣ repeatedly until **NIBP TEST** appears in the message window and **0** is displayed in the SYS and DIA windows.

2. Press ▲ once to select 80 mmHg (10.7 kPa).
3. Wait for the pump to start and stop.
4. Press ▲ once to select 150 mmHg (20 kPa).
5. Wait for the pump to start and stop.
6. Bleed the pressure to 0 by opening the relief valve on the bulb.
7. Close the relief valve on the bulb.
8. Have a timer ready.
9. Press ▲ once to select 300 mmHg (40 kPa), and immediately observe the manometer.
10. As soon as the manometer reads 5 mmHg (0.67 kPa), start the timer.
11. When the manometer reaches 250 mmHg (33.3 kPa), stop the timer.
12. Verify that the elapsed time (step 11 minus step 10) is less than 8 seconds.

To test deflation

1. If the pressure has dropped more than 10 mmHg, use the pump bulb to raise it to 300 mmHg ± 5 mmHg.
2. While the pressure is still at approximately 300 mmHg (as shown by the manometer and the SYS window), press ▲ once to select 0 mmHg, and immediately start the timer.
3. After 10 seconds, verify that the manometer reads less than 15 mmHg.

   If you are doing the NIBP overpressure test, skip to "Overpressure tests (optional)" on page 18.
4. Disconnect the hose from the monitor.

Overpressure tests (optional)

Note Redundant circuitry in the VSM 300 series monitor guarantees that the blood-pressure cuff cannot overinflate.

The allowable cuff pressure and the overpressure cutoff are controlled by software. A software failure (a defective PROM) would generate a checksum error, disabling monitor operation and setting it in a safe mode.

These tests demonstrate that:

- the monitor cannot exceed the maximum allowable cuff pressure for adults (280 mmHg), pediatrics (200 mmHg), and neonates (141 mmHg)
- the overpressure cutoff feature shuts down the pump and dumps pressure before the pressure reaches 330 mmHg (44 kPa)

To verify maximum allowable cuff pressure for NIBP version 3.20.00

1. Assemble one of the test setups illustrated on page 16, using an adult cuff or cuff simulator.

2. Turn on the monitor.
3. Set the monitor to **ADULT** mode.
   a. Press ◉ once.
   b. Press ▲ repeatedly until **ADULT** appears.
4. Set the inflation target pressure to 270 mmHg (36 kPa).
   a. Press ◉ repeatedly until TARGET PRESSURE appears in the display window.
   b. Press ▲ repeatedly as needed to set the target pressure (displayed in the SYS window) to 270 mmHg (36 kPa).
5. Press ✋ to start the pump.

   The pressure reaches approximately 270 mmHg (36 kPa), the pump shuts off, and the pressure begins stepping down.
6. Carefully squeeze the pump bulb to raise the pressure to 280 mmHg (37.3 kPa).
   - The dump valve opens and quickly drops the pressure to approximately 0.
   - The monitor displays **C10** to indicate that an overpressure event has occurred.
7. Set the monitor to **PEDIATRIC** mode.
8. Set the inflation target pressure to 170 mmHg (22.7 kPa).
9. Raise the pressure to 200 mmHg (26.7 kPa).
   a. Press ✋ and wait for the pressure to reach 170 mmHg (22.7 kPa). The pump shuts off and the pressure reading starts stepping down.
   b. Carefully squeeze the pump bulb to raise the pressure to 200 mmHg (26.7 kPa).
   - The dump valve opens and quickly drops the pressure to approximately 0.
   - The monitor displays **C10** to indicate that an overpressure event has occurred.
10. Replace the adult cuff with a #1 neonate cuff, and wrap the neonate cuff securely around a solid cylindrical object with circumference between 1.6 and 1.9 inches (4.1 and 4.8 cm).
11. Set the monitor to **NEONATE** mode.
12. Set the inflation target pressure to 132 mmHg (17.6 kPa).
13. Raise the pressure to 141 mmHg.
    a. Press ✋ and wait for the pressure to reach 132 mmHg (17.6 kPa). The pump shuts off and the pressure reading starts stepping down.
    b. Carefully squeeze the pump bulb to raise the pressure to 141 mmHg (18.8 kPa).
    - The dump valve opens and quickly drops the pressure to approximately 0.
    - The monitor displays **C10** to indicate that an overpressure event has occurred.

To verify overpressure cutoff for NIBP versions 4.20.00 and later

This test demonstrates that the overpressure cutoff feature prevents pressure from rising fast enough to exceed the cutoff pressure (295 to 330 mmHg, or 39.3 to 44.0 kPa) before the pump stops and the dump valve and the bleed valve open.

When the overpressure cutoff triggers, the pump stops, the dump and bleed valves open, and the monitor displays **E40**. Any subsequent button press shuts off the monitor.

Note Due to NIBP implementation differences, this test does not verify overpressure cutoff in earlier NIBP versions.

In those versions, due to a longer software delay in activating the cutoff function, the normal overpressure cuff pressure is exceeded before the overpressure cutoff safety triggers. If the normal overpressure-detection algorithm were to fail, the overpressure cutoff safety function would trigger immediately.

1. Restart the monitor.
2. Set the monitor to **ADULT** mode.
3. Set the inflation target pressure to 270 mmHg (36.0 kPa).
4. Increase the inflation rate, causing the overpressure cutoff to stop the pump and open the bleed and dump valves.
   a. Start the pump.
   b. When the pressure (SYS window) reaches approximately 230 mmHg (32.4 kPa), very rapidly squeeze the pump bulb while observing the digital pressure meter.

      Assuming that you squeeze the bulb rapidly enough to reach the trigger threshold and activate the overpressure cutoff:

      - The pressure does not exceed 280 mmHg.
      - The dump valve and bleed valve open, dropping the pressure to approximately 0.
      - E40 appears in the Sys window.
      - Pressing any button causes the monitor to shut down.
5. Disconnect the test setup from the monitor.

If you executed this test as part of the functional verification procedure, proceed to...

- "Printer" on page 21.
- If the monitor has no printer, "SpO2" on page 23.
- If the monitor has no SpO2 option, "Temperature" on page 25.
- If the monitor has no temperature option, "Nurse call" on page 27.

Printer

Note This test is to be performed only as part of a complete functional verification procedure.

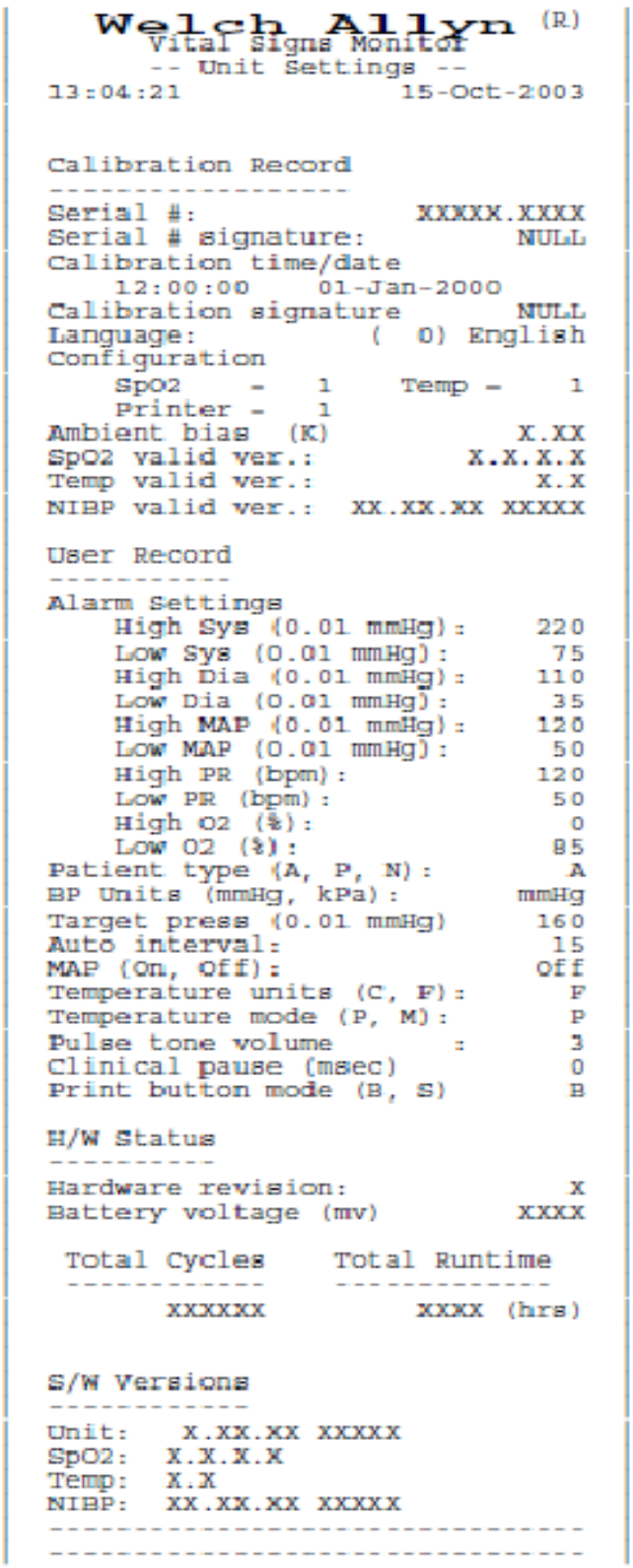
1. Put the monitor into Service Mode.
2. Verify that the printer has paper.
3. Press . Verify that a settings report prints, and that it contains no printed anomalies and no missing or faded sections.

Note With a new roll of paper, the first line might be faded. This does not indicate a problem.

Note The settings report (as shown in the example below) contains a calibration record, user record, hardware status record, and software versions record.

- The calibration record includes manufacturing configuration data: monitor serial number, set parameters, and language.
- The user record includes user-configurable settings: alarm limits, patient type, parameter modes/units, auto interval, tone volume, and others.
- The hardware status record shows the hardware revision number, the battery voltage level, the total number of NIBP monitoring cycles completed on the monitor, and the total number of hours of operation of the monitor.
- The software versions record indicates the software version numbers of the main board, SpO_2 and Temperature options (if present), and NIBP.

4. After 2 seconds of printing, verify that the current draw is no more than 2.5A above the baseline current recorded in step 2 of the verification test "Baseline current draw" on page 13.
5. Exit the Service Mode.



Welch Allyn (R)
Vital Signs Monitor
-- Unit Settings --
13:04:21 15-Oct-2003

Calibration Record

Serial #: XXXXX.XXXX
Serial # signature: NULL
Calibration time/date
12:00:00 01-Jan-2000
Calibration signature NULL
Language: (0) English
Configuration
SpO2 - 1 Temp - 1
Printer - 1
Ambient bias (K) X.XX
SpO2 valid ver.: X.X.X.X
Temp valid ver.: X.X
NIBP valid ver.: XX.XX.XX XXXXX

User Record

Alarm Settings
High Sys (0.01 mmHg): 220
Low Sys (0.01 mmHg): 75
High Dia (0.01 mmHg): 110
Low Dia (0.01 mmHg): 35
High MAP (0.01 mmHg): 120
Low MAP (0.01 mmHg): 50
High PR (bpm): 120
Low PR (bpm): 50
High O2 (%): 0
Low O2 (%): 85
Patient type (A, P, N): A
BP Units (mmHg, kPa): mmHg
Target press (0.01 mmHg) 160
Auto interval: 15
MAP (On, Off): Off
Temperature units (C, F): F
Temperature mode (P, M): P
Pulse tone volume : 3
Clinical pause (msec) 0
Print button mode (B, S) B

H/W Status

Hardware revision: X
Battery voltage (mv) XXXX

Total Cycles Total Runtime

XXXXXX XXXX (hrs)

S/W Versions

Unit: X.XX.XX XXXXX
SpO2: X.X.X.X
Temp: X.X
NIBP: XX.XX.XX XXXXX

SpO_2

Note The tests described in this section are to be performed only as part of a complete functional verification procedure.

Perform one of the following three SpO_2 tests.

Testing the monitor only (Nellcor SpO_2)

Use this procedure to test only the monitor SpO_2 function.

1. Power the monitor off.
2. Connect the Nellcor SRC-MAX SpO_2 functional tester to the SpO_2 input connector through a Nellcor DEC-8 extension cable.
3. Power the monitor on.

Note In the following tests, if the SRC-MAX defaults are outside the monitor alarm limits, readjust the limits or silence the alarms.

4. Verify the following on the SRC-MAX:
   - All of the monitor LEDs flash: left panel, center panel, right panel.
   - SRC-MAX initializes to a default condition where the four test parameter LEDs are lit closest to their selector buttons
   - The default pulse rate is 60 bpm and the default SpO_2 is 75%
5. Give the monitor up to 30 seconds to stabilize, and verify a displayed pulse rate of 60 ± 3 bpm and a displayed SpO_2 of 75 ± 3%.
6. Set the SRC-MAX pulse rate to 200 bpm.
7. Give the monitor up to 30 seconds to stabilize, and verify a displayed pulse rate of 200 ± 3 bpm.
8. Switch the SRC-MAX SpO_2 saturation percentage to 90.
9. Give the monitor up to 30 seconds to stabilize, and verify a displayed SpO_2 saturation level of 90 ± 3%.
10. Disconnect the SRC-MAX.

Testing the monitor only (Masimo SpO_2)

Use this procedure to test only the monitor SpO_2 function.

1. Power the monitor off.
2. Connect the Masimo Tester REF 1593.
3. Power the monitor on.
4. Give the monitor up to 30 seconds to stabilize, and then verify a displayed pulse rate (from SpO2) of 61 bpm ± 1 bpm and a displayed saturation of 81% ± 3%.

Testing the sensor with the monitor

Use this procedure to test the monitor SpO_2 function while verifying a sensor.

1. Connect an SpO_2 sensor to the simulator optical finger and to the monitor.
2. Set the BioTek Index2 SpO_2 simulator as follows:

SpO_2 manufacturer type	Nellcor (MP-506A or Nell-3A) Masimo (MS-11)
% SpO_2	94
Rate	60 (Motion Artifact not selected)

3. Wait for the monitor display to stabilize.
4. Verify an SpO_2 saturation level of 94 ± 4.
5. Verify that the monitor displays a pulse rate of 60 ± 4.

Temperature

Note The tests described in this section are to be performed only as part of a complete functional verification procedure.

Perform one of the following temperature tests.

Testing the monitor only

Use this procedure to test only the temperature function.

1. With monitor power on and with the temperature probe in the well, disconnect the probe cable from the temperature input connector on the rear of the unit.
2. Connect the Welch Allyn Sure Temp Plus temperature test key (06138-000) to the temperature input connector.
3. Remove the probe from the well.
4. Verify that the displayed temperature is 97.3 ± 0.2 °F (36.3 ± 0.1 °C).

Testing the probe with the monitor

Use this procedure to test the temperature function while verifying the temperature probe.

1. If the Welch Allyn Calibration Tester is not already warmed up, warm it up as follows:
   a. Set the tester temperature to the following temperature:

Model	Temperature	
9600	96.4 °F	(35.8 °C)
9600 Plus	96.8 °F	(36.0 °C)

   b. Plug the power adapter into the tester; wait (up to 15 minutes) until the tester 'ready' indicator light is on continuously.
2. Set the monitor temperature mode to Monitored.
3. Insert the temperature probe (without probe cover) into the small thermometer hole on the dry-heat well of the tester.
4. Wait two minutes and verify that the reading displayed on the monitor is as follows:

Model	Temperature	
9600	96.4 °F ±0.4 °F	(35.8 °C ±0.2 °C)
9600 Plus	96.8 °F ±0.4 °F	(36.0 °C ±0.2 °C)

5. Switch the tester to the following temperature and wait about five minutes for the 'ready' indicator to light.

Model	Temperature	
9600	106.0 °F	(41.1 °C)
9600 Plus	105.8 °F	(41.0 °C)

6. Verify that the reading displayed on the monitor is as follows:

Model	Temperature	
9600	106.0 °F ±0.4 °F	(41.1 °C ±0.2 °C)
9600 Plus	105.8 °F ±0.4 °F	(41.0 °C ±0.2 °C)

7. Remove the probe from the tester and replace it in the probe well.
8. Disconnect the tester.

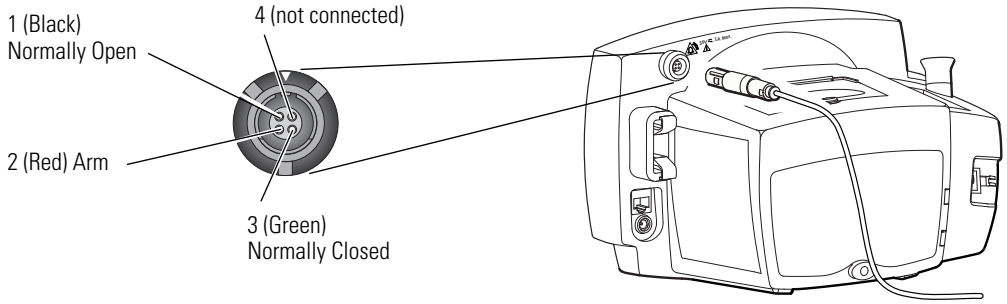
Nurse call

Note The tests described in this section are to be performed only as part of a complete functional verification procedure.

Relay verification

With reference to the drawing and table below, use an ohmmeter to check the contact resistance at the output pins of the Nurse Call connector, while the monitor is in the alarm state and while the monitor is out of the alarm state.

When the Nurse Call verification is done, disconnect the Nurse Call cable and turn off the monitor.



Pins	Resistance (Alarm OFF)	Resistance (Alarm ON)
1-2	> 1 MΩ	< 1 Ω
2-3	< 1 Ω	> 1 MΩ

Putting the monitor into the alarm state

To create an alarm condition for testing the Nurse Call relay, follow these steps.

1. Press repeatedly until **INTERVAL ST** appears in the message display.
2. Wait for the pump to charge twice (about 10 seconds), and verify that error code **C04** appears in the SYS display.
3. Verify that the Nurse Call circuit is shorted. (Refer to the table shown above.)
4. Press .
5. Verify that the Nurse Call circuit is open. (Refer to the table shown above.)
6. To exit the alarm state, press repeatedly until **INTERVAL 15** appears in the message display, and then press .

Battery

Note This test is to be performed only as part of a complete functional verification procedure.

1. With the monitor power off, disconnect the battery substitution-cable connector.
2. Install and connect the battery.
3. Connect the AC power adapter to the monitor.
4. Verify that the AC mains indicator is illuminated on the monitor front panel.

   The indicator could be flashing or steady, depending on the state of the battery. flashing indicates that the battery is charging; steady indicates that the battery is charged to at least 90% capacity.
5. Charge the battery for a minimum of 12 hours (until stops flashing).
6. Disconnect the AC power adapter.
7. Turn the monitor on and set it up as follows:

NIBP Auto Interval	OFF
Printer, if present	OFF (not printing)
SpO_2 sensor (if SpO_2 option is present)	Disconnected
Temperature probe (if temperature option is present)	Either connected or disconnected

8. Note the time and let the monitor run until **low battery** (flashing) is indicated.

   (Run time for a new, fully charged battery is at least 12 hours.)
9. Charge the battery for a minimum of 12 hours (until stops flashing).
10. Disconnect the ac power adapter.
11. Start the monitor in Service Mode.
12. Press repeatedly until "Battery: X.XXV appears in the message window.
13. Verify that the voltage is ≥ 6.10 V.

Patient isolation test

Note This test is to be performed only as part of a complete functional verification procedure.

Patient isolation test - overview

To verify proper patient isolation, it is important to run this test following any procedure in which the monitor is opened.

WARNING Failure to run the dielectric test when indicated could cause serious injury to patients, and could lead to damage to the monitor.

The patient isolation test requires an AC Withstand voltage high potential (hi-pot) tester, such as the AR 3605 or equivalent. If this equipment is not available, Welch Allyn can perform the patient isolation test for you quickly, for a nominal fee.

WARNING The patient isolation test involves exposure to extremely high voltages, and is therefore extremely hazardous.

WARNING Always follow the tester manufacturer's operation instructions exactly. Failure to perform this test properly can result in serious injury or death.

WARNING This test must be performed by qualified service personnel only.

WARNING Run this test only on an insulated table top, and away from other people and equipment.

Test connections

Cable	Monitor connection		Hi-pot tester connection	
	Connector/cable	Connect to	Wiring	Connect to
DC Input	Switchcraft 760 0.100" ID 0.218" OD	DC Input Connector	Both wires connected together and terminated appropriately for your hi-pot tester	Return
SpO_2 (Nellcor)	Nellcor D-connector (DEC-8 or other OXI-MAX equivalent)	SpO_2 Input Connector	All wires connected together and terminated appropriately for your hi-pot tester	High Voltage
SpO_2 (Masimo)	Masimo 14-pin mini D-connector	SpO_2 Input Connector	All wires connected together and terminated appropriately for your hi-pot tester	High Voltage
RS232	RJ45/standard patch cable	Communication Connector	All wires connected together and terminated appropriately for your hi-pot tester	High Voltage
Nurse Call	Welch Allyn Nurse Call cable 008-0634-XX (Uses Lemo connector PAB.MO.4GLAC397.)	Nurse Call Connector	All wires connected together and terminated appropriately for your hi-pot tester	High Voltage

Patient isolation test - procedure

1. Set up the test parameters on the AC Withstand Voltage Tester as follows:

Note Refer to the tester manufacturer's operation manual for complete details on setup and use.

Parameter	Specification	Parameter	Specification
Voltage	1500 Vac	Ramp Down	0
Maximum Limit	2.50 mA	Arc Sense	0
Minimum Limit	0.038 mA	Frequency	local line (50 Hz or 60 Hz)
Ramp Up	5.0 S	Continuity	Off
Dwell	5.0 S	Connect	Off
Delay	0		

Note To create test cables for this procedure, see the previous table.

2. Connect the hi-pot DC input test cable between the return jack on the tester and the DC input connector of the monitor.
3. Test isolation between the Nurse Call and DC input:
    a. Connect the hi-pot Nurse Call test cable between the nurse call connector and the high-voltage jack on the hi-pot tester.
    b. Press the test button to run the AC withstand voltage test.
    c. Verify that the monitor passed the test. (If the input current never exceeds 2.50 mA, the shielding is sufficient.)
    d. Remove the Nurse Call test cable.
4. Test isolation between RS232 and DC input:
    a. Connect the hi-pot RS232 test cable between the RS232 connector and the high-voltage jack on the hi-pot tester.
    b. Press the test button to run the AC Withstand Voltage test.
    c. Verify that the monitor passed the test. (If the input current never exceeds 2.50 mA, the shielding is sufficient.)
    d. Remove the hi-pot RS232 test cable from the RS232 connector and the hi-pot tester.
5. Test the isolation between SpO2 and DC input:
    a. Connect the SpO_2 test cable between the SpO_2 connector and the high-voltage jack on the hi-pot tester.
    b. Push the test button to run the AC Withstand Voltage test.
    c. Verify that the monitor passed the test. (If the input current never exceeds 2.50 mA, the isolation is sufficient.)
    d. Remove the SpO_2 test cable.
6. Remove the DC input test cable.

Checklist and test results report form

Use a copy of this form to track your progress through the functional verification.

✓	Test	Result			Pass (or N/A) ✓	Fail ✓
	Battery charging					
	Power-on self-test					
	Beeper					
	Monitor-off current	(mA):				
	Init/idle current	(mA):				
	Baseline current	(mA):				
	Battery voltage	Monitor (V):		DMM (V):		
	NIBP characterization test					
	NIBP verification					
	Pressure leakage	Before (mmHg):		After (mmHg):		
	Pressure accuracy	80 mmHg	SYS:	Manometer:		
		150 mmHg	SYS:	Manometer:		
		300 mmHg	SYS:	Manometer:		
	Valve/pump current	Valve/Pump (mA) - Baseline (mA) Difference (mA)				
	Inflation	Elapsed time (sec):				
	Deflation	Manometer reading (mmHg):				
	Max allowable cuff pressure					
	Adult	mmHg	kPa			
	Pediatric	mmHg	kPa			
	Neonate	mmHg	kPa			
	Overpressure cut-off	(Pass-Fail)				
	Printer current	Peak (mA):				
	SpO_2	Saturation (%):		Pulse (bpm):		
	Temperature	° Fahrenheit:		° Celsius:		
	Nurse call relay	pins 1-2	Alarm (Ω)	No Alarm (Ω)		
		pins 2-3	Alarm (Ω)	No Alarm (Ω)		
	Battery charge time					
	Battery discharge time					
	Battery voltage	**volts**				

Monitor serial #:
Tested by:
Test date:

Here is an example of verification results for a typical monitor.

✓	Test	Result			Pass (or N/A) ✓	Fail ✓
✓	Battery charging	**charge symbol lit**			✓	
✓	Power-on self-test	**normal**			✓	
✓	Beeper	**audible**			✓	
✓	Monitor-off current	(mA): **0**			✓	
✓	Init/idle current	(mA): **467**			✓	
✓	Baseline current	(mA): **199**			✓	
✓	Battery voltage	Monitor (V): **5.94**	DMM (V): **5.95**		✓	
✓	NIBP characterization test	**C03**			✓	
✓	NIBP verification				✓	
✓	Pressure leakage	Before (mmHg): **100**	After (mmHg): **99**		✓	
✓	Pressure accuracy	80 mmHg 150 mmHg 300 mmHg	SYS: **73** SYS: **142** SYS: **290**	Manometer: **72** Manometer:**140** Manometer: **286**	✓	
✓	Valve/pump current	Valve/Pump (mA) Baseline (mA) Difference (mA)		**560** **199** **361**	✓	
✓	Inflation	Elapsed time (sec): **6**			✓	
✓	Deflation	Manometer reading (mmHg): **0 (3 sec)**			✓	
✓	Max allowable cuff pressure				✓	
✓	Adult (280 [37.3])	280 mmHg	kPa		✓	
✓	Pediatric (200 [26.7])	200 mmHg	kPa		✓	
✓	Neonate (141 [18.8])	141 mmHg	kPa		✓	
✓	Overpressure cut-off	(Pass-Fail)			✓	
✓	Printer current	Peak (mA): **940**			✓	
✓	SpO_2	Saturation (%): **90**		Pulse (bpm): **200**	✓	
✓	Temperature	° Fahrenheit: **105.9**		° Celsius:	✓	
✓	Nurse call relay	pins 1-2 pins 2-3	Alarm (Ω) **> 1M** Alarm (Ω) **< 1**	No Alarm (Ω) **< 1** No Alarm (Ω) **> 1M**	✓	
✓	Battery charge time	**12.5 h**			✓	
✓	Battery discharge time	**19 h**			✓	
✓	Battery voltage	**6.40 volts**			✓	

Monitor Serial #: JA036582
Tested by: RJ
Test date: 8/30/2007

4 Troubleshooting and repair

Troubleshooting chart

This troubleshooting chart includes error codes related to possible internal failures. Based on the observed symptom, perform suggested actions one at a time from top to bottom. To reduce repair costs, determine whether the symptom still exists, by performing the device functional verification after each action. If other error codes appear, refer to the directions for use for information on the cause and suggested remedy for those errors.

Caution Replace parts, components, or accessories only with parts supplied or approved by Welch Allyn. The use of any other parts can lead to inferior monitor performance and will void the product warranty.

Symptom	Possible cause	Suggested action
Monitor does not power up.	Power adapter not powered.	Verify that the power adapter is plugged into the AC source and the monitor.
	Wrong power adapter.	Use the right power adapter.
	Defective power adapter.	Replace the power adapter.
	Battery is fully discharged.	Run the battery verification test; replace the battery if necessary.
	Battery fuse open.	Replace the battery.
Battery run time is low.	Defective battery	Replace the battery.
NIBP air leak exceeds specified limits.	Leaky check valve.	Replace the check valve.
	Leaky tubing or connector.	Replace the tubing or the connector.
	Leaky pump.	Replace the pump.
	Leaky bleed or dump valve.	Replace the POEM2 NIBP manifold (if a POEM2 module is installed) or replace NIBP module. **Warning: Always characterize NIBP after replacing any NIBP component.** (See **"NIBP characterization" on page 36.**)
Repeated C03 error code.	NIBP internal tubing is kinked.	Route tubing properly through the monitor.
Repeated C04 error code.	NIBP internal tubing is disconnected.	Properly connect the NIBP tubing.
	Faulty NIBP module.	Replace the NIBP module. **Warning: Always characterize NIBP after replacing any NIBP component.** (See **"NIBP characterization" on page 36.**)

Symptom	Possible cause	Suggested action
Repeated C07 error code.	Incompatible SpO_2 sensor. Improperly connected SpO_2 sensor. Faulty SpO_2 sensor. Faulty SpO_2 board.	Use a compatible sensor. Properly connect the sensor cable. Replace the sensor. Replace the SpO_2 board.
Repeated C20 temperature error code.	Probe well is not installed in the probe-well housing. Faulty probe. Faulty temperature board.	Install the probe well in the probe-well housing. Replace the probe. Replace the temperature board. For details, see order number 21327-1000 in "Temperature option" on page 92.
Error code E30	PROM is corrupt.	Return the monitor to an authorized service center for PROM programming.
Error code E31	RAM test failure.	Cycle the power. If the error persists, return the monitor to an authorized service center for replacement of the main board.
Error code E32	Factory data failure.	Return the monitor to an authorized service center for replacement of the main board.
Error code E33	User data error.	Cycle the power to reset all user settings to default values.
Error code E34	A/D converter failure.	Cycle the power. If the error persists, return the monitor to an authorized service center for replacement of the main board.
Error code E35	SpO_2 module failure.	Verify all cable connections, and then cycle the power. If the error persists, replace the SpO_2 board. Use the service utility to verify compatibility.
Error code E36	Faulty probe.	Replace the temperature probe with a known good probe.
	Temperature module failure.	Verify all cable connections, and then cycle the power. If the error persists, replace the temperature board, Use the service utility to verify compatibility.
Error code E37	Printer failure.	Verify all cable connections, and then cycle the power. If the error persists, replace the printer module. Verify that the paper guide and sensor are properly attached to the printer chassis.
Error code E38	Error E38 always occurs when the monitor is first powered after a battery has been connected. Real-time clock failure.	Cycle the power, and then reset the date and time. Cycle the power. If the error persists, return the monitor to an authorized service center for replacement of the main board.
Error code E40	NIBP module failure.	Characterize NIBP. **(See "NIBP characterization" on page 36.)** If the error persists, return the monitor to Welch Allyn for service/
Error code E41	NIBP module failure.	Verify all cable connections, and then cycle the power. If the error persists, replace the NIBP module. **Warning: Always characterize NIBP after replacing any NIBP component.** (See **"NIBP characterization" on page 36**.)
Error code E44	POST queue full.	Cycle the power. If the error persists, return the monitor to an authorized service center for replacement of the main board.

Symptom	Possible cause	Suggested action
Missing LED display.	LED failure on the display board.	Replace the display board.
Erroneous LCD characters.	LCD partially connected.	Fully connect the LCD to the main board.
Buttons on the right side of the monitor require noticeably more pressure to actuate.	Screws attaching the display board to the front panel are loose.	Tighten the screws. **Do not exceed 4 in-lbs.**

Requirements for module-level repair and replacement

Note All repairs to a monitor under warranty must be performed at an authorized Welch Allyn service center.

Activity	Recommended action
Update the software	Use the VSM Service Utility (810-1784-XX).
Replace the main board	Return the monitor to an authorized service center.
Replace the NIBP module.	Replacement procedure beginning on page 55. Perform a complete functional verification (page 9). ⚠ **Warning: Always characterize NIBP after replacing any NIBP component.** (See **"NIBP characterization" on page 36.**)
Replace the SpO_2 board	Replacement procedure beginning on page 55. Perform a complete functional verification (page 9).
Replace the SpO_2 side panel.	Replacement procedure beginning on page 55. Perform a complete functional verification (page 9).
Replace the temperature board.	Replacement procedure beginning on page 55. Perform a complete functional verification (page 9).
Replace the printer.	Replacement procedure beginning on page 55. Perform a complete functional verification (page 9).
Replace the front panel.	Replacement procedure beginning on page 55. Perform a complete functional verification (page 9).

NIBP characterization

⚠ **WARNING** Whenever any component of the NIBP assembly (pump, air filter, check valve, tubing, or NIBP board) is replaced, the NIBP module must be characterized before the monitor is returned to service.

WARNING If the NIBP module is not properly characterized, the NIBP cuff could overinflate, which could be hazardous to neonatal patients.

The Welch Allyn Monitor Service Utility facilitates this characterization procedure. For more information, see "Characterizing NIBP" on page 41.

Welch Allyn monitor service utility

Overview

The Welch Allyn Monitor Service Utility is a software tool for use, with the VSM 300 Series service manual, by biomedical technicians, clinical engineers, and other qualified service personnel, to update and repair VSM 300 Series monitors.

The utility supports the following service functions:

- Characterize the VSM 300 NIBP module
- View, read, print VSM 300 logs
- Update VSM 300 software
- Enable the monitor to accept updated NIBP, SpO_2 and temperature modules

Where to find information:

Using the utility	Utility help files
Servicing the monitor	This document (Vital Signs Monitor 300 Series Service Manual).
Supported SW and HW versions	CD release notes

The utility includes the following upgrades, which are for the VSM 300 Series only:

- NIBP module software
- Main board software

Note This upgrade procedure might return monitor user settings to the factory defaults. Refer to the service manual for information about factory default values.

Note Monitors with serial numbers JA020000 to JA044073 were shipped with the NIBP version 3.20.00 software installed.

Note This utility is not required when replacing SpO_2 modules with the same firmware version.

Note This utility is not required when replacing SureTemp modules with the same firmware version. Monitors with serial numbers JA020320 and greater were shipped with SureTemp version 1.2.

Note Nellcor and Masimo SpO_2 modules cannot be interchanged.

Note Monitors with serial numbers JA030012 and greater were shipped with the Monitor Main version 1.20.00 software installed.

Note Monitors with NIBP software version 4.20.00 contain the POEM2 NIBP module. NIBP software version 4.20.00 is incompatible with NIBP POEM1 modules running version 3.20.00 and older. NIBP module software older than version 4.10.00 is incompatible the POEM2 module. Monitors with serial numbers above JA044073 were shipped with software version 4.20.00 or greater.

Required equipment

810-1784-xx Vital Signs Monitor 300 Series Software Upgrade Tool CD-ROM
008-0842-xx Vital Signs Monitor 300 Series serial cable
PC with the following:

- Windows XP SP2 or Windows 2000 SP4 operating system
- Intel Pentium IV CPU, or equivalent
- 256 MB RAM memory
- CD-ROM drive
- At least 20 MB available hard-disk space
- Available printer
- Available RS-232 serial communications port, 9-pin, D-style (If no RS-232 port is available but a USB port is available, you must have a USB-to-serial (DB9) adaptor (not supplied). For Windows 2000 and XP operating systems, the supported adapter is KEYSPAN USB serial adapter USA-19HS.)

Warranty service

All repairs on products under warranty must be performed or approved by Welch Allyn. Refer all warranty service to Welch Allyn Factory Service or another authorized Welch Allyn Service Center.

Caution Unauthorized repairs will void the product warranty.

Non-warranty service

Welch Allyn Factory Service and authorized Service Centers support non-warranty repairs. Contact any Welch Allyn regional service center for pricing and service options. Welch Allyn offers modular repair parts for sale to support non-warranty service. This service must be performed only by qualified customer biomedical/clinical engineers using the VSM service manual (810-1651-XX).

Note Using the procedure described in this document to upgrade the NIBP software to version 3.20.00 does not void the warranty.

Installation and setup

Note Remove any previous versions of the service utility before installing this version. (See "Uninstalling older versions of the utility" on page 53.)

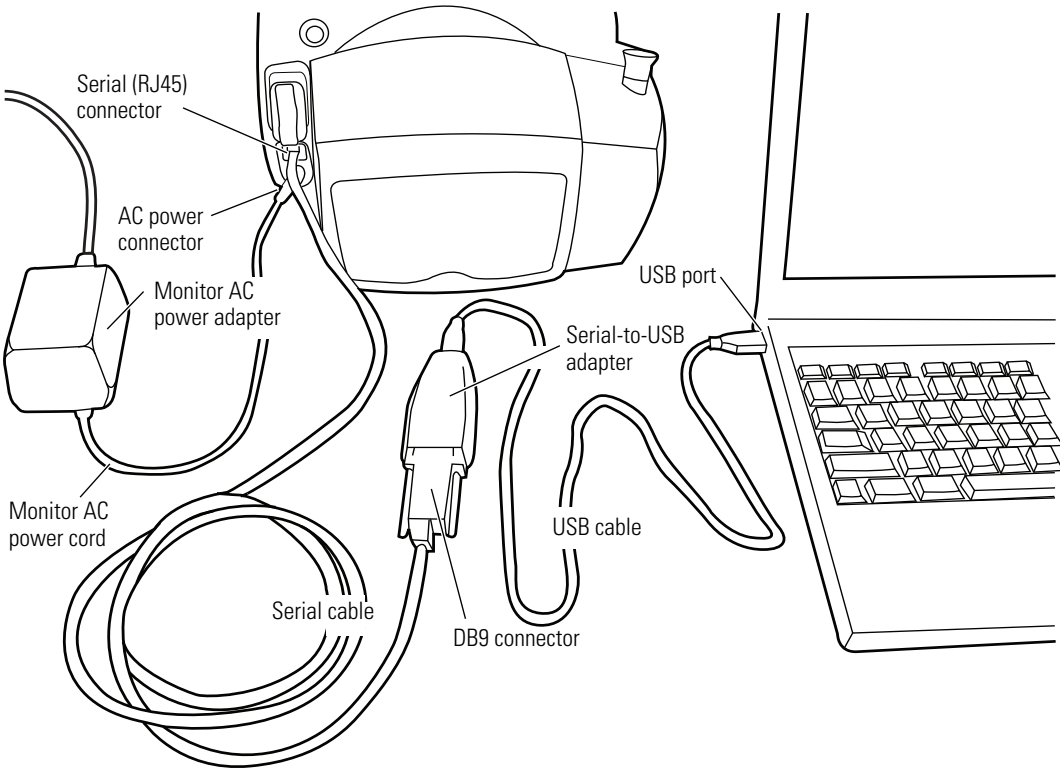
To install the utility

1. Insert the Service Utility distribution disk (810-1784-xx) into the CD-ROM drive of the installation PC.
2. Install the utility software.
   a. If Autorun is enabled on the CD-ROM drive, an installation program starts. Follow the on-screen installation instructions.
   b. If Autorun is not enabled, use Windows Explorer to navigate to the CD-ROM drive and run **setup.exe**. Follow the on-screen installation instructions.

The default utility installation is into:
C:\Program Files\Welch Allyn\Service Tool\VSM 300.

To set up the utility

1. Connect the AC power adapter to the monitor. (Do not turn the monitor on.)
2. Connect the RJ-45 connector on the serial cable to the monitor.
3. If you are not using a USB-to-serial adapter, skip to step 8.
4. Follow the USB-to-serial adapter manufacturer's instructions to load the USB drivers.
5. Connect the serial cable DB-9 connector to the DB-9 connector on the adapter.
6. Connect the USB connector to the USB port on the PC.
7. Skip to step 9.



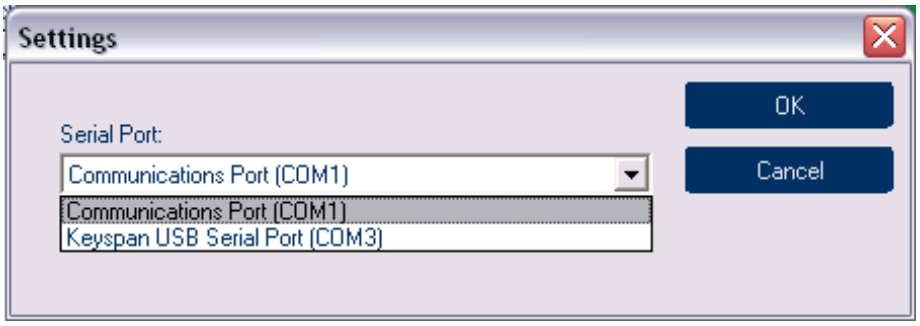
8. Connect the DB-9 connector on the serial cable to the serial port on the PC.
9. Start the utility:

   Start > **Programs** > **Welch Allyn** > **Service Tool** - **VSM 300**

10. Open the **Options** menu and select **settings**. If the status panel in the lower left corner displays "VSM 3 Available", then the utility has connected to the VSM; skip to step 12.
11. Select the com port assigned to the serial port used to connect to the monitor.
12. Disable **Log I/O to file**.

Note If **Log I/O to file** is enabled, the utility captures all communications between the VSM and the utility in the file **io.log**. This file continues to grow until the communications link is broken, because the utility is continuously checking for the presence of the VSM.

The utility overwrites **io.log** each time the service utility is started.



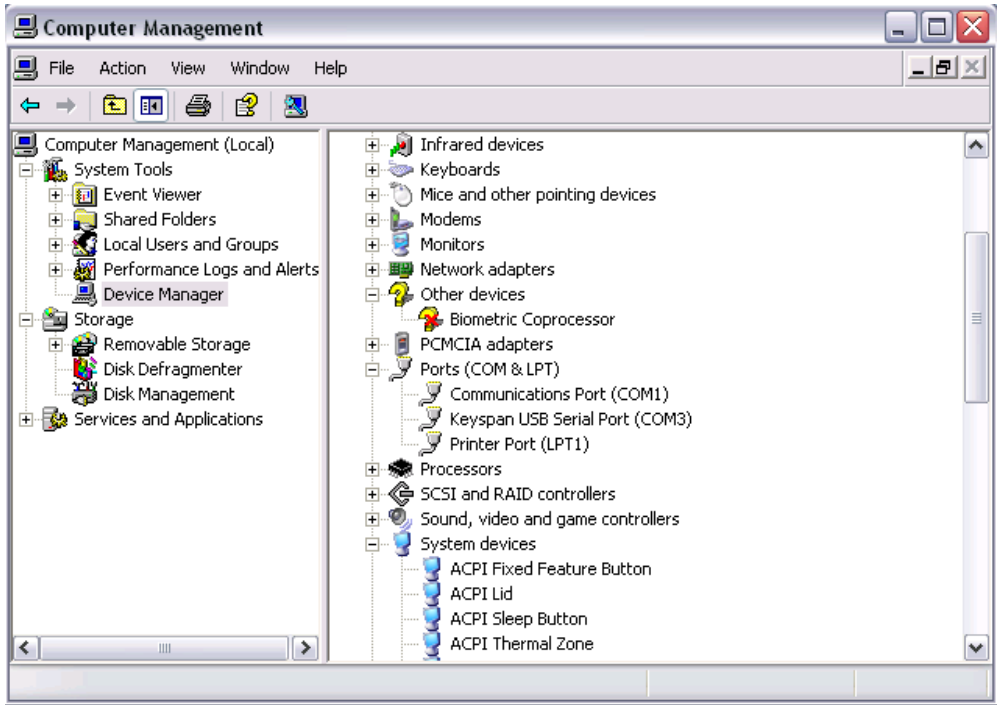
Here, the serial port (Communications Port) is configured to COM1 and the Keyspan USB adapter is configured to COM4.

Note If the utility displays "VSM3 not responding", cycle the power to the monitor.

If the com port cannot be found in the Settings dialog, use the Device Manager to configure the port.

To open the Device Manager

1. **Start** > right-click **My Computer** > **Properties** > **Hardware** >**Device Manager**.
2. Click **Ports (COM & LPT)** to expand the list.



To configure to a different COM port

1. Right-click on the port you want.
2. Select **Properties**.
3. Select **Port Settings**.
4. Click **Advanced**.
5. Select a new COM Port Number.

The port settings for the Keyspan adapter are explained in the documentation included with the device. Keyspan provides an assistant to configure and diagnose the USB-to-serial adapter. Access the assistant from Port Settings in the Device Properties dialog.

The VSM uses these default settings:

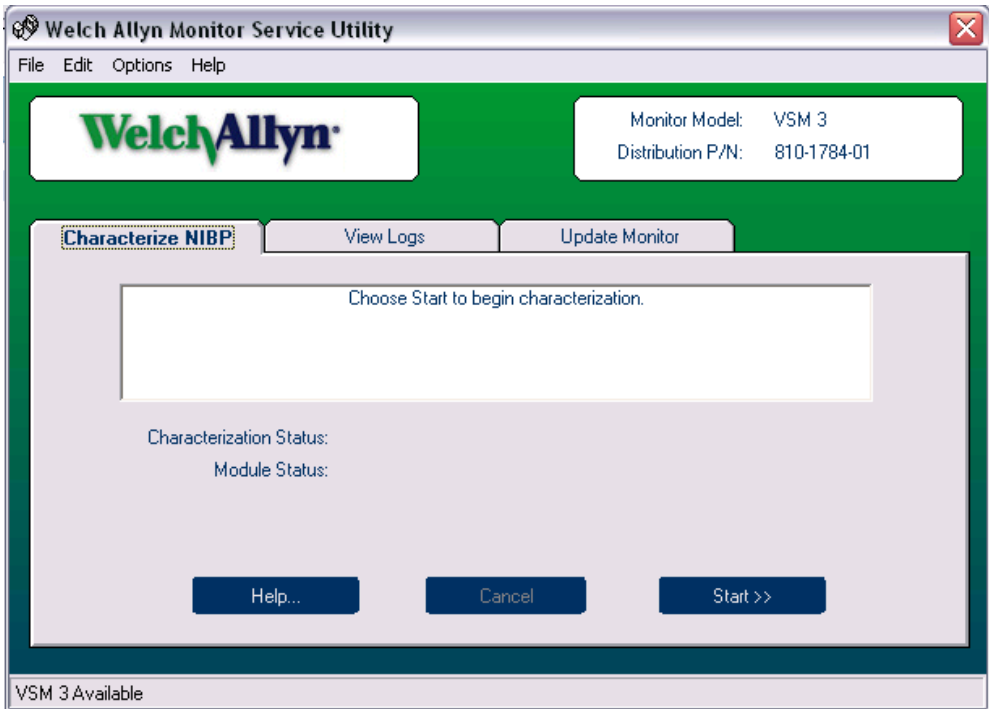
- 9600 bits per second
- 8 data bits
- no parity
- 1 stop bit
- no flow control

Service procedures

Characterizing NIBP

This operation trains the NIBP module to properly account for the volumes of internal and external tubing when the pump is running.

WARNING You must characterize NIBP after replacing any NIBP components: pump, tubing, air filter, check valve, or NIBP module. Failure to properly characterize NIBP can lead to injury of neonatal patients.



To characterize NIBP

1. Select **Characterize NIBP**. The utility displays the message "Choose Start to begin characterization".
2. Click **Start**, and follow the on-screen instructions. The utility attempts to place the monitor in the correct state for characterization:
   - The monitor is turned off.
   - The monitor, operating on charger power, supports communication between the utility and the NIBP module.
3. Connect a 96-inch neonatal cuff hose (008-0265-XX) as indicated.
4. Remove the cuff.
5. Block (with a thumb, for example) or otherwise plug the free end of the tubing.
6. Click **Next** to initiate NIBP characterization. Within a few seconds, the message "Success - Result not yet saved" and "Choose Next to save this value to EEPROM" appear.
7. Click **Next**. The utility displays details from the VNRAM write process, followed by the message "Please wait while the module reboots". The reboot takes several seconds. When it is complete, the message "Characterization is complete" appears.
8. Click **Finish** to clear the display and return the utility to the ready state.

Viewing, saving, and printing logs

To support troubleshooting and service, the VSM 300 maintains an Event Log, a Debug Log, and a Cal & User Log. All can be viewed, saved and printed.

- The Event Log provides a detailed summary of the most recent operations performed, up to the maximum log size.

- The Debug Log lists the most recent warning conditions that have occurred, up to the maximum log size.

When the Event and Debug Logs reach maximum size, new data overwrites the oldest.

- The Calibration & User Log provides the following categories of information:
  - calibration
  - user-configuration
  - run-time and cycle count
  - software versions of all modules

Note Large log files can take several minutes to load.

Note The item counter, located on the right side below the radio buttons, sometimes stops counting until all items have been retrieved from the monitor.

To view the log files

1. Click **View Logs** to access the logs.
2. Under **Display**, choose the desired log to load and view in the window.

To save the log files

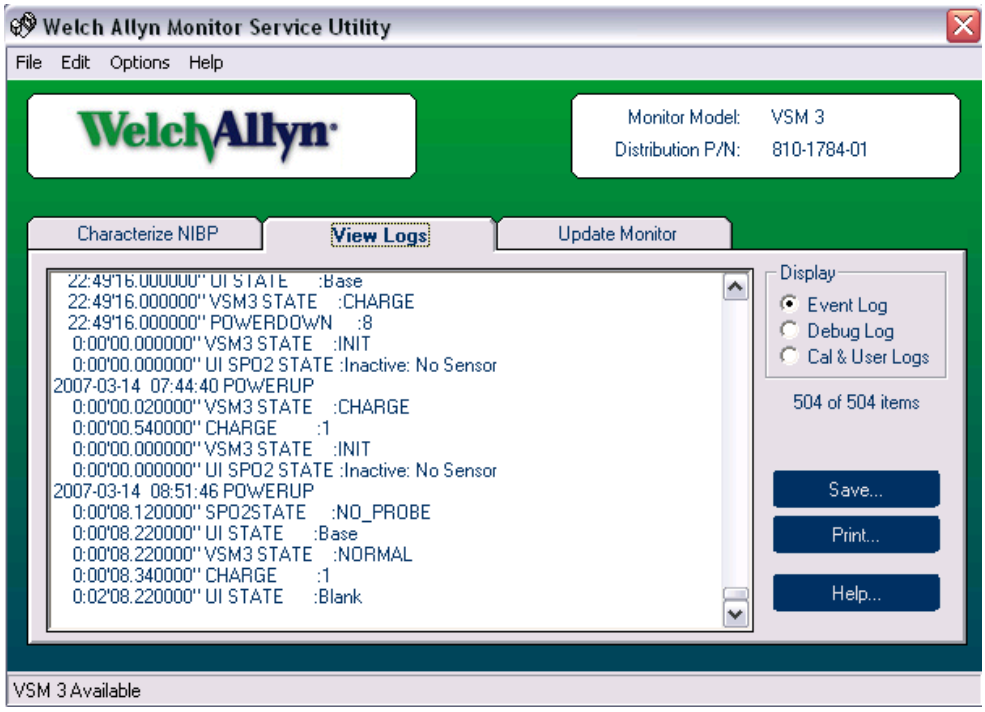
1. Under **Display**, choose the desired log to save.
2. Click **Save**.
3. Navigate to the folder where the file will be saved.
4. Name the file.
5. Click **Save**.

To print the log files

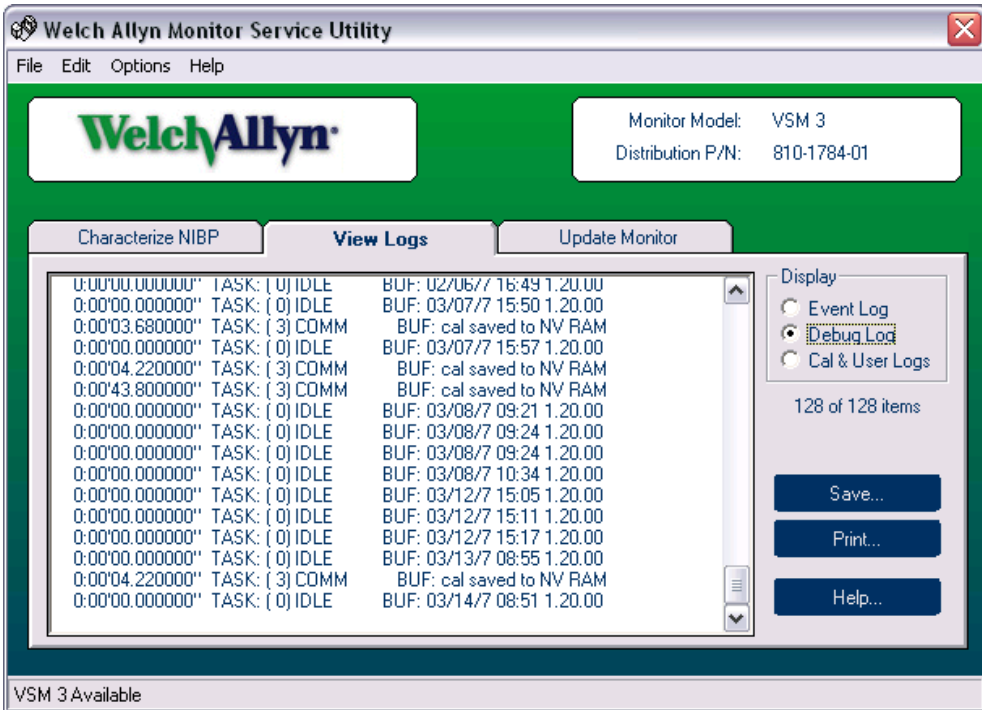
1. Under **Display**, choose the desired log to print.
2. Click **Print**.
3. Select the printer and the print parameters.
4. Click **Print**.

Note Screen images shown are samples only. Actual screens vary with each release.

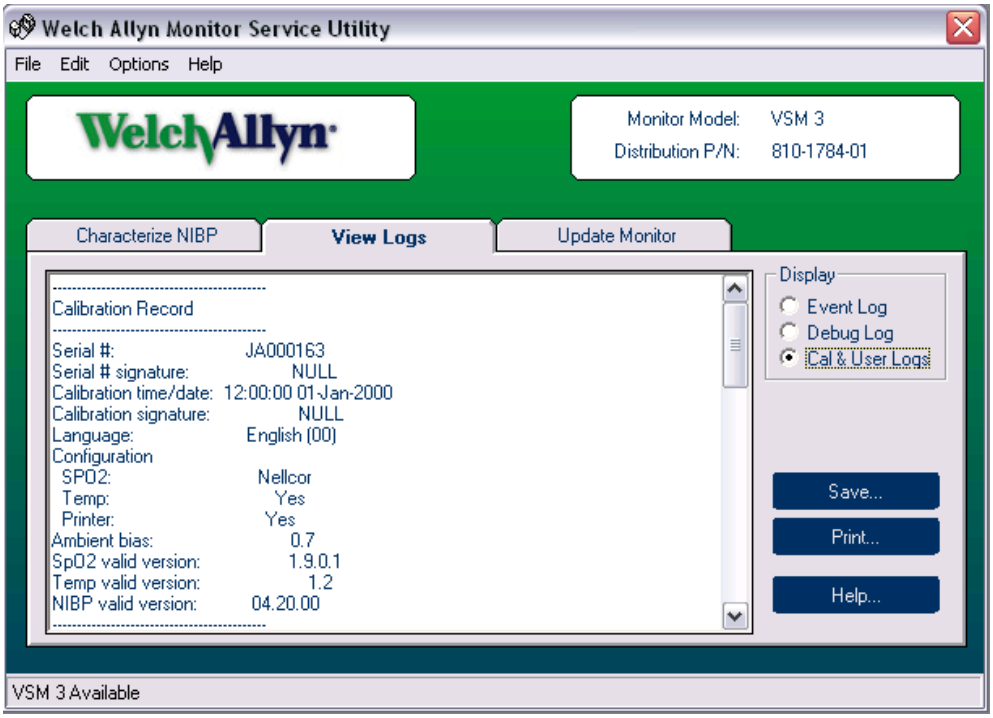
Event Log



Debug Log



Cal & User Logs



Update Monitor Software

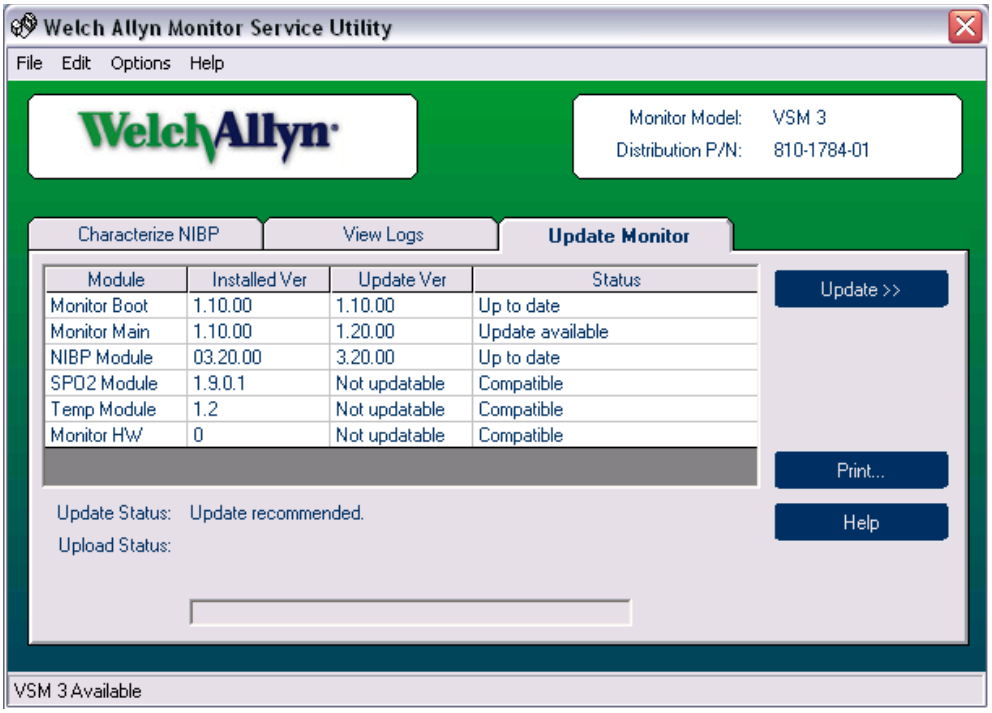
The Update Monitor tab displays installed (Installed Ver) and available (Update Ver) versions for the Monitor Boot, Main, and NIBP module software. If the monitor has an optional SpO_2 or temperature module, the firmware versions are displayed. Update status is shown for each, indicating whether an update is available for those versions that can be updated.

If the version installed on the monitor is newer than what the utility supports, the status displays "Not supported". Contact Welch Allyn Technical Service to obtain an updated version of this utility.

The status also indicates whether the installed software and firmware versions are compatible with the update versions offered. The program checks for compatibility within the module as well as compatibility between modules. If any of the software or firmware is incompatible with the available updates the update button will not be active.

The SpO_2 and temperature module firmware can only be updated by replacing the hardware modules. If the NIBP, SpO_2 or temperature module has been replaced with a different version, the installed version for the new module is shown in orange.

The monitor hardware module field Installed Ver reports the mainboard hardware version. The hardware version is included to prepare for the eventual possibility that incompatible versions might someday be introduced. All VSM mainboards have HW code 0. No incompatibilities currently exist between versions of the board.



Update the Monitor

Caution If the update is interrupted, the VSM monitor might be left in an unusable state.

To minimize the possibility of interruption during the update:

- Do not run other applications on the PC during this process.
- Do not disconnect the monitor from the AC power adapter or the computer until **Finished** is clicked and **Update Monitor** has been refreshed.
- Set the **Power** scheme on the PC to **Always On** to prevent it from turning off the monitor or hard disk and going into standby or hibernation mode.
- Make sure the PC and the VSM are connected to a stable power source.
- Do not connect power cords to switched outlets.
- Do not connect power cords where they may be inadvertently disconnected.

If the update does not complete, the VSM reports an E40 error. Reinstalling the software might result in a recovery.

Caution This upgrade procedure might return monitor user settings to the factory defaults. To create a record of the current settings, select **View Logs**, click **Cal & User Logs**, and save the current log.

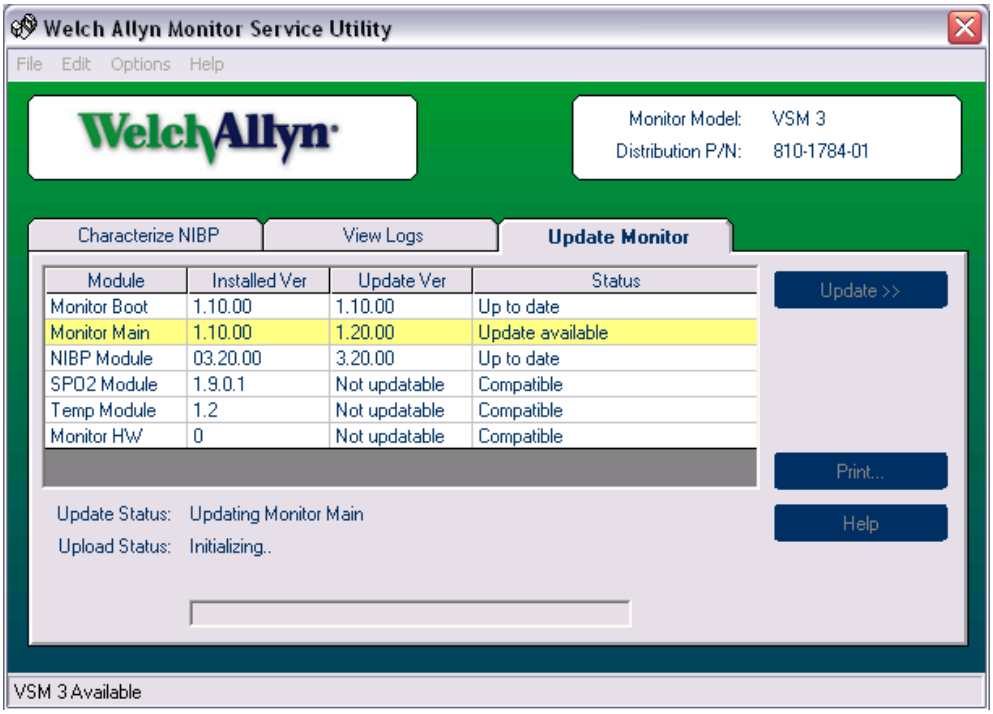
If the installed software is current:

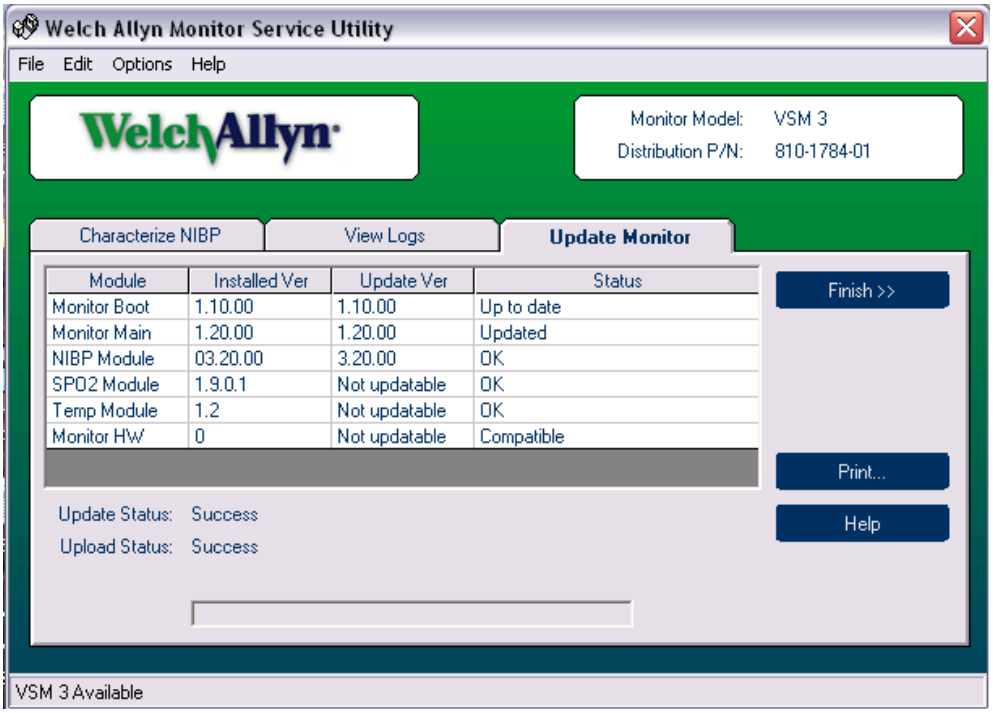
- Update is grayed out.
- Update Status is “Up to date”.
- Upload Status is blank.

If updates are available, Update Status is either “Update required” or “Update Recommended”.

1. Connect the monitor to the AC power adapter and to the PC.
2. Start the utility.
3. Select **Update Monitor**.
4. To start a software update, click **Update**. The monitor reboots and proceeds with all available updates, beginning with the Monitor Boot. During the update process, the monitor reboots as needed.

   The Monitor Boot and Main software modules take about six minutes to load; POEM1 3.20.00 software takes about 15 minutes to load.

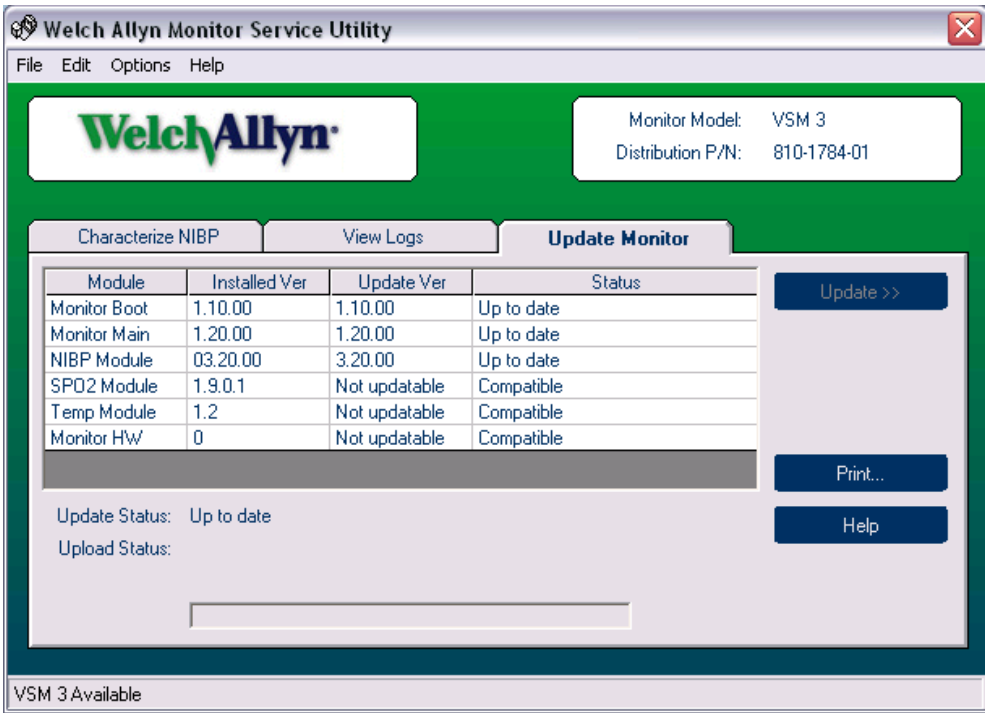




5. When the software upload is complete, the Update Status and Upload Status messages display “Success”. Click **Finish** to cause the service tool to query the monitor and retrieve the newly installed monitor versions.

Caution Do not disconnect the monitor from the AC adapter and the computer before the utility **completes the query** for the new software version. During the query, Update Status displays "working...". When the query is complete, Update Status changes to "Up to date."

After clicking **Finish**, Update Status is “Up to date”; Upload Status is blank.



6. The service utility writes a log file detailing the update. By default, the log file is saved to the same directory the program was installed to. The file name is the word "update_" and the monitor serial number.

   - To view the file without printing, click **Print**, right-click on the file, and select **Open**.
   - To print the file, click **Print**, select the file, click **Open**, select a printer, and click **Print**.

Sample Upgrade Record

WELCH ALLYN SERVICE TOOL UPGRADE RECORD

MONITOR INFORMATION

Model:VSM 3
Serial Number:JA000164
TLA Number:007-0105-xx

INITIAL STATE

ModuleInstalled VerUpdate VerStatus
Monitor Boot1.10.001.10.00Up to date
Monitor Main1.10.001.20.00Update available
NIBP Module03.20.003.20.00 Up to date
SPO2 Module1.9.0.1Not updatableCompatible
Temp Module1.2Not updatableCompatible

Monitor HW0Not updatableCompatible

UPDATE LOG

March 15 2007 11:32:33 Monitor Main:1.20.00 Success
March 15 2007 11:32:34 cmdSetVSM3ValidVersionPoem:03.20.00 Success
March 15 2007 11:32:34 cmdSetVSM3ValidVersionSpo2:1.9.0.1 Success
March 15 2007 11:32:34 cmdSetVSM3ValidVersionTemp:1.2 Success

---

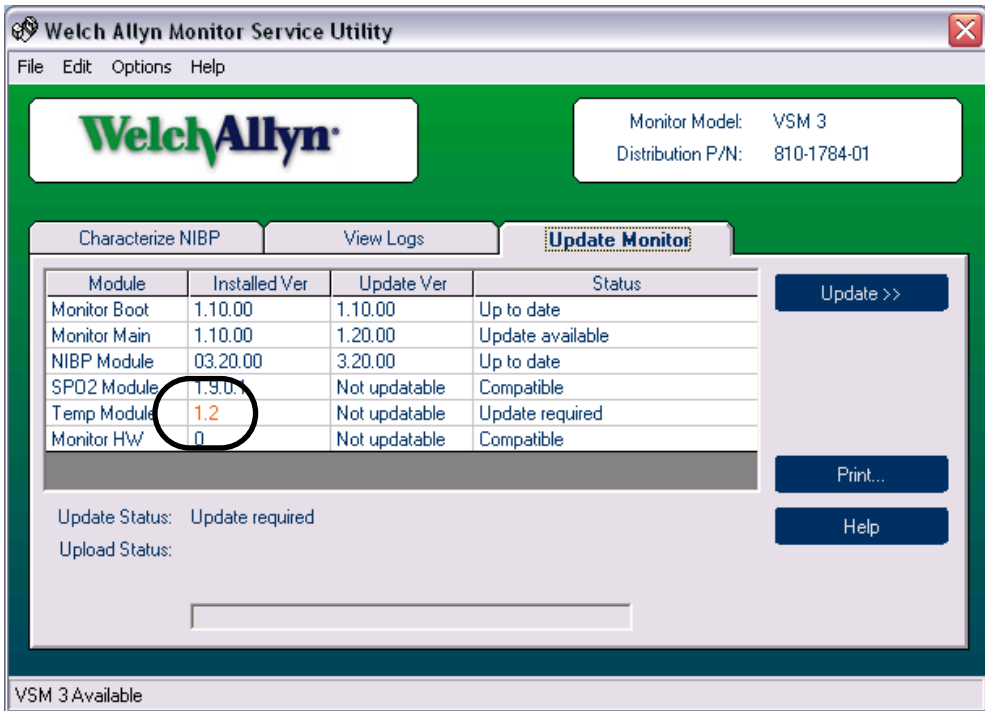
PERSON PERFORMING UPGRADE

Printed Name _____

Signature _____

Updating NIBP, Temperature & SpO_2 Modules

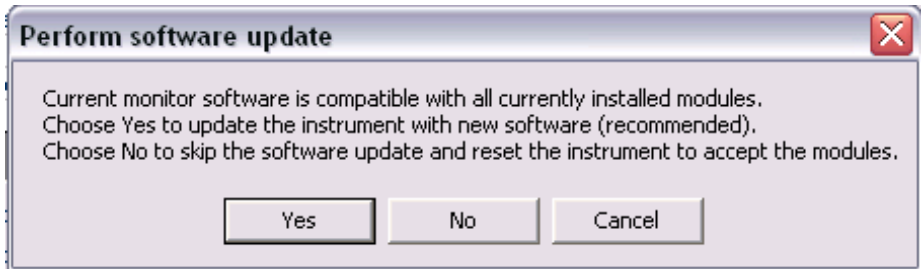
When replacing the NIBP (POEM), temperature or SpO_2 hardware modules with modules containing a different firmware version, the service utility must be run to enable the monitor to accept the new firmware version. If the firmware has been changed since the last time the monitor was configured, the new firmware version is shown in orange in the Installed Version column under Update Monitor.



In this screen shot a new temperature module has been installed with firmware version 1.2. Notice the Upgrade Status displays “Update required”. Until the monitor is updated, it displays an E35 error indicative of a faulty temperature module.

1. After a hardware module has been replaced with a new version, run the service utility to accept the new configuration. To accept the new firmware, click **Update**. The dialog box opens as shown in the screen shot below.
2. Determine whether to update the software.
   - To accept the updated module and update the software, select **Yes**.

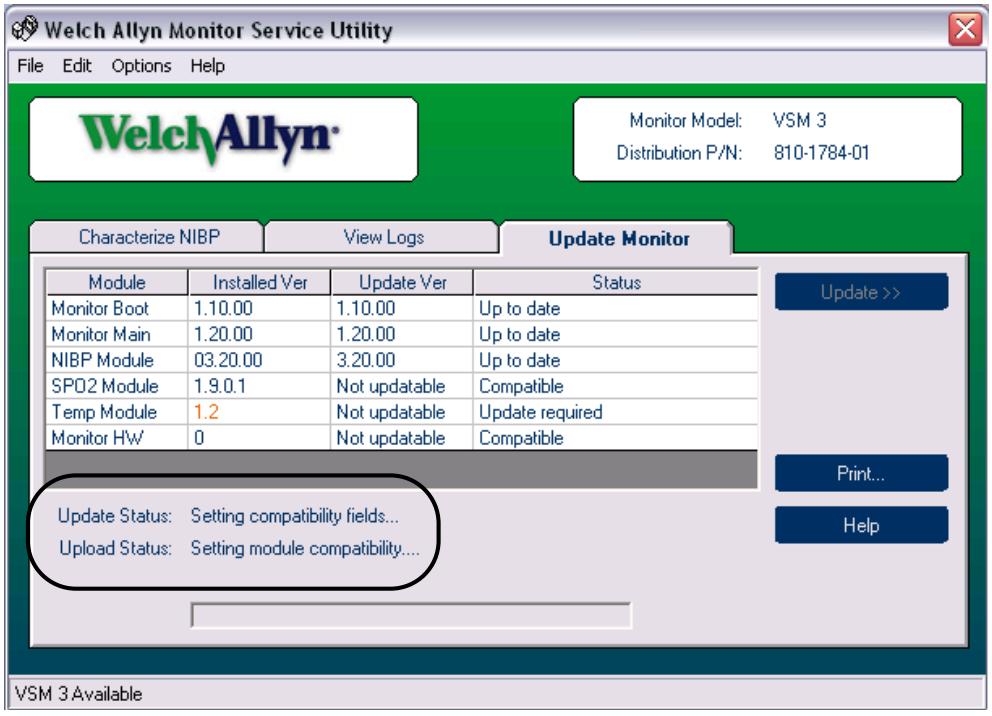
     Update Monitor shows an update available for the software. Selecting **Yes** in the Perform Software Update dialog resets the configuration file to accept the new Temp Module Ver 1.2 and updates the monitor software.



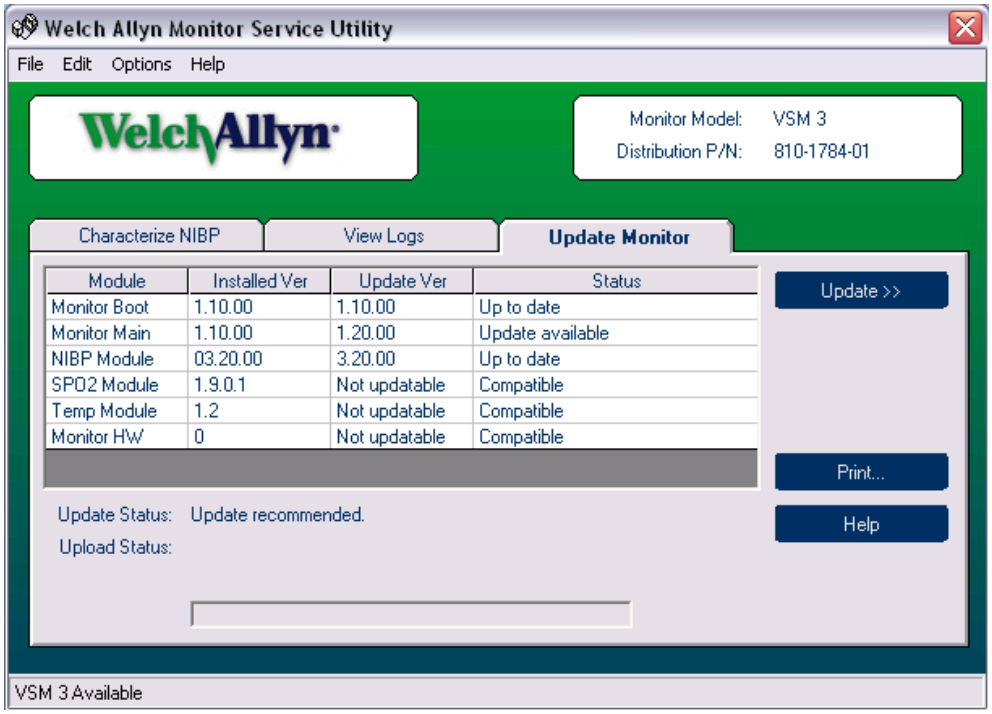
   - To accept the updated module without updating the Monitor Main software, click **No**.
   - To stop the operation without making any changes to the monitor, click **Cancel**.

Note Either Yes or No enables the monitor to accept the new module.

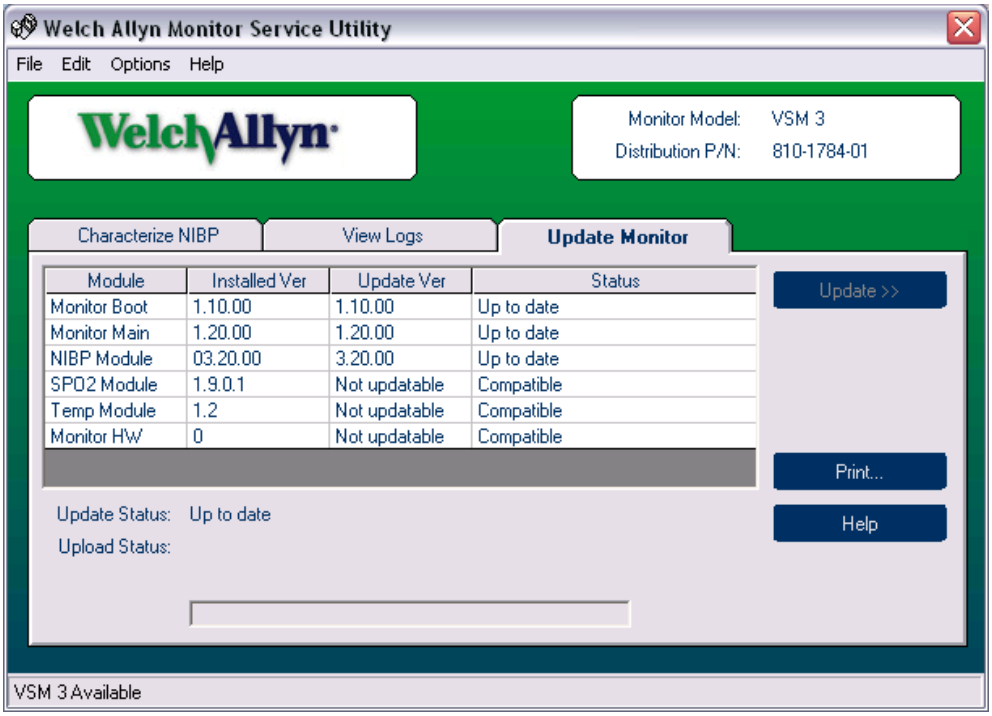
Note the Status messages here. The monitor resets the configuration file to accept the new module firmware before uploading any software.



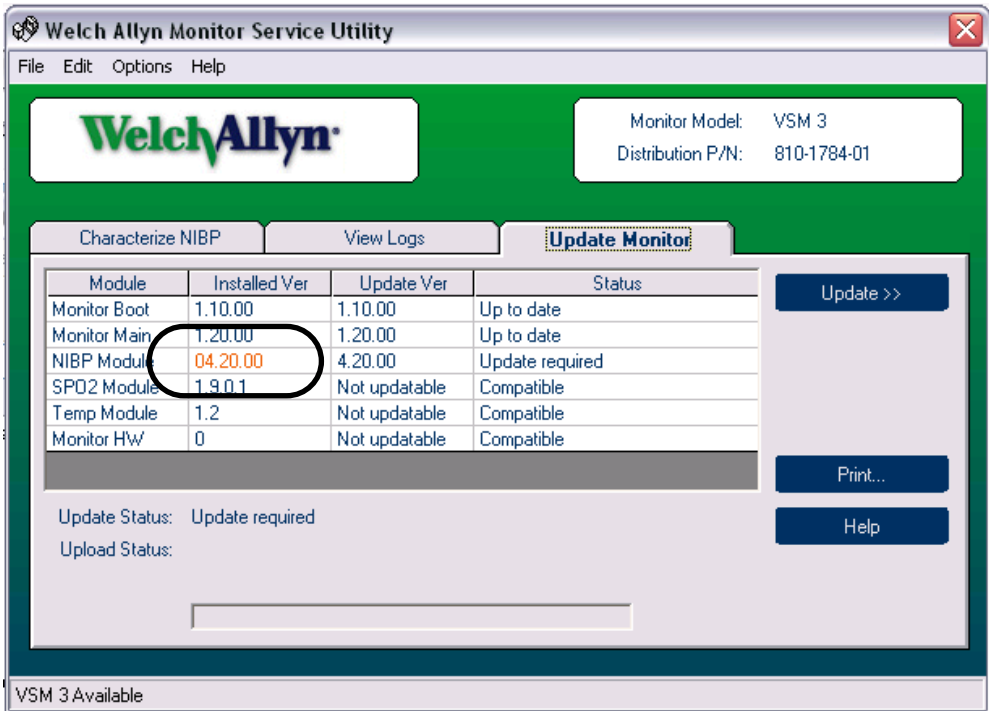
Here, the monitor has been reset to accept the temperature module with firmware version 1.2. Notice that the Upgrade Status message displays "Update recommended". In step 2, No was selected to accept the new temperature module without updating any software.



Here, the monitor has been reset to accept the temperature module with firmware version 1.2. Notice the Upgrade Status message "Up to date". In step 2, Yes was selected to accept the new temperature module and update the Monitor Main software.



In this screen, the NIBP module has been replaced with a POEM2 NIBP module. Before the VSM can use the POEM2 NIBP module, the service utility must update the VSM with the new configuration. In this case, the NIBP module already contains the latest software, so no software updates are needed. When the compatibility fields have been set, the VSM is ready to use.



Uninstalling older versions of the utility

Use this procedure to uninstall an older version of the VSM 300 Service Utility before installing a new version.

To uninstall the Service Utility program

1. From the lower left corner of the Windows desktop, click

   Start > **Control Panel** > **Add or Remove Programs**

2. Click the Welch Allyn Service Tool.
3. Click **Change/Remove**.
4. After the program is removed, reboot or turn off the computer.

5 Disassembly procedure

Procedures overview

These procedures cover monitor disassembly and board removal. Unless otherwise noted, the assembly procedure is the reverse of the disassembly procedure.

WARNING Electrical shock hazard. The battery can deliver currents sufficient to cause serious personal injury and to damage the monitor. When opening the monitor for any reason, always remove and disconnect the battery immediately, before proceeding with disassembly.

Caution Do all repairs at a static-protected station.

Caution Observe recommended screw torque specifications, especially with screws that secure directly into plastic standoffs.

Screws

Caution To avoid mismatching screws and holes, keep the screws for each piece with that piece as you remove modules, circuit assemblies, and other components.

Following are recommended torque specs for all screws:

Qty	Location	Part Number	Type	Size/length	Torque
4	Battery Door	620-0399-00	Machine	#4-40, 5/16"	4 lbf/in.
3	Case	620-0399-00	Machine	#4-40, 5/16"	4 lbf/in.
5	Display Board	620-0393-00	Thread-forming	#4-20, 5/16"	4 lbf/in.
4	Main Board	620-0393-00	Thread-forming	#4-20, 5/16"	4 lbf/in.
4	NIBP Board	620-0393-00	Thread-forming	#4-20, 5/16"	4 lbf/in.
4	SpO_2 Panel	620-0393-00	Thread-forming	#4-20, 5/16"	4 lbf/in.
2	SpO_2 Board	620-0047-00	Machine	#6-32, 1/4"	4 lbf/in.
2	Printer	620-0165-00	Thread-forming	#2-28, 5/16"	3 lbf/in.
1	Printer Board	620-0165-00	Thread-forming	#2-28, 5/16"	3 lbf/in.
2	Printer door/roller	620-0091-00	Thread-forming	#2-32, 3/16"	3 lbf/in.
2	Temp. Module	620-0394-00	Machine	#4-40, 3/4"	4 lbf/in.
4	Temp. Panel	620-0393-00	Thread-forming	#4-20, 5/16"	4 lbf/in.
4	Temp Board	620-0393-00	Thread-forming	#4-20, 5/16"	4 lbf/in.

Connectors

Caution All connectors are keyed or coded to facilitate proper connection. Take care to correctly align all connector halves before attempting to connect them.

Connector types

The procedures described below require you to disconnect and reconnect ZIF (zero-insertion force) connectors, squeeze-release connectors, and pressure connectors.

Zero-insertion force (ZIF) flex-cable connectors

ZIF flex-cable connectors include J1 on the display board, CN2 on the printer board, J1 on the temperature board, and J5 and J12 on the main board.

ZIF connectors use a sliding outer piece that latches and unlatches to secure and release the flex cable.

- To release a ZIF cable, slide the latching piece of the connector away from the connector body and toward the cable; the cable can then be removed without effort.
- To connect a ZIF cable, slide the latching piece of the connector body toward the cable, insert the flex cable easily into the connector, and slide the latching piece back toward the connector body until it clicks into place.

Caution Do not attempt to remove a flex cable until the ZIF latch has been opened.

Side-release connectors

Side-release connectors include J7 and J9 on the main board and J2 on the NIBP board.

To use side-release connectors, squeeze the sides of the connectors to insert or remove the cables.

Pressure connectors

Pressure connectors include and CN1 and CN3 on the printer board; J2, J3, J4, J6, J8, J10, and J11 on the main board; J1 and J2 on the SpO_2 board.

To use pressure connectors, grasp each mating connector half and pull the halves apart or insert one half into the other.

Caution Never attempt to disconnect cables by pulling on the wires. Always disconnect cables by grasping and pulling only on the connector halves.

Main board connectors

For the best results when disconnecting cables from the main board, disconnect the upper cables first and work your way to the bottom of the board, in approximately the following order:

Note See the illustration in **"Main board reassembly notes" on page 66**.

Order of disconnection					
	Main-board Connector	**Connects With**		**Main-board Connector**	**Connects With**
1	J2	External DC Input	7	J8	* Printer data – CN3
2	J1	External RS-232	8	J10	* Printer power – CN1
3	J6	LCD	9	J3	Battery
4	J5	Display board – J1	10	J9	NIBP board
5	J12	* Temperature board – J1	11	J7	* SpO_2 board – J2
6	J4	Nurse call connector	12	J11	Speaker

(* Denotes optional hardware.)

When reassembling the monitor, connect the cables in reverse order.

Display board connector

Connector	**Connects With**
J1	Main board – J5

Printer board connectors

Connector	**Connects With**
CN1	Main board – J10
CN2	Fujitsu printer
CN3	Main board – J8

SpO_2 board connectors

Connector	**Connects With**	**Connector**	**Connects With**
J1	SpO_2 side panel	J2	Main board – J7

NIBP board connectors

Connector	**Connects With**	**Connector**	**Connects With**
J2	Main board – J9	J6	Pump

Temperature board connectors

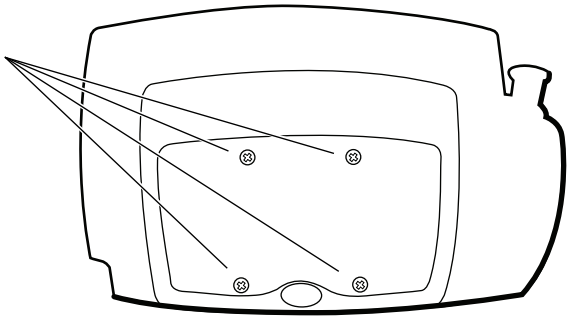
Connector	**Connects With**	**Connector**	**Connects With**

J1	Main board – J12	J5	External Probe

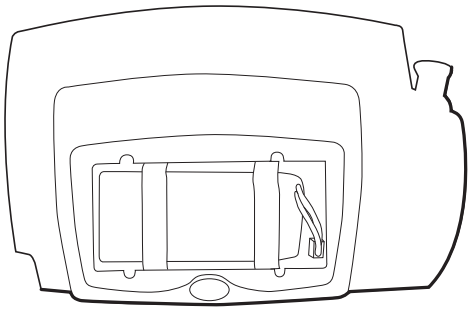
Remove and disconnect the battery

1. Remove the four screws securing the battery door.

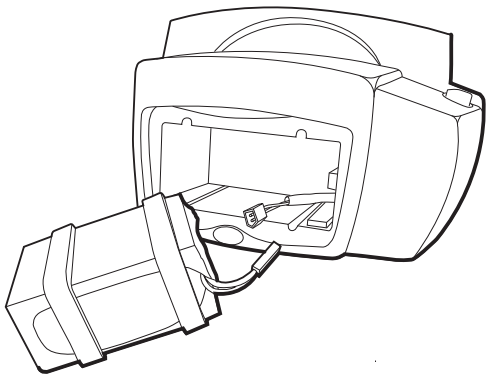
Four screws securing the battery door



2. Remove the battery door.

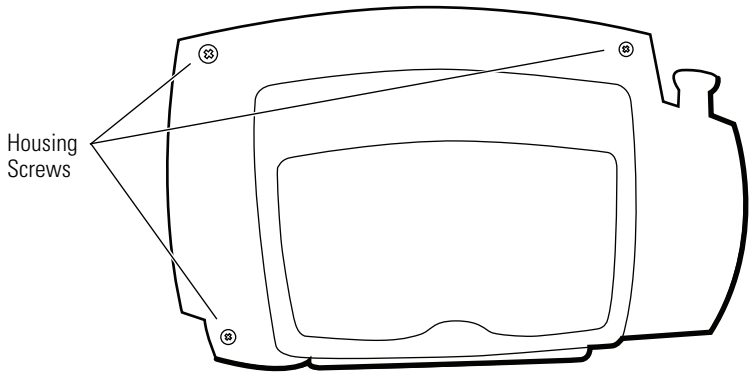


3. Slide the battery out of the battery compartment. This might require lightly shaking the monitor.
4. Disconnect the battery from the monitor.



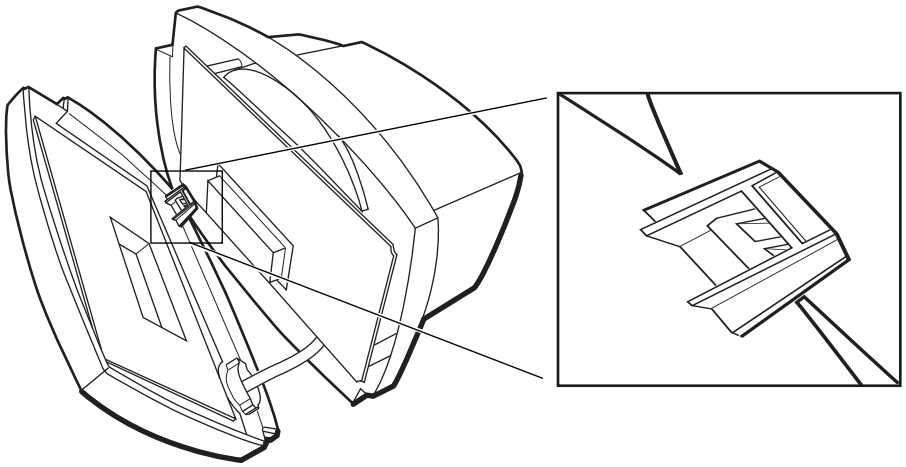
Separate the front and rear chassis

1. Remove the three screws securing the rear chassis.

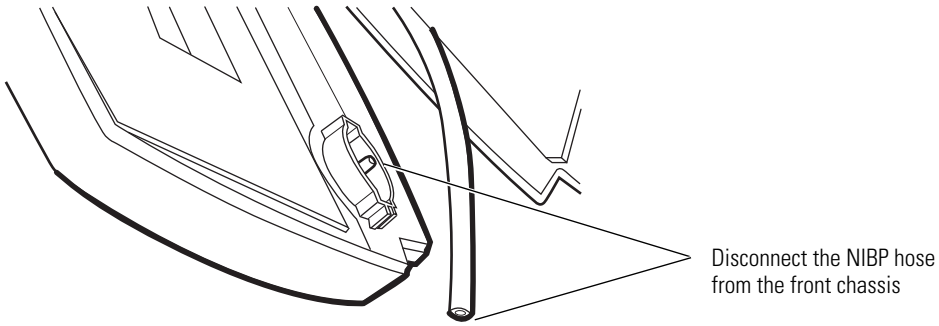


2. Place the unit upright, with the front of the unit facing you.
3. Tilt the top of the front chassis away from the rear chassis while lifting the front chassis, freeing the front chassis from the corner tab feature on the bottom left-hand corner of the rear chassis.

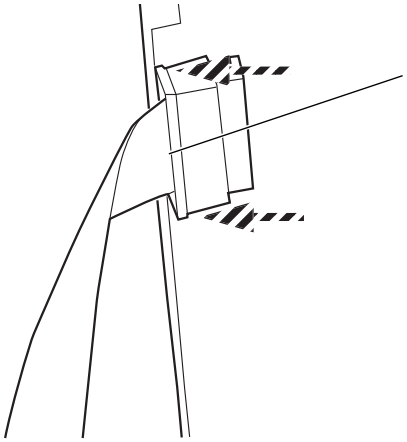
Note On reassembly, engage the tab and the tab receiver before attempting to align and close the chassis halves.



4. Disconnect the NIBP hose from the connector on the front chassis.



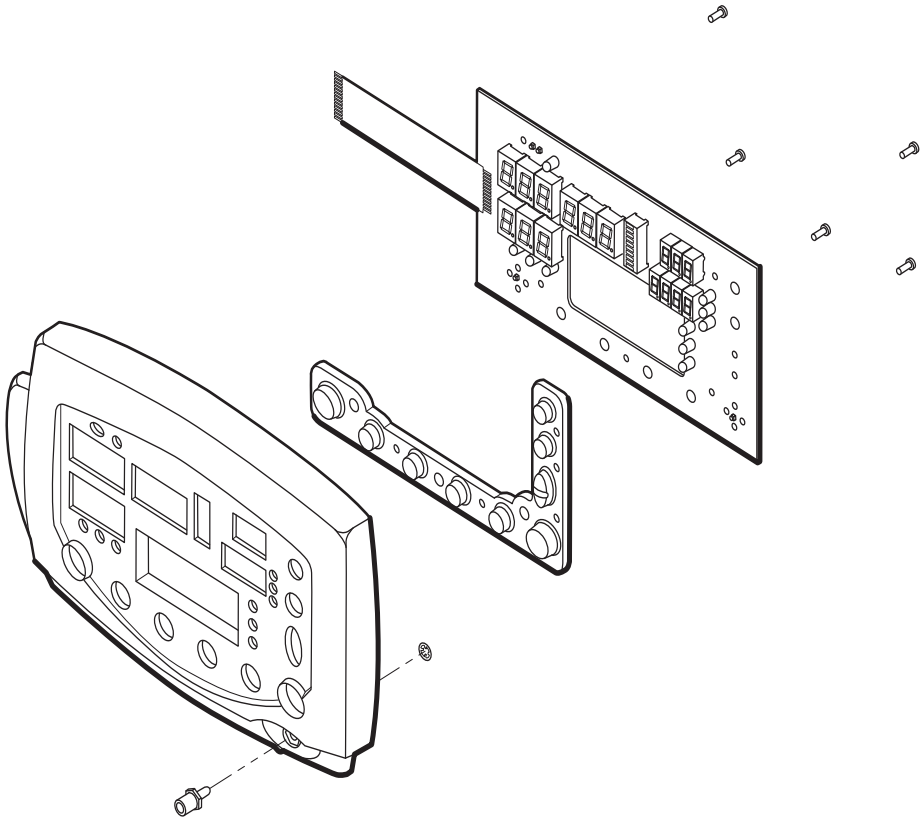
5. Disconnect the display-board flex cable (J5) from the main board.



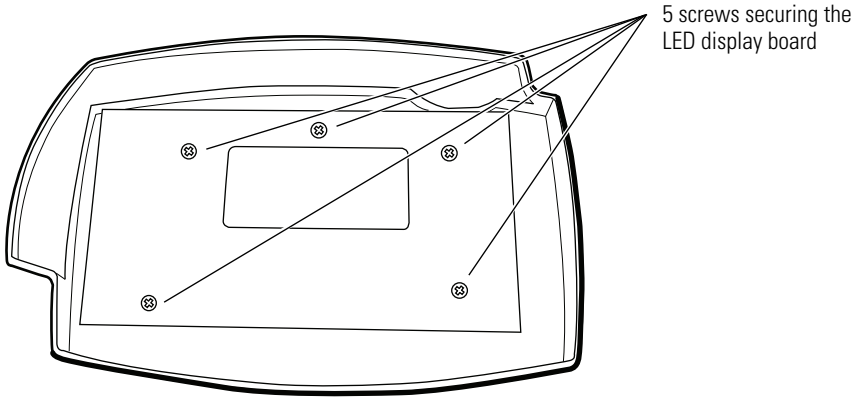
Disconnect the display-board flex cable from the main board (J5). Slide the outer piece of the connector toward the cable to release the cable; then slide the cable out of the connector.

Disassemble the front chassis assembly

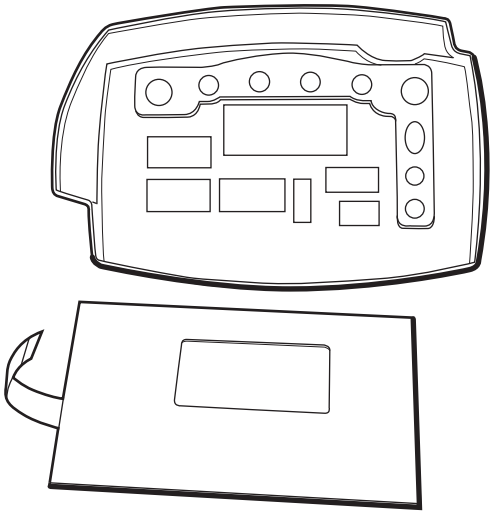
The front chassis assembly contains the display board, keypad, and NIBP air fitting.



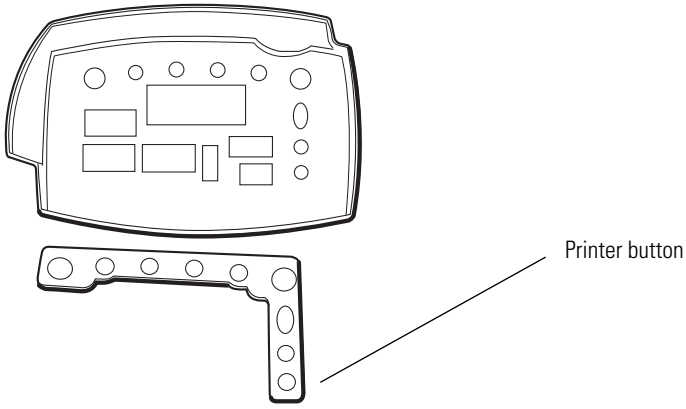
1. Remove the five screws securing the display board.



2. Lift out the display board.

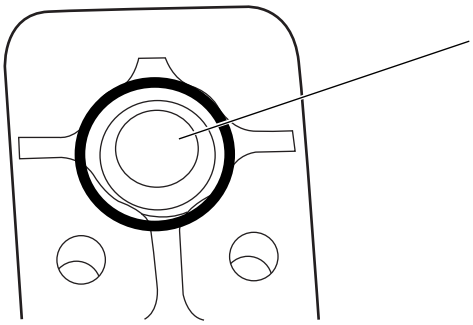


3. Remove the keypad.

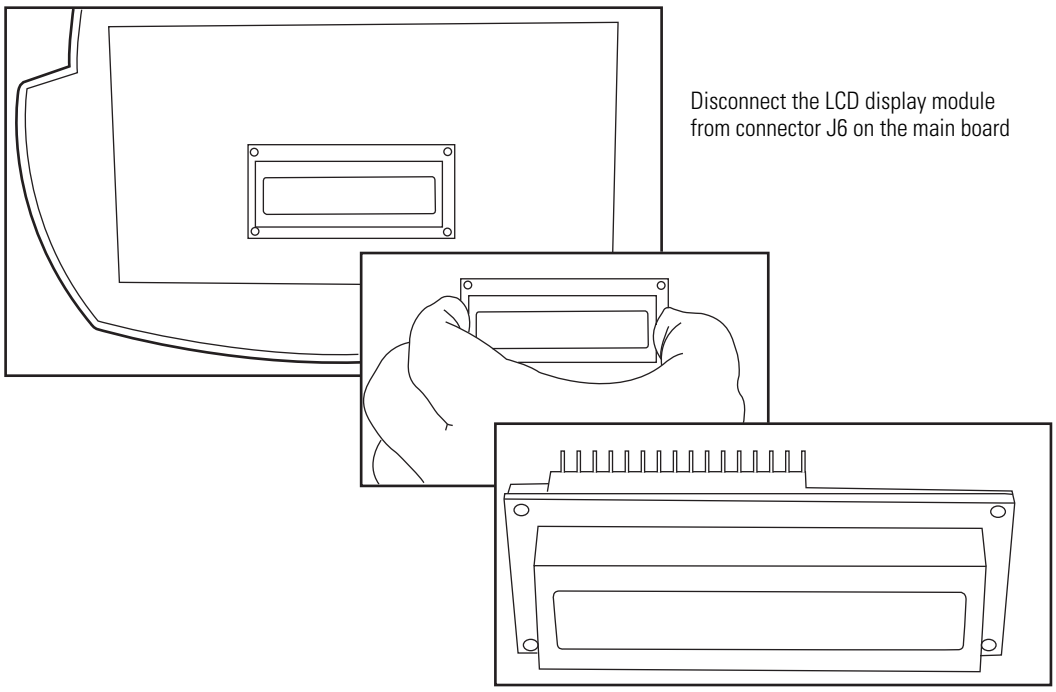


Reassembly notes

If you are replacing the keypad and your monitor does not include the thermal printer option, the Printer button must be removed from the keypad before you reinstall the keypad. To remove the Printer button, cut the membrane connecting the button to the keypad. (Note the circled area in the illustration below.)

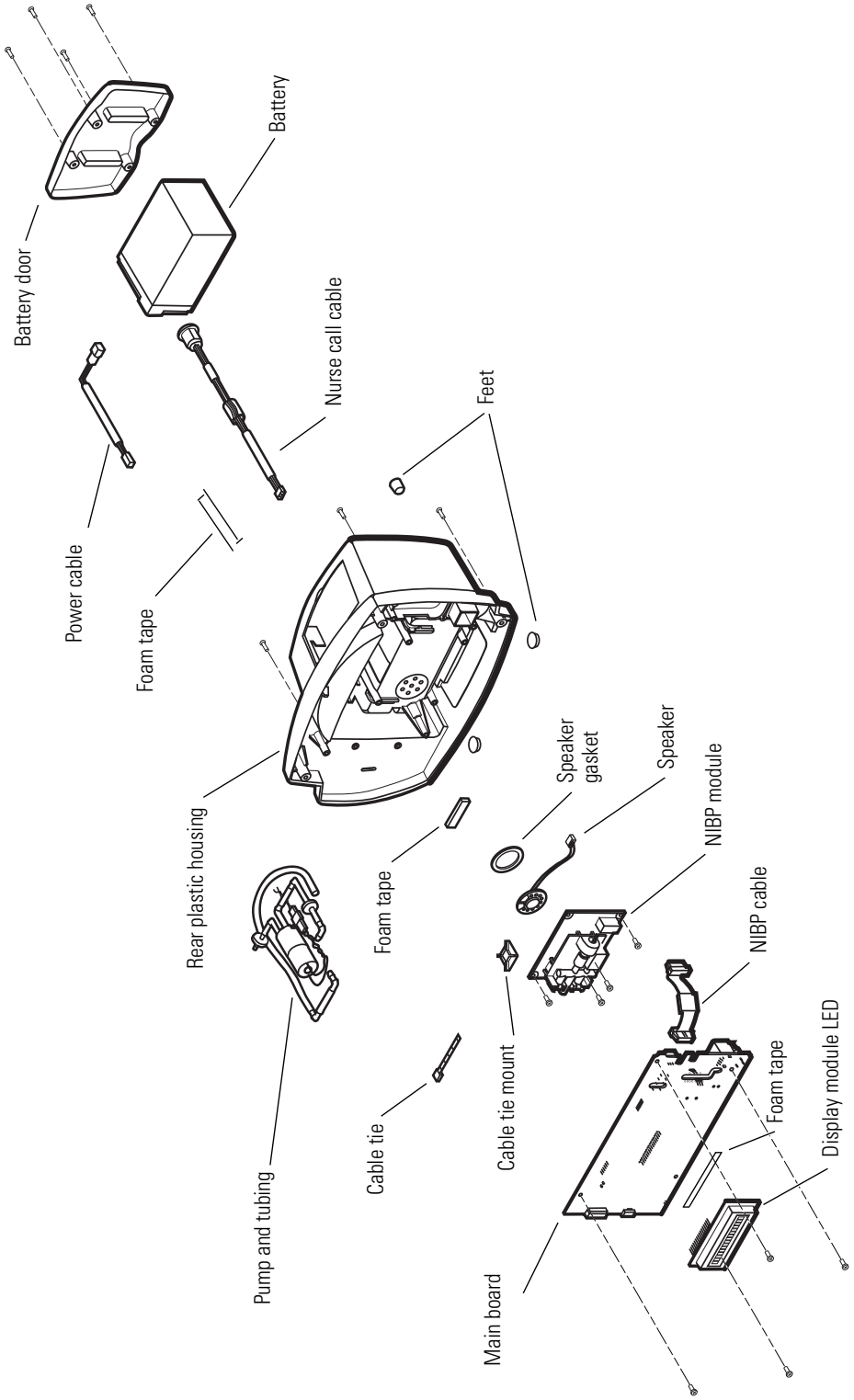


Remove the LCD display from the main board



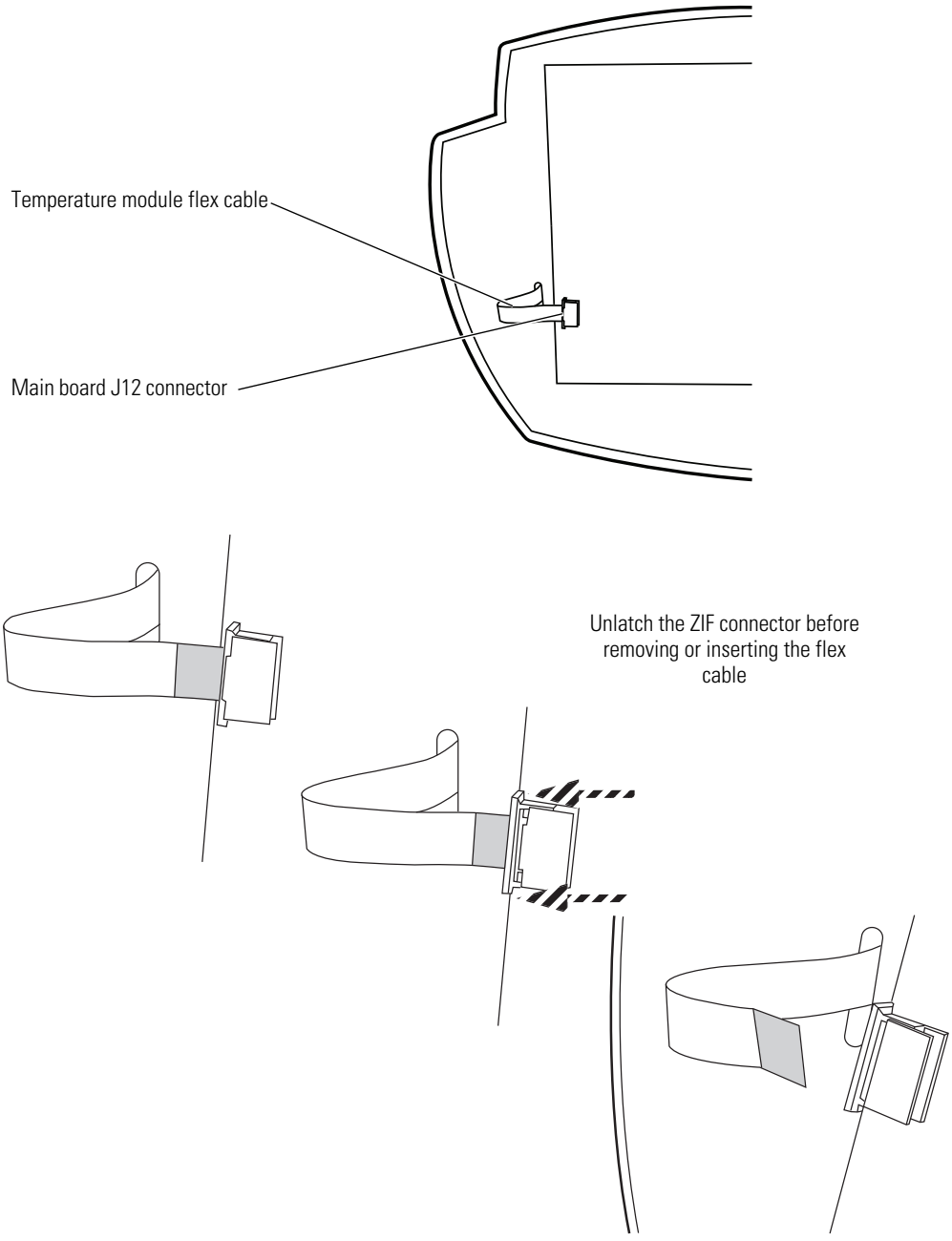
Disconnect the LCD display module from connector J6 on the main board

Disassemble the rear chassis assembly

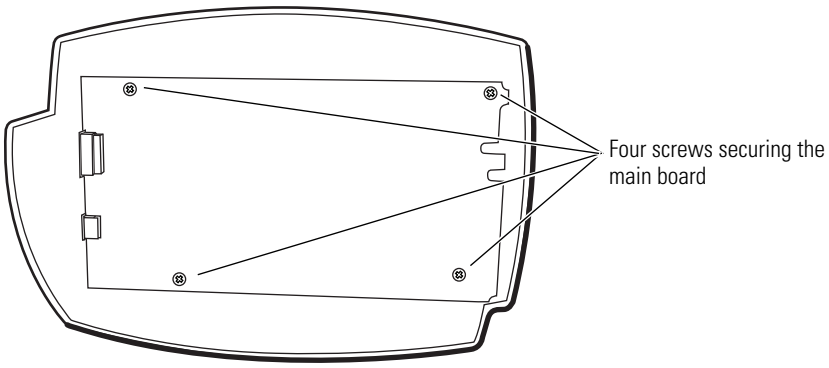


Remove the main board

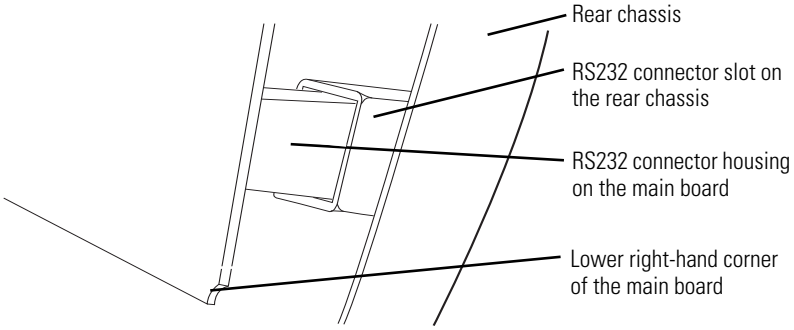
1. Disconnect the temperature module flex cable from J12 on the main board.



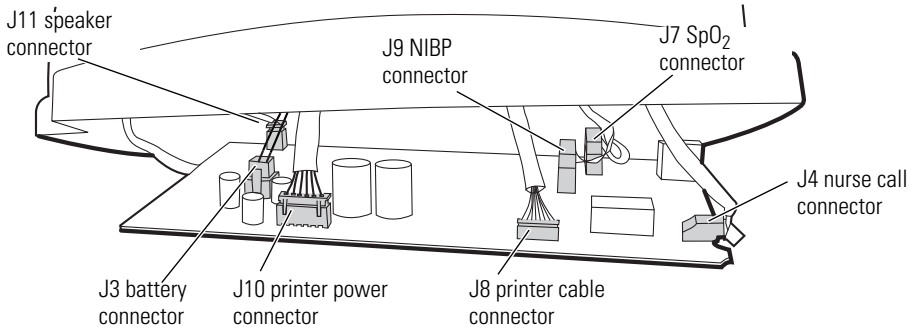
2. Remove the four screws securing the main board to the rear chassis.



3. Pull the lower right corner of the main board away from the rear chassis, just far enough to free the RS232 connector housing on the main board from the RS232 connector slot on the rear chassis.



4. Carefully tip the upper edge of the main board away from the rear chassis, far enough to access the uppermost connectors on the component side of the board.



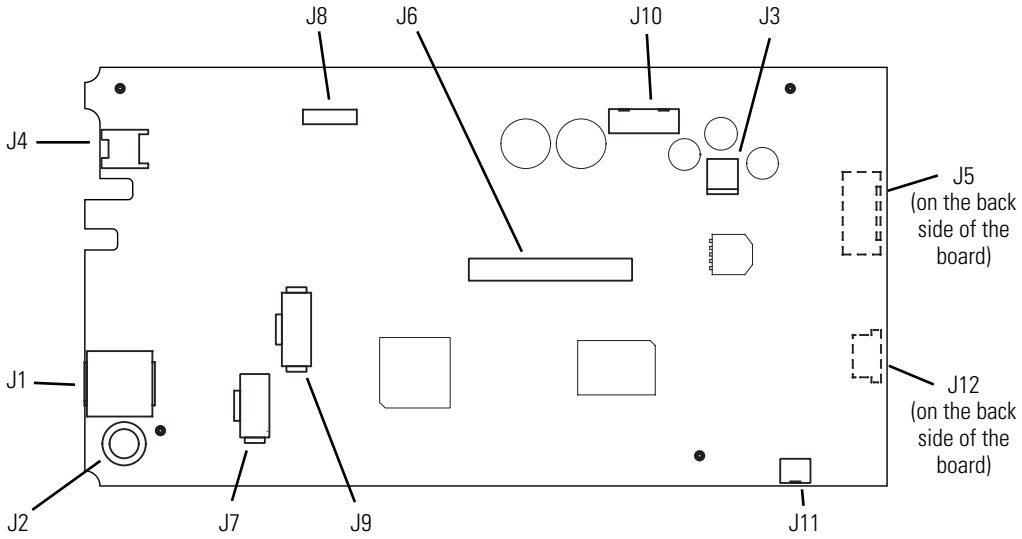
5. For best results, disconnect the uppermost cables first and work your way to the bottom of the main board. For a monitor configured with all options, the approximate order of disconnection is as follows:

Note Refer also to the drawing of the main board in "Main board reassembly notes" on page 66.

Order of disconnection		
	Main-board Connector	**Connects With**
1	J4	Nurse call connector
2	J8	* Printer data – CN3
3	J10	* Printer power – CN1
4	J3	Battery
5	J9	NIBP board
6	J7	* SpO_2 board – J2
7	J11	Speaker

(* Denotes optional hardware.)

6. Remove the main board.

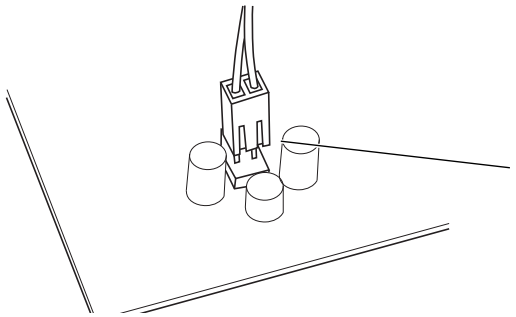


Main board reassembly notes

Caution Take care when reconnecting the main board power connector (J3). If the cable connector is connected improperly, the monitor could be damaged when power is applied.

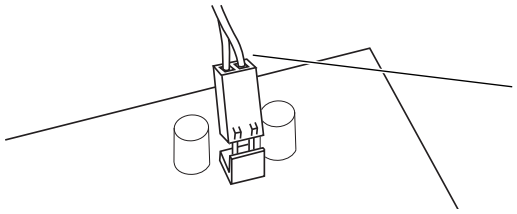
Older main boards (version 031-0150-01)

To reconnect the main board power connector (J3), be certain that the cable connector is oriented with the slotted side up...



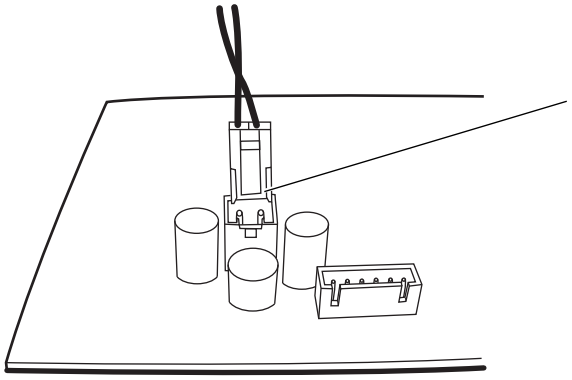
J3 cable connector properly aligned with the J3 connector on the main board. The cable connector is slotted on the top side.

...and the flanged side down.



J3 cable connector properly aligned with the J3 connector on the main board. The cable connector has latching tabs on the bottom side.

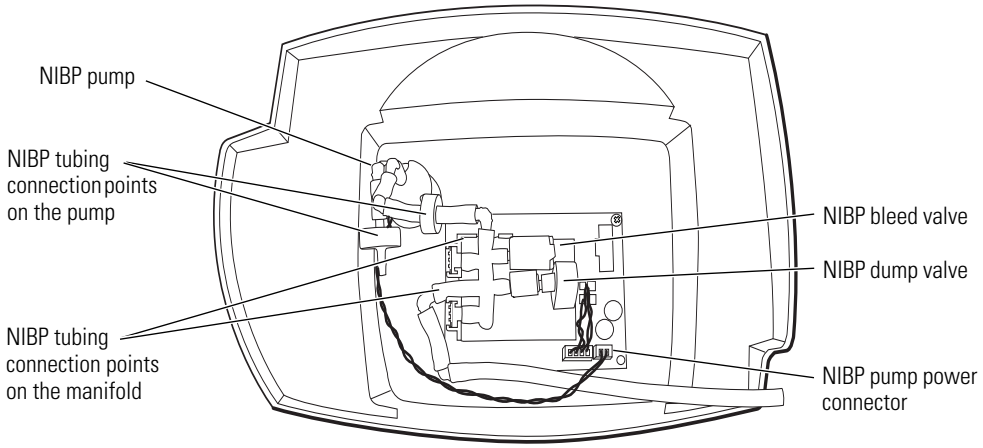
Newer main boards (versions 031-0150-03 and -04)



The power connector is keyed to assure proper connection.

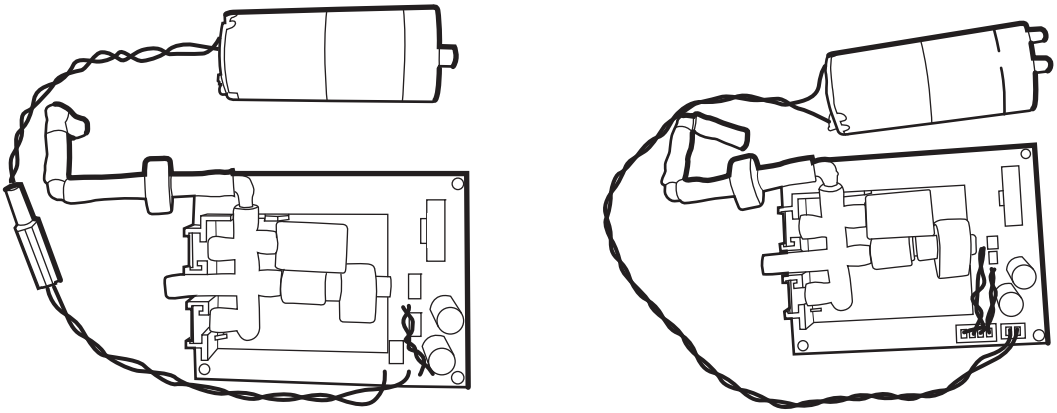
Disassemble and remove the NIBP assembly

1. Remove the tubing and the pump.
   a. Disconnect the tubing from the manifold on the NIBP board.
   b. Disconnect the two sections of tubing from the pump.
   c. Disconnect the pump power from the NIBP board.



Note POEM 1 NIBP modules use a flying NIBP pump power connector that is soldered to the board.

POEM 2 NIBP modules use a standard connector on the board.



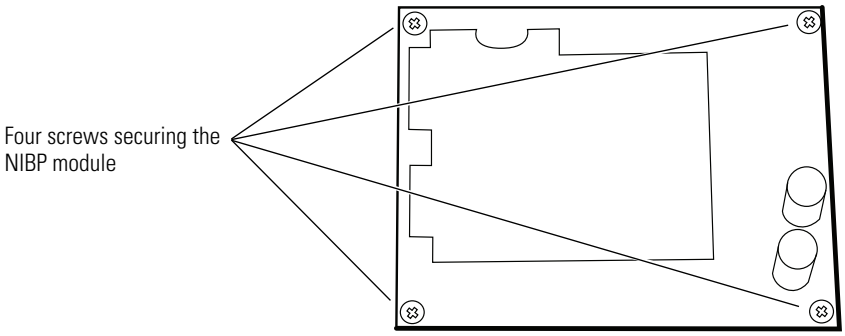
POEM 1 POEM 2

d. Cut the tie-wrap to free the pump from the pump holder.

Note If your monitor has a printer, it is much easier to remove and install the NIBP pump through the printer door, after the printer assembly is removed.

2. Remove the NIBP module.

   a. Remove the four screws securing the NIBP module to the rear chassis.



b. Remove the NIBP module.

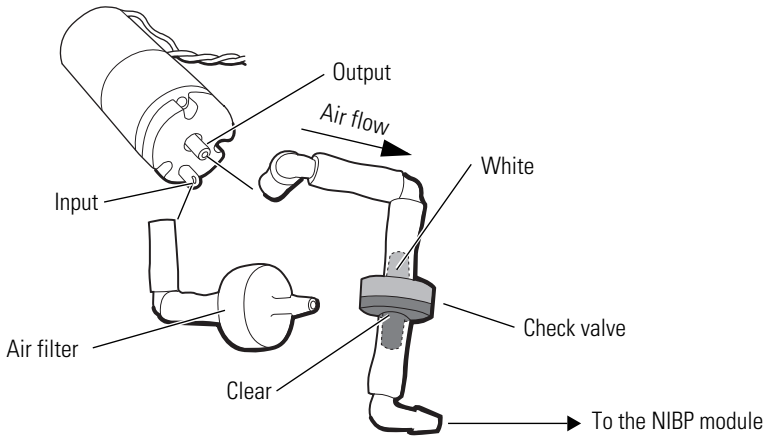
NIBP reassembly notes

WARNING You must characterize the NIPB module whenever you replace any NIBP component (pump, tubing, air filter, check valve, or NIBP module).

WARNING If the NIBP module is not properly characterized, the pump could overinflate a neonatal cuff, which could be hazardous to neonatal patients. (See "NIBP characterization" on page 36.)

The shorter tubing section contains the air filter. It connects to the pump input/suction fitting on the outer edge of the front.

The longer tubing section contains the check valve. It connects to the pump pressure/output fitting in the center of the pump and to the manifold on the NIBP board.



Caution Do not confuse the NIBP pump power cable connection with the speaker cable connection. On monitors with the newer NIBP module, the connectors are similar.

Remove and replace the speaker

Caution Avoid the following:

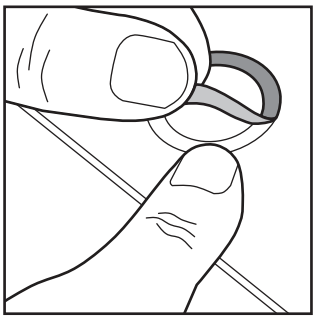
- Stacking or piling-up unpackaged speakers
- Placing the speaker near a magnetic field with high gauss
- Rough handling of the speaker assembly
- Placing pressure on the speaker magnet and terminal area
- Pulling on the speaker wires
- Applying direct pressure to the speaker mylar cone

1. Perform the following disassembly procedures to access the speaker:
   - Remove and disconnect the battery.
   - Separate the front and rear chassis.
   - Disconnect and remove the main board from the rear chassis assembly.

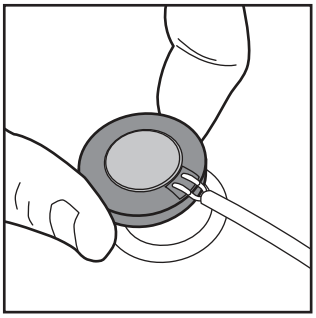
- Disconnect and remove the NIBP assembly.

Note It is not necessary to remove the printer or the NIBP pump.

2. Remove the old speaker and gasket from the rear chassis by prying it loose.
3. Verify that all speaker gasket material is removed from the chassis molded plastic. Locate the cavity and clean it with isopropyl alcohol.
4. Obtain a new gasket (PN 600-0518-xx) and place on a flat, clean surface. Remove the paper to expose adhesive on the top side.
5. Remove the new speaker assembly (PN 660-0231-xx) from its packaging. Visually inspect the new speaker for any visible damage. Do not install the gasket if it is damaged.

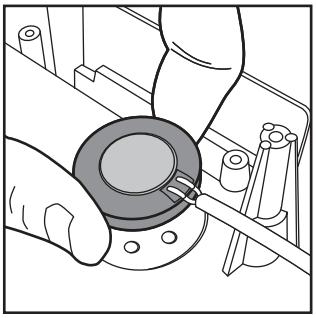


6. Center the speaker on the gasket and apply pressure to only the speaker outer rim, as shown in the figure at right.



Caution To avoid causing irreversible damage to the speaker, *do not press on the magnet or wire-terminal area.*

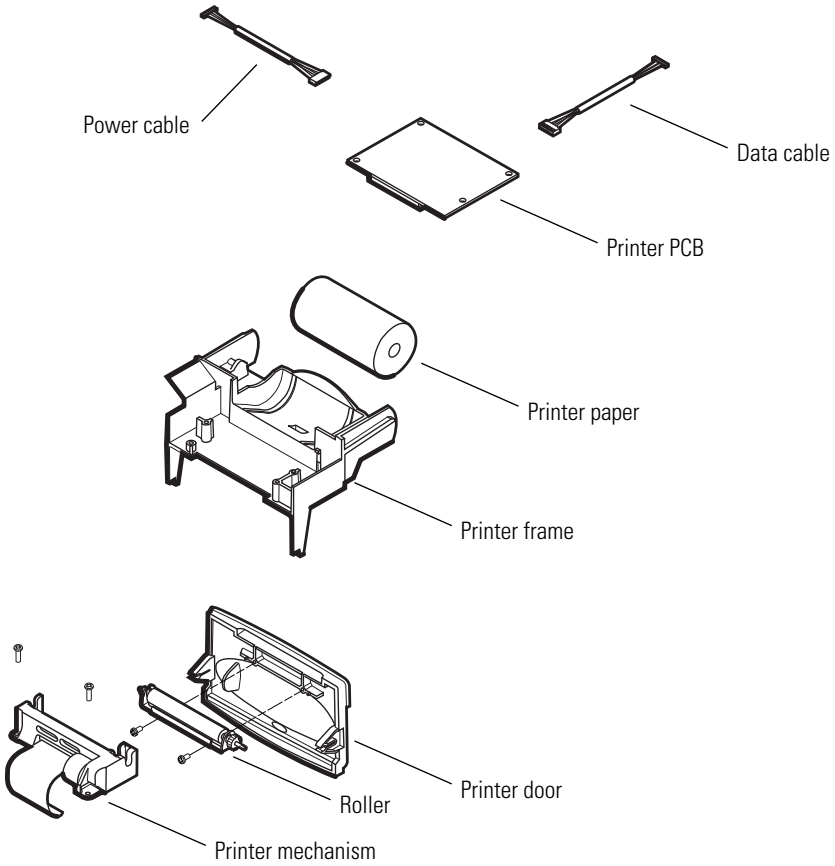
7. Carefully remove the paper backing from the gasket on the new speaker, exposing the magnet, wire, cone, and gasket's adhesive surface.
8. Place the speaker and gasket assembly into the chassis speaker cavity, oriented as shown in the figure at right.



Caution If speaker and gasket assembly are misaligned in the chassis, remove, discard, and install a new speaker and gasket assembly.

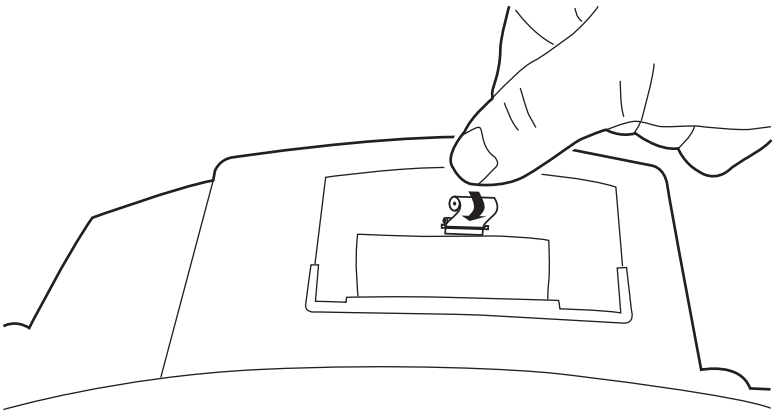
9. Fully seat the gasket and speaker assembly by pressing on the outer rim of the speaker.

Remove and disassemble the printer assembly

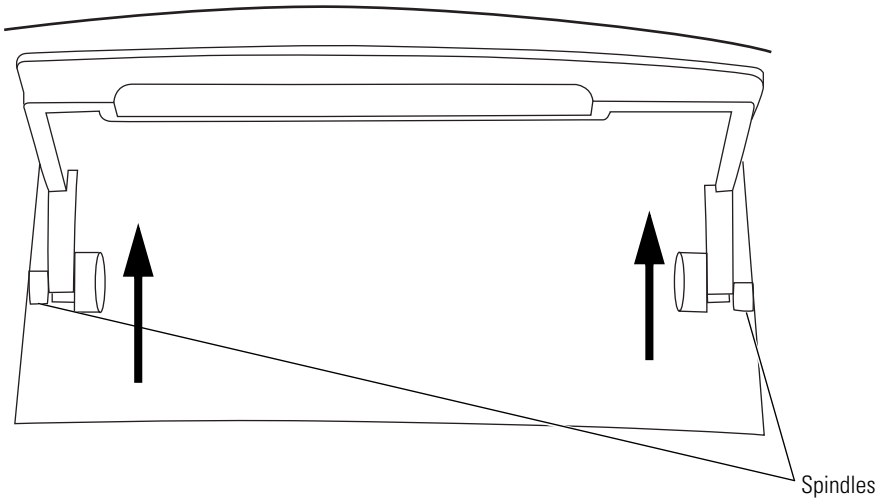


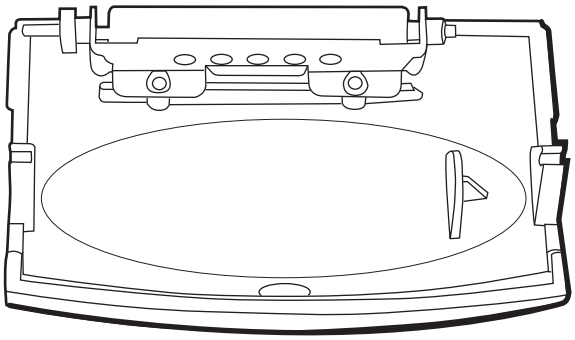
1. Remove the printer door.

   a. Open the printer door and remove the roll of printer paper.



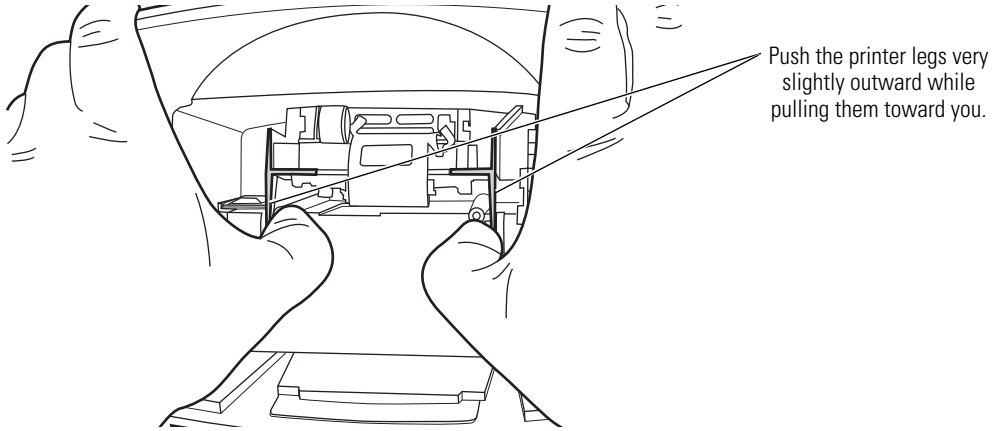
   b. Push the printer door toward the rear of the monitor until it snaps out of the two support spindles on the printer frame.

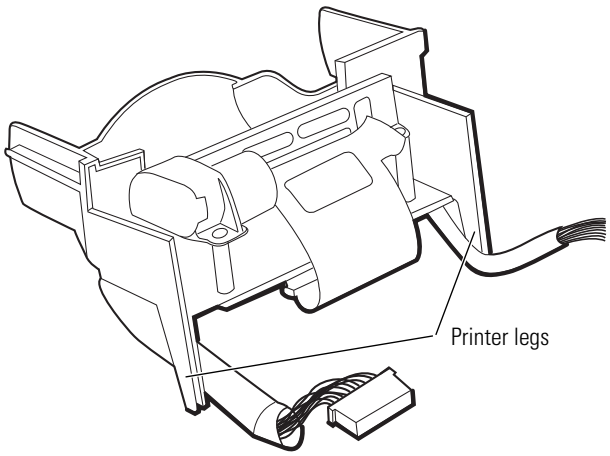




2. Remove the printer assembly.

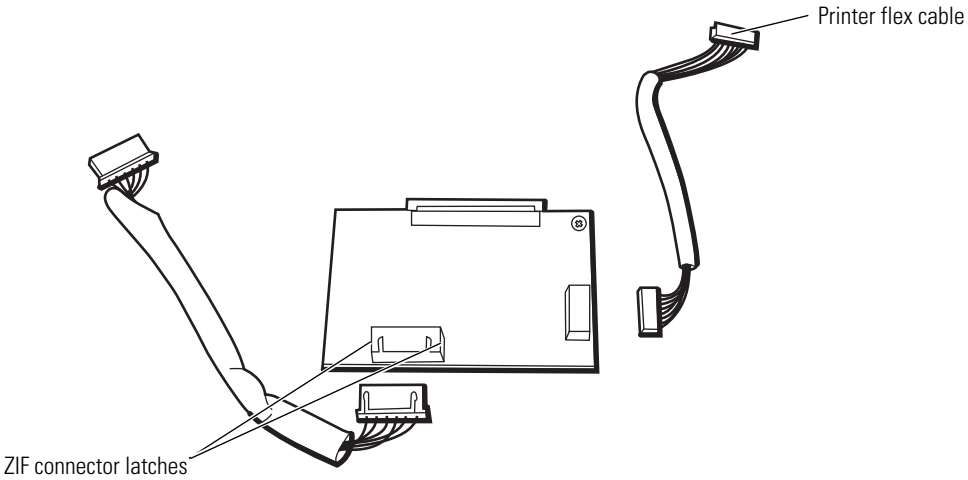
   Push the plastic legs of the printer assembly outward and pull the printer assembly forward to free it from the snap-in seating of the rear chassis bulkhead.





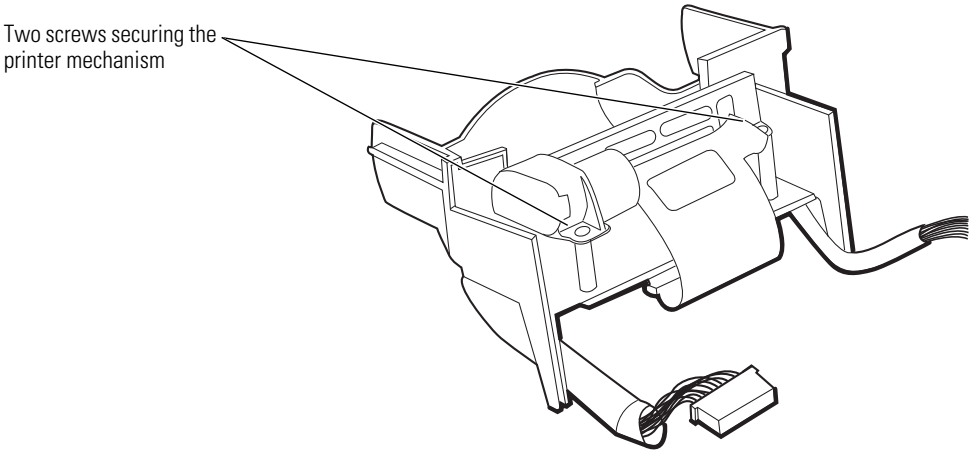
3. Remove the printer subassembly (printer mechanism, printer well, printer board, and cables).

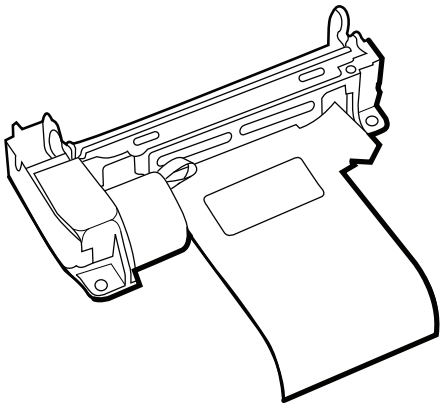
   a. Turn the printer assembly upside-down, and release the ZIF connector latches (CN2) on the printer board.



   b. Disconnect the printer flex cable from CN2 on the printer board.

   c. Turn the printer assembly upright, remove the two screws securing the printer mechanism, and remove the printer mechanism.



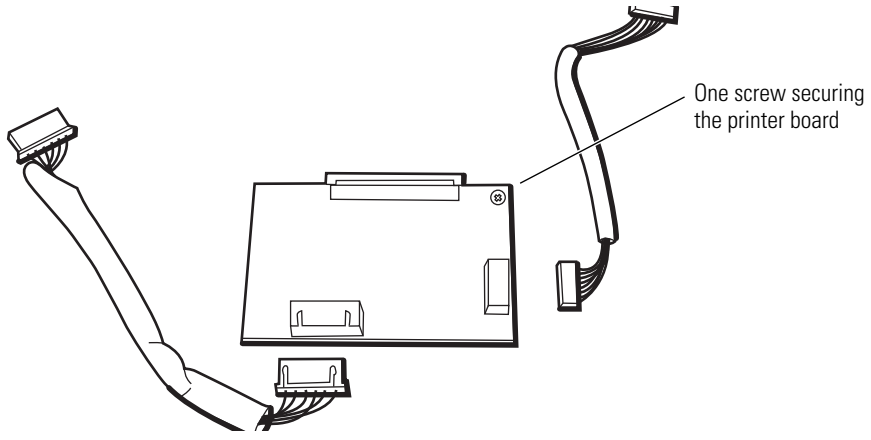


Printer mechanism

d. Turn the printer assembly upside-down.

e. Remove the screw securing the printer board to the printer frame.

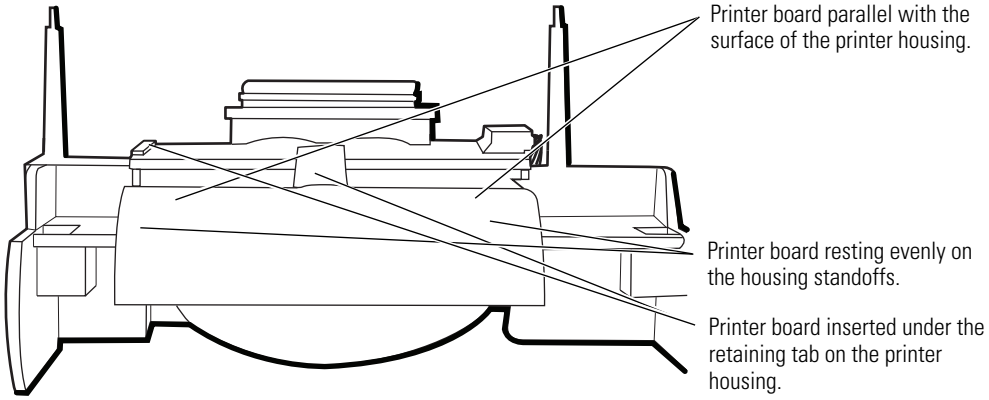
f. If you are replacing the printer board, remove the cables from connectors CN1 and CN3 for use on the replacement board.



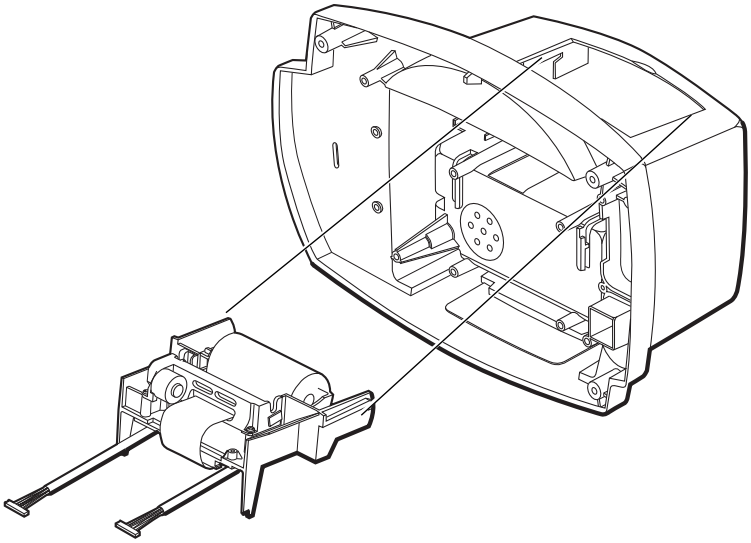
Printer reassembly notes

1. When connecting the printer assembly board to the plastic printer housing, be sure the printer board is seated flat on the housing, within the guide rails on either side of

the housing and with the front of the board secured under the tab on the front of the housing.



2. To install the printer assembly into the cavity in the monitor, orient the printer assembly so that the side rails of the plastic frame are on the left and right and the two printer-frame "piano" legs are toward the front, extending downward from the assembly.



3. Partially insert the printer frame assembly into the printer well in the rear chassis, aligning the rear side rails for insertion between the two slotted side latches on the top of the printer well of the rear chassis.
4. Align the bottom of the two printer frame legs toward the top of the vertical bulkhead slots.
5. Fully insert the printer assembly into the printer well until the side rails engage in the slotted side latches and the legs click into the vertical slots. Be sure that the white plastic shield on the housing rests on the top of the SpO_2 board.
6. Install the printer door by inserting it in the printer slot, tilted slightly forward, and snapping the latches onto the printer frame spindles.

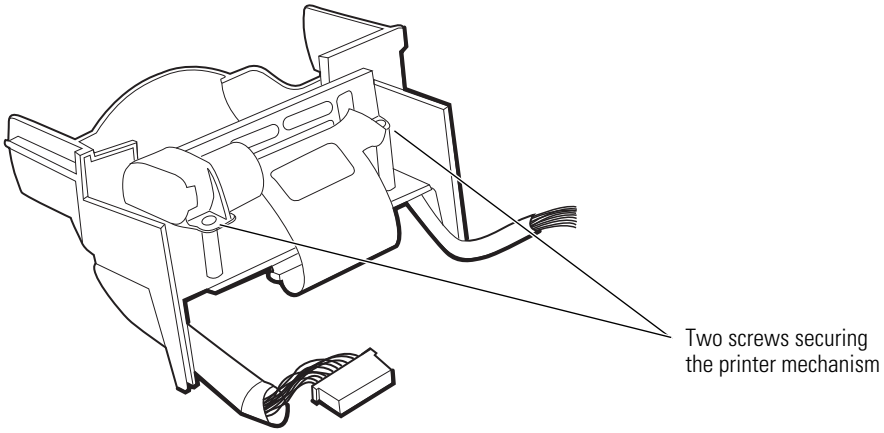
Paper guide and sensor reassembly

The operator, while replacing the printer paper, can inadvertently push the paper guide and sensor out of the chassis, rendering the printer inoperable.

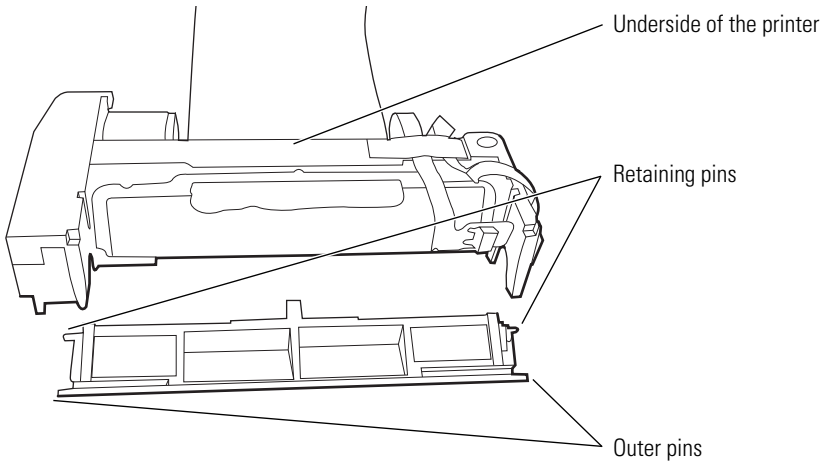
Caution Do not disassemble the paper guide if it is properly attached to the printer chassis. Improper disassembly of the paper guide can damage it.

To reassemble the paper guide and the sensor

1. Remove the two screws securing the printer mechanism to the plastic printer frame and remove the printer.

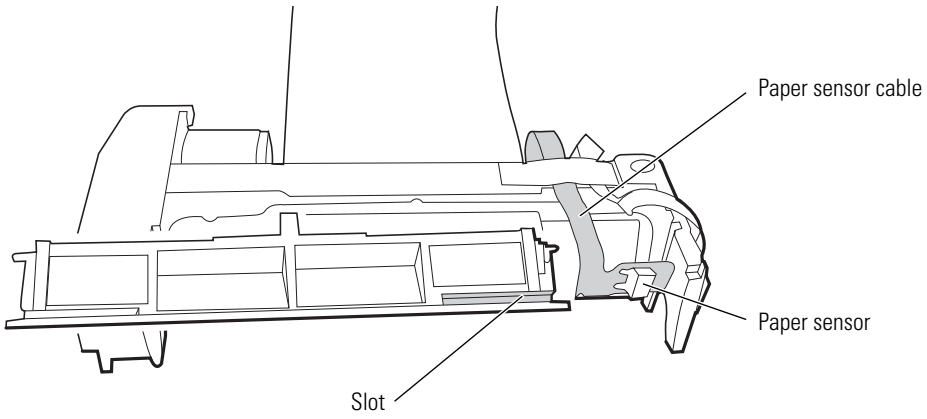


2. See whether the retaining pins or the outer pins on the ends of the black plastic paper guide are bent or broken.



   - If the pins are broken, the printer must be replaced.
   - If the pins are bent, you might be able to bend them back into position.

3. Slide the cable and the paper sensor into the slot on the end of the paper guide until the paper sensor and the edge of the cable are completely inside the paper guide.



When properly aligned, the paper sensor is visible through the hole in the top of the paper guide. (Not shown.)

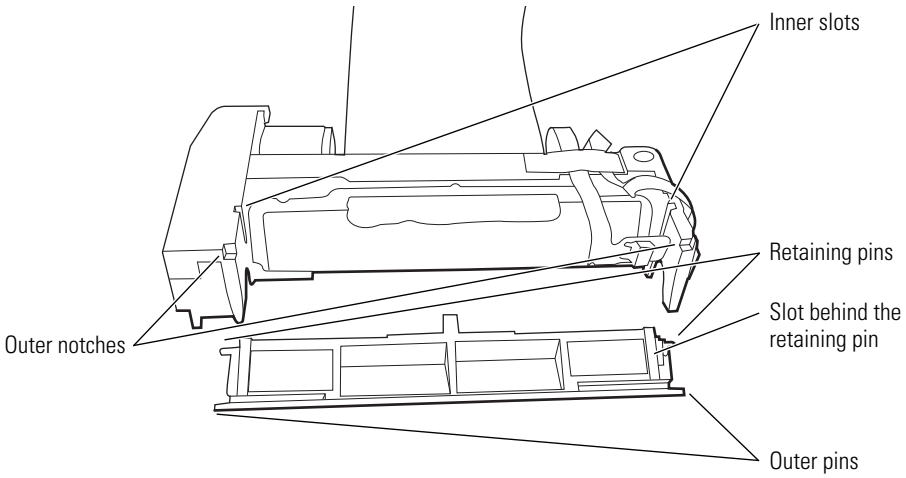
4. Position the outer pins in the outer notches of the printer chassis, with the retaining pins just above the inner slots of the chassis.
5. Rotate the paper guide such that the retaining pins slide into the inner slots and snap into place.

   The bottom of the paper guide is now flush with the printer mechanism.
6. To verify that the rear retaining pins hold the paper guide in place, apply light pressure to the top of the paper guide.

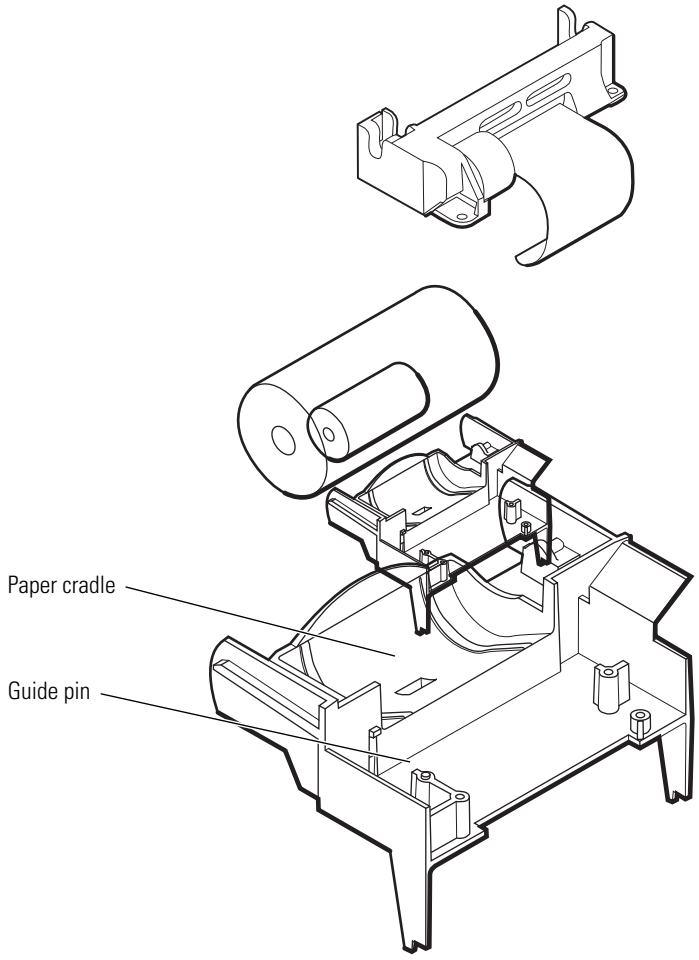
   If the retaining pins do not securely hold the paper guide, follow these steps:

   a. Hold the paper guide flush with the printer.

   b. Place a small slotted screwdriver in the slot behind the rear retaining pins and push the pins outward into the slots in the printer mechanism.



7. Seat the printer in the plastic printer chassis.

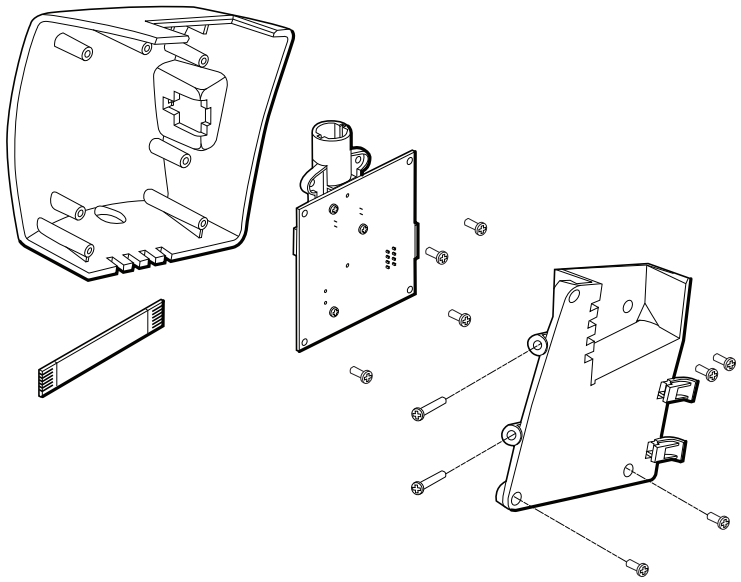


a. Align the guide pin on the chassis with the hole on the bottom of the printer. The paper guide and the paper cradle on the plastic chassis must be flush.

b. Use the two screws to secure the printer to the chassis.

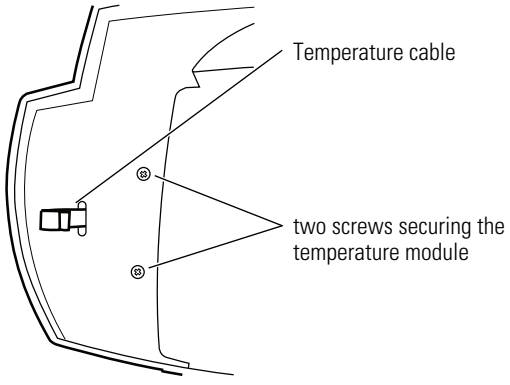
Disassemble the temperature module

Note Disassembly of the temperature module does NOT require removal of the main board.



1. Remove the temperature module from the monitor.

   a. Remove the two screws (located on the left side, inside the rear chassis) securing the module to the slots on the left side of the rear chassis. To prevent the module from dropping, hold it as you remove the screws.

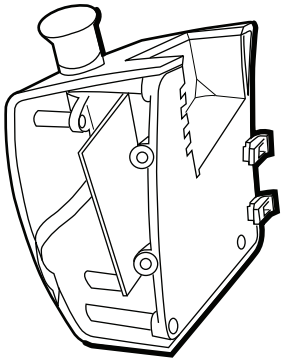


   b. Separate the temperature module from the rear chassis and pull the temperature cable through the slot in the rear chassis.

Note For older monitors where the temperature cable is routed through a ferrite bead on the rear chassis:

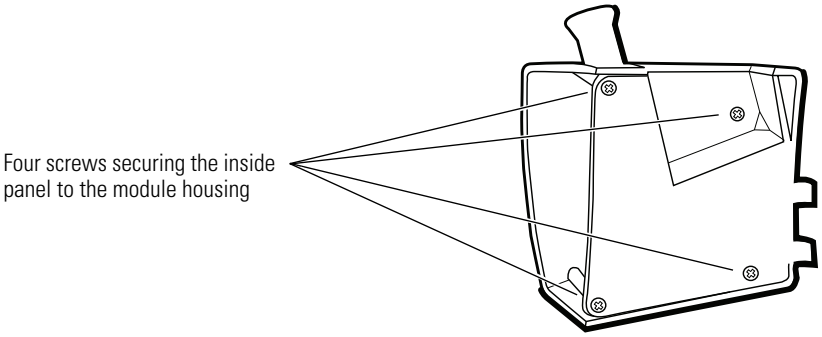
If the temperature cable is pulled through the slot and out of the ferrite bead, it will be difficult to reroute the cable through the bead. To avoid this difficulty, ...

Separate the temperature module housing from the rear chassis just far enough to enable you to release the temp cable from the ZIF connector.

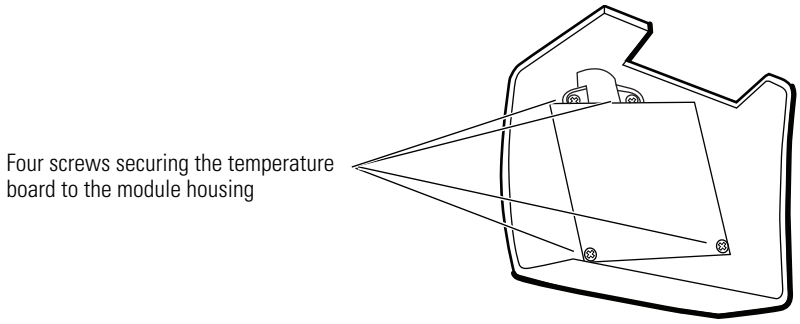


2. Remove the temperature-board assembly from the SureTemp Plus module as follows:

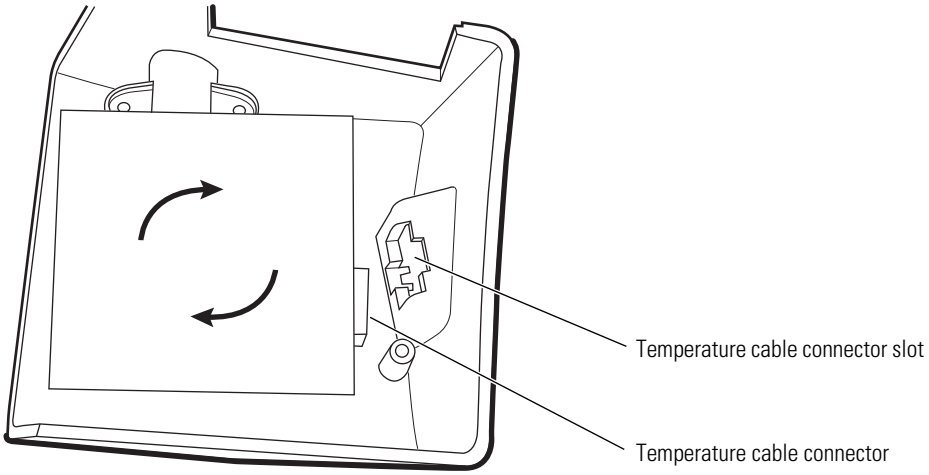
   a. Remove the four screws securing the inside panel to the module housing.



   b. Remove the four screws securing the temperature board to the module housing.

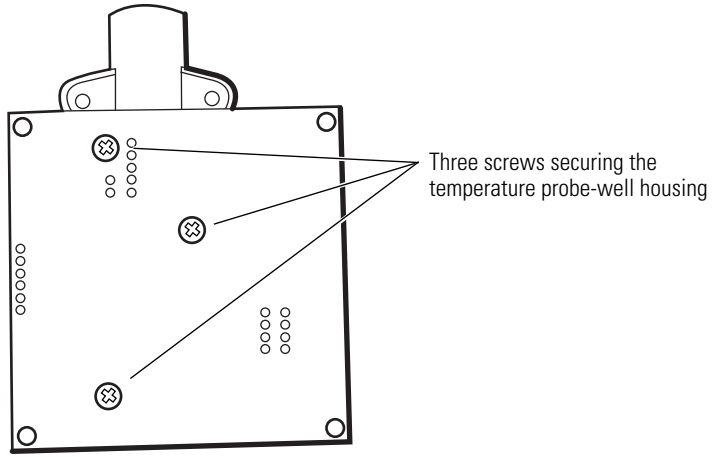


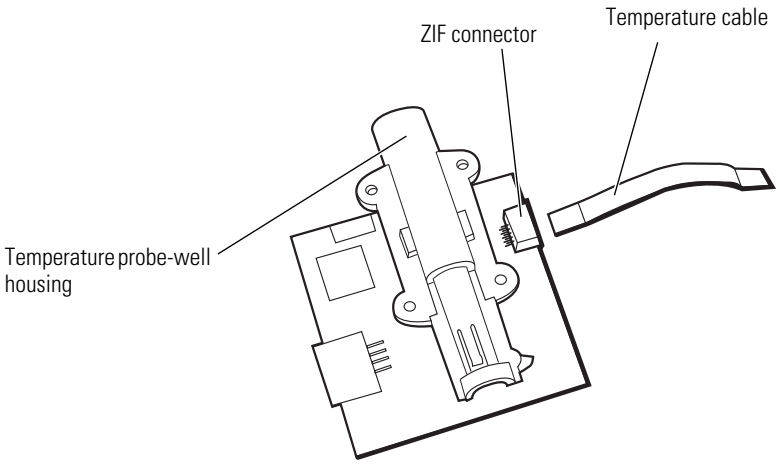
   c. Tilt the temperature board and rotate it clockwise to free the cable connector from the connector slot (J5) in the housing; then lift the board out of the housing.



d. Release the ZIF latches (J1) and disconnect the temperature cable.

Note It is not necessary to remove the temperature probe-well housing when replacing the temperature module.



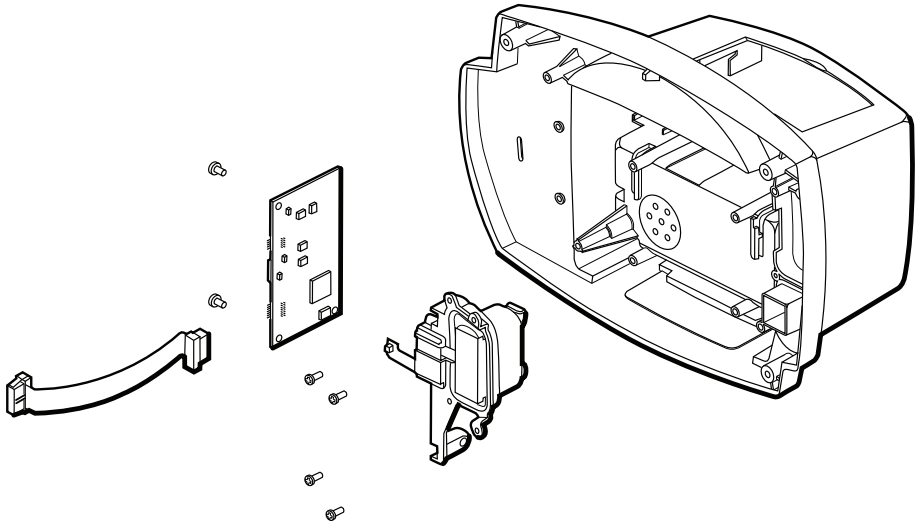


Temperature module reassembly notes

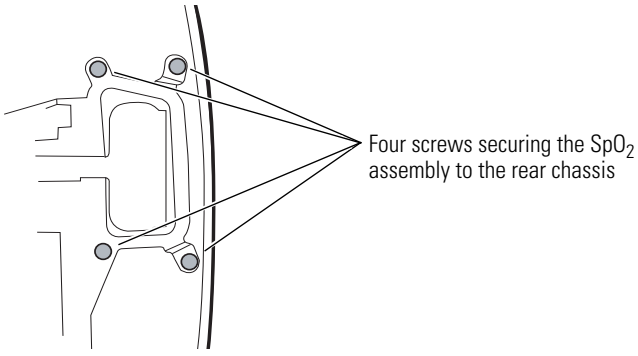
To install the temperature board in the module housing:

1. Square the circuit board in the housing to fit the probe-well receiver into the top of the outside housing.
2. Tilt the board and rotate it counterclockwise so that the temperature cable connector (J5) fits down into the connector slot in the housing.

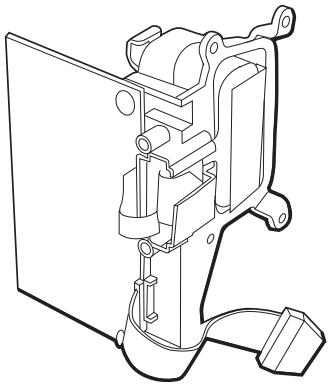
Disassemble the Nellcor SpO_2 assembly



1. Remove the SpO_2 assembly from the rear chassis and disassemble it as follows:
   a. Remove the four screws (located on the inside of the rear chassis on the right side) securing the SpO_2 assembly to the rear chassis.

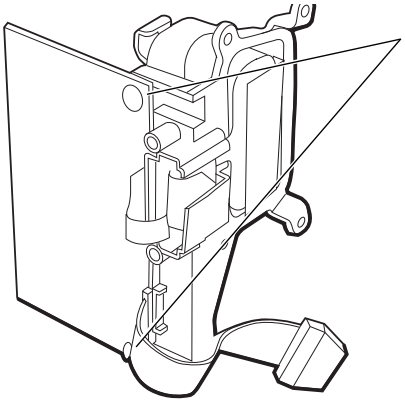


   b. Remove the side panel and board assembly form the rear chassis.



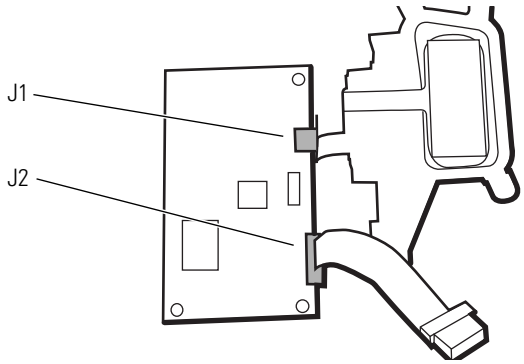
2. Remove the SpO_2 board.

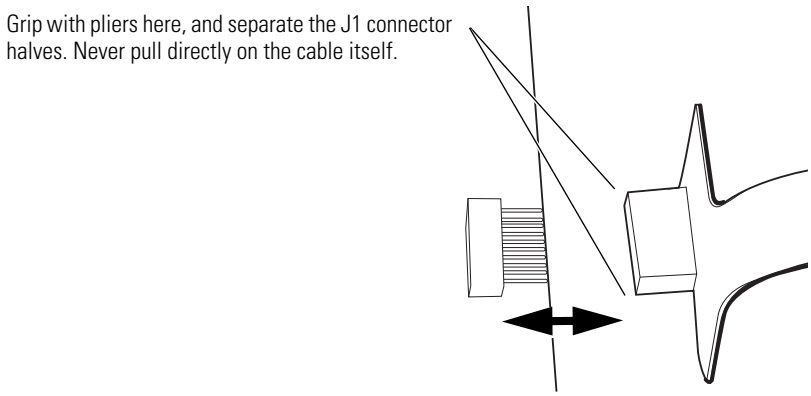
   a. Remove the two screws securing the board to the side panel.



   b. Disconnect J1 and J2.

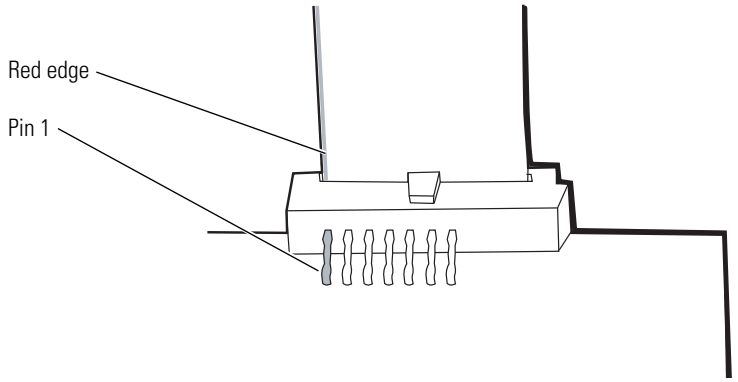
Caution To avoid stressing and damaging the J1 flex cable, disconnect the cable by gripping the J1 flex-cable connector with pliers and separating the connector halves without stressing or otherwise putting any pressure on the flex cable itself.





SpO_2 reassembly notes (Nellcor)

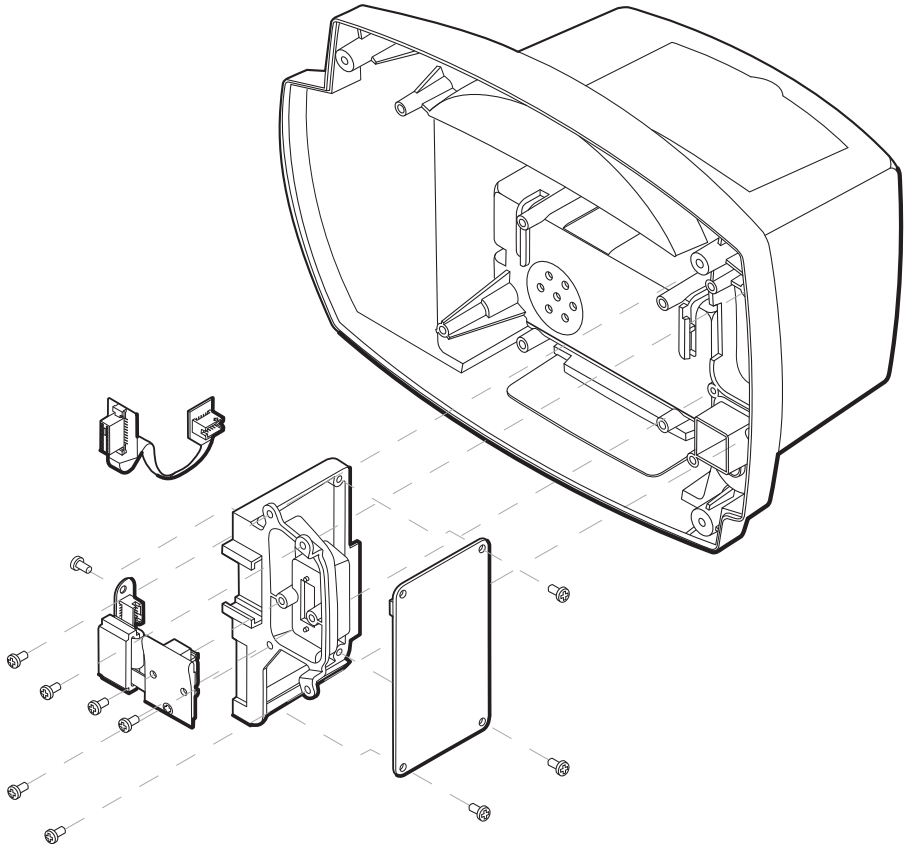
The J2 connector halves are keyed to prevent incorrect connection. However, to facilitate the connection, align the red line on the edge of the ribbon cable with pin 1 of the connector on the SpO_2 board.



Note When replacing the Nellcor SpO2 board, be sure that the DIP switch is set as follows:

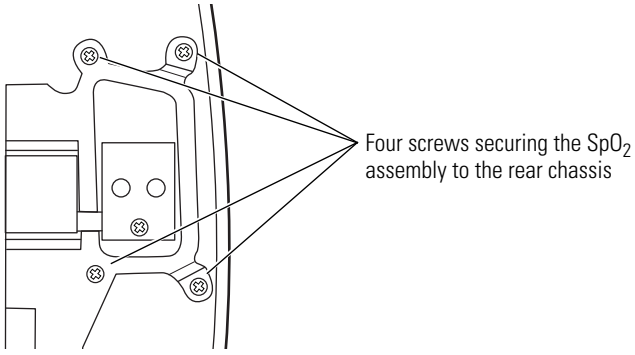
1 - ON 2 - ON 3 - OFF 4 - OFF

Disassemble the Masimo SpO_2 assembly



1. Remove the SpO2 assembly from the rear chassis and disassemble as follows:

   a. Remove the four screws (located on the inside of the rear chassis on the right side) that secure the SpO2 assembly to the rear chassis.



   b. Slide the SpO2 assembly out of the rear chassis.

2. Remove the SpO2 board and sensor flex cable assembly from the connector panel.

   a. Disconnect the mating end of the power flex cable (A) from J3 on the circuit-board assembly.

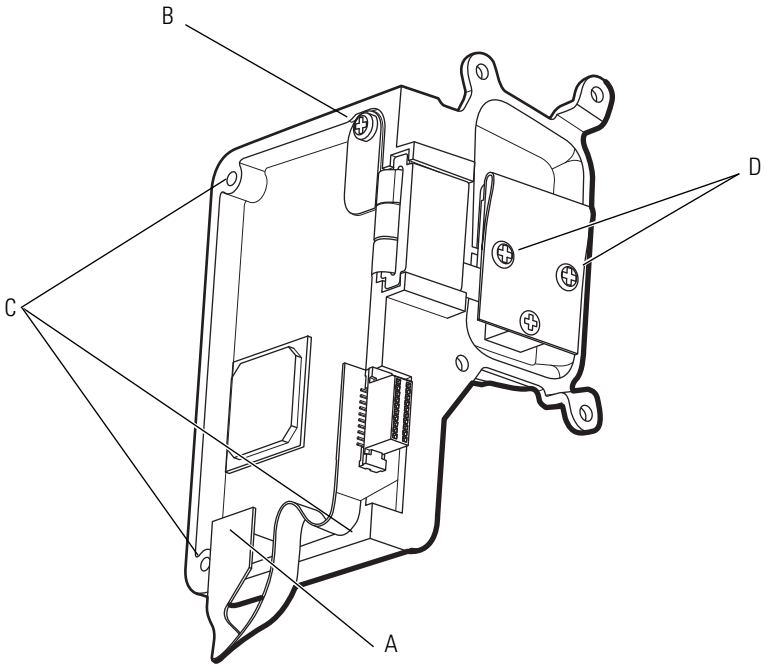
   b. Remove the screw (B) securing the sensor flex connector to the plastic chassis.

   c. Disconnect the sensor flex connector at J1 (B) to the plastic chassis.

d. Remove the three screws (C) securing the circuit board to the plastic chassis.

e. Remove the two screws (D) securing the SpO2 sensor flex to the connector housing.

f. Slide the SpO2 sensor flex cable assembly out of the rails on the connector housing.



SpO_2 reassembly notes (Masimo)

1. Place the SpO2 sensor flex into the connector housing and secure it with two screws (D). (Torque = 4 lbf-in.)
2. Place the circuit board (C) into the plastic chassis and secure it with three screws. (Torque = 4 lbf-in.)
3. Connect the sensor flex connector to the circuit board at J1.
4. Fasten the sensor flex connector in place with one screw (B) . (Torque = 4 lbf-in.)
5. Connect the mating end of the power flex cable (A) to J3 on the circuit board.
6. Slide the SpO2 assembly into place in the monitor rear chassis, seating the rail of the connector housing into the slots in the rear chassis.
7. Secure the SpO2 panel with four screws. (Torque = 4 lbf-in.)

6 Replacement parts

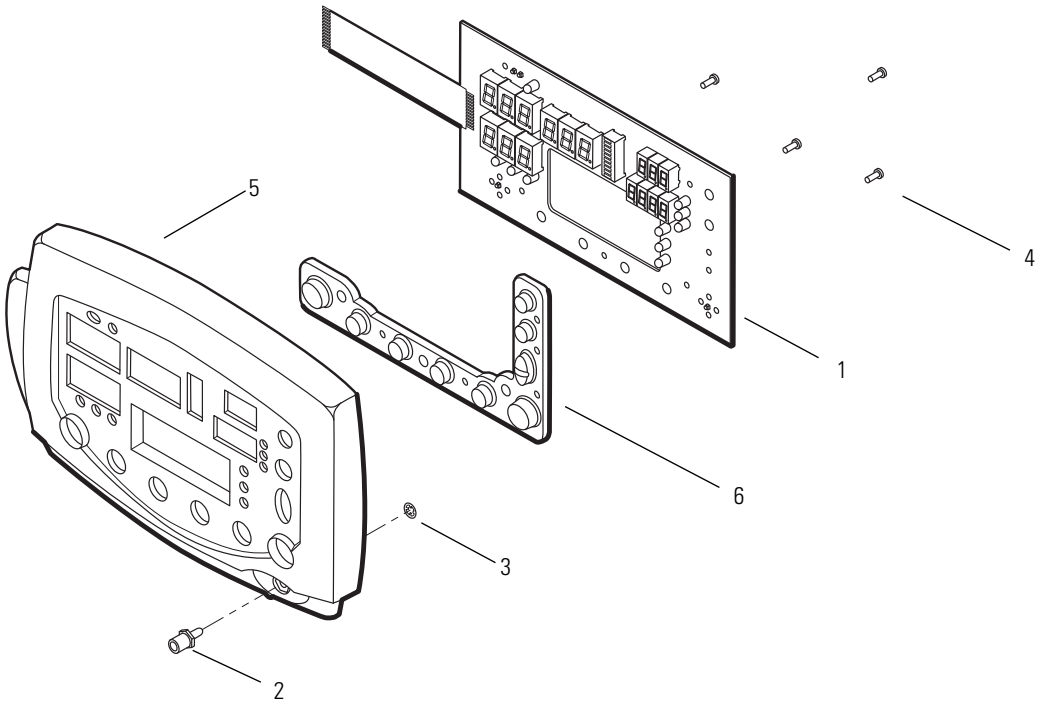
This list includes field-replaceable service parts only. Use only accessories approved by Welch Allyn. Visit www.welchallyn.com. The use of any other accessories can result in inaccurate patient data, can damage the equipment, and can void your product warranty.

Front case (standard configuration)

Drawing Ref #	Order number	Description
1	031-0151-XX	Display board LED
2	600-0495-XX	Fitting, NIBP
3	620-0392-XX	Retainer, NIBP fitting
4	620-0393-00	Screw, #4-20, .31, Plastite, qty. 5
5	630-0216-XX	Case, front
6	680-0072-XX	Keypad, elastomeric

Note For the correct overlay and speaker caution label, see the label section on page 96. See page 94 for the Masimo label.

Note Newer front-case assemblies have the NIBP fitting molded directly into the case.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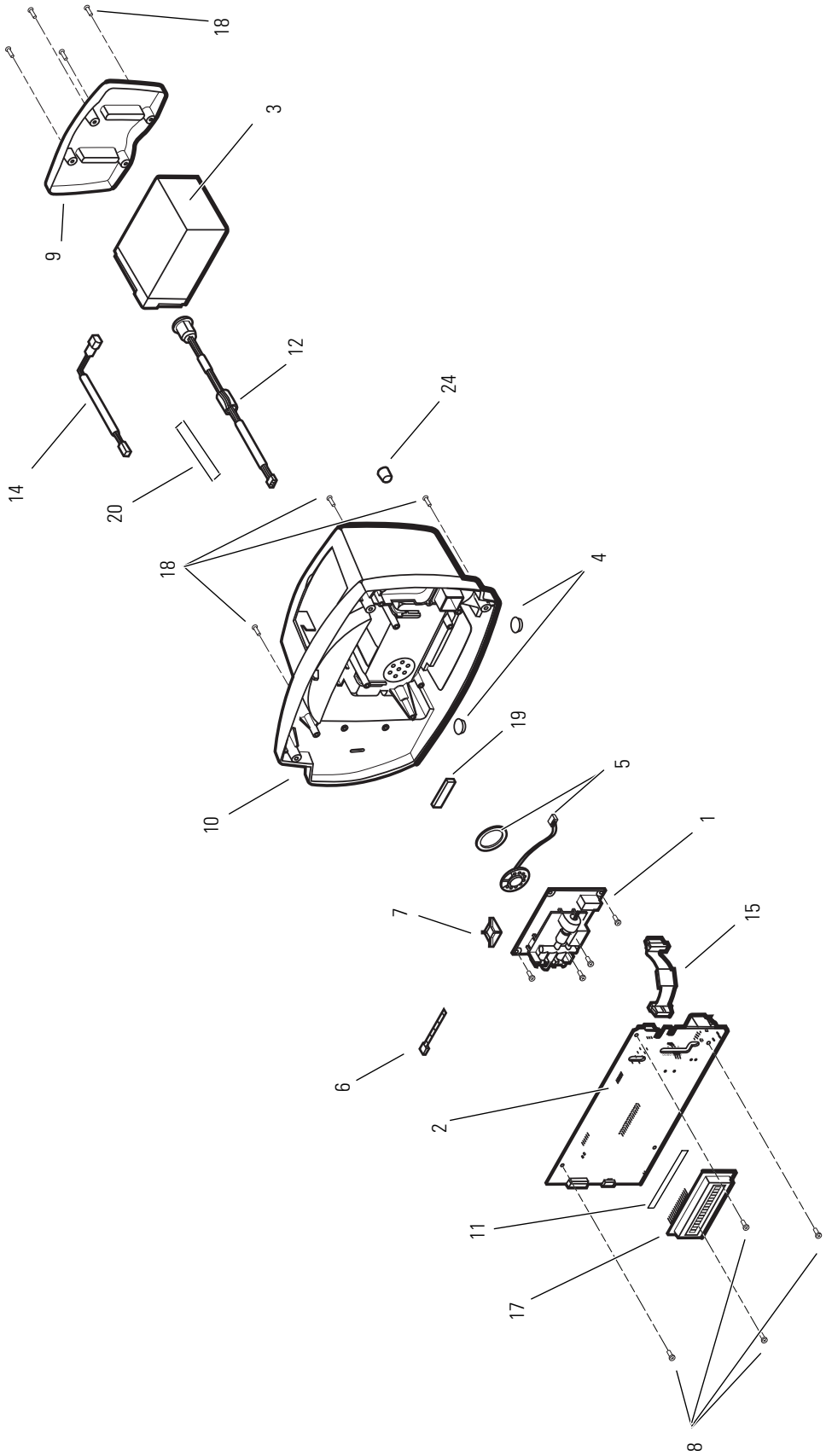
Rear case (standard configuration)			
Drawing Ref #	**Order number**	**Description**	**Notes**
1	020-0621-XX	NIBP module , POEM2 (contains pump adapter cable)	1
2	031-0150-XX	PCB assembly, main board VSM III	5, 6
3	407560	Battery assembly	
4	600-0517-XX	Pad, foot, urethane, .44" d, .2" h, black, qty 2	
5	020-0753-XX	Gasket and speaker assembly	
6	620-0403-XX	Cable tie, nylon, .14" X .05" X 7"	
7	620-0396-XX	Mount, cable tie	
8	620-0393-XX	Screw, #4-20, 5/16", thread-forming (qty 8)	
9	630-0215-XX	Battery door	
10	630-0217-XX	Case, rear (order with 600-0518-XX and 660-0231-XX)	
11		Tape, foam, black, 1", adhesive 1 side	
12	660-0154-XX	Connector assembly, nurse call	
14	660-0232-01	Cable assembly, power, main board 031-0150-03 and newer	3
15	660-0236-XX	Cable assembly, NIBP	
17	500-0044-XX	Display module, LCD	
18	620-0399-XX	Screw, #4-40, 5/16", machine, rear case to front case	
19		Tape, acryllic, foam, 3/4", adhes. 2 sides	
20		Tape, foam, vinyl, 1/8", 1/2"	
	020-0659-XX	Blank printer door kit (not shown)	
	630-0237-XX	Blank panel for no-SpO2 option (not shown)	
24	630-0241-XX	Plug, screw cover	
	020-0656-XX	Mobile stand mount-plate fasteners (not shown)	
	020-0657-XX	Mobile stand mount-plate kit (not shown)	
	020-0752-XX	POEM2 NIBP manifold (not shown)	
	020-0634-XX	PCB assembly, main board VSM III with power cable (not shown)	5, 6

Note To order error code and safety labels, see page 96.

WARNING Replacement of any NIBP component (pump, tubing, air filter, check valve, or NIBP module) requires recharacterizing using the Service utility (part no. 810-1784-XX).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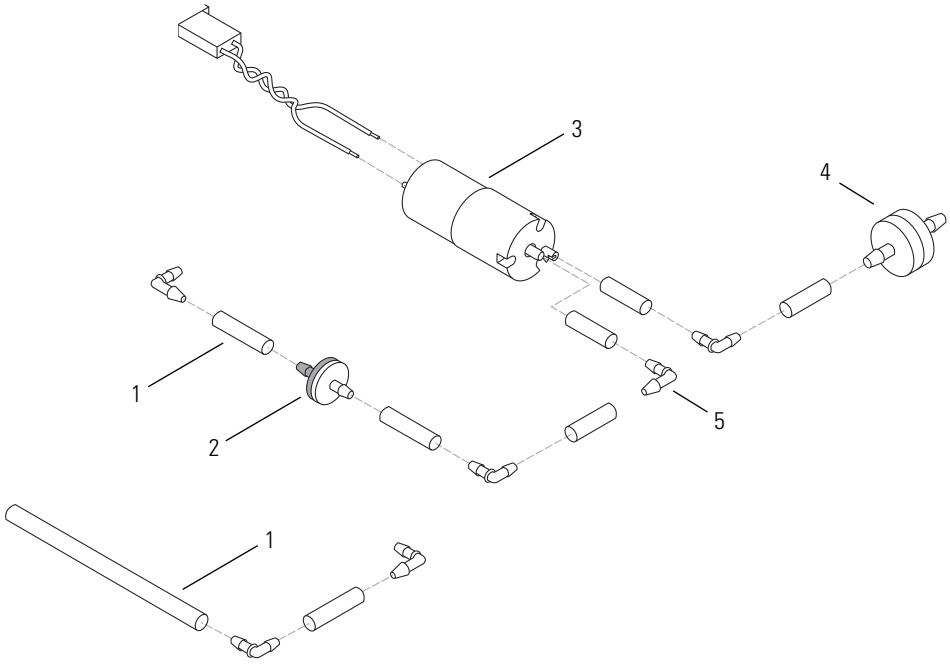
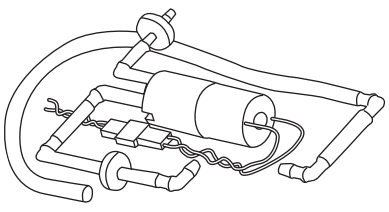
NIBP pump and plumbing parts

Drawing Ref #	Order number	Description
1	600-0179-XX	Tubing, 1′, 0.125″ I.D., 0.250 O.D., silicone
2	600-0396-XX	Check valve, NIBP
3	680-0068-XX	Pump, POEM NIBP, 6V, rolling
4	600-0520-XX	Filter, NIBP
	600-0043-XX	Fitting, 1/8″ ID tube, tee, nylon (not shown; POEM 1 only)
5	600-0178-XX	Fitting, 1/8″ ID tube, elbow, nylon
6	010-0233-01	NIBP pump and tubing assembly, POEM 1
7	010-0233-02	NIBP pump and tubing assembly, POEM 2

WARNING Replacement of any NIBP component (the pump, tubing, air filter, check valve, or NIBP module) requires recharacterizing using the service utility (810-1784-XX).

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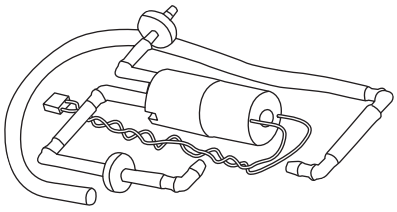
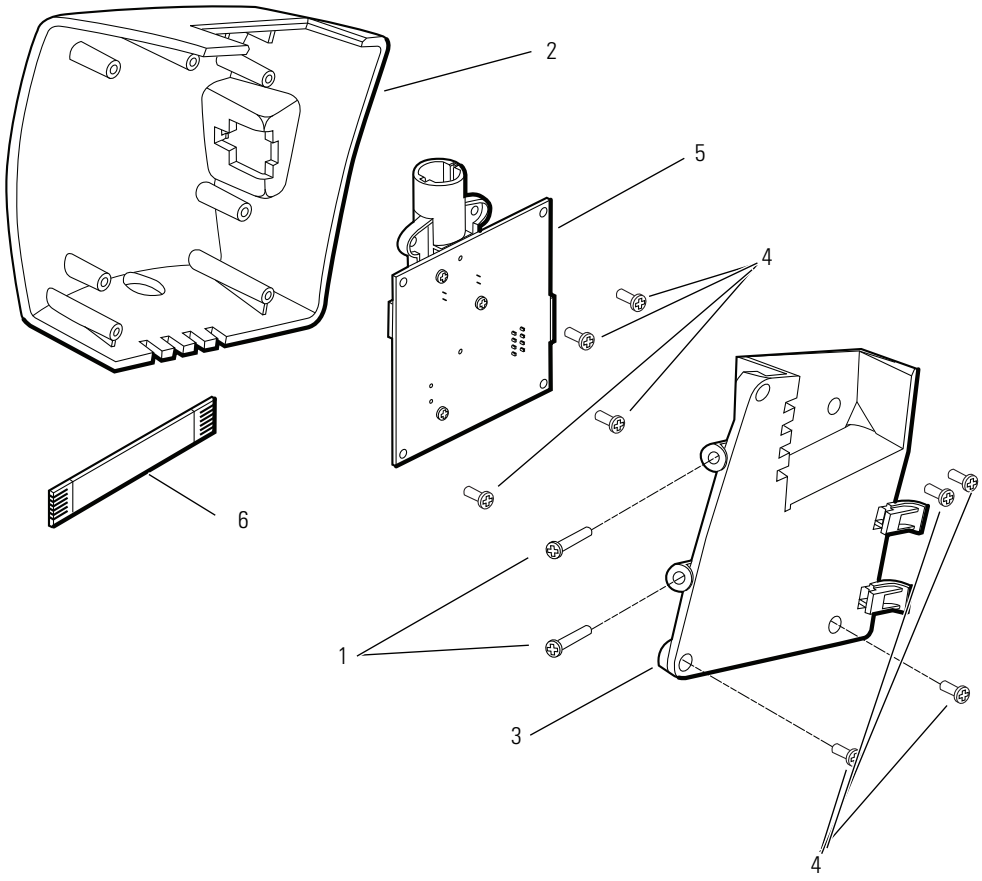
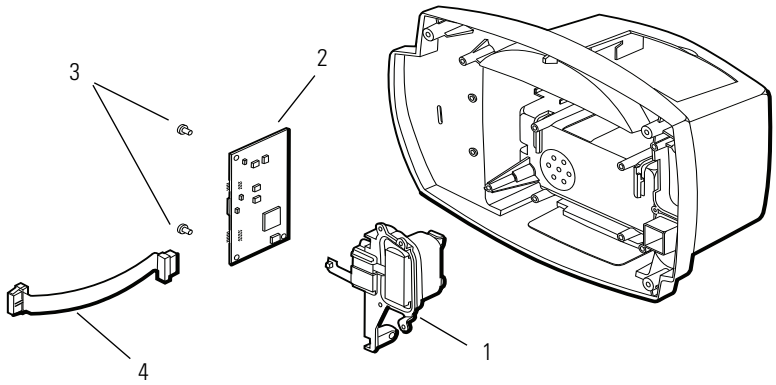

7

Temperature option			
Drawing Ref #	**Order number**	**Description**	**Notes**
1	620-0394-XX	Screw, #4-40, 3/4", machine	
2	630-0211-XX	Outside housing, temperature module	
3	630-0238-XX	Inside panel, temperature module	
4	620-0393-XX	Screw, #4-20, 5/16", thread-forming	
5	21327-1000	PCB, temperature module	**1, 9**
6	660-0230-XX	Cable, flex, temperature main board	

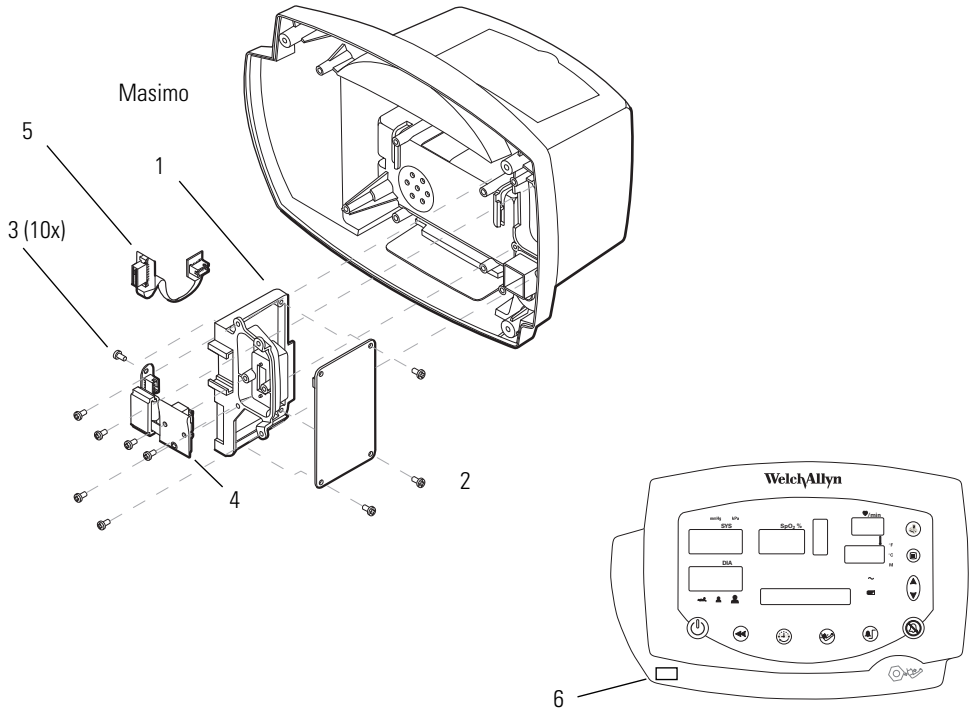


SpO_2 option, Nellcor			
Drawing Ref #	**Order number**	**Description**	**Notes**
1	010-0232-XX	SpO_2 connector panel assembly, Nellcor	
2	031-0169-XX	Board, SpO_2, Nellcor 3A	**1**
3	620-0047-XX	Screw, #6-32, 1/4", machine	
4	660-0233-XX	Cable assembly, SpO_2 main interface	

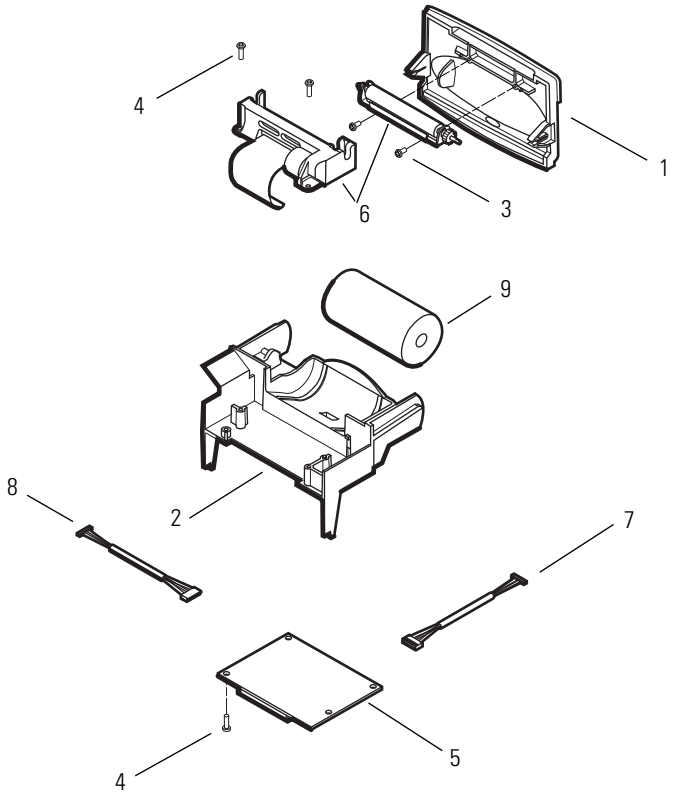


Nellcor

SpO_2 option, Masimo			
Drawing Ref #	**Order number**	**Description**	**Notes**
1	630-0278-XX	SpO2 connector housing, VSMIII, Masimo, plastic	
2	031-0160-XX	SpO2 subassembly board, Masimo MS-11	**1**
3	620-0393-XX	Screw, #4-20 X .31, PNH, PHH, ZN, Plastite 48-2	
4	660-0260-XX	Cable assembly, SpO_2 sensor flex, VSMIII, Masimo	
5	660-0259-XX	Cable assembly, SpO_2 power flex, VSMIII, Masimo	
6	640-0708-XX	Label, Masimo SET, clear Lexan (not shown)	



Printer option		
Drawing Ref #	**Order number**	**Description**
1	630-0213-XX	Printer door without roller
2	630-0214-XX	Frame, printer assembly
3	620-0149-XX	Screw, printer door/roller 2-28 x 1/4"
4	620-0165-XX	Screw, Plastite, 0.312, 2-28, thread-forming
5	532012-000	PCB, printer
6	532013-000	Printer mechanism, with roller
7	660-0229-XX	Cable, printer data
8	660-0228-XX	Cable, printer power
9	008-0827-XX	Thermal paper
	020-0659-XX	Blank printer door kit (not shown)



Order number	Description	Notes
	Labels	
680-0085-XX	Overlay, front panel, 53000, international	
680-0079-XX	Overlay, front panel, 5300P, international	
680-0082-XX	Overlay, front panel, 530T0, international	
680-0083-XX	Overlay, front panel, 530TP, international	
680-0080-XX	Overlay, front panel, 53N00, international	
680-0081-XX	Overlay, front panel, 53N0P, international	
680-0084-XX	Overlay, front panel, 53NT0, international	
680-0071-XX	Overlay, front panel, 53NTP, international	
680-0093-XX	Overlay, front panel, 53000, USA	
680-0087-XX	Overlay, front panel, 5300P, USA	
680-0090-XX	Overlay, front panel, 530T0, USA	
680-0091-XX	Overlay, front panel, 530TP, USA	
680-0088-XX	Overlay, front panel, 53N00, USA	
680-0089-XX	Overlay, front panel, 53N0P, USA	
680-0092-XX	Overlay, front panel, 53NT0, USA	
680-0086-XX	Overlay, Front Panel, 53NTP, USA	
640-0610-XX	Label, error codes, English	
640-0611-XX	Label, icon reference, USA only	
640-0612-XX	Label, safety agency, non-Masimo	
640-0690-XX	Label, safety agency, Masimo	
640-0641-XX	Label, error codes, Italian	
640-0642-XX	Label, error codes, French	
640-0643-XX	Label, error codes, German	
640-0644-XX	Label, error codes, Spanish	
640-0648-XX	Label, error codes, Chinese	
640-0649-XX	Label, error codes, Dutch	
640-0650-XX	Label, error codes, Swedish	
640-0651-XX	Label, error codes, Portuguese	
640-0652-XX	Label, error codes, Polish	
714845	Label speaker, Caution VSM 300, English	
714847	Label speaker, Caution VSM 300, Chinese	
714848	Label speaker, Caution VSM 300, Dutch	
714849	Label speaker, Caution VSM 300, French	
714890	Label speaker, Caution VSM 300, German	

Order number	Description	Notes
	Labels	
714891	Label speaker, Caution VSM 300, Italian	
714892	Label speaker, Caution VSM 300, Polish	
714920	Label speaker, Caution VSM 300, Portuguese	
714893	Label speaker, Caution VSM 300, Spanish	
714895	Label speaker, Caution VSM 300, Swedish	

Order number	Description	Notes
	Special service tools	
06138-000	Temperature test key (tests monitor only)	
01802-110	9600 Plus Calibration Tester, 110 V (tests temperature probe and monitor)	
01802-220	9600 Plus Calibration Tester, 220V (tests temperature probe and monitor)	
020-0702-XX	Fixture, cuff simulator assembly	
407590	Battery substitution connector	
810-1784-XX	Welch Allyn monitor service utility application CDROM	**4**
020-0660-XX	SW update CDROM for POEM1 update to version 3.20.00	
008-0842-00	Serial cable, utility	
	VSM 300 Series AC power adapter	
	AC power adapter (8V, 0.75A, 120 VAC USA)	**7**
	AC power adapter (8V, 0.75A, 240 VAC EU)	**8**
	AC power adapter (8V, 0.75A, 240 VAC NZ, Australia)	**8**

Notes

1 Requires Welch Allyn monitor service utililty application (810-1784-XX) and serial cable (008-0842-XX) when the replacement board software version is different from the existing board.

3 Use with main board 031-0150-03 and higher

4 Used to characterize NIBP, read log files, and update NIBP, SpO2, and temp modules. Requires serial cable (008-0842-XX).

5 Requires Welch Allyn Service Center installation and programming.

6 Use 020-0634-XX to replace PCB assembly 031-0150-01. Use the latest version of 031-0150-XX to replace 031-0150-03 or higher.

7 Refer to the North America price list for part numbers.

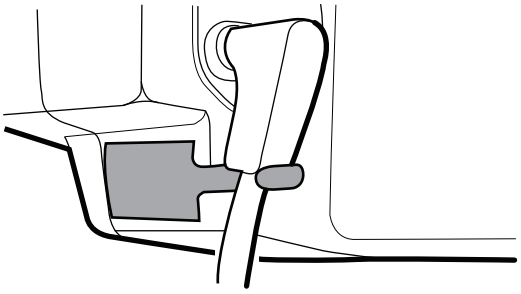
8 Refer to the International price list for part numbers.

9 Field replacement of the temperature board requires main board 031-0150-03 or higher. Devices with main board 031-0150-01 must be returned to a Welch Allyn Service Center for temperature board replacement.

7 Updates and service bulletins

DC power cable clamp

Eventually, the DC power cord might disconnect from the power input connector on the back of the monitor. To prevent this, contact Welch Allyn and order part number 008-0895-XX, VSM 300 Series DC Power Cable Clamp. This item, **which is provided at no cost**, is a set of six cable clamps.



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